

RECENT EXPERIMENTS ON THE INTER-COMPARISON OF GNSS-R WITH MICROWAVE RADIOMETRY

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Outline

- Background
- Experiment Description
- Data Reduction
- Results
- Conclusion

Background

- Sea surface salinity (SSS) retrievals from L-Band radiometry [Yueh, et al 2001]
- Surface emission (T_B) strongly dependent on surface roughness [Sasaki, et al 1987]
- Roughness effects must be removed to estimate SSS
- GNSS-R provides direct measurement of roughness and has been studied for this application [Sabia, et al 2007]
- We will present an experimental test of GNSS-R sensing of sea-roughness ΔT_b

Hi-Winds 2009 Experiment

- NASA P-3 Aircraft
- Instruments:
 - Delay-Mapping Receiver (DMR) – GNSS-R
 - PALS – L-band radiometer
 - PolSCAT – Ku-band polarimetric scatterometer
- Region in N. Atlantic selected for low SST and high winds
- March 2 2009 Data analyzed.

Hi-Winds 2009 Experiment



NASA Langley DMR

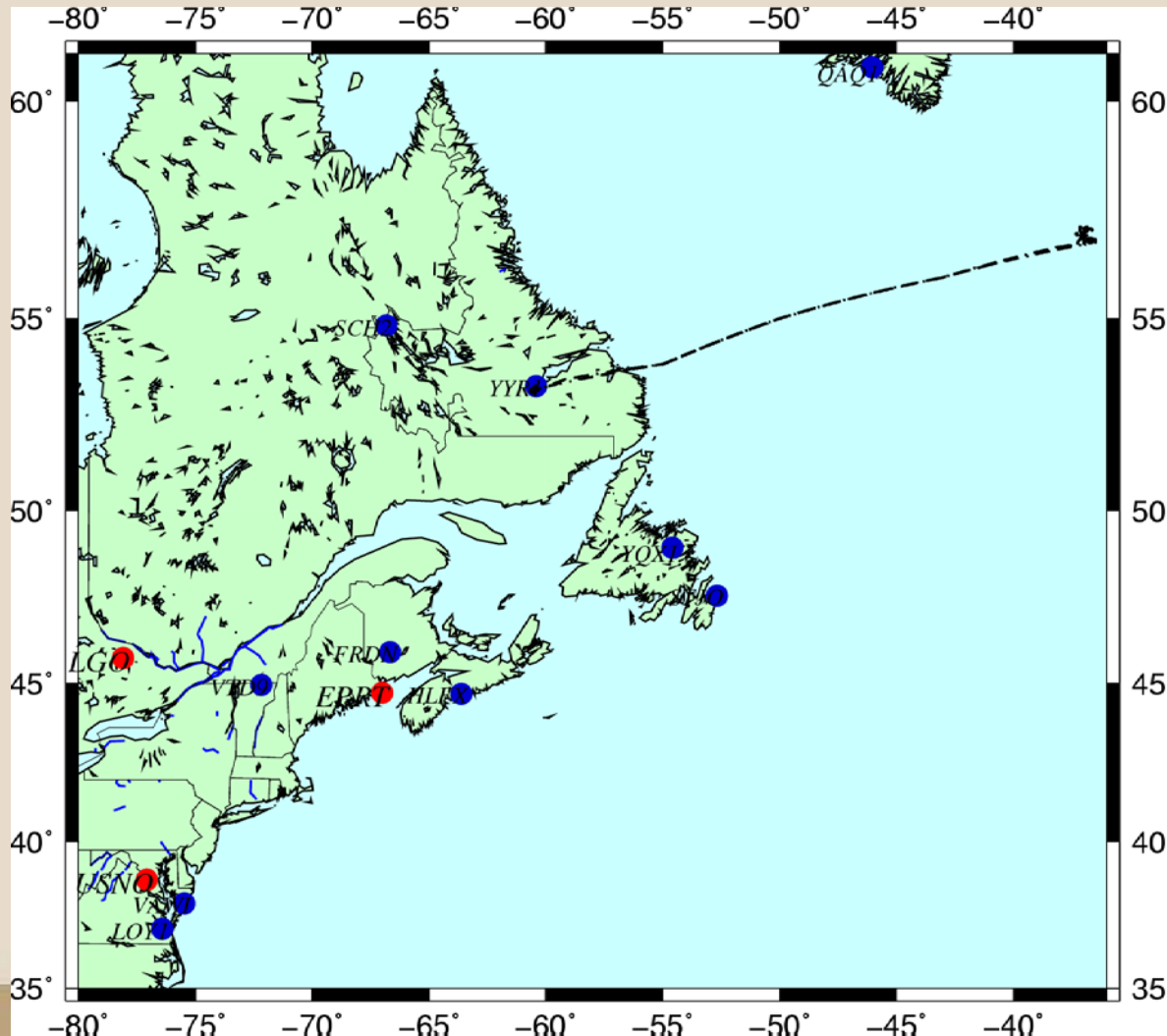


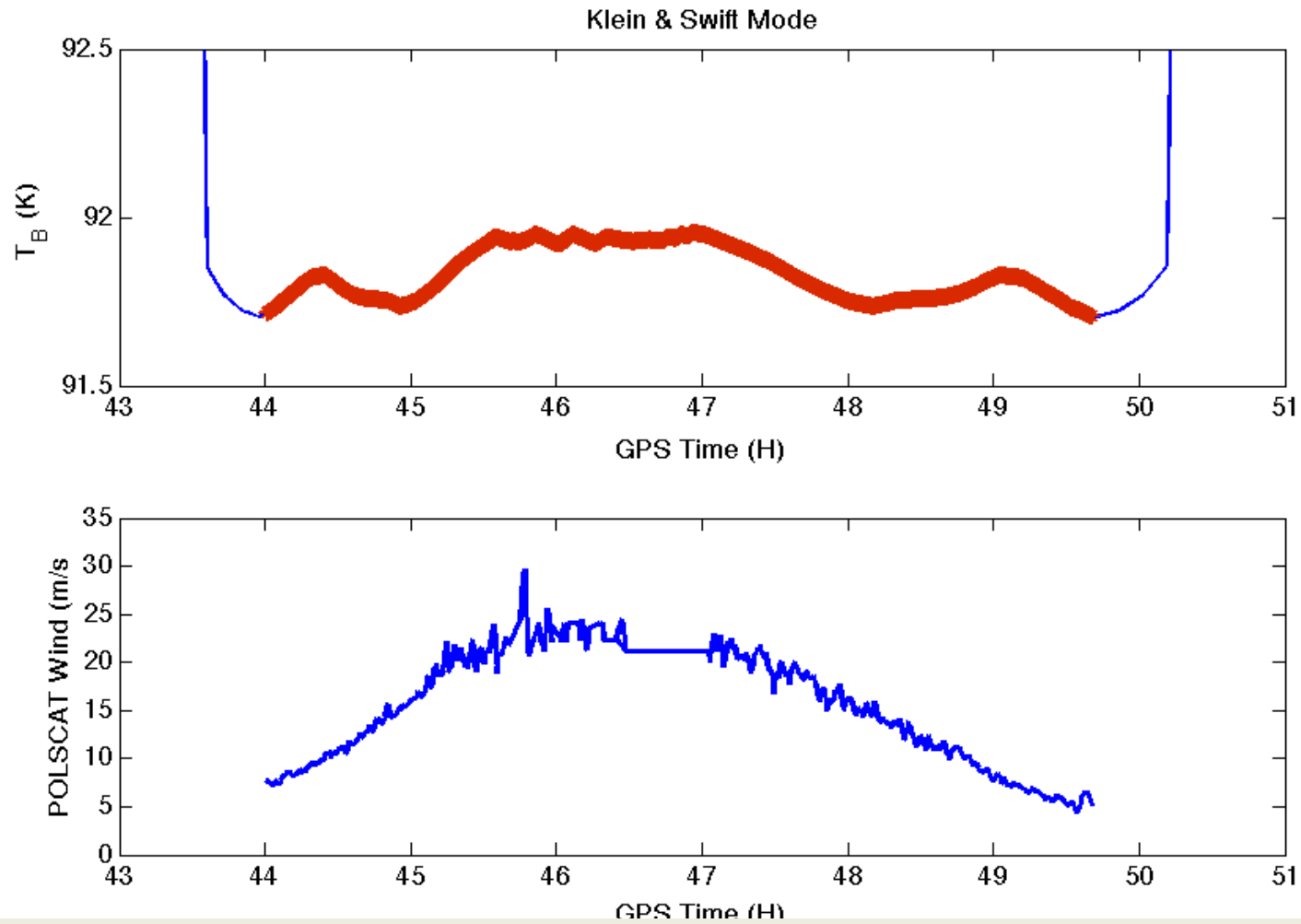
Integration at Wallops Is., VA



GNSS-R Antenna

Hi-Winds 2009 Experiment





