Shallow Clouds and Air-Sea Interaction

NOAA Contributes to International Field Campaign

Shallow convective clouds efficiently move moisture from the ocean into the lower troposphere.

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NOAA Physical Sciences Division-led field campaign observations will be used by NOAA Research to guide weather forecast model development.

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Accurate representation of key air-sea interactions will improve forecast models' predictions of weather and water extremes.

The **Atlantic Tradewind Ocean–Atmosphere Mesoscale Interaction Campaign (ATOMIC)** is a field experiment to investigate atmospheric shallow convection and air-sea interaction in the tropical North Atlantic east of Barbados. This NOAA-led effort will deploy instruments from a research ship and aircraft to measure key cloud and air-sea interaction processes that are needed to improve understanding and prediction of the impacts of shallow convection on weather and climate conditions on the U.S.

Motivation

To improve understanding and prediction of the world's weather and climate systems requires detailed information on how the atmosphere and ocean interact. In the atmosphere above most oceans, vertical mixing occurs through a process called *shallow convection*. The resulting warm clouds cover much of the ocean and can strongly influence weather on seasonal or shorter time scales.

Deep convection (resulting in clouds tall enough to form ice particles) and shallow convection are intricately linked. The process of shallow convection humidifies the lower atmosphere, creating conditions favorable for deep convection. Shallow convection also exerts an important influence on sea surface temperatures and salinity by moderating the exchange of energy and moisture between the atmosphere and ocean. More accurate representation of these key air-sea interactions will improve forecast models and the prediction of weather and water extremes.

Warm ocean water is the fundamental driver of atmospheric tropical convection. In the Tropical Northwest Atlantic, ocean eddies are massive heat reservoirs that capture and transport the fresh waters of the Amazon and Orinoco rivers. These "hot spots" are heat and humidity sources for the atmosphere. However, the exact origin, properties and fate of these ocean eddy hot spots, as well as their actual influence on Tropical Northwest Atlantic air-sea interactions, surface energy, and atmosphere shallow convection is still poorly understood.

Approach

In an effort to advance understanding of these processes, NOAA's Physical Sciences Division will join with other NOAA Research laboratories, the Climate Program Office's Climate Variability and Predictability Program, other federal agencies and several universities during the winter of 2020 to lead ATOMIC.

The U.S. field campaign will collaborate with an intensive European study, called EUREC^{4}A (ElUcidating the Role of Clouds-Circulation Coupling in ClimAte), to investigate atmospheric shallow convection and air-sea interaction in the tropical North Atlantic east of Barbados. NOAA will deploy instruments from a research ship and aircraft to measure key cloud and air-sea interaction processes. This effort will involve a unique combination of ships, piloted aircraft, and remotely-controlled aerial and ocean crafts to characterize the variability of oceanic and atmospheric properties.

Anticipated Benefits

The results of this research are anticipated to improve understanding of the impacts of shallow convection on weather and climate, and will be used by NOAA Research to guide model development for NOAA's Unified Forecast System. Improved representation of convection in the atmosphere in NOAA's model forecast systems is anticipated to improve prediction of high impact weather, water and climate extreme events.

> *"ATOMIC will advance our scientific understanding of atmosphere- ocean coupling and clouds in a way that enhances our models, the numerical guidance they provide National Weather Service forecasters, and ultimately service to the public."*
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> *Brian D. Gross, Director*
> *NOAA/NWS Environmental Modeling Center*

For more information, visit:

ATOMIC: https://www.esrl.noaa.gov/psd/atomic/
EUREC^{4}A: http://eurec4a.eu/

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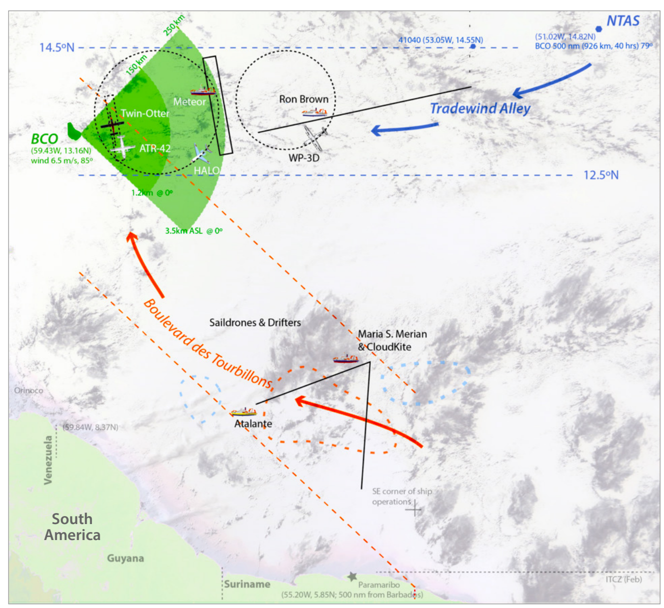
During ATOMIC, NOAA will take measurements from its research ship *Ronald H. Brown*, P-3 aircraft, and in partnership with the University of Washington, remotely-controlled Wave Gliders and SWIFT drifting bouys.



Area of field operations for ATOMIC/EUREC^{4}A showing 'Tradewind Alley' and the Barbados Cloud Observatory (BCO) central measurement area (the green semi-circle defines the radar coverage). Additional research vessels will contribute to these measurements while also exploring the influence and evolution of ocean eddies that frequently ramble toward Barbados from the southeast along the 'Boulevard des Tourbillons'.