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College of Engineering
Department of Atmospheric, Oceanic & Space Sciences

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Aquarius Radiometer RFI Algorithm

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Outline

- Description of Aquarius RFI Flag Algorithm
- Examples of SMOS RFI

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Qualitative Description of Algorithm

- The RFI detection algorithm is a "glitch detector" which identifies samples that deviate anomalously from the average of their neighbors
- Adjustable parameters of the algorithm address
  - How many neighboring samples to use to determine the local average
  - Which neighboring samples to exclude from the average due to possible RFI contamination
  - How large a deviation from the local average constitutes the presence of RFI
  - Which (if any) other samples near a contaminated sample should also be flagged as contaminated even if they are not flagged directly by the algorithm

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Relevant Aquarius Data Sampling Parameters

- Calibrated TB samples are measured every 10ms
- Satellite ground track velocity is ~ 7.5km/s
- Radiometer HPBW footprint diameters are ~ 85, 102 and 125 km
- Derived relationships
  - A very sharp TB feature, such as a coastal crossing, requires approximately 13 seconds (= $HPBW/v_{groundtrack}$) to develop in the Aquarius image
  - There will be approximately 1300 TB samples taken during a coastal crossing transition

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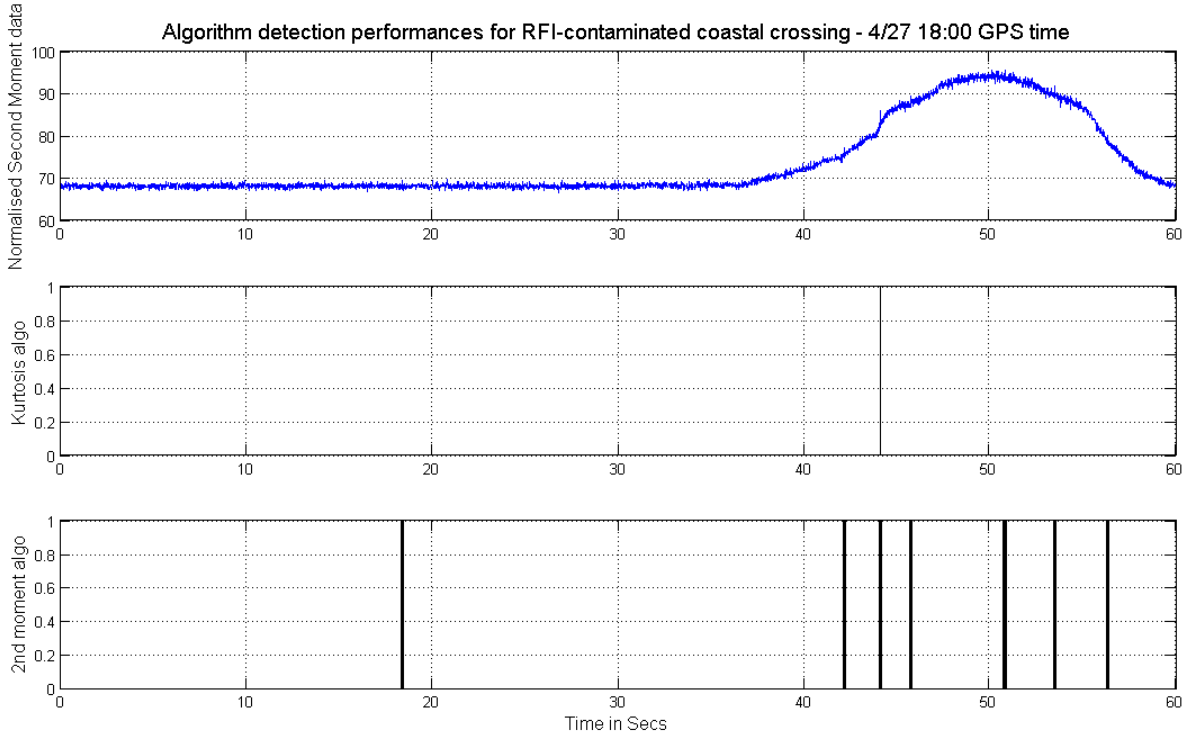
Example of Algorithm Performance

