AIRS Surface Emissivity Experiments

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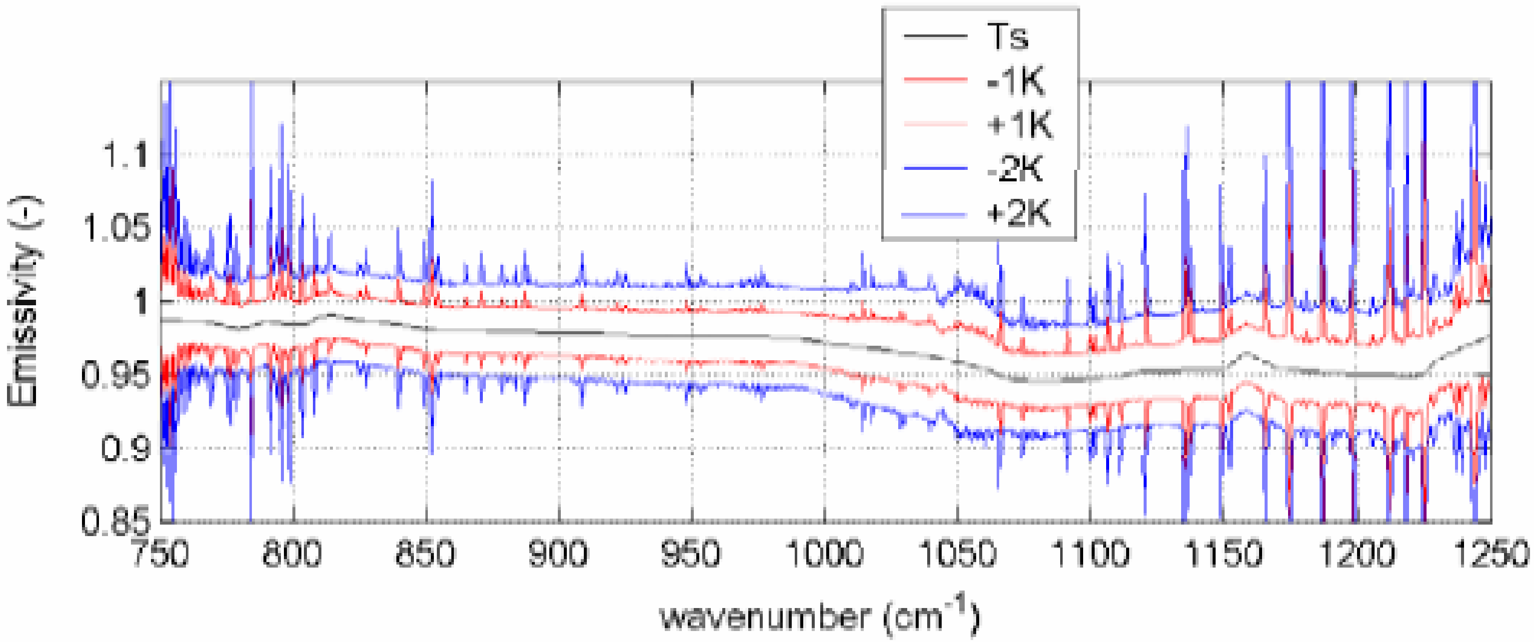
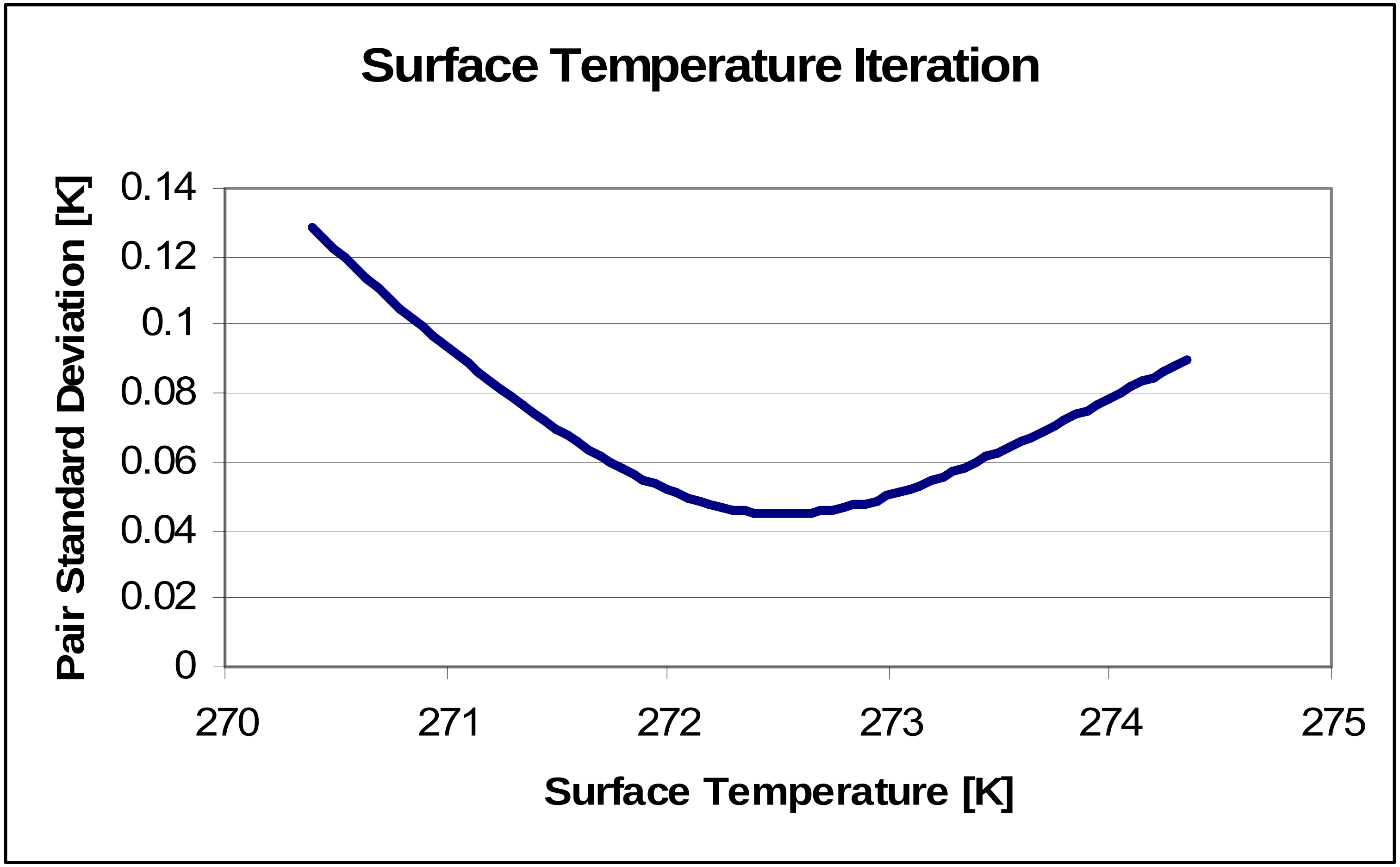
Background

