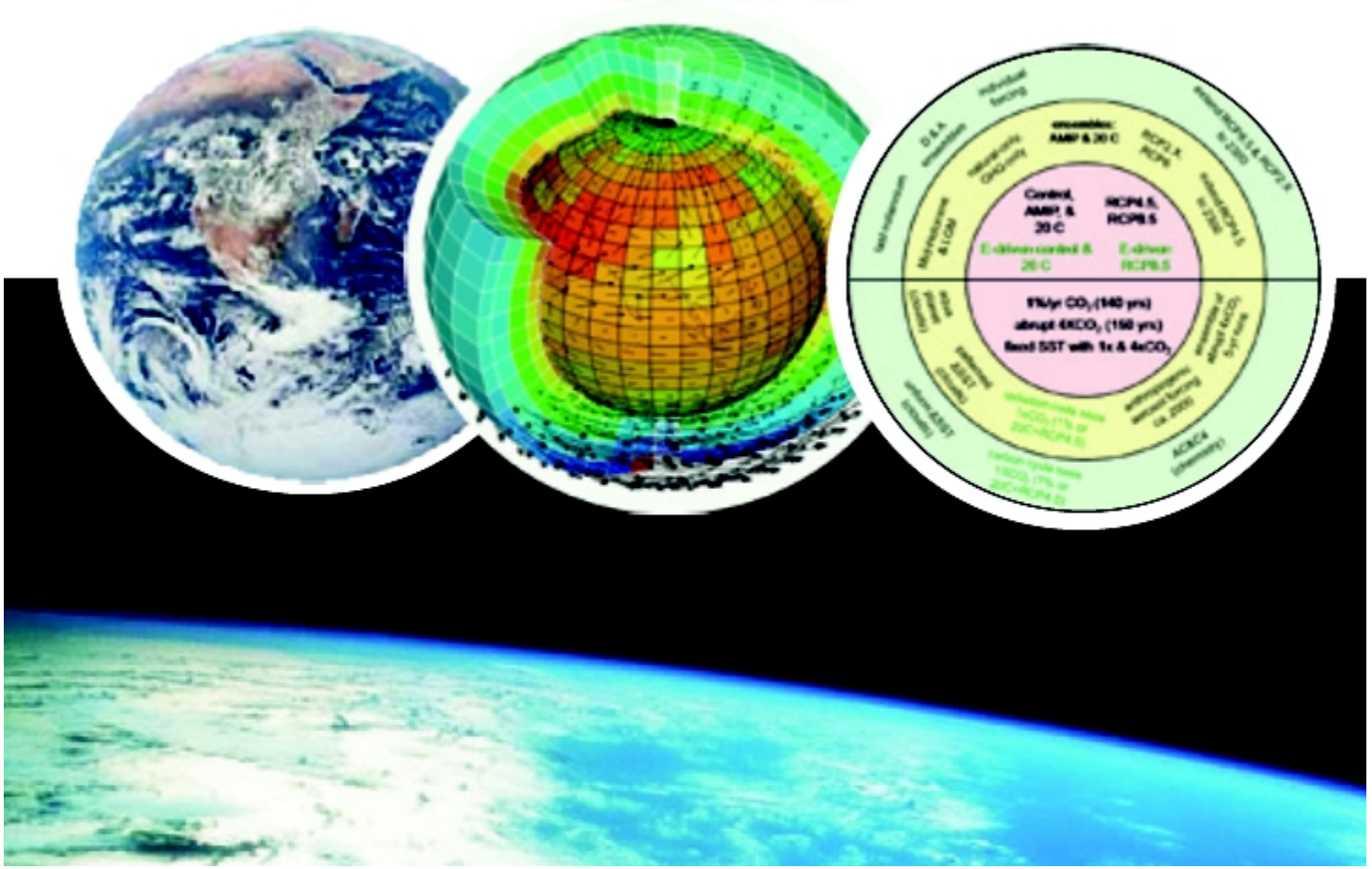
De CMIP5 à CMIP6 ...

Sandrine Bony et al.

Working Group on Coupled Models (WGCM)



WGCM meeting, Sept 24-26 2012, Hamburg
(WGCM-WGSIP meeting on Sept 26th)

Lessons de CMIP5 ?

Science, infrastructure, etc..

