GOES DATA AND A TRANSFER FUNCTION MODEL ARE USED TO ESTIMATE HOURLY AIR TEMPERATURE FOR PUERTO RICO

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In tropical areas the surface air temperature is affected by the interaction with atmospheric and surfaces processes such as solar radiation, cloud cover, rainfall, relative humidity, wind, evapotranspiration, elevation, vegetation, soil texture and soil moisture. Visible and infrared GOES data were used to estimate hourly observations of air temperature measured at each ground station. Twenty one stations located in Puerto Rico with hourly data were used to derive a time series model. The air temperature exhibits three major components, a trend, a seasonal, and a stochastic component. The trend is a deterministic model that includes increasing or decreasing variations through time, and intrinsic physical properties such orography, soil texture, and vegetation index. The seasonal behavior has two major periodic patterns associated to daily and annual variations. Sinusoidal models were used to represent the daily and annual seasonal variations of air temperature. The stochastic behavior is represented by a transfer function model, which includes the impulse response function and the autoregressive moving average (ARMA) model. The impulse response function modulates the visible and infrared radiation effects at the top-clouds and at the surface level. During the daytime time the presence of clouds make an abrupt reduction of surface air temperature, and the intervention of clouds are modeled by the impulse response function using infrared brightness temperature, the visible reflectance (0.65 μm), and albedo from near infrared (3.9 μm) data. During the nighttime only the brightness temperature from the water vapor (WV; 6.7 μm) and thermal infrared channels (10.7 μm and 12 μm) were used to correlate with air temperature. Brightness temperature differences were also used to explain best the air temperature variability. Nonlinear optimization techniques were used to search for the best structure of the impulse respond function and parameter estimations for the model. It was identified that the noise model was represented by an ARMA(1,1). GOES data were collected at every 15 minutes and at 4 km spatial resolution, and the hourly average was computed for each pixel. The nearest pixel in time and space were selected to match with ground stations and to calibrate the time series model. The introduced model explains 63 % of the total air temperature variability, and was implemented for Puerto Rico climate conditions. A real time estimation of hourly air temperature can be computed by using the proposed model that reveals and standard error of 2.5 ^{o}C.