Daily Rainfall Extreme Events in South East South America

Ángel G. Muñoz[1], Andrew Robertson[1], Lisa Goddard[1], Yochanan Kushnir[2], Walter Baethgen[1]

agmunoz@iri.columbia.edu

[1]International Research Institute for Climate and Society, The Earth Institute at Columbia University
[2]Lamont-Doherty Earth Observatory, The Earth Institute at Columbia University

SUMMARY

The occurrence of extreme precipitation events for South East South America's (SESA) austral summer was investigated using gridded observations and reanalysis. Using a K-means cluster analysis for the December-February season we found that the frequency and intensity of six synoptic circulation types are related to the typical precipitation anomaly patterns. The regimes are related to the oceanic flavor of the South Atlantic Convergence Zone (SACZ) and wave train patterns interacting with the Southern Hemisphere Jet. Only two weather types are responsible for the occurrence of anomalous high rainfall (95th and 99th percentiles) in SESA. We also examined the relationships between these regimes and climate drivers associated with SST anomaly patterns in the Pacific, and found that only one of these weather types was preferentially associated with El Niño. We also found that ECHAM4.5 simulations are able to reproduce the main patterns and relationships, although there are some important bias. Finally, we show that a combination of the observed frequency of occurrence of two weather types provides good predictability measures for frequency of extremely wet days.

