Barcelona Supercomputing Center
Centro Nacional de Supercomputación

imprex
Learn from today to anticipate tomorrow

From soil initialization to crop prediction

Chloé Prodhomme
C. Ardilouze, M. Turco, A. Ceglar, E. Dutra,
F. Doblas-Reyes

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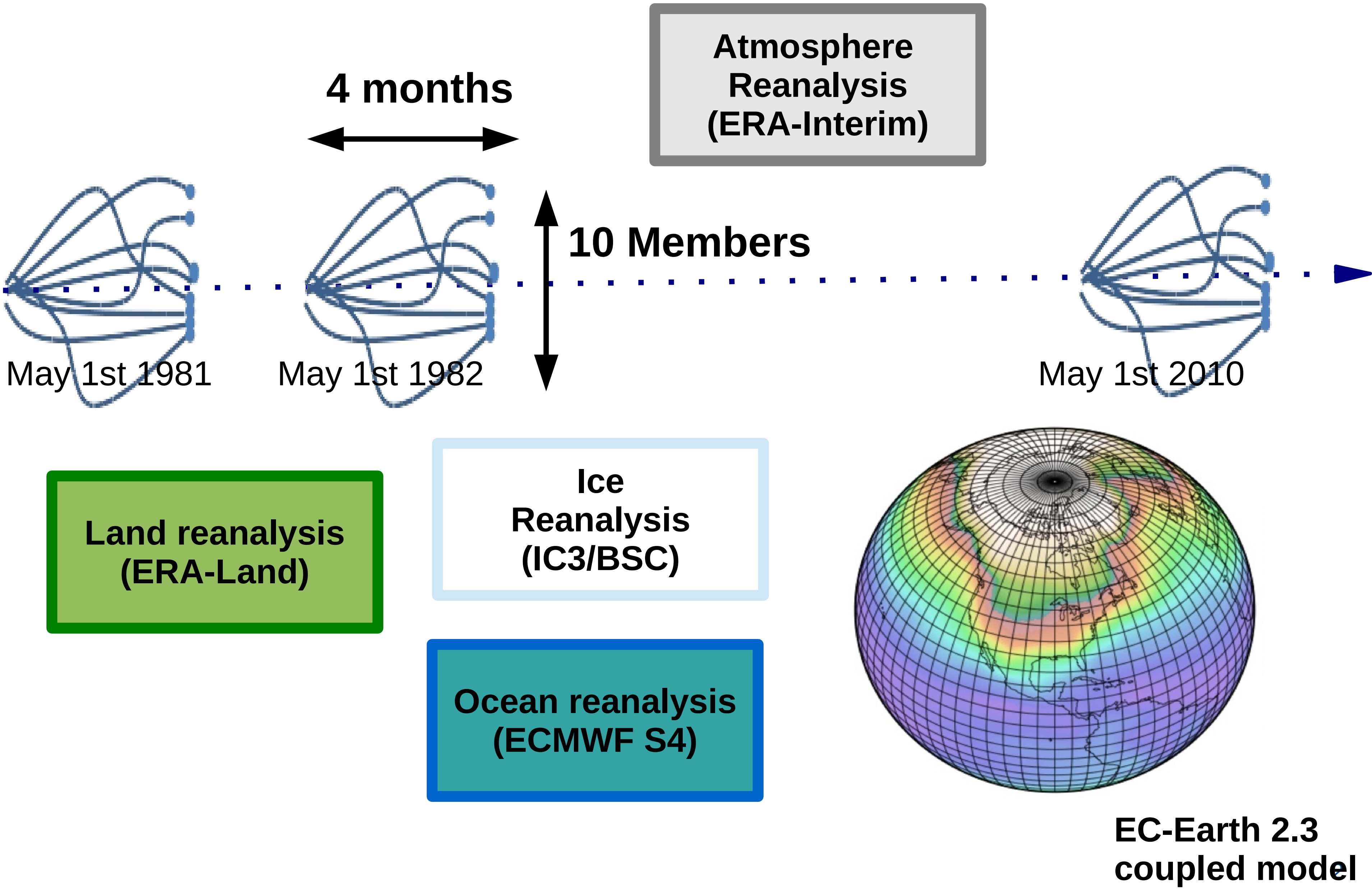
05/10/2016

SPECS
Seasonal-to-decadal climate Prediction for the improvement of European Climate Services

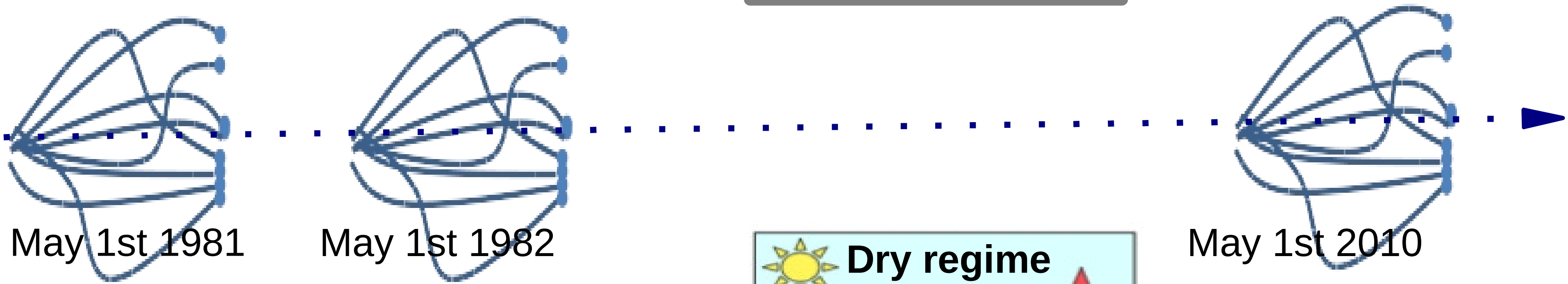
Earth Department
Climate Prediction Group

