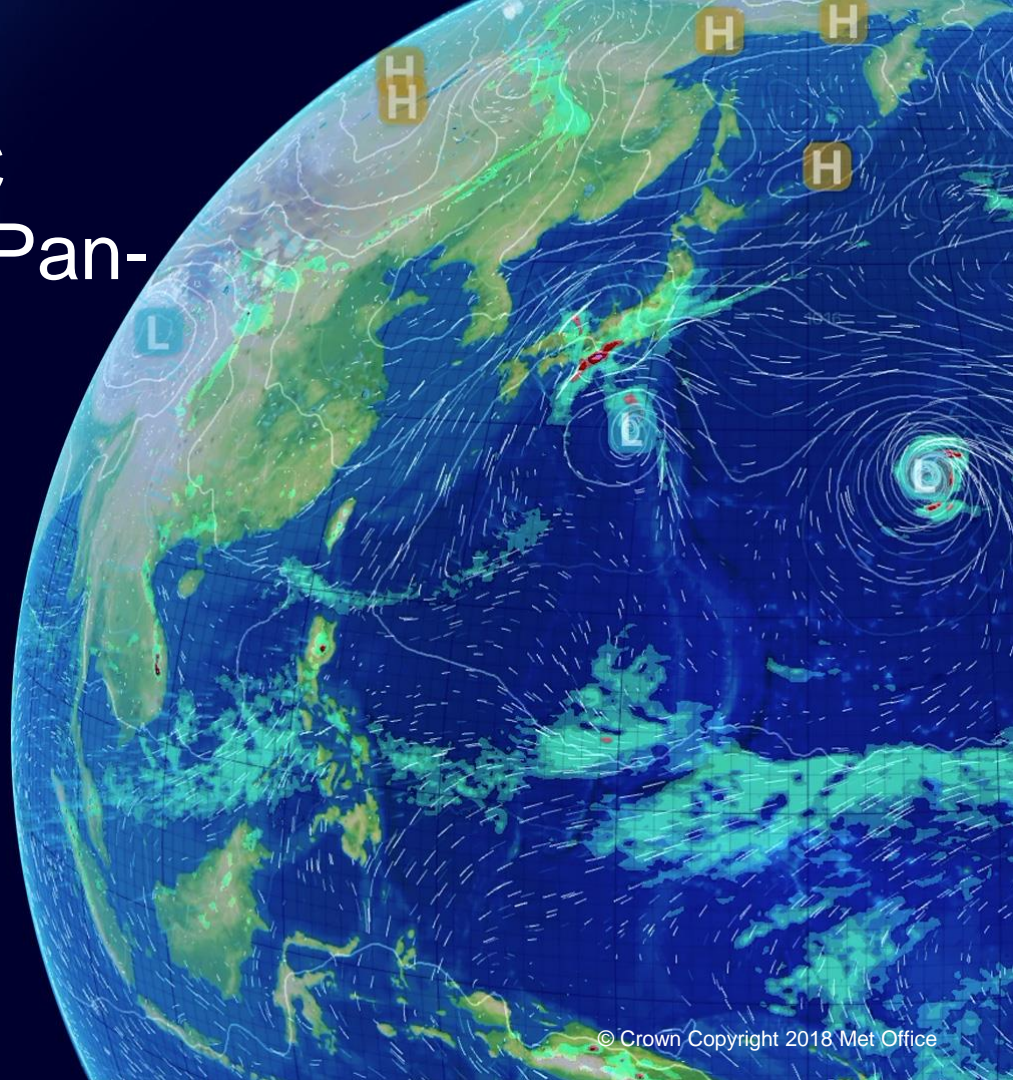
