RÉSEAU MiDi
Milieux & Diversité
Réseau thématique de recherche en Région Centre Val de Loire

International Symposium

Abstract Book:

Climate change & Water 2022

May 31 – June 1 – June 2

ccw2022.sciencesconf.org

Monday, May 30, 2022 Maison des Sciences de l'Homme - Computer lab

Opening training Hydrological modelling : Keynotes		
08h30-10h30	**Claudio Paniconi** invited speaker, INRS, Québec	Introduction to hydrological modelling
10h30-11h00		*Coffee Break*
11h00-12h30	**Sihem Benabdallah** invited speaker, Certe, Tunisia	Introduction to SWAT model
12h30-14h00		*Lunch Break*
Hydrological modelling : Training		
14h00-18h00	**Haykel Sellami**, Certe, Tunisia Kaoutar Mounir, PhD student, Univ. Tours, France Univ Fès, Marocco	Introduction to SWAT manipulation

19h00 **ICE BREAKING (end ~ 20h30)**

Cocktail at the city hall, Tours

For all participants and speakers of the symposium

Venue : https://ccw2022.sciencesconf.org/resource/acces

Tuesday 31 May 2022 UNIVERSITY OF TOURS - Amphitheater Thélème

08h30		*Welcome & Registration*
Opening session (chaired by Isabelle LA JEUNESSE, U.Tours, FR)		
09h00	**Arnaud Giacometti**	Opening by the President, University of Tours
	François Bonneau	Centre-Val de Loire Region President
	Betsabée Haas	Deputy Mayor of Tours, (biodiversity, nature, risk management and animal welfare)
	Nora Semmoud	Dir. Laboratory CNRS 7324 Citeres of the University of Tours
	Sylvie Servain	MiDi Network (Environments & Diversity)
	Isabelle La Jeunesse & Sylvain Pincebourde	Opening CCW 2022 conference
09h45-10h00	**Rosana Lopez Rodriguez** ***Invited speaker***	Current state of impacts of climate changes on Earth vegetation
10h00-10h15	**Denis Salles, *Invited speaker***	INRAe (FR) Bordeaux : Adaptation to climate change: a governance issue
10h15-10h45		*Coffee Break*
Session: Community of European Research and Innovation for Security (CERIS) Side-Event Chaired by Philippe Quevauviller (European Commission DG HOME, BE)		
10h45-11h00	**Philippe Quevauviller**	Introduction to CERIS: Community-building in the area of disaster risk management
11h00-11h15	**Daniel Sempere-Torres**	ANYWHERE EU project
11h15-11h30	**Ilias Gialampoukidis**	BeAWARE EU project
11h30-11h45	**Dominique Darmendrail,** Agathe Euzen, Thibault Datry	Connecting European partnerships and a national research and innovation program (OneWater) on water challenges to accelerate transitions and measure impacts on socio-hydrosystems.
11h45-12h15	**Panel discussion**	**Philippe Quevauviller, Ilias Gialampoukidis, Hripsimé Torossian, Dominique Darmendrail**
12h15-13h45		*Lunch Break*
Poster session		
Session: How governance and policy cope with extremes (Chaired by Isabelle La Jeunesse)		
13h45-14h00	**Hans Bressers,** Gül Özerol	Coping with extreme events in midsized cities: Enabling practitioners to assess the supportiveness of their governance context
14h00-14h15	**Amal Ennabih**	The institutional challenges of the design and implementation of a climate change adaptation policy: the case of treated wastewater reuse for agricultural irrigation in Morocco
14h15-14h30	**Vassili Kypreos,** Guillaume Lacquement, Ludwig Wolfgang	What collective strategies for adaptation to climate change? The role of irrigation associations in water resource management, a case study in Roussillon.
14h30-14h45	**Catteau Suzanne,** Couderchet Laurent	Integrating scales and knowledge of local stakeholders with Geographic Information Systems to develop adaptation strategies based on wetlands functioning
14h45-15h15		*Break*
Session: Adaptation to drought (Chaired by Sylvain Pincebourde)		
15h15-15h30	**Andrea Böhnisch,** Elizaveta Felsche, Magdalena Mittermeier, Ralf Ludwig	Water availability during present and future heat-drought compound events in Europe
15h30-15h45	**Di Costanzo Hadrien,** Martin Philippe	Hydrosec : a drought monitoring tool for watershed managers in south-eastern France
15h45-16h00	**Terence Epule**, bdelghani Chehbouni, Driss Dhiba, Mirielle Wase Moto	The Readiness Index for Climate Change Adaptation in Africa: The Role of Climate and Adaptive Capacity Proxies
16h00-16h30		*Coffee Break*
ECRA Session (chaired by Ralf LUDWIG) Societal challenges related to climate change impacts on the hydrological cycle - risk analysis, vulnerability and adaptation		
16h30-16h45	**Peter Braesicke**	Welcome Presentation of ECRA goals, working groups and outputs by ECRA chair, Helmholtz Association, KIT
16h45-17h00	**Hans-Martin Füssel**	Climate change vulnerability and adaptation in Europe Keynote 1- European Environment Agency, BE
17h00-17h15	**Nathalie Ollat**	Adaptation of wine growing production to drought Keynote 2 - INRAe Bordeaux, FR
17h15-18h00	Panel discussion	**Hans-Martin Füssel - Denis Salles - Peter Braesicke - Nathalie Ollat - Sihem Benabdallah - Rosana Lopez Rodriguez**
18h00-18h10	**Introduction to the wine testing at the cocktail of the wine produced in the Loire Valley and the impacts of climate changes (by Interloire)**	

19h00 **ECRA cocktail at the Tours City Hall (Hôtel de ville) open to all participants : by Walk (10 minutes) or tramway (stop at Jean-Jaurès) - end ~ 20h30**

Wednesday 1 June 2022 UNIVERSITY OF TOURS - Amphitheater Thélème

8h00		*Welcome*
Session: Ecosystems and food security (Chaired by Isabelle La Jeunesse)		
08h30-09h00	**Hervé Le Treut, *Invited speaker***	IPSL (FR)- Global warming : where we are
09h00-09h15	**Achli Soumia,** Terence Epule, Driss Dhiba, Abdelghani Chehbouni	Vulnerability of wheat, barley, and maize yields to growing season precipitation in Morocco
09h15-09h30	**Laurent Léa,** Albin Ullmann, Claude Perrot, Xavier Aubouy, Thierry Castel	How abrupt change in surface temperature impact water balance over France? A case-study of bread wheat cultivated areas.
09h30-09h45	**Leclerc Mathieu,** Pincebourde Sylvain	Early larval stages weakly respond to thermal variance and heat wave event in a dragonfly
09h45-10h00	**Pons Marie-Noëlle,** Poszwa Anne	Effect of clear-cuts on the quality of surface water in the Vosges Mountains
10h00-10h30		*Coffee Break*
Session: Water-energy-food-ecosystem nexus (Chaired by Janez Susnik)		
10h30-10h45	**Ioannou Alexandra,** Chrysi Laspidou	Systemic Resilience Analysis through a Water-Energy-Food-Climate Nexus Approach
10h45-11h00	**Corchero Aitor,** Hannah Arpke, Stefania Munaretto, Lydia Vamvakeridou-Lyroudia, Christos Makropoulos, George Armapatzis, Hella Schwarzmüller, Andrea Marioni	A resilient knowledge boosters for elaborating adaptation and mitigation measures to minimize the effects of climate change
11h00-11h15	**Sylvie Parey,** Joël Gailhard, Hervé Cordier, Alexandre Barré	An example of the climate-water-energy nexus in 2050 for France
Session: Adaptation of wine production to climate change (Chaired by Etienne Neethling)		
11h15-11h30	**Etienne Neethling (keynote)**	Trends in rainfall and soil water availability with climate change: What are the temporal and spatial issues for viticulture in France?
11h30-11h45	**Gaël Bohnert,** Brice Martin	Impacts of Climate Change induced drought and adaptation strategies in winegrowing in the Rhine Valley (France, Germany, Switzerland)
11h45-12h00	**Myriam Laidet**	A "Vinescape Plan" to design the resilience of a World Heritage vineyard : proposal based on case studies on Unesco site of Val de Loire.
12h00-13h30		*Lunch*
Poster session		

14h00 **Departure for the visit of a Loire Valley castle : CHENONCEAU (Bus in front of the Amphitheater main entrance) (back ~ 18h30). The visit contains also a presentation of issues with water levels in the Cher river over which the castle spans (Catherine Boisneau)**

19h00 **Gala Diner at "La Cave" Restaurant in Montlouis-sur-Loire (Bus in front of the Amphitheater main entrance) (Back 23h30)**

Thursdays, June 2, 2022 — UNIVERSITY OF TOURS - Amphitheater Thélème

08h15		*Welcome*
Session : Management of hydrosystems under hydrometeorological extremes (Chaired by Stéphane Rodrigues)		
08h45-09h00	**Sébastien Salvador,** ***Keynote speaker***	**CNRS Loire Workshop (ZAL) : Research on and for the Loire river basin**
09h00-09h15	**Ralf Ludwig,** Gunnar Braun, Raul Wood, Florian Willkofer, Teresa Perez Ciria	Managing water resources under new climatic extremes in the Main river basin, Germany
09h15-09h30	**Lisa Baulon,** Manuel Fossa, Nicolas Massei, Nicolas Flipo, Nicolas Gallois, Matthieu Fournier, Bastien Dieppois, Julien Boé, Luminita Danaila, Delphine Allier, Hélène Bessiere	Sensitivity of a large hydrosystem to changes in climate variability: application to the high and low groundwater level response of the Seine Basin
09h30-09h45	**Julie Gobert**	Climate change hazards and the choice of infrastructural strategies
09h45-10h00	**Pierre-Alain Ayral,** Jean-Marc Domergue, Anne Johannet, Didier Josselin, Nadine Grard	Problem of hydrological metrology of low streams and impact on the estimation of water resources
10h00-10h30		*Coffee Break*
Session: Adaptation to floods (Chaired by Haykel Sellami)		
10h45-11h00	**Kabir Md. Humayian,** Gottfried Kirchengast	Extreme precipitation events and its drivers: an insight from a systematic review from 1993 to 2021
11h00-11h15	**Pierre Cornut,** Nathalie Long	Strategies of protection against marine submersion and environmental inequalities - Case of La Rochelle coastal area, Charente Maritime
11h15-11h30	**Antoine Brochet,** Joana Guerrin	From riskscapes of flooding and marine submersion in the Rhone delta to climate change adaptation strategies
11h30-11h45	**Amélie Monfort**	Experiential learning on coastal flooding risk through the application of the LittoSIM participatory simulation to five French case studies
11h45-13h30		*Lunch*
Poster session		
Session: Modelling approaches for the development of decision support systems (Chaired by Claudio Paniconi)		
13h30-13h45	**Joëlle Nicolas,** Jérôme Verdun, Jean-Paul Boy, Achraf Koulali, Peter Clarke	Space geodesy and climate change : A review
13h45-14h00	**Pierre-Alain Ayral,** Didier Josselin, Nicolas Martin, Vignal Matthieu	Impact of scales and sample size on temperature assessment within downscaling processes
14h00-14h15	**Salih Wiam,** Epule Terence, Abdelghani Chehbouni	An Evaluation of the Performance of Multi-source Satellite Products in Simulating Precipitation over the Tensift Basin in Morocco
14h15-14h30	**Susnik Janez,** Stefano Terzi, Stefan Schneiderbauer, Silvia Torresan, Andrea Critto	Stochastic system dynamics modelling for climate change water scarcity assessment on a reservoir in the Italian Alps
14h30-14h45	**Kaoutar Mounir,** Haykel Sellami, Imen El Ghoul, Abdessalam El Khanchoufi, and Isabelle La Jeunesse	What hydrological modelling Water management issues highlighted by hydrological modelling in the Ouergha catchmentin the Ouergha catchment (Morocco)
14h45-15h00	**Attou Taha,** Sylvain Kuppel, Lhoussaine Bouchaou, Laurence Vidal, Jamal Ezzahar, Abdelghani Chehbouni	A modelling approach for assessing groundwater recharge and crop water use in irrigated, semi-arid agricultural systems
15h00-15h15	**El Ghoul Imen,** Fatma Tliha, Haykel Sellami, Kaoutar Mounir, Slaheddine Khlifi, Marnik Vanclooster	Climate change induced impacts on hydrological extremes at the catchment scale: case of Wadi Siliana (North western Tunisia)
15h15-15h45		*Coffee break*
Session: Adaptation to hydromoteorological extremes in land planning (Chaired by Corinne Larrue)		
15h45-16h00	**Mohamed Taabni**	The implementation of GEMAPI in intercommuncalities in Poitou Charentes: between new areas of jurisdictions restructuring of means of internantion, new modes of action
16h00-16h15	**Mathilde Gralepois,** Sofia Guevara Viquez, Jérôme Cardinal, Marie Fournier	Procedural justice in extreme events management: what challenge for climate change adaptation strategies ?
16h15-16h30	**Le Calvez Caroline,** Oumar Marega, Bertrand Sajaloli, Aladji Madior Diop, Tarek Nasser	Climate extremes adaptation in urban wetlands in Diourbel (Senegal) and in Bourges (France)
16h30-16h45	**Saray Chavez,** Nathalie Molines, Katia Chancibault, Bernard de Gouvello	Deciphering urban planning documents to reveal the potential to accommodate climate change adaptation solutions in a territory
16h30	**Concluding remarks CCW2022 (Isabelle La Jeunesse, Chair of the conference)**	
16h40	**End of conference**	

WELCOME

Climate change is disrupting the water cycle. Impacts are observed in all environments and socio-ecosystems: forests, soils, lakes, cities, and so on. The MiDi (Environments & Diversity) network and its partners propose to focus on the different forms of impacts of climate change via its effect on water. Indeed, if the general trend of global warming is observed in all regions of the world, where are the findings and responses to climate extremes such as droughts, floods, heat waves and sudden and intense rainfall?

For this third edition of Climate Change Water, drought extreme will be highlighted. Also, as far as this crop is particularly important in the Loire-Valley, a focus on wine production is proposed. These choices do not exclude papers neither on other extremes nor on other environments.

Isabelle La Jeunesse

Chairwoman of the conference scientific committee

The MiDi (Habitats & Diversity [Milieux & Diversité]) network is a Thematic Research Network in the Centre-Val de Loire Region, covers multiple fields of BioGeoSciences and Human and Social Sciences.

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Session : Community of European Research and innovation For Security (CERIS) Side Event
Chaired by Philippe Quevauviller (European Commission DG Home, BE)

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CERIS: A Community-Building Initiative on Civil Security for Society –Highlight on H2020 research on Extreme Weather and Climate Events

Quevauviller Philippe[1], Gialampoukidis Ilias[2] & Sempere Torres Daniel[3]

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[2]*Centre for Research and Technology Hellas – Information Technologies Institute, Greece*
[3]*Universitat Politécnica de Catalunya, CRAHI, Spain*

Keywords: Disaster Risk Reduction; Resilience; Climate Adaptation policies;extreme weather conditions; safety and security

Abstract

With *Horizon Europe* - the new framework programme for research and innovation, the European Commission has re-designed its instruments to facilitate necessary exchanges in all domains of security research, further aligning research with the EU's main policies in all areasof security[1] (including Disaster Risk Reduction and Climate Adaptation policies). Throughoutthe years, a strong security research community integrated by highly committed stakeholders has been consolidated. This was greatly facilitated by the development of a "Community of Users" (CoU) which became in 2020 the Community of European Research and Innovation for Security (CERIS). This platform gathers policy-makers, scientists, practitioners, industry/SMEs, and civil society organisations at different levels (International to Regional), creating dialogues around research in various security areas and "bridges" among different sectors, including in the area of weather and climate extreme events. In this respect, in order to better forecast and manage the immediate consequences of weather- and climate-related disasters, in particular regarding emergency responses, the H2020 Secure Societies Programme has funded research to investigate the potential of current and new measures (including local measures) and technologies to enhance the response capacity to extreme weather and climate events affecting the security of people and assets.

Three key projects, namely ANYWHERE, I- REACT and beAWARE, have investigated warning and response systems facing the observed or anticipated changes in frequency and intensity of extreme climate events. In support of EU policies such as the Union Civil Protection Mechanism, the EU Climate Change Adaptation Strategy, the Flood Directive, the projects developed more effective and faster emergency responses to extreme weather and climate events, faster analysis of risks and anticipation, and publicly available online now- and fore-casting systems for disasters triggered by (extreme) weather conditions. The projects involved key actors in policy-making, science, industry as well as practitioners (civil protection units, fire brigades, emergency units), which should

guarantee an efficient uptake of research outputs turned towards enhancing shorter reaction time and higher efficiency of reactions, and thus enhancing citizen's protection and saving lives.

