Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

Experiences with AROME in Austria

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DHMZ SHMU OMSZ ZAMG ROMANIA ANM

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  - Thunderstorm
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Model chain at ZAMG

- ECMWF

16km, +240h, 2 runs

- ECMWF EPS

30km, +240h, 2 runs

50+1 members

- ALARO

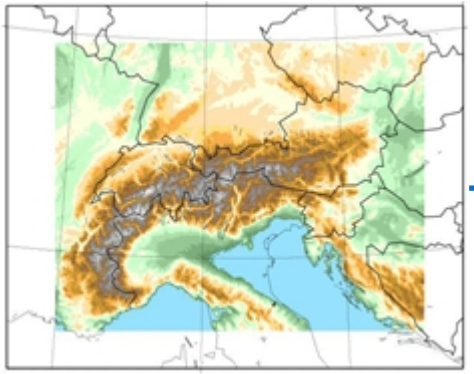
4.8km, +72h, 4 runs

- ALADIN LAEF

11km, +72h, 2 runs

16+1 members

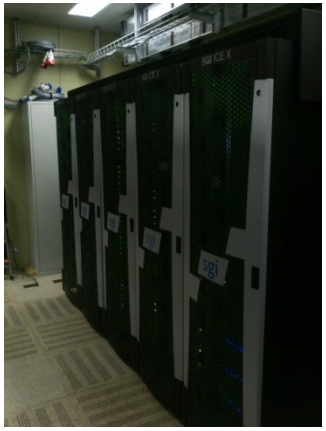
- AROME



2.5km, +30h, 8 runs

- AROME EPS

First tests with pure downscaling of LAEF



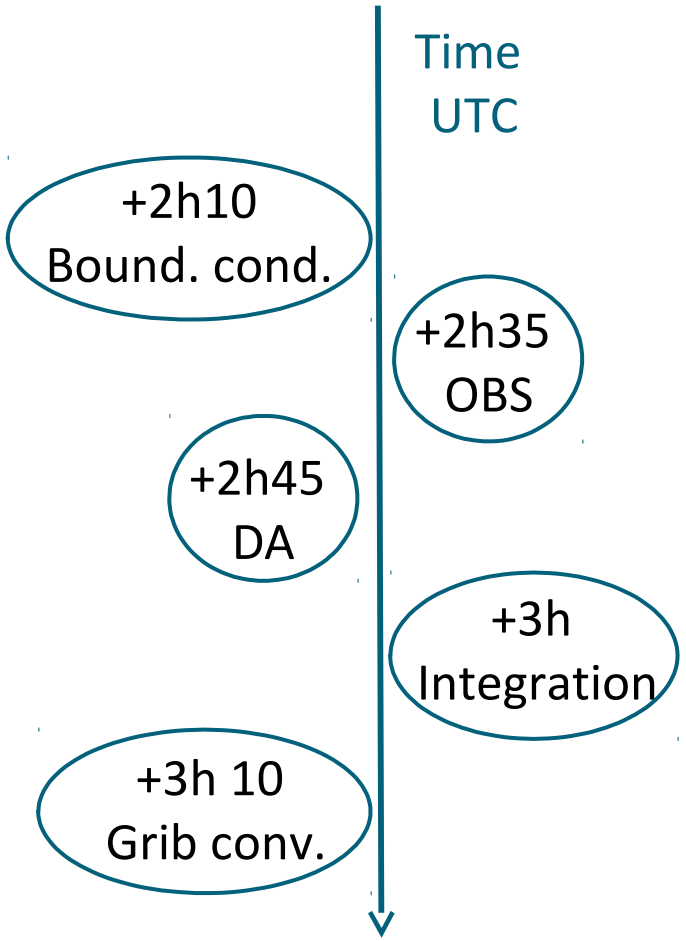
SGI ICE X

AROME history at ZAMG

- **Before 2011**: first test runs with AROME on a small domain, no data assimilation, aggregation of know how
- **2011:** intensive work on implementation of AROME at ZAMG, enlargement of model domain (Alps), build up of AROME assimilation system, adaptations in model physics
- **2012:** new HPC at ZAMG -> basis for operational use
- **Summer 2013:** extensive evaluation- and familiarization phase (ZAMG forecasters), continuous adaptations in model operations (assimilation, model physics)
- **January 2014:** Full operational use of AROME (= maximum fail safe, different backup scenarios)
- **2014:** continuous improvement of the system (data assimilation, microphysics, increase of forecast range, domain, etc.)

