



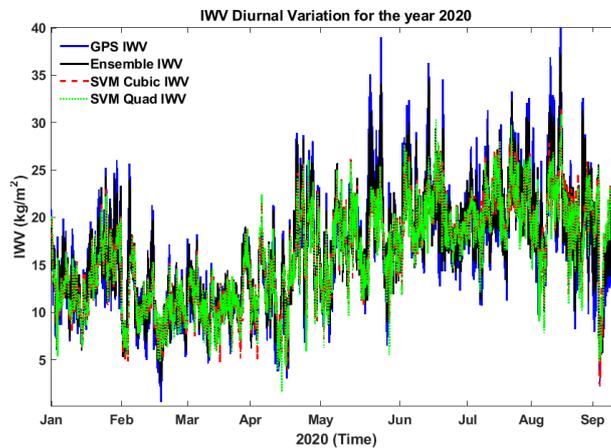
## Prediction of integrated water vapor using Optimized Ensemble-based Machine Learning Algorithm

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Integrated water vapor prediction has long been considered an important parameter in climate and weather phenomena, and a variety of statistical methods have been investigated. In the machine learning community, ensemble approaches have recently gotten a lot of interest. Boosting and bagging strategies have shown to be extremely effective. This study describes a proposal for an optimized ensemble algorithm approach. GPS derived IWV data has been taken from Oregon University, United States for the year 2020 from January to September. Machine learning algorithms like optimized ensemble algorithm, cubic SVM and quadratic SVM are used for the forecasting. GPS IWV data is matching well with ensemble algorithm and showing more deviation for cubic SVM and quadratic SVM. Correlation analysis is conducted and observed a 90% association between GPS IWV and ensemble algorithm, compared to a 66% correlation for cubic SVM and a 65% correlation for quadratic SVM. RMSE value obtained from ensemble algorithm is 1.72 (kg/m<sup>2</sup>) and 3.01(kg/m<sup>2</sup>) for cubic SVM and 3.08 (kg/m<sup>2</sup>) for quadratic SVM. MAE from ensemble algorithm is 1.35 (kg/m<sup>2</sup>) whereas from the other two methods is 2.81 (kg/m<sup>2</sup>) and 2.86 (kg/m<sup>2</sup>), respectively. From the results, it can be concluded that ensemble algorithm can be used as the alternative method for forecasting applications.



**Figure 1.** Time series plot of ensemble algorithm (black), SVM cubic (red dashes), SVM quadratic (green small dots) and GPS IWV (blue)

**Table 2.** Performance evaluation of proposed ensemble algorithm with other algorithms

Parameter	Optimized ensemble algorithm	SVM cubic	SVM Quadratic
RMSE (kg/m <sup>2</sup> )	1.72	3.01	3.08
MAE (kg/m <sup>2</sup> )	1.35	2.81	2.86
MAPE (kg/m <sup>2</sup> )	9.24	18.99	19.43
MSD (kg/m <sup>2</sup> )	3.89	13.94	14.51
R-SQUARE	90%	66%	65%