From South America to European climate: Seasonal forecast assimilation for the Mediterranean area

by

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Seasonal climate prediction

- **Definition**

- **Main sources of predictability** (Doblas-Reyes, 2010*)
  1) ENSO - biggest single signal
  2) Other tropical ocean SST - difficult
  3) Climate change - important in mid-latitudes
  4) Local land surface conditions - soil moisture, snow
  5) Others

- **Methods of seasonal prediction**
  1) Statistical
  2) Dynamical
  3) Mixed

* Available at http://cdsagenda5.ictp.trieste.it/full_display.php?smr=0&ida=a09167. Accessed on October 14, 2010

Linear regression model

- Statistical model based on a simple linear regression between two variables

- The predictand here is considered as the **predictor's persistence**

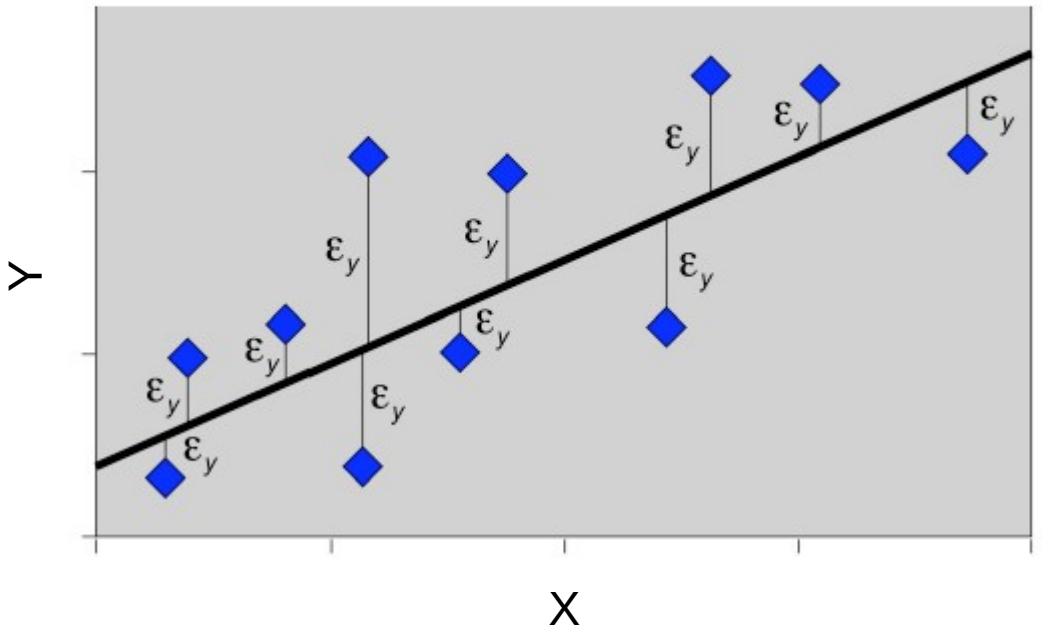
- Variables analysed:
  * SST (Niño 3.4 index)
  * 2m temperature (Southern and Northern EU)
  * precipitation (Southern and Northern EU)

- Two different forecast modes:
  1. forecast mode → training period 1951 to 1980 (N=30) to predict 1981… training period 1951 to 2008 (N=48) to predict 2009
  2. cross-validation mode → training period 1951 to 2009, except 1981 (N=47) to predict 1981

Linear regression model

Regression Model: a proposed equation relating two or more variables (e.g., y = ax + b + ε)
Consider data pairs (xn; yn) for n = 1,...,N
To fit **y** ≈ **a**x + **b**, find a and b and minimizes

