

Interreg
Alpine Space



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www.facebook.com/HyMoCARES

Interreg Alpine Space Project

HyMoCARES

HydroMorphological assessment and management at basin scale for the
Conservation of Alpine Rivers and related Ecosystem Services

Sediment transport and ecosystem services: the HyMoCARES project

Andrea Goltara (CIRF - Italian Centre for River Restoration)



Bolzano-Bozen, 8 November 2018

European Regional Development Fund

PROJECT SELECTED | FOR CO-FINANCING BY THE EUROPEAN UNION



Lead Partner
BZ Civil Protection Agency
Italy



Ticino Cantonal
River Management Agency
Suisse



Adige River Basin Authority
Italy



Institute for Water
of the Republic of Slovenia
Slovenia



Département des Hautes-Alpes
France



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Austria



Bavarian Fishery Association
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Italian Centre
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Italy



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Germany



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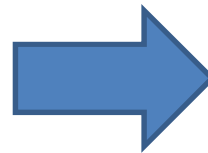
University of Natural Resources
and Life Sciences, Vienna
Austria



ETH Zurich
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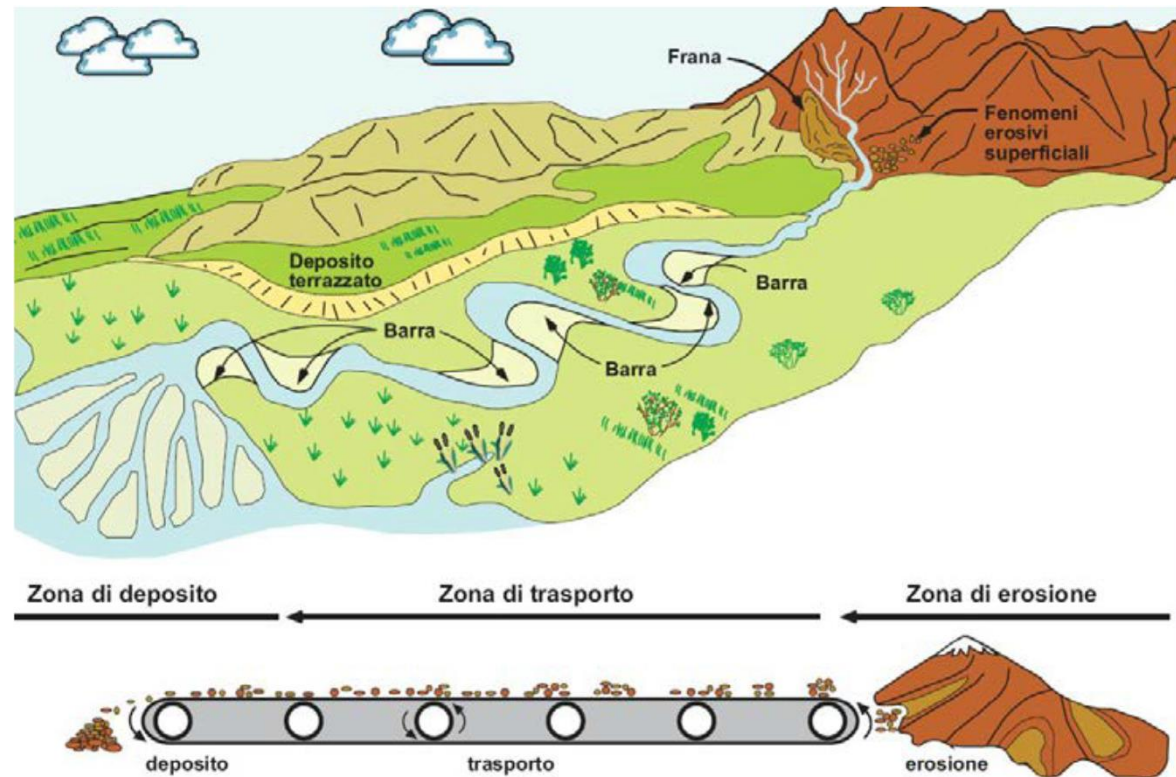
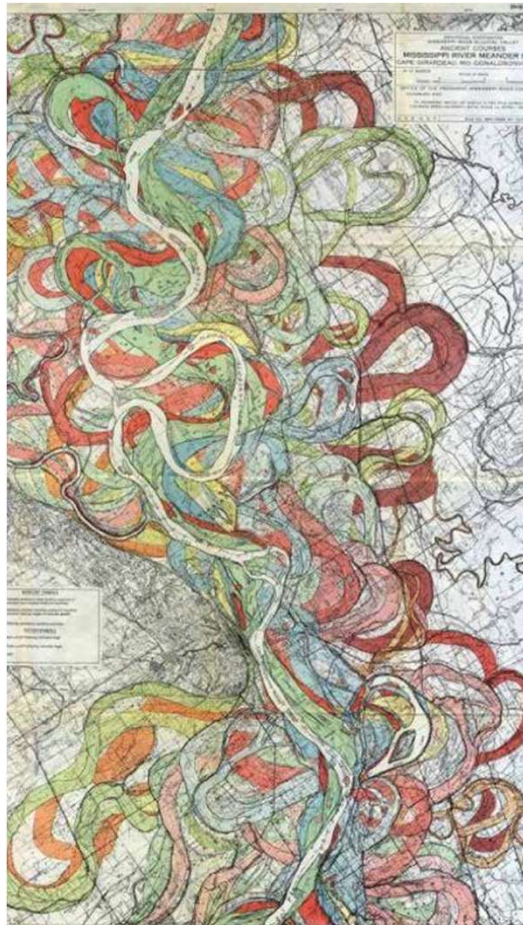


ES provided by rivers ?



Focus on the management of hydromorphological processes

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Identification/classification of ES: previous cornerstone initiatives



MILLENNIUM ECOSYSTEM ASSESSMENT

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Guide to the Millennium Assessment Reports

Full Reports

 The Working Group assessment reports are between 500–800 pages in length, with a volume of summaries of about 120 printed pages.
[Learn more](#)

- Current States & Trends
- Scenarios
- Policy Responses
- Multiscale Assessments

Synthesis Reports

 The first set of assessment reports consists of an overall synthesis and 5 others that interpret the MA findings for specific audiences.
[Learn more](#)

- Overall synthesis
- Biodiversity
- Desertification
- Business & Industry
- Wetlands and Water



About the Millennium Assessment

The Millennium Ecosystem Assessment assessed the consequences of ecosystem change for human well-being. From 2001 to 2005, the MA involved the work of more than 1,360 experts worldwide. Their findings provide a state-of-the-art scientific appraisal of the condition and trends in the world's ecosystems and the services they provide, as well as the scientific basis for action to conserve and use them sustainably.
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Identification/classification of ES: previous cornerstone initiatives



The Economics of Ecosystems & Biodiversity

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Water & Wetlands

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About



The "nexus" between water, food and energy has been recognized as one of the most fundamental relationships and challenges for society. Wetlands are a fundamental part of local and global water cycles and are at the heart of this nexus, providing numerous ecosystem services to humankind.

Nonetheless, **wetlands** continue to be degraded or lost and, in many cases, policies and decisions do not

AREAS OF WORK

- [TEEB Country Studies](#)
- [Agriculture & Food](#)
- [Natural Capital Accounting](#)
- [TEEB for Business](#)
- [Oceans & Coasts](#)
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Related Resources

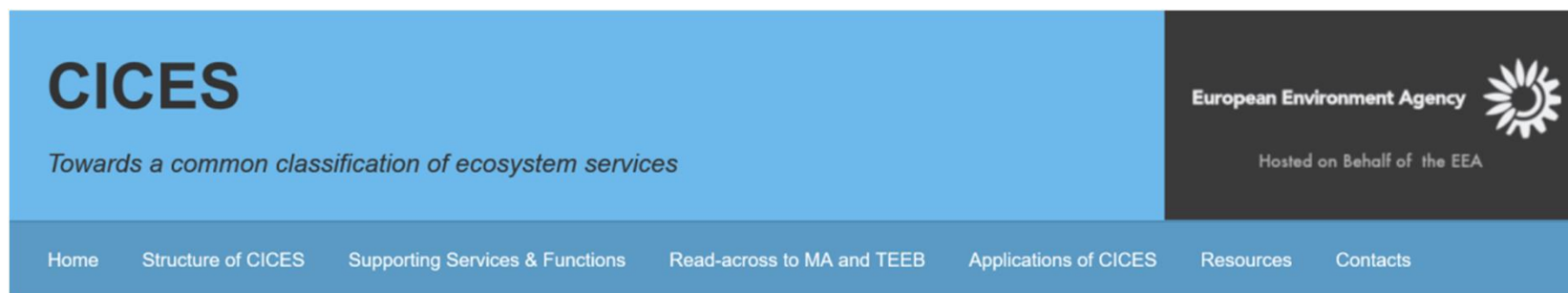
- [Briefing Note: Natural Capital Accounting and Water Quality: Commitments, Benefits, Needs and Progress](#)
- [Summarized extracts from the report](#)
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Identification/classification of ES: previous cornerstone initiatives



The screenshot shows the European Commission Environment website. The header includes the European Commission logo and the word "ENVIRONMENT". Below the header is a navigation bar with links: Home, About us, Policies, Funding, Legal compliance, and News & outreach. The main content area features a large image of a butterfly. On the left side, there is a sidebar menu with the following items: Nature and biodiversity, Biodiversity Strategy, Nature and biodiversity law, Species protection, Natura 2000, Green infrastructure, and Knowledge and data. The main content area is titled "Mapping and Assessment of Ecosystems and their Services - MAES". Below the title, there is a section "In a nutshell" which states: "The Biodiversity Strategy outlines a number of targets and precise actions to stop biodiversity loss. By mapping out and assessing the state of ecosystems and their services, we can help inform the policy decisions affecting the environment." Below this, there is a section "In practice" which states: "The [Biodiversity Strategy](#) called on Member States to map and assess the state of ecosystems and their services in their national territory by 2014, with the assistance of the European Commission. They must also assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020 (see [Target 2](#), Action 5).

