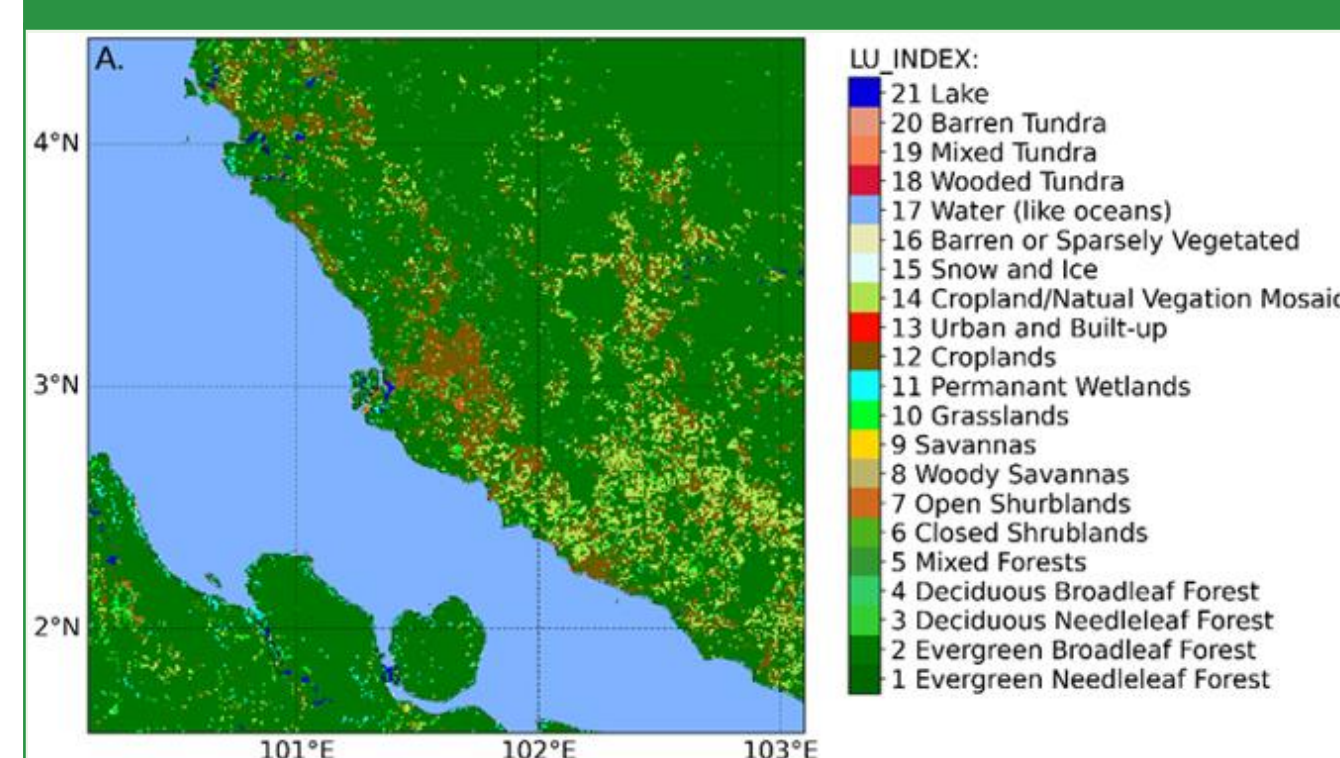


ABSTRACT

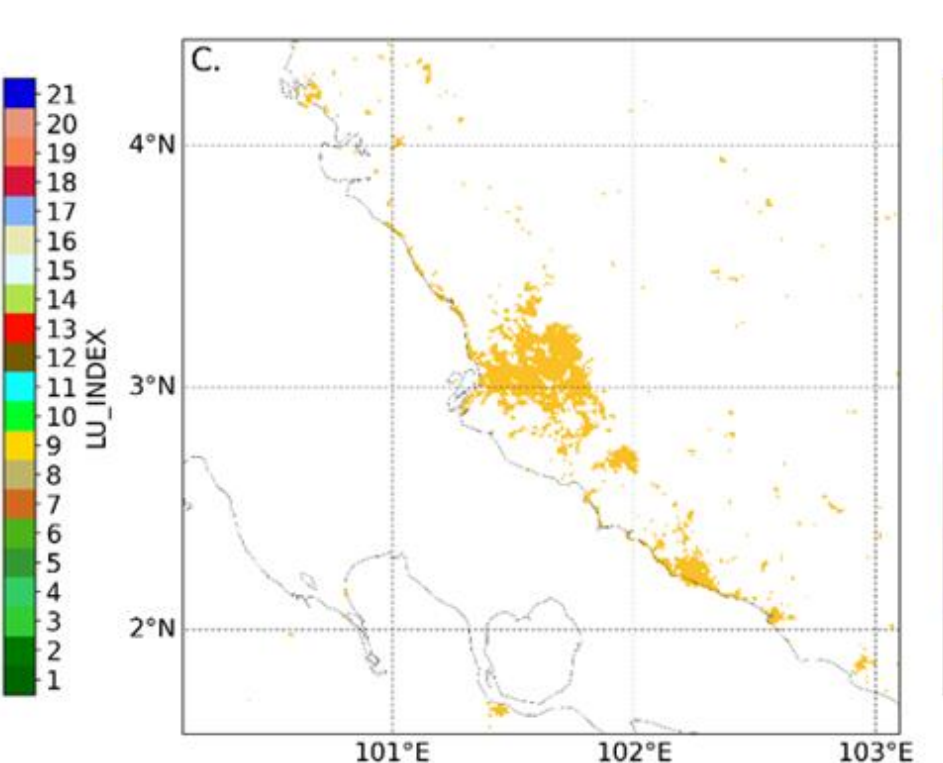
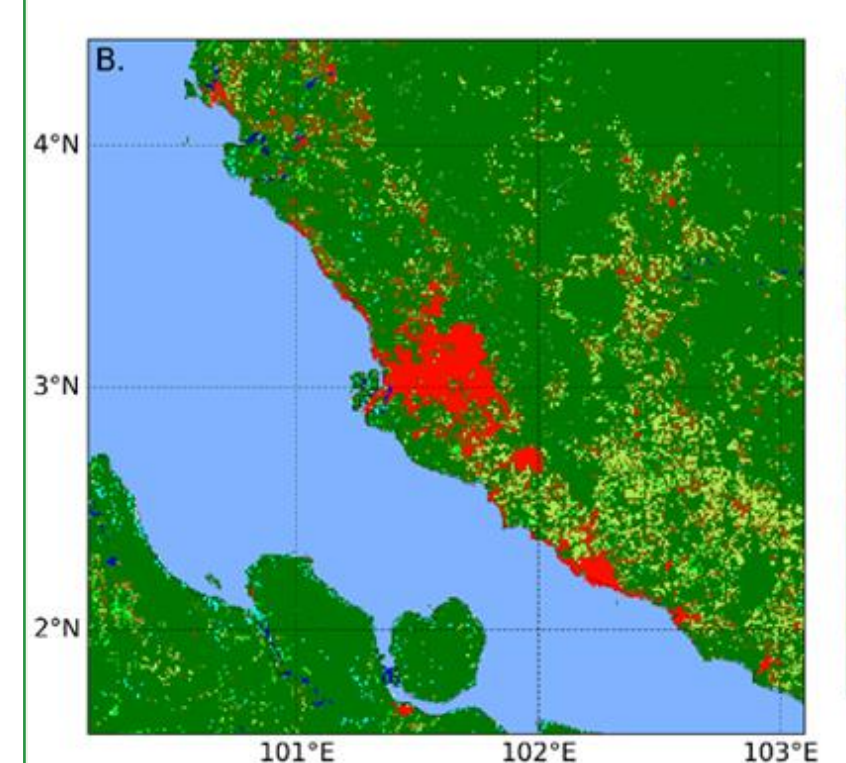
Large cities can have a significant impact on local microclimate through changes in temperature and rainfall. Many studies have shown that the urban heat island (UHI) can increase local rainfall. However, to large extent previous studies have disregarded **the effect of city heterogeneity on precipitation**. Here, we investigated the impact of Kuala Lumpur's urban effect on rainfall through a set of sensitivity studies performed with the Weather Research and Forecasting (WRF) model, in which different representations (**homogeneous vs. heterogeneous**) of the urban landscape are accounted for.

