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Title: From formal errors towards realistic uncertainties

Abstract:

Evaluation of uncertainties of geodetic parameter estimates is the problem that is not yet solved in a satisfactory way. A direct evaluation of the uncertainties derived from a least square solution is labeled "formal" and is usually biased, sometimes up to an order of magnitude. Customary, the use of formal errors for scientific analysis is discouraged. We claim that the root of the problem is neglecting off-diagonal elements in the variance-covariance matrix of the noise in the data. A careful reconstruction of the full variance-covariance matrix, including the off-diagonal terms greatly improves realism of uncertainty estimates derived from least squares. We processed the dataset of VLBI group delays and built the a priori variance-covariance of the atmosphere-driven noise based on analysis of the output of NASA high-resolution numerical weather models. We found that the uncertainties of parameter estimates derived from this least square solution that uses such variance-covariance matrices become much closer to realistic errors. We consider approaches for implementation of this method in routine data analysis of space geodesy data.