Planned developments for the LM-z in 2006

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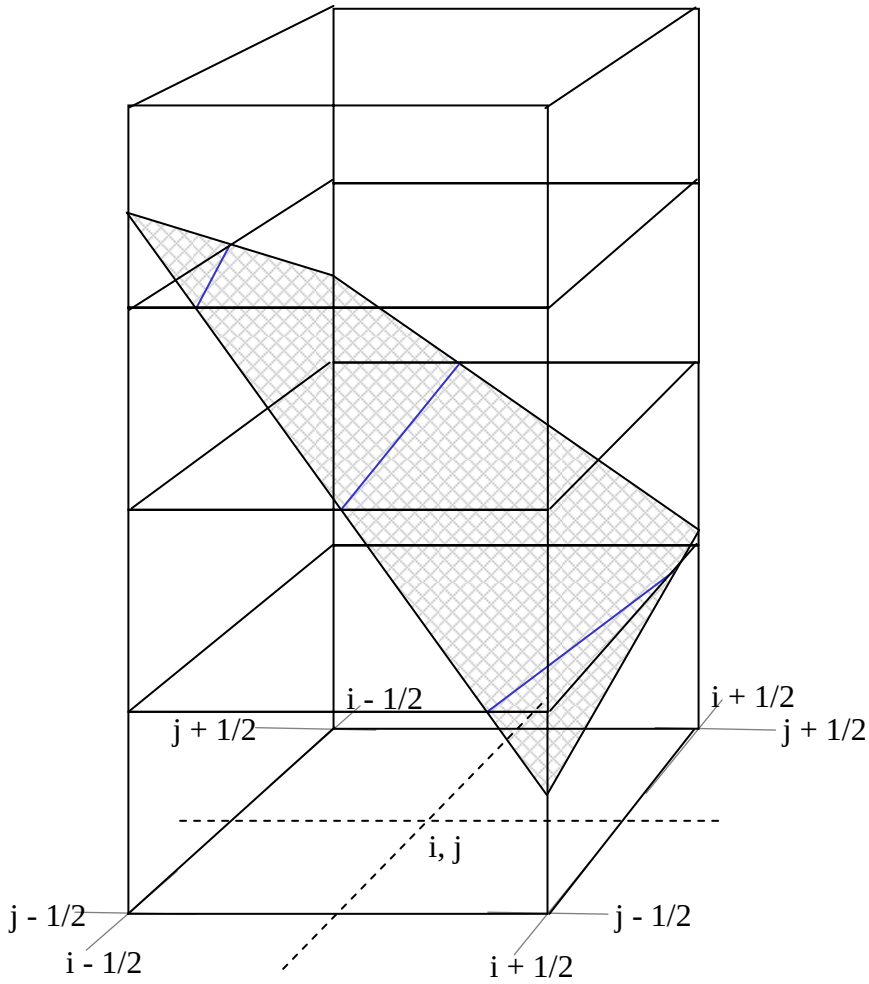
Plan of lecture

- Version 1.4
- New physics interface: 1.5
- Avoiding grid seperation: 1.6
- New horizontal diffusion: 1.7
- Improvement of normal components of velocities at mountains: 1.7
- Using larger timesteps: 1.7
- Up to date physics cycle

Shaved Elements



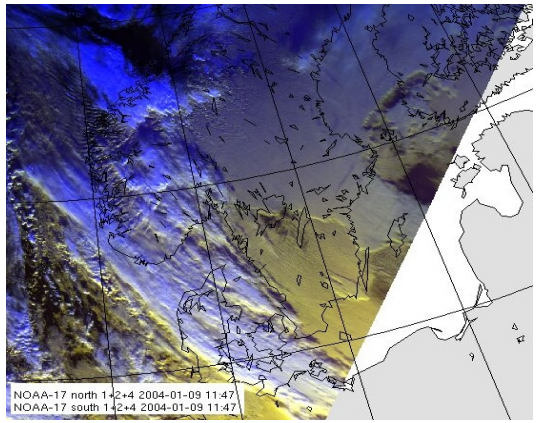
Features of LM-z 1.4

- Euler version runs realistic cases
- Simple interface to nudging available as update but not thoroughly tested
- Bugfixes available as updates
- Extensive test with resolution 7 km available

Physics interface by interpolation

- The physical processes are calulated on the physics grid, which for version 1.4 is the grid of LM-tf.
- The interpolation between the grids is cubic spline for 1.4 but replaced by linear interpolation in version 1.5.
- Advantages of linear interpolation: smoother result near the surface (only preliminary tests available).
- Advantage of the 1.5 scheme for the formation of low stratus has been verified for the SCANIA case.

