AROME-Nowcasting in Austria

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Meteorologie und
Geodynamik

Outline

- Implementation of AROME-Nowcasting at ZAMG
- First results
- Latent heat nudging in AROME-Nowcasting (LACE stay in MF)
- future plans for AROME-Nowcasting at ZAMG

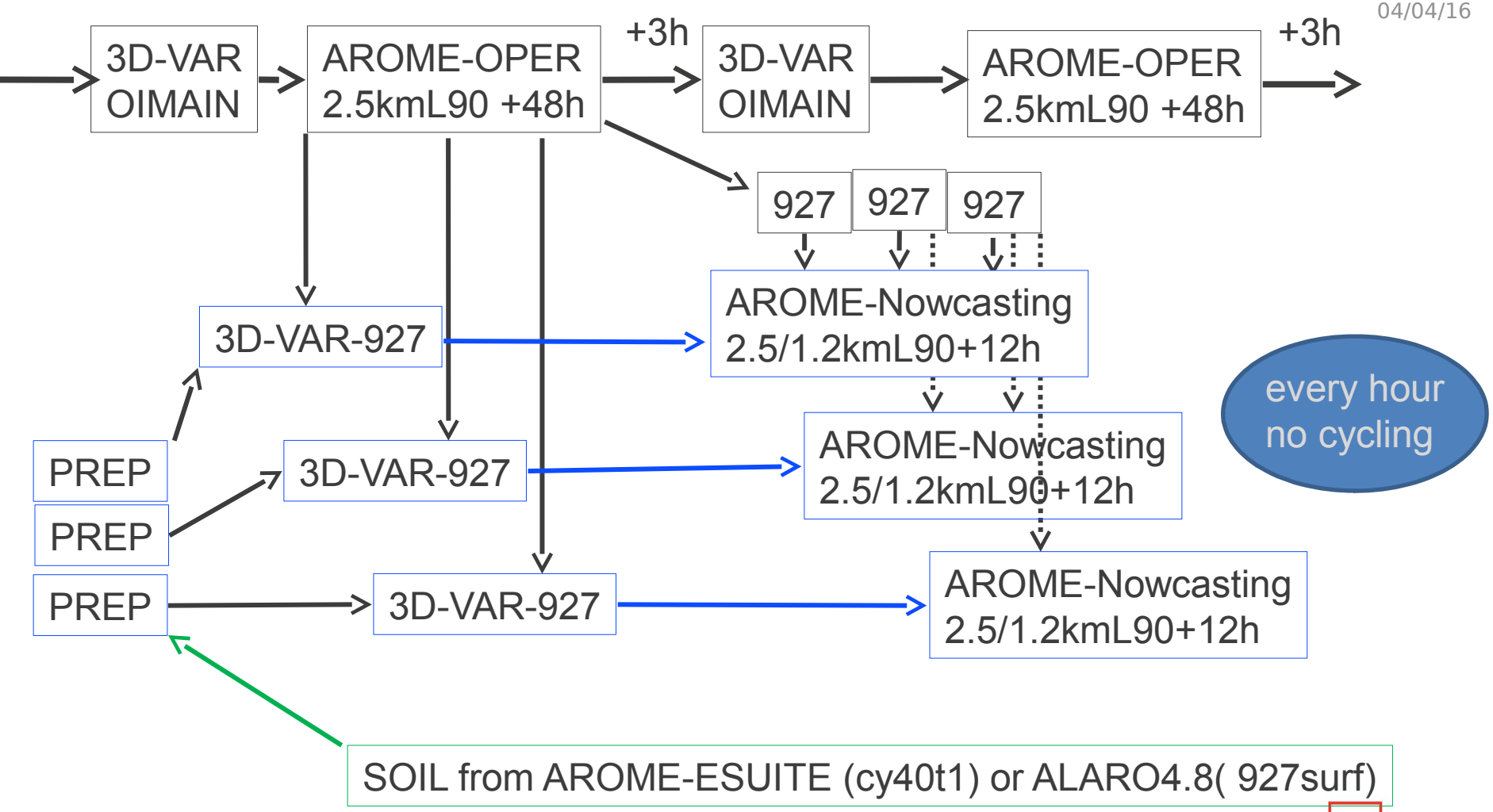
Why we run AROME-Nowcasting?

- Requirement by forecasters and customers for improved nowcasting
- Additional benefit from full dynamical model compared to traditional methods (for example INCA system)?
- Increasing computer power allows to run AROME very frequently and rapidly
- Availability of new observation types with high temporal resolution -> radar, MODE-S, GPS (EGVAP too late)

Challenges:

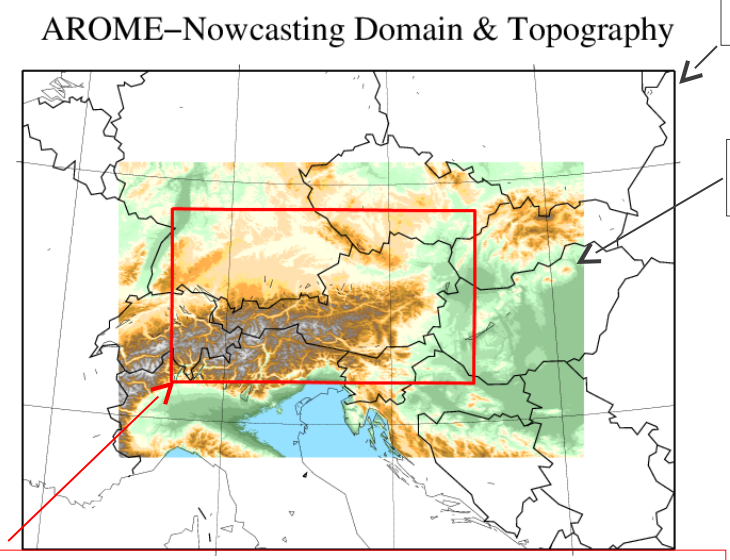
- Amount of data: 24 runs per day ->104GB for 12h forecasts/day
- Computational costly, computation should be finished within 1h
- Maintainance is difficult, almost no time for backup / to intervene manually
- Number of observations limited due to cutoff time
- Spin up off hourly 3D-Var

Schematic picture of AROME-Nowcasting at ZAMG



AROME-Nowcasting test implementation in Au

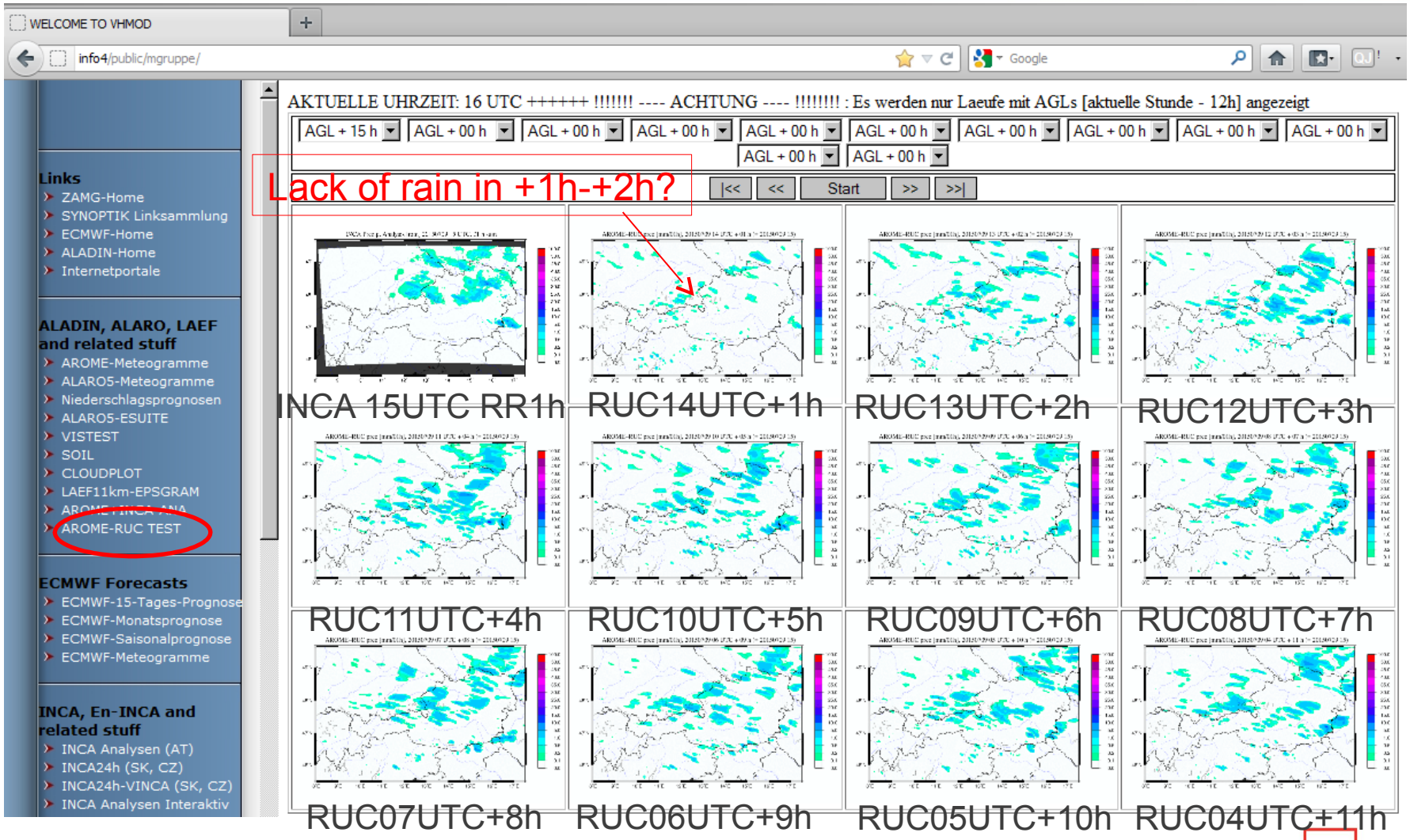
- AROME 2.5km (1.2km) 90L nested into latest AROME-2.5km-OPER
- Hourly 3D-Var +12h forecast ; aim to finish within 1 hour after analysis time
- First guess from latest 3h-AROME-OPER
- Cutoff time for observations: 25min
- soil: downscaled ALARO later downscaled AROME-OPER (PREP-OFFLINE)
- B-Matrix as in AROME-OPER: Ensemble method (downscaled ALADIN LAEF d ember 100 diffs) later: 1.2km-



