# Geography of the attenuation rates of baroclinic tidal energy estimated using wave-wave interaction theory

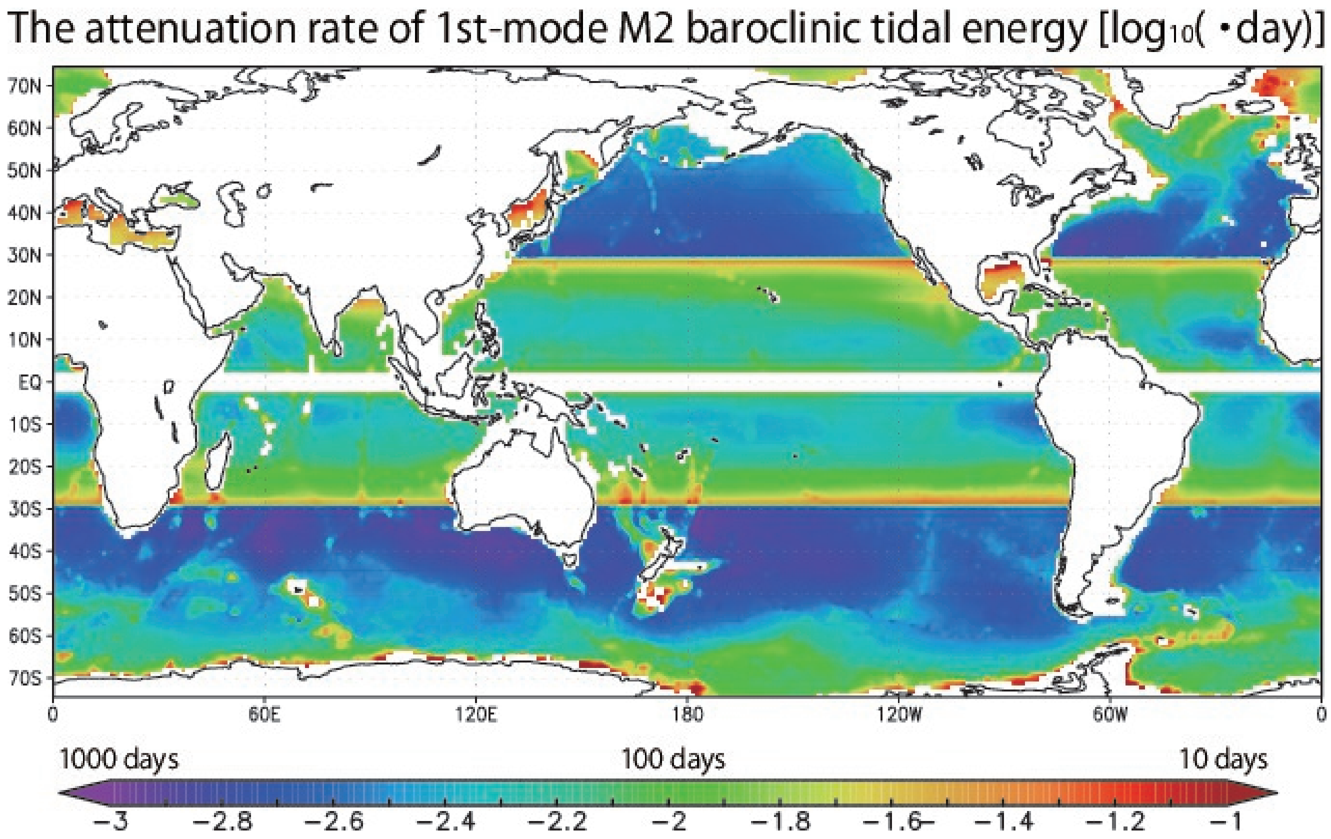
*Yohei Onuki[1,2], Toshiyuki Hibiya[1]

1.Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo, 2.Research Fellow of Japan Society for the Promotion of Science

The baroclinic tides are thought to be the dominant energy source for turbulent mixing in the ocean interior. In contrast to the energy conversion from the barotropic to baroclinic tides, which has been clarified in recent numerical studies, the energy sink for low-mode baroclinic tides is less well understood. One responsible mechanism for such energy sink is nonlinear interaction between the baroclinic tides and background internal wave field. Although the theoretical basis for the resonant interactions among internal waves was established long ago, its practical applicability to the baroclinic tides has not been sufficiently discussed. In this study, we have extended the classical theory to demonstrate the geographical distribution of the attenuation rates of low-mode baroclinic tidal energy resulting from wave-wave interactions.
Our approach is basically following the weak turbulence theory, which describes the statistics of energy transfer through wavenumber space caused by weakly nonlinear interactions. It should be noted that our new formulation is applicable to low-mode internal waves, which are strongly subject to the effects of density structure and total depth.
We have calculated the attenuation rate of low-mode baroclinic tidal waves interacting with the background Garrett-Munk internal wave field. The results clearly show the rapid attenuation of baroclinic tidal energy at mid-latitudes caused by parametric subharmonic instability (PSI) which depends on density structures associated with the subtropical gyre, in agreement with field observation and numerical simulation. This study is expected to contribute to clarify the global distribution of the dissipation rates of baroclinic tidal energy.

Keywords: Internal waves, Baroclinic tide, Resonant interaction


The attenuation rate of 1st-mode M2 baroclinic tidal energy [log10( •day)]
70N
60N
50N
40N
30N
20N
10N
EQ
10S
20S
30S
40S
50S
60S
70S
0
60E
120E
180
120W
60W
0
1000 days
100 days
10 days
−3
−2.8
−2.6
−2.4
−2.2
−2
−1.8
−1.6
−1.4
−1.2
−1