Atlantic Trade-wind Ocean-Atmosphere Mesoscale Interaction Campaign (ATOMIC)

NOAA is developing plans for an air-sea interaction field program conducted in the N. Atlantic tradewind region in January-February 2020. This will be a multiagency US effort that will link with a European program call Elucidating the Role of Clouds-Circulation-coupling in Climate – ERUC4A (see Fig. 1 for the program location). ERUC4A will consist of a large-scale ship-island rawinsonde sounding array plus a 180-km diameter mesoscale region that will sampling with airborne platforms. The primary goal of ERUC4A is to determine the role of shallow convective cloud processes in the CO2 sensitivity of climate models. For the US contribution to EREC4A, NOAA plans to bring our unique observing platforms to complement the European effort. NOAA's science objectives will emphasize mesoscale oceanic-atmospheric coupling and cloud-aerosol interactions. It is expected that this work will be done by NOAA and in collaboration with NSF. This campaign has been endorsed by CLIVAR.

Shallow convection, the effects of clouds on the ocean surface energy budget, and mesoscale oceanic processes are relevant to myriad NOAA applications: climate sensitivity, propagation of Madden-Julian Oscillations (MJO), hurricane track and intensity, annual movement of the Intertropical Convergence Zone (ITCZ), midlatitude storm tracks, and marine stratocumulus cloud regions. Shallow convection is an important issue for NWP overland as well with implications for convective inhibition and the initiation of thunderstorms or for solar energy forecasting. The oceanic region of interest is smack in the middle of the Atlantic Warm Pool (AWP).

ESRL, PMEL, AOML, and GFDL are cooperating in the ATOMIC investigation. ERSL has requested the Ronald H. Brown (RHB) for 30 days in the Jan 15-Feb 20, 2020 date window. NOAA's Climate Program Office has issued an announcement of opportunity for funding to participate on board the RHB; CPO is currently reviewing 15 proposals. NSF is also entertaining proposals from several universities – subject to the availability of RHB. The Naval Research Laboratory is proposing to participate in the field program. ESRL currently has a project funded by NWS to use ATOMIC data to evaluate the physics package in the new NOAA weather model (FV3). ESRL is developing plans with NWS and NESDIS for cooperation on the ATOMIC field program.

The plan to RHB is to load four seacontainer laboratories and the oceanographic assets in an SE US port (Charleston, Ft Lauderdale, ..) and proceed directly to Barbados for a short port call. The ship will then transit to the experimental region to occupy an oceanic feature with an SST signature: priority 1, a large eddy; priority 2, a reasonably linear frontal feature (see Fig. 2). The ship will deploy three kinds of drifting buoys that measure air-sea fluxes and ocean mixing. A UAS system will be deployed from the ship to map fluxes and surface structure. RHB will perform some mapping on scales of a few degrees but will remain in the general area to tend the buoys. At the end of the field phase, we would offload in Barbados. If PNE and NTAS immediately follow ATOMIC, we may request leaving the flux, balloon sounding, and cloud observing systems on board for those cruises (see Fig 3).

