

Observations on Seychelles-Chagos Thermocline Ridge (SCTR) upwelling during April–May 2019 in the western tropical Indian Ocean

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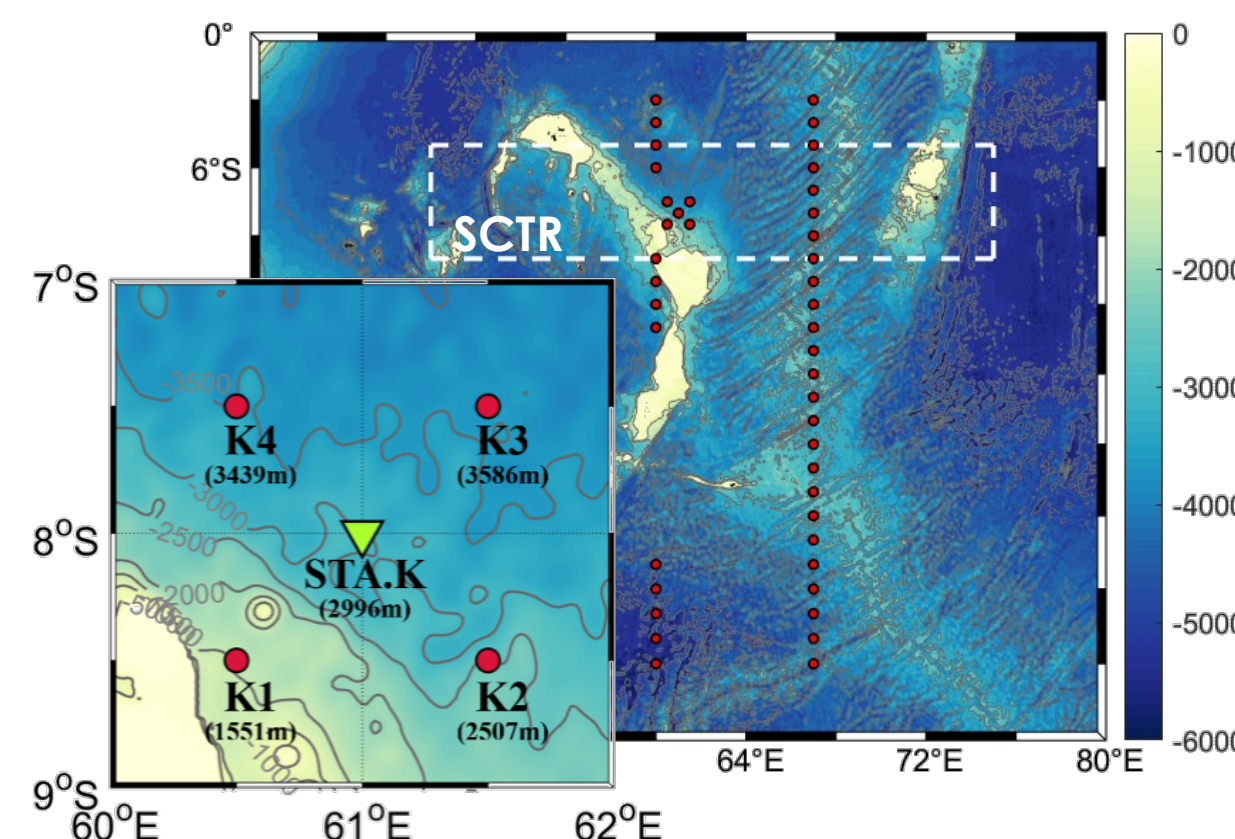
Summary

- Mean upwelling intensity at the upper 250 m during April–May 2019 estimated from current measurements in the SCTR center was $7.0 \times 10^{-3} \text{ m day}^{-1}$
- The upwelling intensity generally decreased with depth but showed multiple peaks during April–May 2019 (maximum at 60 m, minimum at 230 m)
- When DMI increased (decreased), the local wind stress curl-driven Ekman pumping decreased (increased) in September 2019 (September 2016)
- The September 2019 (September 2016) corresponds to positive (negative) DMI and negative (positive) SUI with deepening (lifting) D20

Background

- The **Ocean Heat Content (OHC) in the upper 700 m** in the Indian Ocean **increased from late 1990s to 2015** and **decreased from 2016 to 2018** [Lee et al., 2015; Li et al., 2017, 2018; Ummenhofer et al., 2020]
- **Increased heat transport from Pacific to Indian Ocean** during **positive OHC anomaly** in Indian Ocean [Lee et al., 2015]
- **Dipole Mode Index (DMI) positive peaked in late 2019** related **extreme weather** (Australia bushfires, East Asia heavy rain)
- Increased **OHC** corresponding to weakened **upwelling**
- **Seychelles-Chagos Thermocline Ridge (SCTR) - the most wide open-ocean upwelling region** in the Indian Ocean
- Rare observation on SCTR upwelling in 2019 when the DMI peaked and OHC increased → This study **aims to better observe and characterize the SCTR upwelling** which can affect the OHC in upper Indian Ocean

