



Proposal: The multi-model perturbed parameter ensemble (MMPPE)

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The proposal objectives

For the first time, to quantify and understand both structural and parametric uncertainty via MMPPE

- To carry out a **co-ordinated** perturbed parameter ensemble in multiple global aerosol models
- To use the PPEs to carry out **sensitivity analysis** in individual models
- To use the sensitivity results to help **understand model diversity**

The proposal aims

To provide a deeper understanding of the sources of global aerosol model diversity – where does the variance come from?

- To build on and connect previous AeroCom experiments with a new statistical design
- To aid model **development**
- To produce **better understood** aerosol radiative forcing uncertainty estimates

Approach

Define key science questions and associated model outputs

Expert elicitation

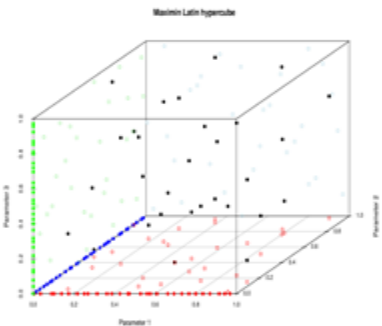
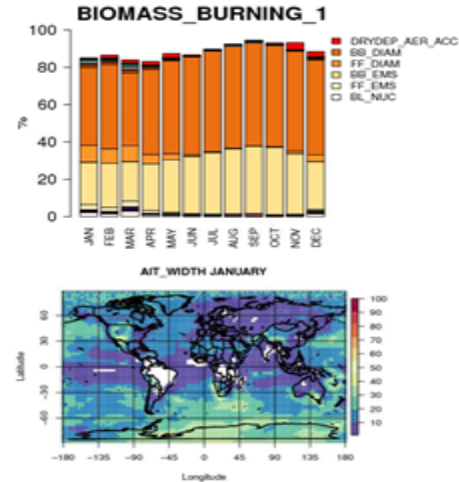
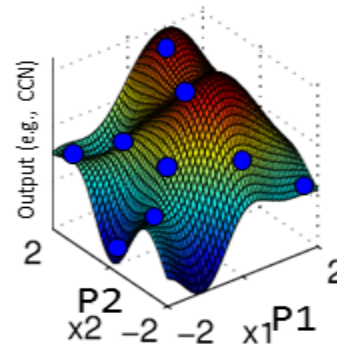
Sampling design for emulation

Produce model runs

Build and validate emulators

Variance-based sensitivity analysis

Intercompare model results



Group participation

Leads key role

Modellers key role

Number of simulations required

- The number of simulations required depends on 3 key things:
 - The **key model outputs**
 - Some model outputs require paired period or multi-year simulation
 - The **number of uncertain parameters** in the study
 - Need to design the ensemble to fill the 'active' dimensions adequately
 - The **signal to noise ratio** of the model response
 - This is dependent on the model set-up and the model output

Model set-up

- Free-running atmosphere-only simulations require **multiple years** ($> n$ years) to extract the perturbation signal from the meteorological noise
- Nudged runs reduce the noise BUT **need >2 years simulation** to extract any signal
- CTM or nudged double-call eliminate this noise leaving **only the perturbation signal**

Science questions therefore dictate the model set-up, run length and therefore the # of parameters that can be perturbed

Simulation budget examples

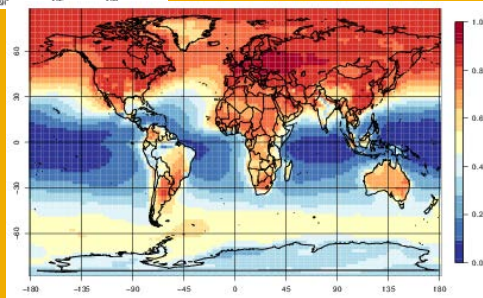
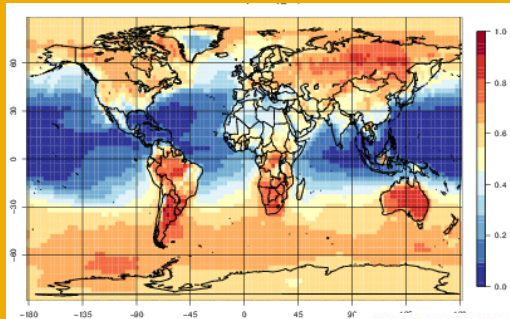
- **AOD** – 10 parameters, 100 PPE members, 1 year simulations = **100 years**
- **Direct forcing** – Same x 2 (paired PI and PD) = **200 years**
- **ERF** – 10 parameters, 100 PPE members, 3 year simulation = **300 years**
- AerChemMIP requires **2640 years** to participate in tiers 1,2,3

Other MMPPE projects I'm involved in...

Chemistry MMPPE

NERC-funded Lancaster led

5 chemistry models, ~20 parameters,
co-ordinated sampling design



Currently
recruiting...

PoEMS – MMPPE of Pinatubo eruption

Part of SPARC SSiRC experiments

Models to perturb 3,5,7 parameters with
a co-ordinated sampling design

1. Volcanoes and climate

2. SSiRC

3. The SSiRC intercomparison experiments

4. How well do interactive stratospheric aerosol models capture the Mount Pinatubo eruption?

5. Pinatubo Emission in Multiple Models (PoEMS)

6. PoEMS uncertain parameters

7. Anticipated results

AeroCom related MMPPE

- Currently setting up UKCA PPE with ~30 parameters to run for 2008
- Philip has set-up ECHAM6-HAM2 to co-ordinate with UKCA PPE

Will soon have co-ordinated PPE with ~30 parameters from which I will emulate and carry out sensitivity analysis to understand diversity in two models

Participation in this larger PPE is not exclusive

The way forward for AeroCom

MMPPE has to be interactive

- Read the proposal document and sign up
- Discuss (and agree) key science questions and feasibility
- Telecon or f2f meeting to discuss (and agree) associated set of uncertain parameters to be perturbed
- Elicit uncertainty distributions on the parameters

PPE References



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