A New Empirical Bay-Delta Salinity Model

CWEMF Annual Meeting

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Model Description

Results

Next Steps

Form proposed by Monismith et. al. (2002):

$X2(t) = A * X2(t-1) + B * Q(t)^{C}$

Assume steady state conditions:

$X2(t) = X2(t-1)$

$Q(t) \approx$ antecedent outflow $= G(t)$

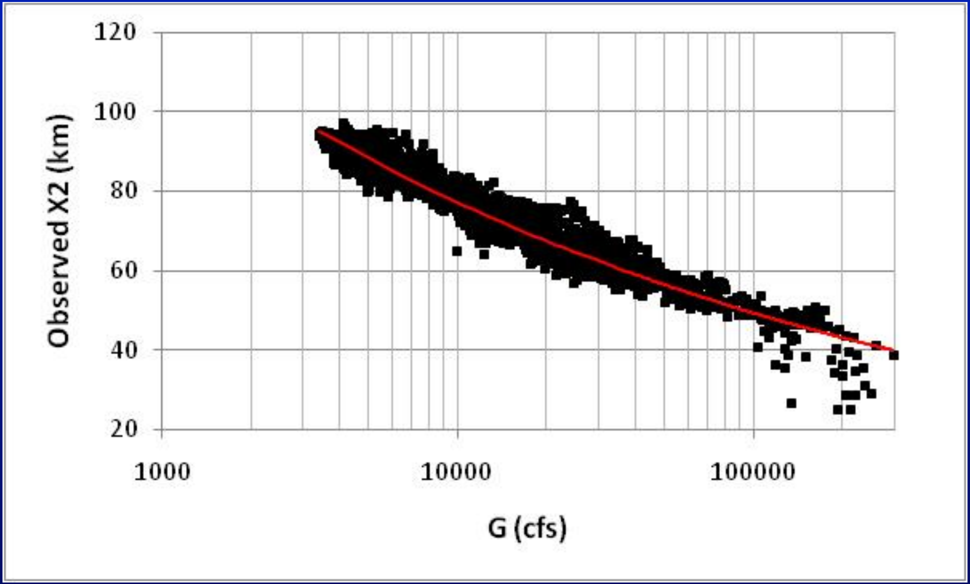
$$X2(t) = \Phi_1 * G(t)^{\Phi_2} \quad \ldots\ldots(1)$$

where constants:

$\Phi_1 \approx B / (1-A)$

$\Phi_2 \approx C$

$X2(t) = \Phi_1 * G(t)^{\Phi_2}$



Calibrating this relationship on a consistent period (1967-1991) and reporting flow in m^3/sec results in:

$\Phi 1 = 190$

$\Phi 2 = -0.160$

Gross et. al. (2010) reported similar "steady fit" model parameters:

$\Phi 1 = 186$

$\Phi 2 = -0.160$

$\Phi_1 = 465$; $\Phi_2 = -0.195$; $r^2 = 0.93$

if G(t) reported in m^3/sec, $\Phi_1 = 232$

Assumptions:

Calibration period – Jan 2000 thru Dec 2009

Daily X2 interpolated values

$\beta = 1.5 \times 10^{10}$ - Denton typical

Form proposed by Denton (1993):

$$S = (S_o - S_b) * \exp[-\alpha * G(t)] + S_b \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

where:

S = salinity (mS/cm)

S_o = downstream (maximum) salinity

S_b = upstream (minimum) salinity

α = fitting parameter

Set S = 2.64 mS/cm and solve for α(X):

$$\alpha(X) = -\tau/G(t) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

where:

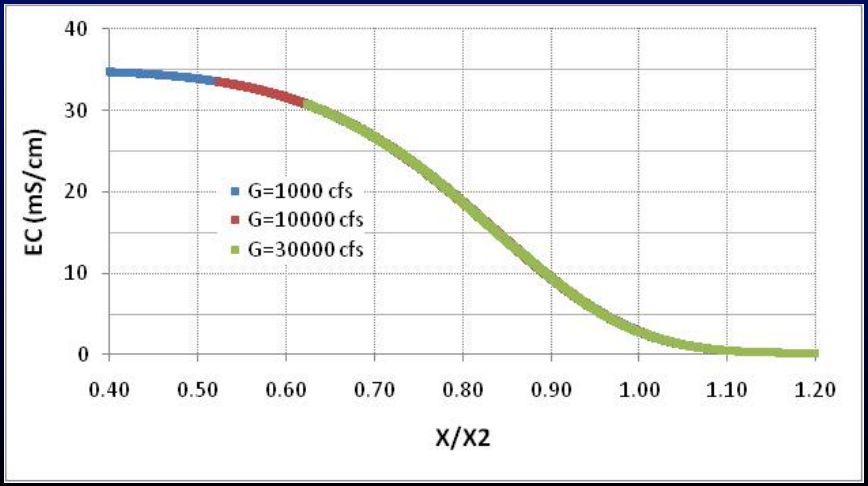
$$\tau = \ln[(2.64 - S_b)/(S_o - S_b)]$$

After some algebra

(this expression can also be expressed as a power function):

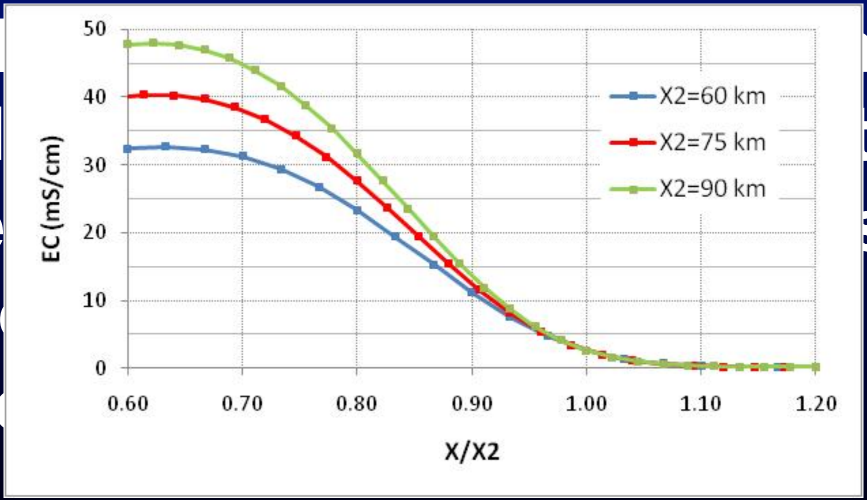
$$S = (S_o - S_b) * \exp[\tau * (X/X2)^{-1/\Phi_2}] + S_b \quad ....(4)$$

Salinity (S) can be determined at any longitudinal distance from Golden Gate (X) given X2 and Φ_2 and assuming reasonable values for S_o and S_b.



- But as observed by Monismith et. al. (2002), “self-similar” behavior breaks down at high outflows
  - Therefore, assume S_o is a variable
  - For illustration, assume a non-optimized relationship: S_o (mS/cm) = 0.35 * X2 (km)

- No absol… measuring station d… te Bridge, but model re… sumptions. Therefor… of an “effectiv…



