Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh

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Chapter 6: New Behaviors and Control Switches in DSM2-PTM

Author: Aaron Miller

6 New Behaviors and Control Switches in DSM2-PTM

6.1 Introduction

This document describes the improvements that have been incorporated into DSM2's Particle Tracking Model (PTM). The improvements include some additional behaviors and control switches. First, a new stage triggering behavior was added so particles can be forced to certain areas of the channel based on whether the tide is flooding or ebbing. Second, a simple control switch to the input will allow or disallow particle removal by seepage flows (i.e., a flow through a levee or some other soil substrate).

6.2 Stage Triggering

A new stage triggering behavior was added to the PTM behavior module described by Miller (2000). This module allows the user to select particle-positioning criteria based on whether the tide is rising or falling. As is shown in an image of the behavior GUI (Figure 6.1), stage triggering is currently limited to the particle's vertical position. However, horizontal (transverse) positioning, along with additional longitudinal velocity, will be added in the future.

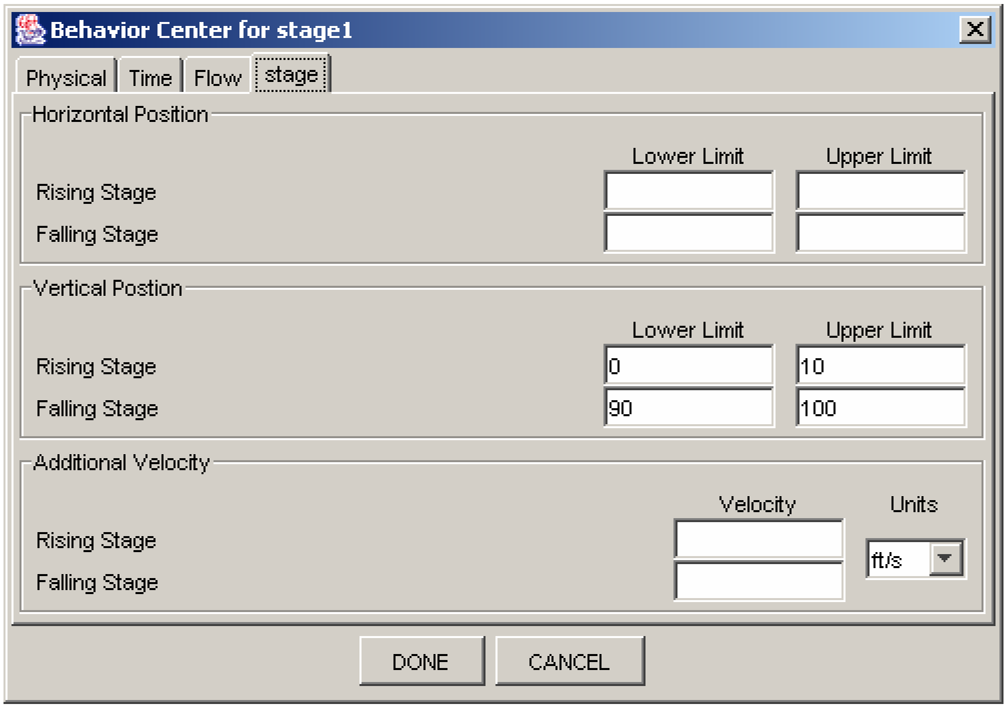

Figure 6.1: View of Stage Behavior GUI Showing Vertical Positioning Based on Rising and Falling Stage.

6.2.1 Vertical Positioning Example

The vertical positioning is based on percentage of channel depth with respect to the bottom of the channel. Using the example from Figure 6.1, during rising stage particles are instructed to stay between 0% and 10% of the depth as measured from the bottom of the channel. During the falling stage, the particles are instructed to stay between 90% and 100% depth as measured from the bottom.

Figure 6.2 shows diagrams of the particle vertical positioning based on rising and falling tides. For this example it is assumed that the rising tide is associated with upstream velocities, and that the particles will be constrained to the bottom 10% of the channel based on the user-established vertical positioning behavior (Figure 6.1). Similarly, the falling tide is associated with downstream velocities when the particles are limited to the upper 10% of the channel.

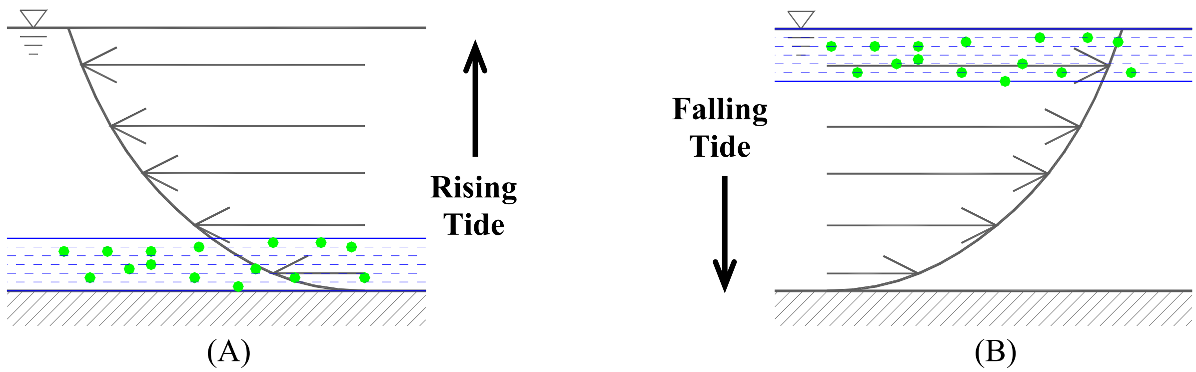

Figure 6.2: Example of Positioning from Stage Triggering and Particle Position Associated with: (A) Rising Stage and (B) Falling Stage.

