ICON-LEM SIMULATION OVER SOUTHERN-ITALY REGION AT 600M GRID RESOLUTION

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WG3a/b COSMO General Meeting

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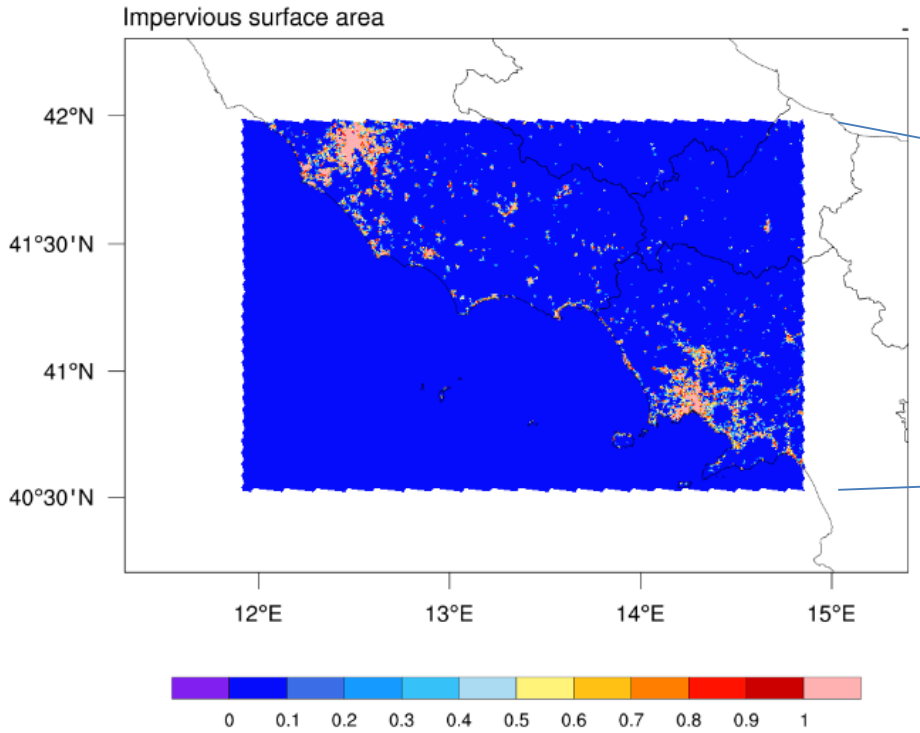
- Domain and Period definition
- ICON LAM Numerical Settings
  - ICON Configurations for comparison
    - Grid size, IC's soil and Turbulence models
- Description of Observational Data sources
- Results
  - Diurnal Cycles and Taylor Diagrams
  - Orography effects
  - Heat Fluxes Evaluation

Domain and Period

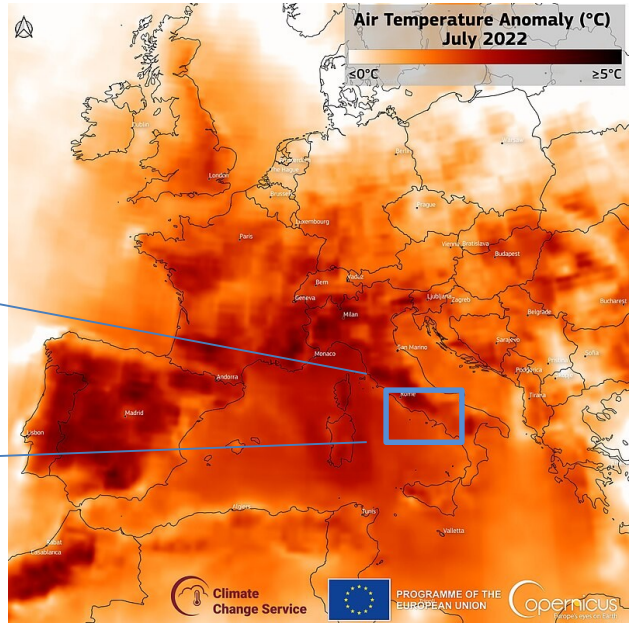
Domain:

- Lazio-Campania Southern Italy regions
- ncells = 109860;
- Horizontal resolution = ~ 0,6 Km (R02B12)
- Vertical resolution:
  - levels: 65
  - First level: 20m; Top height: 22.000 m



Simulated Period:

- Heat waves hit Europe from June to August 2022
- July 2022: severe heat waves over Italy
- ICON forecast run from 18/7 to 24/7 2022



By Contains modified Copernicus Sentinel data 2022, Attribution, https://commons.wikimedia.org/w/index.php?curid=132519157

ICON model:

- exact local mass conservation and mass consistent tracer transport.
- The dynamical core is formulated on an icosahedral-triangular Arakawa C-grid.
- Time integration is performed with a two-time level predictor–corrector fully explicit scheme

Main ICON LAM settings :

BC's and IC's:

- IC: **DWD Soil + IFS** Analysis @ 18:00
- Forecast time: 30h
- BCs reads @ IFS forecast every 3h

- Timestep size= 6 s
- Terra Soil Tiles = 3
- lterra_urb Parameters on
  - Icon 2.6.6 ver

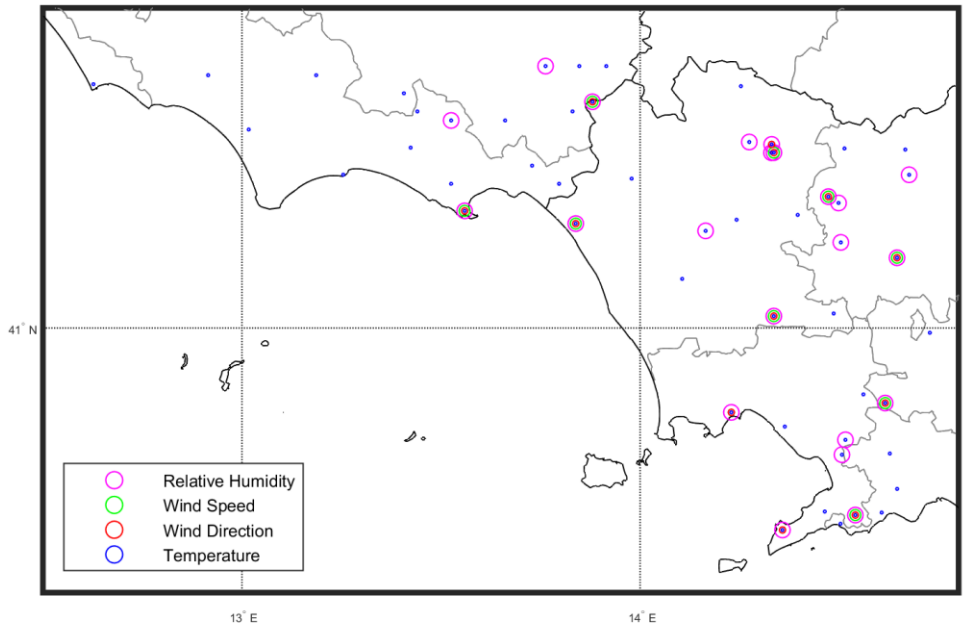
Parameterization schemes

- Shallow convection parameterization active
- Deep and mid-level convection switched off
- Single moment cloud microphysics
- Diagnostic Kohler cloud cover

- Investigations on:
  - GRID effects
    - coarser grid at 1.1km (R02B11) **vs** 0.6 km (R02B12)
  - SOIL effects
    - IC's : IFS Soil + **IFS** Analysis @ 18:00 **vs** ICON soil
  - Turbulence models:
    - COSMO diffusion and transfer: TURBDIFF and TURBTRAN (Raschendorfer (2001))
      - (surface heat fluxes with three tiles (3) in TERRA)
    - Smagorinsky-Lilly model (Dipankar A., (2015)): 3D sub-grid model of Smagorinsky (1963) with the stability correction of Lilly (1962)
      - (surface heat fluxes with one tile (1) in TERRA)

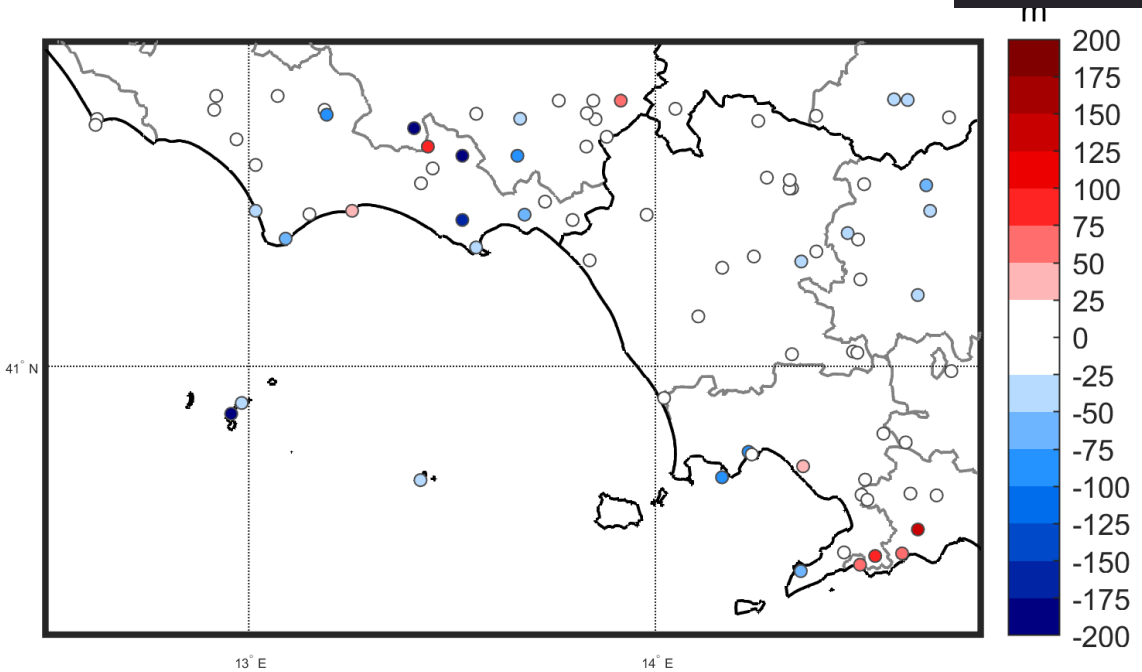
❑ Ground Stations

- Station selected in a box defined as [12.00, 14.75, 40.5, 41.5]
- Model evaluation: comparison with ground observations downloaded from MISTRAL portal



