

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

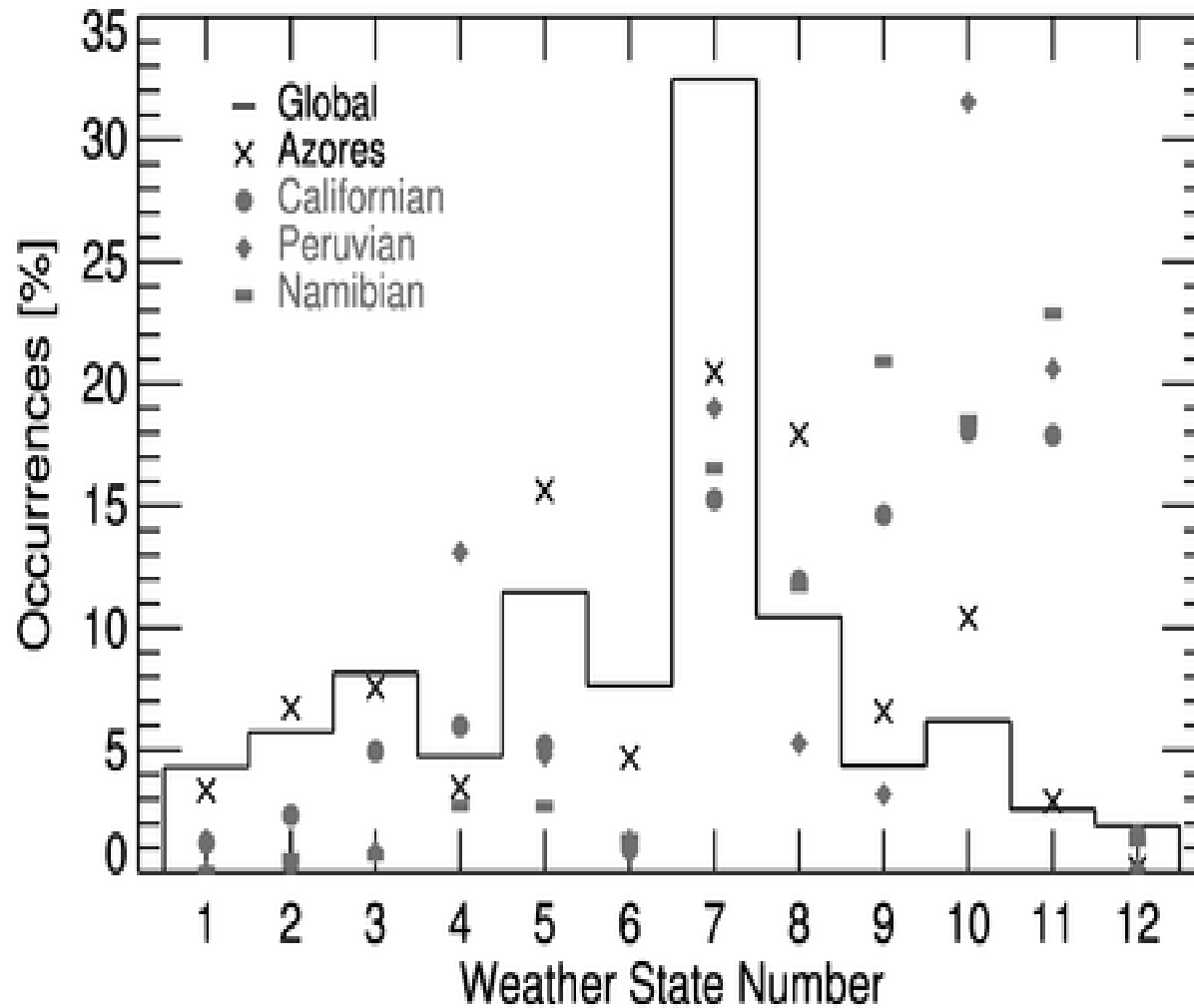
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## Objectives:

- 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:

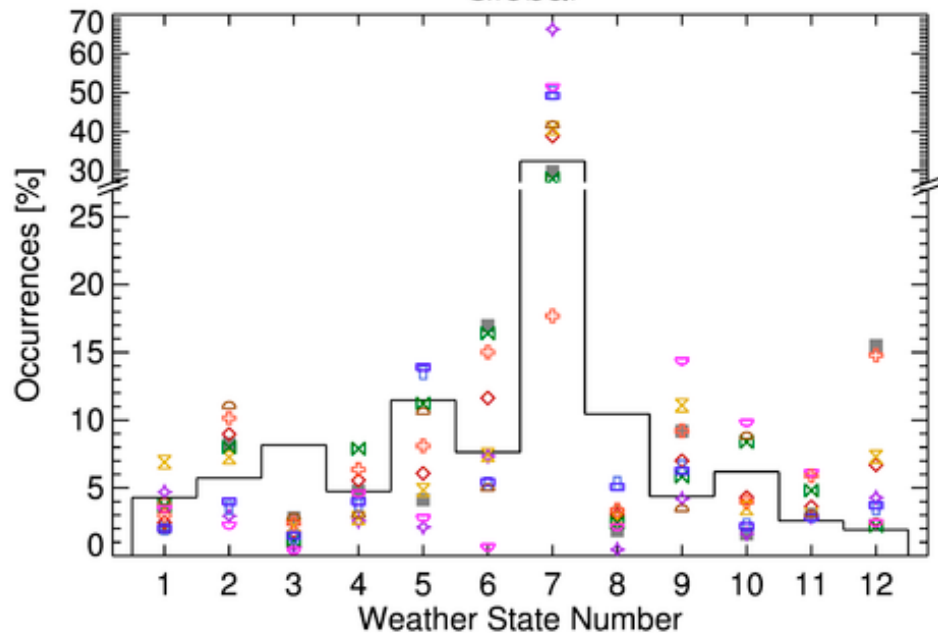
### Weather States – Global and stratocumulus regions distributions



- 1 Deep convection
- 2 Midlatitude storm
- 3 Thick cirrus (anvil)
- 4 Polar clouds (midlevel)
- 5 Thin multi-level clouds (storm-related)
- 6 Thin cirrus
- 7 Fair-weather
- 8 Shallow cumulus
- 9 Transition stratocumulus (lower)
- 10 Marine stratocumulus
- 11 Thick stratocumulus or stratus

Azores Weather State frequency distribution is remarkably similar to that of the global cloud field.....

Global



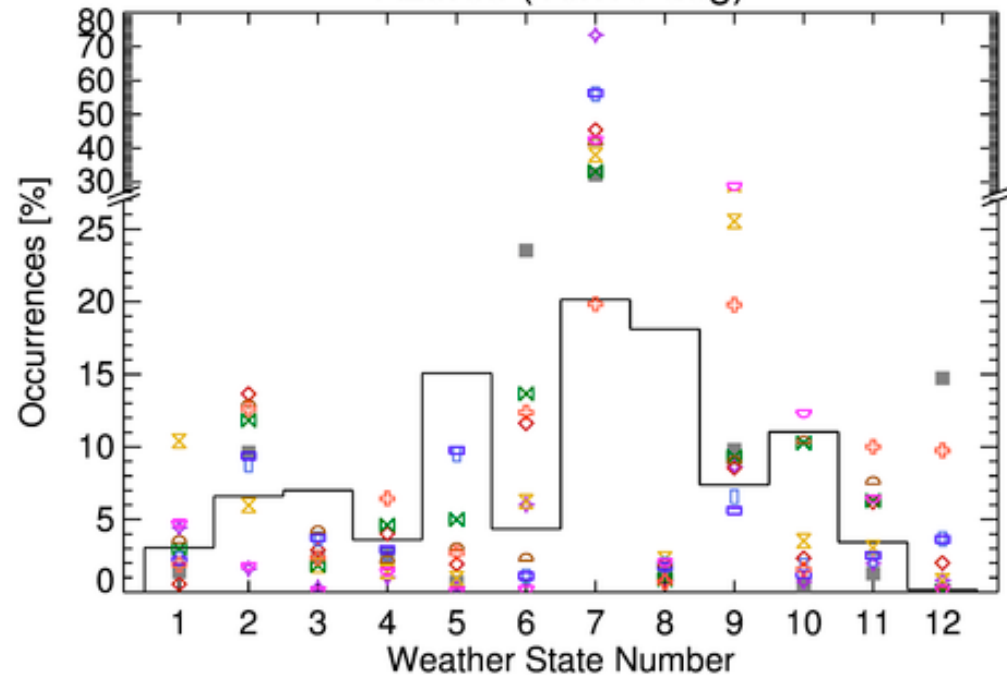
.....therefore the Azores are a good location for **GCM cloud evaluation**.

