Doppler performance assessment of a space-borne cloud stereo-radar concept for a hurricane system

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A space-borne millimeter Doppler scanning stereoradar with a beam looking at nadir and another one at 45 degree in the forward direction is proposed for observing the microphysical and dynamical structure of extreme weather event systems. Because of the potentially high winds involved in such weather phenomena and of the large Doppler fading introduced by the platform movement, polarization diversity capabilities are used to eliminate aliasing and drastically reduce noise errors. An end-to-end radar simulator suited for polarimetric Doppler space-borne radars has been exploited to simulate the performances of such a system when overpassing a hurricane, simulated with a cloud resolving 3D model. The simulation framework allows for a break down of the Doppler velocity measurement error budget into its different components, i.e. noise, non-uniform beam filling, multiple scattering and averaging errors. The impact of each of these errors onto the total error depends on the adopted integration length, the number of scanned tracks and the specifics of the radar (mainly its beam-width). This allows to optimally select the integration length to minimize the total rms velocity error. Results shows that, thanks to reduced non-uniform beam filling and multiple scattering contributions to the total error, large antennas (5 m at 35 GHz and 3 m at 94 GHz) have extremely high potential and they can achieve accuracy in the along-line-of-sight velocities better than 1.5 and 1 m/s respectively for integration lengths of larger than 3 km even when scanning over 17 different tracks. Examples of retrieved along-track wind fields also reveal that these two configurations are capable of identifying most of the dynamic features of the hurricane system like vertical wind shear or convergence/divergence regions over a considerable volume of the storm.