Project Objectives

1) Quantify. the relationship between wind and rain intensity and the elevated concentration of aggregated sediments.
2) Investigate the extent to which dissolved contaminant concentrations are influenced by resuspension of sediment aggregates containing elevated contaminant concentrations.
3) Characterize properties of particle and dissolved constituents that govern elevated contaminant load released through the mobilization process
    a. Source of particles (benthic polymers, algal, mineral, detrital, etc)
    b. Particle character (OM content, nutrients, grain and aggregate size)
    c. Partitioning
4) Estimate contribution of this mobilization process on biotic contaminant burden relative to the system background
5) Improve our ability to monitor for contaminant transport in restoration and regional settings by developing *in situ* methods for determination of contamination exposure potential using optical characterization of particulate and dissolved constituents.

Study Approach

Ruhl and Schoellhamer (2004) report that large, but short-lived, pulses in turbidity can occur due to episodic weather events. However, it is difficult to decouple the effects of rain and wind on particle mobilization. We intend to look at rain and wind events in winter and spring to decouple the physical processes leading to episodic turbidity events in the Bay-Delta. Winter storms typically include rainfall whereas spring and early summer storms are wind-dominated with little or no associated precipitation (www.noaa.gov). We will measure the respective contributions of wind and rain events using a field-based approach, employing *in situ* instrumentation capable of measuring suspended sediment concentrations, water flux, and meteorological variables. These physical measurements will provide a means of elucidating which physical processes dominate sediment mobilization at the study sites. We can then compare our local measurements with the established Bay-Delta suspended sediment monitoring network (www.usgs.gov) to determine the relationship between local observations in intertidal habitats and system-wide turbidity events.

Torres and graduate students will construct a portable sprinkler irrigation apparatus (similar to Torres and Mwamba, 2002) to control the rainfall KE and power, and relate those variables to sediment entrainment, suspended sediment concentration (SSC) and sediment composition. Tones will also monitor and oversee the monitoring of the SSC response to natural rainfall and wind events using OBSs and a Nortek Aquadopp Current Profiler. Also, Torres and students will map topography of the intertidal study areas using an RTK GPS (similar to Tones and Styles, 2006).

We will also characterize the intertidal sediment and porewater properties to those from the substrate sediment and the re-deposited particles. We will determine the organic matter loading of these sediments by measuring the ratios of OC and nitrogen content to mineral surface area (e.g. Mayer, 1994; Mayer et al., 1998. We will use established techniques in our laboratory (e.g., Gordon et al., 2001; Gail et al. 2003) to investigate the relationships between mineral particle surface area, particle organic loadings, particle density, and particle export. We will also investigate the contrasts in the nature, source, and nutritional quality of the mobilized OM relative to that in the substrate sediment. In order to accomplish this goal, we will use a combination of techniques, including elemental analyses (%carbon, %nitrogen, %biogenic silica), stable isotope analyses ($S^{13}C$ and $S^{15}N$), as well as analyses of lignin, cutin, amino acid and lipid biomarkers (sterols, fatty acids, hydrocarbons). Such a combined approach has been used successfully in previous studies to investigate the composition, sources, turnover, and. fate of natural OM in coastal environments (e.g., Benner and Opsahl, 2001; Goni and Hedges, 1992; 1995; Goni et al., 2000; 2001; 2003b). Based on these measurements, we anticipate being able to specifically discern the contributions from benthic diatoms, marsh vascular plants, and bacterial sources. For example, benthic diatom contributions will be assessed based on the biogenic silica contents and concentrations of diatom-specific sterols such as brassicasterol (i.e. 24-methylcholesta-5,22-dien-3(3-01). In contrast, we will use the yields of vascular plant-specific compounds such as lignin phenols, cutin acids and long-chain hydrocarbons to identify the contributions from macrophyte vegetation. Furthermore, bacterial contributions will be investigated using specific branched fatty acids uniquely synthesized by microbial organisms..

We will also characterize the particles mobilized from intertidal habitats using chemical and optical methods and compare them to the background sediment. The characterization will determine the presence and relative proportion of high nutrient and high contaminant particles mobilized at the study sites. The optical characterization will be performed using *in situ* instrumentation developed by the USGS capable of measuring absorption, attenuation and scattering of light in the ambient water matrix at a high temporal resolution over the short duration of episodic events. The characterization is performed through coupling high frequency *in situ* measurments of optical properties of water (particle and dissolved) and chemical analyses of discrete samples collected concurrently with the instrument readings. We will then correlate the optical properties to laboratory measurements of biogeochemical properties of the discrete samples to establish a high frequency timeseries of the mobilized particlulate and dissolved constituents. The combination of these methods will allow characterization of particles at temporal scale necessary to identify the source of high nutrient, high contaminant constituents in the water column.

We will also investigate the extent to which algal and microbial polymers affect the partitioning of Hg species to the sediments. We will conduct equilibrium dialysis experiments to o-explore the binding properties of the exopolymers with mercury and other metals. We will also conduct 203Hg partitioning experiments with suspended sediments eroded under varying climatic conditions in the presence and absence of dissolved organic material to quantify the properties of sediments and other environmental variables that control sorption of MeHg to sediment aggregates.

Finally, we will project the results of these field observations and experiments to the ecosystem scale by developing a regional model of exposure probability. Using the combined parameters of sediment type, bathymetry, wind speed and direction, fetch, light penetration, and intertidal exposure, we will develop a model that predicts the times and locations where significant contaminant exposure may occur. Further, we can estimate the current exposure levels based on ecosystem models (e.g. Sobczak et al.). The hydrodynamic model will provide an estimate of the intertidal habitats that contribute these types of particles and then determine a loading (mass and proportion to total particle load) of these particles to the system under different weather

conditions. Results of such a model will help CALFED managers predict the effects of future restorations, levee breaches, and other landscape alterations.

Table 2. Summary of study tasks and responsibilities, and timeline.

		Proportion of Work			Time line		
Task	Title	USC	USGS	OSU	Begin	End	Lead PI
1	Project Administration	*100%*			1	36	Torres
2A	Acquire, analyze low tide bed sediments in dry season and local suspended seds	64%	13%	23%	1	20	Torres and Goni
2B	Analyze extant wind, rain and SSC data	100%			1	20	Torres
2C	Partitioning and redox in surface sediments		70%	30%	1	20	Bergamachi and Fleck
3A	Evaluate rain effects on SSC, and particle composition	60%	**20%**	20%	4	**28**	Torres and Goni
3B	Optical properties of rain affected suspended sediments		70%	30%	4	28	Bergamachi and Fleck
3C	Partitioning and redox effect on metal cycling in rain affected suspended sediments		70%	30%	4	28	Bergamachi and Fleck...
3D	Current measurements	100%			4	28	Torres and Fleck
4A	Acquire, analyze suspended sediments in dry but windy season	60%	20%	20%		28	Torres and Goni
4B	Optical properties of sediments during wind events.		70%	30%	1	28	Bergamachi and Fleck
4C	Partitioning and redox effects of suspended sediments during wind events.		70%	30%	1	28	Bergamachi and Fleck
4D	Current measurements	100%			1	28	Torres and Fleck
5	Product dissemination	34%	33%	33%	12	36	Torres, Goni, Fleck, Bergamaschi
6	Model of the processes	10%	80%	10%	24	36	Fleck, Bergamaschi,

We propose to work closely with one another. The PIs listed above are the lead investigators overseeing each task to ensure completion and QA&QC.