

# Land Surface Hydrology in the European High-resolution Regional Reanalysis UERRA

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**MÉTÉO-FRANCE - CNRM-UMR3589**

EMS 2018 Annual Meeting, Budapest

# Outline

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- Context and motivation
- Modelling system
- Water balance components
- Hydrological evaluation

# Context and Motivation

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## □ UERRA

- Development and production of an ensemble system of regional reanalysis
- Estimation of ECVs and their uncertainties

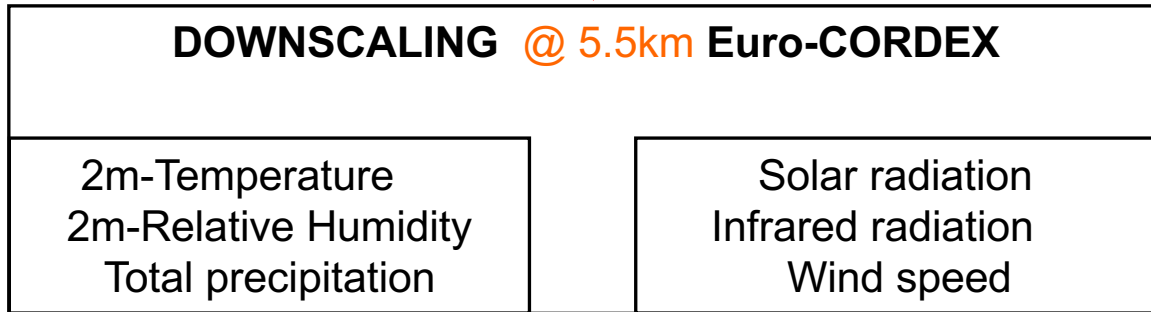
## □ Motivation of the study

- To use the 1961-2015 55-yr high-resolution reanalysis over Europe
- To setup a coupled hydro-meteorological modelling system
  - To assess the reanalysis quality among discharges (independent variables)
    - For the main European rivers
  - **To provide the users:**
    - An estimate of land surface water balance components
      - » Applications: agriculture, droughts, irrigation, ...
    - An evaluation of simulated discharges against measurements
      - » To be compared to existing systems like EU-HYPE, EFAS for floods, ...

# Hydro-meteorological Modelling System

**ALADIN 3D-VAR 6h @ 11km**

*Bubnova et al., 1995*



Surface  
Obs

**MESCAN @ 5.5km**

*Soci et al., 2013*

No feedback to atm.

**Land Surface Model  
SURFEX @5.5km**

*Masson et al., 2013*

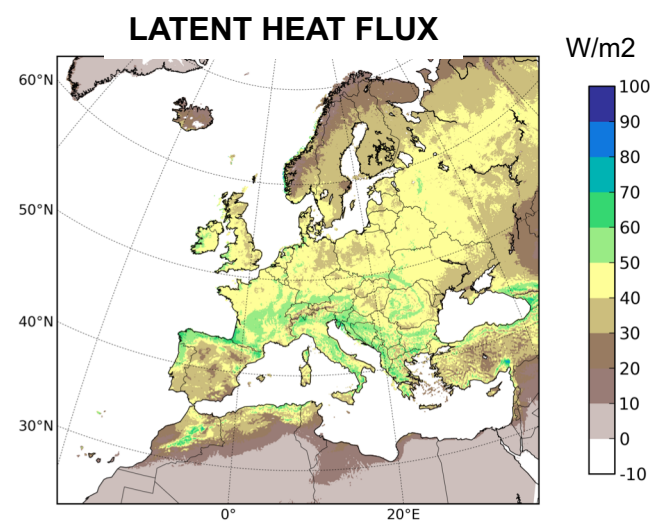
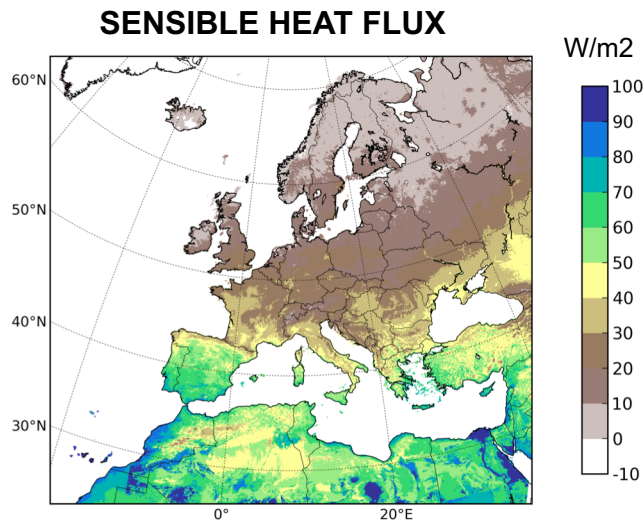
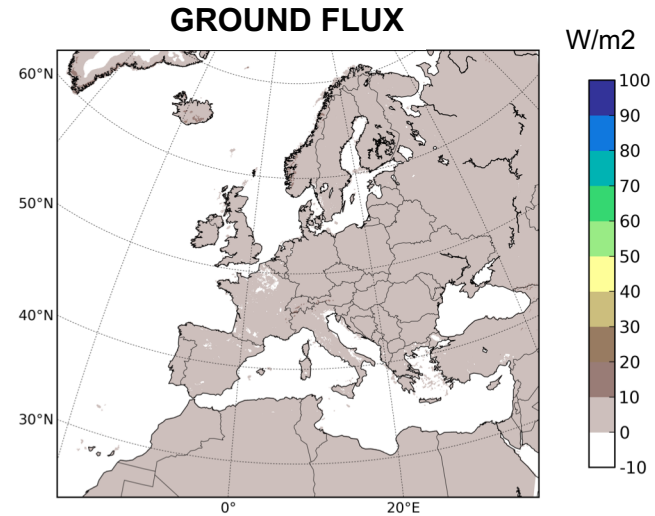
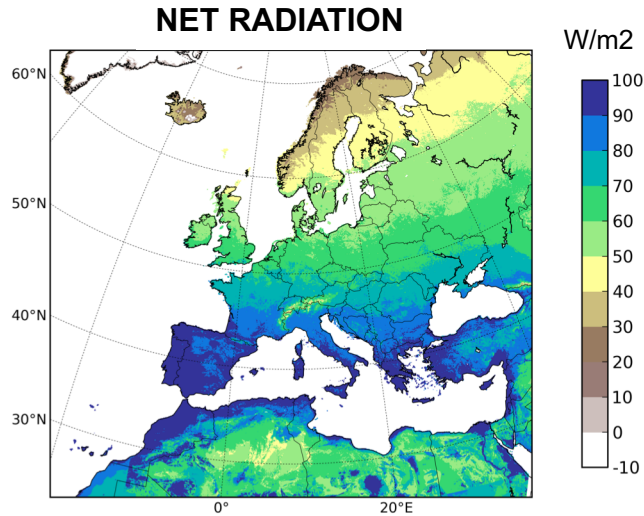
Surface ECVs  
soil moisture,  
snow, etc.