$$\sum_n \epsilon_n^2 = \sum_n (y_n - ax_n - b)^2$$

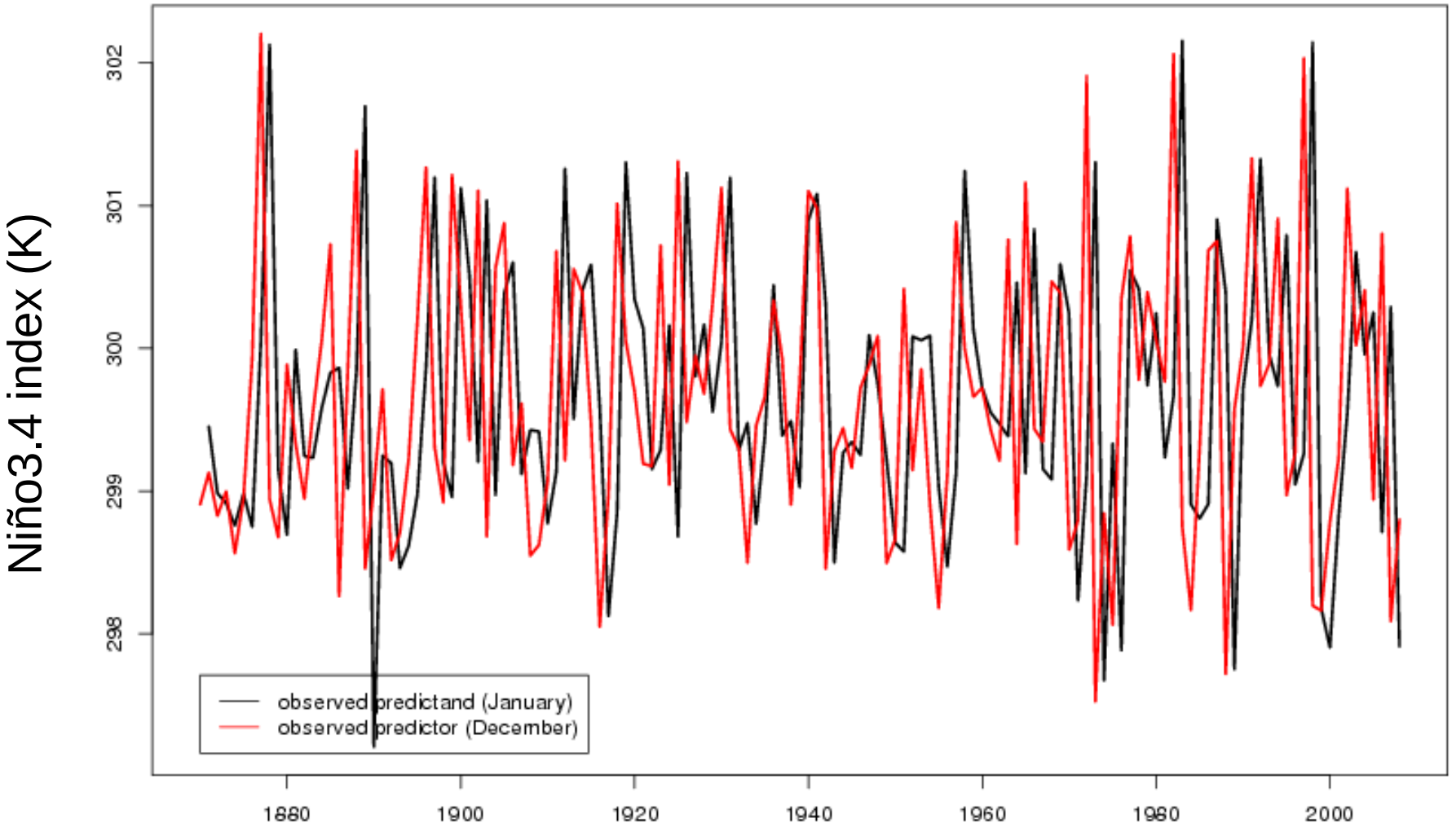


Source: **DelSole (2010)***

* Available at http://cdsagenda5.ictp.trieste.it/full_display.php?smr=0&ida=a09161. Accessed on October 14, 2010

