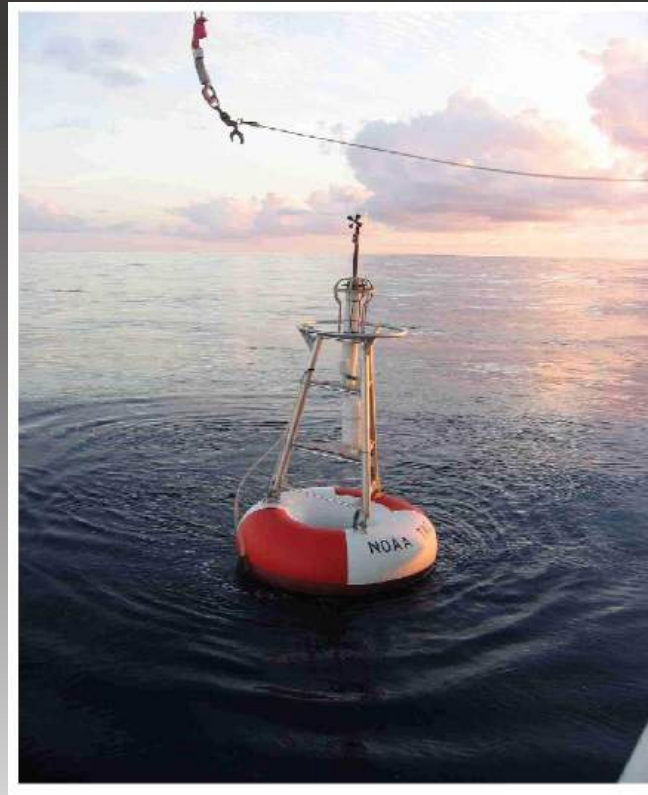




Investigation of Calibration Change in Ocean Surface Wind Measurements from the TAO Buoy Array