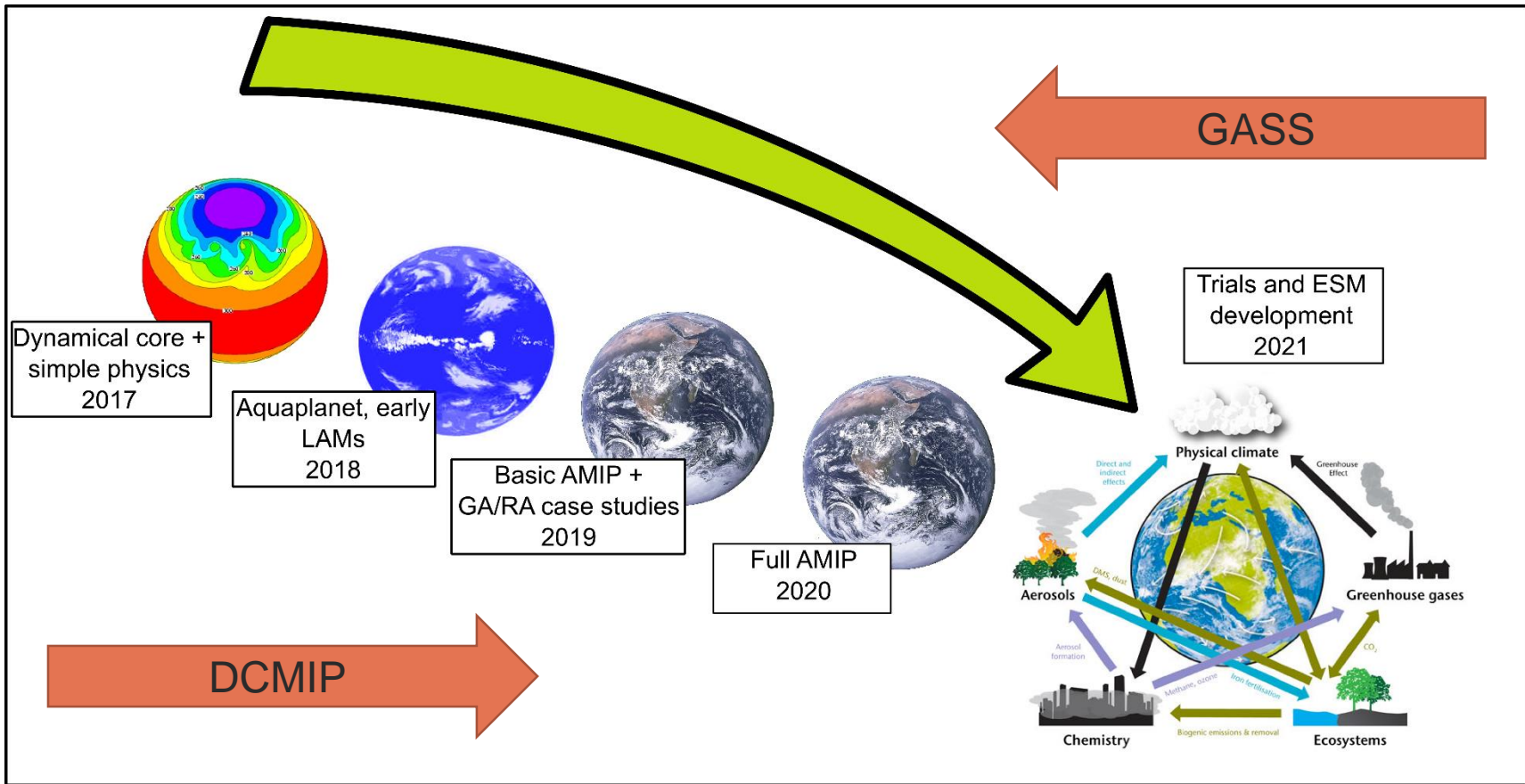