Expected Flat-Surface Brightness Temperature & Wind Speed Variation

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Data Reduction

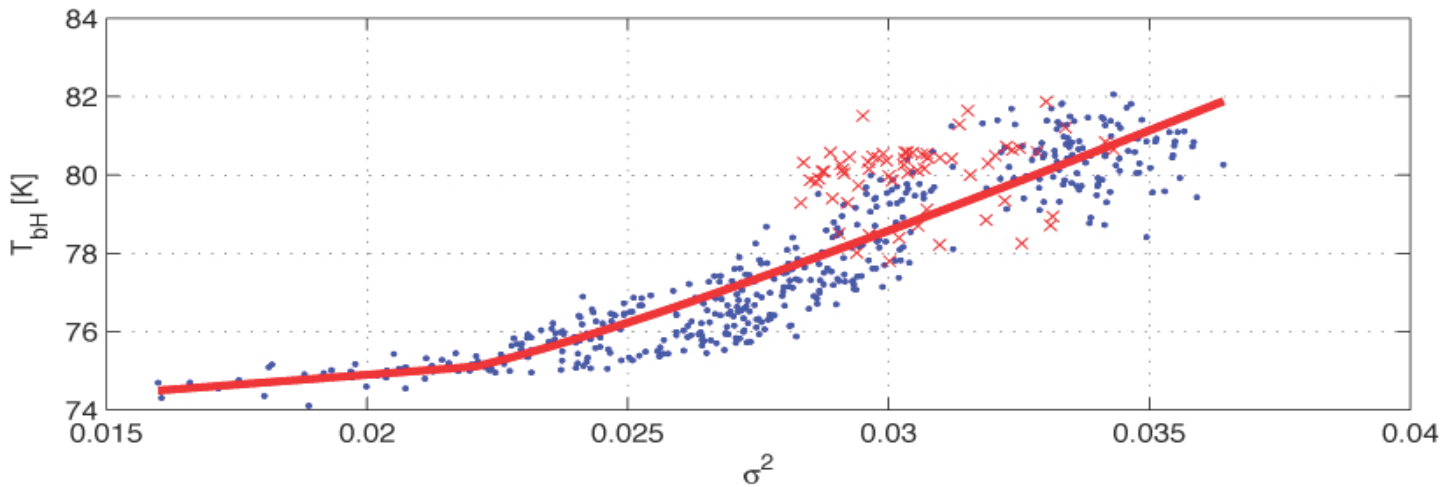
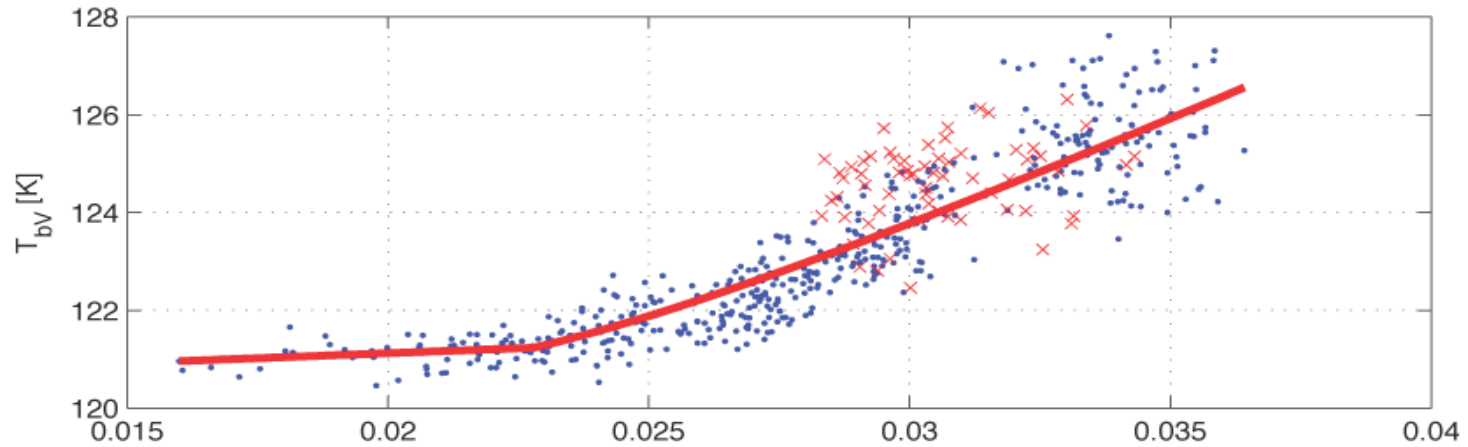
- Non-coherent sum of 100 waveforms
- Highest-elevation satellite
- Least-Squares fit of scattering model to waveform data

$$\hat{\mathbf{x}} = \underset{\mathbf{x}}{\operatorname{argmin}} \sum_k \{ [\bar{C}_k - Y_M^2(\tilde{\tau}_k, f_{D,0}; \mathbf{x})]^T R_Y^{-1} [\bar{C}_k - Y_M^2(\tilde{\tau}_k, f_{D,0}; \mathbf{x})] \}$$

