



Retrieving Infrared Land Surface Emissivity With AIRS Observations

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Outline

Sensitivity study for land surface emissivity

Sensitivity study for atmospheric and surface parameters

The retrieval method: MLEV

Case study

Future plan

Sensitivity Study for Land Surface Emissivity



Fast Model: SARTA (Stand-Alone Rapid Transmittance Algorithm) developed by L.L.Strow, S.Hannon, and H.Mottler

Profiles: six model profiles

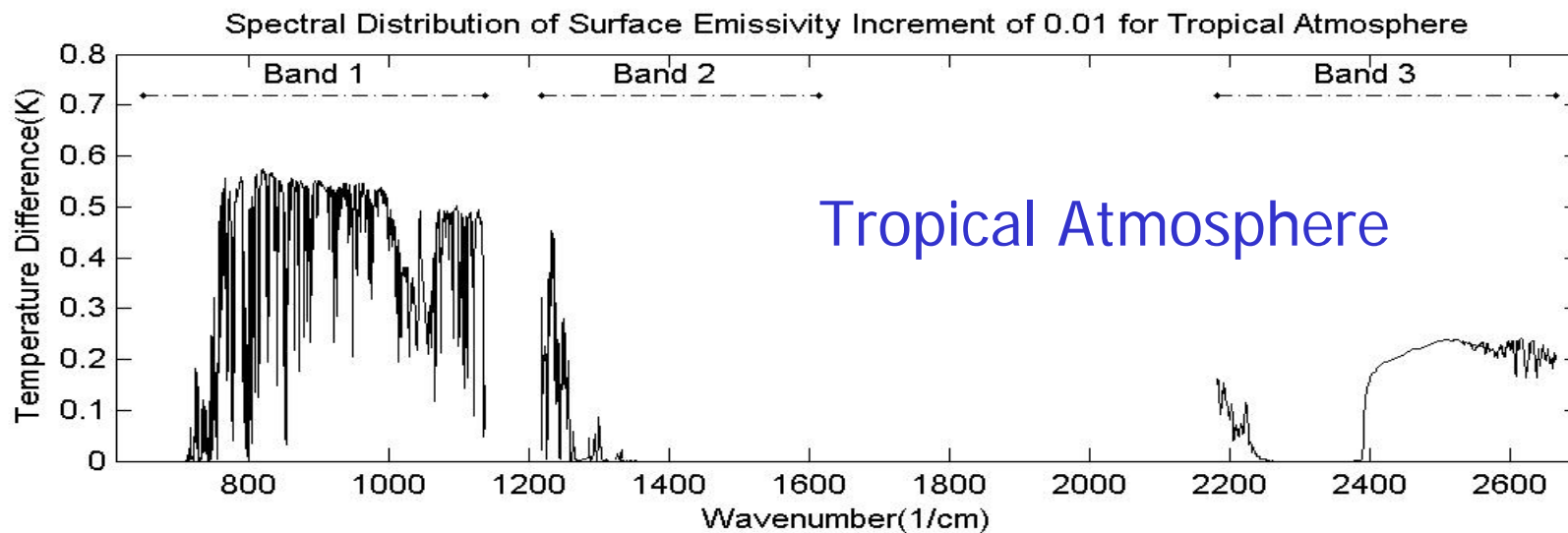
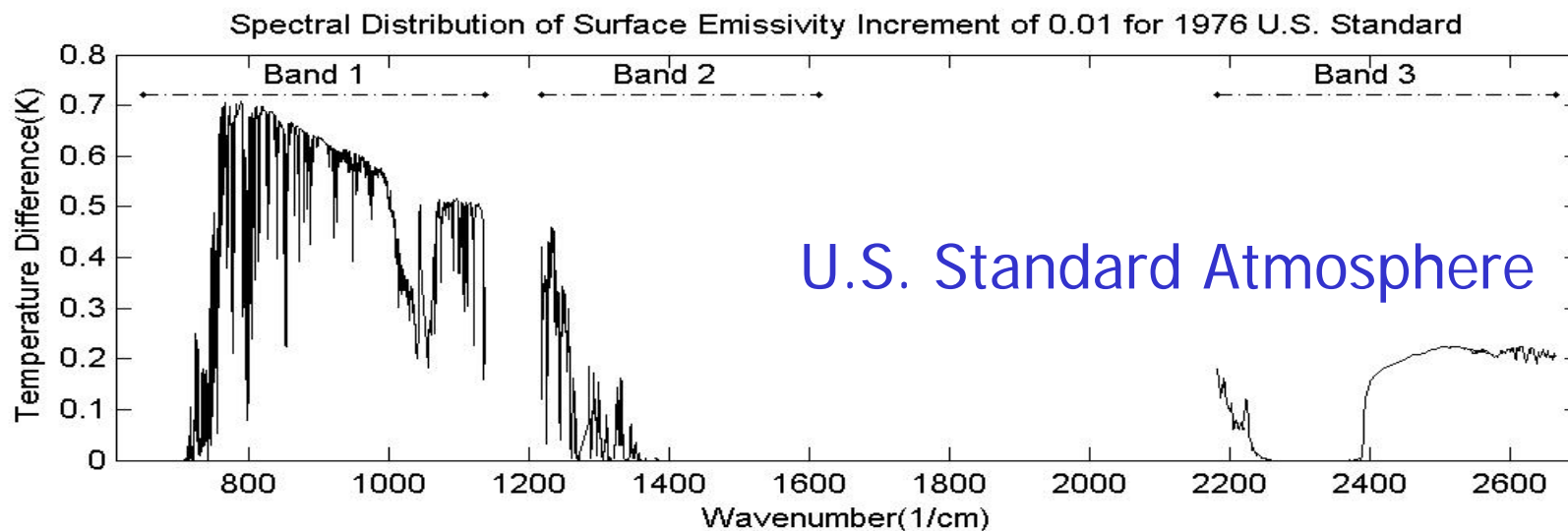
Parameters: zero satellite angle

sea level surface for 6 model profiles

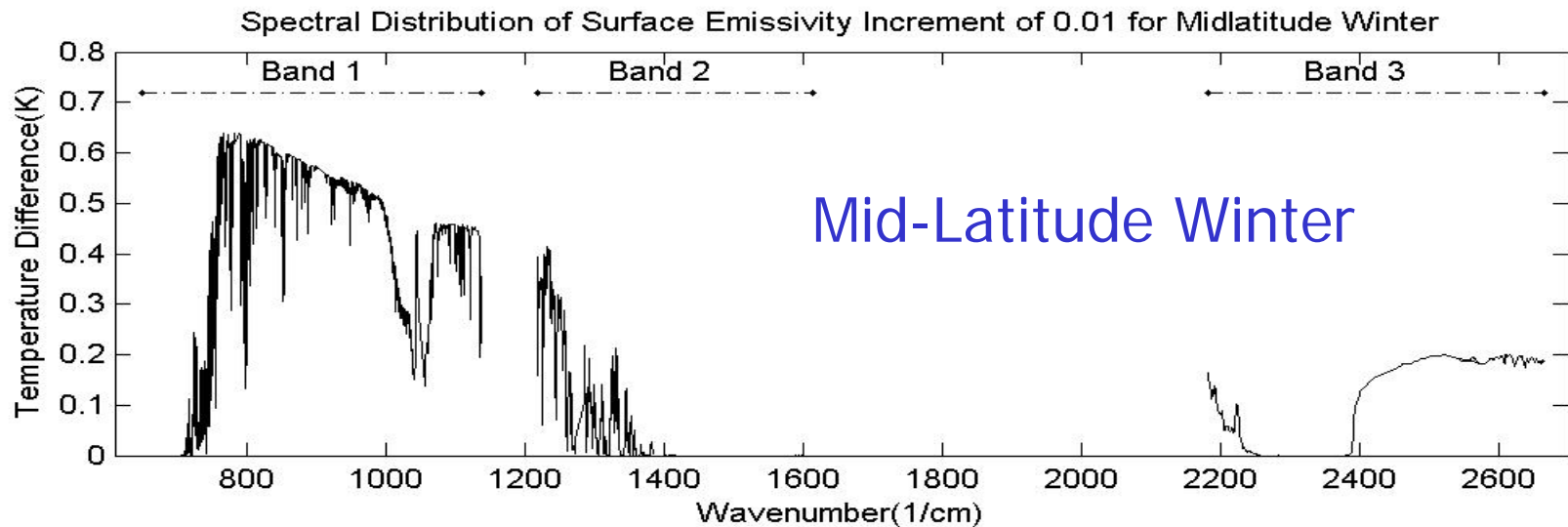
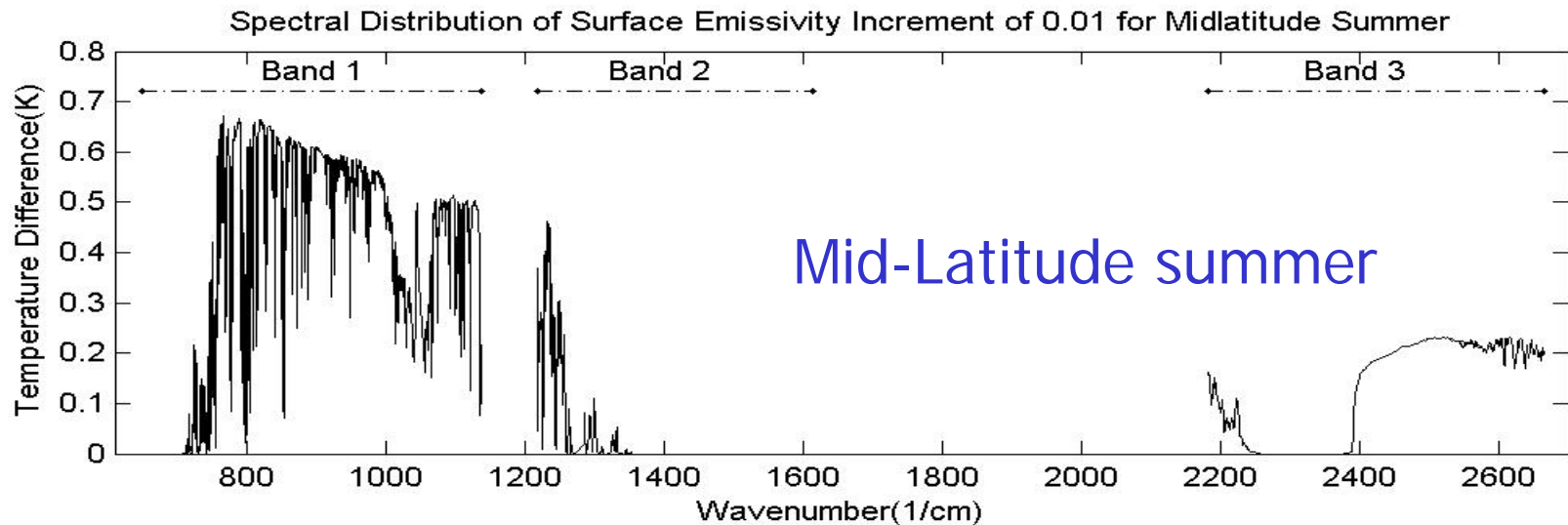
increment of LSE from 0.97 to 0.98

