

Multi-model analysis of clouds by using satellite simulators

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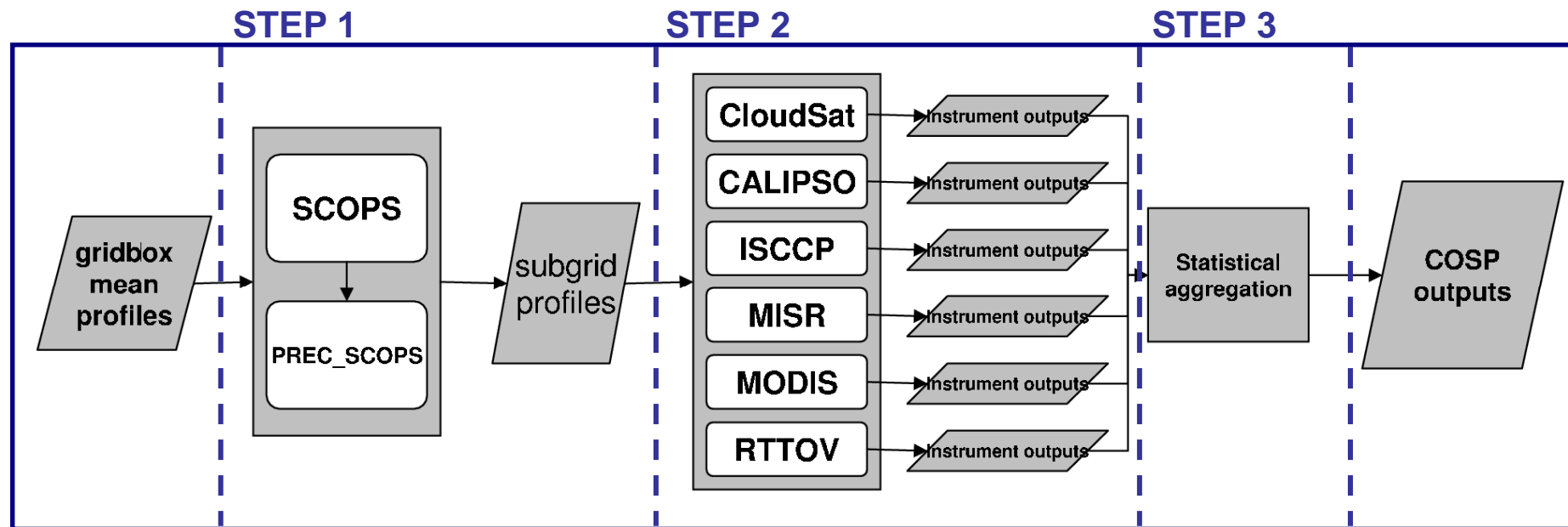
Outline

- **Description of COSP**
- **Multi-model intercomparison**
 - **Experimental design**
 - **Observations**
 - **Results**
- **Conclusions**
- **Future work**

