Evolution and Status of the Stand-Alone Radiative Transfer Algorithm (SARTA)

Christopher Hepplewhite

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1 SAMPLE: Motivation

- Produce Level 1b AIRS,CrIS, IASI and CHIRP radiances for trending and retrievals.
- Goals
  - Radiometric stability, inter-sensor bias, intra-sampling bias and trending analysis.

Working in radiance space is in principle very simple and quick. Allows frequent re-processing.

What's Hard:

- Dealing with clouds
- AIRS radiometric stability estimates (ie. how good?)

2 Outline of talk

- Historical Context
- Design Features
- Strengths
- Limitations
- Applications examples
- Current Needs, Future Developments

3 Historical Context

- The SARTA was developed on 1990s computer systems - light load and memory requirements.
- Origninaly developed as part of AIRS level 2 retrieval suite.
- First supplied to AIRS project with separate coefficient sets for different instrument focal plane and filter temperatures.
- Since 2016 SARTA was delivered for the AIRS.L1C channel SRF specification.
- Used for AIRS validation and more recently for CrIS and IASI validation.
- In the past couple of years has been adapted for use with CHIRP.

4 Attributes: Strengths

- Implicitly high speed computation (even more on modern systems).
- SARTA is available for clear-sky and all-sky (scattering) computations.
- Flexible channel selection, multi-sensor compatible, relatively quick development/update turn-around.
- The scattering version uses a fast 2-slab model for clouds and aerosols (S. De Souza-Machado).
- Model includes H2O, CO2, O3, N2O, CO, CH4, HNO3, HDO, SO2, NH3, nonLTE (4.3 um), Surface emissivity and albedo, scattering from water, ice, aerosols, smoke. Other absorbers could be added.
- Accuracy well quantified.

5 Attributes: Dependencies

- Fast coefficients are derived using Optical Depths calculated using kCARTA - the pseudo-line by line RTA (S. De Souza-Machado)
- The atmospheric layering is currently defined as the 101 AIRS levels set, using Klayers algorithm.
- The atmospheric layering can be changed (see later).
- The data format for file I/O uses the HDF4 specification (original to AIRS project) (see later).
- The spectral line shapes use the HITRAN databases, cross-sections and various dust and aerosol models.

- Code is written in FORTRAN (this is NOT a limitation!).
- Radiometric accuracy may be improved with tuning in some regions.

6 Attributes: Limitations

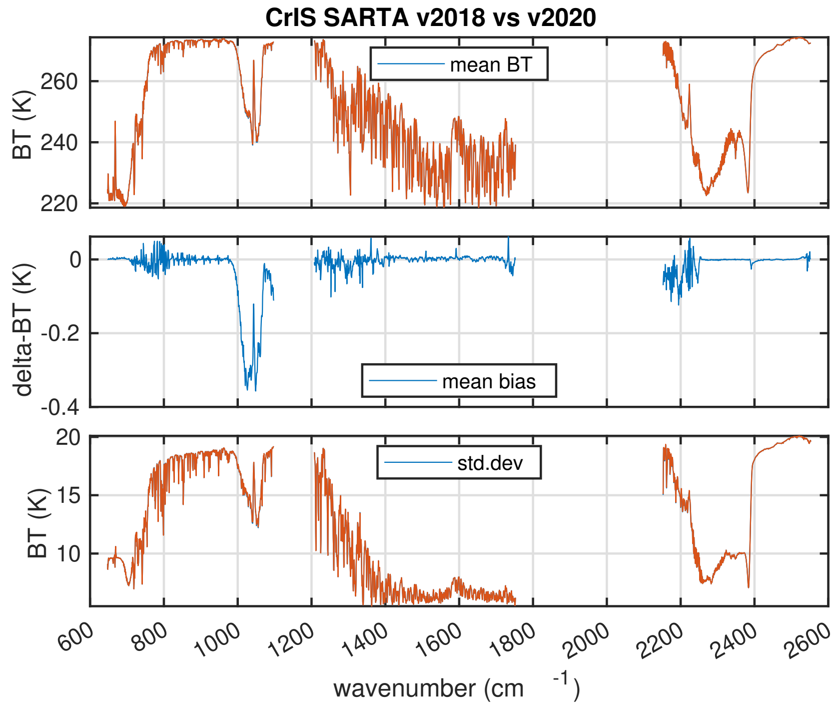
- Finite diff Jacs - until now !
- HDF4 dependency.

7 Most Recent updates

- HITRAN 2020 spectroscopy (actual data available early 2022).
- HDO included.
- New nonLTE model being tested.

8 Updates 1: HITRAN 2020 vs 2016

- Most significant change in 1050 cm-1 O3 band.



9 Updates 2: HDO included

10 Updates 3: nonLTE

11 Beneficial Future Changes

- Make independent (agnostic) of file format types (HDF4, H5, netCDF).
- Simplify packaging and coefficient management.
- Extend/update training set, add machine learning if demonstrably beneficial.
- Adapt to the cloud and complete open-source migration (documentation).
- Re-package code with Julia or Python wrappers for wider community use.
- Include as part of CHIRP processing suite (cloud).

12 Future 1: File format, Coefficient packaging

13 Future 2: Adapt to Cloud