others

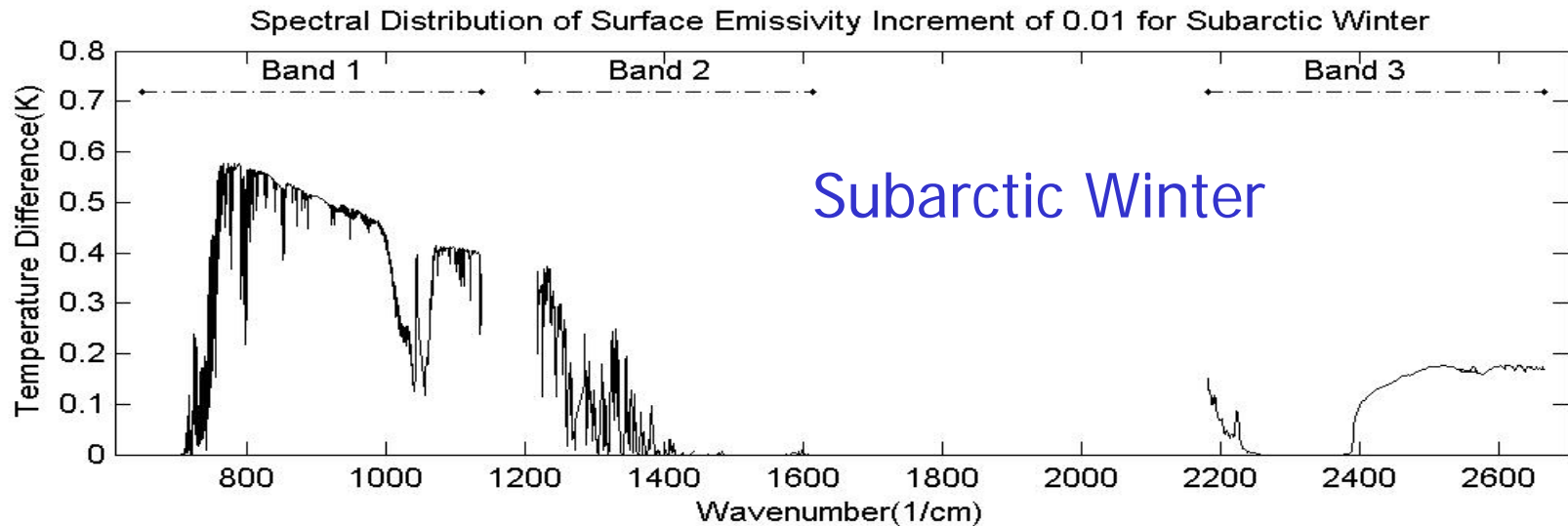
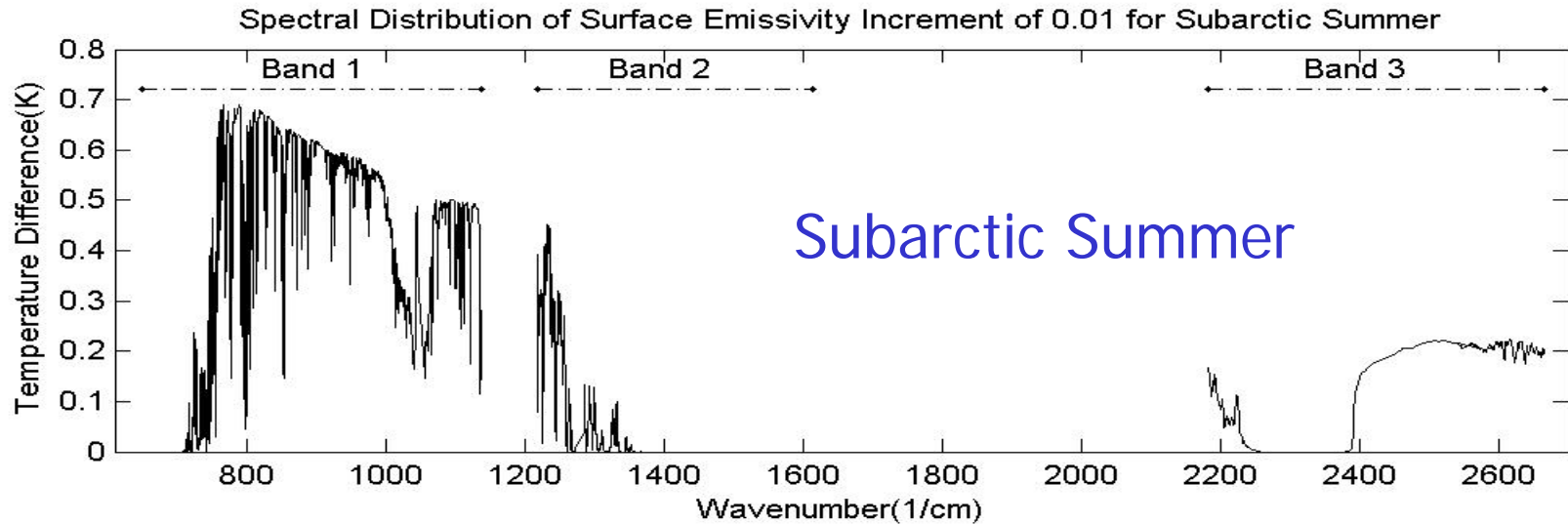
Delta TB from Delta EMIS=0.01



Delta TB from Delta EMIS=0.01



Delta TB from Delta EMIS=0.01





Sensitivity Study for Atmospheric and Surface Parameters

Fast Model: SARTA

Profiles: U.S. 1976 Standard Atmosphere

Increment/Decrement: (700hPa—1000hPa for Low Trop)

