AROME-500m operational configurations at Météo-France in 2024

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4th All Staff ACCORD Workshop

1. Configuration

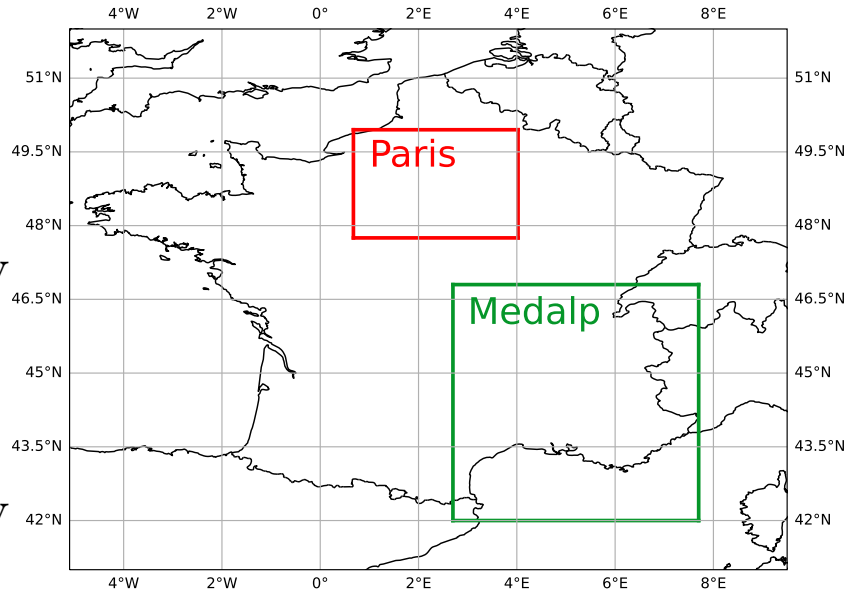
2. Issues and scores

AROME 500m configurations

- Deterministic forecasts
- Without data assimilation
- 2 configurations on 2 domains

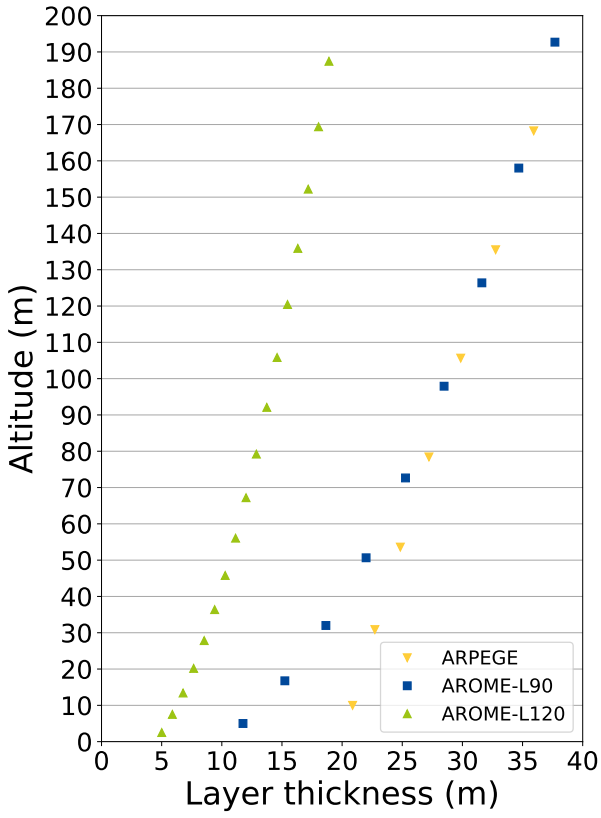
Paris (250km x 250km)
- Forecast 1xP36 at 00 UTC (hourly output)
- Nowcasting 24xP6 (15min output)

Medalp (480km x 576km)
- Forecast 1xP24 at 00 UTC (hourly output)
- Nowcasting 24xP6 (15min output)



The following results concern forecast, but are also valid for nowcasting.

Verical grid



AROME 500m
120 vertical levels (first at 2.5 m)
17 levels under 200 m

AROME France
90 vertical levels (first 5 m)
9 levels under 200 m

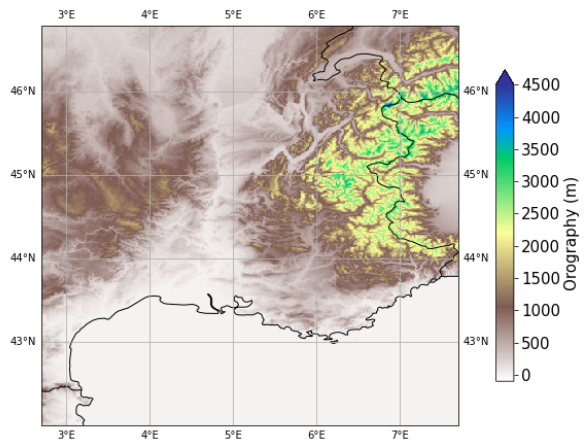
ARPEGE
105 vertical levels (first 10 m)
7 levels above 200 m

-> first level height and higher density of vertical levels near surface important for **fog aspects** (Antoine et al. 2023) and **temperature in mountain**

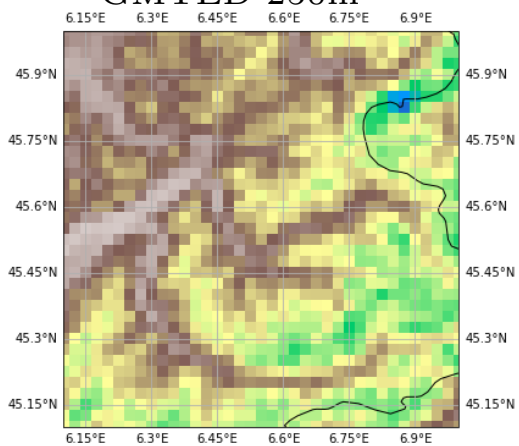
Orography

- Finer orography database (STRM 30m VS GMTED 250m)
- More realistic mountain height
- More realistic valleys

