National Oceanography Centre

SOLSTICE
Sustainable Oceans, Livelihoods and food Security Through Increased Capacity in Ecosystem research in the Western Indian Ocean

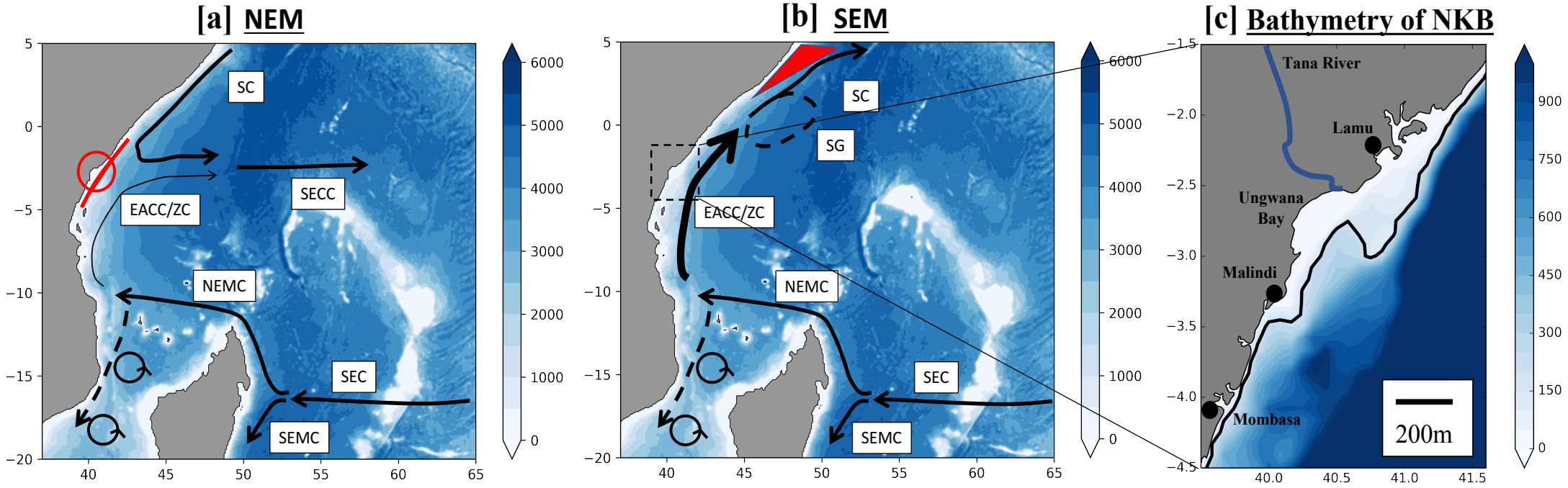
GCRF
Global Challenges Research Fund

A Major Ecosystem Shift in Coastal East African Waters during the 1997/98 Super El Niño as Detected Using Remote Sensing Data

Zoe L. Jacobs, Fatma Jebri, Meric Srokosz, Dionysios E. Raitsos, Stuart C. Painter, Francesco Nencioli, Kennedy Osuka, Melita Samoilys, Warwick Sauer, Michael Roberts, Sarah F. W. Taylor, Lucy Scott, Hellen Kizenga and Ekaterina Popova

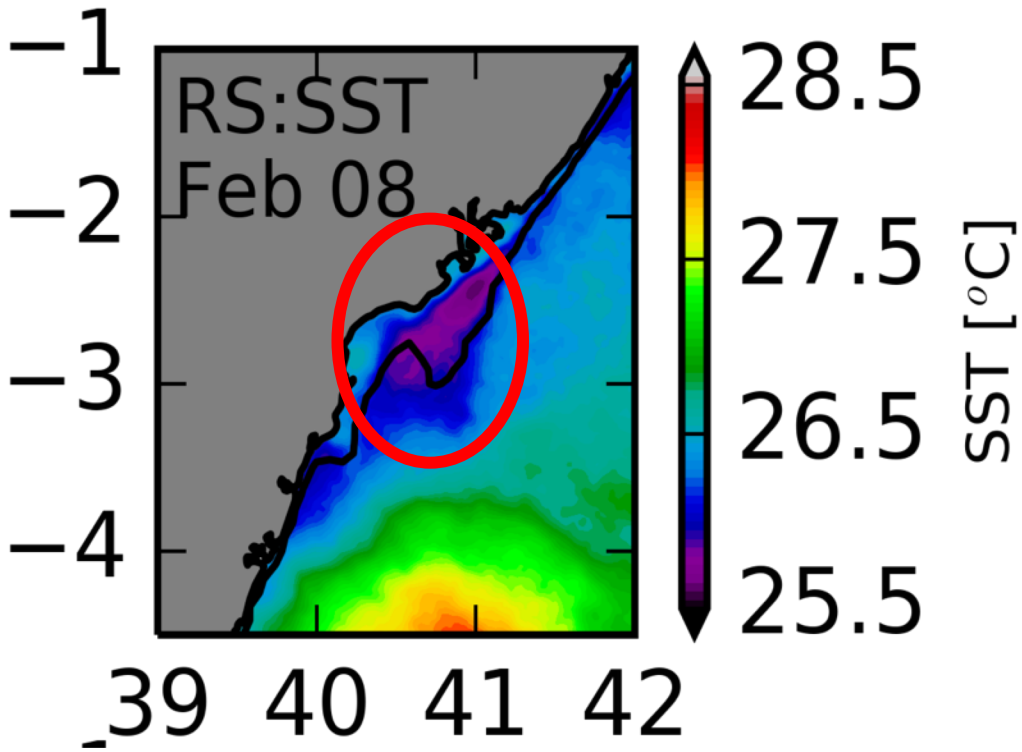
Western Indian Ocean circulation

- Northeast Monsoon: reversal of Somali Current and formation of Somali-Zanzibar confluence zone (SZCZ) near North Kenya Banks (NKBs)
- Southeast Monsoon: fast, northward-flowing East African Coastal Current and Somali Current

