Recent Upgrades To The Collection 5 MODIS Near-IR Water Vapor Algorithm And Cirrus Reflectance Algorithm

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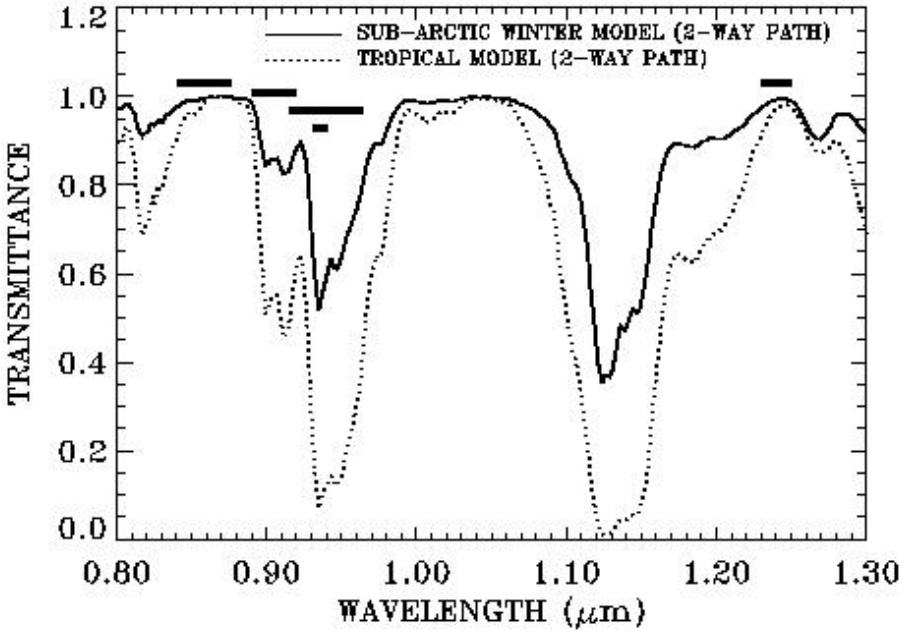
OUTLINE

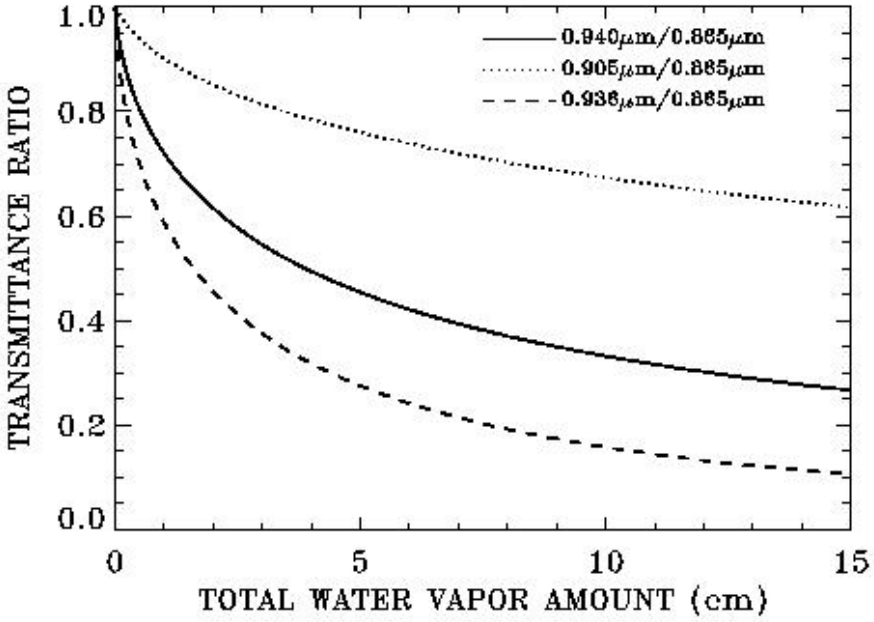
- I will first briefly describe the MODIS near-IR water vapor algorithm and the cirrus reflectance algorithm. Most of you are quite familiar with the subject. Only a few people new to the MODIS science team may not be so familiar.

- I will also report the recent upgrades to both the MODIS near-IR water vapor algorithm and the cirrus reflectance algorithm.

