Numerical Simulation of Drifted Wastes from Yamakuni River Caused by Heavy Rain from 3rd July 2012

山口大学大学院　　非会員　○Andhita Triwahyuni
山口大学大学院　　正会員　　朝位　孝二

1. Introduction

On 7th July 2012, a large amount of drifted garbage such as driftwoods was cast in Ube port, Yamaguchi. Since there is no precedent, the navigation of the ships became difficult and the function of the port cloud be greatly disturbed by this influence. Approximately 600m^3 garbage was pulled and carried out by using heavy machines. A cow was found in the drifted garbage, and this cow was also found to be one of the missing cows in Nakatsu, Oita. Therefore, it can be deduced that the drifted garbage got in the Ube Port come from Yamakuni River due to the heavy rain from 3rd July to 4th in the north Kyushu Island.

According to the interview from the staff of Ube port, the drifted garbage get Ube port has never occurred before, so that it is important to make it clear what condition to make garbage get Ube port from Yamakuni River. The numerical simulations were conducted to investigate the condition.

2. Experimental conditions

Numerical simulation was conducted by using Finite Volume Coastal Ocean Model (FVCOM) which is an ocean model with three dimensions with unstructured grid. One of the characteristics of this model is the adoption of σ coordinate system for the vertical coordinates. In addition, it can construct the complicated topography such as shorelines by using a triangular grid. Figure 1 shows the triangular mesh and bathymetry of the numerical simulation area.

In this study, only M_2 tide is considered because the M_2 tide is dominant in the tidal filed

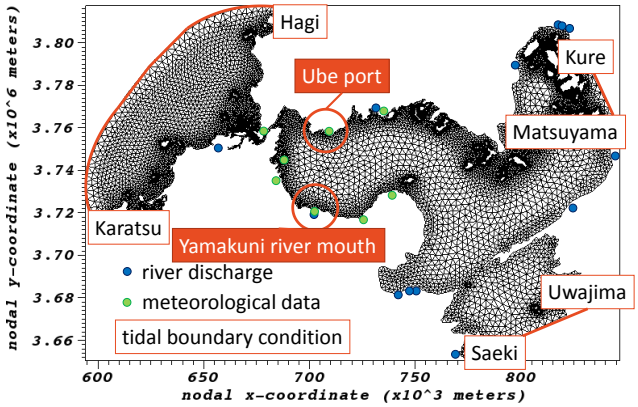

Figure 1 Bathymetry mesh and observation stations

Table 1 Conditions of the calculation

Computation period	2012/6/29 8:00～2012/7/7 12:00
Latitude	33°　～35°
Longitude	130°　～133°
Time interval	1 sec.(external)、10 sec.(internal)
Tidal component	1(M_2)
Vertical layer	10 layers(σ)
Node	11619

of Seto-Island Sea. In this simulation, to stabilize the tide flow the preliminary calculations were conducted for 17 hours, and then the climatic condition and river discharge were inputted. Table 1 shows the calculation conditions.

Wind was considered as the climatic condition, but the wind above the sea were not provided by observatories. Accordingly, the spatially uniform wind was inputted in this study which was based on the weather observation in the model concerned. Wind from 8 stations around Suo-nada Sea was composed and changed it with time.

The Lagrangian particle tracking method was used to investigate how the garbage from

キーワード　平成 22 年北部九州豪雨，周防灘，漂流ゴミ，FVCOM
連絡先　〒755-8611　宇部市常盤台 2-16-1 山口大学大学院社会建設工学専攻
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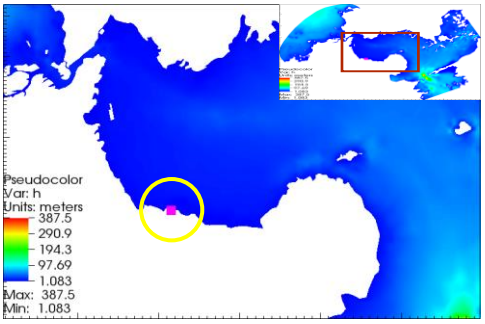