Identification/classification of ES: previous cornerstone initiatives



Welcome to the CICES Website, 2016

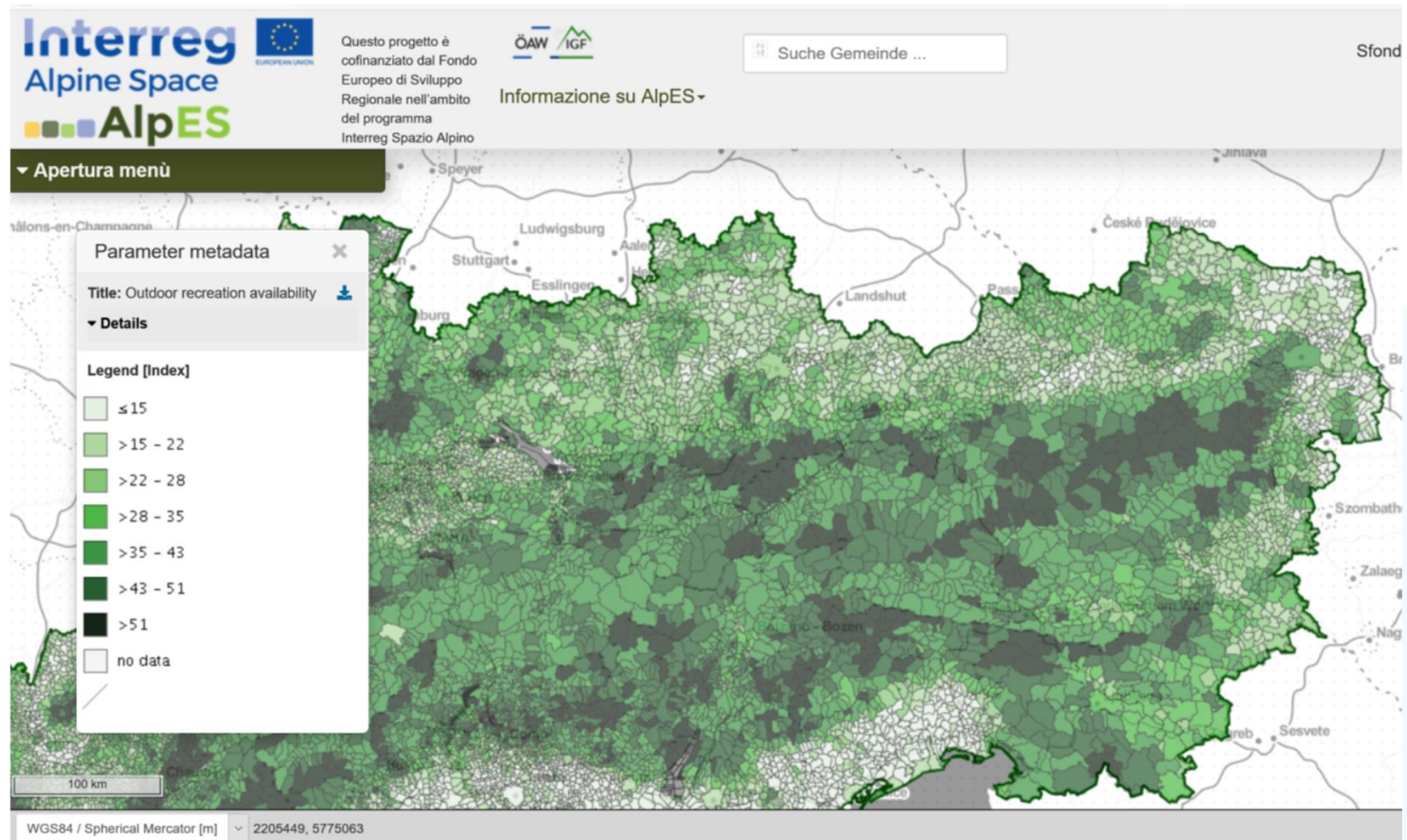
News

The report of the 2016 Survey of people's experience of using CICES V4.3 is now available for download:

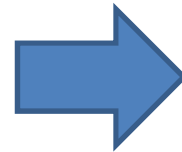
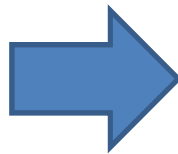
[Report on 2016 Survey Results 19072016](#)

Over 200 people provided information, and their views will be a valuable input for the further development of CICES.

Several ongoing projects



Management measures



Physical/ecological
processes/functions

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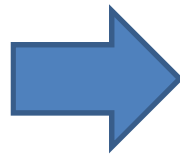


Ecosystem Services



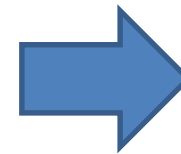
BENEFITS

Different target
groups



Qualitative
explanations
of links

Quantitative
assessments
or predictions



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Salvini, danni da ambientalismo salotto
Annunciato Consiglio dei ministri su calamità

Redazione ANSA
BELLUNO
04 novembre 2018
12:35
NEWS

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CLICCA PER INGRANDIRE

(ANSA) - BELLUNO, 4 NOV - "Troppi anni di incuria e malinteso

VIDEO ANSA

05 NOVEMBRE, 14:09
MALTEMPO, SINDACO CASTELDACCIA: 'AVEND LE RISORSE, GLI IMMOBILI SARANNO DEMOLITI

05 novembre, 13:58
Maltempo in Calabria, torrente Fegato in piena

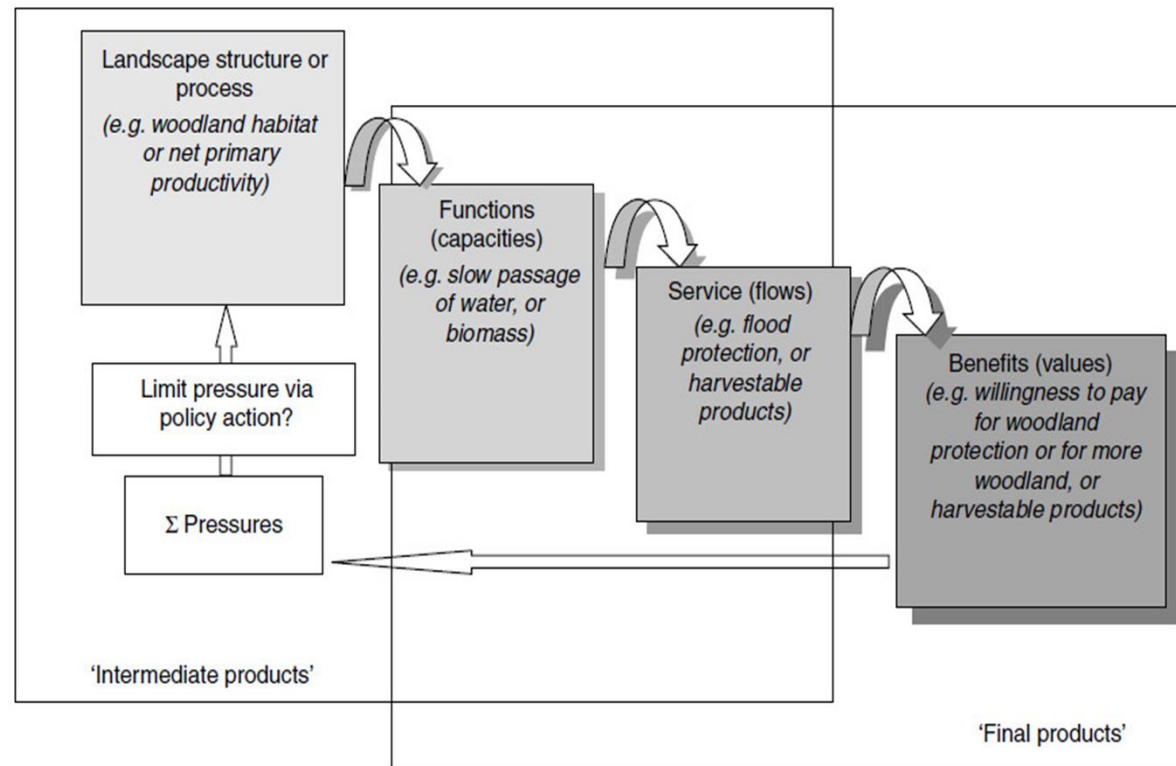
05 novembre, 13:51
ANSAtg delle 15

The Italian deputy Prime Minister few days ago: *rivers have to be dredged !*

Ecosystem services

ES concept: "direct and indirect contribution made by ecosystems to human welfare" (TEEB 2015)

Cascade model
(Haines and
Potschin, 2010)



Management actions and corresponding alteration

Management action	Corresponding alteration
Sediment recharge / restoration of sediment continuity	Gravel extraction
Channel widening	Channelization
Check dam removal	Check dam construction
Creation of macroforms	Removal of river macroforms, homogenize river sections
Dam removal	Dam construction
Deculverting	Culverting
Ensuring ecological flow	Water abstraction
Reintroduction of large woody debris	Removal of large woody debris
Remeandering	Straightening
Removal of bank protection	Bank protection construction
Floodplain reconnection (removal, retreat of levees)	Levees construction
Replanting of in-channel and riparian vegetation	Removal of in-channel and riparian vegetation
Weir removal	Weir construction

















Weir
removal

Sediment
recharge/
restoration
of
sediment
continuity

Removal
of bank
protection

Removal/
retreat of
levees

...

