

Tidal Theory

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This project is about oceanic tides, the rise and fall of the world's oceans and seas. Tides are created by the combined gravitational pull of the Moon and the Sun. One of the first problems is to discover why there are two high tides a day in most parts of the world. This can be understood from a simplified model, the equilibrium theory of tides.

In some places, tides can have an amplitude of over 10 metres, but in other places (in the middle of large oceans for example) the tidal range is less than a metre. These differences can be explained using the dynamical theory of tides, which also involves the formation of bores, a sudden jump in water level occurring at the mouths of some rivers. Simplified models exist based on flow through a canal which explain why tides grow in amplitude as they approach river mouths. Another surprising feature of tides is that on opposite sides of a channel, the tides can be of very different magnitude: the tides on the French side of the English Channel are much greater than those on the English side. This can be explained in terms of Kelvin waves.

Tidal theory has an interesting history, with many famous mathematicians making important contributions. Some knowledge of fluid dynamics (MATH2620, for example) would be an advantage, and some knowledge of vector calculus is necessary.

Books:

Hydrodynamics, H. Lamb (Cambridge University Press Paperback edition, 1993)

Waves, Tides and Shallow-Water Processes, Open University Course Team, (Butterworth-Heinemann, 1999).

Tides: a Scientific History, D.E. Cartwright, (Cambridge University Press, 1999.)