Studying AMV Errors with the NWP SAF Monitoring Website

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NWP SAF AMV Monitoring

The NWP SAF (Satellite Application Facility for Numerical Weather Prediction) is a EUMETSAT-funded activity that exists to co-ordinate research and development efforts among the SAF partners to improve the interface between satellite data and NWP for the benefit of EUMETSAT member states.

The aim of the NWP SAF AMV monitoring activities is to identify and understand errors in the AMV data. As part of the NWP SAF AMV monitoring, an archive of observation-minus-background (O-B) monitoring statistics is maintained. The O-Bs are measured against Met Office and ECMWF global model backgrounds, to help reveal whether features seen in the O-Bs are due to problems with one or both models, or with the AMVs. O-Bs plotted as speed histograms, maps and zonal plots can be viewed on the NWP SAF website which has recently undergone a refresh (see screenshot, Figure 1). The plots can be found at: nwpsaf.eu -> Monitoring -> Winds Quality Evaluation -> AMV

To make sense of the large amount of monitoring information held on the website, every two years an Analysis Report is produced. These assess whether features seen in the monitoring statistics have improved or worsened, and identify any new features which have appeared since the previous report. In some cases the cause of a feature can be investigated using a mix of additional O-B statistics, height assignment differences (between the AMVs, model best-fit pressures and cloud-top height products), model fields and satellite imagery. This poster highlights some results from the 7th Analysis Report, published May 2016.