Point de vue :

- des groupes de modélisation
- des MIPs (CFMIP, PMIP, T-AMIP, C4MIP, CCMVal, GeoMIP, etc)
- WGCM, WGSIP
- IPCC (chapitre 9)

CMIP5 Model Analysis Workshop (March 2012, Hawaii)

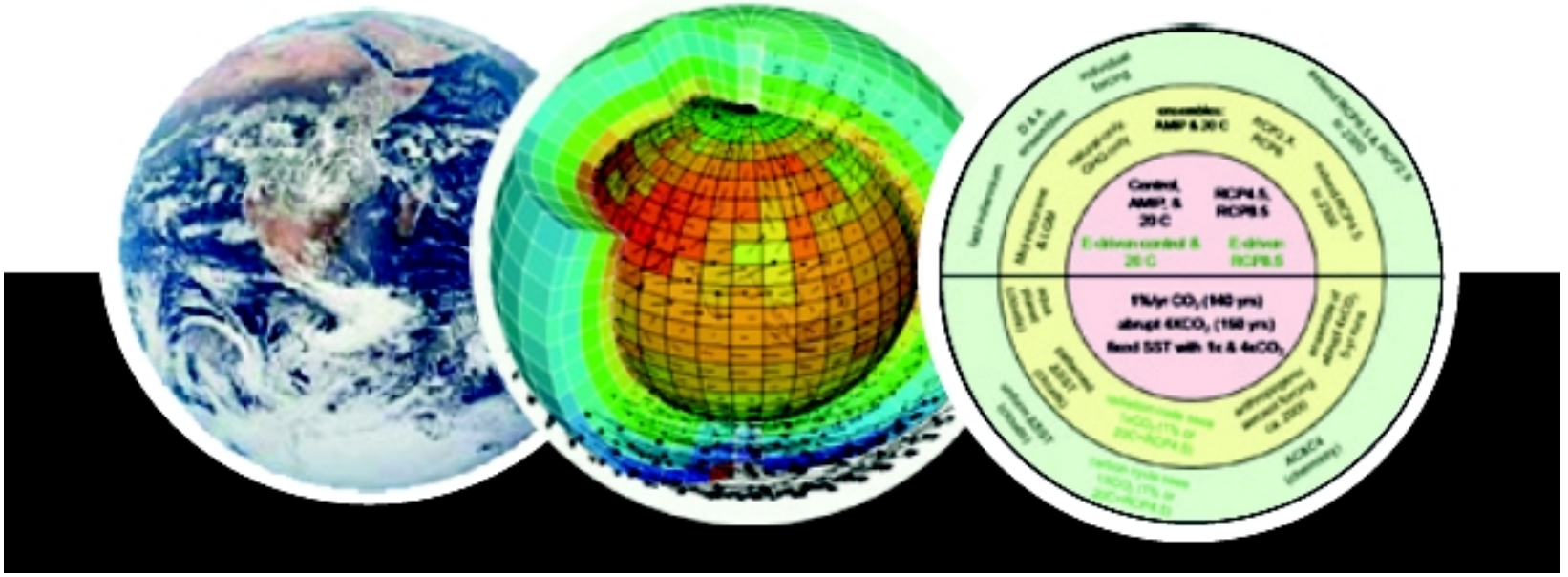
Vers un futur CMIP6 ?

Idées générales

WCRP Grand Challenges

Planning

WCRP Coupled Model Intercomparison Project - Phase 5 - CMIP5 -



CLIVAR Exchanges, CMIP5 special issue (May 2011)

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CMIP5 participating groups 22 Sept. 2012:
59 models available from 24 groups

