



Continuous Evaluation of the AROME and ARPEGE Models at the Météopole-Flux Site

Guyline Canut, Quentin Rodier, Eric Bazile, Jean-Claude Etienne,
Marie Mazoyer
CNRM/GMEI & CNRM/GMME & CNRM/GMAP



Continuous Evaluation of the AROME and ARPEGE Models at the Météopole-Flux Site

Outline

- Measurement site description
- Current observation–model evaluation
- Data access and availability
- Conclusions and perspectives

1- Meteopoleflux site

Objectives of the site:

- Provide long-term monitoring of an urban grassland near Toulouse
- Characterize exchanges of matter and energy between the surface and the atmosphere (turbulent heat and CO₂ fluxes, radiative fluxes, precipitation)
- Monitor soil water content and soil temperature down to 2 m, along with vegetation dynamics
- The site is an associated station of the French research infrastructures ICOS and ACTRIS

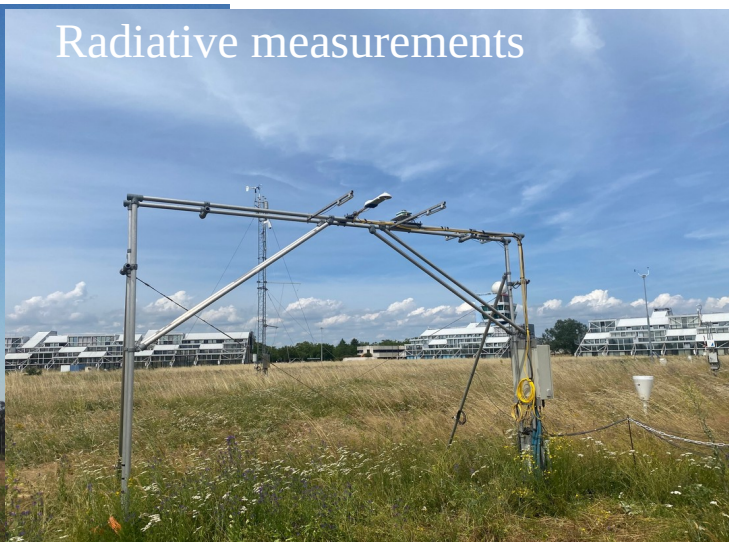
Flux mast



Meteo Mast



Radiative measurements



Soil
sensors

1- Meteopoleflux site

List of variables measured since 2012:

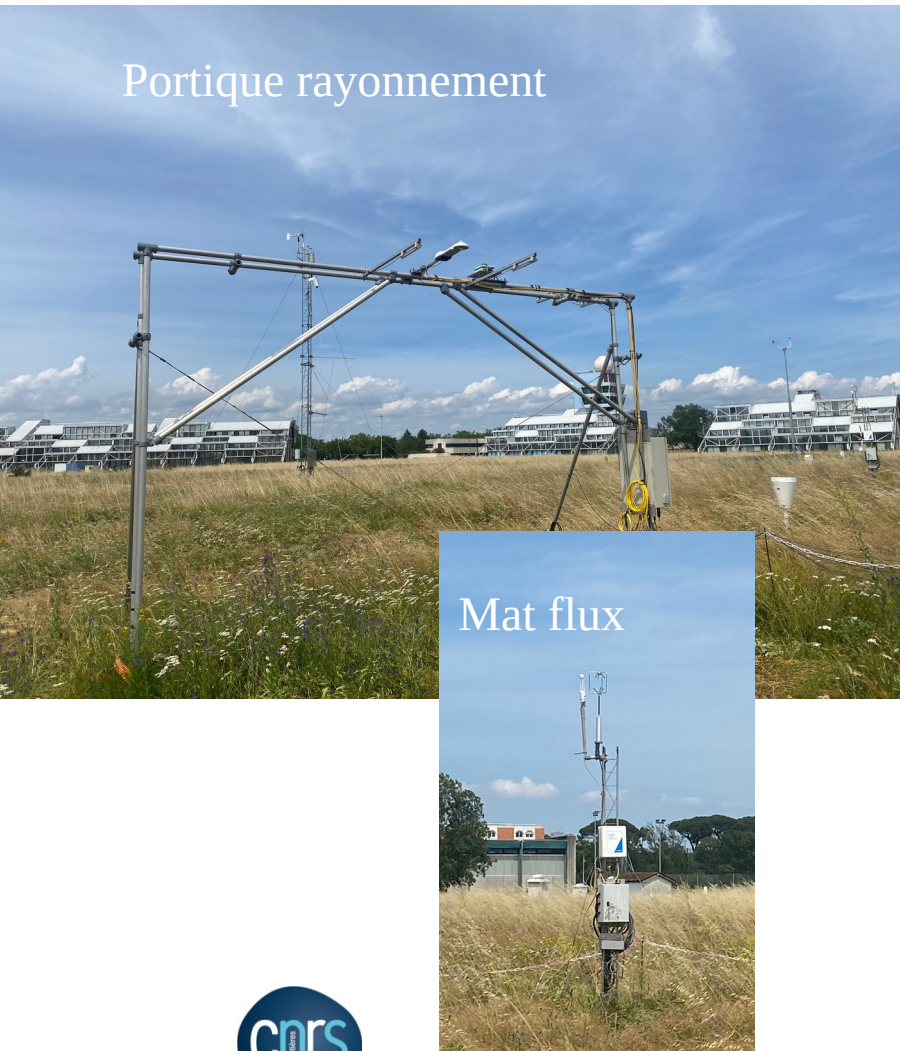


variables	Height (m)	sensor
air temperature ($^{\circ}\text{C}$)	2	Pt100 in SOCRIMA shield
air temperature ($^{\circ}\text{C}$)	10	Pt100 in SOCRIMA shield
relative humidity (%)	2	Vaisala HMP110 in SOCRIMA shield
relative humidity (%)	10	Vaisala HMP110 in SOCRIMA shield
wind speed (m s^{-1})	10	RM Young 5103
wind direction ($^{\circ}$)	10	RM Young 5103
rainfall (mm)	1	Précis-Mécanique, 3039
pressure (Pa)	2	Vaisala PTB210
shortwave radiation (upward and downward) (W m^{-2})	3	Kipp& Zonen CNR1 ventilated
longwave radiation (upward and downward) (W m^{-2})	3	Kipp& Zonen CNR1 ventilated
global and Diffuse components of the radiation (W m^{-2})	3	Delta-T devices BF5 Sunshine Sensor
bright sunshine duration (m)	3	Delta-T devices BF5 Sunshine Sensor
brightness temperature	3	Heitronics KT15
PAR radiation	0.1 0.2 0.3	Solems, PAR/LE
aerosol optical thickness		AERONET photometer
integrated water vapor		AERONET photometer
3D wind components (m s^{-1})	3.7	Gill sonic anemometer
water vapor concentration (m s^{-1})	3.7	licor 7500
CO_2 concentration (m s^{-1})	3.7	licor 7500
turbulent fluxes (sensible, latent and CO_2) (W m^{-2})	3.7	Eddy-covariance method with sonic anemometer and Licor
leaf-Wetness Sensor	1	Campbell 237-L
leaf Aera Index	-	
soil flux	0.05	Hukseflux HFP01
soil temperature ($^{\circ}\text{C}$)	0.01 0.03 0.05 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1 1.2 1.4 1.6 1.8 2 2.2	EuroSensors, PT1000
soil humidity	0.05 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1 1.2 1.4 1.6 1.8 2 2.2	Delta T devices Thetaprobe ML2x

Table 1. Long-term meteorological instrumentation at Meteopole-flux

1- Meteopoleflux site

List of variables measured since 2012:



variables	Height (m)	sensor
air temperature ($^{\circ}\text{C}$)	2	Pt100 in SOCRIMA shield
air temperature ($^{\circ}\text{C}$)	10	Pt100 in SOCRIMA shield
relative humidity (%)	2	Vaisala HMP110 in SOCRIMA shield
relative humidity (%)	10	Vaisala HMP110 in SOCRIMA shield
wind speed (ms^{-1})	10	RM Young 5103
wind direction ($^{\circ}$)	10	RM Young 5103
rainfall (mm)	1	Précis-Mécanique, 3039
pressure (Pa)	2	Vaisala PTB210
shortwave radiation (upward and downward) (Wm^{-2})	3	Kipp& Zonen CNR1 ventilated
longwave radiation (upward and downward) (Wm^{-2})	3	Kipp& Zonen CNR1 ventilated
global and Diffuse components of tghe radiation (Wm^{-2})	3	Delta-T devices BF5 Sunshine Sensor
bright sunshine duration (m)	3	Delta-T devices BF5 Sunshine Sensor
brightness temperature	3	Heitronics KT15
PAR radiation	0.1 0.2 0.3	Solems, PAR/LE
aerosol optical thickness		AERONET photometer
integrated water vapor		AERONET photometer
3D wind components (ms^{-1})	3.7	Gill sonic anemometer
water vapor concentration (ms^{-1})	3.7	licor 7500
CO_2 concentration (ms^{-1})	3.7	licor 7500
turbulent fluxes (sensible, latent and CO_2) (Wm^{-2})	3.7	Eddy-covariance method with sonic anemometer and Licor
leaf-Wetness Sensor	1	Campbell 237-L
leaf Aera Index	-	
soil flux	0.05	Hukseflux HFP01
soil temperature ($^{\circ}\text{C}$)	0.01 0.03 0.05 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1 1.2 1.4 1.6 1.8 2 2.2	EuroSensors, PT1000
soil humidity	0.05 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1 1.2 1.4 1.6 1.8 2 2.2	Delta T devices Thetaprobe ML2x