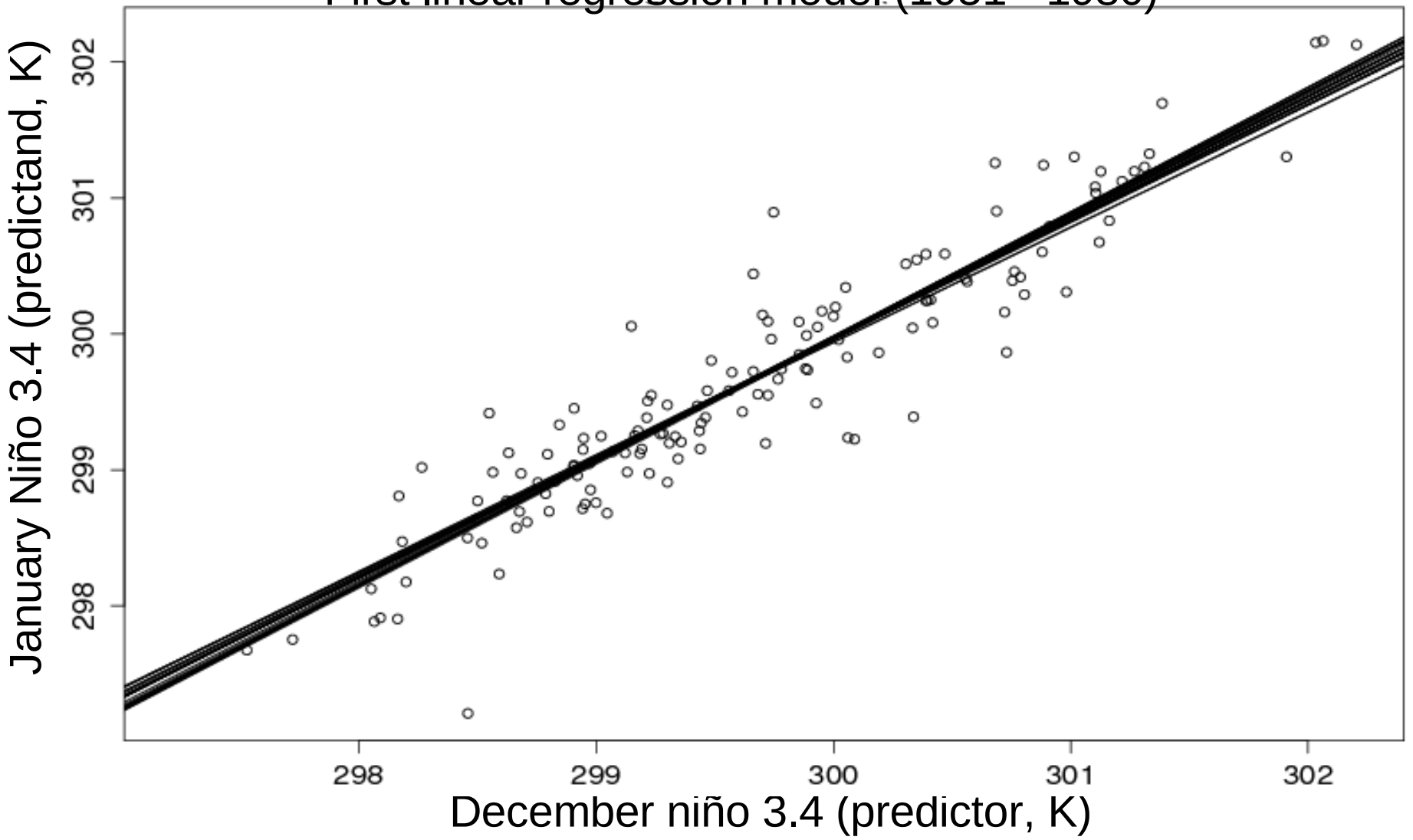
Linear regression model

Observed HadISST Niño3.4 index (5S – 5N, 170W – 120W)
from 1951 to 2009



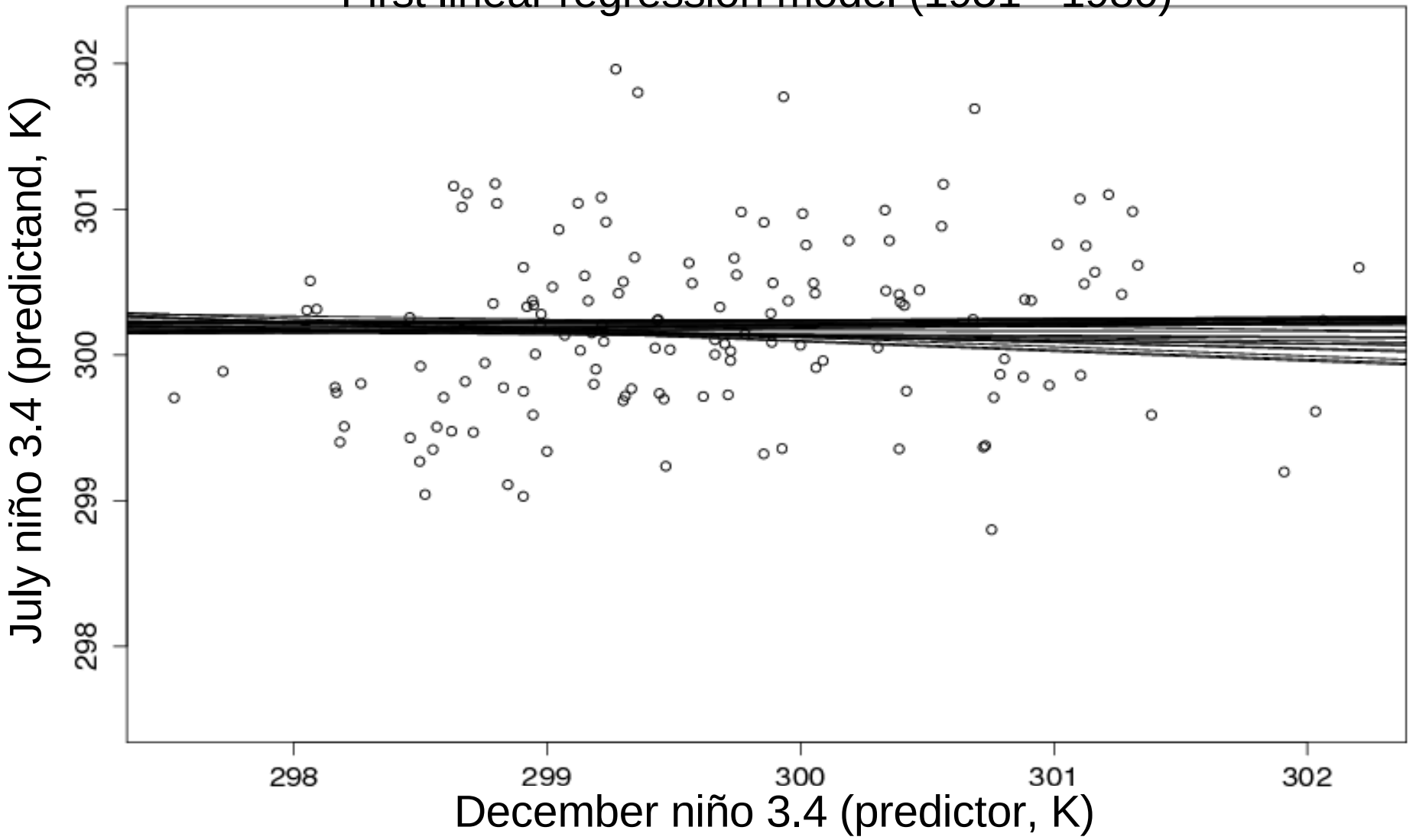
Linear regression model

HadISST Niño3.4 index (5S – 5N, 170W – 120W) in forecast mode
December predicting January over the period 1981-2009
First linear regression model (1951 - 1980)



Linear regression model

HadISST Niño3.4 index (5S – 5N, 170W – 120W) in forecast mode
December predicting July over the period 1981-2009
First linear regression model (1951 - 1980)

