AMSR-E RFI Update

- Towards RFI 2.0
- Adaptive Algorithms 1.0

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Frank, Carl, Chelle, et. al.
Remote Sensing Systems

AMSR Science Team Meeting
Portland, Oregon, 2012.Sep.11-12
RFI

• Surface Based (~7GHz)
  – Ascension Island, Hawaii, Netherlands, etc.

• GeoStationary Satellites (11GHz, 18GHz)
  – “Space Based”
  – “Ocean Reflected”
RFI

• RFI 1.0
  – We know where it’s coming from.
  – We can filter it.

• RFI 2.0
  – We don’t really know where it’s coming from.
  – We can retrieve around it.
Fishing for Geostationary RFI

• Data used: AMSR-E, March-September 2011 (7 months)
  – RFI is very much a moving target

• Calculated the longitude and latitude where the reflection of the boresight vector from the surface crosses geostationary altitude (35,786 km)

• For this analysis:
  – histograms of geostationary crossing longitude at 0.1 deg resolution
  – maps of fraction of observations affected by RFI
  – RFI defined as: SST or Wind diff > threshold
  – 4 different thresholds (1, 3, 6, and 9 K or m/s)
  – Required geostationary latitude to be within +/- 5 deg of equator
  – Removed: land, ice, rain, sun glitter; used both asc/dsc passes
# AMSR-E Ocean Products

<table>
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<tr>
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### AMSR-E Ocean Products

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<td>X</td>
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<tr>
<td>Wind Low Res</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Wind Med Res</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
SST: LO-VL
SST LO-VL > 1 K (Weak RFI)

Smooth Seas
(wind speeds < 7 m/s)

Glassy Seas
(wind speeds < 3 m/s)
SST LO-VL > 3 K (Medium RFI)

Smooth Seas
(wind speeds < 7 m/s)

Glassy Seas
(wind speeds < 3 m/s)
SST LO-VL > 6 K (Strong RFI)

Smooth Seas
(wind speeds < 7 m/s)

Glassy Seas
(wind speeds < 3 m/s)
SST LO-VL > 9 K (V.Strong RFI)

**Smooth Seas**
(wind speeds < 7 m/s)

**Glassy Seas**
(wind speeds < 3 m/s)
Geostationary Direct-Broadcast Services (DBS) Satellites with significant RFI potential

Ocean reflected RFI is arguably the fastest growing source of errors in passive microwave observations. This work-in-progress catalogs Geostationary sources with significant RFI potential via Direct-broadcast Services (DBS). RFI may also result from Fixed-Satellite Services (FSS) aboard the same or similar constellation of satellites.

<table>
<thead>
<tr>
<th>Spacecraft</th>
<th>Longitude</th>
<th>Launch date</th>
<th>Areas Affected</th>
<th>Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>DirectTV-10</td>
<td>102.8°W (257.2°E)</td>
<td>2007-07-06</td>
<td>North America</td>
<td>18.7 GHz</td>
</tr>
<tr>
<td>DirectTV-12</td>
<td>102.8°W (257.2°E)</td>
<td>2009-12-28</td>
<td>North America</td>
<td>18.7 GHz</td>
</tr>
<tr>
<td>DirectTV-11</td>
<td>99.2°W (260.8°E)</td>
<td>2008-03-19</td>
<td>North America</td>
<td>18.7 GHz</td>
</tr>
<tr>
<td>Intelsat 3R (Sky Brazil)</td>
<td>43.0°W (317.0°E)</td>
<td>1996-01-12</td>
<td>Brazil</td>
<td>10.65 GHz</td>
</tr>
<tr>
<td>Intelsat 11 (Sky Brazil)</td>
<td>43.0°W (317.0°E)</td>
<td>2007-10-05</td>
<td>Brazil</td>
<td>10.65 GHz</td>
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<tr>
<td>Hispasat 1E</td>
<td>30.0°W (330.0°E)</td>
<td>2010-12-29</td>
<td>Europe</td>
<td>10.73 GHz</td>
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<tr>
<td>Atlantic Bird 4</td>
<td>7.2°W (352.8°E)</td>
<td>1998-02-27</td>
<td>Middle East</td>
<td>10.65 GHz</td>
</tr>
<tr>
<td>Eutelsat W3A</td>
<td>7.0°E</td>
<td>2004-03-16</td>
<td>Europe</td>
<td>10.65 GHz</td>
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<tr>
<td>Eutelsat W2A</td>
<td>10.0°E</td>
<td>2009-04-03</td>
<td>Europe</td>
<td>10.65 GHz</td>
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<tr>
<td>Hot Bird 6</td>
<td>13.0°E</td>
<td>2002-08-21</td>
<td>Europe</td>
<td>10.65 GHz</td>
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<td>Hot Bird 8</td>
<td>13.0°E</td>
<td>2006-08-05</td>
<td>Europe</td>
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<tr>
<td>Astra 1KR</td>
<td>19.2°E</td>
<td>2006-04-20</td>
<td>Europe</td>
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<tr>
<td>Astra 1E</td>
<td>19.2 -&gt; 23.5°E</td>
<td>1995-10-19</td>
<td>Europe</td>
<td>10.65 GHz</td>
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<tr>
<td>Astra 2D</td>
<td>28.2°E</td>
<td>2000-12-19</td>
<td>Europe</td>
<td>10.65 GHz</td>
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<tr>
<td>Astra 2C</td>
<td>28.2 -&gt; 31.5°E</td>
<td>2001-06-19</td>
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Wind: MD-LO
Wind MD-LO > 1 m/s (Weak RFI)