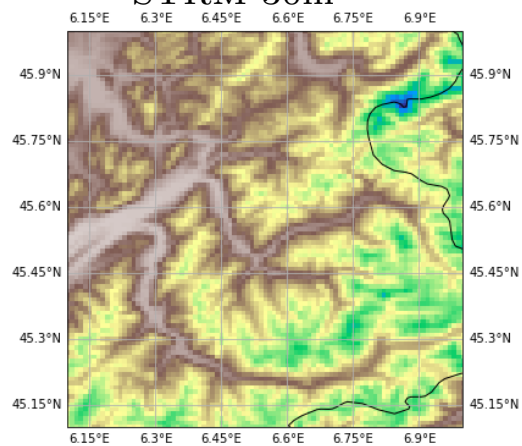
AROME-Medalp



GMTED 250m



STRM 30m



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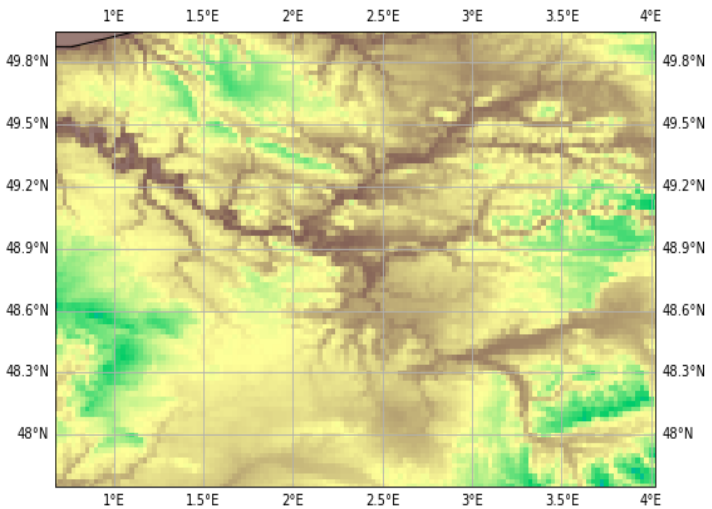
Max height = 4117

Max height = 4471m

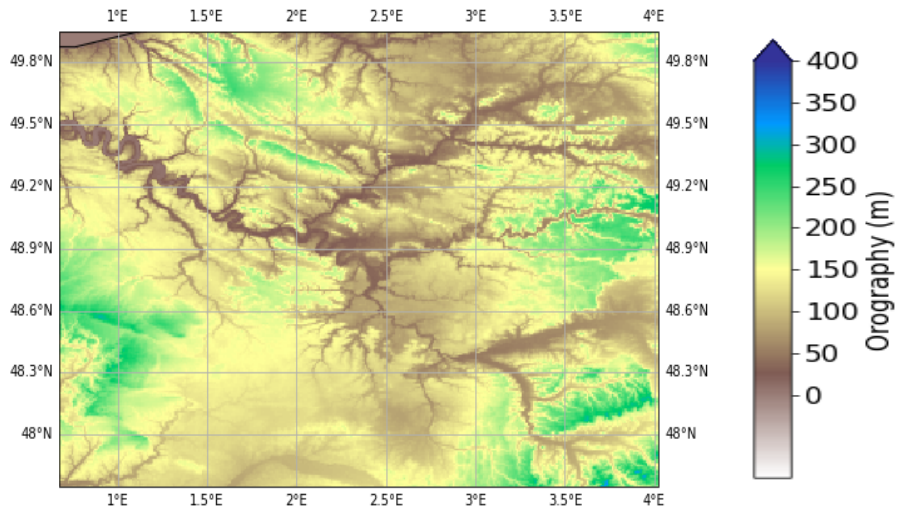
Orography

- Finer orography database (STRM 30m VS GMTED 250m)
- More realistic mountain height
- More realistic valleys

