INTERACTIONS BETWEEN EXTERNAL AND INTRASEASONAL ATMOSPHERIC VARIABILITY

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An interaction between low-frequency intra-seasonal atmospheric variability and external (SST induced) forcing has been suggested by recent observational and modeling work. In particular the existence of regimes (in the Pacific North America sector), defined by non-Gaussian behavior of the multi-dimension probability distribution function in EOF coordinates, has been linked to the existence of cold tropical Pacific SSTs (La-Nina events). This externally induced modification of intra-seasonal variability is studied in large ensembles using two atmospheric GCMs: (i) the COLA GCM (T63, L18) and (ii) the ECMWF GCM (T63L60). The COLA GCM ensembles have 55 members each using the identical observed SST. Such ensembles have been created for the La-Nina winters of 1984/85, 1988/89 and 1998/99. The ECMWF GCM ensembles have 30 members each, also using the identical SST. Here the five ensembles use an idealized SST anomaly of given structure but with varying magnitude and sign. The role of external forcing (SST) will be verified by comparing the COLA GCM results with preliminary results using smaller (nine member ensembles) for each of the 18 winters 1981/82 - 1998/99.

The methodology used is based on EOF-expansion followed by cluster analysis using the dynamic cluster method (see Michelangeli, et. al., 1995 for details[1]). Markov modeling provides the null hypothesis against which the existence and significance of multiple phase space maxima is assessed, and multiple analyses of sub-sampled data provides an estimate of robustness (reproduceability).

To illustrate the method we present some very preliminary results. Using the COLA GCM winter 1988-89 ensemble, we have computed the EOFs of the low-pass filtered 200 hPa height field, where the low-pass filter retains periods longer than about 10 days (exclusive of the annual cycle which has been estimated for that winter alone). The leading two EOFs (shown in Figure 1) explain 29% and 15% of that total variance. The pdf characterizing the GCM behavior in the plane of these two EOFs is shown in Figure 2 with varying degrees of smoothing. The subtle indication of multiple maxima with the least smoothing is not robust and disappears quickly with increased smoothing. However, a distinct skewness is noticed, with the most probable state displaced from the mean state.

Further exploration of the pdfs in this and other planes are underway, as well as an analysis of the other large ensembles.

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[1] Michangeli, P.-A., R. Vautard, and R. Legras, 1995: Weather regimes. recurrence, and quasi-stationarity. *J. Atmos. Sci.*, **52**, 1237-1256.

