

First Results of 2D-LHN in aLMo

Daniel Leuenberger
Andrea Rossa

MeteoSwiss

LHN - the method

- Use radar-derived surface rain rate as proxy for vertically integrated latent heat source/sink from diabatic processes:
 - condensation/evaporation of clouds
 - evaporation of rain below clouds
 - melting and freezing of rain/snow
- Add nudging increment to temperature equation:

$$\frac{\partial T}{\partial t} = F(T) + \frac{\partial T_{LHN}}{\partial t}$$

Calculation of LHN temperature increments

- Scale model-derived LH profiles:

$$\text{Temperature increment: } \Delta T_{LHN} = \frac{RR_{ana}}{RR_{mod}} \cdot \Delta T_{LH_{mod}}$$

$$\text{Analysed rain rate: } RR_{ana} = w \cdot RR_{rad} + (1 - w) \cdot RR_{mod}$$

$$\text{Radar quality function: } w = w(x, y, t) \in [0, 1]$$

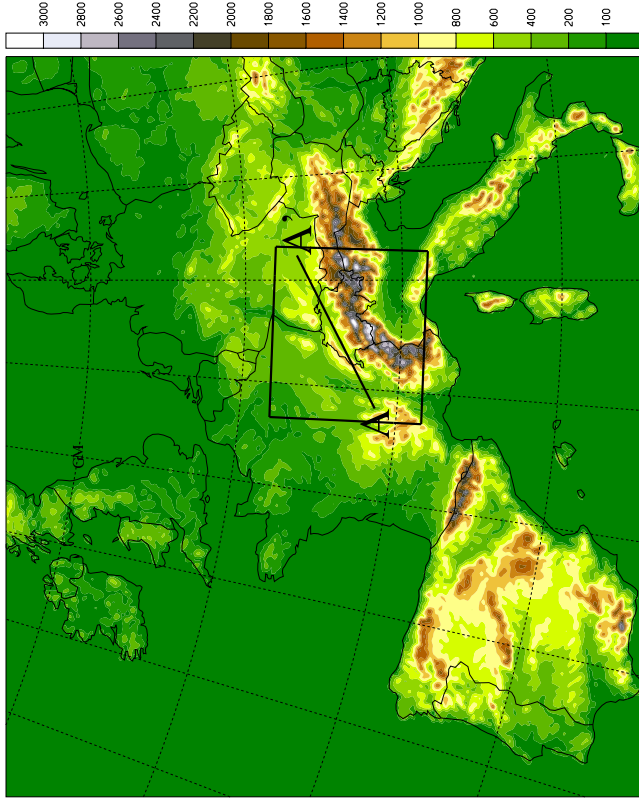
- Search for nearby profiles if model has too little precipitation $\left(\frac{RR_{ana}}{RR_{mod}} > \text{const} \right)$
- Use climatological/idealized profiles for scaling, if search is unsuccessful

First results of a case study

- System of severe convection over the Swiss Plateau
- Triggered by topography, entered Swiss radar domain at 21.8.2000, 00 UTC
- Pre-frontal development ahead of an elongated upper level trough in strong SW winds
- Lifetime \approx 8h
- Strong surface winds, considerable damage in eastern Switzerland

Simulations

- **CTRL** : aLMO run of 21.8.2000, 00 UTC
 - operational setup (7 km resolution)
 - interpolated from GME
- **LHN** : As CTRL but
 - with LHN from 00 UTC - 06 UTC
- **LHN+** : As CTRL but
 - with LHN from 00 UTC - 03 UTC
 - then free run from 03 UTC - 06 UTC



LM_00082100_001_00_CDF_2000/08/21_Mon00(+00)

