



## 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

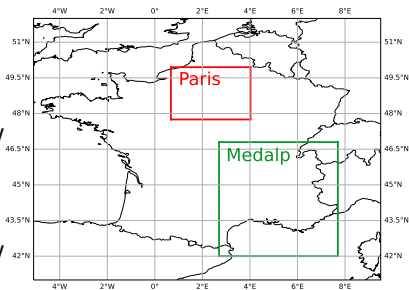
- Deterministic forecasts
- Without data assimilation
- 2 configurations on 2 domains

**Paris** (250km x 250km)

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

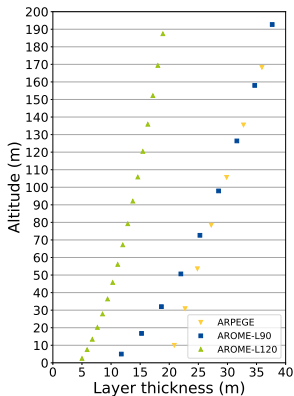
**Medalp** (480km x 576km)

- Forecast 1xP24 at 00 UTC (hourly output)
- Nowcasting 24xP6 (15min output)



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

# Vertical 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)

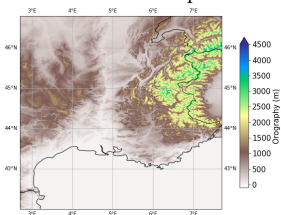
7 levels above 200 m

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

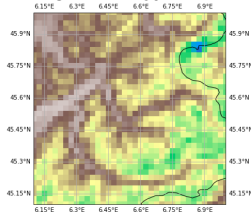
# Orography

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

AROME-Medalp

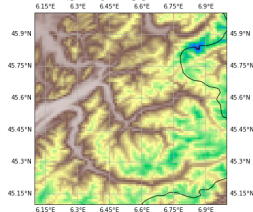


GMTED 250m



Max height = 4117

STRM 30m

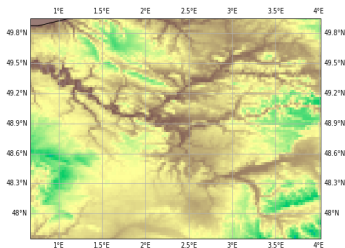


Max height = 4471m

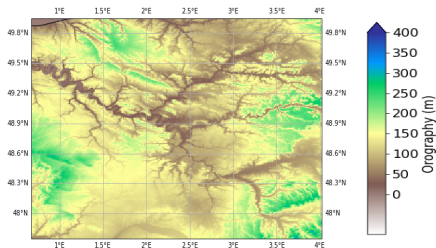
# Orography

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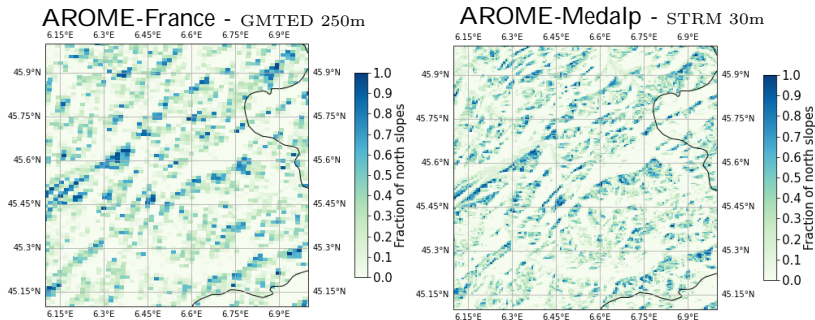
AROME-France - GMTED 250m



AROME-Paris - STRM 30m



- More realistic subgrid parameters



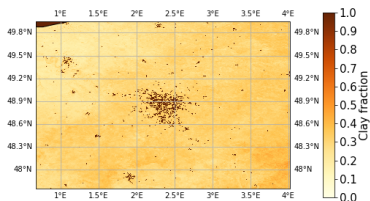
Subgrid fraction of northern slopes

# Surface - Soil type

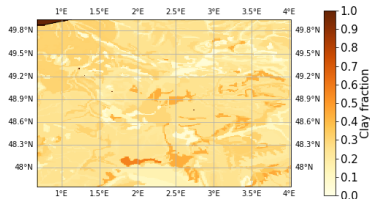
- **Soilgrid** (250m, Hengl et al. 2017) VS **HWSD** (1km)

