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UC SANTA BARBARA
Department of Earth Science

Earth Science Colloquium

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Hydroacoustic and Infrasound Analysis of the 2018 Anak Krakatau Eruption

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Eruptions at submarine and partially submerged volcanoes are often difficult to detect, yet can pose a significant hazard to coastal populations, ships, and aircraft. Infrasound (atmospheric sound with frequency below human hearing between ~0.01 and 20 Hz) and hydroacoustic signals (sound travelling through water) generated by these eruptions are emerging as useful tools for investigating eruption timing, location, and characteristics. This research employs a selection of moored hydrophones and infrasonic stations of the International Monitoring System (IMS) to characterize the 2018 eruption of Anak Krakatau volcano in the Sunda Strait of Indonesia, a partially submerged volcano which can produce either subaerial or submarine eruptions. A climactic eruption phase on 22 December 2018 triggered the collapse of the northwest flank and summit, generating two tsunamis which struck the coastlines of Sumatra and Java. Array processing was performed for the eruptive phase from June through December, 2018, using the Progressive Multi-Channel Correlation (PMCC) algorithm. Results indicate coherent explosive eruption signals arriving from the direction of Anak Krakatau at both infrasound and hydroacoustic stations, and were associated between stations and correspond to reports from the Indonesian Center for Volcanology and Geological Disaster Mitigation (PVMBG) and available satellite imagery. Results suggest signal content evolution during the three weeks preceding the climactic eruption, from intermittent subaerial (infrasonic) and submarine (hydroacoustic) detections, to predominantly continuous hydroacoustic detections, shifting to continuous, entirely subaerial content at the start of the climactic phase. This case study highlights the role that hydroacoustic technology can play in the detection and characterization of eruptive activity at submarine and partially submerged volcanoes.

25,000-year record of hydroclimate in north-western Madagascar and spatio-temporal patterns of Mozambique Channel's SST

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The impact of fresh water-induced perturbation of the Atlantic meridional overturning circulation (AMOC) on the southern hemisphere monsoon is not well understood in part due to the lack of spatially and temporally high resolution hydroclimate records. This research focuses on the southeastern African branch of the southern hemisphere monsoon and the water mass transport through the Mozambique Channel which is believed have an impact on the strength of the AMOC. We use three marine sediment cores collected off the northwestern Madagascar to measure Mg/Ca as a proxy of mixed-layer temperature and $\delta^{18}O$ both from calcite of the mixed layer-dwelling planktonic foraminifer *Globigerinoides ruber*. The local seawater $\delta^{18}O_{sw}$ time-series as a proxy of runoff were obtained by removing the calcification temperature and ice volume imprints on $\delta^{18}O$ in calcite. The proxy record indicates relatively humid conditions during the Last Glacial Maximum (19-25 kyr BP) and Mid-to-late Holocene (1-7 kyr BP). Superimposed on the orbital scale climate trend, the proxy record reveals millennial to multi-centennial scale increase of runoff centered at 11-13 kyr BP, 14-17 kyr BP, and 23-25 kyr BP. Taking age model uncertainties into account, these episodes are coincident with those of the Younger Dryas (YD), Heinrich event 1(H1) and Heinrich event 2 (H2). This is the first strong evidence for an enhanced monsoonal precipitation over southeastern Africa in response to large scale atmospheric circulation changes associated with the fresh water forcing of YD, H1 and H2. Changes in seasonal wind strength and direction not only affect the regional precipitation, but also combined with orography, creates a west-east gradient in the depth of the mixed layer and sea surface temperature (SST) within the Mozambique Channel. We interpret the weakening or even reversing of SST gradient is dominated by the wind fields change over Indian Ocean, which also weakens the Ekman transport. The reducing the water mass flowing through the Mozambique Channel may influence the amount of salt and heat leaking into the Atlantic Ocean and contributes to AMOC weakening.