British Atmospheric Data Centre

NATIONAL CENTRE FOR ATMOSPHERIC SCIENCE
NATURAL ENVIRONMENT RESEARCH COUNCIL

# Providing access to the information in climate model projections

*Martin Juckes*

*British Atmospheric Data Centre*

Reporting on efforts within BADC and with international collaborators to facilitate easy access to climate model data.

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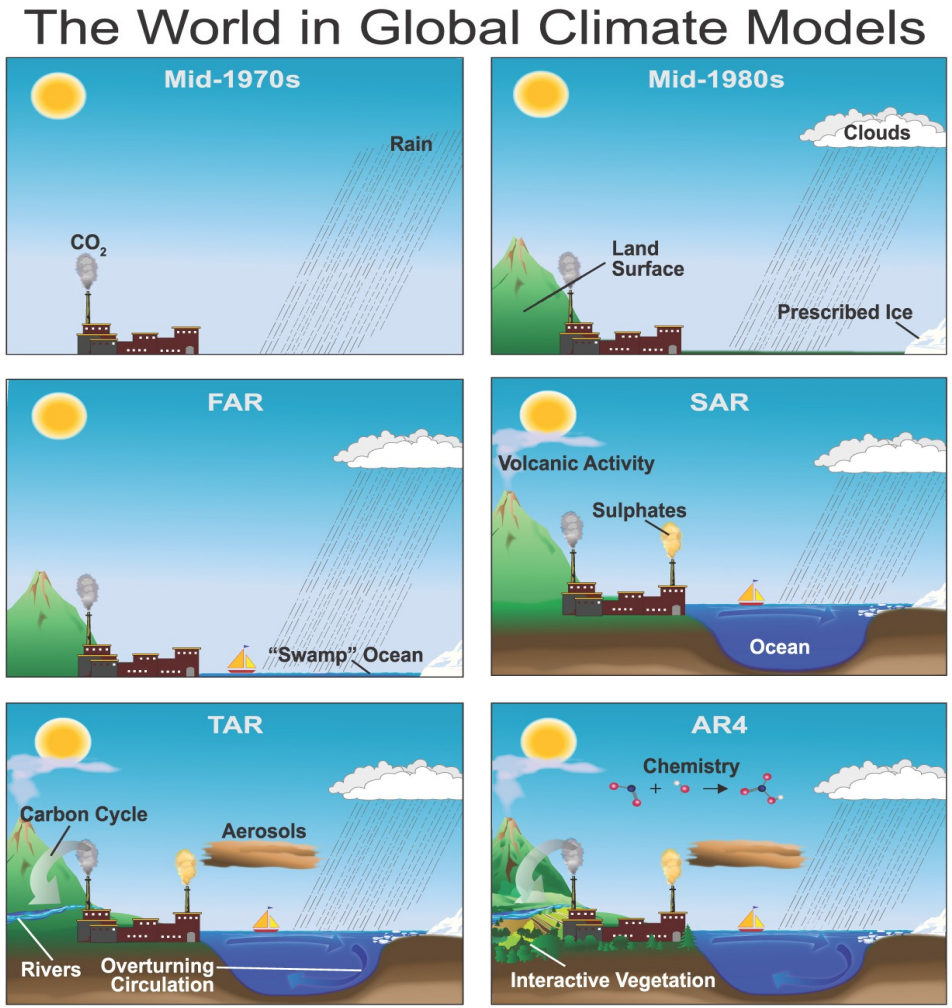
# Outline

* Opportunities and challenges from CMIP5
* Models and Impact Relevant climate Prediction *MIRP* – a project to facilitate climate change impact analysis