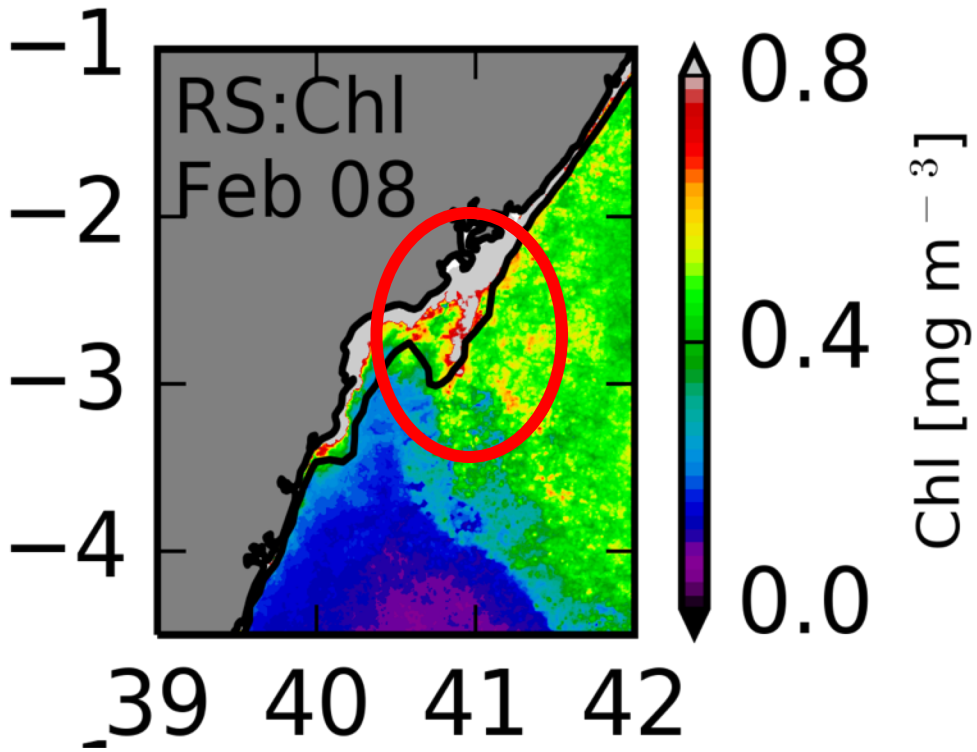


Upwelling event – remote sensing

Cool SST over NKB



Elevated Chl-a over NKB

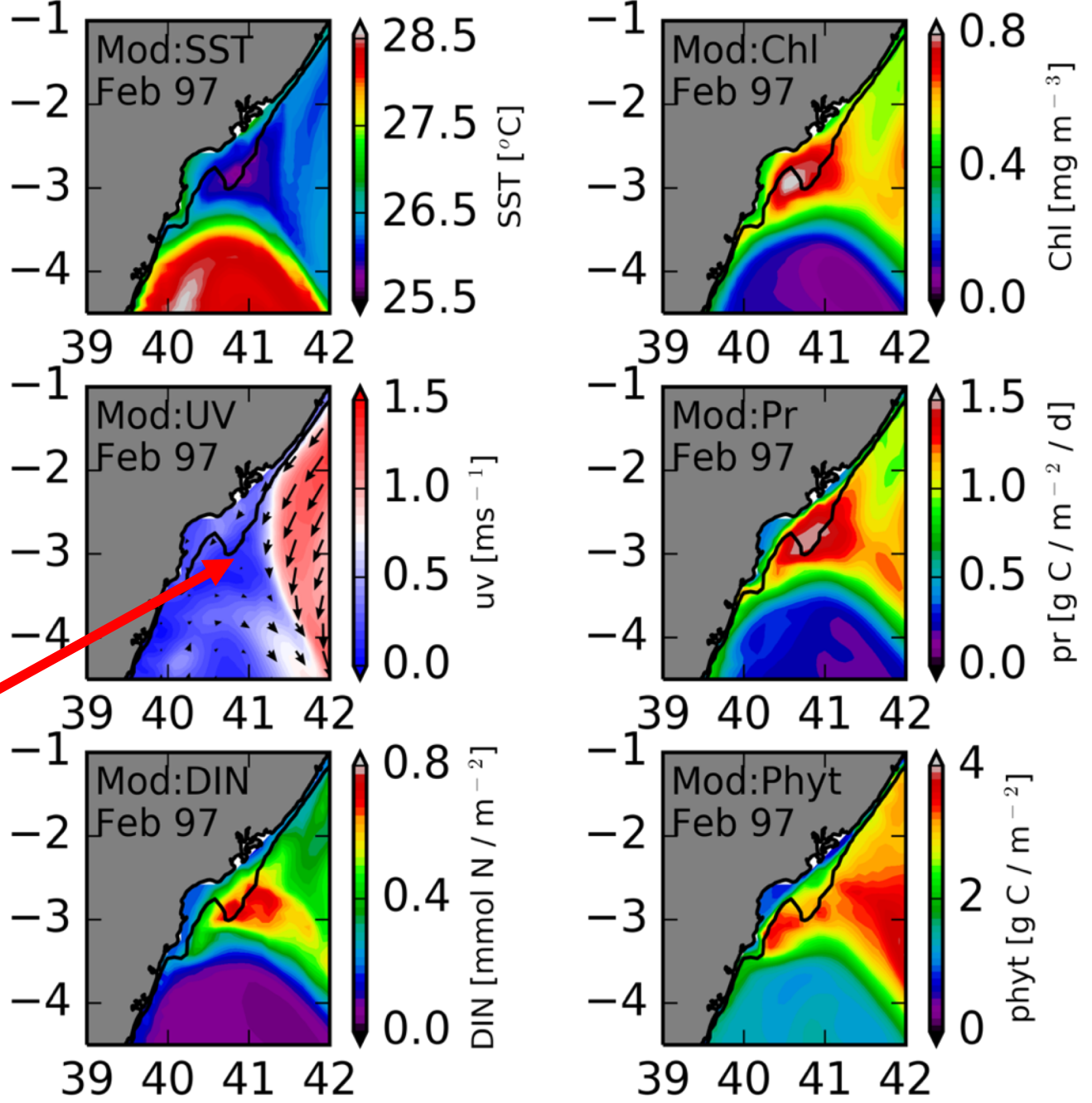


200 m

Jacobs et al., 2020

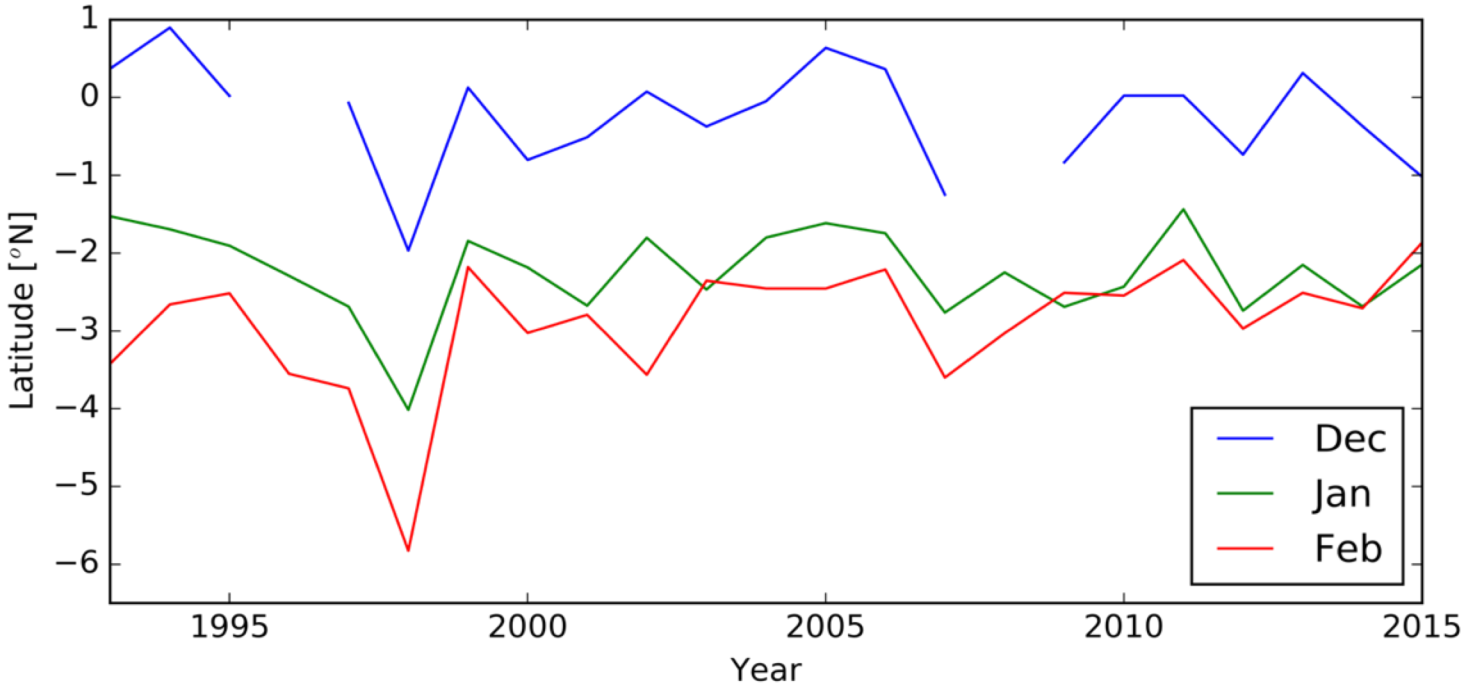
Upwelling event – model

- Cool SST, high Chl-a & primary production over NKB.
- Elevated nutrients & phytoplankton biomass.
- Reversed SC meets weaker EACC to form Somali-Zanzibar Confluence Zone (SZCZ)



Position of confluence zone

- Southward progression Dec-Feb.
- Gaps in Dec correspond to years when SCZC is yet to form.
- Interannual variability exists e.g. Feb 2015 2ºS and Feb 1998 6ºS
- Anomalous situation in Feb 1998 during super El Niño.