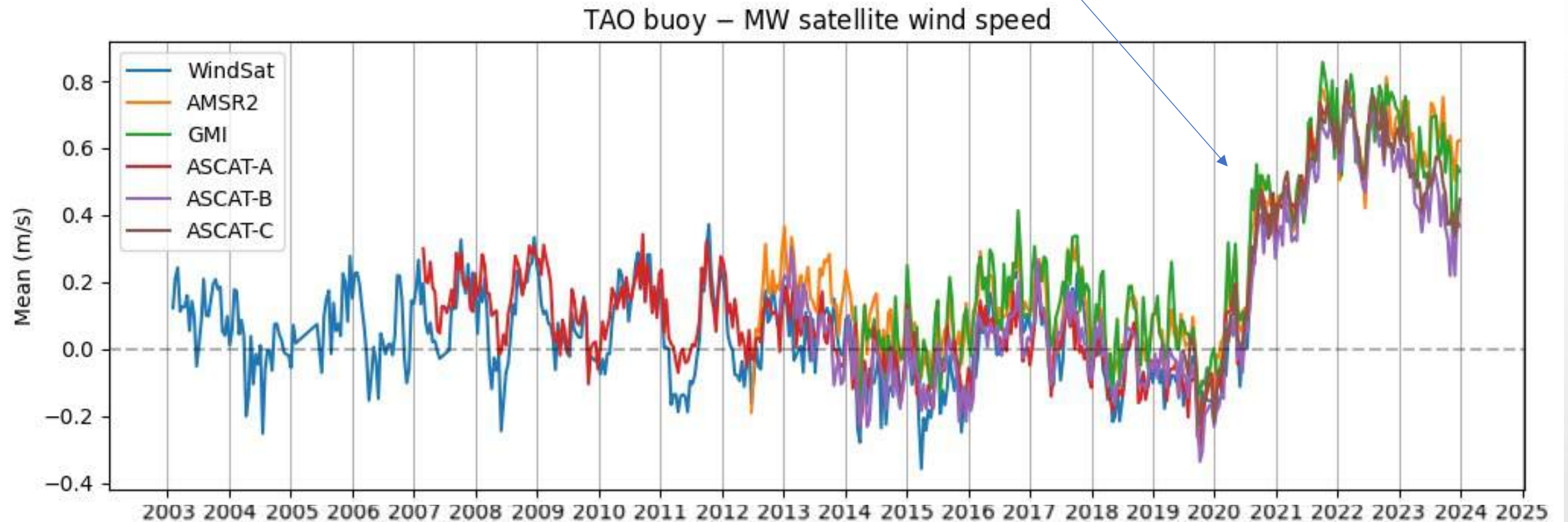


Lucrezia Ricciardulli, Andrew Manaster, Richard Lindsley
Remote Sensing Systems, Santa Rosa, CA, USA



