

Erosion at Del Mar Beach, CA An Application of the Bruun Rule?



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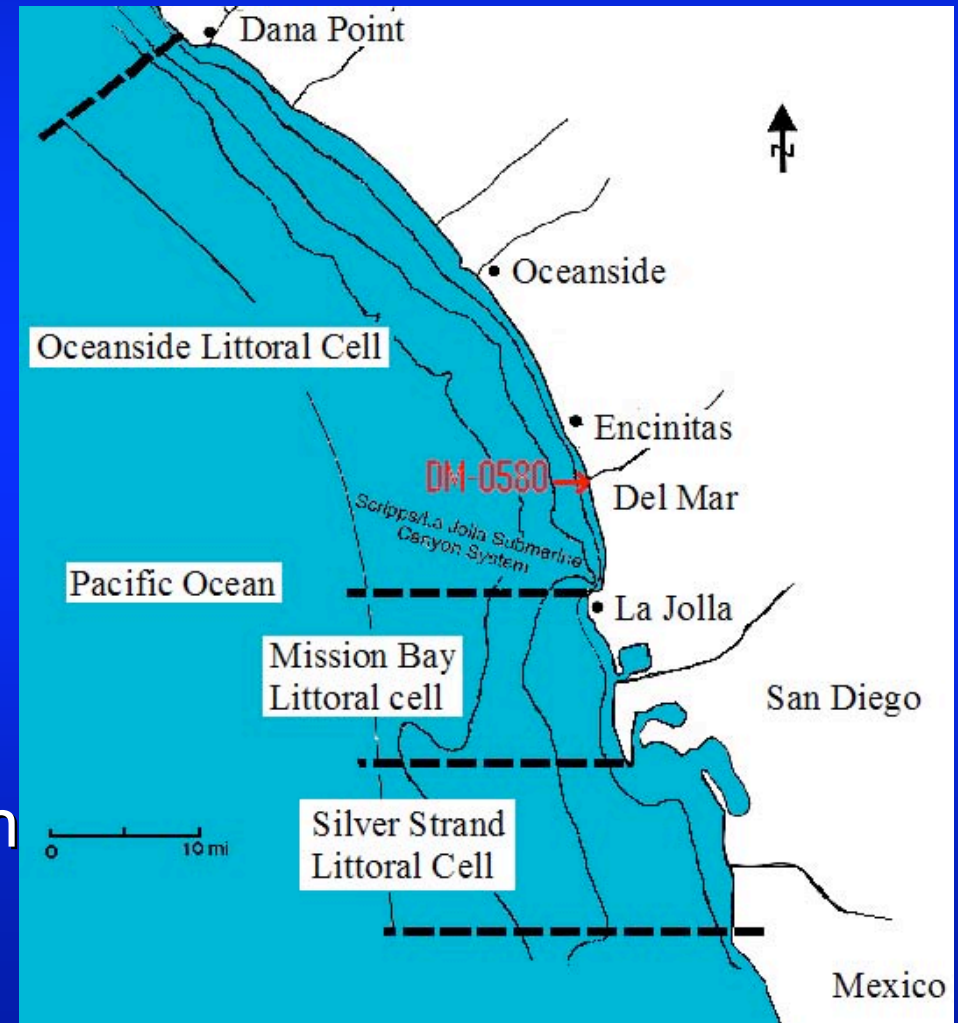
Purpose

- **To determine if sea level rise alone could explain the observed decrease in beach width of Del Mar Beach, CA. from 1978 to 2001**

- **Purpose**
- **Introduction**
 - Location and Coastal setting of Del Mar Beach
 - Beach Width
 - Hypotheses behind the Bruun Rule
 - Limitations to the Bruun Rule
 - Establishing Equilibrium at Del Mar Beach
- **Data**
 - Sea Level Data
 - Calculation of Beach Slope
 - Applying the Bruun Rule to Del Mar Beach
 - Seasonal and long-term Change in Beach Width
 - Measured erosion at Del Mar Beach
- **Conclusion**

Location and Coastal setting of Del Mar Beach (profile DM-0580)

