Multiscale Stochastic Generator of Multivariate Met-Ocean Time Series

Yanira GUANCHE, Roberto MÍNGUEZ and Fernando J. MÉNDEZ   Environmental Hydraulics Institute "IHCantabria", Universidad de Cantabria, SPAIN   http://www.ihcantabria.com
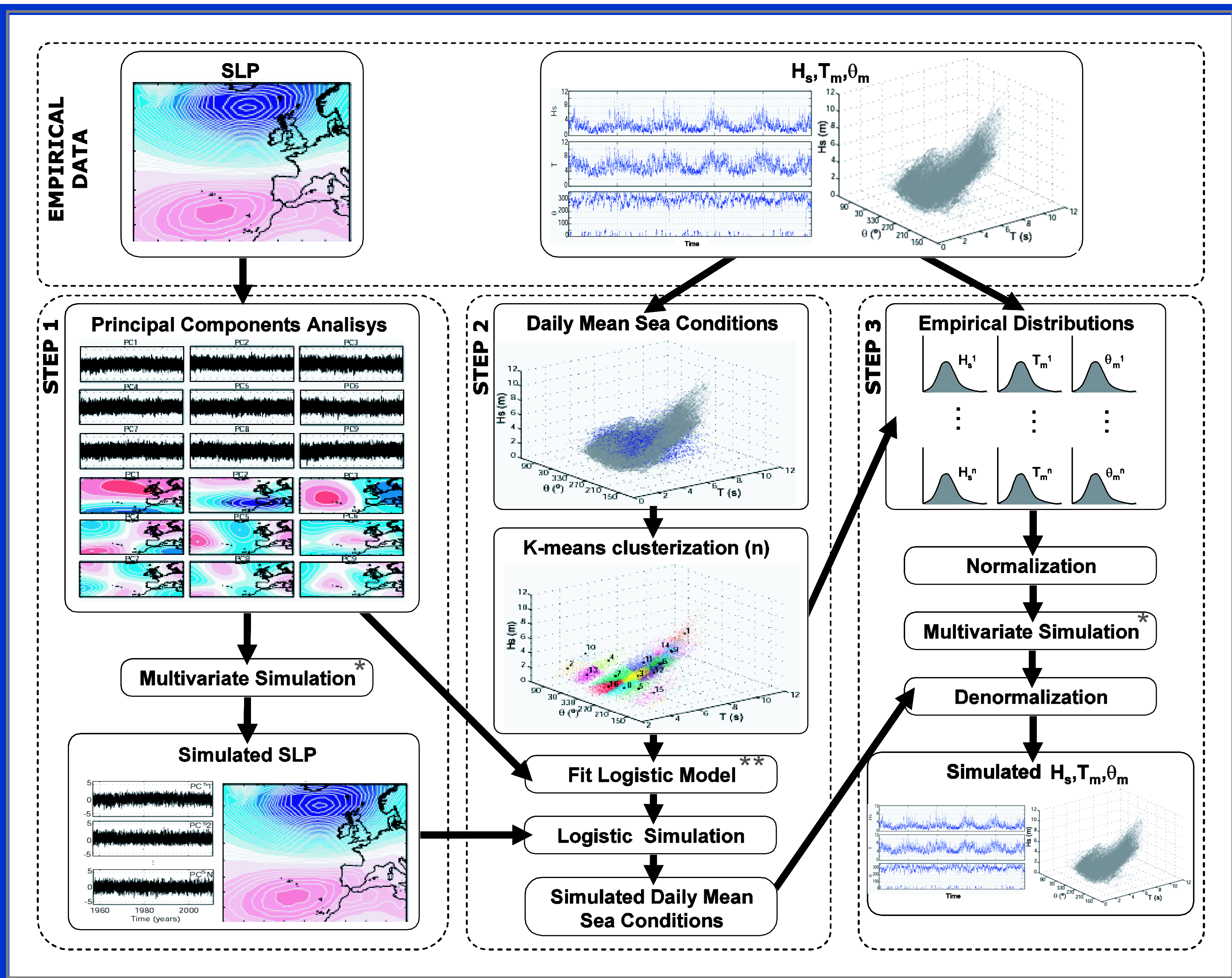
INTRODUCTION

