Status of the AIRS RTA

AIRS Science Team Meeting

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D.P. Edwards (NCAR)

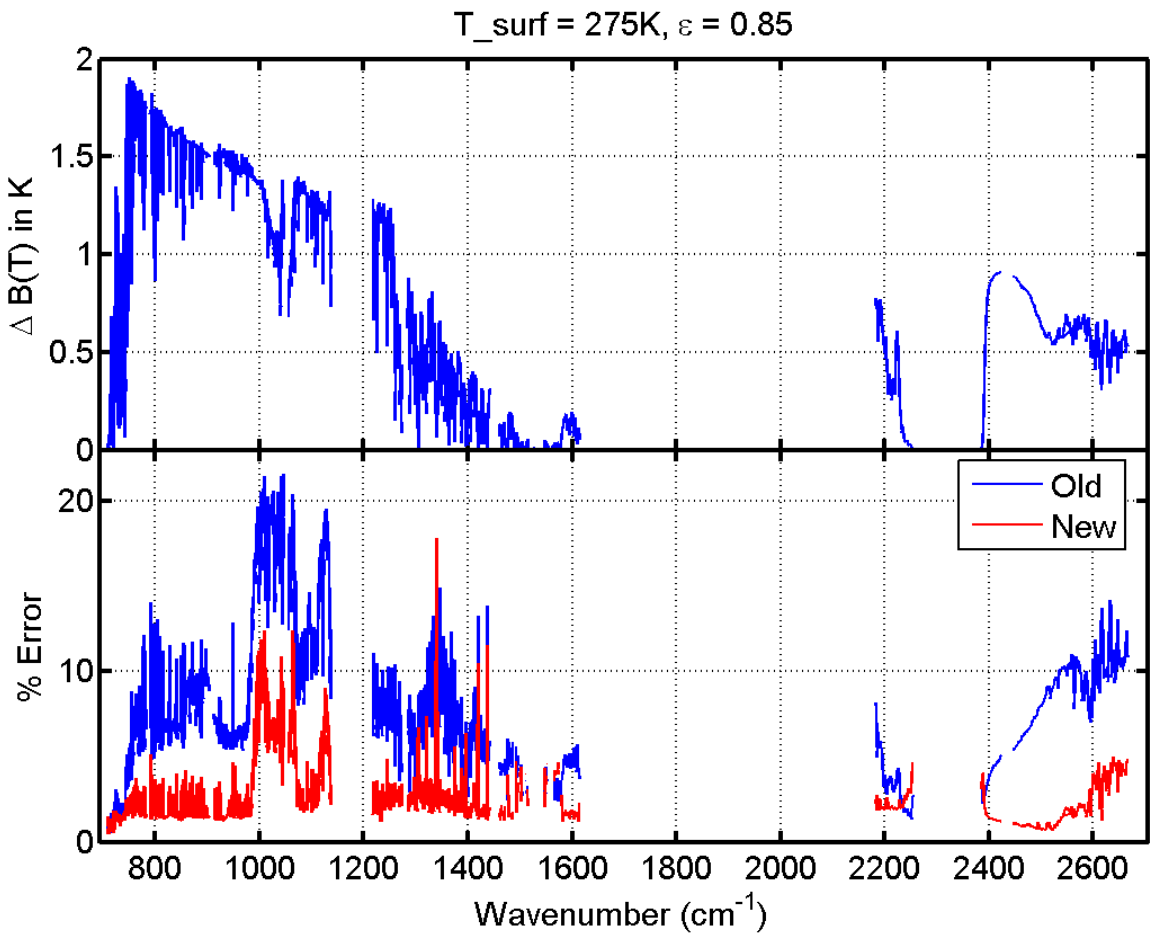
March 8, 2006

Overview

- Non-LTE (with Lopez-Puertas, Funke, Edwards)
- Reflected thermal
- New transmittance adjustments (with Maddy and Barnet)
- Additional minor gas variability

Improvements to Reflected Thermal

- Reflected thermal more realistic, downward radiation computed similarly to upward.



Channel Center Wavenumbers

- Module-12 ((649-682 cm^{-1}) center wavenumbers shifted by $\sim$1.5% of a SRF FWHM.
- Other wavenumber drifts, variations with orbit not changed (these are more on the 0.4% of a FWHM level).

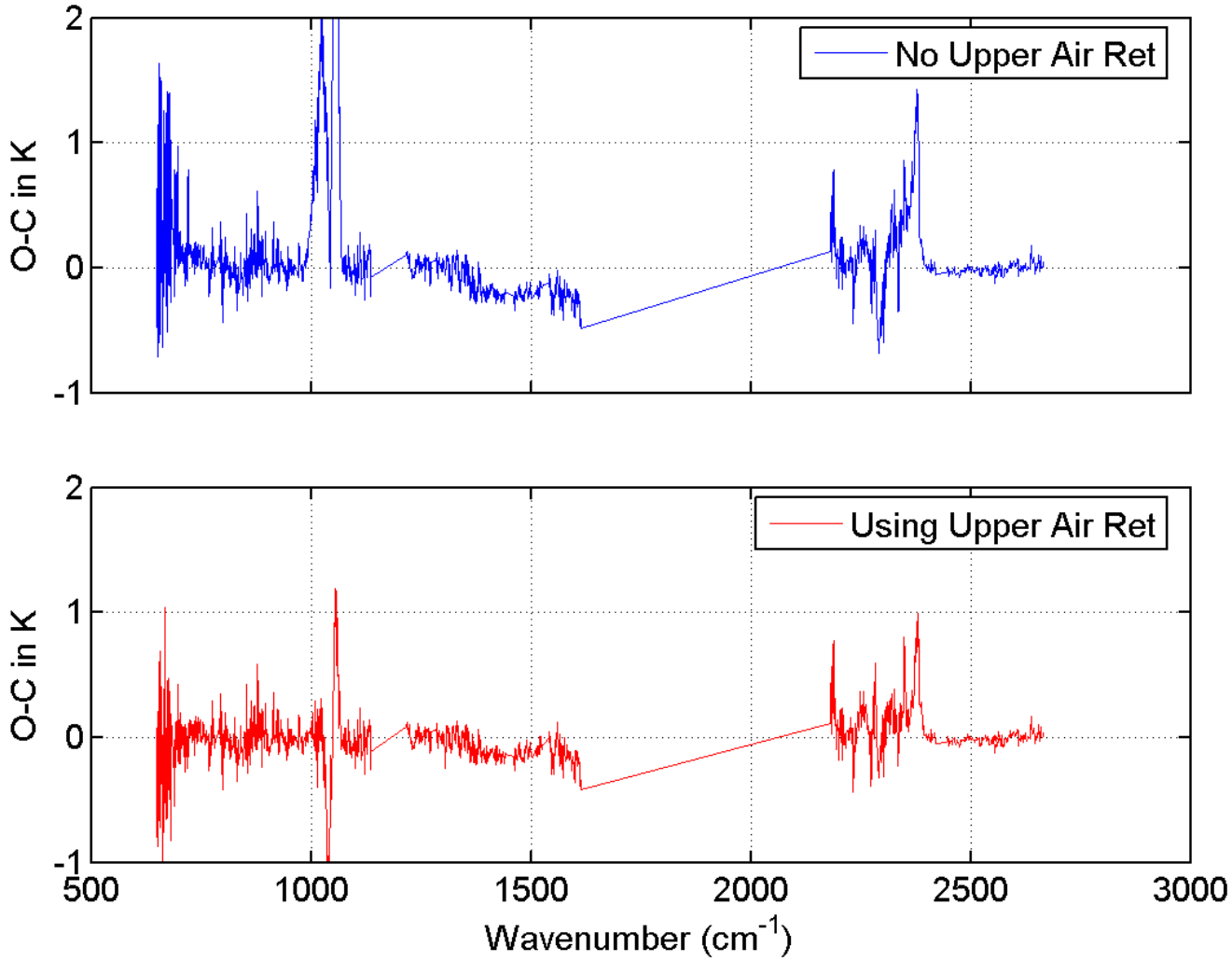
Minor Gases

- CO_2 can now be adjusted on all 100 layers, previously limited to a single scale factor for the whole profile
- N_2O, SO_2, and HNO_3 profiles can now be varied. Note, the reference transmittance is still in the fixed gas term, and we model deviations from these fixed values.

