ES-DOC

Why
Where we've been (CMIP5 and friends)
Where we're going (CMIP6 and beyond)

Bryan Lawrence
(on behalf of es-doc team)

+ others (NCAS,PCMDI, GFDL, IPSL, NOAA etc)

Most of this talk is from the perspective of the information PRODUCERS (the climate **modelling** community)

Another time we should talk about the perspective of the information CONSUMERS

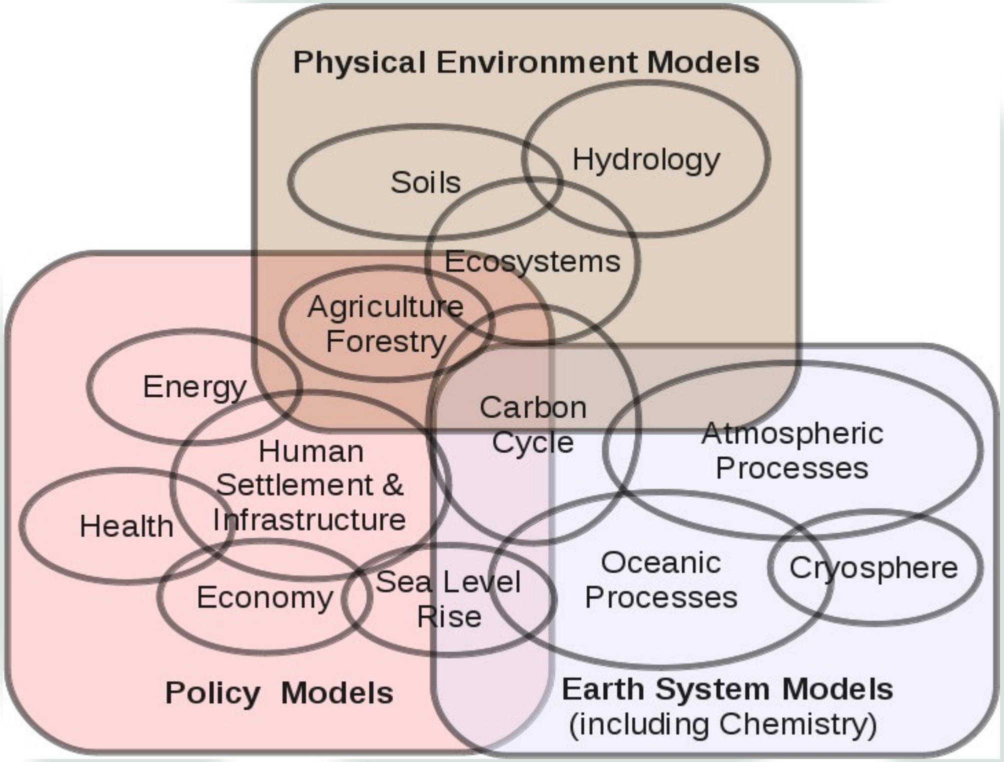
(sometimes the climate modelling community again, BUT OFTEN NOT)

WHY?

James Lovelock at the Geological Society, Burlington House, 5th May 2011

Science is still divided into co-existing disciplines each with its own language, journals and forceful defenders. We are tribal animals and such a trait is hard to resist.

Many, many processes, many, many communities!



Interconnected communities have problems which require coupling of models and sub-models between communities!

Not just a technical problem … language problems … scientific understanding problems … and …

(Figure adapted from Moss et al., 2010).

Quite a few tribes there!

and so to

How we think about models

(Which is not how everyone does!)

Simplified View of the Simulation Process

Identify and **understand processes**

Construct **mathematical** model of the **process**

(Sometimes) Create empirical/**statistical representation** of the process (aka "parameterisation")

Couple the process models together.

Test and improve the "integrated" systems

Prediction/Projection and Consequences

Which processes?

What mathematical representation?

Which algorithm?

What parameters for the model/algorithm?

How coupled?

How tested? How well validated?

How used? To improve the model? To predict/project? In all cases, what and why?

Simplified View of the Simulation Process

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State of the Art: Model Comparison

Table 1 The models used in the present study, including, configurations (near the equator) and number of years of simulations

Model	Institution	Atmosphere resolution	Ocean resolution	Length picntrl	Length 1pctto2x	Length 1pctto4x
CCSM3	NCAR (USA)	T85L26	1.125°×0.27°L40	230	150	n/a
CGCM3.1(T47)	CCCMA (Canada)	T47L31	1.85°×1.85°L29	500	150	150
CNRM-CM3	Meteo-France/CNRM (France)	T63L45	2°×0.5°L31	390	100	110
CSIRO-Mk3.0	CSIRO (Australia)	T63L18	1.875°×0.84°L31	380	10	n/a
ECHAM5/MPI-OM	MPI-M (Germany)	T63L31	1.5°×0.5°L40	332	100	81
FGOALS-g1.0	LASG/IAP (China)	T42L26	1°×1°L33	150	80	n/a
GFDL-CM2.0	GFDL (USA)	2.5°×2°L24	1°×0.33°L50	500	100	160
GFDL-CM2.1	GFDL (USA)	2.5°×2°L24	1°×0.33°L50	500	150	160
GISS-AOM	NASA/GISS (USA)	4°×3°L12	4°×3°L16	251	n/a	n/a
GISS-EH	NASA/GISS (USA)	5°×4°L20	2°×2°L16	500	80	150
GISS-ER	NASA/GISS (USA)	5°×4°L20	5°×4°L13	400	100	n/a
INM-CM3	INM (Russia)	5°×4°L21	2.5°×2°L33	330	n/a	n/a
IPSL-CM4	IPSL (France)	2.5°×3.75°L19	2°×0.5°L31	230	80	n/a
MIROC3.2(hires)	CCSR/NIES/FRCGC (Japan)	T106L56	0.28°×0.1875°L47	100	10	n/a
MIROC3.2(medres)	CCSR/NIES/FRCGC (Japan)	T42L20	1.4°×0.5°L43	500	100	150
MRI-CGM2.3.2	MRI (Japan)	T42L30	2.5°×0.5°L23	350	150	150
PCM	NCAR (USA)	T42L18	0.66°×0.5°L32	350	96	90
UKMO-HadCM3	HadleyCentre (UK)	3.75°×2.5°L19	1.25°×1.25°L20	341	10	n/a
UKMO-HadGEM1	HadleyCentre (UK)	1.875°×1.25°L38	1°×0.33°L40	80	10	n/a
SINTEX T30	IPSL/INGV (France,Italy)	T30L19	2°×0.5°L31	200	n/a	n/a
SINTEX T106	INGV/IPSL (Italy,France)	T106L19	2°×0.5°L31	100	n/a	n/a
SINTEX T106mod	IPSL/INGV (France,Italy)	T106L19	2°×0.5°L31	100	n/a	n/a
HadOPA	CGAM/IPSL (UK,France)	3.75°×2.5°L19	2°×0.5°L31	100	n/a	n/a

The only flux corrected model is MRI-CGM2.3.2

1: Tabulate some interesting property (and author grafts hard to get the information)

Guilyardi E. (2006): El Niño- mean state - seasonal cycle interactions in a multi-model ensemble. Clim. Dyn., 26:329-348, DOI: 10.1007/s00382-005-0084-6

