

A statistical analysis of seasonality of liquid cloud microphysics, biogenic aerosols and rainfall over ocean using the A-Train Satellites

Shan Zeng^{1,2}, ChipTrepte¹, David Winker¹, Jérôme Riedi³, Yongxiang Hu¹ and Hanlan Wang⁴
¹ NASA LaRC, Hampton, VA ² ORAU, Oak Ridge, TN ³ Lille 1 University, Villeneuve d'Ascq, France ⁴ SSAI, Hampton, VA

Abstract: Aerosols influence climate through their direct and indirect effects. The aerosol indirect effect is based on the way they interact with surrounding clouds. During cloud formation and development, aerosols act as cloud nucleation nuclei (CCN) or ice nuclei, which modifies cloud micro-, macro-physical and radiative properties, and hence helps to shape the Earth's radiation budget. Dominant sources of ocean-derived aerosols that may serve as CCN include sea spray and biogenic aerosol. In this study, we used 10-years global observations from the A-Train satellites to show seasonal variations of cloud droplet number concentrations (CDNC), ocean chlorophyll concentrations, aerosol angstrom parameter, and rainfall. Potential cloud-aerosol interactions are further discussed based on seasonal and spatial correlations between microphysics of clouds and aerosols. Emphasis for this study is placed on the southern ocean and tropical Pacific.

DATA: CDNC- MODIS/Aqua & CALIOP/CALIPSO (Zeng et al. 2014); Chlorophyll-MODIS/Aqua [2003-2012]; Aerosols- MODIS/Aqua [2003-2012]; Rainfall/Surface Wind/Water Vapor/SST- AMSR/Aqua [2003-2010]