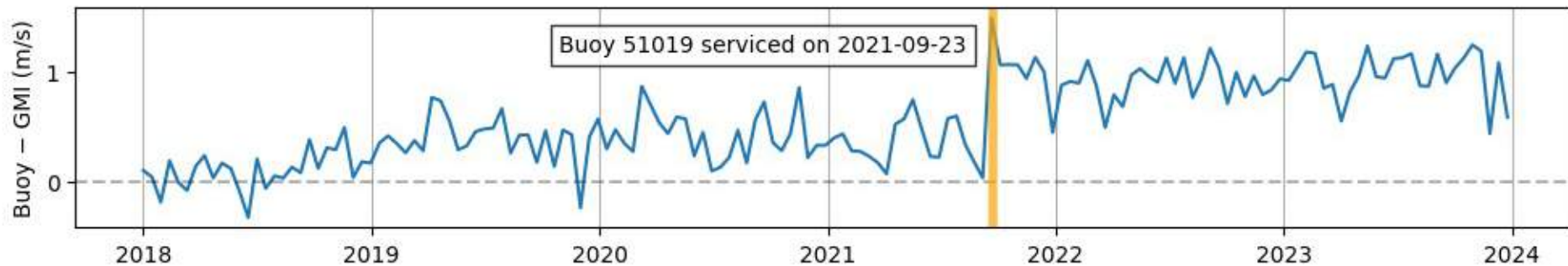
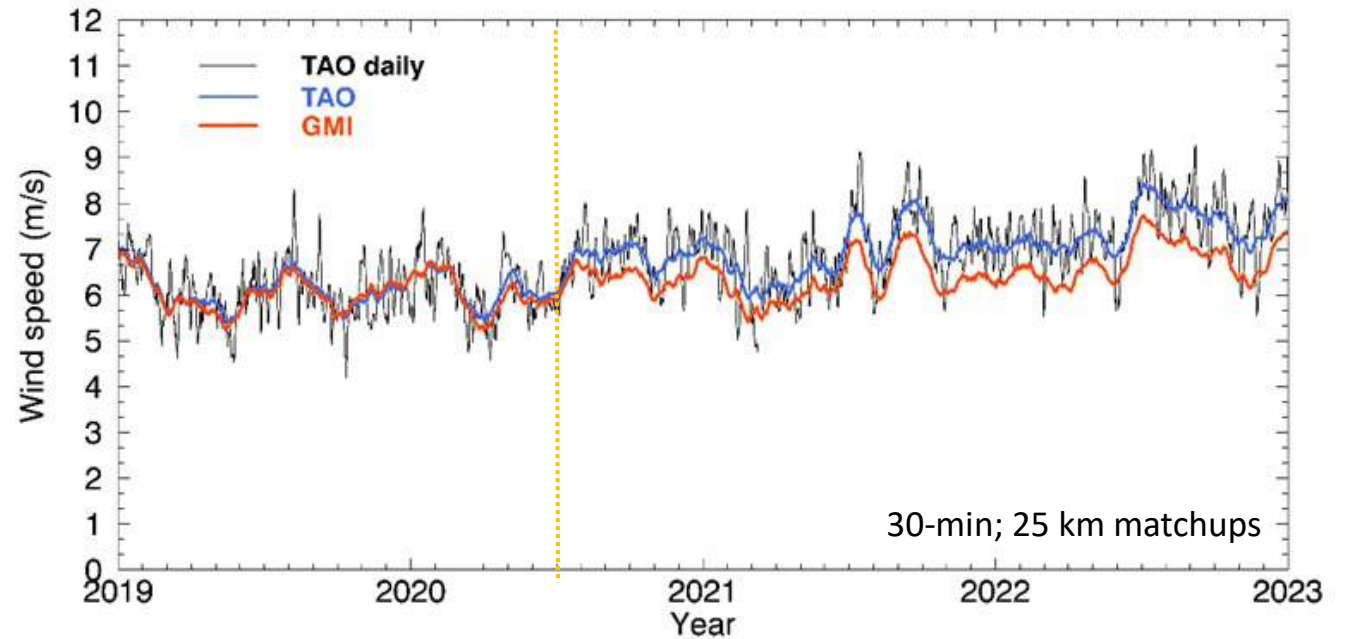
Comparison TAO Buoy Wind speeds vs Satellites

