In-Flight Characterization of Microwave Sounders With the Moon

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Talk Structure

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Moon Intrusions in the DSV

- DSV: circle close to celestial equator
- Moon close to ecliptic
- Depending on season, the Moon moves through the DSV circle.
- Bigger circle => more intrusions
- Bigger beam => longer intrusions
The “light” curve of the Moon in the DSV follows closely a Gaussian.

A Gaussian has three parameters:

- Scan number of strongest signal => pointing accuracy (Bonsignori, 2017)
- Width => beam size
- Maximum signal => photometric stability – accuracy ≈ 0.3 %
The Moon as Reference (I)

- Common reference for all satellites, past, present, and future
- Potential replacement of SNO for inter-calibration
- No atmosphere => no spectral lines => channels with the same central $\nu$ get the same $R_{\nu}$

Bobryshev, 2017
The Moon does not fill the beam of the instrument

- $R_{\text{moon}} \ll R_{\text{earth scene}}$
- Bias between satellites different for Earth and Moon
- Derive constraints on uncertainties of instrumental constants
Example: Bias of AMSU-B/N16 (I)

- “Channel 5 on N16 shows [...] the largest bias which reaches 10 K by the end of 2010.” (John et al., 2013)
- The 3 sounding channels give the same signal when observing the Moon.
- Bias due to non-linearity?
- $Q$ proportional to $(C_E - C_{ICT}) \times (C_E - C_C)$
- $Q_{\text{moon}} = 9 \times Q_{\text{tropical ocean}}$, but no such discrepancy found

Example: Bias of AMSU-B/N16 (II)

- Bias due to cold space temperature bias correction?
  \[ R_{ME} = R_{MS} + \frac{R_{MICT} - R_{MS}}{C_{ICT} - C_S} \times (C_E - \bar{C}_S) + D_{R_{nl}}(C_E) \]

- \( \delta R_{moon} = 39 \times \delta R_{tropical ocean} \), no such discrepancy found

- ICT OK, so instrumental constants in measurement equation are not to blame.

- Frequency shift can be ruled out (common LO)
Conclusions

- Observations of the Moon offer unique possibilities to check the stability and uniformity of sounding channels and to determine the cause for inter-satellite bias.
- No knowledge of the brightness temperature of the Moon is necessary.
- A few suitable Moon intrusions per year
- Smaller beam size of ICI and MWI => Moon no point source, but better SNR