HURRICANES

WEDNESDAY 15 MARCH 2006

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Hurricane dynamics – Prof Roger Smith, University of Munich
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Hurricanes are cyclonically-rotating low-pressure weather systems that develop mostly over the warm tropical oceans where sea surface temperatures exceed about 27 C. At upper levels in the troposphere the winds rotate anticyclonically beyond a few hundred kilometres from the centre.

In this talk I will try to isolate and explain important aspects of the dynamics and thermodynamics of a mature hurricane in an axisymmetric framework. In considering the dynamics of hurricanes it is convenient to distinguish between the primary circulation, i. e. the tangential flow rotating about the central axis, and the "secondary circulation" or "in-up-out circulation" (low and middle level inflow, upper-level outflow and the circulation in the eye), although when these two components are combined, the picture emerges of air parcels spiralling inwards, upwards and outwards. I will discuss first the primary circulation, the structure of which is approximately in thermal wind balance, and go on to explain the maintenance and evolution of the secondary circulation and the roles of friction and moist thermodynamics. I will touch also on asymmetric effects and the dynamics of hurricane motion. Finally I will discuss briefly some areas of current research that I consider to be important.

Problems with data assimilation of tropical cyclones - Dr Lars Isaksen, European Centre for Medium Range Weather Forecasts
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The intensity and small scale structure of tropical cyclones makes it difficult to represent them properly in global data assimilation systems. This talk will describe the importance of model resolution and will discuss the challenges related to assimilation of in-situ and satellite observations in the vicinity of tropical cyclones.

The extratropical transition of tropical cyclones: a potential vorticity perspective – Dr Anna Augusti-Panarada, University of Reading
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Tropical cyclones experience a transition as they recurve and move poleward into the midlatitudes. During this transition they develop a frontal structure and sometimes result

in large and deep extratratropical cyclones. The extratropical transition of tropical cyclones is a common phenomena in all ocean basins where tropical cyclones recurve, and yet the physical processes involved and their interactions during the extratropical transition are not well understood. This presentation will focus on the impact of the transitioning tropical cyclones on the development of extratropical cyclones. The results from three case studies will be presented using the potential vorticity framework.

Operational forecasting of tropical cyclones – Mr Julian Heming, Met Office
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The importance of timely and accurate operational forecasting of tropical cyclones was never so apparent as when Hurricane Katrina struck New Orleans in August 2005. The amount of property damage and loss of life was unprecedented by modern standards in the USA. However, the tragedy could have been far worse if it had not been for warnings from the US National Hurricane Center which gave accurate predictions of the landfall of the hurricane up to 60 hours in advance.

This presentation will discuss where responsibility lies for operational tropical cyclone warnings across the globe and how this responsibility is discharged by the officially designated tropical cyclone warning centres. Some of the tools used for operational tropical cyclone forecasting will be described. These include climatological, statistical and numerical models, ensemble and consensus techniques. An assessment will be made of how both tropical cyclone track and intensity forecasts have improved over the years. Some examples will be presented illustrating the skill of operational forecasts of the track and intensity of tropical cyclones.

How well forecast were the 2004 and 2005 Atlantic and US Hurricane Seasons? –
Prof Mark Saunders, University College London
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The 2005 hurricane season was the most active and destructive on record. Numerous seasonal, monthly and single-storm records were set. This follows the exceptionally active and damaging 2004 hurricane season. How well did the publically-available seasonal outlooks anticipate the record-breaking Atlantic and U.S. landfalling hurricane activity in 2004 and 2005, and would business have benefited from acting upon the forecasts made? The presentation will compare the encouraging performance of forecasts (deterministic and probabilistic) issued by different centres at different lead times. It will also describe how, in 2005, one forecast model was used to successfully adjust the assessed U.S. hurricane loss probabilities given in a standard catastrophe model used by insurers. The presentation will conclude with a preview of the current outlooks for hurricane activity in 2006 and for 2006-2010.

Tropical eddies in a future climate – Prof Lennart Bengtsson, University of Reading

Tropical transient storm tracks the Northern Hemisphere are investigated in the ECHAM5 climate model at a T63 horizontal resolution. The model results agree well

with analyses from ERA40, but with a slightly higher number of tropical storms in the climate simulation. Evaluation of an experiment at higher resolution (T156) indicates more intense vortices at the tail of the high end of the distribution curve. The statistical distribution of storms is virtually preserved under climate change conditions using the SRES A1B scenario until the end of this century. There are no indications of more intense storms in the future climate, but rather a minor reduction of the number of weaker storms. This confirms several previous studies suggesting that other aspects than higher sea surface temperatures play an important role. The tropical storm tracks undergo considerable changes including a weakening in the Atlantic sector and a strengthening and equator ward shift in the eastern Pacific. It is suggested that some of the changes are due to a SST warming maximum in the eastern Pacific, which occurs in the climate change experiment.