

The role of climate information for the urban transition towards sustainability

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Science-based, high-quality, high-resolution climate information and climate services tailored to city needs are required to enhance resilience in urban areas to on-going and projected climate change and to underpin sustainable transformations

RESEARCH GAP & OBJECTIVES

Gap between micro scale urban models that represent the fine-scale urban structures and processes, and climate models that simulate long term climate changes on regional scales including urban-rural contrasts and interactions

→ **Regional climate models are a promising tool to bridge the gap**

Objectives towards urban climate information provision:

- Improved understanding of the opportunities and limitations of the regional climate ensemble simulations from “EURO-CORDEX”* applicability to urban areas
- Understand change in moisture, temperature and related variables under climate change in Berlin and urban-rural contrasts

* EURO-CORDEX is the European branch of the international CORDEX initiative, which is a program sponsored by the World Climate Research Program (WRC) to organize an internationally coordinated framework to produce improved regional climate change projections for all land regions world-wide. www.euro-cordex.net

METHOD

Variables: Relative humidity, specific humidity, temperature, minimum & maximum temperature

Scenario: RCP8.5

Model data: EURO-CORDEX model output data (0.11°), available on ESGF

Case study area: Berlin and surroundings (Figure I)

Observational data: in-situ measurements from individual meteorological stations, obtained from the DWD Climate Data Center

Analysis:

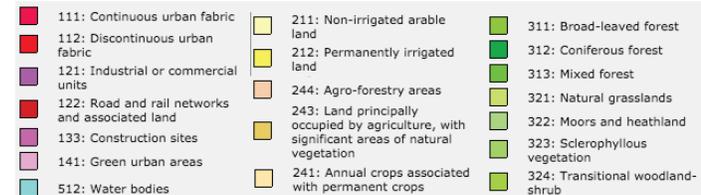
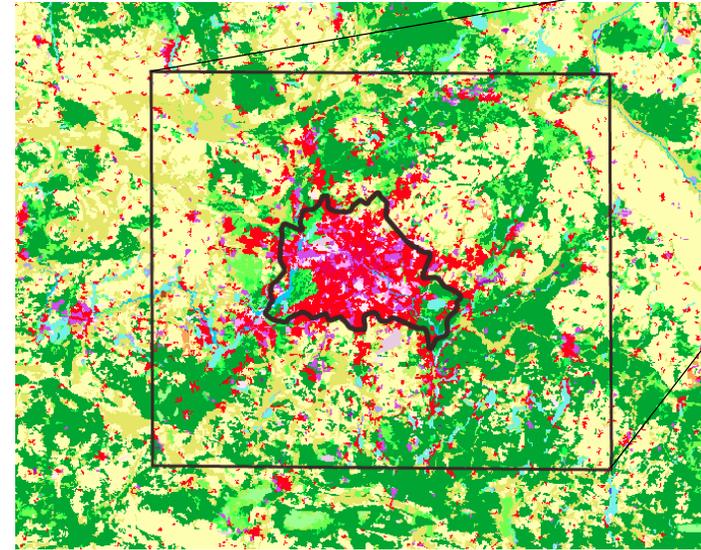
Running mean over 30 years

Climate change trend (Mann-Kendall test)

Climate change signal (U-test)

Daily cycle, annual cycle, seasonality

(b)



(a)