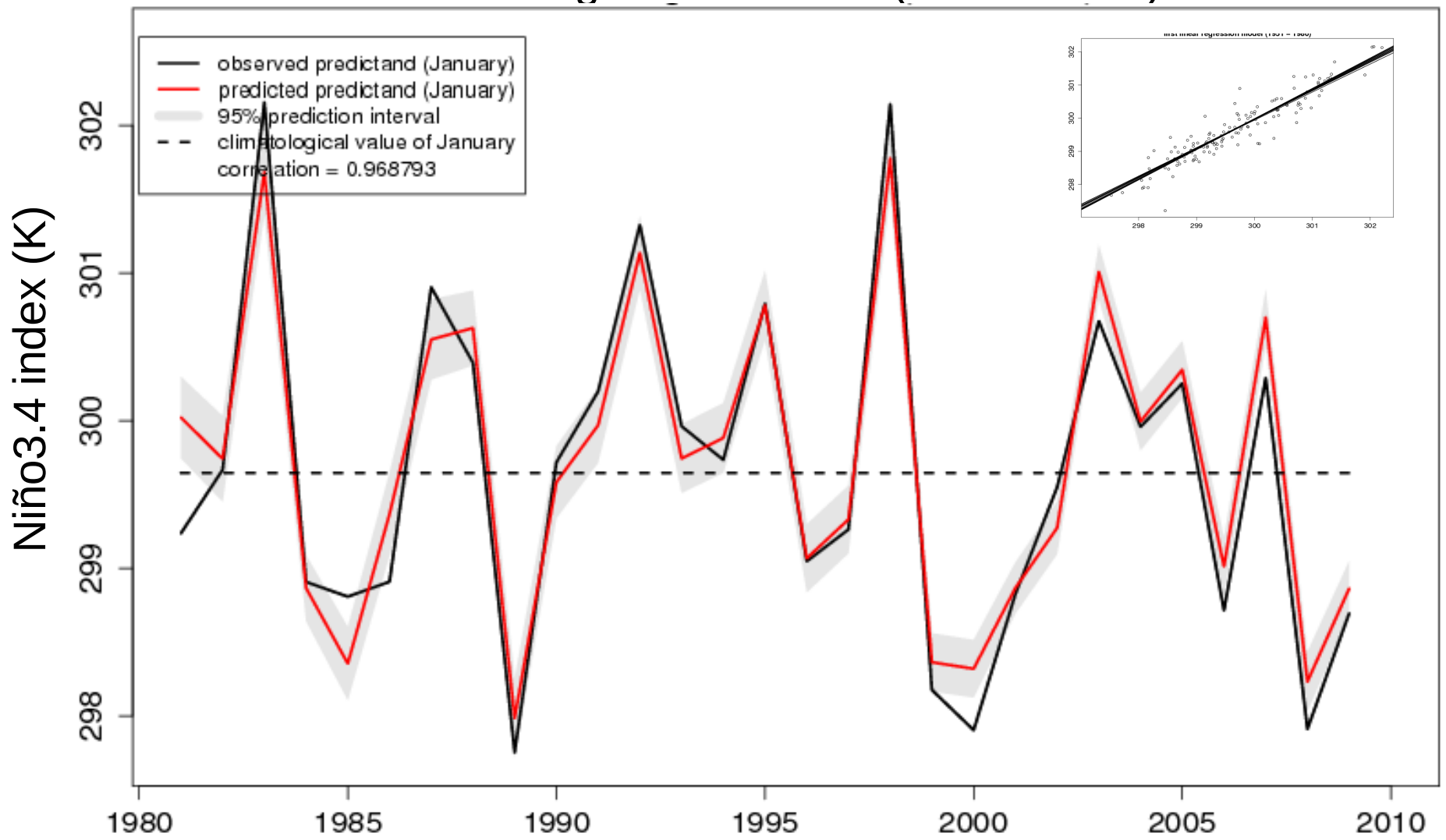


- The system consists of an ocean analysis to estimate the initial state of the ocean, a global coupled ocean-atmosphere general circulation model to calculate the evolution of the ocean and atmosphere;

- More information about the ECMWF system 3 can be found at http://www.ecmwf.int/products/forecasts/seasonal/documentation/system3/ch2.html.

Linear-model predictions

HadISST Niño3.4 index (5S – 5N, 170W – 120W) in forecast mode
December predicting January over the period 1981-2009
First linear regression model (1951 - 1980)



