A preliminary study on the "explicit" integration of building heights in the high resolution AROME model.

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47th EWGLAM and 32th SRNWP Meeting
SMHI, Norrköping 22-25 September 2025

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&
physics update for the next AROME e-suite

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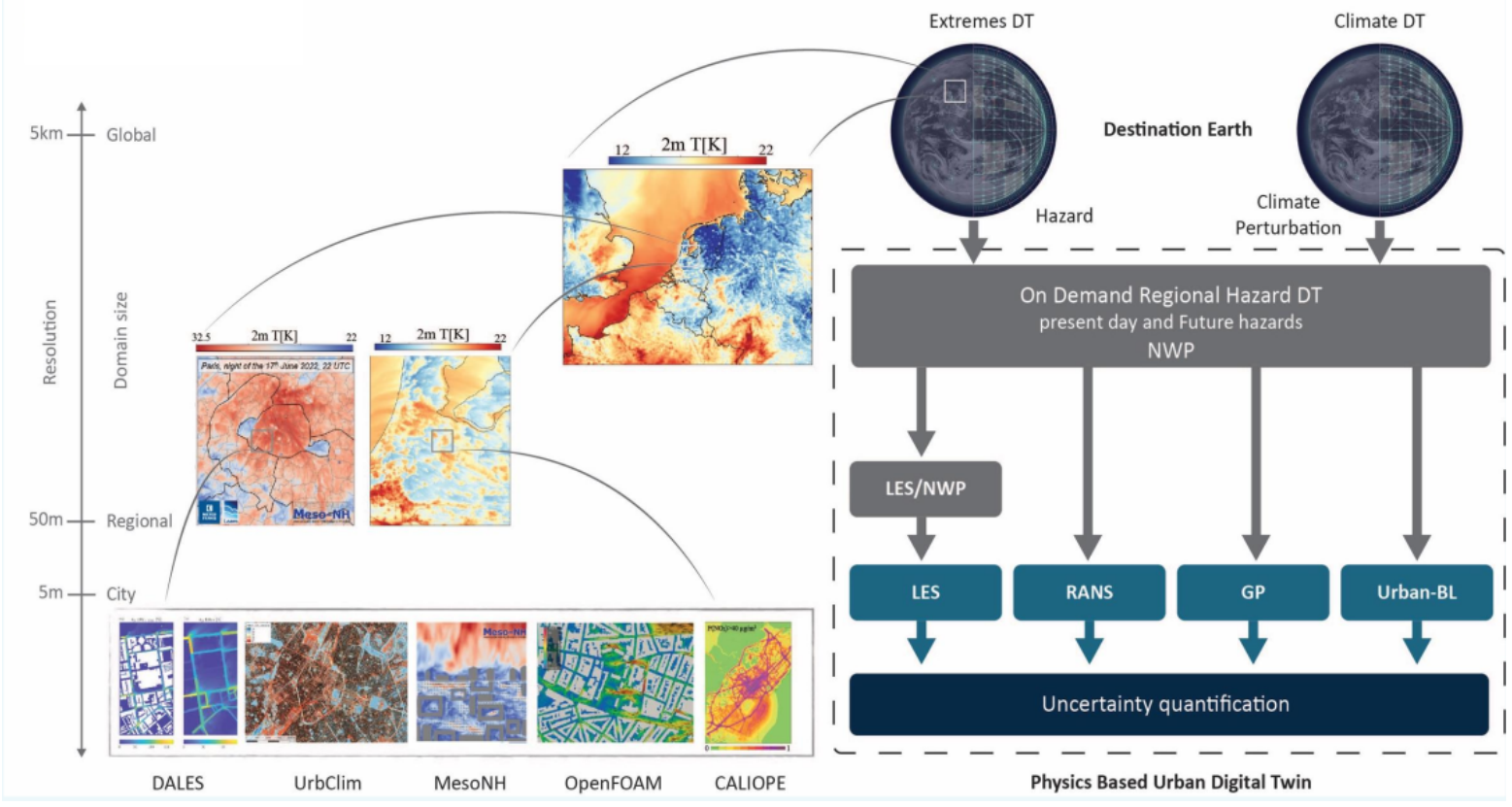
Context

- **UrbanAir Projet** (HORIZON-INFRA-2024-TECH-01-03) lead by Femke Vossepoel (TU Delft)

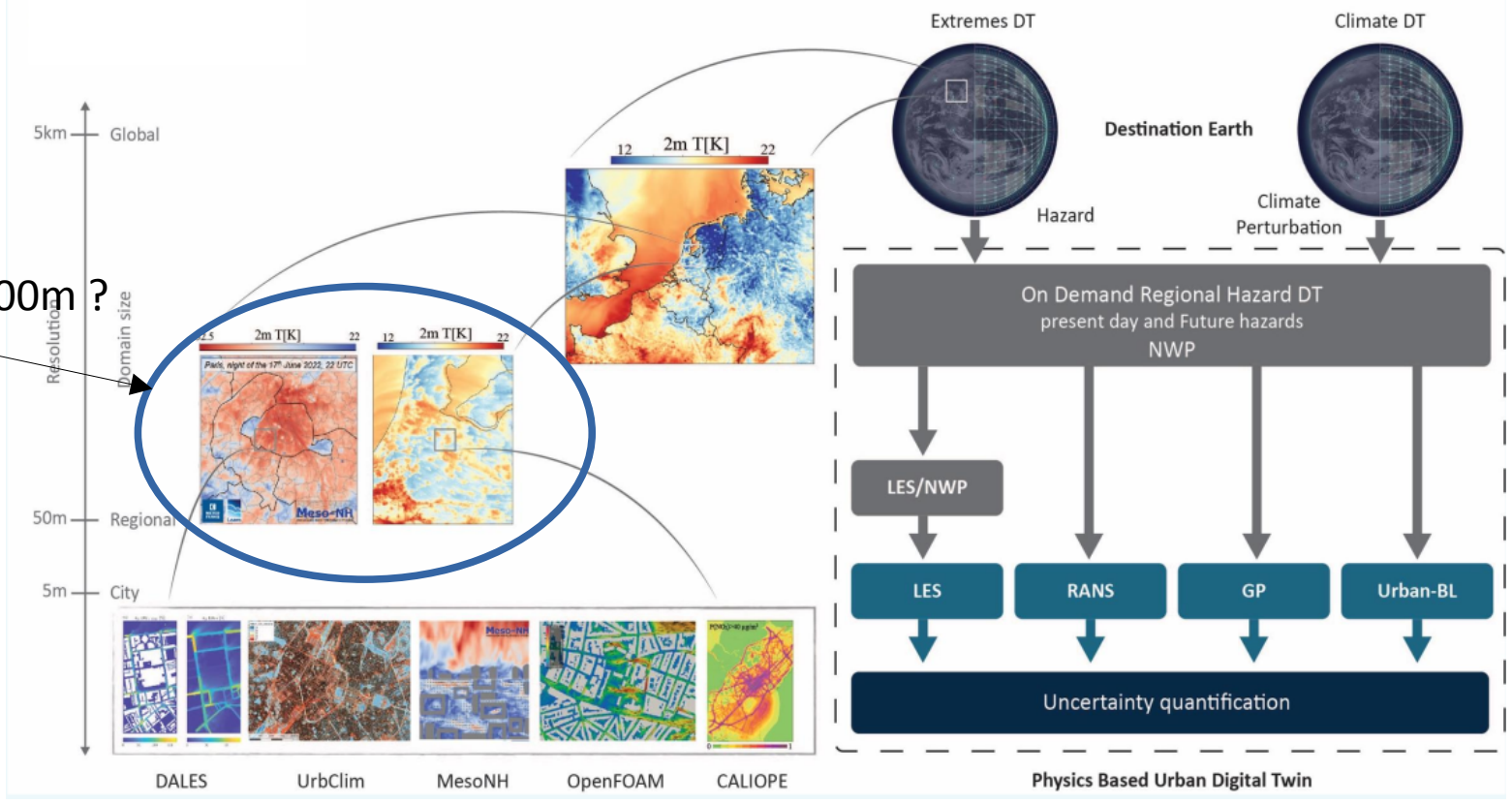


Courtesy N. Theeuwes

Context

- **UrbanAir Projet** (HORIZON-INFRA-2024-TECH-01-03) lead by Femke Vossepoel (TU Delft)

NWP models
@200m → 100m ?

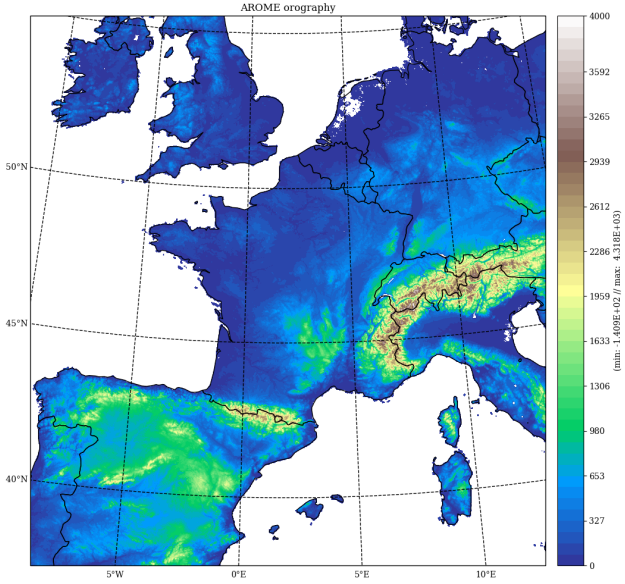


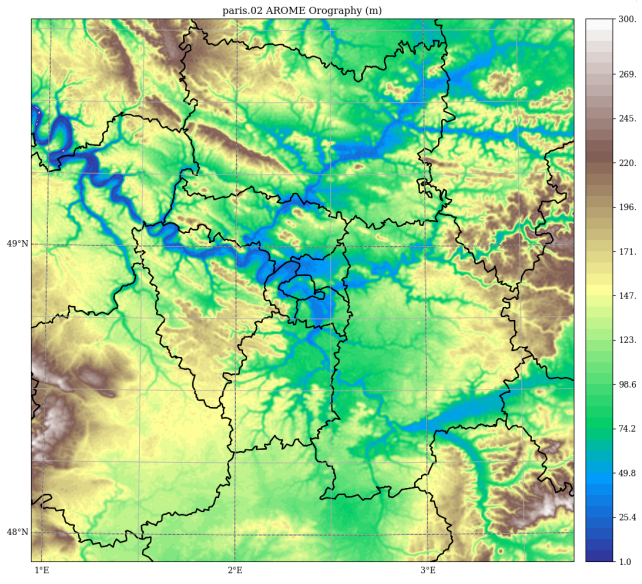
Courtesy N. Theeuwes

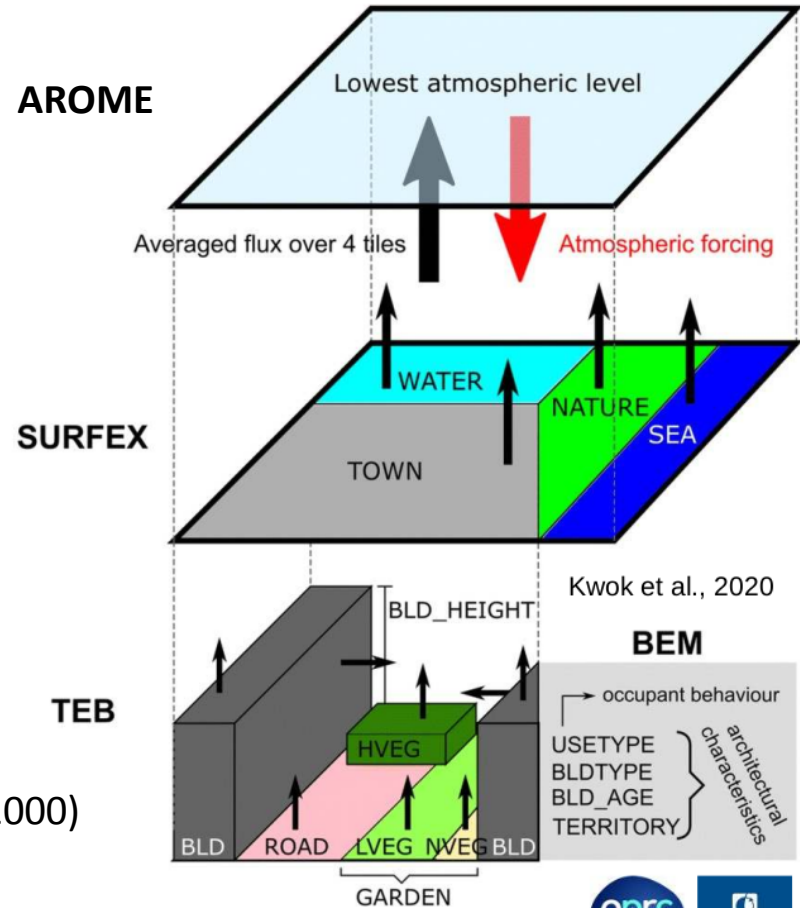
Urban area in AROME

AROME-France (1440x1536 pts): 1.3km L90 (1st level at 5m)

AROME-Paris: (512x512 pts): 500m
L120 (1st level at 2.5m)
More details in Salomé et al. (2024)
ACCORD Newsletter n°6



