

Abstract

This technical report describes 10-year reanalysis data (2008–2017) obtained with an operational system for monitoring and forecasting the status of coastal and open-ocean waters around Japan (the JPN system). This system was developed by the Department of Atmosphere, Ocean, and Earth System Modeling Research of the Meteorological Research Institute. The JPN system includes a double-nested ocean model, the core of which is a Japanese coastal model with a horizontal resolution of 2 km, and an accompanying ocean data assimilation scheme. The ocean model consists of three submodels: a global model (horizontal resolution: ~ 100 km), a North Pacific model (horizontal resolution: ~ 10 km), and a Japanese coastal model (horizontal resolution: ~ 2 km). These three submodels are interconnected by a nesting technique. In the ocean data assimilation scheme, the North Pacific model is analyzed with a four-dimensional variational method. The analysis field of the North Pacific model is assimilated into the Japanese coastal model by the incremental analysis update (IAU) method, which effectively removes high-frequency noise with periods shorter than the assimilation period. One of the features of the JPN system is that its 2-km resolution around Japan enables expression of so-called sub-mesoscale phenomena with horizontal scales of 10 km. For example, it is possible to express the abrupt influx of warm water into the coastal area from the Kuroshio (called the warm water intrusion and sporadic tide), a phenomenon that has been difficult to represent with conventional models, which have a 10-km resolution. In addition, the introduction of a new vertical coordinate system (the z^* coordinate system) has improved the reproducibility of phenomena in shallow water areas near the coast. In the process of data assimilation, representations of short-period variations are improved more effectively with the four-dimensional variational method than the conventional three-dimensional variational method. Because the JPN system takes account of processes such as tides and river runoff, it can provide detailed information about ocean variables such as tides and salinity in coastal areas. This report provides climatological maps of the monthly averages and standard deviations of a variety of ocean variables, including water temperature, salinity, ocean currents, sea ice, sea level, and tidal currents over the entire area around Japan and six regional areas. Note that climate fields of phenomena with significant interannual variations, such as the Kuroshio path, are not well captured by 10-year averages. For such timescales, it is better to recognize the magnitude of the interannual variations with the standard deviation in addition to the monthly average.

The JPN system has already been transferred to the Global Environment and Marine Department of the Japan Meteorological Agency and is being piloted there. The JPN system, which will become operational in 2020, is expected to significantly improve the accuracy of ocean analysis and prediction. The output of the JPN system will be highly reliable, fundamental ocean data that are expected to be widely used in marine operations such as ocean monitoring and forecasting, as well as in research and education related to fisheries and climate.