ZAMG conventional nowcasting INCA domain

Code version:
like AROME-ESUITE
3D-Var: cy36t1
Integration etc:
cy38t1->since 2016
cy40t1bf5 export

Visualisation of AROME 2.5km-Nowcasting 1h-precipitation



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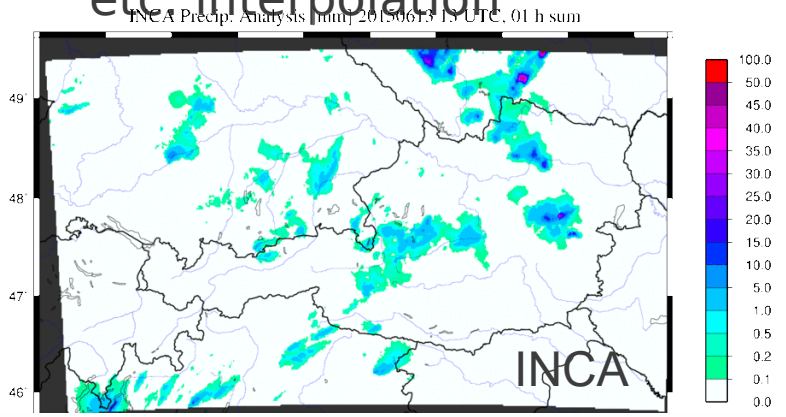
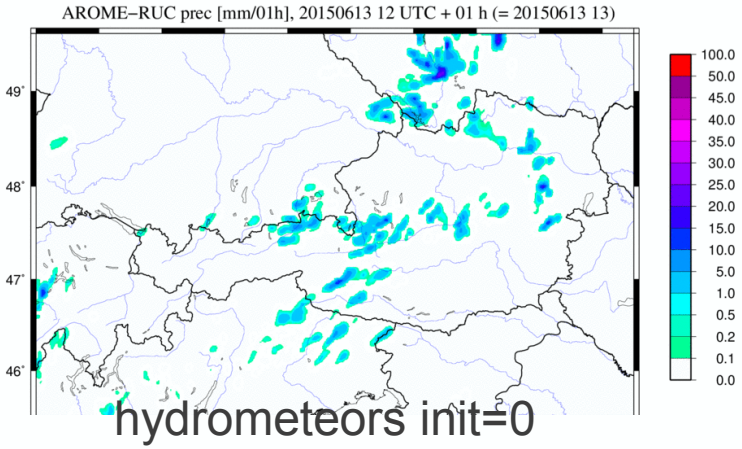
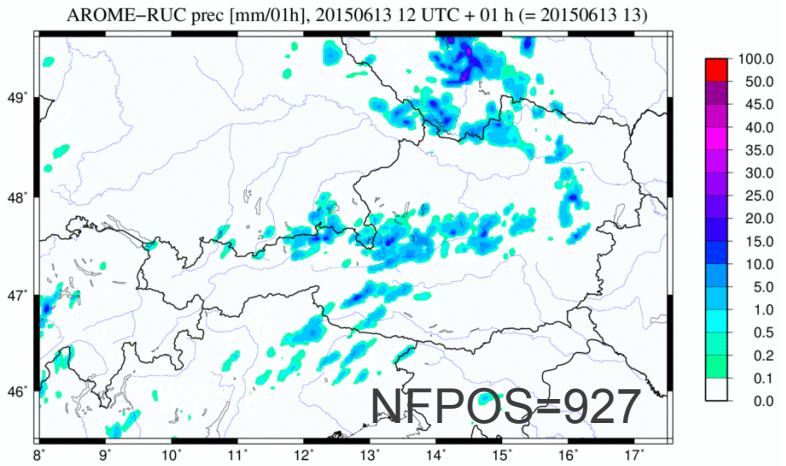
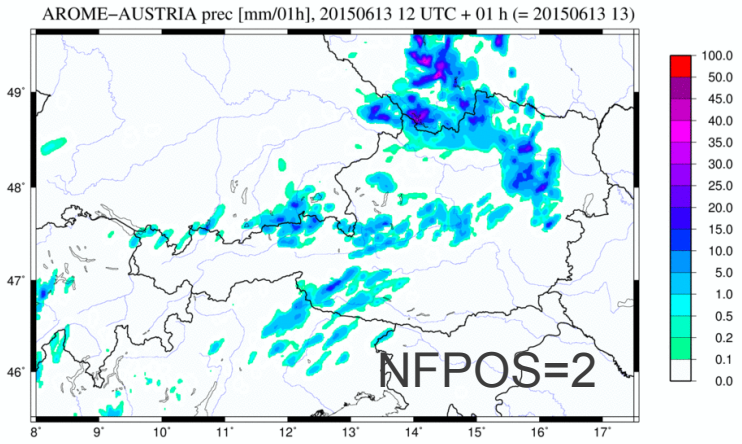
To few precipitation in first two hours (16th June 2015))

- Interpolation of falling hydrometeors in LBC solves the problem almost NFPOS=2, NFPOS=927 does not work for RAIN etc. interpolation