State of the Art: Model Comparison

Table 1. List of IPCC global coupled climate models analyzed in the present study and
Model resolution is characterized by the size of a horizontal grid on which model output wa
levels. Spectral models are also characterized by their spectral truncations. Equilibrium clima

Model label and climate sensitivity	Resolution	Institution
CGCM3.1(T47) 3.6 K	96 × 48 L32 T47	Canadian Centre for Climate Modellin (http://www.cccma.ec.gc.ca/models/cg
CGCM3.1(T63) 3.4 K	128 × 64 L32 T63	Canadian Centre for Climate Modellin (http://www.cccma.ec.gc.ca/models/cg
CNRM-CM3 n/a	128 × 64 L45 T63	Centre National de Recherche Météor manuscript submitted to *Climate Dy*
ECHAM5/MPI-OM 3.4 K	192 × 96 L31 T63	Max-Planck-Institut für Meteorologie,
ECHO-G 3.2 K	96 × 48 L19 T30	Meteorological Institute of the Univers Research Institute, South Korea (Mi
GFDL-CM2.0 2.9 K	144 × 90 L24	Geophysical Fluid Dynamics Laborato et al. 2006)
GFDL-CM2.1 3.4 K	144 × 90 L24	Geophysical Fluid Dynamics Laborato et al. 2006)
GISS-AOM n/a	90 × 60 L12	Goddard Institute for Space Studies La http://aom.giss.nasa.gov)
GISS-ER 2.7 K	72 × 46 L20	Goddard Institute for Space Studies La Russell et al. 2000)
INM-CM3.0 2.1 K	72 × 45 L21	Institute of Numerical Mathematics, R
IPSL-CM4.0 4.4 K	96 × 72 L19	Institut Pierre-Simon Laplace, France (http://dods.ipsl.jussieu.fr/omamce/IP
MIROC3.2(hires) 4.3 K	320 × 160 L56 T106	Center for Climate System Research, J
MIROC3.2(medres) 4.0 K	128 × 64 L20 T42	Center for Climate System Research, J
MRI-CGCM2.3.2 3.2 K	128 × 64 L30 T42	Meteorological Research Institute, Jap
NCAR-CCSM3 2.7 K	256 × 128 L26 T85	National Center for Atmospheric Rese
NCAR-PCM 2.1 K	128 × 64 L26 T42	National Center for Atmospheric Rese et al. 2006)

Kharin et al, Journal of Climate 2007 doi: 10.1175/JCLI4066.1

Table 2. Description of model parameterizations for stratiform (i.e., large scale) and convective precipitation.

Model name	Stratiform precipitation	Convective precipitation
CCSM3, CCSM2	Prognostic condensate and precipitation parameterization (Zhang et al. 2003)	Simplified Arakawa and Schubert (1974) (cumulus ensemble) scheme developed by Zhang and McFarlane (1995)
CGCM3.1	Precipitation occurs whenever the local relative humidity is supersaturated	Zhang and McFarlane (1995) scheme
CNRM-CM3	Statistical cloud scheme of Ricard and Royer (1993)	Mass flux convection scheme with Kuo-type closure
CSIRO-Mk3.0	Stratiform cloud condensate scheme from Rotstayn (2000)	Bulk mass flux convection scheme with stability-dependent closure (Gregory and Rowntree 1990)
ECHAM5/MPI-OM	Prognostic equations for the water phases, bulk cloud microphysics (Lohmann and Roeckner 1996)	Bulk mass flux scheme (Tiedtke 1989) with modifications for deep convection according to Nordeng (1994)
FGOALS-g1.0	Same as PCM	Zhang and McFarlane (1995) scheme
GFDL-CM2.0, GFDL-CM2.1	Cloud microphysics from Rotstayn (2000) and macrophysics from Tiedtke (1993)	Relaxed Arakawa–Schubert scheme from Moorthi and Suarez (1992)
GISS-AOM	Subgrid-relative humidity-based scheme	Subgrid plume and buoyancy-based scheme (online at http://aom.giss.nasa.gov/DOC4X3/ATMOC4X3.TXT)
GISS-ER	Prognostic stratiform cloud based on moisture convergence (Del Genio et al. 1996)	Bulk mass flux scheme by Del Genio and Yao (1993)
HadCM3	Large-scale precipitation is calculated based on cloud water and ice contents (similar to Smith 1990)	Bulk mass flux scheme (Gregory and Rowntree 1990), with the improvement by Gregory et al. (1997)
HadGEM1	Mixed phase cloud scheme (Wilson and Ballard 1999)	Revised bulk mass flux scheme
INM-CM3.0	Stratiform cloud fraction is calculated as linear function of relative humidity	Lagged convective adjustment after Betts (1986), but with changed referenced profile for deep convection
IPSL-CM4	Cloud cover and in-cloud water are deduced from the large-scale total water and moisture at saturation (Bony and Emmanuel 2001)	Moist convection is treated using a modified version (Grandpeix et al. 2004) of the Emanuel (1991) scheme
MIROC3.2-medres MIROC3.2-hires	Prognostic cloud water scheme based on Le Treut and Li (1991)	Prognostic closure of Arakawa–Schubert based on Pan and Randall (1998) with relative humidity–based suppression (Emori et al. 2001)
MRI-CGCM2.3.2a	Precipitation occurs whenever the local relative humidity is supersaturated	Prognostic Arakawa–Schubert based on Pan and Randall (1998)
PCM	Precipitation occurs whenever the local relative humidity is supersaturated	Zhang and McFarlane (1995) scheme

Dai, A.,J. Climate 2006 doi: 10.1175/JCLI3884.1

2: Provide some (slightly) organised citation material (and author and readers graft hard to get the information)

