

Repeat mapping surveys capture changes in seafloor morphology after a well-documented sediment gravity flow event in Monterey Canyon

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Summary

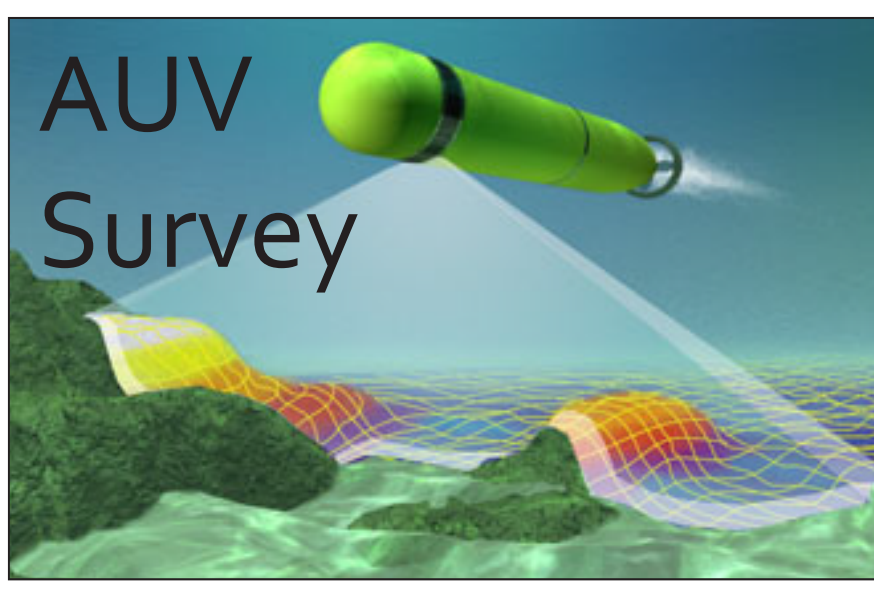
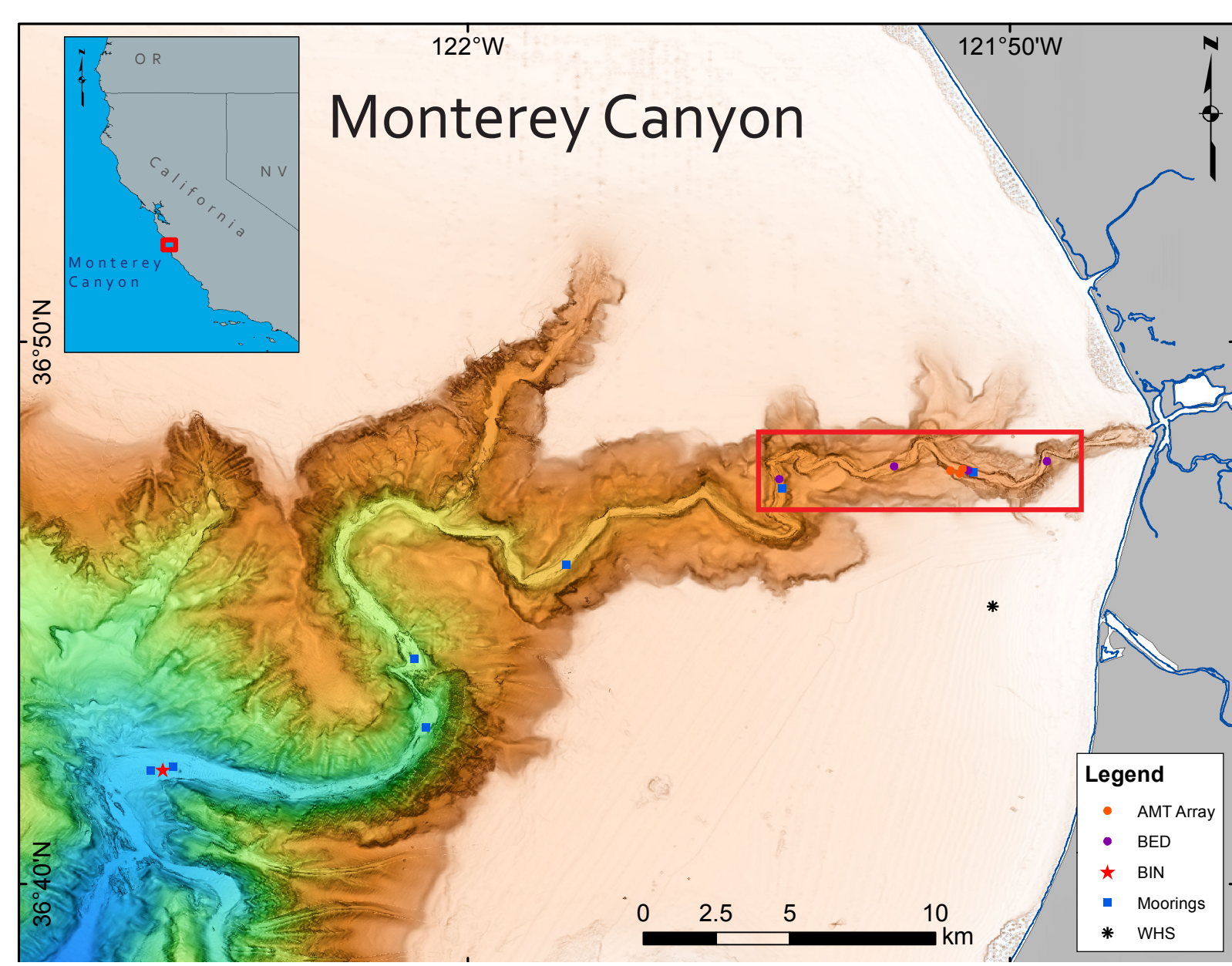
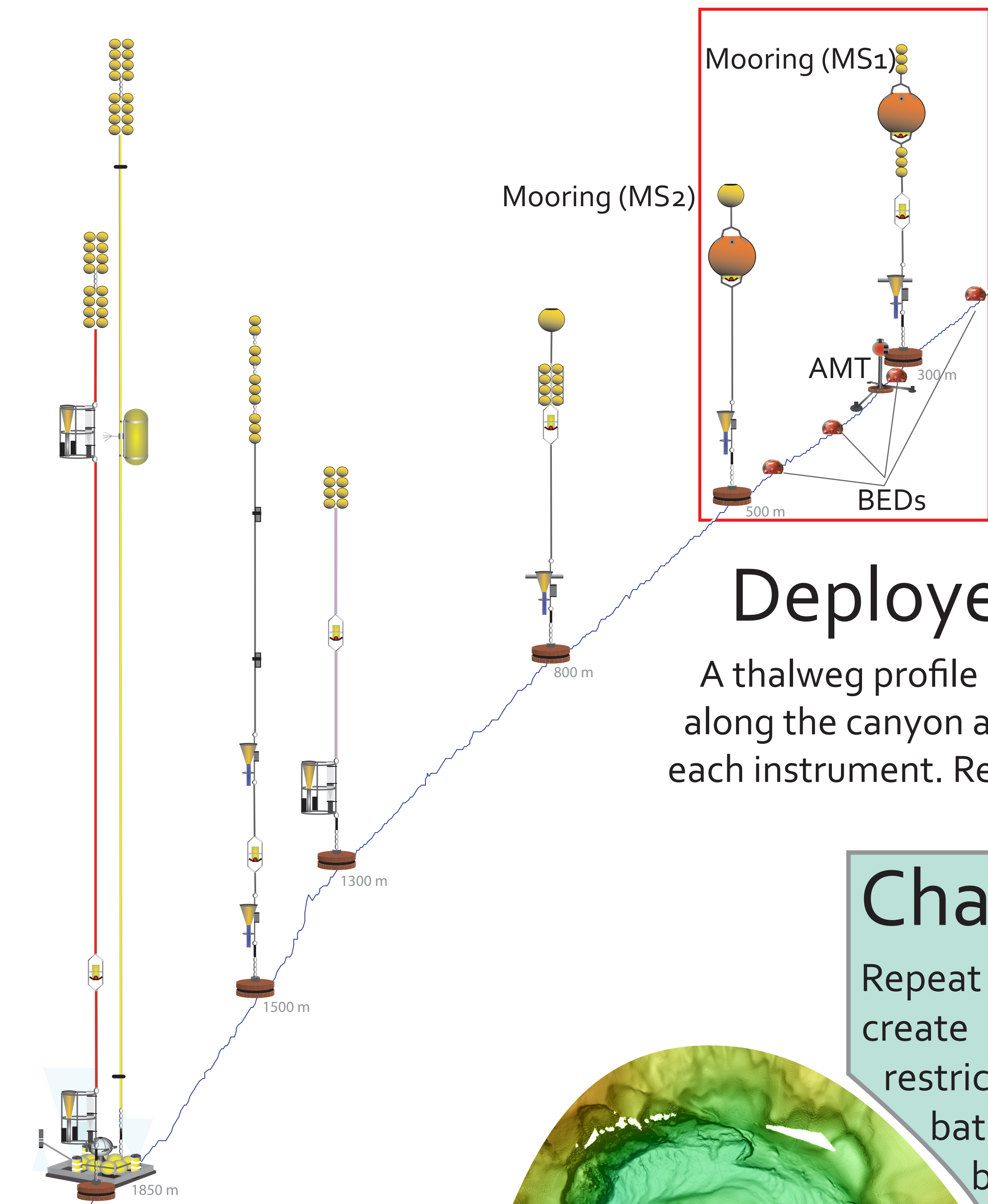
An array of instruments deployed on the seafloor of Monterey Canyon, offshore California, captured a massive sediment transport event as it passed through the canyon system on January 15, 2016. Here we show the change in seafloor morphology in response to this event of known magnitude and duration.