Table 1. Long-term meteorological instrumentation at Meteopole-flux

1- Meteopoleflux site

List of variables measured since 2012:



variables	Height (m)	sensor
air temperature ($^{\circ}\text{C}$)	2	Pt100 in SOCRIMA shield
air temperature ($^{\circ}\text{C}$)	10	Pt100 in SOCRIMA shield
relative humidity (%)	2	Vaisala HMP110 in SOCRIMA shield
relative humidity (%)	10	Vaisala HMP110 in SOCRIMA shield
wind speed (ms^{-1})	10	RM Young 5103
wind direction ($^{\circ}$)	10	RM Young 5103
rainfall (mm)	1	Précis-Mécanique, 3039
pressure (Pa)	2	Vaisala PTB210
shortwave radiation (upward and downward) (Wm^{-2})	3	Kipp& Zonen CNR1 ventilated
longwave radiation (upward and downward) (Wm^{-2})	3	Kipp& Zonen CNR1 ventilated
global and Diffuse components of tge radiation (Wm^{-2})	3	Delta-T devices BF5 Sunshine Sensor
bright sunshine duration (m)	3	Delta-T devices BF5 Sunshine Sensor
brightness temperature	3	Heitronics KT15
PAR radiation	0.1 0.2 0.3	Solems, PAR/LE
aerosol optical thickness		AERONET photometer
integrated water vapor		AERONET photometer
3D wind components (ms^{-1})	3.7	Gill sonic anemometer
water vapor concentration (ms^{-1})	3.7	licor 7500
CO_2 concentration (ms^{-1})	3.7	licor 7500
turbulent fluxes (sensible, latent and CO_2) (Wm^{-2})	3.7	Eddy-covariance method with sonic anemometer and Licor
leaf-Wetness Sensor	1	Campbell 237-L
leaf Aera Index	-	
soil flux	0.05	Hukseflux HFP01
soil temperature ($^{\circ}\text{C}$)	0.01 0.03 0.05 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1 1.2 1.4 1.6 1.8 2 2.2	EuroSensors, PT1000
soil humidity	0.05 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1 1.2 1.4 1.6 1.8 2 2.2	Delta T devices Thetaprobe ML2x

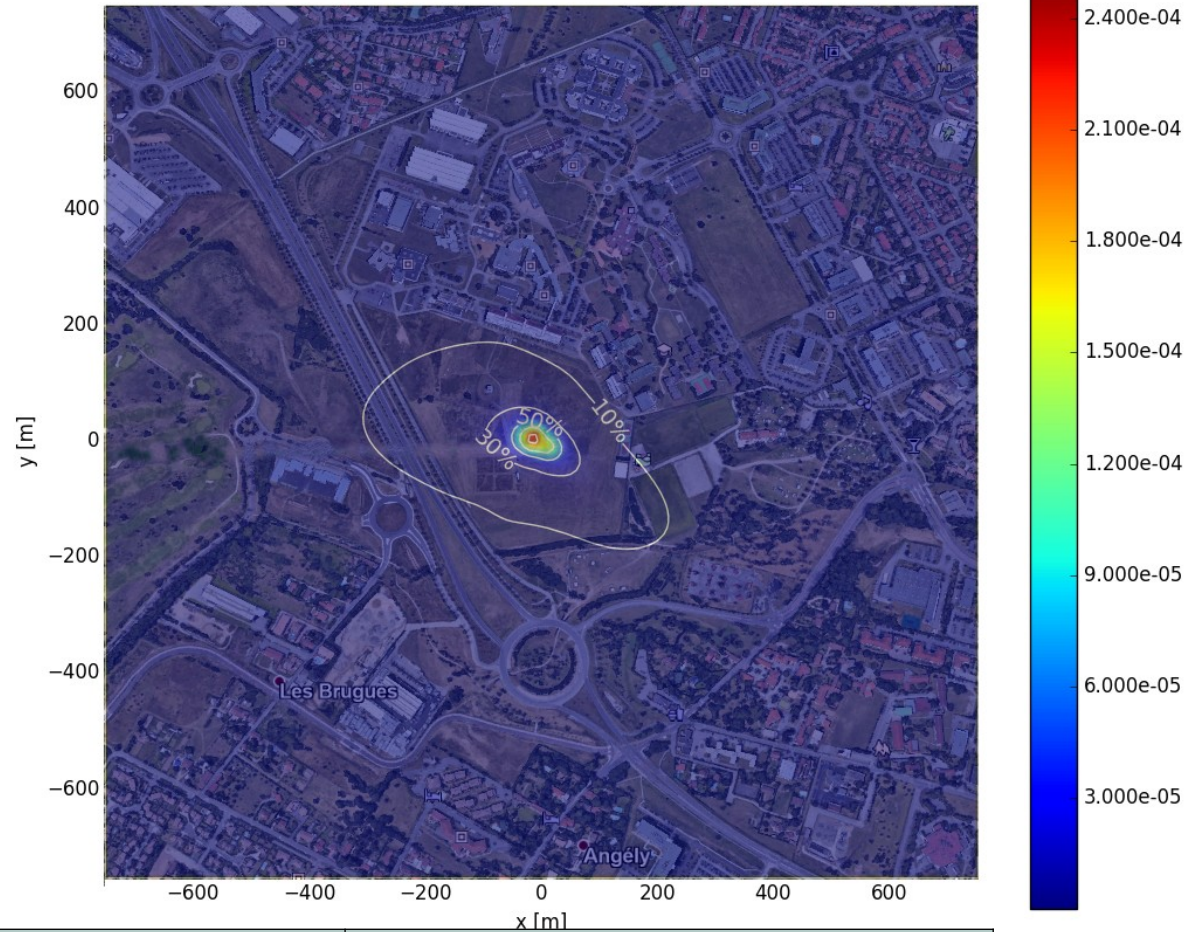
Table 1. Long-term meteorological instrumentation at Meteopole-flux

