Compiler Option Testing
For
Environmental Fluid Dynamics Code
Constituent Mass Balance Problem

November 14, 2008

1 Problem Description

1.1 Test Case Setup

A test case was developed of a rectangular basin with dimensions of 50 by 300 meters. The model was set up with the following configuration:

Grid:	Cartesian grid with 5 by 30 active cells with dimensions of DX=10, DY=10,
Layers:	Five vertical layers,
Bathymetry:	Flat bottom with an elevation of -3 meters,
Depth:	Uniform depth of 3 meters (water surface elevation = 0.0)
Timing:	Simulation time of 1 day.

Added a very small increment of salt (0.01 ppt) to one cell in the top layer, Figures 1 – 4, the model runs for a little while then the water surface begins to fluctuate. The magnitude and timing of this effect is dependent on the grid, bathymetry and boundary forcings. For this test case, after several reflections off of the boundaries, the model begins to set up a harmonic which feeds upon itself. Sometimes the model continues to run, sometimes it crashes, depending on the specifics of grid configuration and delta T.

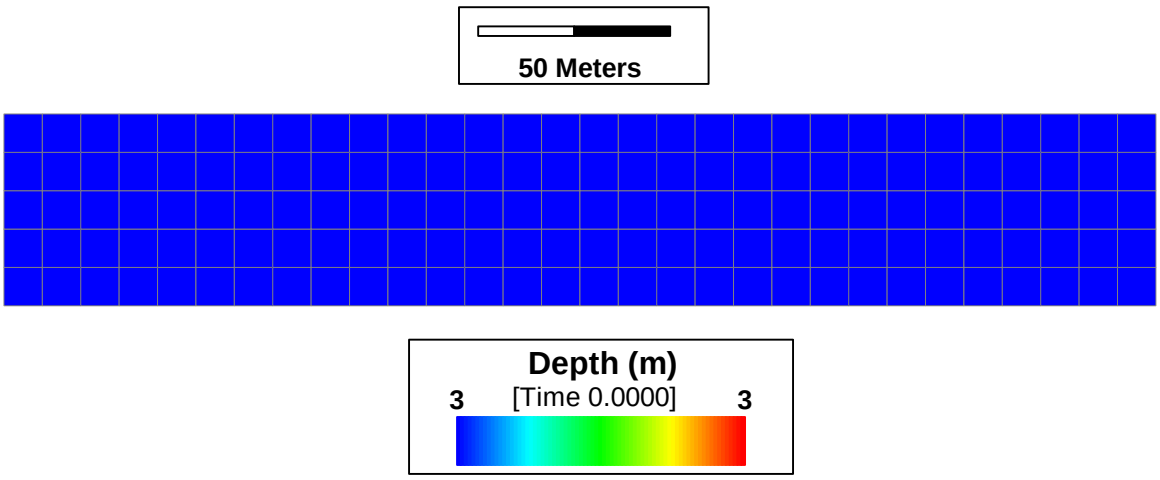

Figure 1 Plan view of water depths.

