Lunchtime Seminars are a seminar series held on Tuesday lunchtimes during term time from 13:00 to 13:50 on Microsoft Teams. All are welcome.

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Tuesdays at 13:00
Microsoft Teams
Mineral dust is the most abundant aerosol in the Earth’s atmosphere. Coarse dust particles have significant impacts on the climate system, yet climate models struggle to accurately represent even basic dust processes. As a result, estimates of radiative forcing by dust are highly uncertain.

Recent observations from aircraft fieldwork suggest that coarse and giant dust particles are more prevalent than previously considered likely, and exist up to high altitudes allowing them to be transported over long distances, and allowing them time to exert a radiative effect which is not represented in climate models.
Synchronisation: how can this help weather forecasts in the future?

Current numerical modelling and data assimilation methods still face problems in strongly nonlinear cases. A different, but interesting tool to help overcome these issues can be found in the synchronisation theory, in which one tries to synchronise a model with the true evolution of a system, using observations. Even when only a reduced part of the system is observed, synchronisation can be achieved.

In this research, two new ideas are proposed: 1) an ensemble version of a synchronisation scheme, where tests with a partly observed 1000-dimension chaotic system show a very efficient correspondence between the model and the true trajectories, both for estimation and prediction cases; 2) a combination of this scheme with a data assimilation method called Particle Filter, in which efficient results are also found for a high-dimensional system, and particles nicely follow the truth both for observed and unobserved variables. This methodology is a promising solution for strongly nonlinear problems and potential benefits are expected for numerical weather prediction.
Anthony Illingworth

Keynote seminar: WIVERN - A proposed satellite to observe global in-cloud winds and precipitation

The contribution of winds to reducing NWP forecast errors is second only to the T and humidity profiles provided by IR and microwave sounders. We report progress of the proposed conically scanning space-borne Dopplerised 94GHz radar, ‘WIVERN’, a ‘WInd VElocity Radar Nephoscope’; a candidate mission for the ESA Earth Explorer programme. WIVERN should provide in-cloud winds with 50km horizontal and 1km vertical resolution and daily visits poleward of 50°.

Ground observations at Chilbolton and Canadian aircraft measurements indicate that WIVERN should deliver each day over a million in-cloud wind observations with an accuracy better than 2 m/s. WIVERN would also supply cloud profiles to continue the global data set started by CloudSat in 2006 but with a fifty fold increase in coverage. Finally, we present very recent results from a new radar algorithm for estimating surface rainfall rates from space that have been validated by the world’s smallest rain gauge at Chilbolton.

Tuesday 17 October at 13:00
Sutcliffe Lecture Theatre – Met GU01
Detection of sulphate aerosol geoengineering

In the face of dangerous climate change, a number of technologies have been proposed to geo-engineer climate. One of these proposals involves deliberate injections of reflective sulphate aerosols into the stratosphere to reduce the amount of incoming solar radiation, and thus cool the Earth’s surface. Controlling sulphate aerosol geoengineering would require a robust system that could effectively discern the climatic effects of geoengineering from other externally-forced changes and the climate system’s internal variability.

The time horizon over which the surface cooling effect of sulphate aerosol geoengineering would be detected in a hypothetical geoengineering scenario will be estimated at various spatial scales using climate model simulations and detection and attribution methods. The possibility of detecting the effects of geoengineering in the vertical temperature structure will then be explored. The optimal spatial scale and detection diagnostic for geoengineering monitoring will be identified in this seminar.

Tuesday 24 October at 13:00
Sutcliffe Lecture Theatre – Met GU01
Implications of evolving SST patterns for atmospheric circulation and climate sensitivity

The patterns of SST change in response to an abrupt increase in CO2 concentration evolve over decadal time scales. I will show that time-evolving patterns of SST increase induce two distinct time scales in the long-term circulation response to step-like CO2 forcing. In most CMIP5 GCMs as well as in the multi-model mean, all of the poleward shift of the midlatitude jets and Hadley cell edge occurs in a fast response within 5 to 10 years of the forcing, during which less than half of the expected equilibrium warming is realized.

