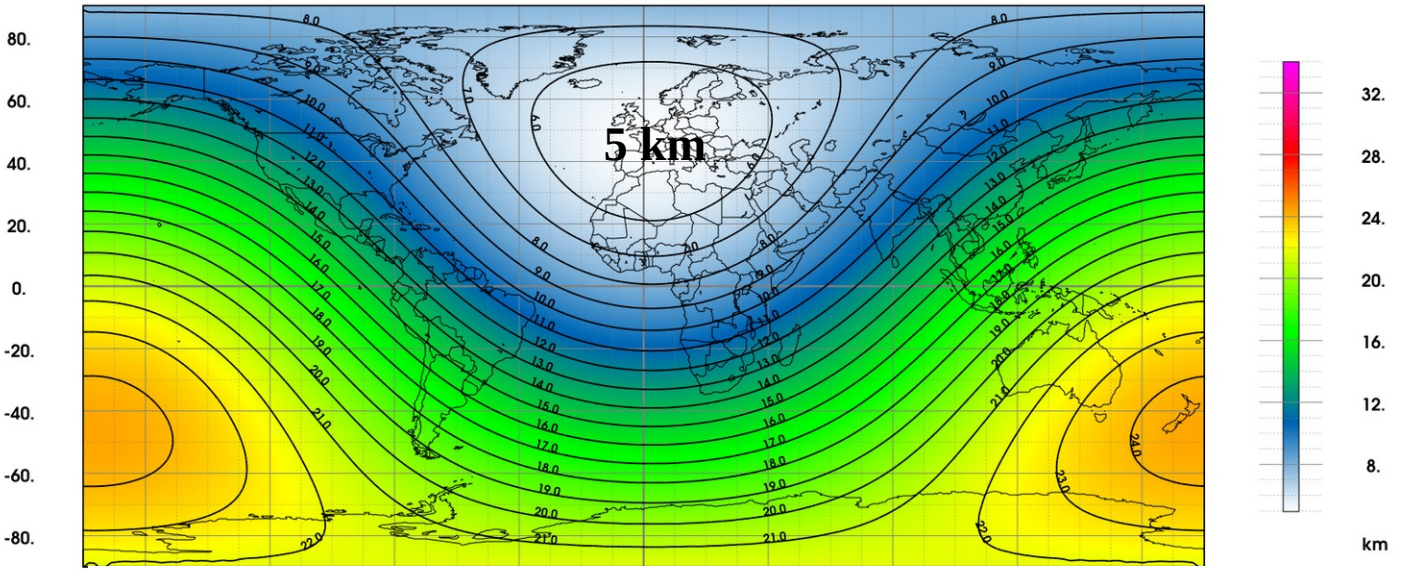
Progress and plans for NWP at Météo-France

Météo-France/DESR/CNRM

*11*th ACCORD Assembly, Brussels, 1/2 December 2025

49T1 current e-suite : evolutions in global NWP systems based on ARPEGE

Systems	Characteristics
ARPEGE *Deterministic*	Tl1798c2.2 L105 (5km on W Europe) 4DVar (6h cycle): Tl224c1L105 & Tl499c1L105 5 forecasts per day up to 114h
ARPEGE-EDA (AEARP)	Tl499c1 L105 ; 50 members 4D-Var (6h cycle): Tl224c1 L105 Background covariances averaged on 12h and updated every 6h
ARPEGE-EPS (PEARP)	Tl1798c2.2 L90 (5km on W Europe) ; 34+1 members ; 4x102h 35 EDA members and singular vectors Perturbed parameters, 2 convection schemes

