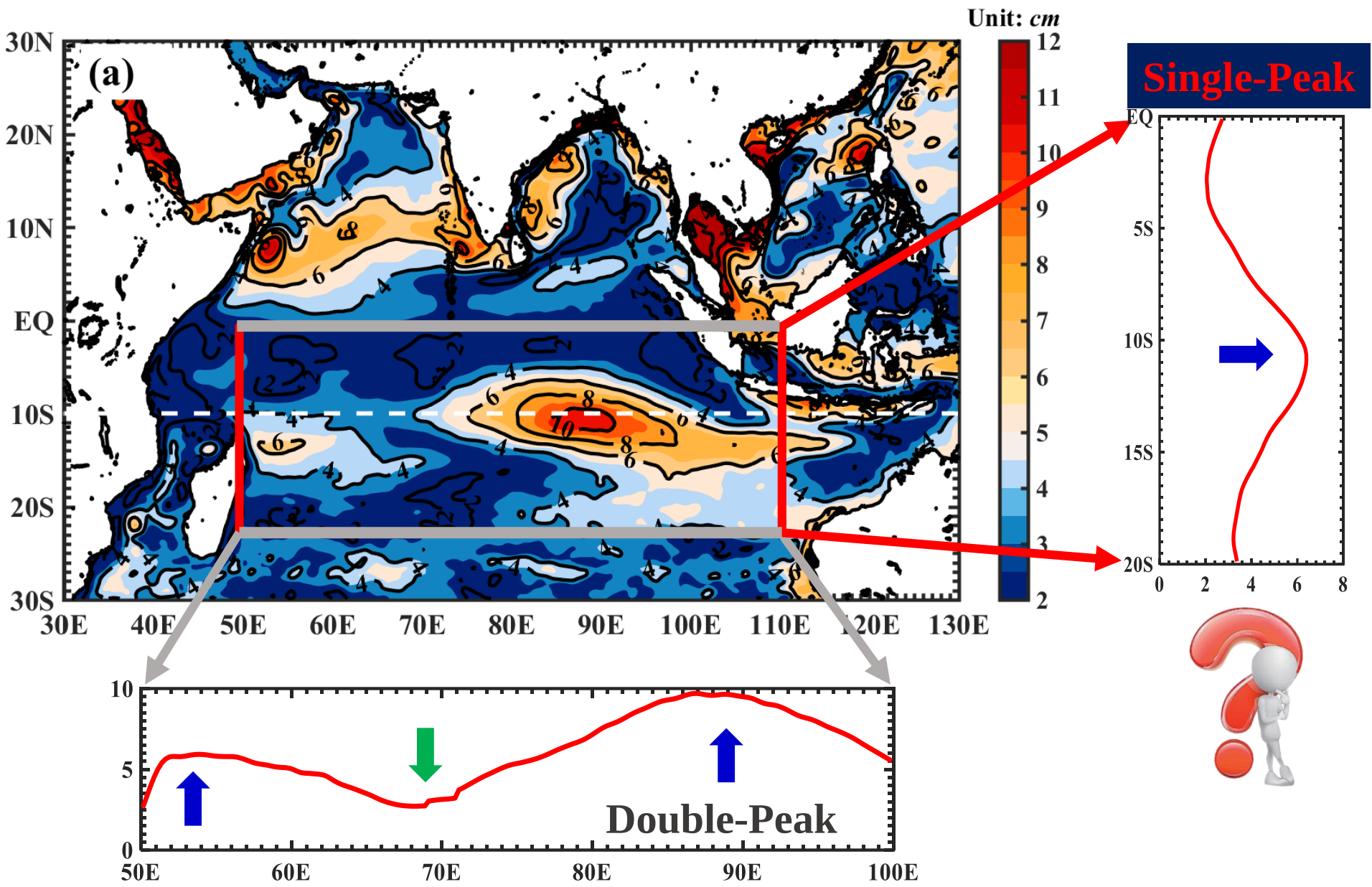


Characteristics and Mechanism of Annual Sea Level Variability in the Southern Tropical Indian Ocean

Ke Huang

LTO, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, China
Email: kehuang@scsio.ac.cn

Amplitude of Annual Sea Level Variability from AVISO (1993-2015, 10-14 month band-pass filter)



