Parallel Session D:
Domain/cross-domain meetings, Convection permitting models

D4: Urban environment and regional climate

POSTER PRESENTATIONS

Parallel Session D: Domain/cross-domain meetings, Convection permitting models

D4: Urban environment and regional climate

D4-P-01

Coastal urban climate change adaptation and disaster risk reduction: Policy, programme and practice for sustainable planning outcomes

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Coastal urban areas are centre of attraction to humans in developing countries of the world based on the various opportunities that abound in these areas, for example sea transportation, marine natural resources, seafood, place of tourist and it also serves as a point for resort and relaxation. However, almost a quarter of the world's population resides within a distance of 100km from the coast and less than 100m above sea level therefore making coastal settlements growing rapidly over the years. Consequently, the impacts of climate change on coastal urban areas are intensifying with significant effects on populaces, environment and ecosystems. This study focused on East London, Eastern Cape, South Africa as a case study using a mixed method approach in data collection. Public perspectives under three groups of identified enablers; policy; programme and practice are discussed. Based on the findings, a framework is proposed to enhance planning systems to maximise synergies between the fields of climate change adaptation and disaster risk reduction to minimise the vulnerability of communities to extreme weather events in coastal urbanised regions. Additionally, findings from this study show that the development of risk descriptions is paramount in the integration of CCA and DRR in achieving a sustainable urban planning development and outcomes.

Keywords: Climate change adaptation, Disaster risk reduction

Parallel Session D: Domain/cross-domain meetings, Convection permitting models

D4: Urban environment and regional climate

D4-P-02

Numerical study of the interaction between oasis and urban areas within an arid mountains-desert system in Xinjiang, China using ALARO-SURFEX

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The rapid oasis expansion and urbanization that occurred in Xinjiang province (China) in the last decades have greatly modified the land surface energy balance which influences the local circulations, mainly the oasis-desert and urban-rural breezes, in the context of the arid mountains-desert system in the north slope of Tianshan mountains. In this study, we first evaluated, during the summers 2001-2013, the ALARO regional climate model coupled to the land surface scheme SURFEX at 4 km spatial resolution using 53 national meteorological stations distributed within Xinjiang. We found that at 4 km resolution the model simulates the daily variation of 2 m temperature and relative humidity correctly although it overestimates relative humidity and underestimates the daily mean temperature. A 4-day clear sky period (9-12 June 2016) has been simulated in order to study both circulations and their mutual interactions. The results from both observations and model simulations show that the low level divergence over oasis appears only between 19:00 and 21:00 Beijing Time (BJT) when the background mountain-plain wind system is weak during the late afternoon transition period. The model simulates a synergistic interaction between Oasis-desert breeze and urban-rural breeze from 16:00 until 22:00 BJT with a maximum effect at 20:00 BJT when the downdraft over oasis (updraft over urban) areas increases by 0.3 x 10-3 (0.2 x 10-3 Pa s-1). The results show that the oasis expansion decreases the nocturnal urban heat island in the city of Urumqi by 0.8°C, while the impact of urban expansion on the oasis cold island is negligible.

Keywords: Oasis-desert breeze circulation, Urban-rural breeze circulation, Urban heat island,TEB

Parallel Session D: Domain/cross-domain meetings, Convection permitting models

D4: Urban environment and regional climate

D4-P-03

Urbanization and surface climate case study: Morocco.

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Urbanization is a major form of land use that affects surface energy, carbon and hydrology in a way that alters local-to-regional climate. It changes the natural land surface by reducing the fraction of vegetation which induces a reduction in photosynthesis and transpiration and thus leads to a surface warming.

The building material such as masonry, asphalt and concrete affects the local energy balance by absorbing, storing, and reradiating more solar energy than vegetation and natural soil typical in rural areas creating thus the so-called 'urban heat island' (UHI), which is a differential heating generated by building material within the city core as compared to the surrounding vegetated area. This urban heat, combined with warming due to climate may have impacts in term of energy use and human health.

During the last decades, the world has experienced unprecedented urban expansion and Morocco has experienced demographic increase such that the majority its population lives in urban areas. In 2013, about 57% of the total population lived in cities and this rate is expected to reach 75% within the next 10 years.

In this study we will use MODIS land surface temperature (LST), normalized vegetation index NDVI and the land use land cover , and Landsat 8 data in a spatial analysis to assess the urban heat island generated by buildups, its amplitude and its size for largest cities in Morocco. A temporal analysis will then be performed to quantify how change in climate may exacerbate urban heat islands.

