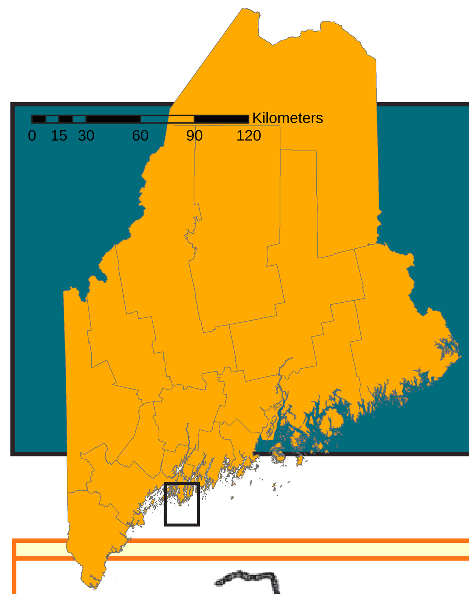
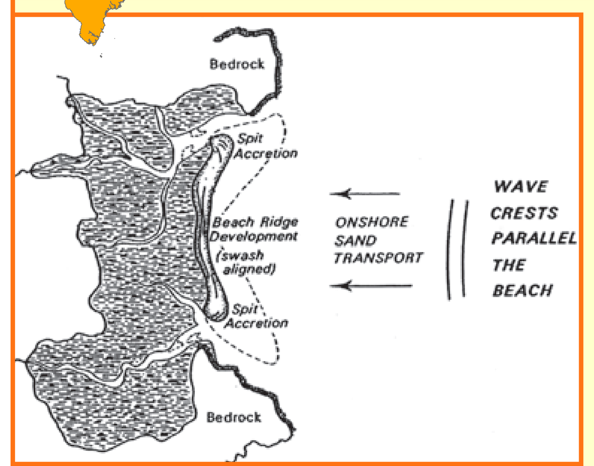


Mapping Seawall Beach to Model the Future

Phippsburg, Maine 2008

by Dana Oster '09

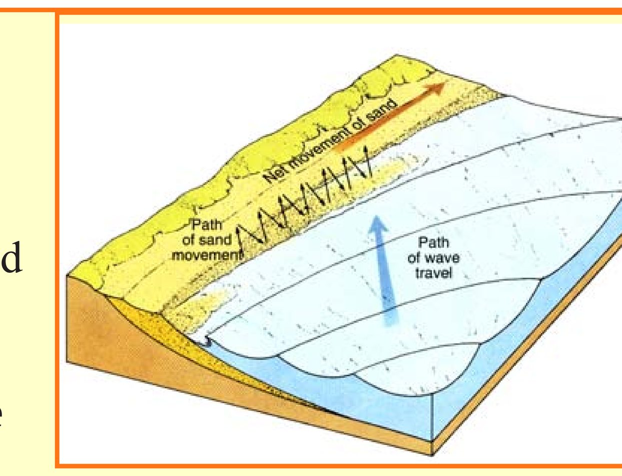


"Pocket" Beach, image from FitzGerald *et al.*, 1989.

Seawall Beach is located in Phippsburg, Maine. It has two rivers on each side; the Sprague River on the west side and the Morse River on the east side, separating it from Popham Beach State Park. It is part of the Bates Morse Mountain Conservation area, managed by Bates College and owned by the St. John family. It is a unique place to study because it is the last large undeveloped sand beach in Maine. It is almost two miles long and has been studied by many Bates College geology students and Professor Mike Retelle. It is a special opportunity for Bates students to study an important location directly related to climate change.

It is significant because Maine has unique beach systems. They are often protected by bedrock on either side and are referred to as 'pocket' beaches. The result is that their processes are more complicated than just long-shore transport and very important to understand for beaches with and without development. Beaches are a dynamic environment that consistently change with seasons, weather and sea level. Seawall Beach is important to study in order to; understand how Maine beach systems work in their natural state, how developed Maine beaches currently behave, and what to expect with a rising sea level.