The EC-Earth forecast system



The EC-Earth forecast system

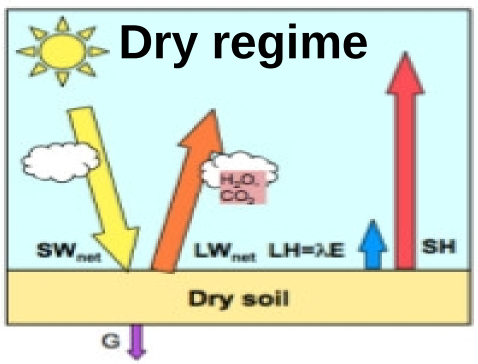
Atmosphere Reanalysis (ERA-Interim)

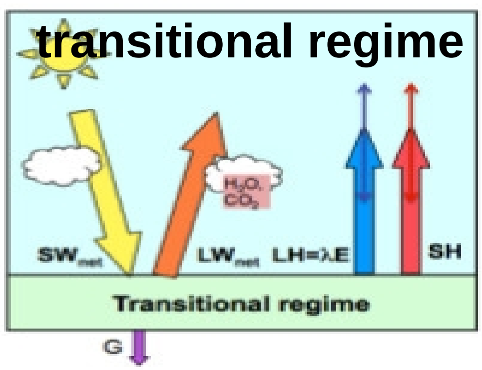


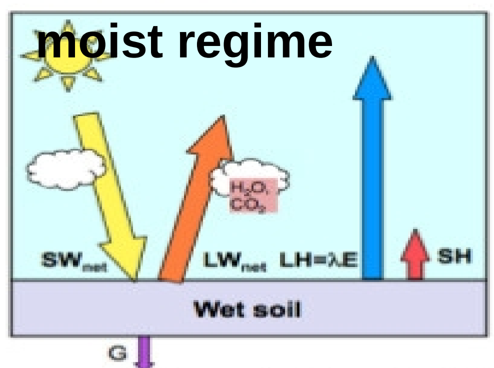
Land reanalysis (ERA-Land)

Land reanalysis (ERA-Land climatology)

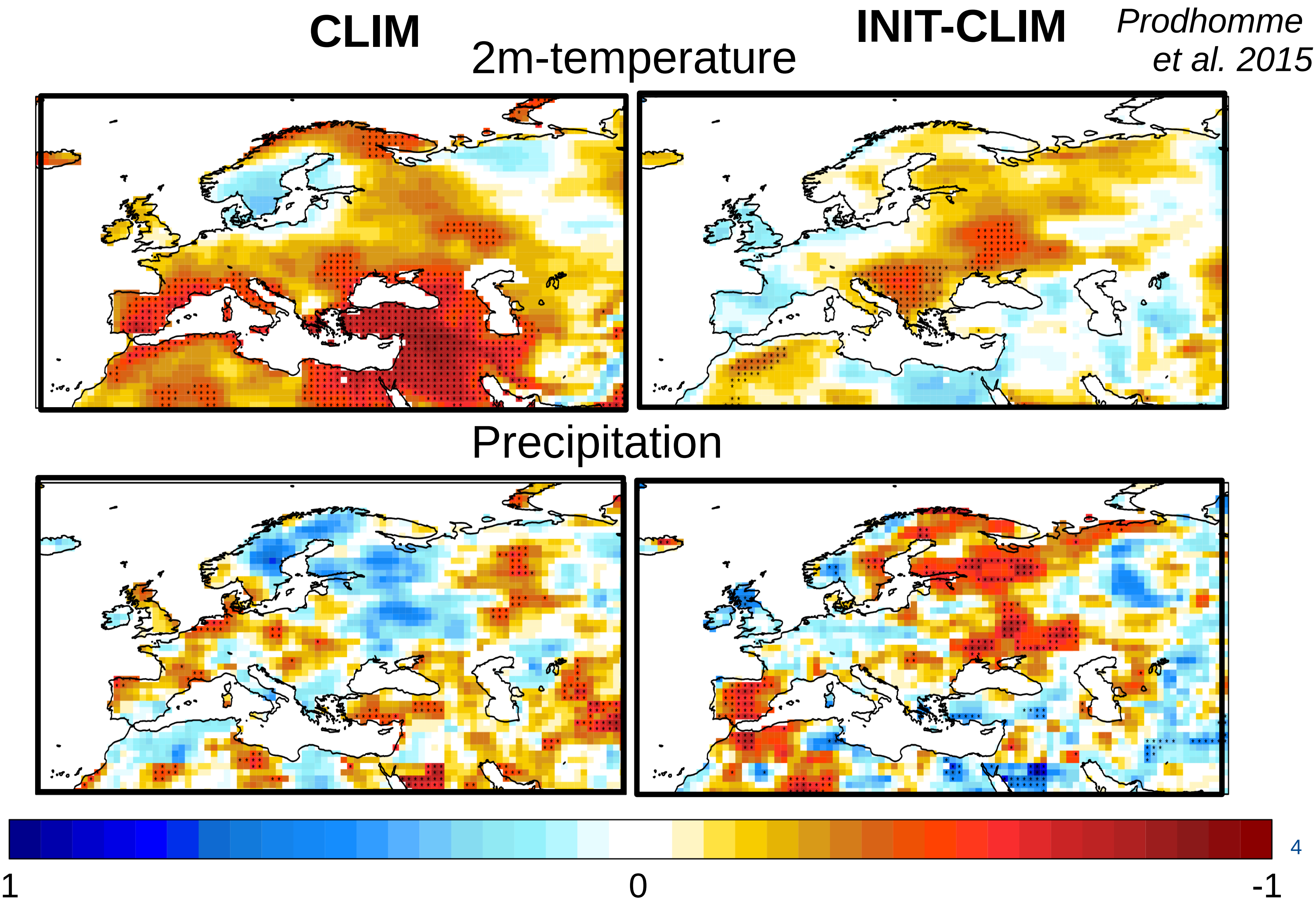
?