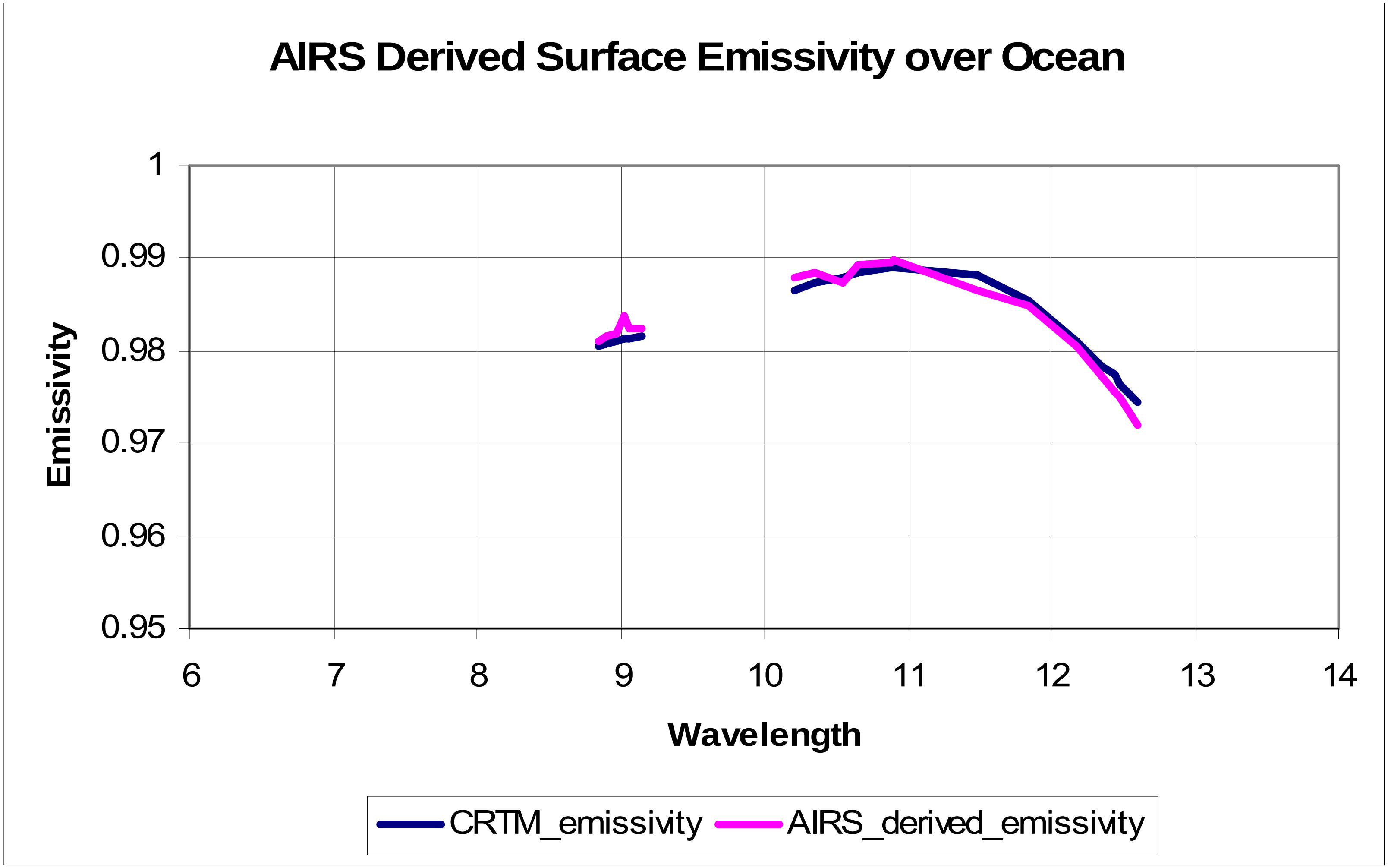
- Used by R. Knuteson et al.
- Iterate skin temp to find minimum variance in emissivity from surface channels
- Use skin temp and model atmosphere to derive new surface emissivity.
- Requires a significant number of surface channels.

