

CONFERENCE BOOKLET

ALPINE WATER –  
COMMON GOOD OR  
SOURCE OF CONFLICTS?  
WASSER DER ALPEN –  
ALLGEMEINGUT ODER  
QUELLE FÜR KONFLIKTE?

4.–6.6.2018, Breitenwang (AT)  
[forumalpinum.org](http://forumalpinum.org)  
& 7th Water Conference



# WELCOME TO THE FORUMALPINUM 2018 AND THE 7<sup>TH</sup> WATER CONFERENCE IN BREITENWANG (AUSTRIA)

On the occasion of the Austrian Presidency of the Alpine Convention, ISCAR is organizing the ForumAlpinum 2018 together with the 7<sup>th</sup> Water Conference of the Alpine Convention in Austria, with the support of the Austrian Academy of Sciences, the Swiss Academies of Arts and Sciences, the Province of the Tyrol, the Austrian Federal Ministry for Sustainability and Tourism, and the Italian Ministry for the Environment, Land and Sea.

This ForumAlpinum, the 13<sup>th</sup> since 1994, will focus on water use. Changing environmental and climatic conditions as well as growing demand likely lead to conflicts in water use and water management in the Alps. The ForumAlpinum will identify hot spots of water use and management in the Alps, will analyze target conflicts, assess their relevance in a regional, national or international context, and discuss possible solutions.

The ForumAlpinum will provide a platform for the ongoing dialogue between scientists, practitioners and policy makers in order to propose policy recommendations on priority topics. Plenary sessions and thematic workshops will focus on questions as: What and where will be the hotspots of conflicting water use in future? How far water use has to be adapted to changing availability or demand? Are there emerging conflicts in water use? Do we dispose on appropriate instruments for avoiding or solving conflicts in water use?

On behalf of the organizers and the International Scientific Committee on Research in the Alps (ISCAR), you are cordially invited to participate and to contribute to the manifold discussions addressing Alpine water. The picturesque Valley of the Tyrolian Lech and the Congress Centre of Breitenwang will provide an inspiring setting.

*Univ.-Prof. Dr. Leopold Füreder, University of Innsbruck  
Chairman of the Organizing Committee & ISCAR*

## THE TYROLIAN LECH VALLEY – LIVING WITH A WILD RIVER

The Tyrolean Lech in northwestern Austria is one of the last wild rivers in the Alps and the flagship of the Tyrolean Lech Nature Park and the Natura 2000 site. A unique mixture of nature, culture and crafts shapes the communities in the Lechtal including the old market town of Reutte and the conference venue Breitenwang. Breitenwang is the starting point for mountain sports and exploration of the unique wild river landscape.

# ALPINE WATER – COMMON GOOD OR SOURCE OF CONFLICTS?

Changing environmental and climatic conditions as well as growing demand is likely to lead to conflicts in water use and water management in the Alps. This ForumAlpinum will identify hot spots of water use and management in the Alps, will analyse target conflicts, assess their relevance in a regional, national or international context, and discuss possible solutions.



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## Programme Overview

Monday 04.06	Tuesday 05.06	Wednesday 06.06	Thursday 07.06
<b>Morning</b>			
	<i>7<sup>th</sup> Water Conference</i> <b>Module 2</b> <b>The impacts of and response to droughts in the Alpine region</b>  09:00 – 12:30 Tauernsaal	<b>Module 4</b> <b>Conflicting water use in the Alps</b>  8:30 – 12:00 Tauernsaal	<b>Excursion Lech catchment area and Streimer Bach Gorge</b>  9:00 – 15:00
<b>Afternoon</b>			
<b>Opening, welcome addresses</b>  13:00 – 13:30	<i>7<sup>th</sup> Water Conference</i> <b>Modul 3 – Part I</b> <b>Green infrastructure for an integrated and sustainable water management</b>  13:30 – 15:00	<b>Module 5</b> <b>Managing conflicting water use</b>  13:00 – 17:30	
<b>Module 1</b> <b>Hydrological and water-driven hotspots in the Alps</b>  13:30 – 16:00	<b>Modul 3 – Part II</b> <b>Common guidelines for the use of small hydropower in the Alpine region</b>  15:30 – 16:30		
	<b>Module 1</b> <b>Hydrological and water-driven hotspots in the Alps</b>  14:00 – 16:00 / 16:30		
<b>Late Afternoon</b>			
<b>Lechtal LIFE project: presentation and excursion to Lechtal, public discussion</b>  14:30 – 16:00	<b>Current programmes and networks &amp; Poster session</b>  17:00 – 19:00	<b>Public Event</b>  16:30 – 18:00	
<b>Evening</b>			
<b>Visit of the Highline, dinner &amp; entertainment</b>  19:30 – 22:00	<b>Conference dinner, entertainment &amp; water tasting</b>  19:00 – 22:30	<b>Regional products &amp; film presentation</b>  20:00 – 21:30	
<b>Meetings</b>			
	<i>7<sup>th</sup> Water Conference</i> <b>Meeting of the EUSALP AG 6 Subgroup</b>  16:30 – 19:00 Closed session	<b>NEMOR Workshop</b>  8:00 – 12:00 Public workshop	<i>7<sup>th</sup> Water Conference</i> <b>Meeting of the Water Platform</b>  8:30 – 12:00 Closed session
			<b>ISCAR Partner meeting</b>  8:30 – 11:00

**Tauernsaal / Veranstaltungszentrum – Venue Breitenwang**

All activities taking place in the Tauernsaal are being translated simultaneously

Day	Time		
Mon 4 June	13:00 – 13:30	<b>Opening ForumAlpinum 2018</b>	
	13:30 – 14:30	<b>Module 1 Keynotes</b>	Hydrological and water-driven hotspots in the Alps
	14:30 – 16:00	<b>Workshop 1.1.</b>	Existing water-related hotspots and hazards
Tue 5 June	08:30 – 09:00	<b>Opening Water Conference</b>	
	09:00 – 10:30	<b>Module 2 – Part I</b>	The impacts of and response to droughts in the Alpine region
	11:00 – 12:30	<b>Module 2 – Part II</b>	The impacts of and response to droughts in the Alpine region
	13:30 – 15:00	<b>Module 3 – Part I</b>	Green infrastructure for an integrated and sustainable water management
	15:30 – 16:30	<b>Module 3– Part II</b>	Common guidelines for the use of small hydropower in the Alpine region
	19:00 – 22:30	<b>Conference dinner &amp; water tasting &amp; music</b>	
Wed 6 June	08:30 – 09:45	<b>Module 4 Keynotes</b>	Conflicting water use in the Alps
	10:15 – 12:00	<b>Workshop 4.2.</b>	Energy production
	13:00 – 14:00	<b>Module 5</b>	Managing conflicting water use
	14:00 – 16:00	<b>Workshop 5.2.</b>	Integrated river basin management
	16:30 – 18:00	<b>Public Event</b>	Wasserkonflikte in den Alpen – und in Breitenwang?
	18:00 – 20:00	<b>Regional products: presentation and tasting</b>	
	20:00 – 22:00	<b>Movie</b>	5gradPlus – wie das Klima die Welt verändert

**Saal Fort Claudia / Veranstaltungszentrum – Venue Breitenwang**

Day	Time		
Mon 4 June	14:30 – 16:00	<b>Workshop 1.2.</b>	Emerging water-related hotspots and hazards due to climate change
Tue 5 June	14:00 – 16:00	<b>Workshop 1.4.</b>	Alpine springs under pressure (add. Module 1)
	16:30 – 19:00	<b>Poster session &amp; Current programmes and networks</b>	
Wed 6 June	10:15 – 12:00	<b>Workshop 4.1.</b>	Local water use: water supply, agriculture, tourism
	14:00 – 16:30	<b>Workshop 5.4.</b>	Alpine multi-purpose reservoirs: Future potential and relevance
Thu 7 June	08:30 – 11:00	<b>Closed session</b>	Meeting of the Water Platform

**Saal Ehrenberg / Veranstaltungszentrum – Venue Breitenwang**

Day	Time		
Mon 4 June	14:30 – 16:00	<b>Workshop 1.3.</b>	Emerging water-related hotspots and hazards due to socio-economic changes
Tue 5 June	15:00 – 16:30	<b>Workshop 1.5.</b>	Monitoring and managing European Union species and habitats of alpine rivers (add. Module 1)
	16.30 – 19.00	<b>Closed session</b>	Meeting of the EUSALP AG 6 Subgroup
Wed 6 June	10:15 – 12:00	<b>Workshop 4.4.</b>	Ecological integrity of rivers
	14:00 – 16:30	<b>Workshop 5.3.</b>	Mitigating future water conflicts
Thu 7 June	08:30 – 11:00	<b>Closed session</b>	ISCAR Partner Meeting

**Saal Kreckelmoos / Veranstaltungszentrum – Venue Breitenwang**

Day	Time		
Tue 5 June	14:00 – 16:00	<b>Closed session</b>	Elisabeth Sötz
Wed 6 June	10:15 – 12:00	<b>Workshop 4.3</b>	Tourism
	14:00 – 16:30	<b>Workshop 5.1</b>	Learning from the past

**Seminar room in the Hotel Moserhof**

Day	Time		
Wed 6 June	08:00 – 12:00	<b>Public session</b>	NEMOR Workshop

# PROGRAMME

MONDAY 4 JUNE 2018

13:00 – 13:30  
Tauernsaal\*

## Opening, welcome addresses

*Leopold Füreder, Austrian Academy of Sciences & ISCAR & University of Innsbruck*

*Markus Reiterer, Secretary General of the Alpine Convention*

*Ingrid Felipe, Landeshauptmann-Stellvertreterin*

*Katharina Rumpf, Bezirkshauptfrau*

*Ronald Petrini, Tourism association Reutte*

13:30 – 16:00  
Tauernsaal\*

## Module 1: Hydrological and water-driven hotspots in the Alps

*Chair: Rolf Weingartner, University of Bern*

13:30 – 14:30  
Tauernsaal\*

### Keynote: Analysing alpine water related hotspots: Setting the ground

*Rolf Weingartner, University of Bern*

### Introduction to the workshops: What is a water-related hotspot and how can we map it?

*Klaus Lanz, International Water Affairs*

## Workshops 1.1. – 1.3.

14:30 – 16:00  
Tauernsaal\*

### Workshop 1.1. Existing water-related hotspots and hazards

*Chair: Andreas Schaffhauser, ZAMG*

*Support for mapping: Heidi Humer-Gruber, University of Innsbruck*

**Input 1** – Hydrological scenarios in the Austrian Alps for the next century – first results of the HydroGem3 project

*Ulrich Strasser & Thomas Marke*

**Input 2** – The Alps Water tower – an earth observation perspective

*Marc Zebisch*

### Discussion & mapping

14:30 – 16:00  
Saal Fort Claudia

### Workshop 1.2. Emerging water-related hotspots and hazards due to climate change

*Chair: Andrea Fischer, Institute for Interdisciplinary Mountain Research (IGF), Austrian Academy of Sciences (ÖAW)*

*Support for mapping: Valerie Braun, IGF, ÖAW*

**Input 1** – AR Big Data and Google Earth Engine: key tools for glaciers health monitoring

*Marco Di Tullo*

**Input 2** – Future lakes – future potentials. New lakes in Austria following glacier retreat  
*Jan-Christoph Otto & Markus Keuschnig*

**Discussion & mapping**

**14:30 – 16:00**  
**Saal Ehrenberg**

**Workshop 1.3. Emerging water-related hotspots and hazards due to socio-economic changes**

*Chair: Elisabeth Sötz, WWF Austria*

*Support for mapping: Anna Schöpfer, University of Innsbruck*

**Input 1** – Fair distribution of risk and benefits – the challenges of social justices in mountain hazard management

*Thomas Thaler*

**Input 2** – The construction of a landscape for tourism. The role of water in the creation of high altitude ski resorts in the French-italian Alps (1950–1980)

*Caterina Franco*

**Discussion & mapping**

**16:00 – 16:30**

**Coffee break**

**16:30 – 19:30**

**Excursions**

**Lechtal LIFE project: presentation and excursion to Lechtal, public discussion**

*Presenters: Leo Füreder & Wolfgang Klien*

**19:30 – 22:00**

**Dinner at Gasthof Klause, visit of the Highline 179 & entertainment**

**Music**

*Bluatschink*

TUESDAY 5 JUNE 2018

**7<sup>th</sup> Water Conference of the Water Platform of the Alpine Convention  
in dialogue with EUSALP AG 6 Subgroup Water**

**Water in the Alps – Management of hydrological extremes and  
sustainable hydropower use**

**8:30 – 16:30  
Tauernsaal\***

**Welcome addresses – Official greetings of the Authorities**

*Markus Reiterer, Secretary General of the Alpine Convention*

*Stefan Wildt, Regional Government of Tyrol*

*Paolo Angelini & Luka Štravs, Co-Chairs of the Water Platform of the Alpine  
Convention*

**09:00 – 12:30  
Tauernsaal\***

**Module 2: The impacts of and response to droughts in the Alpine  
region**

**9:00 – 10:30  
Tauernsaal\***

**Modul 2 – Part I**

*Chair: Hannah Berger, Bavarian Environment Agency, German delegation to the  
Water Platform*

**Input 1** – Current developments and challenges in drought management in Northern  
Bavaria

*Andreas Kolbinger, Bavarian State Ministry of the Environment and Consumer  
Protection, Germany*

**Input 2** – Strategic water resources management and drought  
*Johannes Wiesenegger, Regional Government of Salzburg, Austria*

**Input 3** – TBA

*Gaia Checcucci, General Director of Water and Land Protection Direction, Italian  
Ministry of the Environment, Land and Sea, Italy*

**Debate / interactive section**

**10:30 – 11:00**

**Coffee break**

**11:00 – 12:30  
Tauernsaal\***

**Modul 2 – Part II**

*Chair: Christian Schilling, Austrian delegation to the Water Platform, BMNT, Austria*

**Input 4** – New tools for better drought risk management  
*Andreja Sušnik, SI-ARSO, Slovenia*

**Input 5** – Security of drinking water in light of climate change  
*Gunther Heißel, Regional Government of Tyrol, Austria*



**Input 6** – Facing droughts in the Alpine region – Experiences, approaches and common challenges

*Andrea Bianchini, Italy, Italian Delegation to the Platform “Water Management in the Alps” of the Alpine Convention*

**Debate / interactive section**

12:30 – 13:30

**Lunch**

**Module 3**

13:30 – 15:00  
Tauernsaal\*

**Modul 3 – Part I: Green infrastructure for an integrated and sustainable water management**

*Chair: Luka Štravs, Ministry of the Environment and Spatial Planning, Slovenia*

**Input 1** – Greener Alpine Rivers? Conclusions and Recommendations of the EUSALAP AG 6 – Subgroup Water

*Elisabeth Sötz, WWF Austria, for EUSALP AG 6*

**Input 2** – 50 Shades of Green Infrastructure – Experiences from Slovenia

*Joze Papež, Hidrotehnik, Slovenia, Mateja Ribnikar, MOP, Slovenia & Maja Jelen, MOP, Slovenia*

**Input 3** – Alpine green infrastructure – joining forces for nature, people and the economy

*Manuela Künzl, Bavarian State Ministry of the Environment and Consumer Protection, Germany & Franziska Drasdo, City of Munich – Department of Urban Planning*

**Debate / interactive section**

15:00 – 15:30

**Coffee break**

15:30 – 16:30  
Tauernsaal\*

**Modul 3 – Part II: Common guidelines for the use of small hydropower in the Alpine region**

*Chair: Gaia Checcucci, Italian delegation to the Water Platform, Italian Ministry of the Environment, Land and Sea, Italy*

**Input 1** – Presentation of the elaboration and content of common guidelines

*Pietro Colonna, Italian Delegation to the Alpine Convention*

**Input 2** – Application of the Common Guidelines for the use of Small Hydropower in the Alpine region

*Christian Schilling, BMNT, Austria*

**Debate / interactive section**

**Rapporteur to the Forum Alpinum plenary**

*Joze Papež, Slovenia*

14:00 – 16:00 / 16:30

**ForumAlpinum: additional workshops to Module 1 – Workshops 1.4. & 1.5.**

14:00 – 16:00  
Saal Fort Claudia

**Workshop 1.4. Alpine springs under pressure**

*Chair: Stefanie von Fumetti, University of Basel*

**Input 1** – Alpine springs under pressure will Global Change increase present conflicts of interest?

*Stefanie von Fumetti & Daniel Küry*

**Input 2** – Ecological evaluation, conservation and restoration of spring habitats in the Swiss Alps

*Daniel Küry*

**Input 3** – Long-term monitoring of alpine springs to determine climate change impact

*Gabriele Leonhardt*

**Input 4** – Collecting biota in spring habitats: A proposal for a sustainable methodology in long-term monitoring studies

*Reinhard Gerecke & Marco Cantonati*

15:00 – 16:30  
Saal Ehrenberg

**Workshop 1.5. Monitoring and managing European Union species and habitats of alpine rivers**

*Chair: Norbert Müller, University of Applied Science, Erfurt & Helmut Kudrnovsky, freelancer, Kematen*

**Input 1** – 3230 “Alpine rivers with *Myricaria germanica*” - actual findings along river Lech

*Helmut Kudrnovsky*

**Input 2** – Reintroduction of *Myricaria germanica* in Italy - an overview

*Bruno Michielon & Tommaso Sitzia*

**Input 3** – 30 years monitoring and managing *Typha minima* at the Tyrolean Lech river – a key species of the habitat 7240\* “Alpine pioneer formations”

*Norbert Müller*

**Input 4** – Monitoring *Bryodemella tuberculata* – a key species of the habitats 3220, 3230 and 3240 “Alpine rivers”

*Michael Reich*

**Input 5** – Standardized selections of FFH-species and habitats for protection measures

*Anna Schöpfer & Leopold Füreder*

16:00 / 16:30 – 17:00

**Break**

17:00 – 19:00  
Saal Fort Claudia

### **Current programmes and networks**

*Chair: Thomas Scheurer*

#### **Programme and networks presentations**

**Input 1** – NEMOR network / Vision 2030

*Bernat Claramunt*

**Input 2** – Alpine Space Programme: Outlook

*Primož Skrt*

**Input 3** – Network of River Contracts

*Massimo Bastiani*

**Input 4** – Forum Water

*Georg Niedrist*

**Input 5** – Announcement of Young Academics Awards

*Aureliano Piva*

#### **Poster session**

16:30 – 19:00  
closed session  
Saal Ehrenberg

### **Meeting of the EUSALP AG 6 Subgroup**

19:00 – 22:30  
Tauernsaal\*

### **Conference dinner, entertainment & water tasting**

#### **Welcome addresses**

*Roland Psenner, ÖAW*

#### **Invitation of local politics**

*Hanspeter Wagner, Mayor of Breitenwang*

#### **Music**

*Landesmusikschule Reutte*

#### **Water tasting**

*Roland Psenner*

## WEDNESDAY 6 JUNE 2018

8:30 – 12:00  
Tauernsaal\*

### **Module 4: Conflicting water use in the Alps**

*Chair: Roland Psenner, EURAC Bolzano & Günter Köck, ÖAW*

8:30 – 9:45  
Tauernsaal\*

### **Keynote 1: Water-related hotspots in the Alps – Results of the workshops of Module 1 and perspectives**

*Klaus Lanz, International Water Affairs*

### **Keynote 2: Snowmaking – a vital adaptation measure creating conflicts**

*Robert Steiger, University of Innsbruck*

### **Keynote 3: Results of the 7<sup>th</sup> Water Conference (Modules 2 and 3)**

*Joze Papež, Slovenien*

9:45 – 10:15

### **Coffee break**

10:15 – 12:00  
Saal Fort Claudia

### **Workshop 4.1. Local water use: water supply, agriculture, tourism**

*Chair: Heike Zimmermann-Timm, Goethe University, Frankfurt am Main*

**Input 1** – Problem of private or public use of water resources: case study Val Masino  
*Oliver Ike*

**Input 2** – Is Alpine irrigation overestimated?  
*Calianno Martin*

**Input 3** – Transboundary water supply assessment of surface water resource availability: application in Danube and Tyrol  
*Simone Persiano*

