Towards water management in the SURFEX modeling platform :

Setting-up a satellite-driven hydrological system

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Including Water Management in Large Scale Models

Gif-sur-Yvette, France, 28-30 September 2016

Study the terrestrial water cycle

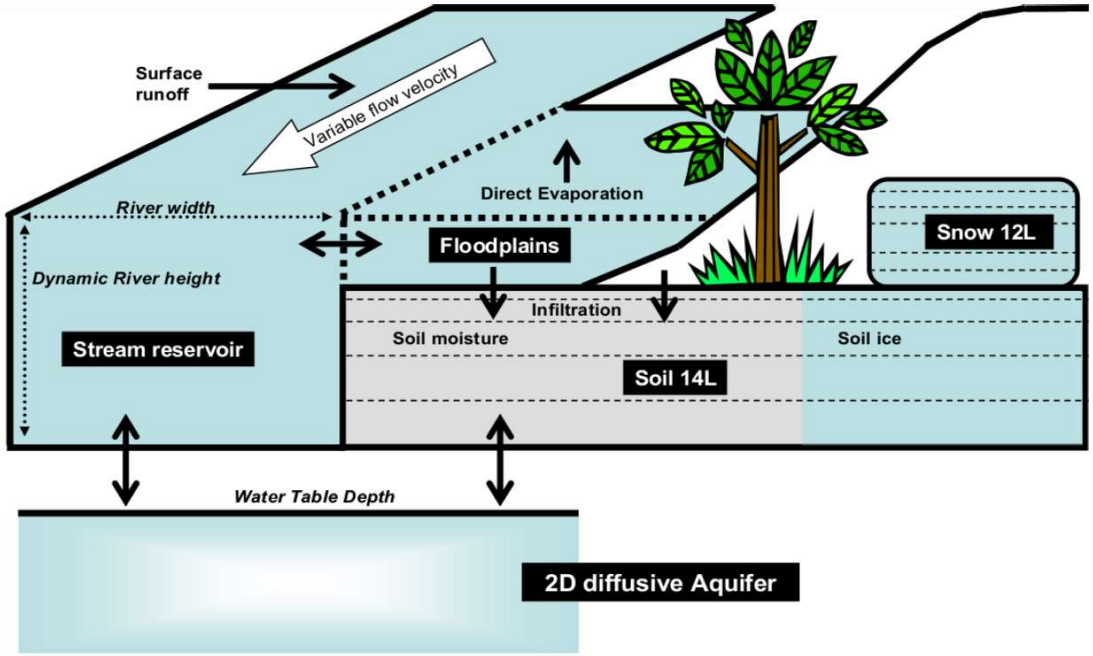
- **Modelling platforms including land surface models (LSMs), forced by gridded atmospheric variables, coupled to river routing models**

(Dirmeyer et al., 2006)

- **LSMs simulated biophysical variables**
  - Fully consistent with surface flux and river discharge simulations
  - Initialized using remotely sensed observations through Land Data Assimilation System

Study the terrestrial water cycle

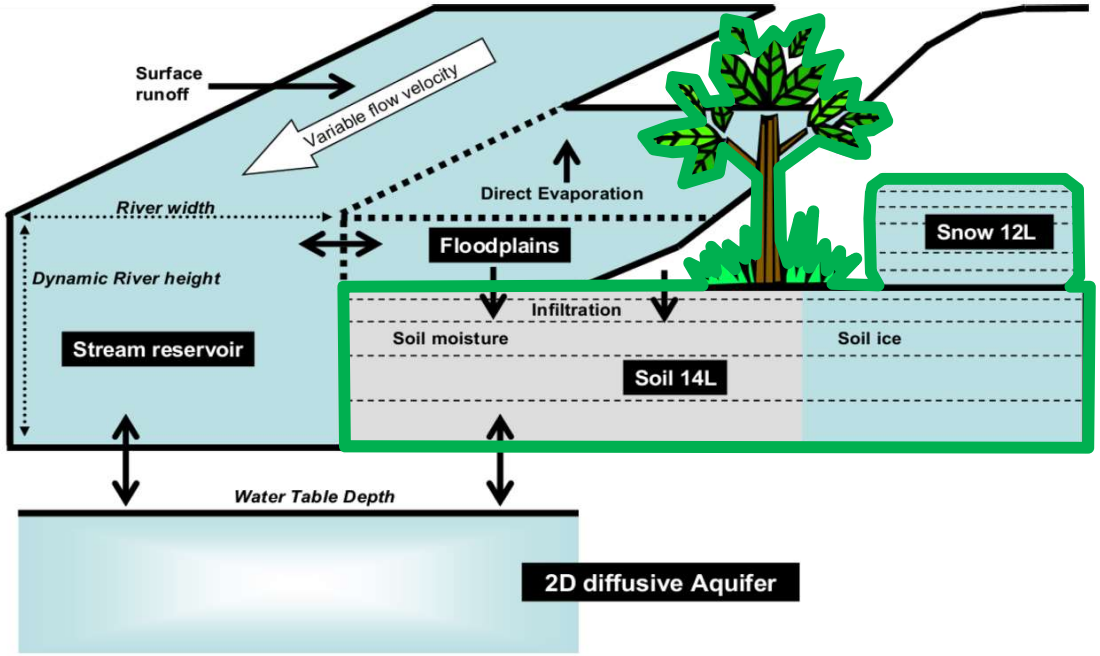
- **SURFEX-CTRIP satellite-driven hydrological system**



