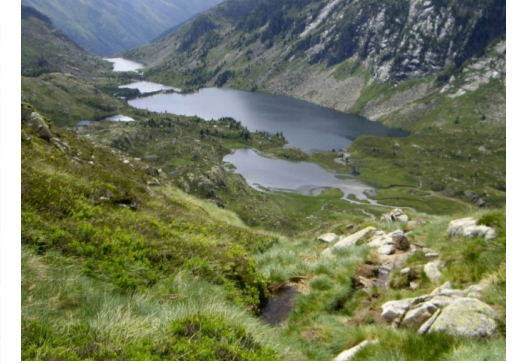


HYDECO

Connections, disconnections and reconnections in socio-hydrosystems: Does (in)visibility make the difference?



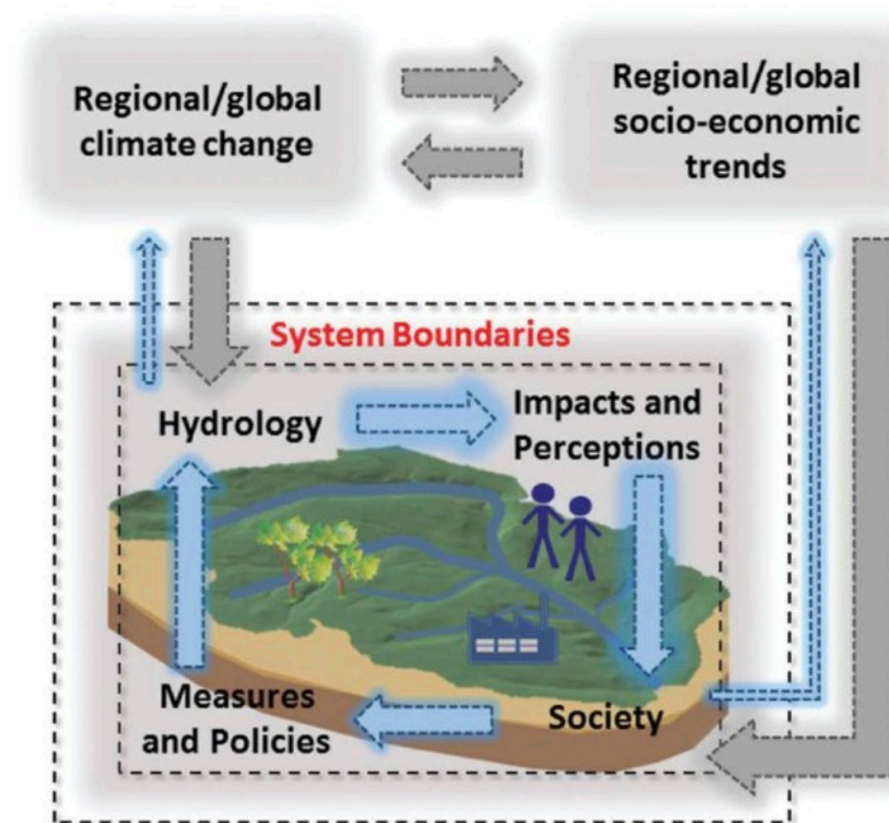
*OHMi Pima County – OHMi Estarreja – OHM Fessenheim – OHM Pyrénées Haut Vicdessos – OHM Littoral Méditerranéen –
OHMi Nunavik – OHM Vallée du Rhône*

Post-doctoral Fellow : Anne-Lise Boyer

"Transversal projects" session

➤ SOCIO-HYDROSYSTEM

- Human beings humans considered as an integral part of the functioning of hydrosystems
- Considering the dynamics and co-evolution of coupled human-water system
- In 5 dimensions :
 - longitudinal (upstream/downstream);
 - lateral (stream channel/flood plain);
 - vertical (surface water/groundwater)
 - time
 - societies



Socio-hydrological system according to Westerberg et al., 2017

➤ CONNECTION / DISCONNECTION / RECONNECTION

Connectivity as a fundamental property of all ecosystems

- **Hydrological connectivity** : “the water-mediated fluxes of material, energy, organisms within and amongst components, e.g. the channel, flood plain, alluvial aquifer, etc., of the ecosystem” (Kondolf *et al.*, 2006)
- In 5 dimensions => operates in :
 - longitudinal, lateral, and vertical dimensions
 - + over time
 - **+ social connectivity** : communication and movement of people, goods, ideas, and cultures along and across rivers

➤ CONNECTION / DISCONNECTION / RECONNECTION

- **Disconnection = lost linkages.**

A long heritage of disconnections in sociohydrosystems, e.g., transverse infrastructures such as dams; withdrawals (pumping for water supply); pollutions (domestic, agricultural and industrial); alteration of the river flow and sediment transport.