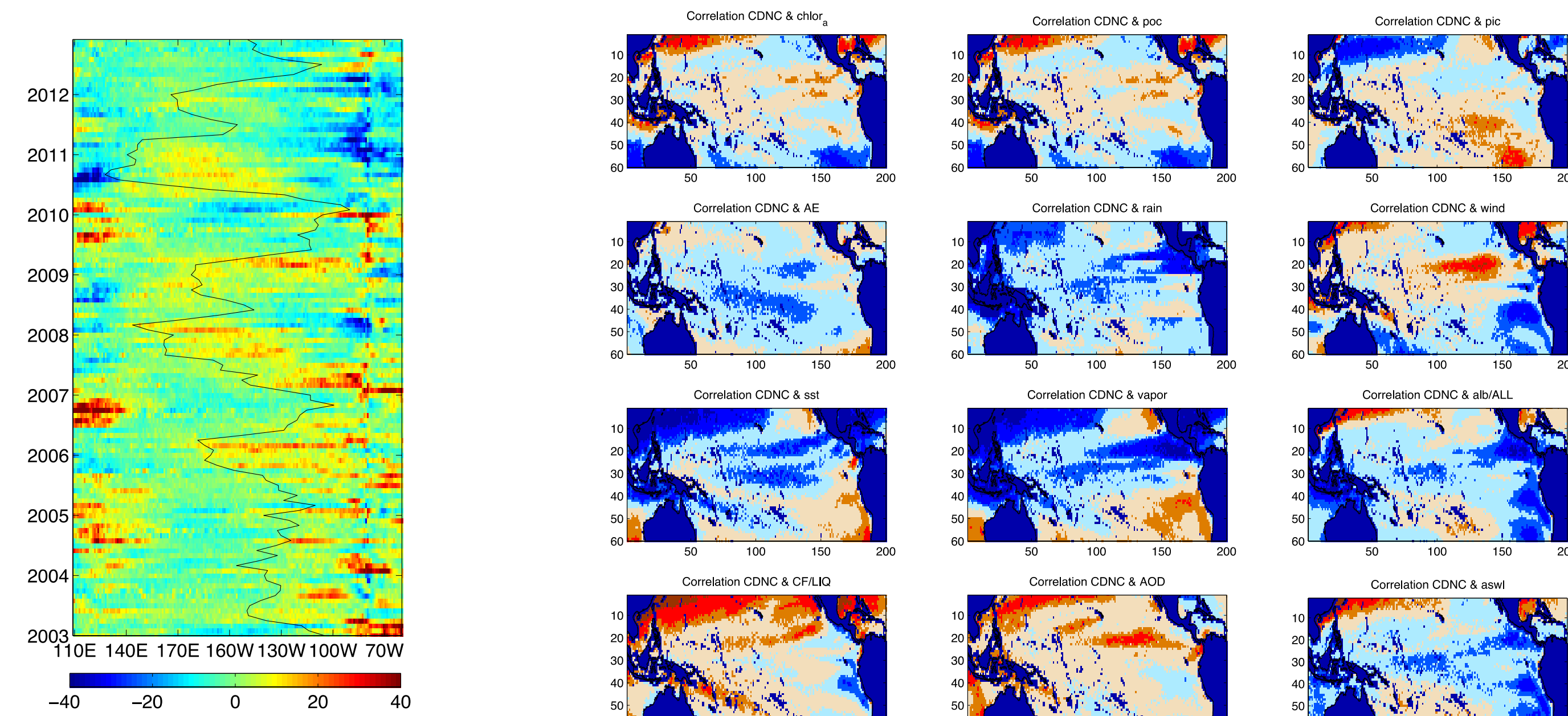


Fig 1: Time vs longitude diagram of monthly CDNC anomalies, averaged over latitudes from 5°S to 5°N for ten-year period from January 2003 to December 2012.