# CMIP5 and AR5

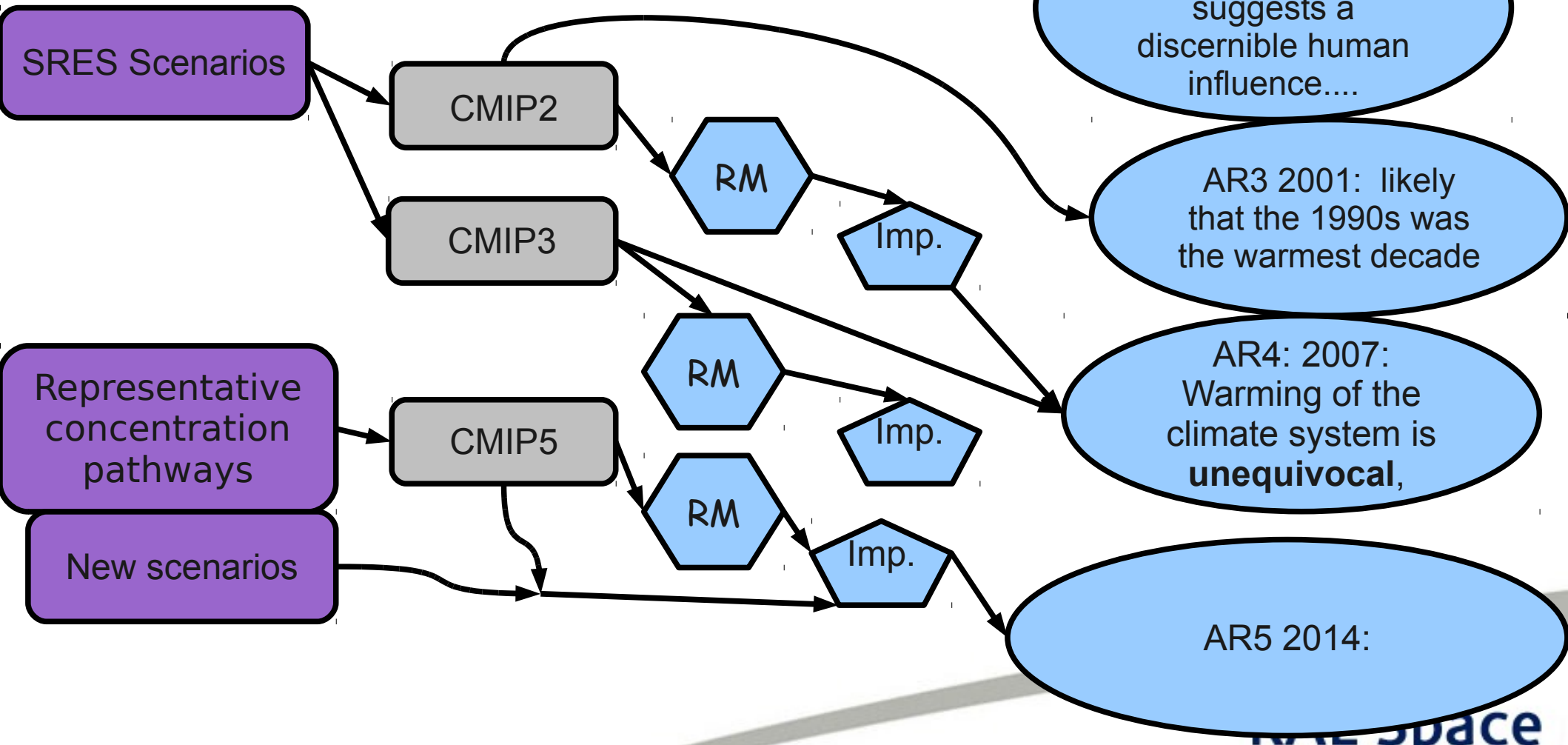



IPCC AR4, WG1, fig 1.2

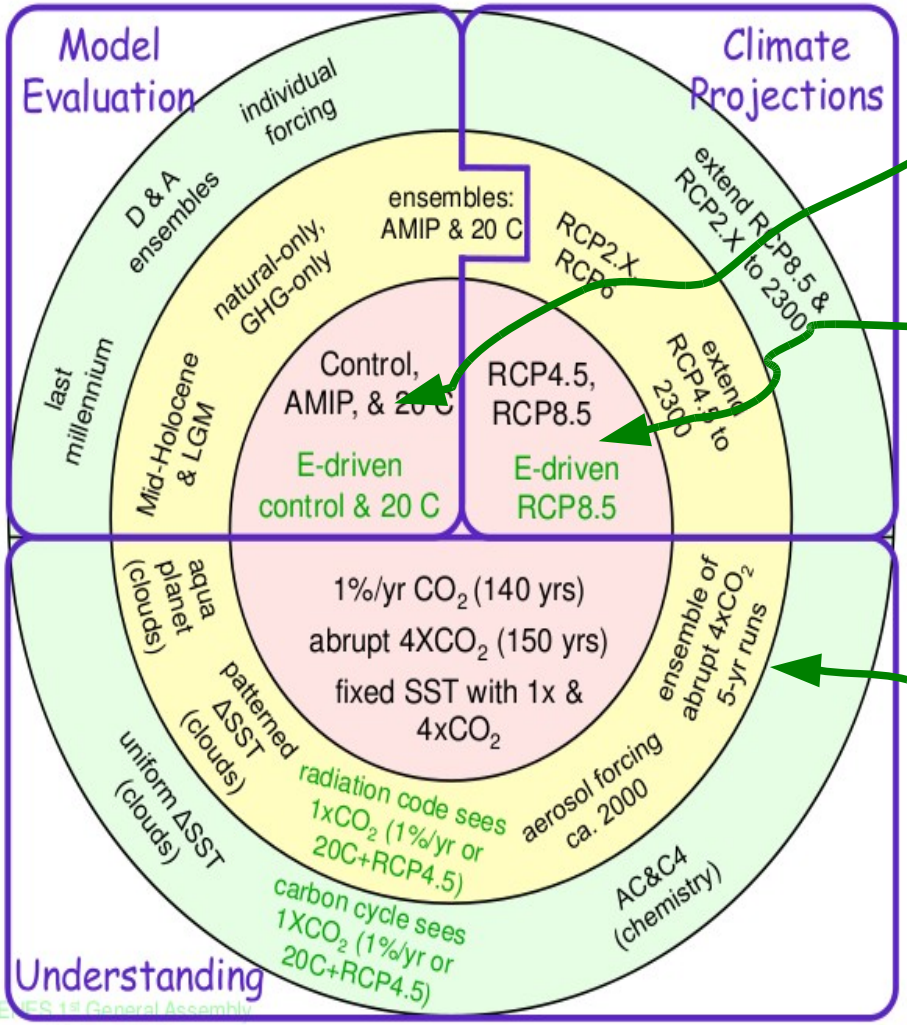
The WCRP identified these gaps in our knowledge which should be addressed in AR5 using CMIP5 models:

*sea level rise and ice sheet instabilities, the full range of possible futures, cloud processes and aerosols producing considerable uncertainties, detection and attribution of climate change on regional level and extremes, model evaluation and ensembles, and carbon/nitrogen cycles including ocean acidification (WCRP, Hawaii, March 2009).*

# The Context – IPCC



# Long term




**Traditional:** 20th Century All forcings ("historical'); AMIP; Coupled Control.

**Prescribed Projections:** High (RCP8.5) and Medium (RCP4.5) (2.X is seen as a commitment projection).

**Diagnostic (lower hemisphere):** transient response calibration, equilibrium climate sensitivity, fixed SST to refine forcing and interpret model differences etc.

