Proceedings for the 14th International Winds Workshop
23-27 April 2018, Jeju City, South Korea

REPORT FROM WORKING GROUP 1 (WG1): AMV EXTRACTION METHODS

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The discussion in Working Group 1 (WG1) for "AMV Extraction Methods", in the 14th International Winds Workshop (14IWW) was led by Jaime Daniels (NOAA/NESDIS, jaime.daniels@noaa.gov) and Javier García-Pereda (AEMET/NWCSAF, jgarciap@aemet.es), and attended by Steve Wanzong, cochair of the IWWG (UW/CIMSS, stevew@ssec.wisc.edu), Miki Abe (JMA, abe.miki@met.kishou.go.jp), Andrew Bailey (NOAA/NESDIS, andrew.bailey@noaa.gov), Manuel Carranza (GMV, manuel.carranza@eumetsat.int), Sung-Rae Chung (KMA, csr@korea.kr), Sanjib Deb (SAC/ISRO, sanjib_deb@sac.isro.gov.in), Olivier Hautecoeur (EXOSTAFF, olivier.hautecoeur@eumetsat.int), John Le Marshall (BOM, j.lemarshall@bom.gov.au), Byung-Il Lee (KMA, bilee01@korea.kr), Wolfgang Lengert (ESA, wolfgang.lengert@esa.int), Feng Lu (CMA, lufeng@cma.gov.cn), Kevin Mueller (NASA/JPL, kmueller@jpl.nasa.gov), Kenichi Nonaka (JMA, k-nonaka@met.kishou.go.jp), Dave Stettner (UW/CIMSS, stettner@ssec.wisd.edu), Anne Grete Straume (ESA, anne.straume@esa.int) and Xiaohu Zhang (CMA, zhangxiaohu@cma.gov.cn).

LIST OF ACTIONS AND RECOMMENDATIONS

Actions and recommendations for different members of the International Winds Working Group (IWWG), and for the attention of the CGMS, are highlighted in blue and red respectively, and listed here:

IWW14 – WG1 – Action 1: Steve Wanzong to put the current "Common QI module" (as defined in his email of May 2017) in a repository in the IWWG webpage, from which it can be taken. Due date: 1 August 2018.

IWW14 – WG1 – Action 2: All AMV producers to implement the "Common QI module" in their algorithms. Due date: before IWW15.

IWW14 – WG1 – Action 3: JMA to make public the "JMA technical note" in English in which they describe their current height assignment. Due date: 1 August 2018.

IWW14 – WG1 – Action 4: Steve Wanzong to put the "JMA technical note on their current height assignment" in the repository in the IWWG webpage, from which it can be taken. Due date: 1 August 2018.

IWW14 – WG1 – Action 5: NWP community to define the best configuration to be used by the AMV producers, for use in global and regional NWP models. Due date: before IWW15.

IWW14 – WG1 – Action 6: AMV producers and users to adopt the new AMV BUFR template. Due date: 30 April 2019.

IWW14 – WG1 – Action 7: Javier García-Pereda to define a questionnaire related to the characteristics of all currently available AMV products, and including information of dependencies on NWP data, and send it through the IWWG email list for AMV producers. Due date: 1 August 2018.

IWW14 – WG1 – Action 8: All AMV producers to send back the corresponding questionnaire to Javier García-Pereda, who will put all information together and provide it for the repository in the IWWG webpage. Due date: 1 October 2018.

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IWW14 – WG1 – Recommendation 1: Kazuki Shimoji invites all AMV producers to read and study "Pattern recognition and Machine learning" by Christopher M. Bishop for understanding of optimal estimation and data assimilation.

IWW14 – WG1 – Recommendation 2: IWW14 continues to encourage collaboration and sharing of software modules and elements between all AMV producers, to compare the methods and algorithm components, and assist in the production of consistent high quality products.

IWW14 – WG1 – Recommendation 3: When ready, AMV producers with geometric height techniques to compare these datasets with AMVs with other height assignment techniques.

