

Unified Model

Zoe Chaplin

HPC Team, Manchester Computing, University of Manchester

The ongoing collaboration between CSAR and the Met Office has resulted in a copy of the latest version of the Unified Model (UM), version 5.3. This replaces the previous version, 4.5 and represents a complete rewrite for much of the code. It has been in development for approximately 10 years and has only gone operational in the last few weeks.

So why was a new model needed? At 4.5 there is a major approximation in the equations governing the dynamics of the atmosphere. This is that the vertical component of the Coriolis force can be considered negligible and can therefore be ignored (the hydrostatic approximation) which means that vertical velocity (w) need not be explicitly calculated. This is true at large grid scales but, as computing power has increased, the potential to run the model at much finer scales ($<10\text{km}$) has meant that this is no longer desirable. The mesoscale model (this is the version that covers the UK) is already run at 12km resolution and is therefore approaching the limit at which the hydrostatic approximation is no longer valid. The dynamics of the UM has therefore been rewritten to remove this approximation and allow work to be done at scales of 2km or less. The new version of the dynamics code together with a new method of solving the physics equations has had the additional benefit of allowing a longer timestep to be used. This means that, in theory, each run should take less time to complete.

The dynamics has also been written in such a way as to include some implicit diffusion so less explicit diffusion is required. Together with the fact that the poles are now being dealt with in a more efficient manner, this means that less time is spent on calculation in these areas.

Another major issue concerned how well the model parallelised. Although 4.5 is a parallel version it is based on code that was originally written for a serial machine. It has long been known that the speedup for this version of the model has been abysmal and so it was important to create a new version that was better designed for the sort of architectures that it

was going to be run on.

Figure 1 shows the speedup curves for the dynamics and physics sections of both 4.5 and a prototype version of 5.3 on the Met Office T3E. There is clearly a dramatic improvement in the dynamics at 5.3 and there is also significant improvement in the physics. The 4.5 dynamics curve indicates that there was little to be gained from running on more than about 36 processors.

So have these differences improved the model? Well, yes. The latest results show a significant improvement over 4.5, at least in the global and mesoscale configurations. The climate version is still undergoing a lot of development - it's got a tough model to beat as the current version is considered to be one of the best in the world. Researchers at JCOMM (Joint Centre for Mesoscale Meteorology) in Reading have already spent a few years looking at resolutions as low as 2km and their results are looking very promising. There appears to be significant improvement over the old model in the way the finer details of the weather are represented.

So when can people start using it? Work is still in progress although 5.3 is available to a limited number of users on Turing. The current release is not portable so it is not yet available for the Origins and it is not an official Met Office release.

Will people notice a difference when running the model? The biggest difference will be in the file sizes. Due to the way the dynamics is now being calculated and with the addition of w as a main variable, the start dumps have increased in size and, for anyone wanting to run a limited area model (such as the mesoscale model) they will find that the boundary condition files are significantly larger. Also, any of the files generated at 4.5 will not be usable at 5.3. And of course, they should notice an improvement to their results!

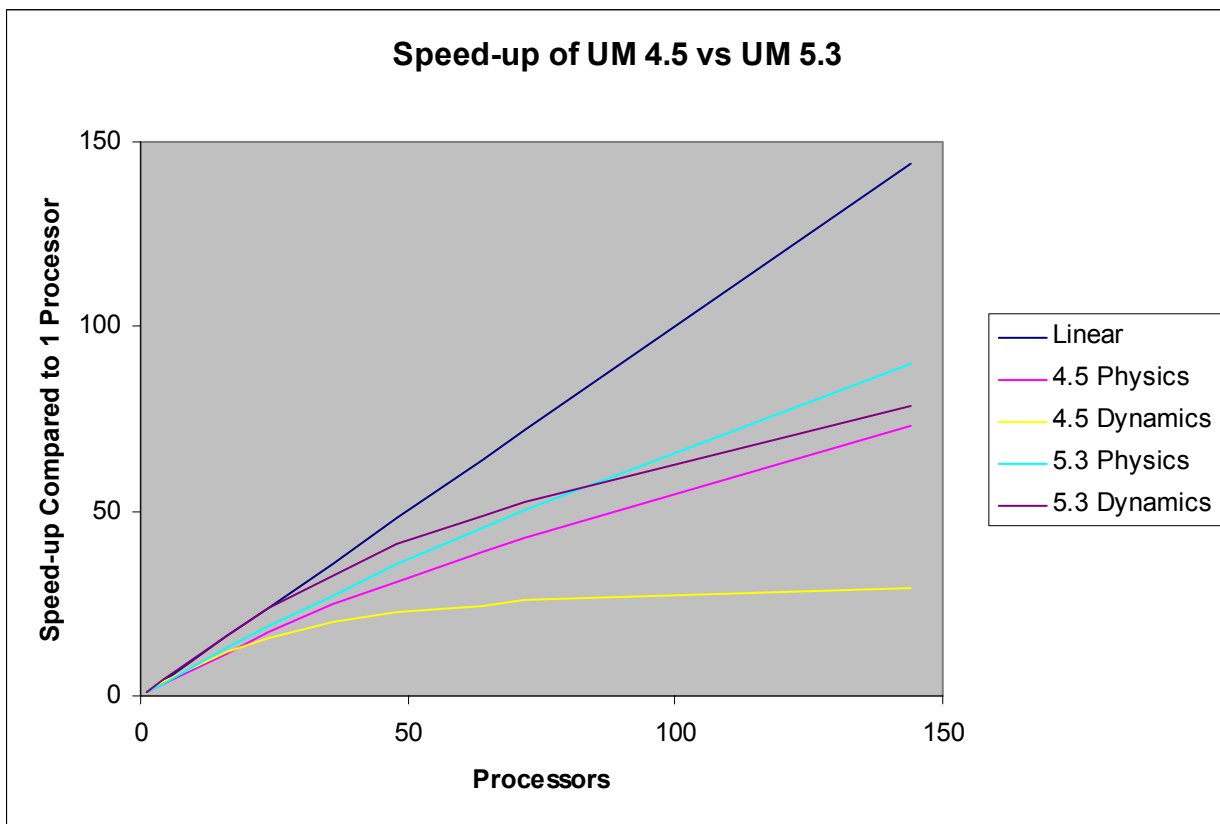


Figure 1

The speed up curves for the dynamics and physics sections of both 4.5 and a prototype version of 5.3 on the Met Office T3E