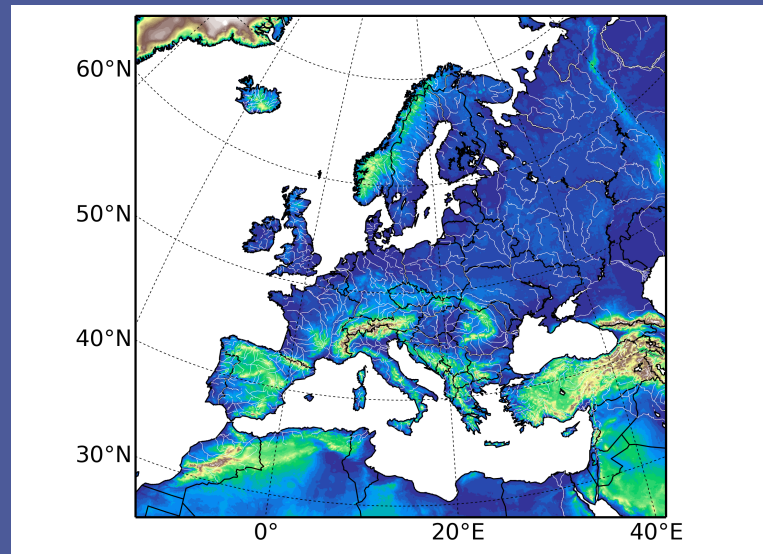


Setup and first evaluation of the coupled hydro-meteorological MESCAN-SURFEX-CTRIIP modelling system over Europe



Szczypta, C., P. Le Moigne, B. Decharme, A. Verrelle, F. Besson, E. Bazile and R. Abida

Project overview and objectives

UERRA (*Uncertainties in Ensembles of Regional ReAnalyses*)

- European project
- Production and development of an ensemble system of regional reanalysis
 - *Europe*
 - *2006-2010*
- Estimation of ECVs uncertainties
- Production of a regional reanalysis over the 1961-2010 period

Objectives

- Setup of a coupled hydro-meteorological modelling system
 - Long term reanalysis of land surface variables
 - Long time series of discharges over the main European rivers
- Evaluation of the system (in situ observations)

The coupled hydro-meteorological modelling system

Atmospheric data

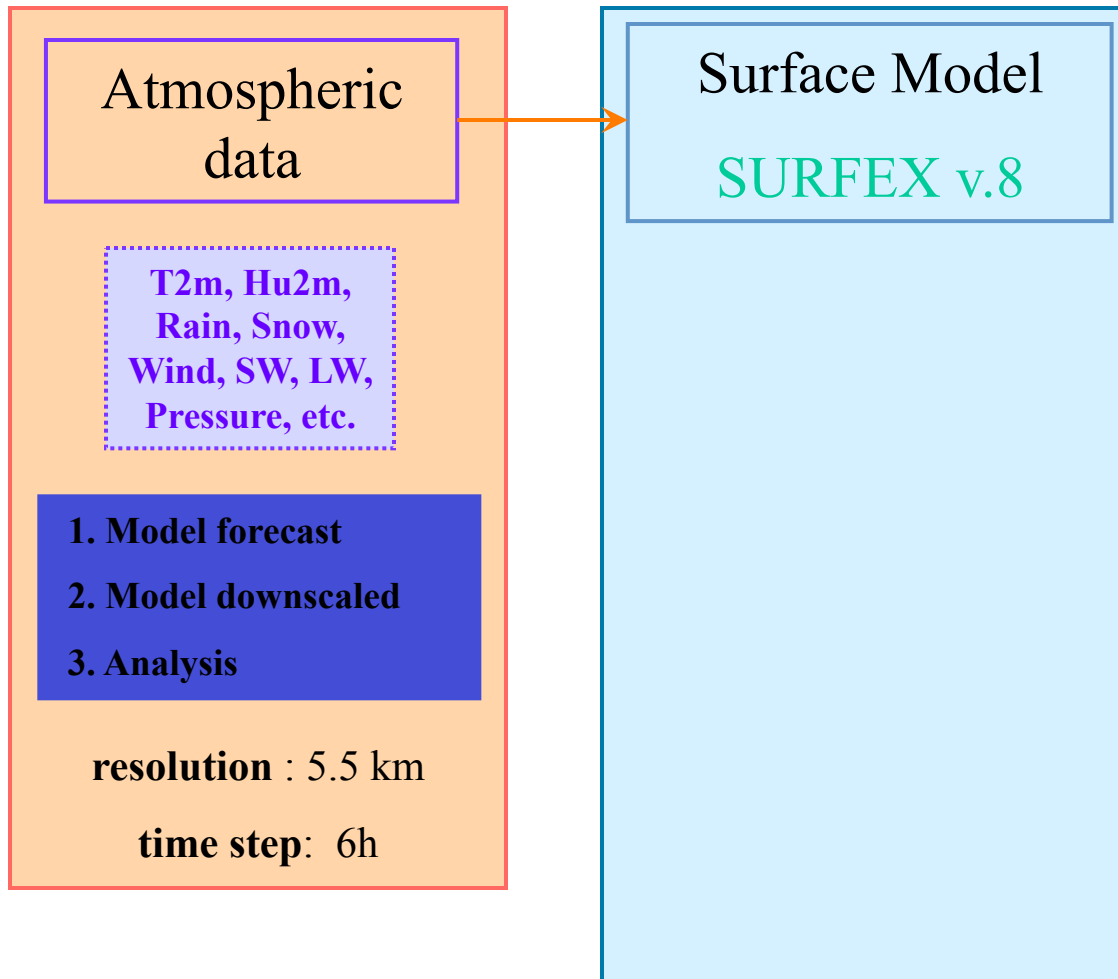
T2m, Hu2m,
Rain, Snow,
Wind, SW, LW,
Pressure, etc.

