Delta Elevation Data Efforts

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The Department of Water Resources and others are involved in several projects to greatly improve the quantity and quality of bathymetry and land elevation data in the Sacramento-San Joaquin Delta, Suisun Marsh, and Yolo Bypass. This briefly describes the data collection, storage, and processing efforts soon to be underway in calendar year 2005. For more information contact the principles for each project.

- **Bathymetry** by DWR Environmental Services and Central District. Depth measurements as small as 10 cm and as close to the shore as the boat operator dares, which means as little as 0.5 m away from the bank under ideal conditions. Will result in an x-y-z data point every 2-4 m, or 500K pts/km. If one assumes 2000 km of Delta waterways, that means a total of about 1 billion data points. Accuracy of the depth measurement is 1-3% of depth; converting to elevation relative to a datum will add tidal and benchmark datum errors. Note that for the tidal correction, we can make use of Eli's and/or NOAA's extensive knowledge of tidal propagation. Horizontal accuracy (Differential GPS) is sub-meter.

  Project is waiting on obtaining a vessel, but is expected to start in Calendar Year 2005. Places with few or no bathymetry data will be done first. Note: could also factor in importance of location to model sensitivity, e.g. small upstream creek with no data would not be surveyed but 3-Mile Slough. with some existing data would be.

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- **LiDAR** by DWR Bay-Delta Office and Flood Management. Expected 1 m spot spacing, 90% of points to have 0.5 ft or better vertical accuracy, 1 ft horizontal. Vegetation will be a problem if it is dense enough to prevent light penetration, and getting "true" ground elevations will require careful automated and manual processing of data. Two surveys are expected, one in the winter (January-February 2006) for less vegetation and the other in the summer (August 2005) for less flooded land (the laser to be used cannot penetrate water).

  Areas to be covered in the winter are the Delta proper; in the summer, the Suisun Marsh and Yolo Bypass. Other areas may be added according to particular user needs but they would probably have to be funded and contracted separately. Total area of the above three areas is about 4.5 Gm^2 and the same number of final data points. Because of overlapping measurements and multiple reflections the raw measurements are about 8-10 times that number.

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  For both of the above projects it would be ideal to measure the bathymetry only at high tide, and the LiDAR at low tide, to try to get overlapping areas for adjustment. But such tidal timing is not practical. Thus some other means must be devised, perhaps spot ground measurements.

- **Existing GIS Bathymetric data**. The USGS put together a 10 m Digital Elevation Model using multiple existing data sources, and also has about 1 TB of orthoquads (photo) coverage in TIFF files. These should be used also in any "global" Bay-Delta elevation project.

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- **Archival Storage**. The BDAT data storage system (http://baydelta.ca.gov/) can store the Tier 1 data points (see below), TIFF files, and utilities to process the data. This would provide a convenient access point for any interested party while not restricting the collectors of the data or utility developers to a single database. BDAT uses advanced Informix spatial and timeseries software and ESRI GIS products for an industrial-strength storage/retrieval site. Replication allows for heavy users to maintain a local copy guaranteed to be identical to the original.

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- **GIS Visualization and Analysis Tools**. Tom and staff (Diana) will be available under a DWR contract to develop and provide processing and visualization tools using ESRI ArcView 9 software. Tom provided an overview of his previous work using LiDAR, and his work so far on the CSDP replacement based on ArcView 9.

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Conceptual Levels of Elevation Data

It may be helpful to consider the following conceptual levels of elevation data when planning for storage, processing, and use of the raw data.

Tier 0 is the raw, unprocessed data coming directly from the measurement devices. Few if any users would be interested in this but I mention it as the lowest possible level of data.

Tier 1 would be the first level of data users would be interested in. It would be processed from Tier 0 data to x-y-z-other format (where "other" could be time of collection, estimates of surface type, etc), and probably still have some noise, errors and duplicate (overlapping) data within each data collection. The LiDAR data would be processed to remove vegetation and buildings but leave berms and levees. Of interest to users for specialized needs that Tier 2 data wouldn't serve.

Tier 2 would be a DEM or equivalent generated from Tier 1 data. Noise, errors, and overlapping data are removed, and the DEM would use multiple data sources, e.g. recent and past bathymetry collection + LiDAR to come up with a single DEM. The DEM would be very fine, perhaps 1 m, which is probably too detailed for most modeling purposes but serves as a basis for Tier 3.

Tier 3 is Tier 2 processed for specific models or other uses. It would typically be on a coarser grid, possible a variable density if the model can use it. In an ideal world with vast computational power, Tier 3 data sets wouldn't be needed, but in the real world they are needed to accommodate practical model limitations.

For example, the Cross Section Development Program (CSDP) used by DSM2 reads Tier 1 data and the user draws Tier 3 cross sections for use in DSM2. Because we skip the Tier 2 process, the user is manually judging errors, noise, and multiple data sets to arrive at DSM2 cross sections. If a Tier 2 existed, data cleanup would have happened there, and probably automatic cross sections could be generated for DSM2.