**ESM Projections: Models with carbon cycles: control, 20th Century, future high forcing (RCP8.5)**

# Farewell to SRES

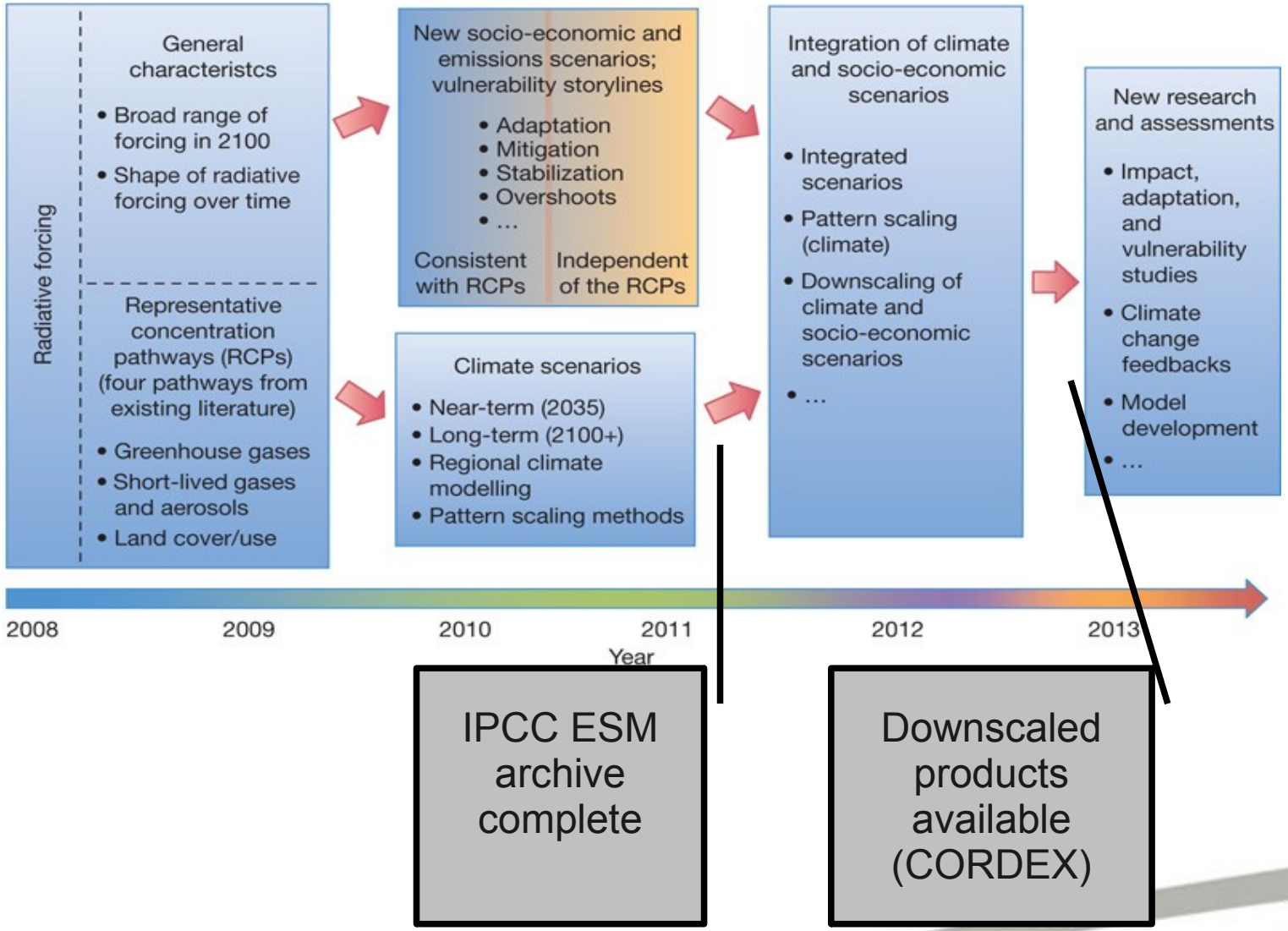
**Special Report on Emissions Scenarios**
The SRES scenarios have a comforting familiarity, but are difficult to defend from a scientific perspective. They do not reflect the improved understanding which has developed over the last 20 years.

**Representative Concentration Pathways**
RCPxx: A set of emissions and the atmospheric concentrations of long lived greenhouse gases derived from the emissions by an integrated assessment model. "xx" refers to the radiative forcing anomaly in Watts/metre$^2$ that an IAM (Integrated Assessment Model) associates with this concentration.

