RMetS Virtual Student & Early Career Scientists Conference 2020

Monday 29 June 2020 | 11.15-11.45
Session 3 – Poster Session A

Mars' annular polar vortex
Emily Ball
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The Martian winter polar vortex has recently been shown to be annular in nature, with a local minimum in potential vorticity near the pole. This suggests barotropic instability, yet the vortex is remarkably persistent. It has been shown that its annular nature may be due to the release of latent heat from CO2 condensation, CO2 clouds, changes in dust distributions, and the strength of the Hadley circulation circulation, with many of these being interlinked. In this poster, we present results using the the Mars Analysis Correction Data Assimilation (MACDA) reanalysis dataset, which demonstrates clearly the annular vortex. Additionally, we perform simulations of the Martian atmosphere and its response to varying topography and radiation scheme in the flexible Isca framework, a climate model capable of simulating the Martian basic state at varying levels of complexity. It is noted that the strength of the Martian polar vortex is significantly lower in Isca simulations than in the MACDA dataset. Through further simulations with Isca, we aim to investigate the effect of CO2 condensation on the strength and shape of the Martian polar vortex.

What are the fine-scale features of the precipitation response to El Niño and what are the meteorological drivers behind this response?
Emma Sanig
Student (Undergraduate dissertation) now completing MSc at University of Birmingham
Precipitation extremes as a result of El Niño can have severe socio-economic impacts though droughts and flooding. Although the general precipitation response to El Niño in the Maritime Continent is well researched, the small-scale precipitation response is not. This study aims; to highlight the local features of precipitation during December-January-February of El Niño in five locations and explain the local precipitation anomalies. This is achieved through investigating the impact of El Niño on both small- and large-scale meteorological influences, based on sea surface temperature, precipitation and surface wind data from over the past 18 years. This study also looks at the regional variations between different events. This includes investigating if there are any differences in impacts between different strengths and between conventional El Niño and El Niño Modoki on a local scale. The results will hopefully be used to improve the quality of local climate models; to better predict the effects El Niño and mitigate the impacts of precipitation extremes appropriately. The findings of this project suggest that the contrasting precipitation extremes between different El Niño events within the Gulf of Carpentaria mainly result from changes to synoptic scale winds. Regions rich in high and complex orography, receive local anomalous high precipitation concentrated in mountainous regions, with the exception of north Borneo where strong anticyclone circulation suppresses convection. The differences to the local precipitation response caused by El Niño Modoki events remains uncertain.

Marine forecast accuracy improvement techniques
Katie Hodge
Met Office, Graduate Trainee Scientist
Typically, the method of bias correction applied to many raw Met Office atmospheric model outputs employs a technique called Kalman Filtering. This is an observation-based statistical method with a memory of recent model performance, used to estimate unknown variables to improve the accuracy of the (future) weather forecasts. The success of these previous atmospheric applications suggests a benefit in Kalman Filtering also being adopted for ocean parameters, for example the predictions of Significant Wave Height used for key decision-making by the offshore oil & gas and marine renewable energy sector. However, this is reliant on the correct configuration of the appropriate algorithms and requires different settings to those applied previously for other variables. Here, we report on recent trials to optimise the tuning of a Kalman Filter on forecasts from the operational Met Office Global (25km) and UK (1.5km) wave models. A set of oil & gas rig locations on the North West European Shelf representative of different site characteristics and exposures were chosen for the trials. In addition to benchmarking against the raw outputs, the results are compared against a new machine learning approach based on an artificial neural network to inform the ongoing development of the marine production system. The impact of improvements in forecast accuracy are of immediate relevance to the commercial marine industry, allowing better informed decisions for planning of maintenance periods and crew change over.

Study of propagation of diurnal cycle of precipitation from western coast to eastern coast over Indian peninsula during Indian summer monsoon
Lakshmi Kalavappilly Sajanhas,
University of Leeds, Master of Research (MRes) Student
Diurnal cycle is due to the responses of atmosphere-ocean-land-cryosphere systems to Solar radiation and its pattern recurs with every rotation of Earth about its axis. It regulates the precipitation patterns over Indian landmass during the Indian Summer Monsoon (ISM) and factors such as contrasts in land/sea heat capacities, monsoon depressions (MDs), intra-seasonal oscillation, orography, complex terrains, land-surface fluxes and soil moisture influence the cycle substantially. In this study, diurnal cycles of precipitation over the west coast of Indian peninsula and its eastward propagation inland through the Western Ghats (WG) are analyzed using Global Precipitation Measurement (GPM) and ECMWF ReAnalysis (ERA5) datasets, during Southwest and Northeast monsoons for a period of 20 years (2000-2019). The results are then investigated to study the spatial variations of convection due to these cycles over the subcontinent and their responses to WG, Boreal Summer Intra-Seasonal Oscillation (BSISO) and MDs formed over Bay of Bengal in ISM. Finally, European Space Agency – Climate Change Initiative (ESA CCI) Soil Moisture Product is used to study the relationship of land-surface soil moisture with the propagation of diurnal precipitation during ISM.