Validation of the AIRS-RTA

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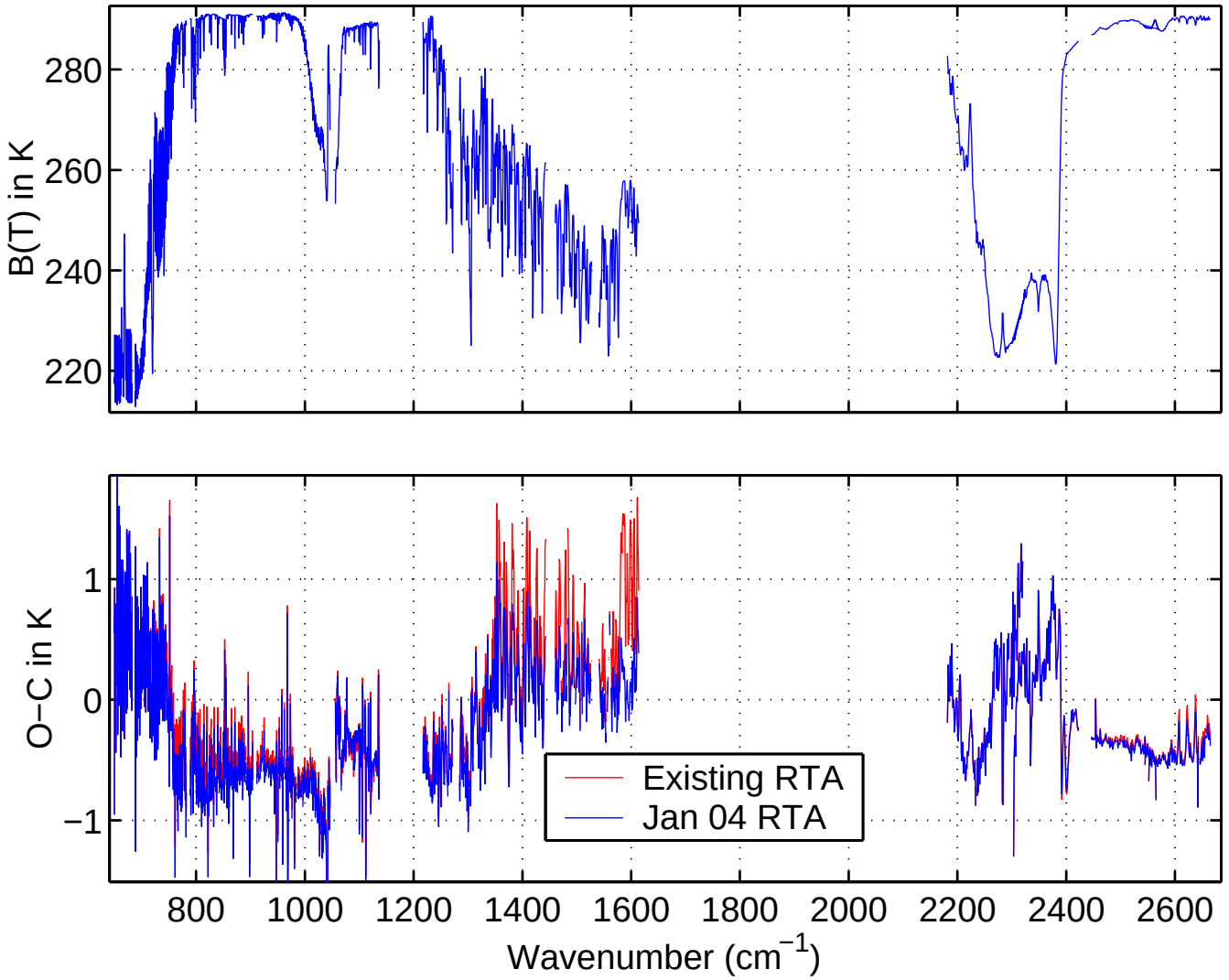
Overview

- Review latest AIRS-RTA delivery (January 2003)
- Review validation data used to modify January 2003 AIRS-RTA
- Biases relative to January 2003 AIRS-RTA
  - Bias versus total column water for ECMWF
  - Bias versus secant(θ) for ECMWF
  - Bias versus ECMWF SST
  - Global distribution of biases
- Candidate cause for low-altitude biases
- Global distribution of biases
- Preliminary results for Voelmel and Schmidlin co-located sondes

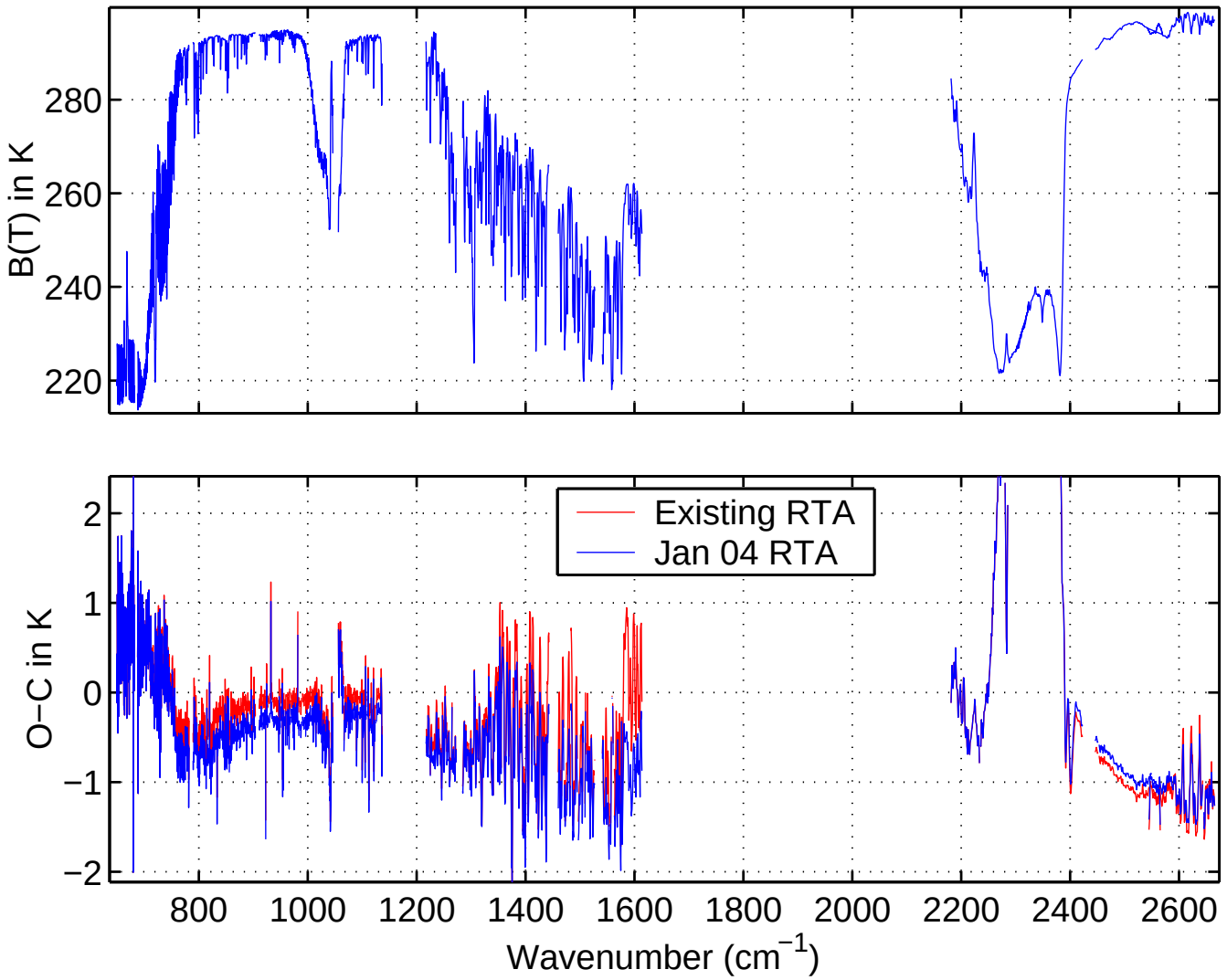
January 2003 AIRS-RTA

- Based on ECMWF and AIRS special sonde launch in the Sept - Oct time frame
- Changes to CO_2 channels based on re-analysis of laboratory data, no changes based on validation data
- H_2O continuum changed in portions of the window regions based on variation of biases with total column water in ECMWF model fields
- Many channels inside the strong H_2O band were modified based on ARM and ABOVE RS-90 co-located sondes
- Weak water lines above 2500 cm^{-1} were also modified, in a very ad-hoc manner, based on biases vs ECMWF total column water
- *New analyses based on ECMWF model fields and field validation data will be used to further improve the AIRS-RTA. When is the next delivery needed?*

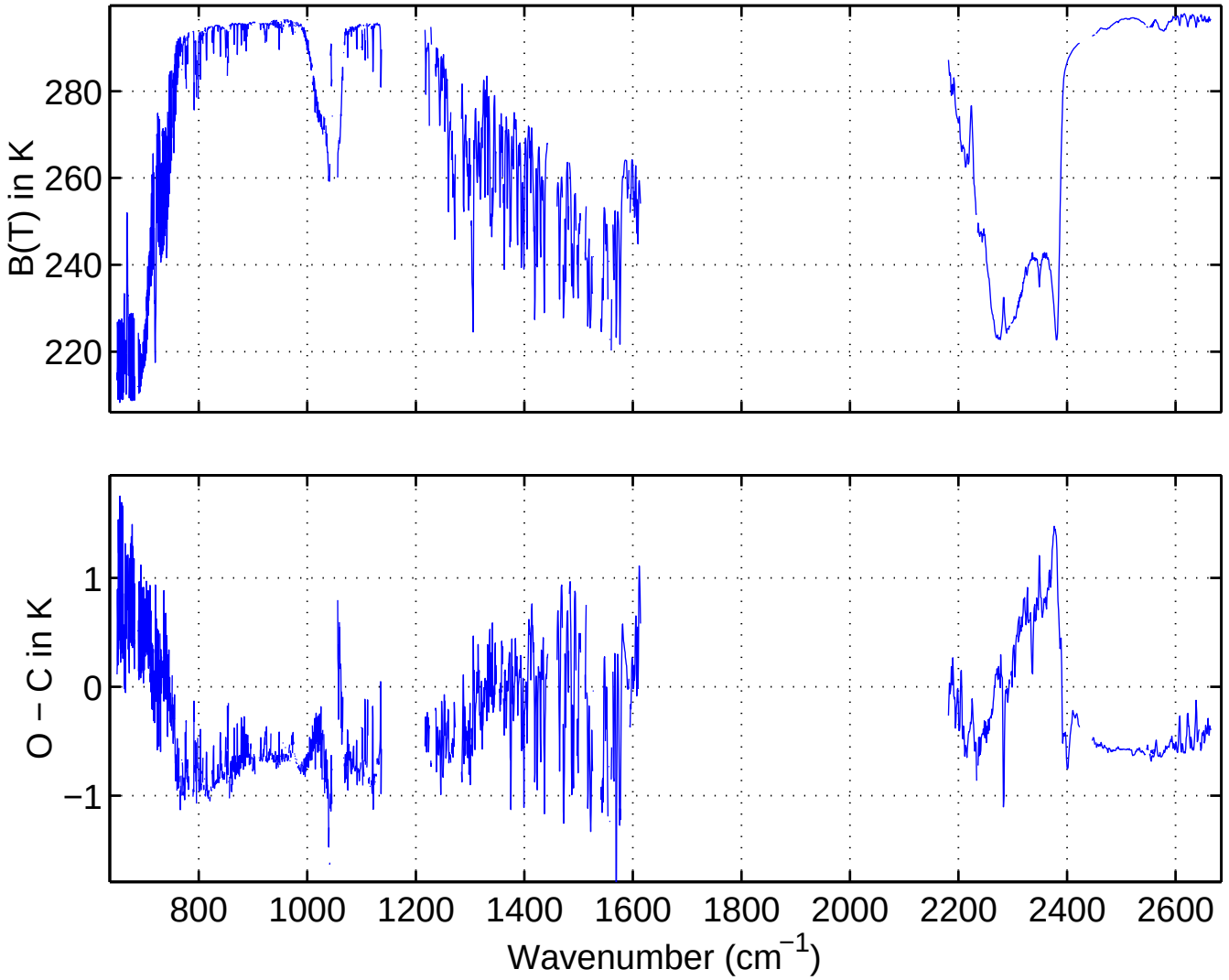
DOE-ARM Special Sonde Results



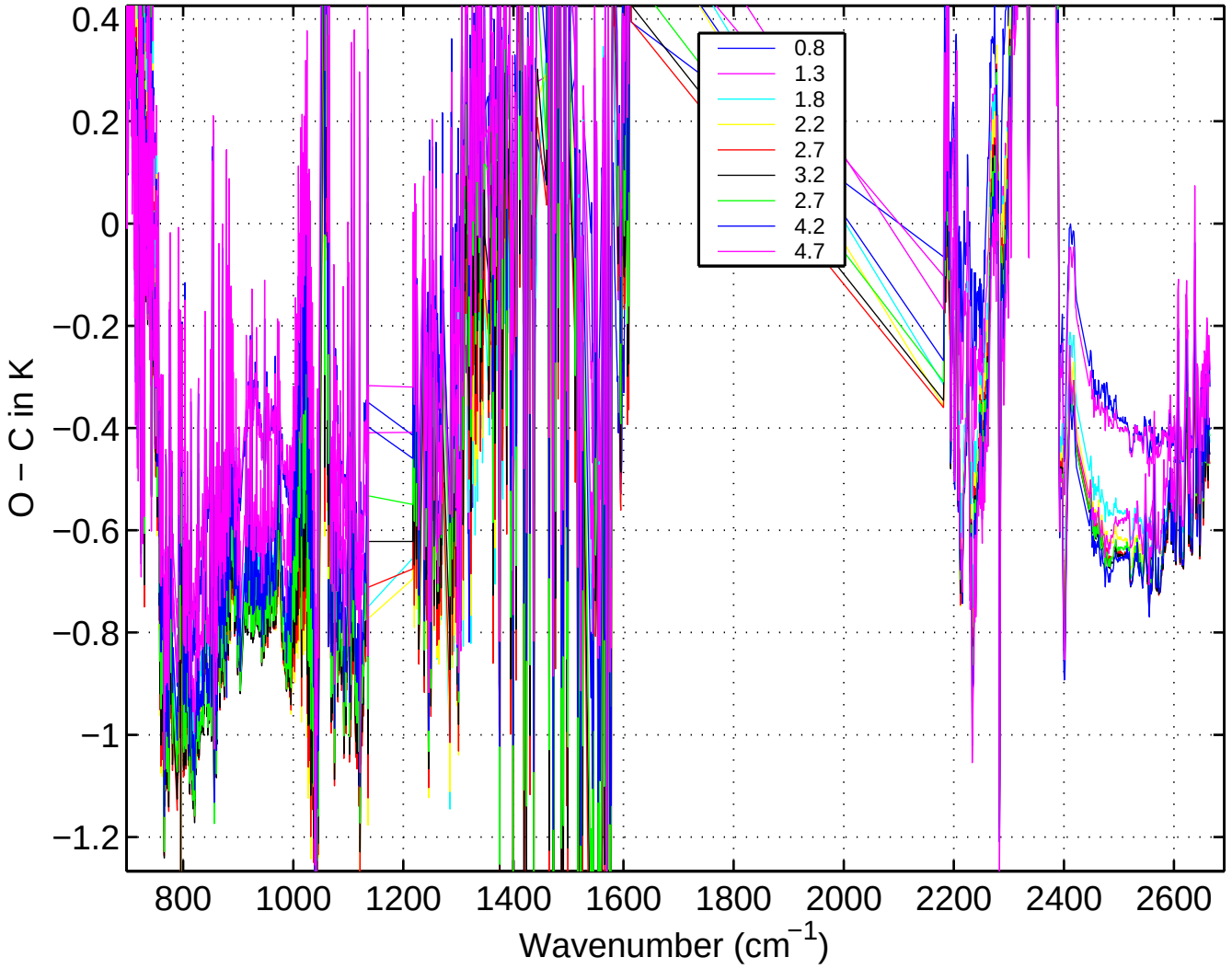
ABOVE Special Sonde Results



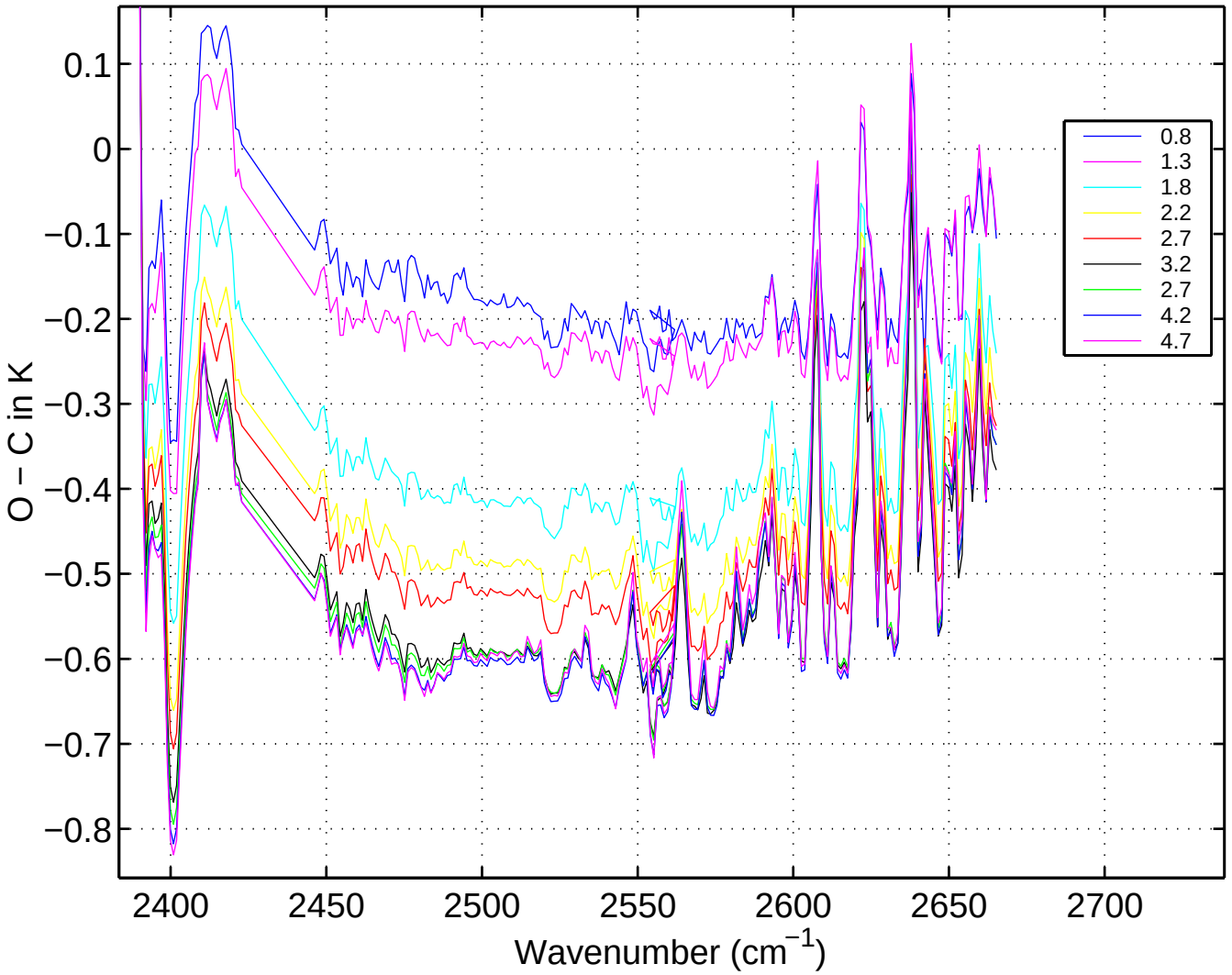
Night/Ocean/$\pm 50^o$ Latitude Bias: October



