LACE data assimilation working days 2013
Status report Austria

Florian Meier, Xin Yan with contributions of
Christoph Wittmann, Florian Weidle and Theresa Gorgas

ZAMG
Zentralanstalt für
Meteorologie und
Geodynamik

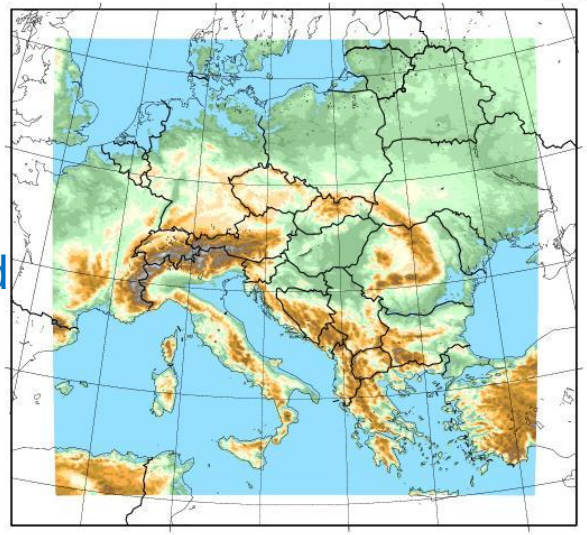
Outline

1. Operational system ALARO+CANARI
    - Setup
    - Bad forecasts due to CANARI: too cold Tmax/ frozen soil
2. AROME-Austria pre-operational and test systems
    - Setup
    - B-Matrix
    - Assimilation of new observations: TLake, Radar, Snow, Pseudo temp, windprofiler,
    - Assimilation problem: “Ghost rain”
    - IDFI

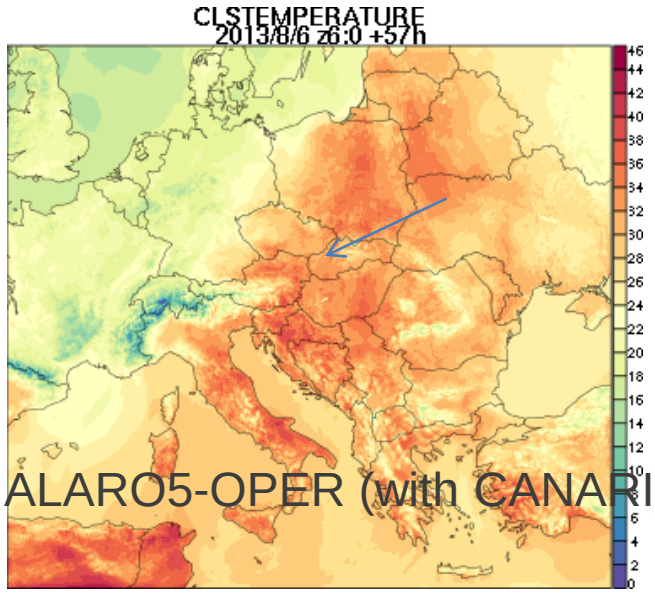
Operational system: ALARO 4.8km L60 + CANARI

- Moved to new machine SGI ICE-X (001 in 13min)
- ALARO-0 4x/day +72h
- atmosphere from IFS; soil CANARI; SST from IFS
- CANARI settings:
  OROLIM=2900,ORODIF=950.,REF_A_H2=REF_A_T2=60km,
  REF_S_H2=0.2,REF_S_T2=3.0, LCORRF=T; SMU0=0.; no vertical correlation function
- Observations T2m/RH2m local+OPLACE
- Coupled with IFS 3 hourly lagged
- cy36t1 export with some modifications
- no major changes planned in DA; forecast files saved for possible B-Matrix calculation NMC-method
- CANARI operational in LAEF since 9th July 2013 (stays of M. Bellus SK)

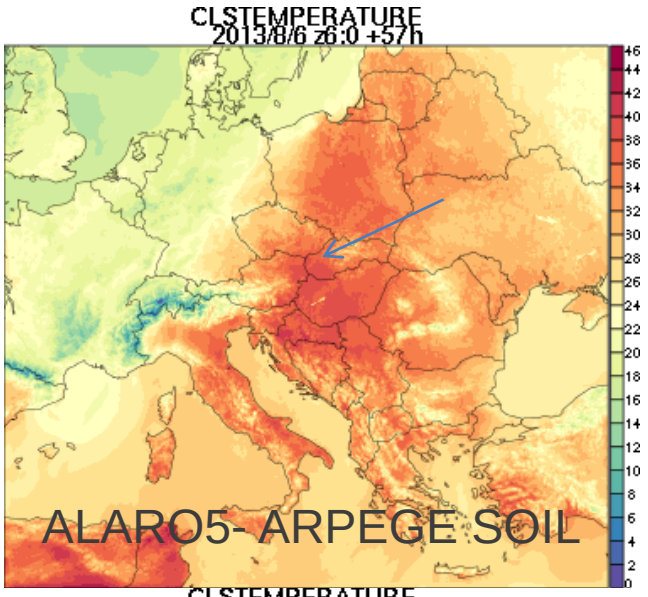
ALADIN–AUSTRIA 5km Domain & Topography



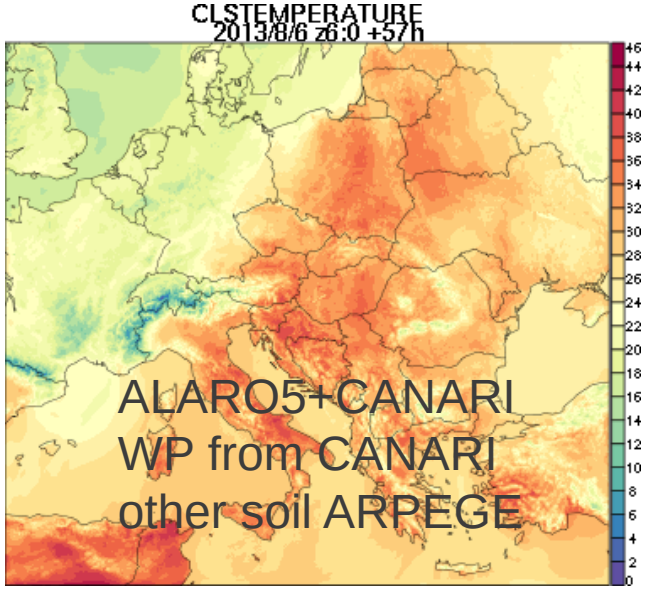
6th August 2013 06 UTC +57h T2m forecast problem ALARO 4.8km caused by CANARI (observed in Vienna TMAX=39.5°C)



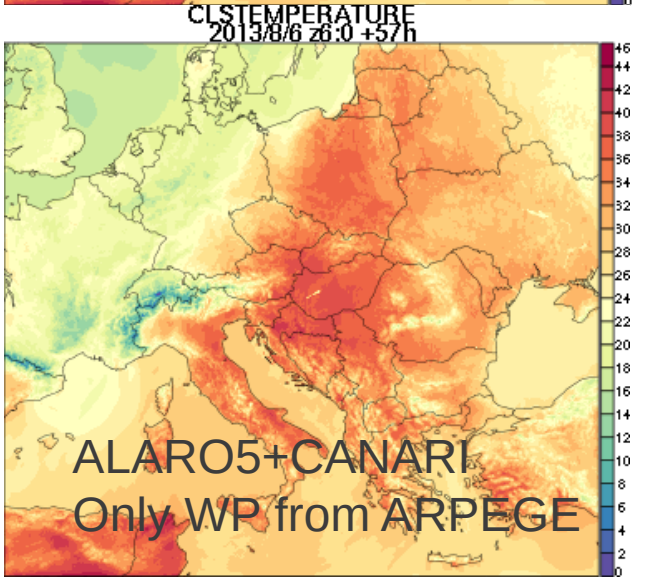
ALARO5-OPER (with CANARI)



ALARO5- ARPEGE SOIL



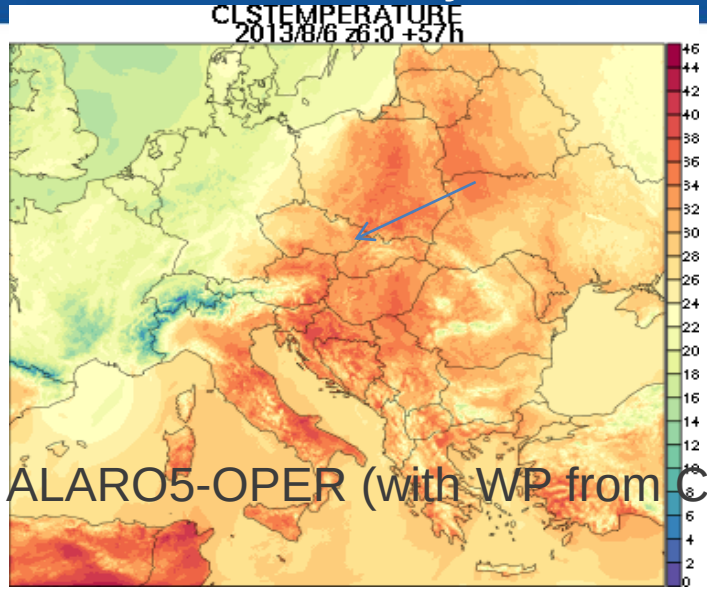
ALARO5+CANARI
WP from CANARI
other soil ARPEGE



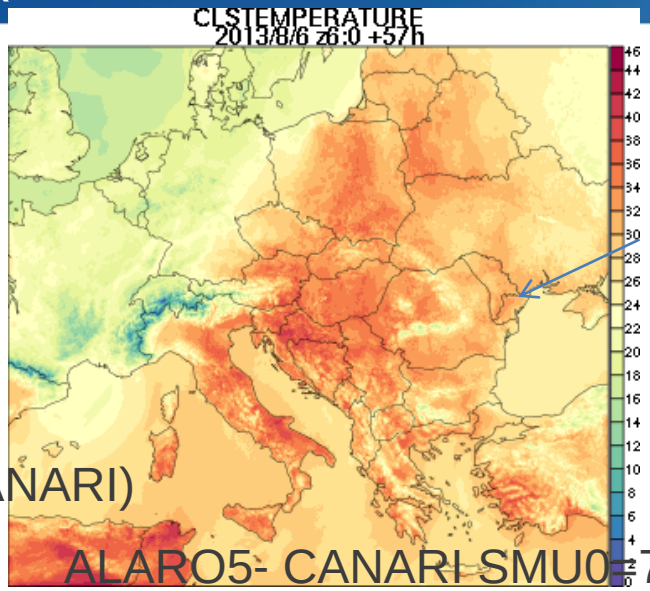
ALARO5+CANARI
Only WP from ARPEGE

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

6th August 2013 06 UTC +57h T2m forecast problem ALARO 4.8km caused by CANARI (observed in Vienna TMAX=39.5°C)

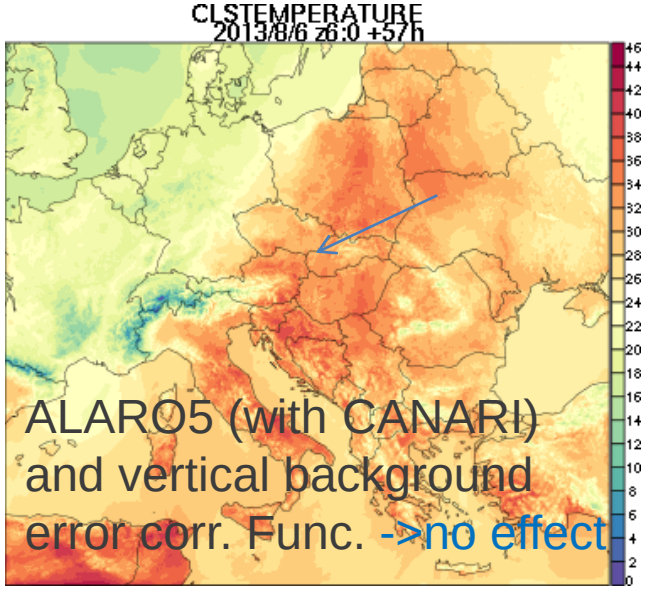


ALARO5-OPER (with WP from CANARI)



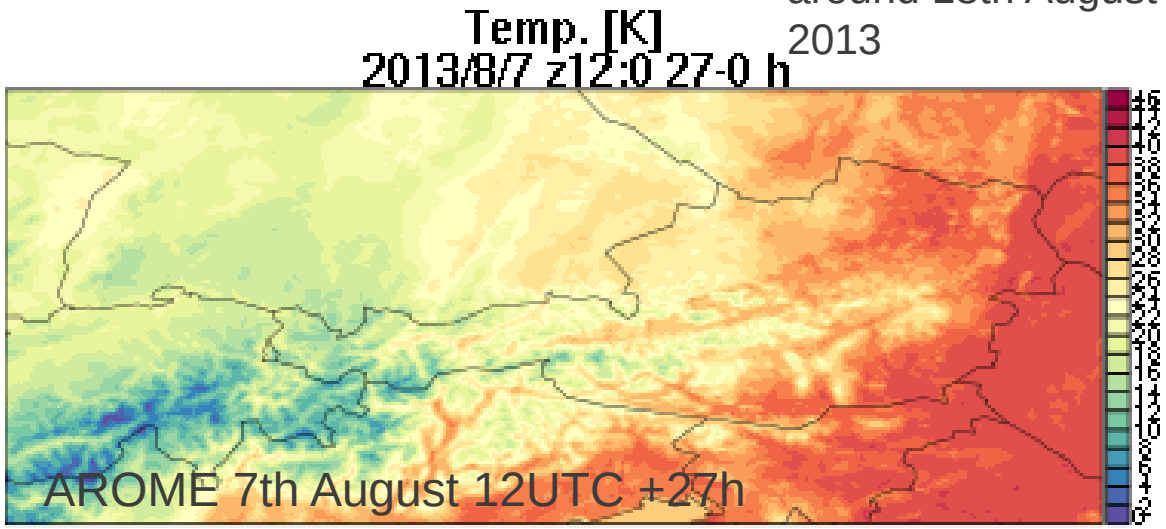
ALARO5- CANARI SMU0=7.

slight improvement



ALARO5 (with CANARI) and vertical background error corr. Func. ->no effect

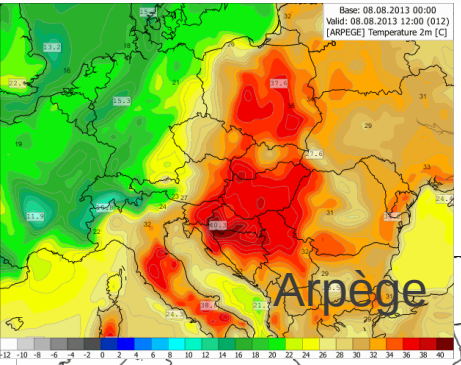
- The effect did not occur in AROME and IFS.
- Could ALARO+SURFEX be better?
- Other lace countries had problems as well
- Similar event around 18th August 2013