Approach (Water Vapor)

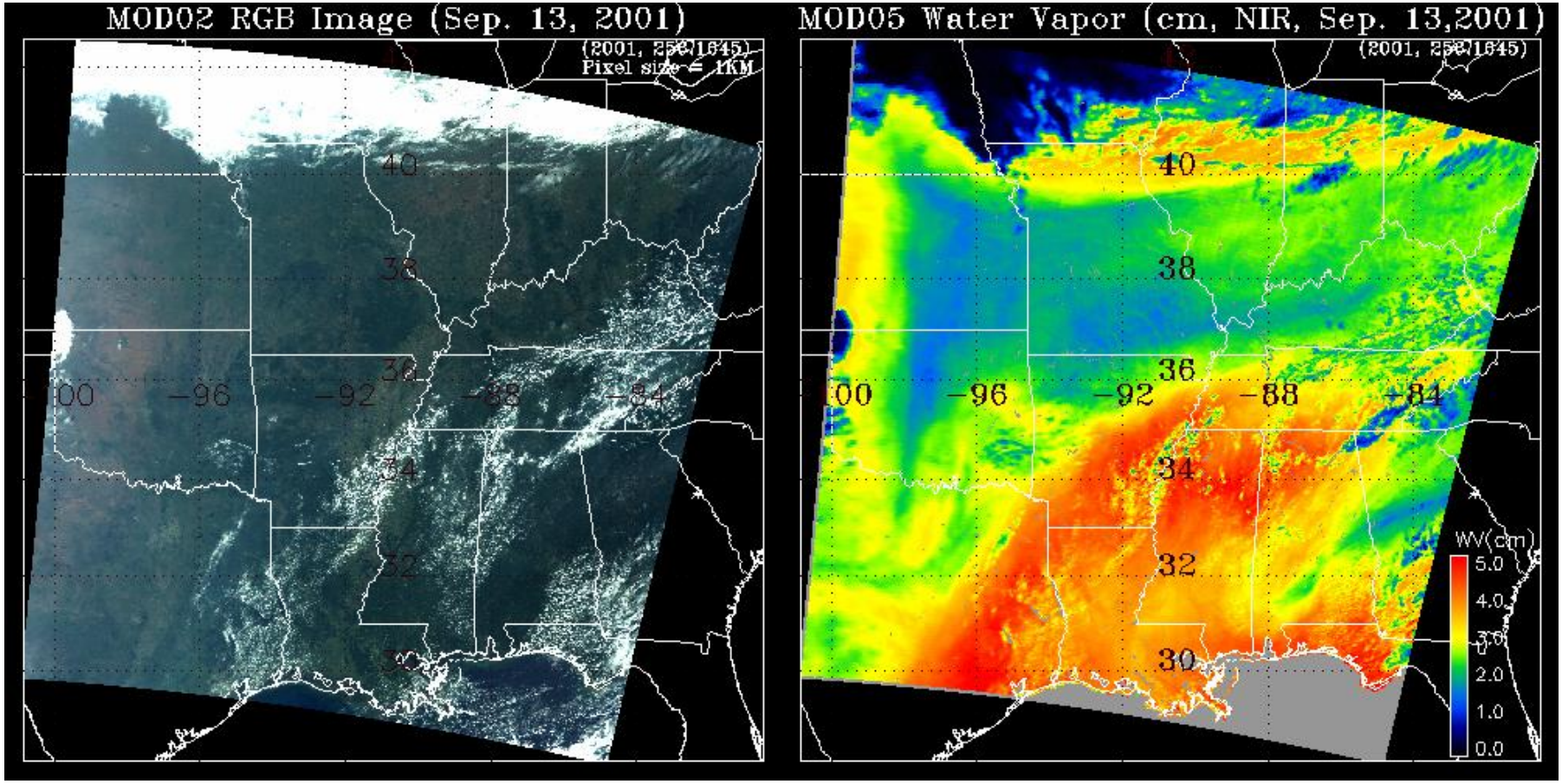


MODIS has 3 water vapor absorption channels near 0.94 micron, and 2 atmospheric window channels near 0.865 and 1.24 micron

