

March 1970

3. GARP TROPICAL EXPERIMENTS

3.1 Review of the objectives

The Conference reviewed the content of GARP Publications Series No. 4, "The Planning of Tropical Experiments", which contains a description of the role and scope of tropical experiments within the GARP Tropical Sub-programme, as well as a detailed specification of the scientific requirements and the observational means to be used in some types of experiments.

As defined in GARP Publication No. 4 (hereafter GP.4), the GARP Tropical Sub-programme is primarily concerned with the problems related to the energy-exchange processes between the various scales of atmospheric motions in low latitudes, on the assumption that an understanding of these processes will lead to finding ways of representing them in terms of parameters defined by the large-scale variables. The GARP Experiments, on the other hand, have been defined (definition adopted by WMO and ICSU) as consisting of large observational programmes designed to determine the behaviour of the whole atmosphere or some part of it relevant to the particular sub-programme. Within this context, GP.4 specifies (section 1.1.2(c)) the four factors which make up a tropical experiment.

The basis for the proposals made in GP.4 (which can be found in chapter 2), is the identification of characteristic scales of atmospheric motions in low latitudes. Fluxes of heat and momentum as well as much of the conversion from potential to kinetic energy is associated, in the tropics, with deep cumulus convection. The problem of parameterizing these sub-grid-scale processes is greatly complicated by the fact that this deep cumulus convection exhibits at least three levels of organization embedded in long wave disturbances. The GP.4 has introduced the following nomenclature:

- Scale A : the large wave-scale (characteristic size of the order of 2,000 to 10,000 km; very long lifetimes)
- Scale B : the scale of cloud clusters (characteristic size of the order of 100 to 1,000 km; lifetime of the order of one to five days)
- Scale C : the meso-convective scale (characteristic size of the order of 10 to 100 km; various types of characteristic life cycle, according to the type of organization)
- Scale D : the scale of convective cells (characteristic size of the order of 1 to 10 km; characteristic time of the order of a few hours).

The purpose of GARP tropical experiments is to determine the inter-relations between the various scales of motions listed above. The primary interest lies in the study of the cloud clusters which can be reduced to two types of experimental studies, namely those concerned (a) with the inter-relations of the cloud clusters with the large-scale waves in which they are embedded, and (b) with the internal structure of the cloud clusters and the dynamics and thermodynamics of the convective elements which make up the cloud clusters. Consequently, the JOC recommended two main types of experiments:

Experiment of type I: an experiment dealing with the interactions between Scales A and B

Experiment of type II: an experiment dealing with the interactions between Scales B and C, including the collective effect of Scale D.

The objectives, the characteristics of observational programme and the specification of the measured and derived quantities to be obtained from the observations for each type of experiment are described in sections 3.2 and 3.3 respectively of GP.4. Chapter 5 of this publication makes specific proposals concerning the observational systems that would be required, taking as an example an area over the western Pacific which includes the Marshall Islands. Other possible alternatives are indicated in chapter 6.

3.2 Place and timing of the experiments

3.2.1 General considerations

The Conference examined the proposals for experiments of types I and II contained in GP.4. The concepts of these experiments were accepted but it was clear from the discussion in the first plenary session that there would probably not be sufficient international support for an experiment in the Marshall Islands area by 1974. Of the other possible areas, preference was expressed for the Atlantic, and the possibilities of mounting an experiment in this area were therefore examined in some detail. It was concluded that a tropical experiment in the Atlantic would be of great scientific interest and would be technically feasible. The Conference felt that an experiment in the Atlantic can be recommended on the basis of the following considerations.

As originally proposed by JOC, the organization of tropical convection in cloud clusters is the phenomenon of major scientific interest from the point of view of GARP. Although this phenomenon occurs with greatest frequency in the Western Pacific, studies of the tropical Atlantic have indicated that a sufficient number occur also in the western tropical Atlantic, with the highest frequency of occurrence in the period August-November. The clusters there are sometimes associated with easterly waves moving in from the African continent and sometimes with disturbances in the Intertropical Convergence Zone. A large variety of degrees of development occur, from short-lived flare-ups of cumulus development to intense hurricanes.

3.2.2 Recommendations

The Conference accordingly recommended that an experiment be mounted in the Atlantic on the following basis:

3.2.2.1 Area

The area to be covered by the experiment should be somewhere within the region enclosed by lines joining the points 75°W 20°N, 20°W 20°N, 35°W 10°S, and 5°E 10°S. The Conference recommended that JOC should review at its next session the specific delineation of the area and the density of the observations and convey its views to those responsible for planning the experiment.

3.2.2.2 Timing

It has been assumed tentatively that a 3-month duration for the experiment will be required to achieve adequate sampling.

3.2.2.3 Type of experiment

In the light of the decision to locate the experiment in the Atlantic, it is recommended that JOC revise GARP Publications Series No.4 to address an experiment to be conducted in the Atlantic. JOC should recommend whether the experiment should be of type I and/or type II (as defined in 3.1 above).

3.3 Possible national contributions

3.3.1 Satellites

3.3.1.1 U.S.A.

The U.S.A. is planning to launch the first SMS/GOES geostationary satellite in mid-to late 1972. If all goes smoothly, a second satellite may be launched by mid-1973 and it may be possible to have such a satellite for use over the Atlantic shortly after launch. Bearing in mind that the SMS/GOES satellite have not yet been flown, it would however entail some risk to count on this possibility. It would be much safer to assume at this stage that the required observations over the Atlantic from a geostationary satellite may not be available until the end of 1973.

There is an existing ATS geostationary satellite over the Atlantic which may still be functional at the time of the experiment, and further ATS satellites are planned. ATS-F is scheduled for 1973 and ATS-G for about 1975. The former will be placed over the Atlantic, primarily for communications experiments, and may or may not carry equipment for observing clouds.

In addition to the above plans for geostationary satellites, the U.S.A. will maintain its polar-orbiting ITOS operational meteorological satellite. This will of course cover the Atlantic but there will be gaps in the soundings but not in the imaging between the zones covered by observation in successive passes over the equator.

GARP Publications Series No. 4