The Scandinavia case

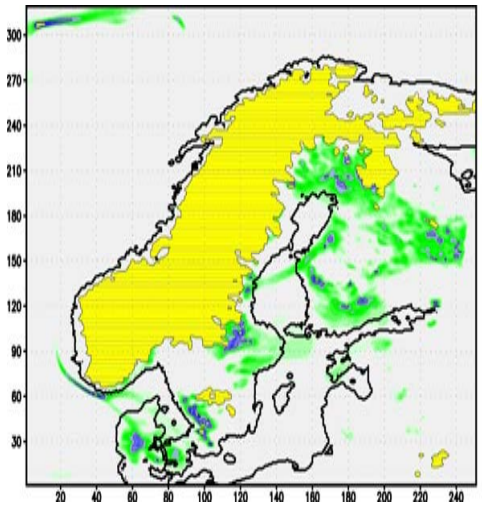


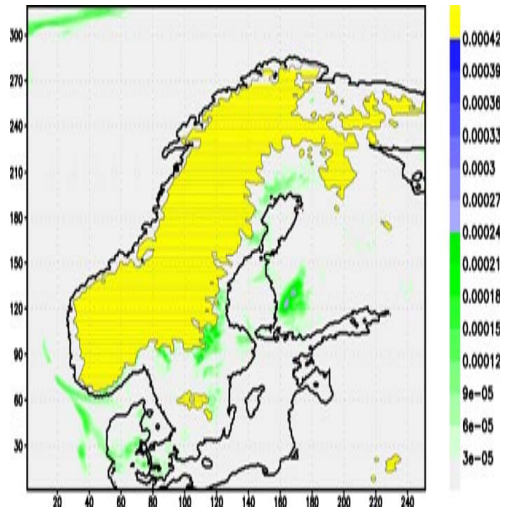
60^0 N

55^0 N

10^0E 20^0E

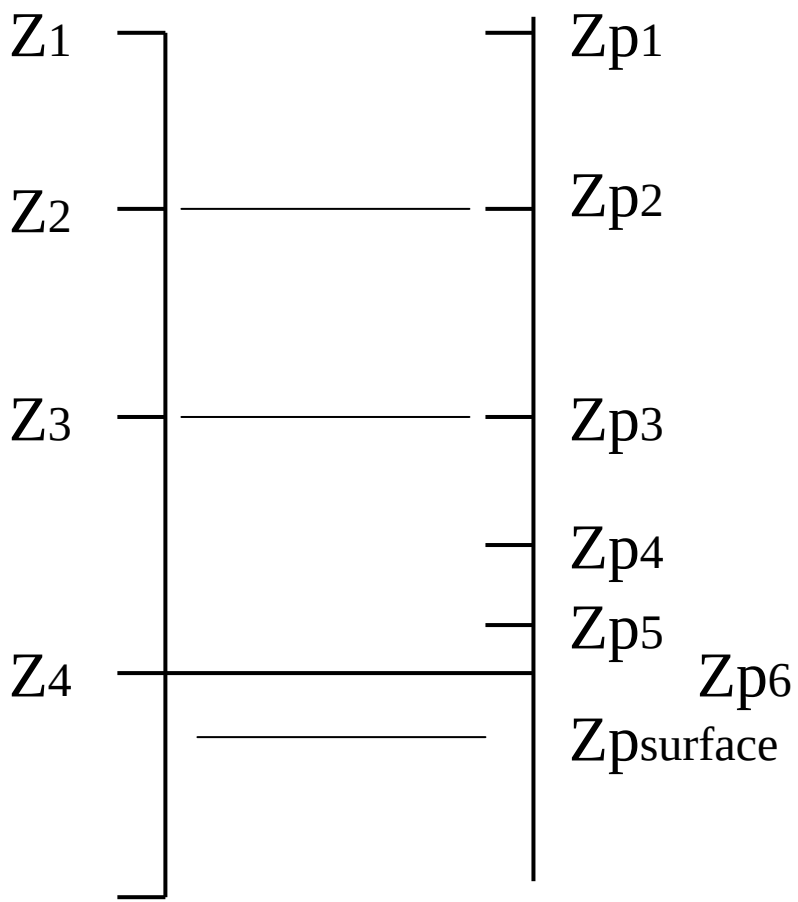
LM-z





LM-tf

Z-grid as part of physics grid

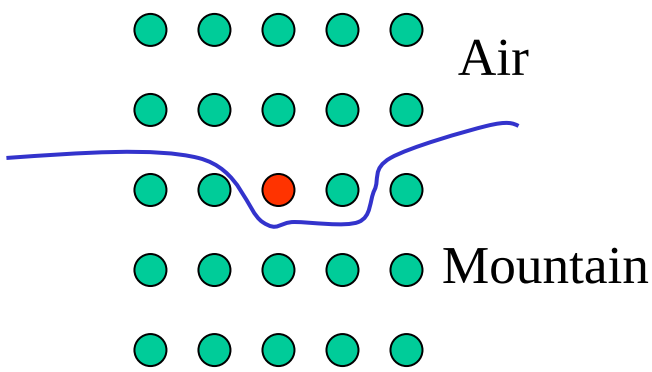


As Z-girdpoints are identical with some physics points, an interpolation error and associated grid separation will not occur (LM-z Version 1.6).

Version 1.6 will distinguish between z-grid, terrain following grid for input/output and physics grid. The storage of the Z-grid can be part of the physics grid.

New horizontal diffusion

The old scheme did Diffusion separately in x- and y-direction, leading to problems in narrow valleys.