1. Model forecast
2. Model downscaled
3. Analysis

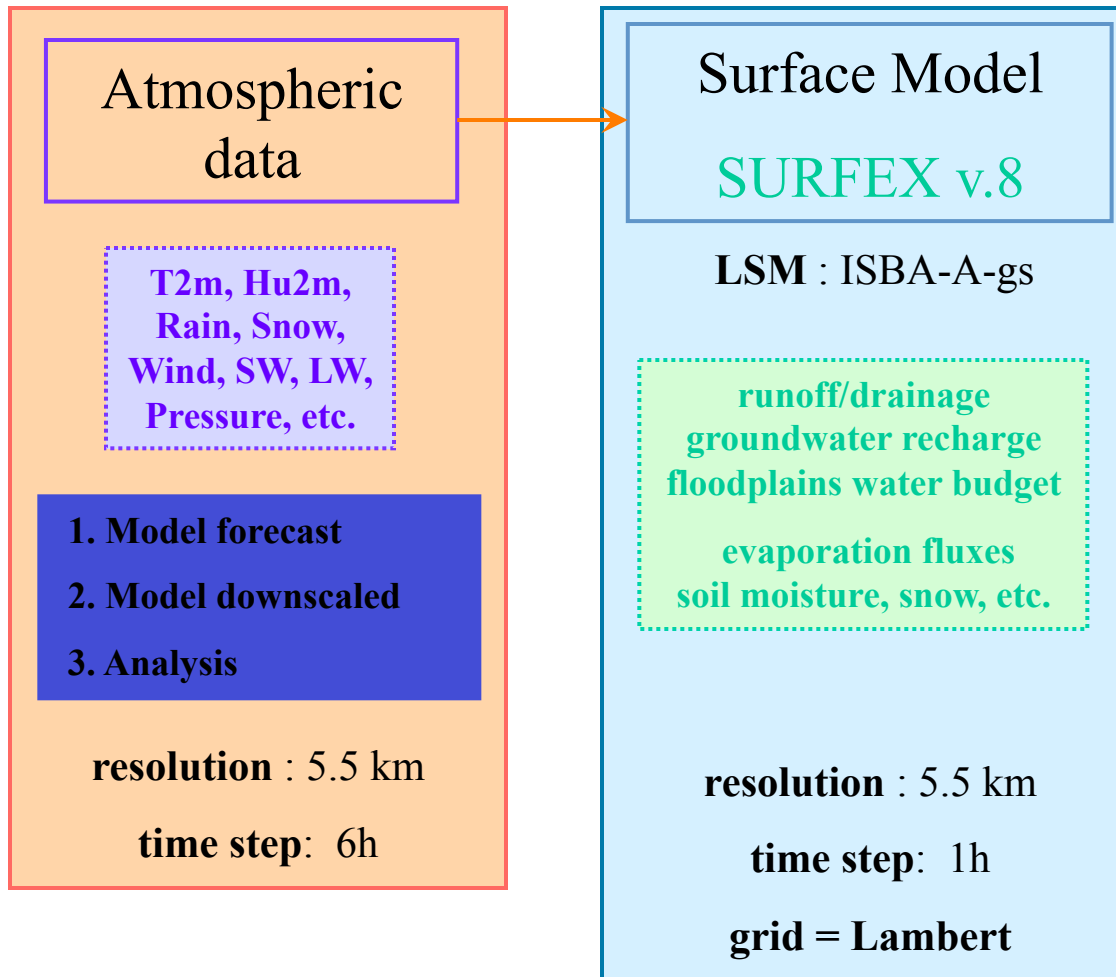
resolution : 5.5 km

time step: 6h

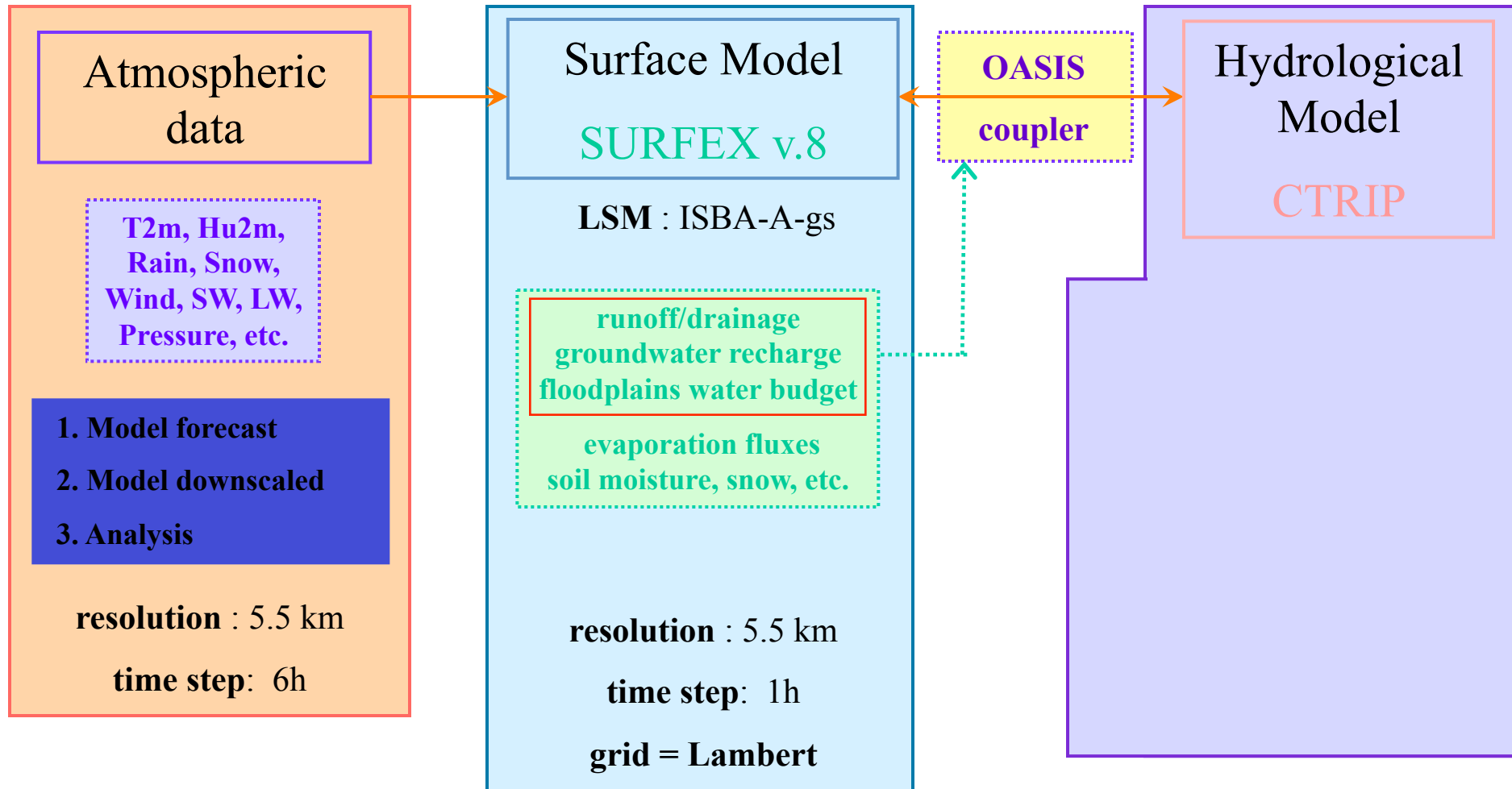
The coupled hydro-meteorological modelling system



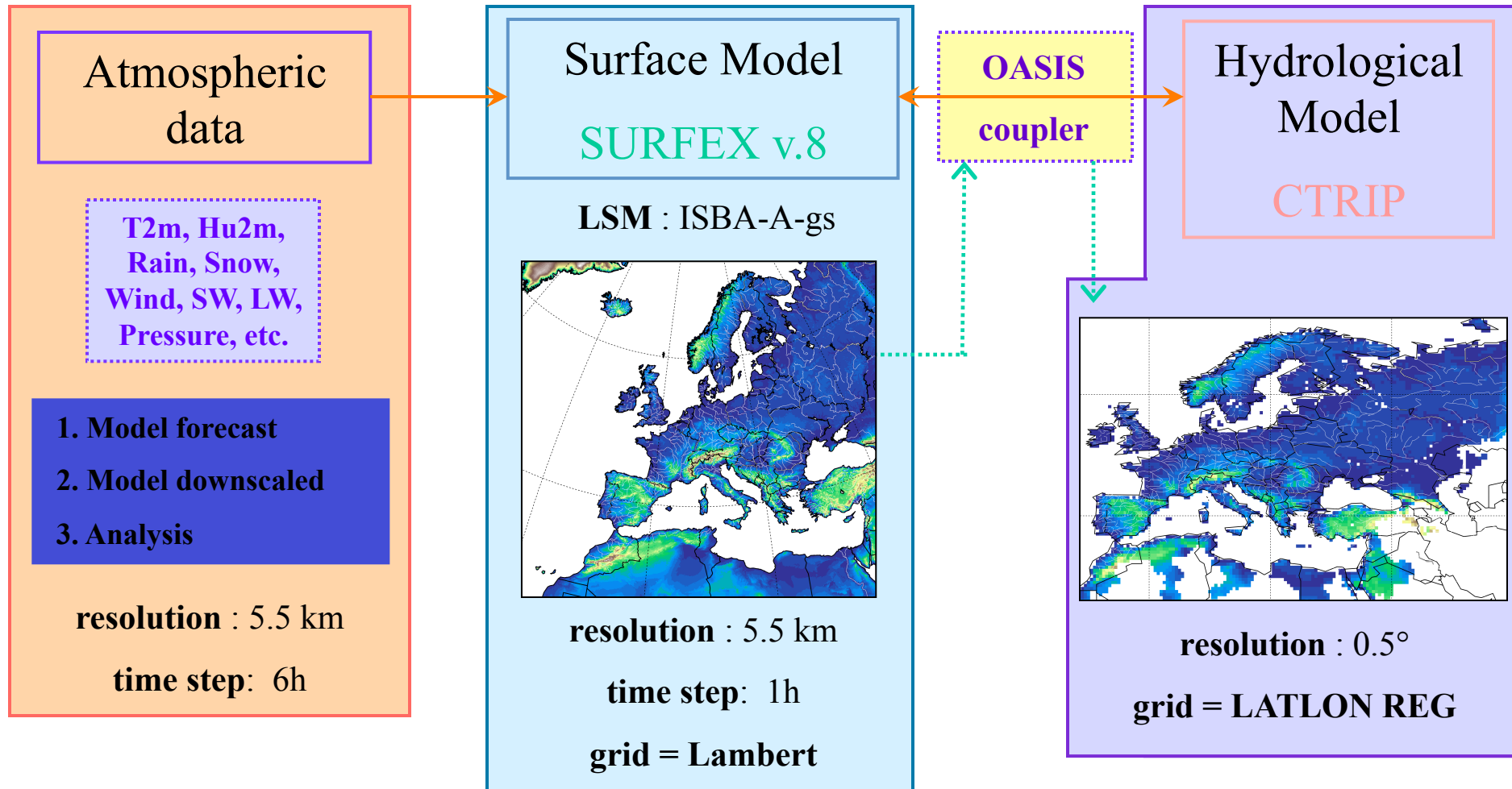
The coupled hydro-meteorological modelling system



