Topographic radiation by a steady flow

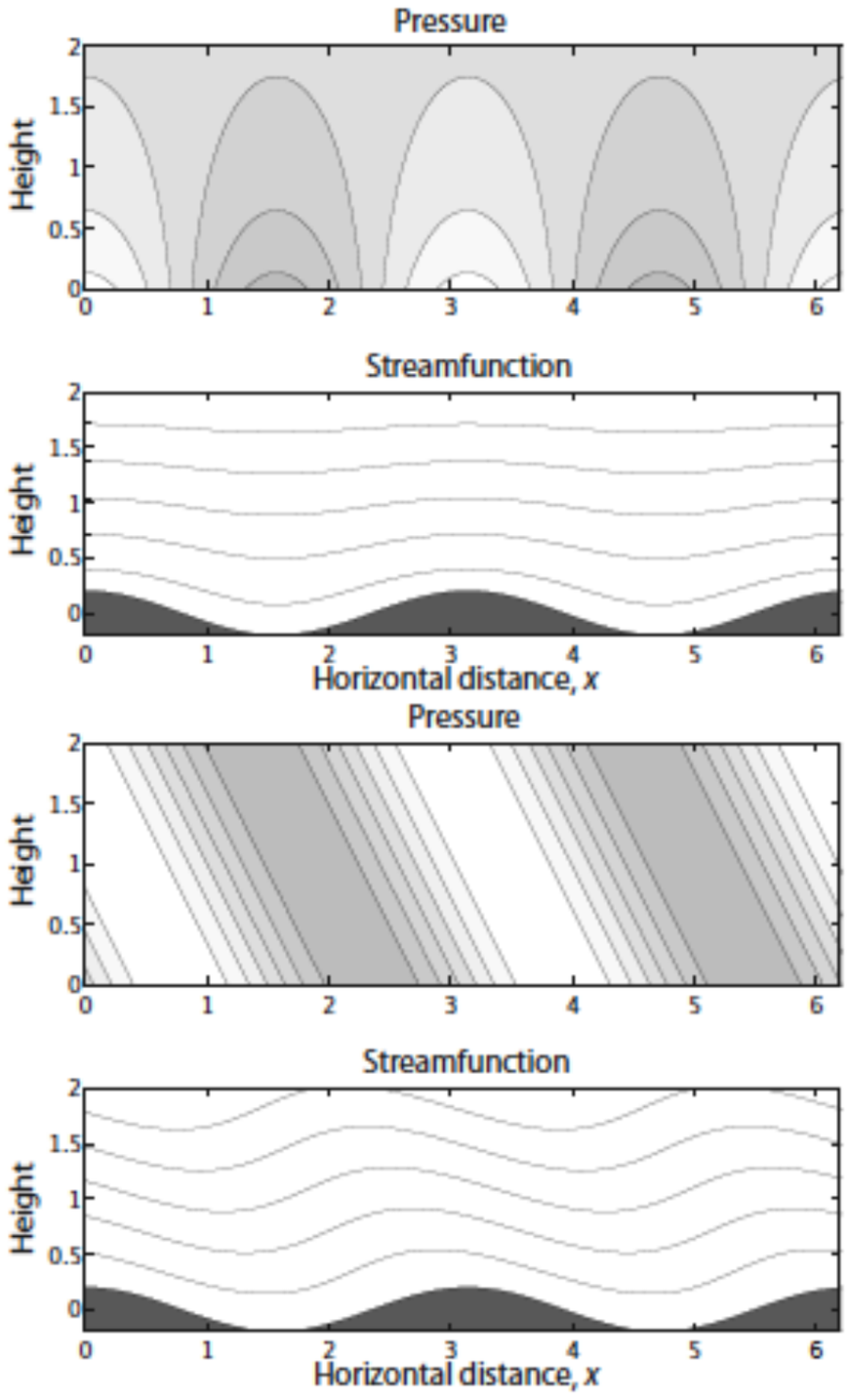
