Diabatic Contribution to Ocean Heat Variability during ENSO Events

Maurice F. Huguenin[1,*], Ryan M. Holmes[1,2] and Matthew H. England[1]

[1]Climate Change Research Center and Australian Research Council Centre of Excellence for Climate Extremes, University of New South Wales, 2052 Sydney, Australia

[2]School of Mathematics and Statistics, University of New South Wales, 2052 Sydney, Australia

[*]E-mail: m.huguenin-virchaux@unsw.edu.au

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- **Warm Water Volume** (WWV, i.e. the volume of water above 20°C in the equatorial Pacific region 5°N and 5°S) is a **key parameter** in ENSO forecasting. Many factors influencing this metric, especially the role of the diabatic processes, remain a mystery.
- Here, we simulate ENSO events in **ACCESS-OM2**, a ¼° global ocean, sea ice model with JRA55-do forcing for **1979-2016** and use the **Water Mass Transformation** (WMT) framework to investigate the importance of **diabatic processes** in changing WWV.

$$\text{Changes in WWV} = \underbrace{\text{meridional transport} + \text{ITF} + \text{P−E+R}}_{\text{adiabatic processes}} + \underbrace{\text{surface forcing} + \text{vertical mixing} + \text{numerical mixing}}_{\text{diabatic processes}}$$

Clim. diabatic processes in the eastern Pacific

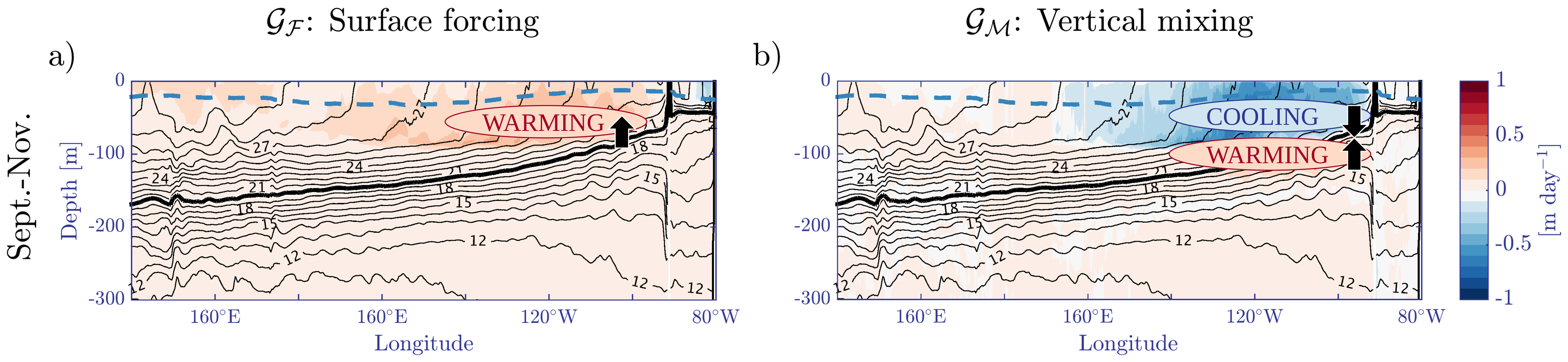

Fig. 1 Equatorial Pacific transects of the climatological (a) surface forcing and (b) vertical mixing water mass transformation velocities [m day^{-1}] for boreal autumn (SON). Surface forcing warms upper layers, increasing their volume and inducing a volume flux across the 20°C isotherm. Vertical mixing cools surface and warms subsurface waters, leading to across-isotherm volume exchanges.