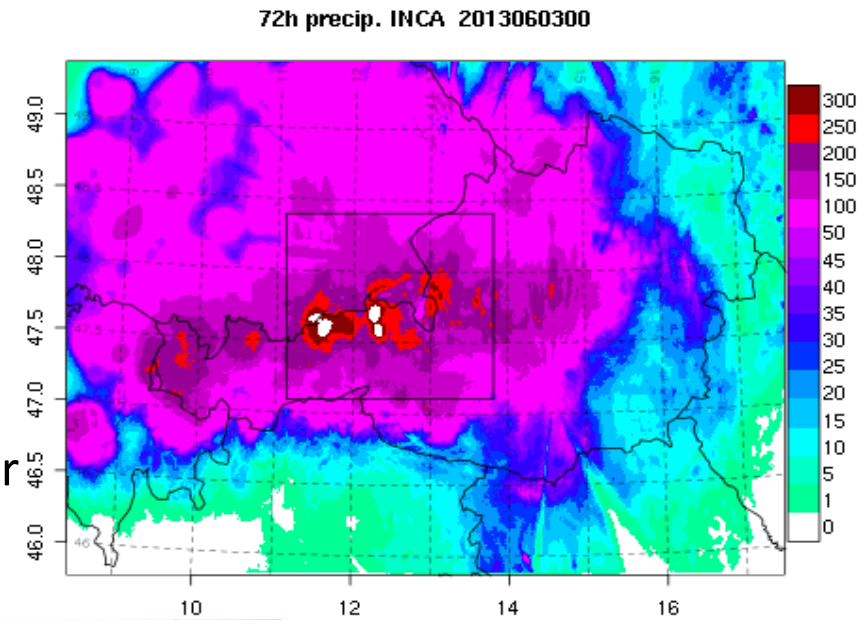
AROME – Operational Setup

Horizontal resolution	2.5km (432x320)
Vertical resolution	60 Levels
Runs / day	8 (00,03,..18,21 UTC)
Forecast Range	30h
Output-Frequency	1/h
Model time step	60sec
Coupling model	IFS (ECMWF)
Coupling update	3h or 1h
Assimilation	3DVAR / OI



Case study: Flood 2013

- Large scale event in northern Alps in Austria and Bavaria; May 30th – June 2nd
- Maximum amounts > 300mm/72h
- Area wide devastation with extensive economic damage and even loss of human lives
- Highest discharge at Danube in Vienna ever (> 11.000m3/sec)



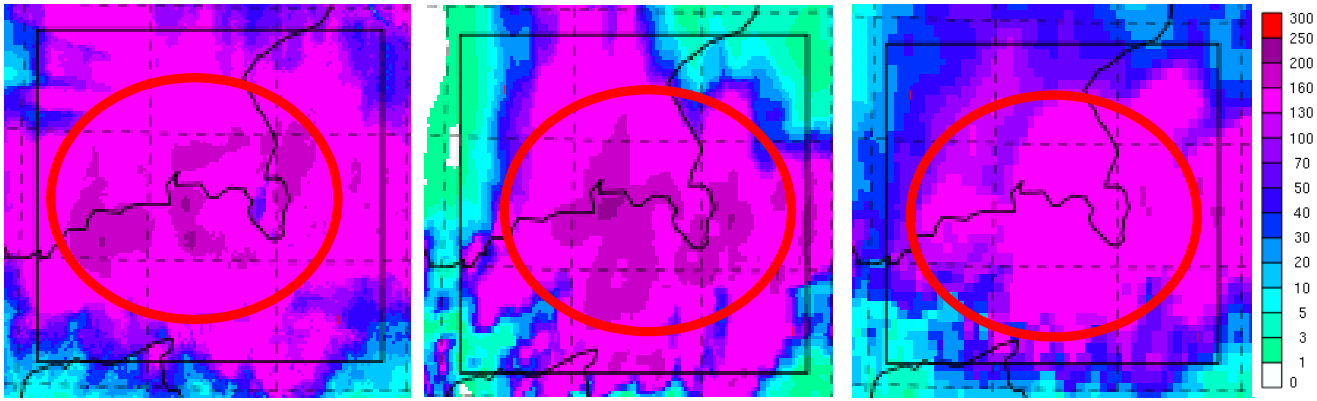
Case study: Flood 2013

Model	24h precipitation sums for different model runs		
	31.5. 00UTC – 1.6. 00UTC	1.6. 00UTC – 2.6. 00UTC	2.6. 00UTC – 3.6. 00UTC
INCA analysis	33.7	44.5	68.6
AROME	30.5	42.1	63.9
ALARO	23.9	36.8	50.9
SAL (AROME)	0.02/-0.10/0.06	0.17/-0.06/0.01	-0.11/-0.07/0.02
SAL (ALARO)	0.24/-0.34/0.07	0.32/-0.19/0.01	0.25/-0.30/0.03

Much better forecast of precipitation in AROME for all 3 runs (area average);
improved scores of structure, amplitude and location compared to ALARO

Higher peaks in AROME (> 150mm/24h)

