



Erratum: wet bias of summer precipitation in the northwestern Tibetan Plateau in ERA5 is linked to overestimated lower-level southerly wind over the Plateau

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Abstract

We sincerely apologize for a technical error revealed in this article, published in 2023: the spectral nudging process at the upper levels was not functioning as intended. Consequently, the final results presented in the original work are based on WRF downscaling without active spectral nudging. To assess the potential impact of this error on the study's main conclusion, we conducted two additional experiments using the same WRF version 3.7.1. Results show that the technical error does not alter the main conclusion of the study: the ERA5 overestimation of summer precipitation over the northwestern Tibetan Plateau is associated with an overestimated lower-level southerly wind.

After publication of the paper (Ou et al., 2023), we found a technical error in the WRF simulation: the spectral nudging process at the upper levels was not functioning as intended. Specifically, due to a small value specified for time (in hours) to stop nudging after the start of forecast (gfdda_end_h) during the modeling period, spectral nudging became inactive after a few months of integration in the WRF downscaling. Consequently, the final results presented in the original work are based on standard WRF downscaling without the use of spectral nudging.

To assess the potential effects of spectral nudging on the simulated circulation and precipitation over the Tibetan Plateau, two new experiments were conducted using the WRF model version 3.7.1 (Skamarock et al. 2008). In the first experiment, the simulation was extended to summer 2020 using the same settings as in the original study by Ou et al. (2023), in which spectral nudging was not active (WRFTP9km). In the second experiment, three continuous simulations were performed for the summers of 2018–2020, starting on May 1, with spectral nudging activated by specifying a larger number for gfdda_end_h, while keeping all other settings identical to the first experiment (referred to as WRFTP9km_SN). The restart file from May 1 in the first experiment (WRFTP9km) was used as the initial condition for the second experiment. Boundary conditions, including sea surface temperature (SST), were provided by the European Centre for Medium-Range Weather Forecasts (ECMWF), ERA5 (Hersbach et al. 2020). Upper-level wind from WRFTP9km and WRFTP9km_SN were evaluated against ERA5, and Precipitation values from two WRF simulations and ERA5 were evaluated against satellite observations, the Integrated Multi-satellitE Retrievals for GPM (IMERG) precipitation product version 06 (Huffman et al. 2019a, b).

The results indicate that the summer mean 200 hPa u-wind component in WRF downscaling with active spectral nudging (WRFTP9km_SN) closely matches ERA5, showing relatively small differences (Fig. 1). In contrast, WRF downscaling without spectral nudging (WRFTP9km)

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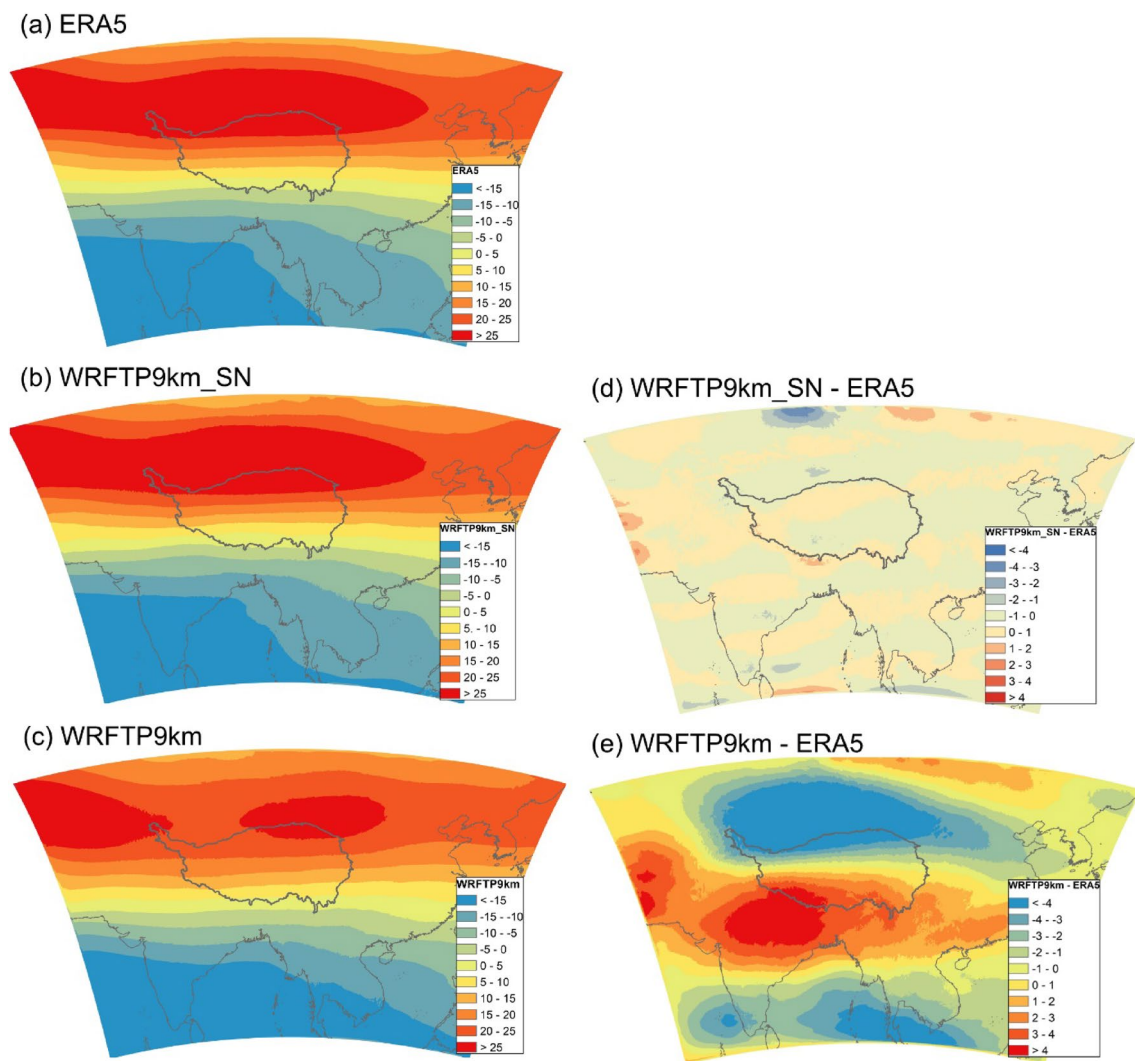