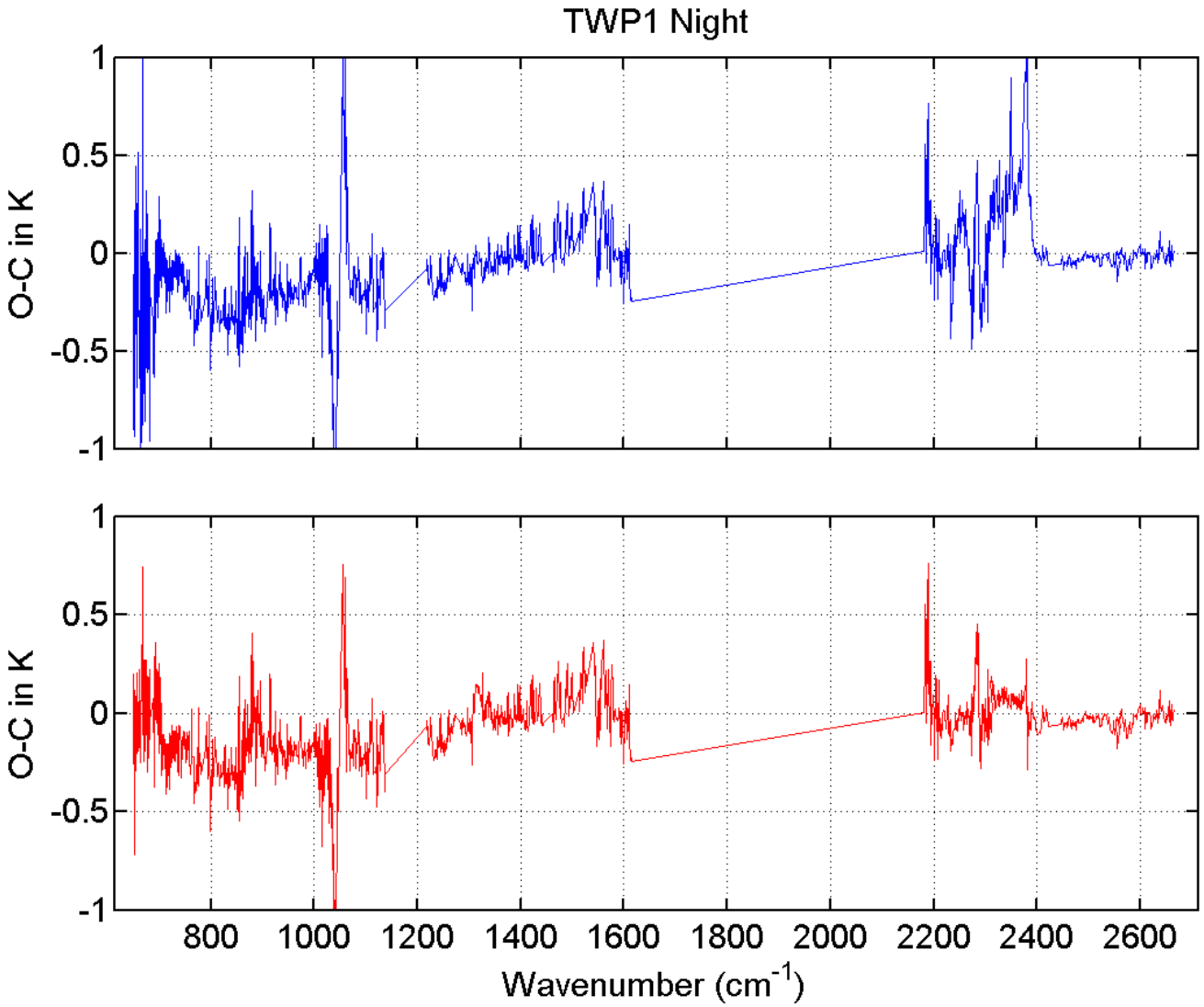
Revised Optical Depth Tuning

- Lack of truth in stratosphere
- Would like to partially validate, improve channels with weighting functions that partially cover the RS-90 water sonde data
- Use AIRS retrievals, with existing Version 4 RTA to retrieve upper air temperatures. Also use CMDL CO_2 (tropical).
- Then, re-do validation and transmittance improvements, a bit circular. Mostly used TWP1 to determine modifications, tested with other validation data.
- Modified upper trop/strat CO_2 channels, so they now agree
- Minor changes to H_2O and CH_4 lines in 1320 cm^{-1} region due to HNO_3. (See Barnet for further CH_4 adjustments.)
- Very minor change to window H_2O continuum (again, due to HNO_3)
- New O_3 transmittances from HITRAN2004 included via transmittance adjustments.
- Are adjustments physical?

TWP1 Version 4 RTA: w/ and w/o Upper Air Retreival



TWP1 Version 4 (blue) and Version 5 (Red) Biases: Night



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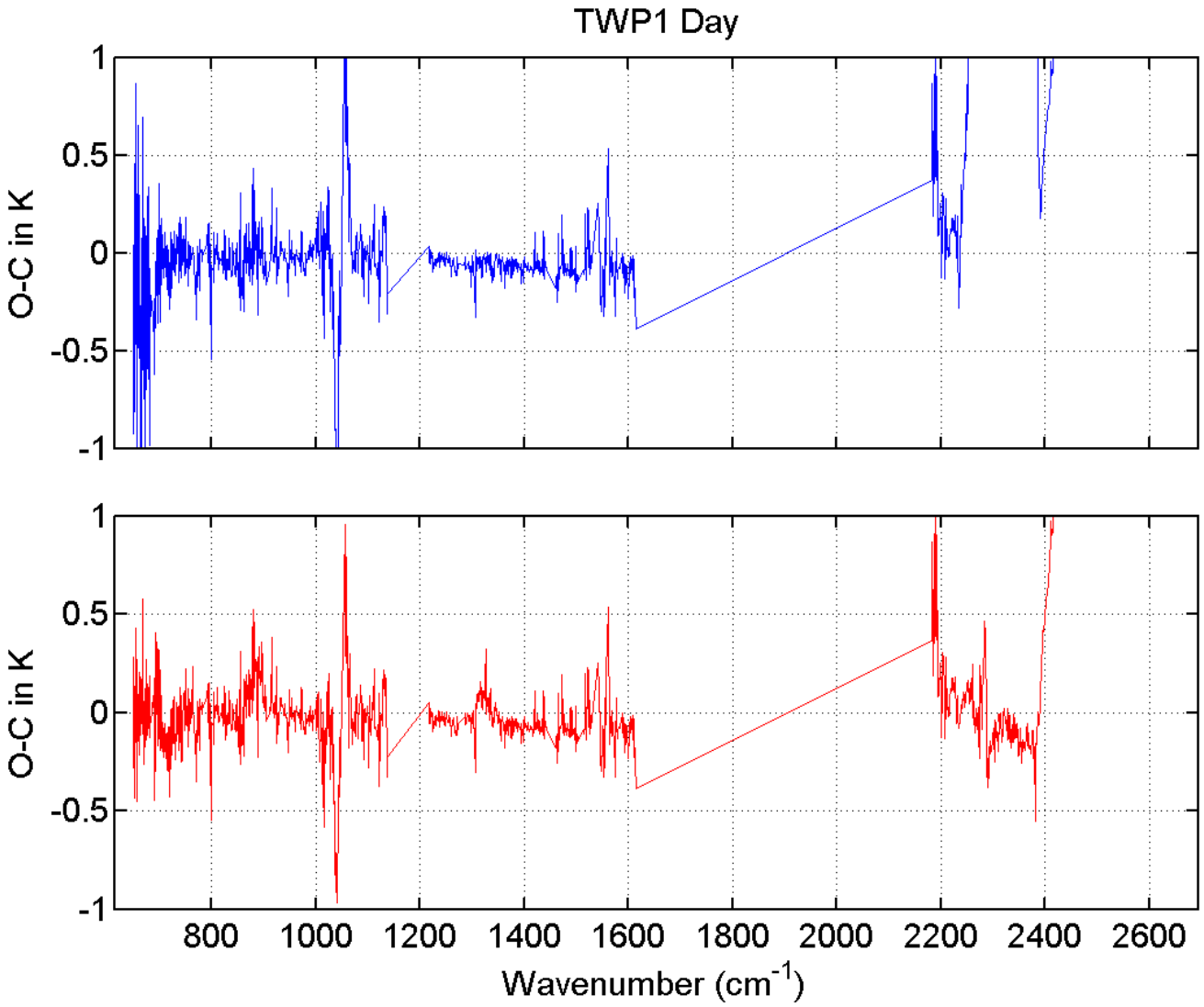
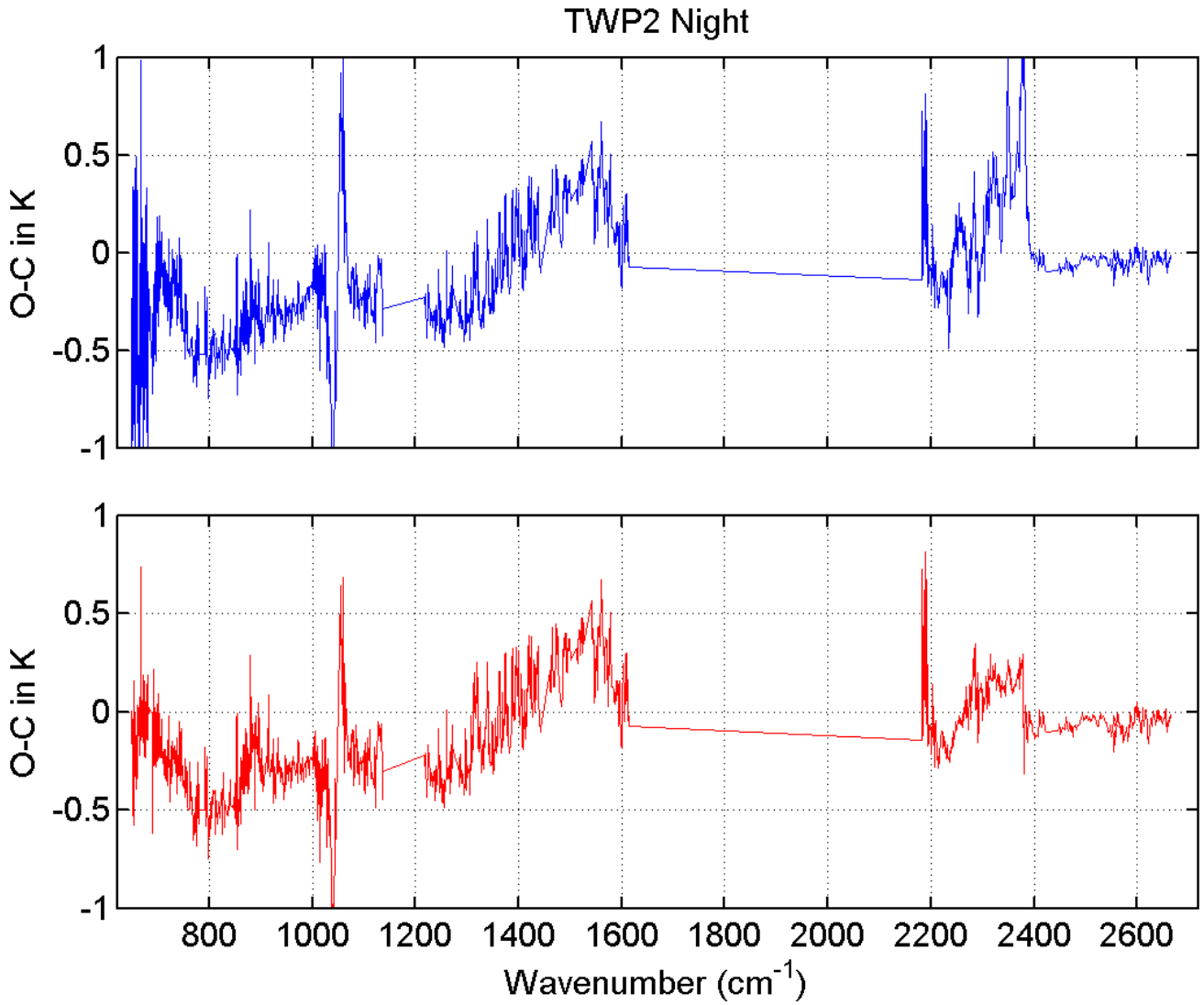
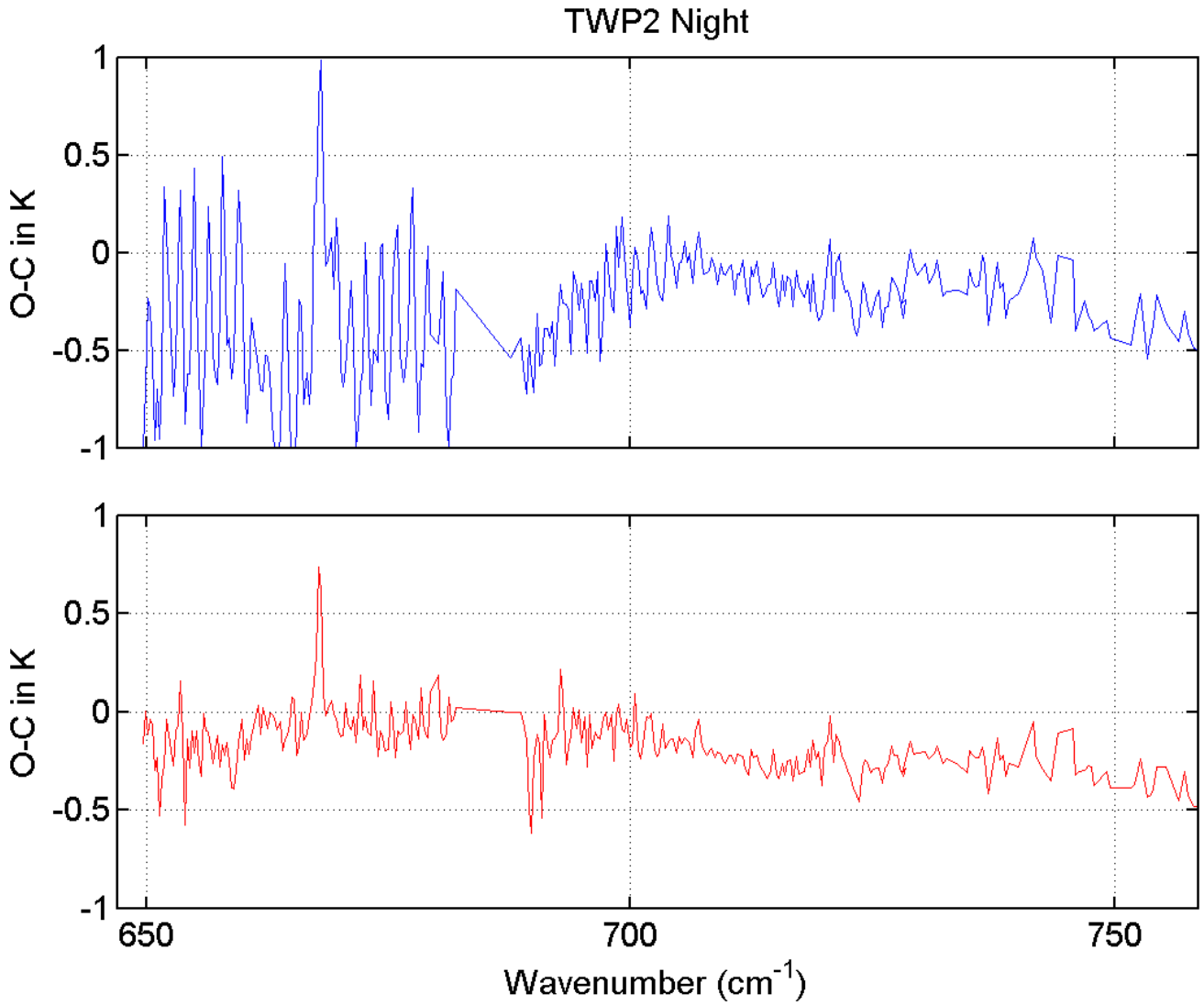


