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INVESTIGATION of LOCAL FLOW FEATURES in ISTANBUL via HIGH RESOLUTION ATMOSPHERIC SIMULATIONS

Y. Ezber (1), Z Boybeyi (2), O.L. Sen (1), and M. Karaca (1)

(1) Eurasia Institute of Earth Sciences, Istanbul Technical University,Istanbul, Turkey , (2) College of Science, George Mason University,VA, USA

Three-dimensional non-hydrostatic meso-scale model, OMEGA (Operational Multi-scale Environment model with Grid Adaptivity), is utilized to investigate the thermally driven local flows and their interaction with each other in Istanbul. The city of Istanbul is located between two water bodies, Black Sea in the north and Sea of Marmara in the south. Two dates with still air and clear sky conditions, one in winter and the other in summer, are selected to determine the contribution of sea-land breezes and urban heat island circulation to the local flow over the city. The simulation results indicate that the model performance is reasonably well for both dates. In comparison with the atmospheric observations at the point where the rawinsonde measurements are taken in Istanbul, the root mean square errors in the simulated temperatures are usually found to be less than 2oC in both seasons.

The simulations produce land and sea breeze circulations over the city in both winter and summer cases. Due to the sea-land-sea positioning of the city, two sea breezes form, one in the north (the Black Sea side) and the other in the south (the Marmara Sea side). Convergence takes place over the region as a result of the merge of the northerly and southerly sea breezes in both cases. The convergence occurs at about 15:00 p.m. in winter and about 11:00 a.m. in summer dates. Re-current circulations are observed above about 300 meters in the winter case and about 1000 meters in the summer case both in the west and east sides of the Bosphorus. Another important local flow feature is the channeling effect of the Bosphorus. Findings from the study further show that the urbanization in the southern coastal areas prevents much inland penetration of the southerly sea breeze. The large-scale wind direction also plays a significant role in the inland penetration of the sea breeze. Location of the sea breeze convergence differs in the simulations depending on the large-scale flow direction.

KEYWORDS: sea-land breeze, urban heat circulation, channeling, meso-scale model, re-current flow.