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Recent PACS-SONET observations of relevance to the North American Monsoon Experiment

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1. Introduction

The Pan American Climate Studies sounding network (PACS-SONET) has been funded since 1997 primarily to make pilot balloon wind soundings in Latin America to monitor the variability of atmospheric circulations on daily to inter annual time scales. The observation sites have been located in generally data poor regions of perceived scientific value, and the observations have provided longer-term perspectives for several field experiments recently carried out in the region (EPIC, SALLJEX). Starting in 1997, and expanding in the year 2000, special pilot balloon observations have been made in Mexico as part of the PACS-SONET. These observations, carried out by the Mexican Navy, have been made during the past 4 years at 6 sites along both Mexican coasts. Two of these sites fall within the inner domain of the planned North American Monsoon Experiment (NAME) scheduled for the summer of 2004. These sites, located at the extreme north of the Gulf of California (Puerto Peñasco) and at Topolobampo, midway between the radiosonde sites of Empalme and Mazatlan, have provided additional information on the synoptic and diurnal variability of the low-level flow along the Gulf of California.

The NAME field observations to be carried out during the summer of 2004 will greatly enhance the measurements over the Gulf of California and surroundings. However, these observations be primarily be focussed on a 4-6 week period; understanding of the seasonal cycle and interannual variability must continue to depend on longer-term measurements.

A more detailed description of the various facets of the PACS-SONET project and all of the historical (and real-time) observations are available on-line at:

<http://www.nssl.noaa.gov/projects/pacs>.

2. Mean monsoonal flow over the Gulf of California

The planning activities associated with NAME has stimulated an increased interest in the mean conditions over the Gulf of California, in order to help design an observational network to monitor variations in the important characteristics of the summertime flow. To describe the mean windfield conditions we have combined radiosonde data from the operational network with the recent pilot balloon observations from the two PACS-SONET stations in the region.

Figures 1a-d show the annual cycle of the meridional wind along the Gulf, from the northernmost site at Puerto Peñasco (~30°N) to the Mazatlan (~23°N). These are based on 3-4 years of observations at the pilot balloon sites and the same period at the radiosonde sites. The Puerto Peñasco and Topolobampo sites have not been entirely quality controlled; this together with the decreasing number of observations with height tends to make these sections slightly "noisier" than the radiosonde sites (where winds are also generally smoothed over a deeper layer). However, this does not affect the basic patterns that are evident in Fig. 1. The most apparent feature is the seasonal reversal of the meridional wind, which takes place around April and October at the northernmost site, but closer to May and October at sites along the central and southern gulf. There is also the suggestion that the maximum southerly flow, at all sites near 3-500 m ASL, occurs earlier in the southern Gulf (~late May at Mazatlan and June elsewhere) and later at the northern end (~July).

Also evident from Fig. 1 is the relatively rapid onset of the southerly winds between April and June after a relatively uniform period of northerly winds during the winter. The decay of these southerly winds is less abrupt, except at the northernmost site, where the decay seems as abrupt as the onset. Above the shallow up-gulf flow, the meridional winds are weaker during the summer months. A time height section of the anomalous meridional winds (Fig. 2), obtained by subtracting the monthly mean meridional wind at each level from the annual mean meridional wind at that level, suggests a meridional circulation with up-gulf flow in the lowest 1 km and a deeper return flow above. Such a pattern is seen at all of the stations.

As noted from Fig. 1, the meridional winds increase towards the north along the Gulf of California. This is displayed more graphically in Fig. 3, which shows the AM mean winds at all sites, averaged from the surface to 1000 m for the years 2000-2003 and the months of June through August. The general pattern of stronger winds over the northern Gulf is in agreement with results found during previous field programs in 1990 and 1993 (<http://www.nssl.noaa.gov/projects/pacs/name>).

