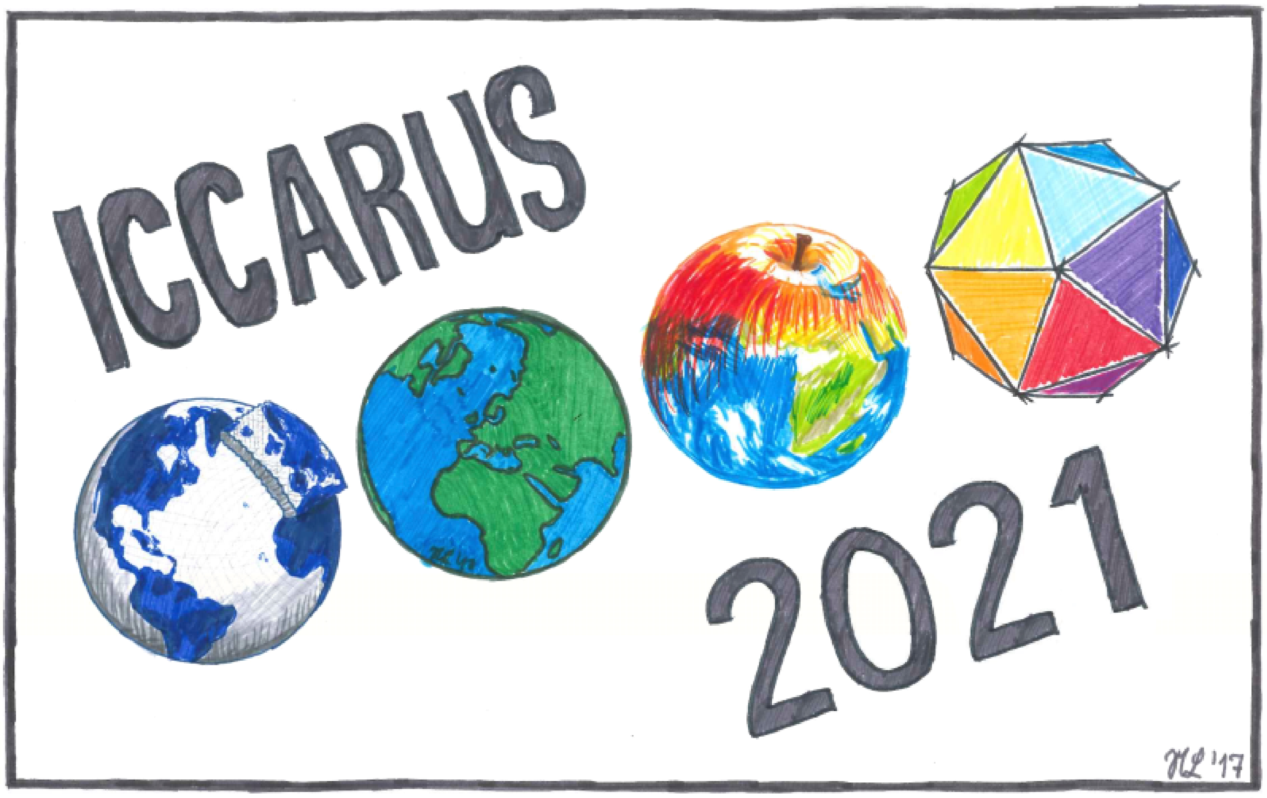
Impact of different external parameters on Turin UHI with COSMO at 1km



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Case study of an Arctic atmospheric river with the ICON model

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The Arctic climate changes faster than the ones of other regions, but the relative role of the individual feedback mechanisms contributing to Arctic amplification is still unclear. Atmospheric Rivers (ARs) are narrow and transient river-style moisture flows from the sub-polar regions. The integrated water vapour transport associated with ARs can explain up to 70% of the precipitation variance north of 70°N. However, there are still uncertainties regarding the specific role and the impact of ARs on the Arctic climate variability.For the first time, the high-resolution ICON modelling framework is used over the Arctic region. Pan Arctic simulations (from 13 km down to ca. 6 and 3 km) are performed to investigate processes related with anomalous moisture transport into the Arctic. Based on a case study over the Nordic Seas, the representation of the atmospheric circulation and the spatio-temporal structure of water vapor, temperature and precipitation within the limited-area mode (LAM) of the ICON model is assessed, and compared with reanalysis and in-situ datasets. Preliminary results show that the moisture intrusion is relatively well represented in the ICON-LAM simulations. The study also shows added value in increasing the model horizontal resolution on the AR representation.

