

Event-based analysis to evaluate the performance of COSMO – CLM model coupled with urban scheme for CORDEX FPS at convection permitting scales

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Overview

- Simulation with the RCM COSMO-CLM coupled with the urban scheme
 - TERRA-URB parametrization
- The strategy to perform an event-based analysis, avoiding the spin-up issues
- Main results:
 - Austria Test case
 - Wien sub-domain: CITY-CENTER and SURROUNDING
- Conclusion



Overview

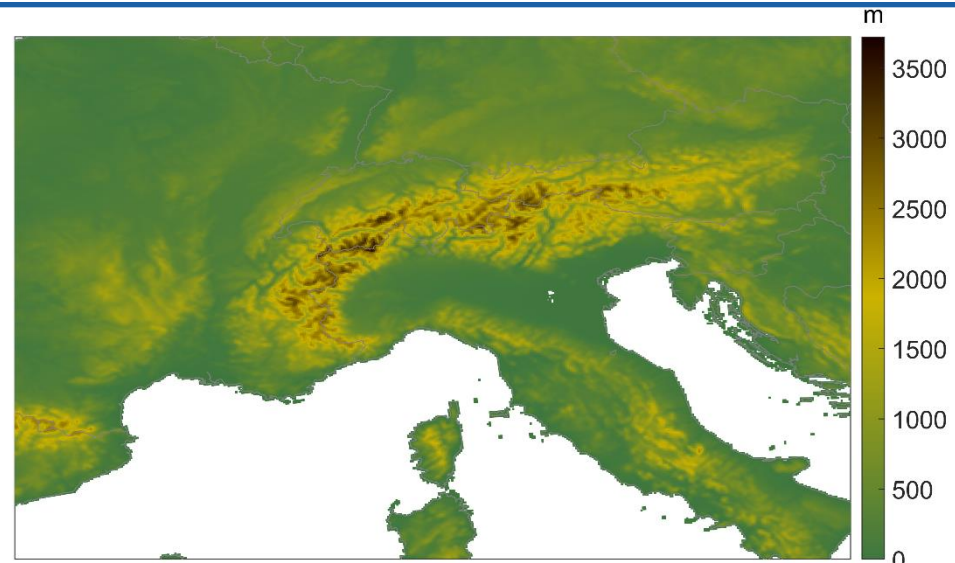
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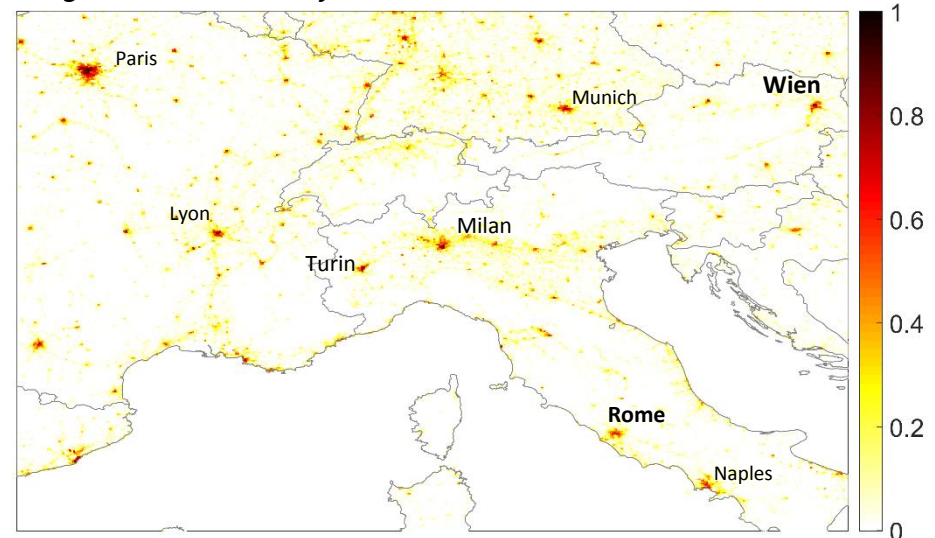
Experimental setup COSMO-CLM

- **COSMO – CLM v 5.00 clm9**
coupled with **Terra-urb v2.2**
- Extended Alpine Region
1-17E, 40-50N
- $N_x=522$, $N_y=490$, $N_z=50$
- Resolution 0.0275° , **3 km**
- Driven by EURO-CORDEX 0.22°
(forced by ERA-INTERIM)

- **Period:**
 - **CM Climate Mode** – from 01/06/2009 to 30/06/2009
 - **WL Weather Like Mode** – from 20/06/2009 to 27/06/2009



Height surface of analysis domain



Impervious surface area of analysis domain



TERRA-URB Parametrization

Urban canopy model accounts for the anthropogenic heat flux, QF :

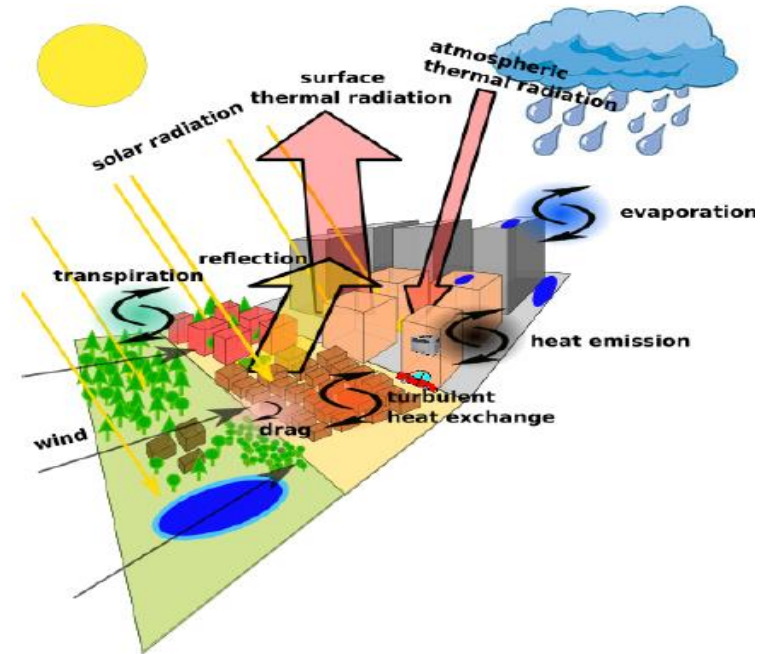
$$QF = QF_v + QF_b + QF_m + Qf_i$$

v = vehicular

b = building

m = human metabolic

i = industrial heat emissions



- Canyon model explicitly calculate these components, using a detailed representation of the generic street canyon.
- **Bulk models (TERRA-URB) uses a pre-calculated QF** , which accounts for country-specific data of energy consumption, calculated based on the population density and the latitude dependent diurnal and seasonal distribution.