But! Too strong gradient at the edge of the precipitation field

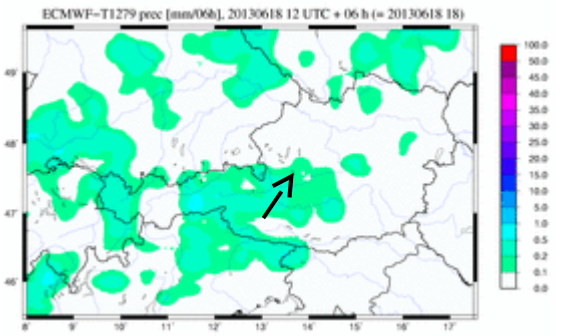


INCA An. **AROME** **ALARO**

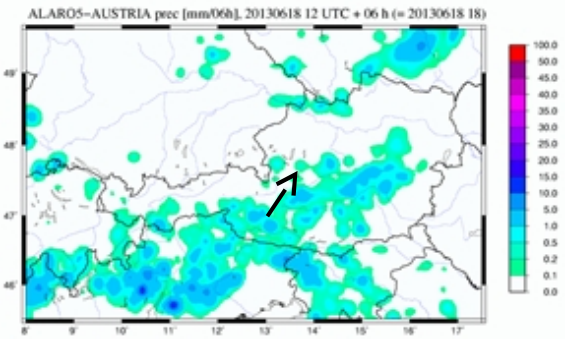
Forecast for 02.06.2013 00 UTC – 03.06.2013 00 UTC

