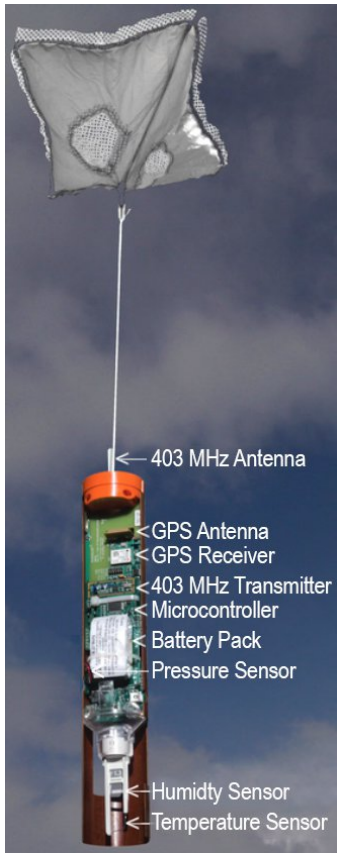
Surface Turbulent Fluxes Estimated From Dropsondes

This study demonstrates that surface turbulent fluxes (stress, latent heat, and sensible heat) can sometimes be estimated from vertical profiles of wind speed, air temperature and humidity. We focus on hurricane conditions.

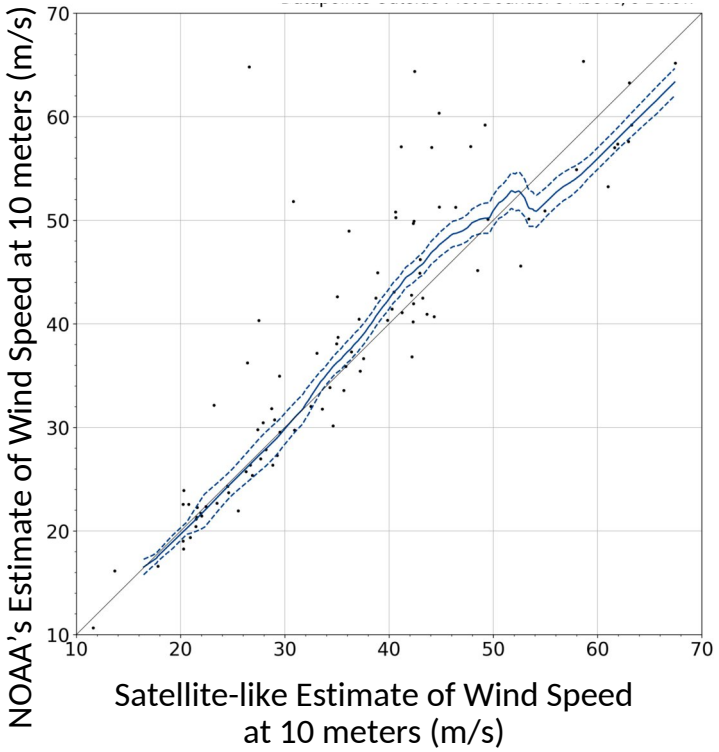


Dropsondes are atmospheric probes that are dropped from aircraft. The descend rapidly, slowed by a parachute, and measure vertical profiles of wind, temperature and humidity.

Why we care:

- Recent modeling students have shown that rapid intensity changes are very sensitive to fluxes of sensible and latent heat. Prior studies suggest that hurricane intensity is sensitive to surface stress (i.e., processes that reduce stress will strengthen storms and vice versa).
- Stress can easily be converted to equivalent neutral winds, which NASA has measured from space (QuikSCAT, RapidSCAT, and COWVR) and aircraft (DopplerScatt). We haven't had reliable in situ comparison data for hurricane conditions, in part because we're unsure if our physics for more mundane wind speeds (<20 ms^{-1}) can be extrapolated to hurricane wind speeds (>33

Comparison of NOAA's Wind Estimate to our Satellite-like wind estimate



- For wind speeds up to 35 ms^{-1}, our satellite-like estimates of wind speed are similar to NOAA's estimated wind speed.
- For wind speeds between 35 and approximately 50 ms^{-1}, satellite-like wind speeds are a little slower.
- For wind speeds >50 ms^{-1}, our satellite-like wind speeds are substantially greater than NOAA's wind speeds. Thus, it appears that another physical process has come into play.

Our analysis technique provides information about energy that powers hurricanes, the stress (drag) that influences surface winds, the surface wind speed, and the conversion of this stress to a satellite-like wind.
The next step is to automate the technique – enabling science and operations.

Wallace, D.E., et al., 2026: Log-Profile Analysis of the Near-Surface Layer and Air-Sea Turbulent Fluxes in Hurricanes Using Dropsondes. *J. Atmos. Ocean Technology*. 43(7), 825-842. DOI: 10.1175/JTECH-D-24-0002.1

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