River discharge, Water  
table height, floodplain  
fraction

**Hydrological Model  
CTRIP @ 0.5°**

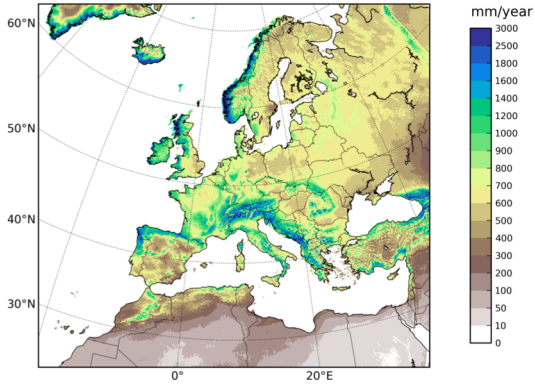
*Decharme et al., 2011*

# SURFEX Energy Budget: 1961-2015

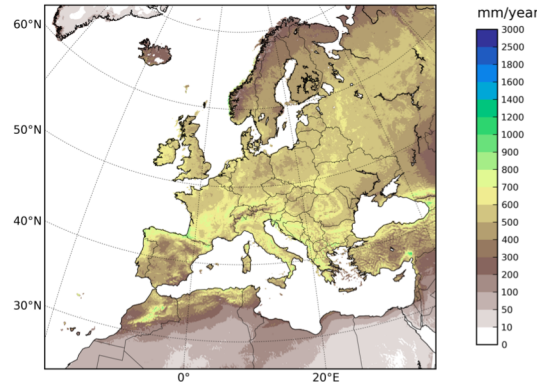


# SURFEX Water Budget: 1961-2015

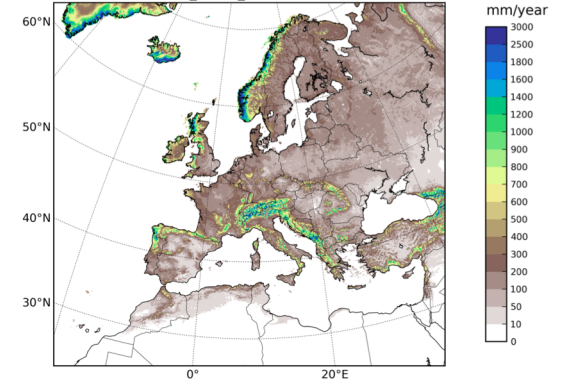
## PRECIPITATION P



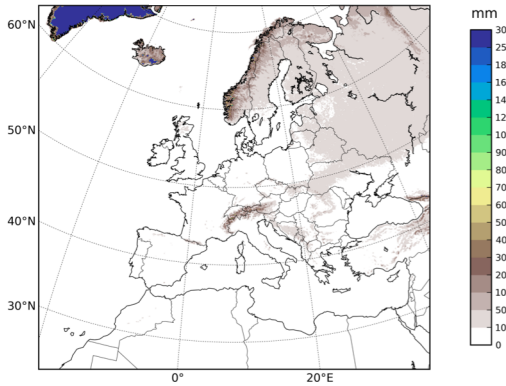
## EVAPORATION E



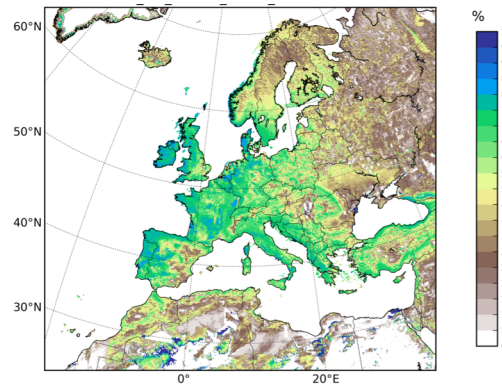
