



AOS 801: Advanced Tropical Meteorology  
*Lecture 17 Spring 2023*  
Paper discussion

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# Questions for paper discussion

- Discuss the WTG moisture budget. Why does it require Nmode to be small instead of Nw? Discuss what each term of the budget means.

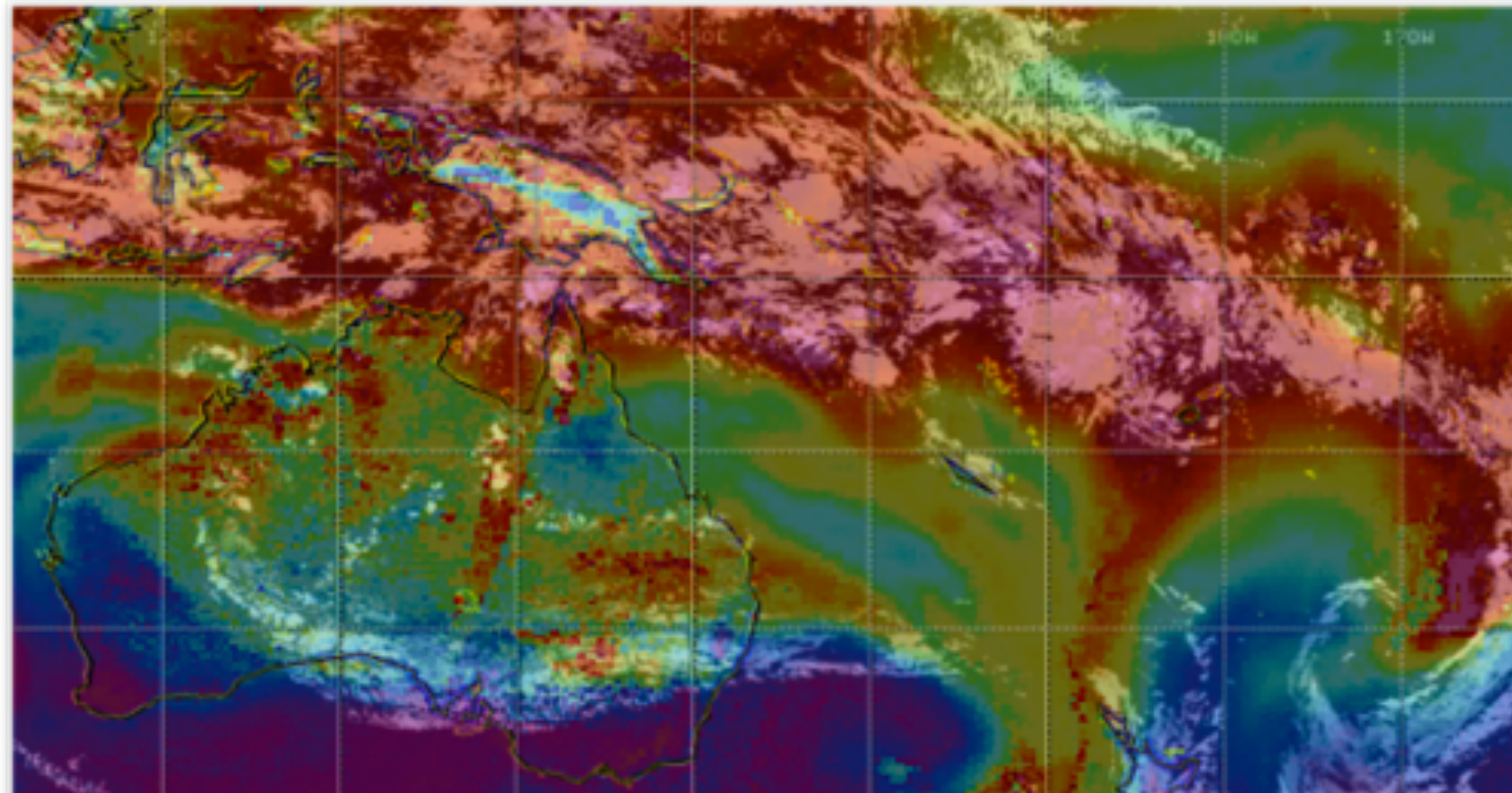
$$\frac{\partial L_v q}{\partial t} = -\mathbf{v} \cdot \nabla_h \cdot L_v q - \omega_c \frac{\partial \text{MSE}}{\partial p} - \omega_r \frac{\partial L_v q}{\partial p} - \frac{\partial F_{\text{MSE}}}{\partial p}$$

- Why is an atmosphere in WTG balance allow for a high diversity of weather systems?
  - Why is there an equatorial and an off-equatorial moisture mode?
  - What are the mixed systems and how do they differ from the moisture modes?
  - What are the moist quasi-geostrophic motions?
- Why does WTG balance restrict the evolution of potential vorticity? What are the consequences?

