Gravitational Acceleration

The gravitational acceleration g in the ocean can be taken to be the following function of latitude ϕ and sea pressure p, or height z relative to the geoid,

$$\begin{aligned} g/(\text{m s}^{-2}) &= 9.780\ 327\left(1 + 5.3024x10^{-3}\sin^2\phi - 5.8x10^{-6}\sin^2 2\phi\right)\left(1 - 2.26x10^{-7}\, z/(\text{m})\right) \\ &= 9.780\ 327\left(1 + 5.2792x10^{-3}\sin^2\phi + 2.32x10^{-5}\sin^4\phi\right)\left(1 - 2.26x10^{-7}\, z/(\text{m})\right) \qquad \text{(D.3)} \\ &\approx 9.780\ 327\left(1 + 5.2792x10^{-3}\sin^2\phi + 2.32x10^{-5}\sin^4\phi\right)\left(1 + 2.22x10^{-7}\, p/(\text{dbar})\right). \end{aligned}$$

The dependence on latitude in Eqn. (D.3) is from Moritz (2000) and is the gravitational acceleration on the surface of an ellipsoid which approximates the geoid. The variation of g with z and p in the ocean in Eqn. (D.3) is derived in McDougall *et al*. (2010b). The height z above the geoid is negative in the ocean. Note that g increases with depth in the ocean at about 71.85% of the rate at which it decreases with height in the atmosphere.

At a latitude of 45°N and at $p = 0$, $g = 9.8062$ m s^{-2}, which is a value commonly used in ocean models. The value of g averaged over the earth's surface is $g = 9.7976$ m s^{-2}, while the value averaged over the surface of the ocean is $g = 9.7963$ m s^{-2} (Griffies (2004)).