- Oceanside Littoral Cell
- Sediment sources
 - 5 Rivers
 - Cliff failures
- Sediment sinks
 - Scripps/La Jolla Canyon
 - Oceanside harbor
- Del Mar Beach DM-0580
 - 650 meters south of the San Dieguito River/Lagoon mouth



Beach Width

Distance from the shore-water interface to a benchmark

Shore-water interface

- Intersection of NGVD and the beach face

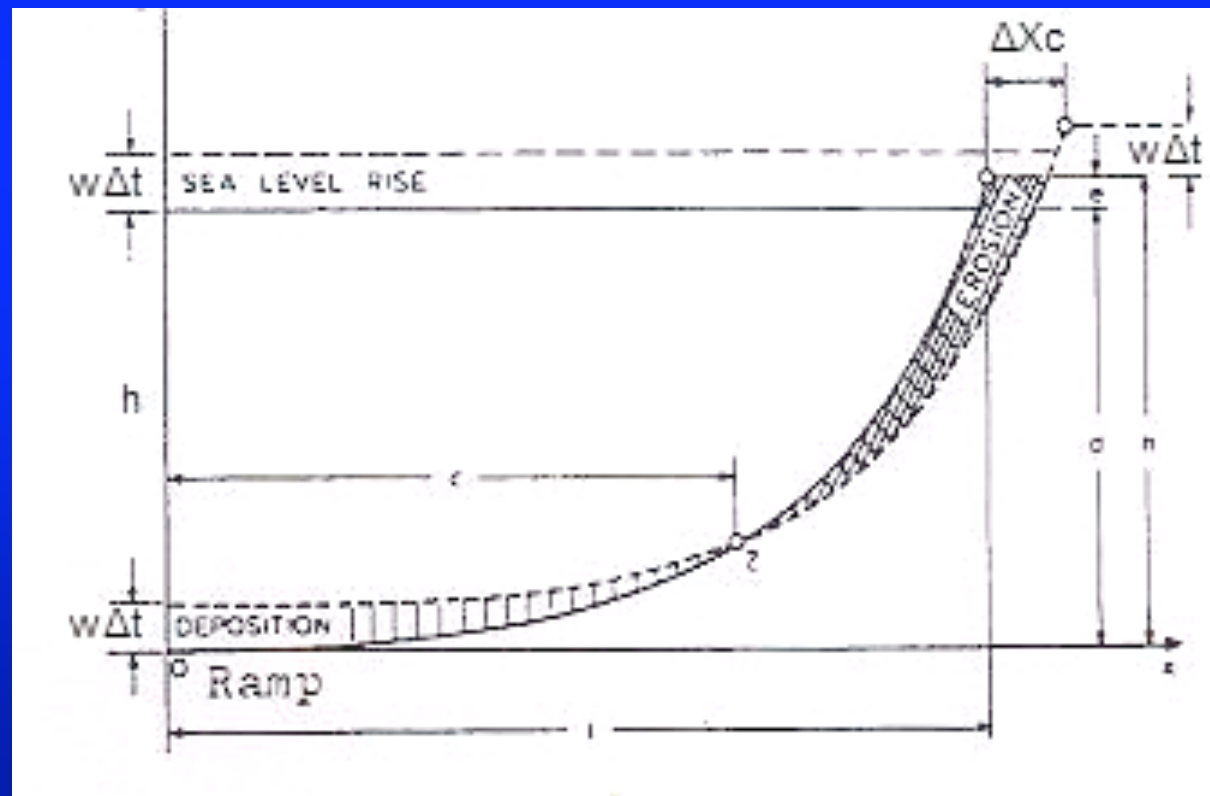
Benchmark

- Fixed point just shoreward of the back beach berm

Hypotheses behind the Bruun Rule (1962)

- With a rise in sea level ($w\Delta t$)
 - Shift of the beach profile
 - Vertical
 - $= w\Delta t$
 - Horizontal
 - $= \Delta X_c$

$$\Delta X_c = w\Delta t / \beta$$



Limitations to the Bruun Rule

- Bruun (1962)
 - Two dimensional experiment
 - Closed material-balanced system
 - The offshore bottom profile
 - The beach and nearshore
- Allison (1981)
 - Apply to an open and/or closed system
 - Beach must be in equilibrium
 - Longshore
 - On-offshore
 - No bedrock platform