The results of this study will facilitate the development of a set of mitigation and adaptation measures for decision makers and urban planners to create socially and environmentally sustainable cities.

Keywords: Urbanization, Climate, Urban heat Island

Parallel Session D: Domain/cross-domain meetings, Convection permitting models

D4: Urban environment and regional climate

D4-P-04

Impact of climate change on extreme rainfall events on coastal cities in the Philippines

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Developing country such as the Philippines, are highly vulnerable to flooding caused by extreme rainfall events such as the enhanced Southwest Monsoon (SWM) and typhoons. Major cities especially those that are in the coastal region, are even more vulnerable primarily because of how this kind of land cover can modify heat and moisture fluxes in the area. With the continued growth and development of these cities along with increasing population, it is very important to understand how these climate hazards will change in a globally warmer future. The aim of this study is to analyze the projected changes in extreme rainfall events due to climate change for the major cities in the Philippines. Historical and future multi-model projections from two scenarios (Representative Concentration Pathway 4.5 and 8.5) from the Southeast Asia Regional Climate Downscaling (SEACLID) / Coordinated Regional Climate Downscaling Experiment (CORDEX) Southeast Asia project is used in the climate change analysis. Comparison of the intensity, frequency and duration of rainy days from the reference period (1971 to 2000) to early (2016 to 2035), middle (2046 to 2065), and late (2080 to 2099) future periods is carried out in this study. Finally, extreme rainfall shifts particularly at return periods of 50 and above is measured and analyzed.

Keywords: climate change, urbanization, extreme rainfall, regional climate models

Parallel Session D: Domain/cross-domain meetings, Convection permitting models

D4: Urban environment and regional climate

D4-P-05

Convection-permitting simulations of urban heat island during a hot-weather case using "weather-like" simulation mode of RegCM4.7/CLM4.5

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Due mainly to computational limitations and costs, decade-long simulations over China with convection permitting regional climate modeling (CP-RCM, with grid spacings under 4 km) have been seldom conducted. The previous studies show that CP-RCM simulations have positive indirect effects on the representation of regional climate through various feedback mechanisms such as soil moisture—temperature and urban effects. In this study, a hot-weather case from 2 July to 6 July 2010 over the North China plain is selected to evaluate the RCM—RegCM4.7/CLM4.5 using "weather-like" simulation mode, prior to launching into expensive decade-long simulations. Especially the urban heat island (UHI) effect over Beijing was analyzed. Except the control run, an idealized simulation with all the urban surface replaced with bare ground and vegetation and four other sensitivity simulations were also performed. Based upon these experiments results, the effect of urban extent, urban categories, anthropogenic heat release (AHR) due to removing heat by air conditioning and energy consumption by the air conditioners were discussed.

The results show that, the RegCM4.7/CLM4.5 model reasonably reproduced the majority of the observed spatial and temporal characteristics of the 2-m temperature field over the simulation period. Strong UHI effects can cause intensification and expansion of the areas experiencing extreme heat stress. In the simulation, an average temperature increase of 0.67 °C in the city center (averaged over the six-ring area of Beijing) was observed under high urbanization conditions. Comparisons among the results of six runs showed that urban land use, classification of urban subcategories, and consideration of AHR respectively contributed 46.3% (0.31°C), 67.2% (0.45°C), and 17.9% (0.12°C) to the simulated UHI effects. The AHR can be further be decomposed into cooling indoor temperature, waste heat due to removing heat by air conditioning, and waste heat due to energy consumption by the air conditioners, which contribute -433.3% (-0.52°C), 250.0% (0.30°C), and 100.0% (0.12°C) to total AHR effect, respectively. It indicates that if waste heat from air conditioning systems is effectively recovered, the AHR effect on UHI can be largely reduced. The UHI peak reached a maximum value of 0.94 °C at 2000 LST around sunset. Analysis of the surface energy balance was also conducted. The results showed that the UHI is mainly caused by a greater heat storage in the urban fabric during the day and the release of this heat in the evening.