- Data Set E (simulated coastal crossing w/ single RFI event at coastline)
- Algorithm parameters: W_s=20, T_m=1.5, T_{det}=4, W_r=W_f=5
- Single RFI event successfully detected; false alarms still present



Pre-launch Algorithm Parameter Values

- Algorithm parameters and suggested nominal values are:
  - Averaging window for local mean TB value: W_s=20
  - Mean threshold to select clean TBs for local mean: T_m=1.5
  - Detection threshold to decide if RFI is present: T_{det}=4
  - Neighborhood of detected RFI also flagged: W_r=W_f=5
- T_{det} has the most significant effect on performance
  - Coastal crossing can trigger false alarms if T_{det} is set too low
  - Missed detections will result if T_{det} is set too high
- Algorithm has capability for lat/lon dependent parameters with 1 deg resolution
  - Currently all the same pending SMOS analysis

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SMOS RFI Impulse Response Test

- Pulse a controlled RFI source on and off during SMOS overpass
  - Half-wave crossed dipole with circular Pol'z
  - Antenna borsesight pointed at center of SMOS FOV
  - TB ~ 450 K
  - Period of modulation = 3 x smallest SMOS integration time (so at least one known integration is 100% ON and OFF)
- ON – OFF difference resolves RFI impulse response
  - Small changes in incidence angle from ON to OFF add background residual error

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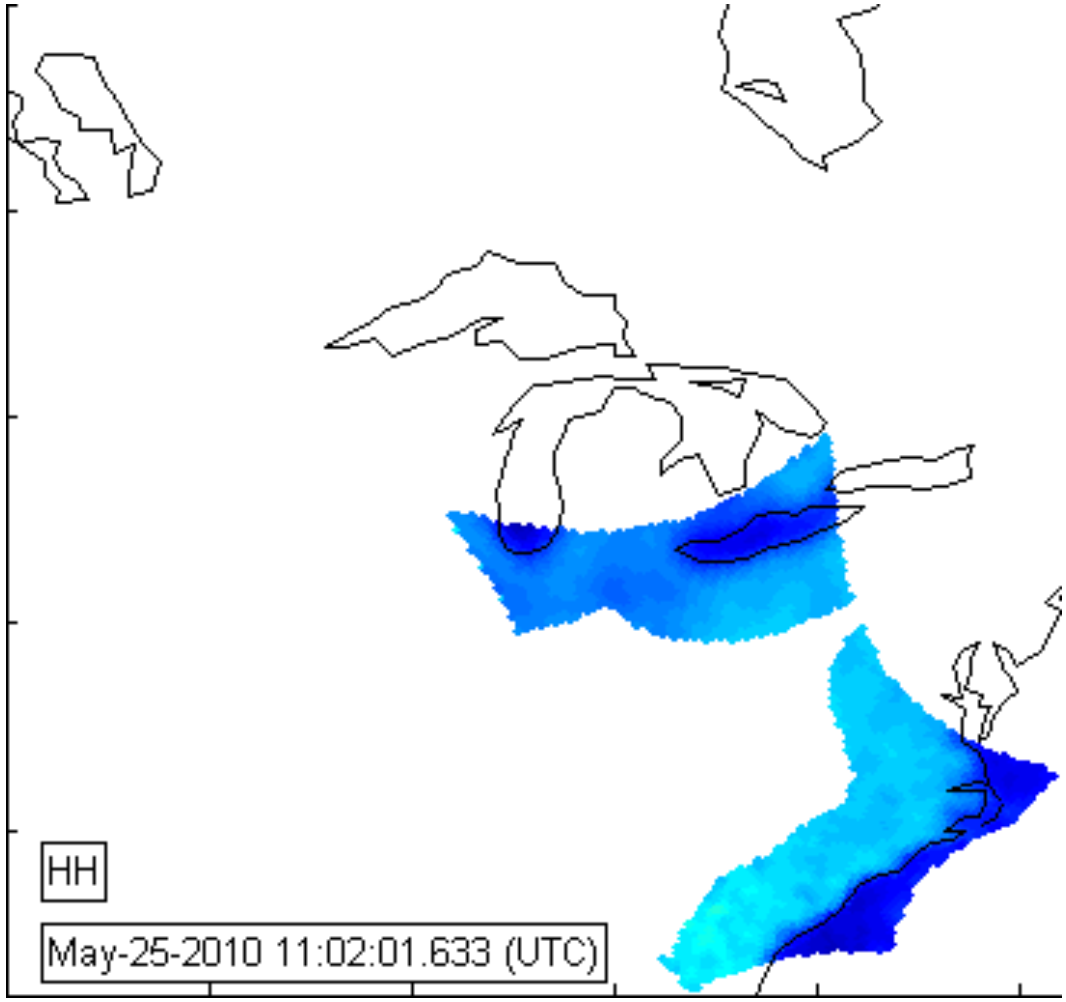
SMOS H-pol TB Image Animation During RFI Impulse Response Test