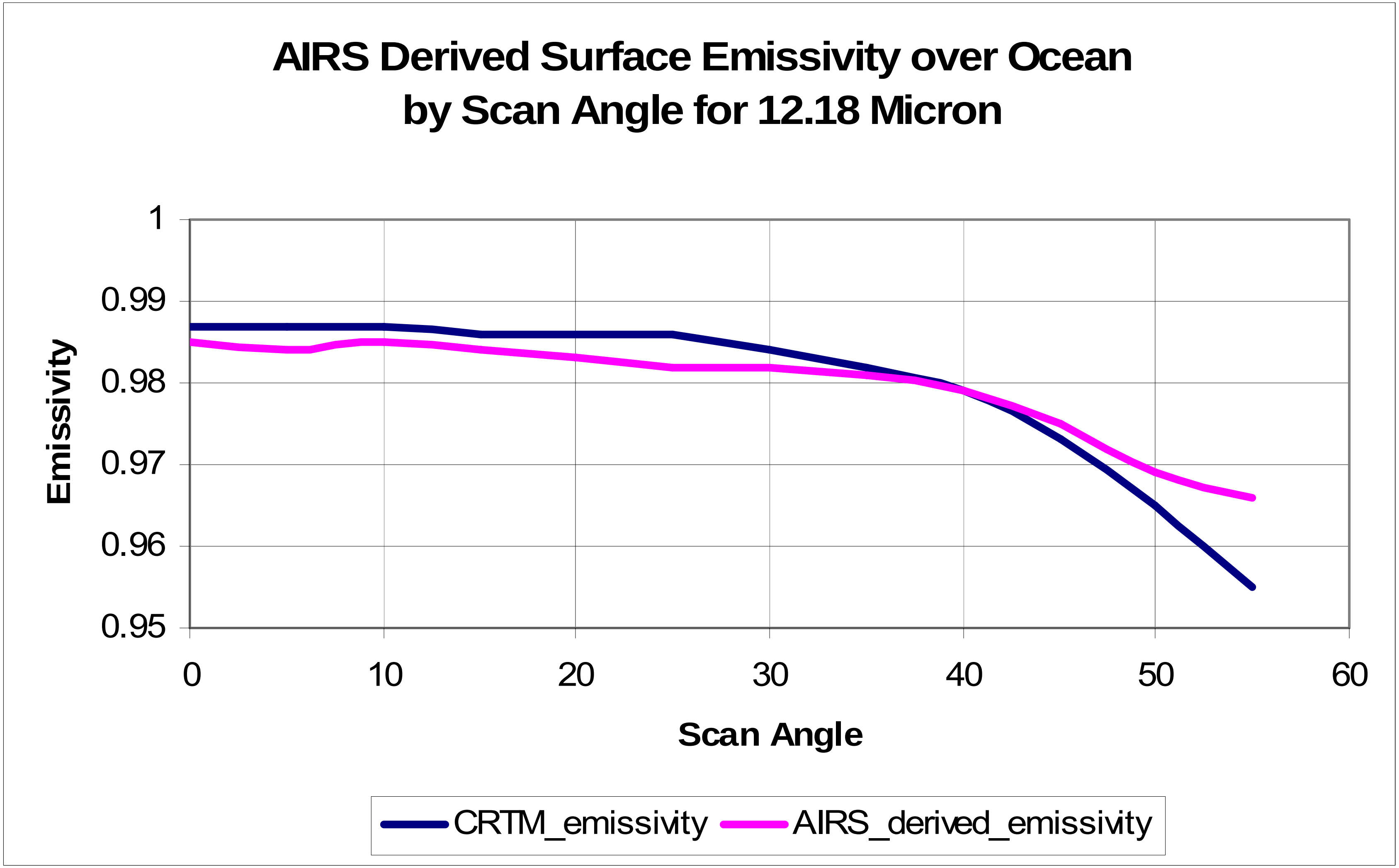


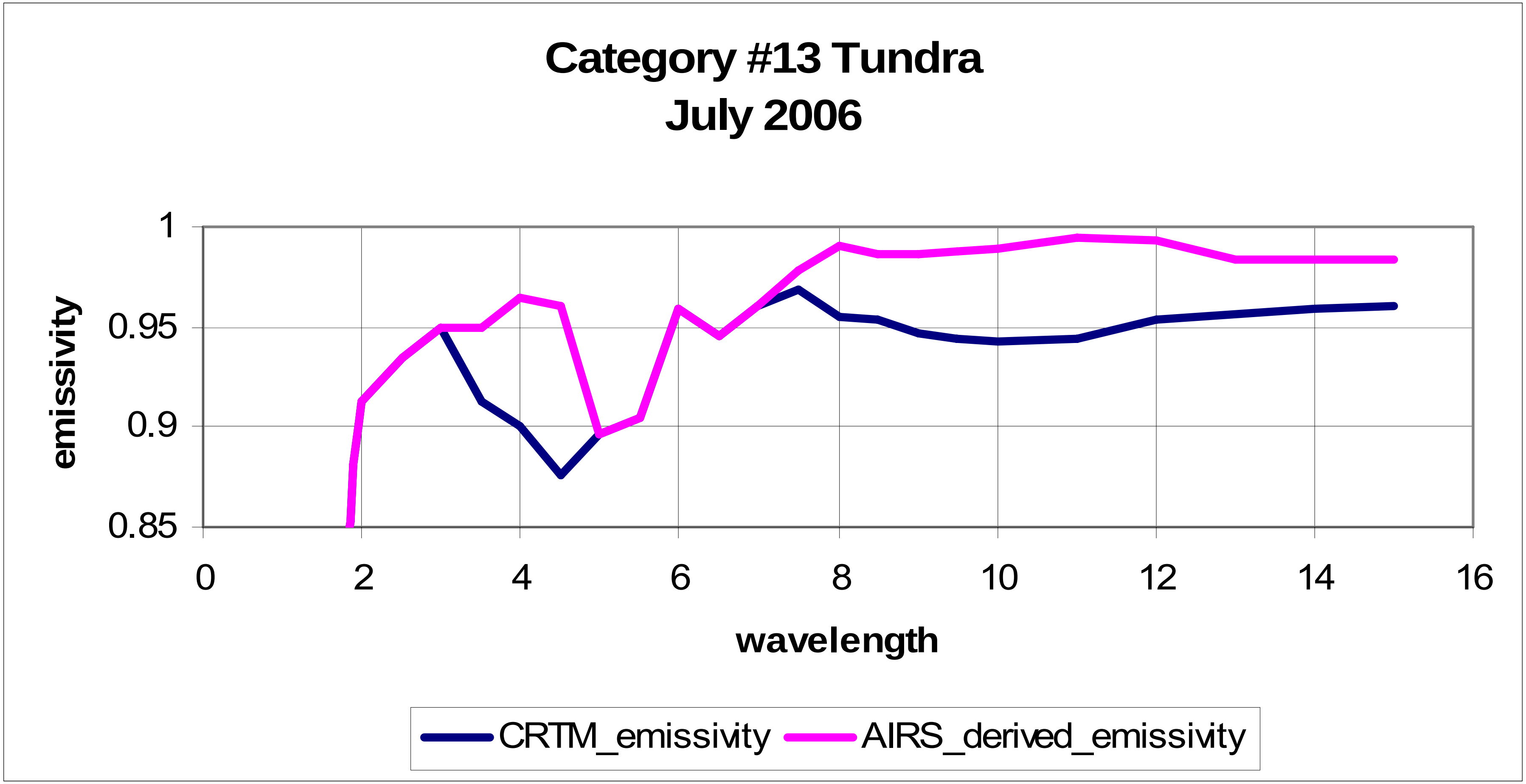
From R. Knuteson (2003)



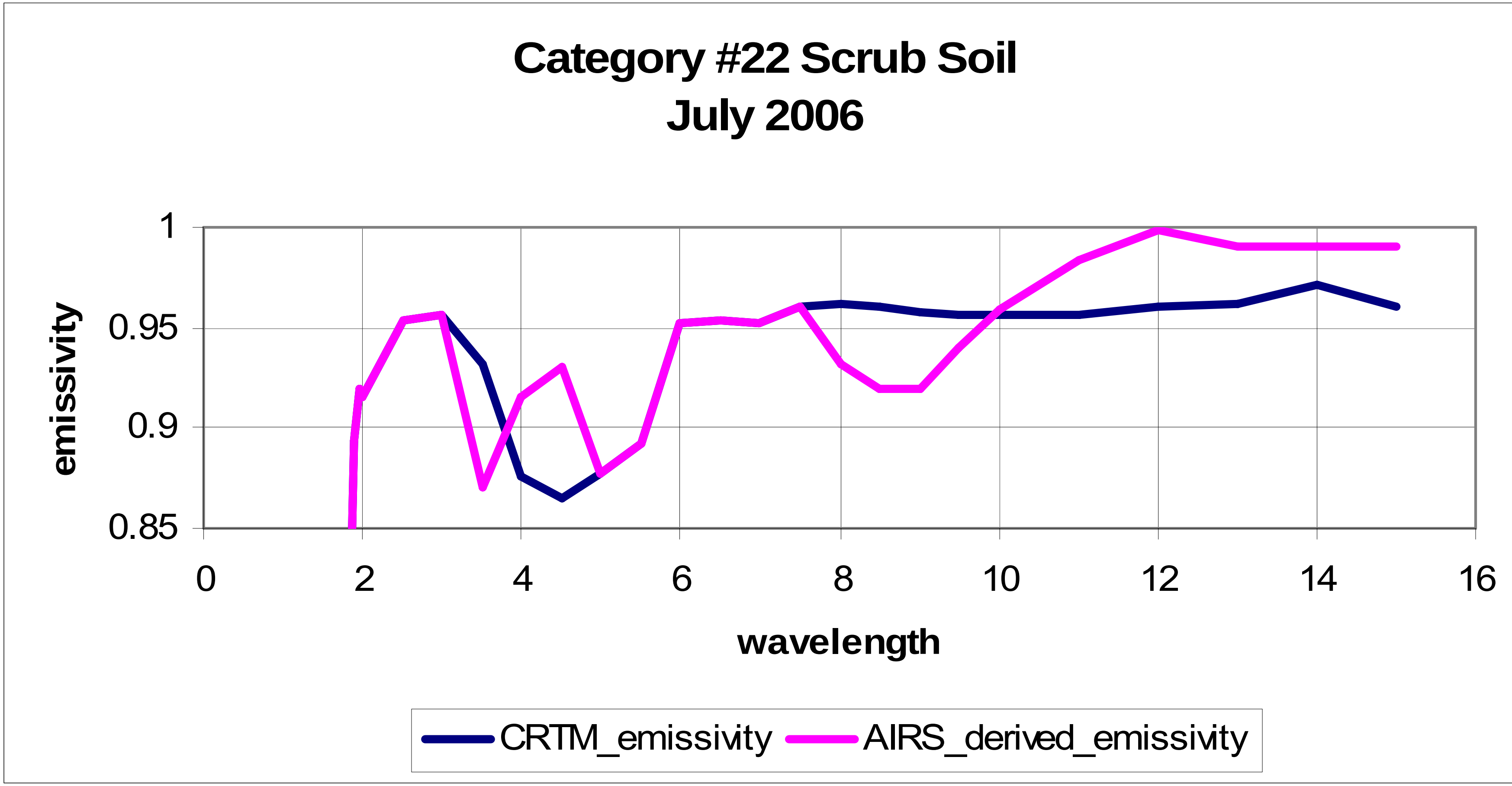
Surface Temperature Iteration
Pair Standard Deviation [K]
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
270
271
272
273
274
275
Surface Temperature [K]


