PRINCETON
School of Engineering and Applied Science

*Development and evaluation of a mosaic/tiling approach in the WRF-Noah framework**

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*Main reference:

Li et al. (2013) Development and evaluation of a mosaic approach in the WRF-Noah framework, Journal of Geophysical Research-Atmospheres (in press).

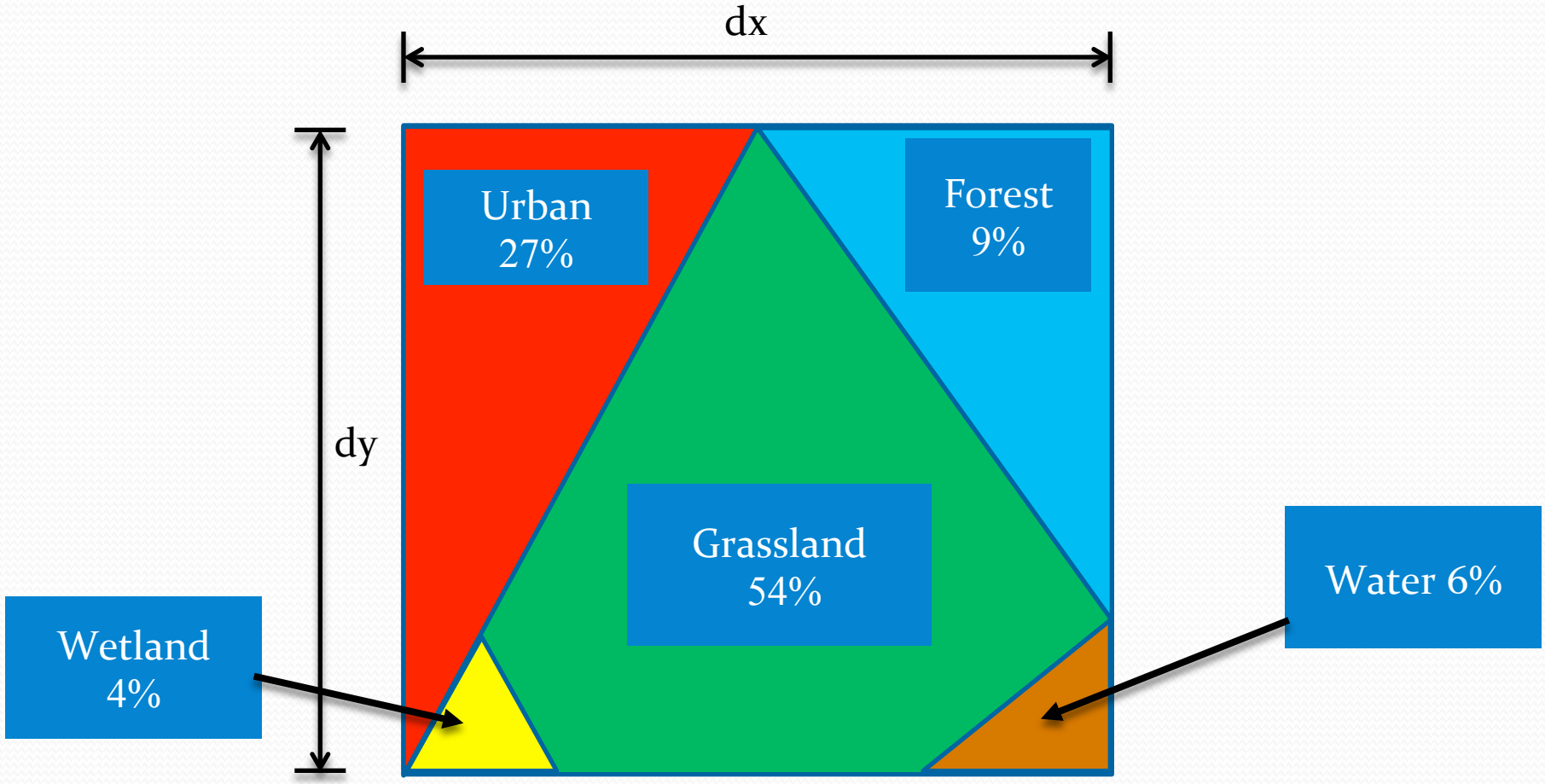
Outline

- Introduction to the mosaic/tiling approach

- Evaluation against observations
  - Case 1: a clear day, 2009-07-14
  - Case 2: a rainfall period, 2008-07-21 to 2008-07-27

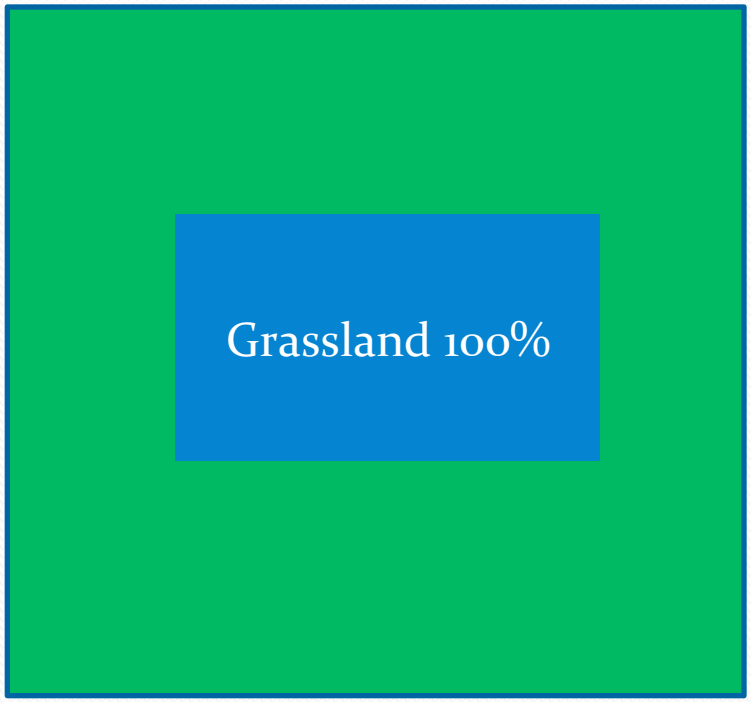
- Conclusions

Real World: multiple "tiles" within a "grid cell"