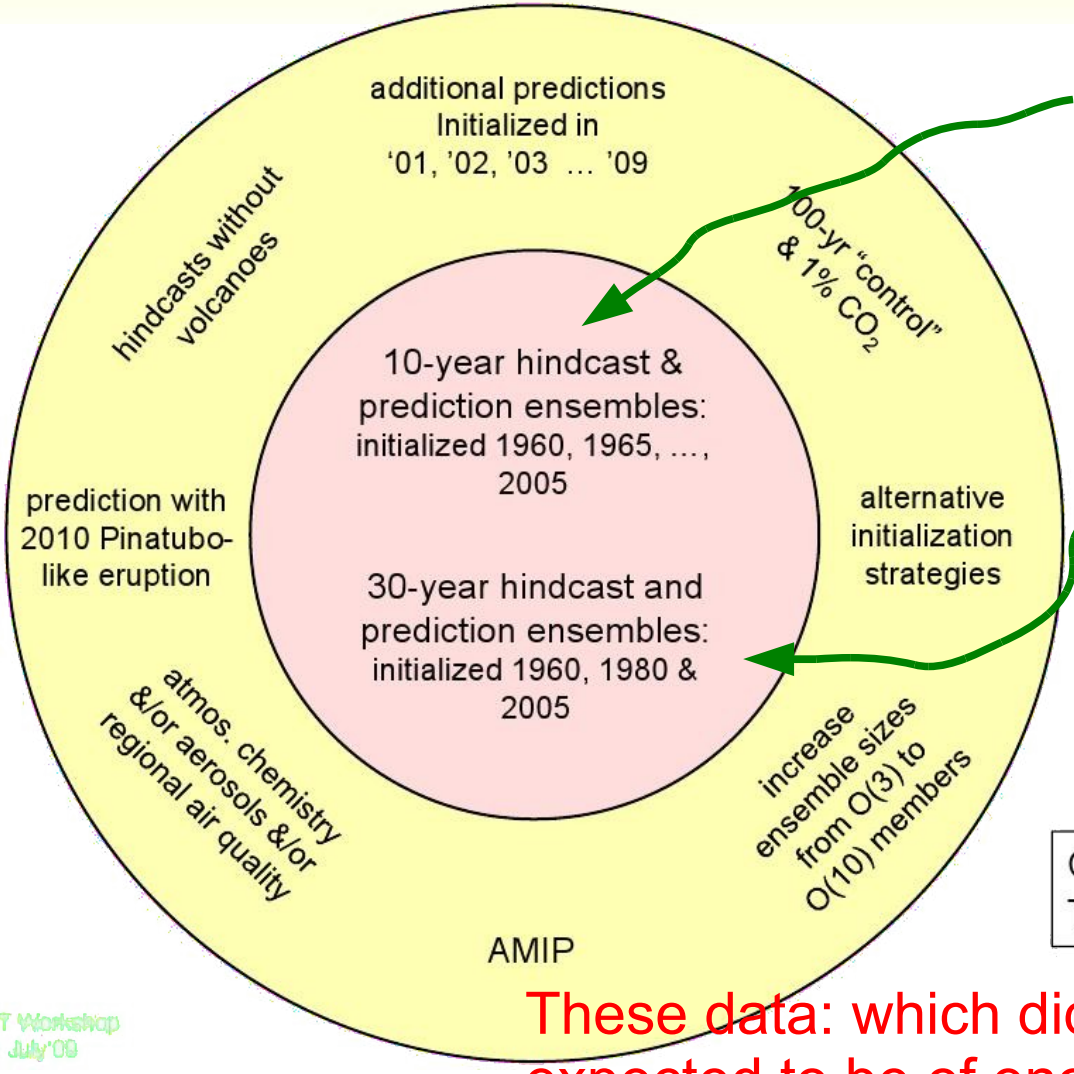
Further informatoion on the RCPs is available from:
*www.**iiasa**.ac.at/web-apps/tnt/**Rcp**Db/*

# Parallel process

Moss et al., (Nature 2010)



# Decadal




**Estimate the theoretical limits to decadal prediction and our current ability.** Essentially these are climate change commitment experiments ...

**Explore predictability over timescales relevant to GHG forcing.** Depending on initialisation, may not require long control runs, so hopefully will see a wider class of models used.

| | |
|---|---|
| Core: | 480 yrs |
| Tier 1: | ≥1700 yrs |

These data: which did not feature in CMIP3, are expected to be of enormous interest for impacts research and policy support.

SMIC-IT Workshop
21 July'09

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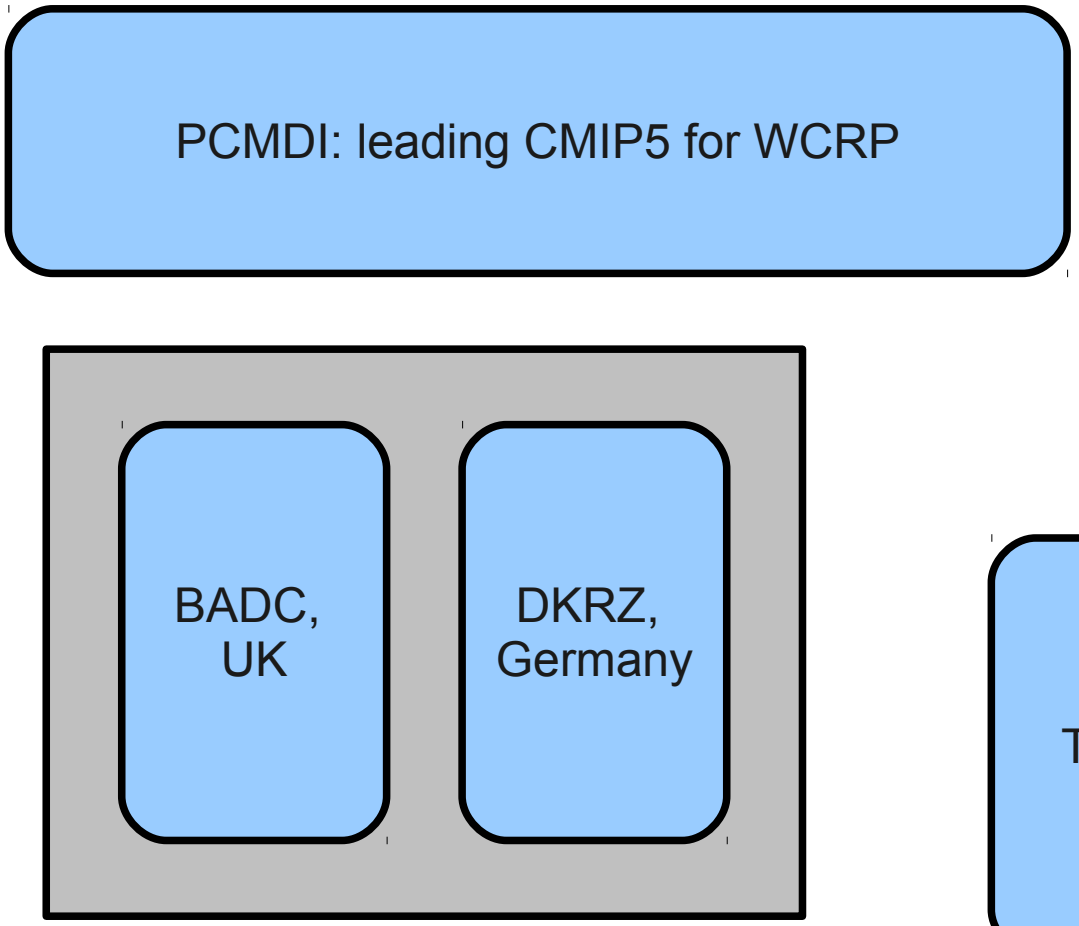
# The Earth System Grid Federation




Five groups will host copies of the most widely used data – in order to provide faster access. There will be global registration system, so registration at any site gives access to all resources – including additional data held at some of the modelling centres.