COSP

CFMIP Observation Simulator Package

- Used in the CFMIP2 and CMIP5 experiments



User group: <http://groups.google.com/group/cosp-user>

Code: <http://code.google.com/p/cfmip-obs-sim/>

Experimental design

- **Atmosphere-only simulations: Sep-Nov 2006**
- **COSP outputs every 3h**

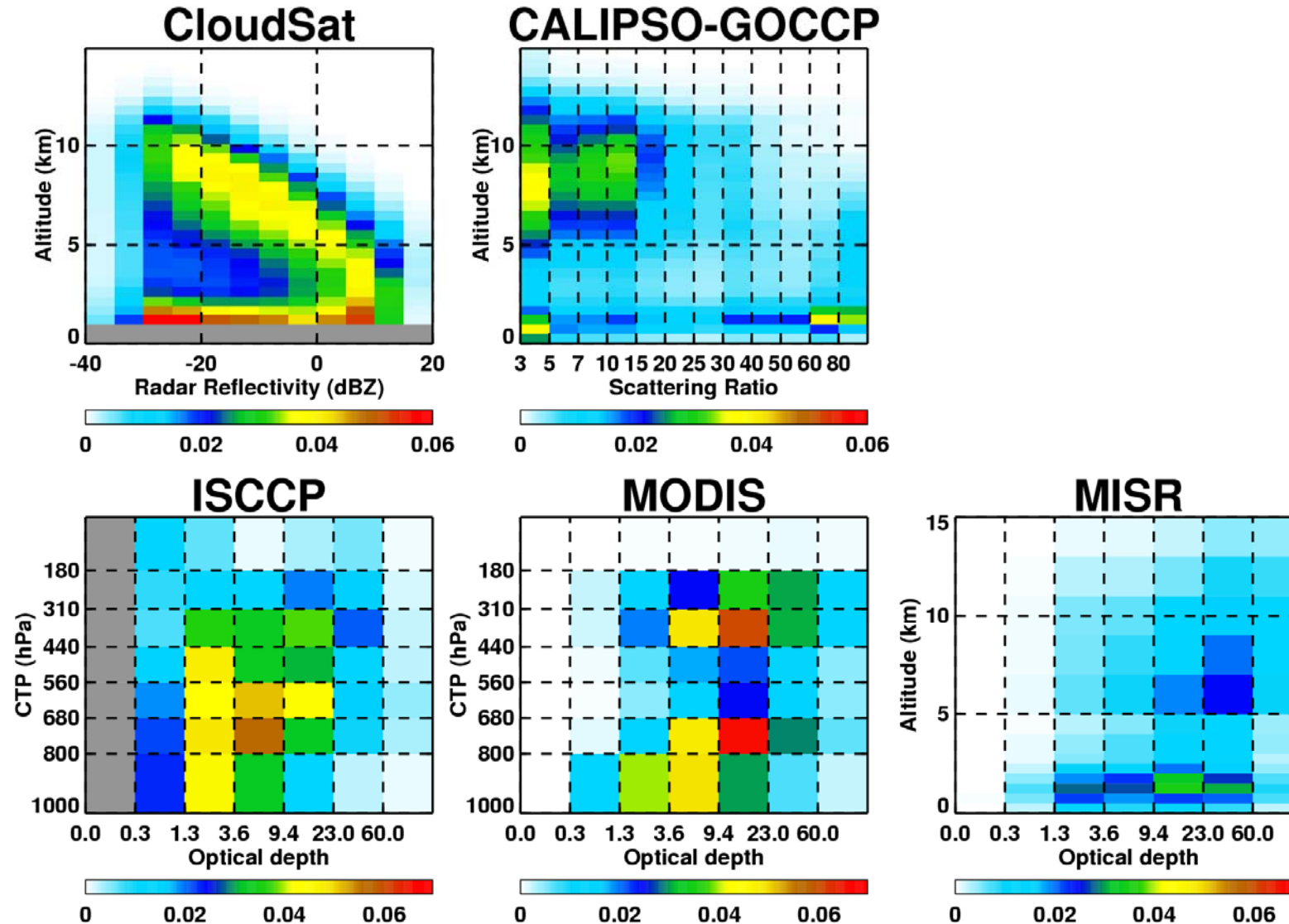
Model	Institution	References	Resolution
HadGEM1	UK Met Office	Martin et al. (2006)	1.875° lon, 1.25° lat, 38 lev.
LMDZ4	LMD	Hourdin et al. (2006)	3.75° lon, 2.5° lat, 19 levels
MMF 4kmL26	CMMAP	(Marchand and Ackerman 2010)	2.5° lon, 2° lat, 26 lev., 4 km
MMF 1kmL52	CMMAP	(Marchand and Ackerman 2010)	2.5° lon, 2° lat, 52 lev., 1 km

TABLE 3. Models used in this study. In the case of the two versions of the MMF model, the number of columns refers to those used by the cloud resolving model embedded in each gridbox of the parent GCM. LMD stands for Laboratoire de Météorologie Dynamique. CMMAP stands for Center for Multiscale Modeling of Atmospheric Processes. Two MMF simulations have been run with different resolutions of the cloud-resolving model embedded in each GCM gridbox: 64 columns and 26 vertical levels, approximately $\approx 4\text{km}$ horizontal resolution (4kmL26), and 256 columns and 52 vertical levels, $\approx 1\text{km}$ horizontal resolution (1kmL52).