State of the art: Model Comparison

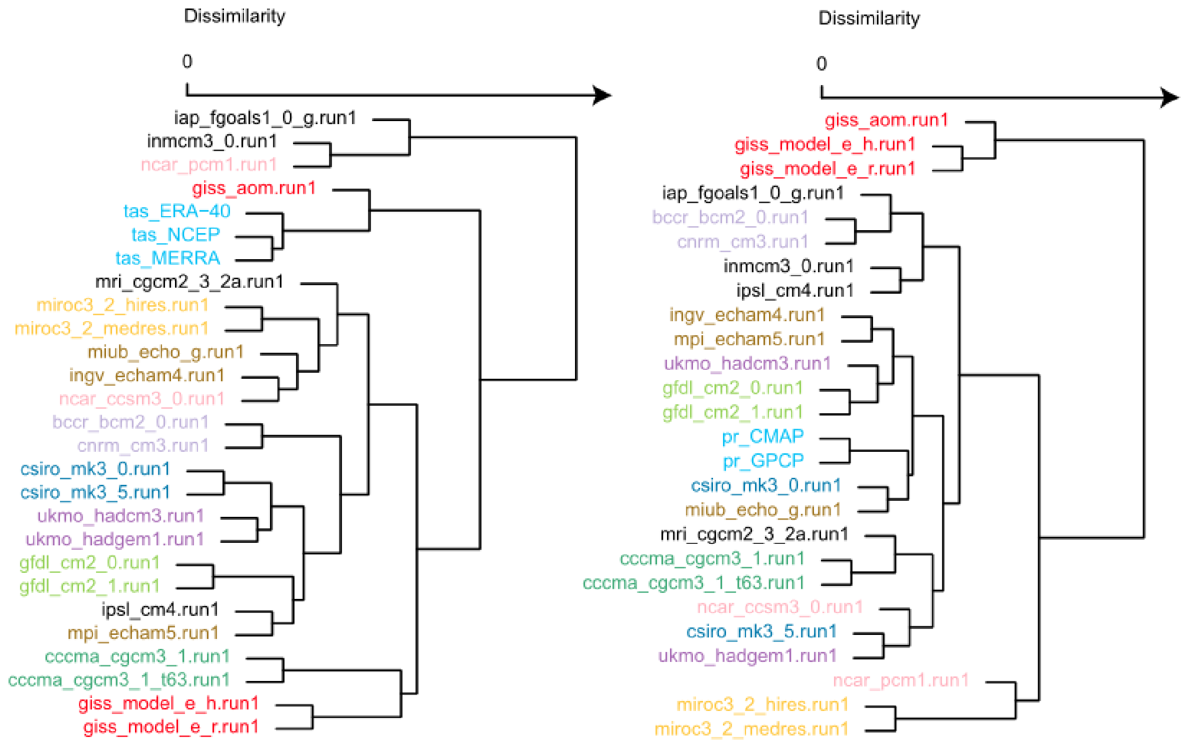


Figure 1. Hierarchical clustering of the CMIP3 models for (left) surface temperature and (right) precipitation in the model control state. Models from the same institution and models sharing versions of the same atmospheric model are shown in the same color. Observations also are marked by the same color. Models without obvious relationships are shown in black.

Masson, D., and R. Knutti (2011), Climate model genealogy, Geophys. Res. Lett., 38, L08703, doi:10.1029/2011GL046864.

3: Resort to statistics to discover something we should **know** (or at least suspect)

So, can we improve the information about the process?

All parties are carrying out **simulations** which **conform** to **experimental requirements** which exploit both **initial data** and **specific versions of software** which encapsulate **specific science** to produce **output data** which is **available somewhere** using some **service**.

And all these concepts can be described, and both the **quality of the descriptions** and the **quality of each of the steps** can be themselves be described.

Ideally,

-these descriptions themselves are **indexed, comparable, and searchable**, and

-both the participants in the process, and the users of it, can exploit it all!

es-doc
Earth System Documentation

http://es-doc.org

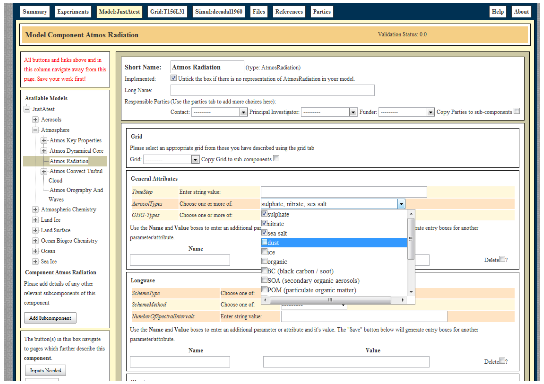
Where have we been?

Metafor and Curator

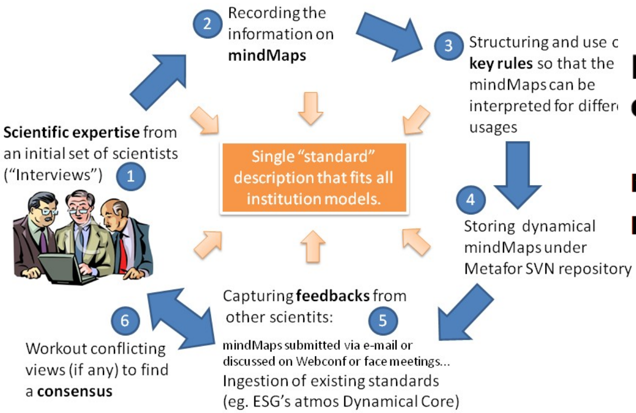
Geosci. Model Dev., 5, 1493-1500, 2012
www.geosci-model-dev.net/5/1493/2012/
doi:10.5194/gmd-5-1493-2012

Describing Earth system simulations with the Metafor CIM

B. N. Lawrence[1,2,3], V. Balaji[4], P. Bentley[5], S. Callaghan[2,3], C. DeLuca[6], S. Denvil[7], G. Devine[1,3], M. Elkington[5], R. W. Ford[8], E. Guilyardi[1,3,7], M. Lautenschlager[9], M. Morgan[7], M.-P. Moine[10], S. Murphy[6], C. Pascoe[2,3], H. Ramthun[9], P. Slavin[8], L. Steenman-Clark[1,3], F. Toussaint[9], A. Treshansky[6], and S. Valcke[10]



Geosci. Model Dev., 7, 479-493, 2014
www.geosci-model-dev.net/7/479/2014/
doi:10.5194/gmd-7-479-2014

