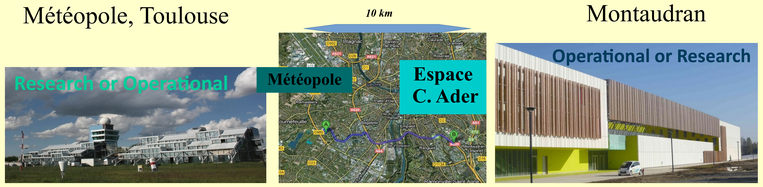
The NWP systems at Météo-France

New HPC at Meteo-France

2 twin HPC, 2 implementations

Centre National de Calcul
Météopole, Toulouse

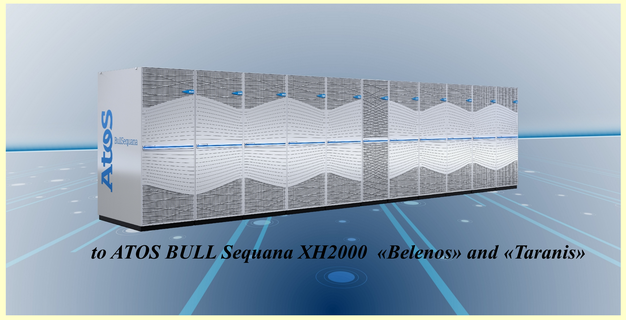
Espace Clément Ader
Montaudran



Computer Belenos *Computer Taranis*

Belenos and Taranis HPC : **ATOS BULL Sequana XH2000**

10.39 PFlops peak performance
Node : **2 AMD Epyc Rome processors with 64 cores at 2.25 Ghz**
2292 computing nodes = 293376 computing cores
Dragonfly+ interconnection topology with **HDR100 infiniband** technology
"hot" water cooling (39°C → 46°C)
Lustre file system : **11.6 Po, 408 Go/s** (Belenos) & **8,2 Po, 288 Go/s** (Taranis)
Disk storage 200 To



=> Five fold increase in performance than the previous HPC
(ARPEGE and AROME-France benchmark runs)

Switch of operations to Belenos on 2 February 2021
Hard switch down of previous HPCs (beaufix and prolix) on 9 February 2021

Taranis enters the TOP500 and is ranked 30 on the list published in November 2020 (Belenos entered in June 2020 and is now ranked 34)

Global operational NWP systems based on ARPEGE

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)
- *Tl1198c2.2 L90 (7.5km on W Europe)*
- *35 members ; four times per day up to 108h*
- *Using 35 EDA members and singular vectors*
- *10 physical packages*
- *Ref: Descamps L. et al., 2014. PEARP, the Météo-France short-range ensemble prediction system, QJRMS*

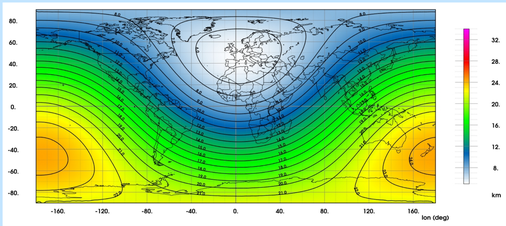


Figure 1: Horizontal resolution ARPEGE
Min 5km – Mean 11km – Max 24km

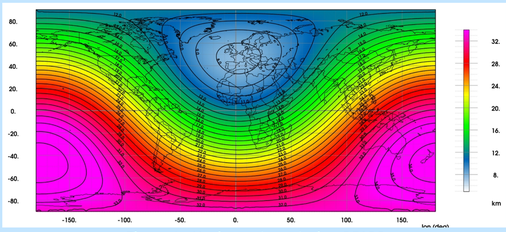


Figure 2: Horizontal resolution PEARP
Min 7,5km – Mean 17km – Max 37km

PRINTED ON 09/04/2021

Météo-France Numerical Weather Prediction Systems

Regional operational NWP systems based on AROME

AROME-France *Deterministic*
- *1.3km (1536 x 1440 pts)*
- *L90: from 5m to 10hPa*
- *3DVar (1h cycle)*
- *5 forecasts per day up to 48h*

AROME Overseas *(5 domains)*
- *2.5km L90 – Dynamical adaptation of IFS (altitude) and Arpege (surface)*
- *4 forecasts per day up to 48h*
- *Ref: ALADIN-HIRLAM Newsletter n°10 Jan.2018, Forecasting the tropical cyclones IRMA and Maria with AROME-Antilles, G. Faure & C. Fischer*

AROME-France Nowcasting
- *1.3km (1536 x 1440 pts)*
- *L90: from 5m to 10hPa*
- *3DVar (no cycling – 10' cut-off)*
- *24 forecasts per day up to 6h*
- *Ref: ALADIN-HIRLAM Newsletter n°9 Sep.2017, AROME for Nowcasting, N. Merlet et al*

AROME-EPS (PEARO)
- *2.5km L90*
- *16 members*
- *Four times per day up to 51h*
- *Initial and boundary conditions from PEARP*
- *Ref: ALADIN-HIRLAM Newsletter n°8 Jan.2017, AROME-France EPS, F. Bouttier et al*

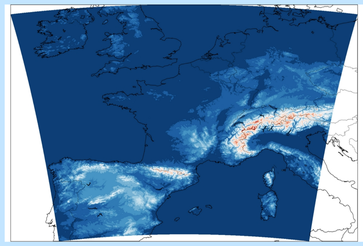


Figure 3: operational AROME-France domain

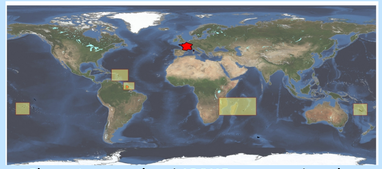


Figure 4: operational AROME overseas domains

AROME-EDA (AEARO)
- *3.25km L90*
- *25 members*
- *3DVar (3h cycle)*

AROME-IFS
- *2.5km L90– Dynamical adaptation of IFS (altitude) and Arome-Fr (surface)*
- *2 forecasts per day up to 48h*

Operational upgrades (2020-2021) and 2021 e-suite cy46t1_op1

Operational upgrades

During 2020 and the first quarter of 2021, several upgrades of operational suites: from cy43t2_op3 (January 2020) to cy43t2_op8:

- **new observations, in particular data from the satellites Metop-C, GOES17, ADM-Aeolus ; new GPS-RO satellites, new providers for airplane data to mitigate the decrease of their number**
- **many technical adjustments for observations dataflow**
- **upgrades of surface: snow analysis in Arome, bugfix of SST initialisation near the coastlines**
- **and some others….**

February 2021 :
Operational suite on new HPC BULL-AMD: cy43t2_op8

E-suite cy46t1_op1

Calendar: currently building in GMAP, formal real-time e-suite from June 2021 for a put into operations expected by Q1 2022)

Few highlights (among many others):

- **EPS systems reach the same resolutions than their deterministic counterpart #arpege #arome**
- **Changes in physics**
  # arpege: Tiedke deep convection scheme, use of SRTM for solar radiation
  #arpege&arome: Ecume v6 air/sea flux parametrisation
- **Coupling with 1d sea-ice model #arpege**
- **All-sky assimilation of microwave data from MHS and ATMS #arpege**
- **Snow analysis #arpege**
- **Change of Arome dynamics to improve moist convection:**
- **Upgrade of horizontal resolution of the Arome-Overseas models**

Contact : Patricia Pottier
http://www.umr-cnrm.fr/?lang=en