Evaluation of SCM and LES simulations using CAP-MBL and satellite retrievals

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Objectives:

• Examine cloud properties in the Azores in the context of the global cloud field/GCM evaluation

• Examine Azores cloud variability and perform model evaluation using dynamic regime partitioning.

• Simulate the whole CAP-MBL campaign period with the GISS SCM and select case studies of model cloud deficiencies. Run LES simulations of the case studies and compare with SCM output and observational retrievals.

• Put the simulated cases in the context of the large-scale cloud field and put the LES/SCM deficiencies in the context of the GCM cloud parameterization deficiencies
Azores clouds in the global context: Weather States – Global and stratocumulus regions distributions

Azores Weather State frequency distribution is remarkably similar to that of the global cloud field.................
therefore the Azores are a good location for GCM cloud evaluation.

For example:

GCM global overprediction of Fair-weather and storm cloud and underprediction of Shallow cumulus cloud..........................

...........is also prominent over the Azores grid boxes
Dynamic Regime approach: Storm influences on the Azores cloud field

A new method is used that delineates the area of influence of a storm using the outer-most SLP contour as the storminess boundary.

- Storm influences produce large increases of the high-cloud weather states while subsidence regimes favor the stratocumulus weather states.
- Shallow cumulus clouds appear with similar frequency in and out of the storm influence area.
Vertical organization of clouds in each weather state, as seen from the ground-based radar/lidar system deployed in the Azores for CAP-MBL.
19-month run with the GISS SCM – Preliminary results
Project Recap:

The toolkit:

Observations: CAP-MBL campaign, Satellite retrievals, Reanalysis products
Models: DARHMA LES, GISS SCM, GISS GCM, CMIP5 GCMs

The methods:

Statistical analysis of climate scale observational data ensembles and GCM/SCM model simulations using a regime approach, to identify model deficiencies and relate them to prevailing atmospheric processes.

LES simulations of selected case studies that relate to identified GCM/SCM deficiencies, to isolate potential sources of model error.

The primary objective:

Take advantage of the long CAP-MBL campaign dataset and the upcoming data stream from the permanent Azores site to address at different scales GCM cloud deficiencies.
Linking results from an LES to observations
(collaborators: A. Fridlind, A. Ackerman, P. Kollias, J. Remillard, E. Luke)

LES (binned or 2-moment microphysics)

Particles size distributions
Air characteristics

Radar Doppler spectrum simulator

Doppler spectra
Radar reflectivity factors

Microphysical retrievals (as with real measurements)