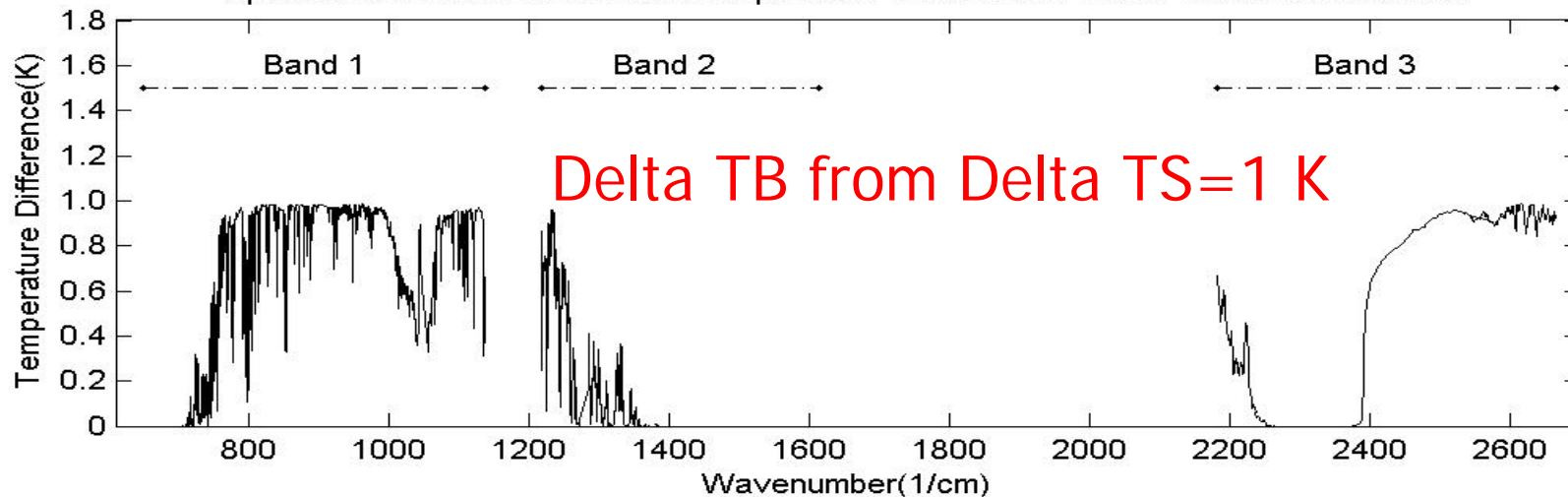
Increase of surface temperature by 1K;

Increase of low troposphere temperature by 1K;

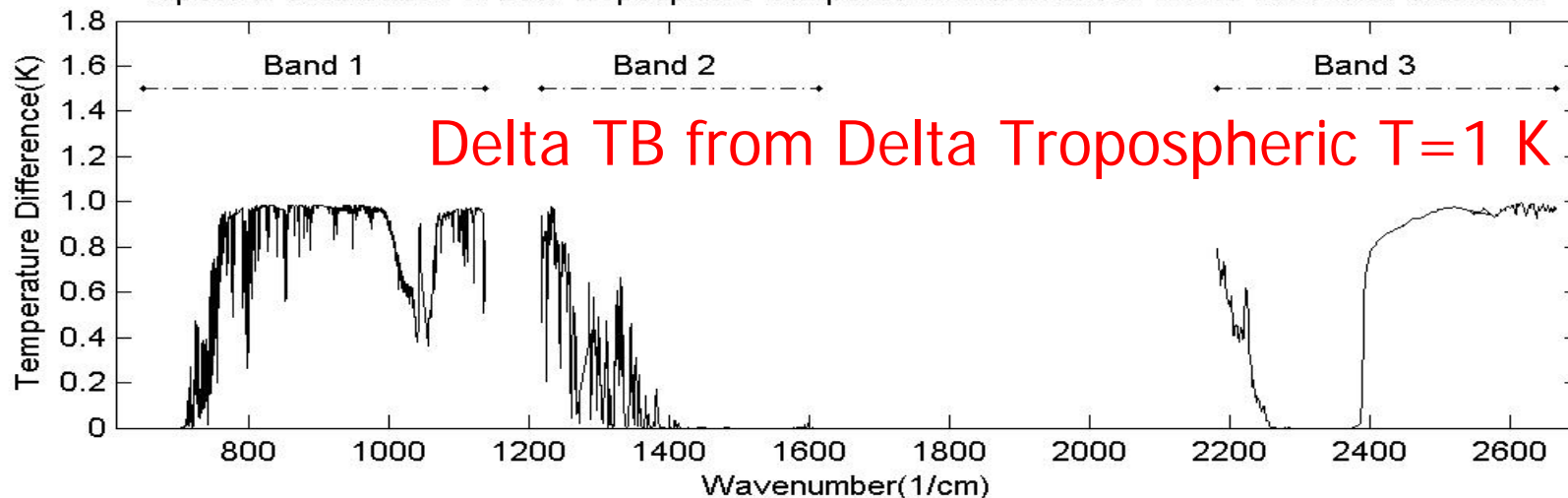
Decrease of low troposphere humidity by 15%;

Decrease of ozone by 10%.

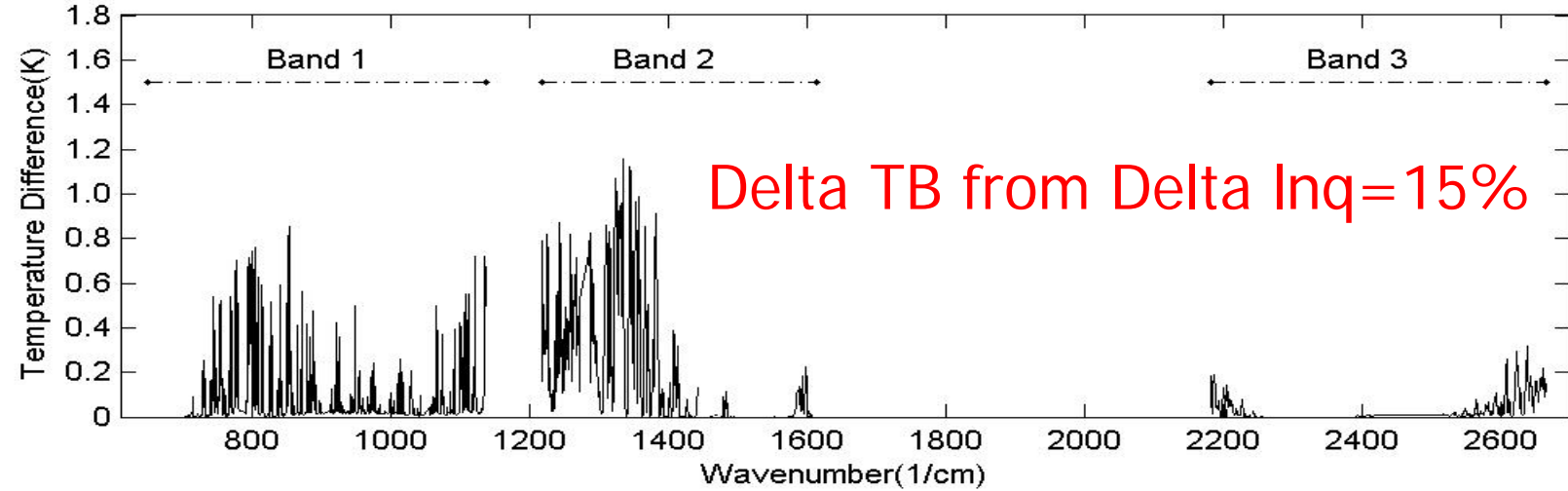
Spectral Distribution of Surface Temperature Increment of 1K for 1976 U.S. Standard