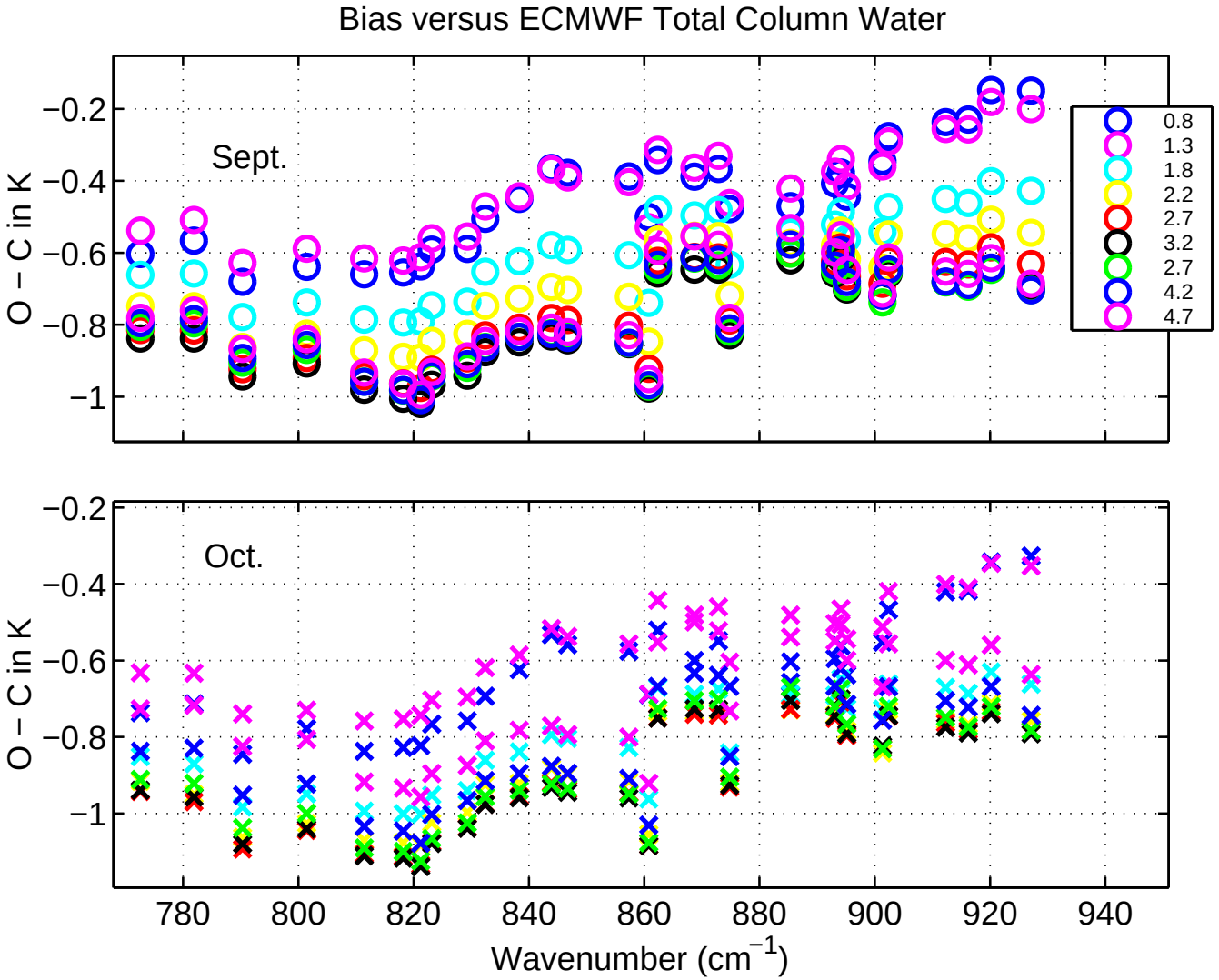
ECMWF Bias Binned by Total Column Water



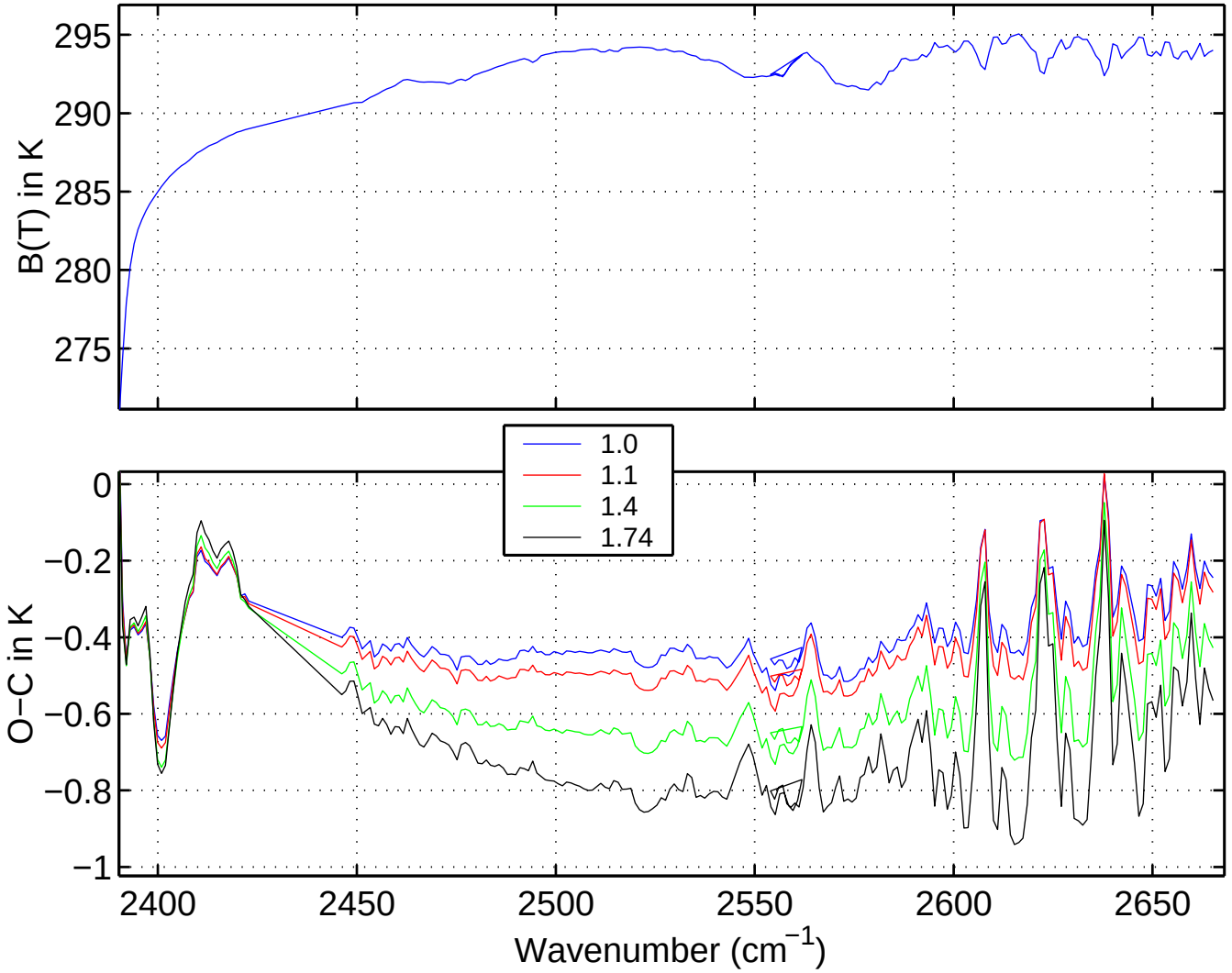
ECMWF Bias Binned by Total Column Water, Shortwave Window



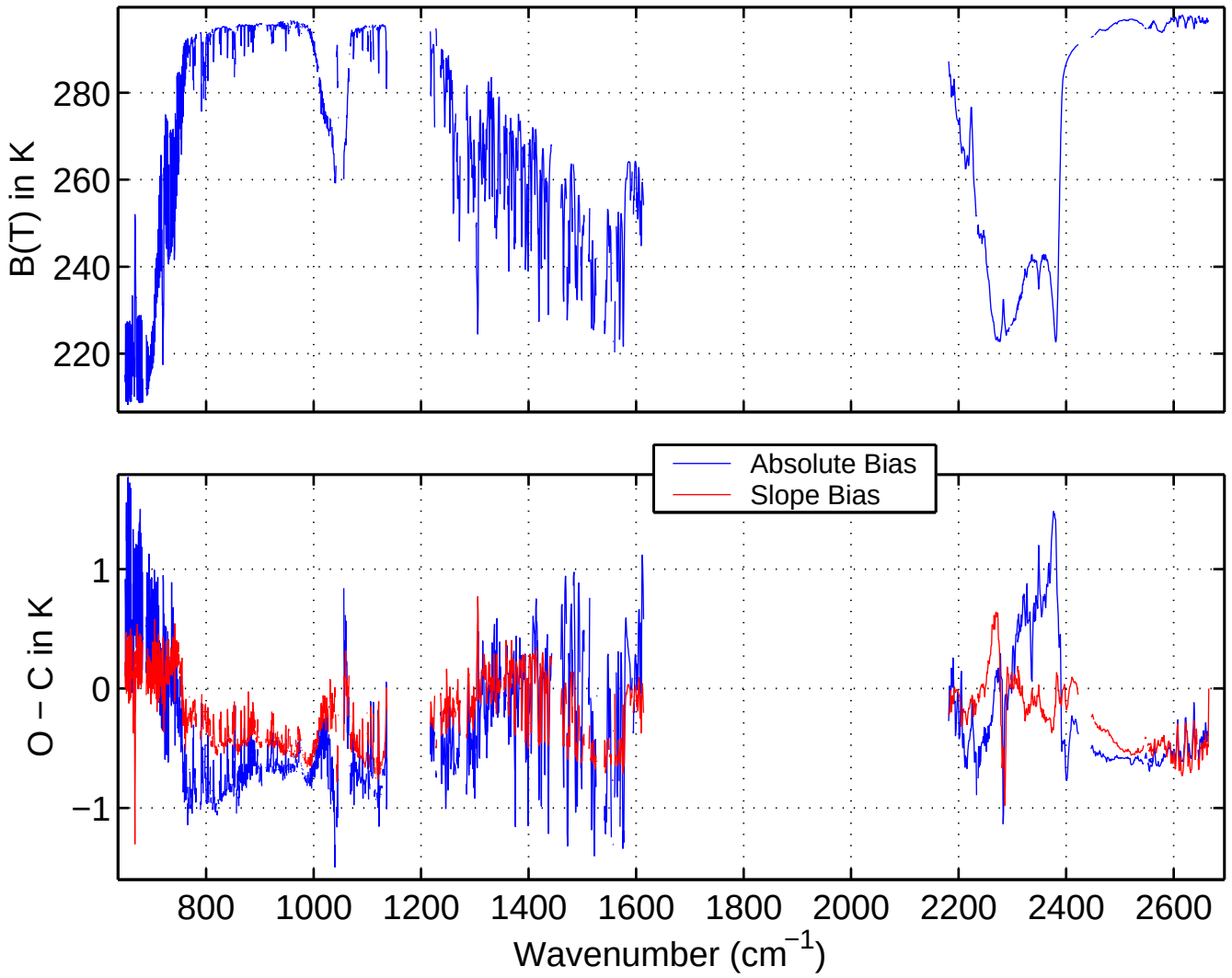
ECMWF Bias Binned by Total Column Water, Longwave Window



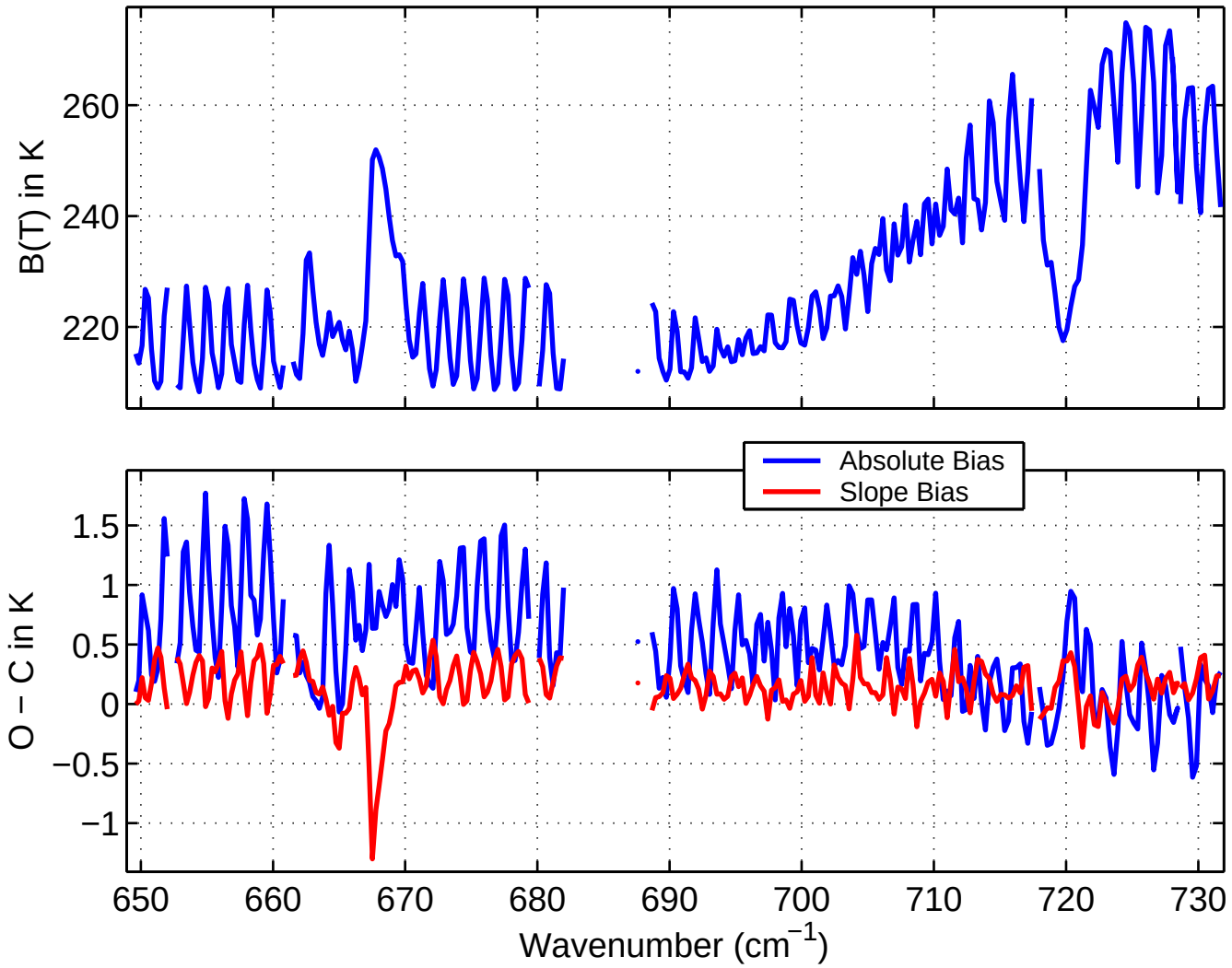
ECMWF Bias by Satellite Viewing Angle



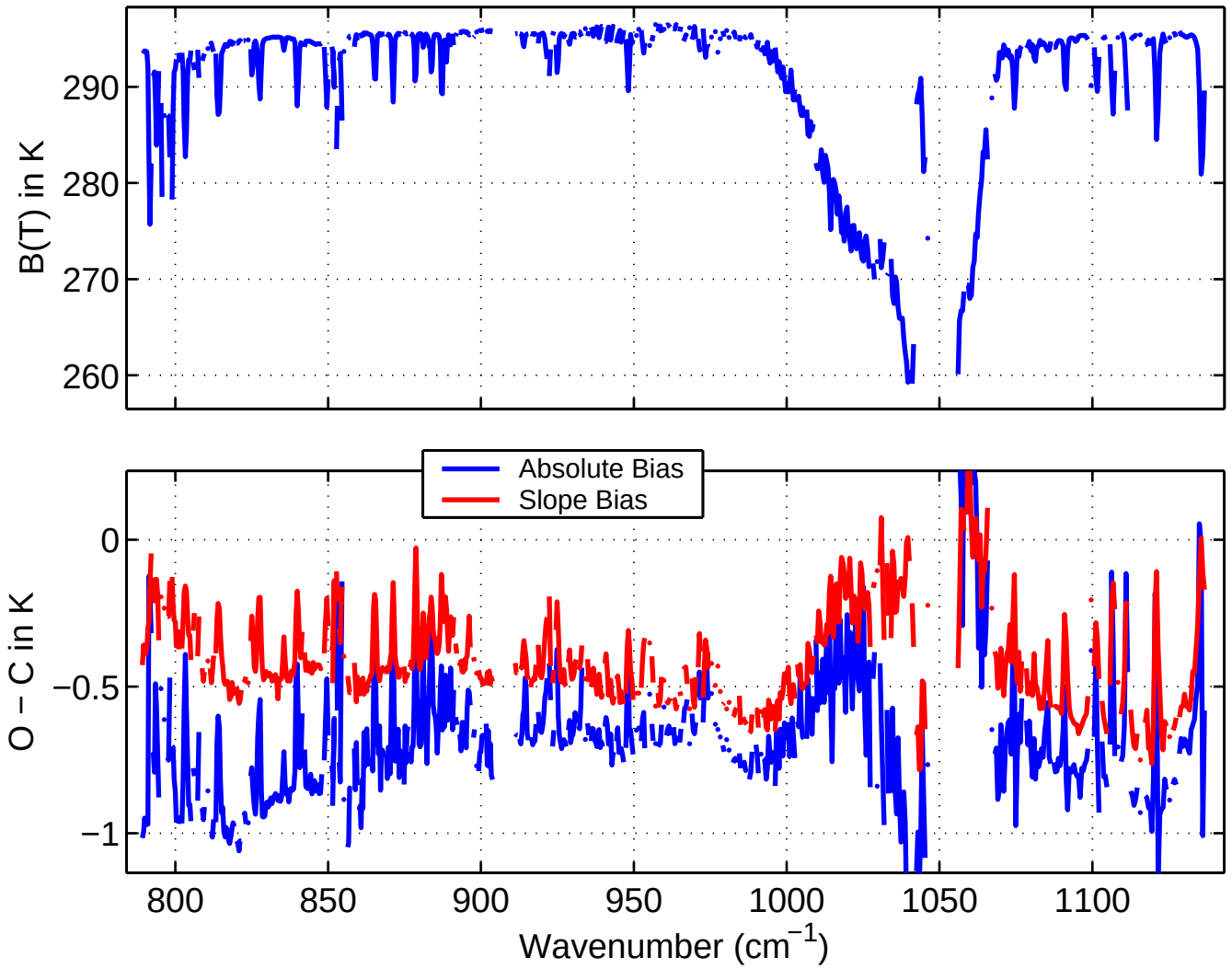
ECMWF Bias; Absolute, Bias Derived from Bias vs Secant(θ)



