WCRP
World Climate Research Programme

The Cloud Feedback Model Inter-comparison Project

A WGCM project in collaboration with GEWEX/GASS and WGNE

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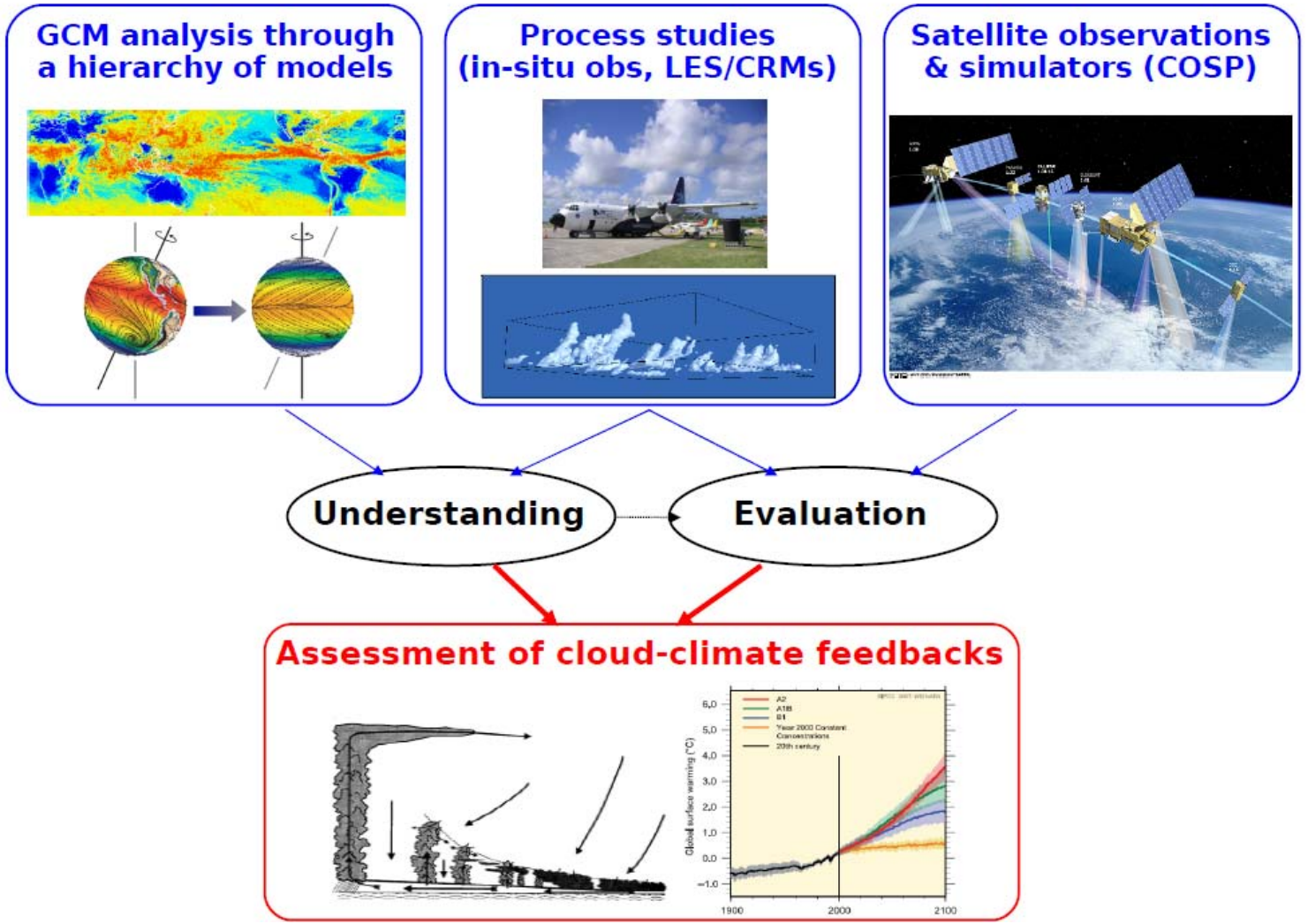
Cloud Feedback Model Inter-comparison Project Phase-2
CFMIP-2 (www.cfmip.net)



The objective of CFMIP-2 is to provide a better assessment of climate change cloud feedbacks by improving the evaluation of clouds simulated by climate models and the understanding of cloud-climate feedback processes.

