Comments for the manuscript "*An Overview of the Western United States Dynamically Downscaled Dataset (WUS-D3)*"

General comments

The authors provided an overview of the WUS-D3 dataset for the complex terrain western United States using the dynamical downscaling method based on 14 CMIP6 GCMs historical and SSP3-7.0 scenario simulations plus two projections SSP2-4.5 and SSP5-8.5 of one GCM (CESM2). The atmospheric model WRF with the horizontal resolution of 9 km and 39 vertical levels was used to conduct downscaling simulations. The authors described the challenges of producing WUS-D3 dataset, including GCM selection and technical issues, as well as an evaluation for the simulations' realism by comparing historical results to temperature and precipitation observations. They concluded that because of its high resolution, comprehensiveness, and representation of relevant physical processes, this dataset presents a unique opportunity to evaluate societally relevant future changes in western U.S. climate.

The method is unusual: "We downscale each GCM year separately and in parallel; at the beginning of each downscaling period (on August 1), the RCM is initialized to the driving GCM state."

The reason given is not yet convincing: "WRF's parallelization procedure, which is advantageous for executing simulations in weeks instead of years, is performed to the detriment of time continuity in simulating the surface and subsurface runoff with high precision." With that deficit, the soil moisture memory is neglected in these simulations. Not using a continuous simulation, will lead to unrealistic jumps in storage variables, especially in soil moisture or the snowpack. This, in turn, may cause effects in other variables, such as evapotranspiration, latent heat flux, albedo and 2m temperature. Hence, the authors should discuss the potential deficits of the dataset implied by not using a transient simulation.

The analyses do not state much about the difference between WRF-GCMs with SSP2-4.5, 3-7.0 and 5-8.5. How to explain in Mid-Century (Figure 6, left) that the mean temperature change of SSP2-4.5 of CESM2 (O) is greater than SST3-7.0 (A)? And why in End-Century (Figure 6, right), the SSP3-7.0 (A) has the longer arrow than O and P?

Any outlook for bias reduction/correction? 5 K cold bias seems to be quite large. Implications of this large bias should be discussed.

Discussion and outlook: as the considered area (WUS) is next to the open Pacific, has any atmosphere-ocean coupled model been applied for this region for downscaling CMIP6? What would be the role of the Pacific Ocean on regional climate over WUS, at least in the 45 km set up which cover half of ocean?

I suggest accepting the paper for publication after minor revisions are made.

Minor Comments
- Lines 66-76: Arguments are not clear. Please rephrase the paragraph.
- Line 92: Please list here names of the 11 states and display them on Fig.1. Not all readers are familiar with their locations.
- Line 106-107: "SSP-2-4.5 and SSP-5-8.5" should be "SSP2-4.5 and SSP5-8.5" to be consistent with SSP3-7.0 and themselves on other pages.

- Line 126: Sentence is not clear: "To address this issue, we propose that the atmospheric fields from WRF be used to drive offline and calibrated hydrology models that are continuous". Please rewrite it.
- Line 128: Which kind of aerosols were used in WRF for these simulations? It's expected to use transient aerosols for such historical-scenario simulations.
- Line 133: Why not using the transient land-use/land-cover from CMIP6?
- Line 190: "if at all in CMIP6 GCMs": not clear what the authors mean here
- Line 262: What is the resolution of PRISM dataset?
- Line 272: Should the "black circles" be plotted in red to increase eyes-catching effect?
- Line 272-273: Any explanation/speculation for the result of "Exceptions are noted across some western states, especially in winter"?
- Line 277-278: What does "meaningful subregional biases of hundreds of percent" mean here?
- Line 290-291: Sentence is not clear
- Line 292: How was "rx1day" defined/determined?
- Line 324-325: "Despite a positive mean change, a handful of simulations suggest drying across the region.": where does the information come from?
- Line 326: "For warming amounts,…"? Should it be "For temperature change,…" as on the line 328, the "precipitation change" is mentioned.
- Line 341: Typo on title of section 4.1 "Patters" instead of "Patterns"
- Line 385: What are "ensemble-mean fractional precipitation changes"?
- Line 433-434: Sentence is unclear
- Line 434: Should it be (Fig.10, middle) instead of (Fig.9, middle)?
- Figure 3 (and some elsewhere): It would be easier to compare if the PRISM dataset figure and the WRF-ERA5 figure locations are exchanged
- Figure 8 and Figure S9 caption: Should "Stippling is not included for temperature because every grid point returns a p value smaller than 0.05." be removed?
- Figure 8 (line 414): There is no a, b, c, d on the Figure 8
- Figure S2caption: Should move the unit [K] after the word "biases" like this: "11-state-mean biases [K] are presented beneath each GCM label."
- Figure S5 caption: Should add the unit [K] after "annual-mean surface air temperature"
- Figure S7 caption: Typo in "the" 16-GCM mean. Should remove "1 April" as the figure shows three months (Jan Apr, Jul)
- Figure S10 caption: Should move [mm d^{-1}] after "rx1day precipitation"
- Figure S11 caption: [% K^{-1}] should be located after "rx1day precipitation"