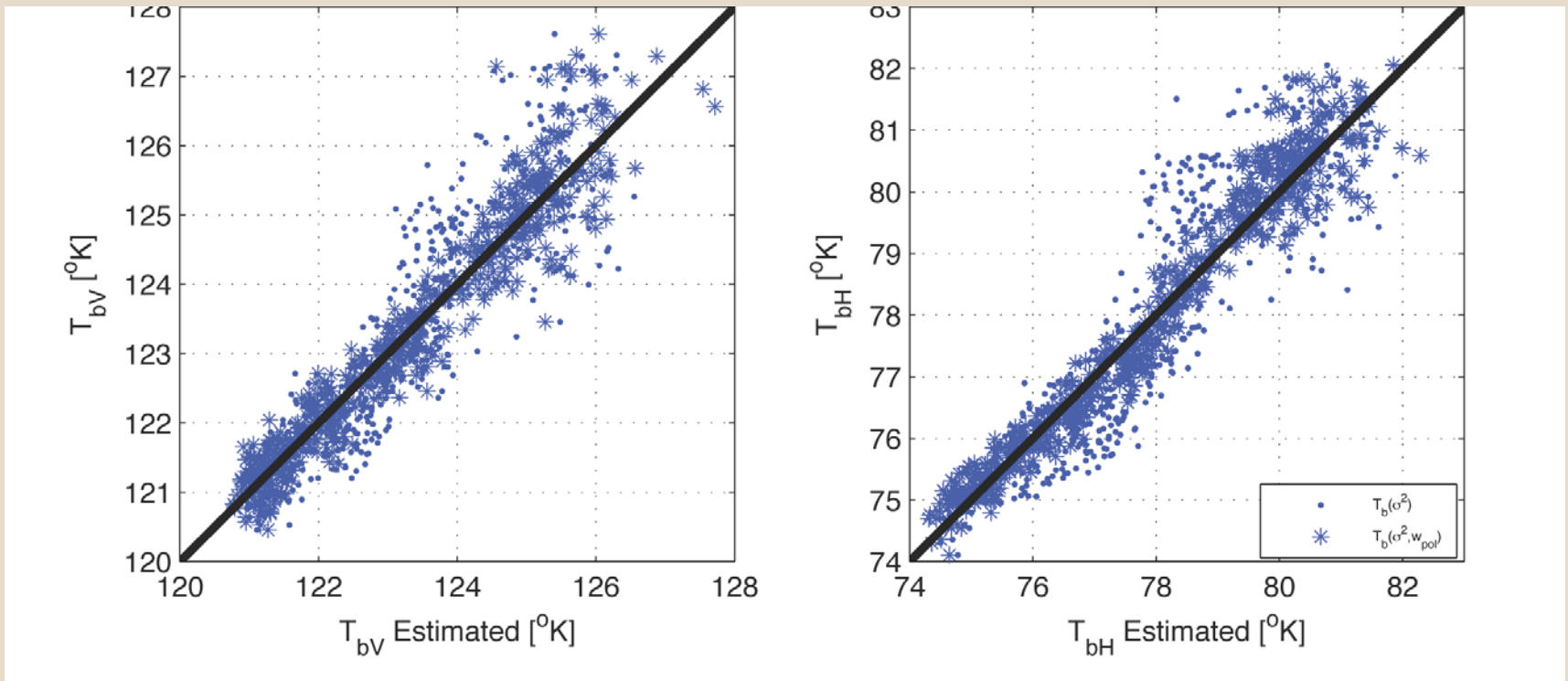
$$\mathbf{x} = \{ \sigma, \tau_0, S \}$$

- Isotropic normal slope PDF assumed – parameterized by Mean Square Slope (σ^2)
- Masking of data for $\theta_0 > 32^\circ$
- Piecewise fit of GNSS-R MSS to PALS T_B

Results: Empirical Model Function



Results: Scatter Plot



(.) – GNSS-R

(*) – Combined PolSCAT and GNSS-R

Conclusions

- Experimental demonstration of L-band roughness retrieval using GNSS-R measurements
- Wind speed range 5-25 m/s
- Residual error: 0.65K (V), 0.67K (H)
- Accuracy comparable to Ku-band scatterometer
- Instrument is much smaller, lower power, and simpler

Acknowledgements

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