The session will provide a snapshot about CERIS objectives and development with some highlights about Horizon Europe research in the area of climate-related disaster risk management and will present key outcomes of research developed under the ANYWHERE andbeAWARE H2020 projects.

[1] Supporting EU policies related to Disaster Risk Management, Critical Infrastructure Protection, Fight againstCrime and Terrorism, and Border Management

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OneWater: A national research and innovation programme to acceleratetransitions, measure impacts on socio-hydrosystems

DARMENDRAIL Dominique[1], EUZEN Agathe[2], DATRY Thibault[3]

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Keywords: national programme, water resources, global change, transitions,impacts

Abstract :

With global change, natural and anthropogenic pressures on water resources are exacerbated, hereby becoming a major challenge for our societies in the 21st century: there is an urgent need for action now and at all levels. **Water is a common good** that is pivotal forlife and socio-economic development. It is a resource, a living environment, a vital element for climate regulation, for the functioning of ecosystems and human development. France has been a world pioneer for the establishment of water governance by river basin, but the underlying assumption that everything can be solved at the basin level is eroding. The global is catching up with the local and new questions are emerging. These challenges must be addressed by **more integrated, systemic, multi-stakeholder approaches to co-constructsolutions adapted to contrasting realities**.

Over a period of 10 years, OneWater aims to **shift the paradigm by placing water as a common good, a central element of socio-ecosystems prone to climatic and anthropogenicforcing**.

OneWater is organised around six major scientific and technological challenges to accompany
transitions:

- Challenge 1 - Anticipate the evolution of water resources to allow the adaptation of territories according to their singularities
- Challenge 2 - Develop a "water footprint" of environmental processes and human activities.
- Challenge 3 - Use water as a sentinel of the health of the environment and human societies along the land-sea continuum
- Challenge 4 - Propose solutions to promote the adaptability and resilience of socio- hydrosystems in the face of global changes, and promote more reasoned and integrated approaches and uses
- Cross-cutting Challenge 5 - Support the socio-ecological transition towards a new governance of resources, for a sustainable and resilient society
- Cross-cutting Challenge 6 - Share, make accessible and understandable by all the water data for knowledge and action

OneWater proposes a national strategy (Metropolitan, overseas territories) adapted to the needs of living and water users associating the water sector and local actors. Part of the French Investment Plan for the future, It makes it possible to **finance innovative and structuring research** to strengthen interdisciplinary and multi-stakeholder dialogues, thanks to different tools:

- **Calls for projects open** to the entire French scientific community, to stimulate new transdisciplinary approaches and collaborations and remove the barriers related to challenges and their interactions
- **Dedicated projects** on topics considered as priorities to structure common, practical tools and develop protocols that can be shared by as many people as possible.
- **Equipment** for 1) complete the existing and respond to the new issues raised; 2) havesufficient storage capacity for the One Water data platform while limiting its environmental footprint.
- **Education through research** actions to train and organize a generation of "OneWater" students who have acquired a strong disciplinary expertise and interdisciplinary culture
- Actions at national, European and international level associated with existing initiatives to promote the programme's approach, leverage and increase its visibility.

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Coping with extreme events in midsized cities: Enabling practitioners toassess the supportiveness of their governance context

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Keywords: Governance, Midsized cities, Climate resilience, Floods and droughts.

Abstract

With increasing awareness and impacts of climate change, many cities strive for the ability to absorb and recover from shocks and disruptions. In northwest Europe, working towards making a city climate resilient implies the design and adjustment of city-wide strategies, which often involve water-related projects and require cross-sectoral collaboration and coordination. The contribution of strategies to be better able to cope with extreme events depends on whether theycan be realized in practice.
The "governance assessment tool (GAT)" is designed to gain insight in this issue. Are the social and administrative circumstances helpful or restrictive for realizing a strategy in practice? Answering this question is not only important during implementation. When designing or adjusting a strategy, one should reckon with its feasibility in practice. The GAT has been applied in a few dozen cases in more than 20 countries, mostly in the field of water governance. However, until now it served as a "researchers' tool", which requires a good understanding of underlying theory. In the CATCH project we have developed a "practitioners" variant" that is streamlined and specified to be used without such theoretical knowledge.

CATCH (water sensitive Cities: the Answer To CHallenges of extreme weather events) is an international collaboration project that is being implemented between 2017 and 2022 within thescope of the EU Interreg North Sea Region Programme. The project focuses on the specific context and needs of midsize cities for climate change adaptation. It brings together a team of 12 partners from six countries (Belgium, Denmark, Germany, the Netherlands, Sweden, and the United Kingdom). Its overall objective is to demonstrate and accelerate the redesign of urban water management of the seven midsize cities involved to become climate resilient. The conceptual basis of the project is the water sensitive cities (WSC) framework, which addresses the multi-sectoral and multi-functional

aspects of water governance in cities. For this purpose,the project team has co-designed an online decision support tool (DST). The DST includes four components, one of which is the adapted GAT.

To develop the DST, the CATCH project team adopted a transdisciplinary research approach involving academic and non-academic participants in the knowledge co-production process. The non-academic participants from local and regional ities in the CATCH partner organizations were encouraged to question the ideas or concepts that were raised during the project and to promote their own knowledge. An iterative process was followed so that all participants could learn from each other and develop a common understanding and shared language. This paper will focus on the development of the practitioners' version and the experiences of the practitioners with the application of the GAT and the results it produced regarding the degree of supportiveness or restrictiveness for realizing their climate change adaptation strategies.

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The institutional challenges of the design and implementation of a climate change adaptation policy: the case of treated wastewater reusefor agricultural irrigation in Morocco

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Keywords: Water scarcity, Irrigation, Wastewater reuse, Institutional change, Blame avoidance

Abstract :

The Economic Social and Environmental Council (CESE) estimates that Morocco's water resources are depleted severely as they are estimated at less than 650 m^3 per person per year, compared to 2500 m^3 in 1960 and should fall below 500 m^3 by 2030. They also announced that climate change could cause the disappearance of 80% of the available water resources in Morocco within the next 25 years.[1] Faced with such extreme anticipated changes, Moroccan ities have planned and invested since 2009[2] in innovative adaptation strategies such as the use of treated wastewater as a resource for agricultural irrigation.

The communication we propose discusses the institutional and organizational challenges ofthe design and implementation of treated wastewater reuse policy through our analysis of an irrigated perimeter project in Tiznit, an arid region in the South of Morocco. Our research shows that the challenges are twofold. The first challenge is to connect institutions that were disconnected before such as urban sanitation and agricultural irrigation. We analyze the strategies deployed by stakeholders in the negotiation of their scope of intervention, the way they compete to gain new prerogatives, to keep old ones or to maintain a status quo. The second challenge is the uncertainty that such a technology holds for public ities in terms of water quality and potential sanitary risks. We will show that the tools and regulations that were put in place in a risk management rationale were in fact a result of the stakeholders' blame avoidance strategy deployed during the decision-making process.

As a consequence, on the local level, the farmers' association of the irrigated perimeter of Tiznit developed a series of actions to counteract those strategies.

On the whole, through our analysis of the public policy process of this specific project we willshow the do's and don'ts needed to build a sustainable wastewater reuse for agricultural irrigation policy.

[1] Maïne Alloui, "Le CESE alerte sur la menace de stress hydrique", *Telquel*, January 9th, 2020 <https://telquel.ma/2020/01/09/le-cese-alerte-sur-la-menace-de-stress-hydrique_1652765> ; The Economic, Social and Environmental Council : "Le droit à l'eau et la sécurité hydrique, gravement menacés par un usage intensif : Le CESE tire la sonnette d'alarme et appelle à entreprendre des mesures urgentes » (Translation : « The right to water and water security under serious threat from intensive use: The EESC sounds the alarm and calls for urgent measures to be taken ») ;
« Document/ Sécurité hydrique: Le CESE tire encore la sonnette d'alarme », *L'Economiste*, September 26th, 2019

[2] « Stratégie nationale de l'eau », Water Department, Morocco, 2009

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What collective strategies for adaptation to climate change? The role ofirrigation associations in water resource management, a case study in Roussillon.

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Keywords: vulnerability, agriculture, climate change, water governance

Abstract :

The Têt River watershed is a hydro-agricultural territory composed of a dense networkof canals managed by ized Syndical Associations (ASA). These have been existing for 1000 years and are participating in the distinctive managing of the water resource in this territory. More than a hundred ASA manage the water resource sharing on watering perimeters through irrigation canals. These associations are leading actors in the management of water resources.

However, climate change, irrigation system modernization, diversification of water uses, and the evolution of societal and ecosystem relationships require reconsidering the managing of water resources. Located in one of the most vulnerable regions to climate change(Giorgi, 2006; Giorgi et Lionelo, 2008), Têt's watershed is exposed to the reduction of water flow. The mean flow has decreased by 30 to 45% in the last 30 years and hydrological modelsare identifying the meteorological variables to be responsible for 80% responsible for this decrease (Labrousse et al, 2020; Labrousse, 2021). This puts under pressure the societies and territories that have developed by using the river flow.

This situation is constraining the political actors to think about new water management. Those decisions are under the influence of international and national orientations. Koronivia Joint Work Action (KJWA, 2017)[1], Water Framework Directive (WFD, 2006) or the National Climate Change Adaptation Plan (PNACC, 2018) and theirlocal applications (SAGE, PGRE) are expressing political objectives tending toward the agricultural model transition and the decrease of water withdrawals.

This normative framework influences the functioning of collective structures of water management like ASA. At the local scale, the ASA, as public institutions, aim to provide water access to their members.

Therefore they participate in the configuration of hydro-social territories. Depending on the watering perimeters they are managing, the ASA uses different levers tomaintain this access, decreasing farmers' vulnerability to the hydrological deficit. Partially, these

levers are technical and act on withdrawals volume. For another, they are social and refer to cooperation between local actors, more or less organized into networks, establishing new forms of water governance. These adaptation strategies reveal original and differentiated relationships depending on the location, between techniques, users, and resources, which shape hydro-social territories.

This communication focuses on collective strategies which aim the reduction of agricultural societies and territories' vulnerability to climate change and water resource decrease (Ostom, 1990; Adger, 2009; Duez, 2011). For this, the analysis presents the results of an empirical survey carried out among the ASA's presidents in the Têt watershed. The semi-structured interviews were processed using a textual analysis tool to identify and characterize the strategic construction mechanisms aimed at adapting irrigation water management to the consequences of climate change.

[1] Within the framework of the Koronivia agreements signed at COP 23 (2017), States and international institutions are collaborating with the aim of supporting the adaptation of agriculture to climate change.

Session : How governance and policy cope with extremes
Chaired by Isabelle La jeunesse

Suzanne CATTEAU
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Tuesday 31th

Integrating scales and knowledge of local stakeholders with Geographic Information Systems to develop adaptation strategies based on wetlandsfunctioning

Catteau Suzanne[1] & Couderchet Laurent [2]

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Keywords: GIS, strategy, knowledge sharing, spatial scales

Abstract :

In the face of climate extremes, wetlands are considered as key ecosystems. Several mapping tools are produced to help water managers. Their development, often by centralised instances, such as water agency, questions the capacity of models to bridge the gap between management scales, the ability of local partners to appropriate this kind of tool and the integration of local knowledge. Using a diversity of parameters is often perceived as a way to improve the representation of interactions between water, climate change, and land cover change. Nevertheless, how to distinguish what is determinant to define strategies ?

Through a succession of workshops, we propose a reflection on wetlands functioning with local stakeholders, from urban planning and water management, near the Saint-Point Lake in France (25). The objective is to identify the convergence of interests and investigate which spatial data are essential to develop local strategies for wetlands. Between each workshops, we propose a GIS translation of their discourses. This method gives us elements on the state of knowledge of participants. Water issues are understand differently depending on levels and roles of stakeholders. Workshops are an opportunity to share knowledge on spatial data, wetlands needs, territorial stakes, as well as power and skills of different actors. Discussions enhance the comprehension of transversal dimension of water and climate change in their territory.

The diversity of actors involved (river basin agency, local waters managers, local decision-makers, departmental urban planning advisor) lead to connect the reflection on wetlands to economic development, agriculture and urban growth. Extreme draught events in the region in recent years may explain the engagement of local decision makers to better understand wetlands functioning to develop adaptation strategies at the local level.

Furthermore, this method highlights how mapping can have repercussions on administrative zonings and management. Hydrological modelling participates to wetlands delineation but could it participate also to underline its connections with surroundings ? Through discussions, technical choices have been specified, such as data formats (vector/raster), resolution or thresholds. Unexpectedly, rasters of flow accumulation appear determinant to enhance functional connections between wetlands site and water supply. Results were presented at different spatial resolutions to investigate the spatial scales of decision making. Despite the assumption that higher resolutions guarantee a better efficiency in decision making, our results show that the relation between data scales and decision- making is non-linear : for some use, lower resolutions can be more relevant.

This experiment discusses the systematic approaches proposed by GIS for ecosystem management. Discussions of technical settings appear essential to develop an appropriate mapping tool used by several actors.

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Water availability during present and future heat-drought compoundevents in Europe

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Keywords: heat-drought compounds, water availability, attribution, large ensemble

Abstract :

Current research finds strong evidence that climate change will increase the frequency, extent, duration, and intensity of hot and dry extremes in Europe. Recent events, both heat waves and droughts, significantly impact a wide range of sectors like health, transport, energy production, ecology, agriculture, and forestry or water management. Among these, water supply is particularly crucial since it affects human society as well as natural ecosystems. Especially the joint occurrence of heat and dry extremes, i.e., heat-drought compounds, pose a risk on water availability in that heat aggravates the lack of moisture during dry periods by enhanced evapotranspiration, while the water demand simultaneously increases during heat extremes (e.g., drinking water, cooling, irrigation). Therefore, novel scientific findings are required to trigger innovation and support decision-making for an adapted water resources management that responds to changes in water availability under such extreme conditions.

This study provides new insights into the risks heat-drought compound events impose on water availability (considering evapotranspiration as well as precipitation) in Europe. It is driven by two guiding research questions as it a) addresses the estimation of the current and future frequency of these compound events under climate change conditions and b) analyzes water availability for various land use classes within the spatial extent of the events.

Compound heat-drought events are defined as contemporaneous occurrences of positive heat and negative precipitation anomalies in a given region. We analyze the spatiotemporal dynamics of heat and drought events, especially their evolving co-occurrences in a pre- industrial, present-day, and climate change world. Using the spatially distributed fraction of attributable risk allows identifying regions in the present-day climate that already experience climate change impacts on heat-drought occurrence.

Thereby, we can investigate and eventually attribute compound events and their individual components to climate change. Since extreme compound events are rare by definition, we exploit a 50-member single-model initial condition large ensemble (SMILE) of the Canadian Regional Climate Model, version 5 (CRCM5-LE; pre-1850 conditions (700 model years representing a counterfactual world), 1950-2099 (7.500 model years), RCP8.5 from 2006 onwards) to obtain an extensive database of events and, subsequently, robust estimations of the risk of occurrence across Europe, from pre-industrial to future states.

This allows contrasting three typical meteorological water availability scenarios: no climate change, present-day, and climate change conditions.

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Tuesday 31th

Hydrosec : un outil de monitoring des bassins versants en situation de sécheresse pour les gestionnaires de bassin dans le sud-est de la France

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Keywords : *Hydrology —Gardon watershed—water resource — DSS — Probabilistic approach*

Abstract :

Drought is a recurrent phenomenon, particularly in the Mediterranean environment. Many studies have shown a recent decrease in precipitation and an increase in temperature in the Mediterranean climate. A accentuating of these trends by the end of the 21st century is also probable. These changes seem to lead to a reduction in water resources, which will have to be managed as closely as possible. In this context of climate change and increase of the anthropic pressure in each basin (increase of the population and water consumption per capita), it is now necessary to set up new operational and local means of monitoring for basin managers.

Depending on the discipline, drought is understood in different ways. Classically, four main types are distinguished: atmospheric, edaphic, hydrological and societal. But this state of lack must always be defined according to social needs, in a given place and time. It is therefore necessary to distinguish between what is related to the hydro system, i.e. the natural component (water deficit), and what is related to the socio-system (water supply, agricultural water...). In this work, we will consider drought as a state of tension between the natural supply and the anthropic needs in water, in a given place at a given time, a level of tensionthat must be evaluated. The question is how?