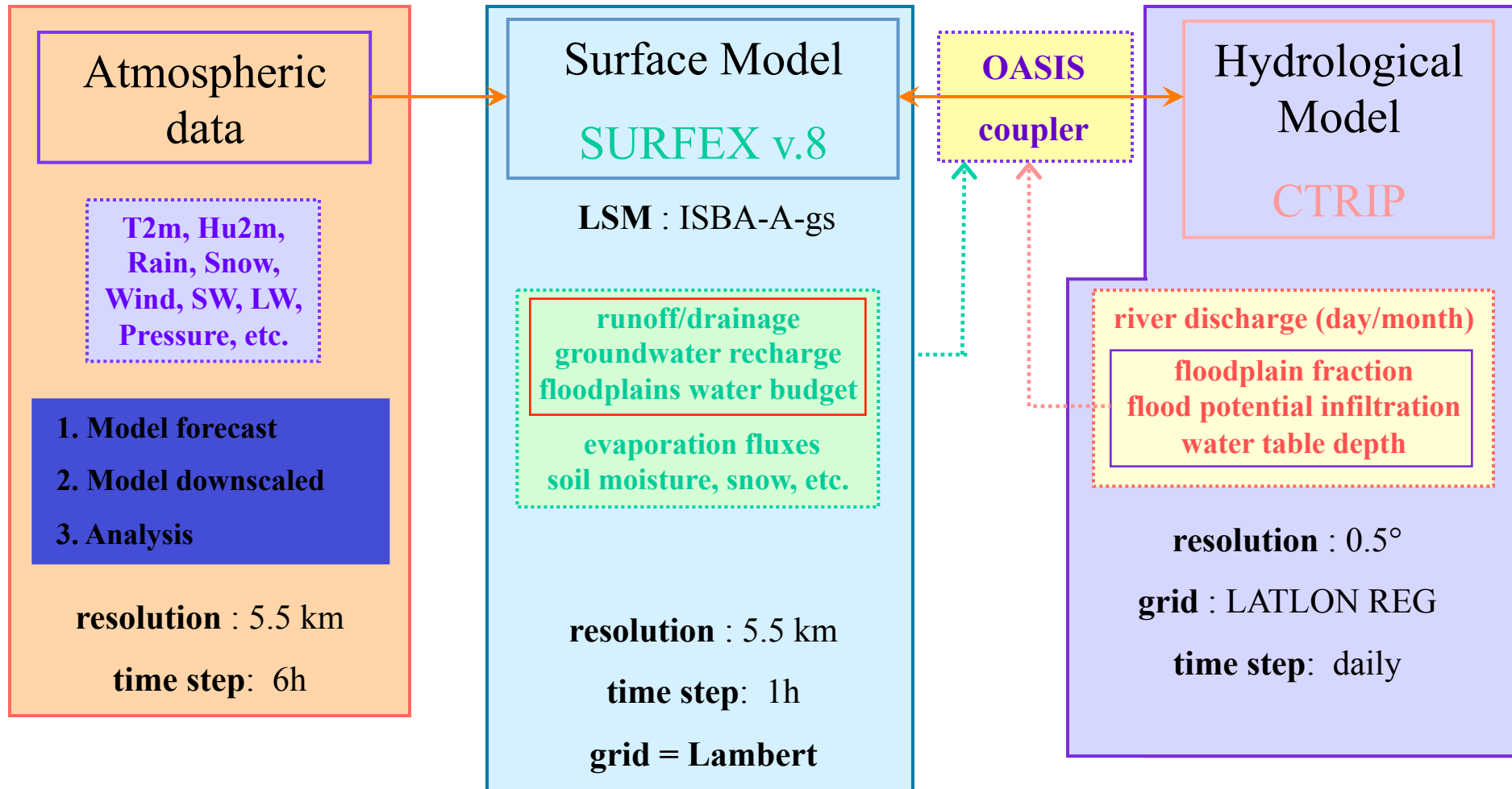
The coupled hydro-meteorological modelling system