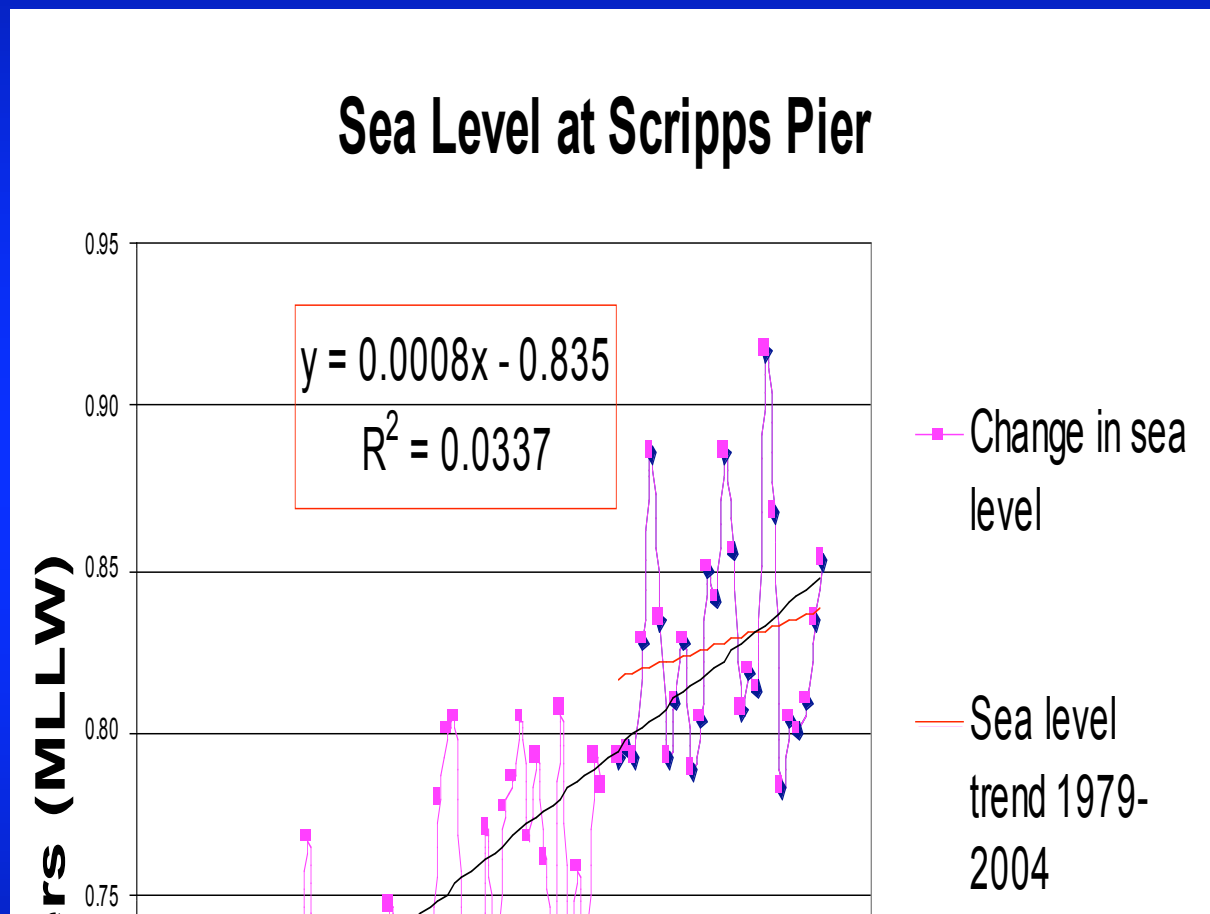
Establishing Equilibrium

- San Dieguito Lagoon
 - Inlet located 650 meters from the profile in question
 - No measurable effects beyond 600 meters (Elwany 2003)
 - The lagoon itself is neither a source or a sink (Elwany 2003)

Establishing Equilibrium (cont)

