Using Data from the Advanced Himawari Imager (AHI) as a Proxy to Assess the Performance of the GOES-R Derived Motion Winds Algorithm

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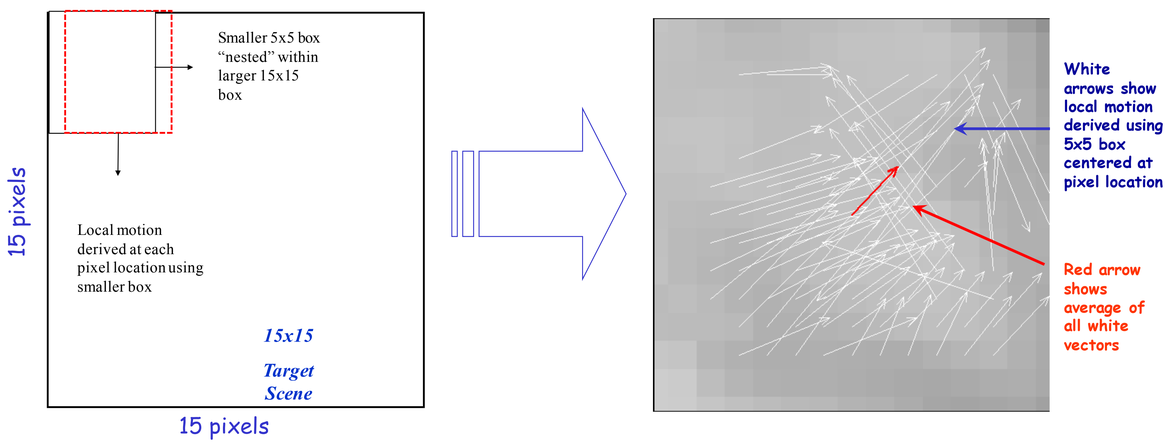
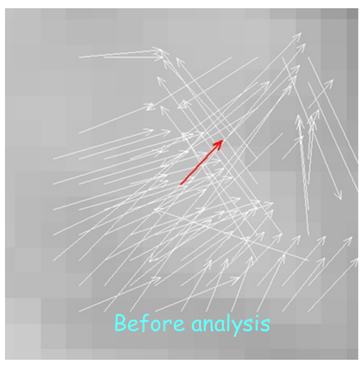
1. Introduction

In preparation for the launch of the GOES-R satellite later this year, the Derived Motion Winds algorithm is undergoing final testing and validation using proxy data from the Japan Meteorological Agency's Himawari-8 satellite which was launched in October 2014 and carries the 16-channel Advanced Himawari Imager (AHI) that is nearly identical to the Advanced Baseline Imager (ABI) to be flown on the GOES-R satellite. Access to data from Himawari-8 presents GOES-R algorithm developers with a unique opportunity to assess the performance of their algorithms prior to the availability of ABI data. It also prepares potential users of GOES-R imagery and derived products for the substantial increase in the volume of information that will be available to the user community.

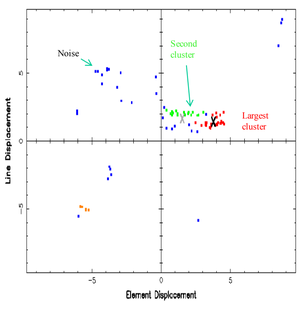
2. Nested Tracking Approach

The GOES-R Derived Motion Winds algorithm is a departure from the legacy algorithm, which has run in NEDIS Operations since the mid 90s, in that it employs a new tracking technique whereby a smaller 5x5 pixel box is "nested" within the larger target scene and local motion vectors are derived over the interior pixels. The local displacements are subsequently analyzed by a cluster analysis algorithm (DBSCAN) to obtain the dominant motion in the scene. One advantage of this approach is that it allows a representative height to be assigned to the derived AMV using only those pixels associated with the dominant motion cluster.

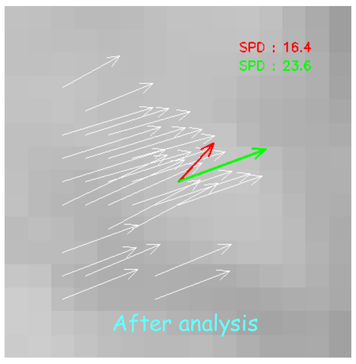




Step 1: Generate field of local motion vectors with nested tracking. Red vector shows the average of all displacements.

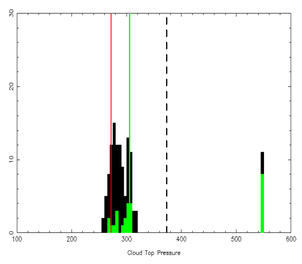


Step 2: Analyze displacements to find motion clusters.