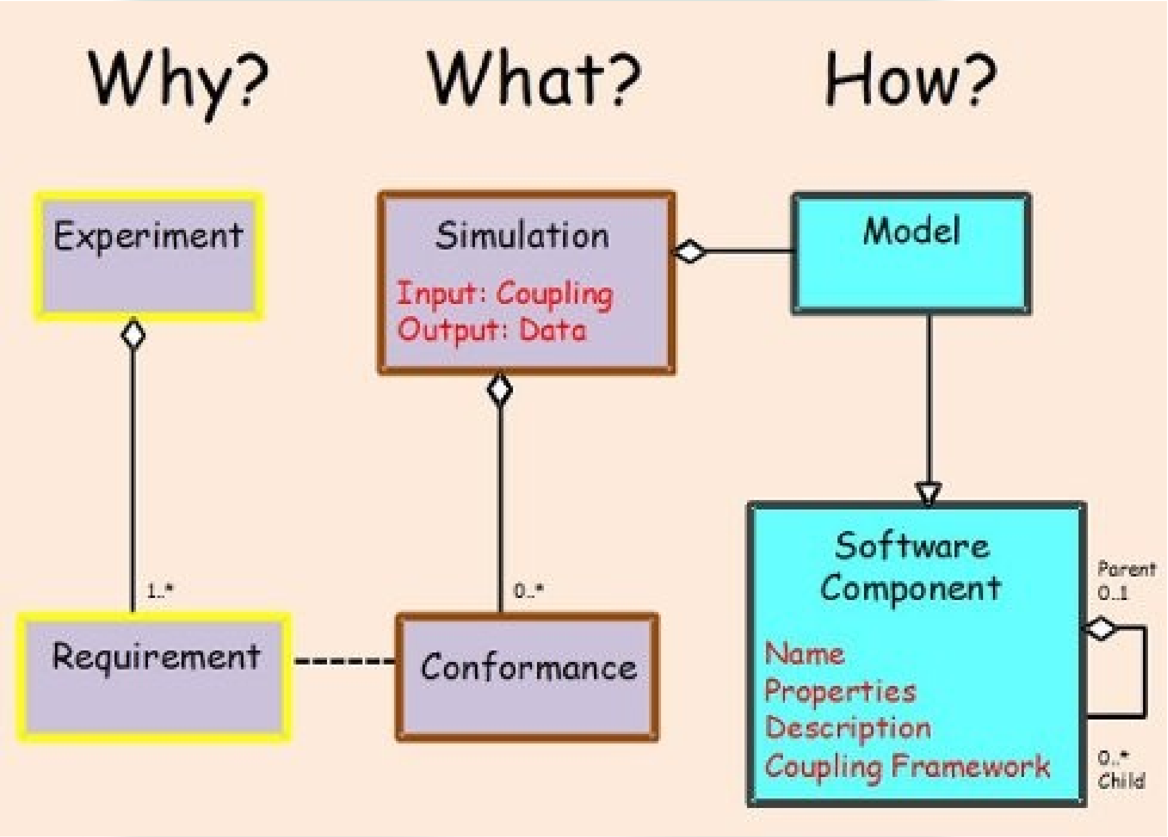


Development and exploitation of a controlled vocabulary in support of climate modelling

M.-P. Moine[1], S. Valcke[1], B. N. Lawrence[2,3,4], C. Pascoe[4], R. W. Ford[5], A. Alias[6], V. Balaji[7], P. Bentley[8], G. Devine[9], S. A. Callaghan[4], and E. Guilyardi[9,10]

Guilyardi, Eric, and Coauthors, 2013: **Documenting Climate Models and Their Simulations**. Bull. Amer. Meteor. Soc., 94, 623–627.
doi: http://dx.doi.org/10.1175/BAMS-D-11-00035.1

A Common Information "Model"



… and more … platform … data etc.

From those concepts, we can, and have, built infrastructure …

A few quick words about what we have built before we talk about what it's for …

- A “Common Information “Model” (CIM) for describing the process.
- Some vocabularies to exploit it …
- Tools to create and consume content

Experiments and Requirements

Project CMIP5

ID 1.3 noVolc1960

Short Name noVolc1960

Long Name decadal 10 year hindcast without volcanoes

Description Hindcast without volcanoes. Additional 10 year runs for experiment 1.1 without including the Agung, El Chichon and Pinatubo eruptions. The atmospheric composition (and other conditions) should be prescribed as in the historical run (expt. 3.2) and the RCP4.5 scenario (expt. 4.1) of the long-term suite of experiments. Ocean initial conditions should be in some way representative of the observed anomalies or full fields for the start date. Land, sea-ice and atmosphere initial conditions are left to the discretion of each group. Simulations should be initialized towards the end of 1960, 1975, 1980, 1985, and 1990. Calendar start date can be 1st September, 1st November, 1st December or 1st January, according to the convenience of the modeling group. Dates should allow complete years/decades to be analyzed. A minimum ensemble size of 3 should be produced for each start date.

Rationale Volcano-free hindcasts. Assess the impact of volcanic eruptions on decadal predictions.

NUMERICAL REQUIREMENTS

Boundary Conditions

Name 1.3.bc.ant_aer **Description** Imposed changing concentrations or emissions of aerosols (anthropogenic)

Name 1.3.bc.ant_aer_prec **Description** Imposed changing concentrations of aerosol (anthropogenic) precursors

Name 1.3.bc.ant_wmg **Description** Imposed changing atmospheric composition (anthropogenic)

Name 1.3.bc.LU **Description** Imposed changing land use

… (skipping some) ...

Initial Conditions

Name 1.3.ic.oc ID ic.007 Description Ocean Initial Conditions must represent in some measure the observed anomalies for the start date used

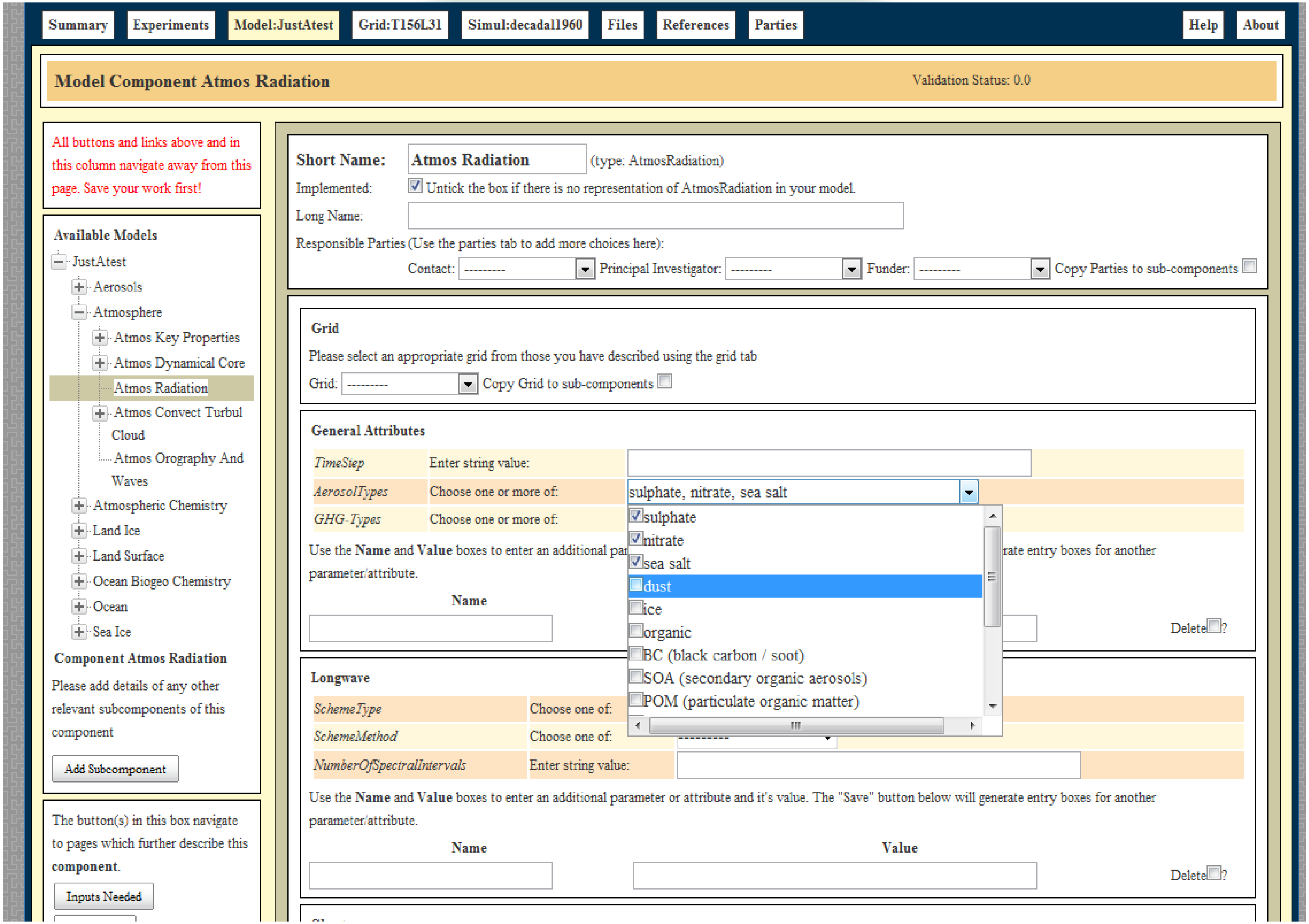
Spatio Temporal Constraints

Name 1.3.stc.decadal_10yr ID stc.001 **Description** Run for 10 years

Name 1.3.stc.decadal_30yr ID stc.003 **Description** Run for 30 years

Can ask the question (and compare answers) to "How was land use forcing done" (How did simulations conform to requirement 1.3.bc.LU)

Tooling to collect model scientific descriptions of models (e.g. CMIP5 questionnaire):



Toolng Exploits Vocabularies: Consensus Process

Single "standard" description that fits all institution models.

