Classroom Series – Module #2

An Oil Tanker Runs Aground Off the California Coast; Plan and Execute an Appropriate Warning and Cleanup Response.

The Scenario

Early this morning (approximately 6:30 am local time) an oil tanker carrying 50,000 gallons of Class B crude petroleum ran aground 40 km (~25 miles) offshore, due West of Drakes Bay (near Point Reyes National Seashore) as it was attempting to navigate in thick morning fog on its way to the Port of San Francisco. It is now leaking 500 gallons of oil each hour. This spill is threatening the health of the beaches and wildlife in this region of Northern California. You and your team members have been hired by the Governor to manage this crisis and mount an appropriate strategic response. In order to be compensated for this work (i.e. earn credit for this project), your team must fully complete each of the following tasks below (Parts 1-4). The people and the wildlife of California are depending on your excellent work. Good Luck!

Team's Name: ____________________

Names of Team Members: __________________ _____________________

Part 1: Oil Spill Research

Use the "Oil Spill Resources" links and your "Oil Spill Online Research Profile" (below) to obtain the appropriate background information about the effects of an oil spill on the surrounding environment and the recommended measures to be taken in response to this event.

Oil spill Resources:

Oil Spill Response/Clean-up Techniques
http://www.epa.gov/emergencies/content/learning/oiltech.htm

Rescuing and Treating Affected Wildlife
http://www.epa.gov/emergencies/content/learning/rescue.htm

Comparison of Different Kinds of Crude Oil
http://www.epa.gov/emergencies/content/learning/crude.htm

Team Name:

Online Oil Spill Research Profile

Directions: Answer each of the following questions as you explore each of the three "Oil Spill Resource" links below. You will need this information to complete your Team's Strategic Response Plan (Part 4 – final section).

1. What are some factors that affect the type of materials and equipment that should be used for cleaning up an oil spill?

2. List three different oil spill response techniques; describe the advantages and the disadvantages of each technique.

3. What are the four critical steps that must be followed when mounting a wildlife rescue effort from an oil spill?

4. How does the rescue and cleaning of birds differ from rescuing and cleaning marine mammals after an oil spill?

5. List the four types of Crude Oil and briefly describe the physical properties of each.

Part 2: Vector Analysis

In this activity you will use the accompanying "Sea Surface Vector Field for the San Francisco Region" to derive the *component* vectors from the indicated *resultant* vector. Carefully follow each of the steps below to complete this task.

Vector Analysis

Step 1: Looking at the "Sea Surface Vector Field for the San Francisco Region", locate the orange, downward pointing vector (arrow) at approximately 37º 36' N latitude and 123º 18' W longitude (lower left-hand corner). This orange arrow in known as a *resultant* vector from which we will derive the *component* vectors in the steps that follow.

Step 2: Compare this orange colored vector to the color scale on the right of the image to find the velocity of this vector. Record this orange resultant velocity of this vector in cm/sec.

Velocity of Orange Resultant Vector = _________cm/sec

Step 3: On this chart, draw a straight line from the Daly City HF Radar antenna station point through the tail of the orange vector. Extend this line beyond the left-hand boundaries of the chart.

Step 4: Label this line "**A**" on one end (farthest from shore) and "**B**" at the other end (at Daly City). Label the point where the line crosses the tail of the orange resultant vector as "**W**". Thus, you have made line "**AWB**" (reading from left to right).

Step 5: Now, draw a straight line from Moss Beach through point "**W**" (on the "**AWB**" line) and, again, extend this line beyond the left-hand boundaries of the chart.

Step 6: Label this new line "**C**" at the left end and "**D**" at the Moss Beach end. Label the point where this new line crosses the tail of the orange resultant vector as "**W**". Thus, you have made line "**CWD**".

Step 7: Label the tip of the orange vector (by the arrowhead) as point "**P**". At this point, check your accuracy with your teacher in order to receive a stamp of approval" before moving on.

Teacher's Approval

Step 8: Complete the triangle by drawing a straight line from point "**P**" to line "**AWB**". Keep the new line parallel to the "**CWD**" line. Mark the point of intersection as point "**Q**".

Step 9: Draw a line from point "**P**" to line "**CWD**" but keep the new line parallel to line "**AWB**". Mark the point of intersection as point "**R**".

Step 10: Lines "**WQ**" and "**WR**" are the *component* vectors. Highlight these two component vectors using a color pencil/pen/highlighter.