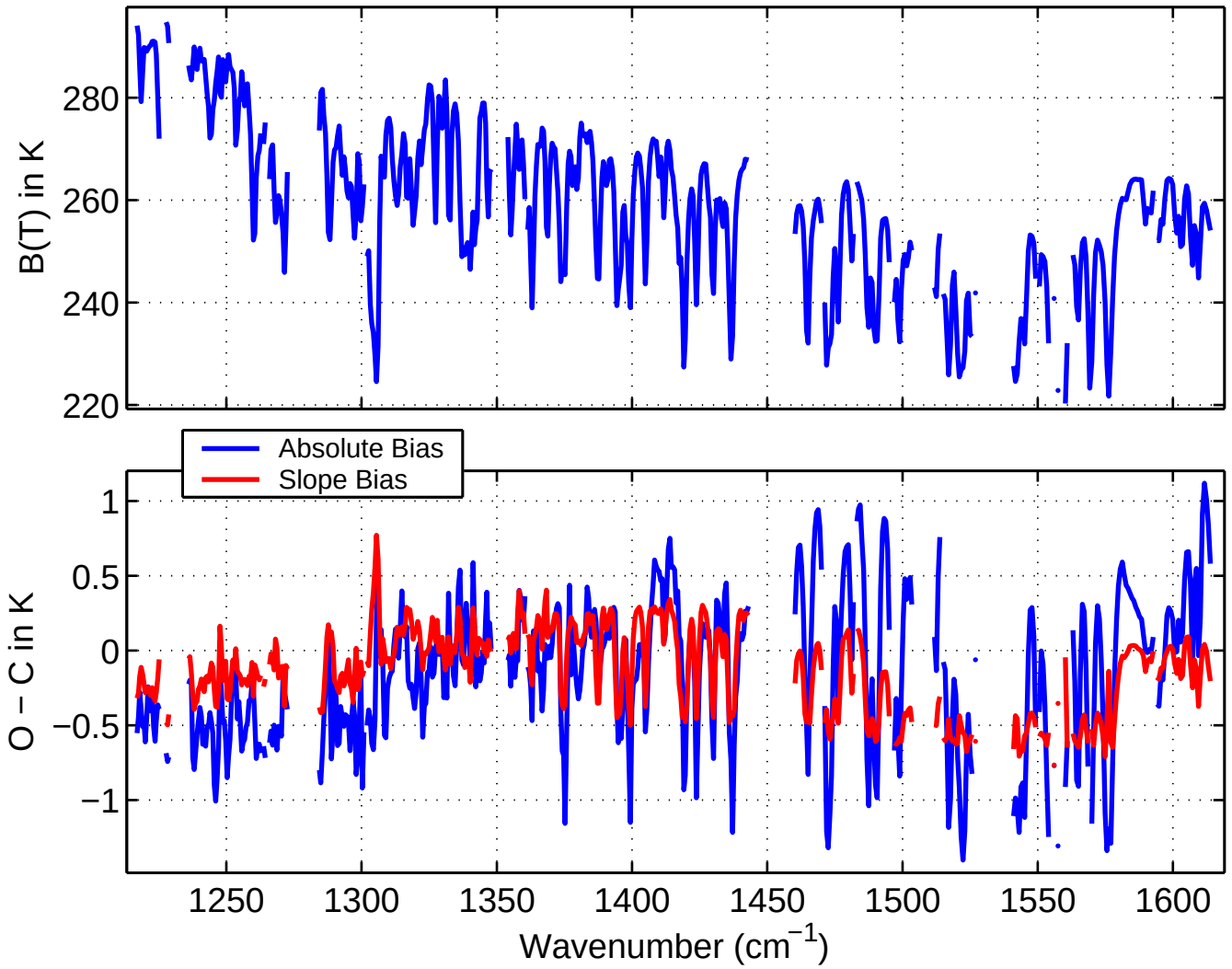
ECMWF Bias; Absolute, Bias Derived from Bias vs Secant(θ), Zoom



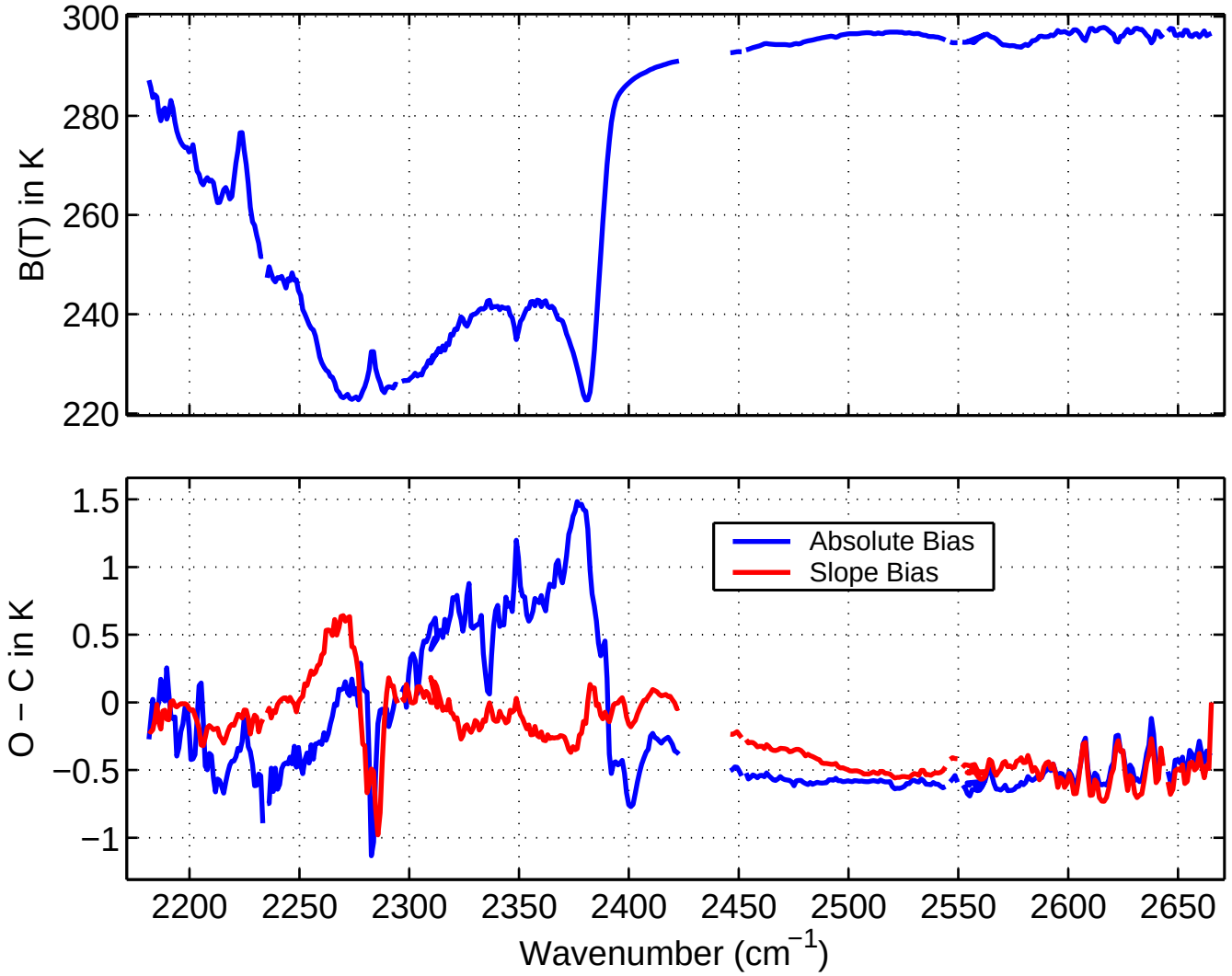
ECMWF Bias; Absolute, Bias Derived from Bias vs Secant(θ), Zoom



ECMWF Bias; Absolute, Bias Derived from Bias vs Secant(θ), Zoom



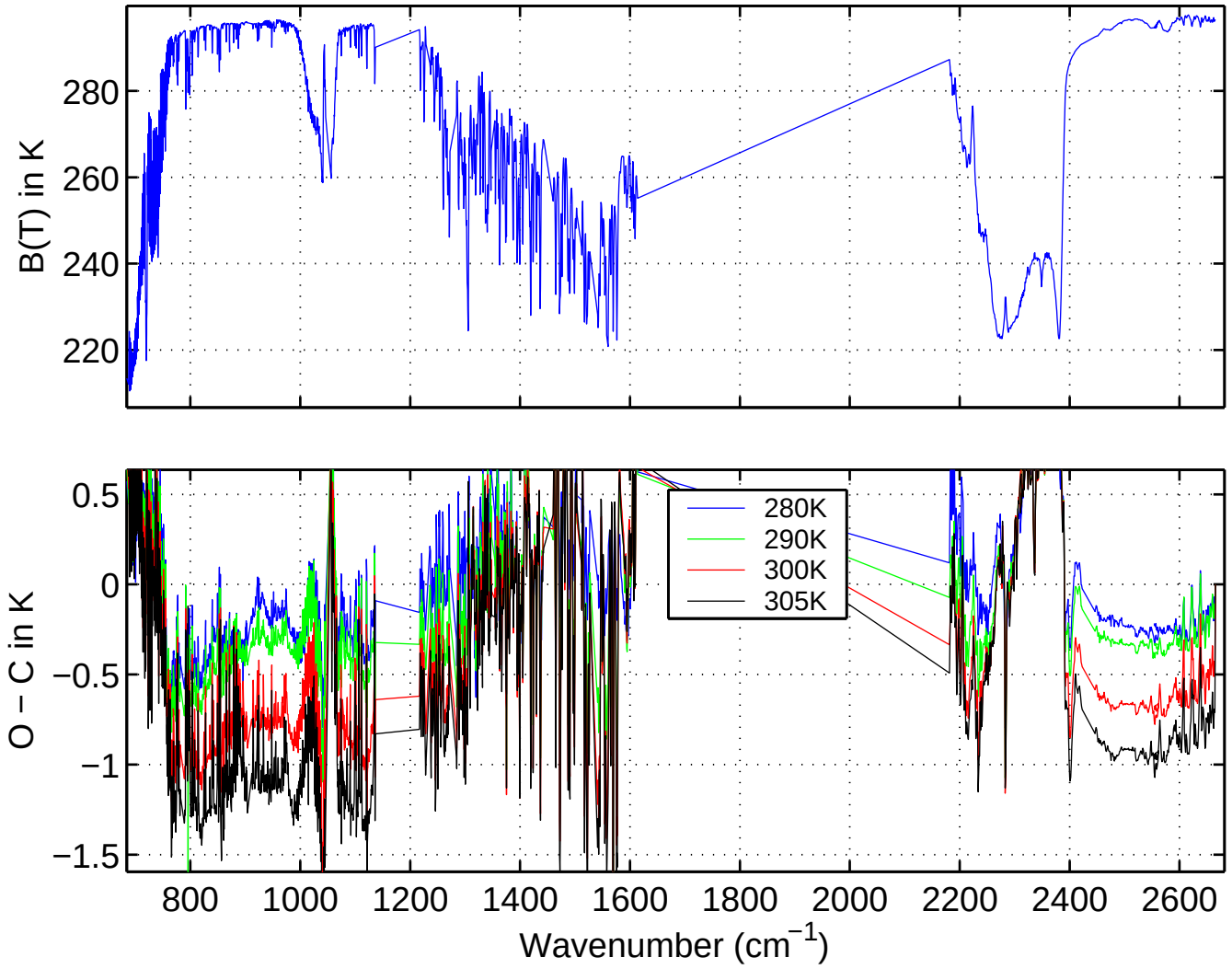
ECMWF Bias; Absolute, Bias Derived from Bias vs Secant(θ), Zoom



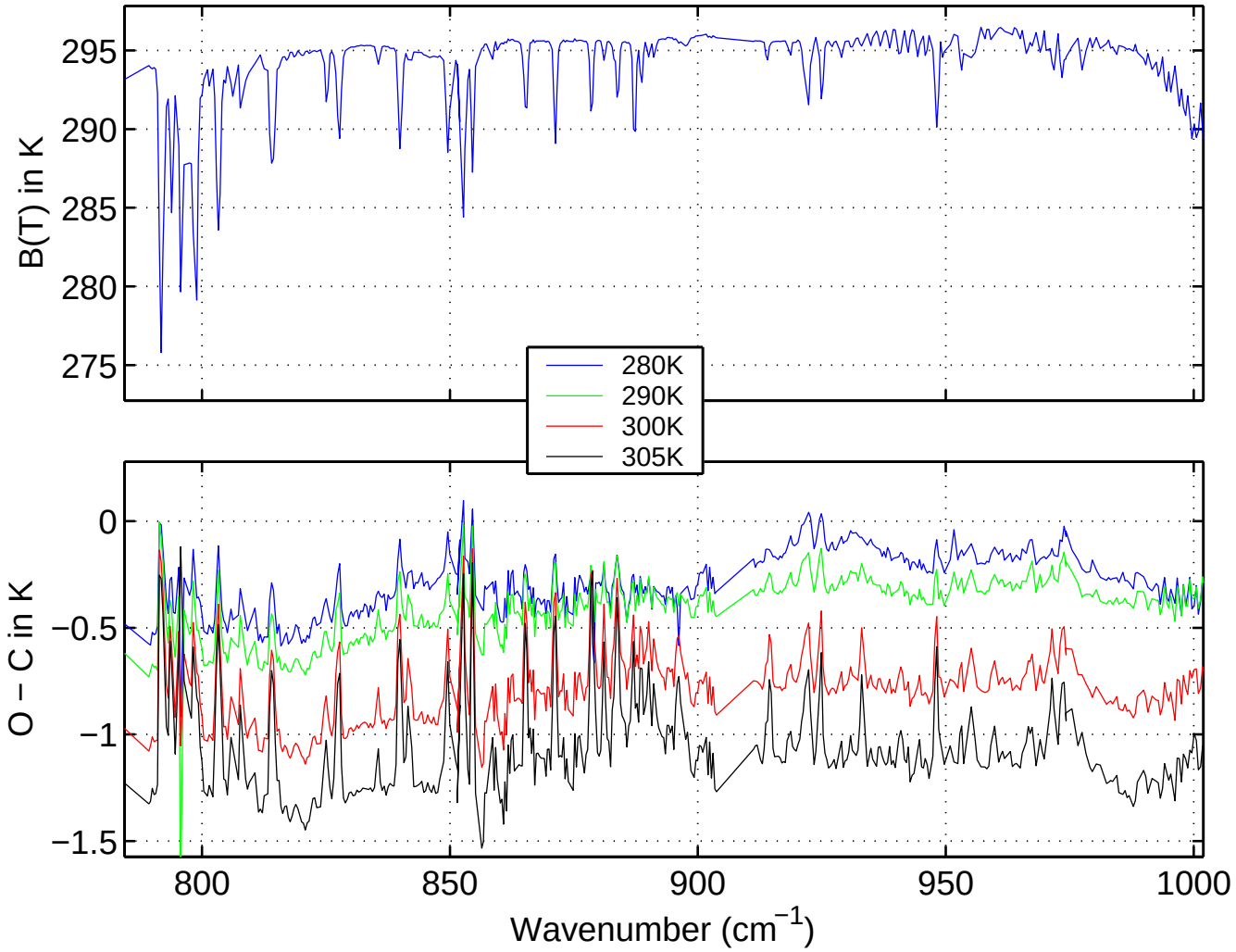
Bias Derived from secant(θ) Dependence

- Should be independent of accuracy of ECMWF to first-order. (Needs analysis)
- Shows very small biases where our confidence level is high.
- Rough agreement with better sonde data.
- Indicates significant absorber/scatterer at low altitudes, origin uncertain
- Now check how bias varies with surface temperature

