Oil Tracking on the TX-LA Shelf

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July 15, 2013

1 Introduction

1.1 Particle Tracking

2 Tracking Algorithm Sensitivity and Details

2.1 Explain Algorithm

2.1.1 2D Boundaries

Due to the basic algorithm of TRACMASS, at boundaries within the numerical domain, drifters will be stopped according to the bounding fluxes. For a given grid cell in the 2D case, there are four fluxes controlling a drifter's movement. Drifters have nonzero fluxes on active sides of the cell and zero fluxes along masked land. They can run along these walls but should not penetrate them. At open numerical boundaries, the drifters will be stopped according to a check built into tracmass itself, and will be left with their final position along the open boundary and a flag indicating that they have exited the domain so they will not be stepped forward.

The addition of subgrid turbulence parameterizations can affect this. One method is to add parameterized turbulent values to the fluxes used to calculate drifter movements. These do not affect the fact that fluxes will be zero at masked land because they are multiplied by the original ufluxes to get the fluctuation to add to the original flux values.

However, there are two methods of adding in a random walk to the particle positions directly, and these were affecting the boundary behavior of drifters near walls. The problem was that when a drifter was alongside a masked land cell, if the random new position of the drifter was just right to move the drifter from its current cell into the land cell, then an error check later in the code for the volume of the cell would catch the drifter (due to its cell having zero volume since it was on land) and the drifter would be stopped at its location near land. Since drifters in the advection-only and turbulent velocity methods do not hit land, the overall behavior was different along the coastline for the diffusion and anisodiffusion methods (in these methods, many more drifters were congregated alongshore). I changed this by adding a check in the diffusion subroutine in tracmass to not accept a new

(a)(b)(c)(d)
NoTurElCir-
difbulipcu-
fulentidear
sioncal

Figure 1: Comparison of types of diffusion for $A_H = 20$ m^2/s, initial spacing of 10km

displacement location for a drifter if the layer thickness (dzt) of that new location is zero. Now, I think that all of the routines will have similar coastline behavior. If, on the other hand, it is desired that drifters should be able to hit the coastline and "beach," then this behavior in the diffusion routines might be desired.

2.2 Examine Sensivity of Results to Input Parameters

A series of numerical surface drifter experiments were run for 16 days forward in time from 11/20/2009 with several changing parameters to understand their importance to the results.

There is little overall difference for the number of time interpolation steps for these simulations (not shown).

The difference in the results from diffusion types is illustrated in Figure 1. For numerical drifter experiments with drifters initially seeded 10 km apart and using the same horizontal diffusivity, the difference in tracks and final positions is not extreme, but is noticeable. The cases with no diffusion and parameterized turbulent velocities (Figures 1(a) and 1(b)) are similar, though a larger value of A_H would presumably change this more. The cases with a random walk-type diffusion added to the particle tracks themselves (Figures 1(c) and 1(d)) show more diffused behavior and are fairly similar to each other.

Drifter tracks and final locations are shown in Figure 2 for changing the size of the horizontal diffusivity, A_H. The overall behavior is the same in all of the plots, but the drifters are somewhat noticeably more spread out as the value of the horizontal diffusivity increases. This is shown for adding diffusion using a random walk on a circle to the drifter positions, but the same type of behavior is found in the results of all of the parameterization techniques (not shown).

(a) No diffusion

(b) Circular diffusion, $A_H = 5$

(c) Circular diffusion, $A_H = 20$

Figure 2: Comparison of size of A_H for initial spacing of 5km and circular trajectory diffusion

2.3 Forward/Backward

3 Performance of Model and Tracker

3.1 Barataria Bay

3.2 Sensitivity to Waves, Tides, and Model Output Frequency

4 Results for Different Conditions

4.1 Dependence of Circulation on Weatherband

4.2 Seasonal Variability

4.3 Cross-Shelf Behavior

5 Analysis

References