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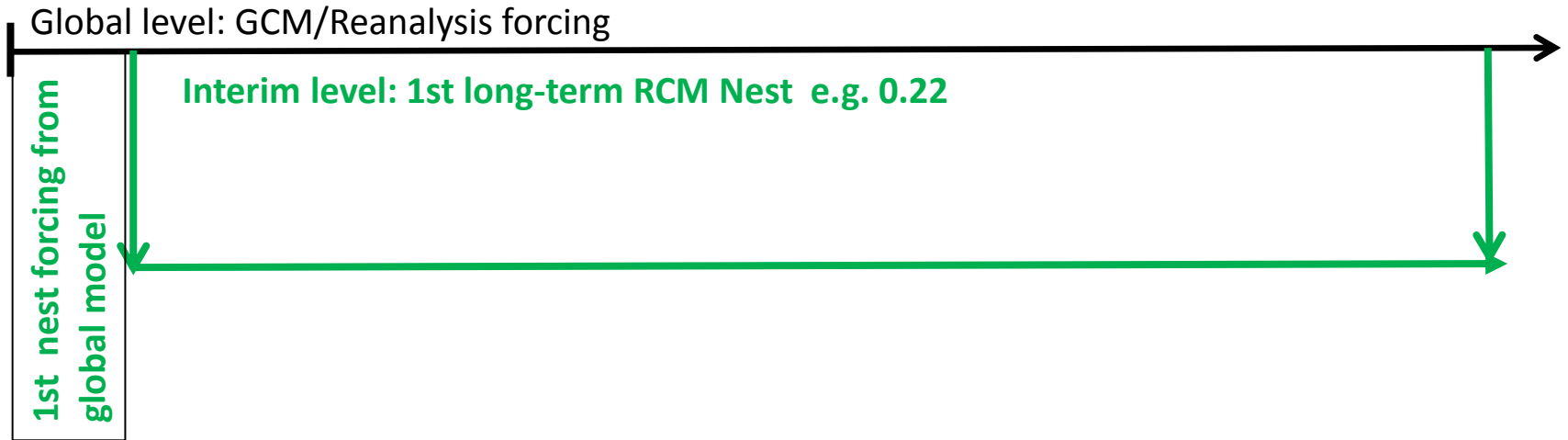