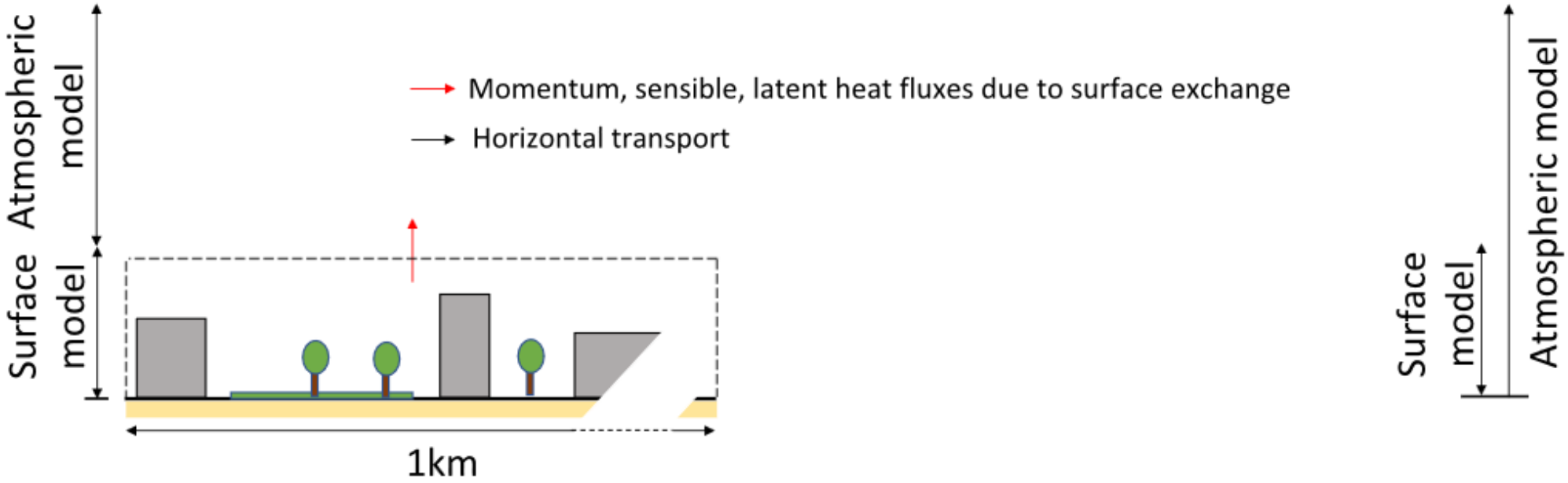




Urban Area is parametrized with TEB (Masson 2000)

UrbanAIR

Interaction between surface and atmospheric model



From Lean, H.W., et al. (2024) The hectometric modelling challenge: Gaps in the current state of the art and ways forward towards the implementation of 100-m scale weather and climate models. Quarterly Journal of the Royal Meteorological Society, 150(765), 4671–4708. Available from: https://doi.org/10.1002/qj.4858

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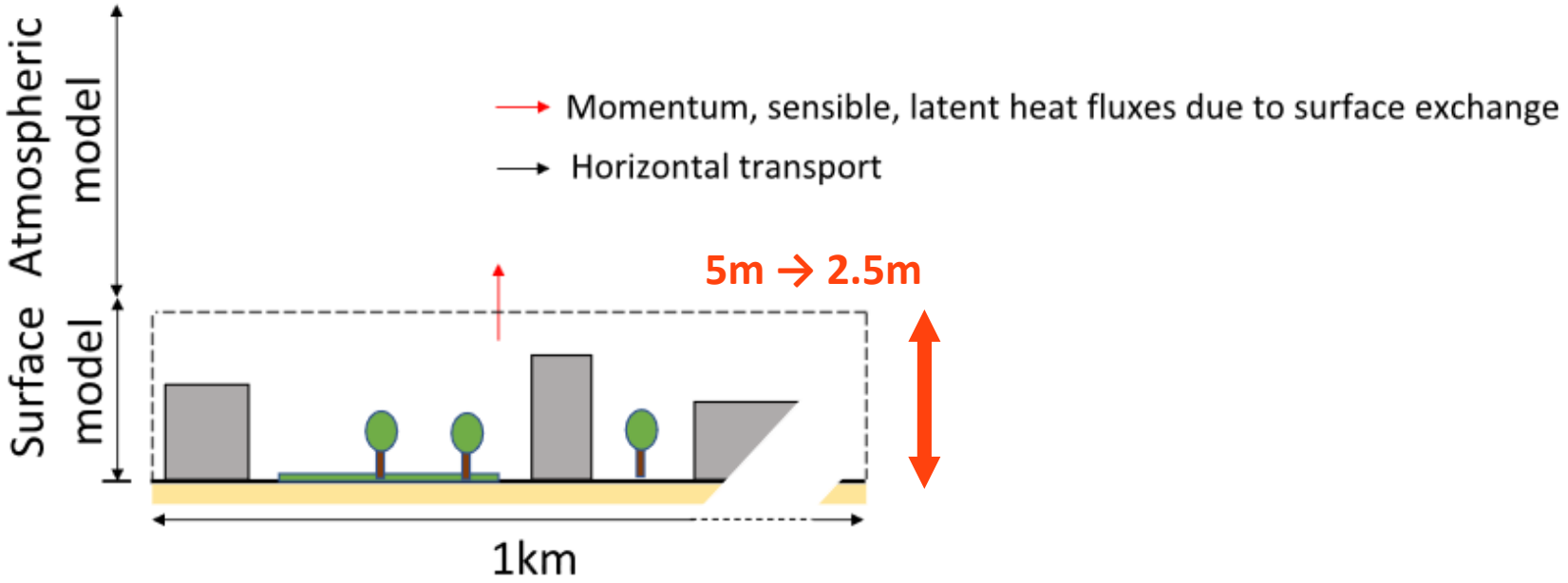

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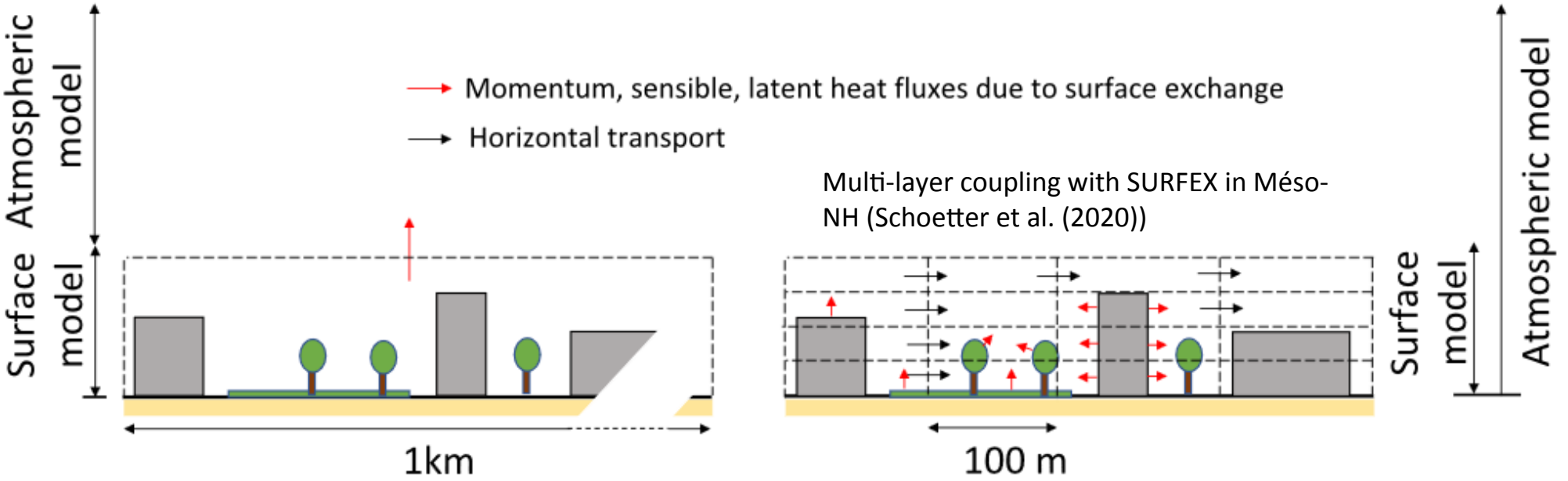

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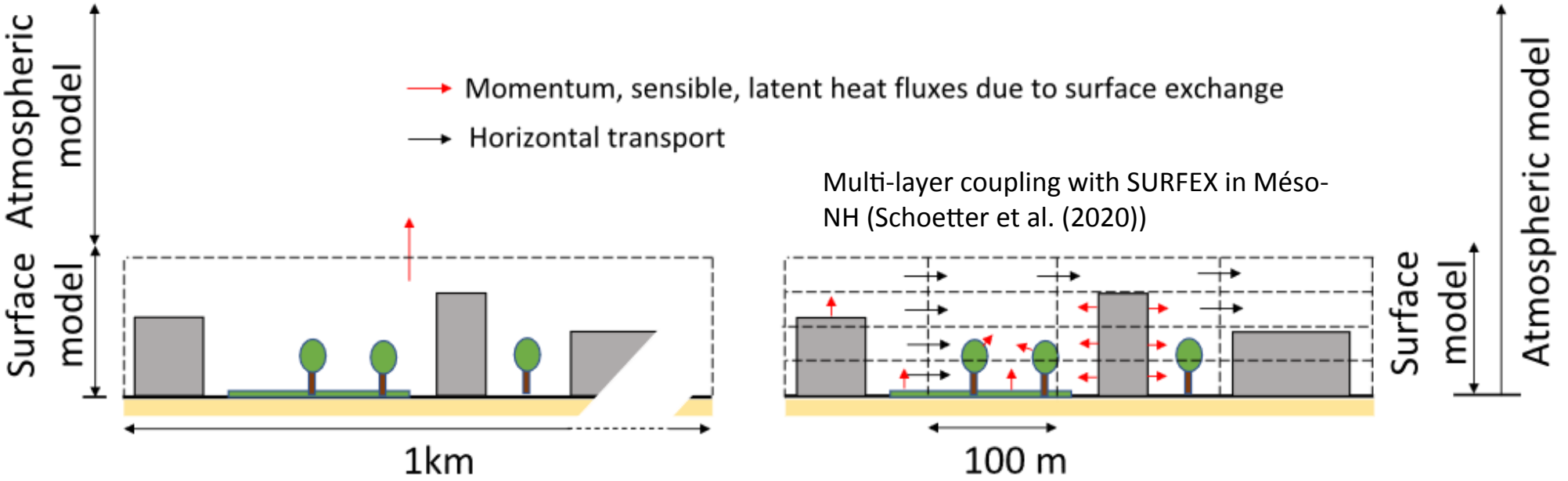

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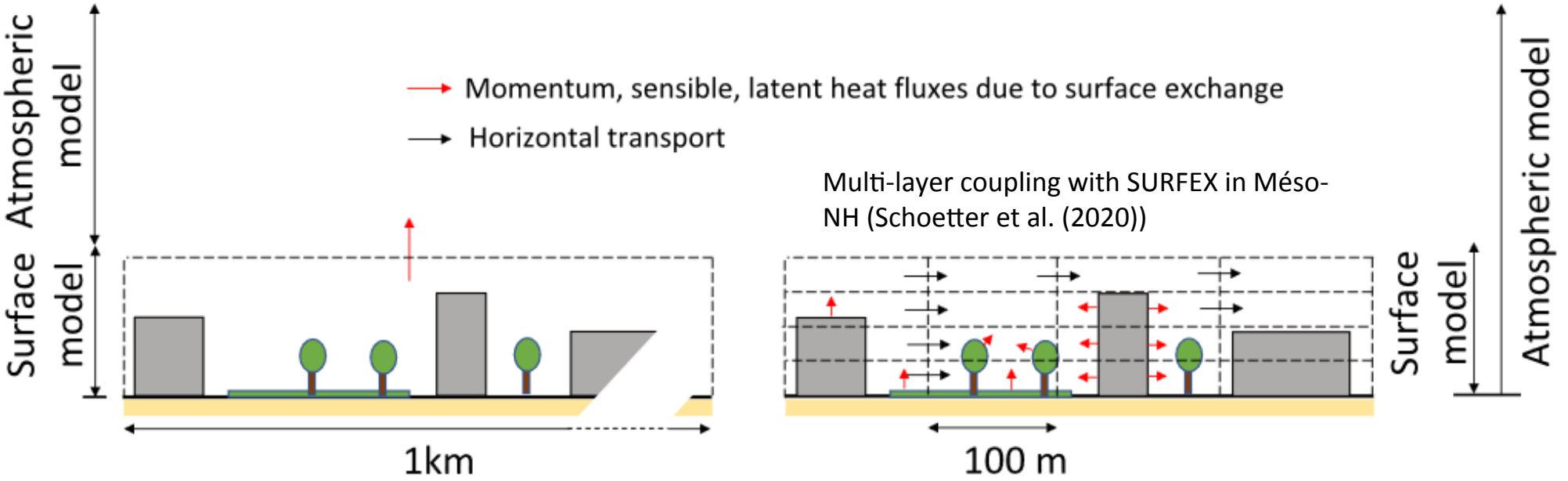


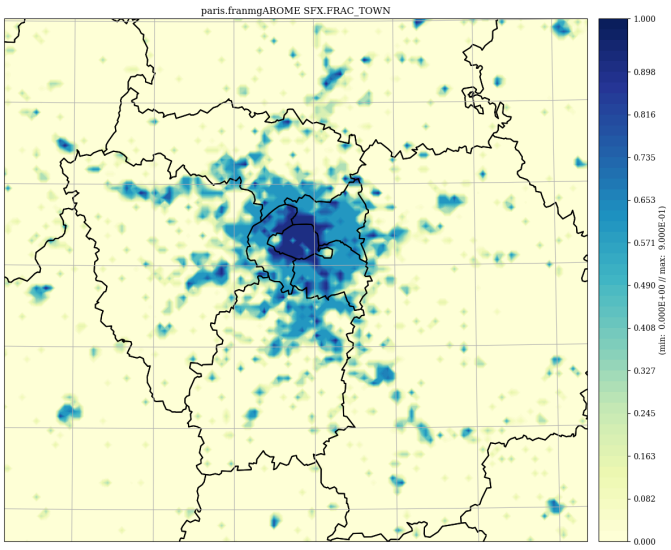
An other option is to modify the input orography by adding the building height

+++ the dynamic will really see the building effect such as fjords or cliff !

