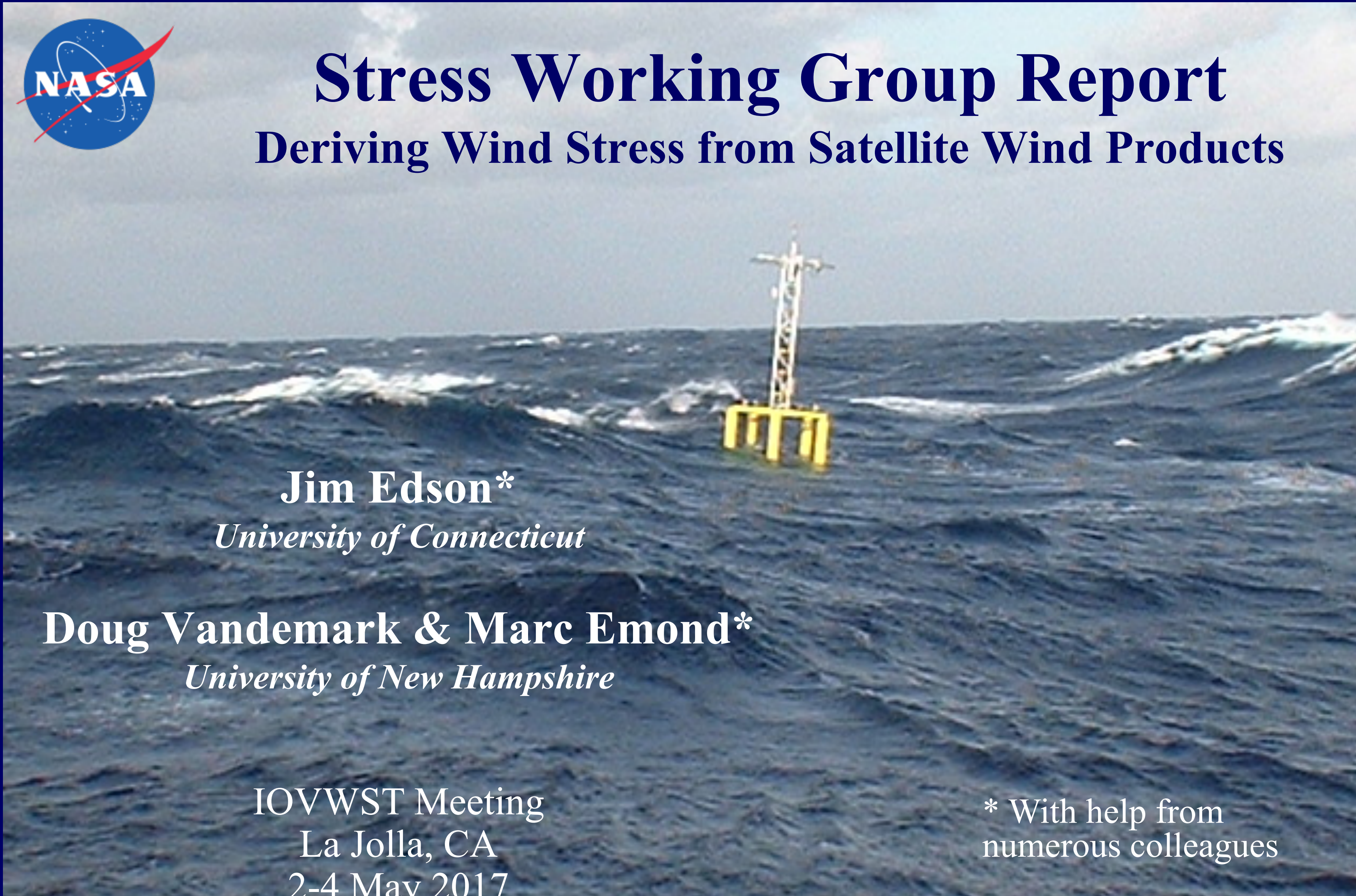

Stress Working Group Report

Deriving Wind Stress from Satellite Wind Products

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IOVWST Meeting
La Jolla, CA
2-4 May 2017