Case study: Thunderstorm - June 18th, 2013

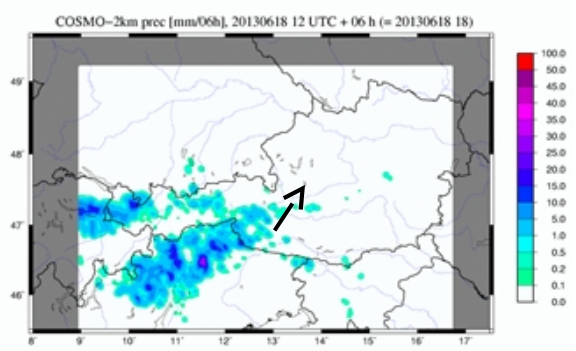
IFS



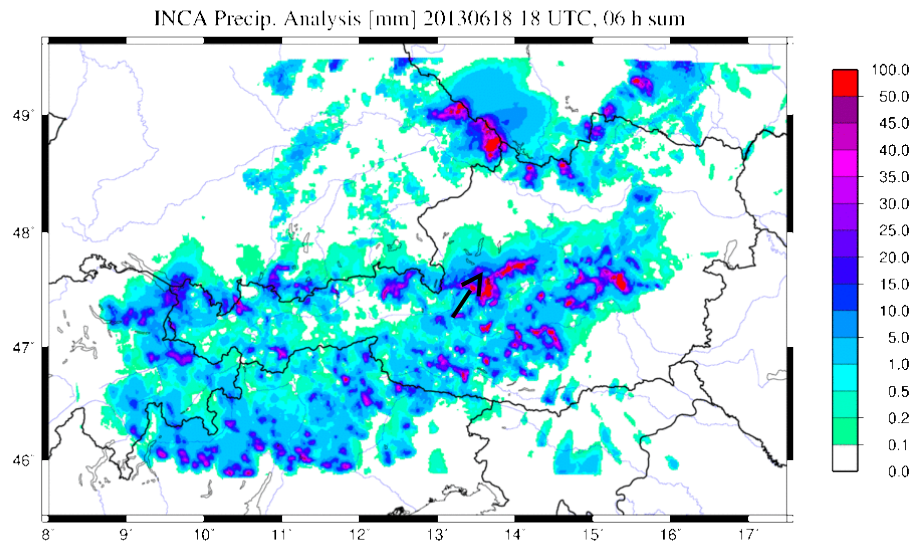
ALARO



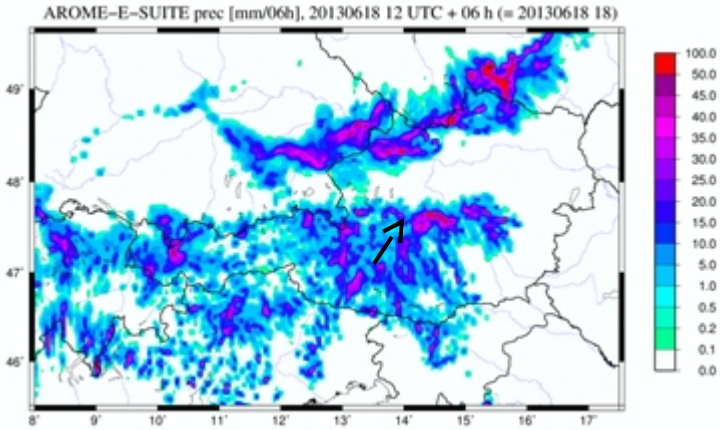
COSMO2



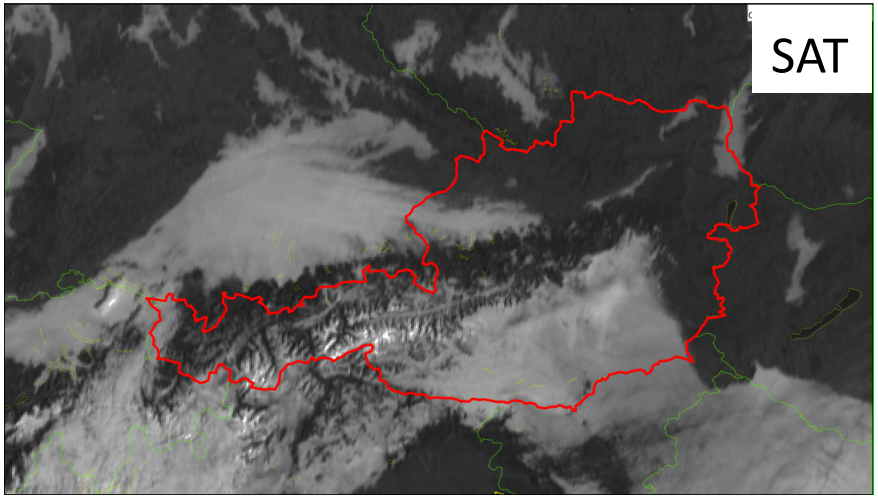
INCA

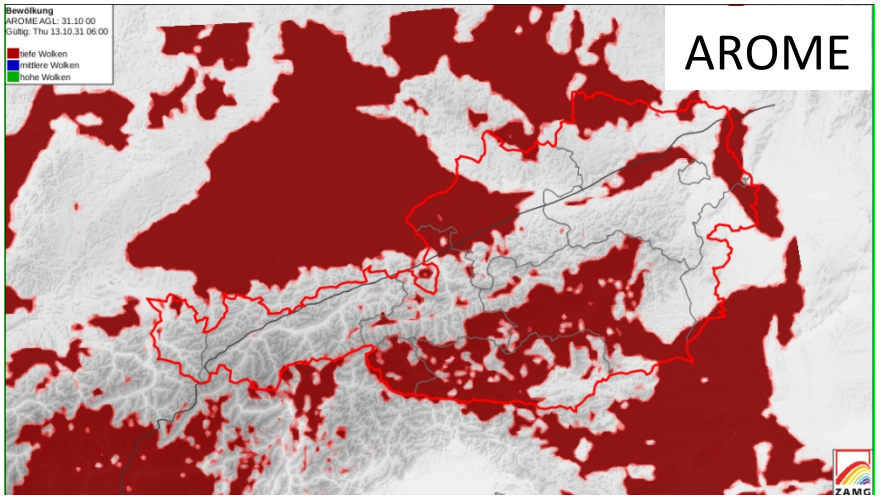


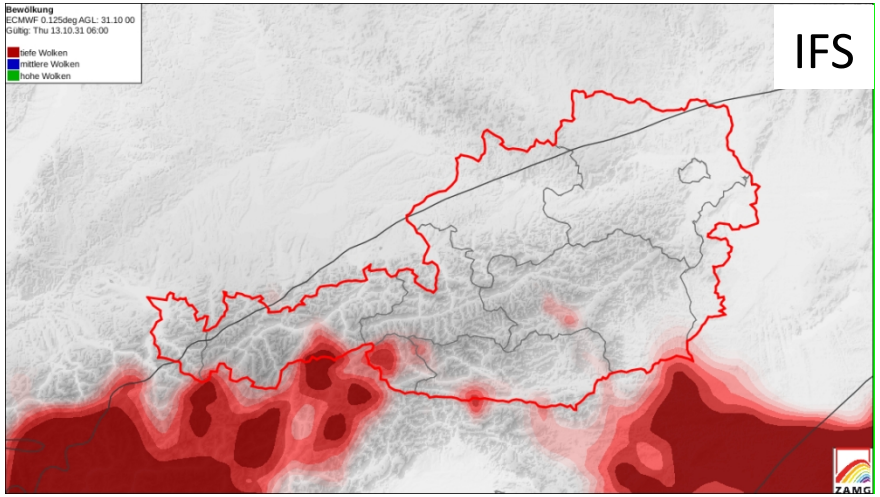
AROME

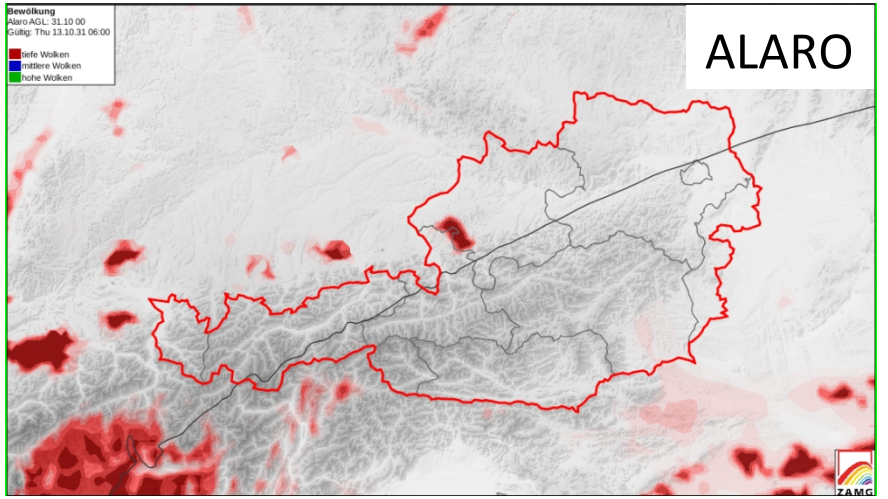


Case study: Low stratus – Oct. 31st, 2013





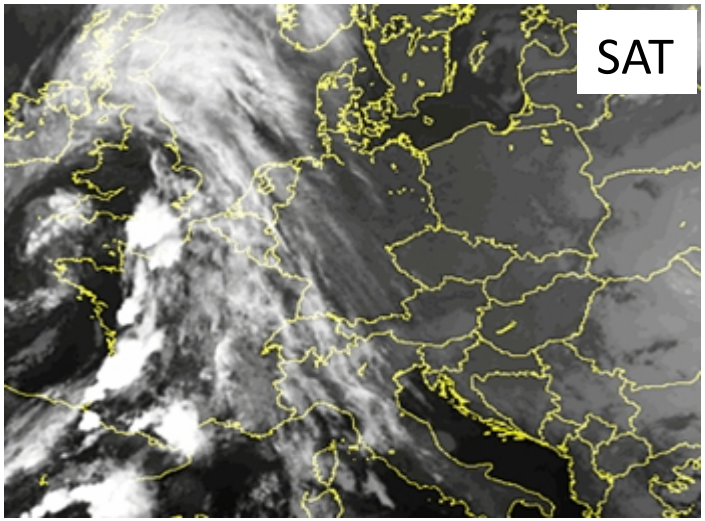


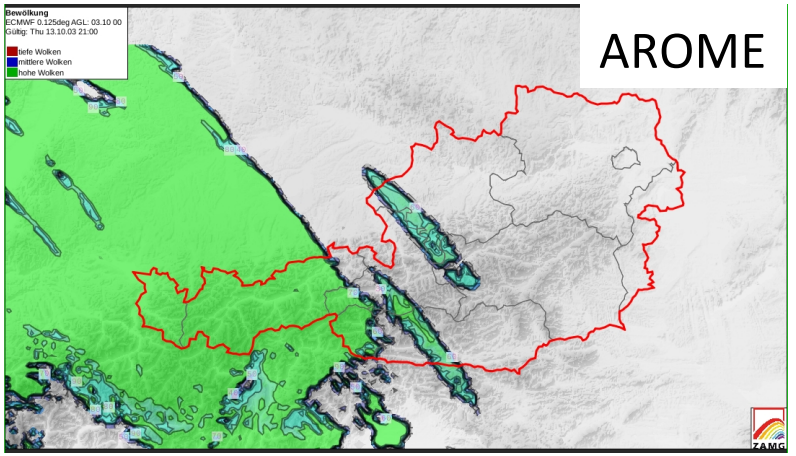