-  Cultivated crops
-  Surface water for drinking/non drinking uses
-  Groundwater for drinking/non drinking uses
-  Retention of nutrients
-  Reduction of GHG
-  Flood risk mitigation
-  Drought risk mitigation
-  Habitat related services
-  Regulating T
-  Education/science
-  Aesthetics of landscape
-  Water related activities
-  Natural and cultural heritage
-  Sediments (for construction)
-  Hydropower
-  Ecological status

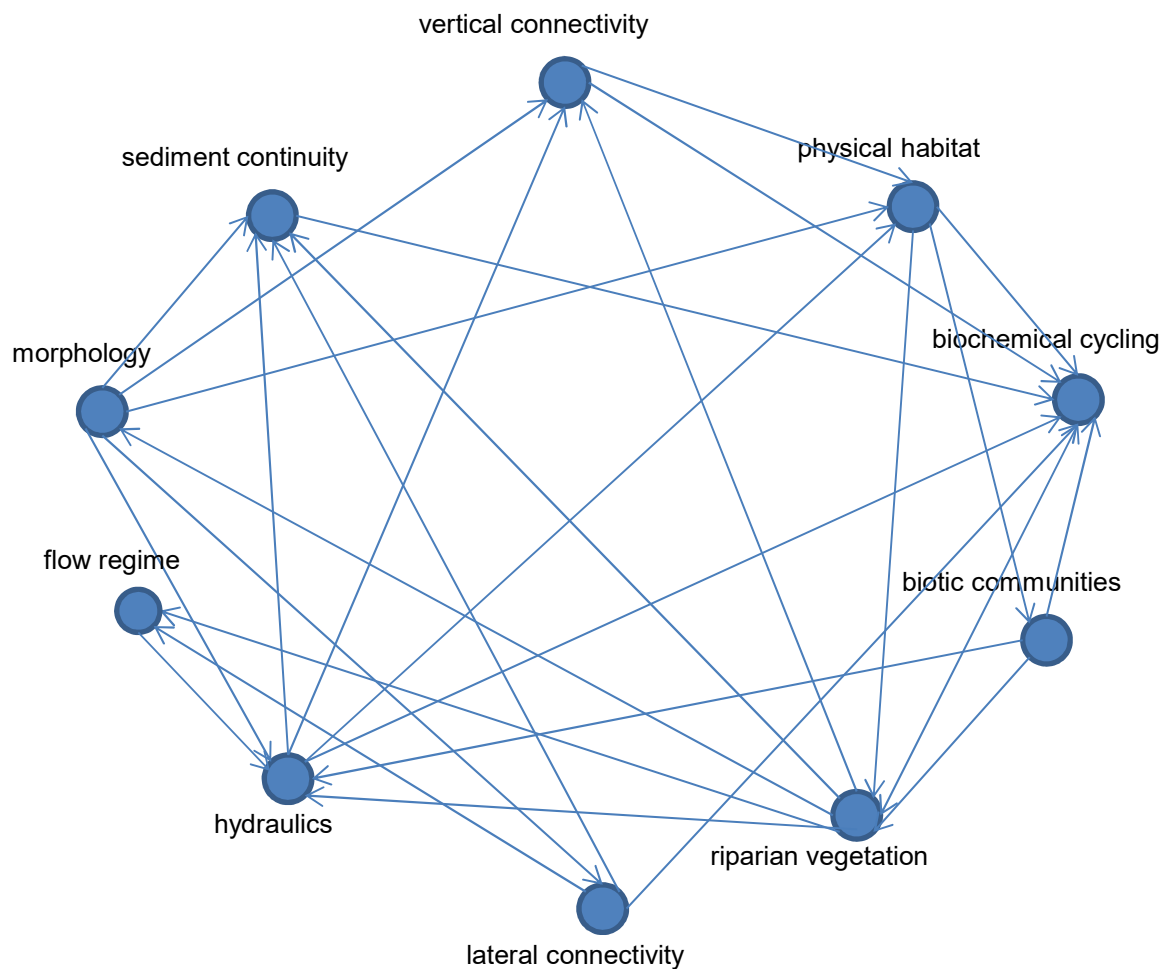
Weir
removal

Sediment
recharge/
restoration
of
sediment
continuity

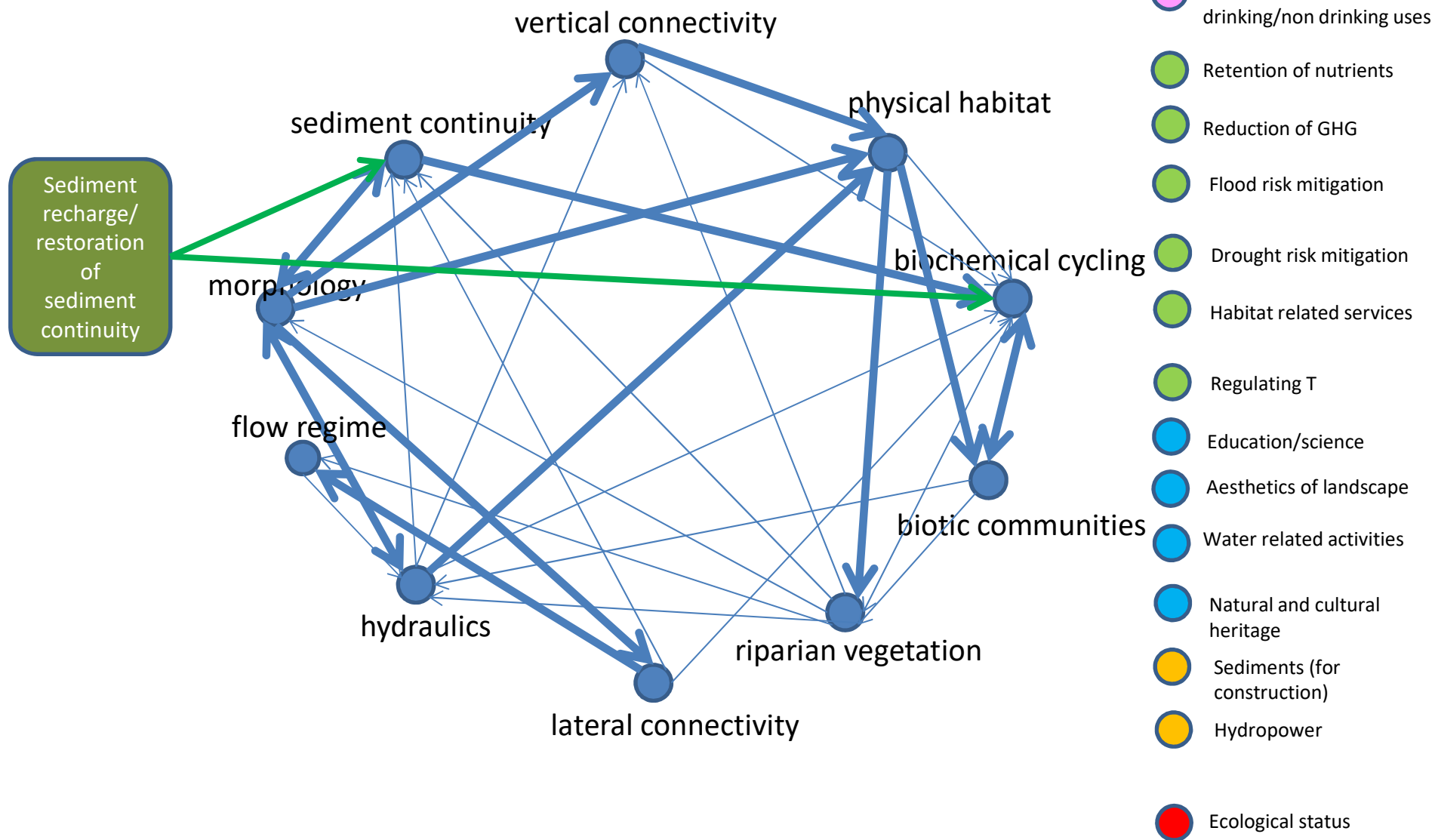
Removal
of bank
protection

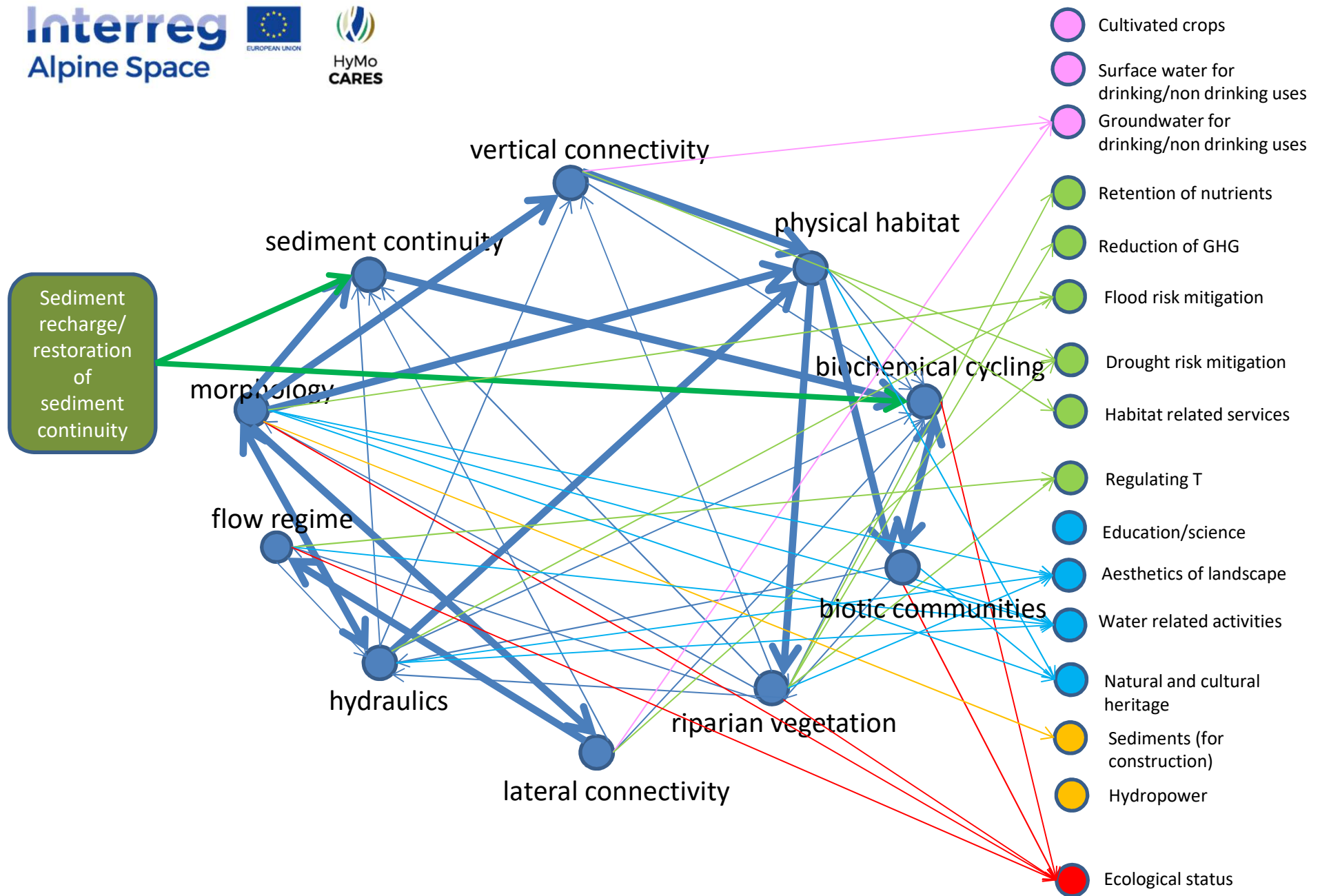
Removal/
retreat of
levees

















...

