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Key Organizing and Evolving Atmospheric Circulations Affecting the East Bay Hills Fire in Oakland, CA (1991)

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Abstract Text:

The East Bay Hills Fire occurred on hillsides within the northern part of Oakland, California on October 19-20, 1991. This wildfire was initiated in a favorable hot and dry northeasterly wind environment known as “Diablo winds”. Local observations revealed that the East Bay Hills fire had a major problem with rapidly shifting winds (U.S. Fire Administration, 1991). The ECMWF dataset was used to initialize the WRF-ARW model for the control simulations with data assimilation. An in-depth synoptic analysis of the fire event environment, as well as the WRF simulations, were performed with 16km downscaled to 4km, and 1km. The ECMWF reanalysis dataset and high-resolution WRF simulations were used to diagnose the primary and secondary circulations at the synoptic-meso-a-meso-b scales, respectively, that preceded the fire event creating a favorable environment. The numerical simulations were validated against the synoptic upper-air observations using reanalysis soundings and satellite imagery and the results indicated small simulation errors at these scales of motion. The aforementioned control nested-grid simulation was produced using the WRF-ARW model prior to numerous simulation sensitivity tests, such as no terrain and different boundary layer parameterizations. For those sensitivity experiments in addition to the larger-scale environment analysis, we generated vertical and horizontal cross-sections to depict the wind and theta field interactions along and across the firelines. The preliminary results showed strong downslope winds on the western side of the Diablo Mountain range. There was strongly sinking air aloft in the background environment and in addition to the terrain-induced downslope winds, environmental adiabatic warming further reduced the relative humidity in the vicinity of the fire event. The hot and dry northeasterly winds were in place when the East Bay Hills Fire was initiated. Moreover, the fire intensification and fire spread were related to the intensity, persistence, vertical profile, and direction of winds associated with the Diablo winds.

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