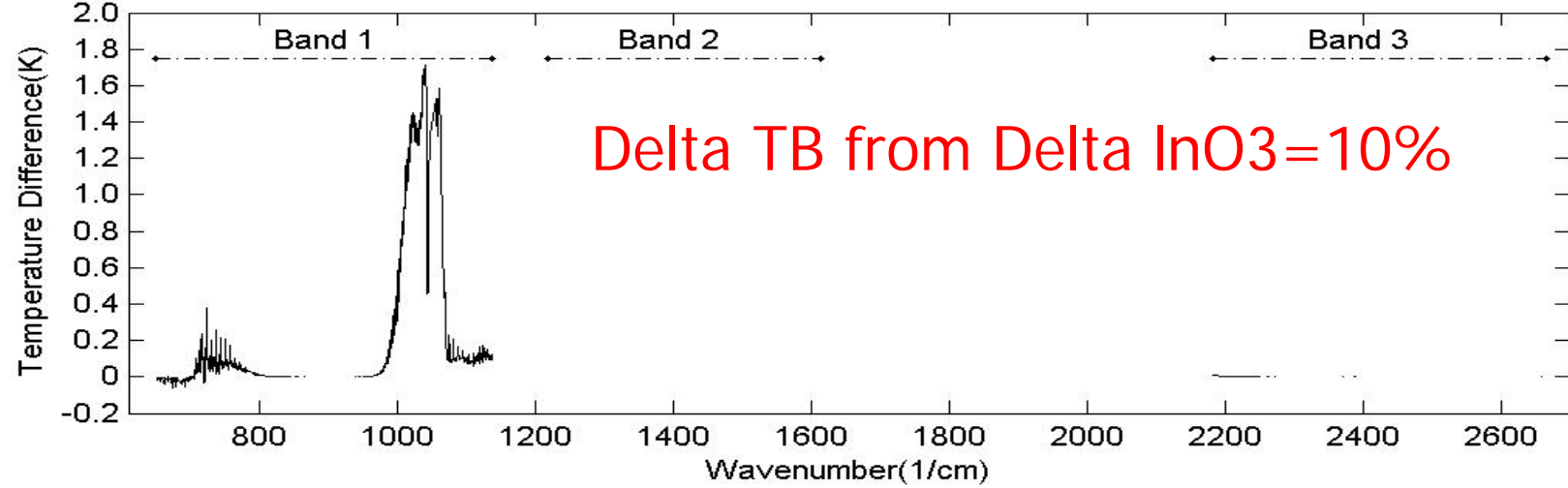
Spectral Distribution of Low Troposphere Temperature Increment of 1K for 1976 U.S. Standard



Spectral Distribution of Low Troposphere Humidity Decrement of 15% for 1976 U.S. Standard



Spectral Distribution of Ozone Decrement of 10% for 1976 U.S. Standard



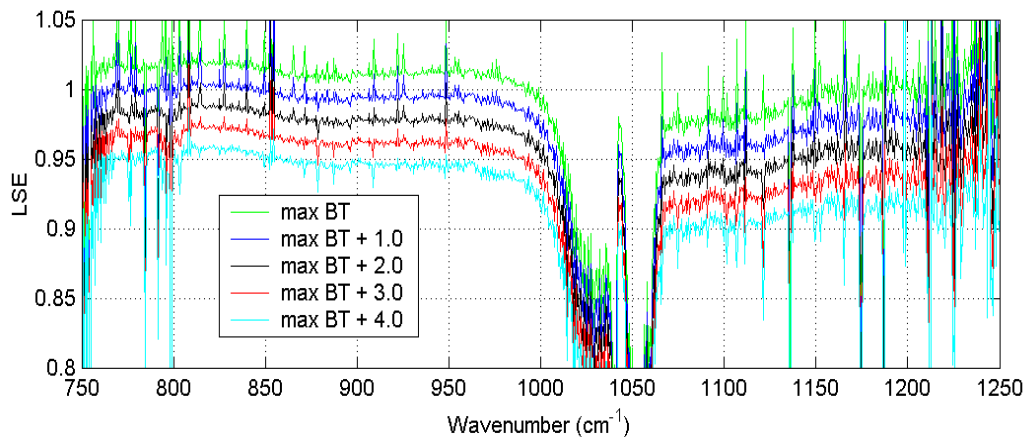
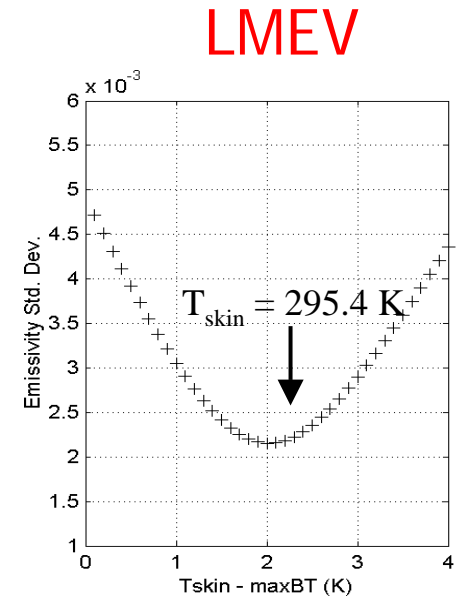
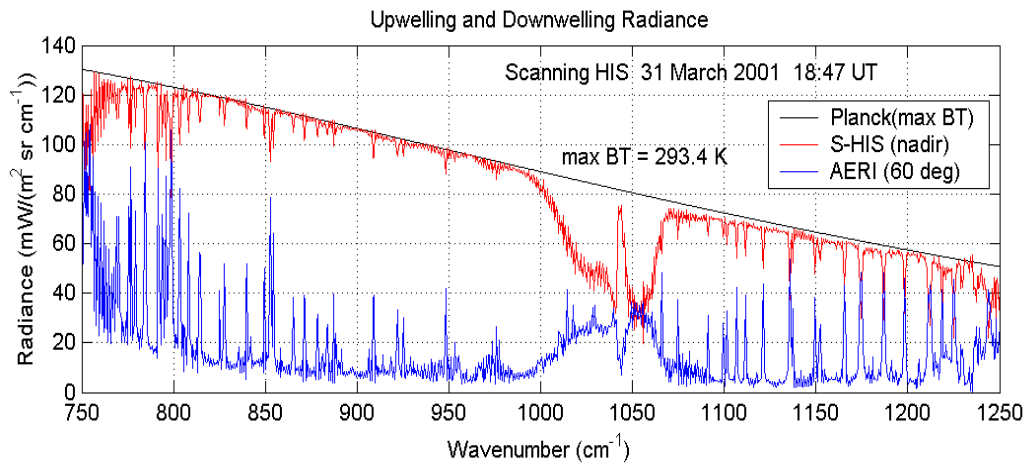


Retrieval LSE with LMEV Method

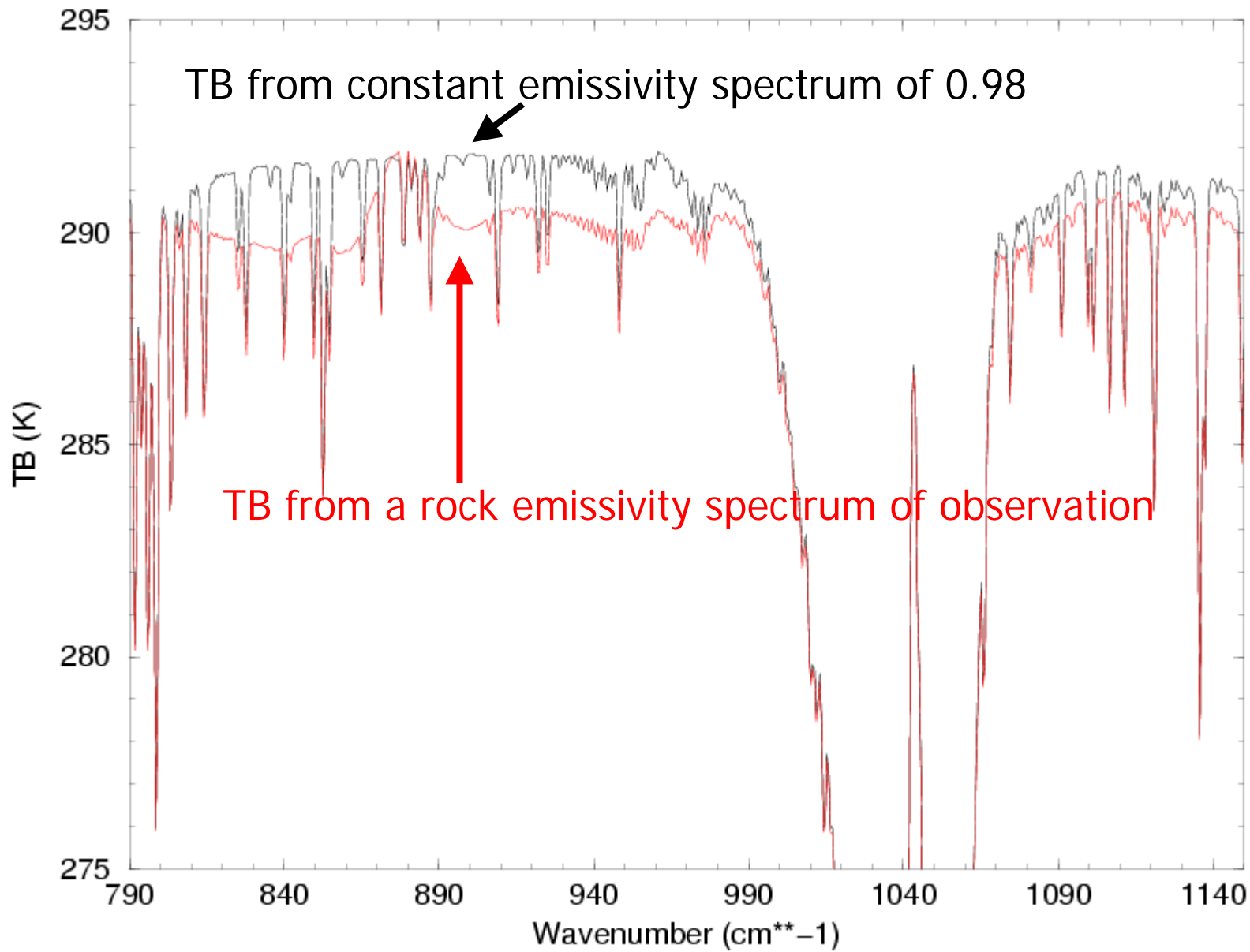
$$\varepsilon_\nu = \frac{R_\nu^{obs\uparrow} - R_\nu^{atm\uparrow} - \tau_\nu \bar{R}_\nu^{\downarrow}}{\tau_\nu \left(B_\nu(T_S) - \bar{R}_\nu^{\downarrow} \right)}$$

