climate change initiative

CLIMATE MODELLING USER GROUP

Quality assessment of CCI products at Meteo-France
Use of the LDAS-Monde tool for cross-cutting ECV evaluation

24 October 2022

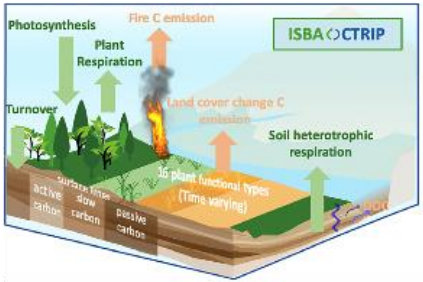
J.-C. Calvet, B. Bonan, C. Meurey, Y. Xu, Y. Zheng

cmug cci

The SURFEX modelling platform

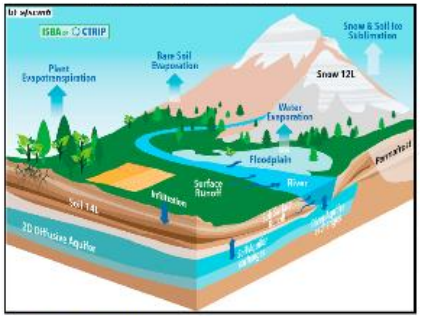
ACCORD
A Consortium for COnvection-scale modelling Research and Development

CARBON CYCLE



Delire et al. 2020

WATER CYCLE



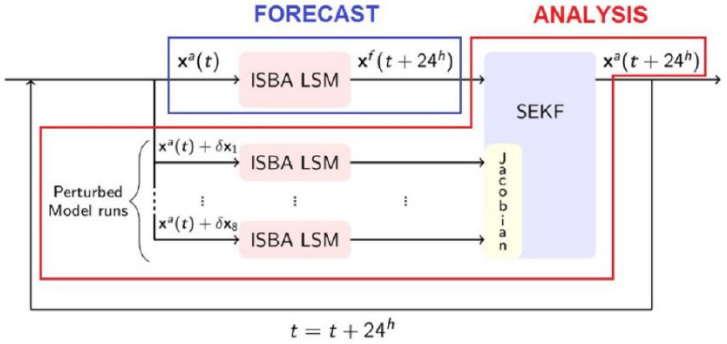
Decharme et al. 2019

ISBA	Soil	Force restore : 2 temperature, 2 or 3 layers for water, icing Diffusion : multilayer (temperature, water, icing)
	Vegetation	Noilhan et Planton 89 (~Jarvis) A-gs (photosynthesis and CO2 fluxes) A-gs and interactive vegetation Slow carbon processes (wood and roots)
	Hydrology	No subgrid process Subgrid surface runoff Subgrid drainage Flooding and coupling with TRIP
	Snow	1 layer, albedo, density variable (ARP/Climat, Douville 95) 1 layer, albedo, density variable (ARP/ALD, Bazile) Multilayer (3, or...) albedo, density, liquid water content (Boone and Etchevers 2000)

