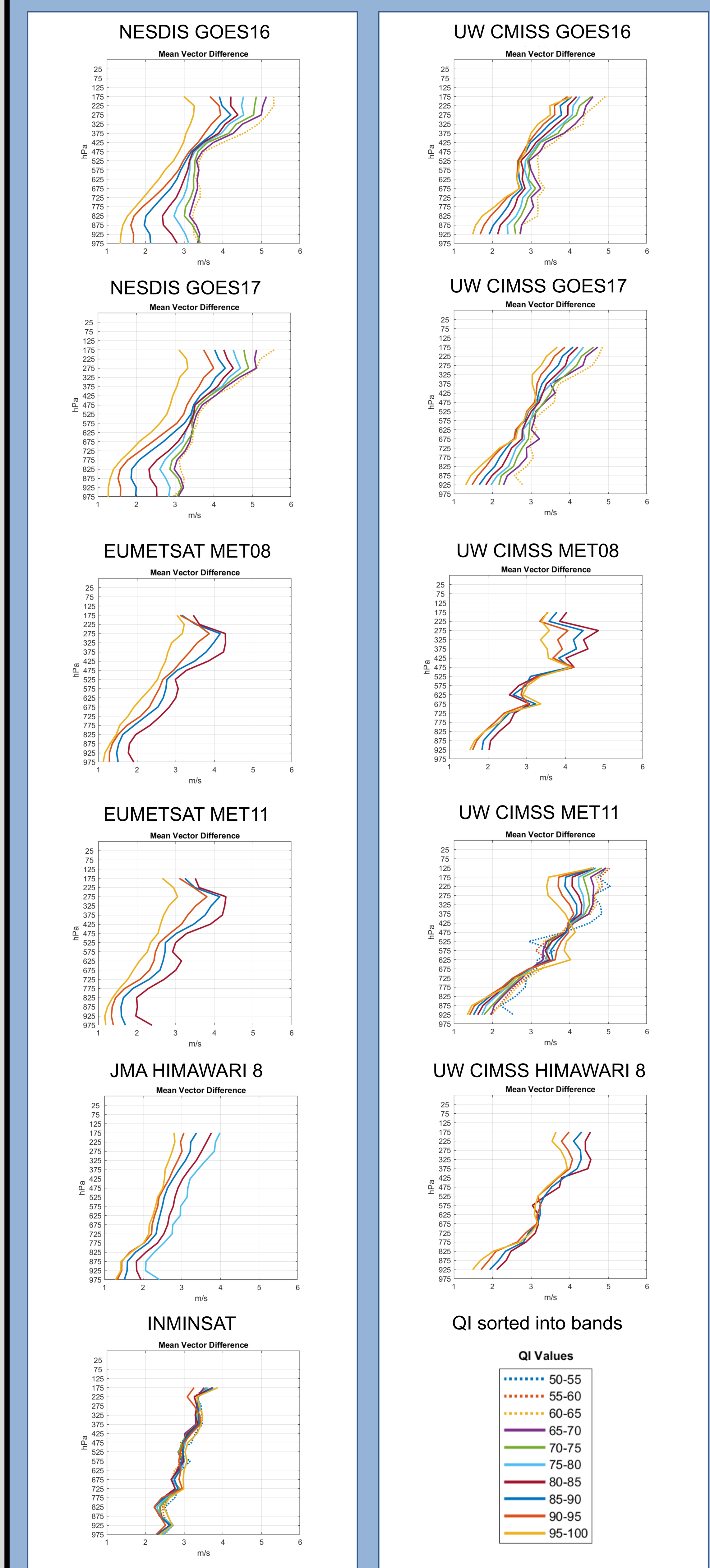
Comparing Effects of Quality Indicator Thresholds for Atmospheric Motion Vectors in NAVGEM

U.S. NAVAL RESEARCH LABORATORY

Rebecca Stone
SAIC, U. S. Naval Research Laboratory, Monterey, CA
Patricia Pauley
Marine Meteorology Division, U. S. Naval Research Laboratory, Monterey, CA

QI and Mean Vector Differences IR



Abstract

NRL is developing a more flexible and easy-to-use architecture for controlling the assimilation of satellite winds. The new architecture will make it easier to accommodate changes in the satellite wind observation suite, and will also facilitate control of various satellite winds quality control measures, such as channel selection, vertical limits, and quality indicator (QI) thresholds. The QI flags associated with each atmospheric motion vector (AMV) are determined during production of the AMVs; each NWP center may apply QI thresholds to select which data to assimilate. While working on our new architecture, we realized that not only do the assigned thresholds vary widely for different providers and channels, but the thresholds in some cases have not been updated since the latest generation of geostationary satellites has become operational. We examine the stratification of counts, innovation statistics, and forecast sensitivity observation impact for various thresholds of QI, for each of the geostationary AMV types assimilated in the U.S. Navy's global numerical weather prediction system NAVGEM.

