Forward modeling and performance estimation for notional next-generation spaceborne Cloud Profiling Radars

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One of the instruments recommended for deployment on the Aerosol/Cloud/Ecosystems (ACE) mission [1] is a new advanced Cloud Profiling Radar (ACE-CPR). This radar is required to i) operate at Ka- and W-band, ii) achieve a sensitivity comparable to its predecessors (i.e., the radars on CloudSat [2-3] and EarthCARE [4]) while iii) providing a range resolution of 250 m (instead of 500 m), iv) include Doppler and v) scanning capabilities. The atmospheric sciences community defined the scientific requirements for this instrument during 2008 and 2009. As part of the studies leading to the definition of this mission, a series of concerted efforts was initiated within NASA to provide accurate simulations of the data expected by this radar, together with an evaluation of the radar performance in delivering retrievals of the desired geophysical quantities. These studies converged with parallel efforts being carried out for the ESA/JAXA EarthCARE mission, for the SnowSat mission concept under consideration by CSA, and other studies [5] aiming at the definition of the next generation of cloud and precipitation radars.

Here we present the comprehensive summary of the results obtained for notional radar configurations for the ACE mission by applying radar simulation tools developed recently [6-7], and under development [8-9], to five modeled cloud scenarios identified by the ACE Science Working Group as representative of the highest priority scientific questions for the cloud-aerosol community. These simulations (see example in Figure 1) were designed to capture effects that impact the radar performance, such as finite sampling, Doppler effects, platform motion effects, and non-Rayleigh and multiple scattering effects. Capabilities and limitations of the configurations considered here

represent what could be expected of the ACE mission radar, should it be deployed in space during the next decade. We will also present the preliminary results of retrieval algorithms applied to the simulated data to obtain estimates of cloud microphysics and dynamics (as those shown in Figure 2).

