CONFESS

Consistent representation of temporal variations of boundary forcings in reanalyses and seasonal forecasts

Update on the H2020 CONFESS project

Progress status

CONFESS Strategic Objectives

- Representation, for the first time, of temporal variations of land cover and vegetation in C3S systems by exploiting state of the art Copernicus observational datasets

- Improved temporal representation of tropospheric aerosols by harmonization of CMIP6 and CAMS datasets.

- Increased prognostic capabilities by inclusion of prognostic vegetation and new capabilities for response to volcanic and biomass burning emissions.

Temporal variations of land cover and vegetation

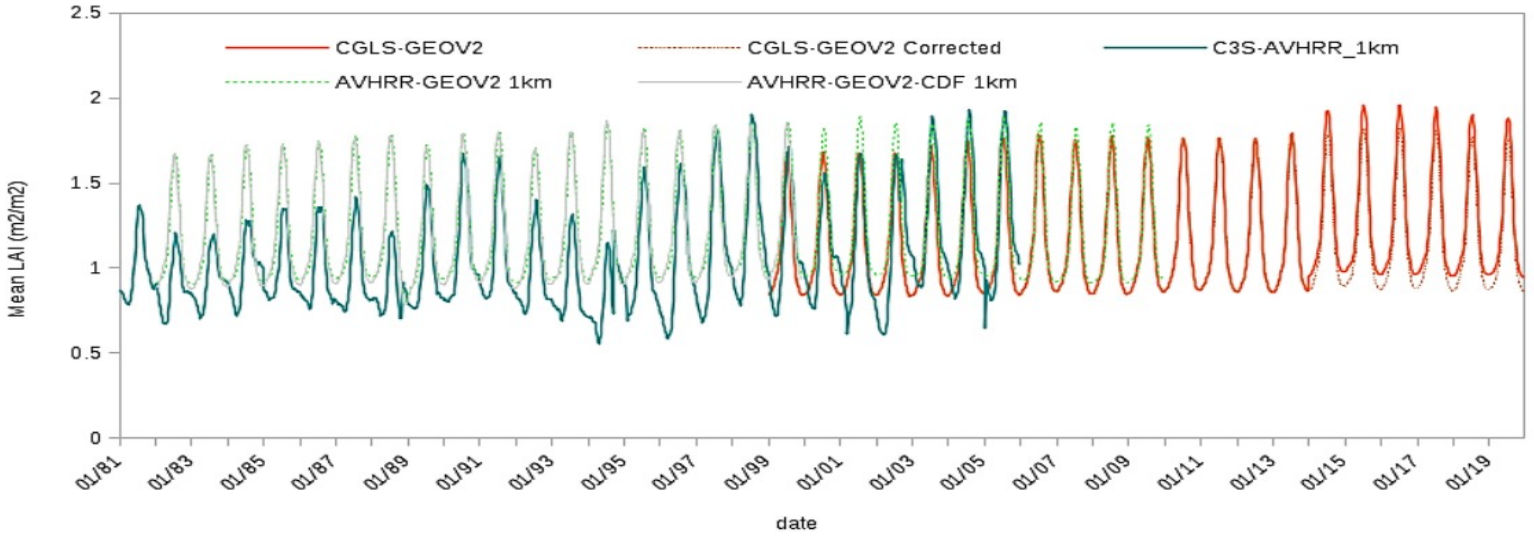
LAI (AVHRR, CGLS; 1993-2019)

FCOVER (CGLS, 1999-2019)

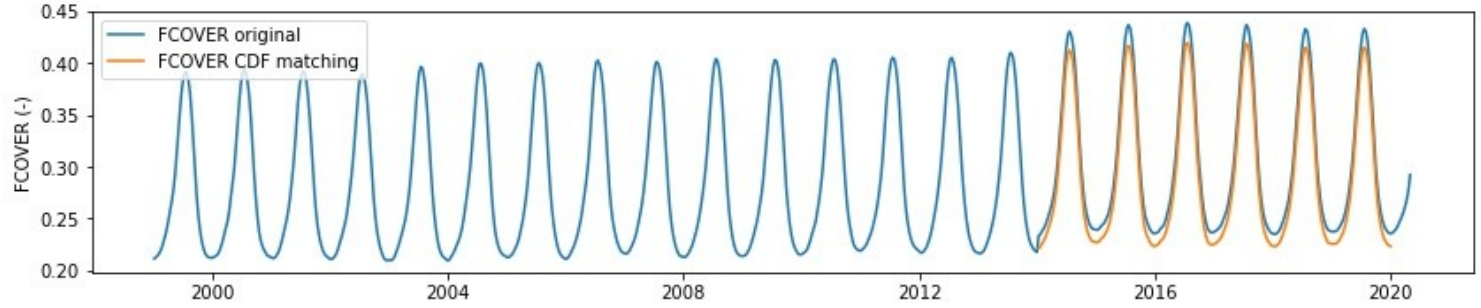
LULC (ESA-CCI/C3S; 1993-2019)

For LAI and FCOVER a CDF matching procedure was needed so as to guarantee conservation of the mean and the variance of the data.

- Harmonized LAI (consistent to ESA-CCI LULC)



- Harmonized FCOVER (consistent with LAI and LULC)