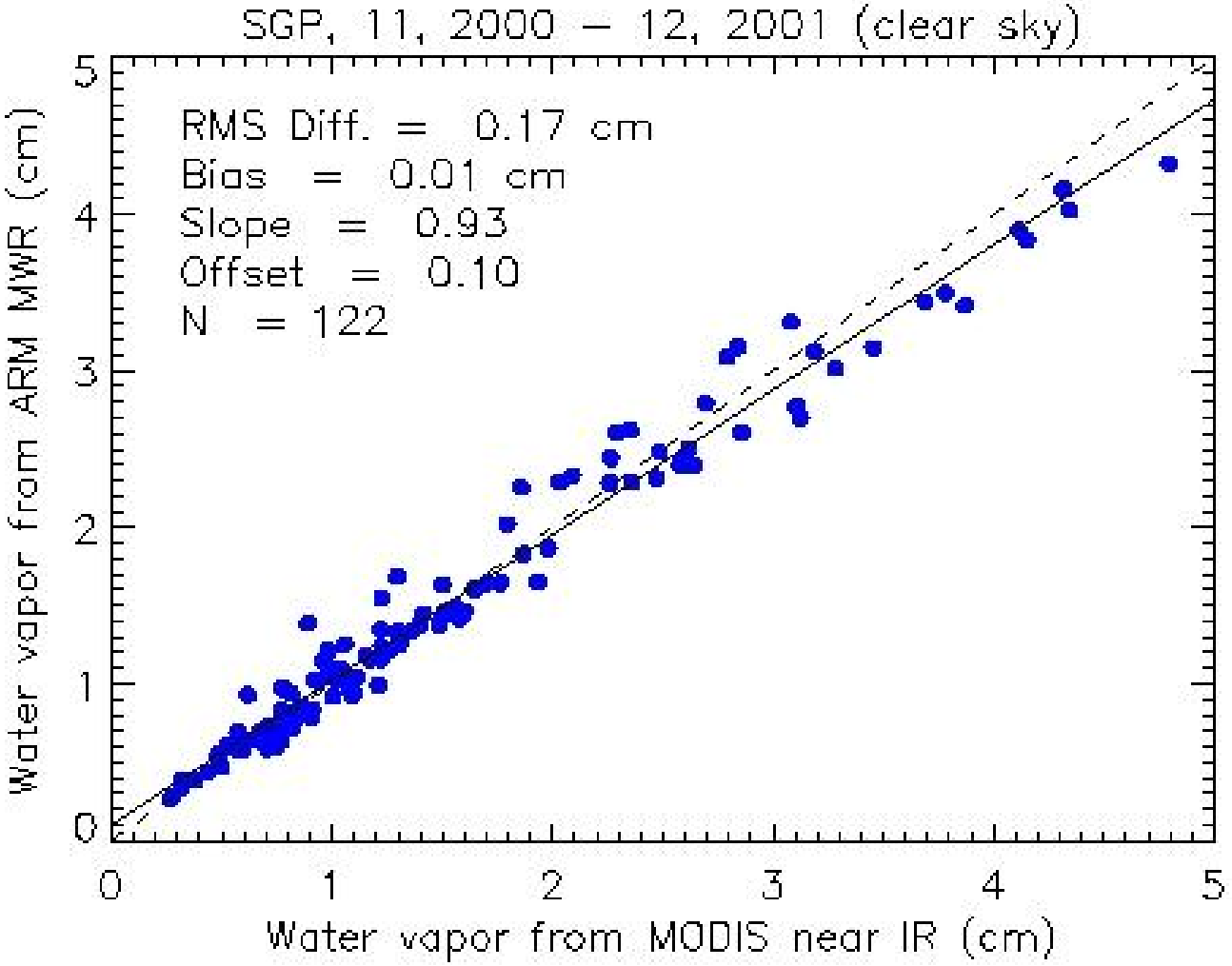


The ratio of absorption channels against window channels allow the derivation of water vapor transmittance, and therefore the amount of water vapor in the atmosphere

