CGMS

CGMS-39 EUM-WP-28
v1, 8 September 2011
Prepared by IWWG Co-Chairs
Agenda Item: G.II/6
Discussed in WGII

IWWG WORK PLAN FOR A SECOND AMV INTER-COMPARISON STUDY

In response to CGMS action/recommendation 38.27

The main objective of the initial AMV inter-comparison study was to compare the operational algorithms of all satellite wind producers including the height assignment of AMVs from clouds using a common data set from SEVIRI on MSG, and the same ancillary data. AMVs generated from a common MSG-SEVIRI dataset (18 August 2006) by five AMV producers – EUMETSAT, NOAA-NESDIS, JMA, KMA, and the Brazilian Meteorological services, were inter-compared. The study assessed how the various AMV producer's data inter-compare in terms of global coverage, speed and direction.

While the initial study demonstrated the potential usefulness of the strategy, it also raised questions in a number of areas that require further study. In addition some operational algorithms have changed since the end of the first study and it will be beneficial to update results.

The purpose of this paper is to answer to the CGMS recommendation 38.27, proposing a workplan for a second AMV inter-comparison study:

Action 38.27: Co-chairs of the IWWG should develop a work plan for a second AMV intercomparison study on the basis of lessons-learnt from the 1st intercomparison and the pertinent feedback and comments provided by CGMS members (see Action above). Due CGMS-39

Action/Recommendation proposed: Work plan for a second inter-comparison study to be proposed and discussed at 11IWW

IWWG Work plan for a second AMV inter-comparison Study

1 INTRODUCTION

The purpose of this paper is to answer to the CGMS recommendation 38.27:

Action 38.27: Co-chairs of the IWWG should develop a workplan for a second AMV intercomparison study on the basis of lessons-learnt from the 1st intercomparison and the pertinent feedback and comments provided by CGMS members (see Action above). Due CGMS-39

The main objective of the initial AMV inter-comparison study was to compare the operational algorithms of all satellite wind producers including the height assignment of AMVs from clouds using a common data set from SEVIRI on MSG, and the same ancillary data. AMVs generated from a common MSG-SEVIRI dataset (18 August 2006) by five AMV producers – EUMETSAT, NOAA-NESDIS, JMA, KMA, and the Brazilian Meteorological services, were inter-compared. The study assessed how the various AMV producer's data inter-compare in terms of global coverage, speed and direction (Genkova et al., 2010).

While the initial study demonstrated the potential usefulness of the strategy, it also raised questions in a number of areas that require further study. In addition some operational algorithms have changed since the end of the first study and it will be beneficial to update results. Following centres already agreed via CGMS to participate to a second inter-comparison study:

- EUMETSAT
- NOAA / NESDIS
- CMA
- JMA
- KMA
- SRC Planeta on behalf of Roshydromet

Several lessons have been learned from the first study that can help refine the test strategies and objectives for a second intercomparison study. A work plan has been developed and is discussed in Section 2. This work plan is going to be proposed to future participants and discussed at 11IWW.

2 PLANS FOR A FOLLOW-UP ATMOSPHERIC MOTION VECTOR (AMV) INTER-COMPARISON STUDY

General Approach for Study:

The AMV derivation process in its entirety is complicated. The algorithms and configurations used by the different satellite operators are different which creates challenges when attempting to inter-compare AMVs generated by these different algorithms and configurations and draw meaningful conclusions. In order to meet the

stated goal above it will be necessary to establish and follow an experimental design and approach that will enable testing and meaningful comparisons of each of the following standard components of the AMV derivation process.

Target selection
Feature Tracking
Height Assignment
Quality Control

Datasets:

1. **Dataset 1:** Fixed full-disk Meteosat Second Generation (MSG) SEVIRI image (10.8um) triplet, Scene and Cloud Analysis associated products and NWP model T, u, v profiles. In this dataset, each image in the image triplet is the same, but the images are artificially shifted in the North/South and East/West directions by a known amount. Satellite operators may use their own NWP model for this test.

   Specific Test(s) to be performed:

   Test 1: Feature tracking testing and comparison – The creation and use of this special image triplet will allow a simple, but important verification, of the tracking algorithm used by each of the satellite operators. Since the same image is used in each image of the image triplet, but shifted by a known amount, the expected displacement solution will be known. The displacement solution produced by each satellite operator can be analyzed and compared to the expected displacement. The strength of this test is the fact that there is little, if any, dependence on configuration (target selection, size of target or search scene) used by the satellite operators or the height assigned to the AMVs

   The expected outcome of this test is that the tracking results from each operator will be very close, with all of them producing the expected displacements. This outcome, if confirmed, would indicate that the tracking algorithms used by each satellite operator, while potentially different, produce very similar displacement solutions under very controlled conditions. While this is the expected outcome, the authors are not aware that this has ever been confirmed in any previous study.