MOTIVATION

Accurate wave climate characterization, which is vital to understand wave-driven coastal processes and to design coastal and offshore structures, requires the availability of long term data series. Where existing data are sparse, synthetically generated time series offer a practical alternative.
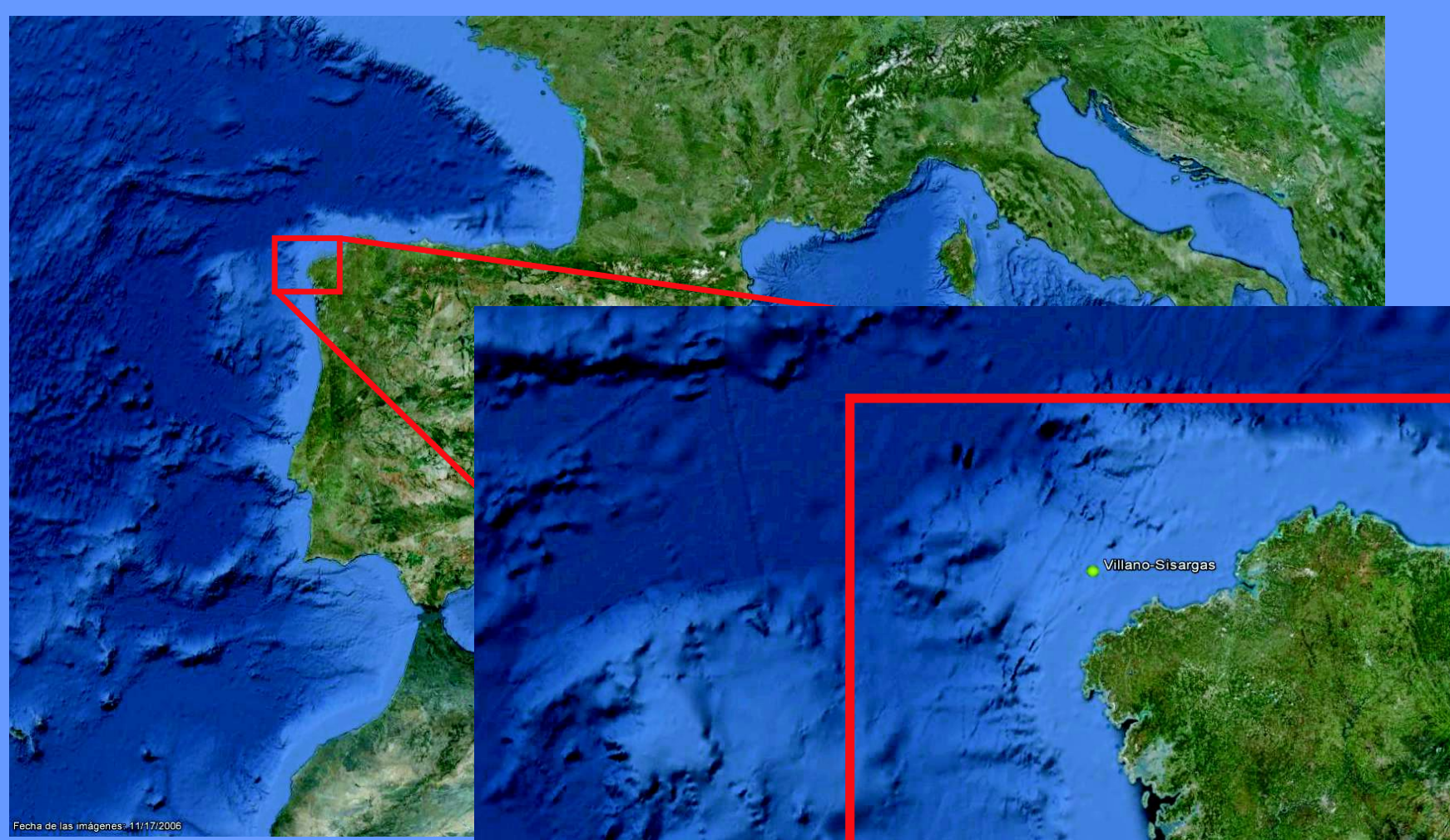
OBJECTIVE

Propose a methodology to simulate multivariate hourly sea state time series that preserve the statistical characteristics of the existing empirical data.

METHODOLOGY

CONCLUSIONS

- The possibility to simulate daily SLP fields decomposed into PCs allows, generating of different atmospheric scenarios.
- The autoregressive logistic model considers simultaneously covariates of different nature, such as DSLP, seasonality or autoregressive influence, where the time and space scales are completely different.
- The methodology is able to reproduce multivariate time series of interrelated variables.
- Being a DSLP-driven model, facilitates the understanding of local wave climate as a function of given synoptic circulation patterns.

REFERENCES

Camus, P., Méndez,F.J., Medina, R., Tomás, A. and Izaguirre, C. (2013). High resolution downscaled ocean waves (DOW) reanalysis in coastal areas. *Coastal Engineering (72)*, 56-68
**Guanche, Y., Minguez, R. and Méndez, F. J. (2013). Autoregressive logistic regression applied to atmospheric circulation patterns. *Clymate Dynamics*. doi: 10.1007/s00382-013-1690-3.
Guanche, Y., Minguez, R. and Méndez, F. J. Climate-based Monte Carlo simulation of trivariate sea states. *Under revision in Coastal Engineering.*
*Morales, J. M., Minguez, R., and Conejo, A. J. (2010). A methodology to generate statistically dependent wind speed scenarios. *Applied Energy* (87) 843–855.
Reguero, B.G., Menéndez, M., Méndez, F.J., Minguez, R. Losada, I. (2012). A Global Ocean Wave (GOW) calibrated reanalysis from 1948 onwards. *Coastal Engineering* 65, 38–55.

CASE STUDY: Hourly Sea States Time Series Simulation in a Location in NW Spanish Coast

