CGMS

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REPORT FROM THE 8TH INTERNATIONAL WINDS WORKSHOP

The paper summarises the outcome of the 8th International Winds Workshop (IWW8). This workshop took place from 24 - 28 April 2006 in Beijing, China. The paper presents:
i) the response of IWW8 to actions from previous CGMS meetings, ii) findings and recommendations of IWW8, iii) other issues related to International Winds Working Group, such as the establishment of a dedicated web site and a discussion of the format and utility of the standard CGMS comparisons between AMVs and radiosondes.

CGMS 34 is invited to discuss the findings and recommendations from the 8th International Winds Workshop.

REPORT FROM THE 8th INTERNATIONAL WINDS WORKSHOP

1 INTRODUCTION

This paper summarises the outcome of the 8th International Winds Workshop (IWW8). The workshop was hosted by CMA and took place from 24 - 28 April 2006 in Beijing, China.
The IWW8 was attended by 52 scientists from 20 countries. With CMA, JMA, NOAA/NESDIS, IMD and EUMETSAT most of the operational satellite data producing AMVs were represented. Most global numerical weather prediction (NWP) centers did participate, some of which with several contributors reflecting the importance of AMV products for NWP.

Members of the Workshop Organising Committee were:
Luo Dongfeng (NSMC/CMA), Guo Lujun (NSMC/CMA), Zhang Shizhong (NSMC/CMA), Christopher Velden (UM-CIMSS), Arthur de Smet (EUMETSAT), Kenneth Holmlund (EUMETSAT), Régis Borde (EUMETSAT) and Michèle Loyer (EUMETSAT)

and the Scientific Programme Committee members were:
Donald Hinsman (WMO), Masami Tokuno (JMA), Christopher Velden (UM-CIMSS), Jianmin Xu (NSMC/CMA) and Kenneth Holmlund (EUMETSAT)

The structure of the paper is as follows:

- Section 2 provides the highlights of IWW8.
- Section 3 recalls the recommendations from CGMS33 to IWW8.
- Section 4 gives a detailed account of issues and recommendations that are specific to NWP applications. This presentation was made by J.N. Thépaut of ECMWF
- Section 5 summarises a special plenary session on AMV height assignment.
- Section 6 summarises the salient points from the three Working Groups at IWW8 addressing the topics: Methods (WG-I), Data Assimilation (WG-II), Height Assignment (WG-III).
- Section 7 highlights further items of general interest to CGMS, namely a new web site for the IWW and a recent exchange of views on the utility of the CGMS standard wind statistics.

2 Highlights of IWW8

In a summary of IWW8 the two co-chairs C. Velden and K. Holmlund provide the following items as highlights:

1) Initial results using AMV data from new satellites, i.e. MSG-2 (EUMETSAT, launched December 2005) and MTSAT-1R (Japan, launched June 2005), were in line with expectation and hold good promise for sustained quality and further product improvement. Data from the FY-2C satellite (China, launched October 2004) are being monitored.
2) MODIS polar winds have become and important part of the standard observing system at most NWP centers showing good impact on forecast quality.
3) ECMWF announced support to plans for testing the retrieval of AMVs on model simulated images in order to help better characterize the error of the real AMVs.

4) There were several presentations on the assimilation of AMVs into regional models, showing promising results. This is considered a major step with regard to previous IWWs.
5) There was progress in deriving a height assignment error estimate, or confidence indicator with each AMV. As this issue has been around since the 1st IWW and been persistently requested by NWP community the progress has warmly been welcomed.
6) Preliminary evidence was presented that AMVs can be better characterized as representing flows over tropospheric layers, rather than being assigned to specific levels. This issue will be further studied and results presented at IWW9.

3 RECALLING RECOMMENDATIONS FROM CGMS 33 TO IWW8

At CGMS 33 the Working Group on 'Satellite Products Including Satellite Derived Winds' formulated the following recommendations to IWW8:

a) Exploit satellite constellations which provide novel opportunities to explore critical issues for AMV derivation (accurate height assignment of cloud tracers with active instruments, e.g. Calipso)
b) Use of geometric approaches to height assignment as independent reference methods and for validation of operational cloud heights
c) AMV quality is an integrated result of many steps, starting with navigation. It is suggested to revisit the individual processing steps. (CMA is an example on how to progress through a comprehensive approach considering all processing steps).
d) Target identification should be revisited considering the errors due to pattern evolution in time.
e) Potential to utilise derivatives from AMVs (e.g. divergence and vorticity) should be further explored.
f) Better ways to derive the atmospheric motions at different scales are needed, however CGMS 33 did not feel in the position to propose a particular method.
g) Good AMVs often get rejected in the pre-processing for NWP models because of too large a difference to the model background. Better description of AMV errors and a better accuracy per se would help.
h) CGMS 33 (WG II) concluded that other items for future research on AMVs, as listed in a working paper from EUMETSAT (EUM-WP-16 for CGMS 33), should also be considered in the specific working groups at IWW8.