Result on precipitation and temperature

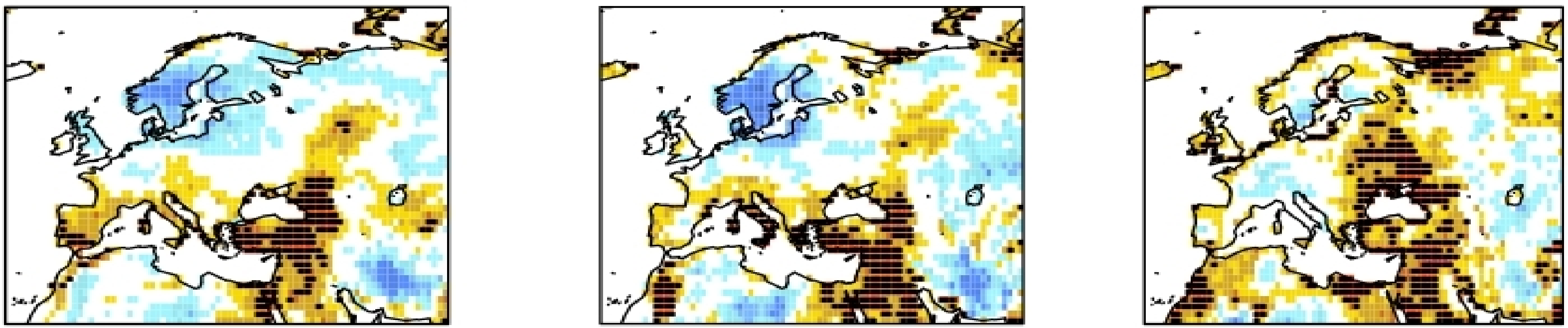


Extreme temperature prediction

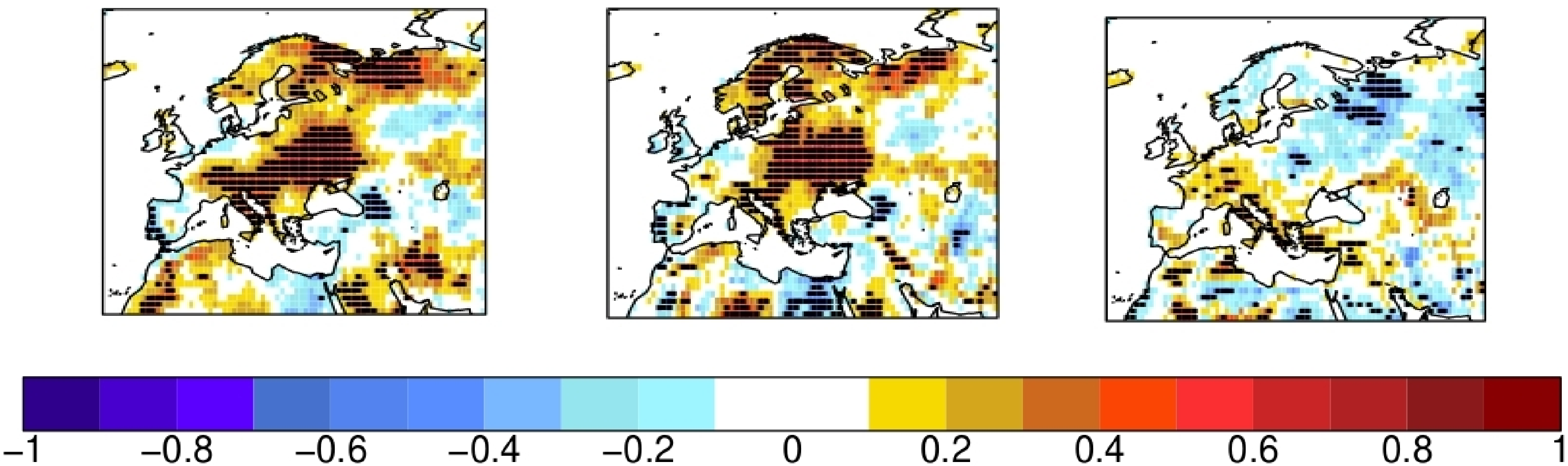
Prodhomme et al. 2015

Correlation between CLIM and ERA-interim

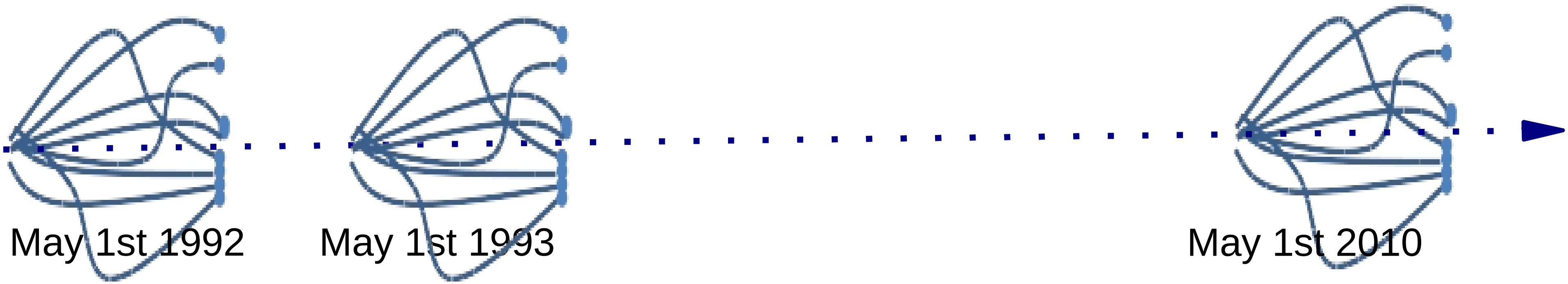
Number of warm day | Number of warm nights | Number of cold nights



