OSTST - SARAL/AltiKa Workshop

Relation of AltiKa Wind Speed to Sigma0 and Its Application to Rain Flagging

Alexander Wineteer
Phillip Callahan
Dimitris Menemenlis
Shailen Desai

October 27, 2014   NASA/JPL-Caltech

Presentation Scope

- ❖ Background Information

- ❖ Objectives and Motivation

- ❖ Wind Speed Model & Validation

- ❖ Rain Flag & Validation

- ❖ Conclusions

- ❖ Looking Forward

Background

- SARAL launched in February 2013 with AltiKa onboard.

- AltiKa is the first space-borne Ka band altimeter.

- Little was known about the characteristics of wind speed or rain for Ka band altimetry.

- Rain causes more signal attenuation in the Ka band.
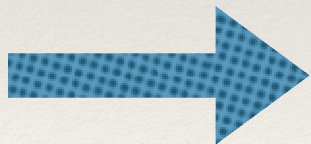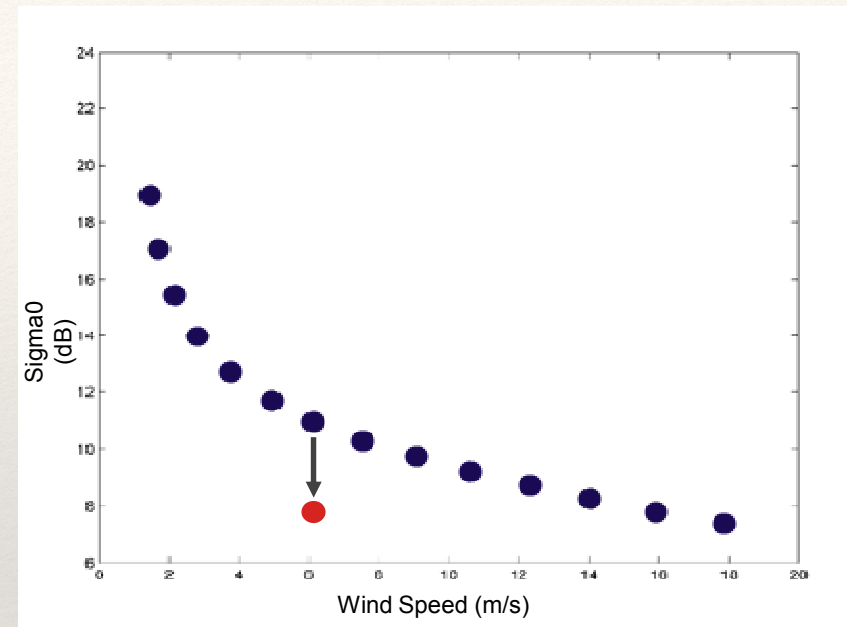
➡️ A particularly weak signal could potentially be attributed to rain.

Objectives and Motivation

- Develop and validate a wind speed model for AltiKa.

  - Ka band, altimeter derived wind speed is not well defined and an inverted model will be needed for rain flagging.

- Invert model to allow for sigma0 prediction from ECMWF wind speed.

  - The validated, inverted wind speed model will provide a key portion of the developed rain flag.

- Incorporate sigma0 model into a rain flag and validate the rain flag.

  - Rain flagging has not been fully implemented into the AltiKa data set. Rain can cause significant, detrimental effects in Ka band altimetry.
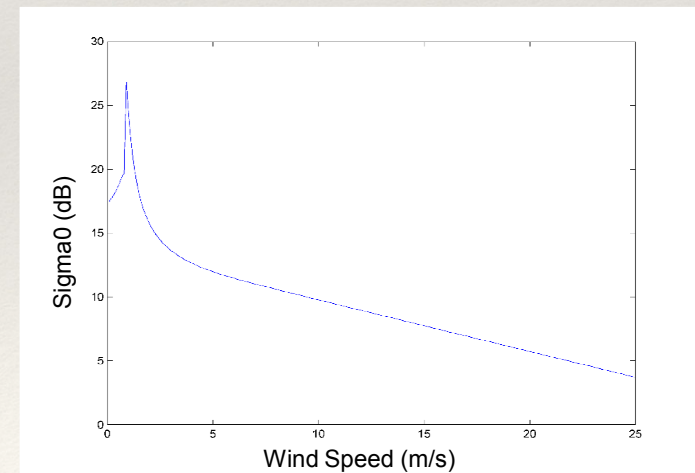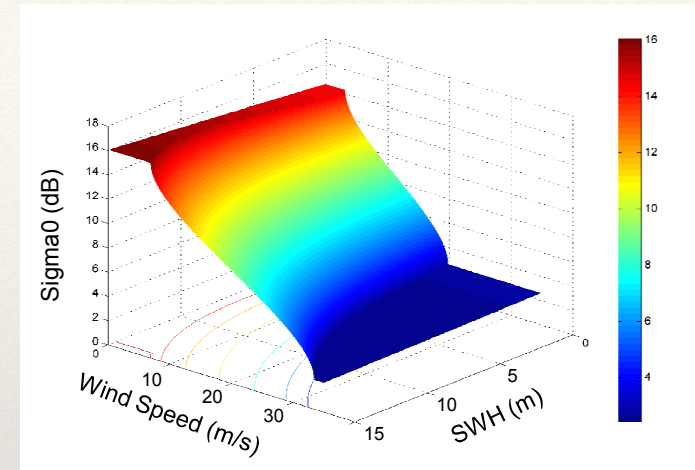
Wind Speed Model