- Sources
 - San Dieguito River
 - 5,000 m³/yr (Inman 1991)
 - < 1% of the 900,000 m³/yr mobilized sediment by longshore currents (Elwany 2003)
- Sinks
 - Scripps/La Jolla Canyon
 - 9 miles to the south of Del Mar Beach
 - Oceanside Harbor
 - 10 miles to the north
 - No bedrock platform

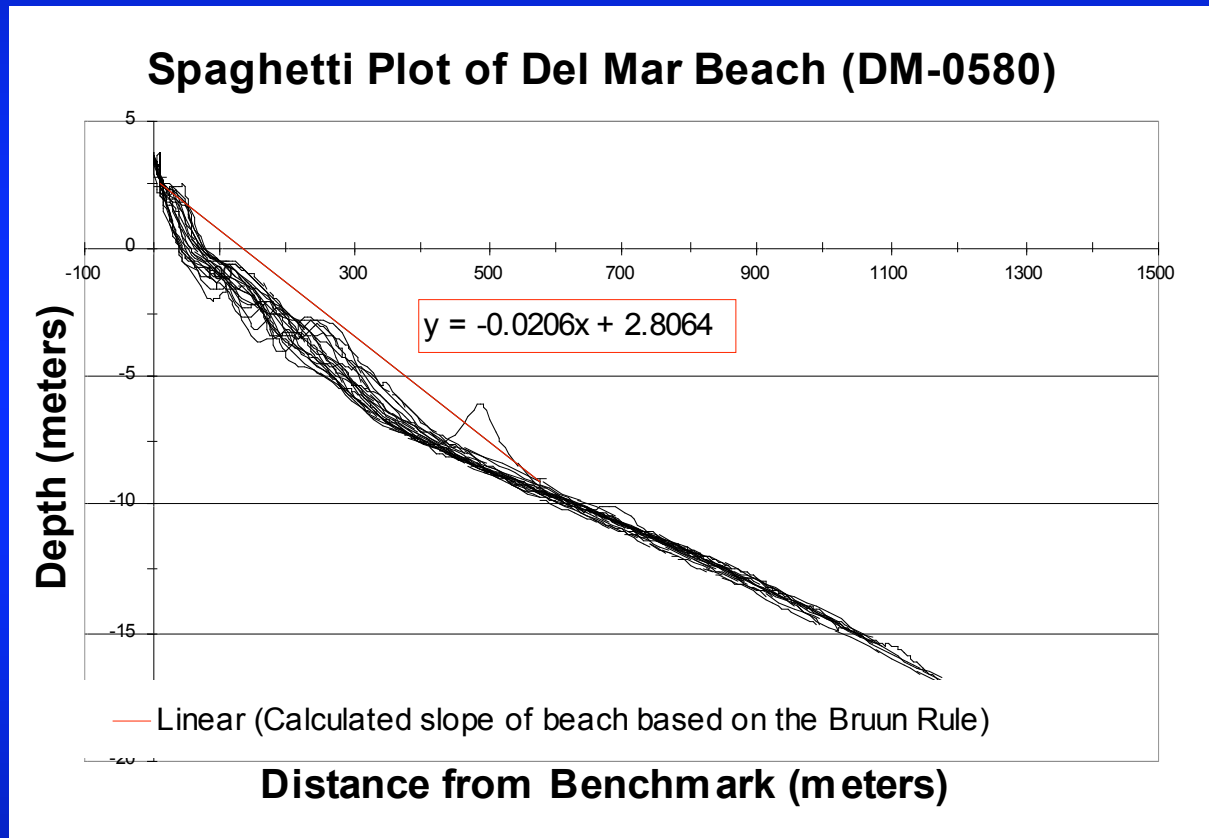
Sea Level Data



$$w\Delta t = 0.0021 \text{ m/yr } 1927-2004$$
$$= 0.0008 \text{ m/yr } 1979-2004$$

Calculation of Beach Slope

Change in elevation over distance from the depth of closure to the back beach berm



Back beach closure:

Location seaward from the shore water interface where the seasonal changes are along a considerable

