Chapter 18

M4: Salinity Penetration into Network

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18.1 Problem Specification

M4 Salinity penetration into simple network.

Focus coupled models, network circulation.

Channel geometry, friction and hydrodynamic open boundary conditions as in schematic application H5. Also, same fixed Δx and Δt as application H5. Use final predicted solution at $t = 2T$ from H5 as hydrodynamic initial conditions at $t = 0$ here.

Contaminant initial conditions are $C(x, 0) = 0$ throughout. The upstream contaminant open boundary conditions at D and E are no contaminant inflow and unconstrained contaminant outflow. The downstream contaminant open boundary condition at A is

$$C(x_A, t) = \begin{cases} 0 & \text{for } Q(x_A, t) \le 0 \\ 1 & \text{for } Q(x_A, t) > 0 \end{cases} \tag{18.1.1}$$

The longitudinal dispersion coefficient is $E_x = 10^3$ ft^2/s.

Compute and write to file in the STANDARD FORMAT the initial conditions at $t = 0$ and the model predictions for every time step to $t = 2T$.

18.2 Background

As observed in the previous chapter, salinity transport into the San Francisco Bay-Delta system is a major issue in the on-going water debate. The major transport influences are tidal transport and fresh water throughflow. The previous problem M3 addressed these issues for a single tidal channel. The present problem extends this investigation to a simple network of tidal channels..

18.3 Contra Costa Water District

No response.

18.4 Department of Water Resources

Figure 18.1 shows the DWR-predicted[1] salinity penetration into a tidal channel network. Salinity transport does not penetrate beyond Reach 1 (Reach 6 in the DWR data files), and only this reach is shown. The expected salinity advance into the solution field on the flood tide and retreat on the ebb tide is clearly seen. The smaller influence of dispersion can be seen in the advancing penetration during the second tide cycle. This is perhaps the expected response.

But a comparison with the RMA prediction, Figure 18.2 below, shows good tend agreement but very poor magnitude agreement. Without independent confirmation, the only certain observation is that at least one of these results must be incorrect.

It is tempting to observe that the DWR model has compromised the dispersive transport (see §17.4) and to favor the RMA model. But advection is expected to domimate this problem, to the extent that disperion may not be a major issue.

18.5 Resource Management Associates

Figure 18.2 shows the RMA-predicted salinity penetration into a tidal channel network. Salinity transport does not penetrate beyond Reach 1, and only this reach is shown. The expected salinity advance into the solution field on the flood tide and retreat on the ebb tide is clearly seen. The smaller influence of dispersion can be seen in the advancing penetration during the second tide cycle. This is the expected response.

[1] Recall the DWR changes to the reach numbering and the flow directions described in Section 7.4 and Table 7.2.

