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On The Characterization Of The Ka-band Ocean Surface Backscatter Using Doppler Scatterometer Measurements From The Air-Sea Interaction Tower Experiment

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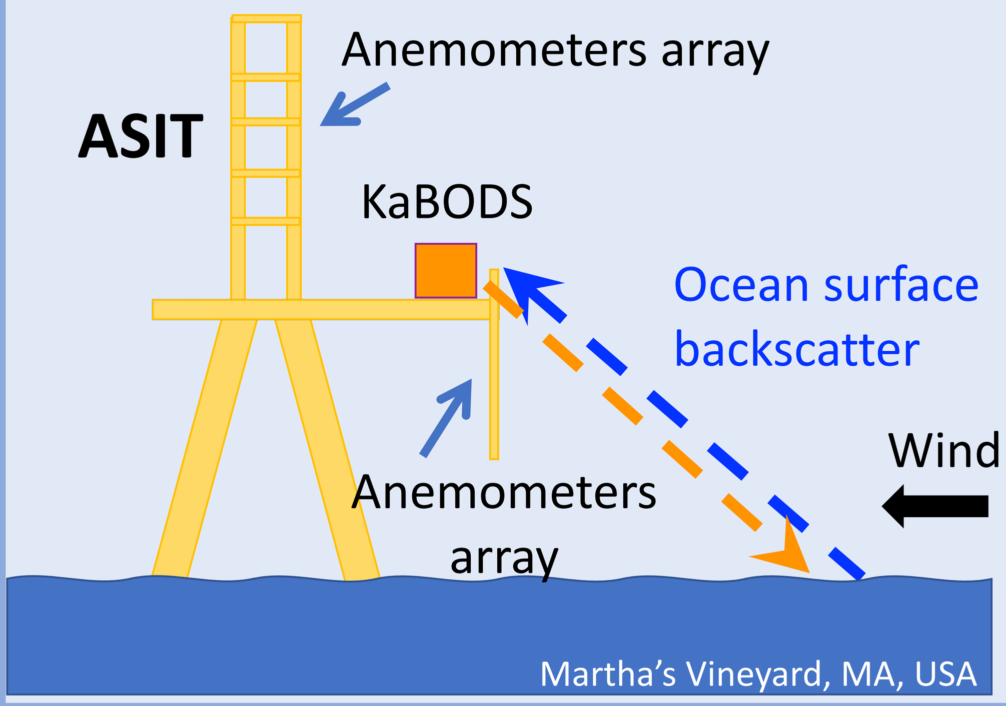
1. MOTIVATION AND OBJECTIVE

- **2017 National Academy's Decadal Survey:** Doppler Scatterometry for *simultaneous measurements* of ocean surface vector *winds* & *currents*.
- The **JPL airborne Ka-band Doppler Scatterometer (DopplerScatt)** has demonstrated its ability to measure surface winds and currents simultaneously.
- DopplerScatt is an essential contribution to the ongoing NASA Earth Venture Suborbital Investigation **Sub-Mesoscale Ocean Dynamics Experiment (S-MODE).**
- **The Winds and Currents Mission (WaCM) concept**: Towards a Ka-band spaceborne mission.

- This work aims at investigating the Ka-band ocean surface backscatter to fully assess the capability of the Ka-band wind scatterometry in order to improve the current DopplerScatt operational Geophysical Model Function and the accuracy of wind retrievals.

S-MODE field campaign 2021. NASA King Air B200 flight crew on Oct. 25. From L to R: Delphine Hypolite (UCLA MOSES operator), Mike Stewart (NASA ARC Pilot), Tracy Phelps (NASA AFRC Pilot), and **Federica Polverari** (NASA JPL DopplerScatt operator). Photo courtesy of Rob Koteskey (NASA ARC). https://espo.nasa.gov/s-mode/image/Crew_for_B200_Flight_4

