Using NPROVS for Evaluation of Suomi NPP Atmospheric Sounding Retrievals against Conventional Radiosonde Observations

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Introduction

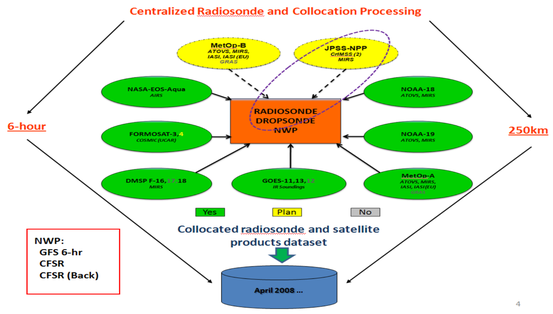
The consistent validation and verification of the multiple satellites, sensors and derived product suites operated by NOAA is critical for their optimal integration and impact in weather forecast and climate applications. The NOAA Products Validation System (NPROVS), supported by the NOAA Joint Polar Satellite system (JPSS), deployed at NOAA NESDIS STAR in April 2008, provides ongoing data access, collocation, monitoring and inter-comparison of these multiple product suites.

In this study, we present the initial analysis of ensemble vertical statistics, based on 12 months of NPROVS collocation data, revealing the performance of derived atmospheric temperature and water vapor retrievals from the Suomi-NPP Cross-track Infrared Microwave Sounder Suite (CrIMSS), including the products from the CrIMSS Interface Data Processing Segment (IDPS), the NOAA Unique CrIS/ATMS Processing System (NUCAPS), and the NOAA Microwave Integrated retrieval Systems (MiRS).

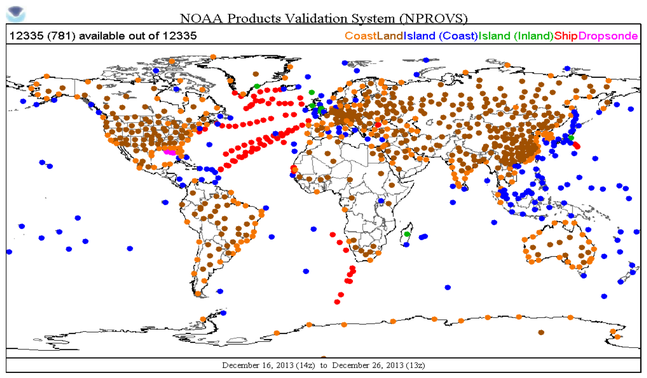
Conventional radiosonde observations (RAOBs) are used as the reference to define the retrieval accuracy. We will also investigate how their accuracy characterization varies with other commonly used reference datasets including NOAA NWP GFS and ECMWF analysis. We discuss how such analysis can advance our understanding of the internal consistency of major components within the retrieval system and, furthermore, if major geophysical variables derived from the hyper spectral sounder represent a nominal level of maturity for application in climate monitoring.

NPROVS

NOAA Products Validation System

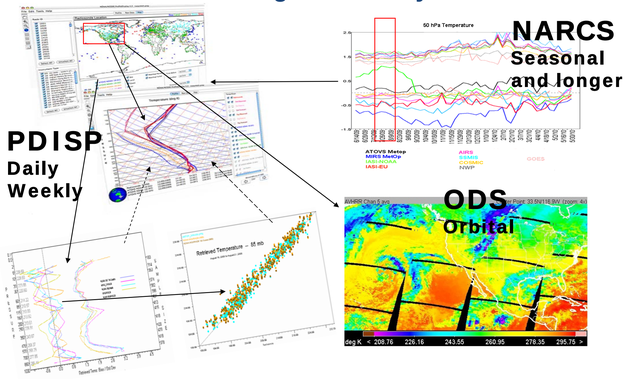


NPROVS provides daily compilation of collocated conventional RAOBs and derived satellite soundings from multiple satellites and product systems. The collocation strategy is consistent for all satellite products, including 6 hr/250 km time/space window, and "single, closest" satellite profile to a given sonde from each satellite product.



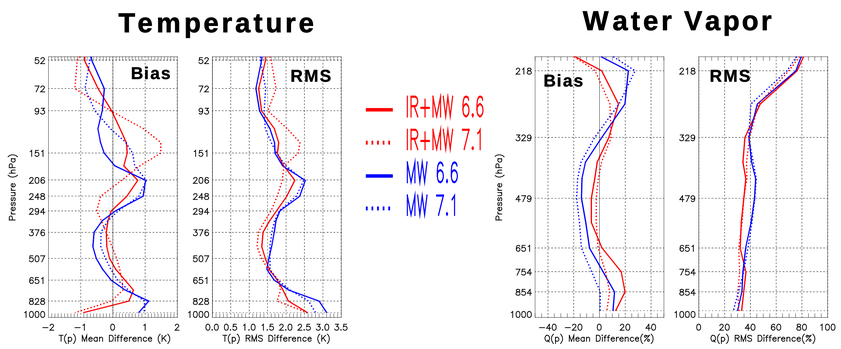
Map of sites of global operational radiosonde/dropsonde observations that are used as the anchor to collocate satellite data in NPROVS. Ten days of data are shown as an example. Different colors represent different RAOB terrain types.