\* Finer data base

Soil grid



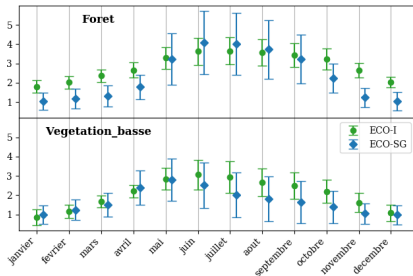
WWSD



# 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)



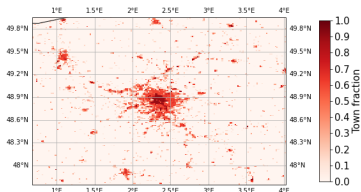
LAI cycle

# Surface - OSM

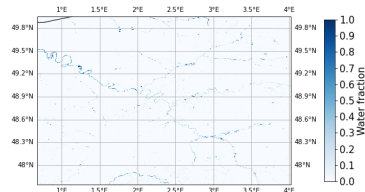
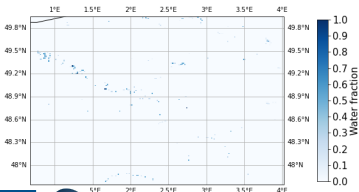
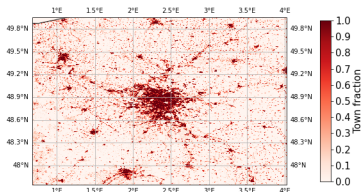
- Vector open source data, **Open Street Map (OSM)**

- \* More water and town
- \* Less nature

AROME-France

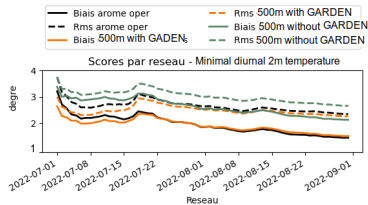
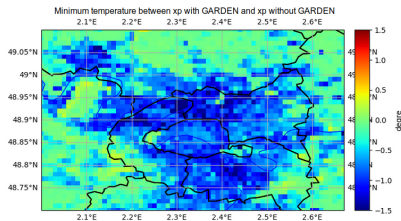


AROME-500m



# 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



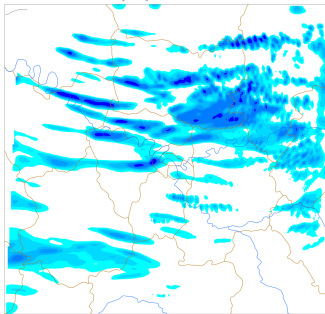
# Specific setting of AROME 500m configurations

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

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

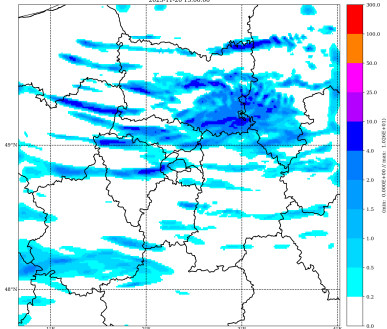
### Reference, $dt=30s$

lundi 20 novembre 2023 00UTC prévision Arome paris1x100 (+15h) lundi 20 novembre 2023 15UTC  
Réflectivités radar simulées à 1000m diagnostic grêle



### With $dt=20s$

parametres/Number:192\_level:1000  
2023-11-20 15:00:00



# Specific setting of AROME 500m configurations

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- **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

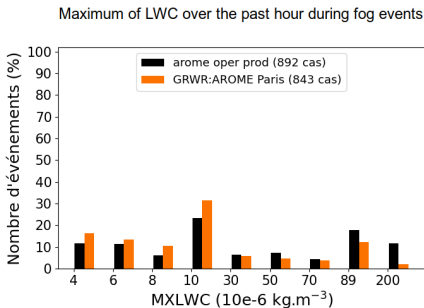
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- **Time step : 20s VS 50s** in AROME-France
- **Numerical diffusion of temperature**, like other dynamic variables
- $Ri_{max}$  tuning to 0.05 VS 0.2 in AROME-France
  - \* Link to lower first level above the ground in AROME-500m
  - \* Reduce warm 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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- 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)
- > Test **performed over 2 years period** (since January 2022)
- > **Daily runs** since August 2023 for the 4 configurations over both domains

