About the JCOPE-T 1ks Ocean Forecasting System

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JAMSTEC/JCOPE Group

At the Application Laboratory of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) is actively engaged in the research and development of *ocean weather forecasting* (Hayashida et al., 2024) as part of the Japan Coastal Ocean Predictability Experiment (JCOPE). JCOPE-T 1ks (1 km scale) (Wang et al., 2025) is a high-resolution ocean weather forecasting system developed through refinement of JCOPE-T DA (Data Assimilation) (Miyazawa et al., 2021). Both systems are based on the JCOPE-T ocean circulation model (Varlamov and Miyazawa, 2021).

JCOPE-T is a third-generation model in the JCOPE series (JCOPE Third Generation), built upon the Princeton Ocean Model with generalized sigma coordinates (Mellor et al., 2002), which employs vertical coordinates that follow the seafloor topography. The model has been rewritten from its original Fortran77 code into Fortran95/2003 and incorporates parallel computing capabilities.

A comparison between JCOPE-T DA and JCOPE-T 1ks is provided in the following table.

Table 1: Comparison of JCOPE-T DA and JCOPE-T 1ks

	JCOPE-T DA	JCOPE-T 1ks
Simulation Period	2018 - Present	2024 - Present
Domain	17.0°–50.0° N 117.0°–150.0° E	17.5°–49.5° N 117.5°–149.5° E
Temporal Resolution	1 hour	1 hour
Horizontal Resolution	1/36°(~3km)	1/120°(~900m)
Vertical Levels	46	46
Bathymetry	SRTM + nautical charts, smoothed according to horizontal resolution	SRTM + nautical charts, smoothed according to horizontal resolution
Atmospheric Forcing	NCEP GFS	NCEP GFS
Tidal Forcing	11 tidal constituents (K1, O1, P1, Q1, K2, M2, N2, S2, M4, MN4, and MS4)	11 tidal constituents (K1, O1, P1, Q1, K2, M2, N2, S2, M4, MN4, and MS4)
Lateral Boundary Conditions	JCOPE2M	JCOPE-T DA
River Discharge	Japan : JAXA Today's	Japan : JAXA Today's

	Earth Japan（368 rivers） Other regions ; monthly climatology	Earth Japan（368 rivers） Other regions ; monthly climatology
Data Assimilation	Daily assimilation of satellite sea surface height, satellite sea surface temperature, and in-situ temperature and salinity using multiscale 3DVAR	Temperature and salinity fields are adjusted to be consistent with those of JCOPE-T DA. No adjustment is applied in areas shallower than 200 m |

As examples to compare the characteristics of JCOPE-T DA and JCOPE-T 1ks, Figures 1 (open ocean) and 2 (coastal region) are presented.

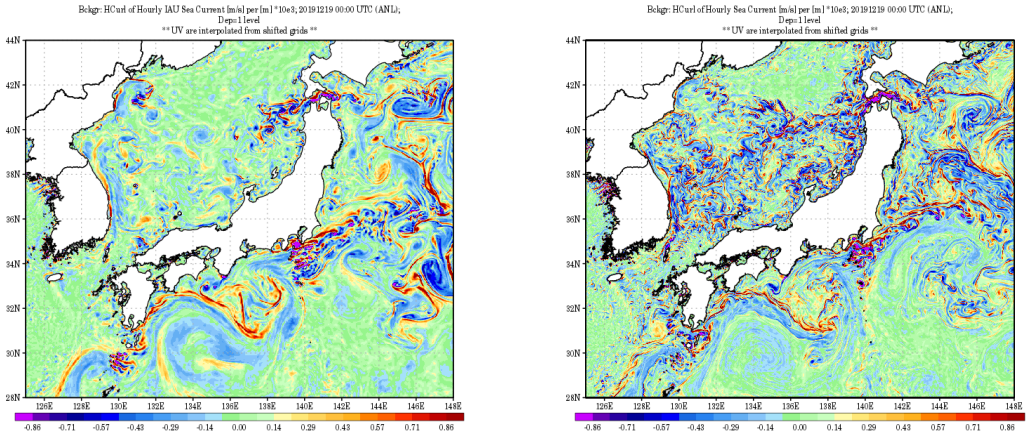

Figure 1. Snapshot of surface current vorticity. Left: JCOPE-T DA. Right: JCOPE-T 1ks

As shown in Table 1, JCOPE-T 1ks adjusts its temperature and salinity fields to be consistent with those of JCOPE-T DA for oceanic features with spatial scales larger than 100 km, such as meanders and mesoscale eddies. As a result, it exhibits characteristics similar to those of JCOPE-T DA in such cases (Figure 1). However, JCOPE-T 1ks is capable of representing smaller-scale eddies more effectively. This tendency is particularly pronounced in regions like the Sea of Japan and off the coasts of Hokkaido and Tohoku, where small eddies frequently occur. At these finer spatial scales, the physical characteristics of the model—such as horizontal resolution—have a more direct influence than the assimilated observational data.

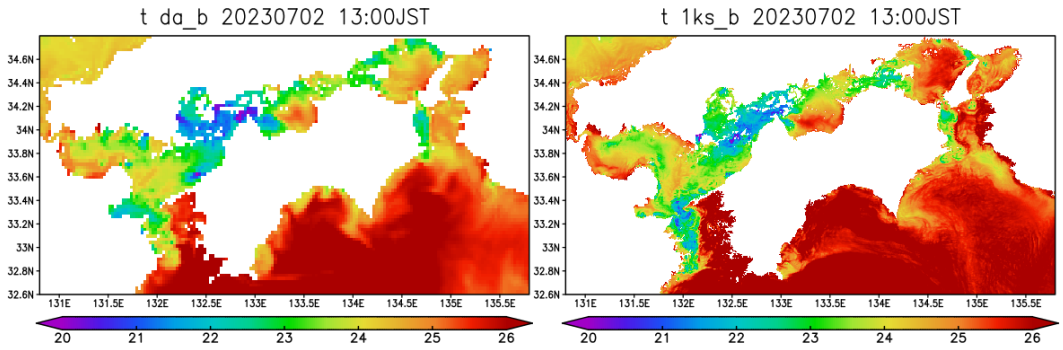

Figure 2. Snapshot of sea surface temperature. Left: JCOPE-T DA. Right: JCOPE-T 1ks

As shown in Table 1, in coastal regions shallower than 200 meters, JCOPE-T 1ks is not constrained by JCOPE-T DA and is allowed to evolve freely, resulting in more clearly expressed differences between the two systems (Figure 2). In particular, tidal currents are better resolved due to the higher-resolution representation of bathymetry, leading to improved accuracy in JCOPE-T 1ks compared to JCOPE-T DA in this regard.

While JCOPE-T 1ks calculates smaller-scale variability in both open ocean and coastal areas due to its higher resolution relative to JCOPE-T DA, it is important to note that these features do not necessarily reflect actual observational data.

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