Inter-Comparison Of the DESIS, PRISMA and AVIRIS-NG sensors


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Australia’s National Science Agency
Background

- Main Mission Objective of the Copernicus Hyperspectral Imaging (CHIME) Mission: “To provide routine hyperspectral observations through the Copernicus Programme in support of EU- and related policies for the management of natural resources, assets and benefits. This unique visible-to-shortwave infra-red spectroscopy based observational capability will in particular support new and enhanced services for food security, agriculture and raw materials. This includes sustainable agricultural and biodiversity management, soil properties characterisation, sustainable mining practices and environment preservation.”

- HySense - CHIME support/preparatory activity
  - Conducted between May – August 2021 (25 June 2021);
  - Acquired concurrent
    - AVIRIS-NG;
    - PRISMA;
    - DESIS;
    - Field & UAV-based spectroscopy and, other ancillary data

- 3 main test areas for raw materials application at the Iberian Pyrite Belt, Spain
  - Aznacólar (historical significant accident (tailings dam breach));
  - Rio Tinto (one of the first, largest & very well known mines);
  - Sotiel Migollas (long history of R&D in EU hyperspectral community);

- 1 additional test site
  - Doñana [Aznacólar Beach] (added to accommodate inland waters, wetlands, coastal applications in internationally recognised national park)
A community approach to the standardised validation of surface reflectance data - A technical handbook to support the collection of field reflectance data. Brisbane: CSIRO Centre for Earth Observation; 2019. [https://doi.org/10.25919/5c9d0ba9e9c12](https://doi.org/10.25919/5c9d0ba9e9c12)
Results: Comparisons PRISMA, DESIS, field

PRISMA - near simultaneous
DESIS - at least 1 year apart, different view angle

Atmosphere ???
Oxygen
Water vapour
Results: Comparisons PRISMA, field

- Oxygen
- Water vapour
- Carbon Dioxide
Results: Implications for CHIME high priority products (no additional in-situ inputs)

- Ferric oxide content = depth of iron oxide crystal field absorption (CFA) feature around 900 nm;
- Hematite goethite distribution = wavelength position at minima of iron oxide CFA feature around 900 nm;
- Simulation based on 7500+ iron oxide laboratory spectra resampled to PRISMA spectral configurations;
- Atmospheric & other noise added based on vicarious calibration results;
- Based on all spectral bands, “tricks” such as dropping impacted bands may be investigated further;
Results: Implications for CHIME HPP (reduced spectral range)

- Comparisons between normal configuration full wavelength range (beyond 1000 nm) and reduced wavelength range (up to 1000 nm);
- Results may improve with different curve fits;
- Simulation with additional “noise” to be completed;
Results: Water vapour estimation

<table>
<thead>
<tr>
<th></th>
<th>Average (cm)</th>
<th>Standard Deviation</th>
<th>Min (cm)</th>
<th>Max (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRISMA</td>
<td>1.458</td>
<td>0.021</td>
<td>1.419</td>
<td>1.491</td>
</tr>
<tr>
<td>MicroTops</td>
<td>1.659</td>
<td>0.049</td>
<td>1.560</td>
<td>1.800</td>
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<tr>
<td>Difference</td>
<td>13.7%</td>
<td>9.9%</td>
<td>20.7%</td>
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</tbody>
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Future directions

• Analysis of and cross comparison of AVIRIS-NG data;
• Analysis of data and comparison from second vicarious calibration site (sandbank at Doñana);
• Generation of first CHIME HPP using AVIRIS-NG for field validation;
• Generation of CHIME-HPP using PRISMA and potentially DESIS where applicable;
• Evaluation of other CHIME HPP;
• Evaluation of DESIS data for inland waters and wetlands applications;
• Evaluation and cross comparison of UAV-based data;
• Generation of bespoke (other than CHIME HPP) products specific to R&D applications
Preliminary Results: UAV-based field supporting data

- Headwall photonics VNIR-SWIR, pixel resolution < 10 cm
Thank you

- Dr Uta Heiden, German Aerospace (DLR) - access to DESIS data;
- Dr Ettore Lopinto, ASI - access to PRISMA data;
- ESA funded airborne AVIRIS-NG acquisitions;
- Flight & campaign crew/managers at Uni Zurich & NASA;
- INTA - data from CIMEL at Doñana National Park and loan of µTops;
- Dr Kurt Thome & Dr Ian Lau for experimental design.