NPROVS Monitoring and Analytical Interface



NPROVS analytical interfaces include 1) Profile Display (PDISP): short-term display and statistical analysis of collocations, NPROVS Archive Summary (NARCS): long-term trend analysis of satellite-minus-sonde difference, and 3) Orbital Display System (ODS): horizontal field display of all satellite data.

CrIMSS IDPS MX 6.6 vs. MX 7.1 GLOBAL

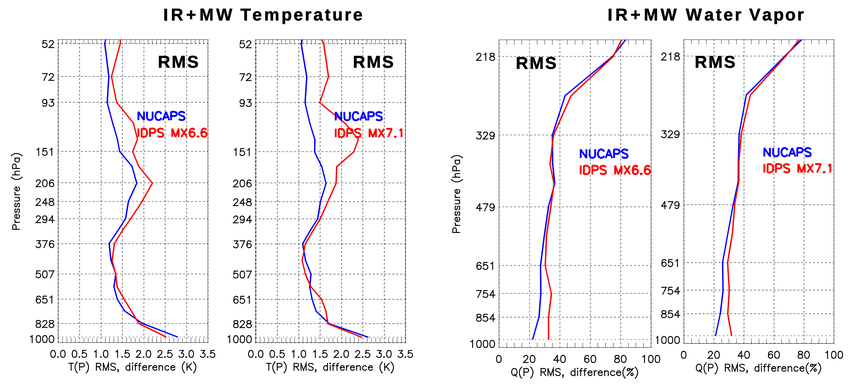


Comparison of CrIMSS IDPS MX 6.6 and MX 7.1 by using NPROVS *GLOBAL* data that the satellite-RAOB collocations are within 3 hr and 100 km. March 2 -June 30 2013 data are for MX 6.6 and July 20- December 31 2013 for MX 7.1. The samples and yields are listed in the Table.

- MX 7.1 shows a significant increase in the IR+MW yield over the MX 6.6 at the expense of MW-only yield.
- MX 7.1 IR+MW temperature retrieval degrades over the altitudes above the tropopause.
- MX 7.1 shows a slight improvement in the lower troposphere in both temperature and water vapor retrievals.
- For both versions in the troposphere, IR+MW temperarure retrieval is better than MW-only.

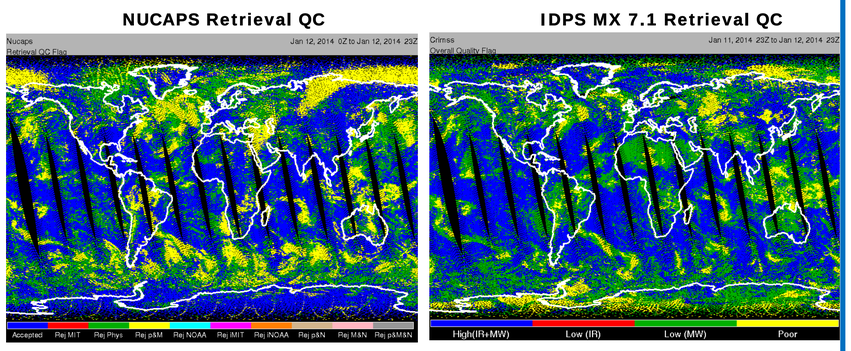
		Prof. number	Yield (%)
	IR+MW	17612	35
MX 6.6	MW-only	26986	53
	Poor	6436	12
	IR+MW	34234	48
MX 7.1	MW-only	28800	40
	Poor	8721	12

NUCAPS vs. IDPS GLOBAL



Comparison of CrIMSS IDPS and NUCAPS IR+MW retrievals by using NPROVS *GLOBAL* data that the satellite-RAOB collocations are within 3 hr and 100 km. Commonly QC "accepted" sample is used for the evaluation. The sample for March 2 -June 30 2013 data (MX 6.6 vs NUCAPS) is ~17,600 and for July 20- December 31 2013 (MX 7.1 vs NUCAPS) is 29,800.

NUCAPS and IDPS are overall comparable but 1) NUCAPS temperature is better in the upper troposphere and lower stratosphere than IDPS particularly MX 7.1 and 2) NUCAPS temperature is slightly worse in the surface, and 3) NUCAPS water vapor is slightly better than IDPS in the troposphere.