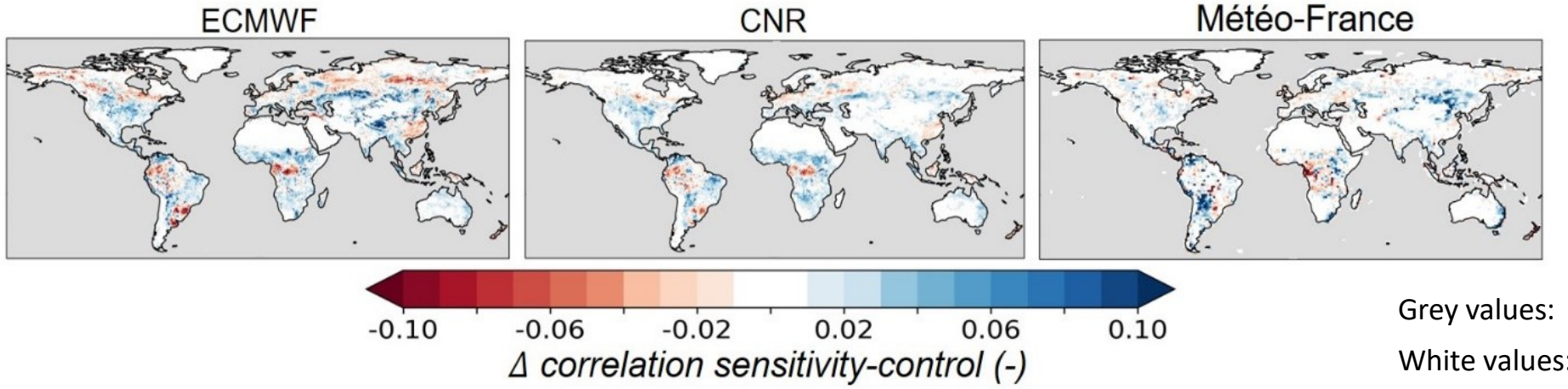


Impact of prescribed varying LAI: offline simulations

- Multi-model assessement

Effects of inter-annually varying (vs. climatological) LAI on correlations coefficients for evapotranspiration (ref: DOLCEv3) and surface soil moisture (ref: ESA-CCI SM -> representative of first ~5cm in the soil)

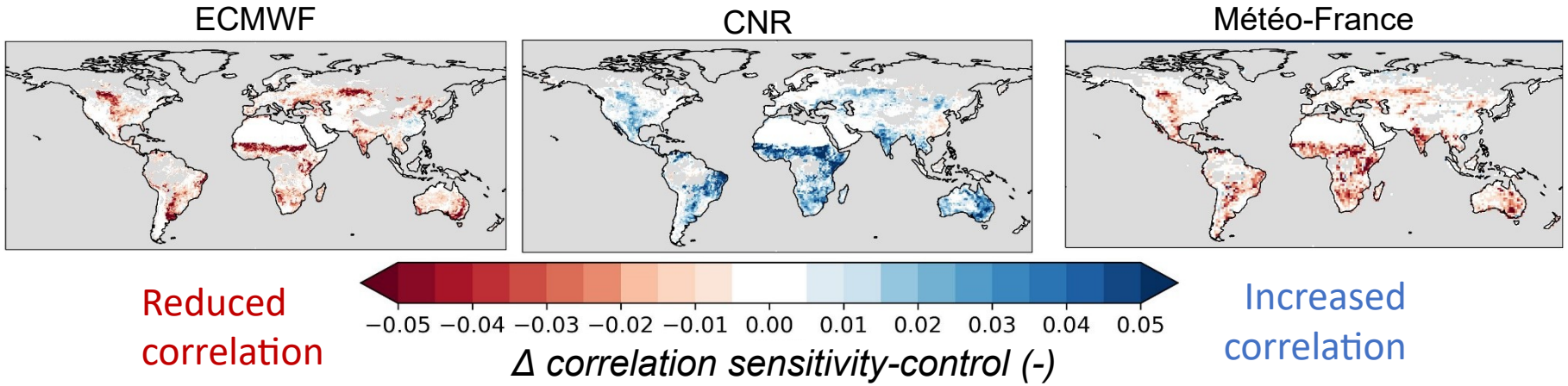
Evapotranspiration



Grey values: undefined

White values: not significantly different (5%)