6.2.2 Vertical Positioning Implementation

Whether the stage is rising or falling is determined using the change in stage between the last and current time steps. Since the time step is fixed, the gradient of the change will be based on the incremental stage. Currently the sensitivity of the stage determination logic is hard coded within PTM to a slope of 0.0001. When the absolute value of the change in stage exceeds 0.0001 ft/sec, the stage trigger occurs. Positive changes are associated with the rising stage limits, and negative changes in stage are associated with the falling stage limits.

As shown in Figure 6.3, stage triggering only occurs during periods when water levels are rapidly changing. During the intermediate periods (i.e., periods between stage triggers) the particles do not have any behaviors that are associated with stage triggering. During periods outside of this interval, the particles will not be constrained to any position in the channel.

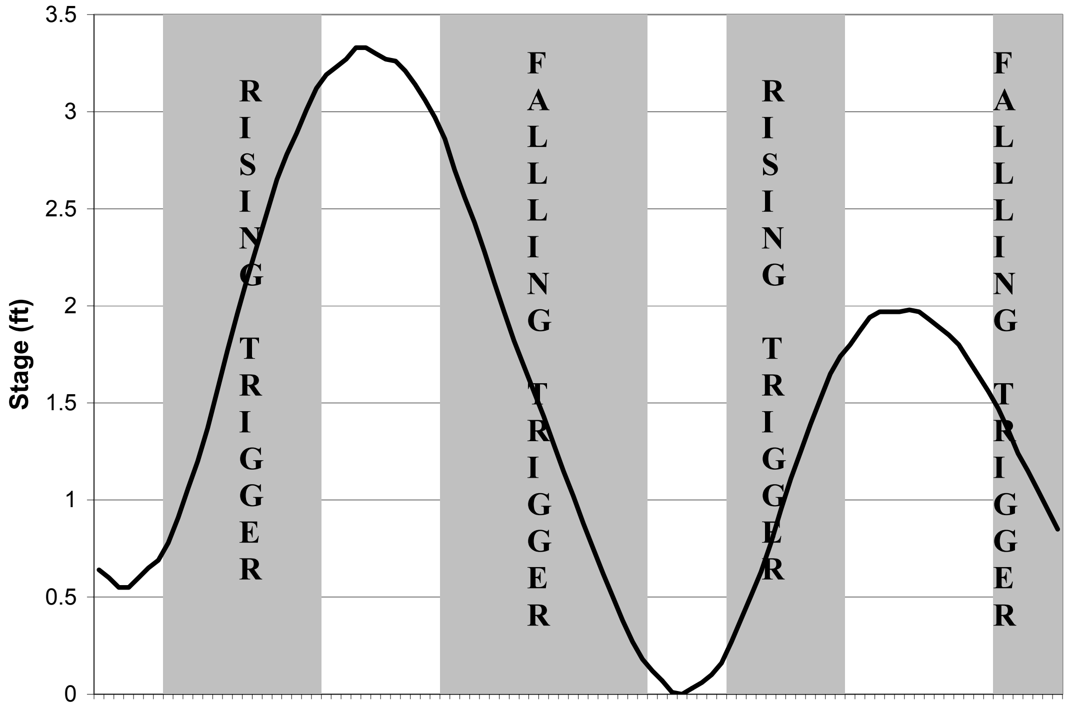

Figure 6.3: Example of How Stage Triggering is Implemented.

6.3 Seepage Switch

In PTM, particles are diverted based on flow splits at flow junctions. These junctions include intersections of multiple channels, agricultural diversion, and seepage nodes. As described by Miller (2002), PTM combines the flows at a given node to calculate the probability of a particle being diverted. In the past, PTM has not treated seepage flows differently than agricultural diversions or channel junctions. If PTM is simulating small particles, such as a water or a contaminate molecule, then having this option on would be appropriate, since the seepage flow simulates water lost to the islands or surrounding groundwater via permeable soil substrate. However, if PTM is simulating an aquatic organism, then no particles should be removed with seepage.

To allow users to decide if particles are lost to seepage, a new scalar flag was added to PTM. The scalar flag `particle_to_seep` determines whether the particles in the PTM may be diverted with the seepage flows.

6.4 References

Miller, A. (2000). "Chapter 5: DSM2 Particle Tracking Model Development." *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. 21st Annual Progress Report to the State Water Resources Control Board.* California Department of Water Resources. Sacramento, CA.

Miller, A. (2002). "Chapter 2: Particle Tracking Model Verification and Calibration." *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. 23rd Annual Progress Report to the State Water Resources Control Board.* California Department of Water Resources. Sacramento, CA.