- **Reconnection** : recovery of lost linkages over time, e.g. restoration projects and the responses they trigger in the system.



Barrage Hoover sur le Colorado



Barrage de Cusset, Villeurbanne

➤ VISIBLE / INVISIBLE

- "visibility lies at the intersection of the two domains of aesthetics (relations of **perceptions**) and politics (relations of **power**)" (Mubi-Brighenti, 2010)
- The term "visibility" puts in tension processes of **recognition** and **control**.
- Making the hydrosocial cycle visible : invisible waters/ infrastructures
- **Groundwater**: the forgotten resources and the challenges for water management
- Symbolic and **charismatic species** (e.g., beavers)
- **Pollutions** and water quality issues
- Environmental perceptions/ education/ communication



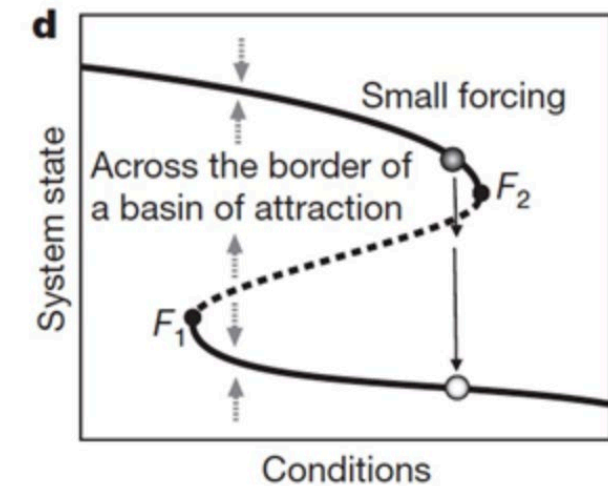
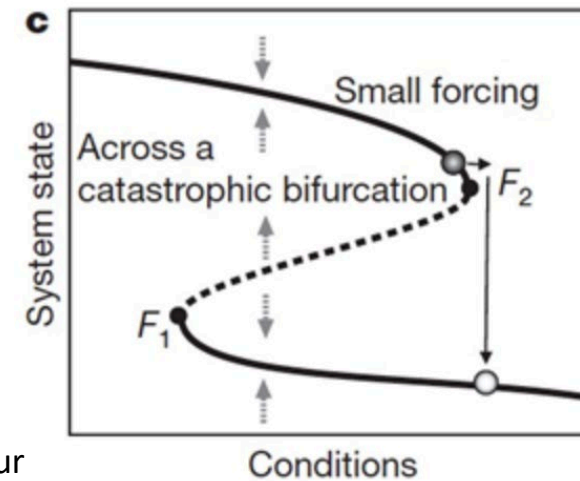
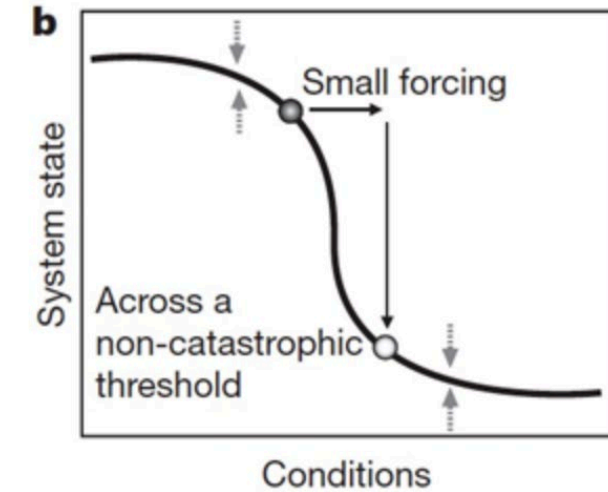
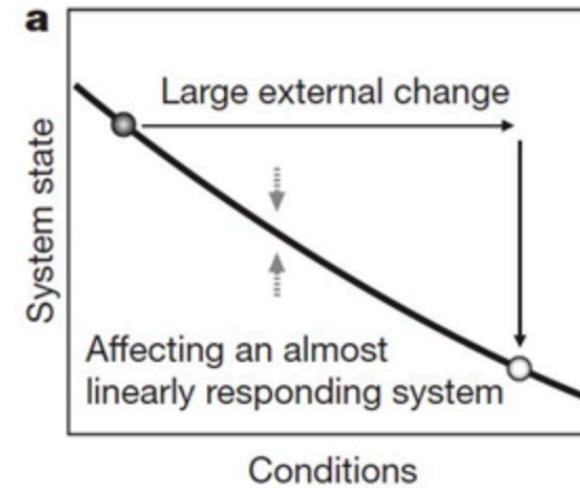
Tucson Diversion Channel
Greenway



Station de pompage, Etang de l'Or

➤ TIPPING POINTS

- The point at which a system can move away from one stable state and into another (Cairns, 2004): ecosystems lose stability passing through tipping points at which they respond abruptly to small changes in external driver (Dakos *et al.*, 2015).
- Crossing a tipping point in one part of the system can lead to a cascade of transitions in another...