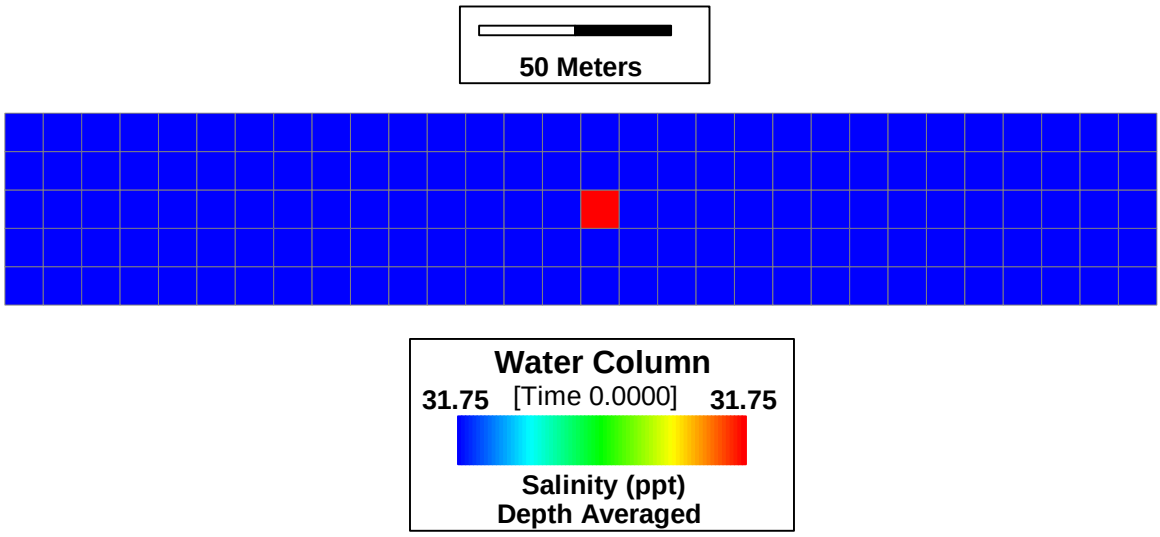

Figure 2 Plan view of depth averaged salinity.

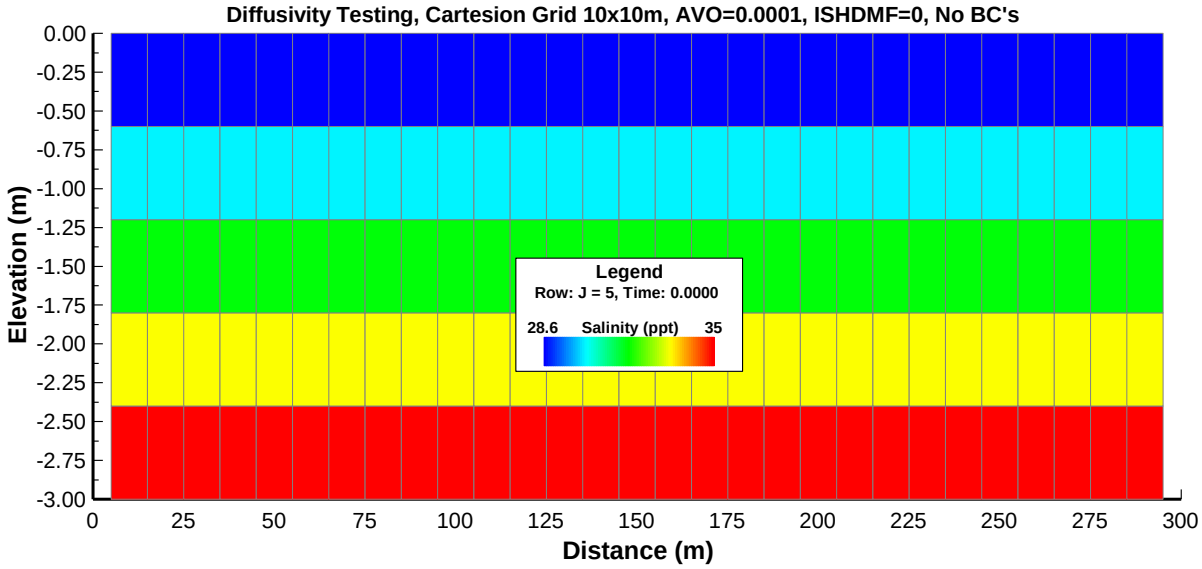

Figure 3 Salinity profile along the long axis of the basin.