AIRS Derived Surface Emissivity over Ocean
Emissivity
1
0.99
0.98
0.97
0.96
0.95
6
7
8
9
10
11
12
13
14
Wavelength
CRTM_emissivity
AIRS_derived_emissivity


AIRS Derived Surface Emissivity over Ocean
by Scan Angle for 12.18 Micron
Emissivity
1
0.99
0.98
0.97
0.96
0.95
0
10
20
30
40
50
60
Scan Angle
CRTM_emissivity
AIRS_derived_emissivity



Category #13 Tundra
July 2006
1
0.95
0.9
0.85
emissivity
0
2
4
6
8
10
12
14
16
wavelength
CRTM_emissivity
AIRS_derived_emissivity



Category #22 Scrub Soil
July 2006
emissivity
1
0.95
0.9
0.85
0
2
4
6
8
10
12
14
16
wavelength
CRTM_emissivity
AIRS_derived_emissivity

Results

- Replicates surface emissivity over ocean (Wu and Smith 1997) reasonably well, including scan angle dependence
- Tends to be noisy.
- Preliminary calculations over land and ice look encouraging.

Future Work

- Noise reduction
  - SARTA (?)
  - More surface channels
  - Eigenvector technique (Smith)
- Spectral resolution
  - Better representation of emissivity curve
  - Scan angle dependence over land and ice
- Investigate potential use within NWP
  - Emissivity seasonal cycle
  - Land categories (now)
  - Land emissivity map

Atmospheric Motion Vector Assimilation Experiments

Tom Zapotocny
John LeMarshall, Chris Redder
James Jung

Background

- EE theory
- Model / Rawinsonde Comparison
- Initial experimental results
- Future plans

Quality Indicator (QI)

Considers

- Direction consistency (pair)
- Speed consistency (pair)
- Vector consistency (pair)
- Spatial Consistency
- Forecast Consistency

$$QI = \sum w_i . QV_i / \sum w_i$$

EE - provides RMS Error (RMS)

Estimated from

the five QI components
wind speed
vertical wind shear
temperature shear
pressure level

