Characterisation Campaign at the Gobabeb RadCalNet Site in Support of Satellite Calibration and Validation Activities

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RadCalNet (Radiometric Calibration Network)

- Provides automated surface and atmospheric in-situ data as part of a network including multiple sites for the purpose of optical imager radiometric calibration in the visible to shortwave infrared spectral range

- The key goals of RadCalNet:
  - To standardise protocols for collecting data
  - To process site data to top-of-atmosphere reflectance
  - To provide uncertainty budgets for automated sites traceable to the international system of units
  - 4 current international locations: La Crau, France, Railroad Valley, Nevada, Baotou, China, Gobabeb, Namibia

- Working under the guidance of Committee on Earth Observation Satellites (CEOS) Working Group of Calibration and Validation (WGCV) and the Infrared Visible Optical Sensors (IVOS)
RadCalNet (Radiometric Calibration Network)

- All RadCalNet sites run automated instrumentation (Gobabeb mast pictured)
- Upwelling radiance is retrieved near ground level and is converted to nadir-viewing Bottom-of-Atmosphere reflectance
- The downwelling irradiance is typically derived through radiative transfer modelling
- This is then processed and supplied through the RadCalNet web-portal for use in vicarious satellite calibration
- Product: SI-traceable, spectrally resolved TOA reflectance for a nadir view at 30 min intervals from 9 am to 3 pm
Gobabeb, Namibia, Africa

- Providing data since July 2017
- Selected through a global search with assessment of spectral characteristics, spatial uniformity and probability of clear skies
Permanent Instrumentation

- CIMEL CE 318 12-filter BRDF sun photometer
- Measures 12 spectral bands, from 414 nm to 1640 nm
- Continuous CIMEL and weather station measurements:
  - Principle plane, almucantar, sun radiance, ground radiance
  - Surface pressure and temperature, column water vapor and ozone
- View of weather/cloud conditions from SkyCam
Field Measurement Preparation

- Regular site visits and field maintenance carried out by NPL and staff at Gobabebb Research and Training Centre

- Opportunity to undertake ground surface characterisation measurements to ensure quality and consistency of site data

- Also completed initial ground characterisation investigation into a new site for similar instrumentation

- March 2020 field campaign:
  - Ongoing data analysis
  - Field considerations and corrections, along with preliminary ASD results are displayed in later slides
Previous Site Characterisation

Ground Reflectance

- **2017**
  - Site homogeneity
  - Nadir ground reflectance (ASD)
  - Hyperspectral BRDF (GRASS)

- **2020**
  - New site homogeneity
  - Nadir ground reflectance (ASD)
  - Multi-band imaging survey (MAIA)
  - Drone imaging
Previous Site Characterisation
Ground Reflectance

• Regular ground reflectance characterisation has been completed since the site was developed
• Necessary to maintain data quality

• Important to consider field of view (FOV) when comparing data
• Large discrepancy in data depending on grain size and vegetation distribution within target FOV
• ‘Scene size’ important for optimum FOV and representative data
Preliminary Panel Testing

- To ensure quality and reproducibility of measurement data, preliminary testing was carried out on calibrated reference panels on location under natural light conditions.

- Notable that ambient light is changing significantly over the 15 minute test period.
Ambient light stability follows the change in the cosine of the solar zenith angle.

The same 1hr period at midday provides a longer period of stable light than 1hr at 3pm.

The faster change in light stability will affect measurements taken in the late morning/late afternoon.

Shadows also become an issue when working with reference panels at solar noon.
To ensure we can account for this change in ambient light during the target testing period we use the DFOV method

- Simultaneous acquisition of reference panel and ground measurements
  - One static spectroradiometer constantly recording the 18” panel
  - One roaming spectroradiometer conducting the survey with regular scans of the 10” panel between targets
  - Comparable measurements taken within seconds of each other
Simultaneous ASD Measurements (Reference Panel)

- Static ASD spectroradiometer continuously running measurements on 18" Spectralon panel
- Monitoring the change in ambient light
- ~47 minutes between first and last reference measurement
- 15% variation in white panel over this time period
SVC Uncorrected and Corrected Reference Panel Data (During Survey)

- SVC spectroradiometer moving down survey line
- Measurement of mobile 10” Spectralon reference panel between every 3 target ground reflectance measurements

- SVC spectroradiometer panel data corrected for change in ambient light during test period against the static ASD reference data
- Confidence to then apply the same method to the ground reflectance measurements
Initial Results of Field Reflectance Survey

ASD Reflectance Data @ SVC Ground Target Times

- Static ASD reference panel data synchronised to ground target measurements
- Only the first 20 measurements are shown in this example, covering a ~10min test period
- Less change in ambient light over this shorter period
SVC Uncorrected and Corrected Survey Data

- SVC spectroradiometer moving down survey line
- Target ground reflectance measurements over same 10min time period

- SVC survey data corrected with the static ASD data
- Homogeneity/heterogeneity considerations of FOV during each target scan
- Variations in measurements may be explained by differing target FOVs
Continuing Analysis

- DFOV hyperspectral imaging survey
  - Continued processing
- Drone image and terrain model
  - Overview of potential new instrumentation site
- Multi-band MAIA imaging survey
  - Continued processing with the Field Spectroscopy Facility, NERC, Edinburgh
  - Matching wavelength intervals with Sentinel-2
  - Multi-scale detail

- Importance of regular field measurements in vicarious calibration projects
- Potential to further analyse level and importance of surface homogeneity on various scales
Acknowledgements

NERC Field Spectroscopy Facility DFOV processing

- https://www.radcalnet.org/#!/