Many studies have highlighted the limitations of quantifying water deficit by mass balances. They are generally ineffective at scales (spatial and temporal) considered operational for basinmanagers. We propose a new methodological approach to report the water stress. This will be based on probability distributions (PD) of water stress indicators and conditional probabilities. Practically and theoretically, it requires developing a causality network, i.e. a Bayesian network. This one is based on Bayes's theorem and comes from Pearl's work (2008), for the most technical questions. This leads us to define

a causality graph allowing us to infer, in theory, the share of each PD in the formation of the PD from natural supply, on the one hand, and from anthropogenic demand on the other.

This approach can be used to better characterize, locally, the alert levels and verify if the estimated water stress level probabilities are in accordance, or not, with the prefectural orders.

Bayesian networks are not widely used for the study of natural hazards and even less for the study of drought. This presentation proposes a first conceptual formalization of a Bayesian network allowing the monitoring, on a large geographical scale (small watershed) and over short periods of time (week, month), of the level of drought in a Mediterranean context. This new methodological approach should allow the realization of territorial diagnoses in order to better guide the basin managers in their watercourse management policy.

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The Readiness Index for Climate Change Adaptation in Africa: The Role of Climate and Adaptive Capacity Proxies

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Keywords : Readiness index, climate change adaptation, adaptive capacity, climadaptcap index, Africa.

Abstract :

As global changes continue, the repercussions in Africa remain profound. This is reflected notably in food and water crises across Africa. This work examines the readiness of Africa to climate change adaptation through a newly developed readiness index (ClimAdaptCap In- dex). In fact, this work shifts the readiness debate from emotional descriptions that currently flood academic scholarship to a more pragmatic evidence-based approach in assessing readi- ness.

Readiness for climate change adaptation is driven by the intensity of climate forcing and adaptive capacity. The historical climate score data or precipitation and temperature for the period 1991–2016 were culled from the World Bank Climate Portal. The historical adaptive capacity score data included proxies such as poverty and literacy rates from 1991 to 2016 were collected from the World Bank and Macrotrends. The climate data were nor- malized using the normalization function to enhance interpretation, comparison, and fusion into the index. Missing poverty and literacy rate data were estimated by linear interpolation of the poverty and literacy rate data. The ClimAdaptCap Index was developed to compute readiness. This index is the first of its kind and will serve as a flagship for assessing readiness for climate change adaptation as it is highly adaptable to different contexts.

This work's first-ever maps of readiness show that North and Southern Africa are the readiest for climate change adaptation under historical climate and literacy and poverty conditions. West Africa is the least ready while Middle and East Africa are in the middle. Consistent is that readi- ness has a positive correlation with literacy rates and an inverse one with poverty rates. In addition, with readiness scores of between 0.35 and 0.39 for all the regions with a maximum potential score of 1, this work has shown that the level of readiness in Africa is generallylow, and there is a very small variation between the different regions. In addition, climate change adaptation will highly be influenced by both climatic and non-climatic indicators. The developed readiness index adequately simulates readiness to climate change adaptation in Africa and complements previous frameworks of adaptation preparedness.

Nathalie Ollat

Wine and water: a systemic approach of this central issue

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Abstract :

The cultivated grapevine *Vitis vinifera* originates from the Mediterranean area and is considered to be well adapted to semi-arid conditions. In such traditional regions, it has been grown rain-fed for centuries, while irrigation is a recent practice systematically used in the New World and quickly developing in the south of Europe. Over the last decades, annual rainfall in France does not show any significant evolution, while evapotranspiration has increased in some regions and the number of years with sufficient winter rainfalls has decreased in others. Climatic predictions for rainfalls are characterized by large uncertainties with few evolutions for annual amounts, slight increases during winter and slight decreases during winter following a north/south gradient. The probability of extreme rainfall events could also increase. Altogether this may increase the frequency of drought events, but also the risk of heavy floods. Socio economic consequences of these climate changes on the wine industry are complex. Impacts need to be assessed at various levels of the system, including the soil component, environmental issues and the effects on vine longevity, yield, and fruit composition with respect to consumer expectations and the potential for oenological correction. The accumulation of "qualitative compounds" into the berries is largely controlled by plant water status with some potential negative and positive effects of water deficits. Multiyear climate effects should also be considered for this perennial where yield components elaborate over two growing seasons. Overall, the sensitivity to water deficit will highly depend on the type of wine produced with various economic consequences.

Coping with water scarcity in the vineyards now and in the future has to rely on a systemic approach. In the short term, technical levers, such as soil management practices and irrigation, can be considered, while at long term, more radical changes in training systems, varieties and rootstocks are major sustainable and environmental friendly ways to adapt viticulture to increasing drought. The selection of soils with a large water holding capacity is a major point to consider. When necessary, irrigation strategies require a strict monitoring to take into account the availability of the resource in the long term and shared strategies with other uses. Alternative sources of water need also to be evaluated. However, the environmental negative impacts of irrigation and the global cost of withdrawing and delivering water are key parts of the equation to evaluate the sustainability of this practice. Choices will highly depend on socio-economic parameters, including consumer perception and the balance between general and professional sector interests. Therefore participative approaches involving all stakeholders should be promoted to address this major challenge.

Hervé Le Treut, Invited speakers

Hervé Le Treut, Climatologist, Professor at Sorbonne University and Ecole Polytechnique, member of the scientific committee of Le climat en questions website, is a Professor at the Pierre and Marie Curie University, former director of the Pierre-Simon Laplace Institute (IPSL) and member of the French Academy of Sciences. His work focuses on the numerical modelling of the climate system and the understanding of the radiative perturbations of the climate, in particular the role of the additional greenhouse effect linked to human activities.

He is also interested in the impacts of climate change and the analysis of associated environmental risks.

He is editor of Chapter 1 of Volume 2 of the IPCC 5th Report. He is the author or co-author of several books for the general public, the latest of which deals with adaptation to climate change in New Aquitaine.

In is keynote, Hervé Le Treut will provide a state of knowledge of Earth climate changes.

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Vulnerability of wheat, barley, and maize yields to growing season precipitation in Morocco

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Keywords: Vulnerability, Exposure, Sensitivity, Adaptive capacity, Precipitation

Abstract :

Climate change continues to have adverse effects on crop yield around the world. The repercussions of climate change on crop yield are even more daunting in Africa. In Morocco, rising temperatures and declining precipitation are having daunting effects on the vulnerability of crops. This study therefore examines the vulnerability of barley, maize, and wheat to variations in growing season precipitation and socio-economic proxies of adaptive capacity such as literacy and poverty rates at both the national scale and sub-nationally in Morocco. The methodology employs the use of a vulnerability index which holds that the vulnerability is a function of exposure plus sensitivity minus adaptive capacity. National and sub-national crop yield data used to compute sensitivity were downloaded from FAOSTAT and the global crop yield gaps Atlas. The mean annual and growing season precipitation data at both the national and sub-national scales used to compute exposure were downloaded from the world bank climate portal. Proxy data for adaptive capacity in the form of literacy and poverty rates data were downloaded from the world bank, figshare and MPR archives.

The results shows that wheat record the lowest vulnerability and the highest adaptive capacity while maize has the highest vulnerability and lowest adaptive capacity. Sub-nationally, vulnerability reduces northwards while adaptive capacity and normalized growing season precipitation increases northwards. Wheat also records the lowest vulnerability and highest adaptive capacity and normalized growing season precipitation at each latitude northward.

These findings have implications for climate change adaptation and climate policy in Morocco as it becomes evident which among these most cultivated crops is more vulnerable nationally and spatially. It also has implications for future research as it might be important to understand how other crops perform and what future projections and yield gaps operate in these crops.

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How abrupt change in surface temperature impact water balance overFrance? A case-study of bread wheat cultivated areas.

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Keywords: climate, hazard, water balance, shift,warming

Abstract :

Agricultural risk management is a major challenge for decision makers, public ities andagricultural insurance companies, as crop losses linked to climate hazard are expected to increase in the context of climate change (Boucher et al., 2019). The present work is part of a PhD in partnership between Groupama insurance company (Domaine Assurance Récolte) and Biogeosciences laboratory (University of Burgundy). This collaborative research aims at depicting how, with the abrupt surface temperature warming, climate hazard evolution has affected water balance over France, and related agro-climatic risks.

Since 1980s over western Europe, the warming trend intensifies strongly, consistent with climate simulations including anthropogenic forcing (Terray & Boé, 2013). As a result of this warming tendency, a shift is detected in maximum and minimum air temperature, delimiting two main climate periods: 1959-1987 and 1988-2009 (Brulebois et al., 2015). Along with this abrupt warming, a trend towards stagnation of crop yields is observed since the 1990s. Bread wheat yields are particularly affected. Yet this crop represents an important part of insured
areas. In addition to maize and grapevine, the impact of climate hazard and agro-climatic risk on the evolution of bread wheat yields is a major issue for agricultural insurance companies. What are the patterns of water cycle responses to abrupt changes in temperature? Beyond that, how did surface warming shift impact water balance over main french bread wheat productionbasins?

Clearly, quality and reliability of surface climate data sets remain an issue for the assessment of water cycle component changes. The SIM (Safran-Isba-Modcou) dataset of reanalysed surface meteorological observations offers the opportunity to address the complexity of processes leading to changes in local water cycle (Soubeyroux et al., 2018).

With an 8km spatial resolution at daily time step, SIM interpolated precipitation and

computed PET (Potential EvapoTranspiration) and AET (Actual EvapoTranspiration) from 1959 to 2019 data are relevant to this aim. Water balance is computed using a two-reservoirs model (Jacquart & Choisnel, 1995), and SIM climate data and bread wheat agronomic parameters as inputs. To focus on bread wheat production basins, only SIM grid point containing at least 10% of surface covered with bread wheat fields are retained. Regions of interest are selected and characterized through a teamwork with the insurance company collaborators.

Our results suggest that the abrupt shift in air temperature in 1987/88 had a strong influence on the water cycle variables evolution. Water balance decreased on the post-shift period,along with the increase of water demand and soil drying. Consequently, water constraints increased fastly at the end of the 1980s, both annual and seasonal scale. Along with various seasonal evolution, changes in the hydrological cycle hide geographical disparities over France.

Evolving climate hazard linked to water balance impacts agro-climatic risk, identified as one of the main factor affecting the evolution of bread wheat yields. Such conclusions suggest that, with both mean and variability changes in water balance state, probability to overcome risk threshold changes. This is of major concern for our partners, and may lead to adaptation process from managers.

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Early larval stages weakly respond to thermal variance and heat waveevent in a dragonfly

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Keywords: Climate change, Odonata, daily thermal variance, heat wave,acclimation

Abstract :

The aquatic world suffers the full brunt of climate change. Disturbances in the water cycle (e.g., drought and floods) affect aquatic organisms. Beyond these major disturbances, climate change is also accompanied by modifications in the water temperature. The aquatic environment partially buffers variations on a short time scale such that thermal fluctuations in the water are lower, but still real, than in the atmosphere. In effect, climate change leads to an increase in the daily thermal variance (DTR) and in the frequency and intensity of heat waves. These increases of DTR and heat wave properties are subjecting aquatic organisms to stresses that are still underestimated. This lack of knowledge is even more pronounced in aquatic ectotherms at their early developmental stages such as, for example, the early larval stages of dragonflies. Therefore, we determined if the interaction between the DTR and occurrence of heat wave modified the larval development of the dragonfly Sympetrum meridionale. We measured the growth and metabolic rates of larvae in three treatments (18°C; 18+2°C; 18+5°C), factored with the exposure to a heat wave (21°C-28°C; duration: 3 days). We showed that there is not interactive effect between the DTR and a heat wave for the measured traits. However, the increase in the DTR enhanced the metabolic rate of larvae without influencing their growth rate while the exposure to a heat wave decreased the metabolic rate and tended to increase the growth rate. These results show that the growth and physiology of young dragonfly larvae are influenced by both heat waves and DTRs separately. Studies on the impact of interaction between the DTR and the occurrence of heat waves must be made on different organisms and particularly on the young aquatic ectotherms to further allow for comparative analyses.

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Effect of clear-cuts on the quality of surface water in the VosgesMountains

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Keywords: clear-cut; water quality; nitrates; rainfall

Abstract :

If the Vosges Mountains (North East of France) have often been compared to a water tower, the situation has deteriorated in recent years due to climate change. Decreasing precipitation and increasing heat waves, especially in 2019 and 2020, have severely affected water resources, which has created direct tensions on the supply of drinking water and livestock watering as well as on the reserves for the production of snow in winter. Trees are also weakened by water stress. An indirect effect is the decline of the forest, especially the softwood plantations (spruce, fir) attacked by bark beetles whose reproduction is favored by the high temperatures. To limit the spread of the insects and save as much wood as possible, clear-cutting is carried out. Exposing the soil disrupts the overall forest ecosystem.

Some of the Vosges watersheds that have been monitored since the beginning of the century within the framework of the Vosges Acidification Observatory (https://deims.org/22915474- 7c50-47c1-8239-6c59fa924a1b) are affected, to a greater or lesser extent, by this phenomenon. Increased erosion on steep slopes, exposure of soils to more intense sunlight and higher temperatures are causing fears of effects on the water quality of the streams concerned.

The Pleinot watershed, in the municipality of Val d'Ajol, is particularly concerned by these clear-cuts, the first of which were carried out in the spring of 2020. An analysis of the evolution of the water quality (minerals, pH, conductivity, dissolved organic matter from monthly samples) is carried out according to the state of the soil occupation and the ground cover, monitored by satellite imagery (ESA Sentinel-2 satellites). Lowland vegetation has started to appear (brambles, brooms, heathers, etc.). In some stands, natural regeneration is taking place. But future reforestation risks disturbing the soil and water of this watershed again. This water chemistry evolution of the Pleinot stream is compared to that of the Hutte stream (commune of Bussang), which watershed located on the same type of rock, was no affected by clear-cutting. This comparison will allow to better follow the situation of the catchment areas for which clear-cutting is starting to be carried out.

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Systemic Resilience Analysis through a Water-Energy-Food-Climate NexusApproach

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Keywords: climate change, resilience, Water-Energy-Food-Climate nexus, SystemDynamics Model, Causal Loop and Stock-and-Flow Diagrams

Abstract :

Water, energy, and food (WEF) are vital resources for human wellbeing, poverty reduction, and sustainable development. Climate change effects are proved to threaten the WEF security and vice versa. Considering these threats as disturbances to a system, resilience is understood as the system's adaptive ability of maintaining its functionality even when the system is beingaffected by a disturbance. Resilience helps researchers and policymakers to comprehend how complex systems adapt and transform to withstand changes in the environment and measure a WEF system's capability to either adapt or collapse due to climate change conditions. Water- Energy-Food-Climate (WEFC) Nexus approach in combination with system's resilience measurement is the key solution to enhance environmental security. This research focuses on exploring the resilience of a WEFC system at national level. The case study is based on the structure of a System Dynamics Model (SDM), that maps sector-specific data from major databases for the national case study of Greece. Using the SDM we developed the Causal Loop Diagram (CLD) and then the Stock-and-Flow Diagram (SFD). CLD helped in the conceptualisation of the WEFC system, identifying the key variables in the system and indicating the causal relationship between them using links and SFD implemented the simulation analysis using stocks, flows and convertors. The system has 4 reinforcing and two balancing loops. In terms of enhancing environmental security, we measured systemic resilience as a next step to CLDs creation, using different metrics, in different cases of disturbances and ultimately indicate the most efficient policies to increase system's elasticity. Since future global challenges will severely affect all vital resources and threaten environmental security, it is urgent to identify how WEFC systems can be more resilient and to formulate policies that help stakeholders and policymakers to adapt to the challenging conditions. This research aims to fulfilling this gap, offering a comprehensive methodology for a combined Resilience-Nexus approach.

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Wednesday, 1st

A resilient knowledge boosters for elaborating adaptation and mitigationmeasures to minimize the effects of climate change

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Keywords: Climate Change Adaptation, Risk and Vulnerability Assessment,Earth Observation, Digital Twin, Semantic Interoperability

Abstract :

Enhanced adaptation and resilience to climate change impacts is a key priority of the "EU Adaptation Strategy". Climate change effects are already evident around the globe and are causing negative economic, social and environmental effects, severely hampering citizens' wellbeing and impacting the natural and built environment. The EU Green Deal set as goal achieving climate neutrality by 2050. Meanwhile, it calls for urgent measures for adapting to the current and expected changes of climate. Importantly, changes are needed in key processes, practices, and structures to prevent risks and moderate potential damages that will occur along the shift towards a sustainable and environmentally-friendly economy. To facilitate such transition, the EC has created a roadmap that includes the development of national adaptation strategies, the mobilisation of regions towards the identification of adaptation measures and their deployment, and the identification of financing and economic models to enlarge the potential solutions. There is a challenge to reduce the gap between what can be achieved using proven adaptation solutions, and what is needed to achieve a rapid and far- reaching change. Raising awareness towards damages and climate change impacts is not sufficient any longer. As the COVID-19 crisis has shown, fair societal consensus is needed to make sure that climate adaptation measures and economic recovery do not antagonize. This is by itself a transformative process requiring, not only innovative physical solutions, but a deep societal change that can only be attained by increasing social participation in decisions related to climate adaptation and the creation of innovative region-specific regulatory, governance and bio-physical strategies.