AROME-France - GMTED 250m

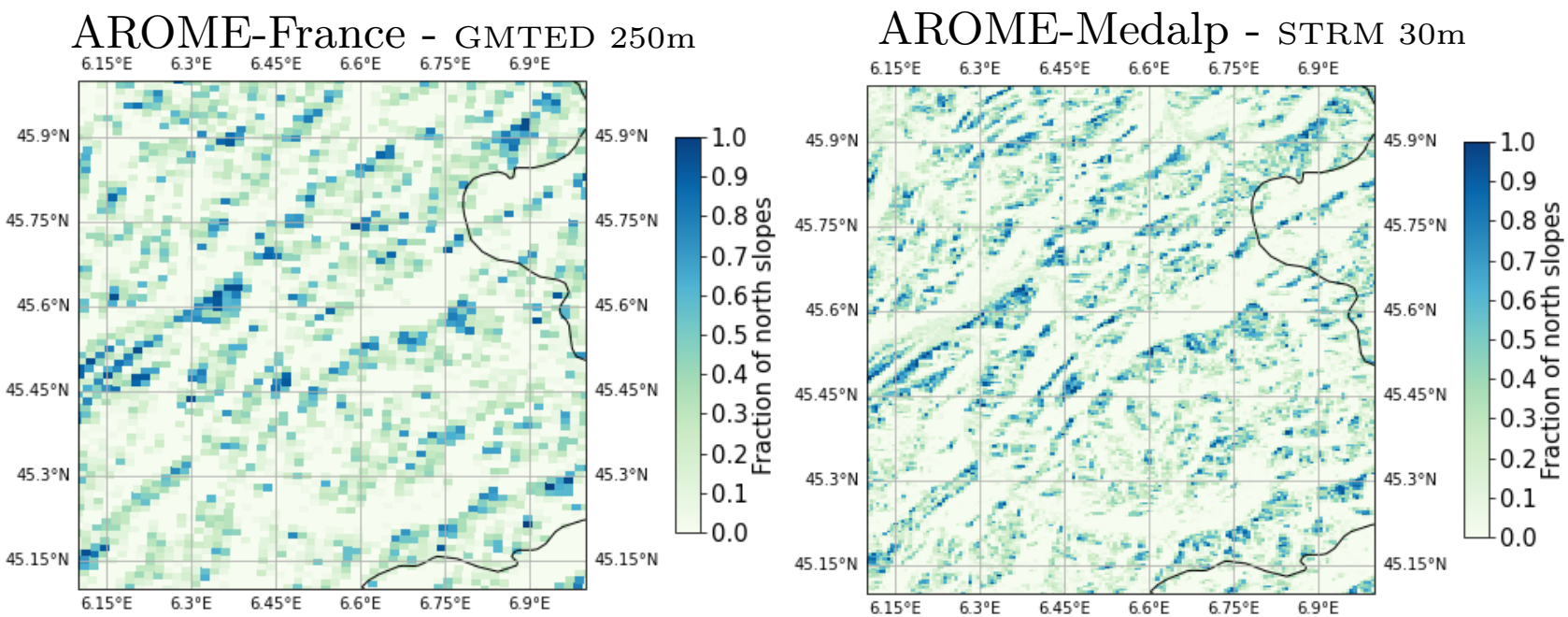


AROME-Paris - STRM 30m



Orography

- More realistic subgrid parameters



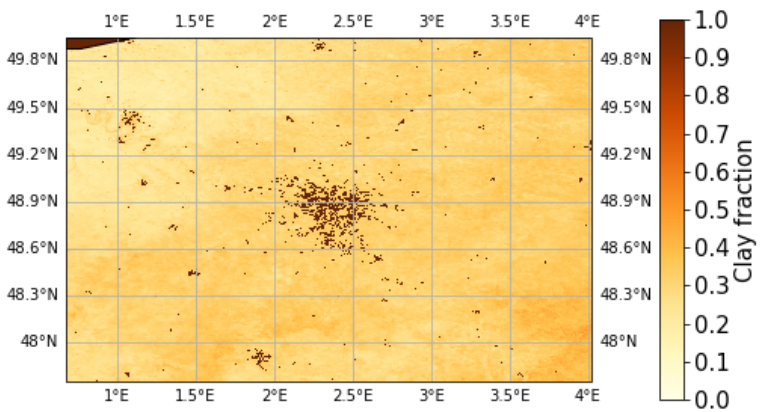
Subgrid fraction of northern slopes

Surface - Soil type

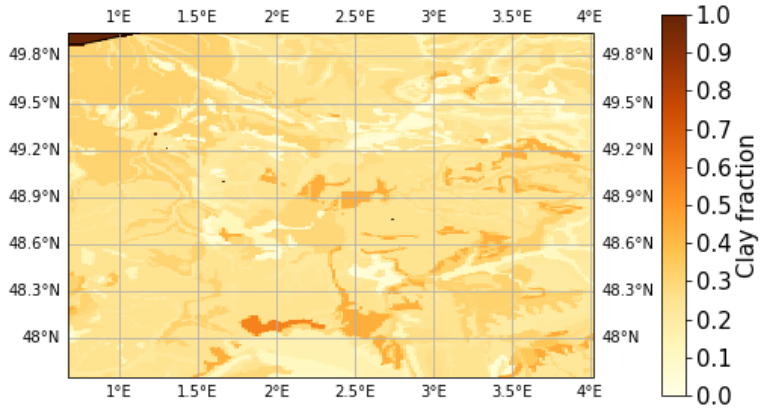
- **Soilgrid** (250m, Hengl et al. 2017) VS HWSD (1km)

  * Finer data base

Soil grid



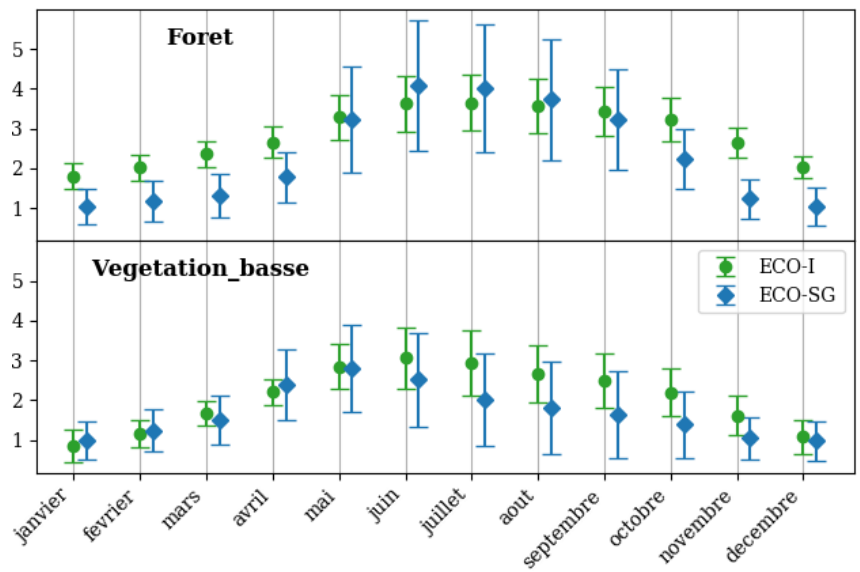
WWSD



Surface - Physiography

- **Ecoclimap-SG** (300m) VS ECOCLIMAP-1 (1km)

  * 33 land cover types VS 256 land covers
  * More recent albedo (from 2008-2012 CGLS data, Carrer et al. 2014)
  * More realistic LAI annual cycle (from 2014-2016 CGLS LAI data, Munier et al. 2018)