- Low wind speeds and wave heights correspond to an upward scattering of sigma0.
  - RMS VS
    - ECMWF : 1.6 m/s
    - SSM/I: 2.09 m/s
- Therefore, any model will not be useful at WS below ~5m/s.

- Two models used:

- 3D Wind Speed vs SWH vs Sig0
  - RMS VS
    - ECMWF : 1.3 m/s
    - SSM/I: 1.10 m/s
- 2D Lillibridge, et al, Wind Speed vs Sigma0.
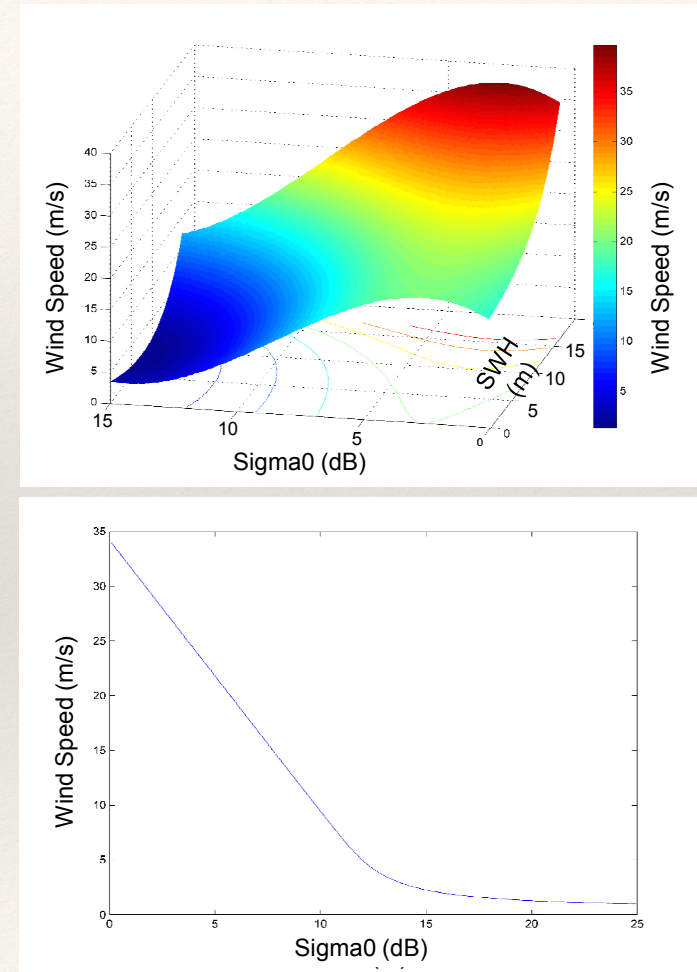
Inverted Wind Speed Model

- ❖ Each wind speed model was inverted numerically and input into a LUT.

- ❖ These LUTs were then used in the computation of a rain flag.

- ❖ Neither model has particularly good low wind speed performance.

