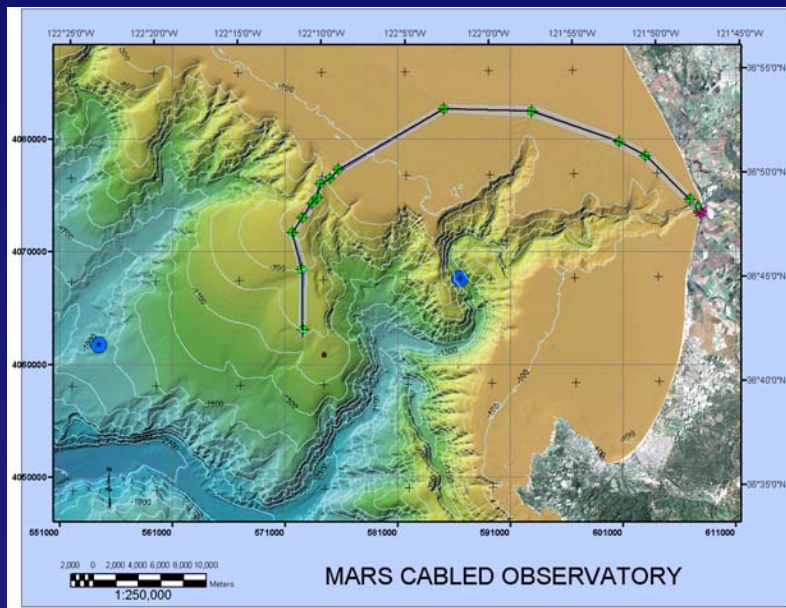


Introduction to the Monterey Accelerated Research System (MARS)

<http://www.mbari.org/mars/>



- Fiber-optic cable to provide power and communications to a deep-sea observatory on Smooth Ridge
- Funded by the National Science Foundation
- Anticipated 25-year lifetime to observatory
- Purpose is to further ocean research requiring long-term records from deep sea and to enhance public education and understanding of ocean issues.

Challenges of Ocean Observing

- No electricity grid
- Solar panels don't work subsea
- Difficult and sometimes impossible to swap batteries when they die
- No telephone grid
- Wireless doesn't work subsea
- For many scientific problems, need the data in real time for it to be very useful

POWER

COMMUNICATIONS

Cable System for Interactive Seafloor Observatory

\$40M
Canadian
\$120M US

Explorer
Plate

Port
Alberni

Seattle

Project NEPTUNE

Pacific
Plate

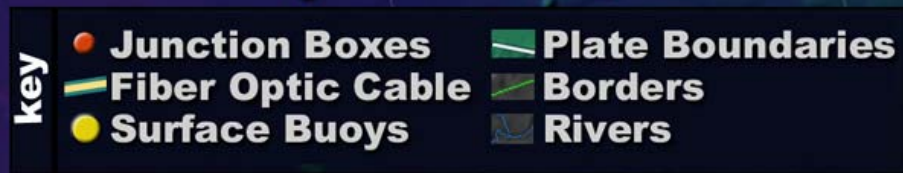
Juan de
Fuca Plate

Nedonna
Beach

North
American
Plate

Axial

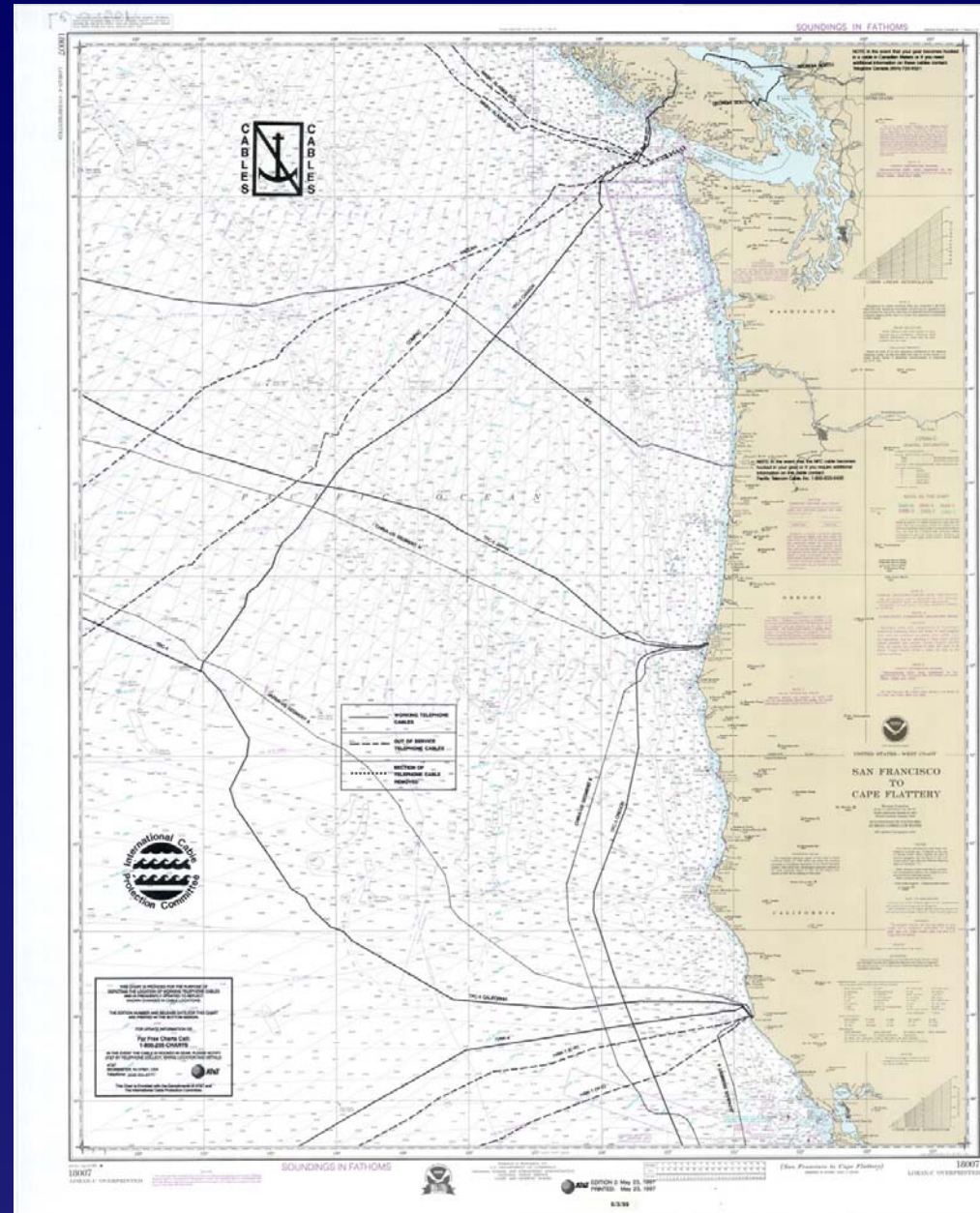
Gorda
Plate



Plan has been endorsed by 5 separate scientific reviews in past 6 years!

