In this thesis, we deal with the flow of a subsurface ocean in the so-called shallow water approximation. From the equations describing general flow of an incompressible fluid, we obtain simplified equations, applicable to a shallow global ocean on a rotating sphere. Based on these equations, we develop a program that can be used to model the flow of an ocean in 2D. We create short simulations of the flow on two icy moons, Europa and Enceladus, forced by the eccentricity and obliquity tidal potentials. The existence of subsurface oceans has been demonstrated on icy moons of outer planets; the mechanism which keeps them from freezing has remained unclear until now. Based on the flow simulations, we attempt to estimate the energy dissipation due to bottom friction.