

Electronic Supplementary Material to: A Neural-Network-Based Alternative Scheme to Include Nonhydrostatic Processes in an Atmospheric Dynamical Core*

Yang XIA^{1,4}, Bin WANG^{2,1,3,6}, Lijuan LI², Li LIU¹, Jianghao LI⁵, Li DONG^{2,6}, Shiming XU¹, Yiyuan LI^{2,6},
Wenwen XIA¹, Wenyu HUANG¹, Juanjuan LIU^{2,6}, Yong WANG¹, Hongbo LIU², Ye PU²,
Yujun HE², and Kun XIA²

¹Ministry of Education Key Laboratory for Earth System Modeling, and Department of Earth System Science,
Tsinghua University, Beijing 100084, China

²State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics,
Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing 100029, China

³Innovation Group 311020008, Southern Marine Science and Engineering Guangdong Laboratory, Zhuhai 519000, China

⁴Shanghai Ecological Forecasting and Remote Sensing Center, Shanghai 200030, China

⁵Key Laboratory of Earth System Modeling and Prediction, China Meteorological Administration, Beijing 100081, China

⁶College of Ocean Sciences, University of Chinese Academy of Sciences, Beijing 100049, China

ESM to: Xia, Y., and Coauthors, 2024: A neural-network-based alternative scheme to include nonhydrostatic processes in an atmospheric dynamical core. *Adv. Atmos. Sci.*, **41**(6), 1264–1265, <https://doi.org/10.1007/s00376-023-3119-1>.

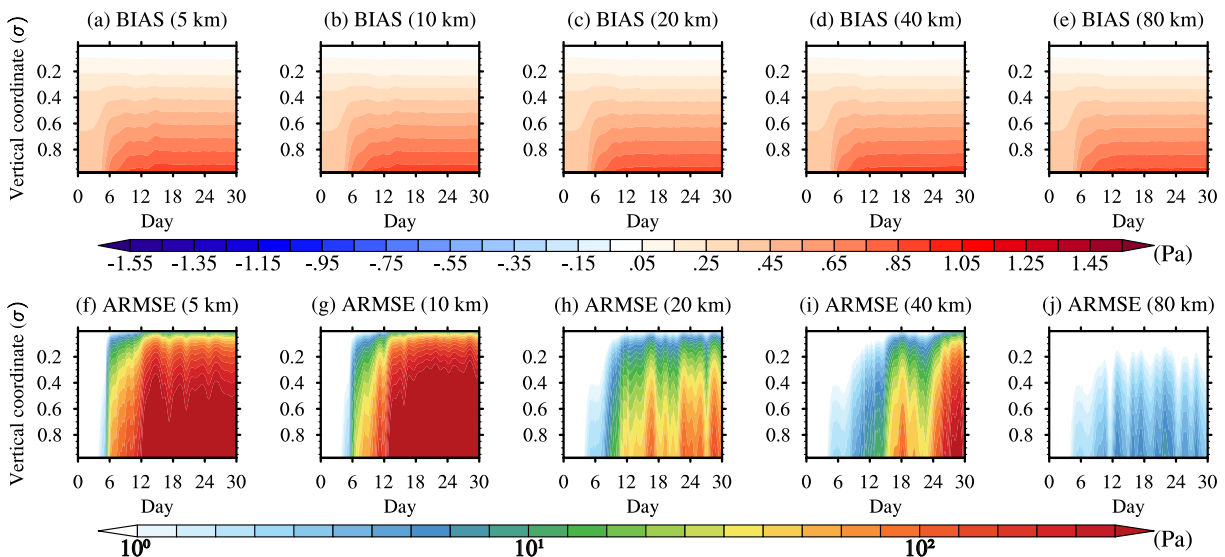


Fig. S1. Time- σ cross-section of the horizontally averaged systematic biases (the upper row) and anomaly root-mean-square error (the lower row) of pressure (Pa) in the hydrostatic solver relative to the nonhydrostatic solver in five tests at the horizontal resolutions of (a and f) 5 km, (b and g) 10 km, (c and h) 20 km, (d and i) 40 km and (e and j) 80 km in the original experimental design domain of the baroclinic-wave test in the WRF idealized package, respectively. All tests adopt the same timesteps of 60 s except the 5km-tests have to reduce the timestep to 30 s for computational stability.