which are used as predictands for
root mean square error

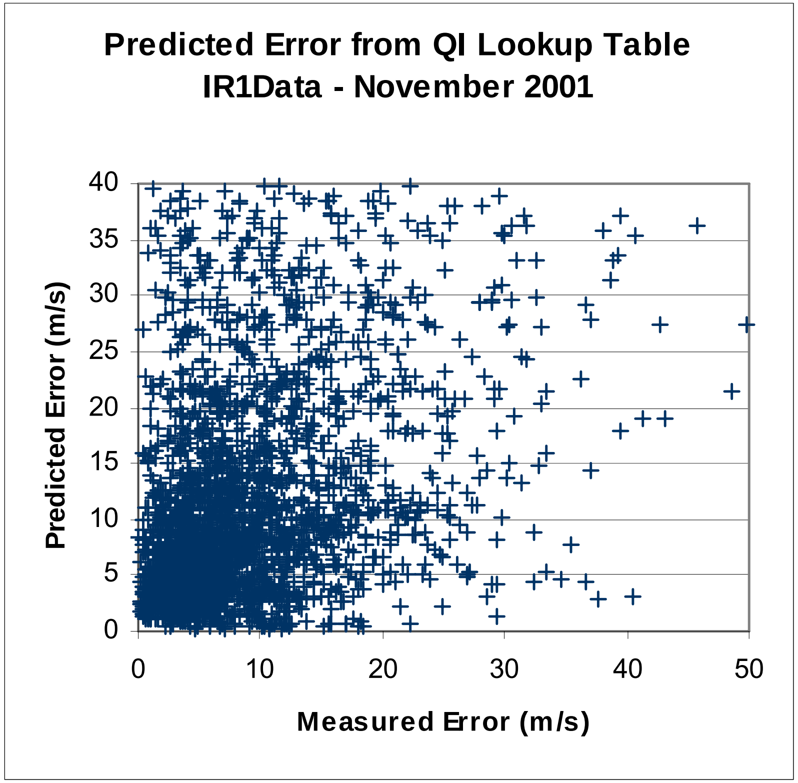


Fig. 4 (a): Predicted error using the QI lookup table

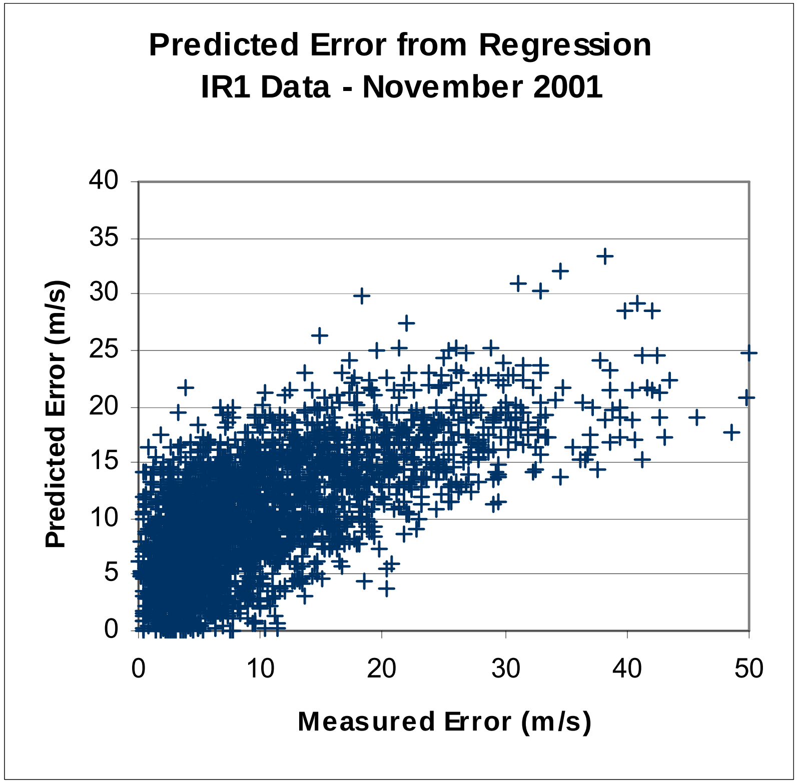
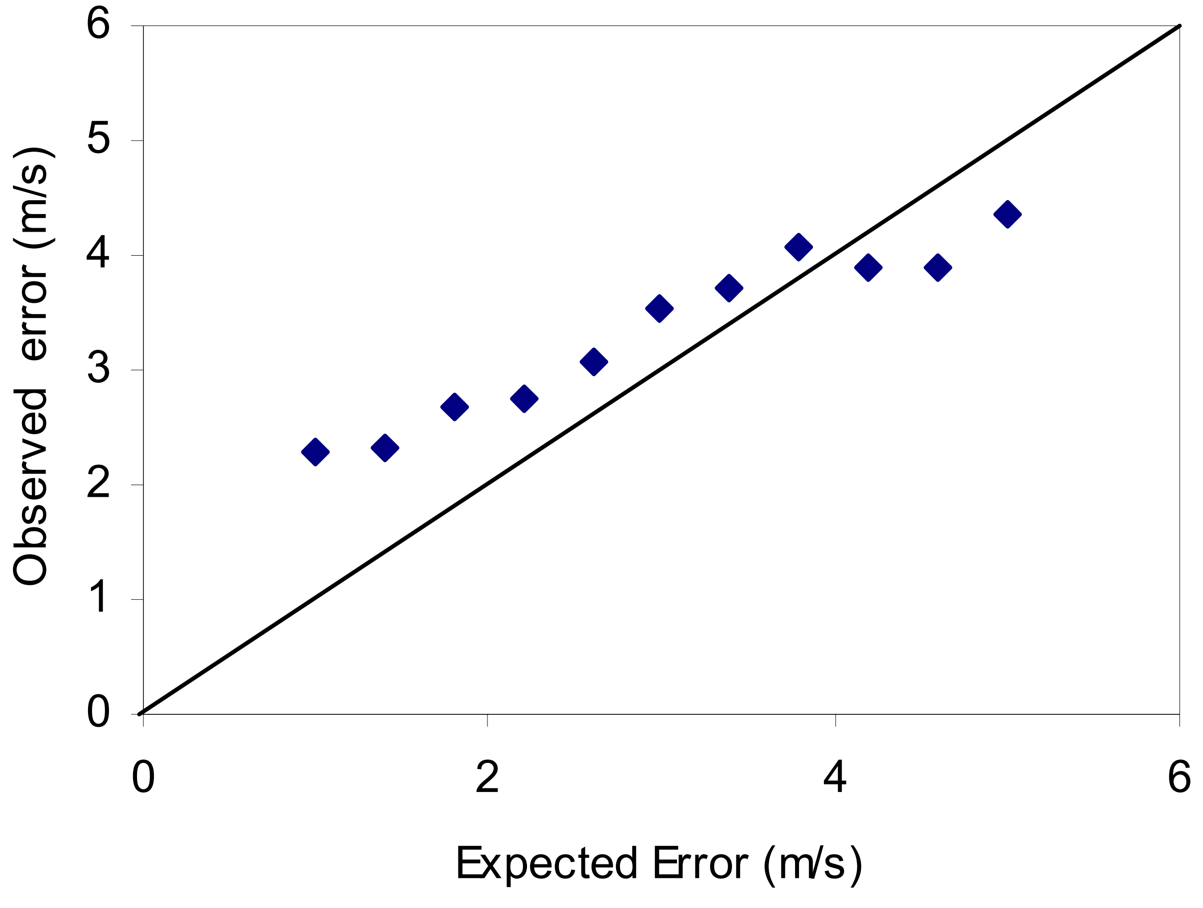
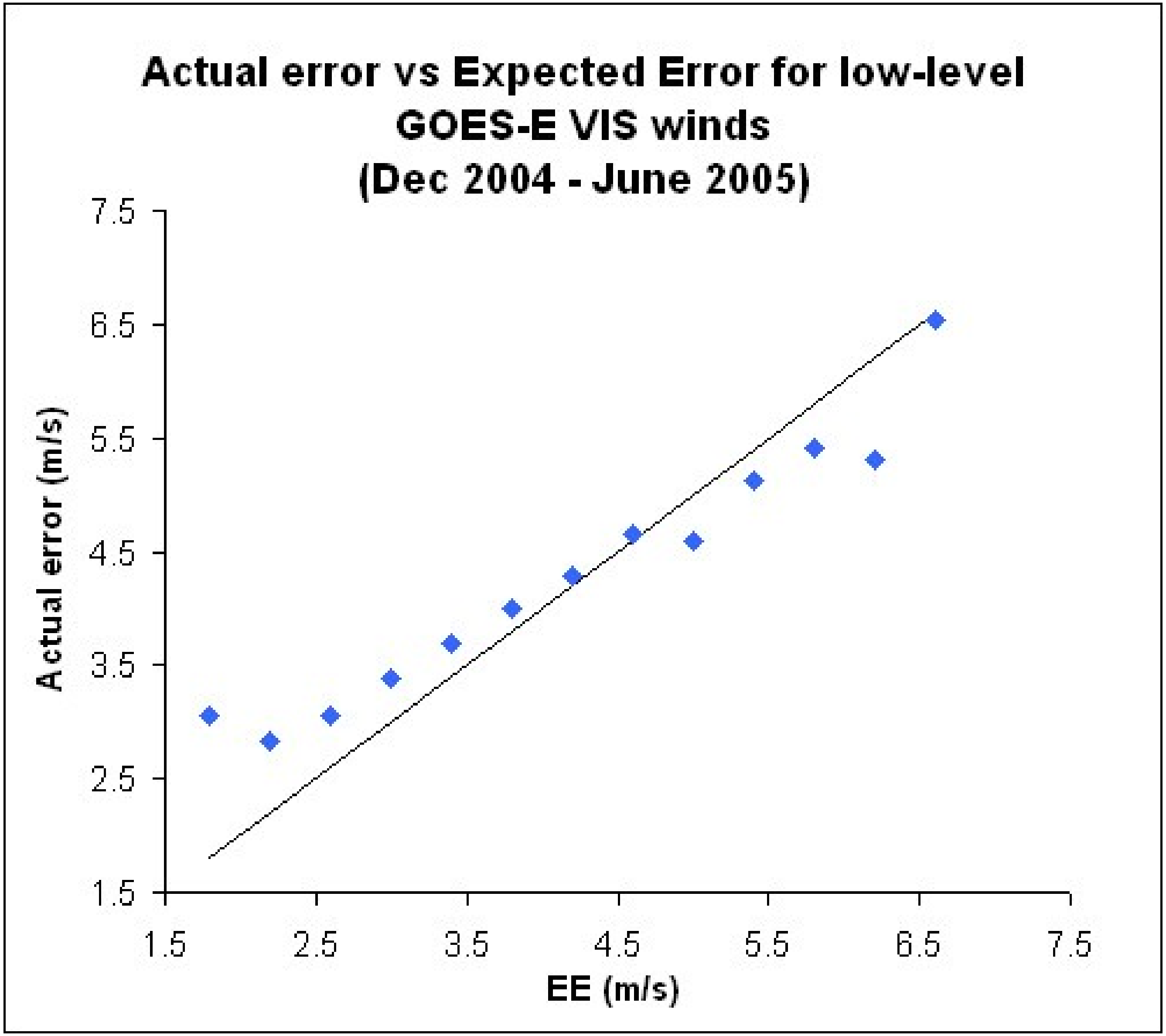
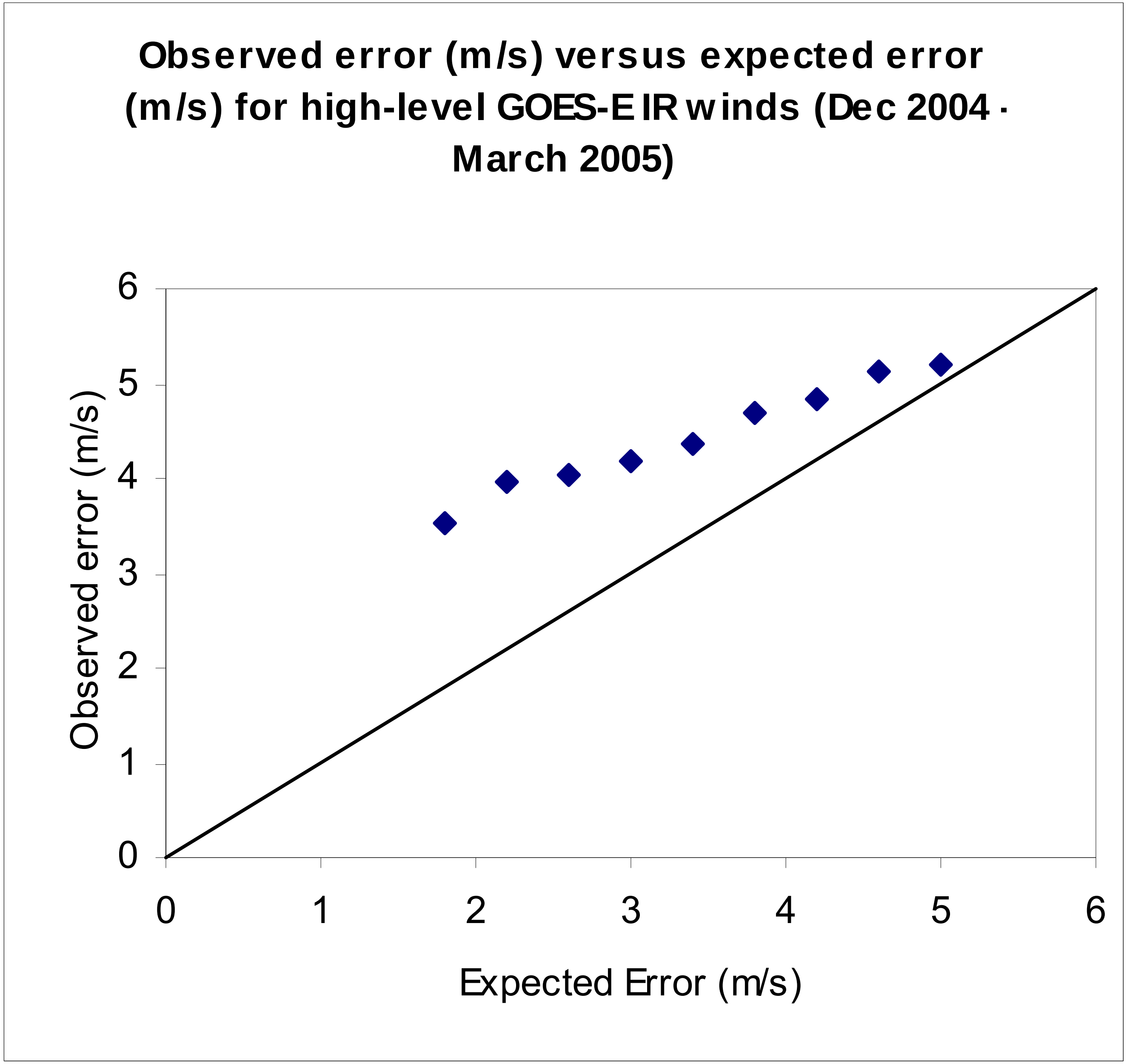


