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Aquarius Radiometer
RFI Algorithm

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Outline

• Description of Aquarius RFI Flag Algorithm
• Examples of SMOS RFI
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
Relevant Aquarius Data Sampling Parameters

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

![Algorithm detection performances for RFI-contaminated coastal crossing - 4/27 18:00 GPS time](image-url)
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
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
SMOS H-pol TB Image Animation
During RFI Impulse Response Test
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)
SMOS H-pol TB RFI Impulse Response
Transects along three $120^\circ$ principle planes
SMOS “Peak Hold” Detected RFI Image
Land V-Pol during 5-11 June 2010
SMOS “Peak Hold” Detected RFI Image
Ocean V-Pol during 5-11 June 2010