Effort and performance of the management of water for agriculture under climate change in Southern Europe

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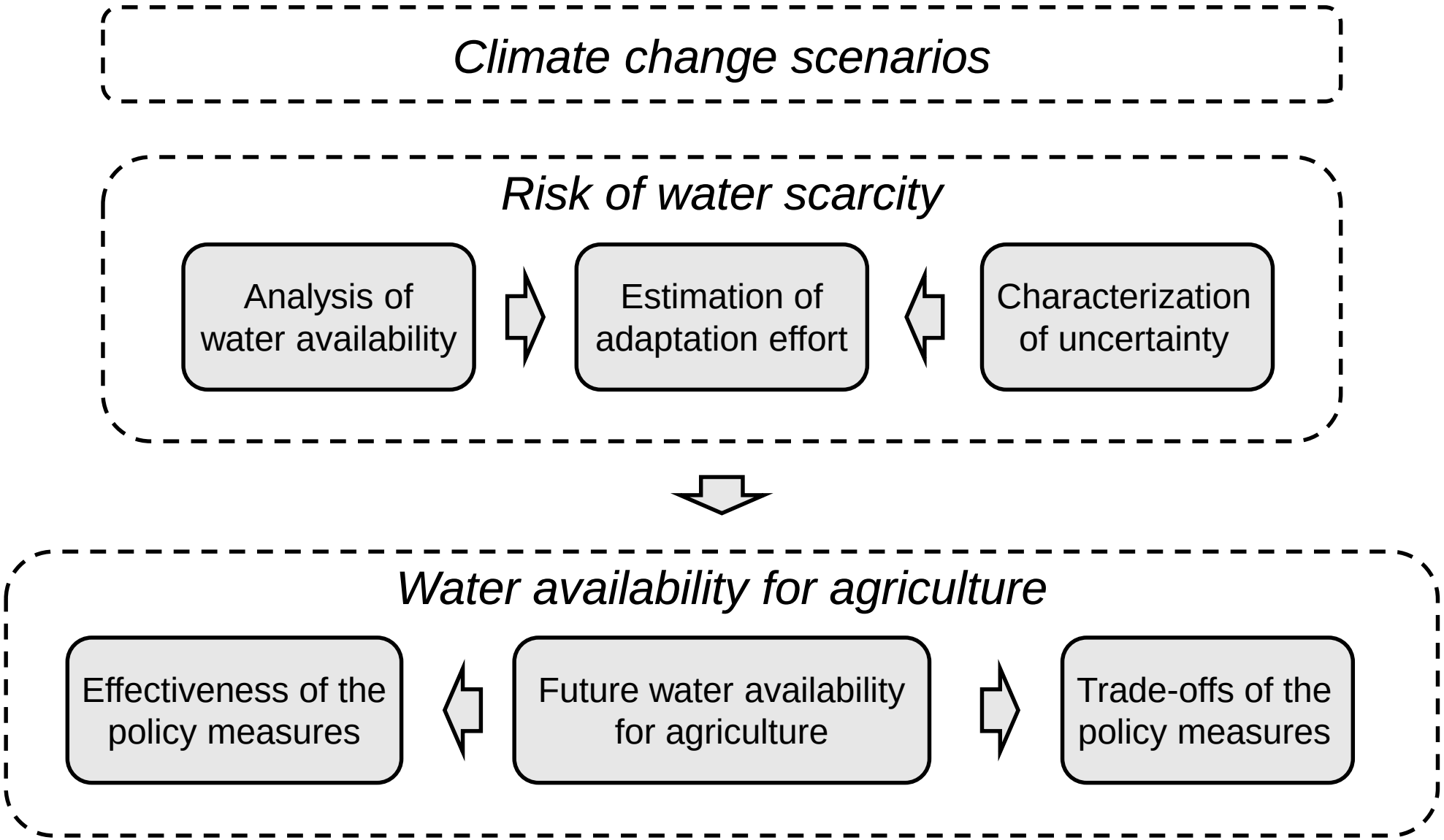
Introduction

- **Water availability**
  - Maximum demand than can be supplied at a given point in the river network under certain conditions
  - Focus: water availability for irrigation once urban demand is satisfied

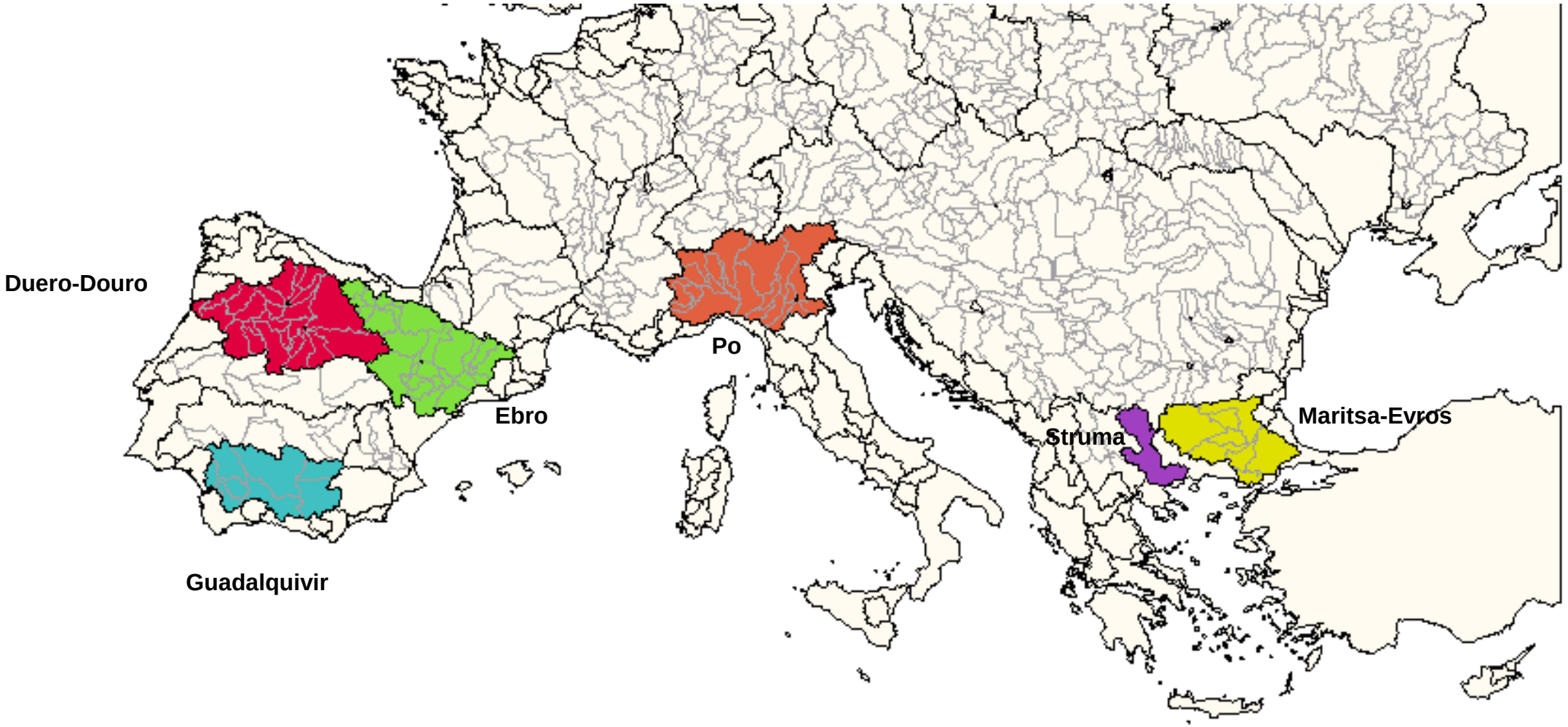
- **WAAPA model to account for reservoirs in water resources systems**
  - Components: streamflow, storage, demands and environmental flows
  - Analysis under current and climate change scenarios

