Comment of “CMIP7 Data Request: Impacts and Adaptation Priorities and Opportunities” by Ruane et al., 2025.

Dear authors,

Thank you for a clear and well-written article, providing in-depth information on the CMIP7 variable selection process.

The purpose of this community comment is to bring your attention to a topic of our concern, namely dynamic changes in land use in Earth System Models (ESM) and their impact on boundary layer winds and other physical variables relevant for Wind Energy and Renewables. In short:

- We are grateful that the CMIP7 dataset will include the 100m wind, as it is not trivial to compute from standard output and the effect of surface roughness is expected to be smaller than for the 10m wind. This reduces uncertainties in our work.
- However, additional information may be required for the users to manage the uncertainty associated with land use change, and we propose some suggestions for downstream applications of CMIP7 dataset which some of the authors of this paper may find relevant and actionable (within the Copernicus Climate Change Service for instance).

This comment was initiated by Rémi Gandoin (C2Wind, Denmark) and subsequently reviewed and amended by Andrea Hahmann (DTU, Denmark) and Jan Wohland (University of Oslo, Norway). They form a small group of practitioners and researchers primarily, all having published studies on the effect of Climate Change on Wind Energy, see the journal articles (Hahmann et al., 2022) (Wohland, 2022) (Wohland et al., 2024) and the technical publications (C2Wind, 2024) (C2Wind, 2025).

Problem statement

All other things being equal, changes in land use can lead to noticeable changes in boundary layer winds, and thereby it can be difficult to quantify in wind resources between future and historical scenarios when using ESM model where land use changes dynamically (Wohland et al., 2024) (Collet et al., 2025).

We do of course acknowledge that surface roughness changes over time and that this needs to be accounted for, however it is important for analysts and scientists to be able to quantify how much of the change in wind resource is due to changes in roughness, and how much is due to

changes in global/regional weather patterns. Some of the land-use changes in the SSP scenarios are highly idealised like the ones in Poland, and they have a strong impact on climate change impact assessments for wind energy in these areas.

We acknowledge that, assuming perfect and seamless access to the entirety of the datasets (including model levels) described in your article, users may be able to perform the required analysis to untangle land use and global/regional circulation effects (using data higher up in the troposphere helps decrease the effect of land use even further). However, based on our experience with CMIP6 datasets, we foresee that an infinitesimally small fraction of industry users will make use of the ESM native or pressure level due to the difficulty in accessing these data. As of today:

- Most practitioners only use single level data available via third party services such as the Copernicus Data Store (CDS).
- Advanced users (typically in academia) can only "afford" (time wise) to use only a subset of ESM datasets at pressure- or native model levels.

Remedial measures

As the CMIP7 modelling phase is about to start, we would like to argue about initiating the actions suggested below. We acknowledge that these fall outside the original scope of your work, but we take the opportunity to present them here to all co-authors of this article with the hope that some of them could be activated as part of downstream application projects such as the CDS here taken as an example.

1) Provide, via a platform like the CDS, pressure levels wind time series with at least daily resolution. To our knowledge, only monthly time series are available from the CDS.

2) Provide, via a platform like the CDS, ESM time series related to the land use type and composition. These could include for instance the below existing variables, but we seek your feedback whether additional variables may be useful too (for instance, we could not find variable describing urban land use types). Note: the names below are the ones reported in the CMIP7 variable database provided with the article. We are unsure whether/how "height" translate to "aerodynamic roughness length", see the next item.
    - Height of Crops
    - Height of Grass
    - Height of Pastures
    - Height of Shrubs
    - Height of the Vegetation Canopy

- Height of the Vegetation Canopy
- Height of Trees.

3) Provide synthetic information (in the form of table with references to sections of ESM documentation) regarding:
    - How land use is accounted for in the surface layer module, for instance see https://escomp.github.io/CTSM/release-clm5.0/tech_note/Ecosystem/CLM50_Tech_Note_Ecosystem.html.
    - Furthermore, the height of the various vegetation types is not always how the surface roughness length is calculated. Each LSM does it differently. The surface aerodynamic roughness length is a more "physical" variable that every land surface modeler and can be directly related to shear and simulated wind profiles; obtaining these values (if they exist, would be very useful).
    - How the single level winds are computed (including information on interpolation method, or any diagnostic procedure).

Could these suggestions be brought forward in future discussions between CMIP7 and other parties concerned with downstream applications such as the C3S?

Additional request

Would it be possible to provide a single csv/yaml file with all CMIP6/7 variable descriptions contained in the json files attached to the article? We have created a test version in all_vars.xlsx, which we believe could be useful to the users not having the time to process all of the json information.

References

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