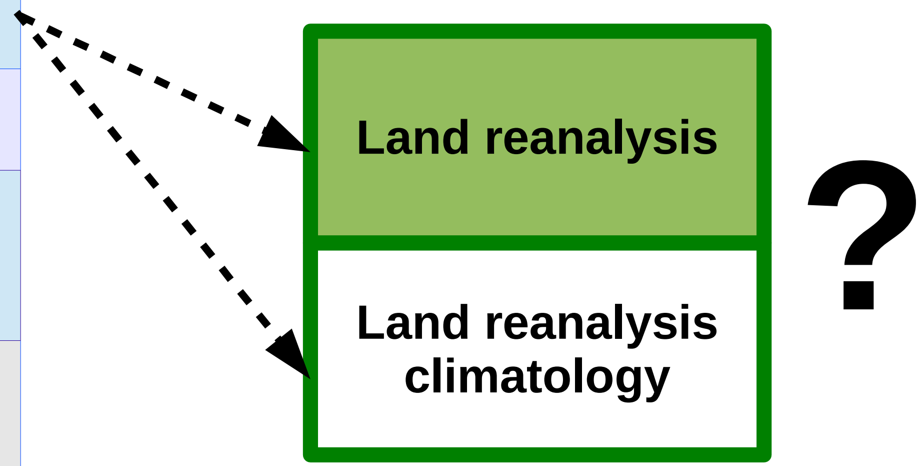
Difference of correlation: INIT-CLIM



Multi-model assessment

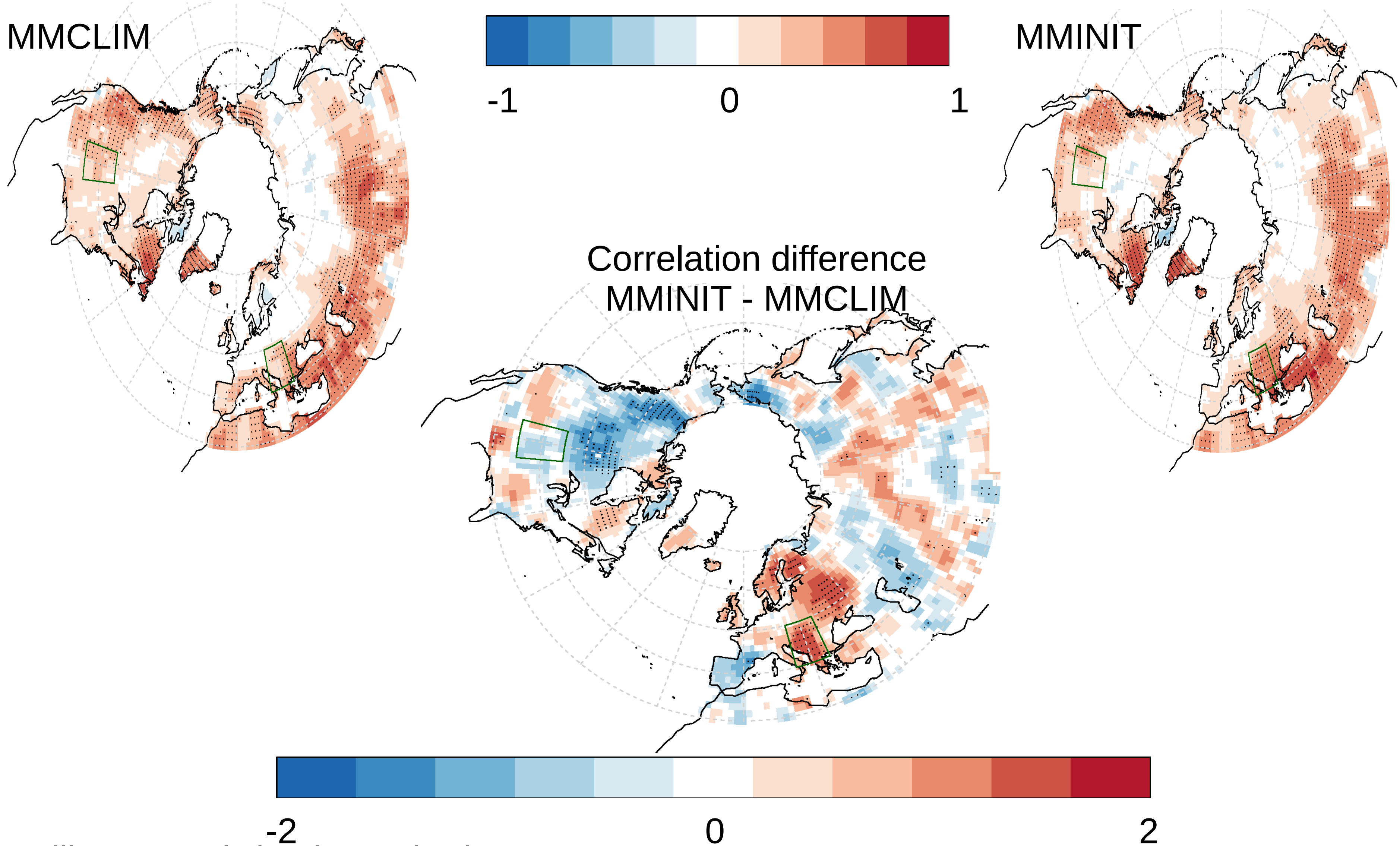


MPI-ESM v.1.1.00 (Stevens et al., 2013)
ECMWF System 4
CNRM-CM5 (Voldoire et al. 2013)
