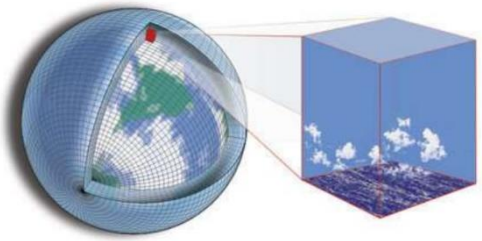
Developing further improvements to weather and climate modelling capability

Why this is important: Met Office climate model simulations show a positive pressure bias in areas around the North Pole, suggesting that the model has difficulty in correctly simulating atmospheric circulation in that region. These circulation errors could lead to changes in weather patterns that affect extreme weather over the UK, such as atmospheric blocking, and implies that these extremes may not be currently captured correctly.



What the UKCR programme is doing: A comprehensive set of observational surface datasets that include a long-term series of surface fluxes and near surface atmospheric data, that can be used to drive and evaluate the land surface component of the climate model, have been compiled. These datasets have been analysed in a way that enables an estimate of some surface factors to be determined, in particular those related to the friction (drag) that different types of land cover have on the flow of air at the surface. This analysis has enabled a comparison between these observationally derived values and those that were used in the model, and this demonstrated that the model had too little surface drag over all land cover types. In addition, a new tree height database highlighted a number of discrepancies with the model values in various regions on the globe, most notably a reduction in tree heights in the Boreal forest region. These tree heights are used to determine the surface drag factors for this type of land cover, so adopting the new database values reduces the drag in the Boreal region and goes against the required changes implied by the analysis of the observational surface datasets.

Results so far: When the new tree height database was applied to the climate model the positive pressure bias around the North Pole was improved due to the reduced drag in the Boreal region. However, results compared to the observational surface datasets are made worse because of the identified requirement for additional surface drag. Removing the tree height dependence of the surface drag parameters and setting these parameters to the observationally derived values generally reduce errors in wind speeds 10 meters above the surface, and near surface temperatures when assessed in several weather prediction case studies. However, this was found to lead to an increase in the positive pressure bias around the North Pole in the climate model.

What is next? Improving model performance for both near surface meteorology and the pressure bias around the North Pole will require a combination of changes to the various components of the atmosphere including larger scale drag from hills and mountains to make them more realistic. Whilst the increased surface drag factors have now been constrained by the observational datasets, the larger scale drag components now need to be refined. Improved model performance for weather patterns that affect extreme weather over the UK, both for present day and into the future, will provide an improved understanding of risk which is highly relevant for policy and contingency planning and will enable vulnerable communities to take steps to become more resilient.

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