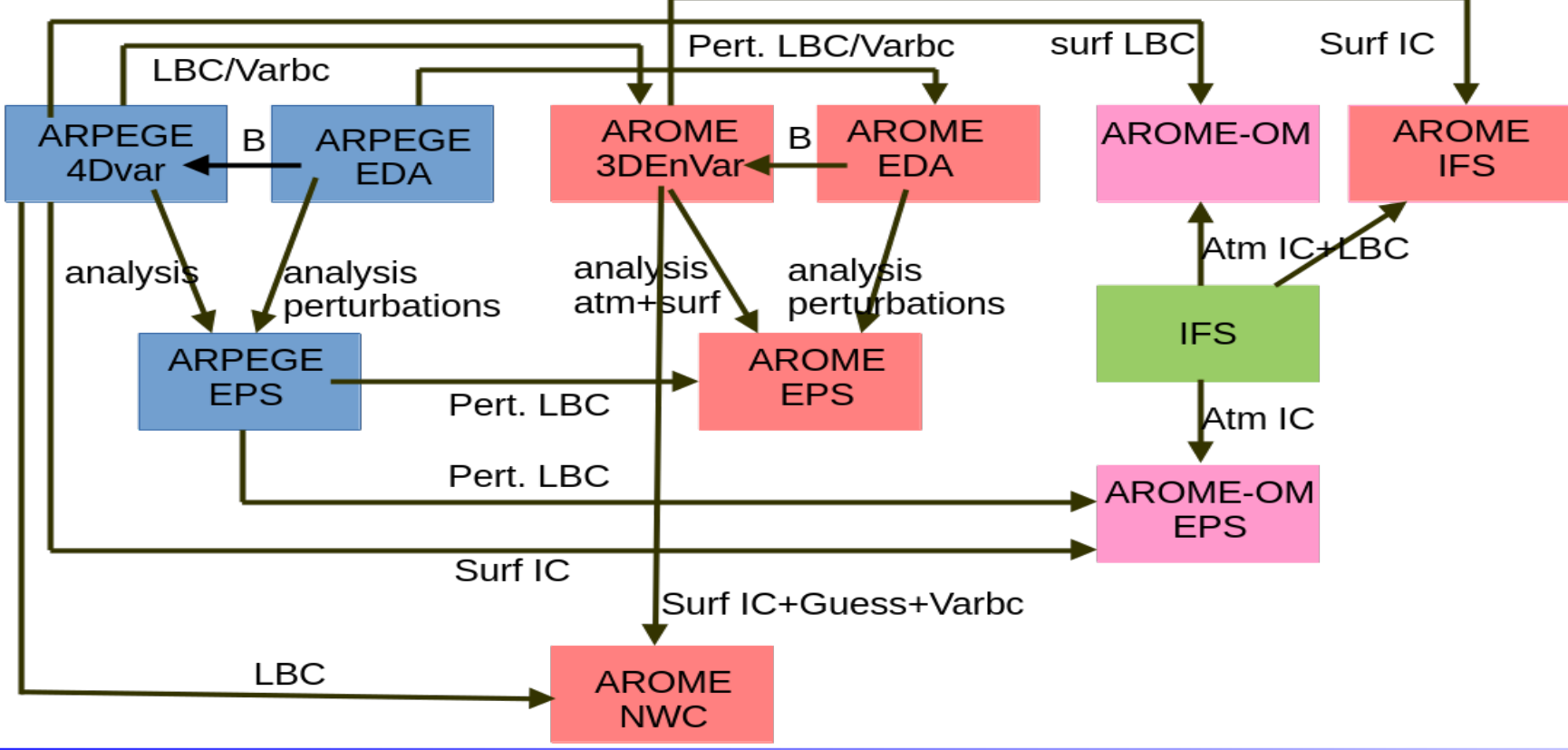


# Overview of Météo-France NWP systems

## Operational NWP systems



## 2 HPC, 2 implementations

In operations since February 2021



No upgrade during the 6 year contract

Each HPC: ATOS BULL Sequana XH2000  
2292 computing nodes

2 AMD Epyc Rome processors  
with 64 cores at 2.25 Ghz  
10.39 PFlops  
peak performance

Migration to next HPC is planned in 2027

## Global operational NWP systems based on ARPEGE

operational suite: cy48t1\_op1 (since mid october 2024)