2. METHODS: AIR-SEA INTERACTION TOWER (ASIT) EXPERIMENT



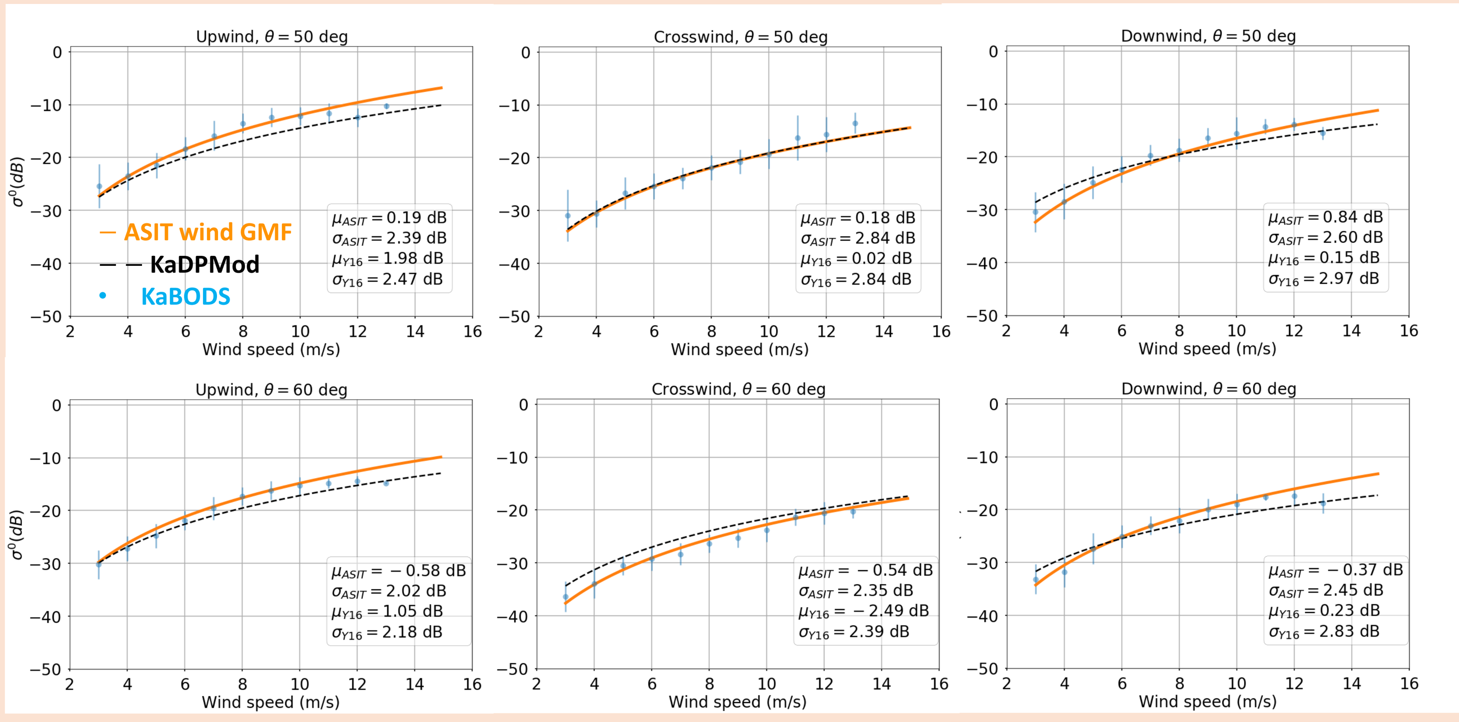
- A new combined data set was collected from the **Ka-Band Ocean continuous wave Doppler Scatterometer (KaBODS)**, the anemometers and other instruments installed on and around the ASIT.
- We developed a new **Ka-band wind Geophysical Model Function (ASIT wind GMF)**.
- The functional form used in Yurovsky *et al.* (2017) was used. It relates the ocean surface backscatter (σ°) to the ocean surface wind speed (U), relative direction (ϕ) and the radar incidence angle (θ), such that:

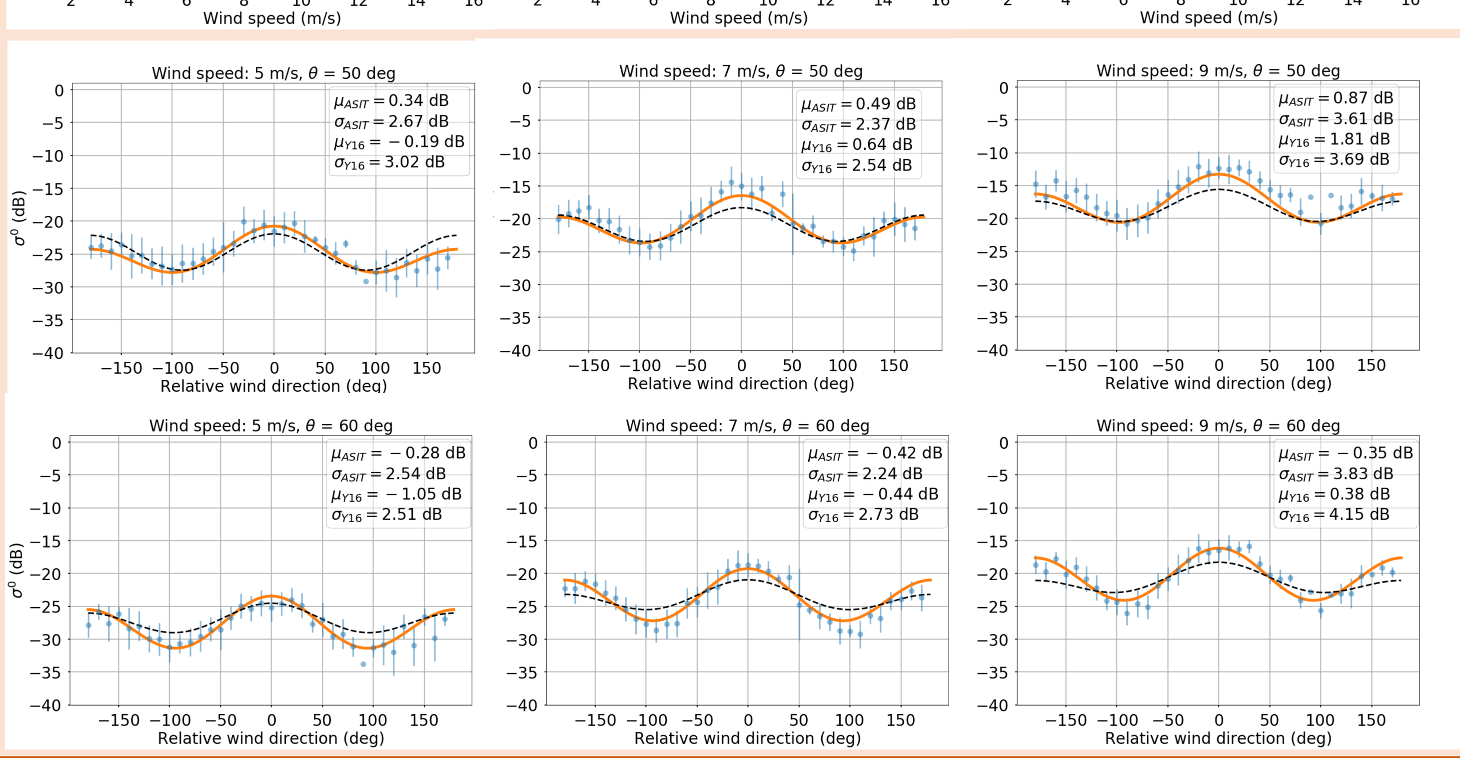
$$\log \sigma^\circ = A_0(\theta, U) + A_1(\theta, U)\cos\phi + A_2(\theta, U)\cos 2\phi$$

- We compared the ASIT wind GMF with the Ka-band Dual co-Polarized Model (KaDPMod) developed by Yurovsky *et al.* (2017)