RESEARCH QUESTIONS
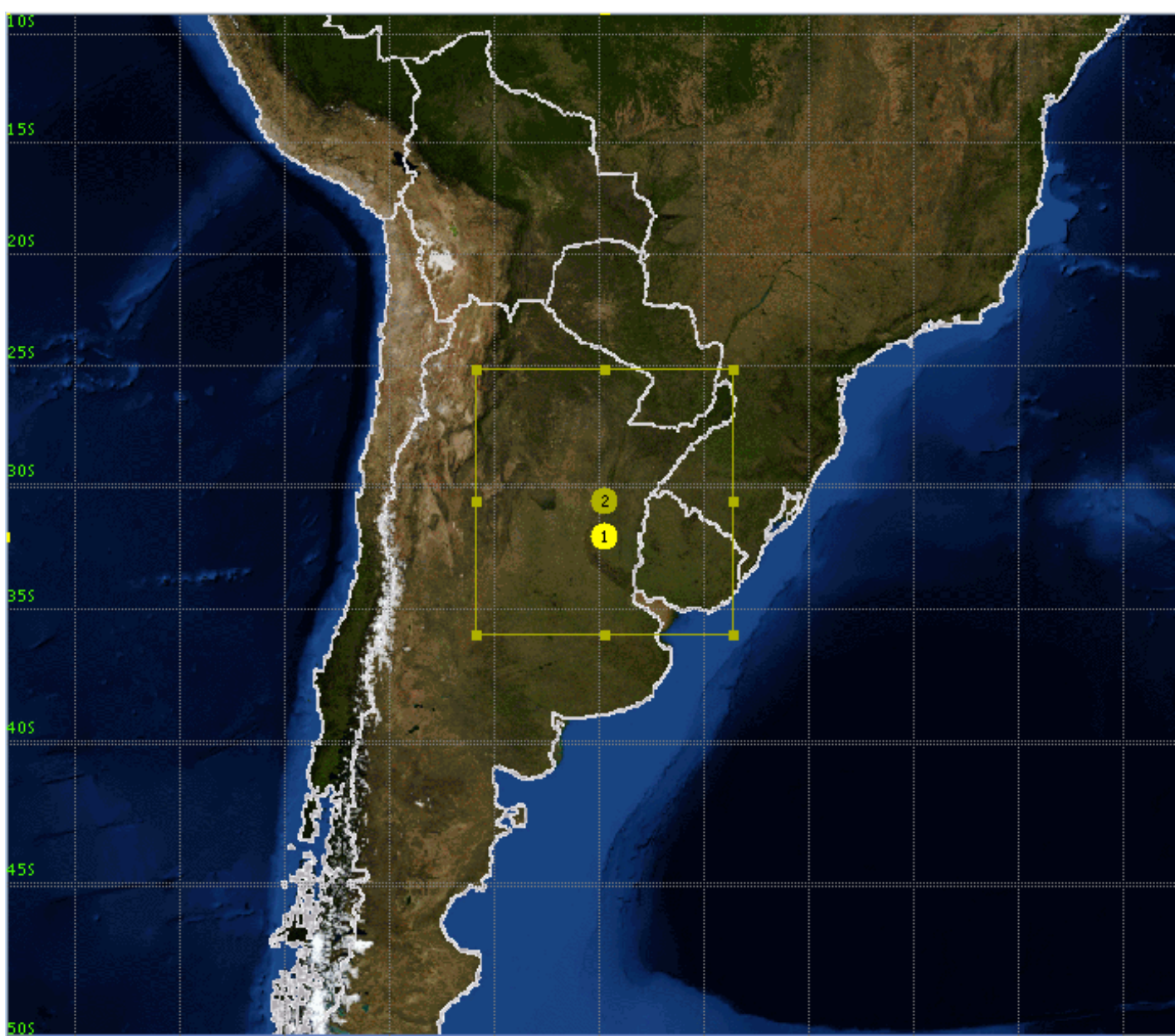
Is there a relationship between frequency of extreme rainfall (95th ,99th percentiles) and rainfall anomaly for DJF?
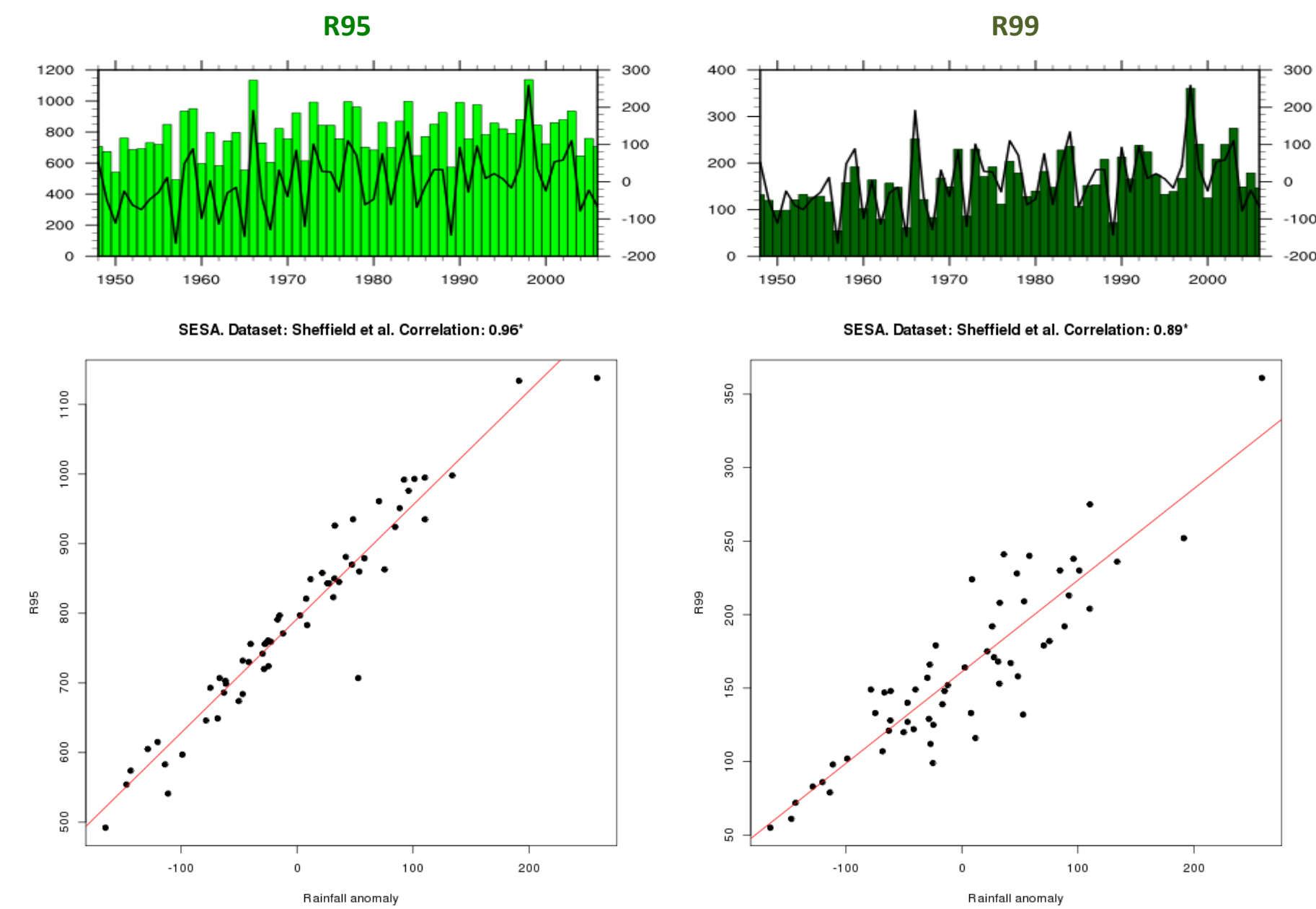
What are the leading daily circulation patterns in the region?