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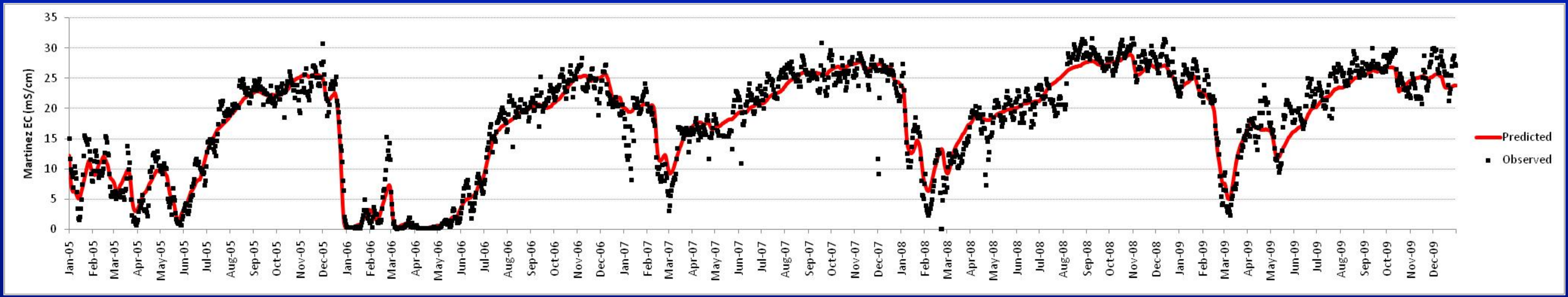
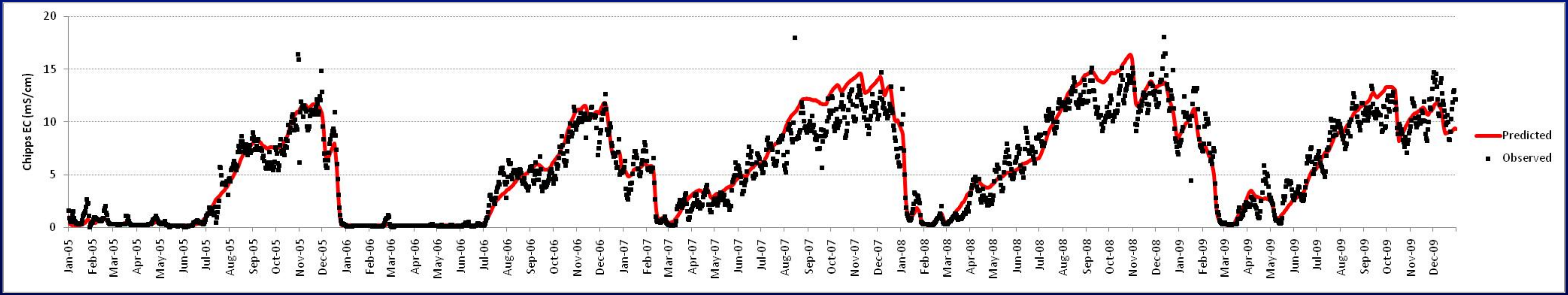
Results: Fixed Station Estimates