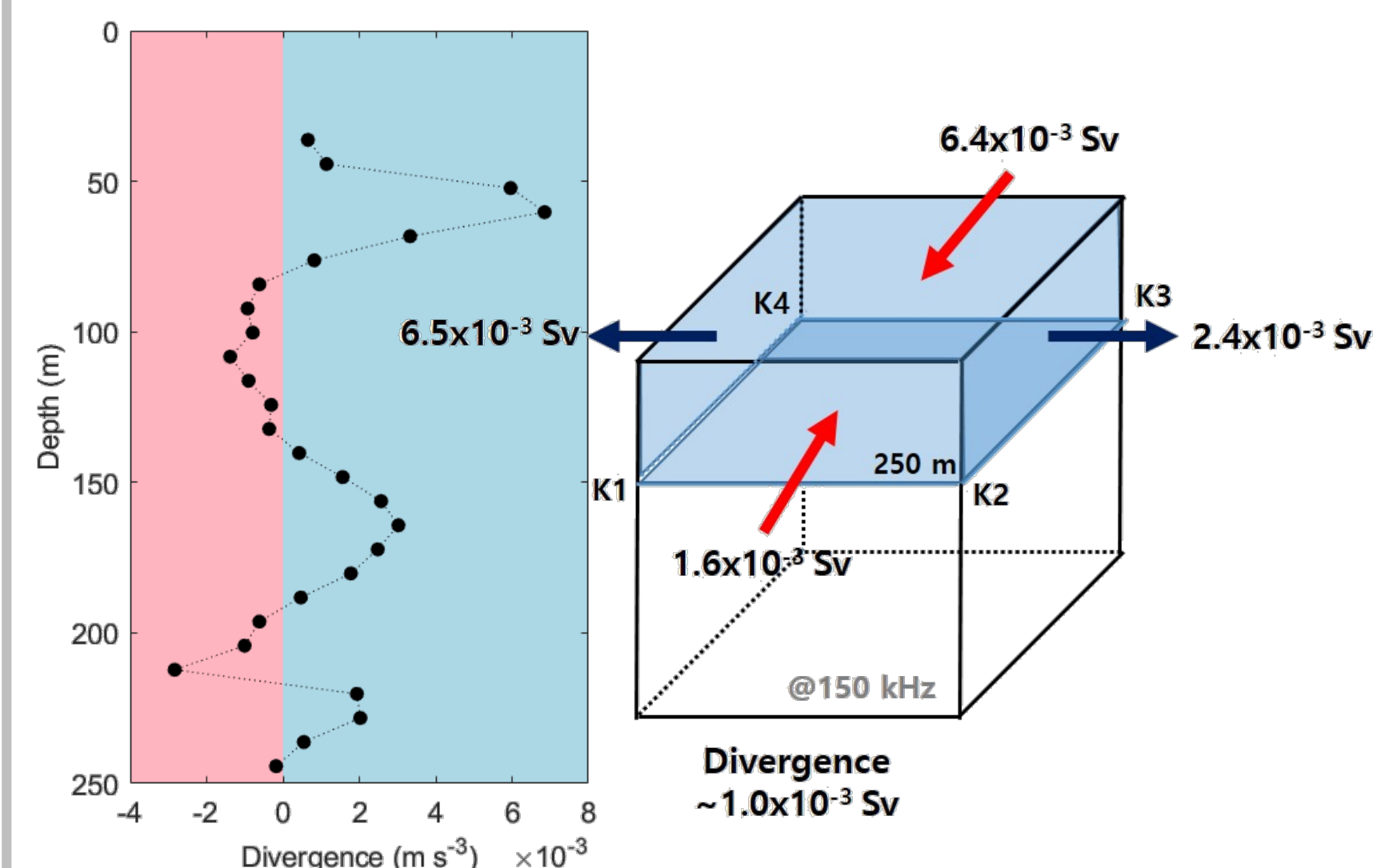
Data and methods



- Part of Korea-US inDIan Ocean Scientific Research Program (KUDOS)
- Horizontal currents from shipboard ADCP (150 kHz, 75 kHz)
- Current measurement along the 1° by 1° closed square boundaries centered (8°S, 61°E); K1-K2-K3-K4-K1
- Subsurface mooring, Station K, launched on May 2019 (will be recovered; need to be monitored continuously)
- Wind stress curl derived from ECMWF ERA 5
- 20 °C isotherm (D20) calculated from RAMA (8°S, 67°E) time-series data

SCTR upwelling in 2019 vs. 2016

Observed upwelling during April–May 2019



- Horizontal divergence estimated along the 1° by 1° area boundaries
- Net divergence transport upper 250 m $\sim 1.0 \times 10^{-3} \text{ Sv}$ (maximum $7.0 \times 10^{-3} \text{ Sv}$)
- Mean upwelling intensity (=divergence/area) $\sim 7.0 \times 10^{-3} \text{ m/day}$

- Wind-curl driven Ekman pumping decreased in September 2019 (positive DMI, negative SUI, deepening D20 to 150 m, negative $\partial D20/\partial t$) $\leftrightarrow$ Wind-curl driven Ekman pumping increased in September 2016 (negative DMI, positive SUI, negative $\partial D20/\partial t$ but lifting D20 to 60 m)
- Observed SCTR upwelling not explained by wind-curl driven Ekman pumping alone
- According to previous studies, OHC in upper Indian Ocean increased in 2019, and decreased in 2016

Comparison between September 2019 (positive DMI) and September 2016 (negative DMI)