Is it possible to relate these daily weather types to rainfall anomaly regimes?

What about weather types and frequency of extreme rainfall?

Is ENSO a source of predictability for extreme rainfall frequency?

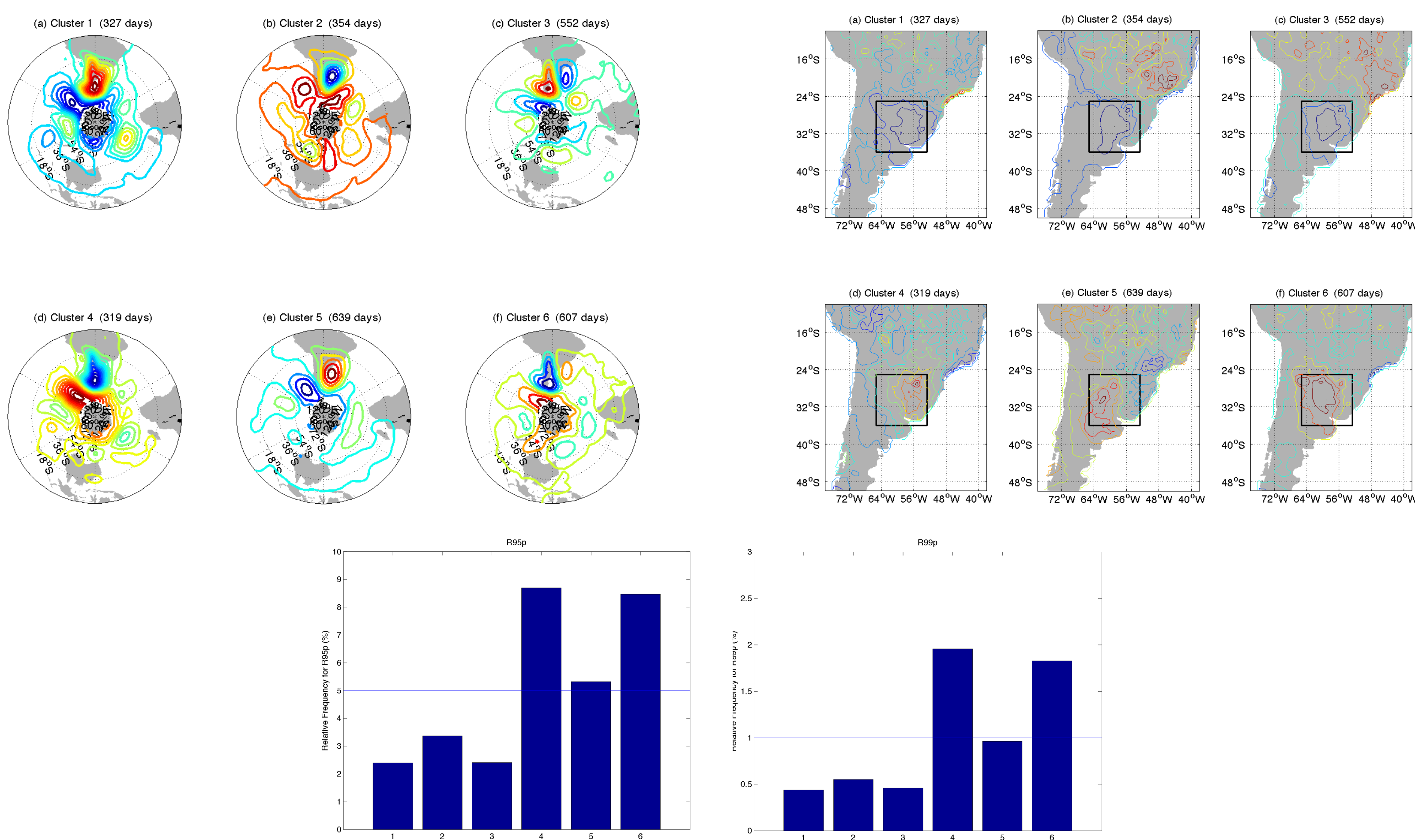Is it possible to build skillfull models for frequency of extreme rainfall for DJF?