Outcomes from the PDC sessions at the Second Pan- GASS meeting

3rd Workshop on Physics Dynamics
Coupling (PDC18)

12th July 2018

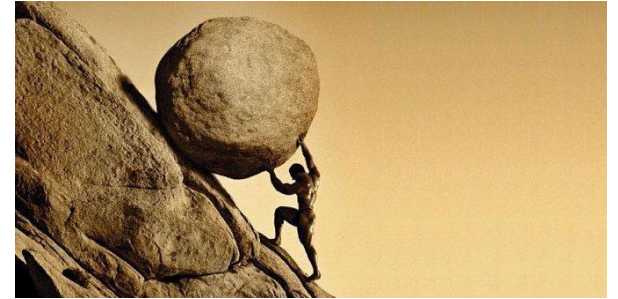




Model development is HARD



Unified Model development is REALLY HARD



**Unified Earth System Model
development is ...**





Met Office

Met Office

2001

GABLS

Global Atmospheric
Boundary Layer Studies



1993

GCSS

Global Cloud
System Studies

2010

GASS

Global Atmospheric
System Studies

80s-00s

ICRCCM

Intercomparison of Radiation
Codes in Climate Models)

2006

CIRC

Continuous
Intercomparison of
Radiation Codes

Radiation

Microphysics

Clouds

Boundary layer

Convection

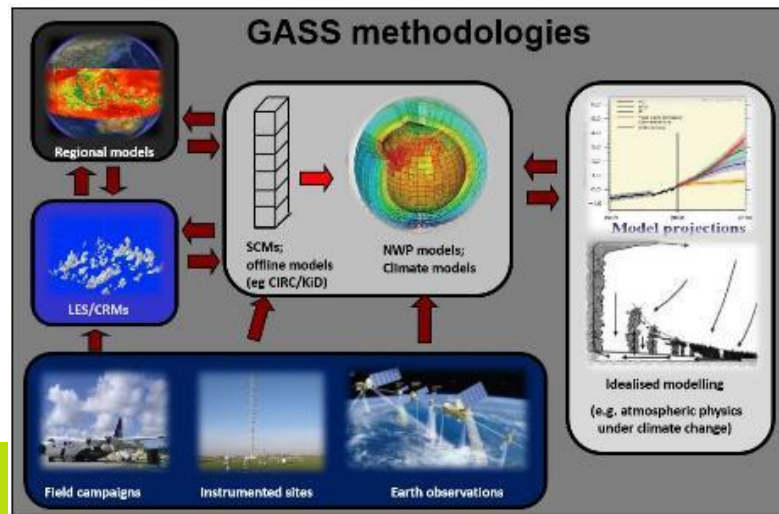
GASS provides leadership for the scientific community involved in improving the representation of atmosphere processes in weather and climate models.

through the coordination of scientific projects that bring together experts in process-modelling, observations, and the development of atmospheric parameterizations.

(All projects to date involve model comparisons)



New Chairs (2018)



CHALLENGES FOR CLOUD MODELING IN THE CONTEXT OF AEROSOL-CLOUD-PRECIPITATION INTERACTIONS

ZACHARY J. LEBO, BEN J. SHIPWAY, JIWEN FAN, ISTVAN GERESDI, ADRIAN HILL, ANNETTE MILTENBERGER, HUGH MORRISON, PHIL ROSENBERG, ADAM VARBLE, AND LULIN XUE

The International Cloud Modeling Workshop (CMW) has been a longstanding tradition in the cloud microphysics modeling community and is typically held the week prior to the International

NINTH INTERNATIONAL CLOUD MODELING WORKSHOP

WHAT: More than 40 experts on cloud modeling convened to discuss key advances in the representation of clouds in numerical models and future efforts to further improve the predictability of clouds and precipitation.
WHEN: 22-26 July 2016



The screenshot shows the EUCLIPSE website header with the title "EUCLIPSE European Union Cloud Intercomparison, Process Study & Evaluation Project". The navigation menu includes Home, Projectinfo, WP1, WP2, WP3, WP4, and Deliverables. There are sections for Publications and Meetings. A circular logo with a cloud and the text "EUCLIPSE" is visible on the right.







gical Organization
al Experimentation (WGNE)

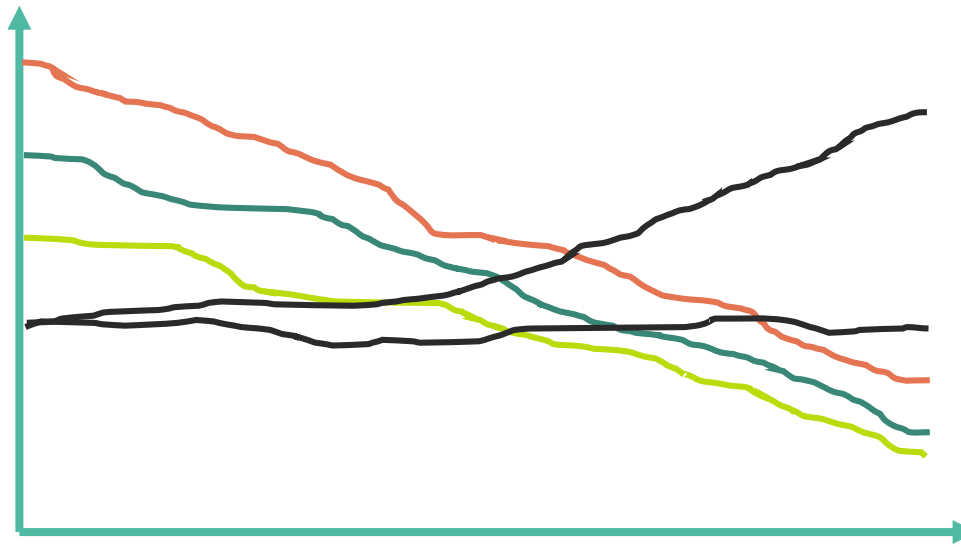
GASS projects are often collaborative with other efforts




CFMIP
Cloud Feedback Model Intercomparison Project

-  Improved representation
-  Truncation error
-  Missing processes
-  P-D coupling

