AN OVERVIEW OF RECENT PROJECTS RELATED TO SAND BUDGETS, SAND SUPPLY, COASTAL ARMORING, MANAGEMENT, AND VALUING SOUTHERN CALIFORNIA BEACHES

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California’s Beaches:
A natural resource that is in need of our research and protection

- Beaches have intrinsic value
- Cultural
- Recreational
- Ecological
- Geomorphic
  - natural buffer zone
  - flood and storm surge protection
- Economic
Keep SAND on our BEACHES

Key Questions:

- How does sand move on the beach?
- Where does the sand come from?
- Are we reducing or increasing the amount of sand on beaches?
- What can we do to reduce the long-term erosion of beaches in light of climate change and the associated sea level rise?

- Are we putting our dollars to good use?
- What are our priorities and values as a society?
Sandsheds

Beach Compartments

Littoral cells

Form the framework for our understanding of the
- Sources
- Sinks
- Transport
- Storage of sand in the nearshore zone
Sediment Budgets aka Sediment Accounting

In an ideal situation, each cell exists as a distinct entity with little to no transport of sand between cells.

Sources:
- River Transport (70-90% in CA)
- Seacliff Erosion
- Onshore transport
- Beach nourishment
- Wind transport onto the beach
- Longshore transport into the area

Sinks:
- Loss to submarine canyons
- Loss to dune fields
- Offshore movement
- Sand mining
- Longshore transport out of the area
Balancing the Budget

- **Sources = Sinks**
  - Equilibrium

- **Sources > Sinks**
  - Accretion

- **Sources < Sinks**
  - Long-term Erosion
Eroding bluffs in Santa Barbara

Santa Clara River Mouth, south of Ventura Harbor
3D Coastal Mapping with Drones

- Increased precision and accuracy with UAVs and photogrammetry software
  - Ventura Beach, Shoreline Cliffs Park,
- Monitoring select beaches in Ventura, Santa Barbara, and Los Angeles counties with our drones for 3 years
Drone Monitoring of Coastal Zone
Barrier Beach Breaching

Documenting breaching patterns of the Ventura River barrier beach
Drone Monitoring of Coastal Zone
Sea Cliff Erosion

Drone speed & flexibility = quickly access bluff loss

North Del Mar Bluff
Cerezo Bluffs Block Failure
South Ponto State Beach
Updating Sediment Budgets
Zuma & Santa Monica Littoral Cells

Leaky Cells?
Hueneme and Mugu submarine canyons capture over a million cubic yards of beach sand each year and transport it offshore.
REDUCTIONS TO SAND SUPPLY
Update the Coastal Armoring Inventory

<table>
<thead>
<tr>
<th>Structure Type</th>
<th>2003 (Length mi.)</th>
<th>2015 (Length mi.)</th>
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</thead>
<tbody>
<tr>
<td>Rock Revetment</td>
<td>69</td>
<td>65</td>
</tr>
<tr>
<td>Seawall or Retaining Wall</td>
<td>69</td>
<td>63</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL:</strong></td>
<td><strong>155</strong></td>
<td><strong>141</strong></td>
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</tbody>
</table>

% of 1100 miles of coastline:

- Rock Revetment: 14%
- Seawall or Retaining Wall: 13%

<table>
<thead>
<tr>
<th>County</th>
<th>% Armored</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Luis Obispo</td>
<td>52%</td>
</tr>
<tr>
<td>Santa Barbara</td>
<td>11%</td>
</tr>
<tr>
<td>Ventura</td>
<td>56%</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>28%</td>
</tr>
<tr>
<td>Orange</td>
<td>40%</td>
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<tr>
<td>San Diego (excluding bay)</td>
<td>39%</td>
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</table>
ADDITIONS TO THE SAND SUPPLY
480 major dams have been built in California’s coastal watersheds, primarily for water supply, irrigation, and flood control.

38% of coastal watershed area impounded by dams (area equal to Massachusetts and New Hampshire combined)

Average annual sand supply has been reduced by 26% (or 3.7 million yd³/yr)
Beach Nourishment
Hueneme Beach and the dredging of Channel Islands Harbor (2014)
Monitoring Beach Volume Change from 2015-2016
Across Southern California

Change in Volume '15-'16
- Heavily Eroded
- Eroded
- Stable
- Accreted
- Heavily Accreted

Littoral Cells
Sediment volume change measured in cubic meters.
Stop Mining Sand from the Beaches and Rivers
Drone Monitoring of the Coastal Zone

Post Thomas Fire
Additional sediment sources?
BALANCING THE SAND BUDGET
Update
Dredging Histories of Harbors to look at trends (proxy for littoral drift)
rapidly assess the condition and value of our sandy beach ecosystem
Beach Sustainability Assessment

Rapidly assess the condition of sandy beach ecosystems using standardized metrics.

We must address the issues facing our coastline with interdisciplinary science with scientists and city managers/planners at the table.
Conclusion: Our Beaches are Threatened

- Sand supply is reduced.
  - Armoring of seacliffs, damming rivers
  - Channelizing streams
  - Drought

- USGS study predicts that 67% of southern California beaches will disappear by 2100

- Loss of tourism economy

- Loss of storm buffer protecting critical development

- Loss of an important habitat

- Human management efforts must increase in order to preserve the beaches

(Credit: Daniel Hoover, U.S. Geological Survey. Public domain.)
Beaches on the Edge

Understanding the importance of California's beaches from a variety of perspectives.
Recap/ Where am I going from here? Sand Accounting

- Updating sediment budgets with new stream flows, armoring, harbor dredging database
- Reassessing littoral cell boundaries
  - Leaky cells
    - Transport around headlands
- Beach Sustainability Assessment: Rapidly assessing the condition and value of the beach
- Monitoring the shoreline in preparation for the removal of the Matilija Dam on the Ventura River and Rindge Dam on Malibu Creek (Drones)
- Assessing Coastal Change (Drones)
- Opportunistic beach nourishment
  - Thomas Fire (281,893 acres burned)
  - Montecito Mudslides Debris
- International perspective on sand mining
  - SAND WARS!
- Barrier beach breaching mechanics
- Seacliff erosion
- Legacy sediment