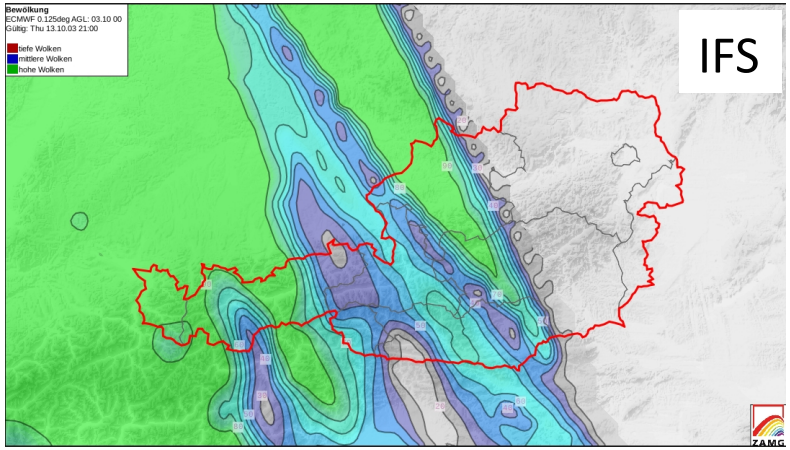
Cloud diagnostics problem

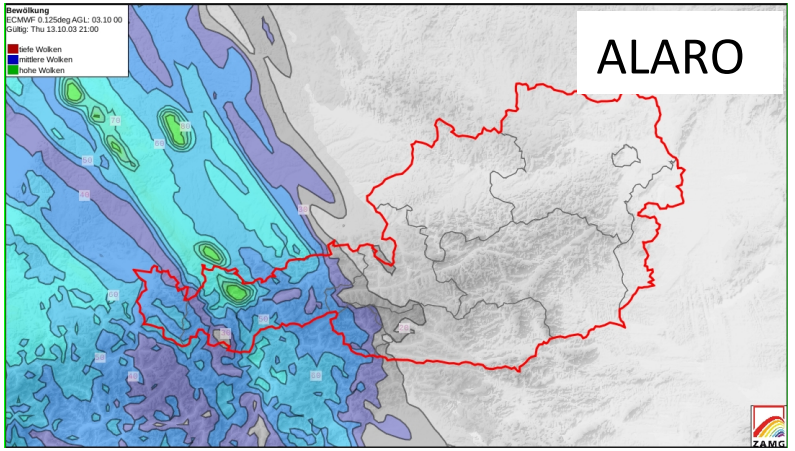
- Too binary clouds, especially high clouds

Oct. 3rd, 2013









Improved cloud diagnostics

- not enough variance with original cloud scheme of AROME cycle 36
- cycle 37: Additional height dependent variance term proportional to qsat in routine condensation.f90:

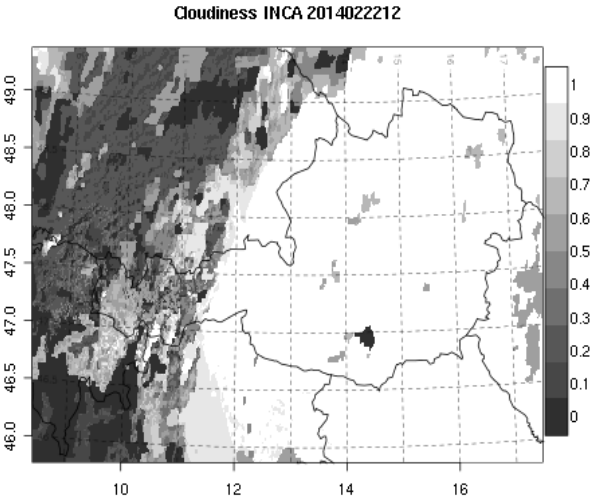
  PCLDFR=0.5+0.36*atan(1.55*ZQ1)

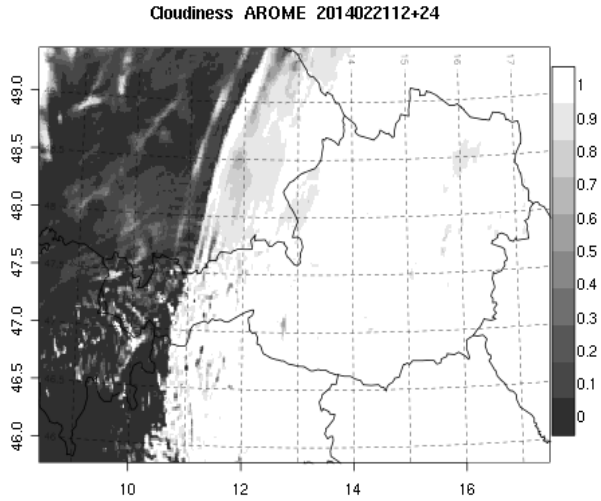