1. **Scientific expertise** from an initial set of scientists ("Interviews")

2. Recording the information on **mindMaps**

3. Structuring and use of **key rules** so that the mindMaps can be interpreted for different usages

4. Storing dynamical mindMaps under Metafor SVN repository

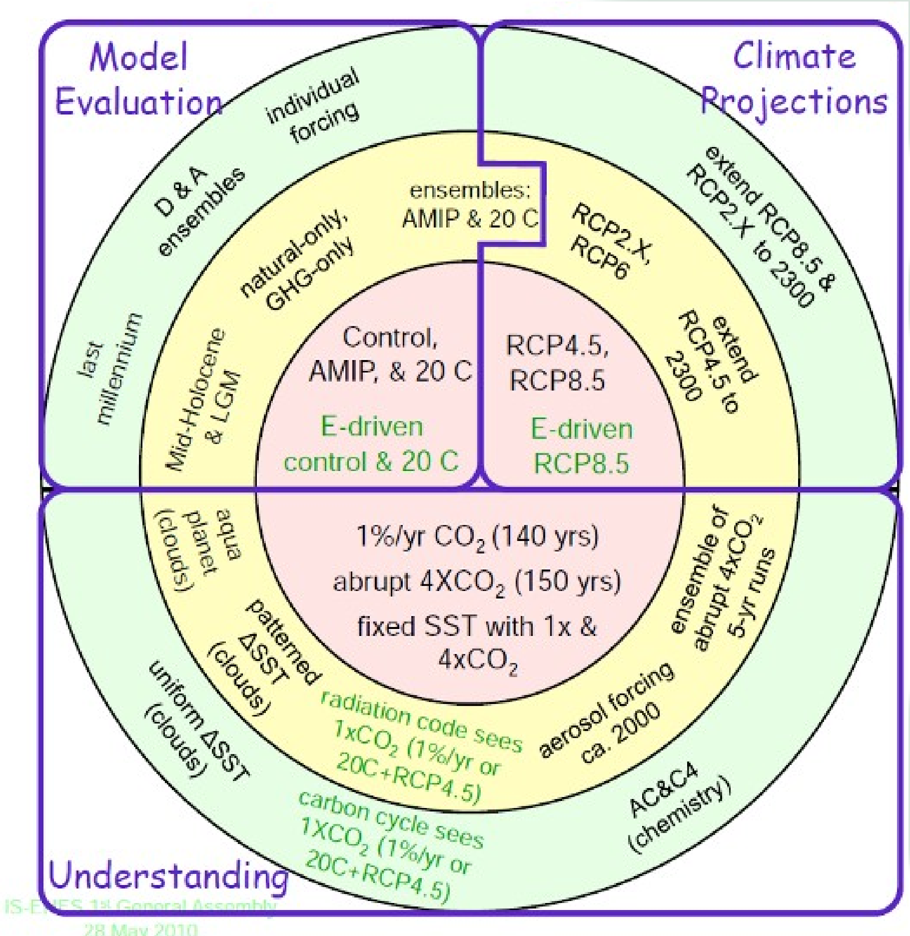
5. Capturing **feedbacks** from other scientits:

   mindMaps submitted via e-mail or discussed on Webconf or face meetings…

   Ingestion of existing standards (eg. ESG's atmos Dynamical Core)

6. Workout conflicting views (if any) to find a **consensus**

Consider CMIP5



CMIP5 Federated Archive

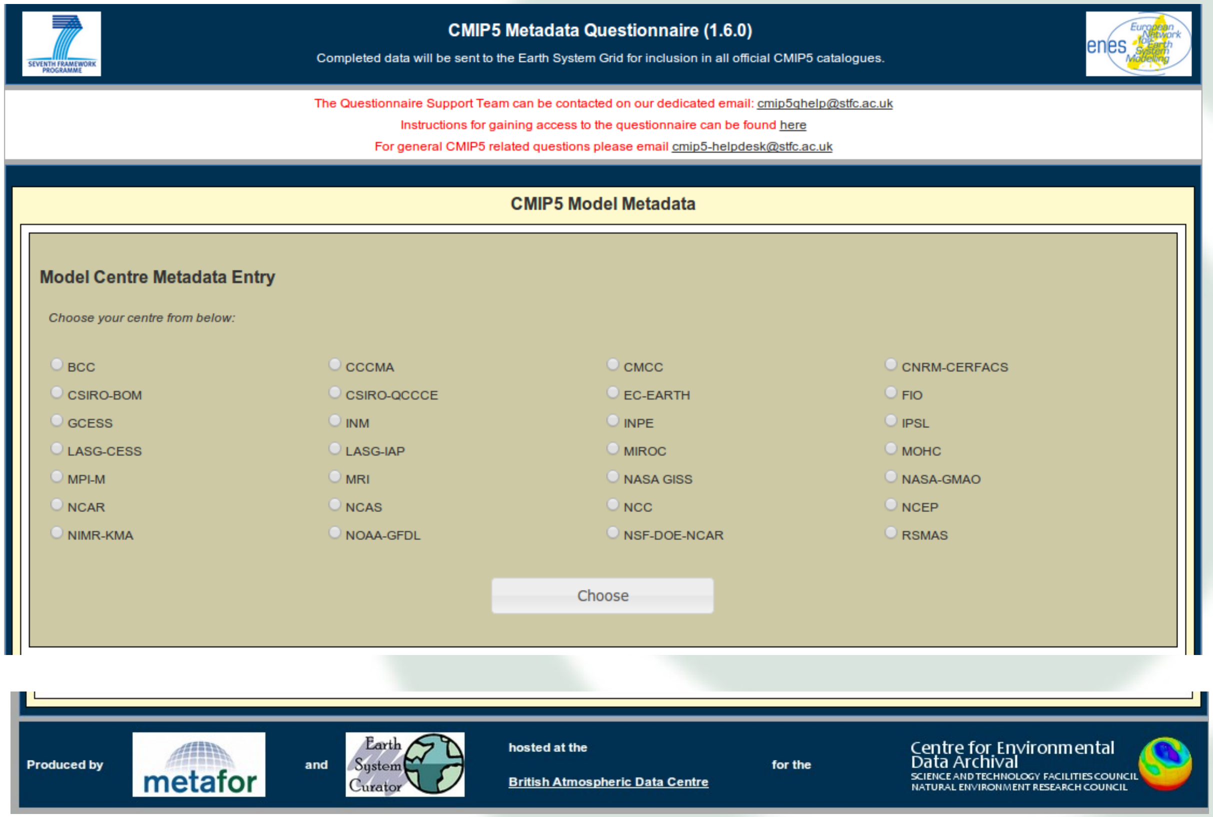
Summary	
Modeling centers	27
Models	59
Experiments	96
Data nodes	22
P2P Index	11
Datasets	57830
Size	1,795.11 TB
Files	3,900,145

(Nov 30, 2012)

Never mind the decadal projections etc

Intimidating!