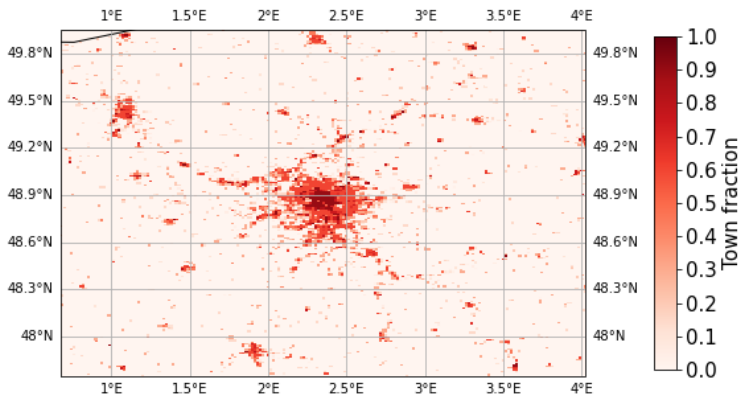


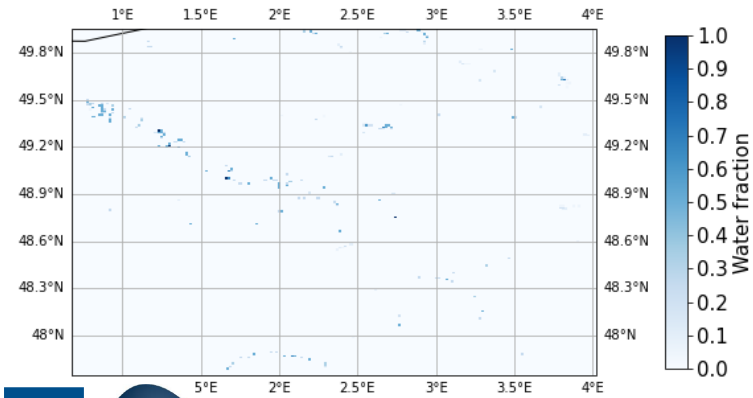
LAI cycle

Surface - OSM

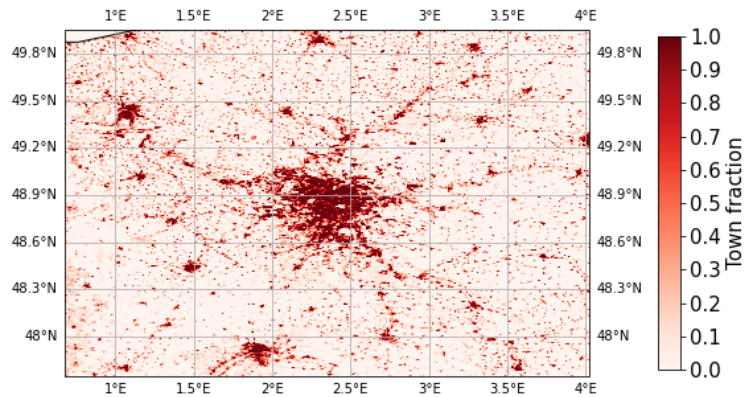
- Vector open source data, **Open Street Map** (OSM)
  * More water and town
  * Less nature

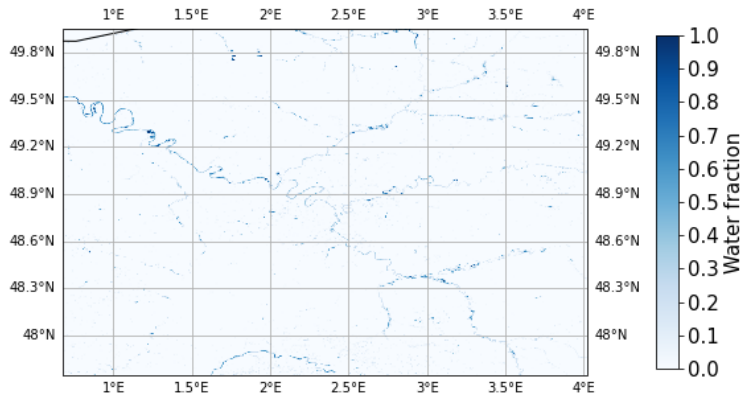
AROME-France





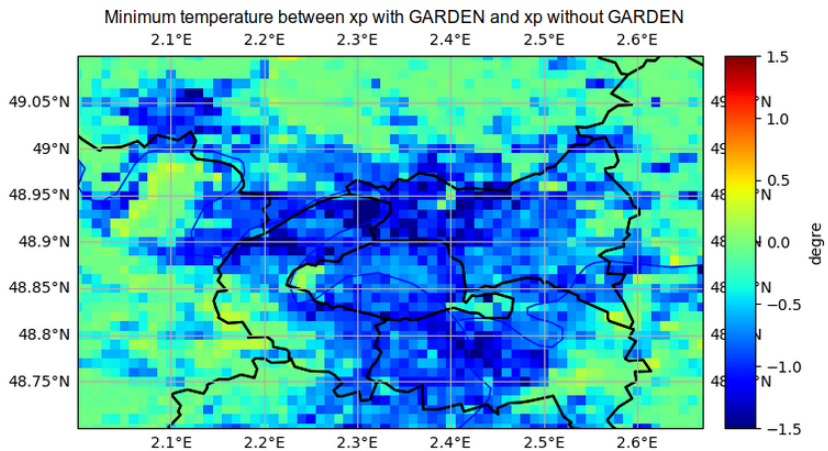
AROME-500m

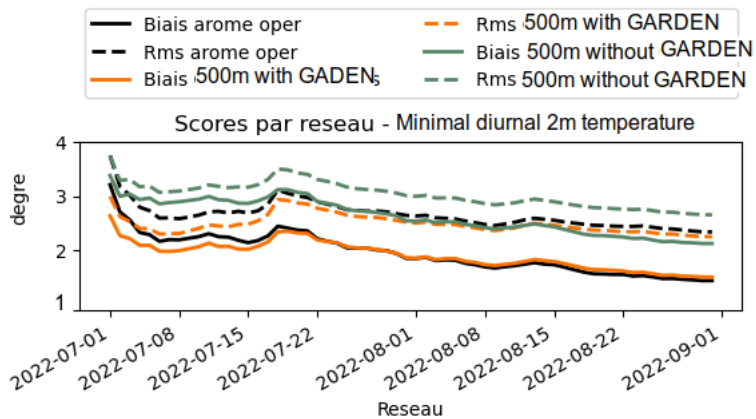




Surface - Garden in TEB

- GARDEN : vegetation is included in the town scheme TEB
- Activation of **GARDEN** option in TEB
  * Colder temperature with Garden over town cover
  * Better minus temperature over Paris