**Input 4** – The role of local community in governing water as a common-pool resource  
*Primož Pipan*

10:15 – 12:00  
Tauernsaal\*

### **Workshop 4.2. Energy production**

*Chair: Peter Hanisch, DonauConsult*

**Input 1** – Energy transition in Alpine regions – what does it mean for water use and water management? A view from South Tyrol  
*Wolfram Sparber*

**Input 2** – Sustainability assessment of hydropower from a stakeholder perspective  
*Lutz E. Schlange*

**Input 3** – Small hydropower plants: A critique related to the Belluno area (Italy)  
*Monica Camuffo*

**Input 4** – Impacts and risks of reservoirs: The case of reservoirs along the Spöl river  
*Christian Schlüchter & Thomas Scheurer*

**Input 5** – Preserving Alpine Floodplain rivers through functional floodplain flows  
*Daniel Hayes*

10:15 – 12:00  
Saal Kreckelmoos

**Workshop 4.3. Tourism**

*Chair: Philippe Bourdeau, Université Grenoble-Alpes, Institut de Géographie Alpine*

**Input 1** – Valuation of recreation related ecosystem services on rivers Soča (Slovenia) and Tara (Montenegro)

*Jernej Stritih*

**Input 2** – Integrated water resource management in tourist areas: moving from the hydrological basin to the water use basin

*Emmanuel Reynard*

**Input 3** – Summary of Conference Water & Tourism 2017

*Emmanuel Reynard*

**Input 4** – On the recent variation of the “Snow Reliability Line” in the south-eastern Alps

*Massimiliano Fazzini*

10:15 – 12:00  
Saal Ehrenberg

**Workshop 4.4. Ecological integrity of rivers**

*Chair: Leopold Füreder, ÖAW & ISCAR & University of Innsbruck*

**Input 1** – Overview of the environmental conditions of the rivers of the Alps

*Susanne Muhar & Carina Seliger*

**Input 2** – The Wild Rivers Label – an effective tool to conserve alpine river landscapes?

*Roberto Epple*

**Input 3** – WWF Austria - River Restoration Concept

*Gebhard Tschavoll*

**Input 4** – Clean Water Project – San Giovanni Torrent (Lake Maggiore – Verbania – Italy)

*Andrea Cottini*

**Input 5** – Holistic (multiscale) analysis of the factors and their effect on the fish fauna in Inner-Alpine space

*Stefanie Oberarzbacher*

8:00 – 12:00  
Seminar room Moserhof

**NEMOR Workshop**

12:00 – 13:00

**Lunch**

13:00 – 17:30  
Tauernsaal\*

**Module 5: Managing conflicting water use**

*Chair: Valerie Braun, IGF, ÖAW*

13:00 – 14:00  
Tauernsaal\*

**Keynote 1: Water as a cause for conflicts**

*Martin Grambow, TU Munich*

**Keynote 2: Participative processes in water management**

*Klaus Michor, Revital*

### Workshops, incl. coffee break

14:00 – 16:30  
Saal Kreckelmoos

#### **Workshop 5.1. Learning from the past for the management of present and future water-related conflicts: Dealing with floods and flood risk in historical Alpine societies**

*Chair: Patrick Kupper, University of Innsbruck, Institute of History and European Ethnology*

**Input 1** – The 1989 flooding of Innsbruck: human induced disaster, social conflict and contemporary challenges

*Reinhard Nießner*

**Input 2** – Taming the torrent? Flood control and conflicts of interest at the Gürbe River (Canton of Bern) from the 19<sup>th</sup> century until today

*Melanie Salvisberg*

**Input 3** – Avoiding conflicts by revisiting historical experience? Flood marks and their use for disaster memory past and present

*Christian Rohr*

14:00 – 16:30  
Tauernsaal\*

#### **Workshop 5.2. Integrated river basin management**

*Chair: Susanne Muhar, University of Natural Resources and Life Sciences, Vienna, Institute of Hydrobiology and Aquatic Ecosystem Management & Primož Skrt, Alpine Space*

**Input 1** – SPARE – Strategic Planning for Alpine River Ecosystems Integrating protection and development

*Susanne Muhar & Kerstin Böck*

**Input 2** – A reference database to support practitioners toward Integrated River Ecosystem Management

*Sašo Šantl & Urška Kocijančič*

**Input 3** – Integrated River Basin Management in the Inn River Basin (CH)

*Angelika Abderhalden & Barbara Grüner*

**Input 4** – Alpine Space: Lessons learnt from past projects

*Primož Skrt*

14:00 – 16:30  
Saal Ehrenberg

#### **Workshop 5.3. Mitigating future water conflicts**

*Chair: Susanne Brandstetter, Austrian Federal Ministry for Sustainability and Tourism*

**Input 1** – Best Management Practices within forested drinking water protection zones

*Roland Köck*

**Input 2** – How NGOs can contribute to water governance on different levels: from EU Water Framework directive to regional management planning

*Bettina Urbanek*

**Input 3** – Planned retreat as an option for the European Alps? To whom, what and when we have to talk

*Thomas Thaler & Sebastian Seebauer*

14:00 – 16:30  
Saal Fort Claudia

**Workshop 5.4 Alpine multi-purpose reservoirs: Future potential and relevance**

*Chair: Astrid Björnsen Gurung, Swiss Federal Institute for Forest, Snow and Landscape Research & Petra Schmockler-Fackel, Federal Office for the Environment, Switzerland*

**Input 1** – The “Hydro-CH2018 Reservoir” Project  
*Manuela Brunner & Manfred Stähli*

**Input 2** – Evolving polycentric climate governance: The case of multifunctional water use in Oberhasli, Switzerland  
*Elke Kellner*

**Input 3** – Management options for Alpine multi-purpose reservoirs  
*Gottfried Gökler*

**Input 4** – Contribution of dam reservoirs to Alpine society under changing context: social-economic and ecological trajectories. A case study in Valais (Swiss Alps)  
*Melanie Clivaz & Emmanuel Reynard*

**Input 5** – One extraction - Several uses: A case study from France  
*Marion Douarche*

**Discussions**

16:30 – 20:00  
Tauernsaal\*  
16:30 – 18:00

**Public Event**

**Wasserkonflikte in den Alpen – und in Breitenwang?**

*Anette Kestler, CEO Tiroler Lech Nature Park*

**Closing panel**

**What is needed to solve (future) conflicts in water use?**

Questions to discuss: Which water conflict management is needed for Alpine space? Water availability between individual interests and public good (all scales from local to European)?

*Chair: Klaus Lanz*

*Leopold Füreder, ÖAW & ISCAR & University of Innsbruck*

*Luka Štravs, Ministry of the Environment and Spatial Planning, Slovenia*

*Astrid Björnsen Gurung, Swiss Federal Institute for Forest, Snow and Landscape Research*

*Elisabeth Sötz, WWF Austria*

*Gaia Checcucci, General Director of Water and Land Protection Direction, Italian Ministry of Environment, Land and Sea*

*Anette Kestler, CEO Tiroler Lech Nature Park*

18:00 – 20:00

**Regional products: presentation and tasting**

20:00 – 21:30

**Film presentation & discussion**

„5 Grad plus – Wie das Klima unsere Welt verändert“ (ORF Universum)

## MODUL 1

# HYDROLOGICAL AND WATER-DRIVEN HOTSPOTS IN THE ALPS

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*CHAIR: ROLF WEINGARTNER, UNIVERSITY OF BERN*

Although there is sufficient water in the Alpine region, seasonal and regional scarcity of supply must be expected in the future. In addition, global warming will lead to a destabilization of high mountain areas and change the landscape. These developments are overlaid by the socio-economic dynamics and the increasing water demand of existing and new user groups. Module 1 aims to identify, describe and locate current and future conflicts of use in the Alpine region. For this purpose, the participants work out an exemplary overview of water-related conflicts (hot spots). The results form the basis for the discussion in the following modules.

## Keynotes

### Analysing alpine water related hotspots: Setting the ground

*Rolf Weingartner, University of Bern*

Despite the abundance of water in the European Alps, conflicts over the utilization and protection of water resources have a long history. Commonly, water conflicts are regarded as competition for water use, for instance when hydropower production is limiting residual water flows in downstream river stretches. However, conflict of interest in the water sector is going far beyond questions of water distribution. The quality of water resources, the hydromorphological state of rivers and lakes, and issues of space are further important causes of water management conflict. In a changing climate, expanding our perception and understanding of water management conflicts is ever more crucial.

### Introduction to the workshops: What is a water-related hotspot and how can we map it?

*Klaus Lanz, International Water Affairs*

Water-related hotspots are situations in which a societal demand in the water sector can no longer be met. In order to understand the causes of such water management conflicts and to work on solutions, it is crucial to identify the involved societal or stakeholder interests and the underlying nature of the conflict. The proposed mapping exercise aims at a systematical characterization of water-related conflicts of interest in the Alps. Its objective is to gain a comprehensive perception of the extent of conflict in the water sector. The focus will be both on existing situations and on conflicts of interest expected to develop in the future, either caused by climate or by societal change.



## WORKSHOP 1.1.

### CHANGING RESOURCES AND SEASONALITY

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CHAIR: ANDREAS SCHAFFHAUSER, ZAMG

SUPPORT FOR MAPPING: ADELHEID HUMER-GRUBER, UNIVERSITY OF INNSBRUCK

Any change or a seasonal reduction of the available water resources can cause serious management challenges and downstream conflicts in the Alpine Region. Therefore the results of hydroclimatological models with different RCP scenarios give a very valuable quantification of future climate change effects on the availability of water resources in e.g. the Ötztal Alps (Tyrol, Austria).

The Copernicus program and Earth Observation in general can contribute to a continuous and area-wide monitoring of water resources in the Alps. Such a monitoring will increase not only the understanding of hydrological processes under a changing climate, but also support sustainable water management for irrigation, energy production or technical snow production.

#### Input 1

Hydrological scenarios in the Austrian Alps for the next century – first results of the HydroGeM3 project

*Ulrich Strasser & Thomas Marke*

*University of Innsbruck, Institute of Geography*

Supply and demand of water in Alpine head watersheds are expected to undergo significant changes in the coming decades. Glaciers are retreating, seasonal snow cover duration is shortening, and streamflow will decrease after peak water. A seasonal reduction of the available water resources can cause serious management challenges and downstream conflicts. In the HydroGeM3 project, we quantify future climate change effects on the availability of water resources in the Ötztal Alps (Tyrol, Austria) by forcing the hydroclimatological model AMUNDSEN with scenario data along the RCP2.6, RCP4.5, and RCP8.5 paths until 2100. Indicators for hydropower generation and winter tourism have been assessed in an inter- and transdis-

ciplinary stakeholder process. Quality assessment of the model results is supported by means of multilevel spatiotemporal validation, and time series of stable isotopes for the streamflow components are analyzed and compared to respective model results. Water demand is quantified by means of a new agent-based model to simulate water fluxes at the human-environment interface. Results indicate considerable decreases in snow amounts of up to 80% in low to medium elevations in the future and strongly retreating glaciers with less than 20% of their present-day volume still left by 2100. Runoff volumes decrease by almost 40% on the annual scale, and peak flows are shifted from July to June, and the average natural ski season length decreases by up to 50 days.

## Input 2

The Alps Water tower – an earth observation perspective

*Marc Zebisch, Claudia Notarnicola, Carlo Marin, Mattia Callegari & Felix Greifeneder*

*Eurac research, Institute for Earth Observation*

The Alps (and mountains in general) are known to be water towers for large downstream regions, which heavily depend on water from the Alps for irrigation, river navigation, energy production and industry. Climate change and climate extremes are already challenging this relationship. In this talk we argue that, particularly with the latest fleet of ESA satellites from the Copernicus program, Earth Observation can significantly contribute to a continuous and area-wide monitoring of water resources in the Alps. Such a monitoring will increase not only the understanding of hydrological processes under a changing climate, but also support sustainable water management for irrigation, energy production or technical snow production. We present hydrological applications of Earth Observation for the EUREGIO region Tyrol, South Tyrol, Trentino as well for the full Alps. In particular, we show how snow cover and its contribution to run-off can be monitored and how run-off can be forecasted over a period of weeks to months. Furthermore, we show how the integration of remote sensing with hydrological models can improve the understanding of key hydrological processes. Finally, we demonstrate how soil moisture and soil moisture anomalies can be tracked with radar satellite data.

## WORKSHOP 1.2.

# EMERGING WATER-RELATED HOTSPOTS AND HAZARDS DUE TO CLIMATE CHANGE

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CHAIR: ANDREA FISCHER, IGF, ÖAW

SUPPORT FOR MAPPING: VALERIE BRAUN, IGF, ÖAW

Alpine Landscapes can be read as imprints of the forming forces, amongst them frozen and liquid water. On various time scales, natural processes as drifting continents, formation and disappearance of seas, erosion and deposition as well as climate changes influence topography and conditions for life. After the last glacial maximum, human activities changed the landscape by land use and cultural practices. The workshop aims at tackling various aspects of water as geomorphological parameter influencing the landscape, as well as modern anthropogenic aspects and views on water availability and management. The workshop aims at discussing past and modern influence of water on natural and cultural landscapes.

### Input 1

SAR Big Data and Google Earth Engine: key tools for glaciers health monitoring

Marco Di Tullo, Andrea Nascetti<sup>1</sup>, Marco Di Tullio, N. Emanuelli, F. Nocchi, A. Camplani & Mattia Crespi<sup>1</sup>

<sup>1</sup>University of Rome La Sapienza, Geodesy and Geomatics Division

The glaciers are a natural global resource and one of the principal climate change indicator at global and local scale, being influenced by temperature and snow precipitation changes. Among the parameters used for glacier monitoring, the glaciers surface velocity is an important element, since it is influenced by the events connected to glaciers changes (mass balance, hydro balance, glaciers stability, landscape erosion). The leading idea of this work is to continuously retrieve glaciers surface velocity using free ESA Sentinel-1 SAR imagery and exploiting the potentialities of the Google Earth Engine (GEE). GEE has been recently released by Google as a platform for petabyte-scale scientific

analysis and visualization of geospatial datasets. The algorithm of SAR off-set tracking developed at the Geodesy and Geomatics Division of the University of Rome La Sapienza has been integrated in a cloud based platform that automatically processes large stacks of Sentinel-1 data to retrieve glacier surface velocity field time series. Several results related to relevant glaciers (i.e. Baltoro (Karakoram), San Rafael and San Quintin (Chile), Aletsch (Switzerland) also validated with respect already available and renown software (i.e. ESA SNAP, CIAS) highlight the potential of the Big Data analysis to automatically monitor glacier surface velocity fields at global scale, exploiting the synergy between GEE and Sentinel-1 imagery.

## Input 2

Future lakes – future potentials. New lakes in Austria following glacier melt

*Jan-Christoph Otto<sup>1</sup> & Markus Keuschnig<sup>2</sup>*

<sup>1</sup>*University of Salzburg, Researchgroup Geomorphology*

<sup>2</sup>*Georesearch, Salzburg*

Glacier melt is the most apparent consequence of temperature rise in the 20<sup>th</sup> and 21<sup>st</sup> century in the European Alps. The space released by the disappearing ice is frequently filled by new glacial lakes that form in the highest parts of the mountains. In Austria, more than 260 new lakes have formed in glacier forefields since the Little Ice Age. Their formation dynamics is consistent with observed increasing temperature trends with rising number and increasing size of new glacial lakes since the 1980s. This trend is assumed to continue in the near future. Glacial lakes constitute an important environmental and socio-economic impact on high mountain systems including water resource management, sediment delivery, natural hazards, energy production and tourism. Their development significantly modifies the landscape configuration as well as visual appearance of high mountain areas. Knowledge on the location, number and extent of future lakes can be used to assess potential impacts on high mountain geoecosystems and upland-lowland interactions. We trace the formation of glacial lakes since the mid 19<sup>th</sup> century and estimate the future formation of glacial lakes in Austria. These lakes potentially develop when the current glacier extend continues to decrease. We will discuss benefits, potentials and threads to hydrological, geomorphological and economical systems in mountain environments.

## WORKSHOP 1.3.

# EMERGING WATER-RELATED HOTSPOTS AND HAZARDS DUE TO SOCIO-ECONOMIC CHANGES

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CHAIR: ELISABETH SÖTZ, WWF AUSTRIA

SUPPORT FOR MAPPING: ANNA SCHÖPFER, UNIVERSITY OF INNSBRUCK,  
INSTITUTE OF ECOLOGY

Human land-uses have been shaping the Alps for millennia, just as the human living patterns have been influenced by the natural environment.

In the course of climate change, hazard hotspots might be shifting – due to glacier retreat, permafrost melting, or changing precipitation. In other cases, it is the human activity, or the sudden abandonment of human activity, which involuntarily is triggering destabilization which leads to new hazards. Apart the hazard occurrence, exposure and vulnerability play an equally important role in disaster risk.

The present workshop will highlight some aspects of this reciprocal impact of nature and human activity, and in conclusion seek to emphasize key factors to take into account when we have to deal with socio-economic development in an environment of increasing destabilization.