Figure 2 Initial condition of particles

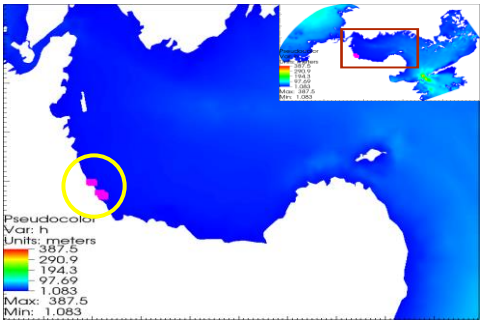

Figure 3 Numerical result of Case 1

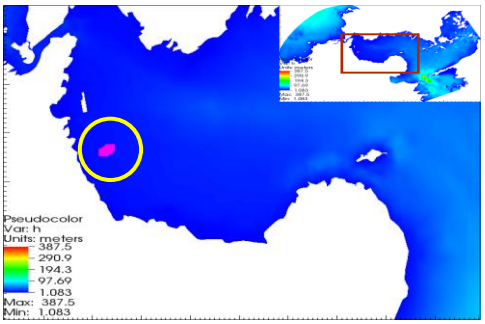

Figure 4 Numerical result of Case 2

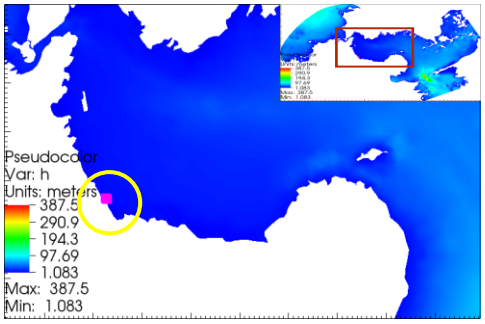

Figure 5 Numerical result of Case 3

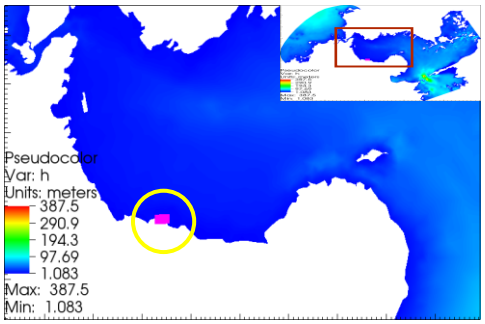

Figure 6 Numerical result of Case 4

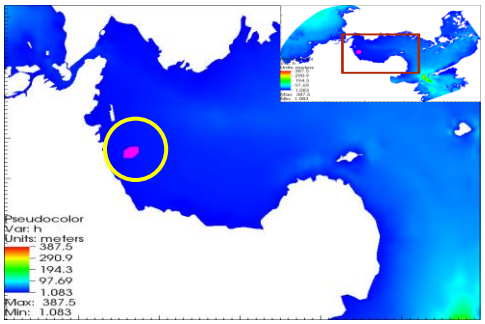

Figure 7 Numerical result of Case 5

Yamakuni River mouth.

The numerical simulation condition of FVCOM including the period is shown in Table 2. The particles released at 11:00 a.m. on 3rd July because of peak flow in Yamakuni River.

3. Results and Discussions

The initial condition of the particle is shown in Figure 2. The 5 cases were considered. Only the M_2 tidal flow is considered in Case 1. The M_2 tidal flow and the river discharge are considered in Case 2. The M_2 tidal flow and the river discharge of which the amount is the half of Case 2 are considered in Case 3. The M_2 tidal flow and the wind stress are considered in Case 4, and The M_2 tidal flow, the wind stress and the river discharge are considered in Case 5. The numerical results at 12:00 p.m. on 7th July are shown in Figures 3-7.

As can be seen in Figures 3-7, the particles do not arrive from the Yamakuni River at the Ube Port in the all cases. But it is well understood that the particles drifted farther with the tide when river flow quantity acted by comparing Case 1 and 2, or 4 and 5. Therefore, by comparing Case 1, 2 and 3, it is thought that the flooding of the river caused by the heavy rain on 3rd July influenced the garbage drift.

Generally speaking, the wind stress has an important role to the garbage drift. However, by comparing case1 and 4, the wind stress does not carry the garbage to offsure. In this simulation, the wind stress distribution are determined under the some assumption. This might be why the wind stress affect the garbage drift.