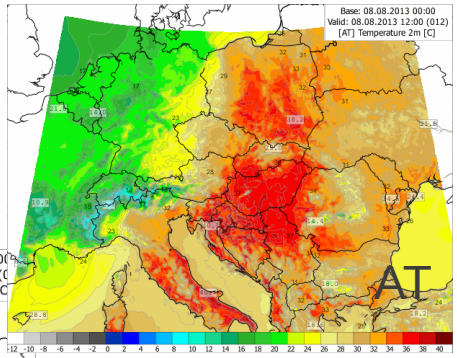


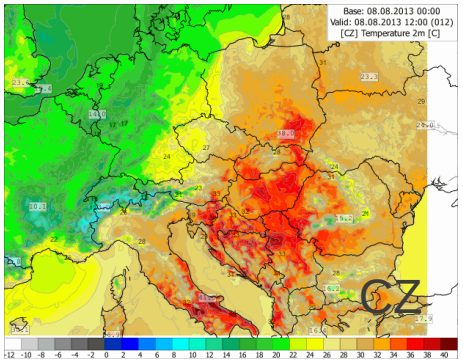
AROME 7th August 12UTC +27h

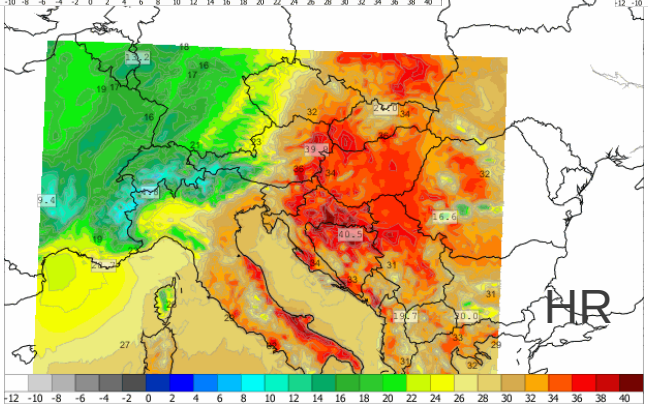
Other Models: 8th August 2013 00 UTC+12

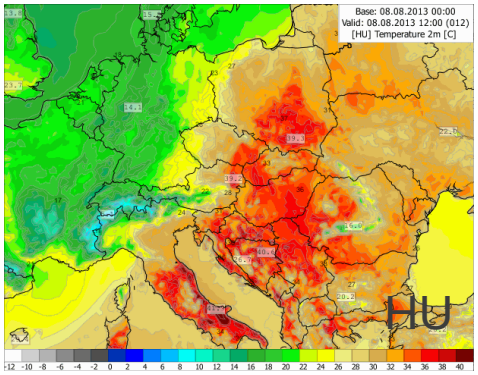
AROME
25.09.2013

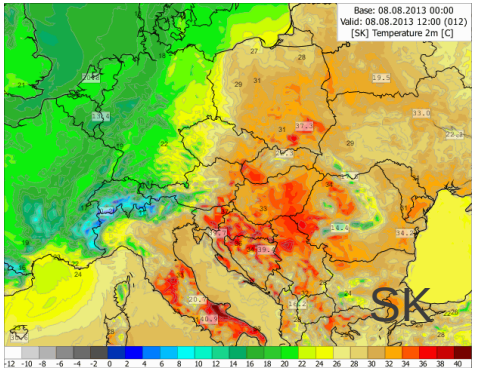


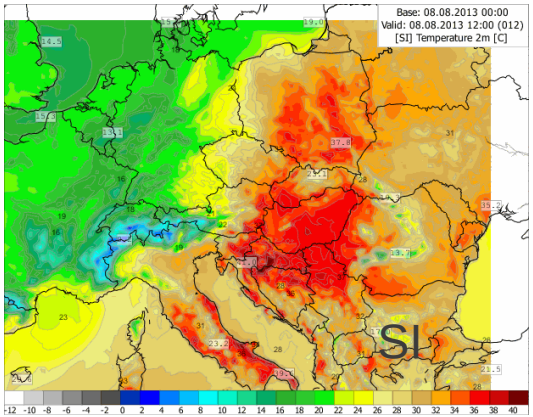


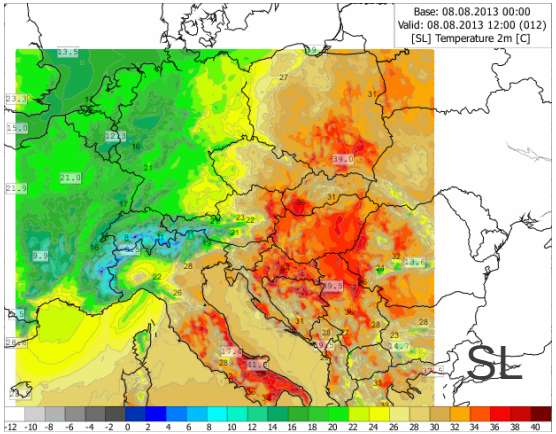


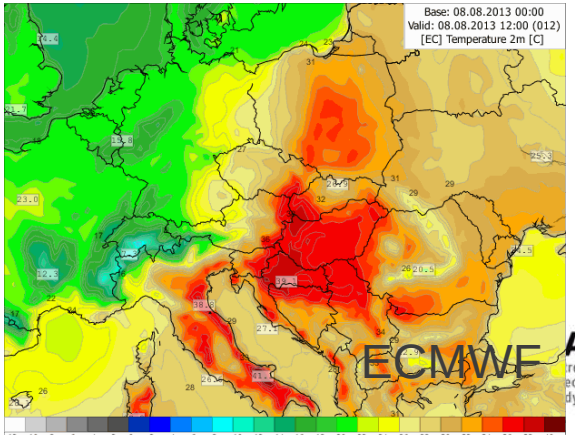










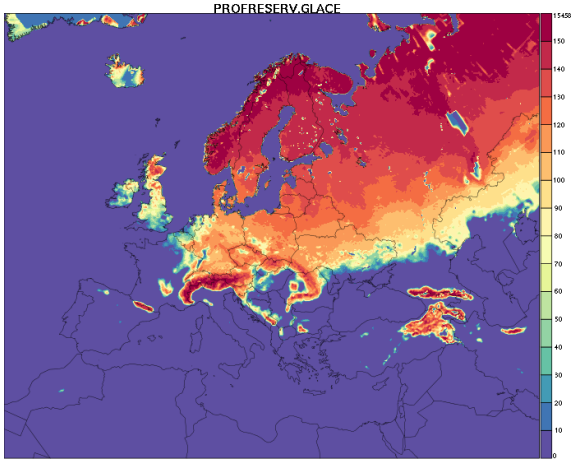


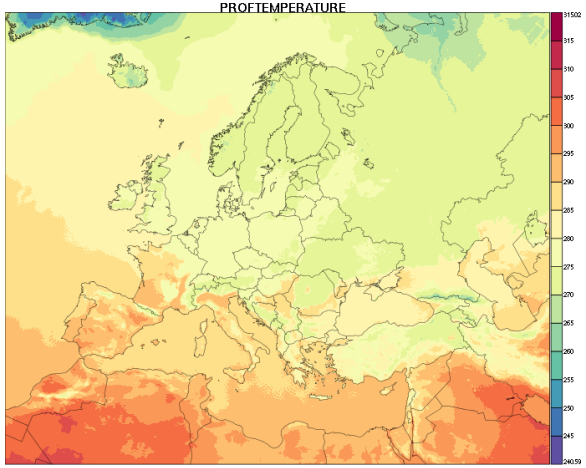
ZAMG
Zentralanstalt für Meteorologie und Geodynamik

901-CANARI frozen soil problem (Florian Weidle)

After cold start from IFS soil, CANARI was not able to reach realistic soil temperature values (spring 2013)

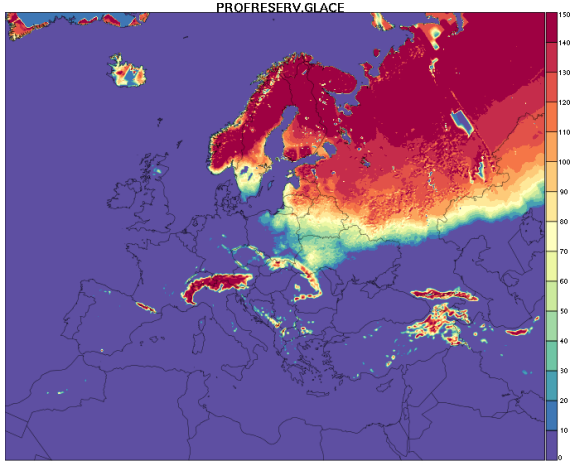
WPI

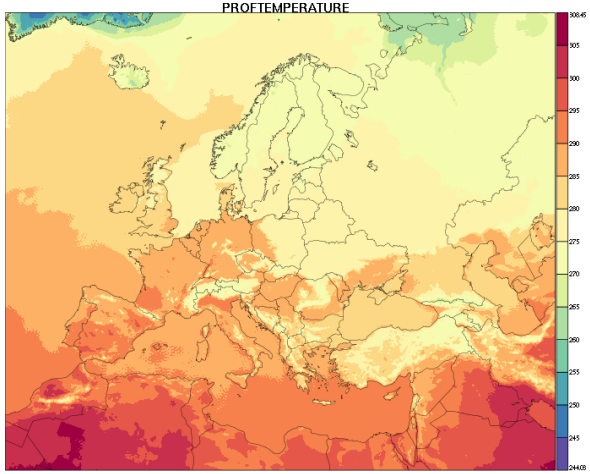




ALARO-LAEF

TP





ALARO-Arpège soil

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

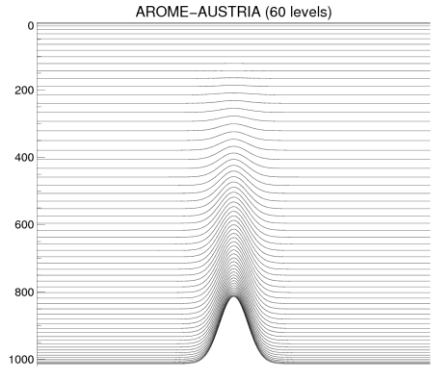
Recent developments in AROME-DA at ZAMG

AROME:

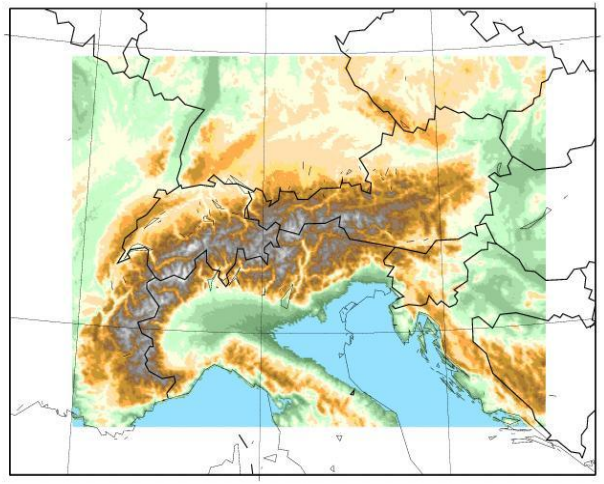
- AROME 2.5km +CANARI +3D-Var in pre-operational mode
- Tests on new observations: GPS (Xin)/windprofiler/lake temperature/radar/pseudo temp assimilation
- Changes due to OPLACE: MSG3/windprofiler/MetOp-B
- Test of AROME on new (bigger domain) with new B-Matrix
- 2x E-Suite: cy37t1op1 physics, small (60L) and big domain (90L)
- Test IDFI in AROME

AROME at ZAMG: pre-operational and test versions

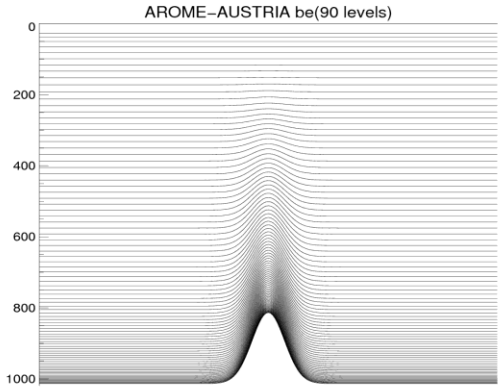
Pre-operational:
432x320 GP L60 2,5km



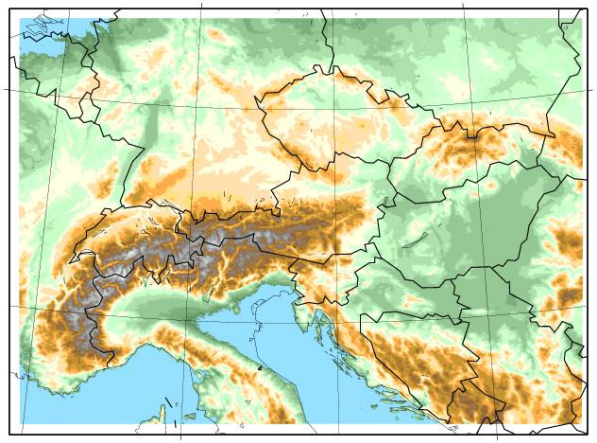
AROME–AUSTRIA Domain & Topography



Test version: 600x432GP
L90 2,5km



Levels like
MF-be



ZAMG
Zentralanstalt für Meteorologie und Geodynamik

AROME setup

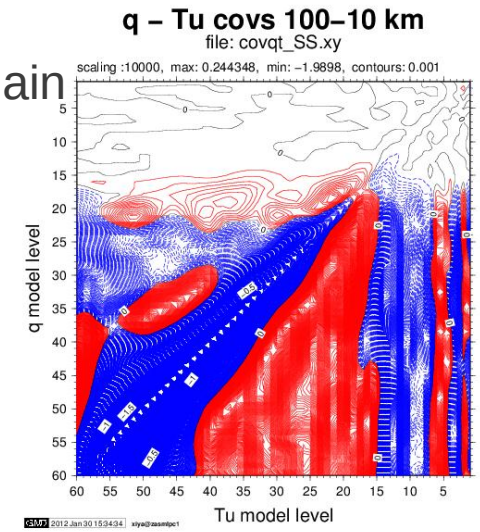
	AROME pre –oper 60L	AROME test 90L big domain
Cycling	3h 3D-Var+OIMAIN	12h 3D-Var+OIMAIN
assimilation	cy36t1 export (cy36t1op2 OIMAIN)	cy36t1 export (cy36t1op2 OIMAIN)
Integration	cy36t1 exp (cy37t1op1)	cy37t1op1
Coupling	3h IFS-lagged	3h IFS lagged
leadtime	8x +30h	2x +30h
Observations	Conventional + SAT	Conventional only
SOIL model:	3L-SURFEX (Paulson)	3L-SURFEX (Canopy)
B-Matrix	LAEF 11km	NEW-LAEF 11km

CANARI settings: OROLIM=3800,ORODIF=1650.,REF_A_H2=REF_A_T2=55km, REF_S_H2=0.1,REF_S_T2=1.6, LCORRF=T; SMU0=7.; vertical background correlation REF_AP_T2=REF_AP_H2=0.05

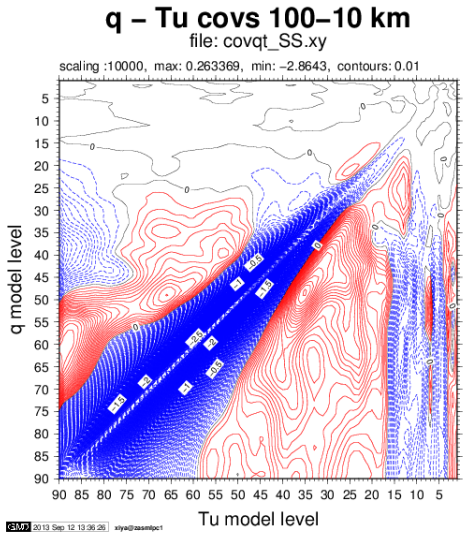
ZAMG
Zentralanstalt für Meteorologie und Geodynamik

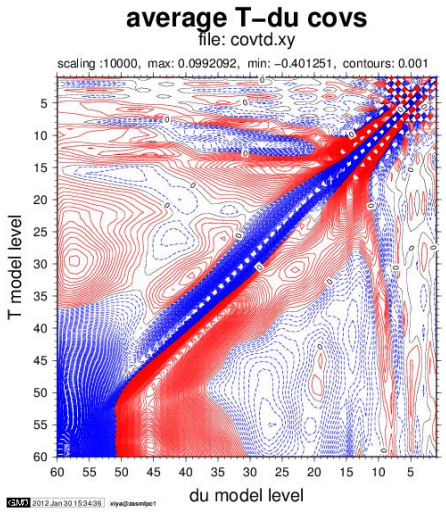
B-Matrix: Covariances L60 vs L90

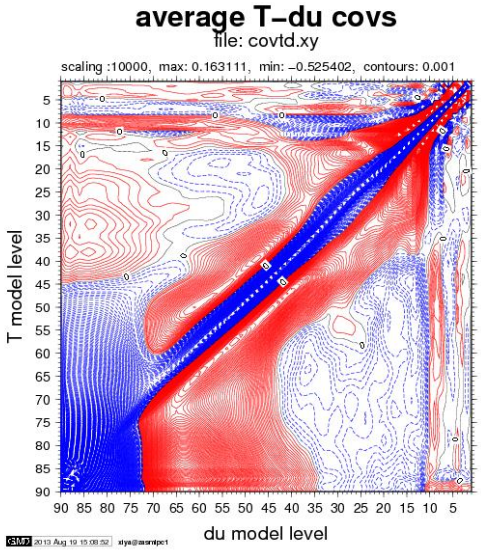
L60
small domain



L90
big domain



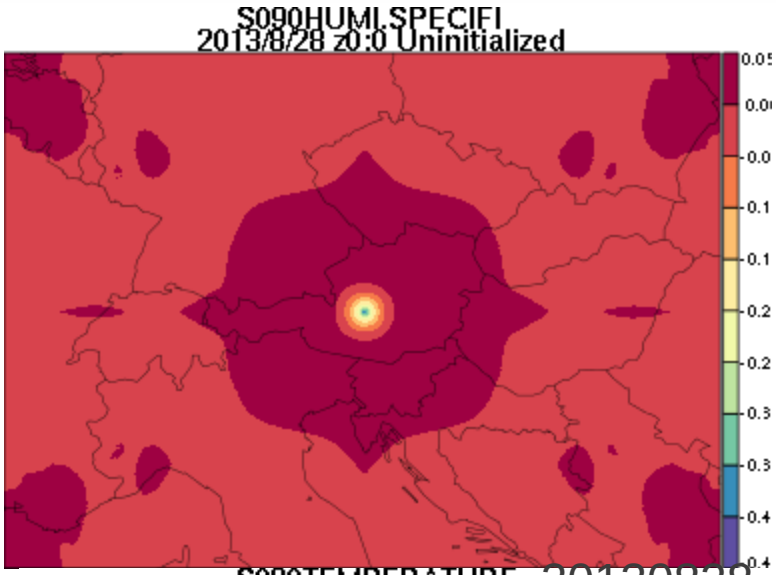


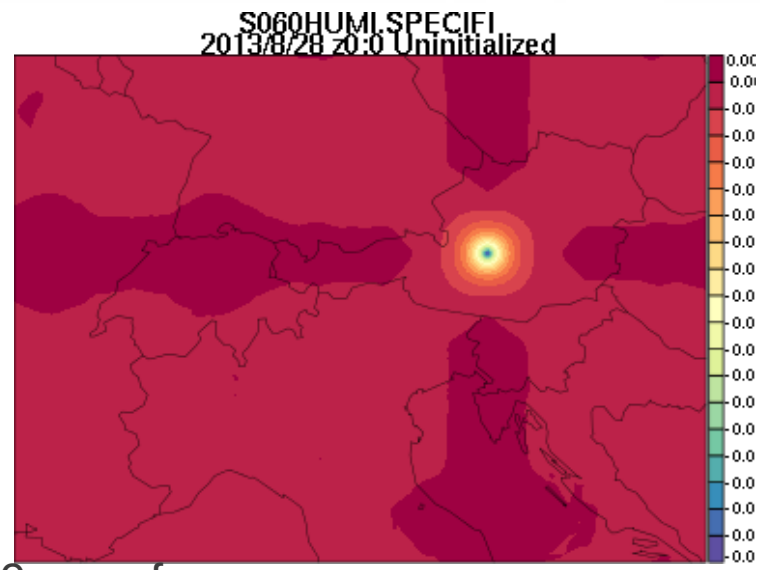


20110512-20110621 4member 78 diffs

20130621-20130704 16 member 100 diffs

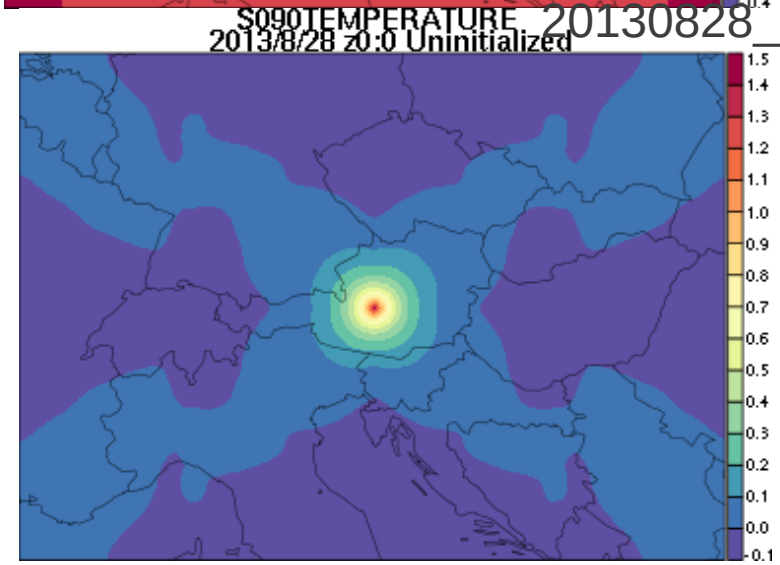
AROME increments (single synop station): Big L90 vs small L60

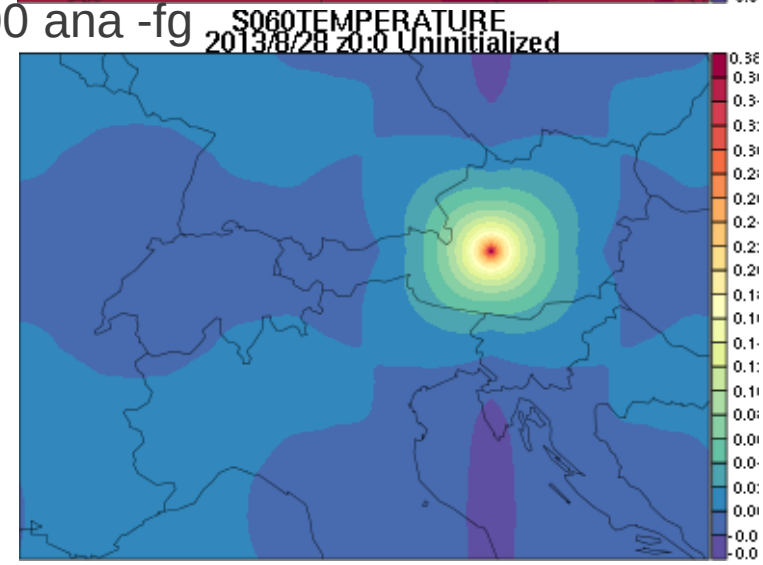




Q [g/kg]

