

## EEMS Test Case Model Description

### TC\_Chapra\_AntDiff

## 1 Overview

This model reproduces the benchmark test case presented by Chapra [1] for studying the effects of diffusivity on water quality parameters. The benchmark simulates a "breakthrough" curve – the temporal evolution of concentration at a fixed downstream location – a classic problem in surface water-quality modeling. The objective is to replicate this curve using EFDC+ Explorer (EE) and EFDC+, and to examine the change in concentration at a point 2,000 m downstream under both conservative and non-conservative tracer release scenarios. By comparing EFDC+ simulated dye concentrations with empirically calculated values in the **Data** folder, this test case illustrates how well EFDC+ reproduces analytical diffusion behavior and helps users better understand how to configure diffusivity parameters in their own models.

## 2 Demonstration Feature

This test case demonstrates the anti-diffusion (AntDiff) capability in EFDC+, specifically its effect on dye transport in a 1D channel. The governing equations in EFDC+ are described in the [EFDC+ Theory Document](#) [2].

## 3 Model Description

The model configuration is summarized in Table 1. The model domain consists of a 1D channel with 100 horizontal grid cells (Figure 1), representing a straight channel reach used to simulate longitudinal dye transport and diffusion. The horizontal diffusion coefficient AHO is set to 5 m<sup>2</sup>/s. The following EFDC+ modules are activated in this test case:

- **Hydrodynamics** – simulates the 1D flow field within the channel
- **Dye** – used as a tracer to visualize and quantify transport and diffusivity patterns

**Table 1** Model configuration summary

| Dimensions | Horizontal cells | Vertical cells | Activated modules                                                             |
|------------|------------------|----------------|-------------------------------------------------------------------------------|
| 1D         | 100 cells        | 1 layer        | <ul style="list-style-type: none"><li>• Hydrodynamics</li><li>• Dye</li></ul> |

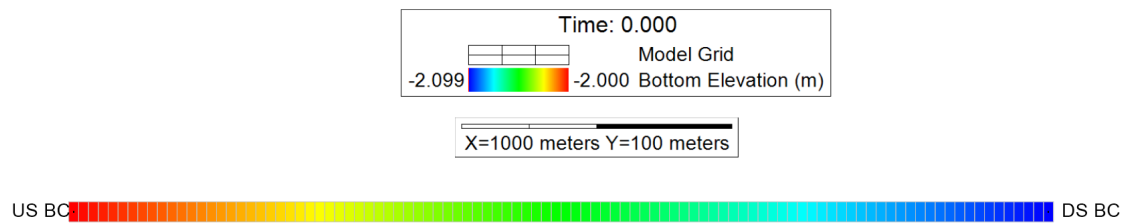


**Figure 1** Model domain

## 4 Model Results

The calibration data files are described in Table 2 and stored in the **Data** folder. As shown in Figure 2, the simulated breakthrough curve at the 2,000 m downstream location closely follows the analytical solution of Chapra [1], demonstrating strong agreement between the model output and the reference concentrations. This result confirms that EFDC+ accurately reproduces longitudinal dye transport and validates its capacity to simulate advection-diffusion processes with anti-diffusion correction.

**Table 2** Description of calibration data files in the **Data** folder

| File                             | Description                                                           |
|----------------------------------|-----------------------------------------------------------------------|
| TS_Dye_ISHMDF2_AHO5_AntiDiff.dat | Dye concentration time series                                         |
| LocationX2000m.dat               | Location of the calibration station with coordinates and I, J indices |

*Data source:* All datasets were derived from Chapra [1].

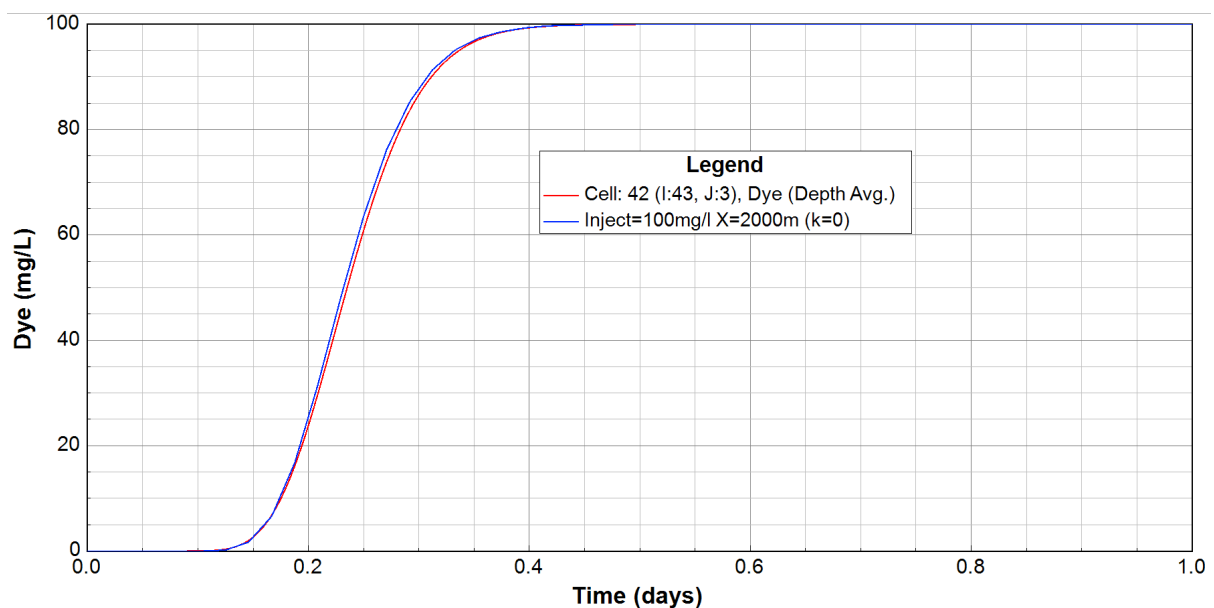


**Figure 2** Time series of observed and simulated dye concentrations

## References

- [1] Chapra, S. C. (2008). *Surface Water-Quality Modeling*. Waveland Press, Long Grove, IL. Published December 31, 2008.
- [2] DSI LLC (2024). *EFDC+ Theory: Version 12*. DSI LLC, Edmonds, WA, USA. Accessed: 2026-04-06.

*Disclaimer:* This model is provided to demonstrate that EFDC+ Explorer and EFDC+ can be used to better understand how to build this kind of model. The model is running as expected; however, it should not be considered final, as it can be modified and refined to obtain improved results.