For example:

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

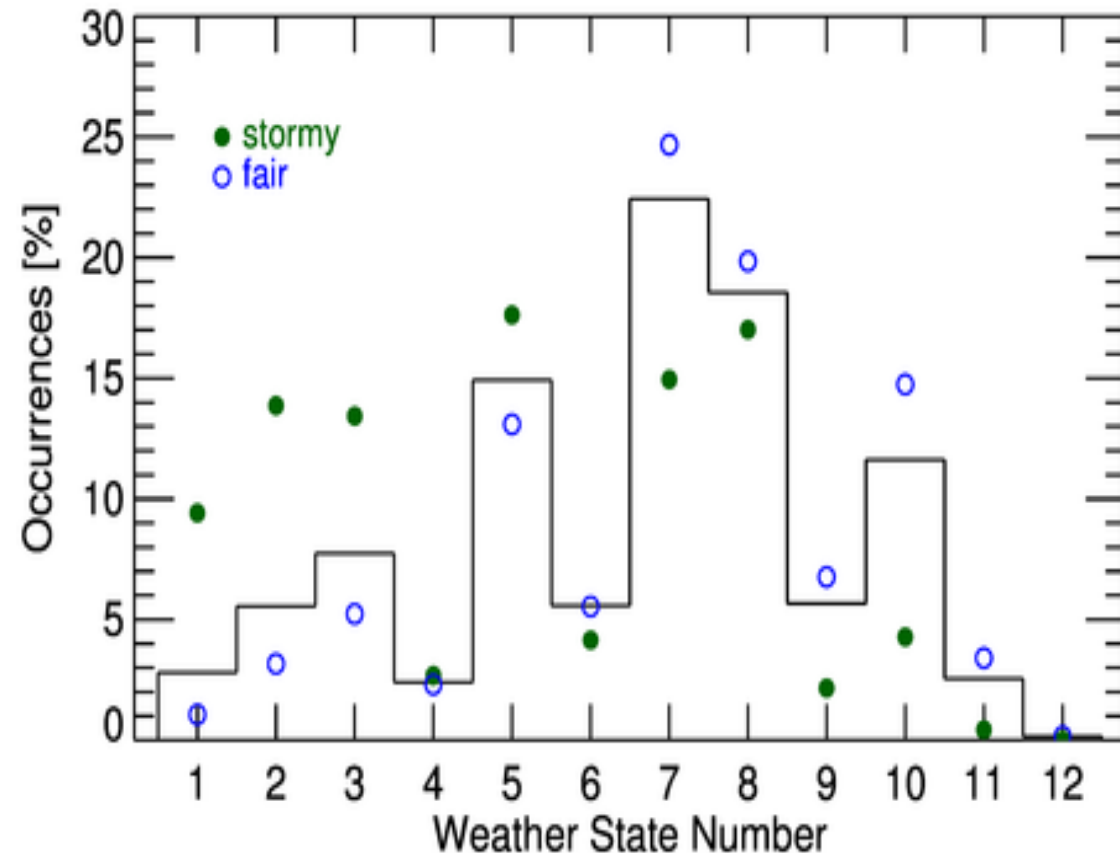
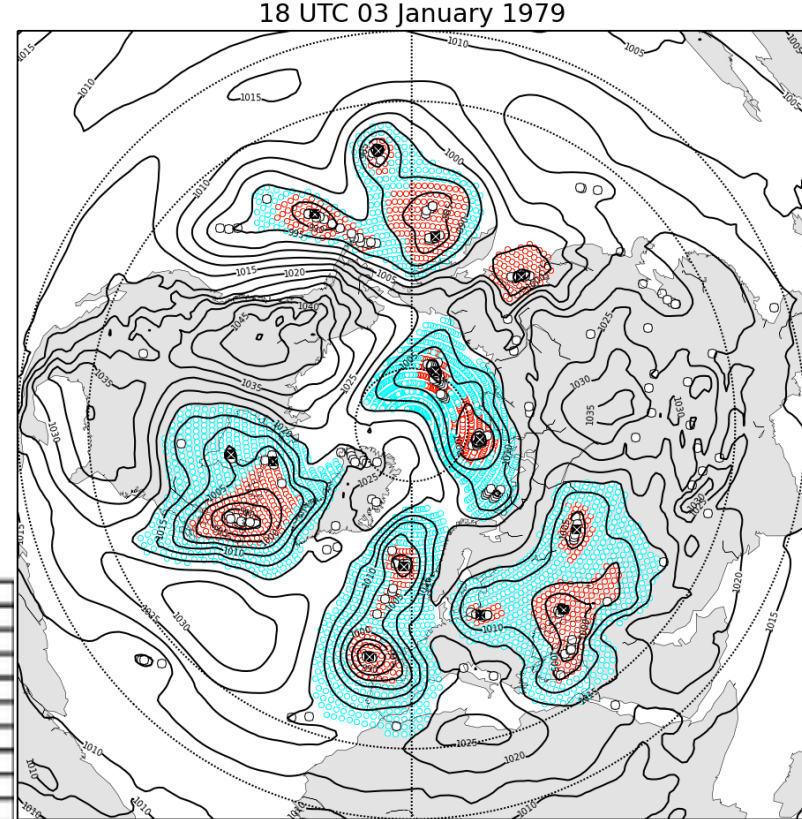
.....is also prominent over the Azores grid boxes