## P - E



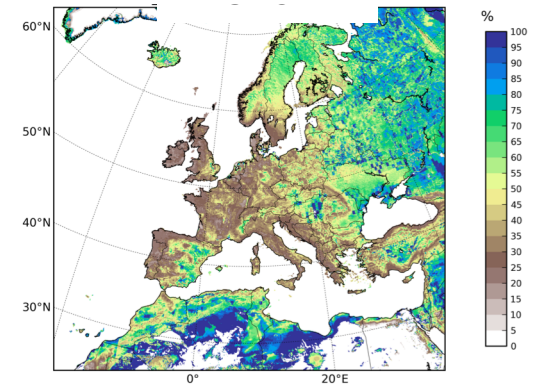
## SWE



## INFILTRATION / ( P - E )

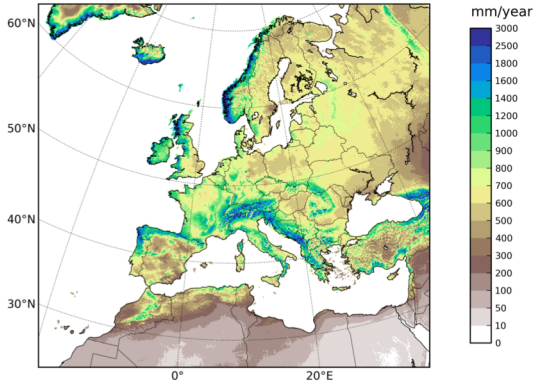


## RUNOFF / ( P - E )

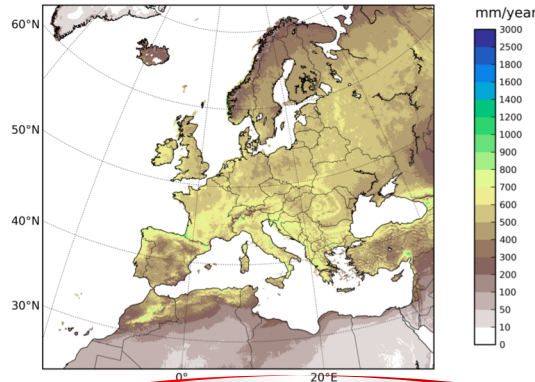


# SURFEX Water Budget: 1961-2015

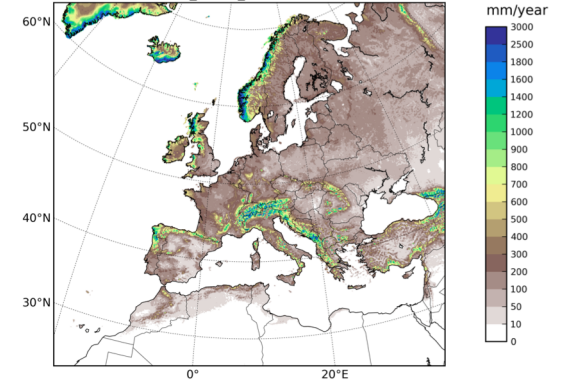
**PRECIPITATION P**



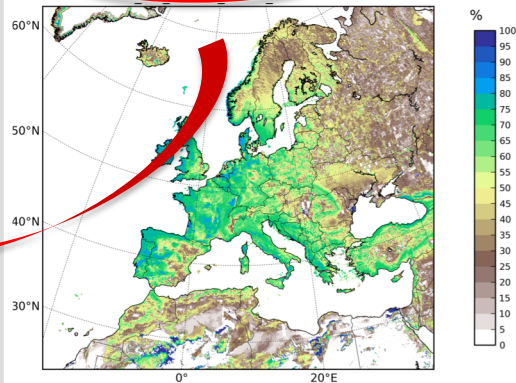
**EVAPORATION E**



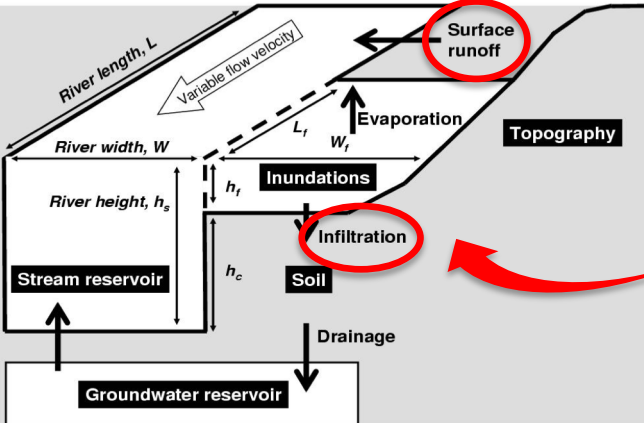
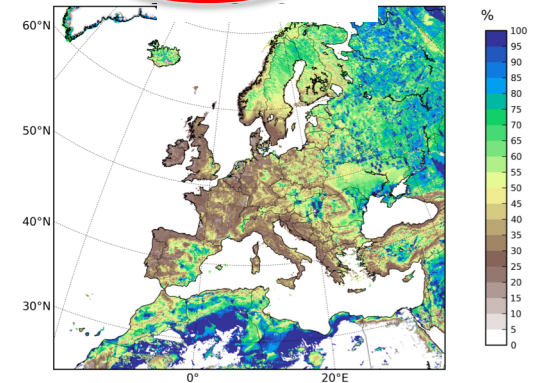
**P - E**