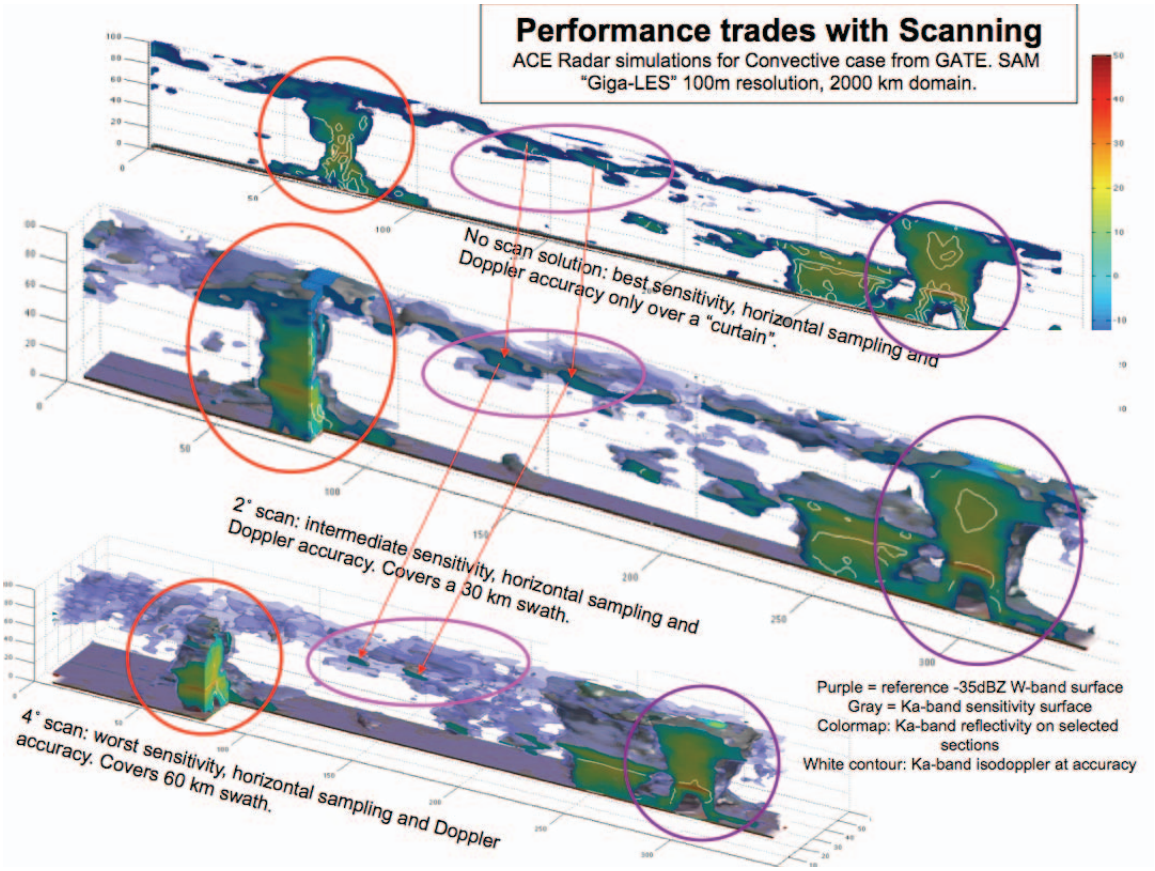

Figure 1: Impact of swath width requirement on radar sensitivity (from [7]).

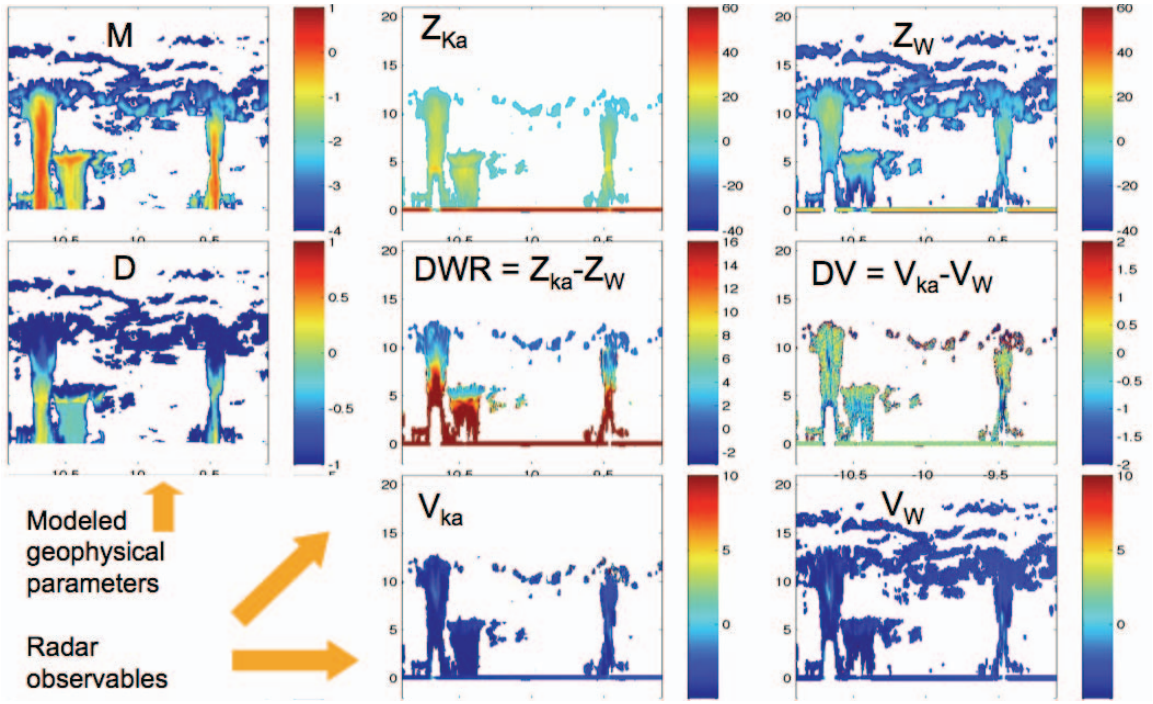

Figure 2: Example of 'truth' fields modeled by Cloud Resolving Models and Large Eddy Simulators and the corresponding simulated products by an ACE radar (from [10]).

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