### ARPEGE (determinist)

- Hybrid 4DVar (OOPS) with 6hr cycle : TI224 c1 & TI499 c1
- Hybrid flow-dependent B matrix from ARPEGE-EDA
- Observations**: "all sky" assimilation of microwave obs (MHS, MWHS2, GMI, AMSR2), ATMS from NOAA-21, ABI from GOES-17, update of R matrix for IASI, GNSS-RO (GRACE-C, Sentinel-6, Spire), WIGOS adaptations
- Physics**: EcRad (McIca solver) radiation scheme, microphysics tunings, Surfex v8.1, use of SST from Mercator-Ocean GLO12, solar eclipse
- Dynamics**: use of WENO interpolations for T and Q in stratosphere
- 4 forecasts per day

### Common features (except otherwise noted)

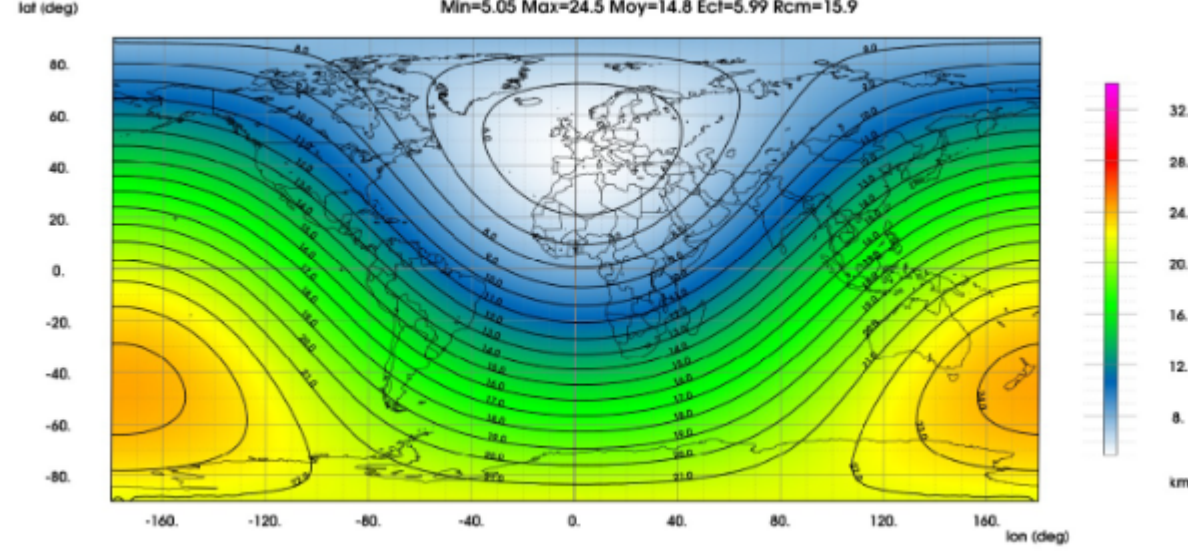
- TI1798 c2.2 (5 to 24 km)
- 240 s timestep
- 105 levels (10 m to 0.1 hPa)
- 102 hr forecast lead time

### ARPEGE-EDA

- TI499 c1 / 600 s timestep
- 4DVar (OOPS) with 6hr cycle (TI224 c1)
- 50 members
- recentering on the control member

### ARPEGE-EPS

- 34 perturbed members + control
- 4 forecasts per day
- Initial perturbations from ARPEGE-EDA+SV
- random perturbed parameters + TKE, GWD, 2 convection schemes, microphysics, oceanic fluxes, solar radiation

