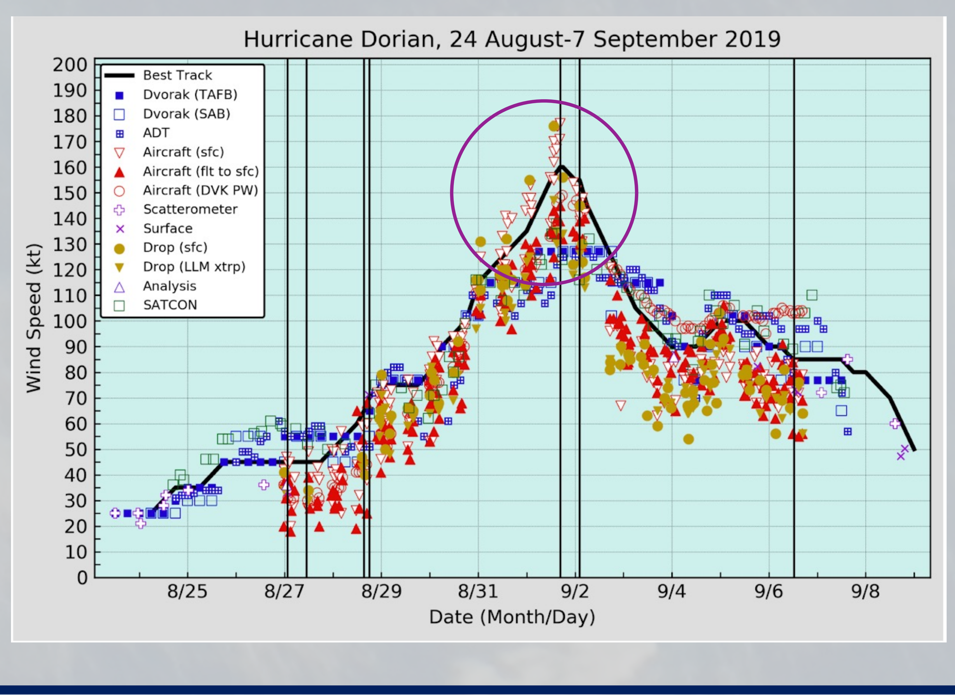
Operational SFMR Algorithm Update: Rain Impacts

Heather M. Holbach
Florida State University, Northern Gulf Institute, NOAA/AOML/HRD

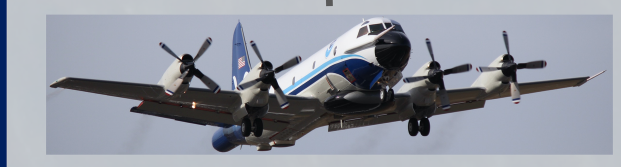
Motivation

Inconsistencies noted between the dropsonde, SFMR, and flight-level surface wind speed estimates, especially in major hurricanes.



SFMR Algorithm

SFMR Measured T_Bs → Minimize Error in Fit Across Frequencies → Wind Speed and Rain Rate

