Status of AIRS RTA Development

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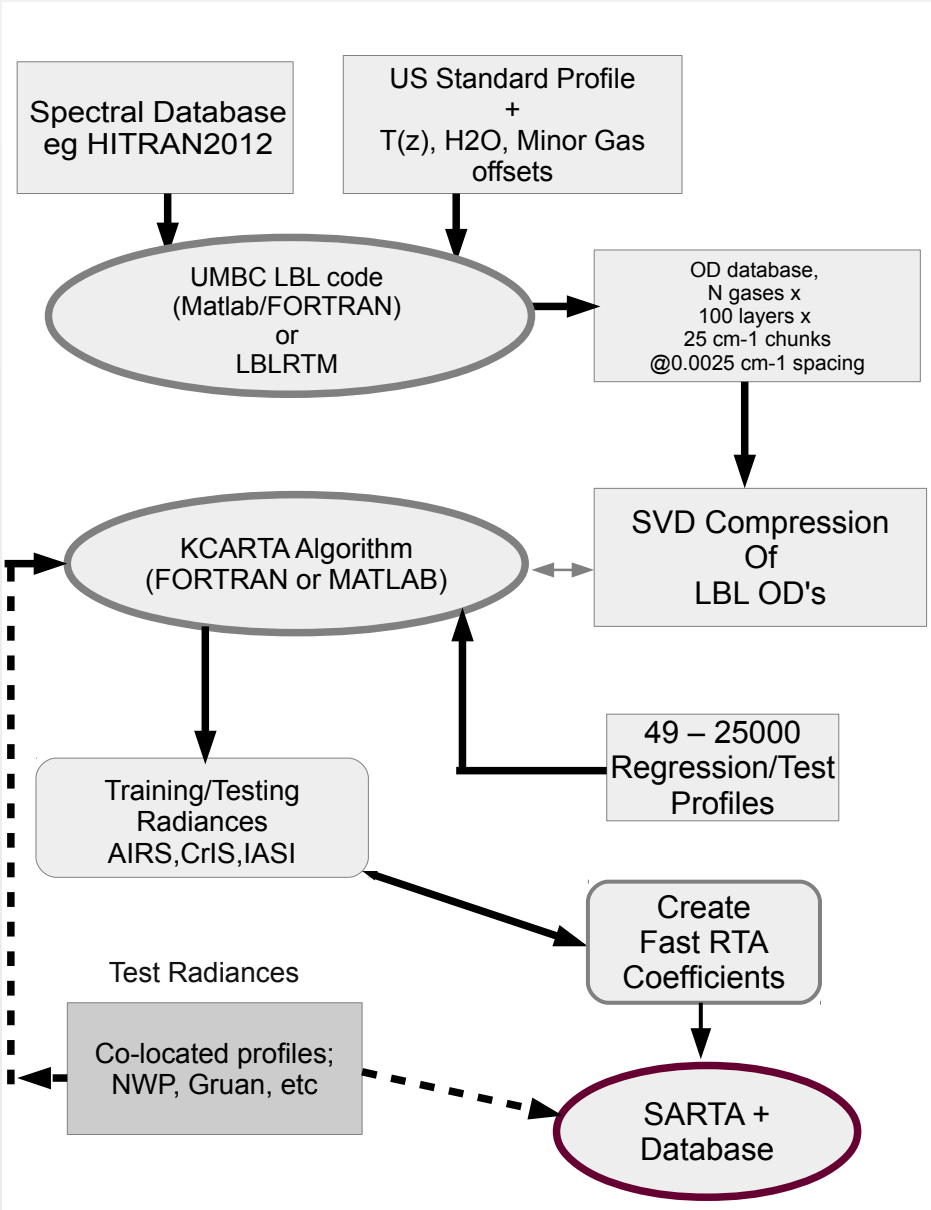
RTA Flow



New Developments

- HITRAN 2012
- Version of kCARTA trained with LBLRTM
- Can support *large* sets of training/testing profiles
- New training code under development
- Will examine new parameterizations

Previous Work

- In-depth analysis of co-incident high-quality sondes
- Sondes indicated that HITRAN 2012 will improve some water lines by $\sim$ 0.2-0.4K
- LBLRTM vs UMBC LBL line-mixing uncertain. CrIS TVAC indicates UMBC LBL better for 720 cm^{-1} Q-branch, LBLRTM maybe better for 667 cm^{-1} Q-branch
- LBLRTM Q-branch mixing is newer, so will use that first
- New MT-CKD water continuum fixes problems at 2400+ cm^{-1} that we dealt with by tuning in early versions of SARTA
- Non-LTE might need a little tuning, will do once parameterization are finished
- Given JPL desire for improved short-wave, will examine (a) solar model, (b) solar ray-tracing for low solar angle polar scenes, and (c) any existing BRDF databases that may be useful (after parameterizations are done).