Coordinated Canyon Experiment (CCE)

Monitoring the passage of sediment gravity flows as they move through the axis of a submarine canyon, and documenting the deposits are the goals of an on-going multi-institution effort called the Coordinated Canyon Experiment (CCE).

January 15th Sediment Transport Event

A major sediment transport event was documented by an array of instruments deployed throughout this survey area. The average velocity of this event, as calculated by the travel time between two moorings (MS1 and MS2), was 5.6m/s. Additionally, several instruments were moved or damaged. The shallowest mooring (MS1) was swept 7.1 km down canyon before breaking loose and floating to the surface. A heavy frame anchored with a 450 kg railroad wheel, originally deployed as part of a creep sensing array (AMT), moved 4.5 km down canyon. Four benthic event detectors (BEDs), electronic smart boulders developed at MBARI to record pressure and motion, moved during this event too. Three BEDs dropped their weights and floated to the surface, a fourth traveled more than 800 m down canyon.



AUV Mapping Surveys

Repeated bathymetric surveys of the upper Monterey Canyon have been conducted using MBARI's Mapping AUVs (Autonomous Underwater Vehicle). The Dorado-class, 0.53 m diameter torpedo-shaped AUVs collected 400 kHz multibeam bathymetry, 110-kHz chirp sidescan, and 1-6-kHz chirp subbottom from a 50 m altitude with 130 m survey line spacing, yielding 1 m lateral resolution bathymetry and sidescan coverage of the canyon walls and axis. The realtime navigation derives from an inertial navigation system (INS) aided by velocity-over-bottom observations from a 300-kHz Doppler Velocity Log (DVL), and drifts no more than about 20 m during a 85 km, 17 hour AUV mission. The navigation within each survey is adjusted so that features observed in crossing and overlapping swathes match, yielding navigation models that are self-consistent to a 1 m precision. Repeat surveys, following the same tracklines, are then co-registered by matching features on the canyon walls that are both distinct and unlikely to have changed between surveys. Differencing the co-registered bathymetry grids yields the seafloor changes that have occurred between surveys. These changes are observed with a 1 m lateral resolution and a 0.2 m vertical precision.

Deployed Instruments

A thalweg profile shows sketches of the instruments deployed along the canyon axis as part of the CCE. Map shows location of each instrument. Red boxes show area of focus in this poster.

Change in Morphology

Repeat mapping surveys conducted November 4, 2015 & January 28, 2016 were used to create a difference map showing the change in seafloor bathymetry. These changes, restricted to a band in the canyon floor, are characterized by -3 m to +3 m change in bathymetry and are attributed to the January 15th event. While crescent shaped bedforms were seen on the canyon floor before and after this event, the kilometer-scale displacements of large instruments (> 500 kg) suggests that the changes in the seafloor are not simply due to short distance migrations of these crescent shaped bedforms along the seafloor.