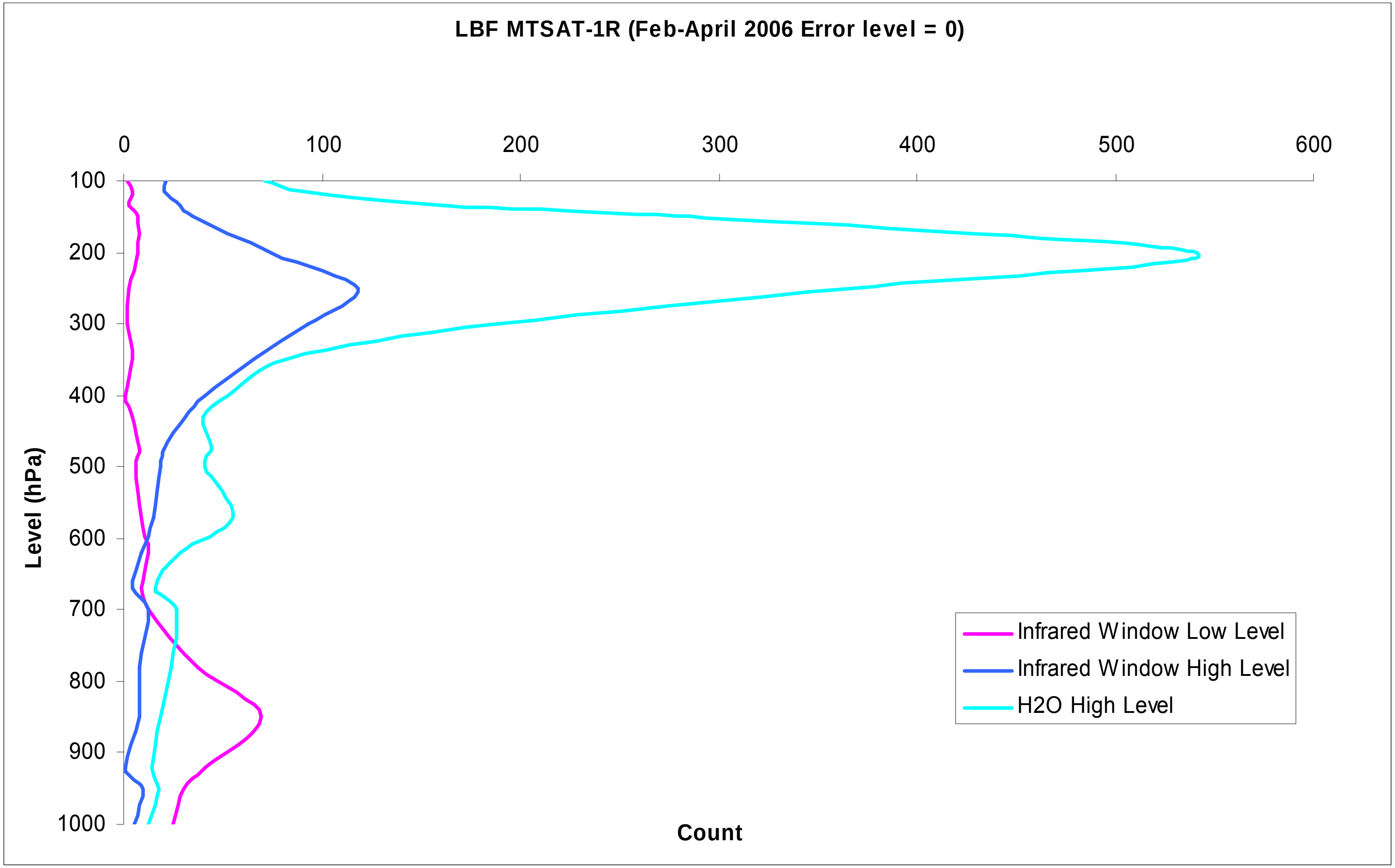
Fig. 4 (b): Predicted error using the EE regression approach