Land Data Assimilation within SURFEX

- **LDAS-Monde**

$$x^a = x^f + K(y^o - H(x^f))$$

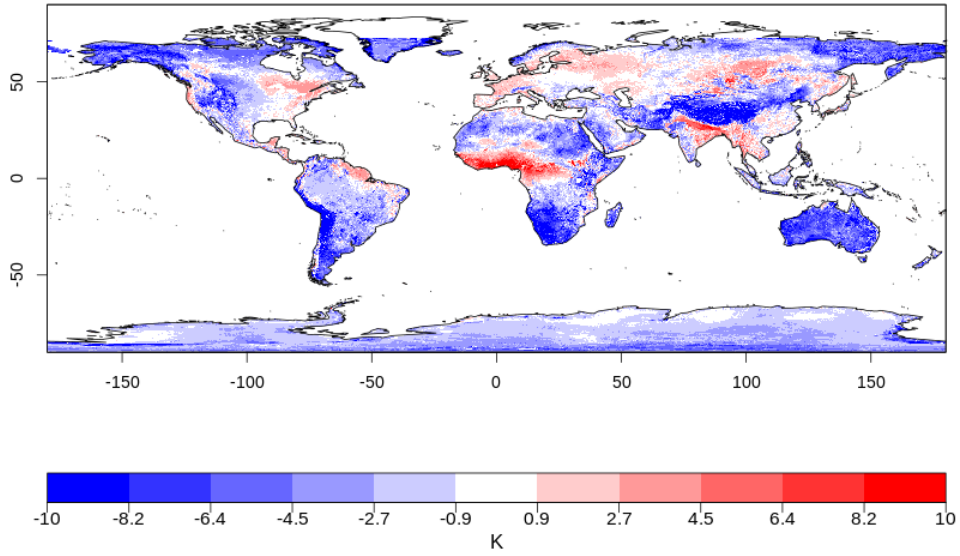


  - Integration of satellite observations into the ISBA land surface model
  - Involves the CTRIP river discharge model
  - Sequential assimilation of LAI
    - Flexible LAI thanks to photosynthesis-driven phenology
    - Root-zone soil moisture can be analysed assimilating LAI
    - Joint LAI and SM assimilation is possible
  - Sequential assimilation of Snow Water Equivalent (SWE)

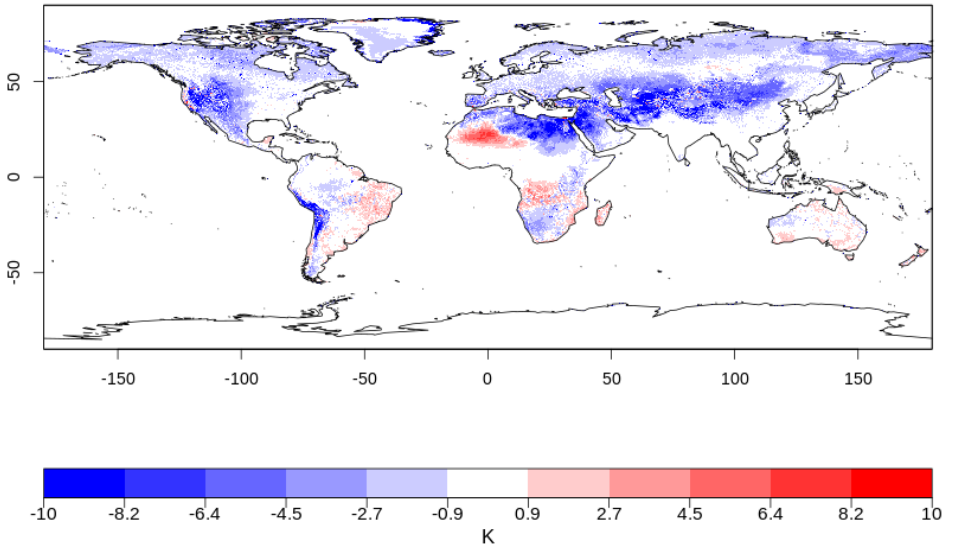
LAI + SM assimilation and LST model bias