The coupled hydro-meteorological modelling system

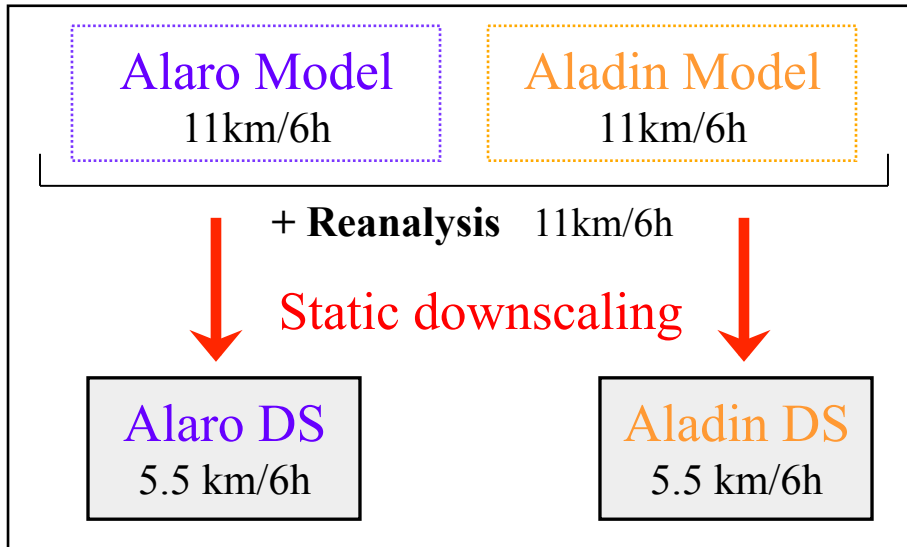


The coupled hydro-meteorological modelling system



The different atmospheric forcing

MODEL DOWNSCALED

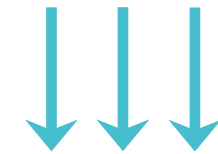
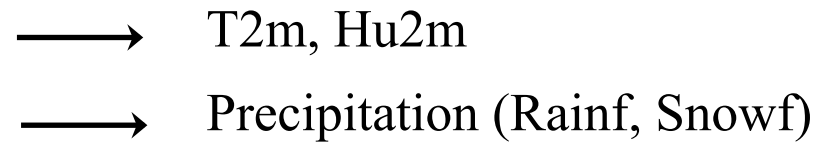
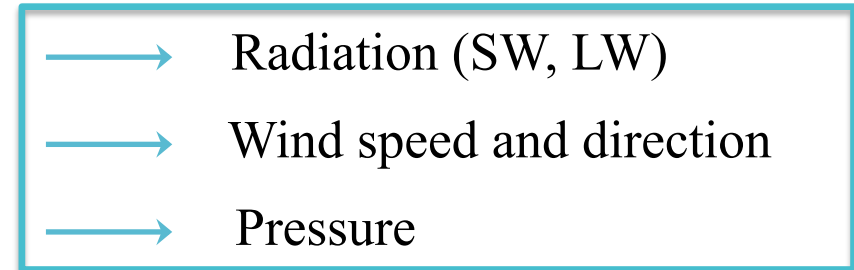
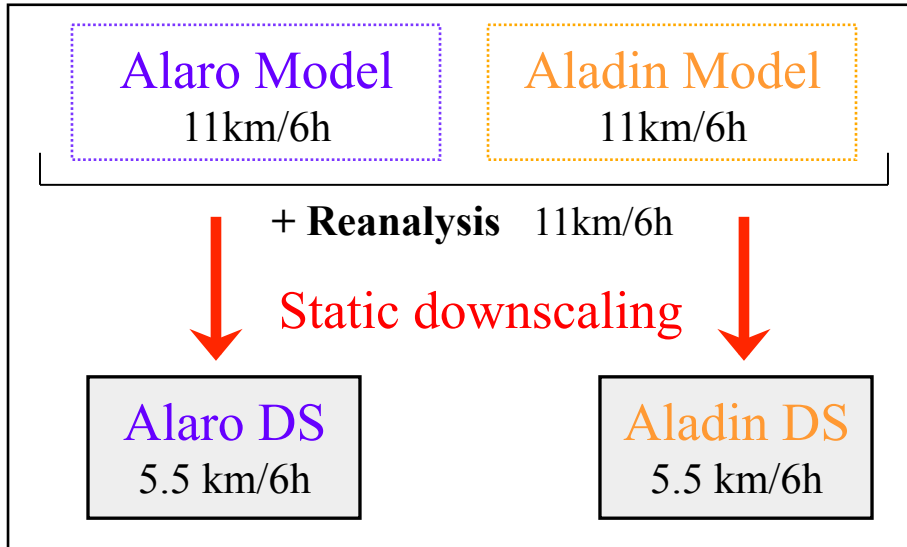


Atmospheric data

- Radiation (SW, LW)
- Wind speed and direction
- Pressure
- T2m, Hu2m
- Precipitation (Rainf, Snowf)

The different atmospheric forcing

MODEL DOWNSCALED



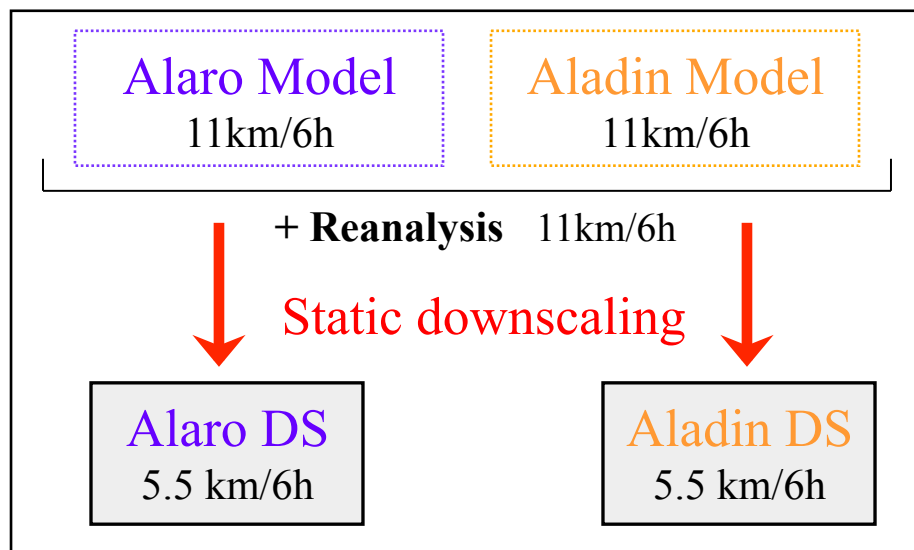
MODEL
SIMULATIONS

SURFEX-CTRIIP



The different atmospheric forcing

MODEL DOWNSCALED



- Radiation (SW, LW)
- Wind speed and direction
- Pressure

- T2m, Hu2m
- Precipitation (Rainf, Snowf)

MESCAN analysis (T2m, Hu2m, PP)
Low Density Network

MESCAN analysis (T2m, Hu2m, PP)
Reference Density Network

MESCAN ANALYSIS → SURFEX-CTRIIP

Evaluation of the MESCAN forcing over France

→ Aladin DS with Mescan analysis based on the reference density network

PRECIPITATION

In comparison to SAFRAN

- the MESCAN analysis improves the Aladin downscaled precipitation
- the precipitation observation network impacts the MESCAN analysis
- the MESCAN precipitation is a little underestimated over France
- SAFRAN and MESCAN present very different diurnal cycles

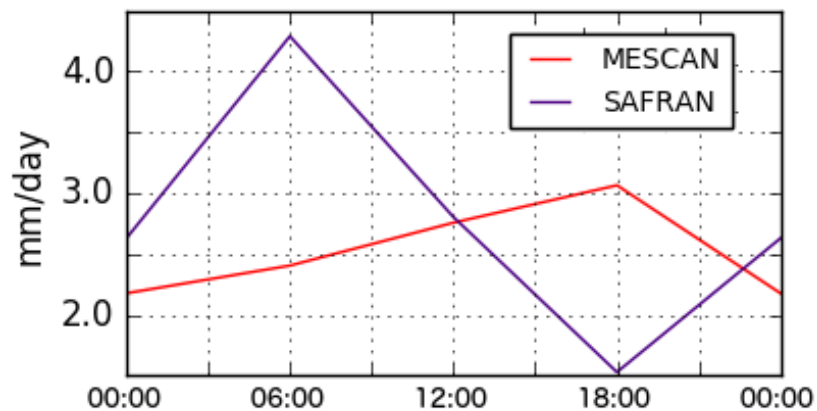


Fig. 1. Comparison of the mean SAFRAN and MESCAN precipitation diurnal cycle computed over France from the 2007-2008 2-year period.

Evaluation of the MESCOAN forcing over France

→ Aladin DS with Mescan analysis based on the reference density network

INCOMING SOLAR RADIATION

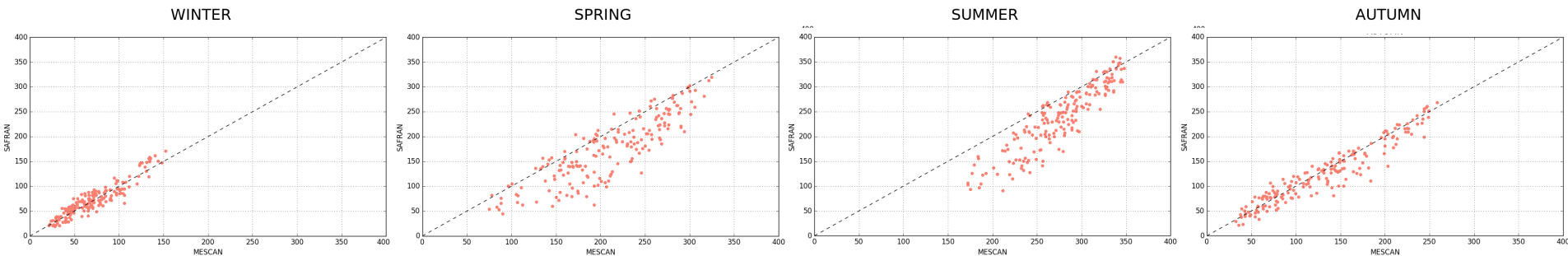


Fig. 2. Scatterplots of the daily SAFRAN vs. MESCOAN incoming solar radiation obtained for each season over the 2007-2008 period.