Surface soil moisture



Reduced correlation

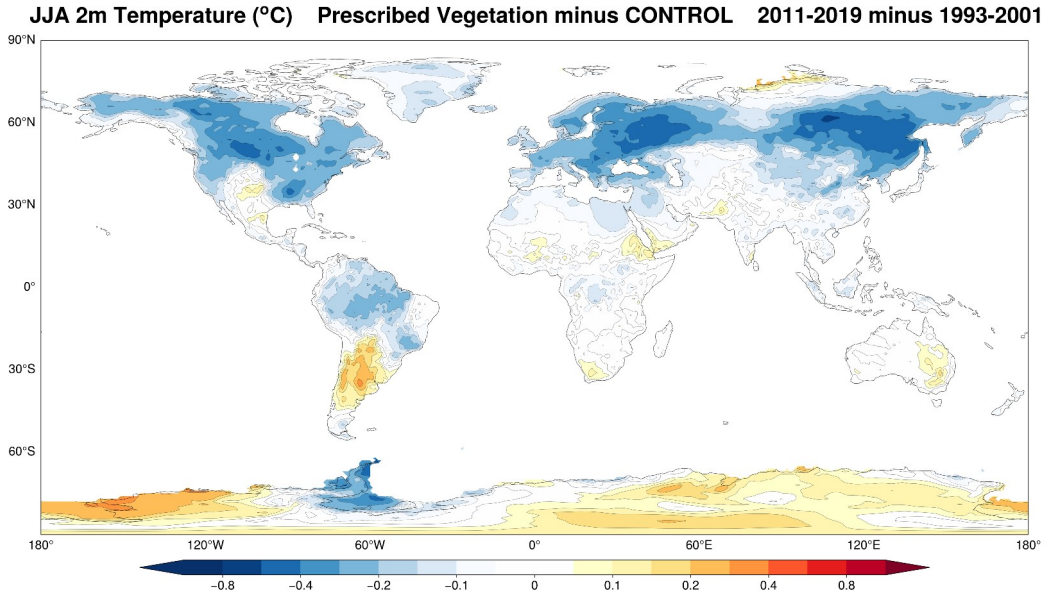
Increased correlation

Impact on seasonal hindcasts

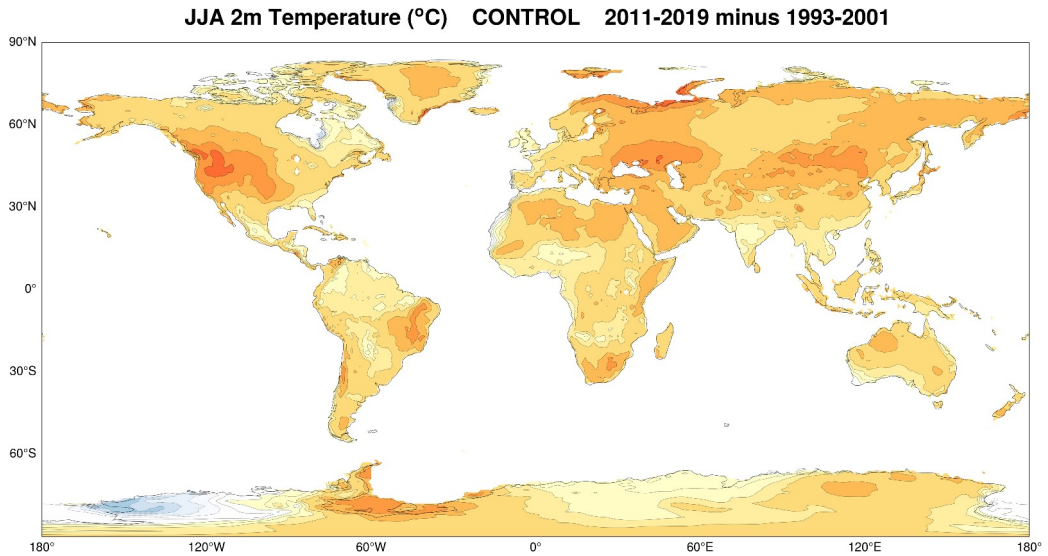
Preliminary results from vegetation hindcasts (ECMWF) with time-varying LULC and LAI

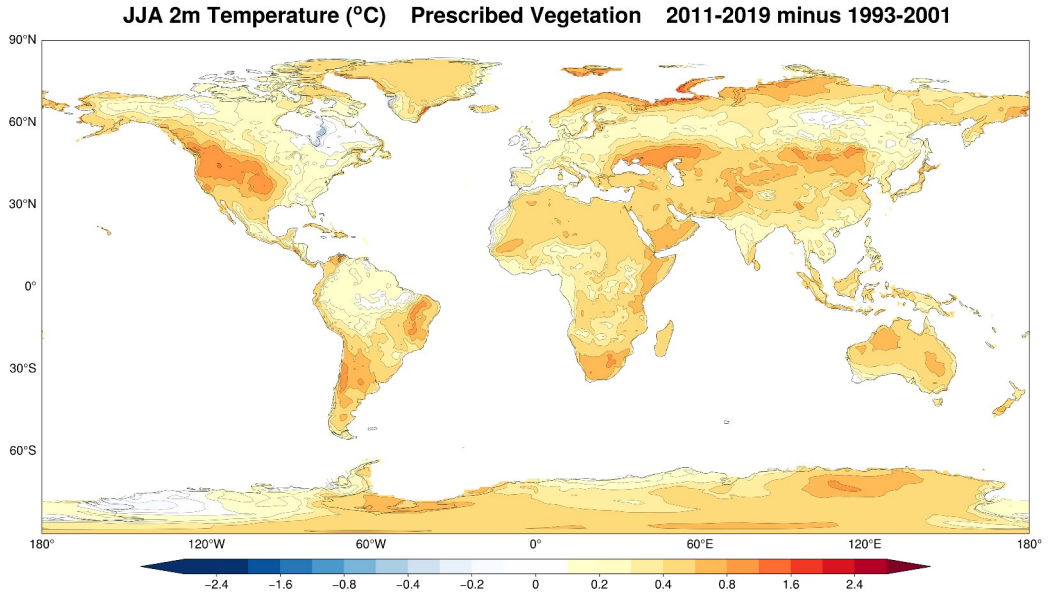
Impact on long-term trend

2011-2019 minus 1993-2001



*Trend calculated as difference over first and last **8-year** periods*





Impact on seasonal hindcasts

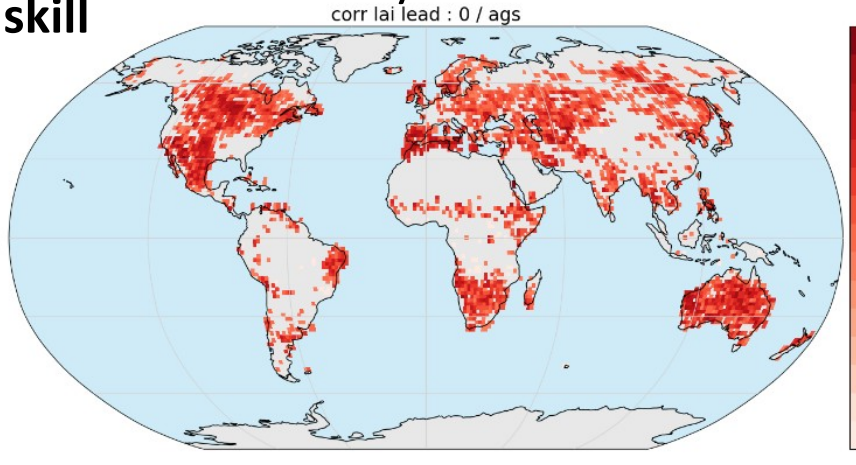
Preliminary results from re-forecasts (Météo-France) with interactive vegetation