Observations

North Pacific [160°E-235°E, 40°N-60°N]

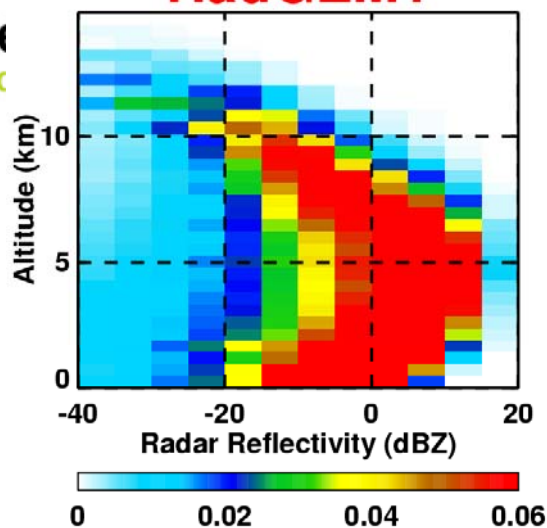




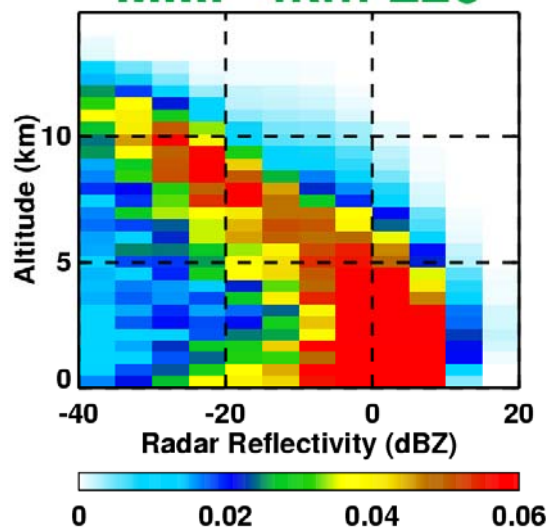
Models vs CloudSat

Met
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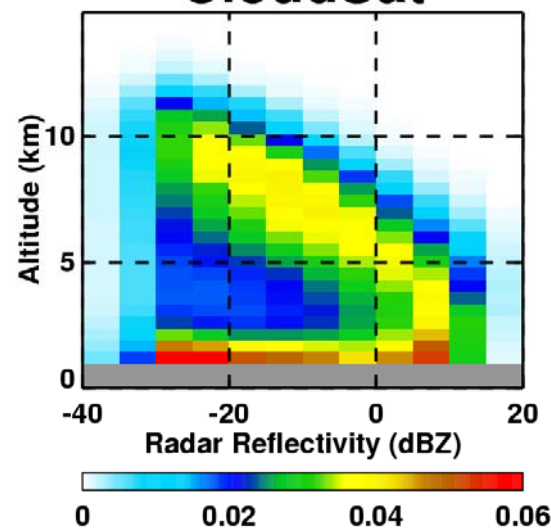
HadGEM1



