

WCRP SATELLITE WORKING GROUP

(Submitted by WMO)

Summary and purpose of document

To inform CGMS of the status of activities within the World Climate Research programme with regard to satellite data, products and services.

ACTION PROPOSED

CGMS Members to note and comment, as appropriate.

DISCUSSION

Development of global climate products by systematic reprocessing of global observations over the last 30 years

1. This draft proposal has been prepared from elements of the January 2004 WCRP satellite Working Group Report entitled "Space mission requirements for WCRP" (WCRP informal report No 3/2004). The report had been presented to CEOS in November 2003, to the WMO Consultative Meeting on High-level Policy on Satellite Matters (CM-4) in January 2004 and on 16 March 2004 to the GCOS Scientific Steering Group. The present proposal is under discussion within WCRP as an element of its new research strategy entitled "Coordinated Observation and Prediction of the Earth System (COPES)".

2. It is presented for information and comments to CGMS, before a more formal project can be submitted as part a cooperative project between WCRP, GCOS, the WMO Space Programme and space agencies. It will be developed during the year with the aim of having a more precise request at the next CGMS session.

Introduction

3. The scientific understanding of the physical climate system and climate processes is essential to determine to what extent climate can be predicted and the extent of human influence on climate. This requires the study of all components (atmosphere, oceans, sea-ice, land-ice and land surface) of the Earth's climate system and, in turn, the study and the analysis of all available *in situ* and space-based observations aided by numerical modelling.

4. The need for a comprehensive observing system for the global climate is now widely recognised (ref.1 & 2) and, according to ref.1, "critical components of such an observing system are:

?? *A climate observing analysis capability that produces global and regional analyses of products for the atmosphere, oceans, land surface and hydrology, and the cryosphere;*

?? *Four dimensional data assimilation capabilities that process the multivariate data in a physically consistent framework to enable production of the analyses for the components of the climate system."*

5. A number of climate re-analyses have been conducted already, in particular in the USA (NASA Data Assimilation Office, GMAO, NCEP, NCAR), in Europe (ECMWF) and in Japan (CPD/JMA). According to the conclusions and recommendations of the recent Workshop on On-going Analyses of the Climate System (ref.2), priorities should be given to:

?? Provide long time series of global and regional climatic analyses for use in design, evaluation and modifications of observing systems;

?? Produce and sustain the growing climate record;

?? Reconcile disparate climate observations and characterize analysis uncertainties;

?? Establish initial conditions for climate predictions;

?? Provide long-term series of global and regional climatic analysis for all types of prediction and projection verification.

6. A programme for on-going analysis of the climate system should:

?? Continue to improve upon the existing analyses and reanalyses of atmospheric, oceanic and land surface observations;

?? Assimilate all remotely sensed and in-situ data into a coupled, comprehensive earth system model in the longer term;

?? Produce high resolution gridded fields of all required/relevant parameters.

7. These conclusions are fully consistent with the recommendations of the WCRP Satellite Working Group concerning the reprocessing of climate related data sets making use of all available sensors and covering the last 20-30 years. It is also consistent with the proposed WCRP strategy for the development of high quality global climate products as briefly described in the section 2 hereafter.

Contribution of WCRP Satellite WG

8. The WCRP Satellite Working Group, set up in 2002 to update the space mission requirements for climate research, also addressed data management issues and interactions between WCRP and space agencies (ref.3). The Working Group recommended a possible strategy for the development of climate products on the basis that the development of a climate change prediction capability requires, *as a first step*, the systematic re-processing of the global, long-term observations of varying climate parameters from operational and experimental satellites in combination with other data sources (in situ...etc).

9. The Working Group stated (ref.3) that:

“ Major effort is underway to assemble quantitative measures of climate forcing changes for the past several decades. The satellite-observed climate record of the past 20+ years, together with observations over the next 10 years by more advanced instruments are or will be available, but these data have not been and are not being analyzed in the *coordinated and systematic* fashion needed to provide the foundation for monitoring and understanding the causes of climate variability.”

Only the analysis of an integrated collection of observations from many systems can provide the required detail and long-term, global coverage. A coordinated program for a comprehensive analysis of the climate variations over the satellite observation period (since the 1970'ies) is therefore needed.

10. A programme for the coordinated analysis and systematic re-analysis of all of the global observations can be built on the several existing WCRP and national global satellite projects and should involve the satellite-operating agencies with the objective to provide the most complete quantitative description of the climate forcing changes and climate response that can be achieved. The datasets produced would be global, covering a period of 20-30 years with consistent time-space resolution that resolves weather-scale variability (e.g., sampling intervals of 3-12 hr and 25-100 km). Immediate release of the “cleaned-up” input datasets and the re-analyzed data products would greatly stimulate climate research and become of significant importance for model evaluations.