LOCATION

DATA

Wave Data
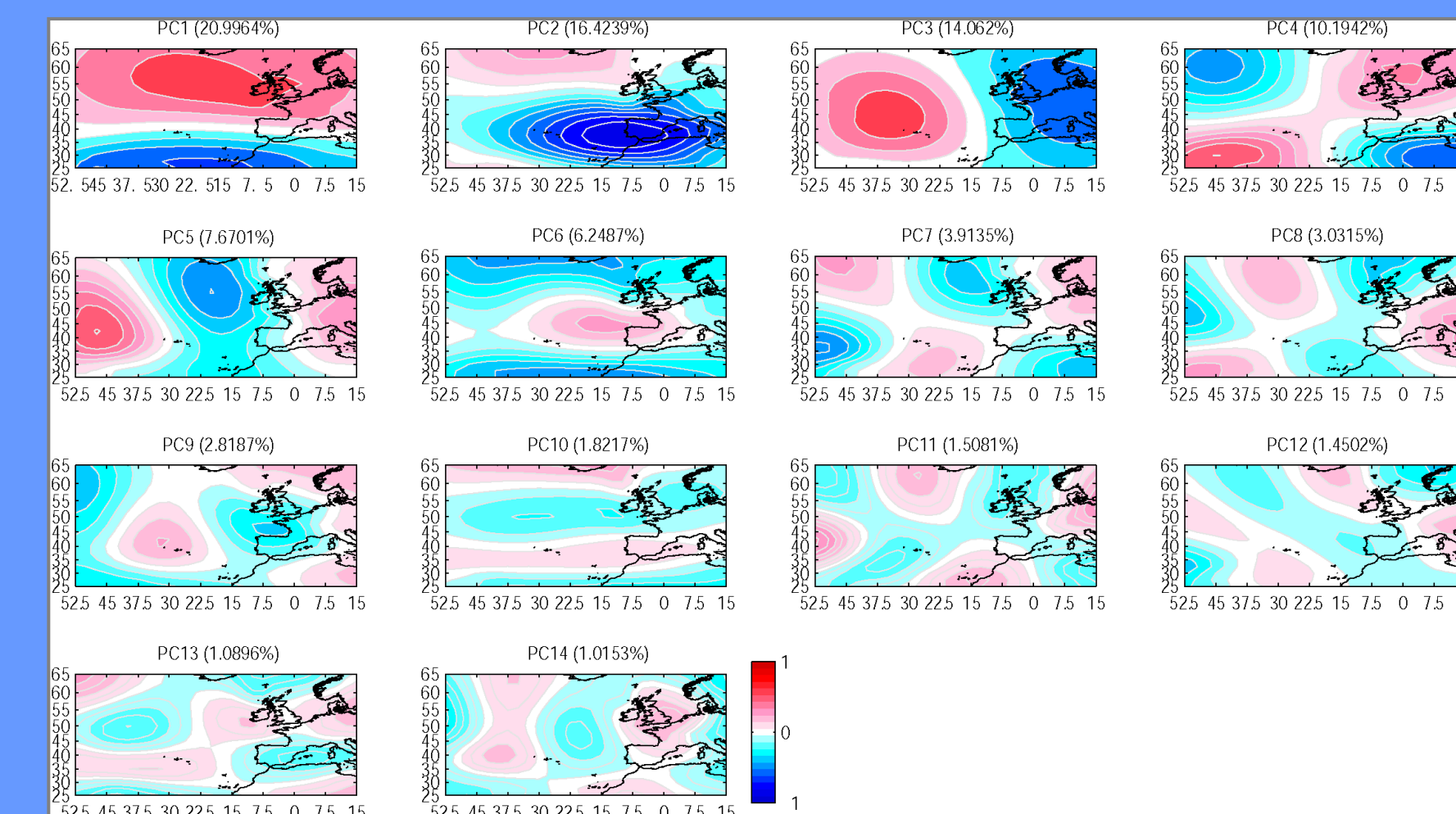
DOW 1.1   Reguero et al.(2012)
Camus et al. (2012)

SLP Data

NCEP-NCAR

Covering 25º-65ºN
52.5ºW -15º E
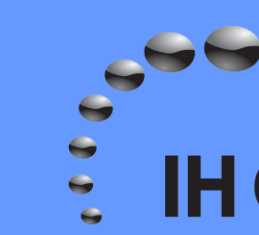
Hourly Resolution
~200 m Spatial Resolution
1948-2008