S090TEMPERATURE_20130828_00 ana -fg

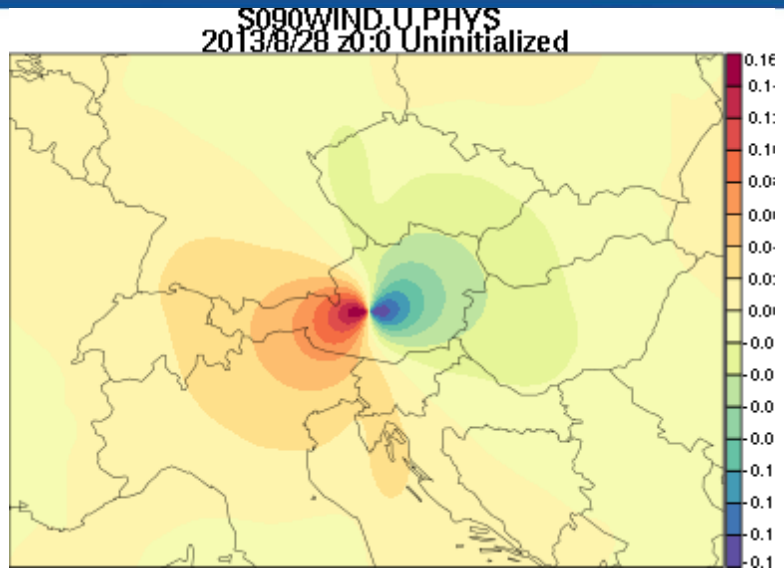


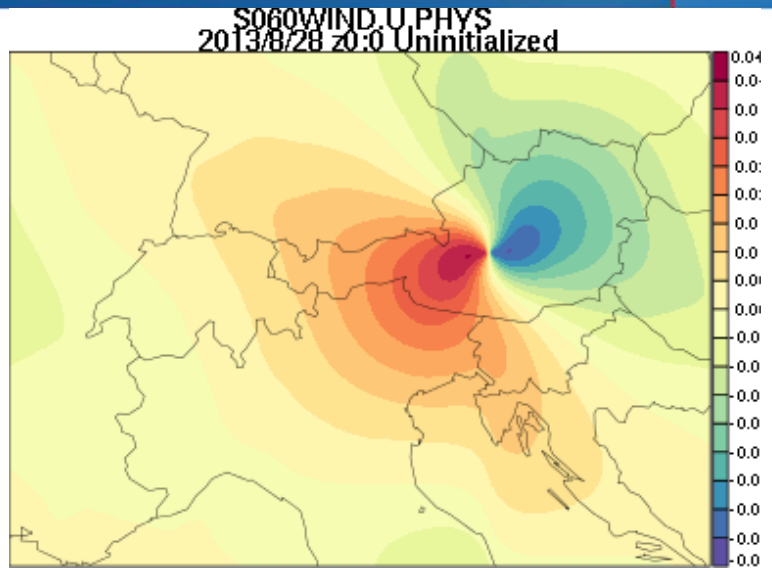


T [K]

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

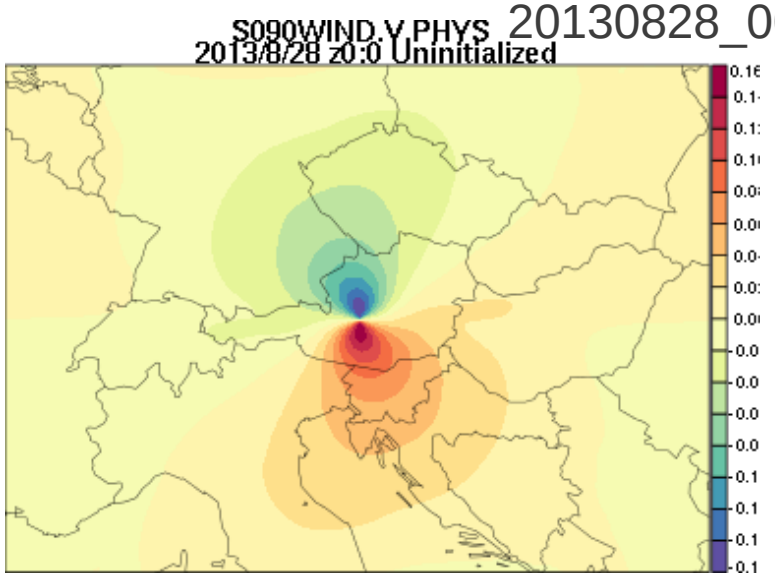
AROME increments (single synop station): Big L90 vs small L60

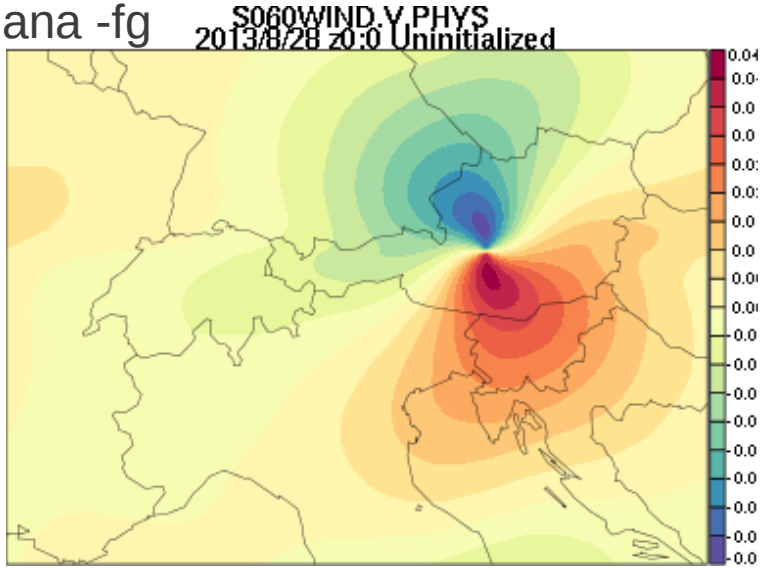




U [m/s]

20130828_00 ana -fg

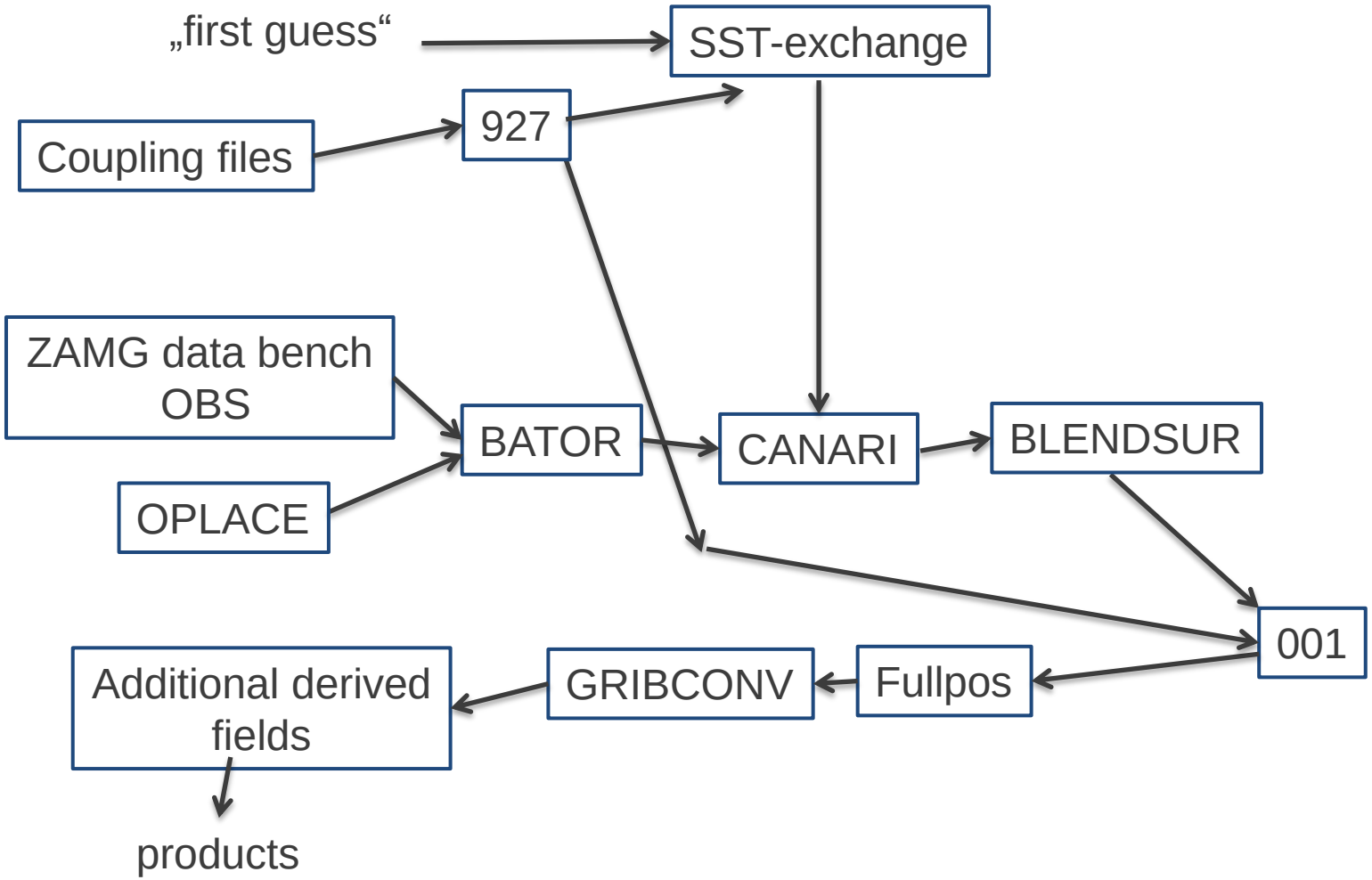




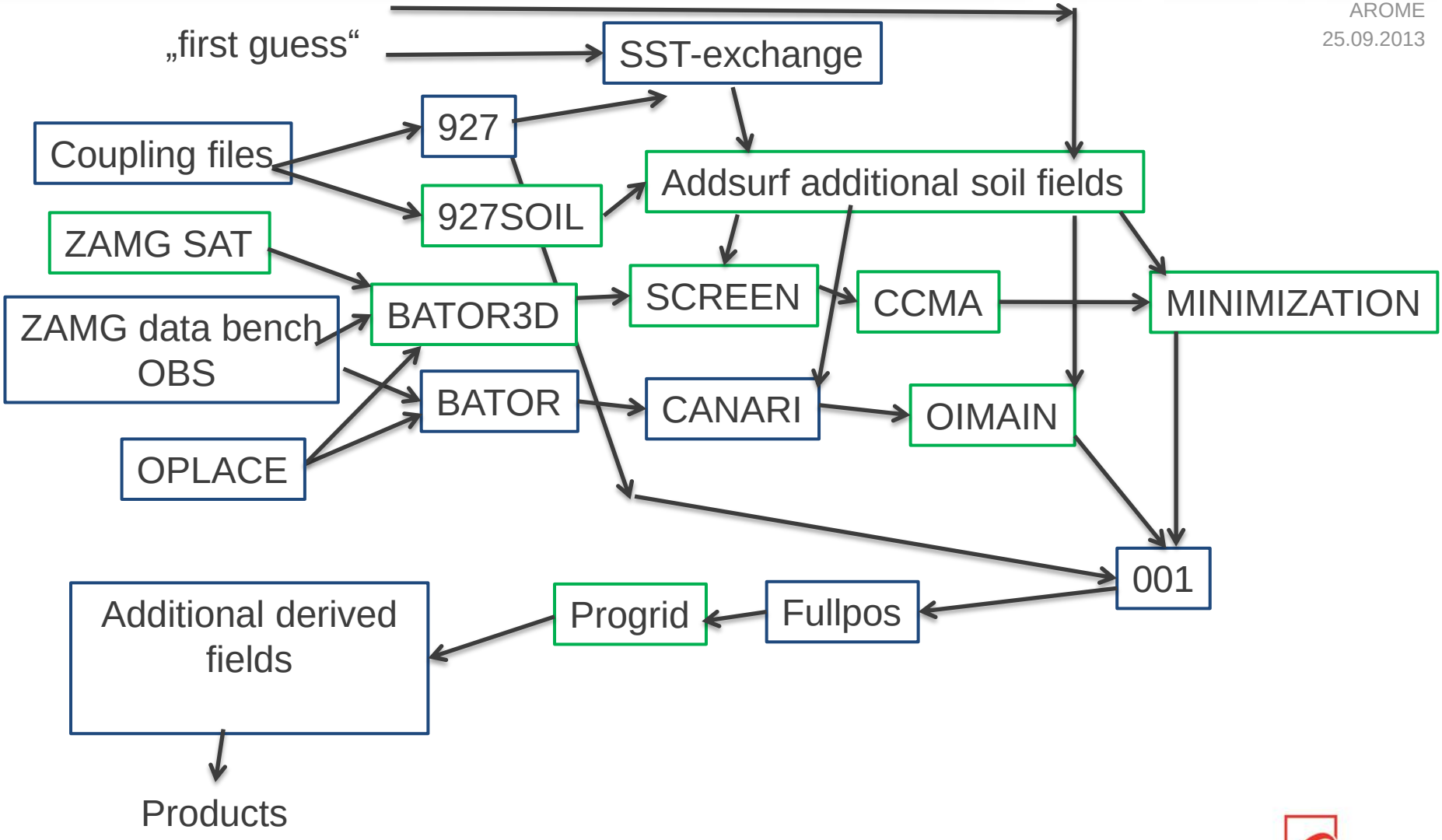
V [m/s]

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Technical scheme: ALARO



Technical scheme: AROME



ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Observation type	assimilated fields	Data source
SYNOP+TAWES	T2m,RH2m,U10m,V10m,ϕ	ZAMG+OPLACE
AMDAR (aicraft)	U,V,T	ZAMG+OPLACE
GEOWIND (SAT-winds) MSG3	U,V	OPLACE
TEMP (radio soundings)	U,V,T,Q,ϕ	ZAMG+OPLACE
PILOT	U,V	ZAMG
WINDPROFILER*)	U,V	ECMWF MARSARCHIVE/OPLACE
MSG2->MSG3-SEVIRI	WV-radiances	OPLACE
NOAA16/18/19+MetOp-A-B AMSU-A,-B,MHS,HIRS	radiances	OPLACE
MetOp-A IASI	radiances	OPLACE
ASCAT 10m sea winds	U10m,V10m (25km)	ZAMG/EUMETSAT
GPS*)	zenith total delay (ZTD)	TU-Vienna
RADAR*)	reflectivity	Austrocontrol/CONRAD
Lake surface temperatures *)	TS_WATER in OIMAIN	Hydrological services
MODIS-snow cover *)	snow yes/no	ENVEO-CRYOLAND

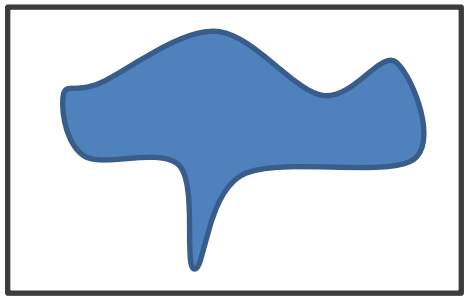
*) Tests; not regularily

Observation type	assimilated fields	Data source
SYNOP+TAWES	T2m,RH2m,U10m,V10m,ϕ	ZAMG+OPLACE
AMDAR (aircraft)	U,V,T	ZAMG+OPLACE
GEOWIND (SAT-winds) MSG3	U,V	OPLACE
TEMP (radio soundings)	U,V,T,Q,ϕ	ZAMG+OPLACE
PILOT	U,V	ZAMG
WINDPROFILER*)	U,V	ECMWF MARSARCHIVE/OPLACE
MSG2->MSG3-SEVIRI	WV-radiances	OPLACE
NOAA16/18/19+MetOp-A-B AMSU-A,-B,MHS,HIRS	radiances	OPLACE
MetOp-A IASI	radiances	OPLACE
ASCAT 10m sea winds	U10m,V10m (25km)	ZAMG/EUMETSAT
GPS*)	zenith total delay (ZTD)	TU-Vienna
RADAR*)	reflectivity	Austrocontrol/CONRAD
Lake surface temperatures *)	TS_WATER in OIMAIN	Hydrological services
MODIS-snow cover *)	snow yes/no	ENVEO-CRYOLAND

*) Tests; not regularily

Tlake assimilation in OIMAIN: 0D-Var

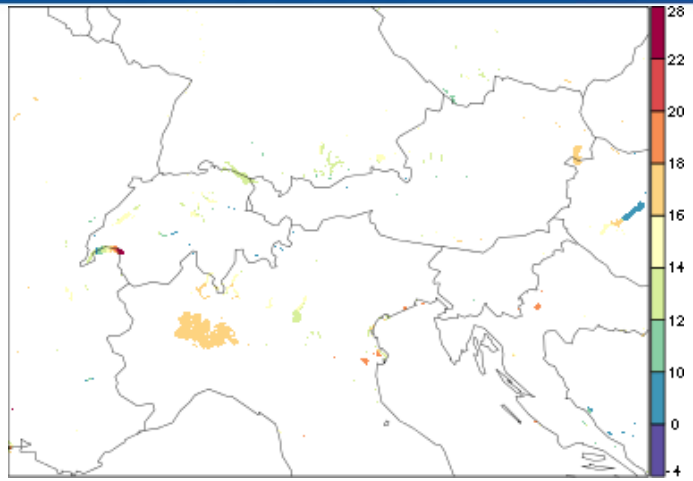
- If available, read ASCII file with box of coordinates, Tlake and estimated Tlake obs error σo
- All lake points inside box get new surface temperature Tlake
- σ_b=2.5K everywhere
- New Routine: oi_lakeini.f90 called from oi_main.f90

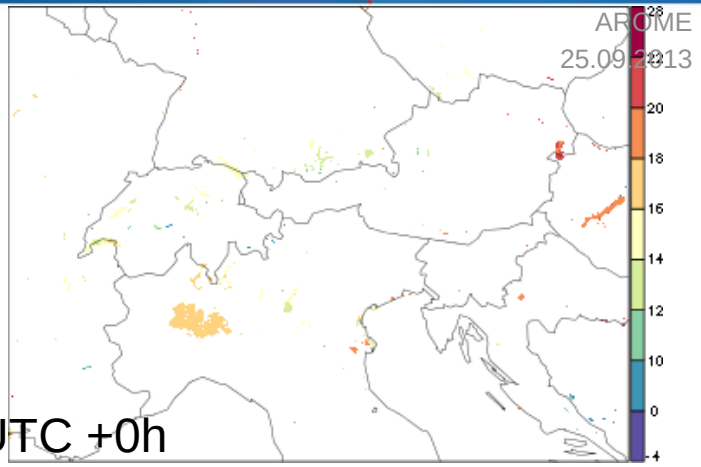


$$\text{Tlake}= \frac{TLake_b{\sigma_o}^2+TLake_o{\sigma_b}^2}{({\sigma_o}^2+{\sigma_b}^2)}$$

