RMetS Virtual Student & Early Career Scientists Conference 2020

Monday 29 June 2020 | 13.00-13.35
Session 4 – Poster Session B

Inferring London's methane emissions from atmospheric measurements
Daniel Hoare
University of Bristol, PhD Student
The UK, along with various cities and other local groups have declared their intent to achieve net-zero emissions over the next few decades. To ensure that plans for greenhouse gas emission reductions progress as expected, it is vital to observe greenhouse gas emissions at various time and spatial scales. Within the UK, a world-leading national greenhouse gas observation network provides the data required to produce observation-based national emissions estimates. A new, denser network throughout London is being established to allow the techniques used to be extended to the city scale, where greenhouse emissions are concentrated and specific actions from local government can be taken to reduce them. Observations from the first sites in this network have already begun recording and the models are undergoing development to enable them to take full advantage of the full network density when it is available. The latest developments include allowing for high-resolution local models to be embedded in lower-resolution regional models, and for lower-cost uncalibrated instruments to be used alongside expensive, but highly accurate instruments. The initial testing is focused on inferring emissions of methane which is predominantly anthropogenic within a city such as London. After this capability is fully realised, work will move towards inferring the more complicated carbon dioxide emissions of London. The methodology developed will allow London's emissions to be monitoring continuously and for the work to be replicated in other cities.

Extracting likely scenarios from high resolution forecasts in real-time
Kris Boykin
University of Reading, PhD researcher
Currently, the Met Office produces a high-resolution ensemble forecast, MOGREPS-UK, which is used for forecasting the risk of high impact weather and issuing severe weather warnings. However, each ensemble forecast produces large amounts of complex data which the forecasters cannot easily digest in real time. Therefore, a lot of weight in forecasts issued is placed on the single "deterministic run" which cannot convey information on the range of possible outcomes or their forecast probabilities. As the speed and accuracy of high impact forecasting is vital for safety and livelihoods alike, this project aims to reduce the amount of data a forecaster must work through before being able to provide a forecast. By using clustering, we can determine a few distinct plausible scenarios among the members of the ensemble, reducing the amount of data a forecaster must go through and by extension, the amount of time it will take to issue a forecast of the event. The method focuses on K-medoids clustering and the results presented will focus on traceability of the clusters through time.

Which dynamical factors influence the seasonal predictability of winter windstorms over the North Atlantic/European region?

Lisa Degenhardt
School of Geography, Earth and Environmental Science, University of Birmingham, UK, PhD-Student

Skilful predictions of the upcoming winter windstorm season (usually December to March) for highly populated regions in Europe are of core interest not only for scientific studies but also for financial industry applications and the general public. A demonstrably skilful seasonal prediction available in advance could bring huge benefits for these different sectors.
This study analyses the skill of windstorms in the seasonal forecast model of the UK Met Office (GloSea5) compared to observational reanalyses (e.g. ERA5). For assessing the forecast quality in advance, large scale patterns such as the NAO and AO and other influencing factors (e.g. Eady Growth Rate or equivalent potential Temperature) are analysed to identify their steering role in prediction skill. Windstorms are tracked with an established algorithm developed by Leckebusch et al. (2008): an exceedance of the local 98th percentile of surface-near wind speed is used to locate regions with potentially damaging windstorm occurrence. Once these areas exceed a minimum spatial area and time duration, tracks of windstorms are achieved. Windstorm and influencing factors are assessed for prediction skill using a variety of different statistical scores.
The results lead to a better understanding of the seasonal windstorm forecast, their driving/influencing factors and help to interpret the seasonal forecasts in advance.

Using model nudging to constrain rapid adjustment radiative forcing from short-lived anthropogenic pollutants

Max Coleman
University of Reading, 1st year PhD student

While the direct radiative forcing of the major Near-Term Climate Forcers (NTCFs) are well understood, their secondary effects are less clear. Changes in other atmospheric variables such as temperature gradients and cloud cover can be triggered by the initial direct radiative forcing. These ‘rapid adjustments’ often cause further radiative forcing. Estimates for the ‘Effective Radiative Forcing’ – which includes both direct forcing and forcing due to rapid adjustments – of NTCFs using a range of climate models are being determined by the Aerosol Chemistry Model Intercomparison Project (AerChemMIP). However, the physical mechanisms causing rapid adjustments and their relative contributions to effective radiative forcing are not well understood for many NTCFs. The differences in effective radiative forcing of NTCFs when emitted from different regions also require further understanding.
In my project I aim to separate out rapid adjustments for three NTCFs: black carbon aerosol, sulphate aerosol, and ozone.

I am running simulations using the UK Earth System Model 1 (UKESM1) configuration of the UK Met Office Unified Model. By running a range of global simulations with specific atmospheric variables (winds, atmospheric temperature) controlled using model nudging techniques, it should be possible to isolate the different rapid adjustments in response to each NTCF. The radiative forcing caused by changes in different atmospheric variables for each rapid adjustment mechanism can then be determined using the SOCRATES radiative transfer code. Further simulations in which emissions are changed in only one region at a time can then establish the different effective radiative forcing for each NTCF when emitted

in different regions. Since black carbon, sulphate, and ozone are air pollutants, the effects of air quality control policies in different regions on future global climate forcing can then be considered.

Future drought risk in East Anglia: from the meteorological to the impact perspective
Nele Reyniers
University of East Anglia, PhD student
How will climate change affect extreme droughts in the East of England, one of the driest areas in the UK, and how will this affect water supply? This question is of major concern for decision makers at Anglian Water, the water company in this region, and we collaborate closely with them from the very start of the project to help build resilience to future drought risk. A crucial element of improving resilience to future droughts is to gain a good understanding of past, present and future drought risk in the region at the catchment level. We analyze the UKCP18 climate simulations for the UK to quantify future drought risk under the RCP8.5 scenario, focusing primarily on the regional model projections. Aside from quantifying future meteorological drought risk, these climate projections will be used to force Anglian Water models as well as an ensemble of hydrological models constructed with a modular framework for hydrological modelling (FUSE). We combine meteorological and hydrological drought indicators with more impact-based metrics to obtain a fuller picture of future drought risk, and aim to construct the model chain in a way that allows us to gauge the impacts of methodological choices made at each step.