AIRS/AMSU Cloud Clearing and Detection

William J. Blackwell and David H. Staelin
MIT Research Laboratory of Electronics

AIRS Science Team Meeting
Pasadena, California
November 6, 2001

Outline:

1. Simulation Assumptions
2. Cloud Clearing Performance for Six Methods
3. Cloud Clearing Sensitivity Analyses
4. Detection of Problematic Golf Balls
5. Summary / Conclusion

■
77 Massachusetts Ave. Room 26-345
Cambridge, MA 02139
617 253-2571
FAX 617 258-7864

WJB

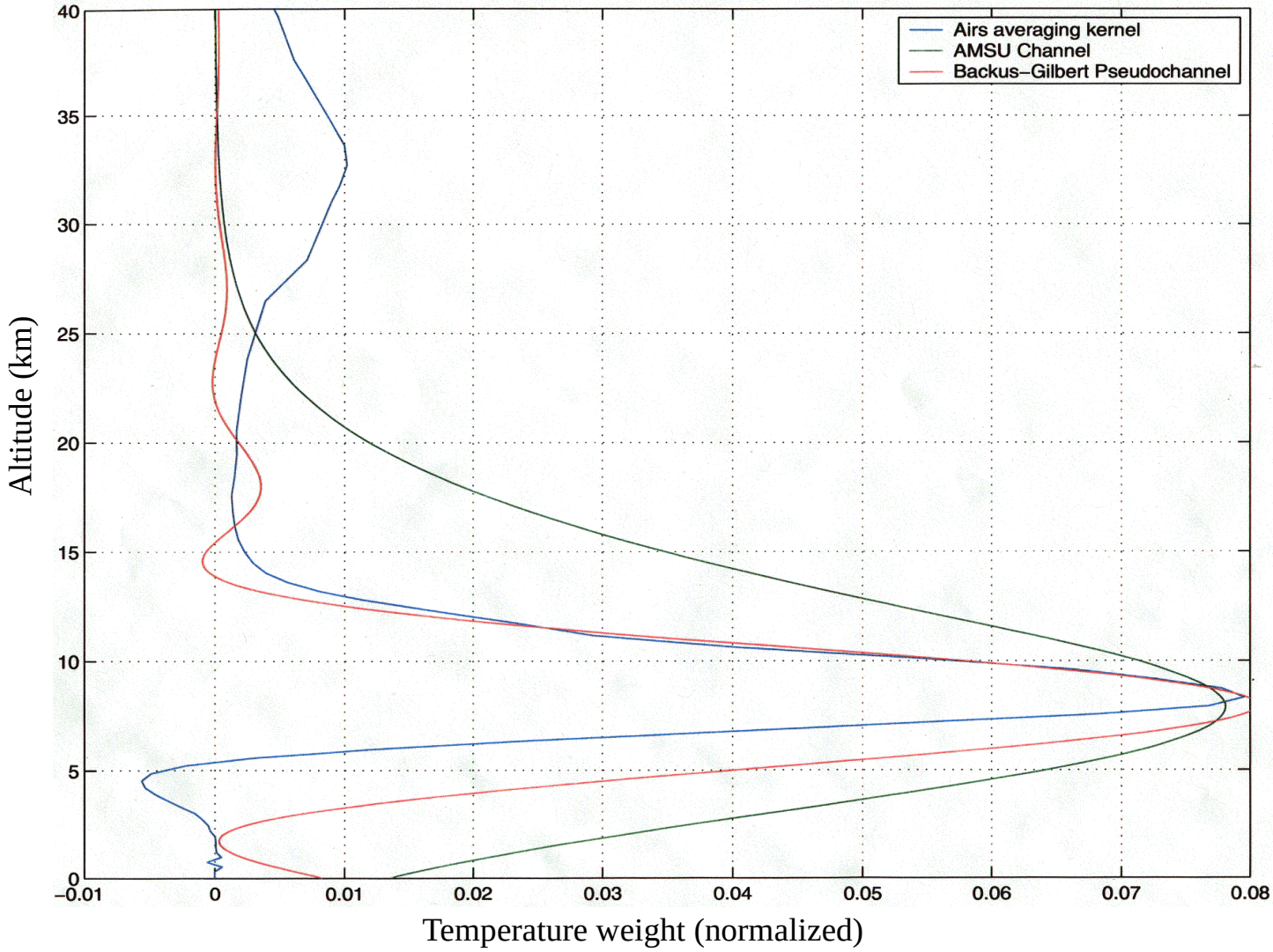
Simulation Assumptions

1. GCM Profile set (12000 profiles, two cloud layers, various cloud top pressures)
2. Random surface emissivity (microwave): mean = 0.94, std = 0.05
3. Random surface emissivity (infrared): mean = 0.97, std = 0.025