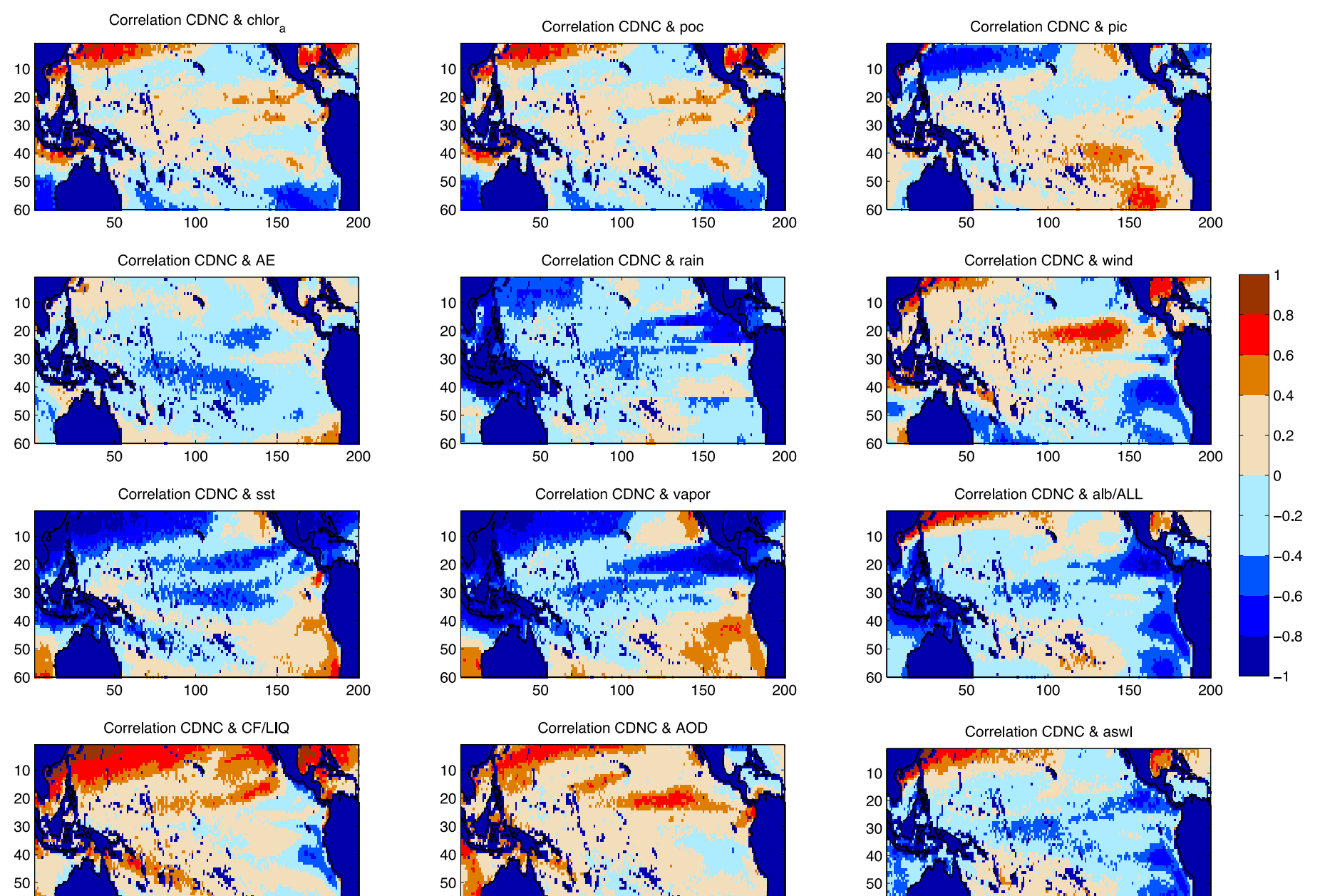


Fig 2: Linear correlations between monthly CDNC and other atmospheric/oceanic parameters

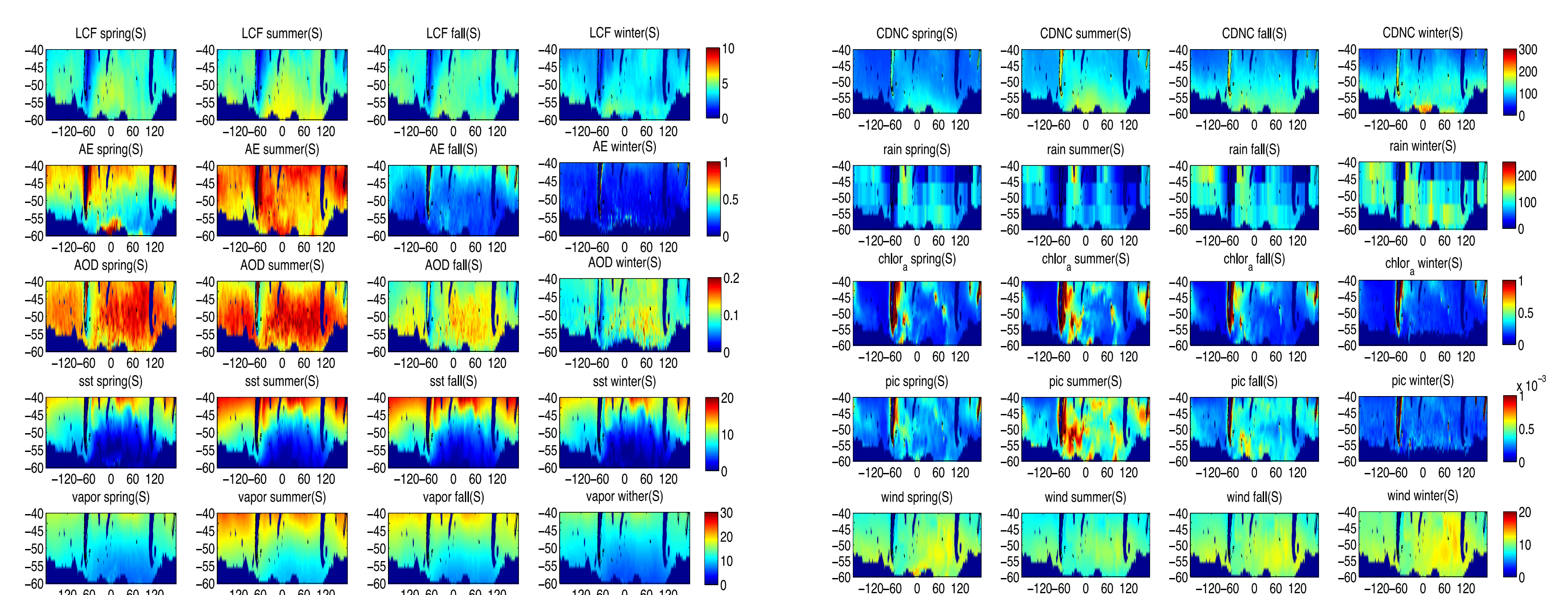


Fig 3: Geographical distributions of CDNC and other atmospheric/oceanic parameters over southern ocean