Model Error



Time

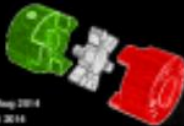


Physics dynamics coupling in geophysical models - bridging the gap

2nd - 4th of December 2014

Topics:

- Background of Physics Dynamics Coupling
- Evidence in current models
- Future directions
- Test strategies
- Thermodynamic consistency



Important dates:



- Final postered code ends - 20 Aug 2014
- Registration deadline - 30 Sept 2014
- Submission of final talk title and abstract - 31 Oct 2014 (through registration page)
- Workshop - 2nd to 4th of December 2014

Speakers:

- Almut Gatzert, Leibniz-Institut für Atmosphärenphysik, Germany
- Andrew Murty, Naval Postgraduate School, USA
- Christine Jakobson, University of Michigan, USA
- Colin Zarzycki, NCAR, USA
- Dean Segawa, Royal Meteorological Institute of Belgium
- Steve Williams, NCAR, USA
- Thomas Lesieur, CNRS, France
- Guillermo Sosa Jimenez, Instituto Mexicano del Petróleo, Mexico
- Hans-Johannes Lorenz, National Laboratory, USA
- Hui Yan, PNNL, USA
- Il-Sun Song, KMA, Korea
- Jean-François Royer, Météo France
- Katrin Sakaguchi, PNNL, USA
- Markus Gross, CICESE, IG
- Mike Cutler, Met Office, UK
- Peter Caldwell, Lawrence Livermore National Laboratory, USA
- Peter Lauritzen, NCAR, USA
- Sylvia Madsen, ECMWF, UK


Comisión Investigaciones Científicas y de Educación Superior de Euzkadi
Carolina Escrivain-Tomás 2014
Tara Payton
2280 Emerald
Suva, California
USA

*Acknowledged to Open-Registration

Physics Dynamics Coupling in Weather and Climate Models

Sept. 20-22, 2016
Pacific Northwest National Laboratory
Richland, WA, USA



Weather and climate models include complex representations of dynamic (fluid motion) and physics (e.g. radiative transfer, chemistry, cloud processes) that span timescales from fractions-of-a-second to millennia. The coupling of these processes is complex and difficult to represent. The PDC16 workshop will work to address challenges in the development of advanced algorithms to accurately and efficiently represent process interactions that determine fundamental characteristics of weather and climate systems.


TOPICS OF INTEREST

- Conceptual issues in model or process formulation, including conservation and consistency
- Discretisation of individual processes and process interactions
- Solution sensitivity to static or dynamic changes in spatial and temporal resolution
- Test strategies, results, and intercomparison
- Optimization, algorithmic efficiency and high-performance computing

SCIENTIFIC ORGANIZING COMMITTEE

- Hui Yan, Chair (PNNL)
- Phil Rasch (PNNL)
- Markus Gross (CICESE)
- Nigel Wood (Met Office)
- Christine Jakobson (U Michigan)
- Sylvia Madsen (ECMWF)