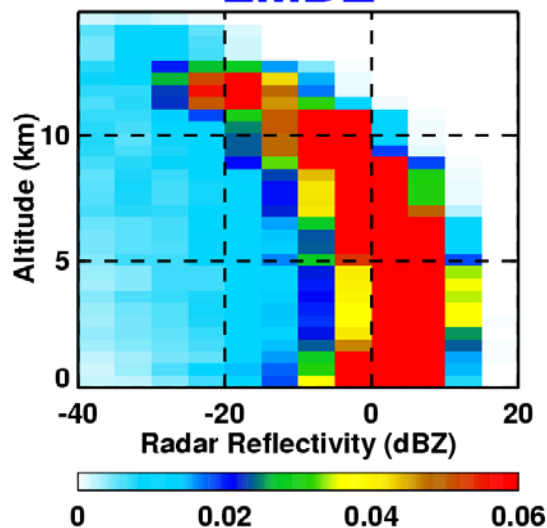
MMF 4km L26



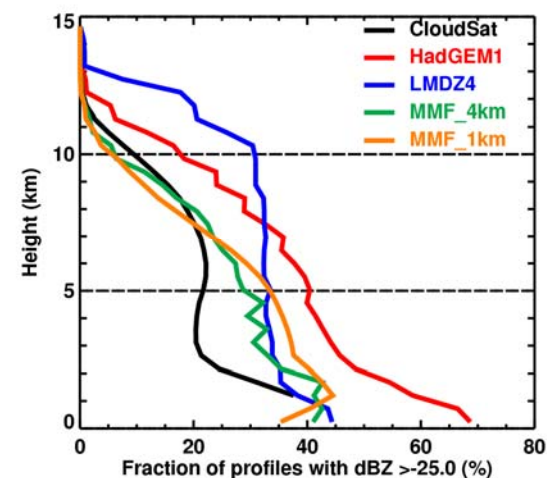
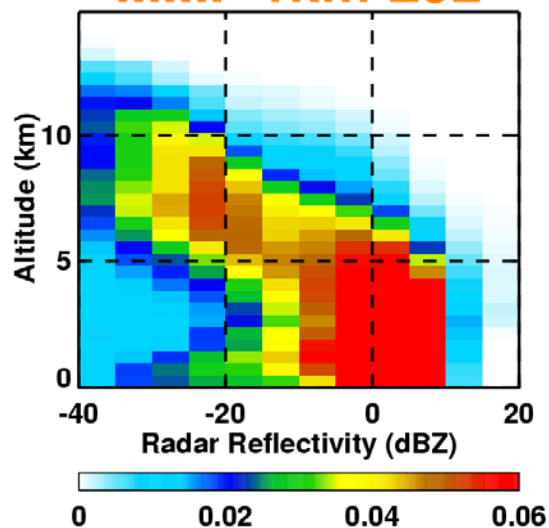
CloudSat