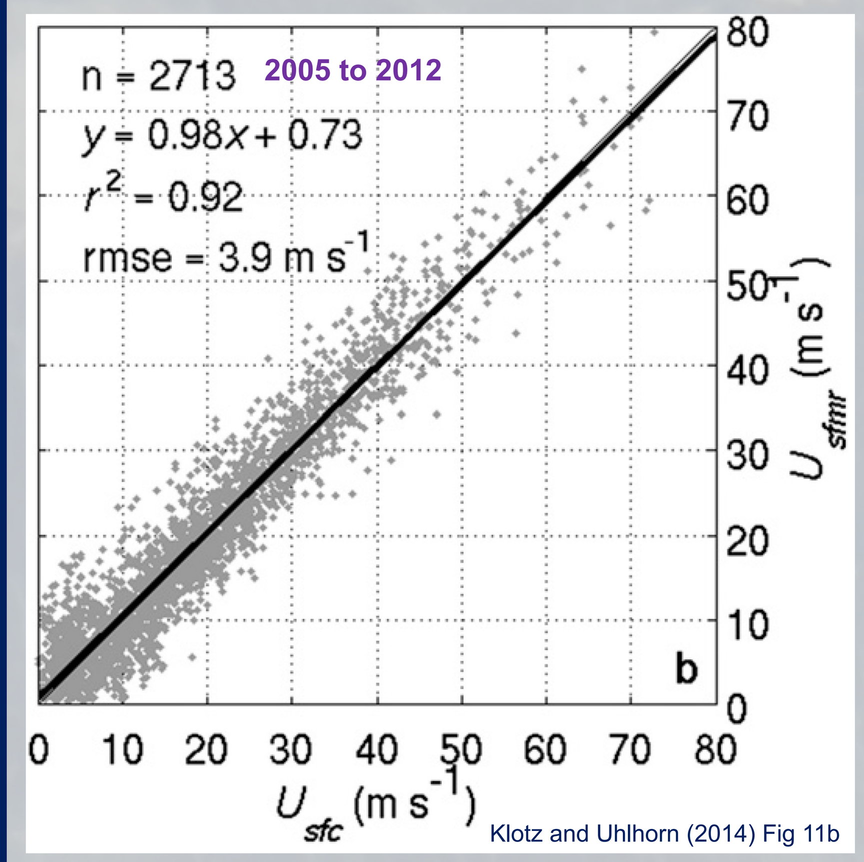


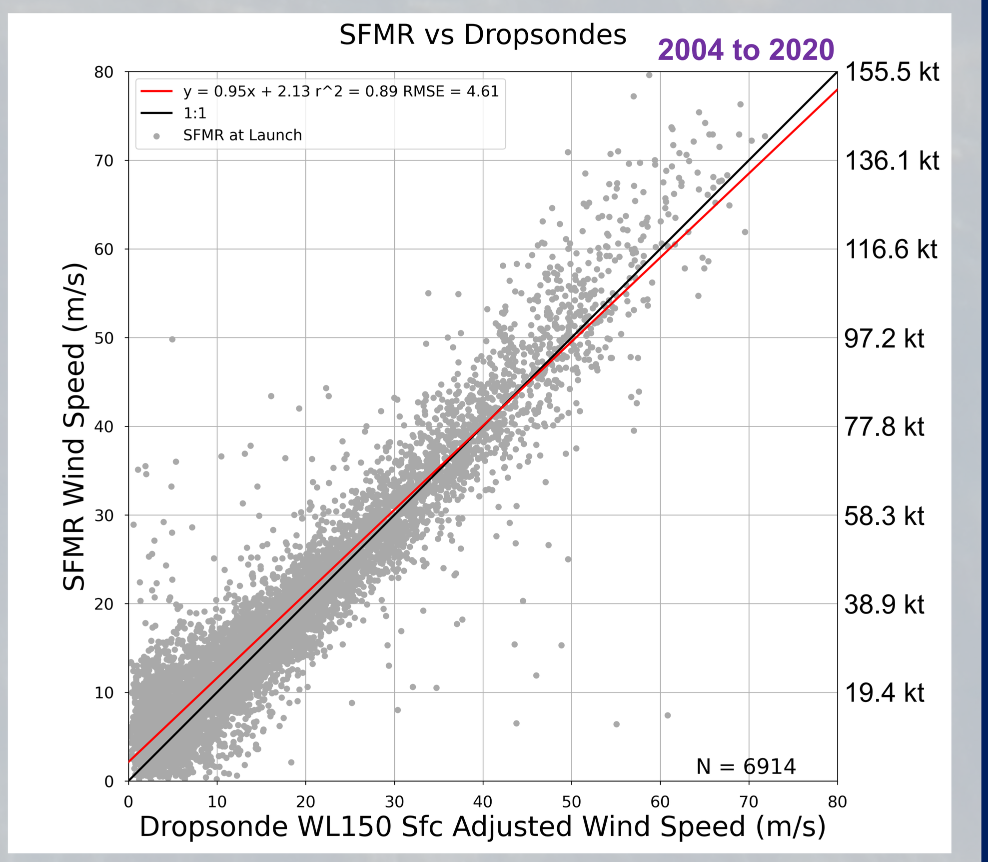
Air Temperature, Salinity, Altitude, Roll Angle, SST (satellite)

