

Overview of Météo-France 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

Global operational NWP systems based on ARPEGE

operational suite: cy46t1_op1

4DVar

- 4DVar with 6h cycle : TI224 c1 & TI499 c1
- Use of EDA background covariances (12h average)
- 4 forecasts per day
- New: Tiedtke deep convection scheme, 1d sea-ice model, SRTM, All-sky assimilation of microwave data from MHS and ATMS

EPS (PEARP)

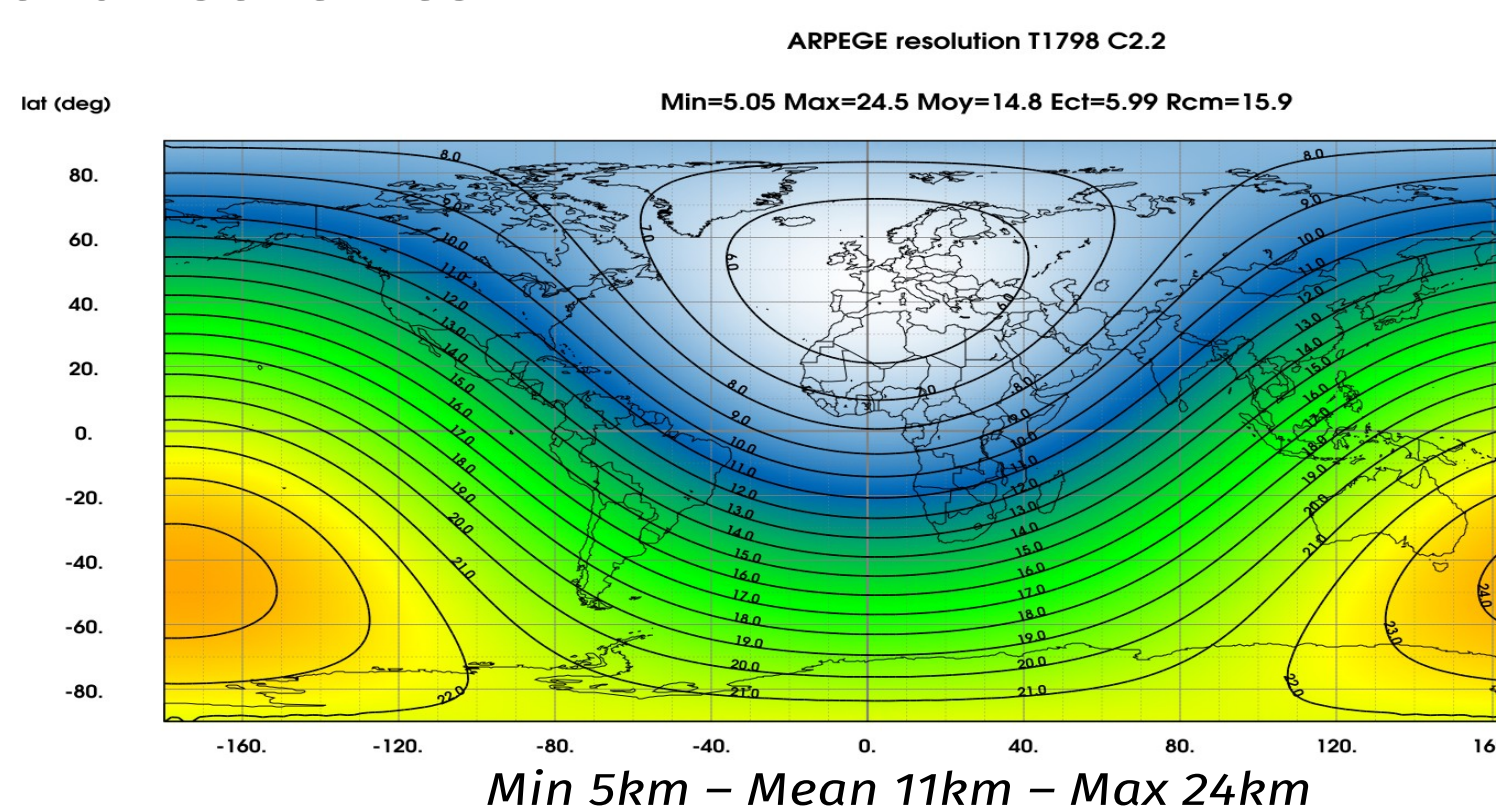
- 34 perturbed members + control
- 4 forecasts per day
- Initial perturbations from Arpege-EDA + SV
- random perturbed parameters + 2 deep convection schemes