During routine analyses of satellite winds' stability, a large sudden temporal instability in the TAO buoy wind timeseries has been detected: 0.5-0.8 m/s (10%) since mid-2020



TAO Wind Sudden Change after Buoy Were Serviced

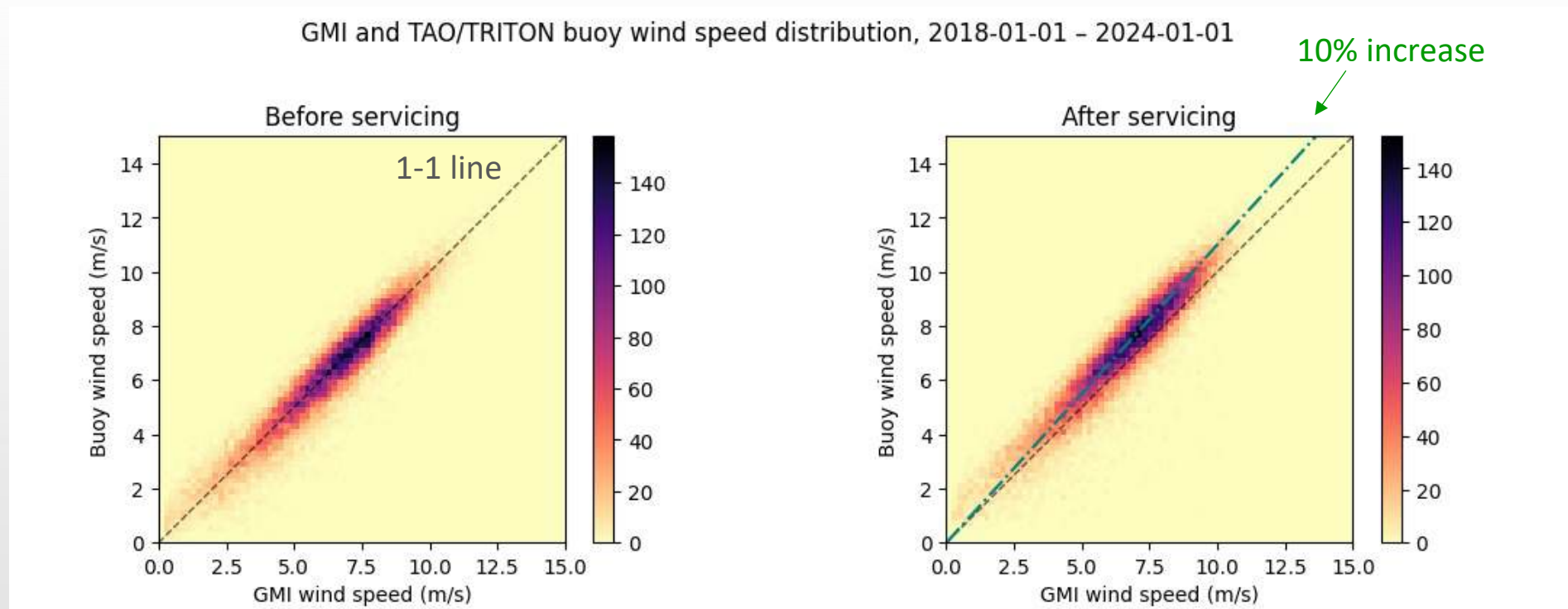
- The timing of the buoys' wind change corresponds to a period when the TAO buoys were serviced, starting from mid-2020, for the following 2 years
- We informed NDBC in 2022: they confirmed a change in calibration coefficients in the new anemometers, still under investigation as of 2024



