Numerical Simulation of DDTs Distribution in Southern California Bight (SCB)

[1]Changming Dong, [2]**Jian Peng**, [3]Hongchun Zhang, [1]James Mcwilliams, [4]*Keith Stolzenbach*

[1]: *IGPP/UCLA;* [2]***Southern California Coastal Water Research Project****;* [3]*JPL/Raytheon;* [4]*Department of Civil & Environmental Engineering, UCLA*

Abstract

Our previous study showed that DDTs are transported out of SCB in the order of about 1 ton per year, and the historical output of DDTs from SCB could be a sizeable portion of the background DDTs in the open ocean. In this study we try to use a 3-D ocean model (ROMS) to refine the above estimates. The preliminary results show that the advection and diffusing patterns of dissolved DDTs from the contaminated sediment of the shelf of Palos Verdes Peninsula has distinct seasonal patterns, and the average pattern is consistent with our previous measurements.

I.Introduction

From the late 1940s to early 1970s, about 2000 tons DDTs were discharged from industrial sources to the Southern California Bight through Joint Water Pollution Control Plant (JWPCP) outfalls offshore of Whites Point, near Los Angeles (See Fig.1) (Ref.1 and 2). A large portion of the remaining DDTs exists as contaminated sediment at the shelf of Palos Verdes Peninsula (Fig.1&2). Previous studies (e.g. Refs.1 and 2) have suggested that this layer of contaminated sediment continues to be the source of water column DDTs (Fig.3). However, its effect on the distribution, dispersion, and long-term fate of DDTs in the nearby waters and beyond remains largely unknown.

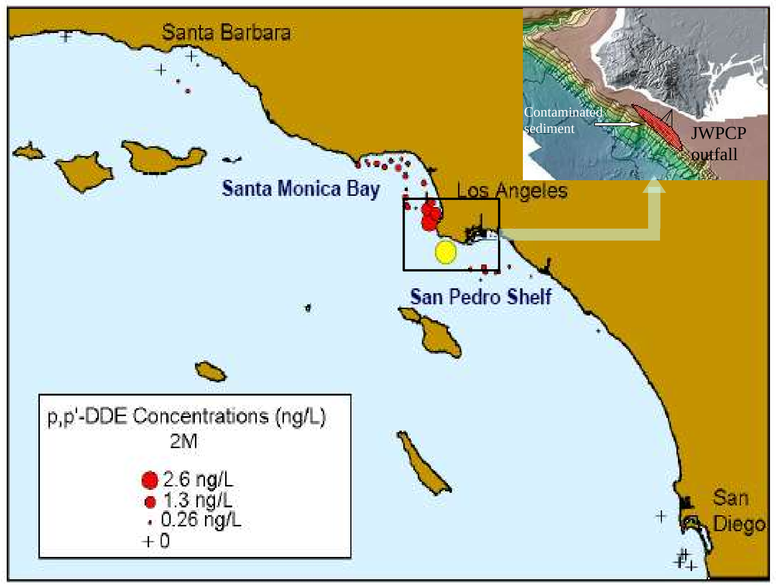

Figure 1. Concentration of dissolved DDTs (ng/L) in SCB, adapted from Zeng et al (Ref.1). Yellow dot near Palos Verdes shelf indicates the location of the most contaminated sediment (see inset).

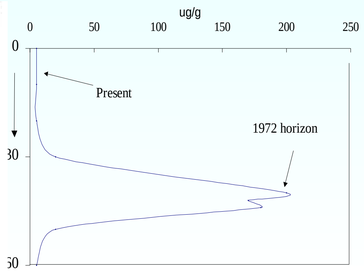

Figure 2. Typical sediment concentration (ng/g) of DDTs in the most contaminated site near Palos Verdes Shelf (Ref.3)

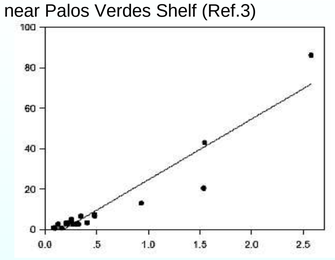

Figure 3. Correlation between water column (ng/L)and sediment ng/g) concentrations across SCB. The pattern suggests that water column DDTs come from sediment (Ref.1)

II. Numerical Model

The Regional Ocean Model System (ROMS) was used in the study. The model is a 3-D, split-explicit, free-surface ocean model that solves rotating primitive equations. The model is forced by MM5 reanalyzed wind. Fig.4 shows a good reproduction of SST (model vs. satellite) by the model for different seasons.

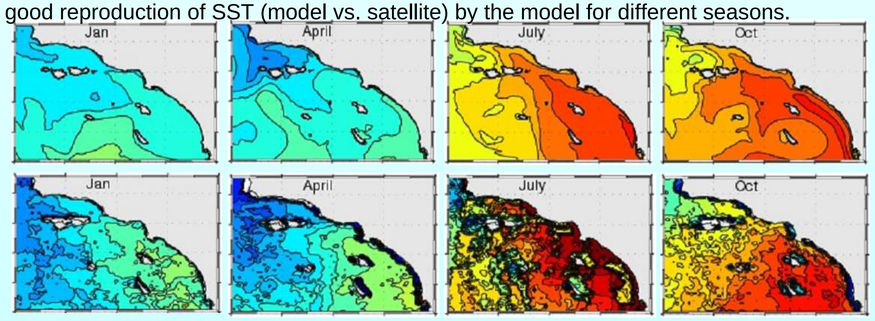

Figure 4. Comparison between modeled (top) and satellite observed sea surface temperature (SST) for different seasons, suggesting satisfactory performance of ROMS used in this study.