4 NWP Requirements for AMV Research & Development

Because Numerical Weather Prediction centres are the main users of AMV products, special emphasis was given to requirements from the NWP community. To this end Dr. Jean-Noël Thépaut of ECMWF had been invited to present the NWP community and to formulate the requirements and main issues of AMVs from NWP:

4.1 General points expected for winds producers from NWP

a) Continuation of coverage is important
   - counteract the threat of losing polar winds after MODIS era
   - there is an urgent need to confirm impact of IR winds and develop such products from AVHRR
b) Harmonisation of AMV processing is desirable (as far as possible and practical), as accounting for different production algorithm characteristics is tedious and time-consuming, and beyond the resources of most NWP centres.
c) Use of forecast data for quality control should be left to NWP centres.
   - Can the dependence on forecast data be reduced in general in the processing?
   - QI (forecast independent) should still indicate something about wind quality!
d) Winds producers should endeavour to provide more automated information on quality for each wind, especially to characterise:
   - Quality of height assignment.
   - Tracer/scene quality (e.g., poorer quality in scenes with multi-layer cloud).
e) More research is needed to reduce empirical/statistical adjustments in the derivation (e.g. speed increase to balance a speed bias, autoeditor height adjustment). Influence of new developments need to be evaluated with and without such adjustments.
f) Reprocessing activities are encouraged (i.e. actions should be taken by all satellite operators to re-process AMVs with current AMV retrieval schemes from historical geostationary and polar satellites using archived image data).

4.2 Areas Requiring Effort from Winds Producers and NWP

a) Error inventory:
   - Study errors of all aspects of winds derivation, to identify largest uncertainties.
   - Assess in particular errors entailed by original biases in radiances and if possible, remove them.
b) Observation operator for AMVs are needed:
   - With regard to cloudy AMVs the question is: Can we do better than claiming: "The cloud motion represents the wind at a single height, which is an estimate of the cloud top/base (layer averaging)"?
   - With regard to clear-sky WV AMVs: These are not assimilated from geostationary satellites. Can we provide an observation operator?
c) Evaluation of AMVs derived from simulated imagery:
   This offers a framework to better characterise clear *and* cloudy-sky AMVs, height assignment, a better error inventory, observation operator.
d) Evaluation of AMVs using ancillary data (ADM-AEOLUS, Calipso)

5 Special plenary session on AMV height assignments

A special plenary session was held on AMV Height Assignment. The session was convened by Mary Forsythe and Chris Velden and provided an opportunity to discuss some of the limitations of the existing methodologies for height assignment of AMVs, suggestions for improvement, ideas for investigating height assignment errors, and options for representing AMVs better in NWP. The salient points and ideas are summarised as follows:

- AMVs should be derived from simulated imagery giving the opportunity to compare the derived AMV with the known wind field
- Comparisons should be made for measurements of cloud heights and cloud properties, particularly with the new opportunities on the A-train (including Parasol, Calipso, CloudSat). Also comparisons to stereo cloud top heights (e.g. MISR) and other derived cloud top pressure products (e.g. MODIS cloud top pressure) have been suggested.
- Inter-comparisons of height assignment techniques should be conducted with the same image data (e.g. from MSG).
- Improve the link between the pixels used for height assignment and those that dominate in the tracking
- Produce height assignment error estimates (or confidence indicator) with each AMV.
- Consider bias correction of radiances prior to height assignment

Chris Velden presented an important preliminary study which indicated that a reduced root mean square vector difference against rawinsondes of 1-2 m/s could be achieved using a **layer** of best fit analysis rather than a level of best fit. Further work on this is planned at CIMSS. Treating the AMV as a layer rather than assigning it to a specific level has two possible benefits: Firstly, the AMVs would represent the movement of a mean-layer flow, and secondly it is a way of allowing for height assignment uncertainty. In view of the potential benefit of this approach it is recommended that NESDIS presents a paper on the progress at CGMS 35.

With regard to improving the utilityof AMVs for NWP applications it has been suggested to:

- Consider modifying the observation operator to treat the AMVs as layer observations.
- Use of a height assignment error (or quality indicator), when available, to help screen bad data and/or to adapt the observation errors.