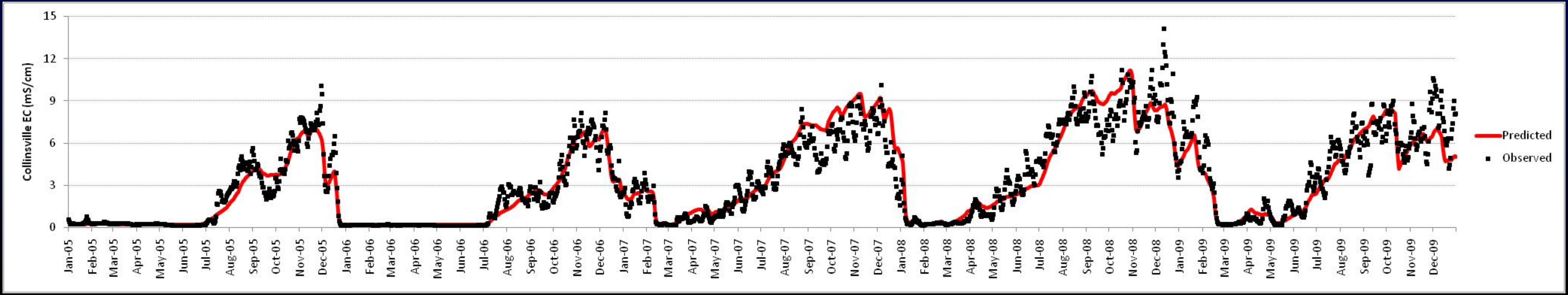
Next Steps

Predicted & Observed Daily Salinity

Time Series Jan 2005 – Dec 2009

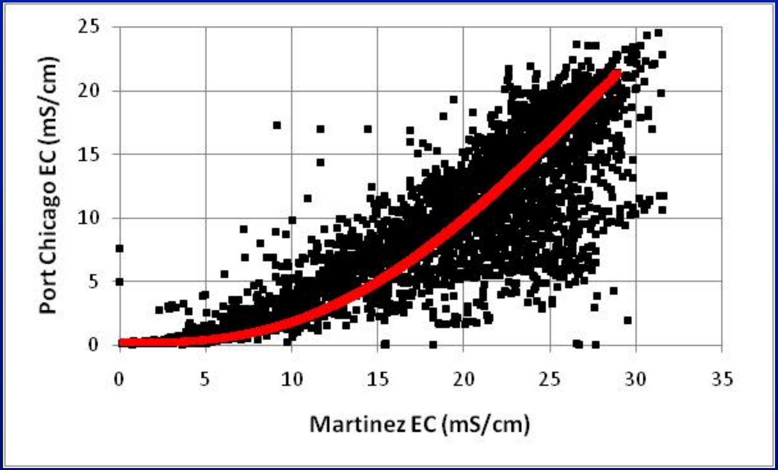


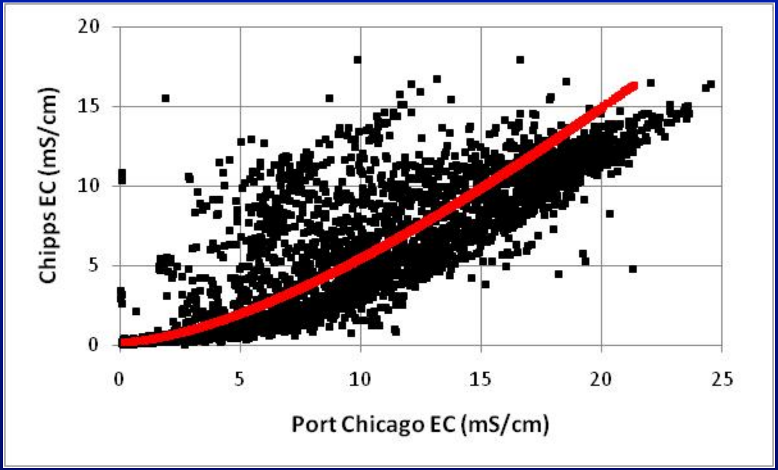


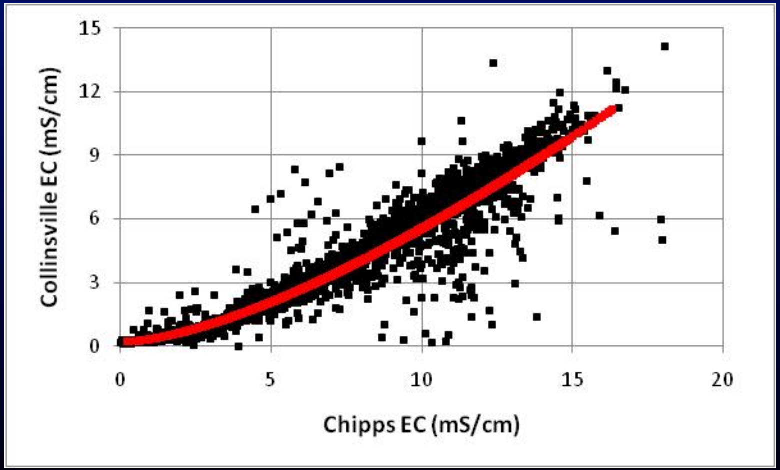


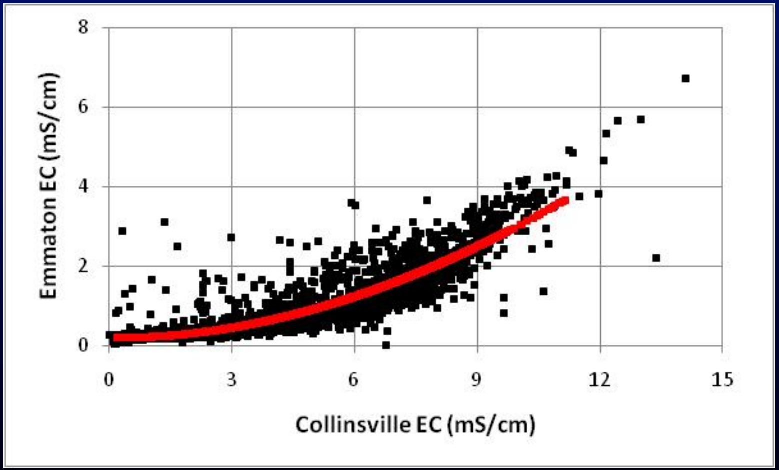