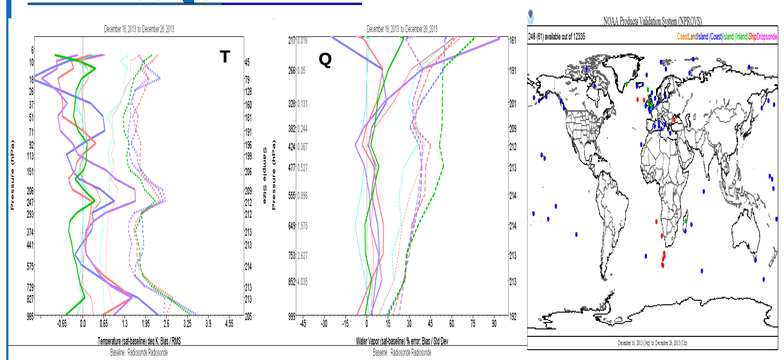


One-day example of quality control flag for retrievals of NUCAPS and CrIMSS IDPS MX 7.1. Yields for SEA and Non-SEA are listed in Table.

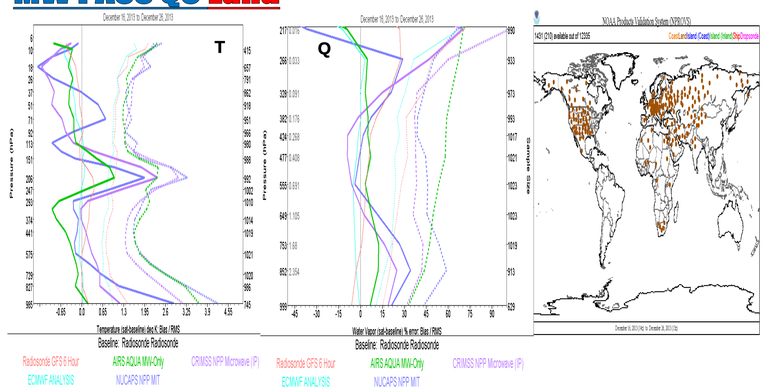
It appears NUCAPS flags too many "Poor" retrievals over Sea particularly along the mid-latitude jet streams of both hemispheres. The yield for Non-Sea IR+MW in NUCAPS is much higher than IDPS.

		Sea yield (%)	Non-Sea yield (%)
	IR+MW	43	58
NUCAPS	MW-only	37	21
	Poor	20	21
IDPS 7.1	IR+MW	52	37
	MW-only	39	44
	Poor	9	19

MW PASS QC Maritime

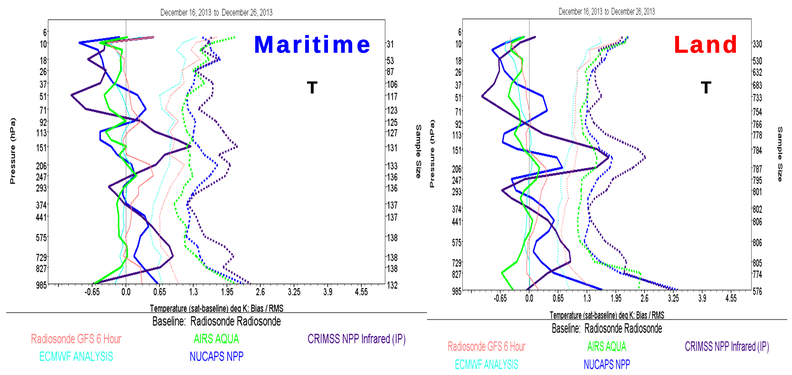


MW PASS QC Land



Inter-comparison of MW retrievals from different products over December 16-26 2013. MW retrievals include both "cloudy" and "clear" retrievals. NPROVS data that the satellite-RAOB collocations are within 6 hr and 100 km are used to compute the statistics. Solid curves are mean biases and dashed ones RMS differences. "T" for temperature and "Q" for water vapor. The collocations are shown on the map and terrain types are defined by RAOBs.

IR+MW Pass QC



Inter-comparison of IR+MW temperature retrievals from different products over December 16-26 2013. NPROVS data that the satellite-RAOB collocations are within 6 hr and 100 km are used to compute the statistics. Solid curves are mean biases and dashed ones RMS differences. "T" for temperature.

Conclusions and Future Work

- NPROVS shows a strong capability of monitoring and analyzing the performance of atmospheric sounding products derived from infrared and microwave instruments of NPP and other satellite platforms and instruments.
- Satellite products inter-compared show respective strengths and weakness in terms of accuracy and yield.

We are working with the product developers to understand more the performance characteristics through further NPROVS validation and product development activities, with the aim to help improve the retrieval algorithms and enhance the product usefulness in weather and climate applications.

STAR Center for Satellite Applications and Research

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