CAN COSMIC-2 BENDING ANGLE DATA ASSIMILATION IMPROVE HWRF TROPICAL CYCLONE FORECASTS? A PRELIMINARY EVALUATION USING SIX CASES FROM THE 2020 ATLANTIC HURRICANE SEASON

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The joint US-Taiwan FormoSat-7/Constellation Observing System for Meteorology Ionosphere and Climate-2 (COSMIC-2) mission, launched in June 2019, consists of six Global Navigation Satellite System (GNSS) radio occultation (RO) receiver satellites. We present a preliminary evaluation of COSMIC-2 RO bending angle data assimilation (DA) in the regional Hurricane Weather Research and Forecasting (HWRF) model through cycled forecasting experiments run retrospectively on six Atlantic hurricane cases from the active 2020 season. Each hurricane case is run using two HWRF configurations: (i) Control, which assimilates a rich set of in-situ and remote sensing observations, including microwave and infrared radiances, but withholds COSMIC-2 RO observations; and (ii) C2, which assimilates COSMIC-2 observations but is otherwise identical to Control. Our offline HWRF configuration assimilates COSMIC-2 bending angles using a local forward operator developed for the operational Global Forecasting System (GFS) model, and its COSMIC-2 RO observation error and quality control (QC) settings have been tuned for COSMIC bending angle assimilation in the GFS.

Results show that COSMIC-2 observation-minus-background characteristics resemble those recently reported for the GFS model background in the tropics. However, we find suboptimal COSMIC-2 bending angle observation error settings for some height layers as well as a large ~ 30 % COSMIC-2 observation rejection percentage in the lower troposphere. Considering a composite set of 108 Control and C2 HWRF 126-h forecast pairs, we find that COSMIC-2 DA has an overall limited impact on HWRF track forecasts, likely resulting in part from HWRF system design limitations. However, C2 intensity forecasts, on average, show a ~ 5-12 % improvement in relative skill over Control intensity forecasts; these differences are statistically significant for forecast lead times t = 36, 54, 60, and 108-120 h. We conclude with a single forecast example from the Hurricane Hanna (2020) cycled experiment, showing how the assimilation of two COSMIC-2 profiles close to the TC center during Hanna's early development period locally enhances 700-850 hPa layer relative humidity in the C2 analysis. Comparing C2 and Control forecasts initialized from this analysis cycle, we find that the C2-forecast Hanna intensifies more quickly in better agreement with National Hurricane Center Best Track data, coincident with its more rapid inner-core convective organization.