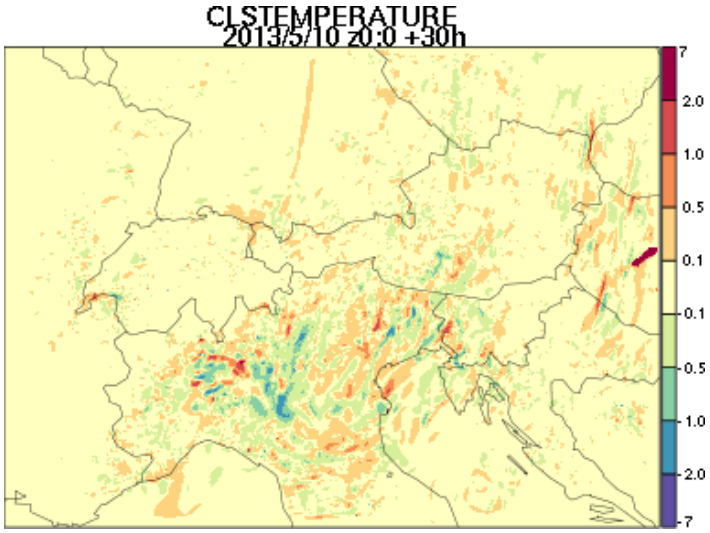
47.4850 47.8110 8.9450 9.7530 24.80 2.00 1 (Lake Constance)

Initialisation of lake temperatures (insitu measurements) 0D-Var in OIMAIN

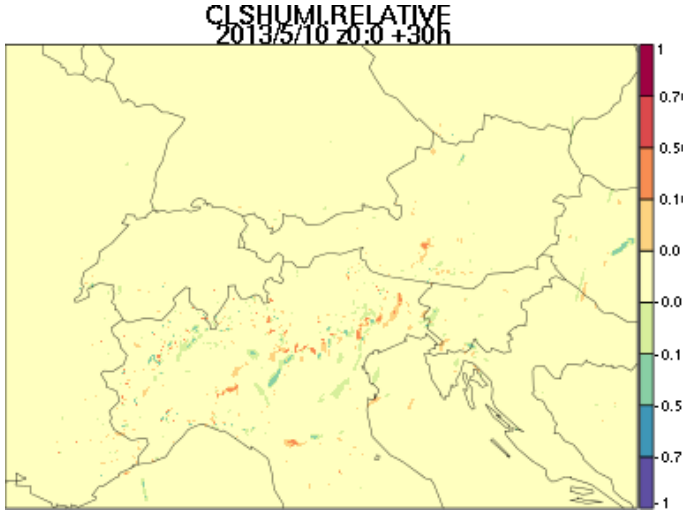




10th May 2013 00 UTC +0h



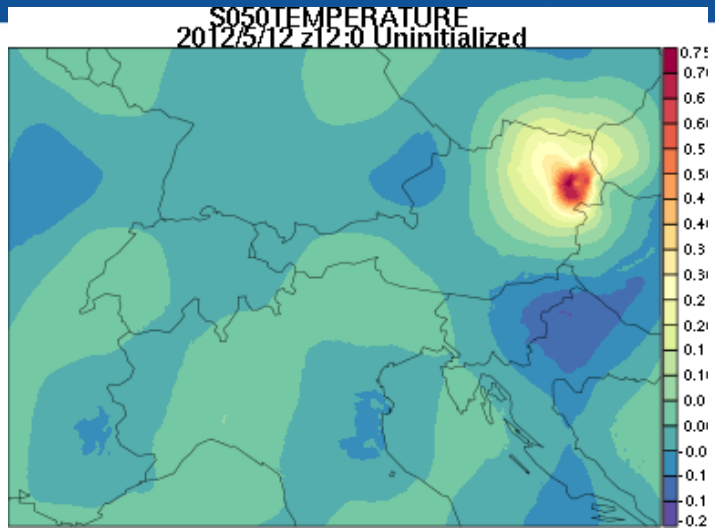
ΔT2m ref-exp +30h



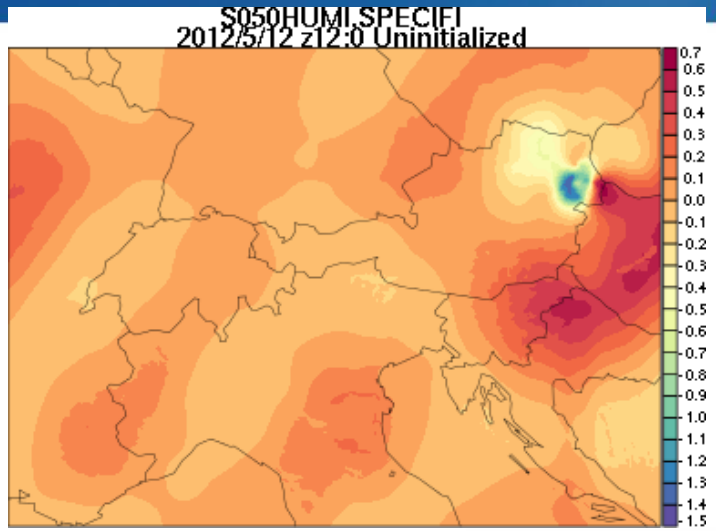
ΔRH2m ref-exp +30h

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

RADAR ASSIMILATION (reflectivity): 12th May 2012 12 UTC

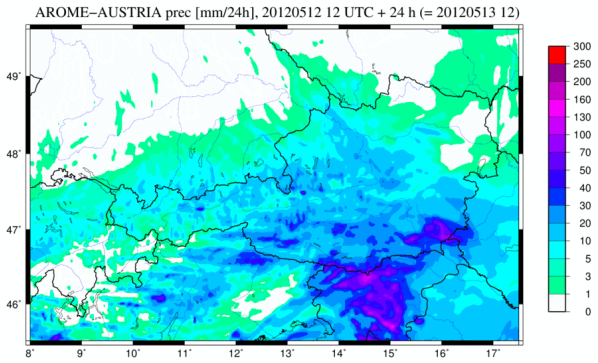


L50 T [K]

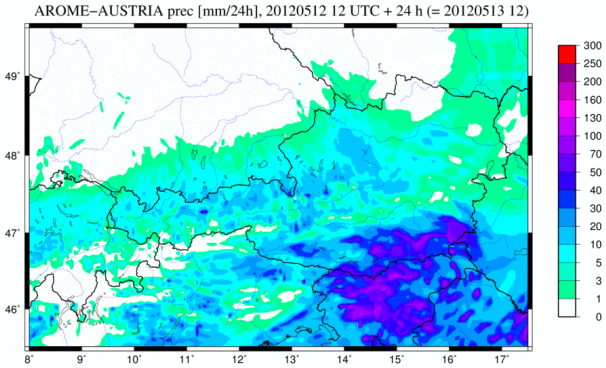


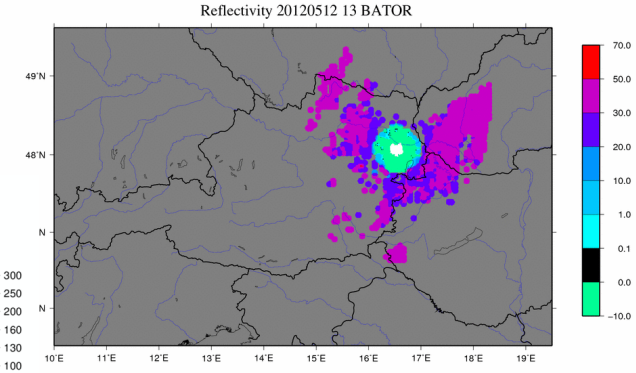
L50 Q [g/kg]

24h-precipitation



24h-precipitation with RADAR

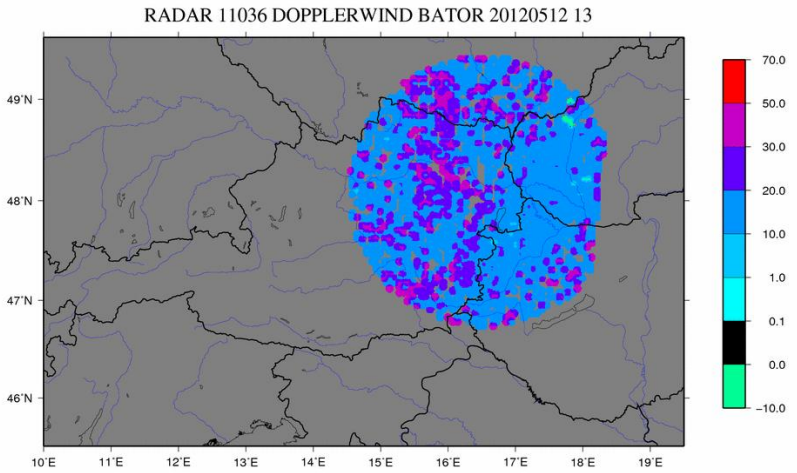




Reflectivity in BATOR

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

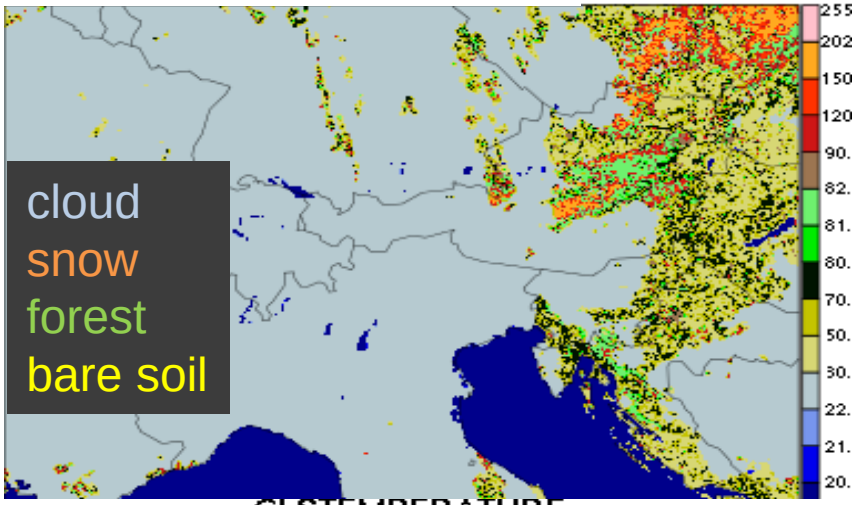
Doppler wind assimilation failed so far

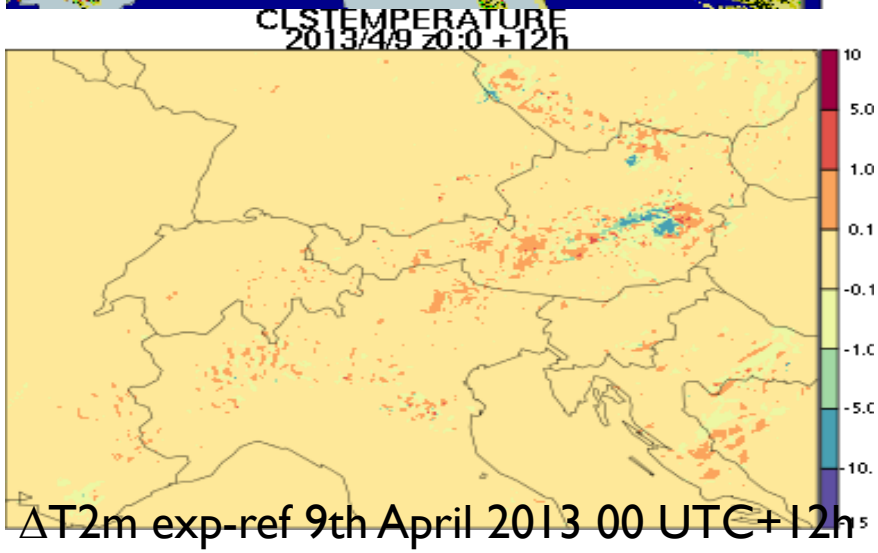


Doppler wind in ODB
all rejected in screening - missing first guess value

Snow initialisation (project: SNOWGRID)

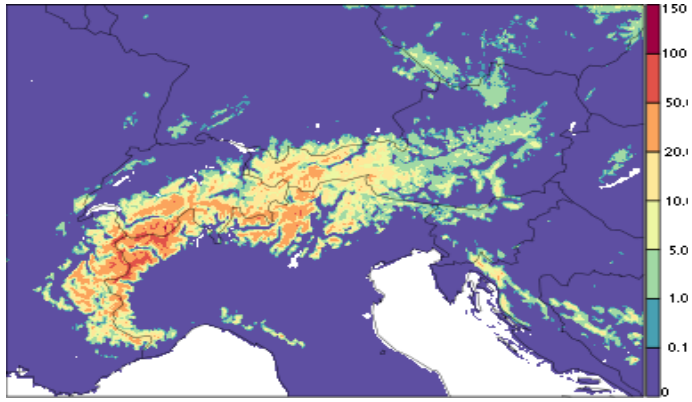
ENVEO-Cryoland
MODIS-snow cover 1km



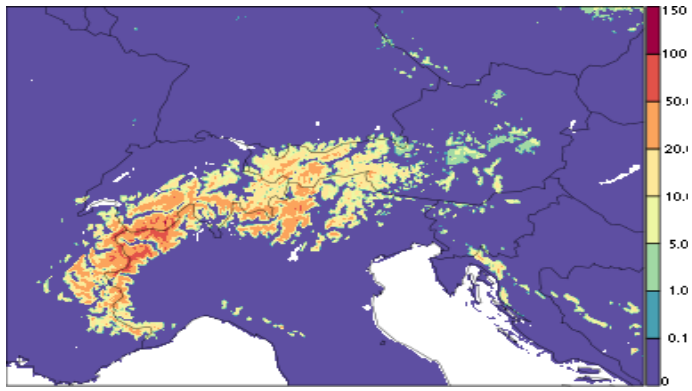


ΔT2m exp-ref 9th April 2013 00 UTC+12h

AROME
25.09.2013



SWC kg/m²
reference



With modified snowcover (OIMAIN)
9th April 2013 00 UTC
In cy37t1op1 also snow assimilation in CANARI possible

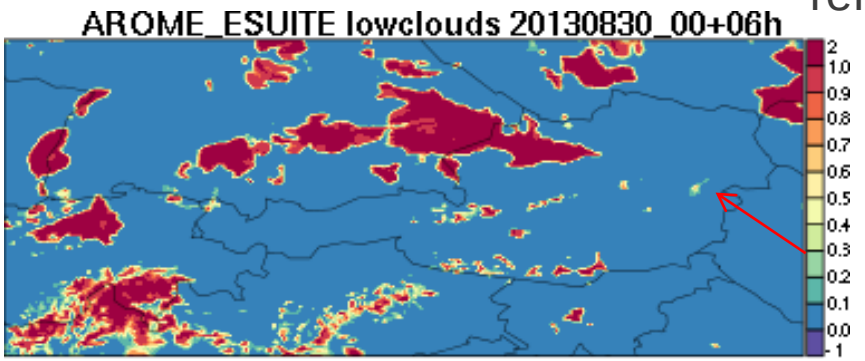
ZAMG
Zentralanstalt für Meteorologie und Geodynamik

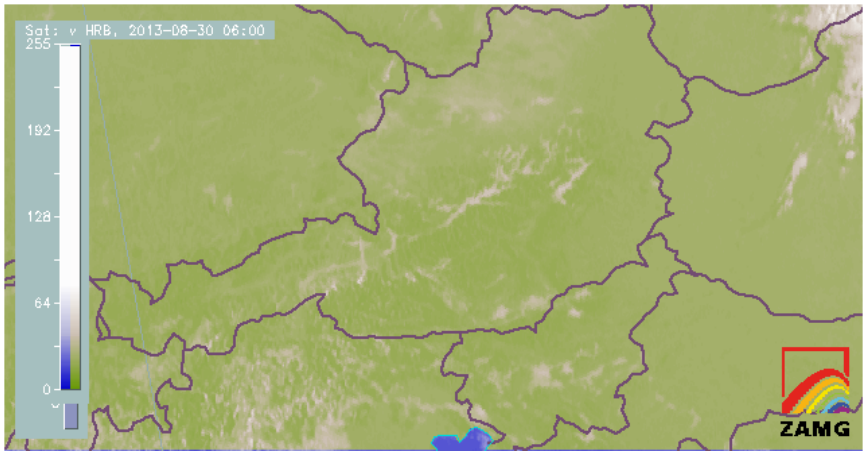
Assimilation of pseudo temp observations

- Low clouds (stratus) are often not captured in AROME in Alpine valleys
- Wrong T and Q profiles -> idea: create pseudo radio sounding (obsoul) from several SYNOP (valley floor to mountain tops) and assimilate them
- Innsbruck, Zell am See, Schladming, Mürztal
- Comparison with sounding at Innsbruck looks fine
- Case study: Impact small, differences in physics cy36t1->cy37t1op1 have more impact

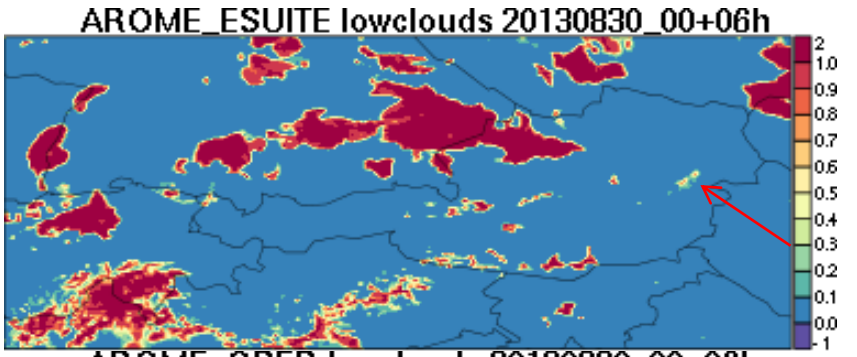
Assimilation of pseudo temp observations