Azores (10x10 deg)



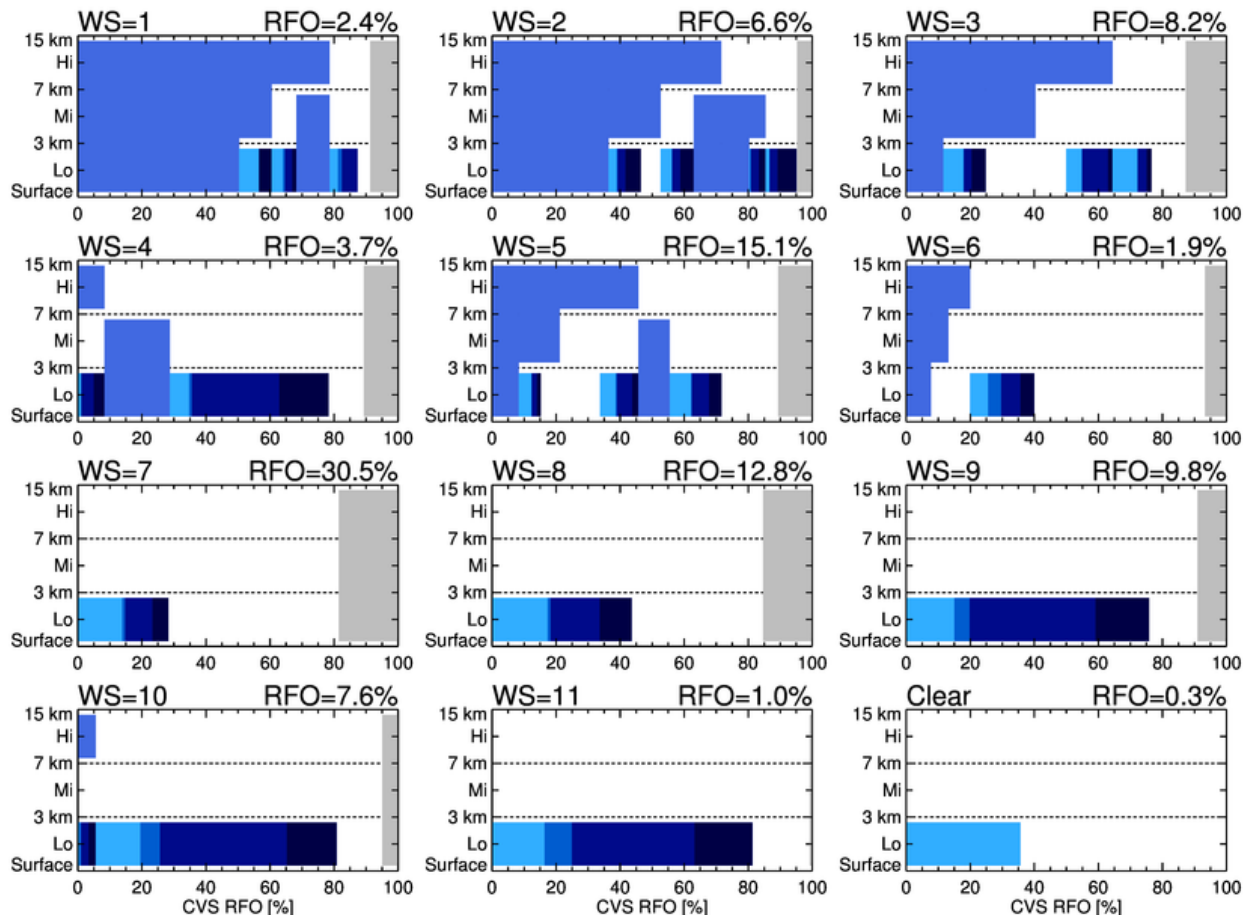
## Dynamic Regime approach: Storm influences on the Azores cloud field