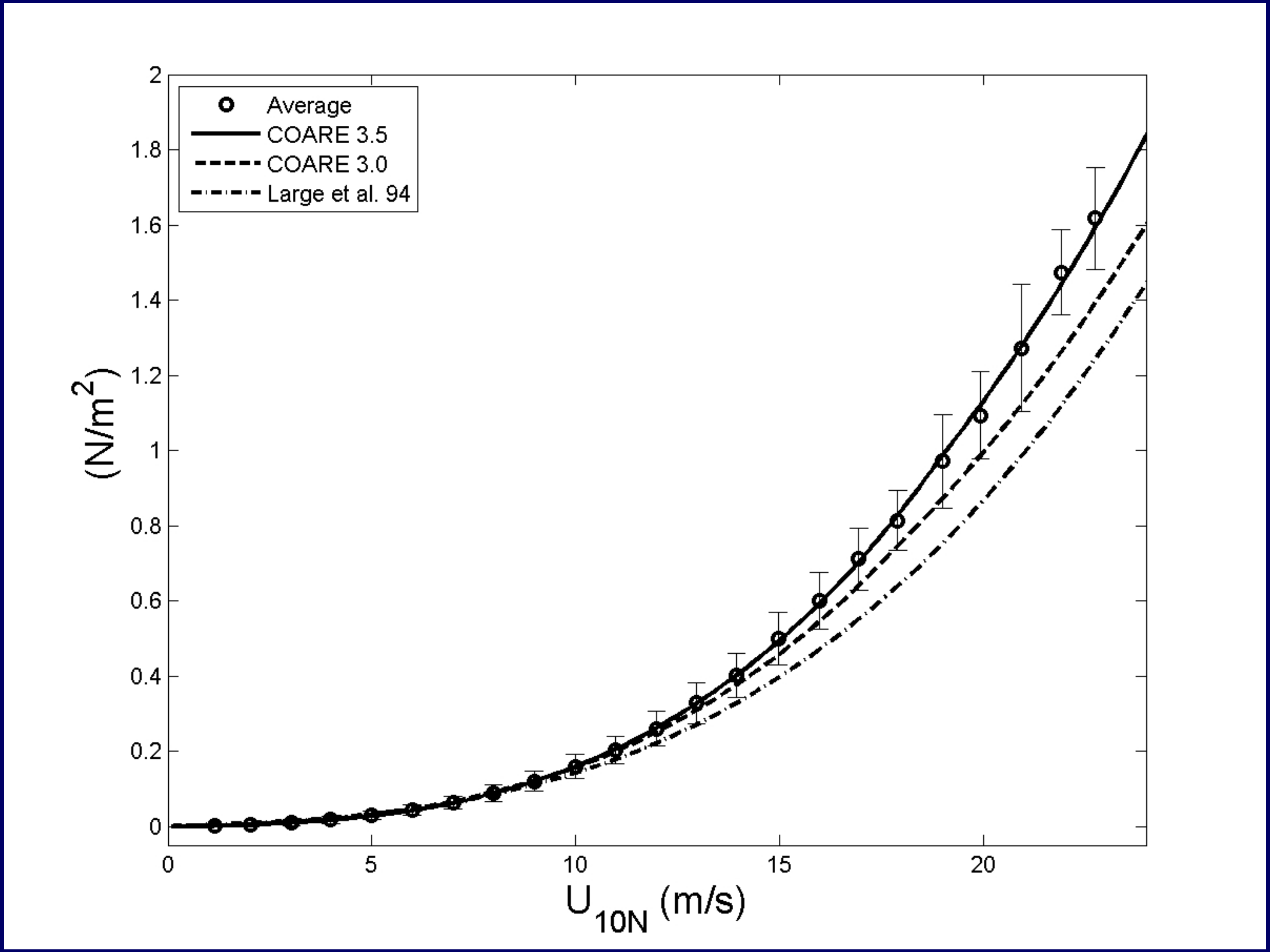
* With help from numerous colleagues

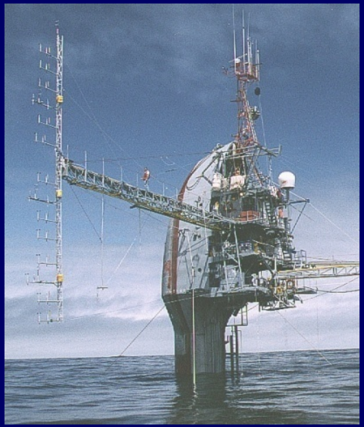
Research supported by grants from the NASA, ONR, and NSF

