

# SUMMARY OF THE THIRD INTERNATIONAL WINDS WORKSHOP

## 1 Introduction

The Third International Winds Workshop was held in Ascona, Switzerland from 10 - 12 June 1996. The Workshop was organised by EUMETSAT, the European Organisation for the Exploitation of Meteorological Satellites, representing National Weather Services of seventeen European countries. The Swiss Meteorological Service (Mr. Hans Peter Roesli) acted as local host and organised the excellent workshop facilities.

Thirty-six scientists attended the Workshop and presented scientific contributions. Fourteen countries and three international organisations were represented at the meeting: Australia, Austria, China, France, Germany, India, Japan, Kenya, The Netherlands, New Zealand, Spain, Switzerland, United Kingdom, United States of America and ECMWF (European Centre for Medium Range Weather Forecasts), WMO (World Meteorological Organisation) and EUMETSAT. It is of note that most meteorological satellite operators participated in this Workshop together with outstanding scientists from around the world representing both the research and user community in Numerical Weather Prediction Centres.

This Workshop was the third one following previous meetings in September 1991 in Washington, DC, and in December 1993 in Tokyo, Japan. Those initial meetings were organised by EUMETSAT (Mr. John Morgan, former Director of EUMETSAT and Dr. Gérard Szejwach, former Head of Technical Department of EUMETSAT) together with leading scientists of NOAA, WMO and JMA.

The need for Winds Workshops was recognized as the understanding of the characteristics of satellite tracked winds increased and their use in Numerical Weather Prediction (NWP) Centres advanced. Initially, satellite tracked cloud winds were based on the deceptively simple concept that one merely has to track a feature, e.g. a cloud, in a satellite image and estimate the cloud height. NWP Centres used the satellite tracked winds as if they were radiosonde report at a single level. Improvements in height assignment techniques, tracking of water vapor features, and motion estimation from more closely time sequenced images has increased the capability of the satellite tracked winds to depict atmospheric motion. Recognition that the satellite tracked winds differ appreciably from radiosonde observations has enhanced their utility in NWP. These improvements were fostered by increased information exchange and good cooperation between satellite operators and wind producers on one side and NWP Centres on the other. The establishment of a Winds Workshop was a logical step to broaden and formalise the cooperation amongst users and producers.

The Third Workshop was organised under the auspices of CGMS (Coordination Group for Meteorological Satellites) which established at its 22nd meeting in 1994 a permanent Working Group on Cloud Motion Winds.

## 2 CGMS Working Group on Cloud Motion Winds

The CGMS Working Group on Cloud Motion Winds (WG-CMW) has been established to continue and emphasize the CGMS accomplishments and objectives in the area of operational extraction of Cloud Motion Winds from satellite data. This includes coordination of complementary and compatible operational procedures, development of common verification and validation procedures, and encouragement of a robust programme of scientific research in this technology.

The objectives of the WG-CMW are:

- a) to devise and implement regular procedures for the exchange of data on inter-comparisons of operational CMW;
- b) to promote similar and, where feasible/practical, standard operational procedures for deriving CMW;
- c) to establish standards for verification and validation of CMW derived from satellite data, including
  - selection of data sources for validation
  - standardization of statistical parameters to be used for verification and inter-comparison, and
  - standardization of verification criteria, i.e. standard windows in space and time for collocations and standard criteria for the acceptance (or consideration) of the validation data;
- d) to promote increased scientific activity in this field, and to establish routine means of exchanging scientific results and progress;
- e) to encourage regular scientific and operational production information exchange regarding
  - an agreed designation of data quality as a part of the delivery of the data (e.g. quality flags),
  - common data formats and codes, and
  - means for verifying the usefulness and quality of the data in numerical analyses and prediction.

The WG-CMW organizes Workshops, co-sponsored by CGMS members. The Workshops promote the exchange of scientific and operational information between the producers of CMW, the research community, and the user community.

## 2.1 Inputs from CGMS to the Third International Winds Workshop

The CGMS Working Group on Cloud Motion Winds at its meeting in April 1996 recommended that the Third International Workshop on Winds considers:

- a) requesting wind operators to assess the appropriate use of wind forecast data in the production of winds;
- b) developing methods to assign “quality flags” to individual winds;
- c) requesting wind operators to improve coverage of the wind product while preserving an acceptable quality of the product;
- d) exploring applications of wind products in addition to NWP;
- e) investigating the generation of wind products with improved temporal and spatial resolution;
- f) proposing an appropriate reporting format for the comparison of CMWs with radiosonde data;
- g) proposing access and maintenance of a common directory of accurate sources of radiosonde data;
- h) investigating whether a consensus can be developed between NWP centres concerning the pre-processing and quality control of winds that should take place at wind producing centres;
- i) compiling a report on the accuracies assigned to winds during the assimilation process at all NWP centres;
- j) encouraging NWP centres to investigate improved techniques for the assimilation of wind information and, in particular, clear air WV winds;
- k) encouraging climatological studies which utilise satellite winds and UTH;
- l) preparing recommendations concerning the re-processing of satellite winds for use in future re-analysis projects;
- m) producing a summary of the product development plans of all wind operators; and
- n) expanding the scope of future International Workshops on Winds (whether to add consideration of scatterometer data; passive microwave surface wind data, wind lidar data, etc.).

Those items have been taken up by the Working Groups and in the Plenary discussion and results are presented in their reports.

### **3 Executive Summary**

The Workshop consisted of four sessions with oral presentations and three parallel Working Group meetings which specifically addressed topics raised by the CGMS WG-CMW.