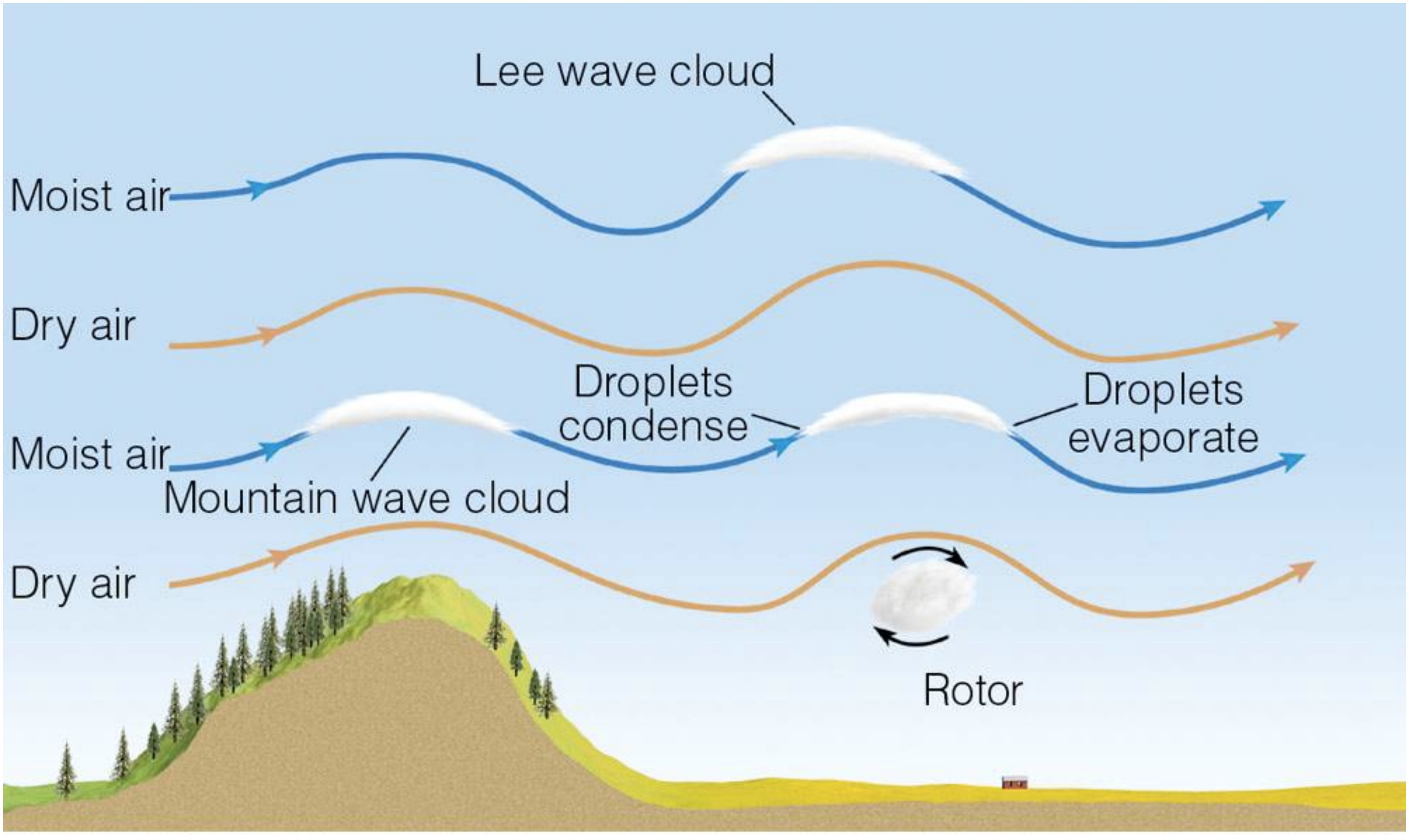