Study the terrestrial water cycle

- **SURFEX-CTRIP satellite-driven hydrological system**
  - ISBA-A-gs : simulates the diurnal cycle of water and carbon fluxes, plant growth and key vegetation variables on a daily basis

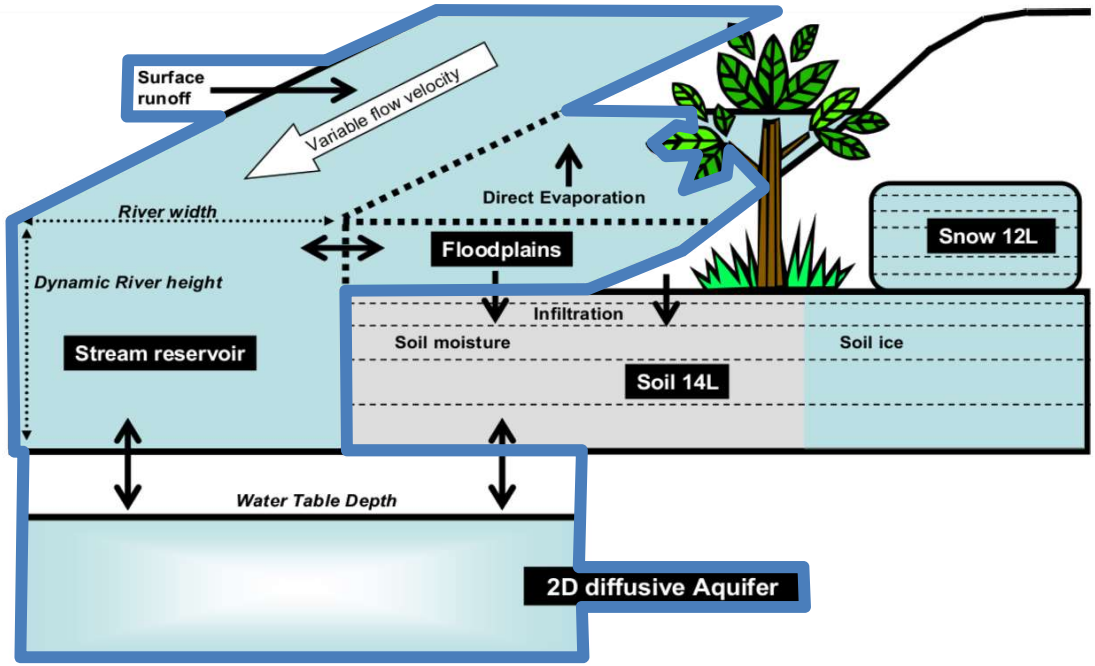
(Calvet et al., 1998, 2007, Gibelin et al., 2006)



Study the terrestrial water cycle

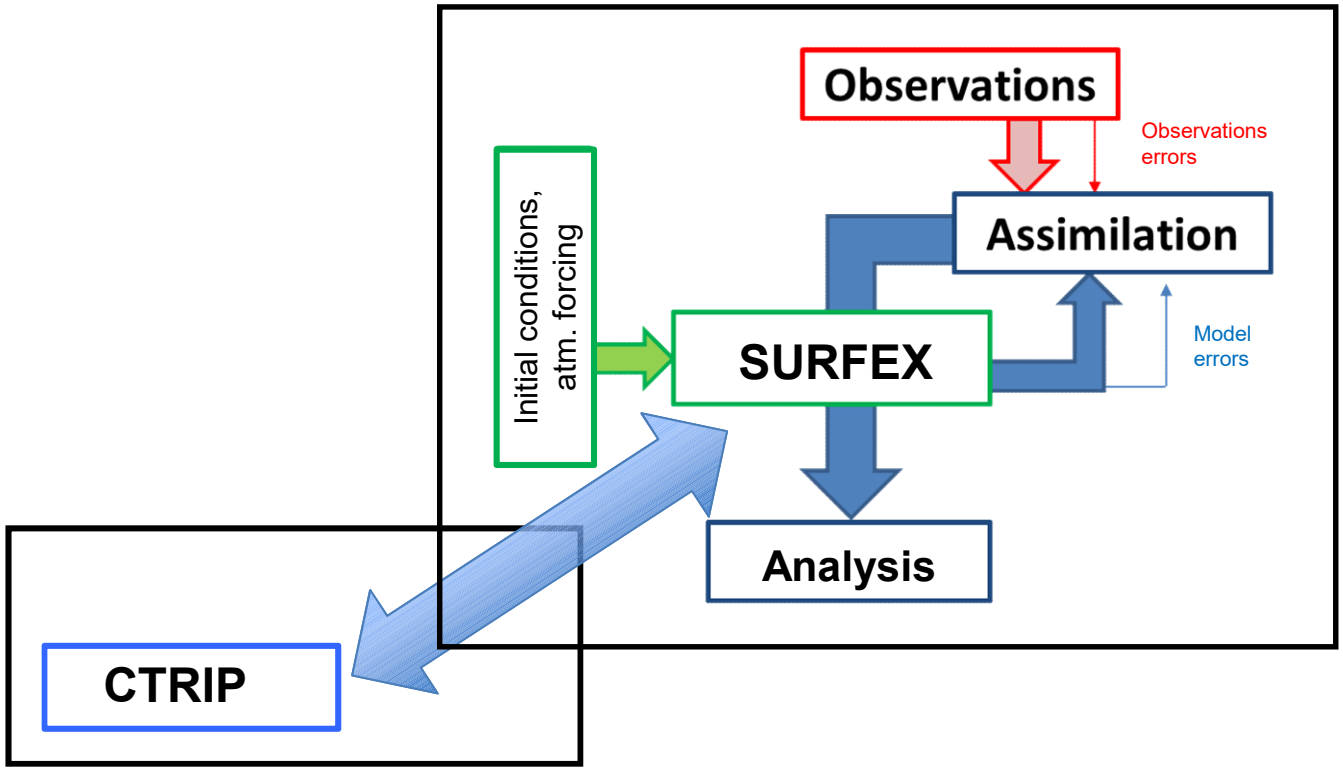
- **SURFEX-CTRIP satellite-driven hydrological system**
  - CTRIP : TRIP based river routing system with CNRM developments for global hydrological applications
  - ➔ variable flow rate, flooding by overflowing rivers, aquifers