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# Quality control

**Level 1**
Check format, valid labels in files;
Data made available for expert assessment – user beware.

**Level 2**
Additional checks on data quality and range of values.

**Level 3**
Final review by archive managers and data providers, publication of a DOI;
Quality assured data available for all users.

A 3-level quality control process to facilitate timely and flexible access to a quality assured archive.

# CMIP5 in numbers

**Simulations:**

~60 experiments

~20 modelling centres using

~30 major(*) model configurations

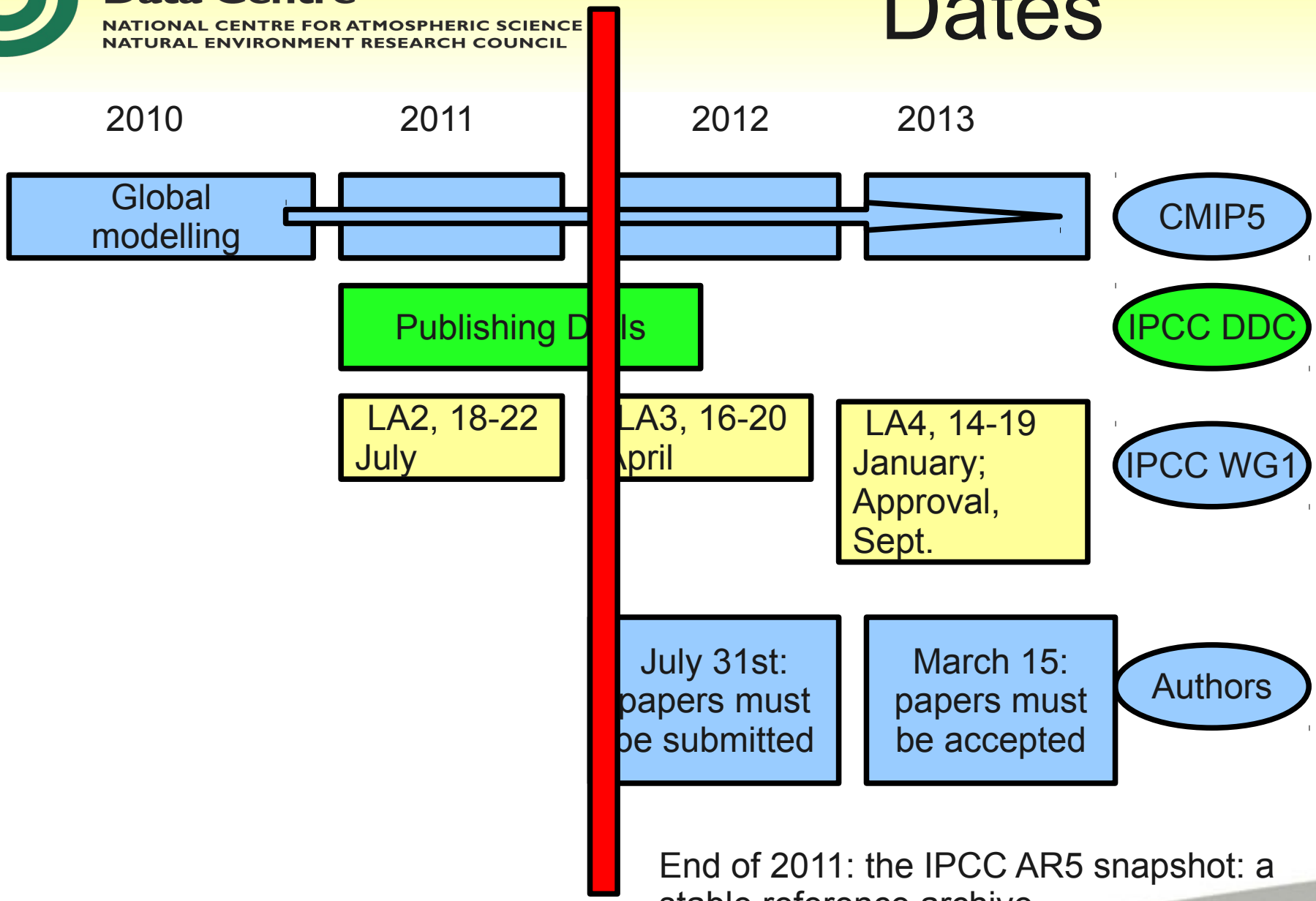
~2 million output datasets

~10's of petabytes of output

~1 petabyte of CMIP5 “replicated” output copied to 5 sites to give faster access

Roughly a quarter of the replicated data (250 TB) are variables requested by the TGICA, orchestrated by the IPCC-DDC on behalf of WG2 and WG3!
e.g. Land biochemistry alone:10 TB!

# Dates




End of 2011: the IPCC AR5 snapshot: a stable reference archive.

