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Forecasting lightning with ECMWF's IFS

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Intense lightning activity is a common threat from severe convective storms. Lightning strikes can cause damage to buildings and electronic equipment, power supply outage, loss of lives and devastating wildfires. Lightning activity predictions could be challenging but potentially beneficial in the bigger task of forecasting severe thunderstorms. A parametrization of lightning has been developed for ECMWF's Integrated Forecasting System (IFS) and was implemented with cycle 45r1 on 5 June 2018. It calculates total (cloud-to-ground and intra-cloud) flash density from Convective Available Potential Energy (CAPE), the amount of convective cloud condensate between 0°C and -25°C and convective cloud base, which are all diagnosed by the IFS convection scheme. A tuning coefficient is used to match the global mean flash density from the LIS/OTD satellite climatology. Instantaneous and time-averaged lightning flash densities are provided as forecast fields. A linearised version of the lightning parametrization has also been developed for future 4D-Var assimilation of lightning observations. Validation of lightning density versus satellite and ground-based lightning observations has been carried out. Overall, spatial distribution of model lightning density is in a good agreement with observations with some underestimation over the Congo Basin and the Mediterranean. Day-to-day variability of model lightning over Europe agrees well with observations on a continental scale but tends to degrade for smaller averaging times and areas, as expected. Compared with ground-based network of lightning sensors, simulated lightning activity peaks about an hour too early and decays too rapidly in the afternoon. A probabilistic approach using ensemble forecasts is particularly suitable for lightning predictions due to the discrete and random nature of lightning activity. Lightning density, alongside with other products such as the EFI and vertical profiles from the IFS, will be shown for a case of severe convection. Plans of future improvements and developments will be presented as well.