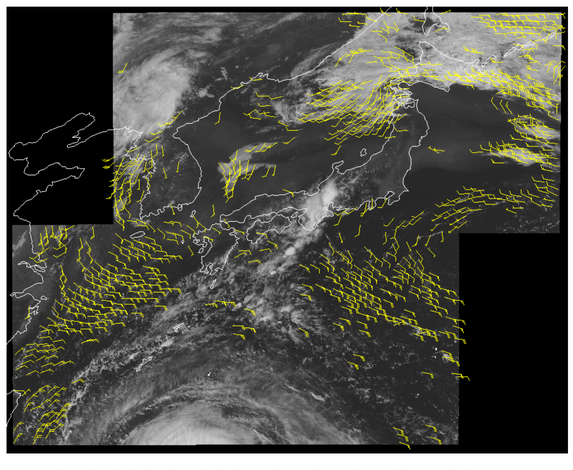
Step 3: Compute final motion estimate from points in largest cluster. Green vector shows the average displacement of points in largest cluster.

Step 4: Compute median CTP of pixels in largest motion cluster.

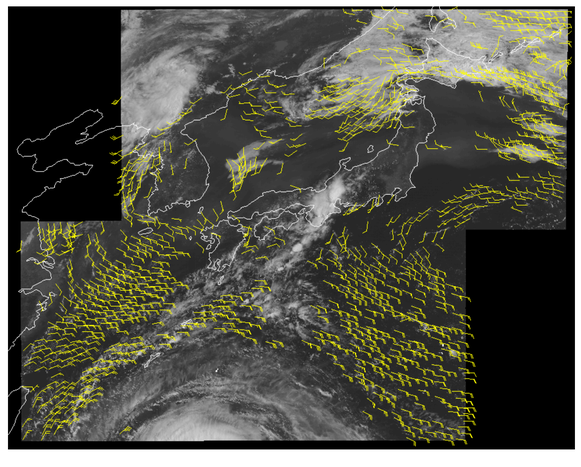


CTP distribution for a target scene (black) and the largest motion cluster (green) in the scene. The red line shows the median of the cold sample, the green line shows the median of the largest motion cluster, and the dashed line shows the mean of the largest motion cluster

3. Testing algorithm with full-resolution 0.5 km AHI visible data



Low level winds in the vicinity of Typhoon Soudelor. Winds exhibiting an acceleration of more than 5 m/s have been removed.



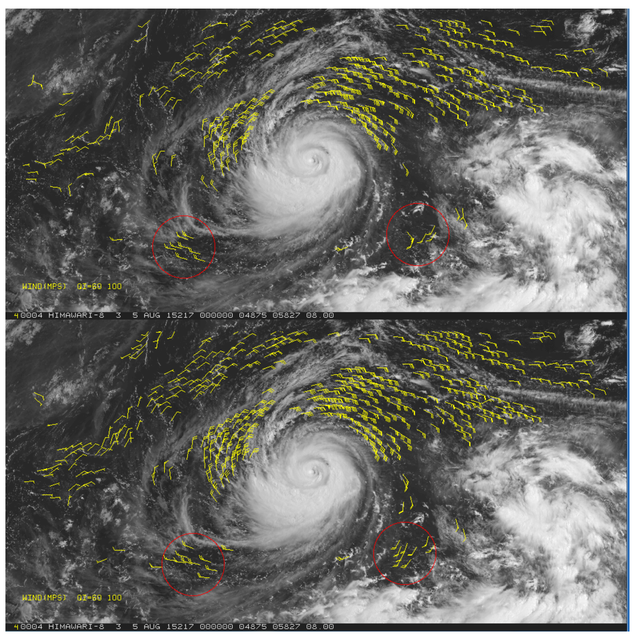
Low level winds in the vicinity of Typhoon Soudelor. Winds exhibiting an acceleration of more than 7.5 m/s have been removed.

3. Testing algorithm with full-resolution 0.5 km AHI visible data (cont.)

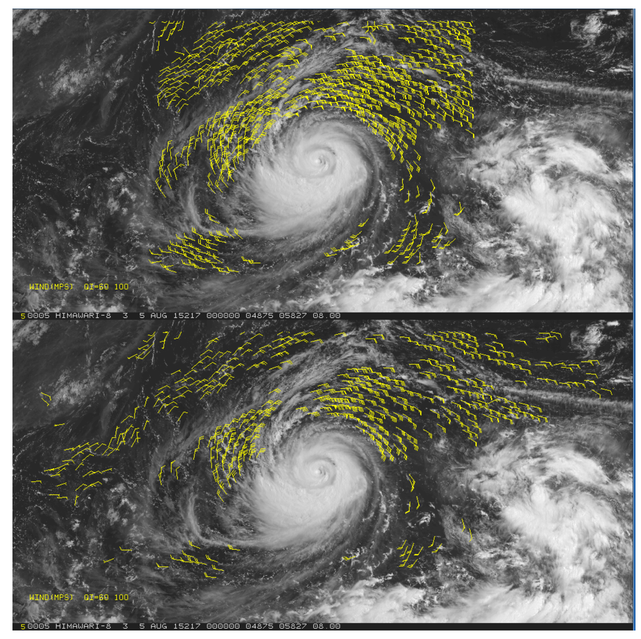
The GOES-R AMV algorithm has been tested with the 0.5 km resolution visible data from AHI in the hopes of gaining valuable insight into the performance of the algorithm prior to the launch of GOES-R. This insight should speed up the transitioning of the algorithm from research into operations.