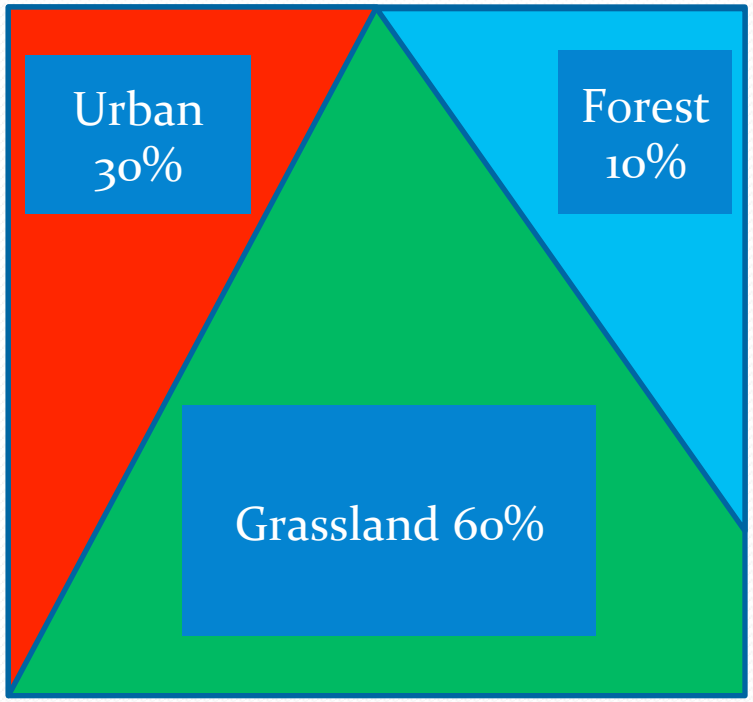


Modelling World: dominant vs mosaic

WRF-Noah



WRF-Noah-mosaic (N=3)

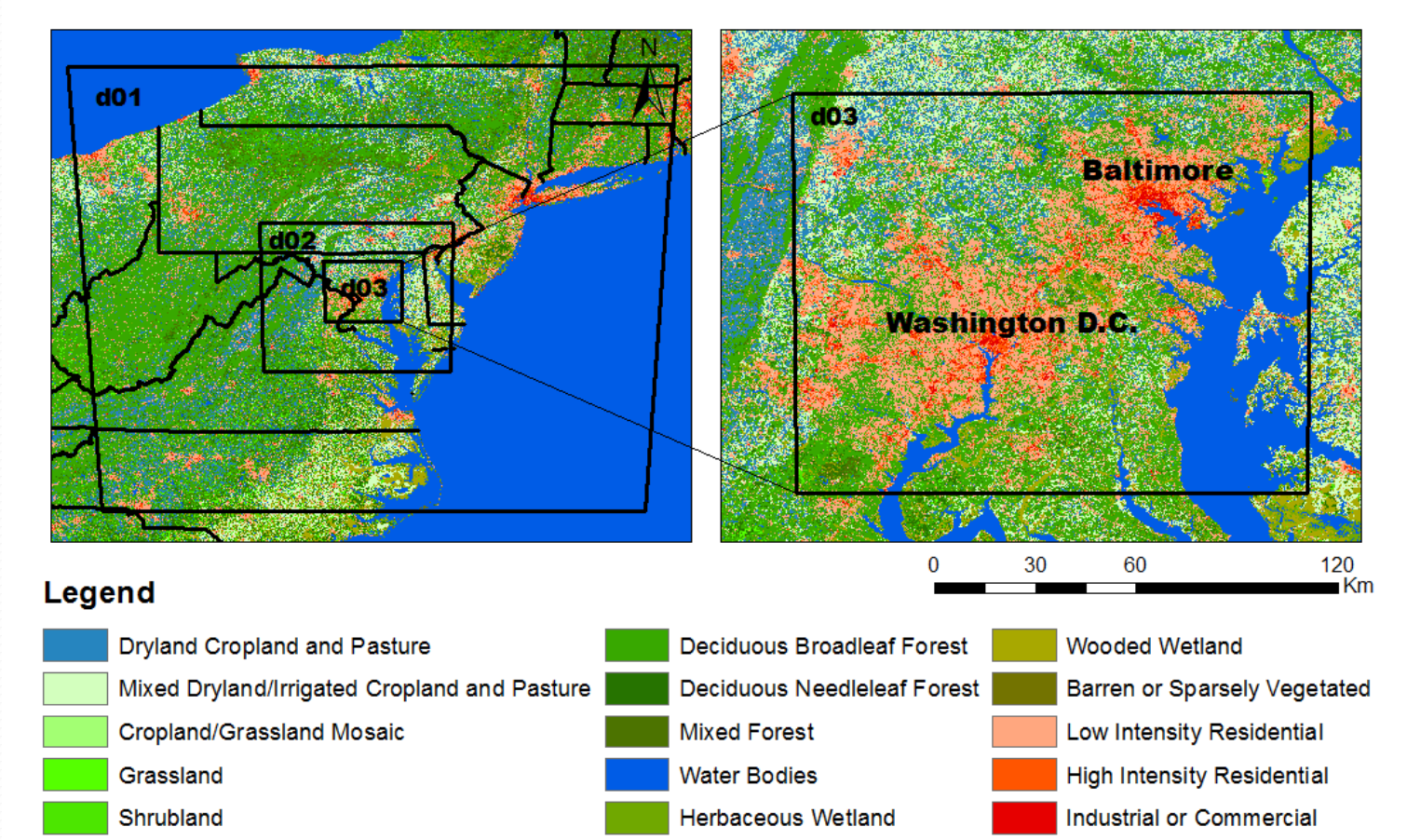


Hypothesis

- Urban environments provide a good test bed for this mosaic/tiling approach due to the considerable surface heterogeneities and the substantial differences between different surface types (e.g., impervious surface and vegetated surface).

- Despite that high-resolution (~1–3 km) numerical simulations are usually conducted in urban environments, the sub-grid scale variability of land surface characteristics remains important.

