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Estimating requirements of observational data for volcanic ash dispersion predictions

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Reliable forecasts of volcanic ash are crucial in terms of air quality, climate, aviation safety, health, and other environmental and economic impacts. Uncertainties of emission source parameters impose the most critical impediments for skillful numerical simulations. Using the information provided by observations of transported volcanic ash in data assimilation allows for better estimations of emission factors and initial values. However, the observability that is estimating the information content provided by the assimilated observations, must be valuable. Even if different observation systems provide various information, in practice, clouds constrain the sufficient detection of volcanic ash. We study and evaluate the observability of the 2010 Eyjafjallajökull ash cloud by assimilating SEVIRI volcanic ash column retrievals and ground-based and space-borne Lidar extinction coefficients within ensemble versions of EURAD-IM. Combining the research fields of observability and predictability enables the identification of regions of low and high uncertainties of transported volcanic ash simulations. Thus, concentration patterns that are controlled by the observational data can be distinguished from those areas, where the reliability of the prediction restricted to uncertain emission parameters. This study discusses the needs for optimized observation configurations for volcanic ash cloud dispersion forecasts in general. A special example is provided for the information of wide spread column satellite imagery by Kolmogorov-Sinai-Entropy.