## Abstract View

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# The Speed of Observed and Theoretical Long Extratropical Planetary Waves

**Peter D. Killworth**

*Southampton Oceanography Centre, Southampton, United Kingdom*

**Dudley B. Chelton and Roland A. de Szoeke**

*College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, Oregon*

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ABSTRACT

Planetary or Rossby waves are the predominant way in which the ocean adjusts on long (year to decade) timescales. The motion of long planetary waves is westward, at speeds $\gtrsim$1 cm $s^{-1}$. Until recently, very few experimental investigations of such waves were possible because of scarce data. The advent of satellite altimetry has changed the situation considerably. Curiously, the speeds of planetary waves observed by TOPEX/Poseidon are mainly faster than those given by standard linear theory. This paper examines why this should be. It is argued that the major changes to the unperturbed wave speed will be caused by the presence of baroclinic east–west mean flows, which modify the potential vorticity gradient. Long linear perturbations to such flow satisfy a simple eigenvalue problem (related directly to standard quasigeostrophic theory). Solutions are mostly real, though a few are complex. In simple situations approximate solutions can be obtained analytically. Using archive data, the global problem is treated. Phase speeds similar to those observed are found in most areas, although in the Southern Hemisphere an underestimate of speed by the theory remains. Thus, the presence of baroclinic mean flow is sufficient to account for the majority of the observed speeds. It is shown that phase speed changes are produced mainly by (vertical) mode-2 east–west velocities, with mode-1 having little or no effect. Inclusion of the mean barotropic flow from a global eddy-admitting model makes only a small modification to the fit with observations; whether the fit is improved is equivocal.

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Headquarters: 45 Beacon Street Boston, MA 02108-3693
DC Office: 1120 G Street, NW, Suite 800 Washington DC, 20005-3826
amsinfo@ametsoc.org Phone: 617-227-2425 Fax: 617-742-8718