**INFILTRATION / (P - E)**



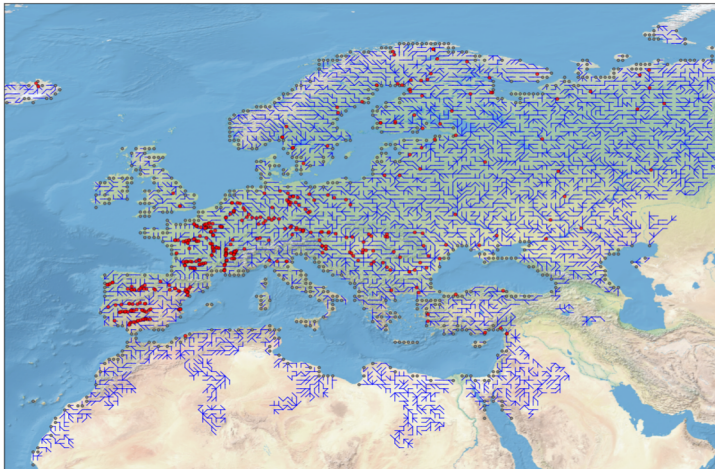
**RUNOFF / (P - E)**



**CTRIIP Hydrological model**

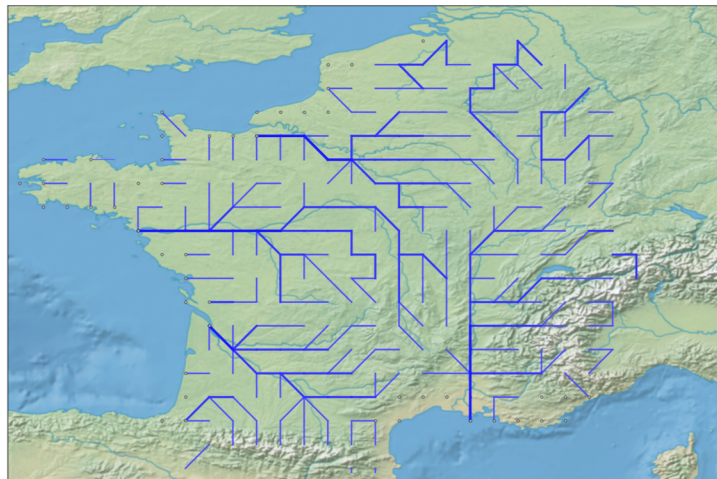
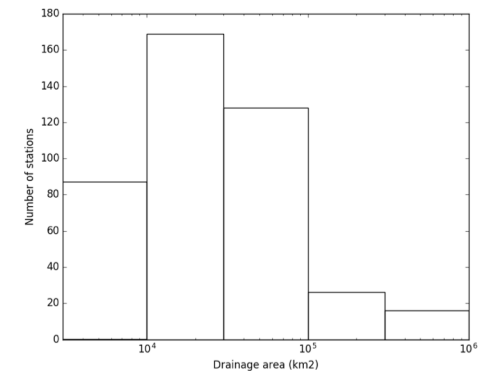
# Hydrological Evaluation: 1961-2015

## CTRIP Network @ 0.5°



- **Gauge stations from:**  
GRDC  
ARCTICNET  
French national database  
Spanish national database
- **Selection criteria:**  
Min drainage area: 5000 km<sup>2</sup>  
Min 3yr with available data
- **Total number of stations: 427**