- Use of LST-CCI MODIS product from 2002 to 2019
  - Daytime model bias

JANUARY



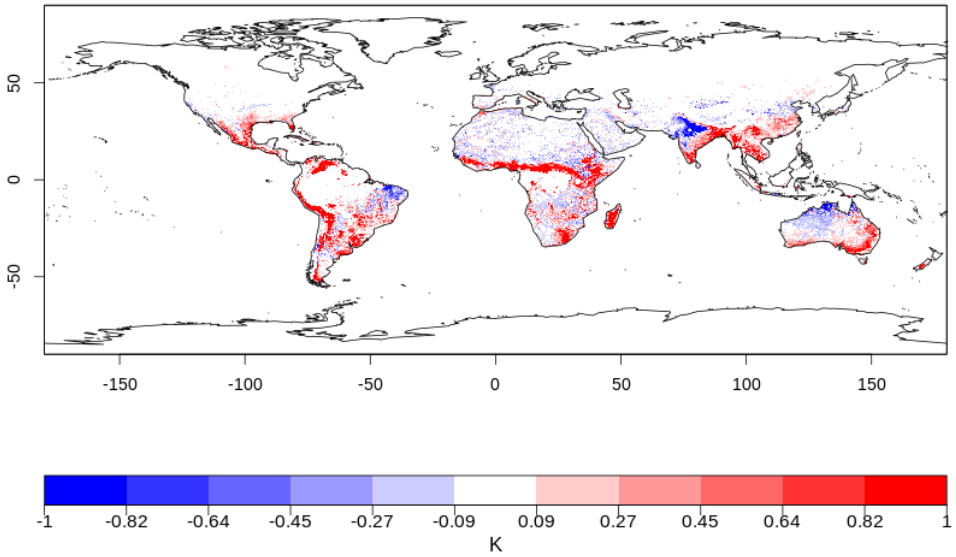
JULY



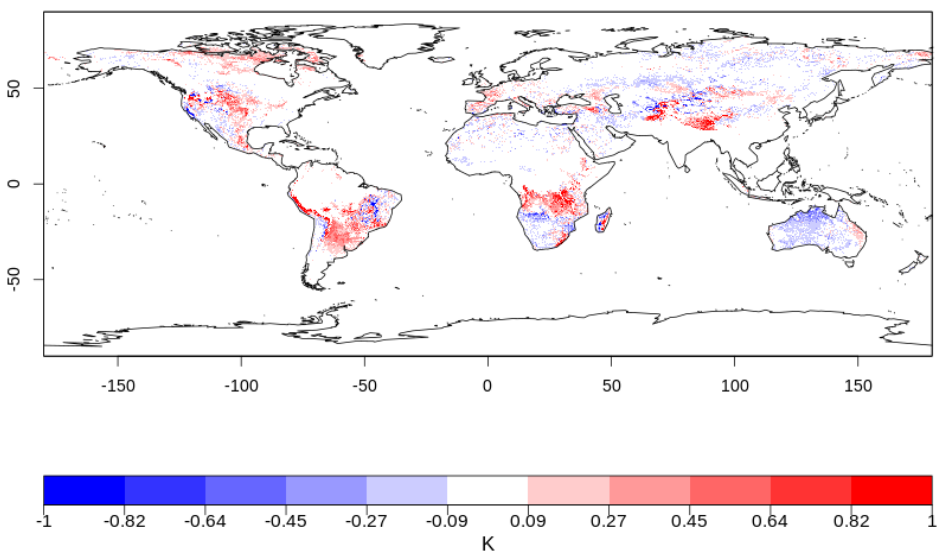
LAI + SM assimilation and LST model bias

- Use of LST-CCI MODIS product from 2002 to 2019
  - Daytime model bias: change due to the assimilation