(Oki and Sud, 1998, Decharme et al., 2008, 2010)



Study the terrestrial water cycle

- **SURFEX-CTRIP satellite-driven hydrological system**
  - Initialize / constrain ISBA-A-gs biophysical variables using satellite derived observations through Land Data Assimilation System



Study the terrestrial water cycle

- **SURFEX-CTRIP satellite-driven hydrological system**

Model	Domain	Atm. Forcing	DA Method	R.S. Obs.	Observation Operator	Control variables
ISBA (CO_2 responsive version, multilayer) **CTRIP**	**Selected zone** (0.5°, 0.25°) **Global** (1°, 0.5°)	**ERA-Interim**	**SEKF**	**SSM** [daily] (ASCAT-SWI, ESA-CCI) **LAI** [decadal]	**Second layer of soil** (1-4cm) **LAI**	**First 8 layers of soil** **LAI**

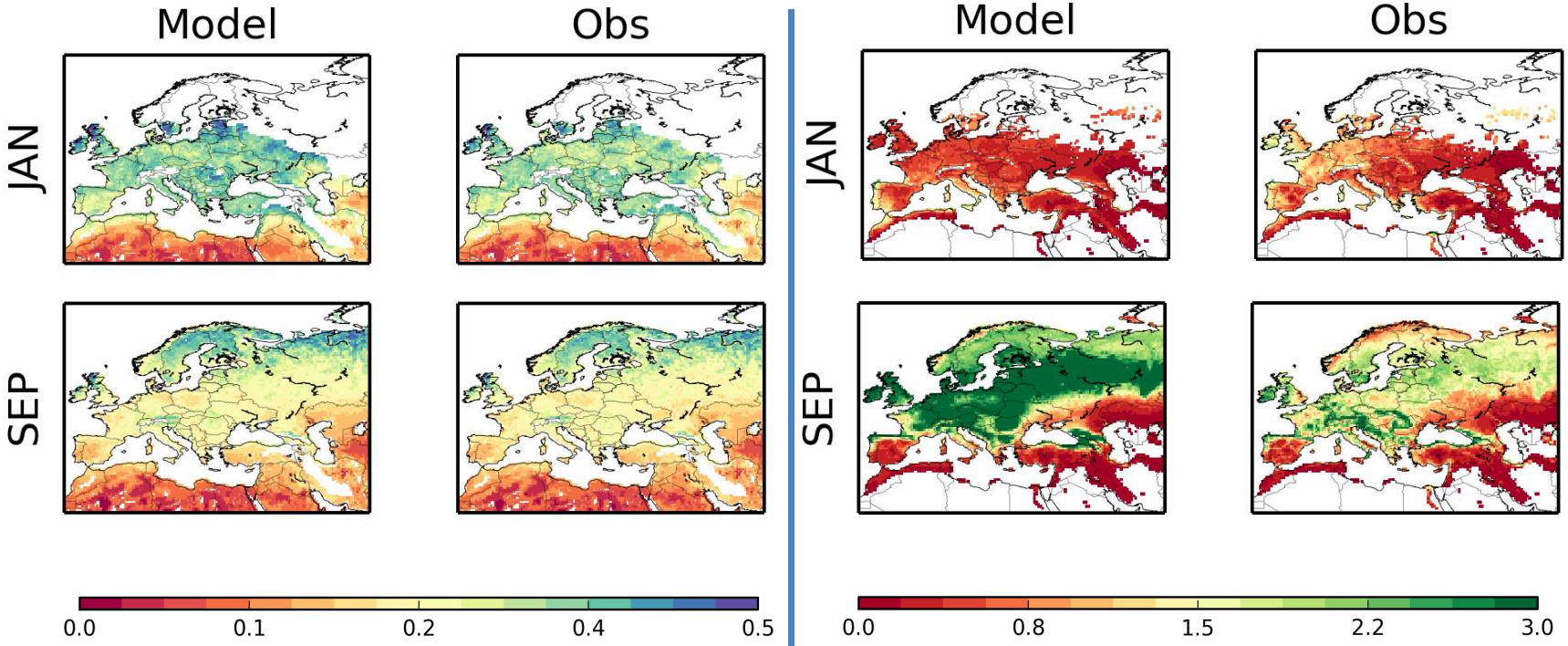
- Direct impact on soil moisture, leaf area index
- Indirect impact on
  - Water / CO2 fluxes
  - CTRIP variables (e.g. river discharge), daily coupling with ISBA

