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CONVECTION OVER THE PACIFIC WARM POOL IN RELATION TO THE ATMOSPHERIC KELVIN-ROSSBY WAVE

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Deep convection over the western tropical Pacific warm pool has been analyzed in terms of its relation to the atmospheric Kelvin-Rossby wave, which dominates the large-scale flow during the austral summer. The Rossby-Kelvin wave structure is characterized by two large-scale cyclonic gyres with a zone of westerlies in between, as illustrated in Figure 1 by the black streamlines. The zone of westerlies lies just south of the equator. The westerlies and the cyclonic gyres were the most convectively active regimes in COARE. The study uses Doppler radar collected by aircraft and ship radars in TOGA COARE to characterize the mesoscale circulations of organized convective cloud systems occuring throughout the season. The results presented here focus on convection in two contrasting phases of the wave: the "westerly onset region" just east of the point within the wave where low-level easterlies change to westerlies, and the "strong-westerly region" (or "westerly wind burst") lying between the large-scale counter-rotating gyres of the Kelvin-Rossby wave. As seen in Figure 1, these periods of the wave were sampled by the NOAA P-3s and the Doppler-radar ships *Xiangyanghong #5* and *Vickers*.

In the westerly-onset region the zonal wind component had midlevel easterlies overlying low-level westerlies (Figure 2a). In the strong-westerly region, a deep layer of westerlies extended from the surface up to the upper troposphere, with a maximum of westerly component at about the 850 mb level (Figure 2b). Because of the different vertical shear of the zonal wind in these two regions of the wave, momentum transport by the mesoscale circulations that develop in the convective systems was fundamentally different in the two regions. The mesoscale convective systems developed strong midlevel inflow jets. The direction of the jet was determined by the environmental shear, which in turn was determined by the dynamics of the large-scale wave. In the westerly-onset region, the large-scale shear determined that the jet had an easterly component. In the strong-westerly region, the jet had a westerly component. In both cases, the inflow intensified within the cloud system as the convective cells of the mesoscale convective system filled a broad region with a deep stratiform precipitating ice cloud, and precipitation from the stratiform clouds sublimated and melted, thus cooling the inflow and causing it to subside. The mesoscale inflow then trans-

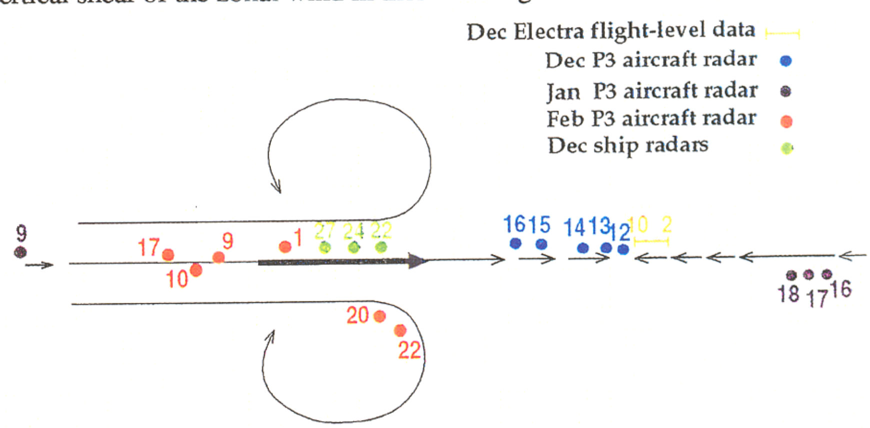

Figure 1 - Composite of 850 mb wind streamlines in a Kelvin-Rossby wave of the type observed over the TOGACOARE domain. The bold streamline indicates where the winds were strongest Positions of precipitating mesoscale convective systems sampled by TOGA COARE aircraft and ship Doppler radars are indicated by dots. On 15 and 16 December, both ship and aircraft radar data were obtained.

ported easterly momentum downward in the westerly-onset region and westerly momentum downward in the strong-westerly region. Thus the mesoscale momentum feedback of the mesoscale inflow jets were negative in the westerly-onset region and positive in the strong westerly region, i.e. they accelerated the westerly wind burst. These momentum transports by the broad mesoscale midlevel inflow affected broad horizontal regions and were sometimes different in sign from the momentum transports of convective-scale cells in the same mesoscale convective system.

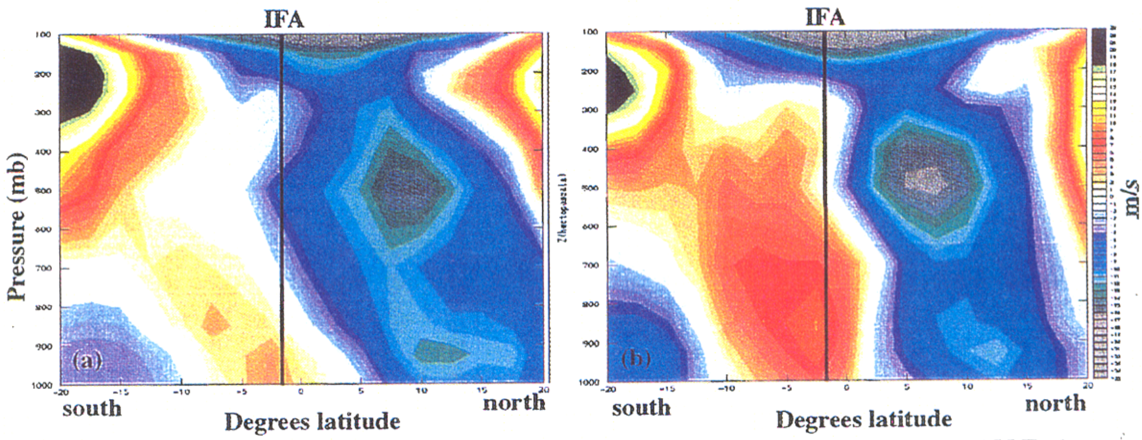

Figure 2 - Time-averaged u-component of the wind from ECMWF initialization fields along 155 E, the longitude of the TOGA COARE Intensive Flux Array (IFA) for (a) 12-15 December 1992 (westerly-onset region) and (b) 21-26 December 1992 (strong-westerly region). The heavy line is at the latitude of the IFA.