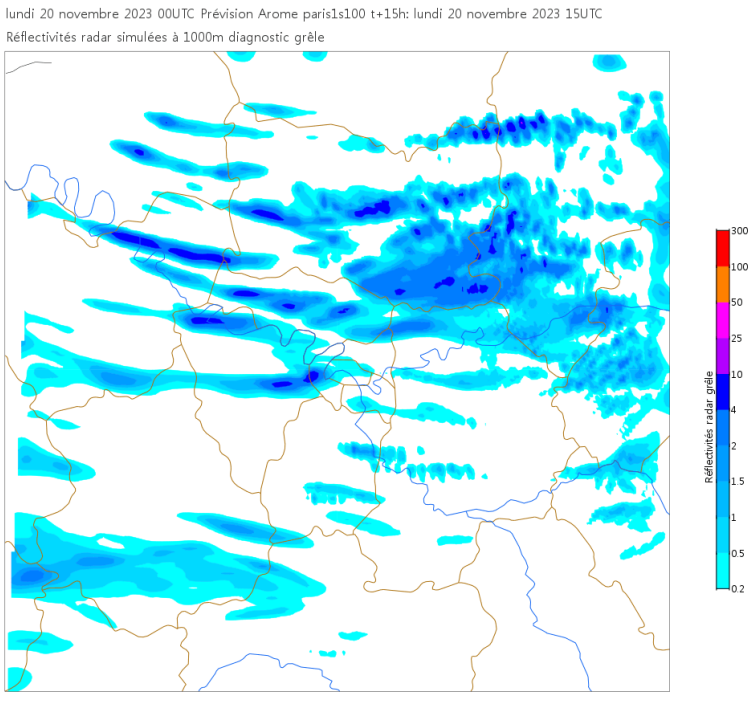


Specific setting of AROME 500m configurations

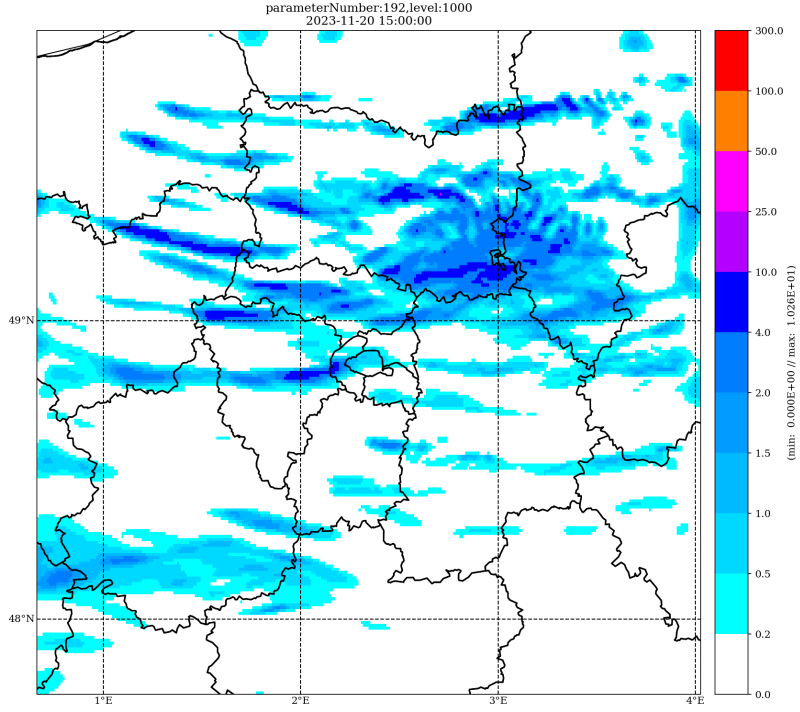
- **Time step : 20s** VS 50s in AROME-France

  * Unrealistic waves in rainfalls, temperature, wind fields
  * No solution found with dt=30s

Reference, dt=30s



With dt=20s



Specific setting of AROME 500m configurations

- **Time step : 20s** VS 50s in AROME-France

- **Numerical diffusion of temperature**, like other dynamic variables (&NAMDYN RDAMPT=20.,)

  * Very sensitive for model stability

  * Low impact on scores

Specific setting of AROME 500m configurations

- **Time step : 20s** VS 50s in AROME-France

- **Numerical diffusion of temperature**, like other dynamic variables

- Ri_{max} tuning to 0.05 VS 0.2 in AROME-France

  * Link to lower first level above the ground in AROME-500m
  * Reduce warm nocturnal temperature bias during summer over Paris

