10th International Conference on Fluvial Hydraulics
July 7-10, 2020

# Evaluating future climate-driven changes in flood hazard in Northwest Spain coastal river reaches

María Bermúdez[1], Luis Cea[2], Javier Sopelana[3]

[1] Environmental Fluid Dynamics Group, Andalusian Institute for Earth System Research, University of Granada, Spain

[2] Water and Environmental Engineering Group, University of A Coruña, A Coruña, Spain

[3] Aquática Ingeniería Civil, Vigo, Spain

mariabermudez@ugr.es

# Introduction and aim of this study

- Coastal river reaches are vulnerable to flooding from multiple sources: coastal (storm surge, tide…) and inland (rainfall, discharge…).
- Global warming is changing the magnitude and frequency of extreme precipitation and sea level events.

AIM: Develop a methodology to explore the individual role of each source in the extreme water levels and to evaluate climate-driven changes in flood hazard integrating all source contributions.


Test case: River Mandeo, NW Spain

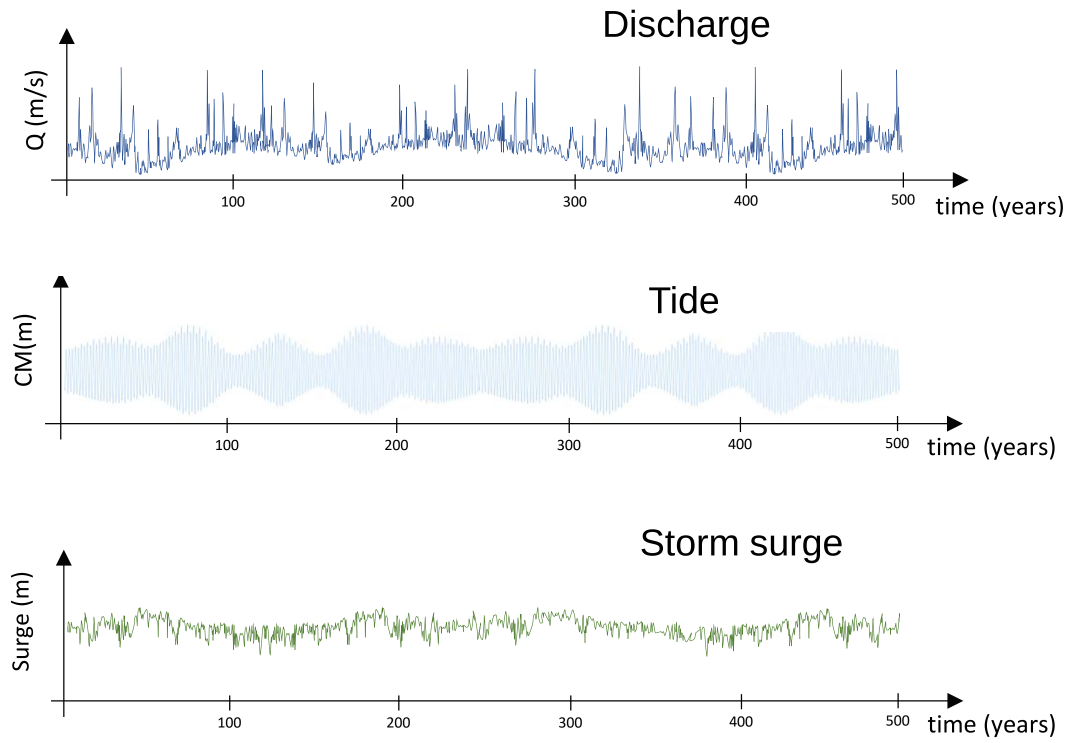
UNIVERSIDAD DE GRANADA

aquática INGENIERÍA CIVIL

UNIVERSIDADE DA CORUÑA

# Methodology
## Compounds events continuous simulation of along-river water levels

(1) Generation of synthetic long-term daily series of the relevant flood sources representing: current conditions / future projections