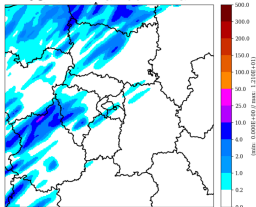
1. Configuration

2. Issues and scores

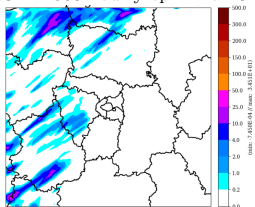
# Unrealistic cumulative rain in shower cases

- Need of a more frequent updated lateral boundary conditions
- **15 minutes** coupling ( available as soon as AROME-France modifications are implemented )

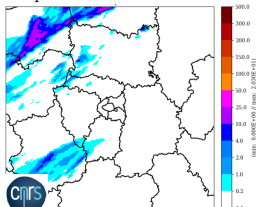
AROME-France - max 12mm



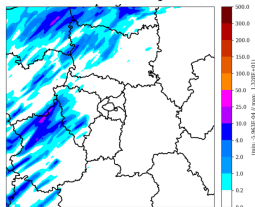
AROME-500 hourly cpl - max 34mm



Antilope observations - max 20mm

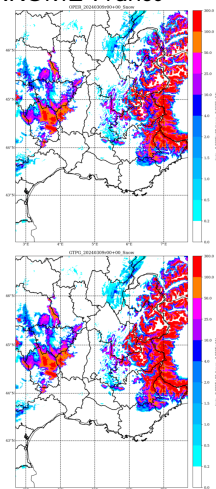


AROME-500 15min cpl - max 13mm

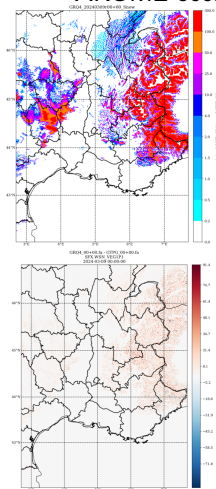


# Suspicious snow contents after prep interpolation

## AROME-France



## AROME-500m



- 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

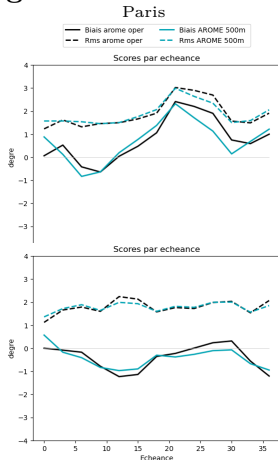
With `LSNOW_IDEAL=T`

T2m difference

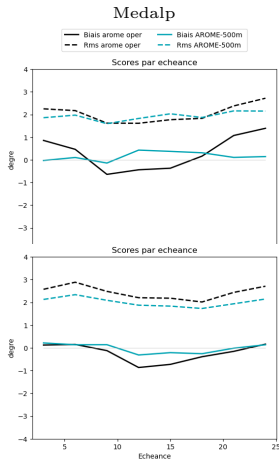
# Temperature scores

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

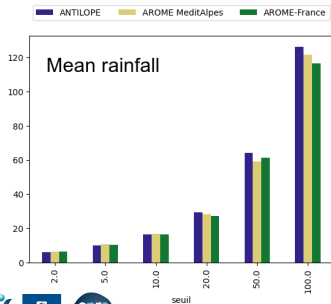
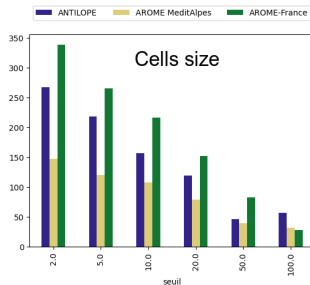
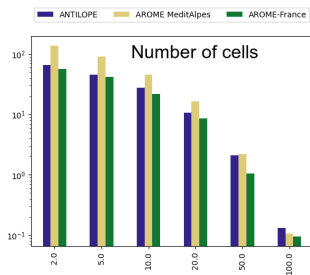
July 2023



February 2023



# 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

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## - 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

- **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 ?

# Bibliography

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