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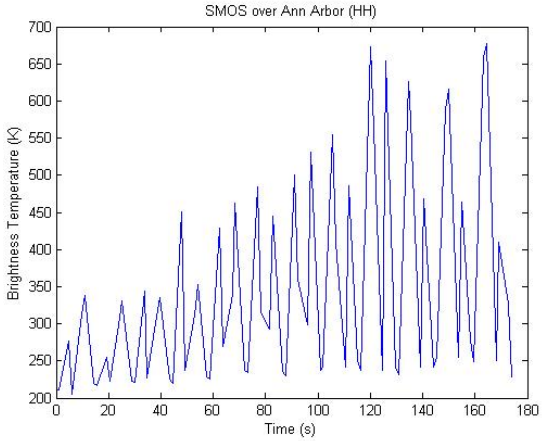
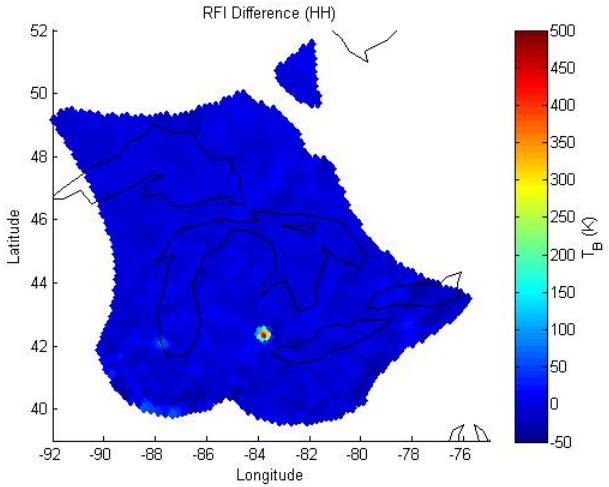
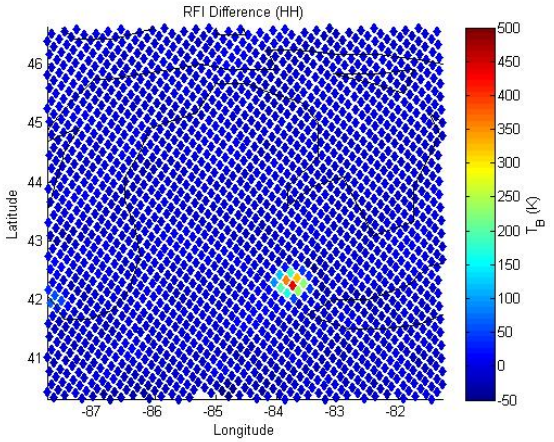
SMOS H-pol TB Time Series and RFI Impulse Response Images