**Smooth Seas**
(wind speeds < 7 m/s)

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(wind speeds < 3 m/s)
Wind MD-LO > 3 m/s (Medium RFI)

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Fraction of Obs with WIND MD - WIND LO > 3 m/s (for Winds < 7 m/s)

Fraction of Obs with WIND MD - WIND LO > 3 m/s (for Winds < 3 m/s)
Wind MD-LO $> 6$ m/s (Strong RFI)

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(wind speeds $< 7$ m/s)

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Wind MD-LO > 9 m/s (V.Strong RFI)

Smooth Seas
(wind speeds < 7 m/s)

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(wind speeds < 3 m/s)
Geostationary Fishing Results

- The analysis finds good agreement between geostationary longitude histogram peaks and the longitudes of:
  - HotBird (13.0°)
  - Astra (19.2°)
  - Astra (28.2°)
  - EutelsatW2A (10.0°)
- Presence of land can give peaks off the nominal longitudes
  - AtlanticBird4 (352.8°) peak is 5-10° west of nominal longitude
  - For 18.7 GHz RFI: DirectTV peaks are about 10° west and east of the nominal longitudes (257.2° and 260.8°)
Geostationary Fishing 2.0

• Assume GeoStat Sats are equatorial
• Look at latitudes as well as longitudes
  – Geostationary Altitude Sky Maps
SST: LO-VL
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All Seas
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All Seas
(all wind speeds)
Geostationary RFI 1.0

Implemented L2A Version B05 (August, 2005)

- Glint Angles computed to 13.0° E and 19.2° E (at geostationary altitude)
Geostationary RFI 2.0

L2A Proposed New Swath Names:

“Geostationary_Altitude_Reflection_Latitude”

“Geostationary_Altitude_Reflection_Longitude”
Towards: Adaptive Algorithms 1.0

Mitigating the Effect of 11 GHz RFI on AMSR-E SST Retrievals

Kyle, Aug 2012
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<td>SST (-11GHz)</td>
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<td></td>
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2011, Descending Passes, Standard Algorithm
2011, Descending Passes, 11 GHz RFI Mitigation
2002, Descending Passes

Standard Algorithm 11 GHz RFI Mitigation

Color = Standard Deviation of AMSR-E – Reynolds SST
2003, Descending Passes

Standard Algorithm

11 GHz RFI Mitigation

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2004, Descending Passes

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2008, Descending Passes

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2009, Descending Passes

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2011, Descending Passes

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2011, Descending Passes, Standard Algorithm
2011, Descending Passes, 11 GHz RFI Mitigation

Adaptive Algorithm, AMSR-E SST(VL) - Reynolds, Descending passes, 2011
L2A Proposed New Swath Names:

“Geostationary_Reflection_Latitude”
“Geostationary_Reflection_Longitude”

~or~

“Geostationary_Altitude_Reflection_Latitude”
“Geostationary_Altitude_Reflection_Longitude”

~or~
Arigato Gozia Mas

- Towards RFI 2.0
- Adaptive Algorithms 1.0

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