Linear-model predictions

HadISST Niño3.4 index (5S – 5N, 170W – 120W) in forecast mode
December predicting July over the period 1981-2009
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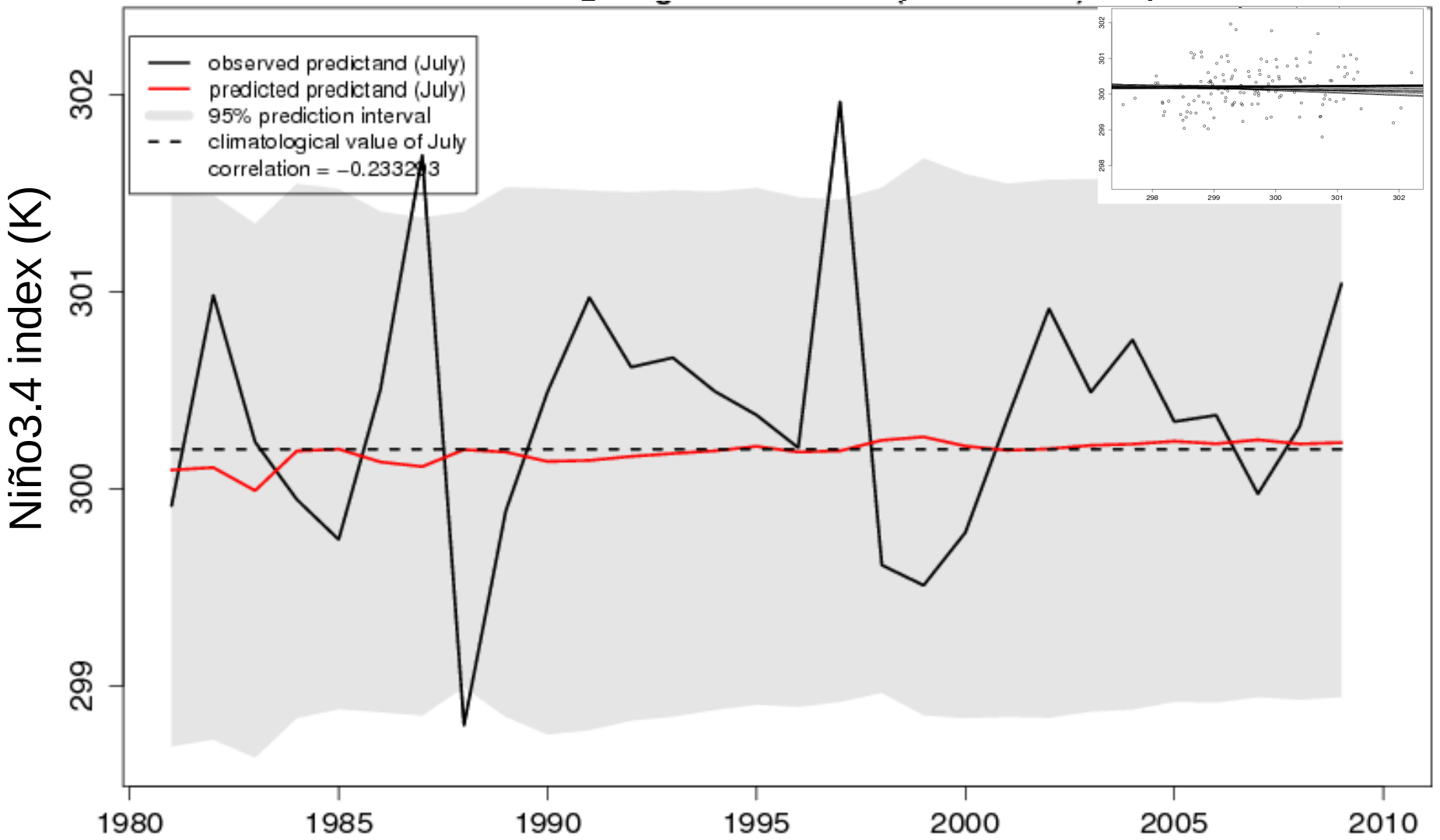
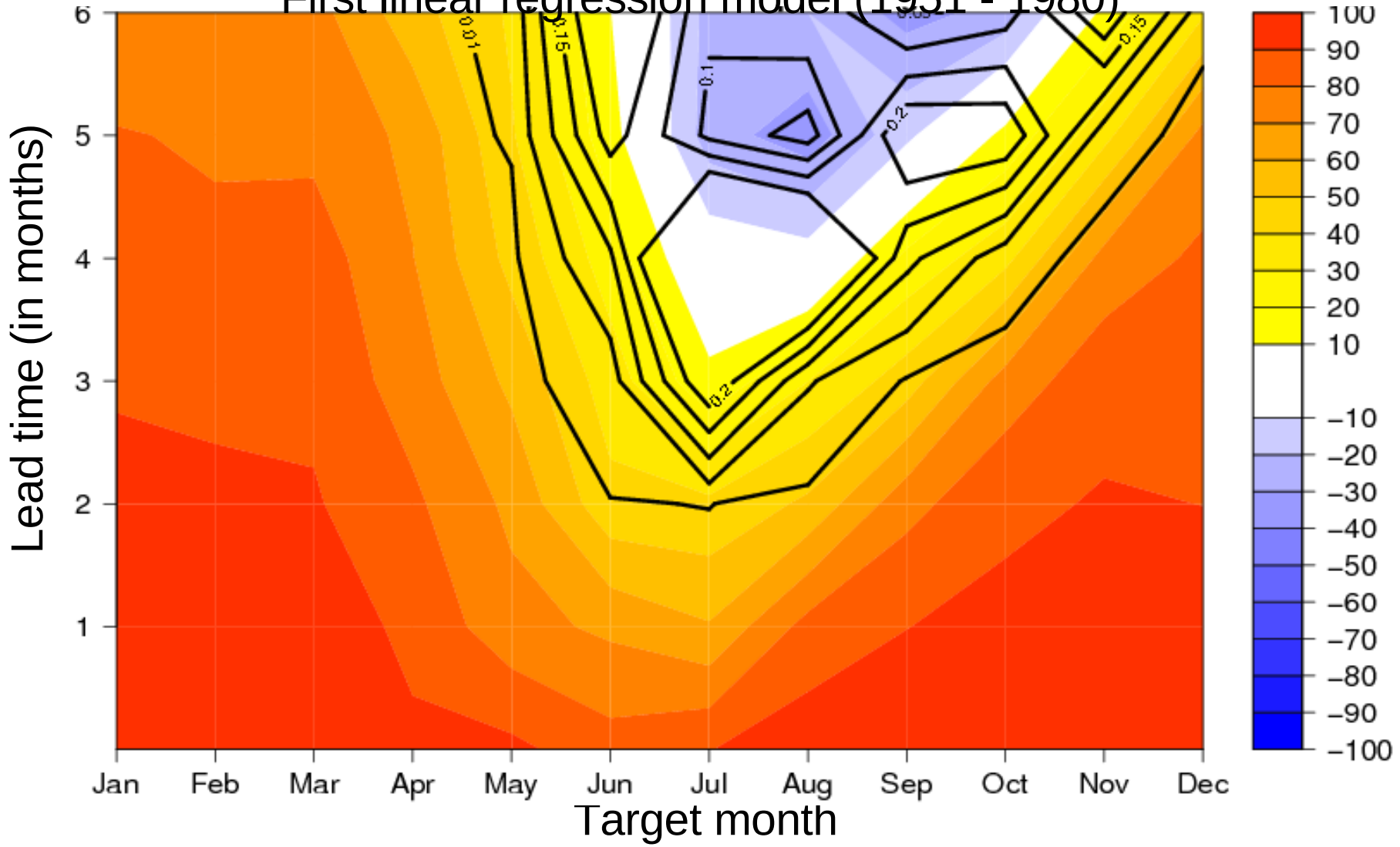