### Input 1

Fair distribution of risk and benefits – the challenges of social justices in mountain hazard management

*Thomas Thaler<sup>1</sup>, Andreas Zischg<sup>2</sup>, Maria Papathoma-Köhle<sup>1</sup>, Margreth Keiler<sup>2</sup> & Sven Fuchs<sup>1</sup>*

<sup>1</sup>University of Natural Resources and Life Sciences, Vienna, Institute of Mountain Risk Engineering

<sup>2</sup>University of Bern, Institute of Geography

As financing protection against mountain hazards becomes increasingly challenging and therefore investments have to be prioritized, dilemmas of justice emerge: some local governments and individuals benefit from natural hazard protection schemes whereas others loose. Decisions on whom to protect often caused contradicting concepts of political understanding, which differ in interpretations of fair resource allocation and distribution. This presentation will explore questions of social justice and injustices in the Austrian natural hazards debate. A spatially explicit object-based temporal assessment of elements at risk to moun-

tain hazards (snow avalanches, river floods, torrential floods and debris flows) in Austria is presented for the period 1919–2012. The assessment is based on two different datasets, a) hazard information using legally binding land use planning restrictions, and b) information on the building stock and citizens combined from different spatial data available on the national level. We found that depending on the respective political direction various local governments gain and others loose within the actual distributional system of mitigation strategies. These findings highlight the distributional consequences of future mountain hazard management strategies and point to the crucial selection of policy direction in navigating the selection of various adaptation schemes.

## Input 2

The construction of a landscape for tourism. The role of water in the creation of high altitude ski resorts in the French-Italian Alps (1950–1980)

*Caterina Franco*

*Laboratoire MHAevt, ENSAG, Université Grenoble Alpes & Department ABC, Politecnico di Milano*

The proposed contribution is part of a research activity for a PhD Thesis in Architecture, still under preparation. It deals with the role that water had in the construction of high altitude ski resorts in the French-Italian Alps, after the second World War. Indeed, when new tourist centers were designed and built on a virgin soil, new strategies had to be found and new infrastructure had to be built to provide water for the service of the new settlement, located sometimes higher than the sources or far from them, and generally in areas that were before uninhabited. We thus question water as an element that played a role in the construction of new tourist centers, exploring two hypotheses. On one side, the hydrographic asset of the site influenced the planning of new infrastructure; on the other side, the design and construction of the new settlements turned out to be a process of modification of a landscape, in its natural and anthropic components. We focus on the case study of Chamrousse, in the French Alps and on the case study of Pila, in the Italian Alps. Through an archival research and using cartography and drawing as tools, we will retrace the trajectory of the construction and modification of water infrastructure, from the creation of the new settlements till the late years, when the need of water augmented due to the necessity of fabrication of artificial snow. Finally, the comprehension of the historical process is seen as a fundamental step to understand the actual asset of a territory, and to point out potentialities and vulnerabilities of it.

## WORKSHOP 1.4.

### SPRINGS UNDER PRESSURE

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CHAIR: STEFANIE VON FUMETTI, UNIVERSITY OF BASEL, DEPARTMENT OF ENVIRONMENTAL SCIENCES

Alpine springs provide ecosystem services such as being a supply of drinking-water. Ecologically, they are important aquatic habitats under pressure. They suffer e.g. from cattle trampling, capturing or relocation. Land use changes and climatic changes threaten springs additionally. Headwaters in alpine regions will be affected strongly by climatic changes such as increased water temperatures or altered discharge regimes. In this workshop we will discuss conflicts of interests and threats for natural springs and how we can monitor them effectively. The development of conservation strategies should be a focus of future efforts in order to sustain important ecosystem services of springs in the Alps.

#### Input 1

Alpine springs under pressure will Global Change increase present conflicts of interest?

*Stefanie von Fumetti<sup>1</sup> & Daniel Kury<sup>2</sup>*

<sup>1</sup>University of Basel, Department of Environmental Sciences

<sup>2</sup>Life Science AG, Basel

Springs are a small, but very central part of the aquatic cycle. Since ancient times they have provided ecosystem services such as being a supply of drinking-water, crop irrigation and health promotion. Almost contrary to this anthropocentric perception they are, from the ecological point of view, important aquatic habitats under pressure. By providing unique prerequisites for the meio- and macrofauna as well as algae and mosses, they are inhabited by especially adapted species, which are threatened owing to the high utilization pressure. Global Change, i. e. land use changes as well as climatic changes, is additionally threatening springs. The IPCC report clearly states, that alpine regions will be affected stronger by climatic changes than lowlands. It can be

imagined easily that alpine springs will experience higher water temperatures or a shift in their discharge regime. There is an urgent need to investigate how alpine spring systems could react to climatic as well as land use changes in order to develop conservation plans for protecting ecologically valuable springs and to sustain a very important ecosystem service in the Alps, namely drinking water.

#### Input 2

Ecological evaluation, conservation and restoration of spring habitats in the Swiss Alps

*Daniel Kury*

*Life Science AG, Basel*

In Switzerland springs are considered as endangered habitats not only in lower altitudes but also in the Alps. In three nature parks of the Canton Graubünden the ecological state of 232 spring habitats was assessed by investigating their structure, flora and fauna by means

of a newly created field protocol. Between 30 and 75% of the crenic habitats were classified as natural or near natural. Based on the structural state and the richness of plant and animal taxa, 21 springs showed to have a high restoration priority and 26 a high restoration importance, respectively. A total of 160 springs were considered having a medium priority and 140 objects had a medium importance. The main disturbance of the springs was trampling by cattle and the diversion of water for chalets or lodges. For damaged or threatened spring habitats restoration measures were elaborated for future programs to support the ecological infrastructure of the nature parks. An action plan of the Federal Office for Environment will help to implement measures for the conservation of springs in Switzerland.

### Input 3

Long-term monitoring of alpine springs to determine climate change impact

Gabriele Leonhardt

Nationalparkverwaltung Berchtesgaden, Forschung und Informationssysteme

Springs are spatially limited transition zones that affect the water balance and the biological diversity in a given watershed. If the quantity and seasonality of precipitation and snowmelt is changing in the future due to raising temperatures, or storms are leading to more sun exposure, spring habitats may subsequently change. This may lead to a shift in species composition, possibly accompanied by invasions or losses. Such effects can only be documented applying a standardized methodology as it is being developed in Berchtesgaden National Park (BNP) and also in Bavarian Forest National Park in Germany. This study combines the revision of data from former monitoring projects in BNP with standardized new field work concentrating to a selected set of springs in both parks. Morphological habitat description is based on standards proposed by the *Landesbund für Vogelschutz in Bayern e.V.*. Main components of physicochemical water analysis are pH, oxygen saturation, electric conductivity and temperature. The study of zoological diversity has a focus on crusta-

ceans, molluscs, mites, and particular insect orders and combines traditional taxonomic methods with (meta) barcoding techniques. The resulting guideline will suggest criteria for choosing best suitable reference sites and indicator species, but also recommendations for monitoring time intervals and a proposal for sustainable data storage.

### Input 4

Collecting biota in spring habitats: A proposal for a sustainable methodology in long-term monitoring studies

Reinhard Gerecke<sup>1</sup> & Marco Cantonati<sup>2</sup>

<sup>1</sup>University of Tübingen, Department of Evolution and Ecology

<sup>2</sup>Museo delle Scienze, Trento, Limnology and Phycology Section

Due to the generally small size of springs and their often extreme microhabitat diversification, a representative documentation of species composition encounters noteworthy difficulties in these habitats. A balance must be found between safeguarding the sensitive habitat, and the need for gaining representative quantitative data. We propose a little-invasive collecting method for benthic invertebrates and diatoms (+ dominant macroalgae). Along a transect over the whole area from the transition eu- / hypocranal to the spring mouth, a summarizing sample is taken. Collection is done mosaic-like, leaving extended parts of the spring area untouched, but covering all representative habitat types, and reflecting their relative cover by varying collection intensity. As concerns algae, an approach focusing on diatoms, integrated by limited, strictly target-oriented, dominant benthic macroscopic algae analyses, is proposed. This technique has been evolved, discussed and applied in the course of more than 20 years of field work, in the Berchtesgaden and Adamello-Brenta Nature Parks, involving more than 50 specialists from 7 countries. The resulting sample can be studied with traditional zoomorphological techniques or molecular sequencing, or combining both. The technique is proposed as a little complicated tool that can be easily applied under strongly different environmental conditions.



## WORKSHOP 1.5.

# MONITORING AND MANAGING EUROPEAN UNION SPECIES AND HABITATS OF ALPINE RIVERS

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CHAIR: NORBERT MÜLLER, UNIVERSITY OF APPLIED SCIENCES, ERFURT &  
HELMUT KUDRNOVSKY, FREELANCER, KEMATEN

The EU Habitat Directive is requiring the monitoring and managing of their Annex species and habitats. In this session, we will discuss this subject area for alpine rivers. Special focus will be on key species and their habitat types 3220, 3230, 3240 "Alpine rivers" and 7240\* and 91E0. Within the last EU Habitats Directive Article 17 Reporting the conservation status of these habitats was assessed with unfavourable inadequate to bad. Therefore, besides methods of monitoring also examples of managing and reintroduction of key species will be part of this workshop. This workshop is also part of the "16<sup>th</sup> International Alpine Workshop" an annual meeting of scientists, practitioners and advanced students working in alpine rivers (see [www.fh-erfurt.de/la/tagliamento](http://www.fh-erfurt.de/la/tagliamento)).

### Input 1

3230 "Alpine rivers and their ligneous  
vegetation with *Myricaria germanica*" – recent  
observations along the river Lech

*Helmut Kudrnovsky*  
*Freelancer, Kematen*

According to the Interpretation Manual of the European Union, the habitat 3230 "Alpine rivers and their ligneous vegetation with *Myricaria germanica*" is described as: Communities of low shrubby pioneers invading the herbaceous formations on gravel deposits rich in fine silt, of mountain and northern boreal streams with an alpine, summer-high, flow regime. *Myricaria germanica* and *Salix* spp. are characteristic (Salici-Myricarietum).

Next to the river system of Isar / Rissbach, the Tyrolean Lech is one of the both hotspots for this specific habitat type in the Northern parts of the Eastern Alps. Additionally, both river sections are part of Natura 2000, the European wide network of protected areas (Tiroler Lech – SiteCode: AT3309000; Karwendel mit

Isar – SiteCode: DE8433301, Karwendel – SiteCode: AT3304000) and challenge conflicts of landscape use like hydropower plants or gravel mining.

In the last years, the author visited the Tyrolean part of the river Lech several times. Based upon the comparison of historic and actual documents (e.g. aerial photos, landscapes pictures and results of habitat mapping over the years), recent observations of trends e.g. in spatial distribution or population characteristics will be presented and discussed with the auditorium.

**Input 2**

Reintroduction of *Myricaria germanica* in Italy -  
an overview

Michielon Bruno & Tommaso Sitzia

University of Padova, Department of Land, Environment,  
Agriculture and Forestry

*Myricaria germanica* (L.) Desv (German tamarisk), a pioneer shrub of natural alpine and pre-alpine rivers, is declining in Europe as a result of human disturbance, which has reduced the spontaneous river dynamics, the input of sediments and the river corridor width. Since all the Italian rivers are subject to some form of human disturbance, conservation of *M. germanica* should be ensured by river restoration, active management of riparian habitats or reintroductions. The reintroduction of *M. germanica* has recently been the subject of projects of national and international interest. *M. germanica* can reproduce easily by cuttings or seeds, but translocations have a variable success rate. Some reintroduction projects have been also performed in Italy. For example, Emilia-Romagna Region coordinated the Life project "Taro-Requalification of Taro fluvial habitats vital to avifauna" (LIFE 98NAT/IT/5138) in which thousands of new *M. germanica* plants, grown in nurseries, have been produced and planted. The plant nursery of the Veneto Region produced hundreds of plants of *M. germanica* in the last twenty years. In South Tyrol a wide range of river enhancement programs were carried out since 1999. In many river sites the Office for Mountain Basins of the Civil Protection Agency of the Autonomous Province of Bozen / Bolzano has planted thousands of rooted cuttings of *M. germanica*, which have generated some new vital populations. We confirm that *M. germanica* is a good indicator of natural riverine conditions. Therefore, a successful reintroduction of *M. germanica* can be used to attest the environmental success of a river enhancement work.

**Input 3**

30 years monitoring and managing *Typha minima* at the Tyrolean Lech river – a key species of alpine rivers

Norbert Müller

University of Applied Sciences Erfurt, Department  
Landscape Management & Restoration Ecology

*Typha minima* Funck ex Hoppe (Dwarf Bulrush) is the outstanding key species for braided rivers of the Alps and its foreland. Within the European Habitat Directive, the species is assigned to the priority habitat 7240\* "Alpine pioneer formations of *Caricion bicoloris-atrofuscae*". This habitat is defined as alpine, peri-alpine and northern British communities colonising neutral to slightly acid gravelly, sandy, stony, sometimes somewhat argilous or peaty substrates soaked by cold water, in moraines and on edges of springs, rivulets, glacial torrents of the alpine or sub-alpine levels, or on alluvial sands of pure, cold, slow-flowing rivers and calm backwaters. Recent mapping guidelines for this habitat distinguish between 4 pioneer formations in the alpine zone and one pioneer formation in the subalpine to montane zone including *Typha minima*. Due to river regulation and the construction of power plants the species and its habitat has declined rapidly in the 20<sup>th</sup> century in the Alps and is today extinct or highly endangered in the most European countries. At the Lech river a last large *Typha minima* population was discovered in 1988 in a gravel pit in Tyrol next to the Bavarian border. After traditional conservation actions in the first years, a species action program started in 2003. This program is including ex situ and in situ cultivation of the species, the management of the last isolated populations and trials for the reintroduction of the species by seeds and young plants in order to found new populations during river restoration. Within a wider scientific collaboration some research on population biology and genetic was done. In this contribution we will present a) results from monitoring of the mentioned actions above b) conclusions for the reintroduction of plant species during river restoration c) recommendations on monitoring and managing of dynamic habitats of alpine rivers within the EU Habitat Directive.

## Input 4

Monitoring *Bryodemella tuberculata* – a key species of the habitats 3220, 3230 and 3240  
“Alpine rivers”

Michael Reich

Leibniz University of Hannover, Institute of Environmental  
Planning

In Central Europe, the grasshopper *Bryodemella tuberculata* is restricted to sparsely vegetated gravel bars of rivers and streams of the Bavarian and Tyrolian Alps. These populations are isolated from Northern and Eastern European populations most probably since several thousand years. The species is classified as threatened by extinction in the red lists of Bavaria and Germany. Many local populations became extinct during the first half of the 20<sup>th</sup> century along the headwater streams of the Iller, the Lech in Bavaria, or the Inn in Switzerland. The local populations at the Isar downstream Bad Tölz disappeared during the second half of the 20<sup>th</sup> century. Today, the Tyrolian Lech and the Isar upstream Sylvenstein reservoir harbor the two most important metapopulations in Central Europe. Smaller populations can be found at the headwaters of the Ammer and Loisach catchments as well as along streams feeding the Lakes Heiterwang and Plansee. *B. tuberculata* is a key species of several habitat types protected by the EU habitats directive. It occurs in – and is restricted to – the habitat types: Alpine rivers and the herbaceous vegetation along their banks (3220), Alpine rivers and their ligneous vegetation with *Myricaria germanica* (3230) and Alpine rivers and their ligneous vegetation with *Salix elaeagnos* (3240). The long-term persistence of *B. tuberculata* is characterized by metapopulation dynamics. Local populations may become extinct by flooding or succession, but can be recolonized or colonized from neighboring local populations. Population dynamics of the single local populations are therefore often not correlated or even show opposing trends. The monitoring of single local populations (like single gravel bars), or a monitoring scheme using permanent observation plots, will not lead to significant results. Therefore, the monitoring of the population viability, or the conservation status, requires a monitoring of entire metapopulations. A simple and fast field method can be carried out using groups of 4–8 people and counting individuals visually during the period of maximum abundance. Results from several small and large metapopulations show that population sizes stay stable along some river reaches, while others are characterized by decreasing populations or even local extinction.

## Input 5

A standardized selection of species and habitats for protection measures

Anna Schöpfer & Leopold Füreder

University of Innsbruck, Institute of Ecology

European directives and international programs provide a framework for a sustainable and effective improvement of habitats and the conservation of endangered species. Nature protection measures are accordingly an integrated component of restoration projects. Nevertheless, action plans often lack a scientific rationale as well as a multidimensional approach, since managers must operate within time and budget constraints. This circumstance calls for simple but efficient mechanisms, which bridge the gap between science and practice by translating scientific knowledge to management policy. The authors developed a standardized method for the evidence-based selection of target species within the frame of the river restoration project LIFE Lech – Dynamic river system Lech. The species of the protected area Tiroler Lech were evaluated on multimetric scales. The index score of the species generates the priority ranking for measures. The standardized selection method was tested on already finalized LIFE projects to examine its applicability and to identify deviations between the standardized approach and the status quo. The standardized selection method is a first step towards a scientifically based Decision Support System (DSS) for LIFE projects.

## 7<sup>TH</sup> WATER CONFERENCE

of the Water Platform of the Alpine Convention in dialogue with EUSALP AG 6 Subgroup Water

### **MODUL 2**

## THE IMPACTS OF AND RESPONSE TO DROUGHTS IN THE ALPINE REGION

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The two sessions of Module 2 are aimed at highlighting experiences with and identification of droughts events in different regions of Alpine Countries (Germany, Austria, Italy, Slovenia) and to present existing approaches to cope with challenges in different sectors of water resources management. The sessions are dedicated to facilitate the knowledge exchange in the field of drought management and to raise the awareness about the importance of drought management. One focus will be sharing existing knowledge, which is already available to mitigate impacts of droughts events which are likely to become more frequent in future in the Alpine area.

### **Modul 2 – Part I**

*CHAIR: HANNAH BERGER, BAVARIAN ENVIRONMENT AGENCY, GERMAN DELEGATION TO THE WATER PLATFORM*

### **MODUL 2 – PART II**

*CHAIR: CHRISTIAN SCHILLING, AUSTRIAN DELEGATION TO THE WATER PLATFORM, BMNT, AUSTRIA*

## MODUL 2 – PART I

CHAIR: HANNAH BERGER, BAVARIAN ENVIRONMENT AGENCY, GERMAN DELEGATION TO THE WATER PLATFORM

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### Input 1

Current developments and challenges in drought management in Northern Bavaria

Andreas Kolbinger

Bavarian State Ministry of the Environment and Consumer Protection, Germany

Already now certain areas in Bavaria are heavily irrigated. In 2015 some water resources were overexploited. Irrigation is an important topic in the future and through the dry summer in 2015 the topic was pushed up the agendas. Some ground water tables in Bavaria have not been sufficiently filled up since 2015. Particularly affected is Lower Franconia in the northwest of Bavaria.

Due to climate change as well as increasing agricultural demands (increase in yield and quality, rise in irrigation-worthy crops, possible frost protection irrigation) some Bavarian regions face increased water needs for irrigation of crops.

Water quality and environmental objectives are not to be adversely affected due to the extraction of large amounts of water for irrigation. In 2016 the Bavarian State Ministry of the Environment and Consumer Protection therefore introduced a pilot funding program which funds the preparation of “Concepts for sustainable and environmental friendly use of water resources” up to 75%. A low flow management guideline for Lower Franconia is in the final phase of development.