Primary Group	Country	Model
CSIRO-BOM	Australia	ACCESS 1.0, 1.3
BCC	China	BCC-CSM1.1, 1.1(m)
GCESS	China	BNU-ESM
CCCMA	Canada	CanESM2, CanCM4, CanAM4
DOE-NSF-NCAR	USA	CCSM4, CESM1 (BGC), (CAM5), (CAM5.1,FV2), (FASTCHEM), (WACCM)
RSMAS	USA	CCSM4(RSMAS)
CMCC	Italy	CMCC- CESM, CM, & CMS
CNRM/CERFACS	France	CNRM-CM5
CSIRO/QCCCE	Australia	CSIRO-Mk3.6.0
EC-EARTH	Europe	EC-EARTH
LASG-IAP & LASG-CESS	China	FGOALS- g2, s2, & gl
FIO	China	FIO-ESM
NASA/GMAO	USA	GEOS-5
NOAA GFDL	USA	GFDL- HIRAM-C360, HIRAM-C180, CM2.1, CM3, ESM2G, ESM2M
NASA/GISS	USA	GISS- E2-H, E2-H-CC, E2-R, E2-R-CC, E2CS-H, E2CS-R
MOHC	UK	Had CM3, CM3Q, GEM2-ES, GEM2-A, GEM2-CC
NMR/KMA	Korea / UK	HadGEM2-AO
INM	Russia	INM-CM4
IPSL	France	IPSL- CM5A-LR, CM5A-MR, CM5B-LR
MIROC	Japan	MIROC 5, 4m, 4h, ESM, ESM-CHEM
MPI-M	Germany	MPI-ESM- HR, LR, P, ESM-P
MRI	Japan	MRI- AGCM3.2H, AGCM3.2S, CGCM3, ESM1
NCC	Norway	NorESM1-M, NorESM-ME
NCEP	USA	CFSv2-2011
NICAM	Japan	NICAM-09
INPE	Brazil	BESM OA2.3

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  28 models for AMIP,
  18 models for decadal hindcasts/predictions,
  11 models for aqua-planets
  6 high-top models (at least)
  7 models for high-frequency pointwise outputs
  etc

- New system in place to access the data : http://pcmdi9.llnl.gov

- At least 260 publications submitted, in revision or published
  (http://cmip.llnl.gov/cmip5/publications/allpublications)

CMIP Coupled Model Intercomparison Project
World Climate Research Programme

U.S. DEPARTMENT OF ENERGY | Office of Science

Submit | Edit | View | Administration

Total Publications Count: 248

All Publications

Author	Article Title	Journal
?eparovi? L. , A. Alexandru, R. Laprise, A. Martynov, L. Sushama, ...	Present climate and climate change over North America as simulated by the fifth-generation Canadian Regional Climate Model (CRCM5); (Citation) (More Information)	Climate Dynamics
Ahlström A. , G. Schurgers, B. Smith	Robustness and uncertainty in terrestrial ecosystem carbon response to CMIP5 climate change projections; (Citation) (More Information)	Environmental Research Letters
Ahmed C. B. , S. Sensoy	Assessment of climate change effects on agriculture in the Mediterranean countries; (Citation) (More Information)	
Alan I. , M. Demircan, S. Sensoy	Trends in Turkey climate extreme indices from 1971 to 2004; (Citation) (More Information)	
Anav A. , P. Friedlingstein, M. Kidston, L. Bopp, P. Ciais, ...	EVALUATING THE LAND AND OCEAN COMPONENTS OF THE GLOBAL CARBON CYCLE IN THE CMIP5 EARTH SYSTEM MODELS; (Citation) (More Information)	Journal of Climate
Andrews T. , J. M. Gregory, M. J. Webb, K. E. Taylor	Forcing, feedbacks and climate sensitivity in CMIP5 coupled atmosphere-ocean climate models; (Citation) **Andrews T. , J. M. Gregory M. J. Webb K. E. Taylor null : " Forcing, feedbacks and climate sensitivity in CMIP5 coupled atmosphere-ocean climate models" , *Geophysical Research Letters* 39 , doi:10.1029/2012GL051607 , http://www.agu.org/pubs/crossref/2012/2012GL051607.shtml** (More Information) Experiments: abrupt4xCO2, piControl, sstClim, sstClim4xCO2 Models: CanESM2, CNRM-CM5, CSIRO-Mk3.6.0, GFDL-CM3, GFDL-ESM2G, GFDL-ESM2M, HadGEM2-ES, INM-CM4, IPSL-CM5A-LR, MIROC-ESM, MIROC5, MPI-ESM-LR, MPI-ESM-P, MRI-CGCM3, NorESM1-M Variables: land area fraction, surface temperature, toa incoming shortwave flux, toa outgoing longwave flux, toa outgoing longwave flux assuming clear sky, toa outgoing shortwave flux, toa outgoing shortwave flux assuming clear sky Keywords: WG1 (physical climate system), Abrupt change, Globe, Energy budget, Radiatiave forcing, Clouds, Radiation, Feedbacks, Climate sensitivity	Geophysical Research Letters

Publication Views

- All Publications
- By Journal
- By Publication Type
- By Publication Status
- By Publication Year
- By Model
- By Experiment
- By Variable
- By Keyword
- By Sampling Frequency

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- At least 260 publications submitted, in revision or published (http://cmip.llnl.gov/cmip5/publications/allpublications)

- CMIP5 research just beginning

- First lessons ?