6 Reports from Working Groups at IWW8

Three Working Groups at IWW8 convened in separate sessions addressing the following topics:

- Working Group I: “AMV Extraction Methods”, chaired by R. Davies and A. Szantai
- Working Group II: “Assimilation”, chaired by A. Cress
- Working Group III: “AMV Characteristics”, chaired by S. Wanzong and A. de Smet

The detailed reports of the working groups are provided as part of the Proceedings of the 8th International Winds Workshop at: Beijing, China, 24 - 28 April 2006 EUMETSAT P.47. The proceedings are available at www.eumetsat.int, → Publications → Conference and Workshop Proceedings

Here the most important recommendations are recalled and should be discussed at CGMS 34. It is expected that CGMS concludes with actions and recommendations to CGMS members as a result of these IWW8 recommendations:

1. WG-I recommends studies that compare accurate cloud height assignments, e.g. from lidar- or multi-angle-based instruments, with the operational AMV heights.
2. WG-I recommends that the general capability of retrieving polar winds be maintained and secured for the future. *This underlines again the importance of continuing WV winds over polar regions.*
3. WG-I recommends that quality indicators also include height confidence information. Quality indicators for different processing steps should remain separated, and should have a unified definition for all AMV producers.
4. WG-I recommends to conduct studies explaining discrepancies between different height assignment methods.
5. WG-II recommends that satellite data providers and NWP centers should use synthetic spectral satellite images as research tool in order to increase the understanding of possible error sources in the processing of AMV winds and to learn more about the errors structure of the AMV winds.
6. WG-II supports the efforts of JMA and EUMETSAT in reanalysis projects and strongly recommends that other satellite operators should conduct similar activities.
7. It is recommended that test AMV data are available for a sufficiently overlap period (2 months at least) when there is a change of operational satellites.
8. WG-II recommends to generate and disseminate AVHRR IR wind products over the polar regions and that the NWP community should test the quality and impact of AVHRR winds.
9. WG-II recommends to survey which QI and observation errors are used at different NWP centers. The information should be sent to Mary Forsythe.
10. WG-III recommends, a case study where all AMV producers are requested to derive winds from a common, pre-selected data set, using imagery from an operational Meteosat second generation satellite. This includes a comparison of different height assignment methods.

Furthermore it is noted that WG-II identified three areas where progress promises a large return on the efforts:

a) height assignment
b) polar winds,
c) winds derived from AVHRR (over the poles)

WG-II also identified the following projects for international collaboration:

1) assimilation of winds from simulated images
2) comparison of derived wind data set from an MSG triplet to be provided by EUMETSAT. The action should be on EUMETSAT to make the triplets available.
3) Comparison of wind data from simulated images and from MSG triplet

7 Other Issues

7.1 CGMS Wind Statistics

All CGMS Satellite Operators deriving winds from their geostationary satellites regularly derive monthly statistics for the comparison of Atmospheric Motion Vectors with collocated radiosondes. The following quantities are reported: mean speeds, mean speed difference (bias), mean vector difference, rms difference, normalised rms, number of collocations.

In principle those statistics should be available through a WMO server, however this appears to be no longer the case. However, the standard CGMS statistics are made available through the regular mailing by the individual satellite operators.

The CGMS statistics had been introduced in the 1980'ies as the means of coordinated quality checking of AMVs. More recently the regular monitoring at of AMVs at NWP centres became the main judge upon the quality and progress of AMVs. For instance, the NWP SAF uses NWP monitoring as their primary tool for evaluating AMV data quality. However, monthly "CGMS statistics" are produced too and are considered valuable for quick comparisons.

While it is suggested that the standard CGMS wind statistics should be continued as an important and independent alternative to the NWP monitoring, it appears sensible to review the CGMS statistics and to ask CGMS satellite wind producers to report on:
- their wind statistic methods and provide any update if necessary
- their own use of their wind statistics
- their use of wind statistics from other satellite operators

Working Group II at CGMS 34 is requested to consider an action on all CGMS members to report on the use of the standard CGMS wind statistics.

7.2 IWW Web Site

A new Web site for the International Winds Working Group is currently under development. Researchers at the Cooperative Institute for Meteorological Satellite Studies (I. Geikova and C. Velden) are creating a site for the group. A draft of this we site will be available in 2007. This will be announced and then CGMS members are kindly invited to visit the web site and provide comments.

8 Conclusions

The paper summarises the outcome of the 8th International Winds Workshop (IWW8). This workshop took place from 24 - 28 April 2006 in Beijing, China. The paper presents: i) the response of IWW8 to actions from previous CGMS meetings ii) findings and recommendations of IWW8 iii) other issues related to International Winds Working Group, such as the establishment of a dedicated web site and a discussion of the format and utility of the standard CGMS comparisons between AMVs and radiosondes.

It is also noted that the proceedings of the 8th International Winds Workshop with all papers and working group summaries are already on the EUMETSAT web site under http://www.eumetsat.int/Home/Main/Publications/Conference_and_Workshop_Proceedings/index.htm?l=en .