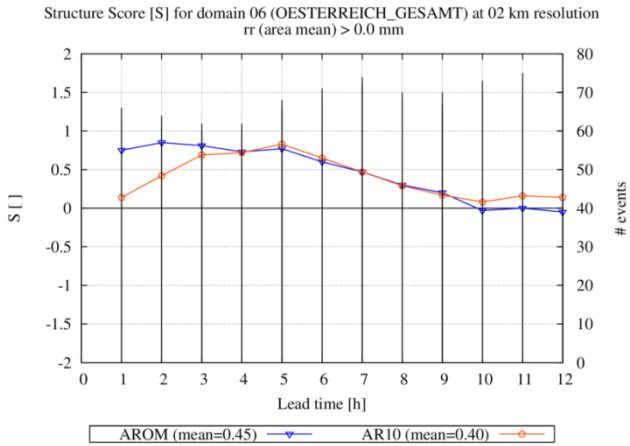


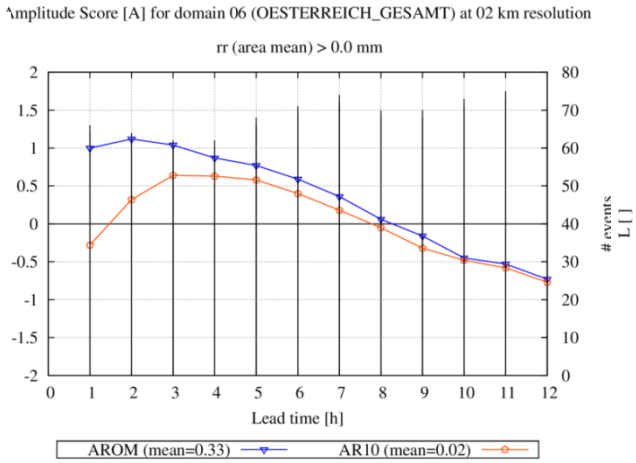


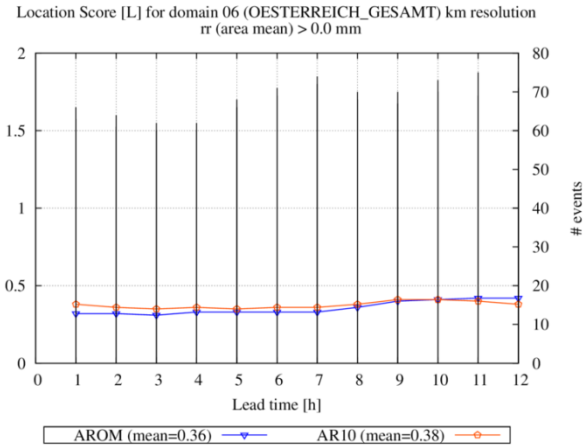




Verification 2.5km version: 2nd June-20th August 2015 12UTC run

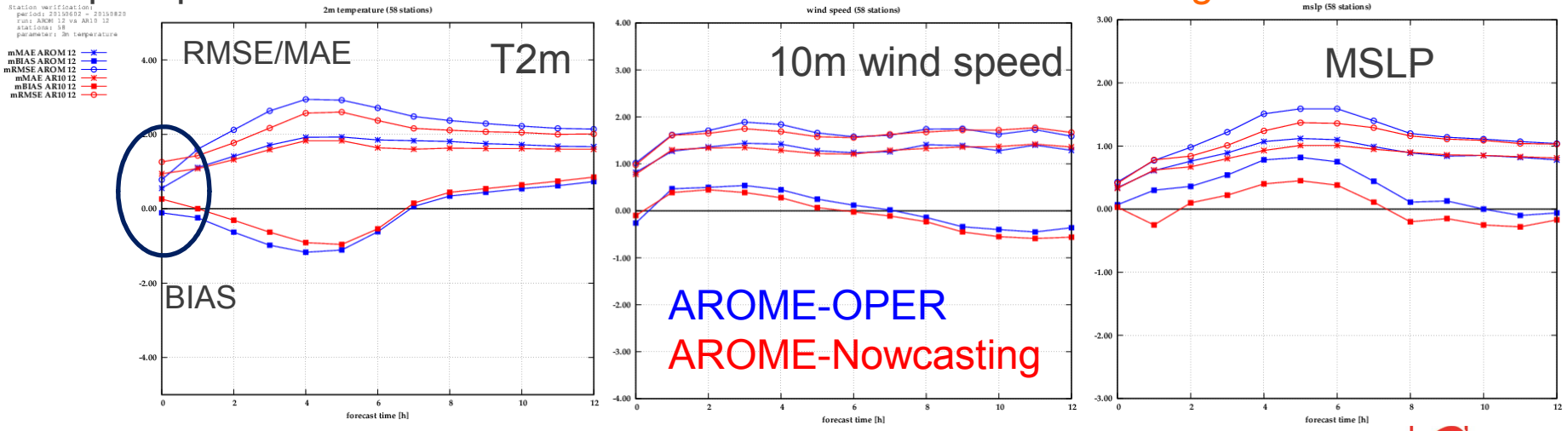






precipitation: SAL

AROME-OPER AROME-Nowcasting



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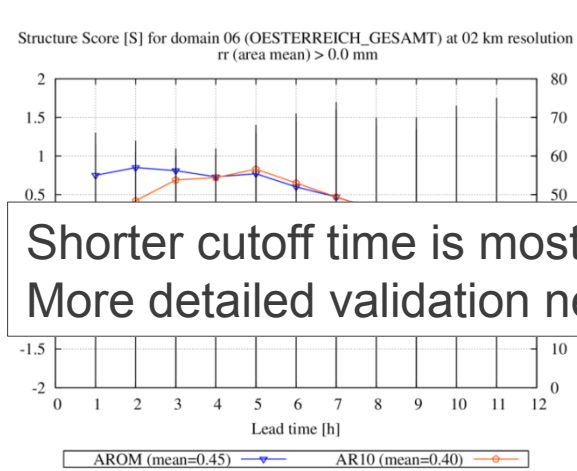
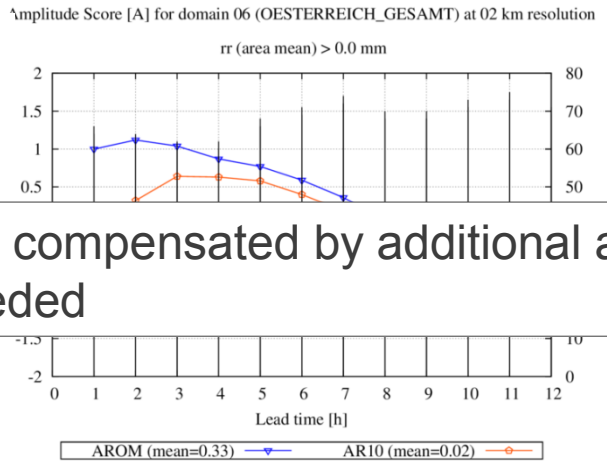
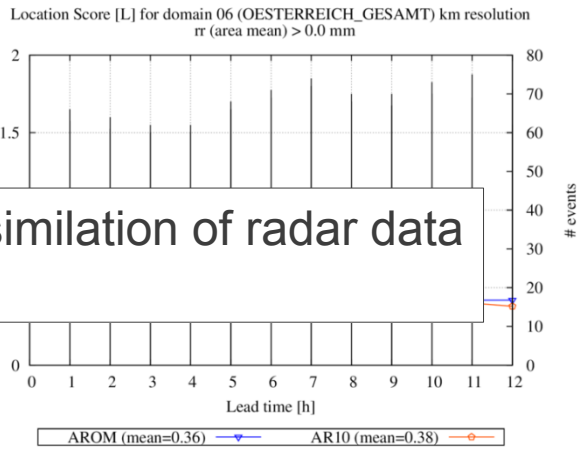


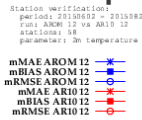


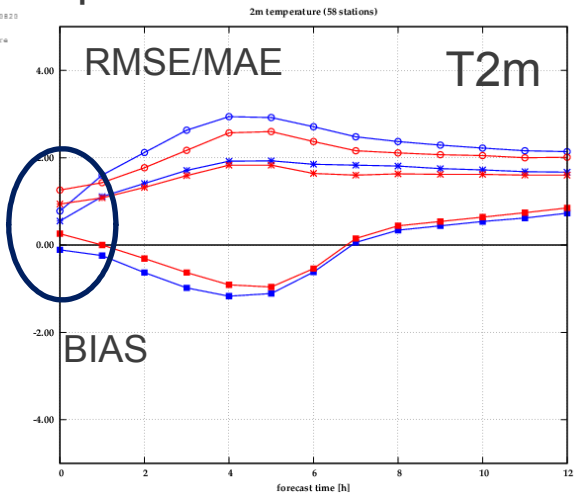


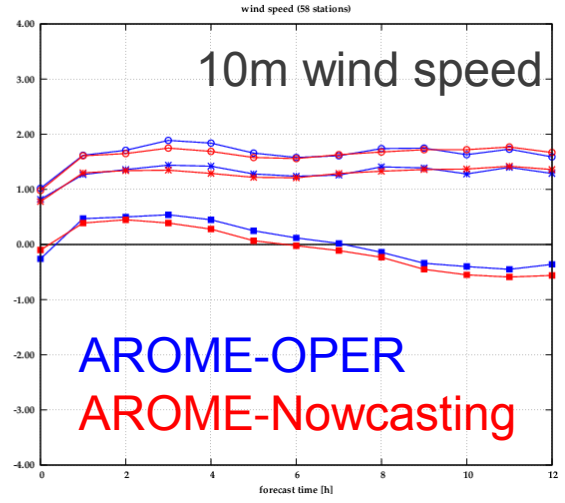
Shorter cutoff time is mostly compensated by additional assimilation of radar data
More detailed validation needed

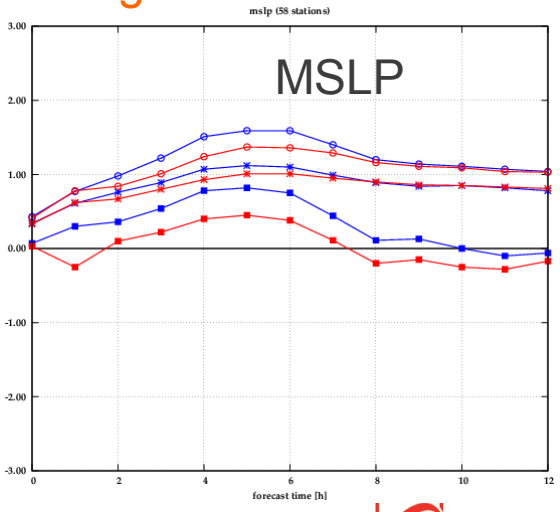
precipitation: SAL

AROME-OPER AROME-Nowcasting



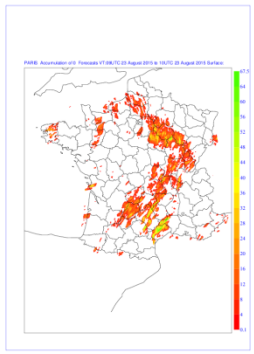


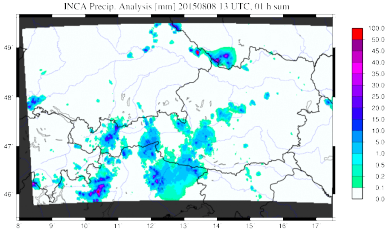




Latent heat nudging with AROME cy38t1/cy40

- LACE stay in Météo France in autumn 2015
- Based on Jones & Macpherson 1997
- 2D-gridded precipitation observation from INCA (combination of radar and rain gauges) every 5min/15min <-> ANTILOPE system in MF
- Nearest neighbour interpolation to model grid into FA file with INTERRROBS binary (modified blendsur) different obs. times safed as S001RAIN-S090RAIN -9999.99, where no data
- Application during 001: observation read at the beginning of integration by cnt3.F90/sugridu.F90
- Calling of nudging from apl_arome.F9
- Computationally cheap





INTERRROBS.F90

RROBS+5min → S001RAIN
RROBS+10min → S002RAIN
RROBS+15min → S003RAIN
...
...
S090RAIN