ECMWF Bias versus Sea Surface Temperature

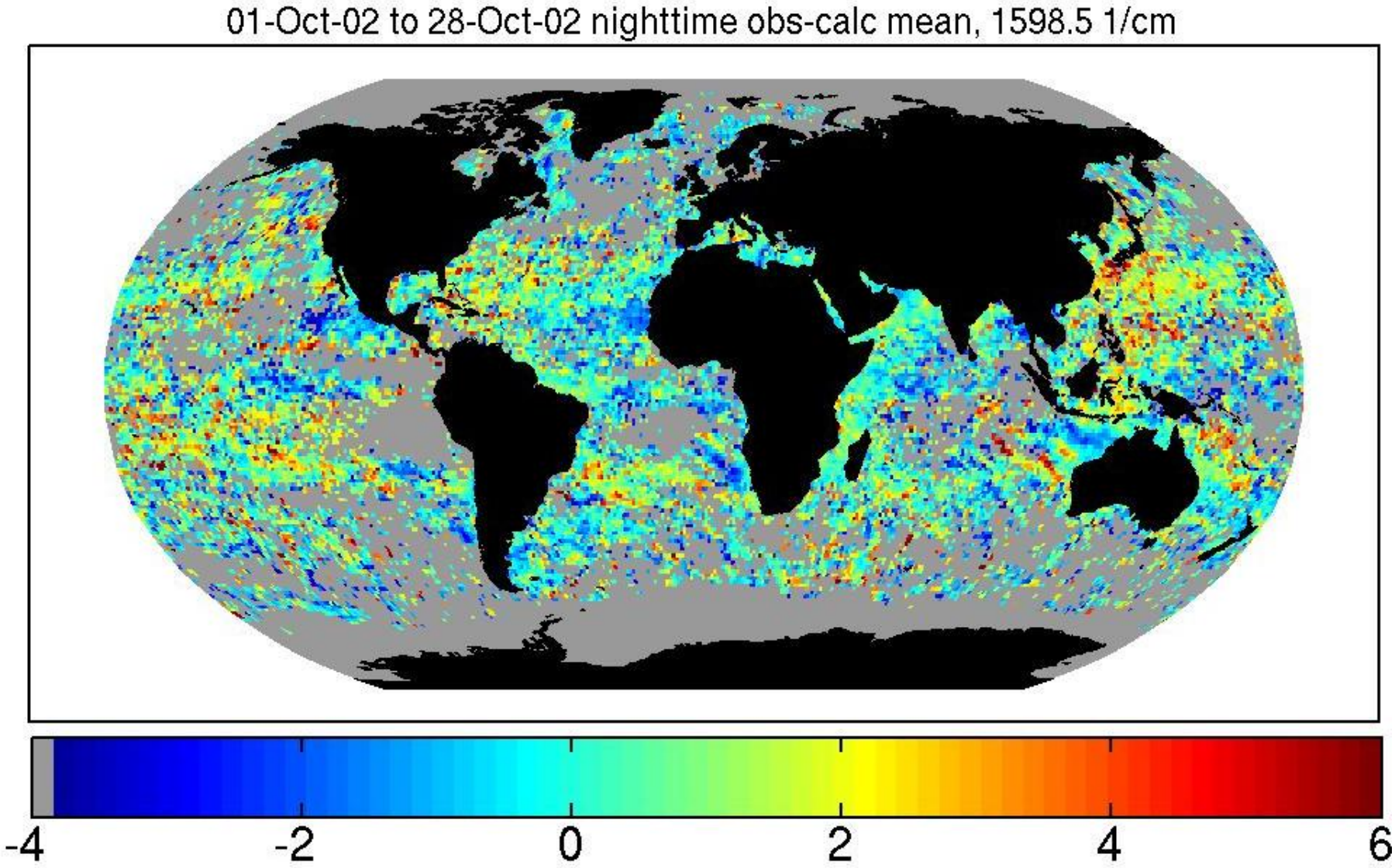


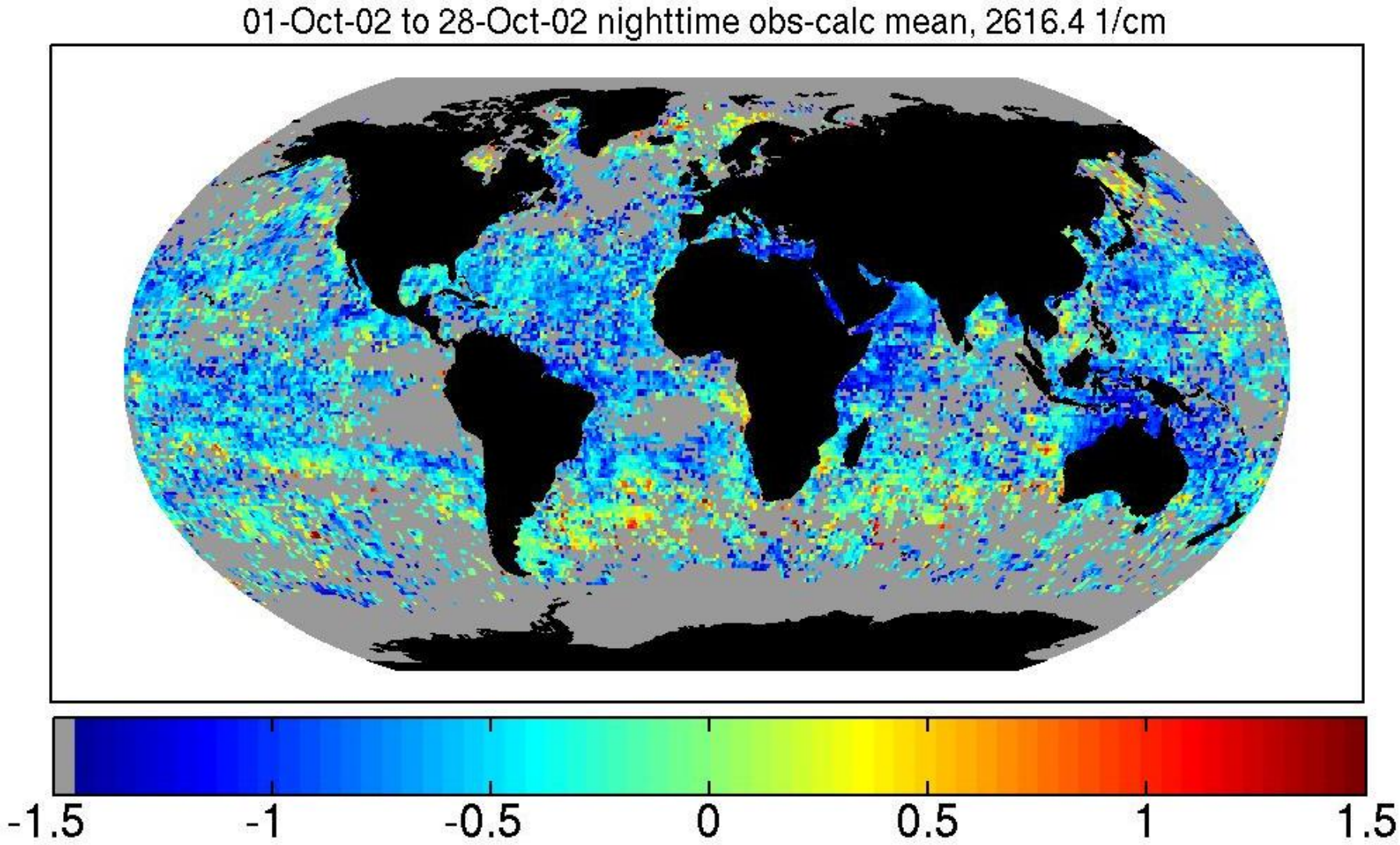
ECMWF Bias versus Sea Surface Temperature, Zoom

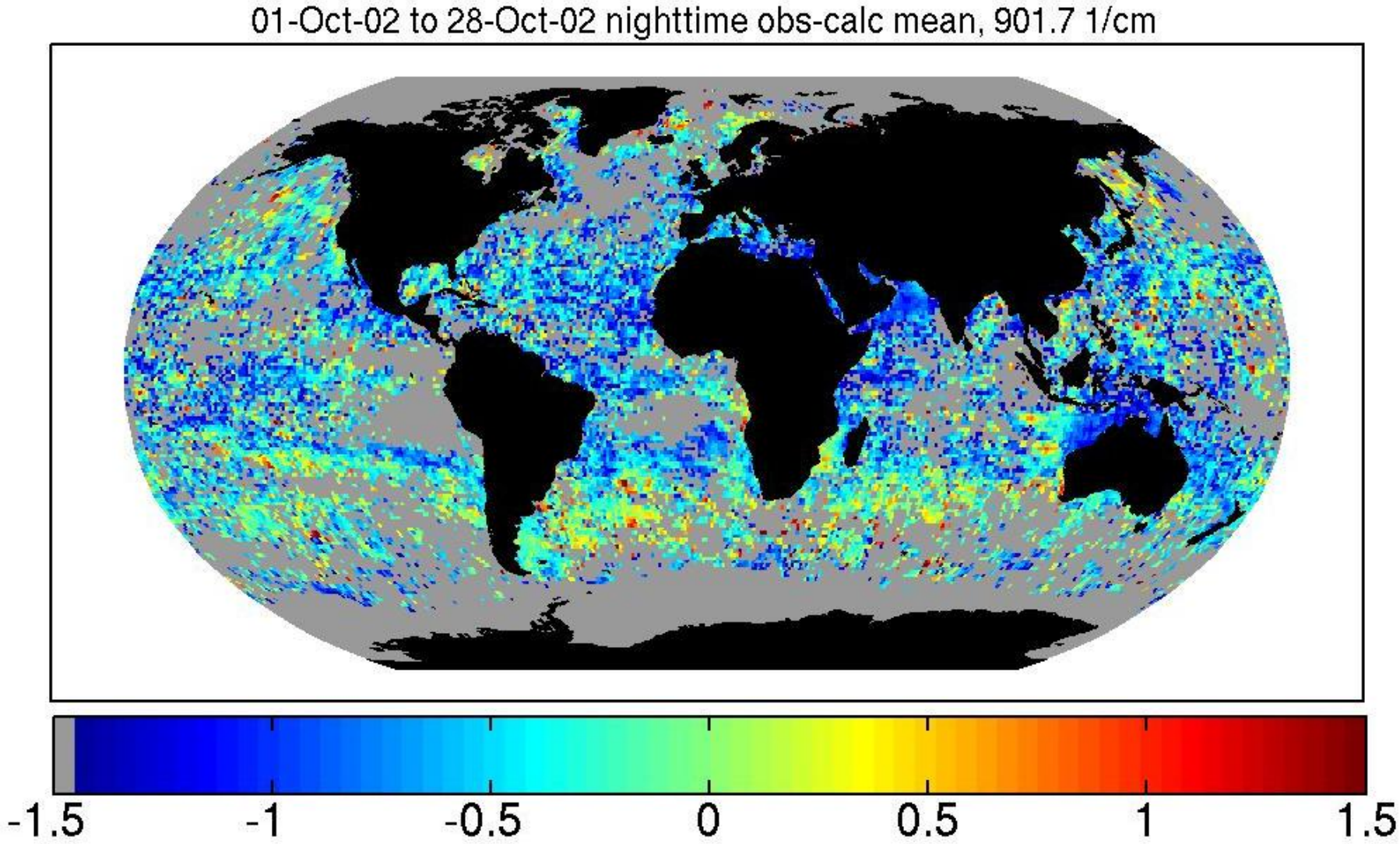


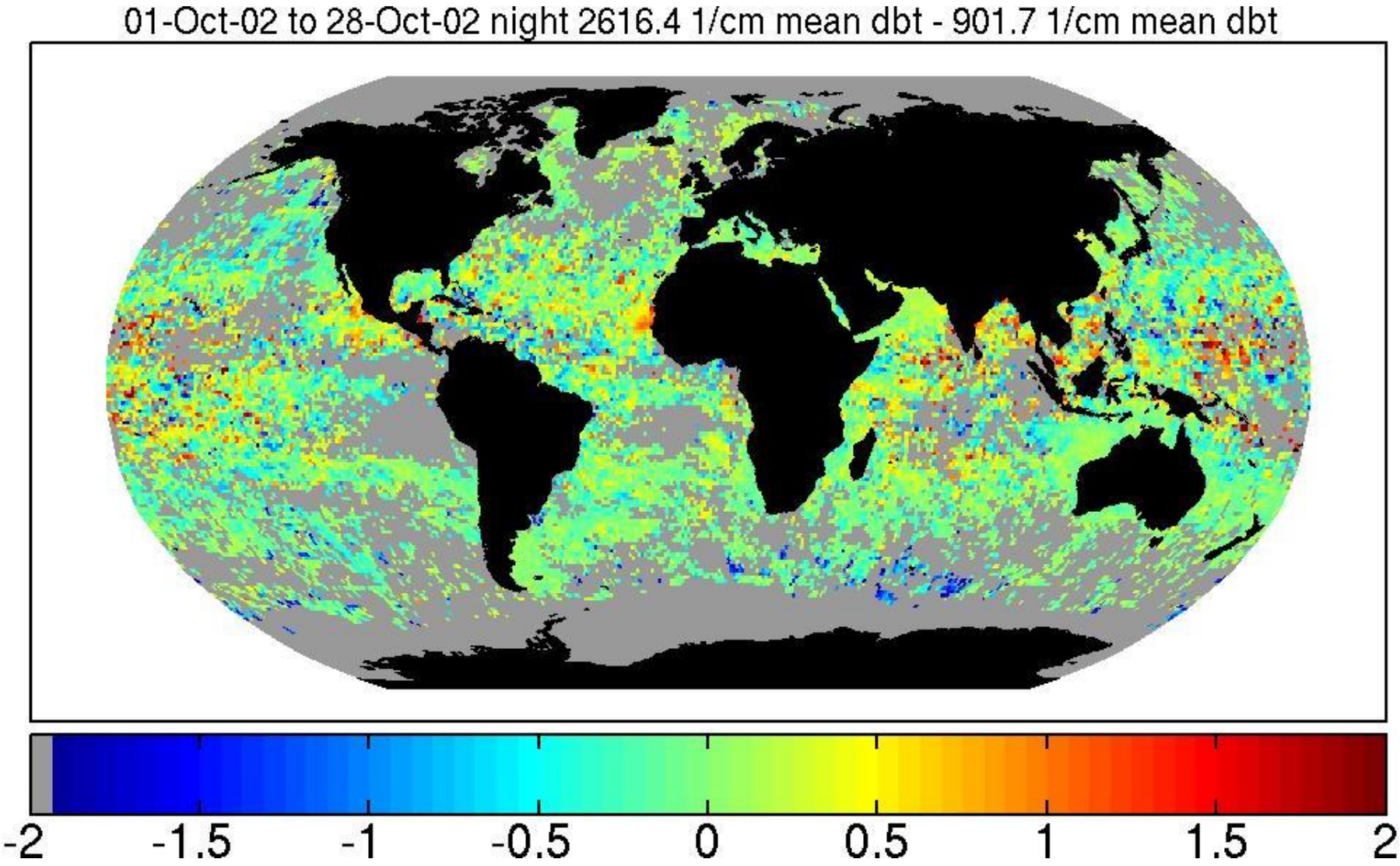
Possible Approach

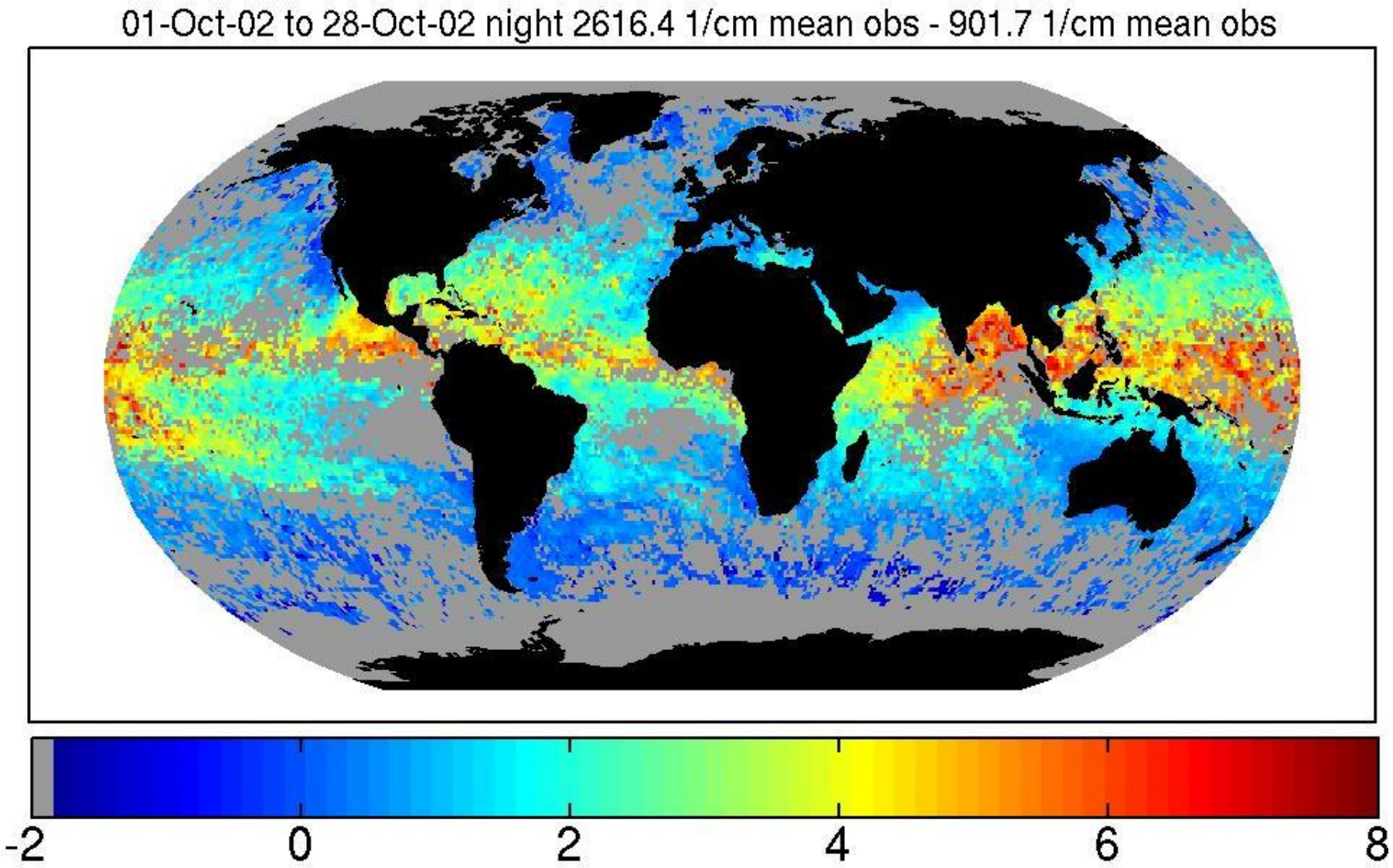
- How global are these biases? How does their spatial distribution vary with channel? (See next few slides.)
- Biases in channels dominated by CO_2 and H_2O atmospheric emission are small enough that they are plausibly due to spectroscopic uncertainties.
- Biases in channels in channels dominated by surface emission appear to be caused by some unknown absorber/scatterer
- No work yet done to determine if these results are true over land
- As a test, we plan to remove biases derived from ECMWF secant(θ) results coupled with biases versus ECMWF SST in the forward model. We will implement a “mystery gas transmittance” that is dependent on the SST.