ISBA to CTRIP : runoff, drainage, groundwater and floodplain recharges

CTRIP to ISBA : water table depth/rise, floodplain fraction, flood potential infiltration

SURFEX-CTRIP satellite-driven hydrological system

- **Experimental set-up：**
  - Open-loop (Model) 1990-2010
  - Analysis 1990-2010, LAI & SSM [ESA-CCI]

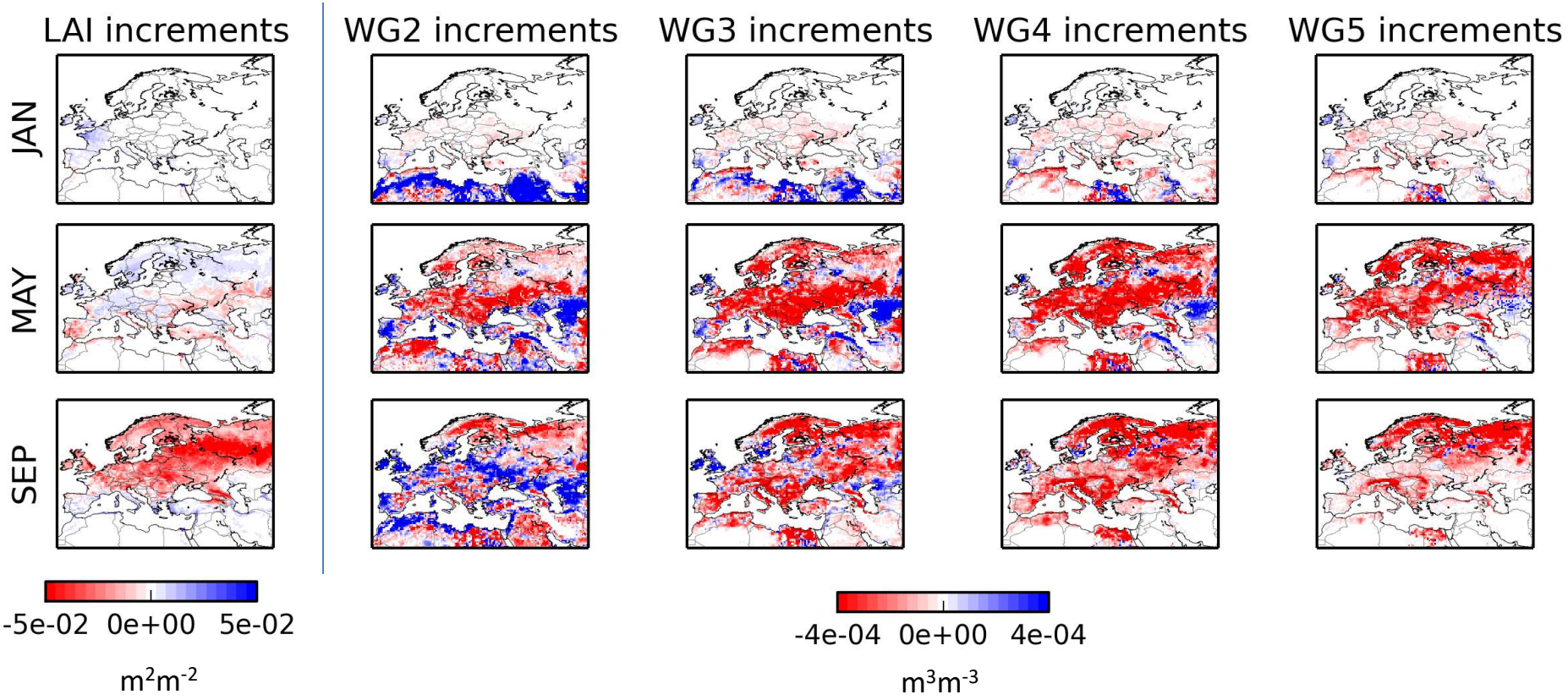


WG2/SSM m^3m^{-3}
Averaged over 2000-2010