RROBS1.fa

3D-Var+RADAR

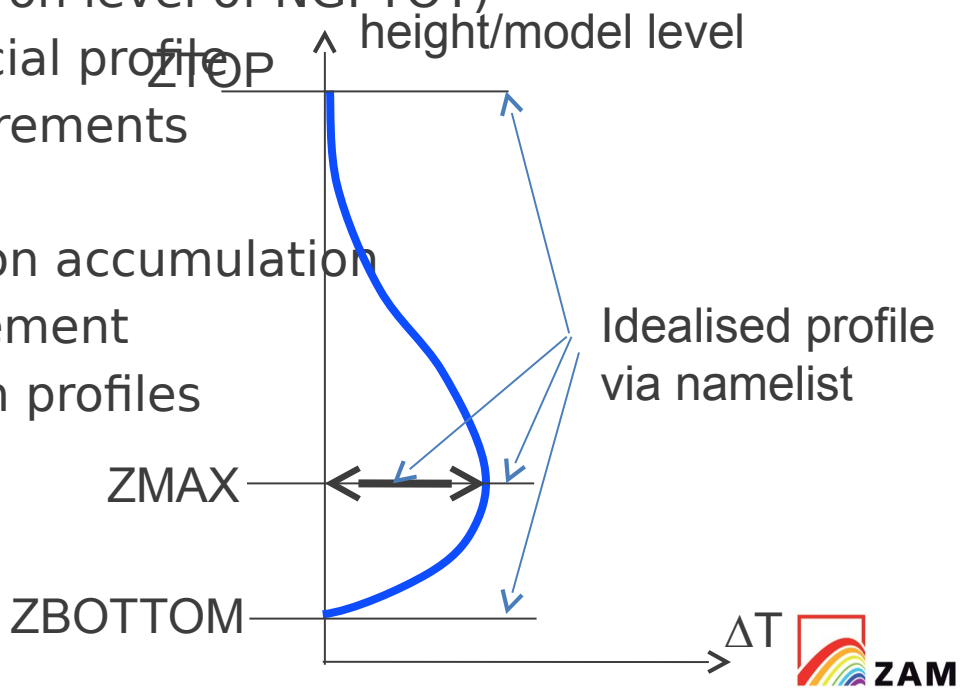
AROME
001

Latent heat nudging

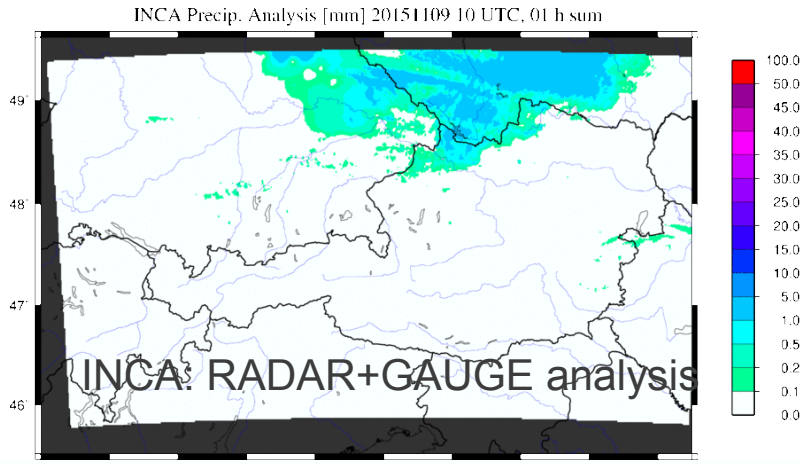
- 2D observed and modeled precipitation is compared and the difference transformed into a 3D latent heat rate increment based on the latent heating from model physics

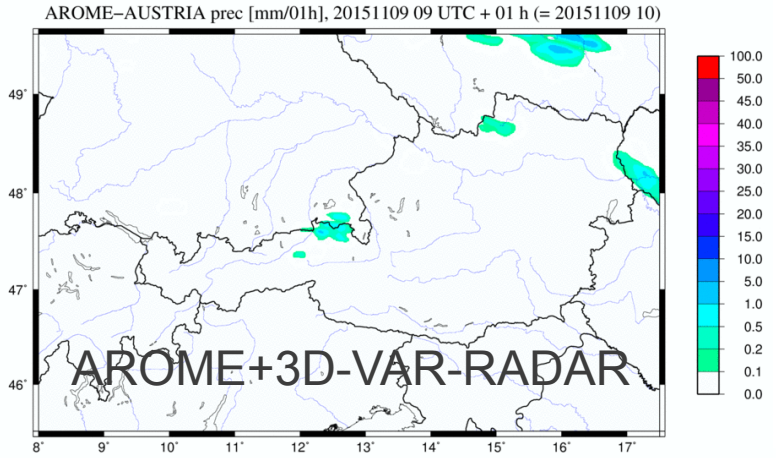
$$\Delta\theta_{LHN} = \Delta\theta_{phys}\frac{RR_{obs}-RR_{model}}{RR_{model}}$$ (Jones & Macpherson)

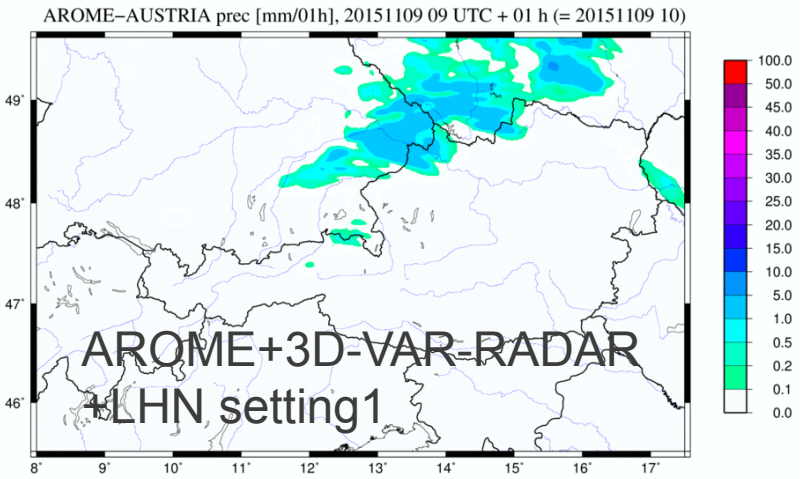
- In case there is no precipitation in the model but observed, we take a neigboured profile (only on level of NGPTOT)
- If this also failes, take an artificial profile
- No horizontal smoothing of increments (difficult in apl_arome)
- Time delay between observation accumulation period and adding of the increment
- Take better climatological mean profiles than idealised ones? (J. Cedilnik 2005 in ALADIN)

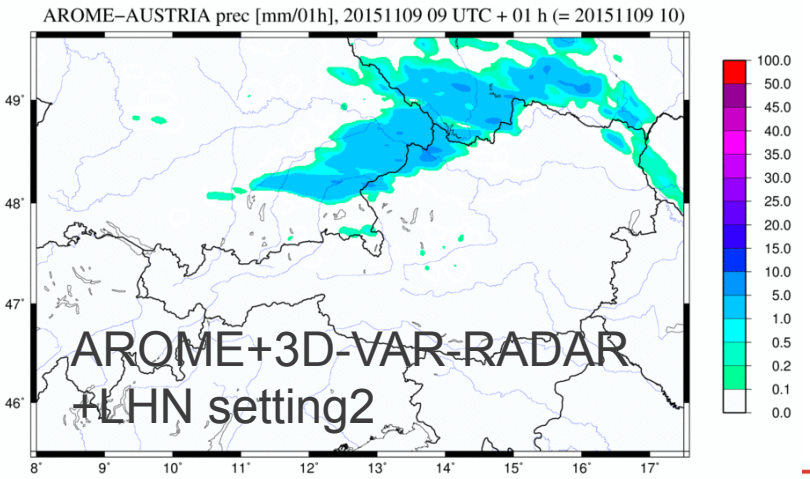


LHN example: 20151109 09-10UTC 5min nudging till +30min









Case study: 29th March 2016: Fast moving showers and thunderstorms in cold air mass

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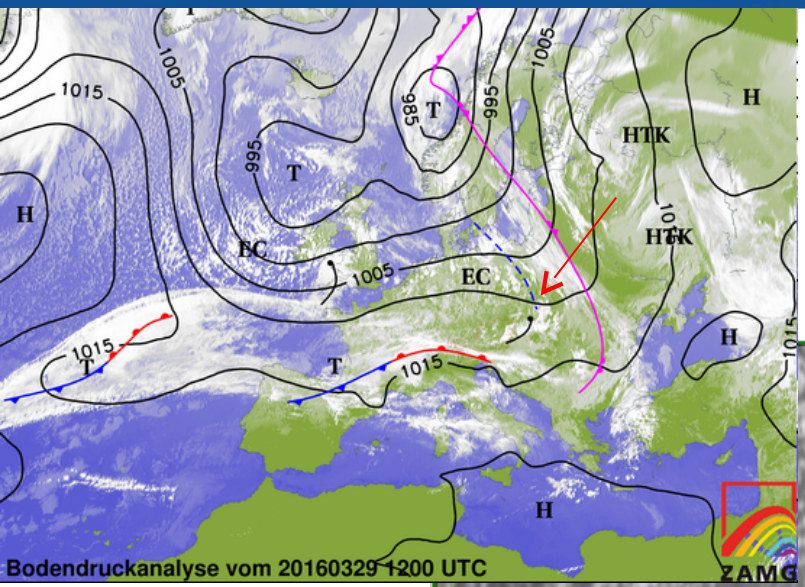