A Sample Terra MODIS Water Vapor Image

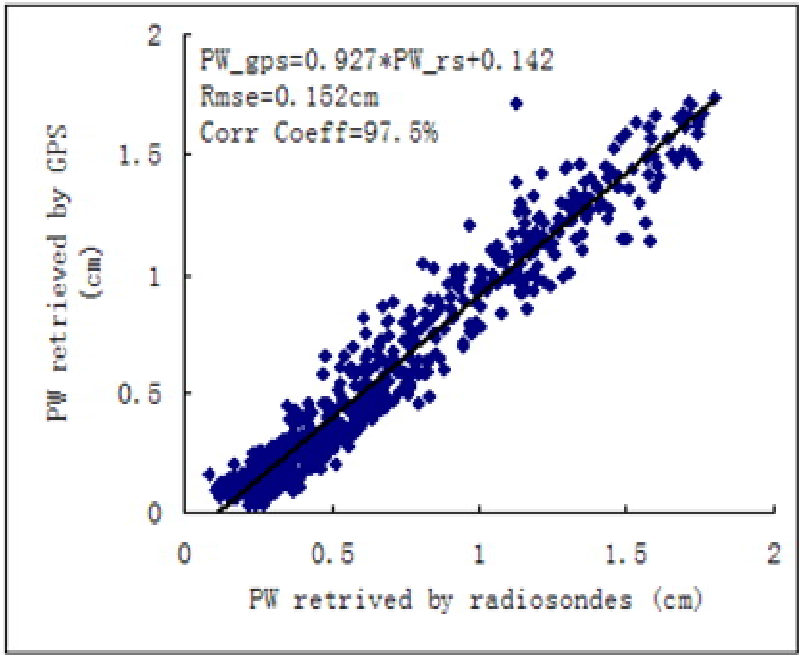


Validation With MWR Data

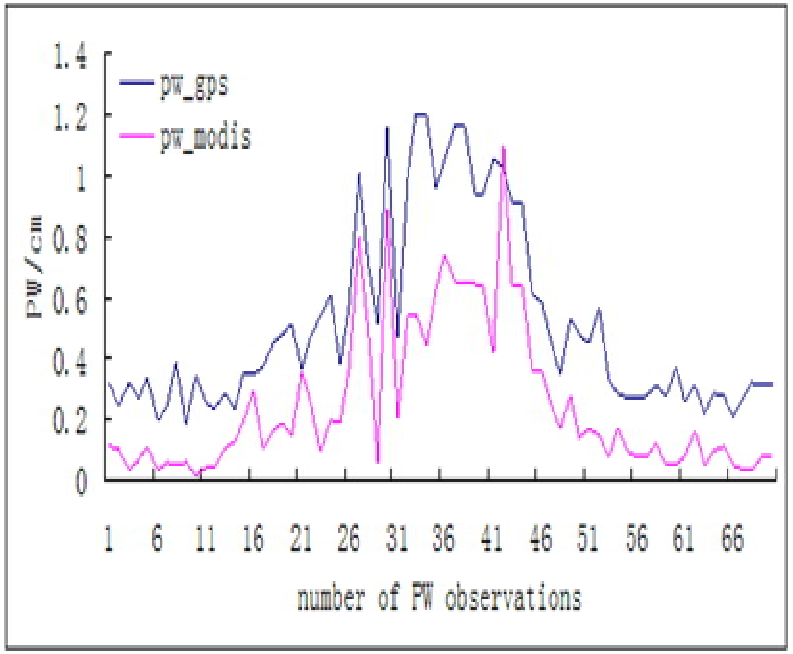


Water Vapor Measurements Over Tibet (Elevations > 4 km) By Researchers in China

GPS VS Radiosonde



Time Series of MODIS & GPS Data



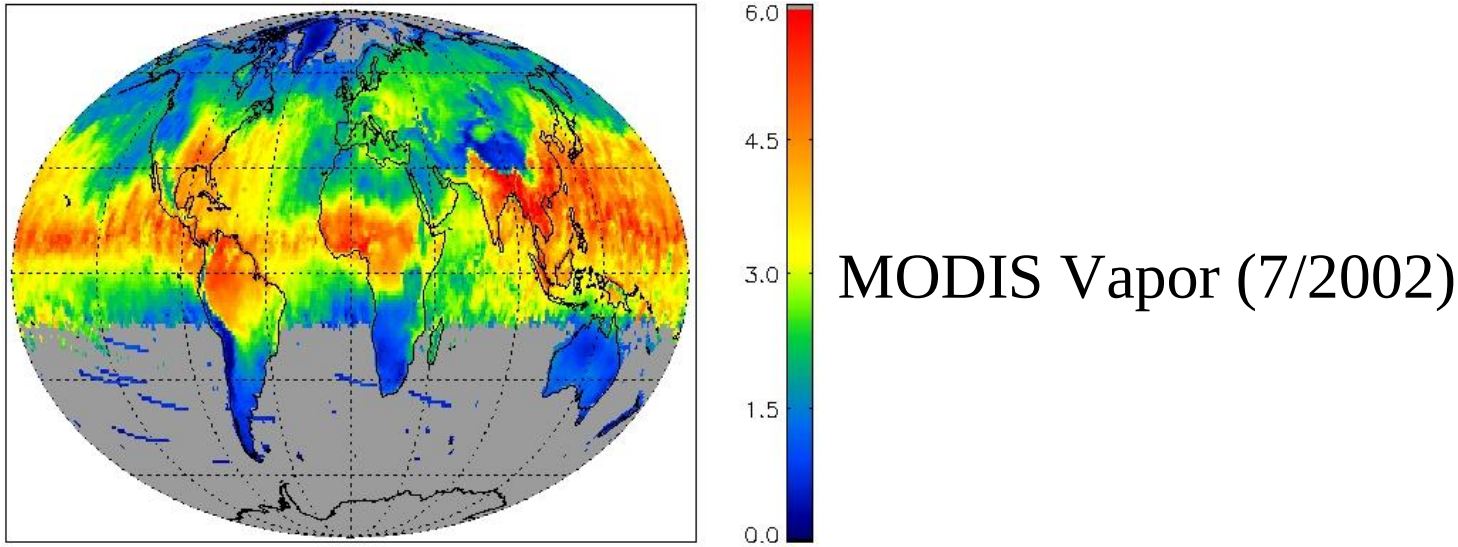
The MODIS Collection 4 near-IR water vapor values are about half of GPS values during the summer season

- In January 2005, these researchers send an e-mail to Yoram Kaufman about their observations.

- Yoram forwarded the e-mail to me, and I started an investigation. Pretty soon, I found an error with the MODIS near-IR water vapor algorithm – a few lines related to the LOWTRAN 7 pressure scaling scheme were incorrectly commented out.

