Nearshore Processes Affecting Neskowin Beach

Outline

- The beach
- Everyday processes
  - Onshore-offshore wave action
  - Longshore currents
  - Rip currents
- Larger-scale phenomena
  - Sea level
  - El Niño
  - Storms

The beach

The beach

Relatively steep and narrow, composed of medium to coarse-grained sand

Backed by dunes fixed by European beach grass

Sand budget unknown, probable sources – streams, dunes, and continental shelf(?)

Sand thickness uncertain offshore, to be surveyed by DOGAMI* during Summer 2011

*Oregon Department of Geology and Mineral Industries

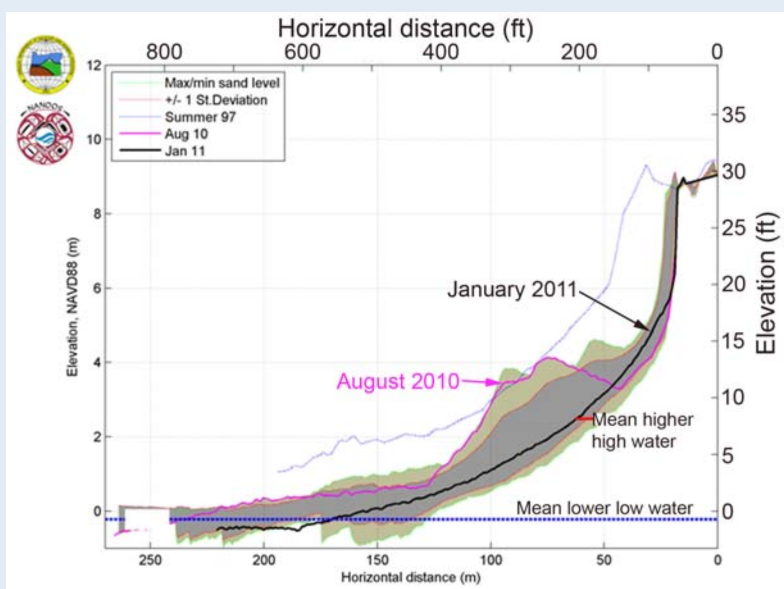
Onshore-offshore wave action

Waves move sediment toward or away from shoreline – cross shore transport

Onshore-offshore wave action

Beach profiles show a seasonal change in sand levels

Profile location ~1000 ft north of Corvallis Ave.

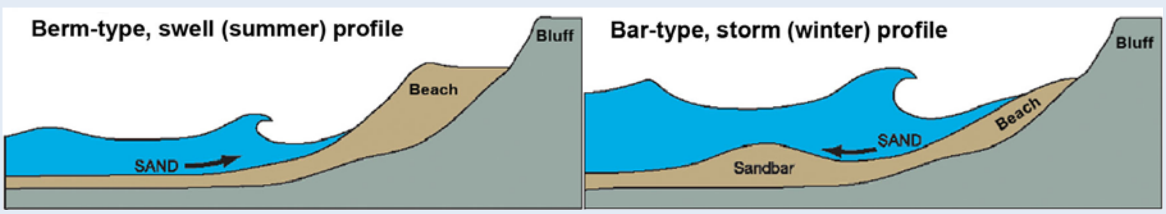


http://www.nanoos.org/nvs/nvs.php?section=NVS-Products-Beaches-Mapping

Onshore-offshore wave action

Beach profiles vary seasonally with changing wave conditions

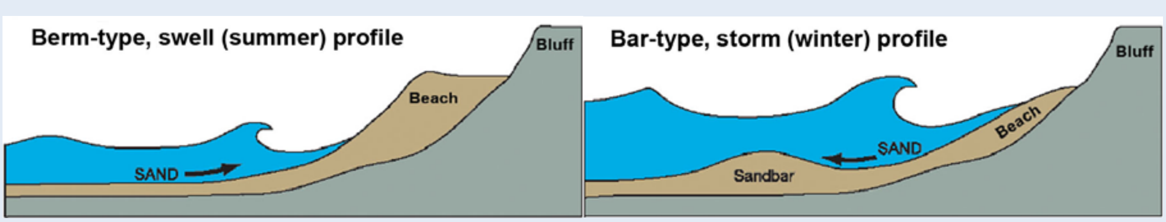
- •Low, gently rolling waves (swell) transport sand onshore, deposit as berms
- •High, steep waves (storm) transport sand offshore, deposit on offshore bars