- : Swiss radar network domain
- A - A' : Vertical cross-section

Hourly sum of precipitation

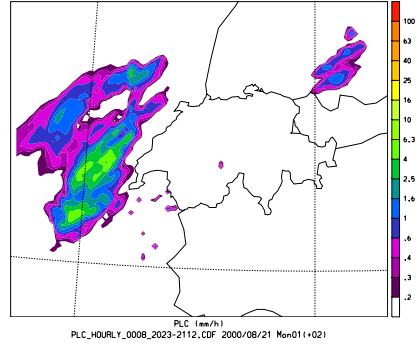
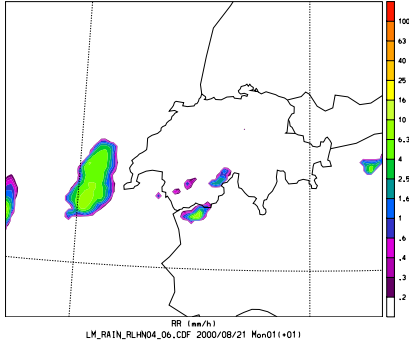
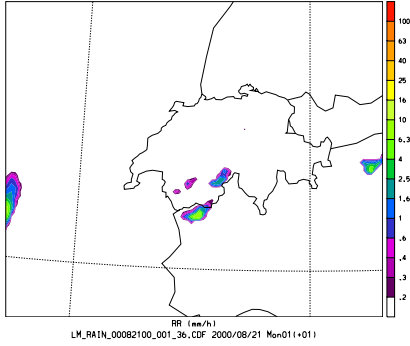
Nudging from 00 UTC to 06 UTC

CTRL

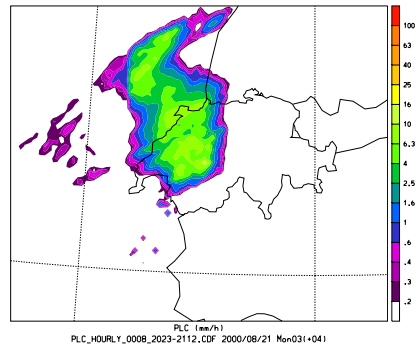
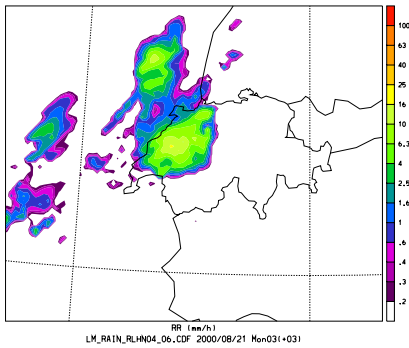
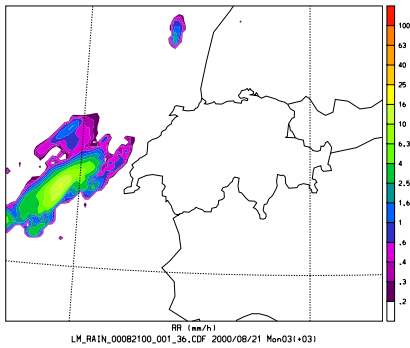
LHN

RADAR

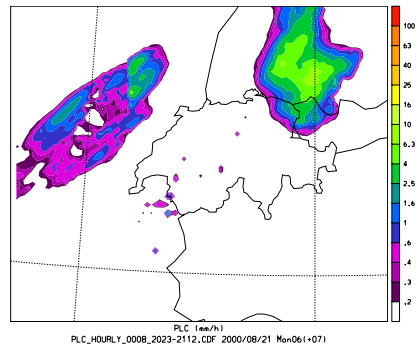
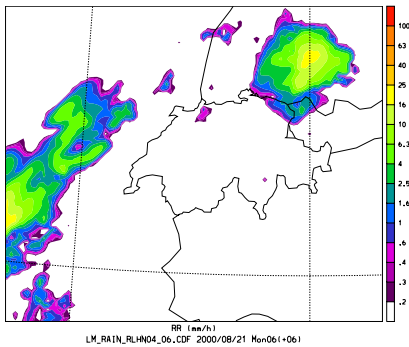
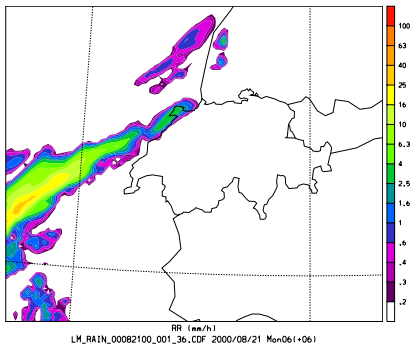
1h