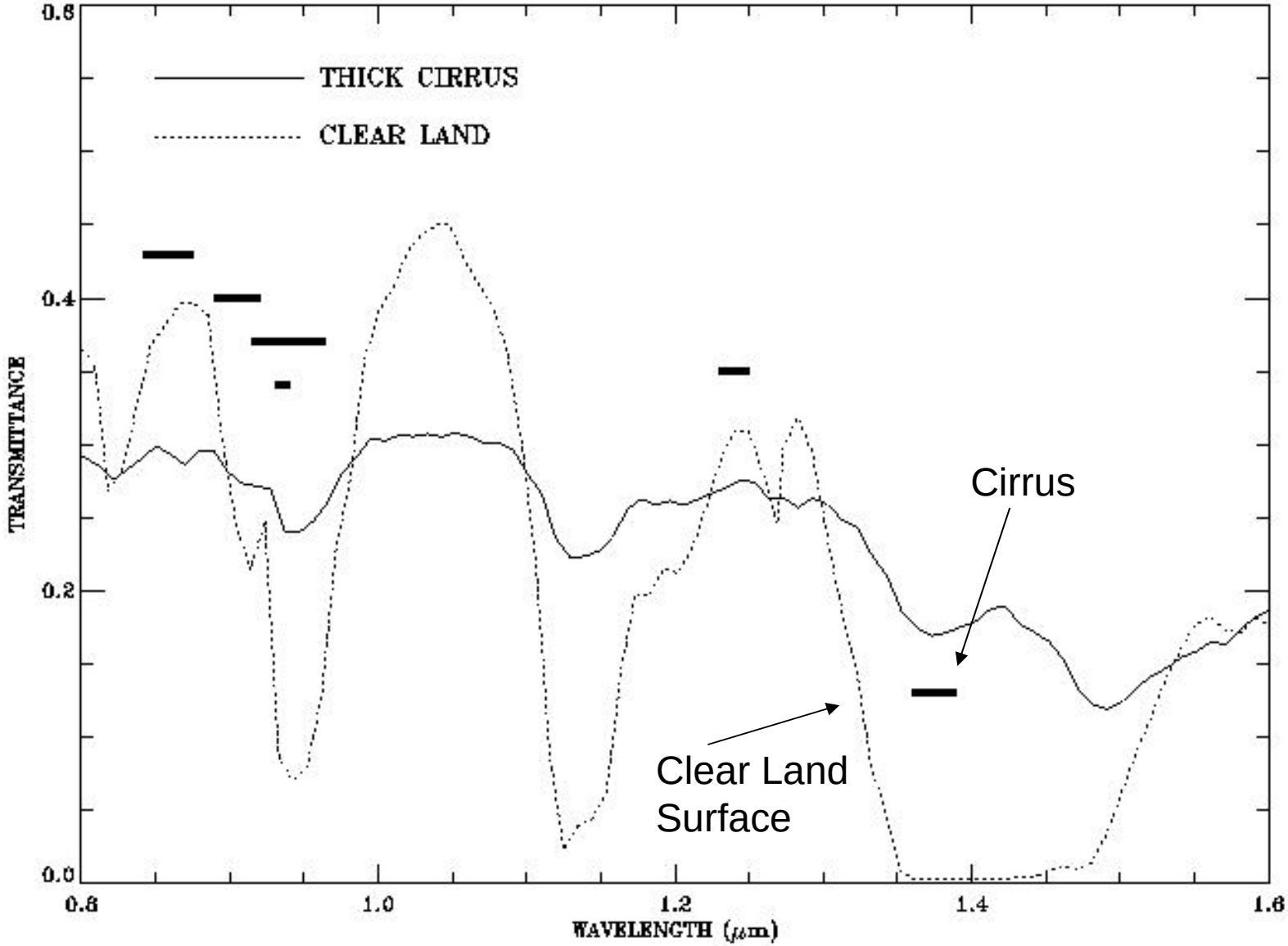
- I soon corrected the error, updated the code, and made a new Collection 5 code delivery to MODIS SDST. The corrected code is now also used for forward data processing.

