STATUS OF THE NOAA/CU TRANS-PACIFIC PROFILER NETWORK

K.S. Gage, D.A. Carter, J.R. McAfee
NOAA Aeronomy Laboratory, Boulder, CO 80303 USA

B.B. Balsley, W.L. Ecklund, C.R. Williams, A.C. Riddle, P.E. Johnston, and S.K. Avery
University of Colorado, CIRES, Boulder, CO 80309 USA

and

R.F. Woodman
Instituto Geofisico del Peru, Lima, PERU

I. INTRODUCTION AND NETWORK STATUS

Since the Sixth MST Radar Workshop held at National Central University, Chung-Li, Taiwan, in August 1993, the NOAA/CU Network of VHF wind profilers has been operated in a routine mode. The network is comprised of VHF wind profilers located at Piura, Peru; Christmas Island, Kiribati; Pohnpei, Federated States of Micronesia; and Biak, Indonesia. The Biak wind profiler was completed in early 1992 and has been in continuous operation since March 1992. In addition to the VHF wind profilers named above a 50 MHz wind profiler is operated in Darwin, Australia through a cooperative research agreement between NOAA's Aeronomy Laboratory and the Australian Bureau of Meteorology's Research Centre. The VHF profiler network was described in more detail by Gage et al, (1990) and the VHF profilers are described in Gage et al. (1994a).

In addition to the 50 MHz wind profilers, several sites have been instrumented with Integrated Sounding Systems (ISS) (Parsons et al., 1994) complete with 915 MHz wind profilers (Carter et al., 1995) equipped with RASS and OMEGA Balloon Sounding Systems and a suite of surface instruments to record surface wind, temperature, humidity, pressure, radiation and precipitation. The ISS were developed jointly by the Aeronomy Laboratory and NCAR's Atmospheric Technology Division. VHF wind profilers at Christmas Island, Biak and Darwin have been complemented with 915 MHz wind profilers. In 1994, 915 MHz profilers were deployed at Tarawa, Kiribati; and San Cristóbal in the Galápagos Islands of Ecuador.

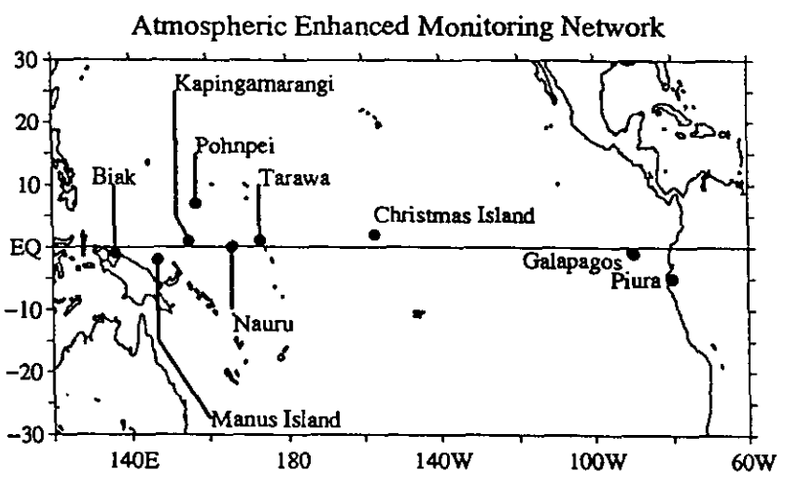

Figure 1. NOAA/CU Trans-Pacific Profiler Network with NOAA enhancements.

The broken and small downward arrows indicate vertical velocity events in cloud cluster and rainfalls on the ground, respectively.

2. TROPICAL DYNAMICS STUDIES

The NOAA/CU Trans-Pacific Profiler Network provides observations from an undersampled region of the tropical atmosphere. The nearly continuous nature of the observations provides unique data for research into atmospheric tides and short-period internal gravity waves. Tidal oscillations have been studied by Williams et al (1992) and Williams and Avery (1996a, 1996b). Their analyses reveal the complexity of tidal oscillations in the lower tropical atmosphere and implicate latent heating from tropical convection as an important forcing mechanism for tides in the lower atmosphere.

Chang et al (1996) have studied the climatology of gravity waves using the VHF profiler observations. These authors have calculated gravity wave momentum flux using the Vincent-Reid method (Vincent and Reid, 1983). Since the quality of the observations and the cleaning process used in the analysis is crucial, the analysis was made using two different approaches to quality control of the data. Momentum fluxes are reasonably consistent for monthly averages obtained using the two cleaning algorithms. The monthly average accelerations associated with the vertical flux of horizontal momentum are generally less than about $\pm$ 0.1 m s^{-1}/day.

At Christmas Island the nearly 10 years of observations is useful for climate research. The annual cycle of tropospheric zonal winds at Christmas Island has been explored in relation to convective activity over the western Pacific. Periods of strongest westerlies observed over Christmas Island generally coincide with periods of intense near-equatorial convection over the western Pacific (Gage et al, 1996a). On an annual basis the westerlies are most pronounced at the time the western Pacific ITCZ crosses the equator which is typically in November and April (Waliser and Gautier, 1993). During northern winter the ITCZ remains closer to the equator than it does in the northern summer. As a result upper tropospheric westerlies continue through northern winter but disappear in northern summer. During El Niño convection weakens over the western Pacific and westerlies are substantially weaker over Christmas Island. An analysis (Gage et al, 1996b) of the last decade of tropospheric winds observed at Christmas Island shows dramatically weaker westerlies since 1990 during the period of an unprecedented persistent warm event (Trenberth and Hoar, 1996).

3. DIAGNOSTIC STUDIES OF TROPICAL CONVECTION

Recently considerable attention has been devoted to the utilization of profilers in precipitation research (Gossard, 1988; Rogers et al, 1993; Rajopadhyaya, 1993, 1994; Ralph, 1994; Gage et al, 1994b, 1996c; Ecklund et al., 1995; Maguire and Avery, 1994; and Williams et al, 1995). The utility of the UHF profilers to visualize the vertical structure of tropical convective systems has been demonstrated by Gage et al. (1994b). Algorithms designed to use this information to classify the precipitating convective cloud systems into low-level (warm) showers, deep convection, stratiform convection and a mixture of deep and stratiform convection have been developed by Williams et al (1995). This research has already confirmed the importance of stratiform convective systems in the tropics. Roughly half of tropical precipitation is thought to be associated with stratiform rain. Determination of the vertical structure of the convective systems is an important step in specifying the vertical distribution of diabatic heating in convective complexes (Houze,1993).

4. CONCLUDING REMARKS

The NOAA/CU profiler network provides a wealth of new information for tropical dynamics and climate research. The nearly continuous nature of the profiler observations makes them ideal for studying high frequency wind variability (Gutzler and Hartten, 1995) including internal gravity waves and atmospheric tides. These studies complement ongoing research on middle atmosphere dynamics (Avery and Palo, 1991; Valentic et al, 1996; Palo and Avery, 1996) and lead to improved understanding of the coupling between the lower and middle atmosphere.

Observations from the earliest sites are now providing a climate record that is proving useful in studying the interdecadal trends in large scale tropical circulation systems. It is essential

that these observations continue through the next decade in order to provide a continuing record of the multiple scale processes (including atmospheric waves, and convection) that play an important role in determining global weather and climate.

5. ACKNOWLEDGEMENTS

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