■
77 Massachusetts Ave. Room 26-345
Cambridge, MA 02139
617 253-2571
FAX 617 258-7864

WJB

Weighting Function Comparison: AIRS vs. AMSU

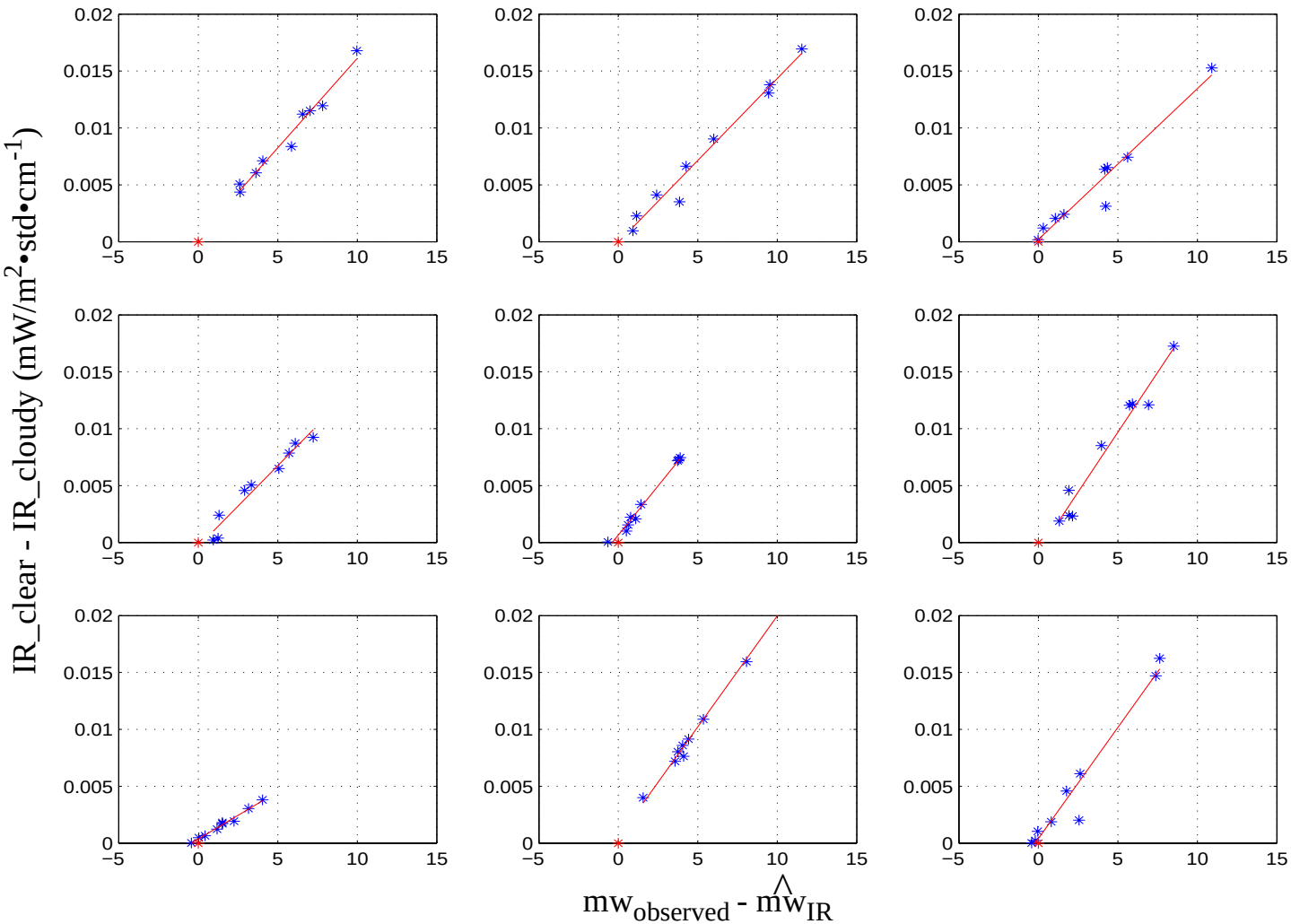


■

77 Massachusetts Ave. Room 26-345
Cambridge, MA 02139
617 253-2571
FAX 617 258-7864

WJB

Pixel 4.19-micron Radiance Regressions vs. Cloud Flags



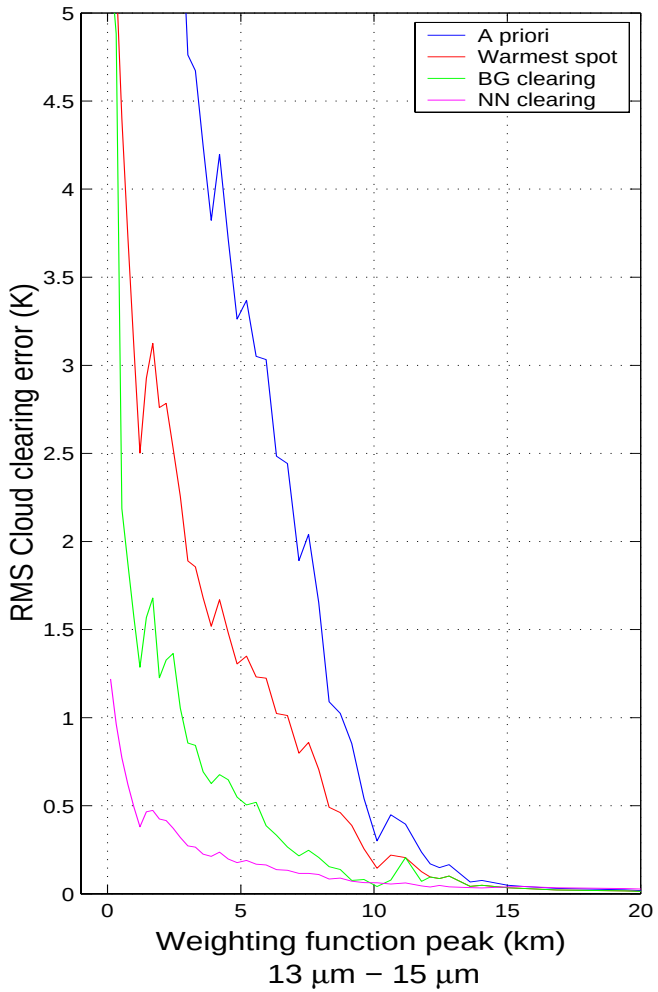
Nine representative pixel clusters are shown