IWW14 – WG1 – Recommendation 4: When ready, AMV producers to compare Aeolus winds to their respective AMV datasets, and report findings at IWW15.

IWW14 – WG1 – Recommendation 5: NWP community to prepare carefully for the use of the new AMV BUFR template by the different AMV providers.

IWW14 – WG1 – Recommendation 6: AMV producers to work on options for this "tracking error" related to the AMV correlation surface.

IWW14 – WG1 – Recommendation 7: NWPSAF to continue the AMV monitoring such as it is being done now.

IWW14 – WG1 – Recommendation 8: AMV producers to investigate and address issues discovered by the NWPSAF, to improve their products.

IWW14 – WG1 – Recommendation 9: Further studies should be undertaken to assess the value of winds from hyperspectral retrievals.

IWW14 – WG1 – Recommendation 10: NWP community to notify impact of Metop-A/B/C Tristar configuration before 2021.

IWW14 – WG1 – Recommendation 11: Participants to the Winds Workshop are encouraged to continue submitting extended abstracts for their work shown in the International Winds Workshop.

DISCUSSION

Working Group 1 participants actively discussed the following topics:

Considering CGMS High Level Priority Plan, HLPP 3.2.1: "Establish commonality in the derivation of AMV products where appropriate":

1) The "Common Quality Index", independent of NWP forecast, was extracted from the NOAA algorithm, distributed through the IWWG email list by Steve Wanzong in May 2017, and used for the Third AMV Inter-comparison. The Common Quality Index was useful in this Inter-comparison Study and resulted to improvements in the quality and consistency between the AMV datasets that the satellite producers provided. It was agreed that the Common Quality index should definitely be pursued. There is a location in the new AMV BUFR table defined for this parameter.

   Some questions were raised about the about the Common Quality Index. For example, there is some redundancy in the direction and vector quality tests that make up this index. In addition, the temporal comparison test is done considering a single AMV vector (not the original idea of considering all AMV vectors in an ellipse around the location of the compared AMV). It was further noted that there could be some dependence of this parameter on the AMV density. While all questions and concerns were considered valid, the Working Group decided that if anything is to be changed with the Common Quality Index that it be done after the current version is implemented. No specific objections were raised on this. A future question to address is how NWP centres/users will adopt this "Common Quality Index" in their processing.

   The following actions are then defined for the adoption and implementation of the "Common Quality Index" parameter:

   IWW14 – WG1 – Action 1: Steve Wanzong to put the current "Common QI module" (as defined in his email of May 2017) in a repository in the IWWG webpage, from which it can be taken. Due date: 1 August 2018.

   IWW14 – WG1 – Action 2: All AMV producers to implement the "Common QI module" in their algorithms. Due date: before IWW15.

2) There was a tremendous amount of interest in the methodology used by JMA to height assign its Himawari AMVs. JMA's height assignments associated with the AMV datasets it produced for the Inter-comparison study matched up the best against the level of best fit heights. Satellite AMV producers are interested to understand the methodology.

   Actions and recommendations that resulted from this discussion are as follows:

   IWW14 – WG1 – Action 3: JMA to make public the "JMA technical note" in English in which they describe their current height assignment. Due date: 1 August 2018.

   IWW14 – WG1 – Action 4: Steve Wanzong to put the "JMA technical note on their current height assignment" in the repository in the IWWG webpage, from which it can be taken. Due date: 1 August 2018.

   IWW14 – WG1 – Recommendation 1: Kazuki Shimoji invites all AMV producers to read and study "Pattern recognition and Machine learning" by Christopher M. Bishop for understanding of optimal estimation and data assimilation.

   IWW14 – WG1 – Recommendation 2: IWW14 continues to encourage collaboration and sharing of software modules and elements between all AMV producers, to compare the methods and algorithm components, and assist in the production of consistent high quality products.

