Satellite Instrument Pre- and Post-Launch Calibration

Tuesday 7th May 2013, Darmstadt, Germany
Satellite Instrument Pre- and Post-Launch Characterization

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The perfect OCR Mission?

• **A perfect instrument (system)**
  – noise, polar, stray-light, spectral response, variation with field-of-view
    ➔ unrealistic or too expensive

• **A perfect characterization**
  – Pre-flight : full characterization
  – In-flight : complete on-board device
    ➔ unrealistic or too expensive

• **A perfect situation**
  – no evolution, no issues, everything as expected
    ➔ unrealistic (from experiences)
Context

• Knowledge of the instrumental radiometric behavior is crucial for OC applications
  – because the signal of interest is roughly 10% of the TOA signal
  – very challenging accuracy: 0.5% on the TOA reflectance
  – that’s not only 0.5% on calibration, but for the total of all contributors

→ challenging

• Experience and feedback from past/current OCR missions
  – Lessons learnt from individual past/current mission
  – Also feedback from cross-comparison, or cross-validation
Context

- IOCCG Report#13 Mission Requirements for Future Ocean-Color Sensors
  - Multi-agency discussion and consensus
  - State of the art report / recommendations
- Need for international/common effort
  - CEOS OCR-VC Virtual Constellation : whitepaper from the INSITU-OCR
  - Calibration Task force
  - other example : GSICS
Characterization keynotes

- Pre-launch characterization according Report#13
  - Absolute calibration (radiance/reflectance)
  - Relative calibration
  - Spectral characterization (inc. rejection)
  - Straylight characterization
  - Polarization
  - Linearity, dynamic, SNR
  - Temperature and offsets
  - Registration, MTF
Characterization vs Calibration

- Radiometric behavior of the instrument
  
  - Ex: link the input radiance $I$ to the measured digits $X$

$$X_{lp}^a = \left( \frac{E_s}{\pi \cdot G \cdot t} \right) \cdot A \cdot T_{lp}^a \cdot g_{lp}^a \cdot SL_{Xlp}^a \cdot NL \cdot \left[ P_{1lp}^a \cdot I_{lp}^a + P_{2lp}^a \cdot Q^a + P_{3lp}^a \cdot U^a \right] + SL_{Xlp}^a + C_{lp}$$

- Several characterizations need to be done (before cal) in order to
  1/ obtain a quantity that is simply proportional to the input radiance
  2/ guarantee the general radiometric quality

- Absolute Calibration
- Equalization
- Variation in fov
- Straylight Correction (proportional)
- Non-linearity correction
- Polarization correction
- Straylight Correction (additive)
- Dark current correction
Characterization keynotes

• **Post-launch characterization according Report#13**
  – Ideally all pre-launch characterization → as if unrealistic
  – Usually more « validation » if not characterization
  – Calibration adjustment always required
    • vicarious adjustment for level-2 but need level-1 consistency/accuracy first
  – Trending is crucial

• **Additional aspects**
  – Be prepared to the unexpected (lessons learnt from MODIS)
  – About the interest to provide cross-comparisons or validation approaches
    • On-board = very useful, but also need validation
Planning

14:45-14:50 Introduction
14:50-15:00 OCM-2 calibration and characterization
15:00-15:10 MERIS calibration and characterization
15:10-15:20 OLCI calibration and characterization
15:20-15:30 GOCI calibration and characterization
15:30-15:40 MODIS calibration and characterization
15:40-15:50 SGLI calibration and characterization
15:50-15:55 Break
15:55-16:05 GSICS
16:05-16:15 IOCCG Calibration Task Force
16:15-17:15 Discussion on future cooperation

Summary