UNIVERSIDAD DE GRANADA

aquática INGENIERÍA CIVIL

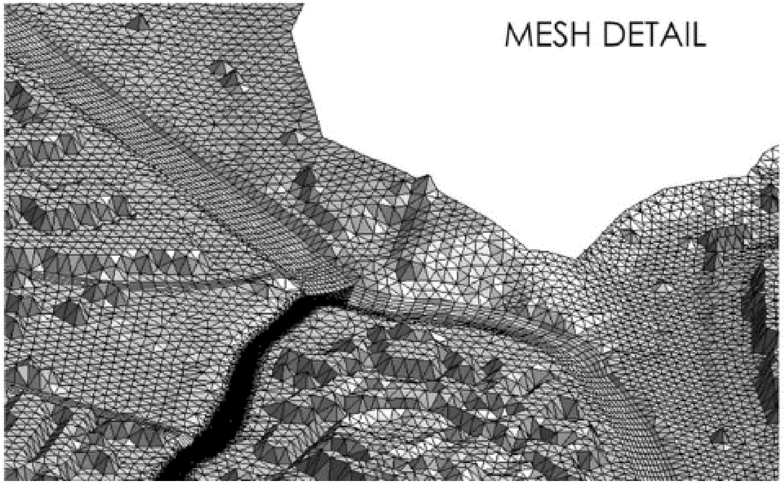
UNIVERSIDADE DA CORUÑA

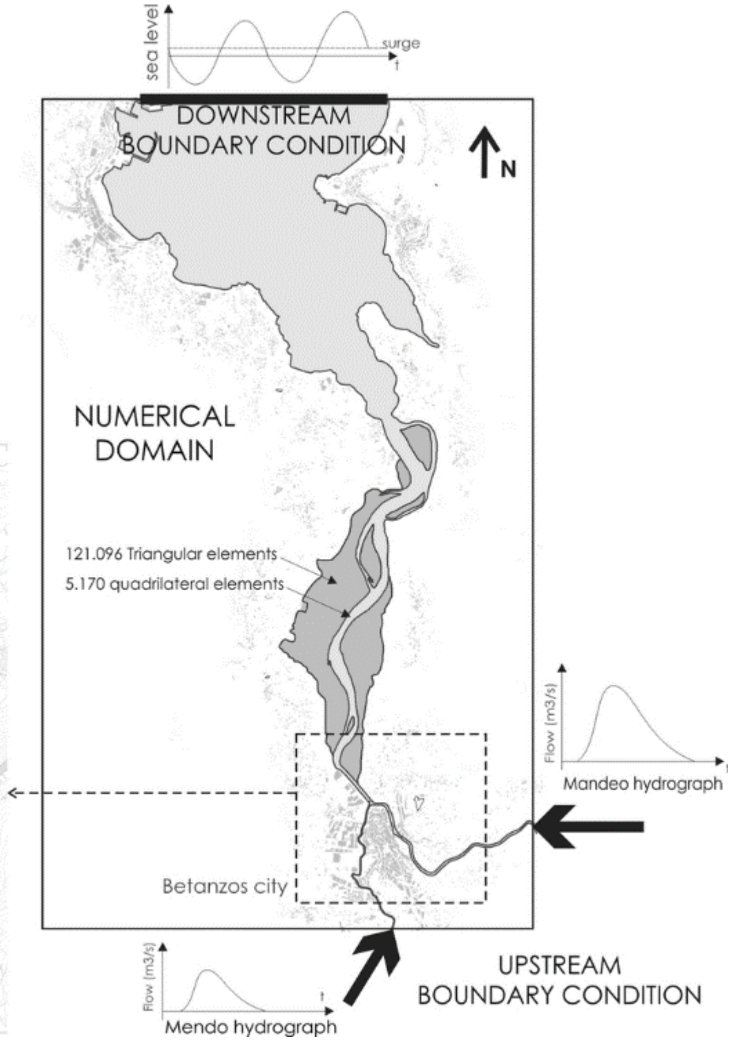
# Methodology

## Compounds events continuous simulation of along-river water levels

(2) Selection of characteristic days and simulation by a 2D shallow water model

www.iberaula.es