… but some of it is quite well described …


CMIP5 Metadata Questionnaire (1.6.0)
Completed data will be sent to the Earth System Grid for inclusion in all official CMIP5 catalogues.

The Questionnaire Support Team can be contacted on our dedicated email: cmip5qhelp@stfc.ac.uk
Instructions for gaining access to the questionnaire can be found here
For general CMIP5 related questions please email cmip5-helpdesk@stfc.ac.uk

CMIP5 Model Metadata

Model Centre Metadata Entry

Choose your centre from below:

BCC	CCCMA	CMCC	CNRM-CERFACS
CSIRO-BOM	CSIRO-QCCCE	EC-EARTH	FIO
GCESS	INM	INPE	IPSL
LASG-CESS	LASG-IAP	MIROC	MOHC
MPI-M	MRI	NASA GISS	NASA-GMAO
NCAR	NCAS	NCC	NCEP
NIMR-KMA	NOAA-GFDL	NSF-DOE-NCAR	RSMAS

Choose

Produced by metafor and Earth System Curator hosted at the British Atmospheric Data Centre for the Centre for Environmental Data Archival
SCIENCE AND TECHNOLOGY FACILITIES COUNCIL
NATURAL ENVIRONMENT RESEARCH COUNCIL

http://q.cmip5.ceda.ac.uk

As of September, 2012, the “Metafor” Questionnaire had been used to document:

42 different model configurations,

used in over

600 simulations

from

17 institutions!

… but …

- Coverage is far from complete.
- Most (but not all) models are quite well described.
- Simulation descriptions are less well done, and the conformance to experiments even less well done.
- We have very little quality control information, of the model output, **or of these descriptions themselves.**
- Tooling to effectively utilise (some of) the information has only recently become available.

CIM (es-doc) and the IPCC

Table 9.A.1: Salient features of the AOGCMs and ESMs participating in CMIP5 (see also Table 9.1). Column 1: Official CMIP5 model name along with the calendar year ('vintage') of the first publication for each model; Column 2: sponsoring institution(s), main reference(s); subsequent columns for each of the model components, with names and main component reference(s). Additionally, there are standard entries for the atmosphere component: horizontal grid resolution, number of vertical levels, grid top (low or high top); and for the ocean component: horizontal grid resolution, number of vertical levels, top level, vertical coordinate type, ocean free surface type ("Top BC"). This table information was initially extracted from the CMIP5 online questionnaire (http://q.cmip5.ceda.ac.uk/) as of January 2013.

(1) **Model Name** (2) Vintage	(1) **Institution** (2) Main Reference(s)	**Atmosphere** (1) Component Name (2) Horizontal Grid (3) Number of Vert Levels (4) Grid Top (5) References	**Aerosol** (1) Component Name or type (2) References	**Atmos Chemistry** (1) Component Name (2) References	**Land Surface** (1) Component Name (2) References	**Ocean** (1) Component Name (2) Horizontal Resolution	**Ocean Biogeochemistry** (1) Component Name	**Sea Ice** (1) Component Name (2) References
(1) ACCESS1.0 (2) 2011	(1) Commonwealth Scientific and Industrial Research Organization (CSIRO) and Bureau of Meteorology (BOM), Australia (2) (Bi et al., 2013b; Dix et al., 2013)	(1) Included (as in HadGEM2 (r1.1)) (2) 192x145 N96 (3) 38 (4) 39,255m (5) (Martin et al., 2011; Bi et al., 2013b; Rashid et al., 2013)	(1) CLASSIC (2) (Bellouin et al., 2011; Dix et al., 2013)	Not implemented	(1) (2) Ess Ko 201			

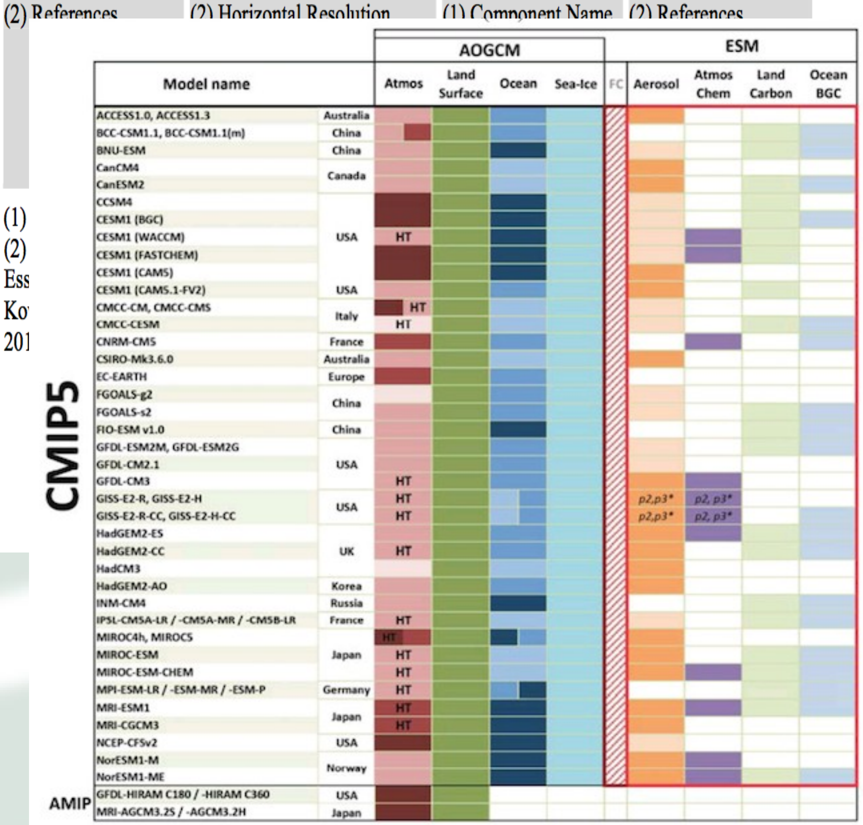


Table 9.1

CIM information used in the IPCC reports, but not (yet) many papers …

… and even then need supplementary information and "fixing"

Peer Review of the Simulation Descriptions

- It was hard to generate the CMIP5 metadata content … and some groups have put more effort in than others, and it shows in quality!

- Even a cursory look suggests a lot of missing material, and a lot of material that might have been erroneously copied.

- Questionnaire output has already been used in the AR5 drafts; process led to improvements in input material, but this has yet to be fed back round the loop … so that all users get the benefit.

- Significant scope for modelling centres to do bilateral “checking of each others' work” … but it'd be yet more work, and the rewards are as yet not visible ...