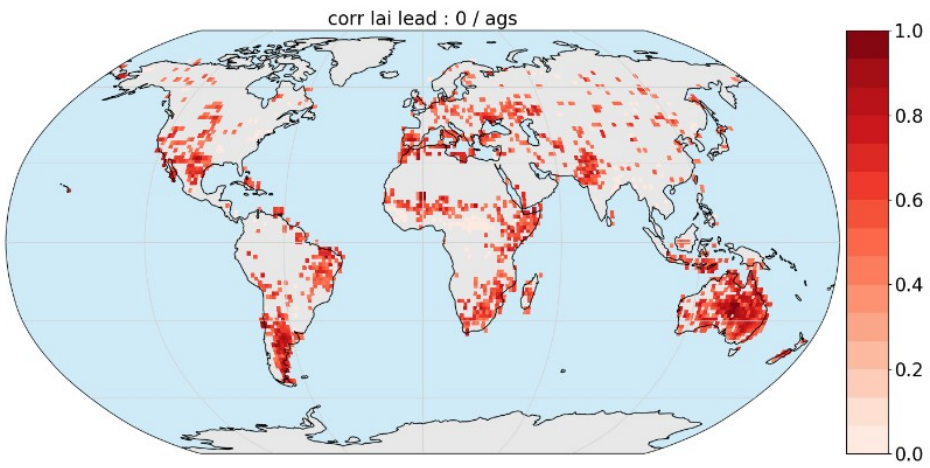
LAI re-forecast skill

May start

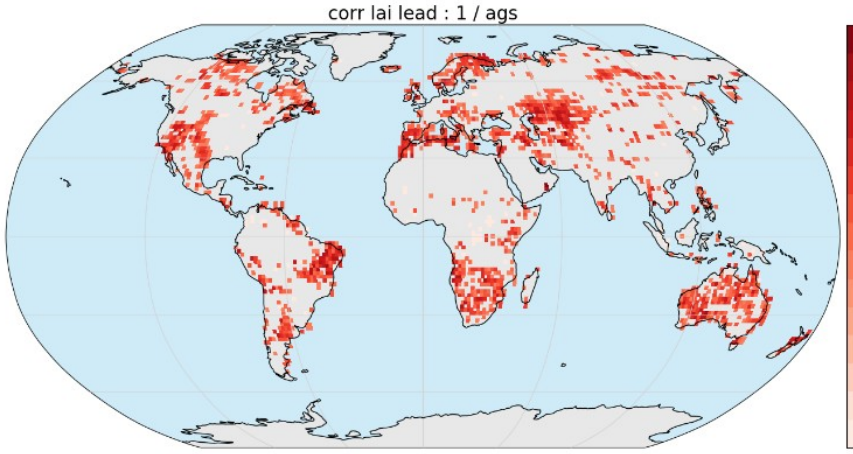
Nov start

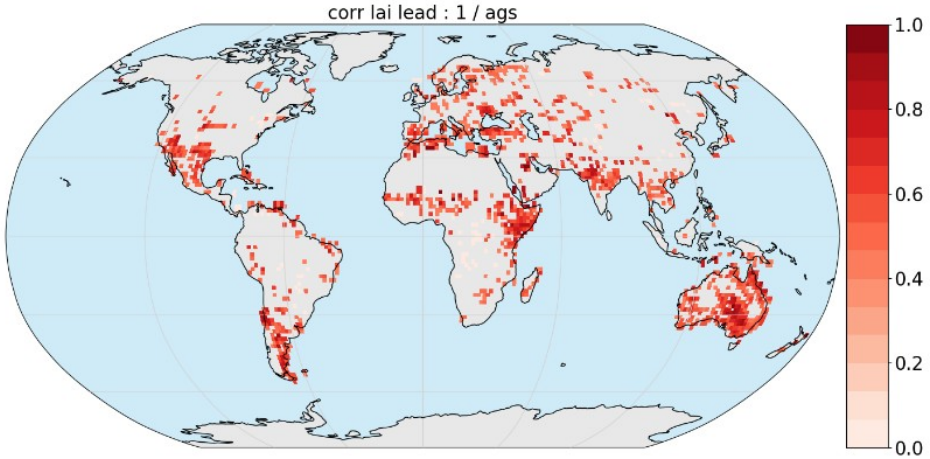
Month 1





Months 2-4

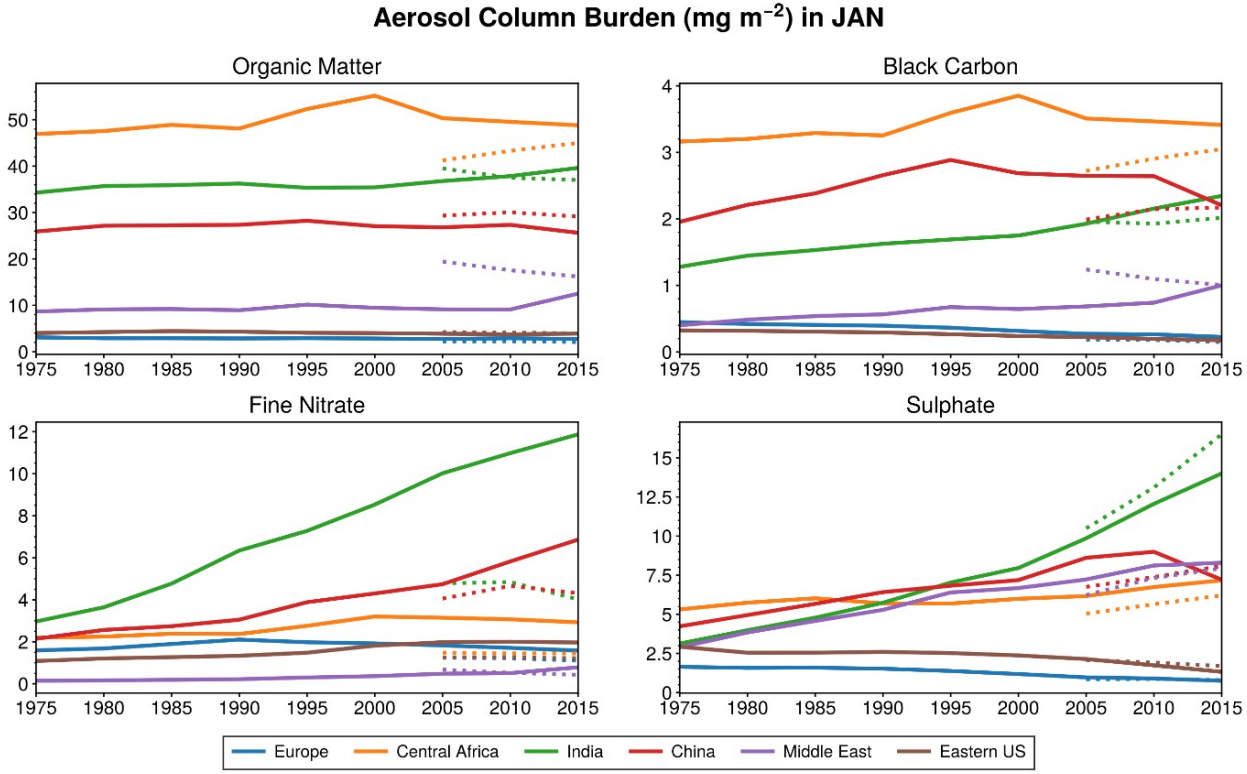




Harmonized tropospheric aerosols datasets

- New aerosol pseudo-reanalysis running CAMS model with specified emissions

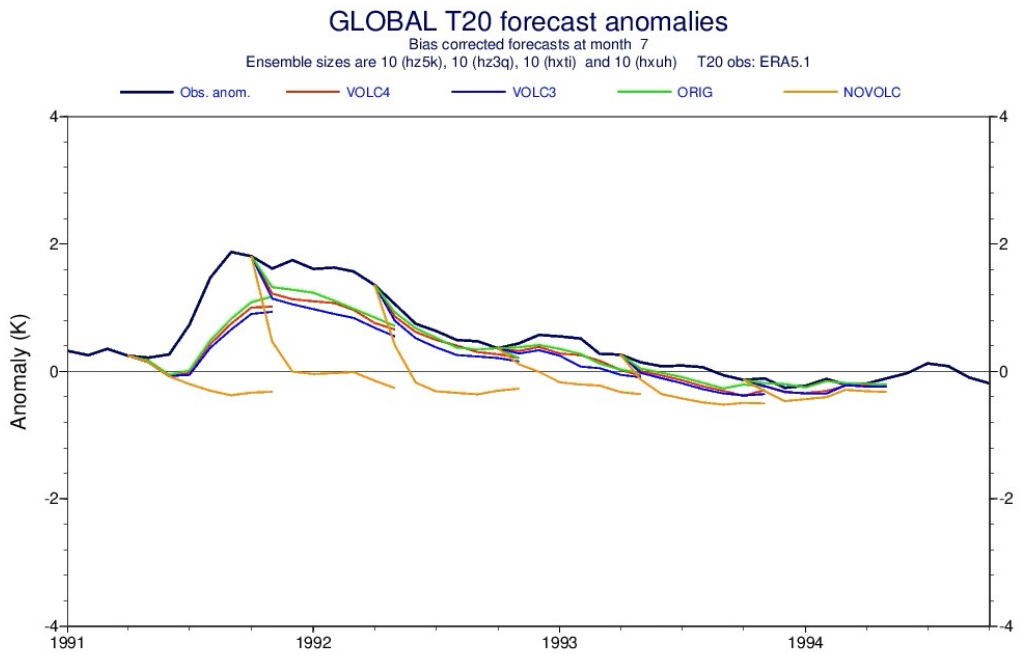