Best fit to LST/LSE when Local Spectral Variance in Emissivity is Minimum

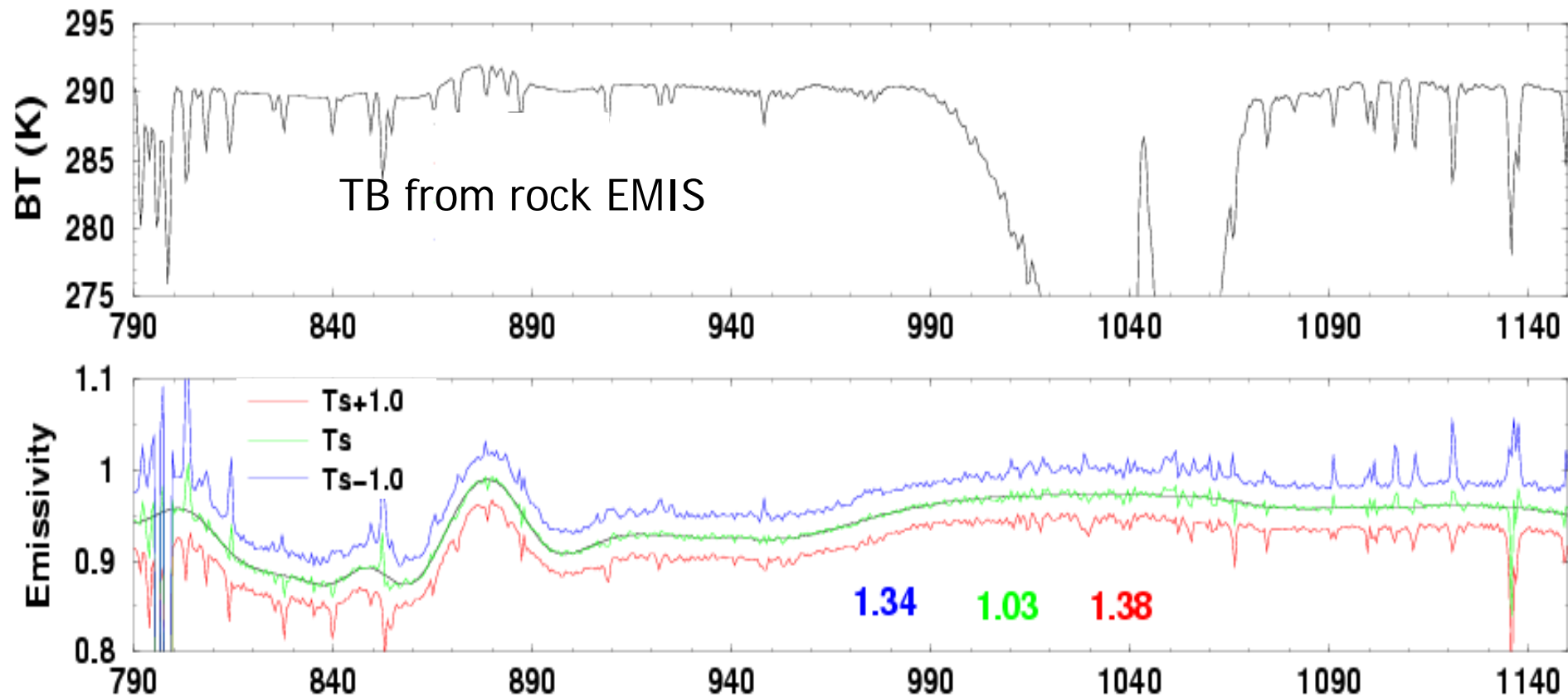
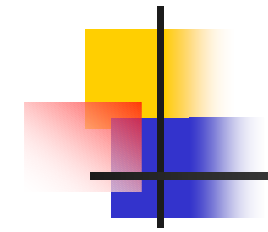
(Robert Knuteson etc)



$$\epsilon_v = \frac{R_v^{obs\uparrow} - R_v^{atm\uparrow} - \tau_v \overline{R}_v^{\downarrow}}{\tau_v \left(B_v(T_S) - \overline{R}_v^{\downarrow} \right)}$$



EMIS spectra derived with the correct/wrong T_s





A Case Study

Retrieval Algorithm: LMEV

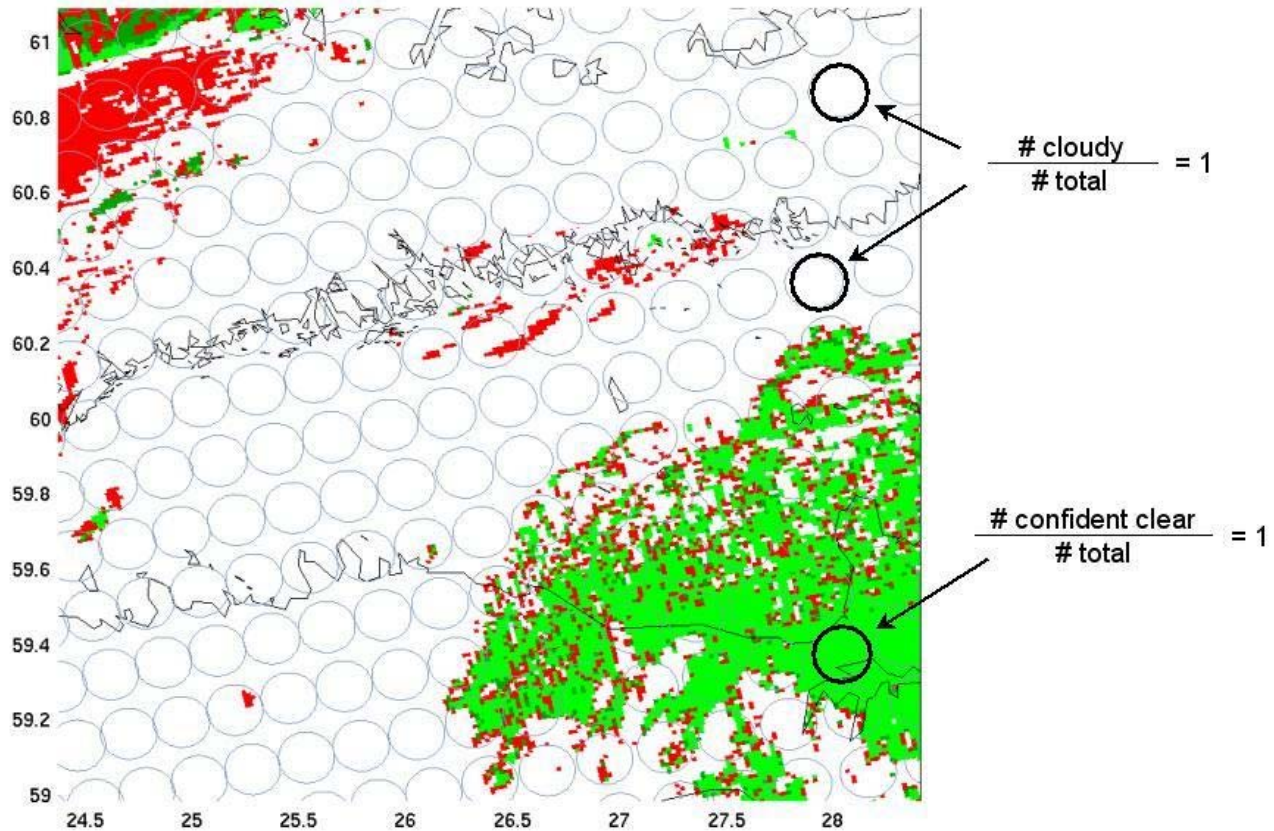
AIRS Fast Model: SARTA

AIRS L1B Data: Granule 182 (6mins, 118MB)