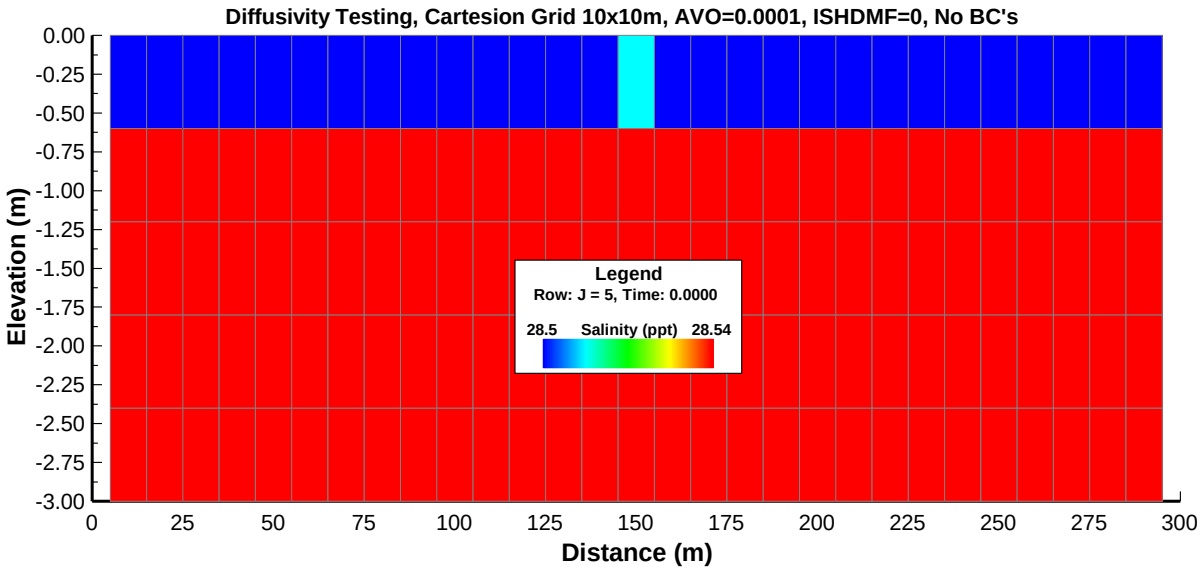

Figure 4 Salinity profile highlighting the 1 cell with added salinity.

1.2 Evidence of Problem

A mass balance of salt and water was conducted for the simulation period (1 day). The model average concentration of salinity and the total water volume for each time step is shown in Figure 5. The concentration of salinity is easily seen to be declining from 31.75 to 31.5 in one day. However, there are no boundary conditions to account for this decline. The concentrations should remain essentially constant at 31.75 ppt.

