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Sea surface temperature: New algorithms for the derivation of sea-surface temperatures from infrared satellite radiometers

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For over a decade, the most effective and widely used atmospheric correction algorithm has been the Non-Linear Sea-Surface Temperature (NLSST) algorithm, which is based on the slightly non-linear combination of top-of-atmosphere brightness temperatures measured in two spectral intervals (channels) where the atmosphere is relatively transmissive. The effects of the changing atmospheric path-length across the swath observed by IR radiometers are compensated by a simple geometrical function, and the non-linear effects of the vertical distribution of atmospheric water vapor, the main constituent that interact with the infrared radiation leaving the sea surface, is approximated using a "first guess" SST in the algorithm. Attempts to improve the NLSST have been tried, for example using squared terms of the brightness temperature difference, or an explicit estimate of the integrated water vapor amount, but have failed to improve on the error statistics of the NLSST when applied globally. In the past several years, "equation discovery" procedures have been developed to determine optimum representations of dependences linking related dependent and independent variables in large data sets. The main advantage of equation discovery over classical regression analysis is that it aims not only at prediction, but also at the objective discovery of the best-performing equations and at elucidating explanations of the underlying natural processes. A valuable result of the equation discovery procedures is the determination of "areas of stability" where one particular output algorithm is more appropriate than another. We will present examples of new formulations for the atmospheric correction algorithms for the retrieval of sea-surface temperatures derived from MODIS measurements. These have been derived using "matchups" between MODIS data and temperatures from drifting buoys, and include an analysis showing the geographical areas where each algorithm is applicable.