Wind Speed and Rain Rate Guess

Compute Modeled T_B ← Wind-Induced Emissivity Curve

Current Algorithm Fit to Dropsondes



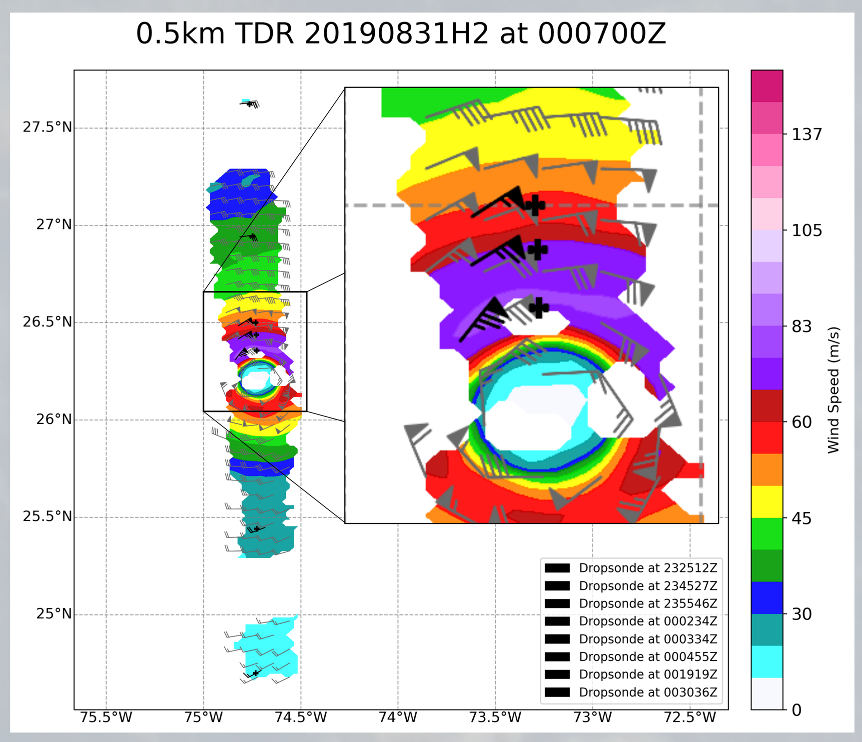


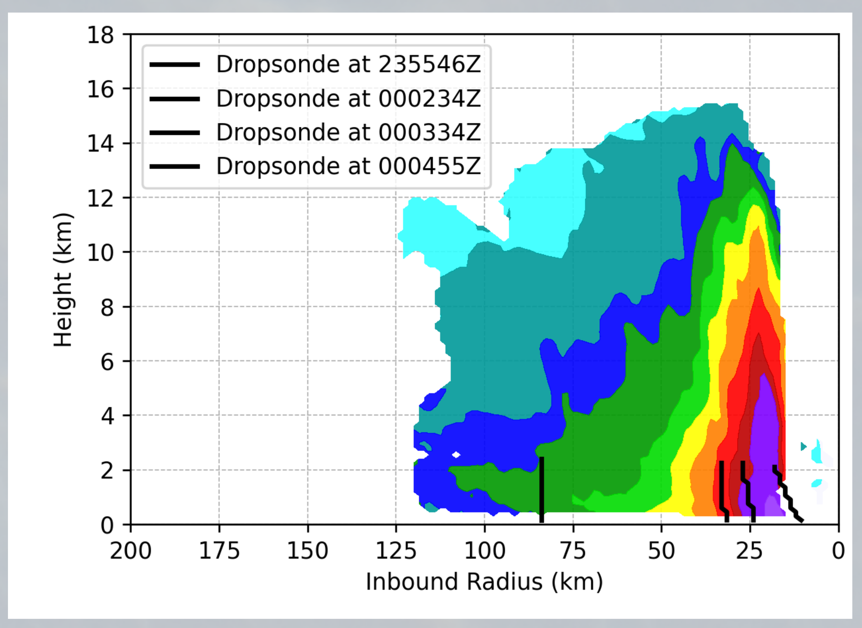
Adding 9 more years of data increases comparison points at wind speeds ≥ 50 m/s.