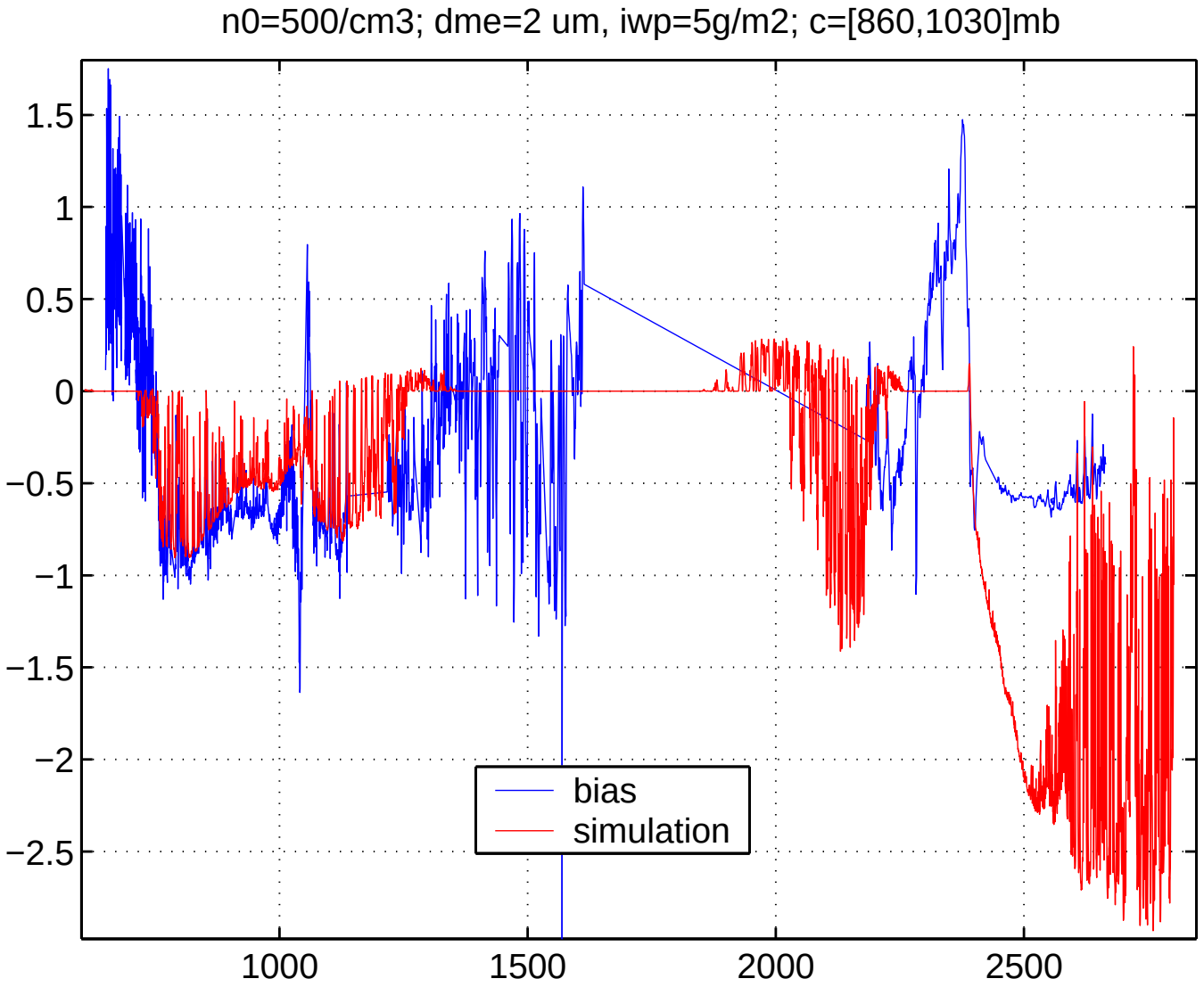

01-Oct-02 to 28-Oct-02 nighttime obs-calc mean, 1598.5 1/cm
-4
-2
0
2
4
6

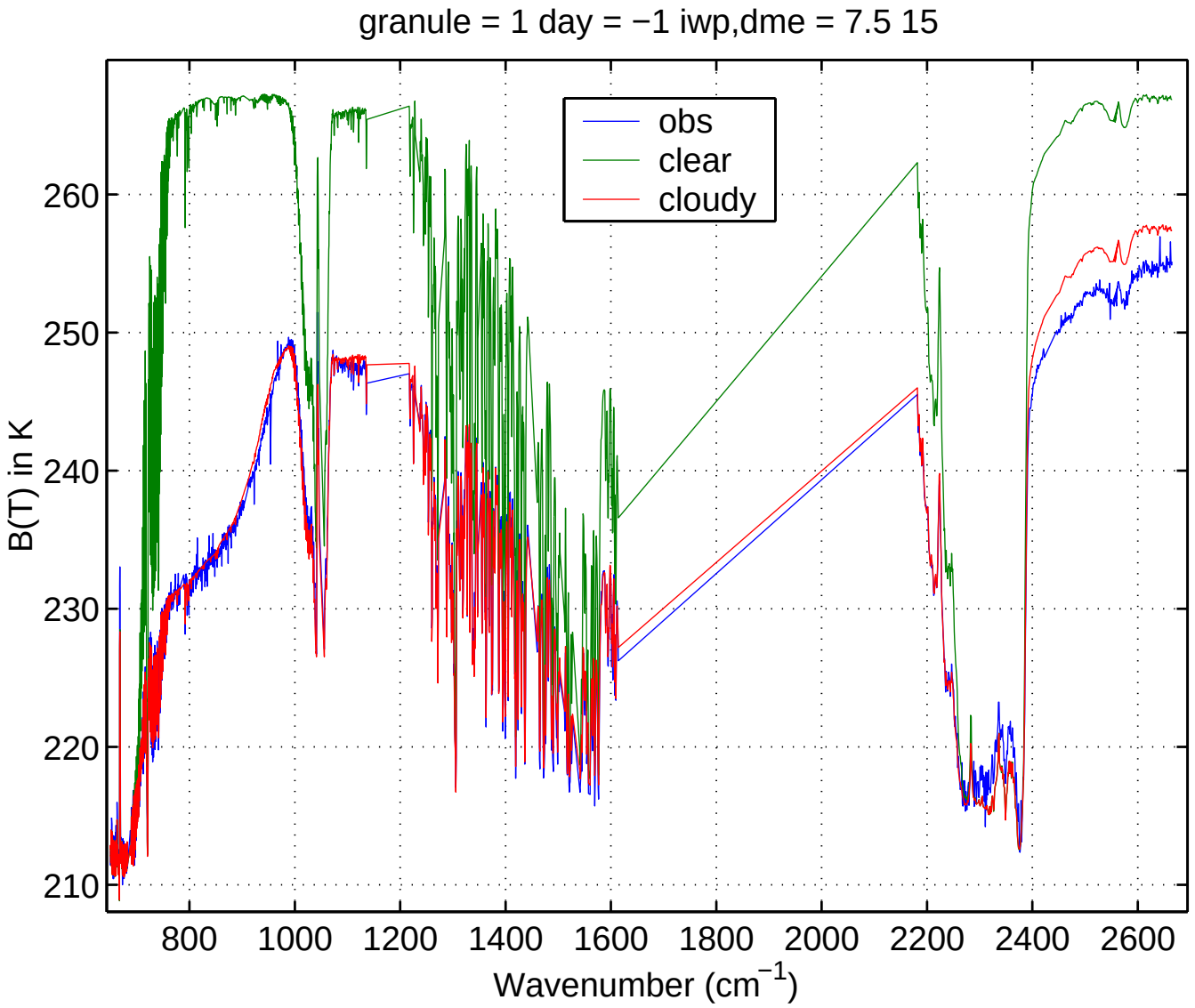

01-Oct-02 to 28-Oct-02 nighttime obs-calc mean, 2616.4 1/cm
-1.5
-1
-0.5
0
0.5
1
1.5

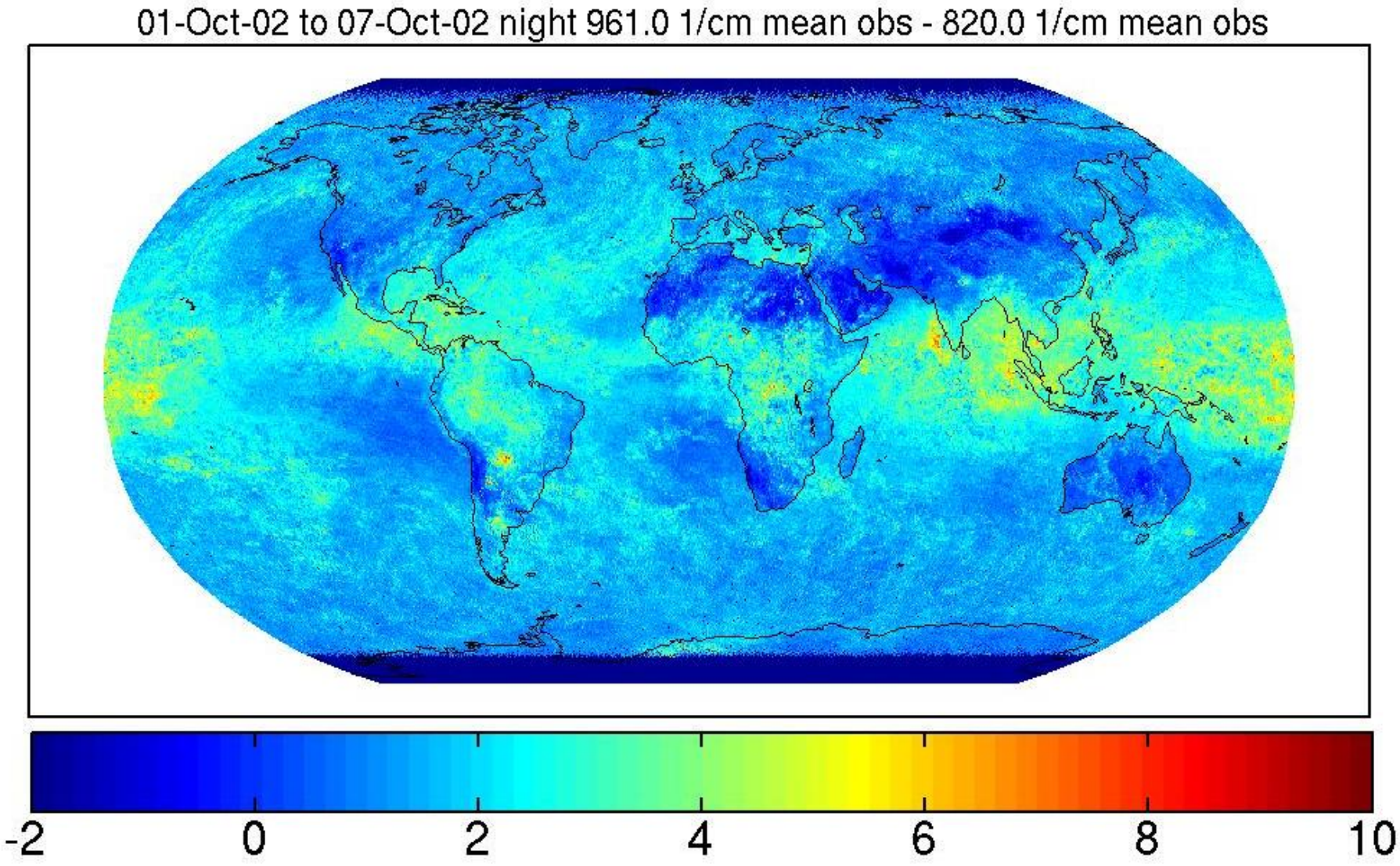

01-Oct-02 to 28-Oct-02 nighttime obs-calc mean, 901.7 1/cm
-1.5
-1
-0.5
0
0.5
1
1.5

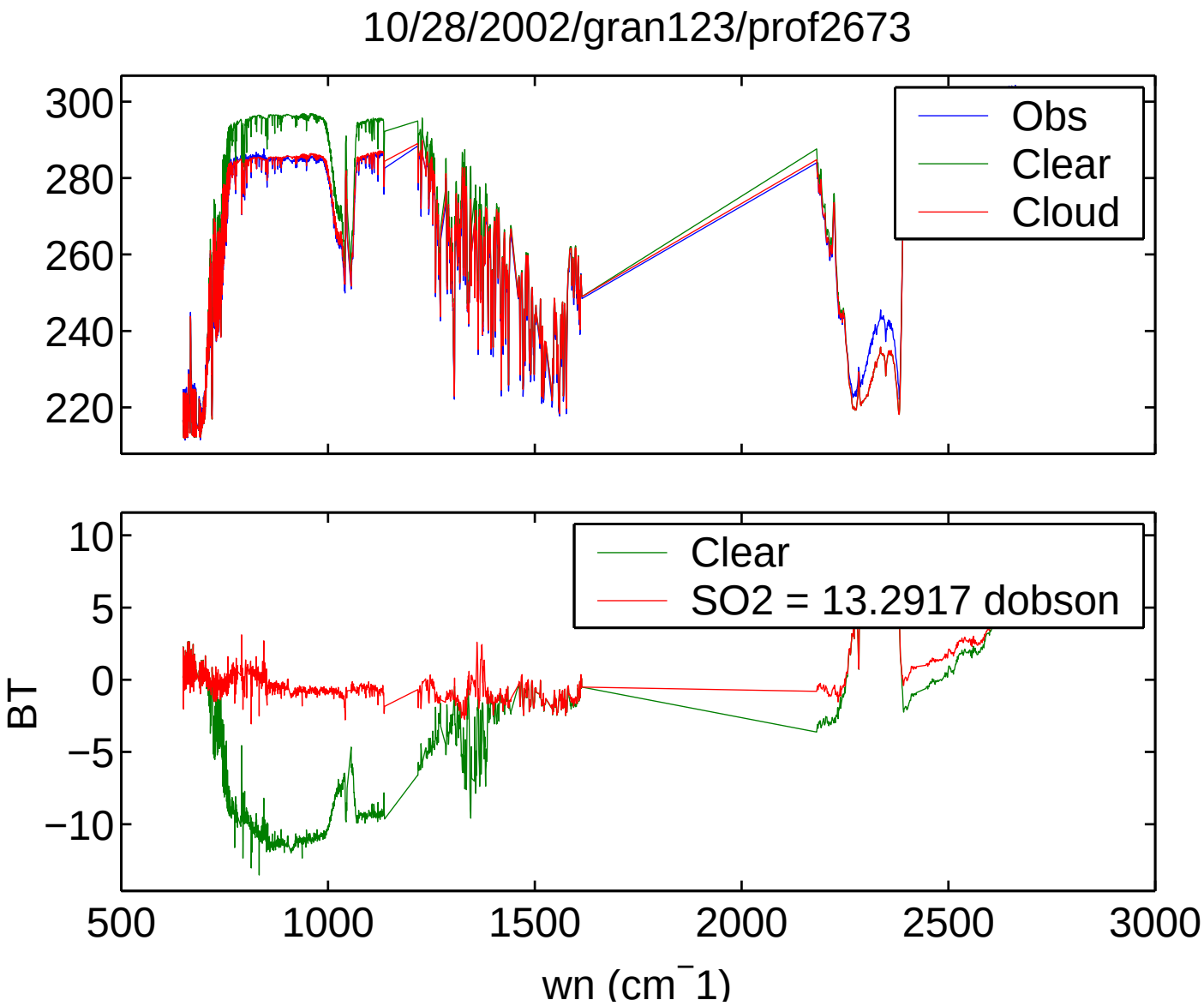

01-Oct-02 to 28-Oct-02 night 2616.4 1/cm mean dbt - 901.7 1/cm mean dbt
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2