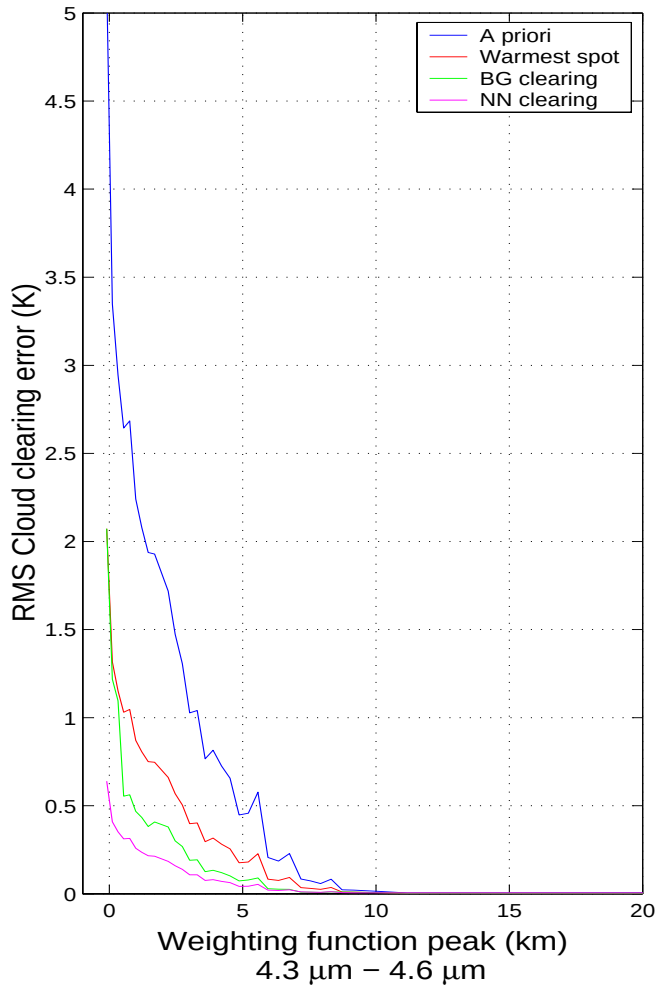
■

77 Massachusetts Ave. Room 26-345
Cambridge, MA 02139
617 253-2571
FAX 617 258-7864

WJB

Cloud Clearing Performance Bounds for Six Methods: Part I

