Southeast Test Case - Year 1 Update

Understanding the contribution of glacier runoff to freshwater flux in the Gulf of Alaska
Southeast Test Case: Physical System

Graphic: Kristin Timm
Southeast Test Case: Physical System

Graphic: Kristin Timm
Glaciers and Seasonal Snow

Physical variables
change in extent/mass
change in runoff

Human Benefits
recreation
aesthetics

Ecosystem Processes
freshwater delivery
nutrient availability

Non-market Valuation
use / tourism
hydropower

Biophysical Covariates
stream temperature
precipitation
air temperature
ocean salinity
Elevation Changes from Altimetry

Physical variables
- change in extent/mass
- change in runoff

Visible Band Satellite Imagery
Elevation Changes from Altimetry

Physical variables
- change in extent/mass
- change in runoff

Airborne Altimetry
Elevation Changes from Altimetry

Physical variables
change in extent/mass
change in runoff

Satellite Gravimetry
Melt Modeling
Assessment of glacier mass changes in Alaska

2003-2010 Alaska Glacier Mass Balance = -65 +/- 12 Gt/yr

Alaska Glaciers contribute 7% to global sea level rise

(Luthcke, Arendt and others, 2013)
Assessment of glacier mass changes in Alaska

Mass Amplitude

(Luthcke et al, 2008)
Southeast Test Case: Study Area
Changes in Glacier Extent

2011 Glacier Extent
1950s Glacier Extent
Elevation Changes from Altimetry
Installing ablation wires on Gilkey Glacier

W. Pat Dryer
Jason Amundson
Point Mass Balance Data: 2013

Jeff Kavanaugh
Jamie Bradshaw
Mass balance stake measurements
Point mass balance data: Comparison to Mendenhall
Planned Instrumentation on Gilkey Glacier

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Ground-based and airborne snow radar surveys
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Students/Technicians

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Temperature Index Melt Model

\[ M = (\sigma + \alpha K)T^+ \]

- \( \sigma \) = melt factor (tuning parameter)
- \( \alpha \) = radiation factor for snow or ice surface (tuning parameter)
- \( K \) = direct potential solar radiation calculated from topography and solar geometry
- \( T^+ \) = positive degree-days (input)
Temperature Index Melt Model

\[
M = (\sigma + \alpha K)T^+
\]

- Air temperature
- Solid precipitation
- Mass balance observations

CALIBRATION
- Simulated mass balance
- Mass balance observations

Map showing the mass balance observations with a map color scale ranging from -2 to 0.5 dh (m yr⁻¹ w.e.) with a value of \(-0.69 \text{ m yr}^{-1}\) at a specific location.