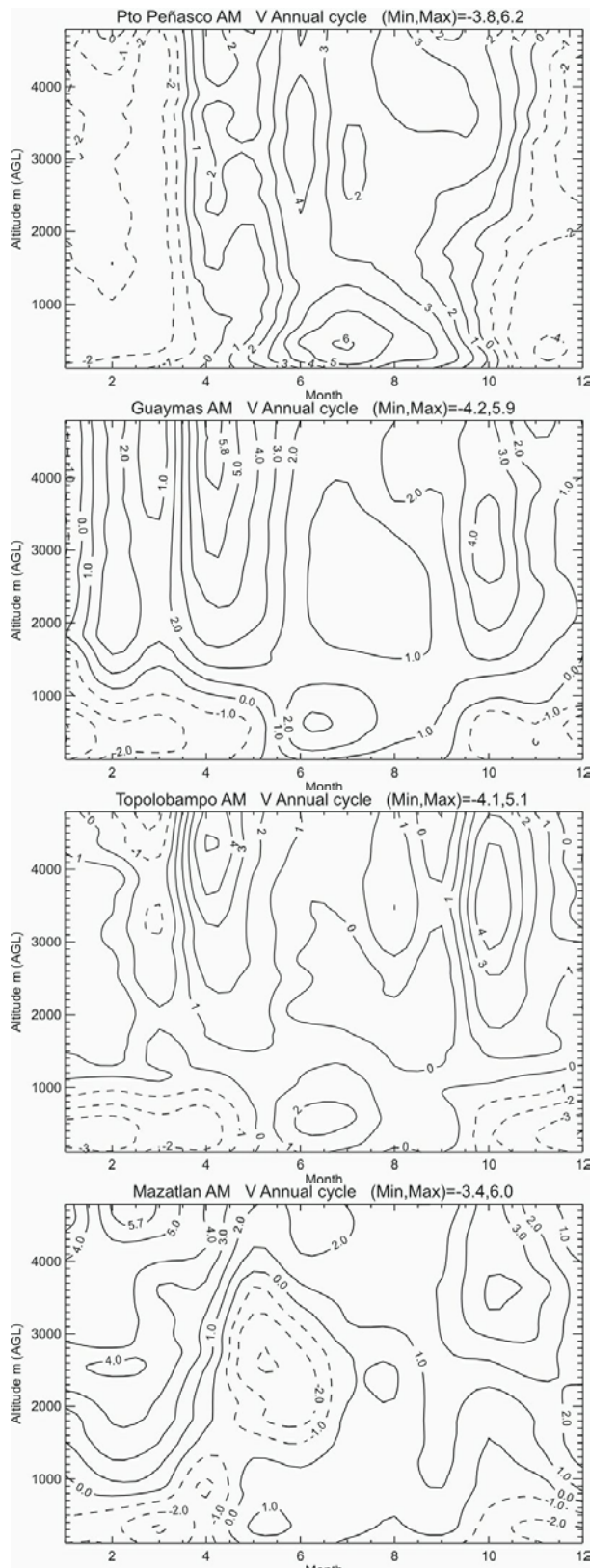


Fig. 1. Monthly mean meridional winds (contour interval 1 ms⁻¹, dashed negative) using observations from the years 2000-2003. (Left column)

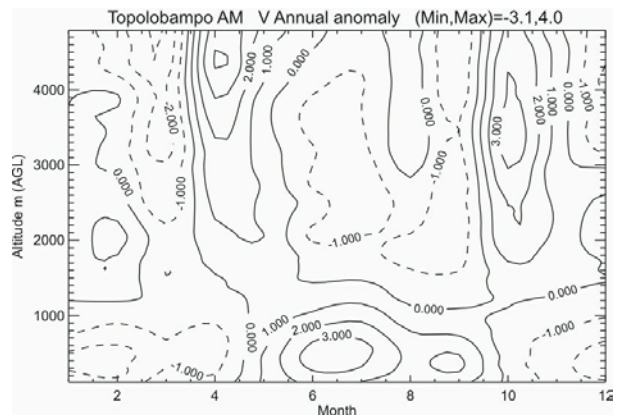


Fig. 2. Anomaly of monthly mean meridional wind from the annual average at the station Topolobampo.

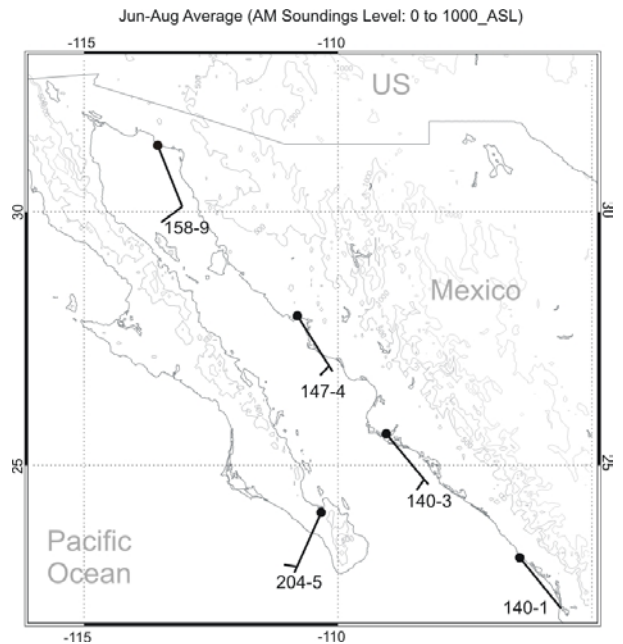


Fig. 3. Mean AM (~12 UTC) winds at sites along Gulf of California averaged over from the surface to 1000 m for months of June-August and over years 2000-03.