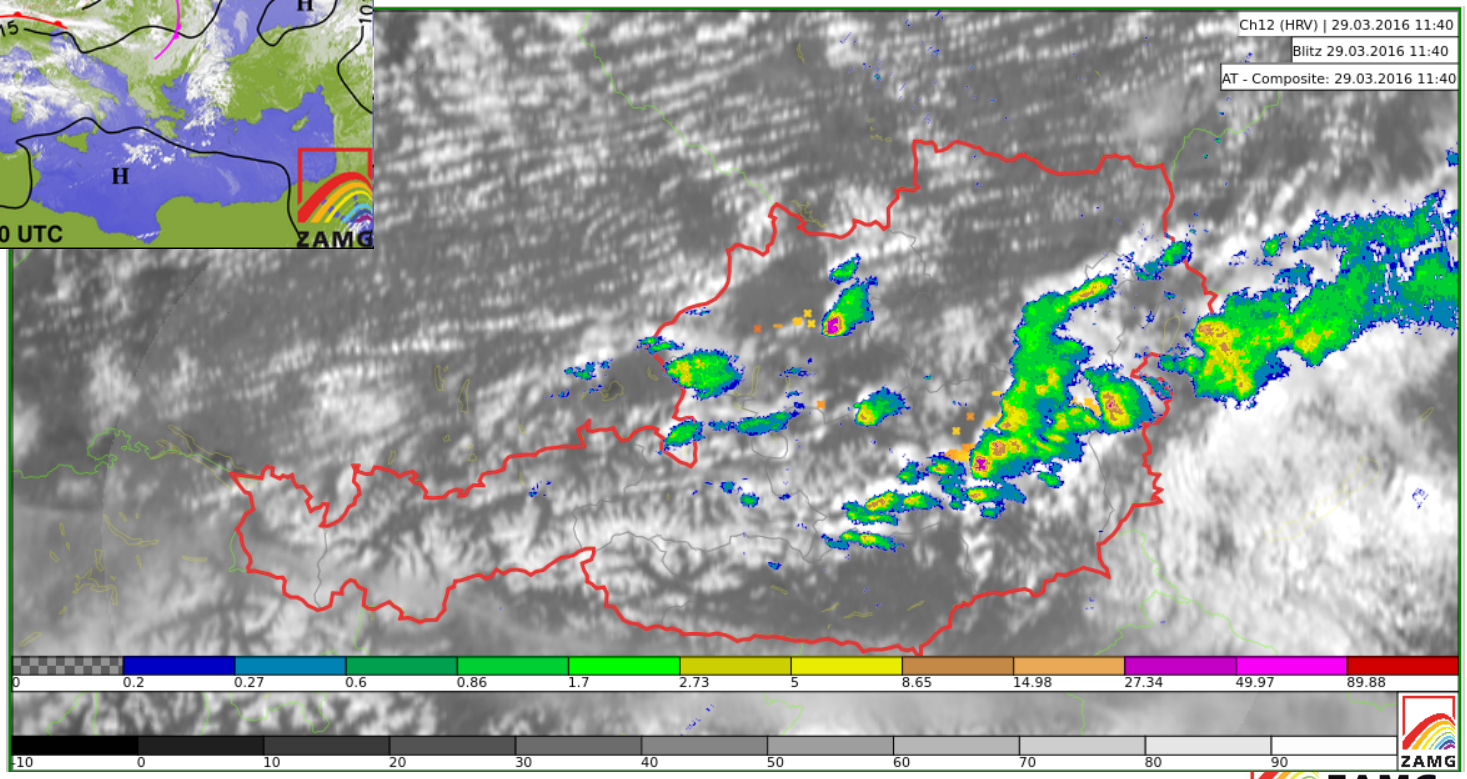

MSG_HR+RADAR+lightning 11:40UTC

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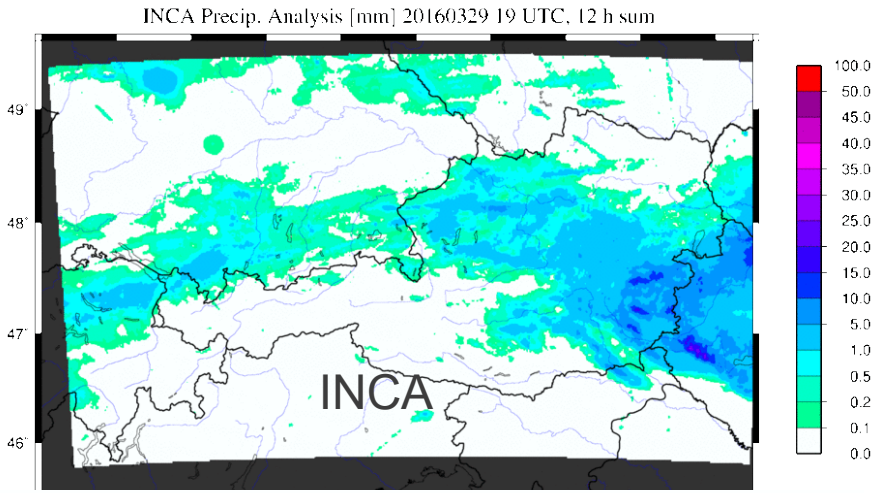