Step 11. Determine the velocity of these component vectors by measuring the length in millimeters (using your metric ruler) and multiplying this length by the scale located in the lower left of the chart. For example, if the component vector is 10 mm long, the velocity of this vector would be 50 cm/sec (10 mm X 5 cm/sec).

Velocity of component vectors = ________**cm/sec**

(If you need further practice in finding component vectors from resultant vectors, chose another vector on the field and repeat the above Steps 2 -11).

You have just derived component vectors which, when combined, represent the velocity and direction of a parcel of seawater in a specific location (represented as the resultant vector). Collectively, a field of resultant vectors provides sea surface current features over a given area of the ocean.

Part 3: Using Real-Time Data from CeNCOOS to Predict the Movement of the Oil Spill.

Use CeNCOOS real-time data (hourly and 25 hour mean) to make a prediction as to the movement and eventual end-point location of this oil spill. The location of the spill is approximately **40 km south-west of Drakes Bay, off of Point Reyes National Seashore**). Hint: Use the scale at the lower left corner on the Google map magnified four times (4 + clicks) to better identify the exact location.

Step 1:
Log onto http://www.cencoos.org/sections/conditions/Google_currents/ to view the latest sea surface current data available and spend some time clicking around in order to familiarize your self with this Google map. Notice the date in the lower right along with other indications of how this data was generated (you should see today's date and time).
Some things to consider when viewing this map:

- You have the option of viewing the HF Radar sites by checking the box titled "HF RADAR Sites.
- You can zoom in and out and pan in the direction of N, S, E, or W.
- You can change image formats (Map, Satellite, or Hybrid)
- Clicking onto any vector reveals its features (Speed (Mag.) in cm/s and its direction (Dir.)).
- You can also compare the color of the vector to the scale at the bottom of the page to determine the relative speed (magnitude).
- You can view this chart as a full page by clicking onto "View Full page".

Step 2: Choose four different vectors from this map that are in the general vicinity of the oil spill (40 km West of Drakes Bay) and record the magnitude and direction (Dir.) for each in the data table below:

Vector	**1st**	**2nd**	**3rd**	**4th**
Magnitude	cm/sec	cm/sec	cm/sec	cm/sec
Direction	º from N	º from N	º from N	º from N

Step 3: Calculate and record the average magnitude and direction for these vectors.

Ave. Mag. = ______cm/sec (Speed)   Ave. Dir. = ______º from N (Direction)

Step 4: Use the following equivalencies to convert the average speed in cm/sec (from Step 3) to km/hr. Show all your work (unit conversion).
Note: 1km = 100,000 cm and 1 hour = 3600 seconds

= __________ **km/hr**

Step 5: Multiply your answer from step 4 by 24 to find the total distance this oil spill will travel over the next 24 hours.

Total Distance Travelled in 24 hours = __________ **km**

Step 6: Using the average direction and the total distance traveled, identify the location(s) that might be impacted by the oil spill over the next 24 hours. Zoom in on the map to obtain the specific location(s) (by name) that will most likely be impacted by this event. List them below.

Step 7: Finally, go to... http://www.cencoos.org/sections/conditions/CENCAL_currents/sf_node.shtml (for the "San Francisco Offshore" region – under "Current Conditions" on the left hand side of the page) and click onto each of the following links located under "Offshore San Francisco Bay Products": "**Hourly Currents", "25 hr Currents"**, **Drifter Animation**, and **Forecast Animation**. Use these data products to confirm the likely path that an object (in this case, the oil spill) would take over the next 24 hours. Use both animation events to draw conclusions about the validity of your team's predictions of the likely path and eventual location of the oil spill.

Part 4: Present Your Team's Strategic Response Plan

Using what you have learned about the nature of oil spill recovery and response (Part 1 and 2) and the use of real-time data in making predictions of the movement and direction of materials on the ocean's surface (Parts 2 and 3), create a response plan to be presented to the rest of the class that addresses the strategy of containment and clean-up of this oil spill. Your plan needs to include the following including the Analysis below:

- A description of the techniques and equipment that should be used to contain and clean up the spill
- The locations (onshore and off) where these techniques and equipment should be deployed
- The evidence you used to make these determinations.
- Identify any potential inconsistencies between your findings and the results you encountered from viewing the drifter animations.

Analysis

1. How reliable to you believe the CeNCOOS data is in making predictions about the movement of objects at sea?

2. How might you gain more reliable information in making predictions about the movement of objects at sea? What other tools might be useful in making these kinds of predictions?