Applying the Bruun Rule to Del Mar Beach

$$\Delta X_c = w\Delta t/\beta$$

Shoreward movement
(using sea level trend from 1927 to 2004)
 $\Delta X_c = -0.10 \pm 0.0012$ m/yr

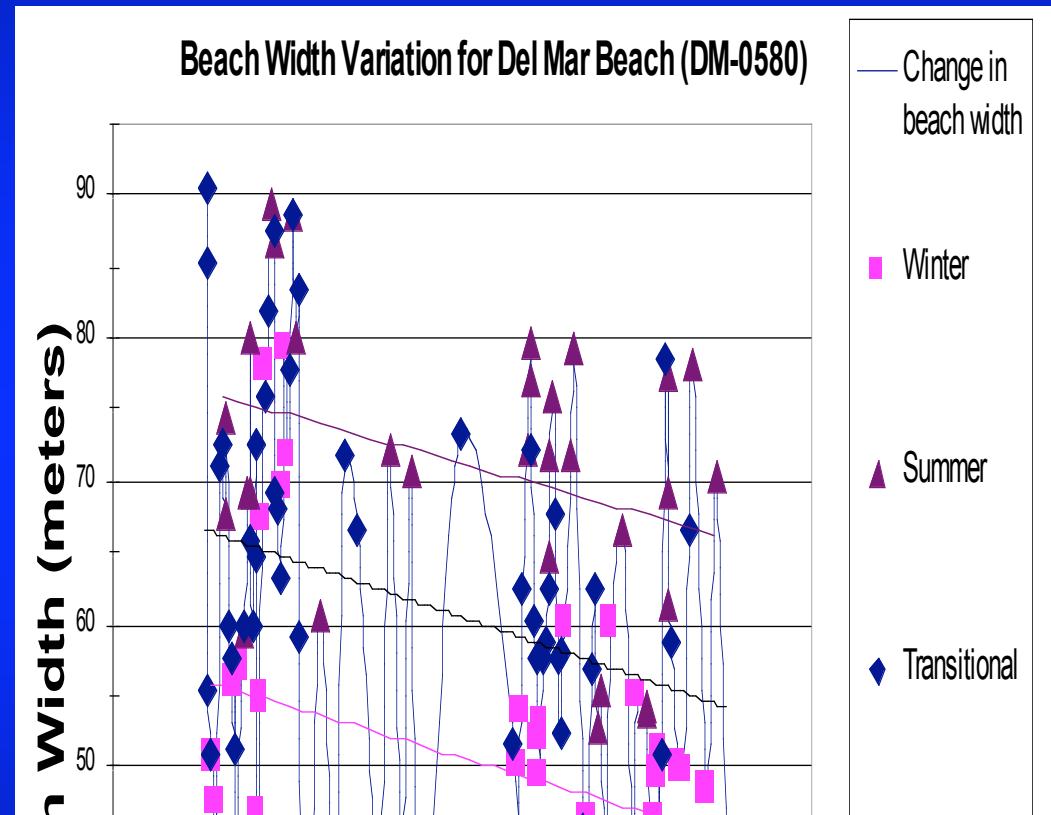
Shoreward movement
(using sea level trend from 1979 to 2004)
 $\Delta X_c = -0.04 \pm 0.0005$ m/yr

Shoreward movement from 1978 to 2001
 -0.93 ± 0.011 to -2.35 ± 0.028 meters

Seasonal and long-term Change in Beach Width

Seasonal variation

- Winter
 - Narrow
 - April-May
- Summer
 - Wide
 - Sept-Oct
- Transitional
- Beach width trends
 - Winter
 - Summer
 - All Data



-0.4870 m/yr

-0.4545 m/yr

-0.5525 m/yr

Measured Erosion at Del Mar Beach

Measured shoreward movement
= -0.55 m/yr

Shoreward movement 12.7 meters
from 1978 to 2001

Conclusion

- Erosion due to rise in sea level
 - -0.04 to 0.10 m/yr
- Total Erosion at Del Mar Beach
 - -0.55 m/yr
- Sea level comprises <20% of the total erosion at Del Mar Beach

Special Thanks

- Ray Kenny, Ph.D.
 - Fort Lewis College
- James Collier, Ph.D.
 - Fort Lewis College