D'après Sheffer *et al.* (2009) : la différence entre les transitions linéaires (a), graduelles avec un point de rupture (*turning point*) (b), et catastrophiques autour d'un point de bascule entre deux états d'équilibre (*tipping point*) - (c) et (d).

1. Socio-hydrosystems are by definition characterized by **connections** in all dimensions (physical and social); these connections are **visible and invisible**.

⇒ **Hypothesis 1:** all socio-hydrosystems have experienced disconnections (physical and social) in the context of their development by local societies

- Which dimensions are mainly affected by disconnections?
- Are these disconnections favored when the linkages are invisible or invisibilized?

How are they facilitated?

- Can these disconnections lead to environmental and social tipping points?

2. In the last decades, the management of socio-hydrosystems has sought **to promote reconnections**

⇒ **Hypothesis 2:** Reconnections are promoted through processes of making connections visible

- How do these processes materialize?
- Are reconnection processes always positive?
- Do reconnections allow a return to a previous state (return to the tipping point) or do they precipitate the socio-hydrosystem into a new phase of its functioning?



Estarreja



Umiujaq

1. OHM Pima County: Tucson Active Management Area and the Santa Cruz River.

- Groundwater and surface water hydrological, geomorphological and ecological interactions in the context of climate change: approaching the tipping point?
- Groundwater and surface water disconnections in stakeholders' perceptions: law and socio-economic challenges
- Social perceptions of intermittent streams: towards an improved visibility?



The Santa Cruz River Heritage Project



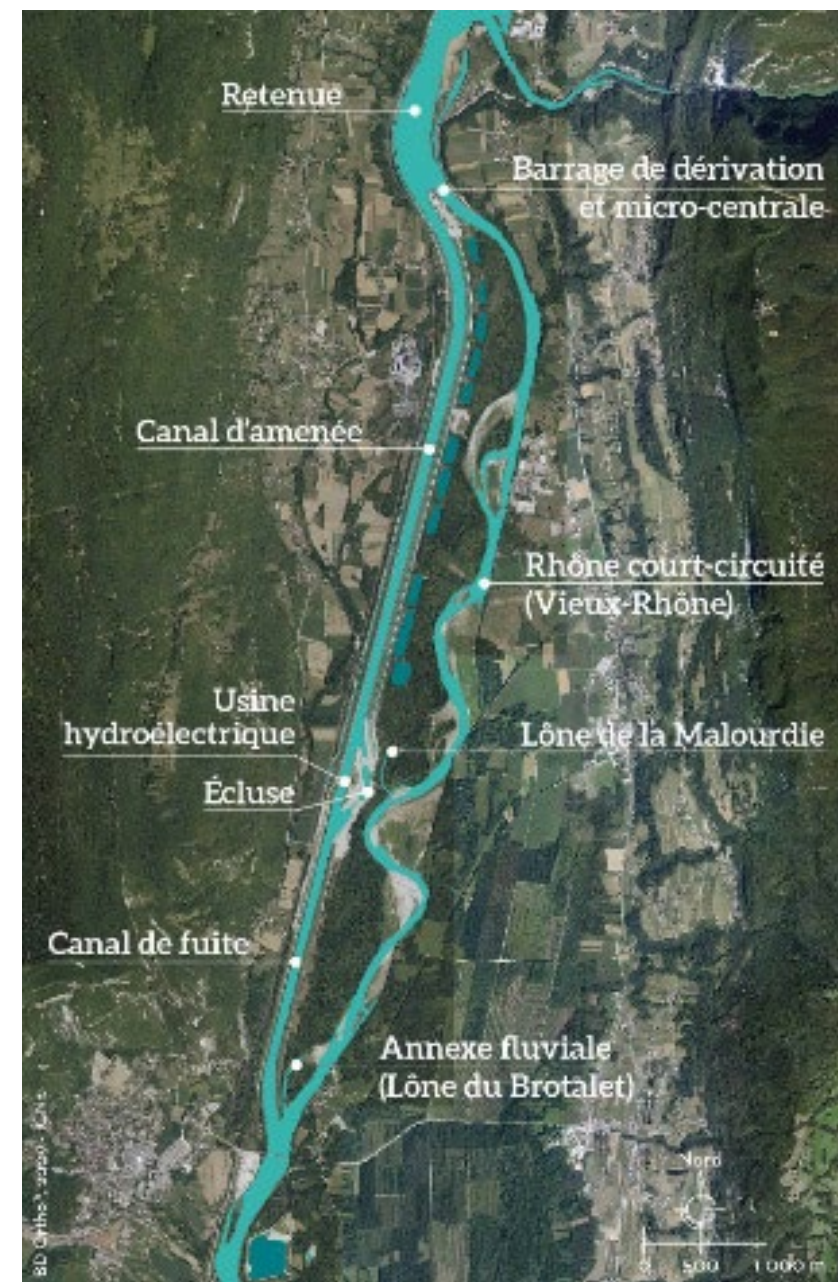
Agua Nueva Treatment Plant Discharge in the Santa Cruz