- **Effort and performance of management measures**
  - Study the effect of policy measures required to maintain irrigation water availability in river basins
  - Analysis of increased storage, increased water efficiency for urban use and water allocation to environmental flows

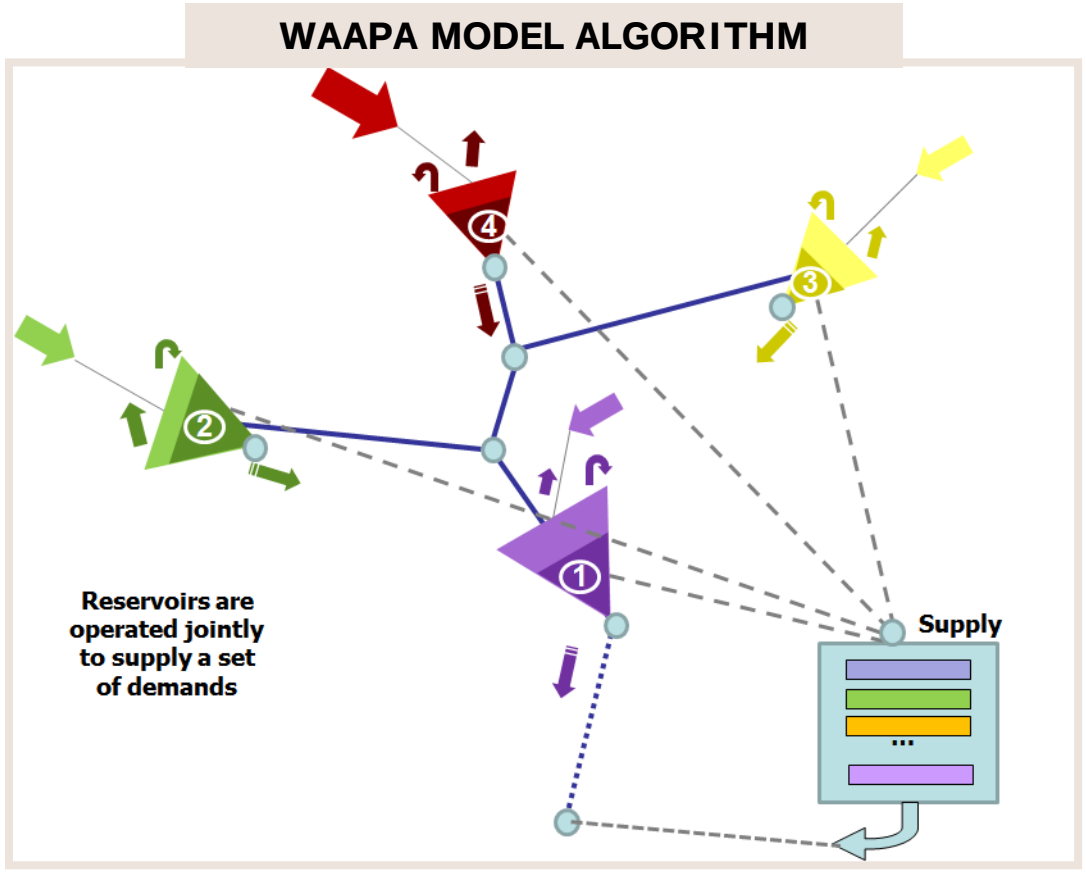
Approach


Climate change scenarios
Risk of water scarcity
Analysis of water availability
Estimation of adaptation effort
Characterization of uncertainty
Water availability for agriculture
Effectiveness of the policy measures
Future water availability for agriculture
Trade-offs of the policy measures