Fig. 7.16 Top two panels. Solutions for the flow over a sinusoidal ridge, using (7.178), in the short wave limit ($Uk > N$) and with $m = \mathrm{i}$. The top panel shows the pressure, with darker gray indicating higher pressure. The bottom panel shows contours of the total streamfunction, $\psi - Uz$, with flow coming in from the left, and the topography itself (solid). The perturbation amplitude decreases exponentially with height.

Bottom two panels. The same as above, but in the long wave limit ($Uk < N$) with $m = 1$. The pressure is high on the windward side of the topography, and phase lines tilt upstream with height for both pressure and streamfunction.

Mountain waves in the atmosphere



Mountain waves in the atmosphere

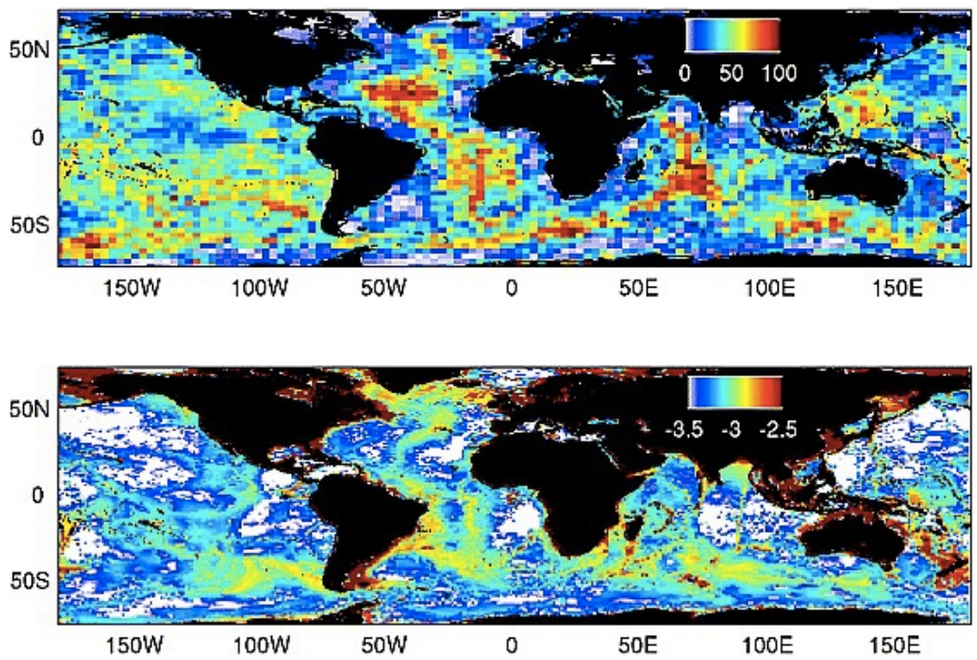
Mountain waves in the atmosphere

Mountain waves in the atmosphere

Topographic radiation by geostrophic flows

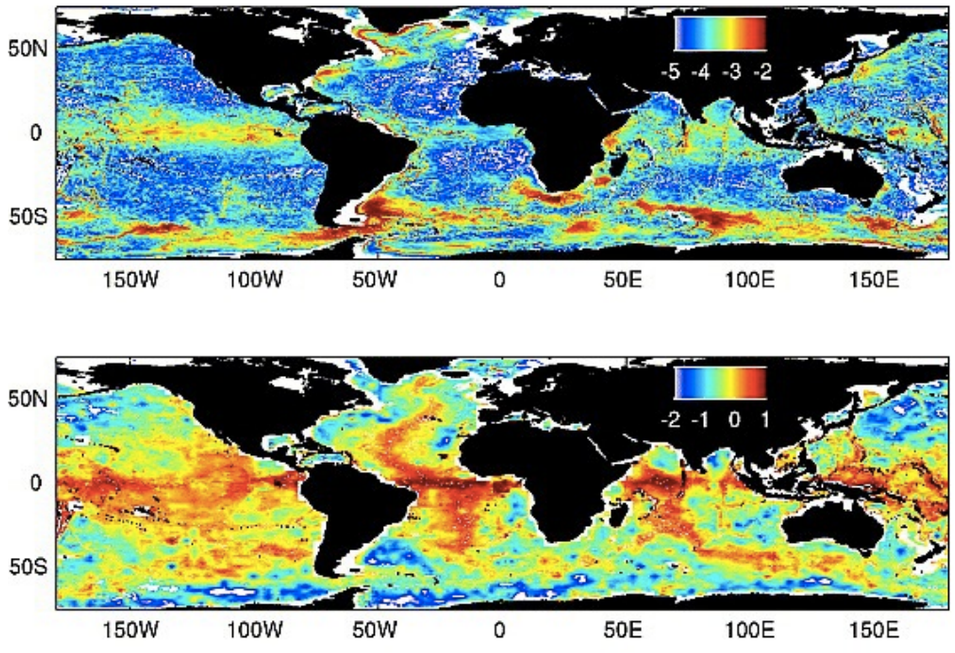
$$E = \frac{\rho_{ref}}{4\pi^2} \int_{-\infty}^{+\infty} |\hat{h}(\mathbf{k})|^2 \frac{\mathbf{U}\cdot\mathbf{k}}{|\mathbf{k}|} \sqrt{\mathbf{N^2} - |\mathbf{U}\cdot\mathbf{k}|^2} \sqrt{|\mathbf{U}\cdot\mathbf{k}|^2 - \mathbf{f^2}}\, \mathrm{dkdl}$$