--- increase the slope and subgrid scale variability --> more numerics and physics problem ?

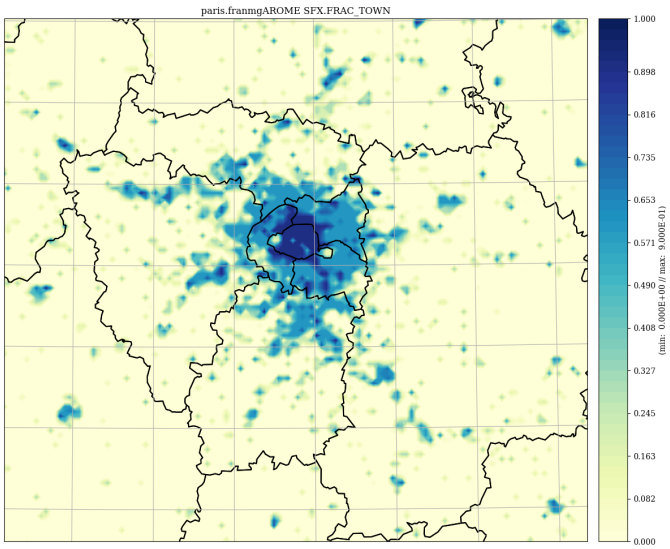
Urban area in AROME

AROME-France-1.3km

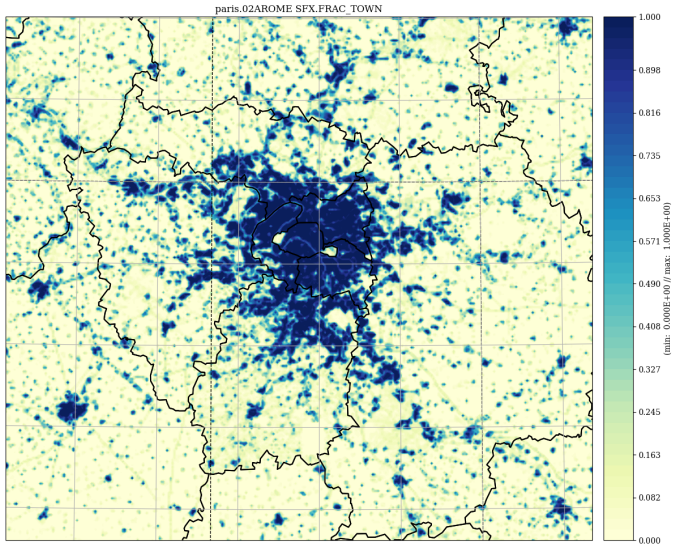


Urban area in AROME

AROME-France-1.3km

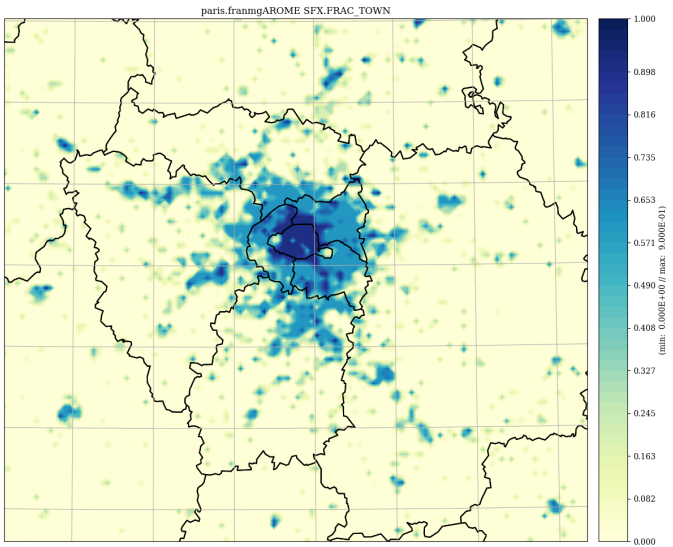


AROME-Paris_500m
with OpenStreetMap



Urban area in AROME

AROME-France-1.3km



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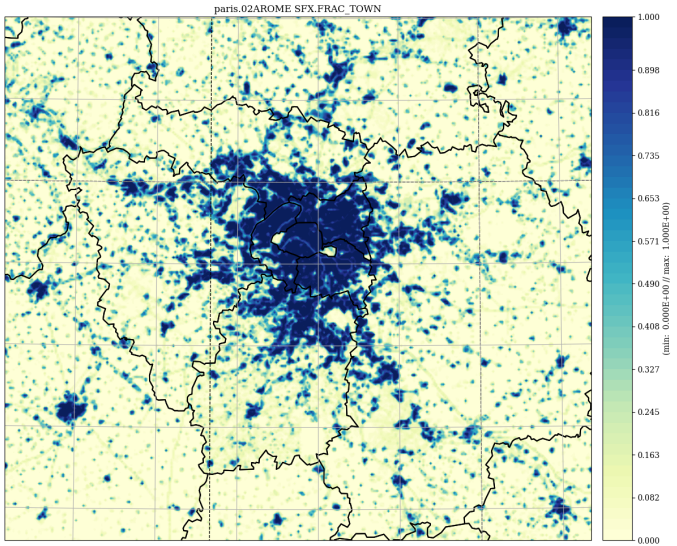
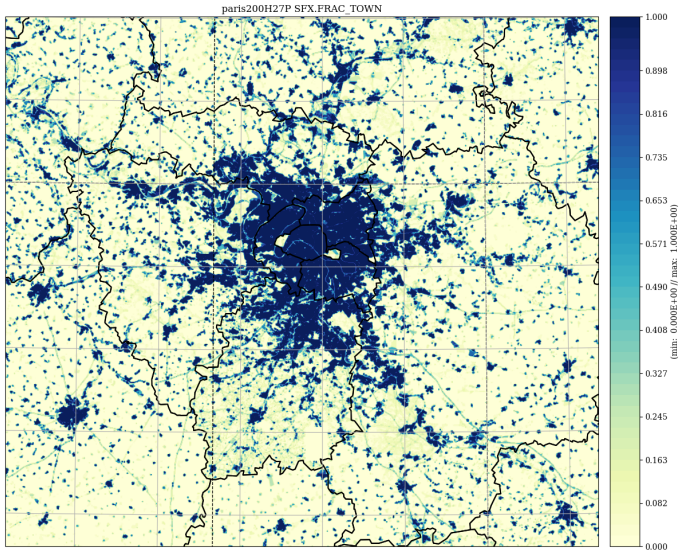


AROME-200m
With OpenStreetMap



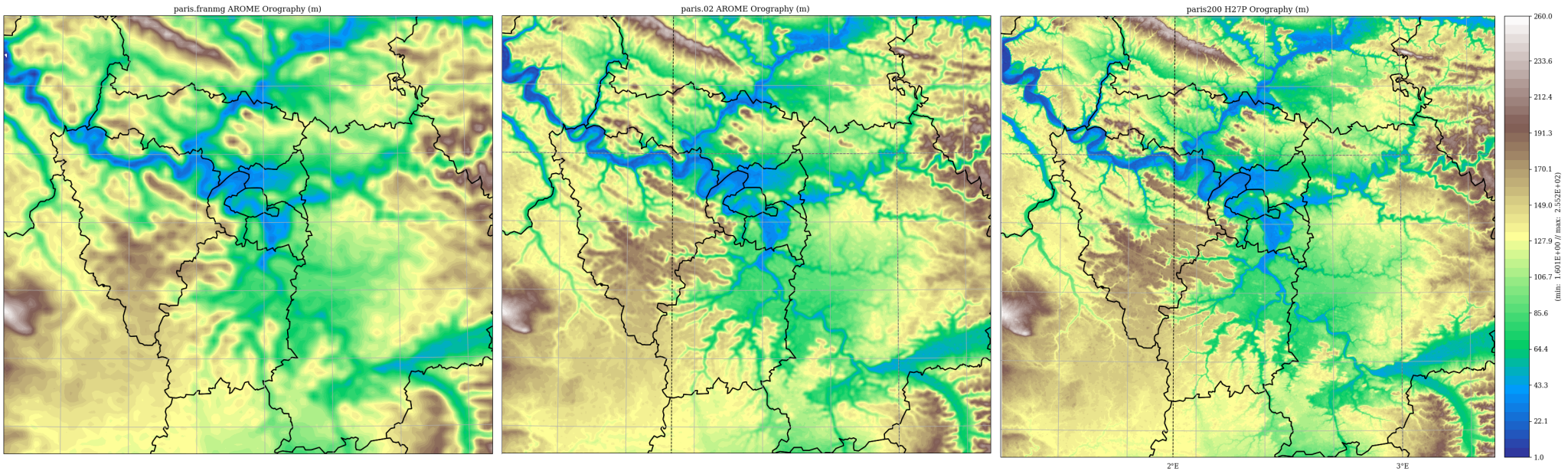
More details and more Urban Area for AROME-Paris-500m and at 200m with OpenStreetMap data

Orography in AROME

AROME-France-1.3km

AROME-Paris-500m

AROME-200m



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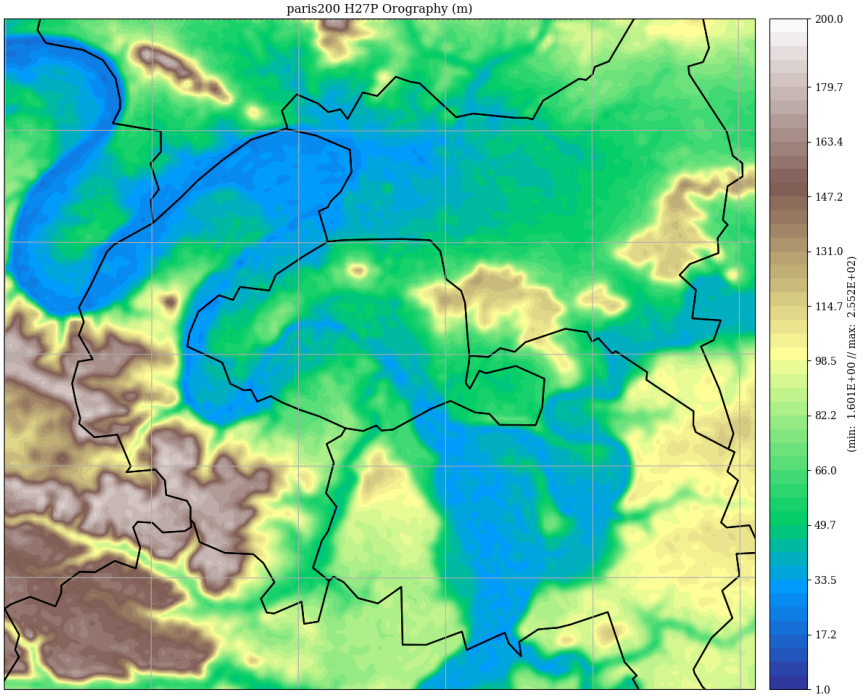
Building Height impact @200m