Domain configuration



- NLCD2006: 30 m resolution, 3 urban categories

WRF other physics and forcing

- the Rapid Radiative Transfer Model (RRTM) scheme for longwave radiation
- the Dudhia scheme for shortwave radiation
- the 2D Smagorinsky scheme for horizontal diffusion
- the Mellor-Yamada-Janjic planetary boundary layer scheme
- the WSM-6 scheme for microphysics
- the Single-layer Urban Canopy Model for urban physics
- North America Regional Reanalysis (NARR)

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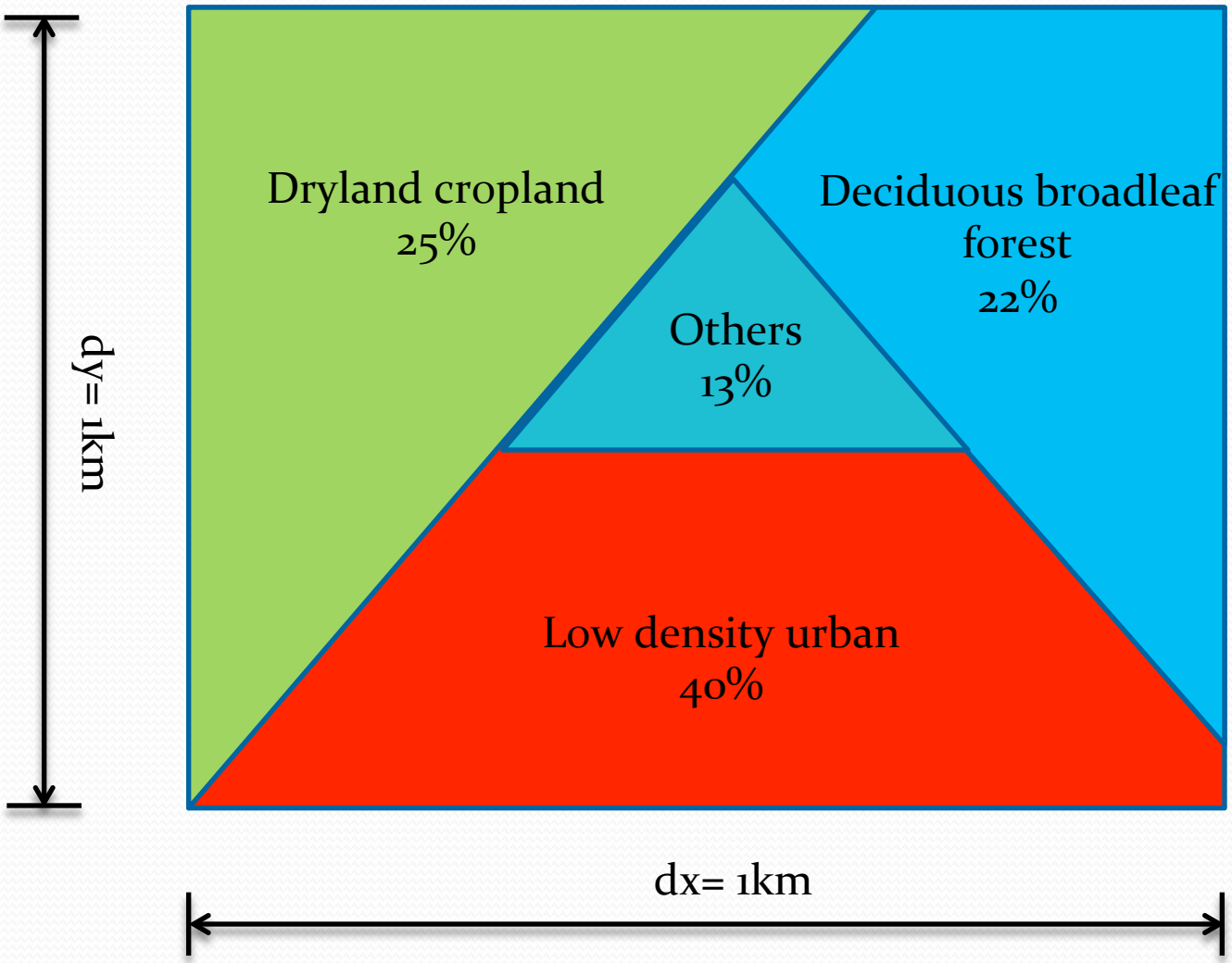
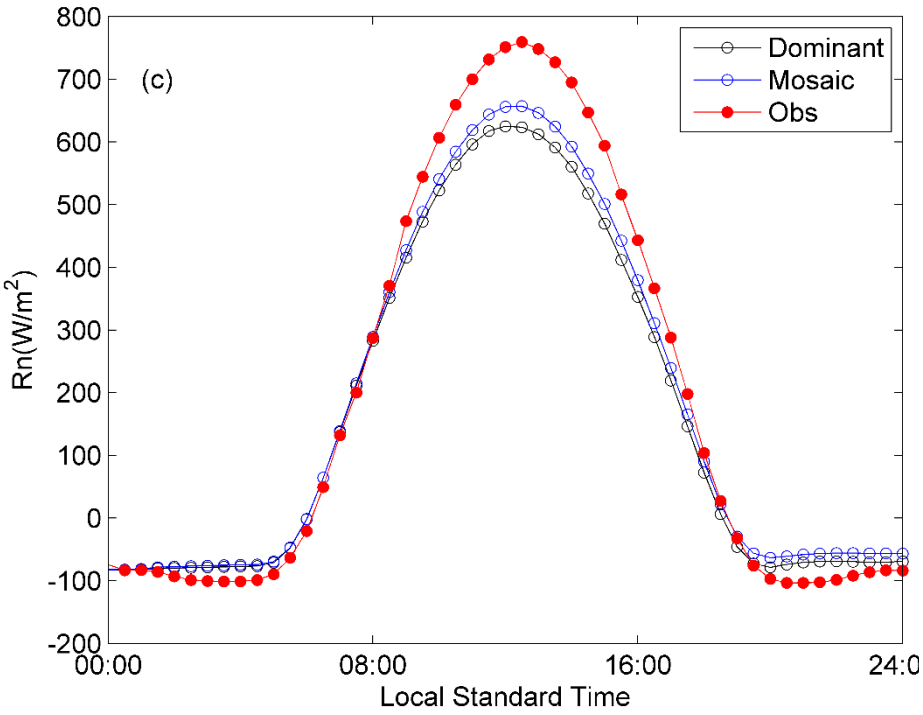
A clear-day case: fluxes at Cub hill