Predicted & Observed Inter-Station

Salinity Relationships Jan 2000 – Dec 2009









A New Empirical Bay-Delta Salinity Model

Model Description

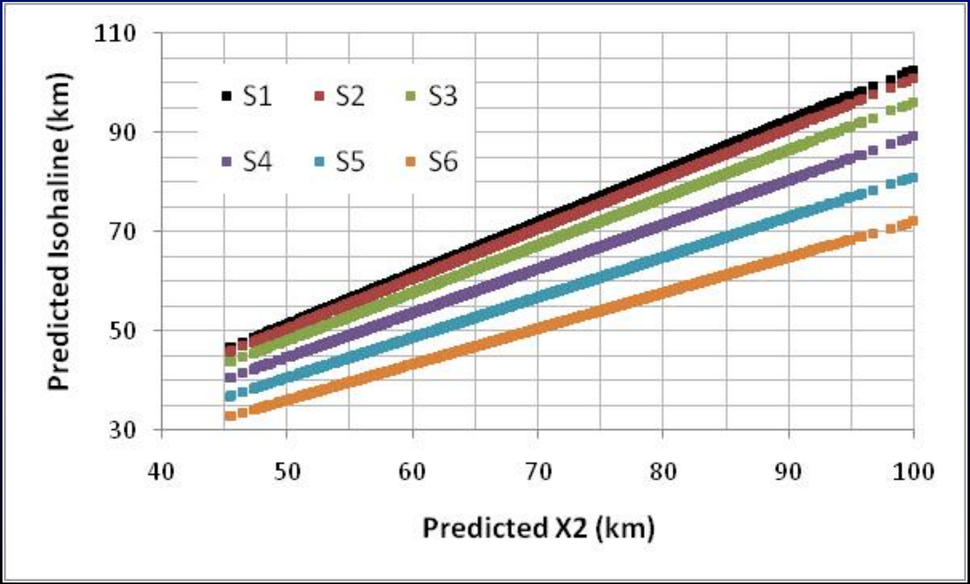
Results: Isohaline Position Estimates

Next Steps

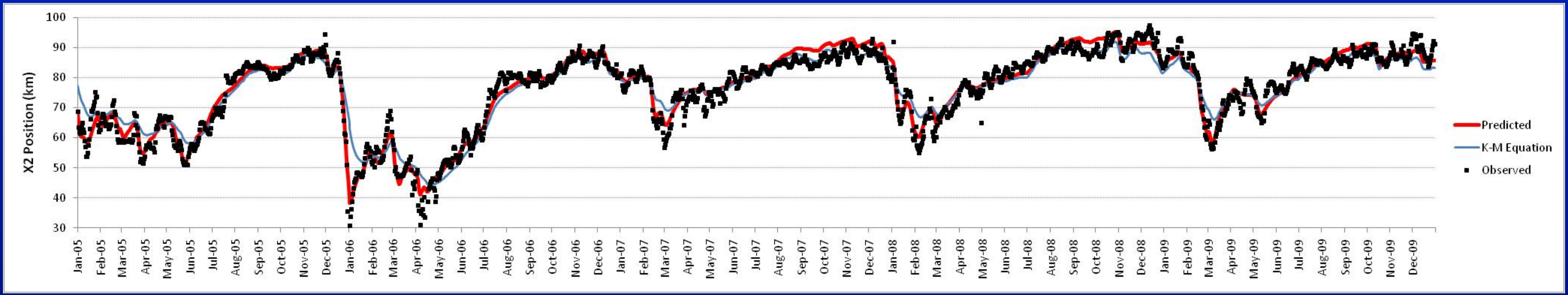
Re-arrange Eq. 4 to solve for X:

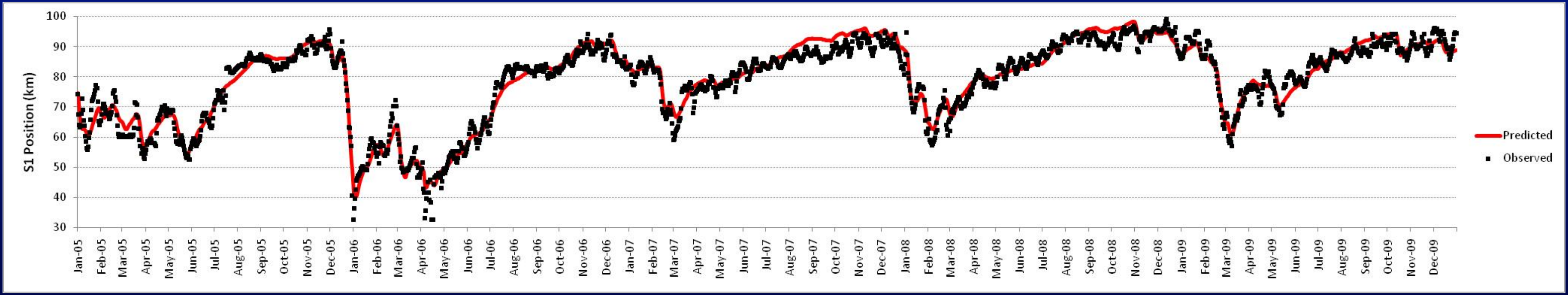
$$X = X2 * \{ \ln [(S - S_b)/(S_o - S_b)] / \ln \tau \}^{-\Phi_2} \quad ......(5)$$

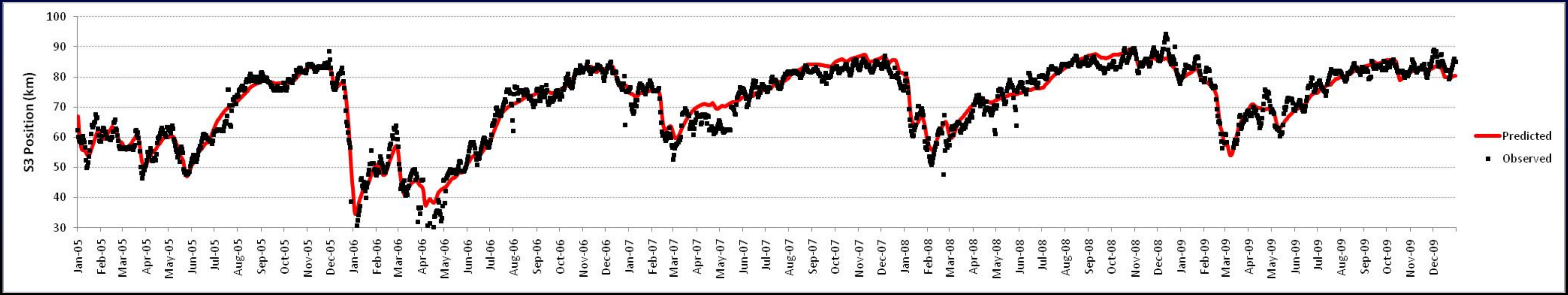
An isohaline position (X) can be determined for any surface salinity (S) given X2 and Φ_2 and assuming reasonable values for S_o and S_b.