We envision to develop and validate a coherent multi-scale, multi-level, cross-sectoral climate change adaptation framework to accelerate the transition towards a climate-neutral and sustainable economy. For that, we will deploy the Resilience Knowledge Boosters (RKBs). The RKBs are open knowledge spaces located in each region to design, monitor and evaluate climate adaptation measures using available data about climate change impacts on the environment, society (including traditions and cultural values), economy and infrastructure. These open spaces can exist at different governance levels (local-local, region-region) or be multi-level (local-regional-international). The RKBs are composed by a robust Quintuple Helix stakeholders community (human dimension) complemented with reliable data and assessment methods to support decision and policy making (digital dimension). This will result in a community empowerment to co- design, assess, deploy, and monitor climate adaptation Innovation Packages, including R&I methodological, technological, governance, awareness, behavioural, economic, financial and pathway components. Supporting decision and policy making, the RKBs provides a virtual and federated space to share data, knowledge and experiences to help fuel ideas, sharing research experiences and promoting data/knowledge exchange between stakeholders and regions. Moreover, the RKBs will include advanced assessment methodologies and tools to plan the elaboration of regional Adaptation Pathways. The RKBs will be developed under the granted H2020 Green Deal project named IMPETUS. The RKB solution will be deployed and validated in all 7 EU biogeographical regions (Continental, Coastal, Mediterranean, Atlantic, Arctic, Boreal, Mountainous) covering all Key Community Systems, climate threats, and multi-level governance.

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An example of the climate-water-energy nexus in 2050 for France

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Keywords: river flow, energy production, water sharing, climate change

Abstract :

Conventional and nuclear power plants use river or sea water for cooling and had been designed according to extreme water quantity and quality levels estimated in the historical climate context of their conception. For the nuclear power plants, these estimations are regularly updated to take climate evolution into account, and prospective studies necessitate projections at a later time horizon. This presentation aims at describing such a prospective study devoted to the nuclear power plant located in Chooz, in France. A special issue linked to this power plant is a regulatory constraint due to an international agreement with Belgium, which demands a shutdown of the plant when the river flow goes under defined levels. The possible evolution of the extreme low flows at this location in the future is thus of special interest and has been studied using a combination of climate projections and stochastic modelling at the 2050-time horizon. After having selected a set of scenarios for the future in the CMIP5 (Coupled Model Intercomparison Project phase 5) climate projections ensemble, a large number of precipitation and temperature time series covering the period 2036-2065 have been produced with a bivariate stochastic model in order to further enlarge the sample of possible evolutions and reach the most severe conditions. These time series are then used as inputs by a hydrological model which in turn produces the same large number of possible evolutions of the river flow. The developed methodology will first be explained, and the results concerning the expected evolutions of the constraint will be detailed before concluding with the possible adaptation solutions. This constitutes a concrete and local example of the well-known climate-water-energy nexus.

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Trends in rainfall and soil water availability with climate change: Whatare the temporal and spatial issues for viticulture in France?

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Keywords: Climate change, water availability, local adaptation, viticulture

Abstract :

In most French wine regions, the vineyards are not irrigated. As a result, the frequency and seasonal intensity of rainfall have a decisive role on the level of water supply, a key factor of grapevine behavior and performance. In the context of climate change, rainfall and therefore water availability is evolving strongly temporally and spatially, and the winegrower needs reliable information on the water conditions of his vineyard. This study aims to assess the recentevolution of the climate, in particular rainfall, and the impact on vine water availability, based on two very contrasting examples in France, namely Champagne under an oceanic climate and the southern Rhône valley, located in a Mediterranean climate. Between 1971-2000 and 1991- 2020, study results highlight a general increase in temperature and a relative stability of rainfall,with however, a greater seasonal variability in the Mediterranean environment. The constant increase in temperature inevitably has an impact on drought, causing increasing problems with vine water availability. Future climate projections predict a sharp increase in summer temperatures and droughts, suggesting even more restrictive water conditions. From here, knowing that the availability of vine water varies also spatially over short distances, this studyalso had the goal to present a tool, made available to professionals in the Loire Valley wine region, allowing them to understand the dynamics of vine water availability at field level. In the context of climate change, this approach combining the spatial and temporal trends in vine water can allow winegrowers a better strategic adaptation to climate change, while also addressing important socio-economic issues.

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Impacts of Climate Change induced drought and adaptation strategies in winegrowing in the Rhine Valley (France, Germany, Switzerland)

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Keywords: Climate Change; drought; adaptation; winegrowing; Rhine Valley

Abstract :

The impacts of Climate Change could be very pronounced in the Rhine Valley, notably because of prolonged and more intense drought periods (Riach et al. 2019). In this geomorphologically homogeneous space shared between France, Germany and Switzerland, topography, climate and soils are very similar. Although German wines remain unknown in Alsace and vice versa[1], the same types of wines are also produced, with emblematic grape varieties like Riesling and Pinots[2]. Some of the typical grape varieties and wines are moreover very sensitive to drought stress, which means they could disappear in the future, or, at least, lose the characteristics for which their quality and singularity is recognized. Considering this, the challenges caused by Climate Change and the adaptation strategies should be very similar. But we must also consider that the obstacles and drivers might differ, due to different cultural and geolegal contexts. For example, the rules on irrigation or on grape varieties are much more restrictive on the French side, and German consumers and producers give less importance to the Protected Designations of Origin than the French ones. Some adaptation measures could thus be easier to implement in Germany and Switzerland than in France, implying that the vulnerability of the wine sector is not the same in each country. This communication will test this hypothesis and, to do so, compare the Climate Change induced risks of drought perceived by the French and German winegrowers and their adaptation strategies, based on around 30 semi-directive interviews conducted with wine growing actors in Alsace, Germany and Switzerland. Studying the obstacles and drivers of these measures, it will try to explain why they diverge or converge, and show what factors have the most impact on the adaptation trajectories. Finally, it will propose to think about the potential benefits of a cross-border work on adaptation to Climate Change and about the reasons why the attempts to initiate it are not more successful.

[1] It is striking that wines from Alsace are most often absent from German catalogs.
See for example:
https://www.ebrosia.de/wein/?p=1&o=2&n=12&f=38; https://www.pinard-de-picard.de/katalog/wein/liste/l-Frankreich.html;
https://hfs-getraenke.de/app/uploads/2019/06/2021-05-13-Wein-Katalog_oP.pdf

[2] Although some common German varieties such as Müller-Thurgau and Dornfelder are not found in Alsace

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A "Vinescape Plan" to design the resilience of a World Heritage vineyard :proposal based on case studies on Unesco site of Val de Loire.

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Keywords : public policy, common good, cultural landscape, sustainability of production ,wine reputation.

Abstract :

Vitis vinifera (var. sativa), "the vine that bears the fruit of wine", has been at the origin of singular cultural landscapes and a marker of territorial identity since Antiquity. Fourteen of these landscapes, all European vineyards, have been recognized by UNESCO between 1997 and 2015 for their Outstanding Universal Value. All of them are situated close to a river, a lake or a sea. In Val de Loire, the vine is considered as one of the components of the cultural landscape listed as a World Heritage. Its heritage landscape value is to be deepened in its relationship to the river, the limestone troglodyte hillside, the garden and the landscape park, one of the patterns of which is the vine.

Works have been carried out on the "wine regions" characterization of the Val de Loire: their geomorphological, pedological and climatic specificities, their cultivation, ampelographic and oenological practices, their built heritage, their traditions, stories and inherited uses for which the proximity of the Loire plays an essential role.

For the past five years, some appellations have been seeking out the specific heritage and landscape features of the "place" to establish origin and typicality of the wine. The cultural landscape is selected as one of the keys to knowledge, appropriation and recognition. Is it a key for its resilience to face climate changes?

The Loire Valley is experiencing a sharp increase in the number of Organic Agriculture and Biodynamic Agriculture labels based on listening to nature. University research laboratory of the Angers School of Agriculture, the regional agricultural chambers and regional offices of the Institute of Vine and Wine are actively supporting professionals in terms of landscape management and agro-ecology, leading to a reconfiguration of the landscape of the vine and its environment.

The climate changes and the ecological transition are disrupting cultivation practices and broadening the framework of intervention, from the vineyard to the territorial space and its

landscape design. Could this evolution not contribute to the emergence, in the long term, of "landscape wines"?

The purpose of this paper is to show, through case studies at Val de Loire, how the cultural characterization of a vineyard landscape allows to approach differently the sustainability of production. The aim is to explore the idea of a “Vinescape Plan” (based on the methodology of a public policy tool, the "Landscape Plan") for the knowledge, protection and enhancement of a territorial identity shared by wine professionals, inhabitants and visitors, a useful tool for strengthening the resilience of the vineyard to face the ongoing climatic and societal changes.

This proposal of communication is elaborated in the framework of a PhD research that I am developing in partnership with the CNRS Research laboratory in Landscape Project (LAREP) of the National School of Landscape Architecture of Versailles and the CNRS Research laboratories of University of François Rabelais of Tours (CITERES) and of University of Burgundy (ArTeHiS).

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Managing water resources under new climatic extremes in the Main river basin, Germany

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Keywords: extreme events, climate resilience, co-designed innovation, Mainriver basin

Abstract :

The 6th Assessment Report of the IPCC (2021) emphasizes that human-induced climate change is already affecting many weather and climate extremes in every region across the globe. It is projected that many changes in the climate system become larger with increasing global warming, including e.g. regional increases in the frequency and intensity of hot extremes, heavy precipitation, agricultural and ecological droughts. Recent observations of high-impact extreme events indicate that this problematic development seems to be particularly relevant also in Central Europe, a region usually perceived as an area of comparatively low vulnerability to climate change due to its high adaptive capacity. However, latest research findings indicate that this conviction is to be more and more questioned.

The presented study focuses on the Main river basin, a tributary to the Rhine river in Germany: the watershed, covering an area of 21.519 km² (at gauge Kleinheubach), is home to over four million inhabitants, several supraregional urban centers (e.g. Nuremberg, Wuerzburg) and characterized by intense gradients of topography and climate and a diversified land use, including highly specialized (irrigation) agriculture. In terms of water resources, the region already suffers from water scarcity, especially during summer months, which is partly compensated with the Danube-Main water transfer system, augmenting water
shortages in river runoff to support regionally important economic sectors, such as navigation or hydropower generation.

The study is presented in two parts: first, results from a single hydrological model initial condition large ensemble (i.e. the spatially explicit process-based hydrological model WaSiM (Willkofer et al., 2020) being driven by 50 members of the Canadian Regional Climate ModelVers.5 (CRCM5) over Europe (Leduc et al., 2019) for the time interval 1950-

2099, project a remarkable decline of mean annual runoff for all 23 gauges analyzed in the Main river basin, largely due to increased evapotranspiration in a rapidly warming climate. At the same time, it is shown that both frequency and intensity of extreme floods (floods with return period over >= 50 years) show strong increasing trends. These apparently contradicting hydrological development pathways challenge the present approaches to an efficient water resources management, as they strongly amplify the already disadvantageous seasonal course of water availability.

Accordingly, the second part of the study presents a concept of co-designing systemic solutions and science-driven technical and cross-sectoral innovations to build new climate- resilient development pathways for water resources management, here represented by an alliance of climate and water scientists with a wide network of municipality utilities and enterprises. It builds on the conviction that the region is at risk for being pushed beyond its resilience threshold and needs a new level of responsiveness to cope with new challenges. There is still a limited awareness among policy makers and resource managers on the severity of (even unavoidable) climate change impacts. Thus, the science-society-policy interface currently operates below capacity and climate change related innovations and methodologies propagate too slow into practice. A new multi-sectoral dialogue is needed to sharpen the responsibilities and develop harmonized structures between private and public bodies to build an advanced adaptive capacity to climate change, particularly by developing innovative tools to serve improved river basin management (plans), which can serve as role model for other river basins across Europe.

The presented study is supported by results from the project ClimEx (www.climex-project.org), funded by the Bavarian State Ministry for the Environment and Consumer Protection, and the project ARSINOE (GA: 101037424), funded under EU's Horizon 2020 research and innovation programme.

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Session: Management of hydrosystems under hydrometeorological extremes
Chaired by Stéphane Rodrigues

Thursday, 2nd

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Sensitivity of a large hydrosystem to changes in climate variability: application to the high and low groundwater level response of the SeineBasin

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Keywords: Changes in climate variability, Seine basin, Low-frequency variability,Extreme groundwater levels, CaWaQS

Abstract :

Groundwater level (GWL) fluctuations can be expressed over a wide range of timescales. In particular, as aquifers act as low-pass filters, low-frequency variability (from interannual to decadal timescales) originating from large-scale climate variability usually represents a significant part of GWL variance. This is typically the case of aquifers in the Seine River basin for which extreme GWL then appear largely dependent on such low-frequency fluctuations. In addition to expected trend behaviours (e.g., progressive increase in air temperature or evapotranspiration, increase or decrease of monthly or seasonal precipitation amounts, etc.), global climate change can also affect, and have maybe already affected, the internal variability as described by climate modes like for instance the El Nino Southern Oscillation (ENSO) or the North-Atlantic Oscillation (NAO), which explain more or less directly the low-frequency variability of hydrological processes including GWL. How GWL in a large hydrosystem may respond to such changes then remains an open question, and even appears as an important issue regarding extreme GWL. Would that lead to more or to less severe extremes, with more groundwater droughts or, on the contrary, more groundwater floodings? Would this be expressed in the same way for aquifers exhibiting different GWL behaviours in terms of low-frequency variance?

To tackle this issue, we implemented an empirical numerical approach that would allow to assess the sensitivity of aquifers to changes in large-scale climate variability, using the whole Seine hydrosystem as a test case. The approach consisted in i) identifying and modifying the spectral content, originating from large-scale climate variability, of the precipitation field using signal processing techniques, ii) re-injecting this modified field as input to a physically-

based hydrological/hydrogeological modeling tool (the CaWaQS software) for the Seine basin. We used the Safran precipitation field over the period 1970-2018, which was initially used for model calibration and validation. GWL dataset for the Seine basin is a subset of a database of climate-sensitive (i.e. with as low anthropogenic influence as possible) GWL time series recently set up at BRGM and University of Rouen Normandy. First, the Safran reanalysis and observed GWL time series were analyzed using continuous wavelet transform (CWT) to identify the relevant spectral content reflecting climate variability: interannual (2-4yr), multiannual (5-8yr) and decadal (~15yr) variabilities. Then, Safran precipitation time series were decomposed into time scale components, or so-called wavelet details, using maximum overlap discrete wavelet transform (MODWT). For each time series of the precipitation field, the amplitude of components corresponding to previously identified interannual, multiannual and decadal variabilities was modified individually, by either increasing or decreasing it by 50%; and then all components, including the one that was amplitude-modulated, were re-agregating. This eventually led to six scenarios of changing variability of precipitation. The corresponding modified precipitation fields were re-injected into CaWaQS model, which produced modified GWL time series.

First results indicated that amplitude-modifications of low-frequency spectral content in precipitation field cause variance-modifications of these same time scales in GWL, which should affect extreme levels, and this will be investigated in the next few months.

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Climate change hazards and the choice of infrastructural strategies

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Keywords: infrastructural strategies, economic activities, low waters, flood,adaptation

Abstract :

Our article will present the analysis of two studies concerning on the one hand the Seine (and more particularly a geographical area named La Bassée - Montois) and on the other hand, the Rhine. These rivers are affected by hazards, that are becoming more frequent because of the climate change (floods and low waters). These hazards have strong effects on human activities and incite the stakeholders in charge of their regulation or dependent of sufficient water flows to maintain their activities to find solutions and to act, collectively or not. The stakeholders are obliged to rethink the relationship with the hydraulic infrastructure and its uses; this leads to the emergence of epistemic coalitions, that try to build and defend common values and solutions in order to tackle the climate change issues.

The separation of nature and culture is tangible in the understanding of many actors, but each according to their own relationship to matter and space (Stepanoff, 2020). The Rhine and the Seine, in the perception of a large number of actors, are no more a natural actor; they are artefacts which have lost their 'natural' character through a disarticulation of ecological and spatial links; they are infrastructure whose rhythm is known and 'mastered', and which had been transformed according to human activities, even if there was still uncertainty about the exact moment of low water or flooding.