- Gives an updated climatology for recent period, for use in NWP.
- Allows a time-varying climatology (anthropogenic related species) from the 1960s to present, for use in ERA6 and SEAS6.
- Consistent with CMIP6 and subsequent enhancements to emissions data.



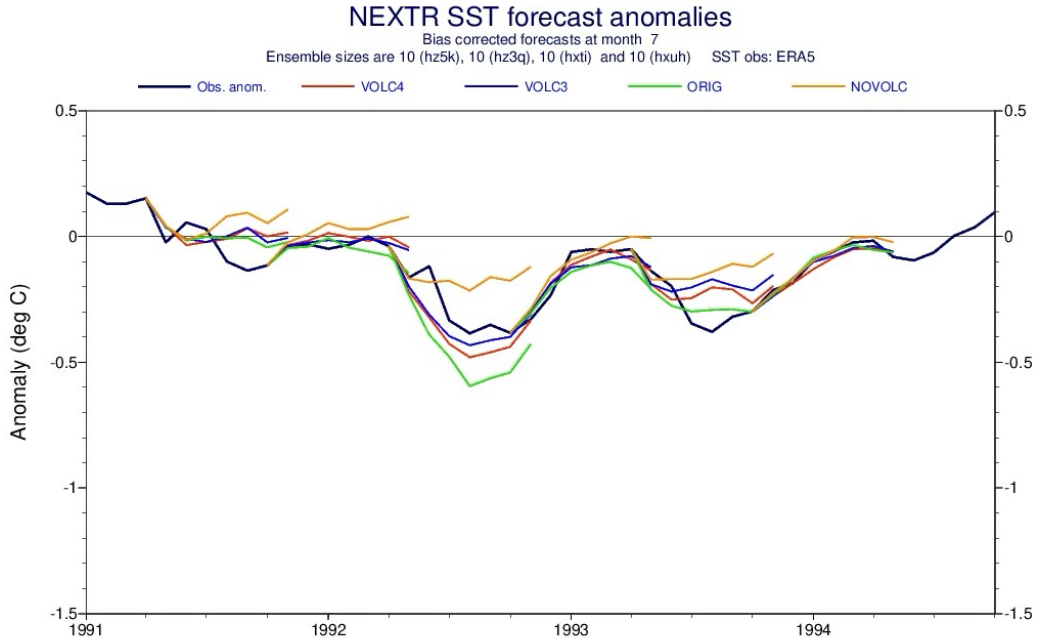
Area-averaged time evolution of different aerosol species AOD.
Dotted lines correspond to a forced experiment using CAMS data.

