GeoHazards

Geodynamic Processes at Rifting and Subducting Margins

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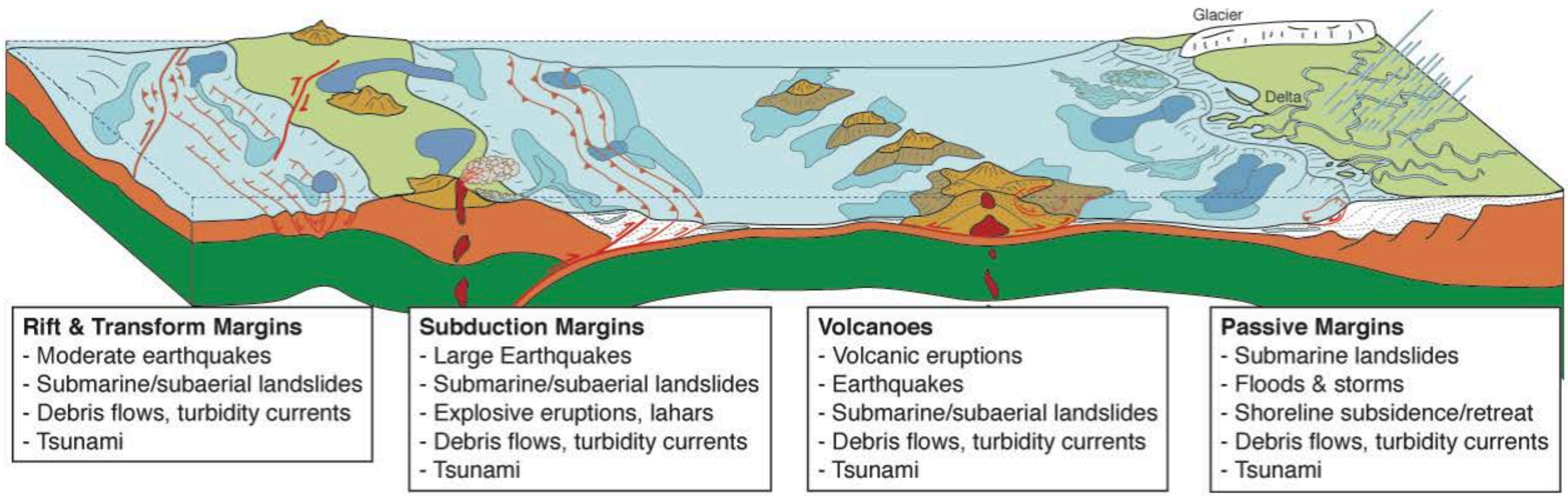

Figure 10.1: Representative geohazards that can originate along continental and volcanic margins. (Figure modified from Morgan et al. [2009]).

-What set of physical and chemical processes operate during hazardous events?

-What are the initial and boundary conditions?

-What is the probability of occurrence of hazardous events?

-What initiates/triggers hazardous conditions?

-What infrastructure is needed to detect/mitigate hazardous events?