Other Errors with the Collection 4 Results

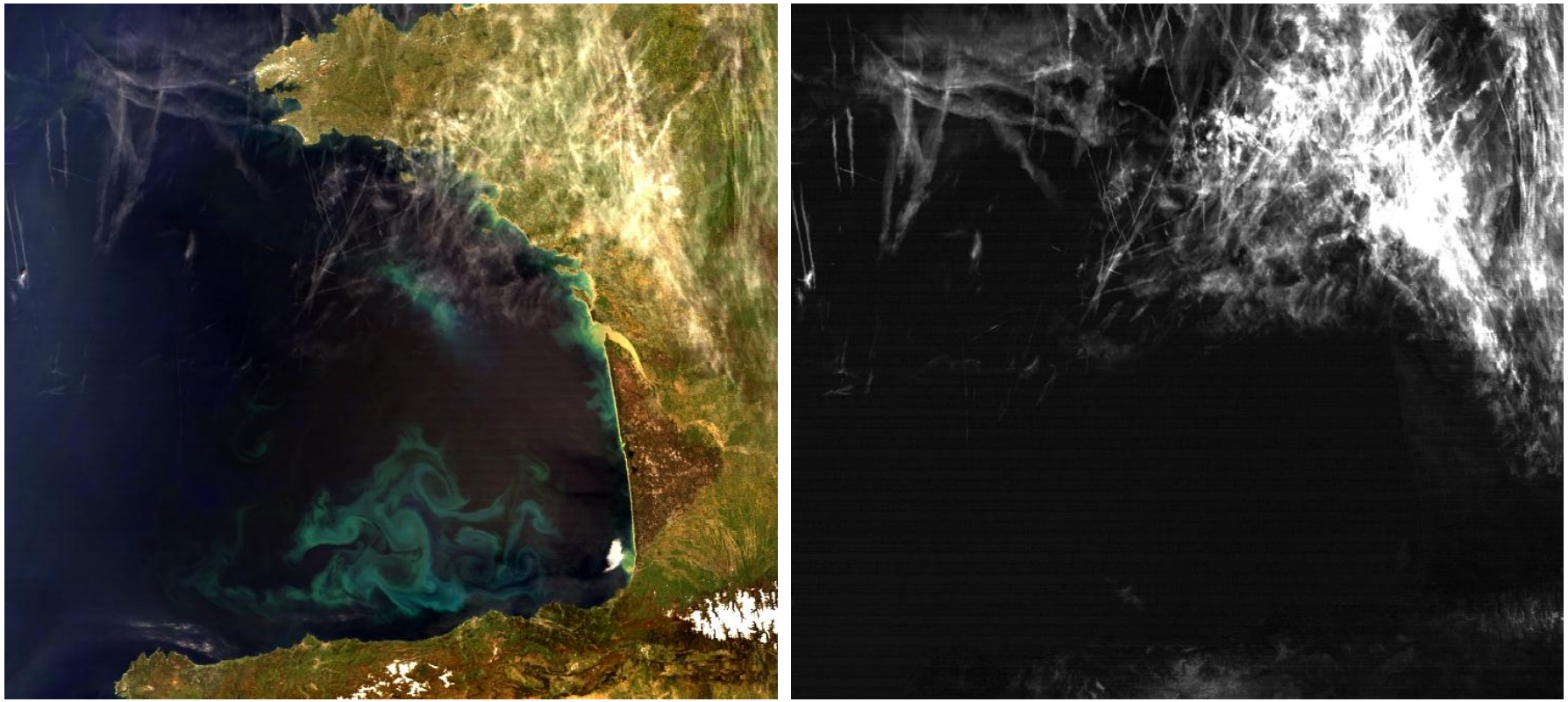


MODIS Vapor (7/2002)

- Bad lines were seen in the L2 and L3 water vapor images.
- Paul Hubanks, Rich Hucek, and I worked together to identify the source for the problem.
- Eventually, we found the problem – the QA parameters for bad lines and partially missing lines in the L1B data were incorrectly assigned.
- We improved the QA routines for the Collection 5 near-IR water vapor algorithm.


THICK CIRRUS
CLEAR LAND
TRANSMITTANCE
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
WAVELENGTH (μm)
Cirrus
Clear Land
Surface

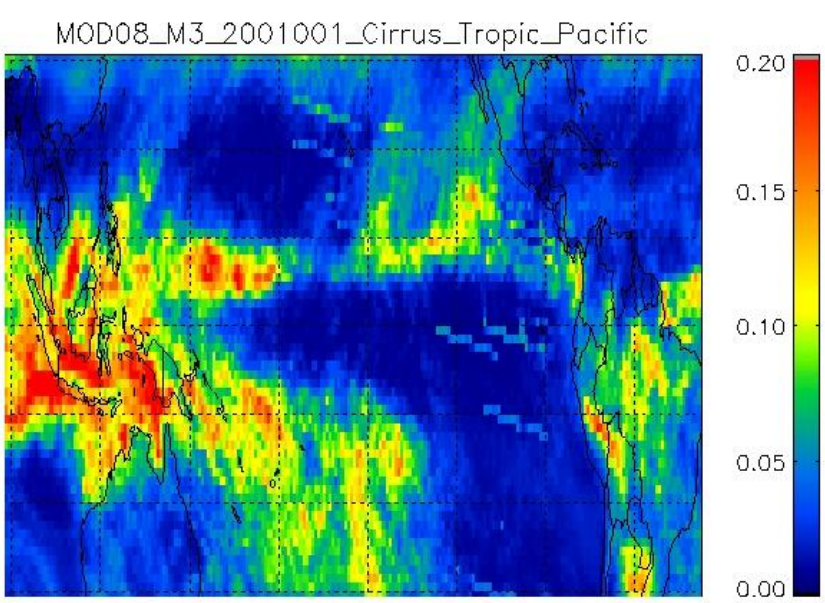
A Sample Cirrus Detection (Over France)