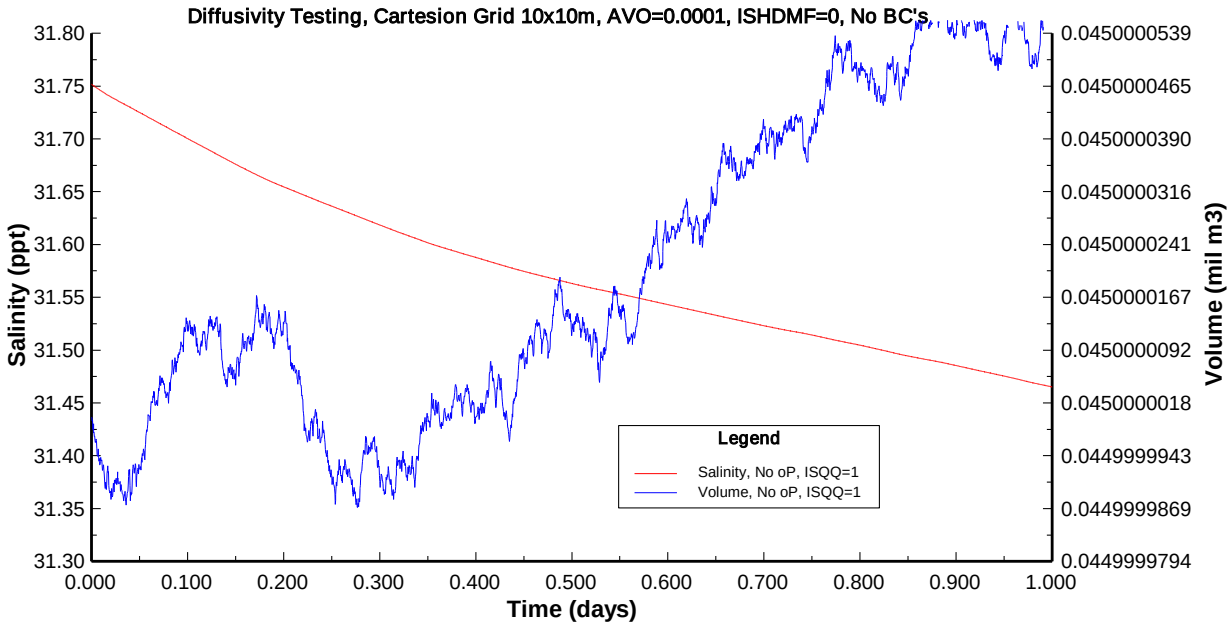

Figure 5 Time series of model salinity concentration and water volume, Original Intel compiler options.

2 Compiler Option Testing

2.1 Option 1 (Original Compiler Options)

EXE: efdc_ds_081109c2.exe

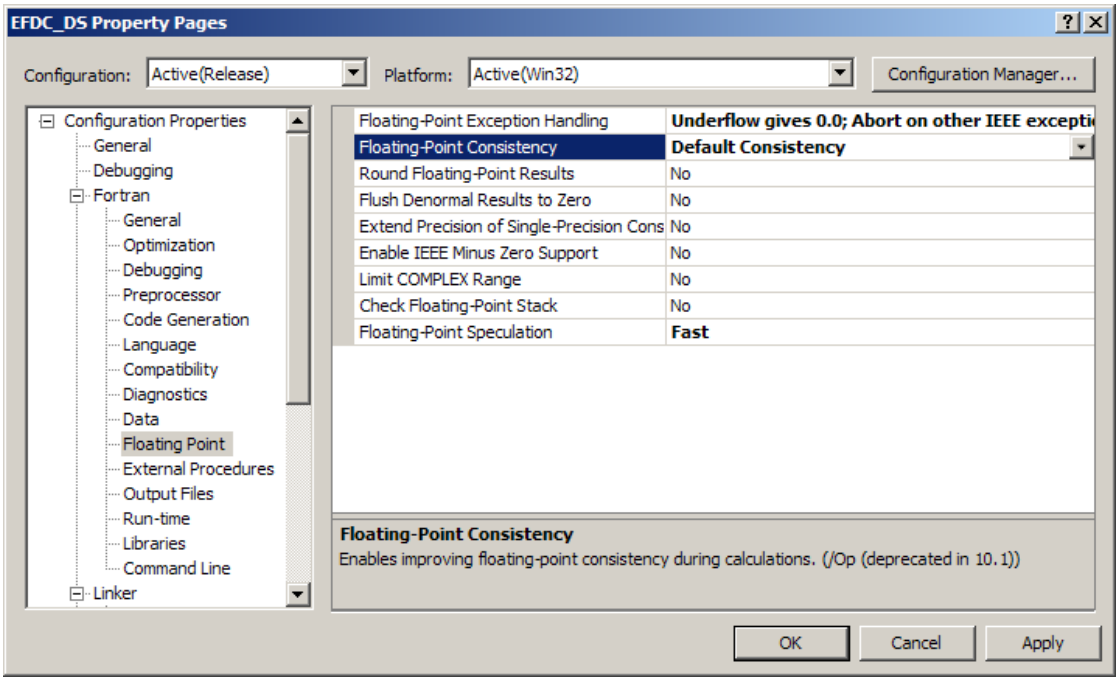

Figure 6 Original EXE: Floating Point compiler options.