Keywords: urban heat island,convection permitting

Parallel Session D: Domain/cross-domain meetings, Convection permitting models

D4: Urban environment and regional climate

D4-P-06

Urban areas under climate change: what does the EURO-CORDEX ensemble tell? A case study investigating near surface humidity in Berlin

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Urban areas are prone to climate change impacts. There is an increasing need to equip decision makers with useful climate information to adapt adequately. Though, many of the urban climate models and regional climate models are currently either not scale compliant for cities, or do not cover essential parameters and/or urban-rural interactions. Furthermore, although e.g. the urban heat island may be better understood, other phenomena such as moisture change are little researched. This research aims to improve the understanding of the change in moisture and temperature variables under climate change. Available EURO-CORDEX 0.11° simulations for RCP8.5 are analysed for relative and specific humidity, as well as for temperature variables throughout the century. Berlin is taken as a case-study. The results show that all the models simulate a difference between Berlin and its surroundings for the variables. There is a water vapor deficit in Berlin and it is generally warmer. The outcomes are similar between the model simulations and observations, though there is a slight overestimation of the water vapor deficit in Berlin by the models. The running mean over 30 years shows a divergence throughout the century for relative humidity between Berlin and its surroundings, with Berlin getting dryer over time, validated by the Mann-Kendall test. The Mann-Whitney-Wilcoxon test for relative humidity indicates a robust climate change signal in Berlin. Berlin is dryer and warmer for all months with the largest difference compared to its surroundings in the summer. Results of the regional climate model REMO is studied to gain further understanding in the processes supporting the findings. This study presents promising results to understand moisture change and related variables under long-term climate change in urban areas, potentially interesting to urban studies in other CORDEX domains.

Keywords: Urban, Humdity, EURO-CORDEX, Berlin, Climate Change

Parallel Session D: Domain/cross-domain meetings, Convection permitting models

D4: Urban environment and regional climate

D4-P-07

Urban environment and regional climate change: A case study of Indian metropolitan city

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India is experiencing rapid urbanisation, and consequently water demand in urban areas is escalating rapidly. The metropolitan city of India is amongst the oldest surviving cities in the world. Despite the fact that city is located on the banks of the River Ganga, residents are primarily dependent on groundwater aquifers for domestic water supply. The decline in the piezometric head of the deeper aquifer during the previous two decades is another concern. This raises concerns about the security of metropolitan city's water supply, and, hence, the economic vitality and sustainability of the city.

In this environment, with already existing pressures on water availability and use, climate change puts further stress on water management and the sustainability of water supplies. Climate change is already having impacts on temperature. Trends in temperature also interact with non-climatic factors, which complicate planning for water supply and demand and increases water insecurity. Moreover, regional annual average monthly maximum temperatures are projected to increase 2.5°C by 2049, based on the ensemble average of 41 CMIP5 models and assumptions of moderate future increases in greenhouse gas emissions. These projected increases in temperature will put further stress on water supplies. In addition, the increasing exposure to climate change, described above, will be superimposed on existing vulnerabilities.

In order to address these vulnerabilities, and to increase the resilience of metropolitan city of India in the face of projected climate changes, the study recommends several measures, which includes incorporating climate information in urban planning and development processes. The study concludes that these rudimentary measures, which are needed just to address metropolitan city's non-climate water management concerns, are necessary as a stepping-stone to transformative pathways for addressing the uncertainties associated with climate change.

Keywords: Urban environment, Urban water supply, Regional climate change, Projected climate change, Groundwater resource

Parallel Session D: Domain/cross-domain meetings, Convection permitting models

D4: Urban environment and regional climate

D4-P-08

Effects on local temperature and energy of urban expansion located in oasis in arid desert area

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The land surface model SURFEX 7.3 was used to study climate effect of urban expansion located in oasis in arid desert area by surface and 2-m urban heat island (UHI) intensity and available energy ratio (B). We performed a true regional development scenario and four assumed scenarios simulations in 1978, 1993, 2004 and 2014. The results show that simulated 2-m temperature in true scenario was well consistent with observation. 2-m UHI always displays positive twin peaks during whole day, while surface UHI only displays a positive single peak with several hours during daytime at four seasons in the four years. Moreover, 2-m UHI intensity during night is higher than that during daytime, indicating that UHI intensity is contributed more by "trap effect" from urban complex geometry or anthropogenic heat and that surface UHI according to land surface temperature cannot reflect UHI comprehensively. The oasis-urban development resulted in local warming and increasing of B, and compared with original undeveloped environment, local climate in study area was in a relatively balanced state in 1978 and 1993 due to "heating effect" of urban and "cooling effect" of oasis, but the offsetting effect from oasis would become weaker in 2004 and 2014.

Keywords: Urban heat island, Climate effect, Arid area