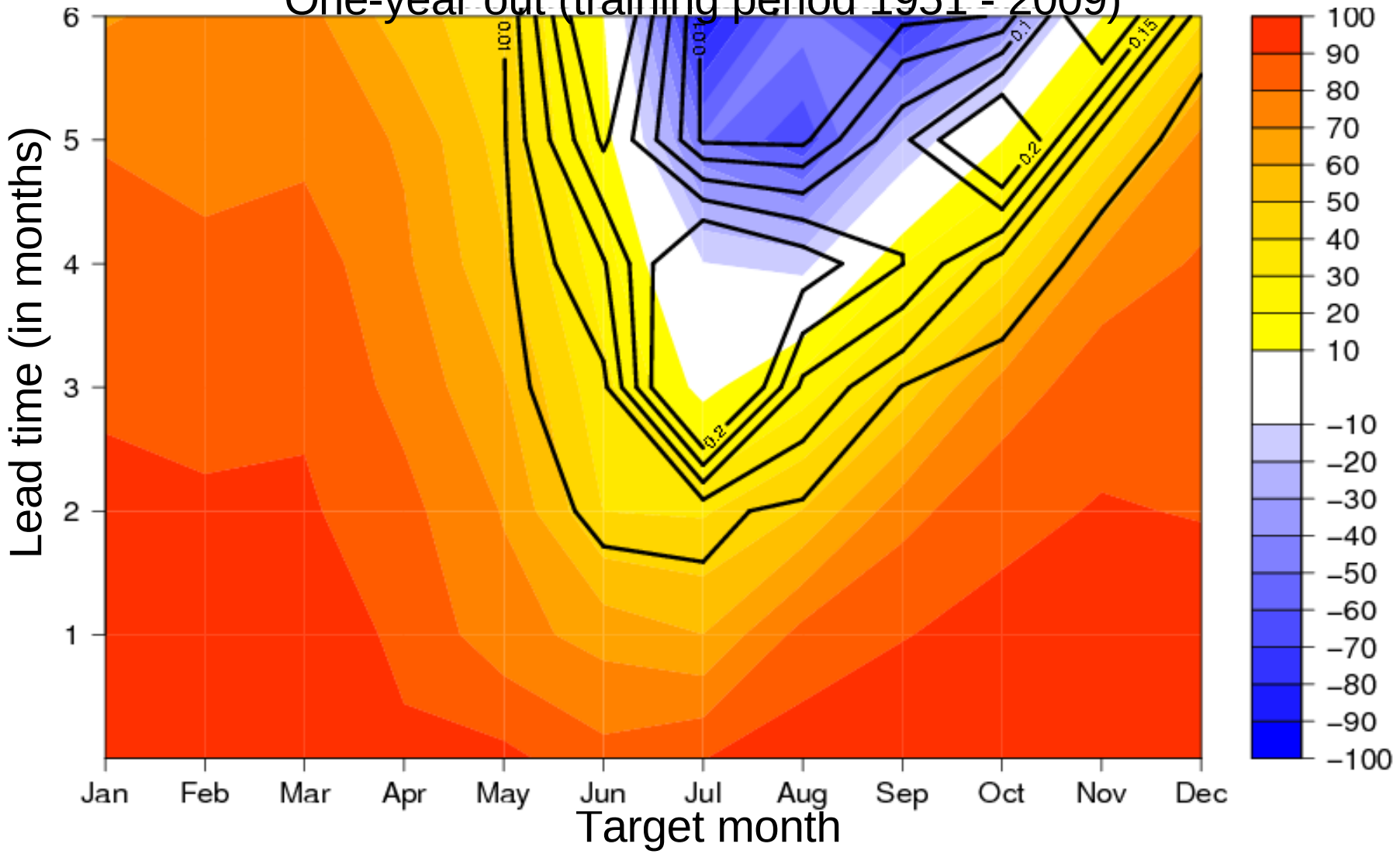
Forecast quality

HadISST Niño3.4 index (5S – 5N, 170W – 120W) in forecast mode
Correlation over the period 1981 – 2009. Contours for p-values.
First linear regression model (1951 - 1980)