LMDZ

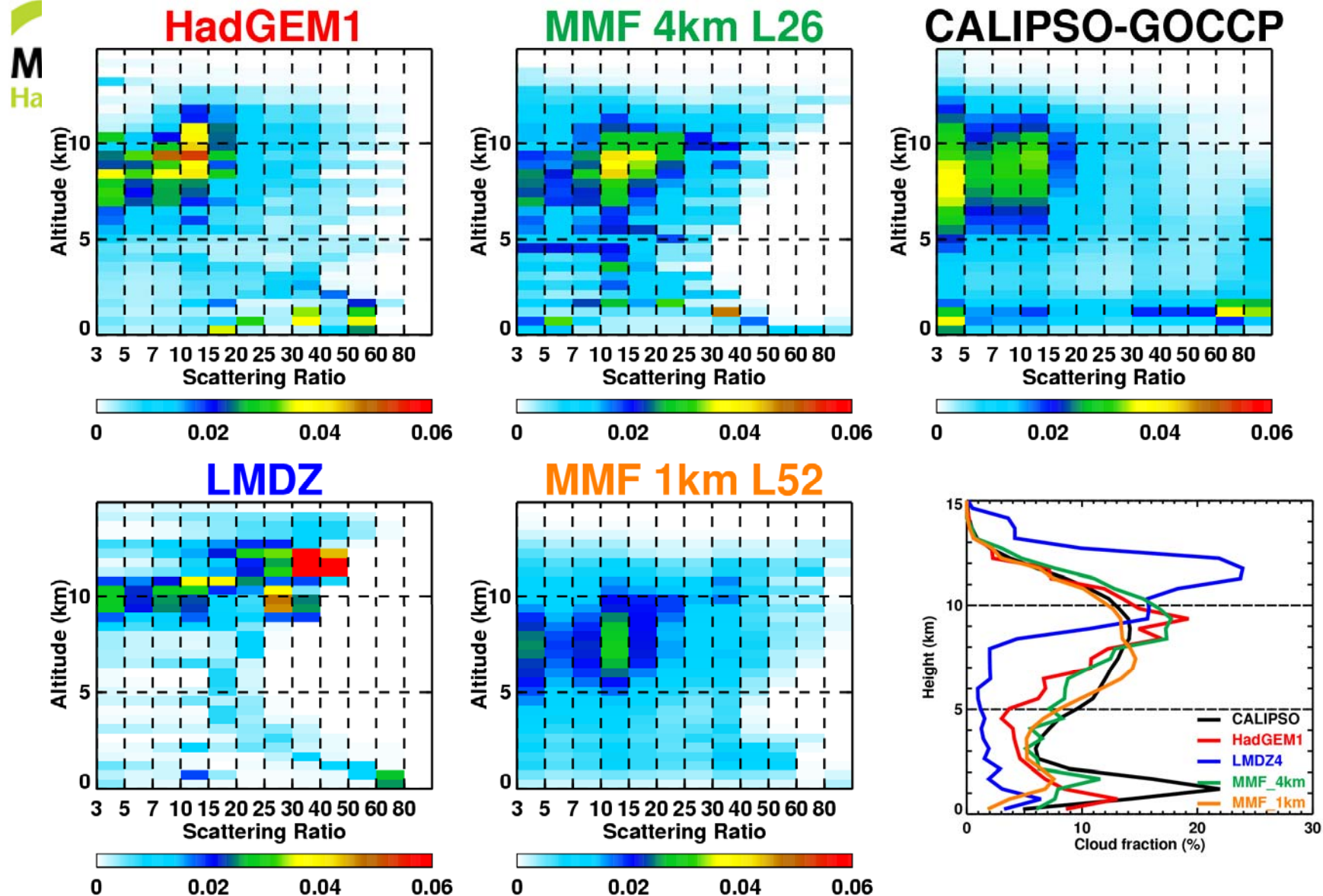


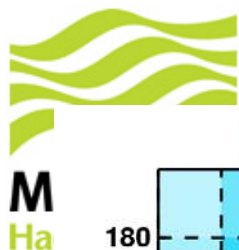
MMF 1km L52



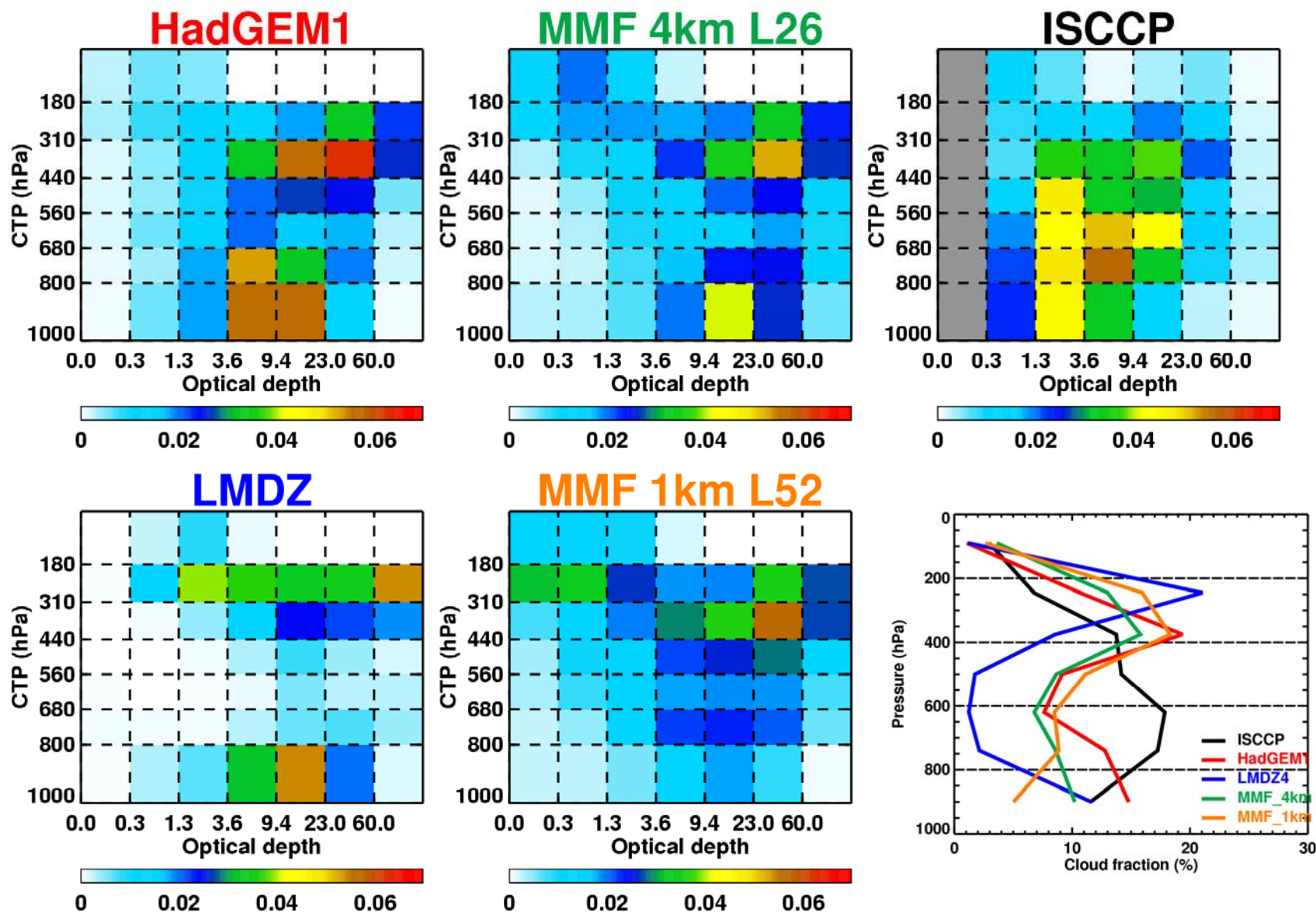