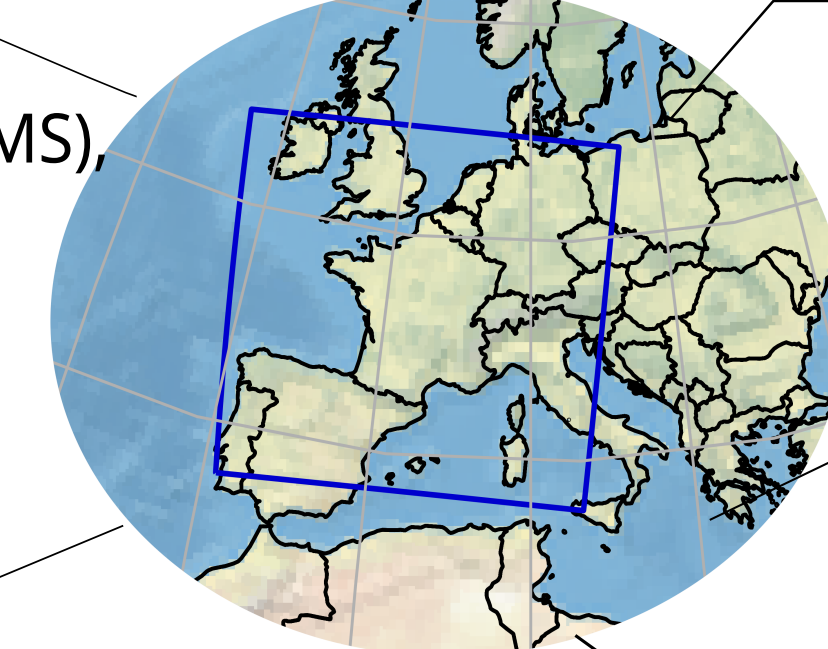


## Regional operational NWP systems based on AROME

operational suite: cy48t1\_op1 (since mid october 2024)

### AROME-France (determinist)

- 3DVar (OOPS) with 1h cycle +IAU
- EcRad+aerosol/ozone climatologies (CAM5), Surfex v8.1, SST Mercator-Ocean Glo12
- scatterometers HY-2B & HY-2C, Mode-S from EMADDC, GNSS-RO (GRACE-C, Sentinel-6, Spire), ATMS from NOAA-21, MWHS2 from FY3-E, WIGOS adaptations
- 8 forecasts per day



### AROME-EDA

- 3.25 km, 100 s timestep
- 3DVar (OOPS) with 3h cycle
- 50 members

### AROME-IFS

- downscaling of IFS
- Arôme surface
- 4 forecasts per day

### AROME-NWC (Nowcasting)

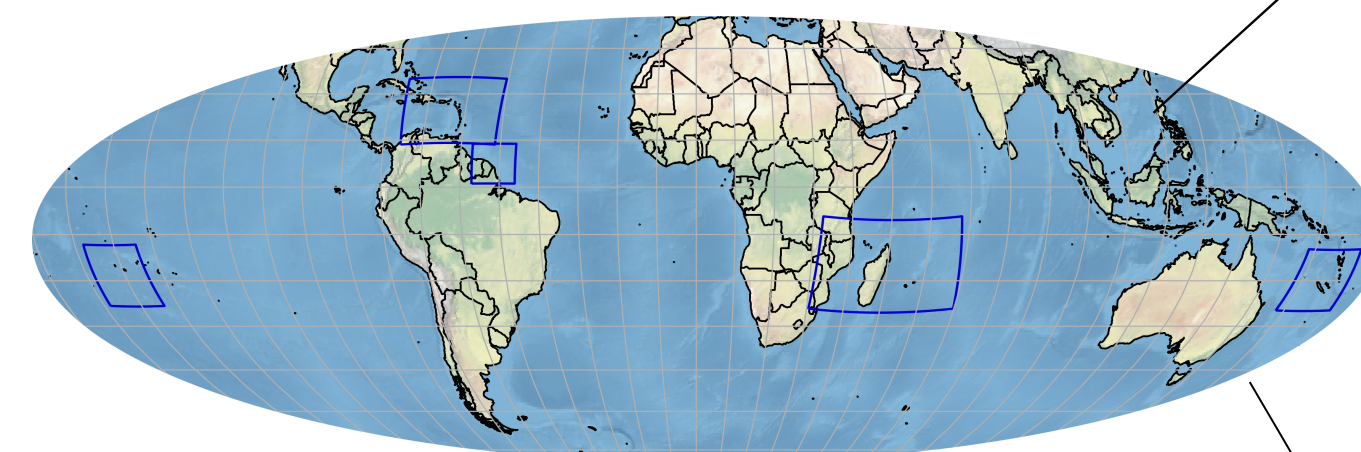
- 3DVar, guess from 3dvarfr, 10' cut-off
- 24 forecasts per day (+6hr)