Already today a key factor for a sustainable handling of water resources in Bavaria are targeted control measures. Moreover the impact of intensified agriculture due to possibilities of irrigation has to be taken into account.

### Input 2

Strategic water resources management and drought

Johannes Wiesenegger

Regional Government of Salzburg, Austria

Despite the fact that the Region of Salzburg is well known for its extraordinary precipitation called “*Schnürlregen*” and quite a number of rainy days, special hydrological situations, e.g. long dry spells as seen in 2003, can cause local problems in water supply in the northern parts of the Province of Salzburg.

But drought related problems, due to specific situations and special demands in tourism e.g. in Obertauern and Saalbach, can also occur during winter. Approximately 16 million m<sup>3</sup> of water is used every year in 52 skiing resorts to produce “artificial snow” which is distributed on 4700 ha ski slopes. Filling the 120 reservoirs, mainly built on the upper part of mountains, needs strategic water resources management especially in regions where wells and springs are also used for local drinking water supply.

Overnight-stay-peaks around Christmas and New Year in combination with low flow can also create difficulties with regards to wastewater concentration in alpine rivers and hence need special management.

Therefore, a multi pillar approach of operational, strategic and creative solutions is used to solve drought related problems with regards to water supply, tourism and waste water treatment.

### Input 3

#### Drought management with negotiated processes in Ital

*Gaia Checcucci*

*General Director of Water and Land Protection Direction,  
Italian Ministry of the Environment, Land and Sea, Italy*

In Italy, summer 2017, is ranked as the 4<sup>th</sup> driest since 1800 on a national basis. Relatively to the 1971–2000 mean precipitations, anomaly of summer 2017 mean precipitations are -41% on the national level, -82% in the month of August.

Anyway, after the frequently recurring droughts of the last two decades, Italy has increased its preparedness, with the Italian Ministry of the Environment that has launched, at the end of 2016, the “Permanent Observatories on Water Uses” at River District level. These commissions of institutions and stakeholders are called, on the basis of the level of water criticality, to play a role that can extend from monitoring activities to acting as a Governing Body for the management of the water crisis, identifying the necessary measures in order to reduce the impacts of drought, based on the contents of the Drought Management Plan and on the negotiation among sectors. In a second phase, these commissions are going to work with standardized procedures linked to threshold values to which associate measures like e.g. water releases from reservoirs and reduced withdrawals (as tested in 2017 plan licensed by the Adige observatory).

The use of reservoirs for improving water discharge for different uses has been experienced as a result of a structured negotiation, even if the Italian law establishes that the agricultural sector has got the second highest priority (after freshwater supply) and that the Ministries of Environment and Economic Development (in agreement with District Authorities and Regions) could decide to release water from reservoirs in case of emergency.

## MODUL 2 – PART II

CHAIR: CHRISTIAN SCHILLING, AUSTRIAN DELEGATION TO THE WATER PLATFORM, BMNT, AUSTRIA

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### Input 4

New tools for better drought risk management

*Andreja Sušnik*

*Agrometeorological Analysis Section/Slovenian Environment Agency (ARSO), Slovenia*

Climate extremes such as drought are becoming more acute and surely affect farmers in Slovenia. Since 1990, agricultural drought notably occurs more often and intense, and reached magnitude of natural disaster in 2000, 2001, 2003, 2006, 2007, 2012, 2013 and 2017. With a set of free tools ARSO helps farmers make smarter weather / climate related decisions. In 2017, we developed Agrometeorological forecast application that lets general and professional public easily access region-specific warnings, measurements and forecasts of agrometeorological variables. For smart-irrigation, tailored products using water balance model IRRFIB to estimate crop water demand are prepared for rainfed agricultural crops, with drought stress also evaluated. Additionally, an interactive Drought User Service (DUS) tool is being developed within on-going DriDanube project for better drought characterization and early warning over Danube region. Available to public online, it includes a range of satellite datasets further processed into ready-to-use drought information. DUS will also display drought impacts, assessed through newly established national reporting networks, and yield forecast. The project will support activities of Drought Management Centre for SE Europe hosted by ARSO.

More on:

Agrometeorological forecast: <http://meteo.arso.gov.si/met/sl/agromet/forecast/>

DriDanube project: <http://www.interreg-danube.eu/dridanube>

### Input 5

Security of drinking water in light of climate change

*Gunther Heißel*

*Regional Government of Tyrol, Austria*

Tyrol, part of western Austria, is a very rangy country. Only 12% of Tyrol are habitable for the about 750 000 inhabitants and the nearly 50 million overnight stays of tourists.

Most of our drinking water comes from springs of our mountains and a small part from the groundwater of our valley floors. Most of our drinking water up to the presence is native water.

Although most parts of the Tyrol are characterized by a comparatively high amount of annual precipitation there are only a few areas with big springs due to the geologic setting of the Tyrolean Alps (e.g. Northern Limestone Alps). Only parts of the Limestone Alps are characterized by a low level of karst-formation. That means that only these areas have big springs with groundwater with long duration hydrogeologic residence times up to years and tens of years.

All other areas of the Tyrolean mountain are characterized by smaller springs with groundwater of short duration residence times. That means that the groundwater of these areas is characterized by a more or less high vulnerability.

In consideration of the above described circumstances and conditions it is obvious that the estimated climate change will influence the security of the supply of drinking water for our population. We have to expect changes of quantity and quality of our water resources. So we will have to work out strategies to make our supply with drinking water fit for climate change.

## Input 6

Facing droughts in the Alpine region -  
Experiences, approaches and common  
challenges

*Andrea Bianchini*

*Italy, IMELS Consultant, Italian Delegation to the Platform  
"Water Management in the Alps" of the Alpine Convention*

Ministers of the Alpine Countries decided to include drought risk management in the 2017–2018 program of work of the Platform „Water Management in the Alps“ of the Alpine Convention and also EUSALP is now drafting a „strategy for water-demand and supply management in order to prevent conflicts among sectors and actors also in case of peaks of demand and/or regional droughts“.

Drought of 2003 was extremely meaningful for all the Alpine Countries with a precipitation deficit for the 8 driest months going from -20% to -60% of long-term annual precipitations, with losses in agriculture for hundreds million €; but other meaningful droughts have been recorded in one or more Countries in most of the years of the last two decades, recurring with an alarming frequency and particularly affecting summer months.

An international comparison of plans and strategies that the Alpine Countries and Regions has put in place in the last years to tackle this „new“ challenge has allowed to highlight the lessons learned, which include: the establishment of commissions of institutions and stakeholders for agreeing on compromises between sectors and introducing procedures linked to threshold values; increasing the resilience of water supply systems (linking networks of distribution, investing in alternative sources, pumping from other regions); improving the efficiency of irrigation and / or limiting agricultural withdrawals; promoting the reduction of drought exposure (crop diversification, sowing of more drought-tolerant hybrids, etc.); helping runoff with planned water releases from reservoirs; increasing natural water retention measures.



7<sup>TH</sup> WATER CONFERENCE

of the Water Platform of the Alpine Convention in dialogue with EUSALP AG 6 Subgroup Water

**MODUL 3**

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**Modul 3 – Part I**

GREEN INFRASTRUCTURE FOR AN INTEGRATED AND  
SUSTAINABLE WATER MANAGEMENT

*CHAIR: LUKA ŠTRAVS, MINISTRY OF THE ENVIRONMENT AND SPATIAL  
PLANNING, SLOVENIA*

**MODUL 3 – PART II**

COMMON GUIDELINES FOR THE USE OF SMALL HYDRO-  
POWER IN THE ALPINE REGION

*CHAIR: GAIA CHECCUCCI, GENERAL DIRECTOR OF WATER AND LAND  
PROTECTION DIRECTION, ITALIAN MINISTRY OF THE ENVIRONMENT, LAND  
AND SEA, ITALY*

## MODUL 3 – PART 1

# GREEN INFRASTRUCTURE FOR AN INTEGRATED AND SUSTAINABLE WATER MANAGEMENT

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CHAIR: *LUKA ŠTRAVS, MINISTRY OF THE ENVIRONMENT AND SPATIAL PLANNING, SLOVENIA*

In the Green infrastructure for an integrated and sustainable water management session possibilities and potentials of using different kinds of green infrastructure (nature based) solutions in the wider framework of sustainable water management will be addressed. Issues, challenges and also some other hot topics (is there a fully green nature based solution in the field of the water management?) connected to the green infrastructure theme will be presented and discussed. Experiences regarding that from different alpine countries will be shared.

### Input 1

Greener Alpine Rivers? Conclusions and Recommendations of the EUSALP AG 6 – Subgroup Water

*Elisabeth Sötz*

*WWF Austria, for EUSALP AG 6*

Over the last centuries, alpine rivers have been straightened and channelized, longitudinally interrupted by dams, artificial reservoirs and weirs, modified in their lateral connectivity by means of concrete walls and embankments. Even if all these measures in most of the cases has revealed to be successful and effective for their own sectoral scope – land use, flood control, hydropower – they have impacted other uses of the water courses and in particular the ecological connectivity, hydro-morphological processes and solid transport, leading to reduced flooding of the inundation areas, lowering of groundwater levels, loss of biotopes as well as less effective protection. Highlighting the effectiveness of such type of solutions also for flood protection

can lead to spreading green infrastructure solutions in the alpine macro-region, substantially contributing to an ecosystem-oriented adaptation to climate changes.

Therefore, the EUSALP EUSALP AG 6 – subgroup 3 has elaborated a document which considers the possibilities for the implementation of the green infrastructure solutions for achieving both the objectives of the EU Water Framework Directive (2000/60/CE) and the Flood Directive (2007/60/CE). As the type of river courses in the Alpine Region differ widely in regard of their environment and specific challenges, recommendations have been formulated for different typologies of Alpine water courses – from torrents in less populated valleys to urban river stretches.

**Input 2**

## 50 Shades of Green Infrastructure – Experiences from Slovenia

*Joze Papež<sup>1</sup>, Mateja Ribnikar<sup>2</sup> & Maja Jelen<sup>2</sup>*<sup>1</sup>*Hidrotehnik, Slovenia*<sup>2</sup>*MOP, Slovenia*

In Slovenia, we strive to meet the demands of green policies which require green approaches and priority treatment of green infrastructure solutions. Therefore, within the framework of the EU co-financing programs, we started to apply projects in which these measures will be actualised – both implemented and established in the environment; for example, the Grevislin Project, which was submitted through the INTERREG V-A Italy-Slovenia 2014–2020 in cooperation with neighbouring Italy.

The paper will also briefly present additional natural-based measures and projects in Slovenia (for example, the FRISCO1 project) that are already established, as well as giving some historical insight into the achievements of the environmentally friendly and “close to nature” management of torrential and forest areas in Slovenia.

When designing green infrastructure projects, diverse and complex interpretations thereof present challenges for designing and implementing flood-risk management schemes which contain a combination of “green” and “grey” infrastructure measures. Unfortunately, by solely implementing green infrastructure measures we cannot solve the problems of reducing flood-risk. Likewise, some grey measures, in fact, enable the establishment/preservation of an existing green infrastructure. It is also important how ‘green’ these grey measures are. How green, then, should a green infrastructure project be for it to rank as such? Which shade of green is enough?

The issue is not solely theoretical, as it also relates to the sources and method of financing these projects.

**Input 3**

## Alpine green infrastructure – joining forces for nature, people and the economy

*Manuela Künzl<sup>1</sup> & Franziska Drasdo<sup>2</sup>*<sup>1</sup>*Bavarian State Ministry of the Environment and Consumer Protection, Germany*<sup>2</sup>*City of Munich - Department of Urban Planning*

Current challenges like climate change, loss of biodiversity or landscape fragmentation call for political leadership for sustainably leading the Alpine region into the future – for the benefits of nature, people and the economy. A strategically planned and coherently managed network of Green and Blue Infrastructure (GI) shall therefore aim at securing the continuous provision of the benefits offered in rural and urban settings. This was declared by 27 Alpine states and regions on 2 October 2017 in Munich. As a result of cooperation with the INTERREG Alpine Space Project LOS\_DAMA!, Mayors of Alpine cities and city regions initiated a GI cities network. Specifically in the Alpine metropolises GI are indispensable for a sustainable water management and to secure a high living quality for the future. Experiences from the cities network showing exemplarily the urban dimension of an integrative Alpine water management: Milan creates GI along the river Lambro to serve as recreational facilities for daily visitors. At the same time their consumption also increases sales for local farmers. In Munich, the near-natural design of the Isar River is also linked to local recreational opportunities and flood protection. Since the restoration the intensive exchange between various stakeholders is maintained in terms of regular “river talks”. These EUSALP AG 7 activities are vivid examples for linking relevant actors in a multi-level approach across borders and bridging urban with rural areas.

## MODUL 3 – PART II

# COMMON GUIDELINES FOR THE USE OF SMALL HYDRO-POWER IN THE ALPINE REGION

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*CHAIR: GAIA CHECCUCCI, ITALIAN DELEGATION TO THE WATER PLATFORM, ITALIAN MINISTRY OF THE ENVIRONMENT, LAND AND SEA, ITALY*

In 2011 the Platform Water Management in the Alps of the Alpine Convention elaborated Common guidelines for the sustainable use of small hydropower in the alpine region including good practise examples. The guidelines are available at the webpage of the Alpine Convention in all Alpine languages.

The Water Platform was mandated by the XIV. Alpine Conference to include a follow-up activity on the Common guidelines during the mandate period 2017–2018. It was agreed to evaluate how the guidelines serve the needs of regional/local administrations.

The session will highlight the motivation for the elaboration and main objectives and the content of the common guidelines for the sustainable use of small hydropower in the alpine region. A second presentation will be used to present the results of the follow-up activity.

### Input 1

Hydropower generation in the Alps – the common guidelines on small hydropower of the Alpine Convention

*Pietro Colonna*

*Italy, Italian Delegation to the Alpine Convention*

Based on the mandate from the X Ministerial Conference of the Alpine Convention (2009), the Platform “Water Management in the Alps” has worked out common guidelines on the use of small hydropower including good practice examples, then approved by the XI Alpine Conference in 2011.

Situation report drafted by the Water Platform showed that of the total electricity production from hydropower, larger plants contribute by far the major share, meanwhile stations with a capacity of less than 1 MW constitute around 75% of all HP plants within the Alpine area yet contribute less than 5% to total electricity production.

Despite small hydropower plants HP often lead to widespread impacts, they can play a crucial role in meeting electricity demand in more remote regions and provide important economic stimulation at local level in less favoured areas.

The key conclusion is that due care and planning on a regional basis is necessary when deciding about new SHP facilities in order to ensure that further development of hydropower is compatible with environmental protection requirements as well as with the targets set for renewable energy. This explains the need for support for decision-making and common guidelines, which specific objective is providing general guidance for the identification of potentially favourable locations for small hydropower plants and for the subsequent authorisation decision considering the principles of sustainable development in the Alps.

## Input 2

Application of the Common Guidelines for the use of Small Hydropower in the Alpine region

*Christian Schilling*

*Austrian delegation to the Water Platform, BMNT, Austria*

At the X<sup>th</sup> Alpine Conference in 2009, Ministers and High Representatives of Alpine Countries decided to set up the platform Water Management in the Alps. One of the tasks of the platform was to elaborate recommendations for the sustainable use of hydropower generation with a focus on small hydropower. As a result, the Common Guidelines for the use of small hydropower in the Alpine Region were published in all Alpine languages and have been approved by the XI<sup>th</sup> Alpine Conference in 2011. The guidelines include common principles and recommendations, an outline for an assessment procedure as well as a pool of evaluation criteria. The intention of the guidelines is to support authorities in charge of authorization of new hydropower plants and to give advice to planners to ensure that the further development of small hydropower will take place compatible with environment protection requirements.

For the mandate 2017–2018, the Water Platform of the Alpine Convention decided to include a follow-up activity how the Common Guidelines are used by the authorities of the Alpine Countries. A questionnaire was distributed to the national and regional administrations of the Alpine Countries. An assessment report has been draft based on the information received which summarizes the feedback and the information provided and concludes about possible further activities.

## MODUL 4

# CONFLICTING WATER USE IN THE ALPS

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CHAIR: ROLAND PSENNER, EURAC BOLZANO & GÜNTER KÖCK, ÖAW

Water resources play a particular role not only in the Alps, but also in large areas of Europe. They occur in various forms, are highly interlinked, belong to different countries and administrative units and provide habitats for rich and particular diverse groups of organisms. However, changing environmental and climatic conditions as well as growing demand is likely to lead to conflicts in water use and to exacerbate existing disputes over water management strategies. The session will identify hot spots of water use and management, analyze target conflicts, assess their relevance in regional, national and international context, and discuss possible solutions.

## Keynotes

### Water-related hotspots in the Alps – Results of the workshops of Module 1 and perspectives

*Klaus Lanz, International Water Affairs*

Which insights have been gained by the mapping exercise? Which new and surprising issues have come up? In which way can the systematic characterization of water management conflicts help make better decisions? What can we learn from case studies in terms of solution approaches? Are there additional areas of concern which need to be addressed by future water policies? How does personal and professional perspective influence perception? How can we make sure to capture all potential water-related conflict causes?

### Snowmaking – a vital adaptation measure creating conflicts

*Robert Steiger, University of Innsbruck*

Snowmaking has developed from a luxury product placed only at selective exposed areas to a standard equipment covering more or less the entire ski area. Climate change will further increase the use of snowmaking as less natural snow will be available thus shortening and interrupting ski operations. An intensified snow production is likely to fuel conflicts. These include water usage, landscape change and land use, energy consumption and environmental consequences on ski slopes. These conflicts require appropriate attention from both public authorities and ski resort operators.

### Results of the 7<sup>th</sup> Water Conference (Modules 2 and 3)

*Joze Papež, Slovenien*

## WORKSHOP 4.1.

# LOCAL WATER USE: WATER SUPPLY, AGRICULTURE, TOURISM

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CHAIR: HEIKE ZIMMERMANN-TIMM, GOETHE UNIVERSITY,  
FRANKFURT AM MAIN

While the climate change and its effects on the water balance in the mountains have attracted considerable attention, the land-use change and water management at the different spatial scales in the Alps have so far received much less attention. Within the framework of this session, examples will be introduced which aim to bridge the gap between theory and practice, such as in agricultural irrigation. Further, the examples do not tie decisions on the water balance to political boundaries and involve the affected parties more actively in decision making processes. The presented examples will be critically discussed to determine if a paradigm shift is indicated and what role identifying with common objectives plays in the success.

### Input 1

Problem of private or public use of water  
resources: Case study Val Masino

*Oliver Ike*

*Sighignola Luxury Holding*

Where should be the limit for the intervention of the public hand in order to unblock a situation where the whole tourism of an entire valley suffers due to the close down of the hot spring water sources that are owned privately?

The hot spring water Spa of Val Masino dating back to the year 1400 in the Valltelin gives a perfect example how the public hand has not been able to resolve such a delicate situation. The Spa is now closed since 2014.