Stations per variables

- ✓ T2m: 57
- ✓ WS10m: 36
- ✓ RH2m: 25
- ✓ WD10m: 33

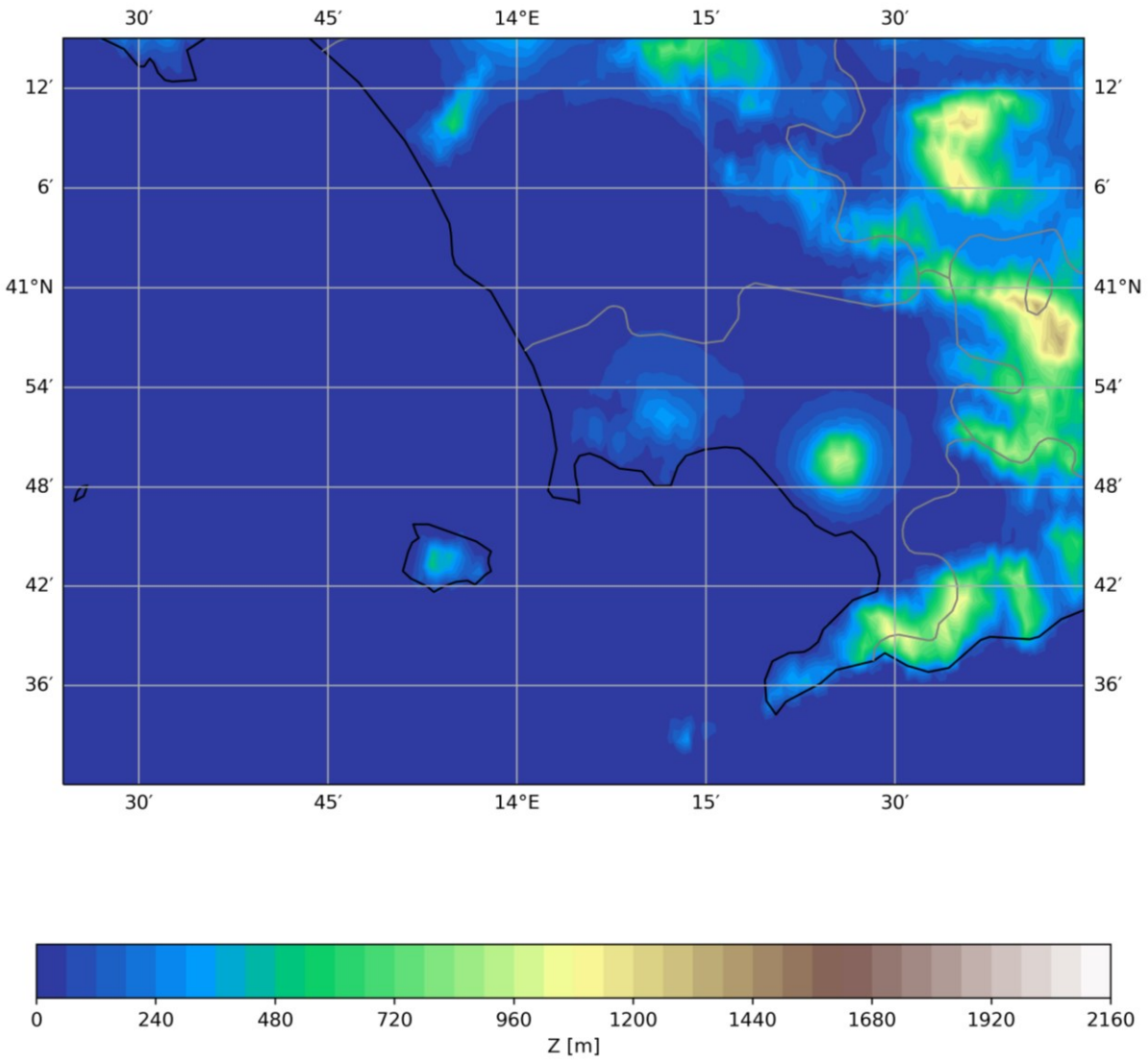


Stations height difference (z_icon – z_stations) [m] @ R02B12 grid

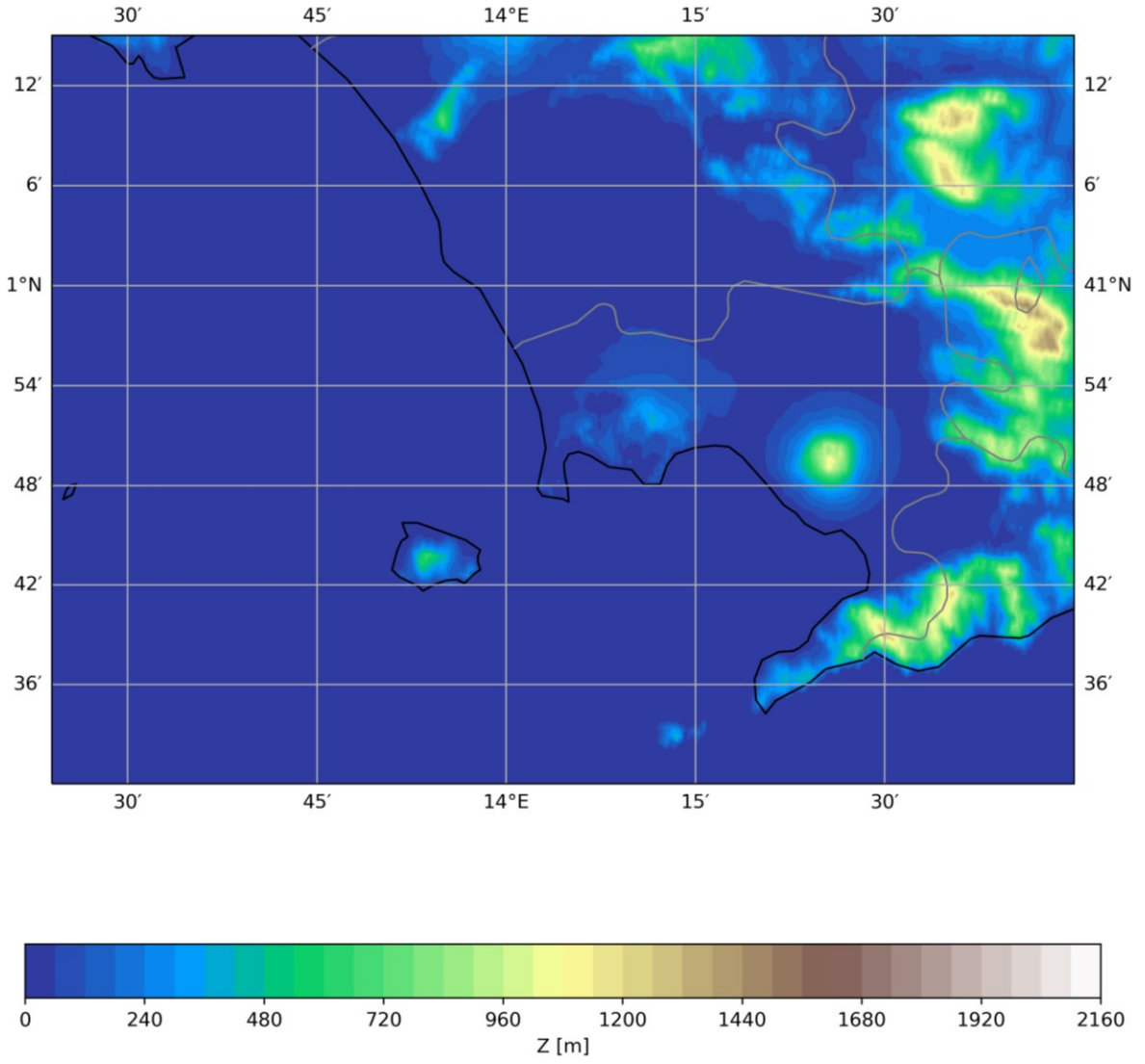
GRID	RMSE (z_icon vs z_stations) [m]
1000	72.0
600 mt	68.0

OROGRAPHY: 1KM VS 0.6KM (ZOOM ON NAPLES METROPOLITAN AREA)

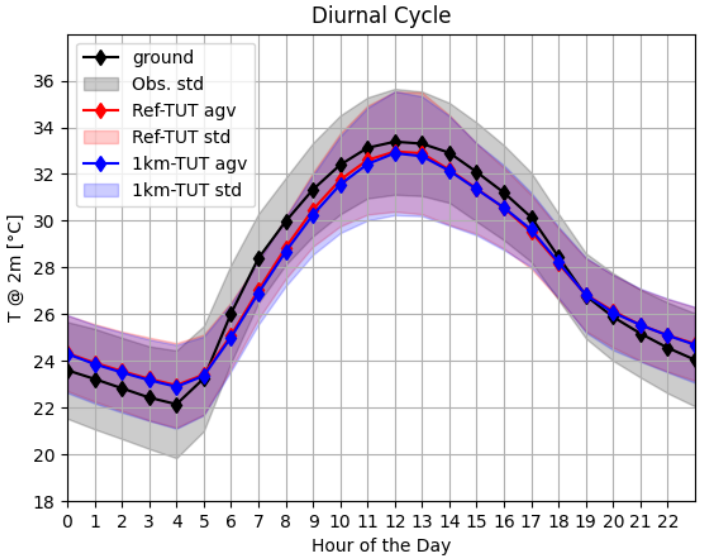
R02B11 -> 1.1 Km

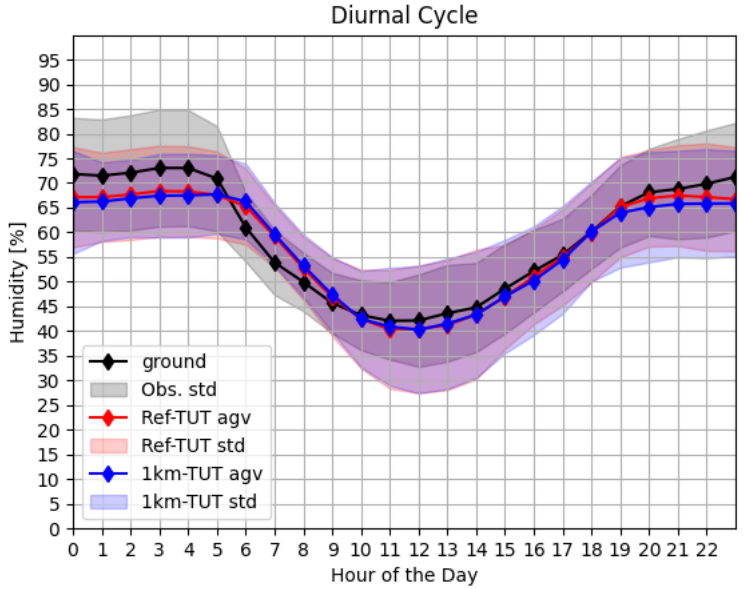


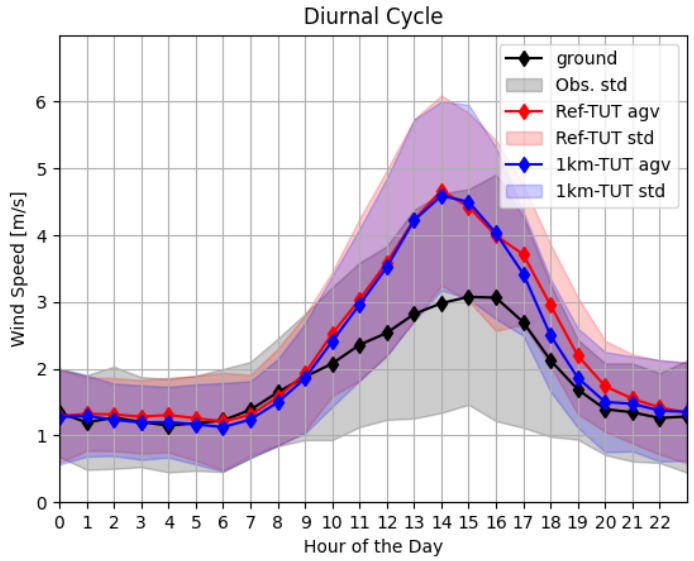
R02B12-> 0.6 Km

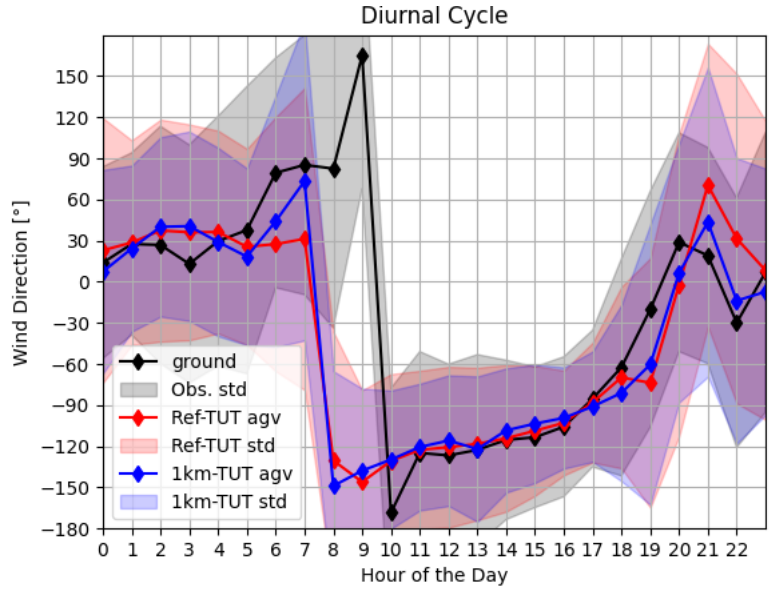


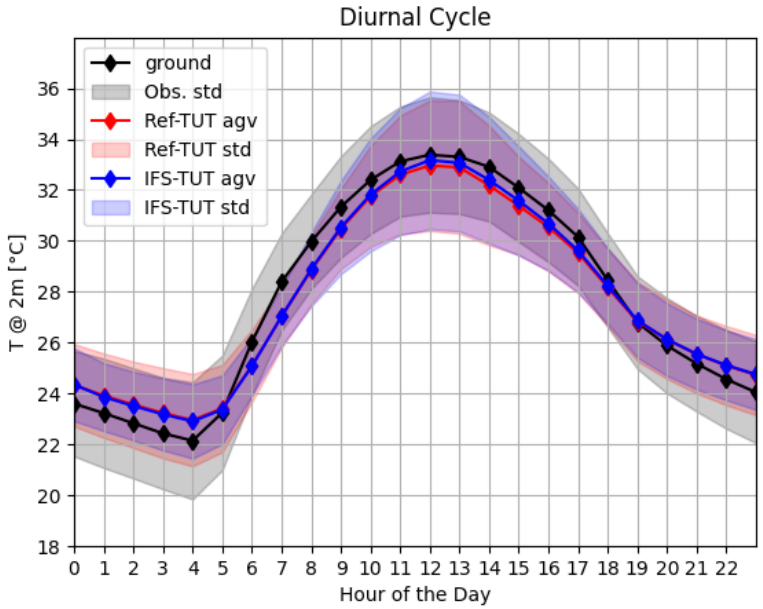
- Comparison of:
  - T2m; rh2m; ws10m; wd10m;
    - REF (0.6 km; Icon Soil; 1D turb; TU on, tiles=3) **vs:**
      - REF-1km (1.0 km; Icon Soil; 1D turb; TU on; tiles=3)
      - LES (0.6 km; Icon Soil; 3D turb; TU on; tiles=1)
      - IFS (0.6 km; IFS Soil; 1D turb; TU on; tiles=3)
    - Taylor plots

