# NWP related activities in Austria

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GeoSphere Austria

## 1. Operational NWP systems at GeoSphere Austria

Geosphere Austria currently runs two configurations of AROME in operations: C-LAEF a 90L 2.5km 16+1 member AROME EPS running on ATOS where control is mirrored on Geosphere's local HPC and an hourly AROME 1.2km nowcasting system.

| | C-LAEF | AROME-RUC |
|---|---|---|
| Code version | cy43t2bf11+ | cy43t2bf11+ |
| grid space/levels/members | 2.5km L90/16+1+1 | 1.2km L90/deterministic |
| grid points /area covered | 600x432 Alpine region | 900x576/Austria |
| cycling frequency, leadtimes | 3hourly, 60hours, EPS only 00+12UTC +60h +3h else | Hourly, +12h (05UTC +25h) sub-hourly output |
| Time step | 60s | 30s |
| Orography/Physiography/Sand-Clay | GMTED2010/ECOCLIMAP1/ HSWD | SRTM/ECOCLIMAP2/ SOILGRIDS+FLAKE |
| Coupling | IFS EPS | C-LAEF control |
| INIT | ENS 3D-Var+Jk+OIMAIN | 3D-Var-VC+OIMAIN +LHN/FDDA-Nudging |
| B-Matrix | C-LAEF EDA | AROME-RUC EDA static |

*Table 1: Setup of operational configurations at GeoSphere Austria*

## 2. E-Suite C-LAEF Alpe Adria

Together with ARSO and DHMZ, GeoSphere is developing a new AROME ensemble configuration C-LAEF AlpeAdria, which runs on ECMWF ATOS machine and will replace the current C-LAEF system within this year. Different to C-LAEF it follows a lagged approach where every 3-hours only 4 members provide a long forecast which can be recombined to a 16 member ensemble while the other members run up to +6h to allow 3h-cycling and lagged EnVar. The domain is extended to the South and the grid space 1km with quadratic truncation. One member uses already 3D-EnVar approach based on 16+16 3h and 6h forecasts to describe the Ensemble B-Matrix. Code version: cy46t1+/cy48t3bf3 for EnVar only.

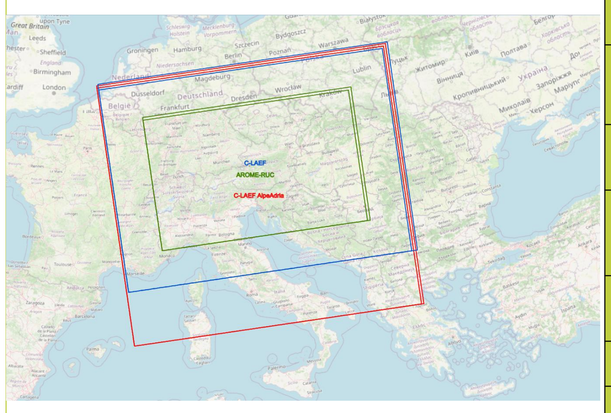
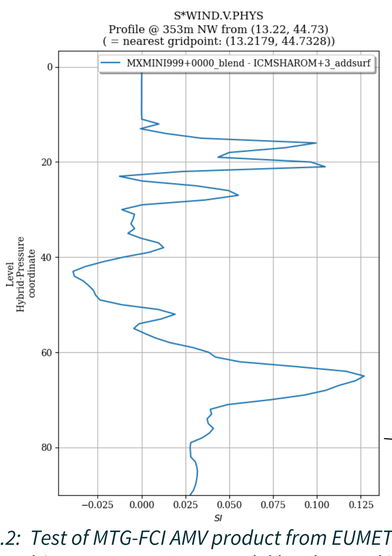



*Fig.1: NWP domains currently used at GeoSphere Austria: C-LAEF: operational 2.5km EPS with EDA, AROME-RUC: hourly nowcasting 1.2km deterministic, C-LAEF AlpeAdria: 1km EPS with one EnVar member common development with DHMZ and ARSO expected to become successor of C-LAEF this summer.*

| Obstype | C-LAEF | AROME-RUC | C-LAEF AA |
|---|---|---|---|
| SYNOP+SHIP+TAWES | YES | YES | YES |
| ZTD | NO | YES | YES |
| aircraft | MODES AMDAR | MODES AMDAR | MODES AMDAR |
| AMVs | SEVIRI-HR | SEVIRI-HR | SEVIRI(FCI tested) |
| Bufr temp | YES | YES | YES |
| W-PROFILER<br>CEILOMETER<br>TOWERS<br>SODAR | NO<br>YES<br>NO<br>NO | YES<br>YES<br>YES<br>YES | NO<br>YES<br>YES<br>NO |
| satellite radiances | none | SEVIRI/IASI/ATMS/ MHS/AMSU-A | FCI allsky in prep. |
| RADAR | NO | REF+DOW+LHN | REF/ direct REF in prep. |
| GNSS-RO | NO | YES | NO |
| SCATTEROMETER | ASCAT | ASCAT | ASCAT |