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



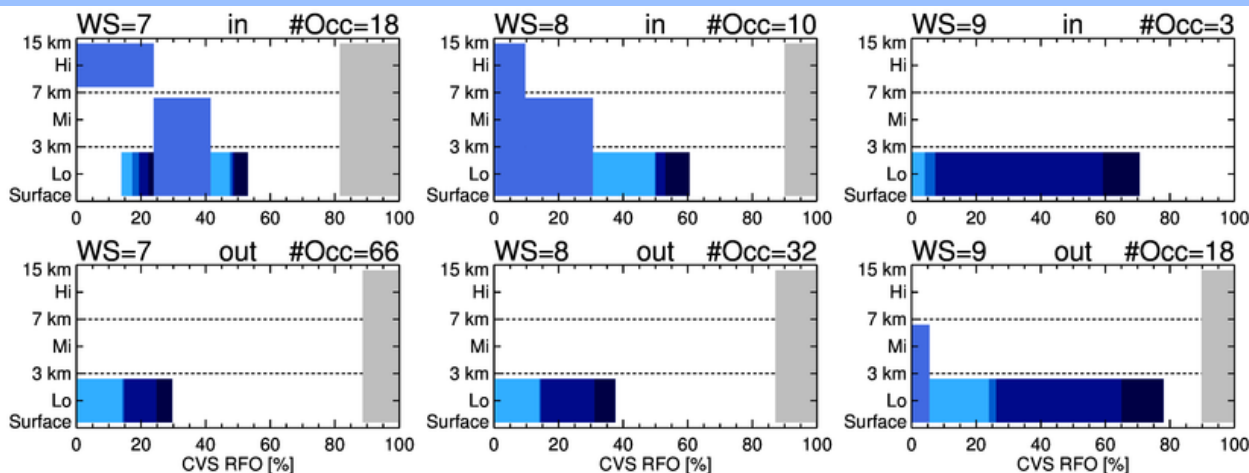
- Storm influences produce large increases of the high-cloud weather states while subsidence regimes favor the stratocumulus weather states.
- Shallow cumulus clouds appear with similar frequency in and out of the storm influence area.

