EMS Annual Meeting Abstracts
Vol. 15, EMS2018-459-2, 2018

Evaluation and calibration of impact-based forecasting system for heatwaves integrated with limited-area ensemble prediction system

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In current severe weather warning system of Korean Meteorological Administration (KMA), the criteria for heatwaves are based only on climatological characteristics and do not consider an impact of heatwaves on human health. Moreover, forecasters use mainly outputs from deterministic models, which do not quantify uncertainty of forecasts. This is a critical issue for decision-making in impact-based forecasts. In order to assess the uncertainty, ensemble prediction systems can be used to provide a likelihood of particular event through a probabilistic forecast. The main goal of this research was to design, develop, evaluate and calibrate a new effective heatwave impact-based forecasting system, which will incorporate both impact of heatwaves on human health and likelihood of the event. The new developed system utilizes probabilistic forecasts of meteorological and several biometeorological indices such as perceived temperature, heat index, daily maximum temperature etc. The alerts are assigned using 4 color scheme according to 4x4 risk matrix. The probabilistic forecasts are based on Limited-area ENsemble prediction System (LENS) that is run by KMA using Met Office Unified Model. The final products are maps providing alerts for 165 regions around South Korea for 3 days ahead. The evaluation of both deterministic and probabilistic forecasts show cold bias of daily maximum of all predicted indices. Because this may negatively affect the ability of the system to predict heatwaves, before using the LENS in impact-based forecast, a suitable bias-correction technique has to be applied. We used adaptive decaying averaging technique to correct prediction of biometeorological indices. The results show significant improvement in ensemble forecast accuracy as well as probabilistic forecast reliability. Impact thresholds in risk matrix were decided upon statistical analysis of heat stress. Several configurations by different biometorological indices were compared and evaluated against heat stress mortality and morbidity data. Overall, the alerts issued by the system during studied period show high correlation with actual number of heat related patients. This work was funded by the Korea Meteorological Administration Research and Development Program “Research and Development for KMA Weather, Climate, and Earth system Services - Advanced Research on Biometeorology” under Grant (KMA2018-00621).