LAI m^2m^{-2}
Averaged over 2000-2010

SURFEX-CTRIP satellite-driven hydrological system

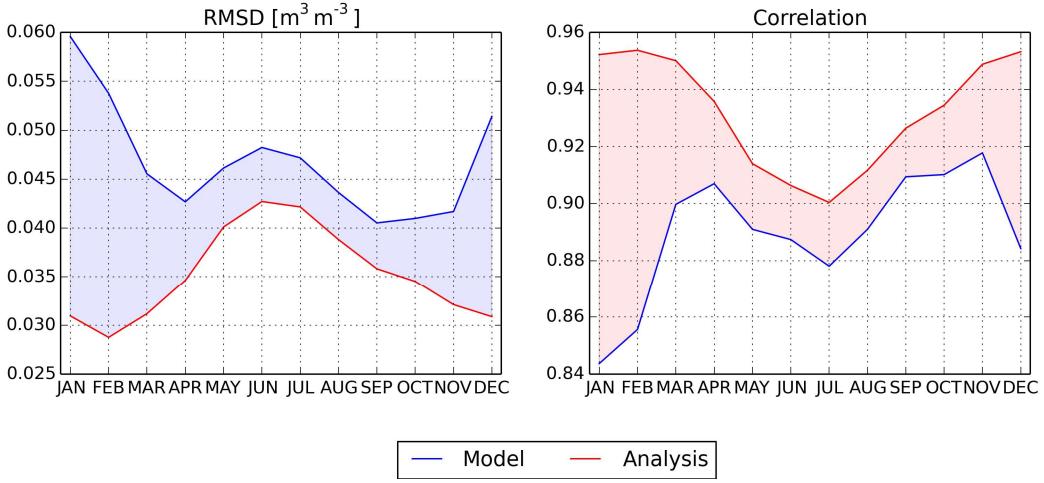
- Analysis increments (averaged over 2000-2010)



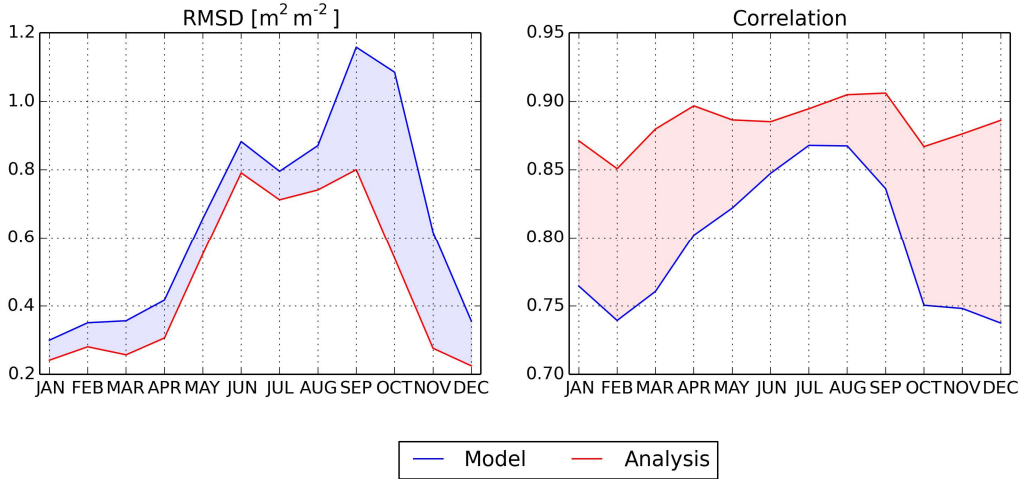
SURFEX-CTRIP satellite-driven hydrological system

- System evaluation SSM (top) and LAI (bottom), 2000-2010
  - ➔ Model and Analysis Vs. assimilated observations

