SMOS Payload Calibration and Image Reconstruction

Based on the work by UPC, AALTO, DEIMOS, IFREMER

and

J. Closa, EADS-CASA Espacio
F. Martín-Porqueras, SMOS CEC
R. Oliva, ESAC
M. Martín-Neira, SMOS Calibration Team – ESTEC

with the support from
ESAC FOS Team
- MIRAS Calibration Plan
- Long-term Drift: NIR and LICEF
- Short-term Drift: NIR and LICEF
- Fringe-washing Function
- Land-sea Contamination in Image Reconstruction
- Conclusions
MIRAS Calibration Plan
MIRAS Calibration Plan

- LO Calibration every 10 minutes (5 epochs)

- NIR Calibration every 2 weeks (cold sky view - 1 orbit)

- Long Calibration every 8 weeks (2 x 0.5 orbits)

- Flat Target Response Calibration every 6 months (cold sky view - 1 orbit)
Long Term Drift: NIR and LICEF
Based on the analysis of the **cold sky calibration data** collected in the period from 11-Jan-2010 till September 2010, a **long-term drift** was identified in the **NIR units**

**Long Term Drift: NIR**

- **Patch Temperature (Tp7)**
- **Noise Injection Amplitude**

![Graph showing noise injection amplitude and patch temperature (Tp7)](image-url)
The long-term drift is correlated with the **physical temperature** of the **antenna** (sensed by the “Tp7” thermistor).
The LICEF exhibit a similar long-term drift as the NIR since they have the same antenna.
- The Flat Target Response exhibits a **long-term drift** as the NIR and the LICEF drifts correct.

- The long-term drift of the FTR **has to be re-assessed after the NIR and LICEF drifts are corrected**
Short Term Drift:
NIR and LICEF
- Based on the analysis of each **cold sky calibration event**, a **short-term drift** was also identified in the **NIR** units.

**Patch Temperature**

<table>
<thead>
<tr>
<th>NIR calibration activity number</th>
<th>NIR Tp7 [K]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>276.5</td>
</tr>
<tr>
<td>2</td>
<td>277</td>
</tr>
<tr>
<td>3</td>
<td>277.5</td>
</tr>
<tr>
<td>4</td>
<td>278</td>
</tr>
<tr>
<td>5</td>
<td>278.5</td>
</tr>
<tr>
<td>6</td>
<td>279</td>
</tr>
<tr>
<td>7</td>
<td>279.5</td>
</tr>
<tr>
<td>8</td>
<td>280</td>
</tr>
</tbody>
</table>

**Noise Injection Amplitude**

- **NIR CA H T_{NA} [K]**
  - 456.0
  - 456.1
  - 456.2
  - 456.3
  - 456.4
  - 456.5
  - 456.6
  - 456.7
  - 456.8
  - 456.9
  - 457
At **QWG-2**, SSS L2 teams report a **bias** in salinity between **descending** and **ascending** passes, which **changed sign around the autumn equinox**.

- The **change** of **sign** at the equinox was a clear hint that such SSS bias could be related to the **solar illumination** on the antenna, as this also changes sign at the equinox.
Short Term Drift: Sun angle and orbit geometry

Ecliptic Plane (bottom view)

Notes:
SP = South Pole
Obliquity of the ecliptic = 23.4°
Orbital evolution of Sun illuminations forces an **orbital evolution of Tp7**

In turn the variation of Tp7 induces an **orbital change of the loss of the antenna** (loss means power attenuation, which also includes mismatch)

The orbital variation of the loss of the antenna causes the bias in SSS between descending and ascending orbits

The same mechanism applies in the long-term

**NIR drift and SSS bias are then both explained by the same mechanism: a variation of the antenna loss due to a variation of its temperature Tp7**
Short Term Drift: Tp7 and bias Hovmoller diagrams

Brightness Temperature Desc-Asc Bias (Stokes-1)

AF-FOV Desc. - Asc. (Tx+Ty)/2 Bias [K]

Patch Temperature (Tp7)

Desc.-Asc. SMCS System Temp CMN1/CH9 [°C]
- The short and long term drifts had \textbf{opposite} correlation sign with the physical temperature of the antenna → \textit{new antenna model}
The LICEFs exhibit a **similar behaviour** since they have the same antenna as the NIR: long and short term drifts of opposite correlation with Tp7.
Short Term Drift:
NIR new antenna model

- Applying the new antenna model of the NIR (one with a loss as a function of its physical temperature Tp7), the descending-ascending bias in the brightness temperature decreases. **Further improvement is needed.**

This result is only preliminary!
Fringe-washing Function
Fringe-washing Function: Stable
Land-sea Contamination
Land-sea Contamination

- The ocean brightness temperature images of SMOS show “shadows” or “halos” around the continental areas (left image).

- The results of our investigation point so far towards a problem in the image reconstruction of the L1 processor (ideal reconstruction looks clean – right image).
Conclusions
CONCLUSIONS

On Drifts:
- Implement and test the new antenna model for both NIR and LICEF using the L1PP, to correct both the long and the short term drifts (including those of FTR)
- If further improvement is still required, an “All-LICEF” based solution might be recommended for assessment, perhaps in combination with a higher FTR calibration rate

On Land-sea Contamination:
- Continue the investigation on the L1 image reconstruction algorithm to find the cause of the land-sea contamination

Objective: to achieve the correction/mitigation of the drifts and the land-sea contamination before the Spring 2011 Reprocessing Campaign