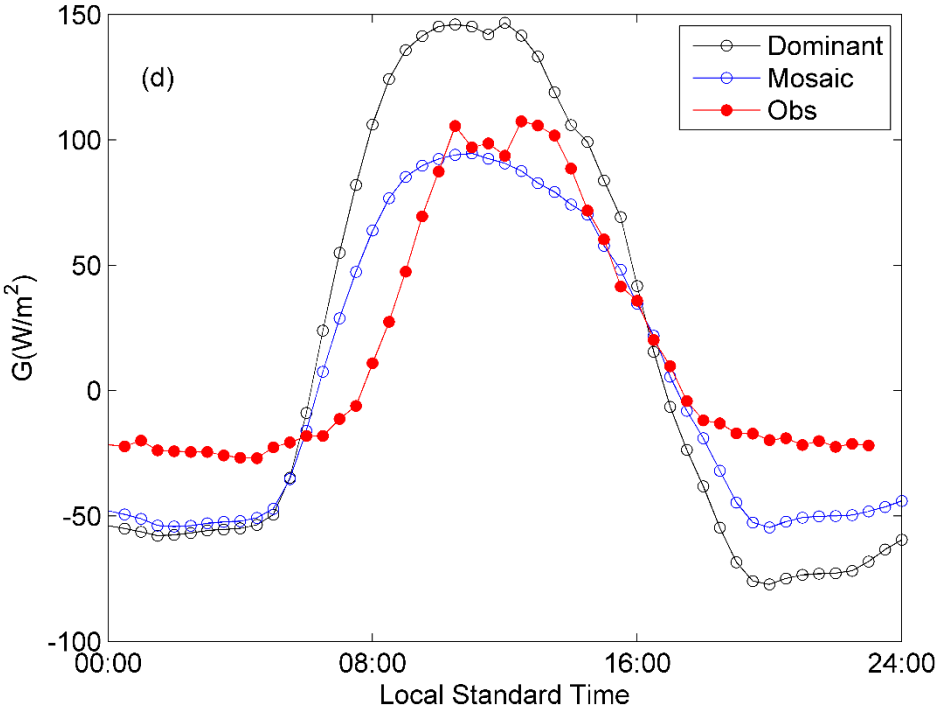


A clear-day case: fluxes at Cub hill

Rn

G

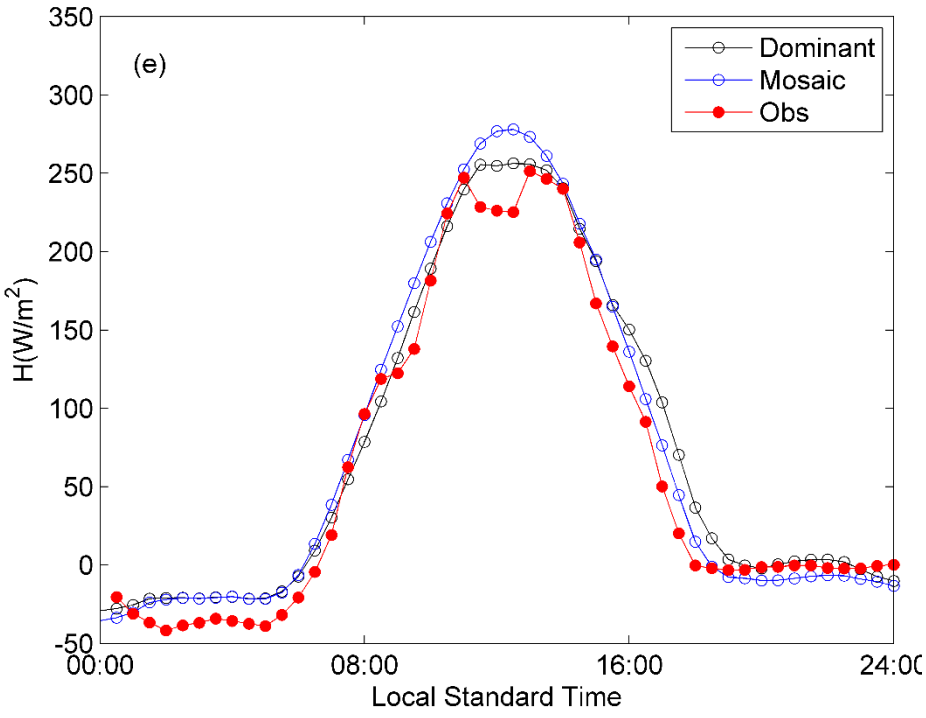


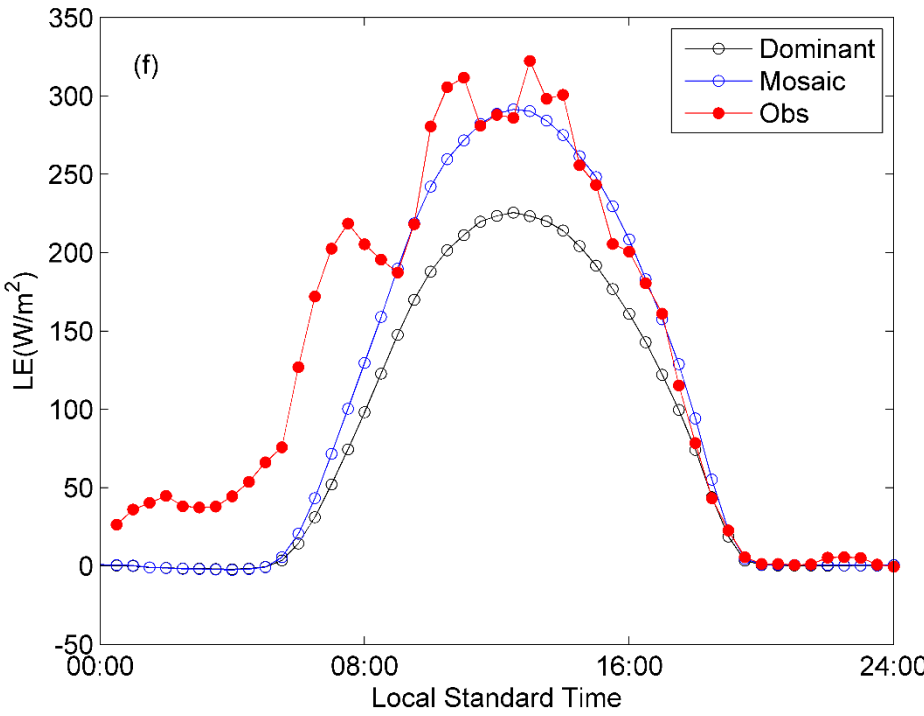


A clear-day case: fluxes at Cub hill

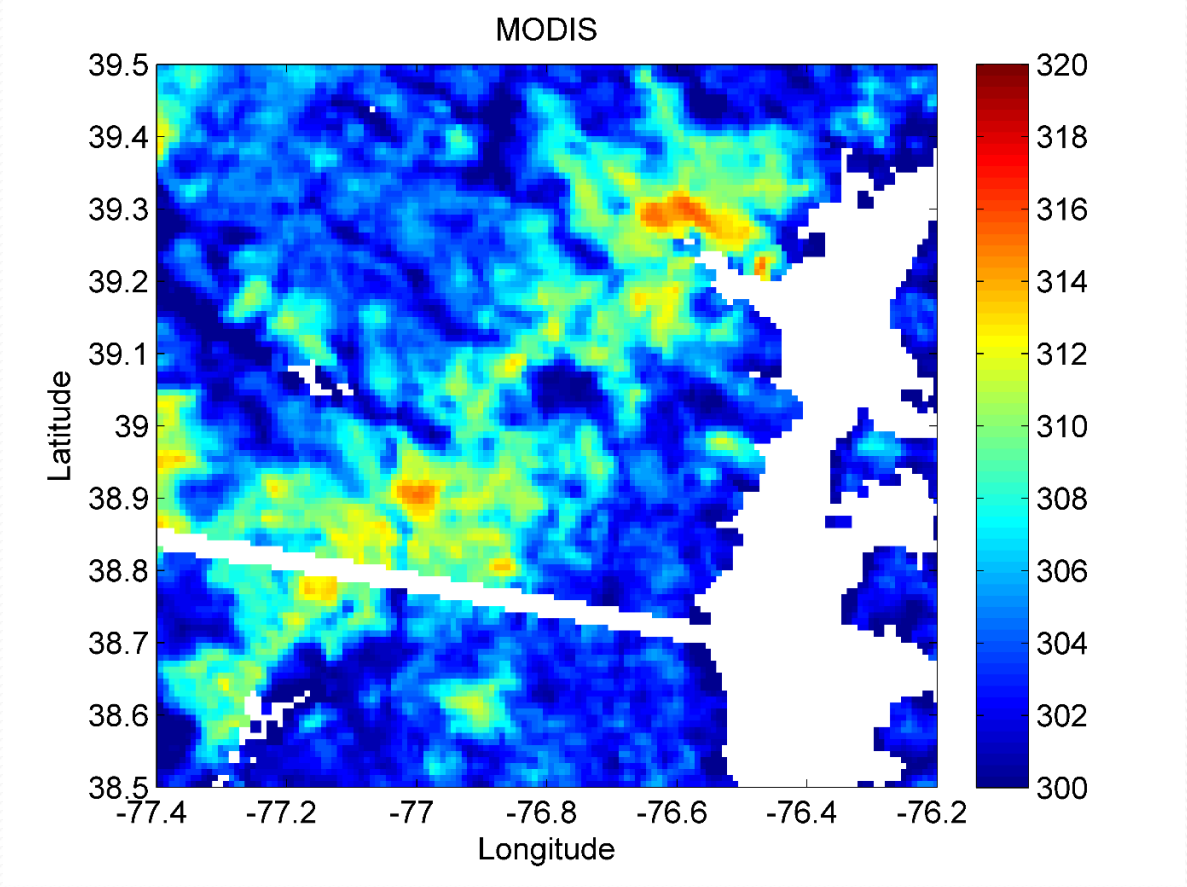
H

LE

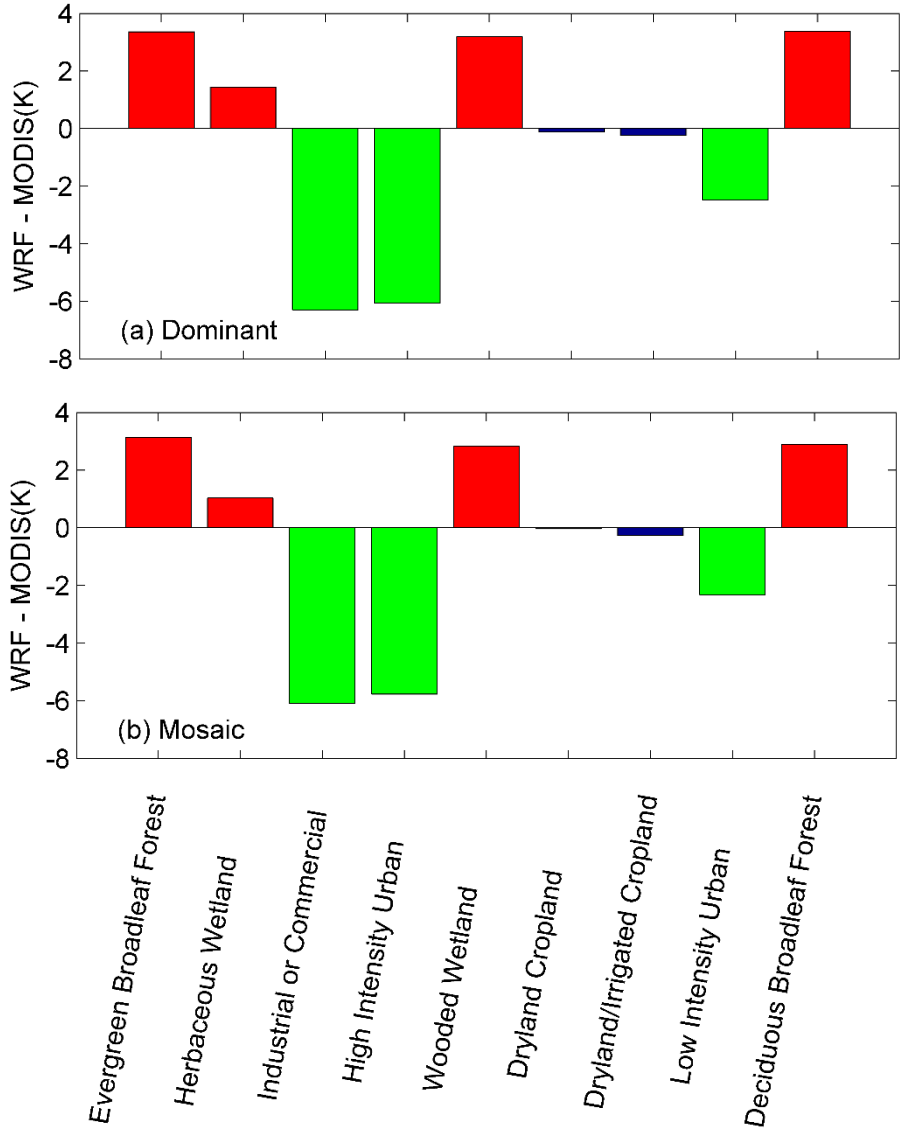


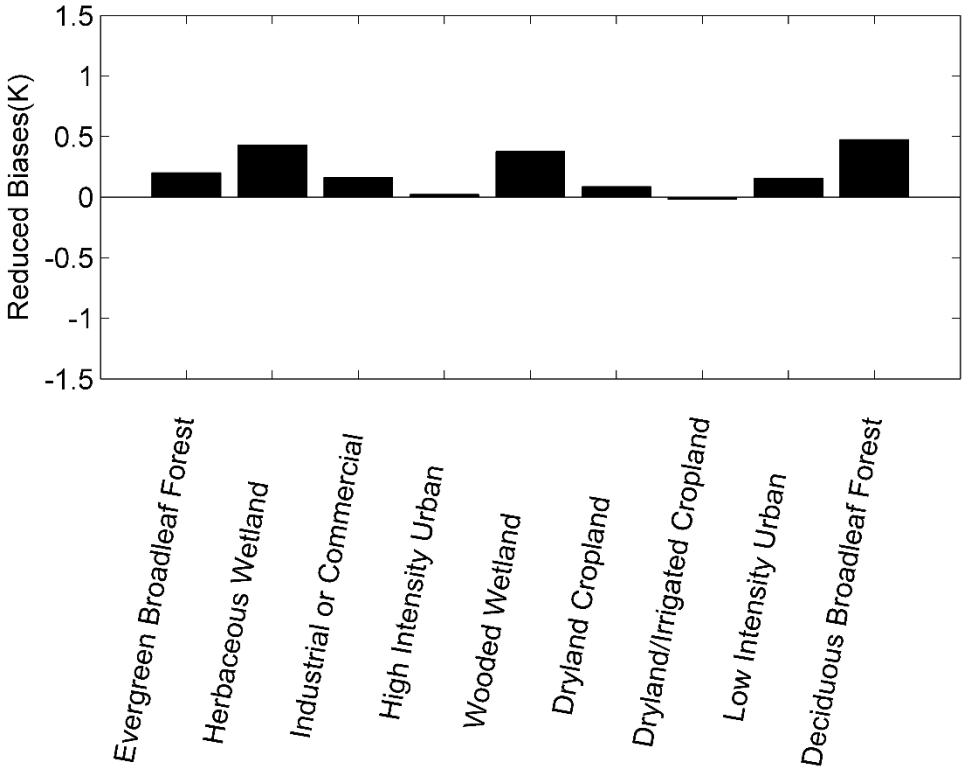


A clear-day case: MODIS over d03

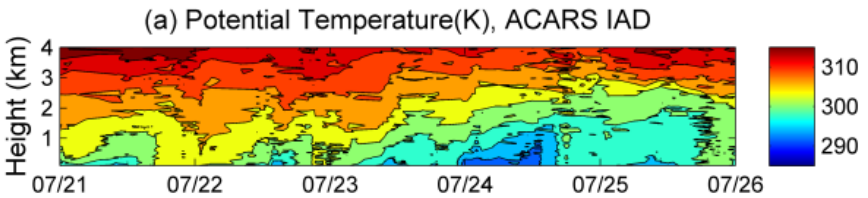