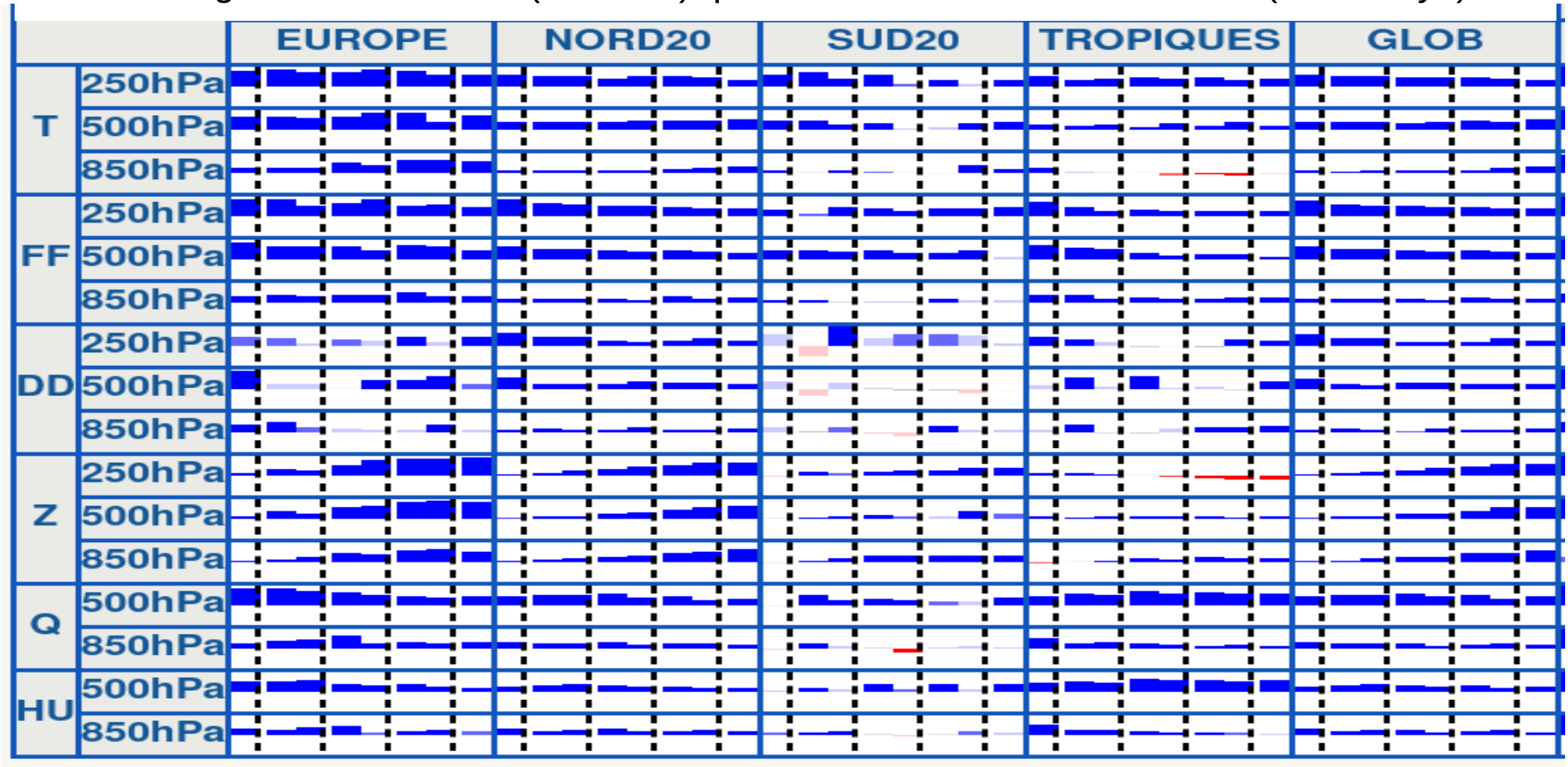


ARPEGE & EPS horizontal resolution : 5 km < Dx < 24 km

- **Better representation of model error in ARPEGE-EDA** (perturbations in physics and obs operator) and in **ARPEGE-EPS** (removal of singular vectors, perturbed surface conditions)
- **Oceanic mixing layer scheme**
- **New observations:** Mode-S aircraft data, new CrIs channels, GOES-18/ABI imager, OceanSAT3, FY-3E/MWTS-3
- **Assimilation of IMS snow cover product**
- Mixed precision in forecasts (~35% calculation gain)
- New diagnostics

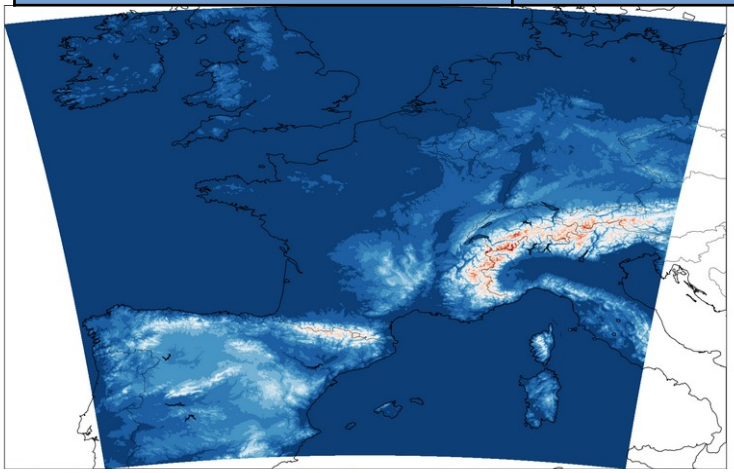
49T1 e-suite: ARPEGE scores

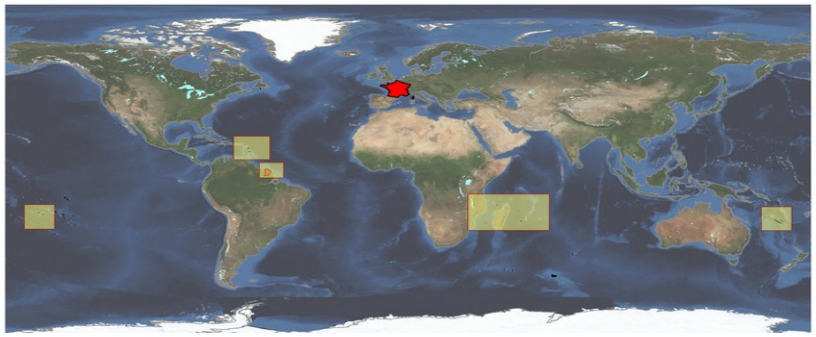
RMSE against radiosonde (max 5%): period 01/09/2024 – 24/11/2025 (~450 days)