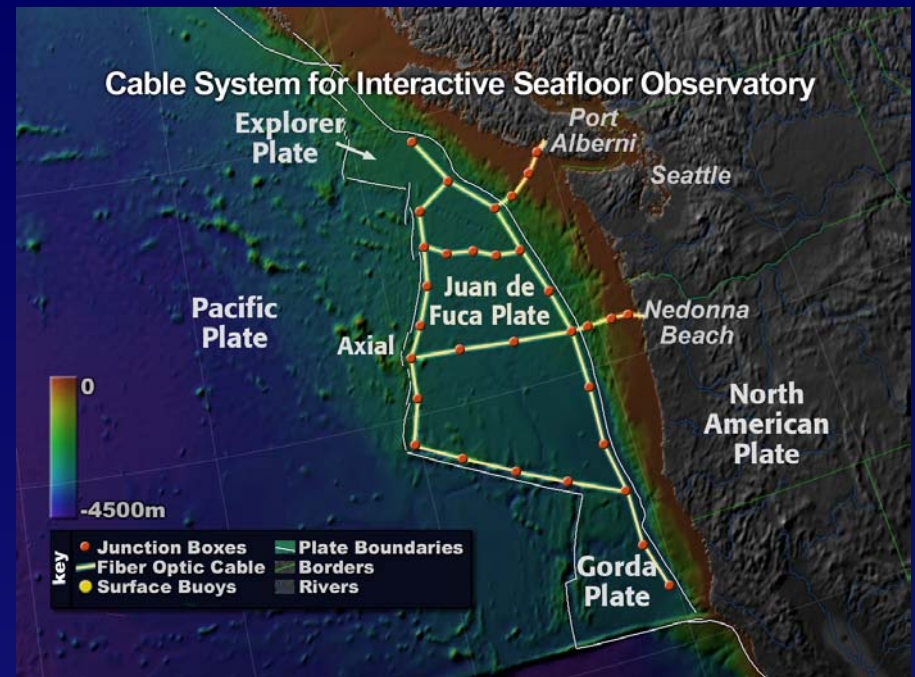
Cables are Common

- > 300,000 km of subsea cable installed by 1997, probably nearly double that today
- Communication capacity of 10-100 Gbs (1000 times what is available from satellites!)
- Delivering the communications and power to undersea scientific nodes is novel



Need for a Test Bed

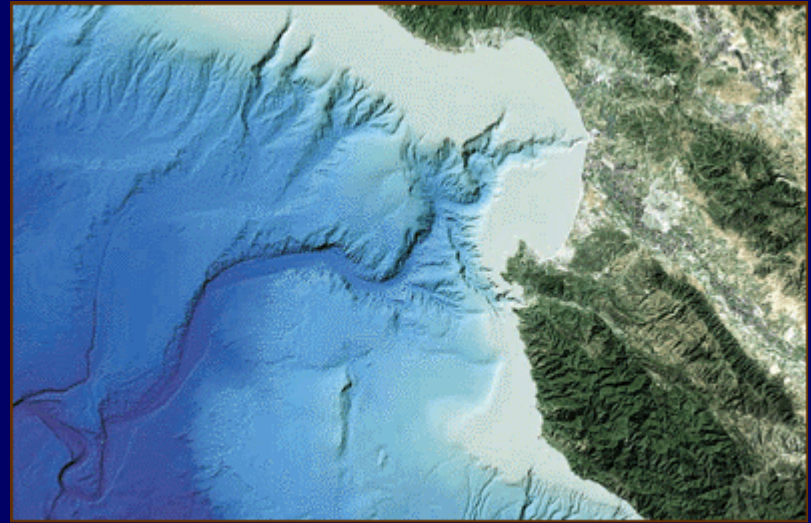
(before spending nearly \$200M on something that has never been done before!)



- Need a proving ground for new instrumentation.
- Provide learning experience for researchers.
- Scope out operations, management, and maintenance costs.
- Test aspects of observatory technology.
- Experiment with effective methods of bringing deep sea science to the public.

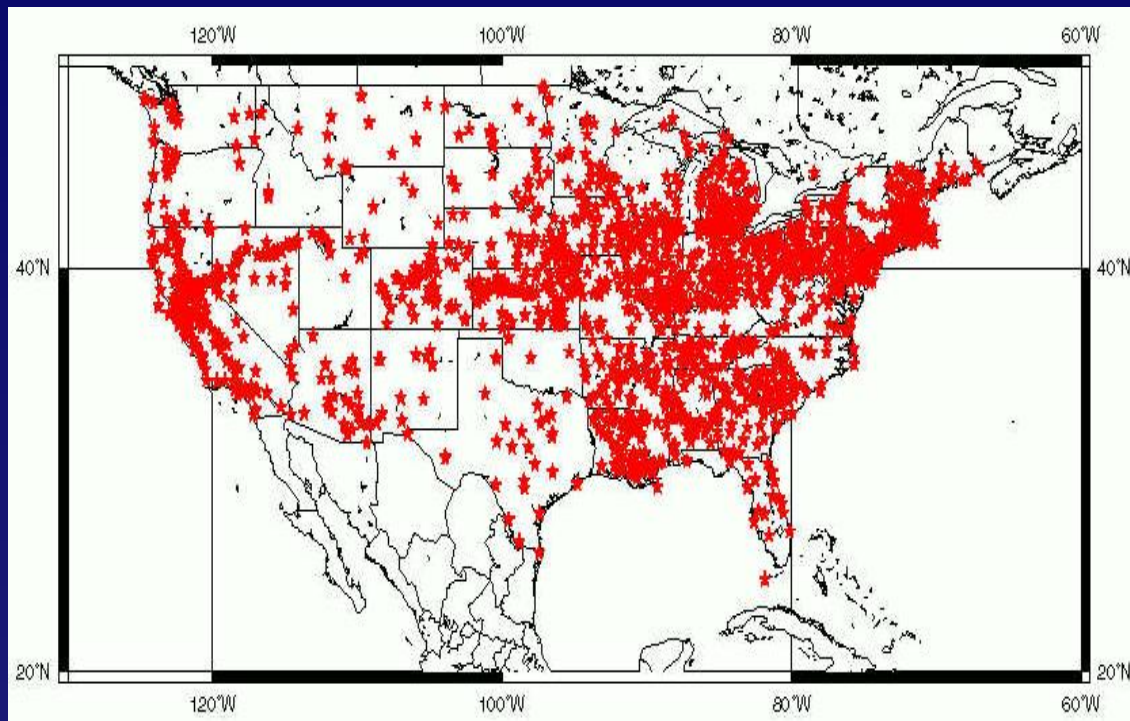
Why Monterey?