Predicted & Observed Daily Isohalines
Time Series Jan 2005 – Dec 2009

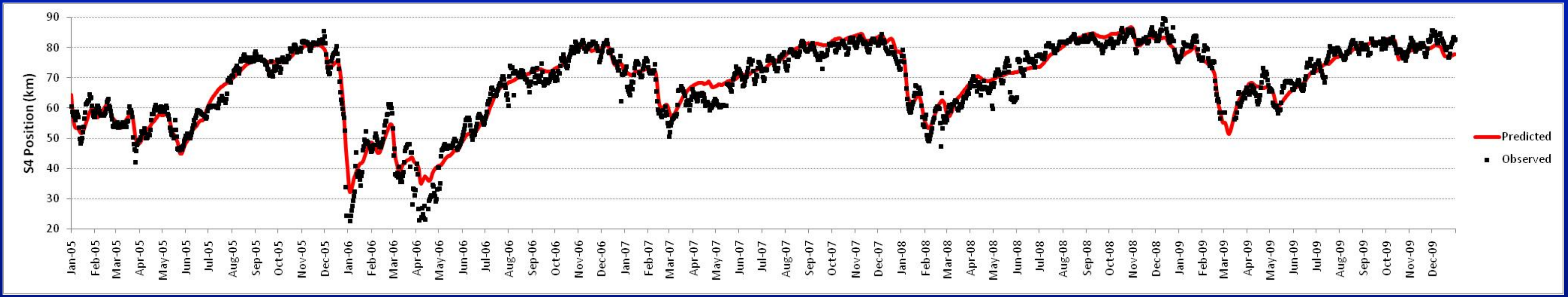


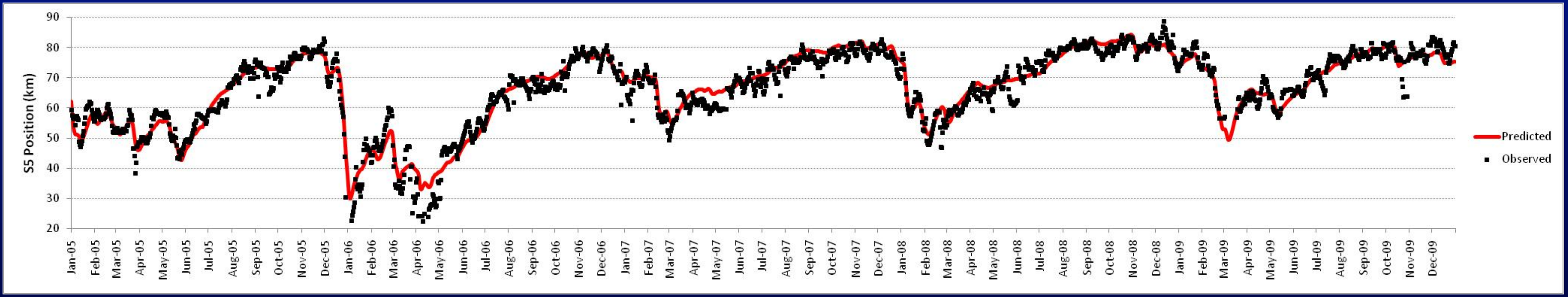


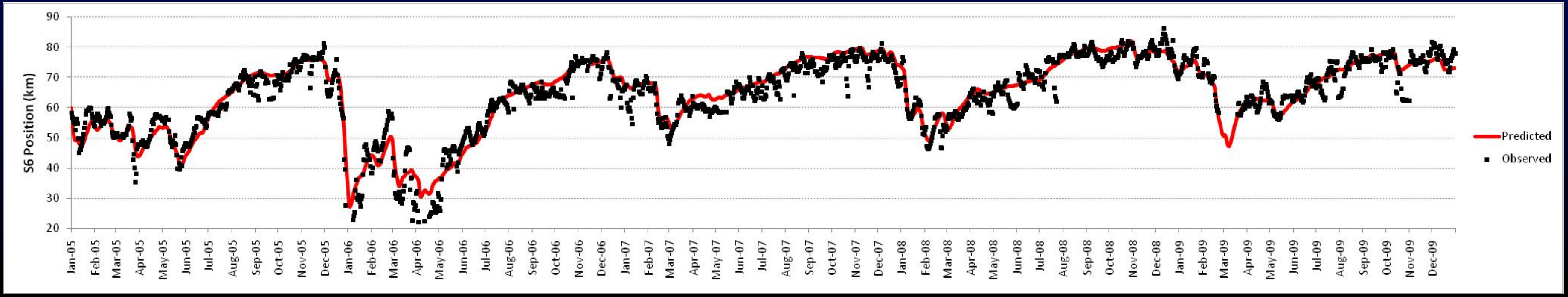


Predicted & Observed Daily Isohalines

Time Series Jan 2005 – Dec 2009







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Results

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