49T1 current e-suite : evolutions in regional NWP systems based on AROME

Systems	Characteristics
AROME-France	1.3km L90 (from 5m to 10hPa) - 3DEnVar (1h cycle) - 8 forecasts per day up to 51h
AROME-Nowcasting	1.3km L90 - 3DVar (no cycling – 10' cut-off) - 24 forecasts per day up to 6h
AROME-IFS	1.3km L90– Dynamical adapt of IFS (altitude) and Arome-Fr (surface) - 4 forecasts per day up to 51h
AROME-EPS (PEARO)	1.3km L90 - 24+1 members - 4x per day up to 51h - IC from AROME-EDA and LC from PEARP
AROME-EDA (AEARO)	3.25km L90 - 50 members - 3DVar (3h cycle)
5 AROME Overseas	1.3km L90 – Dynamical adaptation of IFS (altitude) and Arpege (surface) - 4 forecasts per day up to 51h
5 AROME-EPS Overseas	2.5km L90 – 15 members - Same IC AROME Overseas - LC from PEARP - 2x per day up to 51h
AROME Assistances Commer	2.5km L90 – several domains - Dynamical adaptation Arpege

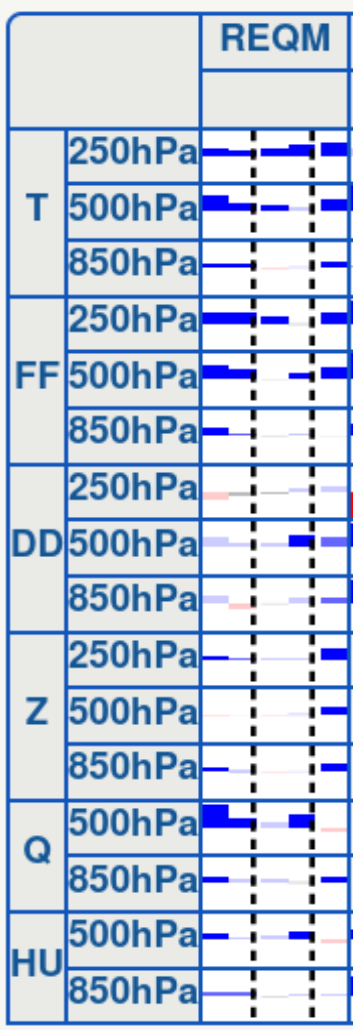




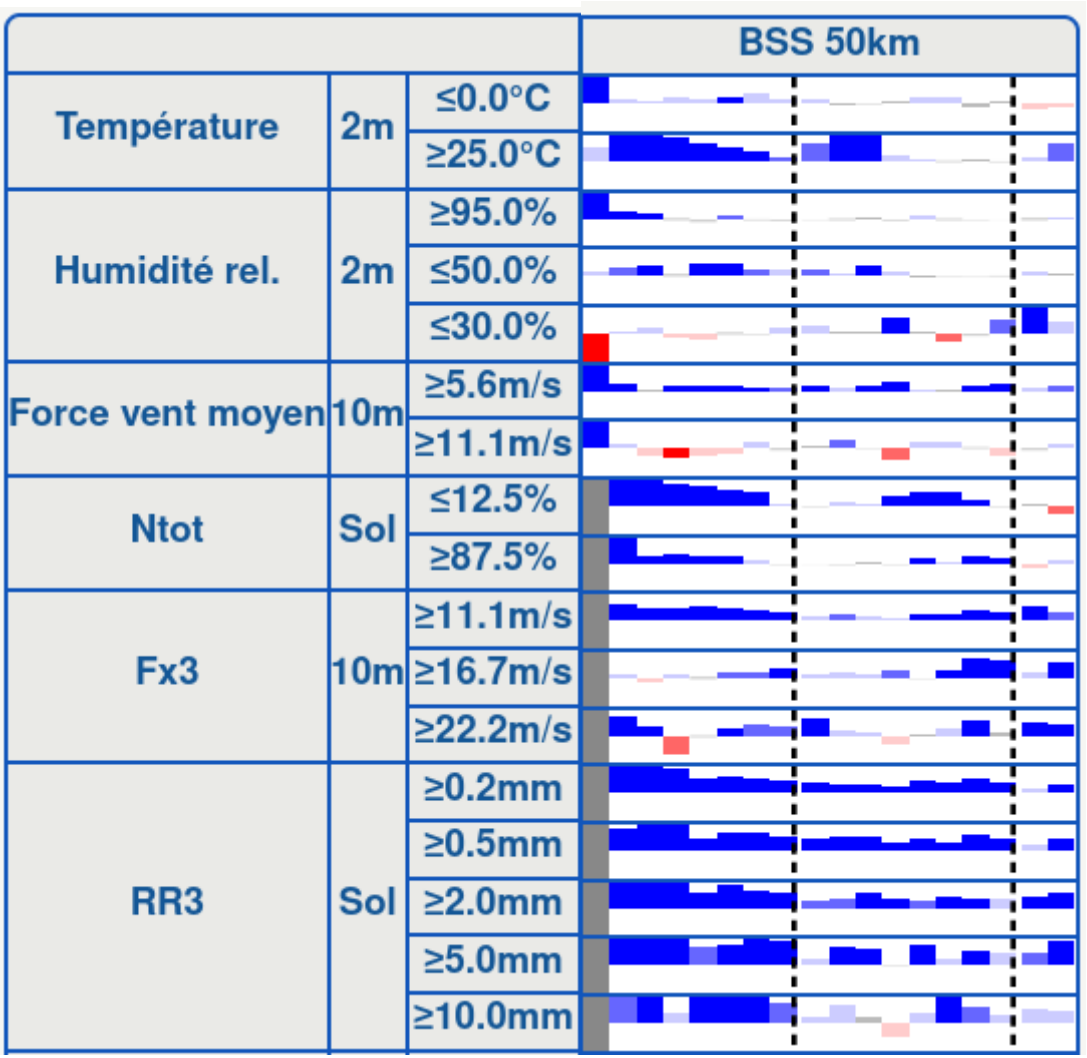
- 4D Ensemble variational scheme **« 4DEnVar » in AROME** with « scale-dependant localization »
- 3D Ensemble variational scheme **« 3DEnVar » in AROME-EDA**
- **Direct assimilation of radar reflectivities with hydrometeors in the control variable**
- **Arome-EPS: Improved representation of model error**
- New diagnostics

