REPORT FROM THE WORKING GROUP ON MESOSCALE APPLICATIONS (WG II)

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1. Introduction

A Working Group on Mesoscale Applications (WG II) was convened for the first time within the framework of an International Winds Workshops (IWW). The growing importance of the topic compelled IWW6 to form this working group.

WG II considered the time and spatial scales of the relevant atmospheric phenomena and concluded that observations at intervals from 5 to 10 minutes with a spatial resolution better than 50 km could be considered mesoscale. It was noted that these requirements are not currently met by satellite observations and a better name for the WG would be 'Satellite wind estimation in support of meso-scale research studies and operational applications'. WG II also noted that broader participation from the meso-scale modelling community is imperative at future IWW. As a way forward, WG II attempted a synopsis of current applications that could help in selecting the relevant topics and lead to focussed discussions at future workshops.

2. Use of Wind retrievals in support of Nowcasting

It was reported that 'Automatic satellite image interpretation' is being developed by the Satellite Application Facility for Nowcasting and Short-term forecasting. Satellite derived displacement vectors are used to forecast the migration of weather phenomena using displacement vectors derived from successive satellite imagery. Along the same lines it was stated that an 'Auto-nowcaster' is being developed in the US, that utilises fuzzy logic and statistics to forecast convection and merges radar and satellite information. These initiatives were welcomed by WG II as it is clear that automatic methods need to be developed to help forecasters to 'digest' the wealth of multi-spectral information with high temporal resolution from current and future (geostationary) satellites. Innovative derived product images that condense the relevant information were considered to be a good means toward this goal.

Progress in deriving high density wind vectors for high resolution models was noted. In concurrence with a recommendation from WG I, WG II requested satellite operators to foster the use of 3.9µm channels during night and solar channels during day-time for the derivation of high-density low-level wind fields. It was suggested that estimations of cloud optical depth could be used as correlative information to cloud top height in order to infer information on the volume displacement of mid- and high-level AMVs; this was understood to be a potential contribution to the recurrent problem that displacement vectors usually represent a volume mean wind.

Two papers presented at IWW6 that analysed meso-scale systems (Rabin, Mecikalski) lead WG II to conclude that VIS and IR channels should be used in addition to the WV channels to resolve features at smaller scales and thus obtain a more complete picture of upper level divergence in meso-scale systems. The missing multi-level analyses could possibly be obtained from future high spectral resolution instruments (e.g. GIFTS) providing wind profiles from water vapor retrievals and lidar measurements (although polar orbiting lidar are compromised by infrequent measurements).

3. Short-term Forecast Quality Checking and Model Validation

Forecasters often inspect short-term forecasts in order to assess whether a longer range forecast is credible. One approach is to compare the analysis or earlier forecast fields with simultaneous observations. It was reported that high resolution wind products from GOES over the Pacific have been useful for that purpose. WG II encouraged production of such high density wind fields by all satellite operators and combination with other observations can be used as an independent test whether the analysis is ok and the forecast model is starting out well.
As models often do not retain the smaller scale circulation apparent in the satellite derived wind fields, it was suggested that models and analyses with higher resolution are needed before these small scale features can be utilised.

4. Rapid Scans

Utility of rapid scans has been demonstrated in many research studies and is corroborated by current operational applications. As an early example of an operational application, rapid scan (15 min instead of 30 min) from GMS in support of Typhoon track forecasting was cited. Recent field experiments (NORPEX, THORPEX, PACJET, CAMEX, ALPEX) have also documented the positive impact of rapid scan measurements. As the principal objective of those experiments is to support small scale studies, rapid scan data provide an excellent basis for the derivation of high resolution wind fields. Research experiments have clearly demonstrated that a 15 minute repeat cycle improves wind field derivation when compared to those from a 30 minute repeat cycle. It is expected that models already making good use of high density wind fields from 30 minute imaging cycles will further benefit from wind fields derived from rapid scans. WG II noted the operational rapid scan service established with Meteosat-6, that was initially prompted by a dedicated support ALPEX and then attained operational status after demand from satellite data users. Finally it was recognised that high density wind fields have proven to be very beneficial in supporting forecasts of severe rainfall and severe convective storms over China.

In view of the very successful developments in the area of rapid scans WG II formulated the following recommendations:

Recommendation (IWW6_WGII_1): Satellite operators are encouraged to provide rapid scan services operationally as they provide a basis for observing rapidly developing systems in real-time and for high quality wind fields. As it is recognised that rapid scan services are at variance with full disk imaging it is recommended that spare or back-up satellites be utilized for that purpose. It is also recommended that the area covered by rapid scans should be programmable, in particular when research studies request dedicated scan patterns for a certain period of time.

Recommendation (IWW6_WGII_2): Satellite operators should establish adequate means to effectively disseminate rapid scan data to all users.

It was noted that the continuous nature of high resolution AMVs allows them to provide important information for mesoscale analysis and initialisation. The efficient use of AMV data at non-synoptic times requires continued emphasis on the development of mesoscale data assimilation techniques. A pertinent recommendation with a view to IWW7 was formulated:

Recommendation (IWW6_WGII_3): Co-chairs of IWW7 should invite representatives from the meso-scale data assimilation community to IWW7 in order to focus on the needs for assimilating high resolution winds from rapid scans.

5. Research on (Tropical) Deep Convective Systems

Rapid scans and associated high-resolution wind fields from satellites can potentially benefit research on deep convective systems. It has been shown that these wind fields have suffcient accuracy to enable estimation of upper level divergence fields. Studies on deep convective systems show promise for better understanding of processes (moistening of the tropical upper tropopsphere, water vapor transport, impact on regional radiation budget, …) and are pertinent to an improved understanding of climate relevant processes. Comprehensive and consistent satellite observations of tropical cloud systems, the cloud parameters, divergence, water vapor outflow and subsequent transport from the tropics into the subtropics would provide compelling tests for climate models and hence benefit climate analysis and prediction.
Therefore WG II encouraged research studies on rapidly changing tropical convective systems with a goal to improve understanding of the moistening of the upper troposphere and the pertinent water vapour transport into the subtropics.
Concerning the upper level divergence fields it was felt that those divergence fields, solely derived from satellite derived winds, provide a useful comparison for numerical models.

As a final issue, WG II discussed user response to the analysis of storm systems in “storm-relative coordinates” (i.e. the mean translation of convective system is subtracted from animated images such that the secondary circulation is discernable). WG II felt that there was considerable merit in storm-relative-motion analysis, noted the existence of this tool in current software packages distributed for training (RAMSDIS), and requested a report on user response to this software package. Therefore WG II recommended.

Recommendation (IWW6_WGII_4): CGMS to request all members to report on their use of software for the analysis of storm systems in a ‘storm-relative’ mode.

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