Questions

- Do the QI values correspond with statistics such as vector difference, wind speed bias, and FSOI?
- How do the different sources' QI values compare to one another?
- What thresholds should be proposed for testing and updating?
- Are existing quality control measures still appropriate?

Methodology

- Forecast Model: NAVGEM v2.1 (T425L60)
- Data Assimilation: NAVDAS-AR (NRL Atmospheric Variational Data Assimilation System – Accelerated Representer)
- Forecast Sensitivity Observation impact at 24 hours computed every 6 hours

Next Steps

- Continue to assimilate all of the QI levels currently received.
- Focus quality control measures on channel and level monitoring.

IR Channel

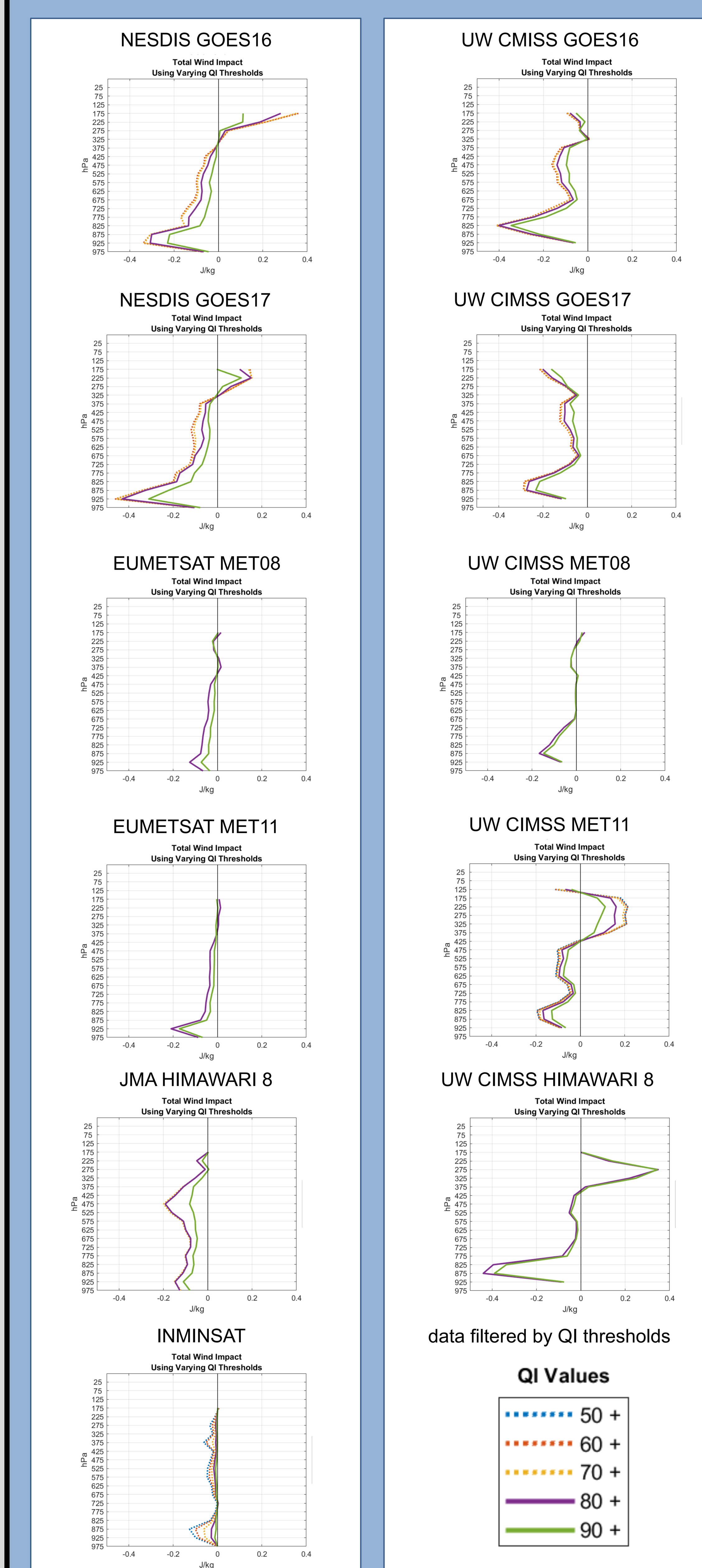
Mean Vector Difference Profiles (QI bands)

