HIGH-ALTITUDE MMIC SOUNDING RADIOMETER (HAMSR) FOR THE GENESIS AND RAPID INTENSIFICATION PROCESSES (GRIP) FIELD EXPERIMENT

Boon Lim, Shannon Brown, Richard Denning, Pekka Kangaslahti,
Bjorn Lambrigtsen, Jordan Tanabe, and Alan Tanner

Jet Propulsion Laboratory
M/S 168-314
4800 Oak Gove Drive, Pasadena, CA 91109
(phone) 818-354-3068
Boon.H.Lim@jpl.nasa.gov

ABSTRACT

The Jet Propulsion Laboratory's (JPL) High Altitude MMIC Sounding Radiometer (HAMSR) is a 25 channel cross-track scanning microwave sounder with 8 sounding channels near the 60 GHz oxygen line complex, 10 channels near the 118.75 GHz oxygen line and 7 channels near the 183.31 GHz water vapor line. It has participated in three previous hurricane field campaigns, CAMEX-4 (2001), TCSP (2005) and NAMMA (2006) [1,2]. In August-September 2010, HAMSR will participate on the Global Hawk unmanned aerial vehicle (UAV) in the NASA Genesis and Rapid Intensification Processes (GRIP) field experiment to study tropical cyclone development and intensification. A main application for the HAMSR instrument is monitoring the atmospheric state by retrieving 3-dimensional profiles of temperature, water vapor and cloud liquid water using a 1-D variational retrieval algorithm. The extended flight duration of the UAV will provide continuous observation of the storm structure and evolution with the added benefit of co-located satellite overpasses.

Beginning in 2008, HAMSR has undergone a major system upgrade under the NASA AITT program to prepare it for the Global Hawk. This includes the addition of state-of-the-art low noise amplifiers (funded by NASA ESTO and developed at JPL) to the 118 GHz and 183 GHz receivers, an upgraded data system capable of on-board science

processing and real-time communication with the Global Hawk data network, a consolidated instrument package and an updated mirror scanning motor. The system maintains the end-to-end two point calibration system with the antennas viewing two external targets every scan. The low noise amplifiers are broadband with low noise and high gain [3,4], have been integrated into HAMSR decreasing the noise figure for the 118 GHz receiver to 4.1 dB and the 183 GHz receiver to 4.9 dB. This represents approximately a three-fold and nine-fold improvement in the NEΔT for the 118 GHz and 183 GHz channels respectively.

Another major objective of the AITT program is to fully characterize and calibrate the HAMSR instrument to ensure the excellent retrievals and to provide high quality brightness temperature datasets for the purpose of algorithm development and satellite validation. Of particular interest are the hurricane warm core anomaly [5] and 'cloud-slicing' techniques [6]. Calibration tests will include characterization of along scan biases, receiver linearity, absolute calibration, stability and end-to-end pass band characterization. These measurements are currently being performed at JPL. The calibration methodology is discussed and the results summarized to provide an overall performance assessment of the radiometer ahead of its deployment in 2010.

Pre-GRIP test flights are scheduled to occur in May 2010. Data and results from the test flights will be presented if available.

REFERENCES

[1] B.H. Lambrigtsen and L.A. Riley, "Microwave scattering observed in convective cells during CAMEX-4," *AMS 25th Conference on Hurricanes and Tropical Meteorology*, 2002.

[2] S. Brown, B. Lambrigtsen, A. Tanner, J. Oswald, D. Dawson, and R. Denning, "Observations of tropical cyclones with a 60, 118 and 183 GHz microwave sounder," *Geoscience and Remote Sensing Symposium, 2007. IGARSS 2007. IEEE International*, 2007, pp. 3317-3320.

[3] P. Kangaslahti, W. Deal, X. Mei, and R. Lai, "Broadband Characterization of a 100 to 180 GHz Amplifier," *Aerospace Conference, 2008 IEEE*, 2008, pp. 1-6.

[4] P. Kangaslahti, D. Pukala, T. Gaier, W. Deal, Xiaobing Mei, and R. Lai, "Low noise amplifier for 180 GHz frequency band," *Microwave Symposium Digest, 2008 IEEE MTT-S International*, 2008, pp. 451-454.

[5] K. Bessho, M. DeMaria, and J.A. Knaff, "Tropical Cyclone Wind Retrievals from the Advanced Microwave Sounding Unit: Application to Surface Wind Analysis," *Journal of Applied Meteorology and Climatology*, vol. 45, 2006, p. 399.
[6] P. Bauer, E. Moreau, and S. Di Michele, "Hydrometeor Retrieval Accuracy Using Microwave Window and Sounding Channel Observations," *Journal of Applied Meteorology*, vol. 44, Jul. 2005, pp. 1016-1032.