OBSERVATIONS

Clusters: NNRP geopotential at 850mb. DJF 1979-2010
Precipitation: CPC-Unified Precipitation dataset

Weather types (WT): Wave train patterns and Oceanic SACZ (WT3, WT6)
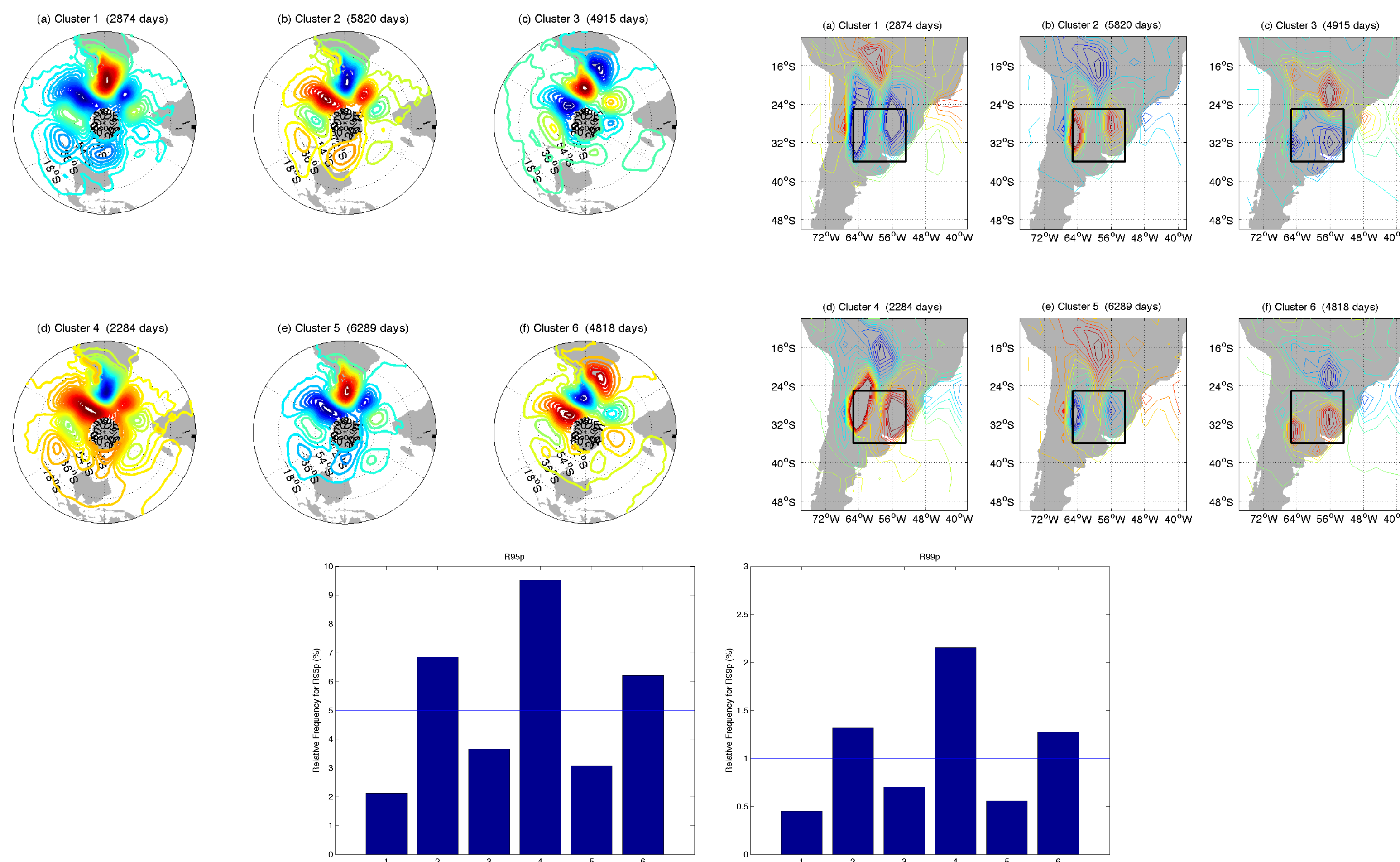Rainfall regimes: WT1-3→ negative anomalies; WT4-6→positive anomalies
Frequency of extreme rainfall: WT4 and WT6 tend to happen more often