Sept.6,2002 18:11-18:17 (GMT)

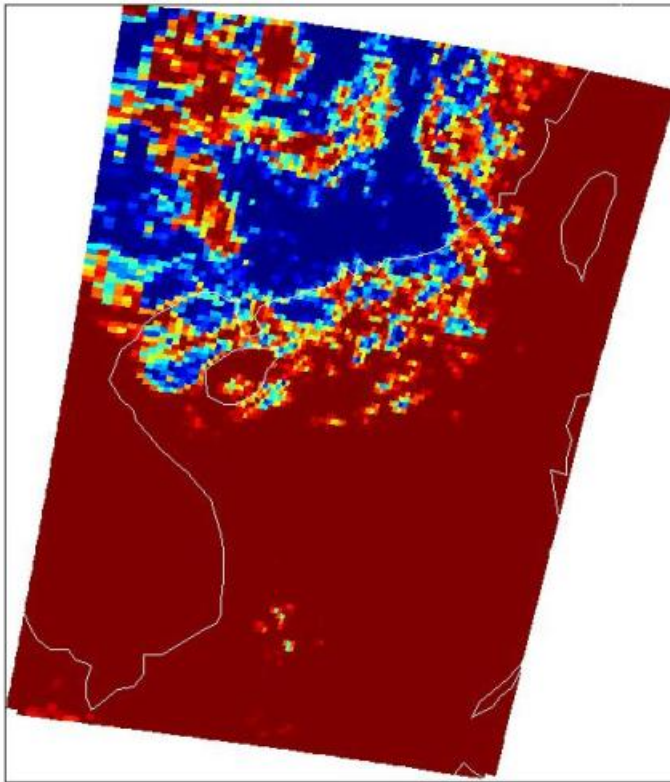
**Atmospheric Profile: ECMWF profile of Sept.6,2002
at 18Z**

AIRS Clear Flag from MODIS Cloud Mask

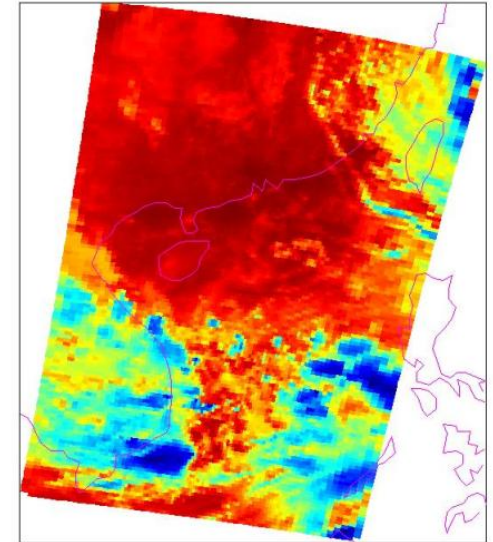


AIRS Clear Flag from MODIS Cloud Mask for G182

AIRS Cloud Flag from MODIS Cloud Mask

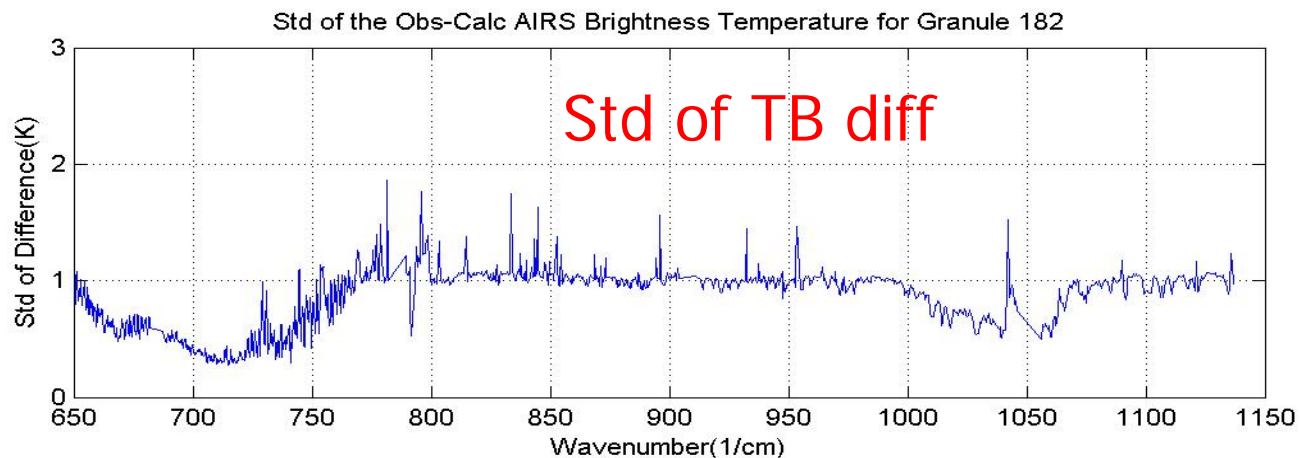
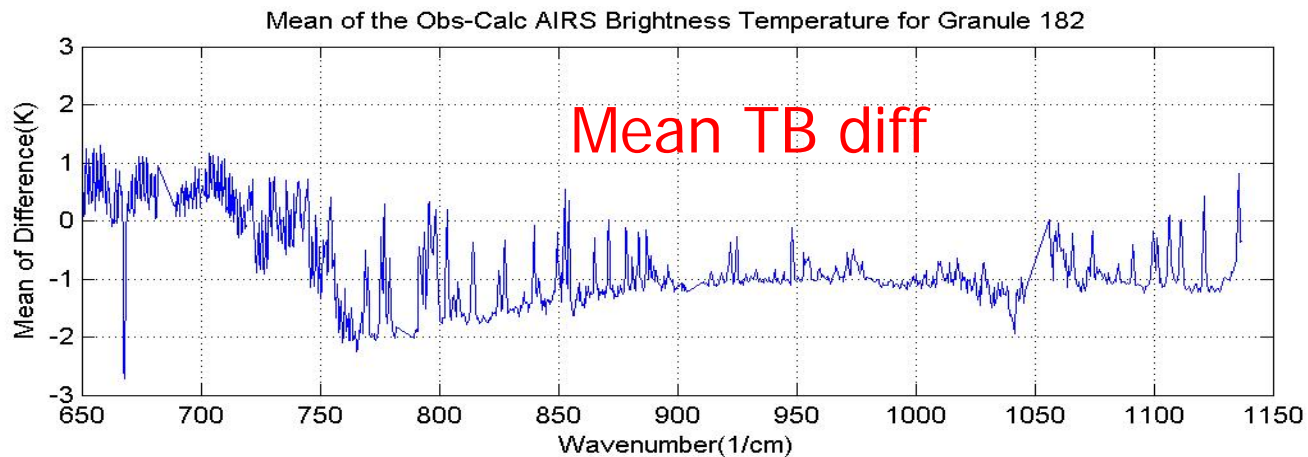


AIRS Channel 560 (12.0047 μm) Brightness Temperature



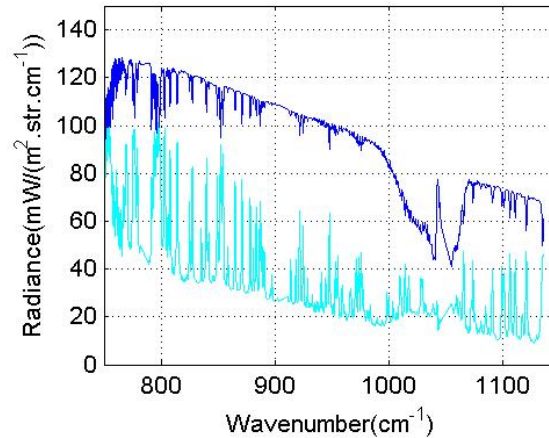
Mean and Std.of the Obs-Calc AIRS Brightness Temperature for G182

(1391 Clear FOVs/12150)