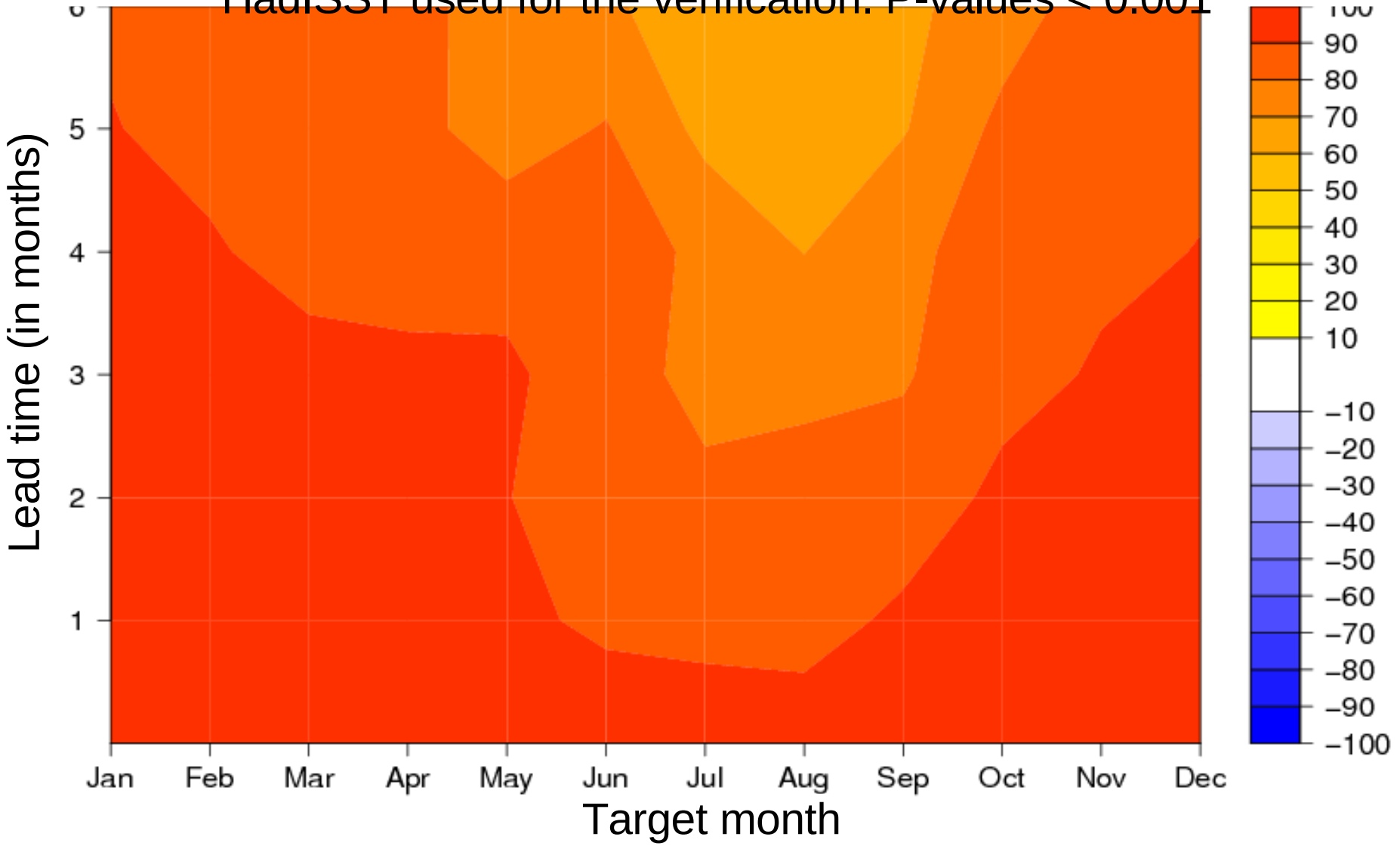
Forecast quality

HadISST Niño3.4 index (5S – 5N, 170W – 120W) in CV mode
Correlation over the period 1981 – 2009. Contours for p-values.
One-year out (training period 1951 - 2009)



Forecast quality

Niño3.4 index (5S – 5N, 170W – 120W)
Correlation over the period 1981 – 2009. ECMWF System 3 predicting a month
HadISST used for the verification. P-values < 0.001



Forecast quality

Correlation in forecast mode over the period 1981 - 2008

First linear regression model (1951 – 1980). Contours for p-values.

Northern EU (40N – 75N, 10W - 40E)