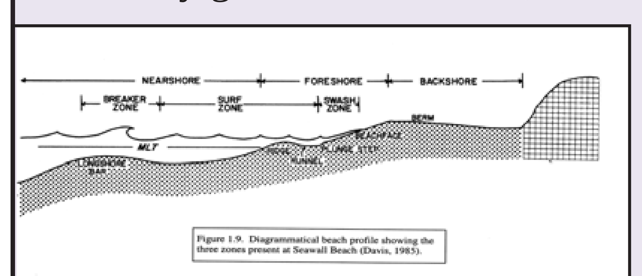
My research at Seawall Beach can be broken down into three categories: recording seasonal changes from summer to winter, detailed mapping of the current beach features, and modeling the beach in the future using ArcGIS. My research began in June '08, supported by the Hughes Summer Fellowship, and will continue through May '09, as my geology senior thesis project.



Longshore transport distributes sand along beach, image from Marshak 2004.

Seasonal Changes

The beach system changes from summer to winter profiles. Sand bars move up against the beach during the summer months by gentle wave action, and severe winter storms scarp the beach and move the sand bars back out. These off shore bars cause violent waves to break further from shore to protect the beach, then the cycle begins again.

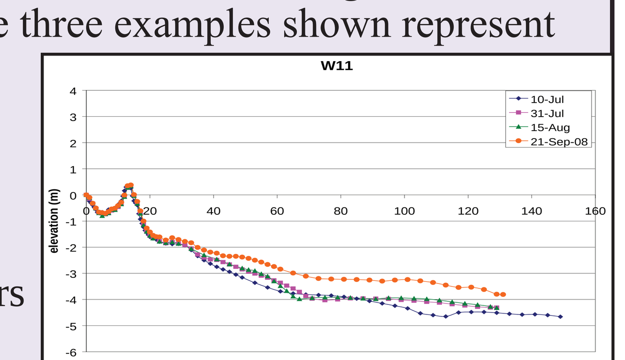


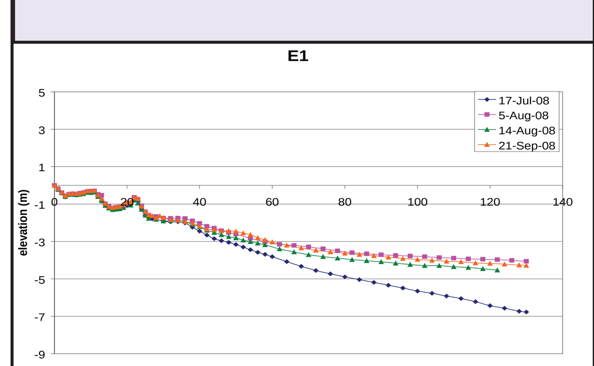
The method for monitoring the beach's profile requires comparing the relative elevation changes on specific transects throughout the beach. Profiles show the elevation from the dune ridge to low tide.

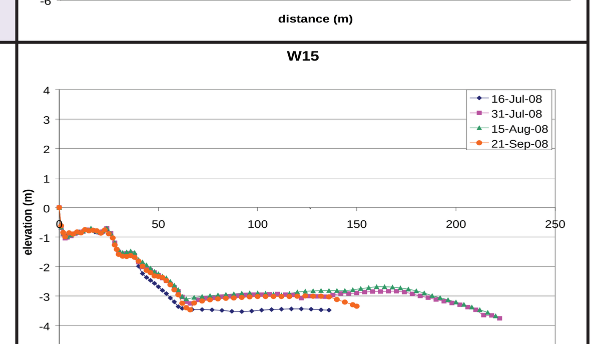
Photo from Chandler 2008

Beginning in July, Emily Chandler '09, and I took profiles of five transects spread throughout Seawall Beach. The five transects are meant to capture the different areas of the beach system to compare how they are changing through the seasons as well as relative to one another.

Each transect is graphed in Excel to show change in the beach profile through time. The three examples shown represent different parts of the beach system and how the transects respond to seasonal processes. All three transects show net accretion from July to August and the progression of sand bars landward.







Mapping the Present

Photo from DeLorme

The mapping of Seawall Beach is done using a high-resolution Trimble GPS unit, which is accurate to within 0-30cm. The GPS is used to map these features of the beach:

- Dune line
- High tide
- Low tide
- Sprague River
- Morse River
- Sand bars in the mouth of the Morse River
- Berm

The reason all these features are mapped is that they are part of the changing dynamic beach system. Their locations migrate with seasonal and climatic changes. Creating an accurate *snap shot* of the beach system now will benefit future studies to compare how the beach has changed even within one year's time. The present data are also incorporated in models of the beach in the future.

