Hybrid PCA representation of Cross-track Infrared Sounder (CrIS) data: the CrIS NASA Version 4 L1B and PCA RED Products

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ABSTRACT

The goal of the CrIS NASA L1B project is to support climate research by providing a climate quality Level 1B (geolocation and calibration) algorithm and create long-term measurement records for the CrIS instruments currently on-orbit on the SNPP, JPSS-1 (NOAA-20), and JPSS-2 (NOAA-21) satellites, and those to be launched on JPSS-4 and JPSS-3 (NOAA-22 and NOAA-23, respectively). The long-term objectives of the project include (1) Create well-documented and transparent software that produces climate quality CrIS Level 1B data to continue or improve on EOS-like data records, and to provide this software and associated documentation to the NASA Sounder Science Investigator-led Processing System (SIPS); (2) Provide long-term monitoring and validation of the CrIS Level 1B data record from SNPP and JPSS-1 through JPSS-4 and long-term maintenance and refinement of the Level 1B software, enabling full mission reprocessing as needed; (3) Provide a homogeneous radiance product across all CrIS sensors through the end of the CrIS series lifetime, with rigorous radiance uncertainty estimates; (4) Development and support of the CrIS/VIIRS IMG software and datasets, which provide a subset of Visible Infrared Imaging Radiometer Suite (VIIRS) products that are co-located to the CrIS footprints; and (5) Development and support of the Climate Hyperspectral Infrared Product (CHIRP) for the AIRS and CrIS sounders. The CHIRP product converts the parent instrument's radiances to a common Spectral Response Function (SRF) and removes inter-satellite biases, providing a consistent inter-satellite radiance record.

EUMETSAT has developed a very useful method for Principal Component Analysis (PCA) representation of IASI and future MTG-IRS data that uses a hybrid approach (e.g., Hultberg et al. 2017). The Hybrid PCA approach efficiently represents the data using global and local (granule) level variability. We have adapted and applied the Hybrid PCA technique to CrIS L1B data to create the CrIS PCA RED (Rapid Event Detection) product. The CrIS PCA RED product will provide approximately 50x data compression and 73% random noise reduction compared to the NASA L1B CrIS FSR product and will also include Rapid Event Detection scores for 25 pre-defined spectral regions. This presentation will summarize the new features of the CrIS Version 4 L1B product, the PCA RED product, and examples of the usage of CrIS Hybrid PCA for detection of anomalous spectral signatures associated with trace gas emissions, volcanic eruptions, and biomass burning. Sample CrIS PCA RED data for NOAA-20 CrIS has been made available to users, and the Version 4 CrIS NASA L1B and corresponding CrIS L1B PCA RED products for SNPP, NOAA-20, and NOAA-21 CrIS will be available in late 2024.

The NASA CrIS products (L1B, IMG, PCA RED, CHIRP) are available via the NASA Goddard Earth Sciences (GES) Data and Information Services Center (DISC) at https://www.earthdata.nasa.gov/sensors/cris.