# Stochastic Multi-scale Atmospheric Modeling for weather forecasting: An atmospheric river case study

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Unprecendented flooding and severe weather occurred across Northern United Kingdom, especially in the Cumbria region, due to storm Desmond in Dec 2015. This storm caused large socio-economic damages over the entire region. Highest amount of daily-accumulated rainfall in UK (340 mm) was recorded in one station over 24 hours. Storm Desmond directed intense water vapor transport associated with an "atmospheric river" (AR) into the region during this period. Convection and cloud processes play a key role in the dynamics of the atmospheric rivers. Our shortcomings in parameterizing convection in global climate models (GCMs) are limiting our ability to simulate and understand the climate and weather of the planet. Recent innovative ideas on convection parameterization such as super-parameterization (embedding cloud resolving models within the GCM grid) or stochastic-parameterization implemented in the ECMWF climate model has helped improve its representation of the climate and weather systems. These two approaches in convection parameterization have emerged as new paths forward and complement the conventional approaches rather than replace them. We study the impact of these two approaches and a combination of the two on forecasts of this AR event in Dec 2015. Especially, results from evaluation of forecast skill in the extra-tropics for vapor transport and for precipitation over UK will be presented. We show that the combination of the two approaches improves precipitation forecasts, especially in regions that are mainly affected by the AR event. This has implications on improving conventional convection parameterization for predicting such high impact weather events as we await the exascale computing systems of the future to resolve convective processes in weather models.