1- Meteopoleflux site

90% of the footprint is located on urban grassland



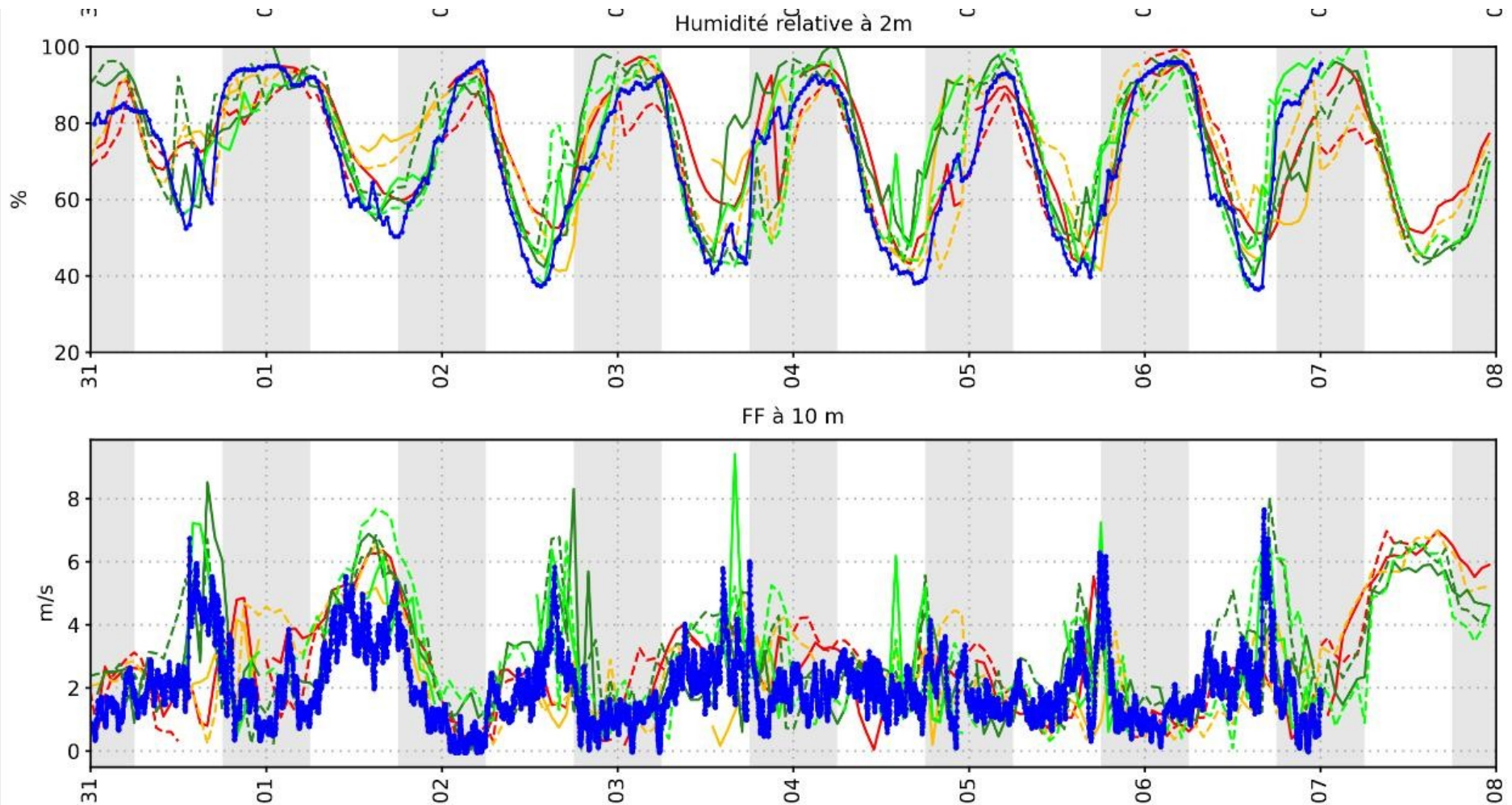
Mean annual footprint [2D Kljun model (2014)] :



