Contribution ID: **30** Type: **not specified**

Transport schemes for weather and climate models

Thursday, 17 September 2020 10:30 (45 minutes)

In this talk “transport” means advection. A google scholar search for “numerical advection schemes” gives 140,000 results. And those will mostly be in the atmosphere and ocean modelling community because advection is called convection in mathematics and engineering. Why so many? It is probably because none of them work very well. There is a lot that we demand from our advection schemes:
1. Accuracy (high order and good accuracy even at coarse resolution).
2. Computational efficiency.
3. Monotonicity - spurious oscillations or unbounded values should not be generated.
4. Conservation - the advected quantity should not be artificially created or destroyed.
5. Stable for long time steps (often the time step is limited by high wind speeds or small grid boxes).
6. Multi-tracer efficiency - it would be nice if advecting 100 tracers were less expensive than 100 times advecting one tracer).
7. Maintaining correlation between tracers - imagine if you were advecting temperature and water vapour. If the warm air were advected too quickly then you could end up with high water content and cold air that could lead to spurious precipitation.
There are many classes of advection scheme and some of these overlap. For example Eulerian, semi-Lagrangian, method of lines, finite volume, finite element. And there are different ways to achieve monotonicity and long time steps. This talk will describe some of these approaches and their advantages and disadvantages. Implicit time stepping for advection has been largely ignored in atmospheric modelling due to its high cost and large errors for long time steps. It may be time to reconsider these assumptions in order to achieve long stable time steps and conservation.

Presenter: WELLER, Hilary (University of Reading)

Session Classification: Moderator: Michail Diamantakis (ECMWF)