49T1 e-suite: AROME scores

Upperair scores against radiosonde
RMSE (max 10%)
~450 days

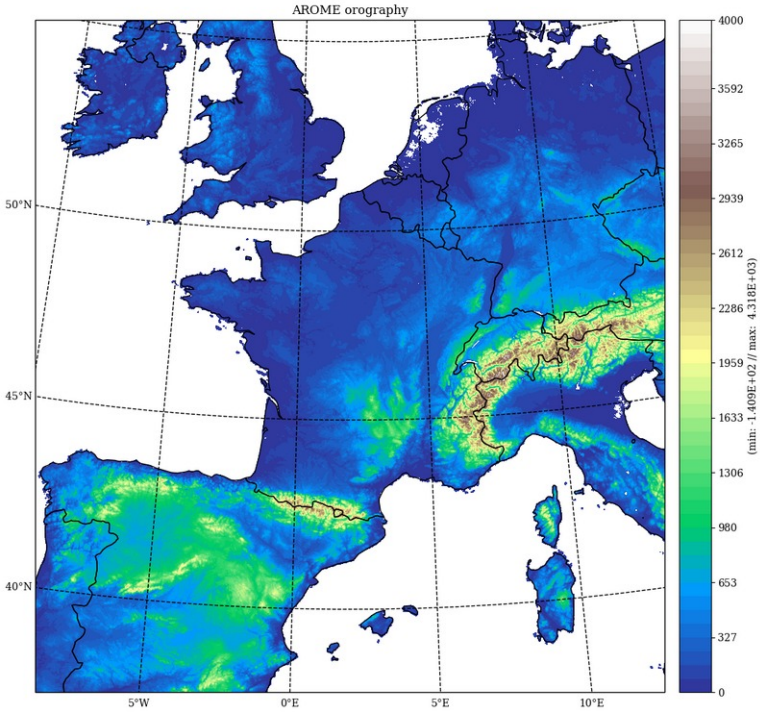


Surface scores
BSS (max 10%)
01/09/2024 – 24/11/2025 (~450 days)

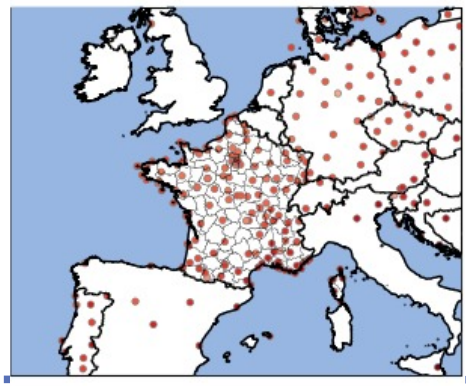


ARRA = Arome ReAnalysis

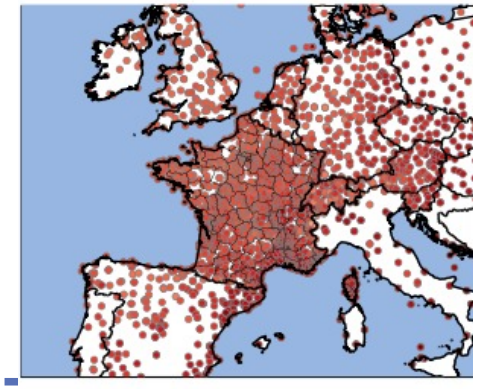
- Based on AROME-France configuration (cy48t1op1) : 1.3km, L90, same domain, same post-processing, should cover at least 1971 - 2020
- Specific changes :
  - Dynamical adaptation with surface assimilation every 3h, with IAU (Incremental Analysis Update)
  - Use annual aerosols based on CAMS and TACTIC (P. Nabat) instead of a 30-year climatology
  - LBC and IC for the upper air : UERRA 1961 - 1985 and CERRA after
  - Lake module (Flake), Solar eclipse extended to the past
- ARRA-Land : SURFEX-offline @ 1.3km with advanced soil and snow scheme forced by ARRA and daily precipitation analysis with MESCAN