Nesting Strategies

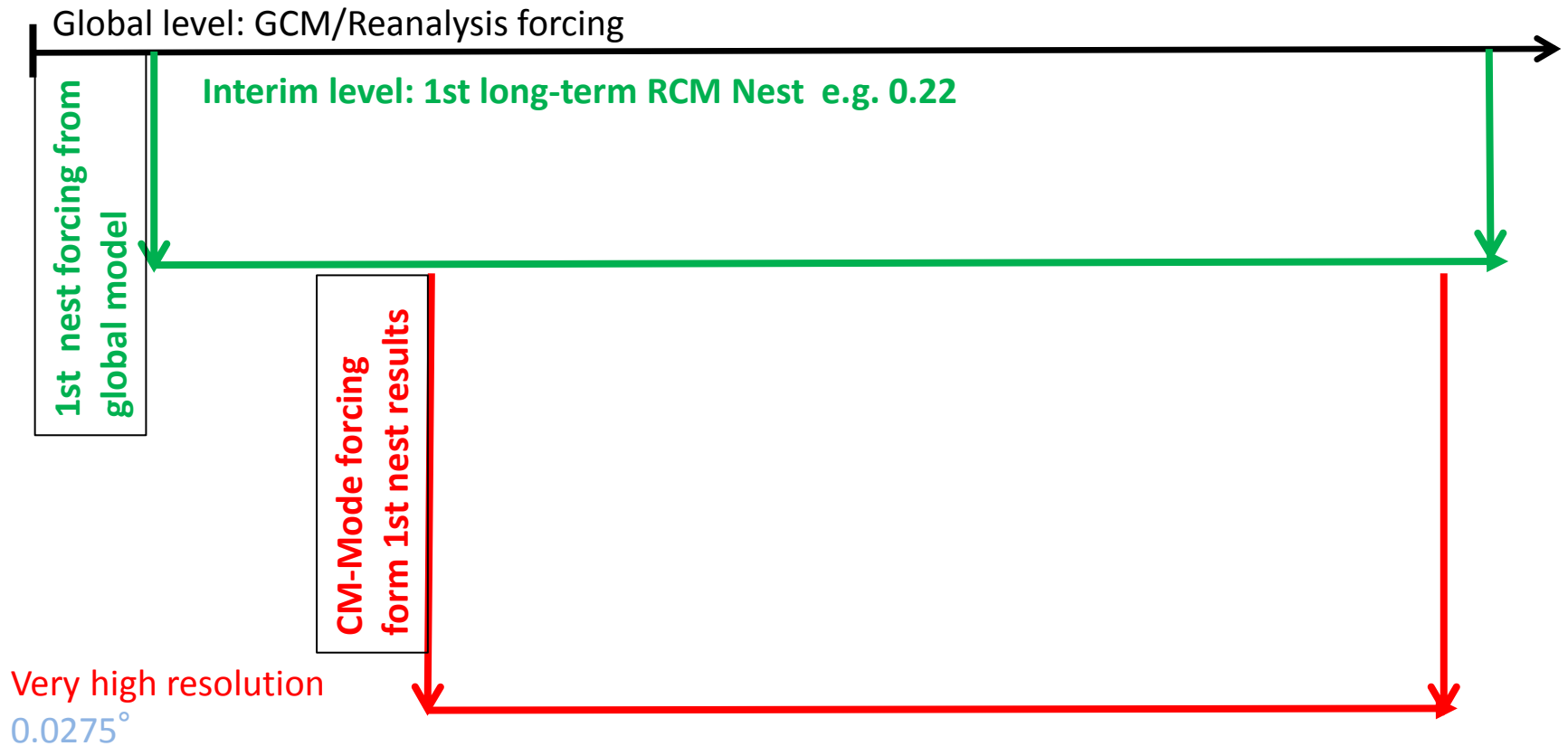
Global level: GCM/Reanalysis forcing 



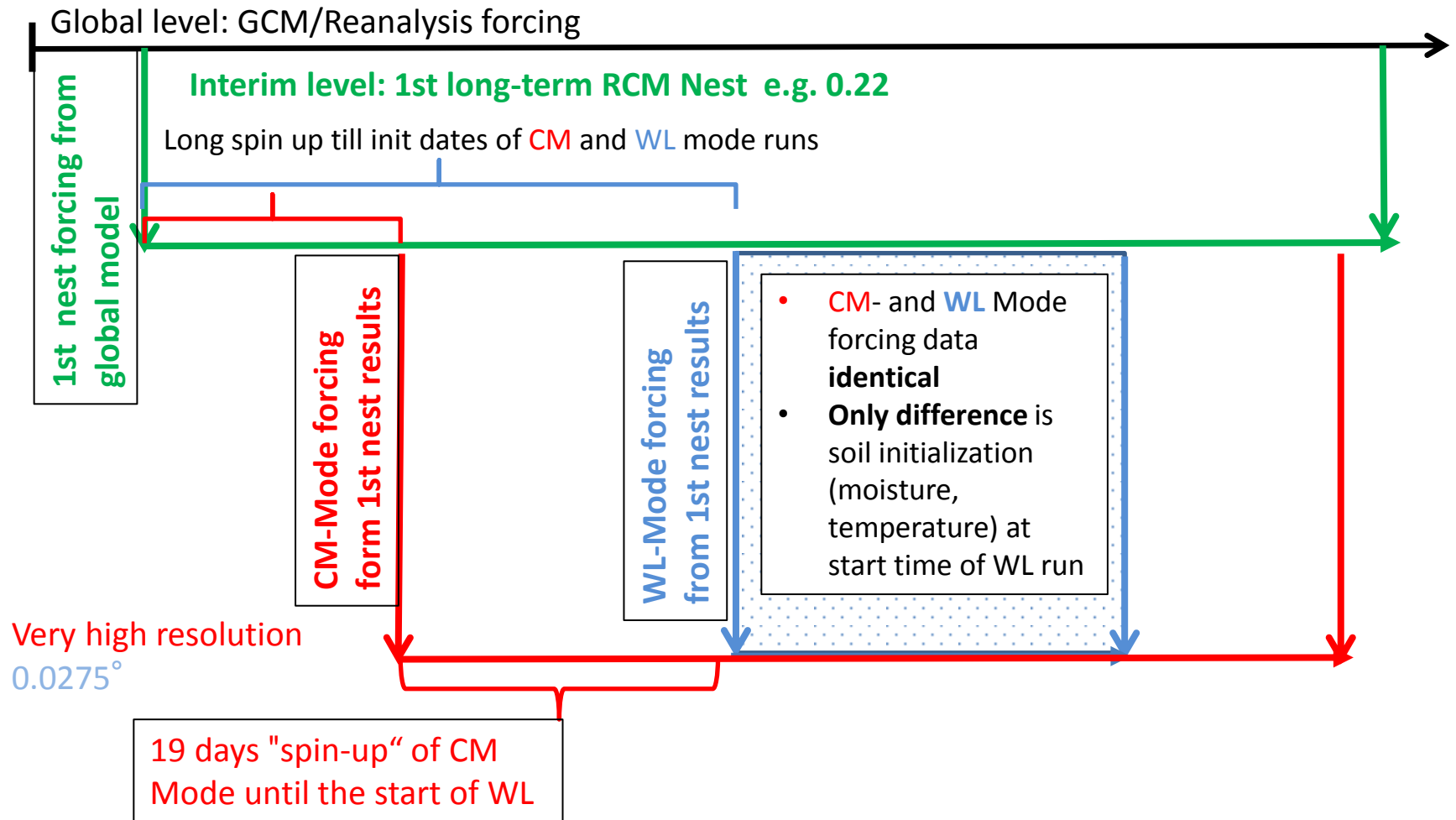
Nesting Strategies



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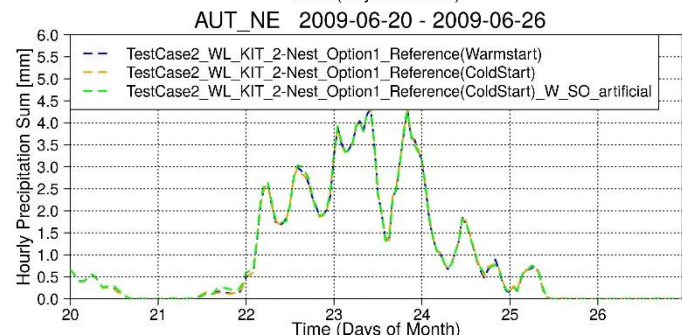
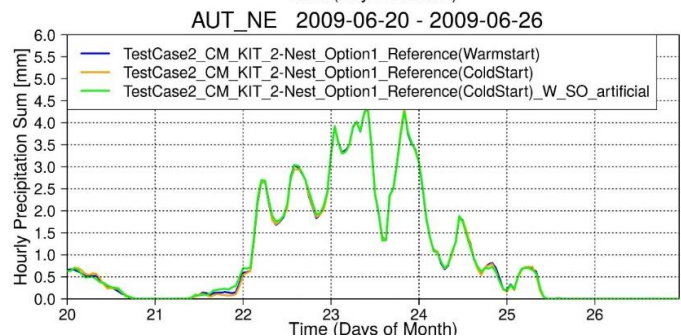
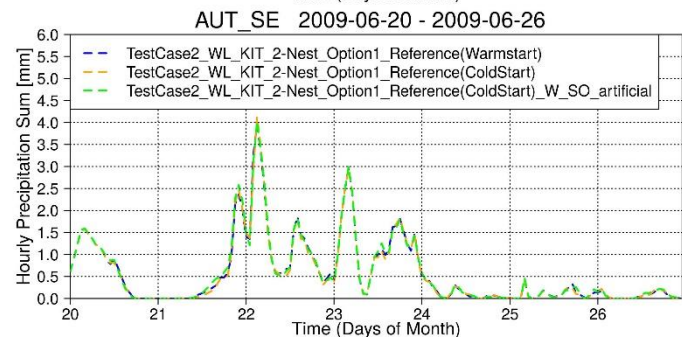
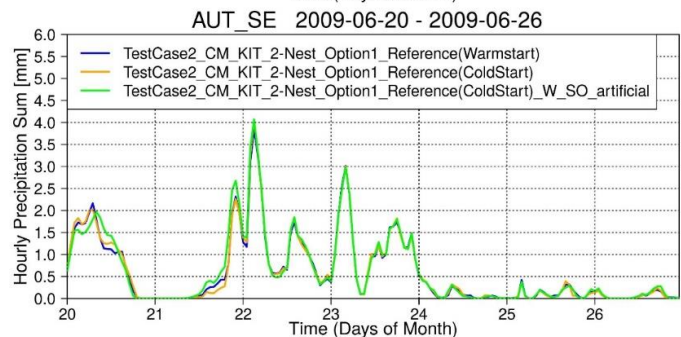
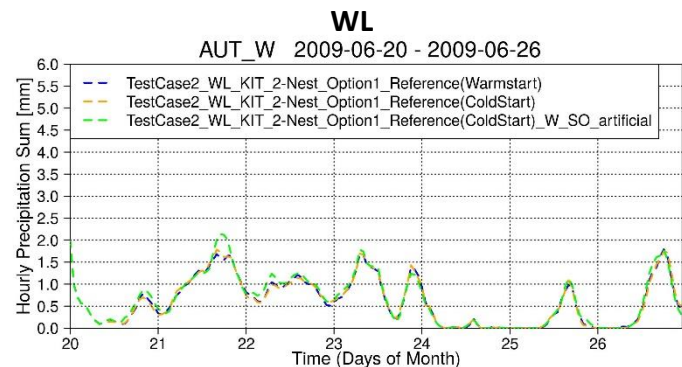
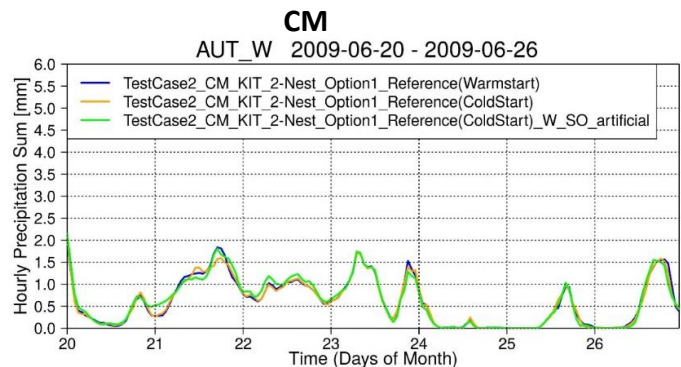
Impact of soil initialization on Precipitation