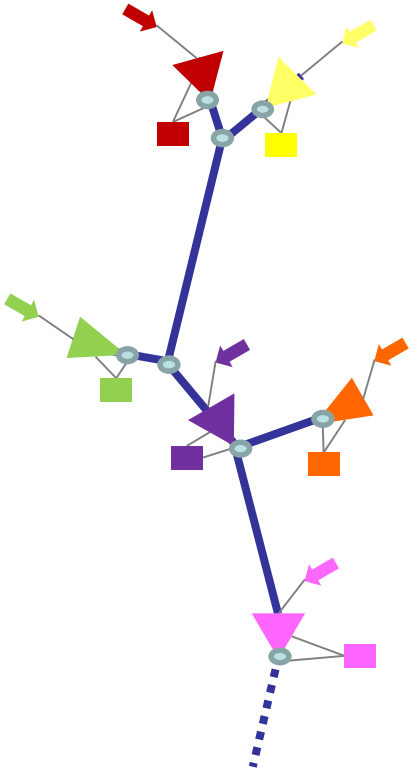
Case study: Six basins in Europe



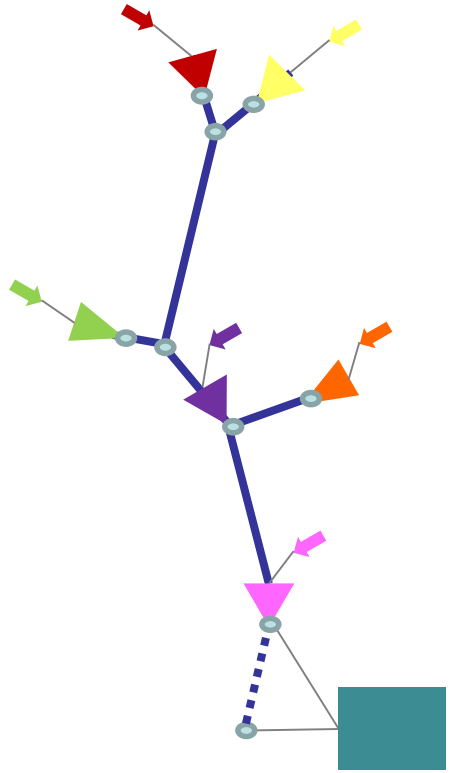
WAAPA : Water Availability and Adaptation Policy Analysis



Local management



Global management



Building geographical data: reservoir location

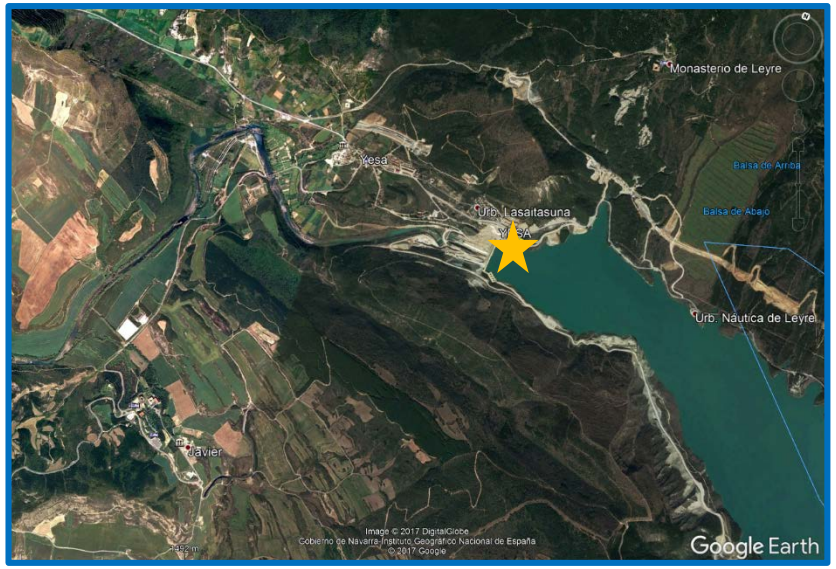
USGS science for a changing world
Long Term Archive

GTOPO30
Hydro1k
Dataset

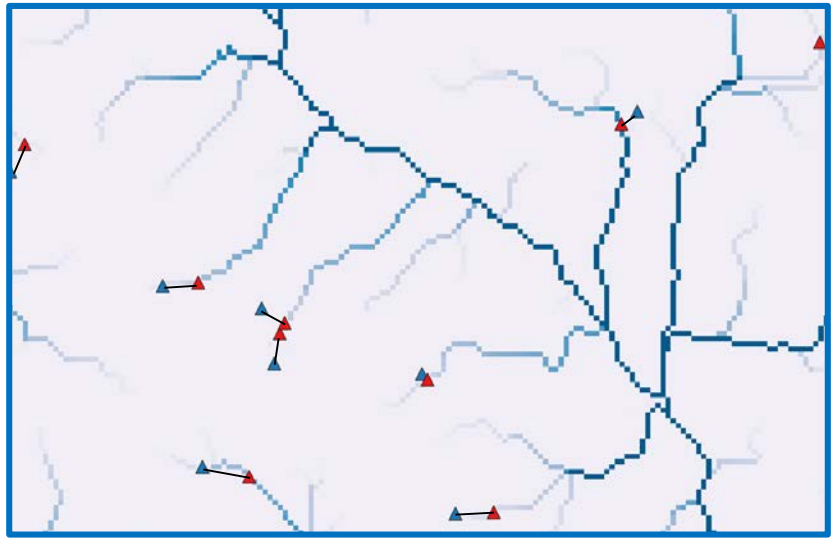
CIGB ICOLD
COMMISSION INTERNATIONALE DES GRANDS BARRAGES
INTERNATIONAL COMMISSION ON LARGE DAMS