Tropical Pacific

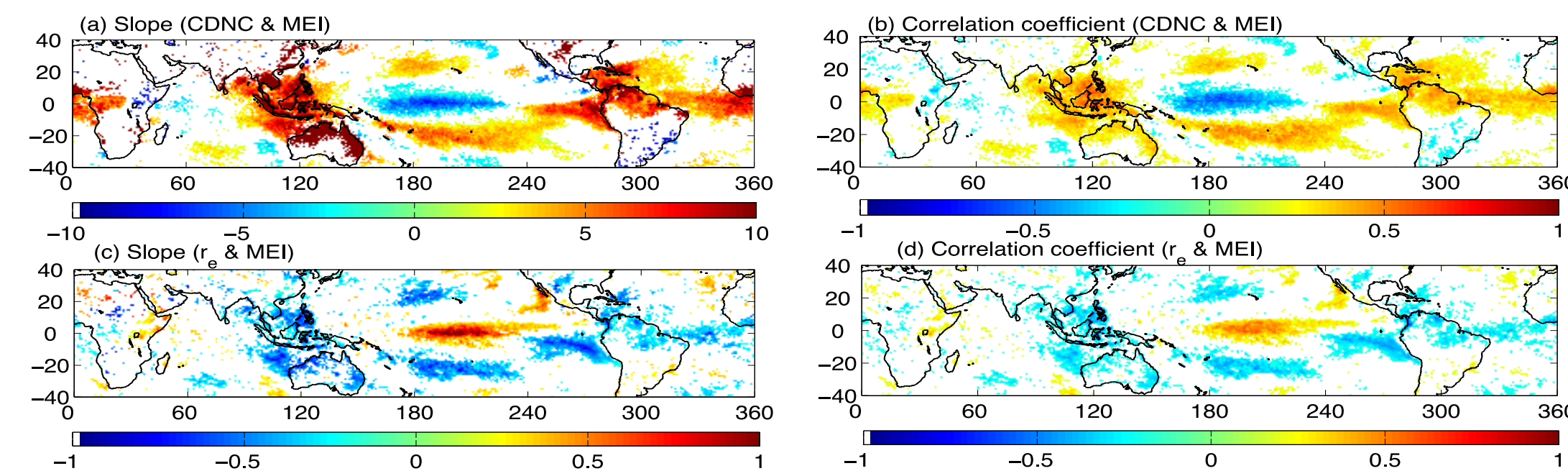


Fig 3a: Slopes (LHS) and correlation coefficients (RHS) of CDNC and effective radius against ENSO MEI. Linear regressions at significant level of 0.05 are shown based on MODIS (Jan 2003 - Dec 2012)

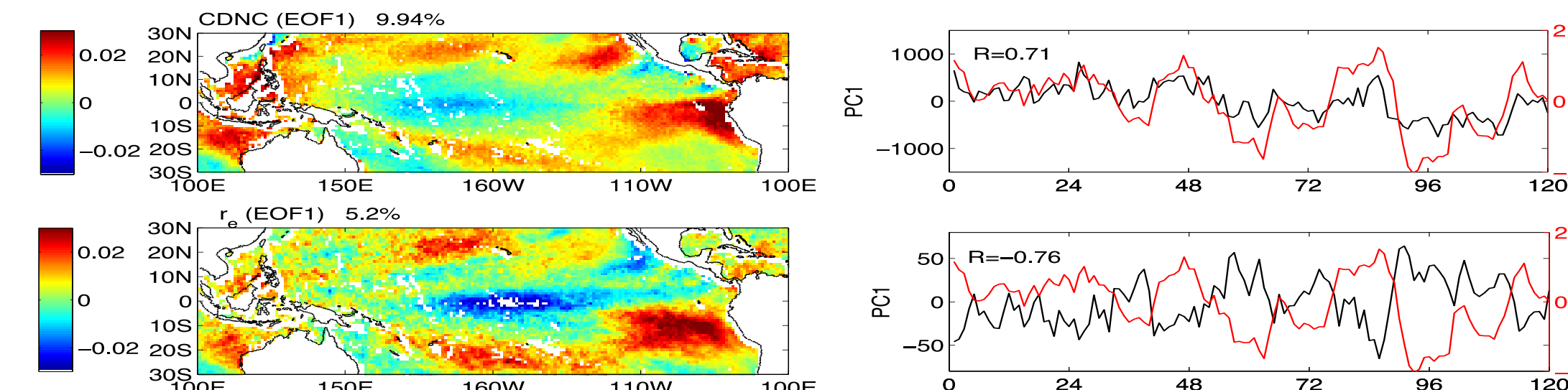


Fig 3b: EOF analysis of CDNC (first ling) and effective radius (re, second ling).