Initialization methods of soil temperature T_{SO} and soil moisture W_{SO}

Warmstart: 30-years climatological averages for temperature and moisture, derived from long-term EUR22 results for June, 1st

Coldstart: instantaneous values for temperature and moisture

Coldstart W_{SO} artificial: instantaneous values for temperature and artificial constant profile for moisture with 75% moisture content at each grid point



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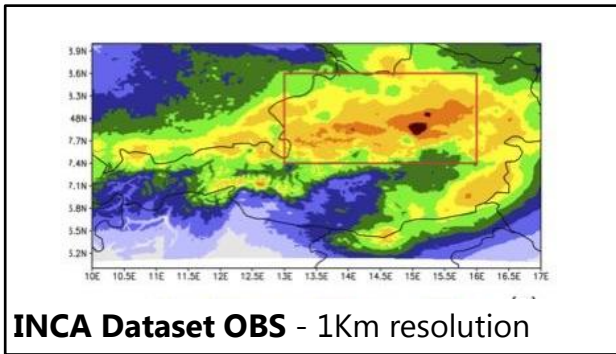
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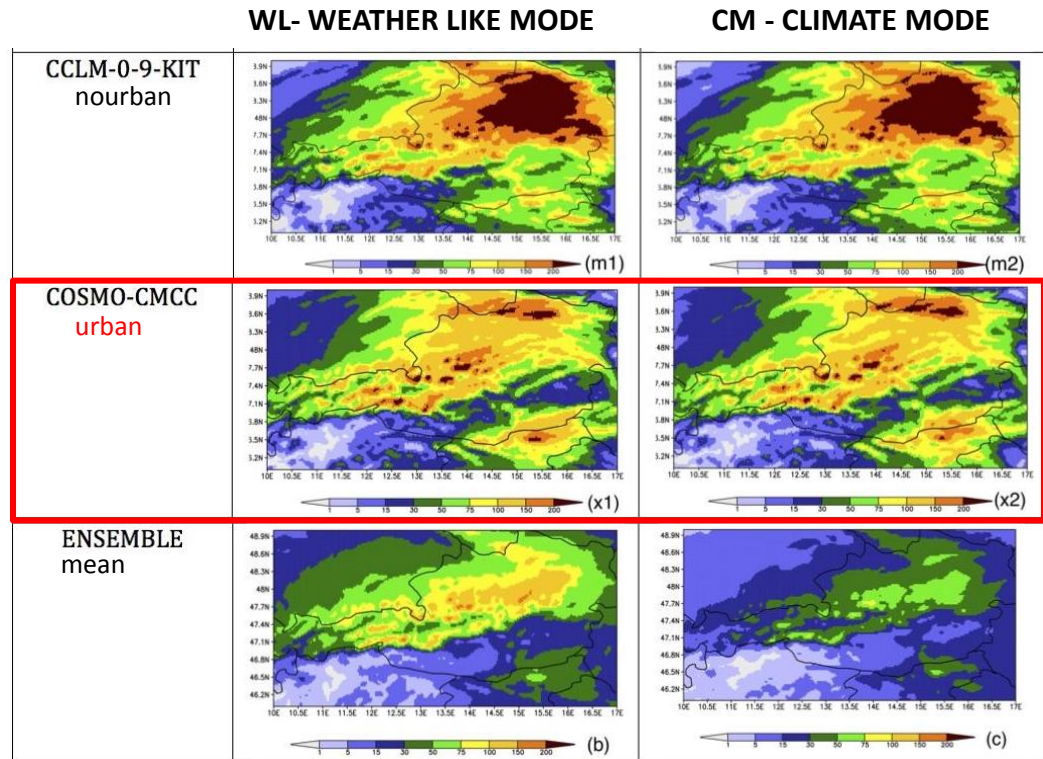
Event based analysis – Austria test case

- Austria – June 2009**

Total Accumulated Precipitation during the event 22-24 June 2009



Haiden et al. 2011



Reference:

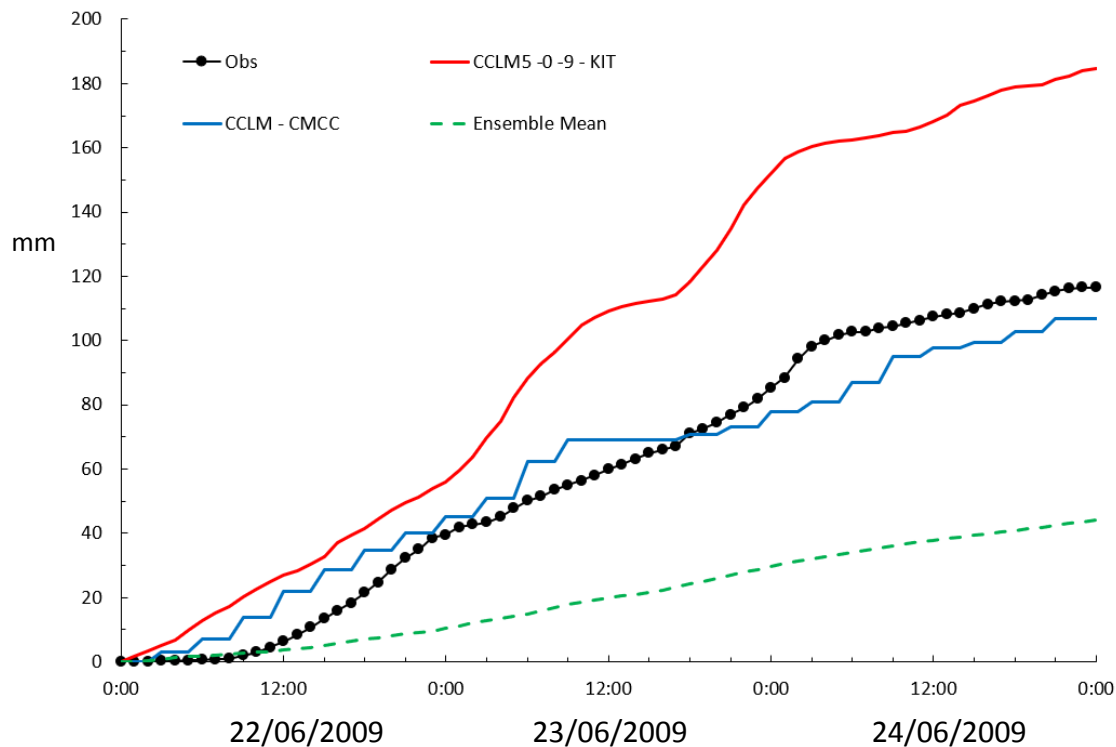
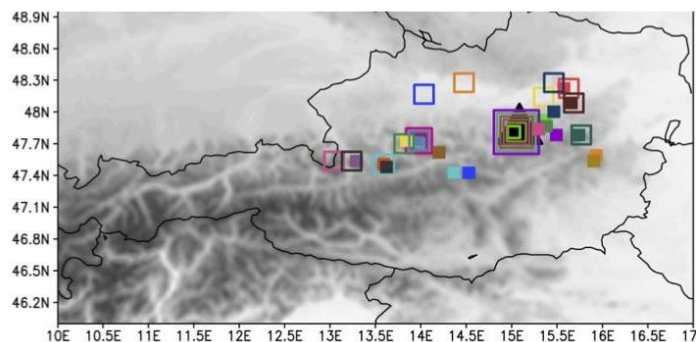
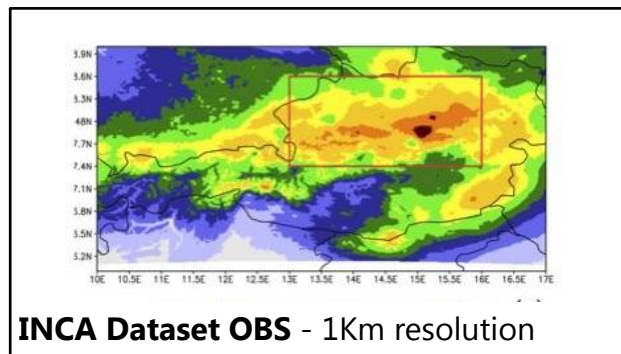
Coppola, E. , Raffa, M. et al., “A first-of-its-kind multi-model convection permitting ensemble for investigating convective phenomena over Europe and the Mediterranean” - Climate Dynamics (under review)



Event based analysis results – Austria test case

- Austria – June 2009**

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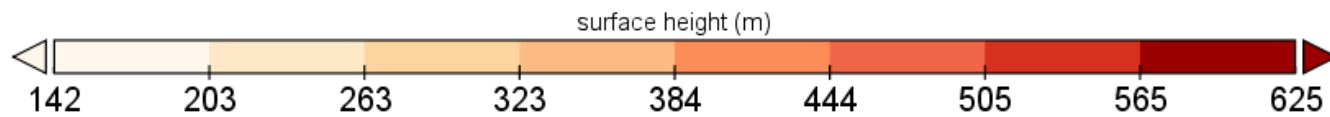
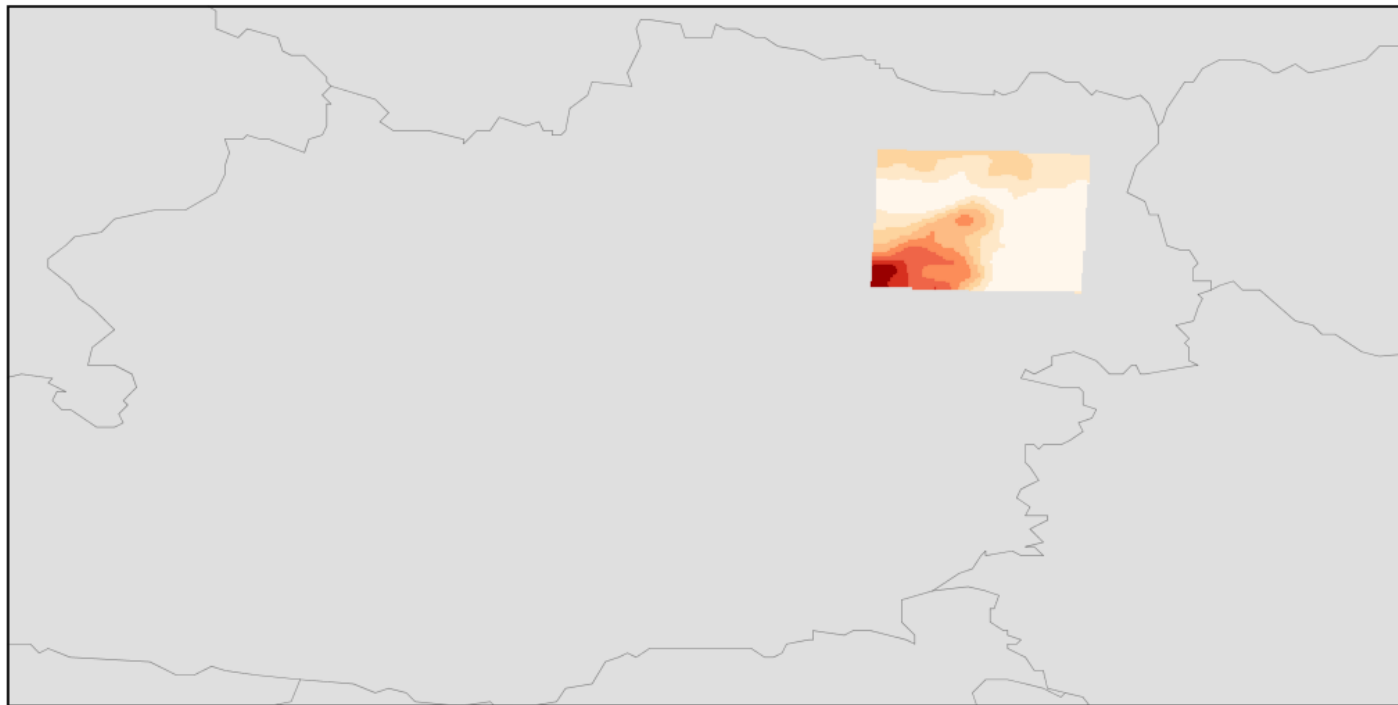
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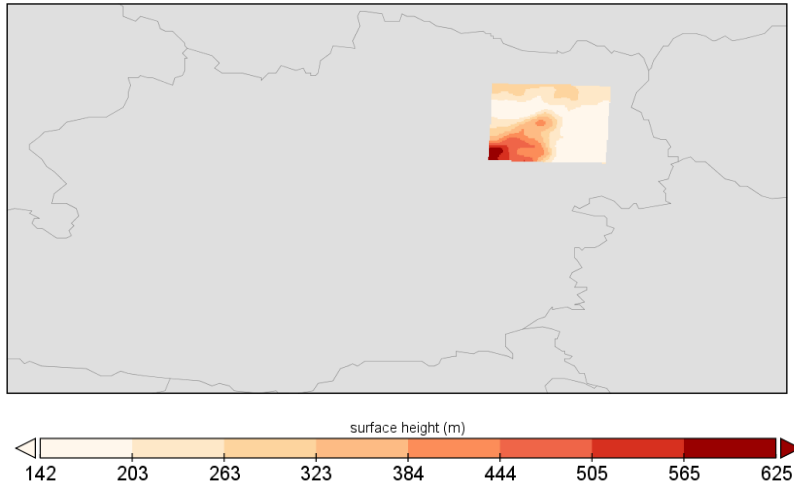
Urban climate – Wien domain