Currently in NOAA Operations 1 km visible data from GOES is downsampled to 2km before winds are generated. To better understand the impact of resolution on the new GOES-R algorithm three tests were performed with the AHI 0.5 km data.

1. The data was converted to 2km by sampling every fourth pixel of the full resolution image prior to generating winds.
2. The data was converted to 2km by averaging (4x4 box) the full resolution image prior to generating winds
3. The full resolution data was used without any downsampling of the data prior to generating the winds.



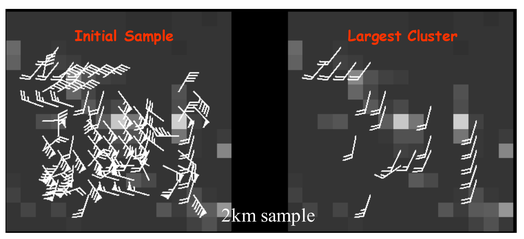
Winds generated using visible imagery reduced to 2km resolution by sampling (top) and 2km resolution by averaging (bottom). Note the improved coverage shown by red circles.

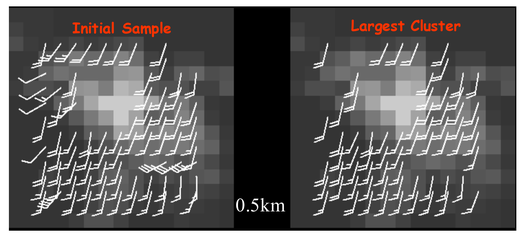


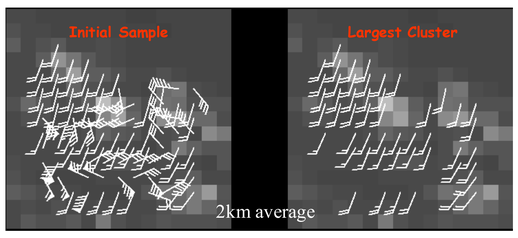
Winds generated using full resolution (0.5km) imagery (top) and imagery reduced to 2km resolution by averaging (bottom).

Results of testing suggest visible imagery should be processed at full resolution to capture the motion of the small scale cumulus clouds at low levels near the storm. If a reduction of the resolution is necessary it should be achieved through *averaging* and not through sampling.

Individual target scenes in southeast quadrant of storm (red circle)



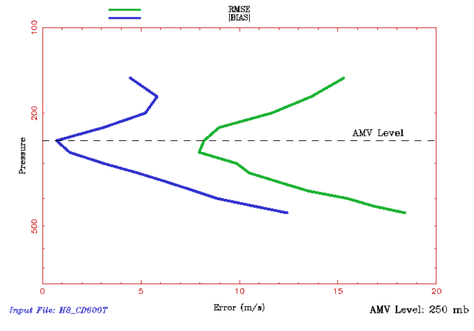




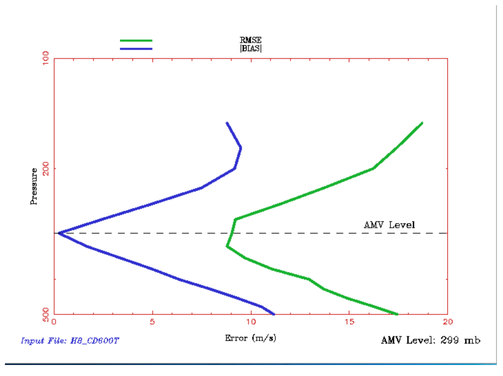
Local motion vectors derived for the same target scene southeast of the storm center. The scene for test 1, in which the resolution was reduced through sampling, is shown at top left. The scene for test 2, in which the resolution was reduced through averaging, is shown at bottom left and the full resolution output (test 3) is shown at top right. The left panel shows the local motion vectors before cluster analysis and the right panel shows the local motion vectors after the analysis to find the largest cluster.

4. AMV height assignment

The GOES-R AMV algorithm exploits upstream information provided by the GOES-R Cloud Team in the form of pixel level values of cloud type, cloud phase and cloud top height. Himawari-8 proxy testing has also included an analysis of the representative AMV height derived from the CTP distribution associated with the largest motion cluster.



Level of Best Fit (LOBF) profiles of speed bias (blue) and vector RMSE (green) for AMVs assigned to 250 mb.



Level of Best Fit (LOBF) profiles of speed bias (blue) and vector RMSE (green) for AMVs assigned to 300 mb.