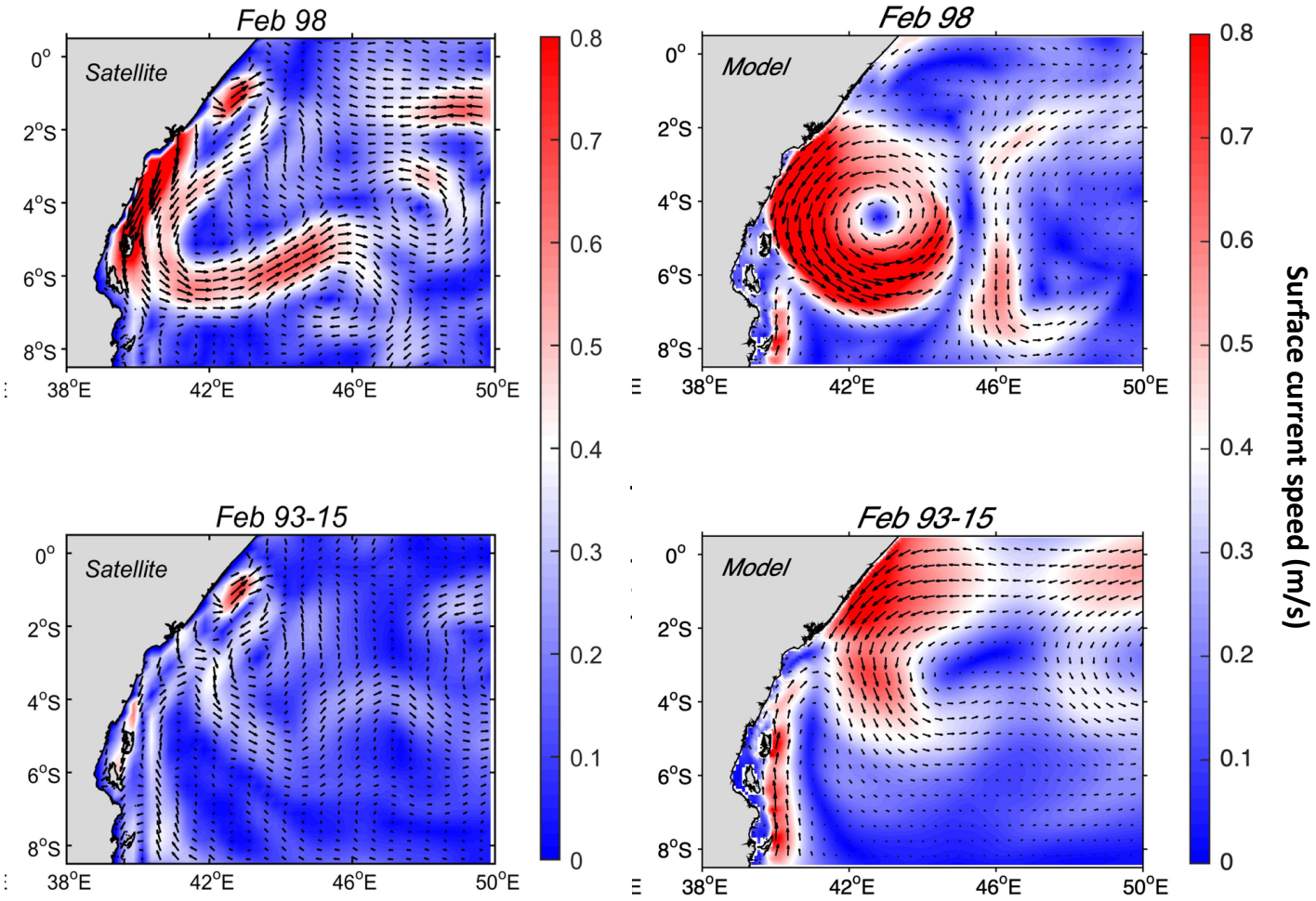


More about the SZCZ here: **Jacobs, Z.L. et al. (2020)** Shelf-Break Upwelling and Productivity Over the North Kenya Banks: The Importance of Large-Scale Ocean Dynamics. *J. Geophys. Res. Oceans*, *125*, e2019JC015519.

