Mediterranean winter weather regimes in reanalysis and C3S models

I. Giuntoli*, F. Fabiano, S. Corti

CNR-ISAC Institute of Atmospheric Sciences and Climate, Bologna, Italy

*i.giuntoli@isac.cnr.it

RATIONALE

The Mediterranean basin is expected to face growing pressures in the coming decades from warming temperatures, more frequent weather extremes and an increased population. Seasonal forecasts are critical for food security and biodiversity monitoring including pests and diseases and adaptive climate risk management. The C3S suite of prediction systems provide a valuable basis for assessing seasonal prediction in this region. In this context, we seek to evaluate their ability in reproducing weather regimes (WR) and teleconnections.

RESEARCH QUESTIONS

- Are C3S models able to reproduce major teleconnections seen in reanalysis?
- Can we say something about the predictability of the C3S using WR frequencies?

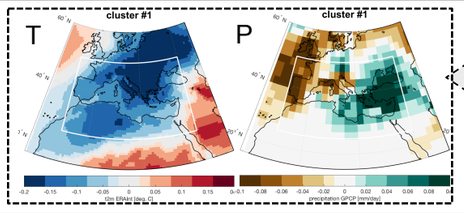
DATA

Geopotential height 500 hPa daily [1993-2016]

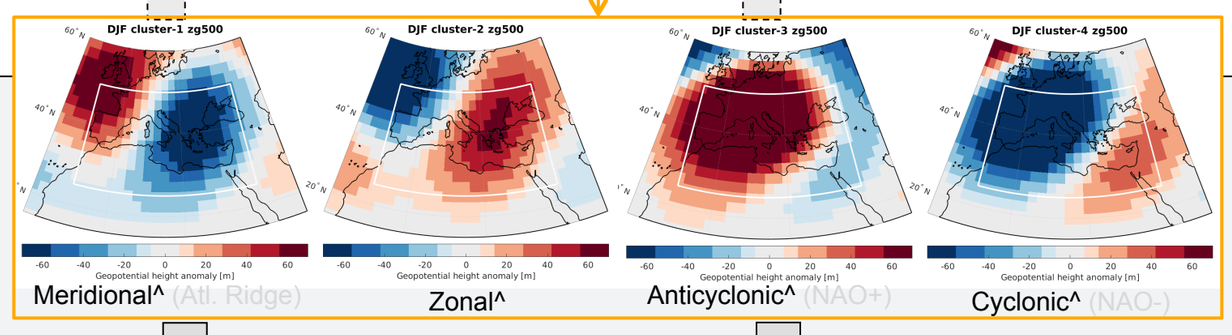
Reanalysis : ERAInt ; C3S models : ECMWF sys5, MeteoFr sys6, DWD sys2, CMCC sys3 (25 members)

METHODS

- Four Weather Regimes (WRs) over the Mediterranean [-10 40 E, 25 50 N]
- Regimes number consistent with previous work (Rojas et al., 2013)^; **major signals WR1 & WR3**
- zg500 anomalies; four EOFs; K-means clustering in the reduced EOF space (on reanalysis)
- For each C3S model cluster the centroids are those computed with ERAInterim (note that C3S clustering yields consistent spatial patterns) – the focus being on the cluster frequencies.



corresponding T and Precip.



