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Title: **Correction of errors induced by pointing uncertainties in spaceborne rainfall Doppler radar measurements**
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ABSTRACT

The global distribution of the vertical velocity of precipitation can be used to estimate the latent heat fluxes, and therefore improve the general knowledge of energy transportation in the atmosphere. Such knowledge can only be acquired with the use of spaceborne Doppler precipitation radars. Although the high relative speed of the radar with respect to the rainfall particles introduces significant broadening in the Doppler spectrum, recent studies have proven that the average vertical velocity in homogeneous rainfield can be measured to the 1 m/s accuracy level by appropriate selection of radar parameters at 14GHz. Even for inhomogeneous rainfall in which significant non-uniform beam filling (NUBF) takes place, the recently developed Combined Frequency-Time (CFT) processing technique also enables a comparable level of accuracy in velocity estimates. A secondary source of error is the uncertainty in the Radar antenna pointing. In this work we describe the CFT and we present a method to treat the error caused by radar pointing uncertainty. The correction procedure for the pointing error is quite straightforward when the radar is observing a homogeneous rainfall field. On the other hand, when NUBF occurs and attenuating frequencies are used, additional steps are necessary in order to correctly estimate the antenna pointing direction. The proposed method relies on the spectral analysis through CFT of the sea surface radar echo to correct for uneven attenuation effects on the observed sea surface Doppler spectrum. The algorithm performances were evaluated by simulating the Doppler precipitation radar backscatter signal from high-resolution 3D rain fields generated by a cloud resolving numerical model. Results show that the errors on vertical velocity estimates can be successfully removed by the proposed techniques.