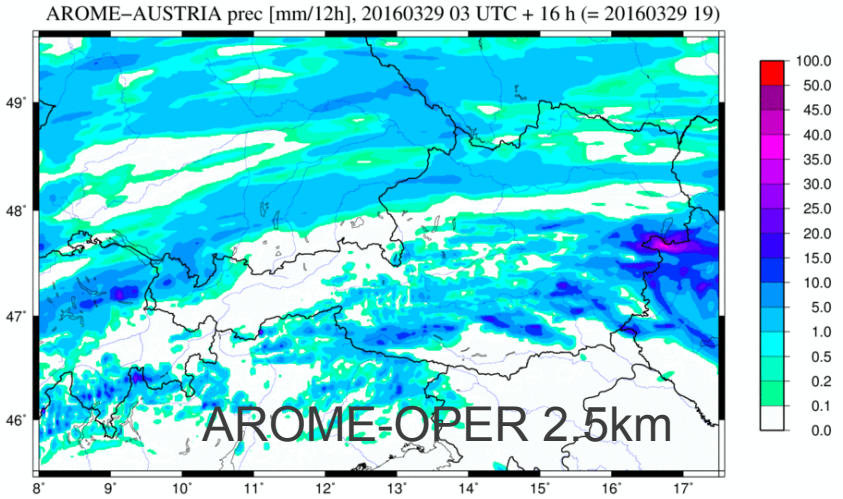

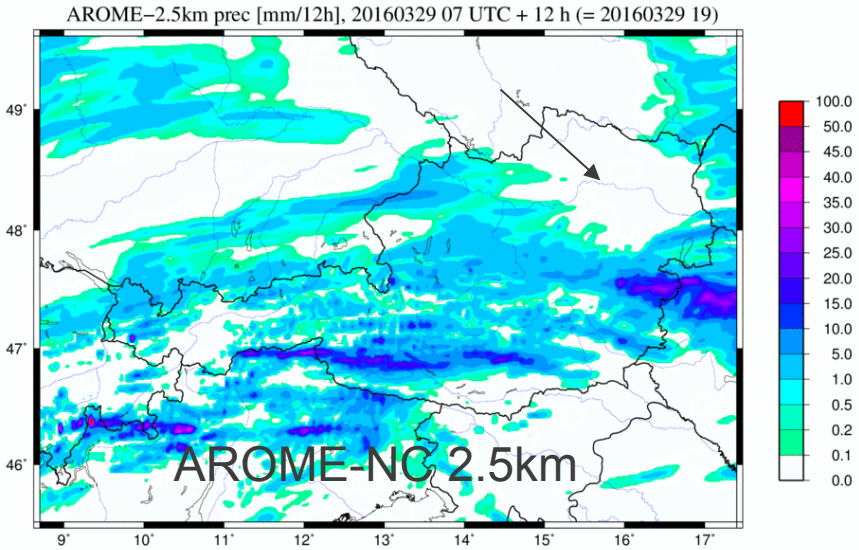

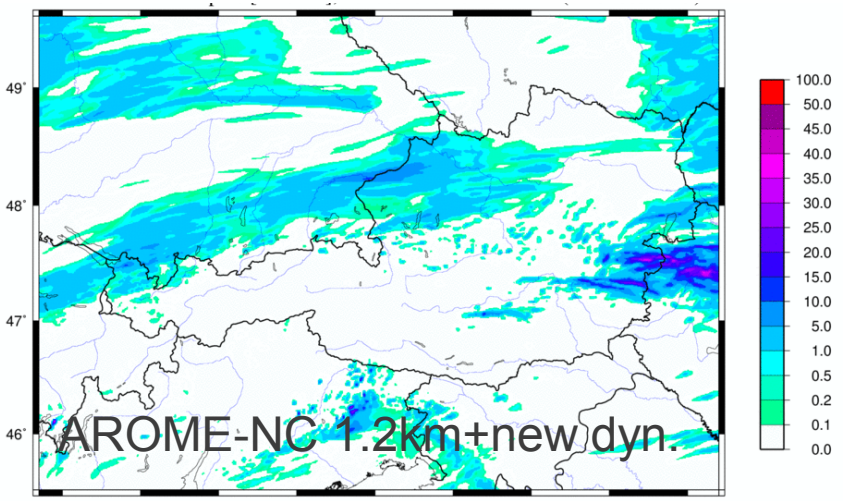

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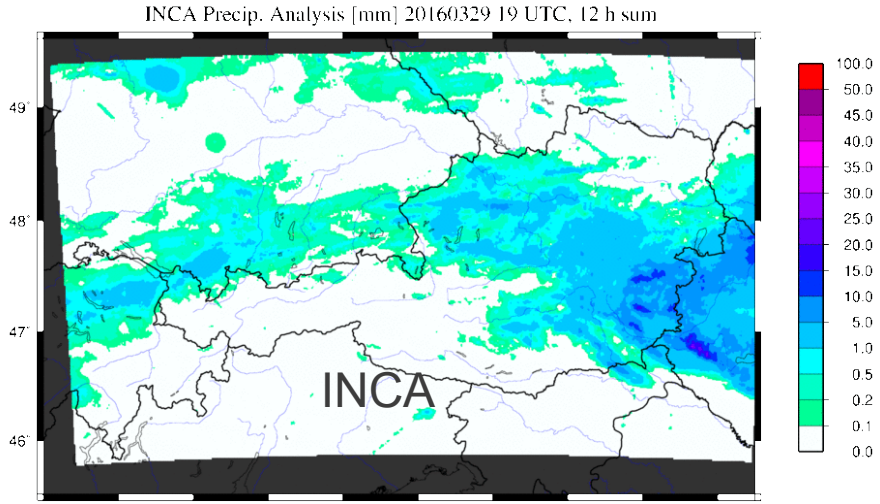

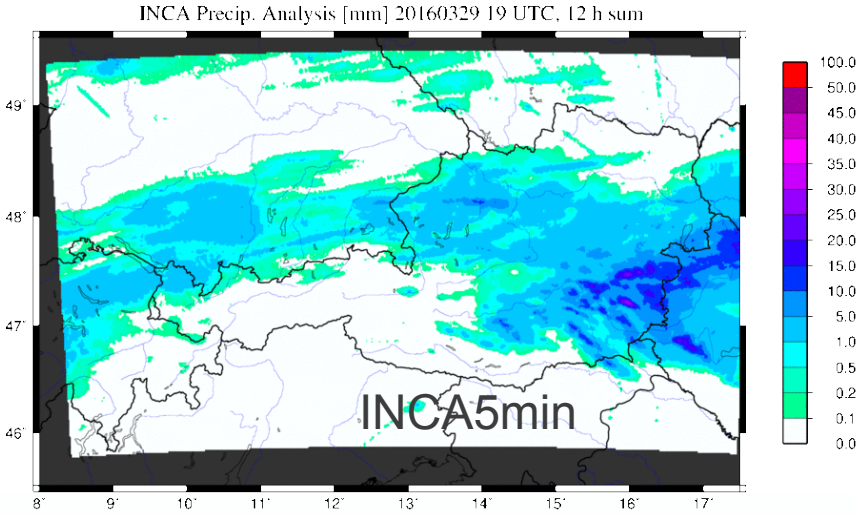

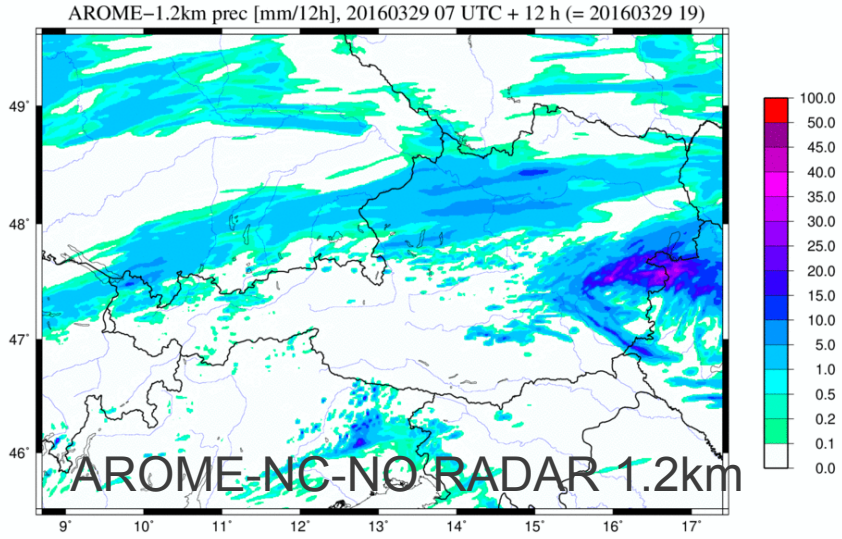

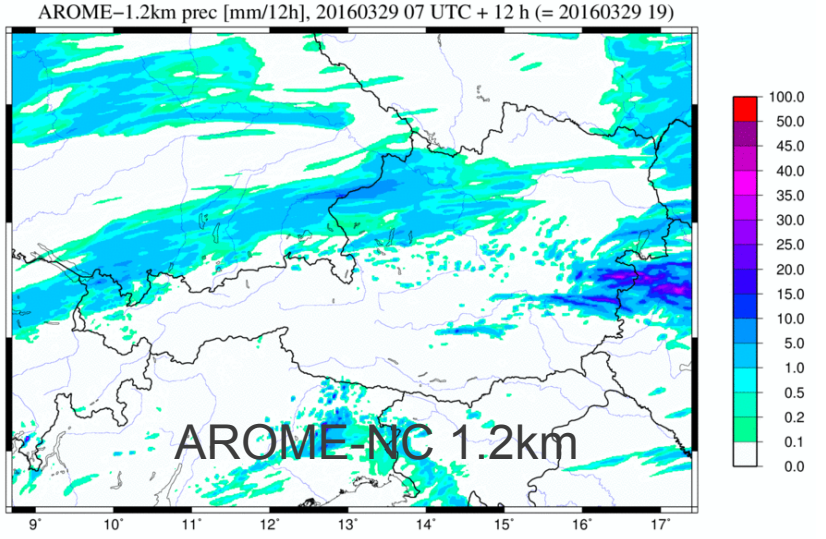

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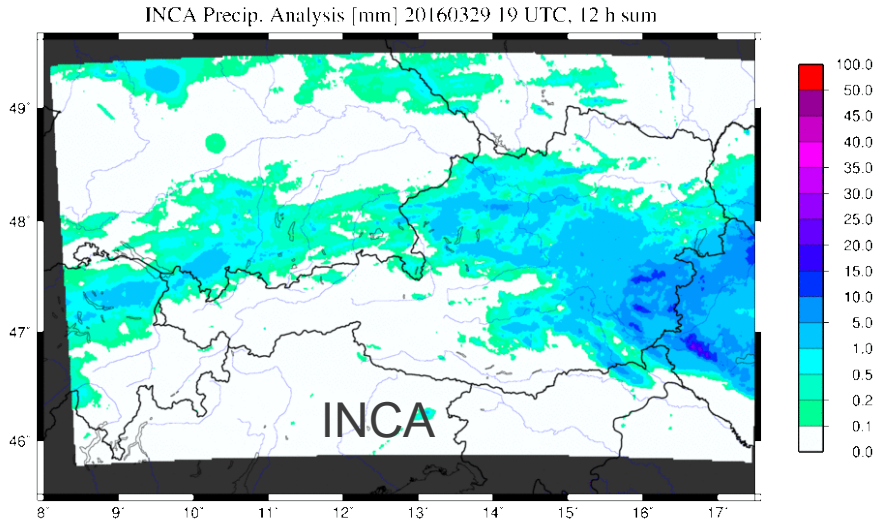