Where should the time limit be to revoke a public water license from a private ownership if the whole tourism industry of a valley is concerned by the wrong decision of a private entity?

Should there be a forced management by the public hand in order to preserve the tourism of the valley,

given that the hot spring SPA in Val Masino represents the main attraction?

### Input 2

Is Alpine irrigation overestimated?

*Martin Calianno*

*University of Lausanne, Institute of Geography and Sustainability*

Irrigation is a common water use in Alpine valleys with hot and dry summers due to continental climate and foehn effect. And because irrigation takes place during summer high tourist seasons, conflicts may happen with drinking water uses. While irrigation is usually seen as an important water use, there is little knowledge about water volumes actually used for irrigation in the Alps. As direct field measurements are rare, irrigation demand is estimated mainly by calculating crop water needs or by using withdrawals values. But withdrawals overestimate the actual demand for irrigation due to losses. Also, not all water withdrawn is demanded by

end-users. In this work we make direct irrigation measurements to evaluate irrigation estimates: empirical methods (from withdrawals and from demands, based on local farmer practices) and agro-climatic models (CropWat, WEAP-MABIA). Montana (Swiss Alps) was chosen as case study to install monitoring devices (water-, flow-meters) on irrigation networks to measure irrigation distributions to pastures and vineyards. Results show that withdrawals and agro-climatic models overestimate by almost ten times the observed irrigation, especially for hot and dry seasons. The empirical method based on local farmers' irrigation practices also overestimates observed irrigation, but only by a factor of 2.5. This highlights the importance to include in the calculation the actual practices (frequency and volumes of irrigation, management constraints).

### Input 3

Transboundary water supply assessment of surface water resource availability: application in Danube and Tyrol

*Simone Persiano<sup>1</sup>, Alessio Pugliese<sup>1</sup>, Alberto Aloe<sup>2</sup>, Jon Olav Skøien<sup>2</sup>, Stefano Bagli<sup>3</sup>, Paolo Mazzoli<sup>3</sup>, Juraj Parajka<sup>4</sup>, Berit Arheimer<sup>5</sup>, René Capell<sup>5</sup>, Alberto Pistocchi<sup>2</sup>, Alberto Montanari<sup>1</sup>, Günter Blöschl<sup>4</sup>, Attilio Castellarin<sup>1</sup>*

<sup>1</sup>Department DICAM, University of Bologna, Bologna, Italy

<sup>2</sup>European Commission, DG Joint Research Centre (JRC), Ispra, Italy

<sup>3</sup>GECOSistema srl, Cesena, Italy

<sup>4</sup>Institute for Hydraulic and Water Resources Engineering, TU Wien, Wien, Austria

<sup>5</sup>Swedish Meteorological and Hydrological Institute (SMHI), Norrköping, Sweden

Representing the hydrological behaviour of international watersheds is a fundamental issue for effectively addressing transboundary water resources planning and management problems. On the one hand, macro-scale hydrological models can be used to compute a variety of hydrological signatures along the stream network. Their output can be open-access and freely distributed, providing extremely useful hydrological information across data scarce regions for the implementation of transboundary policies for water resources management or flood-risk mitigation. On the other hand, geostatistical procedures, such as Top-kriging (TK), have been shown to provide reliable predictions of streamflow, high- and low-flow indices over large study areas. We consider the latter approaches, focusing on two dif-

ferent problems: 1) the representation of streamflow regime at ~4000 prediction nodes in the Danube region, producing a GIS data-layer to be made available for a broader use through the Danube Reference Spatial Data Infrastructure (DRSDI), and 2) the local enhancement of macro-scale runoff simulations, with focus on Tyrol (Austria and Italy). Our applications show that geostatistical approaches 1) accurately interpolate observed streamflow regime over large geographical areas and 2) can significantly enhance local hydrological simulations, in areas where macro-scale models fail to correctly reproduce the hydrologic behaviour.

### Input 4

The role of local community in governing water as a common-pool resource

*Primož Pipan, Mateja Šmid Hribar & Mimi Urbanc*

*Research Centre of the Slovenian Academy of Sciences and Arts, Anton Melik Geographical Institute*

As a fundamental source for life for which it is hard to limit access and is subtractable through use, water is often a vulnerable and conflict-prone common-pool resource that demands a sustainable governance. Elinor Ostrom won the Nobel Prize for her founding that people – when facing a limited resource – are able to act and collaborate for the benefit of common-pool resource. One of the important characteristics of efficient governance is that members have rights as well as obligations or responsibilities, which are counterbalanced. In the presentation we would like to introduce you to a good practice of water governance and management in a small mountain community in Čadrg village near Tolmin in Slovenian Alps. The water supply there had long been managed by the village community. In 2010 the reservoir became problematic in terms of drinking water purity. The water management could be taken over by the public utility company of the municipality, which would appropriately treat the water with chlorine. However, this approach was not acceptable to locals. The only option for avoiding chlorination was to arrange for treatment with UV radiation by the inhabitants themselves. They defended their right to water, made the rules for its use, and established transparent management system with which they are content and proud of. We believe that the case study from Čadrg village could present an example to other local communities how to govern their water sources.



## WORKSHOP 4.2.

# ENERGY PRODUCTION (HYDROPOWER)

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CHAIR: PETER HANISCH, DONAUCONSULT

The presentations show the variety of conflicts arising from hydropower generation in Alpine surroundings. They serve as input for the discussion on how much society is ready to “pay” for the preservation of intact ecosystems or in return for their optimized use. Scale level and dimensions taken into account have a significant impact on the result of the evaluation, as well as the need to shift objectives between different spatial, ecological or socio-economic subsystems.

The objective of the discussion will be to propose how scientific research, technical practice and economic actors can agree on a common approach for evaluation and implementation of hydropower projects that provides democratic legitimacy for the decision process accepted by the society.

### Input 1

Energy transition in Alpine regions – what does it mean for water use and water management?

A view from South Tyrol considering dynamic regional energy modelling and ongoing refurbishments of large scale hydro power plants.

*Wolfram Sparber*

*Eurac research, Institute Renewable Energy, Bolzano*

The EUSALP EU Strategy Alpine Region has set the target to make “...the Alpine Space a model region in energy efficiency and renewable energy applications...”. Many regions within the Alpine Space have set ambitious climate and renewable energy targets to be met until 2020, 2030 and 2050.

But with which energy system can such targets be met? What technology combination, to which extend, has to be applied to reach the target in a most cost effective way? Can the targets be reached considering technical, social, environmental and economic constraints?

Within Eurac Research a method has been developed, that allows to give answers to these questions considering the hour by hour energy consumption for a reference year. The region of South Tyrol with its energy consumption, building stock, landscape and natural resources, transportation mix and its climate plan (target 1.5 ton CO<sub>2</sub> emissions / capita till 2050) has been taken as a demo model. Technical, social and environmental constraints have been considered with regards to the possible expansion of renewable energy sources for electricity and heat production. The energy efficiency potential has been considered, especially with regard to the existing building stock. Further more the mobility sector and its transition to zero emission transport has been considered.

The main results of this model are presented considering as well the important investments going on by the energy utility Alperia in the local hydropower infrastructure. Alperia is investing in a massive refurbishment campaign of existing large scale hydro power plants considering safety, efficiency and environmental aspects.

## Input 2

Sustainability assessment of hydropower from a stakeholder perspective

Lutz E. Schlange<sup>1</sup>, Werner Hediger<sup>2</sup>, Gianluca Giuliani<sup>2</sup> & Marc Herter<sup>2</sup>

<sup>1</sup>University of Applied Sciences Chur, Department of Entrepreneurial Management

<sup>2</sup>University of Applied Sciences Chur, Department of Living Environment

Hydropower being the most important domestic energy resource and backbone of regional economies across the Alpine expanse, it also affects the environment and thus poses a major challenge for sustainable development. The purpose of this research is to advance sustainability assessment of hydropower projects, in particular regarding its integrity, flexibility, and transdisciplinarity. To meet this end, the iterative methodology proposed integrates a systematic assessment on the one hand, and a human-centered dialogue focusing on the semantics and priorities of stakeholders, on the other. In order to comprehensively evaluate the complex effects of hydropower plants, an integrated impact and sustainability assessment is applied to case studies in selected Swiss Alpine regions in the construction and operation phases. In order to foster a critical dialogue about and higher acceptance of the projects under evaluation, trade-offs among sustainability goals are evaluated by stakeholders, including energy companies, investors, politicians, public administrations, NGOs, local citizens, and businesses.

## Input 3

Small hydropower plants: A critique related to the Belluno area (Italy)

Monica Camuffo<sup>1,2</sup>, Giovanna Deppi<sup>3</sup>, Luigina Malvestio<sup>2</sup> & Lucia Ruffato<sup>2</sup>

<sup>1</sup>Università Ca'Foscari Venezia, Department of Environmental Sciences, Informatics and Statistics

<sup>2</sup>Comitato Acqua Bene Comune Belluno

<sup>3</sup>Coordinamento Nazionale tutela fiumi Free Rivers Italia

Small hydropower plants (SHPP) are widely criticized by research communities from many countries. Already in 2011 the Alpine Convention highlights SHPP-associated risks for pristine environments along with small profits in terms of energy production. Despite the questionable benefits of SHPP, Italian government still considers hydropower (and mainly small plants) as one of the ways to energy autarchy. In 2009, Italian government approved measures to implement the *Direttiva 2009/28/CE* without considering their viability and impact on preexisting environmental directives (*Habitat and Water framework directive*). Local institutions were not ready to manage the speculative stress induced by incoming government economic incentives (state-aid) in the absence of adequate territorial planning and regulations and ended up with unprecedented exploitation of unspoiled streams. More than 2000 new SHPP projects have been presented in Italy, mainly in the Alpine region; among which 150 are in the Belluno area, that sadly witnesses this threatening circumstance. We focus on the community reactions to the new wave of hydroelectric projects, conflicts, networks and solutions that arose from the territory. We will show how local communities are able to resist and to invest time, energy and money trying to improve inadequate policies established at national regional and provincial level.

## Input 4

Impacts and risks of reservoirs: The case of reservoirs along the Spöl river

Christian Schlüchter<sup>1</sup> & Thomas Scheurer<sup>2</sup>

<sup>1</sup>University of Berne, Institute of Geological Sciences

<sup>2</sup>ISCAR

This presentation illustrates scientific and technical challenges to manage geocological impacts of reservoirs for hydropower production. The River Spöl in the Engadine Valley has been a high energy alpine river until it was developed as part of a hydropower scheme in two steps, beginning in 1962: construction of an upper dam to form the Lago di Livigno and of a lower dam to create the Ova Spin reservoir. The remaining river segment in between the two reservoirs runs in the Swiss National Park. This fact did allow fundamental research into the geological and biological processes of a managed alpine river with a focus on the nature of the legally reduced and seasonally and daily variable, highly controlled water flow. The technical flooding in 1995 has been monitored scientifically and has been the starting event of a series of monitored floodings of the river with the result of an overall revitalisation of the system to the benefit of all parties involved: plant operators, science community and, above all, nature. However, two events added to the environmental experimental character of the River Spöl: in 2013 fine grained sediment from the upper reservoir (Lago di Livigno) produced a muddy, biohostile river and in 2016 a PCP-dust cloud escaped from a maintenance operation in the facilities of the upper dam. In addition, organic sediments were recorded in the Ova Spin reservoir which were the result of insufficient wastewater treatment from Upper Engadine.

## Input 5

Preserving Alpine Floodplain rivers through functional floodplain flows

Daniel Hayes<sup>1</sup>, Julia Brändle<sup>2</sup>, Carina Seliger<sup>1</sup>, Bernhard Zeiringer<sup>1</sup> & Stefan Schmutz<sup>1</sup>

<sup>1</sup>University of Natural Resources and Life Sciences, Vienna, Institute of Hydrobiology and Aquatic Ecosystem Management

<sup>2</sup>WWF Switzerland

Alpine floodplain rivers constitute biodiversity hotspots. As these ecosystems are particularly sensitive to hydrological modifications, water abstraction poses a serious threat to them, if environmental flow (e-flow) management does not consider the requirements of the whole river system, but only chosen instream criteria. Based on essential functions and processes of unimpaired floodplain rivers, we identify fundamental principles that must be adhered to determine truly ecologically-relevant e-flows. Literature emphasises that the natural flow regime and its seasonal components are primary drivers for functions / processes of abiotic and biotic elements, e.g., morphology, water quality, floodplain, groundwater, riparian vegetation, fish, macroinvertebrates, and amphibians. Based on the liaison between central flow regime elements and associated environmental components within and adjacent to the river, we formulate a process-oriented functional floodplain flow (ff-flow) approach, which offers a holistic conceptual framework for e-flow assessment in floodplain river ecosystems. This approach proposes a dynamic e-flow regime, as it underlines the importance of emulating the natural flow regime with its seasonal variability, flow magnitude, frequency, event duration, and rise and fall of the hydrograph. Thus, the ff-flow approach can safeguard the protection of alpine floodplain rivers by establishing ecologically-relevant e-flows and guiding flow restoration measures.

## WORKSHOP 4.3.

### TOURISM

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CHAIR: PHILIPPE BOURDEAU, UNIVERSITÉ GRENOBLE-ALPES, INSTITUT DE GÉOGRAPHIE ALPINE

While water has become a central resource of the summer and winter tourist experience and economy in the mountains, its increasing uses (sports and leisure activities, well-being, cultural snow...) make it a common good with stakes facing the risks of shortage and competition between recreational and utilitarian uses (daily life, agriculture, industry). The workshop will address key questions for the prospective of recreational uses of water in the mountains: What know-how for regulating water uses between the tourism sector and other activities, and vis-à-vis the downstream watersheds? What governance of water between public and private actors? What are the benefits of integrated water management systems?

#### Input 1

Valuation of recreation related ecosystem services on rivers Soča (Slovenia) and Tara (Montenegro)

*Jernej Stritih<sup>1</sup>, Matjaž Harmel<sup>2</sup> & Klemen Strmšnik<sup>2</sup>*

<sup>1</sup>STRITIH, Sustainable Development, Bovec

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Soča river in Slovenia and Tara river in Montenegro are highly attractive rivers for recreation and tourism in form of fishing, rafting, kayaking, hiking and experience of nature. Both river basins are within UNESCO Biosphere Reserves (Julian Alps and Tara River Basin). Upper Soča river is already highly used for recreation, while tourism and recreation on Tara river are at early stages of development. For upper Soča river in Slovenia, existing added value generated by recreation and tourism was assessed based on actual revenues generated. On Tara, the potential for future revenues was assessed based on comparison with Soča. Both cases show that the economic value of recreation and tourism, while having very low or even positive effect on

river basin conservation, is comparable to the value of energy generation that had been proposed on the rivers previously. But recreation and tourism contribute considerably more to local sustainable development, as they provide a higher number of local workplaces and entrepreneurial opportunities based on non-extractive use of nature. Even though not used at the moment, the biosphere reserve or similar community based mechanism may provide a good framework for the management of nature based recreation and tourism, and of trade-offs with other ecosystem services, in the river basin.

## Input 2

Integrated Water Resource Management in tourist areas: moving from the hydrological basin to the water use basin

*Emmanuel Reynard, Martin Calianno, Marianne Milano & Christophe Clivaz*

*University of Lausanne, Institute of Geography and Sustainability*

Integrated Water Resource Management (IWRM) was proposed to enhance sustainable water management. Although organizing water management according to the hydrological watershed limits is interesting, it can be difficult to be applied at the local level due to anthropic factors that may not fit in within these limits (e.g. water derivations). It is particularly noticeable in mountain tourist resorts, where spatial and temporal concentration of water demand induces a high anthropization of hydrological systems. Is watershed management then the best model for such artificialized watersheds? This issue is discussed by studying the Crans-Montana resort (Switzerland), which experienced several phases of intense development leading to situations of water scarcity. Currently it is a large resort, with more than 40 000 tourist beds and a large set of competing water uses (irrigation, hydropower, drinking water supply and artificial snowmaking). Management issues are here analyzed from the IWRM perspective. We demonstrate that in this resort, straddling several watersheds with multiple artificial derivations of water, the model of watershed management is not the most appropriate. After analyzing the historical evolution of the tourist resort and water needs, we suggest three tools the water use basin, water use density and water use regime, to address highly anthropized water systems with a specific approach focused on the water demand side.

## Input 3

Summary of the Water & Tourism Conference 2017 in Sion/Sierre (Switzerland)

*Emmanuel Reynard*

*University of Lausanne, Institute of Geography and Sustainability*

Organised by the Institute of Geography and Sustainability of Lausanne University and the Institute of Tourism, HES-SO Valais-Wallis, the conference “Water and Tourism” was held in Sion and Sierre (Valais, Switzerland), from 9 to 10 November 2018. It aimed to discuss the relationships between tourism and water and explored three topics: (i) the impacts of tourism on water management; (ii) water as a resource for tour-

ism; (iii) tourism, water and climate change. Around 50 researchers from 10 countries attended the meeting. Three keynote speeches by Prof. Stefan Gössling (Lund University), Melanie Kay Smith (Budapest Metropolitan University) and David Sauri (Autonomous University of Barcelona), 22 oral communications and 5 posters were presented, and the proceedings will be published in *Mondes du Tourisme* and *Journal of Alpine Research*. Several topics were discussed during the conference. The attractiveness of water for tourism is facing several challenges, including changes in public expectations over time, as experienced by thermalism, the privatization of the banks of alpine lakes, or the difficulties of tourism promotion of hydraulic heritage. Tourism also has significant impacts on water resources. The water footprint is often underestimated because it does not take indirect consumption into account. Seasonality of use is also a major issue for integrated mountain water management. Finally, water management in tourist regions faces major challenges related to global warming.

## Input 4

On the recent variation of the “Snow Reliability Line” in the south-eastern Alps

*Massimiliano Fazzini*

The response of the recent nivological signal to climate change is very difficult to quantify in the Alps, closed between the Mediterranean Sea to the south and continental domains to the north and east. However, at altitudes between 1 500 and 2 000 m, despite 90 years, a greater inter-seasonal variability in the nivometric sums is evident but with no trend. A lower durability of the snow cover on the ground, closely dependent on the strong increase in temperature it is clear. At lower altitudes, there has been a reduction in the total amount of snowfalls and a strong reduction in the snow duration on the ground, while over 2 000 m, an evident increase in the sum of fresh snow fallen in close connection to the greater amount of available energy during the passages of low-pressure systems is evident. Through the daily analysis of data, for about 40 monitoring stations located in some of the most important ski resorts in the south-eastern Alps, for the timespan 1985–2017, we calculated the average altitude at which the seasonal thickness of the snow on the ground it was more than 30 cm for at least 100 days. This limit is called “Snow Reliability Line” (SRL); beneath it, the survival of ski resort is not economically guaranteed. The first results would not show a clear trend – with an average share that currently stands around 1 800 m – actually affected by the strong negative nivometric anomalies occurred in the last two winter seasons 2015–16 and 2016–17.