Models vs CALIPSO



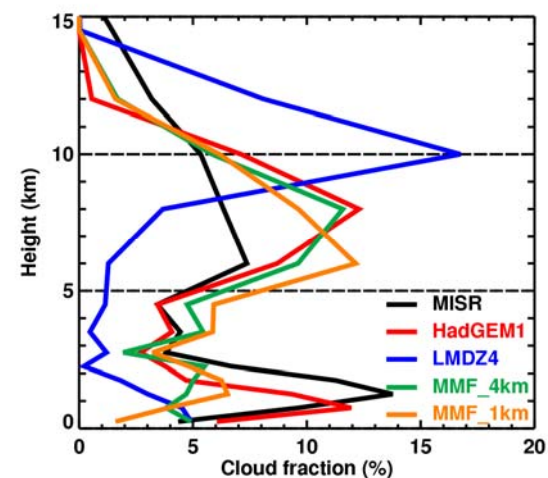
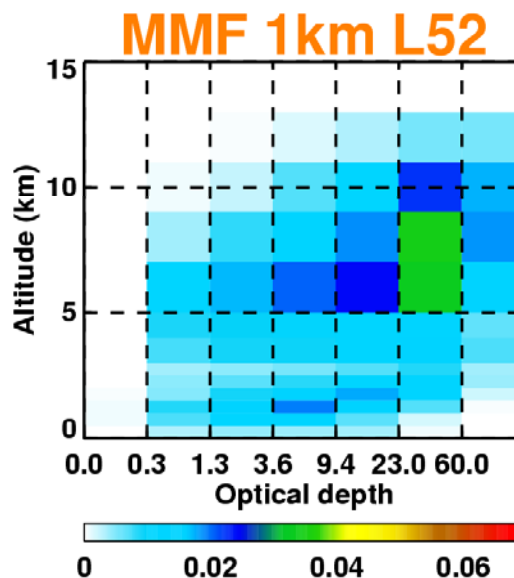
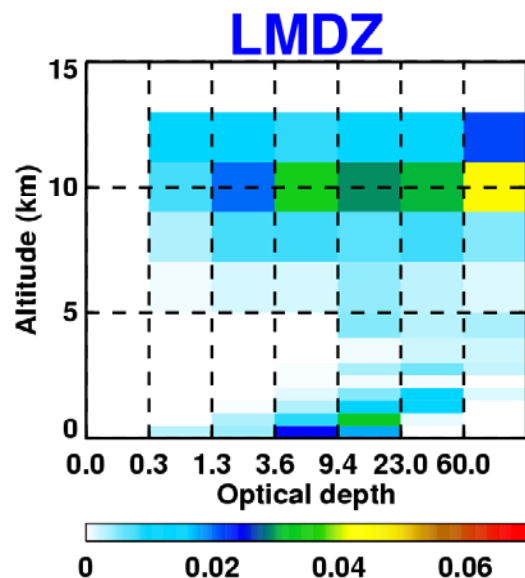