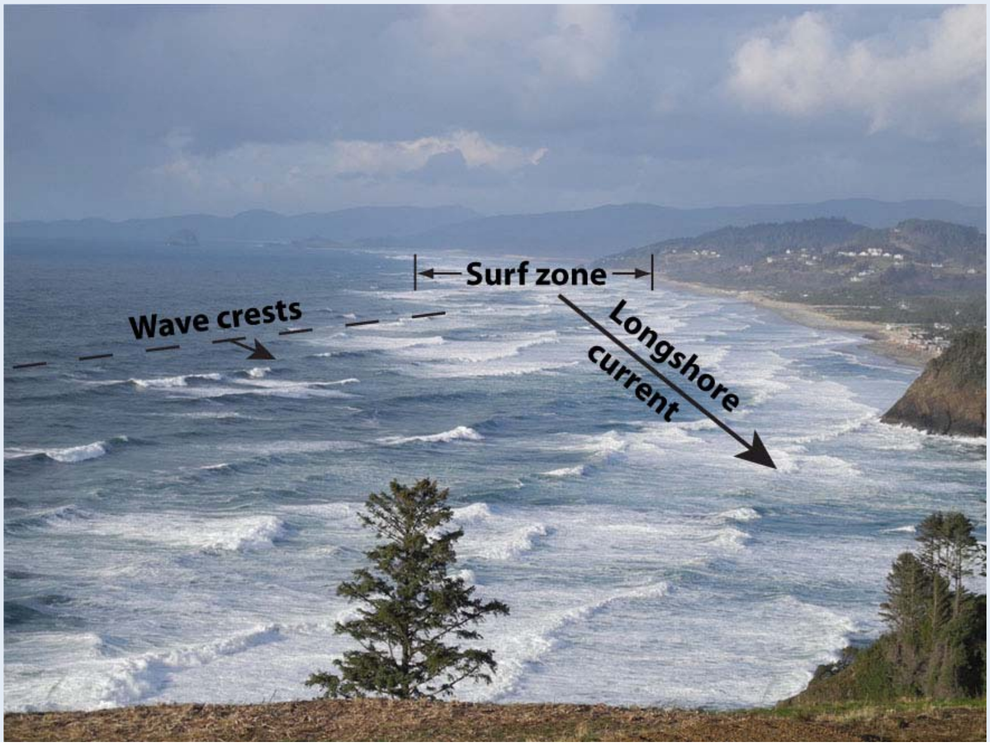
Onshore-offshore wave action

Change between profiles can occur with little net loss of sediment

Large storm waves can cause sediment to be lost to the continental shelf or the longshore transport system



Longshore currents



Longshore currents

Shore parallel currents in the surf zone caused by waves approaching the coast at an angle

Major sediment transport agent – longshore transport, longshore drift, littoral drift

Longshore currents

Longshore currents

Currents predominantly northward in winter, southward in summer

Northward longshore sediment transport greater than southward transport

Northward transport enhanced during El Niño

Longshore currents

Longshore sediment transport along the Oregon coast is divided into cells bounded by the headlands (capes)

Neskowin is at the south end of a sediment deficient littoral cell with a net northward littoral drift

Rip currents

Rip currents

Swift, narrow currents that cut through the surf zone

Generated by variation in breaker height and flow from higher to lower water

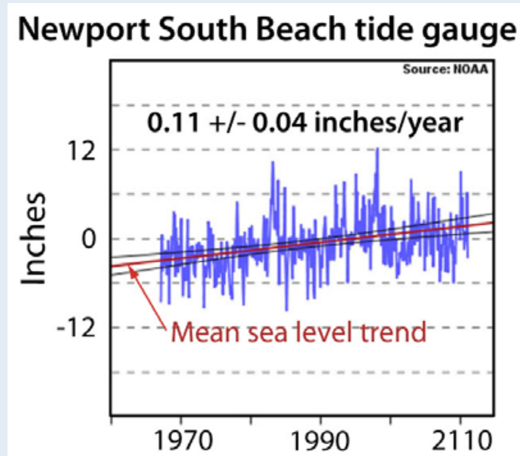
Can cause erosion hot spots, contribute to cross shore sediment transport