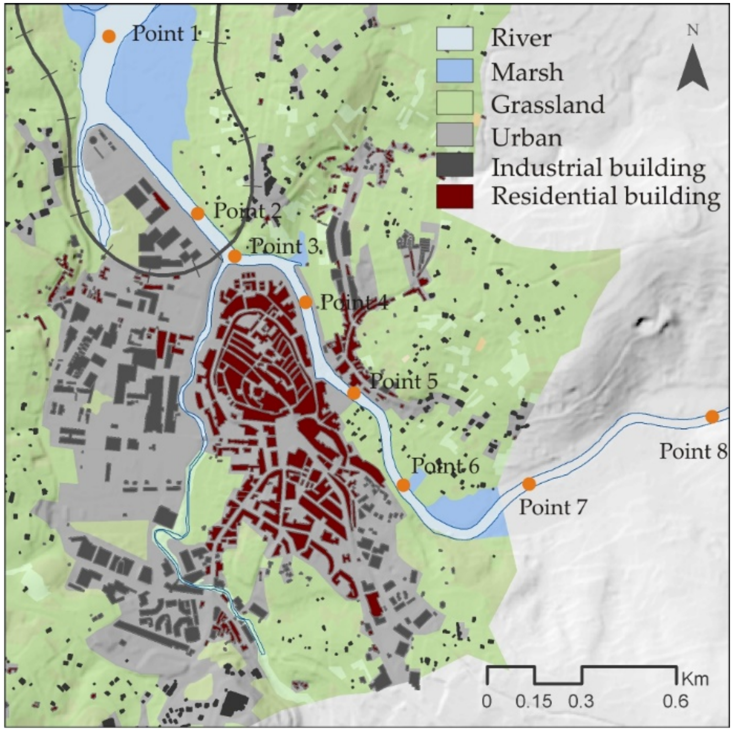



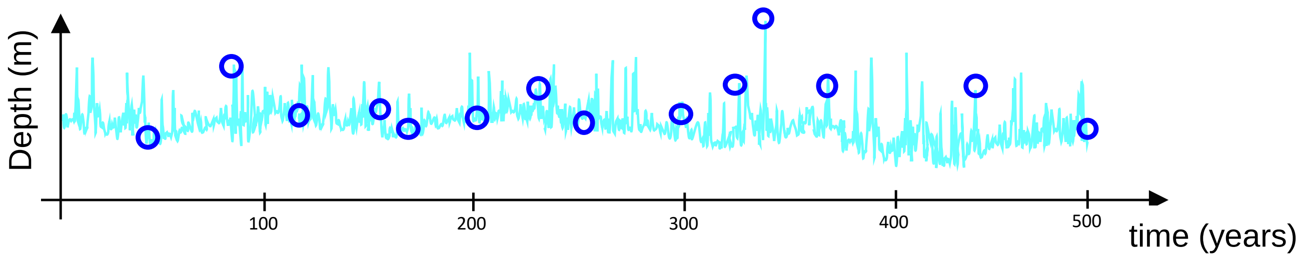
# Methodology

## Compounds events continuous simulation of along-river water levels

(3) Calibration of a computationally efficient surrogate model based on Least Squares Support Vector regression -> Daily maximum water depth at control points