TWP2 Version 4 (blue) and Version 5 (Red) Biases: Night



TWP2 Version 4 (blue) and Version 5 (Red) Biases: Night Zoom



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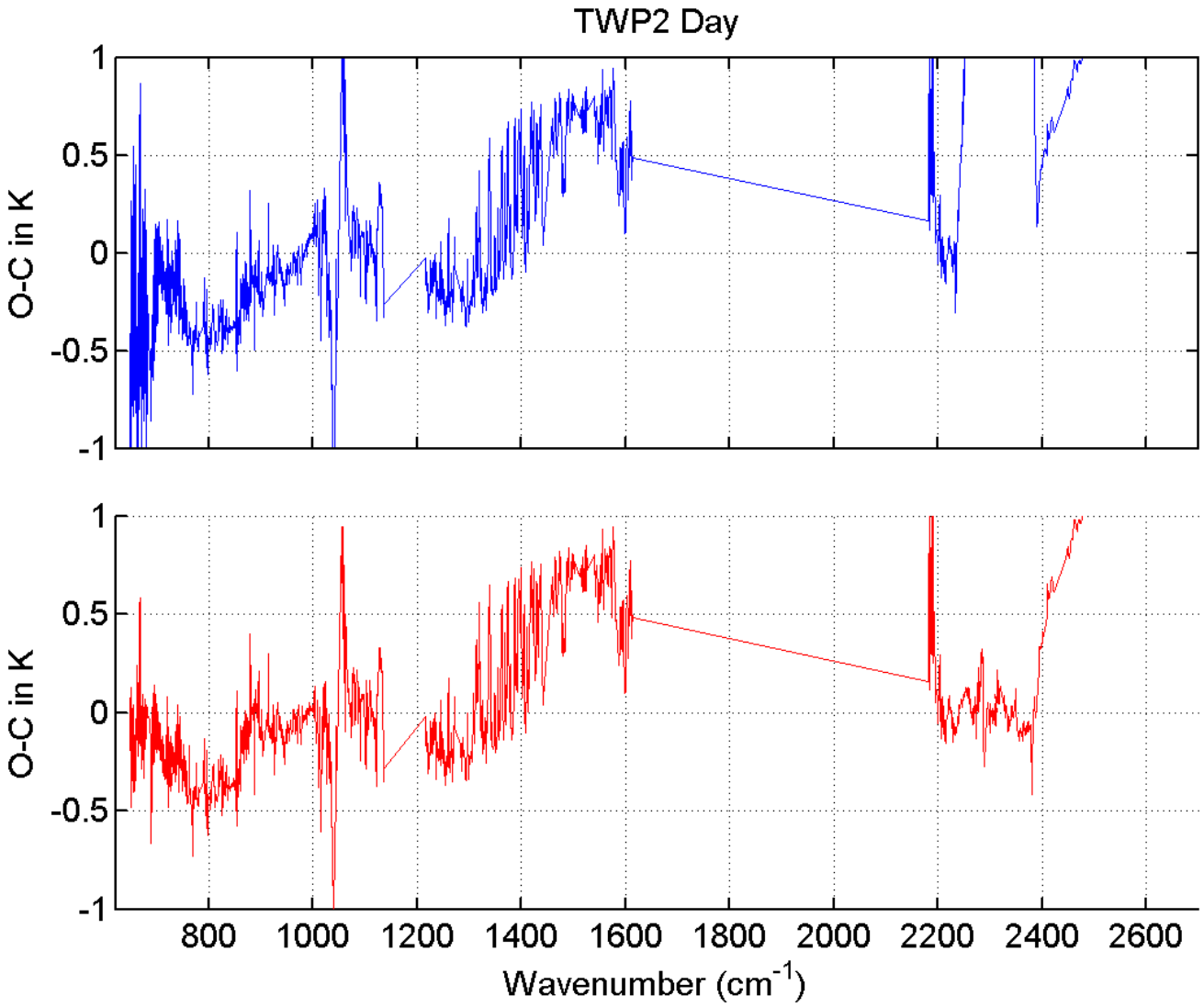