- The tooling has not yet been up to facilitating peer review, but the new comparison tools should expedite this (and show the worth of the effort in doing so).

Where are we going?

Next Steps

1) CMIP5 content “review”

   (David Hassell, Eric Guilyardi)

2) Improving the existing tooling

   (Mark Greenslade)

3) Considering the situation for CMIP6?

   (New WGCM Information Panel)

4) Upgrades to CIM itself and tooling?

   (IS-ENES2 + COG + Coalition of the willing)

Quality control of CMIP5 model metadata

David Hassell (NCAS, IS-ENES2)

Phase 1: Checking whether each model's description is correct in having/not having each of 8 major model components

(CIM questionnaire content v IPCC documentation)

Phase 2 (not yet started): Checking whether the details of each model component are correctly described.

CMIP5 models (42)

Components

Aerosols	N	Y	N	N	N	N	Y	Y	Y	N	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	DB
	N	Y	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	IPCC
Atmos	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	DB
	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	IPCC
Atmos Chem	N	Y	N	N	N	N	N	N	N	N	Y	N	Y	N	N	Y	N	N	N	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	DB
	N	N	N	N	N	Y	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	IPCC
Land Surf	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	DB
	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	IPCC
Land Carbon	Y	Y	Y	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	DB
	Y	Y	Y	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	N	Y	N	N	N	N	Y	Y	IPCC
Ocean BGC	Y	Y	Y	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	N	Y	Y	Y	Y	Y	N	N	Y	Y	DB
	Y	Y	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N	N	N	N	Y	Y	IPCC
Ocean	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	DB
	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	IPCC
Sea Ice	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	DB
	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	IPCC

Initial results (Phase 1)

60% of models have no discrepancies

92% of model components are correctly described

Actions

- The incorrect 8% of model components will be repaired in the metadata database prior to the more detailed checking in phase 2
- The metadata will be endowed with quality control flags so that the information may be used with confidence

Situation not as bad as we thought …

(at least at the top level … we'll see as we go to phase 2).

Aim of this review?

To enable the "Publication"
of
the model descriptions
and
community "faith" in their accuracy.

es-doc
Earth System Documentation

Documentation Search v0.9.0.3

Support

Doc Type :	Doc Version :	Project :	Institute :	Model :	Experiment :
Model	Latest	CMIP5	*	*	*

Search returned 42 of 107 records in 0.087s

1 2 3

Institute	Short Name	Long Name	json
BCC	BCC-CSM1.1	Beijing Climate Center Climate System Model version 1.1	json
CMCC	CMCC-CESM	CMCC Carbon Earth System Model	json
CMCC	CMCC-CM	CMCC Climate Model	json
CMCC	CMCC-CMS	CMCC Climate Model with a resolved Stratosphere	json
CNRM-CERFACS	CNRM-CM5	CNRM-CM5	json
CSIRO-BOM	ACCESS1.0	ACCESS1.0	json
CSIRO-BOM	ACCESS1.3	ACCESS1.3	json
CSIRO-QCCCE	CSIRO-Mk3.6.0	CSIRO Mark 3.6.0	json
EC-EARTH	EC-EARTH	EC-EARTH	json
INM	INM-CM4	inmcm4	json
INPE	HadGEM2-ES	Hadley Global Environment Model 2 - Earth System	json
IPSL	IPSL-CM5A-LR	IPSL-CM5A-LR;atmosphere:LMDZ5A(95x96L39);ocean:NEMOv3.2 (OPA-LIM-PISCES,149x182L31)	json
IPSL	IPSL-CM5A-MR	IPSL-CM5A-LR;atmos:LMDZ5A(144x143L39);ocean:NEMOv3.2(OPA-LIM-PISCES,149x182L31)	json
MIROC	MIROC4h	MIROC4h	json
MIROC	MIROC5	MIROC5	json
MOHC	HadCM3	HadCM3 (2000) atmosphere: HadAM3 (N48L19); ocean: HadOM (lat: 1.25 lon: 1.25 L20); land-surface/vegetation: MOSES1;	json
MOHC	HadGEM2-A	Hadley Global Environment Model 2 - Atmosphere	json
MOHC	HadGEM2-CC	Hadley Global Environment Model 2 - Carbon Cycle	json
MOHC	HadGEM2-ES	Hadley Global Environment Model 2 - Earth System	json

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es-doc
Earth System Documentation

Documentation Viewer v0.9.0.3 Support

Overview Citations Contacts Components

Atmosphere

Overview

The atmospheric general circulation model LMDZ5A is based on a finite-difference formulation of the primitive equations of meteorology (Sadourny and Laval, 1984) on a staggered and stretchable longitude-latitude grid (the Z of LMDZ standing for Zoom). Water vapor, liquid water and atmospheric trace species are advected with a monotonic second order finite volume scheme (Van Leer, 1977; Hourdin and Armengaud, 1999). In the vertical, the model uses a classical so-called hybrid sigma−pressure coordinate. In the LMDZ5A version, (Hourdin et al, 2012) the physical parametrization are very close to that of the previous LMDZ4 version used for CMIP3. The radiation scheme is inherited from the European Center for Medium-Range Weather Forecasts. The dynamical effects of the subgrid-scale orography are parametrized according to Lott (1999). Turbulent transport in the planetary boundary layer is treated as a vertical eddy diffusion (Laval et al, 1981) with counter-gradient correction and dry convective adjustment. The surface boundary layer is treated according to Louis (1979). Cloud cover and cloud water content are computed using a statistical scheme (Bony and Emanuel, 2001). For deep convection, the LMDZ5A version uses the "episodic mixing and buoyancy sorting" scheme originally developed by Emanuel (1991). With respect to the previous LMDZ4 version, the number of layers has been increased from 19 to 39, with 15 levels above 20km and a top at about the same altitude as the stratospheric LMDZ4-L50 version (Lott et al, 2005). The horizontal has also changed, with an increased number of point in latitude to shift the jets poleward (Guemas and Codron 2011). At Low Resolution (LR), the LMDZ5A model has 95x96 points in latitude and longitude corresponding to a resolution of 1.875° ×3.75°.