  ZQ1=ZSBAR/ZSIGMA

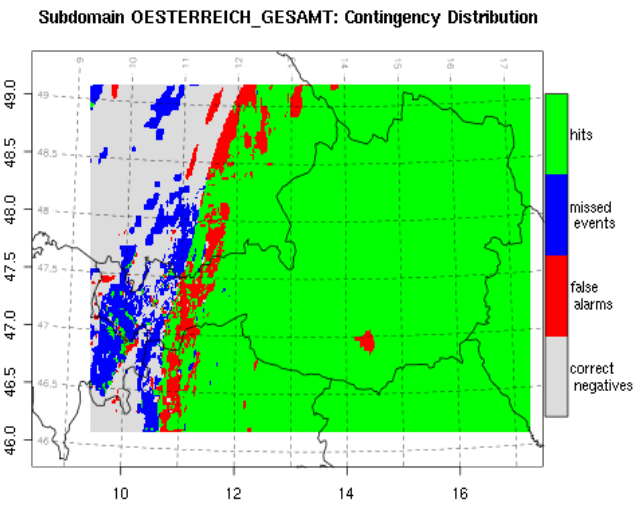
  ZSIGMA=sqrt((2*PSIGS)**2+(PSIGQSAT*ZQSL*ZA)**2)
- minimum of ZSIGMA is set to 10e-10 (10e-6 in cycle 36)
- we calculate ZSIGMA seperately for low, medium and high clouds with different PSIGQSAT values (0.020, 0.025, 0.030)
- -> seperate cloud fraction for low, medium and high clouds is passed to apl_arome.F90
- reduction of high clouds by a simple algorithm
- only diagnostic, no influence on other parameters (T, prec, wind, etc.)