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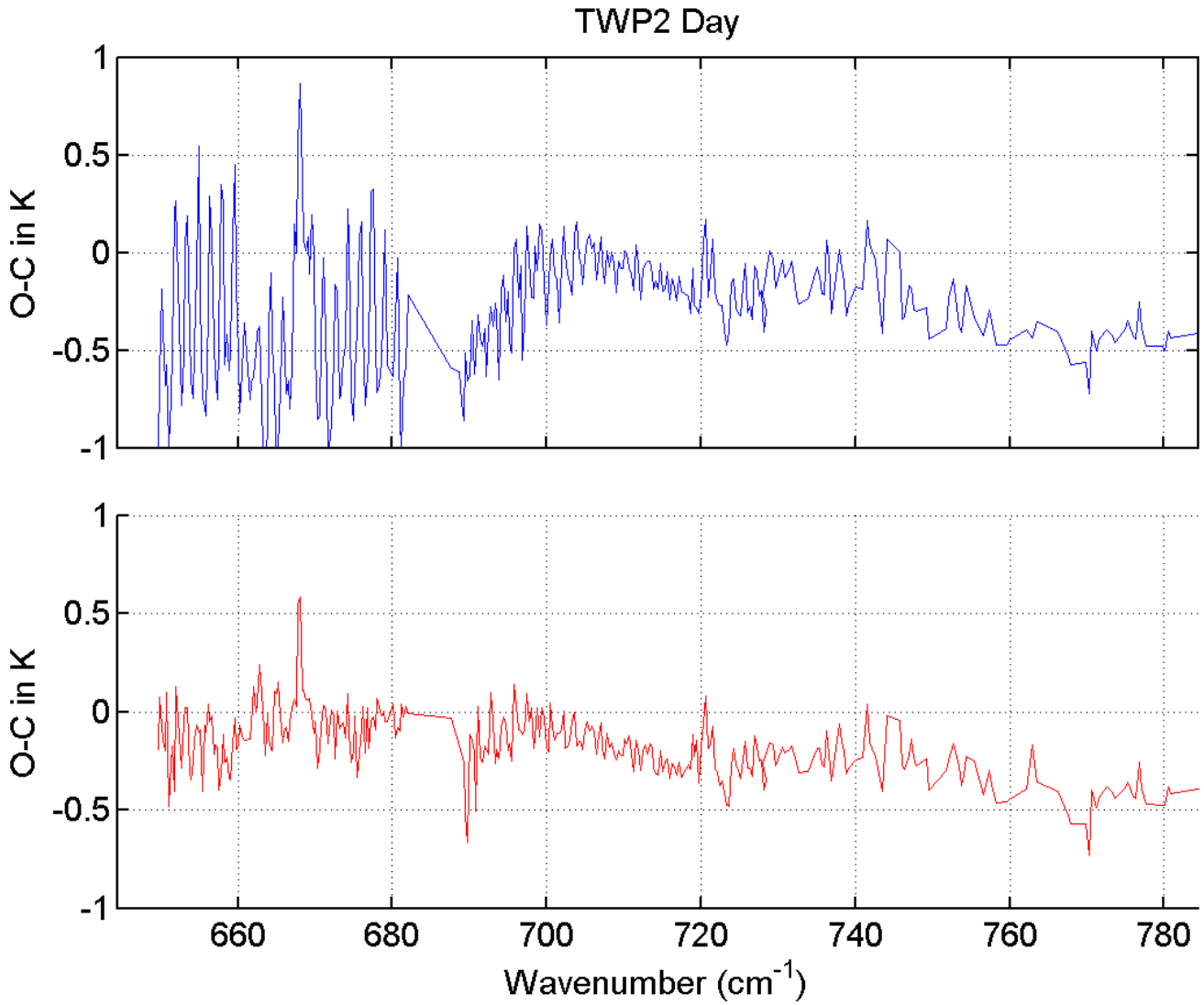
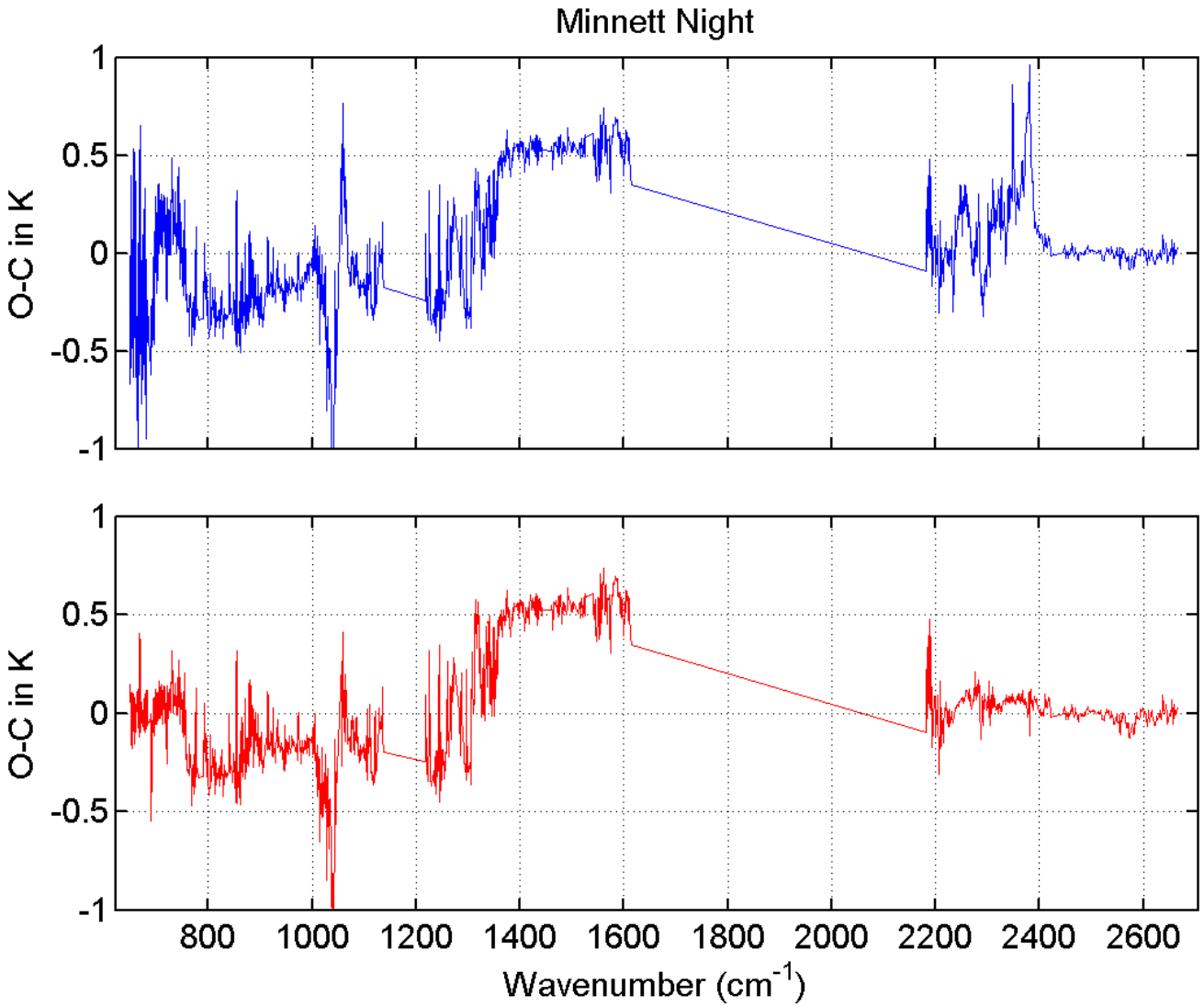


Minnett Version 4 (blue) and Version 5 (Red) Biases: Night



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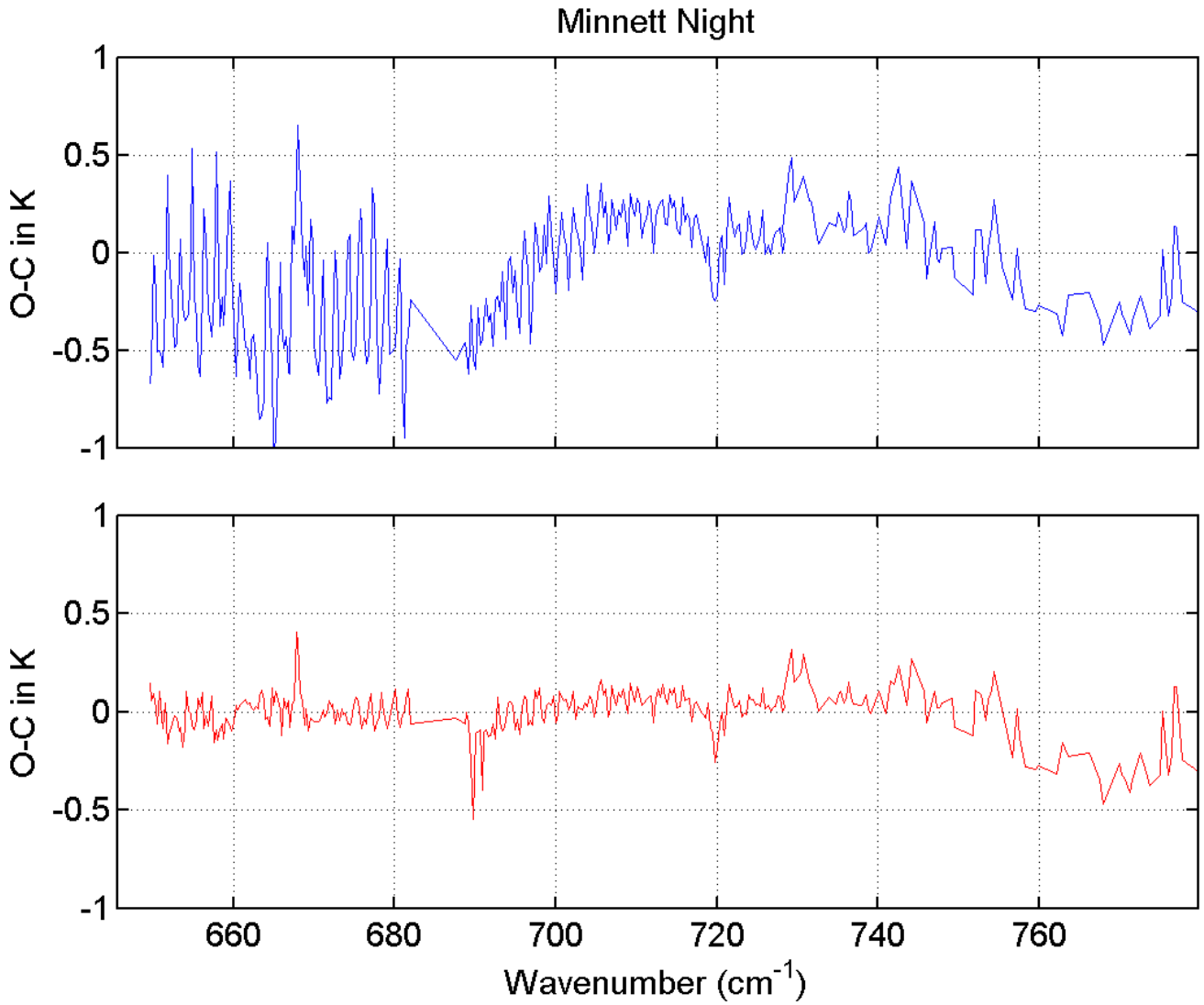

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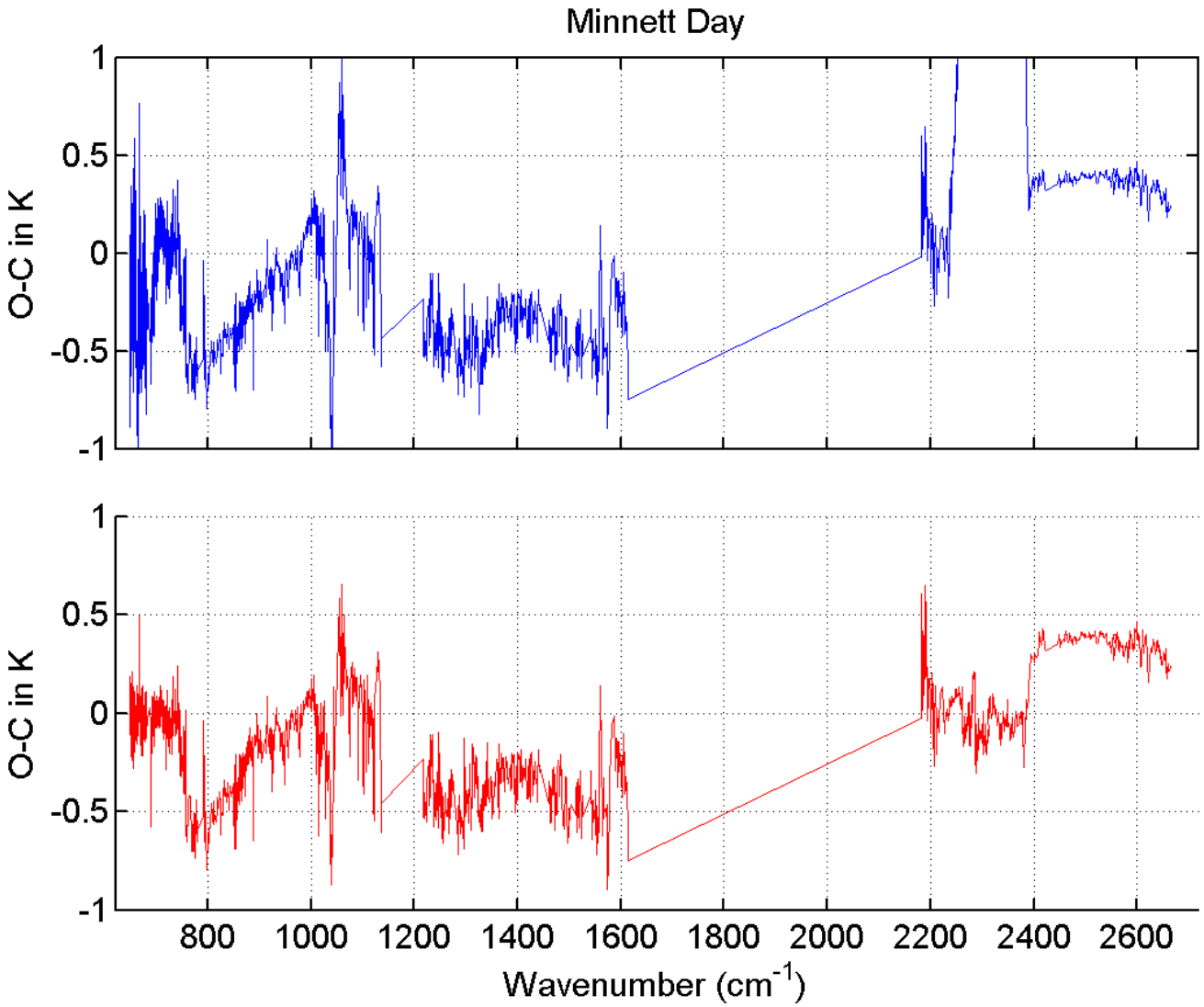

