CURDIF-3D Model

3-Dimensional CURrent and DIFfusion Model
in coastal sea areas extending over tidal flats

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INTRODUCTION

CURDIF-3D Model is able to simulate 3D current field and diffusion of water quality (e.g. temperature, salinity) in coastal areas extending over tidal flats. This model is used for environmental assessment and management for water quality in coastal areas.

With this model, the effect of thermal effluent from a power plant and thermal impacts from tidal flats on the thermal balance of a coastal area is predicted quantitatively.

DEVELOPMENT PROCESS

A large tidal flat extends in a western coast of South Korea, where a power plant is located. Thermal impacts from tidal flat affect the spatial distribution of water temperature in the area and the dispersion of thermal effluents from the power plant. The effects of thermal effluents from the power plant and thermal impacts from the tidal flat on the water temperature distribution cannot be discerned from the results of field observations of water temperature distribution alone.

CURDIF-3D Model has been developed to simulate the water temperature distribution that is influenced by thermal effluents from the power plant and thermal impacts from tidal flats. Numerical simulations with this model can distinguish the two effects clearly.

KEY POINTS

Key points of Model are the following.

- The Model solves 3D multi-level motions under the hydrostatic and Bousinesq's approximations.
- The horizontal eddy viscosity and diffusivity are given on the basis of Smagorinsky formula. The vertical eddy viscosity and diffusivity are given on basis of Munk and Anderson formula in order to give the effect of eddy flow and density stratification.
- The tidal variations with several components (e.g. M_2, S_2, K_1, O_1) are given to simulate temporal and spatial variations of tidal currents.
- The moving boundary condition is used to account for shoreline change on tidal flat.
- The heat transfer components are the following:
  *advective diffusion of water temperature *heat transfer form air to sea surface
  *heat transfer form air to mud at the dried-up tidal flat
  *heat transfer between bottom water and mud on tidal flat *diffusion in mud
- The meteorological conditions (solar, air temperature, vapor pressure, amount of cloud, wind direction, wind velocity and atmosphere) are input to simulate temporal and spatial variations of water temperatures.

APPROVAL/CREDITABILITY

"Effect of tidal flat to the thermal effluent dispersion from the power plant"
(submitted to Journal of Geophysical Research)

Graphical Outputs with CURDIF-3D Model

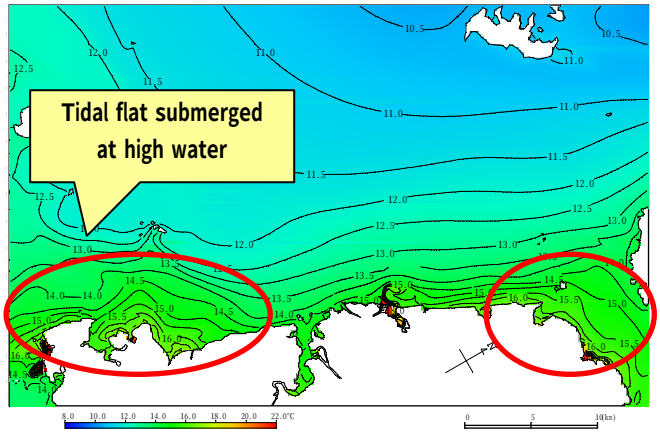

Fig.1 Spatial distribution of water temperature
(at high water)

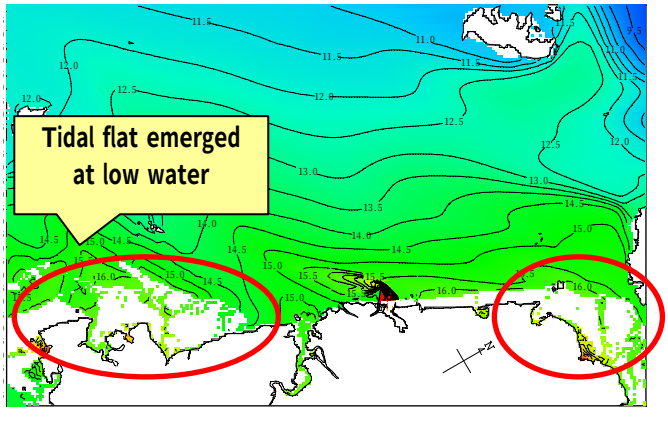

Fig.2 Spatial distribution of water temperature
(at low water)