Code Base Issues

Existing F77 Code

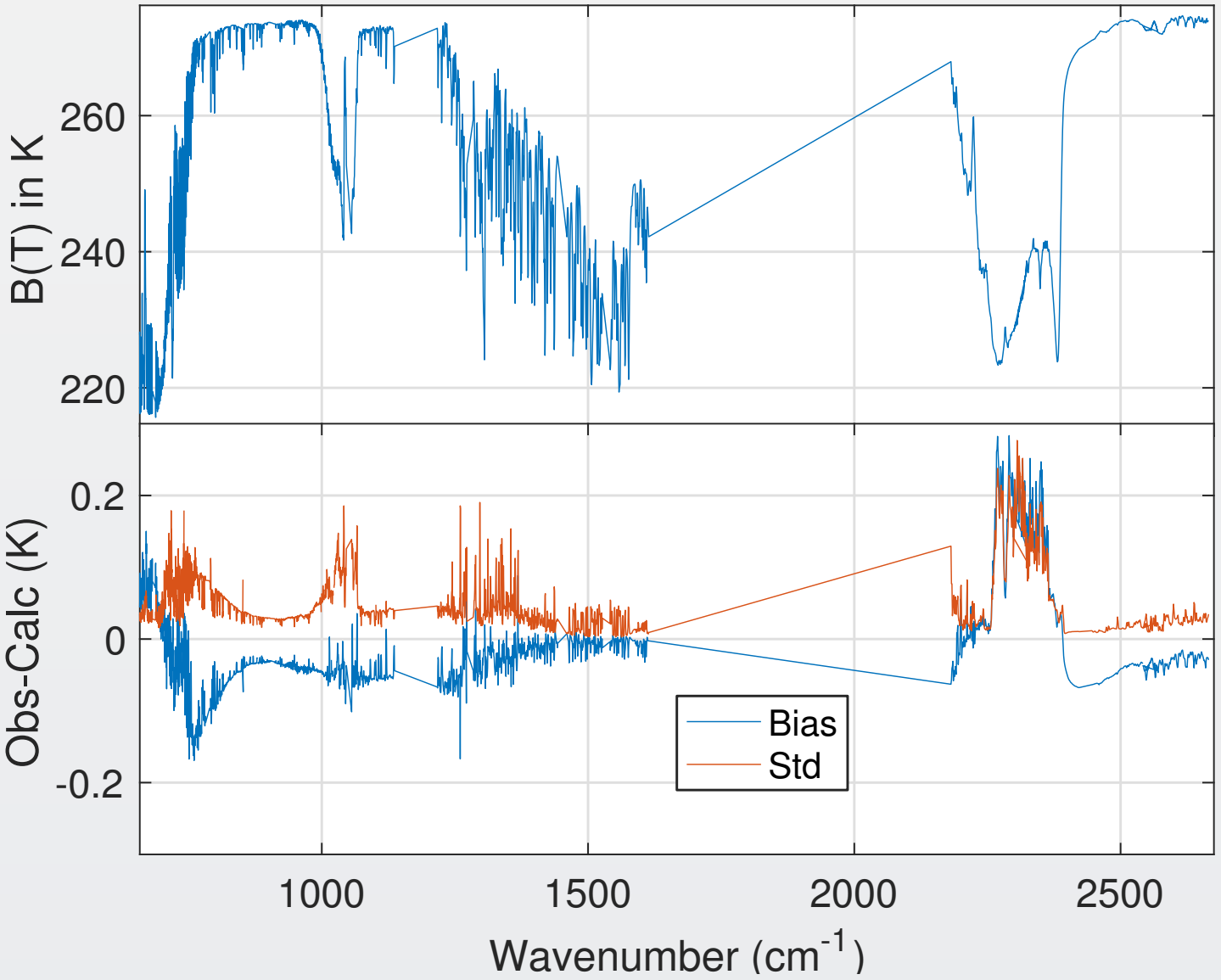
- Huge attempt to run old F77 code written by Scott Hannon, provides a baseline.
- Too time consuming to modify (~100 F77 programs)
- Nearly done for CrIS FSR, but need to create new variable CO_2 approach (old approach not clearly documented).
- Way too time consuming, so I am writing a new, *very* simple MATLAB parameterization code: Pressure-layer done, working on OPTRAN layering for H_2O. Nearly 50X less code, very automated.
- New code base will allow for easy experimentation
- kCARTA + our cpu resources allow us to test SARTA on 25,000+ profiles. (Work already done.)

