An observation operator for geostationary lightning imager data assimilation in storm-scale numerical weather prediction systems

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Abstract

The Lightning Imager (LI) onboard the Meteosat Third Generation (MTG) satellite will provide total lightning observations. The assimilation of such data could improve the thunderstorm prediction accuracy.
To prepare the assimilation of the flash extent accumulation (FEA) measured by LI in the French storm-scale regional AROME NWP system, a lightning observation operator is required to convert the model variables into a product comparable to the observations. Since LI FEA observations are not available yet (launch planned in the forthcoming years), pseudo-LI FEA observations were generated from a ground-based lightning detection system (Erdmann et al., in revision for JTECH).

This study focuses on the evaluation of different FEA observation operators from various proxies encountered in the literature and calculated from the outputs of 1 h AROME-France forecasts for 27 storm days in 2018. The data are processed as distributions over the whole domain and time period since a pixel-to-pixel comparison exhibits a rather poor correlation. Different regression techniques, linear regression as well as machine learning models, are used to relate the synthetic FEAs and the modeled proxies. The training of observation operator is performed on 25 days of the dataset and 2 days are used for validation. The observation operator is finally evaluated by computing Fraction Skill Scores for simulated FEAs. The performance of a principal component analysis is also examined.

Keywords: lightning, satellite

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