Example for sample buoy:
Sudden change

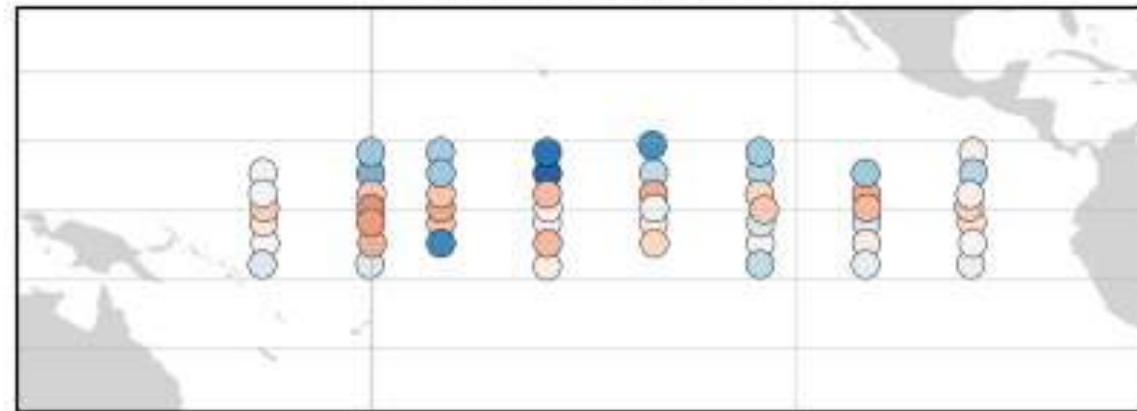
TAO Wind Sudden Change is Proportional to Wind Speed

- The change is not a simple shift, rather it seems proportional to wind speed
- Present in both components
- Estimated ~10% increase
- Consistent with the estimated change in calibration coefficients of the anemometers (Steve DiNapoli, NDBC, personal communication)

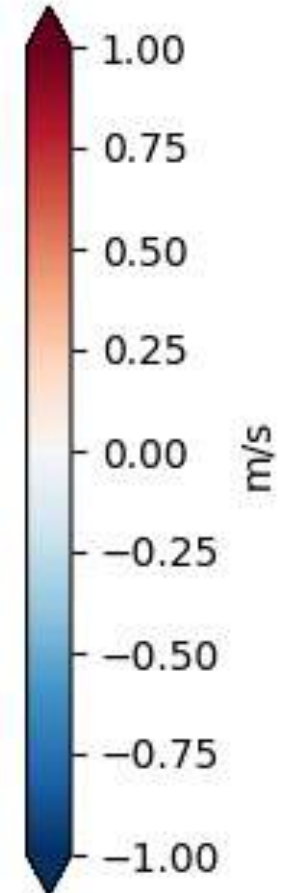
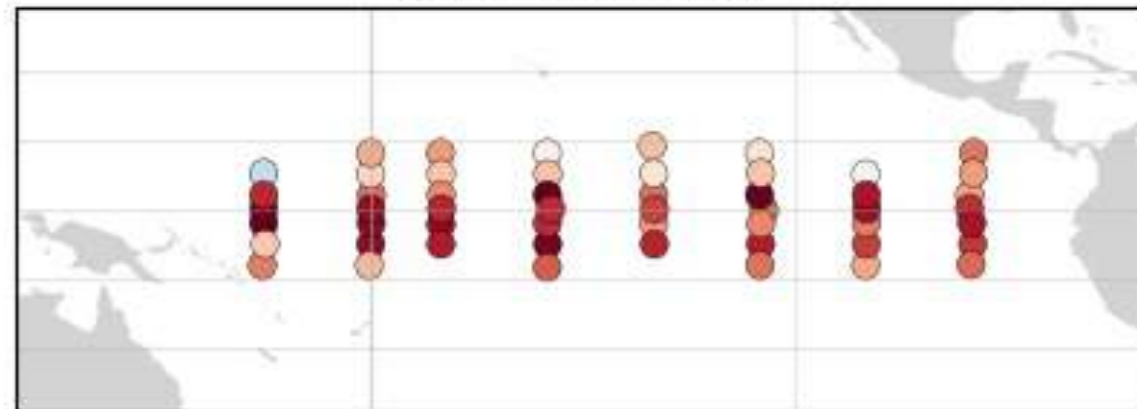