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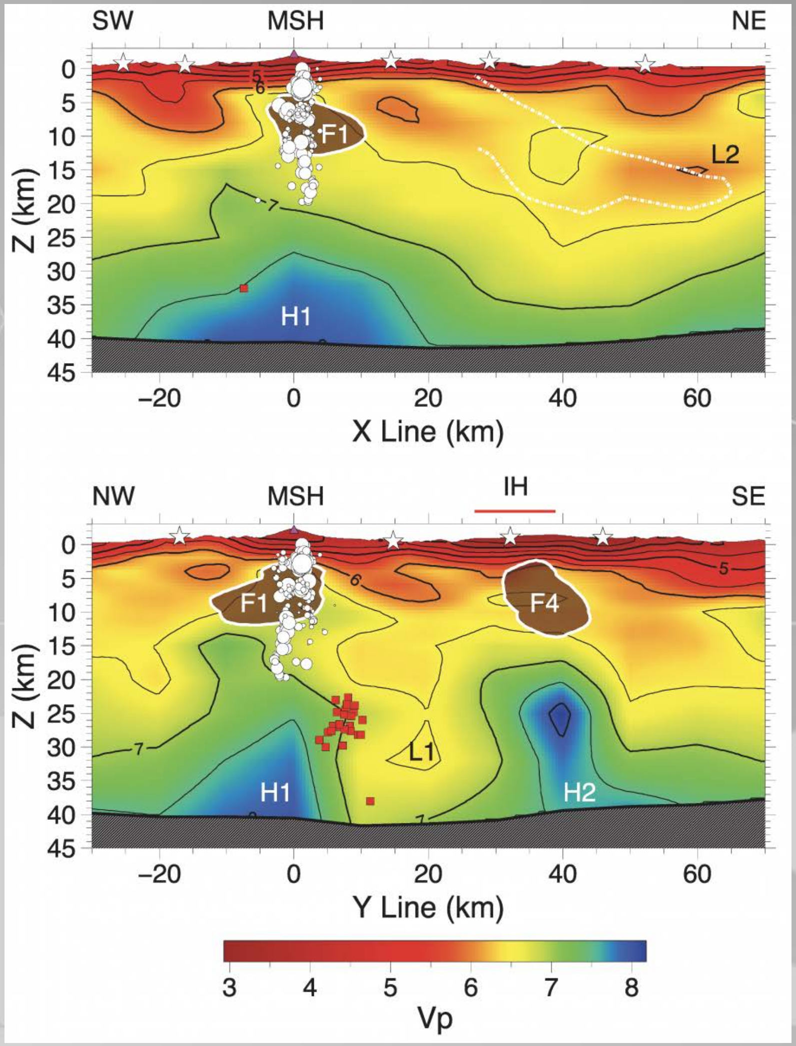
<u>*What is the subsurface distribution of melt in space ?*</u>

iMUSH

An interdisciplinary study to image the magmatic architecture under Mount St. Helens -- combining information from passive and active seismic, MT, and petrologic investigations.

An example of a bottom to top study of a volcano that provides a snapshot of how melt is stored and how it is influenced by tectonic structure.



Kiser et al., 2016

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<u>*What is the subsurface distribution of melt in time?*</u>

Assessing changes in the state of a magma storage system over caldera-forming eruption cycles, a case study at Taupo Volcanic Zone, New Zealand

Explores magmatic system evolution in time encompassing large silicic eruptions and magmatic events before and after as way of better understanding the run-up to hazardous eruptions.

Aim is to develop a better understanding of how the temperature and mobility of a magma body below the surface changes before, during, and after a major eruption using petrological/geochronological constraints.

Kari Cooper (UC Davis), Adam Kent (Oregon State University), Chad Deering (Michigan Tech), and collaborator Darren Gravley (University of Canterbury, New Zealand)

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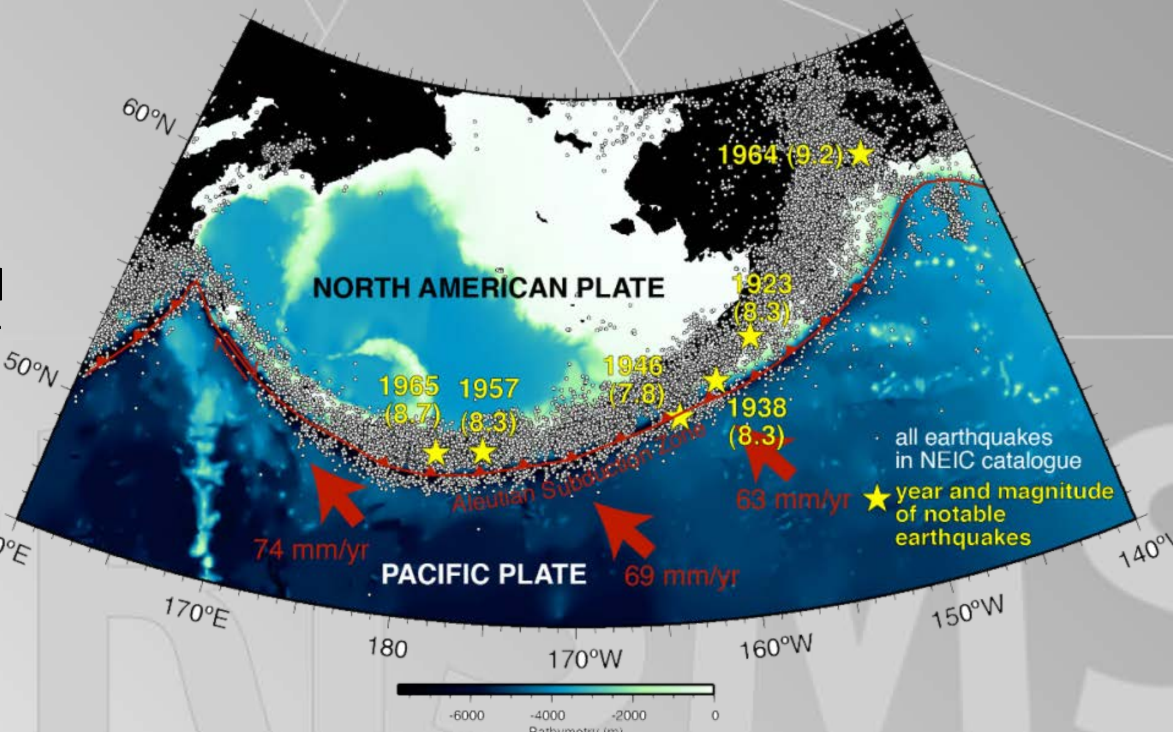
How do fault and rock properties modulate seismic hazards?