Currents

Altimetry

Model



Feb 98

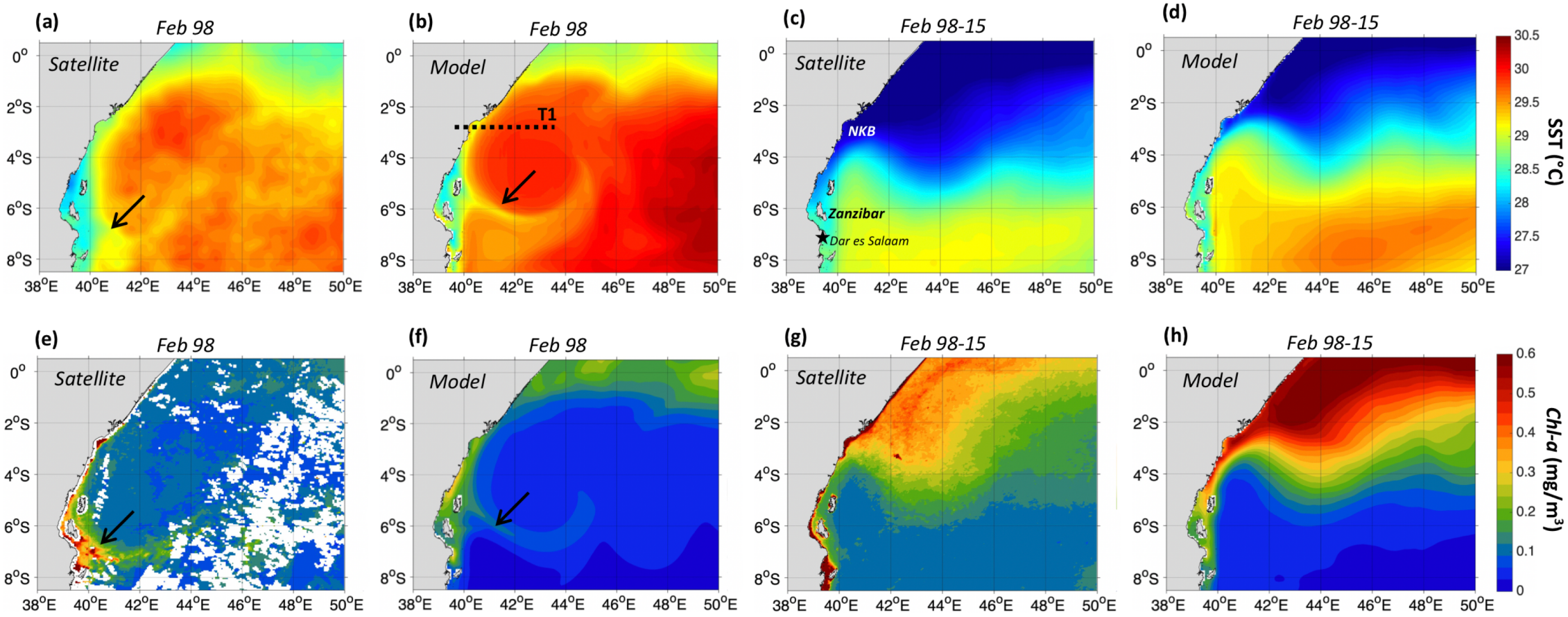
Feb mean

- SZCZ resides near NKBs in climatology
- Somali Current much stronger than in climatology
- Forces SZCZ south to reside south of Zanzibar, Tanzania
- Climatology and Feb 98 represented well in model

SST and Chl-a

- General widespread warming and reduced chl-a concentrations during El Niño
- Southward shift of SZCZ led of upwelling from NKBs to south of Zanzibar