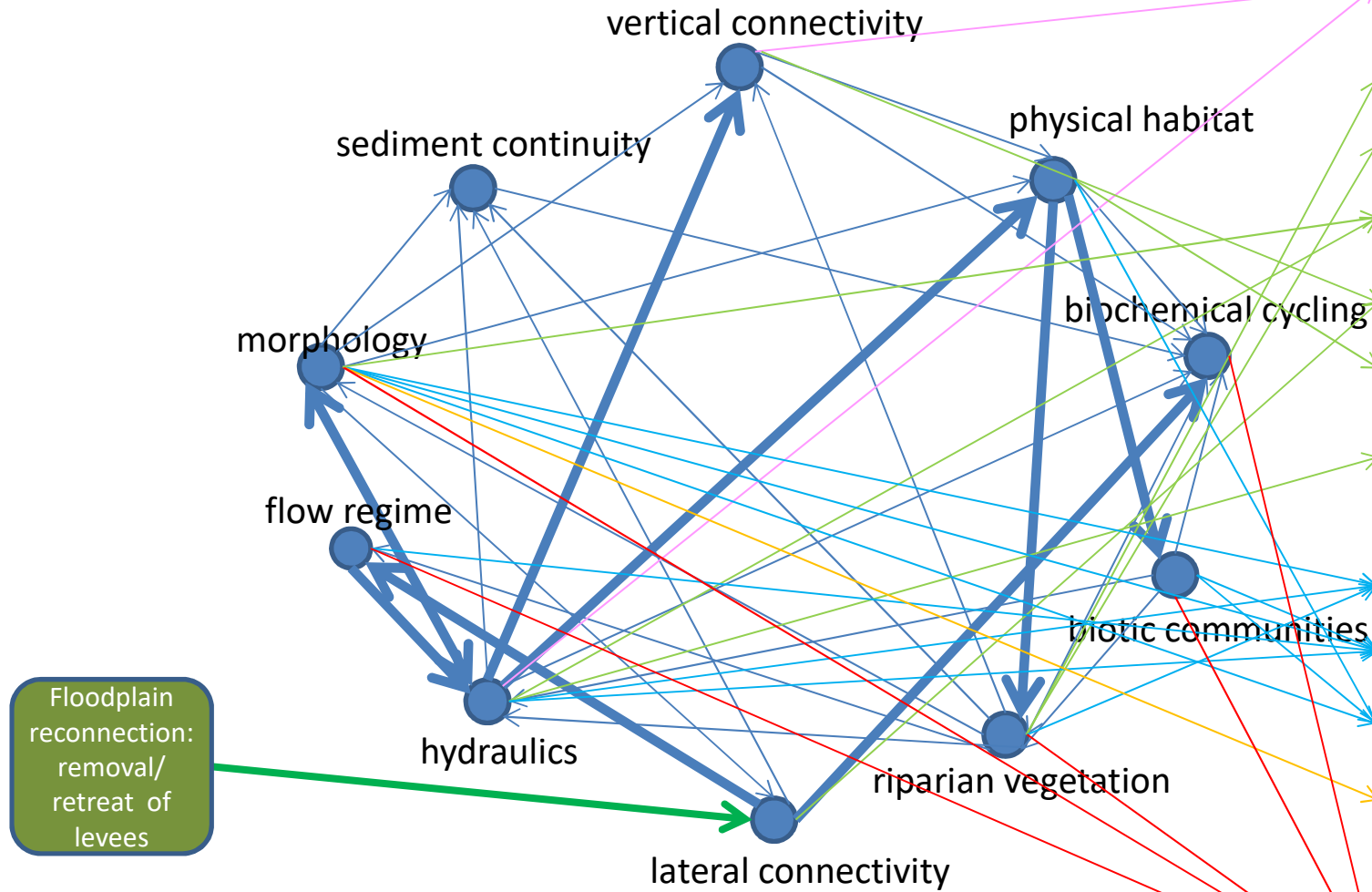


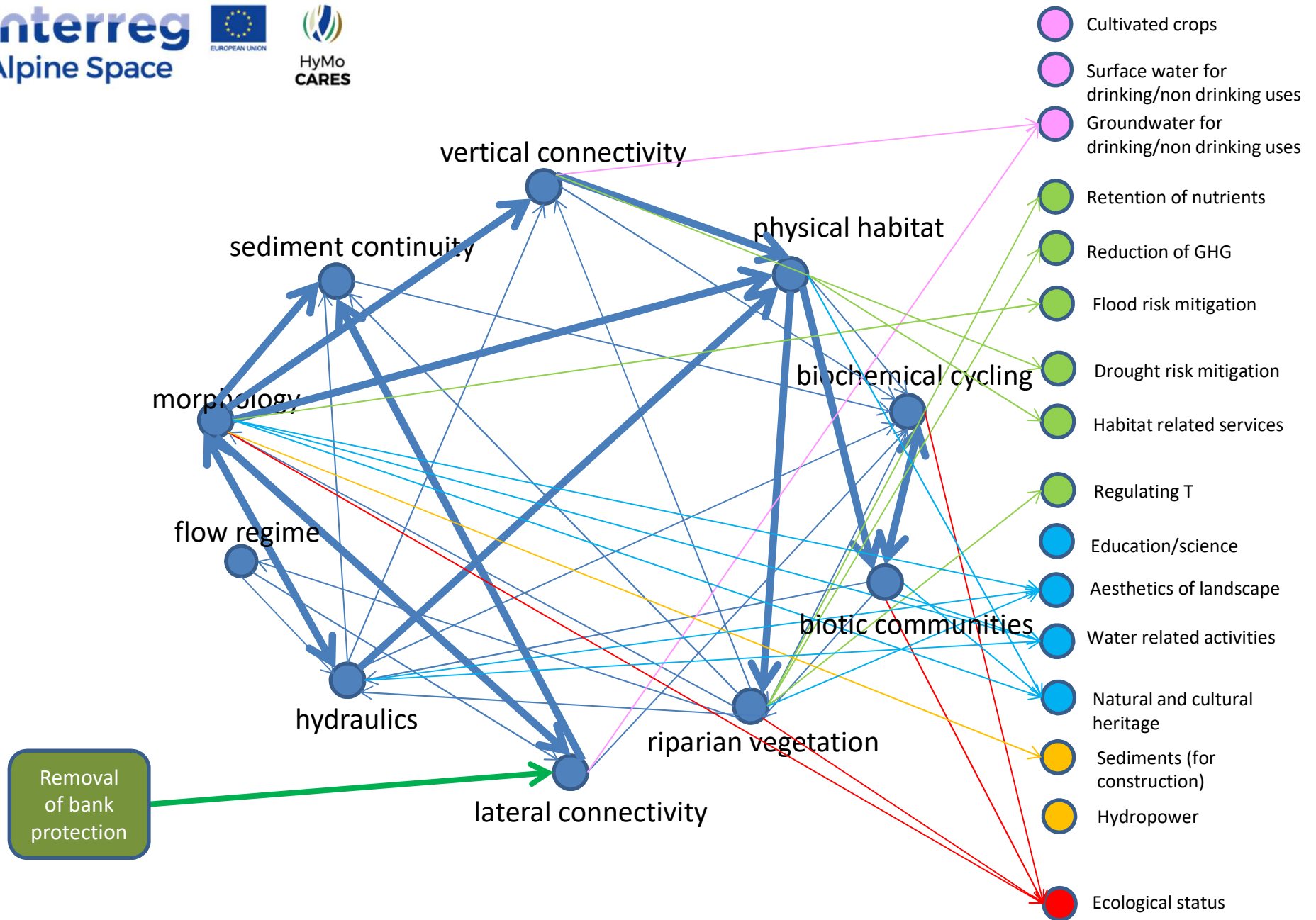
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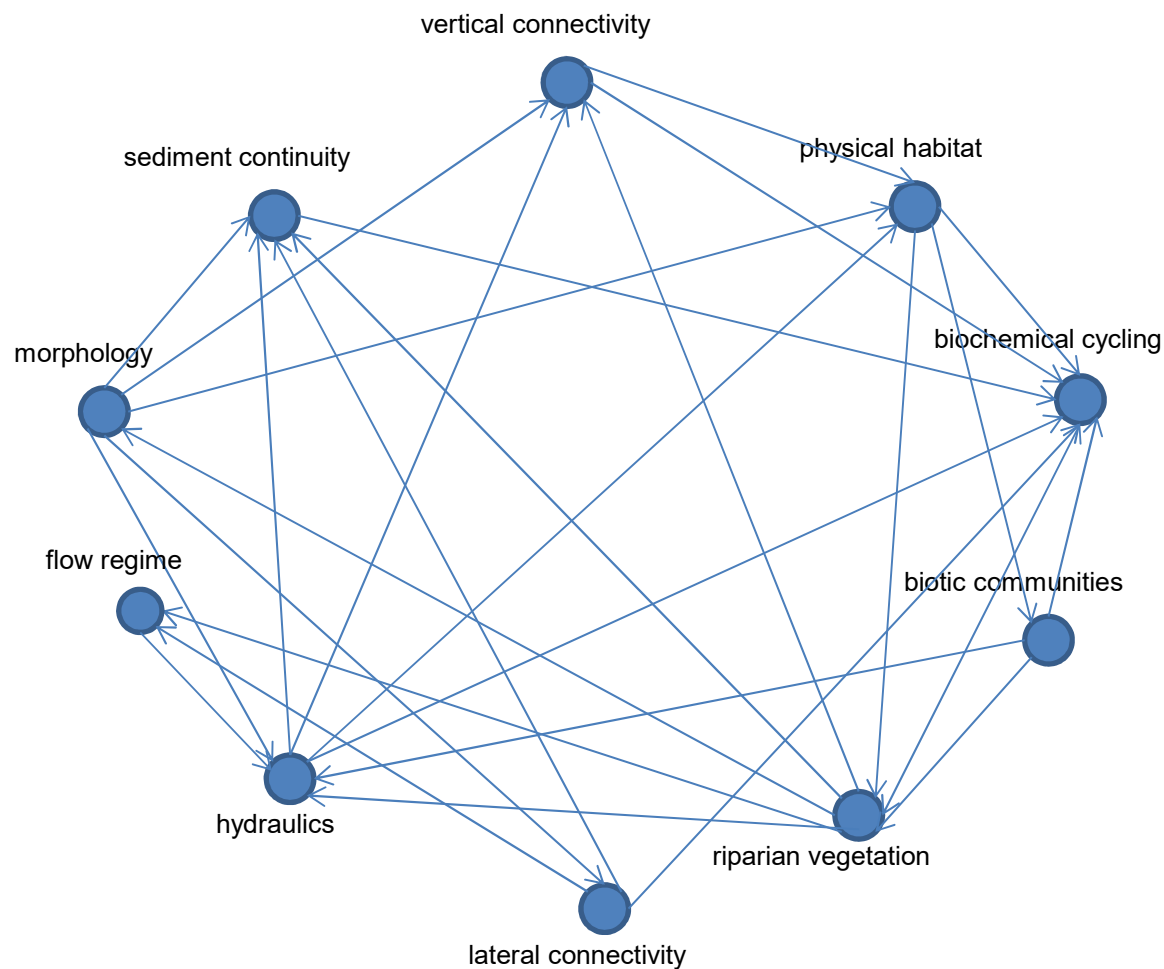


-  Cultivated crops
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Sediment recharge/
restoration
of
sediment
continuity



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Sediment
recharge/
restoration
of
sediment
continuity

Description of the restoration measure

- Mechanical reintroduction of sediments downstream [more info](#)
- Bedload reservoir management (flushing/outlets opening in connections to Q thresholds) [more info](#)
- Sediment bypasses [more info](#)

Links to case studies:

1) Buech



*Results of
monitoring +
evaluation*

2) Avisio...