Methodology

In the frame of two European projects (INTERREG Clim'Ability Design and JPI UNCHAIN), we have studied the consequences of low waters on the inland waterway transport on the Upper Rhine Region. The Seine river (la Bassée Montois) is studied through an integrative research program (8th phase - PIREN Seine). For both case studies, document review, semi-directive interviews and participant observation were employed.

Theoretical framework

According to a bibliographical work and previous studies, we consider that different kinds of adaptation could be distinguished (Thornton, 2010; Rudolf et al., 2018):

- The reactive adaptation which corresponds to an immediate response to the crisis. This adaptative answer is limited to technical and organisational reactions (like short-time work).
- The transformative infrastructural adaptation is the kind of solution which convinces the most the stakeholders. This corresponds for the Rhine to planning strategies to increase the water level and overcome low water levels (use of Lake Constance as a water reservoir, etc.). For the Seine, two projects are intertwined: the digging of a new part of the river and the building of water storage basins.
- The radical adaptation (changing transport and production system and integrating multimodality at an international level) appears for the Rhine case study principally in the discourses of some regulators or representatives of the "river". Accepting a new way to distribute revenues and to supply agro-industrial firms orto transport resources is one proposition made by associations, and underlined by environmental ities, for la Bassée Montois.

Not only does this work bring to light different kinds of adaptation but also different visions of the world and of the relationship between nature, ecosystems and human activities. Even if the power distribution and the legitimacy hold by stakeholders often determine the decisions which are finally taken and for our cases, explain why infrastructural solutions are preferred or chosen, it is essential to observe how an opportunity window opened by a crisis is transformed as a policy window. The crisis enables some stakeholders to focus the attention on a specific problem, to push their solutions and to mobilise resources to make them possible. However, infrastructural adaptation solutions, based on technical register of actions, minimize the uncertainties raised and strengthened by climate change hazards.

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Problem of hydrological metrology of low streamsand impact on the estimation of water resources

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Keywords: water resource, low water, stream rating curve, confidence and prediction intervals

Abstract :

To estimate series of water flows, it is required to collect a set of reliable stream measures, as accurate as possible, and to generalize them using continuous water height measurement from immersed sensors. Many methods are used to do so such as gauging by salt for conductivity, velocimeter based on Dopler radar ultrasound to draw the river bed shape or other more complicated methods including conditional information about gauging for high water or even floods and based on learning approaches (e.g. BAyesian RATINg curve analysis or neural networks).

An important issue of these methods is their capacity of generalisation, directly linked to the gauging sample size and to the sensitivity of the estimated values of water flows. Indeed, scientists and water resource managers face to a rather prickly paradox: when the water isvery high, we miss accurate information to assess the flows due to measurement difficult conditions, when the water is low, since it is easier to get larger samples of measures, any uncertainty or water level variation may strongly impact the water flow estimation.

In this paper, we present a short comparative state of the art on these assessment methods and then we focus on the statistical part of the water rating curve which aims to predict the water flows using a non linear fitting function. Drawing corresponding confidence and prediction intervals, it is noticeable that there is a strong uncertainty in the water flows measurements especially in low water conditions. Thus, it becomes almost impossible to estimate the part of "derating" factor due to the local spatial configuration even if we multiply the gauging surveys in the data series in time. We illustrate these results by a set of data collected in the Cévennes, on two locations along the Gardon river in Southern France. We then propose an optimal method to sample jauging points according to statistical constraints and non linear prediction capacity.

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Extreme precipitation events and its drivers: an insight from a systematic : creview from 1993 to 2021

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Keywords: Extreme precipitation, Summertime, Global climate change, Scientometrics analysis, Drivers

Abstract :

The intensity of extreme precipitation events has increased drastically over the last decades. As a result, the number and frequency of flood and landslide events has also increased. Our analysis of the Georeferenced Emergency Events Database (EM-DAT) found that 5455 flood events (among them 2658 Riverine flood, 85 Coastal flood, 761 Flash Flood), and 768 landslide events (among them 71 Mudslide, Avalanche 114, and 535 Landslide) were recorded around the world. To recognize this, a scientometrics analysis based on Scopus and Web of Science (Core collection) was performed to understand the research trends and areas of focus in extreme precipitation studies starting from 1941 to 2021 (with a focus on 1993 to 2021). A comprehensive overview of extreme precipitation research with connection to annual documents, research areas, institutions, influential journals, core s, and temporal trends and networks of the commonly used keywords were analysed. The results showed that a total of 4373 research records on extreme precipitation in between 1941 to 2021. Overall, USA is leading the board followed by China, UK, and Australia, respectively. Particularly in summertime extreme precipitation research, we found 165 scientific contributions, among them only 50 research focused on short-duration extreme convection precipitation events (SDECPEs). It was found that most of SDECPE study emphasized from 2010, and in 2019 the highest number of papers published. The published articles cover a wide range of subject areas e.g., Agricultural and biological sciences, Computer Science, Earth and Planetary sciences, Environmental sciences, multidisciplinary, Physics and Astronomy, and Social Sciences. However, most of the paper published in the field of Earth and Planetary Sciences (82 paper). We also found that extreme precipitation events and summertime was the most used keywords in the research. Besides, climatology, atmospheric circulation, climate modelling, regional climate, summertime precipitation, atmospheric thermodynamics, seasonal variation, and monsoon is also

used widely in the published articles. Keywords were presented in three clusters. First cluster focused on surface water, sea surface temperature, annual radiation, Pacific Ocean (west and northwest). Whereas second cluster combined the keywords namely extreme precipitation, climate modelling, global warming, climate change, convective precipitation, daily precipitation, Asian summer monsoon. The third cluster mentioned summertime precipitation, atmospheric circulation, temperature variation, moisture, atmospheric humidity, spatial variation. In this study, based on historical observed data on temperature, soil moisture, precipitation, we identified the potential drivers of extreme precipitation events and found that there is strong signal of global climate change, particularly in the mid-latitudes. We conclude that future research investigation should focus on short duration extreme convective precipitation events and its damage risks. The findings of this study can help related researchers better understand the past and future of extreme precipitation research studies.

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Thursday, 2nd 11h00

Social perceptions of flexible coastal management onnatural areas by the Conservatoire du littoral

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Keywords: Social perceptions, public policies, adaptation, flexible coastal management, Climate change

Type of communication :

☒Oral Communication

☐ Poster communication

Abstract :

The Conservatoire du littoral (Cdl) is a French public establishment, created in 1975 and in charge of acquiring natural coastal areas and lands throughout public budget to withdraw them from urbanisation. While preserving and restoring natural and ecological dynamics on these lands, the establishment is also in charge of welcoming the public.

Since the beginning of 2000, the CdL has launched an in-depth reflection on how to adapt its management of coastal areas that are today facing climate change impacts, and especially sea level rise and marine submersion.

Currently embodying an ambitious public policy of natural coastal areas adaptation to cli- mate change impacts, as well as key player in the local discussions on coastal management, the CdL is experimenting flexible coastal management throughout a European Life project called ”adapto”, and tries to anticipate future events caused by climate change.

The overall project is implemented on local contexts and questions the current approach of “resisting against the sea”. Instead, the Cdl promotes a softer way of managing and dealing with coastal risks and environmental issues regarding wetlands

conservation: letting the sea take back its former place, and help local territories plan the withdrawal of activities and inhabitants.

One of the adapto project's objective is to interrogate social perceptions of this flexible coastal management approach by the Cdl, and other local risk' managers. Ecosystem ser- vices, and especially Nature-based Solutions, are a mean for the Cdl to promote this flexible approach, but how does it materialize locally? How its sites' users perceive and understand the need for wetlands adaptation to climate change? In addition, how these perceptions can influence wetlands preservation efforts? How do citizens implicate themselves in these matters?

A questionnaire field survey was conducted between June 2020 and August 2021, on the 11 adapto pilot sites and was addressed to the sites' users: 1678 surveys were obtained, and are now being analysed.

This communication will present results on users' perceptions of coastal flexible manage- ment by the Cdl, but also an analysis on how the Cdl is taking into account these users' perceptions in its management planning. The research, throughout political sociology and environmental and social psychology, aims at showing how knowledge, from users as well as managers, is one of the key of success, but not the only key. Trust, confidence, as well as fear, denial, anxiety can also be keys to understand, more profoundly, the reasons why users can more or less accept a new policy. Listening, co-construction, participation, implication, all these concepts need today to be reconsidered, in order to understand how changes can be acceptable and therefore, possible without too much difficulties.

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Strategies of protection against marine submersion and environmentaline qualities - Case of La Rochelle coastal area, Charente Maritime

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Keywords : marine submersion ; protection strategies ; environmental inequalities ; data analysis ; Charente Maritime

Abstract :

Current climate change involves sea level rise and increased frequency of extreme events suchas floods or storms. The protection of coastal areas has thus been enhanced during these last decade, especially in France since the Xynthia storm of 2010, to reduce the marine submersion. Three main protection strategies exist: hard defense (seawalls, rock armour), retreat (relocation of inhabitants and activities to safer places) and mitigation to strengthen the natural defense of the coast (Williams et al. 2018).
The choice between these strategies has impact on society and the environment (Cooper et Lemckert 2012; Williams et al. 2018). It is generally accepted in literature that the poorest populations are often the most disadvantaged in terms of access to natural amenities and the most exposed to coastal risks (Dolan et Wallace 2012; Vélez et al. 2018). Thus, to measure the impact of these strategies, an entry through environmental inequalities (EIs) is relevant. EIs allow us to analyze inter- and intra-generational differences, determined in part by the quality of the environment and in part by social structure. Despite the risk exposure, coasts, in western countries like France, are indeed attractive places for population and activities, often involving socio-spatial segregation patterns from the coastline to the inland. In consequence, the decision to protect or to relocate a specific coastline can have different impacts according
to social categories and types of coastlines (Long, Cornut, et Kolb 2021). What we also argued in previous research is that the very choice between strategies, based on a cost-benefit approach, impacts, in France at least, indirectly and differently the social categories (Long, Cornut, et Kolb 2019).

Coastal protection thus bears the risk of increasing environmental inequalities. However, an increase in EIs exacerbates social tensions, decreases the acceptance of environmental policies, increases socio-environmental risks and therefore decreases the preventive impact of adaptive measures (Long, Bazart, et Rey-Valette in press;

Uslaner et Brown 2005; Wilkinson et Pickett 2009). Caring for the social impacts is indeed essential to cope with climate change (Klinsky et al. 2017).

In this paper, our aim is firstly to objectify, on a specific coastal area, theses IE patterns: i) socio-spatial segregation from coastline to inland; ii) access to amenities socially differentiated and iii) risk exposure inequalities to the detriment of poorest population. This work is based on indicators: exposure to risks, accessibility to natural amenities and distanceto the coast, and the price of housing, which are compared with the social profiles of households and done on the coastal part of Communauté d'Agglomération de La Rochelle, in Charente Maritime. Secondly, we connect these patterns with the choices of coastal protectionstrategies, to evaluate their impact in terms of EI.

Even if the quantitative figures do not always show clear-cut evidence, given the dataset complexity and the relative absence of data on a fine scale, we argue that there is a strong belief that IE are maintained or exacerbated by coastal protection in this specific area. The paper concludes on path for further studies on other coastlines, in France and beyond.

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Thursday, 2nd

From riskscapes of flooding and marine submersion in the Rhone deltato climate change adaptation strategies

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Keywords: Sea level rise, salinization, adaptation strategies, local conflicts,Camargue delta

Abstract :

France has about 9,000 km of dykes, whether marine or river, historically managed by various actors (State, local ities, owners' associations, etc.) often on a voluntary basis. Most of them were built with a predominant idea of an anthropic conquest over water, leading to oppose these infrastructures to nature (Meur-Ferec and Morel, 2004). However, 21st century evolutions of flood policy in Europe have led to the qualification of dykes from a protective infrastructure to a threatening one (Guerrin, Bouleau, 2014). Indeed the dykes are nowconsidered to be liable to collapse. In addition, in 2018, the competence GEMAPI transferred the responsibility for the management of first rank dykes to intercommunal associations (called “Etablissements Publics de Coopération Intercommunale (EPCI)”), ending the principle of voluntary and multi-stakeholder competence

The importance of climate change predictions in the political agendas at international, national and local levels encourage local ities today to change their existing protection systems towards greener solutions (less based on civil engineering), more integrated (to the environment, to the landscape and territories), multifunctional (protection of man and nature, recreation) and more economical (less maintenance and investment).

In this perspective, the concept of Nature-based Solutions (NbS) has been growing in popularity since 2009. Developed and supported by the IUCN and the European Commission,it supports the development of a territorial approach to risk management supposed to be less costly, less focused on technical solutions, more ecological and more adaptive than classical grey infrastructure. Faced with the sea level rise in the context of climate change and the growing cost of maintenance, in some territories in France, polder dykes are no longer maintained in their initial state but requalified as NbS. The idea of project promoters is to move away from the idea of conquering territory but instead to enable a strategic retreat of thecoastline. The former dykes then

become hybrid objects, infrastructures designed to protect human activities and which are modified and reinvested to become biodiversity protection infrastructure, enabling an environmental-friendly management of marine submersion risk. However, it seems that this evolution is creating significant reluctance from the population to accept this requalification, seen as an abandonment of the territory to the sea and the retreat of State intervention to protect citizens.

Based on these empirical hypothesis, in this oral communication, we will question manner public actors and inhabitants perceive this requalification of classical protection infrastructures. This will lead us to give recommendations about how NbS can enable an adaptive management of marine submersion risk.

Our presentation is based on the case of the Rhône Delta (French Camargue). First, we analyze issues associated with climate change at the territory level (risk of flooding, but also land salinization). Then we present adaptive management risk governance and analyze how actors coordinate to manage the erosion of a protective infrastructure. Finally, we qualify the social representations of the erosion of protective dykes by managers and residents and analyze how these representations can constitute brakes and/or levers in the transition towards an adaptive management of protective infrastructures. To support our demonstration, we mobilize the concept of riskscapes (Mullër-Mahn and Everts, 2013) to account for the plurality of practices and representations associated with sea level rise in Camargue.

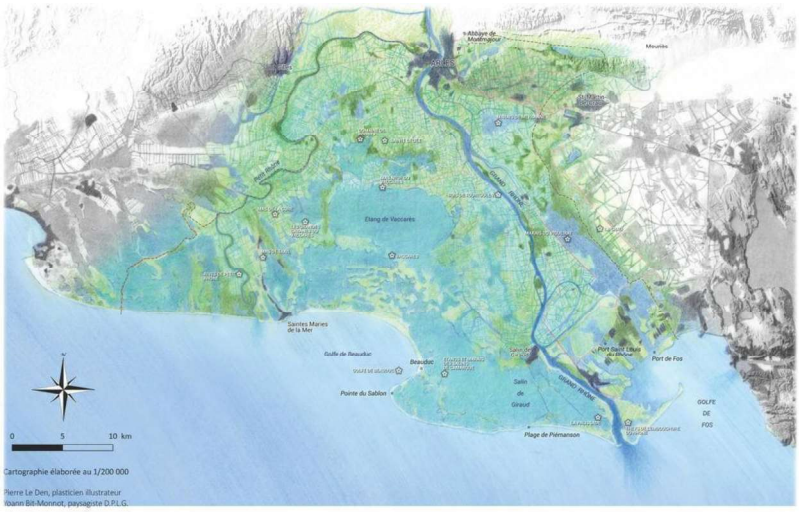

Figure 1 : map of the « Étangs et Marais Salins de Camargue (EMSC) »

Source : http://www.conservatoire-du-littoral.fr/TPL_CODE/TPL_UNITELITTORAL/PAR_TPL_IDENTIFIANT/34/125- les-paysages-fiche.htm

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Experiential learning on coastal flooding risk through the application ofthe LittoSIM participatory simulation to five French case studies

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Keywords: coastal flooding, participatory simulation, adaptation, climate change, experiential learning

Abstract :

According to IPCC forecasts (IPCC, 2019), coastal areas' vulnerability will be increasing due to the impacts of climate change in terms of sea level rise and the increasing frequency and intensity of extreme events such as coastal flooding.
To help territories meet the adaptation challenge, participatory approaches using modelling and role-playing games can be developed. This combination is used to simplify individuals' reality in order to support decision-making processes (Voinov & Bousquet, 2010). Participants are placed in a situation that helps them to make "realistic" decisions whilehaving the freedom offered by the framework of the game to experience different actions without any real consequences.
As part of the LittoSIM-GEN research project, we are using a participatory simulation called LittoSIM[1] to question the prevention of the risk of coastal flooding in France (Amalric et al., 2017; Becu & al., 2020). It offers elected municipal officials and risk managers an innovative space for reflection and experimentation during a half day workshop. The 8 to 12 participants per 'LittoSIM workshop' can test different prevention strategies related to land use and coastal defense management and are encouraged to build a collective plan at the intercommunal level. Thanks to the hydrodynamic model that randomly simulates a coastal

[1] https://littosim.hypotheses.org/

flooding on a simulated territory, the participants can assess the impact of their choices in relation to flooded areas.
The LittoSIM simulation has been co-developed by a group of researchers and risk managers of the Community of municipalities of Oleron island in France to raise awareness and to foster experiential and social learning on coastal flooding among policy makers and managersafter the Xynthia storm that hit the Atlantic coast of France in 2010. Later, the methodology has then been adapted and applied to five other case studies: the Mediterranean Coast (Camargue), the Channel Coast (Normandie Region),

the Opale Coast (Boulonnais Region) and the Atlantic Coast (the Rochefort district). Thanks to a mixed methods evaluation protocol (interview, questionnaire, observation of workshops, recorded simulation action) we collect data for a dozen of workshops on participants' actions and intentions, what they get outof it and the obstacles they face. This contribution will first report on participants' knowledge and representations evolution and on the collective decision-making processes that took place during the experiment in the several case studies. Second, it analyzes the characteristics of coastal flooding, the management strategies, in particular soft defense and managed retreat, and how participants have been able or not to implement long-term strategies that take into account the effects of climate change. Finally, we will identify the obstacles and the drivers of adaptation among the participants, and we will evaluate the interest of the LittoSIM tool in supporting territories to adapt to observed or anticipated changes related to extreme events and climate change effects.

