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Analyze the functional relationship between temperature, salinity and ocean depth.

We aim to analyze the functional relationship between the Atlantic ocean's temperature, salinity and depth using Argo data. Argo data is a high resolution vertical profile of temperature, pressure and salinity, where we used pressure as a proxy for the ocean depth. Pressure is measured in decibars (dbar), where 1 dbar is very close to 1 meter of depth. Temperature is measured in centigrade units and salinity is measured in practical salinity units (psu). Data was collected in oceans around the world, and we used the 46,249 recorded profiles from the Atlantic ocean. Each profile has 100 observations. These profiles can be seen as the evaluated sample points from the true functions that represent the relationship between temperature and pressure, salinity and pressure.

We analyzed the depth of our 46,249 recorded profiles using L2 depth. The depth can be understood as a concept similar to the quantile in multivariate data. That is, the deepest points have a similar meaning with the median. First, I calculated the depth of relationship between temperature and pressure, and the relationship between salinity and pressure from the 46,249 recorded profiles. Then, I categorized these 46,249 relationships based on depth rank.

Figure 1 shows the 10 sampled relationships from the deepest relationships of temperature and the pressure. We can see the general functional relationship between temperature and the pressure. Since pressure is a proxy for the ocean depth, the deeper the ocean, the lower the temperature.

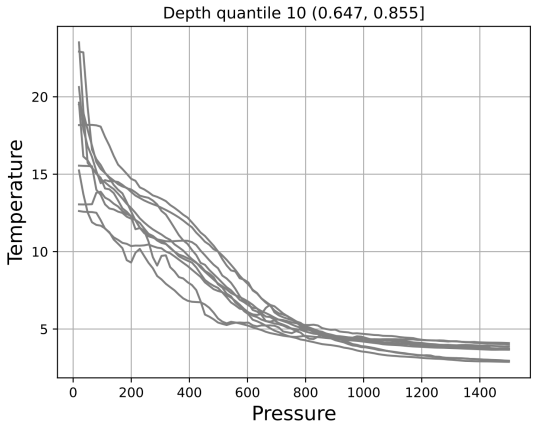

Figure 1: The deepest 10 profiles of the 46,249 relationships between temperature and the pressure.

Figure 2 shows the 10 sampled relationships from the shallowest relationships of temperature and pressure. We can see 2 clusters of outlying patterns. One pattern is that the deeper the ocean, the slower the temperature decreases relative to the deepest samples. The other pattern is that the temperature increases as the sea deepens and then slowly decreases.

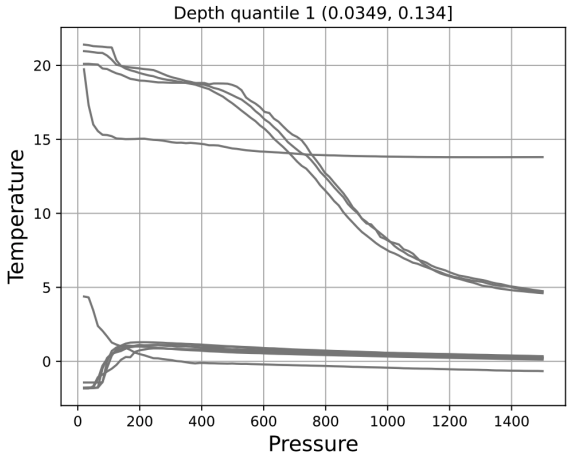

Figure 2: The shallowest 10 samples of the 46,249 relationships between temperature and the pressure.

Figure 3 shows the 10 sampled relationships from the deepest relationships of salinity and pressure. Although more complex than temperature, we can identify some relationships between salinity and pressure. In general, salinity tends to decrease and then increase again as the depth of the sea increases.

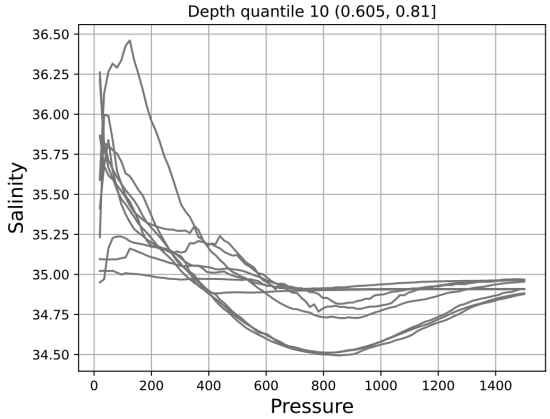

Figure 3: The deepest 10 samples of the 46,249 relationships between salinity and the pressure.

Figure 4 shows the 10 sampled relationships from the shallowest relationships of salinity and the pressure. We can check the 2 outlying patterns. In one pattern the salinity decreases monotonically as the ocean gets deeper. The other pattern is that salinity rather increases as the sea gets deeper.

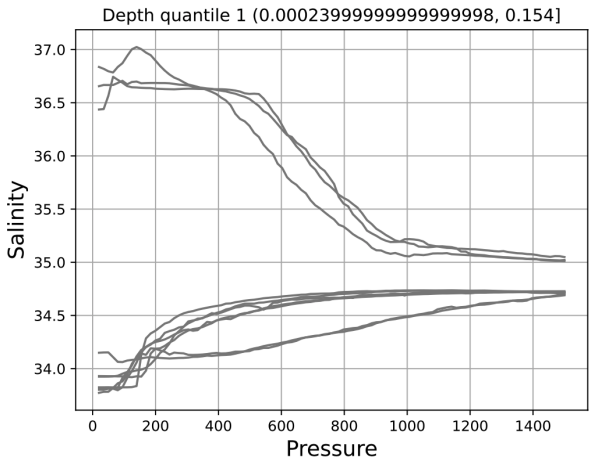

Figure 4: The shallowest 10 samples of the 46,249 relationships between salinity and the pressure.