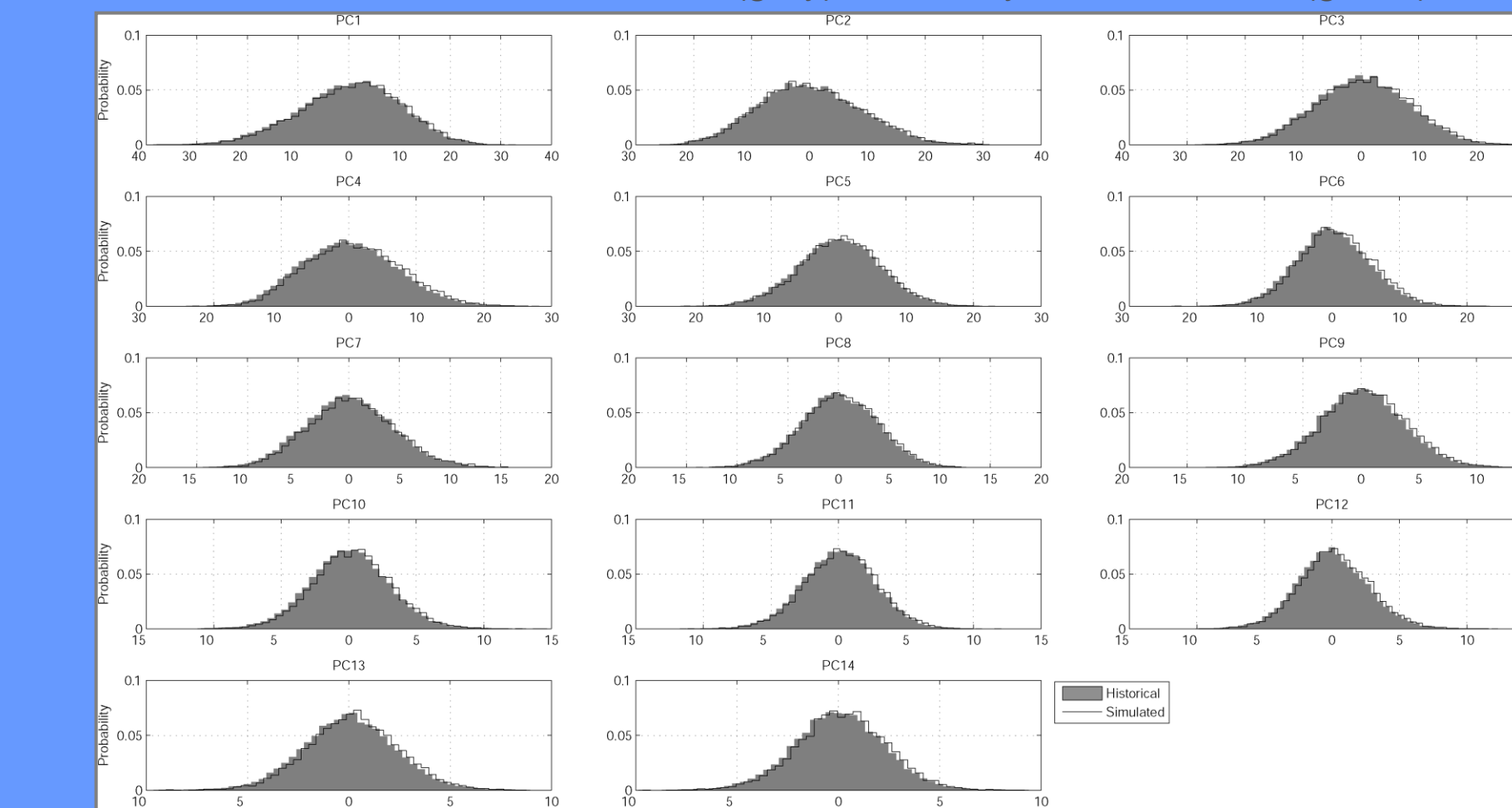### STEP 1. DAILY SLP FIELDS SIMULATION

1. Spatial modes related to de daily Sea Level Pressure principal components
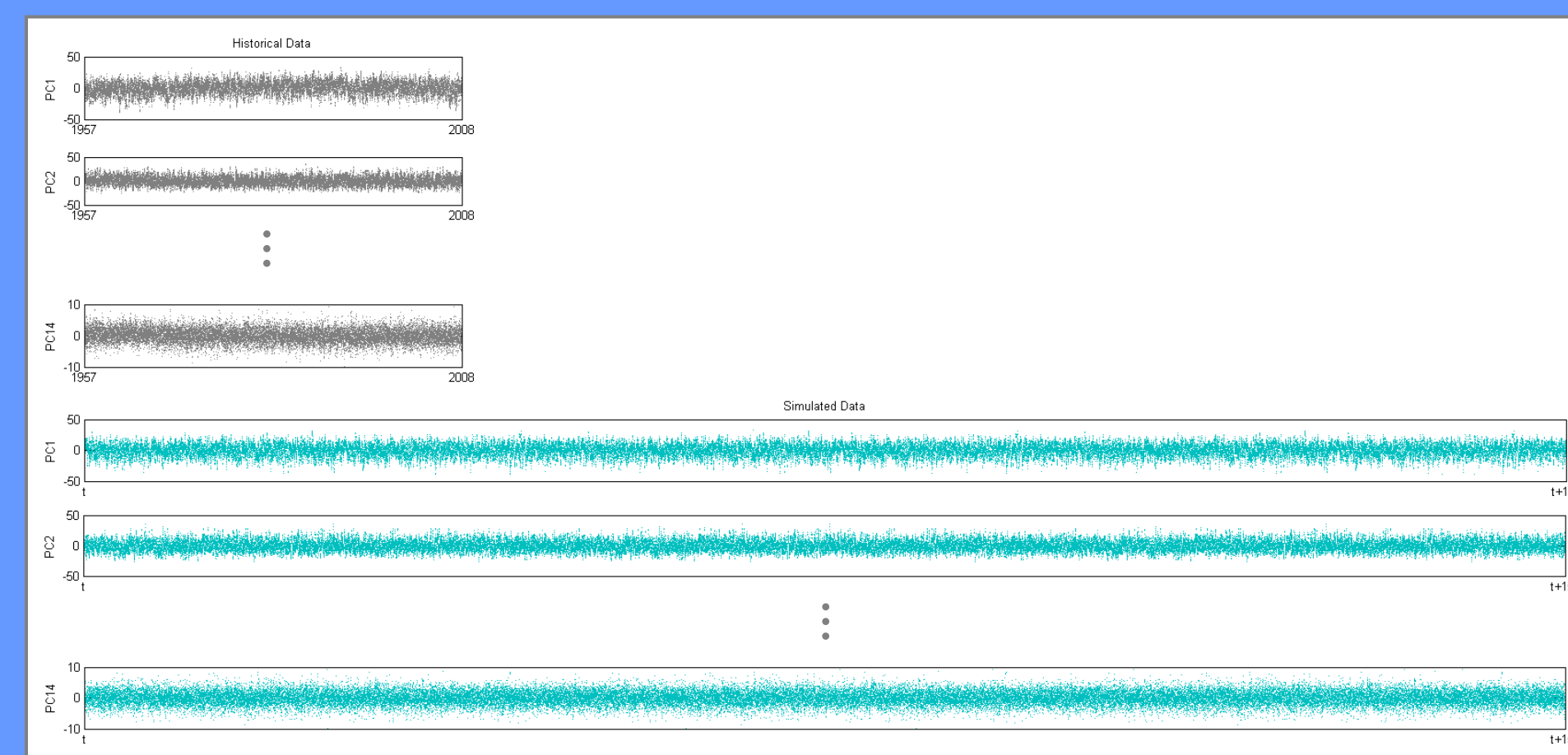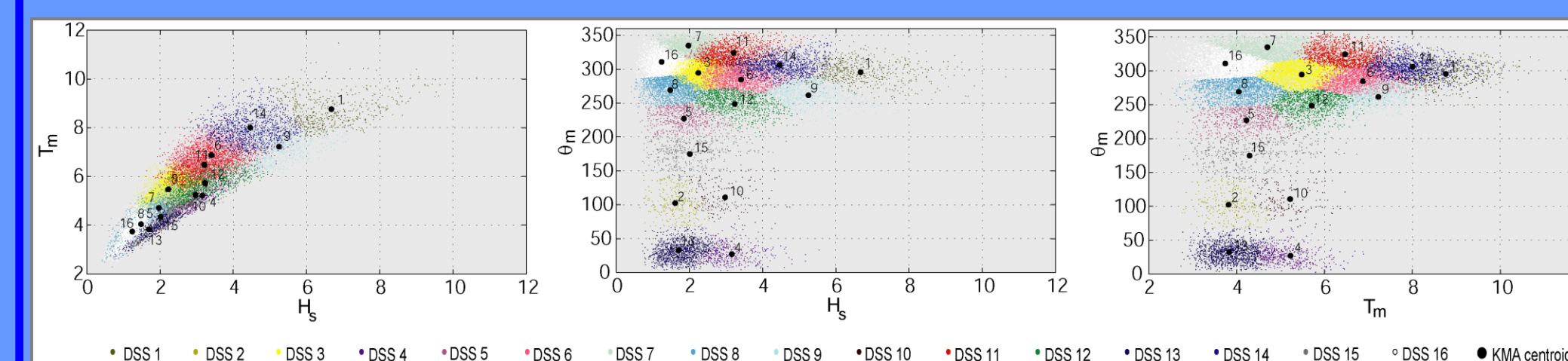