Sea level

IPCC* predicts a 7 to 23 inch sea level rise by 2100 (does not include melting ice sheets)

Melting the Greenland or West Antarctic ice sheets causes a 16 to 23 foot rise in sea level

Reasonable, minimal estimate – 3 to 5 feet by 2100



*Intergovernmental Panel on Climate Change, 2007

Sea level

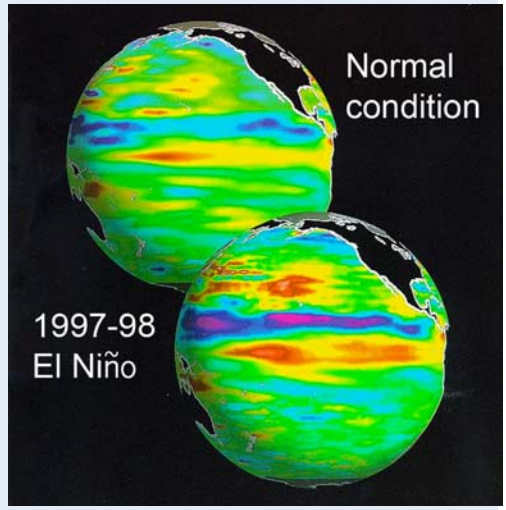
Other factors

- Tides
  - 10 to 12 feet
- Seasonal change
  - 4 to 15 inches
- Storm surge
  - 6 to 12 inches
- Wave setup
  - ~0.17 x height of offshore waves

El Niño

Periodic movement of warm water from the western to eastern equatorial Pacific

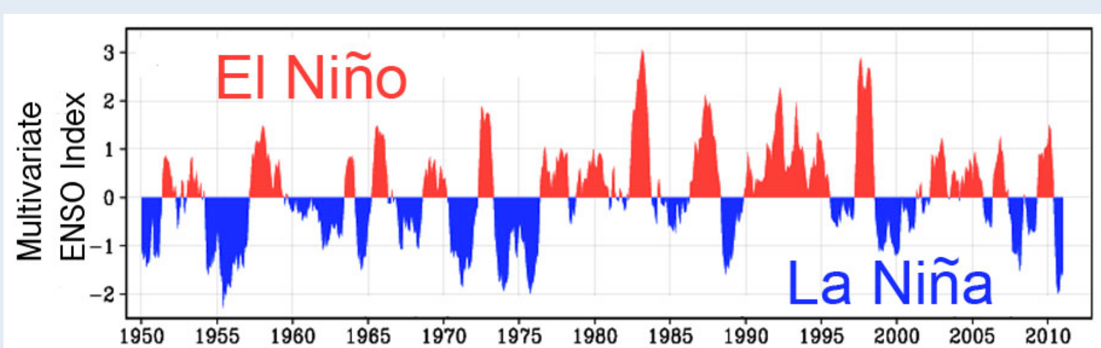
Significant impacts on climate and ocean processes, *e.g.* <u>higher</u> water levels, <u>stronger</u> northward longshore transport