CFMIP-2 strategy

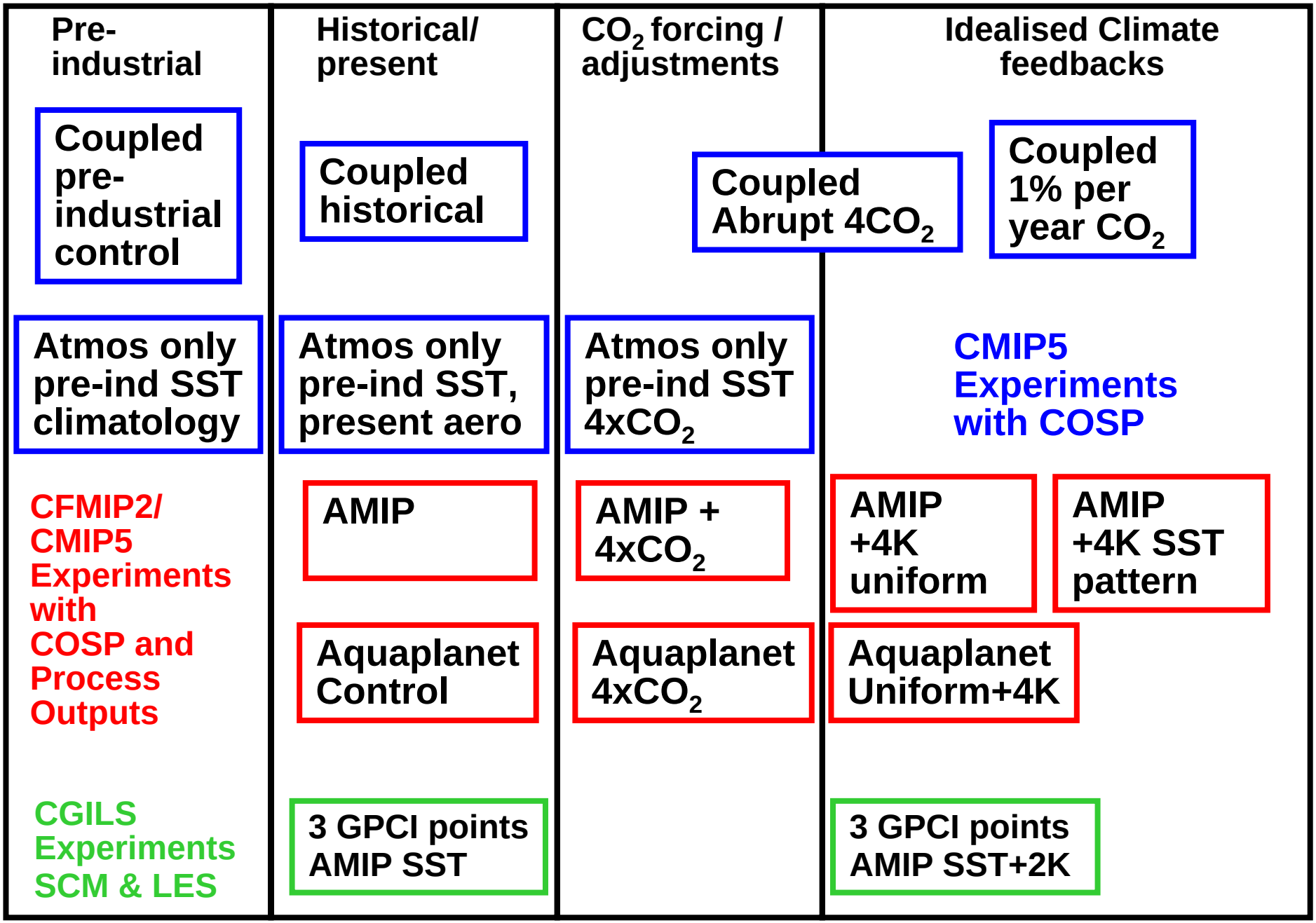
Better exploitation of ISCCP / CloudSat / CALIPSO in CMIP5:

- Adoption of CFMIP Observational Simulator Package (COSP) by modelling groups to evaluate 3D properties of cloud and precipitation

Understand and assess the physical credibility of cloud feedback mechanisms in climate models based on:

- CFMIP/GASS Intercomparison of LES and SCMs (CGILS)
- A hierarchy of experiments in CMIP5 (AOGCM/SST forced/aquaplanet)
- 3D rad fluxes/tendency terms for temperature, humidity, cloud water
- Instantaneous high frequency outputs at fixed ‘cfSites’ locations

CFMIP-2/CMIP5 Experiment Hierarchy



CFMIP-2 Data available on the Earth System Grid as of June 2013

Number of models with each type of data available for each experiment:

	Monthly CFMIP	Monthly ISCCP/ CALIPSO	Daily CFMIP	Daily ISCCP/ CALIPSO	Timestep cfSites Outputs	COSP Orbital CloudSat/ CALIPSO	Gridded Orbital CloudSat/ CALIPSO	3 Hourly COSP Inputs
amip	12	11	11	11	7	4	3	4
amip4K	10	10	10	10	6	4	3	
amip4xCO2	11	12	11	11	4	4	3	
amipFuture	10	10	9	10	4	2	3	
aquaControl	6	7	8	7	4	1		
aqua4xCO2	6	6	7	6	4	1		
aqua4K	6	6	7	6	4	1		
piControl	6	9	10	9				
1pctCO2	4	8	9	8				
abrupt4xCO2	4	8	9	8				

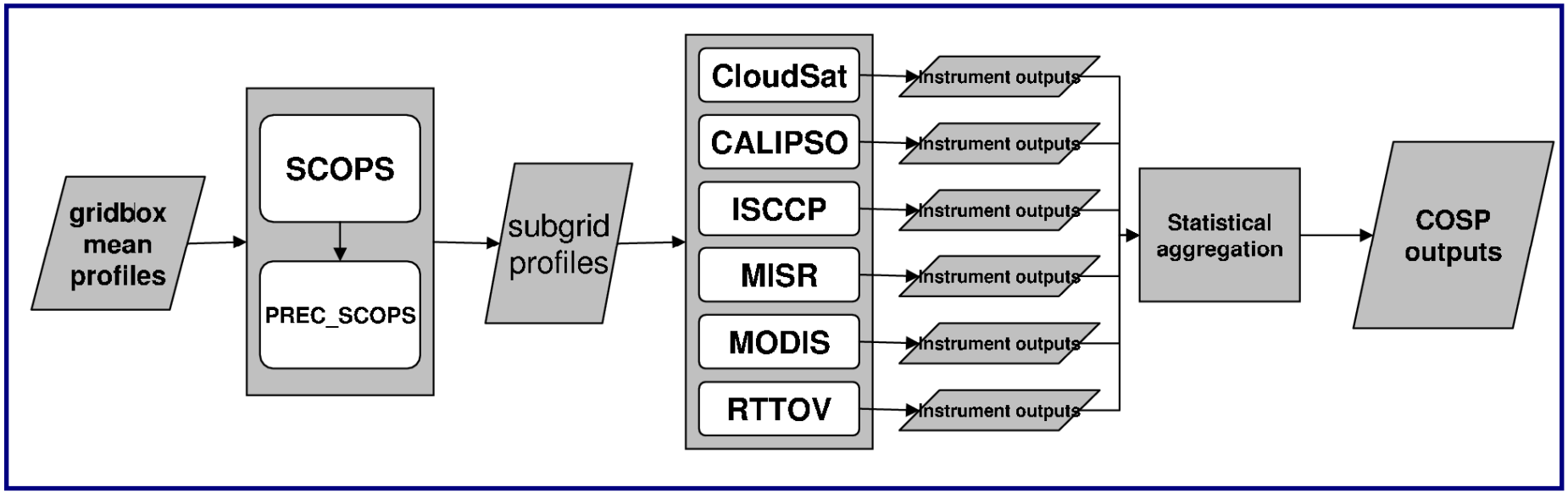
Please see http://www.cfmip.net -> Data Availability
Please also check the data errata page:
http://cmip-pcmdi.llnl.gov/cmip5/errata/cmip5errata.html

Modelling groups' CFMIP-2 submission plans:

Please see http://www.cfmip.net/ -> CFMIP Data availability

UKMO HadGEM2 82 planned, 82 available (Updated Feb 2013)
CCCma CanAM4/CanESM2 64 planned, 60 available (Updated Feb 2013)
MRI 62 planned by Oct 2013, 54 available (Updated Feb 2013)
MIROC5 54 planned by Feb 2013, 54 available (Updated Feb 2013)
IPSL CM5a-LR 79 planned, 58 available (Updated Jan 2012)
CNRM CM5 44 planned, 44 available (Updated Jan 2012)
NCAR CAM4 (Worksheet 1) 44 planned, 38 available (Updated Apr 2013)
NCAR CAM5 (Worksheet 2) 51 planned, 32 available (Updated Apr 2013)
MIROC-ESM 16 planned by September 2013, 8 available (Updated Feb 2013)
MPI ESM 59 planned (Updated Feb, 2013)
ACCESS 23 planned by Jun 2013 (Updated Feb 2013)
GAMIL 5 planned (Updated Feb, 2013)
GFDL CM3 8 planned (Updated Jan 2012)
KNMI EC-EARTH 32 planned (Updated Jan 2012)
NICAM 18 planned (Updated Jan 2012)

CFMIP Observation Simulator Package (COSP)
Bodas-Salcedo et al, 2011 (BAMS)
http://www.cfmip.net -> COSP



COSP is being used by all of the major modelling groups in CMIP5.

Developments: Radar optimisation, LIDAR mixed phase/snow (Bodas-Salcedo, Marchand, Zhang, Klein, Chepfer, Cesana, Edmond)

Funding: EC-INES, NASA bid (Bodas-Salcedo, Pincus)

Some recent papers using COSP:

Klein et al 2013: Are climate model simulations of clouds improving? An evaluation using the ISCCP simulator. (JGR)

Tsushima et al 2013: Quantitative evaluation of the seasonal variations in climate model cloud regimes. (Climate Dynamics)

Zelinka et al 2013: Contributions of Different Cloud Types to Feedbacks and Rapid Adjustments in CMIP5. (J. Climate)

Bodas et al (submitted) Origins of the solar radiation biases over the Southern Ocean in CFMIP2 models. (Submitted to J. Climate)

Konsta, Chepfer and Dufresne (2013): Evaluation of Cloud Description in General Circulation Models Using A-Train Observations. (Advances in Meteorology, Climatology and Atmospheric Physics)

Grégory and Chepfer: Evaluation of the cloud thermodynamic phase in a climate model using CALIPSO-GOCCP. (JGR, in press)

Stevens et al, 2013: Atmospheric component of the MPI-M Earth System Model: ECHAM6. (JAMES)

Xie et al 2013: Sensitivity of CAM5 Simulated Arctic Clouds and Radiation to Ice Nucleation Parameterization. (J. Climate, in press)

More recent papers using COSP:

Franklin et al 2013: Evaluation of clouds in ACCESS using the satellite simulator package COSP. Part 2: Regime-sorted tropical cloud properties. (JGR, in press)

Franklin et al 2013: Evaluation of clouds in ACCESS using the satellite simulator package COSP: Global, seasonal, and regional cloud properties. (JGR)

John et al (2013): Analysis of upper-tropospheric humidity in tropical descent regions using observed and modelled radiances. (Atmos. Chem. Phys. Discuss)

von Salzen et al, 2013: The Canadian Fourth Generation Atmospheric Global Climate Model (CanAM4). Part I: Representation of Physical Processes. (Atmosphere-Ocean)