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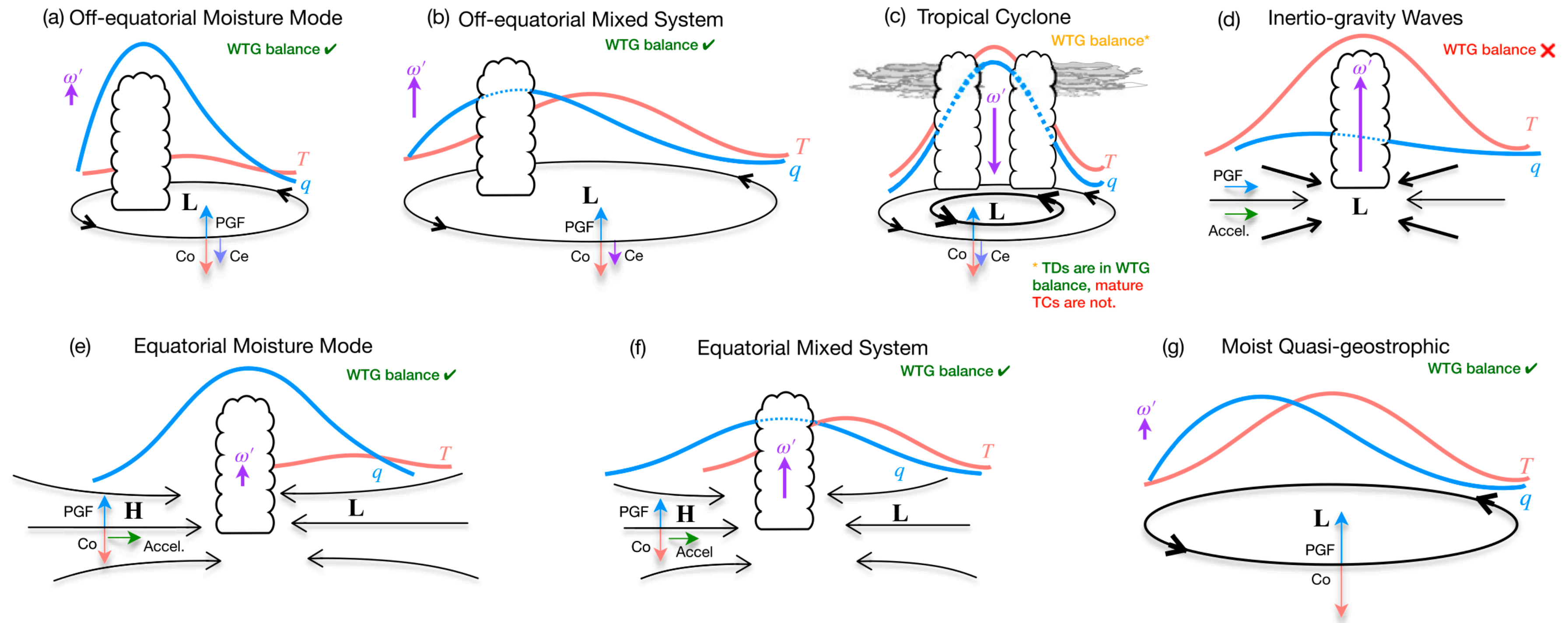
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- Why is an atmosphere in WTG balance allow for a high diversity of weather systems?