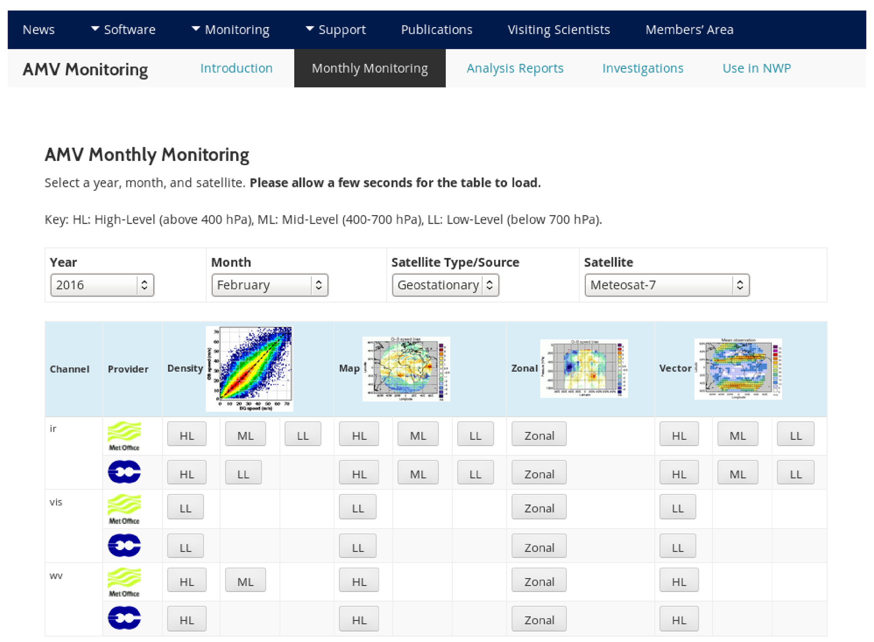


FIGURE 1

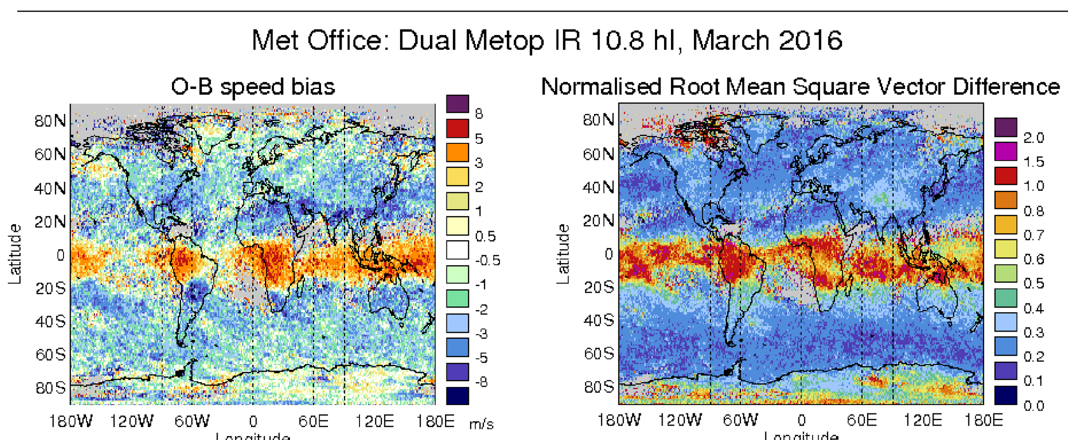


FIGURE 2A

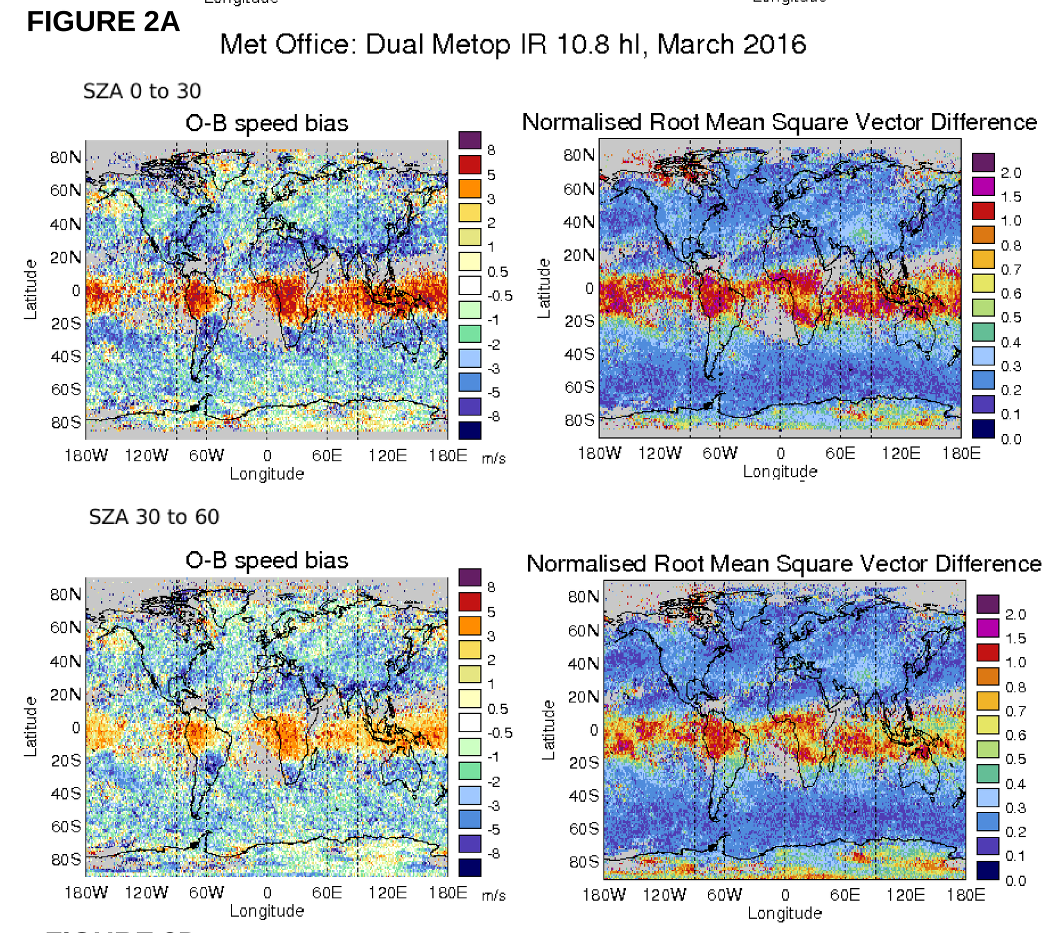


FIGURE 2D

Dual-Metop: Tropical Speed Bias

The Dual-Metop AMVs are derived using one image from each Metop satellite to create an AMV dataset with global coverage. In the tropics the Dual-Metop AMVs have a fast bias and large RMS differences versus the Met Office global model (Figure 2A).