HSURF Height Surface



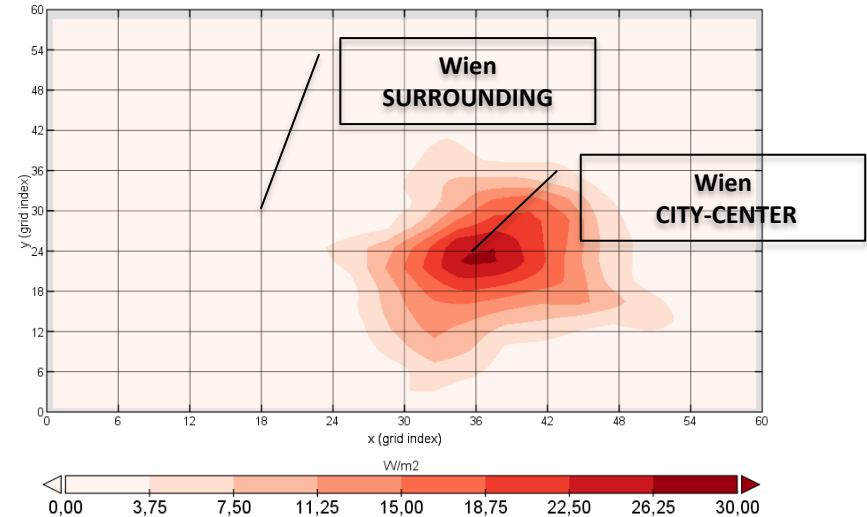
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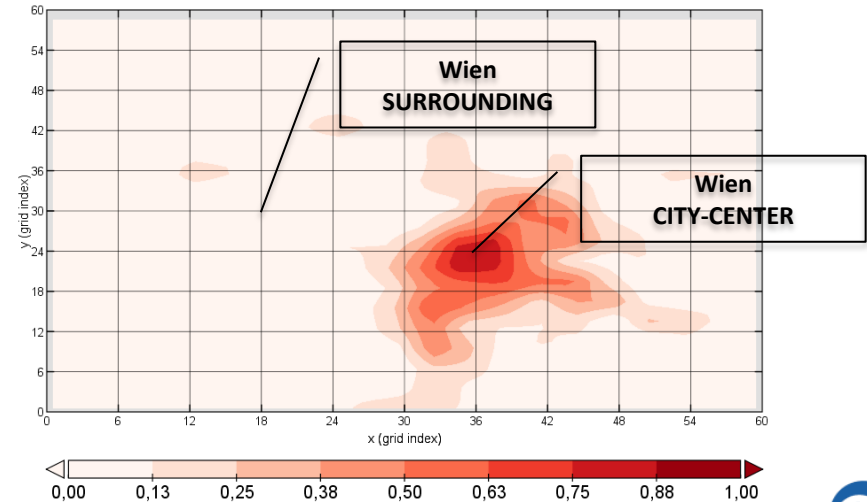


- **Box 3x3 Wien CITY-CENTER**
 - Mean_ISA = 0.78
 - Mean_AHF = 25.12 W/m²
 - Mean_HSURF = 214m
- **Box 3x3 Wien SURROUNDING**
 - Mean_ISA = 0.014
 - Mean_AHF = 0.91 W/m²
 - Mean_HSURF = 350 m