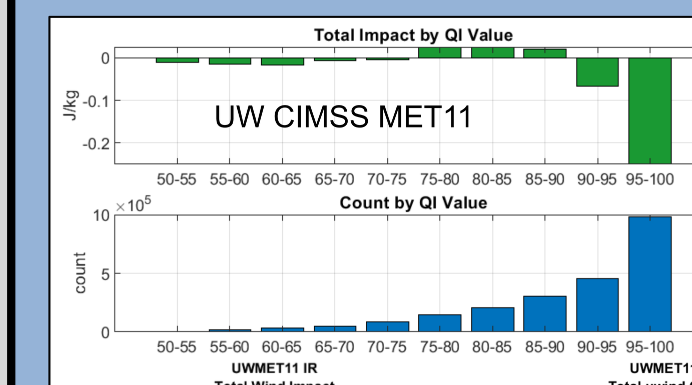
- NESDIS and EUMETSAT vector differences with NAVGEM stratify strongly on QI, with higher confidence values corresponding to lower vector differences.
- JMA wind vector differences with NAVGEM stratify on QI, but not as strongly as for NESDIS data.
- INMINSAT wind vector differences with NAVGEM do not have a clear relationship to QI.
- CIMSS vector differences with NAVGEM stratify with QI for all the satellites shown here, but more so at upper and lower levels than in midlevels.
- For NESDIS and EUMETSAT winds, stratification with QI is weaker at midlevels, except it remains strong for QI 90 and higher.

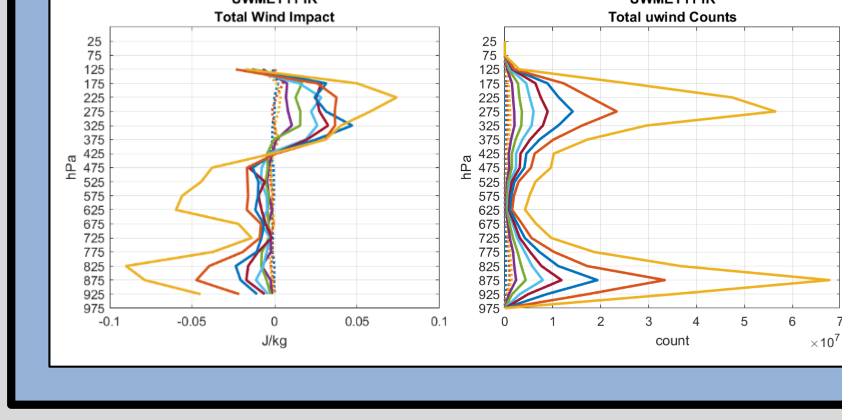
FSOI Ob Impact Profiles (QI thresholds)

- None of the geostationary AMV sets would be more beneficial if a higher QI threshold were applied.
- Using data including the lower QI values is only harmful for sensors and at levels where the FSOI is already nonbeneficial.