Sprague River channel

Photo from Chandler 2008

Trimble GPS

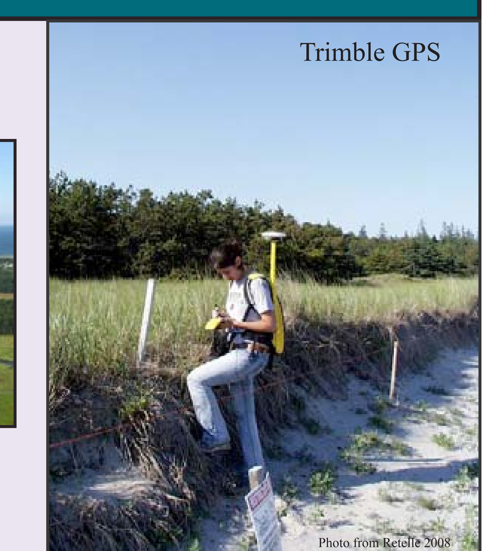


Photo from Emily Chandler 2008

Sprague River channel

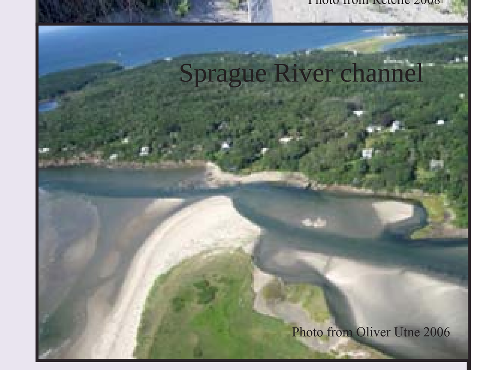


Photo from Chandler 2008

Dune line

Photo from Chandler 2008

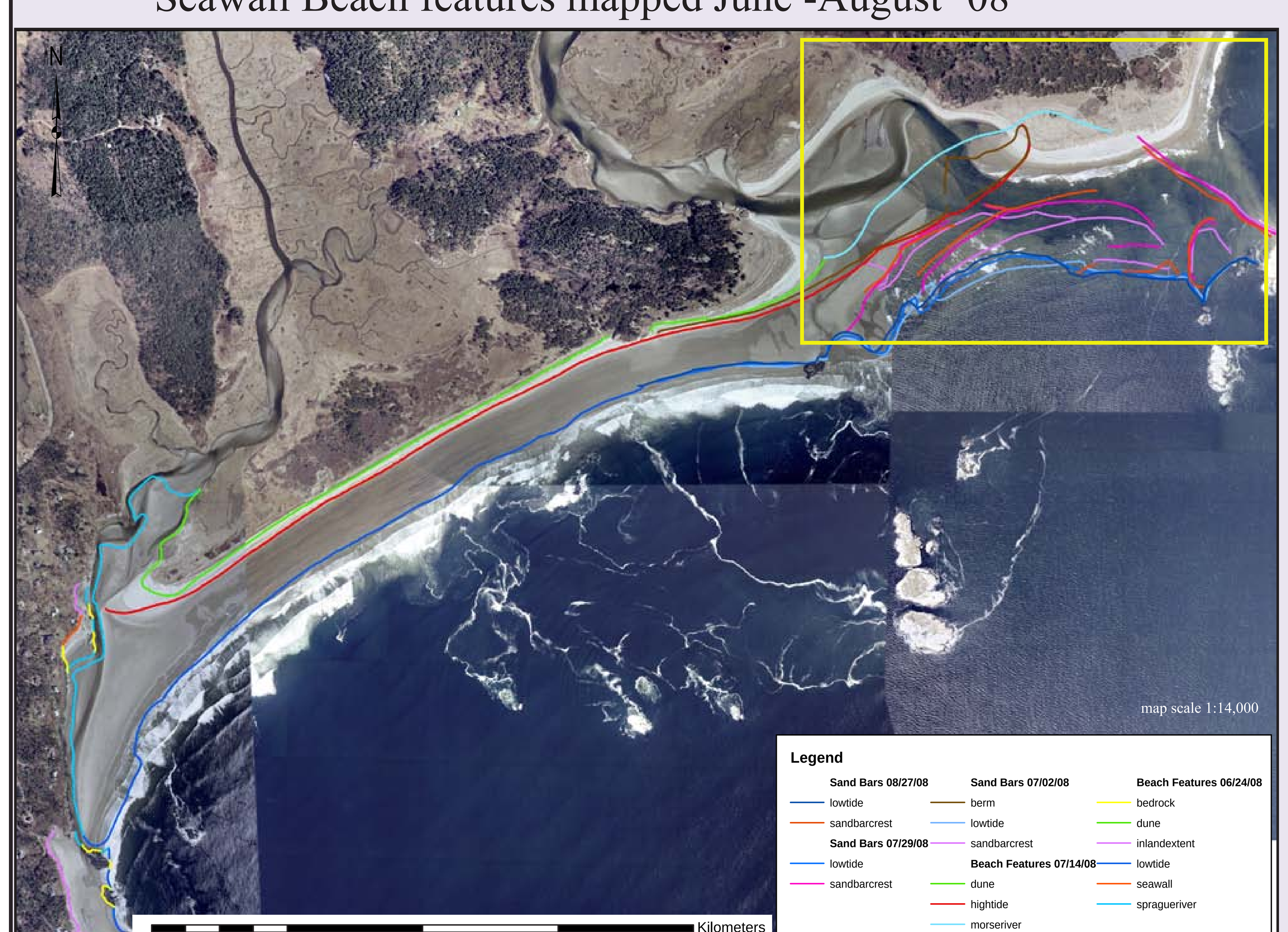
Images to the left; taken from a time lapse camera located at the Southwestern point of Seawall Beach looking Northeast.