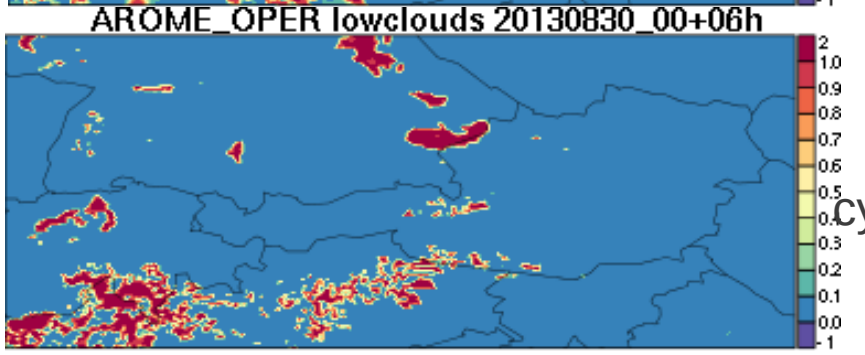
low clouds
reference





low clouds
With pseudo temps



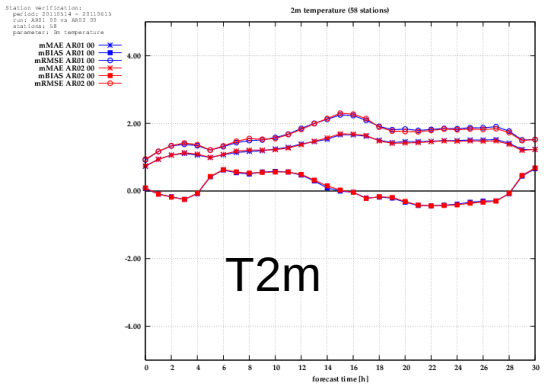


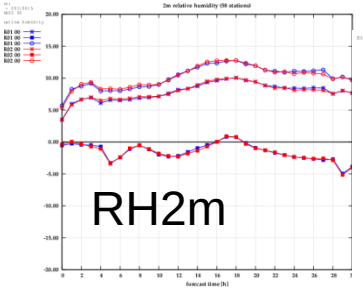
low clouds
cy36t1 instead cy37t1op1

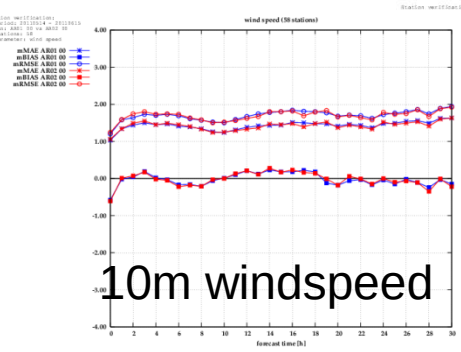
ZAMG
Zentralanstalt für Meteorologie und Geodynamik

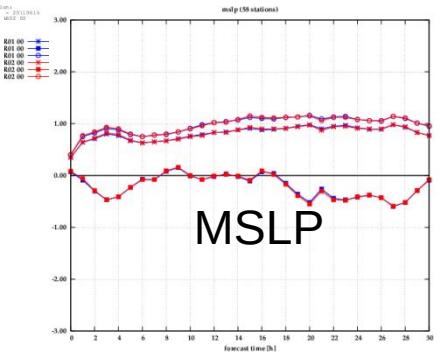
Additional windprofiler from ECMWF (Mars)

More or less neutral impact

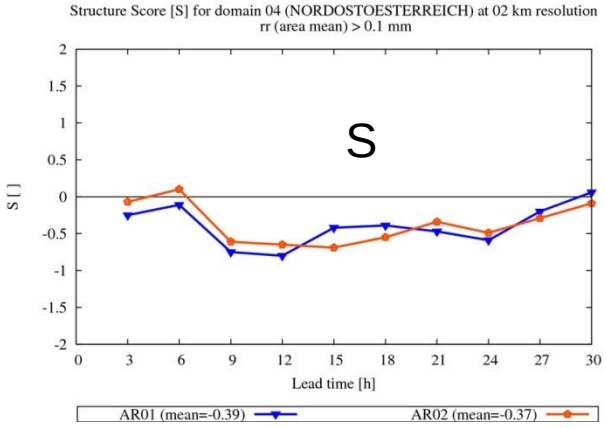


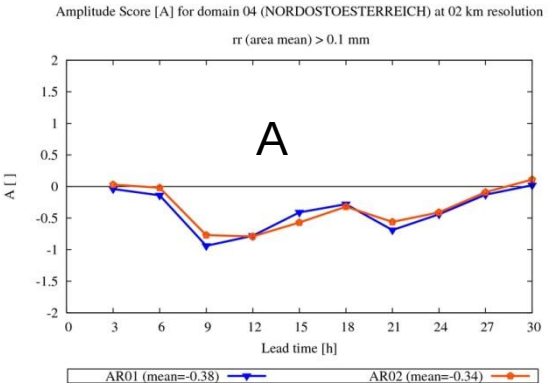


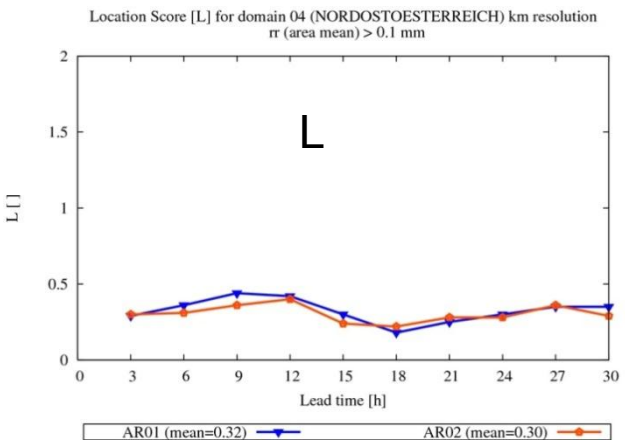




With additional profilers



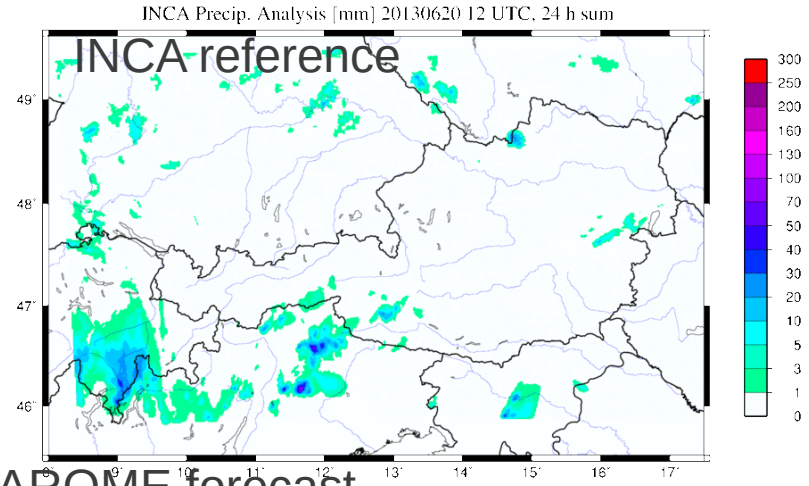




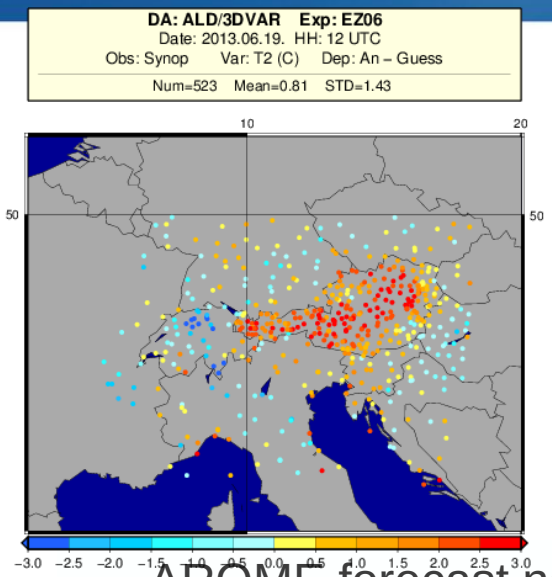
14th May -15th June 2011

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

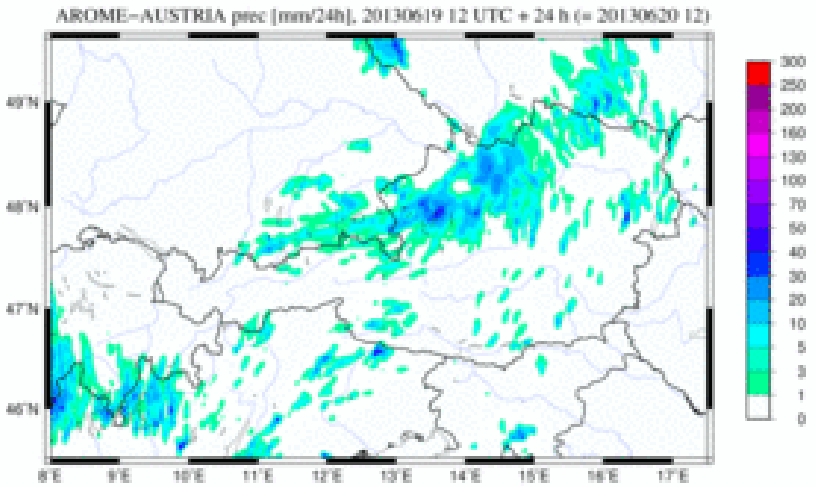
19th June 2013 12 UTC +24h „Ghost rain“

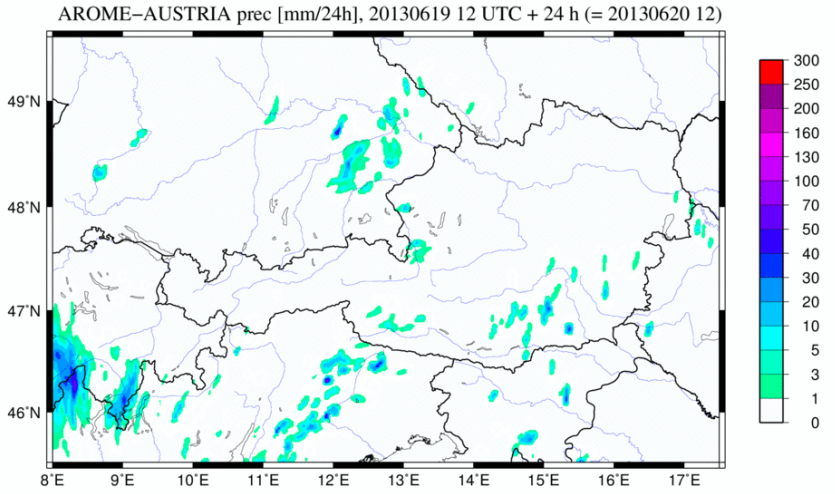


AROME forecast

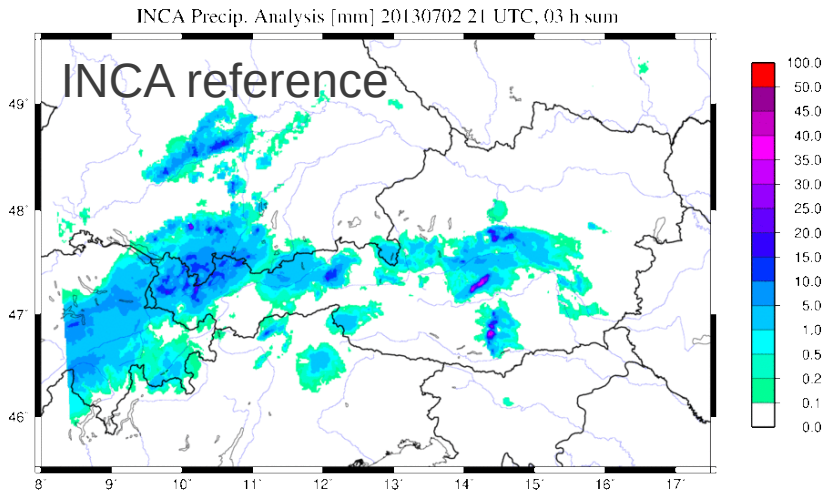


AROME forecast no T2m in 3D-Var





AROME +IDFI: precipitation 20130702 18 UTC+3h



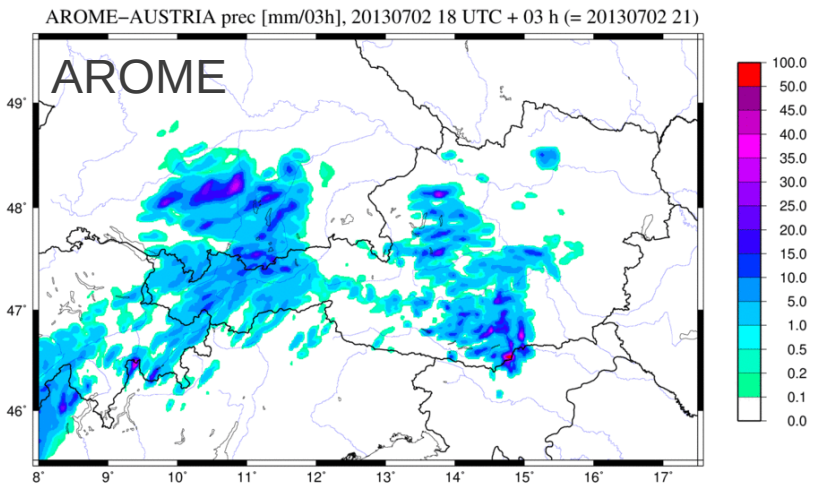
- **Filter first guess: 1x 001**

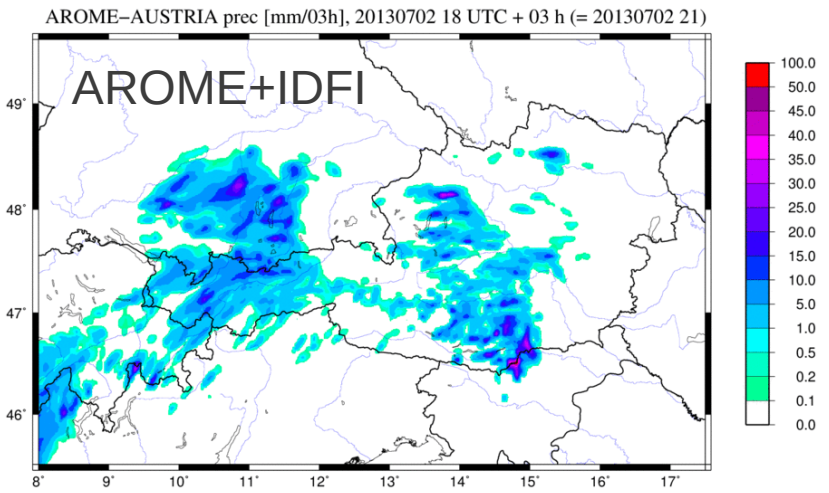
NAMINI:NEINI=2,LBIAS=.T.,LINCR=.F.;
-> ICMSHAR03BIAS

- **Filter analysis: 1x 001**

NEINI=2,LBIAS=.F.,LINCR=.T.;

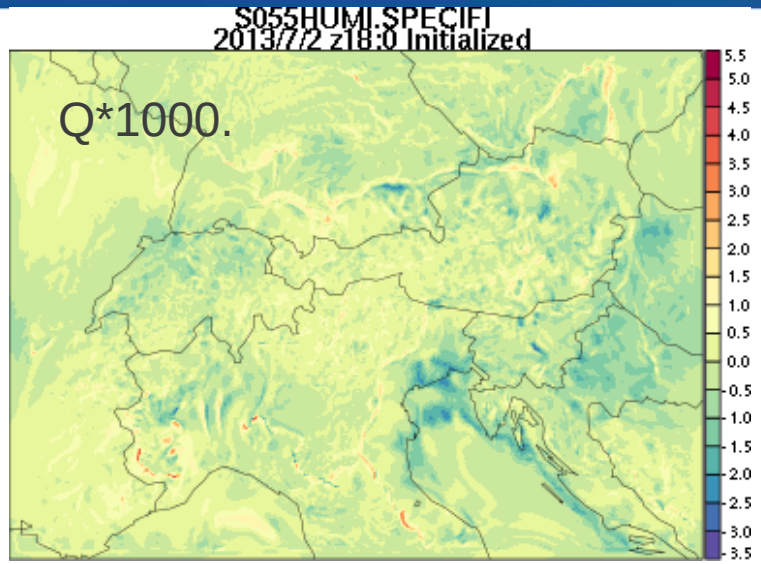
- **ANAIDFI=FG+ANAfiltered-Fgfiltered**
- Works with AROME only with LSPRT bugfix , e.g. cy37t1 and higher

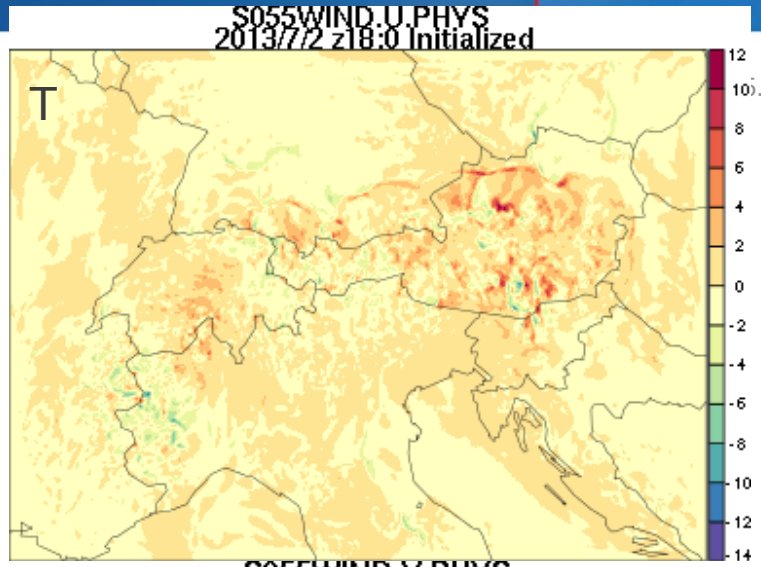


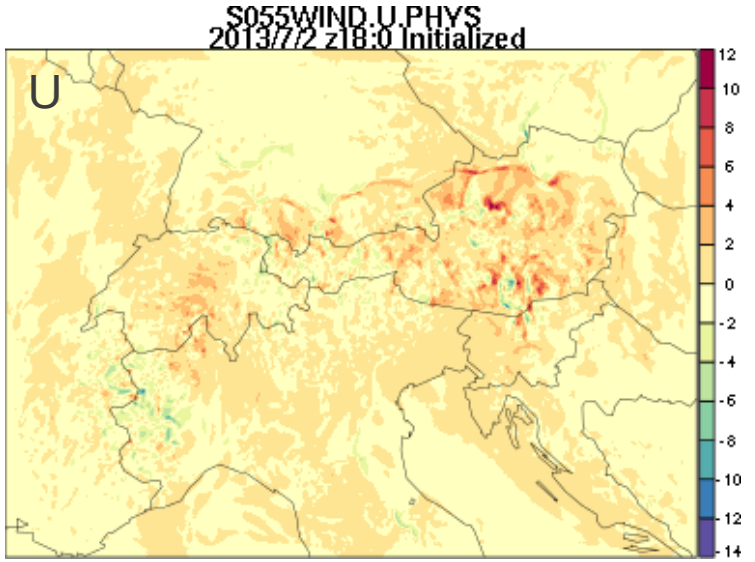


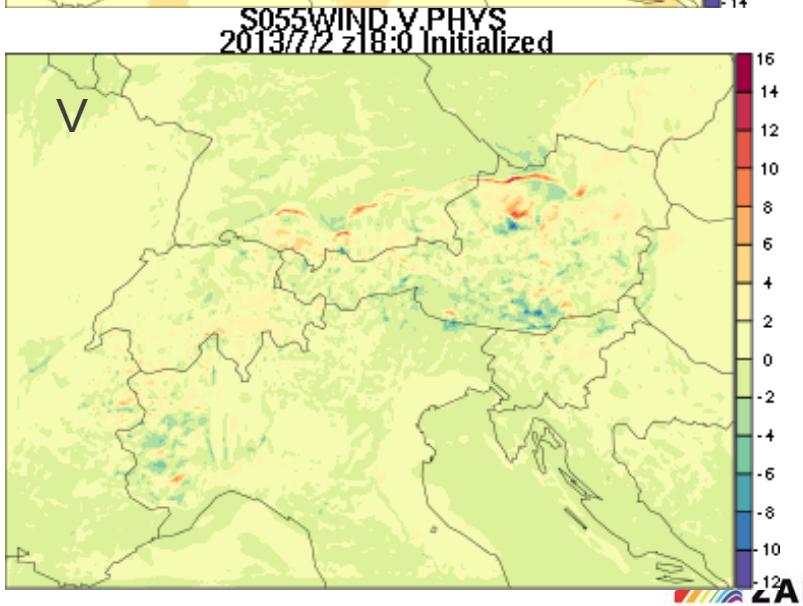
NAMDFI: NEDFI=7,NSTDFI=11,NTPDFI=4, TAUS=5400., LADIFH=.T.