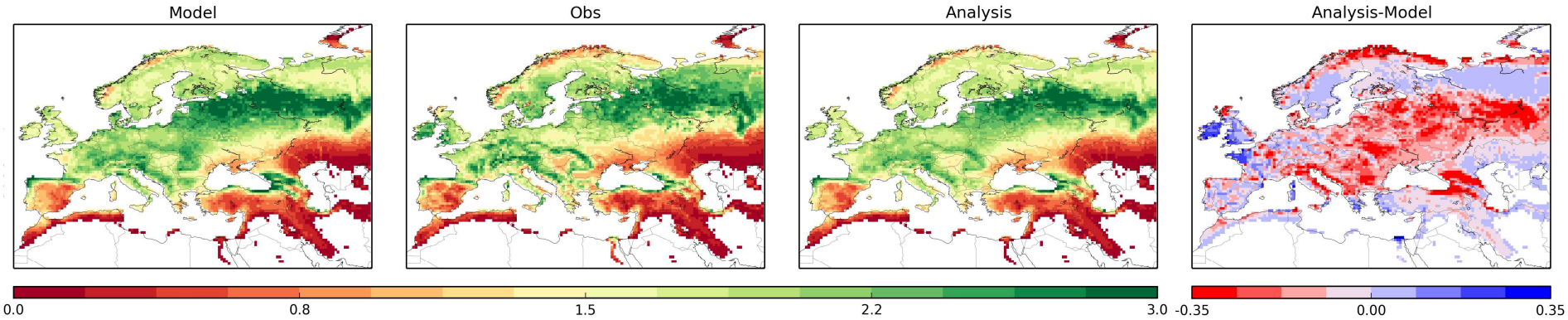
Soil Moisture

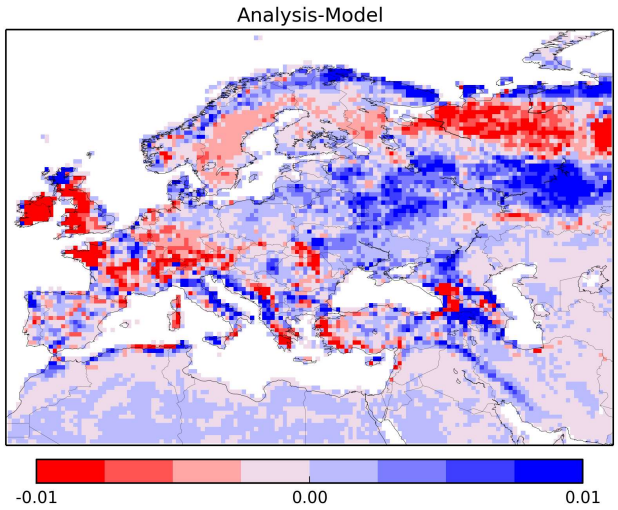


Leaf Area Index

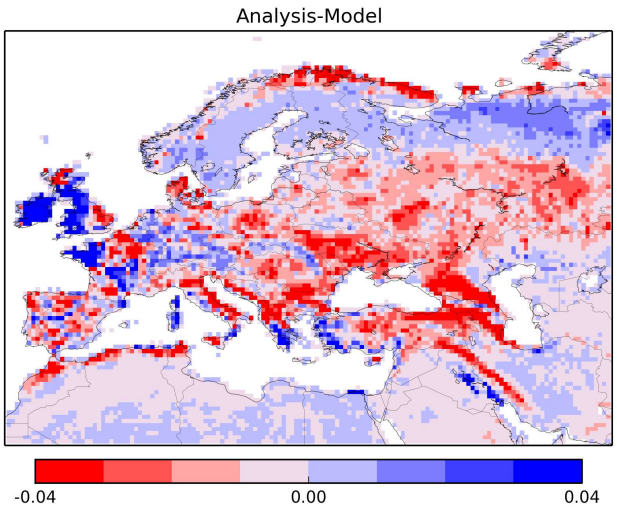


SURFEX-CTRIP satellite-driven hydrological system

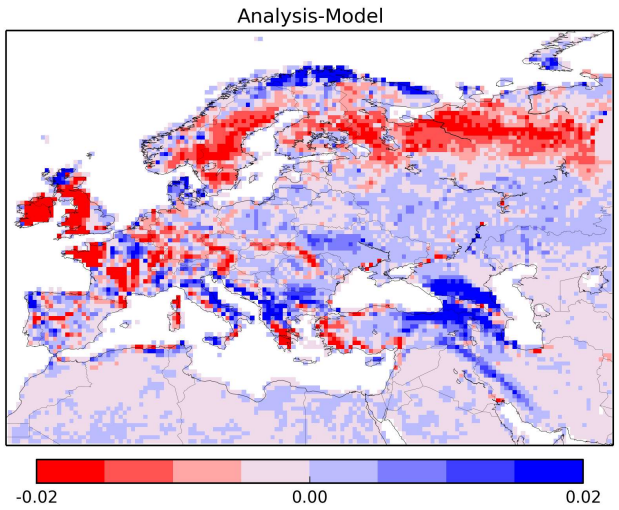




Daily cumulated runoff difference
Kg/m2/day averaged over 2000-2010