By adding the building height to the input orography data



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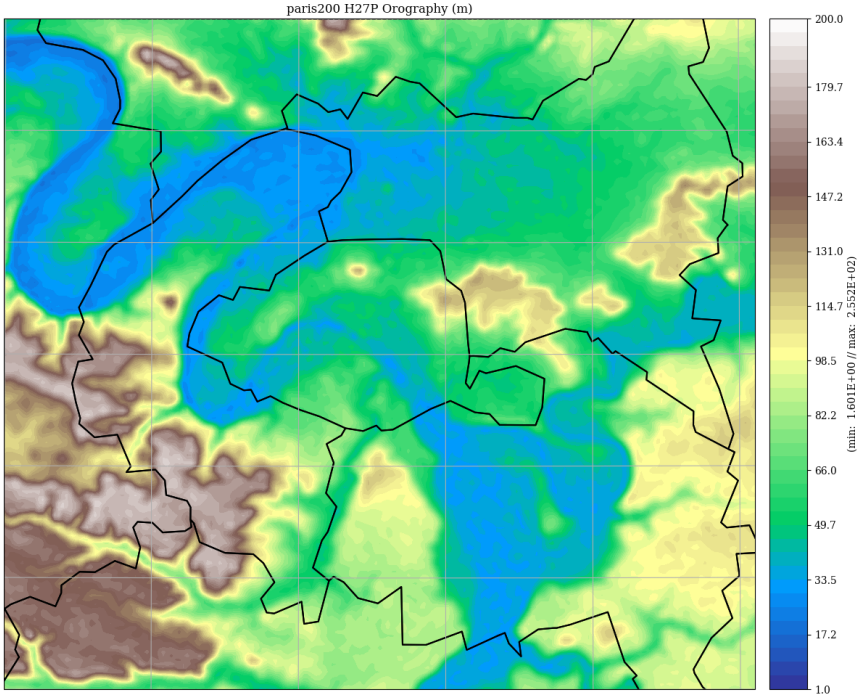
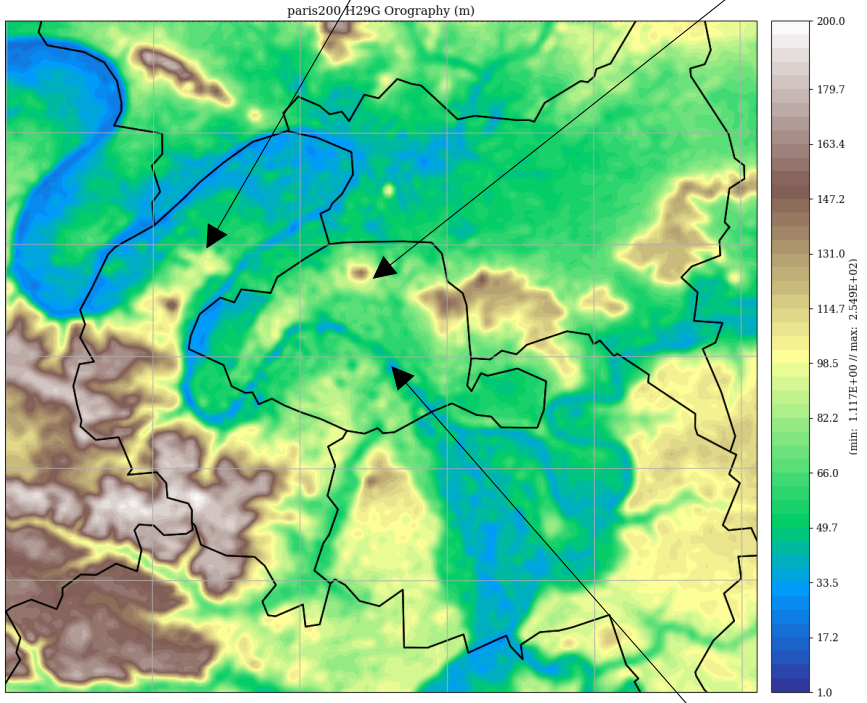