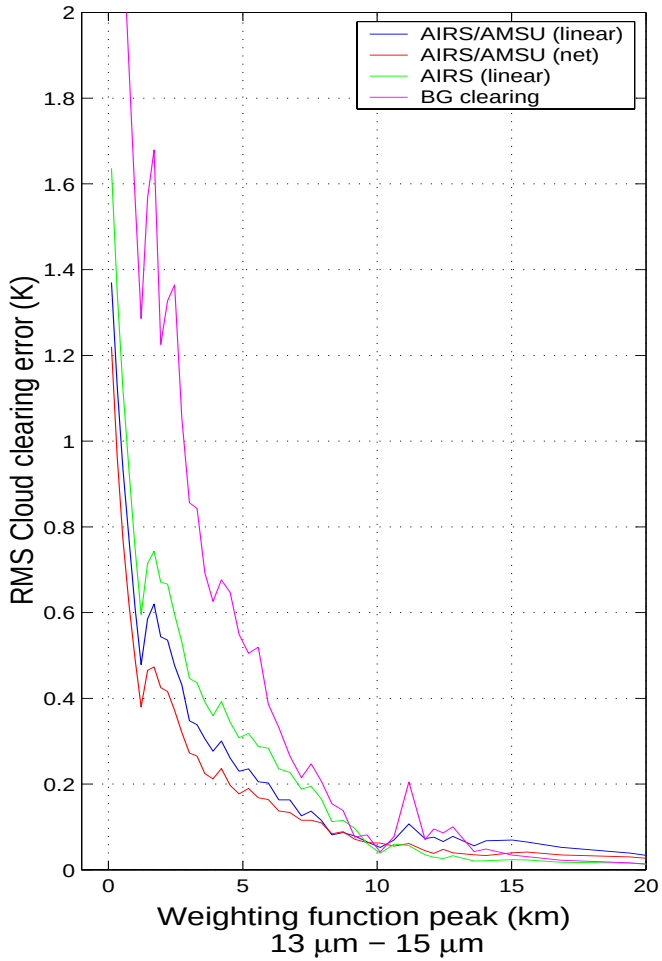


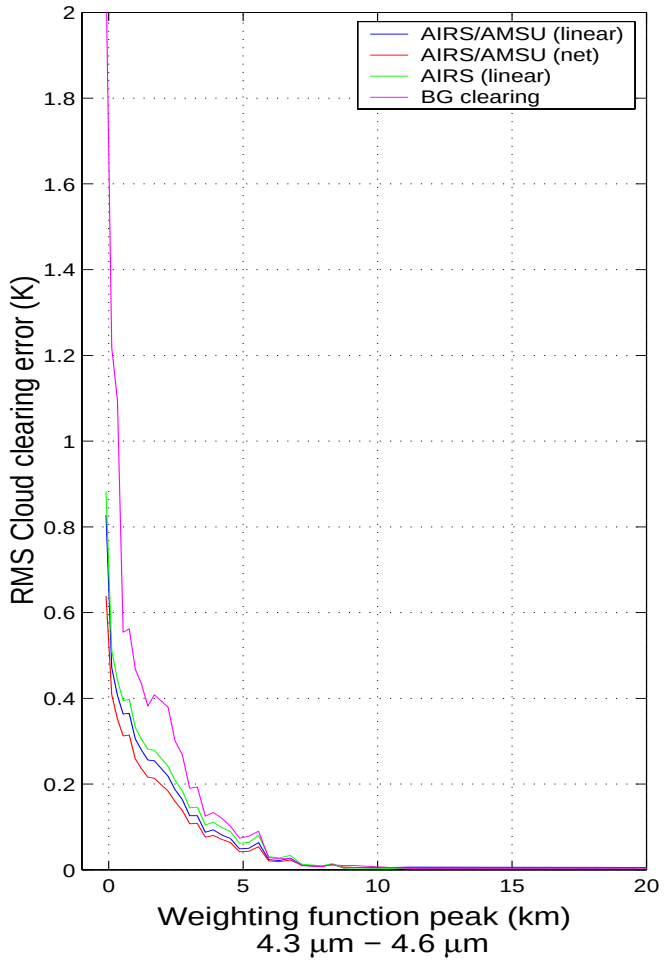


■
77 Massachusetts Ave. Room 26-345
Cambridge, MA 02139
617 253-2571
FAX 617 258-7864

