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# *Interactive comment on* "The role of improved soil moisture for the characteristics of surface energy fluxes in the ECMWF reanalyses" *by* Wilhelm May

**Anonymous Referee #3**

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This paper presents a comparison of two successive ECMWF reanalysis datasets in terms of their surface hydrology. The paper lists a correction to match observational precipitation dataset as the main difference in forcing and presents resulting changes in global patterns of soil moisture and latent heat flux. While this may be useful as a reference to interpret other studies based on these same datasets, the discussion does not move far from a high-level qualitative assessment of features that can be explained by the model formulations.

Major comment.

The paper is full of spatial detail but seems to lack a clear definition of boundary conditions against which the results can be interpreted. As a consequence, it is not clearly formulated what assumptions are confirmed in this study or what unexpected features



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Discussion paper

of the model mechanics were discovered.

Specific comments:

1) Section 3. Differences in soil moisture and precipitation. I suggest starting the results with a presentation of the changes in precipitation between the two reanalysis datasets as this is a change in the forcing data. I expect there are earlier studies that present this too, which could be referenced. Are there other notable changes that may explain regional differences (e.g. soil parameterization, insolation, air temperature?). It is worth noting that the differences in mean soil moisture over desert areas do not originate from changes in precipitation (Fig 1e,f compared to Fig 2c,d). Can these be explained by changes in parameterization of the soil texture?

2) Section 4.1. The differences in latent heat versus sensible heat. First of all, please confirm that the total surface energy is not changed much between the two reanalysis sets. Second, because the models keep an energy balance, changes in one of these two terms are so obviously matched with a corresponding change in the other that it does not need to be treated as completely separate results. The description of sensible heat (page8, lines 18-31 and Figure 5) can be shortened accordingly to focus on the areas that do not conform this expectation (changes in available energy or ground heat flux).

3) Section 4.1. Correlation between differences in soil moisture and latent heat. Please expand on the clarification for negative correlations between differences in moisture and differences in latent heat. It is not clear if the authors explain this as the result of a chain of modeled interactions that ultimately leads to less evaporative demand, or that it simply is the result of parallel changes in the model formulation that are causing an apparent causality. The authors state ERAInt/land has the same meteorological forcing as ERAInt (page 3, line4) so I'm curious what pathway there is for increases in soil moisture to reduce latent heat. Also note that the caption of Figure 6 should mention that these correlations are between the differences, not the absolute values.

4) Regional analysis. Why are these particular regions selected?

5) I'm missing a true synthesis of the results where the main differences are summarized by climate region. Figures 3 and 10 could perhaps be combined for this purpose, if the 4 regions illustrate all the main differences: for example, increases and decreases in rainfall in water limited area, and increases and decreases in rainfall in energy limited areas.

6) General comment on presentation. The way differences are discussed in the paper make it a bit hard to follow at times. Two examples. 1) There is a lot of use of increases (decreases) linked to decreases (increases). Consider also using 'vice versa' or simply talk about the decreased variation or higher minimum or lower maximum values where that is appropriate. 2) Figure 3 could be easier to read if it had three panels on each row: soil moisture for both reanalysis, precipitation for each, and then the difference. This might show more clearly the change in seasonal variation going from one reanalysis to the next.

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