Link to e-seminars
tackling the action



21 November 2017

**Webinar series 'Restoring river continuity:
methods and open challenges'**

Wetlands International – European Association and the Italian Center for River Restoration invite you to join a series of webinars explaining methods and challenges of [...]

Description of the restoration measure

Removal of levees may be performed either without removal of bank protection, or in parallel with the removal of bank protection. In case bank protection remains, the effect of the removal of levees consists in the re-establishment of the (hydraulic) lateral connectivity between the river and the floodplain, thus increasing flooding frequency of the floodplain...

Links to case studies:

[To know more](#)

1) Orbigo

Removal/
retreat of
levees



Figure 4. River bank protections were also removed along the river: on the left, the situation before the project; on the right, the river is reconnected to its floodplain (source: Duero River Basin Authority – Confederación Hidrográfica del Duero, CHD).

2) ...



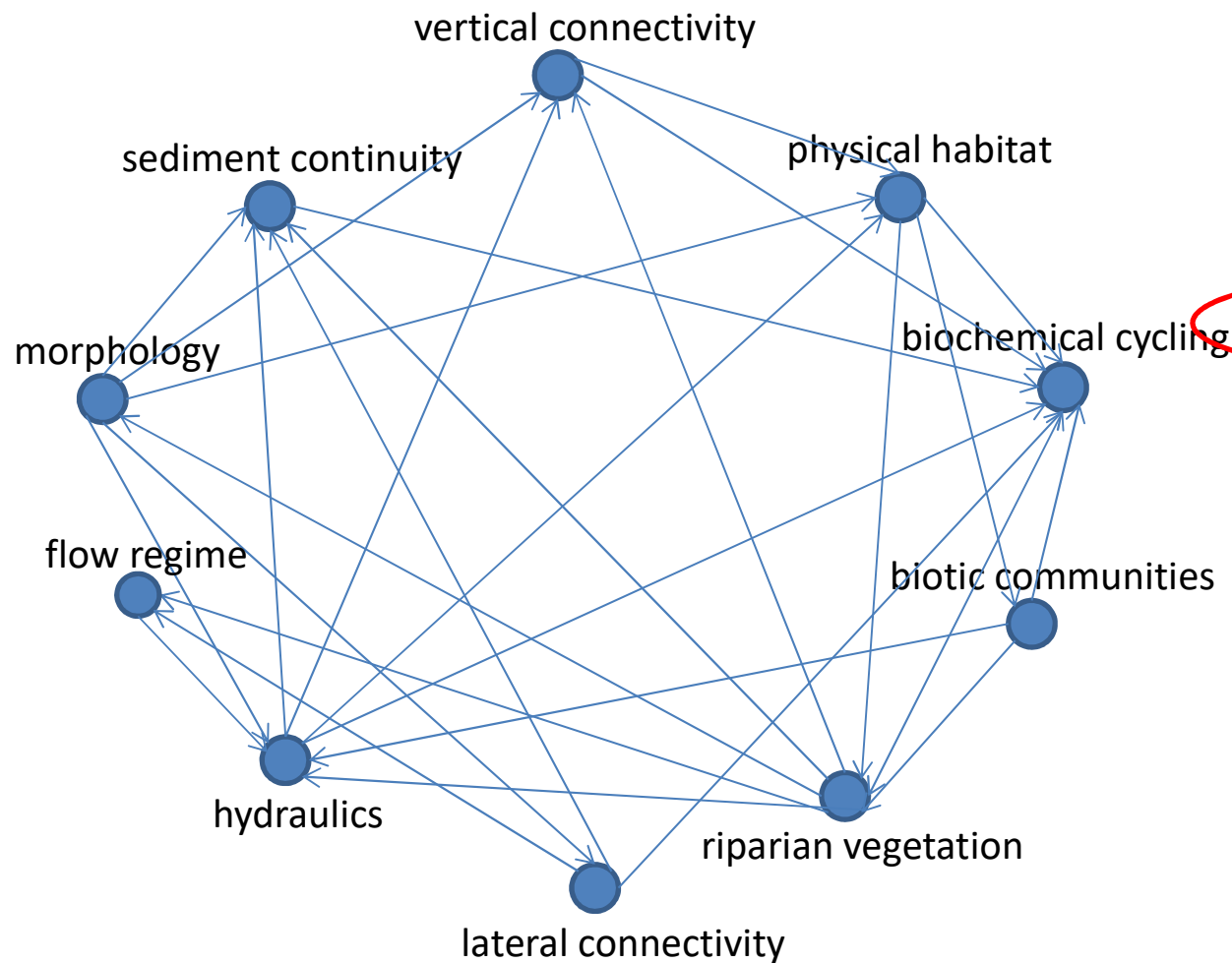
Weir
removal

Sediment
recharge/
restoration
of
sediment
continuity

Removal
of bank
protection

Removal/
retreat of
levees

...

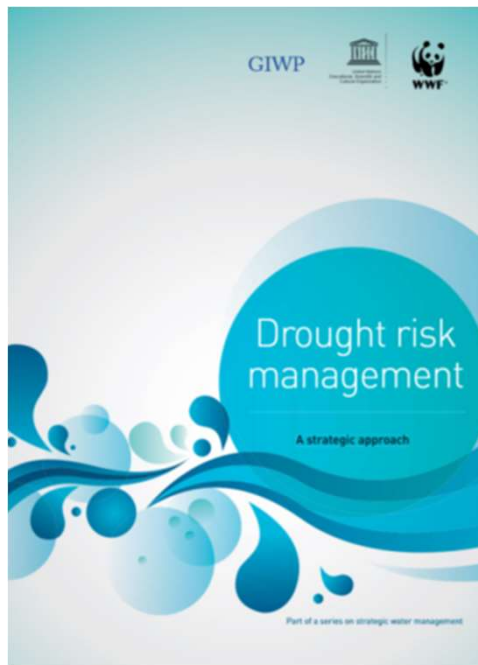


- Cultivated crops
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Description of the ES

Resilience to drought / mitigation of drought effects on river ecosystems by e.g. inflow from floodplain aquifers...

literature



A modern definition of drought

The traditional classification of drought types has evolved primarily from the meteorological and hydrological sciences (meteorological and hydrological droughts) to reflecting agricultural and socio-economic impacts. Today, a myriad of drought types exist with few accepted definitions. This book proposes definitions that more explicitly distinguish different aspects of the 'hazard' (Figure D):

- ▶ A **meteorological drought** (hazard) is defined here as: a temporary, negative and severe deviation from the average precipitation values for a significant period of time across a river basin or region.
- ▶ A **blue-water drought** (hazard) is defined here as: an unusual and significant deficiency of groundwater, stream flow, or lake storage.
- ▶ A **green-water drought** (hazard) is defined here as: an unusual and significant deficiency in water stored in or on top of the soil or vegetation.
- ▶ **Drought risk** is defined here as: an emergent property of the human and natural system, reflecting the interaction between climate (meteorological drought), the hydrological response of the basin (blue-water drought and green-water drought) and the vulnerability of the people, ecosystems and economies exposed to it. Drought risk reflects two components: the chance that a drought hazard will occur and the magnitude of the associated impacts.

Possible assessment indicators

- yearly volume of water infiltrated in the aquifer
- floodplain average groundwater level ?

