Geophysical Research Abstracts
Vol. 18, EGU2016-9399, 2016
EGU General Assembly 2016

Comparison of the resulting error in data fusion techniques when used with remote sensing, earth observation, and in-situ data sets for water quality applications

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Abstract

Ecological modeling and water quality investigations are complex processes which can require a high level of parameterization and a multitude of varying data sets in order to properly execute the model in question. Since models are generally complex, their calibration and validation can benefit from the application of data and information fusion techniques. The data applied to ecological models comes from a wide range of sources such as remote sensing, earth observation, and in-situ measurements, resulting in a high variability in the temporal and spatial resolution of the various data sets available to water quality investigators. It is proposed that effective fusion into a comprehensive singular set will provide a more complete and robust data resource with which models can be calibrated, validated, and driven by. Each individual product contains a unique valuation of error resulting from the method of measurement and application of pre-processing techniques. The uncertainty and error is further compounded when the data being fused is of varying temporal and spatial resolution. In order to have a reliable fusion based model and data set, the uncertainty of the results and confidence interval of the data being reported must be effectively communicated to those who would utilize the data product or model outputs in a decision making process[2]. Here we review an array of data fusion techniques applied to various remote sensing, earth observation, and in-situ data sets whose domains' are varied in spatial and temporal resolution. The data sets examined are combined in a manner so that the various classifications, complementary, redundant, and cooperative, of data are all assessed to determine classification's impact on the propagation and compounding of error. In order to assess the error of the fused data products, a comparison is conducted with data sets containing a known confidence interval and quality rating. We conclude with a quantification of the performance of the data fusion techniques and a recommendation on the feasibility of applying of the fused products in operating forecast systems and modeling scenarios. The error bands and confidence intervals derived can be used in order to clarify the error and confidence of water quality variables produced by prediction and forecasting models.

References

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