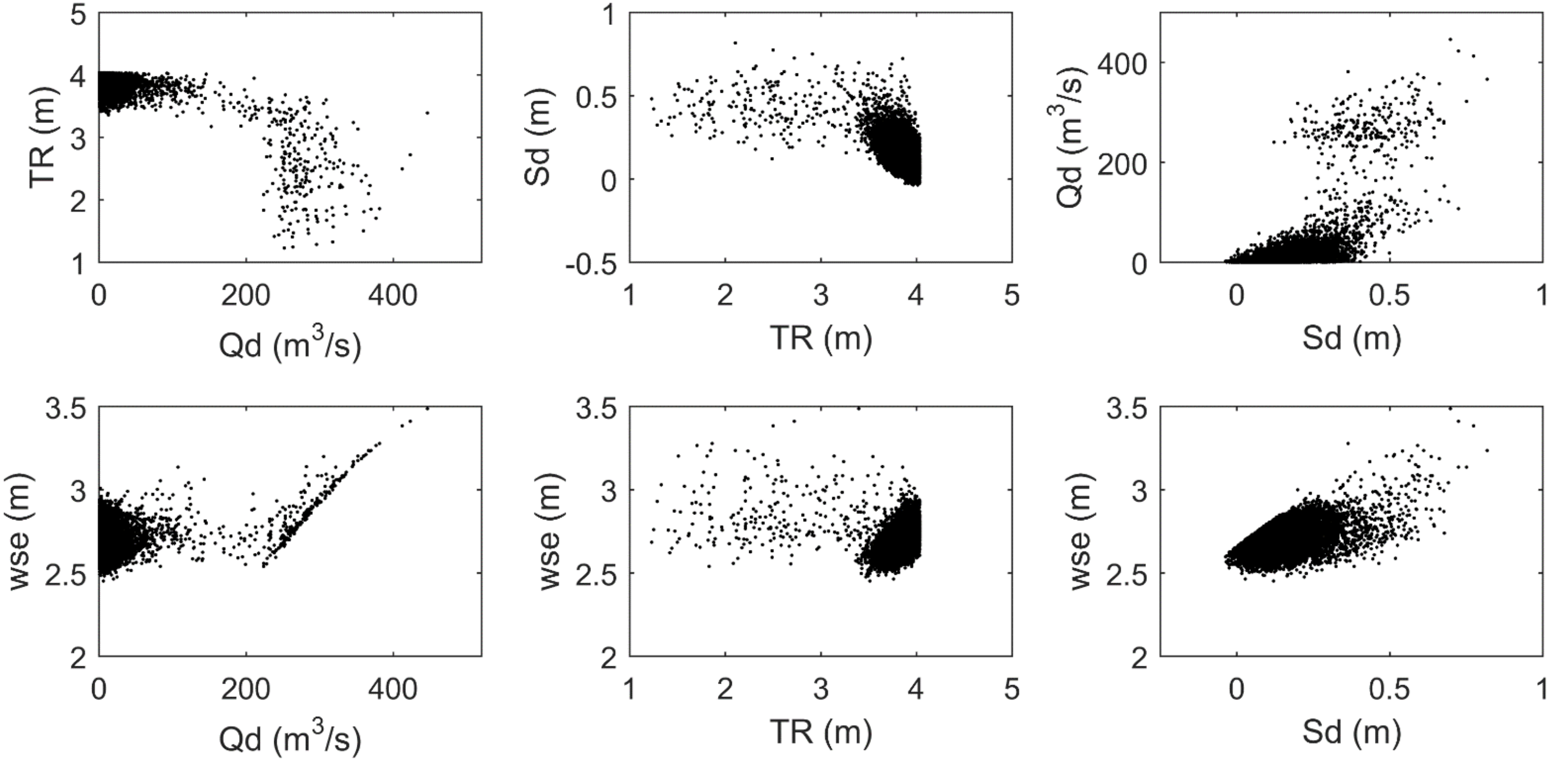
(4) Reconstruction of long-term time series of maximum water depth -> Probabilities of exceedance of water levels



# Results
# **Annual maximum water levels**

- Analyze the combinations of flood sources that are responsible of the maximum water surface elevations




Annual max. wse at control point 1 and associated discharge (Qd), tidal range (TR) and storm surge (Sd)