Code Conversion

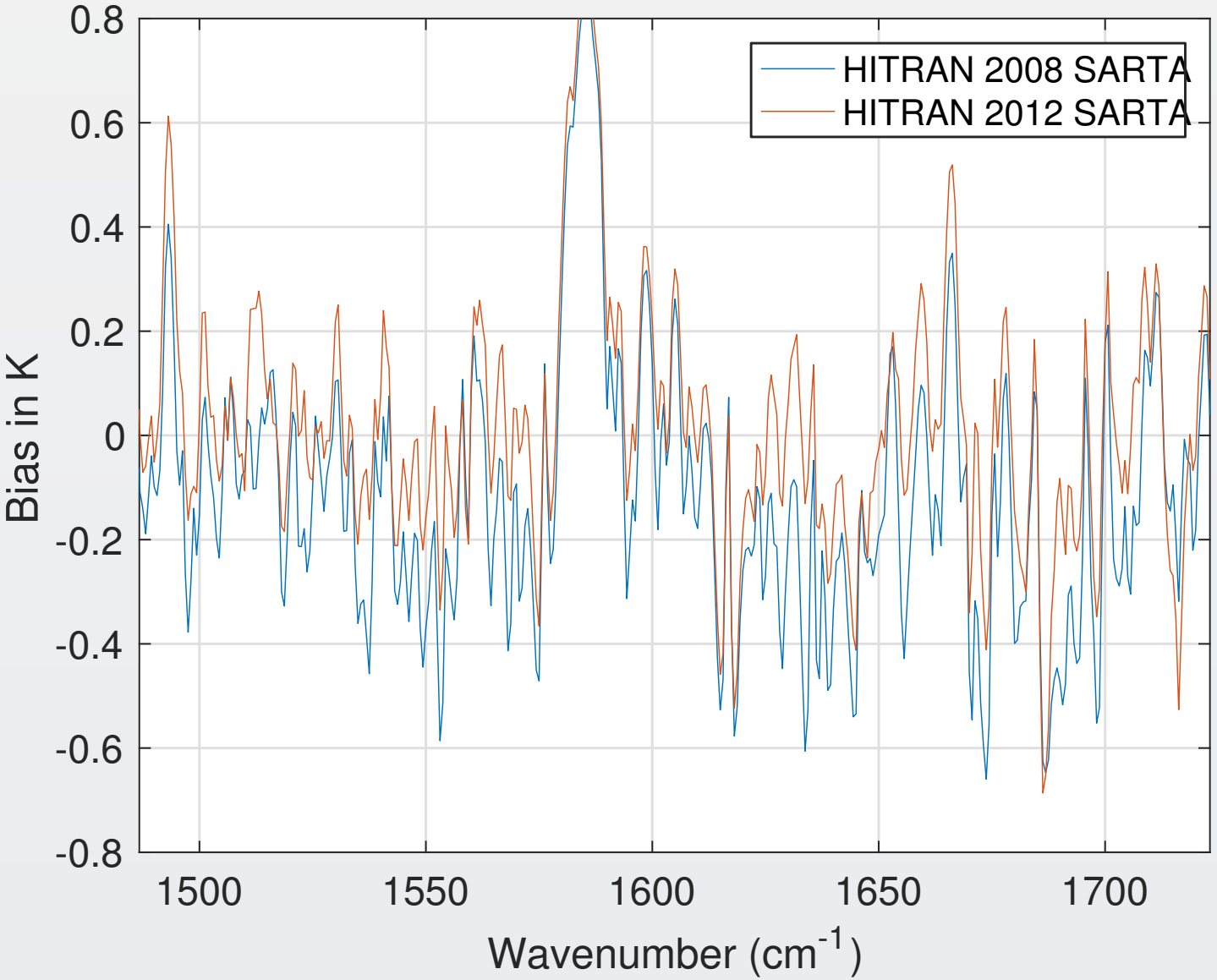
Present Plan

- Produce nominal new parameterizations for AIRS + CrIS (FSR) using old F77 code base
- Develop new (MATLAB) parameterization code using (nearly) the same algorithm as a baseline
- With new code, increase number/type of fitting profiles and possibly produce scene (latitude?) dependent coefficient sets
- Focus on polar areas, where we presently have problems with low water amounts and low solar angles (which are very hard to do).
- Fundamental quantity is layer-to-space transmittance, a 0-1 function that should be weighted by it's vertical derivative
- We think this approach is likely well suited for machine learning algorithms