Woodberry et al. 1989; Masumoto and Meyers 1998; Wang et al. 2001

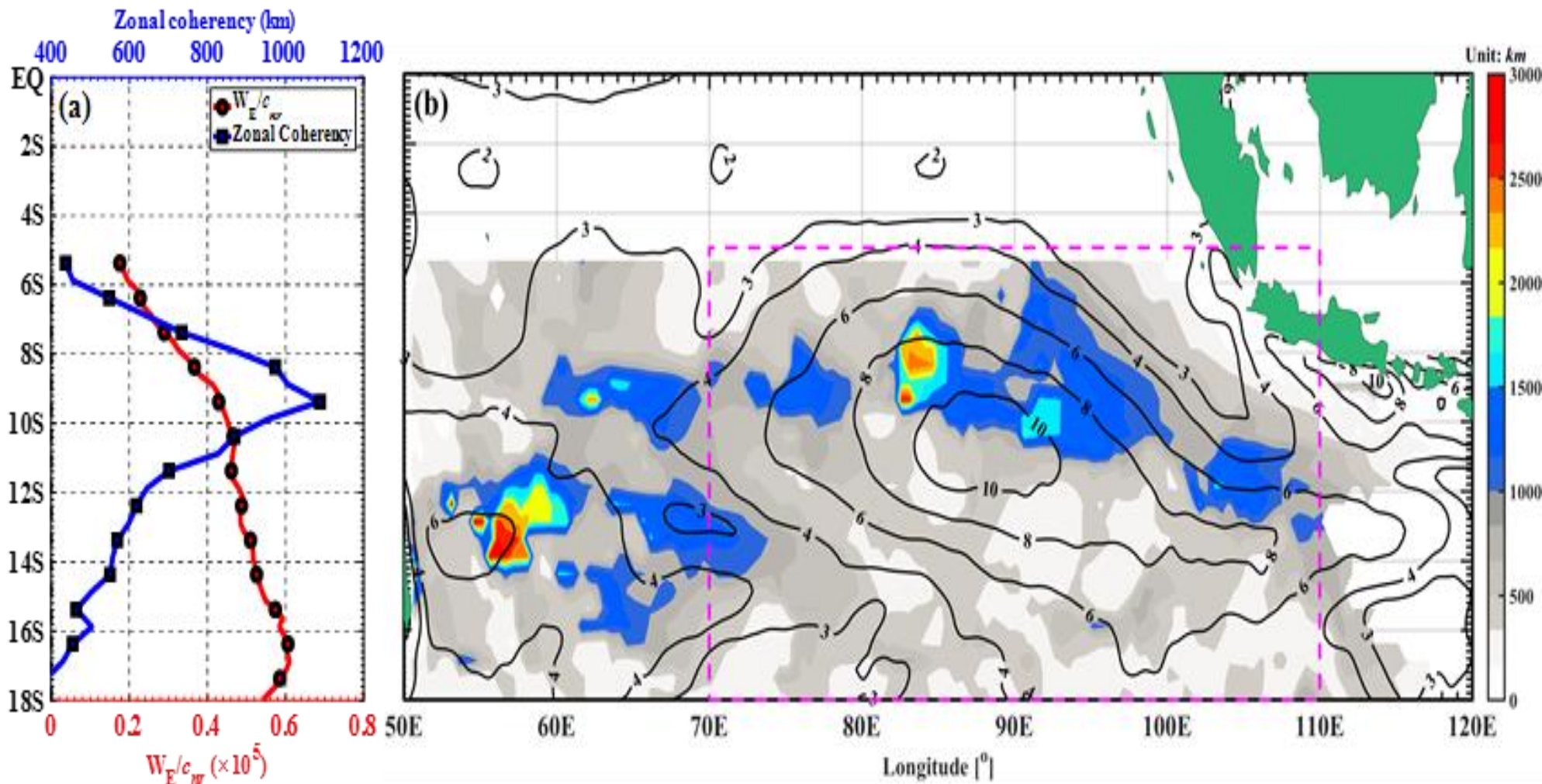
Introduction and Motivation:

- ✓ The southern tropical Indian Ocean (STIO) is a dynamically and climatically important region, which is facilitated by pronounced baroclinic Rossby waves (BRWs).
- ✓ The BRWs in the STIO are primarily driven by the seasonal wind, vertically propagating energetic penetration from the surface to the deep ocean (1600–1900dbar).
- ✓ The observed vertical structure of the annual BRWs in the STIO cannot be explained by a single baroclinic mode with only one dissipation term (Rayleigh type) accounting for energy loss from the surface to the deep ocean.
- ✓ The baroclinic response for the meridional maximum centered at near 10°S (single peak) are not provided.

Result One:

- ✓ An analysis of continuously stratified linear ocean model reveals that the second baroclinic mode also has significant contribution to the annual sea level variability (as high as the first baroclinic mode).
- ✓ The contributions of residual high-order modes ($3 < n < 25$) are much less.
- ✓ The superposition of low-order (first and second) BRWs primarily contribute to the vertical energy penetration below the seasonal thermocline.
- ✓ The low-order BRWs, having longer zonal wavelengths and weaker damping, can couple more efficiently to the local large-scale wind forcing than the high-order modes.

Parameter	Notation	Mode number						
		1	2	3	4	5	8	12
First zero-crossing	z_0 , m	1376	171	92	78	70		
Charac. speed	c_n , m s ^{−1}	2.64	1.67	1.05	0.75	0.6	0.37	0.24
Mode coupling coeff.	$\mathcal{H}_n$, m	276.2	170.9	785.6	910.7	1842	1569.3	2179.3
Wind coupling coeff.	Z_n	0.97	0.95	0.90	0.83	0.75	0.45	0.10
Project coeff.	P_n , m ^{−1}	0.0035	0.0056	0.0011	0.0009	0.0004	0.0003	0.00005
Rossby radius	R_n , km	104.3	66.0	41.3	29.5	23.6	14.5	9.6
Rossby wave speed	c_{rn} , cm s ^{−1}	24.5	9.8	3.8	2.0	1.3	0.5	0.2
Rossby wavelength	λ_n , km	7738	3087	1211	619	395	150	65
Decay scale	α_n^{-1} , km	131762	20967	3226	843	344	50	9.4
Arg. of resp. integral	$ \kappa_n L$	0.65	1.63	4.16	8.18	12.93	37.08	114.5
Amp. of resp. integral	$ I_n $, km	783.6	701.0	300.5	113.9	55.9	21.6	7.0
Convergence factor	γ_n	2762	3911	346	104	23	6.2	0.3



Result Two:

- ✓ The superposition of low-order (first and second) BRWs primarily contribute to the high energy center of sea level variability at near 10°S in the STIO.
- ✓ The zonal coherence of the Ekman pumping results in the latitudinal energy maximum of low-order BRWs.
- ✓ This study extends the traditional analysis to suggest the characteristics of the second baroclinic mode need to be taken into account in interpreting the annual variability in the STIO

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