Variability of WWV anomalies over 1979-2016

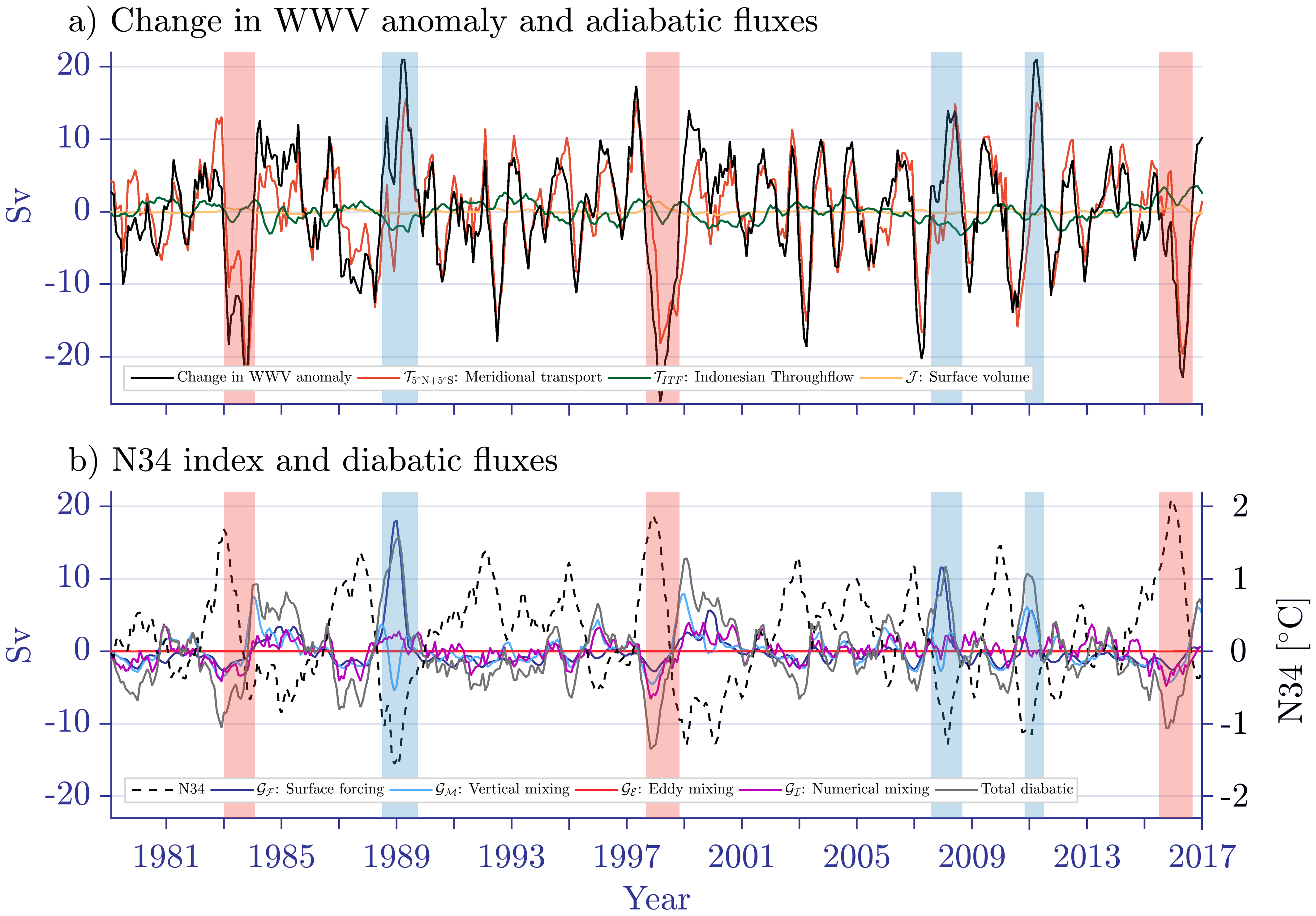

Fig. 2 Time series of (a) the change in WWV anomaly, adiabatic as well as (b) diabatic WWV budget terms [Sv] in the ACCESS-OM2 1979-2016 hindcast simulation. The shading in red and blue shows three strong El Niño and La Niña events each. In (b) the N34 index as a dashed line.