Time series of TB_H at RFI location



ON-OFF TB_H difference (close up of RFI at right)



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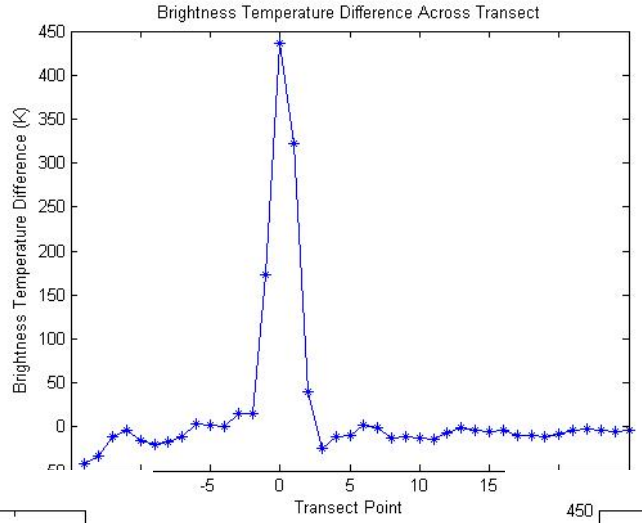
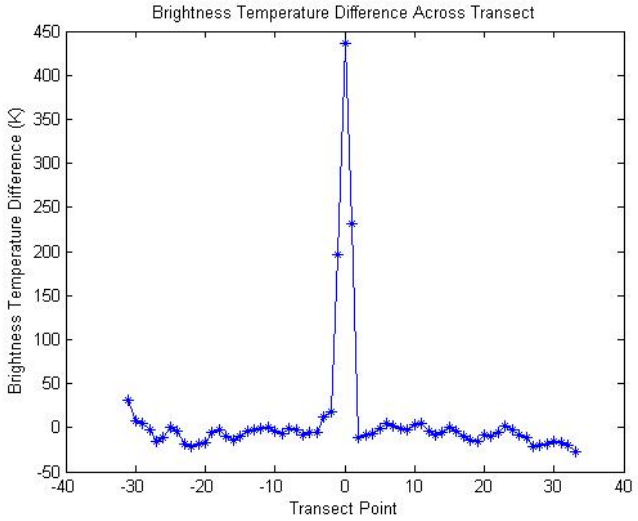
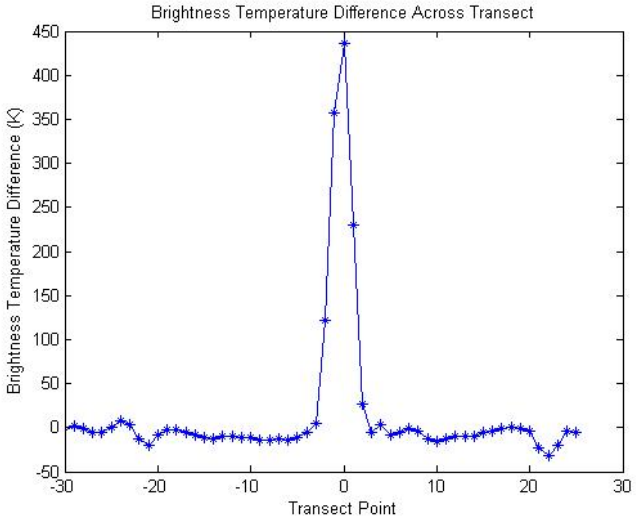
SMOS H-pol TB RFI Impulse Response
Transects along three 120^{o} principle planes