Specific setting of AROME 500m configurations

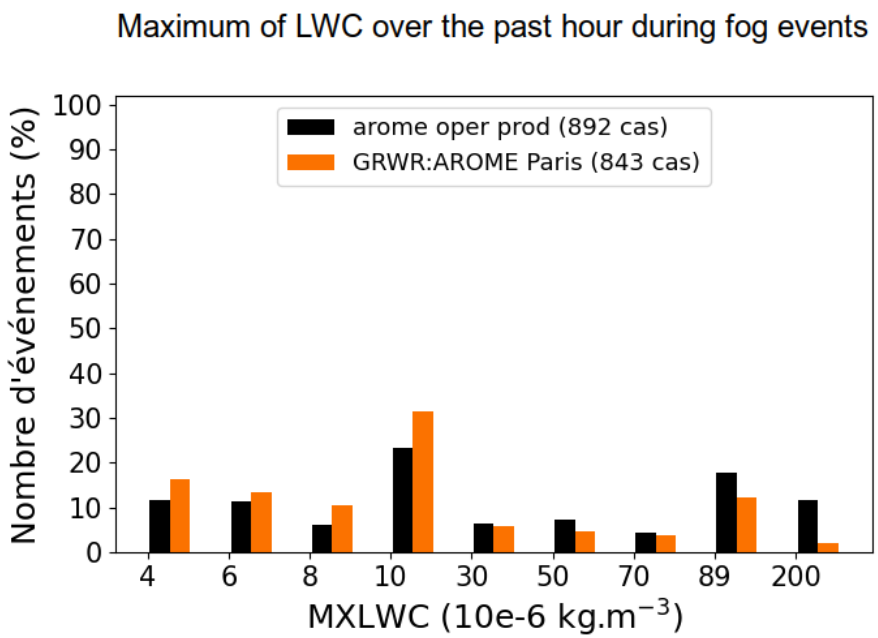
- **Time step : 20s** VS 50s in AROME-France

- **Numerical diffusion of temperature**, like other dynamic variables

- Ri_{max} tuning to 0.05 VS 0.2 in AROME-France

- Taking into account of **droplet deposition** (Antoine et al. 2023)

* Impact LWC in fogs



Specific setting of AROME 500m configurations

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-> Test **performed over 2 years period** (since January 2022)

-> **Daily runs** since August 2023 for the 4 configurations over both domains

1. Configuration

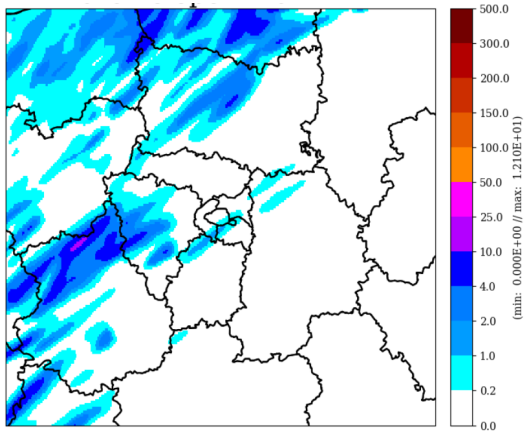
2. Issues and scores

Unrealistic cumulative rain in shower cases

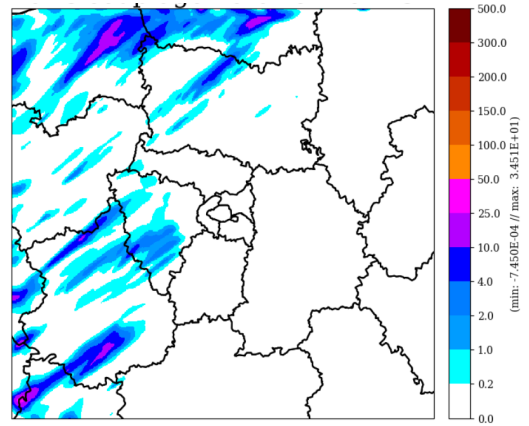
- Need of a more frequent updated lateral boundary conditions

- **15 minutes** coupling (available as soon as AROME-France modifications are implemented)