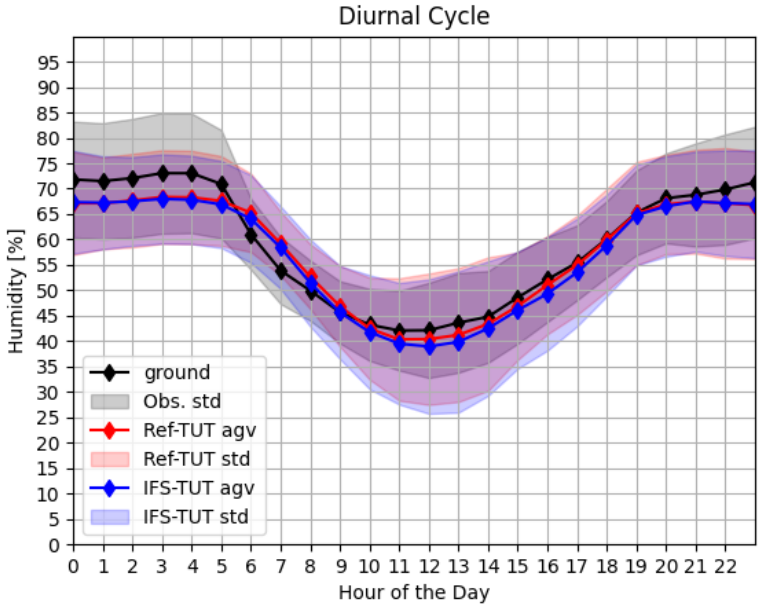


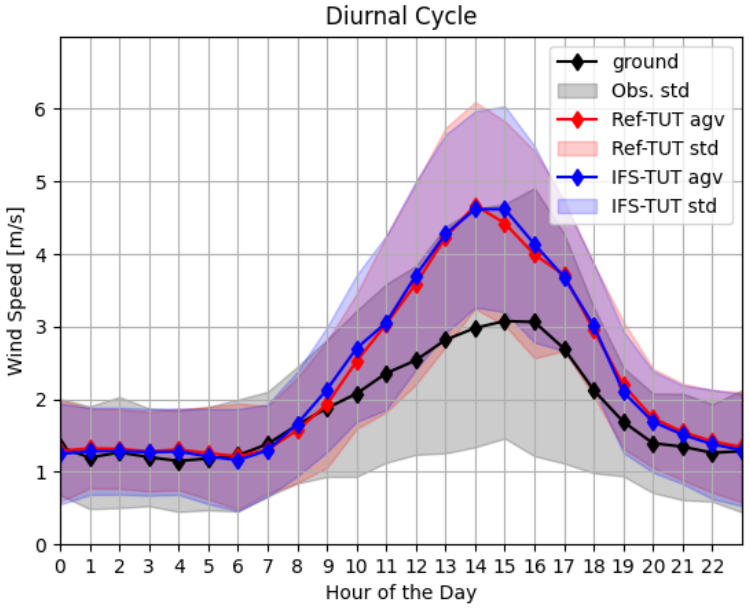


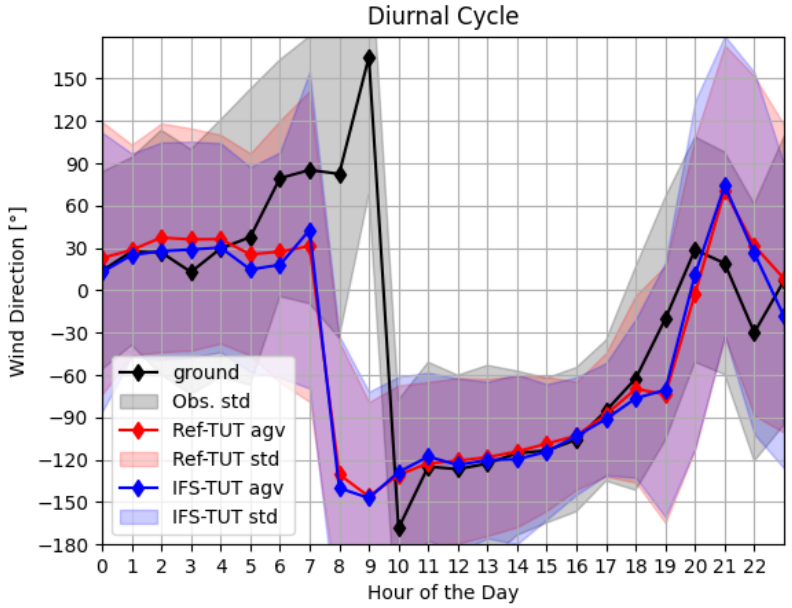




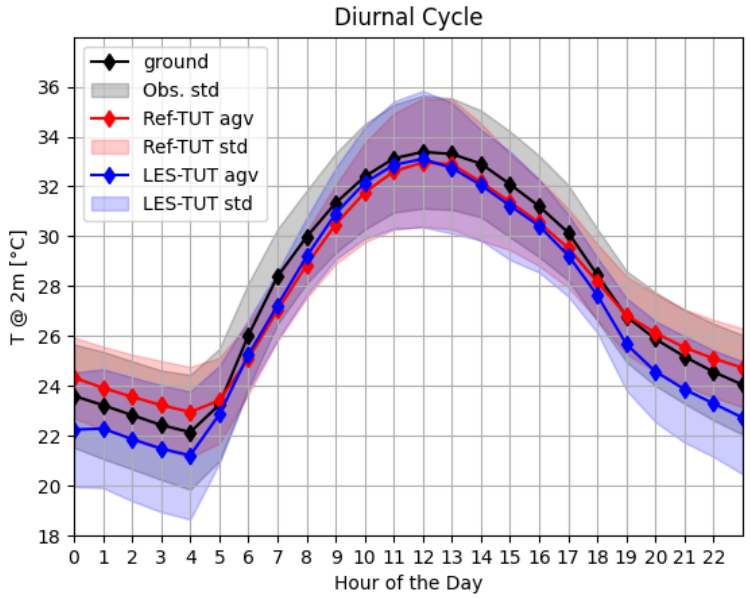


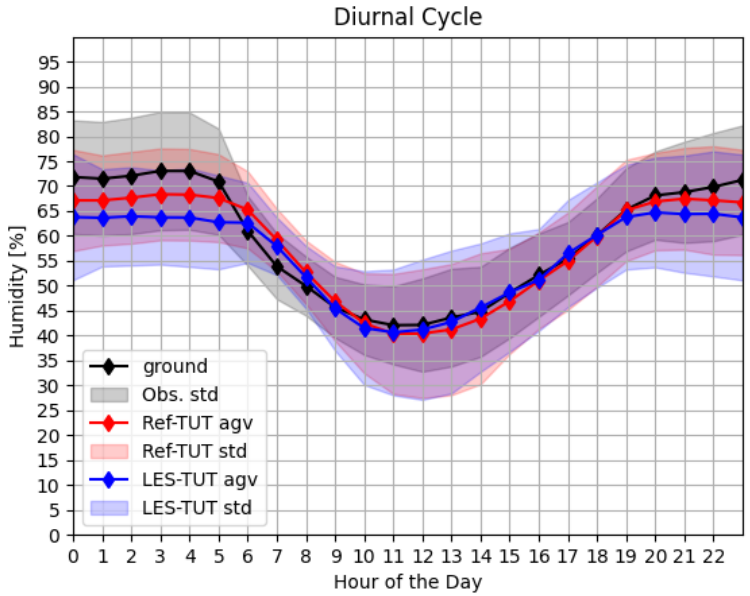


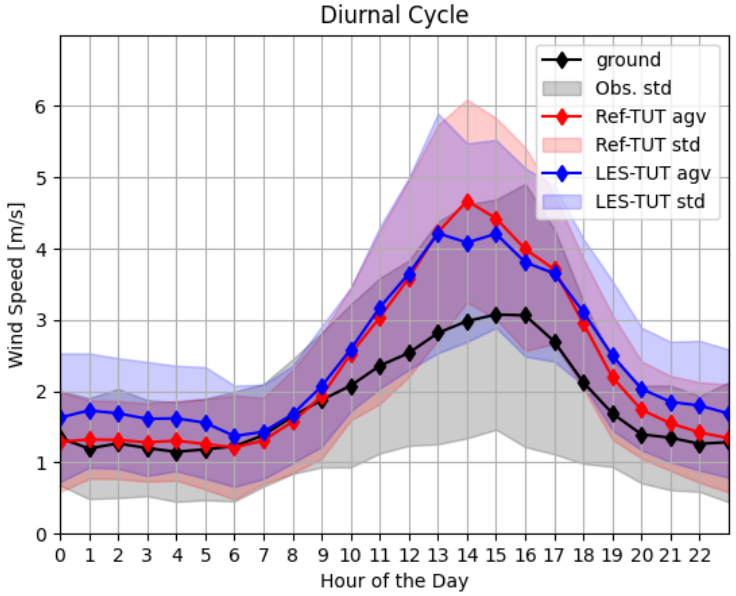


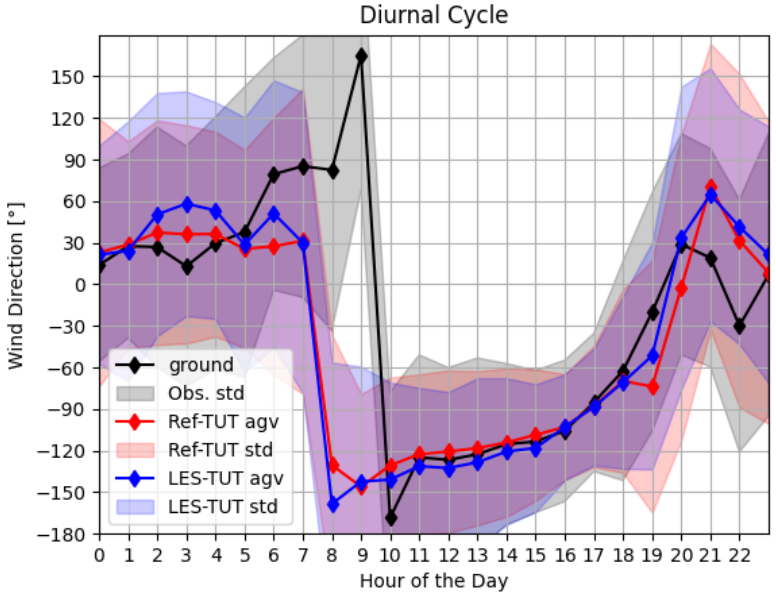


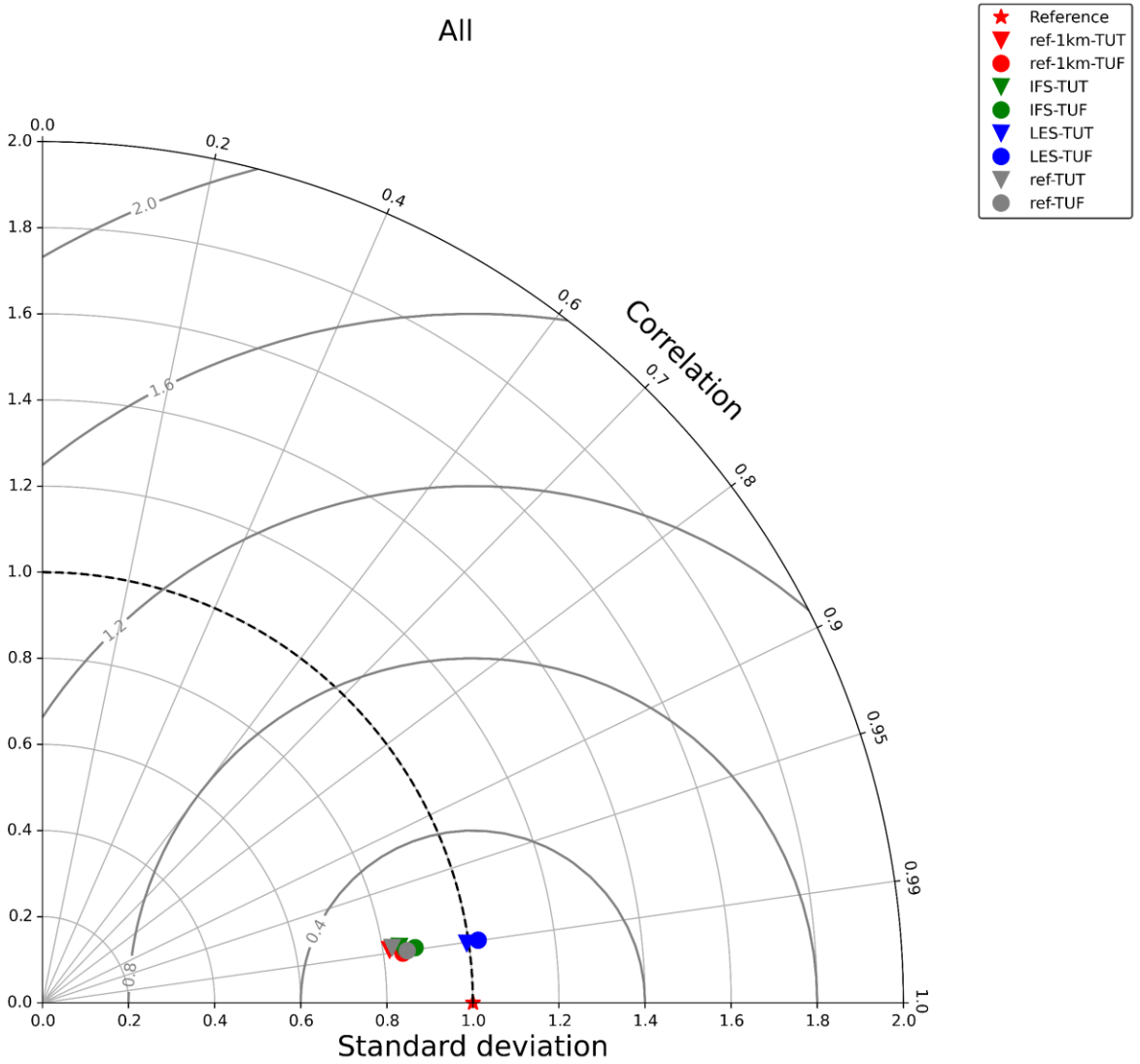
TURBULENCE: LES vs 1D (REF)