- No other warm water US site offers faster access to deep water
- Year-around weather window for operations
- Only region accessible daily by scientific ROVs
- Ocean-aware audience for outreach
- MBARI's reputation for technological innovation



- Strong signals of great scientific interest:
 - * climate change
 - * food transport to deep sea
 - * sound in the sea
 - * earthquakes & landslides

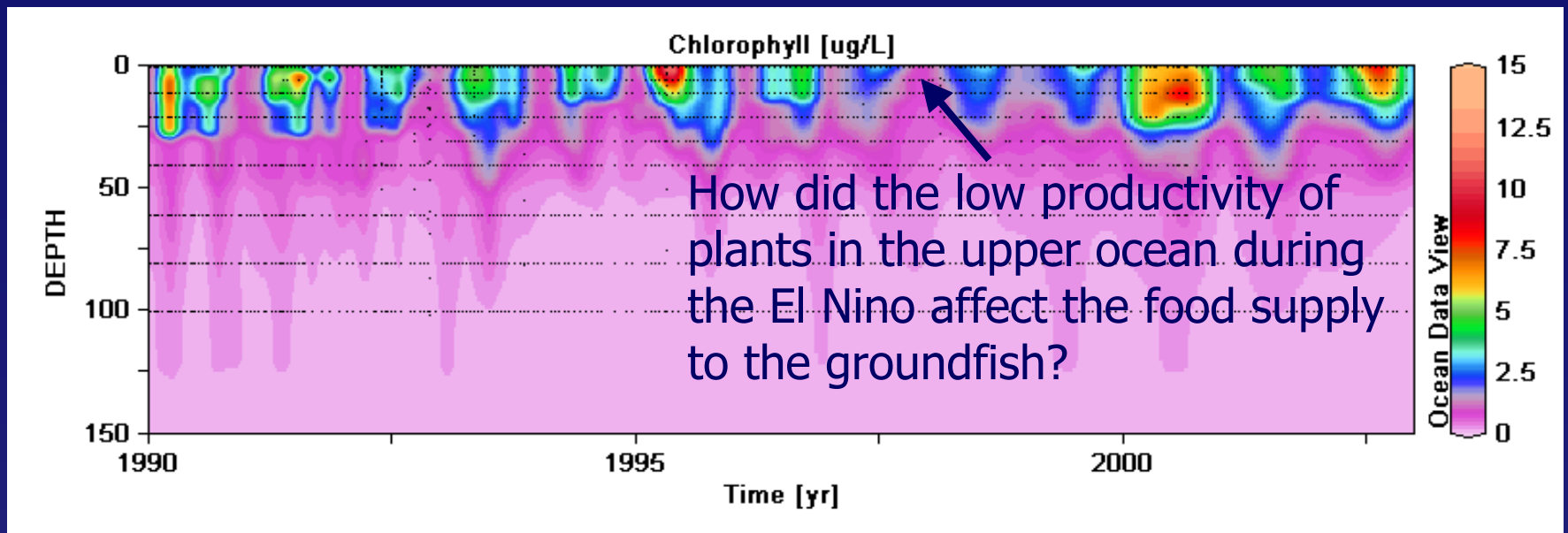
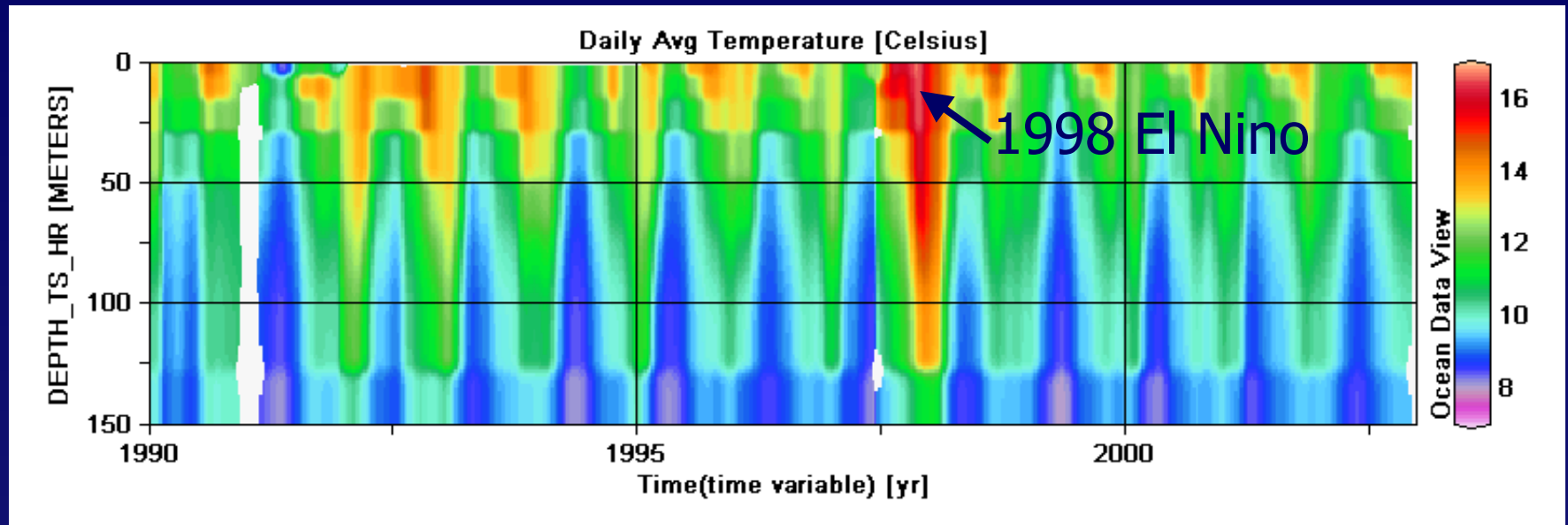
Distribution of Atmospheric Weather Stations