EDA (AEARP)

- TI499 c1
- 4DVar with 6h cycle (TI224 c1)
- 50 members

Common features

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



References
 • Descamps et al 2015, PEARP, the Météo-France short-range ensemble prediction system. Q.J.R. Meteorol. Soc., 141: 1671-1685
 • Bouysselet et al, 2022, The 2020 Global Operational NWP Data Assimilation System at Météo-France, Data Assimilation for Atmospheric, Oceanic and Hydrologic Applications (Vol. IV)

Regional operational NWP systems based on AROME

operational suite: cy46t1_op1

3DVar

- 3DVar with 1h cycle
- 8 forecasts per day

EDA (AE-Arome)

- 3.25 km, 100 s timestep
- 3DVar with 3h cycle
- 25 members

Nowcasting (Arome-PI)

- 3DVar, guess from 3dvarfr, 10' cut-off
- 24 forecasts per day up to 6h

EPS (PE-Arome)

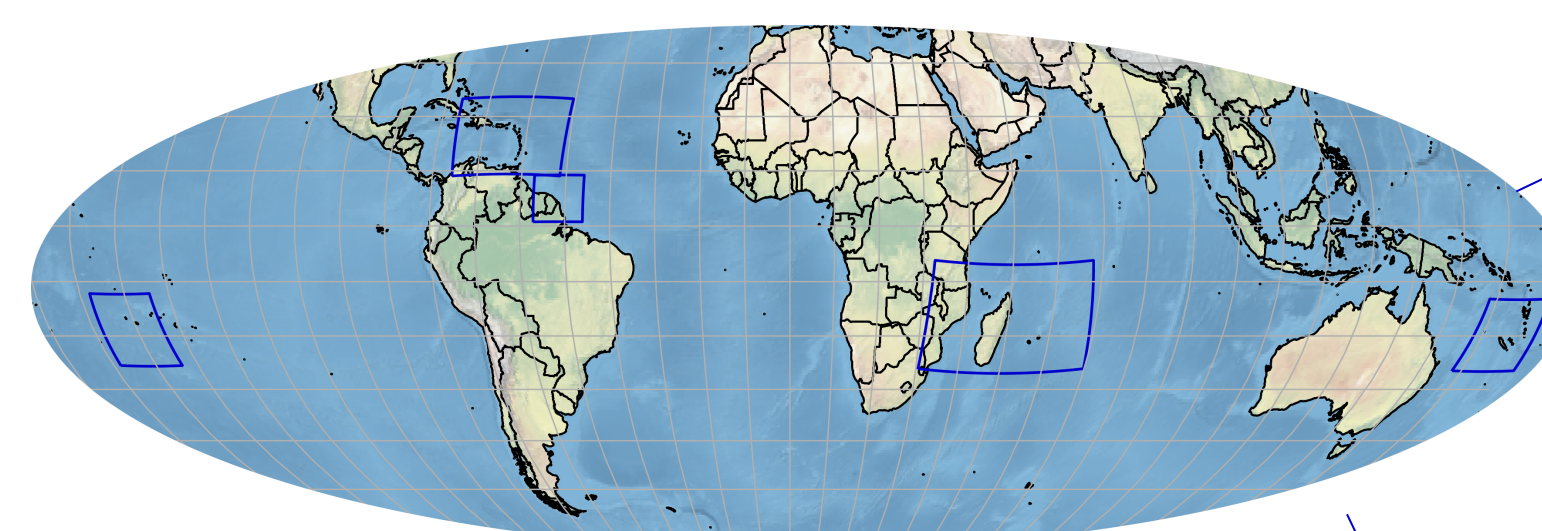
- 16 perturbed members + control
- 4 forecasts per day (+ 51h)
- Initial perturbations from Arome-EDA
- SPPT
- LBCs from Arpege-EPS
- random surface perturbations

Arome-IFS

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

Common features

- (except otherwise noted)
- 1.3 km, 50 s timestep
 - 90 levels (5m to 10 hPa)
 - 51 h forecast lead time