- Aladin ISR is overestimated over France during spring and summer
- In summer : the variability of ISR from one day to another is greater with observations and with SAFRAN than with Aladin.
- Aladin tends to overestimate the smallest daily ISR during summer.
- Bad representation of cloud cover ?

Evaluation of the MESCOAN forcing over France

→ Aladin DS with Mescan analysis based on the reference density network

TEMPERATURE, HUMIDITY, WIND

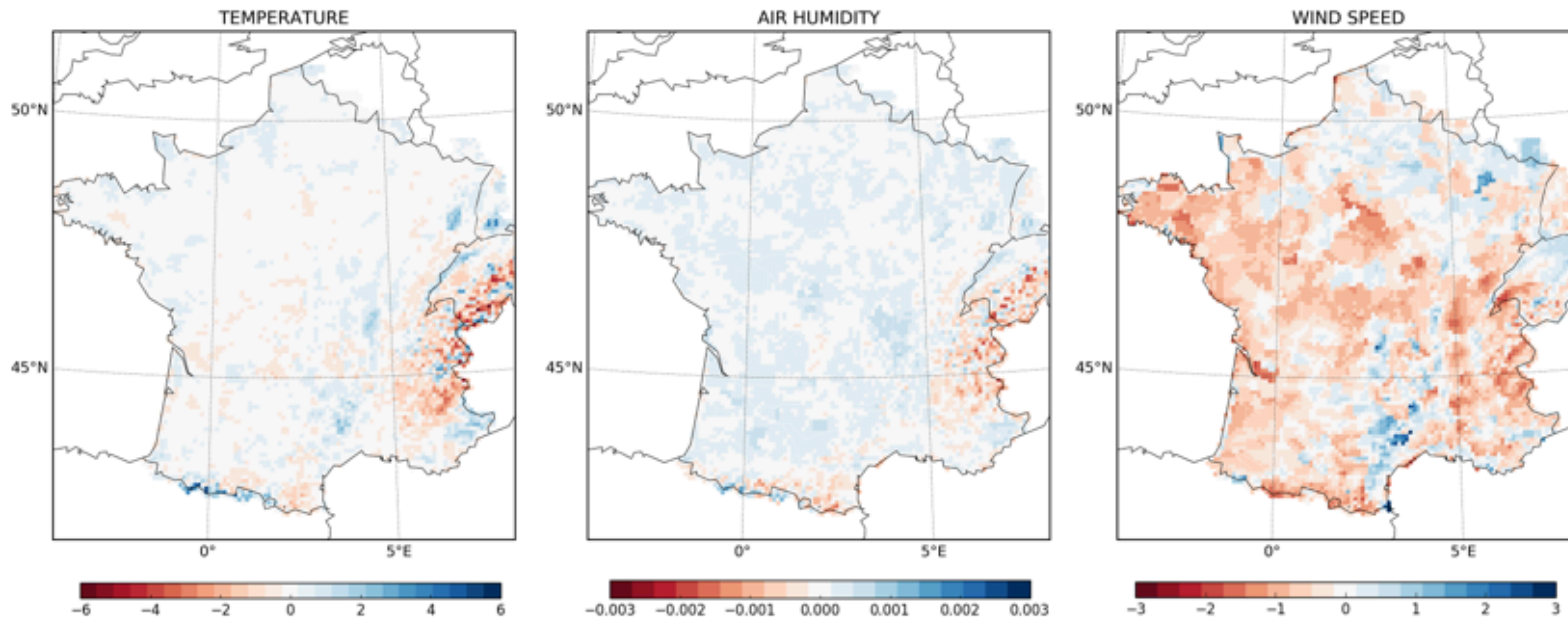


Fig. 3. Comparison between the mean annual SAFRAN and MESCOAN (left) temperature, (middle) specific humidity and (right) wind speed over the 2007-2008 period.

Evaluation of the MESCOAN forcing over France

→ Aladin DS with Mescan analysis based on the reference density network

TEMPERATURE, HUMIDITY, WIND

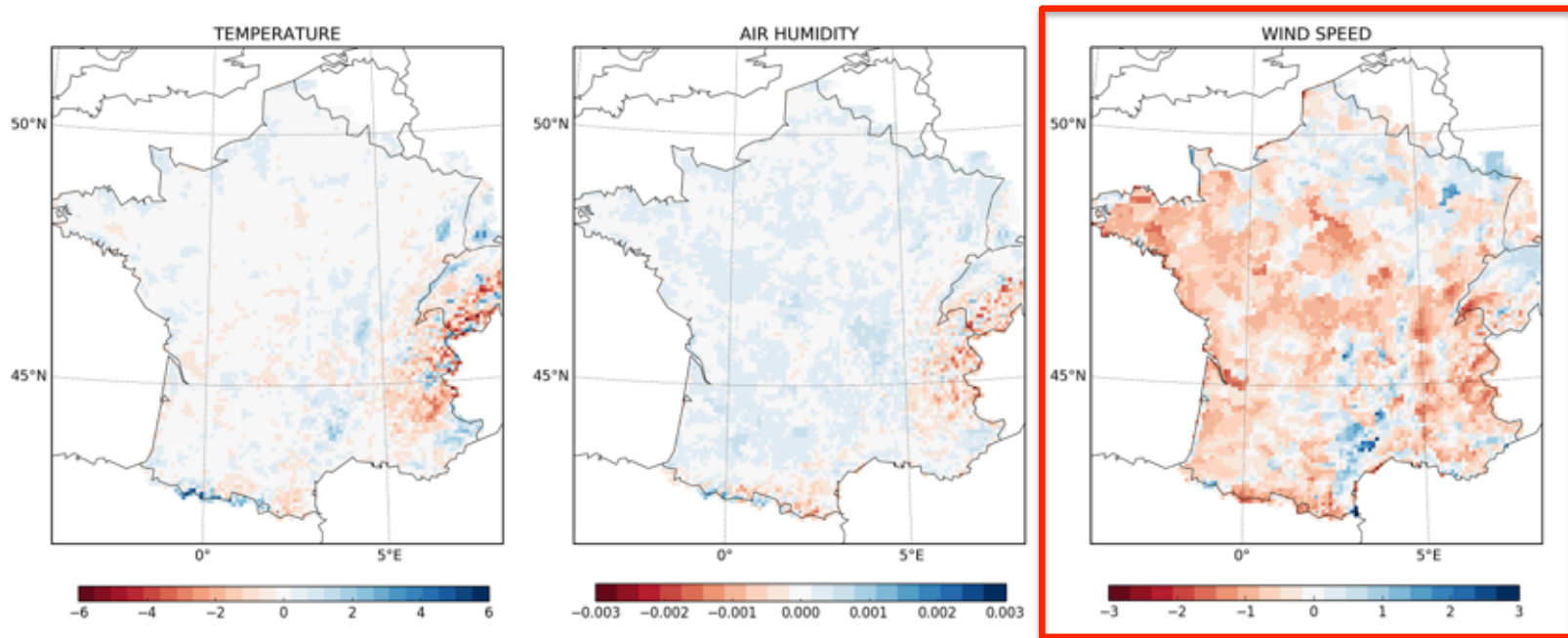


Fig. 3. Comparison between the mean annual SAFRAN and MESCOAN (left) temperature, (middle) specific humidity and (right) wind speed over the 2007-2008 period.