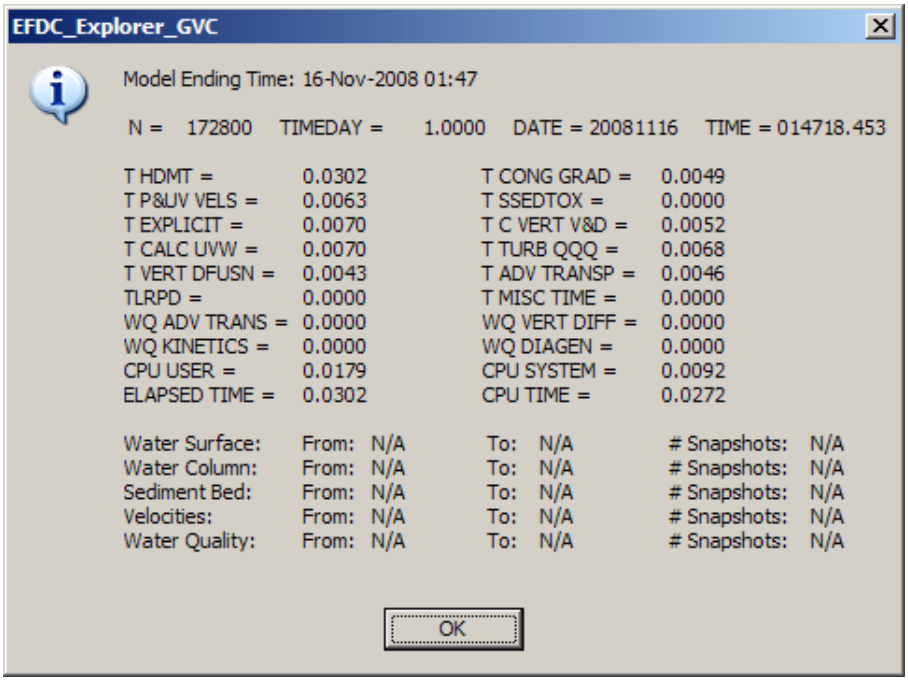

Figure 7 Original EXE: Model run times.

2.2 Option 3 (oP Fast)

EXE: efdc_ds_081109c2_op_fast.exe

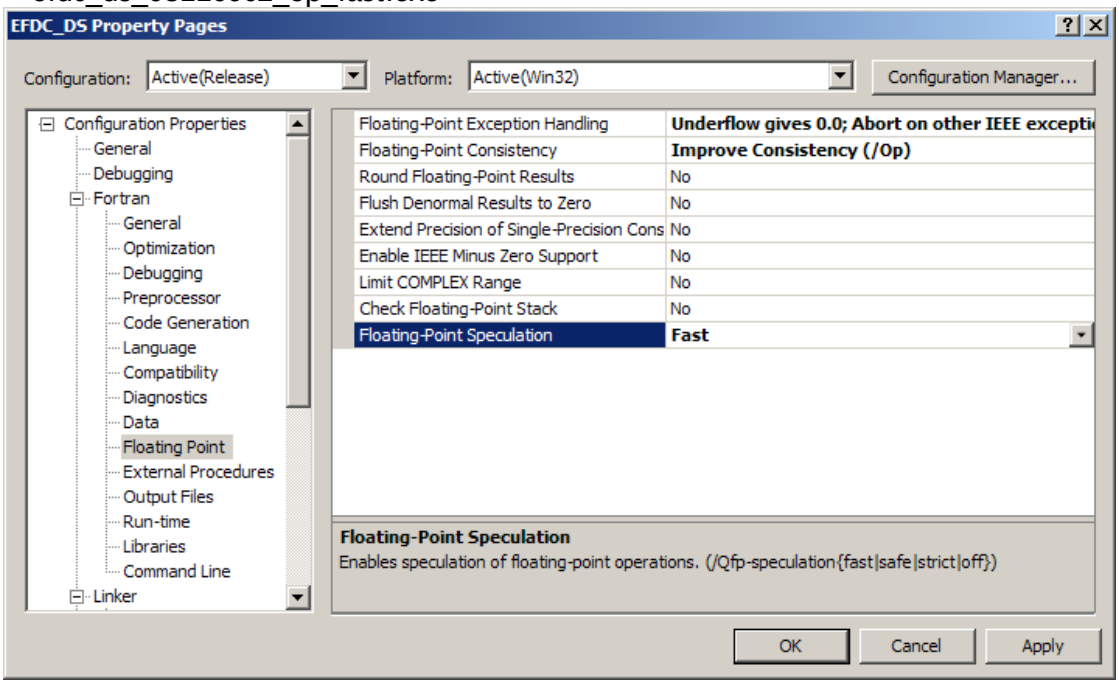

Figure 8 Options oP Fast: Floating Point compiler options.