In addition to their effect of circulation, time-evolving SST patterns also cause a decrease in the magnitude of the climate feedback parameter following an abrupt CO2 increase in coupled GCMs. I will show that the evolution of climate feedbacks in models is highly consistent with the effect of a change in tropospheric stability, itself driven by the evolution of the pattern of sea surface temperature response.
Towards the improved representation of surface roughness in cities and implications for modelling the vertical profile of wind speed

The aerodynamic properties of urban surfaces can be represented using the roughness parameters of the zero-plane displacement ($z_d$) and aerodynamic roughness length ($z_0$). The $z_d$ and $z_0$ can then be used with wind-speed profile laws to estimate the vertical profile of wind speed. During this presentation, current methodologies used to represent the urban surface roughness ($z_d$ and $z_0$) and estimate wind-speed profiles are assessed. Insight to the most appropriate combination of methods is provided through comparison to wind-speeds observed with Doppler lidar in a European city centre (London, UK). A novel method is presented to incorporate a combination of both buildings and vegetation during aerodynamic roughness parameter determination. The method is demonstrated to respond to seasonal variations in roughness with the seasonal change in vegetation phenology, as well as improve wind-speed estimations compared to determining roughness parameters from buildings alone. The ability of globally available digital elevation datasets (e.g. from satellite borne instrumentation) to reproduce the true urban morphology is demonstrated, through comparison to high resolution ‘benchmark’ datasets.
Despite their simplicity and age (112 years old), the two-stream equations underpin the radiation scheme of every weather and climate model currently in use. In this talk I will show how by adding additional terms they can be used to tackle new problems, while retaining computational speed. Firstly, I will show how they may be modified to compute the interaction of radiation with random distributions of 3D objects. This idea has been applied to clouds enabling us to estimate the global impact of 3D radiative transfer for the first time; to open forest canopies enabling more accurate calculations photosynthesis rates; and to urban areas where it will underpin the introduction of a full urban scheme in the ECMWF model in the next few years. Secondly, I will show how additional streams permit directional radiances to be computed, promising the elusive prize of a radiance model fast enough to assimilate solar radiances. The figure shows a visible geostationary image from Meteosat and the corresponding simulation from the 9-km ECMWF model using this new approach. Can you tell which is which?

Tuesday 14 November at 13:00
Sutcliffe Lecture Theatre – Met GU01
A thermodynamic perspective can provide a powerful tool for expressing constraints on climate systems. Here, we unpack the energetics of two coupled tropical regions, coupled by a parametrisation of the large-scale motion such as the weak temperature gradient approximation.

Numerical simulations show that the introduction of such coupling does not distort the energetics of the system in aggregate, although it can have significant implications for each of the columns. The work done by the large-scale circulation is comparable to that done by the circulations contained within each column, even though the large-scale kinetic energy is more than 3 orders of magnitude smaller. This suggests that it is the large-scale that steers the local behaviour of convection.
Principles of governance to engage with the moral hazards posed by stratospheric geoengineering

Since 2006 there has been a rapid increase of interest in geoengineering technologies. Geoengineering raises many ethical questions if we wish to govern it. One of those questions is that of what to do about the moral hazard that it seems to create. In context, the moral hazard concern is that of how taking geoengineering seriously will lead to a change in our efforts to mitigate climate change.

Consequently the mere possession of geoengineering technology will increase the likelihood of being in that situation in which geoengineering is required. This moral concern is premised on there being something undesirable about a reduction in mitigation efforts due to our faith in or use of geoengineering.

In my presentation I explore the moral hazard concern, and propose three principles of geoengineering which can engage with the moral hazard concern. This is in the hope that if geoengineering is governed we can avoid / guard against the moral hazard concern.

Tuesday 28 November at 13:00
Sutcliffe Lecture Theatre – Met GU01
The seasonality of rainfall over Africa plays a key role in determining the length of agricultural growing seasons, influences energy supply from hydropower, affects the length of the malaria transmission season and impacts surface water supplies. Hence, interannual variability resulting in failure or delays of these rains can lead to significant socio-economic impacts for a range of stakeholders. In order to interpret and understand recent trends and variability in the seasonality of African precipitation and robustly evaluate future projections, climate models must correctly represent the seasonality of African precipitation.

A methodology for objectively determining the onset and cessation of multiple wet seasons across the whole of Africa is proposed; compatibility with known physical drivers of African rainfall confirm that the method is capturing the correct seasonal progression of African rainfall. The method is then used to assess the representation of seasonality in atmosphere-only and coupled (historical) CMIP5 simulations. While atmosphere-only and coupled integrations capture the gross observed patterns of seasonal progression, coupled models contain a notable deficiency over the southern coastline of West Africa, related to errors in the SST seasonal cycle over the Gulf of Guinea. Application of this method to RCP4.5 and RCP8.5 projections indicates future changes in the wet seasons, with wet season length reducing over southern Africa.