JANUARY

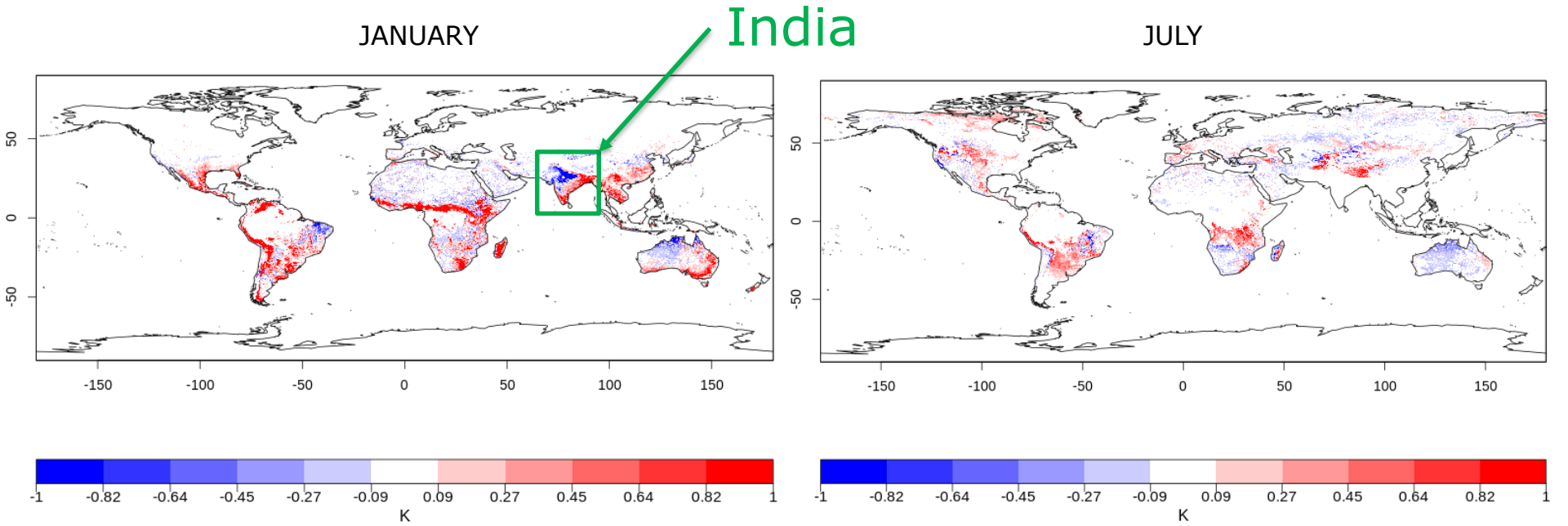


JULY



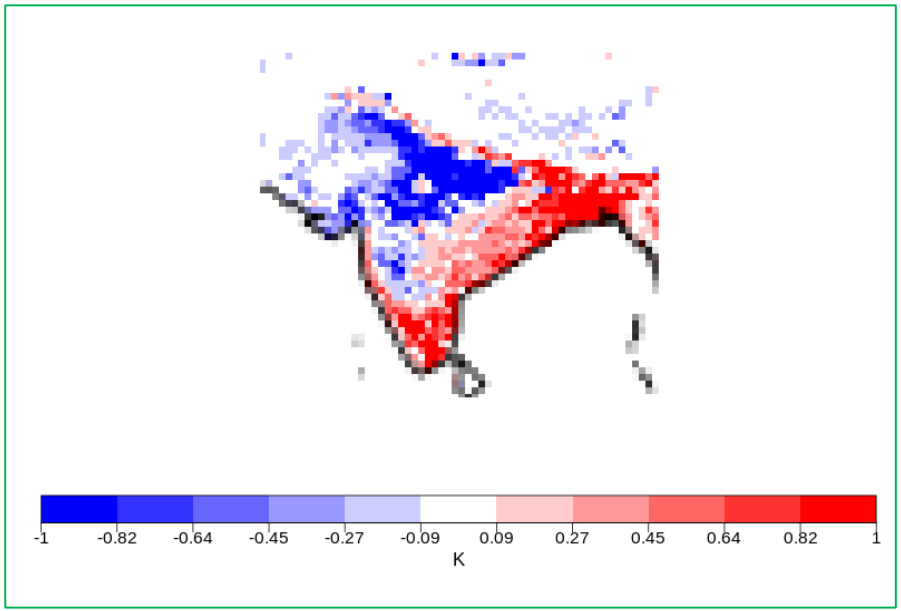
LAI + SM assimilation and LST model bias