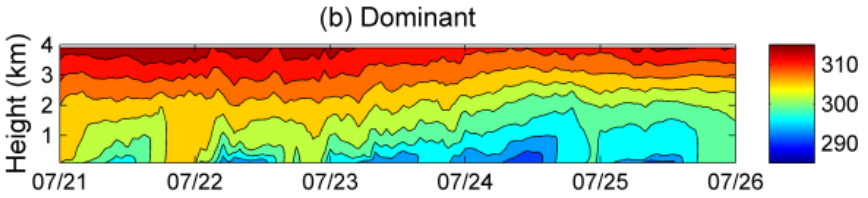
MODIS-observed land surface temperature pattern over d03 at about 12:30 PM.

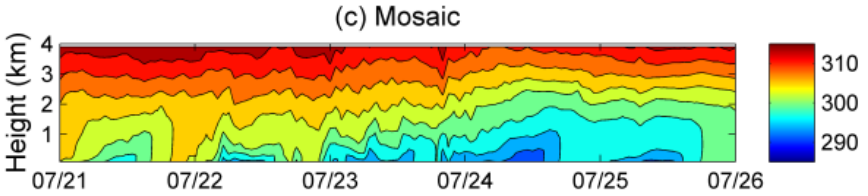

WRF - MODIS(K)
4
2
0
-2
-4
-6
-8
(a) Dominant
WRF - MODIS(K)
(b) Mosaic
Evergreen Broadleaf Forest
Herbaceous Wetland
Industrial or Commercial
High Intensity Urban
Wooded Wetland
Dryland Cropland
Dryland/Irrigated Cropland