   Statistics to be generated:

   i. Average and range for a number of variables that include AMV speed, direction, height.

   Plots to be generated:

   i. AMVs plotted over imagery color-coded by height (low, middle, high)
   ii. Histograms of retrieved speeds and directions

2. **Dataset 2:** Fixed set of full-disk MSG SEVIRI image (6.3um, 7.3um, 10.8um, 12.0um, and 13.4um) triplets, Scene and Cloud Analysis associated products and ECMWF model T, u, v profiles. In contrast to Dataset 1, each of the full-disk images that make up the image triplet are different. This dataset will support the inspection, detailed analysis, and validation (where possible) of AMVs generated

by each satellite operator. For each of the tests specified below, specific and detailed analysis of AMVs will be performed over various geographic locations that are determined a-priori or a-posteriori to have different atmospheric (clouds, temperature, moisture) and/or surface conditions (land, ocean, surface temperature) that the various AMV algorithms may or may not have difficulty in dealing with when retrieving a cloud motion wind. The geographic locations will include land and ocean scenes with varying cloud cover/amounts, cloud types/phases, cloud optical depth, cloud heights, surface temperature, and vertical temperature and moisture profiles.

Specific Test(s) to be performed:

Test 1: Satellite operators will track clouds and assign heights to AMVs using *only* the 10.8um image triplet provided and the accompanying ECMWF model using their algorithms and their standard configurations (target scene size, search scene size, etc). It is understood that using only the 10.8um imagery to assign heights AMVs will not produce optimal winds in all situations, but it will enable analysis and a more apples-to-apples comparison of target selection, feature tracking, and quality control algorithms used by the different satellite operators.

Test 2: Satellite operators will track clouds and assign heights to AMVs using *only* the 10.8um image triplet provided and the accompanying ECMWF model using their algorithms and a *prescribed configuration* (target scene size, search scene size, etc). Furthermore, it will be necessary that the same target scenes are used by all when deriving their respective AMV products. The intent of this test is to remove the different configurations used by the satellite operators (ie., as done in Test 1) and ensure displacement and height solutions are based on the same target scenes. This experimental setup should allow for the best possible apples-to-apples comparison of target selection, feature tracking, and quality control algorithms used by the different satellite operators. Expectations are that the AMVs generated by the different satellite operators will look very similar.

Test 3: Satellite operators will track clouds using the 10.8um image triplet provided, but can use any or all of the other available imagery in different height assignment algorithms (CO_2 slicing, H_2O-Intercept, IR-Window) of their choosing. They must also use the accompanying ECMWF model data in the process of generating AMVs. As was done in Test 2, all of this should be done using the prescribed configuration (target scene size, search scene size, etc) and the same target scenes. The intent of this test is to assess, to the extent possible, the impact of the different height assignment methodologies used by the satellite operators. Expectations are that differences in AMV heights (due to possible differences in height assignment method used) and geographic coverage (due to quality control tests) will be observed as a result of this test. It is hoped that the design of this test will enable conclusions to be drawn about the impact of the different height algorithms used by the different satellite operators through comparison of AMVs generated in this test relative to the AMVs generated from Test 2. This comparison may confirm that height assignment methods used by each of the satellite operators is a key contributor, and possibly

the major reason, for observed differences between their respective AMVs in terms of overall counts, geographic coverage, and quality.

Statistics to be generated for Tests 1-3:

i. Average and range for a number of variables that include AMV speed, direction, height.
iii. Percentage of low level (P> 700 hPa), middle level (400-700 hPa), and high level (P< 400 hPa) AMVs
iv. Number of AMVs generated (QI=0-100 and QI > 50)
v. Comparison statistics between derived AMVs and collocated Analysis fields.

Plots to be generated:

i. AMVs plotted over imagery (low, middle, high)
ii. Histograms of retrieved speeds, directions, heights, QI score

3 CONCLUSION

CGMS39 is invited to:

i) discuss in WG II the proposed work plan for a second AMV intercomparison campaign and
ii) recommend to IWW11 to define and pursue the second AMV intercomparison

4 REFERENCES

Genkova, I., R. Borde, J. Schmetz, J. Daniels, C. Velden and K. Holmlund (2008), 'Global atmospheric motion vectors intercomparison study, Ninth Int. Winds Workshop, Annapolis, USA.

Genkova I., R. Borde, J. Schmetz, C. Velden, K. Holmlund, N. Bormann and P. Bauer. Global atmospheric motion vector inter-comparison study. Tenth Int. Winds Workshop, Tokyo, Japan, 2010.