AROME analysis 20130702 18: after – before IDFI (level55)







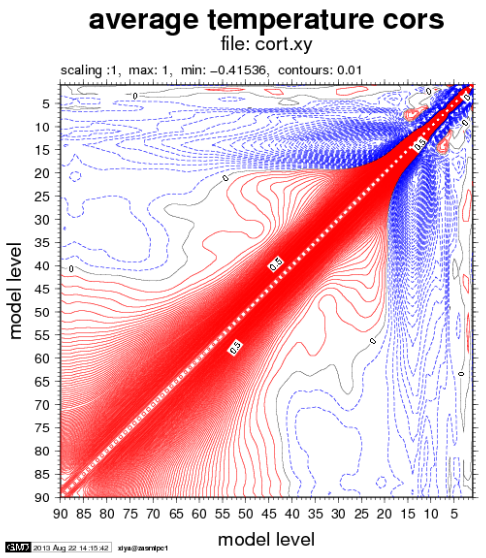


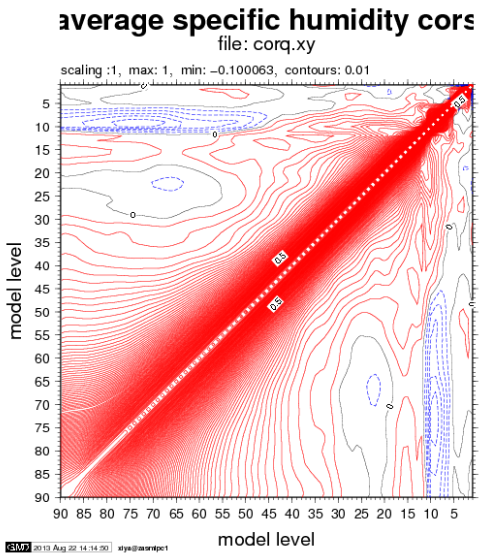
Future plans on assimilation in AROME-Austria

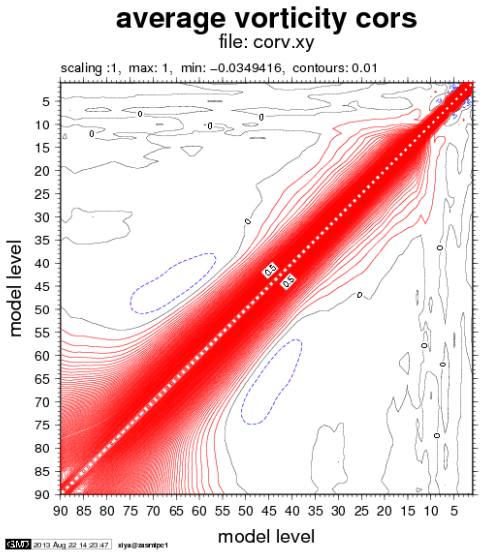
- More tests on radar assimilation (running period)
- Testing IASI in systematic manner (observation impact)
- Testing high resolution satellite winds (MSG)
- Try to get AROME 90L running with satellite data and get it operational
- Tests with AROME 1km
- Further work on GPS / SNOW initialisation
- AROME-EPS
- Comparison: AROME to INCA forecast performance
- More systematic tests on all kind of observations
- Work on background error
- Removal of initial unrealistic precipitation patterns (IDFI?;physics)

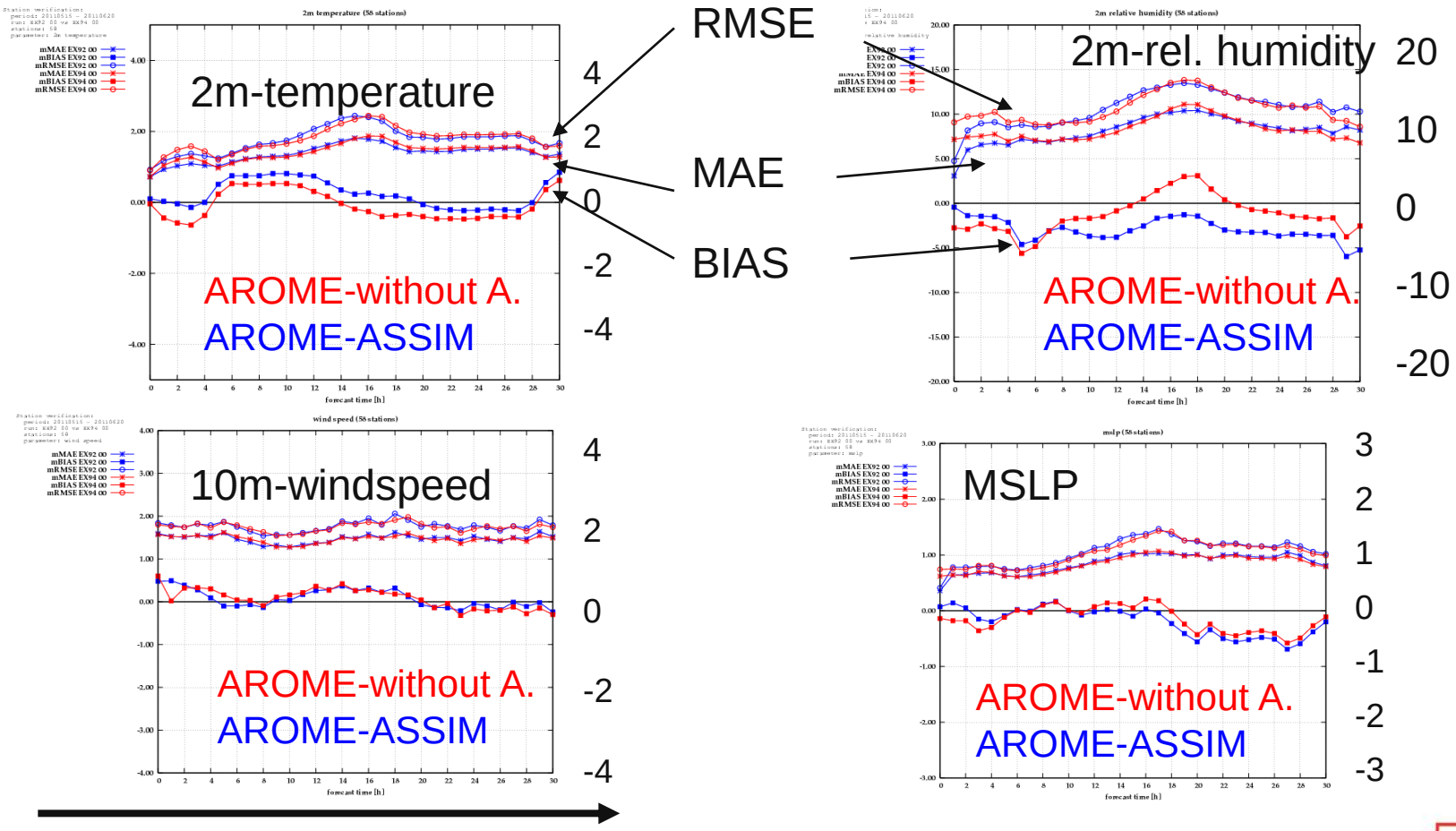
B-Matrix: correlation T/Q/VOR

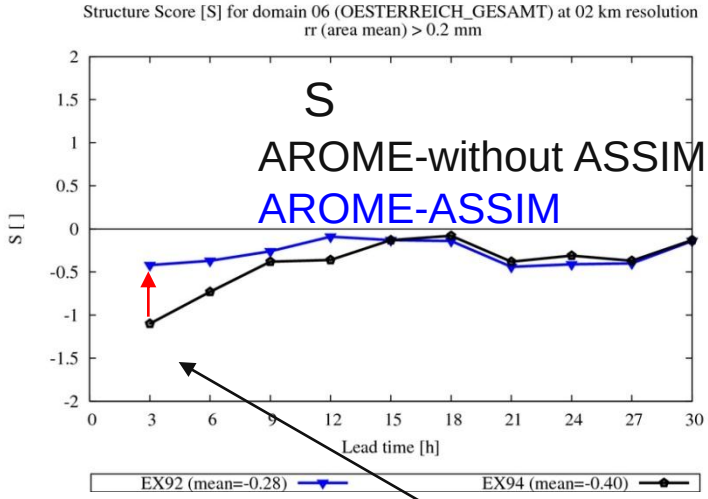
L90
big domain

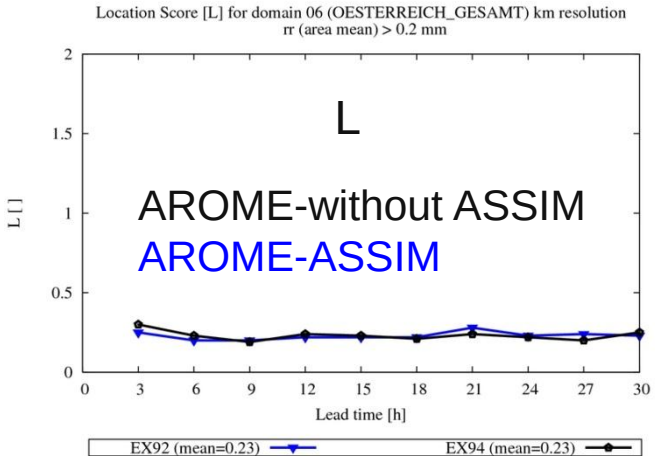


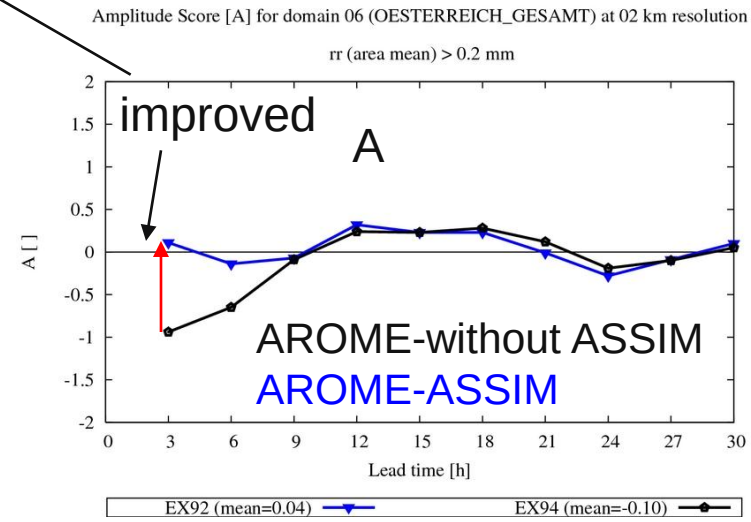





2m-temperature
AROME-without A.
AROME-ASSIM
RMSE
MAE
BIAS
2m-rel. humidity
AROME-without A.
AROME-ASSIM
10m-windspeed
AROME-without A.
AROME-ASSIM
MSLP
AROME-without A.
AROME-ASSIM
Vorhersagezeit







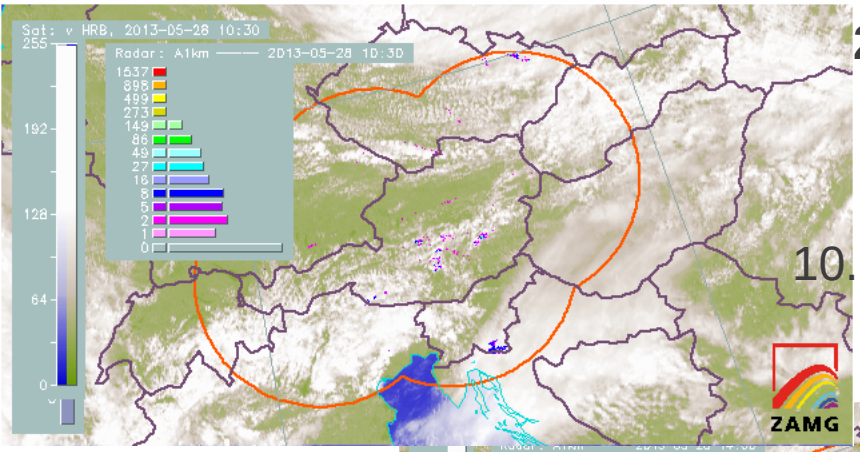
SAL-Score
For whole Austria
Threshold:
0.2mm

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

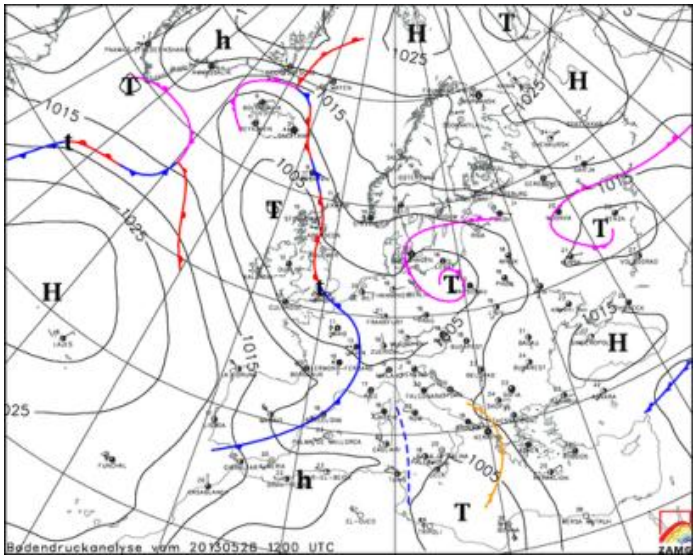
Fallstudien: Konvektion im Bereich Wechsel/Südburgenland

28.5.2013

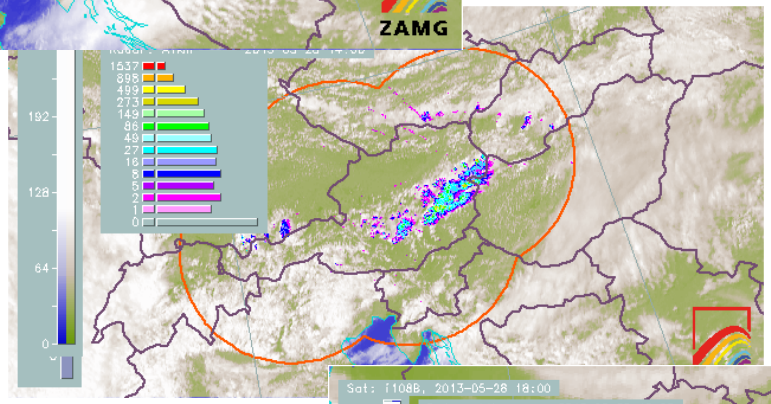
AROME
25.09.2013



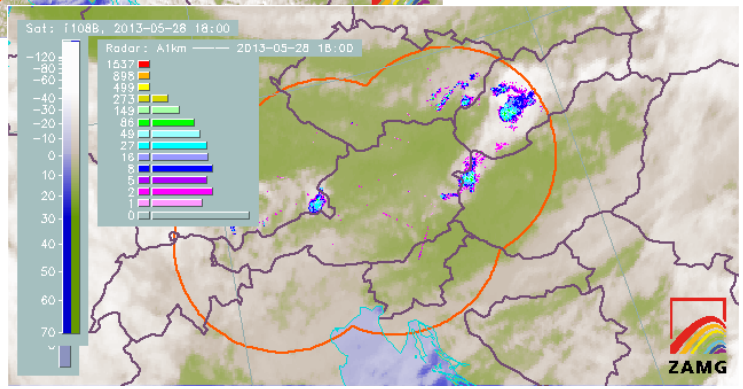
10.30 UTC



12.00 UTC



14.00 UTC



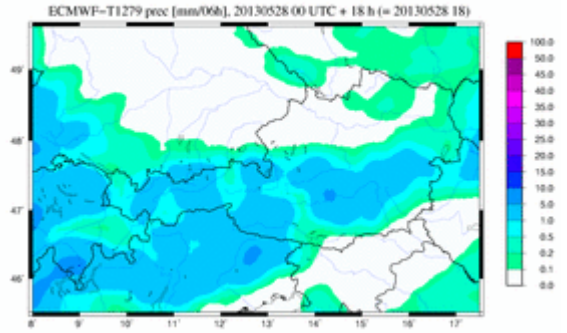
18.00 UTC

ZAMG
Zentralanstalt für Meteorologie und Geodynamik

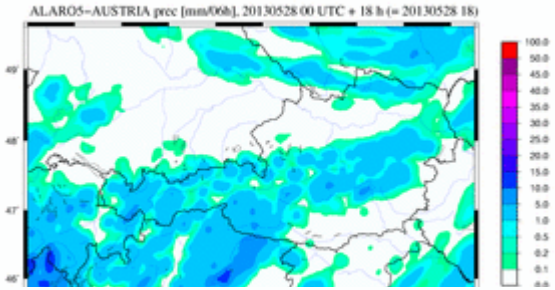
Fallstudien: Konvektion im Bereich Wechsel/Südburgenland