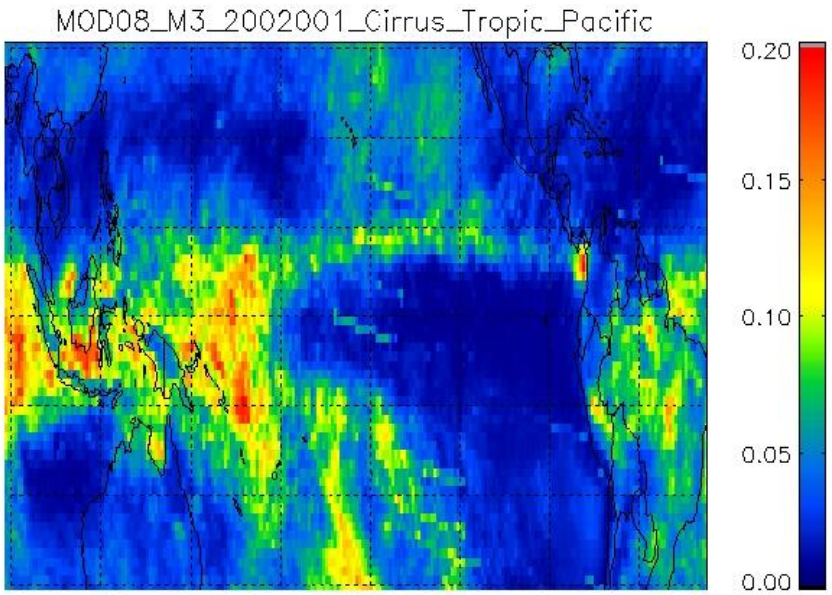
A Sample Cirrus Correction (Over France)

High Cloud (Tropic Pacific)

January, 2001

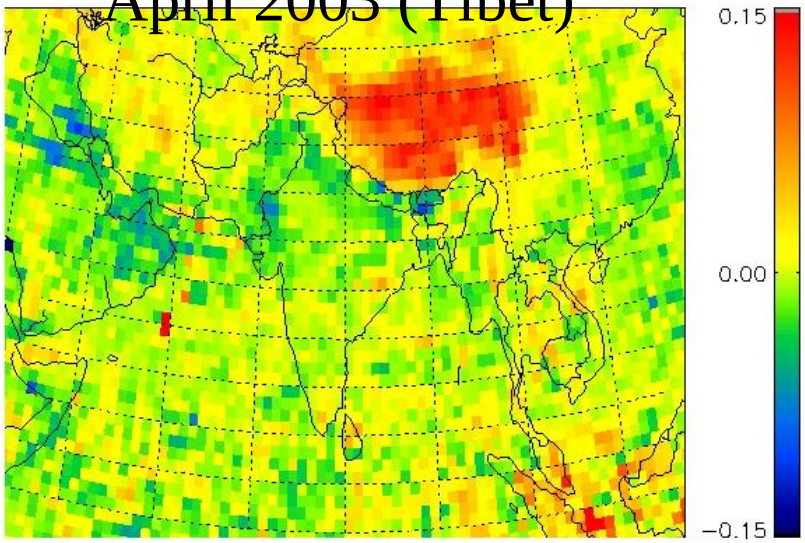


January, 2002

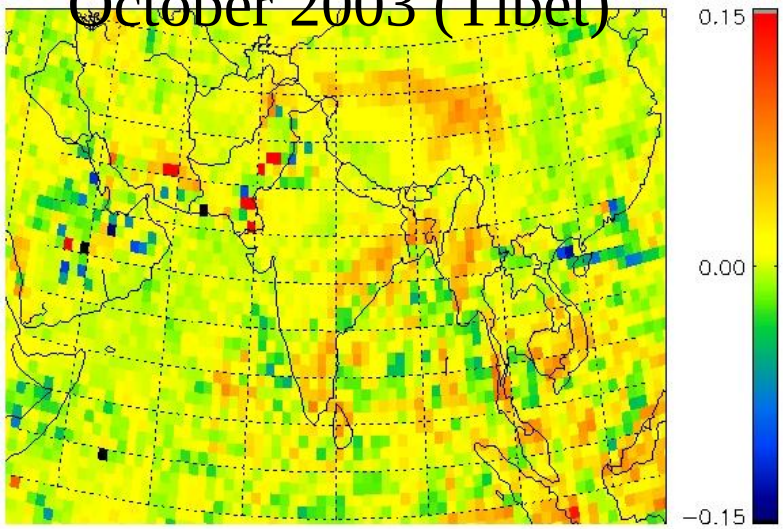


CIRRUS REFL DIFFERENCE (AQUA – TERRA)

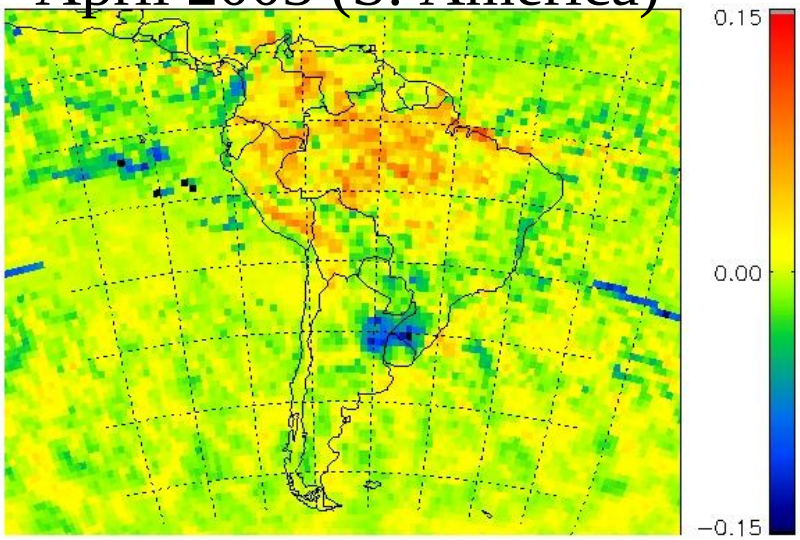
April 2003 (Tibet)



