Topic: land-use change and its impact on weather and climate

Wind loss in Kowloon, Hong Kong from 1964 to 2010

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ABSTRACT:

Wind speeds, as measured at the King's Park Meteorological Station of Kowloon, Hong Kong have decreased dramatically in the last 5 decades. There has been a wind reduction by 0.6m/s per decade from 1968 to 1995 and 0.12m/s per decade since 1995. There is a need to understand how the wind becomes weakening for climate scientists and urban planners. We conducted Computation Fluid Dynamics simulations on the historical wind environments of Kowloon considering the prevailing easterly wind direction. The wind resource and wind loss within 200m of the monitoring station are calculated. Significant changes of wind speed and wind direction are observed. The results show that the overall mean wind speed in the center of the computational domain reduced gradually due to the continuous urbanization, i.e. deification and elevation of buildings. The total wind loss rate has increased from 11% to 30%, i.e. by almost 200% in the past five decades, and it is predicted that the wind loss rate will increase to 50% by 2050 if the current trend of wind weakening continues. According to the observed wind data of the Hong Kong Observatory, there have been continuous changes of wind direction in the King's Park Meteorological Station, but no significant change in weather station at the Tsimshatsui Star Ferry. The simulated results reveal that the change of buildings in the upstream led to the change of the simulated local wind environment near the King's Park Meteorological Station. The upstream buildings formed a wind passage in southeast of King's Park. As a result, more wind could penetrate the buildings via this passage and reach King's Park, causing the change of local wind direction. Our demonstration of the impact of urbanization on the wind weakening phenomenon in Hong Kong reveals the need of reconsideration of designing our city, as a reduction in urban wind speed may lower the ability in removing airborne pollutants, anthropogenic moisture and heat, increase urban heat stress, and result in higher energy consumption of our buildings.

KEYWORDS: wind loss, CFD, urban environment