WJB

Cloud Clearing Performance Bounds for Six Methods: Part II

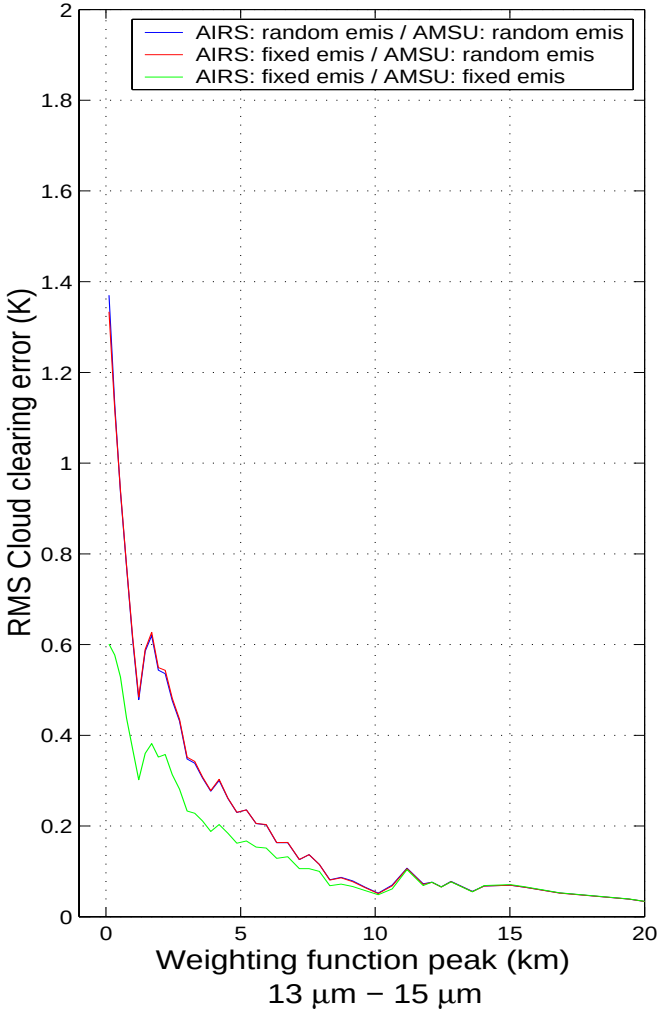


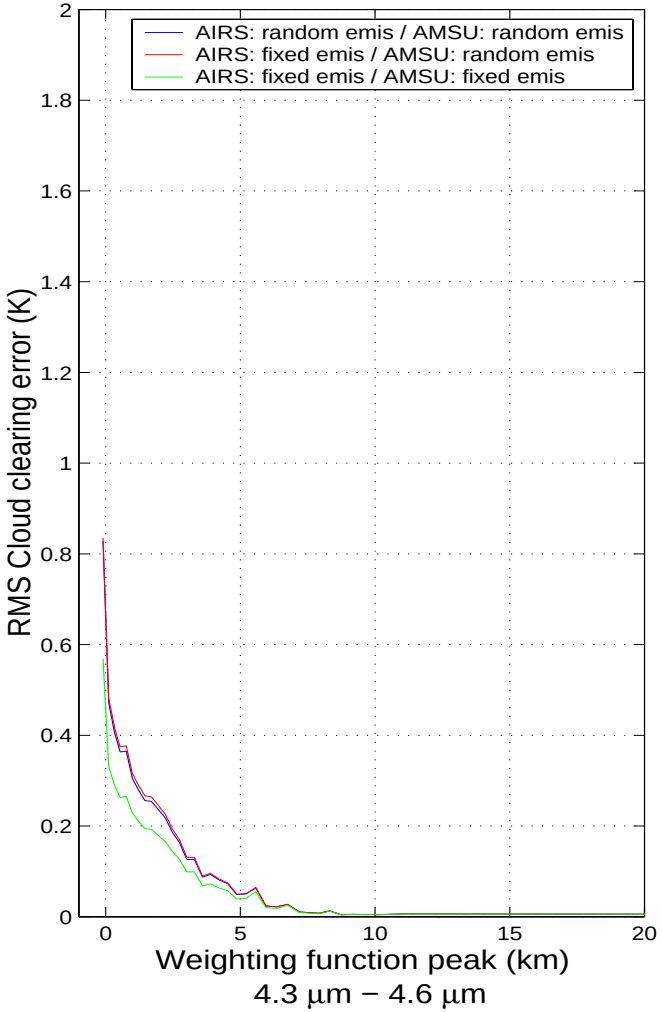


77 Massachusetts Ave. Room 26-345
Cambridge, MA 02139
