PROCESS MODELLING: HOW DOES IT HELP?

WEDNESDAY 15 NOVEMBER 2006

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Orography process modelling: Dr Andy Ross, Leeds University
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Process models, such as the BLASIUS model originally developed at the Met Office, are widely used for studying orographic flows, that is atmospheric flows which interact with hills or mountains. There are a number of reasons for this. These flows are often strongly influenced by the boundary layer and surface processes. The BLASIUS model provides a selection of turbulence schemes for representing the boundary layer.

It also provides a framework in which it is easy to try different surface conditions or develop new schemes. These models are also often capable of running at high resolutions and with relatively steep terrain. This makes them ideal for investigating the important processes controlling the dynamics of the flow. These points will be illustrated using recent simulations of the interaction between the atmosphere and the canopy over forested hills.

Aerosol and chemistry process modelling: Mr Ken Carslaw, Leeds University
This presentation will discuss what we can learn from undertaking process-level studies of convective clouds, in particular their effect on and response to aerosol. Aerosol effects on convective clouds are not normally considered in large scale models and the effect of the clouds on aerosol and chemical distributions is often handled in fairly simple ways without much evaluation against observations. Model studies of individual clouds and cloud fields and they way they interact with aerosol can help us to identify which processes are likely to be most important on the large scale. I will show a selection of model simulations exploring the interaction of aerosol, chemical species and clouds.

Ocean process modelling: Prof Peter Killworth, National Oceanography Centre, Southampton pki- at -noc.soton.ac.uk
In this talk I shall range over some old and new process modelling issues in physical

oceanography with an eye to seeing what we have learned from these and put into practice in larger ocean and climate models.

Modelling urban meteorology and using it for urban design: Prof Stephen Belcher, Reading University s.e.belcher- at -reading.ac.uk

Many of us live and work in urban areas, which is driving a desire to make quantitative predictions about the meteorology of urban areas. Increasingly when engineers and planners design new buildings and developments they require quantitative estimates of the local microclimate and how that microclimate will be changed by the development. In this talk I will describe how basic understanding of the thermodynamic and dynamical aspects of the urban atmospheric environment are yielding quantitative methods for representing urban areas in NWP and underpinning other stand-alone numerical tools. I will indicate how these tools have been used to inform engineers, planners, and government.

Boundary layer and cloud process modelling: Dr Adrian Lock, Met Office

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An important component of an NWP or climate model is the representation (parametrization) of subgridscale physical processes.

A key component of those is the transports of heat, moisture and momentum generated by boundary layer turbulence and cumulus convection. Much progress has been made in these areas through the use of large-eddy and cloud-resolving models which explicitly resolve the majority of the transporting motions. The beauty of these models is that they can be used to explore parameter space to understand better physical mechanisms and sensitivities, and to develop empirical scalings. Examples will be given from improvements made to the Met Office parametrizations over the last decade.

Super parametrization: a direct use of a cloud process model in climate simulation: Dr Marat Khairoutdinov, Colorado State University, USA

Contemporary general circulation models (GCMs) are among major research tools to make predictions about future climate change. Unfortunately, their predictions have large uncertainties mostly because of uncertainties in simulated cloud feedbacks. Due to coarse horizontal spatial resolution, traditional GCMs cannot explicitly represent individual clouds. Instead, clouds are modelled using semi-empirical parameterizations. Recently, preliminary short-term (under a month) global cloud-resolving simulations have been conducted in Japan. While a routine use of such models for climate-change problem is at least a decade away, a compromise (less expensive) approach has recently emerged -- a Multi-scale Modelling Framework (MMF). In its simplest form, the MMF is a traditional GCM in which conventional parameterizations of clouds and turbulence are

replaced in each grid column with a copy of a small- domain cloud-resolving model which in this context called super- parameterization. Super-parameterization simulates individual clouds and allows microphysics, turbulence, and radiation to interact on cloud scale. The results of a relatively simple Cess-type climate sensitivity experiment with such a MMF are discussed. Also, the results of a 19-year long AMIP-style simulation using the prescribed 1985-2004 sea-surface temperatures with the emphasis on simulated sub seasonal and inter annual variability of atmospheric response are presented. In particular, considerable improvement in simulating the Madden-Julian Oscillation (MJO) over the same GCM but with conventional parameterizations is demonstrated.