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EOF analysis of meteorological fields in the Southern Ocean and their relationship to Southern and Antarctic Oscillation

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The objective of this study is to explore the spatial and temporal details between the Southern Ocean climate and El Niño Southern Oscillation (ENSO) and Antarctic Oscillation (AO). Geopotential height (500hPa), mean sea level pressure, air temperature and wind component re-analyses provided by the National Centers for Environmental by Prediction-National Center for Atmospheric Research (NCEP-NCAR) and by the European Centre for Medium-range Weather Forecast (ECMWF) were used to investigate the atmospheric behaviour of the Southern Ocean over a 43 year period from 1958 to 2000 (monthly averaged). Our approach for understanding the relationship between atmospheric variability in the Southern Ocean area and extrapolar climate, and their linkages across scales, is to examine the covariability of the data with Southern Oscillation Index (SOI) and Antarctic Oscillation Index (AOI); to quantify the temporal/spatial variability using Empirical Orthogonal Function (EOF) analysis; to correlate the time series of the leading EOF to those of extrapolar climate indices, and to evaluate the correlation statistics in order to identify those parameters that show the most robust links to extrapolar climate. Correlation maps show localized and well defined spatial structure of the connections between the meteorological patterns of the Southern Ocean and SOI and AOI. The atmospheric behaviour is investigated on monthly basis through EOFs (modes) in order to divide the variability of the data into different and independent functions. The fraction of the total variance explained by the modes is calculated for each meteorological parameter. EOF analysis show that the number of modes needed to reach the 90% of the total variance is different for each parameter (from a minimum value of two modes to a maximum of six modes). The most important EOF modes obtained from our analysis have physical interpreta-

tions in the sense that they show spatially coherent patterns which can be associated, at least qualitatively, with recurrent spatial structures.

Spatial patterns of the three leading EOFs for each parameter and datasets were analyzed and the associated temporal amplitudes were correlated to SOI and AOI time series. Our results show a clear signature of climate variability (ENSO and SAM) for tropospheric circulation in the Antarctic region. The analysis show that these signatures are quite robust, and that the some Antarctic areas are strongly connected with the global climate system.