TITLE: Dynamics and Energetics of the South Pacific Convergence Zone During FGGE SOP-1

RESEARCH INVESTIGATORS:

Dayton G. Vincent
Department of Geosciences
Purdue University
West Lafayette, IN 47907
(317) 494-3290

Franklin R. Robertson
USRA Code ED 42
MSFC/NASA
Huntsville, AL 35812
(205) 453-1944

SIGNIFICANT ACCOMPLISHMENTS TO DATE:

The contract is a new one and began on 15 October 1983. Our major objectives are to: (1) diagnose the physical processes responsible for the maintenance of the South Pacific Convergence Zone (SPCZ) and (2) examine the role of the SPCZ in the large-scale circulation patterns of the Southern Hemisphere. To accomplish these objectives, we initiated a series of tasks which should take about three years to complete.

Our first task was to acquire the necessary data. This was recently completed with the gracious help of Dr. John Ward of the National Meteorological Center (NMC). We now have a set of grid-point analysis at increments of 2.5^{o} lat/lon for the globe for the period 10-27 January 1979. The set contains twice daily values (0000 and 1200 GMT) of horizontal wind components, geopotential height, temperature and relative humidity at all mandatory pressure levels from 1000 - 100 mb. It is based on Level III-b analyses originally produced by the European Centre for Medium-range Weather Forecasts (ECMWF). A detailed description of this data set appears in Vincent (1982). We also have acquired, at essentially no cost, weekly averages of sea surface temperatures from NESDIS/NOAA, twice daily values of Level III-b mean sea level pressure from ECMWF, 6-hourly surface charts with station data from NMC, 6-hourly GOES-W enhanced IR satellite imagery and twice daily charts of outgoing longwave radiative energy from NESDIS. Finally, we are currently in the process of supplementing our data set with various satellite products derived from the McIDAS system and computing facility at MSFC.

Our second task, which is currently underway, is to investigate cyclone development in the SPCZ, since it appears to play an important role in some of the Zone's physical processes (e.g., condensational heating and precipitation). Vincent (1984) is in the process of revising a manuscript which describes the life cycles of two SPCZ-cyclones. A Ph.D. student, Ms. Deirdre Kann, has begun a thorough investigation of these two cyclones, including a diagnosis of their energy budgets and the extent to which baroclinic processes are important. In this study, we plan to apply a cumulus parameterization scheme, developed by Dr. Robertson, which estimates vertical distributions of different forcing functions on cumulus heating. We also are using satellite-derived products, such as IR satellite imagery and cloud-top temperatures, to deduce cloud amounts and types.

A third task, also presently in progress, is a study by another Ph.D. student, Huo-Jin Huang, to compute Southern Hemisphere energy budgets for the tropics (0 - 30 S) and middle latitudes (30 - 60 S), as well as the South Pacific portion of the tropics. His study includes a diagnosis of energy conversions and contents in: (1) zonal and eddy form based on compilations derived both in spatial domain and mixed space-time domain; and (2) wave number domain. Mr. Huang also has been examining variables related to daily variations of convective cloud systems (SPCZ and others) in the Southern Hemisphere.

Papers, which have been published to date, that relate to the above-named tasks are Vincent (1982), Huang and Vincent (1983), Robertson (1983), Vincent and Huang (1983), Vincent et al. (1983), Huang (1984) and Huang and Vincent (1984). The research for the last paper, plus the manuscript by Vincent (1984) were conducted primarily under this contract.

FOCUS OF CURRENT RESEARCH:

Our current research involves the work of Ms. Kann, Mr. Huang and Dr. Vincent noted above. In this context, Dr. Vincent and two of his graduate students, Ms. Kann and Mr. Bernie Miller spent the week of 4 March 1984 at Huntsville, AL discussing research with Dr. Robertson and using the McIDAS system and MSFC computing facility to conduct their research. While there, they briefed Dr. George Fichtl, Branch Chief for global-scale processes, on their research progress. Our ongoing research also includes the work done by Dr. Robertson on modifying his cumulus parameterization scheme for application to the SPCZ. An important aspect of his research is to obtain quantitative estimates of satellite-derived IR precipitation rates. Details of his work are discussed elsewhere in this report.

PLANS FOR FY-85:

In the coming year we plan to focus our research efforts in four areas: (1) completion of SPCZ and Southern Hemispheric energetics work begun by Mr. Huang; (2) completion of the cyclone cases investigation begun by Dr. Vincent and Ms. Kann; (3) extension of Dr. Robertson's cumulus parameterization scheme and work on satellite-derived precipitation estimates to regions beyond the SPCZ; and (4) initiation of work by Mr. Bernie Miller to use satellite-derived sea surface temperatures, together with our ECMWF data set, to compute moisture budgets for the SPCZ and Southern Hemisphere. The latter task will provide us with another estimate of precipitation to compare with Dr. Robertson's results.

Since this contract was only recently initiated, it is not feasible at this time to suggest recommendations for new research.

PUBLICATIONS:

Vincent, D.G., 1982: Circulation features over the South Pacific during 10-18 January. Mon. Wea. Rev., 110, 981-993.

* Huang, H-J. and D.G. Vincent, 1983: Major changes in circulation features over the South Pacific during FGGE, 10-27 January 1979. Mon. Wea. Rev., 111, 1611-1618.

* Robertson, F.R., 1983: Cumulus-scale heating and its influence on meso-α dynamics during AVE/SESAME I. Preprint, 13th Conference on Severe Local Storms, Tulsa, OK, October 17-20, 1983, American Meteorological Society, Boston, MA, 02108, 350-353.

* Vincent, D.G. and H-J. Huang, 1983: The role of stationary waves in maintaining the South Pacific Convergence Zone. Preprint, International Conference on the Stationary Wave Component of the Atmosphere, Paris, France, 29 August - 2 September 1983, 4 pp.

* Vincent, D.G., H-J. Huang and R.A. Fulton, 1983: Diagnostic analysis of the South Pacific Convergence Zone during FGGE SOP-1, 10-27 January 1979. Preprint, First Conference on Southern Hemisphere Meteorology, Sao José dos Campos, Brazil, 31 July - 6 August 1983, American Meteorological Society, Boston, MA, 02108, 4pp.

* Huang, H-J., 1984: Daily variations of convective cloud systems in the tropics during FGGE SOP-1, 10-27 January 1979. Postprint, 15th Technical Conference on Hurricanes and Tropical Meteorology, Miami, FL, January 9-13, 1984, American Meteorological Society, Boston, MA, 02108, 4 pp. (in press).

* Huang, H-J. and D.G. Vincent, 1984: Potential to kinetic energy conversion in wave number domain for the Southern Hemisphere. Preprint, 10th Conference on Weather Forecasting and Analysis, Clearwater, FL, June 25-28, 1984, American Meteorological Society, Boston, MA, 02108, 6 pp. (in press).

* Published since June 1983