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# AN IN SITU MEASUREMENT SYSTEM FOR THE GLOBAL ATMOSPHERIC RESEARCH PROGRAM USING BALLOONS, BUOYS AND A SATELLITE

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The Global Atmospheric Research Program (GARP) is an international cooperative program whose ultimate goals are to increase our understanding of the general circulation of the atmosphere and to develop physical and mathematical bases for extended weather prediction. GARP was established in response to United National resolutions of 1960 and 1961; most of the GARP research efforts are scheduled for the decade of the 1970s.

GARP encompasses two separate but closely related communities: the World Meteorological Organization (WMO), made up of national meteorological agencies and services and including most of the observing, telecommunications, and automatic data processing facilities now obtaining weather data; and the International Council of Scientific Unions (ICSU), a research community composed of university groups and various research organizations and institutes operated by agencies other than the national meteorological services. This latter group devotes a large portion of its effort to fundamental research problems of the atmosphere.

A primary element of a research program is obtaining data. The data necessary for GARP will be collected from a composite of many systems, some of them already in operation. Meteorological satellites will be primary tools, and data from them will be supplemented by shipboard and aircraft observations, ground-based rawinsondes, and regular weather station data.

In this discussion just one aspect of using satellites will be considered: to retrieve meteorological and oceanographic data from in situ platforms in the atmosphere and on the sea. The feasibility of obtaining such data has been demonstrated. Two systems tested by the United States are the Interrogation, Recording, Location System (IRLS) and the OMEGA Position and Location Experiment (OPLE). IRLS used an earth-orbiting satellite, OPLE a geostationary one. Later this year the French Eole satellite will be launched from Wallops Island in an inclined orbit and will interrogate, locate, and obtain data from some 500 balloons launched in the Southern Hemisphere.

The IRLS, OPLE, and Eole systems are all costly and complex, however. For a global program such as GARP, when we will need lots of data from lots of sensor platforms over, probably, extended periods of time, they are too costly and too complex. We need a similar but simpler system, a low-cost satellite-balloons or satellite-balloon-buoy system.

Such a system has been proposed: a random access doppler technique wherein the environmental platforms (balloons and buoys) randomly transmit data which is received when within view of the orbiting satellite. The platforms are neither commanded nor interrogated by the satellite, nor do they determine their own location.

A random access doppler system will be a payload experiement on Nimbus F as part of a cooperative research program involving scientists from the National Center for Atmospheric Research, the University of Wisconsin, and the Goddard Space Flight Center. The scientific objectives will be:

- investigation of the tropical winds in the upper troposphere
- production of a pressure reference level at 150 mb in the middle latitudes of the Southern Hemisphere
- an energy conversion experiment

Three hundred constant-level balloons launched from several sites in the tropics will obtain the data for these experiments. At first the balloons will drift with the tropical winds, providing data for the tropical wind experiment. After some time they are expected to "leak" into the Southern Hemisphere middle latitudes where they will fulfill their scientific mission by obtaining data for the energy conversion and reference level experiments. During all of this time they will transmit temperature, pressure, and altitude data which will be received and relayed to the reduction center at GFSC by the satellite; the sensor platform locations will be determined by doppler frequency shift. Wind velocities will be

determined from the position of the balloons on successive orbits of the satellite.

The orbiting satellite locating and collecting measurements from a large number of balloons and drifting buoys (note: a buoy program is not part of the NCAR-UWisc-GSFC proposal) offers an opportunity to develop a data base over a large data-sparse region of the globe. The expendable and inexpensive platforms measuring variables of pressure, temperature, and wind make this prospect of data collection for the Global Atmospheric Research Program possible and practical.

A significant factor in the development of this system is that the scientific objectives of the program were set forth early and the system was designed to meet those requirements.