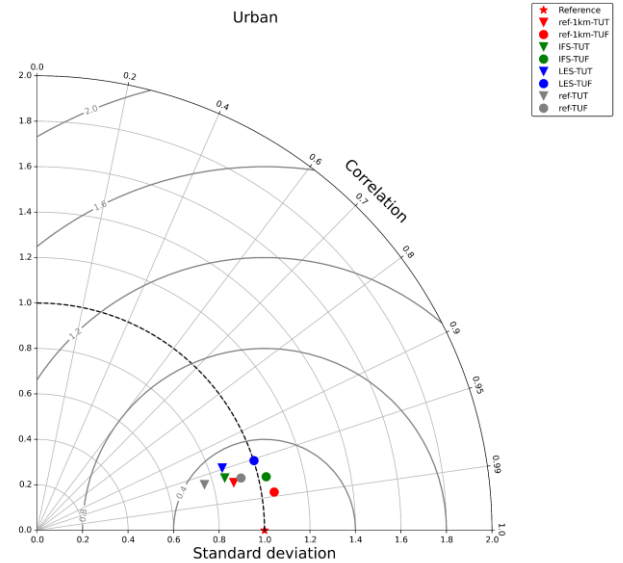


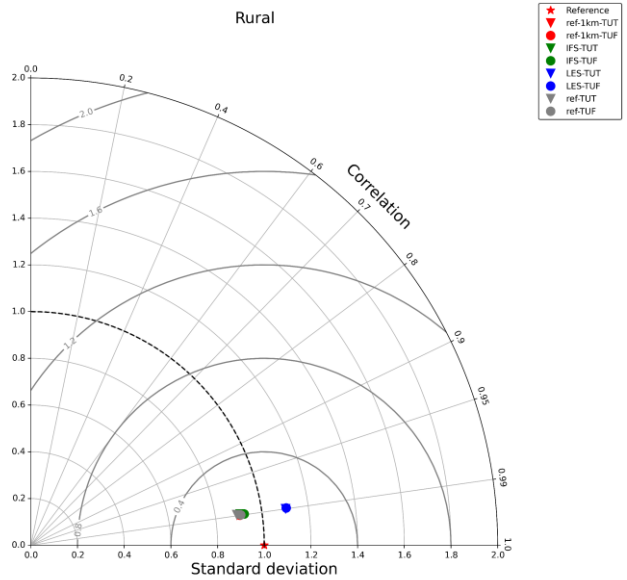


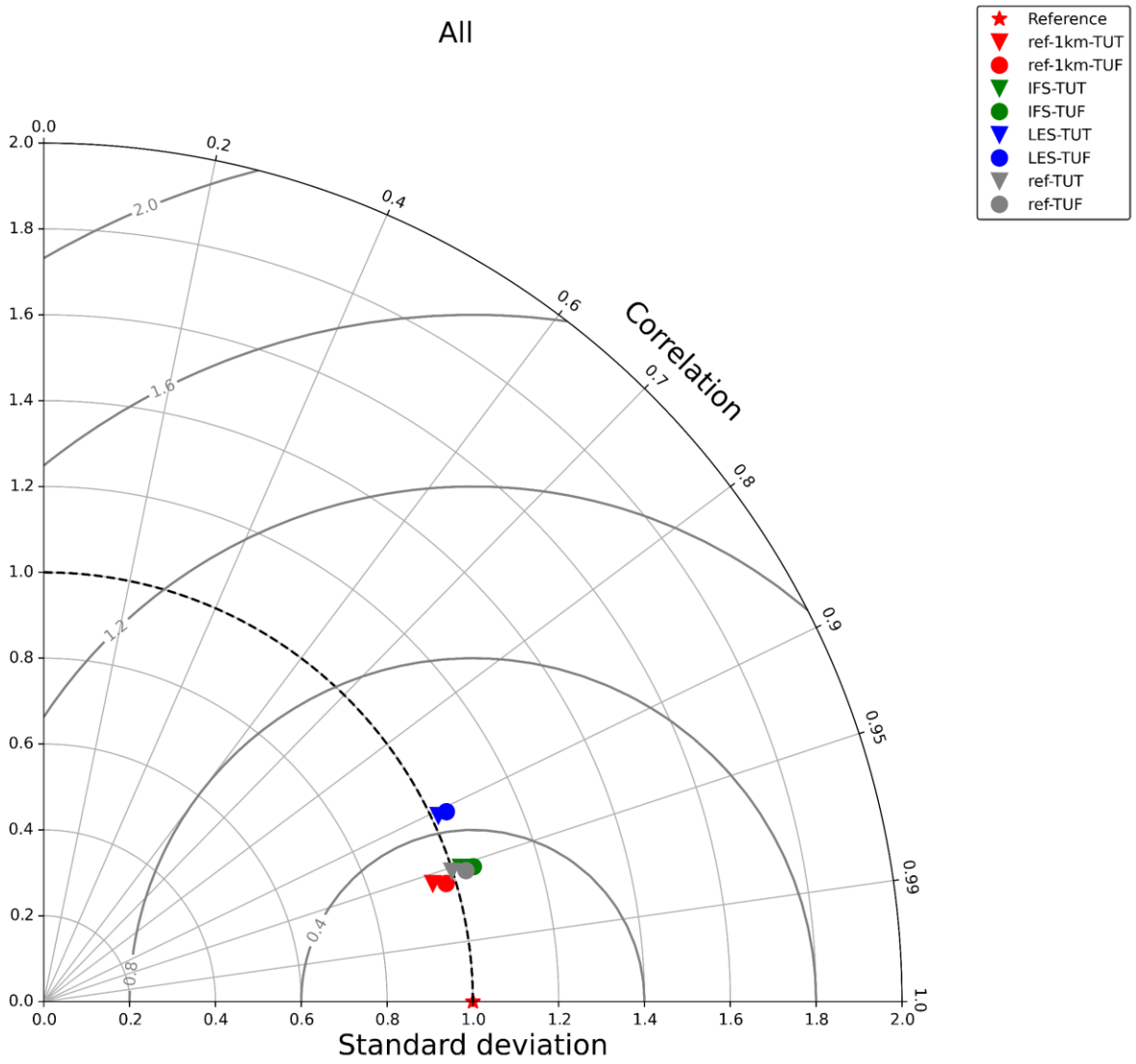


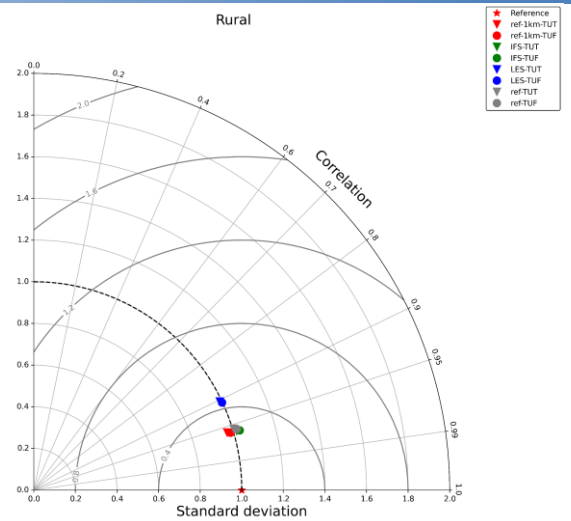


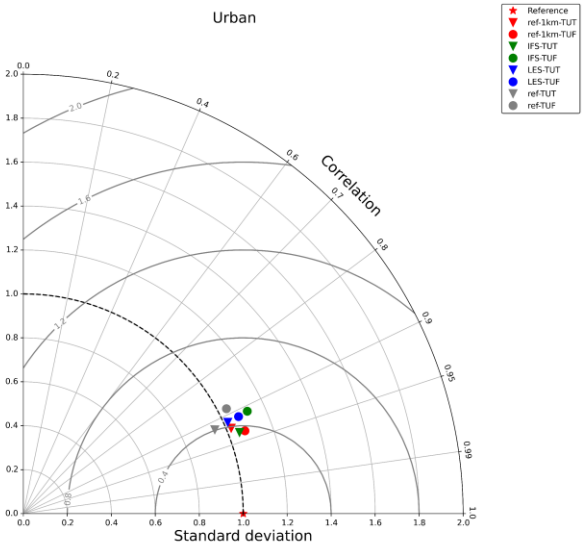




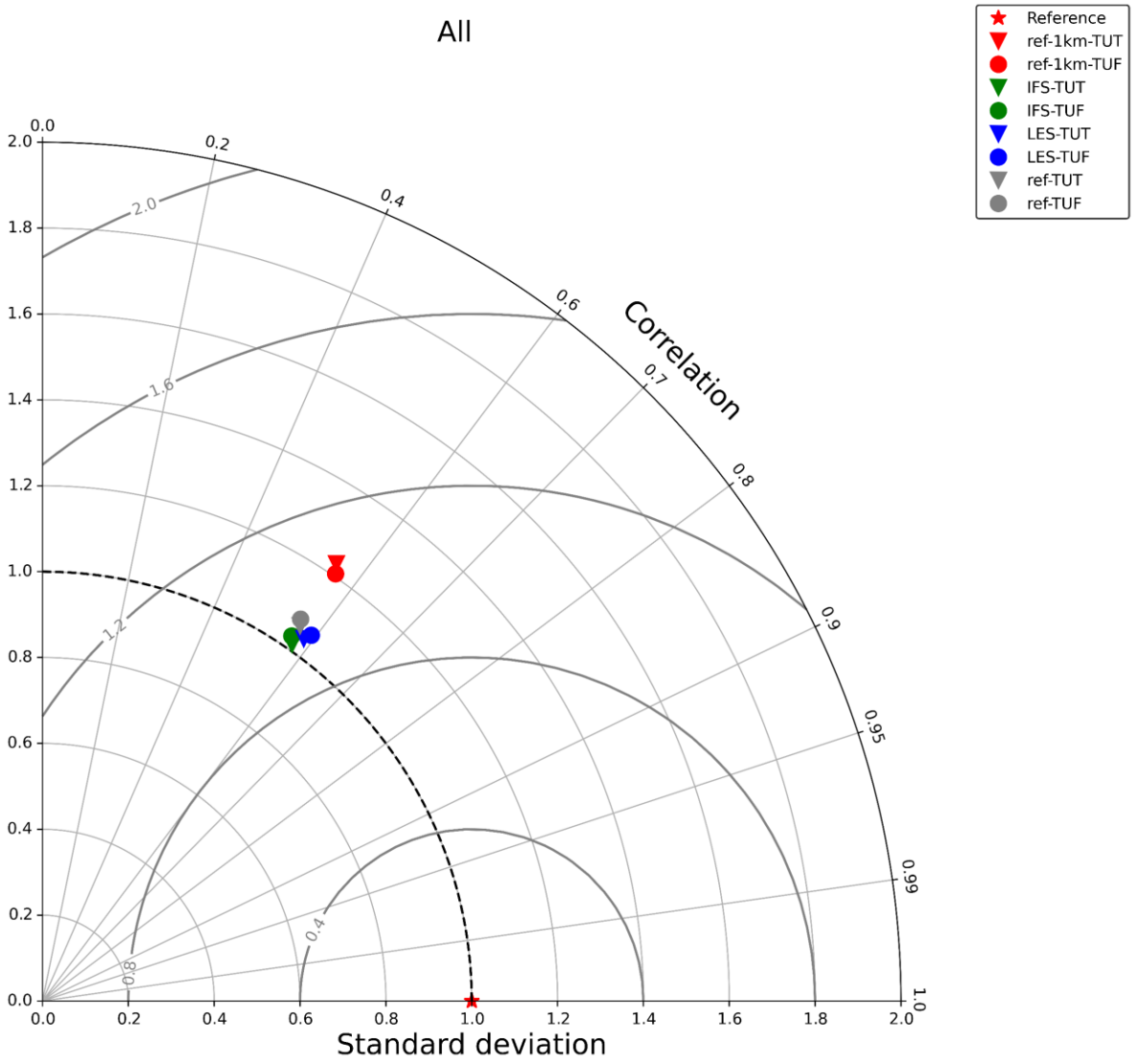




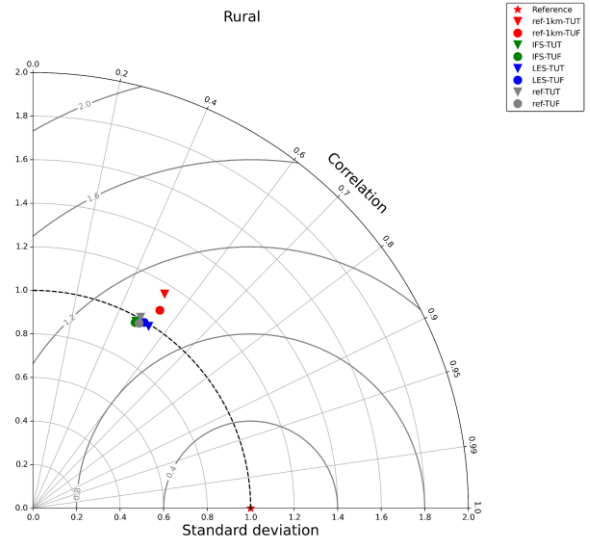




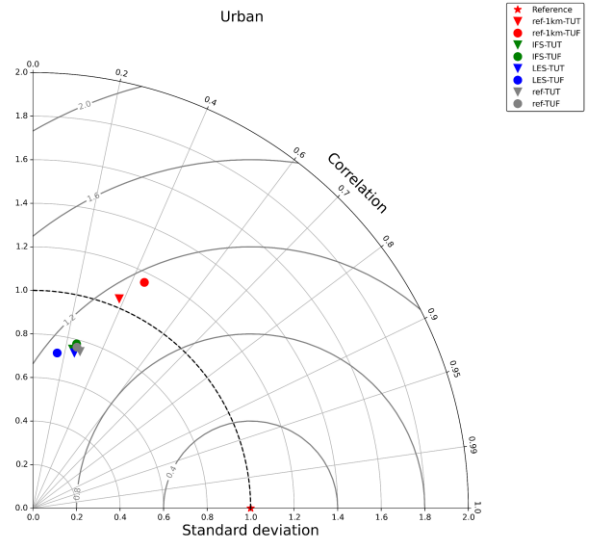
All