2. OHM Rhône Valley: The Rhône corridor from Lake Geneva to the delta

- Water contaminant and pollutions in the Rhône corridor: the invisible threat?
- Groundwater and surface water interactions in the context of climate change: approaching the tipping point?
- Urban waterfronts: towards a social reconnection between cities and rivers?

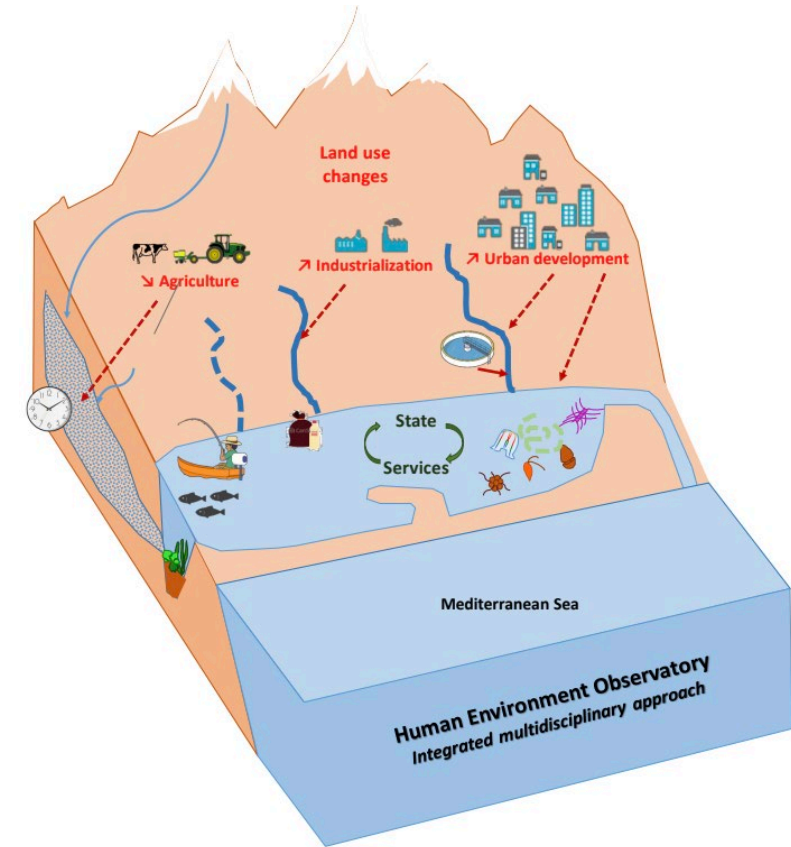


Casiers Girardon



3. OHM Mediterranean Coast: The lagoons of Etang de l'Or (Montpellier) and Biguglia (Bastia, Corsica)

- Groundwater and surface water interactions in the hydrological functioning of lagoons
- Water contaminant and pollutions: connectivity as a potential issue in the functioning of a lagoon
- Connection sea/lagoon/flood plain: impacts of human infrastructures on the functioning of the lagoon



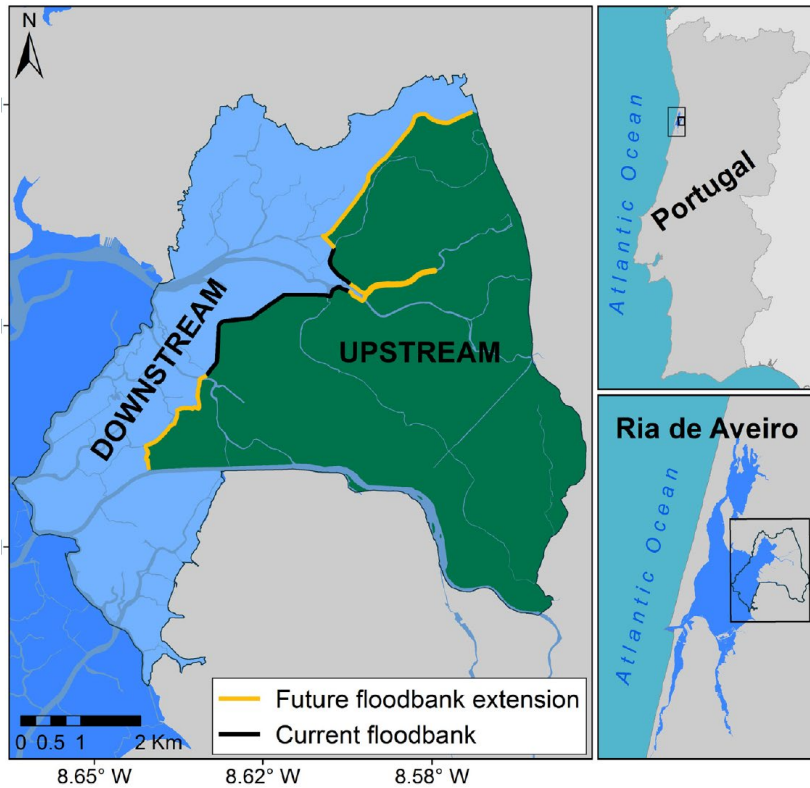
4. OHM Fessenheim: The Rhine islands between the Grand canal d'Alsace and the Rhine River