Fig. 1 Spatial distribution of the summer (June-July-August) mean u-wind component at 200 hPa during 2018–2020: **a** ERA5, **b** WRF downscaling with spectral nudging active (WRFTP9km_SN), **c** WRF downscaling without spectral nudging active (WRFTP9km), **d** dif-

ference between WRFTP9km_SN and ERA5 (WRFTP9km_SN – ERA5), and **e** difference between WRFTP9km and ERA5 (WRFTP9km – ERA5)

exhibits significant differences from ERA5, with weakened wind speed over the jet stream center over the northern Tibetan Plateau.

At 500 hPa, the summer mean wind in ERA5 over the southern Tibetan Plateau is reduced in both WRFTP9km and WRFTP9km_SN, with a smaller reduction observed

in WRFTP9km_SN (Fig. 2). Additionally, the wet bias in ERA5 is reduced in both experiments, with the reduction being more pronounced in WRFTP9km_SN (Fig. 3).

These findings confirm that the ERA5 overestimation of precipitation over the northwestern Tibetan Plateau is associated with an overestimated lower-level southerly wind.

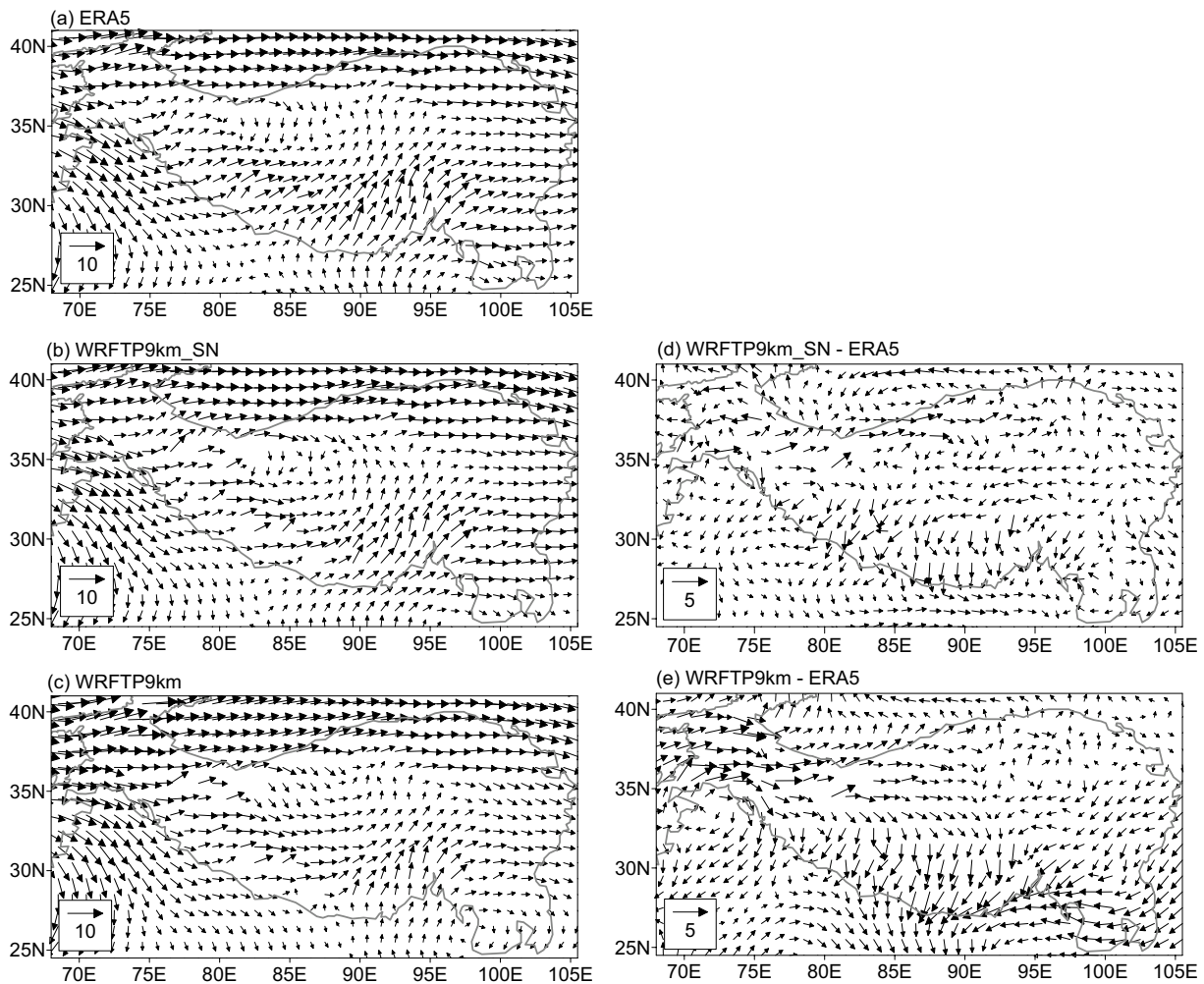


Fig. 2 Spatial distribution of the summer mean wind vector at 500 hPa during 2018–2020: **a** ERA5, **b** WRF downscaling with spectral nudging active (WRFTP9km_SN), **c** WRF downscaling without spectral nudging active (WRFTP9km), **d** difference in wind vector