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Space geodesy and climate change – A review

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Keywords: space geodesy, GNSS, satellite gravity mission, hydrological loading, time series

Type of communication :
☒Oral Communication
☐ Poster communication

Abstract :

This presentation consists of a comprehensive review illustrated by different examples of studies using space geodetic observations in the frame of climate change. Earth is a dynamic planet subject to many processes. Detectable changes in the shape of the solid Earth and its gravity field arise due to the varying mass distribution of the surface fluids (oceans, atmosphere and terrestrial water storage). These include variations related to climate change such as sea level changes, loss of ice sheets, post-glacial rebound, and changes in precipitation, water storage, and runoff. Space geodesy provides unprecedented coverage of the Earth's surface and can contribute to monitoring accurately the interaction between climate change and Earth's time-dependent shape and gravity field. Space geodetic observation analysis can address key science questions related to surface deformation associated with water distribution and water cycle change, as well as the processes controlling
variations in relative land and sea levels. The Global Navigation Satellite System (GNSS), and in particular the Global Positioning System (GPS), has become the essential tool for the mm to cm level positioning requirements within the geosciences. The hydrological signal study from GNSS observations is classically performed from 3D positioning time series analysis with a daily or sub-daily sampling over long period (more than 20 years) for permanent sites more or less dense depending on the region of the world. In addition, gravity satellite missions

such as the Gravity Recovery and Climate Experiment (GRACE) can observe the global movement of environmental fluids and provides estimates of seasonal, yearly, and long-term hydrological, cryospheric and oceanic mass variations at spatial scales of a few hundred km and more, to accuracies close to 1 cm water thickness. These two techniques give very long and accurate time series of observations that are extremely complementary in terms of spatial and temporal resolution, for monitoring crustal deformations induced by environmental mass transport at the Earth's surface. Space geodetic time series analysis enhances global comprehension of the water cycle at different scales and offers a unique opportunity to identify climate change signals, improving our knowledge of how Earth responds to the water cycle. Better understanding this interaction is essential for applications such as how coasts react to relative sea level change and storms as well as natural hazard mitigation. Moreover, space geodesy also contribute to the validation of hydrological models and monitoring extreme events such as storm, drought or floods. In addition, satellite radar altimetry is another key component of the global Earth system observation. For over 25 years, altimetry missions such as TOPEX/Poseidon, Jason-1 and Jason-2, CryoSat-2 or ICESat-2 highly have contributed to a large number of applications including those related to essential climate variables monitoring such as sea level, ocean circulation, hydrology or cryosphere. In this presentation, we give a comprehensive review of the potential of space geodesy measurements for the observation, analysis and identification of climate signals, with specific examples such as seasonal and inter-annual hydrological signal, drought or current ice melting monitoring.

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Impact of scales and sample size on temperature assessmentwithin downscaling processes

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Keywords: change of support, downscaling, climatological modelling, temperature

Abstract :

Measuring the evolution of temperature in space is currently rather easy thanks to cheap and efficient sensors on a given location. However, from a set of measurement points, it becomes difficult to estimate or interpolate the real temperature values in every unknown locations. A response to this issue may be geostatistics. Denser the points, more efficient those methods, since they handle larger samples of data spread on restricted areas. Behind this relationship between space and measures samples is hidden the Modifiable Areal Unit Problem, that is highly related to the way these samples are spatially allocated and aggregated and consequently, how many data each sample counts. When processing downscaling at different nested spatial granularities, this change of data density can have a major effect on the quality of the estimation. That is what we suggest to explore, by recomposing and comparing the estimates following several random spatial partitions with the same sets of data.
The scientists of ESPACE laboratory developed different methods and concepts about upscaling and dowscaling. Some previous works were done on upscaling using spatial segmentation algorithms on aerial images, on downscaling for assessing and monitoring temperature using statistics from ALADIN-climate models. On two series of measures both inSouthern France, relatively accurate in space (in Alpes Maritimes) and on a long term (in the Cévennes, up to 40 years of measures), we collected meteorological data. Those data a computed by downscaling models according to several spatial partitions randomly rebuilt. The results of the models are compared and discussed. The effect of the partition and the granularity is assessed and gives some room of confidence on the estimations provided by the models.

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An Evaluation of the Performance of Multi-source Satellite Products inSimulating Precipitation over the Tensift Basin in Morocco

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Keywords: Precipitation; Tensift Basin; Spatio-Temporal; Satellite Products;weather stations

Abstract :

The Tensift basin in Morocco is prominent due to its agricultural and hydrological diversity. This diversity is marked by a lot of rivers flowing into the heart of the agglomerations, notably, the agglomeration of Ourika. In addition to its agricultural prowess, the basin is a hub of variable land use systems. As a result of this mix, it is important to acquire a better understanding of precipitation measurements in this region to be able to better understand its role in the hydrology and climate of the region. As such, this study aims at evaluating the performance of multi-source satellite products in simulating precipitation in the basin. This approach will improve our ability to measure and model hydro-metrological events and therefore underscores the importance of meteorological satellites and their uniqueness and ability to measure precipitation in both space and time to enhance flow forecasting. In this work, the data were first collected, for seven satellite products namely PERSIANN, PERSIANN CDR, TRMM3B42, ARC2, RFE2, CHIRPS, ERA5 (simulated precipitation) from, CHRS iRain, RainSphere, NASA, EUMETSAT, NOAA, FEWS NET, ECMWF respectively, and then for the precipitation observations from three weather stations, located at Tachedert: 2343 m, Asni: 1170m, and Grawa: 550m, at different altitudes, and temporal scales (1D, 1M, 1Y), over the period 13/05/2007 and 31/09/2019, at Tensift basin. The data were analyzed through inferential statistics such as Nash-Sutcliffe efficiency coefficient, Bias, Root Mean Square Error (RMSE), the correlation coefficient (R) and the coefficient of determination (R^2) to compare between seven satellite products and the observed precipitation data. The results show that Persiann CDR performs best and is more reliable given its ability to estimate precipitation rates over a wide spatial and temporal scale over the basin. It has significant rates for the different statistics (Bias:-0.12, RMSE: 2.89, R: 0.77, R^2:0.61), and shows the same trend without major differences from the observed weather station precipitation data. However, most of the time, this product records low or negative Nash values (-6.06), due to insufficient weather station data in the study area (Tensift). This suggests that more work should be done to develop weather stations in the basin. Moreover, it was observed that TRMM overestimates precipitation during heavy precipitation and underestimates during the low precipitation. This makes it important for the latter observations to be viewed with caution due to the quality of annual comparison results and underscores the need to develop more efficient precipitation comparison approaches. Also, the performance of the satellite products is better at low altitudes and during wet years.

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Stochastic system dynamics modelling for climate change water scarcity assessment on a reservoir in the Italian Alps

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Keywords: Climate change; reservoirs; stochastic system dynamics; water security.

Abstract :

Water management in mountain areas is facing multiple pressures due to climate change and anthropogenic activities. This is particularly relevant for mountain areas where water abundance in the past allowed for many anthropogenic activities, exposing them to future water scarcity. Here stochastic system dynamics modelling (SDM) was implemented to explore water scarcity conditions affecting the stored water and turbined outflows in the Santa Giustina (S. Giustina) reservoir (Autonomous Province of Trento, Italy). The analysis relies on a model chain integrating outputs from climate change simulations into a hydrological model, the output of which was used to select statistical models in an SDM for replicating turbined water and stored volume within the S. Giustina dam reservoir. The study aims at simulating future conditions of the S. Giustina reservoir in terms of outflow and volume as well as implementing a set of metrics to analyse volume extreme conditions.

Average results over 30-year time slices of simulations show that under the short-term RCP4.5 scenario (2021–2050) future reductions for stored volume and turbined outflow are expected to be severe compared to the baseline (1999–2004 and 2009–2016; -24.9% of turbined outflow and -19.9% of stored volume). Similar reductions are expected for the long- term RCP8.5 scenario (2041–2070; -26.2% of turbined outflow and -20.8% of stored volume), mainly driven by projected precipitations having a similar trend, especially in the last part of the 2041–2070 period. At a monthly level,

stored volume and turbined outflow are expected to increase for December to March (outflow only) and January to April (volume only), depending on scenarios and up to +32.5% of stored volume in March for RCP8.5 for 2021–2050. Reductions persistently occur over the rest of the year from April to November for turbined outflows (down to -56.3% in August) and from May to December for stored volume (down to -44.1% in June).

Metrics of frequency, duration and severity of future stored volume suggest a general increasein terms of low volume below the 10th and 20th percentiles and a decrease of high-volume conditions above the 80th and 90th percentiles. These results point at higher percentage increases in frequency and severity for values below the 10th percentile, while volume values below the 20th percentile are expected to last longer. Above the 90th percentile, values are expected to be less frequent than baseline conditions, while showing smaller severity reductions compared to values above the 80th percentile. These results call for the adoption of adaptation strategies focusing on water demand reductions. Months of expected increases in water availability should be considered periods for water accumulation while preparing for potential persistent reductions of stored water and turbined outflows. This study provides results and methodological insights that can be used for future SDM upscaling to integrate different strategic mountain socio-economic sectors (e.g. hydropower, agriculture and tourism) and prepare for potential multi-risk conditions.

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Water management issues highlighted by hydrological modelling in the Ouergha catchment

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Keywords: Water governance, irrigation, Hydorlogical modeling, Euro-cordex, Ouergha catchment

Abstract :

According to the 6th IPCC report, the climate is changing all over the world and this will have more impact on water stress and food security. Water management has been studied in many disciplines, but an efficient outcome won't be achieved just through studying hydrological modeling or elaborating future scenarios or studying management from a social, economic and political point of view, but in combining all the mentioned tools. In this study, we analyzed water-irrigation management based on hydrological modelling, bias-corrected euro-cordex scenarios, and by studying socio-economical and political aspect in Ouergha watershed. The insights from this study are significant in improving understanding the challenges of water governance, particularly in low- and middle-income rural areas that rely heavily on agriculture.

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Session: Modelling approaches for the development of decision support systems
Chaired by Claudio Paniconi

Thursday, 2nd

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A modelling approach for assessing groundwater recharge and cropwater use in irrigated, semi-arid agricultural systems

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Keywords: Irrigation, Groundwater recharge, Ecohydrological modelling sustainableagriculture, water resource management.

Abstract

An efficient water management system is required in Morocco, where irrigated agriculture is the largest user of water, in order to deal with the increasing pressure on hydrological resources as well as the effects of climate change (1). Eco-hydrological models may be able to give ecologically informed solutions for the sustainable development of agricultural systems, which are often heavily degraded but have the potential to produce significant ecosystem outcomes if they are managed properly. Using a distributed and process-based ecohydrological model, Ech2o-iso, we investigated the simulation of ecohydrological processes occurring in the soil-vegetation-atmosphere continuum, specifically linking plant water uptake by plants to subsurface water partitioning and the resulting groundwater recharge (2). Using appropriate parameterization, this model is capable of reproducing the most important water flux and storage dynamics. When water isotopic tracers (2H and 180) are incorporated, it has the potential to quantitatively link water stores and fluxes with spatiotemporal patterns of isotope ratios and water ages (3). A winter wheat field was used as a test site for the model, which was applied in the heavily cultivated Haouz plain during the 2011-2012 agricultural season. Weather and irrigation data, as well as expert knowledge of soil hydrodynamic parameters and crop characteristics, were used to predict water fluxes and storage dynamics on an hourly time scale utilizing hourly time scale simulation. The outputs are evaluated using field-level surface energy flow measurements taken using an eddycovariance instrument, as well as soil moisture measurements taken at various depths. Preliminary results revealed a decent correlation between model fit and data fit. The second step will consist in performing an automated model calibration using the diversity of the abovementioned datasets in order to better constrain groundwater recharge estimates and subsurface water residence times in order to better constrain groundwater recharge estimates and subsurface water residence times. These first findings indicate the potential of the EcH2O-iso model for disentangling ecohydrological couplings in agricultural areas, highlighting the importance of further research into this field.

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Climate change induced impacts on hydrological extremes at thecatchment scale: case of Wadi Siliana (North western Tunisia)

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Keywords: Hydrological impacts, climate change, ensemble climate models, Cordex

Abstract:

High and low flows are hydrological flow extremes threatening human being by causing floods and droughts. They are caused by meteorological extremes and human activities. Changes in meteorological conditions will inevitably impact the frequency of hydrological extremes and exacerbate their associated hydrological impacts.
This study focuses on modelling projected change in both frequency and magnitude of flow extremes as consequence to change in climate condition in the Siliana catchment in Tunisia. The SWAT and HBV hydrological models were calibrated using historical data and fed with an ensemble of high resolution CORDEX climate models. Results project a warmer and drier hydrometeorological conditions in the Siliana catchment. The precipitation is expected to decrease in the future by an average of 10% in dry season and 12% in wet season. In contrast, temperature is expected to increase by an average of +2°C in dry season and 1.8°C in wet period.
While magnitude and frequency of high flows are expected to decrease, low flows frequency is expected to increase.
The Siliana catchment is likely to experience severe hydrological conditions with reduction in water availability and increase in drought frequency.

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The implementation of GEMAPI in intercommunalities in Poitou Charentes, between new areas of jurisdiction,restructuring of means of intervention, new modes of action.

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Keywords(5 max.)**:** Water, aquatic environments, floods,Poitou-Charentes

Abstract :

Since January 2018, the GEMAPI competence has officially been transferred to the Intercommunalities (EPCI) in each French department. The purpose of this new competence is to organize the management of aquatic environments and the prevention of flooding at the watershed level.

It is within the framework of the NOTRe law that this transfer of powers takes place, from the River Syndicates to mixed Syndicates under the direction of the EPCIs. The latter must take over the management skills issued by the river unions and add the new GEMAPI skills. There is therefore the need to create mixed unions for the management of BV (upstream, downstream, on all river tributaries) as part of the implementation of this new competence. The accountability of EPCIs is therefore divided into two major pillars:

- Management and maintenance of watercourses, and flood control
- Management of aquatic environments (rivers, remarkable wetlands, sensitive areas, prefectural biotope protection decree, etc.)

In this contribution, the aim is to show how the EPCIs organize themselves in Poitou-Charentes to implement the GEMAPI? What are the transformations and new management methods for developments linked to GEMAPI, aquatic environments (“GEMA”), flood prevention and, ultimately, what relationship does al GEMAPI have with the SAGEs?

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Procedural justice in extreme events management: what challenge for climate change adaptation strategies?

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Keywords *:* adaptation strategy, public policies, local governance, justice

Abstract :

Although there are plans for adaptation to climate change in Europe (EU Adaptation Strategy, 2021) and in France (PNACC 2011-2015; PNACC 2018-2022), adaptation initiatives are driven at the local level, by the national ities and the local ities (Bertrand, 2013; Bertrand & Richard, 2014). Local action is justified by the socio-spatial characteristics that lead in situ forms of adaptation (Huitema et al., 2016). In the face of inevitable extreme events, local action builds regeneration development projects in at risk areas. Those projects severely limit construction, relocate activities and develop shock- coping functions (landscaped parks, urban gardens). Although they aimed at people safety, these initiatives generate opposition from communities. They raise questions of justice and challenge the acceptability of projects and policies (Gralepois, 2021; Rode, 2008, 2010).