EC-Earth V2.3 (Hazeleger et al. 2012)
GloSea5 (Maclachlan al., 2015)



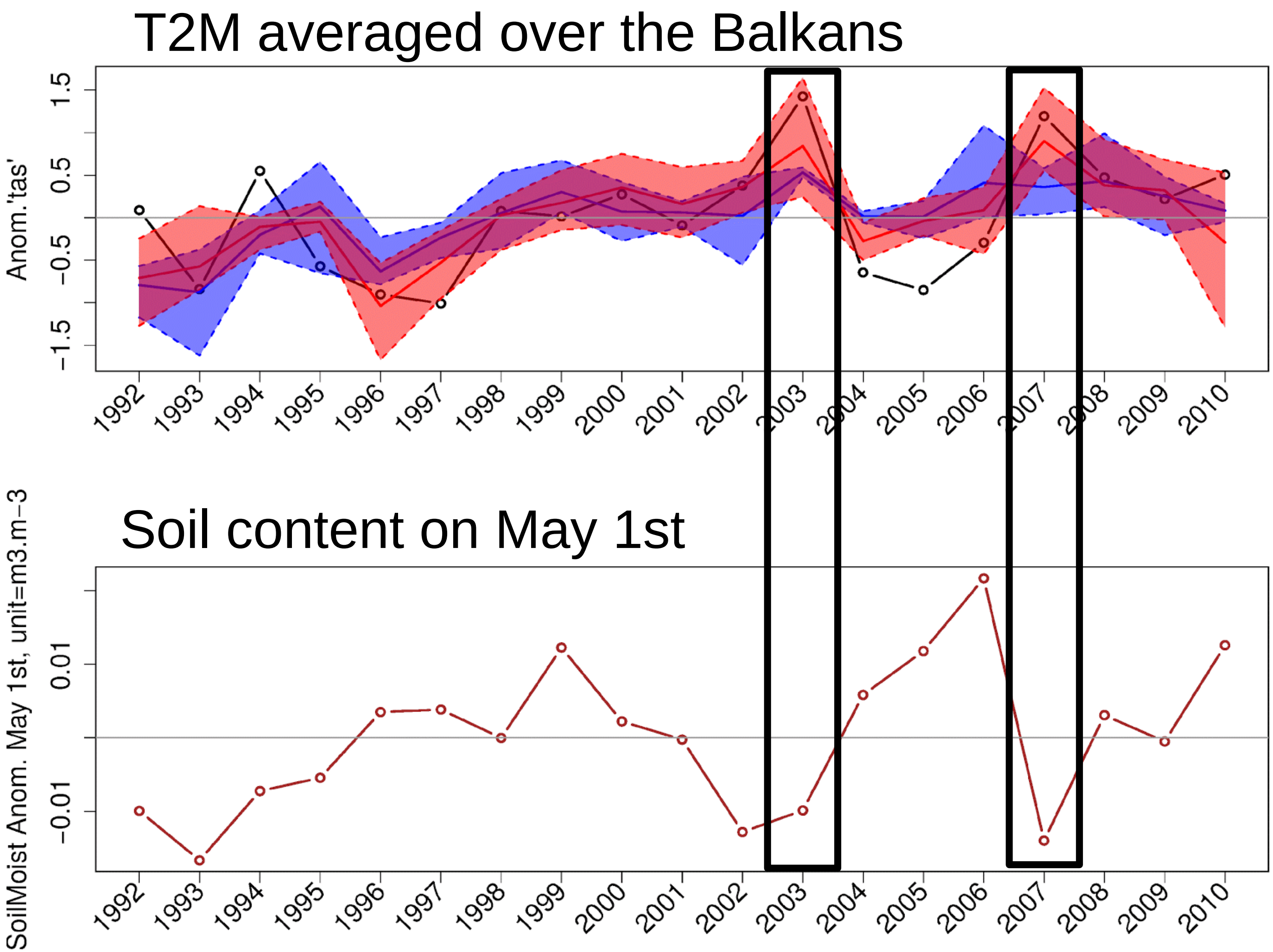
Ardilouze et al. (under review)

Multi-model assessment



Ardilouze et al. (under review)