Deep Mapping of the Megathrust on Land and at Sea around the Alaska Peninsula

The 2500-km-long subduction zone offshore southern Alaska regularly produces large, destructive earthquakes.

This project collected data on land and at sea to produce an image of the megathrust, constrain the properties of rocks around and within the megathrust, and link fault properties to the earthquake history.



Demian Saffer, Donna J. Shillington, Geoffrey A. Abers, Anne Bécel, Katie M. Keranen, Jiyao Li, Mladen Nedimović

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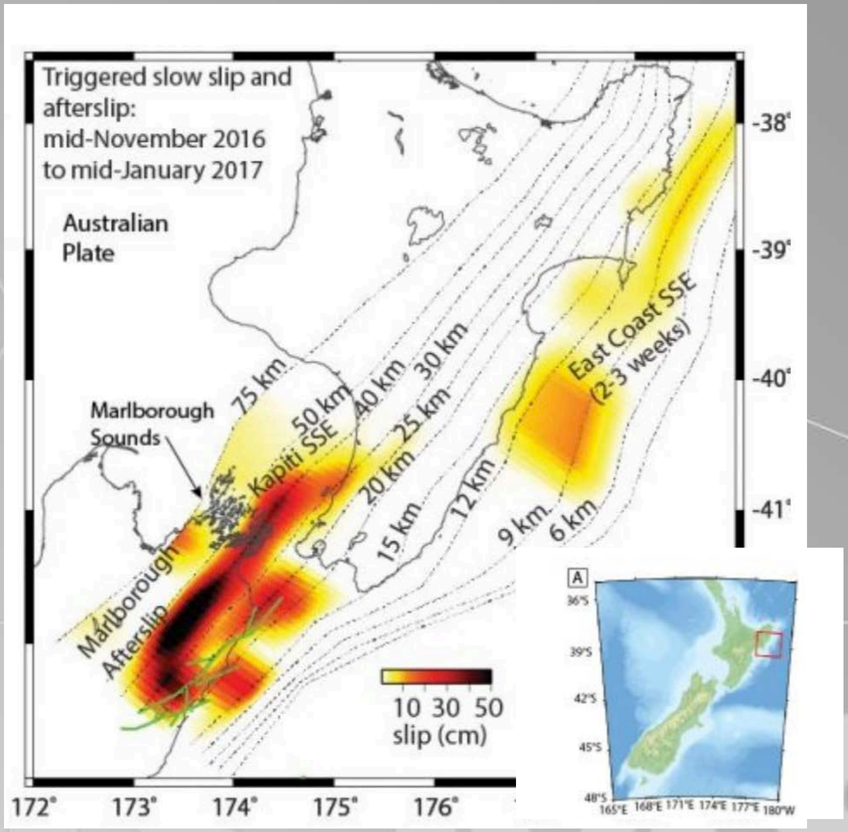
Triggering mechanisms?

Slow slip and future earthquake potential in New Zealand and Cascadia

Study explores slow slip events and their ability to trigger earthquake hazards.