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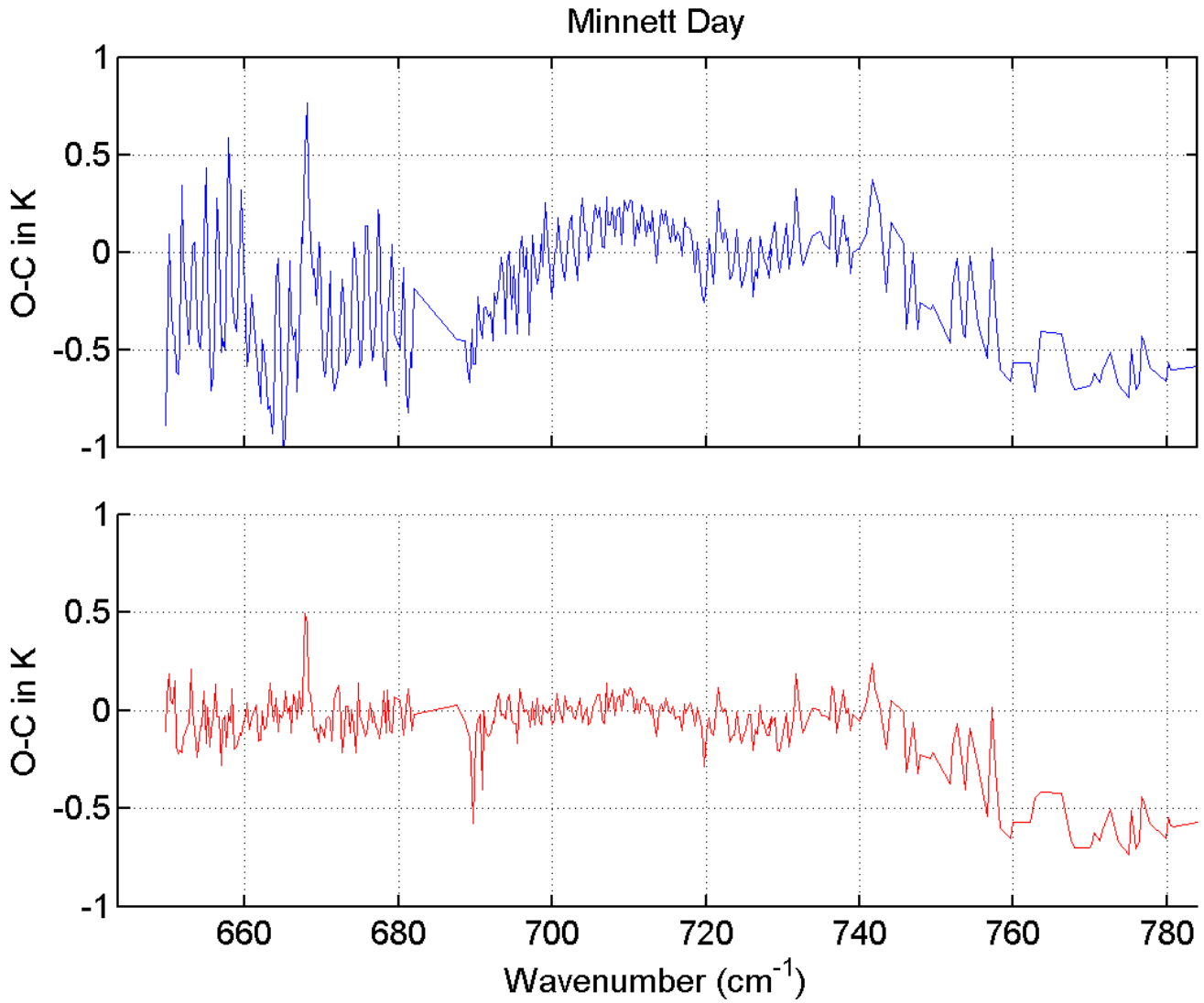
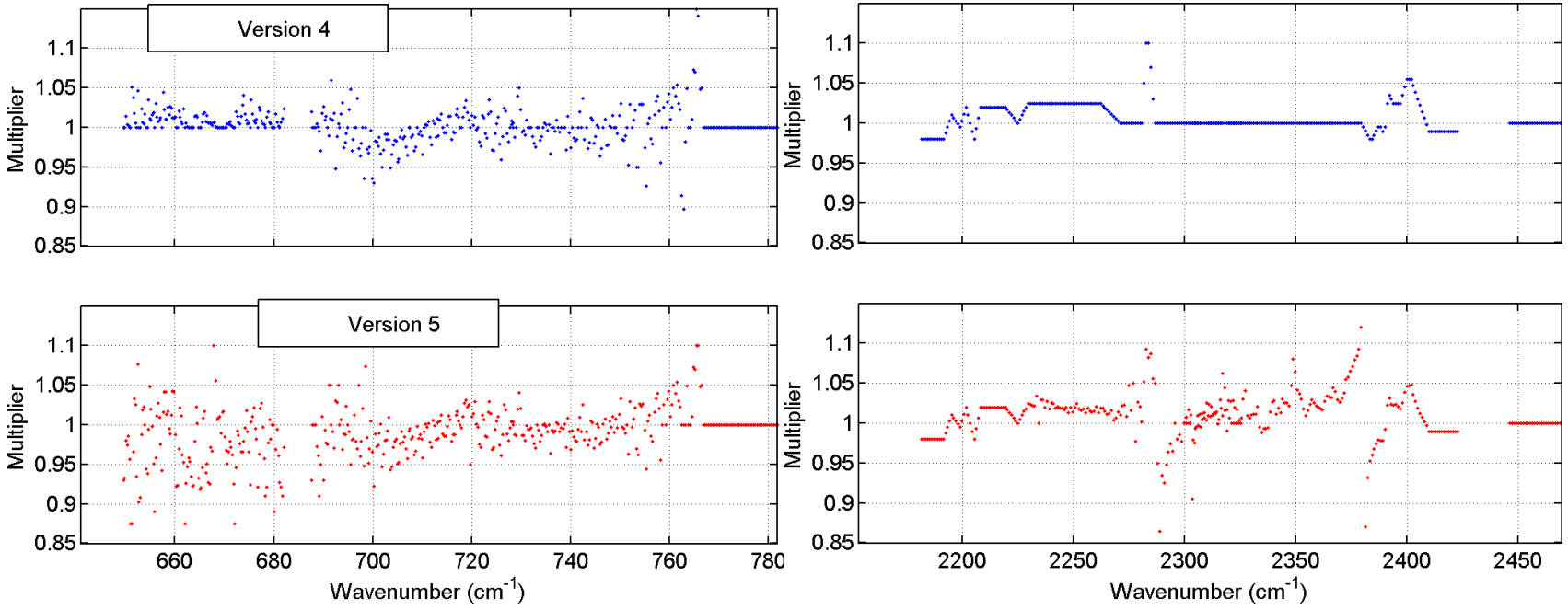
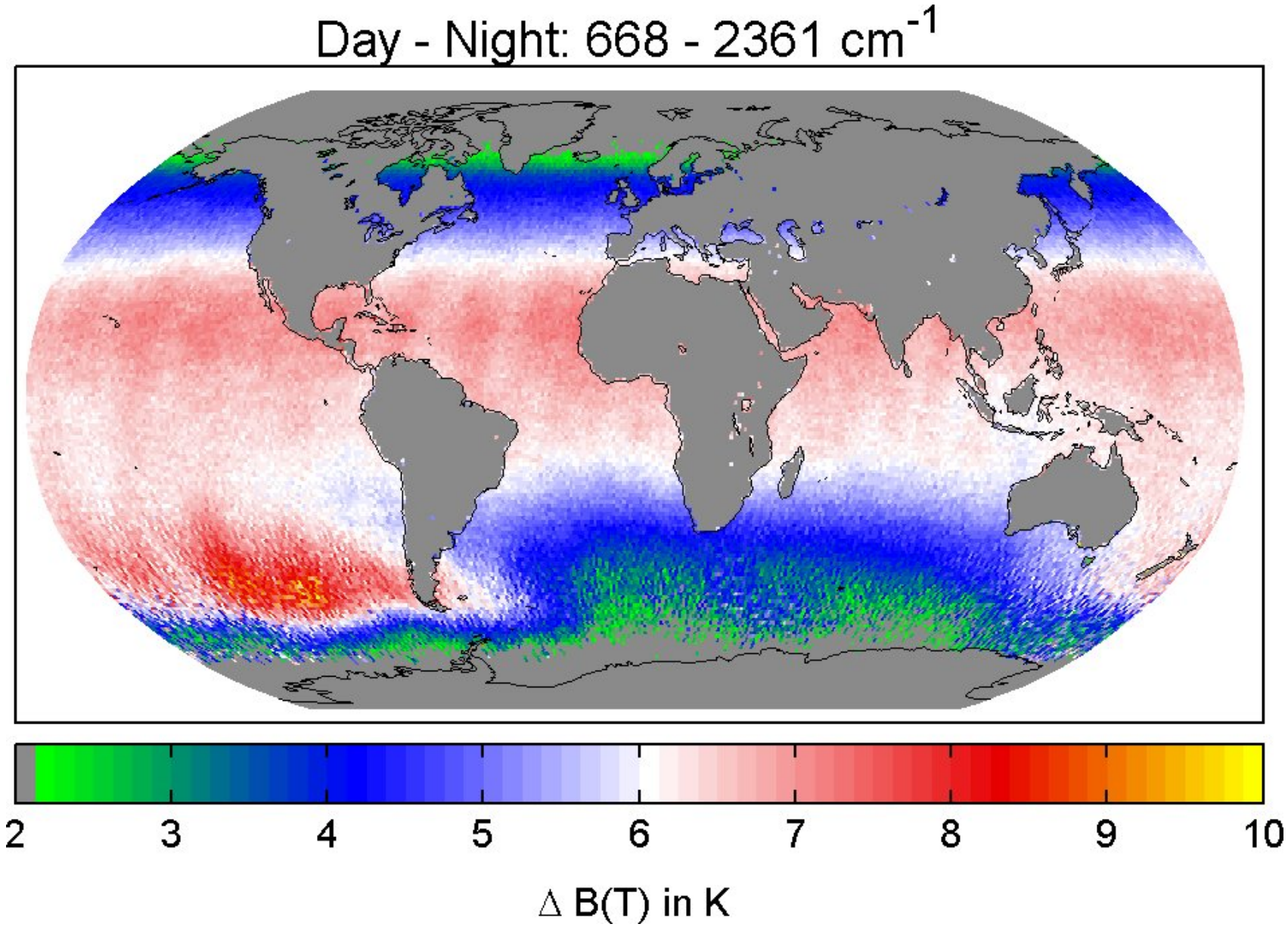