QI and Forecast Sensitivity Observation Impact IR





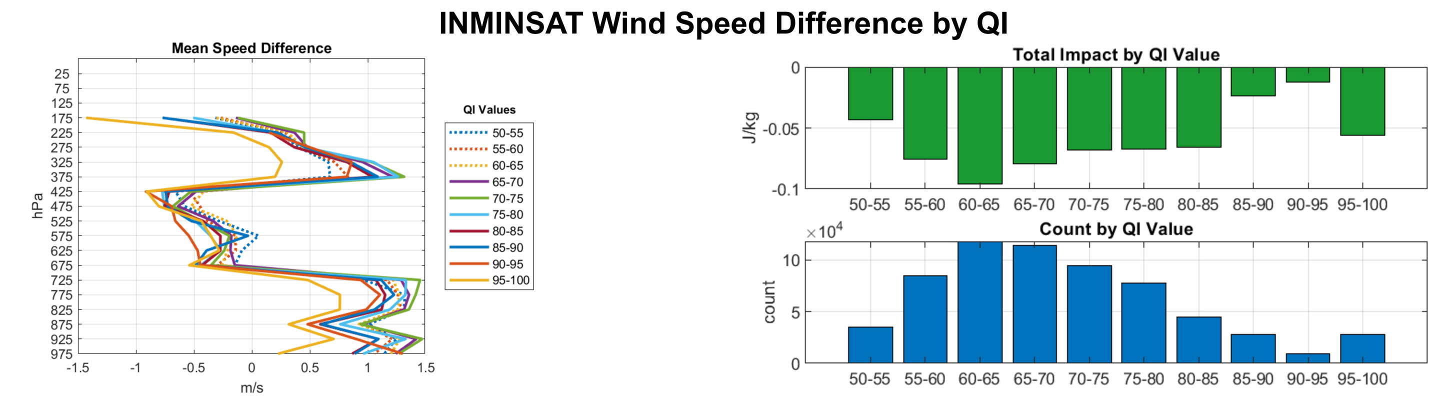


This is one of only two cases where some QI bands of the IR channel were found to be nonbeneficial.

- Column totals (bar plots at left) suggest raising the QI threshold for these winds would filter out the nonbeneficial winds.
- However, looking at the vertical profile for each QI band shows that imposing a vertical limit on this channel would be a better solution.
- The second case of nonbeneficial IR winds was for UW Himawar-8 (not shown here), and similarly, a vertical level limit was found to be a better filter.

QI and Wind Speed Differences

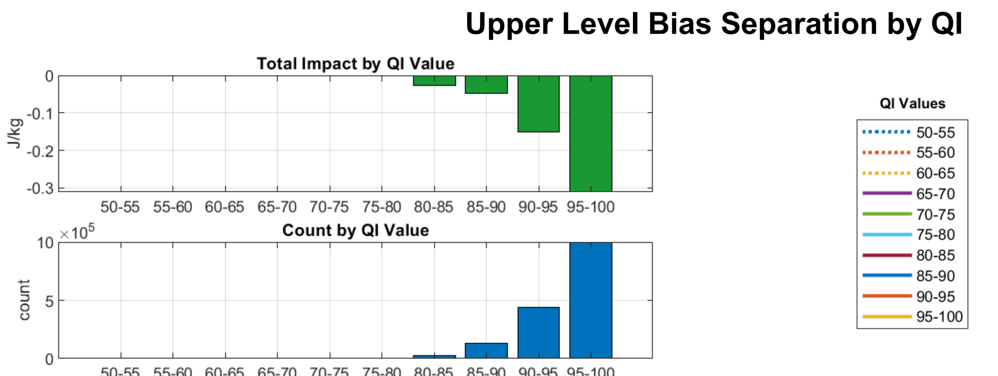
INMINSAT Wind Speed Difference by QI

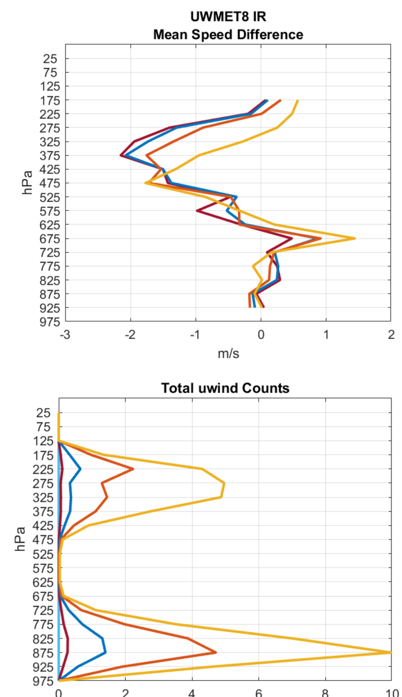


For INMINSAT, the distribution of QI values is quite different from other processing centers, with greatest quantity of QI values below 85. While MVD does not show a clear relationship to QI, wind speed difference does show some stratification on QI.

All QI bands give beneficial impact.

Upper Level Bias Separation by QI





UWMET8, UWGOES16, and UWGOES17
IR

At lower levels, all QI bands have similar small wind speed bias relative to NAVGEM background. Counts are very low in midlevels. At upper levels, the highest QI curve, 95 and greater, separates.

The highest QI values dominate the counts at both upper and lower levels. Aloft, they have less negative (or more positive) bias relative to NAVGEM.