28.5.2013 00 UTC +18h RR/6h

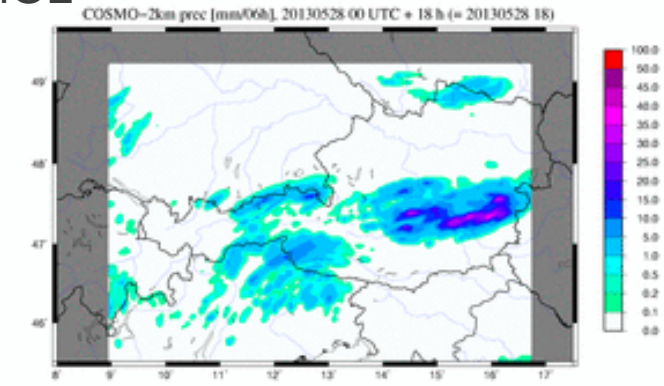
IFS

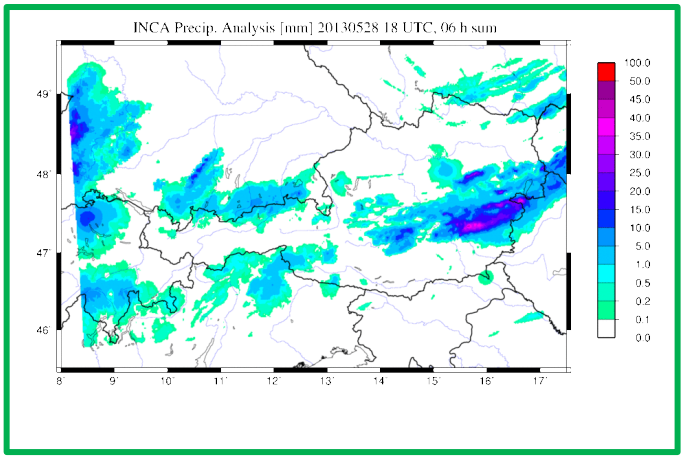


ALARO



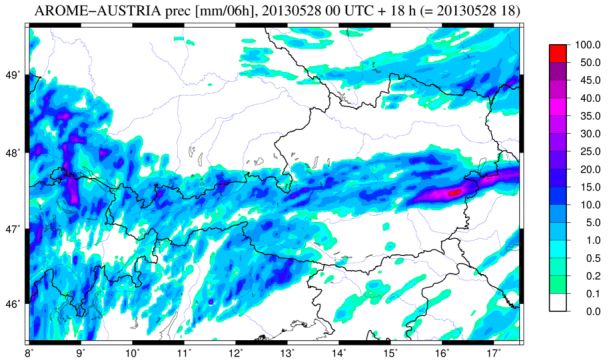
COSMO2





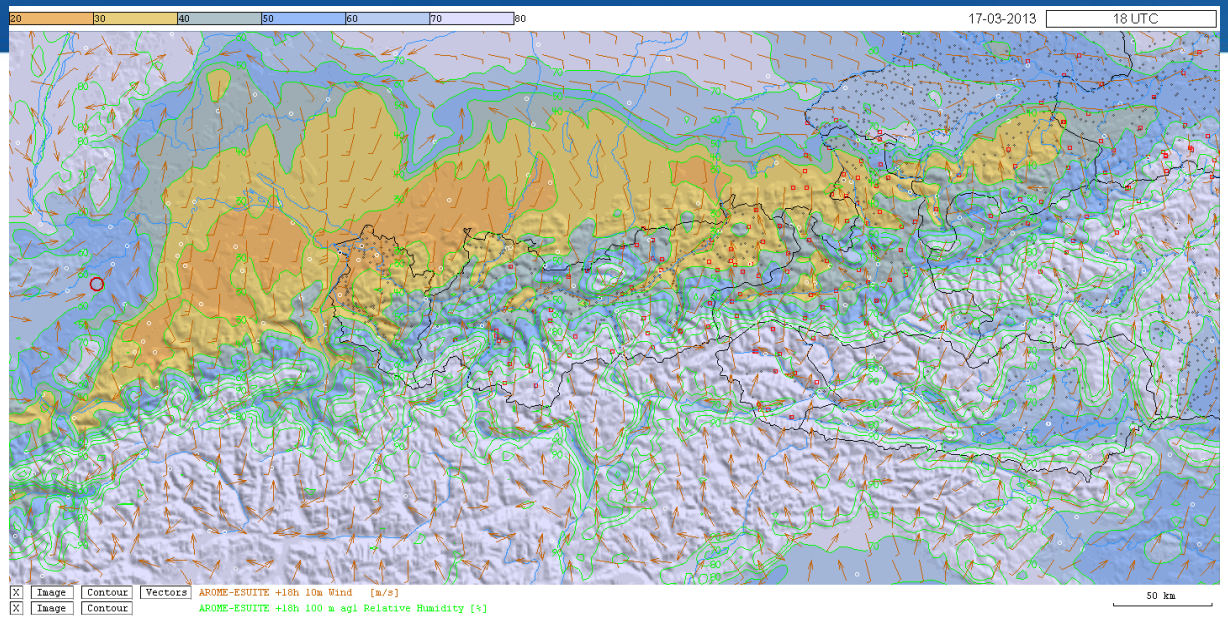
INCA Analysen

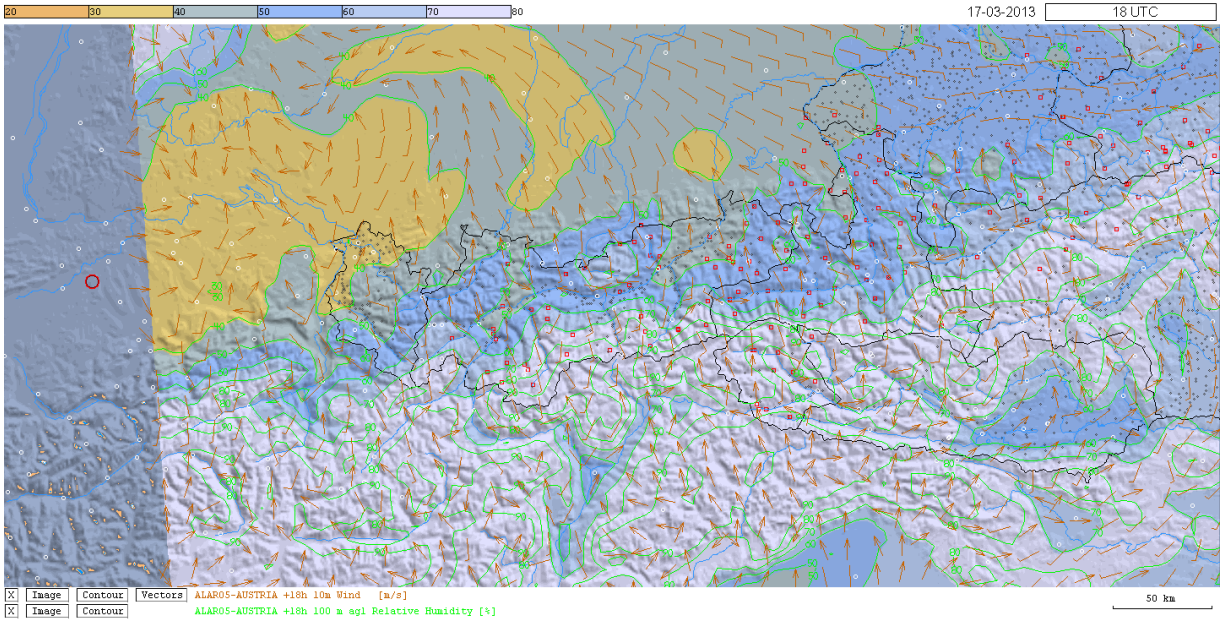
AROME



ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Föhn am 17.3.2013 18 UTC





AROME
25.09.2013

Rel. Feuchte 100m
10m Wind

AROME

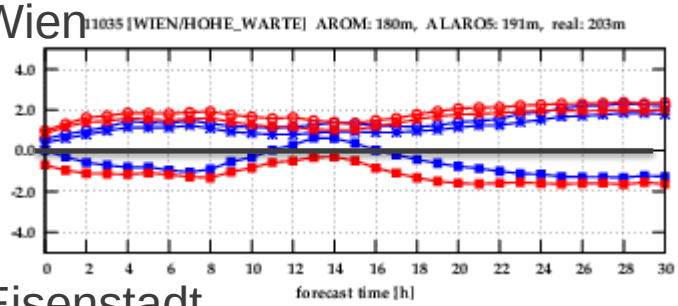
ALARO

Freuen uns über Feedback/Expertise der KS Innsbruck ☺

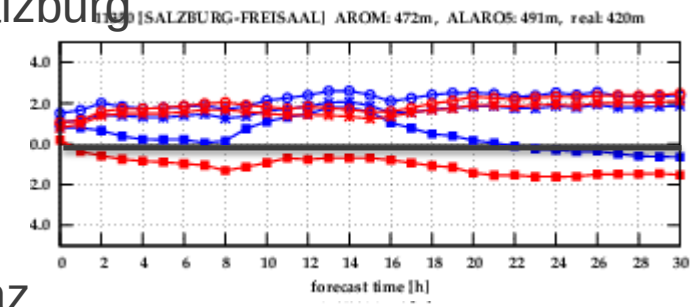
ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Verifikation T2m 12.11.12-31.1.13 00 UTC Läufe

Wien



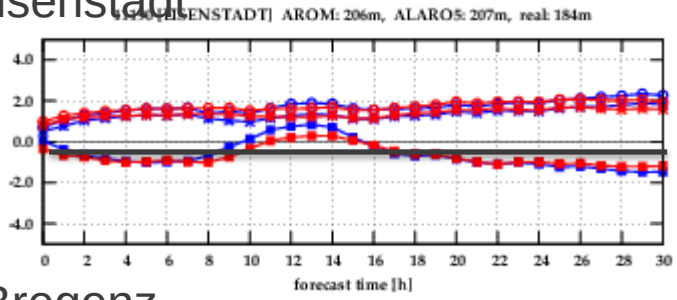
Salzburg



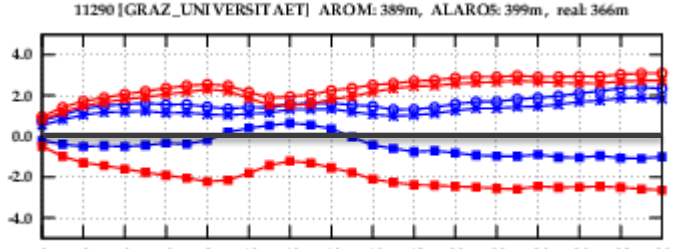
AROME

ALARO

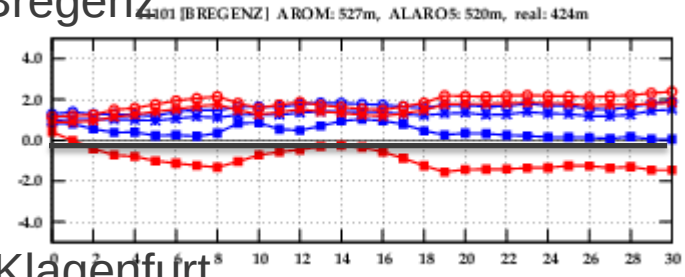
Eisenstadt



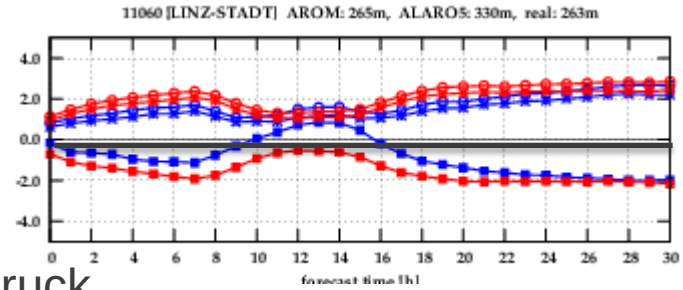
Graz



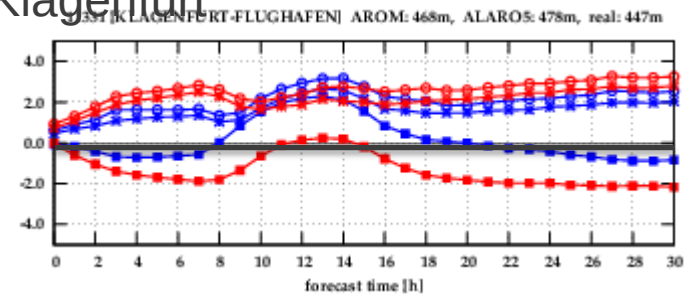
Bregenz



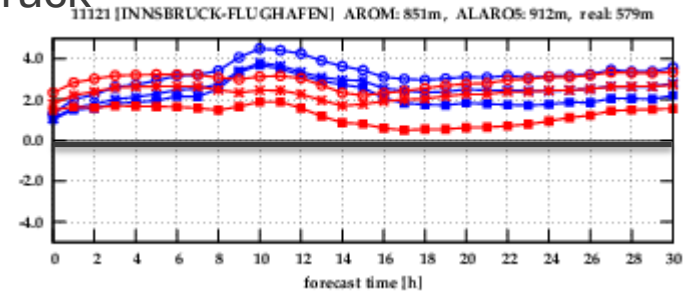
Linz



Klagenfurt



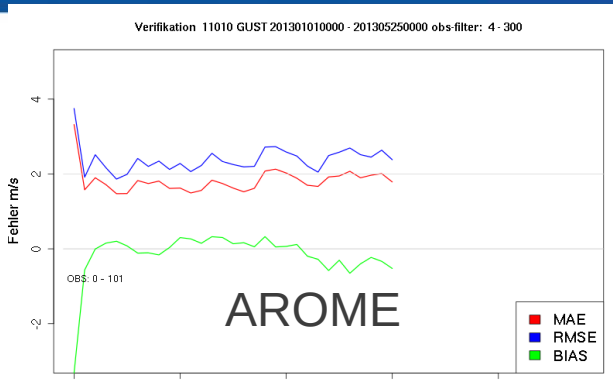
Innsbruck

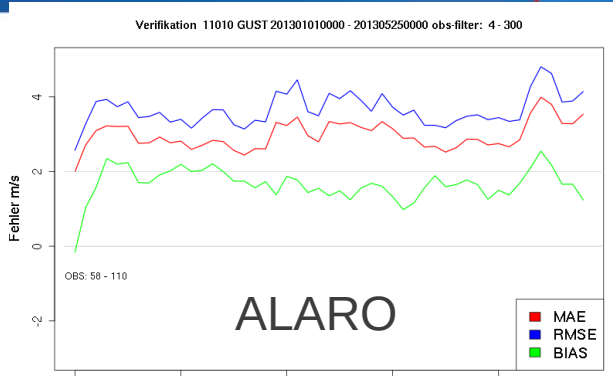


ZAMG
Zentralanstalt für Meteorologie und Geodynamik

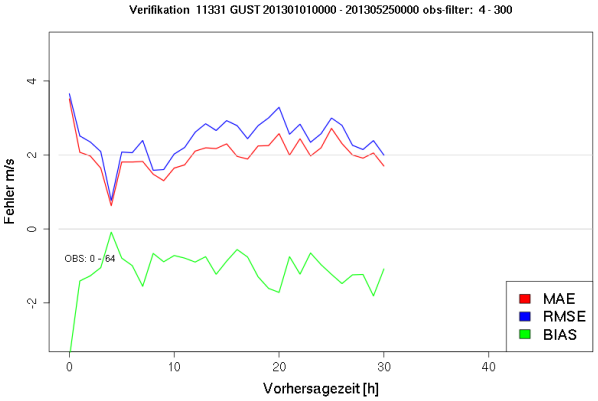
Verifikation Böen: 1.1.-25.5.13

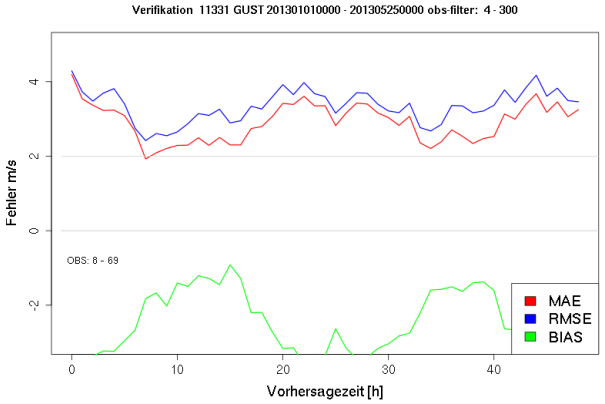
Linz



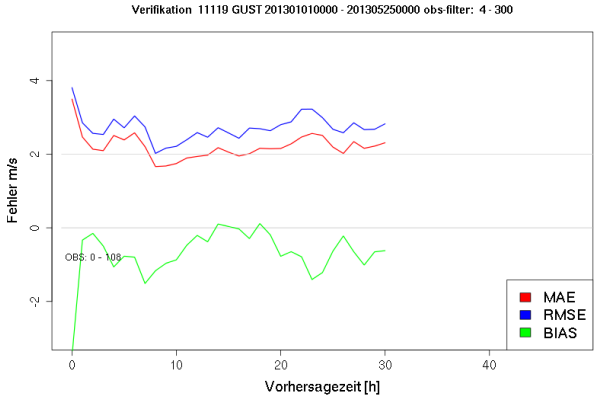


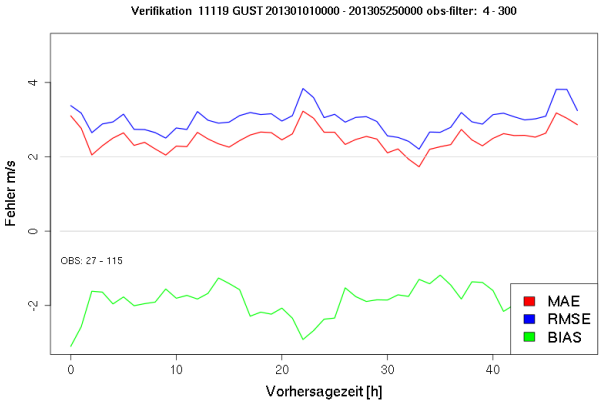
Klagenfurt





Seefeld





ZAMG
Zentralanstalt für Meteorologie und Geodynamik

Inhalt

i. AROME Einführung (CW)
ii. Implementierung an der ZAMG (FM)
    i. Überblick Modellphysik und –dynamik
    ii. ZAMG spezifische Entwicklungen (Modellphysik, Assimilation)
iii. Fallbeispiele (FM)
    i. Hochwasser 2013
    ii. Hochreichende Konvektion
    iii. Föhn
iv. Zusammenfassung und Ausblick (CW)

Zusammenfassung und Ausblick I

- AROME läuft nun im regulären Testbetrieb inklusive Datenassimilation
- Organisation des AROME Systems wesentlich komplexer als ALARO bzw. ALADIN
- Ausfallssicherer Betrieb große Herausforderung
- AROME soll dort ansetzen wo ECMWF, ALARO und LAEF die größten Schwächen aufweisen
- Erstellung des Ausgangszustandes für den Modellrechnung nun erstmals zu 100% „made by ZAMG“ (bietet viele Möglichkeiten / Fehlerquellen ;-)).
- Radarassimilation steht am Anfang (dzt. erste Erfahrungen), bis zur möglichen Operationalisierung noch viel zu tun ☺
- Performance von derzeitiger AROME Version vielversprechend, jedoch laufend Änderungen notwendig (laufende Analyse der Stärken u. Schwächen)
- Erhöhung der vertikalen Auflösung, Vergrößerung der Modelldomain geplant
- AROME bietet viele Möglichkeiten für die Entwicklung neuer Produkte (Hageldiagnostik, Blitzdiagnostik, simulierte Radarreflektivitäten sim. Satellitenkanäle, etc.)