Response to volcanic aerosol emissions – S2D timescales

- Building capacity to respond to volcanic aerosol emissions
  - Improvement of representation of stratospheric aerosols using vertical structure from GloSSACV2.2 data in the IFS; implementation of the EVA_H (Aubry et al. 2020) calculated aerosol
  - Preliminary tests: 7-month forecasts around the Pinatubo event



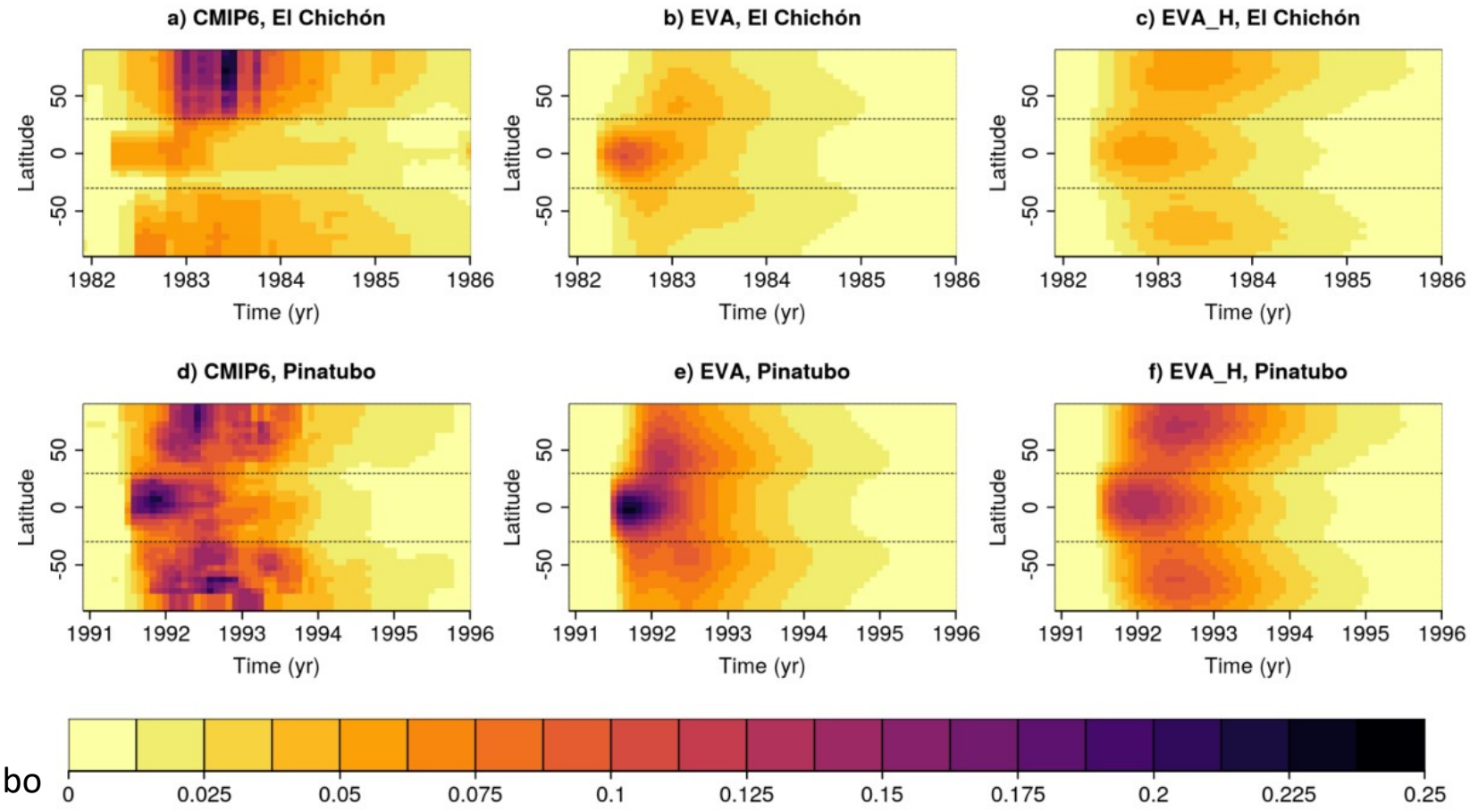
Global mean temperature at 20hPa



Ensemble mean NH extratropics SST anomalies

Response to volcanic aerosol emissions – S2D timescales

- Building capacity to respond to volcanic aerosol emissions
  - Implementation and testing of the EVA_H (Aubry et al. 2020) in the IFS and EC-Earth3 to consider injection height of volcanic SO_2