IOVWST Stress Overview Paper

- Introduction
  - History of GMFs that link backscatter to ENW for various Satellites
  - Relationship between Equivalent Neutral Winds and Stress
- Equivalent Neutral Winds
  - Density effects
  - Role of surface currents
  - Role of stratification & Gustiness
- Drag Coefficient
  - Semi-Empirical Formulations of neutral drag coefficient
  - Role of surface roughness
    - Smooth flow & capillary waves (SST effect on viscosity, surface tension)
    - Wind-wave parameterizations
    - Large scale waves and sea-state effects
      - Using wave measurements to produce a sea-state/wave-age dependent Charnock parameter.
      - Using a surrogate such as a wind-speed dependent Charnock parameter.
  - Parameterizations to be tested
- Stress measurement and comparison
  - Direct covariance data description
  - Comparison of flux parameterizations using buoy data
  - Comparisons using QuikScat and ASCAT equivalent neutral winds
- Recommendations and Conclusion

MBL/CBLAST/CLIMODE Drag Coefficients





Long time series data sets are found at:
http://tds-opal.sr.unh.edu/thredds/catalog/opal_ts/opal_asflux/catalog.html

Future Plans: NASA SPURS, NSF's OOI & NOAA TPOS

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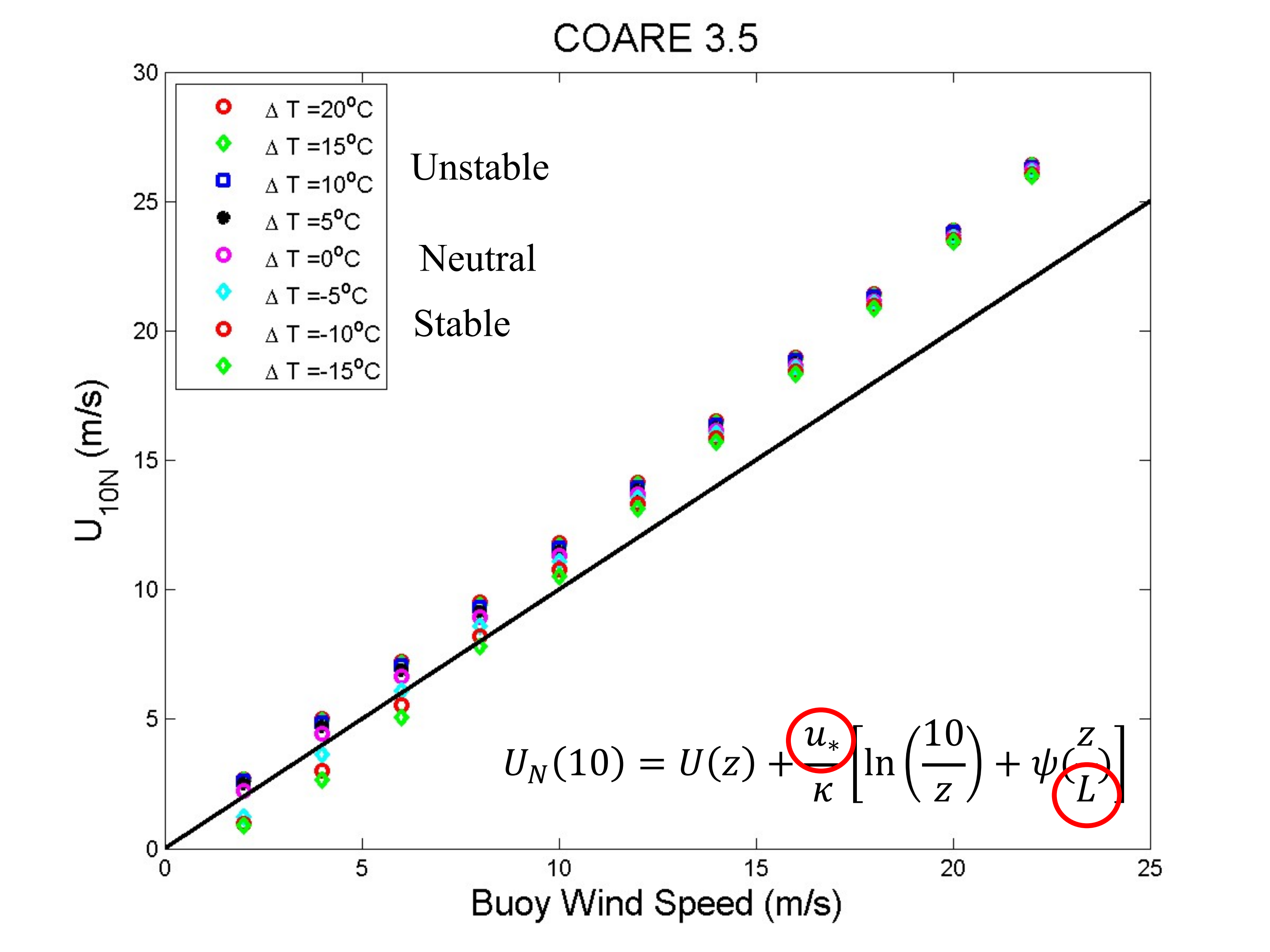
Quick Survey of Stress Products