Obs 28/06/1961

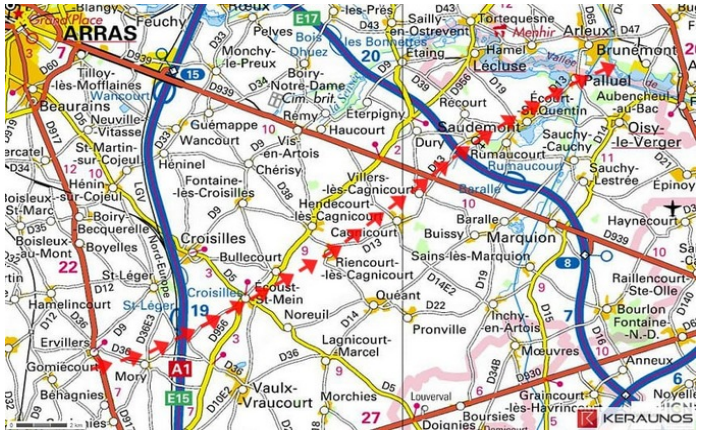


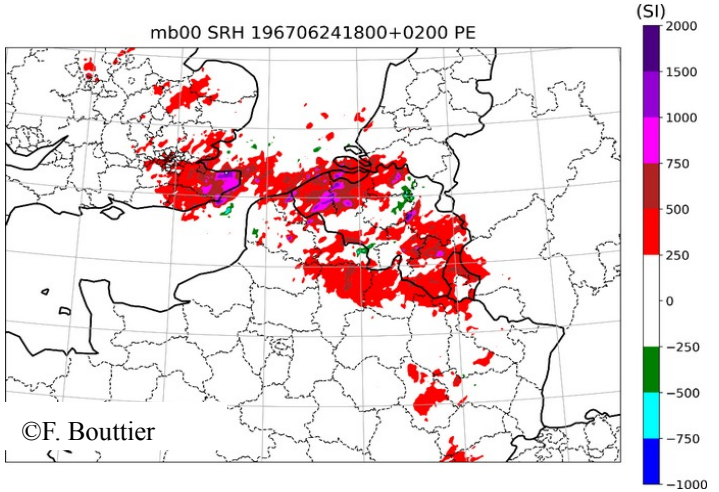
Obs 28/06/1998



ARRA = Arome ReAnalysis

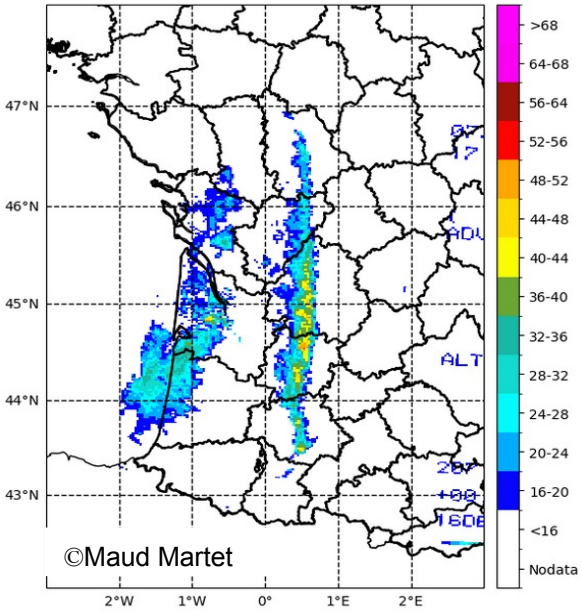
Tornado 24 June 1967. Tornado, maximum intensity EF5, FF ~ 320 km/h, Distance: 25 km