### Common features (except otherwise noted)

- 1.3 km, 50s timestep
- 90 levels (5m to 10 hPa)
- 51 forecast lead time
- uncycled forecasts in single precision

### AROME-EPS

- 25 perturbed members + control
- 4 forecasts per day (+ 51hr)
- Initial perturbations from AROME-EDA
- SPPT
- LBCs from ARPEGE-EPS
- random surface perturbations

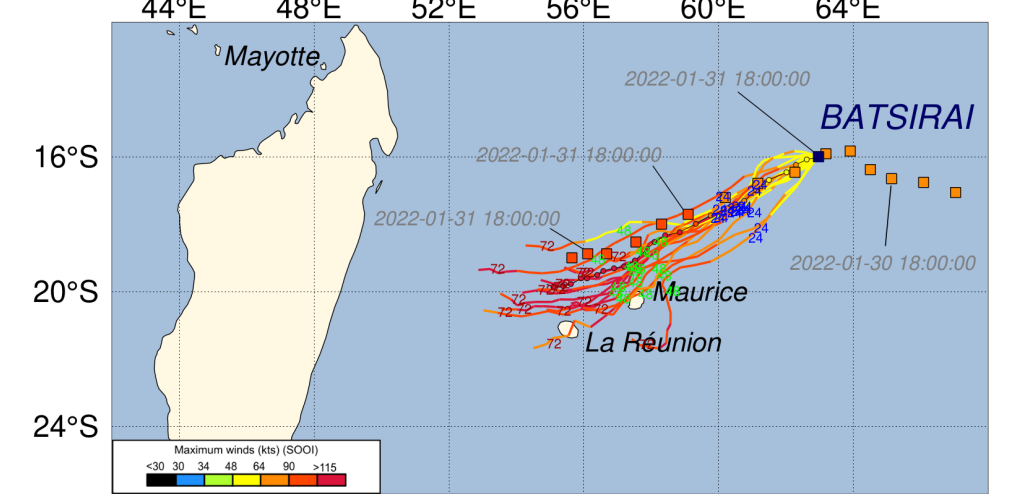


### AROME-Overseas (AROME-OM)

- 5 domains, use of mixed precision
- 4 forecasts per day (+78hr on demand)
- Downscaling of IFS with prior "warmup"
- Use of Arpege surface (continent)
- 1D ocean model

### EPS AROME-Overseas (AROME-OM-EPS)

- 15+1 members at 2.5 km, mixed precision, hydrostatic, SPPT
- 5 domains, 2 runs per day (+78hr on demand)
- Use of IFS as unperturbed initial conditions
- Boundary conditions + initial perturbations : ARPEGE-EPS
- Perturbation of surface + ocean layers



## Next e-suite for Global NWP systems in cy49t1\_op1

e-suite in may 2025, swich in operation in autumn 2026

### Observations

- surface winds from Scattermeters on board HY-2D and Oceansat3
- review of AMV assimilation with new adjustments and new observations (winds from MetOp low-orbiting moving satellites)
- EMADDC Mode-S data

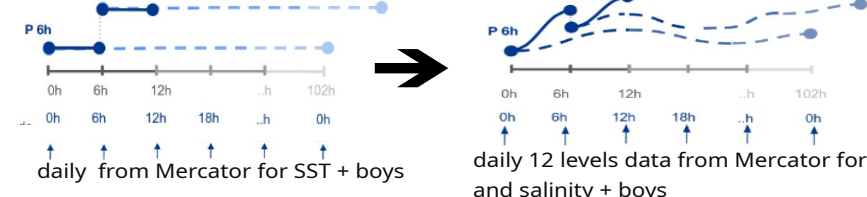
wind data impacting surface to upper air analyses