Product name	Org	Sensor	Time Span	Time Res.	Spatial Res	Variables	Cd and z/L	References
SCOW	OSU	Qscat	1999-2009	monthly	25 km	u,v,τx,τy,|τ|,…	Large,1994	Risien Chelton 2008
Cersat daily turb. flux V3	Ifremer	Qscat	1999-2009	daily	0.25°	τx, τy, |τ|	Coare3	Bentamy et al 2013
Qscat/NCEP Blend V5	CRA/NRA	QSCAT+NCEP	1999-2009		0.5°			Milliff et al., 2004
Pseudostress	coaps	Nscat	96-97	daily	1°	|τ|,τ_dir	Bourassa	Weissman and Graber 1999
Pseudostress	coaps	QScat	1999-2009	daily	1°	|τ|,τ_dir	Bourassa	Pegion et al., 2000
SAF wind stress	KNMI	ERS1-2	1992-2001	6 hourly	0.5°			
CCMP - pseudostress	RSS (GSFC in past)	Satellite blend + ERA Int		6 hourly	0.25°			Atlas et al., 2011
J-OFURO3	SMST	Blend Passive, ERS, Oscat, ASCAT, QScat	1988-2013	daily	0.25°		Fairall et al. 1996, LKB	Kutsuwada et al., 2016-7
West Coast Reg. wind stress	OSU	Qscat	1999-2009		0.1°	See podaac		Vanhoff, Risien, Strub, 2011
Sea surf. wind stress	NOAA/NCDC	Blend	1987-2011	6 hourly, monthly	0.25°	τx,τy		Zhang et al., 2006
IFR L3 flux	Ifremer	ERS1,2	91-96, 1996-2001	weekly, monthly	1°	See podaac		Also for NSCAT