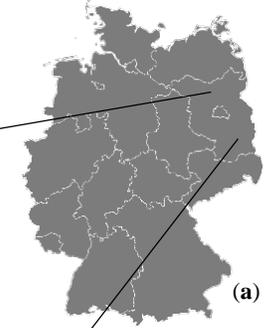
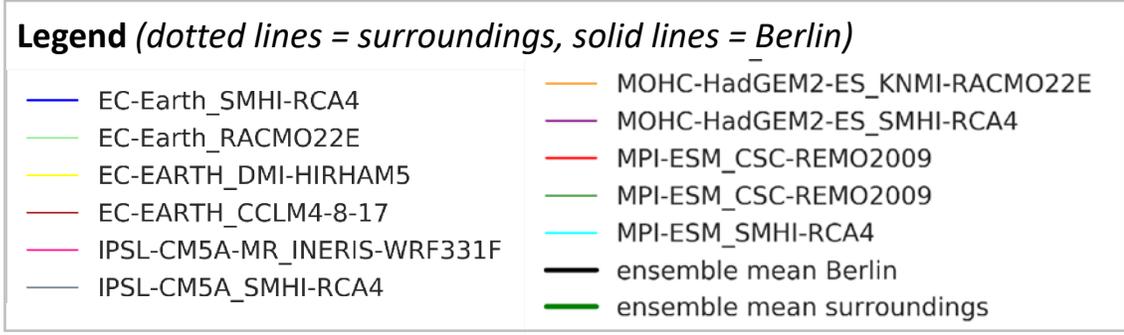
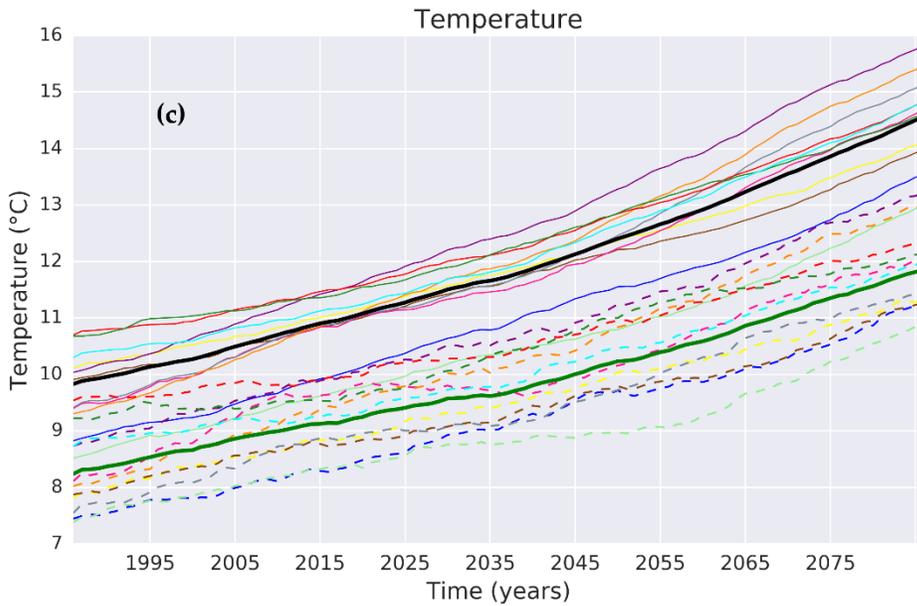
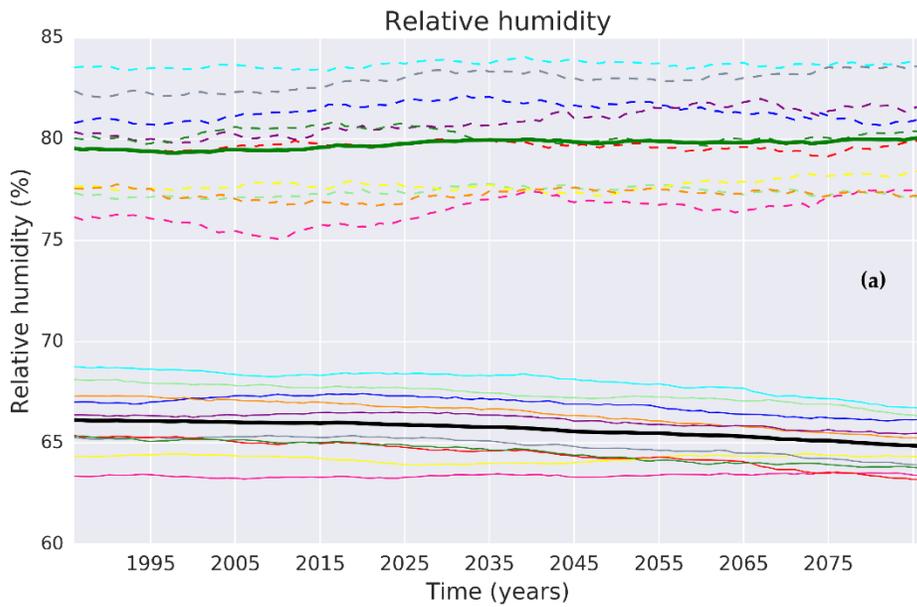


Figure I. Research area. (a) Germany and (b) a land-cover map indicating Berlin's administrative boundaries (black polygon) and research domain including the surroundings (black rectangular). Land cover following CORINE land cover map



RESULTS

Figure II. Running mean (30) for relative humidity (a), temperature (c), RCP8.5 for Berlin and surroundings, EURO-CORDEX models. Statistically significant, robust decreasing trend for >66% of the models for relative humidity (U-test). EURO-CORDEX models represent urban areas through the simple 'bulk' parameterization scheme.



