Error Analysis of Interpolation Methods used on Ground Measurements in validating Global Precipitation Measurement (GPM) Rainfall Data

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The Global Precipitation Measurement (GPM) mission is a group of satellites that provides global observations of precipitation. Satellite-based observations act as an alternative if ground-based measurements are inadequate or unavailable. However, the satellite measurements must be validated to be reliable and used effectively. The data provided by satellites present information on areas with specific spatial and temporal resolutions whereas ground measurements from weather stations are presented as point data. Adjustments to spatial and temporal resolutions of measurements are therefore necessary in the proper validation of satellite data. In this study, two interpolation methods are considered: Inverse Distance Weighting (IDW) and a hybrid method of IDW and Successive over Relaxation (SOR). The hybrid (IDW and SOR) method uses IDW to produce boundary values and interpolates rainfall values in a specified area. These two methods are used in interpolating ground measurements from sixteen ground stations in Metro Manila. The data from these stations are automatically sent to Manila Observatory's server for storage and processing. The area considered in the study is the region 14.4° - 14.8° latitude and 120.9° - 121.2° longitude, subdivided into twelve 0.1° x 0.1° grid squares, which correspond to satellite (IMERG) grids. The interpolated measurements were compared against the Integrated Multisatellite Retrievals for GPM (IMERG) Final Run v5 half-hourly product aggregated to 1-day temporal resolution over the span of June 1 –August 31, 2014. These months are wet months in Metro Manila. Rain events during this time are caused by southwest monsoon, local thunderstorms, and typhoons. The root-mean-square error (RMSE) and fractional RMSE (F-RMSE) between ground and satellite measurements are calculated to compare the ground-based measurements with satellite measurements. The RMSE provides the values that show the difference between ground and satellite measurements. The F-RMSE provides a measure of how large the error is compared to the assumed true value. The results show that in terms of RMSE, the satellite data performs similarly when compared to ground data interpolated with either IDW or SOR. IDW showed slightly better results than SOR in the comparison between satellite and ground data with an average difference of 0.31 mm RMSE in June, 0.94 mm RMSE on July, and 0.07 mm RMSE in August. The high RMSE in July is due to a high incidence of the satellite overestimating rainfall. Using IDW method to compare satellite data produces smaller F-RMSE. The monthly average F-RMSE of IDW is 53.30 less in June, 29.48 less in July, and 0.45 less in August compared to SOR. This discrepancy can be attributed to extreme cases wherein the satellite data performs poorly when compared to ground data interpolated using SOR. These cases correspond to days of near zero rainfall as measured on ground. June was a month of low rain with the ground station data showing multiple days with near zero rainfall, which the satellite inaccurately estimated. Ground station data in July showed a more consistent distribution with only a few days of near zero rainfall and more frequent days of moderate to high rainfall. Ground station data in August also showed a good distribution with a few days of near zero rainfall and moderate rainfall. The stations reported one week of zero rainfall in August and the satellite exhibited good performance in capturing these events. The results show that using IDW instead of the hybrid method to interpolate ground data generally produces less RMSE in the comparison with satellite data. Using IDW produces much less F-RMSE than the hybrid method especially for cases wherein near zero rainfall is measured by

ground stations.

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