Wind speed retrievals using current operational algorithm illustrate that SFMR wind speeds appear to be slightly stronger than dropsondes at wind speeds ≥ 50 m/s.

Dropsonde Collocations

SFMR at time of dropsonde launch is compared to dropsonde WL150 surface adjusted wind speed.

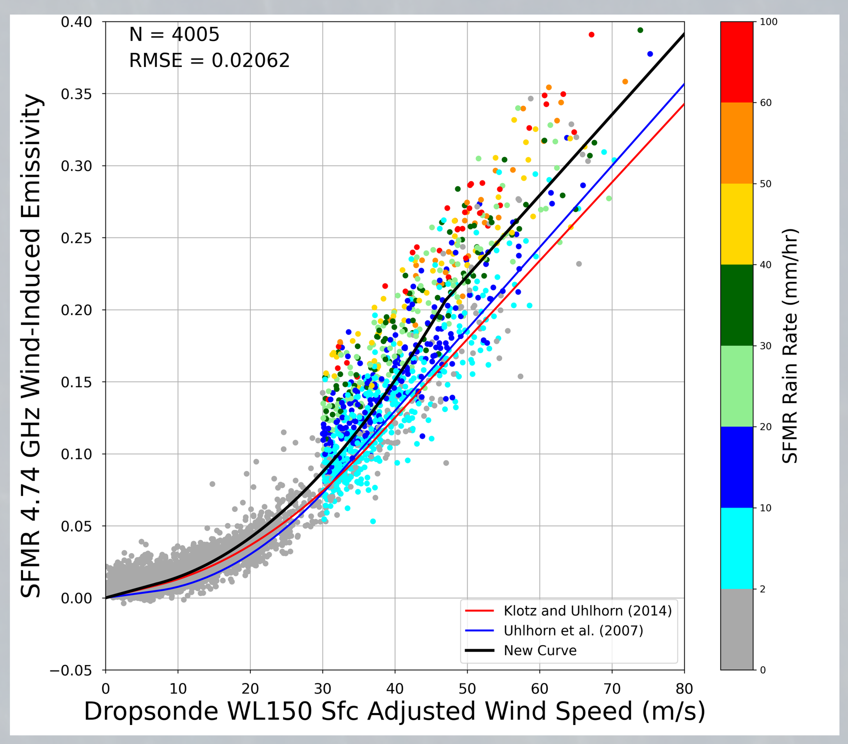


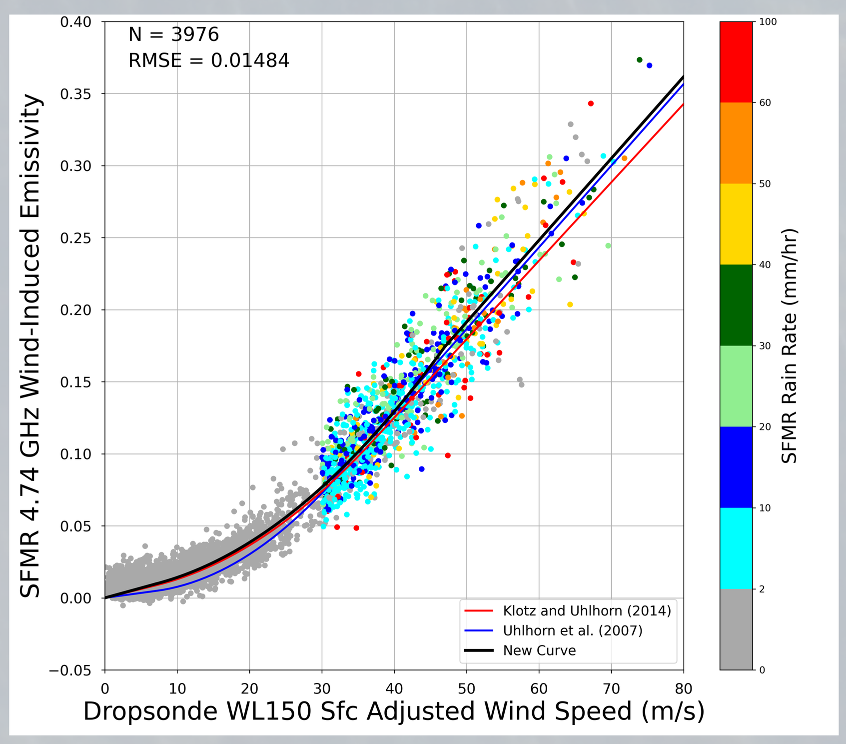


Tail-Doppler Radar (TDR) winds (color contours and gray wind barbs) illustrate the challenges of collocating SFMR at time of dropsonde launch (black +) with lower level dropsonde winds (black wind barbs).