- CrIs FSR, GOES-18/ABI, FY-3E/MWTS-3 (monitoring) → new T and Hu profiles
- satellite snow cover IMS data → first satellite data for surface analyse



evaluation in progress  
launch 2025-07 and 2025-08

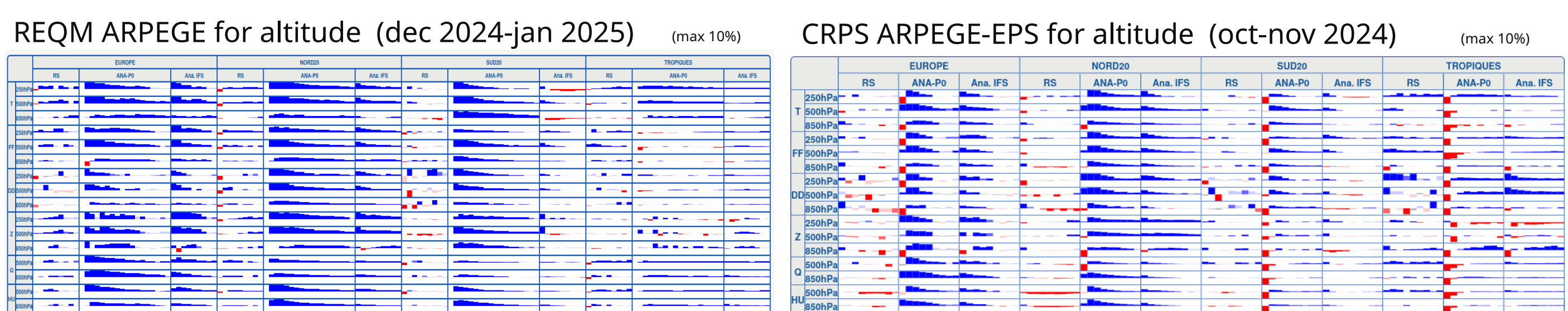
**Physics**: Ocean Mixing Layer (1D model) to enable SST to evolve



**ARPEGE-EDA**: random perturbations applied to model parameters ; representation of hydrometeor uncertainties in allsky microwave observations → improved EDA perturbations & covariances

**ARPEGE-EPS**: perturbation of initial surface states singular vectors removed

All uncycled ARPEGE forecasts and ARPEGE-EPS forecasts run using single precision (in test)