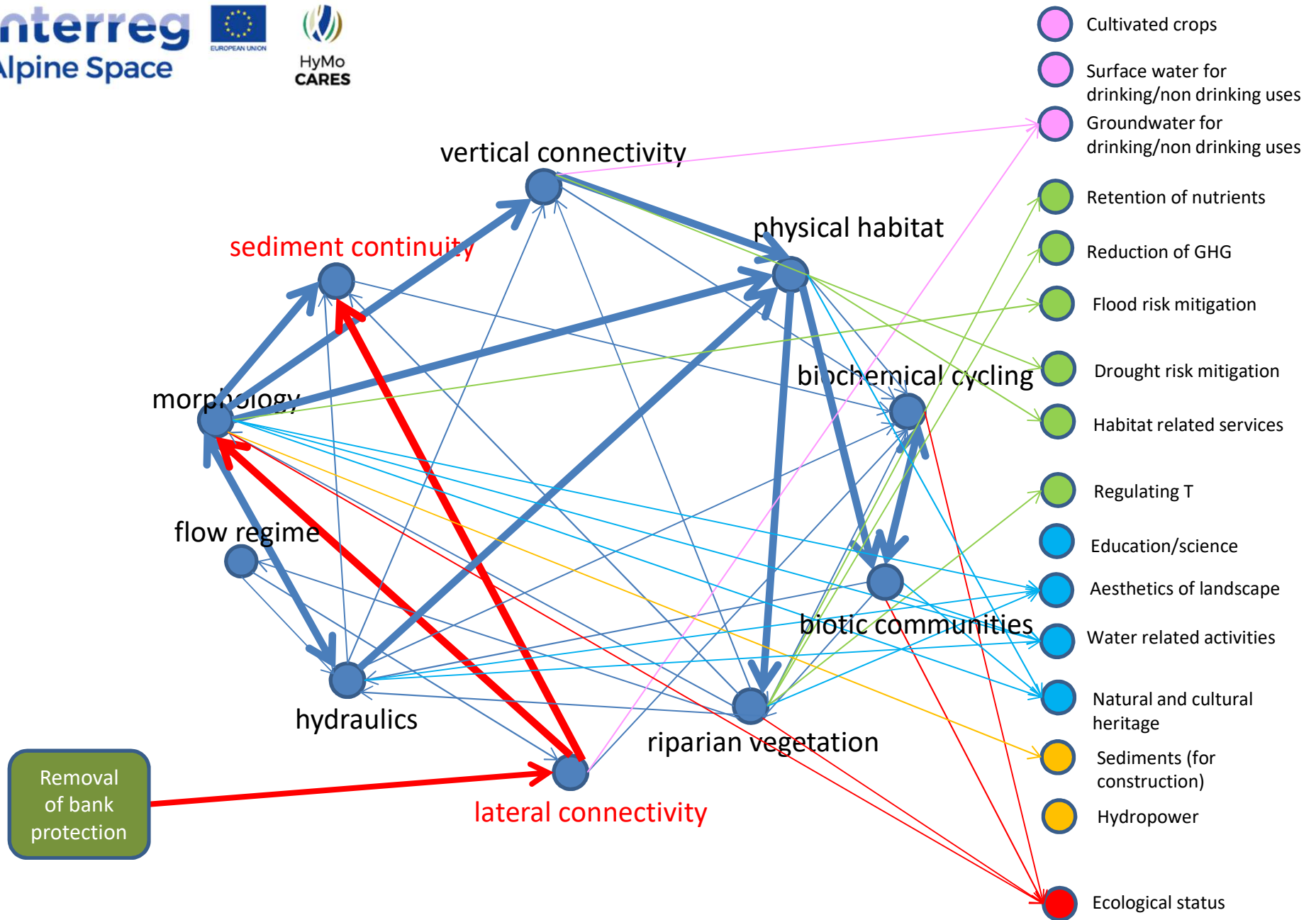
habitat

biochemical cycling

otic communities

tation

- Cultivated crops
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sedi
morpho
flow reg

Removal
of bank
protection

Explanation of the connection

Bank protection removal increases lateral connectivity, i.e. bank erosion and sediment supply to stream channel; the increased supply subsequently increases sediment transport downstream...

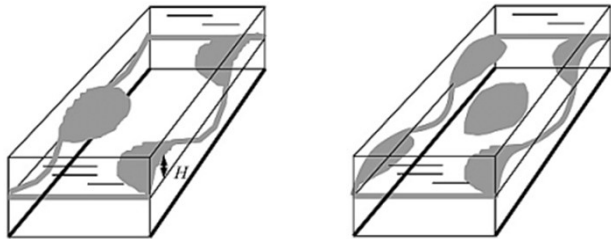
Useful predictive tools

- River bank erosion model (to predict bank retreat velocities after removal of bank protection and bed level response); [link to description](#) **literature**
- Model of self-forming cross section geometry (to predict width with erodible banks); [link to description](#) **literature**
- Diacronic approaches to estimate needed erodible corridor width [link to description](#) **literature**
- ...

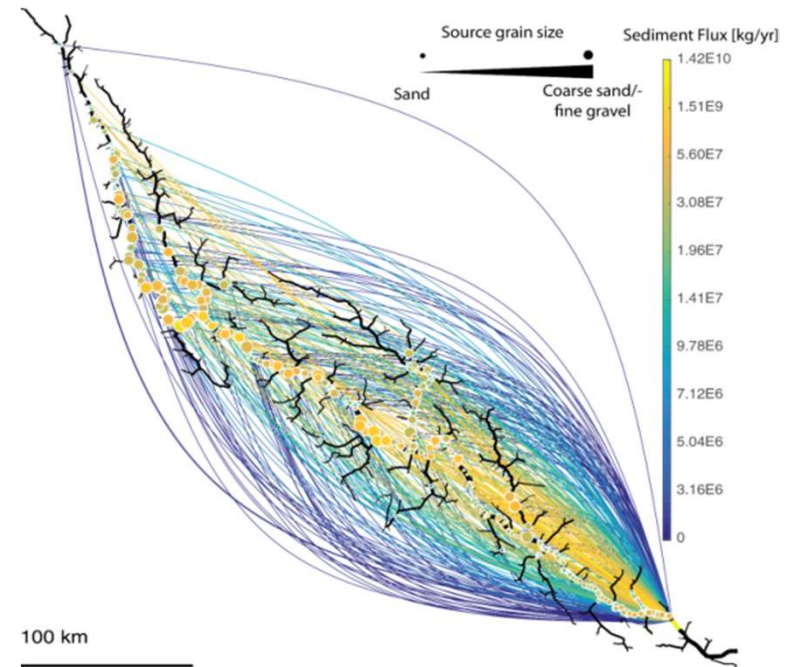
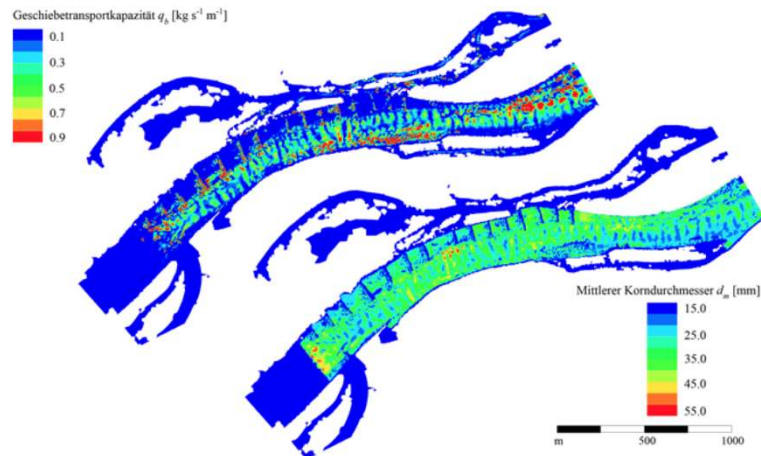
Useful assessment tools

- Tools for the analysis of channel changes
-

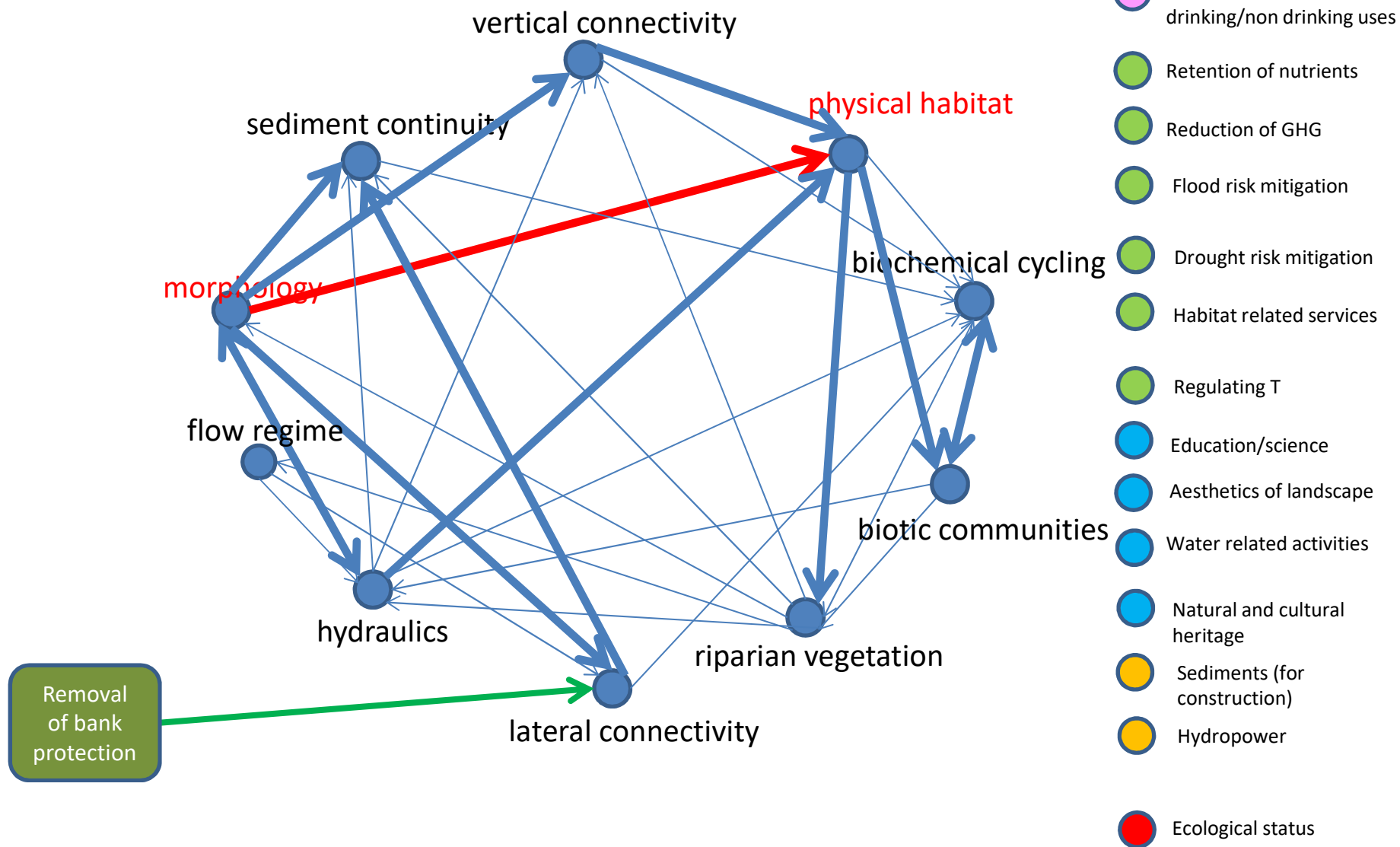
River bar predictor (Crosato and Mosselman, 2009)