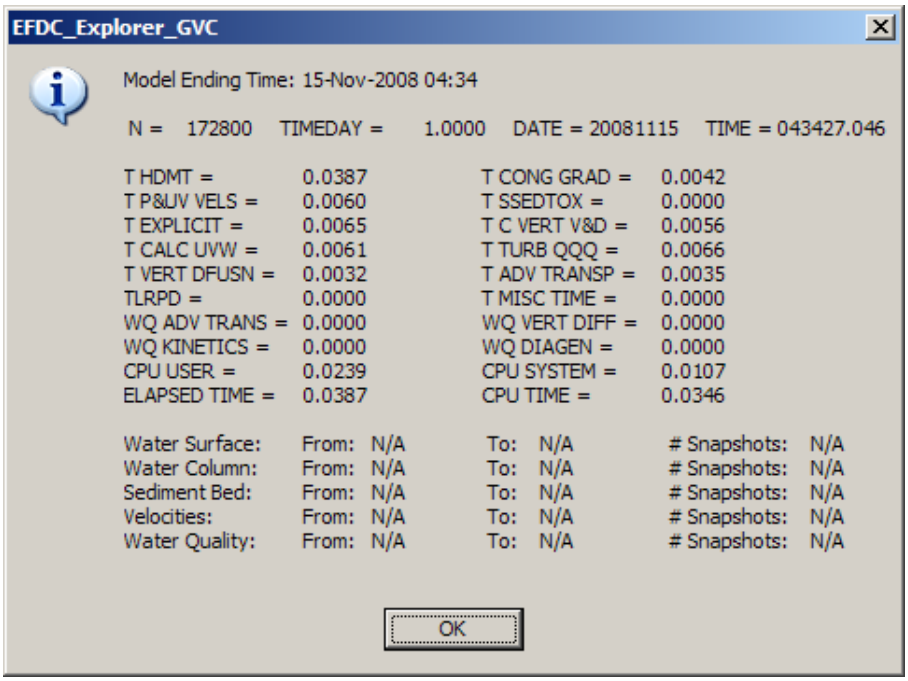

Figure 9 Options oP Fast: Model run times.