World Register of Dams

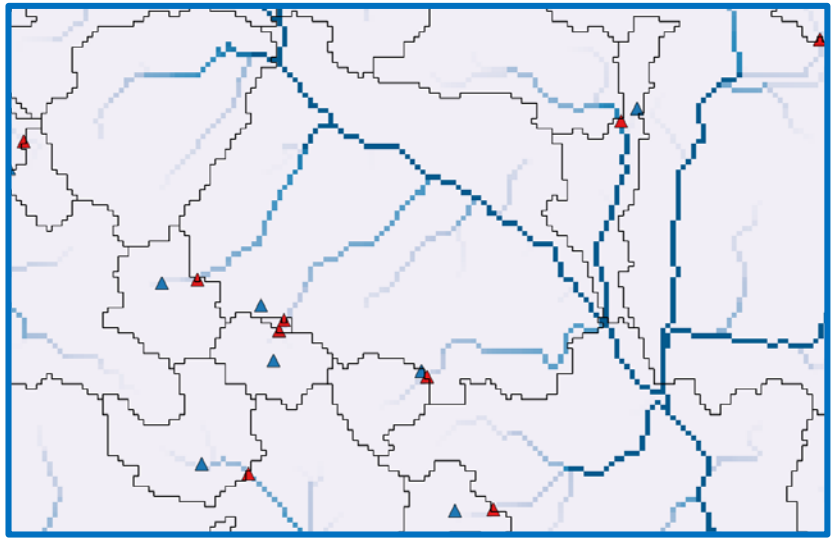
Dams georeferenced in Google Earth



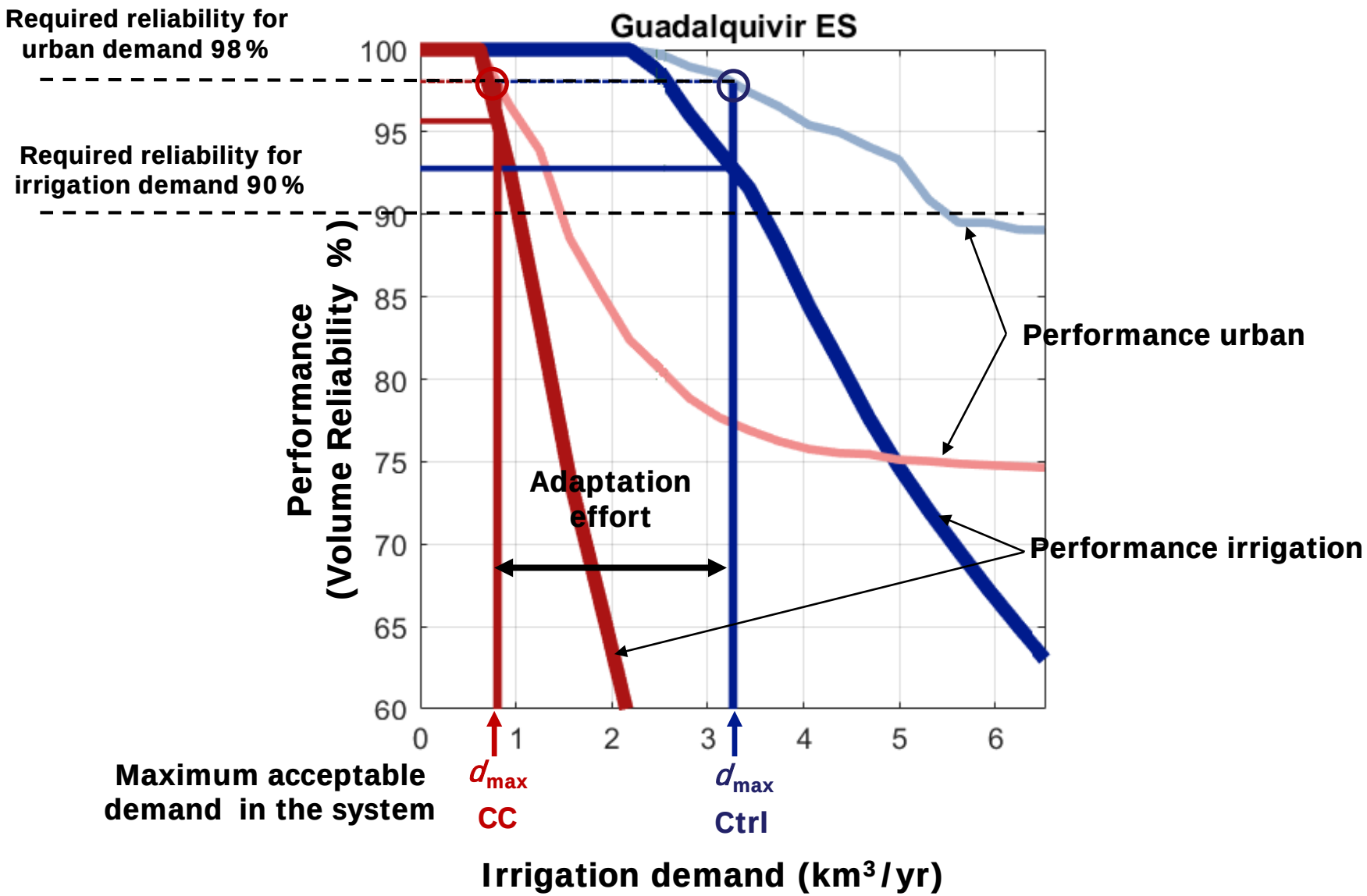
Dams aligned to Hydro1k rivers



Basin delineation



Water availability analysis



Climate scenarios

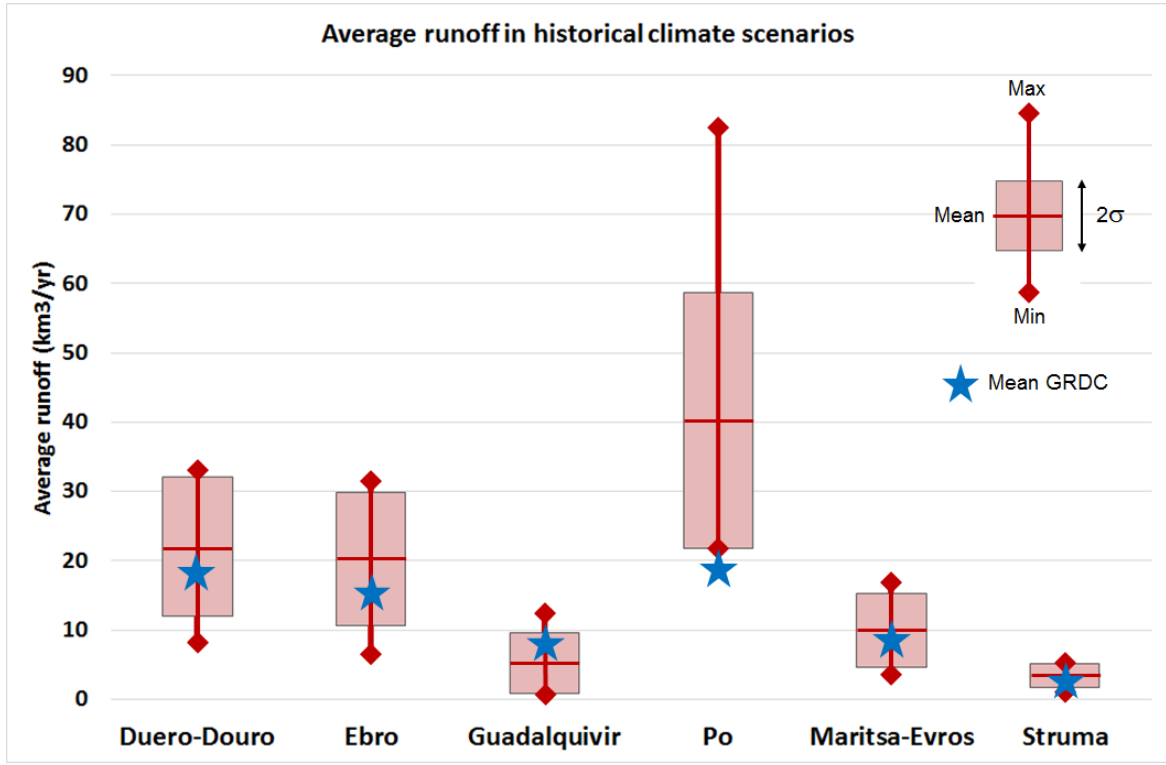
- Multiple scenarios were compiled from different sources