### Types of convectively-coupled motions in the tropics



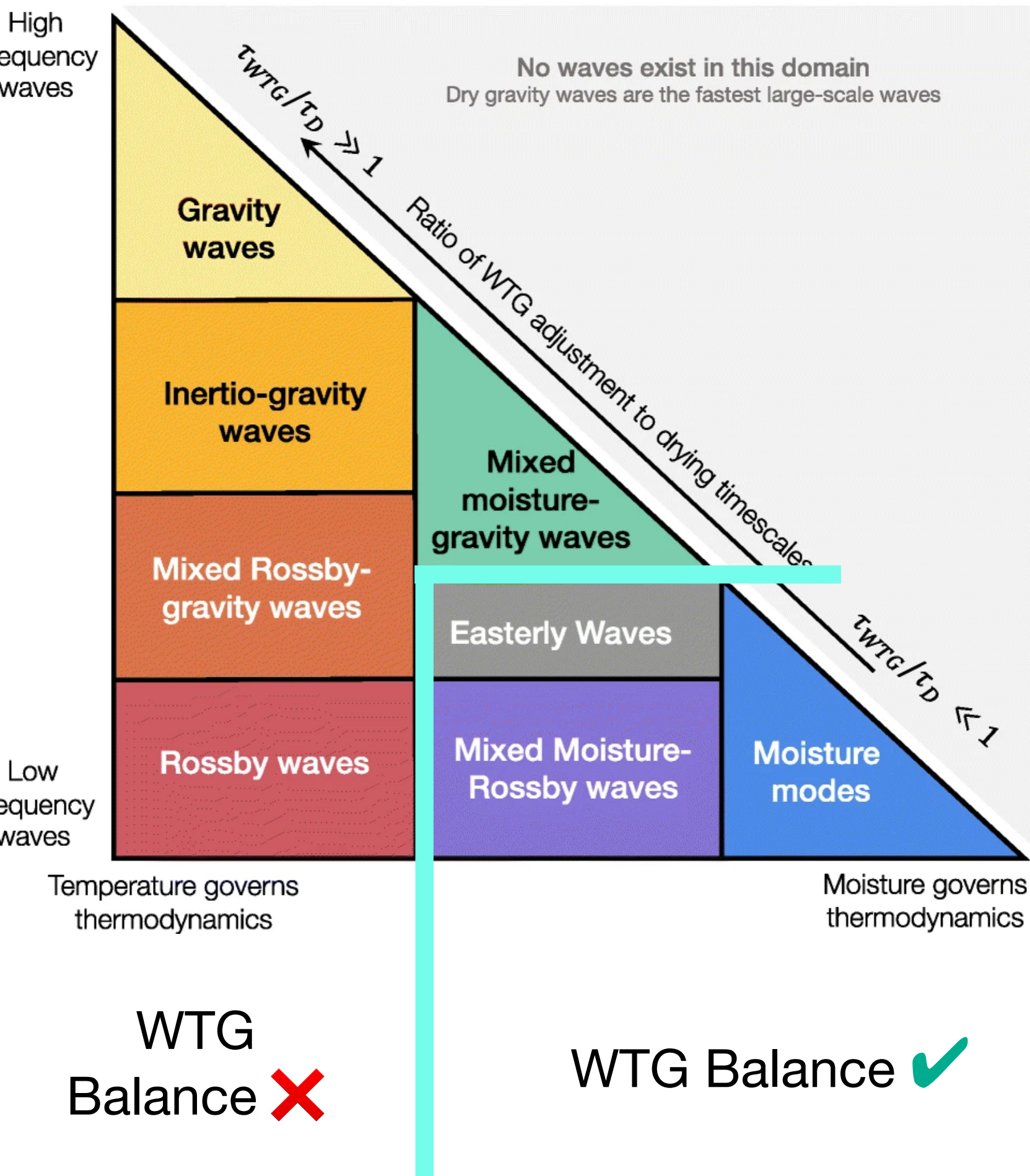
- Why is there an equatorial and an off-equatorial moisture mode?
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TABLE 3. Types of convectively coupled motions obtained from scale analysis, their related scaling parameters, and leading momentum balance. For all waves, a first baroclinic vertical structure is assumed ( $c = 50 \text{ m s}^{-1}$ ), except for inertio-gravity waves in which a second baroclinic structure is assumed ( $c = 25 \text{ m s}^{-1}$ ). For the scaling values obtained here a value of  $f$  of  $3 \times 10^{-5} \text{ s}^{-1}$  is assumed.

