(3) In order of magnitude, the energy stored in ocean waves is as much as the Earth receives from the sun in what length of time?

Let \( h \) be the wave height from trough to crest; \( h/2 \) is the amplitude. If \( y \) is the height of the surface at any point, measured from the mean surface, the potential energy there per unit area is \( \rho gy^2/2 \). But averaged over many wavelengths \( \bar{y^2} = h^2/8 \), so the potential energy per unit area averaged over a large region is \( \rho gh^2/16 \). Doubling this to include the kinetic energy, we have \( \rho gh^2/8 \) for the total wave energy per unit area of ocean. For example if \( h = 2 \) meters, this gives \( 5 \text{ J/m}^2 \) for the mean energy density. Sunlight with a power density of \( 1 \text{ kW/m}^2 \) is being intercepted at any moment by an area equal to \( 1/4 \) the Earth’s surface. If waves with \( h = 2 \) meters prevailed over half the Earth’s surface, their energy would be equivalent to \( 1/100 \) second of sunlight.