Balkans heat waves

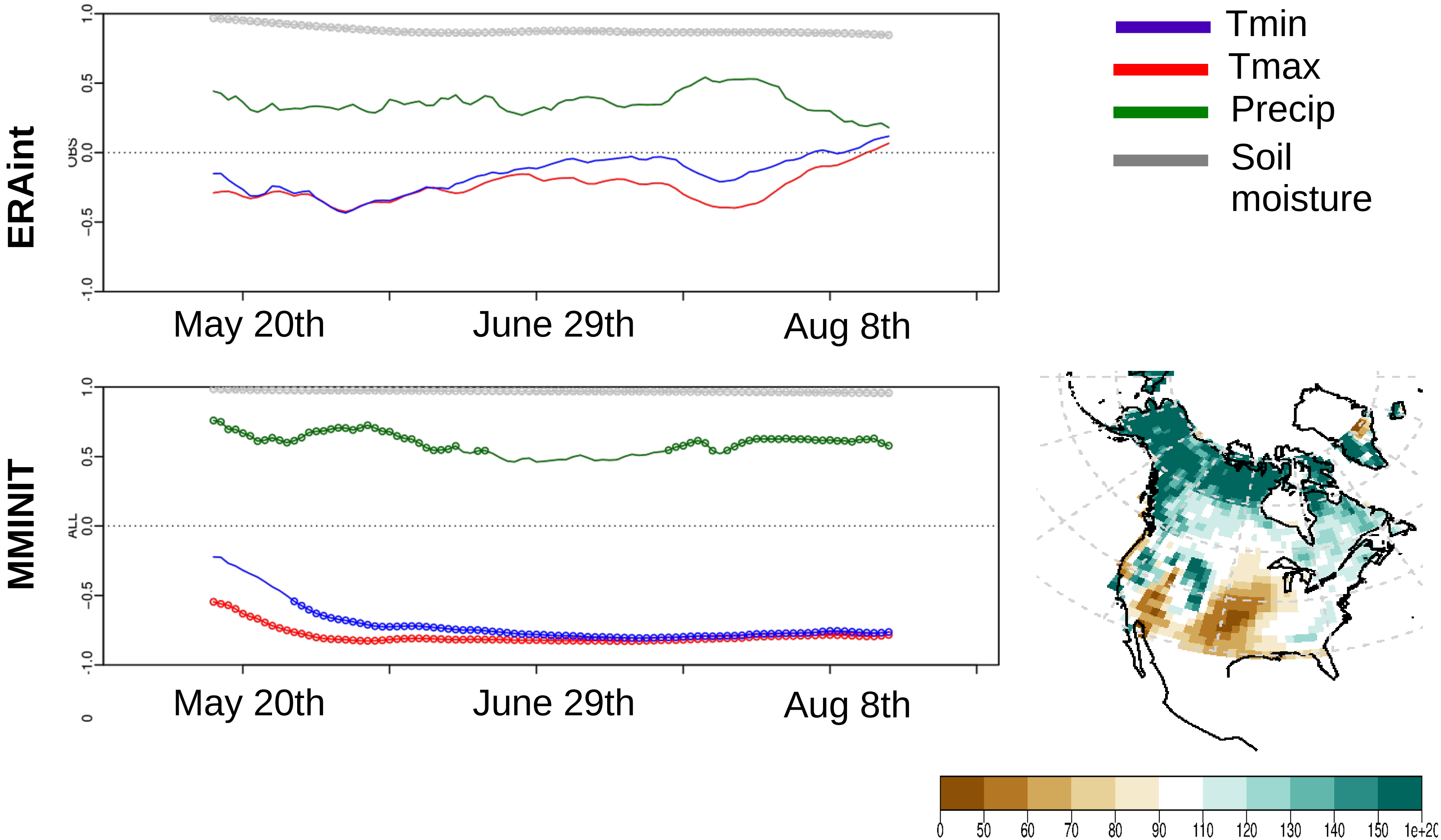


Heat waves are better predicted over the Balkans

Ardilouze et al. (under review)

Great Plains biases

Correlation between soil moisture averaged in the Great Plain on May 1st with:



Ardilouze et al. (under review)

Summary

→ Land surface initialization improves the skill over Europe of temperature, precipitation and extreme temperature indices.

→ This improvement is robust among several seasonal prediction systems, especially in the Balkans region.