AHF Annual Mean Anthropogenic Heat Flux



ISA Impervious Surface Area

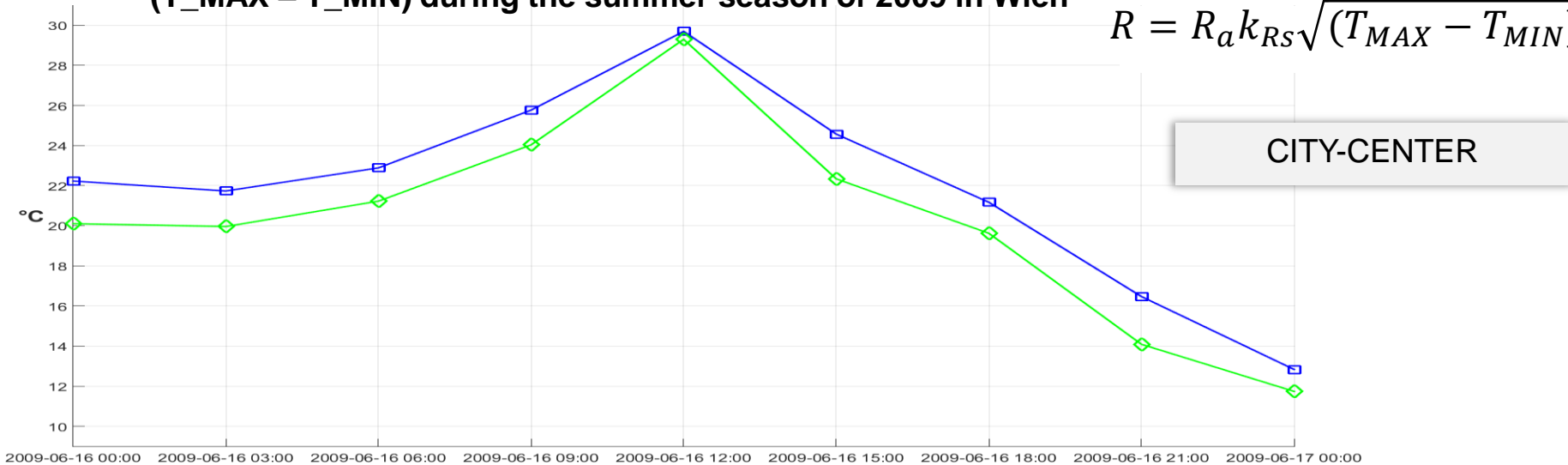


2m Temperature

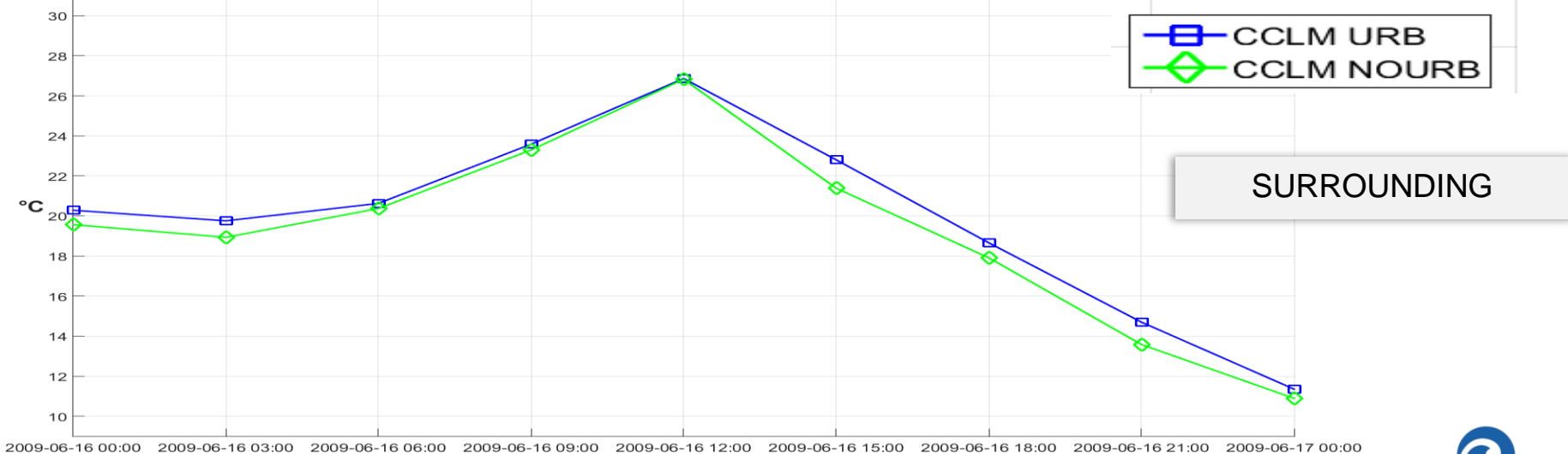
16/06/2009 – Day with maximum Diurnal Temperature Range (T_MAX – T_MIN) during the summer season of 2009 in Wien