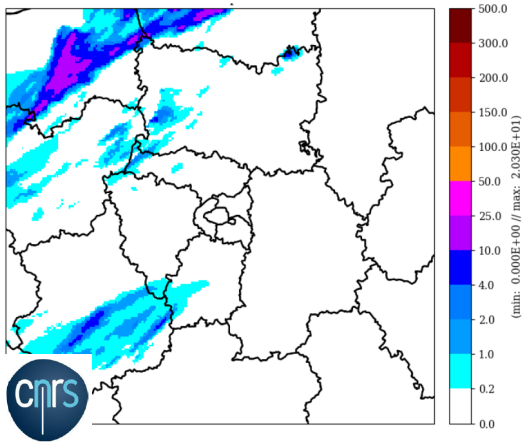
AROME-France - max 12mm



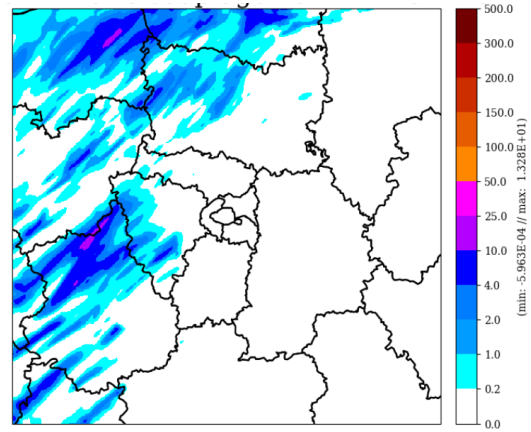
AROME-500 hourly cpl - max 34mm



Antilope observations - max 20mm

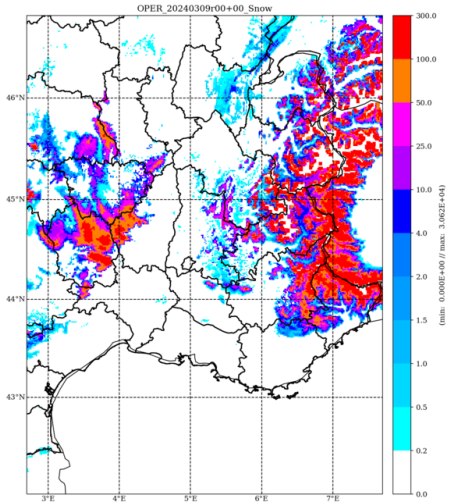


AROME-500 15min cpl - max 13mm

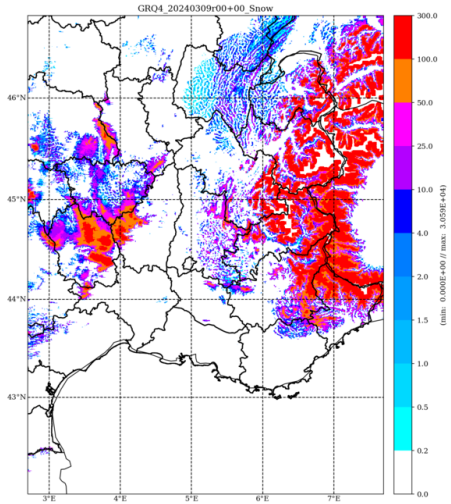


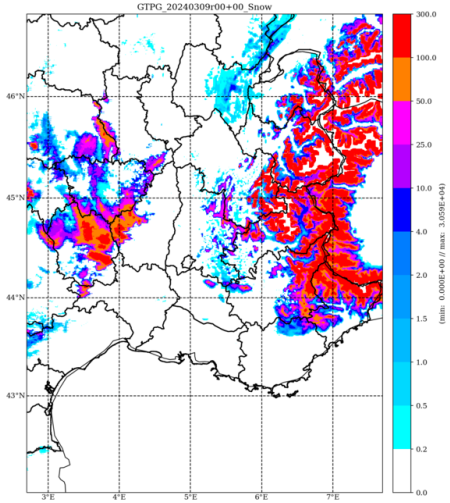
Suspicious snow contents after prep interpolation

