

## **A review of “Inherently mass-conservative version of the semi-Lagrangian Absolute Vorticity (SL-AV) atmospheric model dynamical core”**

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### **Conclusion**

This paper should be accepted for publication in GMD after minor revisions.

### **Summary and general comments**

The authors present a mass conserving semi-Lagrangian absolute vorticity atmospheric dynamical core. The inherent mass conservation avoids the need for a cumbersome mass correction to restore mass lost due to semi-Lagrangian advection. The modification to the standard non-conservative model is minor. Mass conservation is achieved through a 3-D extension of a previously 2-D advection scheme.

The paper is interesting and well written.

### **Specific comments**

- **Page 4810, line 9.** I'm never really sure, but I think it should be “a posteriori” (with a space).
- **Page 4810, line 21.** The “1 Introduction” section is blank.
- **Page 4811, line 2.** Maybe delete “The” so that it reads “Both conservation properties...” where “both” refers to “local” and “global” conservation.
- **Page 4811, line 14.** Space in “abovementioned”
- **Page 4811, line 15.** Maybe “... is very suitable for use in general circulation models because ..”
- **Page 4811, line 17.** Maybe “Attempts were made....”
- **Page 4812, line 5.** Maybe “The SL-AV (semi-Lagrangian absolute vorticity) is a global semi-Lagrangian ...”
- **Page 4812, line 14.** Maybe “... coordinates are used.”
- **Page 4812, line 18.** Maybe “In particular, there is the non-hydrostatic ...”
- **Page 4813, line 2.** Maybe “reviewed” instead of “overviewed”.
- **Page 4814, line 18.** “Sect 3.2”
- **Page 4816, line 11.** Maybe “It can be excluded from (10) by integrating ...”

- **Page 4817, line 1.** Maybe “A similar technique ...”
- **Page 4818, line 8.** Maybe “... midpoint and trapezoidal rules ...”
- **Page 4822, equation 20.** missing dot on sigma dot.
- **Page 4822, line 6.** Maybe “as follows:”
- **Page 4822, line 15.** I would like to know a little bit about the elliptic solver used here.
- **Page 4823, line 11.** It seems a bit strange to me that same diffusion coefficient is used for all resolutions. Wouldn't that make the higher resolutions unnecessarily diffusive? Have you run with a smaller diffusion? You conclude that the model has converged as you increase resolution from 400X250 grid to 1200X750 grid since the results are very similar. However, it might be the case that the diffusion is killing the development of any new details or sharper gradients.
- **Page 4824, line 2.** Shouldn't the SL method allow for a much larger CFL than 0.72?
- **Page 4824, line 4.** I'm a little surprised the results for 400X250 and 1200X750 are so similar. Have you looked at plots of the vorticity? Typically relative vorticity shows enhanced details as resolution increases from 1° degree to 0.3° degree.
- **Page 4828, line 7.** Bates et al. reference. “... a vector semi-Lagrangian finite-difference scheme ...”