## Drainage Area



## Future Network @ 1/12°

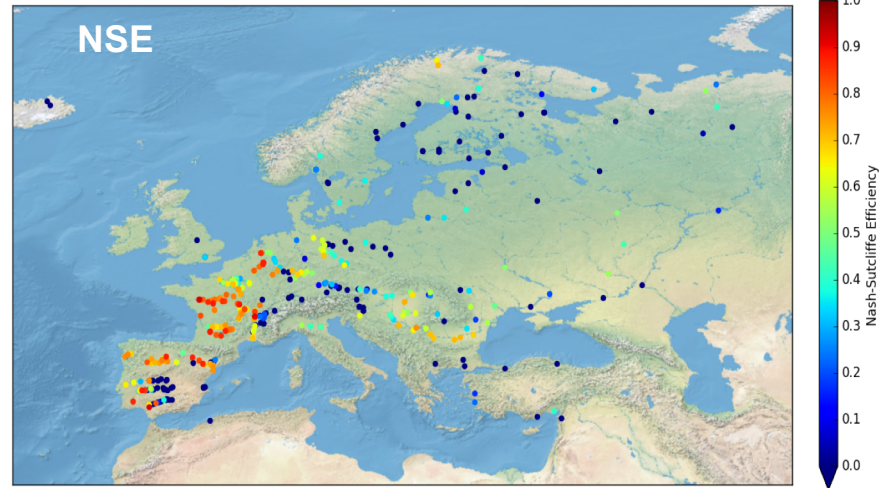
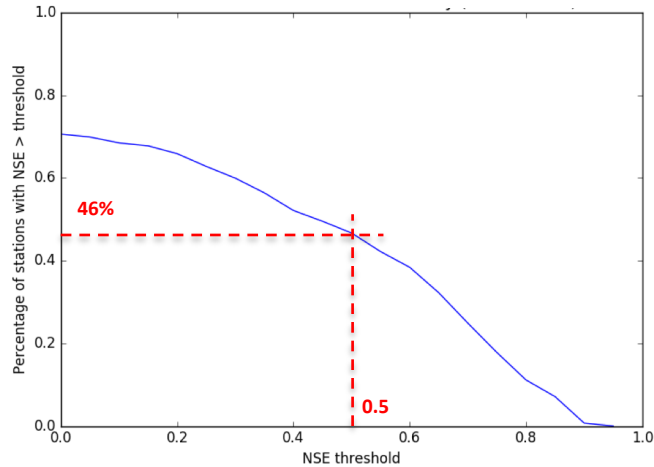


Under development @ CNRM

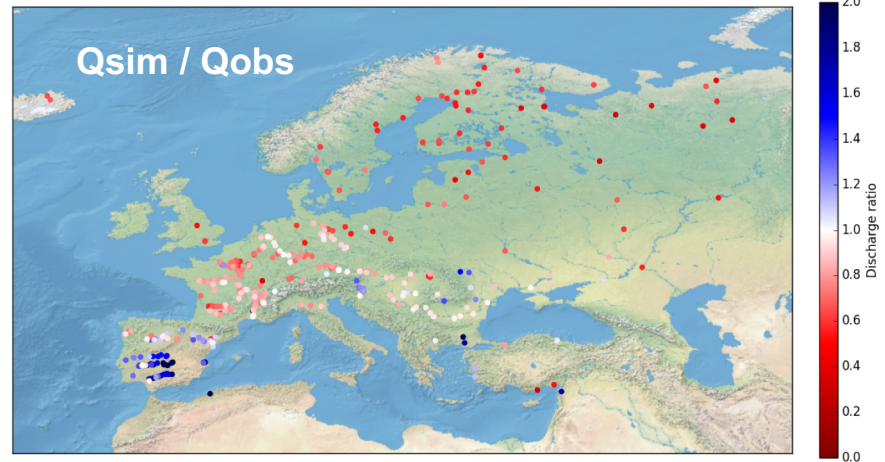
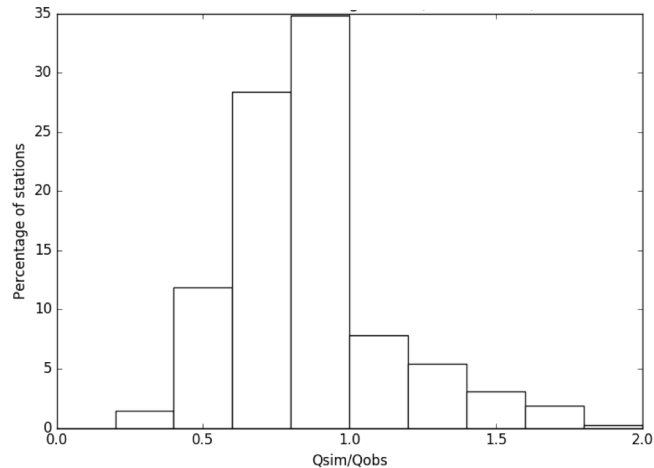