617 253-2571
FAX 617 258-7864

WJB

Cloud Clearing Sensitivity Analysis

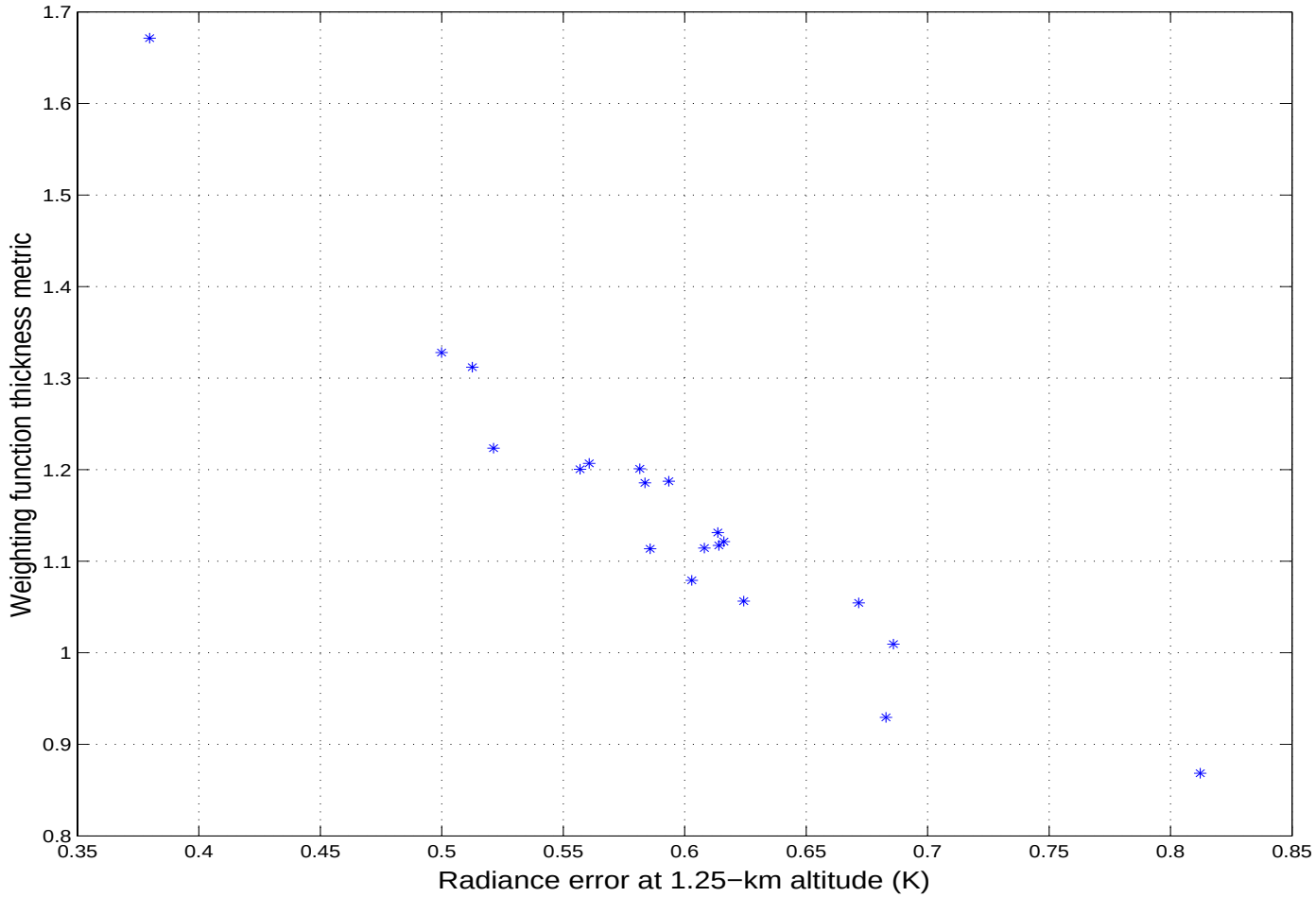




■
77 Massachusetts Ave. Room 26-345
Cambridge, MA 02139
617 253-2571
FAX 617 258-7864