## Next e-suite for Regional NWP systems in cy49t1\_op1

e-suite in autumn 2025, swich in operation in autums 2026

**Assimilation**: 4DVar+SDL (AROME), 3DVar +SDL (AROME-EDA)

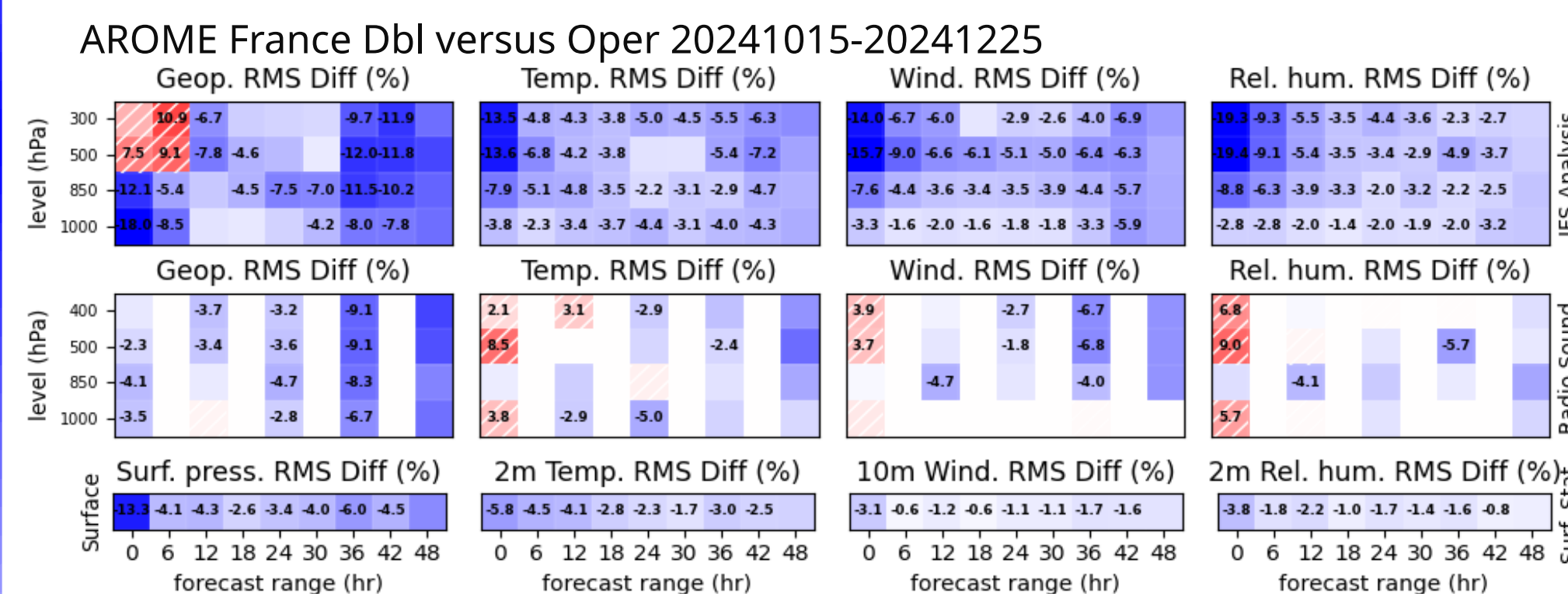
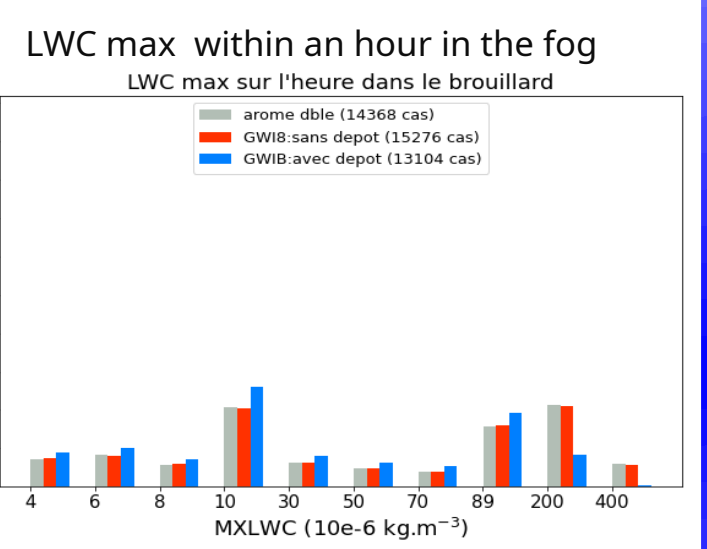
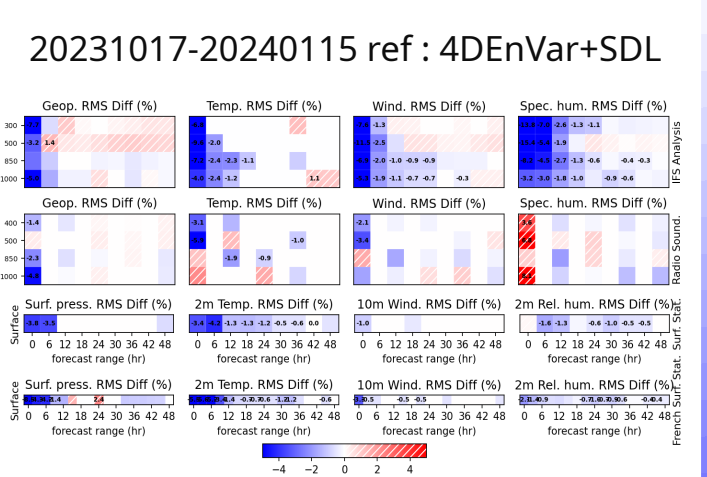
### Observations