→ EURO-CORDEX models show a clear difference between Berlin and its surroundings for humidity (a) and temperature variables (c).

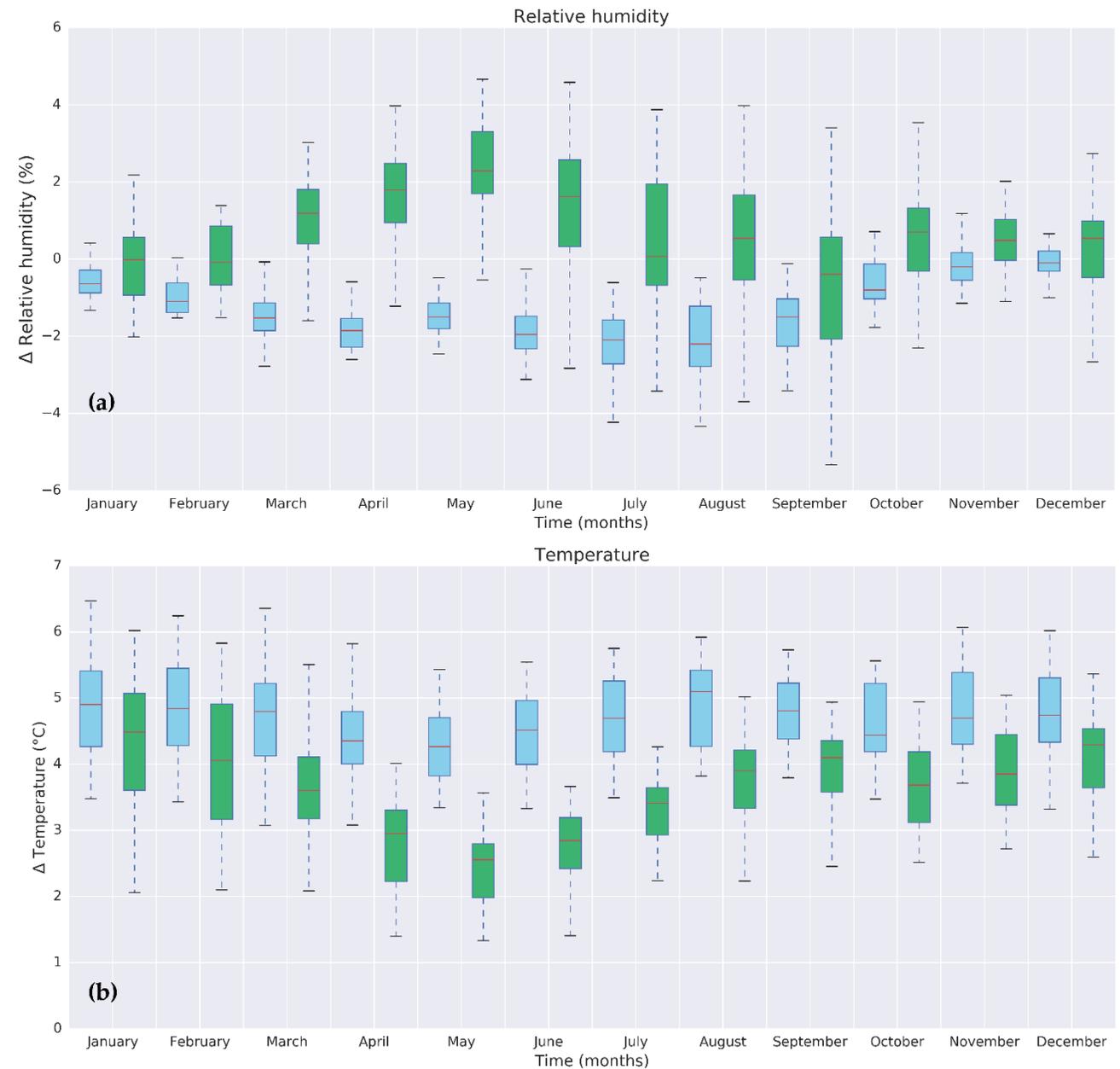
→ An urban dry island and heat island is quantified for Berlin. Berlin is drier and warmer than its surroundings. This urban-rural contrast is getting more profound under climate change.