- Hydrological reconnections and invisibility of groundwater dynamics in the framework of the rehabilitation of the Alsace potash mines on the Rhine River
- Water contaminant and pollutions: re-mobilization of polluted sediments
- Connection/disconnection events on pollutant levels in alluvial sediments and ecological processes - chemical, physical and ecological modelling of tipping points



5. OHM Estarreja: The Atlantic lagoon of Estarreja (Portugal)

- Delineation of freshwater/saltwater interface in the area of Baixo Vouga Lagunar (Aveiro) using geochemical and geophysical techniques
- The effect of multiple climatic factors on the toxicity of historically contaminated soils.
- Microplastics in Estarreja rivers and their role in the spread of pathogens and antibiotic resistance



Extracted from Javier Martínez-López et al., 2019.



Extracted from <https://www.ua.pt/en/news/0/47673>



Extracted from <https://www.pacopar.org/contents/files/2015-revistapacopar-pt.pdf>

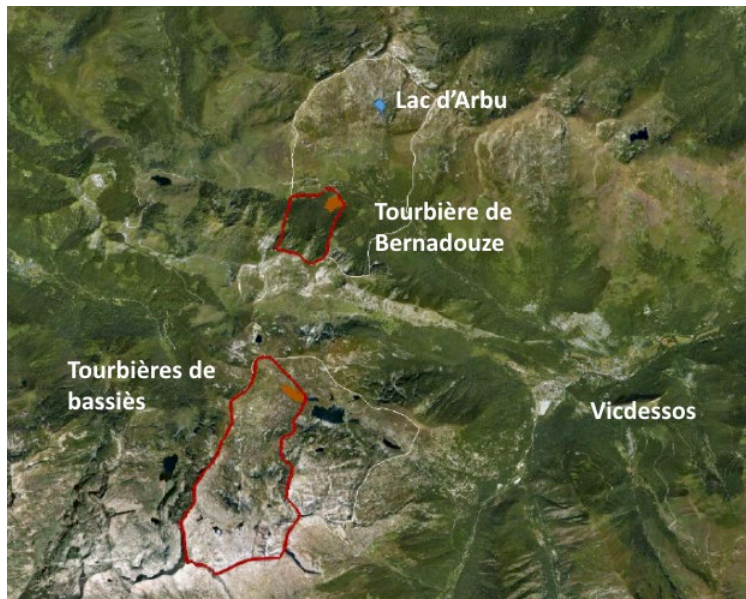
6. OHM Nunavik: The Watershed of Umiujaq (Québec, Canada)

- Evolution of the hydrosystem in response to climate change and following the recent establishment of the village of Umiujaq in 1986
- Impacts of changes in the hydrosystem on the village of Umiujaq (increase in river turbidity caused by landslides, presence of contaminants in the water, growth of shrubs in the watershed resulting in the decline of the endemic vegetation, appearance of thermokarst ponds as a result of the degradation of the permafrost, appearance of beaver dams, etc.)



7. OHM Pyrénées-Haut Vicdessos: The Peatland of Bernadouze and high mountains lakes

- Understanding of the landscape configurations that favor water storage in winter by analyzing vertical snow flows and groundwater tables in order to allow active management of territories to favor storage and support of low water levels in the summer.
- Assessment of nutrient and micropollutant flows which are impacted by invasive species, themselves associated with very specific and punctual (spatially and temporally) practices such as fish rearing.
- Geo-historical reconstruction of upstream/downstream connectivity over the long term (18th-21th centuries) in relation to the development and exploitation of the water resources



➤ Main transversal research topics :

- **Vertical (dis)connection between surface water / groundwater : hydrological, legal, social**
- **Water contamination: % and transport of pollutants (old and emerging)**
- **Remobilization of polluted sediments**
- **Urbanized areas – hydrosystems & low population density – hydrosystems**

+ Freshwater/saltwater interfaces: OHM Estarreja & OHM Littoral Méditerranéen.