## WORKSHOP 4.4.

# ECOLOGICAL INTEGRITY OF RIVERS

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CHAIR: LEOPOLD FÜREDER, UNIVERSITY OF INNSBRUCK, INSTITUTE OF ECOLOGY

Alpine rivers play a particular role in the Alps, their surroundings and over large areas of Europe. They occur in various forms, are highly interlinked, cover surfaces involving different countries and administrative levels, provide habitats for a rich and particular biodiversity, but also suffer from multiple demands and use. A wide spectrum of anthropogenic impacts has resulted in an alteration of catchments and discharging rivers, sometimes even in a complete disruption of river systems. Several national and international directives for their protection and sustainable use as well as improvements of their ecological status are in place and contribute to the high conflict potential. Here, we discuss a) the ecological status of rivers in the Alpine regions, b) look at conflict scenarios and key management measures, and c) propose innovative projects and concepts towards a sustainable ecological integrity.

### Input 1

Overview of the environmental conditions of the rivers of the Alps

*Susanne Muhar & Carina Seliger*

*University of Natural Resources and Life Sciences,  
Vienna, Institute of Hydrobiology and Aquatic Ecosystem  
Management*

The major river systems of the Alps are under strong pressure due to the still ongoing exploitation of their water resources. However, healthy rivers and their multiple functions receive increasing awareness and appreciation by people as well as by representatives of administration and policy. That goes hand in hand with key legal frameworks, which require to maintain ecologically intact rivers and/or their biodiversity and to enhance the status of degraded aquatic ecosystems.

Based on our investigations and the establishment of an alpine wide data base, an overview of the environmental status of Alpine rivers can be provided. The results assist to establish a prioritisation framework to halt the loss of healthy rivers and their biota by appro-

priate conservation strategies. Emphasize is put on this “pan-Alpine perspective” because the scope of most existing conservation activities are rarely going beyond national borders. This is crucial for a sustainable implementation of protection and restoration and, hence, helps to avoid short term, single-case decisions without knowledge of the Alps wide context.

## Input 2

The Wild Rivers Label – an effective tool to conserve alpine river landscapes?

Roberto Epple

European Rivers Network

Rivers and streams that have remained untouched and escaped any major changes to their natural shape (for example, with flood barriers, changing river channels, embankments, various alterations) and maintained crystal clear water are extremely rare in France and Europe. They should all be protected. However, the current regulations, mainly those stemming from the European Water Framework Directive, are not sufficient. To counter the threats to wilderness rivers, WWF and ERN France initiated the “Wild Rivers Program” (*programme rivières sauvages*) and a respective certification scheme. The label is a high-level instrument for the protection and development of the region that acquires it, strengthening its image among various populations. It is certified by Afnor Certification, after a technical audit of the application file and a visit to the site of the river basin to ensure the assessment criteria for wilderness and governance (the Chart) are respected by the applicant (Regional Nature Park, local authority, river association, etc.). The label is awarded on condition that a conservation actions plan is established and spread over a period of time. Today, it consists of 3 levels, with a fourth envisaged that would correspond to optimum wilderness across all European rivers. A recent feasibility study discusses the options and changes to develop an equivalent label on a pan-alpine level.

## Input 3

WWF Austria – River Restoration Concept

Gebhard Tschavoll

WWF Austria

Austria's major rivers have lost much of their original characteristics over the past 150 years. Although water quality could be improved due to targeted remediation programmes, economic pressure and over-exploitation led to a general deterioration of the ecological quality of the riverine natural areas. This is accompanied by an increasing risk of damage caused by flooding, as settlements and infrastructure have moved closer to the rivers. Climate change, with a higher probability of extreme precipitation events, adds further to this situation. In its first module, the WWF River Restoration Concept uses reference routes distributed across all river systems in Austria to show which habitats were most affected by loss and projects the development into a medium- and long-term future. A scenario called “WWF river vision” compares this development with a nature-compatible variant. In its second module, the River Restoration Concept uses the link and evaluation of data on flood risk, population distribution and ecology to show in a masterplan in which river-sections the greatest possible synergies for flood protection, biodiversity and recreation can be generated through flood protection and revitalization measures. The River Restoration Concept was developed in cooperation with the planning office *Revital Naturraummanagement*, from which the entire GIS evaluation was carried out. The results will be made available to the public on the website [www.fluessevision.at](http://www.fluessevision.at)

## Input 4

Clean Water Project – San Giovanni Torrent (Italy)

Andrea Cottini<sup>1</sup>, Filippo Miotto<sup>1</sup>, Marzia Ciampittiello<sup>2</sup>,  
Angelo Boggero<sup>2</sup> & Stefania Cerutti<sup>3</sup>

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<sup>2</sup>ISE CNR Verbania

<sup>3</sup>Università Piemonte Orientale

Lake Maggiore basin (North western Italy), has always provided opportunities for hydroelectric plants. As is generally known, the right balance between the preservation of the ecological quality of rivers and hydro-power generation is not easy to maintain, mainly due to lack of further research. The exploitation of water for hydroelectric purposes can alter the habitats inducing their loss, causing a biodiversity impoverishment, with significant effects on the most sensitive taxa and on the ecological quality of the water course.

As a result of these requirements, the “Clean Water” Project, a pilot study carried out on the River San Giovanni with ISE CNR of Verbania, was launched.

The main aims were: 1) to gain scientific knowledge on the effects on the biodiversity of the different human impacts in river basin; 2) to verify how the presence of human impacts affect the hydro-morphological, chemical and biological quality of the rivers systems, up and down the infrastructures; 3) to set up a best practice to analyse impacts, 4) to verify the compliance with the European Directives and Italian standard.

The results showed the reduced effect of small hydroelectric plants if proper facilities have been realized to increase the river quality, so they can be compared with the effect of other anthropic river structures. A next step is to apply the procedure in a river before and after a construction of a hydroelectric plants to understand the real effect about ecological status.

## Input 5

ALFFA – Holistic (multiscale) analysis of the factors and their effect on the fish fauna in inner-Alpine space

Stefanie Oberarzbacher<sup>1</sup>, Roberta Bottarin<sup>1</sup>, Alberto Scotti<sup>1</sup>, Wolfgang Mark<sup>2</sup>, Bernd Pelster<sup>2</sup>, Michael Niederwanger<sup>2</sup>, Josef Wieser<sup>3</sup> & Erich Tasser<sup>1</sup>

<sup>1</sup>EURAC Research, Institute for Alpine Environment

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(ITAT1041 ALFFA, INTERREG Italien-Österreich)

River ecosystems are strongly influenced by land-form and human activities within their surroundings. Most rivers worldwide have been severely altered by a combination of different anthropogenic interventions, leading to dramatic changes in the aquatic habitat and the organism community. Fishes are an established biological indicator. With information about species composition, abundance, dominance and population structure it is possible to make reliable predictions about the status of the river ecosystem.

The disappearance of species, local decline of populations and the endangering of fish stocks (in general) are evidence for the dramatic change within the fish fauna in Tyrol and South Tyrol. An additional threat is the loss of the genetic integrity due to stocking activities with non-native species and the loss of autochthonous species.

In contrast to most of the previous research, where only individual drivers were examined, in this project we will: 1) determine the impact of (as far as possible) all influencing drivers (incl. land cover in the catchment; agriculture, fisheries, fish-eating birds, pesticides); 2) visualize them through geostatistical and multiscale models; 3) and incorporate the results into river management plans to provide guidelines for future decisions making.



## MODUL 5

# MANAGING CONFLICTING WATER USE

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*CHAIR: VALERIE BRAUN, IGF, ÖAW*

The growing demand and the availability of Alpine water resources for water provision, energy production and tourism in Europe makes the future of water resources relevant for the local population, economy and politics. Moreover, the Alps are considered as the water tower of Europe providing the lowlands with water for agricultural, domestic and industrial use. Alpine water resources are threatened by climate change and may lead to social conflicts. In this modul we will discuss past, present and future water-related conflicts.

## Keynotes

### Water as a cause for conflicts

*Martin Grambow, TU Munich*

Water is the most political resource in the world. Every living thing needs water. Every life form is adjusted to a certain amount of water. Water is a gravimetric resource, always flowing top – down. On its way, water collects memories, at least in terms of quality.

When one considers water as a political resource one might think of the major conflict zones like Israel, Jordan or Syria. In comparison, any water conflict in our region seems insignificant. But when we look closer, we are forced to admit that many of the current political and social challenges in Europe are inextricably linked with the resource water. The alpine space is a culmination point in which these effects are magnified, it is the water "reservoir" of Europe, the high gradient means energy but also power (hydro energy but also erosion), it is home to extreme and therefore always vulnerable systems, in the ecological and the hydrological sense. Climate change will exacerbate things further. The basis for any solution has to be to acknowledge the problem and to place it at the centre of a social and political debate.

Water has one dramatic characteristic: it links things that appear, at first glance, unlinked: Irrigation and urban planning – Innsbruck and Budapest – renewable energy and water quality – drinking water and fish populations. As inconvenient as this "water link" may be, it does provide us with an excellent and integrated indicator for sustainable and socially responsible action.

### Participative processes in water management

*Klaus Michor, Revital*

Rivers are multi-functional systems. Stakeholders from the public, private and civil society sector often represent their interests vehemently. Consequently, the demand for participatory planning processes is of great importance. Yet the solutions are often determined by technical, economic and licensing-relevant framework conditions. In addition, the planning processes are getting longer, more complex and unmanageable.

Technically and legally complex questions are a special challenge in participatory processes. Experience has shown that it is important and at the same time difficult to communicate planning principles and measures for all persons involved.

## WORKSHOP 5.1.

# LEARNING FROM THE PAST FOR THE MANAGEMENT OF PRESENT AND FUTURE WATER-RELATED CONFLICTS: DEALING WITH FLOODS AND FLOOD RISK IN HISTORICAL ALPINE SOCIETIES

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CHAIR: PATRICK KUPPER, UNIVERSITY OF INNSBRUCK, INSTITUTE OF HISTORY AND EUROPEAN ETHNOLOGY

Conflicts over water use and water management have affected historical societies in the Alps at least since the Middle Ages. As water had been a common good in many Alpine regions, people had to find solutions how to share the costs for water supply and flood protection and how to avoid significant disadvantages for the one party caused by initiatives of another party. This workshop wants to shed light on historical adaptation and coping strategies towards floods in 18<sup>th</sup> to 20<sup>th</sup> century Austria and Switzerland and will highlight the question, why learning from the past will also help dealing with conflicts over water and flood management today and in the future.

### Input 1

The 1789 Flooding of Innsbruck: Human Induced Disaster, Social Conflict and Contemporary Challenges

*Reinhard Ferdinand Nießner*

*University of Innsbruck, Institute of History and European Ethnology*

One of the most serious floods in the history of the city of Innsbruck took place on October 10, 1789. To contemporaries, it was the “greatest flood” in remembered history. The authorities of Innsbruck had to cope with the two rivers in the city, Inn and Sill. Whereas the Sill River caused most damage to begin with on October 9, the water level of the Inn increased rapidly overnight on October 10, virtually putting the entire city under water. Even though the water level rose, the river by itself was not alone to blame. Humans were equally, if not primarily, responsible for the disastrous dimension of the flooding. Wood for the salt works in Hall and the silver mine in Schwaz was traditionally

stored for rafting on the banks of the Inn River upstream of the city. With increasing water levels, the river washed away thousands of cords of wood – directly downstream towards the city’s main bridge. There, the wood got stuck under the bridge and formed an artificial dam. As a result, the water masses were directed to the city, putting most of it under water, until the bridge was no longer able to withstand the water’s pressure. This human induced flood consequently destroyed other bridges downstream the river. The flooding also led to social conflicts: Who was to blame? Who should bear the costs of the reconstruction of buildings and bridges? Moreover, who should sanction the owners of houses if they did not clean their cellars as a municipal decree ordered shortly after the flooding? A detailed analysis of this extraordinary flooding of Innsbruck can help us sharpen our awareness of flood risk management and coping strategies in the early modern period, which are not as different from today’s challenges as one might assume.

## Input 2

Taming the torrent? Flood control and conflicts of interest at the Gürbe River (Canton of Bern) from the 19<sup>th</sup> century until today

Melanie Salvisberg

University of Berne, Institute of History

The Gürbe Valley, being located south of Bern, is very prone to floods due to the hydrological and geological circumstances. After heavy thunderstorms, the Gürbe River carries huge amounts of water and bed load and often causes inundations. Large scale flood control measures were taken since the mid-19<sup>th</sup> century: The flat lower course of the river was channelled and the steep upper reach was consolidated by a large torrent control. These efforts allowed intensified use of the riverine zone, which created a vicious circle: The more the land was used the more important the flood protection became. Therefore big hydraulic engineering projects were implemented without interruption and the flood control system grew bigger and bigger. In the last decades of the 20<sup>th</sup> century, the protection philosophy slowly began to change: Instead of hard engineering now passive measures should be preferred and the watercourses should be ecologically improved. On the local level of the Gürbe River the new principles were hesitantly discussed from the 1980s, but only realized after a heavy flood in 1990. Due to the versatile land-use the implementation turned out to be difficult, and conflicts of interest arose. Long lasting negotiation processes delayed the projects for years.

The input aims to discuss the history of flood protection at the Gürbe River and to answer the following questions: How did flood protection change within the last 200 years? When did the respective conflicts of interest arise and how were they solved?

## Input 3

Avoiding conflicts by revisiting historical experience? Flood marks and their use for disaster memory past and present

Christian Rohr

University of Berne, Institute of History

In historical societies in Central Europa, flood awareness and flood management was mostly based on local knowledge, on adaptation concerning the settling places, and on disaster memory. As the German cultural historian Arno Borst has been arguing already in 1981 that this memory culture has mostly vanished today and has been followed by a “culture of banished memory” (*Verdrängungskultur*). Flood marks constitute one of the most visible types of flood memory until today. This information on a specific flood event could be just a simple line with the corresponding year, but also a marble tablet with a short description of the events. They were fixed on public buildings, town gates or houses prone to the river and constituted a permanent warning to take care. The building techniques and the use of the endangered houses were in many cases adapted to the flood risk.

After the large-size river regulations in the second half of the 19<sup>th</sup> century, however, people became more incautious concerning the flood risk, because small and medium-size floods were not threatening any longer. Major, destructive floods were too rare to keep up a culture of flood memory. Finally, also more and more flood marks vanished and were in some cases even banished on purpose, e.g. because houses with flood marks might lose value for resale. This paper will highlight, why learning from the past and reintroducing a culture of flood memory will also help dealing with conflicts over water and flood management today and in the future.

## WORKSHOP 5.2.

### INTEGRATED RIVER BASIN MANAGEMENT

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*CHAIR: SUSANNE MUHAR, UNIVERSITY OF NATURAL RESOURCES AND LIFE SCIENCES, VIENNA, INSTITUTE OF HYDROBIOLOGY AND AQUATIC ECOSYSTEM MANAGEMENT*

*& PRIMOŽ SKRT, INTERREG ALPINE SPACE, JOINT SECRETARIAT*

The Interreg Alpine Space project "SPARE" aims to harmonize the protection and development of Alpine river ecosystems. After more than two years of intensive work, SPARE shares some first results: An interactive workshop will be held to present, test and discuss an online database of reference cases, which shall support practitioners and decision makers by introducing existing solutions of Integrated River Ecosystem Management (IREM). Also, one of the five SPARE pilot areas will present itself and the participatory process that was started to develop long-term solutions to balance the use and protection of the Inn River Basin in the Engadine valley.

#### **Input 1**

SPARE – Strategic Planning for Alpine River Ecosystems Integrating protection and development

*Susanne Muhar & Kerstin Böck*

*University of Natural Resources and Life Sciences,  
Vienna, Institute of Hydrobiology and Aquatic Ecosystem  
Management*

The Interreg Alpine Space project SPARE aims at contributing to an improved harmonization of human use requirements and protection needs of Alpine rivers. Project partners from six Alpine countries are collaborating to show how strategic approaches for the protection and management of rivers can be enhanced across different spatial and governance levels. A central element to reach this goal are five different pilot areas across the Alpine space that are committed to integrative river and catchment management and engaged in participatory processes. The manifold SPARE project activities lead to the development of a range of different outputs. This includes a pan-Alpine overview of

priority rivers with high protection needs, a collection of river management challenges and best solutions in the Alps, a set of governance tools that shall enable river managers to plan, apply and evaluate integrated and participatory river management approaches and a guidance on innovative river protection and management processes. An additional core output of the project is the Action and Policy Support Service SPARE-LIVE, an interactive platform of knowledge exchange that will provide synthesized knowledge and experiences for policy and decision-making. The SPARE project activities and outputs aim to contribute to capitalizing and improving strategic river management approaches and increasing awareness and knowledge about the functions, services and the vulnerability of healthy rivers.

## Input 2

A reference database to support practitioners toward Integrated River Ecosystem Management

Sašo Šantl & Urška Kocijančič

*Institute for Water of the Republic of Slovenia*

One of the aims of the Interreg Alpine Space project is to support practitioners and decision makers with existing solutions or reference practices about the coordination and integration of river ecosystem protection objectives within a river basin management. If this process is based on the principle of sustainable development, integrates different spatial levels and policy sectors and involves a wide range of stakeholders, it can be called Integrated River Ecosystem Management (IREM). To facilitate this support, the project foresees to establish an online platform. Among other services this platform will provide a searchable reference database that collects numerous practices with different levels of compliance with IREM. To provide efficient pre-identification of relevant practices we developed a quick assessment tool, which follows the principles of IREM by introduction of relevant criteria and supporting scoring methods. To establish a usable reference database, a sound testing and validation is required. The workshop aims to support this process and will also provide the opportunity for a broader discussion on the topic.

## Input 3

Integrated River Basin Management in the Inn River Basin (CH)

Angelika Abderhalden

*Stiftung Pro Terra Engiadina, WWF Schweiz*

Integrated River Basin Management is a cross-sectoral approach to manage water resources, rivers and water related infrastructure. In a participatory process, a long-term plan regarding water supply, use and protection of and from water is developed. A set of actions is defined to guarantee a high efficiency in the use of water for all sectors involved. These decisions face a higher acceptance, as they are developed by the affected stakeholders themselves. The Engadine is an inner-alpine dry valley. As the Engadine is facing a change in discharge (amount and seasonality) due to climate change within the next decades, existing conflicts between the sectors energy, tourism, agriculture and public water supply might increase. To avoid this, an Integrated River Basin Management Plan is developed within the project IEM Inn. The aim of this project is to develop a long-term solution to balance the

different uses as well as the protection of water in a sustainable way, using different participatory methods. This project is a part of the Interreg Alpine Space Project SPARE (Strategic Planning for Alpine River Ecosystems) that aims to gather, analyze and adapt strategic planning approaches in the management of rivers within the Alpine Region, to test innovative participatory methods within selected pilot case areas and to develop and adapt different tools for balancing use and protection of water.