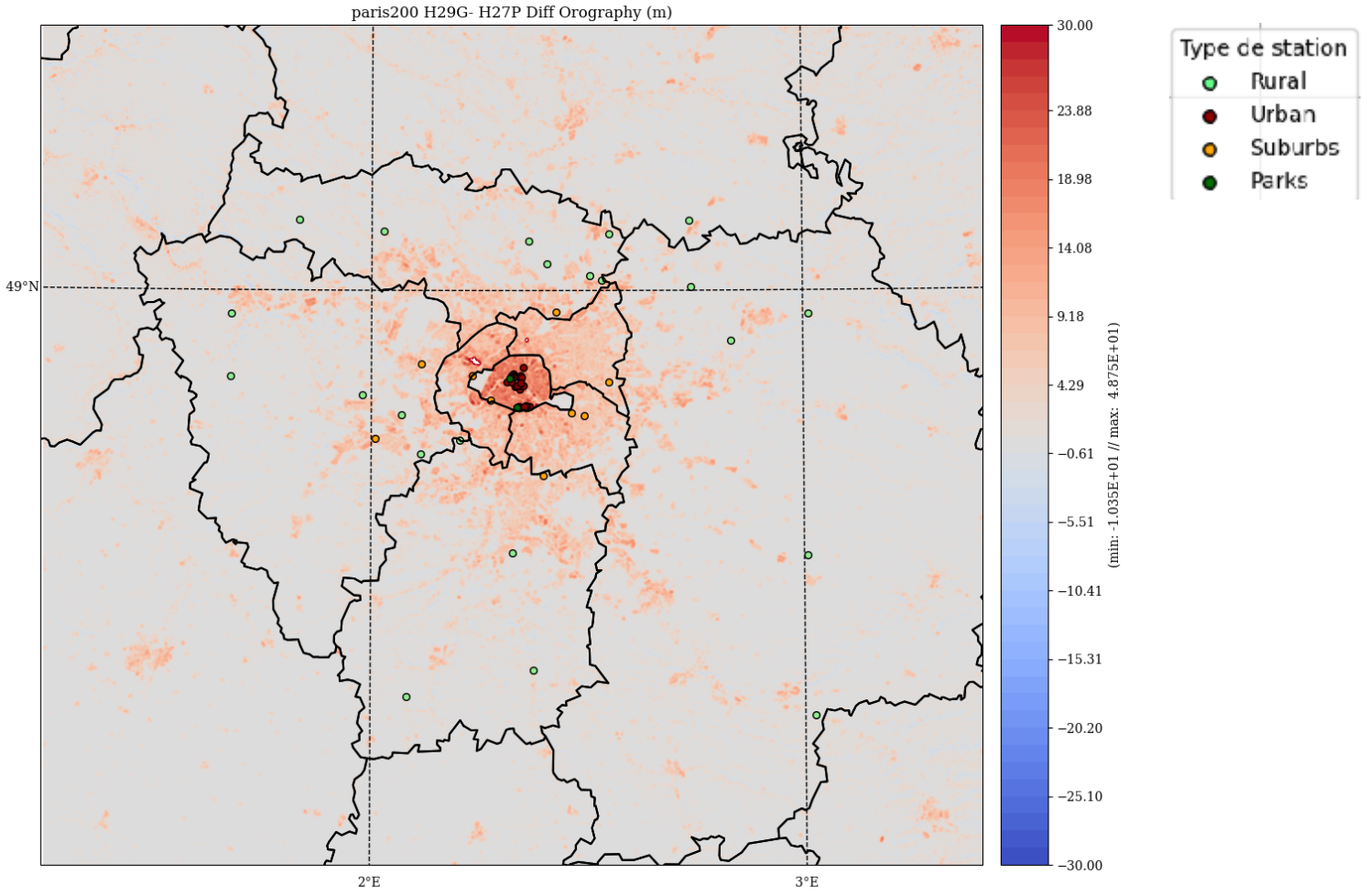


La Défense

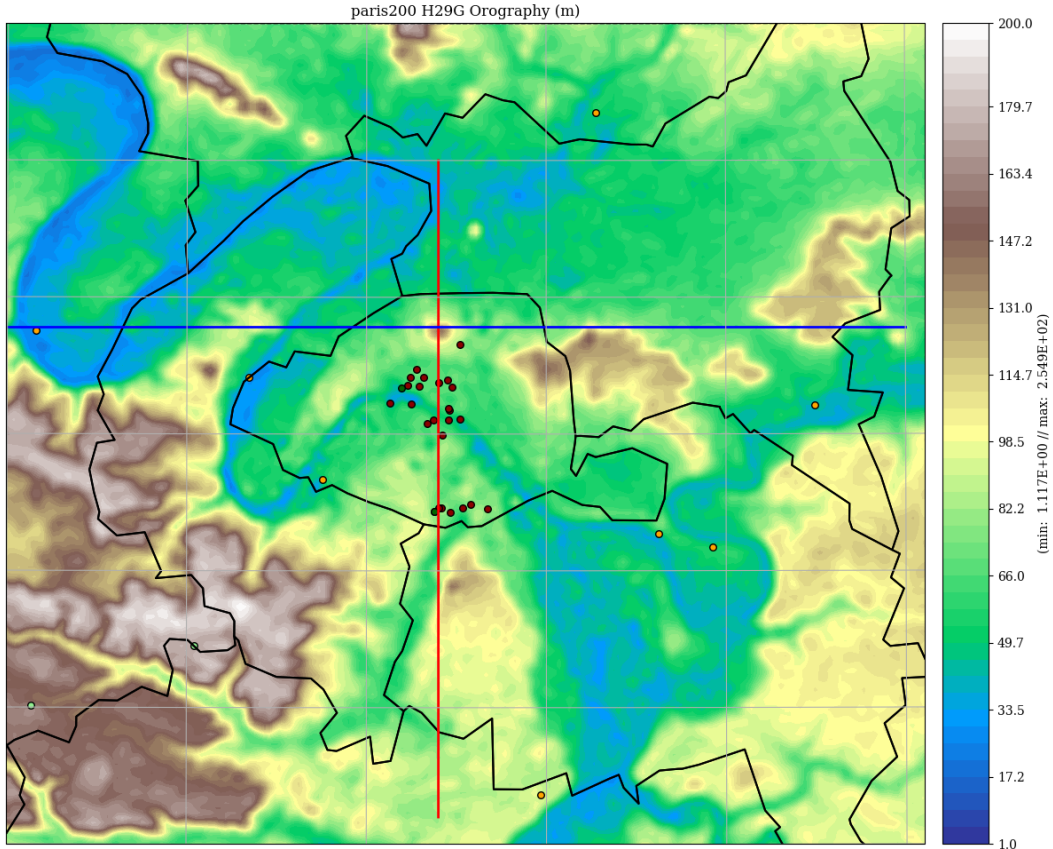
Montmarte

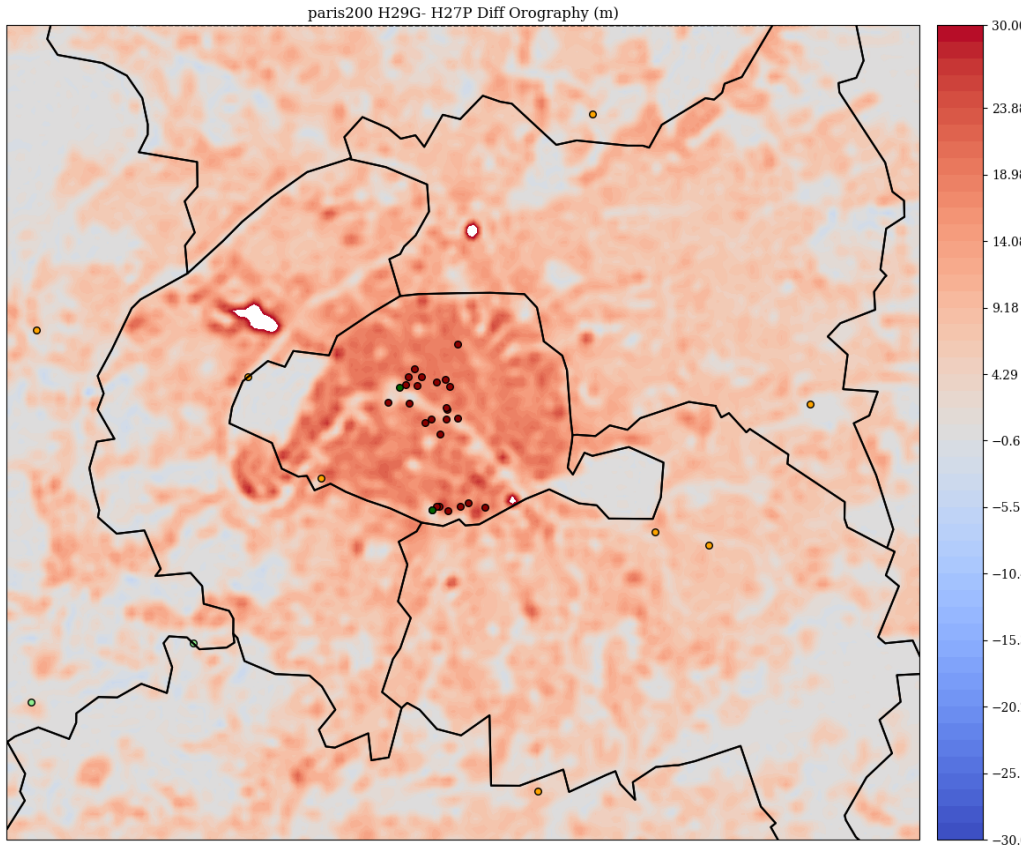
The Seine river

Building Height impact

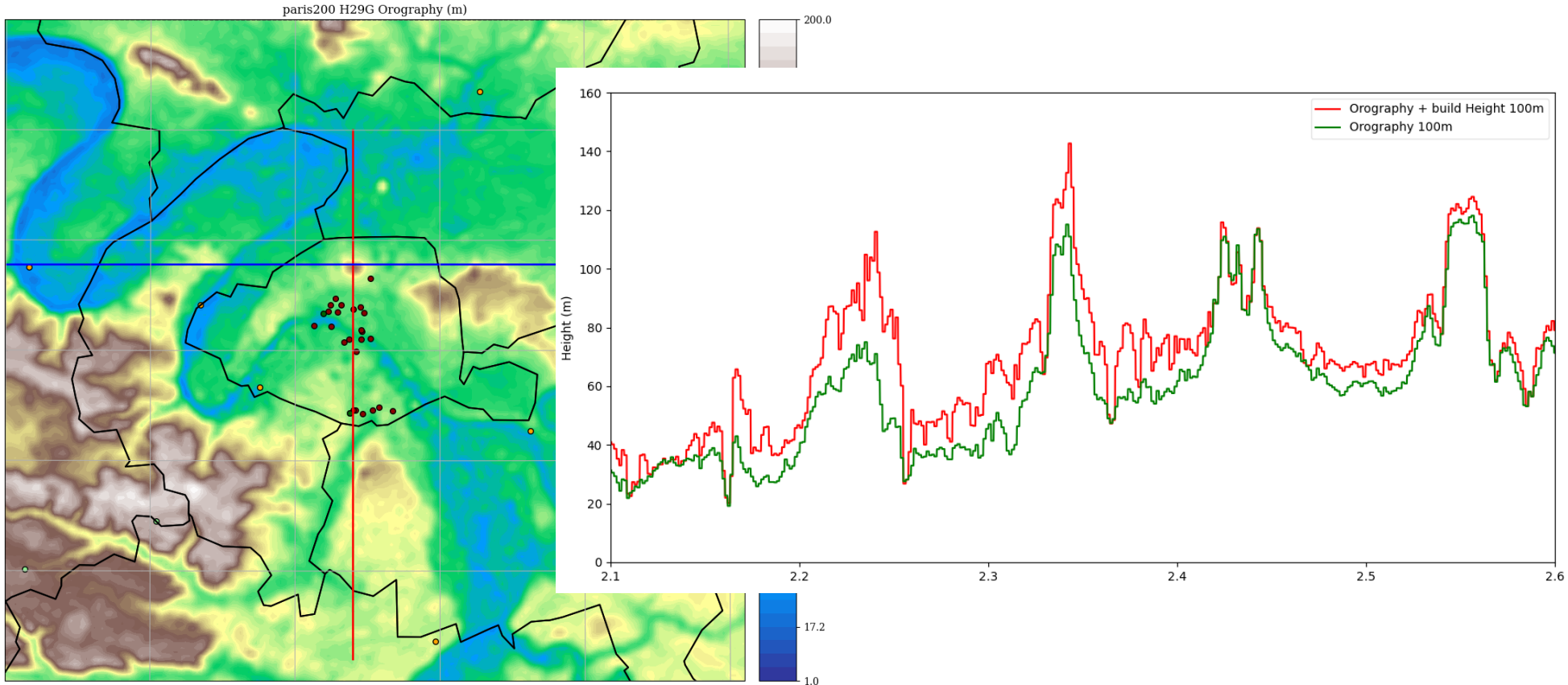


Building Height impact





Building Height impact



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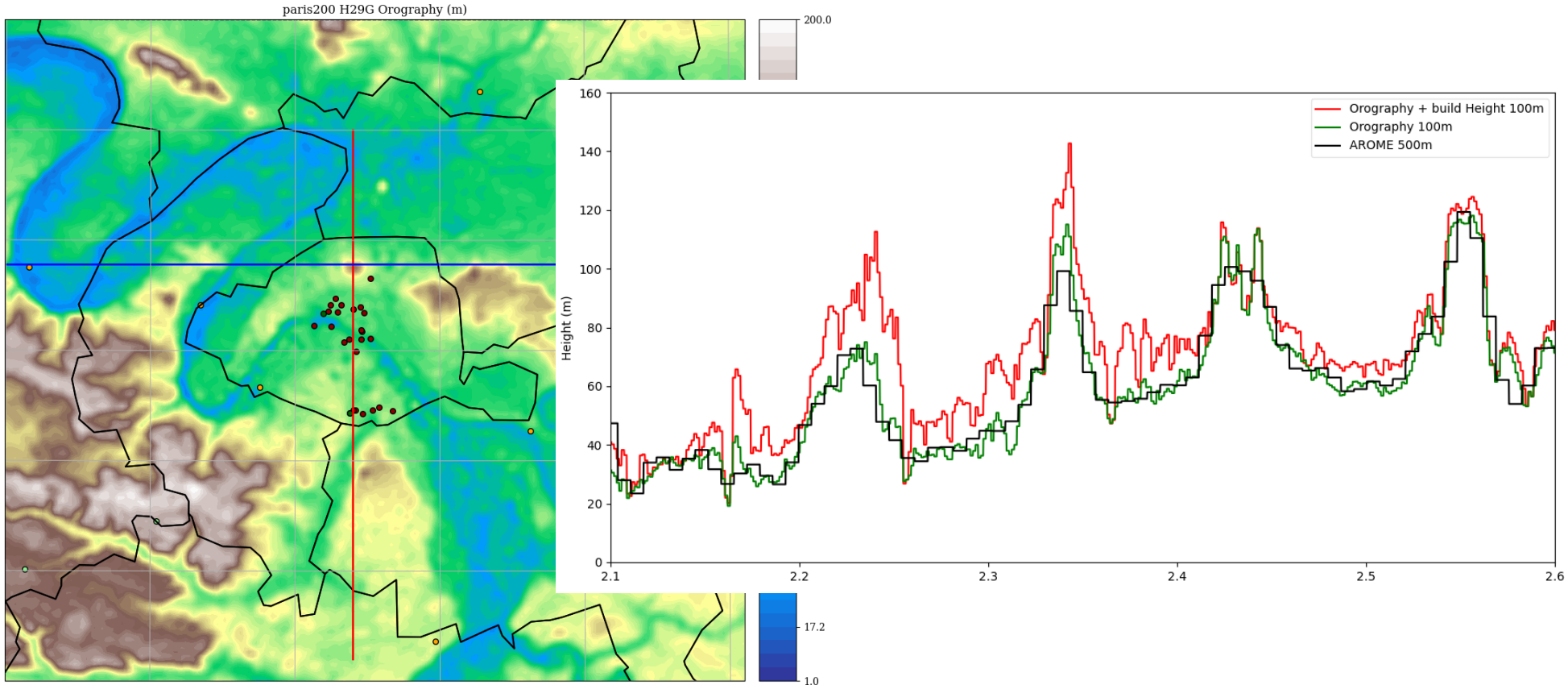
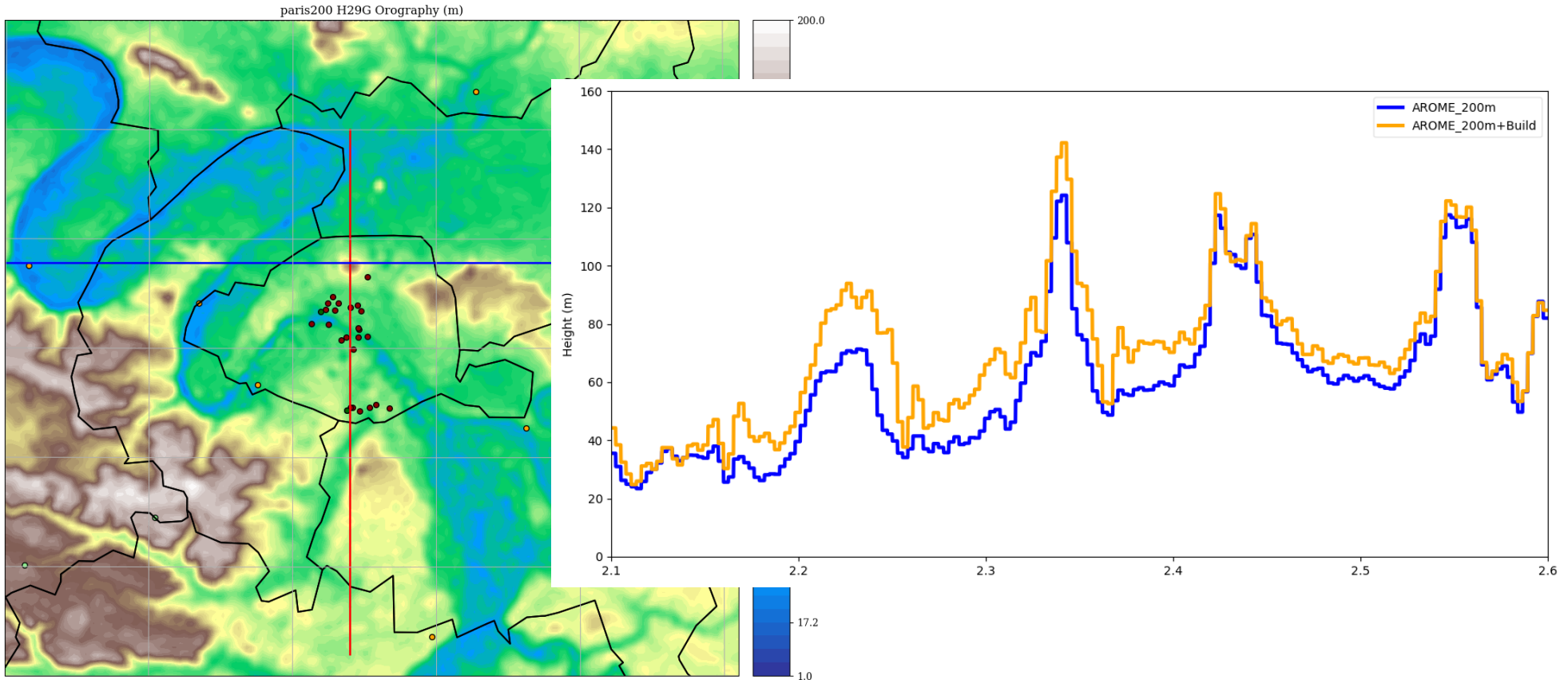
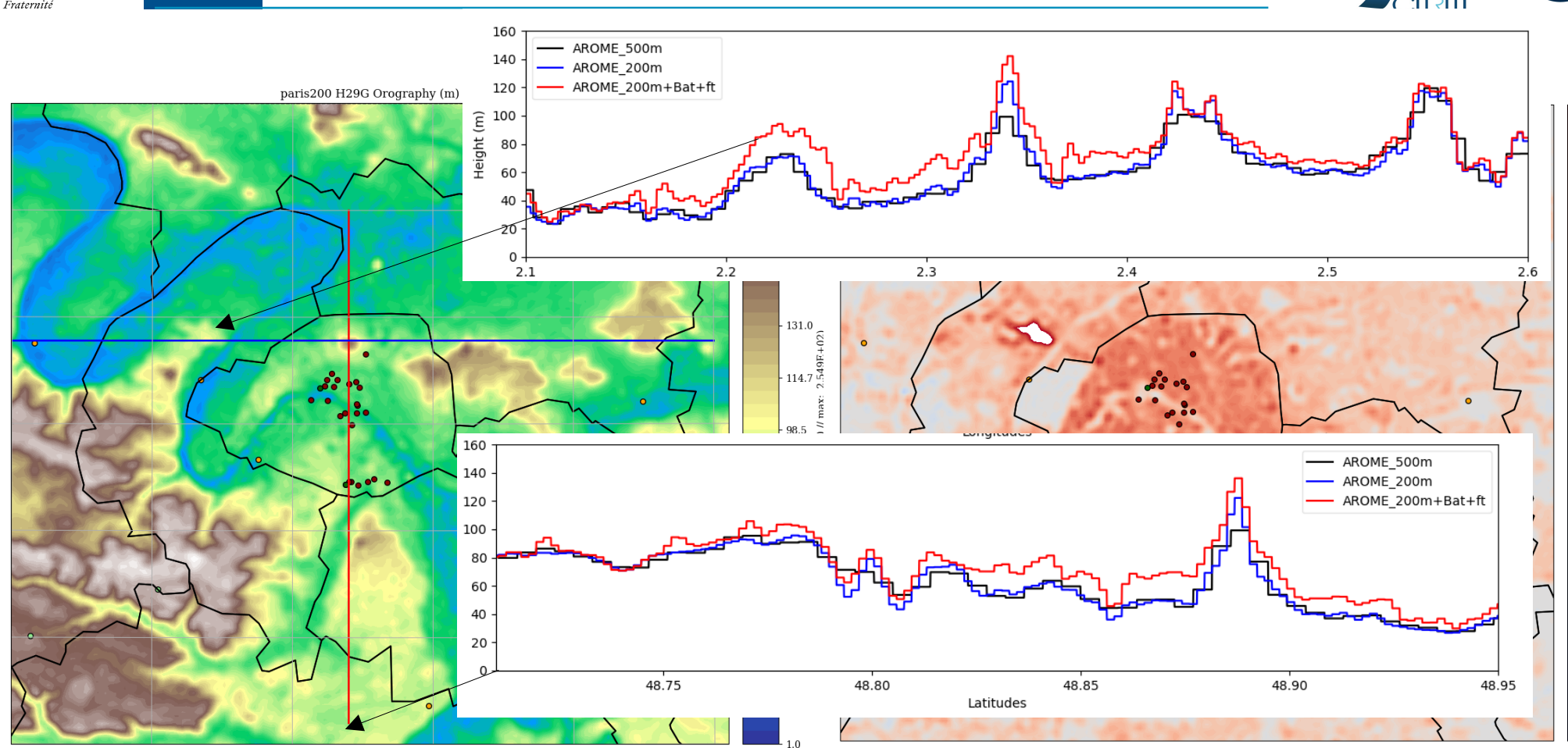