3h



6h



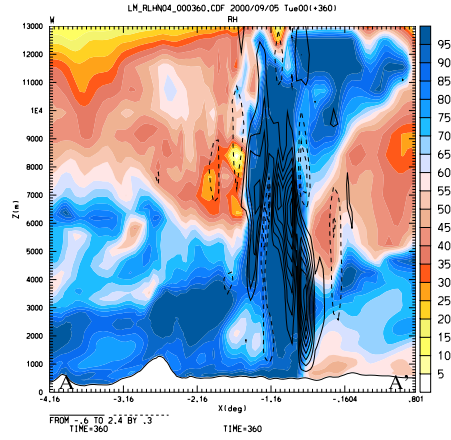
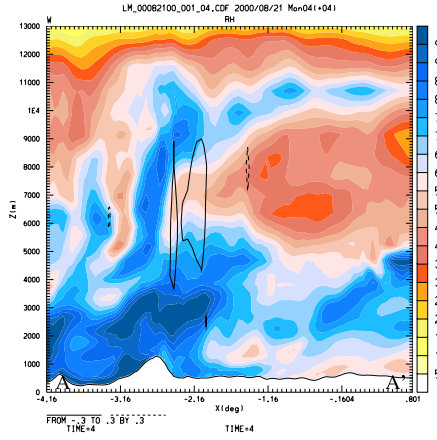
Dynamic circulation at 4h

CTRL

LHN

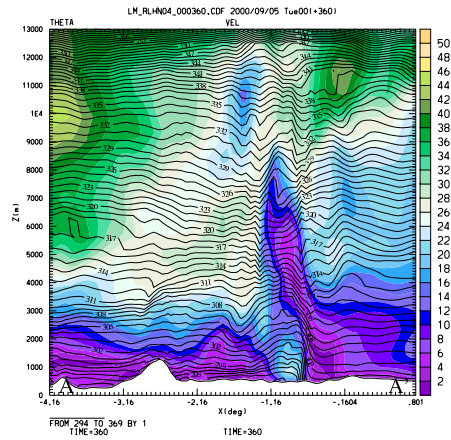
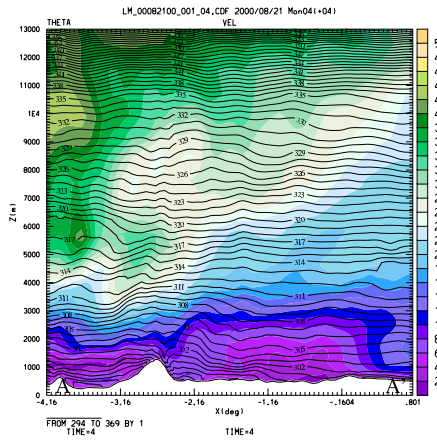
RH and W

RH and W



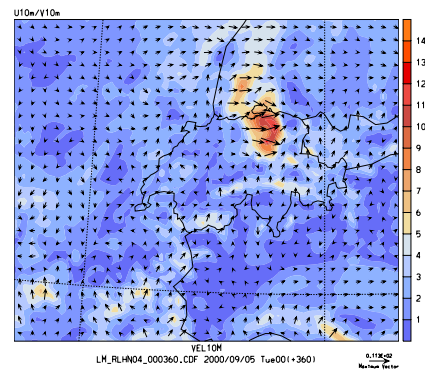
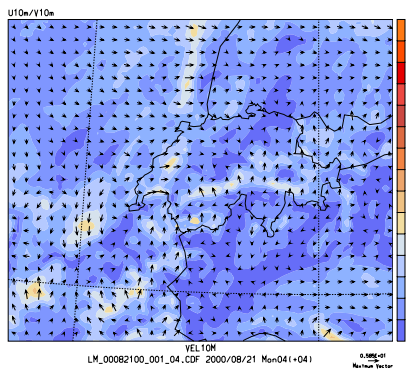
$|\vec{v}_H|$ and isentropes