Mean Annual rainfall	Min-max Leaf Area index	Mean Shortwave down	Soil composition
550mm	1-3	158 W/m2	0-20 cm = clay // 20-50 cm = clay/rock 20-200 = rock // >200 = sand

2- Current observation-model evaluation

Every day, temporal evolution of thermodynamical parameters between operational AROME/ARPEGE and observations

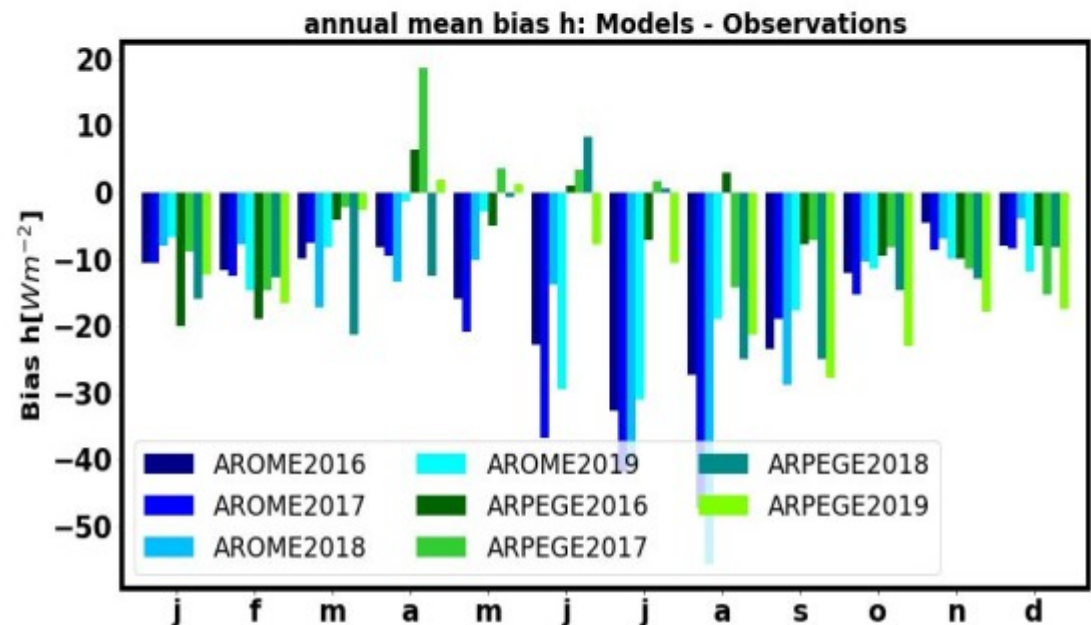
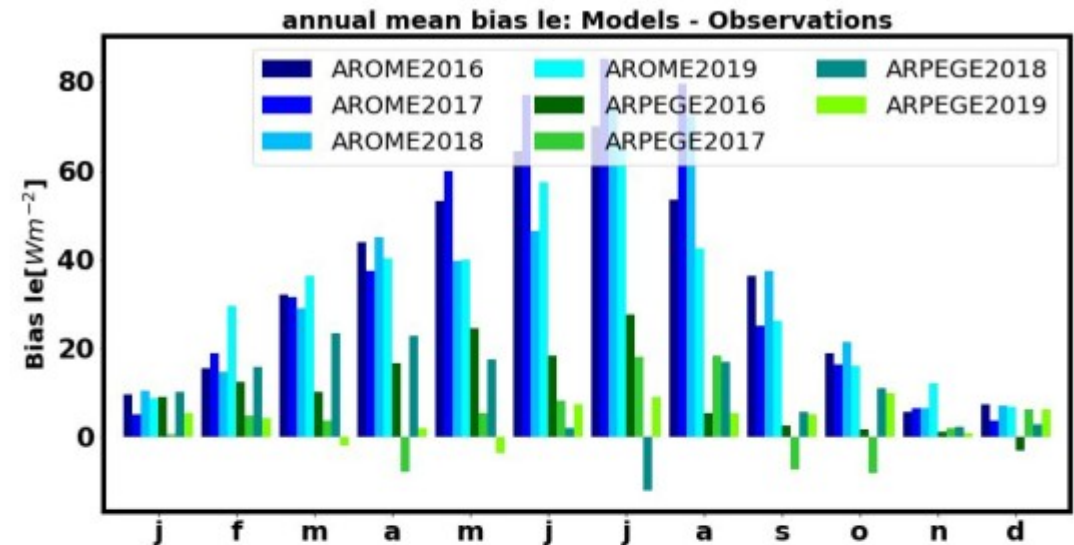