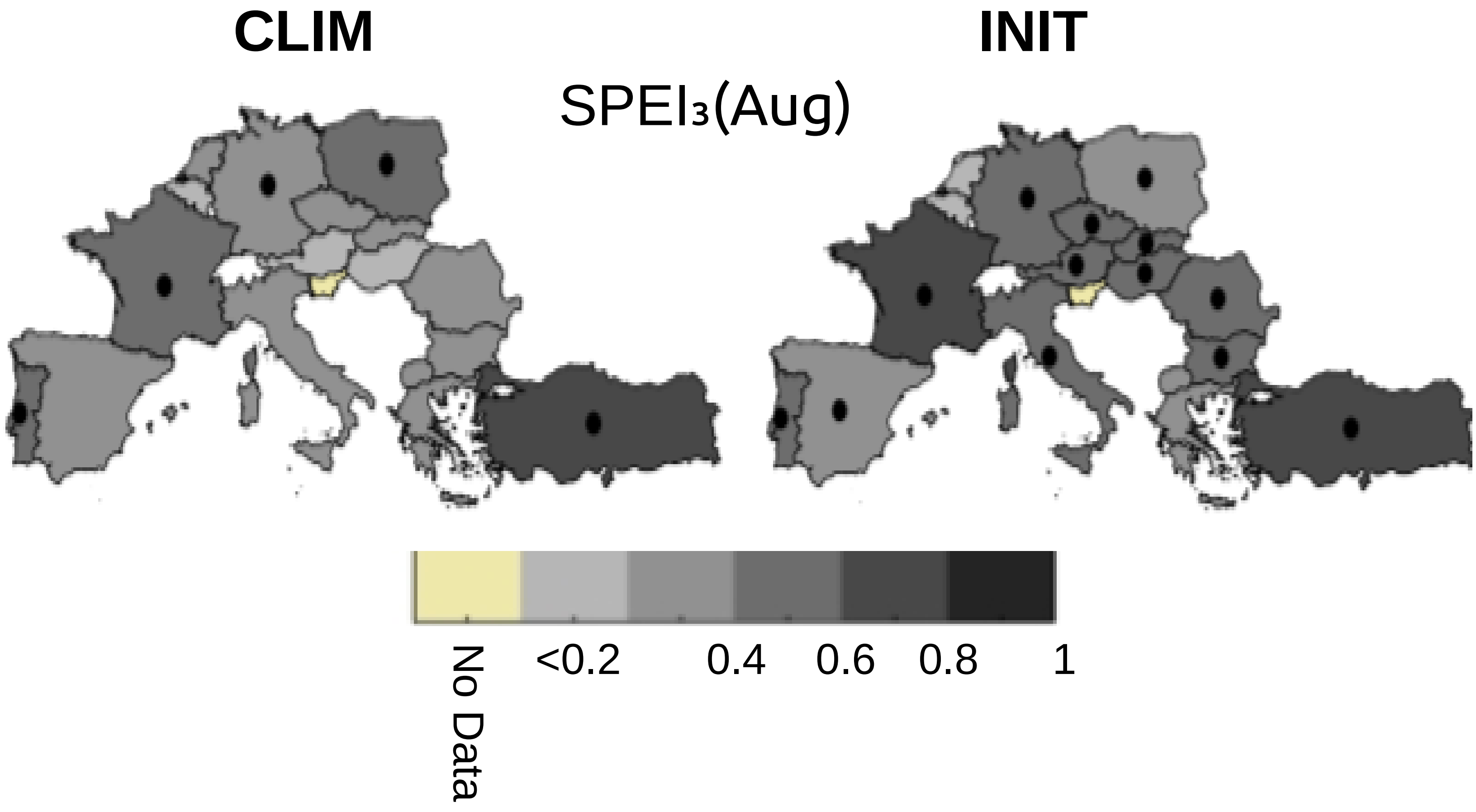
→ Thanks to a better soil initialization heat wave a better predicted in the Balkan region

→ The initialization does not improve the skill over the Great Plains due to misrepresentation of land-atmosphere coupling in the region, associated to a dry soil moisture bias.

Can these results be useful for applications?

Impact on drought prediction

SPEI: Calculated through a non parametric approach based on *Hao and Aghakouchak et al. (2013)*



Turco et al. in preparation

Application on agriculture: Grain maize yield

For each European Country:

$$\text{Yield}(t) = a + b \cdot \text{Trend} + c \cdot \text{Trend}^2 + d \cdot \text{DrougthIndex}(t) + \varepsilon(t)$$

↓ SPEI

The procedure to develop this MLR model consists in several steps:

- Normalize the Yields (i.e. Y = log(yields)).
- Standardize both the yields and predictors series.
- Test several drought index: SPEIn (m), where m indicates the final month of accumulation of the SPEI index (June, July or August) and n indicates the different accumulation periods.
- For each country and drought indicators, we develop the MLR. Significance of the coefficient estimated with a boostrap.
- Calculate the correlation between simulated and observed series and keep the best model that one that shows the highest correlations (in out-of-sample conditions).