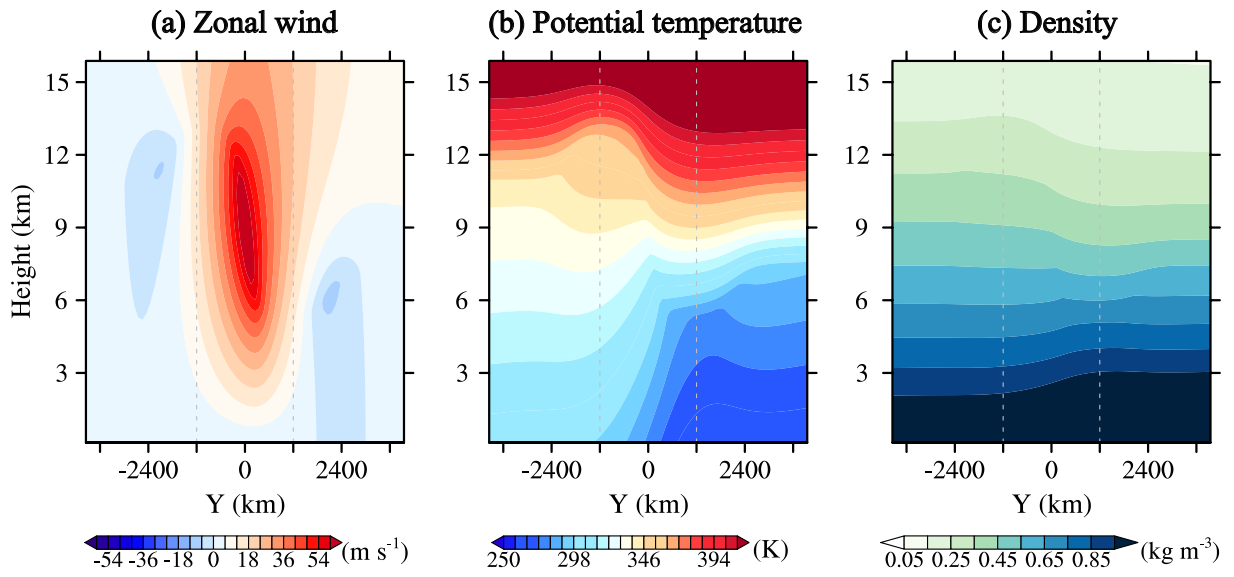


Fig. S2. Meridian-height cross of the initial state of the (a) zonal wind, (b) potential temperature, and (c) density of the baroclinic wave test in the original idealized package of WRF. The two parallel dashed grey lines in each subfigure mark the meridional range of the reduction domain.

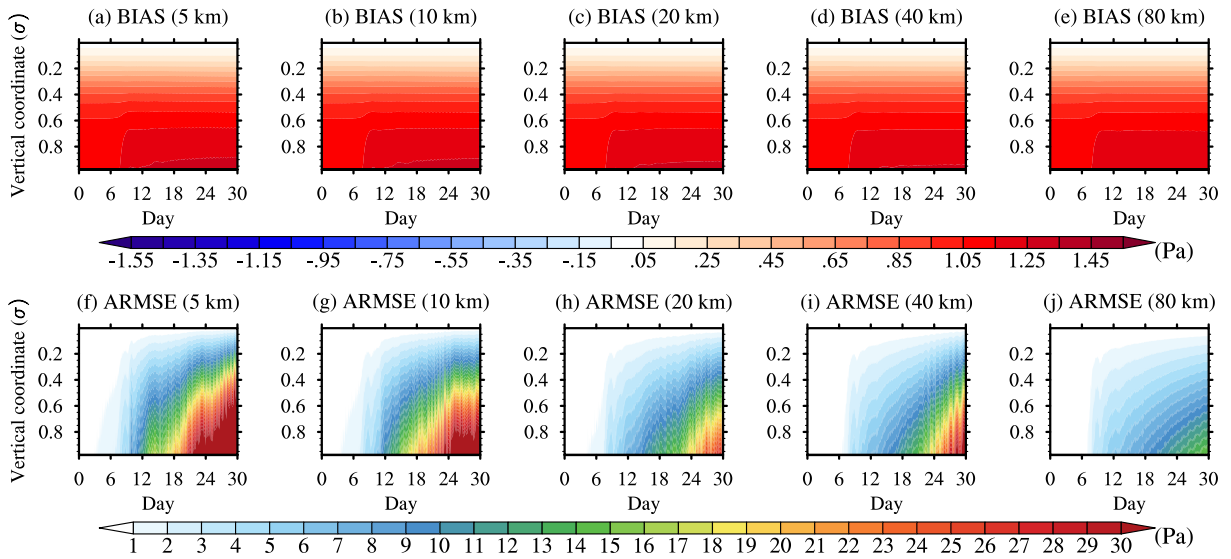


Fig. S3. Same as Fig. S1 but for the tests at the reduced domain (2000 km \times 2400 km).