Do SST gradients drive the monthly climatological surface wind convergence over the Tropical Atlantic?

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1. Introduction

Socio-economical influence of the ITCZ

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- The surface wind convergence occurred over the thermal ITCZ (the warm SST belt).
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- The surface wind convergence occurred over the thermal ITCZ (the warm SST belt).
- This air-sea coupling feature is well captured in Reanalysis.
1. Introduction

SST-Wind interaction under the ITCZ: the Lindzen and Nigam paradigm

SST gradients drive surface wind through hydrostatic pressure gradients adjustment
Lindzen et Nigam, 1987

- Back and Bretherton (2009a, hereafter BB09a) pointed out this mechanism as the dominant one over marine ITCZ at climatological timescale (4 years average and with low resolution reanalyze).
- Do conclusions of BB09a remain true even at the climatological monthly timescale (10 years) even with high resolution reanalyze?
- What is the role of the horizontal advection (none taken into account in BB09a)?
QUISCKAT, Reynolds SST, and ERAI (0.75x0.75 °) & CFSR (0.5x0.5°) reanalyses monthly data over 2000-2009.

Analyses are based on the surface momentum budget using the Takatama et al. (2012) approach.

\[
\text{div} U = -\frac{1}{\rho_o} \left[ \frac{\varepsilon}{\varepsilon^2 + f^2} \nabla^2 P + M_1 \partial_x P + M_2 \partial_y P \right] + \\
\left[ \frac{f}{\varepsilon^2 + f^2} \nabla \times \tilde{A} + \frac{\varepsilon}{\varepsilon^2 + f^2} \nabla \cdot \tilde{A} + M_1 A_x + M_2 A_y \right] + \text{Residual}
\]

\[ M_1 = \left[ \frac{\varepsilon}{\varepsilon^2 + f^2} \right]_x + \left[ -\frac{f}{\varepsilon^2 + f^2} \right]_v \quad M_2 = \left[ \frac{f}{\varepsilon^2 + f^2} \right]_x + \left[ \frac{\varepsilon}{\varepsilon^2 + f^2} \right]_y \]
2. SST influence on surface wind convergence at monthly timescale

Surface wind convergence budget using Takatama et al. (2012) approach: case of July

The Lindzen and Nigam mechanism do hold over the coastal regions and under flanks of open ocean ITCZ but not over deep convection region.
2. SST influence on surface wind convergence at monthly timescale

Surface wind convergence budget using Takatama et al. (2012) approach: case of July

The Lindzen and Nigam mechanism do hold over the coastal regions and under flanks of open ocean ITCZ but not over deep convection region.

The horizontal advection term do play a significant role over deep convection region.

Surface wind convergence over the deep convection region is controlled by the residual mainly dominated by elevated heating by cumulus and diffusion.
2. SST influence on surface wind convergence at monthly timescale

Pressure contribution decomposition following the McGauley et al. 2004 method

Pressure contribution is dominated by boundary layer contribution highly controlled by the laplacian component.
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La contribution de la couche limite, résulte-elle de l’ajustement hydrostatique du laplacien de pression à celui de la SST?
2. SST influence on surface wind convergence at monthly timescale

SST forcing?

YES surface wind convergence in coastal and open ITCZ meridinal flanks is driven by SST under LN mechanism in addition to horizontal advection contribution.

Over deep convection area, the residual probably dominated by elevated heating by cumulus and diffusion appears as the key term.
The July findings remain the same for the others months of the year
Using the Takatama et al. 2012 approach, the monthly surface wind convergence momentum budget over the Atlantic subdivides the marine ITCZ into 2 zones:

- **Deep convection area**, where the LN paradigm does not hold. In this region, the surface wind convergence seems to be controlled by entrainment via induced by elevated heating.

- "Moderate" (coastal ITCZs) or "none deep" ZCIT within which surface wind convergence is controlled by SST gradients through the LN mechanism in addition to horizontal advection.
THANKS!!!