We showed that the city of Kuala Lumpur causes a localized increase in total rainfall accumulation, intense rainfall accumulation and frequency of rainfall events within the boundaries of the urban area. This effect is **more pronounced when the city is represented as a high-density homogeneous landscape than in the more realistic heterogeneous case**. In the homogeneous case, the increases also occur over a larger area and the impacts propagate more strongly into the upper layers of the atmosphere. Thus, it is crucial to include a more realistic representation of the city and its heterogeneities to better capture urban induced rainfall changes.

METHODOLOGY



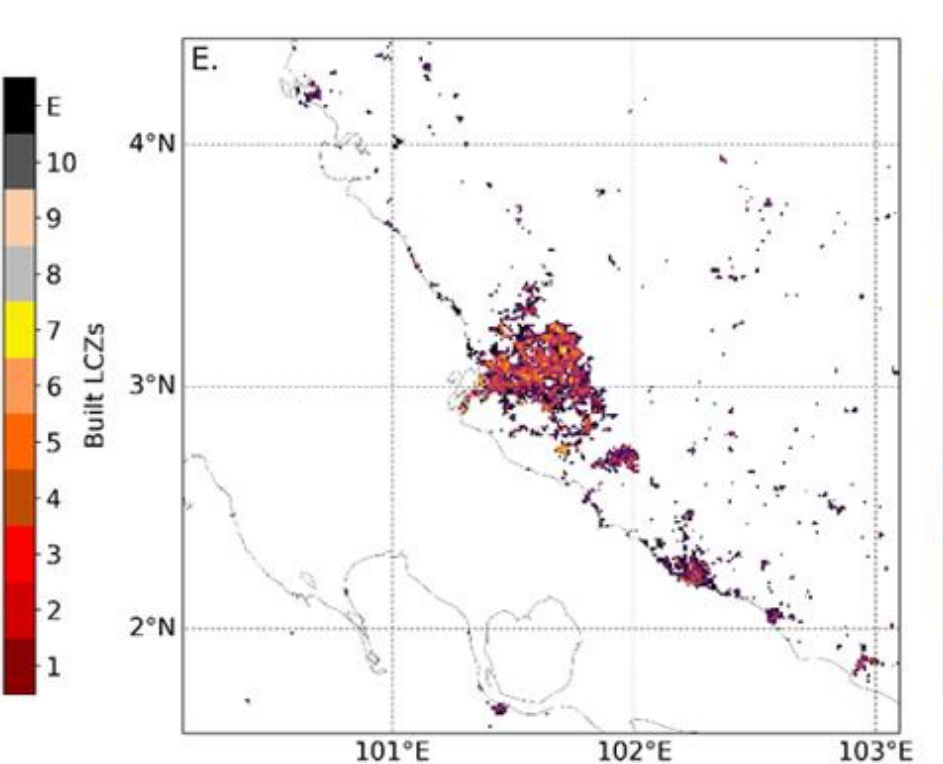
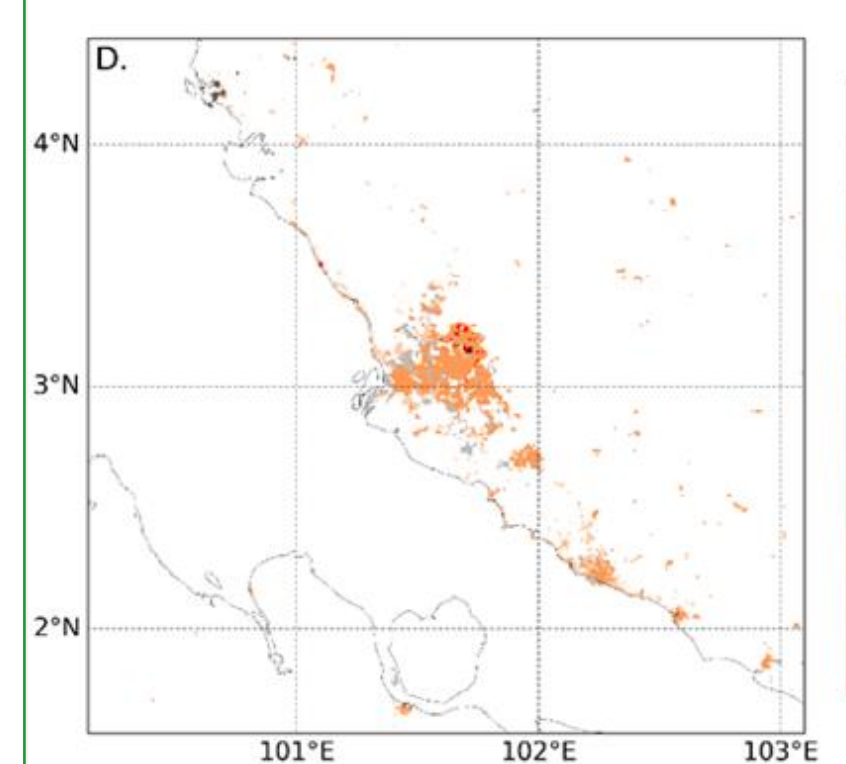
Three simulations were performed with the **Weather Research and Forecasting (WRF)** model using different representations of urban areas:



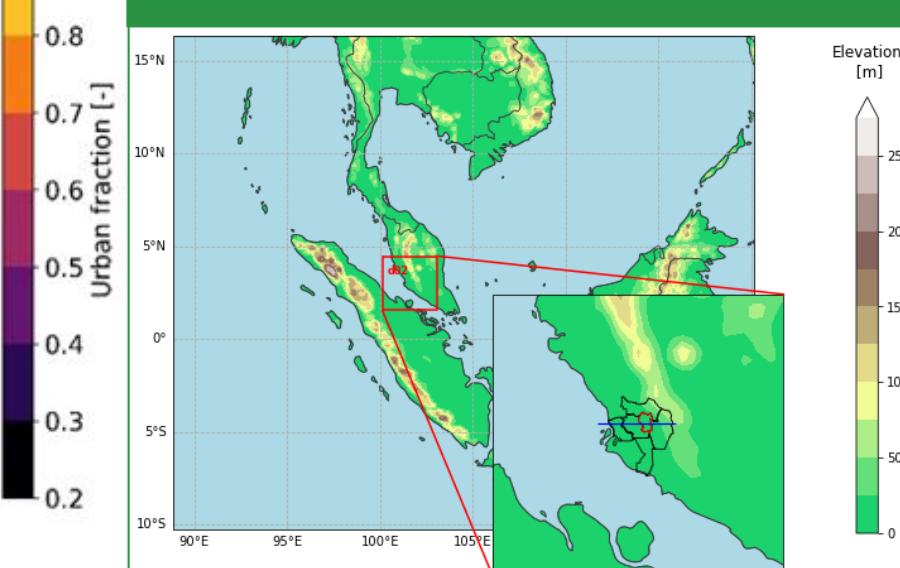
A NoUrban

B - C UrbHom

D - E UrbHet

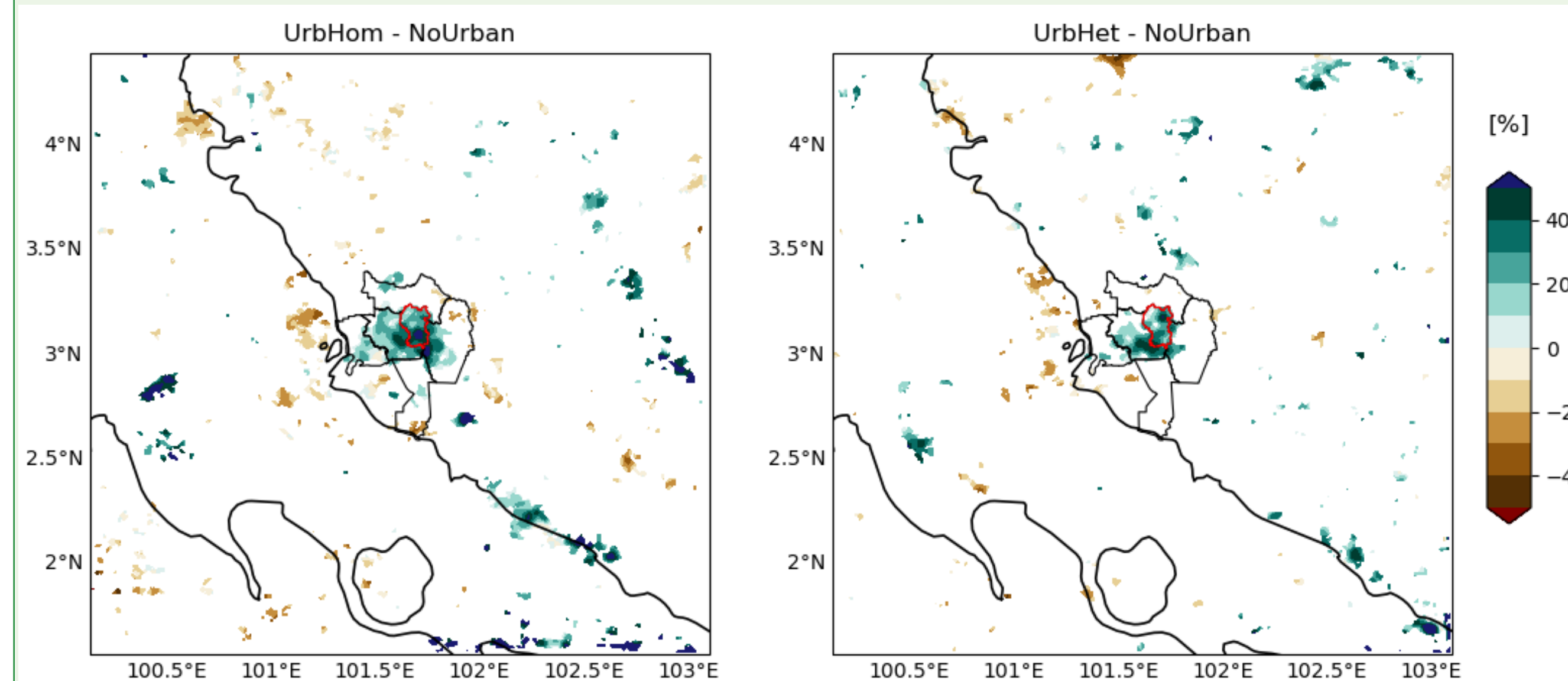


MODEL DOMAIN



URBAN-INDUCED PRECIPITATION EFFECT

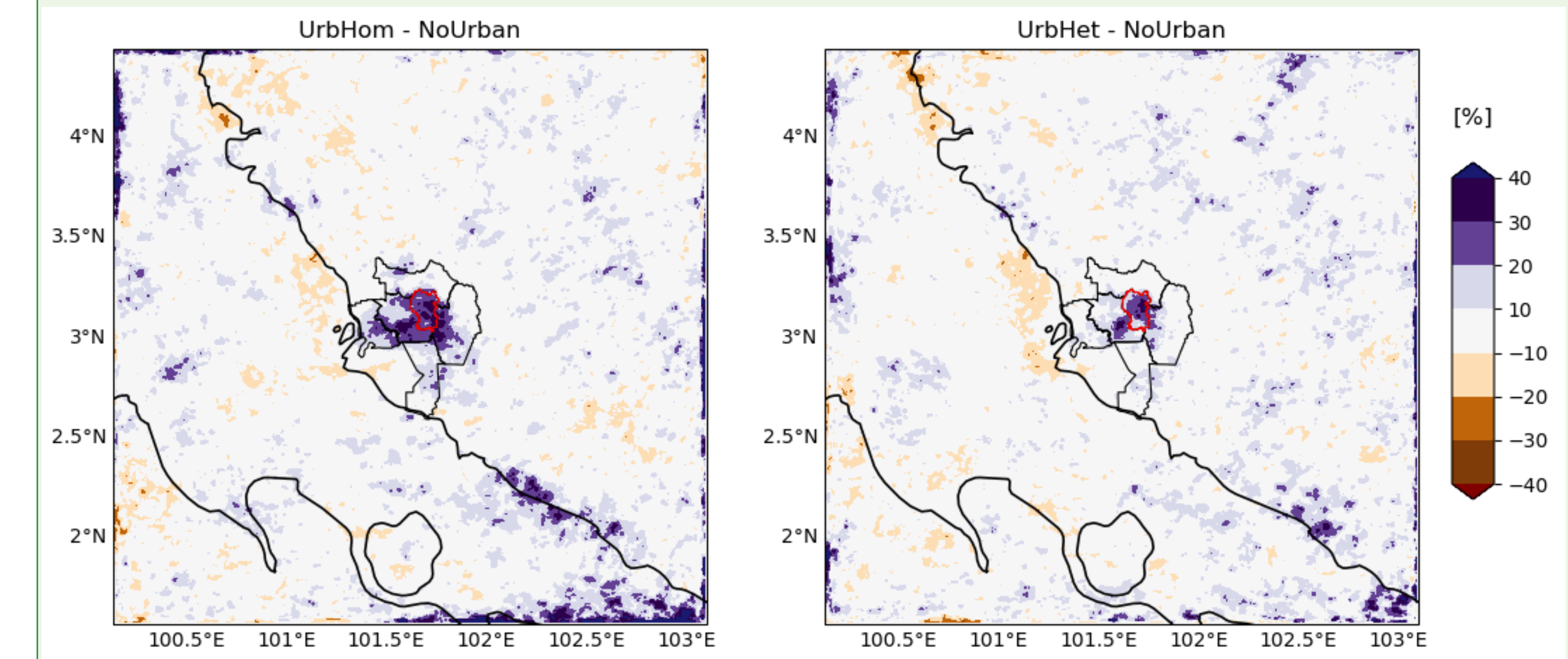
Difference [%] in total precipitation induced by considering the city in the model with the two different urban representations



The increased rainfall can be seen in both *UrbHom* and *UrbHet*, but the model produces more precipitation when representing a high-density uniform city (*UrbHom*) than a heterogeneous city (*UrbHet*).