Downwind drift and inward radial translation of dropsondes can bring them into regions with different wind speeds compared to launch location.

Rain Impacts





Previous algorithm development included all data above 60 m/s for wind-induced emissivity curve. New colocation dataset shows rain dependence exists at high wind speeds as well when 0 mm/hr is used as input into calculation of modeled T_B (left).

SFMR rain rate used as input removes this dependency (right).

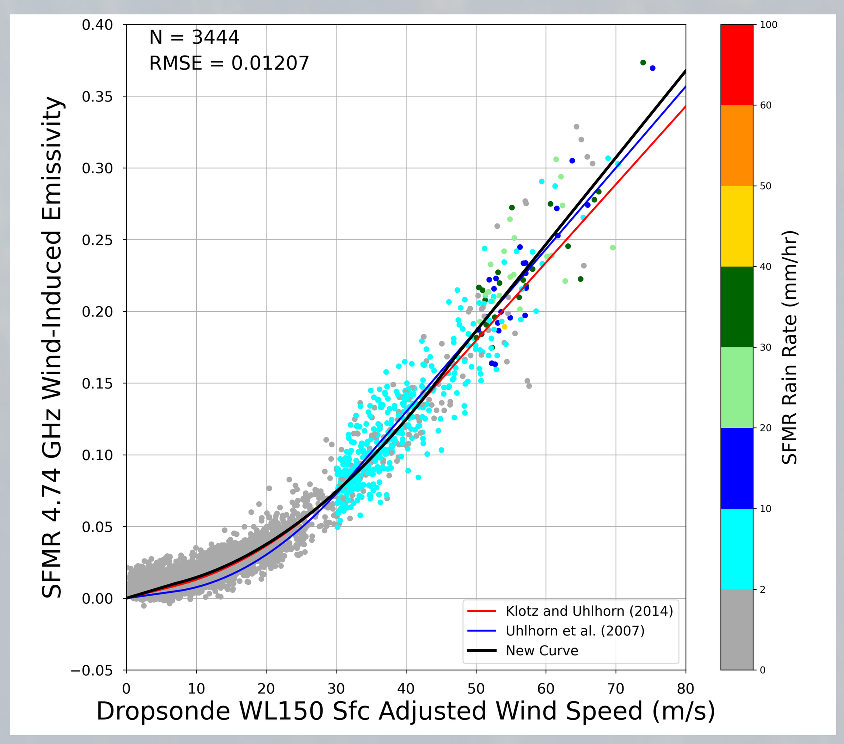
Ongoing work is using independent rain rate estimates to produce new wind-induced emissivity curve.

