Seminar “Ocean, Ice and Atmosphere”,
Institute of Environmental Physics (IUP), Univ. Bremen
Date: 30-Jun-2026, 12:15
Place: Building NW1, Room S1360

Tropical Upwelling Systems: From the Southwestern Indian Ocean to the Northeastern Atlantic

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This talk focuses on two tropical upwelling systems in the southwestern tropical Indian Ocean and the northeastern tropical Atlantic. The persistent, basin-scale upwelling area in the southwestern tropical Indian Ocean, which is also known as the Seychelles-Chagos Thermocline Ridge (SCTR), exists due to the southeast trade winds and the Indian monsoon winds. To monitor the upwelling variability in the SCTR, we utilize mooring observations including Pressure Inverted Echo Sounder (PIES). PIES measure the acoustic travel time that can be converted into a vertical temperature profile. These observations show that SCTR upwelling was strongly suppressed in December 2019 and 2023 due to the propagation of downwelling Rossby waves associated with the positive phase of the IOD and/or ENSO.

In the North-Eastern Tropical Atlantic (NETA), significant coastal upwelling occurs between February and April (FMA). During the upwelling season of 2024, a strong warm event was observed in the NETA. This warming was related to a weakening of the northeasterly trade winds which suppressed upwelling and resulted in less latent heat loss to the atmosphere. Despite a strengthening of the winds in March, the surface warming persisted through April. Based on high-resolution ocean reanalysis data, we relate this to persistent subsurface temperature anomalies near 50 m depth. Enhanced stratification further limited cooling by entrainment.

Although the SCTR and NETA represent different types of tropical upwelling systems, both regions demonstrate that upper-ocean temperature variability cannot be explained solely by changes in local upwelling. Remote oceanic forcing, local wind forcing, and stratification can substantially modulate the upper-ocean thermal response in tropical upwelling systems.