SW Seawall Beach at low tide.

SW Seawall Beach at high tide

The elevation of the SW spit is lower than the high tide line and reflects that area's vulnerability to SLR and storm surges.

Seawall Beach features mapped June -August '08



The east side of the beach has had dramatic changes in the last year with the movement of the Morse River and sand bars. The sand bar crests were mapped every four weeks to show their movement.

June through August the Trimble GPS was used to map the features of Seawall Beach. The image above shows the location of all the features in 2008, overlayed on a satellite image from 2001. The rivers and sand bars migrate the most and need to be mapped at least every year.

Sources:

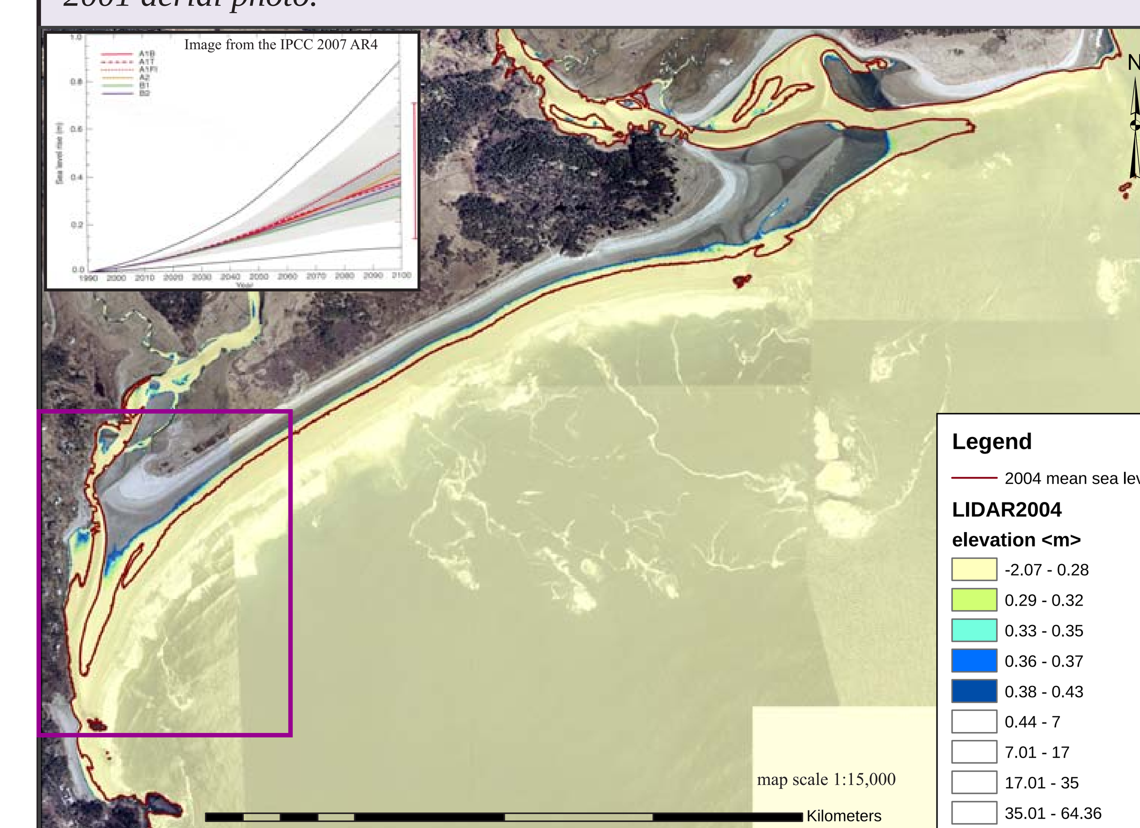
- -IPCC
- -FitzGerald et. *al* 1989, 2000, 2002
- -NOAA
- -The Seawall Beach Project
- -Marshak 2004
- -Pfeffer et al. 2008
- -Kelley et al. 1993
- -Buynevich et al. 2000
- -Fenster et al. 2001
- -Cohen, E.S., unpublished 2003
- -Jones, M.G., unpublished 2000
- -Cary, C.L., unpublished 2005
- -Davis, 1985

