Metadata unit conversion for the samples from OSD 2018 and 2019

1. Seawater optical property (downward PAR)
   PAR = Photosynthetic Active Radiation
   Handbook standard = mE/m²/s, where
   E = Einstein = energy of I mole of photons / m²/s
   Photon Flux = 1µE
   Normally, for visible light, wavelength λ = 400-700nm
   PAR is in the range 0 - 2000µE/m²/s = 0 – 2mE/m²/s

   Conversion from actual samples
   Received samples marked with photons/m²/s:
   Believe it means Photon Flux, µmol photons/m²/s = µE/m²/s
   So, to convert, divide it by 1000 to get mE/m²/s

2. Seawater nutrient concentrations, handbook standard = µmol/L
   µmol/L is the conventional unit, while mg/l is an old-fashion unit
   We need to know the molar mass of each nutrient in order to convert:
   Nitrate NO_3^- = 62.01 g/mol
   Nitrite NO_2^- = 46.005 g/mol
   Phosphate PO_4 = 94.97 g/mol
   Silicate SiO_3^{2-} = 76.083 g/mol

   Conversion from actual samples
   *µmol/L = sample weight (mg/l) / (Molar mass (g/mol) * 1000), or*
   *= sample weight (µg/l) / (Molar mass (g/mol) * 10^6)*

3. Dissolved oxygen concentration, handbook standard = µmol/Kg
   Molecular weight: 1µmol dissolved O_2 = 0.022391 mg O_2
   Density of seawater at T=25˚C, salinity at 35g/Kg = 1023.6 kg/m³
   Guideline for interpretation of Dissolved Oxygen:
   - 0-2 mg/L = not enough oxygen to support life
   - 2-4 mg/L = only a few kinds of fishes and insects can survive
   - 4-7 mg/L = acceptable for warm water fish
   - 7-11 mg/L = very good for most stream fish including cold water fish

   Conversion from actual samples:

   1 mg/l = 43.6311 µmol/kg (dissolved O_2)

   Others conversions:

   - *1 ml/l = 1 mg/l*
   - *1 % = 0.1 mg/l*
   - *1 mol/m³ = 1 µmol/kg*

4. Seawater optical properties – Turbidity, handbook unit = NTU or FTU; sample unit = FNU
    - NTU = Nephelometric Turbidity Units, measured with white light scattered at 90˚, according to USEPA Method 180.1. For OSD 2018 4 stations recorded values in this unit.
    - FNU = Formazin Nephelometric Units, measured with infrared light scattered at 90˚, according to ISO7027. No stations recorded values in this unit.
    - FTU = Formazin Turbidity Units, do not specify how the instrument measure the sample. For OSD2019 all 6 stations recorded values in this unit. For OSD2018, 3 stations recorded in this unit.

    Because suspended particles scatter light of different wavelengths with varying efficiency, turbidity data collected with infrared light sources are not directly comparable to turbidity data collected with white light sources. (https://or.water.usgs.gov/grapher/fnu.html)

    Conversion from actual samples*: No comparable conversion between FNU and NTU. Since FTU is the most commonly-reported unit and matches OSD 2014, that one will be adopted and values in other units will be discarded.*

5. Dissolved Organic Nitrogen DON, handbook unit = mg/L; sample unit = micromolar µM (10^{-6}mol/L)
    DON includes all nitrogenous compounds in living organisms: proteins, free amino acids, amino sugars, nucleic acids (DNA / RNA), etc
    DON is usually calculated as:
        DON = TDN – DIN
            TDN = Total Dissolved Nitrogen
            DIN = Dissolved Inorganic Nitrogen = (nitrite + nitrate + ammonia)

    Conversion from actual samples:
        µM cannot be converted to mg/L because exact chemical composition of DON is not known → measurements discarded