Considering CGMS High Level Priority Plan, HLPP 3.2.2: "Potential recommendation for High Resolution AMV producers to work with the NWP community - global and mesoscale domains - to determine optimal configurations and improve the assimilation of those High Resolution AMVs":

3) The following items noted in various talks during the workshop served as starting points for this discussion:
   - The latency associated with high resolution AMVs needs to be very small.
   - AMVs should be produced at least every 100km to be useful for NWP processing (correlated errors associated with AMV observations were mentioned).
   - The generation of AMVs every 10 minutes (over the full disk) should be considered. EUMETSAT and NOAA are currently calculating AMVs from their geostationary satellites every hour. EUMETSAT plans to produce AMVs every 30 minutes from its future MTG series. It was noted that this frequency may be insufficient given the options today to produce AMVs more frequently with the new generation of instruments in orbit and those coming in future years. The NWCSAF, for example, can generate AMVs for every slot (15 min with MSG, 10 min with next generation satellites, starting with Himawari this year).
   - Different target scene sizes should be used to generate winds that meet the needs of regional NWP and the needs of global NWP.

   It is clear that global and regional NWP models need wind observations of different scales. Ultimately, satellite operators will need to generate unique AMV datasets that meet the needs of global and regional NWP - separate requirements are needed for each of these AMV datasets.

   It was noted that NWP resolution is increasing very quickly, and that these configurations could change very quickly in the future, with the need to get the motion in very local scales. The progressive increasing resolution of ECMWF models and the existence of regional NWP models with a 4 km grid or less are examples of this.

   The calculation of AMVs becomes more difficult for higher image resolutions (as experienced by studies at EUMETSAT, NOAA, CMA, and others), and a clear knowledge of the scale up to which calculations can go is needed.

   From the discussions, it became clear that that the NWP community can define the best requirements for wind observations needed at mesoscales and global scales. These requirements cannot come from the AMV producers. Considering this, the following action resulted:

   IWW14 – WG1 – Action 5: NWP community to define the best configuration to be used by the AMV producers, for use in global and regional NWP models. Due date: before IWW15.

Considering CGMS-45 Action A45.02 to CGMS space agencies, IROWG, IPWG, IWWG, ICWG, ITWG: "CGMS International Science Working Groups and CGMS space agency members to formulate science questions, including the impact of data latency, in view of the 7th Impact WS 2020 (ref. CGMS-45-WMO-WP-02) and provide these to lriishojgaard@wmo.int":

4) From the perspective of satellite-derived winds, the working group discussed items that it thought NWP should look at and assess. Apart from the previous discussion on the generation of winds for assimilation in regional and global NWP, the group discussed the need for studies related to the "AMVs with geometrically assigned heights (like stereo observations)" and "3D winds (like Aeolus)". Methods to derive AMVs with geometrically assigned heights by two geostationary satellite asynchronous observations were nicely presented by Feng Lu (CMA).

   The current GOES-16 and GOES-17 configuration/coverage currently offer a good opportunity to explore and study the performance and impact of geometric cloud heights on AMV performance.

Using MSG1 or FY-2H in the IODC region was discussed as an option to explore geometric cloud heights, but the testing would be more difficult due to the current drift of the satellite. Other geometric cloud height studies however, could be done in the future. For example EUMETSAT has plans to produce and explore "AMVs with geometric height techniques" with Sentinel-3.

One recommendation resulted from this discussion:

IWW14 – WG1 – Recommendation 3: When ready, AMV producers with geometric height techniques to compare these datasets with AMVs with other height assignment techniques.

Aeolus is to be launched in August 2018, with the availability of Aeolus winds around 6 months after launch. It was noted that Aeolus winds have great potential to improve NWP forecasts. It is expected that in 2019 it could be used operationally, and that there could be some requirements for Aeolus before 2020.

One recommendation resulted from this discussion:

IWW14–WG1 – Recommendation 4: When ready, AMV producers to compare Aeolus winds to their respective AMV datasets, and report findings at IWW15.

Considering the new AMV BUFR Sequence:

5) Given that the new AMV BUFR sequence was formally approved by the WMO, most of the working group discussion centered on issues related to the adoption of the new AMV BUFR sequence by satellite operators and NWP centers. Here, the working group was reminded of the following long standing Recommendation from IWW12:

   "IWWG community to agree a new standard BUFR template, which when rolled out should be adopted by all producers".