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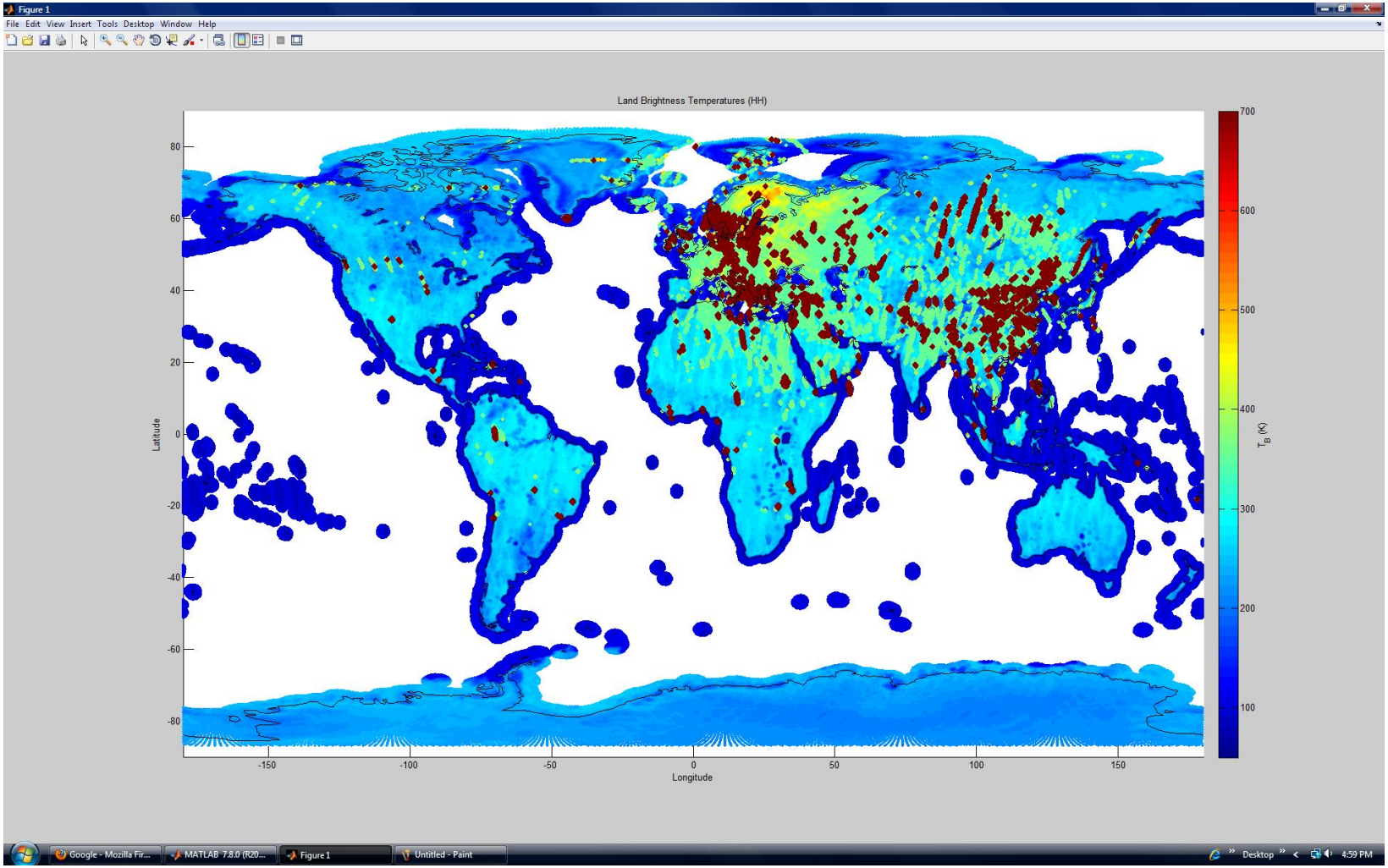
SMOS "Peak Hold" Detected RFI Image Land V-Pol during 5-11 June 2010