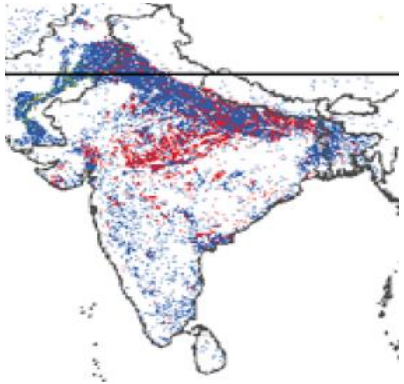
- Use of LST-CCI MODIS product from 2002 to 2019
  - Daytime model bias: change due to the assimilation



LAI + SM assimilation and LST model bias

- Use of LST-CCI MODIS product from 2002 to 2019
  - Daytime model bias: change due to the assimilation

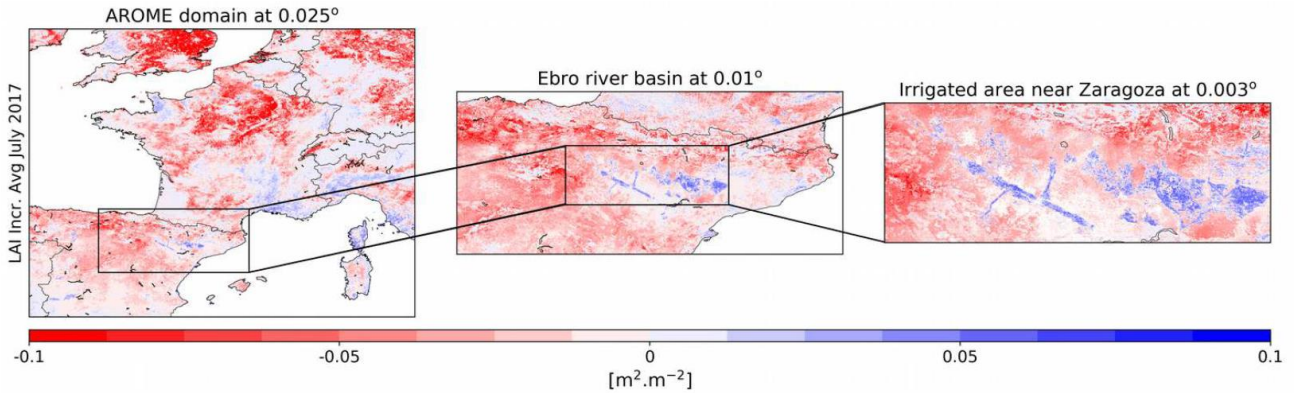




From global **irrigation** map of Meier et al. 2018

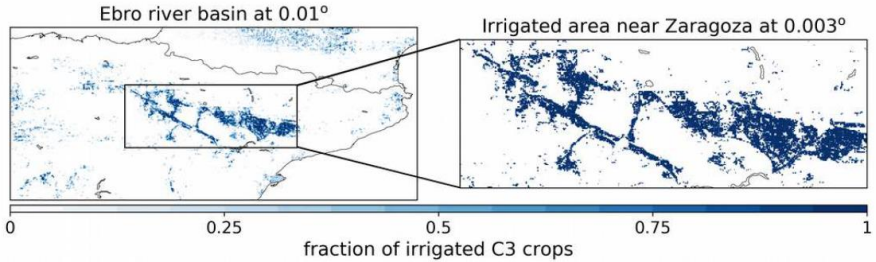
LAI + SM assimilation and LST model bias

- Detection of irrigation using LAI analysis increments



Positive increments match map of irrigated C_3 crop (wheat, …) as shown by figures

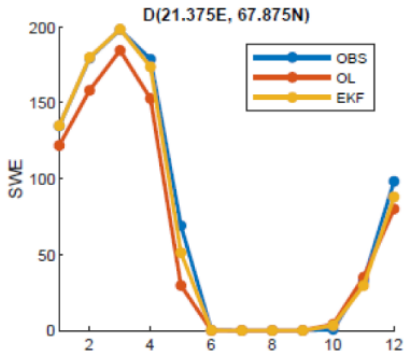
CoCO2
Prototype system for a Copernicus CO_2 service

