WINDSAT RETRIEVAL OF OCEAN SURFACE WIND SPEEDS IN TROPICAL CYCLONES

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1. INTRODUCTION

The WindSat polarimetric microwave radiometer is a spaceborne instrument that measures top-of-atmosphere brightness temperature. The ocean surface wind vector can be retrieved from these observations, a procedure previously well known for atmospheric conditions in which wind speeds are low to moderate and with non-raining to light precipitation [1,2]. Observations with high wind or rain contain a very significant atmospheric contribution that makes the determination of the surface emission component much more difficult. A robust atmospheric model is required to characterize and remove the contamination of the surface signal. An ideal case for developing such a model is a tropical cyclone, in which extreme precipitation and wind speeds are present.

2. ATMOSPHERIC CLEARING ALGORITHM

An atmospheric clearing algorithm was developed previously for WindSat which attempted to remove the emissive and absorptive effects of moderate to strong precipitation on the observation of tropical cyclones in order to retrieve the emissivity of the wind-driven ocean surface [3]. The algorithm was successful under moderate precipitation but was unable to describe the atmosphere near the hurricane core, where precipitation is strongest and the winds are highest. The initial algorithm was based on a scattering-free forward radiative transfer and this was considered to be one possible reason for its limitations. This paper improves the atmospheric forward model by adding the effects of spherical hydrometers in the Mie regime. The new robust model is evaluated and results are presented that show it is much more capable in the desired regions of heavy precipitation and strong winds.

3. SURFACE EMISSIVITY RETRIEVAL

Three WindSat tropical cyclone overpasses from the 2005 Atlantic season are selected as case studies: Dennis, Katrina and Rita. The early absorption model describes the atmosphere adequately around the storm edges where only moderate rain and winds exist, but the improved atmospheric model is useful in

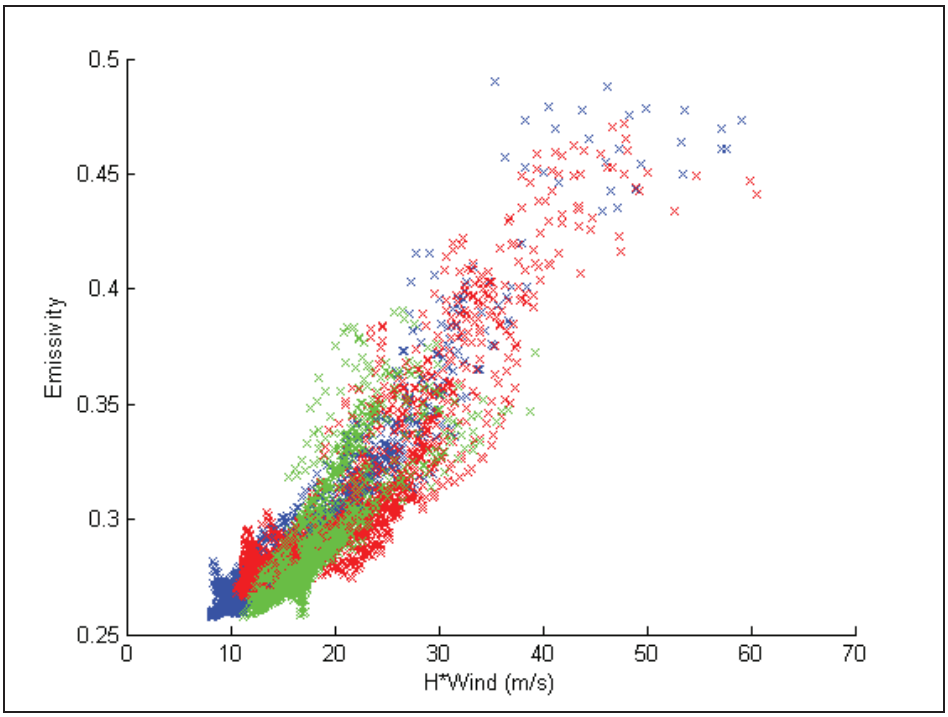

Figure 1. Ocean surface emissivity versus wind speed for three separate hurricane overpasses. Green data points represent Dennis, blue represents Katrina and red represents Rita.

the intense regions of the storm around the rainbands and eyewall. The retrieved surface emissivity is compared against an external "ground truth" wind field, served by the NOAA-HRD H*Wind product [4]. The result of this comparison is a monotonic dependence between the wind and the surface emissivity that is well-behaved into the Category 3 scale of hurricane wind speeds. Figure 1 illustrates the usable relation.

4. SUMMARY

An overview of the surface emissivity retrieval from WindSat brightness temperatures will be presented. The capability of the atmospheric clearing process will be detailed, including a comparison of the original absorption-based model with this paper's expanded treatment of scattering. The advantages and disadvantages of both models will also be illustrated. This discussion will be followed by an examination of the surface emissivity retrieval and its key comparison with the near surface "ground truth" H*Wind analysis wind field.

5. REFERENCES

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