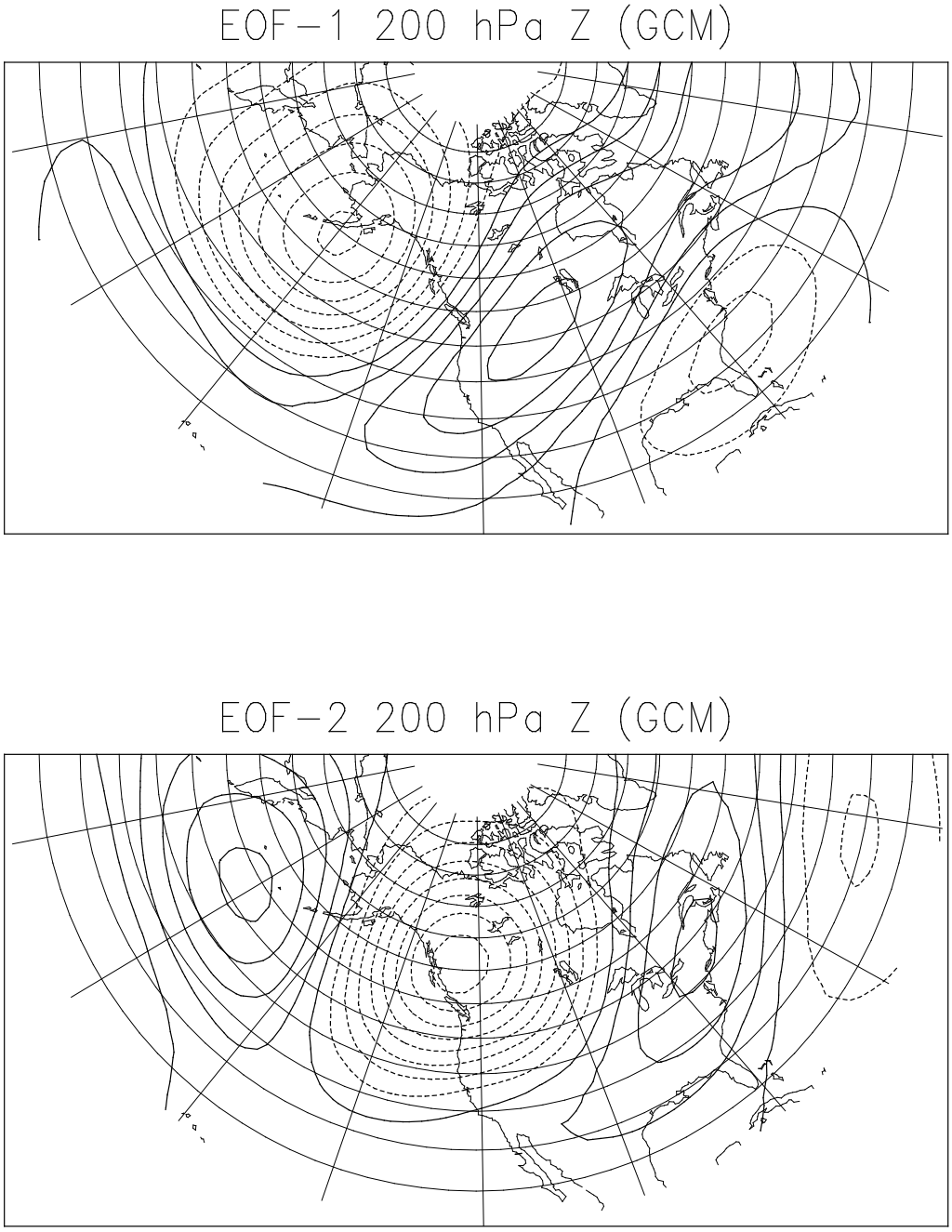

Figure 1. Leading two empirical orthogonal functions (EOFs) of low-pass filtered 200 hPa height fields for the winter of 1988-89 from 55 GCM runs. See text for details.

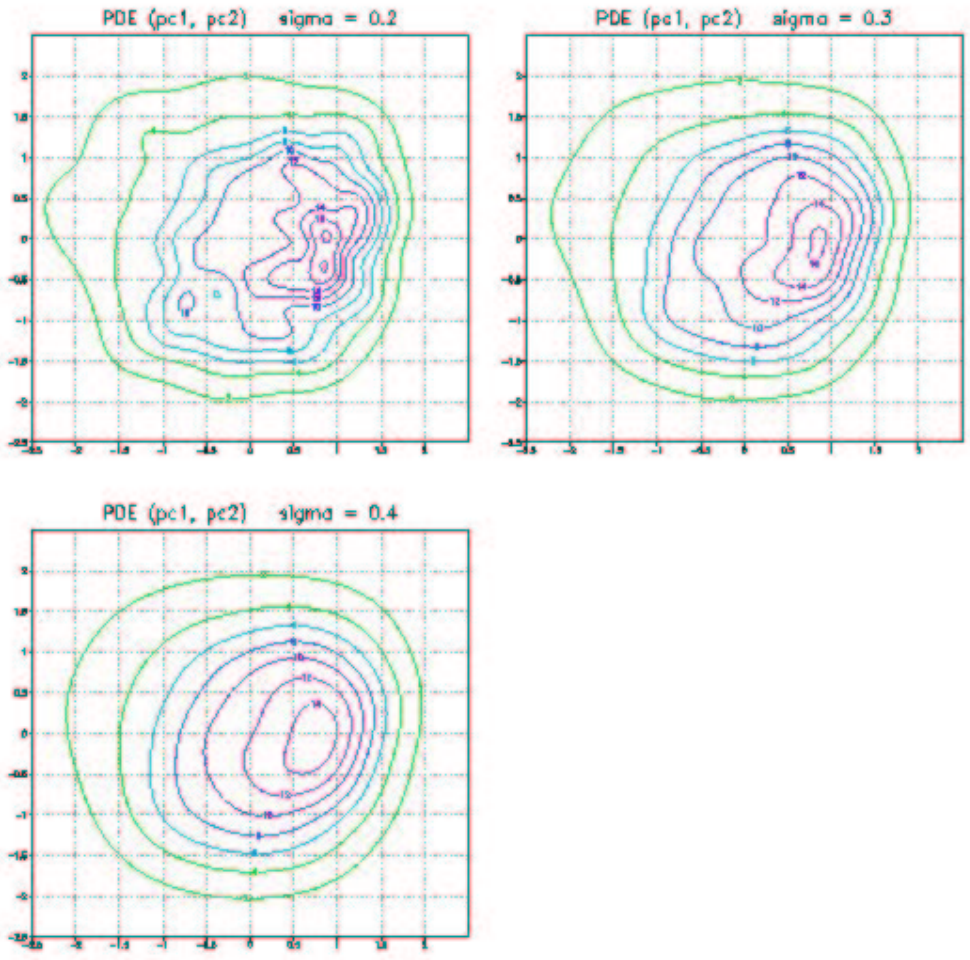

Figure 2. Three estimates of the probability distribution function of low-pass filtered fields for the winter of 1988-89 from 55 GCM runs. The pdf is represented in the plane of the leading two EOFs shown in Figure 1. See text for details.