UNIVERSIDAD DE GRANADA

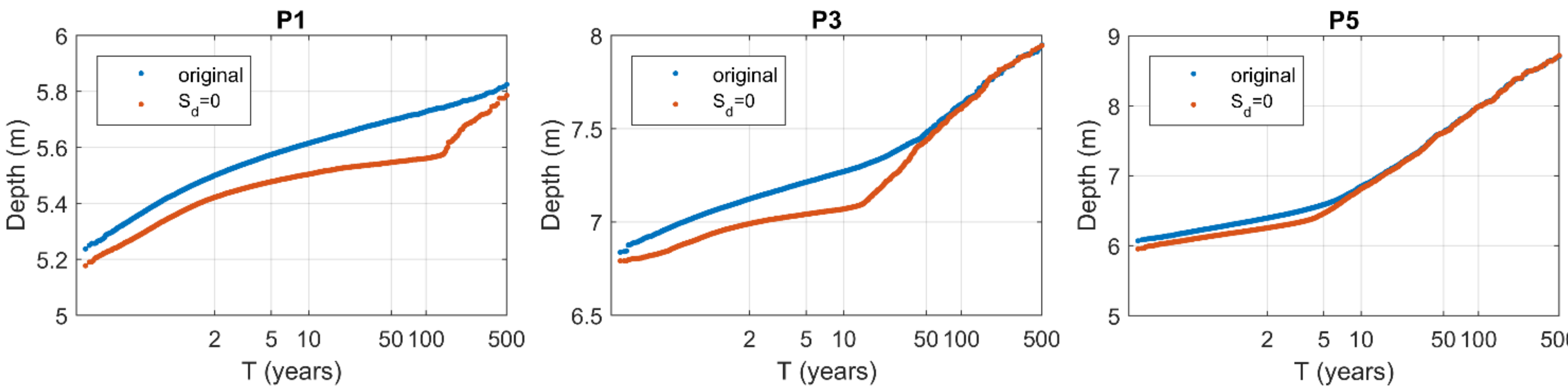
aquática INGENIERÍA CIVIL

UNIVERSIDADE DA CORUÑA

# Results

## Depth frequency distribution: current conditions

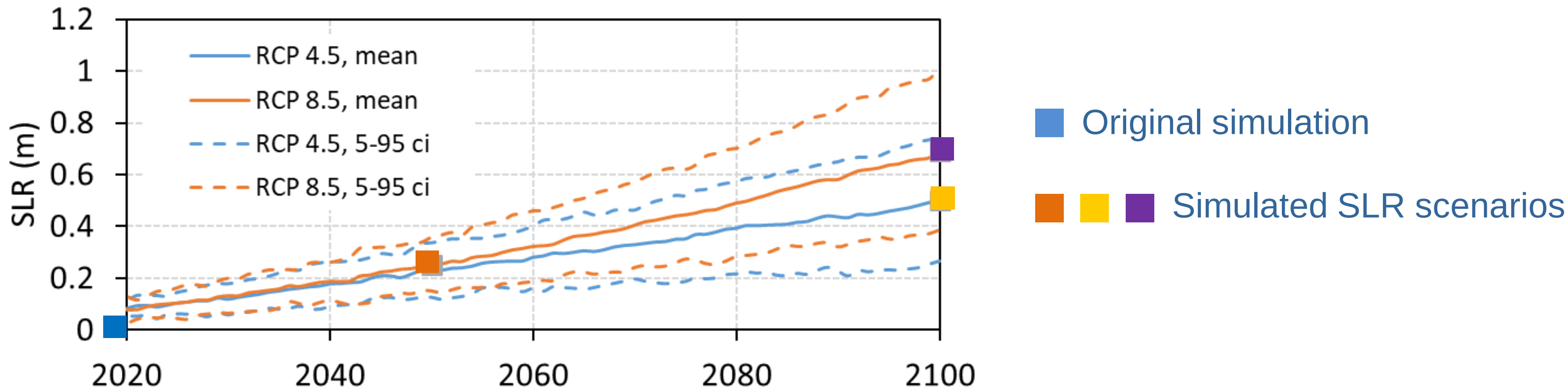
- Estimation of the return period jointly considering the relevant flood sources and their combinations.
- Quantify how return water level estimates vary if the contribution of certain sources are neglected, depending on the location within the reach.

