**Geoscientific
Model Development
Discussions**

Interactive comment on "Mass-flux subgrid-scale parameterization in analogy with multi-component flows: a formulation towards scale independence" by J.-I. Yano

Anonymous Referee #1

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General comments

It is an interesting idea that time evolution of subgrid-scale quantities are represented in a manner analogous to multi-component flow system, because the notion seems to be widely applicable to the macroscopic-scale systems composed of multi-components, such as volcanic smoke, mantle convection, and so on.

While you state that the situations considered in the standard mass-flux parameterization are not always achieved, you do not seems to state how the standard parameterization does not work quantitatively (what specifically modelers of numerical weather prediction or climate change and you get frustrated). Therefore, the motiva-

tion to present new parameterization is somewhat unclear. For example, as you refer to the resolution-dependence of the standard parameterization, you should also illustrate what kind of problems have arisen in the previous model simulations specifically.

You should refer to the numbers of operations estimated theoretically in brief. Modelers and model users will want to know how much the numbers of operations by using the new parameterization increase compared to the case that the standard parametarizations are used (or whether the computational resource required is realistic or not).

Some of researchers of geophysical and planetary fluid dynamics may be interested in the paper, because some of them would like to get rid of assumptions and approximations inherent in the Earth's atmosphere, and use more general parameterizations or schemes. For the purpose of getting their attentions, the "generalization" may be emphasized more (but it is just my opinion, and not compulsory).

Specific comments

In the section 2.2, while you state the reason why the primitive equation can be adopted, you do not seems to state the background to adopt the primitive equation explicitly. I imagine that you basically aim for numerical weather prediction or climate change, and if so, you should refer to it.

In the section 3.1, although it is trivial, the direction of the contour integral (clockwise or counter-clockwise) should be noted.

In the section 3.1, "w" of the left of Eq.(3.2b) is not defined in the paper. Probably it will be typographical error, and it should be "ω".

In the section 3.1, it is not easy to imagine readily the geometry of ∂S_{j}^{+}, ∂S_{j}^{-}, and $\partial S_{j,i}^{-}$. If possible, you should prepare the schematics of geometrical configuration (if you have already drawn the schematic in the same situation at the other paper, then you should cite it).

In the section 3.1, for the case of inflow in Eq.(3.6), the condition that the subscript "i"

satisfies is not shown, and it will be the number of the subcomponent located in the upstream region. However, if the total number of categories are more than three, I think "i" cannot be determined because the spatial distribution of each sub-area is not determined in the parameterization. Is it right?

In the section 3.2, you refer to the existence of vertical wind-shear with respect to the approximation used in Eq.(3.13). At least, the vertical wind-shear is common in the Earth's atmosphere, and I wonder how much the approximation is reasonable in practice. Is it possible that you estimate the magnitude of the shear when the approximation becomes unjustified ?

In the section 4.4, as you discuss the "triggering condition", you do not explain what kind of problem it is specifically. And if there are any references about the problem, then you should cite them.

Technical corrections

The followings will be typographical errors, and words in parentheses will be correct.

p.3137 line 16: "j-the" (j-th)

p.3139 line 5: "form" (from)

p.3143 line 18: "than" (that)

p.3145 line 5: "from" (form)

p.3151 line 26: "ides" (ideas)

p.3153 line 15: "," (.)

p.3154 line 13: "presnet" (present)

p.3155 line 9: "approixmation" (approximation)

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