Sensitivity to Parameterizations



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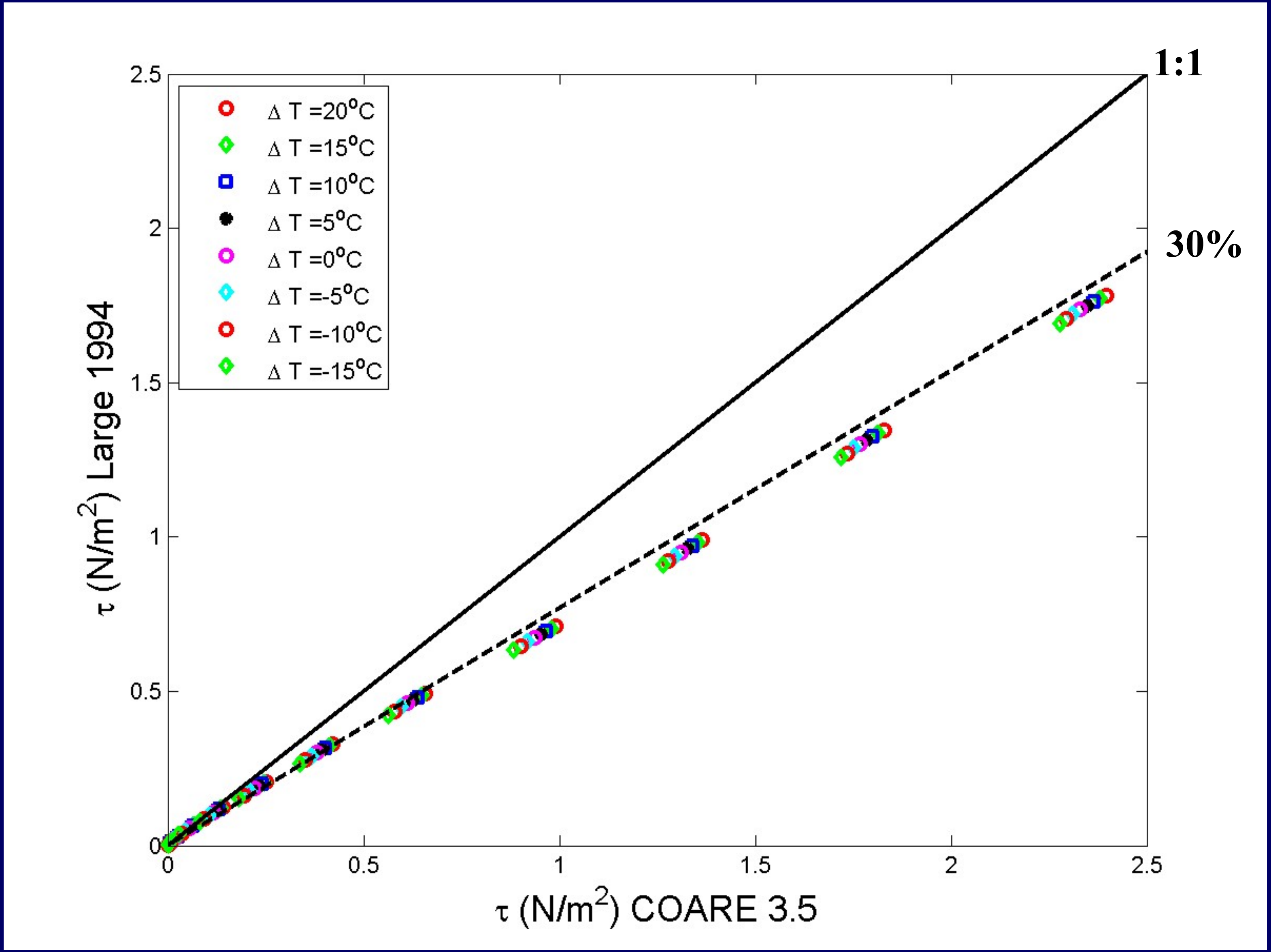

Discussion Topics

- Is there interest and are we ready to produce a Synthesis Paper on "Surface Stress and Scatterometry" to summarize our recent work? Topics could include:
  - Role of surface currents and the relative wind
  - Role of atmospheric stability and the equivalent neutral wind
  - Role of air density
  - Role of "long" surface waves on surface stress
  - Role of surface variability and gustiness
  - Role of SST and viscosity
  - Impact of SST gradients
  - Recommendation for drag coefficients
- Can the Coastal Working Group provide any guidance on specific phenomena they'd like to revisit including wave age, wave steepness, enhanced breaking, shallow-water waves, wind-wave directional differences, & fetch limited seas.
- How do we move forward in our attempts to combine scatterometers and observations to improve estimates of wind speed and stress at extreme winds (> 25 m/s)?
- **Is there any desire to work on a GMF that directly relates stress measurements with backscatter? The stress measurements could include both DC and bulk derived measurements using our recommended algorithm.**