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Geoscientific Model Development Discussions

Interactive comment on "The Cloud Feedback Model Intercomparison Project (CFMIP) Diagnostic Codes Catalogue – metrics, diagnostics and methodologies to evaluate, understand and improve the representation of clouds and cloud feedbacks in climate models" *by* Yoko Tsushima et al.

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Thank you for your comments, which were useful to improve our repository and paper. Please see our responses below.

>To give as much information and files as possible, and to classify their diagnostics in a

few categories, from the diagnostic that have all the necessary file to run a small demo to diagnostics that will require a lot of preprocessing and auxiliary material.

Thank you for your suggestion. We have now included the corresponding information in each repository. If the sample input data size exceeds the GitHub limit, either the location information is provided or it is suggested to contact the author, which is described in the Readme page for each repository. We also have created a table which summarizes the descriptions of each of the diagnostics. (Attached as a figure file)

>The list of input and output variables are missing for some diagnostics (e.g. 3.7, 3.10,...)

All diagnostic repositories were supposed to provide information about the input data required and the output variables in the Readme pages for their repositories. We apologise for the missing information for some of the diagnostics. We have now added the list of input and output variables for all diagnostics. For 3.10 the author was extremely busy, I created a folk branch, added these information to its Readme file. Pull request has been sent to the author.

>general: most of the diagnostics use monthly mean data, some of them use daily (or other frequency) data. Please provide some information.

The information is included in the new summary table.

>p. 5, line 5: the metrics also often quantify the distance with observations.

The sentence is amended as follows: '), m_i is the error in simulating the regime i, which quantifies the distance from the observations, as defined below.'

>section 3.1: MODIS data are used according to Fig 1, but are not mentioned in the Text

The following sentences have been added to the manuscript: "As a point of comparison, we also use roughly analogous observations from the MODerate resolution Imaging Spectrometer (MODIS) instruments for the period March 2000 through April 2011 [Pincus et al., 2012].In Fig 1 (a), the ETCA measure between the MODIS and ISCCP climatologies is 0.47. All model differences with ISCCP exceed this value, so it is likely that errors in the climatology of total cloud amount are robustly determined."

>p. 4 l. 15: "measures of fidelity": can you say some words on it?

We have added 'closeness to the observations (fidelity)' where the word 'fidelity' appears for the first time in the manuscript.

>p. 5, l. 13: specify unit of a_i (W/m2)

It is specified as follows: "The model error (RMSE) associated with each regime i (a_i[Wm-2]) can be approximated. . ."

>p. 5, sect 3.2.2: this diagnostic is not available on github

There was a mistake with adding this diagnostic to the repository. The diagnostic code is now under the repository: https://github.com/tsussi/cloud-regime-error-metric/tree/master/code/

>p. 5, l. 20-24: the explanation is not clear for me.

The explanation has been modified (a figure file attached):

>sect 3.4, 3.6 and 3.7: are the ncl routines loaded at the beginning of the srcipt standard routines?

Yes, the NCL routines loaded are standard routines which are used in all scripts.

>p. 7, sect. 3.5: the matlab routines use a large number of auxiliary files

We have modified the matlab routine. The auxiliary files that are necessary give information on the model grids and on the choice of the appropriate solar zenith angle. We have added explicit information on how to obtain the auxiliary data in the Preprocessing section.

>p. 7, l. 18: “and the cloud vertical distribution from CALIPSO”: not on the figures, should be removed

The sentence was amended to “the histogram shows the relationship between cloud cover from CALIPSO (Winker et al., 2007) and cloud reflectance measured by PARASOL (Parol et al., 2004)”

>p. 12: line 9 and followings: “The too few, too bright problem.” The Konsta et al., 2015 paper should also be cited here.

