WET Labs
PO Box 518 Philomath, OR 97370 (541) 929-5650 FAX 929-5277

6/9/10

Client Advisory

Crude Oil Detection with WET Labs ECO CDOM Fluorometer

Chris Fuller of Texas A&M University presented data from an experiment on detecting aged crude oil using WET Labs fluorometers at the 2005 International Oil Spill Conference.

The paper is available on-line in the IOSC archive:

http://www.iosc.org/papers/IOSC%202005%20a356.pdf#search=%22Fuller%22

Figure 4 from that paper presents a linear regression of the raw ECO CDOM channel fluorescence response against GC-MS analysis of crude oil concentration with an R2 > 0.9.

Because the CDOM fluorometer will respond to a wide range of fluorophores other than crude oil, ancillary measurements are useful to decrease false positive results.

For crude oil spills in offshore ‘blue water’ conditions such as the outer shelf and deep water of the Gulf of Mexico, CDOM fluorescent response should be quite low and high positive response in CDOM raw counts on the order of tens to hundreds of counts would indicate the presence of crude oil. Ancillary measurements will also help constrain the CDOM/crude oil relationship and decrease the possibility of false positives.

Near shore and in areas with significant fresh water influence ancillary measurements will be increasingly useful.

Note that in the following discussion the term ‘backscattering’ is used to indicate either backscattering or beam attenuation measurements.

Best practices:

The best indicator of crude oil in natural waters is a dramatic increase in CDOM response where other parameters are relatively constant. Backscattering response should also be positively correlated with the presence of crude oil.

1) Determine a dark count for the instrument by taping over the LED and detector and recording the value given. This is the 'dark count' or blank value for your system. Subtract this value from all in-situ data to derive the relative fluorescent response.
2) Deploy the instrument in a known area where oil is not present but is a similar water mass, i.e. upstream of the source of contamination. Record the CDOM counts as your 'background' level.
3) If your instrument also has chlorophyll a and backscattering (turbidity) channels, record those counts as the 'background' values. Calculate the ratio of chlorophyll to backscattering or turbidity. Changes in this ratio are indicative of particle sources.
4) If the instrument is on a profiling package, glider or AUV, you can derive the vertical temperature to CDOM and salinity to CDOM relationships.
    a. Natural sources of CDOM will generally show an increase in concentration and fluorescence with decreasing temperature and depth as in the absence of horizontal inputs the largest source of CDOM is upwelling. CDOM is broken down through photo-oxidation ('bleaching') over time in the photic zone.
    b. Where fresh water inputs from land are significant, e.g. river plumes, CDOM is negatively correlated with salinity as fresh water generally contains significant loading of CDOM derived from soils and inland sources.
5) Within the suspected contaminated zone, crude oil presence may be indicated by:
    a. An increase in the CDOM fluorescence channel above background values.
    b. An increase in backscattering or turbidity above background
    c. Increases in CDOM, chlorophyll and backscattering at depth

   If possible, take bottle samples in the suspected layers for analysis.
6) A decrease in the chlorophyll to backscattering ratio in the absence or only a weak CDOM response is indicative of a benthic nepheloid layer, a detached benthic nepheloid layer.
7) Near surface CDOM increases may be due to either fresh water inputs or crude oil. Check for the influence of fresh water by checking the salinity value as you may be in a river plume.
8) After deployment wipe the ECO face and clean with dilute detergent.