The Workshop participants were welcomed by Dr. Tillmann Mohr, Director of EUMETSAT. In his opening remarks he noted the improvements in the space observing system since the last Winds Workshop in 1993 with the launch of the American GOES-8 and -9 and the Japanese GMS-5 satellites and encouraged further work toward utilisation of the data. He also suggested that serious consideration be given to widening the scope of future Winds Workshops to include surface winds from microwave sensors on board polar satellites.

The first session on operational systems to derive satellite-tracked winds outlined the recent improvements and remaining deficiencies of the systems in operational use. The advent in the last three years of new satellites with better sensors and more spectral bands has considerably enhanced the capabilities of the operational geostationary observing system. The smooth transfer of METEOSAT operations from the European Space Operations Centre (ESOC) to EUMETSAT in November 1995 was also significant; the quality of winds remained good, but data coverage needed expansion.

The second session on utilization of satellite-tracked winds focused on methods for assimilation of these wind data and their impact on numerical forecasts. The positive impact of satellite-derived winds on hurricane trajectory forecasts was demonstrated. Several papers presented results from assimilation experiments that showed substantial positive impact from satellite tracked winds in numerical forecast models. One notable paper on the assimilation of satellite tracked winds in the Australian Bureau of Meteorology's next generation forecast model clearly indicated further potential improvements when assimilating hourly wind fields.

The following session on validation and verification was mostly centered on improved methods for validation of the satellite derived winds. A central issue in verification is better segregation of good and poor satellite derived winds. Work is progressing towards reliable quality indicators provided with each satellite wind which will enhance the impact of the winds in the analysis for NWP.

The fourth and last session on new techniques heard presentations on research developments regarding lifetime of cloud trajectories, tracking features in rapid scan images, application of neurofuzzy techniques, and scatterometer winds. Several papers provided important insight into the nature of the tracked targets and how they relate to the scales of motion of the atmosphere. It was shown that some cirrus have been observed for 24 hours and the tracked winds agreed well with radiosonde measurements. Satellite images taken at intervals on the order of a minute provide a wealth of new information that has not yet been exploited. New ideas on the application of neurofuzzy techniques and variational analyses were presented. The last paper was a first for the Workshop; it presented results based on scatterometer wind data.

The Working Group on Methods reviewed the current methods and algorithms used for the derivation of operational winds and discussed future improvements and new ideas. The Working Group indicated the following:

- The use of forecast data in the production of satellite tracked winds is highly controversial. While the Working Group recognised the success of wind derivation methods that use forecasts, it pointed out the inherent danger of deleting new information contained in the satellite data in areas of incorrect forecasts.
- Considerable progress since the last Winds Workshop was noted in the derivation of objective quality flags assigned to individual tracers.
- Research modes of using the satellites should be considered for quasi-operational application. This would pave the way for an efficient transition of research developments into operations. As a specific example, the utility of short interval images (15 minutes or less) for the derivation of winds in the vicinity of tropical storms was mentioned.
- There is an increased need for better mechanisms for comparing and exchanging ideas and results. It was suggested that a well defined data set for the derivation of winds should be established and distributed to interested scientists. Results from different algorithm applications on this common data set would be exchanged and differences investigated. A sub-group will commence work on the definition of an initial data set. It is intended that this initial exercise lead to a global "virtual laboratory" exploiting the increased capabilities of modern communication systems.

The Working Group on Utilisation addressed satellite tracked winds in NWP and other applications. The group noted:

- The main questions concerning utilisation in NWP are (1) what level of quality is still acceptable for dissemination by wind producers and (2) what quality indicators/quality information should be distributed with the satellite winds.
- A spatial resolution of 50 km for the wind product will be adequate for NWP applications for the foreseeable future.
- Data coverage should be extended as much as possible and multispectral wind derivation techniques should be utilised for that purpose.
- Other potential applications of satellite tracked winds include:
  - monitoring the integrity of the operational analysis at regional centres
  - helping to solve synoptic analysis and local forecast problems at regional centres
  - contributing to the physical understanding of meteorological phenomenon (e.g. rapid scan winds)
  - nowcasting
  - monitoring sub grid scale events (e.g. high resolution visible winds)
  - helping to understand tropical cyclone events (investigations of intensity and low level vortex structure as well as qualitative interpretation of the environment (e.g. shear))
  - climatologies

It was noted that NWP centers already perform studies concerning new techniques for the assimilation of wind. Notably ECMWF started assimilation and simulation of Meteosat WV

winds/radiances and NCEP uses GOES sounder radiances. Progress is made by the Australian Weather Service regarding advanced variational assimilation techniques.

The Working Group on Verification Statistics completed the important work of defining a new reporting format for the comparison of satellite tracked winds with radiosonde data. These comparisons have been and will continue to be an important means of tracking the performance of the operational systems. While the methods for comparison of satellite tracked winds and radiosonde observations already exist, this reporting format provides commonality of collocation requirements and statistical parameters.

- It was recognised that maintaining existing local trend analyses based on different collocation requirements or statistical parameters would require some additional effort at the individual operational site.
- The group also suggested an approach for establishing and maintaining a directory of accurate sources of radiosonde data that would be used for the wind statistics.

#### **4 Concluding Remarks**

The plenary discussion addressed broadening the scope of future Winds Workshops to include winds from microwave sensors. It was agreed to open and enhance the current forum by an invitation to contributors from the field of "operational winds from scatterometers". It was suggested to invite one presentation on wind fields from passive microwave radiometers. There was a general agreement that the aspect of "operational application" should continue to be the guiding theme for future workshops.

The Workshop commended the local organiser on the very suitable facilities for the Workshop and the Working Group meetings and invited WMO to give consideration to hosting its next meeting in early 1998 in Switzerland.