Observed error (m/s) versus expected error (m/s) for low-level GOES-E IR winds (Dec 2004 - March 2005)




Actual error vs Expected Error for low-level
GOES-E VIS winds
(Dec 2004 - June 2005)
Actual error (m/s)
7.5
6.5
5.5
4.5
3.5
2.5
1.5
1.5
2.5
3.5
4.5
5.5
6.5
7.5
EE (m/s)


Observed error (m/s) versus expected error (m/s) for high-level GOES-E IR winds (Dec 2004 - March 2005)
Observed error (m/s)
Expected Error (m/s)
0
1
2
3
4
5
6
0
1
2
3
4
5
6



LBF MTSAT-1R (Feb-April 2006 Error level = 0)
0
100
200
300
400
500
600
100
200
300
400
500
600
700
800
900
1000
Level (hPa)
Count
Infrared Window Low Level
Infrared Window High Level
H2O High Level

EE is calculated for:

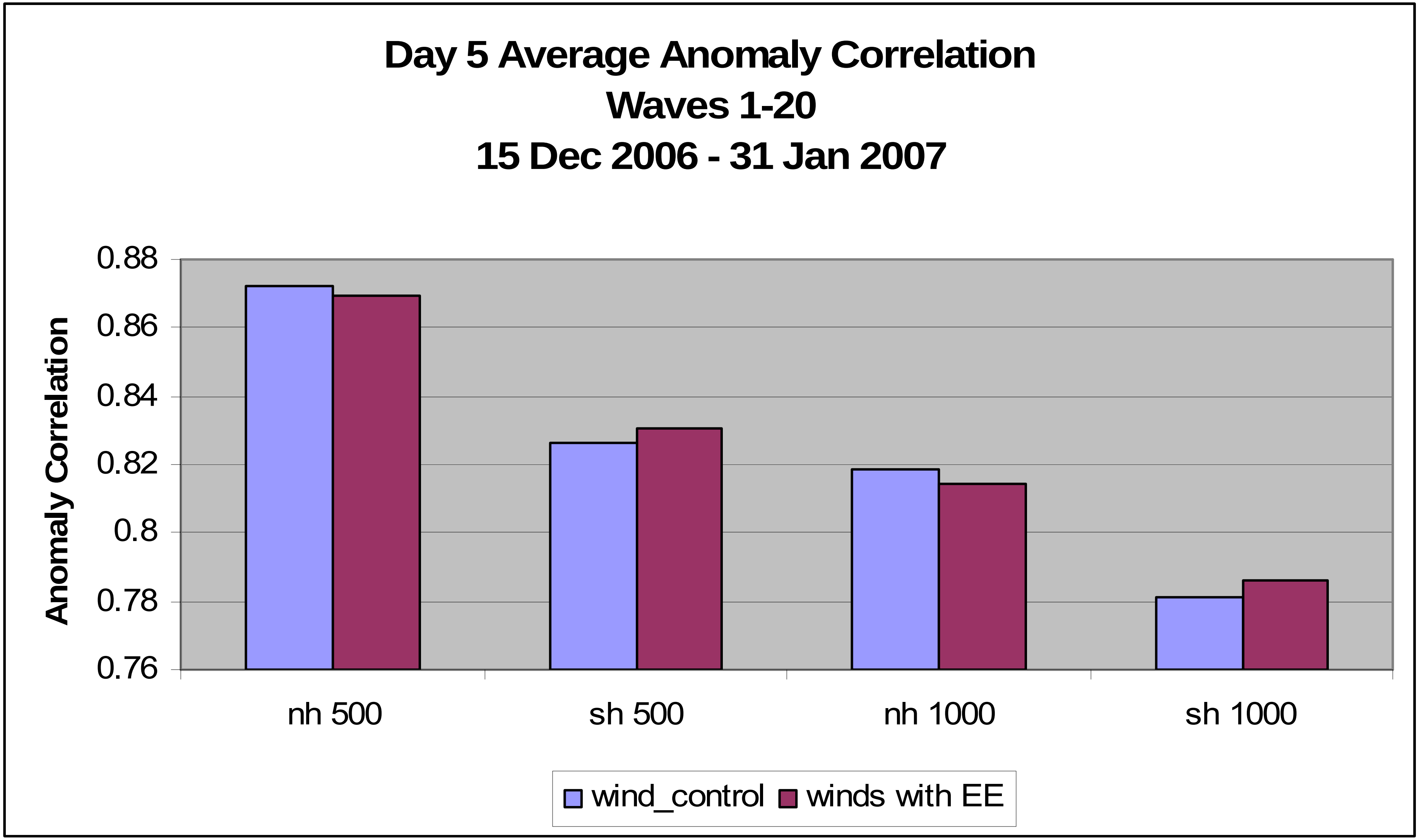
- GOES – 11 IR,WV,VIS,(SWIR)
- GOES – 12 IR,WV,VIS,(SWIR)
- AQUA-MODIS IR, WV
- TERRA-MODIS IR, WV