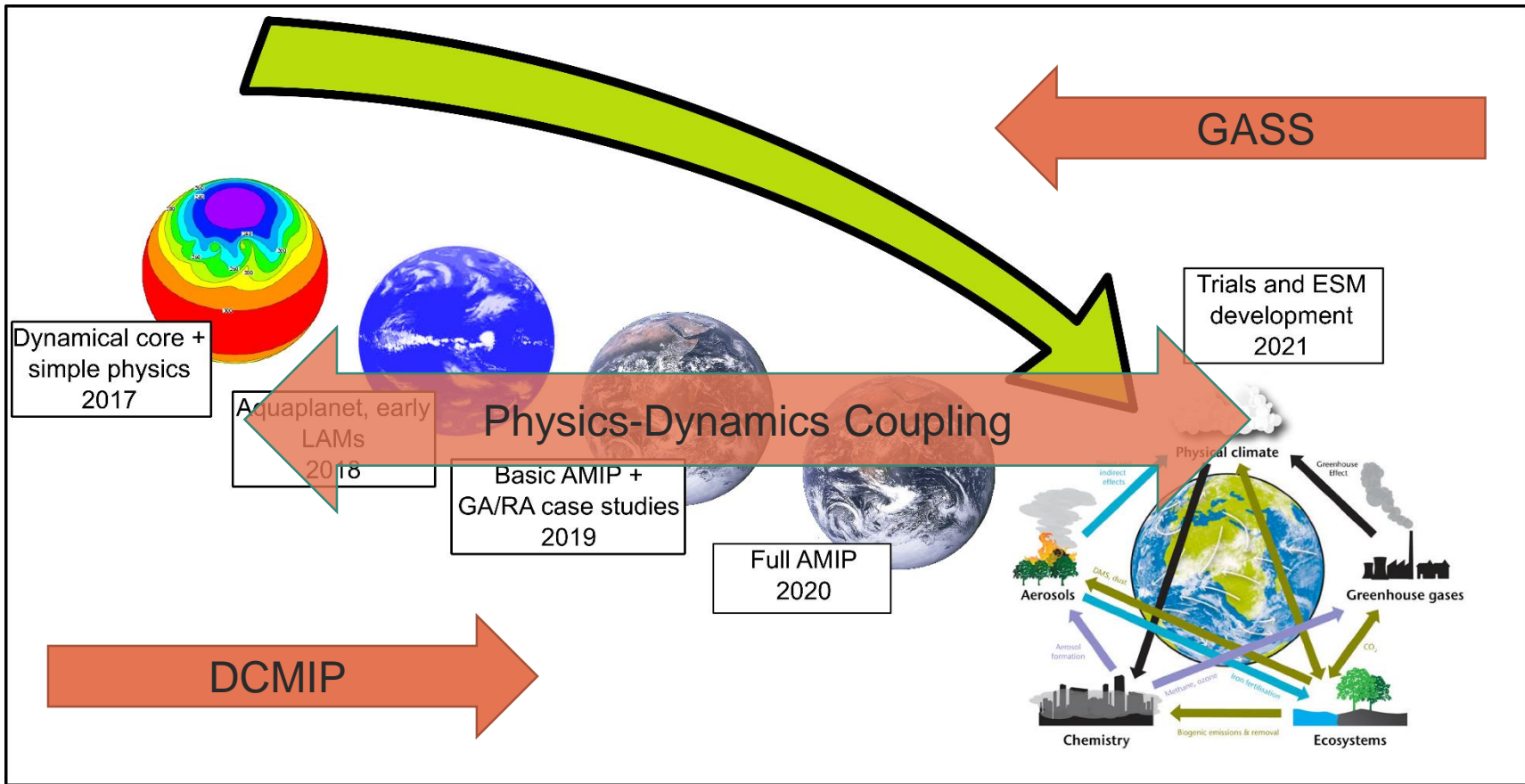
PDC16 Website and Registration
events.pnnl.gov




3rd workshop on Physics Dynamics Coupling (PDC18)

ECMWF | Reading | 10-12 July 2018







Understanding and Modelling Atmospheric Processes

The 2nd Pan-GASS meeting sponsored by the ARC Centre of Excellence for Climate System Science

The PDC workshop series explicitly targets the issues outlined here. The next workshop is at ECMWF, UK in July 2018. Hui Wan is a member of the PDC organizing committee. DCMIP aims to develop intercomparisons of dynamical cores. In recent years these have started to extend to use simple physics parametrizations. We aim to engage with both of these communities.

The planned b

- Constraining
- Modelling
- Fog modelling (White paper)
- Dynamics-physics coupling (White paper)
- Joint modelling activity over the Caribbean (White paper)
- Land temperature and snowpack on subseasonal to seasonal prediction (White paper)
- Grey-zone modelling (White paper)

Catherine Ric⁹

<https://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-18-0139.1>

1030-1100 **Coffee break**

1100-1230 **Session VI: Next generation modelling**

Chairs: Walter Hannah, Mike Pritchard

- | | | | |
|----|----------------|---|---------|
| 1. | Tanmoy Goswami | Simulation of Indian summer monsoon rainfall extremes by superparameterized community models | 20 mins |
| 2. | Qi Tang | How well does regionally refined model represent the uniform high-resolution E3SM V1 atmosphere model over the Contiguous United States | 20 mins |
| 3. | Masaki Satoh | Recent outcomes of the Non-hydrostatic Icosahedral Atmospheric Model NICAM for global simulations of multi-scale convective systems | 20 mins |
| 4. | Mike Pritchard | Ultraparameterization: Global Modeling with Explicitly Simulated Boundary Layer Turbulence | 15 mins |
| 5. | Walter Hannah | A Super-Parameterized Model for the Exascale Era: Results from the new SP-E3SM | 15 mins |