*Table 2: Observation usage: Beside transfer from RUC to C-LAEF AA*



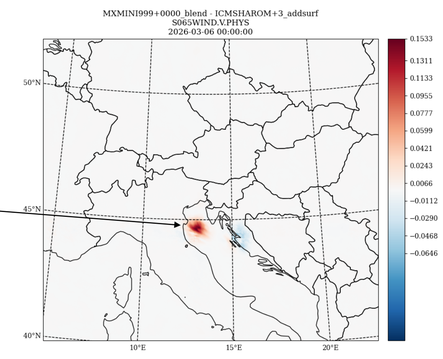




*Fig.2: Test of MTG-FCI AMV product from EUMETSAT in C-LAEF AlpeAdria: V-Increments on model level 65 and increment profile.*

Assimilation of MTG-FCI based EUMETSAT L2 atmospheric motion vector product (5 channels; bufr) was tested within C-LAEF AlpeAdria (cy48t3 OOPS) and in AROME-RUC (cy43t2 MASTERODB). Technically it is rather straight forward: bufr file has to be added in BATOR to geowind base (obstype 3) and namelist adapted for satellite number 71 (MTG) and blacklist in screening needs to allow satellite 71 to pass trough. Data density is similar to SEVIRI-HR product from NWC-SAF. There is also a NWC-SAF MTG-HR product which was not tested yet with 2.5x as many winds. See slide at last ACCORD WW for namelist adaptations on ACCORD Wiki.

## 3. Reflectivity assimilation

3DEnVar allows direct assimilation of reflectivities into the model (M. Martet et al. 2025) as the control variable can be extended to hydrometeors and thereby the reflectivity incrementally adapted avoiding the 1D-3D Bayes approach (Wattrelot et al. 2014) currently used. This scheme was successfully tested within C-LAEF AlpeAdria 3D-EnVar member in cy48t3bf3+modset. We hope to get it into operations later after some more systematic validation. The costs of minimization increase significantly with extended control variable. The definition of hydrometeor correlations in the case no hydrometeors are in the EPS used for EnVar is still an open question for further investigations.

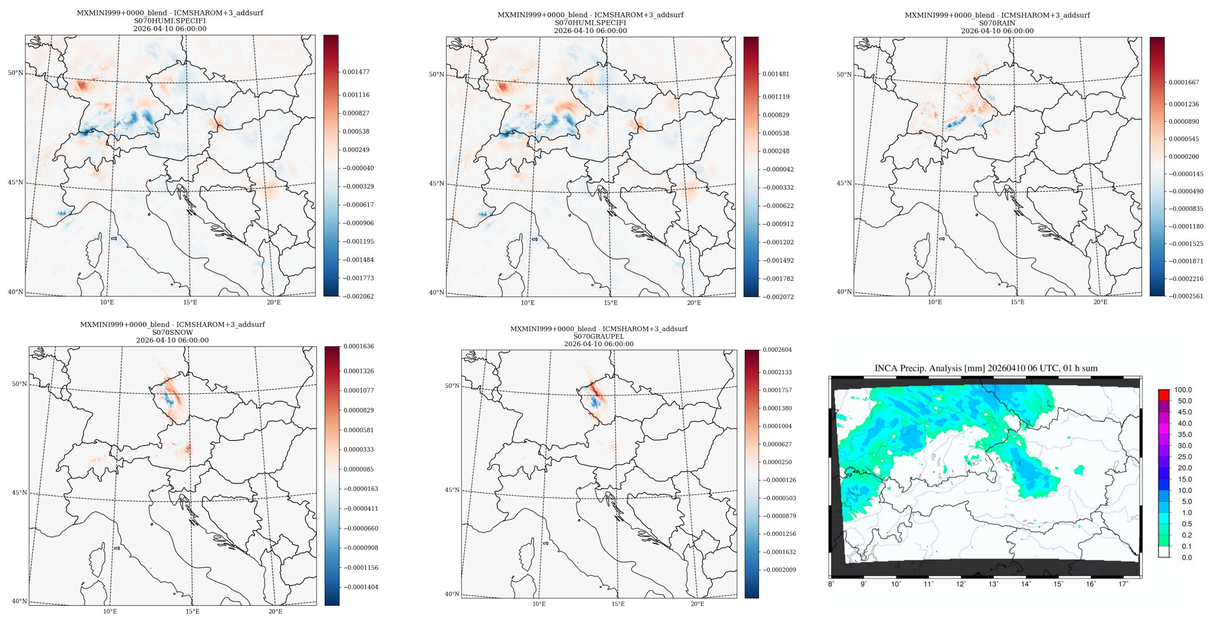



*Fig.3: Increments at 10th February 2026 06UTC on model level 70 (about 940hPa/500m AGL): Q in EnVar with RADAR 1D+3D Bayes approach (top left), Q in direct REF assimilation(top middle), and from same run for rain, snow, graupel and 1h INCA rain bottom right. Q increments are similar, Bayes approach does not provide any hydrometeor update. Cloud ice increments are very small in this low level and only relevant over the Alps, cloud water is not part of the control variable.*

## 4. Land Sea Mask (LSM) mismatch

There is a mismatch between SURFEX tile fractions and atmospheric LSM. This can lead to rather low SSTs under special circumstances (MPI settings) in OIMAIN in cy46t1.