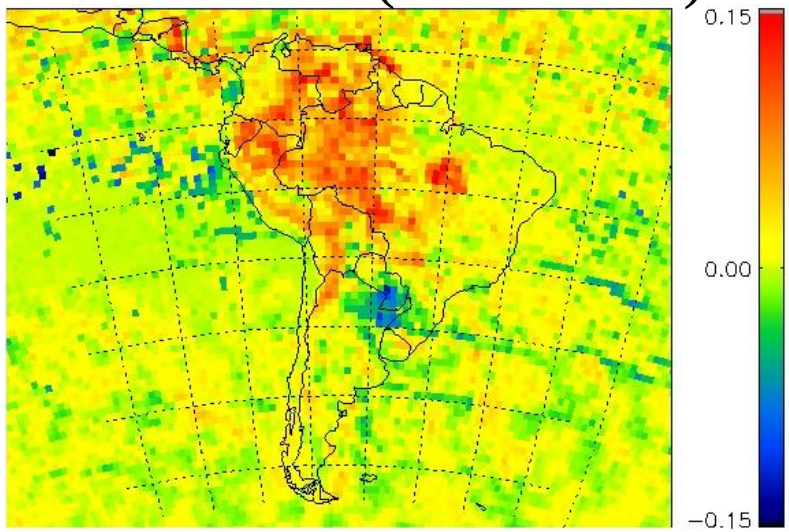
October 2003 (Tibet)



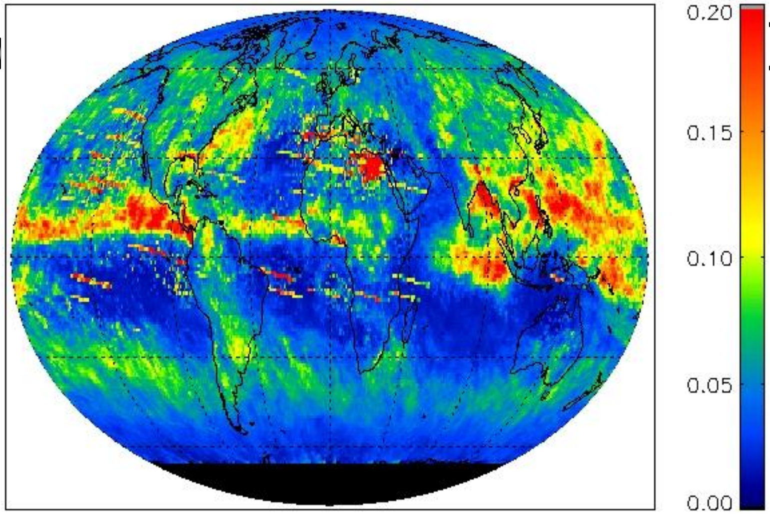
April 2003 (S. America)



October 2003 (S. America)



Erro irrus Reflectances



July, 2002

- Bad lines were seen in the Collection 4 L2 and L3 cirrus reflectance images. These bad lines were also due to incorrect QA parameter settings for bad lines or partially missing lines in the L1B data. The problem has been corrected in the Collection 5 MOD06 CD code.
- The L1B reader in the Collection 4 code used a wrong coefficient when converting digital numbers to solar and view zenith angles. The error has also been corrected in the Collection 5 MOD06 CD code.

Issues On Cirrus Fractions

- The user community is very interested in cirrus area fractions, and has raised lots of questions.
- In reality, the MODIS near-IR cirrus fraction has inherent problems. The cross-talking problem with the MODIS 1.375-micron channel has never been fully understood. Chris Moeller at U. of Wis. has developed an empirical algorithm to correct for the x-talking problem. Minor over- or under-corrections still occur over different geographical regions.
- For the Collection 5 MOD06 CD code, the Level 2 pixels with cirrus reflectances less than 0.5% will not be used to produce the Level 3 1 x 1 degree data products.
- We would like to encourage modelers to use the L3 cirrus reflectance product, instead of the cirrus fractions, because residual x-talking effect still affects cirrus fractions.
- After all, cloud amount does not have a simple and unique answer. Over the same imaging area, Landsat, MODIS, AIRS will give very different cloud amounts. Spatial resolution, sensitivity of the channels, and various thresholds all affect the estimates of cloud fractions.

Summary

- Global water vapor and cirrus reflectance products have been derived from MODIS channels in the near-IR spectral region.
- Errors found in the Collection 4 algorithms have been corrected, and the improved Collection 5 codes have been delivered to NASA Goddard. Code integration and testing have been made under the operational computing environment.