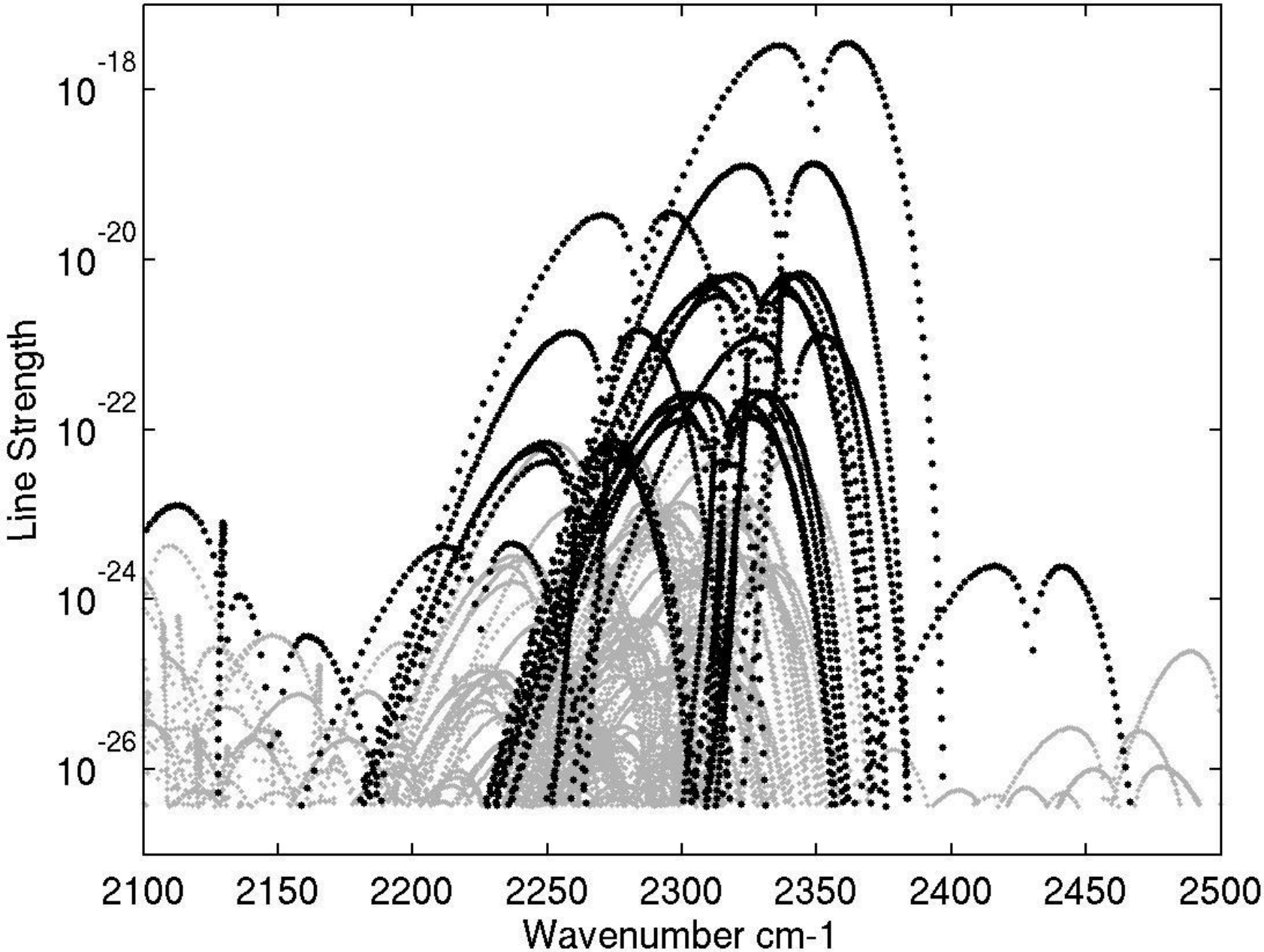
Transmittance Adjustments



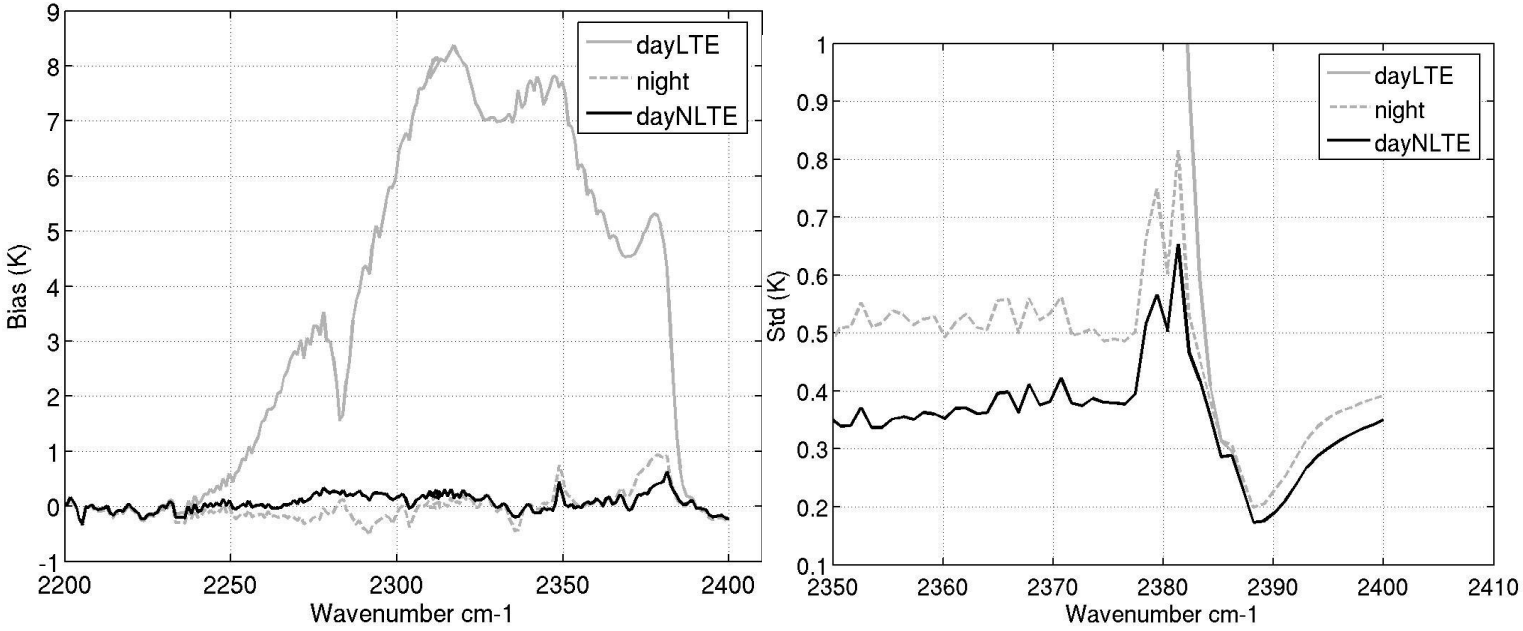
Global Picture of Non-LTE Emission



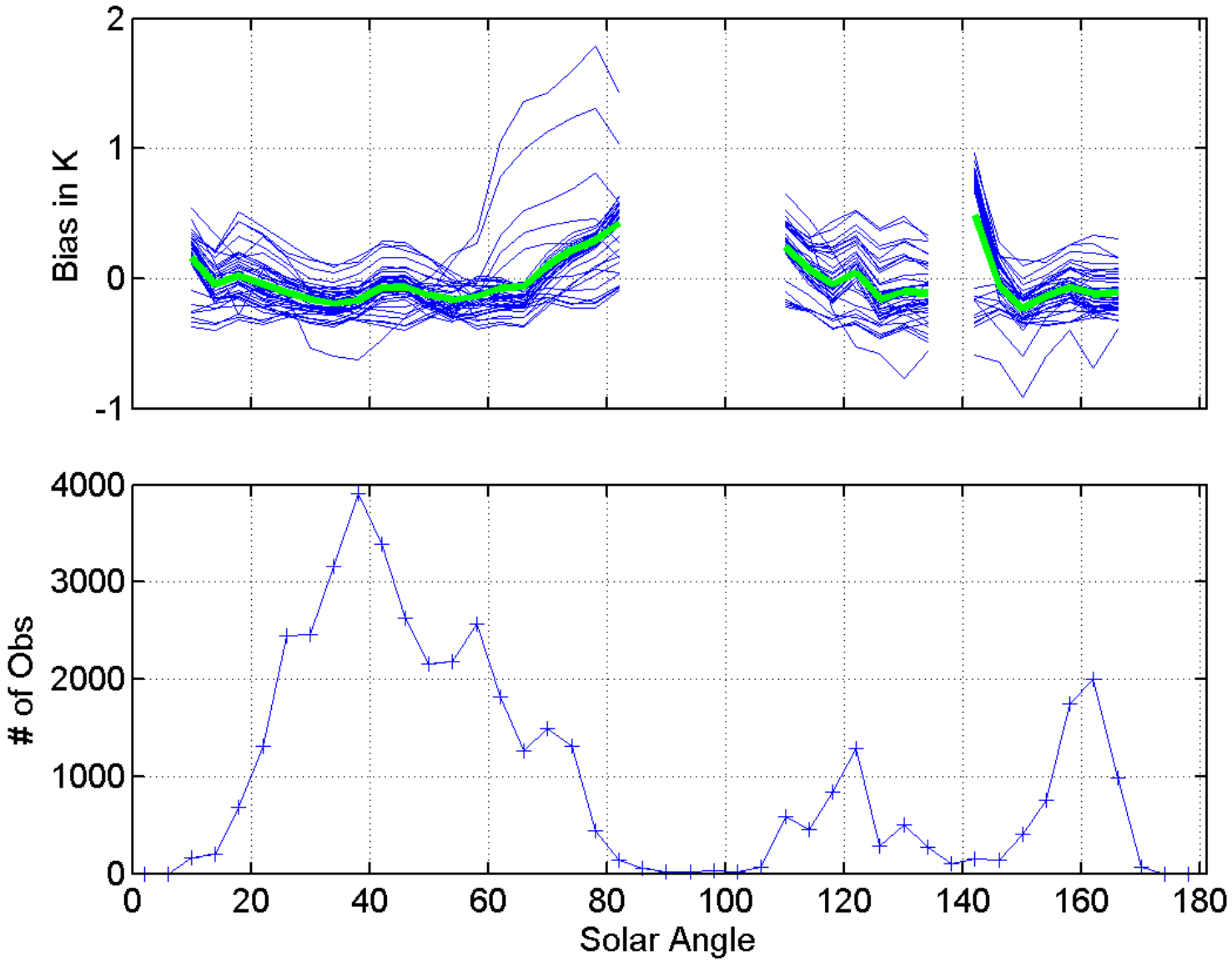
Band Included in Non-LTE



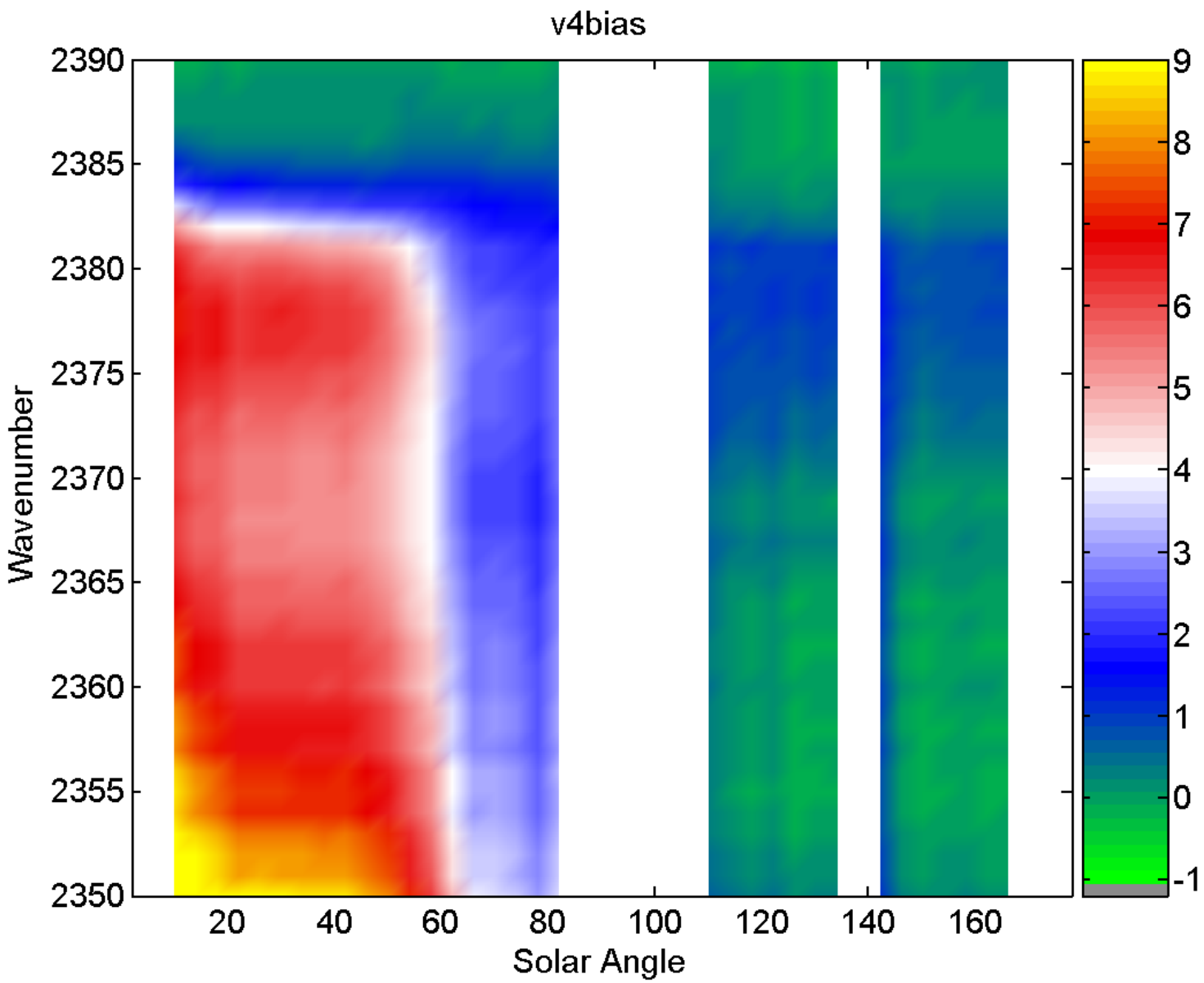
Global Bias in Non-LTE Channels



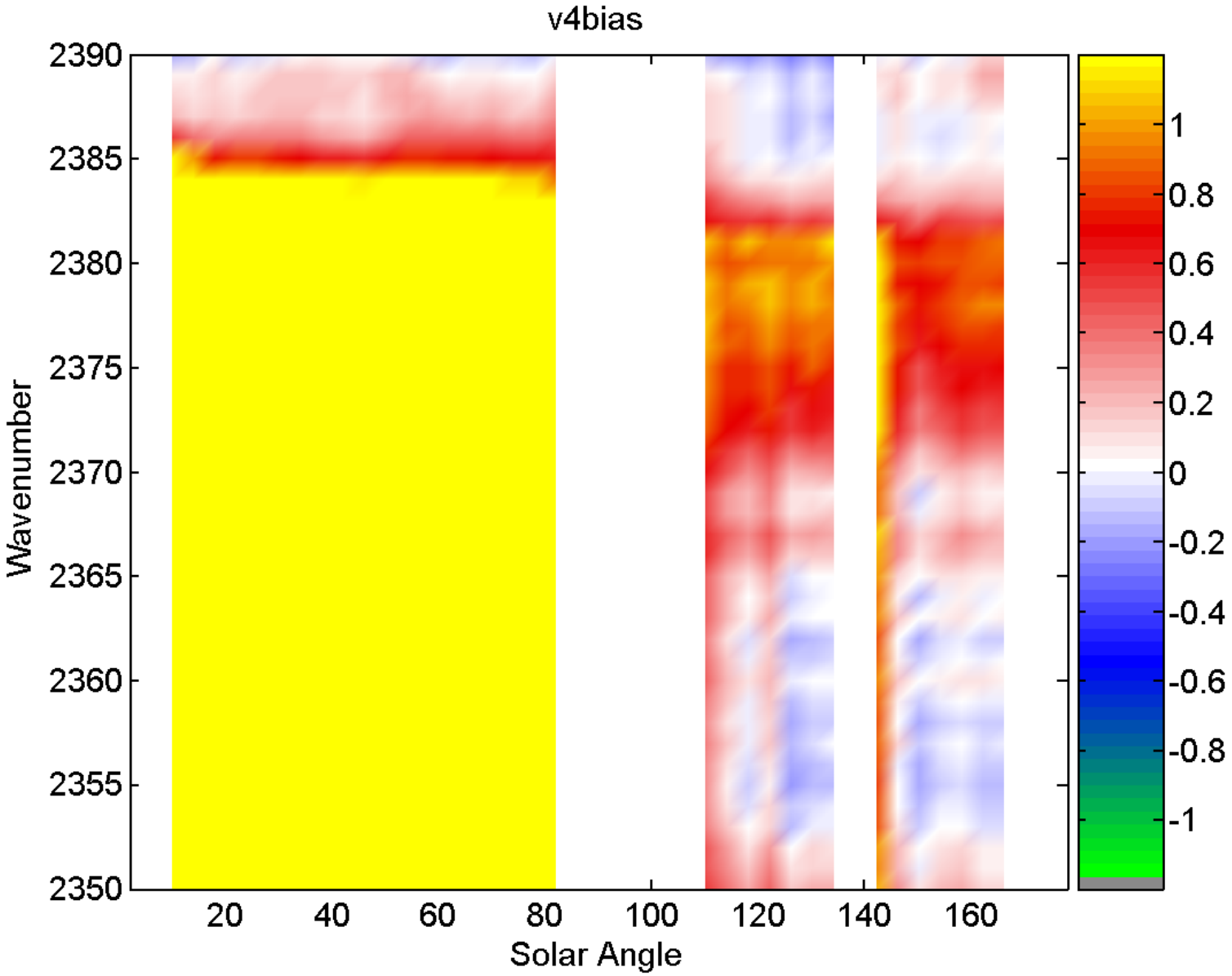
RTA Bias (ECMWF) vs Solar Angle



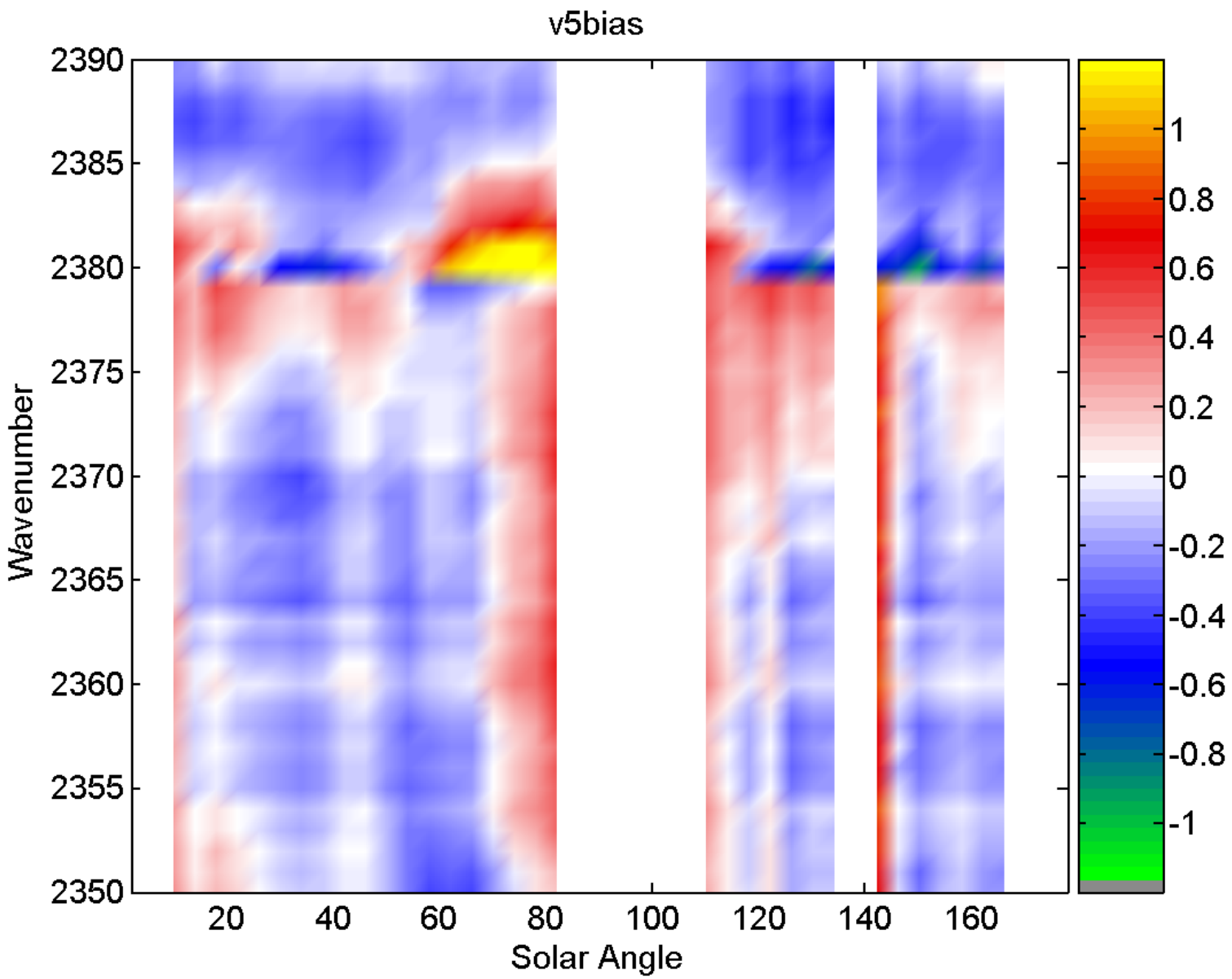
RTA Version 4 Bias vs Solar Angle



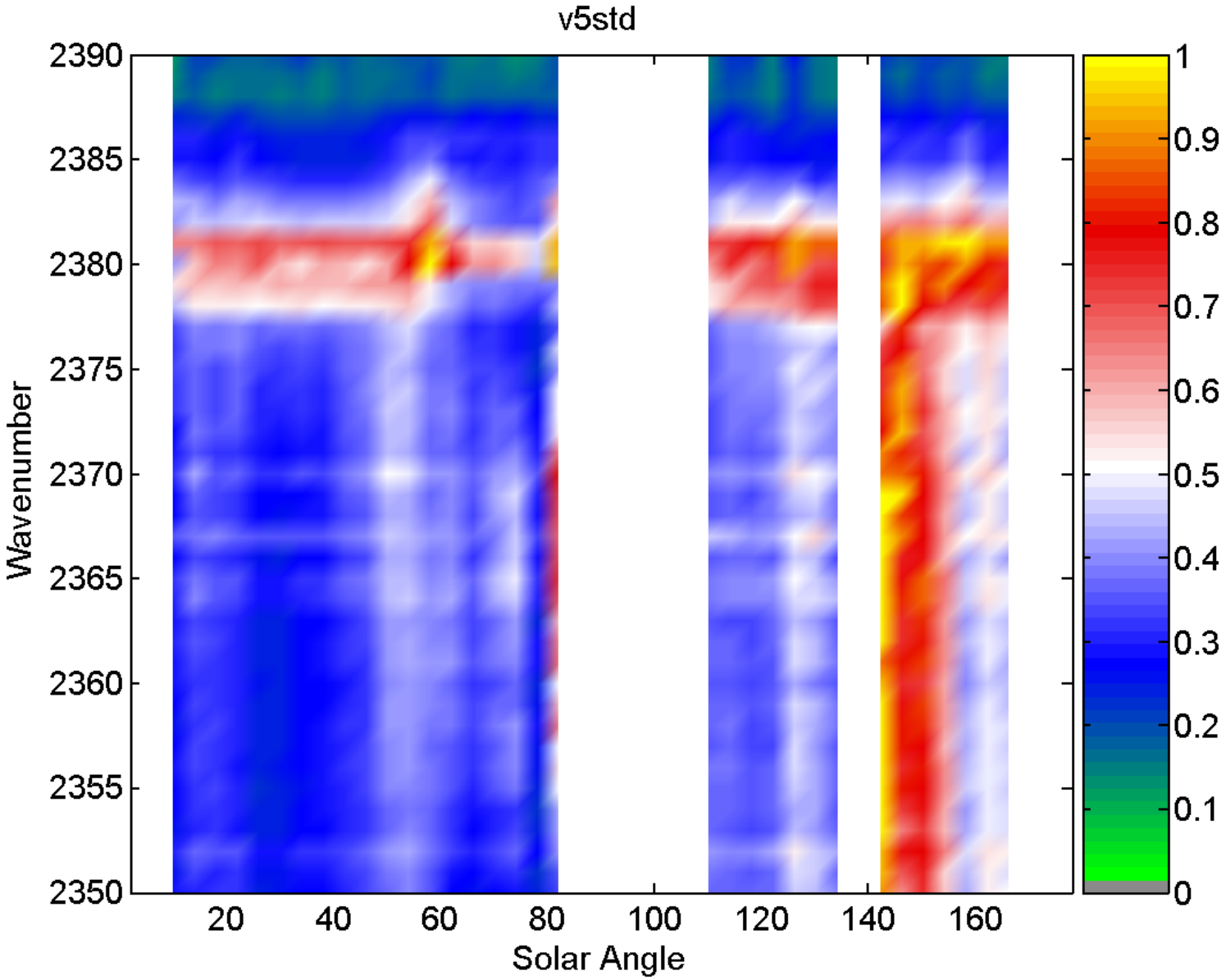
RTA Version 4 Bias vs Solar Angle: Colorscale Change



RTA Version 5 Bias vs Solar Angle



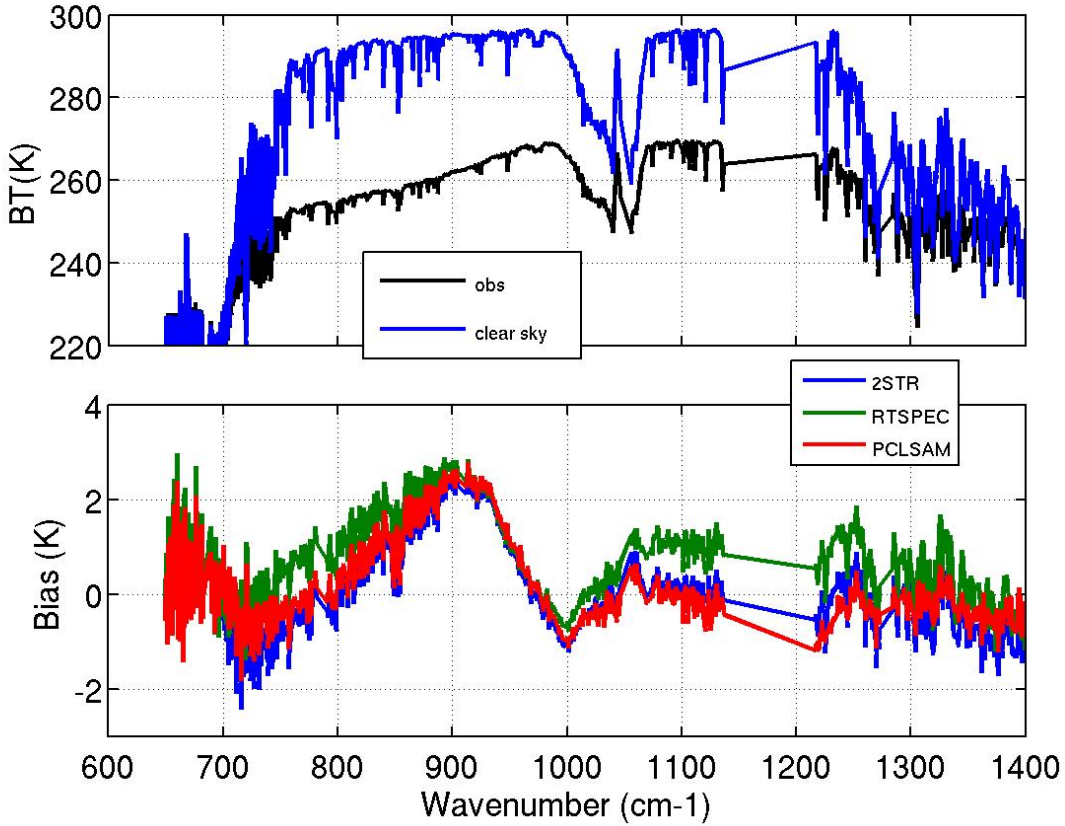
RTA Version 5 Std vs Solar Angle



New Scattering Model: PCLSAM