WJB

CC Error vs. AIRS Weighting Function Width

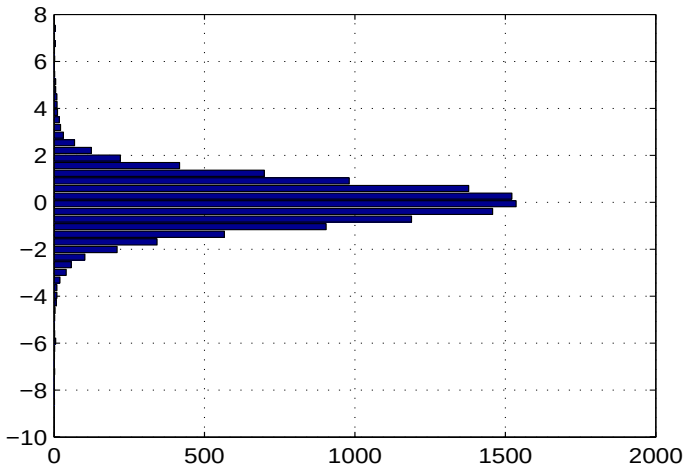


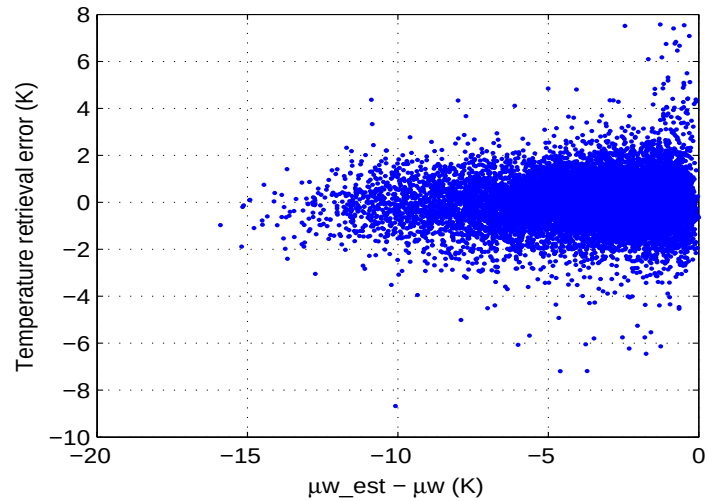
■

77 Massachusetts Ave. Room 26-345
Cambridge, MA 02139
617 253-2571
FAX 617 258-7864

WJB

Cloud Flag / Temperature Retrieval Correlation



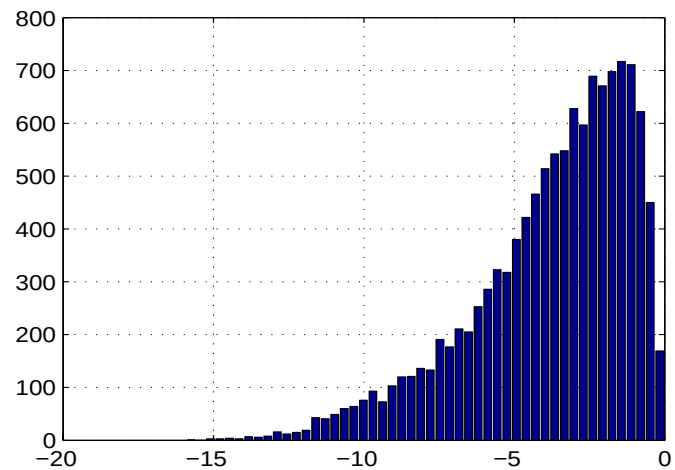


X axis

μw_{est} = μw(53.6 GHz) estimated from IR (single pixel)

