University of Reading

IMPACT CASE STUDY

Storm tracking

Helping to better forcast storms

Research on tracking storms has been used to develop a storm-tracking and analysis software package, known as TRACK. This package has widespread applications, particularly in weather forecasting, climate model development and in the insurance industry. The software enables the detection of many types of storm features in a wide variety of numerical weather and climate models, and the observational and re-analysis datasets offer new insights into severe weather impacts. This research has given rise to a large number of quantitative practical applications in forecasting, the insurance industry and safe maritime operations during bad weather.

The ability to adequately simulate storms is a major challenge for weather and climate models

Research

Damaging extreme weather, including high winds and flooding, is frequently associated with storms or cyclones in many parts of the world. However, the ability to adequately simulate storms is a major challenge for weather and climate models due to the required fine spatial scales and the complexity of the processes involved.

Simulating storms is important when planning for defence against extreme weather. It is also important for the insurance and reinsurance sectors when they are looking at risk assessment and insurance pricing, as storms cost the industry a lot of money. For example Munich Re, the world's largest reinsurance company was reported in the Wall Street Journal as saying that global insurers and reinsurers will have to pay around $25 billion for the widespread damage caused by the U.S. superstorm Sandy.

Scientists working at the University of Reading have developed a software package known as TRACK, which is a diagnostic tool to identify storms, track their movement and evolution, and record their characteristics (for example intensity and growth rates). To maximise its usefulness, this tool has been designed to be suitable for use with very large meteorological datasets, and produce output data in a format that is suitable for end-users.

The software itself has been designed to be highly flexible, and TRACK has been used to study a range of storm types. More generally, though, the ability to identify storms rapidly, automatically and objectively is essential for unlocking the storm information contained in the petabyte-scale datasets now generated by weather and climate models (traditional manual identification is prohibitively time intensive). This means that the outputs from TRACK and the research conducted with it have provided important new insights into storm behaviour and extreme weather phenomena.

The development of the TRACK software along with its free availability has led to its adoption by a number of international groups including operational meteorological centres and specialist users. This has enabled these groups to conduct analysis of their in-house meteorological simulations and datasets using the software.

Impact

Users of the TRACK software include a wide range of national meteorological services and private-sector meteorological service providers. The results of this are that insurance brokers are able to make improved assessments of wind-storm risk; and national and commercial operational meteorological centres are able to validate and improve storm properties in their models. Improved storm simulations lead to better forecasting and reduced forecast errors. They also enable better simulations of future climate for evaluating long term changes to risks and hazards.

The impact of the development and use of the TRACK software has global reach. Storms affect many regions of the globe, and the software has already been applied to operational meteorological centres worldwide. The use of the software by meteorological centres will help to better forecast storms, which could reduce potential loss of life by these extreme weather events through improved warning and better preparation.

One example of the private sector's use of TRACK is how BMT ARGOSS, who produce weather-forecast products for maritime emergency response and vessel routing, use the software. TRACK-based research demonstrates that the movement rate of storms is underestimated in weather forecast models, and this is informing BMT ARGOSS's in-house meteorologists' understanding of maritime weather forecasts. This will enable, for example, improved estimates of storm arrival times at offshore oil rigs, increasing the reliability of safety margins and decreasing the length of time that they need to be shut-down due to extreme weather hazards. BMT ARGOSS are now in the process of modifying their business practices by applying TRACK software directly as part of their operational forecasting process.

Storms also pose an insurance risk worldwide, and TRACK is helping to better quantify this. Its adoption in modelling and risk assessment by the insurance and reinsurance sector is a big indication of the importance that this industry places on the value of the TRACK software and its related research.

Willis is one of the 'big three' global insurance brokers dealing with weather and climate risk. Wind storms are a key item of insurance exposure, for example Swiss Re reported that in 2008, wind storms accounted for 75% of total insured losses, equating to $40M. Research performed with TRACK, and embedding its outputs into co-developed industry-based catastrophe models, is enabling Willis to better understand global-scale correlations in storm risk due to large climate-patterns. Willis are now investing in developing quantitative links from TRACK analysis performed on extremely high resolution climate model simulations, to the risk-modelling tools used directly by insurance brokers.

Hiscox Catastrophe Modelling is a world-class corporate facility for catastrophe modelling, focusing on what is known as 'short-tail' reinsurance; which are exposures related to large, but short-lived and quantifiable hazards. Through their catastrophe modelling, they work with quality expert insurers, aiming to limit their own liability from either major accumulations of, or individual insured losses from, catastrophic events. Given around 85% of major hurricanes in the Atlantic develop from phenomena known as African Easterly Waves and these drive enormous economic and insured losses on the eastern seaboard of the United States (for example Hurricane Katrina and Hurricane Sandy), understanding the intraseasonal variability of these events remains an urgent priority area of research for Hiscox. Partnership with the research team's academic expertise, and development access to new scientific knowledge from TRACK has given Hiscox specific and competitive insight into tropical cyclone variability. A recent joint MSc project led to a change in Hiscox's organisational culture and practice, to work more closely with researchers from academic institutes. This resulted in a jointly funded, co-supervised PhD studentship (which started in October 2011) to investigate African Easterly Wave statistics using TRACK. The aim of the research is to examine the impacts of the general circulation on their transformation to Atlantic hurricanes, with a view to improve current seasonal forecasting schemes and inform future business decisions in the face of catastrophic events.

They also enable better simulations of future climate for evaluating long term changes to risks and hazards

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NATURAL ENVIRONMENT RESEARCH COUNCIL

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