First lessons from CMIP5
1. Data and infrastructure

Good :

- amazingly complex compared to CMIP3 but : worked out !
  (ex 1.7 Pb of data in CMIP5, 40 Tb in CMIP3)

- distributed data management system was a first !
  amazing accomplishment (although the complexity is not always well appreciated by users)
  + software effort from many different people
  + system in place extensible

Not so good :

- infrastructure funding initially underestimated, governance too informal
- capabilities not deployed in time
- modeling groups were late making data public (feb 2012 for most of them)
- model documentation (metafor) : lots of efforts, very little feebdack so far

First lessons from CMIP5
2. Science

CMIP5 Model Analysis Workshop
(IPRC, Hawaii, March 5-9 2012)
175 participants (230 abstracts submitted)

First lessons from CMIP5
2. Science

- **Spread of projections in CMIP5 AOGCMs comparable to CMIP3**, and first generation ESMs produce comparable first order results to AOGCMs

- However CMIP5 offers the opportunity :

* to study climate change with **many additional capabilities** (carbon and chemistry, short-term climate change, comparison paleo/future, forcings and feedbacks diagnostics, high-resolution, high-frequency outputs, etc)

* to **better understand the spread and better assess the robustness** of model results ; **great value of idealized CMIP5 experiments.**

- Decadal prediction : challenging...

- RCPs may not sample the range of plausible pathways regarding aerosols and land-use.

- Model biases :

    * **some quantities show considerable improvement** (e.g. rate of sea ice loss in Arctic)

    *** many others have not significantly improved** (e.g. double ITCZ, Arctic clouds and circulation, Antarctic sea ice loss, southern ocean too warm, SPCZ too zonal..)

Next Steps

- **Conduct survey on CMIP5 (users, providers)**

- Improve the governance and funding of the ESGF

- Encourage all MIPs to follow CMIP5 standards

- **Think about the articulation between CMIPs and model development**
  - → decouple the two ?
  - → use CMIP variable names, file structure, ESGF, etc
  - → leverage community efforts (e.g. codes for analysis and visualization)

- Ask CMIP5 analysts some feedback about model shortcomings (and interpretation)

- **Encourage the writing of synthesis papers about CMIP5 results (~2013/2014)**

What would future CMIPs look like ?

