Modeling North Pacific Ocean Climate Realistically

The climate of the North Pacific Ocean varies over decades; it influences weather systems in both Asia and North America and affects marine ecosystems and fisheries. Prediction of such climate variations is therefore useful but only possible if we understand what causes them. The main tool for understanding the ocean is the study of its variability in numerical modeling.

The region with one of the largest variations in SST, the coast off northeastern Japan, has not been simulated accurately until now; generally, models have produced SSTs in the region that are too warm. Recently, **Humio Mitsudera** at the IPRC and his Japanese colleagues **Yasushi Yoshikawa**, **Bunmei Taguchi**, and **Hirohiko Nakamura** have successfully simulated the temperature and salinity fields of this region. In particular, they have found striking impacts of including the outflow from the Sea of Okhotsk through the Bussol Strait, which lowered the simulated ocean temperature to realistic levels. The outflow first flows along the Kuril Islands and the Japanese coast as a density current that carries the very cold, low salinity and low potential vorticity Okhotsk water southward. It is then transported by mesoscale eddies into the ocean interior, where it occupies the intermediate levels.

Figure 2 on the opposite page shows the effects of two numerical modeling experiments on ocean temperature at 250-m depth (the depth at which air no longer affects water temperature): in (a) the Okhotsk Sea outflow is present; whereas in (b) it is absent. Water temperature is represented by the color bands, ranging from purple (1ºC water) to red (24ºC). It can be seen that in the region of interest the ocean is much colder in the open Bussol Strait case than in the closed case. This is shown even more clearly in (c), which represents the mean temperature differences in winter (December, January, and February or DJF) between the open and the closed conditions. The numbers in white rectangles show that between 35ºN and 45ºN the water is between 0.5ºC and 6ºC colder for the open condition. The final panel shows how SST is modified by the Sea of Okhotsk outflow. During the three winter months, SST is colder with outflow than without outflow by the amounts shown, a consequence of the colder subsurface temperature appearing at the surface owing to the formation of a deep mixed layer.

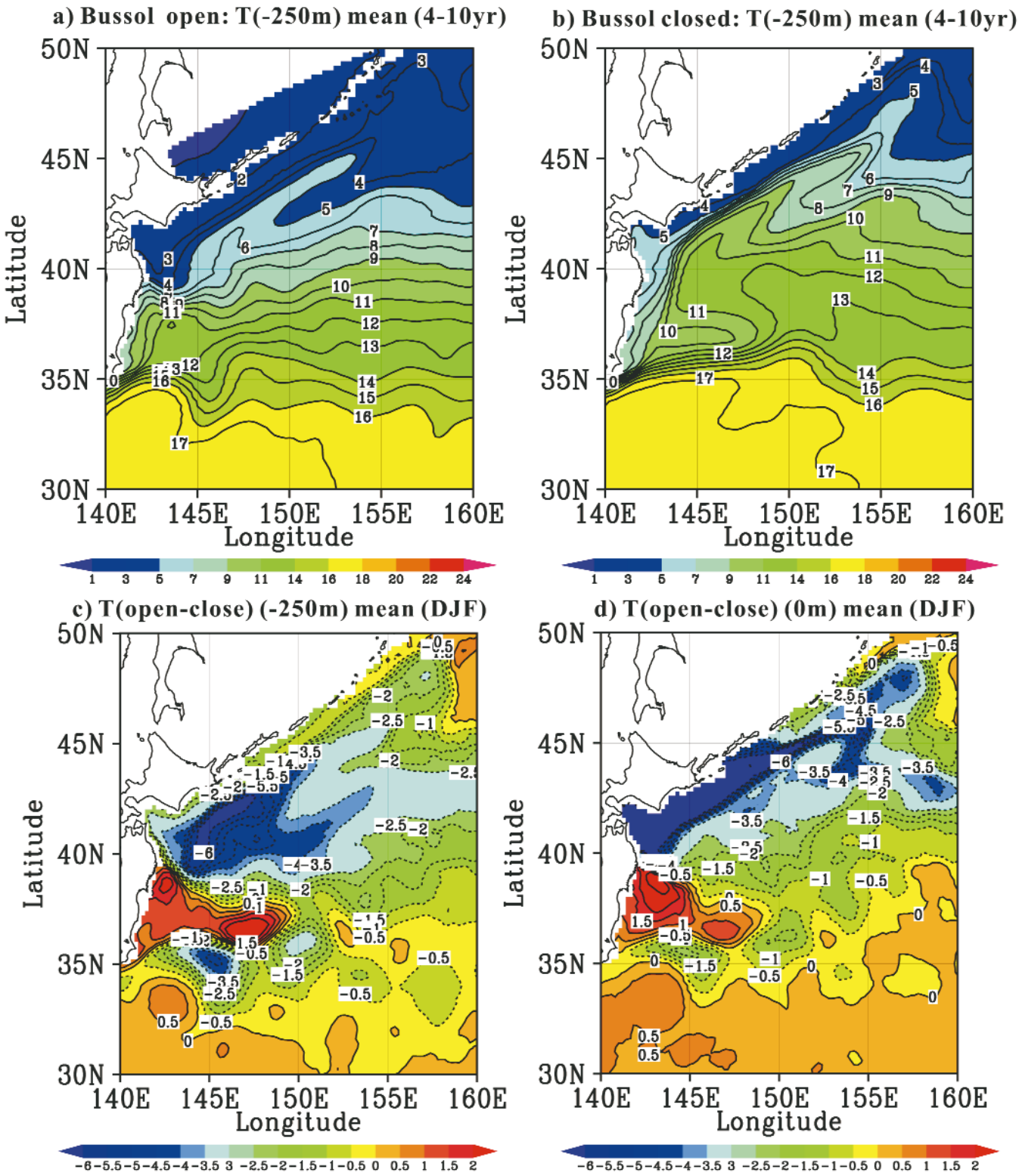

Figure 2. *Model simulations of ocean temperatures (°C) at 250 m under open (a) and closed (b) Bussol Strait conditions. Winter-time temperature differences for solutions with open and closed Bussol Strait at depths of 250 m (c) and at the ocean surface (d).*