2- Current observation–model evaluation

Multi-year studies:

- Similar behavior with systematic seasonal biases
- The closest point is not necessarily representative of the cover

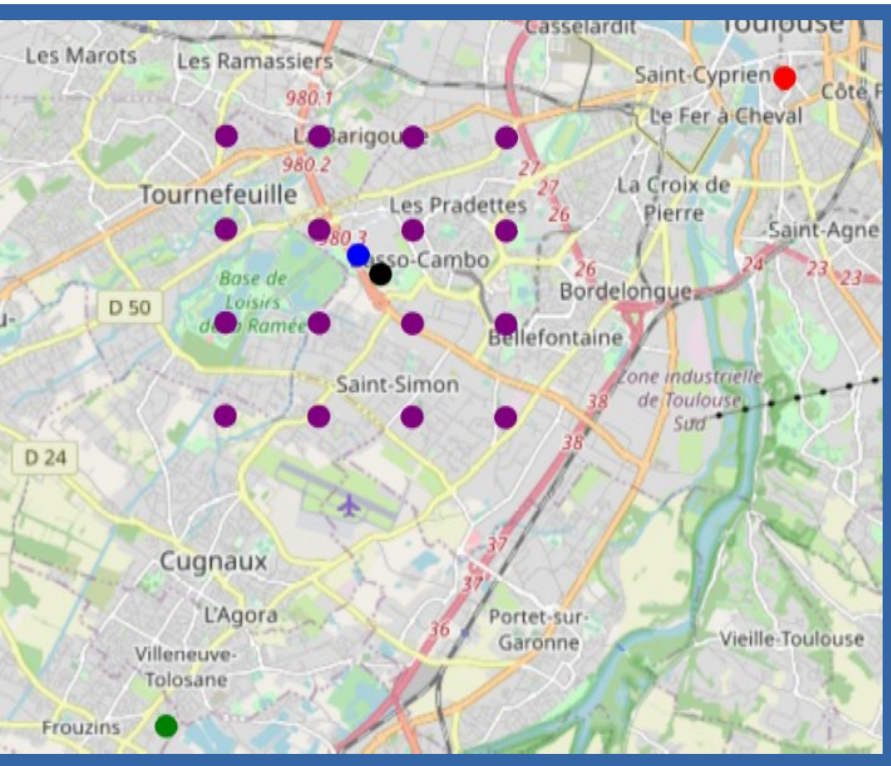
Implementation of comparisons on close points but with different covers