Diabatic processes during ENSO

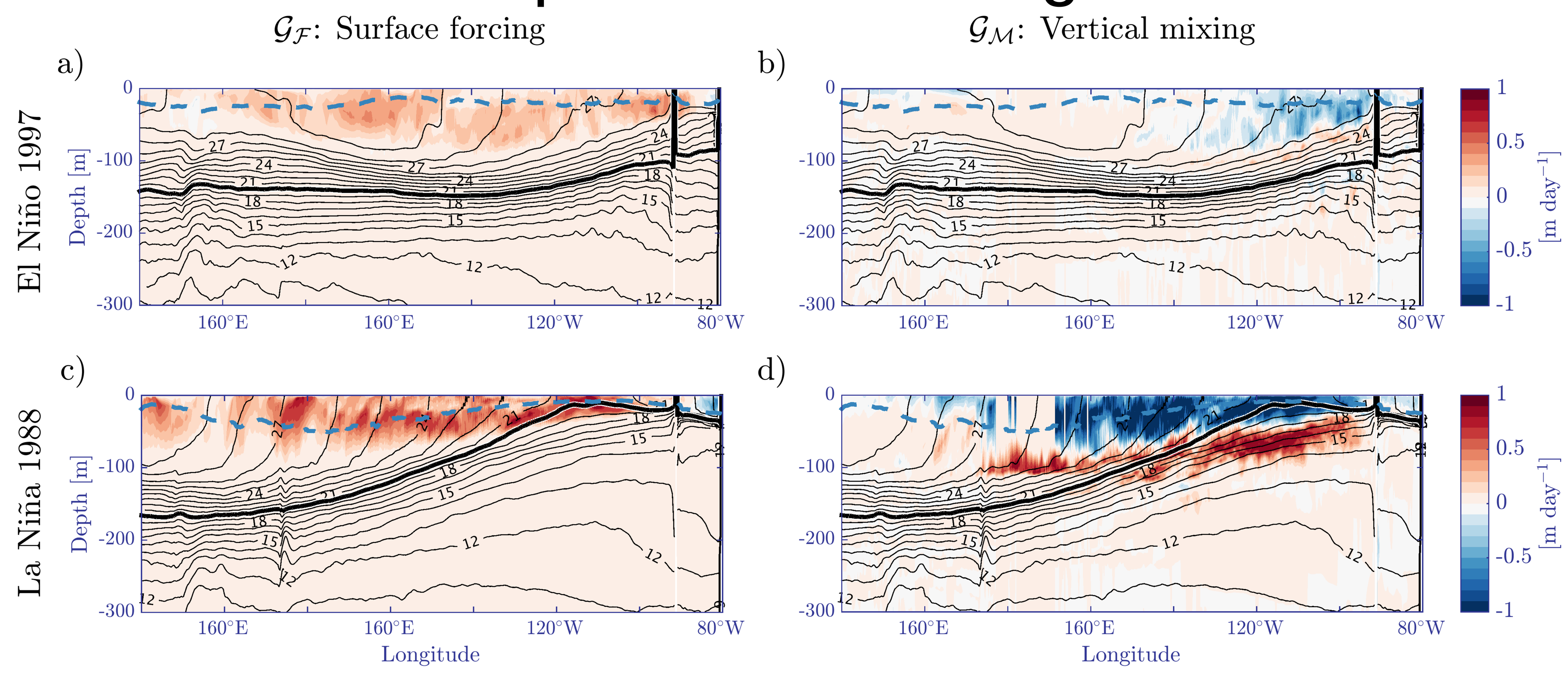

Fig. 3 As in Fig. 1 but for SON during El Niño in 1997 & La Niña in 1988.