SAL cloud verification

- SAL precipitation verification of Wernli et al. (2008) was adapted to cloudiness
- Reference: INCA total cloudiness (combination of satellite information and ground solar measurements)
- 3 values: S (structure), A (amplitude) and L (location) for predifined domains
- Contingency tables with hit rate, false alarms, etc.







SAL:

Structure: 0.07
Amplitude: 0
Location: 0.07

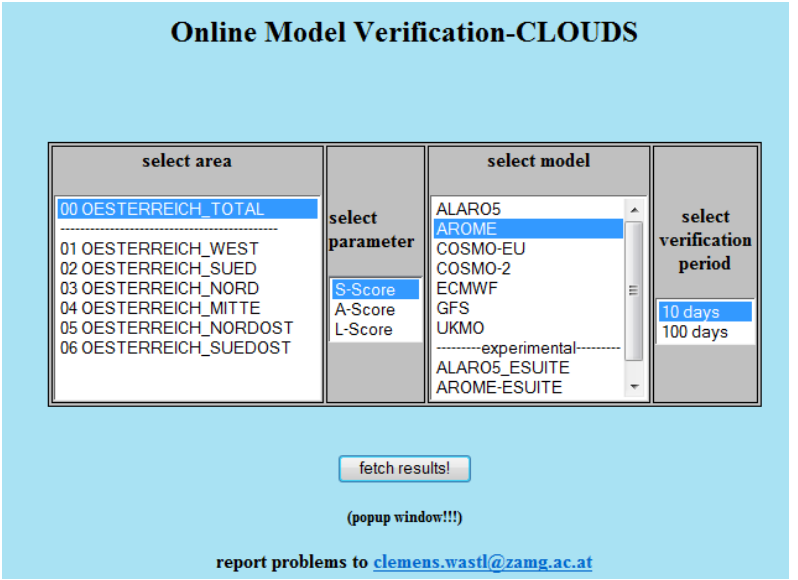
Contingency Table %:

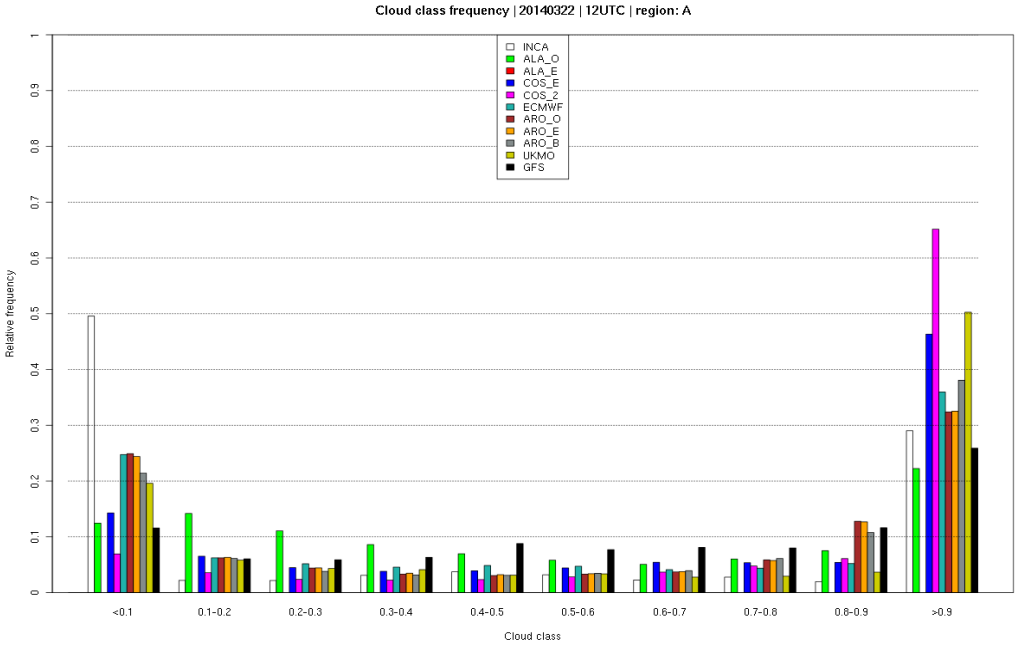
Hits: 0.74
False Alarms: 0.05
Missed: 0.06
Corr. Negatives: 0.16