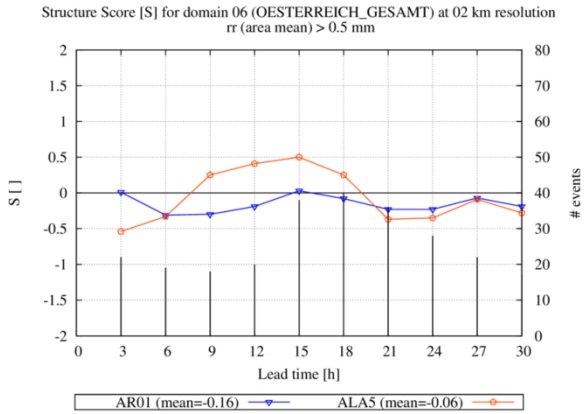
Zusammenfassung und Ausblick II

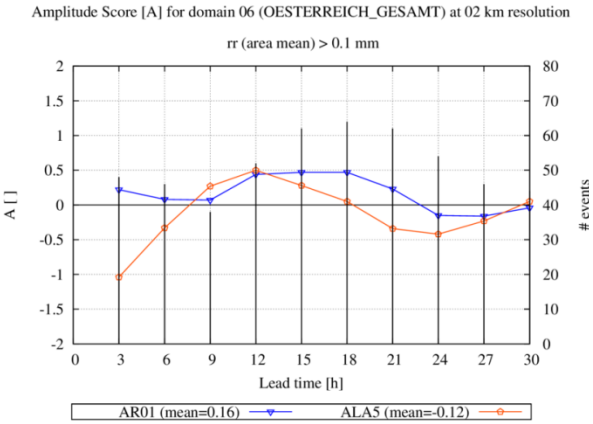
Fahrplan operationeller Betrieb:

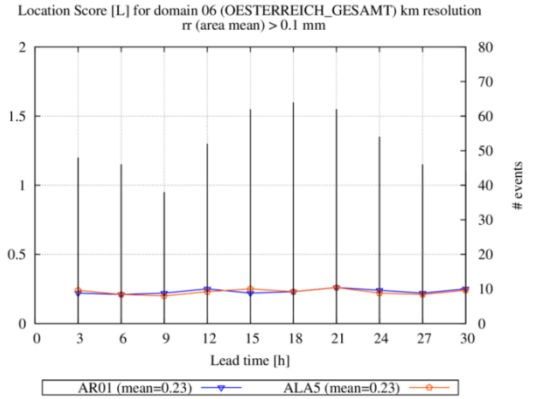
Zielzeit	Aktion
demnächst	Bereitstellung von Niederschlagsplots, etc. für ForecasterInnen (=Beginn der Kennenlernphase); „Themancafe AROME“ mit ForecasterInnen; VisWeather?
Sommer	Überführung des AROME Systems in den operationellen User inkl. Ablaufoptimierung, Fallbacks
Sommer/Herbst	Laufende Änderungen im Modellbetrieb (techn., Physik, Assimilationssystem), intensive Evaluierung/Verifikation
Herbst	informelles Treffen mit interessierten ForecasterInnen (Erfahrungsaustausch, Stärken/Schwächen analysieren, Steuerung weitere Entwicklung)
Herbst	Aufbau des Backup-Systems
Winter	Freigabe bzw. operationeller Betrieb der AROME-AUSTRIA

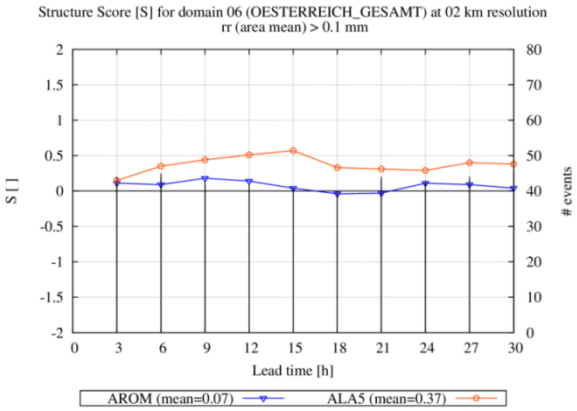
SAL Sommer: 15.5.-31.7.2011 und Winter 12.11.2012-31.1.2013

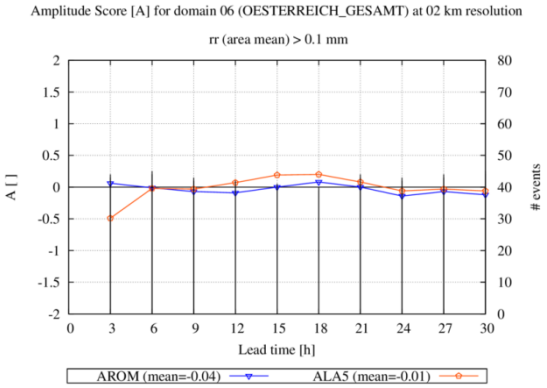
AROME

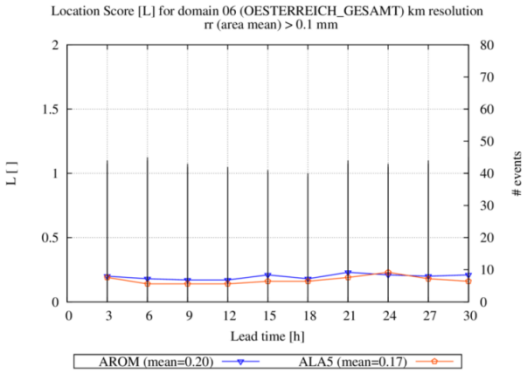








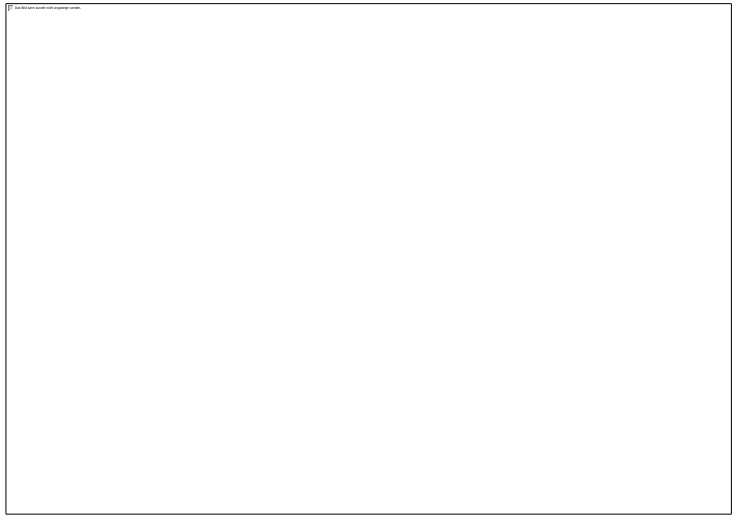


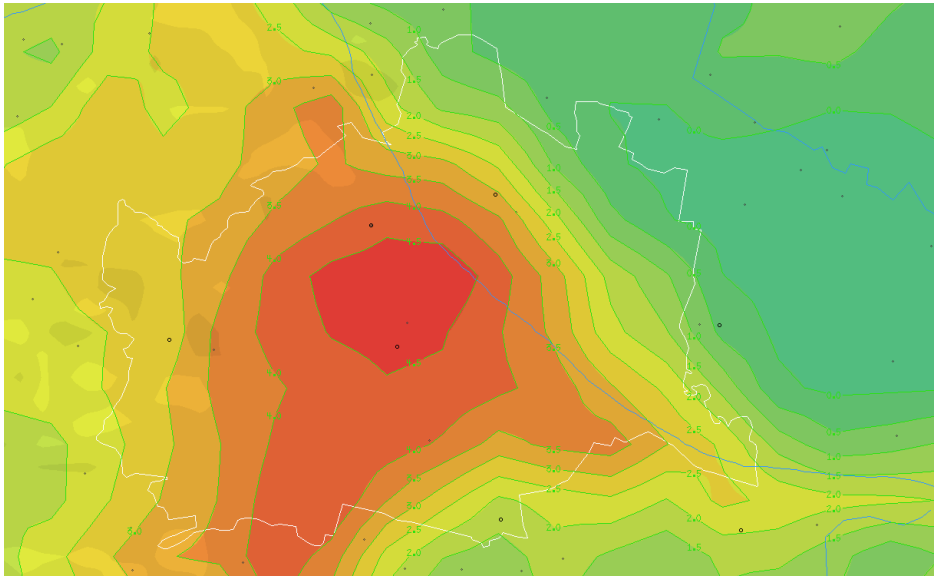


ZAMG
Zentralanstalt für Meteorologie und Geodynamik

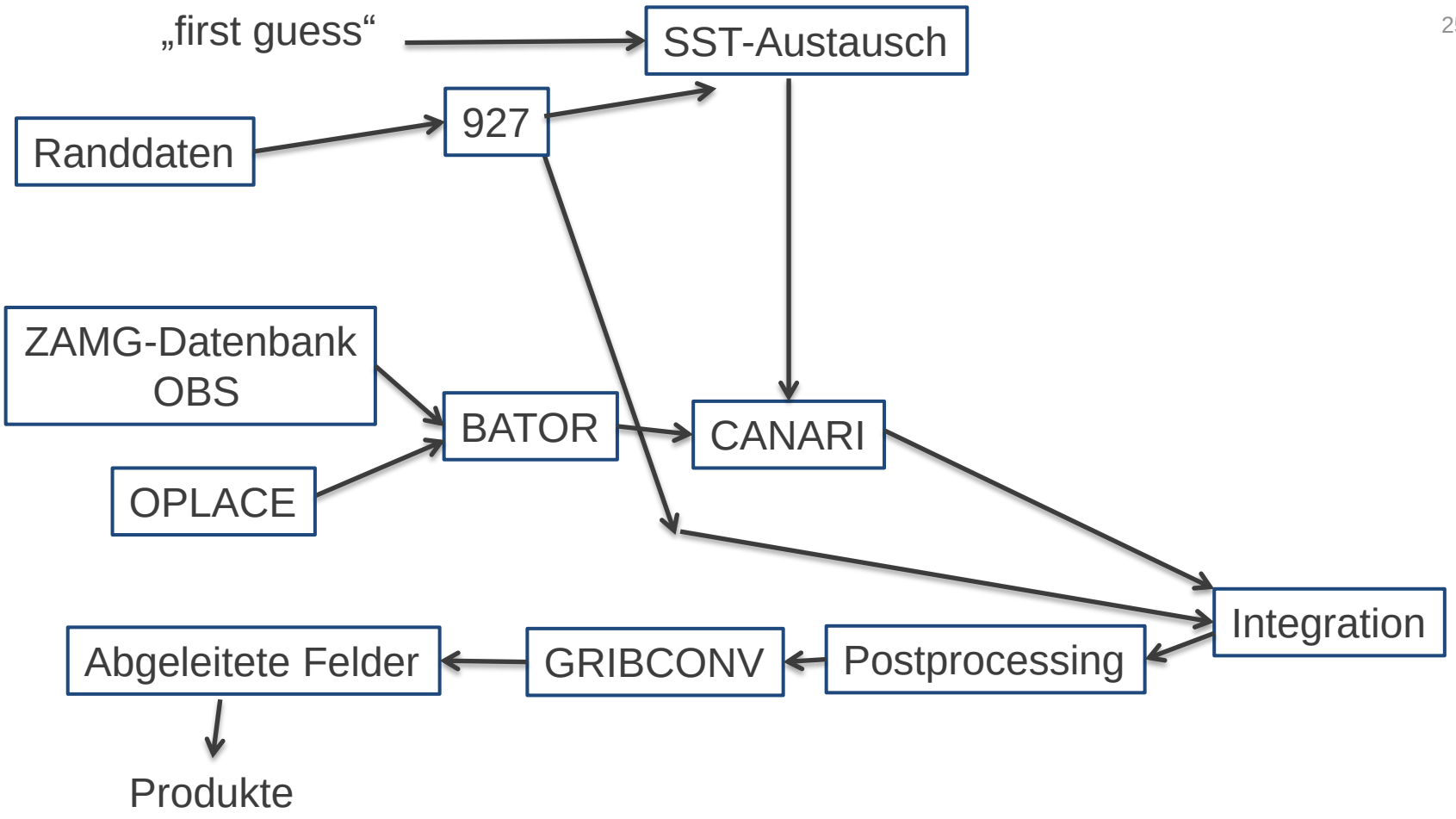
Urbanes Klima: TOWN-Schema

Quelle: Météo-France

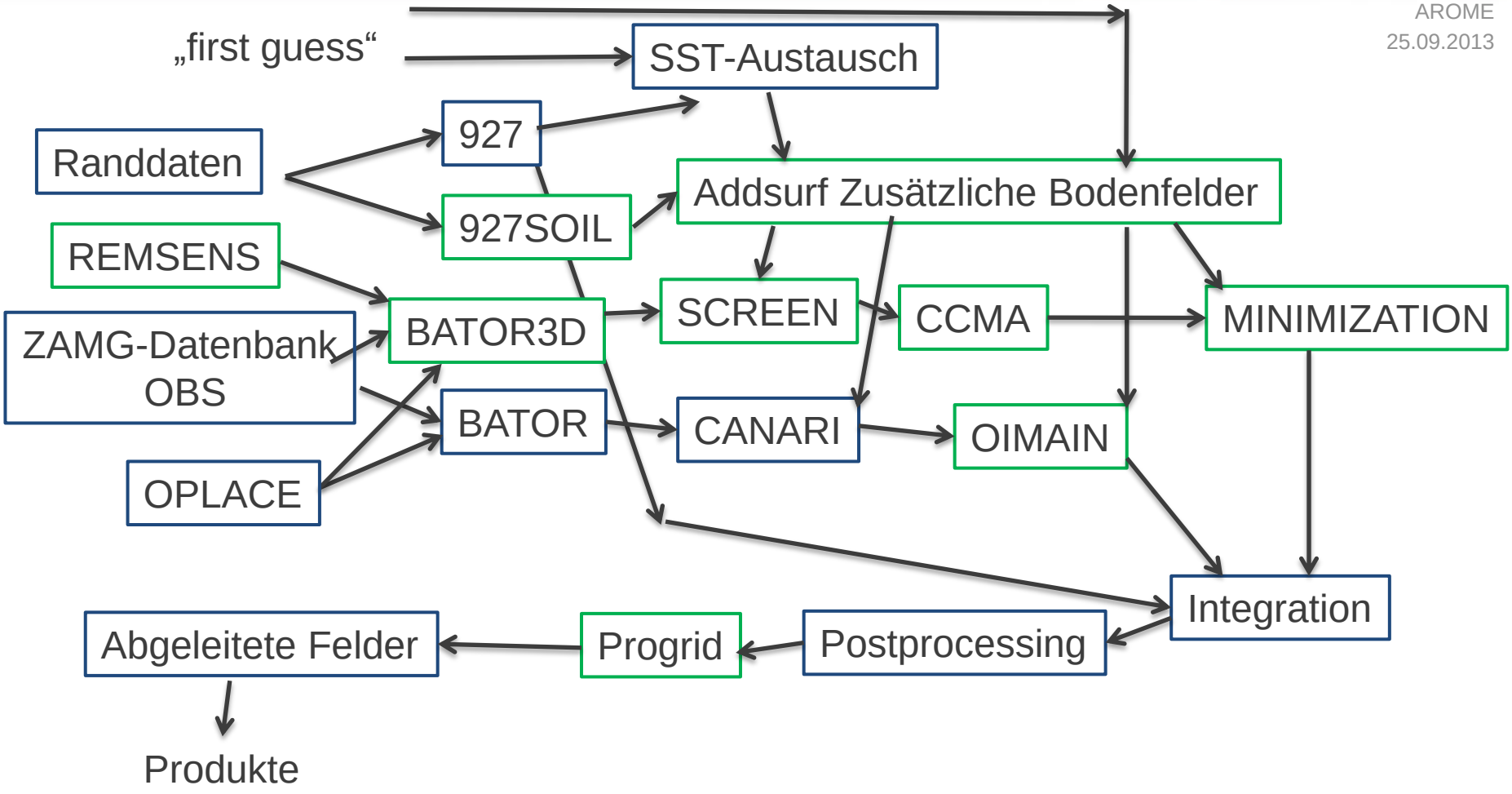
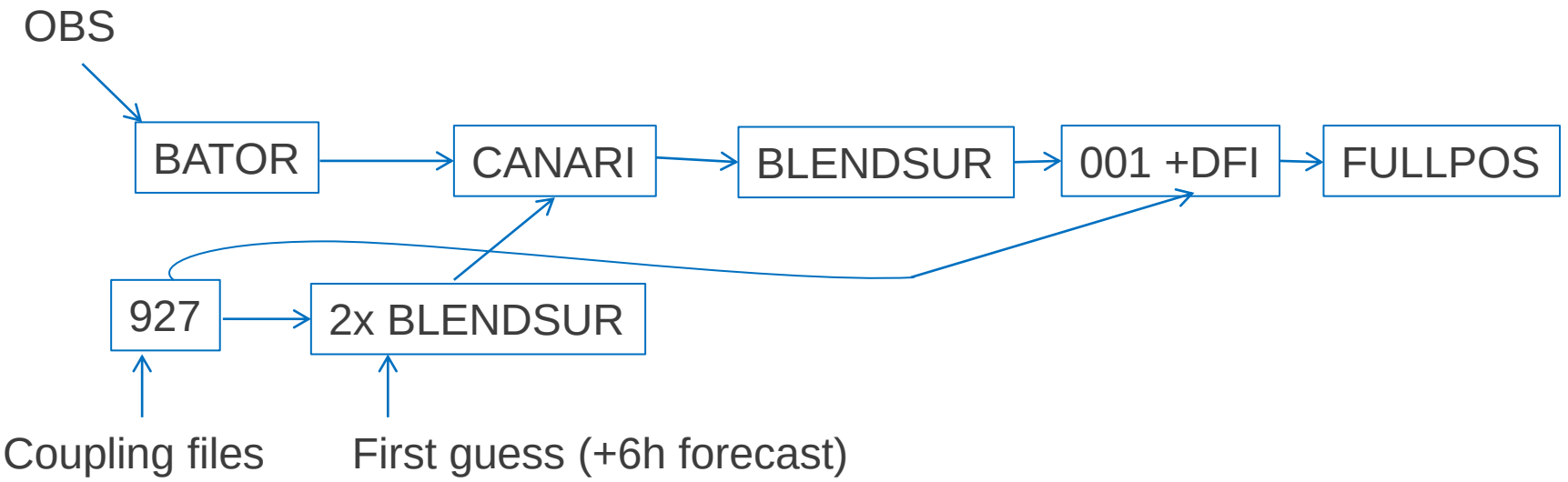




Technischer Ablauf: ALARO



Technischer Ablauf: AROME



ALARO 4.8km schematic overview