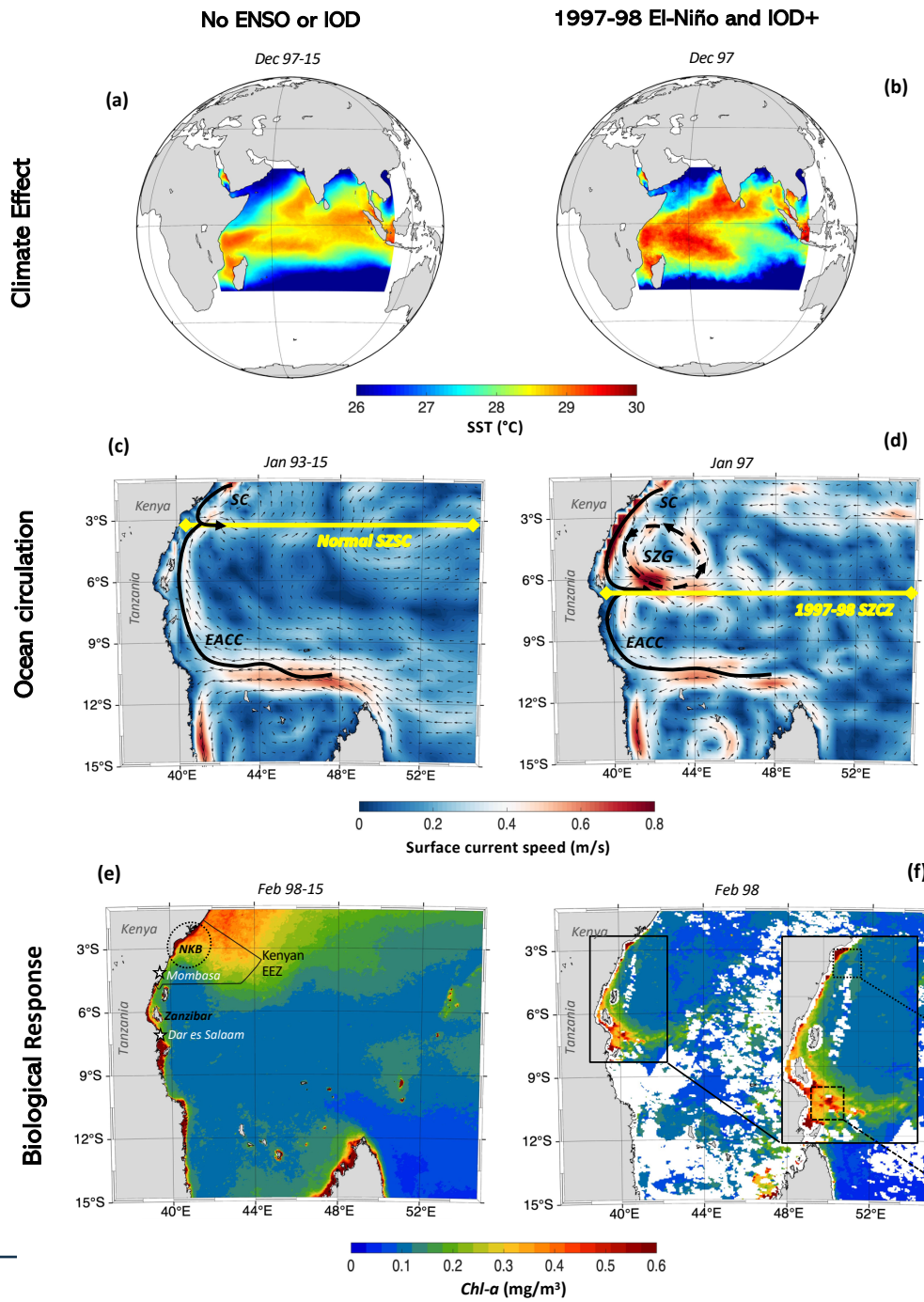
Feb 98 | Feb mean



SST

Currents

Chl-a



May have had negative impact on NKBs fish catch

But

Possibly increased near Zanzibar and Mafia

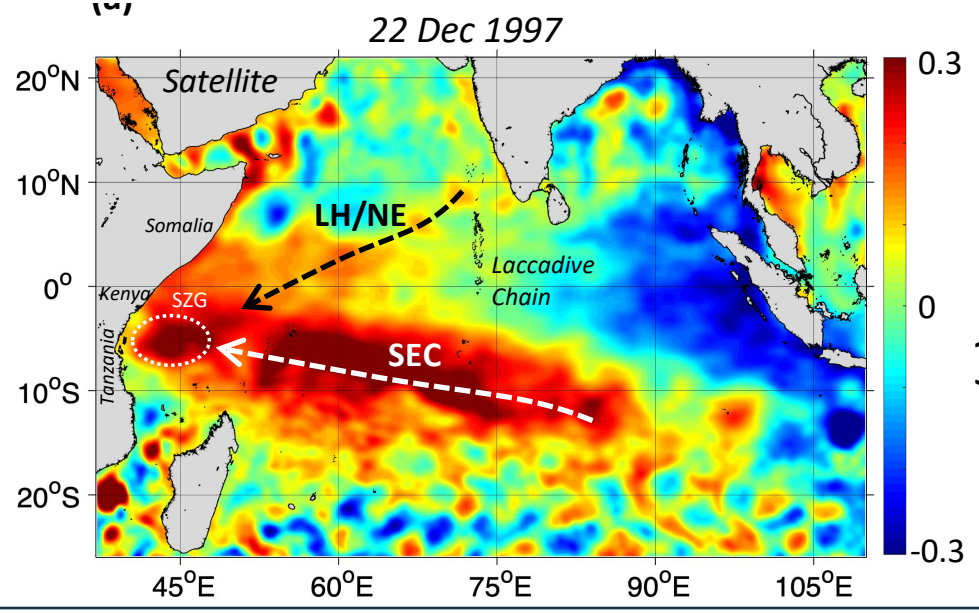
Kenya

Tanzania

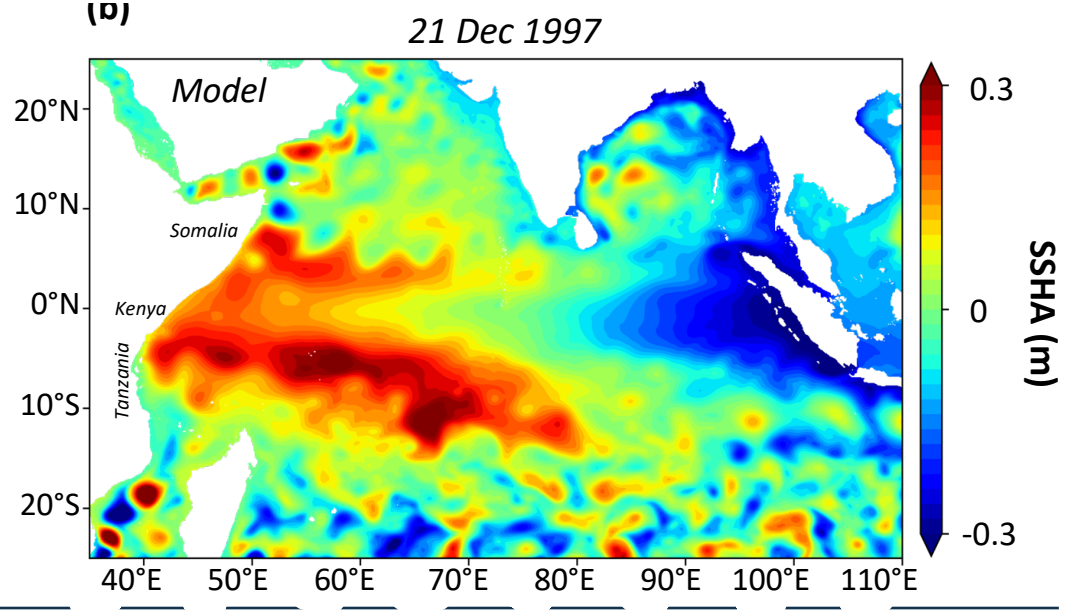
Mechanisms: SSHA

- Change in orientation of SEC from normal westward flow to more northwestward flow
- Somali Zanzibar Gyre visible in the SEC from ~Sept and joins with eddies travelling southwestward from the SW coast of India in Dec (below).
- Feature detaches from main flow and interacts with EACC and SC.