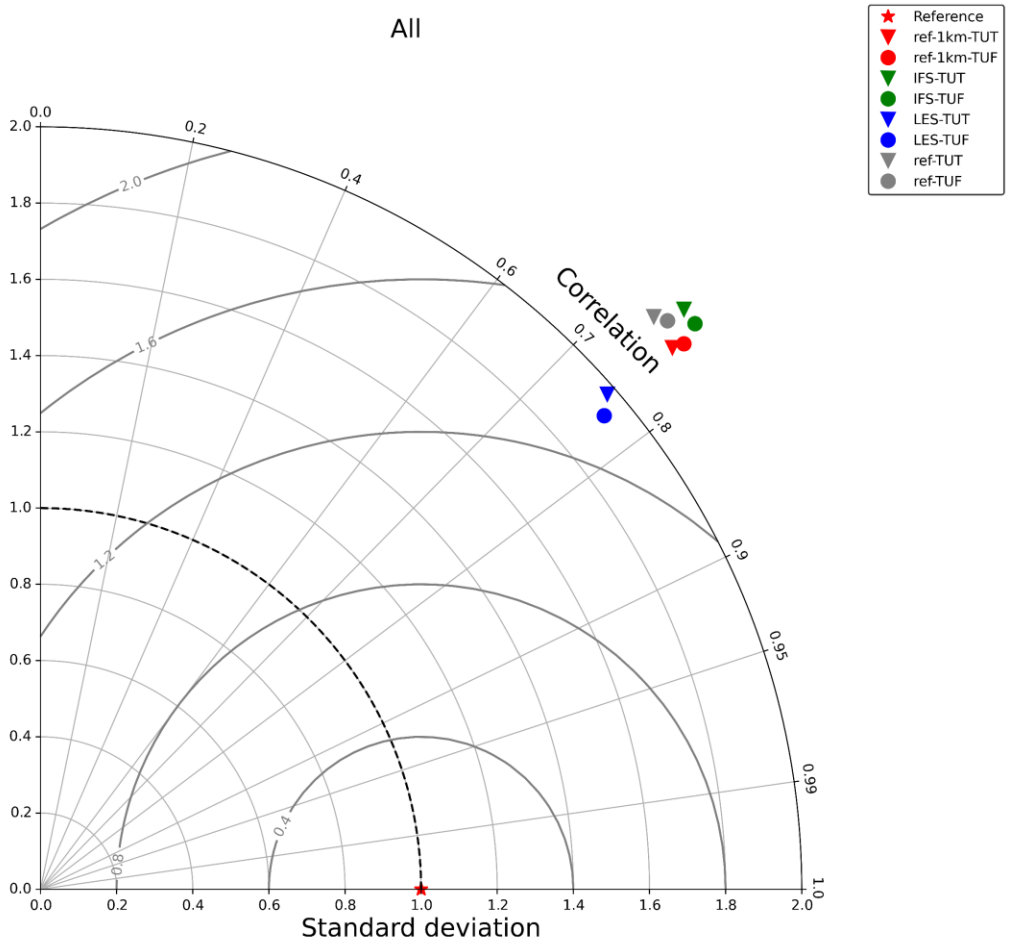


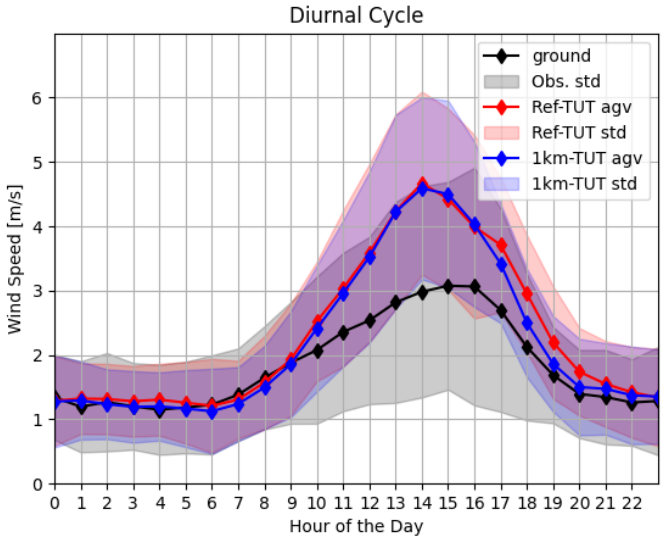
Rural

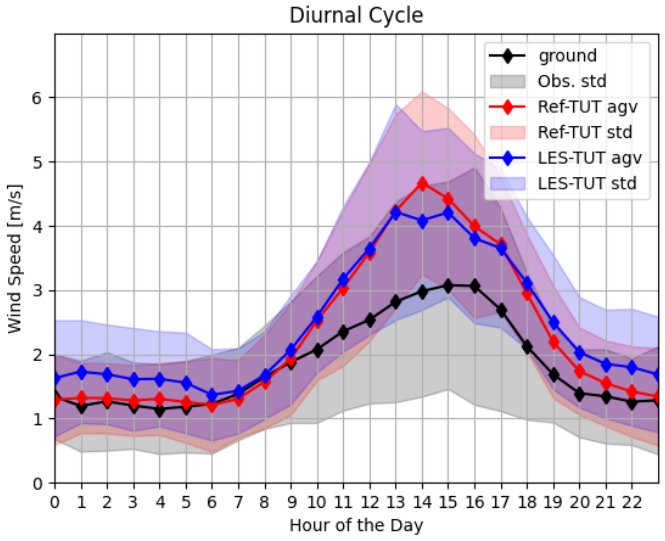


Urban

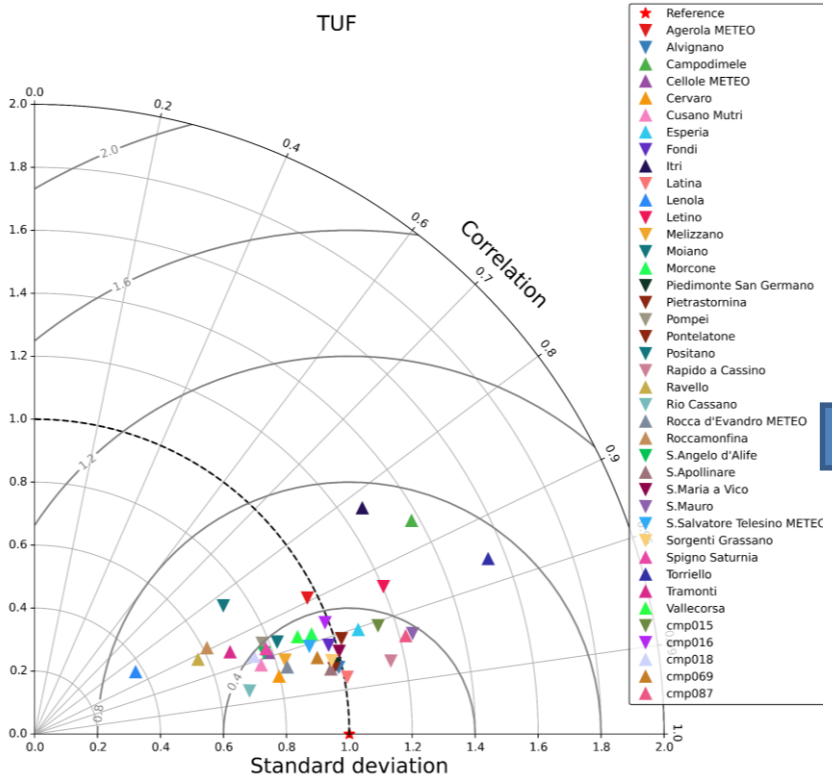




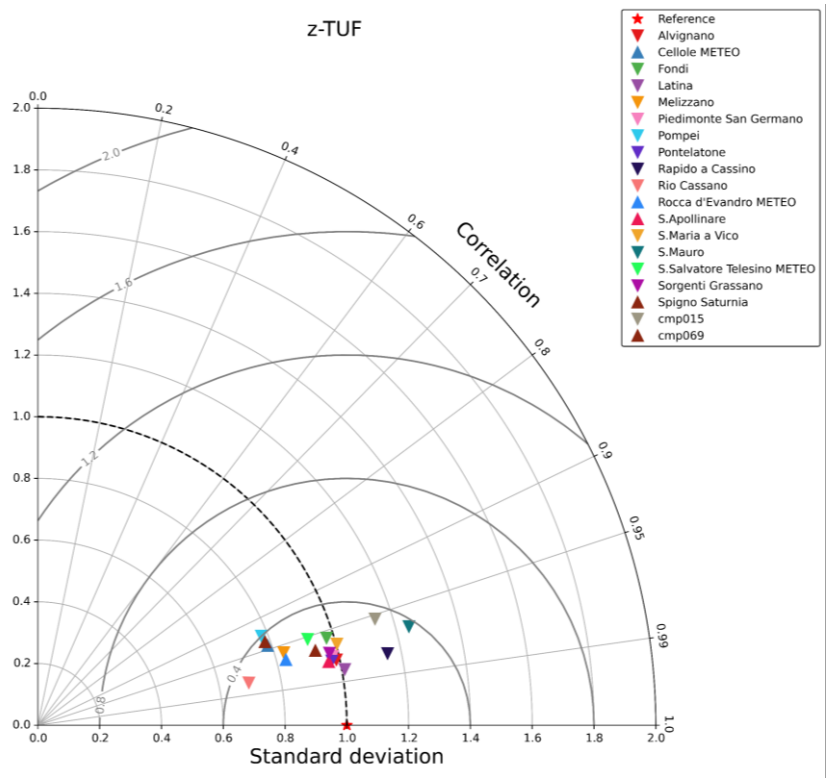




Taylor plot for T2M



Filter out z >200mt



- Filtering out stations higher than 200mt, clustered distribution
- Some preliminary investigations are followed…

