

**The Cloud Feedback Model Intercomparison Project (CFMIP)
contribution to CMIP6.**

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Full paper available via the CFMIP website

Science questions

Tier 1 experiments are proposed for CMIP6 to address the question:

“1) What are the physical mechanisms underlying the range of cloud feedbacks and cloud adjustments predicted by climate models, and which models have the most credible cloud feedbacks?”

Science questions

Additional Tier 2 experiments are proposed to address the following questions:

2) Are cloud feedbacks symmetric when subject to climate cooling rather than warming, and if not, why?

3) How do cloudradiative effects impact the structure, the strength and the variability of the general atmospheric circulation in the presentday climate?

4) How do responses in the climate system due to changes in solar forcing differ from changes due to CO_2 , and is the response sensitive to the sign of the forcing?

5) To what extent is regional climate change per CO_2 doubling state-dependent (nonlinear), and why?

6) Are climate feedbacks during the 20th century different to those acting on long term climate change and climate sensitivity?

7) How do regional climate responses (e.g. in precipitation) and their uncertainties in coupled models arise from the combination of different aspects of CO_2 forcing and sea surface warming?

CFMIP also proposes a number of additional model outputs in the CMIP DECK, CMIP6 Historical and CMIP6 CFMIP experiments, including COSP simulator outputs and process diagnostics to address the following questions:

- 1) How well do clouds and other relevant variables simulated by models agree with observations?
- 2) What physical processes and mechanisms are important for a credible simulation of clouds, cloud feedbacks and cloud adjustments in climate models?
- 3) Which models have the most credible representations of processes relevant to the simulation of clouds?
- 4) How do clouds and their changes interact with other elements of the climate system?

The COSP data request for CMIP6 includes data from 6 simulators:

ISCCP: pseudoretrievals of cloud top pressure and cloud radiative properties (Klein and Jakob 1999; Webb et al., 2001).

CloudSat: a forward model for radar reflectivity as a function of height (Haynes et al., 2007).

CALIPSO (Chepfer et al., 2008; Cesana and Chepfer, 2013): forward model for lidar scattering ratio as function of height, and cloud phase retrieval.

MODIS: pseudoretrievals of cloud top pressure and cloud radiative properties (Pincus et al., 2012).

MISR: pseudoretrievals of cloud top height and cloud radiative properties (Marchand and Ackerman, 2010).

PARASOL: simple forward model of monodirectional reflectance (Konsta et al., 2015).

Observations consistent with COSP outputs (dedicated dataset):
CFMIP-OBS data base available CFMIP , Climserv, and ESGF/Obs4Mips websites