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Tide-topography interactions: the influence of an along-shelf current on the internal wave spectrum

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We investigate the influence of a barotropic geostrophic current on
the internal wave (IW) generation over a shelf slope.
It is well known that most of the energy in the tide-topography
generated waves lies in waves with tidal frequency σ_T.
Here we restrict our attention on the frequencies other than the dominant frequency σ_T.
The current $V_g(x)$ is modeled as an idealized Gaussian function centered at
x_0 with width x_r and maximum velocity V_{max}.
The bathymetry is modelled as a linear slope with smoothed corners.
Since the center of the current lies on the slope, there will always
be a region on the slope where the effective frequency f_{eff} is
greater than the Coriolis parameter f and another region where
$f_{eff} < f$. Parametric subharmonic instability (PSI) occurs where
waves with approximately half of the primary wave frequency, in this
case $\sigma_T/2$, are generated. In the presence of a large current,
PSI can occur where $f_{eff} < \sigma_T/2 < f$. This could not
happen without a current, i.e. $f_{eff} = f > \sigma_T/2$. Other interesting
interactions, including interharmonics and strong tidal harmonics, are also observed.