Low Intensity Urban
Deciduous Broadleaf Forest

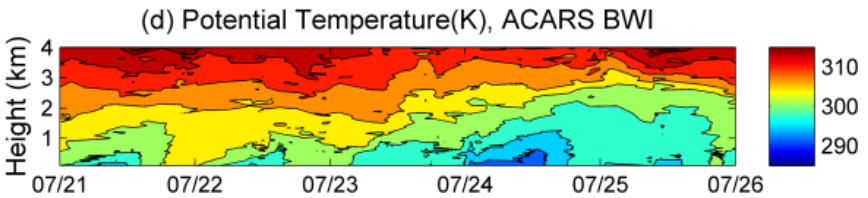

Reduced Biases(K)
1.5
1
0.5
0
-0.5
-1
-1.5
Evergreen Broadleaf Forest
Herbaceous Wetland
Industrial or Commercial
High Intensity Urban
Wooded Wetland
Dryland Cropland
Dryland/Irrigated Cropland
Low Intensity Urban
Deciduous Broadleaf Forest

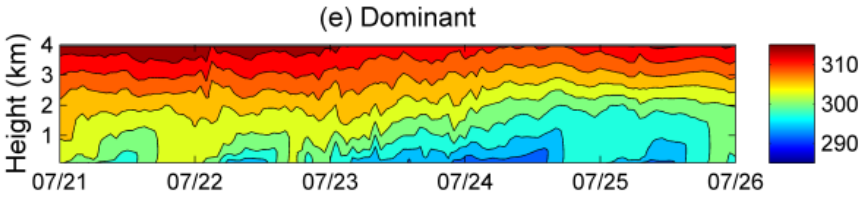
A rainfall period: Boundary layer profiles