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# Exploiting CMIP5

enes European Network for Earth System Modelling

*Two projects to facilitate access*

MIRP

**IS-ENES [EU FP7 – infrastructure]**

**Led by Sylvie Joussaume, IPSL**

**Data portal activities led by Martin Juckes (BADC) and Michael Lautenschalger (DKRZ)**

**Provide distributed archive infrastructure for European contribution to the CMIP5 archive. Key contributions to the security infrastructure and the quality control process for the global archive.**

**MIRP [UK NERC Knowledge Transfer]**

**Led by Martin Juckes, BADC**

**Facilitate access to CMIP5 data and provide derived products for users outside the Natural Environment Research Council Community.**

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# IS-ENES


**Data will be held both at modelling centres and at data archives (PCMDI, BADC, WDCC).**

**Search and discovery access will be through portals at PCMDI, BADC and WDCC, each of which provides access to ALL data.**

**Data files will be available via wget or the OpenDAP interface (which will allow users to obtain regional subsets of the files held in the archive).**

# MIRP

- The Models and Impact Relevant Prediction project (just starting) will facilitate use of the CMIP5 data for climate impacts analysis.

- Preparing secondary data products which are more accessible than the raw model output.

# Identification and specification of post processed products

- Which experiments and variables are of interest?
- What format do the users want?
- What sort of processing would be useful?
- What time periods and data frequency?
- What standardised indicators are of interest (e.g. the Environmental Vulnerability Index)?
- What will the data be used for?

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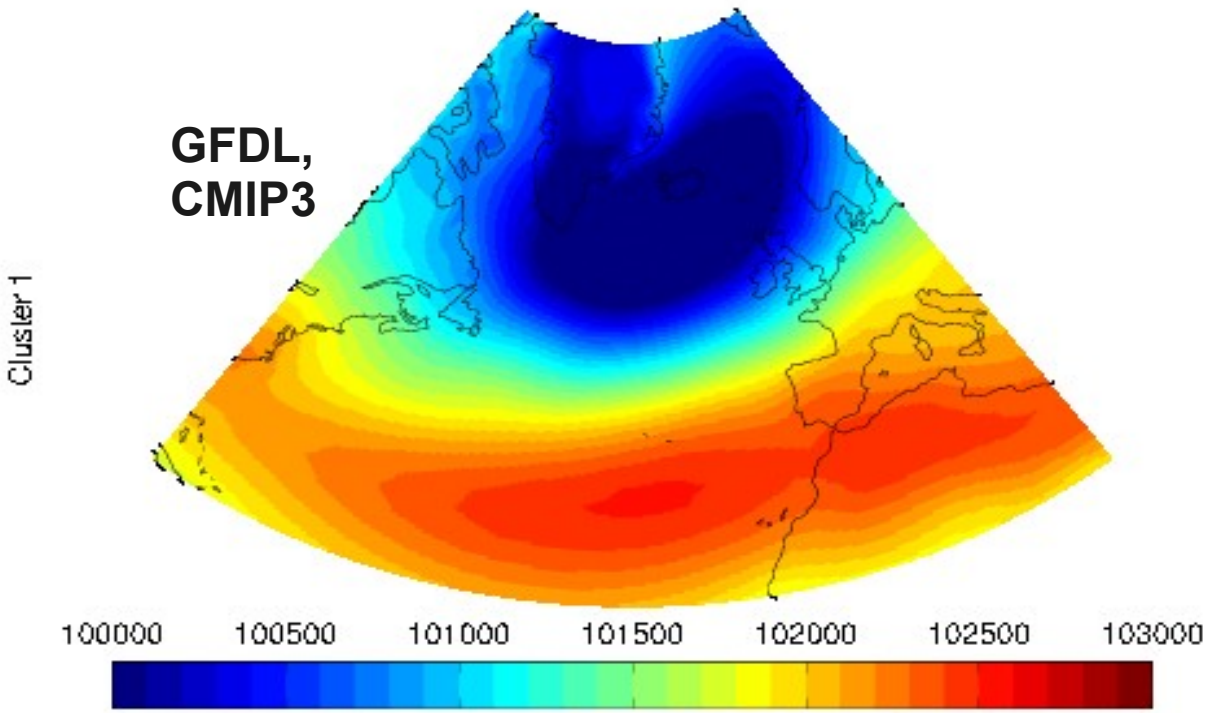
# Weather regimes in MIRP

**GFDL, CMIP3**




**The weather regime software developed under COST 733 may help to bridge the gap between what the climate models provide and the weather and climate associated with climate impacts.**

**Preliminary work: Eduardo Damasio da Costa have adapted the COST 733 software to read in the CMIP flavour of NetCDF.**

**To do:**

**Identify the pathways to exploitation by users outside the climate science community**

**Make a plan for assessment of weather regime patterns and changes found in CMIP3 and CMIP5.**

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# Questions

- Can weather regimes provide a pathway to impact relevant climate prediction?
- If there is no “best” method, can we identify a set of “representative” methods?
- Can we use a weather regime analysis to make sense of the flood of data provided by CMIP5?

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# The End

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# Abstract

An international consortium will provide access to a new archive of climate model projections over the next 12 months, projections generated by CMIP5 (Climate Model Intercomparison Project, Phase 5). The archive will be unprecedented in the range of Earth system processes represented, the number of different experiments performed, the sophistication and resolution of the models, and the volume of data -- up to 10 petabytes. The Earth System Grid Federation (ESGF) is developing software which will provide flexible access to the data -- but where do you start with 10 petabytes of data? With the "Models and Impact Relevant Prediction" (MIRP -- http://proj.badc.rl.ac.uk/mirp) project, the British Atmospheric Data Centre (one of the founding members of the ESGF) aims to provide support and services to facilitate access to the vast repository of information concealed in the mountains of data.

# UKCP09 Lessons

- We delivered the data management and user interface components of UKCP09
- User engagement was extensive...
- over a long period of time...
- interacting with a large community of potential users.