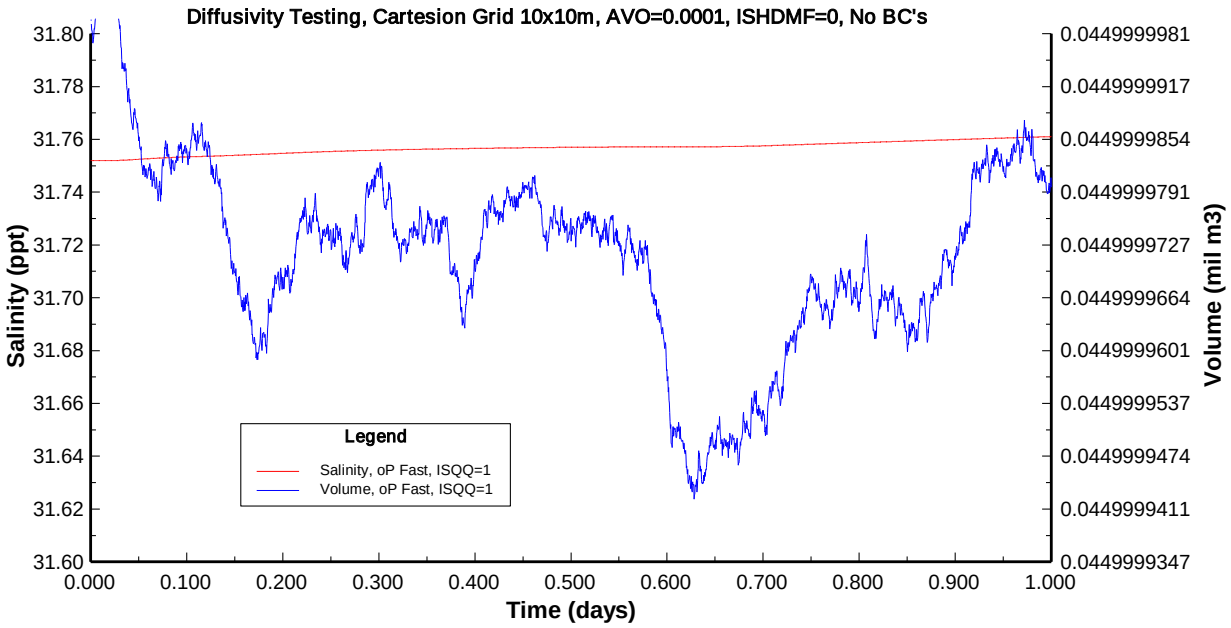

Figure 10 Options oP Fast: Time series of model salinity concentration and water volume.

2.3 Option 2 (oP Safe)

EXE: efdc_ds_081109c2_op_safe.exe

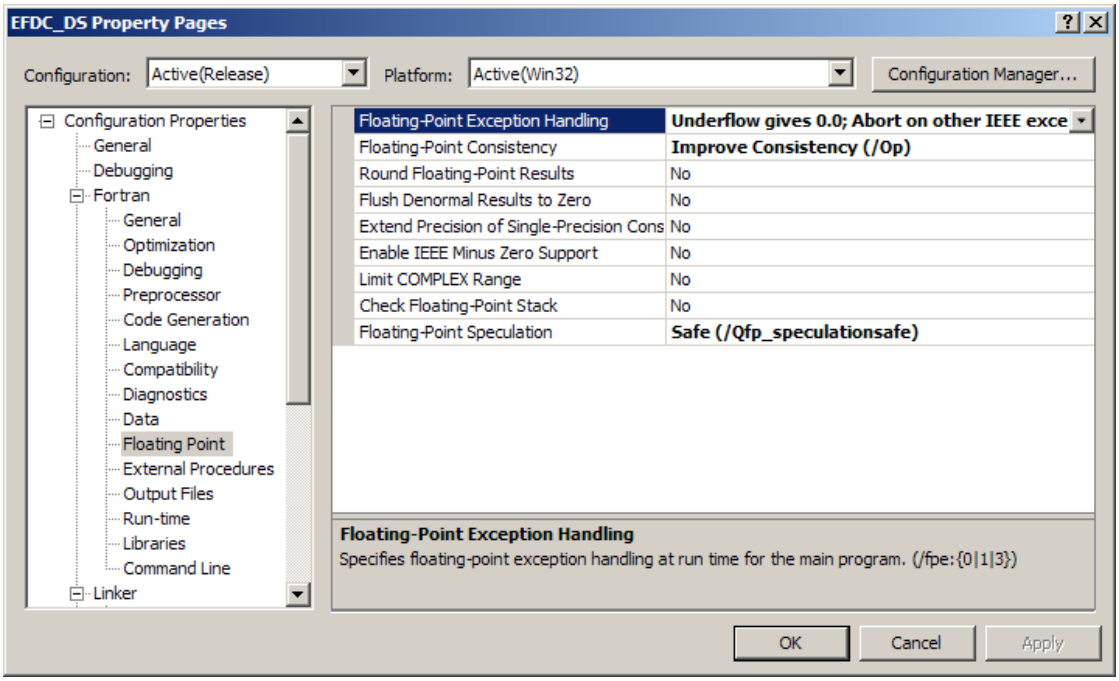

Figure 11 Options oP Safe: Floating Point compiler options.

