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Numerical simulations of severe weather events using the WRF-ELEC model

Barry Lynn (1,2), Yoav Yair (3), Ling Sun (4), Zhixiong Chen (4), and Xiushu Qie (4)

(1) Hebrew University of Jerusalem, Jerusalem, Israel, (2) Weather-It-Is, Efrat, Israel, (3) Interdisciplinary Center (IDC) Herzliya, School of Sustainability, Herzliya, Israel , (4) Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China

We present high-resolution WRF-ELEC simulations with lightning assimilation (Fierro et al., 2012; Lynn et al., 2015) from at least three different convective events over different regions. The first, a super-cell event, produced very strong winds, hail, and lightning over a large area over the Mediterranean Sea and coastal areas, while the second produced an intense convective cell over the southern Arava Desert, flooding and damaging hail. The third one was a squall line that occurred in Beijing, China, where the complex topography and urban heat island (UHI) effects both play important roles in severe convective events. The first developed on October 25th 2015 within a maritime environment over the northern tip of a Red-Sea trough off the Egyptian coastline near Alexandria, with deep convective cells rapidly growing over the sea, exhibiting cloud top temperatures colder than -70°C (∼18 km) and radar reflectivity cores > 65 dBz at 10 km. The second developed in a tropical air stream over southern Israel, most likely containing high aerosol concentration, during the morning of 15 September 2015. It is hypothesized that high aerosol concentration within this southern storm intensified microphysical processes within a unstable environment to produce the flooding rains and damaging hail (severely flooding the city of Eilat with extensive damage to a car park), as well as moderate amounts of lightning. The Beijing squall line case occurred on 7th August 2015, and it propagated from the northwest mountainous area to city of Beijing and produced maximum rainfall over 50 mm in 3 hours and frequent lightning flashes in the city region. WRF-ELEC (WRF with an explicit charging and discharge scheme) will be used to investigate microphysical and charging distribution differences between these 3 cases. The goal is to understand how differences in generated electrical fields relate to microphysical development that led to storm structural variations with different outcomes, including lightning intensity.

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3Lynn, B. H., Y. Yair, C. Price, G. Kelman, and A. J. Clark, 2012: Predicting cloud-to-ground and intracloud lightning in weather forecast models.Wea. Forecasting, 27, 1470–1488, doi:10.1175/WAF-D-11-00144.1.