Remote sensing

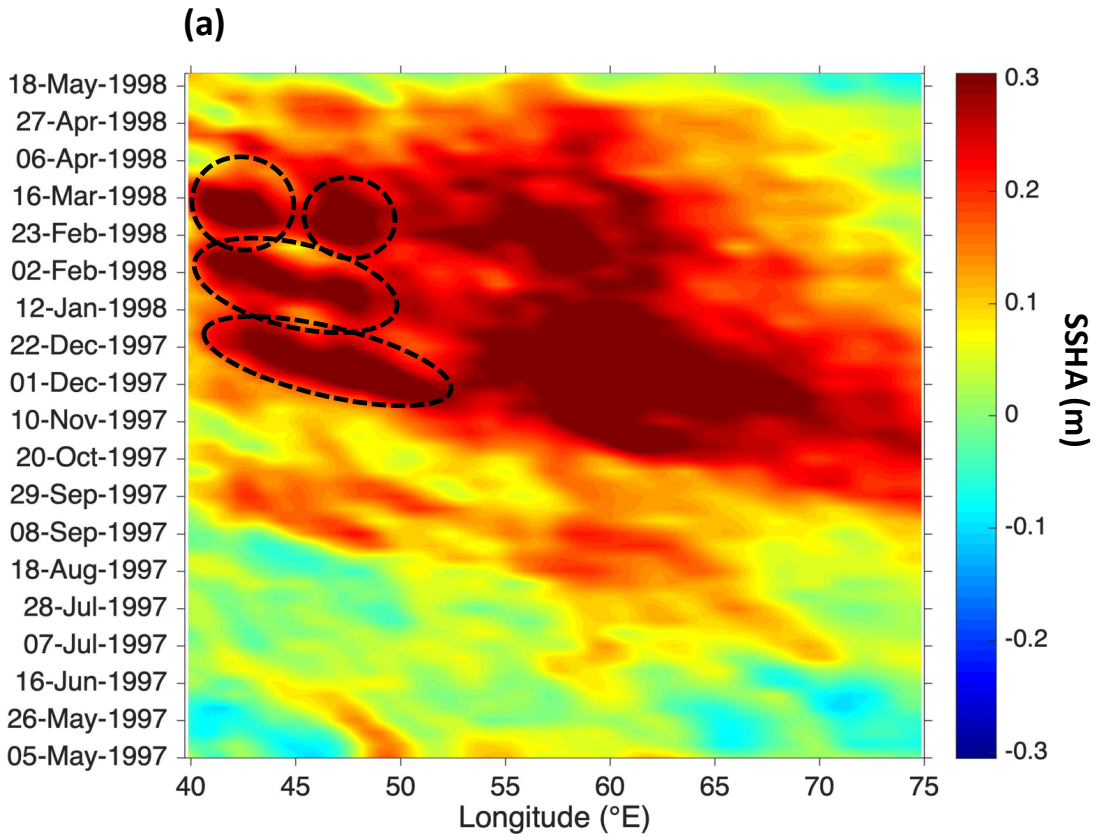


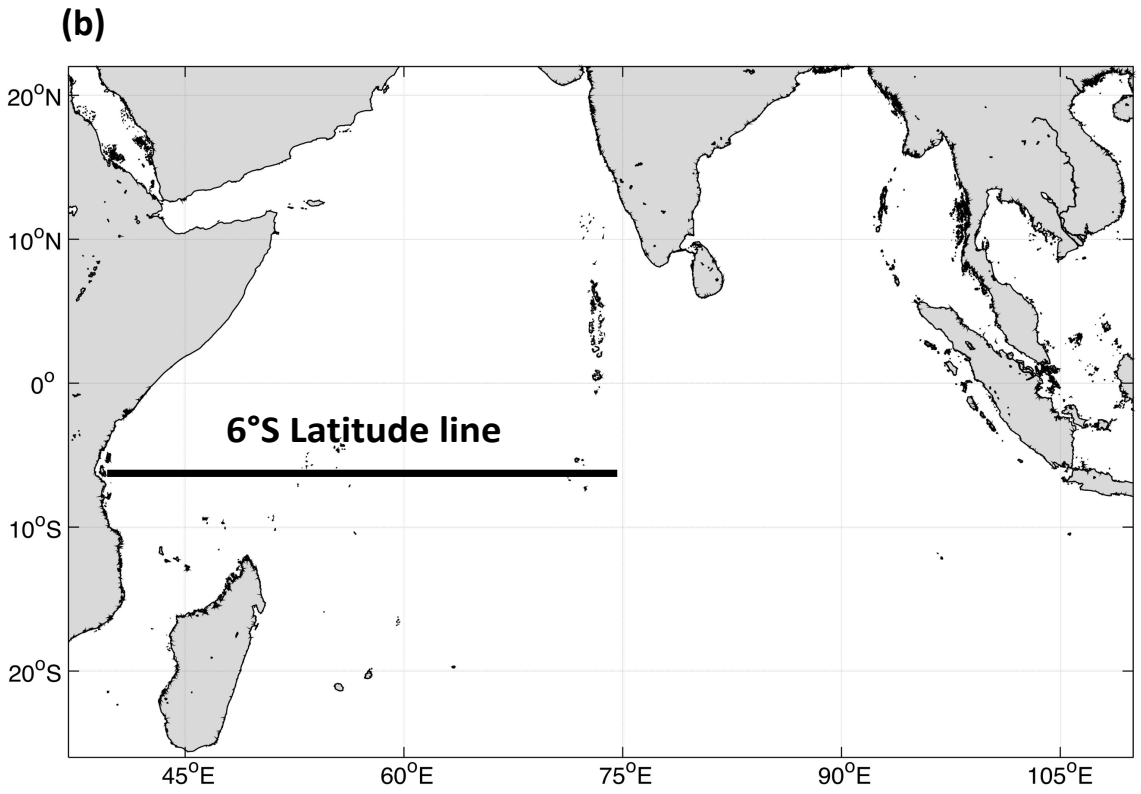
Model



Rossby waves

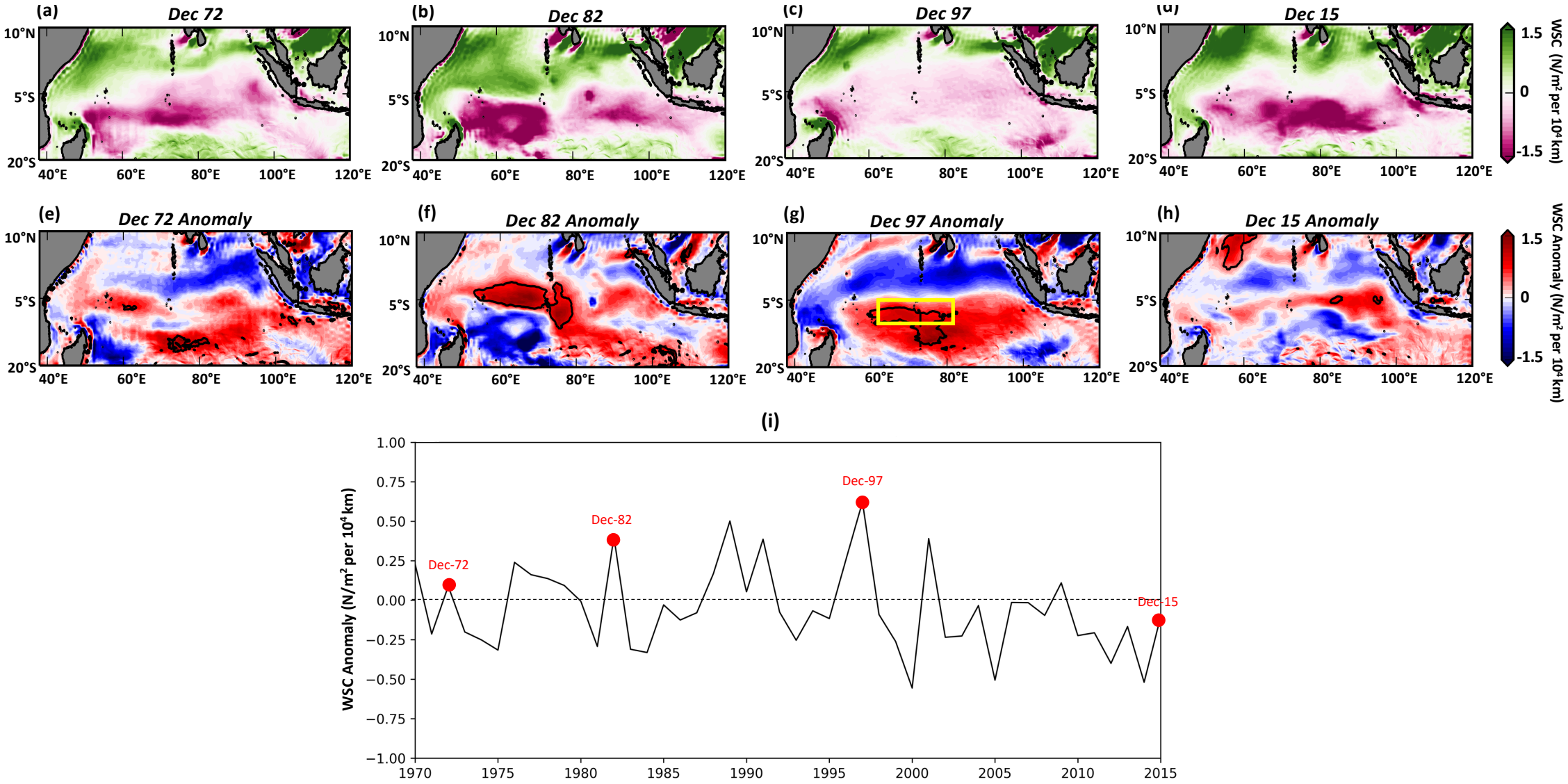
- Initiated by Rossby waves





Wind stress curl

- These were initiated by anomalous +ve WSC
- Much more anomalous in Dec 97 than during other major El Niños



National Oceanography Centre

Thank you

More here:
Jacobs, Z. L., Jebri, F. et al.(2020) A major ecosystem shift in coastal East African waters during the 1997/98 Super El Niño as detected using remote sensing data. *Remote Sensing*, *12*(19), 3127. https://doi.org/10.3390/rs12193127