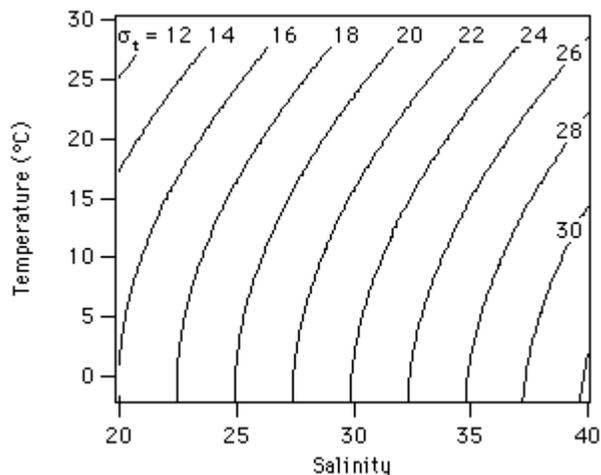


Information about ocean salinity, temperature, and density

Anyone who has taken in a mouthful of seawater while swimming knows that the ocean is really salty! This data tool will help you discover how salty seawater is, at any location and depth in the world.

The salt content (or **salinity**) of seawater is measured by parts per thousand (ppt). Ocean scientists also define salinity as a dimensionless conductivity ratio, known as "practical salinity units" (psu). For example, salinity of 35 psu is equivalent to 35 ppt; this means that there are 35 pounds of salt per 1000 pounds of seawater.

In addition to salinity, it is also important to know seawater **temperature**. Ocean temperature commonly varies between -10C and 30C (30.20F - 860F). At the surface, patterns of mean temperature generally coincide with latitude: the warmest temperatures are found in the tropics and the coldest waters are found near the poles. However, important exceptions to this trend are seen near coastlines and along the equator in the Pacific Ocean.



Temperature and salinity determine seawater **density** (Figure 1). The density of fresh water is 1 gram (mass) per cubic centimeter (volume). If you have a volume with dimensions 1 m by 1 m by 1 m and fill it with pure water, the water will weigh 1000 kg. If you dissolve salt into the water -- increase the water's salinity -- the mass will increase while its volume stays the same; thus the water density will increase. Decreasing the water's temperature will also increase its density. Together, typical ocean surface salinities and temperatures result in densities between 1016 and 1028 kg per cubic meter.

Figure 1. Temperature-Salinity diagram for seawater. Lines represent isopycnals (lines of constant density) at the sea surface defined as σ_t (density - 1000) kg/m^3 .

It should be pointed out that the temperature and salinity data presented here are derived from the World Ocean Database 2005 (pull-down menu item labeled as "database", Johnson et al., 2006) and the World Ocean Atlas 2005 (pull-down menu item labeled as "atlas", WOA05) provided by the NOAA's National Oceanographic Data Center. The database refers to the raw measurements averaged over every one-degree by one-degree square over the world ocean at 33 standard depths from 0 m to 5500 m. As a result, there are data gaps where salinity (less so for temperature) has *never been measured from 1800 to 2005*. The atlas is the objectively analyzed maps that extrapolate the database measurements into all data gap regions. The density is simply computed from the temperature and salinity using the equation of seawater (Fofonoff, 1985).

References

1. Johnson, D.R., T.P. Boyer, H.E. Garcia, R.A. Locarnini, A.V. Mishonov, M.T. Pitcher, O.K. Baranova, J.I. Antonov, and I.V. Smolyar, 2006. *World Ocean Database 2005 Documentation*. Ed. Sydney Levitus. NODC Internal Report 18, U.S. Government Printing Office, Washington, D.C., 163 pp, Available from <http://www.nodc.noaa.gov/OC5/WOD05/docwod05.html>.
2. Antonov, J. I., R. A. Locarnini, T. P. Boyer, A. V. Mishonov, and H. E. Garcia, 2006. *World Ocean Atlas 2005, Volume 2: Salinity*. S. Levitus, Ed. NOAA Atlas NESDIS 62, U.S. Government Printing Office, Washington, D.C., 182 pp, Available from <http://www.nodc.noaa.gov/OC5/WOA05/pubwoa05.html>.
3. Locarnini, R. A., A. V. Mishonov, J. I. Antonov, T. P. Boyer, and H. E. Garcia, 2006. *World Ocean Atlas 2005, Volume 1: Temperature*. S. Levitus, Ed. NOAA Atlas NESDIS 61, U.S. Government Printing Office, Washington, D.C., 182 pp, Available from <http://www.nodc.noaa.gov/OC5/WOA05/pubwoa05.html>.
4. Fofonoff, N. P., 1985. Physical properties of seawater: A new salinity scale and equation of state for seawater. *Journal of Geophysical Research*, **90**, 3322–3342.