- Runoff from RCMs in PRUDENCE project
  - Eight climate models: DMI, ETHZ, GKSS, ICTP, KNMI, MPI, SMHZ, UCM
  - Two SRES projections: A2, B2

- Runoff from RCMs in PRUDENCE project
  - Three climate models: CRNM, KNMI, ETHZ
  - One SRES projection: A1B

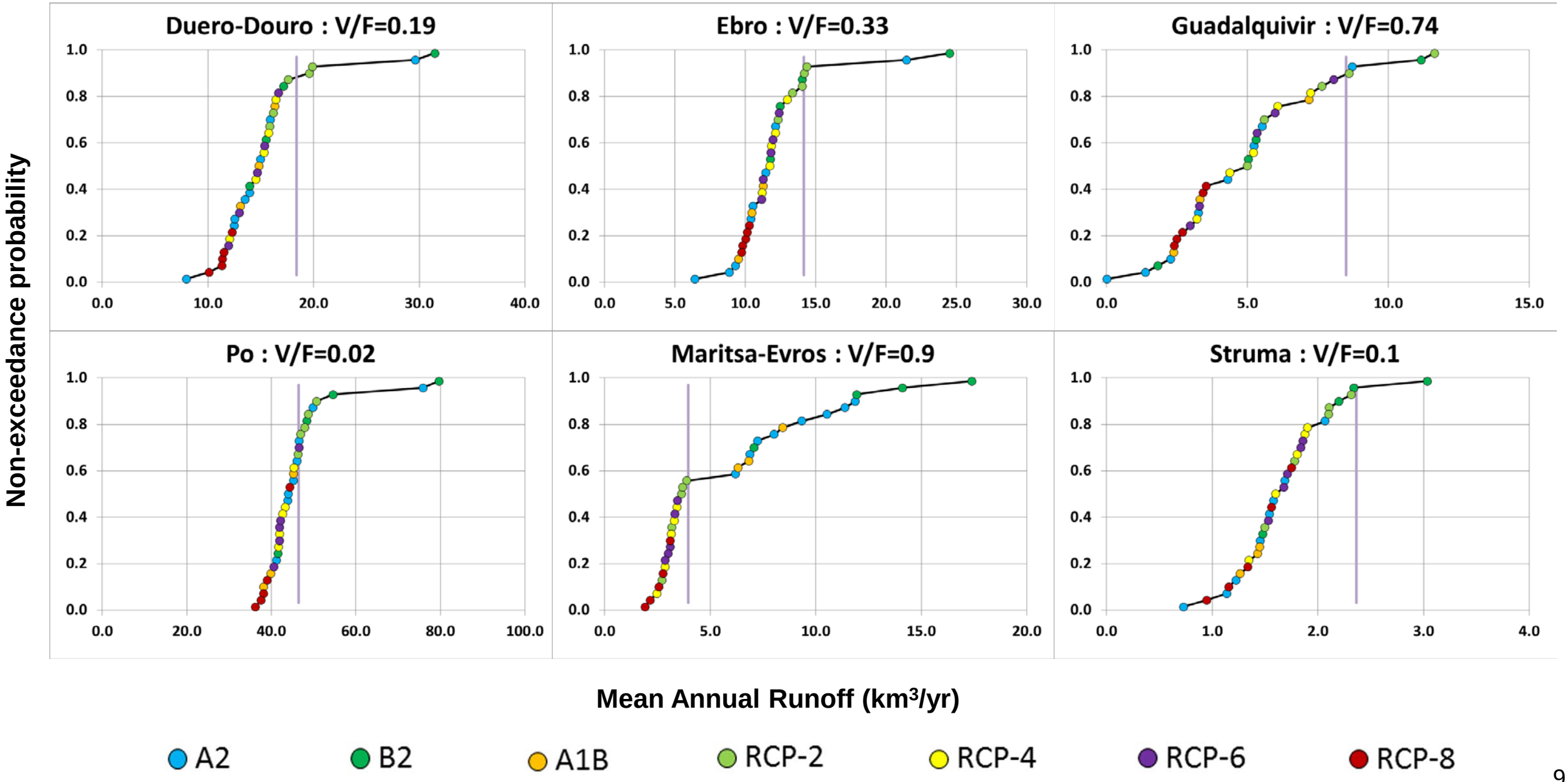
- Runoff computed with PCRGLOBWB model in the ISIMIP experiment
  - Five climate models: GFDL-ESM2NM, HadGEM2-ES, IPSL-CM5A-LR, MIROC-ESM-CHEM and NorESM1-M
  - Four RCP projections: RCP2P6, RCP4P5, RCP6P0 and RCP8P5