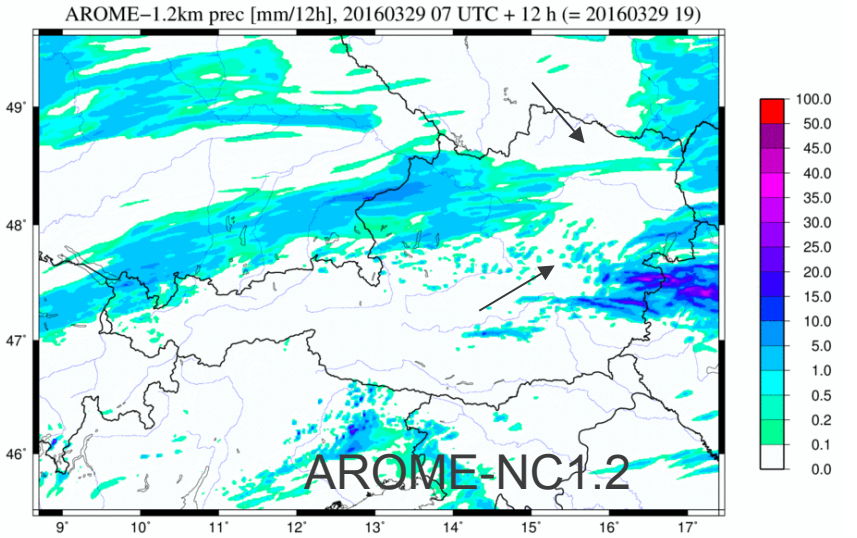

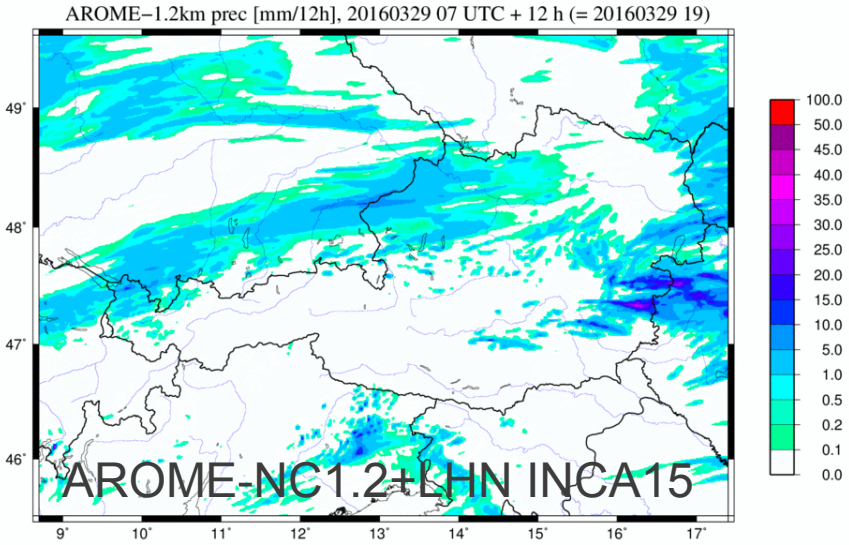

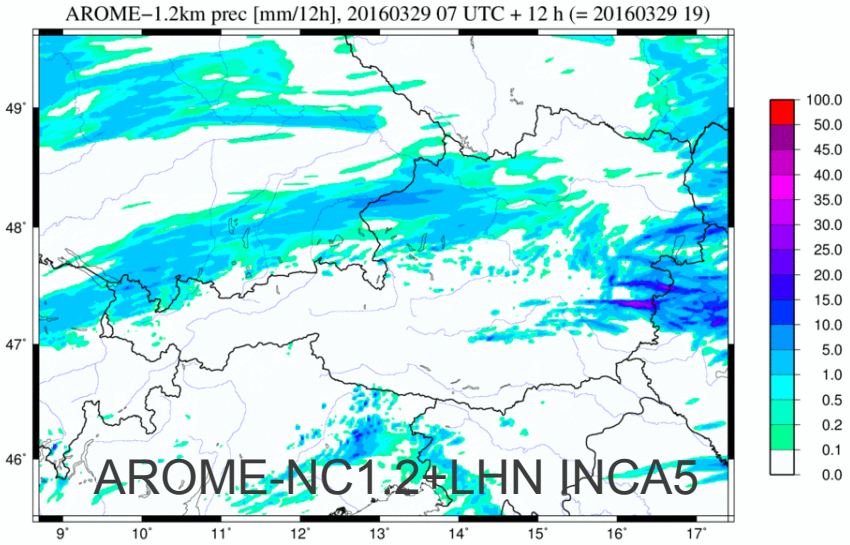

Outlook

- Need for intense validation of AROME-nowcasting
- Switch 3D-Var to cy40t1
- More tests with AROME 1.2km vs 2.5km especially also 1.2km-3D-Var
- Tuning and improving latent heat nudging (climatological profiles)
- Including MODE-S observations
- Real time 1.2km version is only possible on new super computer

Case study: 29th March 2016: Fast moving showers and thunderstorms in cold air mass

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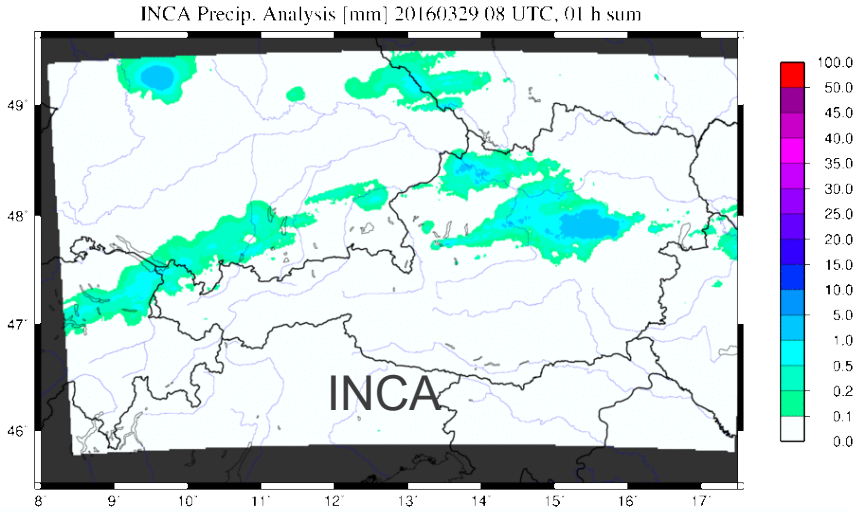

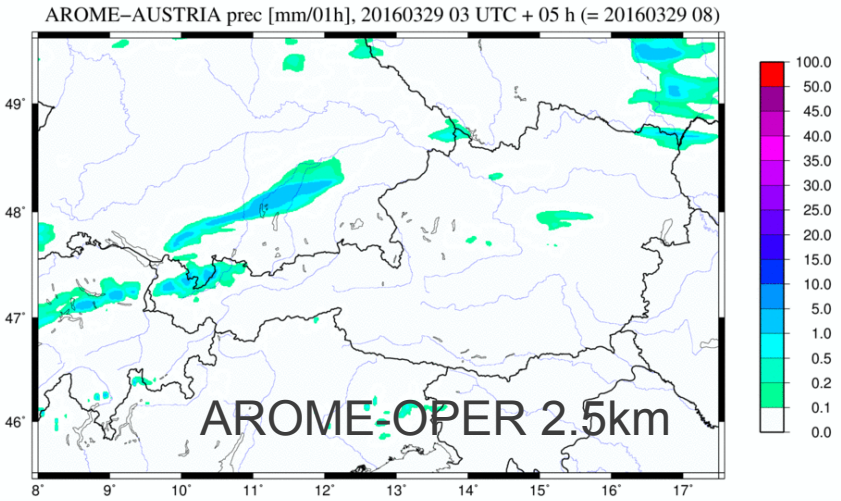

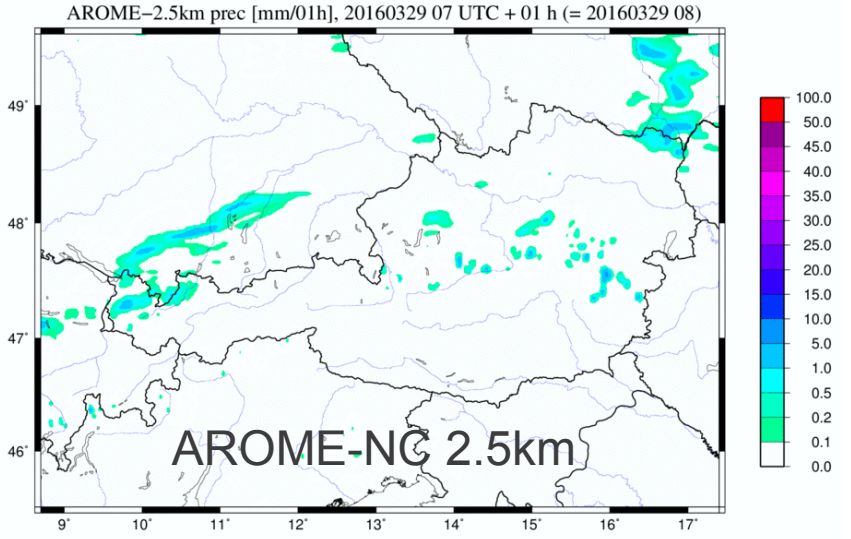

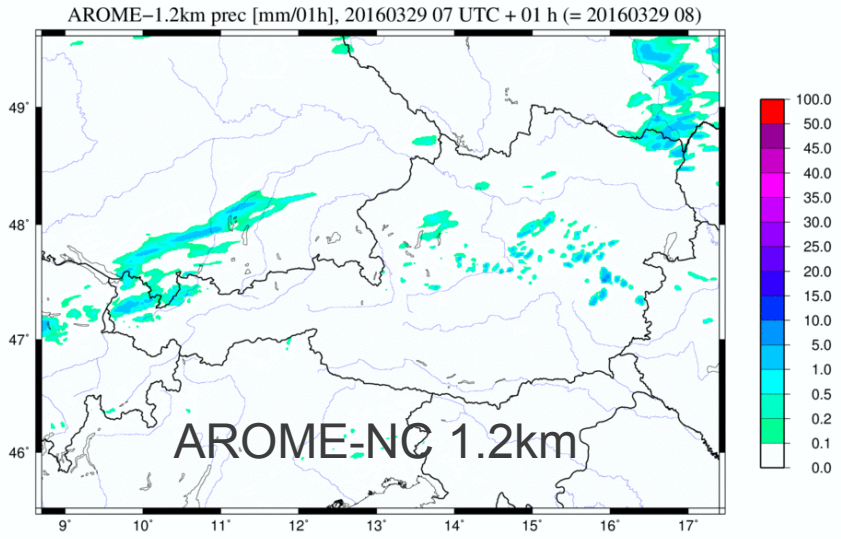

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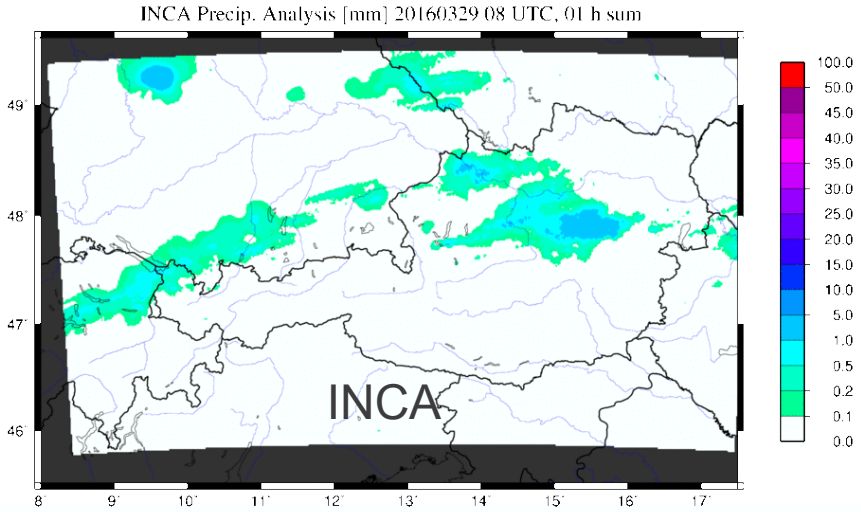