RESULTS

Figure III. Monthly change of relative humidity (a) and temperature (b) for 2070-2100 compared to 1970-2000, RCP8.5, in Berlin (blue) and surroundings (green).

→ Berlin is getting particularly less humid in summer months and warmer throughout the year under climate change.

The surroundings are getting more humid in summer months and the overall warming is less profound than in Berlin.



DISCUSSION & CONCLUSION

- EURO-CORDEX models show a clear difference between Berlin and its surroundings for humidity and temperature variables.
- Berlin shows an urban dry island and heat island. This urban-rural contrast gets more profound under climate change.
- Berlin is getting especially less humid in summer months under climate change.

→ **Regional climate models are a promising tool to understand climate change in urban areas and urban-rural contrasts and to underpin climate information provision for sustainable urban transformations**

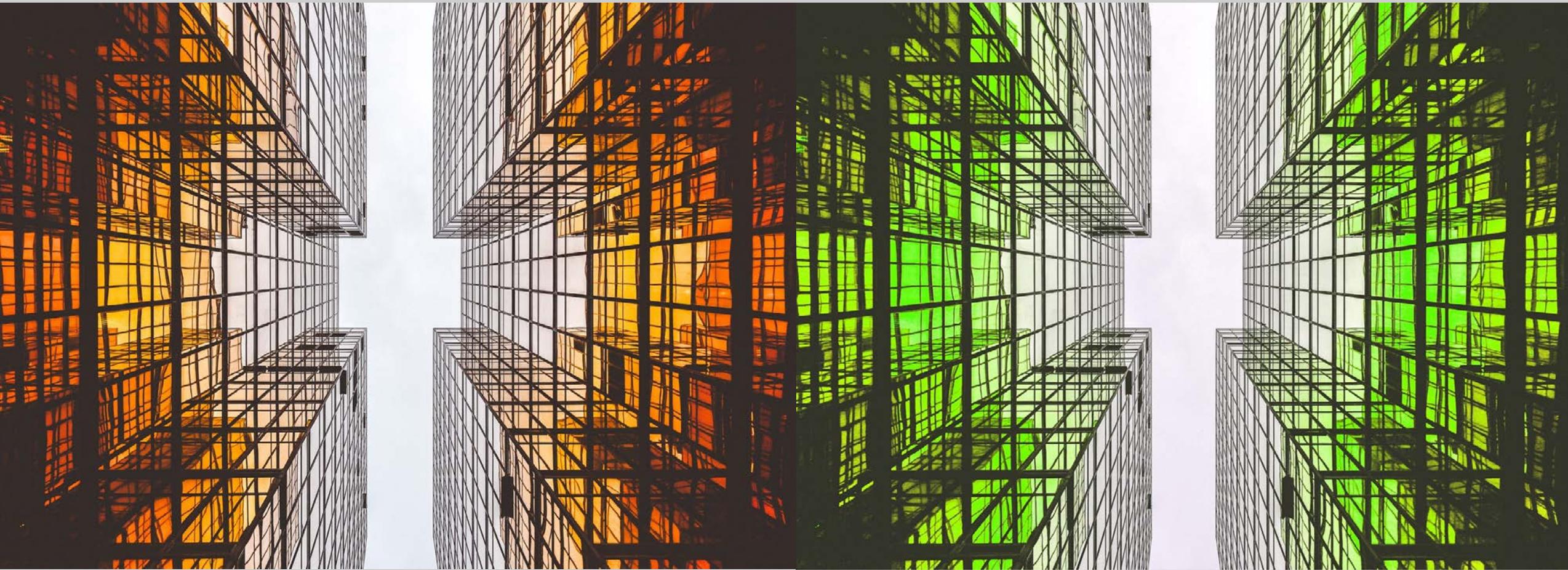
- The EURO-CORDEX models represent urban areas in a simplistic manner ('bulk scheme') and particularly underestimate the expected nighttime UHI effect.
- Spatial and temporal model resolutions are coarse to capture detailed urban processes.

→ **Need for further downscaling**

→ **Need to improve urban parameterization schemes in regional climate models.**

Read more about the results:

Langendijk, G.S., Diana, R., Daniela, J., Urban areas and urban-rural contrasts under climate change: what does the EURO-CORDEX ensemble tell? - Investigating near surface humidity in Berlin and its surroundings (2019). Atmosphere. <https://doi.org/10.3390/atmos10120730>



THE END

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