Validation of the SNPP CrIS Full-Resolution NUCAPS Carbon Trace Gases


NOAA Unique Combined Atmospheric Processing System (NUCAPS)

- **Operational algorithm**
  - NOAA Enterprise Algorithm for CrIS/AIRS (Susskind, Romanov and Roberts, 2005; Gambacorta et al., 2014)
  - Multi-step physical retrieval
  - Global non-precipitating conditions (clear to partly cloudy)
  - Atmospheric Vertical Temperature and Moisture Profile (AVTP, AVMP, O3)
  - Trace gas EDRs (CO, CO2, CH4)
  - Version 1.5 NUCAPS/Spectral Resolution AVTP/AVMP/O3 are fully validated (Sulli et al. 2018a, Sun et al. 2021)
  - Version 2.0 (Phase 4), CrIS full spectral resolution (152 bands)
    - Inclusive IR early version (limited spectral for AVMP)
    - Phase 4 algorithm Readiness Review (ARR) delivered in July 2017

- **Combination of**
  - NOAA ERG
  - NUCAPS
  - AIRS

- **Upgrades**
  - Utilize field campaign datasets (e.g., from NOAA-CMDL)
  - Investigate TCCON "outlier sites"
  - Despite this, our validation approach is comprehensive and validated

- **Users**
  - Weather Forecast Offices (AWIPS)
    - Meteorologizing / ex-expected
    - Cold air aloft, stability indices, etc.
    - NOAA/ERG (L3)
    - NOAATOH product (IR ozone)
    - NOAA/STAR EDRs (IR, O3, CO, CO2, CH4)
  - Users for the Cross-track Infrared Microwave Sounder Suite, 2003
  - AIRS (jointly from NOAA-CMDL, ESA, NIPR, AERI)
  - AIRS/AMSU/HSB data in the presence of clouds, 2003
  - AIRS/AMSU/HSB data in the presence of clouds, 2003

Preliminary SNPP NUCAPS Carbon Trace Gas Validation Results

**NUCAPS Versus AIRS v6**

- Carbon Monoxide (CO) EDR
  - NUCAPS CO versus AIRS CO at SNPP Overpasses (version 4)
  - NUCAPS CO for AIRS Overpasses (version 4)
  - NUCAPS CO for AIRS Overpasses (version 4)

- Methane (CH4) EDR
  - NUCAPS CH4 versus AIRS CH4 at SNPP Overpasses (version 4)
  - NUCAPS CH4 for AIRS Overpasses (version 4)
  - NUCAPS CH4 for AIRS Overpasses (version 4)

- Carbon Dioxide (CO2) EDR
  - NUCAPS CO2 versus AIRS CO2 at SNPP Overpasses (version 4)
  - NUCAPS CO2 for AIRS Overpasses (version 4)
  - NUCAPS CO2 for AIRS Overpasses (version 4)

**NUCAPS Versus Total Carbon Column Observing Network (TCCON)**

- 17 Feb, Mar, Jul, Sep 2015 Focus Days
  - TCCON Sections (4): 17 Feb, 15 Mar, 15 Jul, 15 Sep (15 Day Blocks)
  - Product: TCCON CO2
  - Product: TCCON CO2
  - Product: TCCON CO2

**NUCAPS Carbon Monoxide**

- NUCAPS Carbon Monoxide (version of AIRS and AIRS) Oct 2017

**NUCAPS Carbon Monoxide**

- Oct 2017

**CEOS AC-VC-14 2018 Poster**

Analysis of the SNPP CrIS Full-Resolution NUCAPS Carbon Trace Gases

- **Discussion**
  - Carbon trace gas EDR validation: several ongoing/completed experiments; opportunities for intercomparison of products (e.g., with other TCCON, AIRS, AIRS, AIRS)
  - Using future versions of NUCAPS, with parallel evaluation of the validation approach

- **Future Work**
  - Investigating TCCON "outlier sites"
  - Integrating TCCON datasets into NUCAPS for validation
  - Importance of the TCCON "outlier sites" issues
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Selected References