1400-1530 **Session VII: Physics-dynamics coupling**

Chairs: Ben Shipway, Daniel Klocke

- | | | | |
|----|--------------------|--|---------|
| 1. | Phil Rasch/Hui Wan | Quantifying and Understanding the Impact of Time Integration Errors Related to Atmospheric Physics Parameterizations | 20 mins |
| 2. | Robert Beare | Understanding couplings between the boundary layer and the large-scale dynamics` | 20 mins |
| 3. | Ligia Bernardet | Community infrastructure for facilitating improvement and testing of physical parameterizations | 20 mins |
| 4. | Martin Jucker | MiMA: Closing the Gap Between Simple and Comprehensive General Circulation Models | 15 mins |
| 5. | Jiong Chen | Boundary Layer Parametrization Coupling to Charney-Phillips Vertical Grid in GRAPES Model | 15 mins |

Phil's breakout notes

Topics

- Need to define scope of PDC activity
- Worth considering various subtleties of parallel vs sequential time stepping
 - Ordering of schemes
 - Use and impact of sub-stepping
 - Handling of fast vs slow processes
 - Position of advection/dynamics within the model

Models

- NWP vs climate models (impact of initial conditions vs. physics schemes)
- Model domain: include regional models in the activity (e.g., SP-WRF)?
- Use of simplified models: Which reduced models? Worth considering a hierarchy of models with different levels of complexity
 - Start with dynamics + dry physics, e.g.,
 - boundary layer
 - gravity wave
 - Held-Suarez physics package
 - Moist physics
 - Convection coupled with planetary waves
 - Baroclinic wave test with simplified physics used by DCMIP
 - Dynamical core on aqua-planet with simplified physics
 - Aqua-planet simulations
 - Include chemistry and aerosol?
 - Single-column models (e.g., SCM + dynamics?)

Experimental design

General

- Need test cases that could serve as benchmarks
- Need to define measures of accuracy (e.g., conservation vs other measures)
- What are the true solutions for physics?
- How to do convergence test?
- Impact of short step sizes on equilibrium assumptions?

Possible experiments / test cases

- "DTMIP", e.g., Hui's initial comparison, SST + 4K with default and smaller delta t.
Other participants:
 - ECMWF? CMA? Taiwan SM
 - Mike Pritchard
 - Walter Hannah
- Investigation of the structure of physics suite by separating off aspects of physics (e.g., just call boundary layer or radiation scheme)
- What is the simplest physics-dynamics coupling problem?
 - Density current (need horizontal viscosity)?
- Compare SISL vs finite-difference / Runge-Kutta methods
- Intercomparison of the ordering of operations

- Use nudging to address internal variability
- Keep in mind that vertical resolution can have large impact on results.

Proposal for intercomparison work

Key aims:

- Design experimental and analysis methods to identify coupling issues
- Promote/facilitate the evaluation of coupling methods developed by individual groups/researchers in multiple models.

Initial experimental setup

- +4K climate simulations
- Timestep sensitivity
- Following Hui and Phil's previous work

Timeline

- **Confirmed participants** of the first climate change simulations...exchange results at end 2018.
- A survey to **gauge interest** in additional experimental design and analysis foci will be distributed in summer 2018
- **Further planning** of the intercomparison will be organized at the AGU Fall meeting in 2018 and EGU General Assembly in spring 2019.

...further gathering of community requirements needed?

10. What flavour of dynamical core do you have?

Spatial aspects

- Finite difference/Finite volume
- Spectral
- Spectral Element
- Finite Element
- Other

8. What kind of model(s) would you run for any intercomparison?

You can select more than one.

- Global (NWP/Climate)
- Regional (NWP/Climate)
- CRM (Process model)
- Single Column Model
- None

7. Which of the following areas of PDC are you currently most interested in?

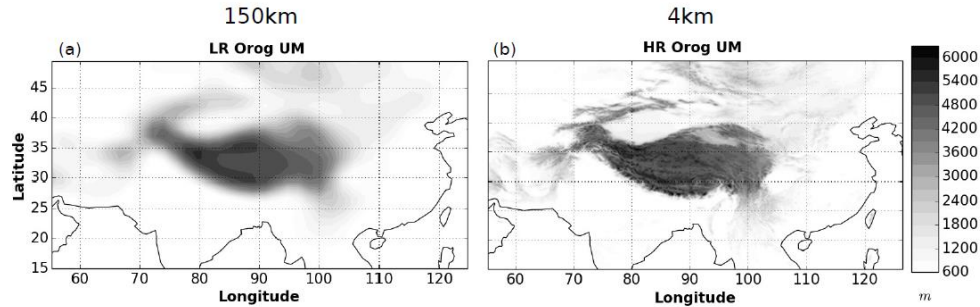
Please use the last question to add any more detail about aspects that interest you and aren't explicitly covered below.