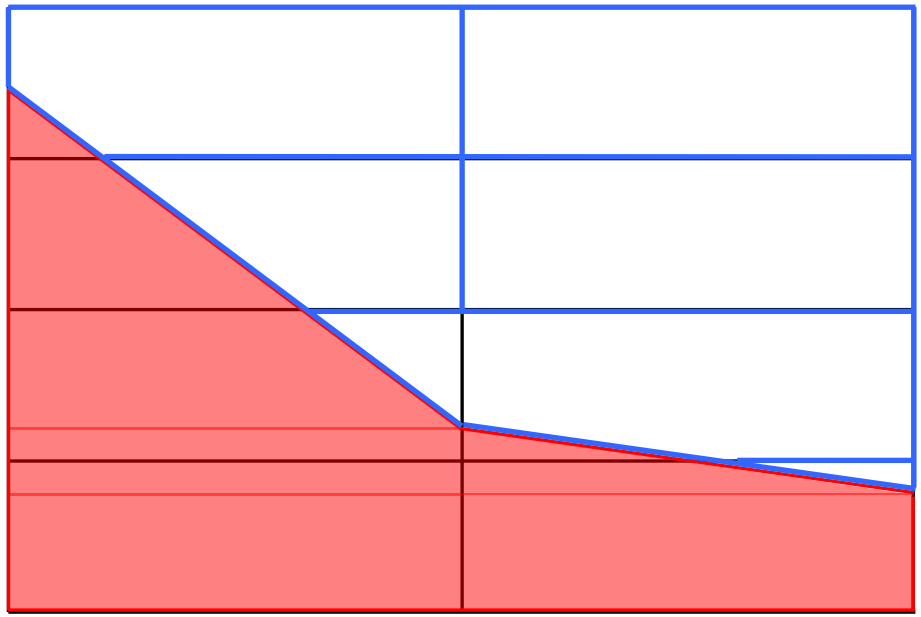
- Compute least square second order polynomial to 5 x 5 surrounding points
- Nudge point in question towards the point on the fitted polynomial

The new scheme avoids noise near mountains

LM-z with increased timestep

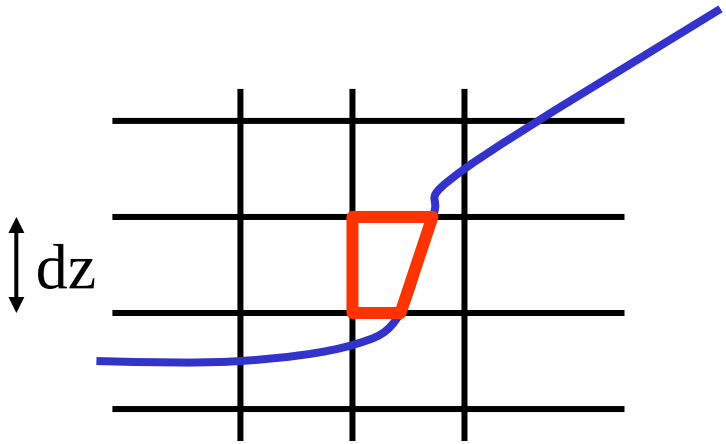
- Versions 1.4, 1.5 and 1.6 of LM-z run with a reduced timestep, bein about 1/4 that of LM-tf
- The horizontal combination of grid elements avoids the very small timesteps due to very small elements.
- Modifications of this scheme will be used in version 1.7 to come within reach of the normal timestep, in order to achieve operational efficiency.