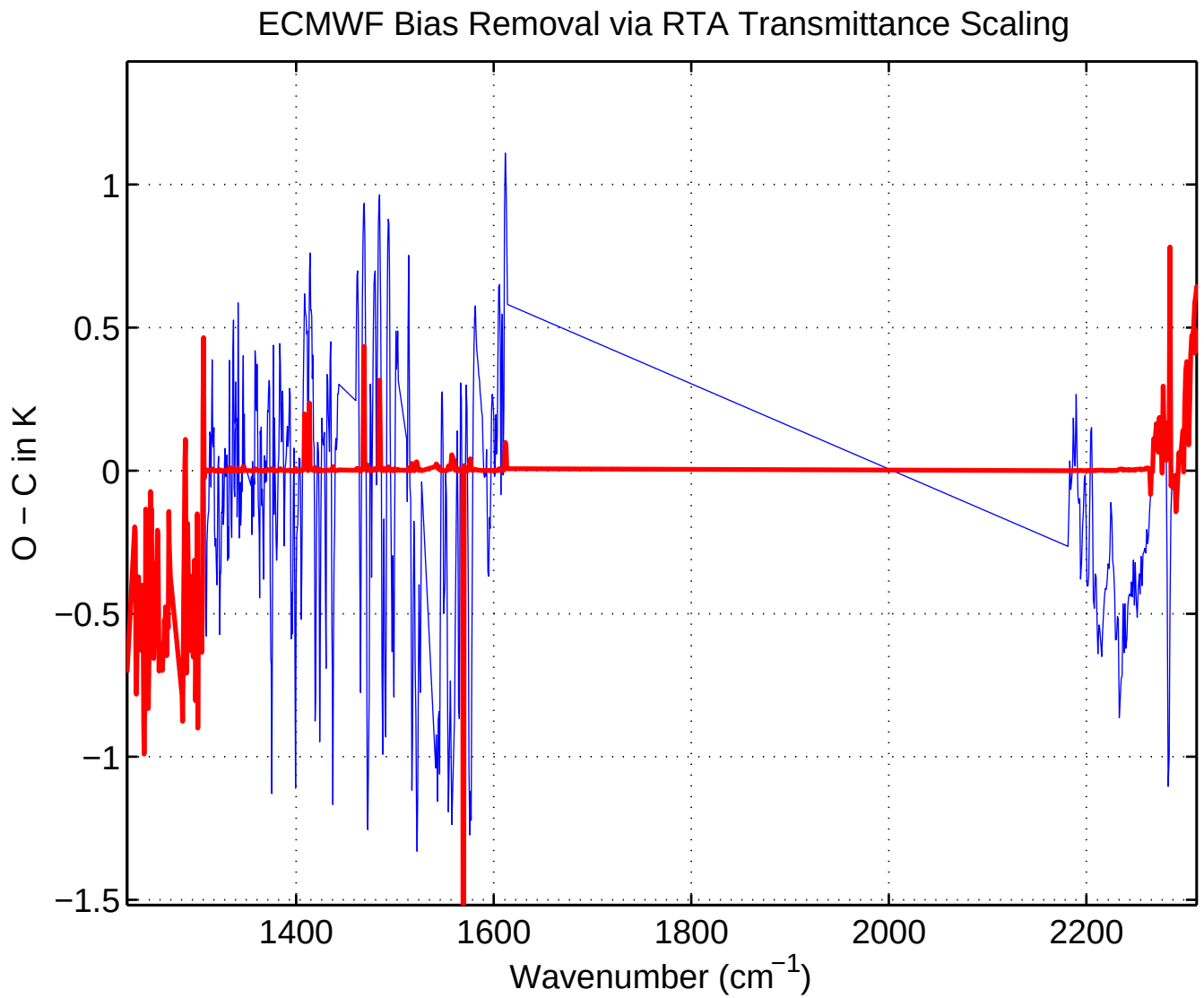

01-Oct-02 to 28-Oct-02 night 2616.4 1/cm mean obs - 901.7 1/cm mean obs
-2
0
2
4
6
8


n0=500/cm3; dme=2 um, iwp=5g/m2; c=[860,1030]mb
1.5
1
0.5
0
−0.5
−1
−1.5
−2
−2.5
1000
1500
2000
2500
bias
simulation

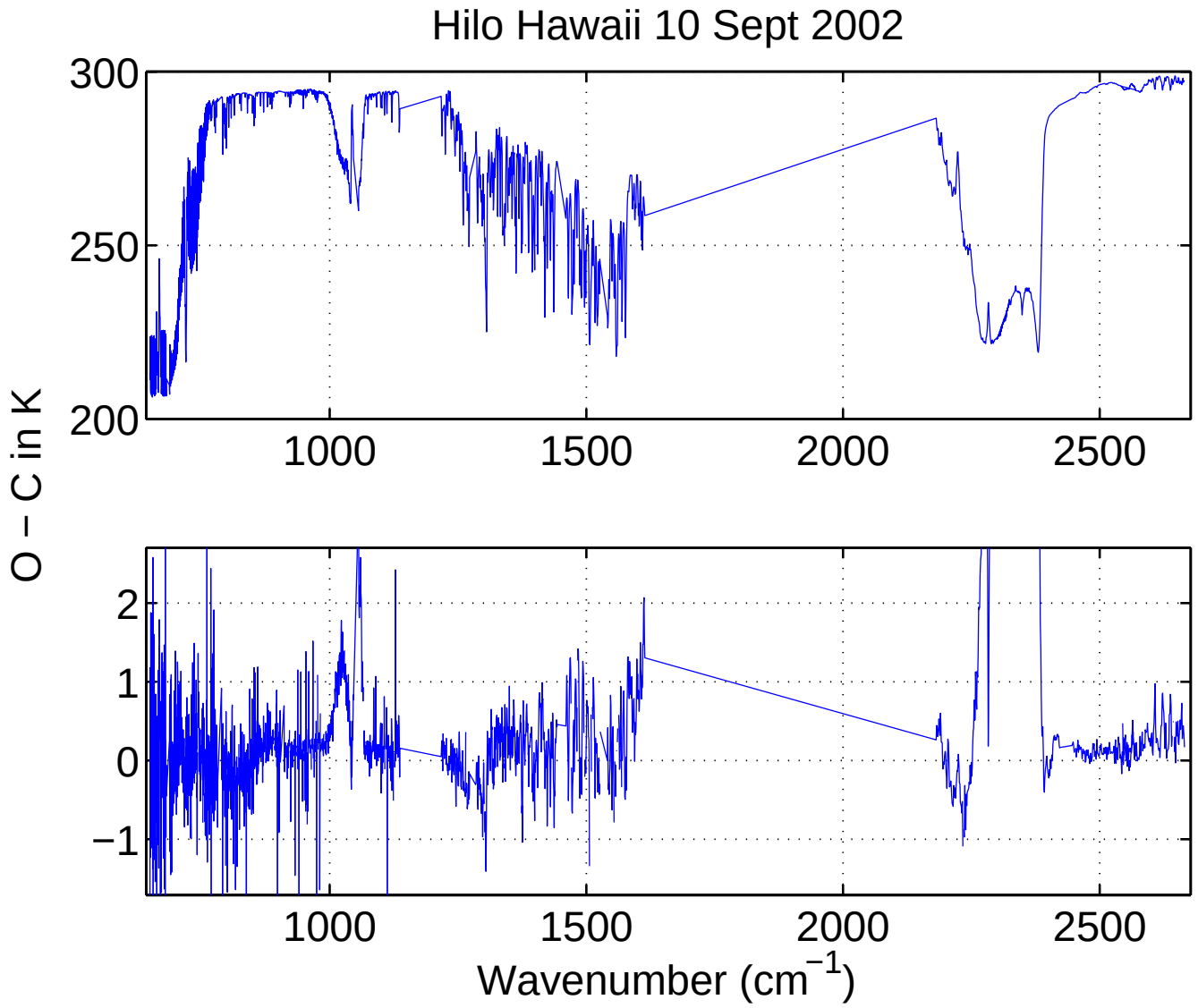

granule = 1 day = −1 iwp,dme = 7.5 15
obs
clear
cloudy
B(T) in K
210
220
230
240
250
260
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
Wavenumber (cm^{-1})

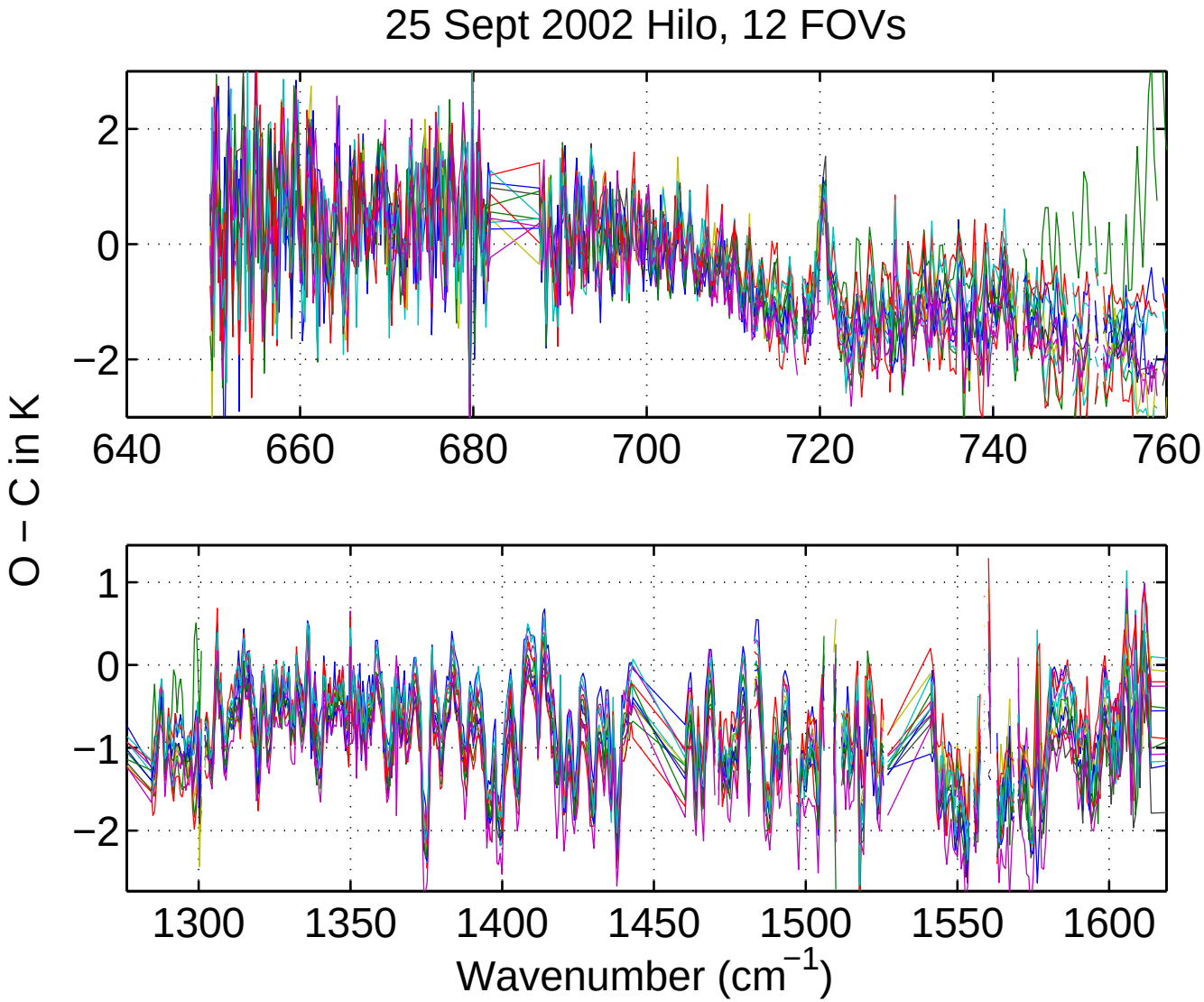

01-Oct-02 to 07-Oct-02 night 961.0 1/cm mean obs - 820.0 1/cm mean obs
-2
0
2
4
6
8
10

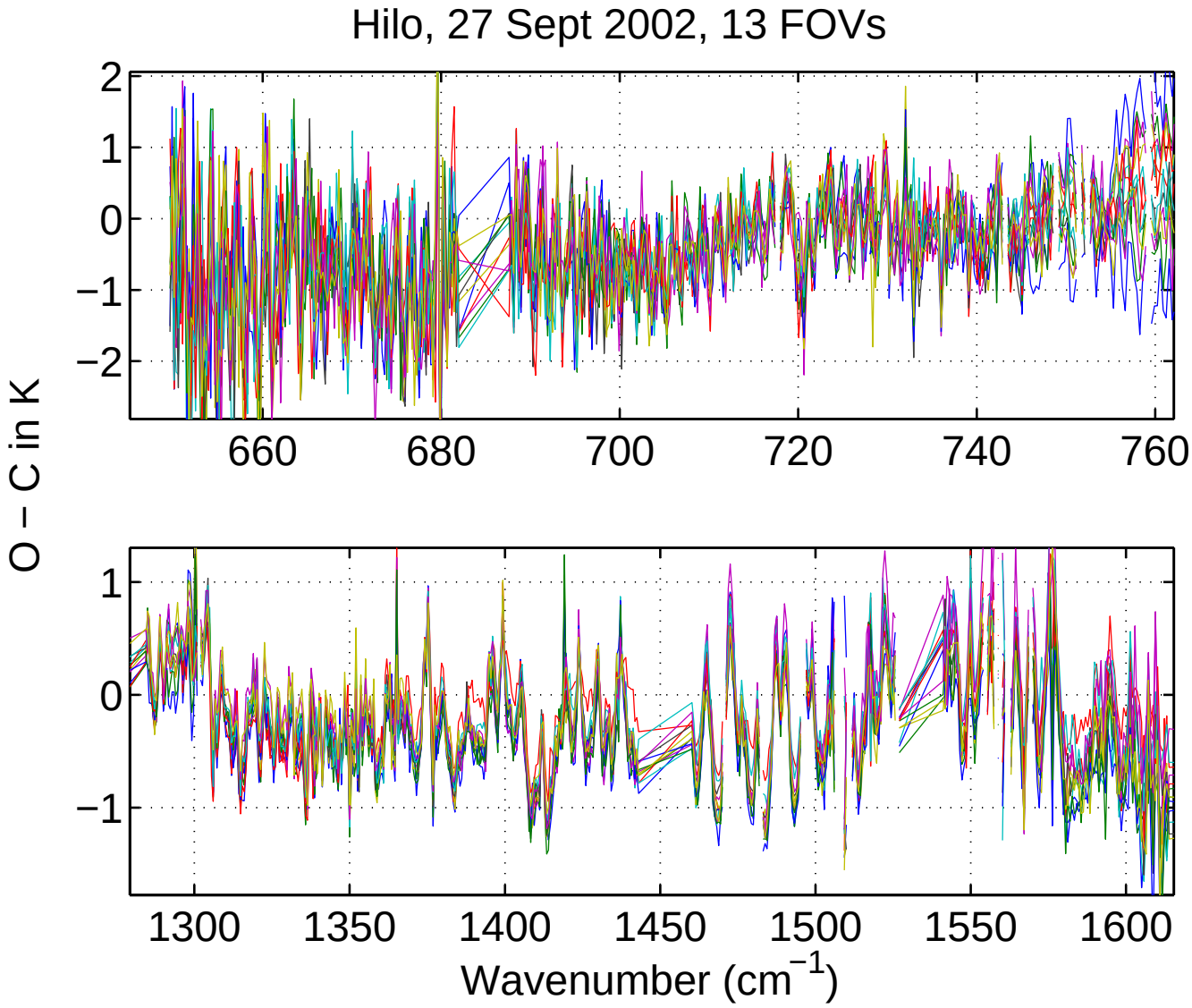

10/28/2002/gran123/prof2673
300
280
260
240
220
Obs
Clear
Cloud
10
5
0
−5
−10
BT
Clear
SO2 = 13.2917 dobson
500
1000
1500
2000
2500
3000
wn (cm¯1)

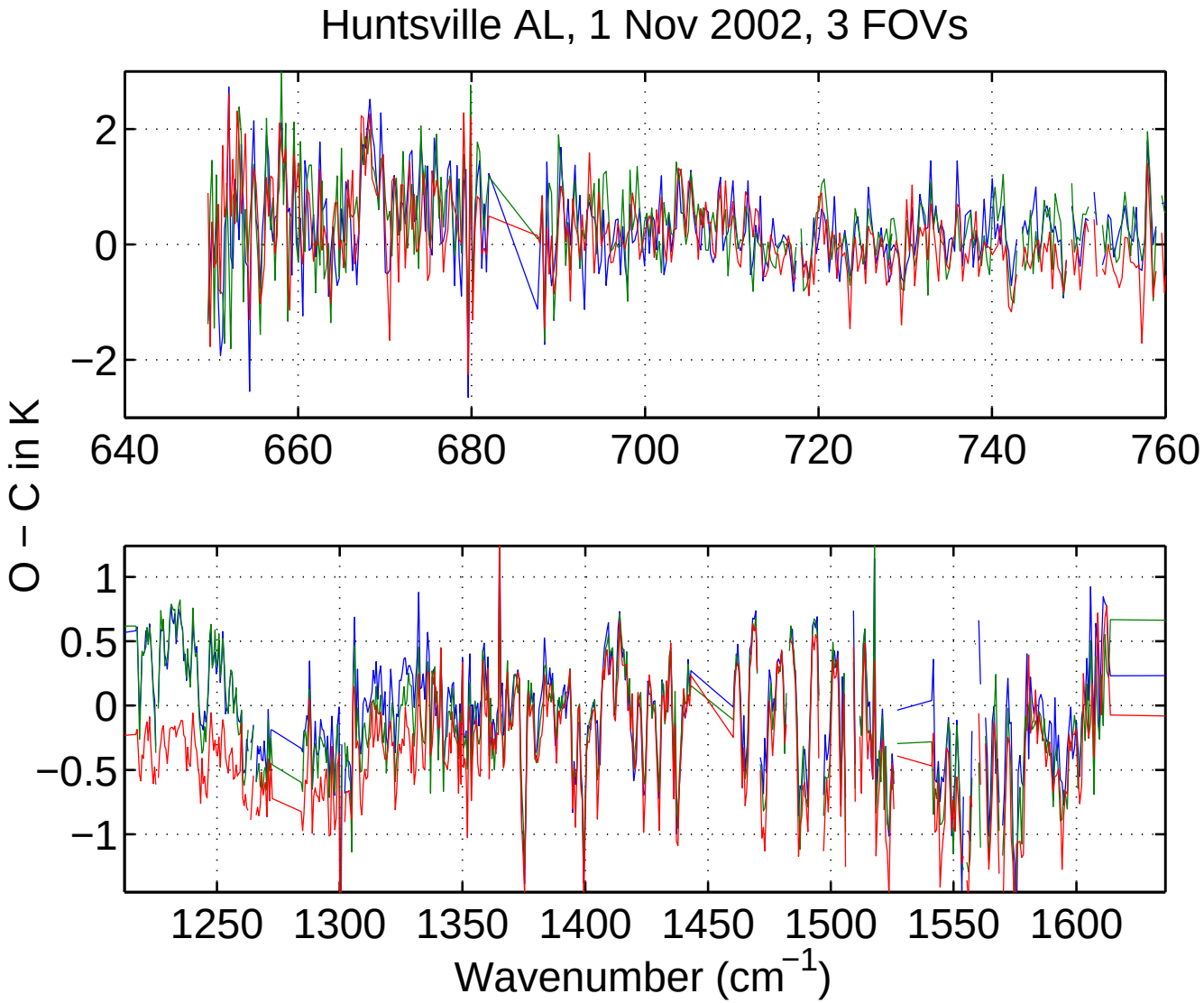

ECMWF Bias Removal via RTA Transmittance Scaling
O – C in K
1
0.5
0
−0.5
−1
−1.5
1400
1600
1800
2000
2200
Wavenumber (cm^{-1})