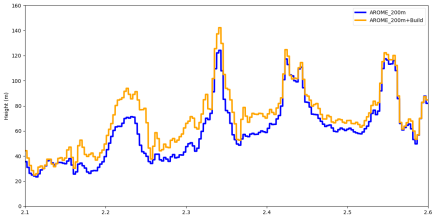
Building Height impact



Building Height impact

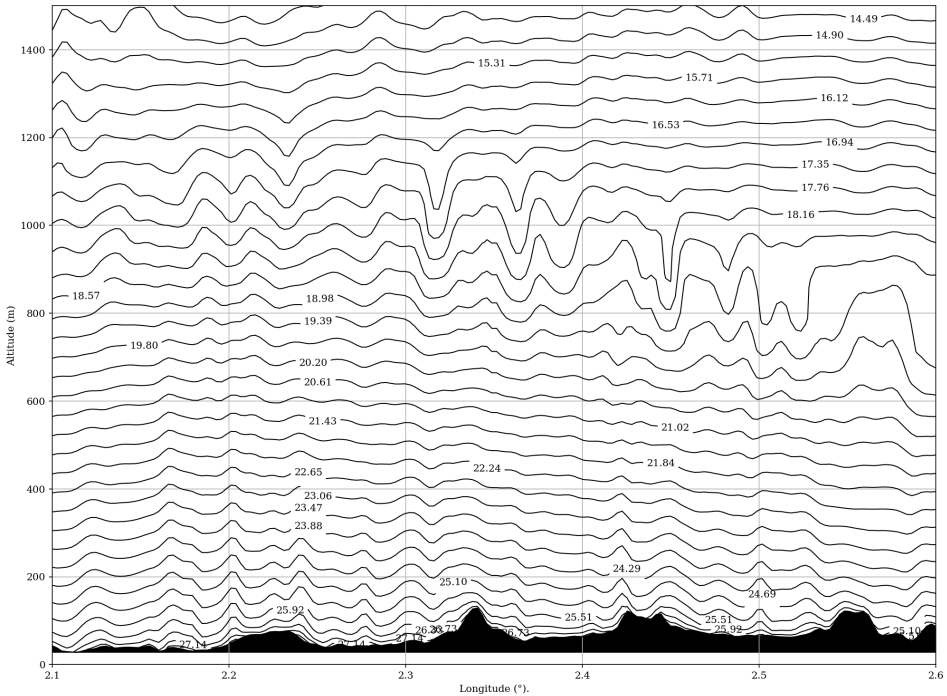


Cross section West-East AROME-200m

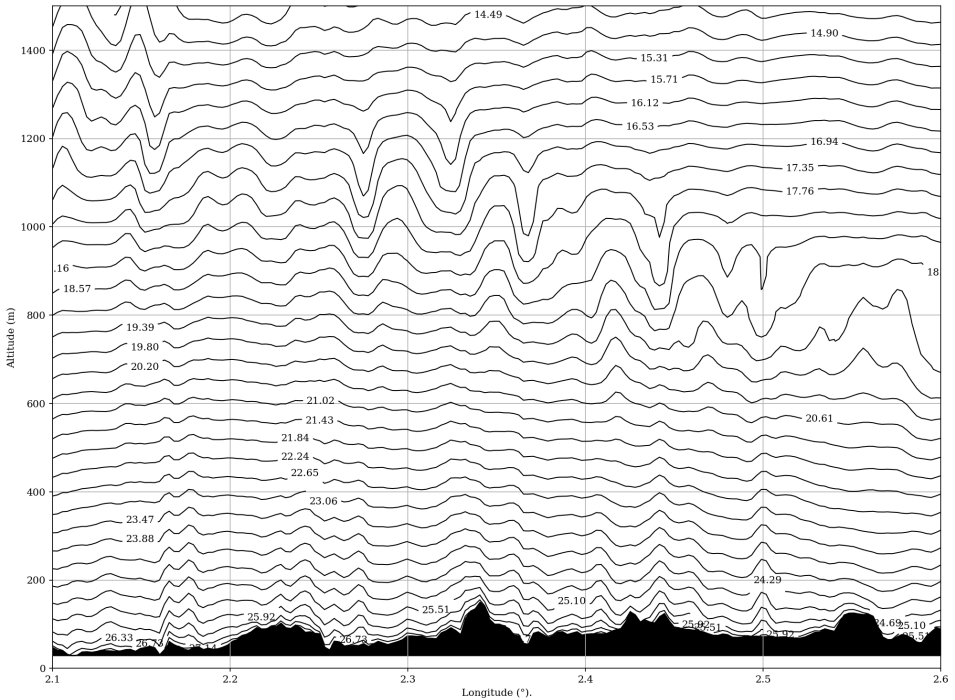


Temperature 2023-09-02 +12h

Ref

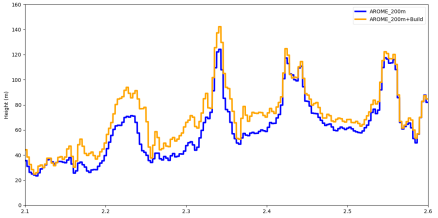


With building height



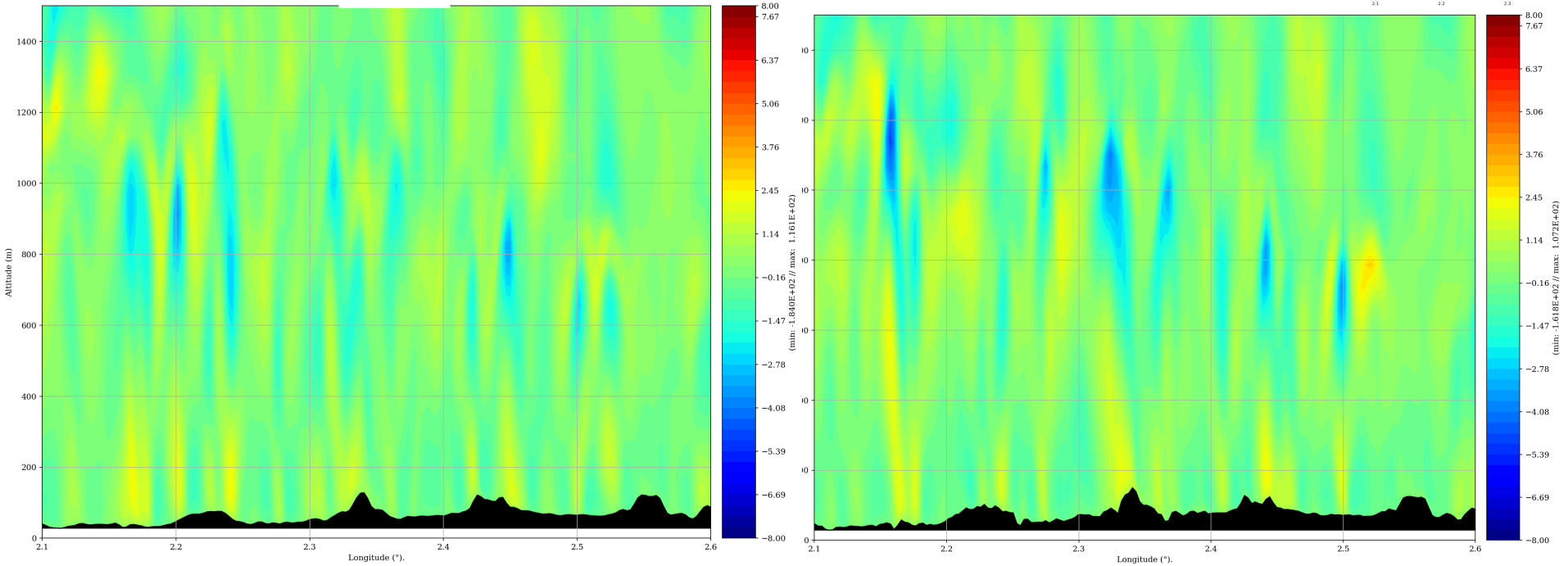
Cross section West-East AROME-200m

Vert. Depart (m2/s3) 2023-09-02 +12h



Ref

With building height



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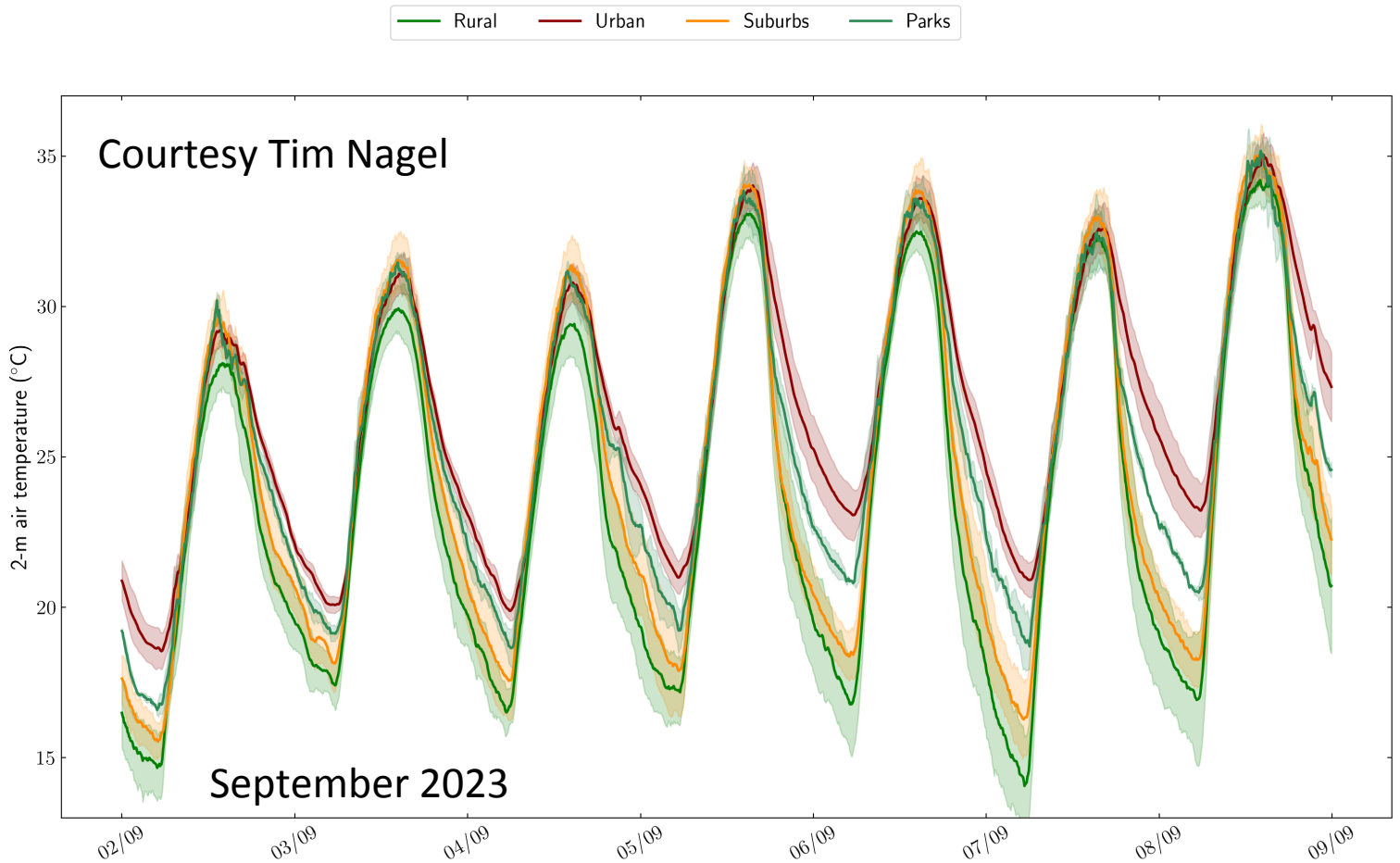
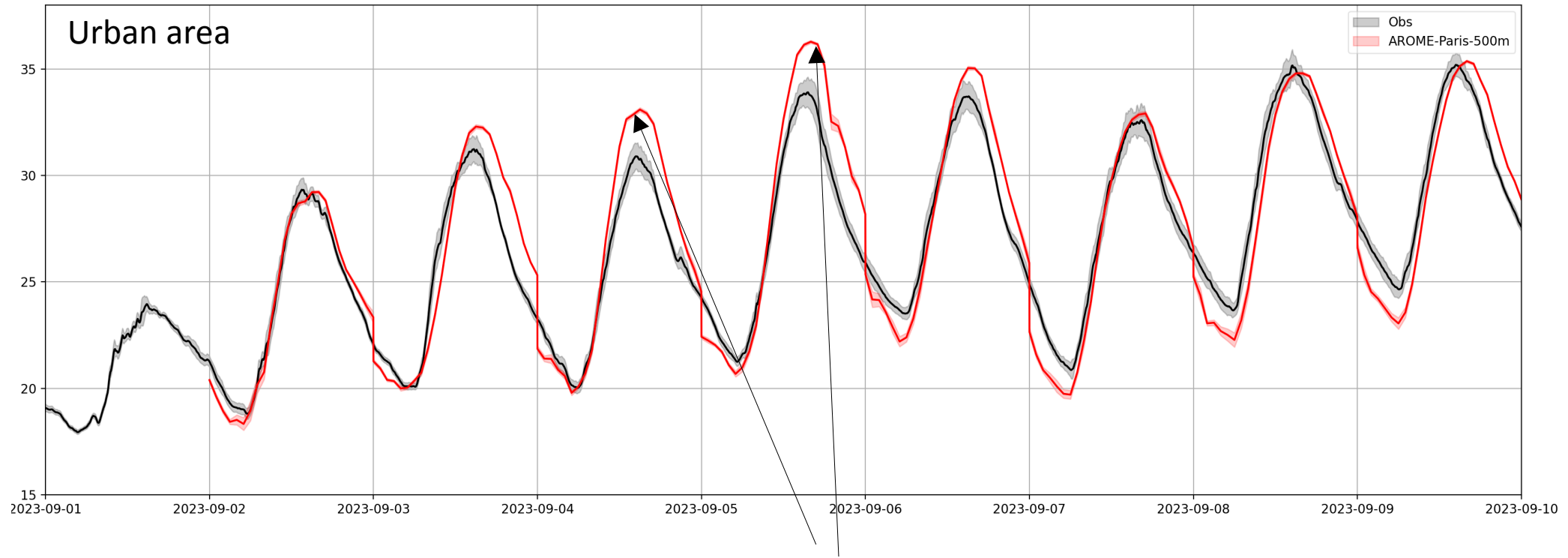
Comparison with observations (Lemonsu A. et al. in rev BAMS)