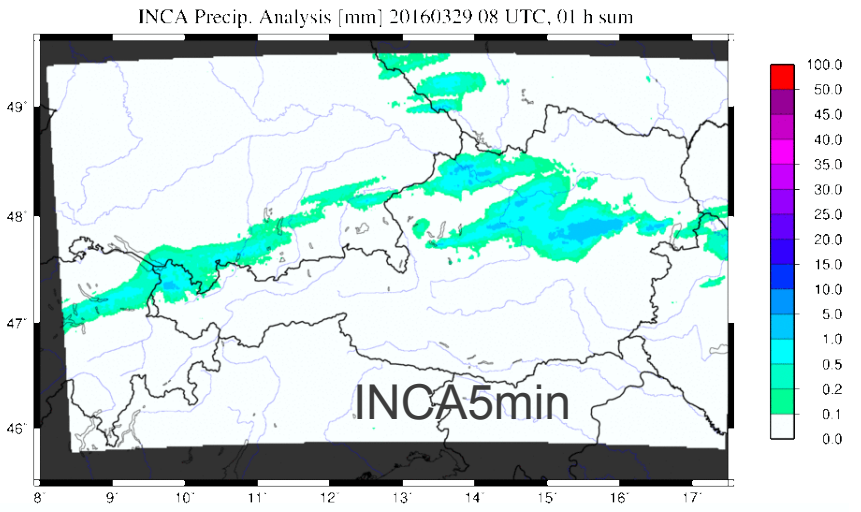

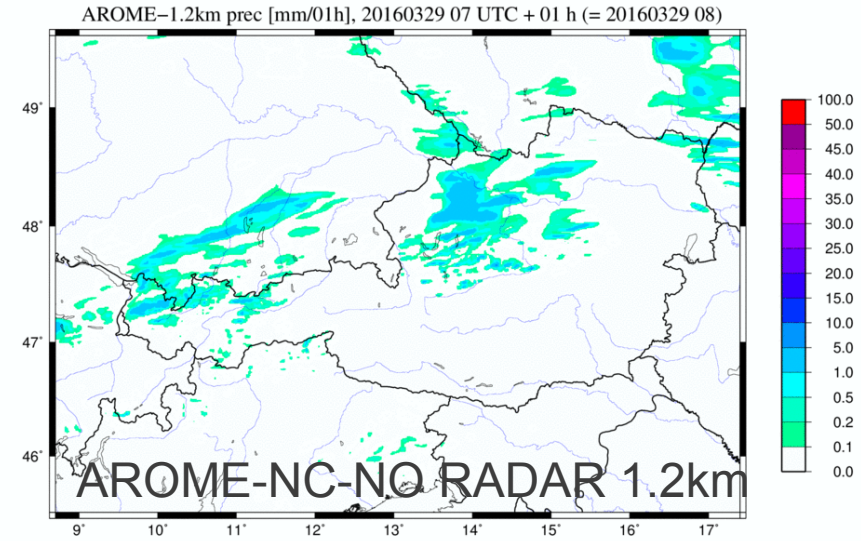

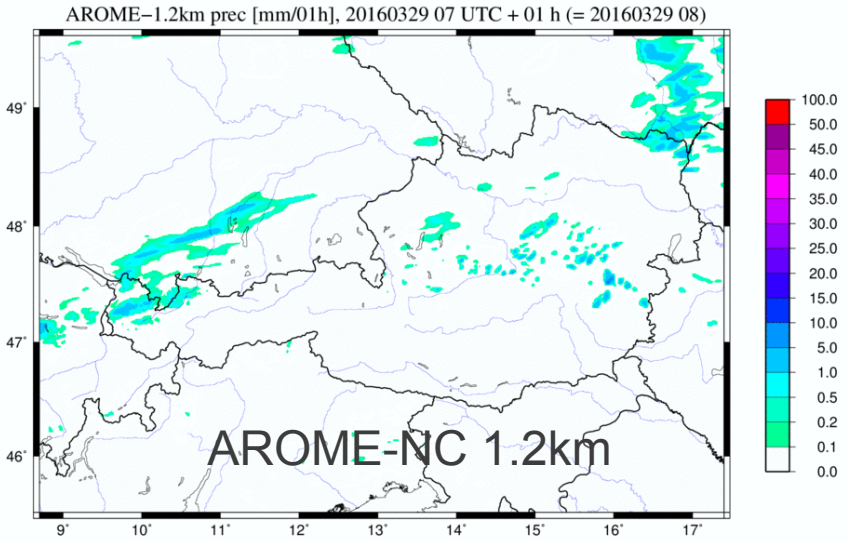

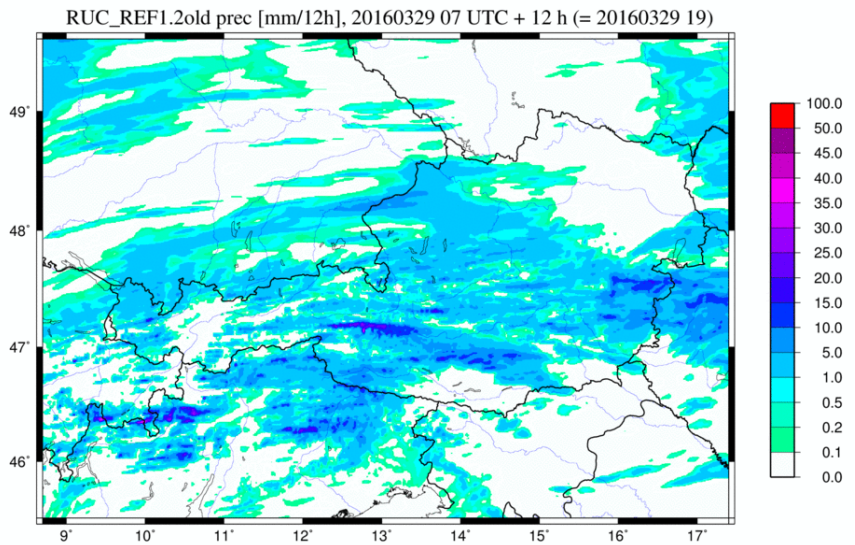
RUC_REF1.2old prec [mm/12h], 20160329 07 UTC + 12 h (= 20160329 19)
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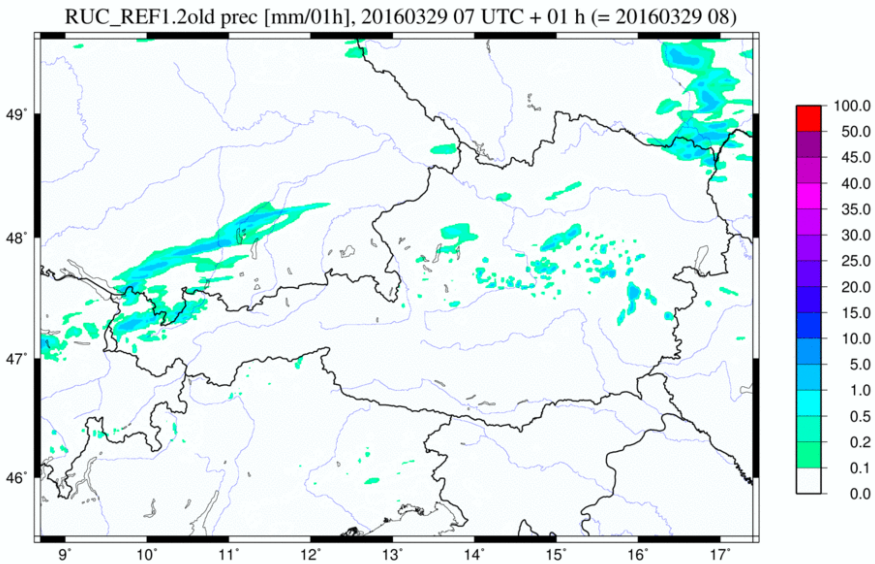
RUC_REF1.2old prec [mm/01h], 20160329 07 UTC + 01 h (= 20160329 08)
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