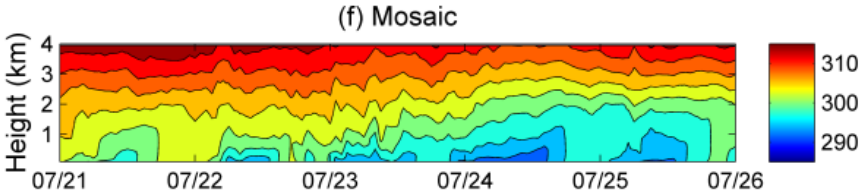




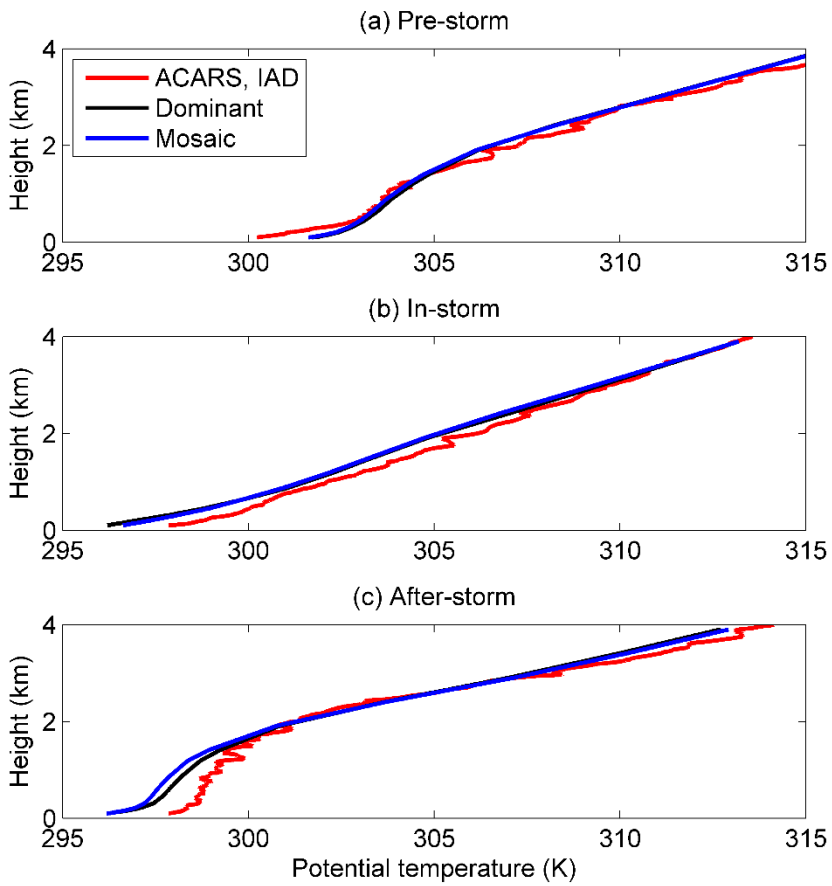


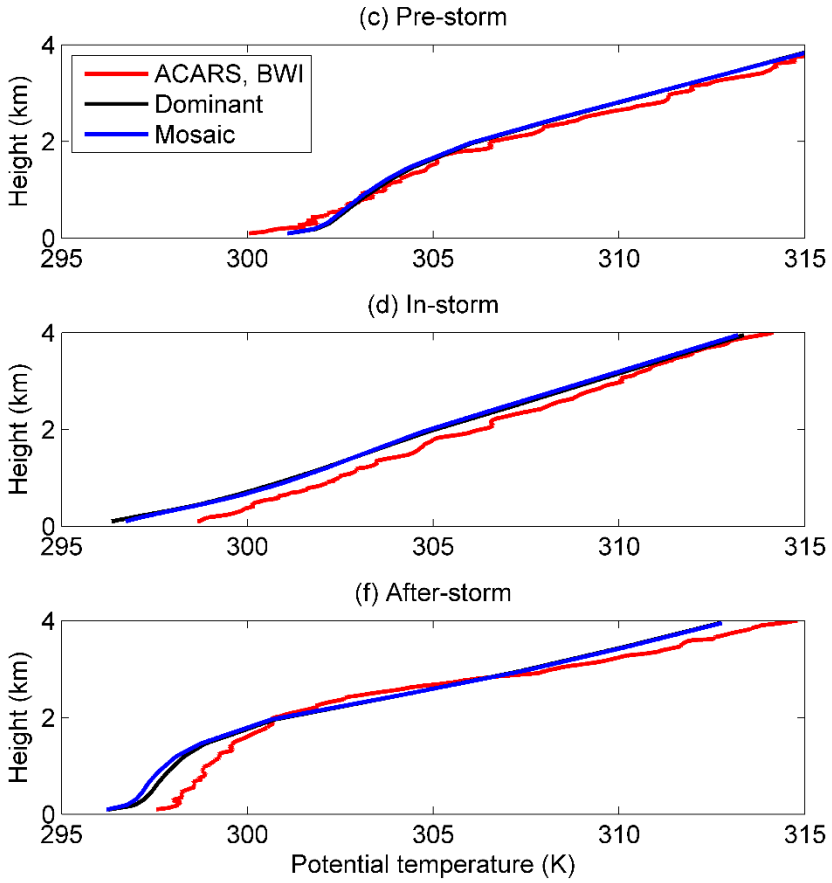




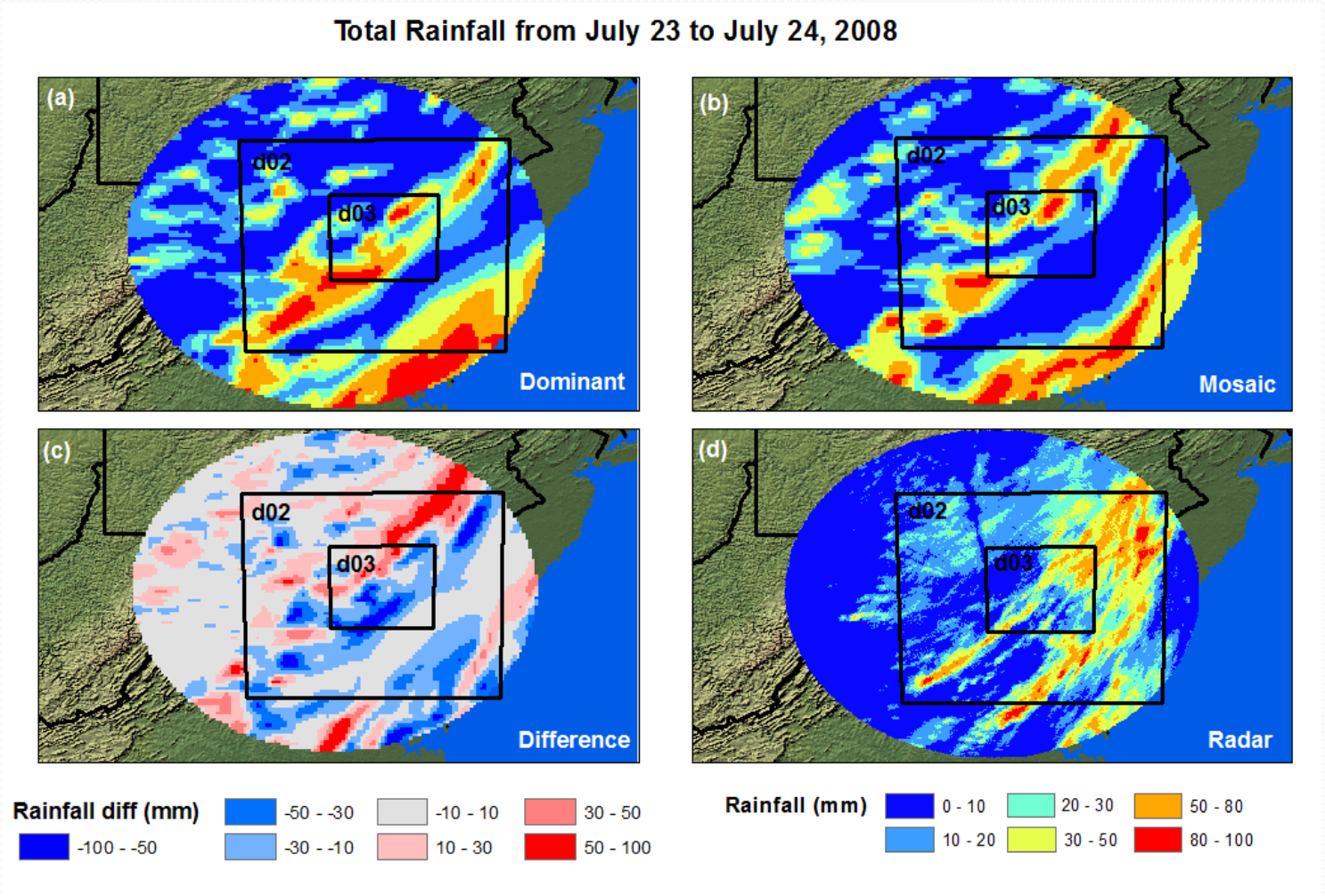


A rainfall period: Boundary layer profiles

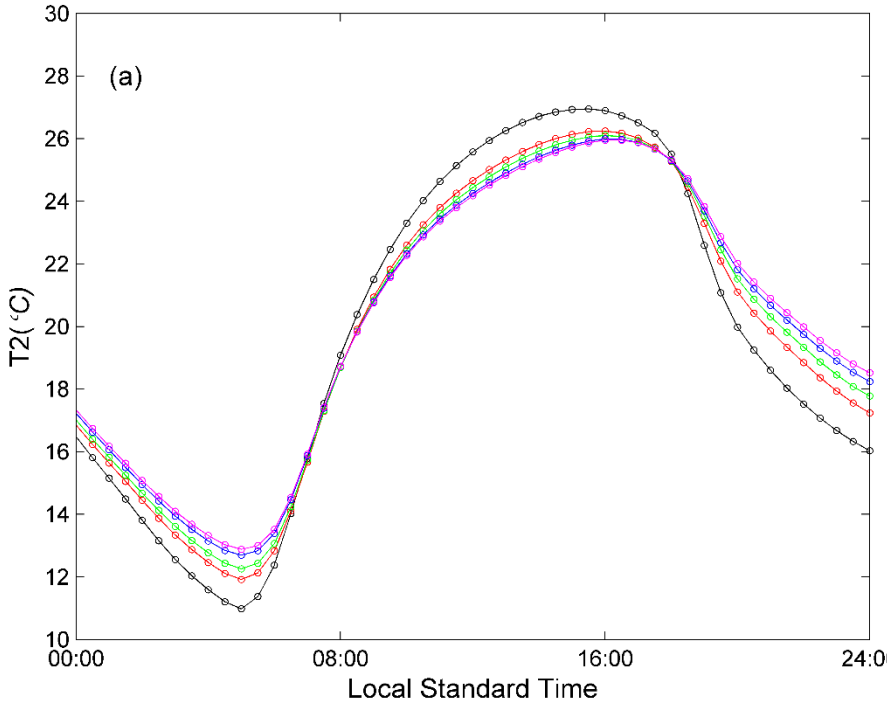


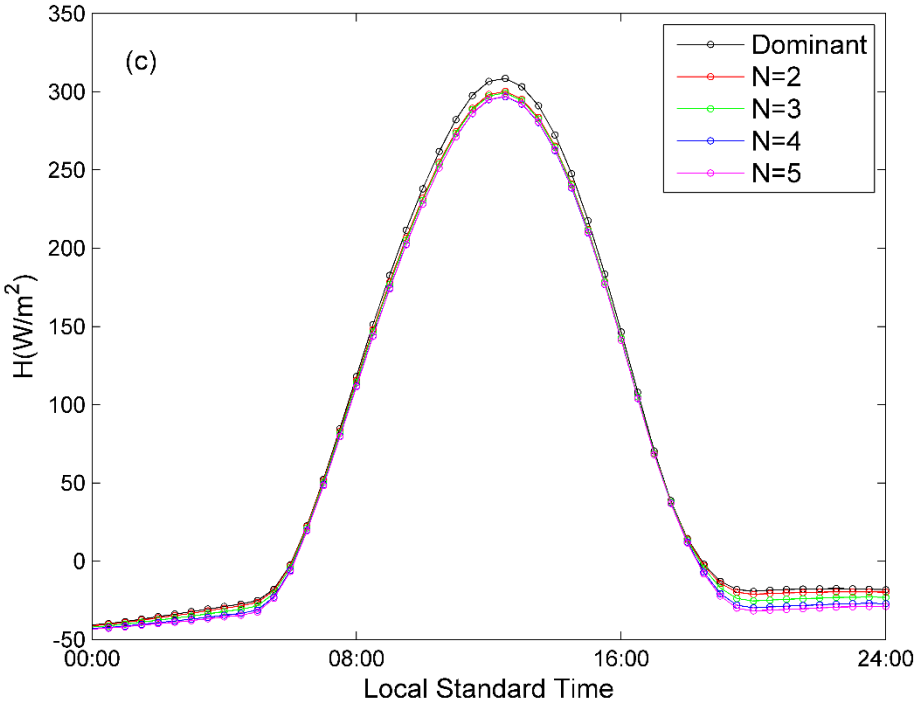


A rainfall period: rainfall distribution



The impact of *N*





Conclusions

- A mosaic/tiling approach is developed and tested within the WRF-Noah framework.
- It generally shows better performance over the dominant approach in the domain that we examined here, especially under clear-sky conditions.
- Simulated results are sensitive to the number of tiles.

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Thank you !

A few assumptions

- The atmospheric properties are uniform across the grid.
- The land-atmosphere coupling is uniform across the grid.
- Each land-cover tile has a soil tile associated with it, but the soil properties are uniform across the grid.
- For grid cells that are dominated by water/sea-ice, the mosaic approach is not used. For grid cells that are not dominated by water/sea-ice, water/sea-ice tiles are not considered.