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A split-step IR-advection/model-convection approach to fill temporal gaps in the microwave remote sensing of severe storms

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The increasing number of low-Earth-orbiting microwave sensors is making it possible to obtain more frequent three-dimensional "snapshots" inside severe (and not so severe) weather systems around the globe. Collecting data from all the different space-borne microwave sensors today as well as in the up-coming GPM era, one can reveal the three-dimensional distribution of condensed moisture over any region of the globe updated on average every six hours, though revisit times do vary and can easily exceed nine hours especially in the tropics. Such widely separated snapshots are insufficient to study the dynamics underlying precipitating systems, or to accurately estimate the resulting heating and divergence. The long gaps also make it very difficult to extract from the instantaneous data the kind of quantitative information about crucial fine-scale convective processes that is required by large-scale circulation models. This talk proposes a model to "propagate" microwave-derived water profiles during the long periods between consecutive passes of microwave sensors over a given system. The interpolation is guided by 1) measured IR radiances, which can reveal much detail about the horizontal advection, the type (convective vs stratiform), and the vertical deepening/detrainment within individual pixels, and 2) a physical solution of the evolution equations between two consecutive IR maps. Since the temporal coverage of the geostationary IR sensors is vastly superior to that of the microwave radiometers, it is natural to try to combine the two to take advantage of the strengths that each has to offer. While many, many procedures have been developed to "train" the IR data to reproduce the microwave-derived surface precipitation estimates, the idea behind the model at hand is fundamentally different and, indeed, builds on the CMORPH "morphing" approach: acknowledging that the IR measurements are only tenuously related to precipitation rates, and that they are much more directly indicative of the evolution

of cloud height and density, the approach tries to infer from them some quantitative information about the advection and intensification/decay of the underlying system. Given two consecutive passive-microwave passes over a storm, separated by several hours, it seems more credible to use the half-hourly IR data in the interim period to infer the "geographic" evolution of the top of the condensed moisture, and to then "propagate" accordingly the vertical profiles of atmospheric liquid and ice that were obtained at the start and end of the period, rather than to merely convert the IR data into dubious estimates of the near-surface rain. This presentation describes the resulting "split-step" IR-advection/model-convection approach.