Eurec4a

exploring the interplay between clouds, convection and circulation

in the focus: **trade wind clouds**

- properties of trade wind cumulus (life-time, density, optical depth) are very sensitive to their environment
- trade wind cumulus are poorly represented in global modeling (cover too low, COT too high) … yet are main contributors to climate cooling by clouds.

BCO ...since 2010

35GHz Ka-Band radar

35GHz radar

μ radiometer

BB-radiation

MAX-DOAS

Wind-Lidar

MRR

2 weather sensors

all-sky imager

Raman-Lidar

ceilometer

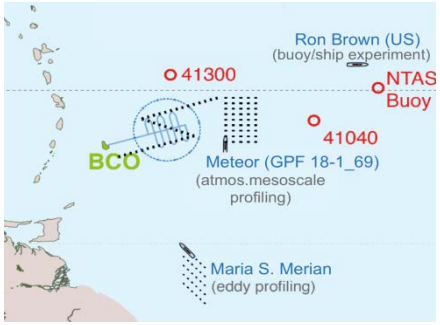
MPI-M's long-term sampling site at Barbados

Max-Planck-Institut für Meteorologie

main goals

- **improved representation in (global) modeling …**
  - cloud development
  - precipitation out of clouds
  - cloud decay
- **understanding (cloud) controlling processes …**
  - large scale dynamics ?
  - moisture supply (lower boundary) ?
  - atmospheric stability ?
  - aerosol ?
- in need for the spatial component → **Eurec4a**

Eurec4a !



- focused field campaigns covering a wider region … with extra instruments for more detail
  - the 'network' elements
  - **BCO** western anchor station
  - **plane 1** (Halo) rem. sens. from above / drop-sondes
  - **plane 2** (ATF) cloud profiling and remote sensing
  - **plane 3** (GB) in-situ cloud and aerosol sampling
  - plane 4 (US)
  - **ship 1** (Meteor) aircraft coordination /cld processes
  - **ship 2** (Merian) fresh water eddies / cloud processes
  - ship 3 (Atalante)
  - ship 4 (Ron Brown)

Eurec4a questions ?

- **what infl. by large-scale synoptic divergence ?**
  - coordinated 6-hourly radio-sondes from all ships supplemented by aircraft drop-sondes
- **what infl. by ocean cond.** (fresh water eddies) **?**
  - (cloud) measurements in and outside of eddies
- **what are the processes near cloud-base ?**
  - in-situ sampling with a tethered balloon
- **a new 'complete' reference data-set !**
  - for modeling and satellite remote sensing

capture cloud properties

- structure
  - top/base/shear, aggregation state
- properties
  - droplet size, water content/profiles , precipitation
- temporal changes
  - life time, daily cycle

impact of environment on clouds

- water vapor
- large scale meteorology
- mesoscale features
- small scale mixing
- aerosol

tools 1: active remote sensing

	ship	plane	BCO
• radar (35 Ghz)		2	1
• radar (94Ghz)	3	1	1
• water vap radar (163hz)	1		
• ceilometer	3		1
• backscatter-lidar	1	1	1
• DIAL water lidar		1	
• Raman-lidar	1		1
• HSRL-lidar		1	
• wind-lidar	1		1

tools 2: atmosphere – in situ

	ship	plane	BCO
• cloud-kite	2		1
– microphysics			
– turbulence			
– CCN			
• UAVs	1		
– met package			
– camera package			
• radio-/drop-sondes	4	1	1
– vertical profiling			

tools 3: passive remote sensing

	ship	plane	BCO
• microwave radiometer	2	1	1
• UV/VIS n-IR spectrometer	1	3	
• broadband radiation	3	1	1
• precipitation radar	2		1
• X-band radar eddy cov.	2 ?		
• sun-photometer	4		1
• disdrometer	3		1
• isotopes in water vapor	3	1	
• vis/thermal cloud camera	3	1	2

tools 1 - defining the **ocean**

	ship	plane	BCO
• CDT (ocean profiling /sampling)	3		
• pump CTD/ MIMS	1		
• ocean biology (water filtering)	2		
• gliders	2		1* argonaut/ seaglider
• drifting buoys	1		
• surface floats with tracking	1		
• far-IR spectrometer (M-AERI)	1		

coordination …

of similar instruments for maximum value…

- **calibrate / compare** (how often, when, how)
- assure **spatial connectivity** (pattern, setup)
- **timing** of sampling

of complementary instruments for insights…

- needed **co-location** yet non-interference

of logistics

- getting instrument ready, **transport**, setup