Evaluation of the MESCOAN forcing over France

→ Aladin DS with Mescan analysis based on the reference density network

TEMPERATURE, HUMIDITY, WIND

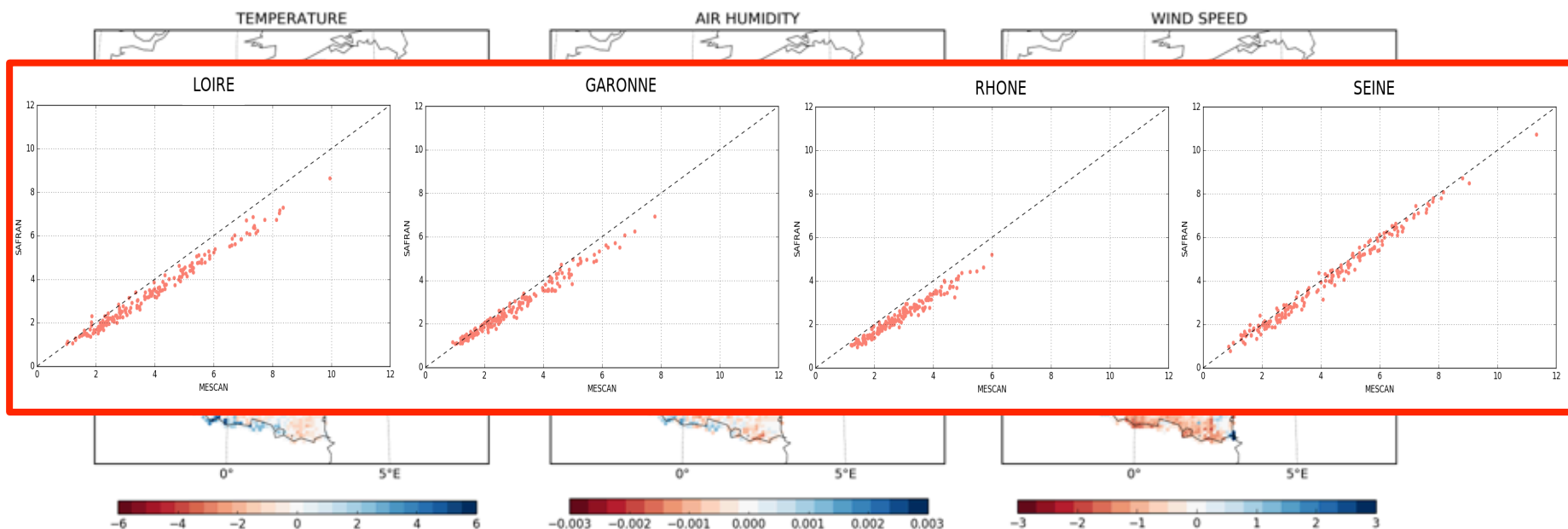


Fig. 4. Scatterplots of the daily SAFRAN vs. MESCOAN wind speed for the 4 main French catchments over the 2007-2008 period.

Evaluation of the MESCOAN forcing over France

→ Aladin DS with Mescan analysis based on the reference density network

New T2m analysis method : for the 50-year reanalysis

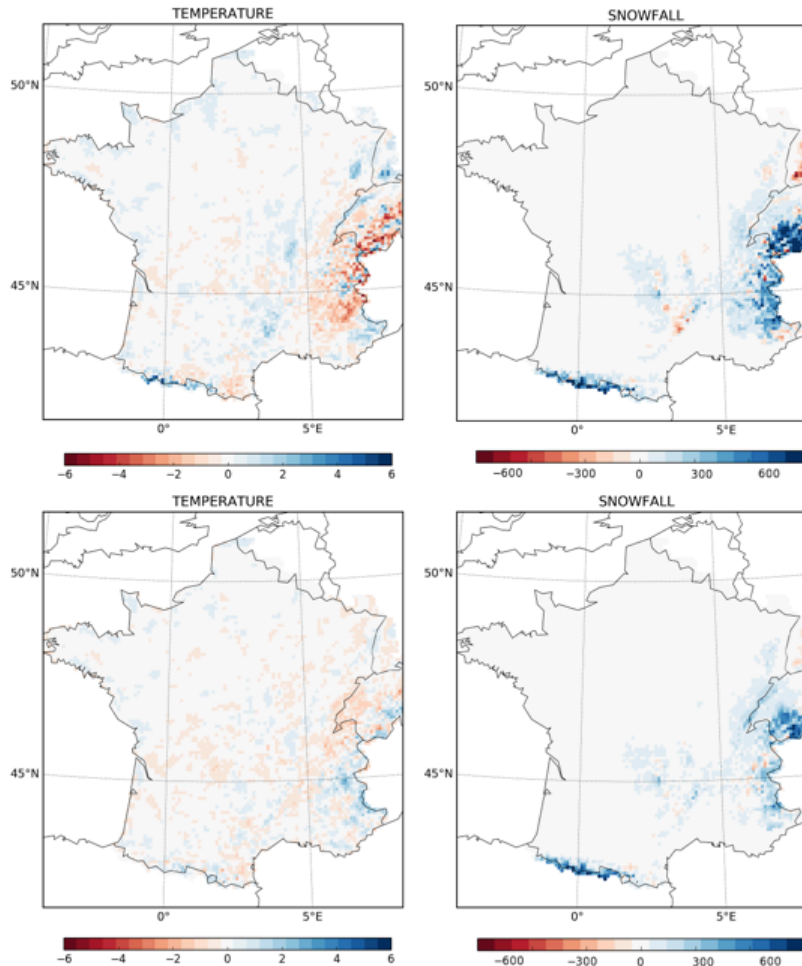
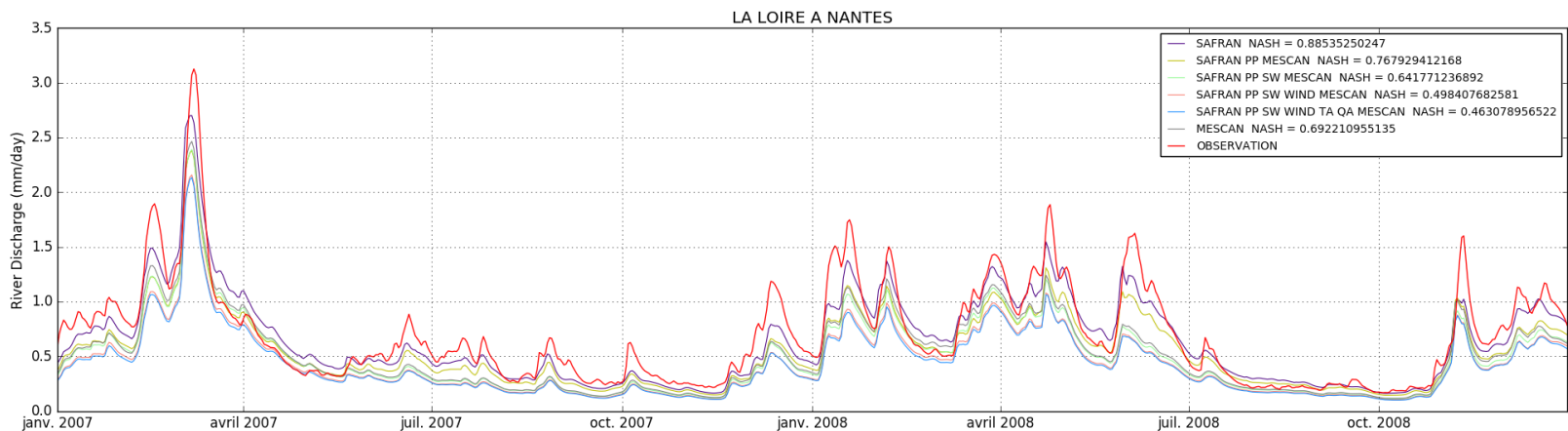
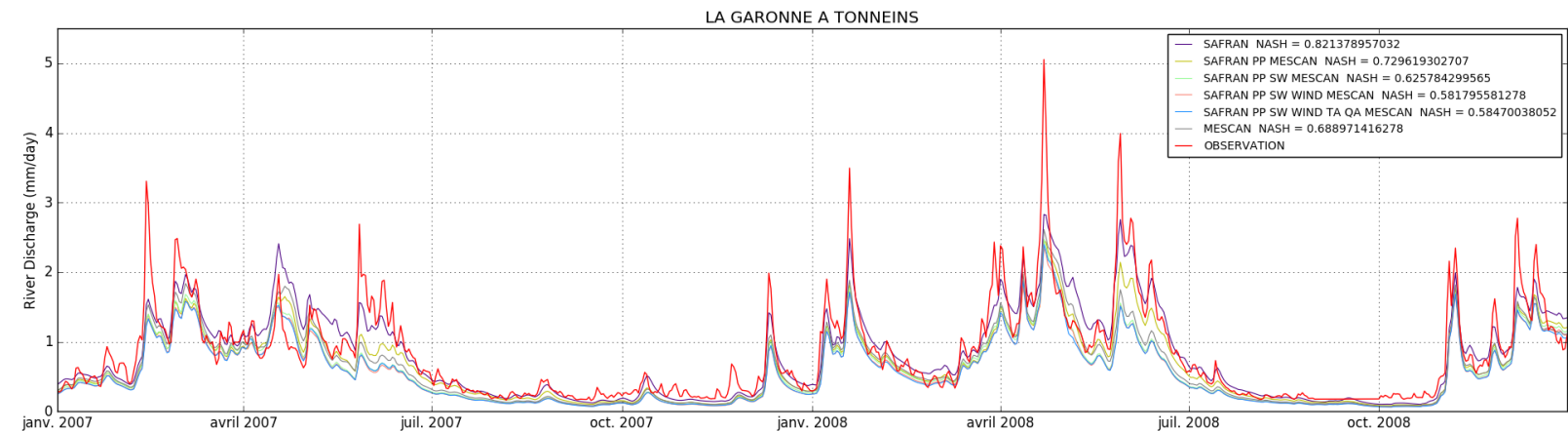


