THE ARABIAN SEA TRANSITION LAYER (ASTRAL): EXCHANGE ACROSS THE AIR-SEA INTERFACE

Almost all climate models exhibit a cool sea surface temperature (SST) bias in the Arabian Sea with direct consequences to the modeled atmospheric moisture and precipitation (too dry). The southeastern Arabian Sea develops a 'mini warm pool' region with SSTs rising through the low wind, clear sky conditions of the boreal spring intermonsoon period. When present the mini warm pool sets up a north-south SST gradient with cooler waters to the north. Limited observations of the atmospheric boundary layer (ABL) show similarly pronounced latitudinal variation in structure (mixed layer height, stability, and inversion strength) and turbulent surface fluxes. With the onset of the summer monsoon, the mini warm pool collapses suddenly; the coincident evolution of the ABL and air-sea exchange has yet to be observed. In the upper ocean, the seasonally reversing exchange with the neighboring, fresh Bay of Bengal contributes to the stratification of the mini warm pool region through lateral stirring and mixing of the distinct water types. A contrasting scenario is present in the northern Arabian Sea where the Gulf of Oman and Aden are salinity sources for the basin. This geography sets up 'a natural laboratory' for the study of localized air-sea interaction with clear north-south variation in ocean stratification that evolves rapidly in time. ASTraL seeks to understand the dynamical mechanisms that control the *structure within* and the *coupling across* the ocean and atmospheric boundary layer, i.e., "the transition layer", in the Arabian Sea, and, consequently, to provide a framework for resolving coupled model biases in the region's ocean heat, atmospheric moisture, and precipitation.

Objective

ASTraL will combine atmosphere-ocean observations acquired via autonomous and ship-based platforms with multi-tiered modeling (process-resolving idealized modeling, coupled regional modeling, and data assimilative forecasting) to understand the dynamical mechanisms controlling the upper ocean and lower atmosphere structure, as well as the transfer of heat and moisture at the interface, in the Arabian Sea. We anticipate UNOLS cruises during the second and third years of the program with a reduced pilot for a subset of investigators in the first year. Fieldwork and modeling will be designed to address the following questions:

1. What processes control the maintenance and dissipation of the Arabian Sea warm pool?
2. How does variation in warm pool strength and stability in the ABL modulate local air-sea fluxes?
3. How does the collapse of the warm pool change boundary layer structure and surface fluxes?
4. What exchange processes are misrepresented in coupled models leading to moisture & precipitation dry biases in forecasts?
5. Do improved physical parameterizations of local air-sea exchange lead to improved ocean and atmosphere forecasts from short-term to sub-seasonal time scales?

Request for Planning Letters

The first step in the DRI process is for prospective investigators to prepare planning letters. The purpose of the planning letters is to allow investigators to submit a short (three pages maximum) summary of their ideas on this topic for ONR to evaluate, provide technical feedback and indicate whether a full proposal would have a reasonable chance of success.

Important Dates

May 15, 2022: Last date to submit planning letters (submit by email)
June 15, 2022: Last date ONR will respond to all submitted planning letters and requests for proposals
August 31, 2022: Full proposals due. Submission of proposals is through ONR's Long Range Broad Agency Announcement.

Award recommendations will be made prior to the start of the FY23 fiscal year. All planning letters should be submitted by email to:

Dr. Emily Shroyer (emily.l.shroyer.civ@us.navy.mil) and Dr. Josh Cossuth (joshua.h.cossuth.civ@us.navy.mil).

Planning letter guidelines can be found here. **Please note "ARCTERX planning letter and 'Your Name'" in your email subject line. If you do not receive a thank you note within 10 days, please follow-up with a resend.**