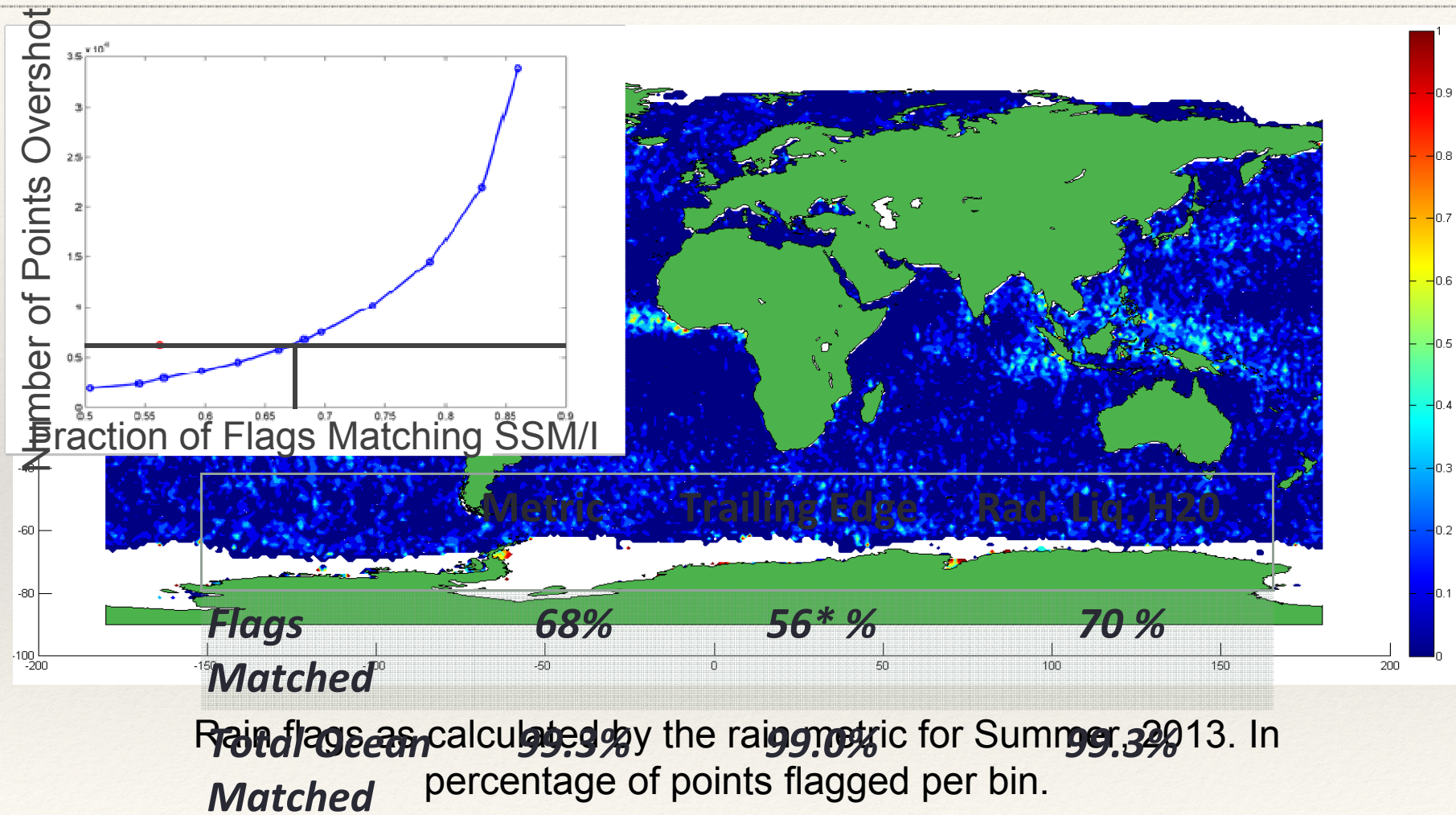 - ❖ This region was planned to be excluded due to scatter, anyway.

NASA/JPL-Caltech

Rain Metric

$$M = W_1(\sigma^0_{model} - \sigma^0_{actual}) + W_2(L_{rad}) + W_3(V_{rad}) \qquad (1)$$

❖ Rain metric is composed of the weighted sum of sigma0 deviations and liquid/vapor atmospheric water content.

❖ Sigma0 deviations are calculated based on the inverted wind speed model.

❖ Both the liquid and vapor water content measurements are taken using the microwave radiometer onboard SARAL.

❖ Weightings are currently set to give approximately equal contribution from each component.

❖ At low wind speeds, the metric is replaced by a simple liquid water flag.

Metric	Trailing Edge	Rad. Liq. H20
Flags Matched	68%	56* %	70 %
Total Ocean Matched	99.3%	99.0%	99.3%

Rain flags as calculated by the rain metric for Summer, 2013. In percentage of points flagged per bin.

Conclusions

❖ The sigma0 deviation rain metric could offer a reliable rain flagging method, and would benefit from:

    ❖ A more accurate wind speed model.

        ❖ Especially one to model low wind speed scatter.

    ❖ Weighting optimization.

    ❖ A comparison with an Altimeter derived rain flag.