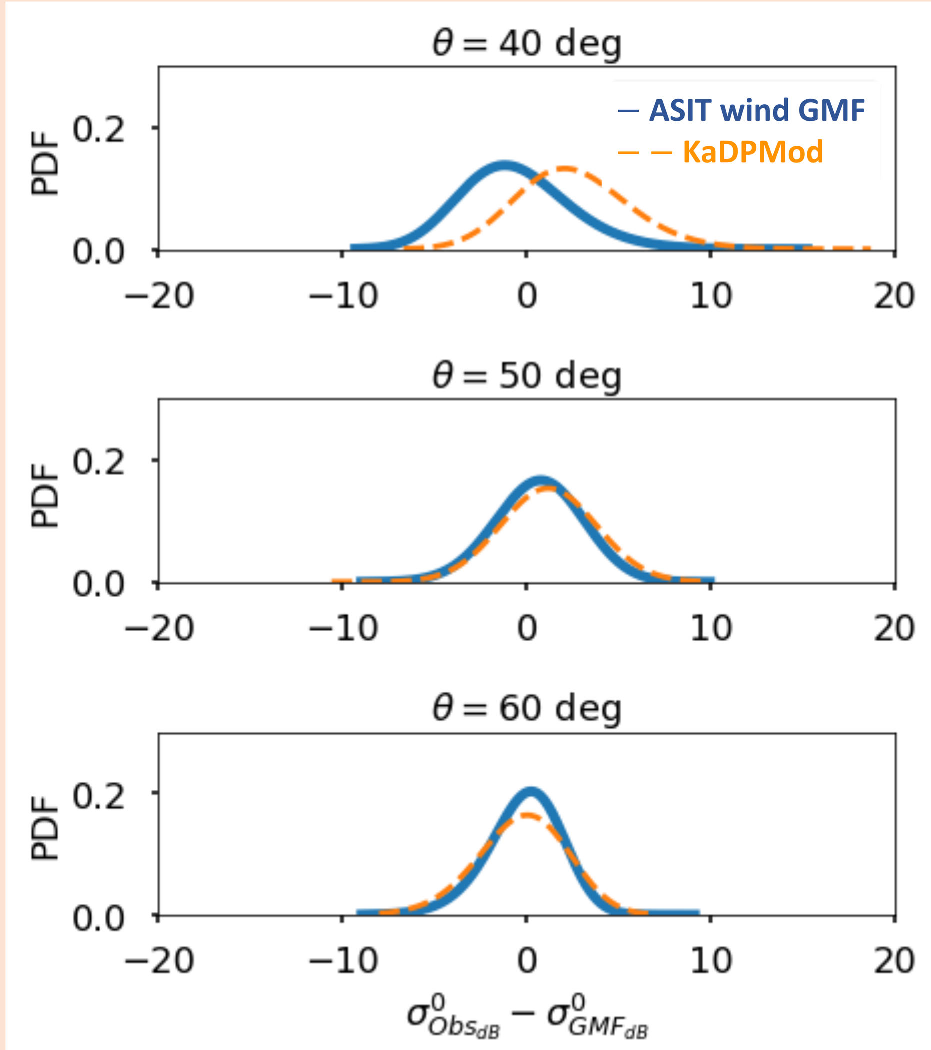
3. RESULTS

- **Good agreement between the two GMFs**. Slightly different wind modulation, especially in the relative wind direction.





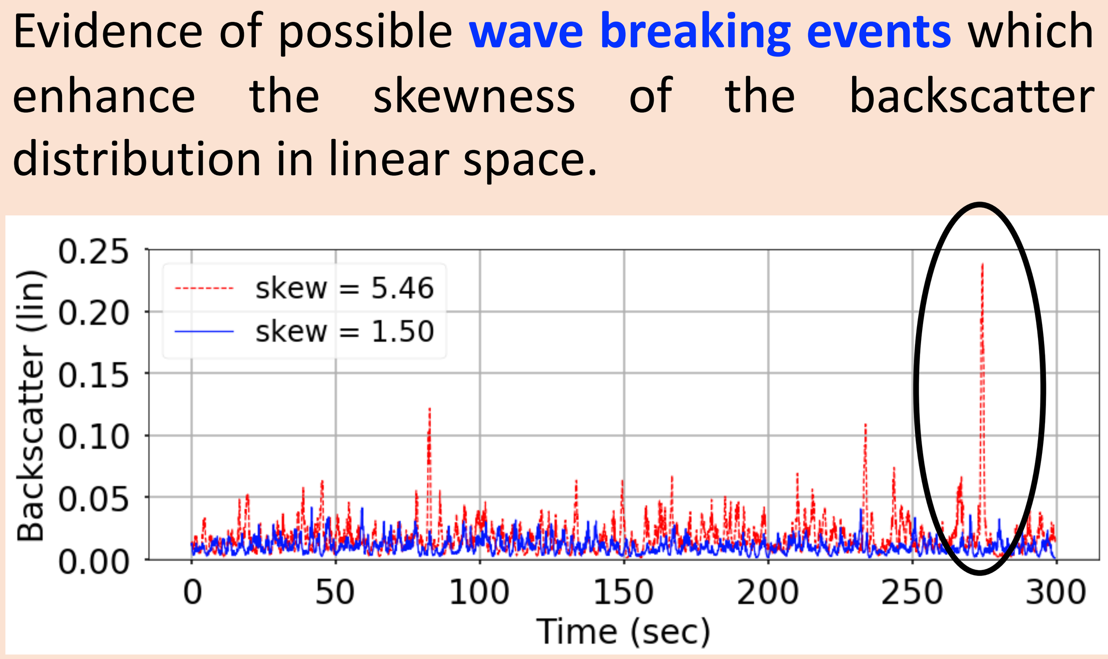
- The two GMFs show consistent values of the standard deviation of the model residuals. This suggests the presence of a **backscatter geophysical variability.**
- The model statistics show that at 60 deg both GMFs better agree with the data then at other incidence angles.



- No significant difference is seen in the **standard deviation of the ASIT wind GMF residuals** when filtering swell-dominated data for different wave ages (w_a): **no significant effects due to the long-wave modulation**

	θ = 40°	θ = 50°	θ = 60°
5-8 m/s	2.70	2.38	2.09
5-8 m/s & w_a<2.2	2.62	2.32	2.09
5-8 m/s & w_a<2	2.63	2.30	2.09
5-8 m/s & w_a<1.8	2.62	2.26	2.07
5-8 m/s & w_a<1.6	2.69	2.33	2.16

- Evidence of possible **wave breaking events** which enhance the skewness of the backscatter distribution in linear space.



4. CONCLUSIONS

- The Ka-band ocean surface backscatter shows sensitivity to the wind.
- The KaBODS backscatter shows a variability mostly due to geophysical sources.
- The long-waves-induced modulation is not the primary source of this variability.
- We observe isolated spikes due to possible wave breaking events.
- We are investigating the wave breaking signature, the incidence angle dependence and the sea surface temperature effects.

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