11. An initial draft plan concerning the Global Energy and Water Cycle and the “faster” atmospheric responses to change was presented and discussed by the Group (private communication from Dr William Rossow, Chairman of GEWEX Working Group on Data Management and Analysis). This plan can serve as a prototype for a WCRP Plan which would include other key climate processes and the observation of some aspects of the slower climate components.

12. The next specific tasks to be performed as part of consultations within WCRP, in cooperation with the WMO Space Programme, and with space agencies are:

- ?? To define the scope of the analysis (time-space resolution and / or sampling, time period, state variables and diagnosed exchange quantities);
- ?? To list specific datasets to be included in the processing or to be used for evaluation;
- ?? To propose a draft schedule for specific analysis tasks;

- ?? To define modelling tasks;
- ?? To list expected outcomes ("cleaned-up" input datasets, data products and analysis results, evaluations of quality, identification of problems);
- ?? To describe the types of contributions sought;
- ?? To list possible space agency contributions;
- ?? To describe the benefits of participation .

13. The Group concluded that an international collaborative effort is mandatory to re-process the existing data sets into a physically consistent set of high quality climate products. The Group recommended that a proposal for a *Coordinated, Integrated Observational Analysis Strategy for the World Climate Research Programme* be elaborated by the WCRP Project Directors/Offices in cooperation with space agencies on the basis of the above approach and submitted when ready to the Joint Scientific Committee (JSC) and to Consultative Meetings on High-level Policy On Satellite Matters (CM) between WMO and Space Agencies for action. The link with the European GMES (Global Monitoring for Environment and Security) Initiative, aiming at the provision of global environmental information, should be ensured in order to avoid duplications".

14. The above recommendations were fully endorsed at the CM-4 in January 2004 and subsequently by WCRP/JSC in March 2004. They were presented to GCOS SSC on 16 March 2004, for discussion and possible cooperation, and to AOPC in April 2004. The cryosphere project outlined below is a pilot project being set up as an example of the approach outlined in this short paper.

Cryosphere Component of Climate: The Globe-Ice project

15. In support to the WCRP CliC/ACSYS project, the European Space Agency (ESA) has recently decided to allocate resources for the generation of high quality climate "Ice products" derived from the 13-year SAR (Synthetic Aperture Radar) data acquired from the ESA Earth Observation radar missions (ERS-1 & 2, ENVISAT) since 1991 over polar caps and Greenland. This initiative, called (tentatively) the Globe-Ice project, is consistent with the decision taken at the third session of the ACSYS/CliC Scientific Steering Group to support the recommendations of the WCRP Satellite WG of producing a climate data reanalysis subject to further information on the scope and content of the project.

16. A group of scientific experts will meet in May 2004 at ESA/ESRIN in Frascati, Italy, to identify priority climate ice products and define preliminary characteristics/specifications for these products. A close interaction and coordination, as appropriate, will be ensured with related activities initiated in the framework of IGOS-P by WCRP and SCAR (proposal for an IGOS-P Theme on Cryosphere) and also of SEARCH (concerning an Arctic System Reanalysis) supported by CliC. Use of ACSYS Data and Information Service (ADIS) working now as CliC Data and Information Service (DISC) will be consider as necessary for the Globe-Ice project.

17. Particular attention will be given to coordinate with relevant on-going IGBP activities (e.g. IGBP project supported by ESA) as strongly recommended during the joint session of WCRP/JSC and IGBP/Scientific Committee in March 2004.

Conclusions

18. The need to organize a reprocessing of climate related data sets making use of all available observations (space and non-space) and covering the last 20-30 years is widely accepted and considered as urgent to make progress in the scientific understanding of climate present state and evolution. To achieve this ambitious objective, an international collaboration is essential involving complementary expertise (modelling, data processing, data assimilation techniques, data validation and sensor calibration...). Proper organizational arrangements have to be put in place to minimize unnecessary duplication of efforts and resources and building upon existing developments made in the USA, Europe, Japan...; Involvement of space agencies in

these activities is important and would contribute to a better planning of future space missions for the benefit of climate research. This also corresponds to priorities expressed by GCOS.

References

Ref 1: K. Trenberth and al., Bulletin of the American Meteorological Society, November 2002, **83**, 1593-1602)

Ref 2: Conclusions of the workshop on “On-going analysis of the Climate System” sponsored by NOAA, NASA and NSF and held on August 18-20, 2003 in Boulder, Colorado (Workshop web page: [http://www.joss.ucar.edu/joss_psg/meetings/climatesystem/.](http://www.joss.ucar.edu/joss_psg/meetings/climatesystem/))

Ref.3: “Update of Space Mission Requirements for WCRP” by WCRP Satellite Working Group; Final reports dated January 15, 2003 and October 2003 and presented to WMO Consultative Meetings on High Level Policy on Satellite Matters, CM-3 and CM-4, held respectively in February 2003 and January 2004.