ECHAM4.5

Clusters: ECHAM4.5 geopotential at 850mb. DJF 1979-2010
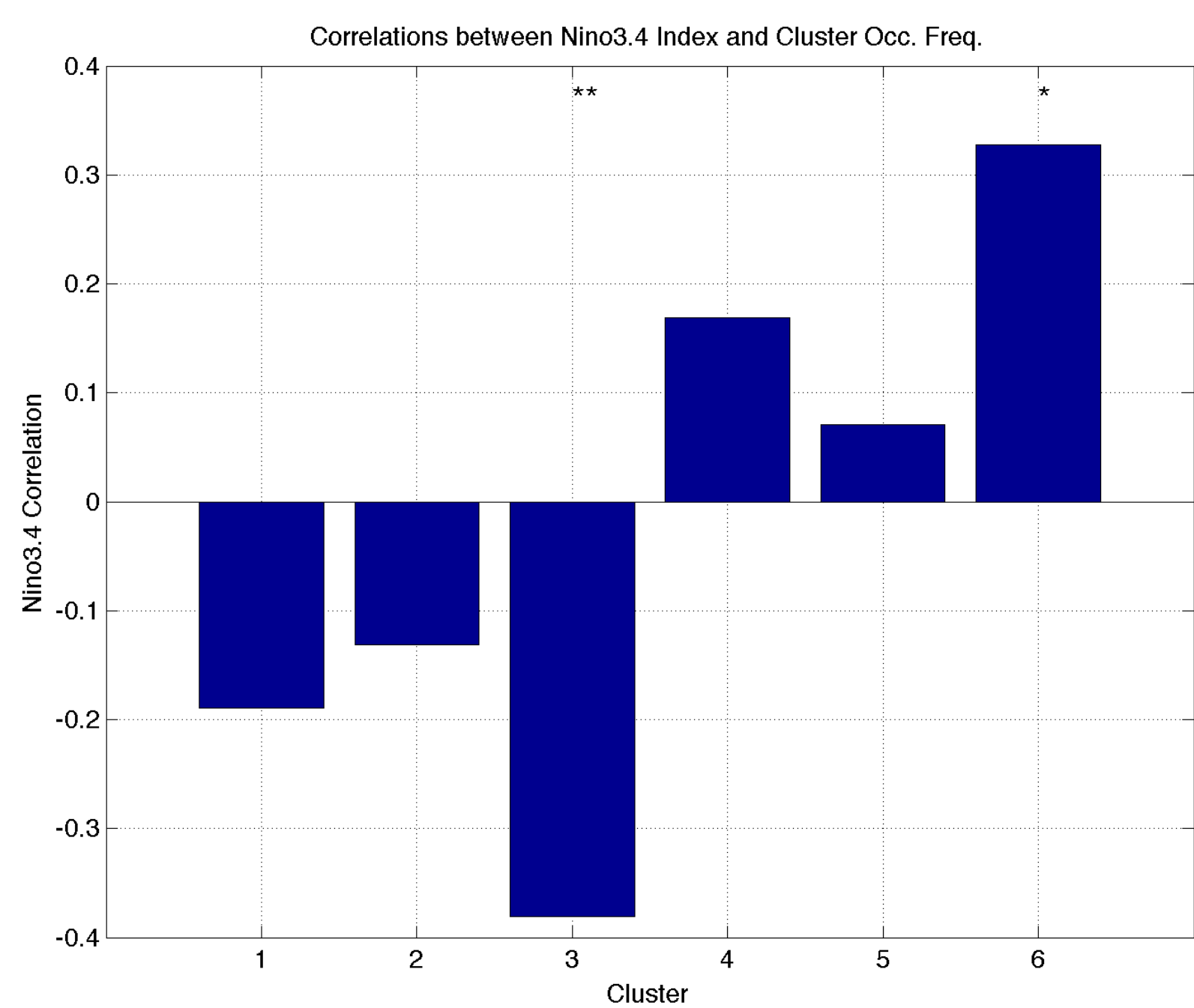Precipitation: ECHAM4.5   10 members