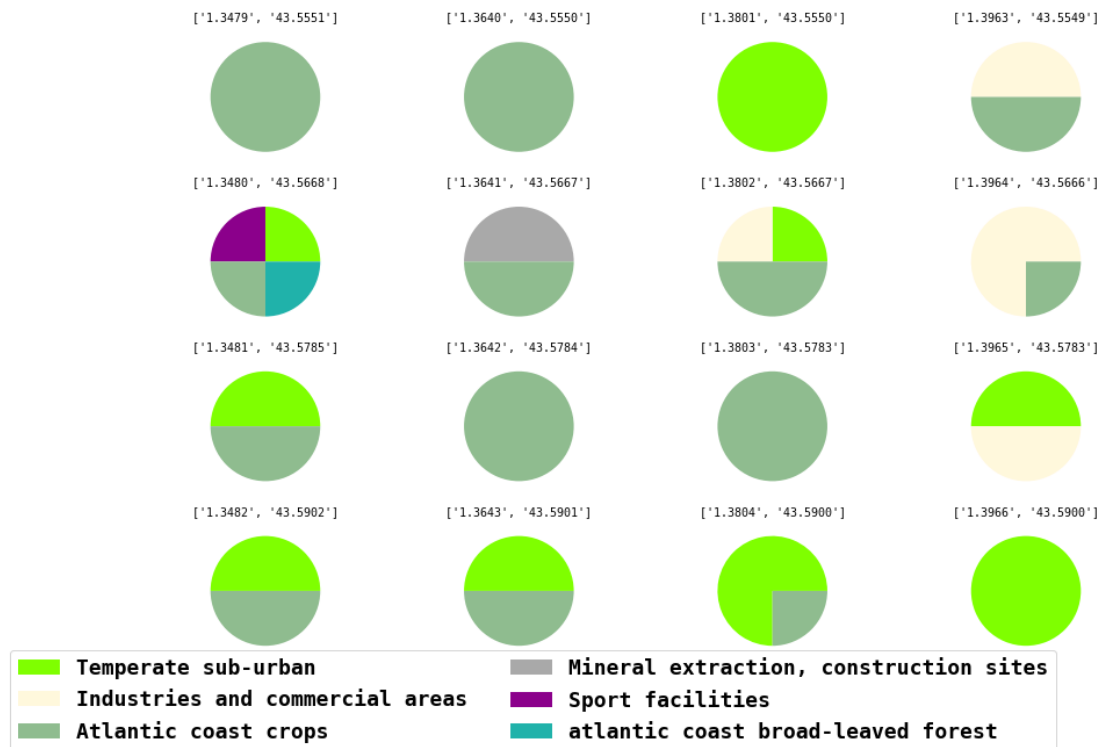
2- Current observation–model evaluation

16 AROME points around the site

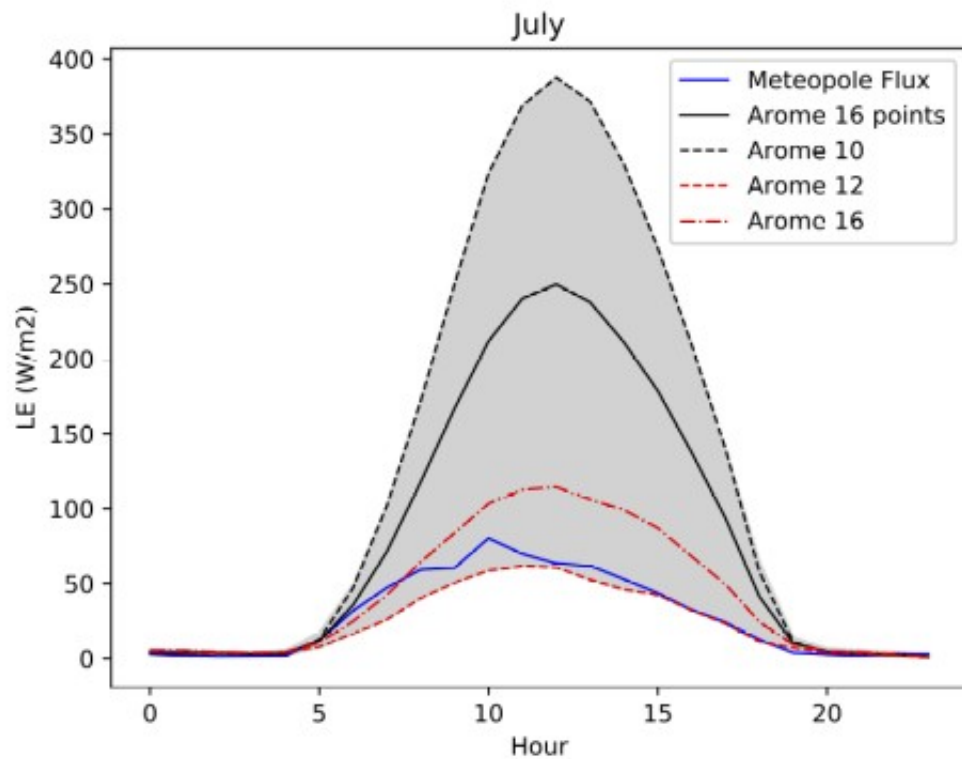
-save 1 netcdf file per day since 2020 with thermodynamical parameters



Differents covers :



2- Current observation–model evaluation



Diurnal cycle of latent heat in July:

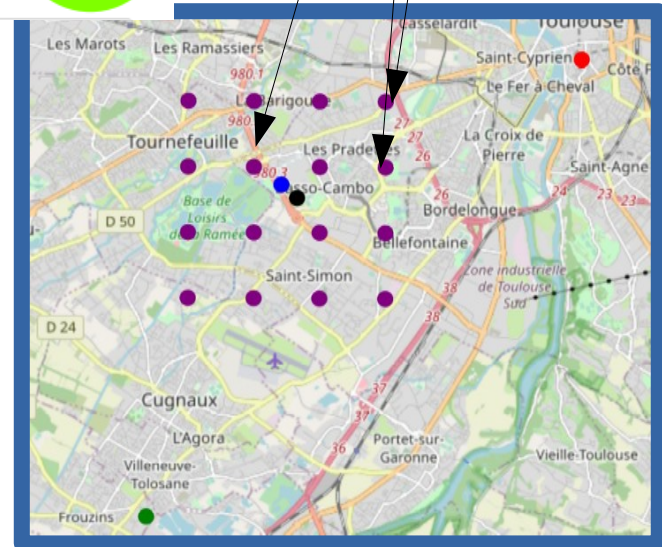
→ Strong dependence on surface type

Other points have a more realistic representation of latent heat

Temperate sub-urban
Industries and commercial areas
Atlantic coast crops

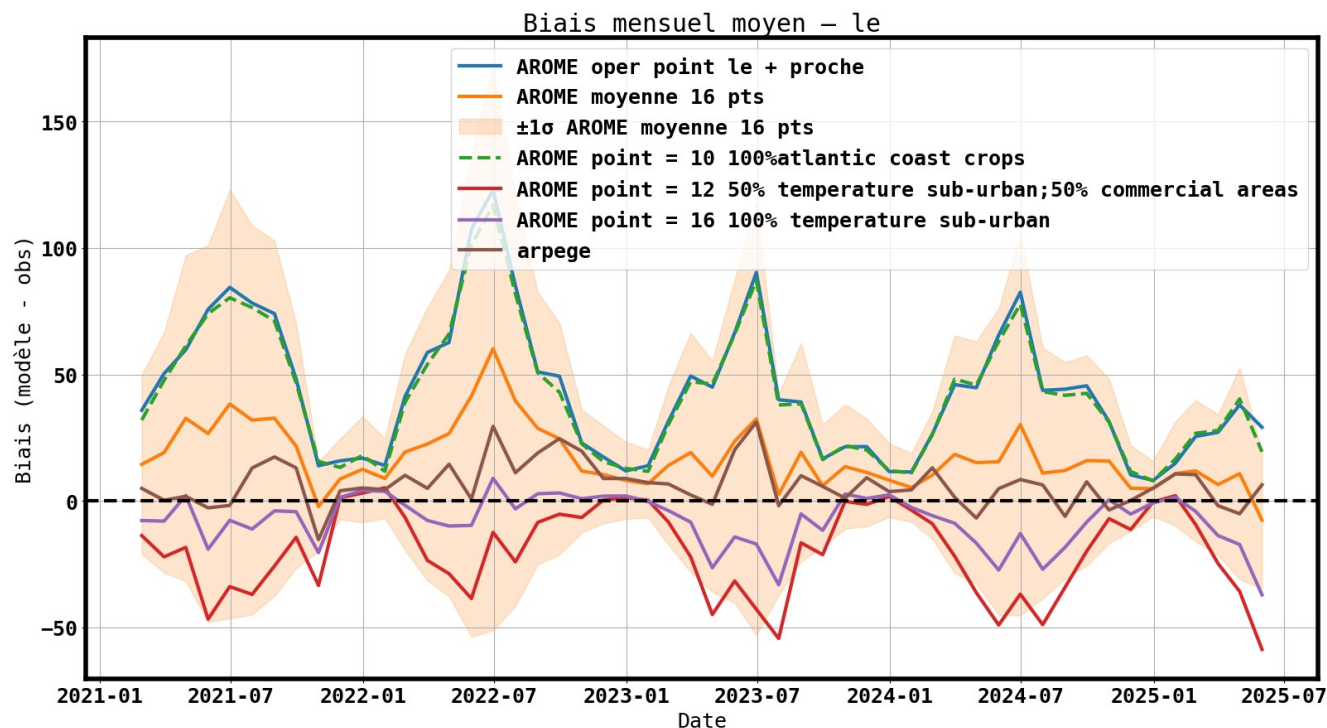


Points	Cover
10	100% grassland
12	50% grassland / 50% sub-urban
16	100% sub-urban



2- Current observation–model evaluation

Meteopoleflux – 4-year summary of daily intercomparisons – use of different points with various land covers



3- Data availability

- **Turbulent fluxes : 1 netcdf file everyday AERIS database**
- **Mean parameters : 1 netcdf file/year since 2013**

Contact : Jean-claude.etienne@meteo.Fr ; Guylaine.canut@meteo.fr

Lien aeris database :

<https://www.aeris-data.fr/catalogue/?keywords=%5B%22meteopole%22%2C%22flux%22%5D¤tSelection=37046d89-d3cc-4657-97ea-c89e67636ee3>

4-Conclusions/perspectives

- Data available for models evaluations (atmospheric and soil parameters)
- It is necessary to consider a point representative of the surface and not the nearest point
- Ongoing work with the AERIS database to make the daily comparisons visible outside of CNRM on Meteopoleflux and 3 other French stations

<http://intra.cnrm.meteo.fr/MeteopoleX/>

5- MeteopoleX