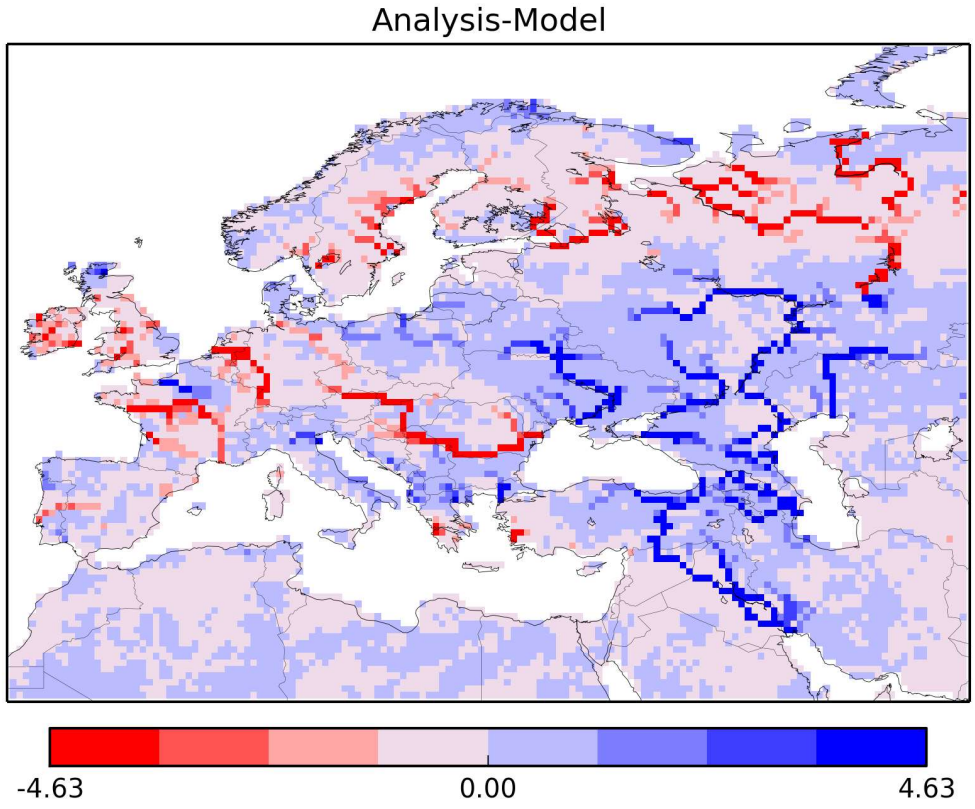
Daily cumulated evapotranspiration difference
Kg/m2/day averaged over 2000-2010



Daily cumulated drainage difference
Kg/m2/day averaged over 2000-2010

SURFEX-CTRIP satellite-driven hydrological system

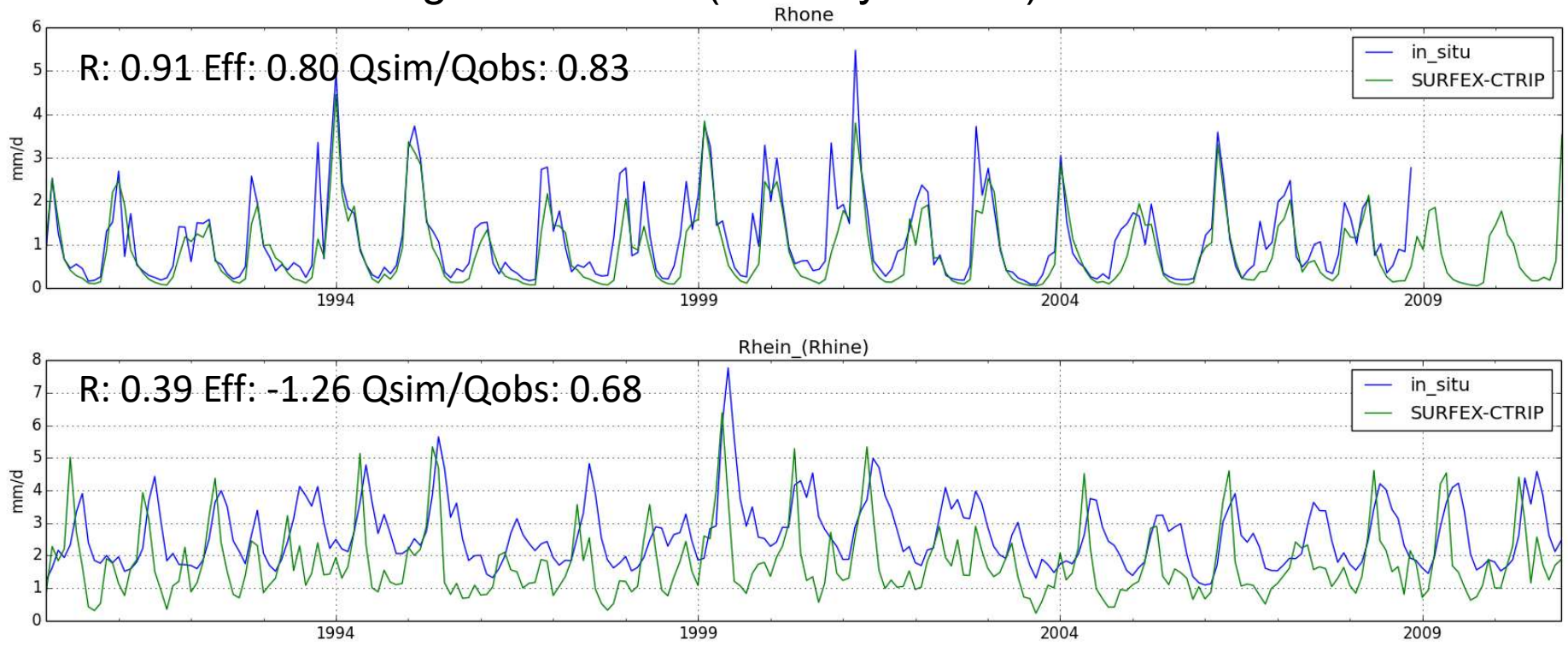
- Impact on CTRIP river discharge (averaged over 2000-2010)