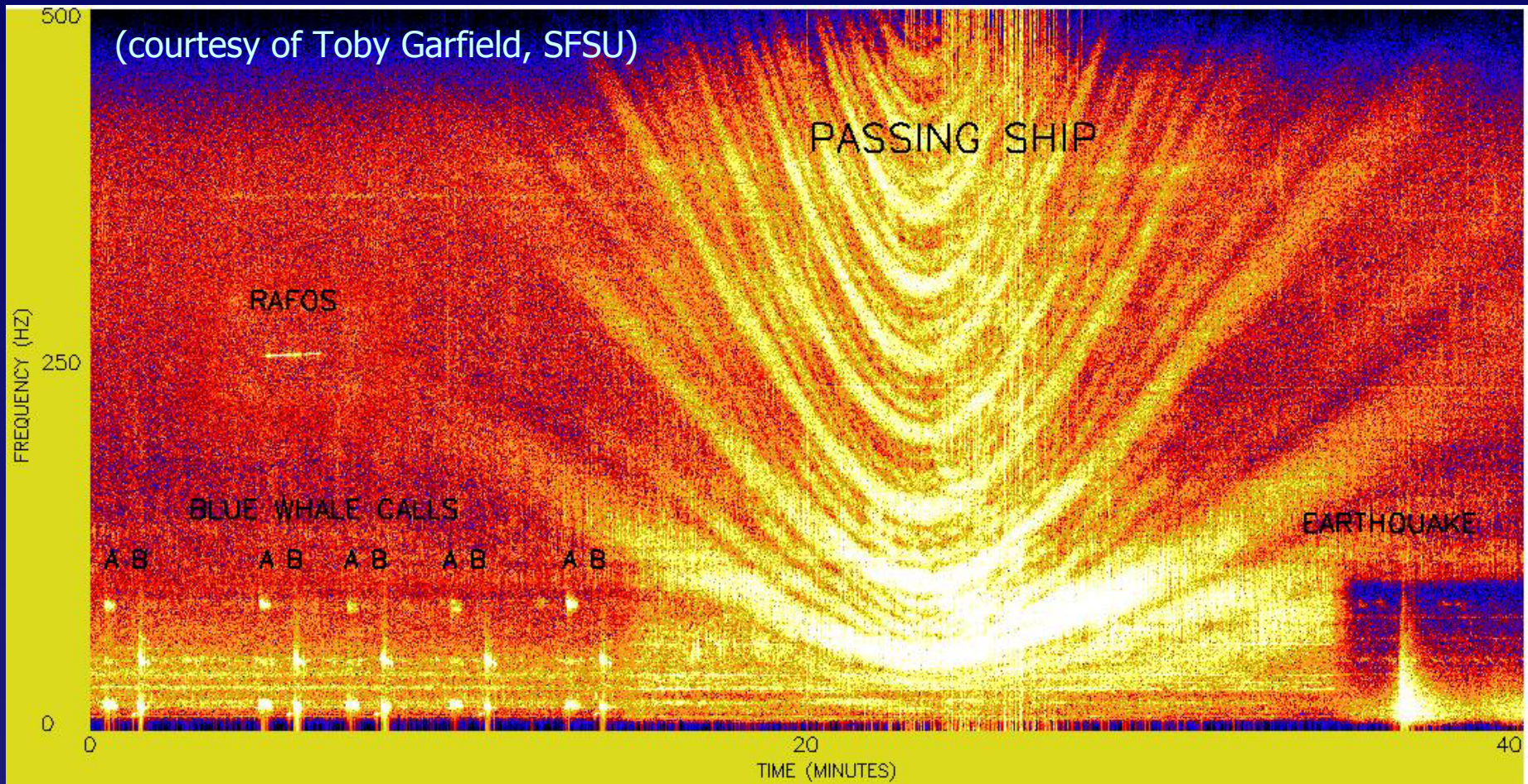
We know a lot about climate change on land thanks to a dense network of continuously operating weather stations. By comparison, we know little about climate change in the ocean and nothing about climate change in the deep sea.

Stations operating for more than 100 years!

MBARI time series for ocean weather and climate. MARS will extend these observations deeper into the ocean!



Monterey Bay is home to many marine mammals! Passive listening receivers on MARS will provide real-time, publicly available (via internet) data on marine mammal vocalizations and the various other sources of sound in the sea.



Example of a sound record from a hydrophone on an early generation cabled observatory originally installed by military for classified use.

Education and Outreach

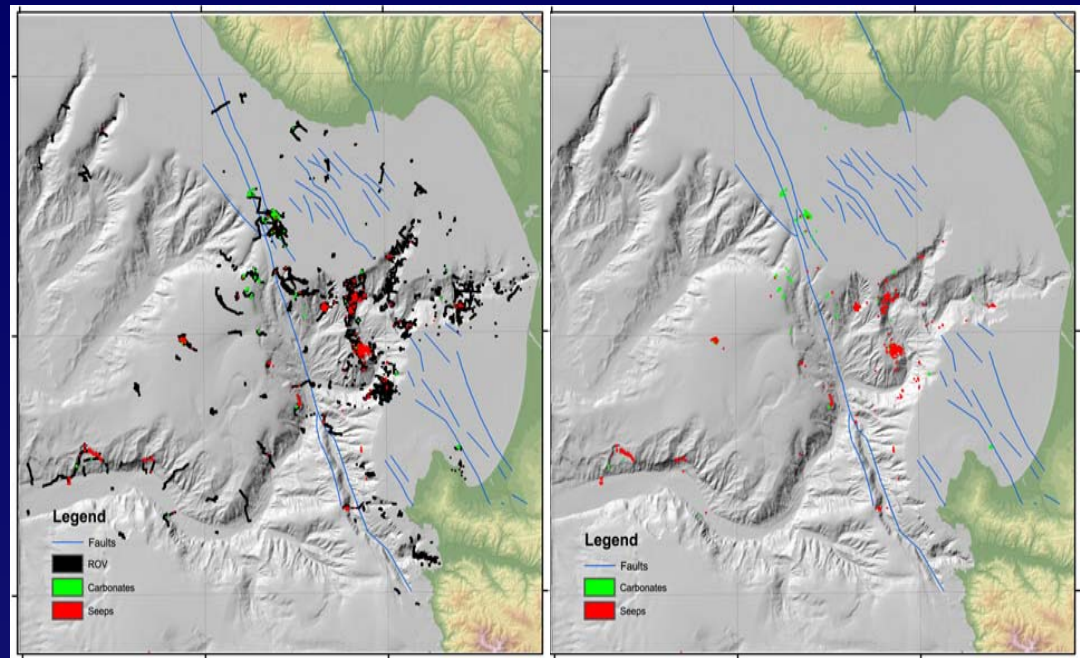


Teachers at EARTH workshop experiment with using real-time data for instruction.