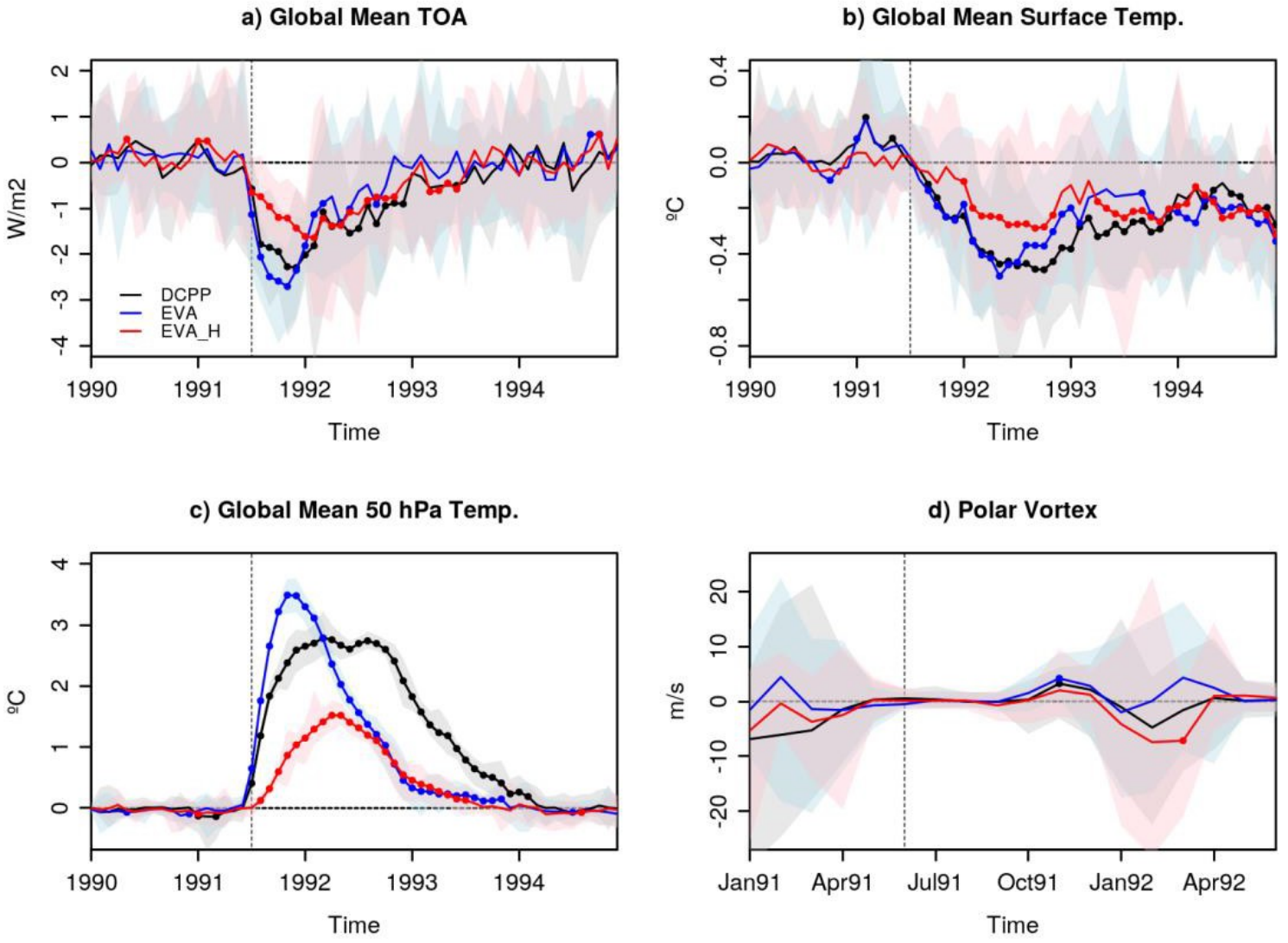


AOD at 530 nm for El Chichon and Pinatubo eruptions as a function of time and latitude

Response to volcanic aerosol emissions – S2D timescales

- Building capacity to respond to volcanic aerosol emissions
  - Implementation and testing of the EVA_H (Aubry et al. 2020) in the IFS and EC-Earth3 to consider injection height of volcanic SO_2
  - Similar protocol to DCPP-C experiments with EC-Earth3

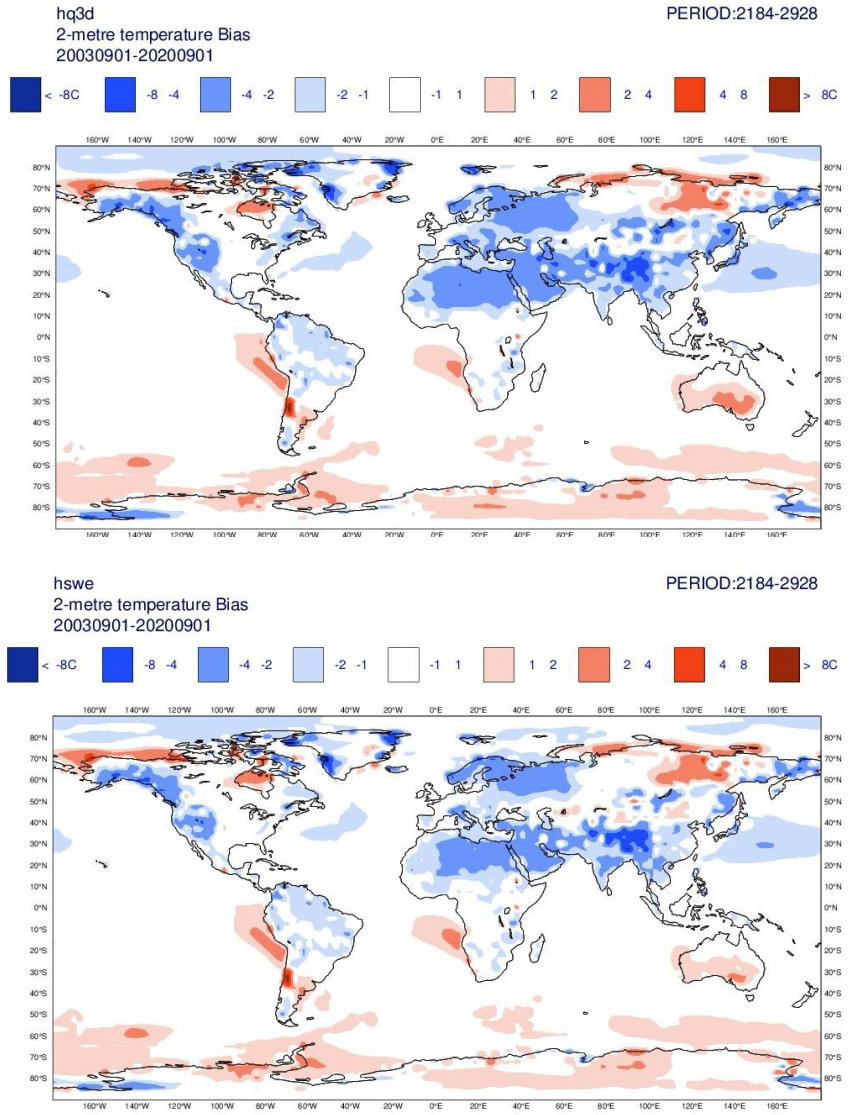
Response (Volcanic forcing – Background) to Pinatubo eruption with CMIP6, EVA, EVA_H forcings



Building capacity to respond to biomass burning emissions

- Study potential impact of time-varying aerosols from biomass burning in ECMWF S2S and seasonal forecasting system
  Simulations with free-running aerosols with
  → GFAS observed emissions for biomass burning
  → GFAS-based climatological emissions

