

Workshop Overview

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A Department of Energy (DOE) field campaign focused on low marine boundary layer clouds (stratocumulus) and cloud physics has converged on the Azores islands in the north Atlantic during June and July 2017. The airborne atmospheric measurement platform (instrumented ARM Mobile Facility, G1 plane) augments the fixed installation of advanced radar and profiling sensors on Graciosa Island in the central group of the Azores to conduct an intensive study of cloud formation, composition and evolution.

We took the opportunity of the arrival of international scientists on the Azores archipelago to convene a workshop/summer course on “Earth System processes in the North Atlantic.” A cohort of over 20 graduate students based in the U.S. and Portugal (many from the Earth System Ph.D. program of the University of Lisbon) met from 2-7 July 2017 on the island of Terceira for lectures and site visits. The lecture topics covered the diversity of earth science represented in and around the Azores – from volcanology and plate tectonics to the teeming extreme life of the seamounts and hydrothermal vents along the Mid-Atlantic Ridge.

The Azores are uniquely situated in a transition region between the subtropical Azores high pressure system and the midlatitude storm track. In the summer, winds are largely controlled by the Azores high - with northerly winds being the most common wind orientation. The preponderance of marine boundary layer clouds (over 50% of the time) makes the Azores attractive from an atmospheric radiation measurement perspective (Wood et al., 2015). Furthermore, the Azores occupies a rich confluence zone for oceanic eddy and frontal activity generated by the Gulf Stream and Azores Current systems (Le Traon and De May, 1994; Volkov, 2005; Volkov and Fu, 2011; Caldeira and Reis, 2017). These factors, along with the volcanic origin of the islands, make the Azores an ideal laboratory for studying earth system interactions.

Each day of the workshop incorporated lectures from the numerous atmospheric scientists stationed as part of the DOE ARM ACE-ENA field campaign. Well over a day of lectures were devoted to the ocean environment - covering the regional scale flow and water masses along with the energetic Azores Current that bifurcates off the Gulf Stream. Then lecturers from Madeira (Oceanic Observatory of Madeira) the U.S. (Stevens Institute), and U.K. (University of Reading) described the local in situ generation of oceanic and atmospheric eddies through interaction with the islands. Faculty from the University of Lisbon and Duke University discussed mountain flows, orographic precipitation, and land surface processes.

The group conducted a visit to the 1761 lava flow and cave sites on Terceira Island led by faculty from University of the Azores. As well, the students toured the ARM G1 aircraft to learn about the state-of-the-science field campaign instruments for measuring clouds and aerosols. The field campaign is conducting 5 flights a week through July each lasting ~4 hours and centered around Graciosa Island where the fixed installation is located.

The comprehensive nature of the workshop encouraged synthesis and connections across earth science disciplines, and benefited enormously from the hands-on access to the dedicated atmospheric science measurement campaign. The workshop is envisioned to be an annual event. More details on the 2017 workshop and ACE-ENA campaign can be found here:

Websites

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