Global Precipitation Retrieval Algorithm Trained for SSMIS using a Numerical Weather Prediction Model: Design and Evaluation

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ABSTRACT

This paper presents and evaluates a global precipitation retrieval algorithm for the Special Sensor Microwave Imager/Sounder (SSMIS). SSMIS was first launched in October 2003 aboard the Air Force Defense Meteorological Satellite Program (DMSP) F-16 Spacecraft. Its 24-channels conically scan the Earth's surface at a constant incidence angle of 53.1° with spatial resolutions that range from 44 x 72 km at 19 GHz to 9 x 15 km at 183 GHz over the full width of its ~1700-km swath.

The algorithm is based on those developed earlier for the Advanced Microwave Sounding Unit (AMSU) [1]-[6]. The algorithm employs neural networks trained with the fifth-generation National Center for Atmospheric Research/Penn State Mesoscale Model (MM5). Brightness temperatures (TBs) at 5-km resolution were simulated for SSMIS channels using 122 MM5 global storms spanning a year. Since surface signals are largely removed from the TB vectors using principal component analysis (PCA) before they feed the neural network, less accurate models for surface emissivity suffice. The FASTEM surface emissivity model was used for ocean and the emissivity for land was uniformly distributed randomly over a large range. Simulated 5-km resolution TBs were convolved with Gaussian filters with FWHM that match the specified SSMIS ground resolutions. For the purpose of precipitation retrieval, SSMIS

channels 1-5, 8-11, and 14-18 were used. Gaussian random noise levels roughly approximating the true values [7] were added to the simulated brightness temperatures. Different neural networks will be used for different situations as presented in [6]. Potential advantages of SSMIS precipitation retrievals over AMSU include the use of dual linear polarizations at 37 and 91.655 GHz, and the higher spatial resolution at most wavelengths; disadvantages include the narrower swath width (~1700 km vs. ~2300 km) and the constantly high incidence angle.

The paper will present 1) precipitation rate retrieval accuracy as evaluated using MM5, 2) examples of precipitation rate images retrieved using SSMIS on F-16 and F-17, 3) comparison of SSMIS annual precipitation global maps with those retrieved from AMSU and also with the Global Precipitation Climatology Project (GPCP), and 4) comparison with rain gauges.

References

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