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Early warning products for extreme weather events derived from operational medium-range ensemble forecasts

M. Matsueda (1,2) and T. Nakazawa (2,3)

(1) Department of Physics, University of Oxford, Oxford, United Kingdom (matsueda@atm.ox.ac.uk), (2) Typhoon Research Department, Meteorological Research Institute, Tsukuba, Japan, (3) World Meteorological Organization, Geneva, Switzerland

Accurate predictions of extreme weather events are important for the society, economy and environment in regions affected by such events. In this paper, we report the development and testing of a suite of prototype ensemble-based early warning products for extreme weather events, which are now quasi-operationally available at http://tparc.mri-jma.go.jp/TIGGE/tigge_extreme_prob.html. The early warning products are based on operational medium-range ensemble forecasts from four of the leading global numerical weather centres: the European Centre for Medium-Range Weather Forecasts, the Japan Meteorological Agency, the United Kingdom Meteorological Office and the National Centers for Environmental Prediction in the USA. In the products, the forecast probability of the occurrence of extreme weather events, including heavy rainfall, strong surface winds and extreme high/low surface temperatures, is defined based on each model's climatological probabilistic density function. Several case studies have demonstrated the ability of the products to successfully predict extreme events, including Hurricane Sandy in 2012, the Russian heatwave in 2010 and the 2010 Pakistan floods. The construction of a grand ensemble by combining four single-centre ensembles can improve the forecast reliability regarding probabilistic forecasts of extreme events, up to a lead time of + 360 hr. The grand ensemble can provide more reliable forecasts than single-centre ensembles, especially with respect to strong wind speeds, although the grand ensemble is still overconfident, especially for lead times greater than +216 hr. Thus, these early warning products may aid the reliable detection of extreme weather events far enough in advance to help mitigate the associated catastrophic damage, especially in developing countries.