# Hydrological Evaluation: 1961-2015

## Distribution of NSE



## Distribution of discharge ratio



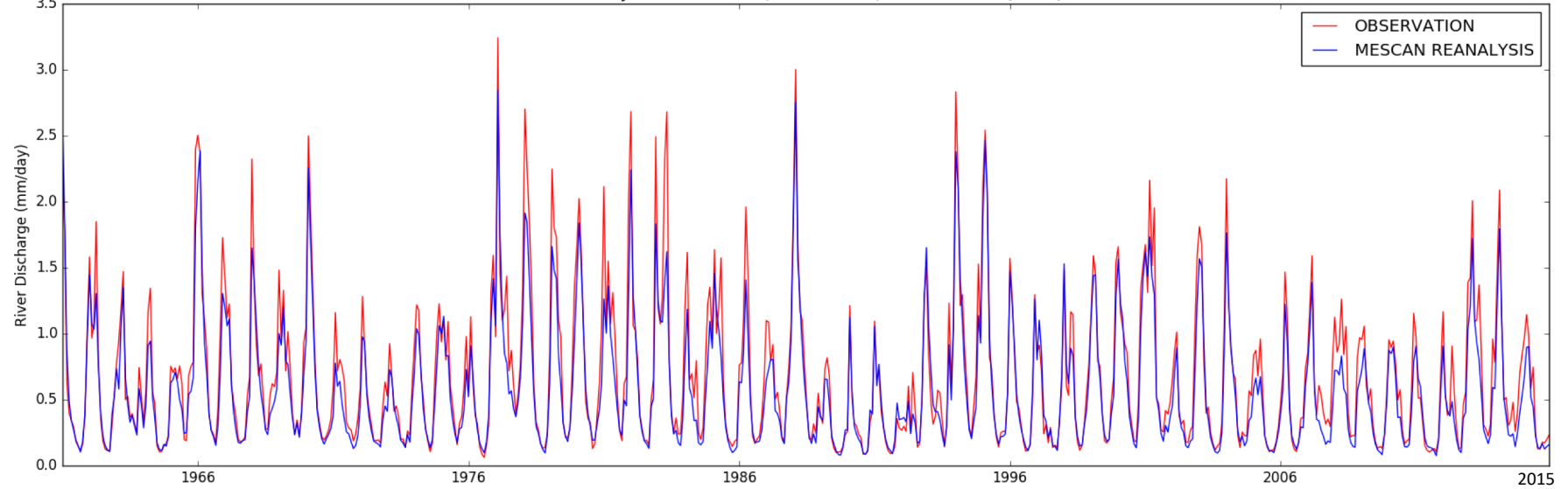
How to explain discharge underestimation?

Physics of the system: Radiation overestimation, Underestimation of precipitation

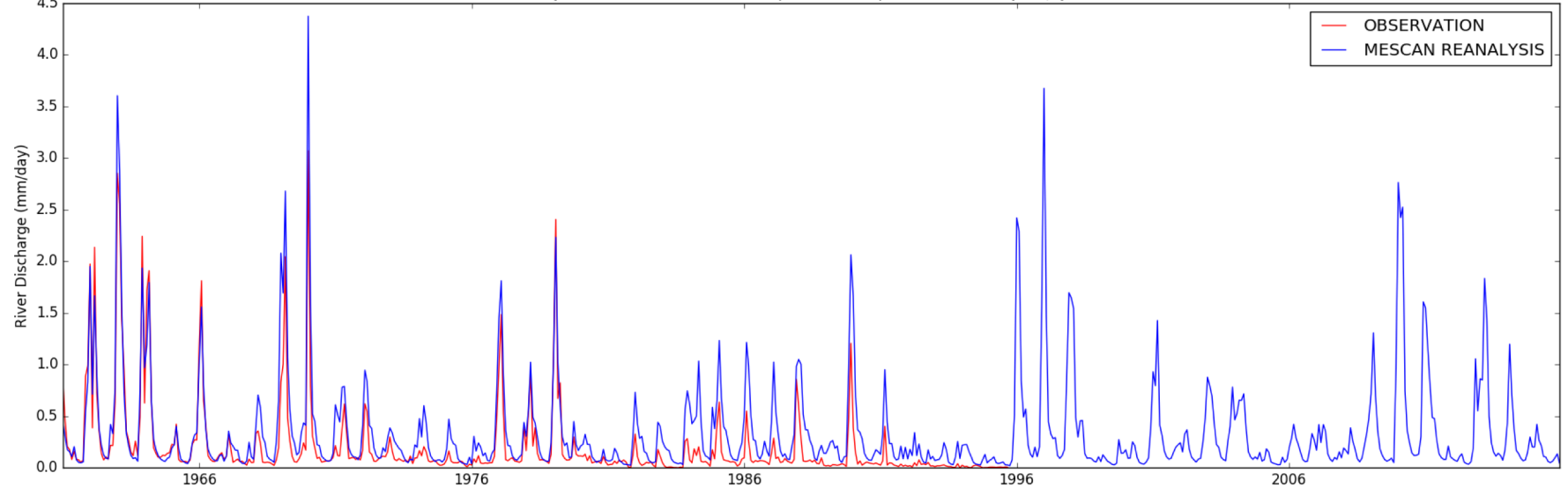
Human activity not accounted for in the model: Presence of dams

# Some examples

LA LOIRE at MONTJEAN-SUR-LOIRE (109930 km<sup>2</sup>) - NSE=0.89 - Qsim/Qobs=0.86