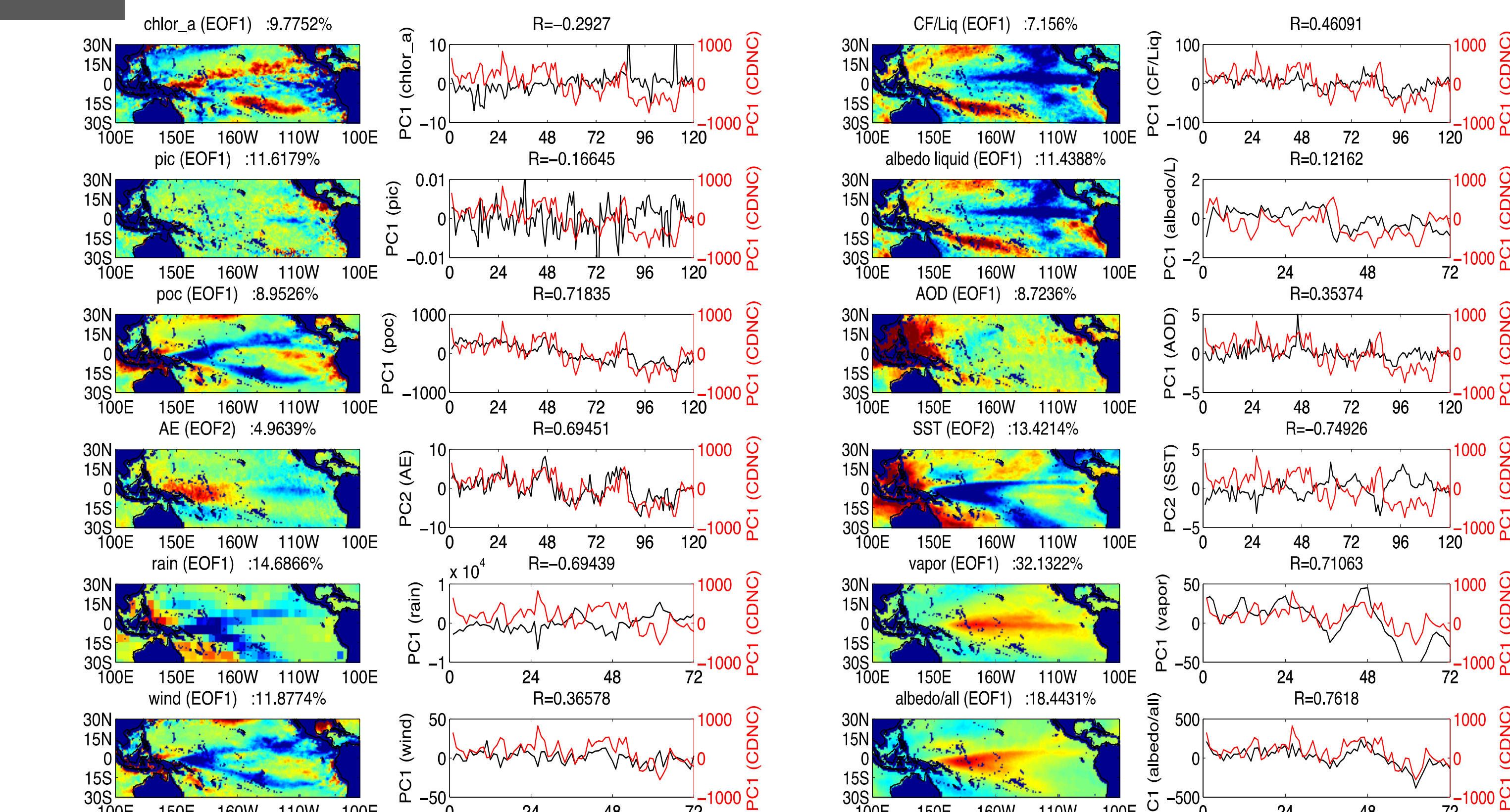


Fig 4: EOF analysis of different satellite-derived atmospheric/oceanic parameters (1st and 3rd columns) and their relationships with CDNC (2nd and 4th columns)

