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Tsunamis as normal modes of the Earth,
and a venture into extracurricular geophysics

講義内容 ：

In a series of seminal papers, Ward [1980, 1981] has shown that tsunamis can be interpreted as a special branch of the normal modes (free oscillations) of a planet including an oceanic layer. This approach is particularly powerful as it expresses naturally the coupling between the solid Earth (where most tsunami sources are located) and the oceanic column, and in particular can handle directly any intermediate sedimentary structure. Routine algorithms used in classical seismological synthesis are seamlessly applicable to tsunami excitation.

Normal mode theory is also extended effortlessly to higher frequencies outside the shallow water approximations, known to have a crucial effect on the final small scale of harbor response. On the other hand, its limitations stem from its inability to handle lateral heterogeneity.

Recently, and especially in the wake of the 2004 Sumatra tsunami, a number of fascinating observations were made on instruments not designed for that purpose: in most cases, they express subtle coupling between media of extremely different properties, such as the oceanic column, the solid Earth, or the atmosphere. They include recording of tsunamis by seismometers at land stations and on the ocean bottom, by hydrophones of the CTBTO, the definitive observation and explanation of tsunami shadows, tsunami signatures in the geomaetic field, the generation of deep infrasound, and the perturbation of the ionosphere detected on GPS receiver arrays. In most cases, these phenomena are readily explained by the continuation (in a mathematical sense) of the tsunami eigenfunction outside of the water column; we will show that in many instances, the order of magnitude of the effect is well predicted by simple arguments derived under the normal mode approach.