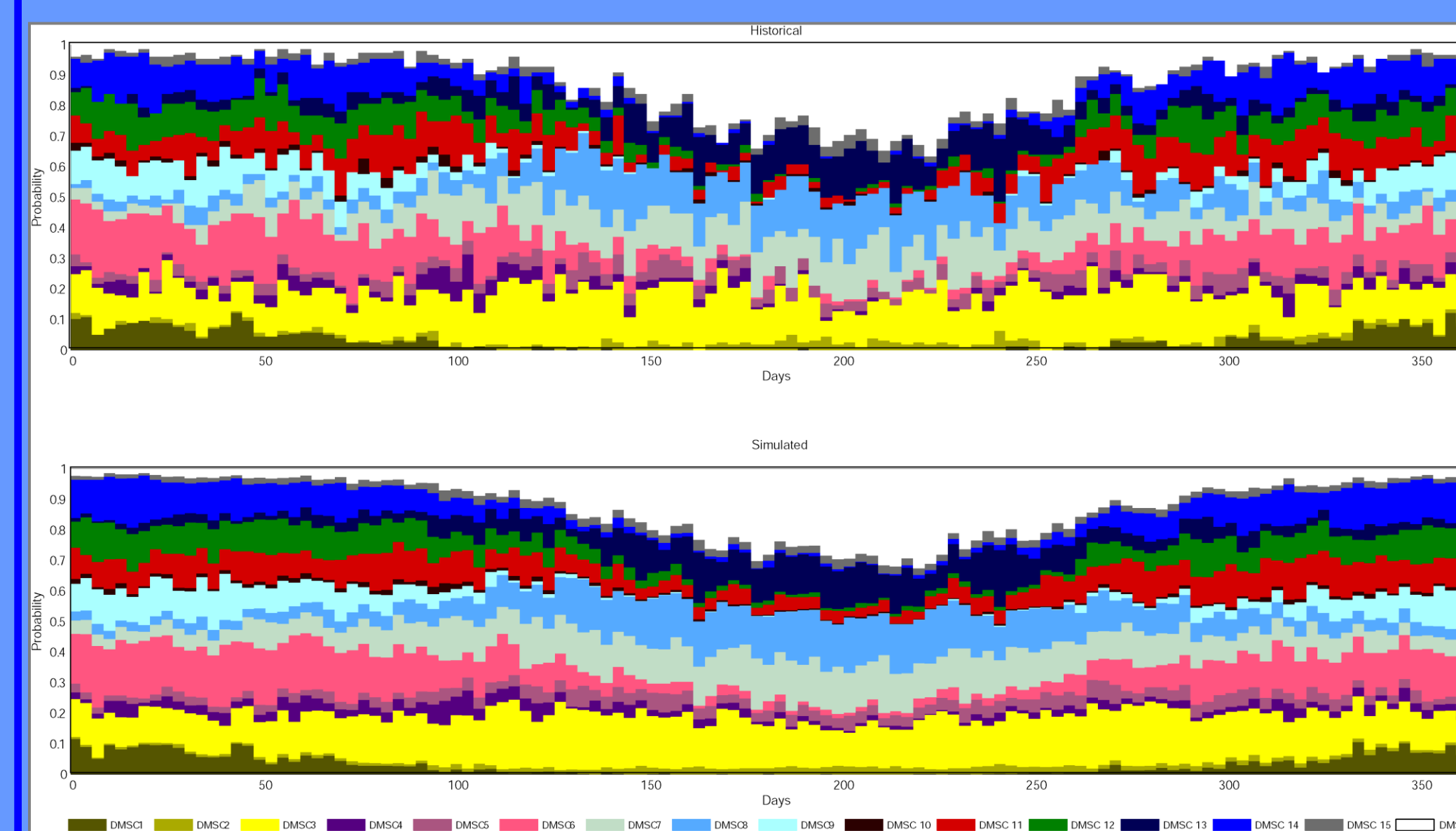2. PCs time series: historical (grey) and 150 years simulation (green)