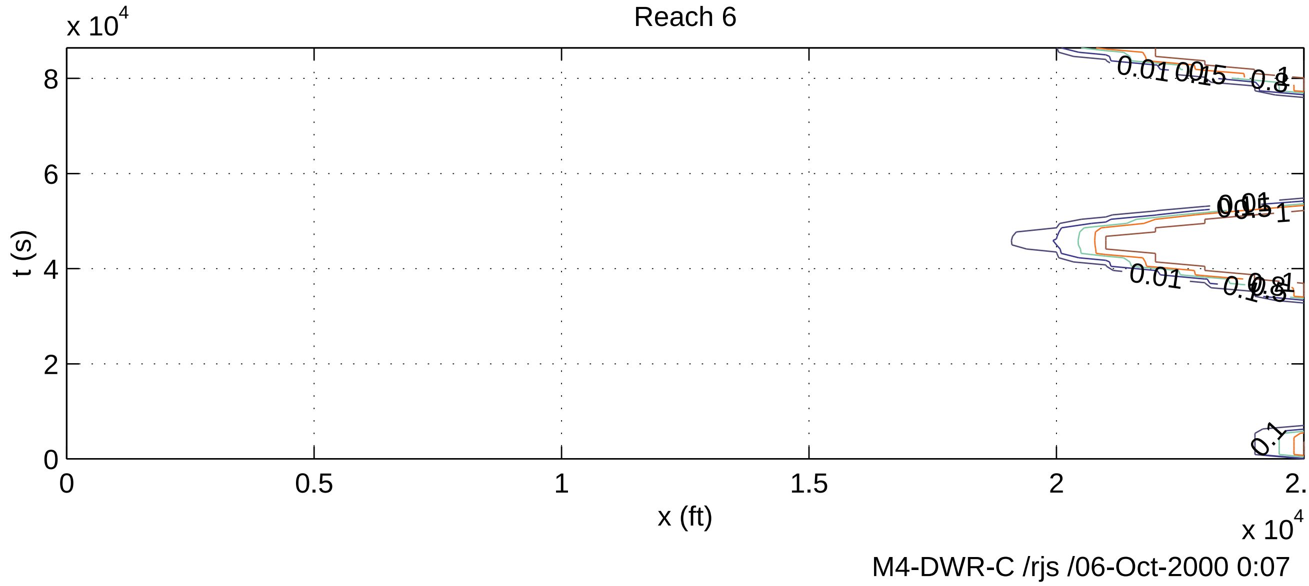

Figure 18.1: M4 DWR-predicted Evolution of Salinity Penetration into Channel Network. Contour levels in part (a) are 0.01, 0.1, 0.5, 0.8, 1.0.

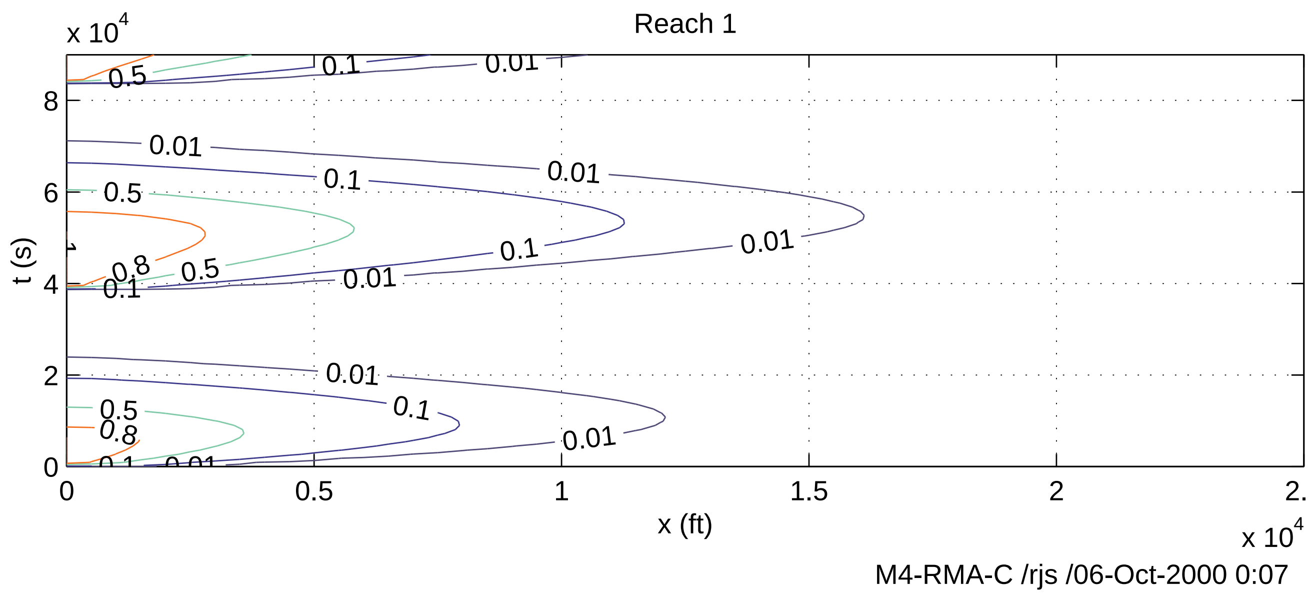

Figure 18.2: M4 RMA-predicted Evolution of Salinity Penetration into Channel Network. Contour levels in part (a) are 0.01, 0.1, 0.5, 0.8, 1.0.