Update on Perturbed Physics Ensembles

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128 HadSM3 (atmosphere-slab ocean model) ensemble with parameters perturbed simultaneously

Additional simulations underway to explore more of parameter space

Murphy et al., 2004
Webb et al., in press
Stainforth et al., 2005
Understanding the drivers of uncertainty

- QUMP spans 80% or more of the range in global cloud feedbacks seen in other models.
- The largest spread in net cloud feedback comes from areas dominated by changes in low level cloud amount.
- Used to inform the implementation of the discrepancy term.

Webb et al 2006, Climate Dynamics, in press.
HadCM3 Ensembles

- Need coupled model experiments to capture time-dependent climate change
- A 17 member ensemble of HadCM3 (atmosphere-dynamic ocean) experiments with perturbed atmosphere, surface and sea-ice parameters

Collins et al., Clim. Dyn. in press
New Ensemble with Reduced SST/Salinity Biases

HadCM3 – Obs

Flux-adjusted – Obs (Collins et al. 2006)

New flux-adjusted – Obs
New Ensemble with Reduced SST/Salinity Biases

- Old ensemble (grey)
- New ensemble (black)
- HadCRUT observed series (red)
- Slightly wider range of feedbacks explored in new ensemble

Glen Harris, Ben Booth
Changing these ocean parameters has little effect on the rate of time-dependent climate change.
Perturbations to key parameters in the ocean component

1. Horizontal diffusion of heat and momentum
2. Gent and McWilliams + Visbeck scheme
3. Vertical diffusivity
4. Mixed layer scheme (Quadratic/Full Large scheme)
5. Marginal sea outflow
6. Water type

16 members (+standard) Latin Hypercube design
Perturbations to key parameters controlling the HadCM3 sulphur-cycle representation

1. Background volcanic emission scaling
2. Scavenging rate of SO4 by large-scale and convective rain
3. Background minimum cloud droplet number of continents
4. Particle size distribution for Aitken mode
5. Particle size distribution for Accumulation mode
6. Level for high-level sulphur emissions

16 member (+standard) Latin Hypercube design

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Carbon-cycle Parameter Perturbations

- Have been setting up a carbon-cycle version of HadCM3 with 1.25° x 1.25° horizontal ocean resolution
- Currently in spin-up phase
- Plan to perturb parameters in the terrestrial carbon cycle component only

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Simultaneous perturbations made to parameters in the atmosphere, surface, sea-ice, ocean, sulphur-cycle and terrestrial carbon cycle

To investigate interactions between uncertainties in different components and different physical and biogeochemical feedbacks

Hopefully starting mid 2007, dependent on proceeding work and computer resources
Down-scaling to the UK and Europe

- A small number of 25km resolution HadRM3 (regional model) experiments driven by boundary forcing from the HadCM3 ensemble (1950-2100)
- Evaluating test experiment now

Robin Clark, David Hassell, …