To better differentiate what events may trigger earthquakes with destructive potential the PIs have endeavored to generate a catalogue of slip events using GPS and sea floor vertical deformation and linking these observations to models with spatially variable elastic properties.



Noel Bartlow (University of Missouri), Laura Wallace (UT Austin & GNS Science), Ryan Yohler (University of Missouri), and Charles Williams (GNS Science)

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Faulting mechanisms and instrumentation?

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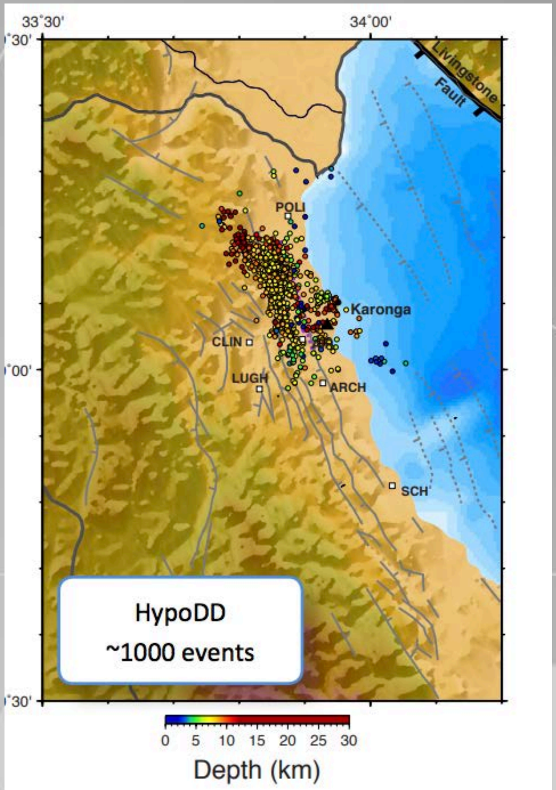
Faulting processes during early-stage rifting: analysis of an unusual earthquake sequence in northern Malawi

Study examines faulting style during early stage rifting using a combination of seismic and geodetic data.

Interaction helped establish Malawi's first national seismic network.



James B. Gaherty, Donna J. Shillington, Matthew E. Pritchard, Patrick Chindandali, Ashley Shuler, Winstone Kapanje, Hassan Mdala, Nathan Lindsey, Leonard Kalindekafe, Cynthia Ebinger, Andrew Nyblade, Scott Nooner

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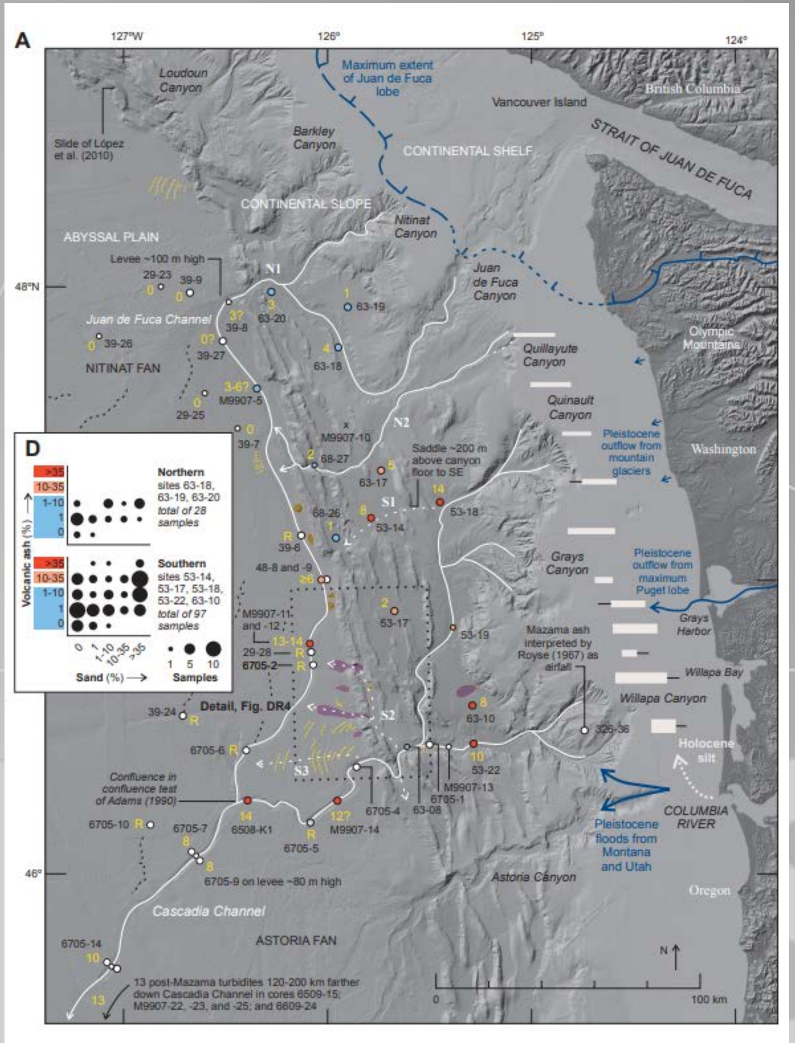
Paleoseismology Studies