Mode-S from EMADDC with new white list and adapting weighting

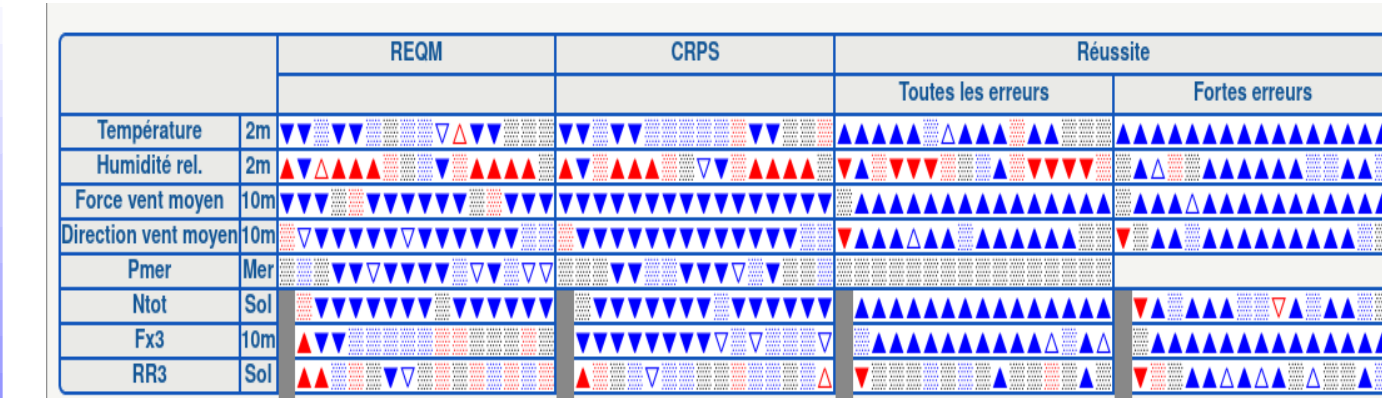
direct assimilation of ground-based radar reflectivities →

- surface winds from Scattermeters on board HY-2D
- review of AMV assimilation with new adjustments and new observations (winds from MetOp low-orbiting moving satellites)

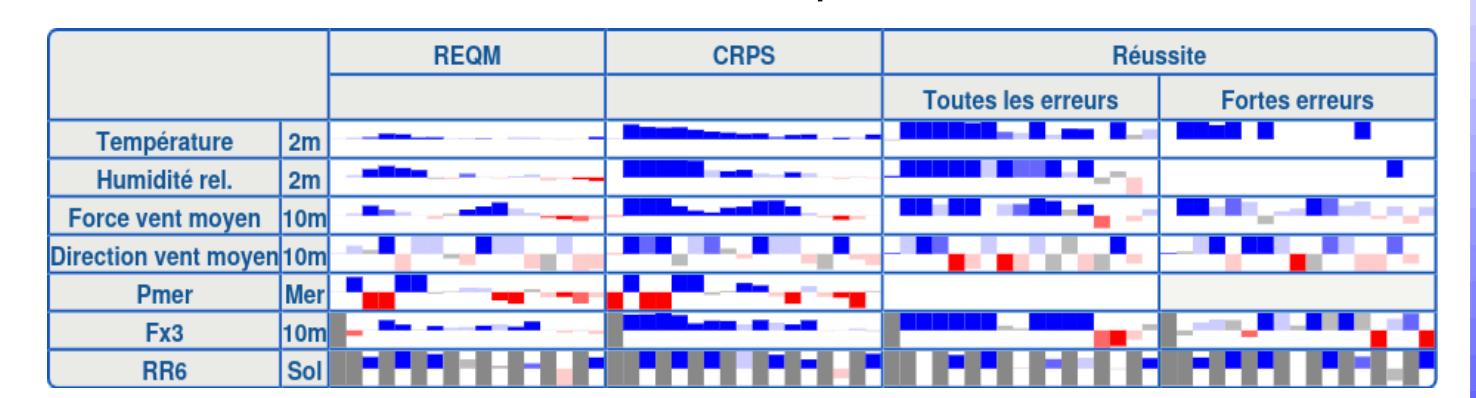
**Physics**: account taken of the deposit to reduce overestimation of cloud water content in fog