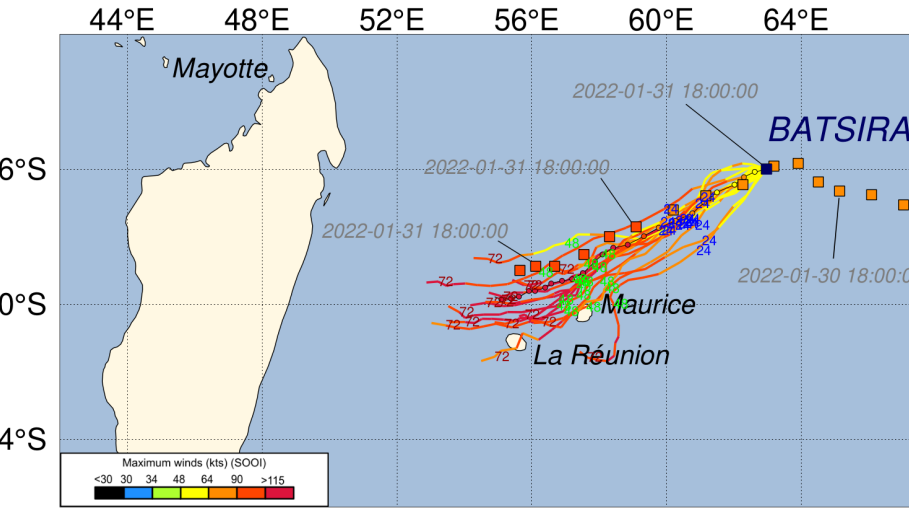
Arome-Overseas (Arome-OM)

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

EPS Arome-Overseas (PE-Arome-OM)

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

NEW!



References
 • Brousseau et al 2016, Improvement of the forecast of convective activity from the AROME-France system. Q.J.R. Meteorol. Soc., 142: 2231-2243
 • L. Raynaud et F. Bouttier, 2016: Comparison of initial perturbation methods for ensemble prediction at convective scale. Q. J. R. Meteorol. Soc.
 • Bouttier et al. 2016 Sensitivity of the AROME ensemble to initial and surface perturbations during HyMeX. Q. J. R. Meteorol. Soc.
 • Merlet et al, 2017: Arome for nowcasting, Aladin-Hirlam Newsletter n°9
 • Faure et al, 2020: Operational Implementation of the AROME Model in the Tropics, Weather and Forecasting, 35(2), 691-710