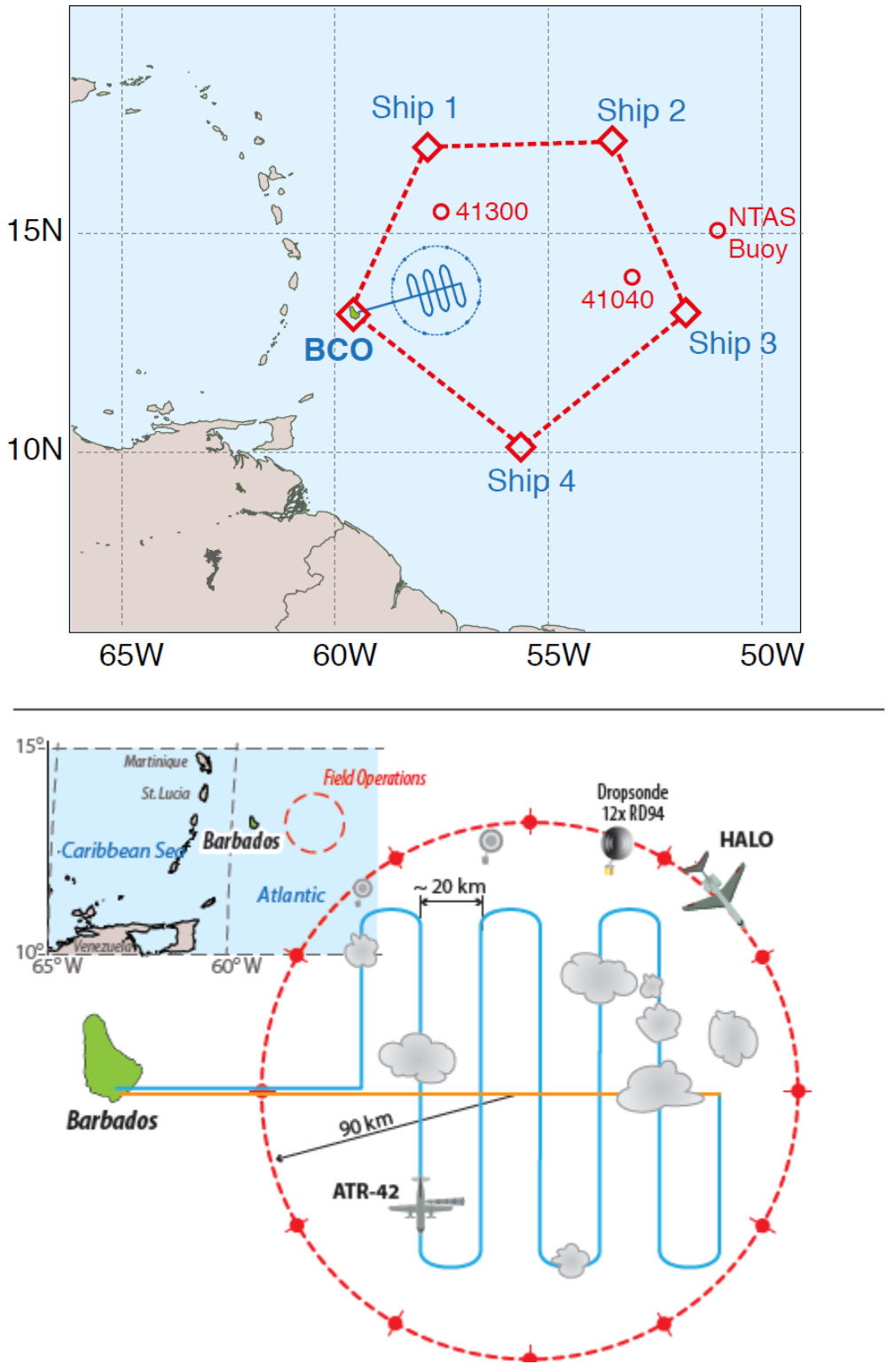

Figure 1. Schematic of EUREC4A field program region in the N. Atlantic. Upper panel: large scale surface-based sampling array; lower panel: mesoscale aircraft sampling region.

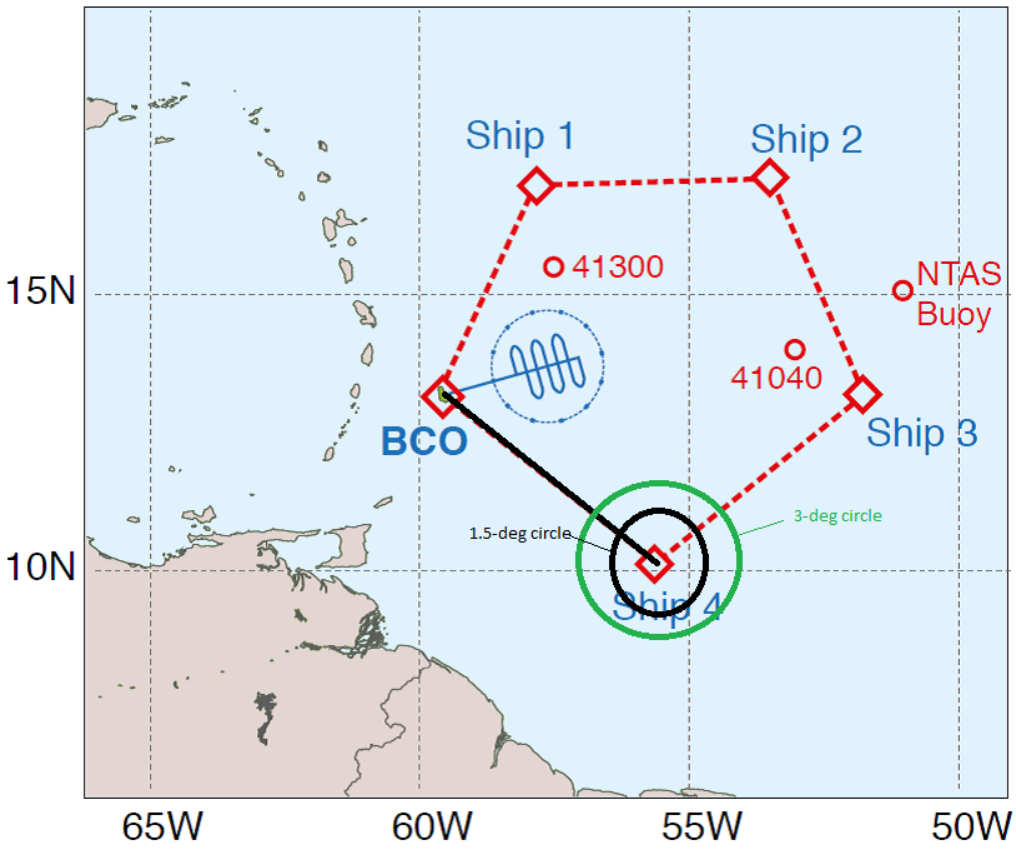

Figure 2. Example NOAA aircraft flight from Barbados to NOAA ship R. Brown assuming it is occupying Ship 4 location. The green and black circles are dropsondes segments for the G-4. The P-3 will a grid pattern at 2.5 km altitude to map the ocean-atmospheric structure near the ship.