3. Empirical probability density function of each PC related to: i) historical data (grey bars) and ii) simulated data (black line).
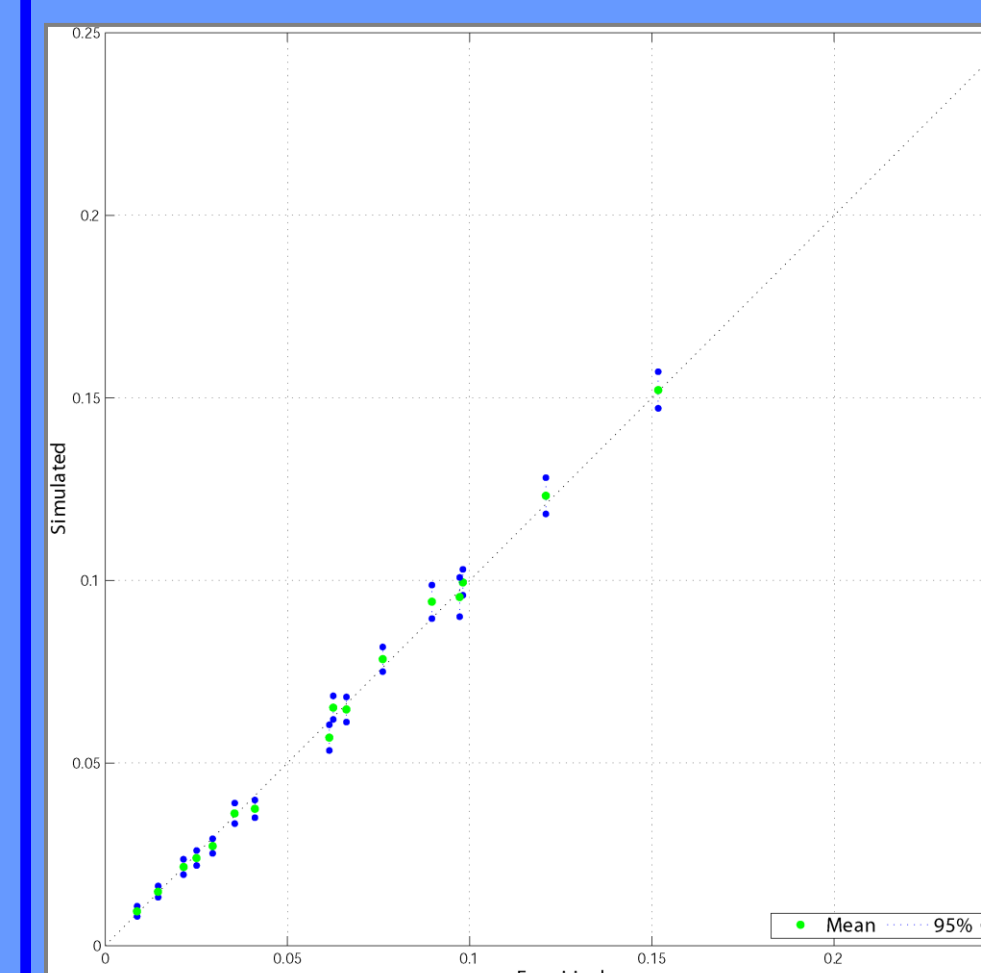
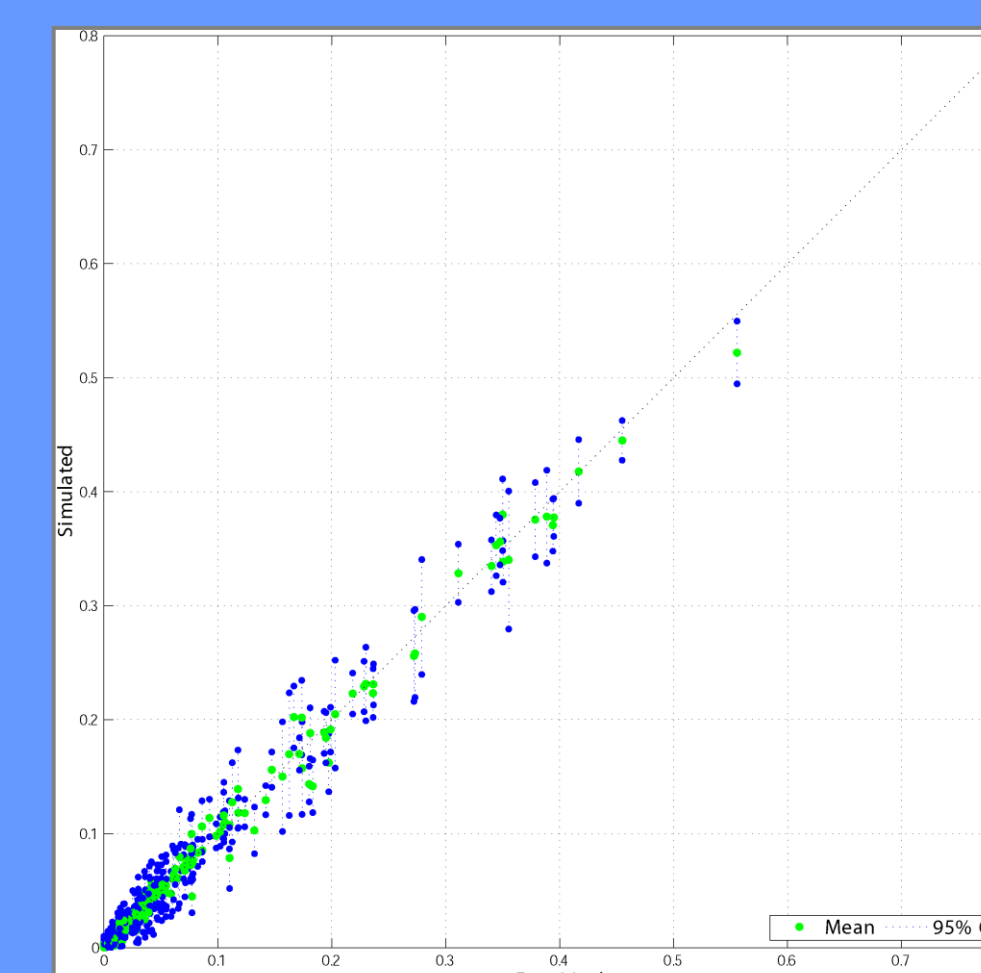### STEP 2. DAILY MEAN SEA CONDITIONS SIMULATION