Validation against GRDC data

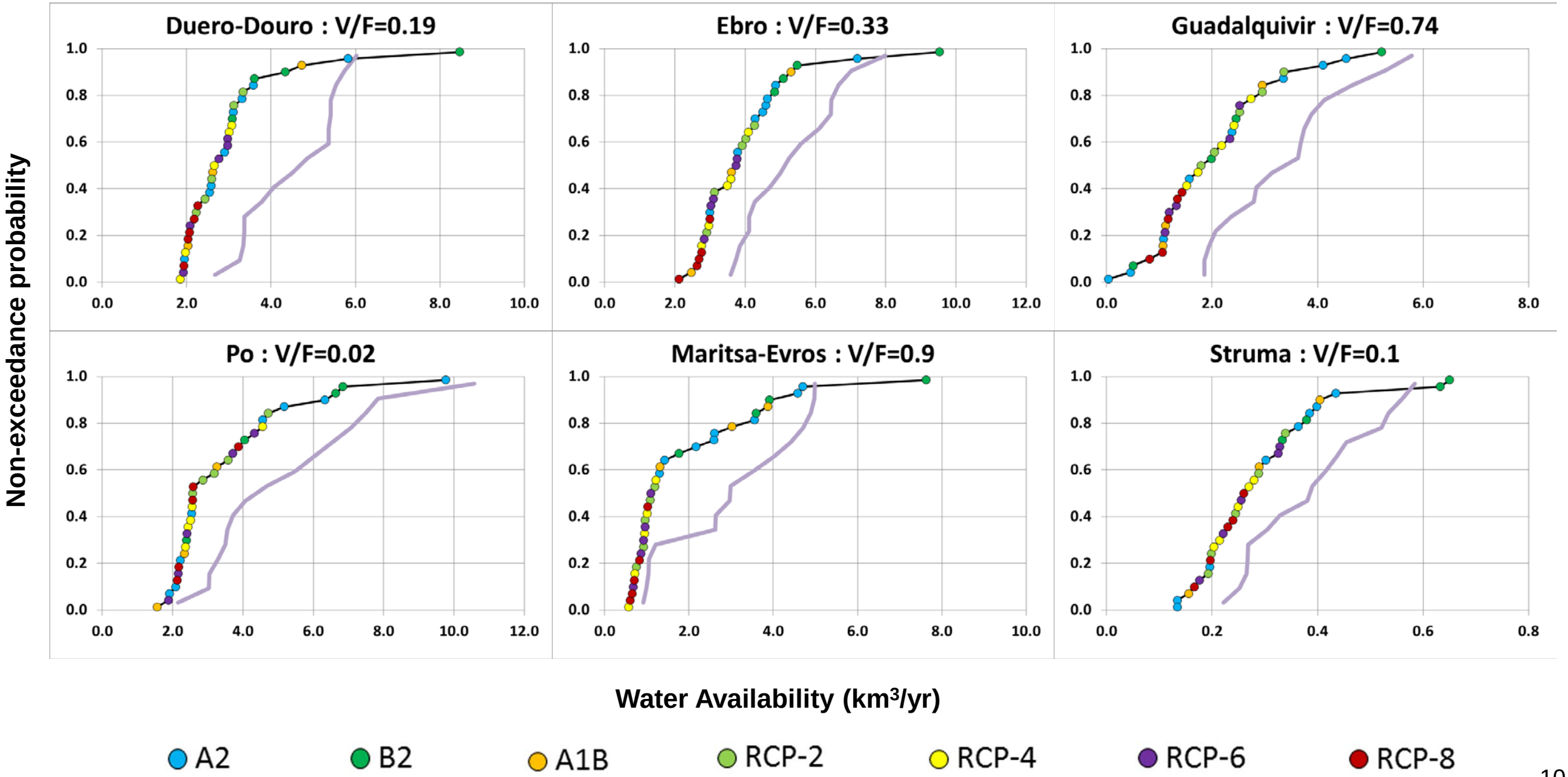


- Streamflow data had to be corrected for bias

Results for climate forcing: model and scenario uncertainty

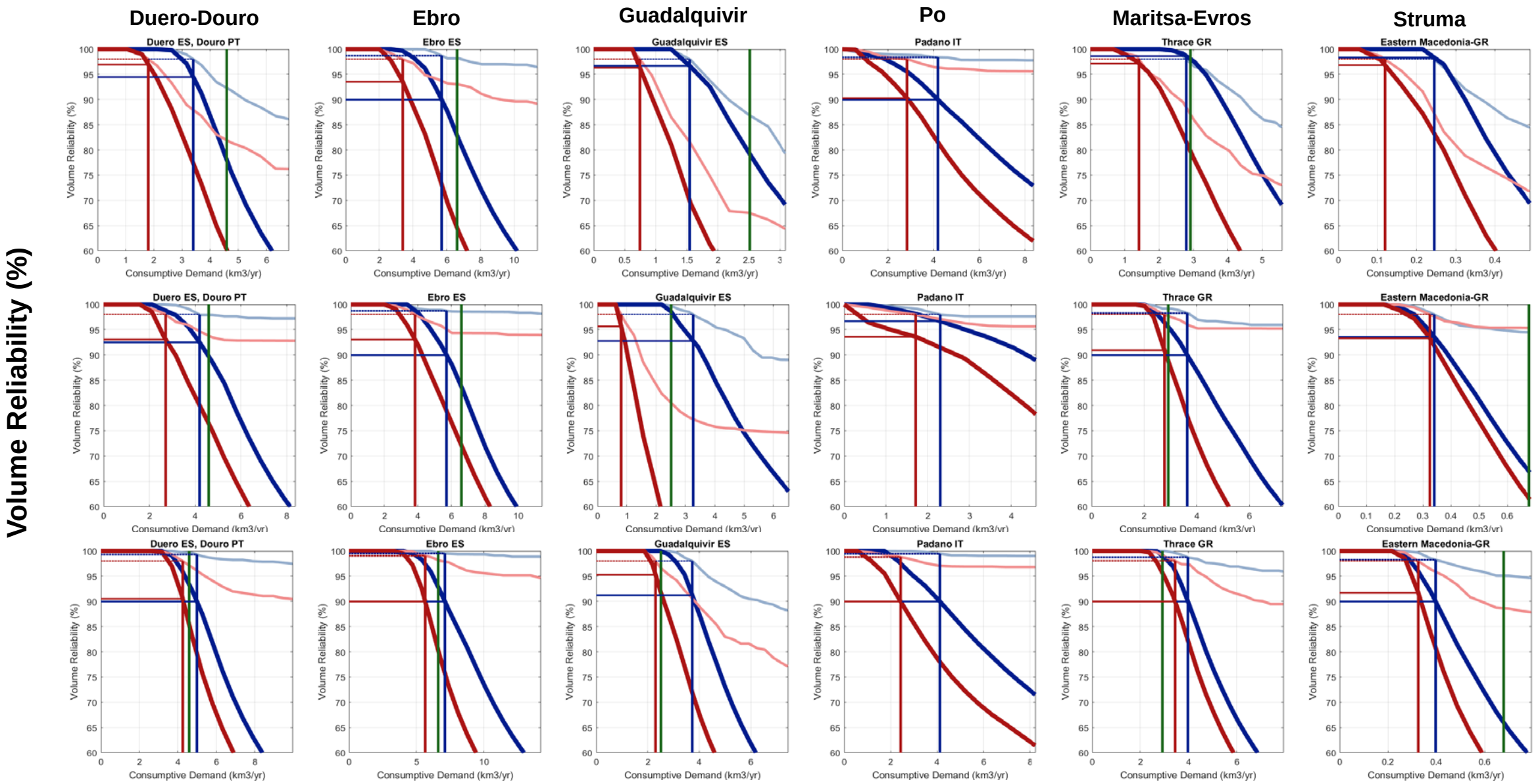


Results for water availability: model and scenario uncertainty



Results for water availability: adaptation effort

A1B emission scenario; long term 2060-2099

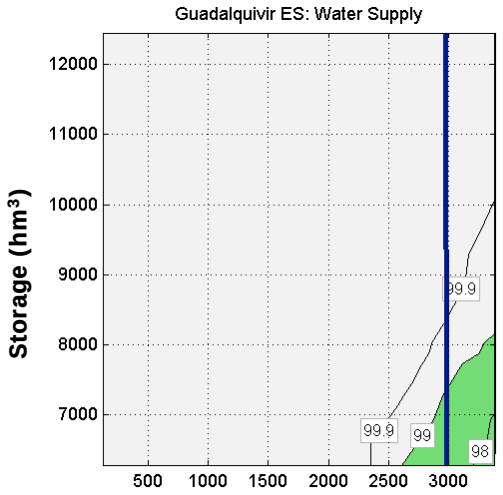
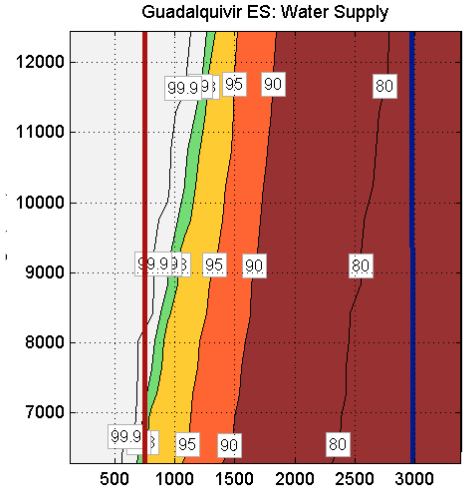
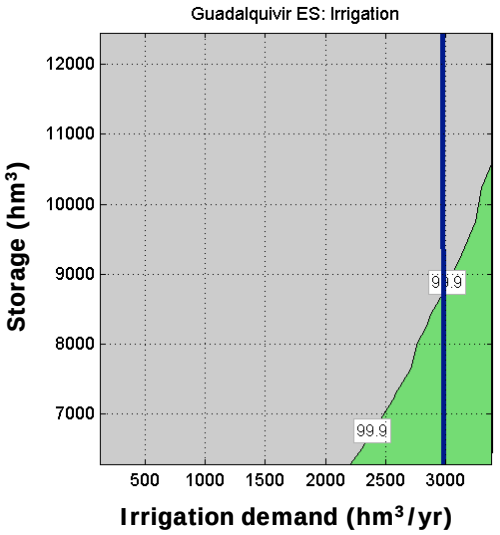
