Geophysical Research Abstracts
Vol. 21, EGU2019-10130, 2019
EGU General Assembly 2019

Improving GPS-IWV estimations using spatio-temporal cloud distribution extracted from satellite data

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Water vapor (WV) is one of the greenhouse gases which plays an important role in global warming, and since it's the most variable component in the troposphere, investigating its distribution and motion is of great importance in meteorology and climatology studies. Here, we suggest a new strategy for augmenting integrated water vapor (IWV) estimations using global positioning system (GPS) tropospheric path delays along with remote sensing satellites data. The strategy is based first on the ability to estimate METEOSAT-10 7.3 μm WV pixel values by extracting the mathematical dependency between the IWV amount calculated from GPS zenith wet delays (ZWD) and the METEOSAT-10 7.3 μm channel. We then use the surface temperature differences between ground station measurements and METEOSAT-10 10.8 μm infra-red (IR) channel to identify spatio-temporal cloud distribution structures. As a last stage, the identified cloud features are mapped into the GPS-IWV distribution map when preforming the interpolation between adjusted GPS station inside the network. The suggested approach improves the accuracy of estimated regional IWV maps, in comparison with radiosonde data, thus enables to obtain the total water amount (both in the form of clouds and vapor) in the atmosphere. Mean and root mean square (RMS) difference between the GPS-IWV estimations, using the spatio-temporal clouds distribution, and radiosonde data are reduced from 1.77 and 2.81 kg/m2 to 0.74 and 2.04 kg/m2, respectively. Furthermore, by improving the accuracy of the estimated regional IWV maps distribution it is possible to increase the accuracy of regional Numerical Weather Prediction (NWP) platforms.