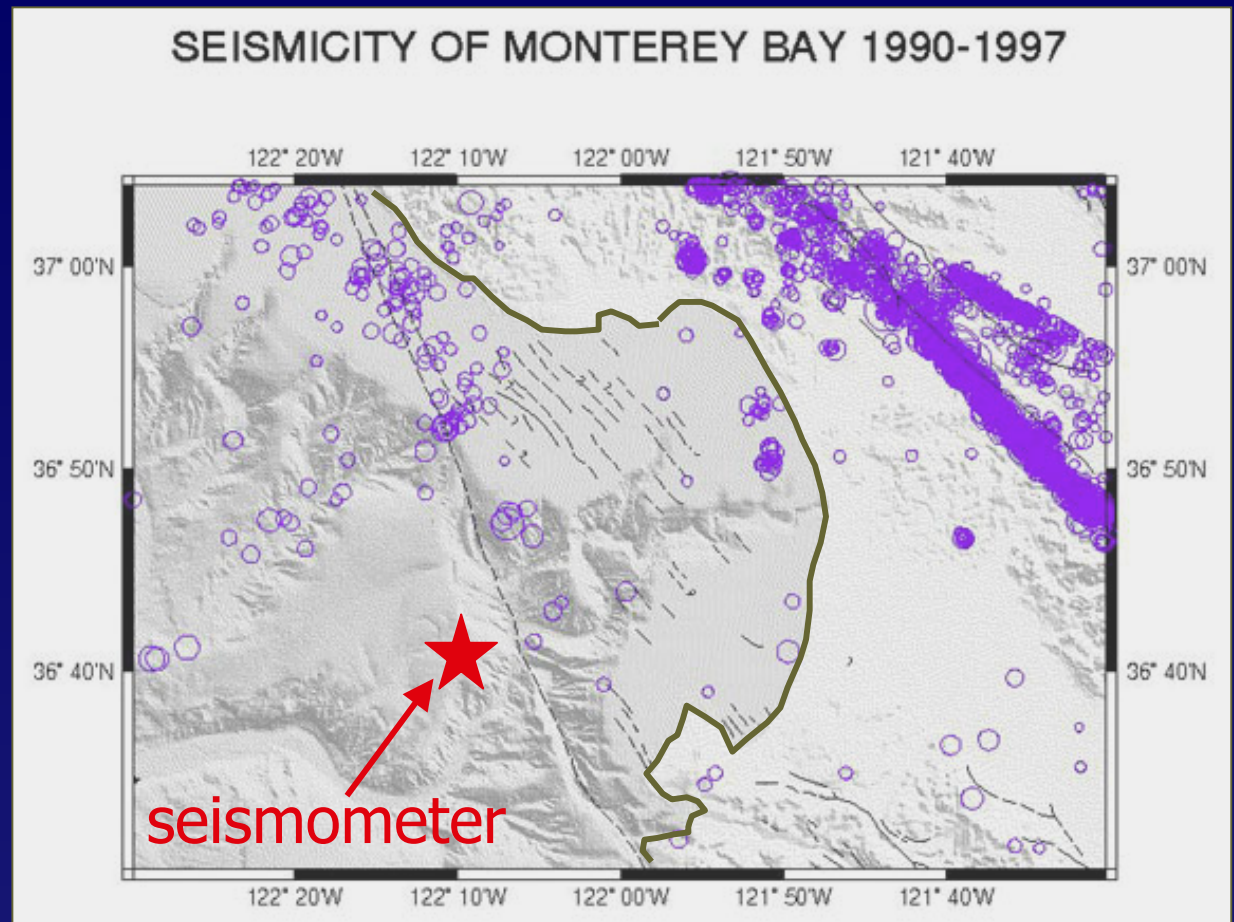
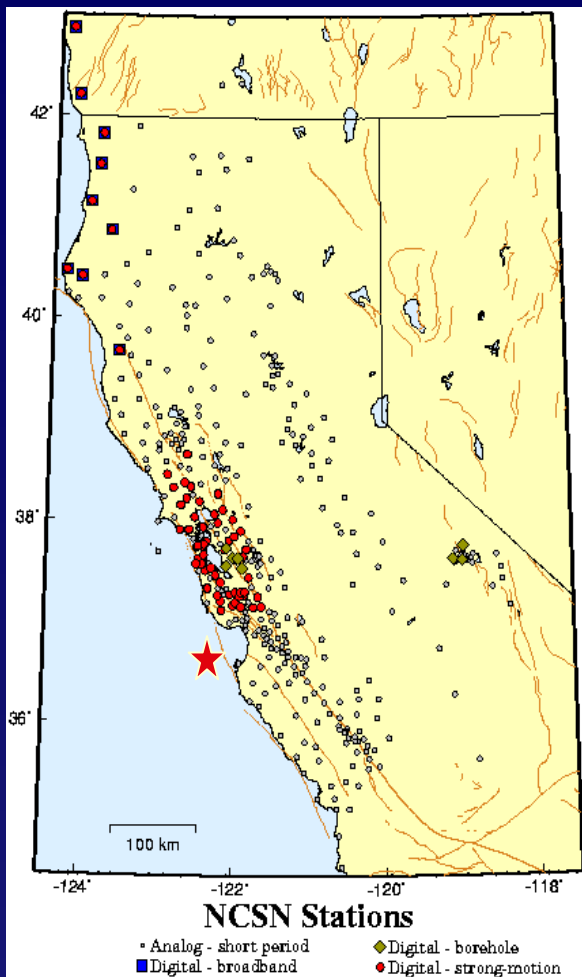
- *Education and Research: Testing Hypotheses* (EARTH) provides teachers with means for integrating real-time data with existing educational standards and tested curriculum in an interactive and engaging way.
- Project will use near-real-time data from the MARS ocean observatory to design and test outreach with the Internet as an interface to scientists, teachers, students, and the public.
- Project is in collaboration with the Monterey Bay Aquarium.

Why Smooth Ridge?

- Neck of Smooth Ridge provides only viable route to deep water
- Allows seismometer to be connected from far side of San Gregorio to seismic network