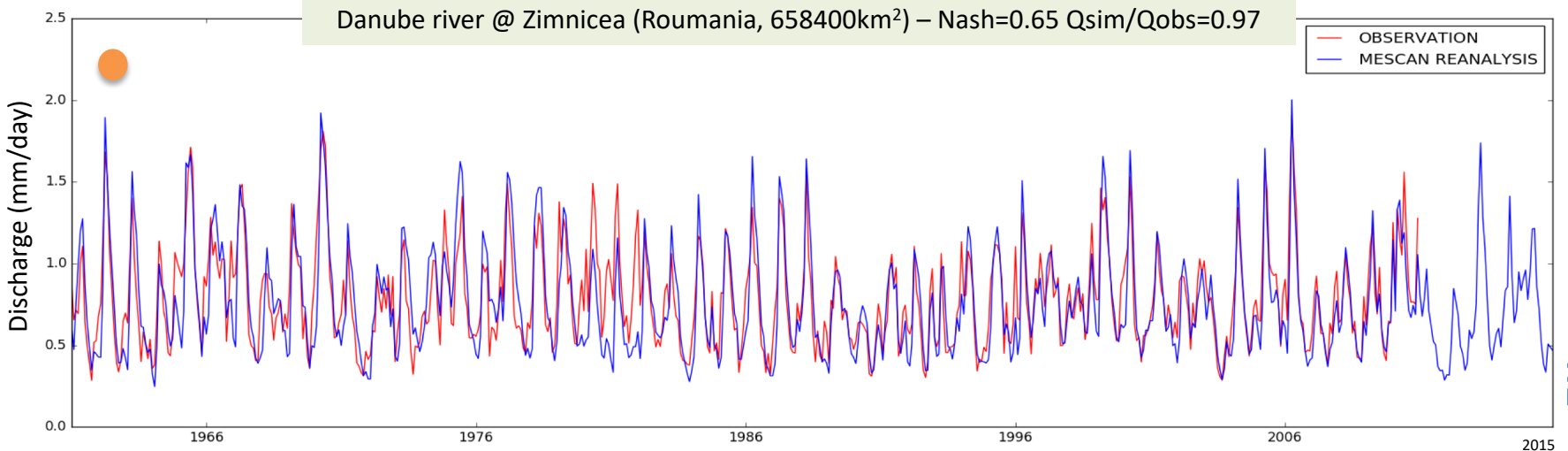
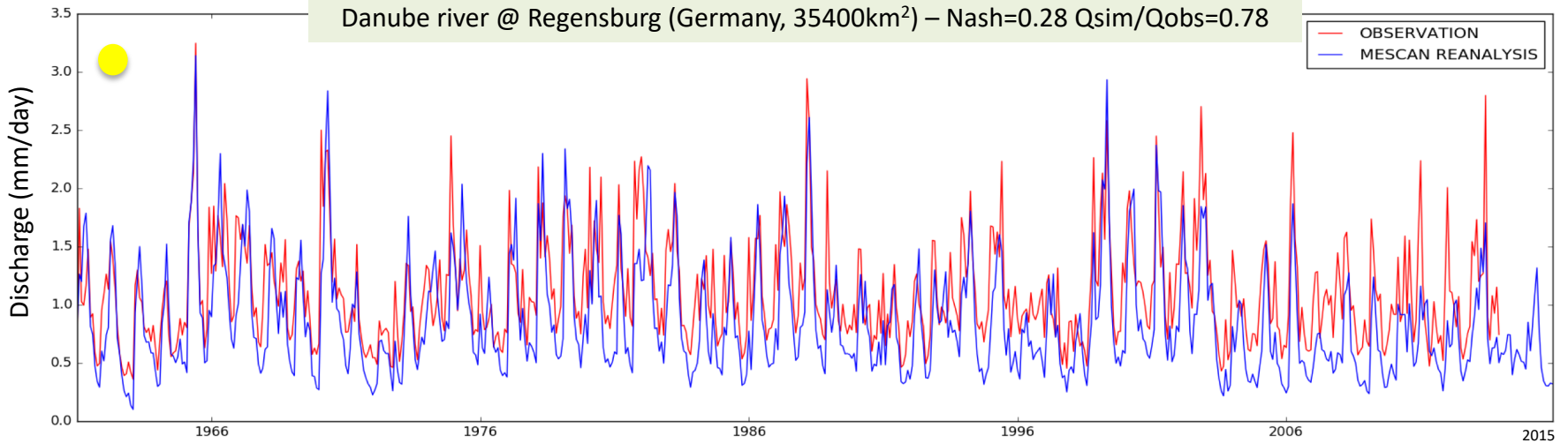
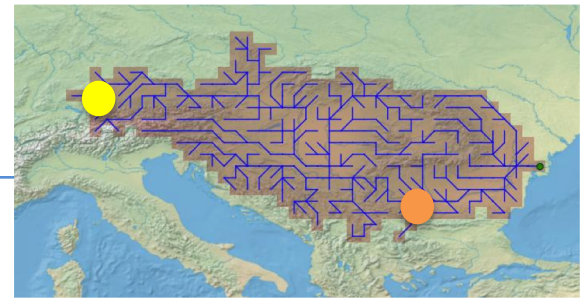


GUADALQUIVIR at ALCALA DEL RIO (46134 km<sup>2</sup>) - NSE=0.65 - Qsim/Qobs=1.64

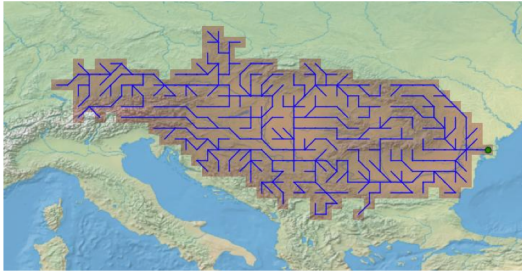


# The Danube River

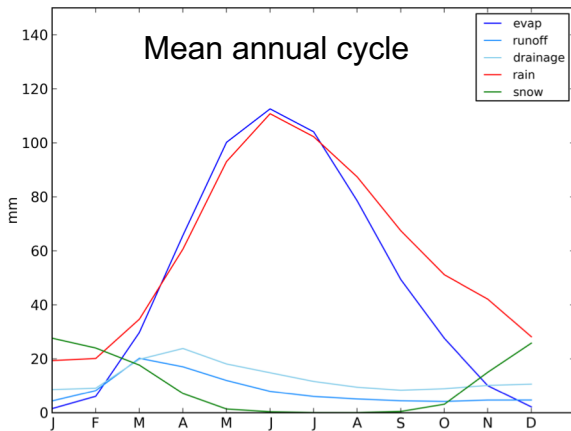
A complex catchment area in terms of climate, morphology, human practices, etc.