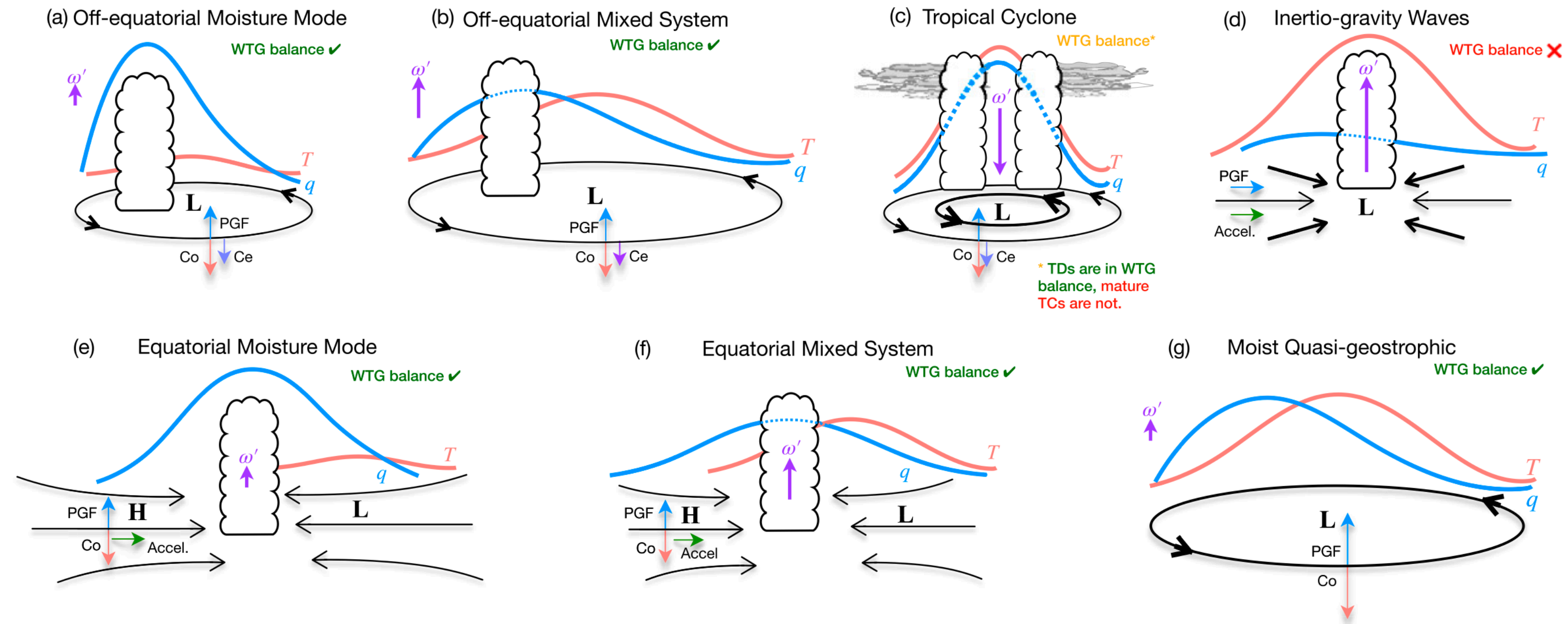
Motion type	$\text{Ro}_\tau$	$\text{Fr}_\tau^2$	$c_p \text{ (m s}^{-1}\text{)}$	$L_y/L_x$	$N_{\text{mode}}$	$\lambda_x \text{ (m)}$	$\lambda_y \text{ (m)}$	Balance in $\mathbf{v}'$
Equatorial moisture mode	0.1	0.01	5	0.1	0.1	$10^7$	$10^6$	Semigeostrophic
Off-equatorial moisture mode	1	0.005	3.5	1	0.1	$10^6$	$10^6$	Nonlinear
Equatorial mixed wave	1	0.1	16	0.1	1	$3 \times 10^6$	$3 \times 10^5$	Semigeostrophic
Off-equatorial mixed wave	1	0.1	16	1	1	$3 \times 10^6$	$3 \times 10^6$	Nonlinear
Tropical depression	1	0.005	3.5	1	1	$10^6$	$10^6$	Nonlinear
$n = 1$ inertio-gravity waves	1	1	25	0.5	10	$4 \times 10^6$	$2 \times 10^6$	Unbalanced
Moist QG	0.1	0.001	1.6	1	1	$3 \times 10^6$	$3 \times 10^6$	Geostrophic

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### Hypothetical spectrum of tropical waves



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