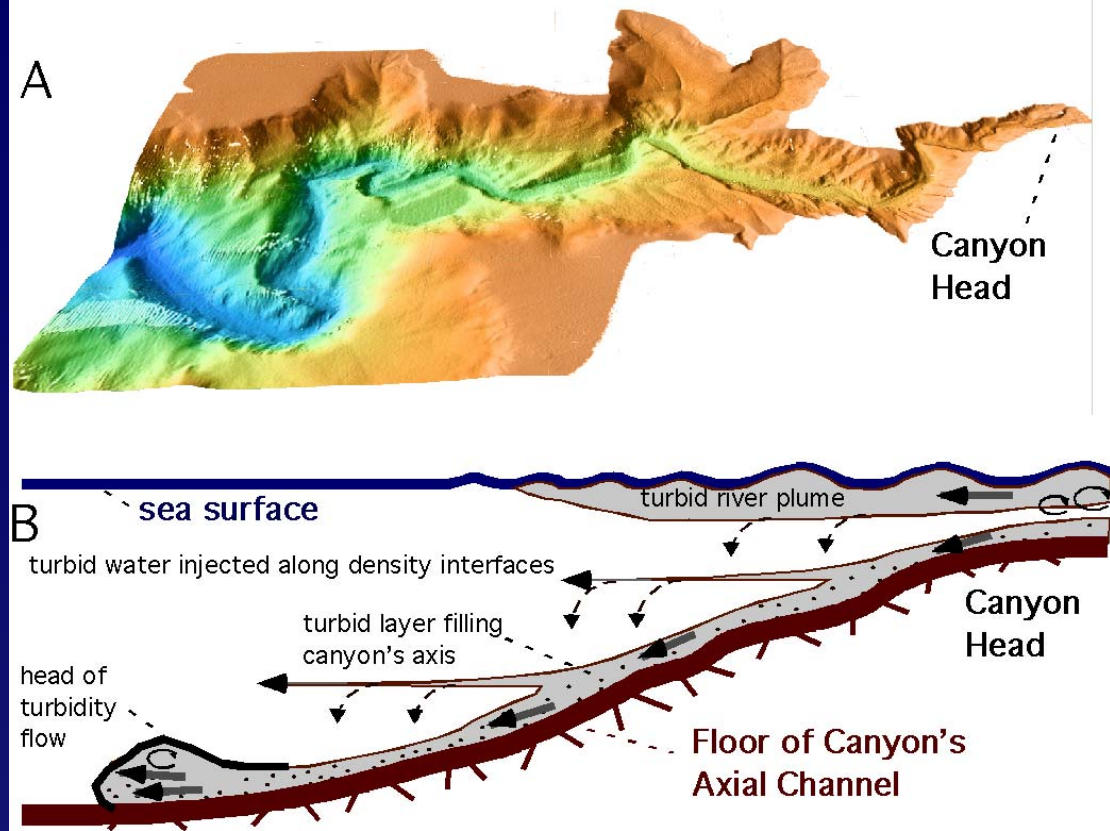


- Easy access for extension cables to instrument
 - * seep sites supporting unusual chemosynthetic biological communities
 - * the dynamically active Monterey Canyon
 - * potential IODP boreholes

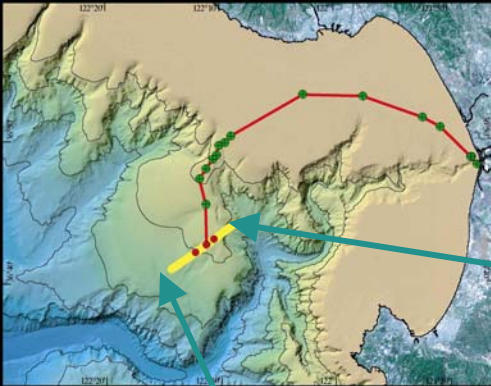


MARS will allow us to connect a deep-sea seismometer to the Northern California Seismic Network, improving our ability to forecast seismic hazards in the Monterey Bay area.

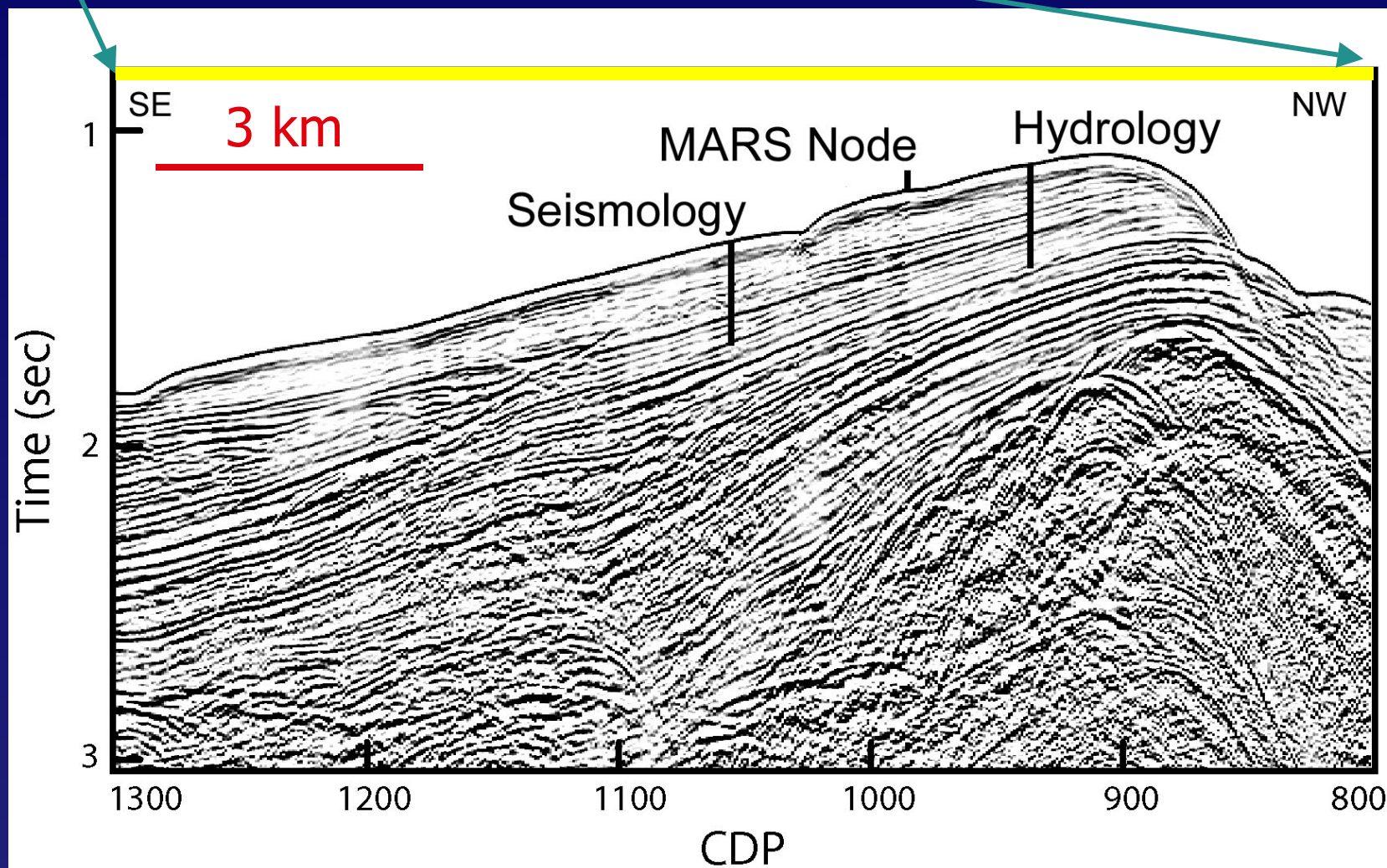
Giant landslides (some associated with large waves) can occur in Monterey Canyon. MARS will allow us to understand the frequency of such events, the risk they pose, and the effect they have on deep sea communities.