HYDECO – Grille d'analyse descriptive

L'objectif de cette grille d'analyse est de collecter les informations qui seront utilisées en plus des données collectées sur les différents terrains envisagés dans le cadre du projet HYDECO. Il s'agit d'une étape importante qui va nous permettre de rassembler les informations nécessaires pour l'analyse finale et transversale des données, rendant ainsi possible le bon déroulement de ce projet interdisciplinaire.

✓ 1. Description du cas d'étude

1.1 Localisation du socio-hydrosystème considéré (données géographiques de base)

1.2 Données hydrologiques de base sur l'hydrosystème considéré

1.3 Historique du socio-hydrosystème

1.4. Acteurs impliqués dans le socio-hydrosystème

1.5. Intensité de la recherche sur le site considéré : Depuis quand le site est-il étudié ?

✓ 2. État de l'hydrosystème

2.1. Pressions sur la ressource

2.2. Pollutions

2.3 État des écosystèmes aquatiques

✓ 3. Connexions, déconnexions et reconnexions

3.1 Connexions socio-historiques

3.2. Facteurs de déconnexion

3.3. Facteurs de déconnexion socio-politique

3.4 Re-connexions

✓ 4. Tipping points

4.1 Pollutions

4.2 Biodiversité

4.3 Morphologie et métamorphose fluviale

✓ 5. Visible / Invisible

5.1 Médiatisation du socio-hydrosystème

5.2 Problème public et mobilisation sociale autour du socio-hydrosystème ?

Date	EVENTS
3/11/2021	Kick-off meeting
1/01/2022	Post-doc hiring
13/01/22	Meeting – OHM Vallée du Rhône
17/01/22	Meeting – OHM Littoral Méditerranéen
24/01/22	Meeting – OHM Fessenheim
25/01/22	Meeting – OHMi Nunavik
02/02/22	Meeting – OHMi Esterraja
07/02/2022	Internship – OHM PHV – 6 months + OHM Fessenheim
18/02/22	Meeting – DMP : Plan de Gestion des données (1)
23/02/22	Meeting – OHM Pyrénées Haut Vicdessos
05/03/22	Internships - OHMi Pima County (4 x 3 mois de stage)
10/03/22	Workshop HYDECO/ENERGON OHMi Pima County – Accueil des stagiaires
21/03/22	World Water Week : Groundwater, Making the Invisible Visible – EUR H2O Lyon
30/03/22	Plenary HYDECO working meeting
06/04/22	Presentation of the HYDECO project at the IRL iGlobes international workshop
19/04/2022	Meeting – DMP : Plan de Gestion des Données (2)
20/05/2022	Sending the analysis grid for comments and amendments
20/06/2022	Transversal Project Session – Séminaire annuel du Labex DRIIHM à Nantes

NAME	OHM	DEGREE	TOPIC	DURATION
Clément ARTIGUE	Fessenheim	M2 Sciences de la Terre	Etude de la chimie des sédiments fins du Rhin en lien avec les activités anthropiques	4 mois
Linda CHOUACHE	Pyrénées Haut Vicdessos	M2 Biodiversité Santé Environnement	L'effet d'anciens contaminants (métaux) vs des polluants émergents (plastiques) sur le biote aquatique des écosystèmes de montagne	6 mois
Clément ALIX	Pima County	M1 Gestion de l'eau	Visible/invisible : la gestion des connexions eaux souterraines-eaux de surface dans le comté de Pima (1) – Une approche de géographie du droit sur l'eau	3 mois
Louise BIVILLE	Pima County	M1 Gestion de l'eau	Visible/invisible : la gestion des connexions eaux souterraines-eaux de surface dans le comté de Pima (2) – L'entrée par les acteurs de terrain	3 mois
Coline CLERGEAU	Pima County	M1 Gestion de l'eau	Ressusciter la Santa Cruz : les projets de restauration écologique de Tucson Water (1) - Le Projet Heritage au centre de Tucson	3 mois
Manon DELÈGUE	Pima County	M1 Gestion de l'eau	Ressusciter la Santa Cruz : les projets de restauration écologique de Tucson Water (2) Le projet Sweetwater Wetlands Park	3 mois
Grégoire RAMÉ	Pima County	M1 Gestion de l'eau	Connexions/ Déconnexions : la restauration d'un cours d'eau intermittent transfrontalier	3 mois

MEXICAN WATER FOR THE AMERICAN RIPARIAN ECOSYSTEM

Clément Alix¹
Grégoire Ramé²

1. Université Paris-Nanterre
2. ENS de Lyon

CONTEXT "A river now and then"
Decline and restoration of an intermittent stream

The Upper Santa Cruz was an intermittent river that hosted the first native settlements and was particularly developed under Spanish colonization (XVIth century). Yet, it "sunk" underground in the 1930s due to increasing pumping by the growing Ambos Nogales. However, the International Treatment Plant (NIWTP) somehow fixed the river in the 1950s. This technological infrastructure enable the creation of a new semi-artificial riparian ecosystem.