Looking at a sample of Dual-Metop AMVs over the Mid Atlantic (Figure 2B) it can be seen that O-B speed difference appears highest where satellite zenith angle (SZA) is low The SZA is that of the first image of the pair. Averaging this relationship over a month, it can be seen that a correlation exists for Dual-Metop quality and SZA in the tropics but not the extra-tropics (Figure 2C). The correlation is even clearer in the tropics at high level (heights above 400 hPa).

The correlation may exist because the Dual-Metop AMVs use the height assignment of the 2nd image. This could explain the relation seen between SZA and quality, if the height assignment is lower quality when done at a high SZA on cumulonimbus clouds.

Figure 2D gives an idea of the benefit that may be achievable by using the first image for height assignment when it has lower SZA. It shows the effect of filtering by SZA on O-B speed bias and RMS vector difference.

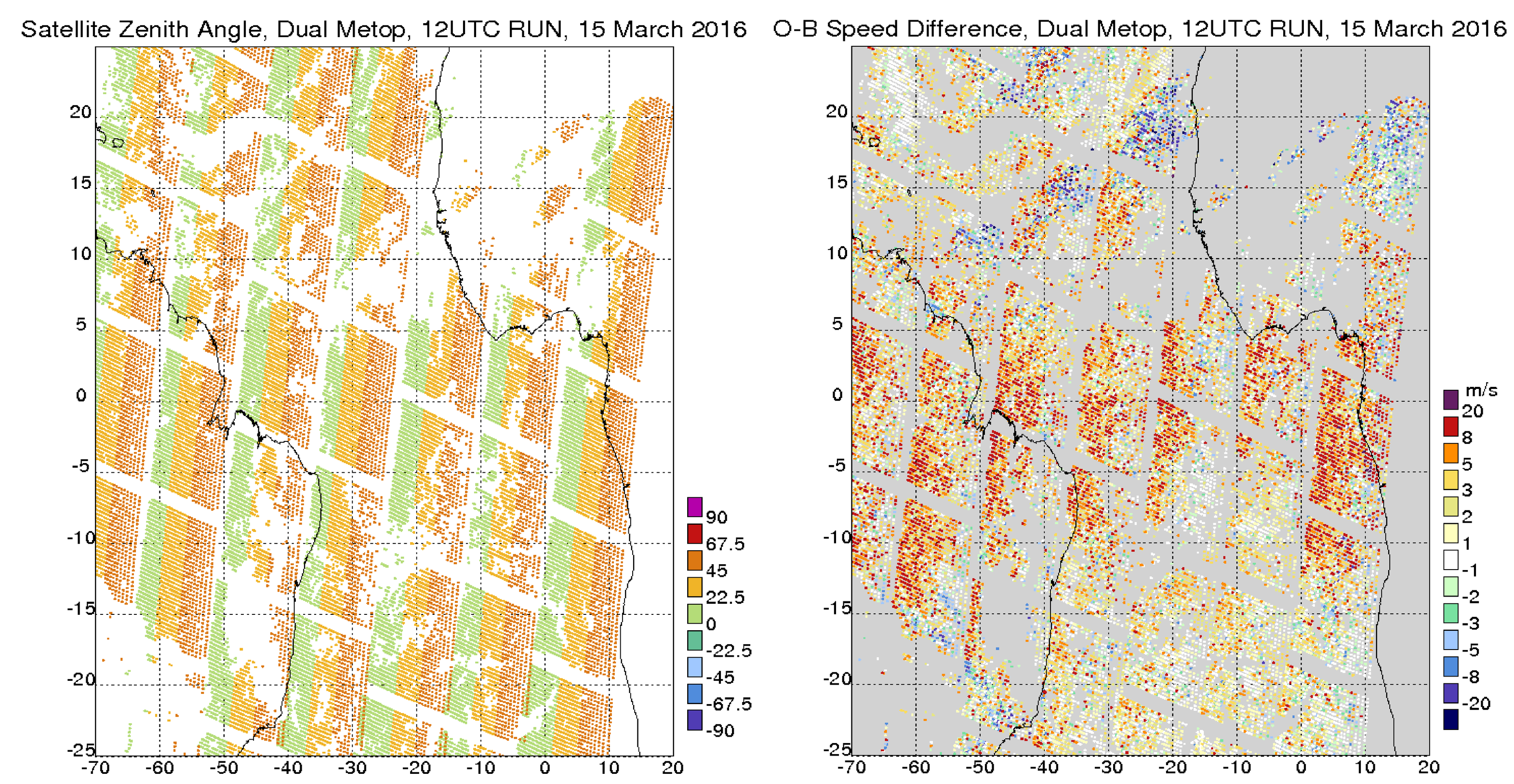


FIGURE 2B

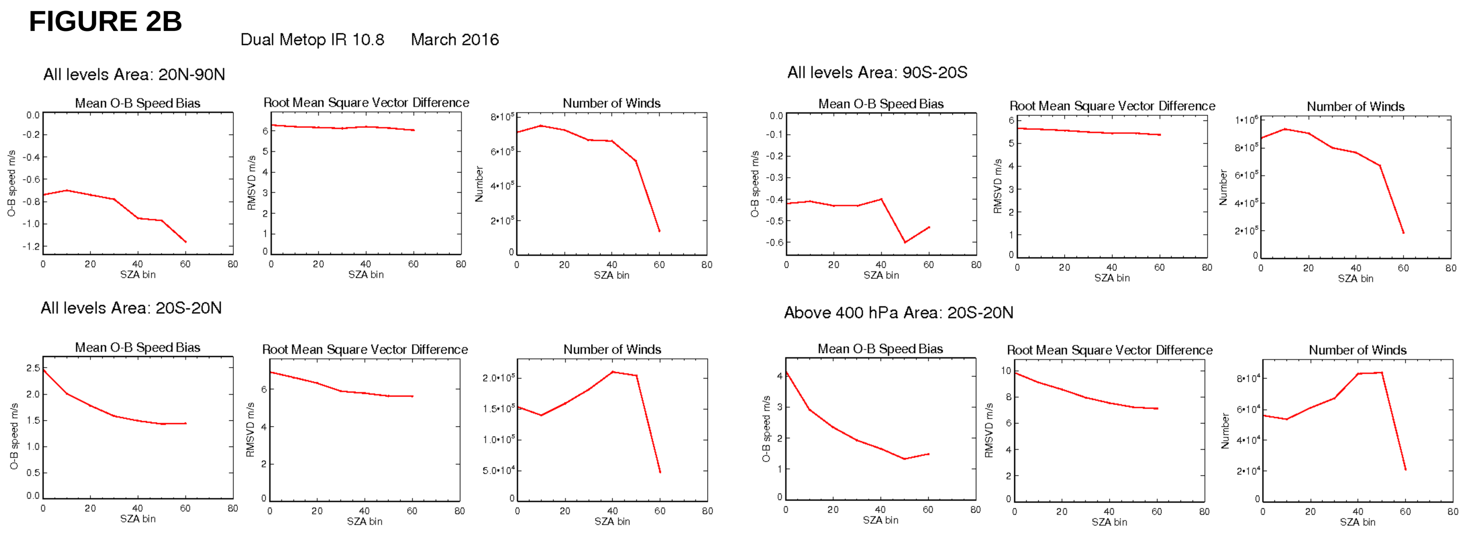


FIGURE 2C

MISR: Positive Speed Bias over Ice and Desert

The MISR instrument, on the Terra polar orbiter, has nine cameras at a range of forward and aft viewing angles. MISR can be used for wind derivation by tracking cloud motions through the range of view angles and using the apparent along-track motion due to parallax for height assignment.