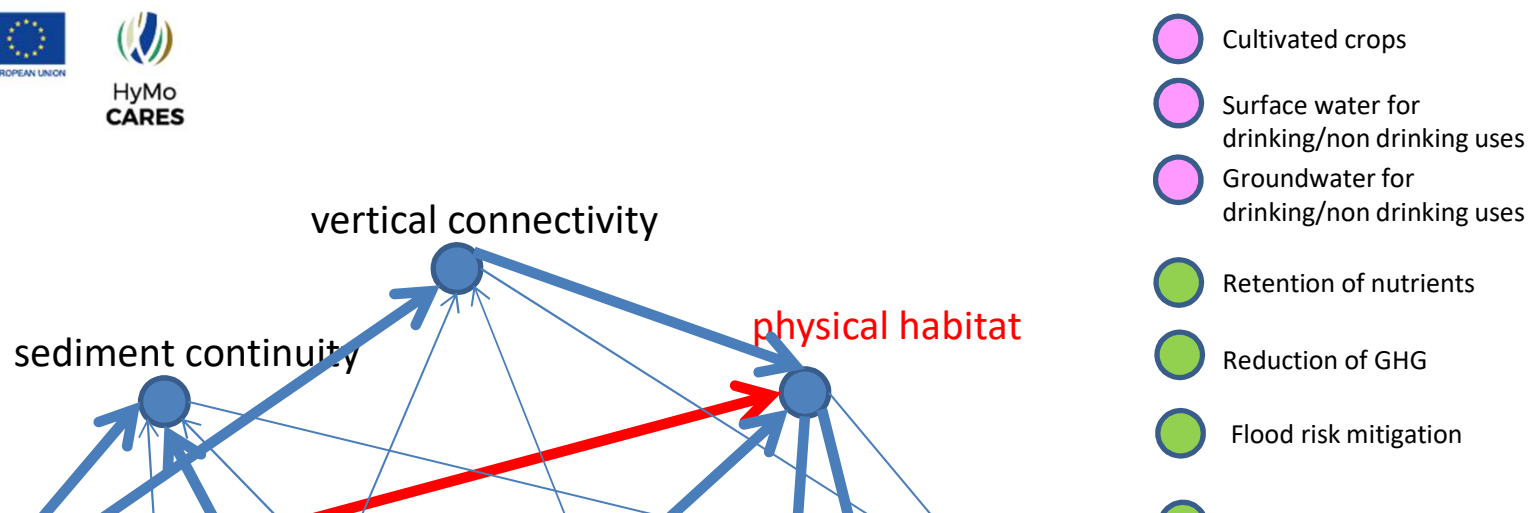


Diverse morphodynamic models (e.g. iSed – Tritthart et al., 2011)



Sediment connectivity (CASCADE - Schmitt et al., 2016)





Explanation of the connection

Changes in morphological configuration and physical stream channel features directly and indirectly (through the interaction with water flow) affect the features that make up physical habitats, at different scales, such as substrate type and size distribution, water depth, flow velocity, water temperature, etc. In other terms, changes in morphology determine a change in type and distribution of hydromorphological units, thus of habitats.

Useful assessment and predictive tools

- Comparison of different **habitat models** and **habitat suitability indicators**
[link to guidelines](#) [literature](#)



Manuale tecnico-operativo per la modellazione e la valutazione dell'integrità dell'habitat fluviale



MANUALI E LINEE GUIDA

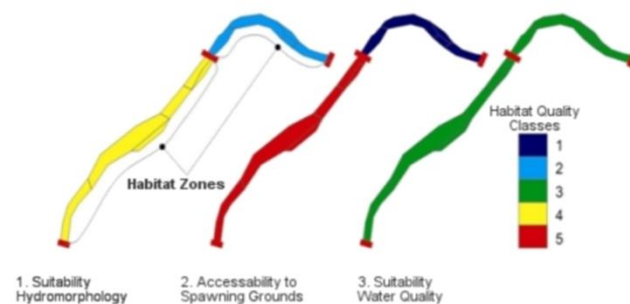
CASiMiR

Computer Aided Simulation Model for Instream Flow and Riparia 

Home	Workshops	Applications	Case Studies	Download	Publications	Contact
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Applications of the CASiMiR Model

Meso CASiMiR



Past habitat models have focused especially on changes to the local scale using short (hundreds of meters) investigation reaches. The development of the Meso CASiMiR model aims to increase the application of expert knowledge based habitat modelling to the regional scale. Such meso scale models are required for the evaluation and management of river systems under the Water Framework Directive, where the smallest watershed management area is set at 200 km².



Applications

CASiMiR Model Concept

Fish Habitat Simulation 1D/2D

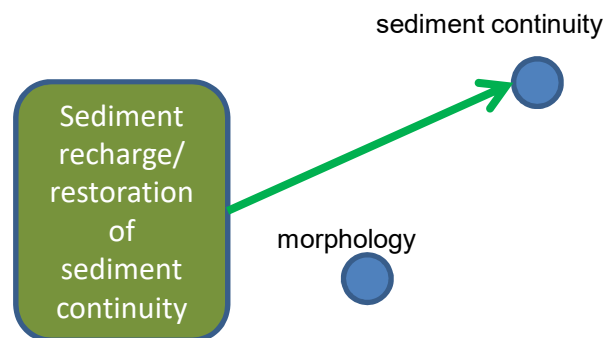
Morphodynamic und Habitat Modeling

Minimum Flow Studies

Hydropeaking

>> Meso CASiMiR

Floodplain Vegetation



Sediment recharge/restoration of sediment continuity	Sediment continuity
SedRace - Bedload velocity tool	
D.T2.2.1 procedure of assessment of barrier permeability	
bedloadweb Sediment transport website	
Index of connectivity (SedAlp)	
Stéphane BRAUD - Adrien ALBER, "Synthèses des connaissances & proposition d'une méthode d'évaluation de l'impact des ouvrages transversaux sur la continuité sédimentaire des cours d'eau, 2013, 76 p. Direction régionale de l'Environnement, de l'Aménagement et du Logement Centre	
CASCADE (assessment of sediment continuity and bottlenecks at catchment scale)	
Mélanie Bertrand, Frédéric Liébault et Hervé Piégay (2017). Regional Scale Mapping of Debris-Flow Susceptibility in the Southern French Alps. Journal of Alpine Research, 105-4. Consult doctoral thesis of Bertrand M. for more information: Bertrand Mélanie (2014). Debris-flow susceptibility assessment at the regional scale of the Southern French Alps. Doctoral thesis, University of Lyon.	
Brardinoni, F., Cavalli, M., Heckmann, T., Liébault, F., Rimböck, A., (coordinateurs) 2015. Guidelines for assessing sediment dynamics in alpine basins and channel reaches. WP4 Final Report of the SedAlp Project, Alpine Space Program, 71 pp. (plus Annex: Case studies and software tools)	
Jože Papež, Bruno Mazzorana, Alessandro Vianello, Mateo Cesca, Helmut Habersack 2015, interactions with structures. WP6 final report of the SedAlp project.	
Bogdan, S-M. et al. (2016). "The assessment of regulatory ecosystem services: the case of the sediment retention service in a mountain landscape in the Southern Romanian Carpathians", Procedia Environmental Sciences 32 (2016) 12-27	
soil conservation/sediment delivery model: Alatorre, L. C., Beguería, S., Lana-Renault, N., Navas, A., and García-Ruiz, J. M.: Soil erosion and sediment delivery in a mountain catchment under scenarios of land use change using a spatially distributed numerical model, Hydrol. Earth Syst. Sci., 16, 1321-1334	

Planning and Management Tools

SedRace

- Aims:**
- Calculation of residence time of replenished sediment in sections
 - Time lag between upstream measures and downstream effects

Replenishment at the Mur River



Planning and Management Tools

SedRace

Method of tool development:

Derivation of formulae from the field

$$V_u = 0.96 \sqrt{\frac{\rho_s - \rho}{\rho} g d} \left[\frac{\tau}{(\rho_s - \rho) g d} - 0.055 \left(\frac{d}{d_{50}} \right)^{-0.83} \right]^{\frac{3}{2}}$$

Tracer survey at Drau River

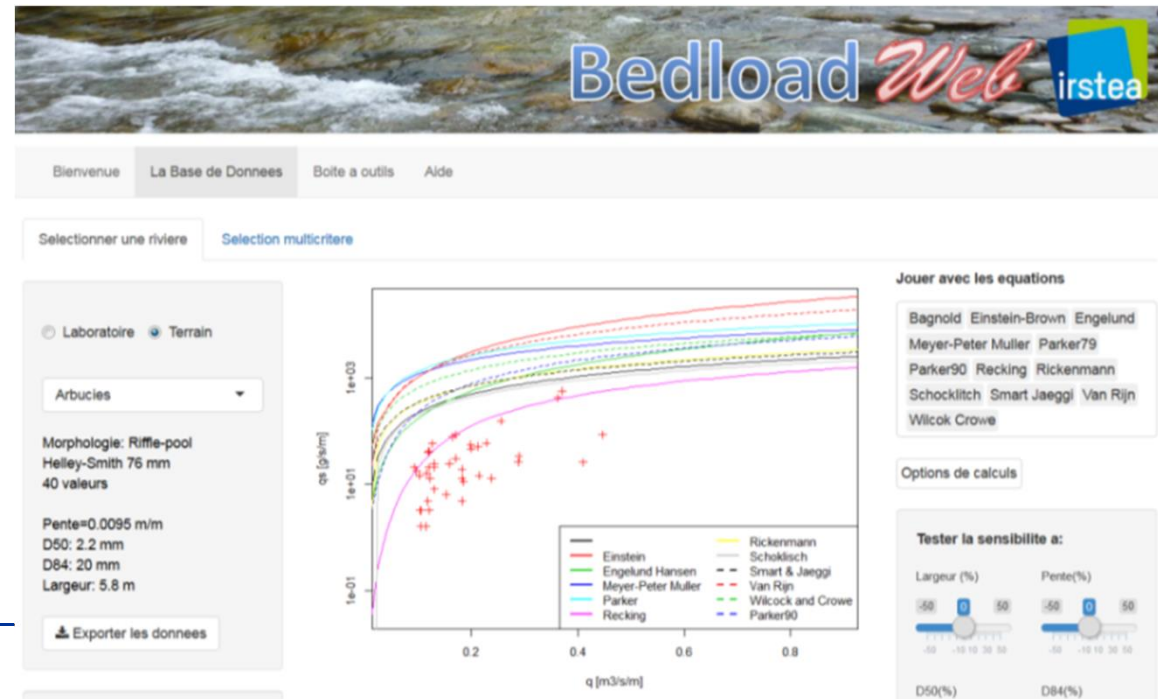
Planning and Management Tools

BedloadWeb

Aim: Collaborative, pedagogic platform of bedload calculation

Method: Computing the hydraulics, bedload and transported grain size distribution for given bed surface grain size distribution and flow condition