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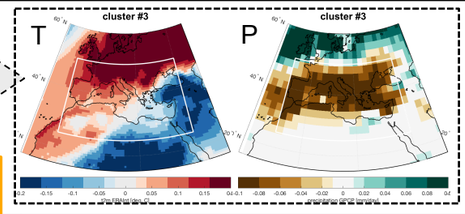
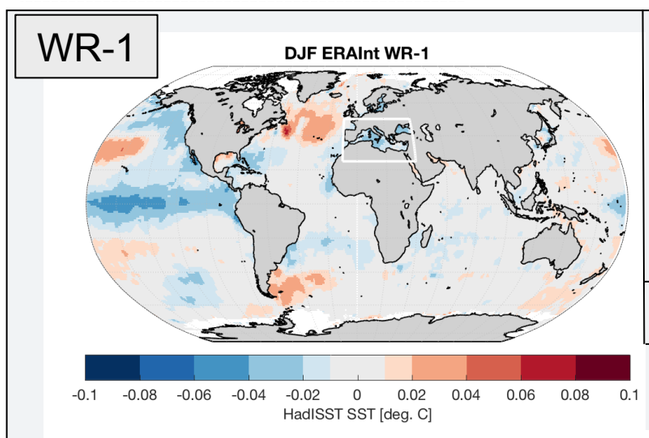
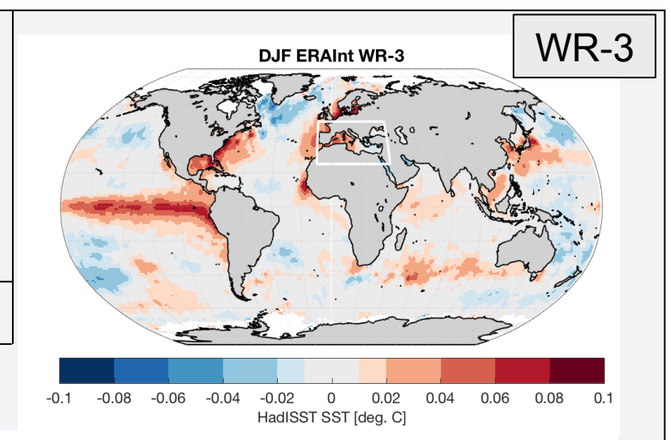
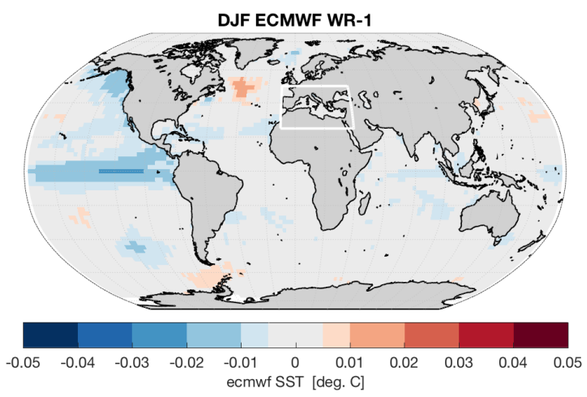
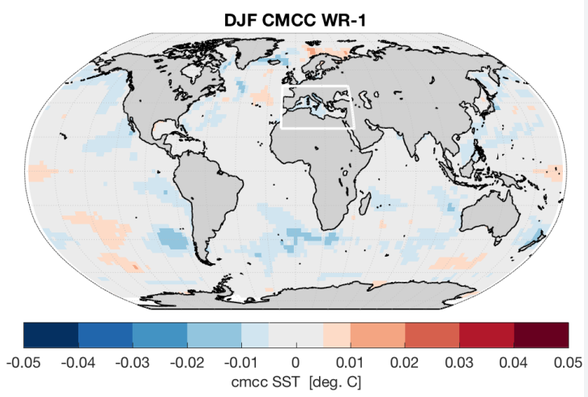