Fig. 5. Comparison between the SAFRAN and the MESCOAN (left) temperature and (right) associated snowfall over the 2007-2008 period, with the initial and new temperature analysis methods.

Forcing impact on the French river discharge simulations



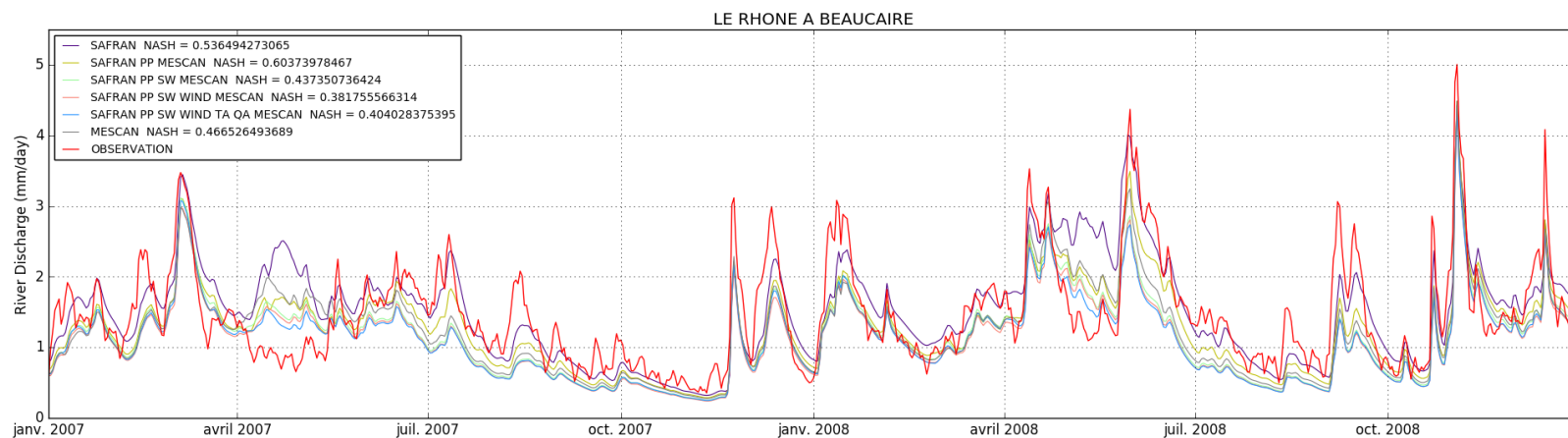
Nash
 Safran: 0.89
 PP Msc: 0.77
 SW Msc: 0.64
 Wind Msc: 0.5



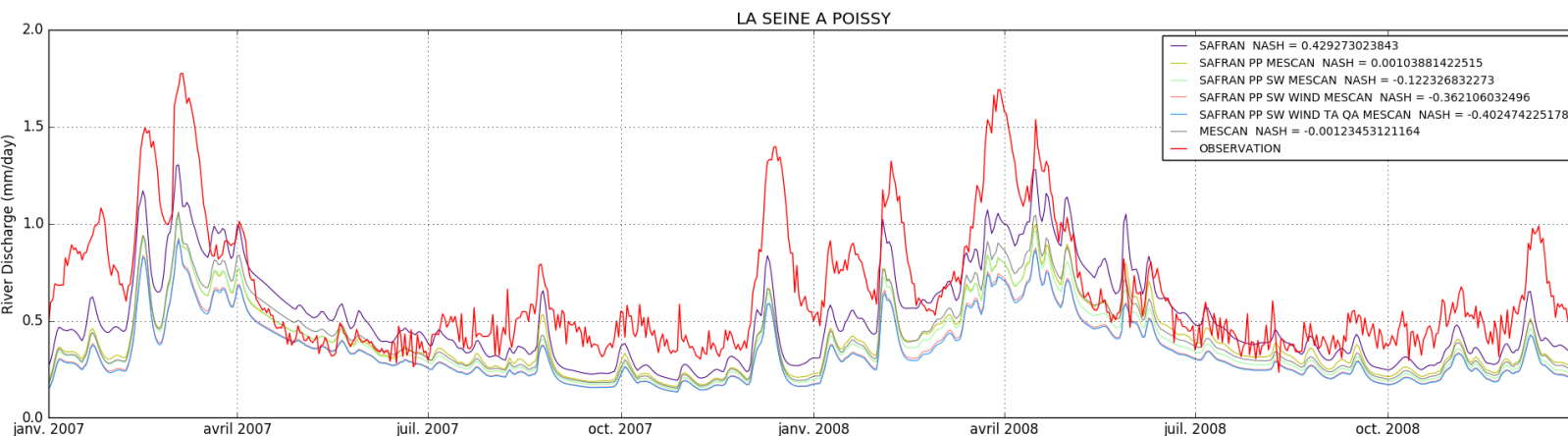
Nash
 Safran: 0.82
 PP Msc: 0.73
 SW Msc: 0.63
 Wind Msc: 0.58

Fig. 6. Comparison of river discharges obtained with the SAFRAN forcing, with SAFRAN combined with MESCAN meteorological variables and observations on the Loire and Garonne rivers over the 2007-2008 period