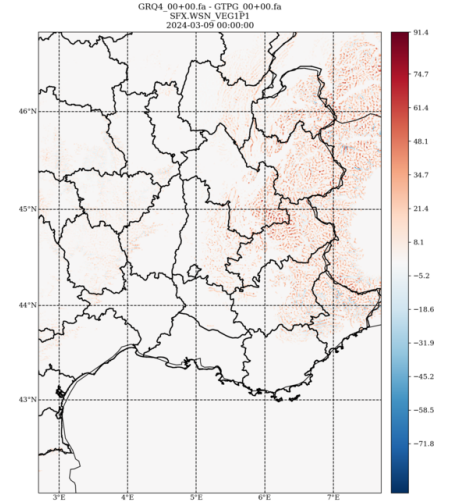
AROME-France



AROME-500m







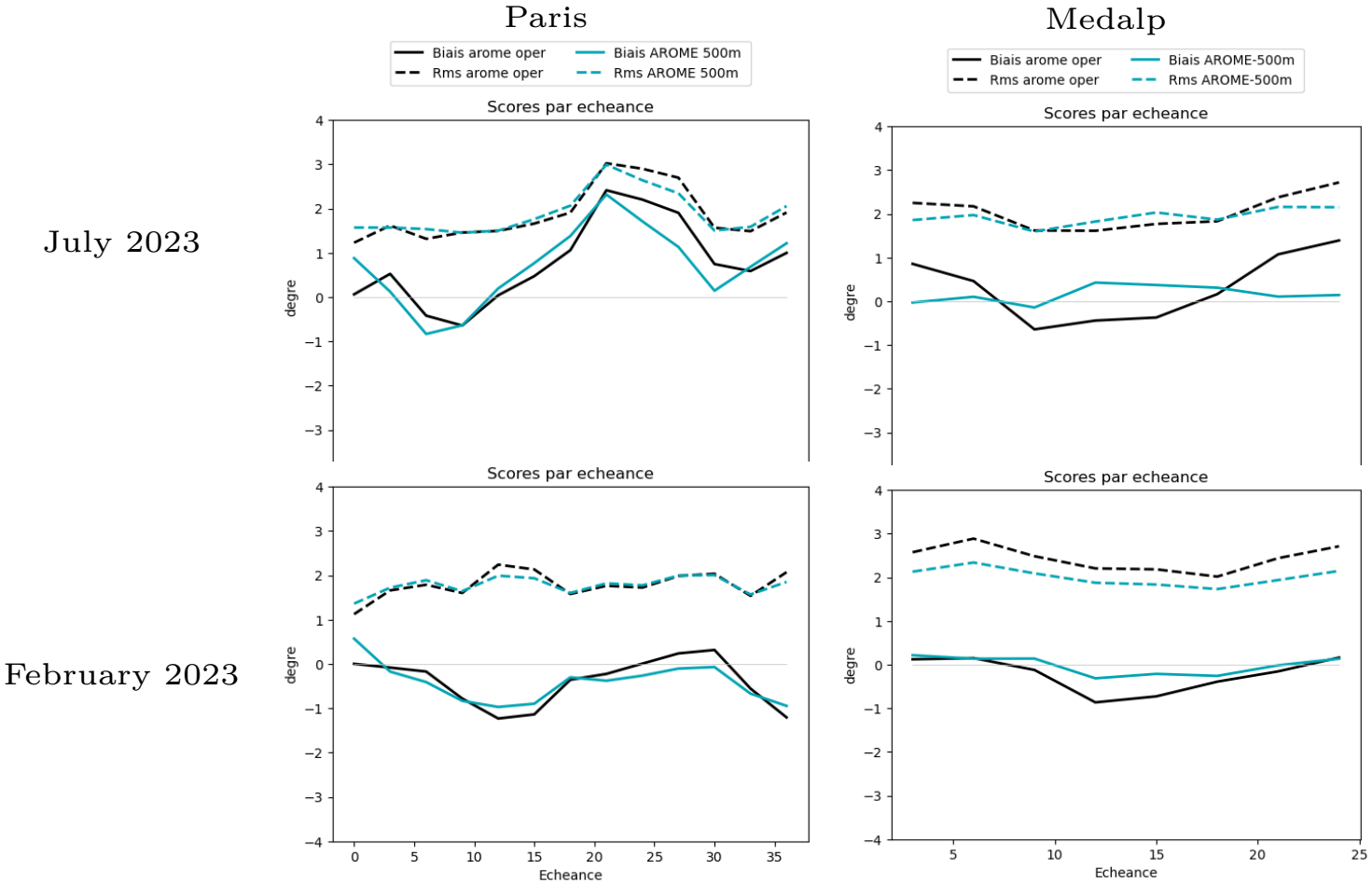
With LSNOW_IDEAL=T

T2m difference

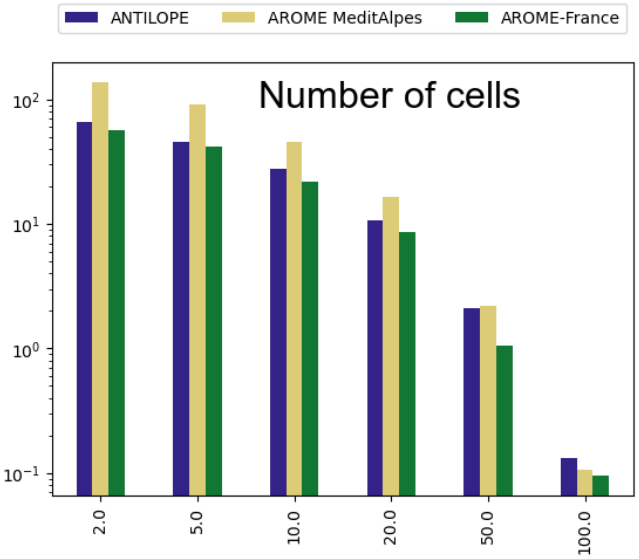
- Suspicious snow contents in surface after interpolation for initial file preparation, especially in mountain area
- Activation of the key LSNOW_IDEAL=T
- Impact 2 meter temperatures

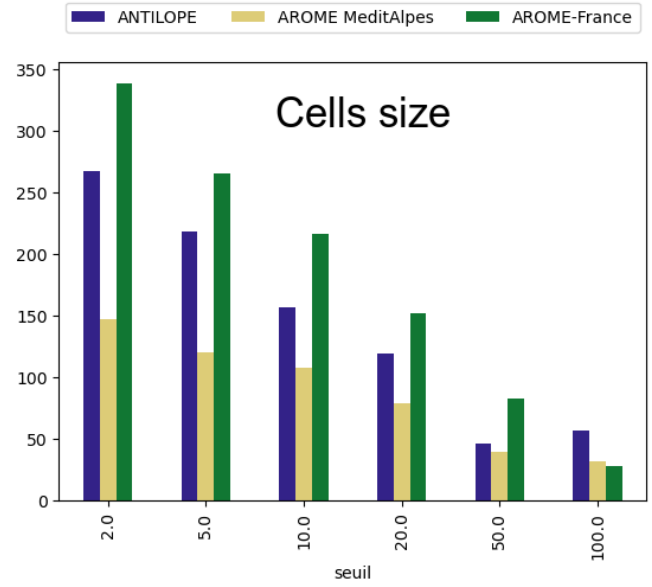
Temperature scores

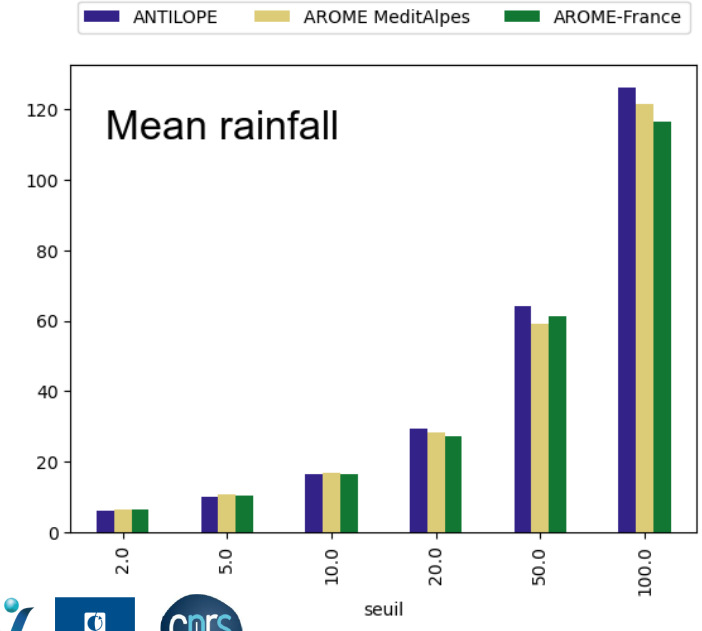
- Better scores over Medalp domain
- Neutral over Paris except a warm bias during summer nights
- **Tuning of vegetation thermal inertia** to fix nocturnal bias



Convective rain scores







- Too small and numerous cells in AROME-500m
- In the past, when moving AROME from 2,5 km to 1,3 km we were closer to observations (Brousseau et al., 2016), by chance ?
- But, at 500m, we have correct 3h rainfalls

Scores summary

- AROME-500m Forecast
  * FF10m : Reduce AROME-1,3km overestimation (light overestimation during night over Medalp)
  * Hu2m : Reduced night dry bias.
  * T2m : Better over Medalp, more neutral over Paris
  * Rainfalls : Too small and numerous convective cells, but with correct rainfalls.
- AROME-500m Nowcasting
  * Good scores over Medalp (T2m, Hu2m, Gusts10m, neutral for Rainfalls
  * More neutral/slightly worse over Paris

Next steps

- **Summer 2024** for various reasons, not operational for Paris Olympics Games, but will participate to model intercomparison exercise (PARIS-RDP)

- **Autumn 2024** operational Medalp forecast

- **Winter 2024 to Winter 2025** model support for the TEAMx field campaign over the Alps (new intercomparison cases with detailed observations)

- **2025** preparatory work for AROME-Fr 4D EnVar @750m. End of small AROMEs-500m ?

Thanks for your attention

Any questions ?

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