MISR wind monitoring shows a positive speed bias over the Sahara desert and Greenland (Figure 3A). In the Figure 3B, some west-by-southwesterly Saharan MISR wind vectors can be seen over the Sahara. These agree well with cloud motion seen in Meteosat-10 imagery (not shown). However, the heights assigned to the MISR winds (Figure 3C) disagree strongly with those of the Met Office global model Meteosat-10 cloud height product (Figure 3D).

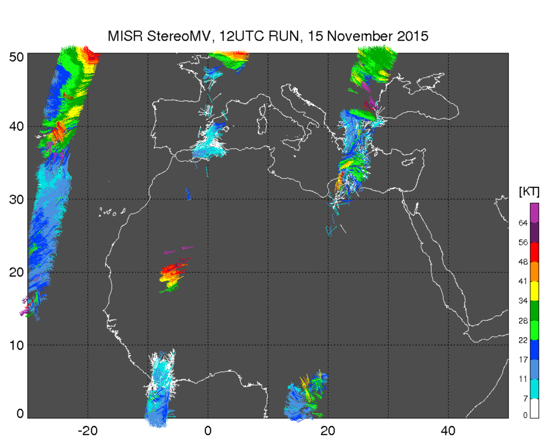


FIGURE 3B

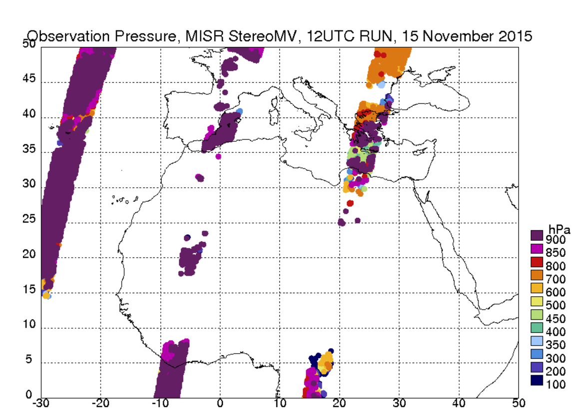


FIGURE 3C

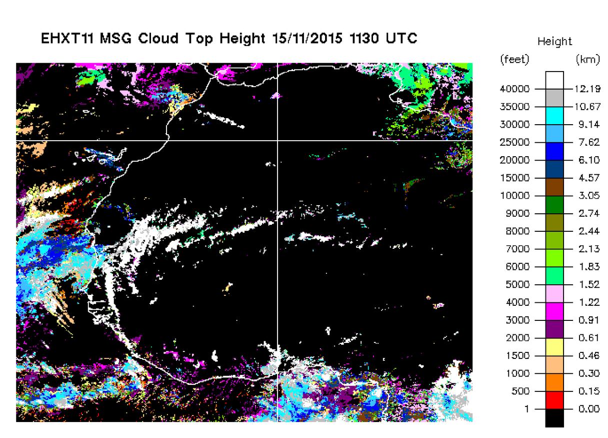


FIGURE 3D

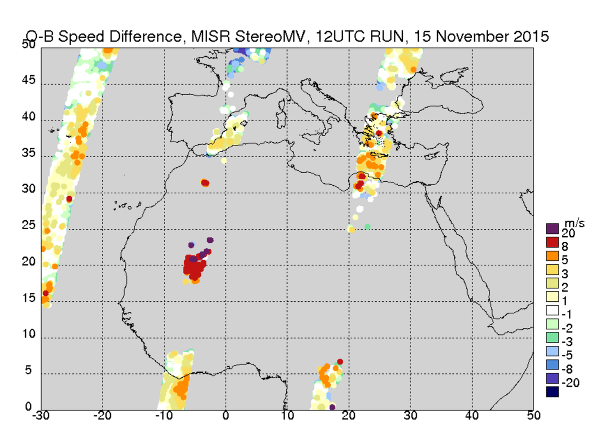


FIGURE 3E

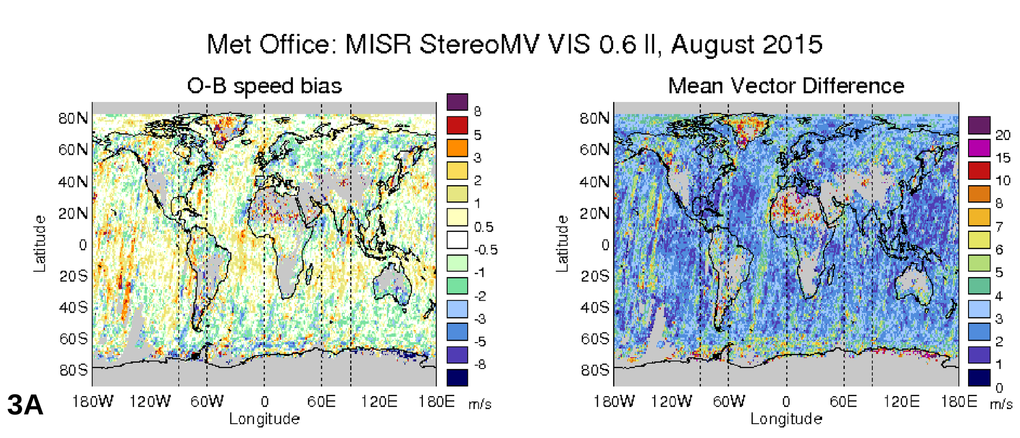


FIGURE 3A

