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A hybrid approach for ground fog retrieval based on a combination of satellite and ground truth data

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Fog has a substantial influence on many ecosystems and it impacts economy, traffic systems and human life in many ways. In order to be able to deal with the large number of influence factors, a spatially explicit highly resoluted data set of ground fog (GF) frequency distribution is needed. In this study a hybrid approach for GF retrieval based on Meteosat Second Generation (MSG) data and ground truth data is presented. The method consists of a triangular irregular network (TIN) interpolation of cloud base altitude (CBA) observations from Meteorological Aviation Routine Weather Reports (METAR) as well as synoptic weather observations (SYNOP) and a subsequent merge with random forest (RF) machine learning predictions. GF is assumed where interpolated and predicted CBA values decrease below a dynamic threshold above the terrain elevation. Cross validation results show good accordance with observation data with a mean absolute error of 228m in CBA values and a Heidke Skill Score of 0.49 for GF occurrence. Using this technique, a 10 year GF baseline climatology was derived for Europe for the period from 2006 to 2015. Spatial and temporal variations in GF frequency are analyzed. Mountain ranges show higher GF occurrence in summer and during cyclonic weather conditions whereas plains and lowlands show higher GF occurrence in winter and during stable anticyclonic conditions. Possible reasons for these distributions are discussed.