Southern Ocean

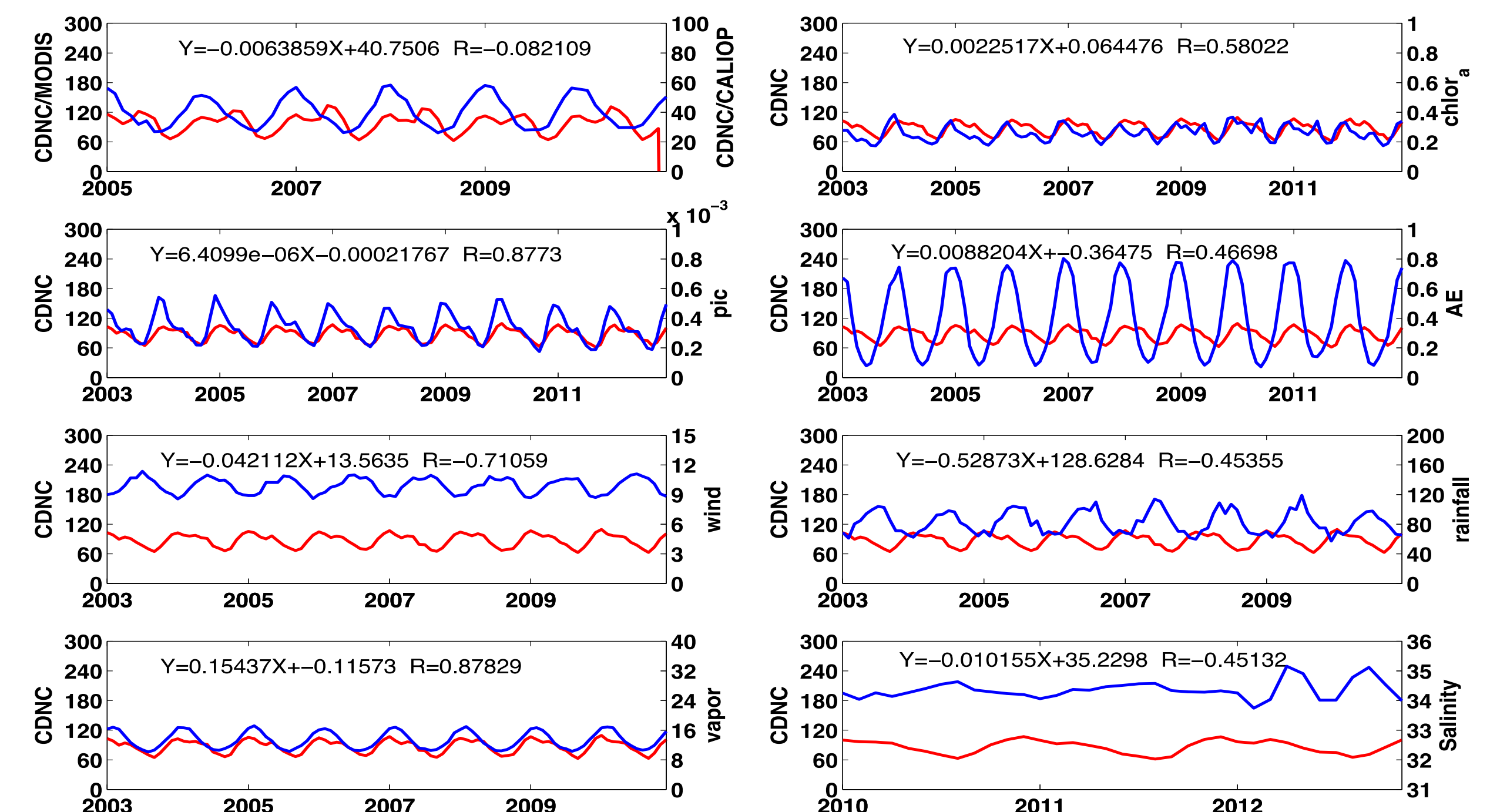


Fig 6: Seasonal variations of CDNC and other atmosphere and oceanic parameters over southern ocean