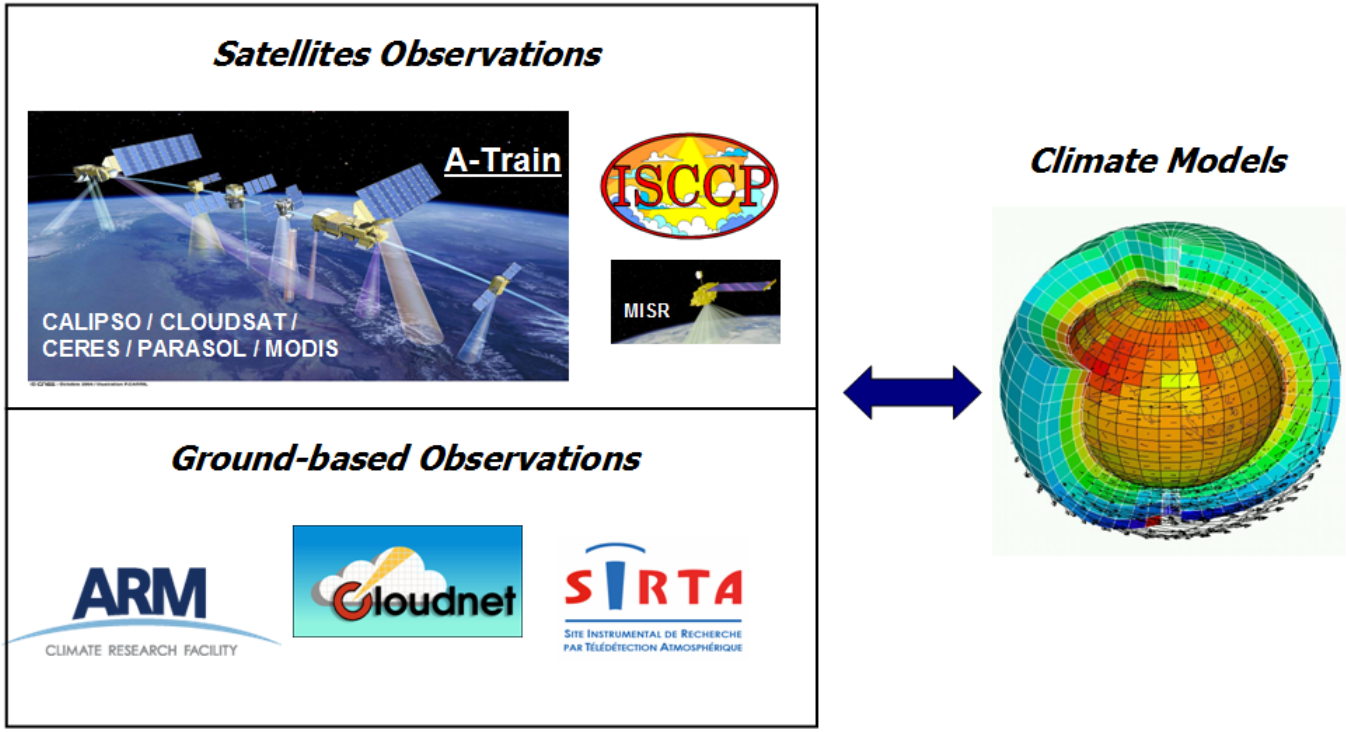
Wang and Su, 2013: Evaluating and understanding top of the atmosphere cloud radiative effects in Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5). (JGR)

Nam et al, 2012: The ‘too few, too bright’ tropical low-cloud problem in CMIP5 models. (GRL)

- CFMIP Observations for model evaluation
- CALIPSO-GOCCP
  - 3D_CloudFraction
  - 3D_CloudFraction phase
  - 3D_CloudFraction phase temp
  - MapLowMidHigh
  - MapLowMidHighphase
  - SR_histo
  - SR_histophase
  - Instant_SR
  - Instant_SRphase
- CERES
- CLOUDSAT
- Ground ARM
- Ground EUROPEAN
- ISCCP
- MISR
- MODIS
- MULTI-SENSORS Analysis
- MULTI-SENSORS data
- PARASOL
- References

CFMIP-OBS

http://climserv.ipsl.polytechnique.fr/cfmip-obs



- Work in progress to convert data into CMOR compliant NetCDF format to facilitate comparison with CMIP5 data -
- Many CFMIP-OBS datasets converted and on ESGF

(Helene Chepfer, Gregory Cesana, Robert Pincus, Yuying Zhang, Roj Marchand)

Quantifying forcings and feedbacks in idealised CFMIP5/CFMIP-2 experiments:

Zelinka et al 2013: Contributions of Different Cloud Types to Feedbacks and Rapid Adjustments in CMIP5. (J. Climate)

Andrews et al 2012: Forcing, feedbacks and climate sensitivity in CMIP5 coupled atmosphere-ocean climate models. (GRL)