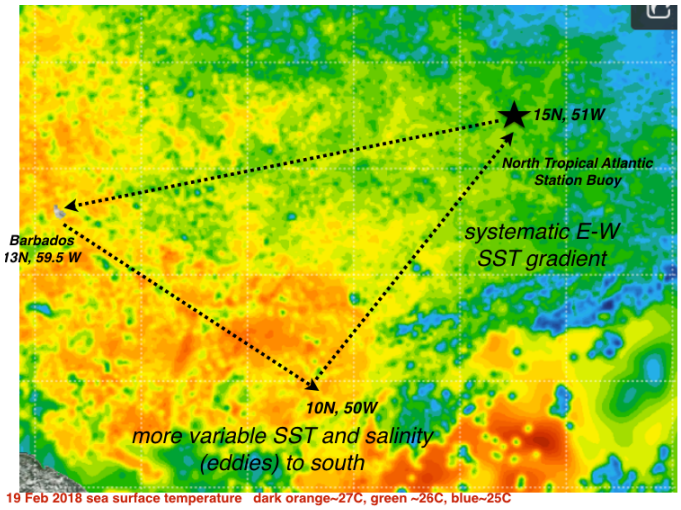

Figure 3. Example of possible cruise track for NOAA ship R. Brown following occupation of Ship 4 location.

Background Information

Atlantic Trade-wind Ocean-atmosphere Mesocscale Interaction Campaign (ATOMIC). A ship-aircraft-island study of cloud-ocean interactions on multiple scales.

ESRL is requesting the G4 and P3 to engage in an international field program in 2020. NOAA is developing plans for an air-sea interaction field program conducted in the N. Atlantic tradewind region in January-February 2020. This will be a multiagency US effort that will link with a European program call Elucidating the Role of Clouds-Circulation-coupling in Climate – ERUC4A (see Fig. 1 for the program location). ERUC4A will consist of a large-scale ship-island rawinsonde sounding array plus a 180-km diameter mesoscale region that will sampling with airborne platforms. The primary goal of ERUC4A is to determine the role of shallow convective cloud processes in the CO2 sensitivity of climate models. NOAA plans to bring our unique observing platforms (research aircraft and a ship) to complement the ERUC4A effort. NOAA's science objectives will emphasize mesoscale oceanic-atmospheric coupling and cloud-aerosol interactions.

The ship will be instrumented with atmospheric and oceanic instrument systems to measure clouds, precipitations, air-sea fluxes, atmospheric and oceanic boundary layer turbulence. The ship will operate within the EUREC4A sounding array and will form one of the weather balloon launching platforms. Mesoscale oceanographic structure will be sampled around the ship. Operations will be coordinated with NOAA P-e and G-4 aircraft.

The G4 will be used to deploy an array of dropsondes (30/flight) in a circle about 200 km diameter - similar to the El Nino Rapid Response (ENRR2016) project.. The TDR will be used to map precipitation within the circle. Operations will be coordinated with NOAA P-3 and G-4 aircraft and aircraft deployed by the European team.

A NOAA ship will be instrumented with atmospheric and oceanic instrument systems to measure clouds, precipitations, air-sea fluxes, atmospheric and oceanic boundary layer turbulence. The ship will operate within the EUREC4A sounding array and will form one of the weather balloon launching platforms. Mesoscale oceanographic structure will be sampled around the ship.

12 full length mission flights will be conducted east of Barbados. Flights will be done in a mixture of disturbed and undisturbed conditions. These observations will provide estimates of mesoscale forcing of convection within the circle.

Shallow convection, the effects of clouds on the ocean surface energy budget, and mesoscale oceanic processes are relevant to myriad NOAA applications: climate sensitivity, propagation of Madden-Julian Oscillations (MJO), hurricane track and intensity, annual movement of the Intertropical Convergence Zone (ITCZ), midlatitude storm tracks, and marine stratocumulus cloud regions. Shallow convection is an important issue for NWP overland as well with implications for convective inhibition and the initiation of thunderstorms or for solar energy forecasting. The oceanic region of interest is smack in the middle of the Atlantic Warm Pool (AWP).

The measurements made during this project will provide data that are required to improve climate simulations, and our understanding of the impact of atmospheric convection, aerosols and clouds on climate. Data from past cruises have been used to assess and inform air quality and climate policy decisions and improve climate simulations on a regional basis.

This project will continue collaboration to improve CFS/FV3 forecasts that was begun with the DYNAMO 2011 study in the Indian Ocean and continued with the ENRR study of El Nino in 2016. https://www.esrl.noaa.gov/psd/enso/rapid_response/