Based on two French case studies, Ault (Somme) and Blois (Loir et Cher), the paper is proposed for axis 3 'Management, public policies, governance and strategy'. It is based on the SOLARIS project (SOLidarity in climate change adaptation policies), part of the Climate SOLSTICE JPI (2021-2024). SOLARIS questions the socio-spatial injustices linked to the implementation of extreme hydrological risk management policies, in a context of adaptation to climate change.

The proposal analyses how local institutions integrate the mobilisation of inhabitants

and communities opposed to adaptation initiatives in the face of extreme events. Exposed to severe risks (coastline reduction for one, and flood risk for the other), these case studies develop reconversion projects based on mandatory risk management documents which strongly constrain the possibilities of benefits for economic development.

The issues of justice raised by the inhabitants slow down the progress of the projects (degradations, spontaneous actions, legal recourse, public speaking out...). If certain types of argument are heard and integrated, other protests do not seem to influence the development. The literature and the first results of SOLARIS show that these arguments are made by marginalised people with few resources and powers. Their claims are hardly understood. These mobilisations, whether legitimised or delegitimised, threaten adaptation policies and underline the necessity to ground the concept of justice into concrete local policies and procedures.

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Climate extremes adaptation in urban wetlands in Diourbel (Senegal) andin Bourges (France).

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Keywords : extreme climate evets ; adaptation ; urban wetland ; strategies ; social survey

Abstract :

The paper will examine the adaptation to extreme climate events such as droughts and floods in two urban wetlands in Diourbel (Senegal) and in Bourges (France). Adaptation is understood as the process of adjusting local systems and societies to climate change and its consequences. It will be examined both from the point of view of collective strategies e.g. publicpolicies and individual strategies e.g. practices and perceptions.

This theme and the two case studies that will be developed in the paper are part of a research-action programme called Boudiou, which focuses on the same urban wetlands facing climate change. The Bourges and Diourbel wetlands share two functional crises. The first one is related to climate change and the second is related to the redefinition of social and environmental expectations in these wetlands. The urban wetland in Diourbel shrank followingthe droughts in the 1970s and 1980s. Residential areas replaced ancient vegetable gardening; the agricultural vocation was lost due to drying out. A new phenomenon appears during the 2000s with the return of significant rainfall during the winter months. Rainfall regularly led tothe saturation of the urban space by run-off water and flooding in the areas around the wetland.At the same time, local population uses wetlands as rubbish dumps which promote floods. Therefore, these events are a major environmental and public health problem at city scale. Both floods and droughts questioning adaptation capacity. An answer might be a form of an environmental multifunctionality that would mix vegetable gardening space and an ecological function e.g. green corridor. The Yèvre and Voiselle wetland in Bourges is confronted more recently with recurrent droughts. First developed in the 19th century for vegetable gardening, wetland is now protected and non-professional gardening activities have replaced professional

activities. A new leisure function grown up at the same period, when the urban population began to frequents it. However, as in Diourbel, droughts have enhanced attention et contribute to highlight problems in water management and the

maintenance of the hydraulic system. Thus, how do the stakeholders in Diourbel and in Bourges to deal with the problem of extreme climate events? What responses do they provide and on which scale?

We will first document droughts and floods and their evolutions through a pluviometric data and vegetation dynamics data analysis. One of the purpose is to highlight the temporal and spatial shifts that may exist in the response of populations. A second step will focus on contemporary adaptation strategies. Method is based on one part an analysis of institutional and technical documentation and on the other part on social surveys with wetlands stakeholders. Two scales of investigation will thus be examined during the survey. We will try to highlight the way(s) in which institutional actors but also recurrent or occasional users adapt their practices i.e. their techniques and behavior and document perceptions and representations.

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Spatial planning for climate change: identifying opportunities and constraints for implementation of adaptation solutions in an urban planning document

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Abstract:

Regulatory and operational urban planning tools have now the capacity to integrate the obligation and/or incentive to implement adaptation solutions in the city (alternative water management techniques, presence of vegetation and soil...), particularly following the evolution of planning after the 2000s (Maytraud, 2018; Thoidou, 2021). Urban planning documents such as the Local Urban Plans (PLU in french and PLUi when it is inter-municipal), are potential drivers for the adaptation to climate change -to manage stormwater and climate regulation- at the local scale (Dameron, 2016; Groux, 2014). However, they can also be barriers to the implementation of adaptation solutions or limit the territory's adaptation potential (Houssemand, 2020; Thébault, 2019). This raises the question of whether planning tools are an epiphenomenon of adaptive action or whether they play a central role in the development of "adapted" cities.
In the context of decision-making, it is essential to know whether regulatory resources are sufficient to address barriers to adaptation, and to understand if they have the real potential to adapt the city to the challenges it faces. But how can we assess whether the territory will be able to adapt under existing rules?

In this regard, "urban planning modeling" is of particular interest in understanding the extent to which documents have the capacity to adapt the city to the challenges of climate change. Several studies have attempted to model urban form from planning documents (Brasebin et al., 2016; Colomb, 2020; Luo et al., 2017). Other studies have relied on regulations to align urban form with water management system and to accommodate infrastructure needed for sustainable development (Bach et al., 2018; Houssemand, 2020), and to assess the environmental impacts of amenities (Prévost, 2013). However, the complexity of PLUi regulations expressed in terms of qualitative and quantitative rules makes it difficult to assess the potential effects that these could have on the implementation of adaptation solutions in a modeled approach.
The objective of this work is therefore to study a PLUi in order to deduce its capacity to be a vector of integration of climate change adaptation and represent this territorial capacity in a modeled form. The groundwork for the study is the city of Nantes, France's sixth largest metropolitan area, whose population is expected to increase by 100,000 inhabitants by 2030, therefore, reducing the impact of urbanization through adaptation strategies could represent a challenge (Chancibault et al., 2014).
More specifically, for this contribution, we will present a first approach on the creation of a GIS multi-criteria analysis protocol to identify the opportunities or constraints proposed by the PLUi

of Nantes with regard to the characteristics of adaptation solutions by developing a cross analysis of the types of rules and the characteristics of adaptation solutions. This will allow spatialization of areas where it might be attractive to implement such solutions but where the set of regulatory measures based on permissions or limitations of constructability does not foresee it.

These results will be a part of a research project aiming to create regulatory-compatible development scenarios for ex-ante evaluation of the plans (Molines et al., 2020). They will be confronted with hydro-climatic modelling to study the evolution of the hydraulic and thermal trends in the study area over the long term.

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Poster session

Number	Authors	Title
1	**Attar Oumaima**, Youssef Brouziyne, Lhoussaine Bouchaou, Driss Dhiba, Abdelghani Chebouni	Research on water resources challenges in the Souss-Massa Basin-Morocco: the ways forward to bridge the gaps
2	**Badji Aïssatou**, Elsa Mohino, Juliette Mignot, Moussa Diakhate, Amadou Thierno Gaye	Decadal variability of extreme rainfall indices in Senegal
3	**Hanchane Mohamed**, Jaafar Kassioui	Evolution of extreme weather types in relation to atmospheric circulation types in morocco
4	**Isabelle La Jeunesse**, Rémi Coquard, Samuel Leturcq, Corentin Thermes, Michel Badier	Climate change pressures on wine production in France: a preliminary study of the evolution of the spatial distribution of grape varieties
5	**Isabelle La Jeunesse** & NEXOGENESIS partners	Facilitating the next generation of effective and intelligent water-related policies utilising artificial intelligence and reinforcement learning to assess the water-energy-food-ecosystem (WEFE) nexus (H2020 NEXOGENESIS)
6	**Isabelle La Jeunesse** & ARSINOE partners	Climate resilient regions through systemic solutions and innovations (H2020 ARSINOE)
7	**Judith Eeckman**, Jean-Michel Fallot	Characterization of the drought risk in the Vaudois Alps and topoclimatic specificity of mountain territories
8	**Kabir Md. Humayain**	Trends of extreme compound events research: A global perspectives
9	**Medjadj Tarek**, Setti M'Hamed	Spacing Hinterland water for Algiers
10	**Nicolas Joëlle**, J. Verdun, J.P-Boy, A. Koulali, P. Clarke	Space geodesy and climate change - Case studies
11	**Ouattara Sangboliewa Lanzeny**, Aichatou Koné	climate change and adaptation strategies of producers in Napié (North of Côte d'Ivoire)
12	**Sasse Alexander**, Benjamin Poschlod, Ralf Ludwig	Climate change impacts on riverine low flows " Setting up a hydrological large ensemble"
13	**Shudufhadzo Godlive Mukwevho**, R. Makungo	Climate change impact on hydrology of Latonyanda Quaternary catchment, Limpopo, South Africa
14	**Silva Nathan**, Isabelle La Jeunesse, Alexis Metzger	Flood risk culture in the city of Tours: a work in progress
15	**Sohou Serge Olivier**, N'Da Kouadio Christophe	Caractérisation des extrêmes pluviométriques par l'analyse des indices climatiques dans le nord savanicole ivoirien de 1981 à 2020
16	**Zied Ajimi**, Slim Rouz, Dalanda Haddaji, Latifa Bousselmi	Living green wall (LGW) performances to treat real grey water

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Research on water resources challenges in the Souss-Massa BasinMorocco: the ways forward to bridge the gaps

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Keywords: Souss, Massa, climate change, drought, water resources, scientic review

Abstract:

Located in the South-west of Morocco, Souss-Massa is one of the regions that suffers the most from water stress and drought. The economy is mainly based on agriculture and consumes an important part of the region's water resources. In addition, climate change and the important socio-economic development of the region in recent years, has led to an increase in demand from all sectors which affected the water availability in the region and consequently the abilityto meet the demand of humans in this area. This paper focuses on research performed on water resources, gaps and potential research opportunities. By adopting an analysis of the methodologies and results of recent research performed on water quality and quantity as well as climate change impacts on this basin, we describe the water situation over the past few decades. Although the basin has been the subject of research on climate and water for several years, many gaps in knowledge remain. After a detailed discussion on the remaining gaps in water resources research; we highlighted research needs of the region and we proposed future direction in order to reduce the gap. Research can be improved by focusing on the quality and availability of data, innovative modeling approaches, and trans-disciplinarity in addressing water research.

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Decadal variability of extreme rainfall indices in Senegal

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Keywords: Decadal variability; Extreme rainfall indices; Senegal

Abstract :

The extreme rainfall events affect most socioeconomic sectors of West African countries and particularly for Senegal, the westernmost country of the region. Moreover, there is evidence that some extreme storms have shown strong changes in recent decades. However, the decadal variability of extreme rainfall events during the 20th century has received little attention in the literature so far. In this study, we analyze the decadal modulations of heavy (R20mm, R75p) and extreme (R95p) rainfall in Senegal, based on daily data measured at different stations over the period 1918-2000. Our results show that R20mm, R75p and R95p indices have shown a marked decadal variability during the 20th century, with a higher frequency of extreme events in the 1950-60s and a sharp decrease in the 1970-80s, consistently with the total seasonal amount of rainfall over the whole West Africa. Such variability of heavy and extreme rainfall in Senegal is strongly linked to the Atlantic Multidecadal Variability (AMV). Warmer SST over the tropical and extratropical North Atlantic and over the Mediterranean sea, associated with a positive phase of the AMV, are linked to a decrease of sea level pressure in the North Atlantic and a general northward shift of the Intertropical convergence zone and lead to more heavy and extreme rainfall events over Senegal. The representation of this modulation is investigated in atmospheric simulations forced by the historical SST. The model simulations will be used for an in-depth understanding of the associated mechanism.

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Evolution des types de temps à température extrême en relation avec lestypes de circulations atmosphériques au Maroc

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Keywords : ***Evénements météorologiques extrêmes; Températures maximales;Types de circulation atmosphérique; Maroc***

Abstract (FR):

L'augmentation des gaz à effet de serre n'a cessé d'augmenter depuis l'ère industrielle. Les conséquences d'une telle augmentation sur le forçage radiatif est sans précédent. Les impacts sur le système climatique planétaire se traduisent par de nombreuses manifestations météorologiques extrêmes qui ne cessent de d'intensifier et d'augmenter en fréquence.
Au Maroc, la tendance vers l'augmentation des températures observées à partir des enregistrements historiques est incontestable. Cette augmentation concerne aussi bien les températures maximales que minimales. Les conséquences sur les ressources en eau et les écosystèmes agricoles et forestiers sont de plus en plus décelables. En effet, le stress hydrique s'intensifie, certaines rosacées cultivées en montagne, exigeant une période de froid, sont menacées, les incendies de forêts sont de plus en plus fréquents et les vagues de froid et de chaleur menacent de plus en plus les populations vulnérables. La présente étude se focalise sur les types de temps chauds.
Après une phase de diagnostic des tendances thermiques au Maroc, il est devenu nécessaire aujourd'hui d'établir un lien entre les types de temps chaud et les types de circulation atmosphérique. On suppose que cette évolution au niveau des températures maximales est expliquée par une modification des tendances des types de circulations atmosphérique qui dominent le Maroc.

Pour répondre à cette problématique, nous disposons d'une série de données journalières sur les températures maximales pour une ensemble de stations qui couvrent l'ensembles des

différents climats du pays (période 1980-2015). Cette base de données permet de dégager les types de temps chauds et d'analyser leur tendance sur le territoire marocain en utilisant le test de Mann-Kendall.

Par ailleurs, un moyen pour comprendre et expliquer objectivement ces situations météorologiques est l'utilisation de l'approche des types de circulation météorologiques (CWT) qui est décrite par Jenkinson et Collinson (1977) et développée par Jones et *al* (1993). En effet, ces études ont montré l'importance de la classification objective des types de circulations météorologiques (CWT: Circulation Weather Types) pour une explication des types de temps. Cette classification décrit les types de circulation expliquant les types detemps qui succèdent d'un jour à l'autre au dessus d'une région donnée. Les types de circulations sont identifiés automatiquement à travers l'emploi d'une série d'indices qui sont calculés par l'emploi des données de la pression atmosphérique au niveau de la mer qui couvrent le Maroc (période 1980-2015). Le calcul est effectué par rapport au point central de latitude 30°N et de longitude 7.5°O qui est situé à proximité de la ville de Tata afin de tenir compte de l'intégralité du territoire marocain. Cette position rend compte des positions de l'anticyclone des Açores et de la dépression saharienne qui déterminent le sens d'écoulement au Maroc. Les données de la pression atmosphérique au niveau de la mer sont issues des données de NCEP/NCAR.
L'objectif de cette étude est d'établir le lien entre les types de temps chauds et les types de circulation et de mettre en évidence l'éventuelle modification des types de circulation atmosphériques en relation avec la tendance vers l'augmentation des températures extrême.

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Climate change pressures on wine production in France: a preliminary study of the evolution of the spatial distribution of grape varieties

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Keywords: climate change, winegrowing, adaptation, grape variety,

Abstract (500 words maximum)**:**

The spatial distribution and the diversity of grape varieties in France, due to historical evolution of wine growing activities from the Mediterranean region to northern regions, is an asset for facing the challenges that are emerging. Among these challenges, climate change is now a reality faced by wine producers and at the agenda of wine sector in general and protected designation of origin in particular.
In this context, the aim of this preliminary study is first to look at the influence of climate change on the spatial and temporal dynamics of grape varieties in France. This exploration was carried out at different time and spatial scales :

(i) first of all the study has been conducted at national and regional scale (Centre-Val de Loire region) to explore the major trends in varietal innovation. Outputs of this fist part of the study permitted to develop a spatialized prospective model for grape variety based on the impact of the evolution of the temperature on grape maturity ;
(ii) The developed model was implemented at department scale ;
(iii) All the departments have provided a cartography of grape varieties possibilities in France in 2050, 2070 and 2100.

The results of the model show an increase of grape varieties in the French territory. It reflects the current strategies observed in the wine sector. However, this type of modeling does not reflect the reality of the "chances of becoming a success story" of a new grape variety resulting from interactions between multiple factors comprising not only environmental but also socio-economic ones. And, one may know that at national scale, past transformations have finally led to a drastic decrease in cultivated diversity. Finally, do climate change threats appear to be a new element that is reversing this process of decreasing of varietal diversity? What could be the criteria able to promote a new grape variety?

