How many drops of water in all the world’s oceans?

We are basically interested in how many drops will FIT in a volume equal to that of the Earth’s oceans. So we really want the fraction:

\[ N = \frac{V_{\text{Oceans}}}{V_{\text{drop}}} \]

The oceans are a thin layer of water on the surface of the Earth, so we can calculate the volume as we did Lake Ponchartrain:

\[ V = A \cdot D = 4\pi R^2 \cdot D = 4\pi (6.4 \cdot 10^6 \text{ m})^2 \cdot (6000 \text{ m}) = 3 \cdot 10^{18} \text{ m}^3 \]

Contrary to popular opinion, there is reasonable agreement on the size of a drop – in the dozen or so papers that did the calculation there were no drops smaller than about 0.01 mL and none larger than 1 mL. In general, a drop of water will be about 3 mm or so across, which gives a volume of:

\[ V = (0.3 \text{ cm})^3 = 0.027 \text{ cm}^3 \sim 0.03 \text{ mL} = 3 \cdot 10^{-8} \text{ m}^3 \]

So the number in question is:

\[ N = \frac{(3 \cdot 10^{18} \text{ m}^3)}{(3 \cdot 10^{-8} \text{ m}^3)} = 10^{26} \]

Try this – if I spread a single drop of water over the whole world, how thick would it be? Express the answer in meters and number of atomic layers.