

### A Neural Network Approach for Improving QuikSCAT Winds in Rain

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#### Overview

- Method
- Case Studies
- Statistical Results on January 2008



### Method

- Neural Networks were developed to estimate several geophysical quantities from QuikSCAT data.
  - Inputs: Ku band  $\sigma_0$  of each flavor for each 25 km cell, cross track distance as a proxy for viewing geometry, MLE wind solutions
  - Outputs: Total Liquid, wind speed, and a set of 4 ambiguous wind vector components u and v
  - Training set: SeaWinds/AMSR data with ECMWF winds and AMSR liquid value used as truth
  - Validation set: QuikSCAT data from January 2008





## **DIRTH-ECMWF** Bias

Only 2% of data is rain contaminated, but this leads to a prominent bias in rainy areas like the ITCZ.





# **ANN-ECMWF** Bias

The neural net winds reduce rain biases, but ECWMF is biased vs. QuikSCAT, so training on ECMWF yields a systematic bias.





#### This systematic bias is easily removed!





# **DIRTH-ECMWF** Bias

#### After we match wind speeds in clear data ...





### **ANN-ECMWF** Bias

Rain effects can be removed without biasing clear regions.



# New Guinea Case - DIRTH

#### January, 20 2008



SSM/I Rain Rate for comparison (~40 min off, Scale 0-5 mm/hr)





### New Guinea Case - ANN



SSM/I Rain Rate for comparison (~40 min off, Scale 0-5 mm/hr)





### Florida Case - DIRTH



SSM/I Rain Rate for comparison (~80 min off, Scale 0-10 mm/hr)





### Florida Case - ANN



SSM/I Rain Rate for comparison (~80 min off, Scale 0-10 mm/hr)





#### Hawaii Light Rain Case: ECMWF does not resolve inter-island wind jets January 2, 2008



NASA

# Hawaii Light Rain Case: Official QuikSCAT winds resolve jets, but scattered "gusts" look like rain.





~ 40 min off Scale = 0-2 mm/hr



# Hawaii Case: ANN winds resolve jets, but "rain gusts" are greatly reduced.















#### **Clear Data: Speed Bias**





### Rainy Data: Speed Bias





#### **Clear Data: RMS Direction Error**





#### Rainy Data: RMS Direction Error









#### **DIRTH Winds- January 2008**





### ANN Winds - January 2008





# Summary

- The ANN method substantially improves wind speed accuracy in rain contaminated areas.
  - 6 m/s speed bias drops to 1 m/s
  - 8 m/s RMS error drops to 3 m/s
- Directional improvement is also promising
  - Need to port code to do multi-pass ambiguity removal in order to fully evaluate impact.
- As was desired, the technique has little impact in clear areas.
- The performance of the ANN retrieval on QuikSCAT lends credence to the ANN-based all weather retrieval under consideration for DFS.