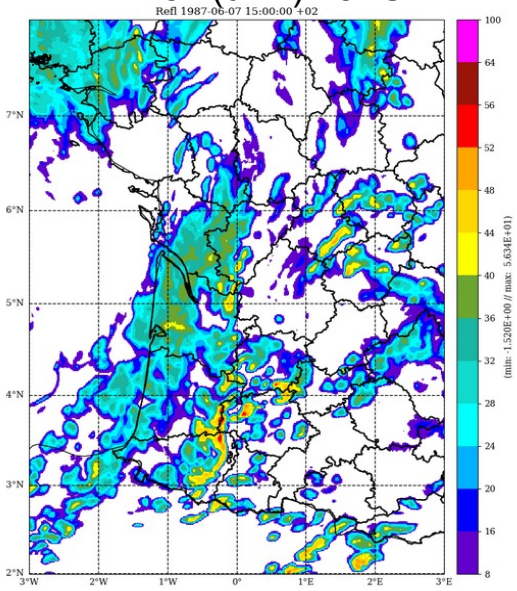


Squall line
7 June 1987

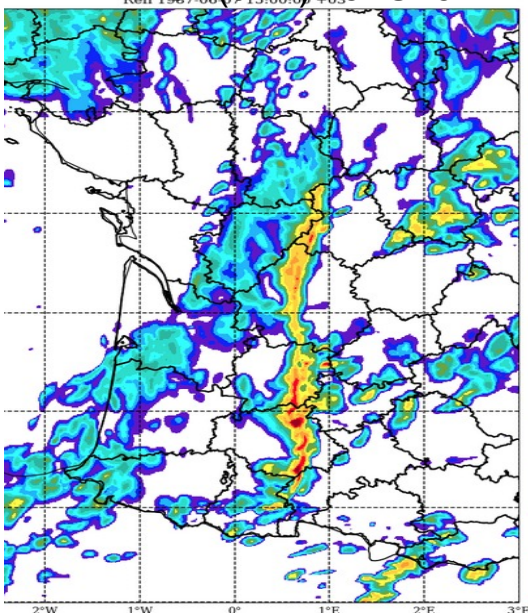
RADAR (dBZ) 17TU



ARRA Refl (dBZ) 15TU+2H



ARRA Refl (dBZ) 15TU+3H



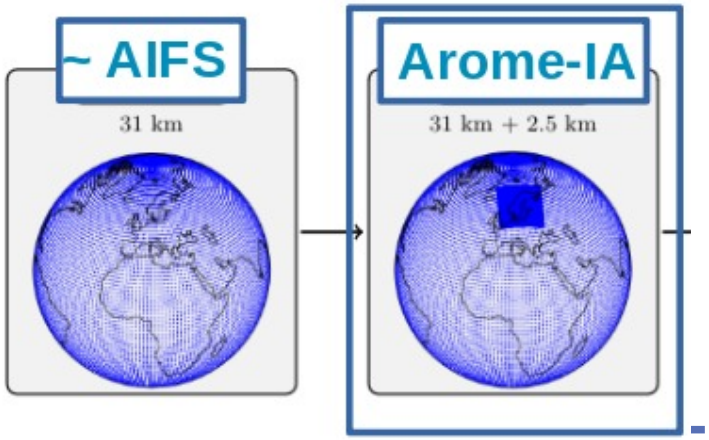
GPU – MF forecast component adaptation progress (Q4 2025)

Model component	Benchmark (Cycle 48t2)	Cycle 50t1	Comments
Spectral Transform	Move data YDVARS ↔ GMV/GFL	Move data YDVARS ↔ GMV/GFL	Being reengineered to interface with Field API in 2026
Grid point dynamics	FIELD API + fxtran	FIELD API + fxtran	
Semi-Lagrangian	fxtran	fxtran	
Semi-Implicit	hand ported	fxtran	
ARPEGE physics	fxtran	fxtran	
AROME physics	Not used	First tests with fxtran	Should work in 2026
Surface model	Old ISBA scheme	SURFEX not yet ported	Adaptation of SURFEX to GPU has started ; a prototype is expected by the end of 2026
Radiation (ecRad scheme)	48t2 version hand ported by ECMWF	50t1 version not available on 50t1	Plan to use the ECMWF's ecRad Loki ported version in 2026
Input/Output	Hand ported	Refactoring	

Arome-AI

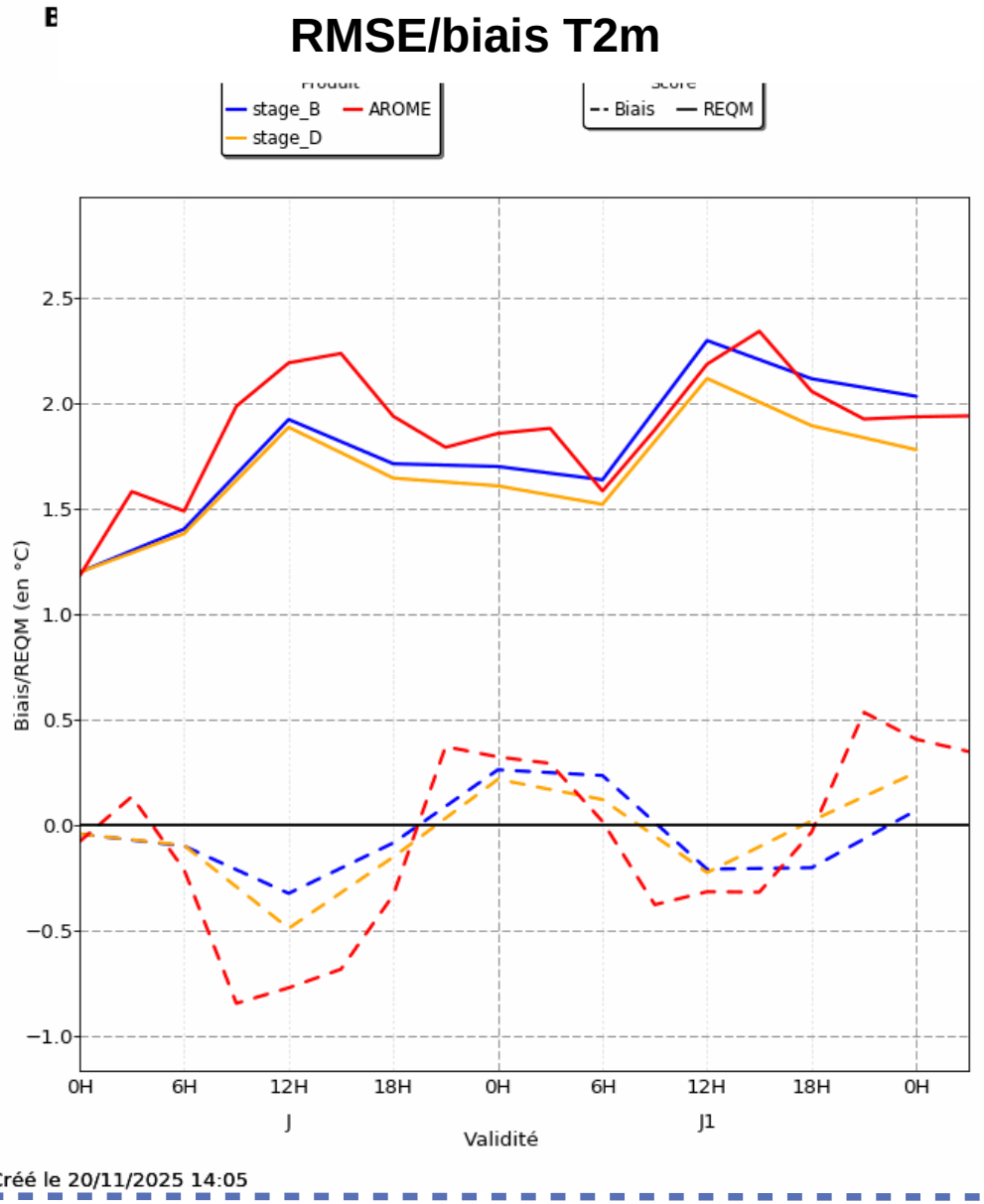
- Completion of a full implementation based on the Bris model (Met Norway), using Arome operational analyses (2020-2025)
- Encouraging performance, but not yet at the level of Arome:

  - Objective + subjective evaluation to be consolidated (with forecasters)
- Many scientific questions still to be explored
- Several areas for improvement
- Priorities:
  - improvment of deterministic version (evaluation, ARRA, experimental real time production, new parameters, hourly forecast)
  - developement of an ensemble Arome-AI

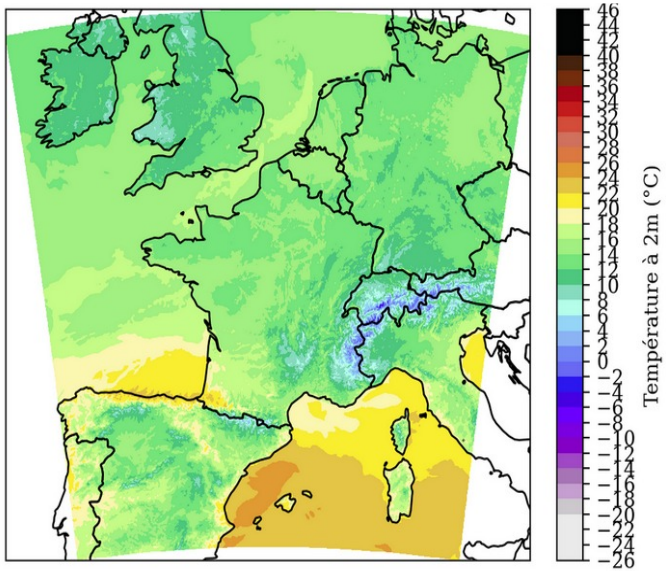


Evaluation of Arome-AI

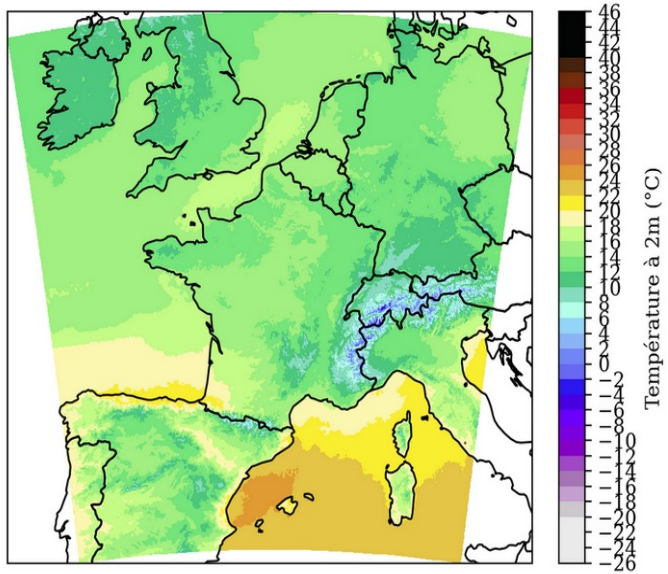
Arome **AIFS** **Arome-AI**



Arome oper +24h



Arome-IA +24h

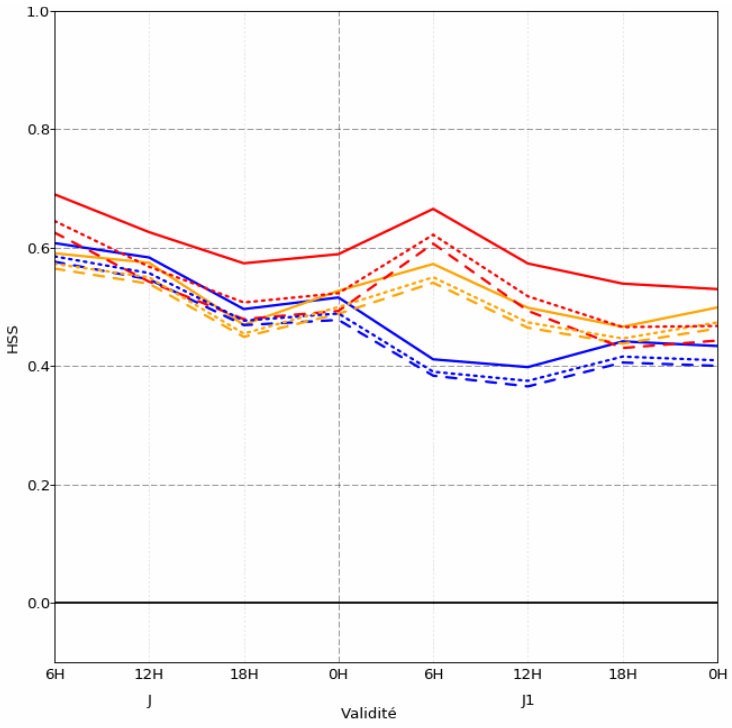


Evaluation of Arome-AI

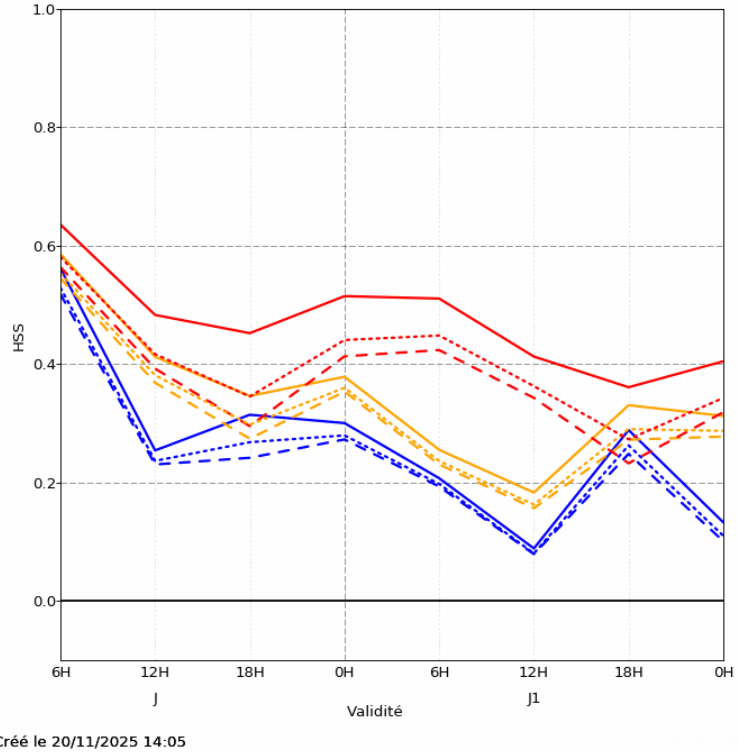
- Performance needs to be improved in rainy conditions, particularly for high thresholds

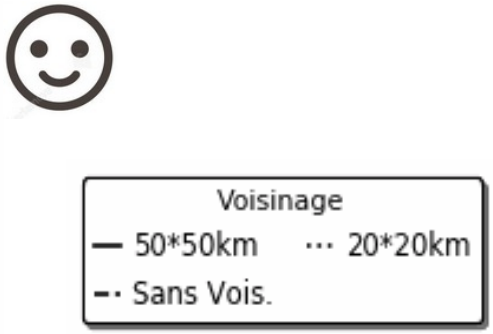
Arome **AIFS** **Arome-IA** Heidke Skill Score

rr6 > 0,5mm



rr6 > 5mm





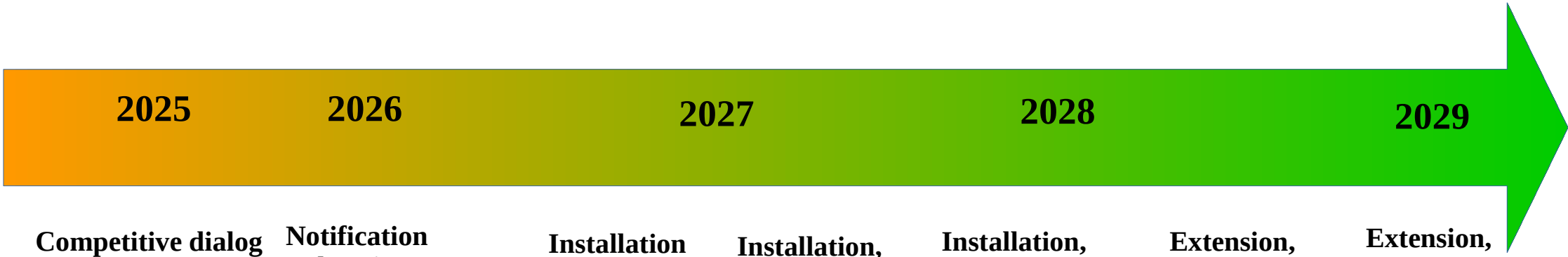
Next HPC procurement

- Current procurement with Atos (now Eviden) since 2020 until 2028
- The goals were defined in 2021 with a x6 throughput increase in mind to have finer horizontal resolutions and more vertical levels on physically based models
- The main focus of the next HPCs will still be “traditional” NWP, but there will be more AI workloads than today
- Because of large uncertainties in performance of running ARPEGE and AROME forecasts on GPU and resources needed for developing and running AI NWP systems, the renewal of HPC will be in two phases :

  1) A large part in CPU + a smaller part in GPU

  2) Purchase order to extend the clusters, proportions CPU/GPU to be defined during the first phase

Timeline of the HPC renewal



Competitive dialog (3 rounds) during 2025

Notification to the winner (May 2026)

Installation of porting machine (Jan 2027 March 2027)

Installation, Acceptance cluster #1 (May 2027 Sept 2027)

Installation, Acceptance cluster #2 (Feb 2028 May 2028)

Extension, Acceptance cluster #2 (Nov 2028 Feb 2029)

Extension, acceptance cluster #1 (July 2029 Sept 2029)

<FIRST PHASE> **<SECOND PHASE>**

Purchase order for second phase (Sept 2027 - Nov 2027)

Thank you for your attention