   The first Action that the working group agreed to was:

   IWW14 – WG1 – Action 6: AMV producers and users to adopt the new AMV BUFR template. Due date: 30 April 2019.

   The following items were brought up in the discussion:

   - NOAA is already providing both formats in different bulletin headers.
   - EUMETSAT agrees with the procedure, although the adaptations to include actual values for all parameters in the new BUFR template could take longer to complete.
   - JMA, SAC/ISRO agree with the procedure.
   - NWCSAF says this would be ready with version v2018, released in the end of this year.

   It was noted that very good communication, along with careful and staged planning, will be necessary between satellite operators and NWP users to facilitate the transition to the new BUFR template.

   AMV producers should provide their AMV datasets using this new winds BUFR template and the heritage winds BUFR template for a six month overlap period. This overlap period would give NWP users time to transition to their systems to use the new AMV datasets in the new BUFR template. NOAA/NESDIS has made offline test data available for its AMV datasets using the new BUFR template for technical testing and implementation purposes.

   It was noted in discussions that it may be difficult for NWP centers to quickly adapt their processing to accommodate the multitude of new AMV datasets (using the new BUFR template) from the

various satellite operators. As noted above, a careful and staged preparation is needed so that NWP centers can methodically make the switch to the new AMV datasets as they become available. The following recommendation is defined for this:

IWW14 – WG1 – Recommendation 5: NWP community to prepare carefully for the use of the new AMV BUFR template by the different AMV providers.

Considering the dependence on the NWP model and other general aspects of each AMV algorithm:

6) It is recalled that a general table with the characteristics of all the AMV algorithms used by the satellite operators is still not available. The group was reminded of the Recommendation from IWW13:

"IWW13 encourages all producers to document the settings used in their systems in production of high resolution winds. To assist in this task a template will be available on the IWW website and the collected data will be made available to the community".

To assure this information is gathered and documented, the following two actions were agreed to by the working group:

IWW14 – WG1 – Action 7: Javier García-Pereda to define a questionnaire related to the characteristics of all currently available AMV products, and including information of dependencies on NWP data, and send it through the IWWG email list for AMV producers. Due date: 1 August 2018.

IWW14 – WG1 – Action 8: All AMV producers to send back the corresponding questionnaire to Javier García-Pereda, who will put all information together and provide it for the repository in the IWWG webpage. Due date: 1 October 2018.

While the working group was discussing the new AMV BUFR template, there was some further discussion on a possible "tracking error" variable(s) related to the shape/size of the AMV correlation surface. It was noted that there is already a location in the new AMV BUFR template for such a variable. The working group agreed to the following recommendation:

IWW14 – WG1 – Recommendation 6: AMV producers to work on options for this "tracking error" related to the AMV correlation surface.

The working group was reminded of a Recommendation from IWW13 that was related to this discussion and recommendation 6 above:

"There should be continued discussion with wind product users and NWP centres in order to determine the optimal error characterisation that should be included in data products."

Considering the AMV Monitoring and Reports by the NWPSAF:

7) It was agreed by all that the AMV Monitoring Reports prepared by the NWPSAF are really useful to identify and document AMV errors/issues previously unnoticed by the AMV producers. It is good that they continue with this work. It was noted that AMVs with new sensors/methods could present difficulties and tasks for the monitoring not seen before. There is need that this is evaluated with care.

There was some additional discussion related to the AMV height monitoring that the Deutscher Wetterdienst is currently performing, using collocated cloud heights from CALIPSO. The working

group endorses that this monitoring be moved to the NWPSAF AMV monitoring web page as soon as possible.

Based on the discussion, the working group agreed to the following recommendations:

IWW14 – WG1 – Recommendation 7: NWPSAF to continue the AMV monitoring such as it is being done now.

IWW14 – WG1 – Recommendation 8: AMV producers to investigate and address issues discovered by the NWPSAF, to improve their products.

