Southern California Bight Nutrient Loading Study

Quantification and characterization of nutrient inputs

This study component will likely include the following elements:

Atmospheric Deposition

Atmospheric deposition of nutrients will be measured during three climatic conditions intended to capture the range of expected variability in rates: 1) wet deposition during rain events, 2) quarterly sampling of dry deposition, and 3) dry deposition during a Santa Ana wind event. Rates of wet deposition and dry deposition will be measured at three coastal stations and one station based on Catalina Island. Measurement of dry deposition during a Santa Ana wind event will be made at one of the coastal stations.

Upwelling

To estimate the upwelling contributions of nitrate to the nutrient budget, a three-dimensional ocean circulation model, called the Regional Oceanic Modeling System (ROMS), will be used to analyze the ocean environment from November 2008 to October 2009. This model integration will result in a high resolution output of the three dimensional physical and biogeochemical parameters, one of which is nitrate. The quantity of upwelled nitrate will be compared to the amount of nitrate from the other studied sources (POTWs, atmospheric deposition, and terrestrial runoff) over a range of spatial scales, from the entire Bight to smaller volumes, such as just Santa Monica Bay. Nitrate concentrations will be correlated to phytoplankton blooms as detected from either satellite or ship-board measurements. The annual mean distribution of surface nitrate will also be computed, which would then enable quantification of the potential impact or other nitrate sources on the local ocean environment, for instance, near a river mouth.

Terrestrial Sources

Watershed-based sources of nutrients will be estimated from a combination of measured and modeled wet weather and dry weather loads from all coastal watersheds that drain to the SCB. Dry weather loads will use measured flows where possible and where not, relationships will be developed between watershed size, land use, and measured flows for the non-gauged watersheds. Watershed wet and dry weather models will be calibrated using nutrient data collected by Storm Water Monitoring Coalition (SMC).

Large POTW Effluent

Nutrient concentrations in the effluent will be measured monthly at each of the following large publically owned treatment works (“POTWs”):

- Hyperion Treatment Plant (HTP) operated by City of Los Angeles
- Joint Water Pollution Control Plant (JWPCP) operated by Los Angeles County Sanitation District
- Treatment Plant No. 2 operated by Orange County Sanitation District
- Point Loma Wastewater Treatment Plant (PLWTP) operated by City of San Diego

Table 1 provides a complete list of constituents being measured for this nutrient source from November 2008 to October 2009. These concentrations will be multiplied by measured effluent discharge rates to produce monthly loads to the SCB.

Offshore vessel surveys

There will be 3 ship based surveys between February and May 2009 following the onset of a 'trigger', which is either an algal "bloom" or an upwelling event. Data will be collected at 163 stations during these surveys. The sampling at the five SCCOOS piers, the data from the SCCOOS gliders and daily satellite imagery will determine the onset of a trigger event.

Two additional ship based surveys will be conducted by the Central Bight Water Quality (CBWQ) group and City of San Diego (SD) as part of their permit monitoring programs during the same time period. Data will be collected at 216 stations for each of the two surveys. All of the offshore field surveys will consist of physical, biological and chemical measurements such as CTD (conductivity, temperature, depth) and bio-optical (transmissivity; chlorophyll, and CDOM fluorometry) vertical profiles and discrete water samples collected at the surface and at the subsurface chlorophyll *a* maximum (domoic acid, chlorophyll *a*, nutrients, and *Pseudo-nitzschia* cell counts). The ship-based indicators that are likely to be sampled are listed in Table 2.

Table 1. The Bight study will consist of the following constituents for each nutrient source.

Constituent	Watershed Loading	Atmospheric Deposition		POTW Effluent	Upwelling
		Wet	Dry		
Nitrate+Nitrate	X	X	X	X	X
Ammonia	X	X	X	X	
Phosphate	X	X	X	X	X
Silicate	X			X	X
Urea	X			X	
Particulate Nitrogen	X	X	X		
Total Nitrogen	X	X	X	X	
Total Dissolved Phosphorus	X	X	X	X	
Total Phosphorus	X	X	X	X	

Total dissolved nitrogen will be calculated from the total nitrogen and particulate nitrogen measurements.

Table 2. The ship-based surveys will consist of the following indicators:

Component	Indicator/Analyte
CTD profile	Temperature Salinity dissolved oxygen turbidity fluorescence (for chlorophyll a and CDOM)
Discrete water samples	chlorophyll *a* nitrate nitrite phosphate silicate urea particulate nitrogen total dissolved phosphorus total nitrogen total phosphorus *Pseudo-nitzschia* cell counts Domoic acid

Figure 1. Bight'08 offshore water quality sampling locations for the event surveys.

Figure 2. Bight'08 offshore sampling locations conducted by the Central Bight Water Quality (CBWQ) and San Diego as part of their NPDES permit monitoring program.