Impact of different external parameters on Turin UHI with COSMO at 1km

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In an increasingly urbanized world, the numerical weather prediction models need to better represent the urban areas, in order to capture the micro-climate phenomena induced by the cities. The parameterization TERRA_URB (TU) (Wouters et al., 2016), recently implemented in COSMO (Bucchignani et al., 2019), not only represents a novelty in this field but has proved to correctly reproduce the Urban Heat Island effect over different European cities (Garbero et al., 2020, submitted). TU provides a heterogeneous description of the urban-atmosphere interactions, through the definition of several urban external parameters, such as the anthropogenic heat flux (AHF), the impervious surface area fraction (ISA), and other urban canopy parameters such as the building area fraction (BF), the mean building height (H) and the height-to-width ratio (H/W). In this study we performed simulations with COSMO model at 1 km resolution with the aim of a better characterization of the UHI over the city of Turin. In particular, we compared the results by using AHF and ISA from the EXTPAR preprocessor and from the Local Climate Zones (LCZ) classification system (Stewart and Oke, 2012).

Furthermore, we focused on the influence of the urban parameters BF, H and H/W by comparing

two different approaches: as a default, their values are assumed constant for all the urban grid points, while a different 2-D approach consists in deriving their values for each urban grid point based on LCZ classification (Demuzere et al., 2019).
A sensitivity analysis was then performed to detect which of the 2-D urban parameters have a greater impact on the results, with an emphasis on the Surface Energy Balance (SEB). With the purpose of unravelling the driving mechanism behind the UHI, we analyzed the individual SEB components and evaluated how much each flux contribute to the urban heat island effect.

Towards understanding the role of uncertainty in microphysical processes for warm conveyor belt ascent using microphysical heating rates along online trajectories in ICON

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The characteristic large-scale cloud band in extratropical cyclones is often formed by the so-called warm conveyor belt (WCB), a coherent and strongly ascending airstream in extratropical cyclones that typically ascends cross-isentropically from the boundary layer into the upper troposphere within two days. This transport of air into the upper troposphere can significantly influence the large-scale flow evolution and lead to ridge amplification downstream. The cross-isentropic ascent and the WCB outflow strength in the upper troposphere are strongly driven by latent heat release from the formation of liquid, mixed-phase and ice clouds. In this way, WCBs provide an environment where small-scale cloud microphysical processes are directly linked to the large-scale atmospheric circulation in extratropical cyclones. The need for parameterization of microphysical processes and convection in numerical weather prediction models introduces uncertainties in their representation which can feed back on the larger-scale flow. In particular, ice cloud formation and the phase partitioning are often poorly represented in numerical weather prediction models.We analyse the role of uncertainty in microphysical process rates in the ICON 2-moment microphysics scheme for (i) the detailed WCB ascent behavior and (ii) the large-scale flow evolution. Therefore, we run two-way nested simulations with two refined nested domains for a WCB case study in the North Atlantic. To quantify the effect of individual parameterized microphysical processes for (i) WCB ascent and (ii) the circulation, we implement temperature and associated potential vorticity tendencies for each process and aggregate their evolution along online trajectories implemented in ICON. Subsequently, we explore parameter uncertainty in microphysical parameterizations in an ensemble of sensitivity experiments with systematically varying microphysical parameters and quantify the effects for WCB ascent. Here, we present first results including the technical setup, the dominating microphysical processes for WCB ascent and associated temperature and potential vorticity tendencies, and an outlook for our diagnostic framework.

Lagrangian analysis of an Alpine Foehn event

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