# There were many good points

- Engaged early with *perceived* users
- Got feedback and developed use cases
- Developed prototypes and test on users
- Wrote guidance to support users on:
  - usage examples
  - usage caveats
- Select some *super users* to develop user stories
- After launch:
  - continued development of user stories
  - began user forums

# CORDEX

- Following closely on the heals of CMIP5, the CORDEX project will provide downscaled products (at 50km Europe for most land areas, closer to 10km resolution over Europe). The time scales for availability are less clear, but probably 2011/12.

- CORDEX is a WCRP project, coordinating activities, but, like CMIP5, with no central funding

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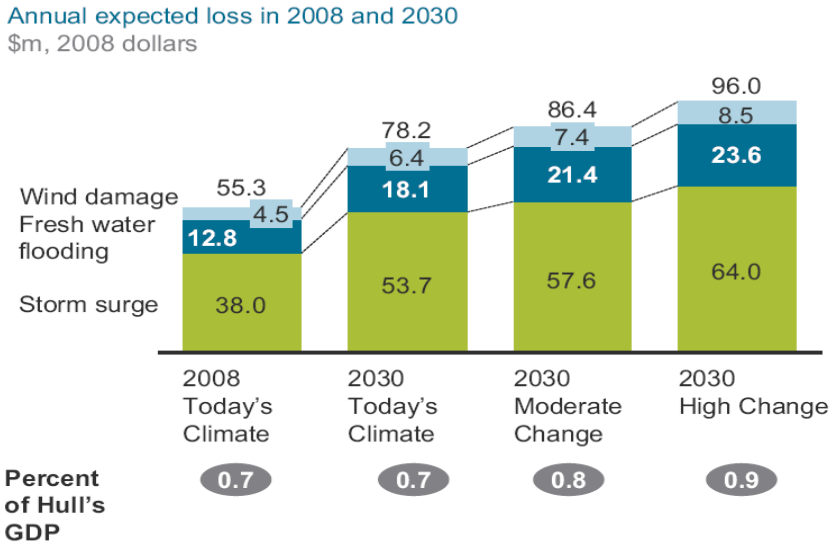
# Influencing the cost of climate change

Swiss re (ecomonics of climate adaptation, 2009): Estimate loss incurred by Hull City Council due to climate change related disasters to be £50 million per annum by 2030.

Much of this (up to 65%) can be averted through adaption measures: infrastructure measures; technological measures; awareness; response pr




Designing and prioritising such measures will depend on accurate information about projected changes.

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# Environmental Vulnerability Index

www.vulnerabilityindex.net

The EVI consists of 50 country level indicators, of which 7 are directly related to climate:

| Number | Indicator | Short description |
|---|---|---|
| 1 | High winds | Knots of “excess” winds annually |
| 2 | Dry periods | Annual mean monthly rainfall deficit |
| 3 | Wet periods | Annual mean monthly rainfall excess |
| 4 | Hot periods | Annual mean monthly temperature excess |
| 5 | Cold periods | Annual mean monthly temperature deficit |
| 6 | SST | 5 year mean anomaly |
| 36 | Water | Usage as a percentage of resource |

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**Traditional:** 20th Century All forcings ("historical'); AMIP; Coupled Control.

# A wide range of experiments will be conducted.

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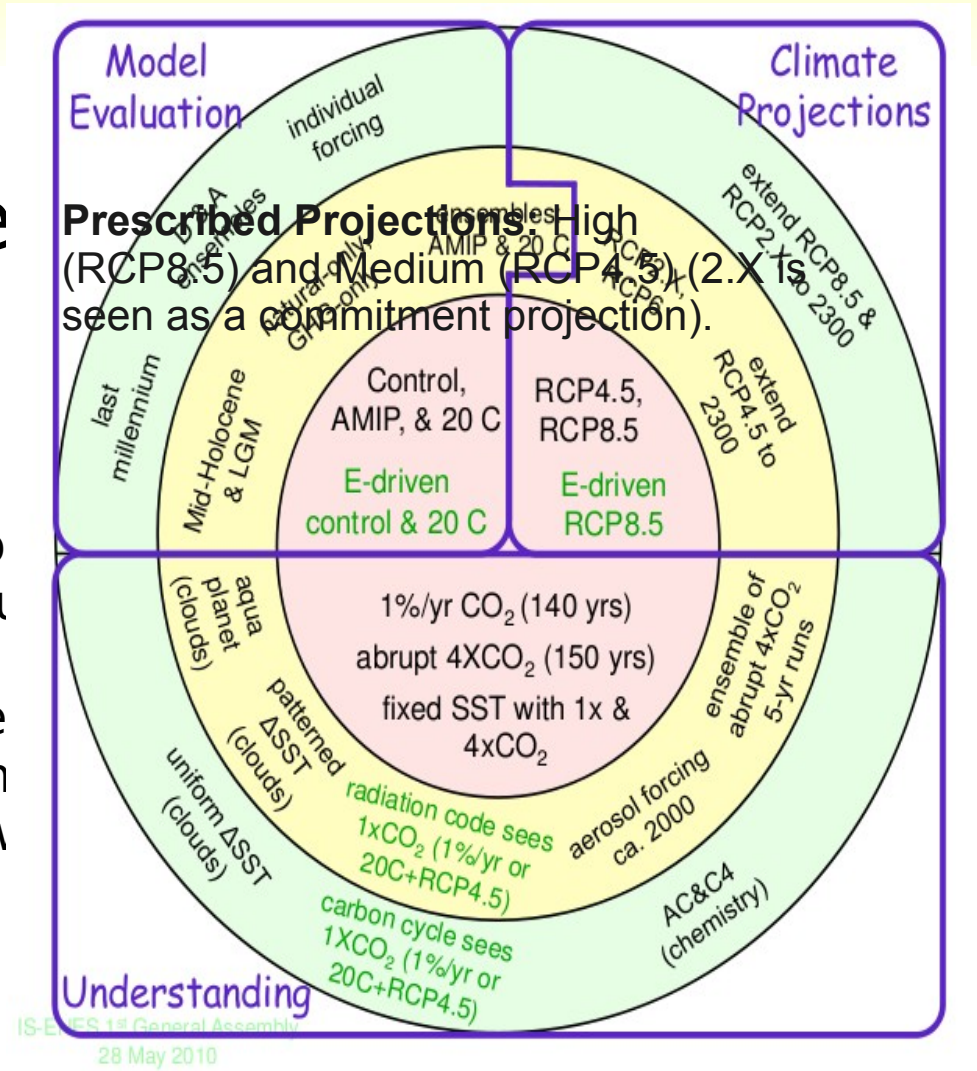