All TAO Buoys Are Affected

Mean of TAO buoy wind speed – GMI (2018-01-01 – 2024-01-01)
Before servicing



After servicing



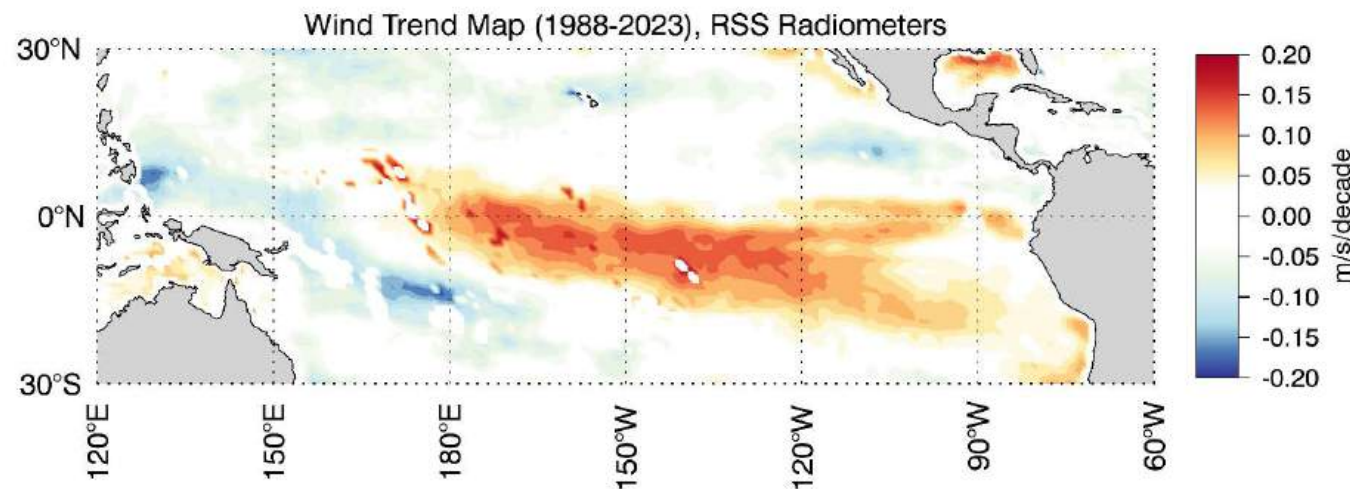
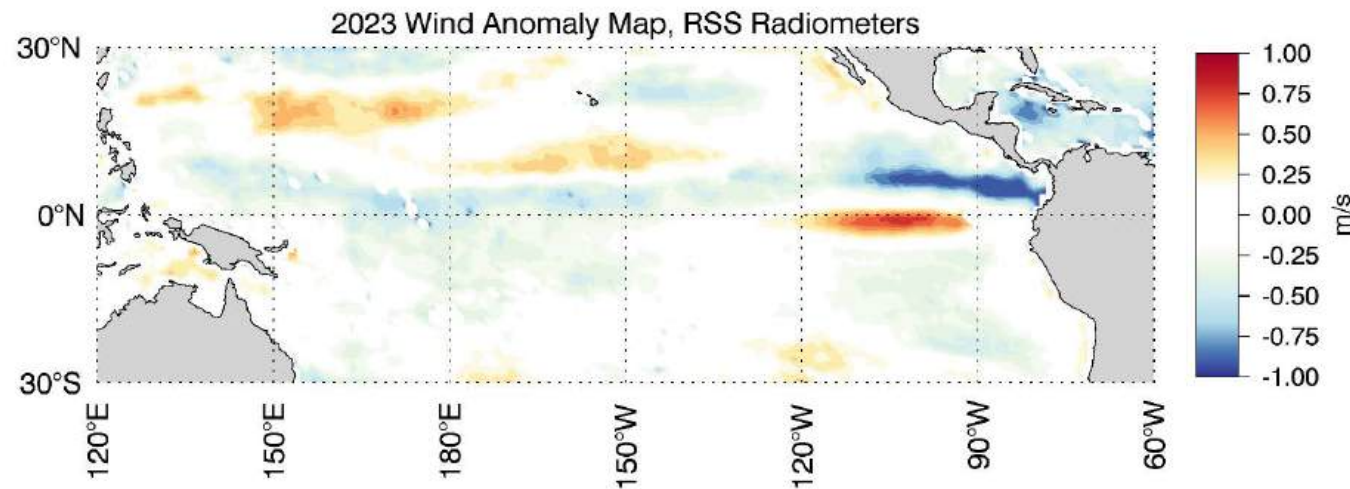
Is the TAO wind sudden change significant?