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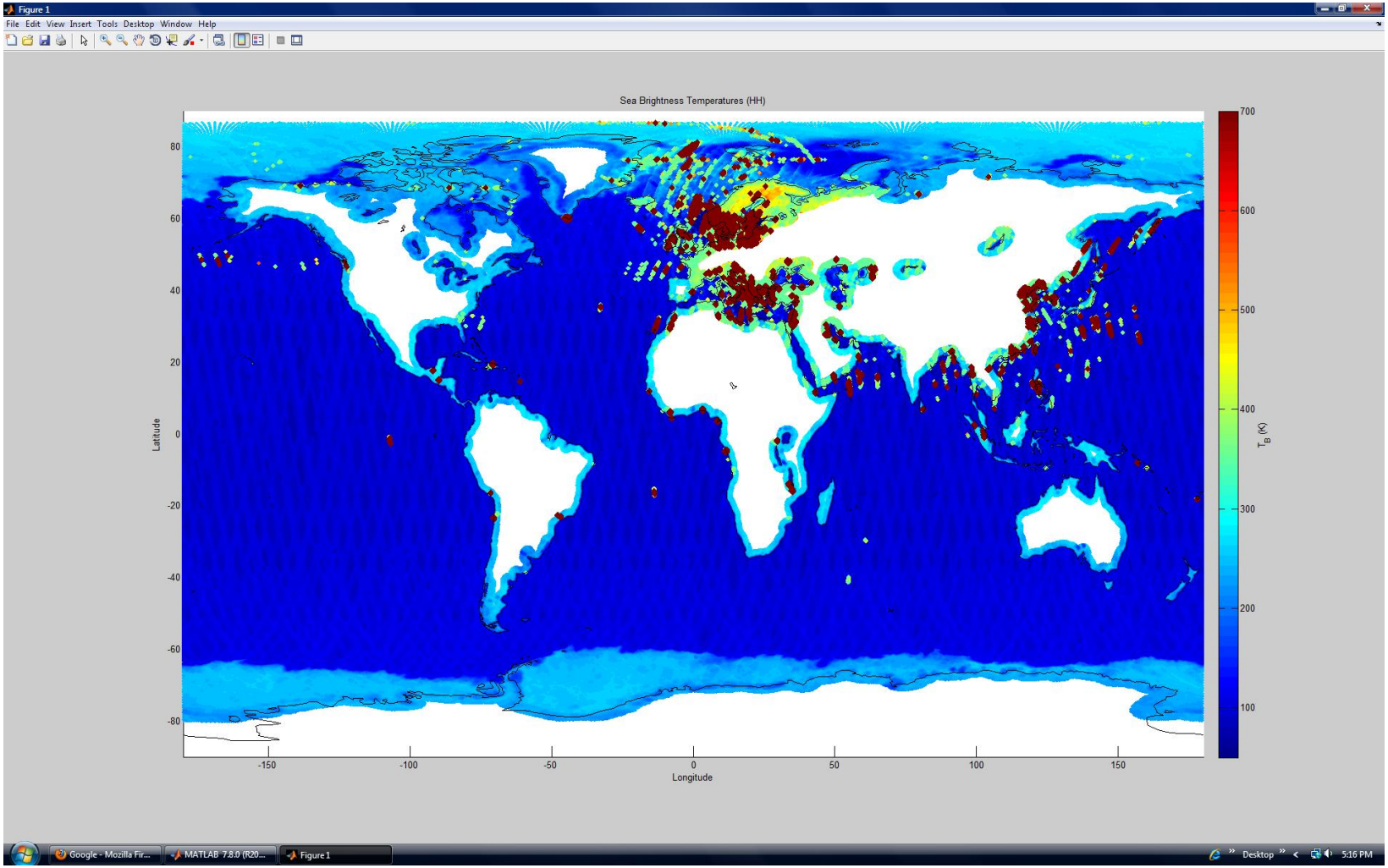
SMOS "Peak Hold" Detected RFI Image Ocean V-Pol during 5-11 June 2010



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