El Niño

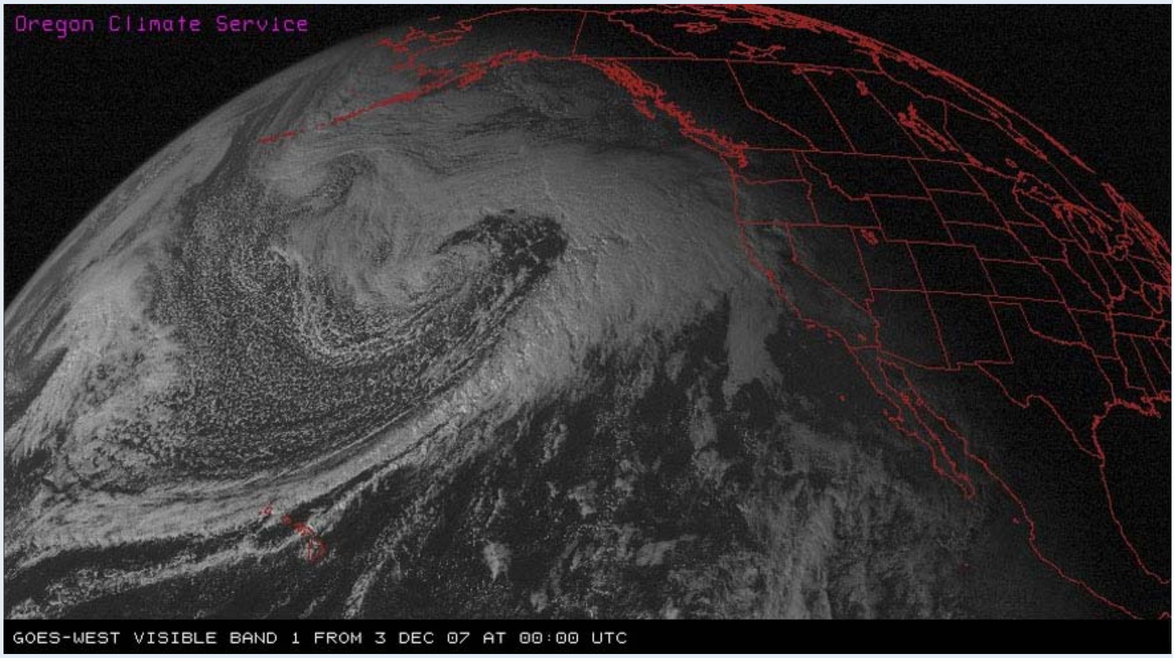
Climate models used by the IPCC predict a more El Niño-like pattern in the future, some models predict the opposite

Models nearly equally split on the year-to-year variability in strength



Source: NOAA

Storms



Storms

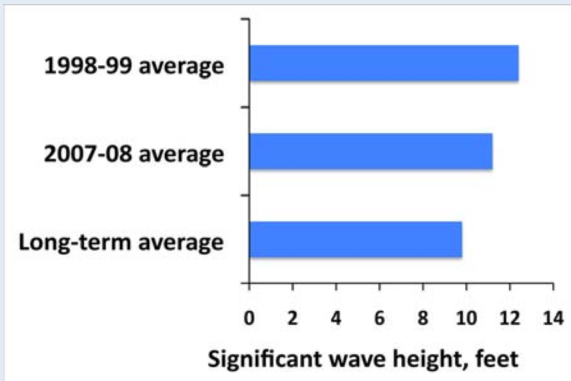
Storms ➔ higher winds, waves, sea level, and rainfall ➔ more erosion

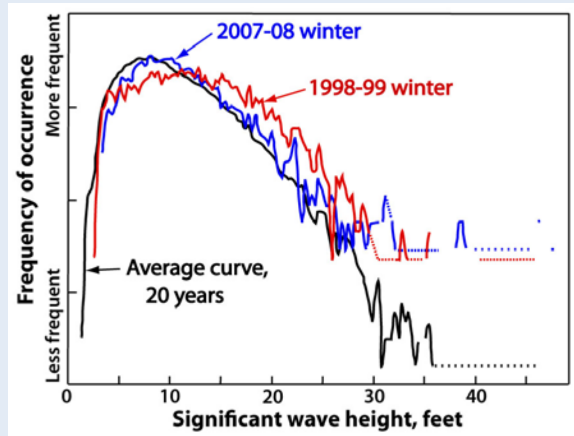
1.3 to 2.0 million cubic yards of sand removed from Neskowin beach from 1997 to 2006

IPCC predicts -

- more frequent intense mid-latitude storms (extratropical cyclones, low pressure systems)
- fewer storms overall

Storms





***Significant wave height =**
the average height of the largest
one-third of the waves

Modified from Allan & Hart (2008)

Storms

Recent studies of deep water wave data from buoys off Oregon and Washington suggest that wave heights are increasing

Potential water height at the toe of the riprap –
•<u>26 feet</u> (50-year storm, 48 ft offshore wave)
•<u>33 feet</u> (100-year storm, 52 ft offshore wave)

Take Home Message

- ✓ Waves, longshore currents, and rip currents contribute to sediment transport on the beach
- ✓ Neskowin Beach is in an erosive state
- ✓ Sea level will continue to rise in the future, probably at a higher rate resulting from melting continental ice sheets
- ✓ Neskowin most likely will experience larger waves produced by more intense mid-latitude storms