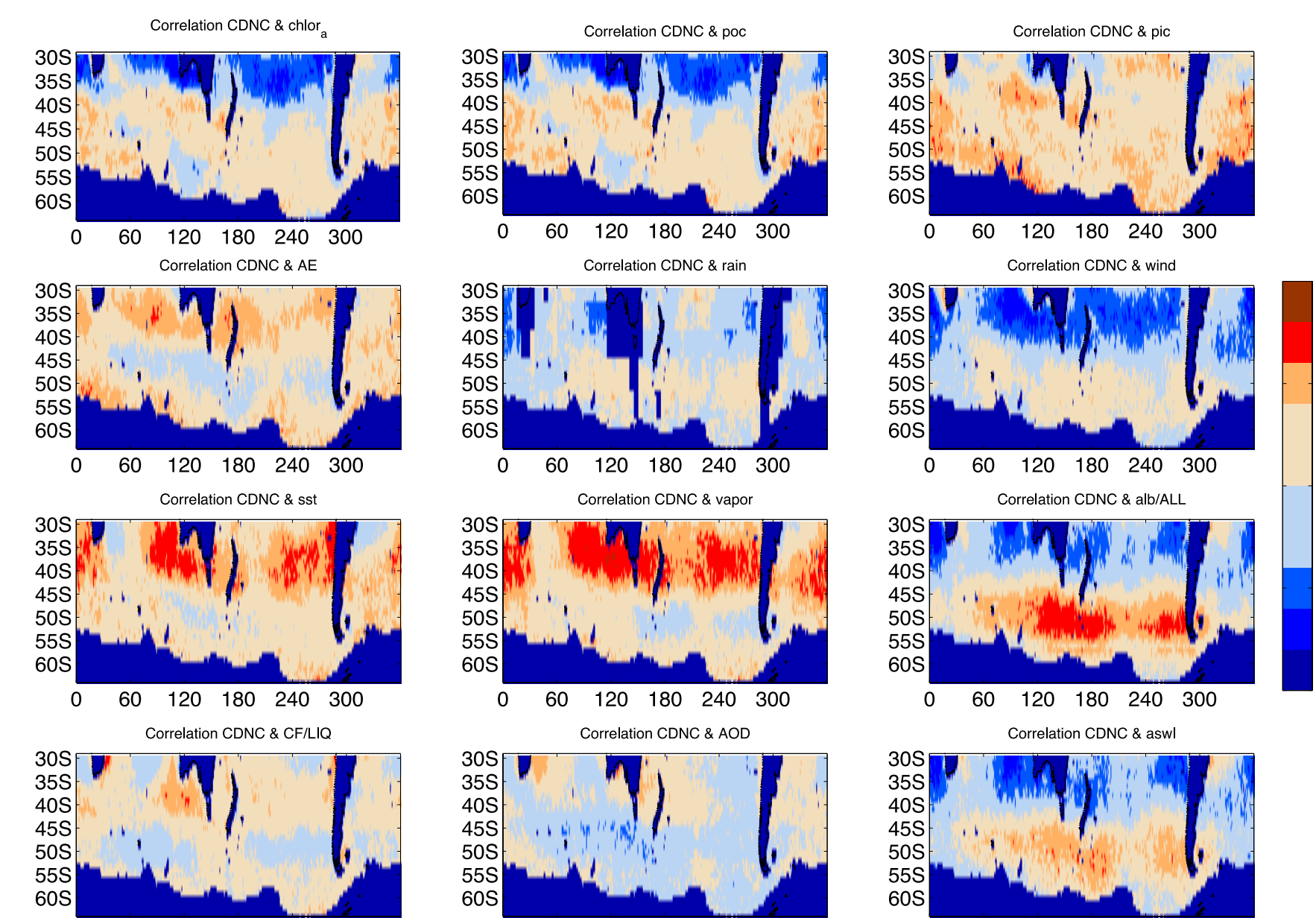


Fig 7: Linear correlations between monthly CDNC and other atmospheric/oceanic parameters