AROME-EPS Dbl versus Oper 58 days winter 2024

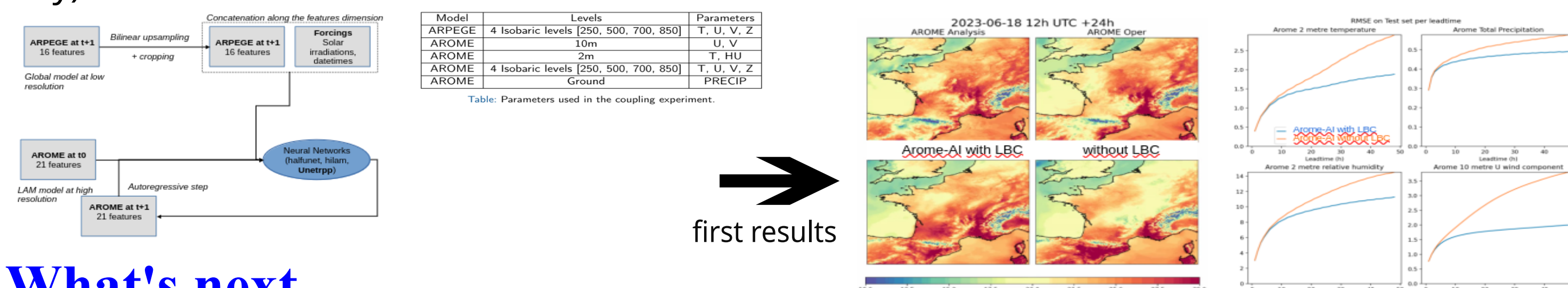


AROME-OM-EPS Dbl versus Oper 01-31 march 2024



## Towards an AROME-AI model

- Météo-France has developed the py4cast framework for the training of deep learning models
- 1st prototype of AROME-AI (2.5km, 1hr timestep): trained in py4cast using 2 years of oper AROME analyses as training data and ARPEGE analyses/forecasts as forcing data (in LBC exp only)

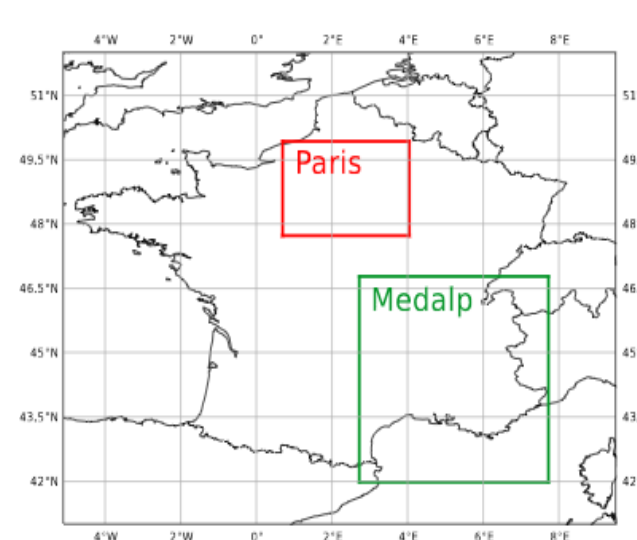


## What's next

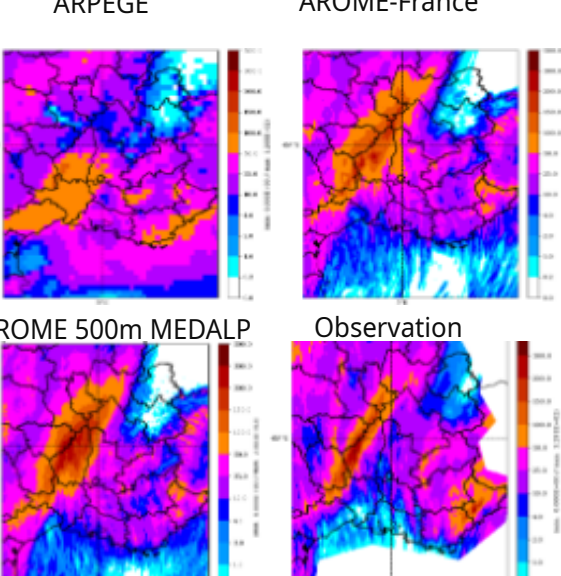
- Moving to Anemoi to develop an operational stretched-grid approach (~Bris model of Met Norway)
- Several training datasets to be considered
  - Operational AROME archive (~ 4 years)
  - ERA5-AROME : a dynamical downscaling of ERA5 with AROME (1959-2023 available mid-2025)
  - ARRA : an AROME analysis (1970-2020 available end-2025)
- And also : probabilistic emulator, statistical downscaling

## AROME@500m 2 domains

- Downscaling of Arome at 00utc
- 120 vertical levels, 20s timestep
- SRTM30 orography database, Ecoclimap-SG300m, Soilgrid250m,
- numerical diffusion of temperature
- +36h over PARIS/+24h over MEDALP



2024-11-17 daily cumulative rainfall



## Collaborative work of DESR/CNRM/GMAP

contact cecile.loo@meteo.fr

5th ACCORD All Staff Workshop  
31 March-4 April 2024, Zalakaros