Topographic roughness [m]



Bottom stratification estimated using the WOCE hydrographic atlas [$\mathrm{Log_{10}}$ ($\mathrm{s^{-1}}$)]

Bottom kinetic energy obtained from an ocean model [$\mathrm{Log_{10}}$ ($\mathrm{m^2 s^{-2}}$)]

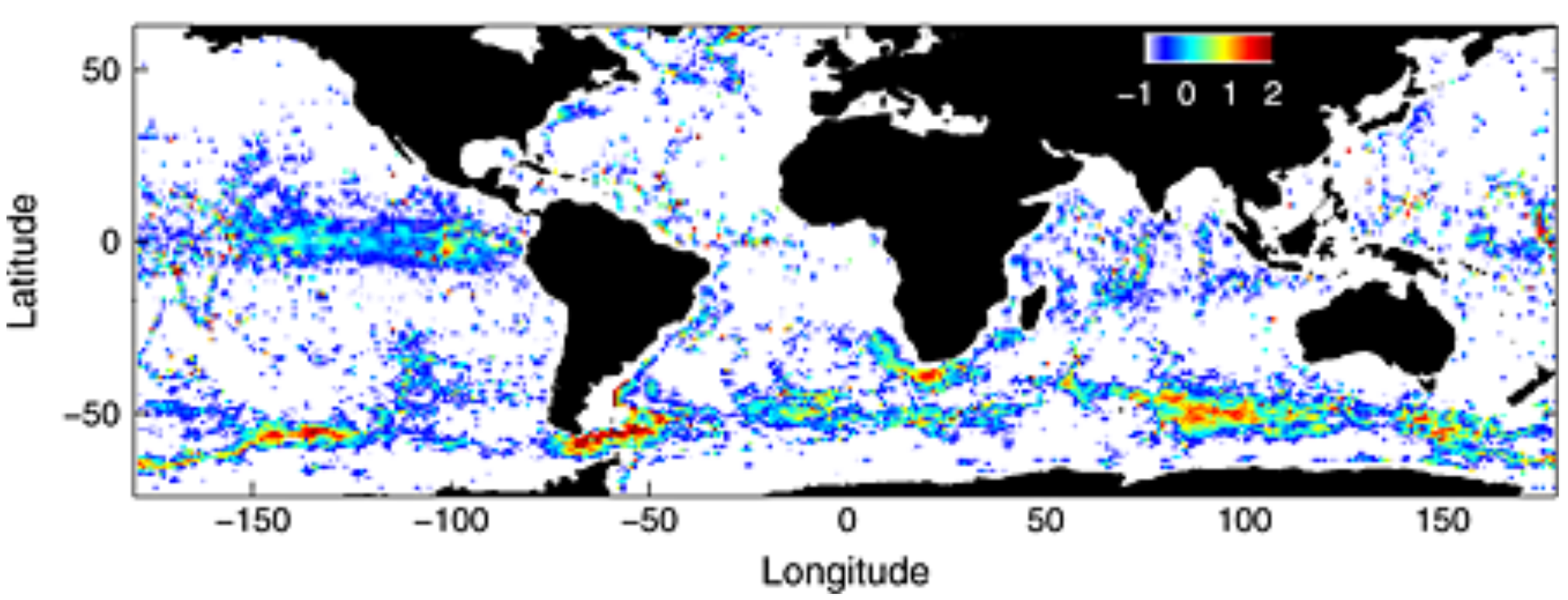


Topographic steepness parameter (degree of nonlinearity in log scale)

