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Better Assessment of the Urban Effect on the Humidity Field based on Commercial Microwaves Links

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The humidity in the atmosphere has a crucial role in a wide range of atmospheric processes determined by the water vapor concentration in the air. The accuracy of weather forecasts, especially the prediction of rain, is largely determined by the humidity field measured at low atmospheric levels, where most of the atmospheric water sinks and sources. At this level, the absolute humidity variation can be large due to the land covers' variability. One of the main manmade land covers which has a great impact on the humidity field is the city. Large urban areas are developing and covering more land, causing a significant change in the humidity field above the surface. The total effect of the city is noticeable at a few meters height above the surface, where the city's water sinks and sources are summed up at the "urban canopy" level. Measuring the general effect of the city requires a wide deployment of instruments at the canopy level, a requirement that is not satisfied by the currently available tools for measuring humidity. A new method for measuring the humidity based on the cellular network is addressing exactly this issue of measuring the humidity at the city canopy level. This method is based on the fact that water vapor in the air attenuates the signal between two antennas (link). A significant attenuation occurs around the resonance line for water vapor of 22.23 GHz. This value is close to the frequency of many links deployed by the cellular companies which are located at $\sim$30m above the ground, a good height for measuring the city canopy. For comparison, the weather stations are located according to WMO rules normally at 2m above the ground. The humidity field around Tel Aviv was retrieved from the cellular links, interpolated using IDW interpolation and analyzed. The calculations were performed for different seasons and atmospheric conditions. The results show a well-noticed impact of the city on the humidity field over the Tel-Aviv metropolitan region. Most of the time, the absolute humidity was found to be higher around the city as compared to the nearby rural area. The results are compared to weather stations, INCA and ERA-Interim, data sources that have a low spatial resolution and/or rely on instruments that are not located at the canopy level. In summary, the new method for measuring the humidity based on the cellular network can provide a better description of the humidity field at the city canopy level and a good assessment of the urban effects on the environment and on rain in particular.