Hargreaves' radiation formula

$$R = R_a k_{RS} \sqrt{(T_{MAX} - T_{MIN})}$$



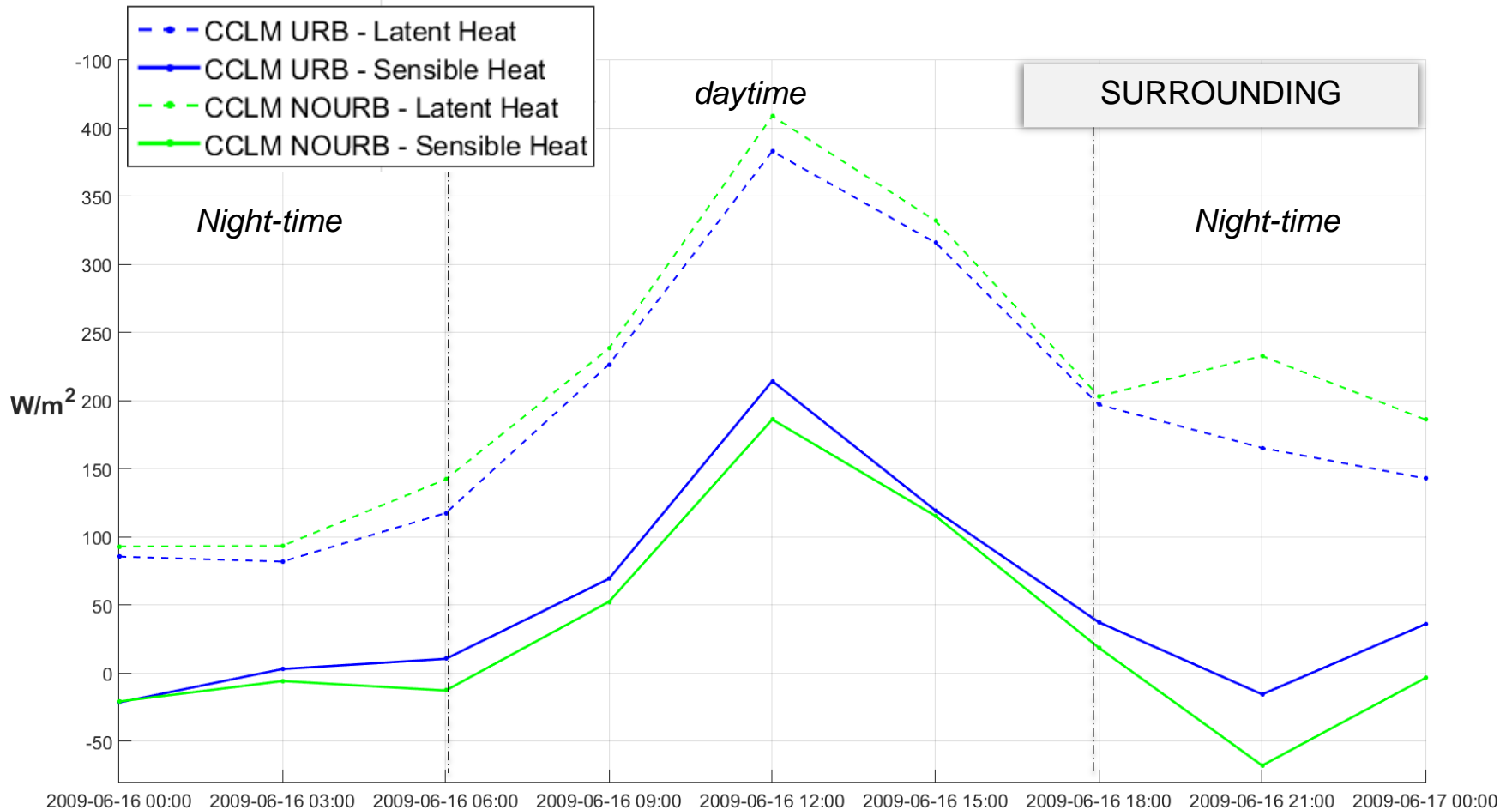
CITY-CENTER



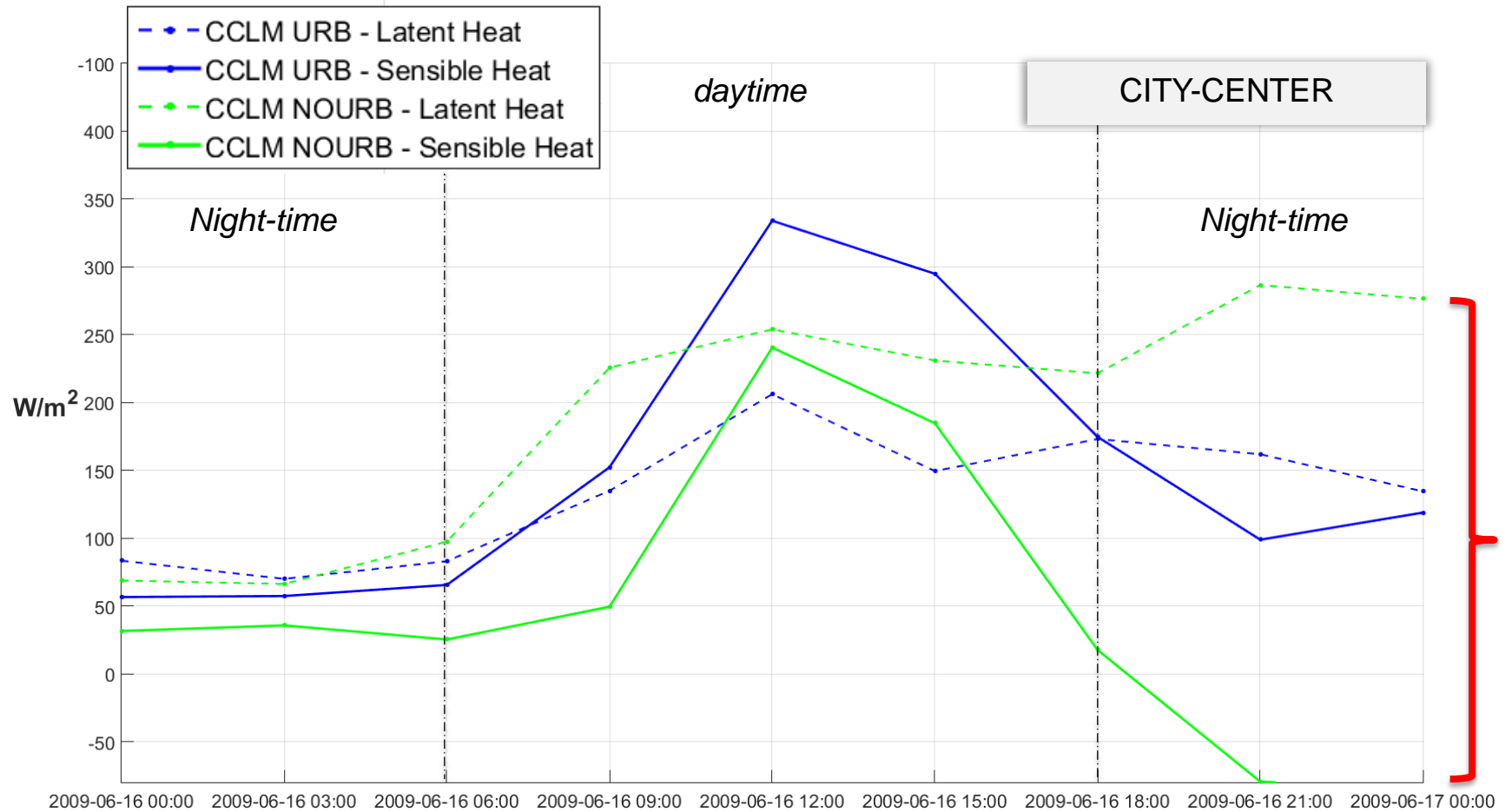
SURROUNDING



Energy Flux Budget



Energy Flux Budget



Conclusions

- How to create such a high resolution data set without performing a long-term, ERA-INTERIM driven, CCLM simulation?
 - Adopting a nesting strategies with soil initialization for event-based approach.
 - Warmstart and Coldstart (replacing T_SO and W_SO respectively with climatological average of long tem simulation or instantaneous field) don't affect the precipitation, both in Climate (one month of simulation) and Weather-like Mode (one week)
- CCLM with TERRA-URB parametrization shows good agreement with cumulative precipitation observed (pattern and intensity), compared both to equivalent simulation without urban module and ensemble mean
- Urban climate for Wien test case
 - In the city center of Wien, the urban parametrization is physically coherent with the energy balances (Sensible heat > Latent heat)
 - In the city center, during the night-time, latent heat flux can not be predominant respect to sensible one (like simulated by model without TERRA-URB).

We need to adopt an urban parametrization to analyze the urban climates

- Future work: Urban analysis for IOP16 and Foehn test cases in CORDEX-FPS



Thank you

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Cumulative precipitation