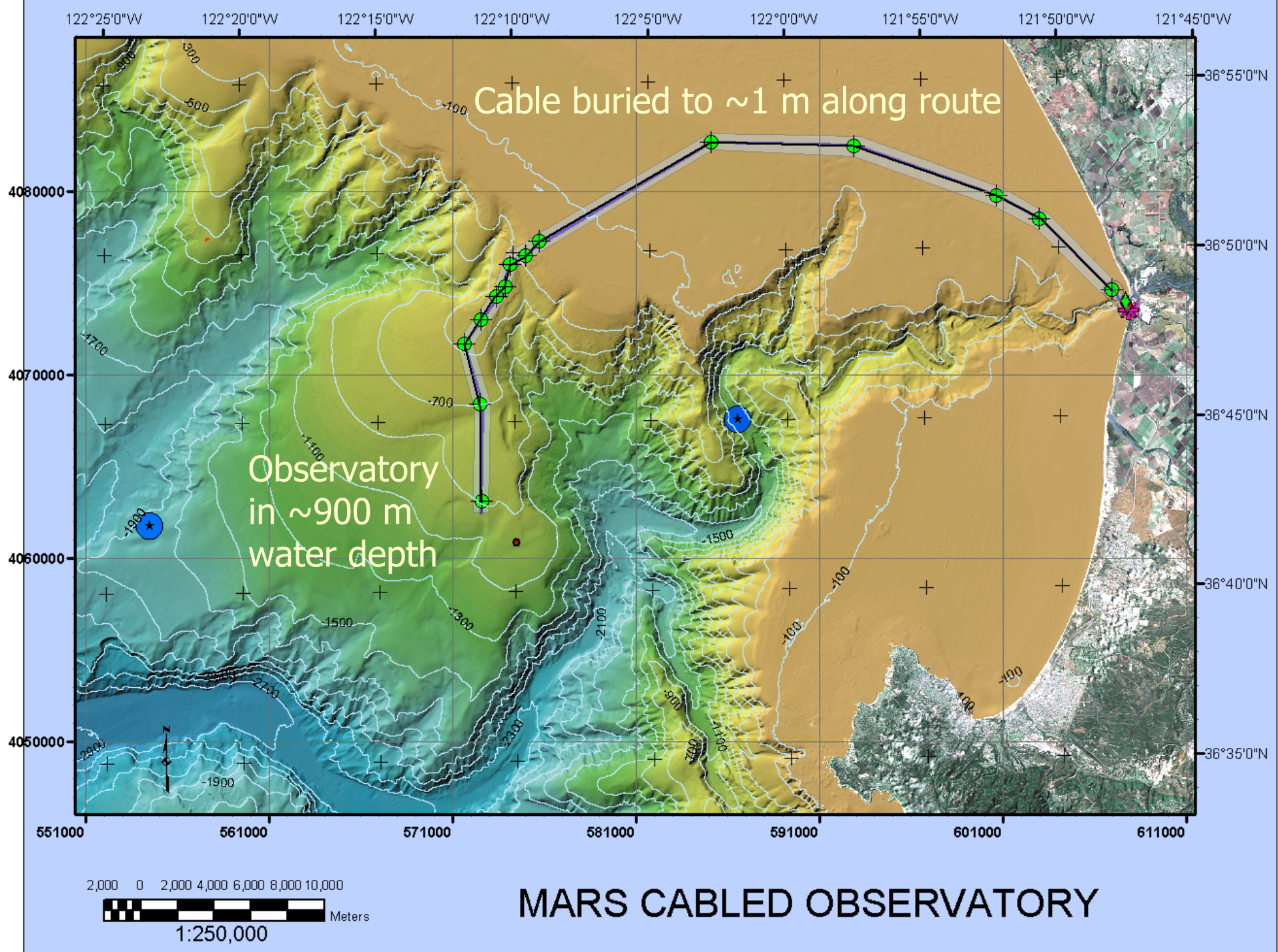


Landslide moved 1000-kg instrument node 100's of meters down canyon.



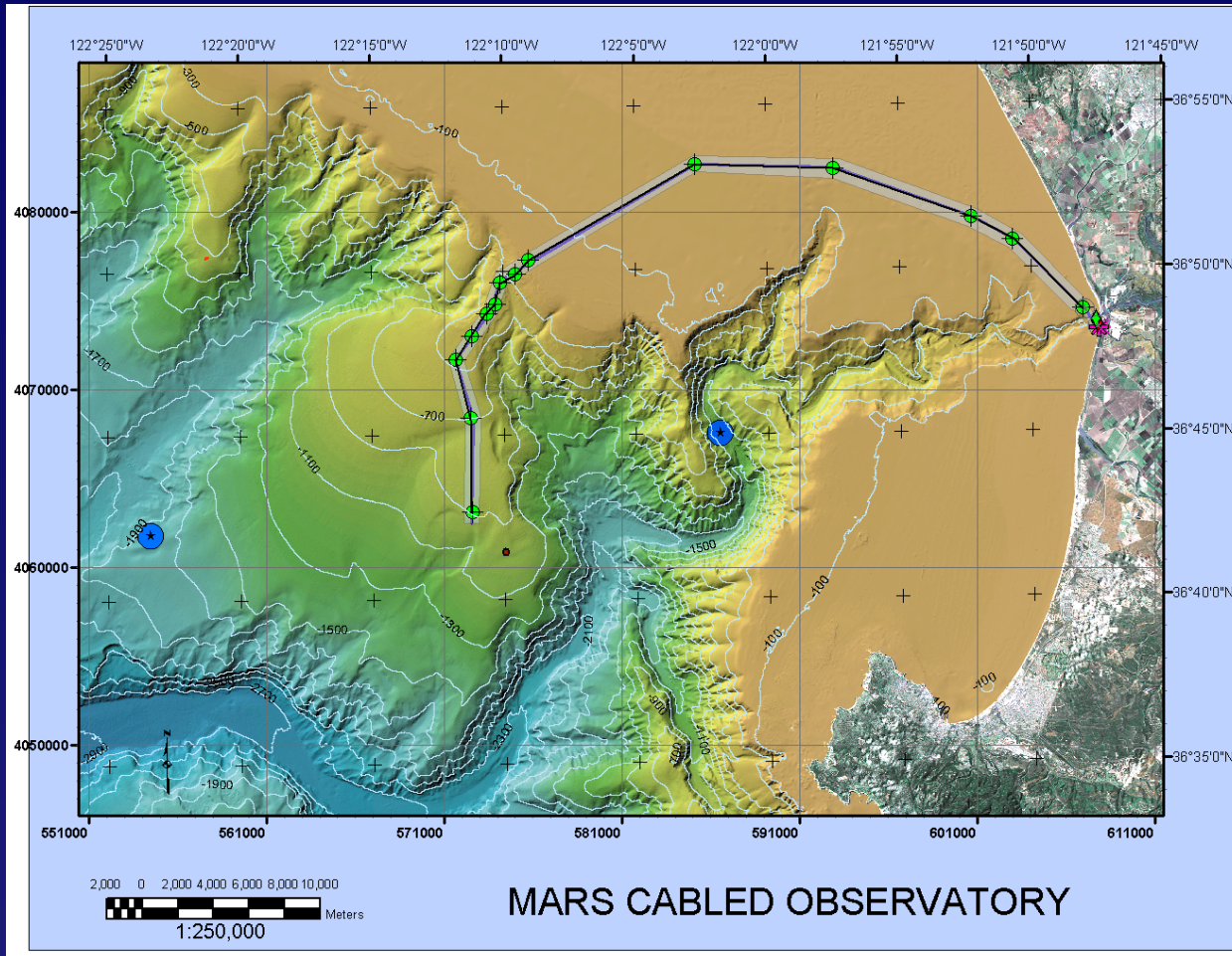
Monterey Bay is part of the great Salinas aquifer, but little is known about the quantity and history of fresh water seeps into the ocean. MARS will allow us to better understand the hydrological connection between land and sea by instrumenting core holes.