Aknowledgments
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Characterization of the drought risk in the Vaudois Alps andtopoclimatic specificity of mountain territories

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Keywords : Drought risk, Alpine climatology, Instrumental set up

Abstract :

Alpine regions are particularly exposed to climate change. However, these territories present a specificity regarding the risk of climatic and hydrological droughts. Indeed, complex mountain topographies significantly influence local climatologies. A precise estimate of the site effects influencing the temperatures allows to better determine the fine-scale climatic variables. In addition, alpine soils, generally poorly consolidated (moraine deposits), can induce significant flow delays and significantly influence flows in rivers during low water periods. In particular, the snowmelt flow is particularly conducive to slow infiltration into soils. A better description of the link between snowmelt and infiltration processes in the soils can then lead to a better understanding of a drought risk induced by a lack of reserves in the soils.

The Nant valley (Vaud, Switzerland), instrumented within the framework of various projects within the Faculty of Geosciences of the University of Lausanne, represents a case study for this work. This terrain has the advantage of being highly described and instrumented, with a history of measurements. An important instrumental park is set up in this work within the study site.

First, in order to describe the altitudinal temperature gradients as well as the phenomena of cold air accumulation, a series of temperature sensors are installed along altitudinal transects. This work presents a temperature spatialization method based on the extrapolation of in-situ measurements which integrates solar radiation variables. High resolution monthly temperature maps are thus proposed, with a precise description of the local site effects.

On the other hand, the melting and infiltration processes in the soils are estimated through the installation of soil moisture sensors at different depths in areas of alpine meadows. The dynamics of the melt flow is described at one measurement point using dedicated instrumentation. The instrumental device as well as the results deduced from current measurements are presented in this work.

This study proposes a methodology for estimating a drought risk induced by a deficit in soil reserves at the local scale for the study case of a mountain territory.

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Trends of extreme compound events research: A global perspectives

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Keywords: Compound events, Impacts, temporal and spatial scale, research trend

Abstract:

The frequency and intensity of extreme compound event has increased drastically over the last decades. As a result, the number and frequency of flood and landslide events has also increased. A scientometrics analysis based on Scopus and Web of Science (Core collection) was performed to understand the research trends and areas of focus in compound event studies starting from 1960 to 2021. A comprehensive overview of compound events research with connection to annual documents, research areas, institutions, influential journals, core s, and temporal trends and networks of the commonly used keywords were analysed.

The results showed that a total of 195 research records on compound events in between 1960 to 2021. Overall, USA is leading the board followed by China, UK, France, and Australia, respectively. The published articles cover a wide range of subject areas e.g., Agricultural and biological sciences, Meteorology and Atmospheric Sciences, Environmental sciences, multidisciplinary, Physics and Astronomy, and Social Sciences. However, most of the paper published in the field of Earth and Planetary Sciences (51 paper). This study also found that compound events, temperature, precipitation, droughts and risks was the most used keywords in the research. Besides, climatology, atmospheric circulation, climate modelling, regional climate, statistical modelling, heatwave, multivariate analysis is also used widely in the published articles. Keywords were presented in three clusters. First cluster focused on flooding, storm surge, climate change, dry and wet days, compound events, droughts, spatio-temporal analysis, atmospheric circulation. Whereas second cluster illustrates the biological and chemical aspects of compound events. The third cluster mentioned impacts of compound events on human health and ecosystem. Results also showed the trend of compounds research has increased over the recent past. Nature Communications, Geophysical research letters, Environmental Research Letters, Journal of Climate, Weather and Climate Extremes, Journal of Hydrology, Science of the Total Environment are the most influential journals.

This study clearly shows that there is strong coupling among the s and institutions of the published articles. However, there is limited study in the developing countries due to mainly lack of good data infrastructure. The main conclusion is that future research investigation should focus more on extreme events and its damage risk assessment. The findings of this study can help related researchers better understand the past and future of compound event studies.

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Spacing Hinterland water for Algiers

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Keywords: Algiers, City, Water, Hinterland water.

Abstract

Of all the kinds of relationship, the one that links man with water is considered as pro- found and serious in geographical survey. Yet in the past, the greatest threat to agriculture was a major problem, the attention of people is now captured by water in cities.
The increasing need of water in Algiers is due to the growing of population and urbanism.On the other hand, there is a rise in water need per capita.
This problem didn't arise during the last decades, but today the situation is no longer the same. It's a considerable challenge for the capital Algiers, especially for the next generations. Through a geographical survey, we obtain valuable information about the extension, the distance of the hinterland water supplier from the city.

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Space geodesy and climate change – Case studies

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Keywords: space geodesy, GNSS, satellite gravity mission, hydrological loading, time series

Abstract:

The Earth is an active planet continuously evolving with surface and interior changes. In addition to Earth's crustal deformations such as tectonic plate motions and volcanism, detectable changes in the shape of the solid Earth and its gravity field arise due to the environmental fluid mass redistributions (oceans, atmosphere, groundwater, soil moisture, lakes, snow and ice). These changes are called loading effects and can reach significant amplitudes (several mm). Climate change has impacts on sea level rise, ice sheet and glacier melt, changing rainfall patterns, declining snow cover, and changing extremes of flooding and drought. Since climate change modifies the regional and global oceanic, atmospheric and hydrological circulations, it will have an impact on loading crustal deformation. Besides global climate changes, loads exhibit regional variations over all time scales, and the different physical processes contributing to loading effects are not globally uniform.

Space geodesy can fully contribute to monitoring and modelling the interaction between climate change and the Earth's shape and gravity field. Today space geodesy provides unprecedented coverage of the Earth's surface and can detect time-dependent deformation and gravity changes on time scales ranging from seconds to decades and over length scales ranging from meters to major continents. The Global Navigation Satellite System (GNSS), and in particular the Global Positioning System (GPS), allows to monitor 3D surface loading deformations at the mm accuracy level.

This accuracy coupled with a great number of unevenly distributed permanent GNSS ground receivers allows studying loading signal at different scales (local to regional) and periods (sub-daily to decadal) and can providing estimates of water storage variations or giving insights of extreme events such as droughts. The GNSS high temporal resolution enables also the study of transient loading signals induced by storm surge. Moreover, a change in surface or underground water storage implies a mass change and corresponding gravity field change. Therefore, by measuring the gravity variations we can estimate the total water mass change, both in liquid and ice forms. Satellite gravimetry missions such as the Gravity Recovery and Climate Experiment (GRACE) providing monthly global gravity field maps have been very successful for climate research studies and other geophysical and geodetic applications. GNSS and GRACE provide long time series of observations (20 years or more) with complementary temporal and spatial sampling for monitoring loading effects.

Combining these observations allows discriminating regional and local signals and providing quantitative estimates of water storage variations. Analysis of loading signal enhance global understanding of the mass transport at the Earth's surface providing a better understanding of the interaction between the solid Earth and the mass redistributions at its surface linked to natural climate variability and human activities.

In this poster, we present results of GNSS and GRACE time series combination to monitor hydrological loading effects and infer spatiotemporal variations in continental water storage obtained in areas of great interest such as the Amazon Basin and the Great Lakes in North America.

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climate change and adaptation strategies of producers in Napié (North ofCôte d'Ivoire)

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Keywords: Climate change, social perceptions, agricultural production, adaptation strategies

Abstract

Climate change is a global challenge and a major concern for the countries of the world, particularly the developing countries. In order to cope with it, each country must develop its own measures. Farmers have always been considered the most vulnerable category to change. However, Napi_e producers manage to develop strategies despite the fact that they do not gain real support from the outside. This assertion justifies the present study whose objective is to analyse the endogenous strategies put in place by agricultural producers to adapt to the changes induced by climate change.

The methodology used is based on a qualitative approach, the data processing tools are the interview guide through the individual semi-directive interview and the focus group. These tools allowed us to analyse the data in order to highlight the results. The observed results show that farmers (producers) perceive the effects of climate change and that this impacts on agricultural production and yields, thus also a_ecting social relations. Also, these results show that the adaptation strategies of the farmers are the result of the individual perceptions of these actors.

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Climate change impacts on riverine low flows
– Setting up a hydrological large ensemble –

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Keywords (5 max.)**:** hydrological modeling, climate change, low flow, large ensemble

Abstract:

In the past two decades, Europe has been hit by major summer heat waves and droughts, with heavy impacts on ecology, economy and civil society.
In addition to increased risk of crop failure and forest fires and danger to human health, extensive dry conditions may lead to riverine low flows and general water scarcity. Low flow conditions can restrict river navigation, limit water use for power plant cooling or for agriculture. Furthermore, the ecological state of the river is impaired. Climate models project a very strong increase in the frequency and intensity of such summers in Europe.
To address these challenges, setting up a hydrological model based on a large ensemble climate simulation provides the required data to evaluate the water availability under future heat and drought conditions. Therefore, we create a hydrological large ensemble with 50 realizations for the periods 1990 – 2099 featuring the Water balance Simulation Model (WaSiM). The single-model initial condition large ensemble (SMILE) of the Canadian Regional Climate Model, version 5 (CRCM5-LE, RCP8.5) delivers the meteorological boundary conditions to drive the hydrological model. Due to the total of 5450 years of simulated runoff acquired by the 50 members, we are able to sample a sufficient number of extreme events, which allows to conduct robust statistics and sound statements on the changes in intensity, frequency and seasonality oflow flows.

The main goal of the study is to set up a hydrological model for the hydrologically bounded Bavaria, to analyze the current and future low flow conditions. Furthermore, we aim for a holistic model calibration to ensure a high consistency in the study area and to prevent overparameterization. Given that WaSiM is deterministic and spatially distributed, the model structure shows a high degree of complexity. This requires a high level of detail as well as temporal and spatial high-resolution in the input data. Since there is a special focus on low flows, the model is set up to represent these dynamics particularly well. To achieve this, we perform a sensitivity analysis on potential calibration parameters and apply a novel objective function combining established quality metrics to evaluate the performance of the model regarding dry conditions. Thereby, we can assess whether certain aspects of the model affectthe low flow dynamics and further assist enhancing the model quality.

We show exemplary results of individual catchments in the study area to contrast the benefits and drawbacks of a holistic calibration approach as well as the differences of the hydrological regimes within Bavaria. We find that major effects of climate change on these regimes are shaping the future water availability and form the framework conditions for adaptation in watermanagement.

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Climate change impact on hydrology of Latonyanda QuaternaryCatchment, Limpopo, South Africa

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Keywords: Climate change, Hydrology, Latonyanda River Quaternary Catchment, Luvuvhu River Catchment, Model.

Abstract

A study on the impact of climate change on hydrology of Latonyanda River Quaternary Catchment (LRQC), Limpopo, South Africa will be undertaken. Since Luvuvhu River and its tributaries in theupper reaches of the catchment are the main recharge sources of Nandoni Dam which is used for municipal water supply and small-scale farming it is important to undertake this study to ensure that the climate change conditions are understood and readily prepared for. The aim of the study is to model the impact of climate change on hydrology of LRQC using an efficient model that is designed for assessing the impact of climate change on hydrology. To determine the impact of climate change on hydrology of LRQC, soil and water assessment tool (SWAT) model with Arc- SWAT interface on Arc-GIS software will be used. The model is designed to estimate surface runoff, evapotranspiration, baseflow, and soil moisture change for each hydrological respond unit (HRU) in a catchment area. The model will be evaluated based on the performance. Findings of thestudy will help in awareness and preparedness from the prevailing conditions at the catchment areawhich in turn will make it easy to mitigate or adapt to the current climatic condition and also help in obtaining information that will be used for climate change mitigation.

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Flood risk culture in the city of Tours: a work in progress

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Keywords: flood risk, sustainable flood memory, flood marks, Tours city

Abstract:

According to the flood risk prevention planning document of the Val de Tours - Val de Luynes (Plan de Prévention du Risque Inondation), approximately 100,000 people from Tours are threatened by flooding in the event of an exceptional flood leading to a disaster, a figure that is undoubtedly important, especially when one considers that the city of Tours has a population of approximately 137,000 inhabitants. In fact, Tours city is surroundered both by the Loire and the Cher rivers and is mainly located in their riverbeds. Because of this, the municipality is currently updating its information document for the population on major risks to prevent and plan evacuation in case of flooding events. By definition, the culture of risk is *"the awareness of vulnerability"* which allows "*the development and implementation of behaviors to protect against threats*" (Baud et al., 1995). Even though this terminology is widely debated within the scientific community, several concepts are often attached to it. Among them, there is the memory of risk. The memory of the risk represents *all the physical or immaterial traces that testify to the past of a risk that has become a hazard*. The concept of sustainable memory of risks adds that this memory applies for a form of social and cultural remembering of teaching and learning to live with floods (Garde-Hansen et al., 2017). In this paper, the question is how to start from a very low memory of risk and almost from zero culture or risk. In this purpose, we are studying the state of traces by starting from flood marks in the cities and to study how these are supporting or not a level of awareness in the inhabitants and then to analyze how these can offer a basis for raising flooding awareness and foresight in the city.

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Garde-Hansen J., McE. Lindsey A. Holmes, O. Jones Bath (2017). Sustainable flood memory: Remembering as resilience, *Memory Studies* 2017, Vol. 10(4) 384–405 https://journals.sagepub.com/doi/10.1177/1750698016667453

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Caractérisation des extrêmes pluviométriques par l'analyse des indicesclimatiques dans le nord savanicole ivoirien de 1981 à 2020

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Keywords: extrêmes pluviométriques, indices climatiques, nord savanicole, Côted'Ivoire.

Abstract:

La pluie est observée comme l'élément climatique le plus variable en Afrique subsaharienne. Singulièrement en Afrique de l'Ouest, depuis les années 1960, les hauteurs des pluies sont marquées par des évolutions extrêmes. Les régions ivoiriennes en générale et le nord savanicole particulièrement, n'est pas à l'abri de cette variabilité. Cette étude vise à caractériser l'évolution spatiale et temporelle des indices des extrêmes pluviométriques, à partir de la Théorie des Valeurs Extrêmes (TVE), à travers le calcul des indices des PRCPTOT, SDII, R95p, R95pTOT, R99p et R99pTOT. Les données des cumuls pluviométriques journaliers des stations météorologiques ont été analysées sur la période 1981-2020. Les résultats montrent qu'entre 1981 et 2000, une diminution généralisée des pluies suivant le gradient sud-nord et une reprise à partir de 2000.

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Living green wall (LGW) performances to treat real grey water

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Keywords: Green wall; Water treatment; Ornamental plant; Nutrients; Colour

Type of communication:
☐ Oral Communication
☒Poster

Abstract:

LGWs are increasingly being considered as a suitable, low cost and sustainable greywater treatment technology. Nevertheless, until now there have been no clear recommendations forthe use of effective lightweight media in greywater treating green walls. Previous studies of potentially suitable growing media have suggested that a combination of fast and low hydraulic loading media might be the most effective for these novel systems which overcome the issue of space intensive for greywater recycling. This study aims to treat greywater naturally using ornamental plant species that can be integrated vertically into green building structures and assess the main mechanisms occurring therein.

A pilot system was designed at the Centre for Water Research and Technologies, CERTE to treat real greywater for a period of two months in open greenhouse. Overall treatment performance and removal trends over the 32cm filter depth were monitored. Three separate wallsections were constructed to monitor the treatments effects of containing wall material choice (perlite and peat with report 1 : 2) and presence of vegetation (*Chlorophytum comosum*). The used greywater volume was 16L per day, the irrigation was performed during only five hours per day. In these conditions, the system achieved average reduction rates of over 56.87%, 69.36% and 40.47% for BOD5, $NH4^{+}$ and Mg^{2+} respectively.

Comparing to the unvegetated configuration, the plants achieved average removal efficiencies (RE%) of 53.86% for $N\text{-}NO3^{-}$, 57.01% for $PO4^{3-}$ (with high performance by 83.51%) and 37.75% for K^{+} (high performance by 58.17%).

The pH analysis showed a clear variation between influent and effluent with an average pH of 7.193 for effluents and 8.295 of influents with a fully concentration of greywater. For the EC analysis, there was no significant variation between unvegetated pots and Chlorophytum comosum (1.753 mS/cm) pots.

In contrast, the maturation stat, the rhizosphere and the foliar volume of plants have a great influence for the removal capacities. This study also showed the relation between the rhizosphere and the infiltration rate, which is great for Chlorophytum comosum configurations

The results of this study showed that Chlorophytum comosum can greatly treat greywater. Regardless of the removal performance, it was found that used peat was leaching nutrients that are beneficial to plant growth but disadvantageous to the quality of the effluent. Moreover, theleaching of humic acids resulted in a yellowish colour to the effluent, which is unwanted when the effluent is reused for flushing. Hence, other substrates should be thoroughly evaluated inthe future.

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