Assigning the fast high level motion of cirrus near the Saharan surface where the wind speeds are very low leads to a large positive O-B speed bias (Figure 3E). Looking at MISR true colour imagery for this case (Figure 3F), it can be seen that the MISR wind vectors agree well with that of the cloud shadows, leading to a near-surface height assignment. It is thought that the shadows are tracked instead of the clouds when they have more contrast with the surface than the clouds do over a bright surface (K. Mueller, pers comm. Apr 2016).

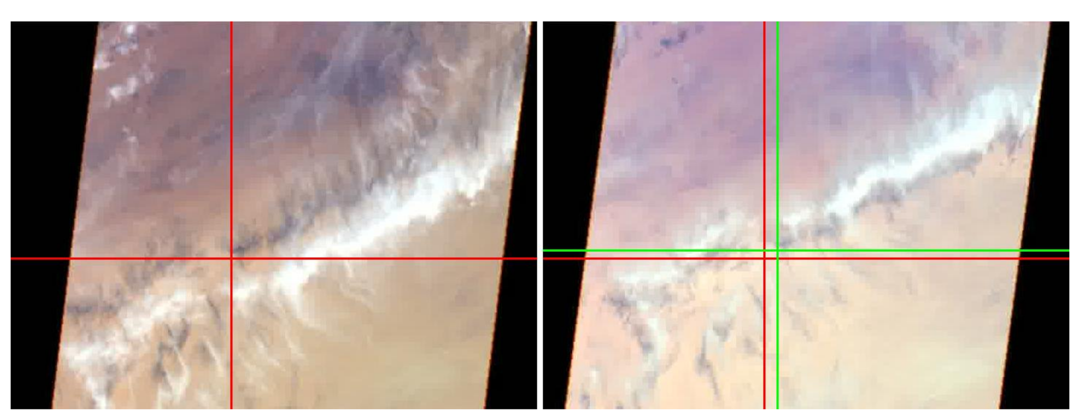


FIGURE 3F

Himawari-8 Typhoons

A positive O-B speed bias of MTSAT WV AMVs surrounding tropical cyclones was noted in previous NWP SAF Analysis Reports.

