AN EXAMINATION OF WRF/CHEM: PHYSICAL SCHEMES, NESTING OPTIONS, AND GRID RESOLUTIONS

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SUMMARY

The Weather Research and Forecast/Chemistry Model (WRF/Chem) offers several options for planetary boundary layer (PBL) schemes (i.e., the YSU and MYJ schemes), land-surface models (LSM) (i.e., the slab, NOAH, and RUC schemes), and nesting (i.e., one- and two-way). In this work, we examine the sensitivity of WRF/Chem predictions to various PBL schemes and LSMs, nesting options, and grid resolutions. WRF/Chem is applied for the 28 Aug. – 2 Sept. 2000 Texas Air Quality Study (TexAQS-2000) episode over a domain that covers primarily Louisiana and eastern Texas. Simulations at a 12-km grid spacing with various combinations of LSM and PBL schemes (e.g., slab/YSU, RUC/YSU, and NOAH/MYJ) are conducted and compared with those from the baseline simulation with NOAH/YSU. In addition, one- and two-way nested simulations with 12- and 4-km grid spacings have been conducted with NOAH/YSU. For this episode, results show that for meteorological predictions, the NOAH/YSU and RUC/YSU pairs perform similarly in terms of normalized mean bias (NMB) for temperature (-0.3%), while slab/YSU performs more accurately for wind speed, wind direction and relative humidity (RH) (NMBs of 1.7%, 5.7%, and 2.5%, respectively). The NOAH/MYJ pair simulates PBL height more accurately than others, with an NMB of 22.7%. For chemical species, the slab/YSU pair performs best for O_3 and CO (NMBs of 9.7% and -14.9%, respectively), while the RUC/YSU pair performs slightly better for $PM_{2.5}$ (NMB of 0.5%). All simulations perform poorly for NO_x with NMBs < -50% for NO and > 50% for NO_2. The model predictions are also sensitive to nesting options and grid spacing, particularly at 4-km. The relative accuracy and computational efficiency for various physical parameterizations and configurations will be evaluated. These simulations and analyses will provide insights into WRF/Chem's capability of capturing the variability of meteorological variables and chemical species at various grid resolutions.

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