III. Preliminary Modeling Results

Because the contaminated sediment is the source of DDTs in the water column, it is reasonable to use “fixed value” boundary condition in the study, where an area of fixed concentration of DDTs was assigned at the most contaminated site near Palos Verdes Shelf (Fig.1). This high concentration area acts as the source of water column DDTs in the study area. After quasi-equilibrium is reached, the dispersion patterns of DDTs during different seasons were captured, as shown in Fig. 5 and 6 below.

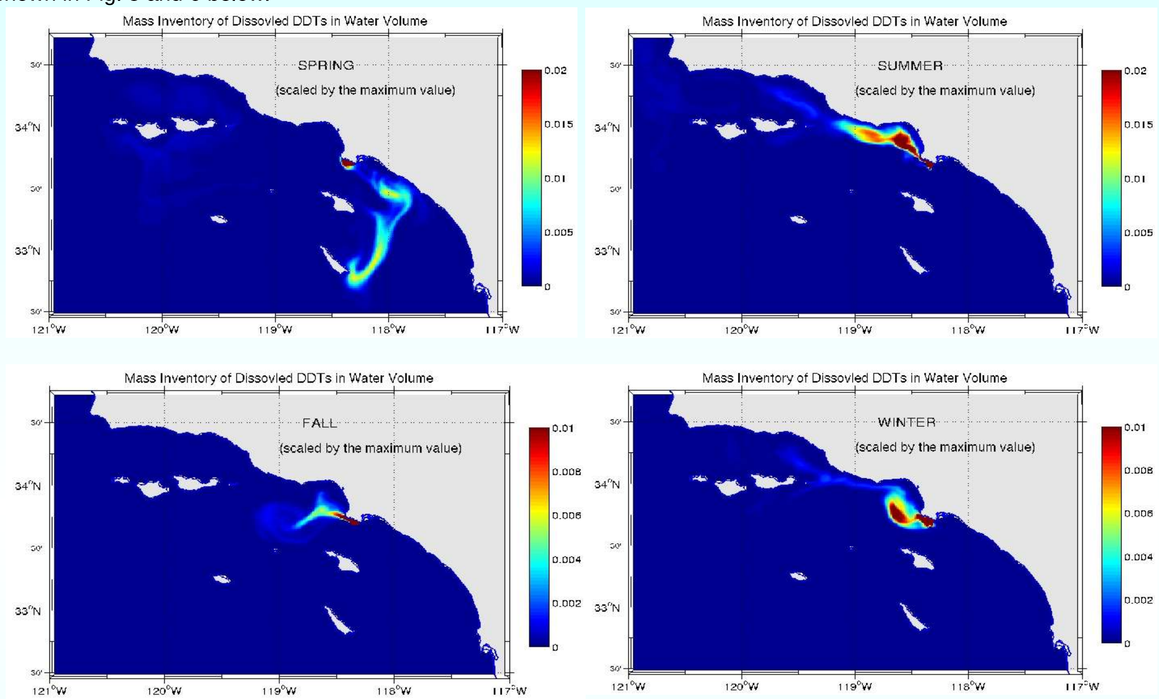

Figure 5. Simulated dispersion patterns of dissolved DDTs in the SCB. The general northward trend of DDT dispersion is compatible with observation (Fig.1). Note that particle dynamics and biological productivity are not included in the model for simplicity. They will be considered in future modeling efforts.

IV. Discussions

Despite the simplified approach used in this study, it is shown that the model is capable of simulating the distribution, dispersion, and transport of DDTs from the contaminated sites to other parts of SCB. In the future study, boundary conditions will be refined, particle dynamics and biological processes will be incorporated in the model to improve the model performance. The improved model can be used to calculate the inventory of DDTs in SCB waters and to estimate the mass flux of DDTs from SCB to the open ocean. It can also be used in the studies of long-term fate of DDTs and their bioaccumulation patterns of the local infauna.

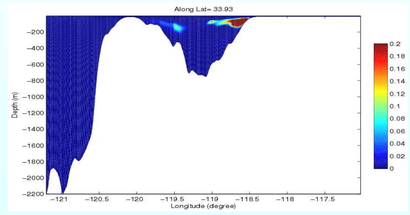

Figure 6. Cross section of SCB from Palos Verdes Shelf westward toward the open ocean. Note the trapping of DDT plume in the nearshore basin.

References:

3. *Zeng, E. D. Tsukada, D. Diehl, J. Peng, K. Schiff, J. Noblet and K. Maruya: 2005: Distribution and Mass Inventory of Total DDT in the water column Of the Southern California Bight, Environ. Sci. Technol. 39, 3347-3353*
4. *Southern California Coastal Water Research Project Authority, 1992-1999, Southern California Coastal Water Research Project Annual Report 1992-1999, Westminster CA.*
5. *Sherwood C., D. Drake, P. Wiberg and R. Wheatcroft, 2002: Prediction of the Fate of p,p'-DDE in sediment on the Palos Verdes shelf, California, USA. Cont. Shelf Res, 22, 1025-1058.*