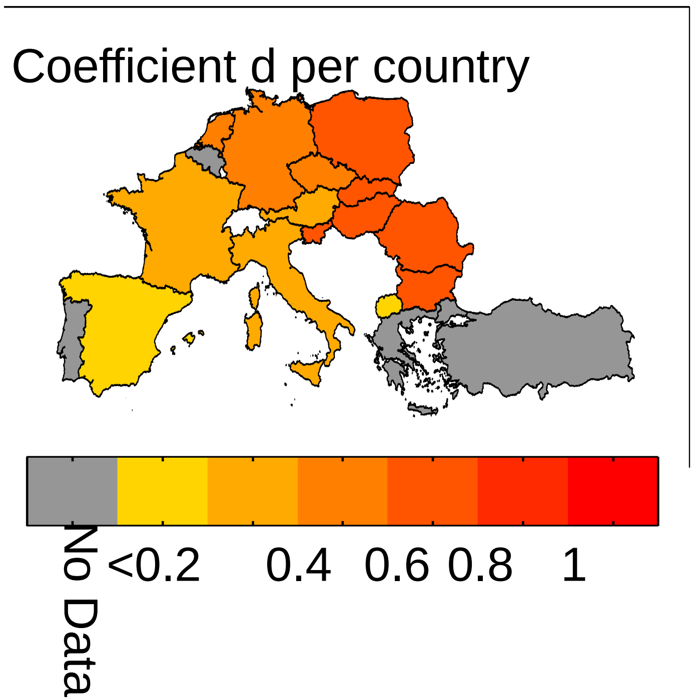
Turco et al. in preparation

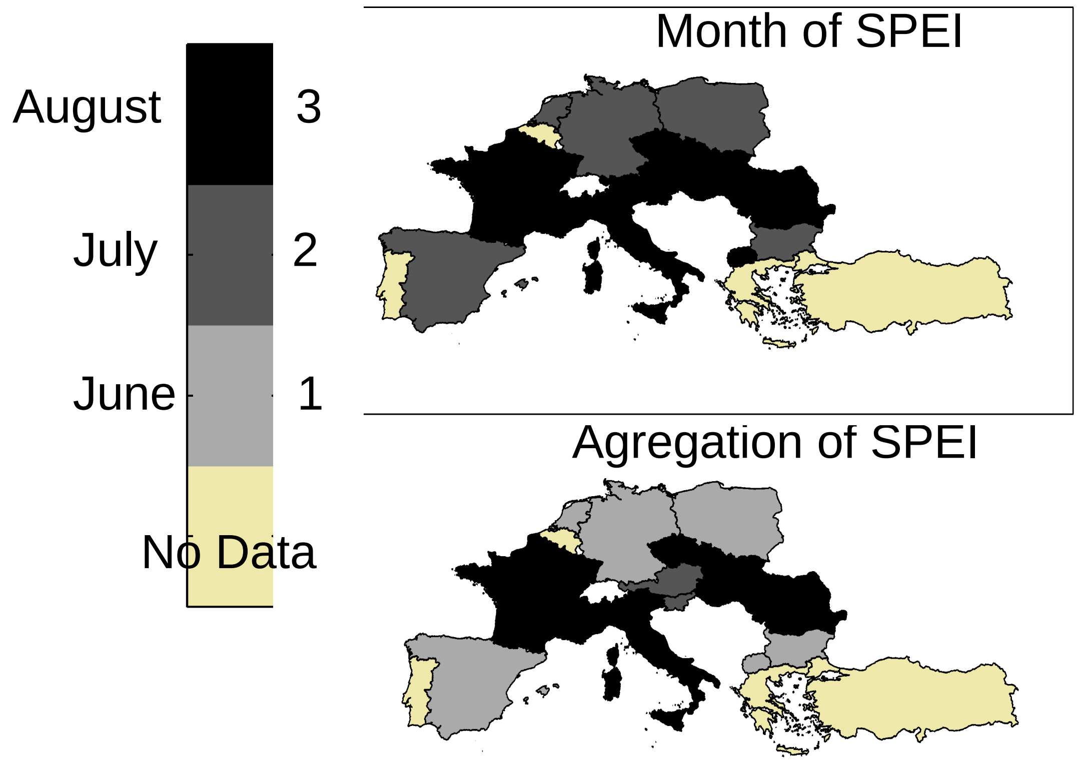
The regression model

For each European Country:

$$\text{Yield}(t) = a + b \cdot \text{Trend} + c \cdot \text{Trend}^2 + d \cdot \text{DrougthIndex}(t) + \varepsilon(t)$$

$SPEI_1(June)$ .... $SPEI_3(Aug)$

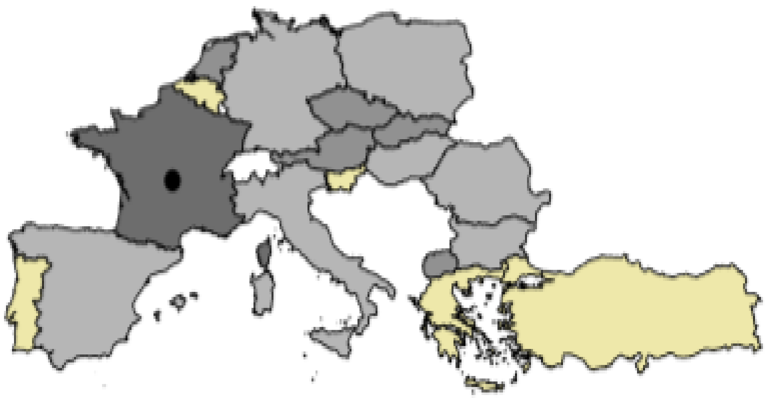




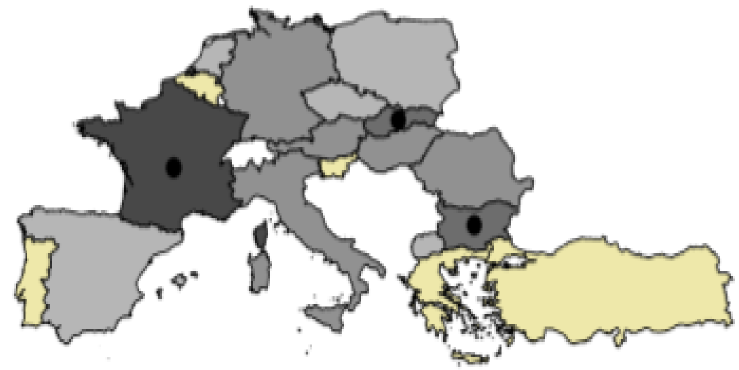
Turco et al. in preparation

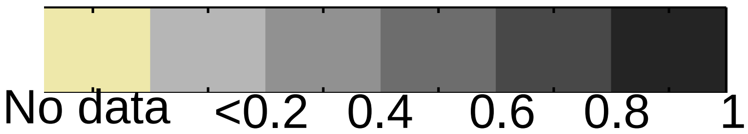
Grain maize yield prediction

Correlation **without** soil initialization



Correlation **with** soil initialization





Time serie over France
without soil initialization

Time serie over France
with soil initialization

Turco et al. in preparation

Summary and prospects

→ Land surface initialization improves the skill over Europe of temperature, precipitation and therefore drought index for several prediction systems.

→ Using a MLR based on drought index with dynamical seasonal forecast allow to predict the grain maize yield 3 month ahead.

→ Improve the land initialization (data assimilation, anomaly initialization...)

→Improve the crop prediction system including the heat stress which can be very damaging for grain maize.

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Thank you!

For further information please contact

Chloe.prodhomme@bsc.es
Constantin.Ardilouze@meteo.fr
andrej.ceglar@jrc.ec.europa.eu
Marco.Turco@bsc.es