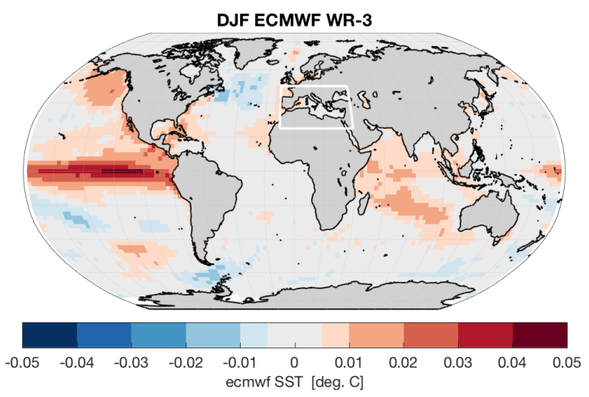


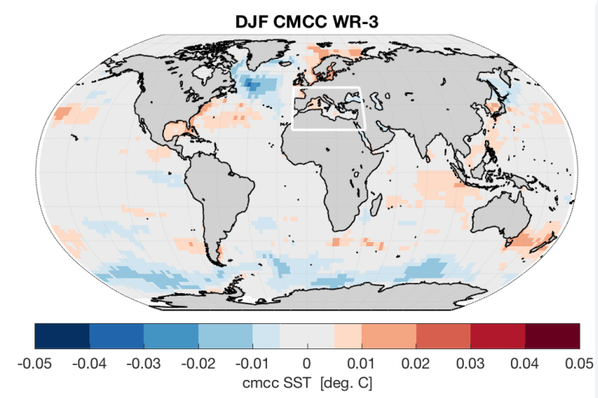


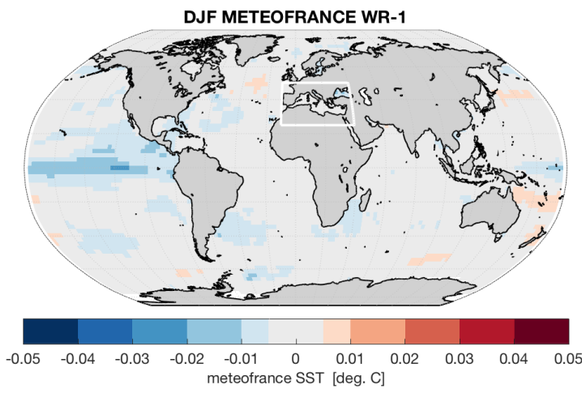
DJF SST teleconnections

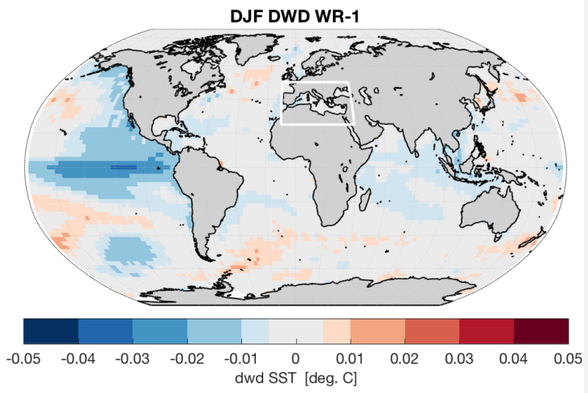


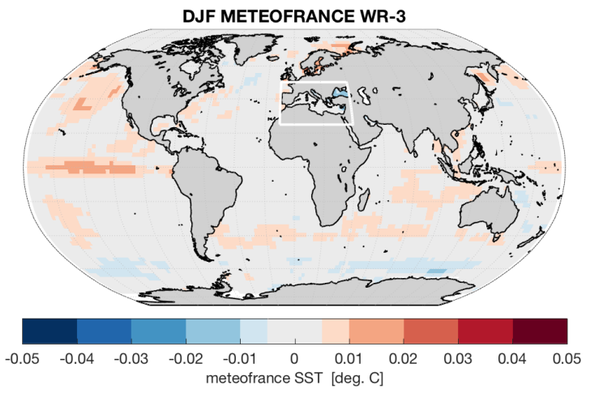


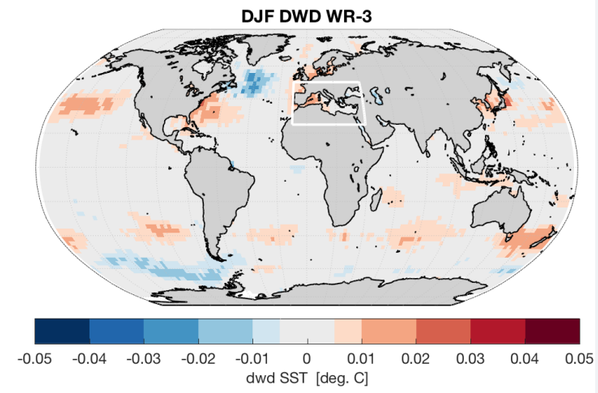








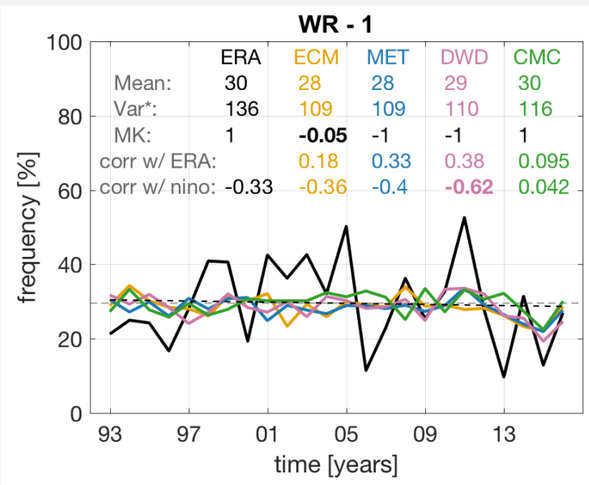


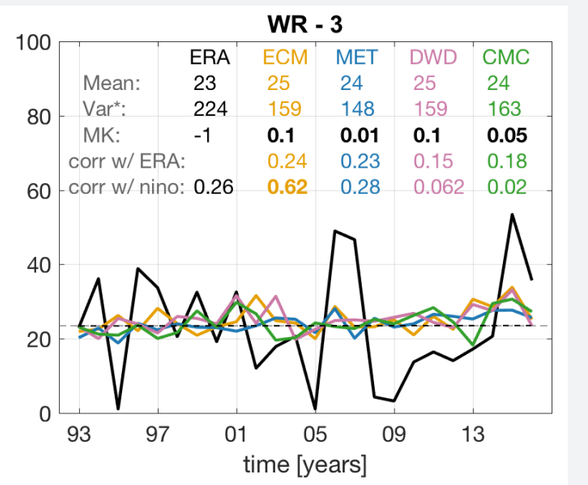


	WR1	WR3
ERAInterim	La Nina / PDO-	El Nino

- Most C3S capture the signal but not the amplitude | note colorbar limits of ERA and C3S

WR seasonal frequencies

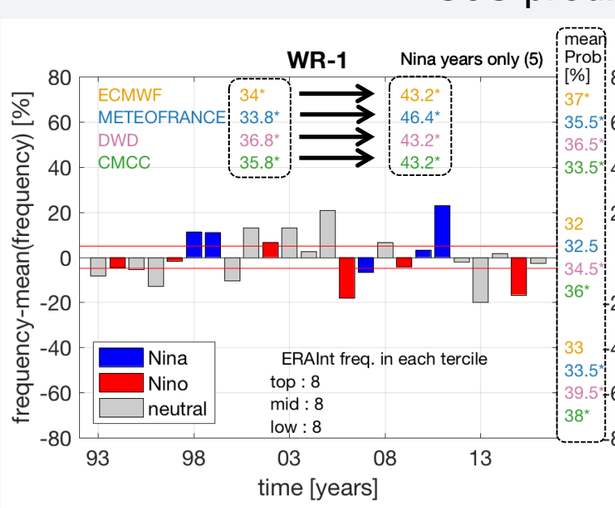


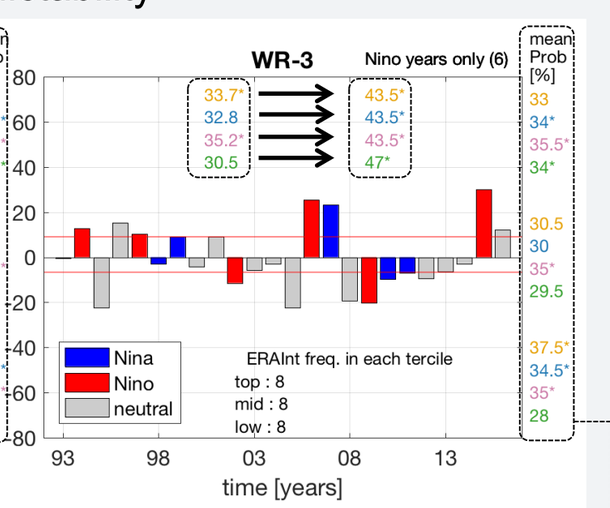


- Correlations with ERAInt are generally low but all positive.
- Correlations with Nino 3.4 index* are consistent with WRs' teleconnections.

WR seasonal frequency correlations ERAInt vs C3S				
DJF (24 total)	**WR1**	WR2	**WR3**	WR4
ECMWF sys5	0.18	-0.2	0.24	0.18
MeteoF sys6	0.33	0.14	0.23	0.052
DWD sys2	0.38	0.14	0.15	0.11
CMCC sys3	0.095	0.018	0.18	0.17

C3S predictability





Bars on graph refer to ERAInterim WR frequency anomaly

- The skill of the C3S improves if only Nina/Nino intense years are considered.

P > 33 % the model has a higher probability than the climatology to reproduce cluster frequency.	P = 33 % the model is not sensitive, it predicts nothing but the climatology.	P < 33 % worse than climatology

La Nina years: 1998, 1999, 2007, 2010, 2011 ; El Nino years: 1994, 1997, 2002, 2006, 2009, 2015**

CONCLUSIONS

- WR1 and WR3 show clear teleconnection patterns in the Nino region. Regime frequencies of both regimes are correlated with the Nino 3.4 index.
- Most C3S models reproduce major teleconnections depicted by the reanalysis data – but not the amplitude.
- Overall, C3S have little predictability in predicting changes in the mean seasonal frequencies of WRs (although still better than the climatology).
- Preliminary results show that the predictability improves considering only Nina (WR1) and Nino (WR3) years, indicating a good sensitivity of the models to the ENSO signal.

*https://www.esrl.noaa.gov/psd/data/climateindices/list/ **https://www.esrl.noaa.gov/psd/enso/climaterisks/years/top24enso.html