(1) To verify the reliability of the HYCOM ocean current data, this study downloaded the 2011 reanalysis ocean current data and compared it with the measured ocean current data from the Hong Kong and Macau Ocean Research Center for the waters near China in 2011. The ocean current data for March 30th and July 20th were randomly selected for comparison, and the results are shown in Figure S1.

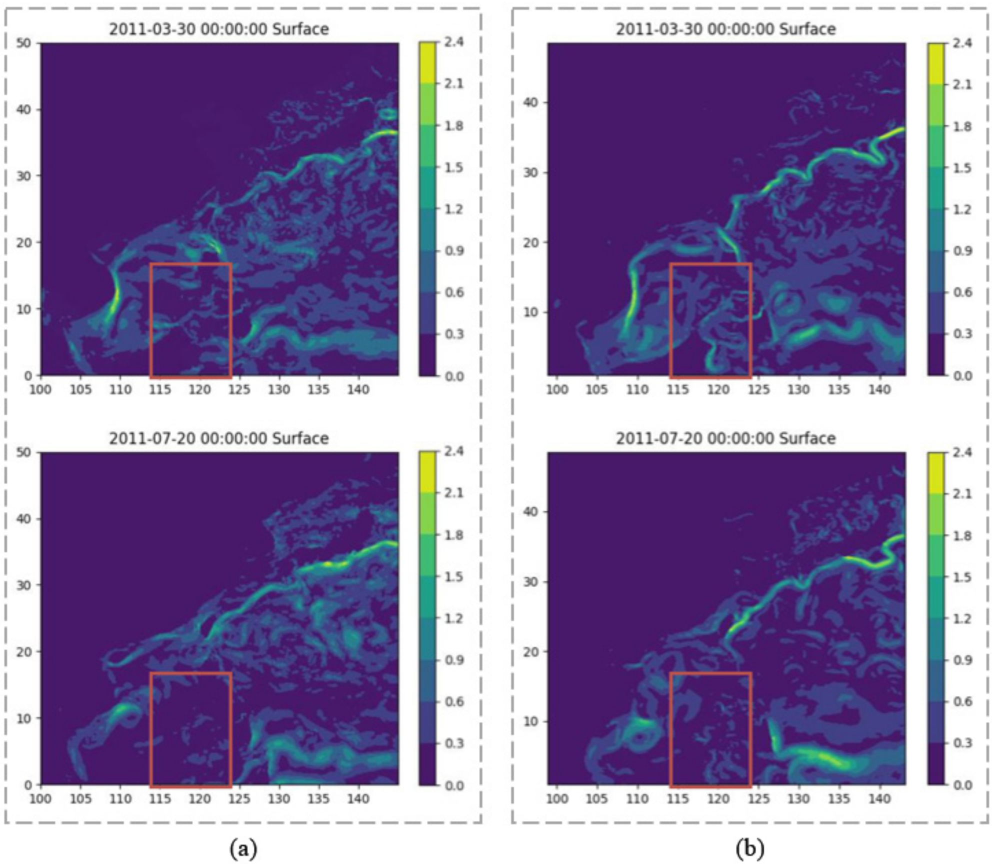

Figure S1. Implementation flow of pollutant diffusion program. (a) Data set of HYCOM [39]; (b) Data set of Center for Ocean Research in Hong6 Kong and Macau [35].

By comparing the data sets, it can be seen that from the perspective of accuracy, the HYCOM data is generally more accurate than the data from the Hong Kong and Macau Ocean Research Center in most areas, except for some missing data near the Nansha Islands within the red box. In terms of current velocity, both data sets show a high degree of agreement in high-speed areas near China, but there is some deviation between the HYCOM data and the data from the Hong Kong and Macau Ocean Research Center in low-speed areas.

(2) To implement the analysis process of pollutant diffusion, it is necessary to first determine the corresponding simulation analysis process, further encapsulate the diffusion simulation sub-processes, define key attributes, and then achieve the storage of pollutant diffusion simulation results and facilitate subsequent expansion applications. The specific algorithm process is shown in Figure S2.

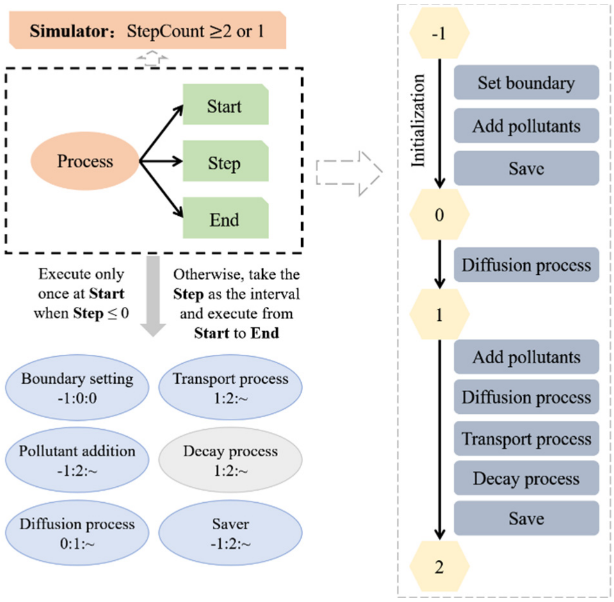

Figure S2. Algorithm flow of Pollutant Diffusion Simulator.

In this study, C# language is used for programming, and the grid division, concentration matrix, and other contents are managed within the Simulator; the addition of pollutants, diffusion process, and transport process are all treated as Processes, and the concentration matrix is handled at each step through the Handle method of the Process object. For the StepCount parameter of the Simulator, formula (S1) can be used for automatic configuration.

$$StepCount = \frac{Days \times 24 \times 3600}{\beta \times \Delta t} \tag{S1}$$

Here, $Days$ is the simulation days (d) set by the user; β is the simulation time step coefficient, and Δt is the simulation time step (s).

The advantages of this operation are as follows:

1. There is no need to manage a large number of complex attributes in the Simulator, such as flow field data can be divided into the attributes of the transport process and do not need to be directly managed by the Simulator;
2. The combination or expansion of sub-processes is more convenient and can be combined freely. For example, radioactive pollutants only need to add the decay process.
3. The subsequent expansion of other sub-processes of the pollutant diffusion model (such as the degradation process of organic pollutants) only requires creating a new Process subclass, overriding the OnHandle method, and deleting or adding corresponding elements in the Simulator's Process collection. In addition, considering the issue of different simulation time intervals between the diffusion process and the transport process in the Euler analysis method, the Start, Step, and End attributes have been added to the Process, which enables each step to be executed at a specified step size.