4. KMA classification of the Daily Mean Sea Conditions
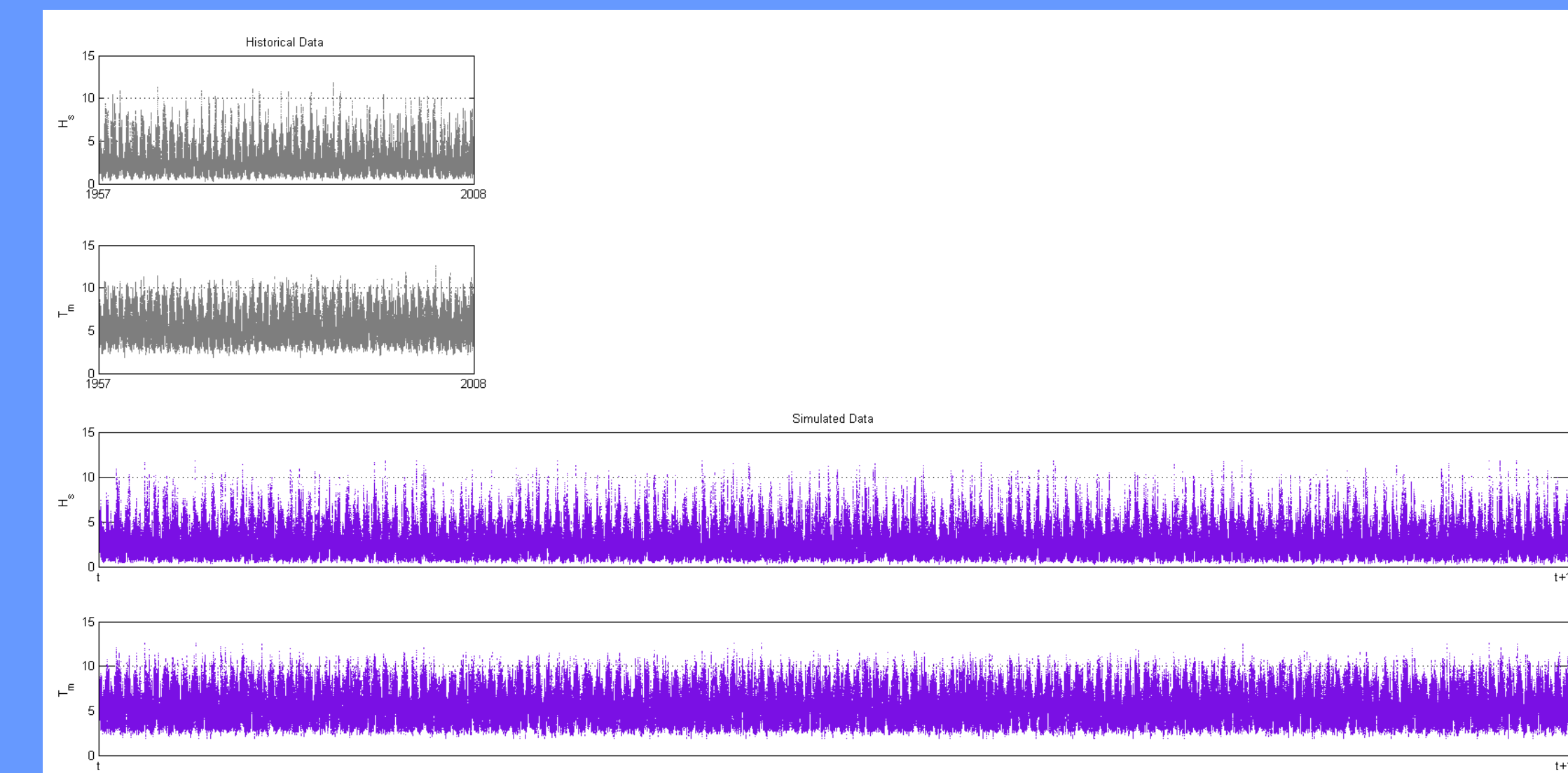

5. Model fitting diagnostic plot.

6. Scatter plot of the occurrence probabilities associated with the DMSC: empirical vs. simulated
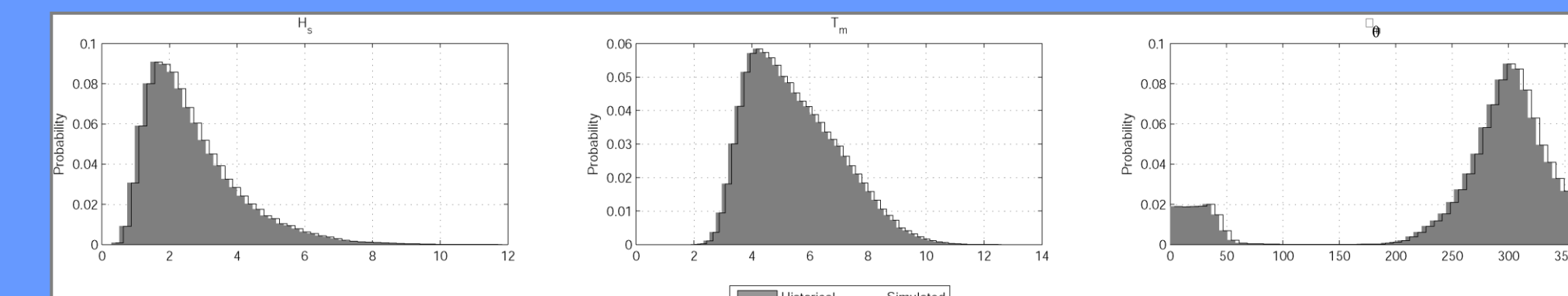