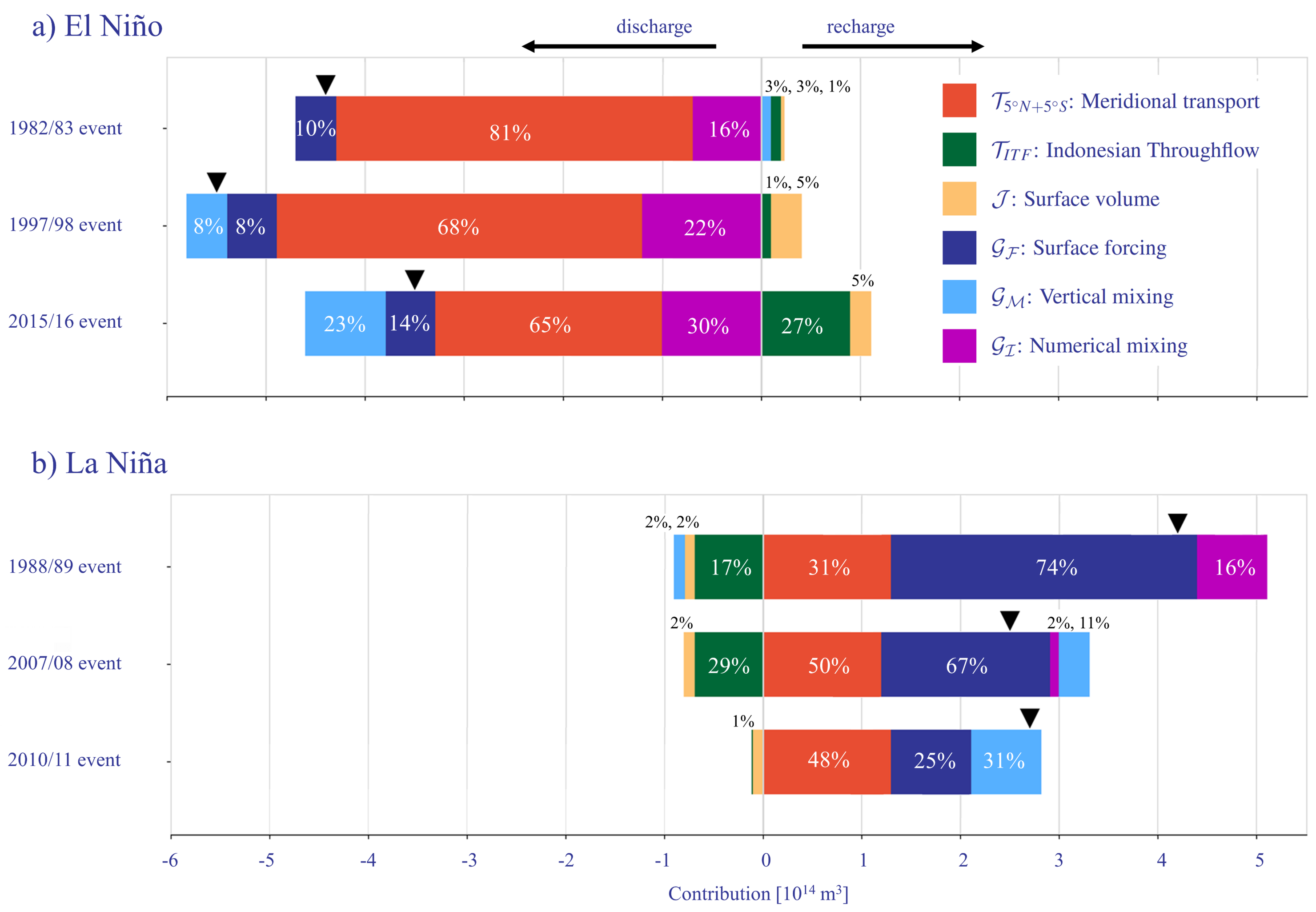

Fig. 4 The total time-integrated contribution of each anomalous WWV budget term [10^{14} m^3] during the three strong (a) El Niño and (b) La Niña events shaded in Fig. 2. The triangles mark the total change in WWV over the event.

Take Home Messages

- This study presents a comprehensive **analysis** of processes contributing to **changes in WWV** during **ENSO** events
- **Adiabatic** volume fluxes are mostly **symmetric** for El Niño and La Niña, **diabatic** fluxes show a strong **asymmetry and** peak three to six months **earlier**, even in simulations with symmetric forcing (not shown)
- The large variability and **asymmetry** of the **diabatic** volume fluxes is linked to the **shoaling of the 20°C isotherm** in the eastern Pacific

Stay tuned! This project is in the final stages of preparation before submission to Journal of Climate next month.