Vertical organization of clouds in each weather state, as seen from the ground-based radar/lidar system deployed in the Azores for CAP-MBL

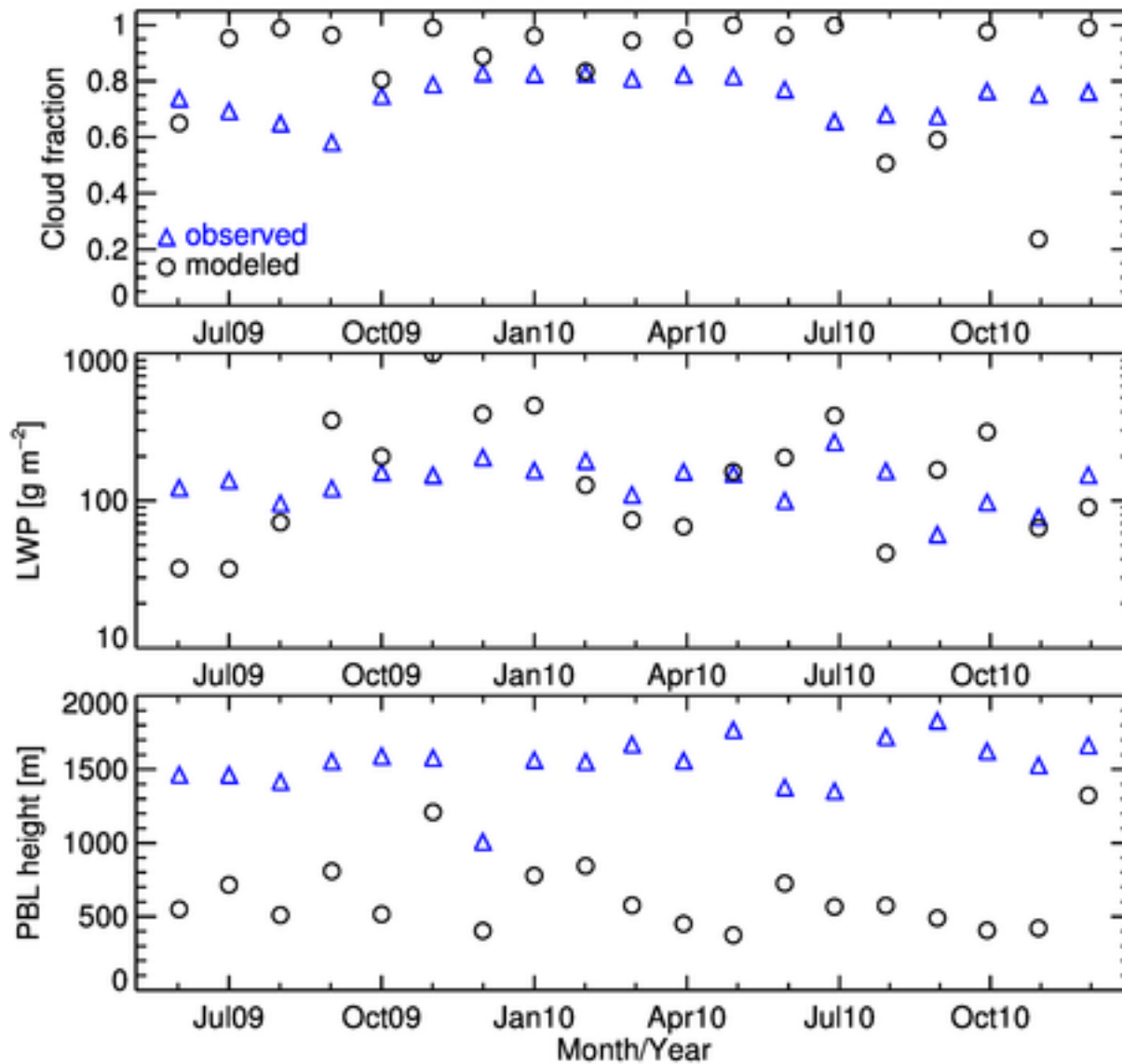


In a storm

Out of storms



## 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)