Considering the Next AMV Inter-comparison Study:

8) There was some discussion about the AMV validation ground truth/reference data sources used in the AMV inter-comparison studies. It was agreed that use of CALIPSO LIDAR cloud heights for validation of AMV was not too useful since the amount of collocated AMV and CALIPSO data was so small and did not yield very meaningful information. The working group felt that the AMV/CALIPSO comparisons be replaced by comparisons of AMVs generated with cloud heights produced via geometric cloud height techniques.

   There was also some further discussion about including NWP analyses along with NWP forecast information. The NWP forecast data would continue to be used by participating satellite operators to generate the AMVs and the NWP analysis data would be used for AMV validation purposes and to help identify potential issues associated with NWP forecast errors.

Considering Hyperspectral winds versus Radiance Assimilation:

9) There was good discussion in the working group on the question, and the value of assimilating hyperspectral radiances versus assimilating winds derived from this information. The impact of assimilating hyperspectral radiances on ECMWF forecasts was clearly shown by K.Salonen (ECMWF) and it is expected that this approach will continue at ECMWF and other NWP centers for the foreseeable future.

   Methods to derive 3D winds from hyperspectral sounders (e.g., optical flow from IASI L2 products: T, Q, O3) were nicely presented by Olivier Hautecoeur (EUMETSAT). While some limitations exist, expectations are that there is some real potential and information content that can be extracted from this approach and used in nowcasting and operational watch and warning missions. Based on this, the working group agreed to the following recommendation:

   IWW14 – WG1 – Recommendation 9: Further studies should be undertaken to assess the value of winds from hyperspectral retrievals.

Considering Scatterometer Winds:

10) Scatterometer wind data coverage is critical for weather nowcasting and forecasting of quickly developing mesoscale weather events. Good and spatially consistent scatterometer wind coverage enables analysis and forecasts of near surface convergence and divergence fields over the ocean and in coastal regions.

The MetOp-A/B/C configuration provides a unique opportunity to obtain nearly full global coverage at 9:30 LST in both the morning and the evening for ASCAT, which fulfills the main user requirement for many applications supported by the International Ocean Vector Winds Science Team (IOVWST). As such, the IOVWST strongly recommends to maximize the ASCAT-A/B/C coverage over its lifetime.

A decision is to be taken on the Metop-A/B/C configuration (Tristar or Trident) one year from now on. The Tristar configuration is defined as the near-term option and the proposed Trident configuration could be reconsidered later up to 2021. User inputs will be important for decisions made regarding the optimal configuration.

Based on this discussion, the working group agreed to the following recommendation:

IWW14 – WG1 – Recommendation 10: NWP community to notify impact of Metop-A/B/C Tristar configuration before 2021.

Considering IWWG Administrative Items:

11) There was discussion about the decreasing trend in the number of submitted extended abstracts. For IWW12, only 63% of the extended abstracts were submitted and for IWW13, only 52% were submitted. Numerous possible reasons for this were discussed. One reason was that the presentations are made available on the workshop web page. While true, most agreed that it was difficult to glean all the important information from these alone. In addition, presentations cannot be cited in scientific articles – extended abstract can be. Another reason was that people intend to publish their work in a refereed journal. This, of course is highly encouraged, but it was felt that drafting an extended abstract was still a valuable thing to do.

    Overall, there was agreement by the Working Group that extended abstracts are good for a better understanding of all the work done. Furthermore, the collection of extended abstracts provides a single source of invaluable information on the current state and evolution of satellite-derived winds. Based on the discussion, the working group agreed to the following recommendation:

    IWW14 – WG1 – Recommendation 11: Participants to the Winds Workshop are encouraged to continue submitting extended abstracts for their work shown in the International Winds Workshop.

    There was also discussion about the maintenance of the IWWG email list, webpage, and wiki pages. All of these things are currently being maintained at the University of Wisconsin which is fine for the immediate future, but a more permanent solution will be needed for the long term (~2024). The working group did not come up with a solution for this, but all agreed this topic needs further discussion.