- A preliminar investigation, supported metrics based on statistical correlation shows that a statistical significant relation is found among the stations altitude and the centered RMS error

Matrix of Correlation for each model investigated: *Columns for errors in Taylor graph, rows related variables related to heights parameters*

REF

	z-err	z-ground	z-icon
crms	0.23	0.33	0.27
std	0.35	0.25	0.15
rho	-0.21	-0.11	-0.051

IFS-SOIL

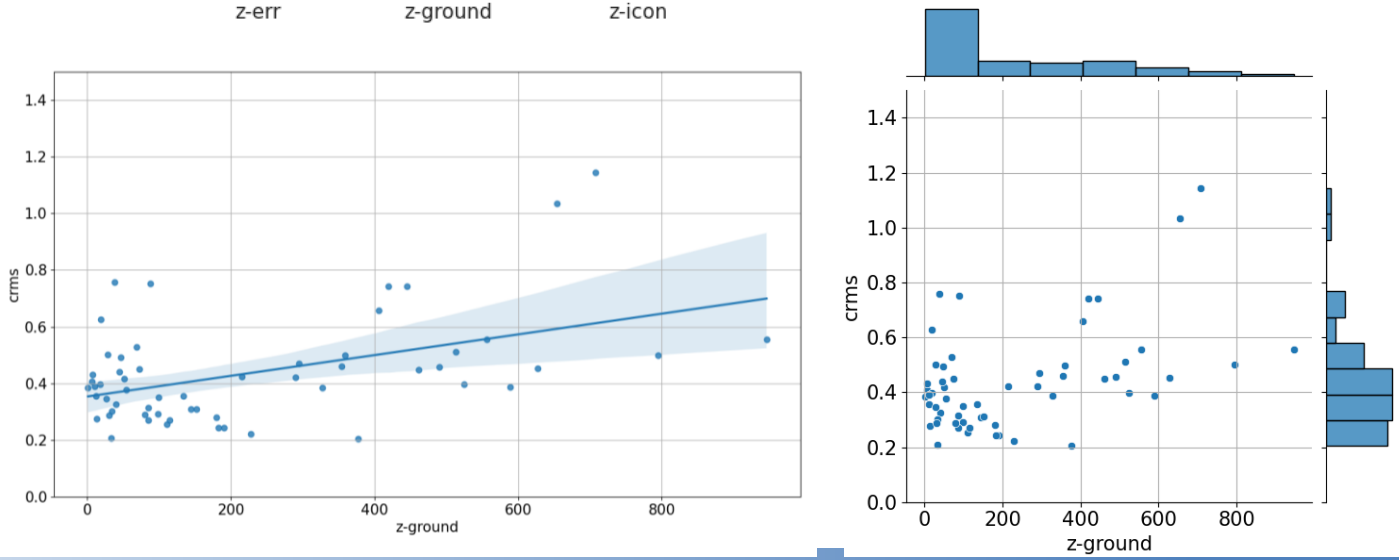
	z-err	z-ground	z-icon
crms	0.18	0.34	0.29
std	0.23	0.23	0.17
rho	-0.22	-0.19	-0.13

LES

	z-err	z-ground	z-icon
crms	0.43	0.46	0.35
std	0.37	0.41	0.31
rho	-0.22	-0.24	-0.18

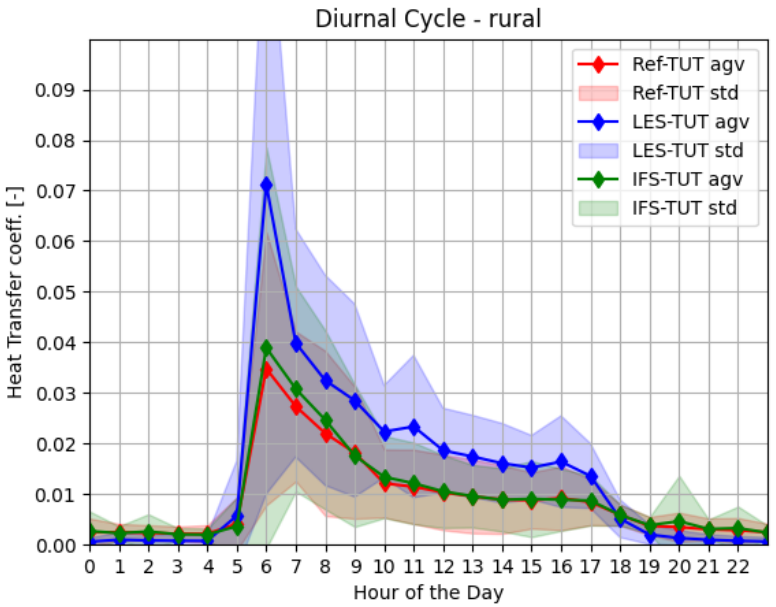
- Highest relation found in LES models

Crms error vs z-ground for LES model:

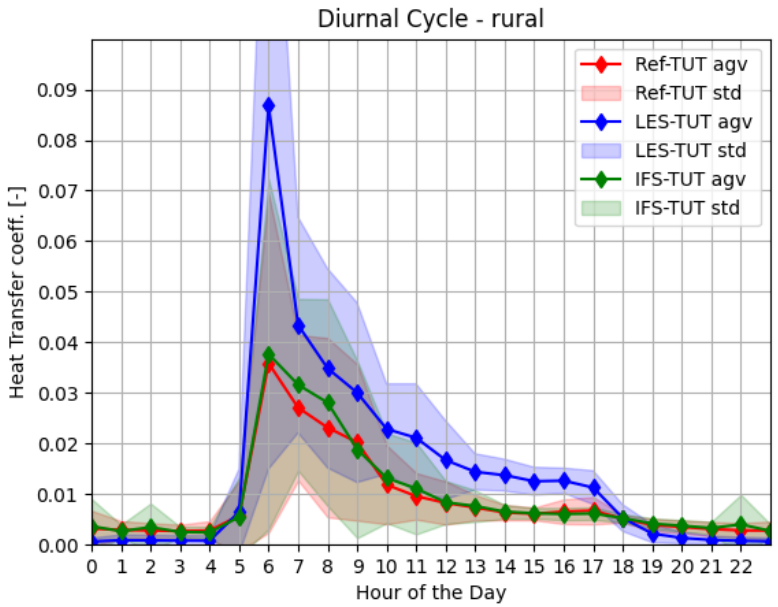


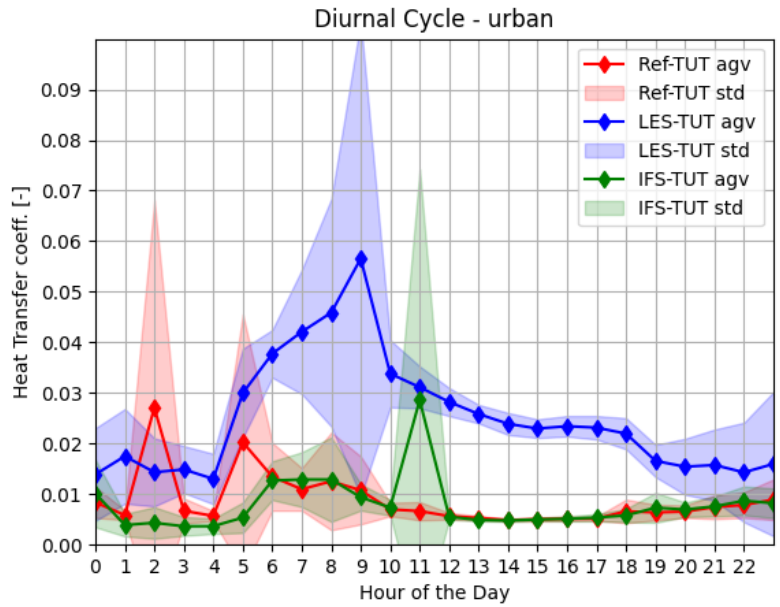
- Check on surface Fluxes
  - Turbulent Heat transfer coefficient, CTH
  - Sensible HF, SHF
  - Latent HF, LHF

< 2000 mt



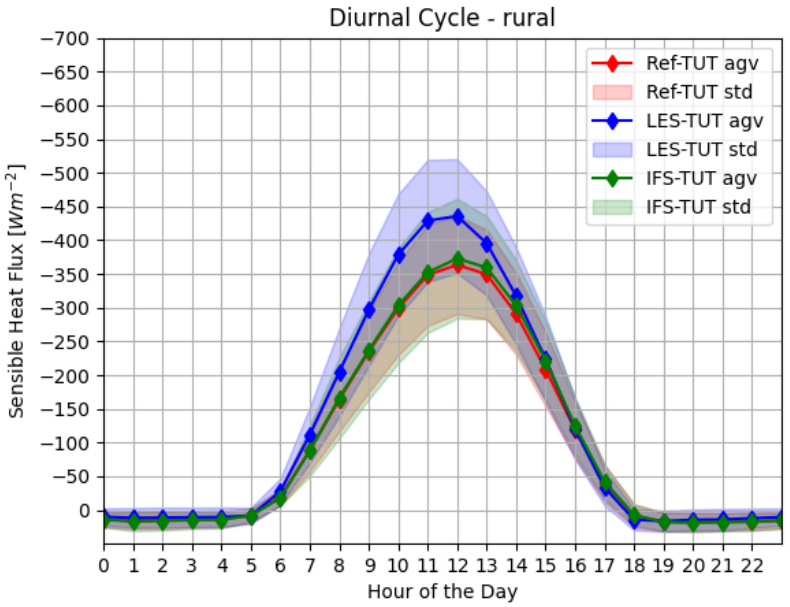
< 200 mt



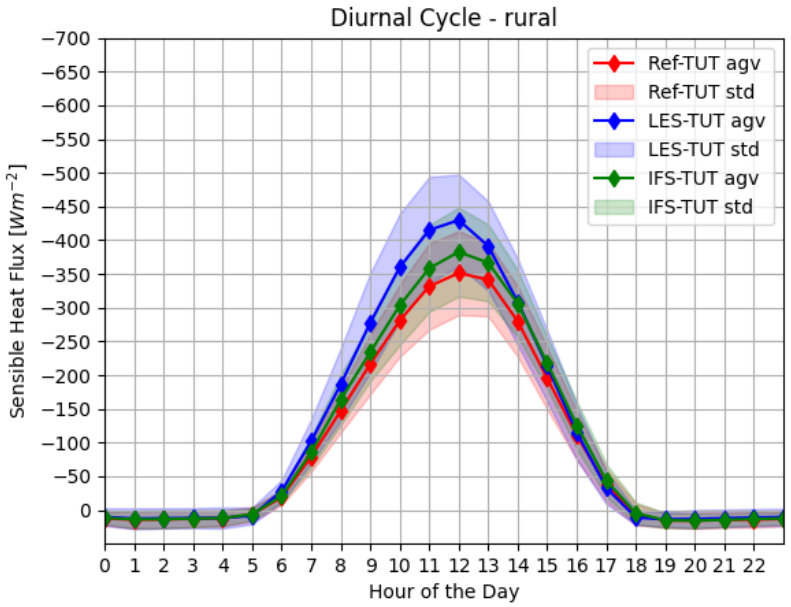


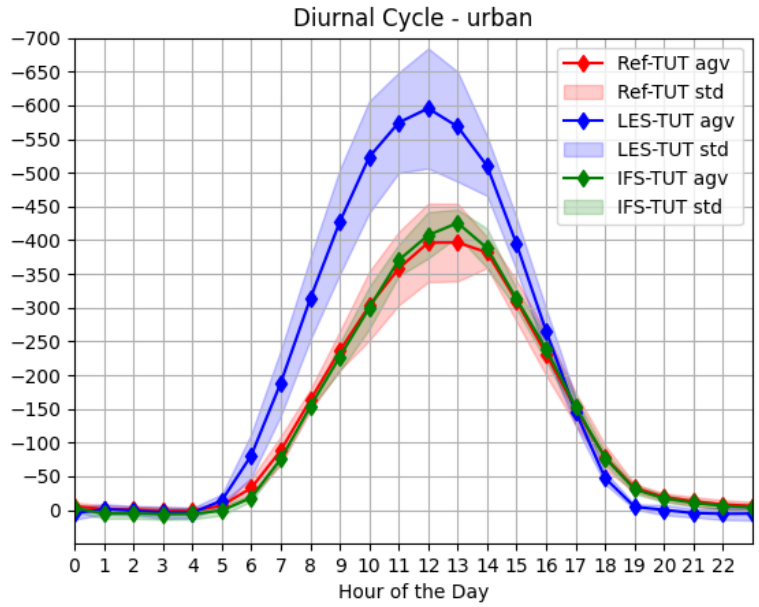
Q > 0 when entering towad ground/soil/surface, i.e., atmosphere is warming soil.
Q < 0 when flowing from surface to atmosphere.

