RMetS Virtual Student & Early Career Scientists Conference 2020

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Pre-Recorded Poster Session

How important are post-tropical cyclones to European windstorm risk?

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Post-tropical cyclones (PTCs) extend many hazards associated with tropical cyclones to the mid-latitudes. In 2017 Ex-hurricane Ophelia impacted Ireland, killing three people and causing US$87.7 million insured losses. Despite high impact cases such as Ophelia, little research has been done to investigate the role of PTCs climatologically for Europe. Here we present a comparison between mid-latitude cyclones and PTC climatologies, along with their intensity distributions, using storms tracked through the ERA5 reanalysis using three TC identification methods: The Cyclone Phase Space (CPS), objective matching with the best track dataset and criteria on system associated fields (vorticity). Tracking storms through a reanalysis dataset allows for more of the storms life cycle of to be identified compared with the best track record, which is crucial for PTC studies. The storms which are identified as TCs are considered as PTCs upon impact with Europe. Analysis is undertaken to explore the sensitivity of the resulting PTC climatologies to the method of TC identification. It is shown that PTCs are, on average, significantly more intense in terms of their central pressure, 10m and 925hPa wind speed over Europe than mid-latitude cyclones. This result highlights the need for a robust PTC climatology and motivates further work to investigate the drivers of interannual variability and how PTCs may change in a warmer climate. We also show that TC identification using the CPS is in best agreement with observational best track data, though some weak storms and storms of extratropical origin are missed. Substantial differences in the resulting PTC climatologies exist depending on the TC identification method used, however all methods broadly agree in terms of the seasonal cycle of PTCs impacting Europe, along with their spatial density and interannual variability. These uncertainties should be considered when comparing PTC climatologies constructed using different TC identification methods.

The role of increasing vertical resolution on the detection and attribution of North Atlantic storms

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Accurately determining extratropical cyclone paths is key in determining regional impacts associated with precipitation and wind. It is known that the stratosphere plays an important role in atmospheric dynamics and can extend its influence down to the surface. Despite this, many attribution studies have not included a stratosphere in their experiments. We believe that not considering the stratosphere could affect the results of these experiments, so the role it has on North Atlantic storm tracks is analysed using an idealised, atmospheric only model named Isca. With the aim of identifying clear implications of including the stratosphere in storm track analysis in the North Atlantic basin, a large ensemble formed of 4 separate experiments is set up for the winter of 2013/2014. The four experiments are as follows; 1) no vertical layers in the stratosphere, 2) vertical levels extended to the upper stratosphere, 3) doubling of vertical levels throughout the atmosphere, and finally, 4) an increase of vertical levels at the tropopause. We expect that including the stratosphere, in addition to increasing

vertical resolution, will help improve model representation of storm tracks and their intensities during the 2013/2014 winter. The results of this study hope to highlight how the inclusion of the stratosphere and increased vertical resolution can lead to the improvement in modelling storm track statistics, which in turn will help to make more reliable attribution statements in the future.

Effects of cumulus physics, nudging and air-sea flux parameterizations using ERA5 as initial and boundary conditions on the intensity and trajectory of Typhoon Haiyan (2013)

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Since the Philippines is one of the countries most frequently affected by tropical cyclones (TCs), it is important to understand how large-scale environmental variables affect the characteristics of intense TCs, and how global warming may affect these characteristics and hence TC impacts. Initially, the Weather Research Forecasting Model (WRF) was used to simulate Typhoon Haiyan (2013), one of the most intense and highly destructive TCs to affect the country, for a 174-hour period using ECMWF Re-analysis 5th Generation (ERA5) as initial and boundary conditions. Sensitivity experiments were conducted by systematically altering the choice of cumulus schemes, surface drag coefficient, spectral nudging and TC bogusing. Most simulations were not able to capture the deepening of the mean sea level pressure or strengthening of low-level winds during Haiyan's intensification phase. However, most of the simulated tracks agree with the recorded track available from the observed (IBTrACS). The uncertainty in the large-scale parameters in the ERA5 10-member ensemble most relevant for TC intensification such as relative humidity, vorticity, geopotential and vertical wind shear were also examined, wherein large and significantspreads were observed. Moving forward, representative members from the ensemble will also be used as boundary conditions in WRF, to investigate whether the changes to Haiyan's characteristics (i.e. intensity, trajectory and rainfall) are a response to the uncertainty in the boundary conditions. Moving forward, the relative change in the characteristics of Typhoon Haiyan and other intense TC case studies will be explored by comparing the simulated TCs under current climate conditions with simulations of the same TCs under different future perturbed climate conditions, which will be generated by coupling the current reanalysis data with data extracted from Global Climate Models (GCMs) representing different scenarios.

Evaluation of a prediction for road surface conditions by METRo model with ASOS

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Road circumstances are directly affected by weather and wet or icy roads can occur terrible accidents for drivers, passengers and even pedestrians. Especially glaze ice on black asphalt is a significant cause of road traffic accidents during winter season but forecasting ice formation on a site is challenging because it has happened suddenly on a small spot for a few hours. For this reason, high-density observations are necessary to have a high-accuracy forecasting model in microscale meteorology. According to winter driving accident statistics in South Korea, more than 2,000 vehicle crashes happen every year. However, there are only 29 stations of road weather information system (RWIS) over 4,200km of

expressway. In this study, I design a compact IoT weather sensor node instead of RWIS to estimate the change of road surface temperature by surface heat energy balance equation and propose cloud-based icy warning system to alert drivers in real-time to the oncoming danger. As sensing data, the economical node included IoT technology will employ BME280 and infrared sensor for measuring air temperature, humidity, pressure, and road surface temperature to compute surface heat exchange. After computing heat energy balance between surface and near-surface air, the estimation will be combine with numerical weather forecasts published by Korea Meteorological Administration (KMA) to predict road conditions in a day or couple of days on a cloud operation system. This study tries to find an effective weather node what can be applied for a road ice forecasting model and expects for development of winter driving safety with modern technologies.

How is human-induced climate change altering extreme wildfire events?

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Wildfires constitute a major natural hazard and pose a huge risk to many regions of the world. The series of large fires across both hemispheres in recent years have led to inevitable questions about how human-induced climate change may be altering the character of such events. Providing answers to these questions is a crucial step to increasing resilience to major wildfires.
Long-term projections produced by state-of-the-art climate models, even when reliable, are not always a suitable means of communicating risk. Methodologies to attribute trends in meteorological phenomena associated with high-impact events to anthropogenic climate change have the potential to better communicate risk and guide adaptation strategies. While the link between a warming world and heat-related extremes (e.g. heatwaves and droughts) is reasonably well-understood, there is a lack of consensus on the most appropriate and effective methodological approach for many variables, potentially impacted by warming climate, such as wildfire attribution. The link with climate change remains poorly understood and wildfires have been largely ignored by attribution studies to date.
As a first step towards the development of a seamless, globally-applicable framework for assessing past, present and future risk in wildfire danger, we present a global attribution analysis of wildfire danger. With an initial focus on observational records, we use both established and novel empirical-statistical methods to attribute historical trends in episodes of extreme weather and climate conducive to wildfire ignition and spread. Particular consideration is given to the sensitivity of attribution findings to the spatial scale upon which the analysis is conducted. We also draw attention to a series of important, often overlooked, conceptual and technical challenges in event attribution, including validation and bias-correction of climate models and discuss the value of linking attribution of recent wildfire events with future risk assessment.