- **Offshore cable route**
- **Proposed landing location**
- **Shore facility**
- **Installation plans**
- **Alternate routes**

Offshore cable route



Proposed Landing Location



Preferred landing:

- North of canyon through existing Duke Energy pipeline

Alternate landing:

- South of canyon at MLML's new pier



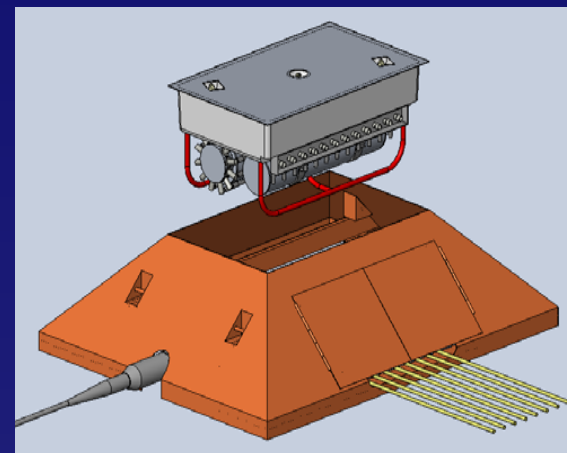
Shore Facility



- MARS cable will run along or through the Duke Energy pipeline to a location where we will install a modular building on an existing concrete pad
- Connect to shore power and terrestrial fiber at this modular building

Summary of Installation Plan

- **Pre-Lay Grapnel Run**
 - * Grapnel will be pulled from shore, along the route to the node to clear debris along the cable route
- **Main Lay Operations**
 - * Alcatel cable laying vessel, *Ile De Re*, will install the cable and the trawl resistant frame (approx 6 days)
 - * Cable will be plough buried to 0.8m-1.0m depth
 - * Node will be installed into the trawl resistant frame using the ROV *Ventana*



Summary of Installation Plans, cont'd

- **Post-Lay Inspection & Burial (PLIB)**

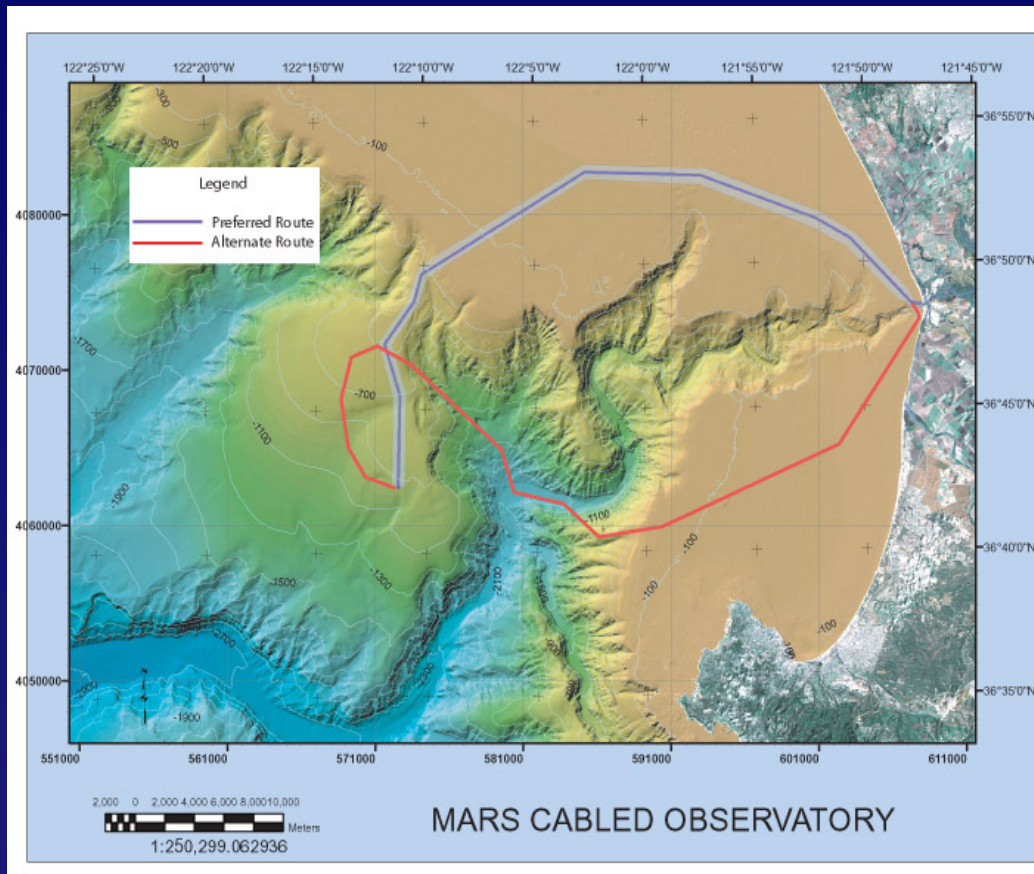
- * Following the cable lay, an ROV will inspect the cable installation and post lay bury the cable near the node

- **Shore End Operations and Services**

- * Cable will be pulled ashore near the location where the pipeline exists the harbor near Highway 1



Alternate Route



Alternate cable route to the south of the Canyon:

- Burial on shelf similar to preferred route
- Crosses canyon
 - Survivability an issue
- Difficult to bury on Smooth Ridge due to the relatively sharp turn radius during ploughing