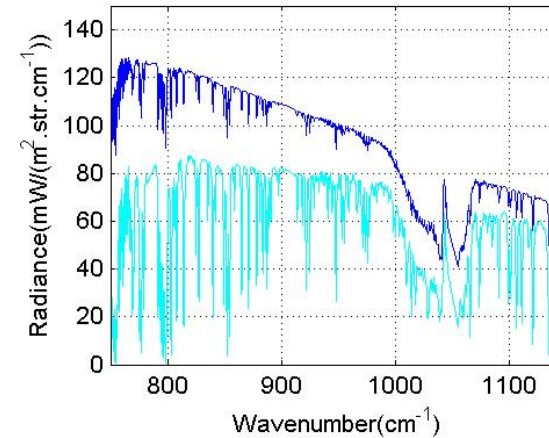


The Upwelling/Downwelling Radiance and Total Transmittance

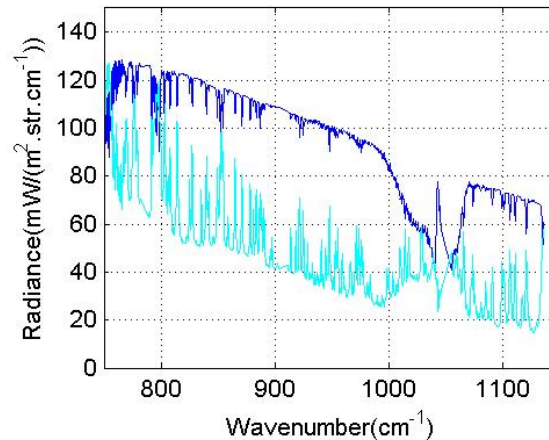
The Calculated Upwelling Radiance



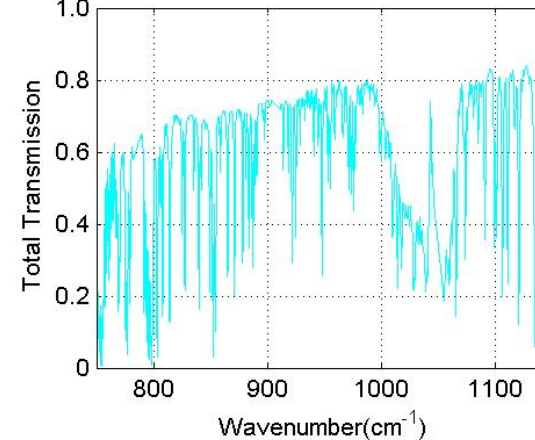
The Calculated Surface Radiance



The Calculated Downwelling Radiance

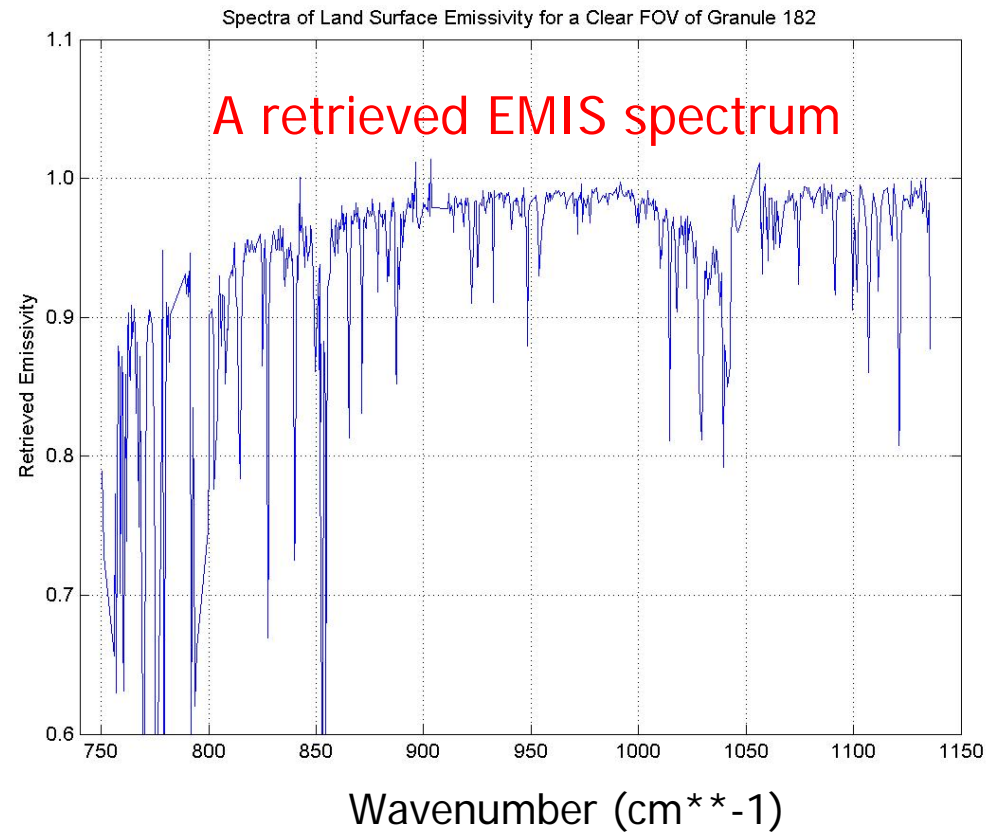
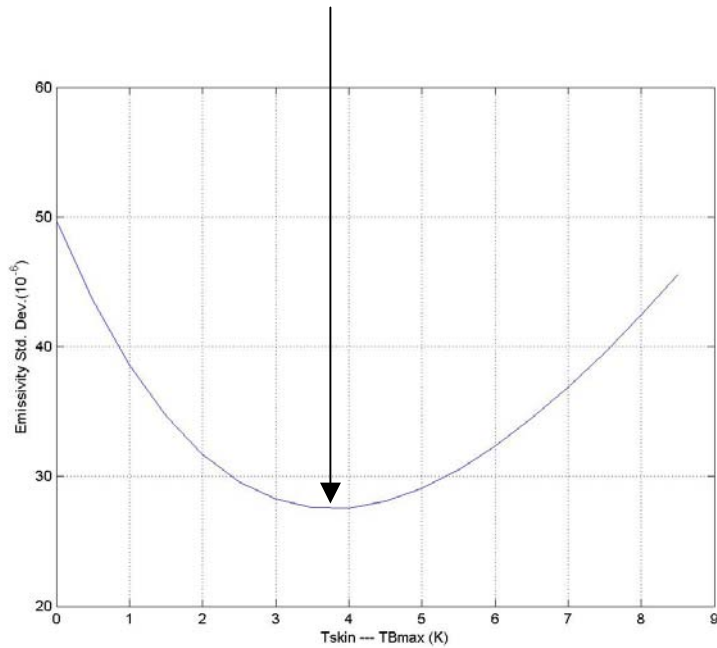


The Calculated Total Atmospheric Transmittance

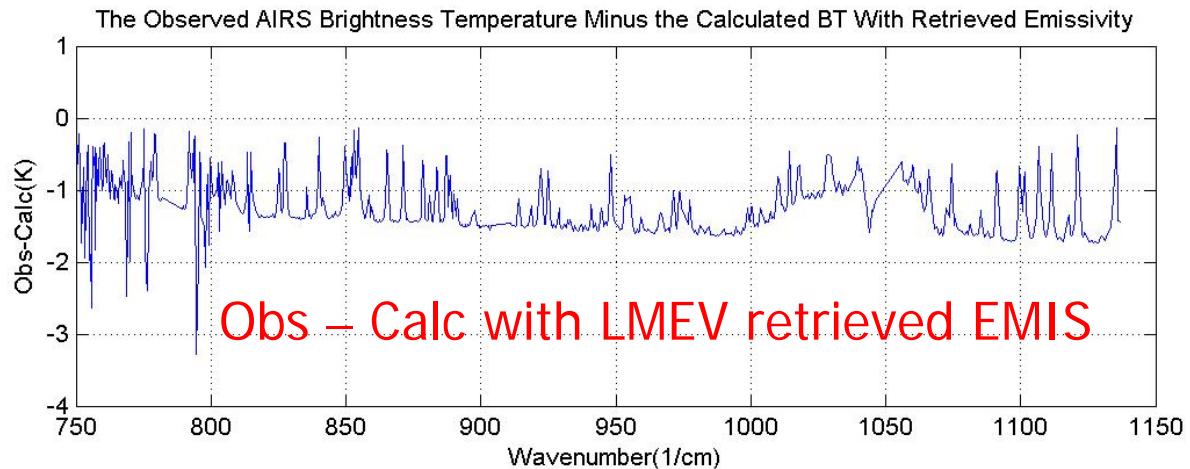
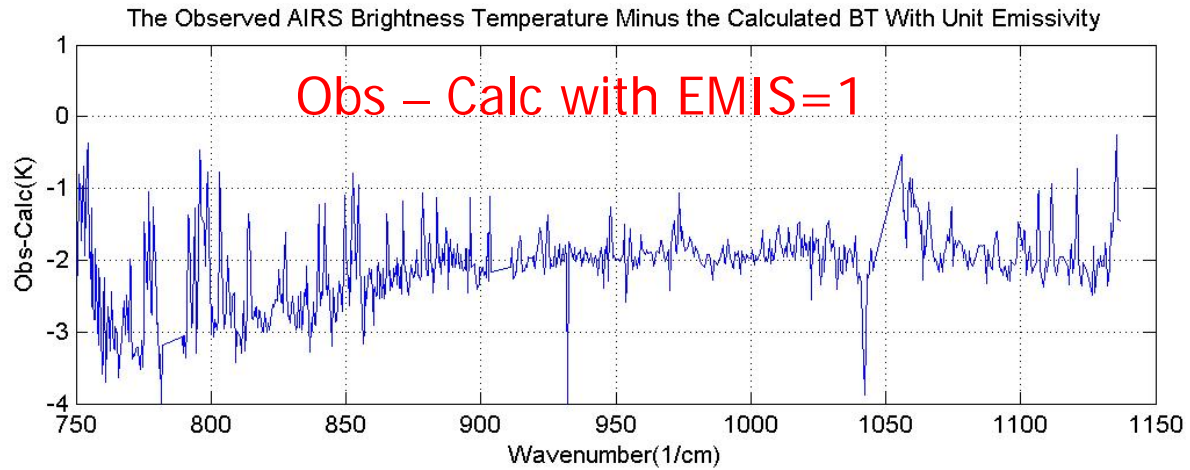