Vial, Dufresne and Bony 2013: On the interpretation of inter-model spread in CMIP5 climate sensitivity estimates. (Climate Dynamics)

Geoffroy et al, 2012: Transient climate response in a two-layer energy-balance model. Part I: analytical solution and parameter calibration using CMIP5 AOGCM experiments. (J. Climate)

Geoffroy et al, 2012: Transient climate response in a two-layer energy-balance model. Part II: representation of the efficacy of deep-ocean heat uptake and validation for CMIP5 AOGCMs. (J. Climate)

Shiogama et al al 2012: Perturbed physics ensemble using the MIROC5 coupled atmosphere–ocean GCM without flux corrections: experimental design and results. (Climate Dynamics)

Adjustment/feedback mechanisms in GCM/SCMs:

Kawai 2012: Examples of Mechanisms for Negative Cloud Feedback of Stratocumulus and Stratus in Cloud Parameterizations. (SOLA)

Brient and Bony 2012: How may low-cloud radiative properties simulated in the current climate influence low-cloud feedbacks under global warming? (GRL)

Kamae and Watanabe, 2012: Tropospheric adjustment to increasing CO2: its timescale and the role of land-sea contrast. (Climate Dynamics)

Kamae and Watanabe, 2012: On the robustness of tropospheric adjustment in CMIP5 models. (GRL)

Brient and Bony 2013: Interpretation of the positive low-cloud feedback predicted by a climate model under global warming. (Climate Dynamics)

Webb and Lock 2013: Coupling between subtropical cloud feedback and the local hydrological cycle in a climate model. (Climate Dynamics)

Zhang et al (submitted): CGILS: First results from an international project to understand the physical mechanisms of low cloud feedbacks in general circulation models. (Submitted to JAMES)

Ogura at al (submitted): Importance of instantaneous radiative forcing to tropospheric adjustment. (Submitted to Climate Dynamics)

Understanding cloud feedback/adjustment mechanisms in LES/MLMs:

Rieck, Nuijens and Stevens 2012: Marine Boundary Layer Cloud Feedbacks in a Constant Relative Humidity Atmosphere. (J. Atmos Sci)

Zhang et al 2012: The CGILS experimental design to investigate low cloud feedbacks in general circulation models by using single-column and large-eddy simulation models. (JAMES)

Blossey at al 2013: Marine low cloud sensitivity to an idealized climate change: The CGILS LES intercomparison. (JAMES)

Bretherton, Blossey and Jones 2013: Mechanisms of marine low cloud sensitivity to idealized climate perturbations: A single-LES exploration extending the CGILS cases. (JAMES)

De Roode et al (submitted): The stratocumulus response to a single perturbation in cloud controlling factors. (Submitted to J. Climate)

Dal Gesso et al (submitted): A mixed-layer model perspective on stratocumulus steady-states in a perturbed climate. (Submitted to QJRMS)

CFMIP community – widening interests….

CFMIP has up to now mostly focused on the evaluation of clouds using satellite observations and the understanding of cloud feedbacks and adjustments.

However, the CFMIP-2 experiments are now being applied to other questions:

- Evaluation of model clouds using in-situ observations (e.g. ARM, CloudNet)
- Understanding of precipitation and circulation responses to climate change, e.g.
  - Clouds On/Off Klimate Experiment (COOKIE)
  - Regional precipitation responses to CO_2 (Bony et al 2013, NGS)
- The role of cloud processes in atmospheric dynamics and variability

Many of these activities have been developed in EUCLIPSE

The Grand Challenge is a further development of these widening interests

CFMIP Future Plans

CGILS Phase II

Further exploitation of the CFMIP-2 experimental database:

- Fuller implementation of the CFMIP-2 protocol – co-authorship?
- CFMIP Publications list
- CFMIP-user list (see http://www.cfmip.net)

Drawing it all together:

- Autumn 2013 Publication of IPCC AR5 Assessment report
- CFMIP synthesis/assessments post-AR5?

Next CFMIP Meeting Summer 2014 - Offers to host very welcome!

CMIP6 / CFMIP-3: A similar design but fuller implementation?

Beyond CFMIP-2 – The WCRP Grand Challenge on clouds