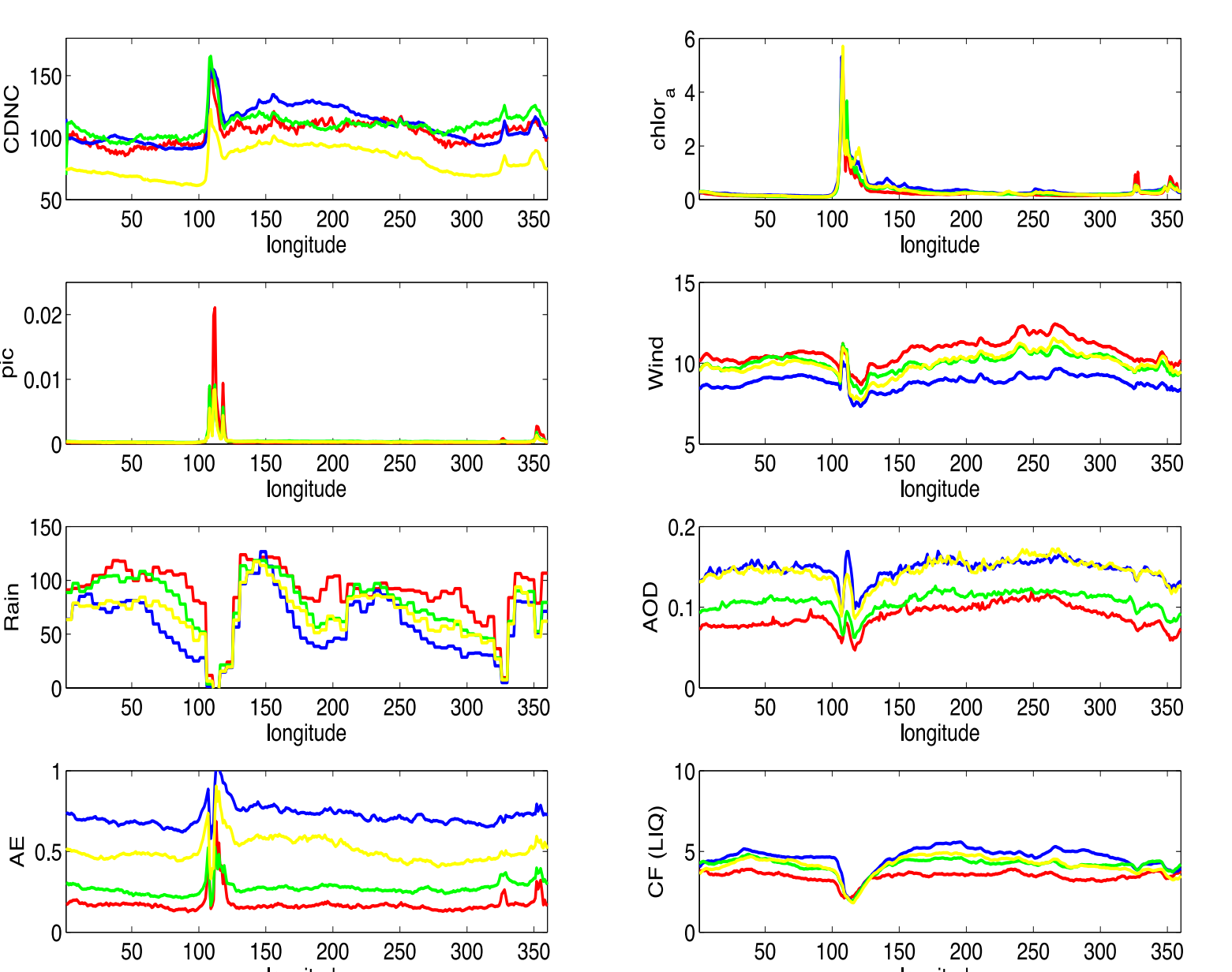


Fig 8: Longitudinal variations of seasonal CDNC and other atmosphere/oceanic parameters