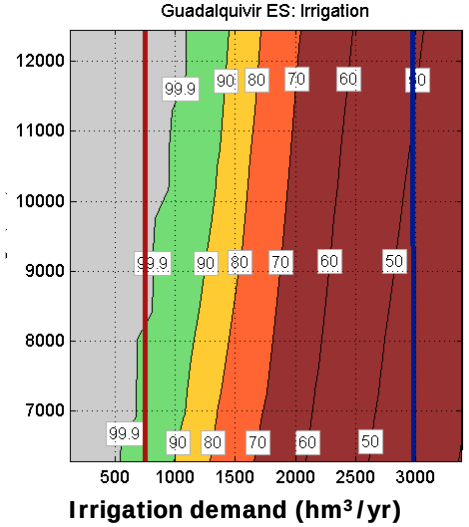


Adaptation options

- **Policy target**
  - Maintain acceptable reliability under climate change scenarios
- **Main policy action**
  - Demand reduction to maintain reliability under climate change
- **Additional policy actions**
  - Supply enhancement through increased reservoir storage
  - Increase water efficiency in urban use
  - Modify environmental flow conditions

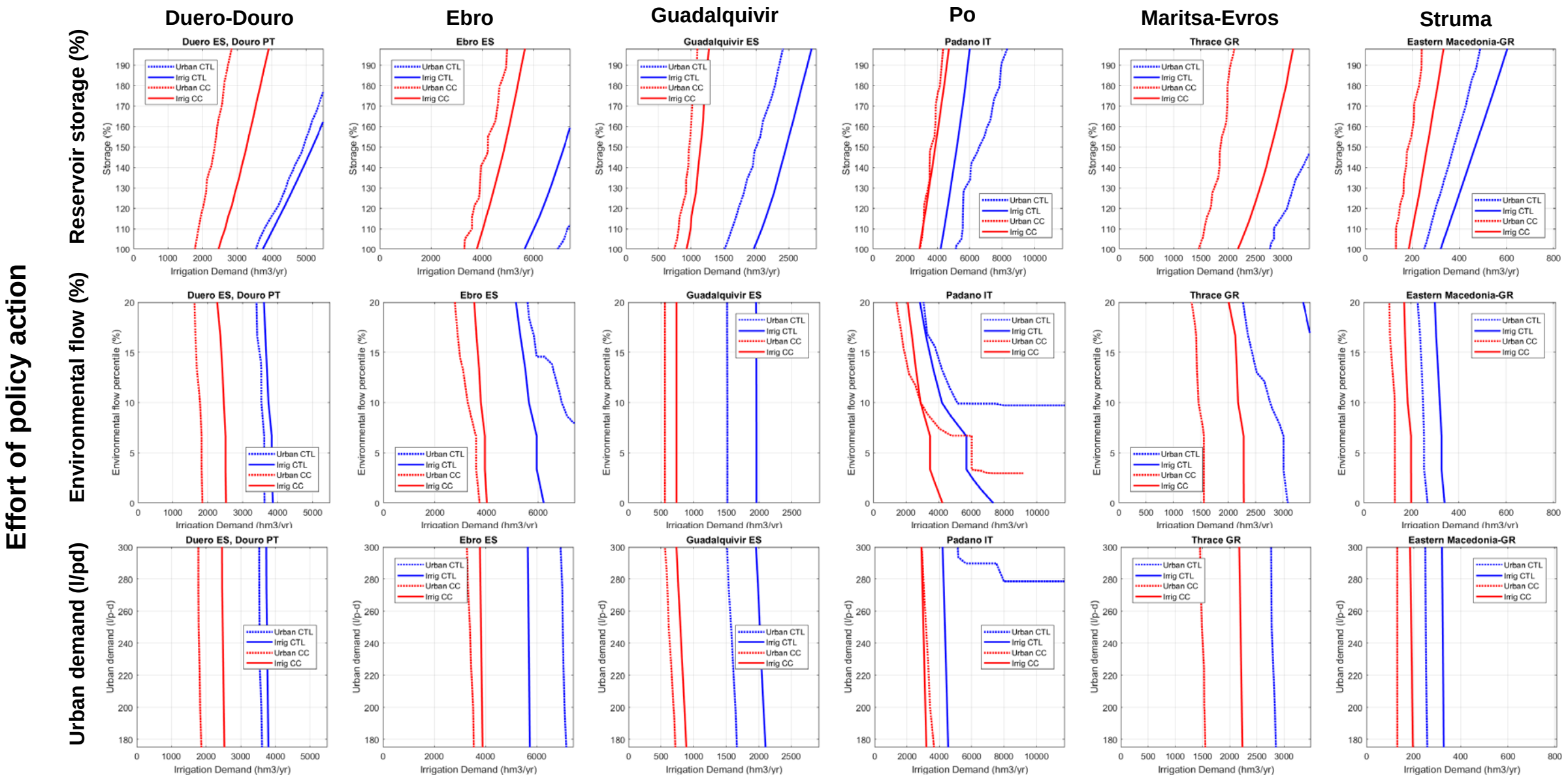
Sensitivity of Demand-Reliability Curve to Public Policy