## Input 4

Current programmes and networks – Poster and network presentation

Integrated river basin management in the Alpine Space – Lessons learnt from past projects

*Primož Skrt, Interreg Alpine Space, Joint Secretary*

Interreg Alpine Space is an EU funded programme (ERDF) that supports transnational cooperation in the Alpine region. Water is one of key priorities of the programme.

A special focus is given to the rivers-landmarks of the Alps. Rivers have unmeasurable importance from the ecological and biodiversity perspective. They provide several ecosystem services as well as direct economic benefits. Alpine rivers are also one of the fundamental landscape elements for the tourism development.

Combining so different, sometimes conflicting interests (especially between protection and development) is a challenge that does not stop at borders and requires an integrated and transnational approach. This need has resulted in several projects that have achieved important results and provided solutions in the area of river basin management.

The project SHARE focused on balancing river ecosystems with hydropower requirements. It developed and tested an integrated decision support tool which combines both perspectives. Alp-water-scarce advanced management strategies against water scarcity in the Alps. The project surveyed the different users in pilot river basin in order to find joint solutions. The project SedAlps helped reducing sediment-related risks and conflicts by promoting integrated approaches to river sediment management. AIM capitalised results in the field of renewable energy production in order to optimise hydropower exploitation and the conservation of ecosystems.

These projects have also proved the need to address challenges on transnational level and an added value of integrated and holistic approach. This was an important lesson that resulted in new (currently ongoing) projects such as SPARE, HyMoCARES and Eco-AlpsWater.

## WORKSHOP 5.3.

### MITIGATING FUTURE WATER CONFLICTS

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CHAIR: SUSANNE BRANDSTETTER, AUSTRIAN FEDERAL MINISTRY FOR SUSTAINABILITY AND TOURISM

The "River dialogue" format in this exact term has been developed by the Austrian Federal Ministry responsible for Environment and Water Management and the regional government of Upper Austria. More broadly seen, it is about stakeholder involvement and dialogue processes in the field of Water and integrated river basin management (IRBM). At the Forum Alpinum 2018, there is a parallel workshop on IRBM. So the present one will mainly focus on the following topics (while embracing the submitted inputs): 1) Main obstacles for a successful dialogue, and how to prevent/mitigate them. 2) Defining the scope – how to take the river basin system into account, while not neglecting the local perspective? 3) How to make sure all concerned stakeholders can participate in an equitable and fair way? 4) The role of brokers and facilitators. 5) The specific challenge of transboundary dialogue processes.

#### Input 1

Best Management Practices within forested drinking water protection zones

Roland Koeck<sup>1</sup>, Hubert Siegel<sup>2</sup>, Elisabeth Gerhardt<sup>3</sup> & Eduard Hochbichler<sup>1</sup>

<sup>1</sup>University of Natural Resources and Life Sciences, Vienna, Institute of Silviculture

<sup>2</sup>Austrian Federal Ministry for Sustainability and Tourism

<sup>3</sup>Austrian Research Centre for Forests

Within the Austrian Alps several legally decreed drinking water protection zones (DWPZ) are existing providing the water source for the supply of the majority of Austrian citizens. Forest ecosystems as dominant land cover in the Alps are seen as adequate for DWPZ, since forestry in general does not involve the application of chemical fertilizers or pesticides. Despite this fact forest management can create adverse impacts for water supply security. In order to guarantee the high quality of drinking water resources in a sustainable way it is necessary to adapt forest management according to the overall purpose of water protection. For achiev-

ing this aim a catalogue of Best Management Practices (BMP) has been formulated in the course of EU-funded Interreg projects. The BMP catalogue should secure or re-establish the water protection functionality of forest ecosystems. BMP for land use category forestry comprise e.g. creation of stable forest ecosystems through natural tree species diversity, prevention of clear cuts, limitation of timber extraction, application of small-scale regeneration techniques, conservation of strong, old and stable tree individuals or the establishment of continuous cover forest management concepts. The implementation of the BMP catalogue requires profound knowledge transfer towards involved stakeholders.

## Input 2

How NGOs can contribute to water governance on different levels: from EU Water Framework directive to regional management planning

Bettina Urbanek  
WWF Austria

When discussing Water Governance, in most cases the focus stays on governments – on national, regional or local level – and public administration, while the role of non-state actors is often underestimated. Nevertheless Non-Governmental Organizations can offer valuable contributions: they allow a look from a different angle, and act more independently from personal, political and economic interests than e.g. land owners or local majors; Through their networks, they can facilitate the exchange between public authorities and local citizens, or between people / organisations in different countries who might be concerned by the same issue. This presentation will highlight the potential roles on two specific examples: 1) The current review process of the EU Water framework Directive and the respective public consultation process 2) The Austrian Water Act allows for submission of regional water management plans by everybody interested in water management goals. WWF took this opportunity to submit a proposal for a river management plan of the Inn Valley to the national ministry.

## Input 3

Planned retreat as an option for the European Alps? To whom, what and when we have to talk

Thomas Thaler & Sebastian Seebauer

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Disaster risk management has developed a large inventory of adaptive responses to natural hazards. From this wide array of measures, managed retreat of at-risk residents is usually only taken into account if other adaptation strategies are ineffective or unavailable. Despite its potential to permanently reduce vulnerability, managed retreat is highly contested in the public risk discourse. Households consider a wide range of risk judgments, economic consequences and emotional aspects when deciding to move or to stay. Many residents infer their future flood risk from prior flood experiences. Households contrast the offered compensation to the current and future property value of their building. Personal circumstances, such as recent family foundation, retirement or the prospects of one's children play into their economic assessment. The emotional appraisal is shaped by the personal attachment with the residence or farmyard and by the extent to which the available coping options threaten one's self-identity and way of life. Some households fear stigmatization, e.g. those who remain in the flood plain are concerned about receiving less public support during future flood events. Throughout, households lacked opportunities to contribute their individual perspectives to the design of the relocation scheme. The paper addresses the questions whom to talk to, what to talk about and when to talk and shall illustrate how to navigate common pitfalls in communication and implementation.

## WORKSHOP 5.4.

# ALPINE MULTI-PURPOSE RESERVOIRS: FUTURE POTENTIAL AND RELEVANCE

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CHAIR: ASTRID BJÖRNSEN GURUNG, SWISS FEDERAL INSTITUTE FOR FOREST, SNOW AND LANDSCAPE RESEARCH & PETRA SCHMOCKER-FACKEL, FEDERAL OFFICE FOR THE ENVIRONMENT, SWITZERLAND

Concerns about water scarcity and related conflicts are almost absent in Switzerland. Yet, both the summer drought of 2003 and the anticipated impacts of climate change on alpine water resources remind us about the increased probability of local water shortages towards the end of this century. Multi-purpose reservoirs might alleviate the negative effects of regime shifts triggered by rising temperature, reduced snow pack and glacier melt. Ideally, such reservoirs would meet various demands, such as electricity production, agricultural irrigation, snow-making, drinking water supply, ecological needs and flood control. But is this realistic? Can reservoirs, glacier lakes and other natural or artificial ponds indeed hold back enough water to compensate for the anticipated losses? This workshop presents the first insights from the project Swiss Water Potentials while drawing from the experience in other Alpine countries.

### Input 1

#### The "Hydro-CH2018 Reservoir" Project

*Manuela Brunner & Manfred Stähli*

*Swiss Federal Institute for Forest, Snow and Landscape Research*

A change in runoff from snow dominated towards rainfall dominated regimes is expected for Alpine rivers under future climate conditions. Current projections suggest that summer runoff will be reduced while more frequent droughts increase the probability of local water shortages. Reservoirs might alleviate the negative effects of such regime shifts if they are not limited to a single use, such as electricity production, but operated to fulfill multiple needs, e. g. water supply or flood control. Such multi-purpose reservoirs allow for the storage of winter rainfall and for water release later in the year when the natural water availability is generally lower and water demand is high not least due to irrigation requirements. In an ongoing project, we investigate the potential of multi-purpose reservoirs for alleviating wa-

ter scarcity under a future climate in Switzerland. To do this, we propose a multi-modular framework which consists of three modules: water supply, water storage, and water demand. This modular structure allows for the consideration of different scenarios within each of the modules. We apply this framework to a set of 22 large hydrological regions in Switzerland to assess the potential of multi-purpose reservoirs for alleviating water scarcity.



## Input 2

Evolving polycentric climate governance: The case of multifunctional water use in Oberhasli, Switzerland

Elke Kellner<sup>1,2</sup>, Christoph Oberlack<sup>1,3</sup> & Jean-David Gerber<sup>1,4</sup>

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Many resource regimes in advanced democracies are complex rather than integrated (due to the sectoral division of labor within public administrations, the lack of transversal coordination, competition for resources, strong property rights, etc.), leading to contradictory incentives in resource management. This presentation shows how governance processes are evolving to regulate competing multifunctional water uses under climate change in Oberhasli (BE), in the Swiss Alps.

Our approach combines the frameworks of Institutional Resource Regimes (IRR) and Polycentric Governance. The IRR framework stipulates that formal institutional rules – public policies and property rights – shape the leeway that is available to resource users for defining localized resource-use modalities. Polycentric governance systems are those in which political authority is dispersed amongst a range of bodies that operate in overlapping jurisdictions which are not in a hierarchical relationship to one another. Recent scholarship suggests that polycentric organization of governance has a higher capacity to deal with complex challenges arising from climate change. The project aims to analyze under which conditions polycentricity can lead to a better coordination of resource uses.

We performed a detailed case study to analyze governance processes of climate change mitigation and adaptation in Switzerland. Data were collected through 22 semi-structured interviews between 2016 and 2018 and document analysis. The results show that if the number of regulations increases and if simultaneously their coherence decreases, then this constellations promotes polycentric governance. The results further show the conditions under which polycentric governance improves or not the coordination of resource uses.

## Input 3

Management options for Alpine multi-purpose reservoirs

Gottfried Gökler

Vorarlberger Illwerke AG, Austria

Since the foundation in the 1930s Vorarlberger Illwerke AG now operates 11 hydropowerplants with four large reservoirs in the south of Vorarlberg in the middle of the Central Alps. Altogether these plants have a total capacity of more than 2000 MW in turbine and 1000 MW in pump mode. The total storage capacity of the lakes Silvretta, Kops, Vermunt and Lünensee amounts 165 Mio. m<sup>3</sup> water and is mainly used for producing peak energy and for pumpstorage.

But the facilities are also used for touristic reasons although in a relatively small scale. The development of wintertourism with larger skiing resorts and longer seasons in combination with the effects of climate change enhances the production of artificial snow and has reached a noteworthy amount up till now.

It also has to be mentioned that the existing facilities help to reduce costs for measures of floodprotection because of the existing retention of the reservoirs. Nevertheless the potential of retending water during a flood event only helps regional. So for an example it was possible to beware the city of Feldkirch, which lays at about 30 km downstream, of flooding, because the peak of the maximum flood in 2005 could be reduced for a small amount. There have been considerations for preparing drinking water too. Because of economic reasons these ideas have been postponed so far.

On a few examples taking into account the developments of tourism and the effects of climate change some ideas for the future are made and shall illustrate how far multipurpose uses of reservoirs in the alps can go and what we can expect from these in the future.

#### Input 4

Contribution of dam reservoirs to Alpine society under changing context: social-economic and ecological trajectories. A case study in Valais (Swiss Alps)

Melanie Clivaz & Emmanuel Reynard

University of Lausanne, Institute of Geography and Sustainability

Hydropower reservoirs are a major landmark in the Alpine landscape, both physically and socially. The construction and operation of large infrastructures impact the territory and the society in many ways. Both positive (benefits) and negative impacts change through the infrastructure lifetime according to social-economic development, changing perception of different values and the evolution of the legal framework. The first objective of this work was to reconstruct social-economic trajectories of reservoirs. This required the description and assessment of major past contributions of dam reservoirs to Alpine society, including economic, social and ecological impacts. A specific focus was put on the ecosystem services provided by water stored in reservoirs (in particular various water uses). The second objective was to identify economic, social and ecological indicators to describe such trajectories. Three reservoirs, situated on tributaries of the Upper Rhone River (Switzerland), were chosen as case studies: Mauvoisin, 211.5 Mm<sup>3</sup>, in use since 1957; Toules, 20.5 Mm<sup>3</sup>, in use since 1963; and Tseuzier, 51 Mm<sup>3</sup>, in use since 1957. This study shows that hydropower reservoirs are not only energy production infrastructures but provide society with a wide range of services, which should evolve in the future, in the context of global warming, the need to develop multifunctional reservoirs, and the energy transition.

#### Input 5

One extraction – Several uses: A case study from France

Marion Douarche

CIMEO agence pour l'eau en montagne, France

The little ski resort Saint Leger les Melezes, in south Alps, manage to take advantage of one spring for several uses. The main spring of the commune was first collected for drinking water. As the resource is sufficient, the same spring fills a pool located near the ski slopes. There, water is transformed into snow during winter. In summer, the pool supplies an agricol network. This situation was already a good example of sharing uses.

Nethertheless, the local context became responsible for new work progress: in this part of the Alps, with climate changes, several dry and warm seasons, the basin management plan argue that everybody should take less water, in order to leave more for the environnement. The water network at Saint Leger les Melèzes was too old and with many leaks and waste. The commune decided to substitute the old pipes. As the installation for extract water from the mountain was the same, the quantity was thus more importante in the network. The spring, located few hundred meters above the village could be used for hydropower elctricity: by substituting the baffle blocks by a turbine. When the flow is too important to be caught, it fills the pool. For the same reasons of dry seasons, artificioal snow was one of the choices of the commune to maintain its touristic economy. So the pool had been expanded (x 1.5). In summer this larger stock permits to irrigate more cuture. In the same time, the new network allows to abandon others, more ancient, and to leave other springs to go free, without human uses. Last, the pool is designed to be pleasant for the landscape, and the surrounding area is a picnic and recreational place in the mountain. During the work progress, a particular attention was upon toad and newt. The National Park "les Ecrins" is an observer very satisfied, as those two populations are growing each year.

Finally, the extracting is the same at the spring, but with less leaks and waste, it permits more uses on the network (for human and natural satisfaction), and also it relieves pressure on other springs.

However, the project was slow by administrative barriers as the place where the ground shoud be deplaced, the fees linked to the extraction, the security norms to turbine drinking water...

## POSTER SESSION

The blue gold of lake Parón - Relevance of Social Capitals in the Development of a Socio-Environmental Conflict Around Water Management in a Micro Basin in the Peruvian Andes Region

*Fabio Azzolin*

In 2008, the conflict around the water management of an important Andean lake basin Parón was considerably aggravated. The hydroelectric installation, granted to Duke Energy company, was in fact occupied by peasants of Cruz de Mayo, a Peruvian Andean rural community. This nonviolent conflict, after several years of impasse, has seen the recent introduction of various negotiating tables between Cruz de Mayo, Duke Energy, CEAS a Peruvian catholic organization local and state institutions. Our research focuses on social factors that have addressed the water conflict towards a process of institutionalization, as well as on social facets, which have resulted in the community. Social capital concept can help us to analyse this kind of socio-environmental conflict and, in turn, could contribute to developing environmental conflict theories that often overlook social complexity of involved populations. Social capital, as a social resource embedded in a networks association, gives us a detailed picture of interactions, which in a struggle process, can be created inside and between social groups. Our hypothesis is that the conflict has been gradually institutionalized mainly due to the improvement of a specific kind of social capital which has conducted towards a peculiar opening of community social boundaries. Through our outcome, we intend

to provide an analytical framework and guidelines that could be used by other social and politic actors

Klimareport Südtirol 2018: impacts of climate change on water resources in South Tyrol

*Giacomo Bertoldi*

Climate change is already influencing natural environment, society and economic activities in Alpine regions. It is urgent to monitor the impacts, and to develop region-specific adaptation and mitigation strategies. In 2018, Eurac Research published a report, where the climate change impacts on the natural environment and on the society are analyzed with a fully interdisciplinary approach, involving researchers of different disciplines, experts and public officials. Moreover, a series of indicators have been identified for quantifying the climate change impacts on the different sectors. The report has been written in rigorous, but plain language, for a wide audience of stakeholders, interested people, school students and public administrators. In this poster, we present the major impacts of the current climate trends on the water cycle and water resource management in South Tyrol. Results show an increase of water needs for agriculture, with possible increasing water conflicts, which will require changes in current water management policy.

### Potential of multi-purpose reservoirs for alleviating summer droughts in the Alps.

*Manuela Brunner*

A change in runoff regimes from snow dominated towards rainfall dominated regimes is expected for Alpine rivers under future climate conditions. Under a rainfall dominated regime, summer runoff will be reduced while more frequent droughts increase the probability of local water shortages. Reservoirs might alleviate the negative effects of such regime shifts if they are not limited to a single use, such as electricity production, but operated to fulfill multiple needs, e.g. water supply or flood control. Such multi-purpose reservoirs allow for the storage of winter rainfall and for water release later in the year when the natural water availability is generally lower and water demand is high not least due to irrigation requirements. We propose a multi-modular framework that allows for the assessment of the potential of multi-purpose reservoirs for reducing anticipated water scarcity. The framework consists of three modules: water supply, water storage, and water demand. This modular structure allows for the consideration of different scenarios within each of the modules. The application of this framework allows for the assessment of the potential of multi-purpose reservoirs to alleviate water scarcity both under current and future climate and socioeconomic conditions.

### The function of water protection in the mountain forests of the Alps

*Enrico Calvo*

Under the current Austrian Presidency of the Convention, the work of the Working Group of Mountain Forests of the Alpine Convention is aimed at investigating the functions and ways in which forests protect drinking water areas and against floods.

These two functions are historically carried out by mountain forests, but the ongoing climate changes, socio-economic and territorial changes, the new sensitivity towards ecosystem services, today call for greater attention to the management and conservation of forest ecosystems integrated into the cycle of the waters.

On the basis of the data provided by the representatives of the Delegations of the Alpine Countries participating in the Working Group, the surfaces, characteristics, functions, distribution of the forests with these particular protective functions will be compared, highlighting specific models and good examples of projects and practices.

The proposed poster intends to inform about the work carried out and to present, starting from the first data collected, the framework of these protection

forests and the initiatives that in the Alpine countries are currently underway for their management and enhancement.

### A framework to assess linkages between river hydromorphology and ecosystem services

*Mauro Carolli, Simone Beichler, Sašo Šantl & Martin Pusch*

Alpine river corridors provide a number of key ecosystem services (ES).