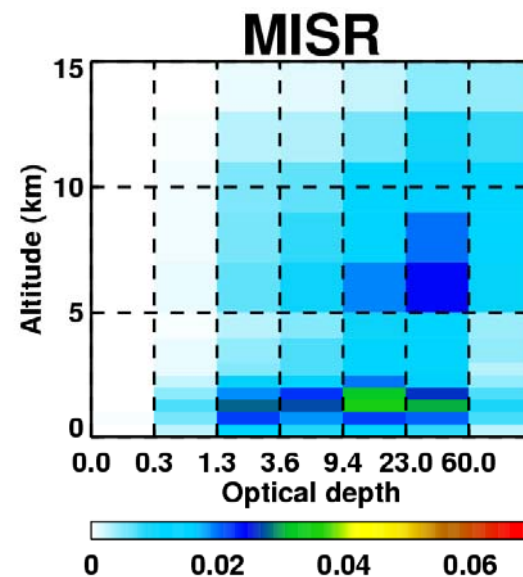
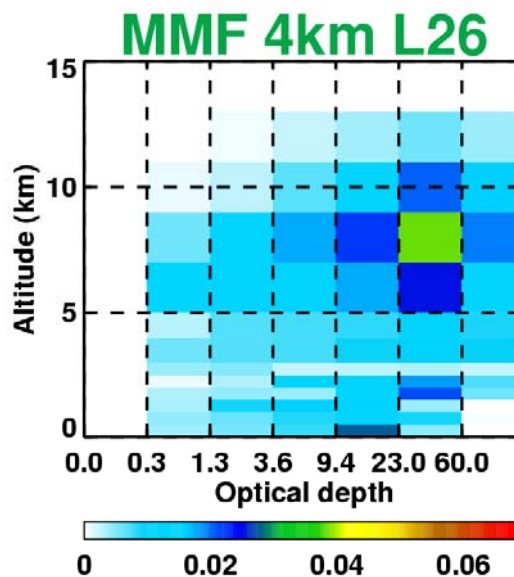
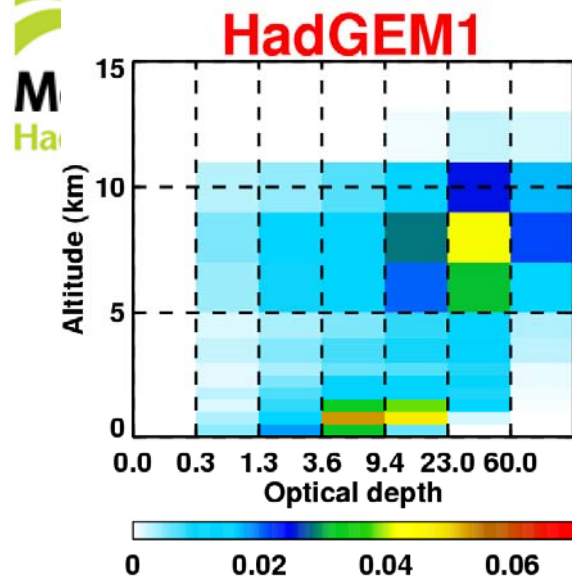