- **Instrumental record lasts slightly more than 100 years. Record is not long enough to capture even a single full earthquake cycle for a great earthquake rupture.**
- **Information about past events will tell us if earthquake segment boundaries are persistent, and provide key information on the recurrence intervals.**
- **Promising 'amphibious' approaches developed to test correlating offshore turbidite records with those from onshore studies.**



Atwater et al. 2014

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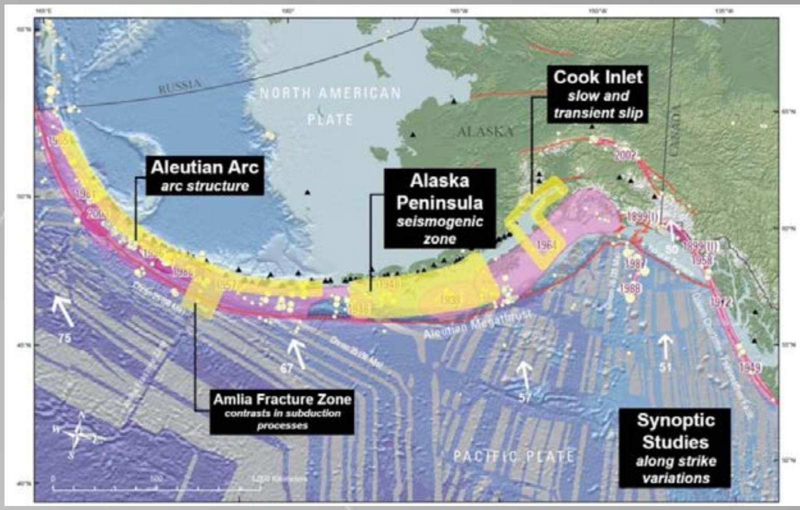
Paleotsunami Studies

- **Paleotsunami investigations along several focus sites, but here highlighting the Alaska-Aleutian arc, can provide crucial data to estimate tsunami recurrence intervals, characterize the source mechanisms and assess inundation hazards for vulnerable communities in Alaska and around the Pacific Ocean.**



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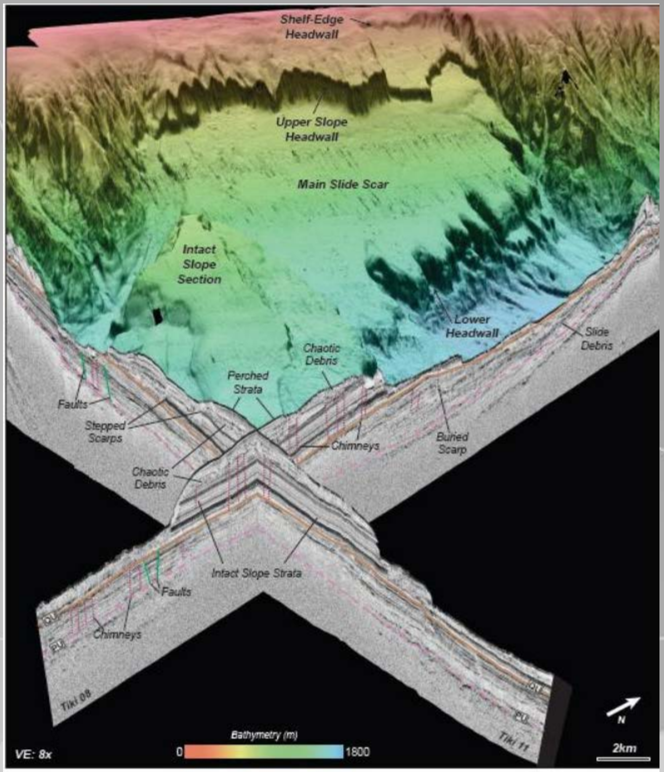
Paleoseismology and Paleotsunami Studies