Forcing impact on the French river discharge simulations



Nash
 Safran: 0.54
 PP Msc: 0.6
 SW Msc: 0.44
 Wind Msc: 0.38



Nash
 Safran: 0.43
 PP Msc: 0.0
 SW Msc: -0.12
 Wind Msc: -0.36

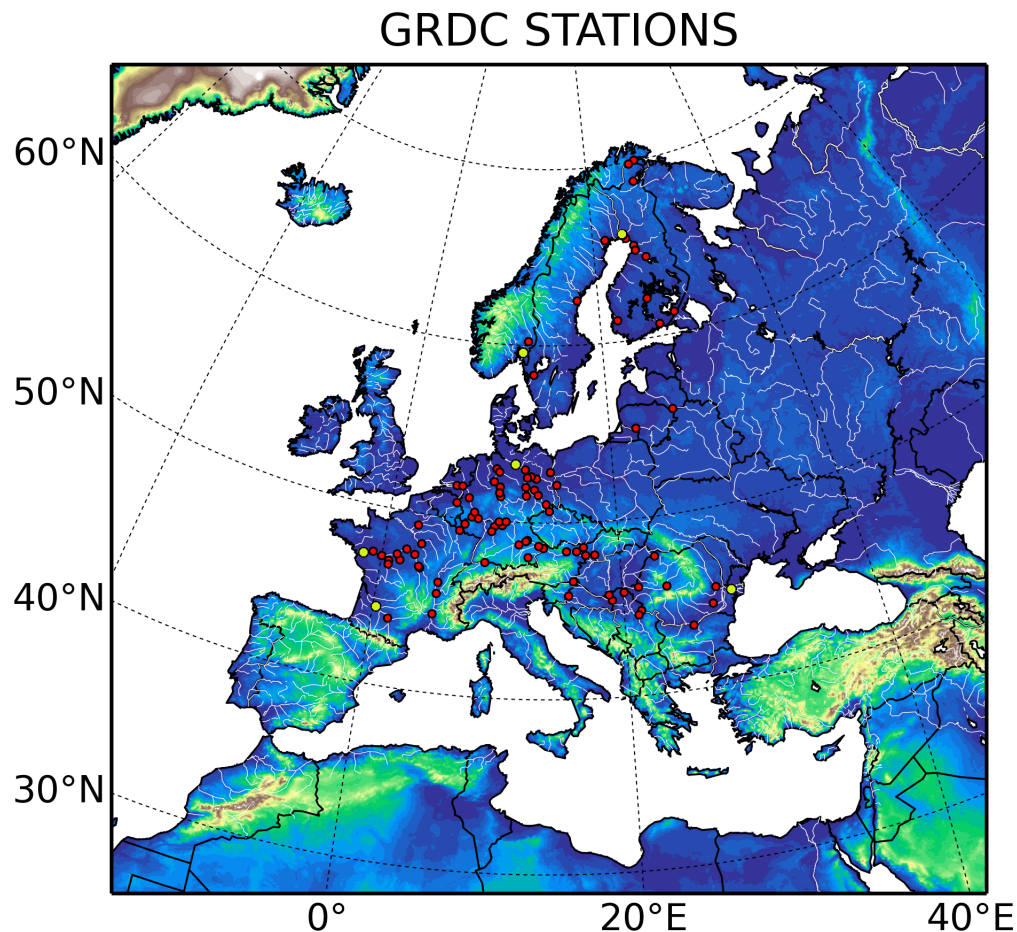
Fig. 7. Comparison of river discharges obtained with the SAFRAN forcing, with SAFRAN combined with MESCAN meteorological variables and observations on the Seine and Rhone rivers over the 2007-2008 period

Forcing impact on the ISBA water fluxes over France



Fig. 8. Comparison of SAFRAN and MESCOAN cumulative precipitation, evapotranspiration, runoff and drainage over the 2007-2008 period over France

Evaluation of TRIP river discharge simulations over Europe



GRDC Network

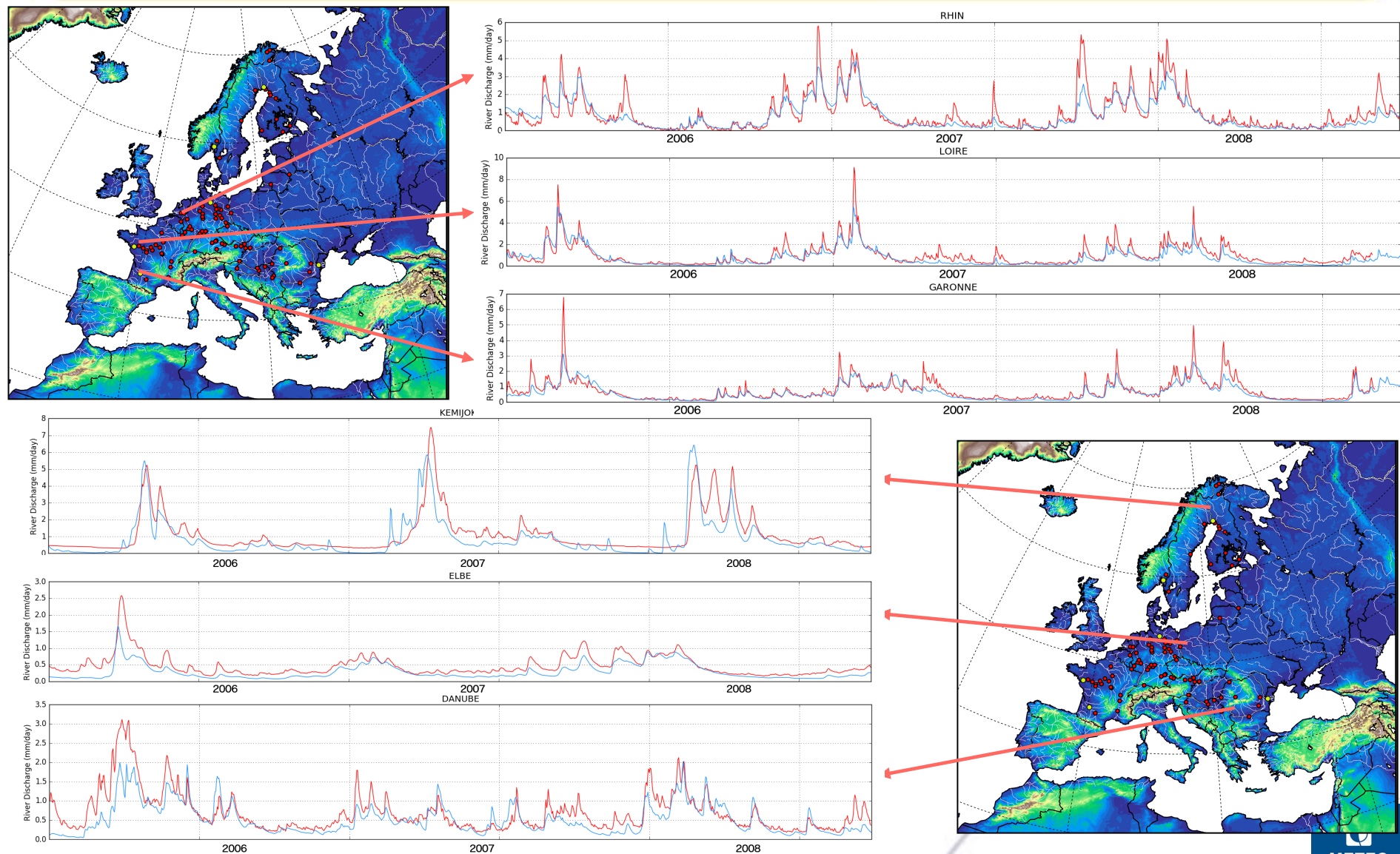
Global Runoff Data Center observations

For the 2006-2010 period

- 101 stations with daily observations
- Monthly observations on Spanish and Italian rivers

Fig. 9. Map of GRDC stations available between 2006 and 2010 over the UERRA domain

River discharge simulations with the Member 1 (2006-2008)



Perspectives

- Production of the ensemble of land surface variables (8 members)
- Evaluation of the different simulation data sets
 - simulated snow depth vs. observation network
 - TRIP river discharge vs. the GRDC data
 - the latent and sensible heat fluxes vs. the fluxnet product
- Quantification of uncertainties
- Improvement of the TRIP resolution from 0.5° to $1/12^\circ$ (0.083°)
- Impact study on the river discharge simulations
- Production of a 1961-2010 regional reanalysis over Europe

Thank you for your attention!

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SUW2017