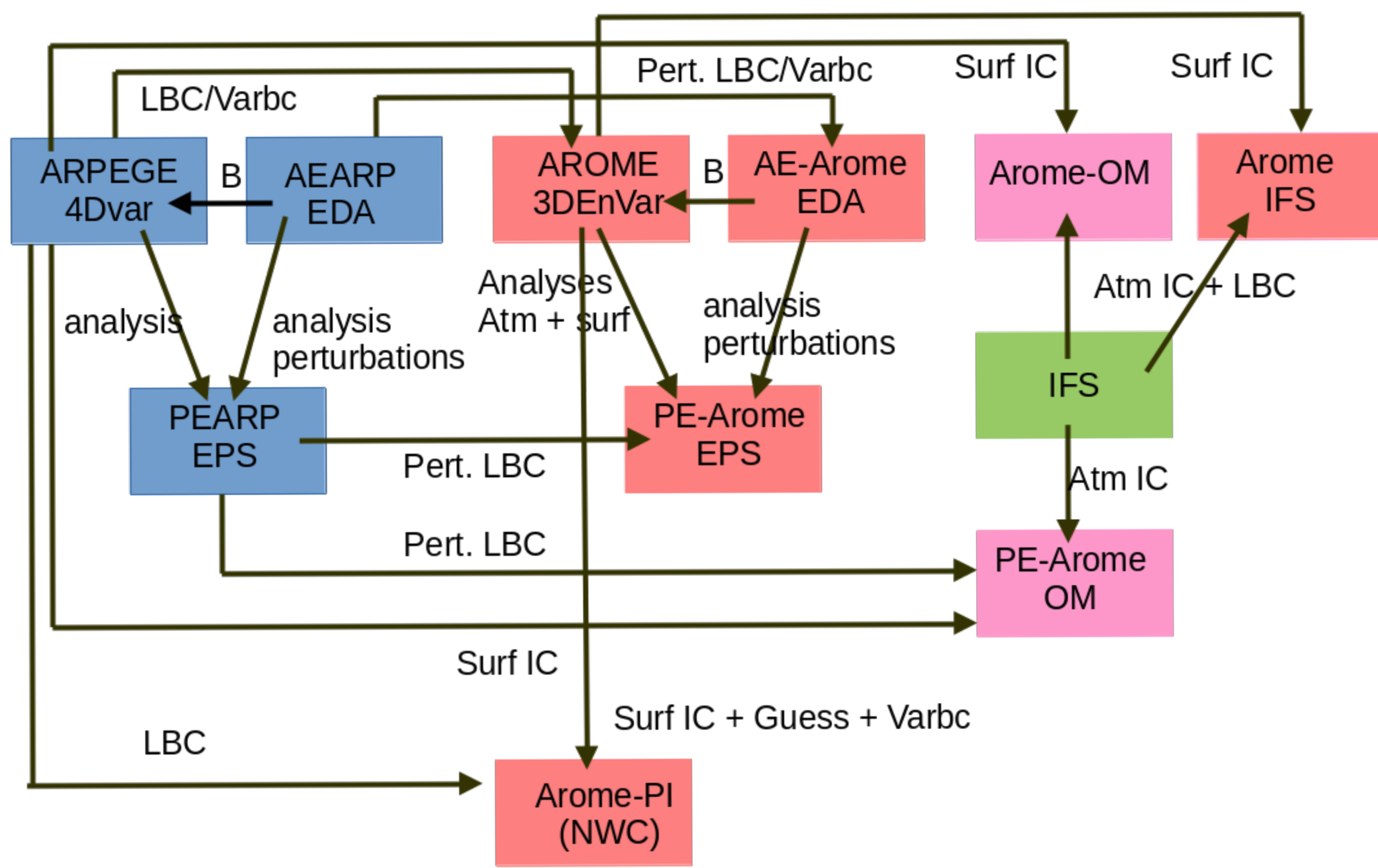
Switch to operations by the end of 2024

- 2 domains for Arome applications @500 m in near real time (2023) then in operations (end 2024)

Next e-suite: cy48t1_op1

- OOPS in 3DVar and 4DVar analyses
- Assimilation: 3DEnVAR Arome, hybrid B matrix in Arpege 4Dvar
- Arome EDA: 50 members (instead of 25 currently)
- Physics: EcRad (Arome), use of SST from Mercator-Océan global model and enhancement of Tiedtke deep convection scheme (both for Arpege), change of aerosol and ozone climatologies (from CAMS, Arome)
- Dynamics : use of WENO interpolations for T and Q in stratosphere (Arpege)
- Observations: "all sky" assimilation of microwave obs, Arpege: GOES-17, CrIS mode «FSR», GNSS-RO (GRACE-C, Sentinel-6, Spire), scatterometers HY-2B & HY-2C(Arome), AMV HIMAWARI/AHI, Mode-S from EMADDC (Arome), WIGOS adaptations
- PEARP: revision of singular vectors and of the range of perturbed parameters
- All uncycled Arome forecasts will be run using single precision

Dependencies between NWP systems



Further perspectives 2025-2026

e-suite: cy49t1_op1 (modifications to be confirmed)

- Assimilation: 4DEnVar+SDL (Arome), perturbations of physic's parametrisations with Random Parameter Method (AEARP)
- Arome EDA: 3DEnVar +SDL
- Physics: tunings of Tiedtke deep convection scheme and clouds/radiation interactions, Ocean Mixing Layer (Arpege),
- Dynamics : finding the origin of the most efficient SL trajectory
- Observations: - Arpege : satellite snow cover data, GOES-18 ABI, TROPICS, Mode-S from EMADDC
 - Arpege and Arome : "all sky" assimilation of AMSU-A , GNSS-RO (PlanetIQ), Scatterometers HY-2D
 - Arome : direct assimilation of ground-based radar reflectivity, monitoring of MTG/LI
- PEARP: adaptation to AEARP modifications, Ocean Mixing Layer
- PEARO: random perturbations of parameters in physical parametrisations
- All uncycled Arpege forecasts and PEARP forecasts will be run using single precision