SP-class: 3 - Overcast

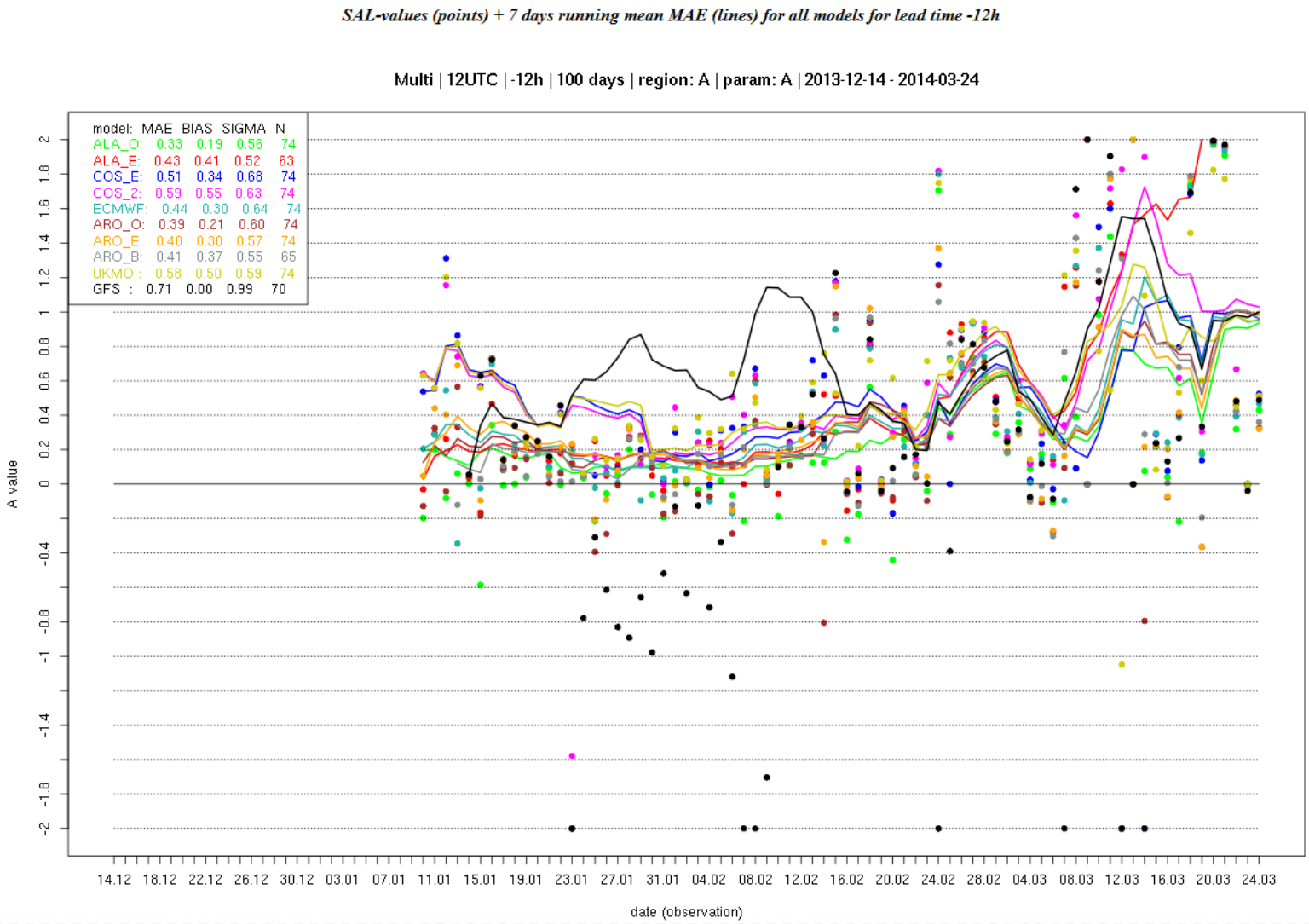
SAL cloud verification

- Realtime tool
- Selection of model, score and time period
- -> SAL values
  -> contingency tables



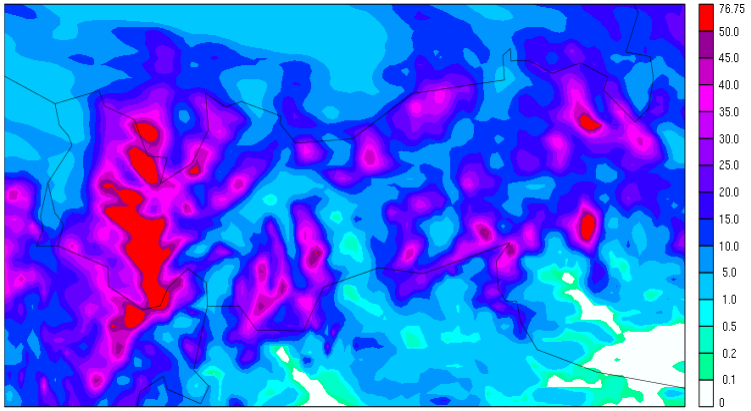


SAL cloud verification



Outlook

Most important topics to be handled in near future:



- Luv/Lee problem: Too strong precipitation gradients in the Alps
  (tests with modifications in microphysics)
- Triggering of convection (too early onset)
- Intensity of convective precipitation (too hig
- Strong positive BIAS in small valleys at sunrise
  - orographic radiation scheme in SURFEX
  collaboration with MF and FMI + LACE
- AROME EPS
- AROME 1km version