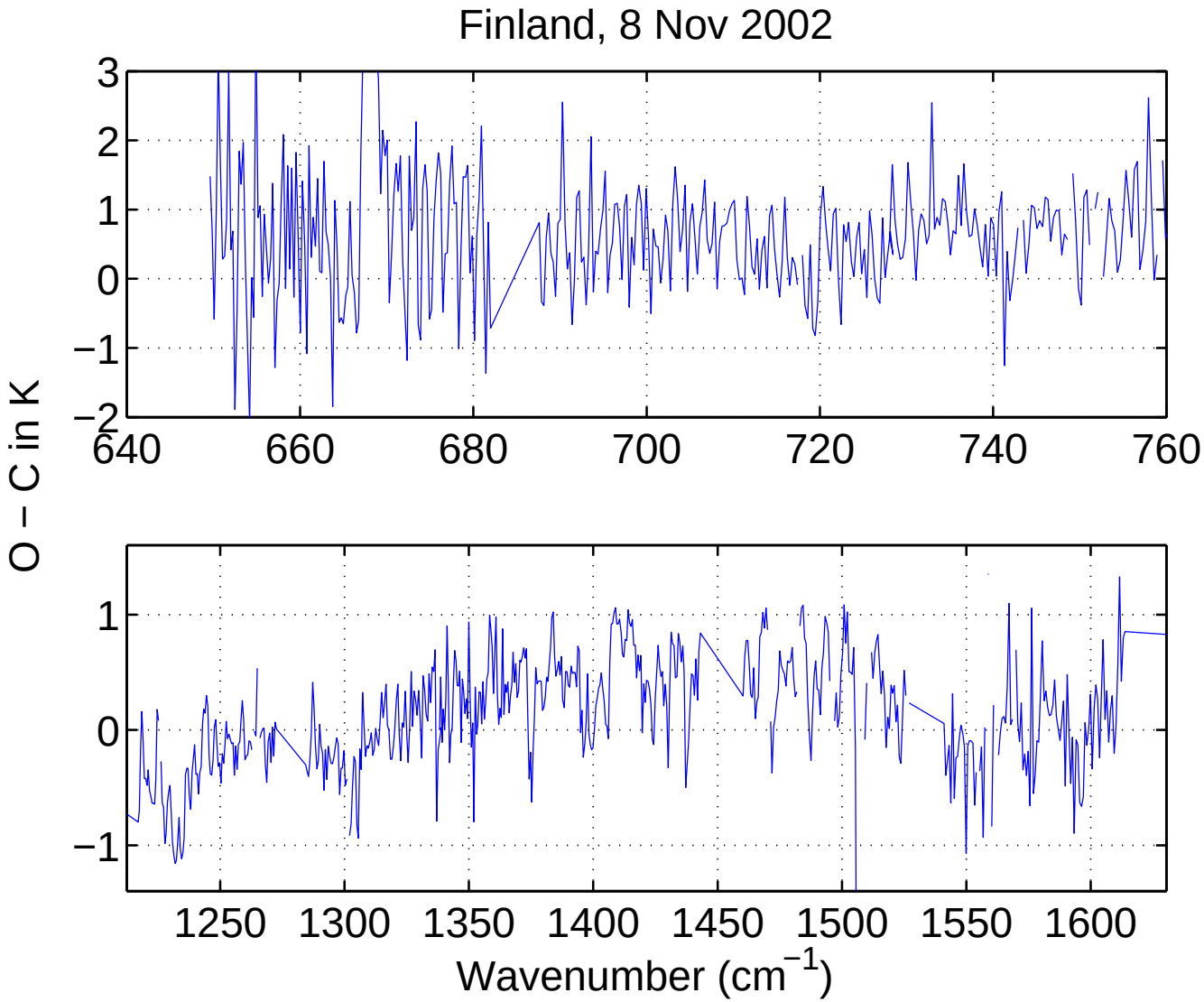
Voemel Early Results


Hilo Hawaii 10 Sept 2002
O – C in K
300
250
200
1000
1500
2000
2500
2
1
0
−1
Wavenumber (cm^{-1})

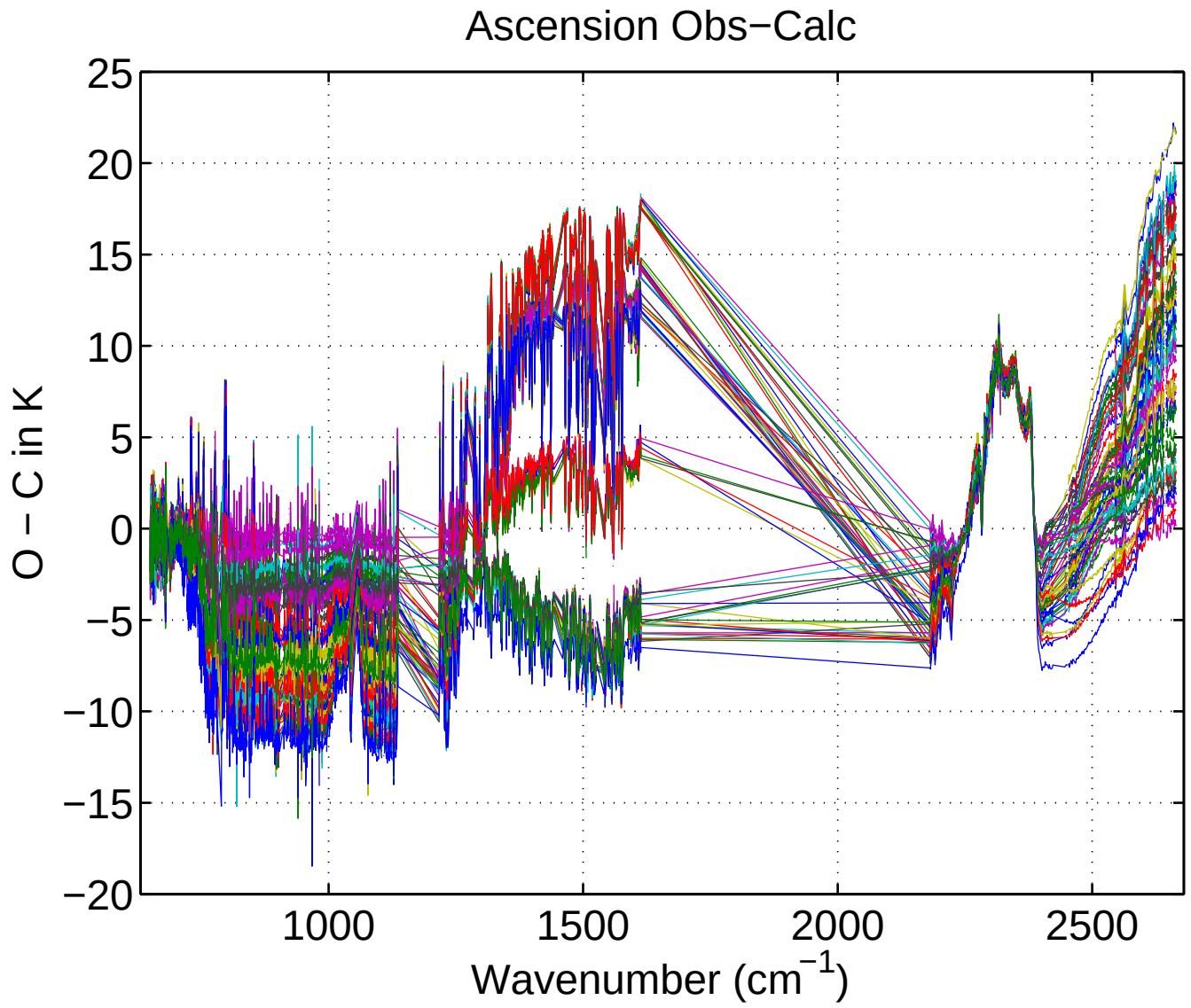

25 Sept 2002 Hilo, 12 FOVs
O – C in K
2
0
−2
640
660
680
700
720
740
760
1
0
−1
−2
1300
1350
1400
1450
1500
1550
1600
Wavenumber (cm^{-1})

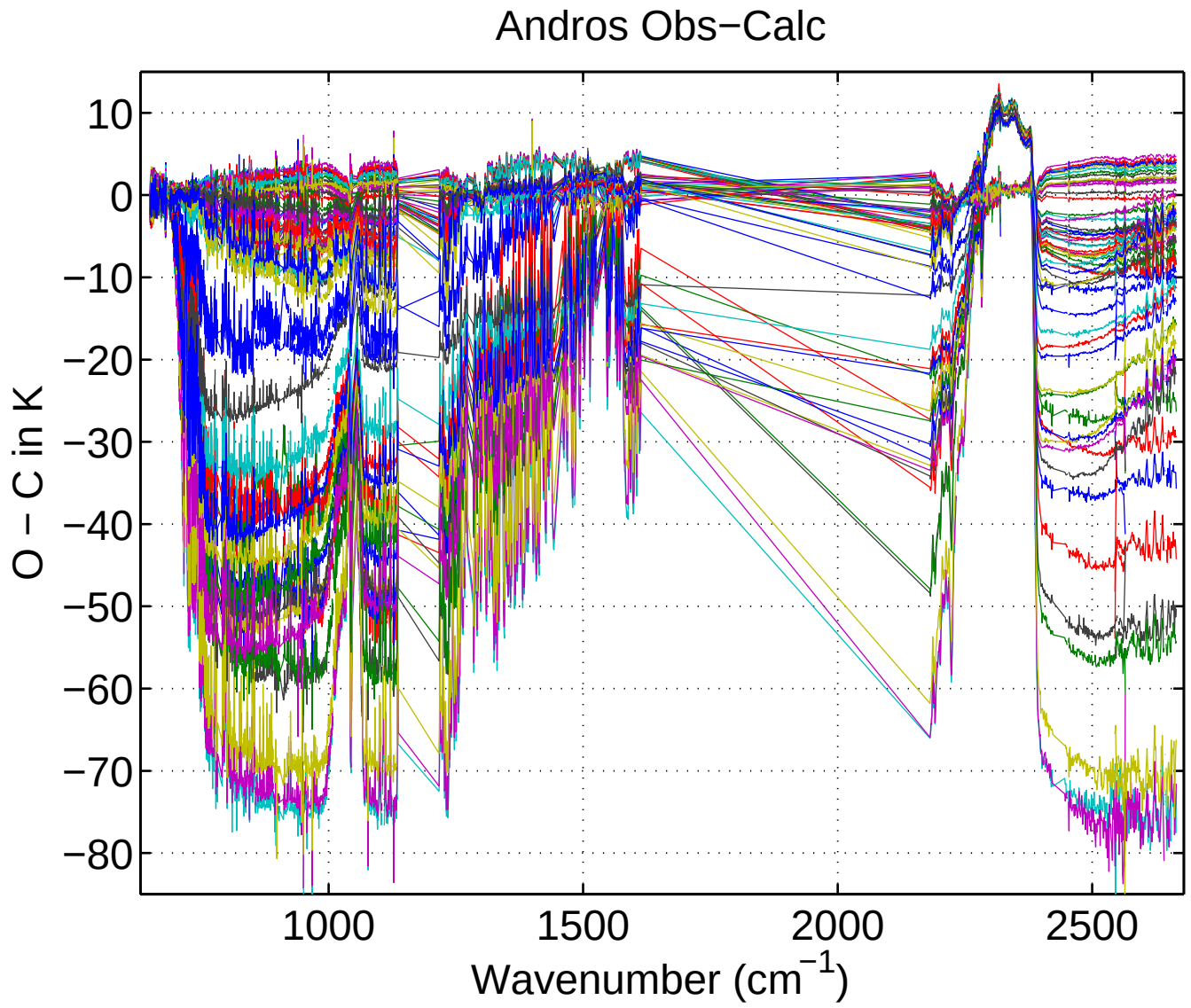

Hilo, 27 Sept 2002, 13 FOVs
O – C in K
2
1
0
−1
−2
660
680
700
720
740
760
1
0
−1
1300
1350
1400
1450
1500
1550
1600
Wavenumber (cm^{-1})

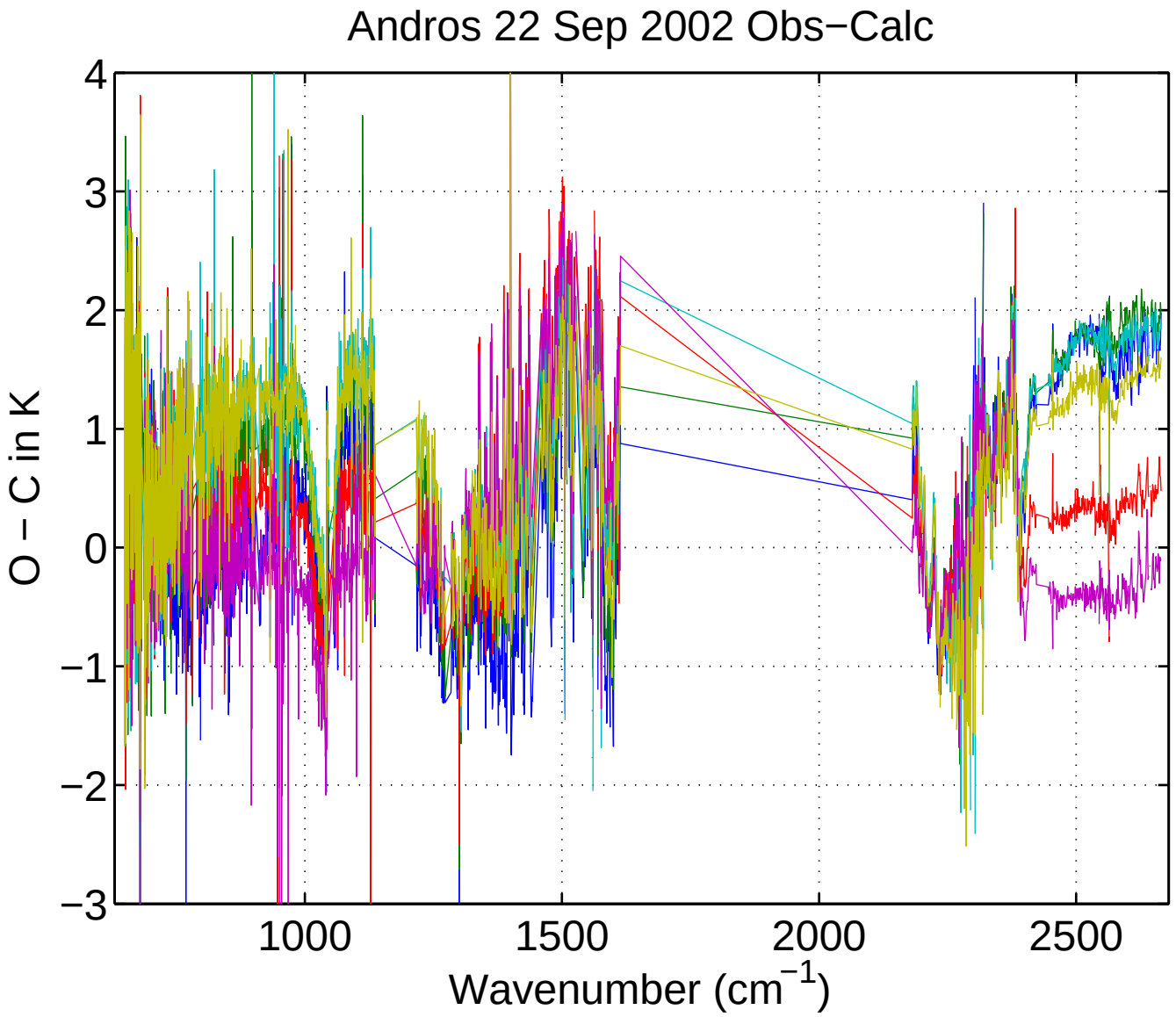

Huntsville AL, 1 Nov 2002, 3 FOVs
O – C in K
2
0
−2
640
660
680
700
720
740
760
1
0.5
0
−0.5
−1
1250
1300
1350
1400
1450
1500
1550
1600
Wavenumber (cm^{-1})

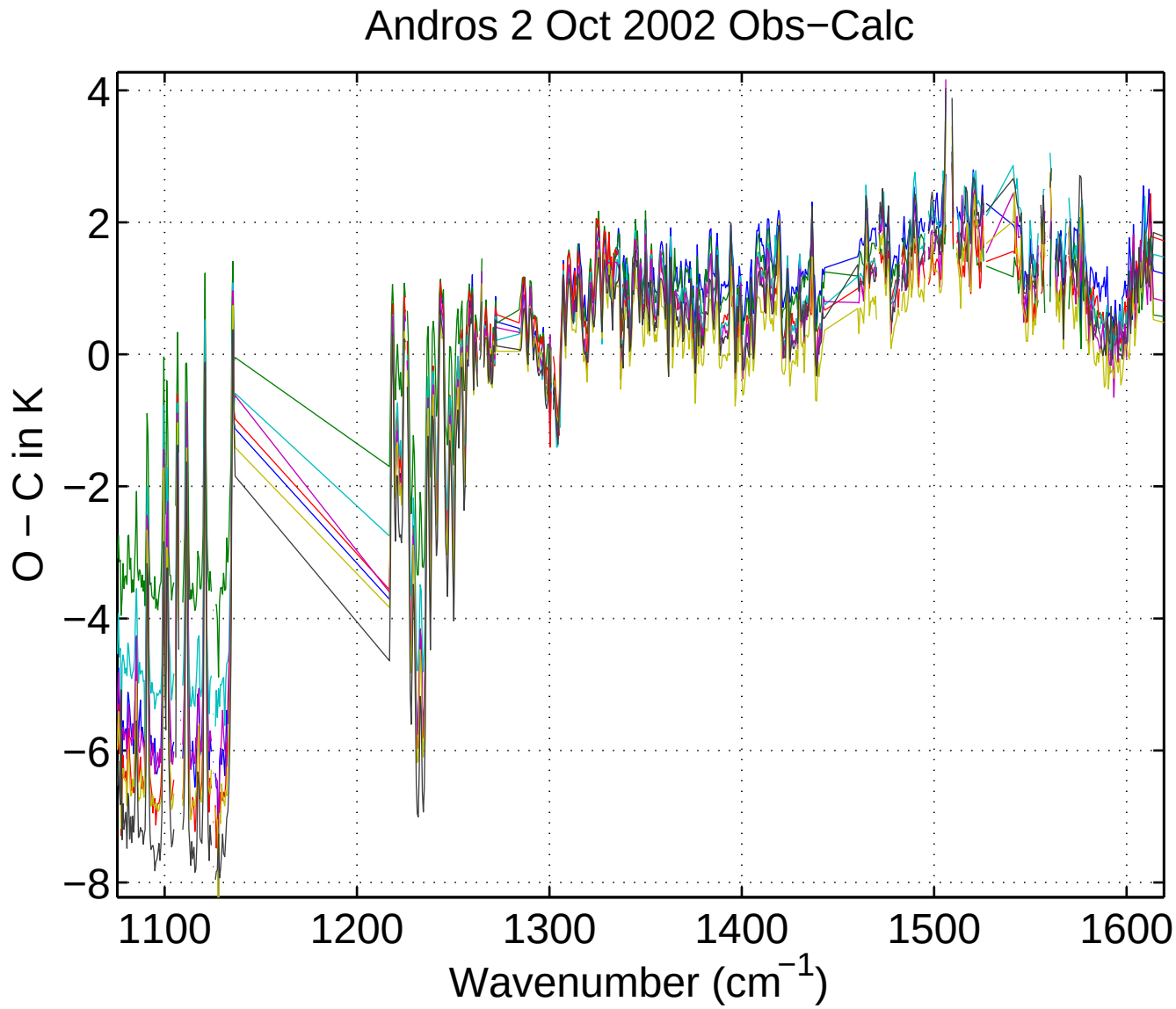

Finland, 8 Nov 2002
O – C in K
3
2
1
0
−1
−2
640
660
680
700
720
740
760
1
0
−1
1250
1300
1350
1400
1450
1500
1550
1600
Wavenumber (cm^{-1})