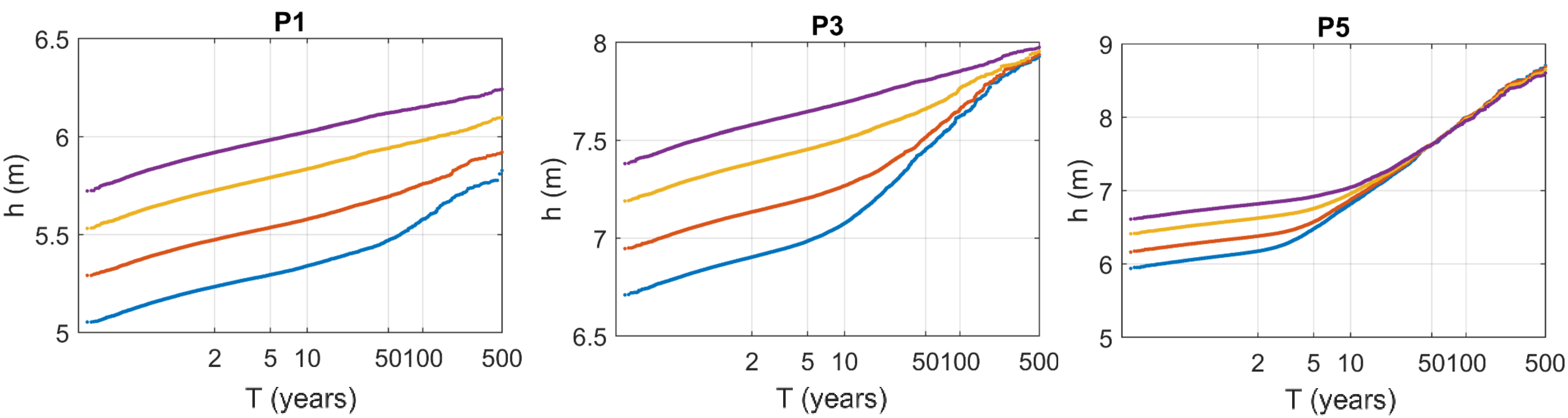



Depth frequency distribution considering all sources (original), and neglecting storm surge (Sd=0)

# Results

# Depth frequency distribution: future conditions




Depth frequency distribution with the reference simulation and the simulations that consider sea level rises

UNIVERSIDAD DE GRANADA

aquática INGENIERÍA CIVIL

UNIVERSIDADE DA CORUÑA

# Further reading and acknowledgements

**Bermúdez, Cea & Puertas.** *A rapid flood inundation model for hazard mapping based on least squares support vector machine regression.* **Journal of Flood Risk Management, 2018.**

**Sopelana, Cea & Ruano.** *A continuous simulation approach for the estimation of extreme flood inundation in coastal river reaches affected by meso- and macrotides.* **Natural Hazards, 2019**

**Bermúdez, Cea & Sopelana.** *Quantifying the role of individual flood drivers and their correlations in flooding of coastal river reaches*. **Stochastic Environmental Research & Risk Assessment, 2019.**

athenea 3i

**MSCA-COFUND-Athenea3i 2017**

Flood risk analysis under global warming for long-term coastal cities planning

UNIVERSIDAD DE GRANADA

OFPI Oficina de Proyectos Internacionales

European Commission

UNIVERSIDAD DE GRANADA

aquática INGENIERÍA CIVIL

UNIVERSIDADE DA CORUÑA

# Coming soon…


IAHR
AIRH
Hosted by
Spain Water
and IWHR, China
39th IAHR
WORLD CONGRESS
GRANADA, SPAIN 2021
From Snow to Sea
www.iahrworldcongress.org
4-9 July 2021
#FromSnowToSea
Organized by:
International Association
for Hydro-Environment
Engineering and Research
UNIVERSIDAD
DE GRANADA
IWHR
SPAIN WATER
Congress Secretariat:
KENES
GROUP

39th IAHR WORLD CONGRESS
GRANADA, SPAIN 2021
From Snow to Sea

IAHR AIRH
Hosted by Spain Water and IWHR, China

www.iahrworldcongress.org
4-9 July 2021

## Theme 8

# Extreme events: from droughts to floods

This theme addresses extreme events, the occurrence and severity of which is expected to increase in the coming years as a result of climate change (among other aspects).

---

8.a. Droughts prediction and management; impacts of climate change
8.b. Tsunamis, storm surges and effects of tropical storms under rising sea levels
8.c. Flood risk assessment, mitigation and adaptation measures
8.d. Urban flood management
8.e. Flood recovery and resiliency
8.f. Impact of global change on extreme environments (cold/arid regions)
8.g. Adaption to climate change: guidance to engineering design