Empirical modeling of biomass burning emissions



Impact of prognostic aerosols on 2-meter temperature bias at month 4

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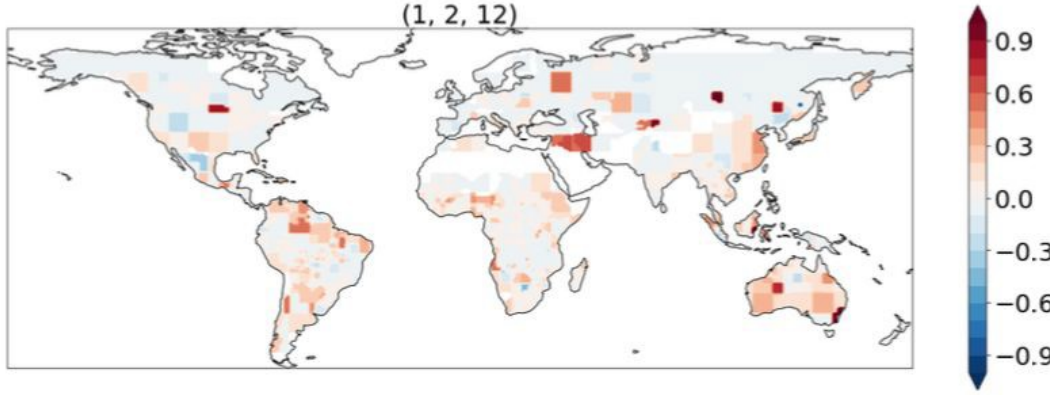


Correlation with GFAS data of DJF biomass burning derived from a LASSO linear regression empirical model using large-scale climate indices (1 month lag)

CONFESS legacy

- Evaluation of CONFESS developments is currently underway for possible inclusion in future C3S seasonal prediction systems, and ERA6
  - → LU / LC influence on trends
  - → interactive vegetation : may not be mature enough at this stage
  - → time-evolving tropospheric aerosols
  - → building capability to react to large-scale events (biomass burning, volcanic eruptions)

- Analysis of CONFESS experiments is informing on process representation in models and current limitations

- CONFESS developments will be the base of new Horizon Europe projects such as CERISE or ASPECT (2023-2026)

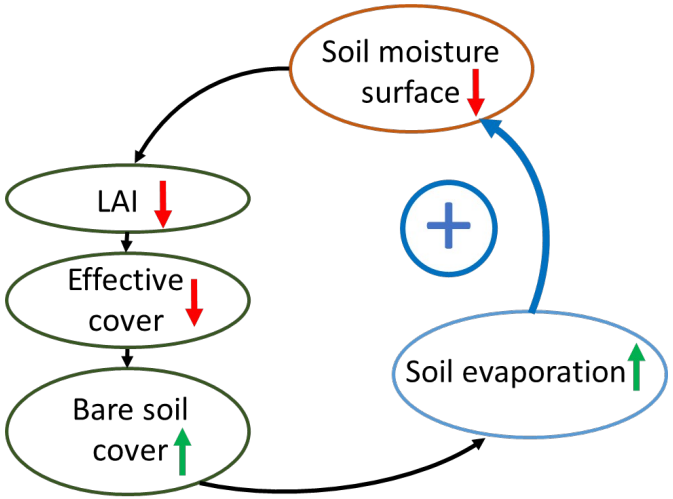
Questions?

The CONFESS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101004156.

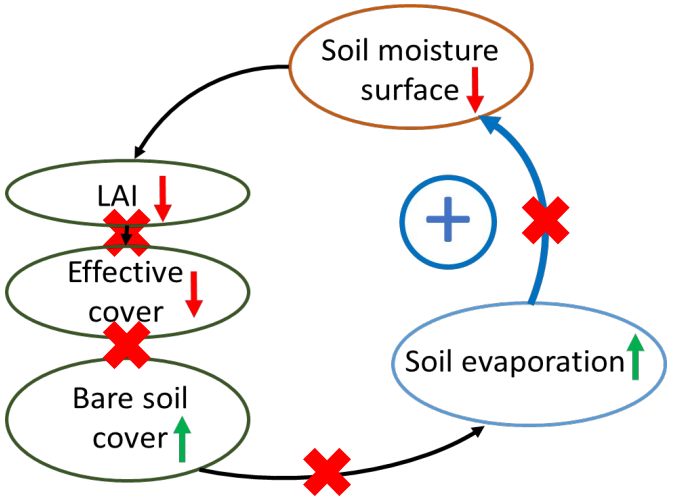
Additional slides: Impact of prescribed varying LAI

Vegetation – surface soil-moisture feedback

CNR model



ECMWF and MF models



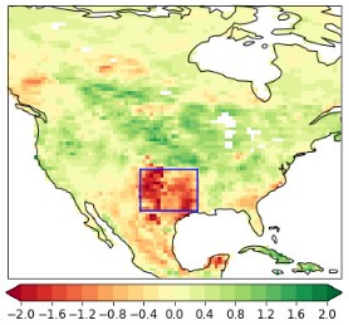
(CNR)

Negative soil moisture during drought
→ Reduced LAI → Reduced Eff veg cover
→ Increases bare soil cover → Increases soil evaporation → reduces surface soil moisture

(MF + ECMWF)

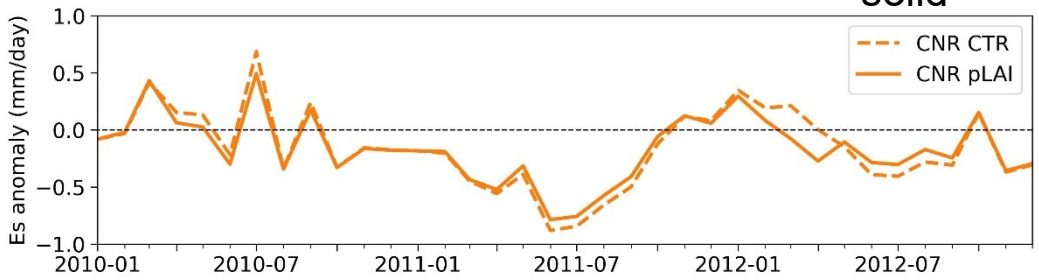
Negative soil moisture during drought
→ Reduced LAI ~~→~~ No effect on Eff veg cover
→ No change in bare soil cover & soil evaporation & surface soil moisture

Summer (JJA) LAI anomaly 2011



Soil evaporation

dashed -> control
solid -> sensitivity



Surface soil moisture