Topographic radiation by geostrophic flows

$$E = \frac{\rho_{ref}}{4\pi^2} \int_{-\infty}^{+\infty} |\hat{h}(\mathbf{k})|^2 \frac{\mathbf{U} \cdot \mathbf{k}}{|\mathbf{k}|} \sqrt{\mathbf{N^2} - |\mathbf{U} \cdot \mathbf{k}|^2} \sqrt{|\mathbf{U} \cdot \mathbf{k}|^2 - \mathbf{f^2}} \, \mathrm{d}\mathbf{k}\mathrm{d}\mathbf{l}$$

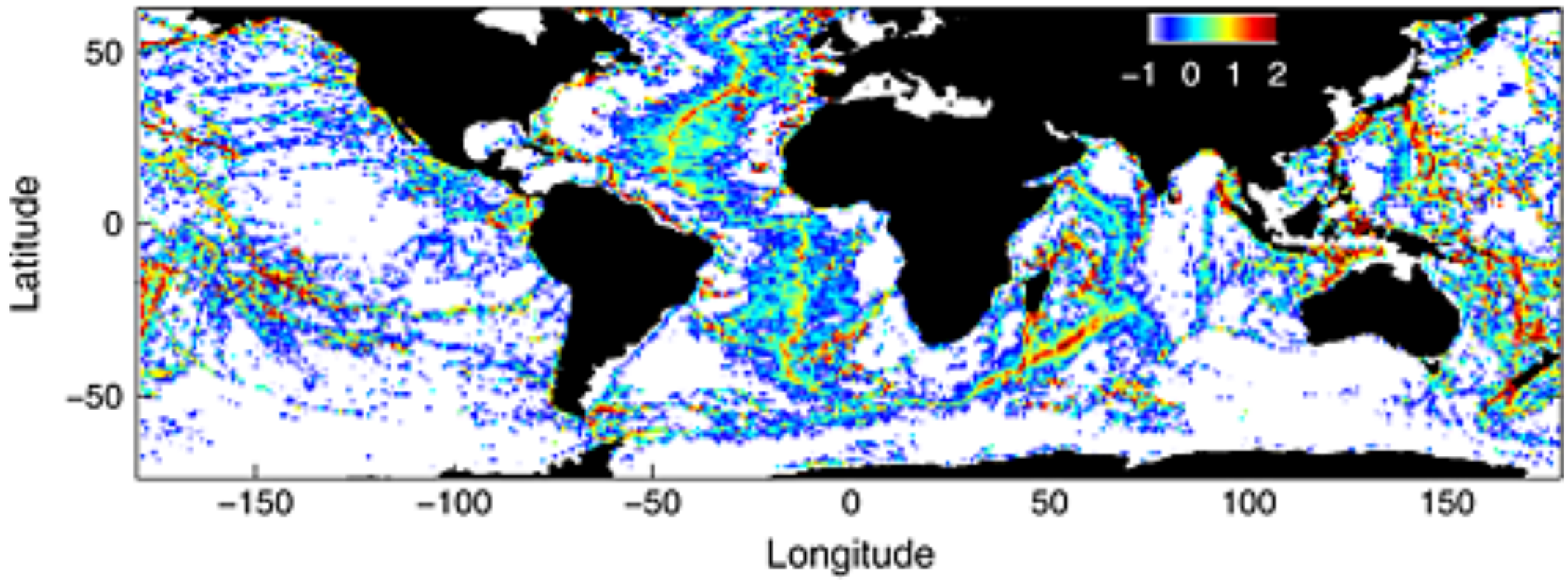
Energy flux into internal lee waves in [Log_{10} (mW s^{-2})]