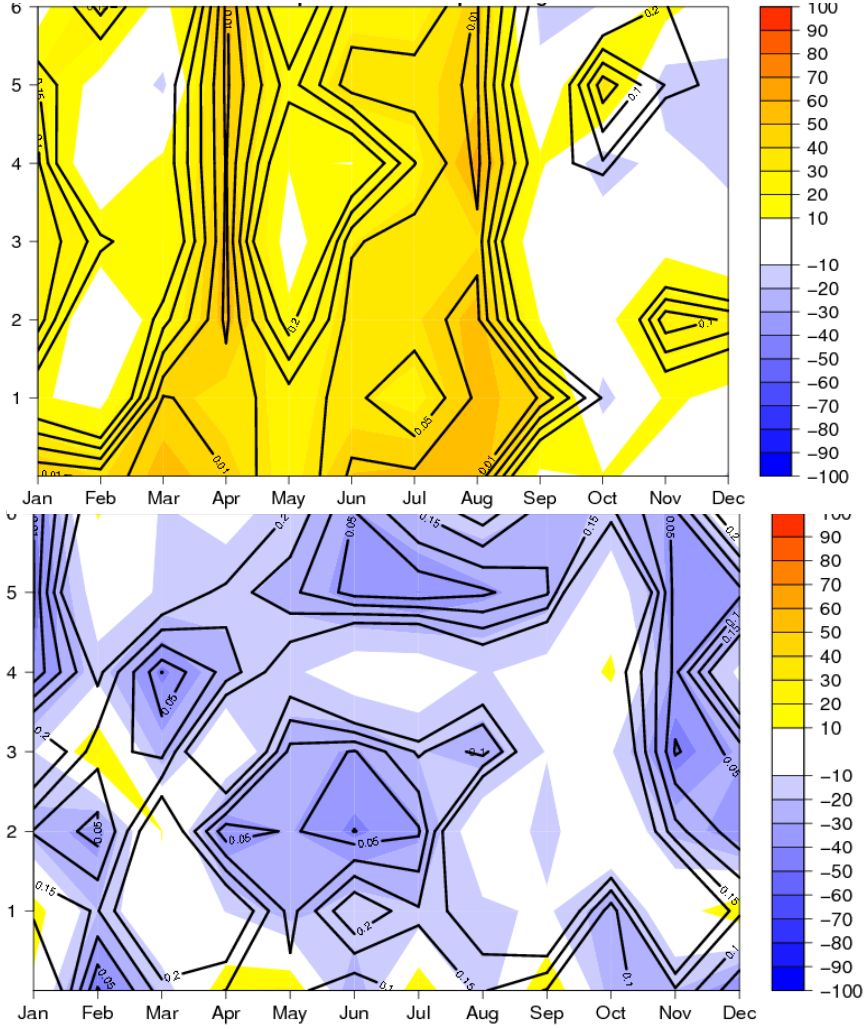
Southern EU 35N – 45N, 05W - 30E)

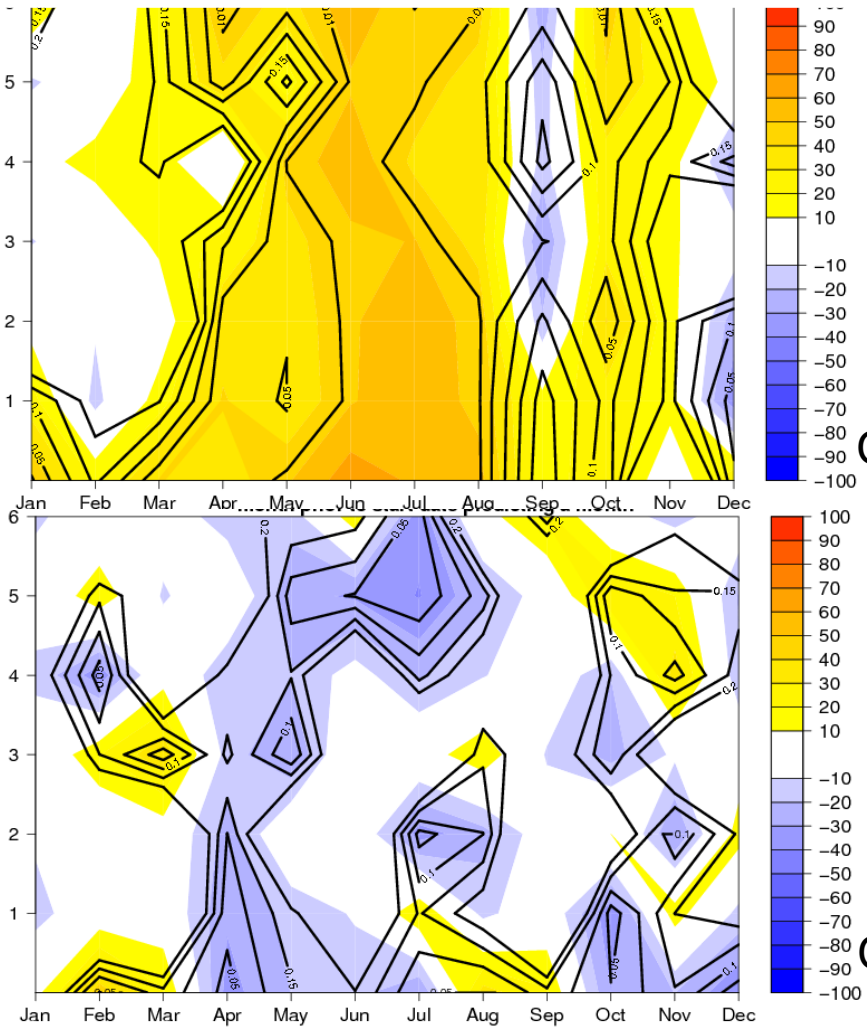
2m temperature

precipitation

GHCN

GPCC





Target month

Conclusions

- The ECMWF system 3 outperforms the simple statistical model based on persistence for Niño 3.4

- Over Europe the statistical model based on persistence suggests
  - No persistence for precipitation
  - Seasonal predictability from persistence in two-metre temperature (associated with observed trend?)

Future work

1) Evaluate forecast quality performed by statistical and dynamical models achieved over Europe;

2) Develop a more sophisticated statistical model to predicted two-metre temperature, low-level wind and precipitation over Europe;

3) Calibration and combination of two-metre temperature, low-level wind and precipitation from the ENSEMBLES coupled models using the **forecast assimilation** method;

4) Assess different forecast quality aspects of the predictions obtained in (3).

Thank you