**Prescribed Projections:** High (RCP8.5) and Medium (RCP4.5) (2.X is seen as a commitment projection).

IS-ENES 1st General Assembly
28 May 2010

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# CMIP5: Projection and Evaluation

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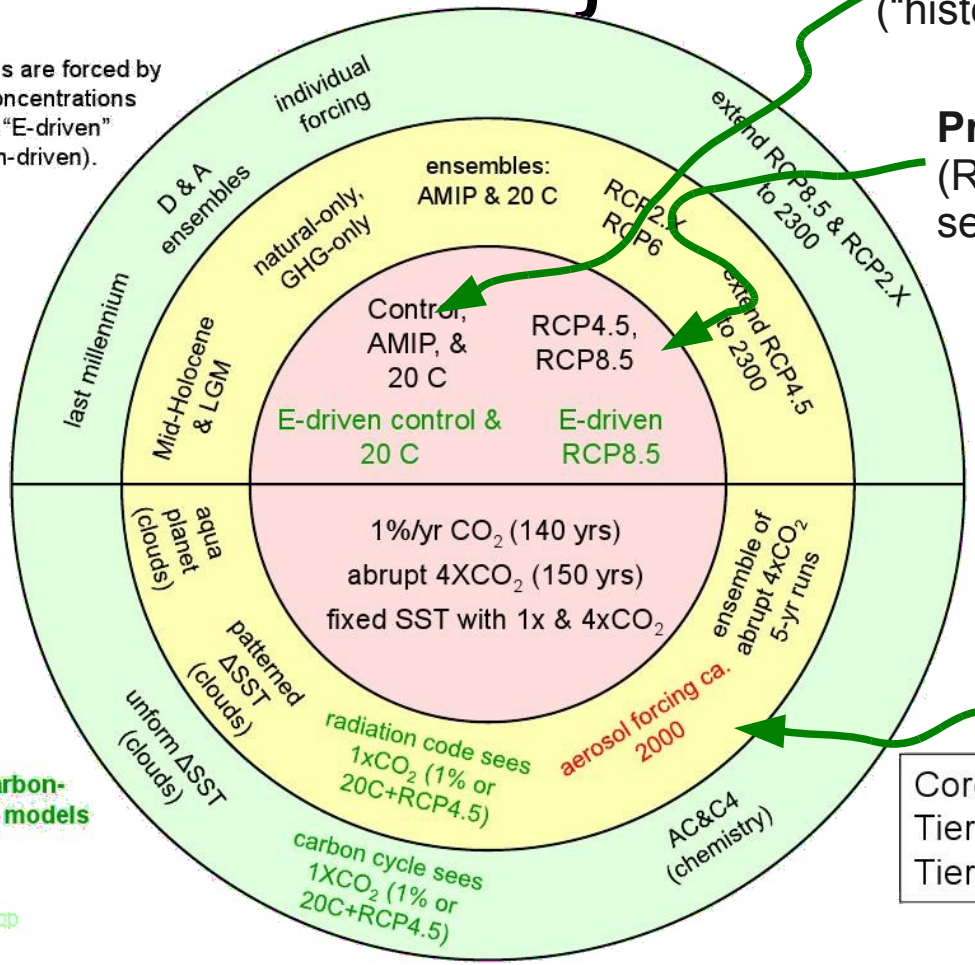


**Diagnostic (lower hemisphere):** transient response calibration, equilibrium climate sensitivity, fixed SST to refine forcing and interpret model differences etc.

| | |
|---|---|
| Core: | ≥1718 yrs |
| Tier 1: | ≥1727 yrs |
| Tier 2: | ≥2038 yrs |

K. E. Taylor

(Includes both the long term and atmosphere only experiments: upper half of major interest to the widest IPCC community)

**ESM Projections:** Models with carbon cycles: control, 20th Century, future high (RCP8.5)

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# Using ensembles – a x-point guide

- There is no representative model
- Not all models are equal

  e.g. if you are interested in impact of changing ocean currents, your ensemble of results should include output from a range of ocean models.
- Know your model
  - Does it have a reasonable representation of the relevant processes?

# Providing access to the information in climate model projections

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# Models and Impact Relevant climate Prediction

*MIRP*

- The 5th round of the IPCC Assessment Process is under way;
- The climate model experiments which encapsulate the state of knowledge of climate physics are in progress;
- The climate data archive generated will be unprecedented in scale, complexity and impact;
- BADC is part of the global federation managing the archive and will host more than 1Pb of climate data;
- NERC have awarded BADC a knowledge transfer grant which, *inter alia*, will provide additional support for climate data users from the impacts community .....

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# MIRP

WP1: User Access to high resolution decadal data from HIGEM

WP2: Storage (100Tb for this project)

WP3: Identification and specification of post processed products

WP4: Production of post processed products

WP5: Collecting and providing information about IAMs.

WP6: Intellectual Property Disclaimers

WP7: Active engagement in the user community