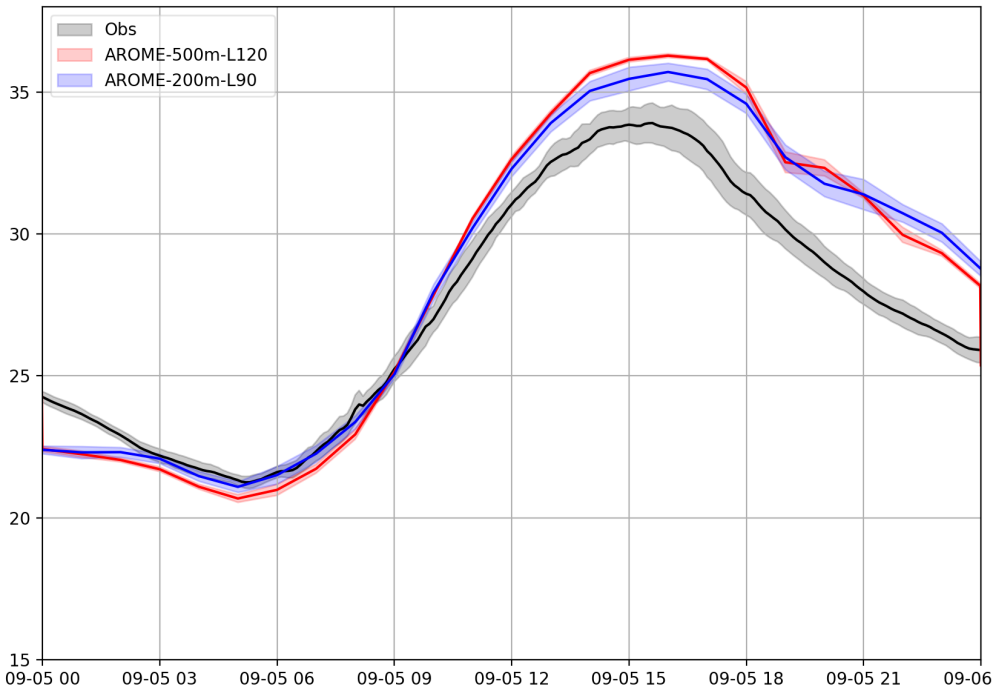
AROME-500m Urban Area



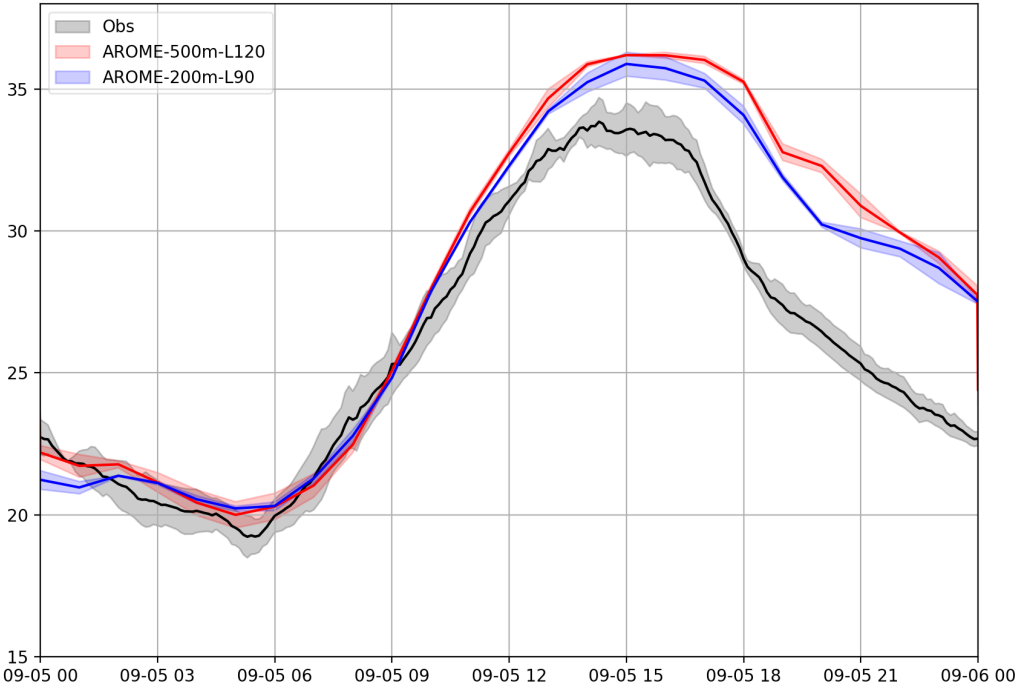
T2m AROME-500m warm bias for the T2max

5th September 2023

Urban area



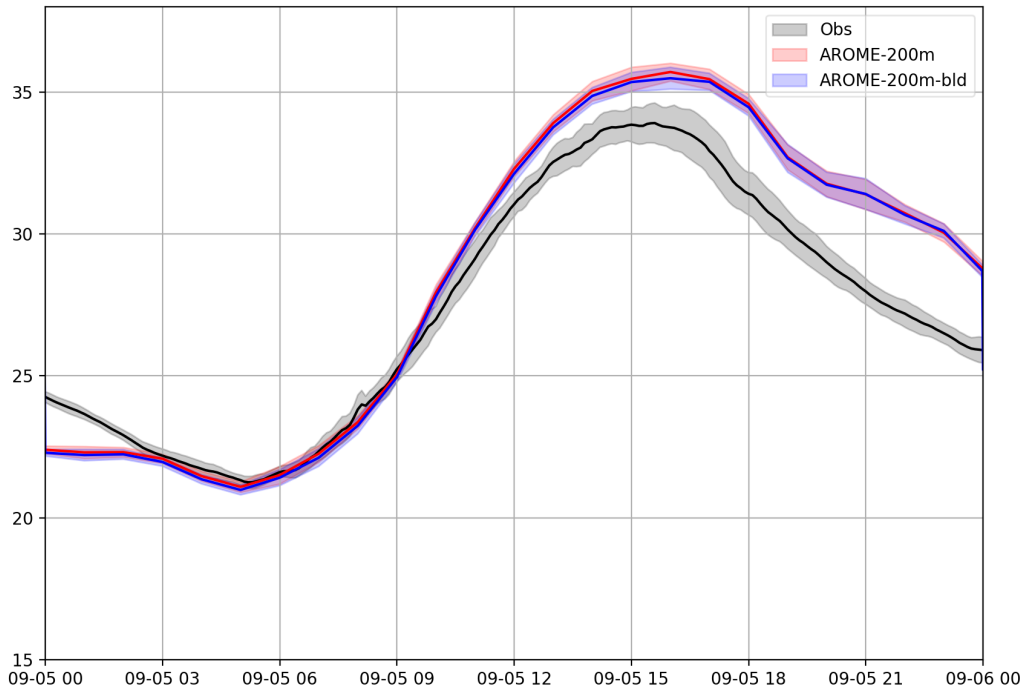
Urban parks



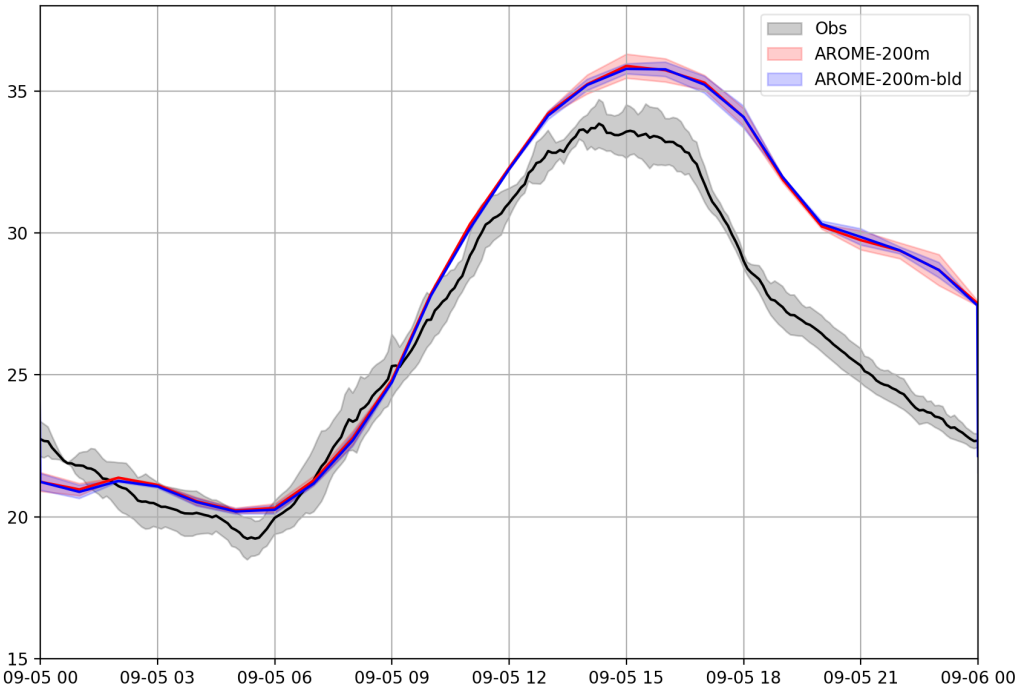
AROME 200m less warm for the T2m maximum, however still warm bias in late afternoon