Daily river discharge difference
m^3s^{-1}

SURFEX-CTRIP satellite-driven hydrological system

- River discharge evaluation (monthly values)



- More evaluation is required (better selection of stations)
- Set up a specific case over Spain where more observations are available (eartH2Observe project)

Towards water management in SURFEX

- Representation of irrigation and agricultural practices
  - <u>What do we have:</u>
  - LAI is forced below a minimum value up to a sowing date
  - Add irrigation amount to precipitation forcing each time the simulated extractable soil moisture content reaches a predefined threshold (maize only)

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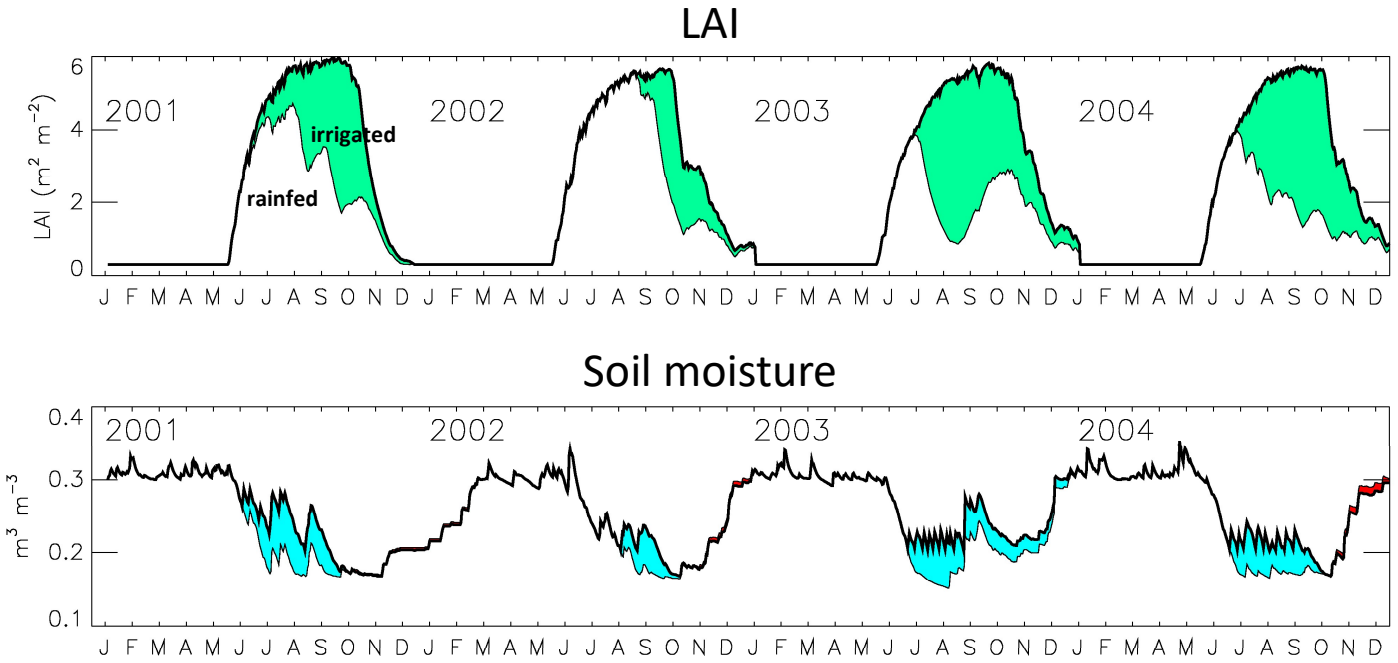

Optimal Irrigation : 120mm 60mm 270mm 240mm

(Calvet et al., 2007, ACP)

Towards water management in SURFEX

- Representation of irrigation and agricultural practices
  - <u>What do we have:</u>
  - LAI is forced below a minimum value up to a sowing date
  - Add irrigation amount to precipitation forcing each time the simulated extractable soil moisture content reaches a predefined threshold (maize only)

  - <u>What do we want:</u>
  - Develop irrigation for all (most of) crops
  - Add irrigation amount to precipitation forcing each time the simulated extractable soil moisture content reaches a predefined threshold
  - Account for water availability!
  - Different irrigation methods (sprinkler, drip, flooding)

  (Lawston et al., 2015)

  - Account for agricultural practices (crops rotation)

  ➔ impact SURFEX ecosystem and surface parameters database (ECOCLIMAP)

Towards water management in SURFEX

- Representation of irrigation and agricultural practices

(Lawston et al., 2015)

- Representation of reservoir / dam
  - Locate them on CTRIP digital global river network map
  - Set up operating rules

(Hanasaki et al., 2006)

Merci pour votre attention !