Weather types (WT): Wave train patterns and "SACZ-like" pattern (WT3, WT6)
Rainfall regimes: WT1,3,5→ negative anomalies; WT2,4,6→positive anomalies
Frequency of extreme rainfall: WT2,4,6 tend to happen more often
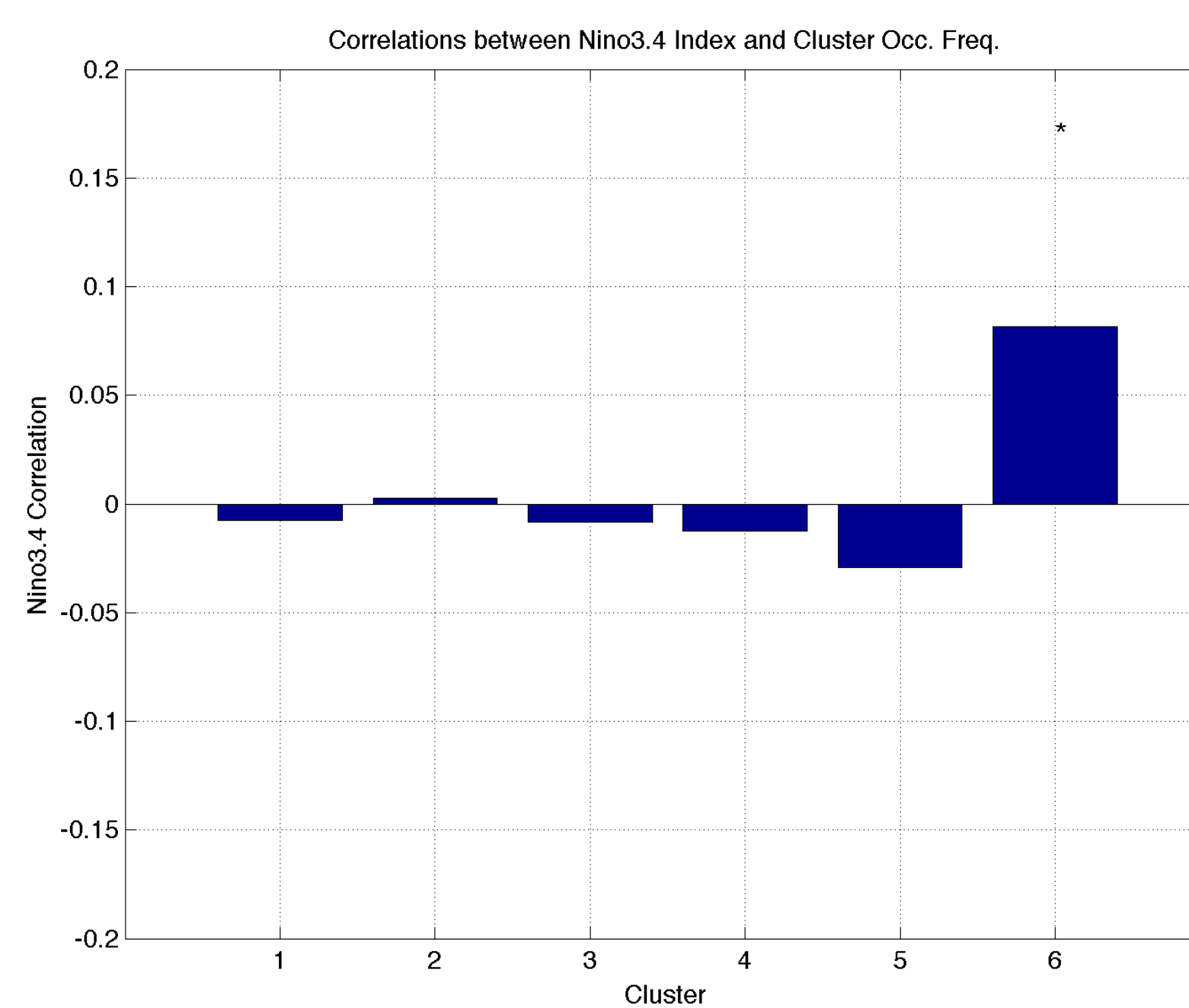
ASSOCIATION WITH ENSO
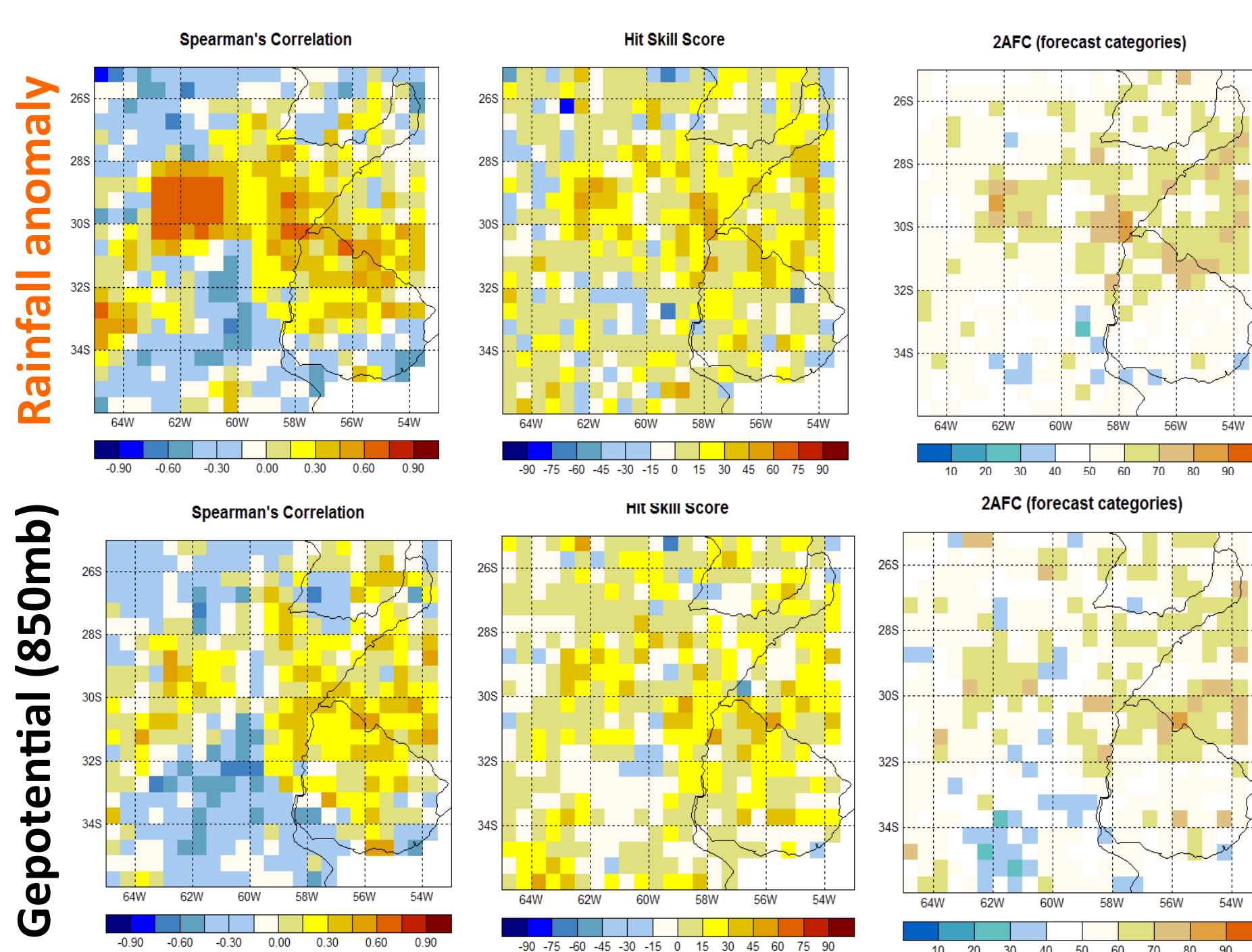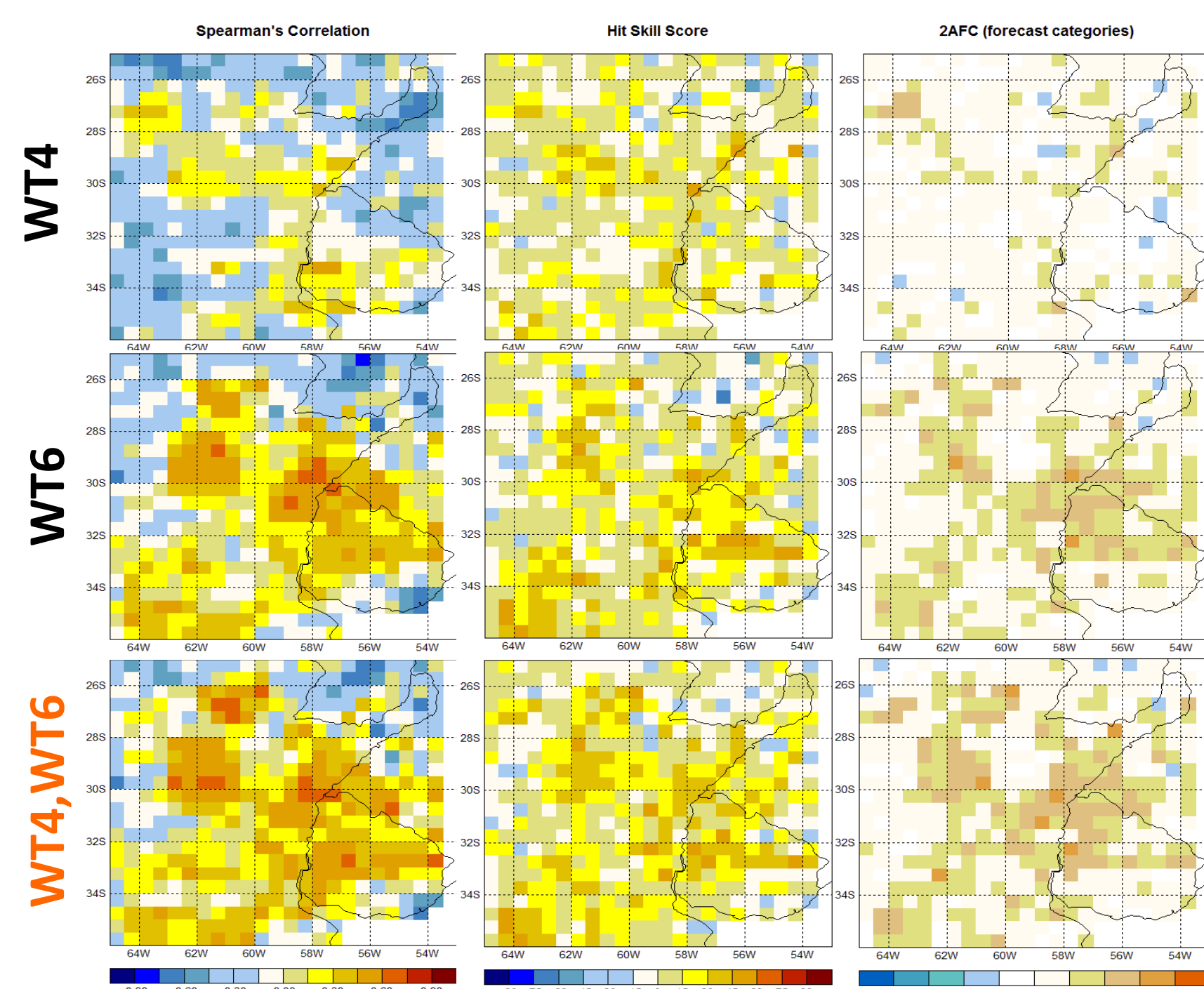