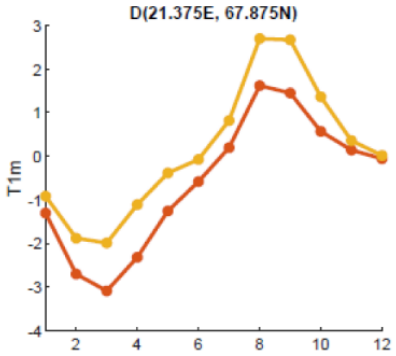


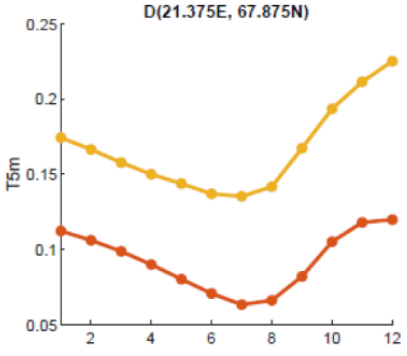
SWE assimilation and PERMAFROST model bias

- Use of SWE-CCI product from 2008 to 2018
  - Assimilating SWE reduces the model cold bias in northern Europe

EXAMPLE: EAST OF KIRUNA (SWEDEN)







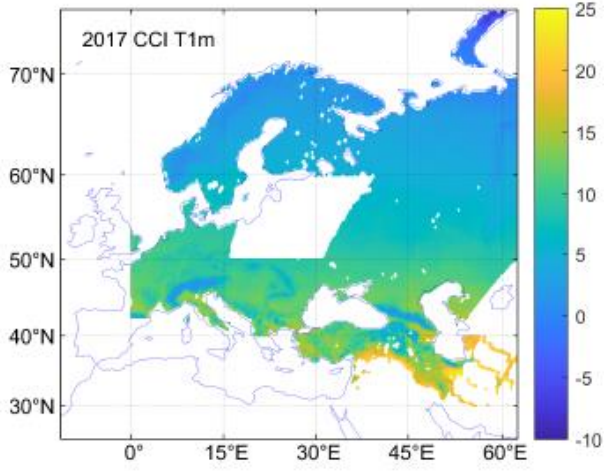
-1m: ~ + 1 degree C

-5m: ~ + 0.1 degree C

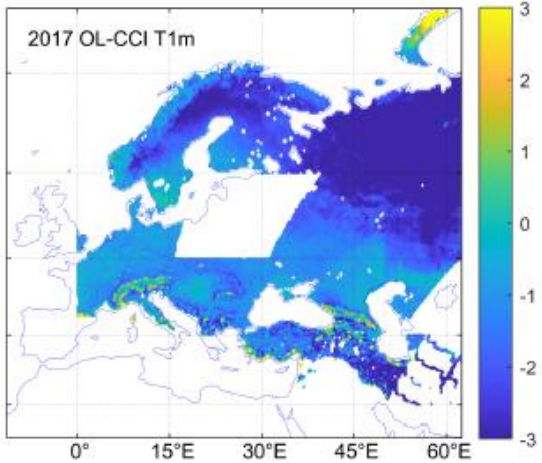
SWE assimilation and PERMAFROST model bias

- Use of SWE-CCI product from 2008 to 2018
  - Assimilating SWE reduces the model cold bias in northern Europe,
    … not in the permafrost area