< 2000 mt



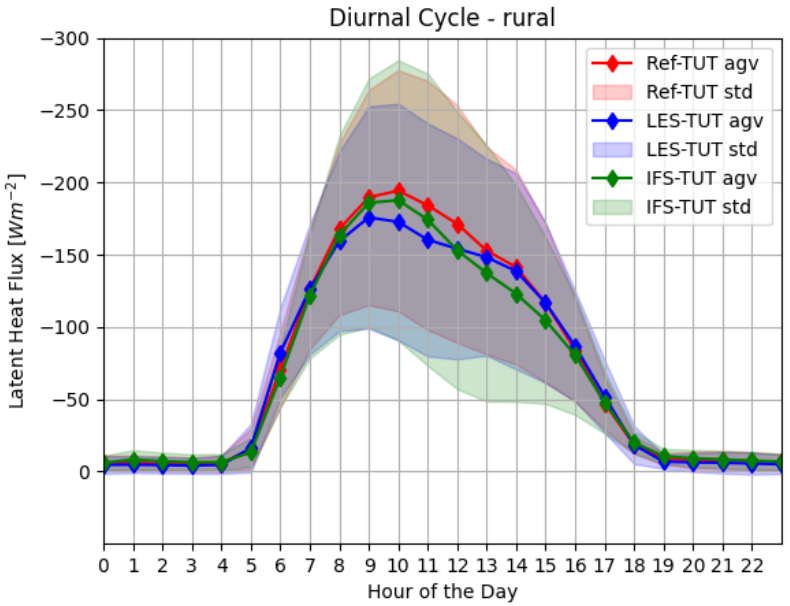
< 200 mt

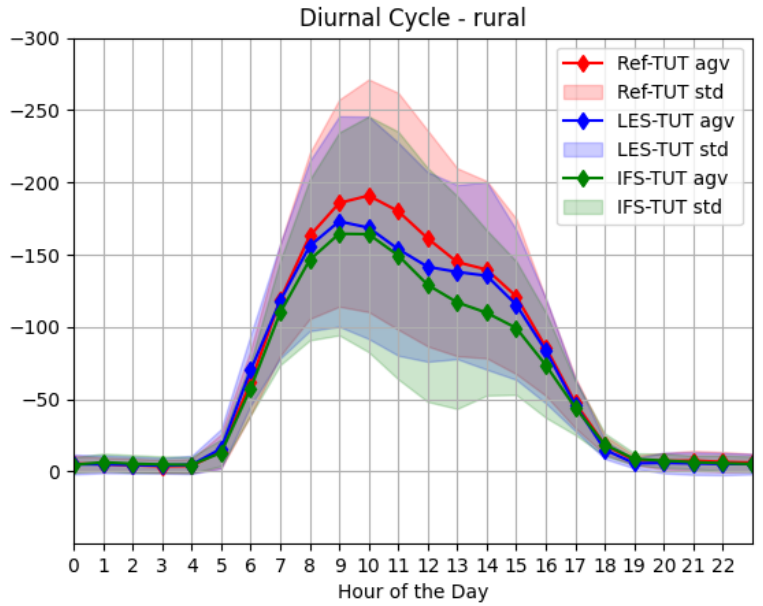


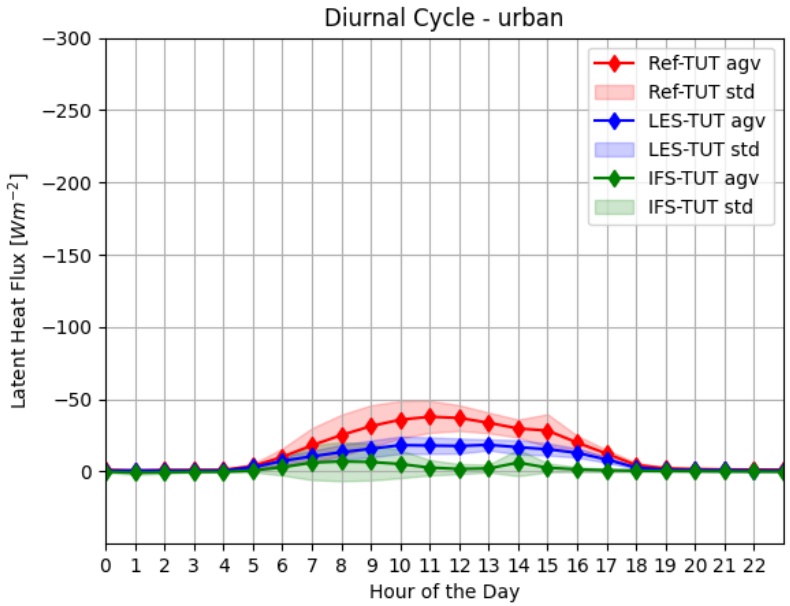


< 2000 mt

< 200 mt



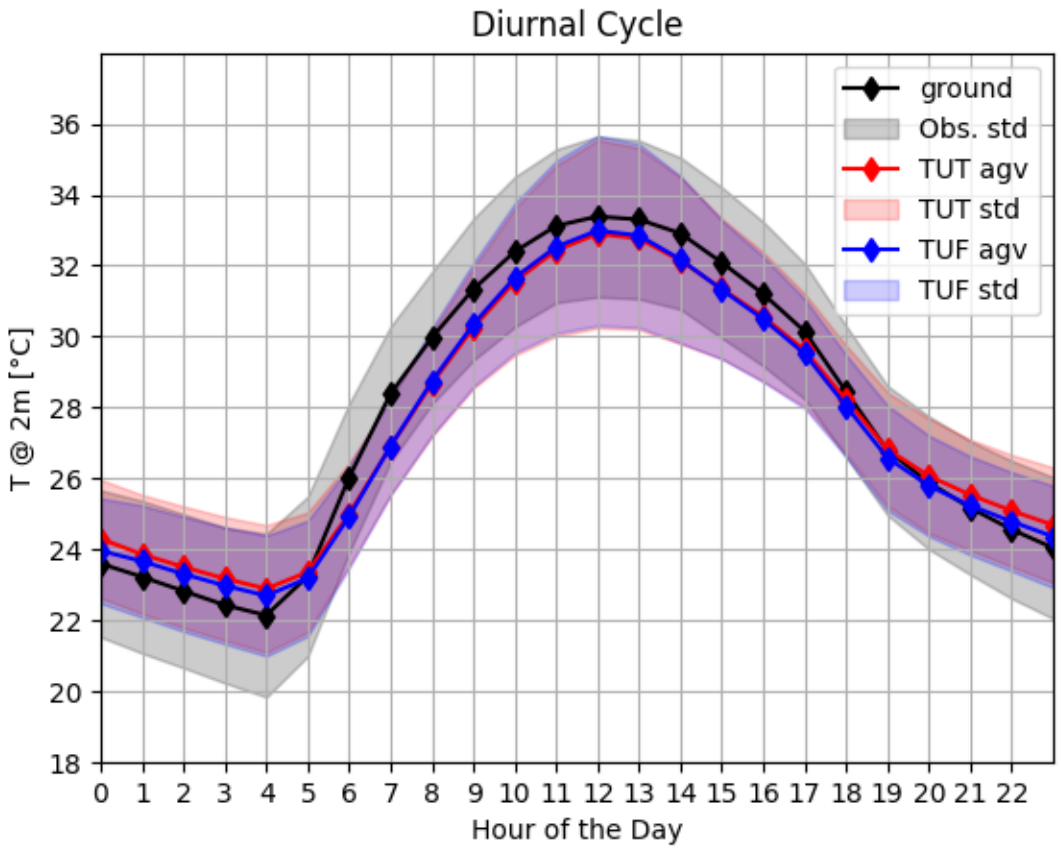




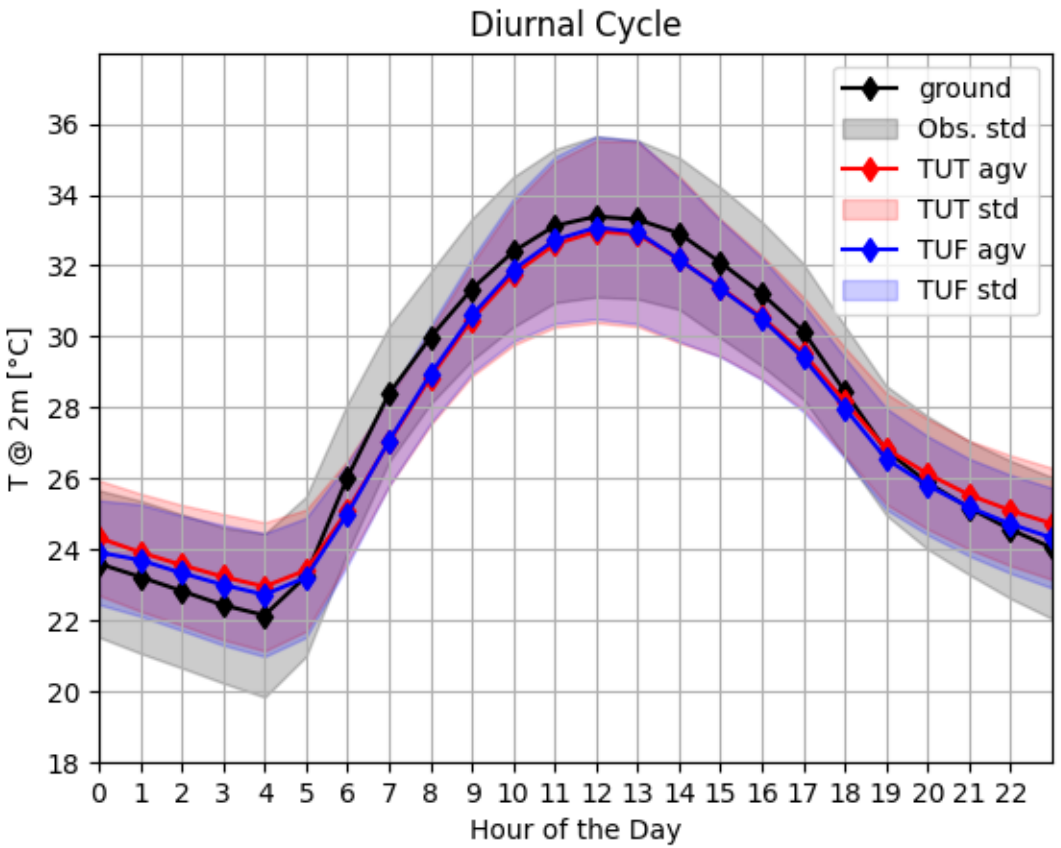
- Comparison of ICON –LAM configuration performed over a region in Southern Italy
  - 7-day simulation, considering a week with a severe heat wave in July 2022
  - Consideration on grid effects
  - Soil IC’s
  - Turbulence model

THANK YOU FOR YOUR ATTENTION!