7. Scatter plot of the transition probabilities associated with the DMSC: empirical vs. simulated
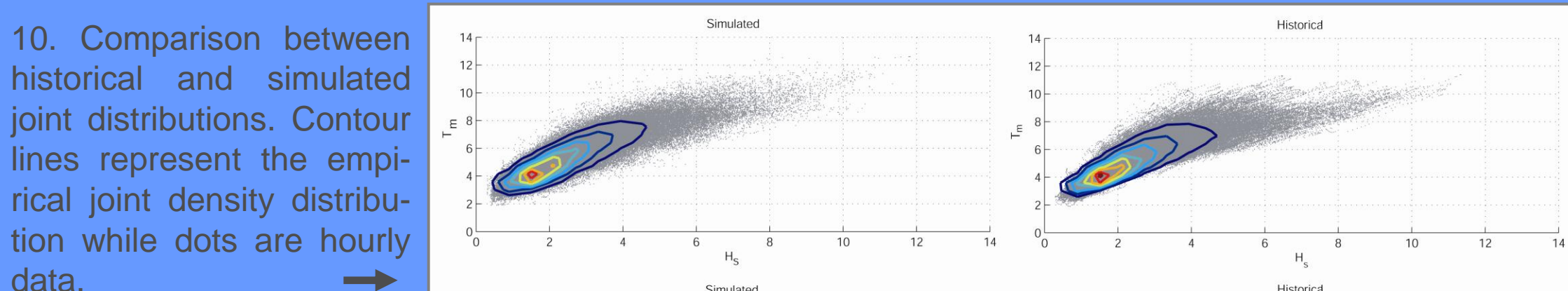
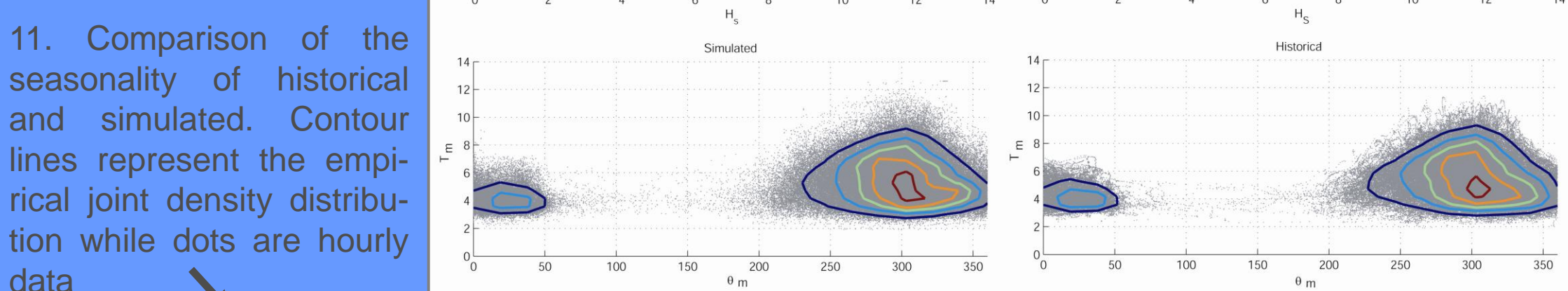### STEP 3. HOURLY SEA STATES TIME SERIES SIMULATION

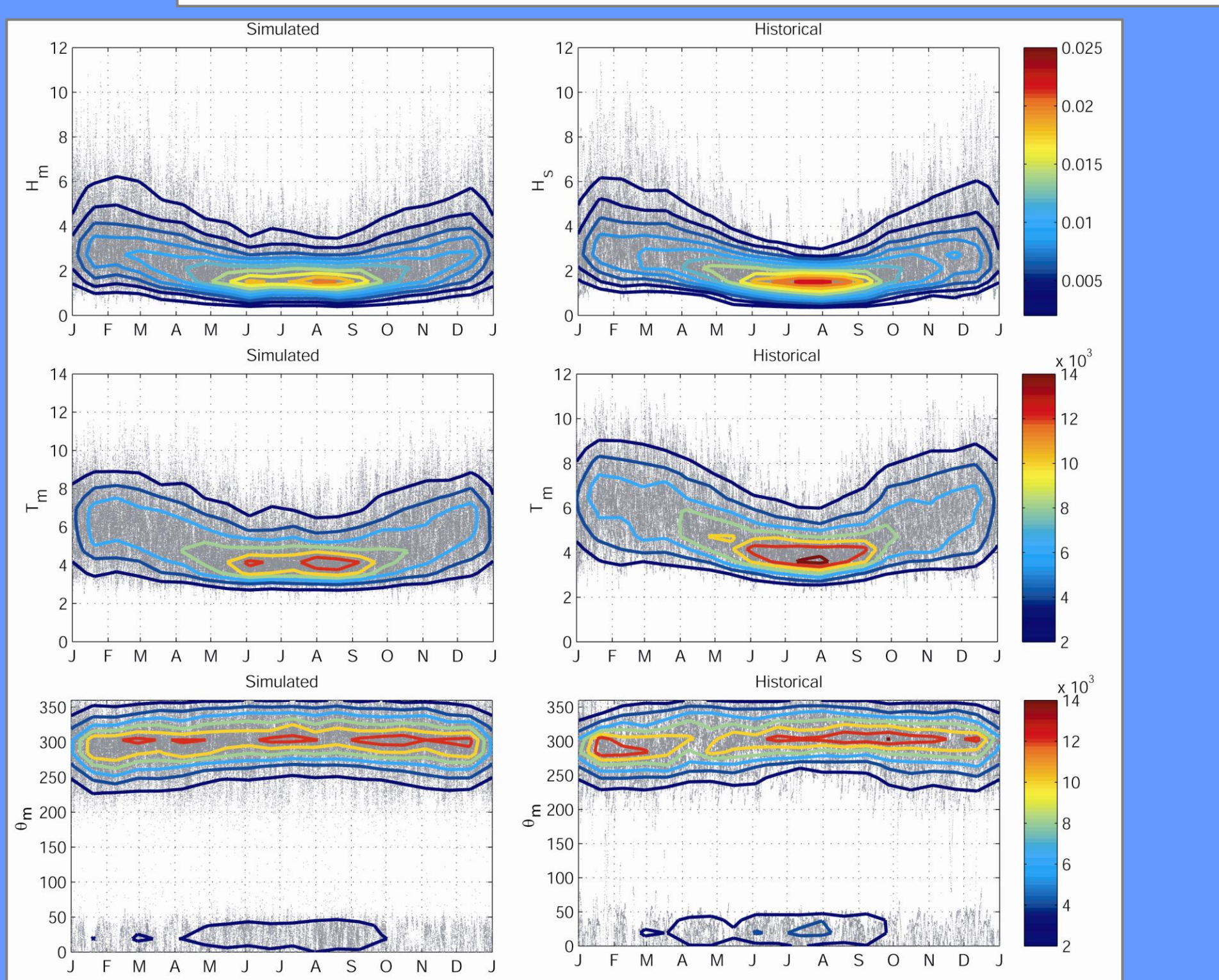8. H_s and T_m time series: historical (grey) and 150 year simulation (purple)

9. Empirical probability density function of H_s, T_m and θ_m related to: i) historical data (grey bars) and ii) simulated data (black line).

10. Comparison between historical and simulated joint distributions. Contour lines represent the empirical joint density distribution while dots are hourly data.

11. Comparison of the seasonality of historical and simulated. Contour lines represent the empirical joint density distribution while dots are hourly data