	Interested and this is a priority for our model development	Interested from a personal perspective	Not interested	Don't know what this means
Temporal coupling (e.g. time-splitting)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Spatial coupling (e.g. spectral element to FD)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thermodynamic consistency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coupling between earth system components (e.g. ocean and atmosphere)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Computational aspects (e.g. task parallelism)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tracer transport	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Balance (e.g. between competing terms such as convection and resolved ascent)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gray-zone/scale awareness	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Summary

- Summer 2018 (NOW): Would like to identify participants of an initial model intercomparison for +4K climate sensitivities
- Summer 2018 (NOW): Gauge broader interest and start to plan follow on activities and experimental design
- Meetings of opportunity: Possibly AGU (end 2018) and EGU (spring 2019)
- Contact me (Ben Shipway) or Hui Wan. Sign up to GASS mailing list: <https://www.gewex.org/panels/global-atmospheric-system-studies-panel/>

Irina...



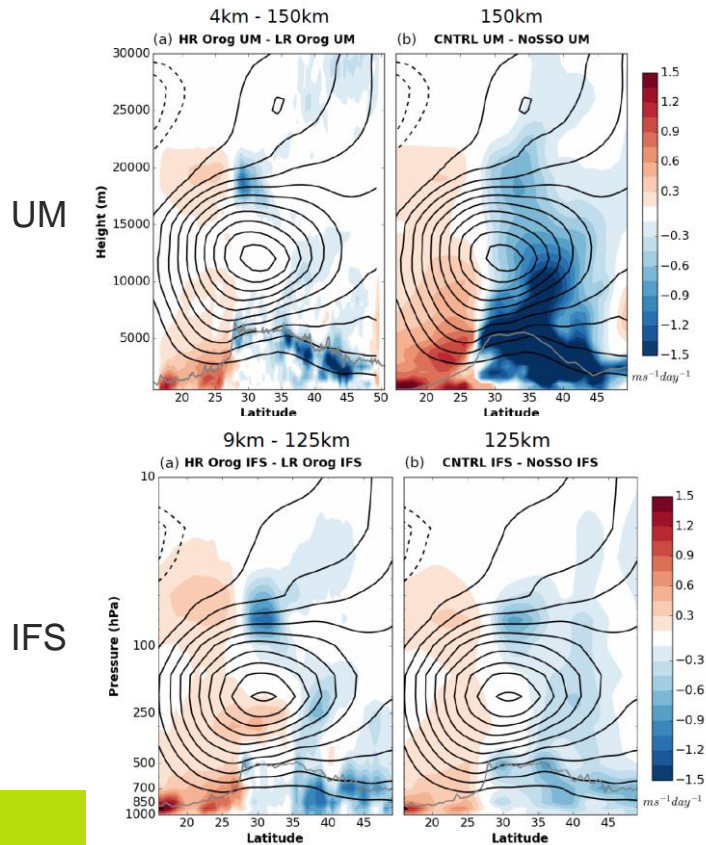
1. Run high resolution (4-9km) simulations with high resolution orography
 2. Run high resolution simulations with low resolution orography (150/125km) (Global or regional)
- Difference gives the impact of resolved orography

3. Run low resolution global simulations with parametrized orographic drag
 4. Run low resolution global simulations without parametrized orographic drag
- Difference gives the impact of parametrized orographic drag

Change in winds after 24 hours due to :

explicit orography

parametrized orography



A.van
Niekerk, I.
Sandu and
S. Vosper

Change in winds after 24 hours due to :

explicit orography

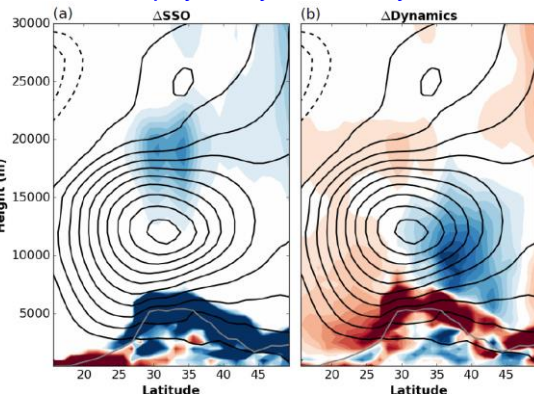
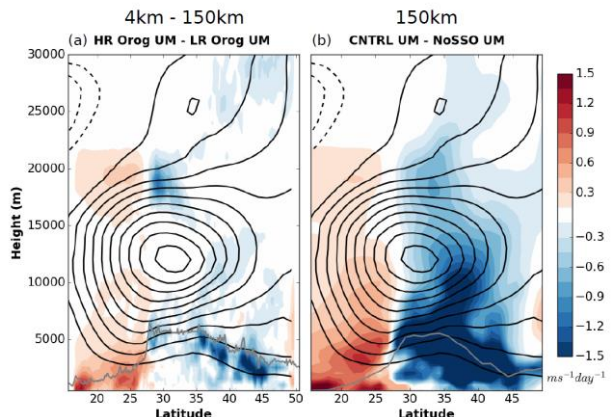
parametrized orography