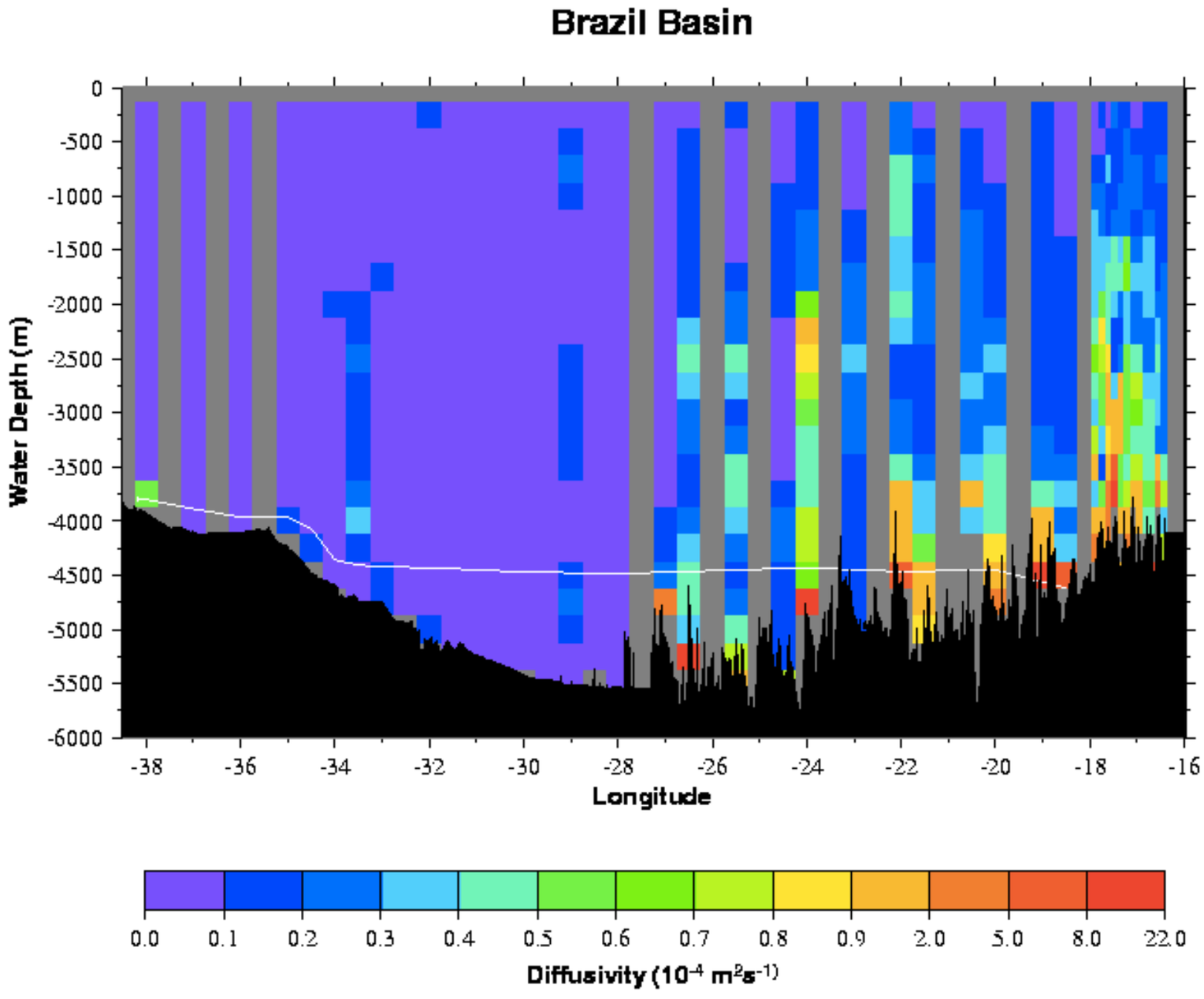
Topographic radiation by tidal flows

$$E = \frac{\rho_{ref}}{8\pi^2} N \sqrt{1 - \frac{f^2}{\omega^2}} \int_{-\infty}^{+\infty} \frac{|\mathbf{U} \cdot \mathbf{k}|^2}{|\mathbf{k}|^2} |\hat{h}(\mathbf{k})|^2 \, \mathrm{d}\mathbf{k}\mathrm{d}\mathbf{l}$$

Energy flux into internal tidal waves in [Log_{10} (mW s^{-2})]