LEGAL DISCONNECTION

METHODS

- > Legal literature review;
- > 16 interviews with institutional actors and stakeholders along the valley;
- > Economic and ecological history of the river

HISTORIC RECONNECTION.
"Tumacacori as an example of a community in connection with the river"

- > Spanish missions were built along the river were geological resurgences "pushed" the surface at the surface: "As intensive agricultural locations, these missions were absolutely tied to the geography of the river";
- > The church became a National Monument in 1908 under the Antiquities Act (10 acres) extended into a National Historical Park in 1990 (360 acres) by a decision of Congress who wished to emphasize the environmental history of the valley;
- > "So much water now flows in the channel, it may surpasses any perennial flow within historic memory" (The Lessening Stream);
- > People are now going to the mission in order to see the river banks (i.e. Sonoran Institute's map)

HYDROLOGIC DISCONNECTION : THE NIWTP FIX

1951: First wastewater treatment plant of Nogales AZ.
1972: NIWTP moved from Nogales to Rio Rico because of land-use change.
1998: NIWTP now owned by the NIWTP.
2009: An upgrade in the filtration system reduces the effluent in the entire but also the overall length of the river (20 miles → 12 miles).
2012: Opening of the LAWRTP (Los Alamos Wastewater Treatment Plant) in the monsoon part of the Sonoran desert.
2013-2018: Decrease in input of effluent from the IOI (more expensive but some of them is amortized).

CONCLUSION

- > Legal disconnection continues between surface and groundwater, leading to **Bifurcated Water Policies**;
- > Yet, restoration of river is due to effluents entering a legal limbo where they cannot be reapropriated;
- > Restoration marks the shift toward new landscapes of leisure for local residents;
- > Necessity of transboundary rights for Mexico and environmental flow policy.

OPENING COMMENTS

- 1 Question of environmental justice with the restoration of the Nogales Wash ("Bring back the water");
- 2 Mysterious effluent-rivers appearing at border due to unplanned estate development ("streams by a thousand cuts");
- 3 Border wall monsoon floods ("get the water out as fast as possible")

Source: M.L. Villareal and al. (2011)

LabEx DRIIHM, Université de Guyane, CNRS, International Symposium of Labex DRIIHM - 2022 Inter-Disciplinary Research Facility on Human-Environment Interactions - ANR-11-LABX-0010 20-22 June 2022 - Nantes (France)

What are the vectors of social reconnection to a dried up urban watershed ?

Louise Biville, Coline Clergeau Laurans, Manon Delégué, Master 1 Gestion de l'eau et développement local, Université Paris-Nanterre.

Université Paris Nanterre, CNRS, iGLOBES Interdisciplinary and Global Environmental Studies, DRIIHM COMITÉ

Introduction

The research presented on this poster focuses on the Santa Cruz River socio-hydrosystem, a tributary of the Colorado River, located in the Southwestern United States in Arizona. Subject to anthropogenic pressures, the Santa Cruz River is an essential resource for the supply of urban areas, such as the city of Tucson in the Sonoran Desert. In the 1940s, the river dried up and became intermittent, particularly because of excessive groundwater pumping. Only during the rainy season does a surface flow appear. Today, various initiatives are carried out in the Tucson area to "bring back to life" the Santa Cruz River and thus make visible a river that had become invisible. This social reconnection is all the more important as Arizona is currently facing drought and water shortage that is affecting the water supply of its residents. Through the projects studied - social network mobilization, recreational reconnection, socio-cultural reconnection - local actors aim to reconnect residents to the river and to the ecological functioning of the Santa Cruz watershed.

The Santa Cruz River : an effluent-dependent river

In a drought and urban growth context, treated effluents are a sustainable way to recharge diminishing groundwater table levels. On this effluent dominated river, we focus on two groundwater recharge projects by Tucson Water that recharge groundwater levels and, by reconnecting groundwater and surface water, restore riparian areas, providing wildlife habitat and amenities for the community.

Sweetwater Wetlands Park

This constructed wetlands depends on highly treated effluents to provide wildlife habitat and recreational amenities to visitors. Opened in 1996, the facility is managed by Tucson Water, while non-profits, such as Tucson Audubon Society, organize field trips in this "birding hot-spot". After moving through the wetlands, treated effluents are sent to infiltration basins surrounding the park to recharge groundwater.

Heritage Project

Confronted with excess effluent and in order to reconnect residents to their river, Tucson Water and Pima County chose what can be considered the birthplace of Tucson to discharge effluent and thus revive a portion of the river. Launched in June 2019, the project has attracted a crowd of professionals, enthusiasts and residents. In a short time, this formerly dry area has become an ecosystem again and the site has become a favourite place for various species. Three years after its implementation, the Heritage project remains a popular place, thanks to its loop cycle path, making it a must for cyclists.