Kombination of Elements



Computation of the divergence term

•The CFL problem is caused by grid elements which are small in horizontal direction.

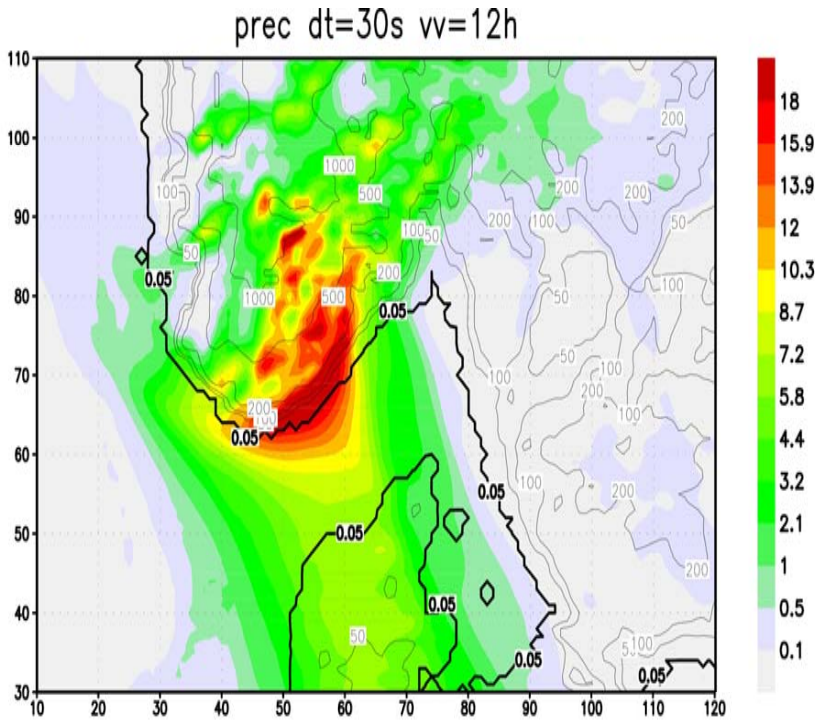


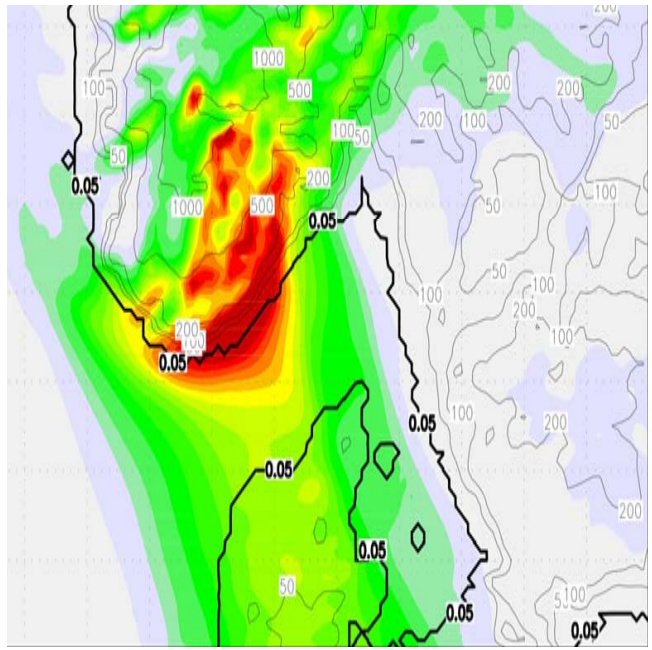
Approximation for horizontal divergence:

$div_{hor}=u_{i-1}*dz/dV$

Better CFL are achieved by assuming dV=dx*dy, if necessary. This assumes that the compressibility of a cell is that of a larger volume.

Precipitation of SCANIA case with 8 sec and 30 sec timesteps





Conclusion

- Current Version: 1.4
- 1.5: better surface fields, in particular better low stratus
- 1.6: no grid separation
- 1.7: New horizontal diffusion/larger timesteps

Cloud water for lowest 3 levels of SCANIA case with 8 sec and 30 sec timesteps