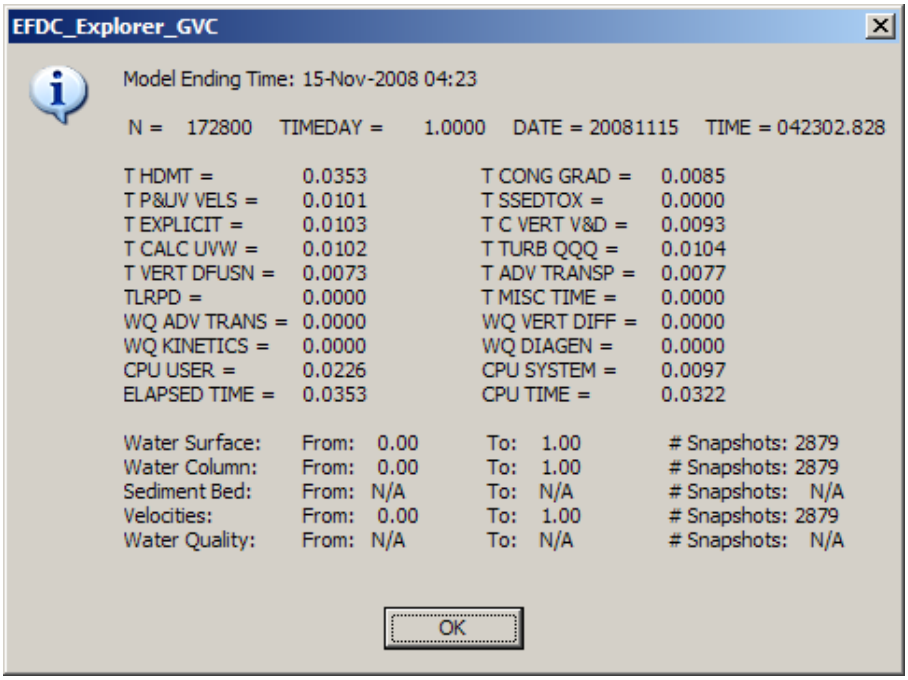

Figure 12 Options oP Safe: Model run times.

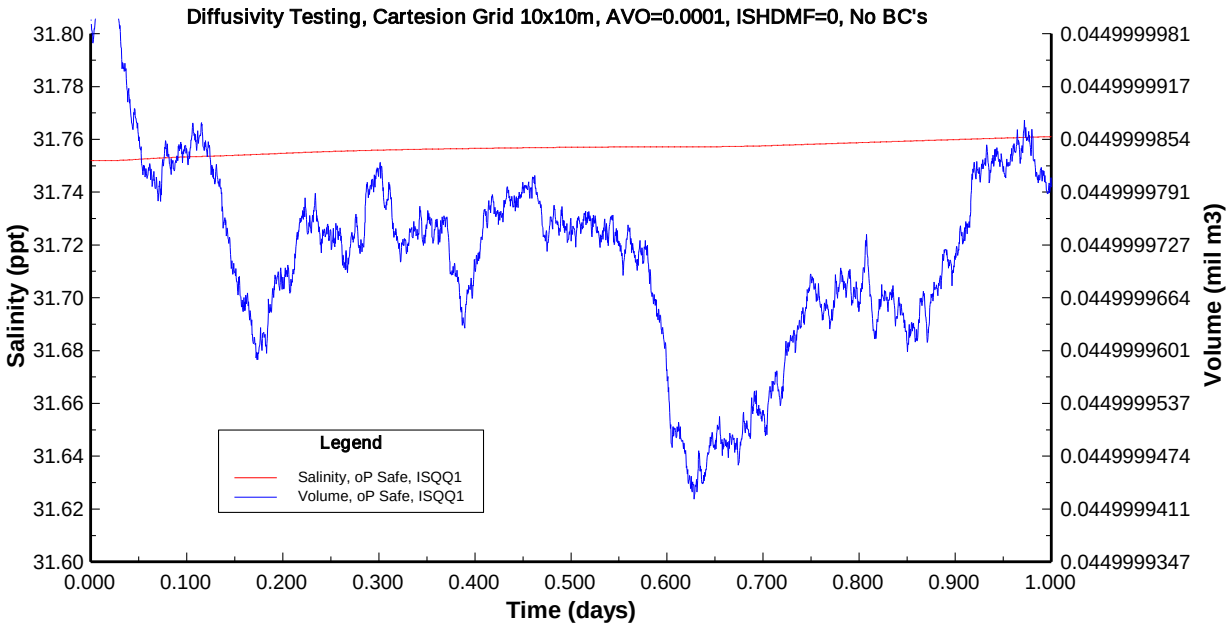

Figure 13 Options oP Safe: Time series of model salinity concentration and water volume.