$|\vec{v}_H|$ and isentropes



$|\vec{v}_H|(z=10m)$

$|\vec{v}_H|(z=10m)$



Hourly sum of precipitation

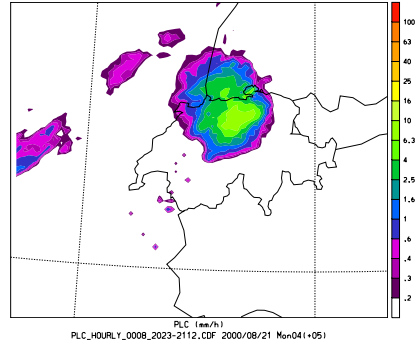
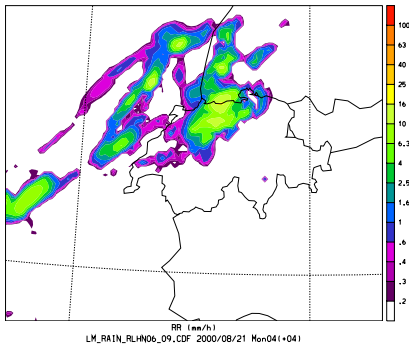
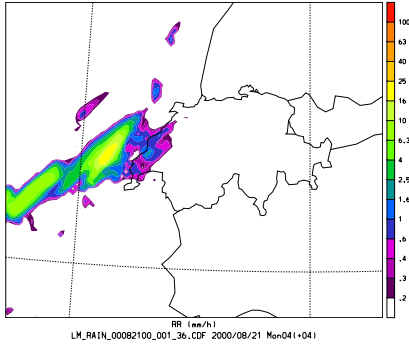
Nudging from 00 UTC to 03 UTC, then 3h free run

CTRL

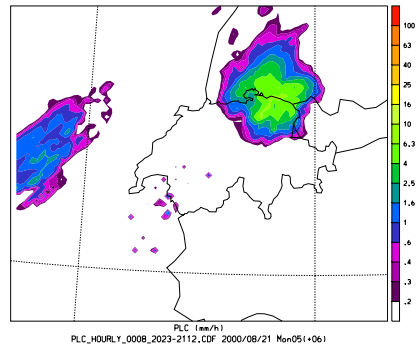
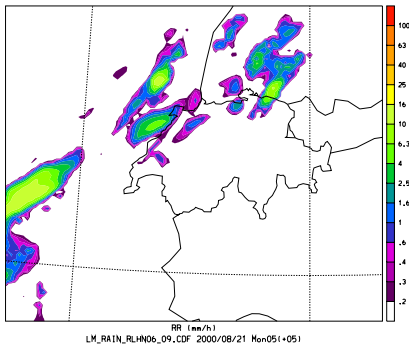
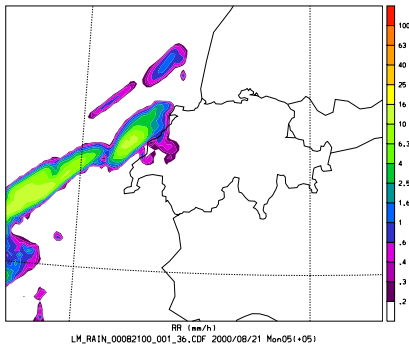
LHN+

RADAR

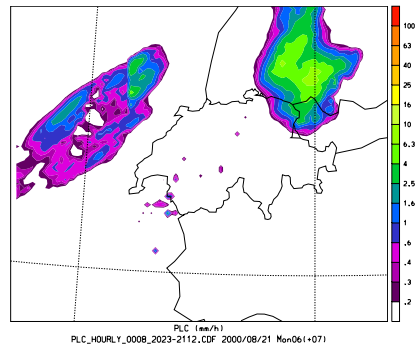
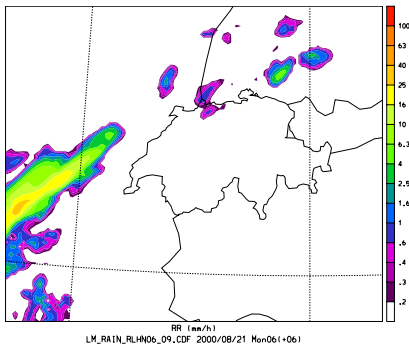
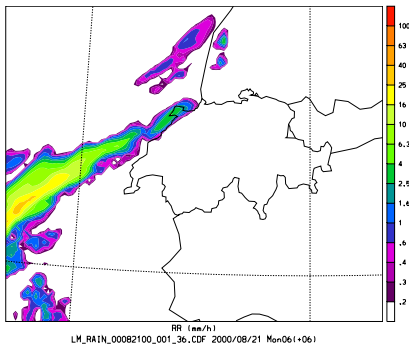
4h



5h



6h



Summary and future plans

- Summary
 - Model is able to assimilate radar data
 - Positive impact in analysis and during 3h forecast time
 - Model loses information in spite of favorable environment for 'survival' of storm
- Future plans
 - Runs with 2.8 km resolution
 - Idealized experiments
 - Impact of vertical structure of idealized profiles (stratiform vs. convective)
 - Assimilation of Doppler radar-derived wind fields