EUREC^{4}A Ringberg Planning Meeting Summary

General Overview

The workshop took place at Schloß Ringberg from 14-17 April, 2019. We had forty-one participants representing all fo the major groups participating in EUREC4A (including remote participation from the EUREC4A-UK consortium). The workshop addressed two main themes: (i) review of scientific objectives; (ii) identification of issues and gaps in planning; (iii) formation and scoping of working groups to facilitate further planning; articulation of next steps.

Issues:

1. *How to best coordinate the synergistic use of different platforms:* In particular how to position platforms, how to scope their work in complementary ways. The discussion identified a main axis of operations on a rough (EW) line between the NTAS buoy and the BCO, and possibly a secondary axis extending to the South, from the BCO toward Guyana, along the line of eddies that move off the coast of South America. Aircraft operations are seen as being concentrated along the major (EW) axis, but there is considerable interest, and plans, for a subset of Research Vessels to work eddies that may be better formed south of Barbados
2. *Flight composition:* An essential aspect of EUREC4A is to characterize the relationship of clouds to the properties and dynamics, including turbulent dynamics, of the air masses in which they are embedded. This is complicated by strong diurnal and mesoscale variability, which compounds sampling challenges. Different options were outlined, in particular for sampling diurnal and mesoscale variability. A general idea was to try and specify fixed patterns — repeatable patterns — that could meet these objectives, but at the same time build in sufficient flexibility to allow us to make slight adjustments for changing conditions (i.e., detailed positioning of circles) or to address complementary objectives or other targets of opportunity. The workshop helped clarify the issues and the tensions. These will serve as a basis for more detailed flight planning by a subgroup, who will develop different, but specific, scenarios, and outline their pro's and cons as a basis for finalizing flight plans.
3. *Considerable complementarity between the ATR-42 and Twin-Otter.* How best to take advantage of this complementarity is an open issue that should be discussed in more detail between the two groups. Major questions include the degree of responsibility or distribution of responsibility for turbulence and microphysical measurements, some of which also depends on the availability of the Boreal drone.
4. *Additional Platforms:* It will only be known toward the end of May as to whether L'Atalante and Ron Brown will be available, and if there will be additional US aircraft. Only when this is known does it make sense to engage in detailed ship planning, but it was recognized that regardless of the number of ships, it is important for the ships to contribute to measurements along the E-W Axis as this gives the best possibility to constrain air-sea interaction. For the US aircraft, areas of complementarity that were particularly attractive included the use fo the G4 to characterize the large-scale, with much larger flight/ sounding circles enveloping the ships. The P3 could provide complementary measurements by flying above cloud (between 4-6 km) with the other aircraft; link possible ship deployments along the Southern Axis, or perhaps fill a night gap.

Decisions (somewhat incompletely incorporating input from break-out groups):

- Data policy is okay, modulo a non-commercial use clause; also data provider agreements should be developed with a data delivery commitment and plan.
- Essential targets focus on a full characterization of the dynamic state of the sample volume defined by the circles. This includes sufficient measurements to differentiate the state of condensate (3D distribution of clouds) among flights, and constrain the energy budgets to 10-20 Wm^{-2}.
- Targets (flight) of opportunity should be identified and worked out more fully to sharpen the hypotheses, flight plans, and decision processes should flexibility merge in the flight plan. Here discussion was focused on sampling regions of mid-level moisture intrusions, or coordination with satellites.
- Standard, foundational flight plans, should try to build in flexibility, also to allow some subset of the time to pursue a secondary objective.
- Ensure that the E-W axis is well measured, with sufficient ship time — not just Meteor — in the area between Barbados and the NTAS buoy.
- Desire to sample the diurnal cycle, with a weekly 0400, 0800, 1200 take-off being an initially favored schedule.

- Try to define flight corridors for ATR-42 and TwinOtter in Barbados airspace which extends roughly 120 km East of Barbados and to a height of 7.5 km. This is also linked a region of excellent shore-based C-band radar coverage. Need to address question of what happens if sondes cross between air-spaces.
- HALO flights mostly at 8 km, desire to have low-level legs (4-5 km) to provide better lidar signal to noise. Would be best if these could be low enough to meet the signal to noise targets, but high enough to allow the lidar to remain cool enough on the one hand, and the radar to maintain operation on the other.
- The ATR will fly in the sub-cloud layer and in the cloud layer; the determination of the flight levels optimizing the characterization of the cloud fraction and the PBL turbulence will have to be worked out, taking into account the complementarity with the other aircraft and the Boreal drone.
- Attention should be devoted to better characterizing surface fluxes, in particular how each ship will make these measurements, and what complementary measurements are available from other platforms. The possibility to measure sensible and latent heat fluxes with the Boreal drone should be investigated.
- Basic flight plan should incorporate coincidence as much as possible, and see about incorporating super curtains along a scan-line (RHI) of the ground-based (Cband) radar. Coordinated (joint) measurements between ships also should be built into plan, for instance having the 20th be an inter calibration day as ships steam from Barbados on the 20th.
- EUREC4A data bank is being organized by French team and could be co-hosted by Barbados; Barbados/CIMH/CMO also interested in exploring ways to contribute to continuity and sustainability of certain experimental elements.
- Define working groups based on the break-out groups that were identified, and use these as coordinative elements for the project as a whole. Specific working groups, and their coordinators, were identified (see below) and tasked with meeting and advancing the discussion of topics within their scope prior to the next (late September) workshop.
- Outline and input for logo was provided and final decision was delegated to S. Bony.

EUREC4A Working Groups (& contact/responsible person):

1. Ship deployment (& Sargassum) — Sabrina S. & Johannes K.
2. Real-time data/model-output products — Vera S.
3. Co-location & super-curtain (also with ships) — Florian E.
4. Logistics (data distribution, coordination, communication) — Lutz H.
5. Detailed flight planning — Heike K.
6. Data products — Raphaela V., Markus K. & Tobias K.
7. Outreach — TBD

We agreed to use working groups to provide much of the coordination. Groups are asked to define tasks and begin working on them, based on feedback from the breakout groups, and under the leadership of their coordinators. Most if not all groups are expected to meet in early summer as their deliberation will prepare the September planning workshop. Several volunteered to coordinate outreach group, but choice of coordination team pending email confirmation. Each group is asked to send a summary/task list in the next couple of weeks.

Next Steps:

Website Work
- Presentations.
- Meeting Summary.
- Figure Gallery (clouds, facility schematics, photos, flight schematics).
- Augmented background (further reading) documents.

E-Mail list.
Volunteers for outreach.
Logo finalisation
Summaries (incl. task scoping/next steps) from coordination groups.
Identify main points of contact, lines of communication.
24-26 Sept Meeting in Paris.