Special Thanks to:

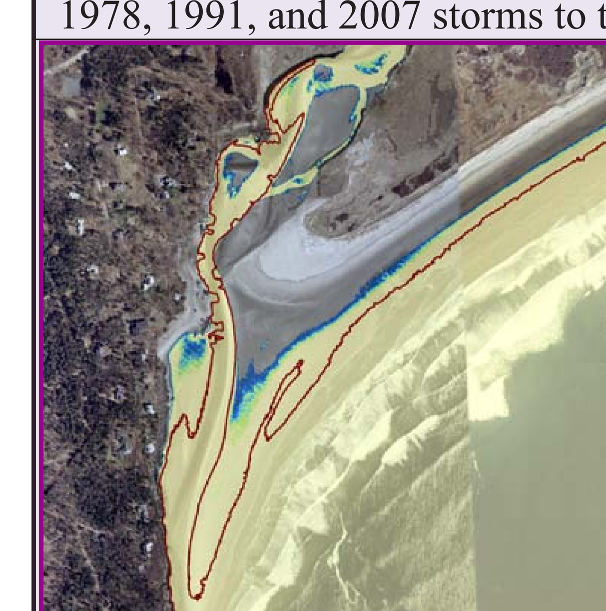
Mike Retelle
Hughes Summer Fellowship
Emily Chandler
Laura Sewall
Imaging & Computing Center
Steve Dickson (MGS)
Pete Slovinsky (MGS)
St. John Family
Megan Arnold
The Chandler Family
Bates Student Research Fund

Modeling the Future

In the IPCC's most recent assessment report in 2007 the projected global sea level rise (SLR) by the year 2100 ranges between 0.28-0.43m. These values are found from different carbon emissions scenarios and the resulting average global temperature increase. The IPCC's estimates for SLR are highly debated considering the values are based on thermal expansion, and general estimations for ice melting. Recent research on the kinematics of ice sheets suggest a 2m rise is a realistic maximum for 2100 (Pfeffer et al. 2008). In order to create a computer model I will calculate various scenarios of SLR and project where and how fast the beach features will transgress landward. *The image below shows the IPCC's SLR estimates for 2100 with 2004 LIDAR data on a 2001 aerial photo.*



The computer model will be created using ArcGIS and a series of equations and scenarios. In the model I will use between 0.3-2.0m of SLR by 2100. This will not only produce various amounts of SLR rise, but varying rates of rise, which will estimate how fast the beach can adapt and transgress, or if it will flood. The areas of the beach will be turned into polygons and have a value for erosion to estimate how wave action will change the shape of the beach and the course of the river channels. A severe storm buffer will be added based on past damage from the 1978, 1991, and 2007 storms to the beach.



Projecting how Seawall Beach will respond to SLR can help predict the impacts SLR will have on developed Maine beaches. The SW end of Seawall Beach is an important part of the Small Point community with many homes near the beach. The spit has a low elevation and is below the high tide line, and it will be permanently lost by 2100.