- Continuity with CMIP5

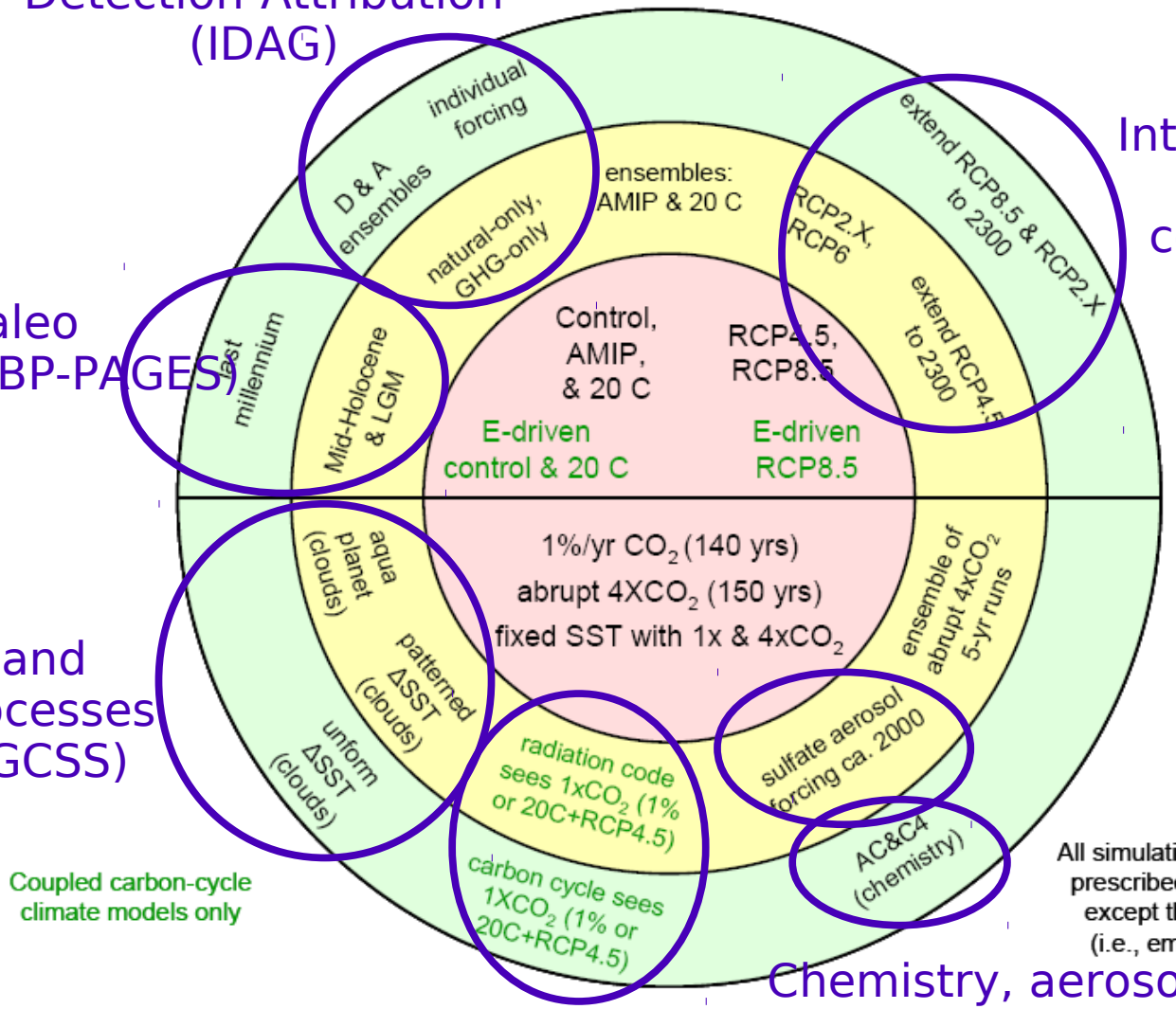
  → CMOR to become the standard protocol of our community

  → Variable list to be revisited/prioritized based on CMIP5 survey

- Experiments

  → Core set of CMIP experiments + satellite MIPs ?
  → Subset of experiments decoupled from IPCC cycle ?
  → **Promote (idealized) experiments focused on science questions (cf GC)**
  → identify the most fruitful associations

CMIP5 Long-Term Experiments



Detection-Attribution (IDAG)

Integrated Assessment Consortium (IAM), connection to WG-III

Paleo (PMIP, IGBP-PAGES)

+ Satellite simulators & process diagnostics (CFMIP-GCSS)

