

# Calculating the humidity convergence with finite differences

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# General remarks

- Vertical component of humidity convergence is the same as it is already in finite difference space, only horizontal components are considered further
- Unlike in spectral method, many solutions are theoretically possible, constraints (e.g. conservation, accuracy) help to make a choice
- The task is to approximate  $u \frac{\partial q}{\partial x} + v \frac{\partial q}{\partial y}$  *on the unstaggered grid*

# Simplest solution is bad

$$u_i \frac{q_{i+1} - q_{i-1}}{2\Delta x}$$

- Large error of differentiation for small scales : instead of  $ik$  for spectral differentiation of  $k$ -th harmonic

$$i \frac{\sin k\Delta x}{\Delta x}$$

- Nonlinear (representation) error

# Pseudostaggering (Staniforth et al, 1990)

$$\frac{1}{4} \left[ (u_i + u_{i-1}) \frac{q_i - q_{i-1}}{\Delta x} + (u_i + u_{i+1}) \frac{q_{i+1} - q_i}{\Delta x} \right]$$

- **Avoids second problem**
- **Still has unacceptably large error for derivative**

# Solution used in SLAV model

- Pseudostaggering + 4<sup>th</sup> order formula for differentiation

$$\frac{1}{4} \left\{ (u_i + u_{i-1}) \frac{(27(q_i - q_{i-1}) - (q_{i+1} - q_{i-2}))}{24\Delta x} + \right. \\ \left. + (u_i + u_{i+1}) \frac{(27(q_{i+1} - q_i) - (q_{i+2} - q_{i-1}))}{24\Delta x} \right\}$$

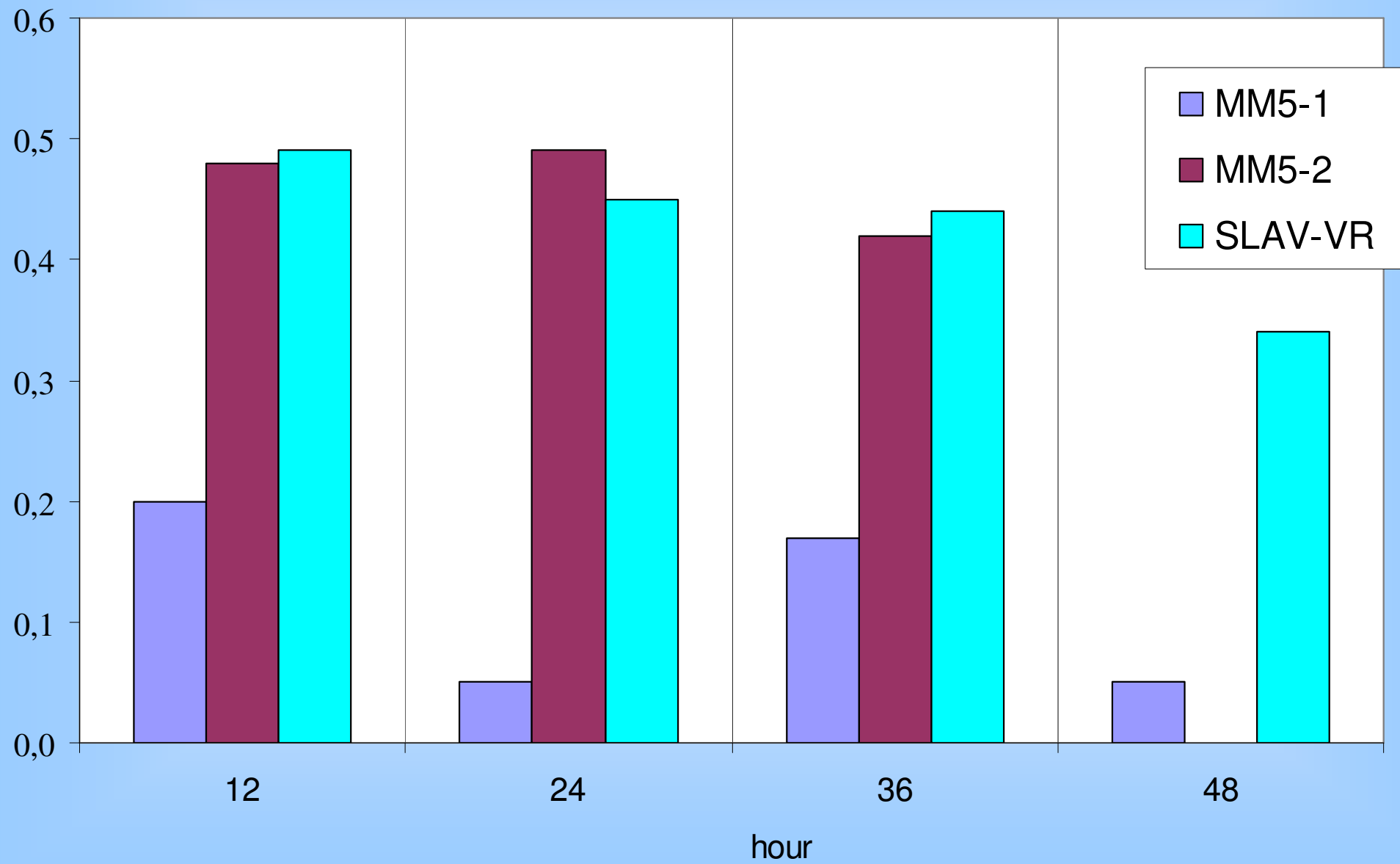
# Evaluation of precipitation forecasts over Central Russia for 1/07-24/09/2006

- Two versions of MM5 model running at Russian Hydrometcentre and Moscow Hydrometeobureau (18 and 15 km resolution) and variable-resolution SLAV-VR model (~30 km resolution over that region) compared.

*SLAV global model=own FD SISL dynamics+ALADIN parameterizations.*

- Both versions of MM5 started from NCEP analysis and boundary conditions, SLAV-VR started from Hydrometcentre OI assimilation based on operational SLAV 0.72°x0.9° version.

# Pearcy criteria, Central Russia



## Heidke skill score (HSS), Central Russia