Contains bedload data from 120 sites for comparison



Planning and Management Tools

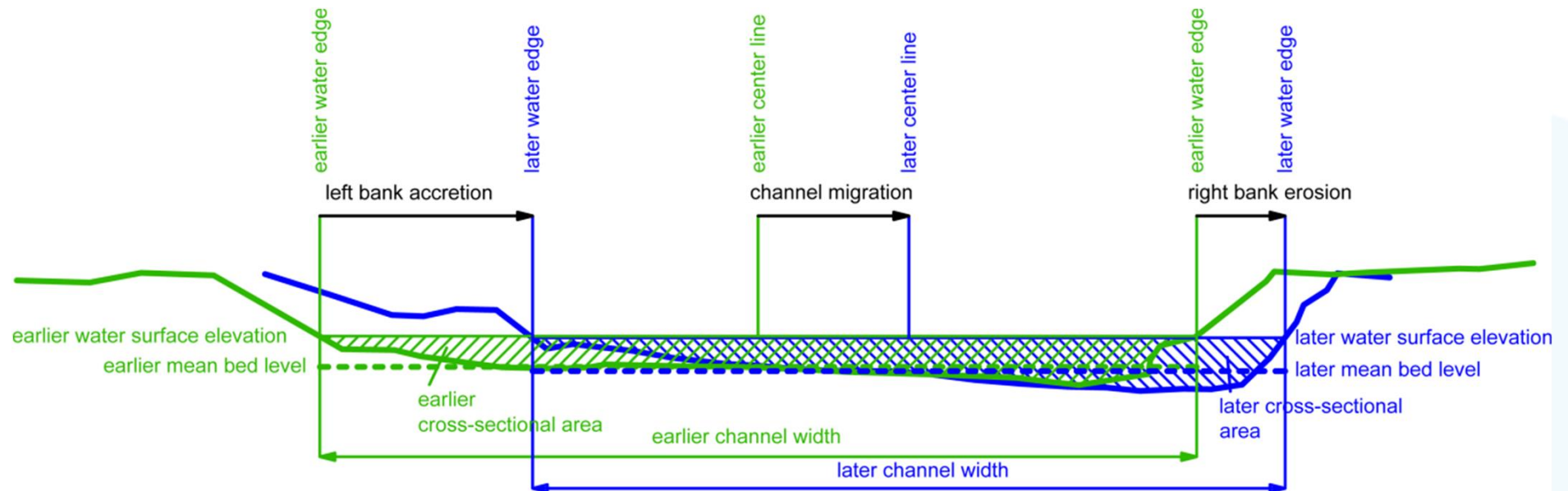
Widest – Width Estimator of Restored Alpine Streams

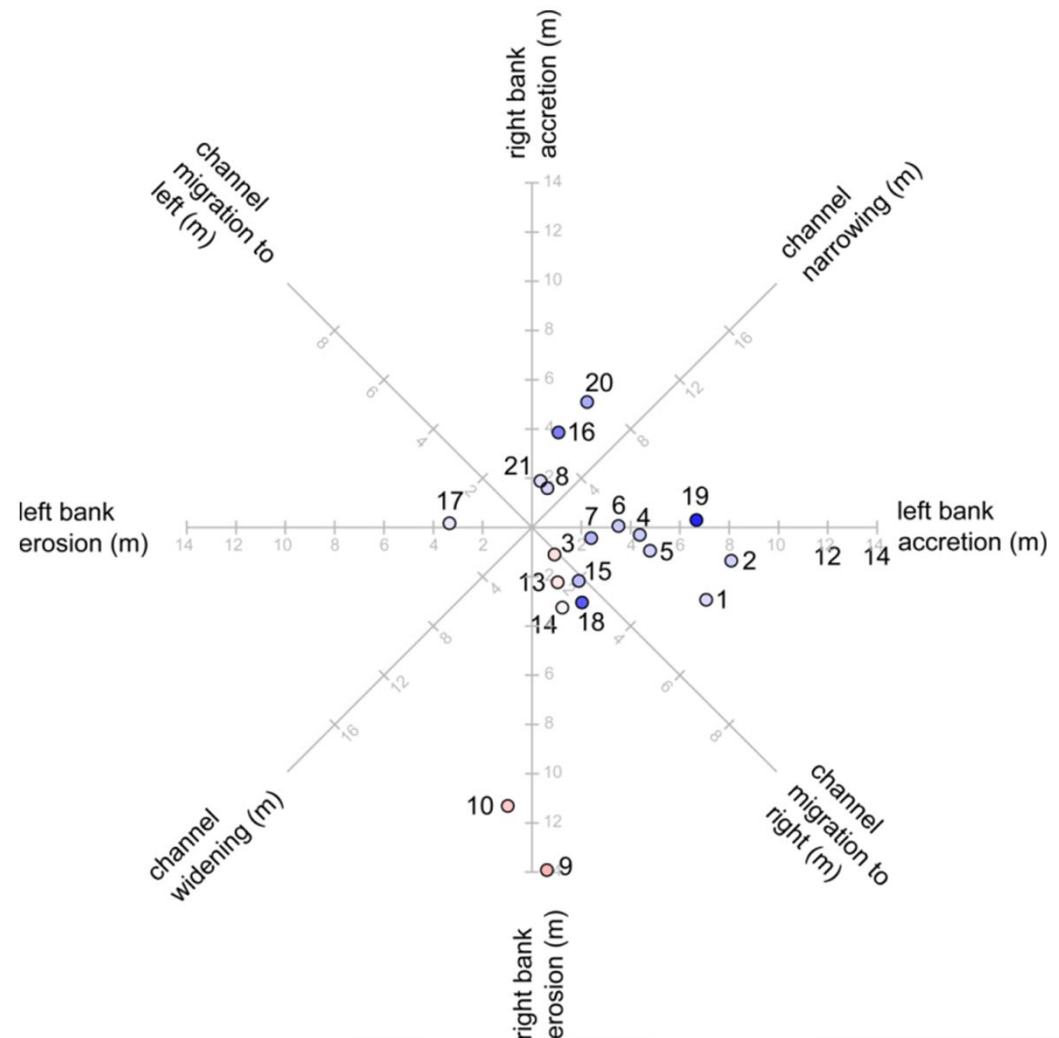
Aims: • Estimation of space and sediment demand of restoration



Planning and Management Tools

Chevo – Tool for standardized assessment of channel evolution







- 1) BUECH
- 2) DRAC
- 3) MAGGIA
- 4) ADIGE
- 5) AVISIO
- 6) ISARCO
- 7) TALVERA
- 8) WERTACH
- 9) LECH
- 10) DRAU
- 11) DRAVA
- 12) MUR
- 13) SALZACH
- ALPINE SPACE COOPERATION AREA



Talvera - Talfer



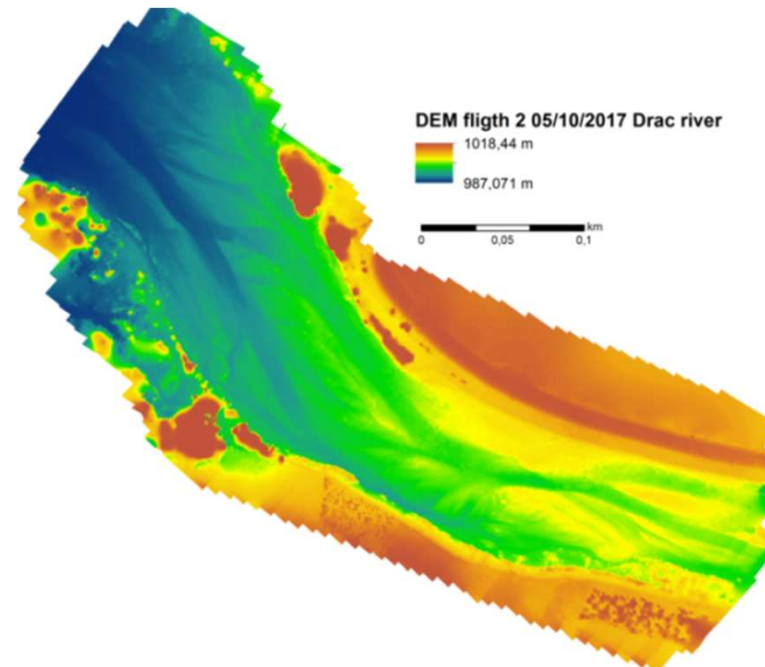
Isarco - Eisack



Adige – Etsch



MONITORING AND EVALUATION of case studies



MONITORING AND EVALUATION

Typically critical issues

1. Lack of an explicit identification of the objectives
2. The main drivers affecting the variables/quality elements to be assessed and the cause-effect relationships linking them are not explicitly defined, thus not monitored;
3. The range of natural variability of the variables/quality elements to be monitored is usually unknown and not taken into consideration in the monitoring plan; monitoring results are often statistically too weak;
4. The spatial and temporal scales of the processes involved (therefore the needed spatial and temporal scales of monitoring activities) are often neglected; this applies both to physical processes and to recovery of biological communities;
5. Control sites are often not included in the monitoring scheme.
6. Monitoring pre-project implementation is often neglected.

Study site

The Upper Drac is a gravel-bed braided river of the Southern French Alps, draining the southern part of the Ecrins National Park. It is one of the major alpine tributary to the Isère River. The study reach is located close to St-Bonnet-en-Champsaur at an elevation of 1000 m above sea level. This reach drains a 340-km² upland catchment with a maximum elevation of 3441 m. The catchment geology is composed of a complex assemblage of crystalline and sedimentary rocks.

The study reach extends from the Champsaur leisure center to the village of St-Bonnet-en-Champsaur. This 3.7 km reach presents a mean active channel width of 110 m and a mean channel slope of 0.01 m/m. The channel morphology is an artificial wide and shallow channel with a rectangular cross-section recreated by the restoration project; it is expected to rapidly transform into a braided channel. The water discharge is monitored since 1972 at the Ricous gauging station, located 14 km upstream from the study reach. The water regime is characterized by a major snowmelt peak during May and June. The mean daily discharge is 5.46 m³/s, and the 2 and 10 yr daily flood discharges are estimated at 41 and 61 m³/s, respectively.



Drainage area (km ²)	340
Location	44°39'17"N, 6°6'23"E
Length of the study reach (km)	3.7
Active channel width (m)	110
Channel slope (m/m)	0.01
Planform morphology	Braided pattern



DISSEMINATION



Cerca



HyMoCARES: presentation of the project (subtitled in French)



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HydroMorphological assessment and management at basin scale for the
Conservation of **Alpine Rivers** and related **Ecosystem Services**



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