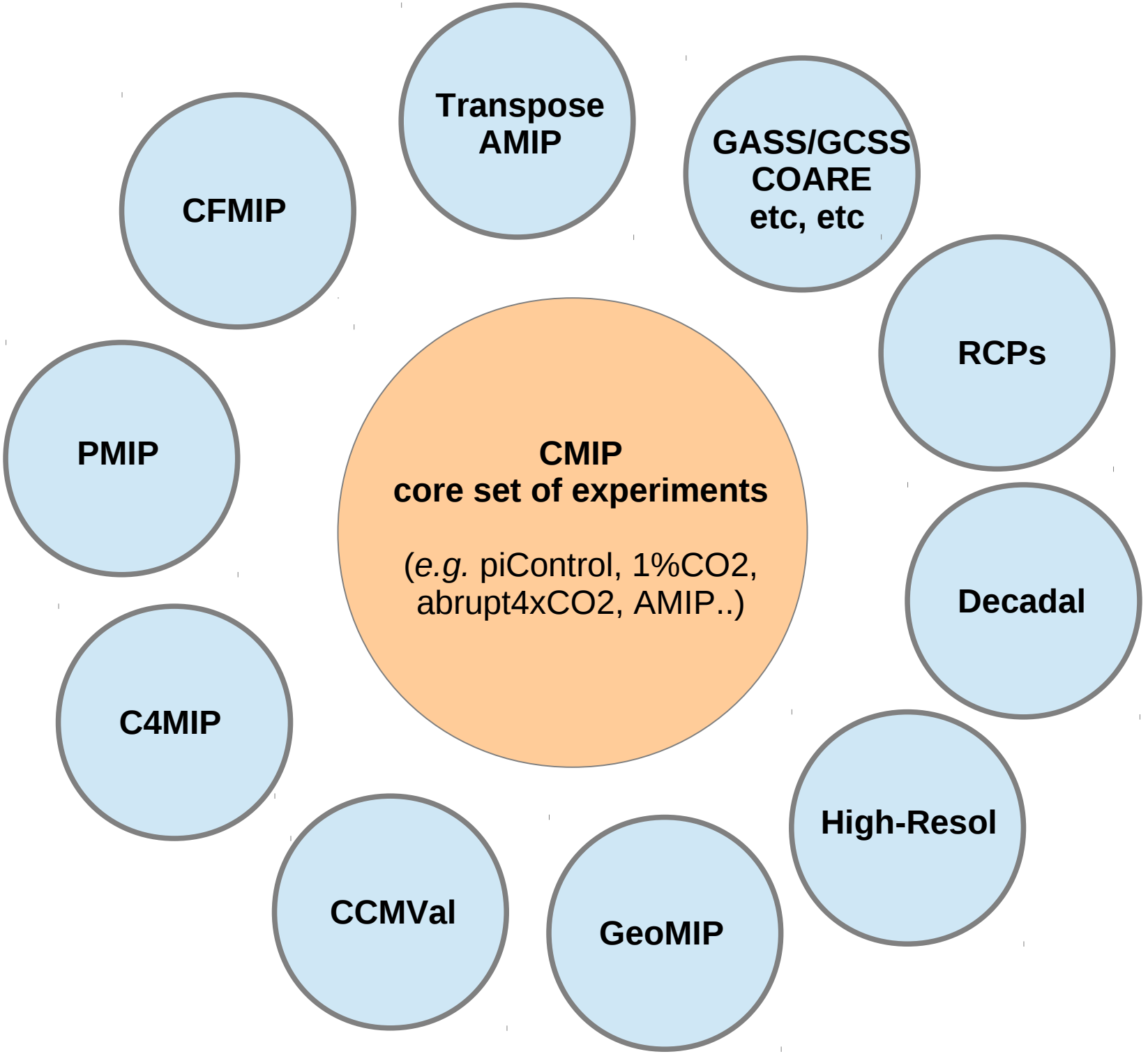
Cloud and moist processes (CFMIP-GCSS)

Coupled carbon-cycle climate models only

All simulations are forced by prescribed concentrations except those "E-driven" (i.e., emission-driven).

Chemistry, aerosols

Carbon-climate feedbacks (SPARC, AC&C)
(C4MIP, IGBP-AIMES)