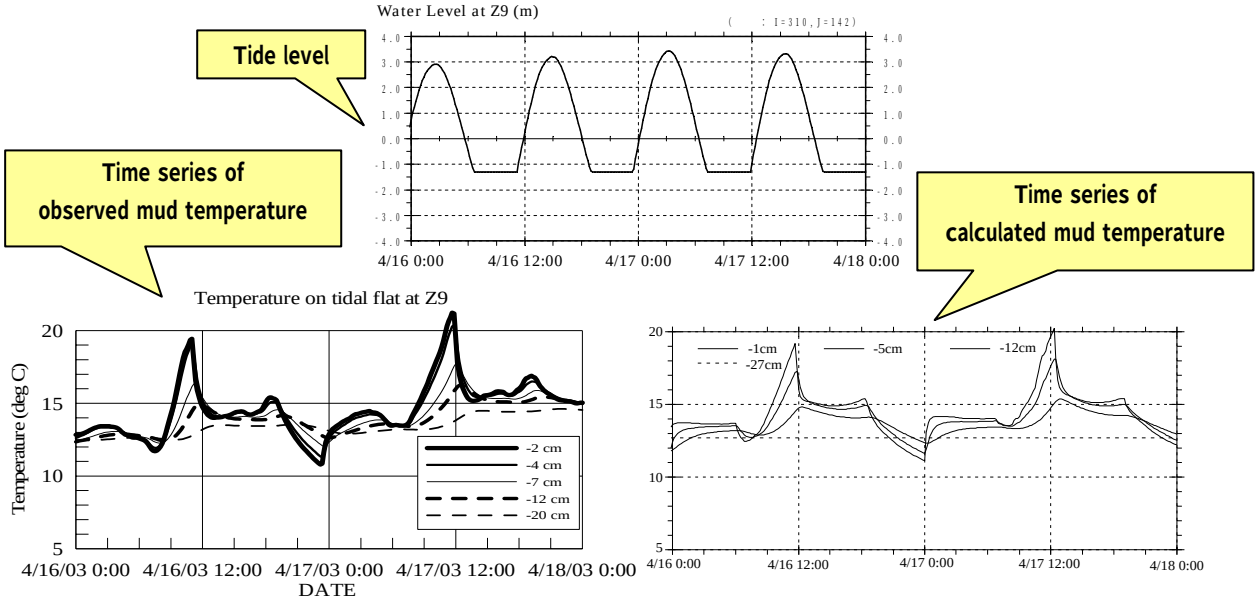

Fig.3 Comparison of time series of mud temperature at tidal flat (observed and calculated)

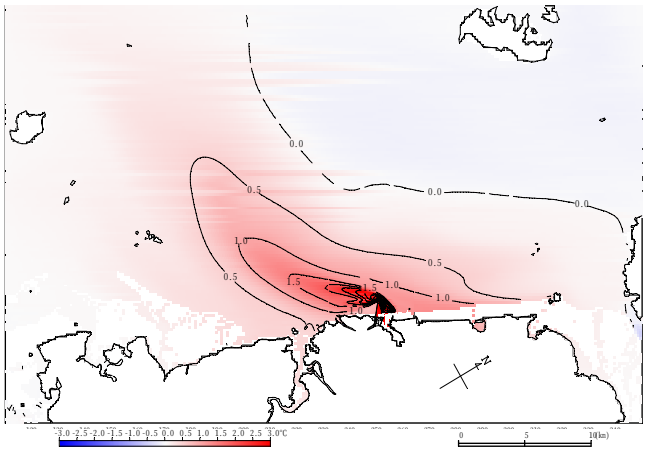

Fig.4 Thermal effluent area from power plant
(at low water)

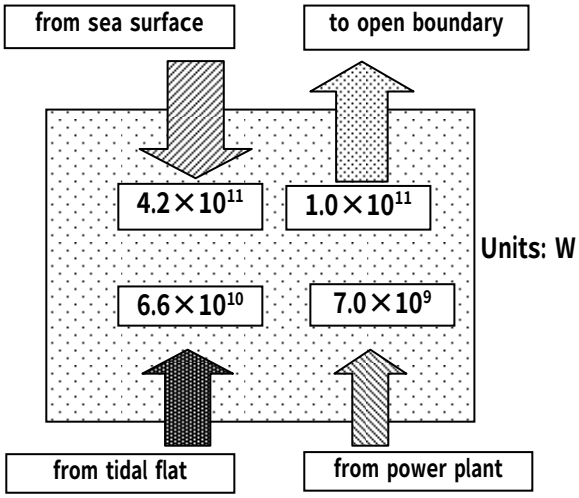

Fig.5 Heat budget in sea area under study
(Spring tide in Spring season)