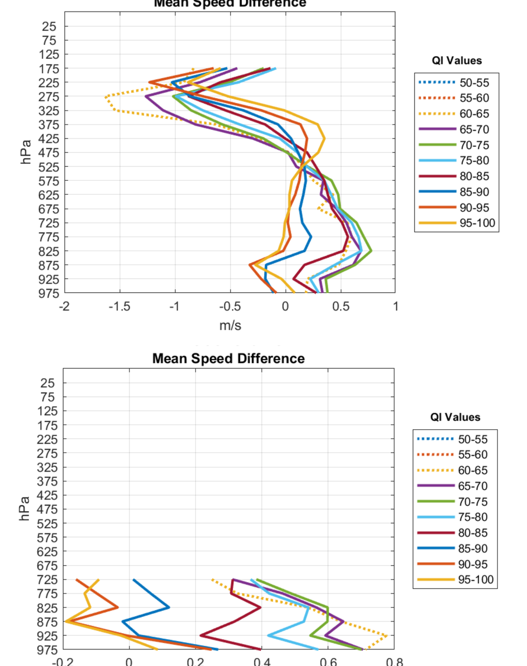
Plots for UWGOES16 and UWGOES17 are similar to those shown here for UWMET8.

Lower Level Bias Separation by QI

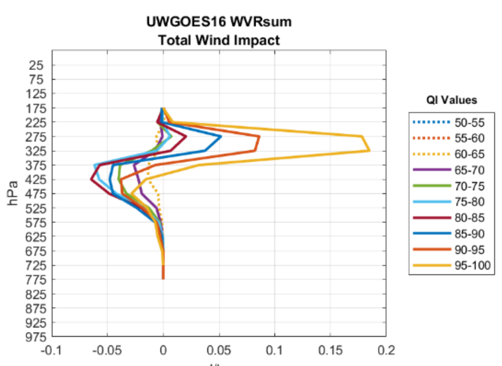
NESDIS GOES16
IR

At upper levels, all QI bands have significant negative bias relative to NAVGEM (slower than background); at lower levels, the high QI bands have small bias, while the lower QI bands have significant positive bias.

NESGOES16. EUMET08, and EUMET11 SWIR and VIS channels (low level winds) showed a similar bias separation above and below QI 85.

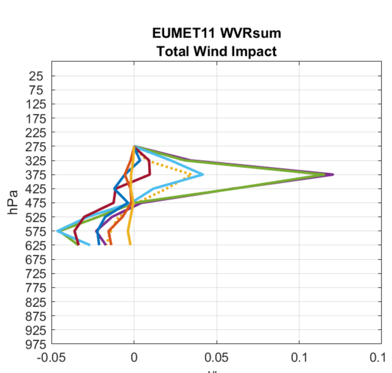


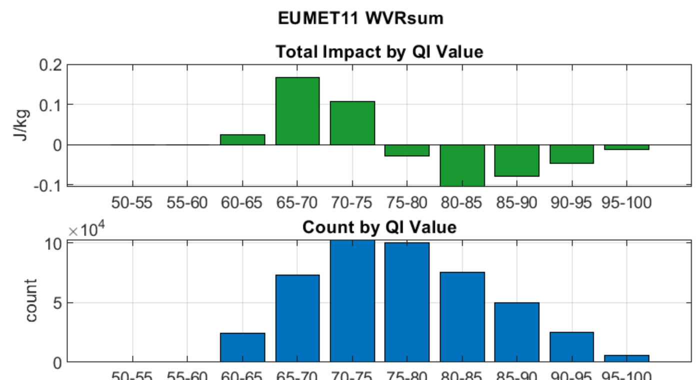
Water Vapor Channels



At right, plots show EUMET11 gives beneficial FSOI at higher QI, and nonbeneficial impact at lower QI. This suggests more benefit might be extracted from water vapor channels by tightening QI thresholds. However, the vertical profile for each QI band shows that imposing a vertical limit on this channel would be a better solution. EUMET8, JMAHMWR08, and NESGOES16 showed similar patterns.

At left, UW GOES16 clear air water vapor channels' highest QI values give nonbeneficial FSOI. Vertical QC limits are more useful for this situation than QI selection. UWHMWR08 and UWMET8 showed similar patterns.





Acknowledgements: RES and PMP gratefully acknowledge support from the U. S. Naval Research Laboratory under program element 0603207N.