Impact due to
parametrized orography

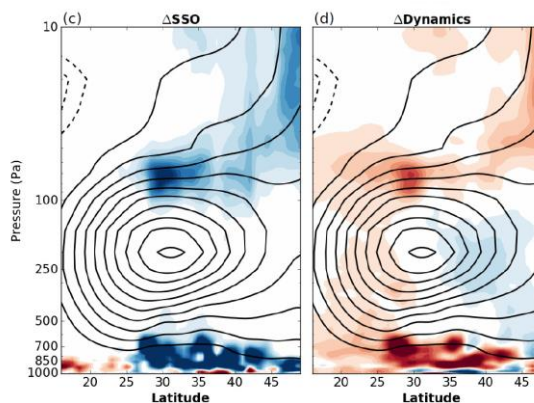
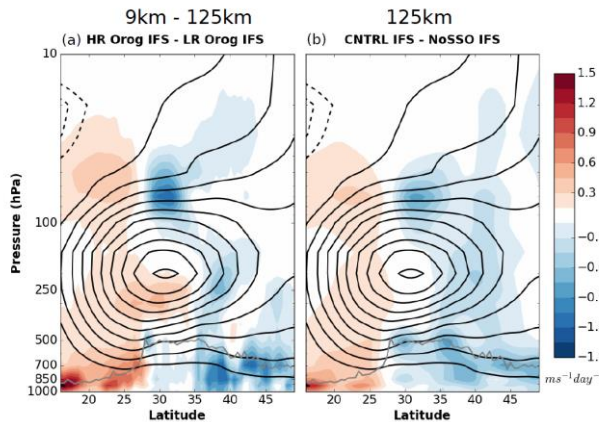
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phys + dyn tendency

UM



IFS



As much a
parametrization problem
as a physics-dynamics
problem

A.van
Niekerk, I.
Sandu and
S. Vosper

Change in winds after 24 hours due to :

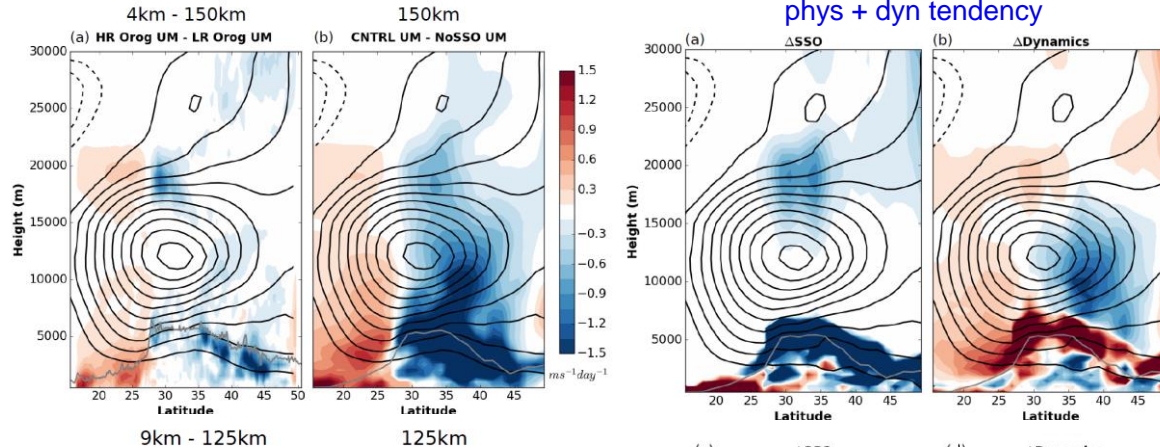
Impact due to
parametrized orography

explicit orography

parametrized orography

=

phys + dyn tendency



As much a
parametrization
problem as a physics-
dynamics problem

New GASS/WGNE intercomparison

Confirmed participation: DWD, Meteo-France, CMC, KIAPS, NOAA/NCEP, JMA

Contact: annelize.vanniekerk@metoffice.gov.uk & irina.sandu@ecmwf.int