- Marco Matricardi (ECMWF/IASI) uses a scattering model, developed by Chou, M.-D. and Lee, K.-T. and Tsay, S.-C. and Fu, Q. (J. Climate, v12, pg 159 [1999])
- This model is called PCLSAM (Parameterization of Cloud Longwave Scattering for use in Atmospheric Models)
- With some assumptions, it re-parameterizes the (extinction) optical depth and so simplifies the solution to the radiative transfer equation.
- With these simplifications, it typically overestimates the final answer.
- The model runs very quickly (and can include solar effects)
- Jacobians included

PCLSAM vs kTWOSTREAM



AIRS spectrum over the Pacific Ocean on September 6, 2002. Top panel shows actual observation (black). Bottom panel shows biases using kTwostream (b), RTSPEC (g), PCLSAM (r). Parameters : cloud top/bottom at 300/350 mb, ice particles (spheres) of diameter 18.46 μm and IWP = 12.7 g/m2, ($\tau_{900} \simeq 1.12$)

PCLSAM status at UMBC

- Inserted into kCARTA; tested against RTSPEC, TWOSTREAM etc
- PCLSAM ported to SARTA, some small (known) bugs remain with solar term that will be fixed
- PCLSAM runs very fast (almost same speed as clear sky case)
- For dust and water clouds and small aerosols ($\leq$ 10 um), can include scattering effects due to spherical particles
- For ice can include scattering effects due to hexagonal plates and aggregates (computations by Anthony Baran)
- For these different spieces, we will supply the scattering tables that need to be present at run time

ASL