between WRFTP9km_SN and ERA5 (WRFTP9km_SN – ERA5), and **e** difference in wind vector between WRFTP9km and ERA5 (WRFTP9km – ERA5)

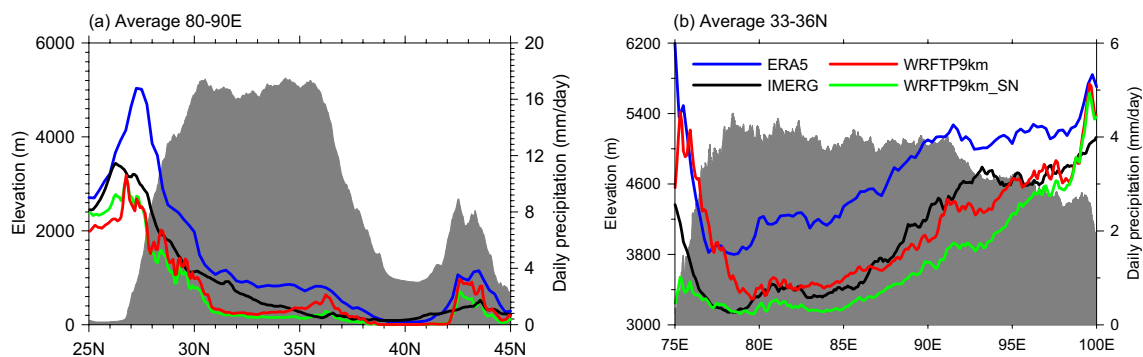


Fig. 3 (a) Latitudinal evolution (averaged between 80° and 90° E) and (b) Longitudinal evolution (averaged between 33° and 36° N) of the summer mean precipitation (mm/day) during 2018–2020 from ERA5, WRF downscaling without spectral nudging active (WRFT-

P9km), WRF downscaling with spectral nudging active (WRFTP9km_SN), and Integrated Multi-satellitE Retrievals for GPM (IMERG). The gray shaded area represents the mean elevation

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Data availability The ERA5 reanalysis (Hersbach et al. 2020) is accessible from: <https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-v5>. The Integrated Multi-satellite Retrievals for GPM (IMERG) precipitation product version 06 (Huffman et al. 2019a; b) can be accessed at: <https://gpm.nasa.gov/data/IMERG>. The WRF9km simulations (Ou et al. 2023) can be accessed at: <http://biggeo.gvc.gu.se/TPReanalysis>. New WRF simulations with spectral nudging active (WRF9km_SN) can be accessed by contacting the authors.

Declarations

Conflict of interest The authors have not disclosed any conflict of interest.

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