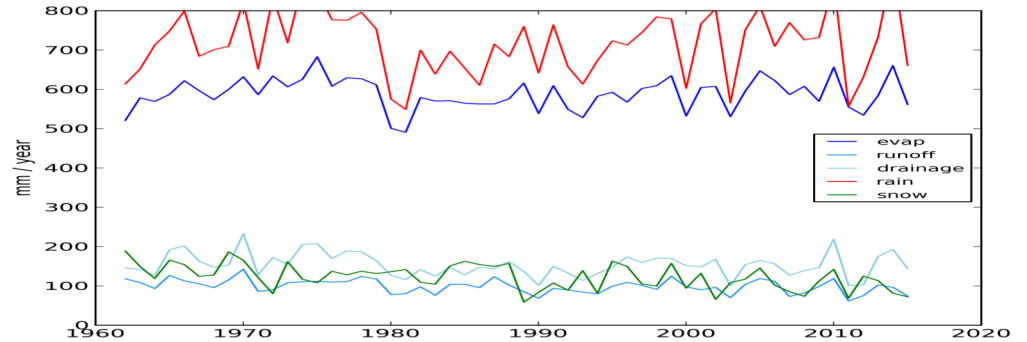
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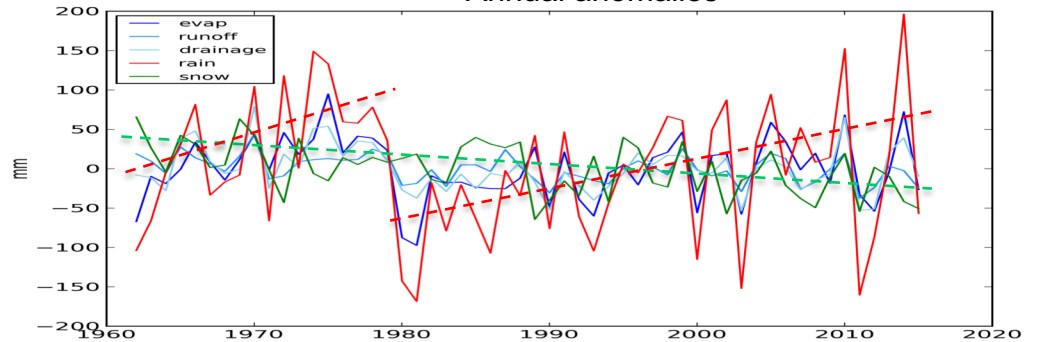
Typical of a mountainous area with a balance between rain and evaporation during summer, snow in winter, and increasing runoff and infiltration after melting



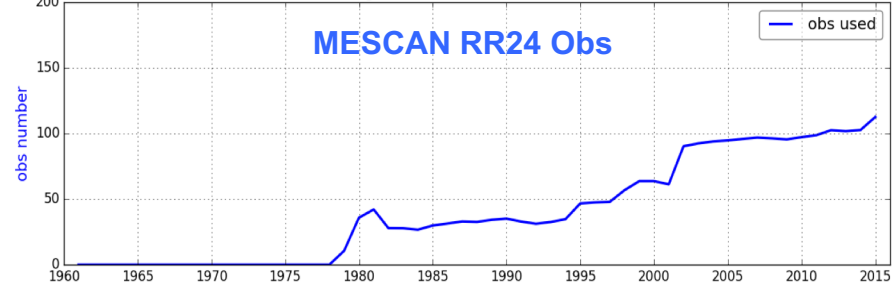
Annual means



Annual anomalies



Annual average observation number (RR24) Dom=East



# Summary

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- ❑ A hydro-meteorological modelling system was set up to assess the UERRA reanalysis performance over Europe using independent variables
- ❑ Production of a climatology of the water balance components: surface runoff, soil deep infiltration, soil moisture, evaporation, etc.
- ❑ Comparisons over Europe highlight discharge underestimation, that can be attributed to human activity and system errors
- ❑ Studying the 55-yr reanalysis will help understanding inter-annual variability of river discharge
- ❑ SURFEX-CTRIIP has provided a valuable dataset for users to study droughts, floods, etc.
- ❑ 1961-2015 data is available in ECMWF MARS archiving system

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- ❑ Production of a climatology of the water balance components: surface runoff, soil deep infiltration, soil moisture, evaporation, etc.
- ❑ Comparisons over Europe highlight differences that can be attributed to human activities
- ❑ Studies help understanding inter-annual variability of river discharge
- ❑ SURFEX-CTRIP has provided a valuable dataset for users to study droughts, floods, etc.
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**Thank you for your attention**