Observations (left):
Only weather types 3 (La Niña, p<0.05) and 6 (El Niño, p<0.1) are related to ENSO.

ECHAM4.5 (right):
Only weather type 6 (El Niño, p<0.1) is related to ENSO.

PREDICTABILITY METRICS

CONCLUSIONS

Is there a relationship between frequency of extreme rainfall (R95,R99) and rainfall anomaly for DJF?
Yes. Stronger for R95 than for R99. Good predictor.

Is it possible to relate daily weather types to rainfall anomaly regimes?
Yes. WT1-3: negative anomalies. WT4-6: positive anomalies. ECHAM4.5 tends to reproduce them, although there are some important bias.

What about weather types and frequency of extreme rainfall?
Only WT4 and WT6. ECHAM4.5 reproduces this, but also suggests WT2.

Is ENSO a source of predictability for extreme rainfall frequency?
Only for WT3 (La Niña) and WT6 (El Niño). ECHAM4.5 only gets WT6.

Is it possible to build skillfull statistical models for frequency of extreme rainfall for DJF?
Yes. Observed frequency of WT4,WT6 is the best predictor. ECHAM4.5's rainfall anomaly presents good skill too. Regional vs local forecasts.

International Research Institute for Climate and Society
EARTH INSTITUTE | COLUMBIA UNIVERSITY

@climatesociety
/climatesociety