5th September 2023 : Impact of Building height

Urban area

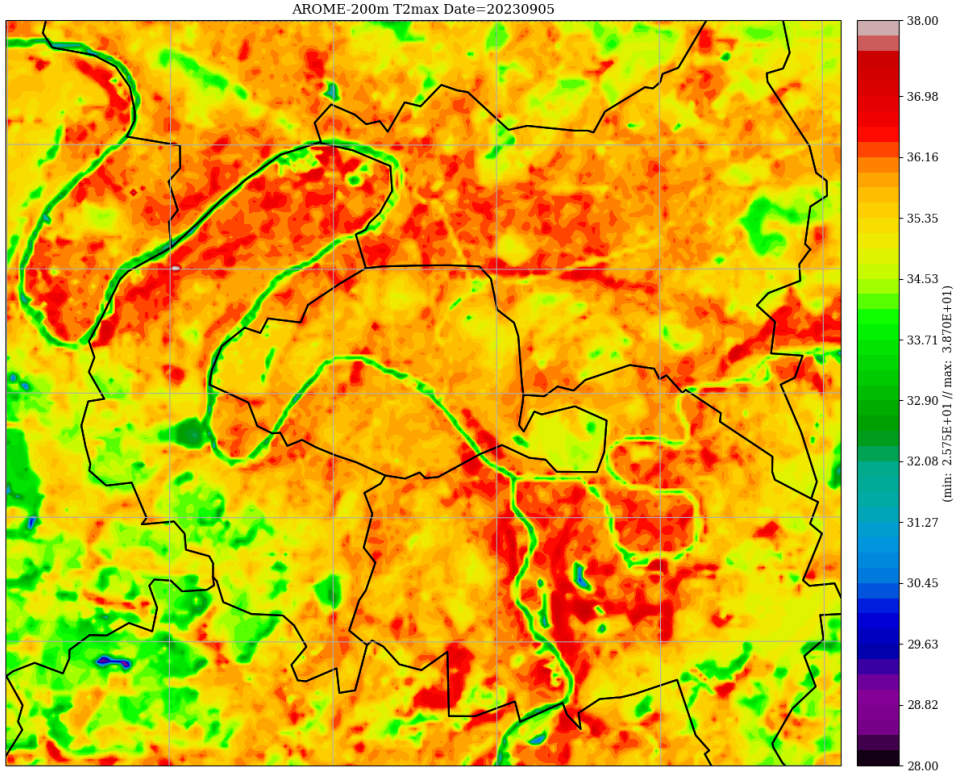


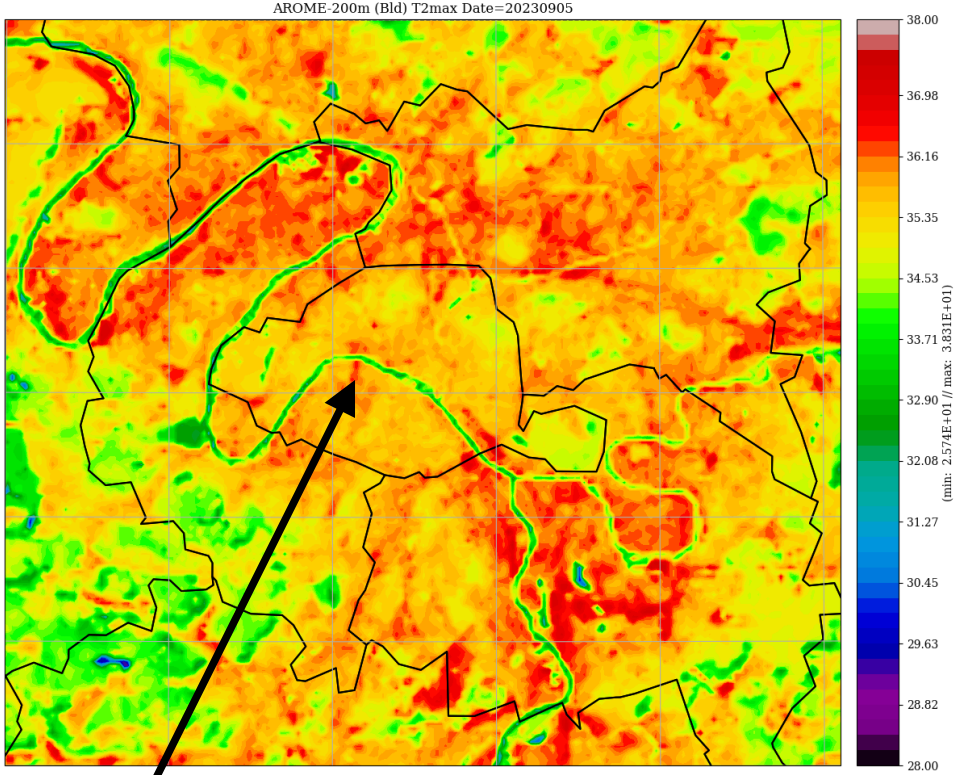
Urban parks



Small impact on the T2m with the modified orography with the building height

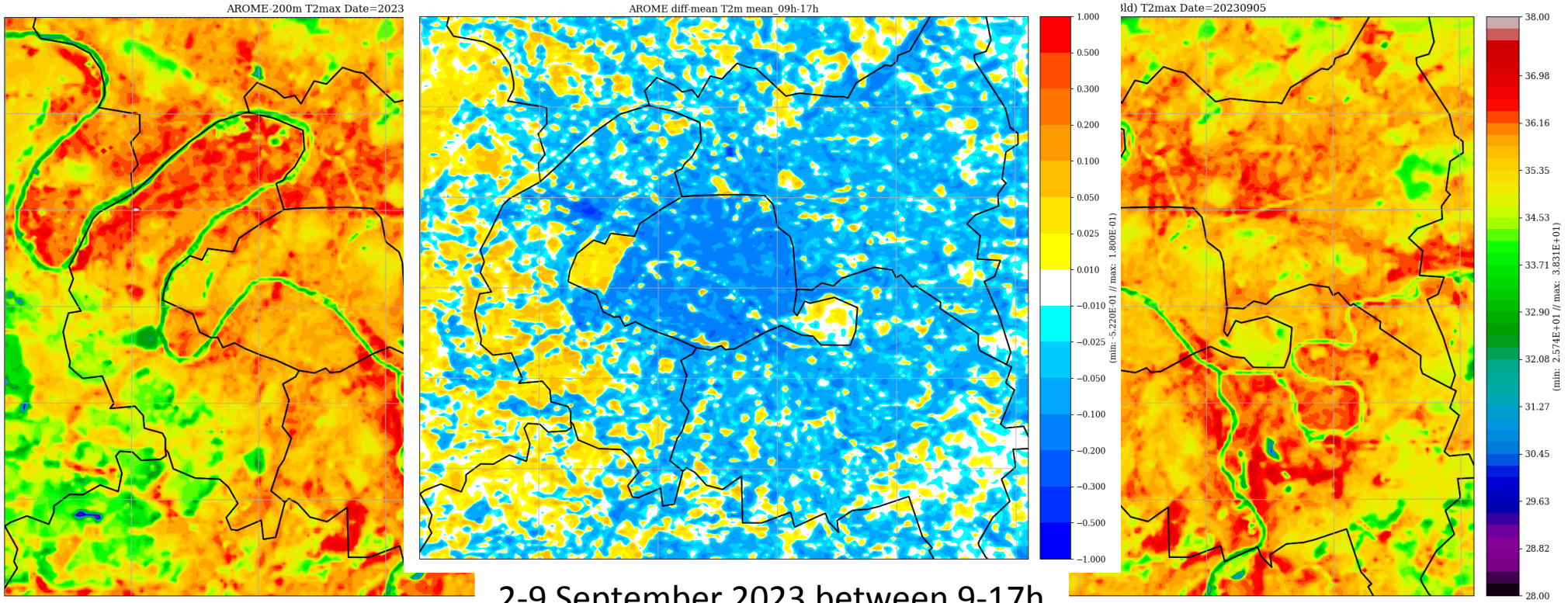
20230905 T2m maximum





Slightly lower T2max

Mean T2m impact of the building height @200m



2-9 September 2023 between 9-17h

Conclusions and perspectives

- Now, it is possible to evaluate the building height effect “explicitly” in AROME
- Comparison with the multi-layer coupling (available soon in the cy49T2_h_Deode ?) with a focus on TKE and wind field
- Use the PANAME data for validation and a winter period (more challenges for the dynamic ?)
- The “pseudo” 3D effect (horizontal shear production) and the new surface coupling (slope effect) will be tested soon ….
- Compare the two options also for Antwerp and Barcelona (UrbanAir project)
- Evaluate this approach also @100m over Paris with AROME and with 120 levels (1st level at 2.5m)

Physics plan for the next AROME e-suite

- New input orography SRTM30m, updated orography treatment (quadra → linear, grid point filter)
-1D Ocean Mixed Layer (available in SURFEX) : already used in AROME-OM and in ARPEGE (A. Napoly)

- NRT-CAMS in EcRad (also in ARPEGE) **S. Antoine,** S. Schaeffer (ACCORD coll.)

Courtesy S. Antoine

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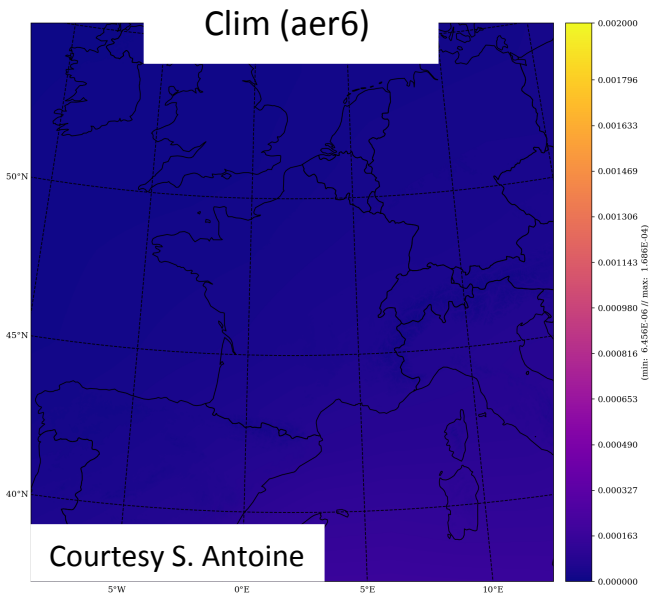

A Consortium for COnvection-scale modelling Research and Development

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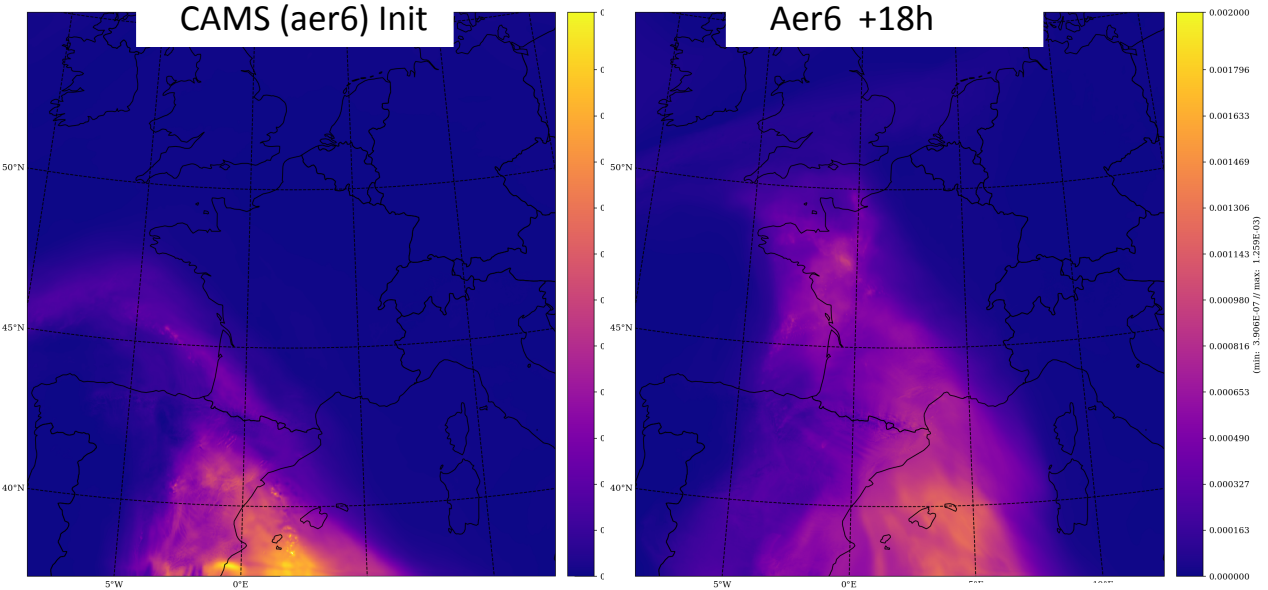

Courtesy S. Antoine

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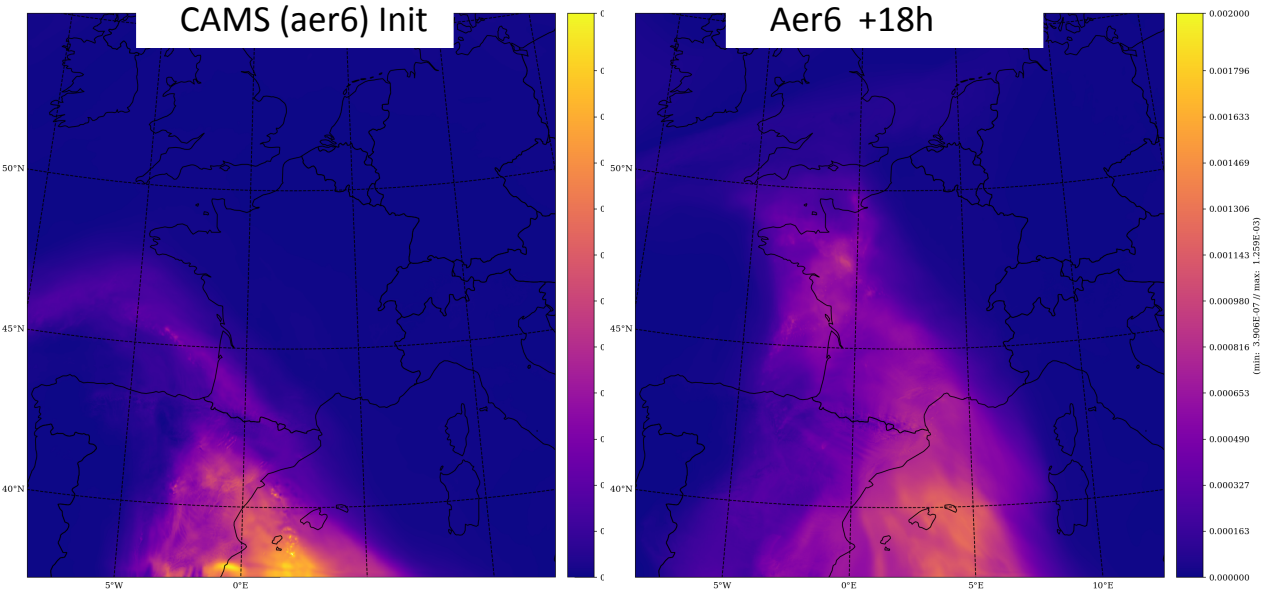

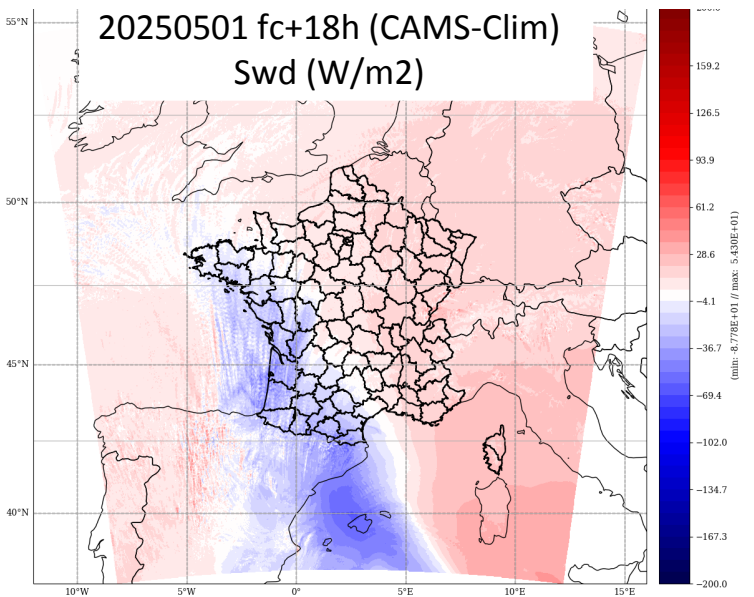

Courtesy S. Antoine

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Physics plan for the next AROME e-suite

- New input orography SRTM30m, updated orography treatment (quadra → linear, grid point filter)
-1D Ocean Mixed Layer (available in SURFEX) : already used in AROME-OM and in ARPEGE (A. Napoly)

- NRT-CAMS in EcRad (also in ARPEGE) S. Antoine, S. Schaeffer (ACCORD coll.) → **AROME daily run for NRT evaluation soon**
- NRT-CAMS in ICE3 (or in LIMA-1m ?) M. Mazoyer, S. Antoine (ACCORD coll.)

- Surface : ECO-SG with diffusion scheme (14 layers), ES+MEB , 2 or 3 patchs (A. Napoly, C. Birman coll. ACCORD/DE_330) (also in ARPEGE)

- ? re-tune and updated shallow convection, more linked with the TKE (A. Marcel PhD, S. Riette)

- ? Pseudo 3D (Horizontal Shear Production), impact of the slope on the surface fluxes (Léo Rogel, F. Voitus)

- ? LIMA -2m (model +25%) M. Mazoyer, C. Strauss, B. Vié AROME daily run with LIMA (4 configurations in //)