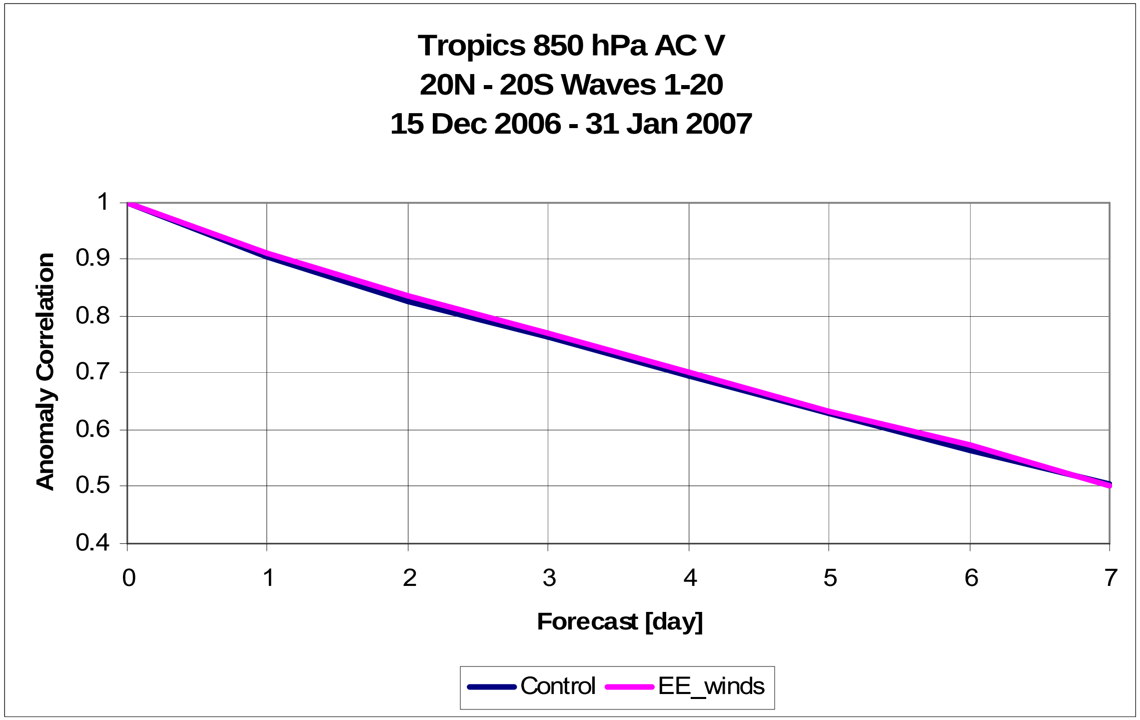
Could get EE via BOM for:

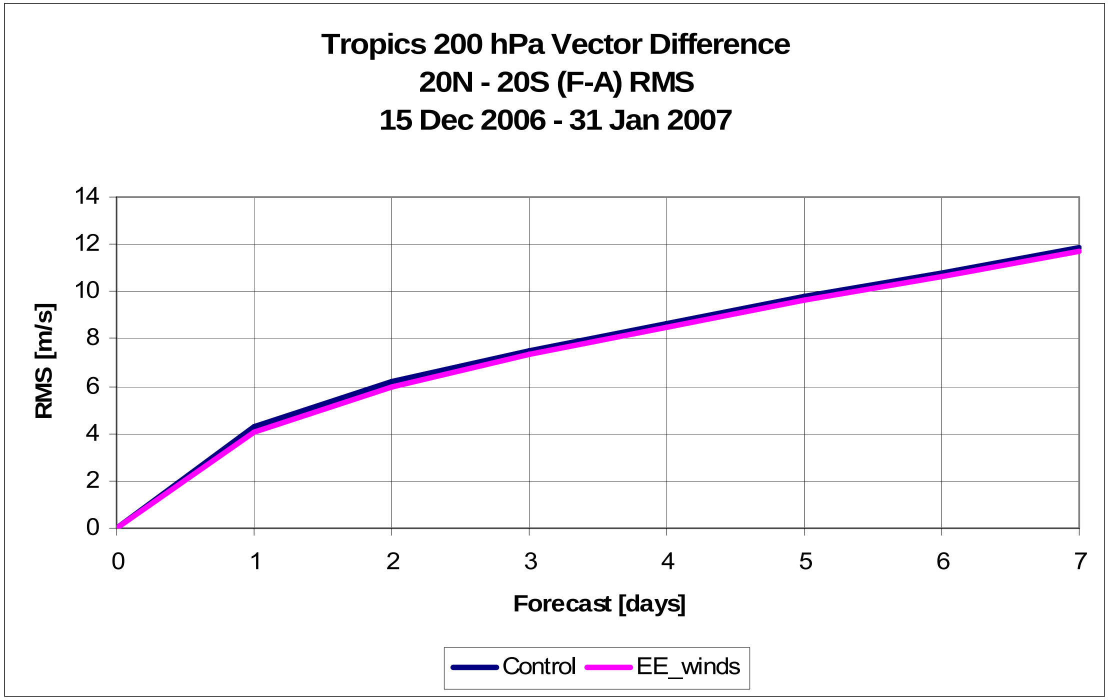
- MTSAT IR
- FY-2C IR

Assimilation Technique

- 200701 version of GSI
- Hybrid Coordinates
- T382L64
- Control and experiment use the same winds BUFR files.
  - The EE is ignored in the control
- Low, middle and high cutoff values for EE used
  - Low < 3.0 m/s
  - Mid < 2.5 m/s
  - High < 4.5 m/s
- Thresholds based on error comparisons to rawinsondes


Day 5 Average Anomaly Correlation
Waves 1-20
15 Dec 2006 - 31 Jan 2007
Anomaly Correlation
0.88
0.86
0.84
0.82
0.8
0.78
0.76
nh 500
sh 500
nh 1000
sh 1000
wind_control
winds with EE


Tropics 850 hPa AC V
20N - 20S Waves 1-20
15 Dec 2006 - 31 Jan 2007
Anomaly Correlation
1
0.9
0.8
0.7
0.6
0.5
0.4
0
1
2
3
4
5
6
7
Forecast [day]
Control
EE_winds


Tropics 200 hPa Vector Difference
20N - 20S (F-A) RMS
15 Dec 2006 - 31 Jan 2007
RMS [m/s]
14
12
10
8
6
4
2
0
0
1
2
3
4
5
6
7
Forecast [days]
Control
EE_winds

Results

- Better in Southern Hemisphere
  - 20S-80S (midlatitude)
  - 60S-90S (pole)
- Better in tropics
  - 20N – 20S
- Worse in Northern Hemisphere
  - 20N-80N (midlatitudes)
  - 60N-90N (pole)

Future Work

- Investigate EE with respect to model
  - Mean-Vector-Difference
  - Height assignment method
- Investigate Improved height assignment from using CALIPSO in coordination with:
  - NESDIS (Jaime Daniels)
  - CIMSS (Steve Ackerman, Chris Velden, Iliana Genkova)

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