Typhoon Dujuan of 19th-30th September 2015 developed a well defined eye (Figure 4A). Himawari-8 imagery is higher resolution than that of MTSAT. The Himawari-8 AMVs also have a new derivation scheme which mixes the benefits of tracking fine detail with a small tracking box with the reliability that comes with the use of a larger target. These two differences help explain the difference in AMV coverage (Figure 4B). The Himawari-8 AMVs are more numerous and are extracted closer to the eye of the typhoon.

By inspection of the two satellites' O-B speed differences (Figure 4C), it can be seen that where WV AMVs are extracted for both satellites, the Himawari-8 speed differences tend to be lower than those of MTSAT-2. For example, over sea to the south of the Philippines, the MTSAT AMVs mostly have large positive speed differences, which is not the case for Himawari-8 WV AMVs at the same locations. The Himawari-8 AMVs derived near to the southeast of the typhoon eye have large positive speed differences, others near the eye have a mix of positive and negative differences.

O-Bs for Typhoon Krovanh during 16-17 September 2015 (not shown) are similar in that Himawari-8 AMVs have smaller O-B speed differences than co-located MTSAT AMVs, however the Himawari-8 AMVs near the eye show a mix of O-B differences with no clear pattern.

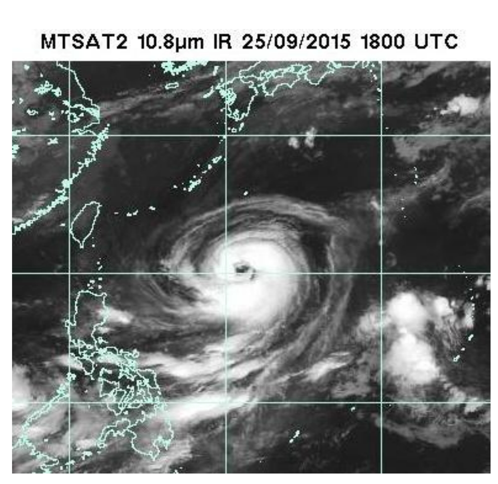
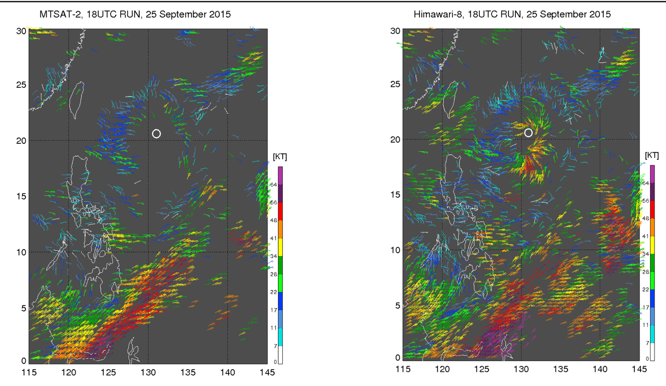


FIGURE 4A

FIGURE 4B



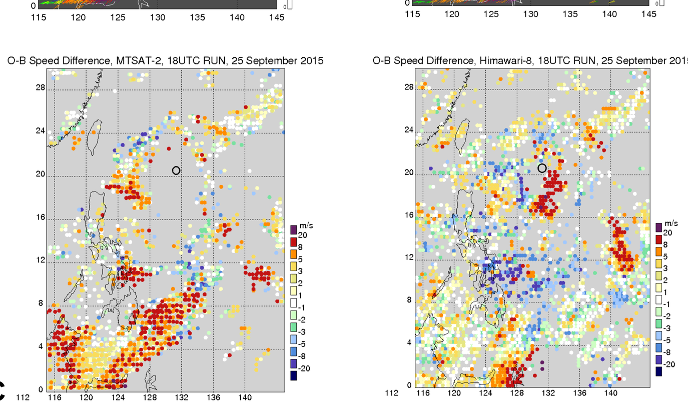


FIGURE 4C

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