Transpose AMIP
GASS/GCSS COARE etc, etc
CFMIP
RCPs
PMIP
CMIP
core set of experiments
(e.g. piControl, 1%CO2, abrupt4xCO2, AMIP..)
Decadal
C4MIP
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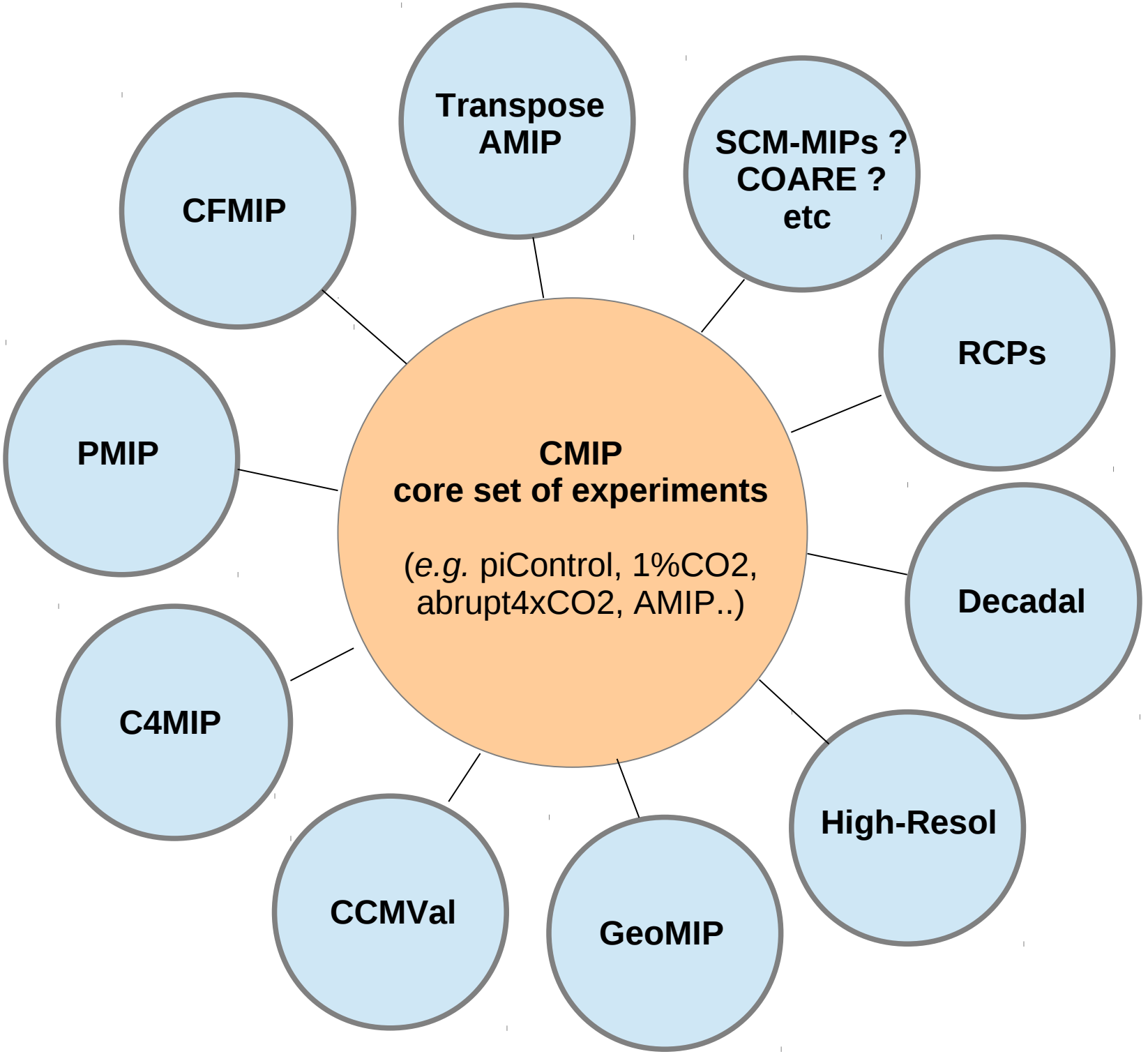
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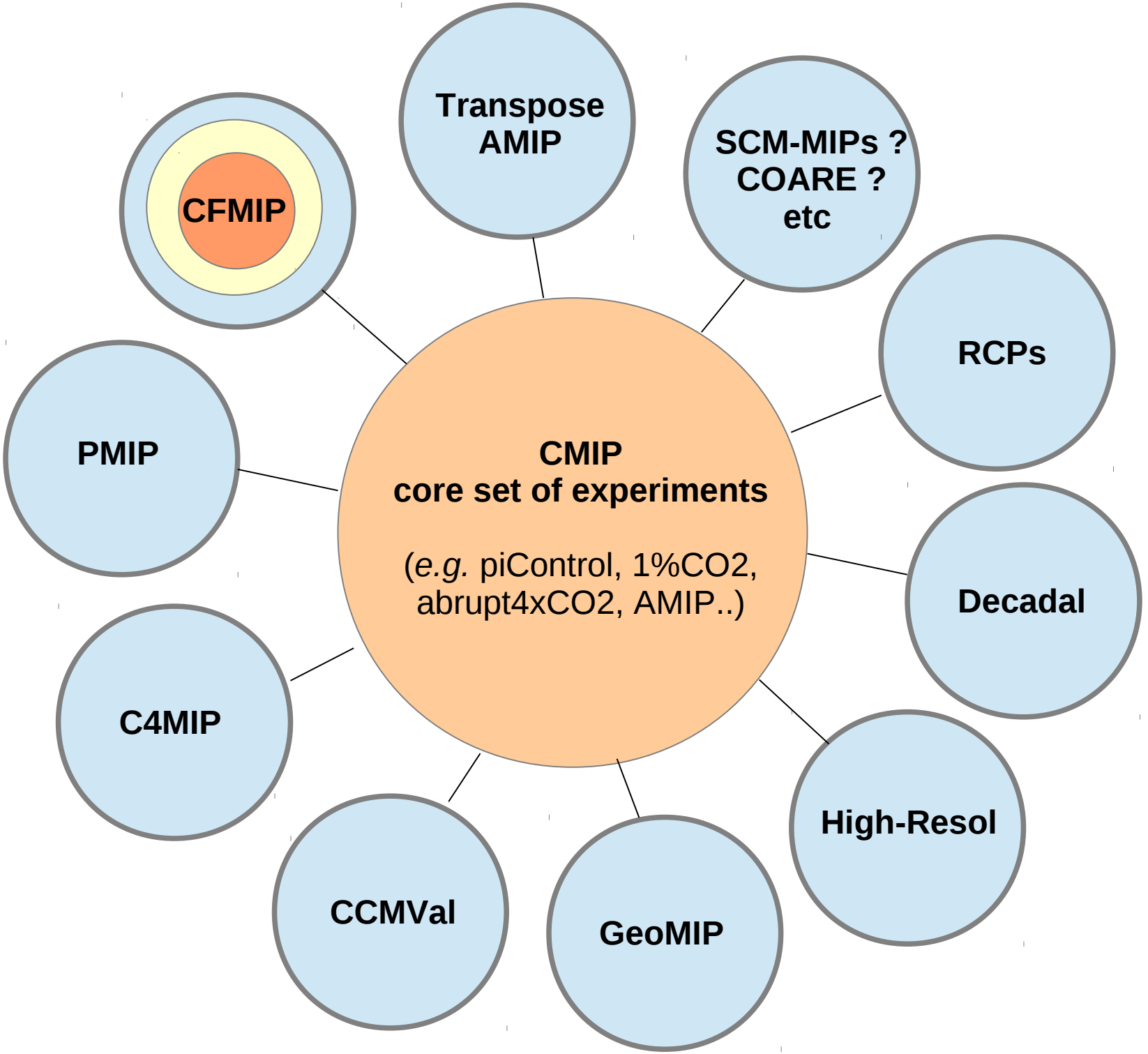
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- Planning CMIP6 :