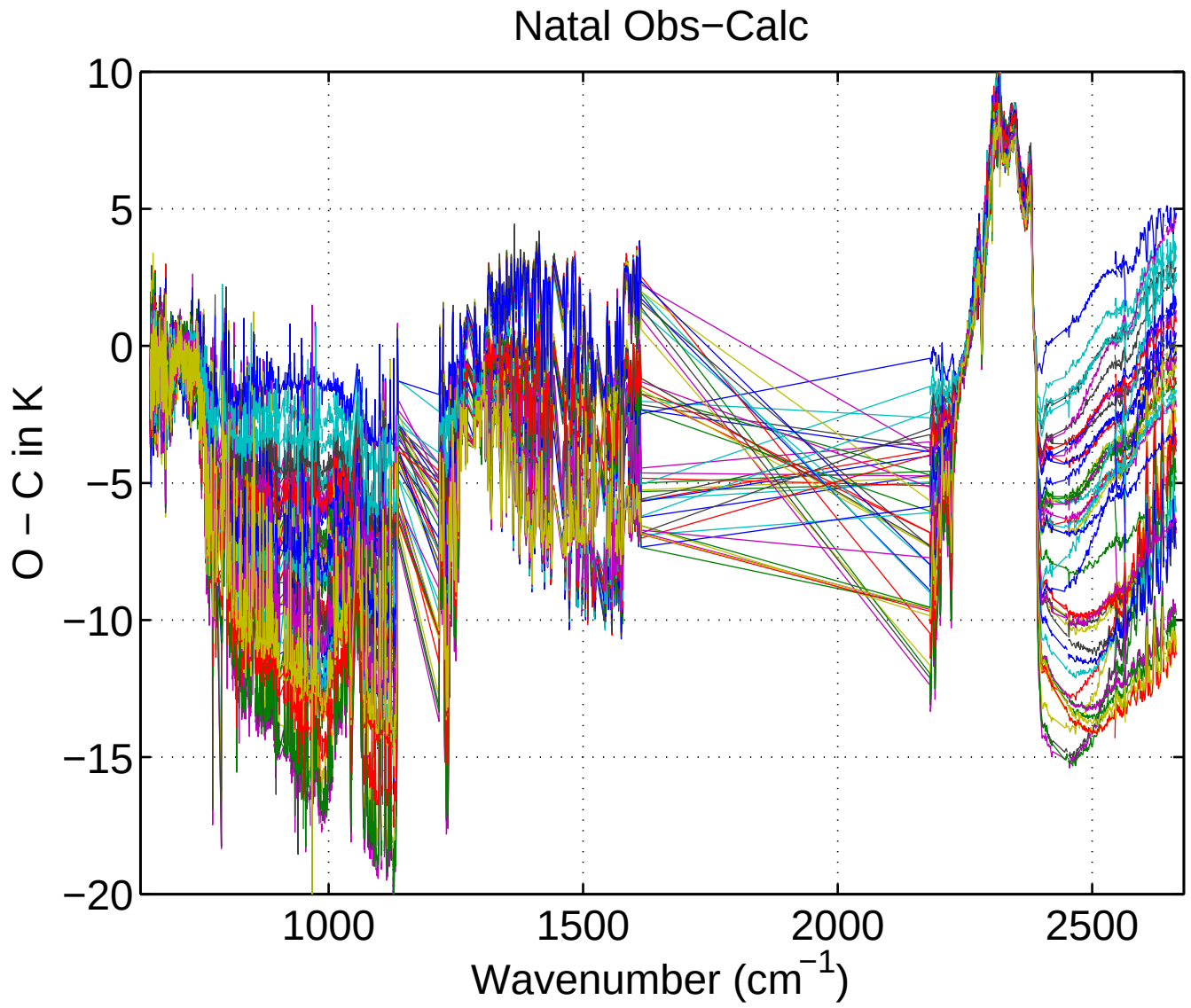
Schmidlin Early Results

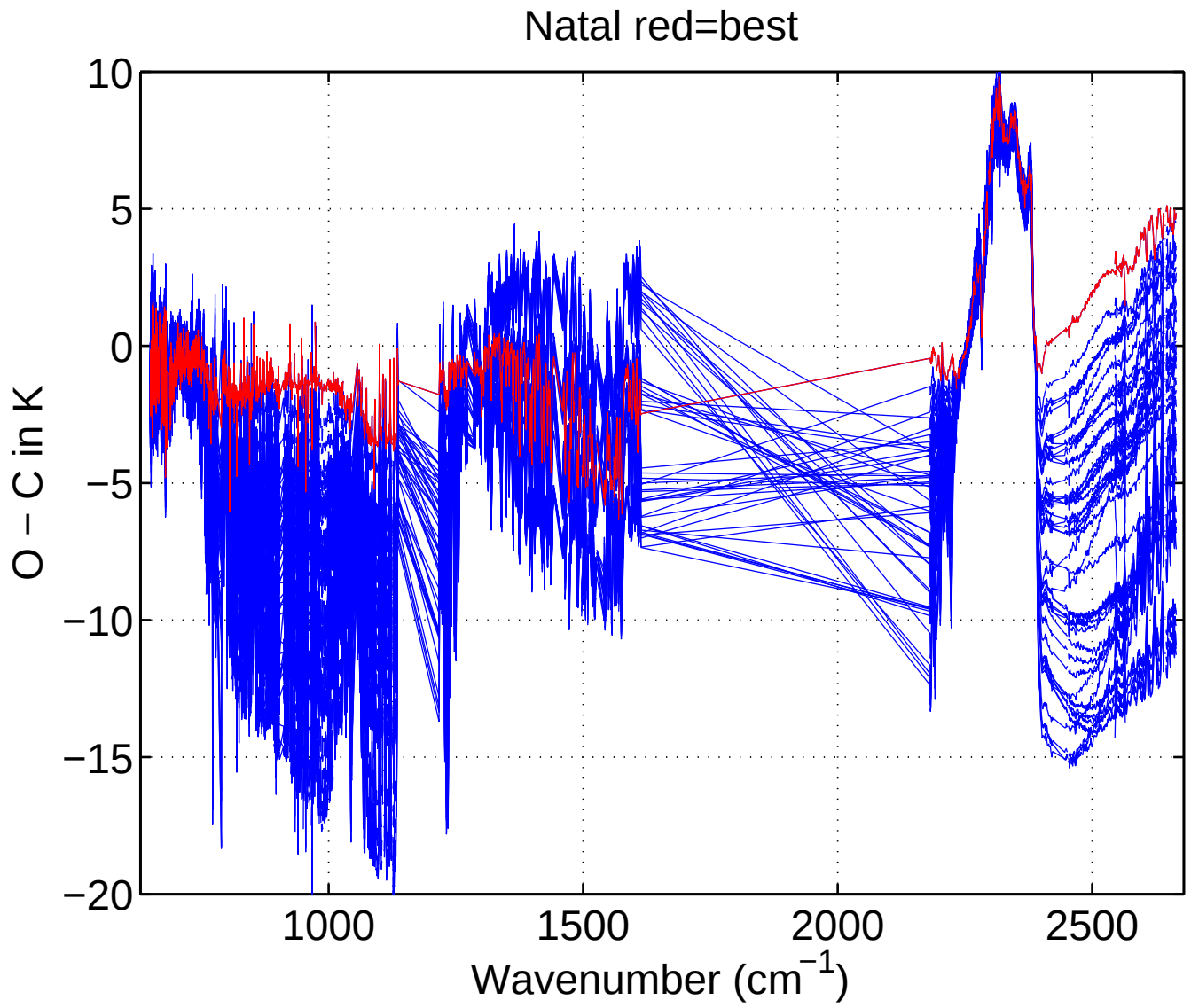

Ascension Obs−Calc
O − C in K
25
20
15
10
5
0
−5
−10
−15
−20
1000
1500
2000
2500
Wavenumber (cm^{-1})

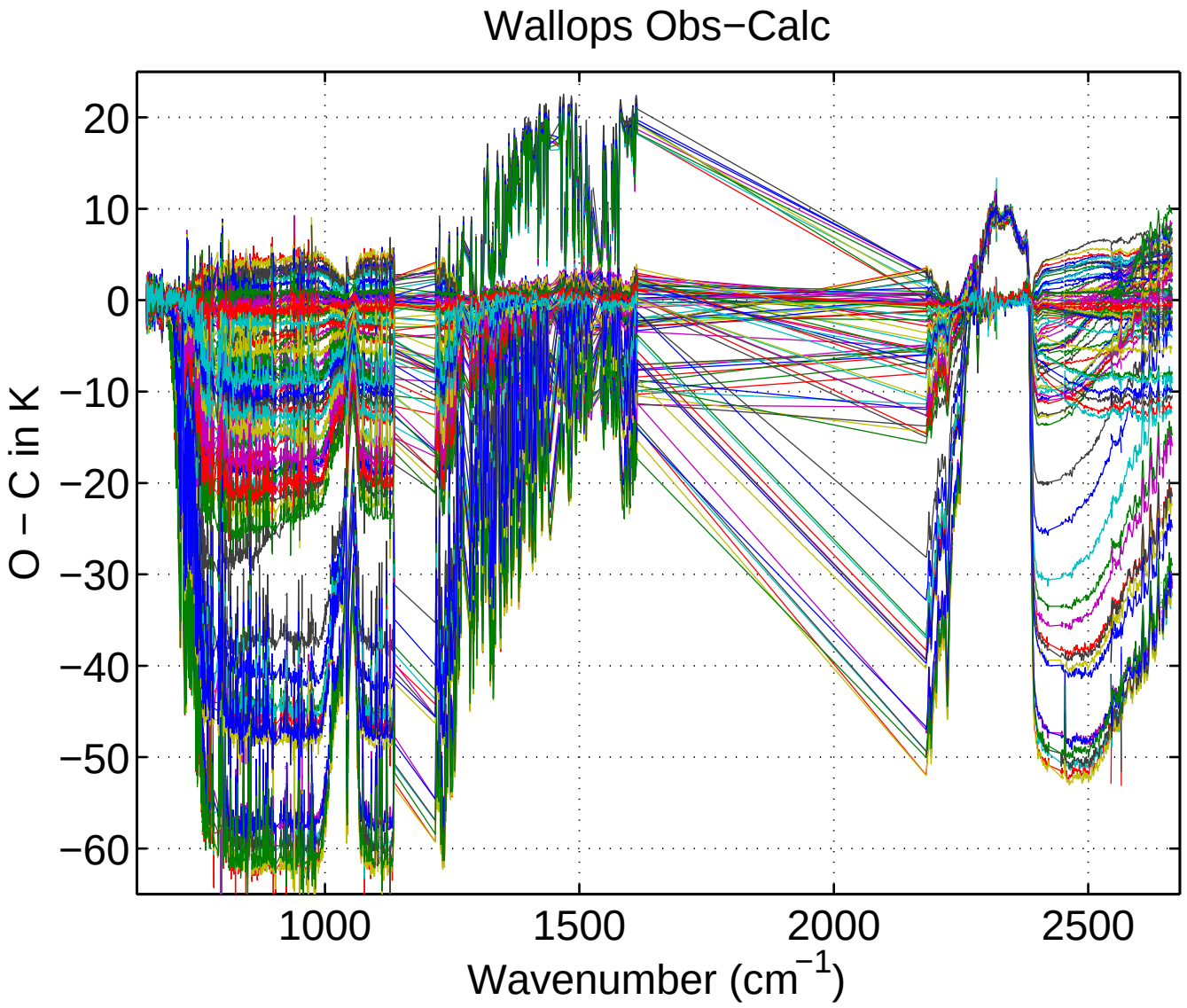

Andros Obs−Calc
10
0
−10
−20
−30
−40
−50
−60
−70
−80
O − C in K
1000
1500
2000
2500
Wavenumber (cm^{-1})

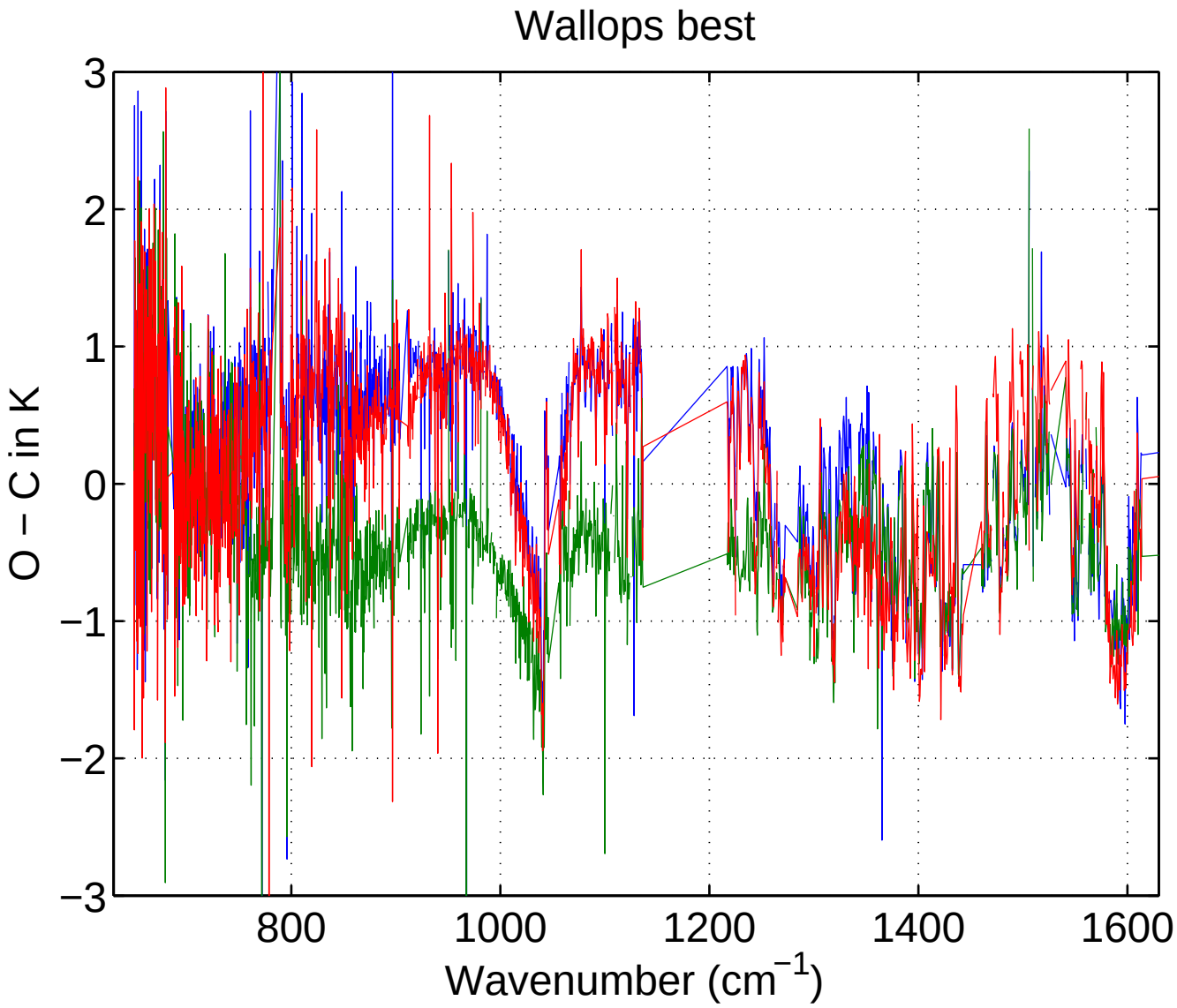

Andros 22 Sep 2002 Obs−Calc
O − C in K
4
3
2
1
0
−1
−2
−3
1000
1500
2000
2500
Wavenumber (cm^{-1})


Andros 2 Oct 2002 Obs−Calc
O − C in K
4
2
0
−2
−4
−6
−8
1100
1200
1300
1400
1500
1600
Wavenumber (cm^{-1})


Natal Obs−Calc
10
5
0
−5
−10
−15
−20
O − C in K
1000
1500
2000
2500
Wavenumber (cm^{-1})


Natal red=best
10
5
0
−5
−10
−15
−20
O – C in K
1000
1500
2000
2500
Wavenumber (cm^{-1})


Wallops Obs−Calc
O − C in K
20
10
0
−10
−20
−30
−40
−50
−60
1000
1500
2000
2500
Wavenumber (cm^{-1})


Wallops best
O – C in K
3
2
1
0
−1
−2
−3
800
1000
1200
1400
1600
Wavenumber (cm^{-1})

Conclusions

- Implement bias correction in the RTA, since these appear to be transmittance errors.
- A lot of work remains to fully evaluate the special sonde data and lidar data as a whole. We have also just received many new ARM matchups. If these data agree with ECMWF biases versus secant(θ) we may be in good shape - for atmospheric channels.
- Continue to look for candidates for low altitude biases. These could arise from a combination of factors, so may be hard to figure out.