TAO wind change is larger than climate signals
In the Tropical Pacific

Wind anomaly
Typically < 0.8 m/s

(except intense ENSO events)

Wind trend
< 0.2 m/s





- Misalignment with other buoy arrays: What is the “ground truth”?
- Any other observationally-based method using buoys for verification (i.e. Saldrones, CCMP)
- Satellite calibration/validation
- Climate Data Record developers
- Data assimilation in NWP
- Surface Heat Fluxes: dataset development and verification
- Tropical climate variability analyses → need to account for spurious signal

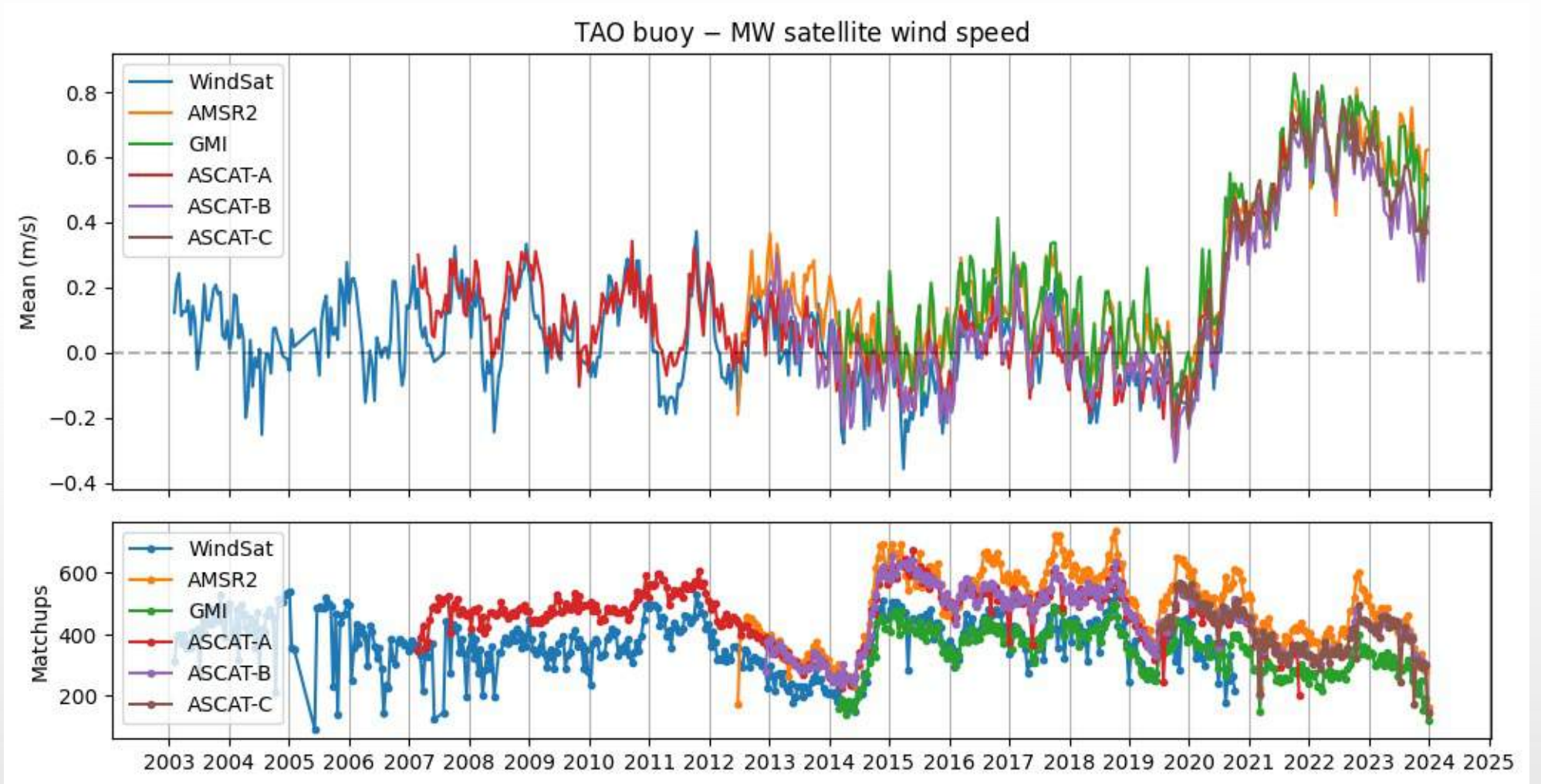


- Large sudden temporal instability in the TAO buoy wind timeseries has been detected: 0.5-0.8 m/s (10%) since mid-2020
- Cross-calibrated satellite data proved very useful for detecting this change
- Changes are of the order or larger than climate signals
- No official statement from NDBC whether this is temporary or permanent
- Users need to be aware and decide how to deal with it
- Manuscript to be submitted to BAMS in June

Suggestions for future course of action:

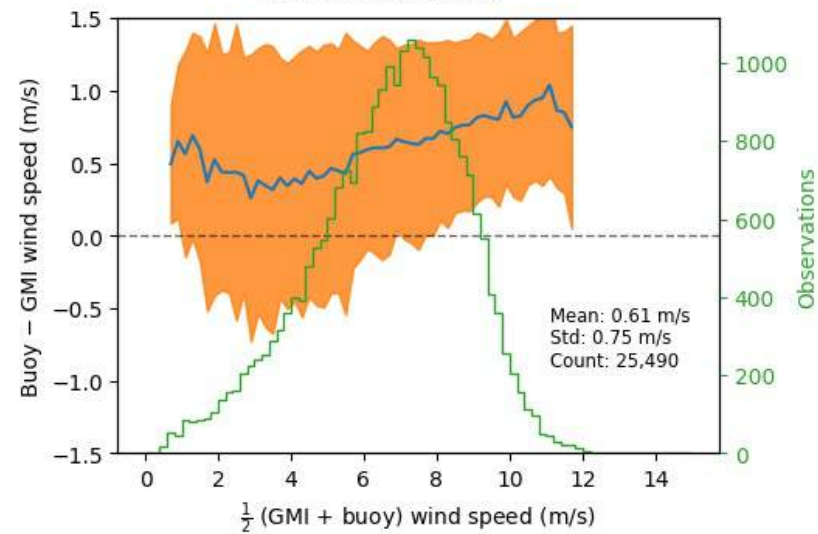
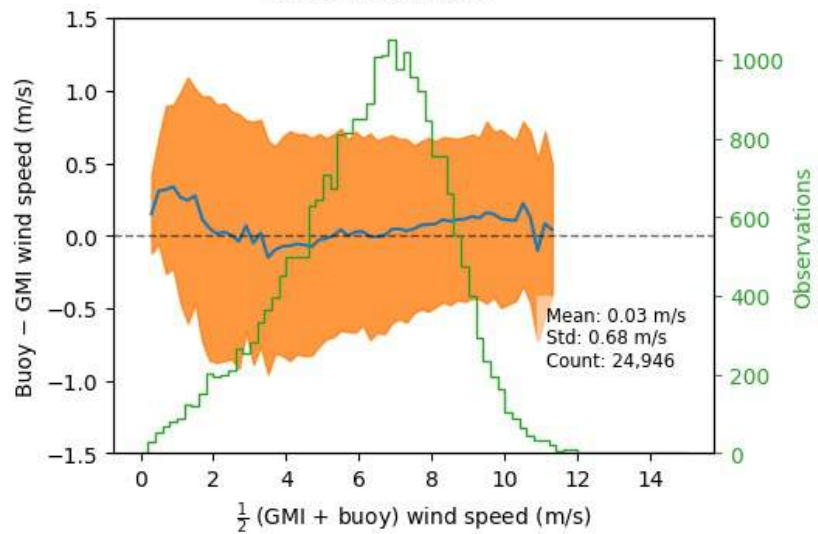
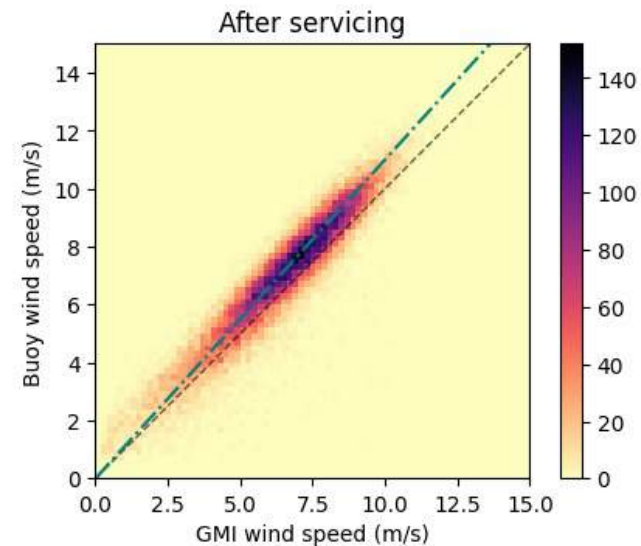
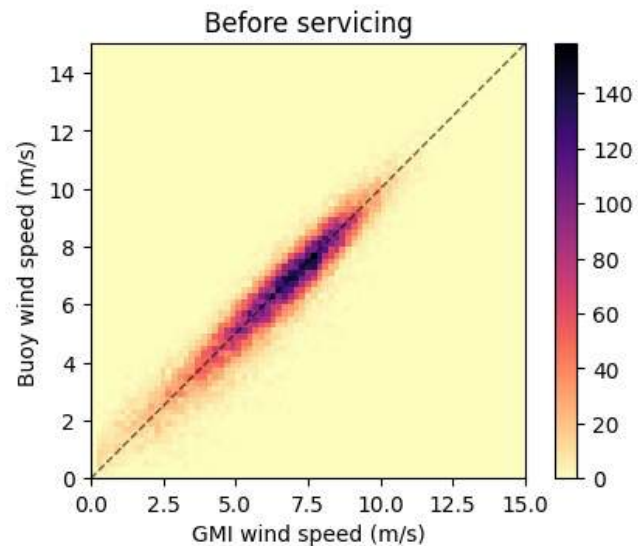
1. Use satellite data to develop near real time monitoring of buoy quality
2. Ask NDBC to provide clear communication and guidance to users.
3. Ask NDBC to coordinate any such major changes at the global level with other observing systems in the future
4. Discard TAO buoys for new satellite verification (post-2020) until the mismatch with other buoy arrays is resolved

Extra figures



Number
Of matchups

GMI and TAO/TRITON buoy wind speed distribution, 2018-01-01 - 2024-01-01



Buoy-GMI

Bias as function of wind speed,
Before (L) and after service (R)