GUADALQUIVIR BASIN: INCREASE RESERVOIR STORAGE

	CONTROL: KNMI 1960-1990	CLIMATE CHANGE: KNMI 2070-2100
URBAN WATER SUPPLY		
IRRIGATION		

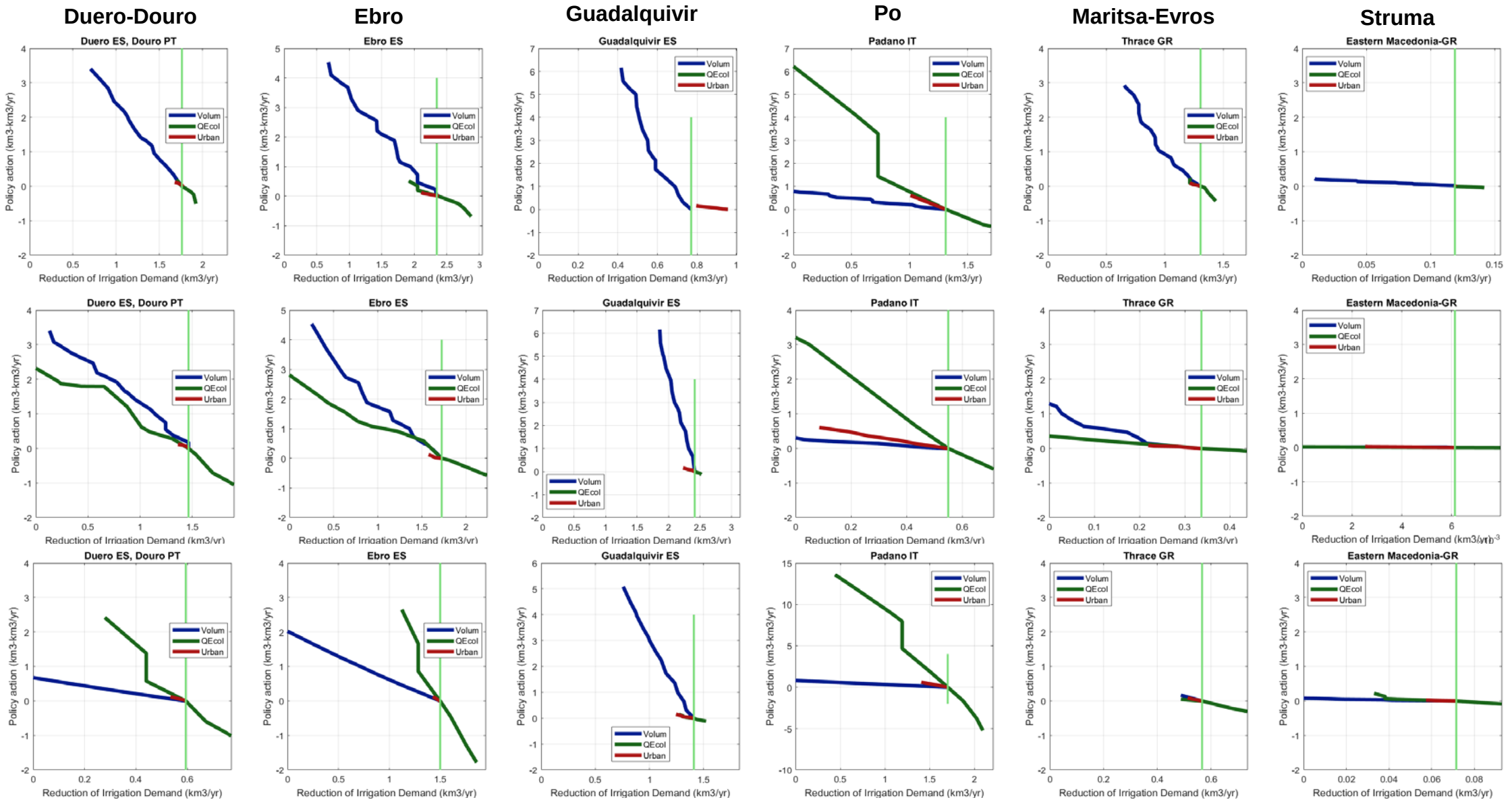
Results for policy actions: effect on irrigation availability

A1B emission scenario; CRNM model; long term 2060-2099



Results for water availability

A1B emission scenario; long term 2060-2099



Conclusions

- **Climate forcing and water availability**
  - All basins under study will have to reduce water allocation to irrigation
  - In some cases the adaptation effort will have to be very large
  - There is still very large model and emission scenario uncertainty

- **Adaptation policy**
  - Analyzed policies may compensate adverse effects of climate change on water availability, but only to some extent
  - The effectiveness and the required intensity of policy options depends on location: current water use, reservoir storage and hydrologic regime
  - Reservoir storage would require very large investments
  - Water efficiency of urban use has little scope
  - Water allocation to environmental flow shows the largest impact

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