Properties

Basic Approximations : Hydrostatic

Basic Approximations : Primitive Equations

Model Family : AGCM

Orography > Orography Type : Present-Day

Top Of Atmos Insolation > Impact On Ozone : Yes

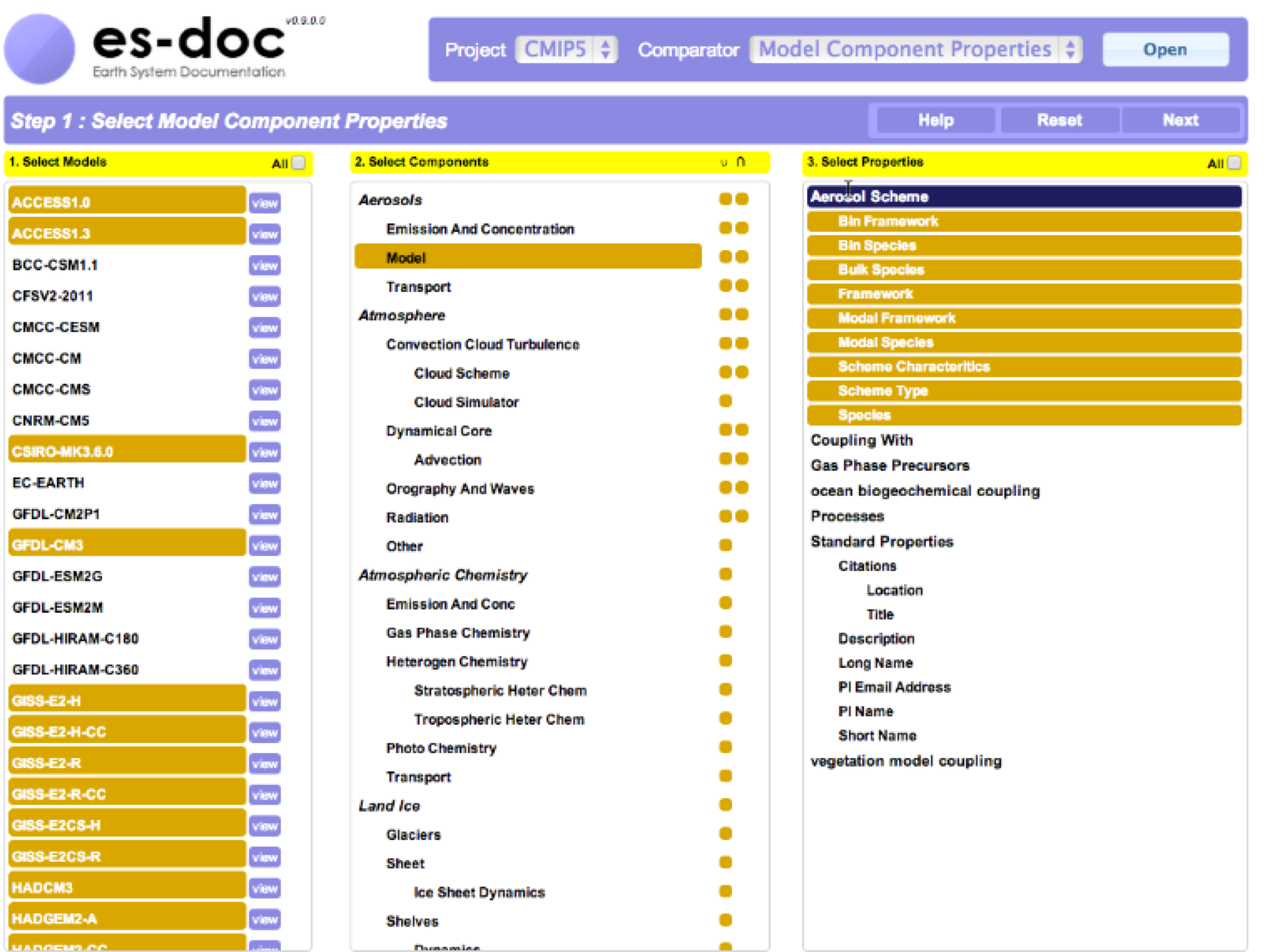
Top Of Atmos Insolation > Orbital Parameters > Computation Method : Berger 1978

Top Of Atmos Insolation > Orbital Parameters > Reference Date : 2000

Top Of Atmos Insolation > Orbital Parameters > Type : Fixed

Top Of Atmos Insolation > Solar Constant > Type : Fixed

Top Of Atmos Insolation > Solar Constant > Value : 1366.0896


es-doc
v0.9.0.0
Earth System Documentation
Project
CMIP5
Comparator
Model Component Properties
Open
Step 1 : Select Model Component Properties
Help
Reset
Next
1. Select Models
All
ACCESS1.0
ACCESS1.3
BCC-CSM1.1
CFSV2-2011
CMCC-CESM
CMCC-CM
CMCC-CMS
CNRM-CM5
CSIRO-MK3.6.0
EC-EARTH
GFDL-CM2P1
GFDL-CM3
GFDL-ESM2G
GFDL-ESM2M
GFDL-HIRAM-C180
GFDL-HIRAM-C360
GISS-E2-H
GISS-E2-H-CC
GISS-E2-R
GISS-E2-R-CC
GISS-E2CS-H
GISS-E2CS-R
HADCM3
HADGEM2-A
view
2. Select Components
Aerosols
Emission And Concentration
Model
Transport
Atmosphere
Convection Cloud Turbulence
Cloud Scheme
Cloud Simulator
Dynamical Core
Advection
Orography And Waves
Radiation
Other
Atmospheric Chemistry
Emission And Conc
Gas Phase Chemistry
Heterogen Chemistry
Stratospheric Heter Chem
Tropospheric Heter Chem
Photo Chemistry
Transport
Land Ice
Glaciers
Sheet
Ice Sheet Dynamics
Shelves
3. Select Properties
All
Aerosol Scheme
Bin Framework
Bin Species
Bulk Species
Framework
Modal Framework
Modal Species
Scheme Characteritics
Scheme Type
Species
Coupling With
Gas Phase Precursors
ocean biogeochemical coupling
Processes
Standard Properties
Citations
Location
Title
Description
Long Name
PI Email Address
PI Name
Short Name
vegetation model coupling

Aim of the new tooling?

To enable the “Use”
of
the the model descriptions
In
our scientific workflow!

Considerations for CMIP6?

Simplification?

Avoiding redundancy in NetCDF/ES-DOC/DRS content?

Quality Control Information

- (of the simulations); where to put the evaluation information? Errata?
- (of the descriptions); Peer Review
- Possible role for charme annotation?

Better tooling?

- Tools to create metadata from the command line (or from your own information repository, pyesdoc)
- More than one “CIM questionnaire”?

Evolution of the underlying information model

We know there are problems with “the CIM” (v1.5 and the associated vocabularies):

- Confusion between scientific description of a model and the layout of the code.
- A raft of issues exposed by dynamical core intercomparison workshops.
- Poor support for recording the computational properties of the simulation, the platform, and the code (“the performance”, a la Balaji proposal at Hamburg in March).
- Mismatch between the existing CIM paradigm and the Observations and Measurements paradigm becoming prevalent in other communities.

Should we, can we, evolve the information model? What then are the consequences for the tooling (and the effort we have available?)

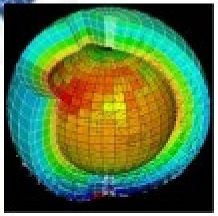
The need for standardisation

- Integrated modelling is becoming the norm
  - bioregional assessment
  - eReefs
- When using heterogeneous (data) sources, discovery & integration is a major challenge

- **Standards make this easier**

  Many private contracts
  →one public agreement

Slide courtesy of
Simon Cox, CSIRO



Remote sensing

Sens…
Valu…
Para…

Earth science

Algo… simu…
Mod…

Metrology

Instr…

Chemistry

Instr… anal…
Anal…
Anal…
Sam…

Environmental monitoring
Gauge, sensor
Value, time-series
Parameter
Station

Observations & Measurements
procedure
result
observed property
feature of interest

The missing section?

The one which discusses how we will use CIM content and information to contribute to publication credit for the modelling groups

(probably the main reason why the producers are willing to do the real grunt work to collect the information.)

Another time!