- ***Slope Stability:*** **Large submarine landslides mapped along much of ENAM.**
- **Some large submarine landslides and associated tsunamis are generated by earthquakes and others may be driven by depositional processes, groundwater hydrology of continental shelves, or hydrate dissociation.**
- **To unravel the relative role of these drivers, specific locations have been studied where slope instability is present and the driving mechanisms are known to be different.**



ENAM Margin: Brothers et al., 2016

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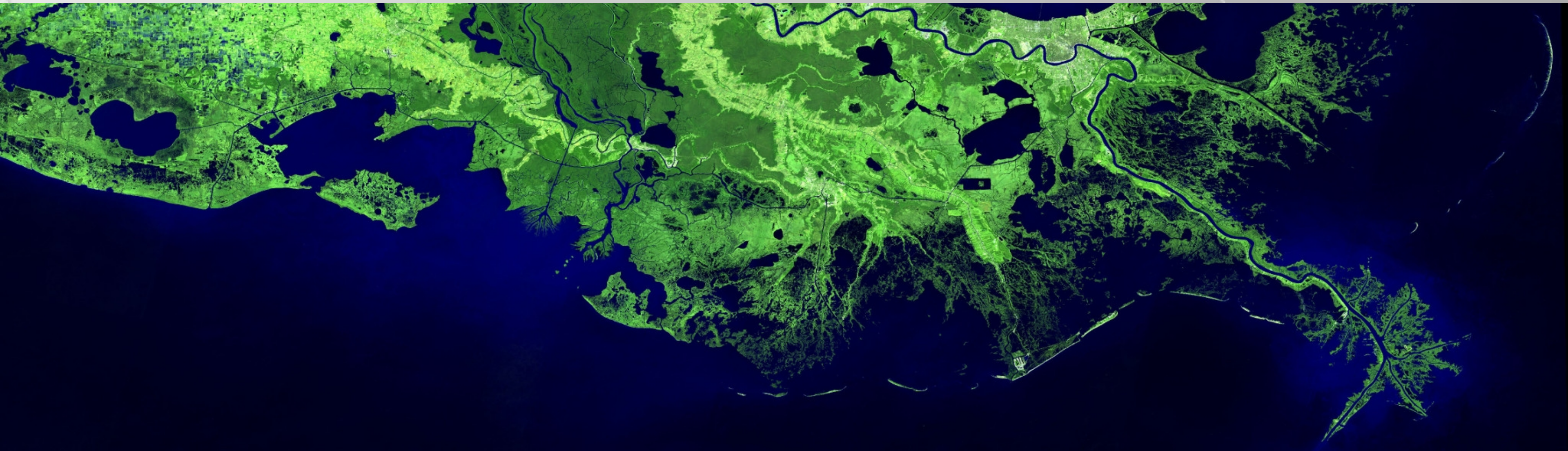
Coastlines Under Threat

Under current anthropogenic regime, severe land loss

How do we balance our “sediment checkbook”

- **Sea level rise and coastal erosion**
- **Sediment starvation**
- **Subsidence**

Under “business as usual”, by 2050 expect ~30,000 km^2 land loss on deltas alone with ~9 million people at risk (Ericson et al.,2006)



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Fluid Exchange on Passive Margins:

Fluid and element exchange at passive margin systems has arisen as a central issue as we look at methane venting in the arctic and hydrocarbon seepage in the Gulf of Mexico.

Understanding mechanisms and fluxes of mass exchanges Will help us understand the carbon cycle, support of ecosystems, and the impact on global change.

Pockmarks from gas hydrate release