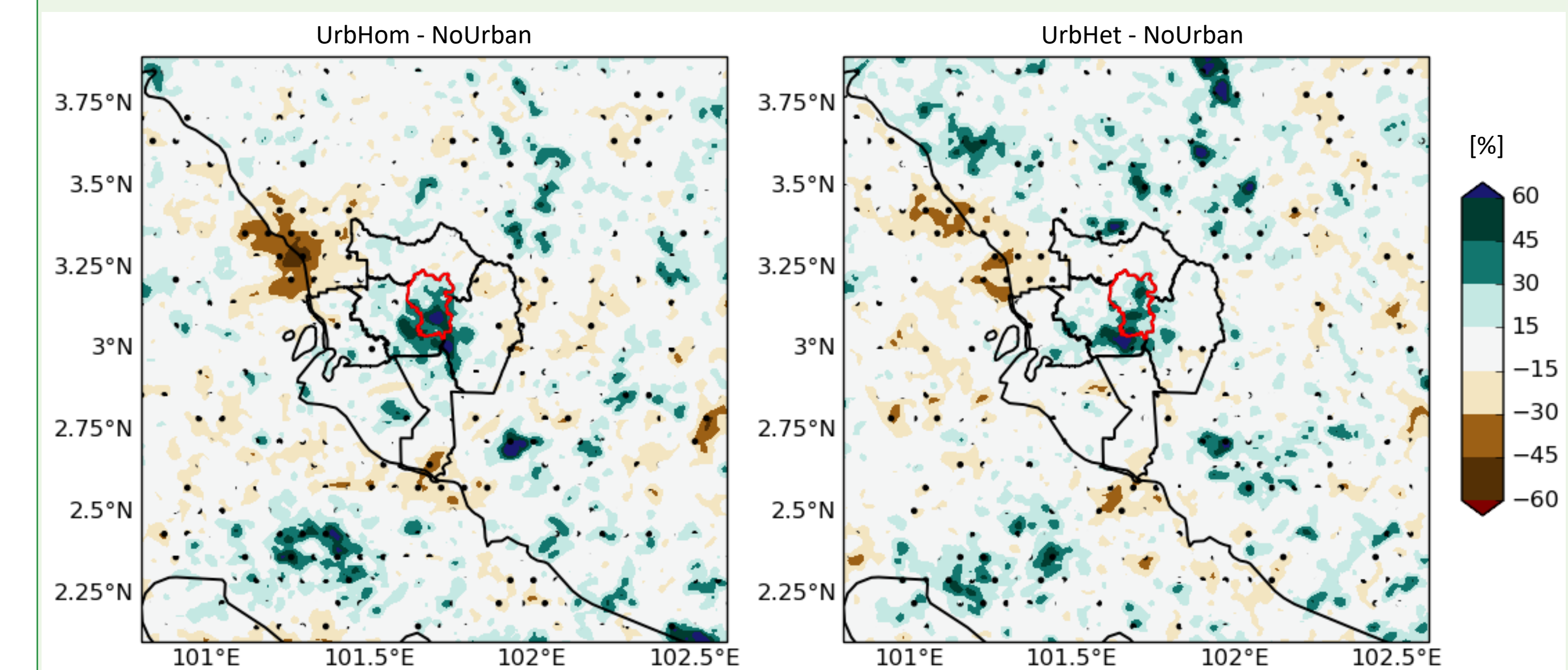
FREQUENCY OF RAINFALL

Difference [%] in the number of rainy days



HEAVY RAINFALL

Difference [%] in the total amount of rainfall exceeding 90th percentile



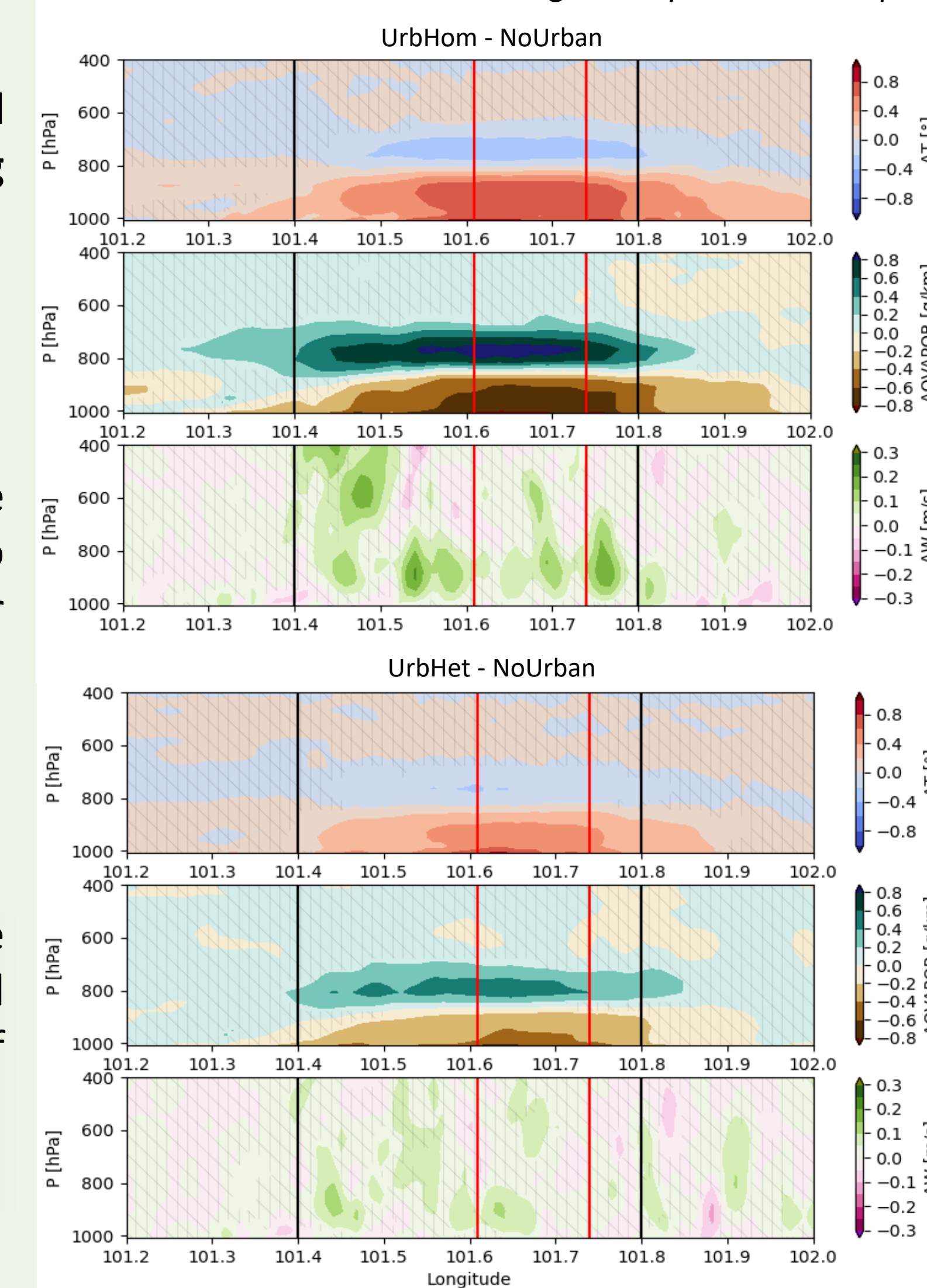
VERTICAL PROFILE

Difference on the vertical profile of temperature, mixing ratio and vertical wind at 15h

The alterations caused by the city at the surface also propagate into the upper layers of the atmosphere.

UrbHom shows a more intense and vertically extended response to the presence of the city in the model.

Cross section at 3.12°N traversing the city of Kuala Lumpur



CONCLUSIONS

- Consideration of the city's presence in the model increases average, moderate and heavy rainfall over the urban area in experiments representing the city at different levels of detail.
- The alterations caused by the city at the surface also propagate into the upper layers of the atmosphere.
- In the homogeneous simulation all urban effects are more intense.

➔ **The different representation of an urban area in a climate model can have impacts on the simulation of the local microclimate**