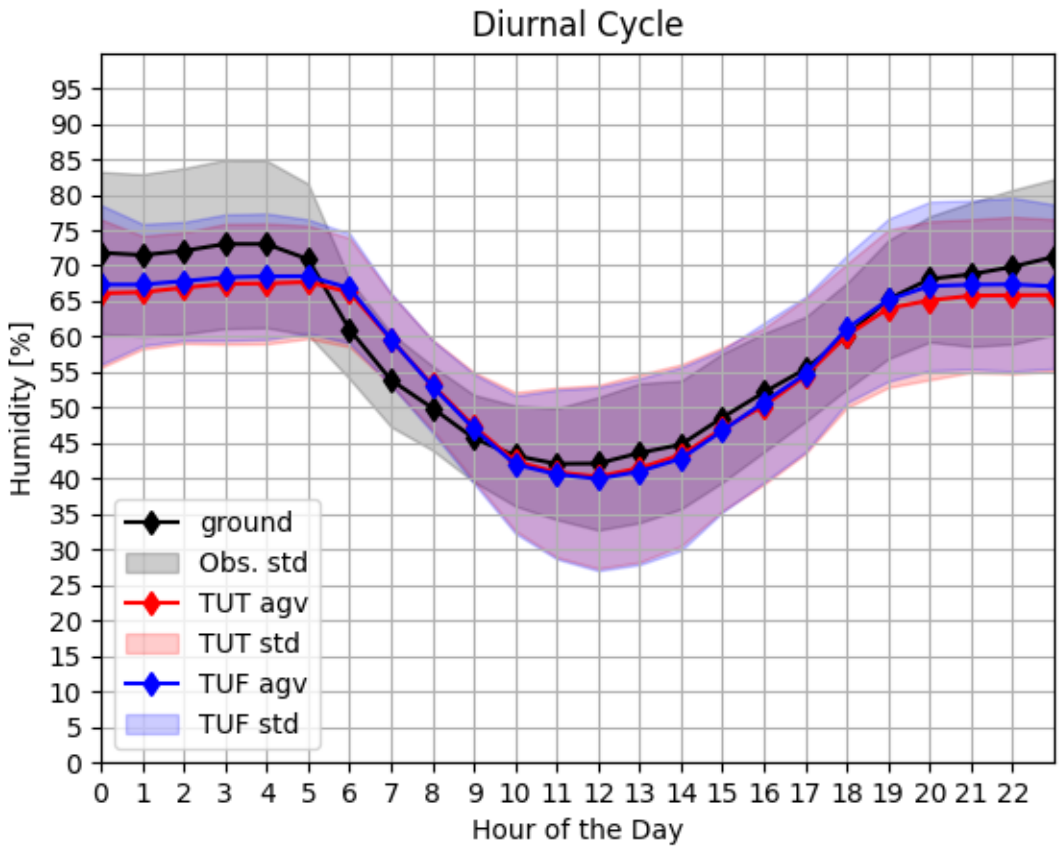
1.1 KM



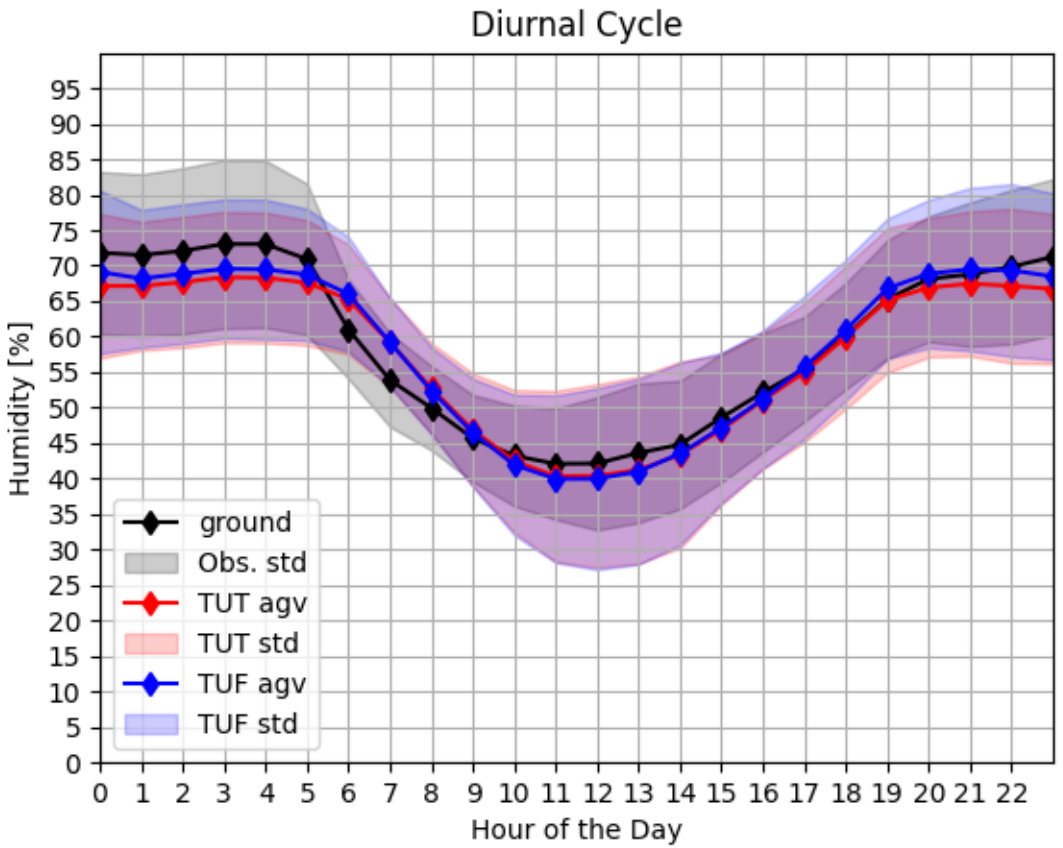
0,6 KM



1.1 KM



0,6 KM



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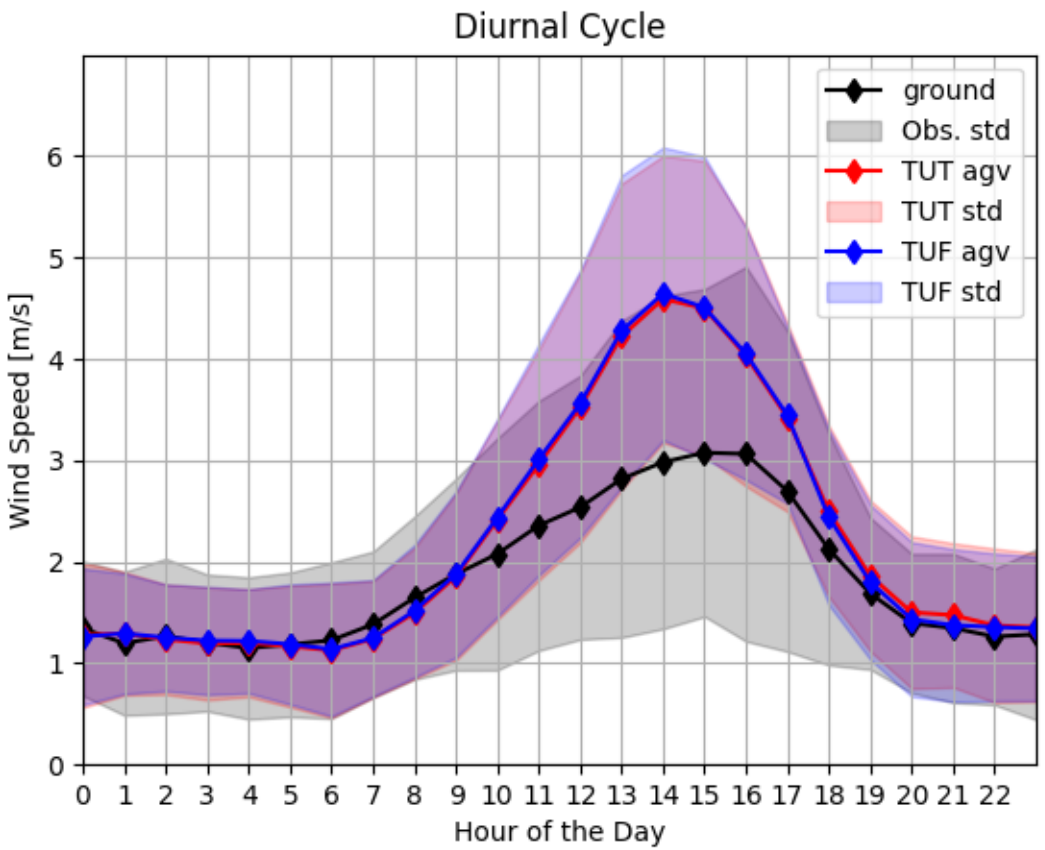

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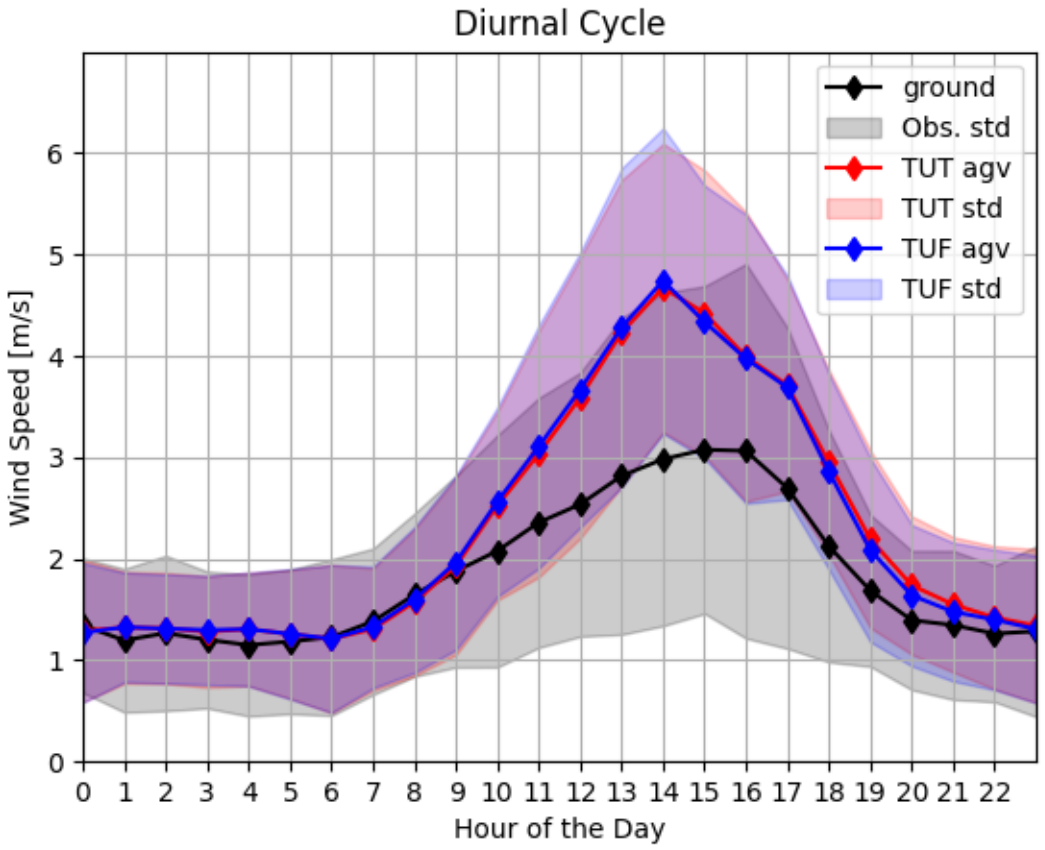
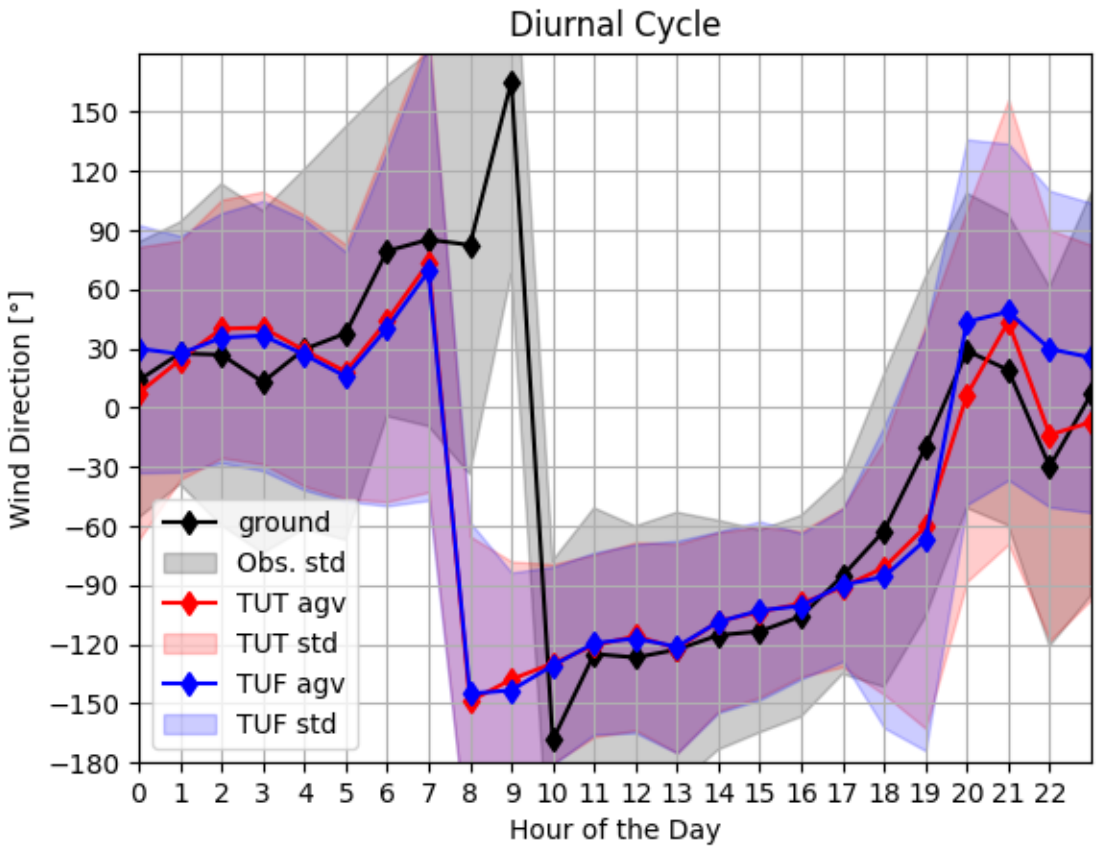


1.1 KM



0,6 KM