Methods

- Semi-structured interviews with managers, non-profits, scientists.
- Participatory observations : seminars, bird-watching field trips, exhibitions, workshops, collaborative worksites.
- Counting and analysis of the frequentation of the studied sites.
- Online participatory observations and social medias analysis.

Mobilizing social medias

- "Environmental influencer"
"I didn't even wanna do social medias, and then I thought, oh yeah, the stories are actually very useful for communicating!" (M. Bogan, 2022).
- Environmental communication
Word cloud from @TucsonWater and @SonoranInst on Twitter:
The 130-mile length of this bike path is a great asset to the city, as it connects users to the various rivers that run through Tucson, making it a must for residents.

Cultural reconnection

- Tucson birthplace The foot of the A-Mountain (Sentinel Peak) is what the locals consider to be the birthplace of the town, especially with the Hohobam and the agriculture developed around the Santa Cruz River for centuries.
- San Juan Day, June 24 is for Mexicans the feast of St John The Baptist (according to the catholic tradition), which heralds the beginning of the monsoon. The choice of this date for the inauguration of the Heritage project is particularly appropriate and symbolic.
- The Living River of Words is an art and science program promoting contact and connection with the Santa Cruz River for hundreds of young people around Pima County's schools.

Citizen reconnection

- Waste removal workshops and initiatives along the Santa Cruz River are promoting a way to restore and preserve the river ecosystem. Volunteers can reconnect to the river's natural resources and its cultural heritage.
- Invasive plants removal
Arundo is an invasive specie from Middle East. The non-profit Watershed Management Group has initiated participative restoration around "Arundo removal" to allow native plants to grow. The participants come in the morning at Tanque Verde Creek and they pull out Arundo right from the riverbed.
- Citizen science is a way to reconnect to natural resources. WJMG organizes Wet/Dry surveys with volunteers to track surface flow in the Santa Cruz River watershed. While Tucson Audubon Society promotes the use of e-Bird, an online data base of bird sightings.
- Castoriando is another participative restoration program hosted by RRR. It takes place in Génega Creek and participants "think like beavers" in order to build wood dams to slow stormwater flow.

Recreational reconnection

- The Loop
"By September 2020, about 22,300 pedestrians and 45,500 cyclists will use this stretch of the path"
Living River-2020 Water Year, Sonoran Institute
- Bird-watching
The Tucson area hosts a large biodiversity of bird species and offers an ecological corridor for migration thanks to the Santa Cruz River's riparian areas. The Sweetwater Wetlands Park is a well-known hot-spot for birding.
- Dragonflies
It's only few days after the beginning of the Heritage Project that dragonflies have taken up residence where the flow began. It became such an important species that a festival is organized in their honor.
- Native plants
are a big part of the Tucsonian culture. Here, heat mitigation is a huge deal. Native plants, such as mesquites are praised as they create shade and a cooling effect without needing irrigation.

Limits and perspectives

- Very artificial restoration and human dependent.
- One of the challenges of water management is the risk of pollution from numerous landfills.
- Green gentrification.
- The illusion of an oasis in the desert ?

LabEx DRIIHM, Université de Guyane, CNRS, International Symposium of Labex DRIIHM - 2022 Inter-Disciplinary Research Facility on Human-Environment Interactions - ANR-11-LABX-0010 20-22 June 2022 - Nantes (France)

- **June 24th, 2022:** Workshop “Making the invisible visible: Tipping Points, Early Warning Systems and Sentinel”, Campus Condorcet, Paris.
- **June 27th-30:** Visit of the OHM Littoral Méditerranéen
- **September ?:** Online Seminar to discuss the synthetic analysis grid?
- **October 24-25th:** Visit of the OHM Fessenheim

Work in progress and other on-going tasks:

- **Filling and answering the synthetic analysis grid**
- **Data Management Plan (DMP)**
- **Other internships: Spring 2023**

Reminder : Funding is available for exchanges between OHMs: fieldtrip, seminars, etc !!!

Journée d'étude

24 juin 2022

SALLE 50 – CENTRE DE COLLOQUE – Campus Condorcet

Rendre visible l'invisible :

Tipping points, Early Warning Systems and Sentinel



Matin

9h30-12h30 : Les Tipping Points : comment se préparer à/identifier l'imprévisible ?

Après-Midi

14h-18 h : Capteurs, EWS et Sentinelles pour rendre visible l'invisible

Thank you for your attention...

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David Blanchon: david.blanchon@parisnanterre.fr

Anne-Lise Boyer: annelise.boyer@ens-lyon.fr

"Transversal projects" session