AN ALGORITHM FOR ESTIMATING RELATIVE HUMIDITY, BASED ON GOES AND MODIS SATELLITE DATA

Nazario D. Ramirez-Beltran[1], and Joan M. Castro[2]

[1]Department of Industrial Engineering, University of Puerto Rico, Mayagüez, PR, U.S.A;

[2]Department of Civil Engineering, University of Puerto Rico, Mayagüez, PR, U.S.A

The relative humidity is a required information to understand near-surface atmospheric and environmental processes. Estimates of relative humidity are especially important for applications in weather and climate forecasting, health, and agricultural development. The analysis of spatial and temporal variations of relative humidity near the ground is the basis to better understand of the processes related to climate variability that affects life on Earth. Thus, behaviour of the surface relative humidity is mostly related to the dynamics of surface processes. It has also been shown that relative humidity is a fundamental parameter to calculate the Fire Weather Index, which is used to mitigate forest fires around the world. Relative humidity and air temperature are used to estimate the heat index, which is the key parameter to monitor the occurrence heat extreme events. The aim of this study is to create a product to provide hourly estimate of relative humidity near surface

A real time algorithm is proposed to estimate hourly relative humidity at the surface level. The algorithm was developed with Geostationary Operational Environmental Satellite (GOES)-13 and the Moderate-Resolution Imaging Spectroradiometer (MODIS) data. The methodology is also designed to operate with the newer GOES-16 satellite data. The algorithm uses the brightness temperatures from the water vapour (6.7 μm) channel and albedo from the near infrared (3.9 μm) channel to model short term variations. The algorithm also includes three physical parameters extracted from satellites to complement the short-term variations of relative humidity at surface level. The parameters are: precipitable water (PW), land surface temperature (LST), and normalized difference vegetation index (NDVI). Two years (2010-2011) of hourly data from 584 ground stations were used to build the model. Validation was conducted with 2012 (GOES-13) and 2018 (GOES-16) data. Stations are located in the Caribbean islands, including the Peninsula of Florida, and in Mesoamerica countries, including part of Mexico, Central America, Colombia, and Venezuela. A regression model was used to estimate relative humidity, and validation was performed over different rainfall seasons. It was found that the average of the mean absolute error, the root mean squared error, and the coefficient of multiple determination were 7.4, 9.9, and 0.58, respectively.