# Development of Gridded Innovations and Observations Supplement to MERRA-2

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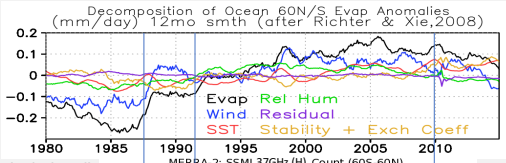
## Motivation

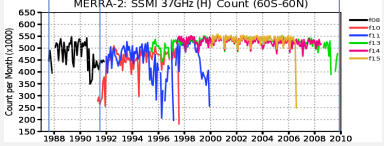
- Observations are a key resource making reanalyses possible
- Formats are different for essentially each observation type
- Any given time or place may have multiple observations or no observations at all, multiple instruments may overlap but a channel on an instrument may stop working while others proceed
- Here, we demonstrate the usefulness of having easily accessible observation and their innovations to evaluating the MERRA-2 reanalysis
- Assimilated Observations are binned to the MERRA-2 grid

## Wind Influence on Ocean Surface Evaporation

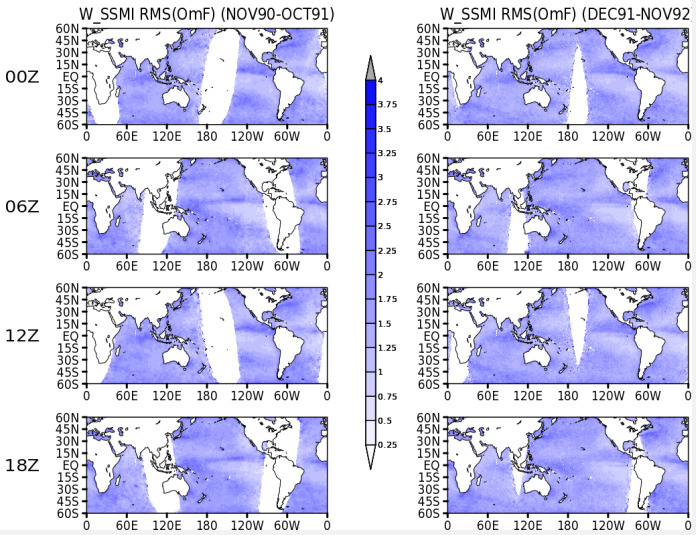
- Evaluating MERRA-2 surface evaporation shows sensitivity to surface winds (**right**)
- The onset of SSMI retrieved winds is particularly obvious




- Gridded observations include all assimilated observations, e.g. SSMI brightness temperatures and retrieved winds
- The observation count (**right**) time series shows the changing SSMI radiance observations assimilated in MERRA-2



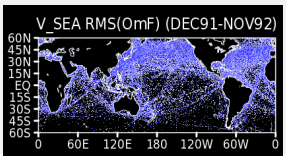

## Changes In SSMI Wind Retrievals



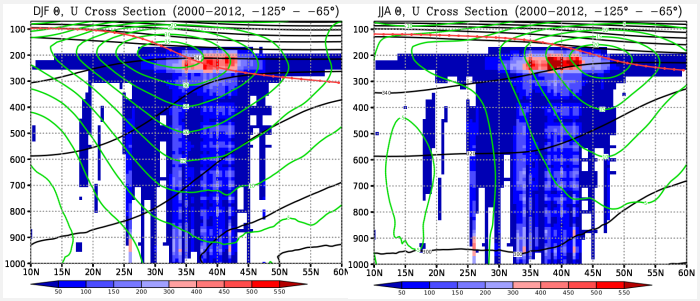

**Above:** Annual mean of RMS of the forecast departure of the SSMI wind speed assimilation for the transition years with only F08 available (left) and that with F10 and F11 assimilated (Right)

Around 1991, there is a substantial change in SSMI wind speed area coverage.

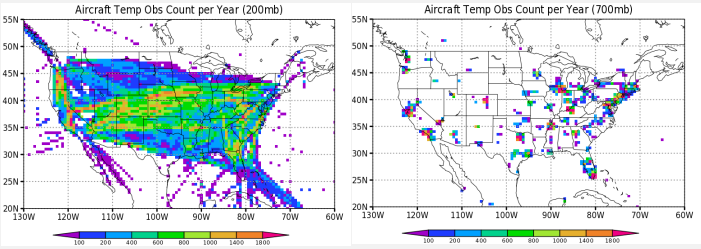
**Right:** Ship and buoy wind speed RMS of the forecast departure. Ship RMS increases by 10% from 1990 to 1991.



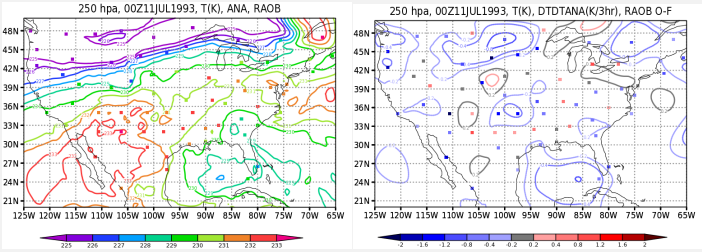

## Aircraft Observations Distribution




**Above:** Zonal cross section over the united States showing the vertical distribution of commercial aircraft observations (red/blue shading, relative to the zonal mean potential temperature (black), wind (green) and tropopause (red) from MERRA-2.




**Above:** Spatial distribution of commercial aircraft observations at 200 mb (left) and 700 mb (right), where the aircraft record tracks at cruise level, and profiles on landing and takeoff.




**Above:** Comparison of instantaneous analysis temperature field with radiosonde values (left, radiosonde obs are boxes) and comparison of the mean analysis increment with radiosonde forecast departures (right, departures are the colored boxes). These data could be used to develop detailed analysis statistics (e.g. Desroziers et al. 2005)

## Summary

- GIO includes the assimilated observations, O-F, O-A, count, standard deviation, RMS and bias correction (radiances).
- Provides users with a method to investigate MERRA-2 observations.
- Binning reduces information content, but allows for simplified access and processing across all the assimilated observing systems.
- Aircraft standard levels are heights, which can lead to systematic differences with raob data when binned to the same pressure level.
- Care must still be taken with area averages, and consider representativeness of the observing system in and area.

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