Y axis

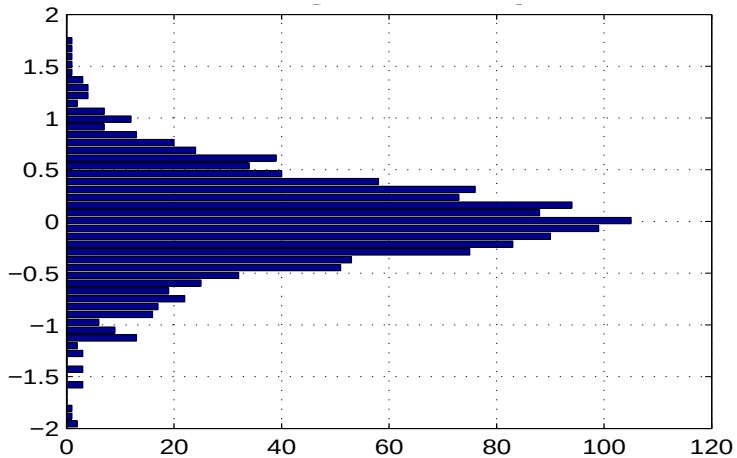
Temperature retrieval error (4.2 km, black surface)

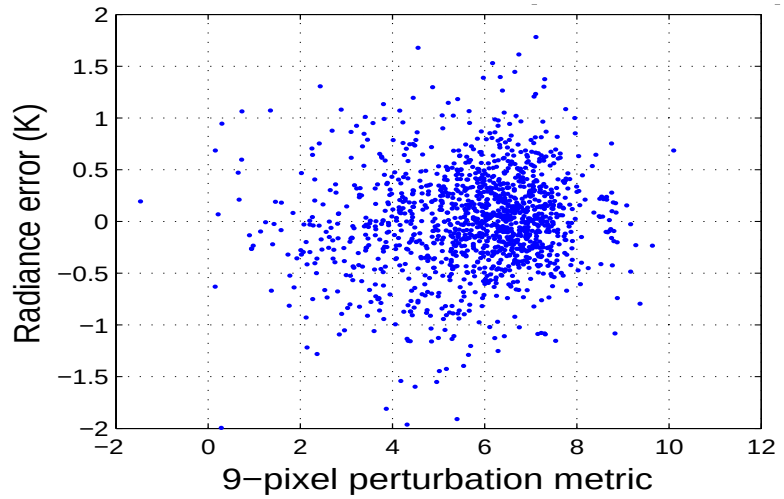


■
77 Massachusetts Ave. Room 26-345
Cambridge, MA 02139
617 253-2571
FAX 617 258-7864

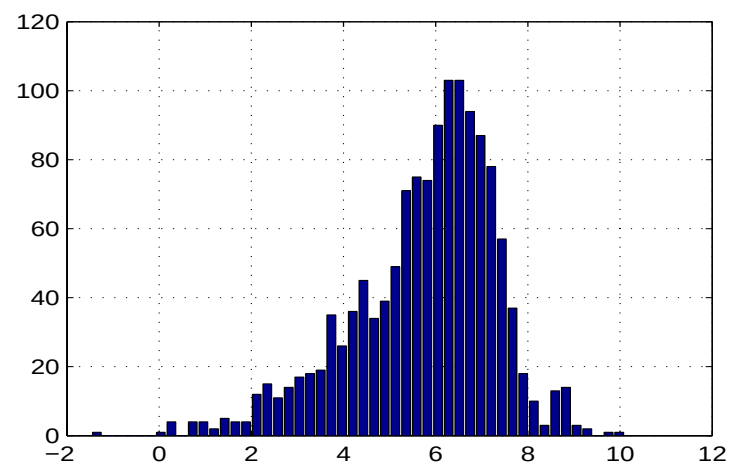
WJB

Cloud Flag / Temperature Retrieval Correlation (Golf Ball)





4.2 km, 53.6 GHz, 13.71 μm



■

77 Massachusetts Ave. Room 26-345
Cambridge, MA 02139
617 253-2571
FAX 617 258-7864

WJB

Summary/Conclusions

1. Radiance cloud clearing success is a function of weighting function altitude
2. For two clouds Modified-N* substantially outperforms warmest pixel method
3. Regression-based radiance clearing or neural nets outperform Modified-N*
4. Combining microwaves with IR at the pixel level always helps
5. Microwave surface emissivity uncertainties are a key contributor to residual errors
6. Single-pixel radiance clearing errors are nearly undetectable even if large
7. Golf ball radiance clearing errors may be undetectable even if large (based on one strategy)

■

77 Massachusetts Ave. Room 26-345
Cambridge, MA 02139
617 253-2571
FAX 617 258-7864

WJB