Models vs ISCCP





Models vs MISR

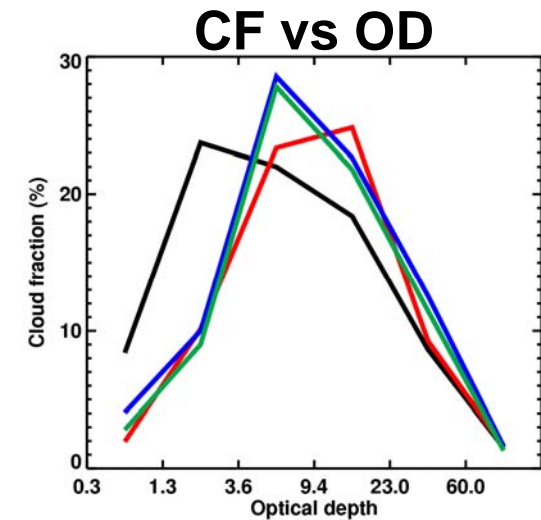
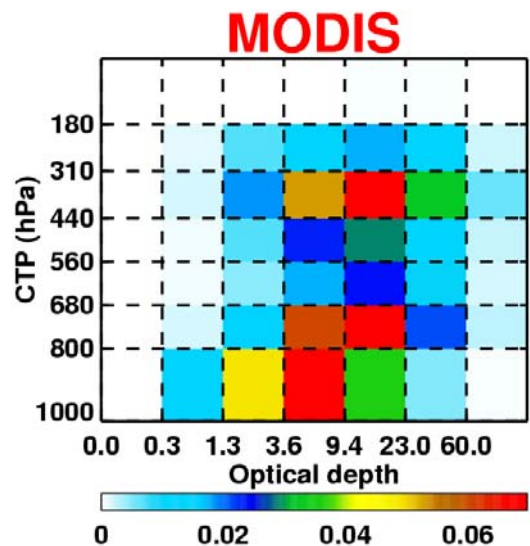
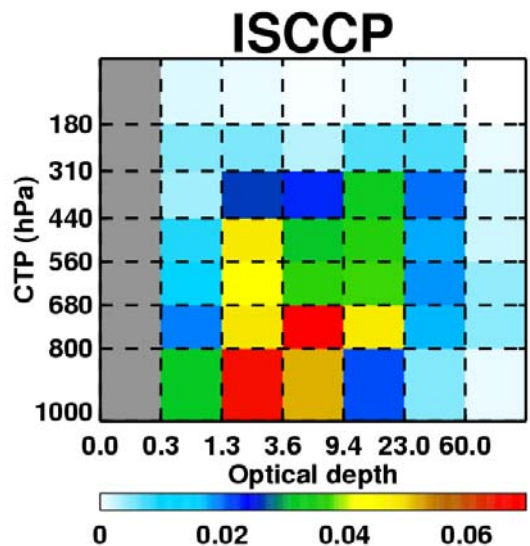
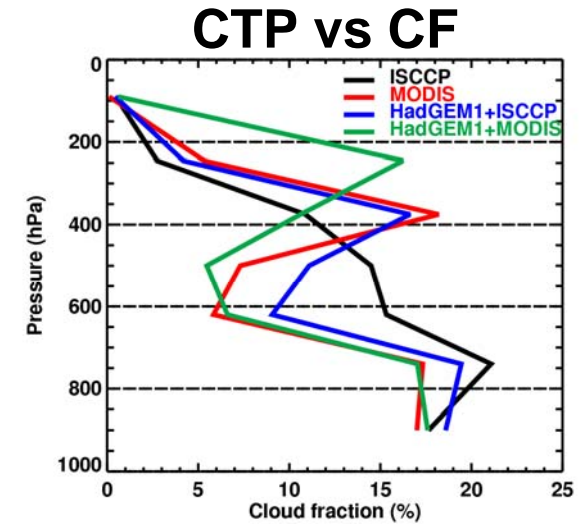
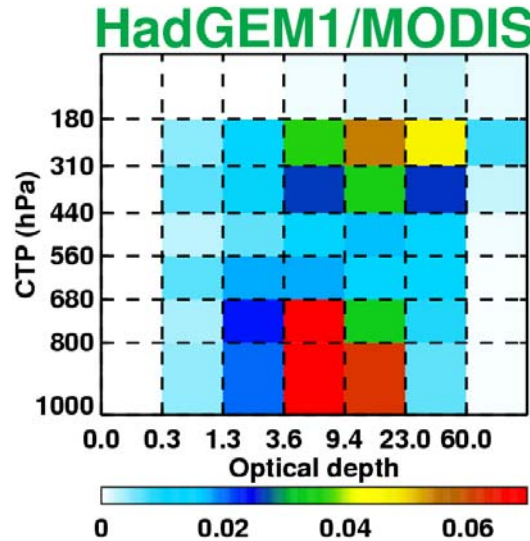
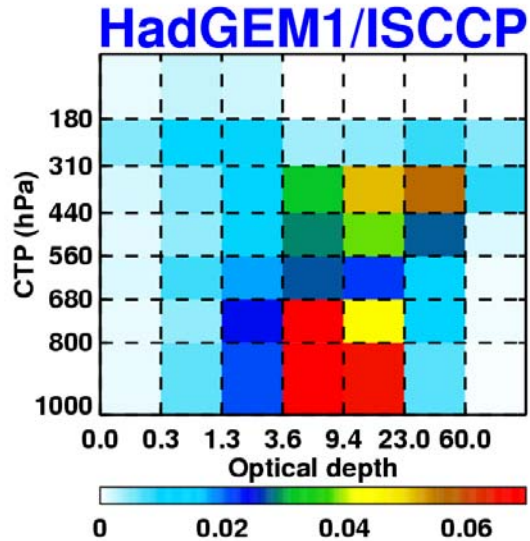




MODIS vs ISCCP

South Pacific [180°E-255°E, 60°S-40°S]

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Summary

- **Example of use of COSP for model evaluation**
- **Use of several instruments provide complementary information**
- **Common model biases**
 - **CloudSat: lack of non-drizzling mode**
 - **CALIPSO: suggestion of lack of supercooled clouds**
 - **ISCCP/MISR: too much bright high cloud**

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<http://journals.ametsoc.org/doi/pdf/10.1175/2011BAMS2856.1>

Future work

- **Extend this analysis to the CFMIP-2 multi-model ensemble and longer time series**
- **We have not considered the impact of mismatch between meteorological regimes in the observations and models due to positional errors (e.g. displacement of the storm tracks) => plans to apply clustering/compositing techniques in CFMIP-2**
- **More detailed studies for single models and specific problems**