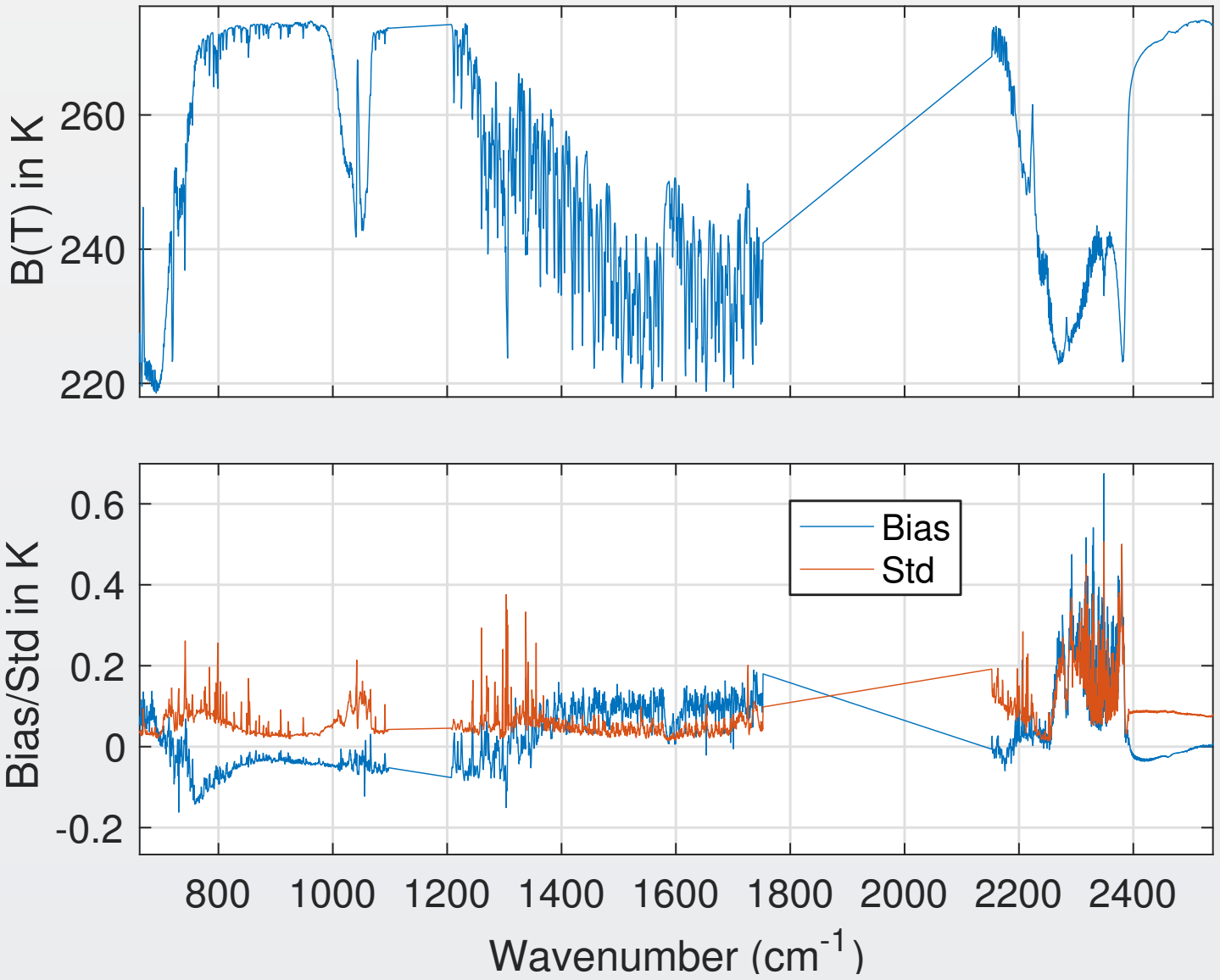
Early AIRS Parameterization



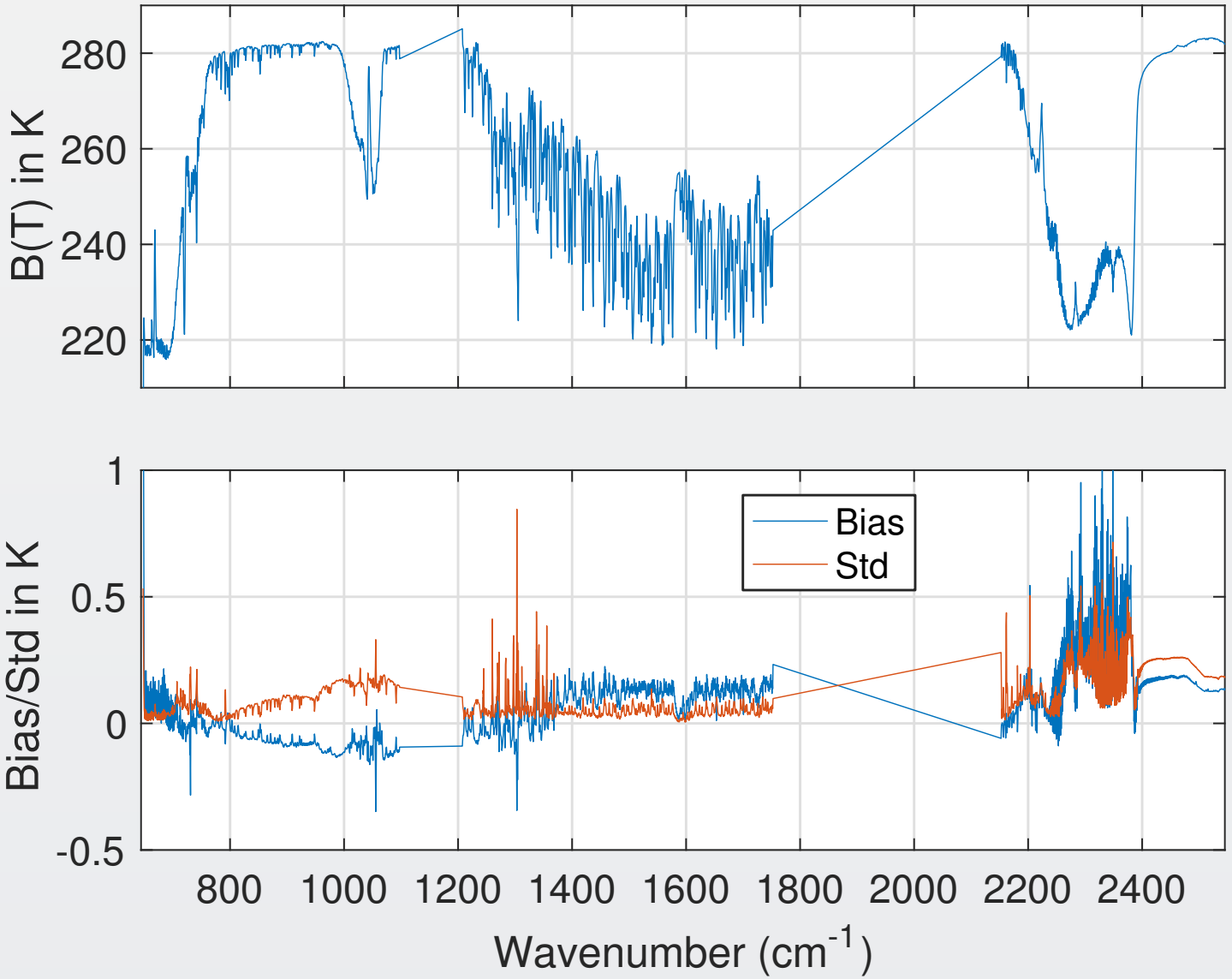
CrIS FSR vs ECMWF in Mid-Wave



CrIS FSR Fitting Errors

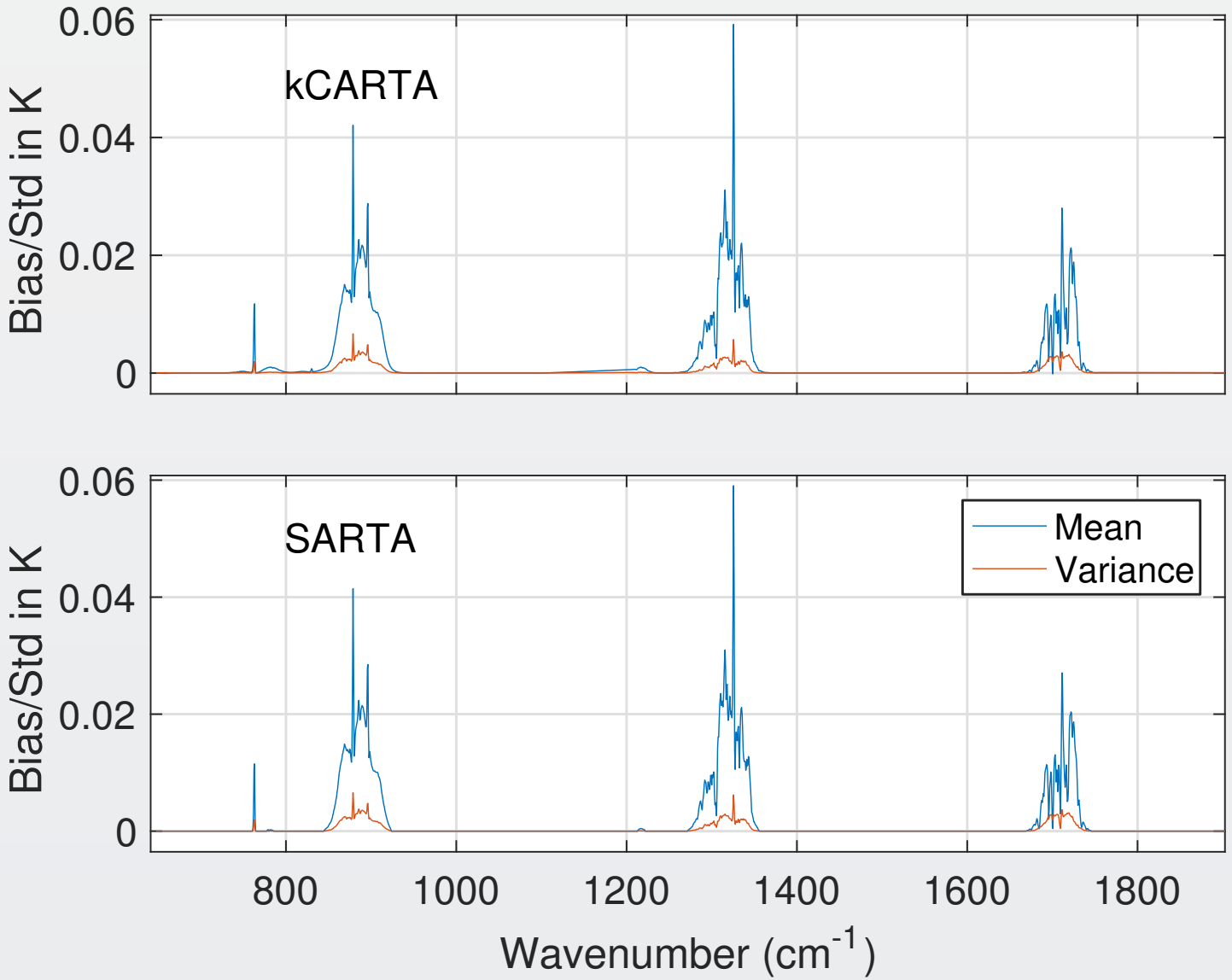


CrIS FSR Independent Test: 705 Profiles



HNO_3 Signals in kCARTA vs SARTA

SARTA response to 10% change in HNO_3



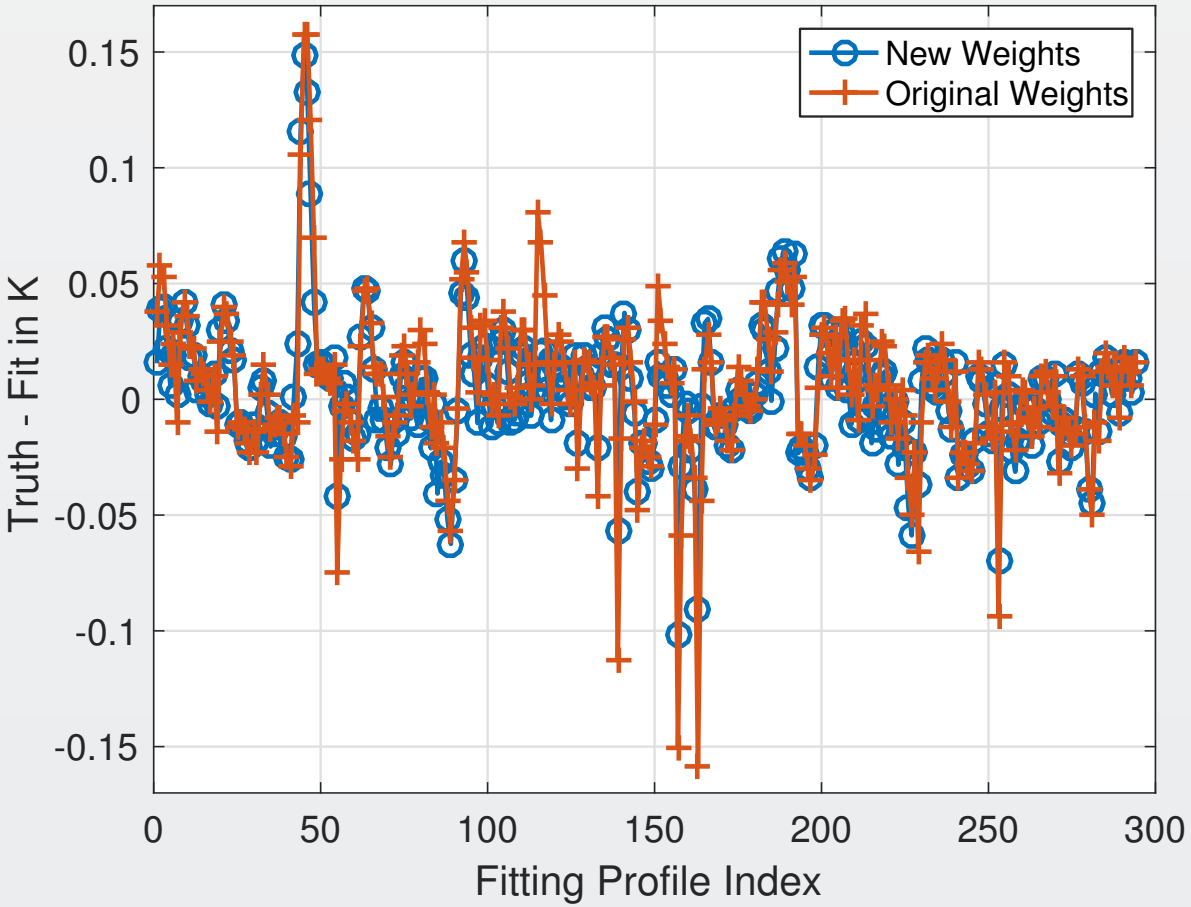
Changes in New Approach (and Code)

Preliminary

- Empirical weighting of OD's replaced with a physically based approach: Derivative of layer-to-space transmittance. Improves fitting accuracy.
- Automated selection of predictors out of a pool of possible ones. Lowers number of predictors a bit, but Scott did a very good job overall.
- Continuous testing with radiative transfer comparisons

Fit Diagnostics with New System

677 cm^{-1} channel



Improvements with New Weighting

Old Weighting	
Bias	0.0048K
RMS	0.0328K
New Weighting	
Bias	0.0024K
RMS	0.0275K

Conclusions

- Able to run old SARTA regression codes except:
  - Missing complete CO_2 recipe, working on fixes now
  - Apparently some bias issues, maybe with water continuum
  - Other minor gases working OK, but need some improvements to CH_4
- Plan to build acceptable RTA's using mostly existing code
- Re-build with new code base, improved weighting, etc.
- Explore better parameterizations with new code base (machine learning)
- If time, do regional testing and improvements, concentrating on polar scenes in the shortwave