Dear Travis O'Brien,

thank you very much for taking over the editorial handling and for your encouraging comments! Please find below our responses, where changes to the manuscript are highlighted in bold letters. Line numbers refer to the version with highlighted changes.

Best regards,

Stefan Hergarten und Jörg Robl

Editor (Travis A. O'Brien)

Technical issues

1. The model name should include a version number or other unique identifier in the title (e.g., LFPM 1.0): see https://www.geoscientific-model-development.net/about/manuscript_types.html for the policy on titles in "Model description papers"

Fixed.

2. I identified some grammar issues and typos that should be fixed:

line 64: "approaches were" → "approaches have been"

We were not sure here initially; **fixed (line 64).**

line 75: "in upwind" → "in the upwind"

Fixed (line 75).

line 90: "I was adopted" → "It was adopted"

Fixed (line 89).

line 703: "respectiv" → "respective"

Fixed (line 721).

Additional comments

Symbol choices:

The symbol choices made this section somewhat hard for me to follow, since the convention in climate/atmospheric science is that q is atmospheric moisture, and u and v are the E/W and N/S wind components. You might consider using Q for the column integrated water, U for the column integrated wind, and F for the horizontal moisture flux.

Makes sense, **so we changed $u \rightarrow Q$ and $q \rightarrow F$.** However, we kept the lowercase v for the velocity since our x-axis is not necessarily N-S or E-W oriented, and U would overlap with the uplift rate in the examples of landform evolution.

It might also be worth stating that this equation can be derived directly from a column-averaged moisture budget (with the exception of the dispersion term, which I have a comment on below).

Yes, it is nothing but the column-integrated moisture budget. **We added it in line 118.**

It might also help declutter the equations to annotate variables in Equation 4 as something like Q_i, with $i \in [v, c]$.

After thinking about it, we arrived at the point that it may be good for the moment for decluttering the equations, but the notation v/c may be clearer when it occurs again later. And when the equations become more complicated later in the paper, it would not help. So we kept it.

Consider simplifying to only one advective velocity:

On line 109, $v_{v/c}$ is introduced as the advective velocities for water vapor and water condensate. While it physically is correct that the two need not have the same vertically-averaged advective velocity (since this advective velocity can be interpreted as the moisture-weighted, vertically averaged wind velocity), it turns out not to matter. The only place where they appear later on is in the definition of β, which ends up being associated with a tunable equation. If instead $v_v = v_c$, then $\beta = \alpha$, and all the arguments for the form of β still hold. Therefore, it may help to declutter the equations if the subscript is omitted (perhaps with a comment justifying the choice to do so).

Right, we thought about this when writing the first draft. However, we feel that it does not make much difference whether we start from different velocities and show in a few steps that it has no effect or whether we justify the choice of a single velocity. Finally, we found it safer for the review process to show that it makes no difference.

The dispersion term:

I was initially somewhat baffled by the motivation for the form of the dispersion term at first. If one uses Reynolds averaging on the column-averaged moisture budget equation, with $F \equiv \overline{Q} \cdot \overline{U}$ (using my notation above, and where the overline represents a spatial average operator), then a second order term appears that represents the subgrid transport of water: $\nabla \cdot (\overline{U'Q'})$. The form of the dispersion term in your Equation 4 implies that the subgrid flux of water is equal to

$$\overline{U'Q'} = L_D \cdot \frac{\partial \overline{QU}}{\partial y}$$

The above implies that the subgrid flux operates only in the y-direction and that its magnitude is proportional to the gradient of the flux in the y-direction. This can roughly be interpreted as "horizontal shear in the flow leads to cross-shear transport of water." This seems like a reasonable approximation to the effect that subgrid eddies–which would be generated by horizontal shear–might have on the transport. It might be worth elaborating this in the manuscript, since otherwise it is difficult to understand what is the physical motivation for form of the dispersion.

The description and motivation of the dispersion term was indeed a bit rushed, perhaps we are familiar with this concept in other fields, but not so much in the context of turbulent flow. **We tried to improve it (lines 123-137).**

Reviewer 2 (Sebastian Mutz)

Line 95: Change to "It was adopted [...]"

Fixed (line 89).

Line 171: This seems identical to eq 14-15 in the previous version of the manuscript (see my previous comments on L135-144 in the first review) except written on one line. Please double check.

Yes, indeed the same since it was already correct in the first version. **Anyway, we have now introduced one more step and wrote it in the form $e^{-(x-y)}$ instead of e^{-x+y} in order to avoid any confusion (line 173).**

Fig 5: Add the dashed line (ramp "topography" to the legend).

Done.