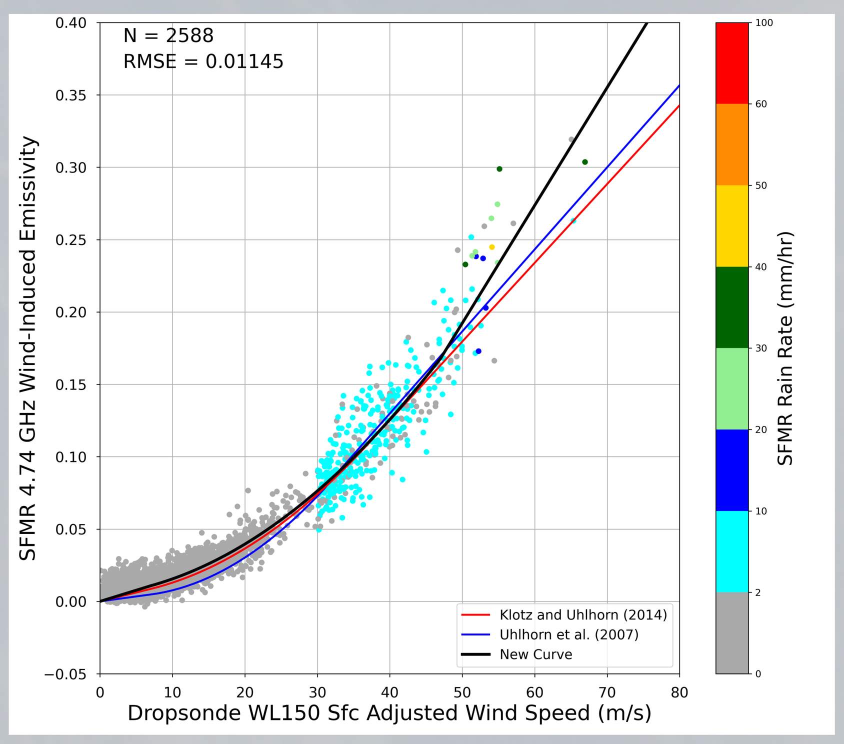
Conclusions and Future Work

Need to determine how to correct TDR reflectivity data to obtain reliable rain rate estimates.

Investigate differences in wind speed peaks between IWRAP and SFMR that could be linked to changes in raindrop-size distribution making scattering non-negligible in the eyewall.

Rain Rate Thresholds and TDR





Revised wind speed and rain rate thresholds and SFMR rain rate used as input (left) result in a curve that follows current operational curve (Klotz and Uhlhorn 2014) closely below 40 m/s then has higher wind-induced (or excess) emissivity values at the higher wind speeds.

Using TDR rain rate results in curve on right. Challenges with TDR are that the data are only available for NOAA flights, which reduces sample size, and the reflectivity data is not calibrated, which causes inconsistent rain rate retrievals.

References and Acknowledgments

Klotz, B. W., and E. W. Uhlhorn, 2014: Improved Stepped Frequency Microwave Radiometer tropical cyclone surface winds in heavy precipitation. *J. Atmos. Oceanic Technol.*, **31**, 2392–2408.

Uhlhorn, E. W., P. G. Black, J. L. Franklin, M. Goodberlet, J. Carswell, and A. S. Goldstein, 2007: Hurricane Surface Wind Measurements from an Operational Stepped Frequency Microwave Radiometer. *Mon. Wea. Rev.*, **135**, 3070–3085.

This work was supported by awards NA16OAR4320199 and NA21OAR4320190 to the Northern Gulf Institute and award NA19OAR0220087 from NOAA's Office of Oceanic and Atmospheric Research, U.S. Department of Commerce.