

Sakazaki, T., and M. Schindelegger, 2025: Global atmospheric normal modes identified in surface barometric observations. *J. Meteor. Soc. Japan*, **103**, <https://doi.org/10.2151/jmsj.2025-019>.

• **Plain Language Summary:** The atmosphere displays global, resonant oscillations (normal modes), occurring at discrete sets of eigen-frequency and zonal wavenumber. The present study confirmed that a global array of normal modes, recently detected in atmospheric reanalysis fields, also exists in raw barometric measurements. Not only low-frequency modes such as Rossby and Rossby-gravity modes but also high-frequency modes such as Kelvin and inertia-gravity modes and even the modes of Pekeris resonance with tiny amplitudes are identified.

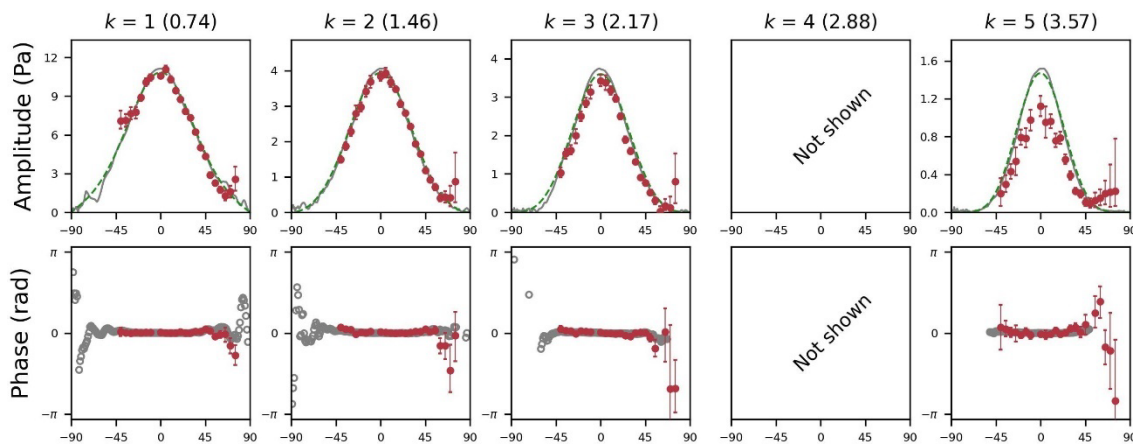


Figure: Meridional structure of (top) amplitude and (bottom) phase for Kelvin modes of Lamb resonance for (from left to right) $k = 1$ to 5 . Red circles denote the results from station and buoy observations, with their vertical bars showing the 95% confidence level. The number in the parentheses at the top of each panel denotes the wave frequency (unit: CPD). Gray curves (for amplitude) and open circles (for phase) show the results for All-ERA5 data, while green curves for amplitude represent the Hough function fitted to the results for All-ERA5 (gray curves). (“Not shown” indicates either that the spectral peaks are too close to diurnal harmonics or that the fitting to the Lorentzian function failed.)

Highlights:

- For each mode, a time series of its index is constructed using ERA5, and the raw barometric measurement data are then regressed onto this index to identify coherent signals corresponding to the normal mode signals in ERA5.
- It is confirmed that normal mode signals previously identified in ERA5 do exist in the real atmosphere, not only for low-frequency modes such as Rossby and Rossby-gravity modes but also high-frequency modes such as Kelvin and inertia-gravity modes and even a few modes of Pekeris resonance.
- Owing to data assimilation, ERA5 can reproduce even global wave signals with surface pressure amplitudes of 0.1~1 Pa.