Models and Mapping of Precipitable Water Vapor Based on Meteorological and Satellite Data for Northern Thailand

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Abstract:

The long-term spatial distribution of precipitable water vapor (PWV) over Northern Thailand was studied for the first time. A statistical model combining actual vapor pressure and specific humidity was developed. The actual vapor pressure was calculated from temperature and relative humidity data acquired from 30 ground-based meteorological stations, from the FLDAS model, and from the AIRS/Aqua satellite. Specific humidity was calculated from the FLDAS and GLDAS models. PWV data from a sun-photometer for the years 2012-2019 was collected from the Northern Meteorological Center, Chiang Mai Province and used as the basis for the model (R2= 0.90-0.94). The model was tested on independent data sets obtained from PWV measurements for 2020-2024. The accuracy of the model in terms of root mean square deviation (RMSD) was between 6.82% and 7.79% (MAPE, RSR, NSE, and PIN scores were also very good). After the model was validated, it was used to calculate water vapor using a combination of meteorological and satellite data. To fully cover the Northern Region of Thailand, data gaps between meteorological stations were filled using interpolation techniques such as kriging, Local Polynomial Interpolation, Kernel Interpolation with Barriers, and Radial Basis Functions. The results of the model forecasts are displayed as monthly and annual PWV maps for the 1 0 years from 2 0 1 5 -20 2 4 . The monthly PWV maps reveal that PWV values area relatively high across the Northern Region during the rainy season (May-October), but low during the dry season (November-April). Furthermore, the annual water vapor column map shows that PWV in the region is mainly influenced by mountain ranges, and the southwest, and northeast monsoons.

Keywords:

Precipitable water vapor, actual vapor pressure, specific humidity, meteorology data, satellite data.