Following sentences have been added: “Konsta et al., (2015) confirmed this at the instantaneous time scale. The tropical low-level cloud properties are grouped in two clusters according to the observations. One cluster corresponds to cumulus-type clouds (with low cloud fraction and low cloud reflectance), while the other corresponds to stratocumulus-type clouds (with almost overcast cloud fraction and with large cloud reflectance values). However, in two versions of the LMDZ climate model (Dufresne et al., 2013, Hourdin et al., 2013a, Hourdin et al., 2013b) these properties are not reproduced. The clouds with small cloud cover have too large reflectance values and clouds with a cover close to one are overestimated.

>p. 12, l. 27: CFODDs: please expand the acronym

The acronym has been defined in earlier section 3.7 as ‘Contoured Frequency by Optical Depth Diagram (CFODD)’. So we use this acronym in the later part of the manuscript.

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Diagnostics	Scientific target to evaluate	Does the code read CMIP data? (i.e. no preprocessing)	Time Frequency of Input Data	What auxiliary data is needed/ provided?
Klein et al.(2013)	ISCCP global cloud amounts	Y	Monthly	Processed Obs data/Y
Williams and Webb (2008), Tsushima et al.(2013) annual	Annual mean climatology of cloud regimes	Y	Daily	Processed Obs data/Y
Tsushima et al.(2013) seasonal	Climatological seasonal cycle of cloud regimes	Y	Daily	Processed Obs data/Y
Zelinka et al.(2012)	Cloud radiative kernels	Y	Monthly	Radiative Kernel /Y
Nam and Quaas (2012)	Zonal plots of GCM cloud and hydrometeor fraction	Y (post-processing done in script)	Monthly	N/A
Konsta et al (2015)	Instantaneous A-train cloud property	N	8 hourly Or daily	N/A
Nam et al.(2012)vertical distribution	Vertical distribution of low-clouds	Y (post-processing done in script)	Monthly	N/A
Nam et al.(2012)albedo	SW CRE and Parasol reflectance of low-clouds	Y (post-processing done in script)	Monthly	N/A
Suzuki et al.(2015)	Warm rain microphysical process diagrams	N	6 hourly	Processed Obs data/Y
Brient and Schneider (2016)	Sensitivity of tropical low-cloud reflection to SST at various time scales and the constraint to ECS	N	Monthly	Processed Obs data/Y
Qu et al.(2014)	Sensitivities of low cloud cover to EIS and SST	Y	Monthly	The observational estimates of EIS and SST slopes in the figures not included.
Sherwood et al.(2014)	Lower Tropospheric Mixing Indices	Y (,but IO routine not included)	Monthly	Land-sea mask/Y

Fig. 1. Summary Table

Printer-friendly version

Discussion paper

This scalar metric evaluates variations of climatological monthly mean net CRE over the chosen number of cloud regimes.

An error in the climatological annual variation of the CRE for regime i can be caused by an error in the amplitude of the variation and an error in the pattern (e.g. phase, shape) of the time variation. The centred RMS error of the climatological seasonal variation of the CRE for regime (s_i) relative to the observations is expressed as:

$$s_i^2 = \left(\sigma_{i,m} - \sigma_{i.o}\right)^2 + 2\sigma_{i,m}\sigma_{i,o}(1 - R) \quad (3)$$

, where $\sigma_{i,o}$ and $\sigma_{i,m}$ denote the standard deviation of the climatological monthly mean of the observed and modelled CRE for a regime i from the climatological annual mean, R is the linear correlation coefficient between the anomaly (difference from annual mean) of the model and that of the observation over the 12 months of the seasonal cycle. We use these standard deviations as a measure of the amplitude in the seasonal variation. The error in the amplitude of the variation $\left(s_{i,amp}\right)$ is defined by:

$$s_{i,amp} = \sigma_{i,m} - \sigma_{i,o} \quad (4)$$

The second term of s_i is a covariance term between the observations and the model. We define the error in the pattern of the time variation $\left(s_{i,cov}\right)$ as:

$$s_{i,cov} = \sqrt{2\sigma_{i,m}\sigma_{i,o}(1 - R)} \quad (5)$$

(See Tsushima et al., 2013 for details).

Fig. 2. Description of the Section 3.2.2