Nowadays, most Alpine valleys are intensely used, and river networks have been largely modified (e.g. for hydropower production, flood protection). In addition, climate change is profoundly altering the hydrological regime of these rivers. Both trends affect the hydromorphological processes and functions of Alpine rivers which play a fundamental role in shaping and maintaining river habitats and related ecological functions. As a consequence, many ES have been reduced, which may affect human wellbeing now and in the future. Hence, requests to mitigate the environmental impacts of different hydro morphological alternations also include the improvement of ES availability into the decision making process. A proper framework may also improve communication among stakeholders. The EU HyMoCARES project develops instruments for the practical application of the ES approach in river and floodplain management using available knowledge on a) the functional linkages between fluvial hydromorphology and ES, and on b) how management measures may influence those linkages.

### DIRECT CLOSE-RANGE PHOTOGRAMMETRY AS A TOOL FOR 3D MODELING IN GLACIOLOGY: APPLICATIONS IN THE ALPS AND IN THE CHILEAN PATAGONIA

*Marco Di Tullio*

Close-range photogrammetry is a technique to generate 3D models of objects based on overlapping imagery, provided ground control points are available to orientate the imagery. This technique benefited of the fast Computer Vision algorithmic developments, among which the Structure-from-Motion (SfM) plays a special role.

On the other hand, the Real Time Kinematic (RTK) or very rapid-static GNSS survey techniques are efficient tools to collect high number of ground control points.

The aim of the study is to generate 3D models of melting glaciers which are the most important climate change indicator. Our proposal is to merge the benefits

of SfM based close-range photogrammetry and RTK/very rapid static GNSS surveys to generate 3D models of glaciological interest using the GNSS surveying techniques.

Some examples related to the Alps (Forni and Lys Glaciers) and Chilean Patagonian (Exploradores Glacier) are presented.

#### Recent trend of isotherms 0 and -1°C in the south – eastern sectors of the Alps

*Massimiliano Fazzini*

In the last century, the temperatures recorded in the alpine domain were increased on average twice that calculated for the northern hemisphere and is estimated at about 2°C and in the last three decades of about 1°C. The effects at high altitudes in the central – eastern Italian Alps and in Slovenian alpine sector have particularly evident, so much so that the percentage of glacier retreat has increased to 89.5 % and it is likely that most of the glaciers of the Southern Alps will disappear during the 21<sup>st</sup> century. This study aims to provide a quantification of the increase in temperature in the Tridentine and Slovenian Alps. Thanks to the recent remarkable improvement of meteo-climatic monitoring to high elevation, it was possible to conduct a first study of the thermal – currently temporal generally extended from January 2003 to December 2017 – so as to determine the variation of the elevation of annual isotherms of 0° C and -1° C. Twenty-two clusters were thus identified at an elevation between 600 and 3300 m a.s.l. – consist of a meteo climatic station located in the valley bottom, slope and peak – so as to calculate the mentioned thermal thresholds. The first result of analysis shows dramatic results; the thermal increase for the short period of study is about 0.3°C. and the average elevation of annual isotherms 0°C and -1°C are 2598 and 2801 m; finally, the trends show a strong increase of the elevation, estimated respectively at about 32 and 34 meters / year.

#### The International Scientific Committee on Research in the Alps (ISCAR): Commitment, past and future activities. 2018

*Leopold Füreder & Thomas Scheurer*

The International Scientific Committee on Research in the Alps promotes international cooperation in Alpine research. In 2000, ISCAR was recognized by the Alpine Conference as an official observer of the Alpine Convention. ISCAR provides a platform for science – policy interaction on issues concerning the Alpine Convention or EUSALP, and facilitates research coop-

eration among protected areas. In this respect, ISCAR organises biannually the ForumAlpinum or (together with Alpine networks) the AlpWeek on topics of acute interest, and specialised workshops. More information: <http://www.iscar-alpineresearch.org/iscar/>

#### Creating an Integrated River Basin Management Plan: IEM Engadin.

*Barbara Grüner & Angelika Abderhalden*

Integrated River Basin Management is a cross-sectoral approach to manage water resources, rivers as well as water related infrastructure. In a participatory process, a long-term plan regarding water supply, the use and protection of and from water is developed. A set of actions is defined to guarantee a high efficiency in the use of water for all sectors involved. These decisions face a higher acceptance, as they are developed by the affected stakeholders itself.

The Engadine is an inner-alpine dry valley. As the Engadine is facing a change in discharge (amount and seasonality) due to climate change within the next decades, existing conflicts between the sectors might increase.

To avoid this, an Integrated River Basin Management Plan is developed within the project IEM Inn. The aim of this project is to develop a long-term solution to balance the different uses as well as the protection of water in a sustainable way, using different participatory methods.

The Integrated River Basin Management in the Engadin (IEM Inn) is a pilot project for integrated river management in the canton of Grison.

This project is a part of the Interreg Project SPARE (Strategic Planning for Alpine River Ecosystems) that aims to test innovative participatory methods within selected pilot case areas and to develop and adapt different tools for balancing use and protection of water.

#### Analysis of different hydrogeologic settings along the river Mur (Austria) long term development and drought conditions

*Johannes Christoph Haas & Steffen Birk*

Using standardized hydrological time series we investigate the interaction between groundwater, surface water, precipitation and evapotranspiration in the Austrian Mur valley. We highlight the differences and similarities between different stretches of river and thus hydrogeological settings. In the case of the river Mur, this is an inner-alpine basin, a narrow valley and wide, pre-alpine basins. Each shows a distinctive behavior, ranging from the river being the dominant factor for

groundwater dynamics in the narrow and inner-alpine settings to the foreland, where precipitation is the most important driver of groundwater level variations. These behaviors are shown by using correlation matrices and by analyzing long-term averages of all groundwater measuring stations in a region. Besides these natural effects and constraints, human impacts greatly affect groundwater levels by various mechanisms, such as groundwater extraction for settlement or industry use or by the construction of run of river hydro power plants. However, lack of information on such uses and lack of long-term measurements can make the identification and quantification of such effects difficult. Since a changing climate will likely increase the occurrence and magnitude of extreme events, we observe the well known 2003 drought in detail and compare the different aquifer bodies along the river under extreme drought conditions.

FORUM WASSER – Water in and around the European Alps: Maintaining water availability and high quality in times of global change.

*Martin J. Kainz & Georg H. Niedrist*

Water is arguably the most precious resource in the European Alps and its availability and quality of uppermost importance for society. Millions of people in and around the European Alps receive their drinking water from the Alps; and water for commercial use, most importantly for the provision of hydroelectric power, is largely derived from the Alps. It is thus evident that the requirement for the provision of high water quality and quantity is of top public priority that requires economic, societal, and institutional visions, in particular in times of global change. FORUM WASSER is a platform that aims to stimulate debate, backed by science, about current and future water availability and security with strong interdisciplinary connections. In this presentation, I will identify emerging issues, such as large-scale and long-term consequences of climate-change induced extreme events on water availability, quality, and use. A variety of risk reduction measures, including precautionary measures, forecasting, and early warning, and how such measures are embedded in economic, societal, institutional, and above all scientific context will be reflected. In particular, I will present selected examples of how climate change may affect water and its ecosystems in and around the Alps; for example, as means of future diet provision, as habitat of decreasing aquatic biodiversity, and as potential contributor to, or withholder of, greenhouse gas emissions.

Caddisfly larvae as sensitive bioindicators of metal pollution in rivers

*Günter Köck, Claudia Köck & Leopold Füreder*

Monitoring the metal load of rivers by metal analysis of water and sediments is often not sufficient because of fluctuating metal concentrations in the water and delayed responses of sediments. It also provides little information about metal bioavailability in aquatic ecosystems. Thus the abundant caddisfly larvae (*Allogamus auricollis*) were used to study long-term trends of metal pollution in the River Inn (Tyrol, Austria) over a period of 25 years (1990–2015). Until 1990 a stretch of the river was contaminated by lead (Pb)-containing industrial effluents. Metal concentrations in pooled samples of caddisfly larvae from an upstream unpolluted reference site and a site downstream from the effluents discharge were investigated from 1990 onwards to study short-term and long-term effects of the installation of a “state of the art” industrial waste water treatment plant (WWTP). In spring 1990 concentrations of Pb in caddisfly larvae from the sampling site downstream the pollution source were approximately 50 times higher than at the reference site. However, after putting the WWTP into operation, Pb concentrations in caddisfly larvae decreased during the first two years at a constant rate of 64% per year. In 1992 Pb burden of the larvae from the downstream site were only 13% of the Pb concentrations measured in 1990. From 1992 onward, Pb concentrations decreased more slowly, reaching Pb values comparable to larvae from the reference site in 2002. In 2015 the Pb concentration in larvae from the downstream site were only 1.25% of the values measured in 1990 with no statistical difference between reference and downstream sites. To conclude, our study shows that caddisfly larvae do reflect metal contamination of aquatic systems at pollution levels hardly detectable by analysis of sediment or water samples, thus being sensitive bioindicators of metal pollution in freshwater ecosystems.

Research on “Water issues” funded by the International Research Programs of the Austrian Academy of Sciences

*Günter Köck & Roland Psenner*

The research program “Earth System Sciences (ESS)” of the Federal Ministry of Education, Science and Research (BMBWF), conducted by the Austrian Academy of Sciences (ÖAW) aims at studying the physical, chemical, hydrological, biological, social, technological and economic processes of the Earth System and their interactions. ESS seeks to fill gaps in the Austrian funding landscape by supporting, for example, interdisciplinary projects, long-term research projects

and projects in areas that have hitherto gone largely unexamined and thus can be considered as pioneering. Furthermore, ESS is an interface between Austrian science and international research and is integrated in international research programs and cooperations (e.g. UNESCO's MAB, IGCP and IHP, LTER, ISCAR) through its three National Committees (NC) Global Change, Geo / Hydro-Sciences, and Man and the Biosphere (MAB). These NCs, made up of renowned scientists and representatives of several ministries and federal organizations, monitor the Austrian research scene, analyse its strengths and knowledge gaps and work out targeted new research foci and the scientific orientation of calls for research projects. Two calls for projects in 2013 and 2015 saw a total number of 32 "state of the art" research projects (including two projects funded in cooperation with the Belmont Forum), worth more than 8 million Euros. About half of these projects are focused on topics related with water issues. The new call for projects 2018 will be focused on water issues in connection to the UN Sustainable Development Goals (SDGs).

#### Innovative Ecological Assessment and Water Management Strategy for the Protection of Ecosystem Services in Alpine Lakes and Rivers (EcoAlpsWater)

*Rainer Kurmayer*

A new project co-funded through the Alpine Space program with the aim to improve surface water quality monitoring by i) advanced DNA sequencing techniques enabling metabarcoding of aquatic biota relevant for the implementation of the EU Water Frame Work Directive and the Swiss Water Protection Ordinance, and ii) novel technologies in data processing (automation in data processing, data storage, information retrieval).

Along with the identification of gaps in the monitoring approaches across the Alpine regions, the new technologies will allow to define improved experimental monitoring protocols to be applied in selected areas (including large perialpine lakes and smaller waterbodies, and key rivers). The transnational approach fills the scientific divide between academia and governance agencies, putting into practice the EUSALP agenda, i.e. capacity building of research institutions, networks and infrastructure with an Alpine Region dimension.

#### Molecular ecology of river cyanobacteria

*Rainer Kurmayer & Eugen Rott*

Cyanobacteria constitute an autotrophic key component of biofilm on stony substrates in running water responding to the deterioration in ecosystem integrity. In general, morphological characters have been applied to investigate the species composition of these macroscopic patch-forming cyanobacteria as well as their ecological niche. We apply single cell/colony genetics to characterize the niche diversification and adaptation potential of abundant cyanobacteria in rivers. The genus *Chamaesiphon* occurs with a dozen of morphospecies in habitats, stressed for example through mechanical abrasion (fluctuation in flow regime), desiccation, UV-irradiation, or eutrophication. In order to understand adaptation processes, we investigate i) whether the morphological differentiation is influenced by habitat characteristics and ii) whether the physiological adaptations are revealed by functional genes. In the field individual colonies of cyanobacteria are isolated under the microscope and analyzed both morphologically and genetically. Besides the morphological description, single colony PCR and subsequent sequencing of 16S rDNA marker genes and functional genes reveals taxonomic and phylogenetic information. By linking molecular biological characteristics with traditional morphological analysis this approach contributes to the implementation of high-throughput monitoring tools (metabarcoding) based on marker DNA sequencing.

#### The potential of the storage basins in the Grimsel area as multi-purpose reservoirs

*Peter Mani*

Based on a quantitative approach the potential of the storage basins of the Kraftwerke Oberhasli (KWO) was evaluated. Beside the hydroelectric power production the protection against floods and the reduction of drought impacts were examined. In doing so climate change impacts were taken into account.

Related to flood protection the water retention in the storage basins procures a considerable reduction of flood risk in the upper part of the Aare catchment. In the lower part the damping effect of the Lake of Brienz and the Lake of Thun is more effective.

The hotspot of drought lies in the lower part of the Aare catchment. To compensate for this the water ponded in the storage basins in the Grimsel area is by far not sufficient.

Potential water scarcity emerging in future water balance simulations with combined land use and climate change scenarios for an Alpine catchment (Brixental/Austria)

Thomas Marke

In the present study, the impact of coupled storylines of potential future climate and land use evolution on the water balance of the Alpine catchment of the Brixentaler Ache in Tyrol / Austria (322 km<sup>2</sup>) is analysed. Therefore, downscaled and bias-corrected climate simulations for the A1B and RCP 8.5 emission scenarios are combined with three future land use developments of forest management. Both are later applied as input for the physically-based, distributed water balance model WaSiM. Land use evolution is elaborated by means of an inter- and transdisciplinary approach together with local actors to define plausible and consistent projections for forest management, policy, social cooperation, tourism and economy: i) Ecological adaptation: The forest management consequently applies the political guidelines, and the forest cover is dominated by an ecological, place-adapted mixed cultivation with a harmonious age structure. ii) Economical overexploitation and wildness: The increase in efficiency, cost reduction and short-term results are in focus of the forest management. iii) Withdrawal and wildness: Cultivation in general is decreasing, and the forest becomes vulnerable against natural hazards. The results presented show the impact of the combined climate and land use evolution on the water balance of the Brixentaler Ache. We demonstrate the effect of growing forests on abandoned alpine pastures on the water balance.

Alpine rivers a book project

Susanne Muhar & Kerstin Böck

Rivers are characteristic elements of the natural and cultural landscapes of the Alps. To document the manifold significance of Alpine rivers from a natural, cultural and social science perspective a book with authors from all over the Alpine space will be published. This book aims to raise awareness about the development and functions of Alpine rivers, their ecological, societal and economic significance in past and present, the extent and the consequential effects of human use as well as the need for coordination between protection- and exploitation interests. It comprises technical chapters, river portraits and an atlas section. In the technical chapters, basic knowledge on rivers of the entire Alpine Arc is provided. The river portrait-part describes specific characteristics of approximately 50 selected rivers from all Alpine countries. In the atlas-section the environmental status of Alpine rivers is documented in

maps, based on the scientific outcome of the Alpine Space project SPARE Strategic Planning of Alpine River Ecosystems. The book intends to stimulate the readers curiosity and interest to learn more about the diversity and beauty of Alpine rivers. At the same time, it will serve as a reference book with spatially explicit data and maps for future investigations. Finally, awareness about the uniqueness and the value of these rivers and their threats from resource overuse, as well as readers motivation to advocate for river conservation shall be increased.

A „riverscape“ study: effects of alpine land covers on assemblages and functional traits of stream benthic macroinvertebrates.

Alberto Scotti

The term „riverscape“ refers to a riverine landscape that can be studied at different scales, from the single habitat patch to the catchment level. This definition stems from the observation that streams and rivers are characterised by the interaction and the reciprocal influence of different habitats located both in and outside the water bodies. While several studies have previously assessed the effects of land cover conversion on the aquatic environment in different parts of the world, very few studies examined these effects in the European alpine region. Using GIS analysis of the whole Italian alpine province of South Tyrol (Central Eastern Alps), we selected 15 riverine sites grouped by land cover typology (rocks, grasslands, forests, pastures) and comparable regarding discharge, altitude, catchment dimension and mean slope. We sampled stream benthic macroinvertebrates in three occasions during spring and summer 2017 at the selected sites. At the same time, we measured a set of water parameters (pH, ORP, EC, nitrate, turbidity, temperature). The typology of land covers in the surroundings of the sampled streams proved to be a crucial driver for the benthic macroinvertebrate communities, being a statistically significant factor in explaining the variation of the samples both in terms of structure and of functional diversity. This result may represent an important finding considering the land use intensification and abandonment currently experiencing by the alpine region due to different socioeconomic processes. Finally, in addition to climate change effects in mountainous regions, this phenomenon may constitute an additional indirect factor influencing structures and functions of aquatic riverine ecosystems in the region.



## The adaptive capacity of Norwegian ski resorts

*Anna Maria Urbaniak-Brekke*

Skiing is probably the closest you get to a national sport in Norway, and skiing can be conducted in all parts of the country. However, climate change is leading to less stable winters, creating a need for adaptation or transformation. Despite an increasing body of literature on the impacts of climate change on ski tourism from all over the world, very little is known about the impacts and adaptation options for Norwegian ski resorts. The larger resorts are concentrated in the eastern part of the country, with three large resorts in the western Fjord region, and one in Northern Norway. The large resorts in Eastern Norway are situated in regions that in the foreseeable future will have good opportunities for technical snow production. The climate projections are more worrying for the ski resorts in Western Norway, as these already enjoy a less stable winter climate due to its proximity to the sea. Employing projections for future snow and snow making conditions, we investigated adaptive responses among ski lift operators, winter sport destinations and winter sport tourists in the Western Norway. It develops a framework for assessment of the transformative capacity of the destinations, drawing on literature on sources of adaptive capacity.

## Opportunities for monitoring droughts in the Alps with Satellite Data

*Marc Zebisch, Claudia Notarnicola, Felix Greifeneder, Carlo Marin & Mattia Callegari*

In the last years, a series of drought events was affecting the downstream regions of the Alps. The 2017 drought in northern Italy led to yield losses and a financial damage of almost two Billion Euros. One of the main reason for this type of drought is missing water from the Alps, which is caused by a combination of missing snow and therefore missing run-off from snowmelt and hot and dry summers with low precipitation and high evapotranspiration losses. Earth Observation can significantly contribute to a continuous and area-wide monitoring of water resources in the Alps such as snow-cover or soil moisture as well as the impacts of droughts on vegetation. Particularly with the latest ESA Sentinel satellites, a constant data stream of high-resolution data is available every few days. From an Earth Observation perspective, droughts and their triggers can be recognized as anomalies in time. For instance, snow cover in the Alps (or in a specific catchment) at a given time can be compared to long-term averages to understand if water availability from snowmelt will be below average or below a critical threshold. In combination with meteorological data and seasonal climate forecast, such information can even be used to project the water availability within the upcoming weeks or months. In this poster, we discuss the opportunities for monitoring droughts in the Alps by combining Earth Observation with meteorological data and show first results for Alpine catchments.

# IMPRESSUM

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