  - exploratory workshop in 2013 (before next WGCM)
    -> promote idealized expts focused on key science questions
    -> promote link to WCRP Grand Challenges

  - WGCM to approve experimental design in 2014 **(?)** (CMIP6 : 2014-2019)

  - CMIP6 model analysis workshop in 2018

  - deadline IPCC AR6 papers : 2019 (assuming AR6 published in 2020)

WCRP Grand Challenges

GC concept (discussed at the JSC in October 2011) :

Critical areas of climate science where specific barriers are preventing progress and where targeted research efforts are likely to demonstrate significant progress over the next 5-10 years.

WCRP Grand Challenges :

1. Climate Information on Regional Scales (CLIVAR, WGRC, SPARC)

2. Regional Sea-Level Rise (CLIVAR)

3. Cryosphere in a Changing Climate (CLIC)

4. Clouds, Circulation and Climate Sensitivity (WGCM)

5. Changes in Water Availability (GEWEX)

6. Prediction and Attribution of Extreme Events (GEWEX)

White Paper on WCRP Grand Challenge #4 – *Draft, November 14, 2012* -

Clouds, Circulation and Climate Sensitivity:

How the interactions between clouds, greenhouse gases and aerosols affect temperature and precipitation in a changing climate

Lead Coordinators*: Sandrine Bony[1] and Bjorn Stevens[2]

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* There are many WCRP groups and individuals who have contributed to this document. The authors wish to thank in particular the WGCM and GEWEX/GASS steering committees for their input and the WCRP Joint Scientific Committee for its support and encouragement. Specific and extensive comments from Alessio Bellucci, Pascale Braconnot, Christopher Bretherton, Veronika Eyring, Christian Jakob, Masa Kageyama, Stephen Klein, Natalie Maholwald, Teruyuki Nakajima, Jon Petch, William Rossow, Adam Scaife, Cath Senior, Ted Shepherd, Philip Stier, Kevin Trenberth, Mark Webb and Steve Woolnough also helped sharpen and broaden the articulation of this grand challenge.

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