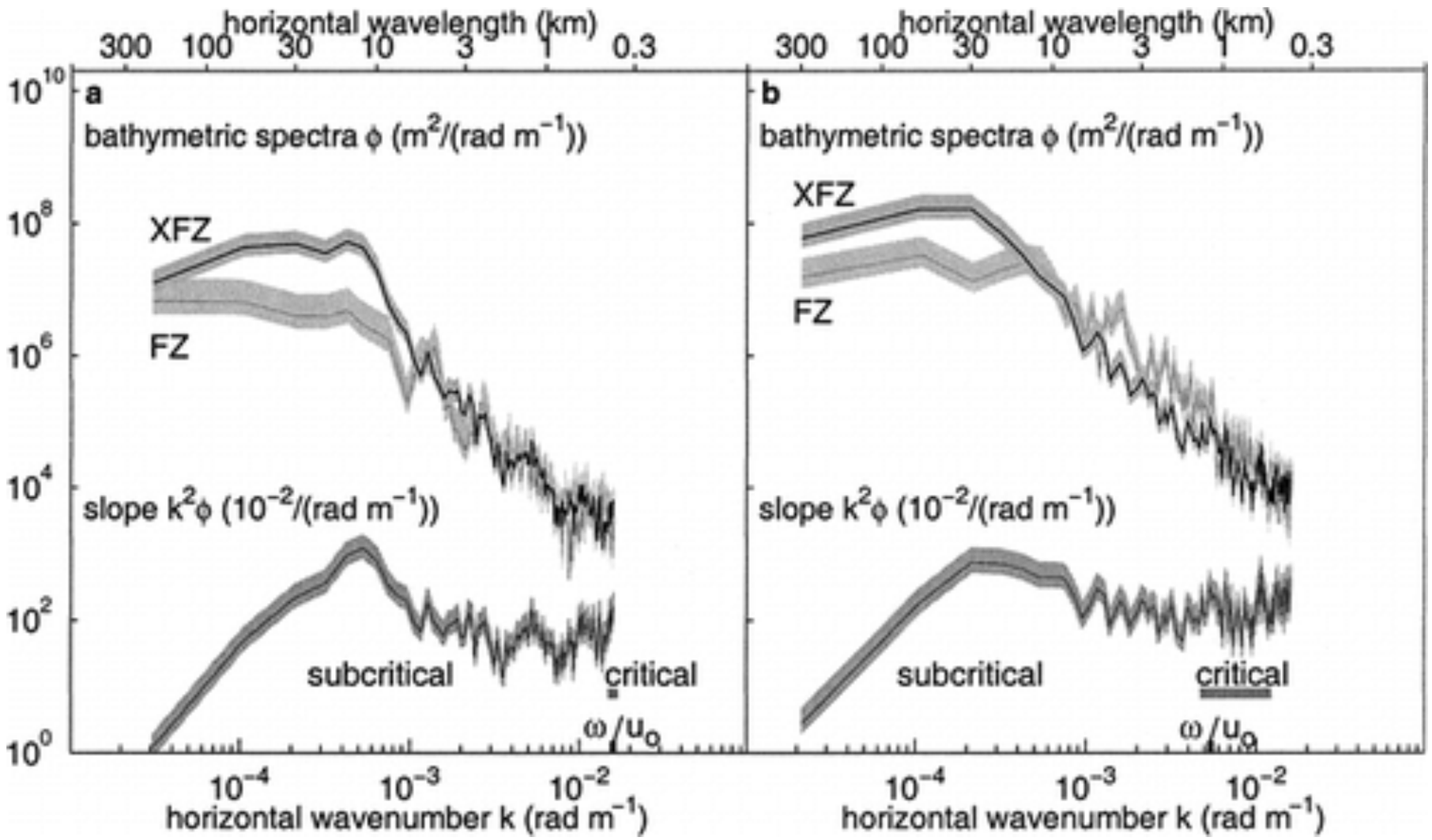
Brazil Basin Experiment



Jim Ledwell and WHOI Microstructure Group

Brazil Basin Topography

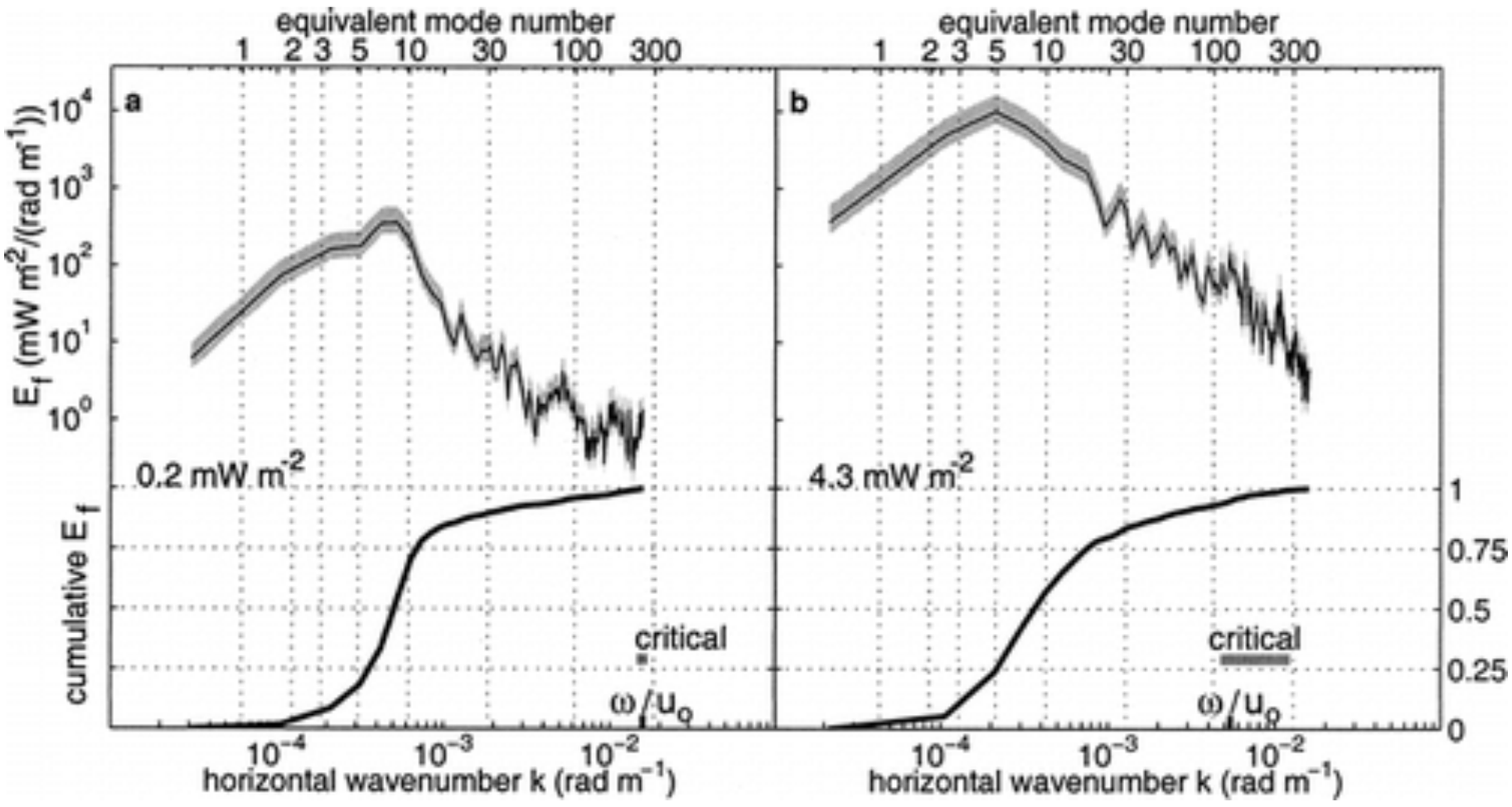
$$1/m \gg h \qquad \Longrightarrow \qquad k/m \gg hk = slope$$



St Laurent and Garret, 2002

Brazil Basin Topography

Radiation is dominated by low modes



St Laurent and Garret, 2002

Topographic radiation by tidal flows