The Retrieved LSE Spectral with MLEV

Minimum Std. Variance



The Comparison Between Obs. and Calc. BT with Unit/Retrieved LSE





Future Plan

Update of model : Fast Model and Retrieval Algorithm

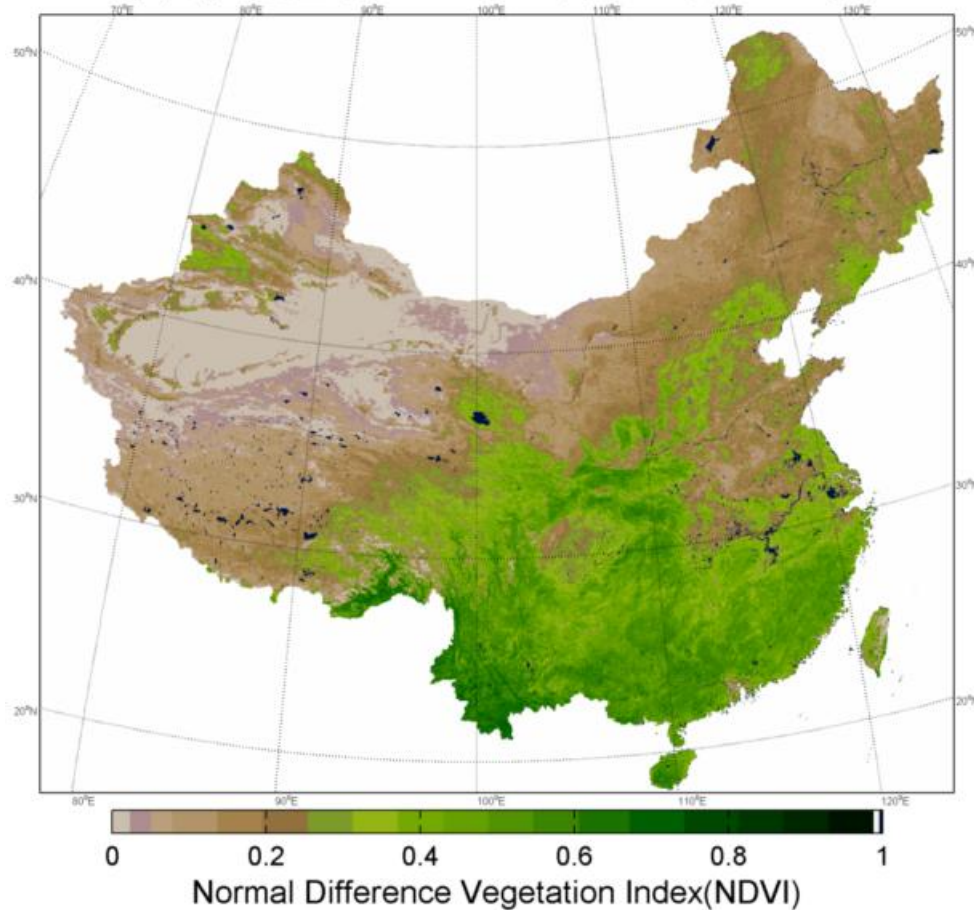
Initial Guess of LSE:

- 1) in accordance with IGBP Atlas
- 2) in accordance with NDVI

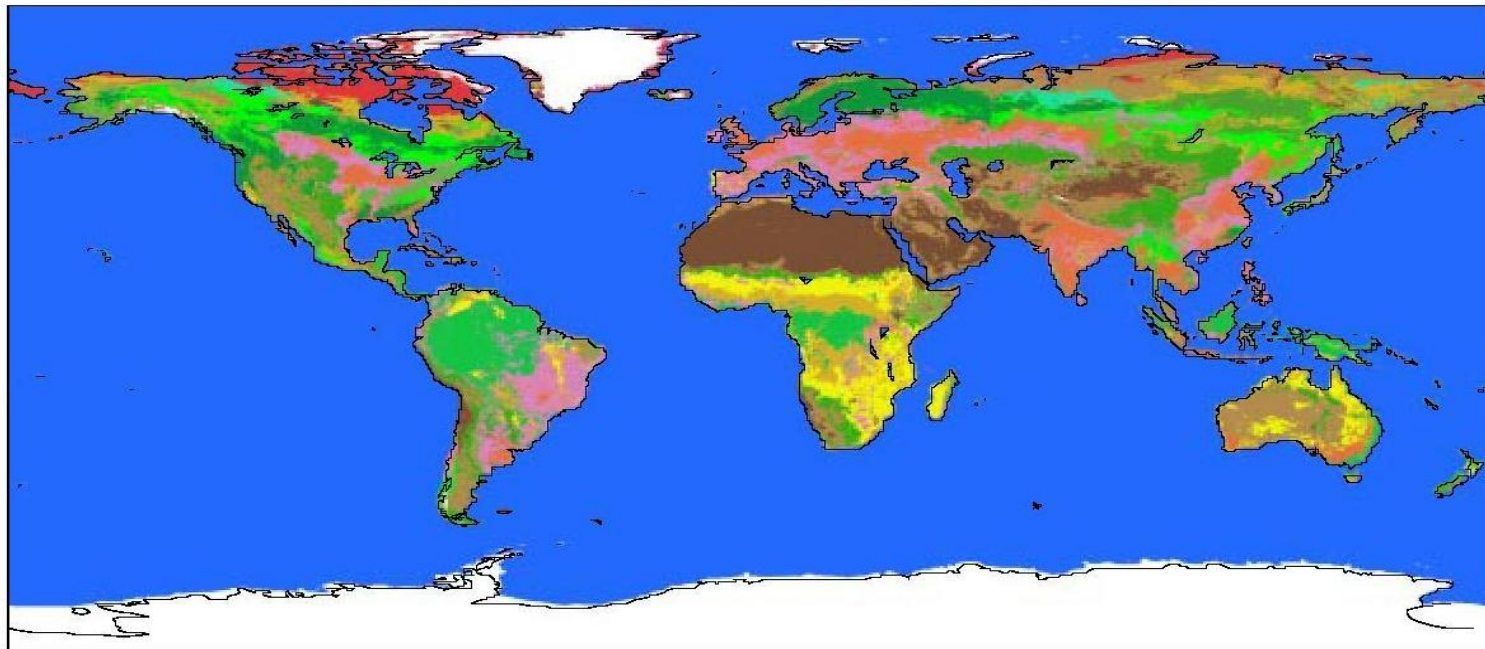
Validation

NDVI Distribution Over China

中国大陆地区2002年10月1-10日NDVI图



18 Classes of IGBP Surface Type



Evergreen
Needleleaf

Evergreen
Broadleaf

Deciduous
Needleleaf

Deciduous
Broadleaf

Mixed
Forests

Closed
Shrubland

Open
Shrubland

Woody
Savannas

Savannas

Grassland

Wetlands

Croplands

Urban

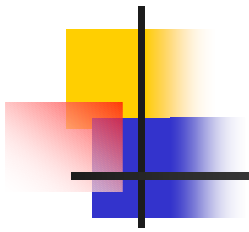
Mosaic

Ice/Snow

Barren

Water

Tundra



Thanks!

International TOVS Study Conference, 13th, TOVS-13, Sainte Adele, Quebec, Canada, 29
October-4 November 2003. Madison, WI, University of Wisconsin-Madison, Space Science and
Engineering Center, Cooperative Institute for Meteorological Satellite Studies, 2003.