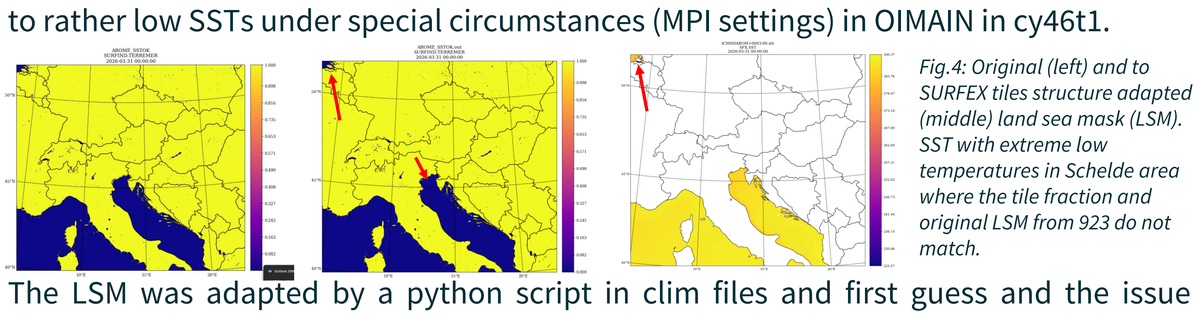



*Fig.4: Original (left) and to SURFEX tiles structure adapted (middle) land sea mask (LSM). SST with extreme low temperatures in Schelde area where the tile fraction and original LSM from 923 do not match.*

The LSM was adapted by a python script in clim files and first guess and the issue disappeared. Another strange SST pattern where low land temperatures ended up as SST values could be avoided by a bugfix in oi_control.F90

## 5. Modified 2m SYNOP usage in AROME

Using T2m and RH2m in 3D-Var (and even EnVar) can lead under stable conditions to unrealistic increments spreading rather high and thereby creating unrealistic cloud patterns in the stratus layer (see our Poster from 2022). Therefore, we do not use them in our operations during nighttime (LSOE switch in screening). However, information on humidity in the PBL is limited then as not many other observations (few radio soundings/aircraft) exist and low levels cannot be easily observed by satellite or RADAR (no signal for stratus). Two approaches were tested to cope with that:
Instead of blacklisting the observation error of 2m observations could be inflated at nighttime (obs_preproc/addoer.F90). 2. and/or vertical localisation in EnVar can be setup such that near surface increments don't spread up higher up above PBL (elocalization_setup_mod.F90 set vertical localisation to default in PBL and free atmosphere (0.3 for us), but only 5% when crossing the boundary set to a low model level.

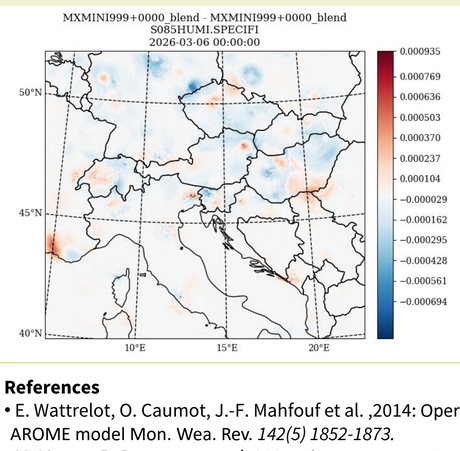



*Fig.5: Difference in low level Q due to the usage of error inflated (1%/10%) SYNOP RH2m/T2m and with very sharp vertical localization between levels below and above model level 80 (about 200m above ground). We see drying where stratus was much to intense and widespread around Vienna on that day. However, it does still not improve much cloud forecast later. The sharp vertical localisation might also affect correct spreading of ZTD increments in that case.*

**References**

- E. Wattrelot, O. Caumot, J.-F. Mahfouf et al. ,2014: Operational implementation of the 1D+3D-Var assimilation method of radar reflectivity data in the AROME model Mon. Wea. Rev. *142(5) 1852-1873.*
- M. Martet, B. Brousseau et al. 2025: The new Arome-France E-suite : data assimilation aspects and general performances presentation at ACCORD ASW Zalakaros, Hungary

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