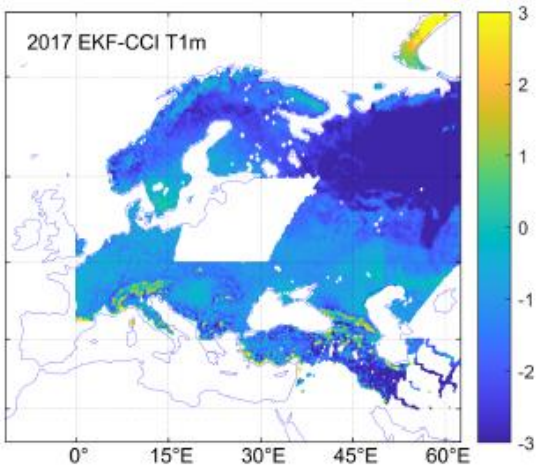
GROUND TEMPERATURE AT -1m



MODEL BIAS

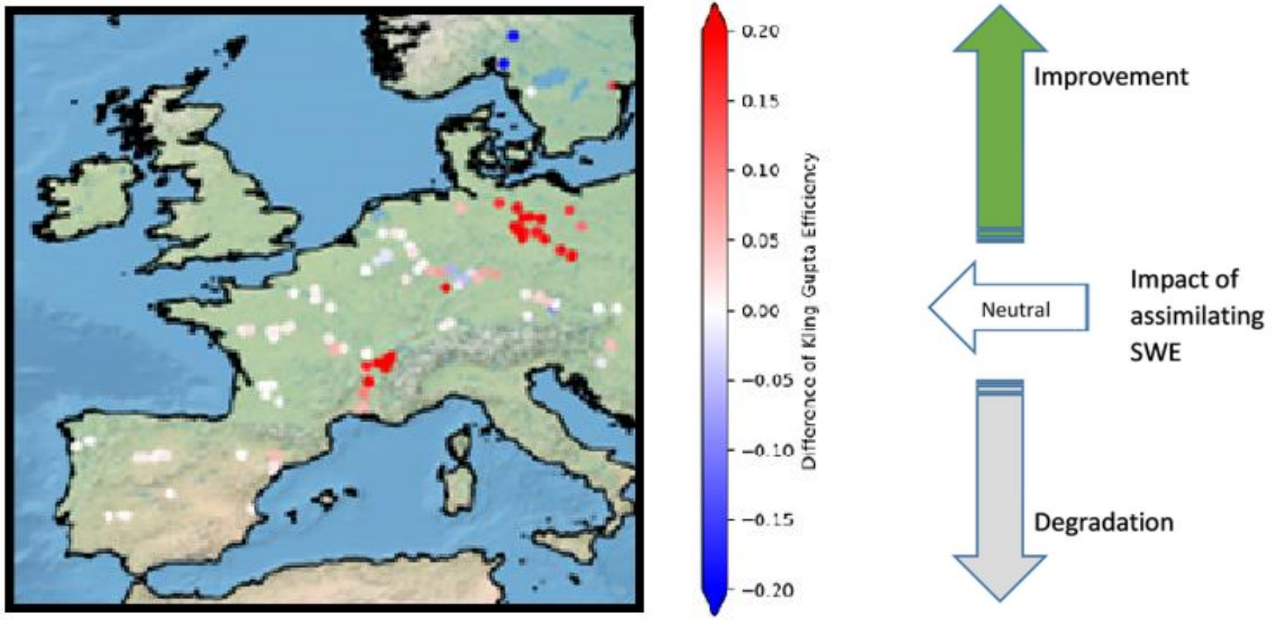


ANALYSIS BIAS



SWE assimilation and river discharge

- Use of SWE-CCI product from 2008 to 2018
  - Assimilating SWE improves river discharge simulations in western Europe



CONCLUSIONS: LAI + SM assimilation

- Root-zone soil moisture (RZSM) analysis
  - assimilating SM alone has minor impact on RZSM
  - assimilating LAI alone (or together with SM)
    - improves RZSM
    - improves river discharge
    - reduces LST model bias
    - can be used to detect irrigation

CONCLUSIONS: SWE assimilation

- Assimilation of SWE in ISBA
  - improves ground temperature in northern Europe
  - improves river discharge (better simulation of snow melt)
  - has minor impact on SM and on PERMAFROST ground temperature
- Model implementation
  - a long spinup is needed to achieve equilibrium ground temperature in permafrost areas (>200yr)

Quality assessment of CCI products

Thank you for your attention