

An aerial photograph showing a large, dark brown landslide scar cutting through a dense green forest. The landslide is roughly vertical, starting from the top center and extending down towards the bottom center. The surrounding forest is lush and green, with some smaller, more horizontal landslide scars visible in the lower left and right areas.

# **Landslides in Sitka**

**Katherine (K.K.) Prussian, Hydrologist and  
Jacqueline Foss, Soil Scientist, Tongass NF**

Starqaven Landslide

Photo courtesy of John Reed



- General Dynamics of Landslides
- Recent Sitka Area Slides
- Geo Task Force Efforts



Photo – Rob Dunbar/Scott Harris

# Parts of a slide

- Initiation
- Runout
- Deposition

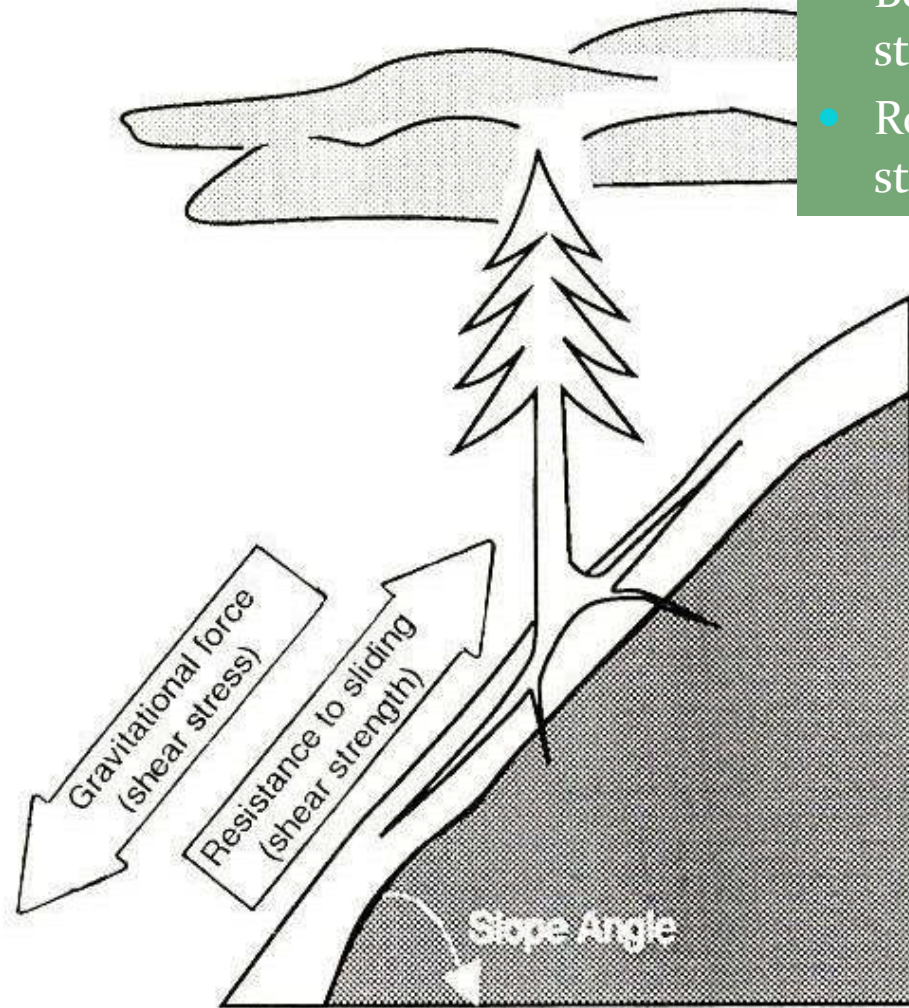


# Why Landslides Happen

- Topography
- Geology
- Soils
- Water
- Vegetation
- Wind
- Earthquakes



- Bedrock structure/shape
- Roots and soil strength



*Diagram of force acting on a vegetated slope*

- Weight of the hillslope material
- Slope
- Pore pressure

# Topography

- How steep is the hill?
- What is the shape?

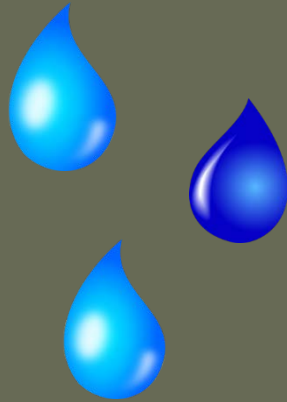




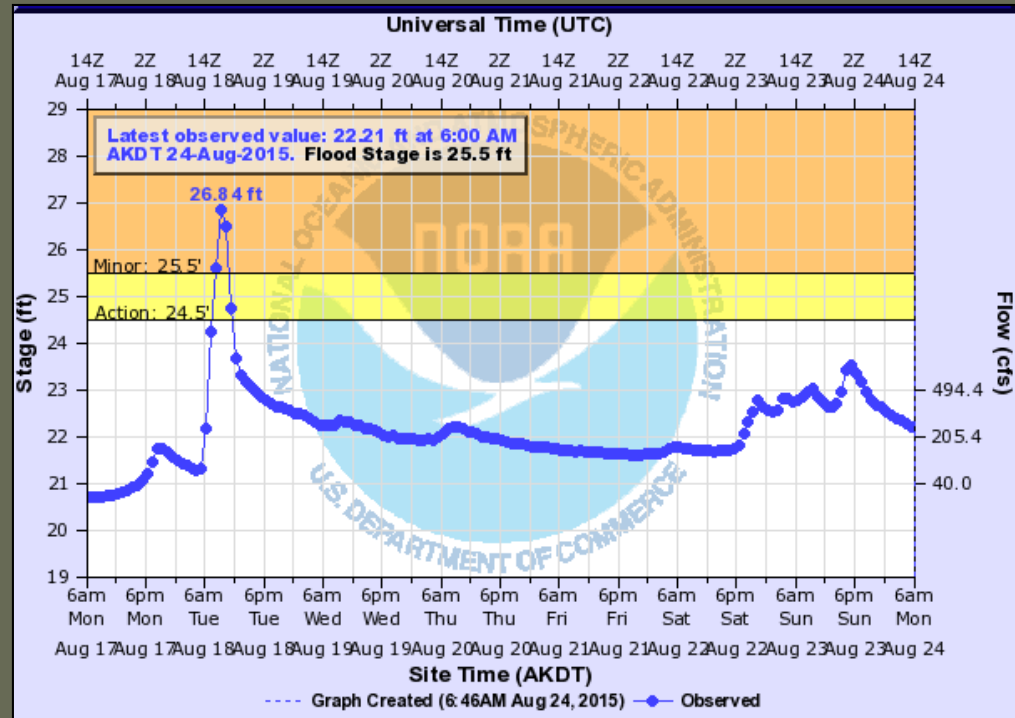
# Bedrock



# Water



- Amount of rainfall
- Rate of rainfall
- Previous rainfall
- How does it move into and through the soil?



Indian River hydrograph.  
Two, 2-inch storms.



# Soils





# Vegetation





# Sitka has it all,...

- Bedrock = smooth rock and slick till
- Soils = ash and glacial till
- Topography = steep slopes
- Abundant rainfall



# Colluvium





# Glacial Till



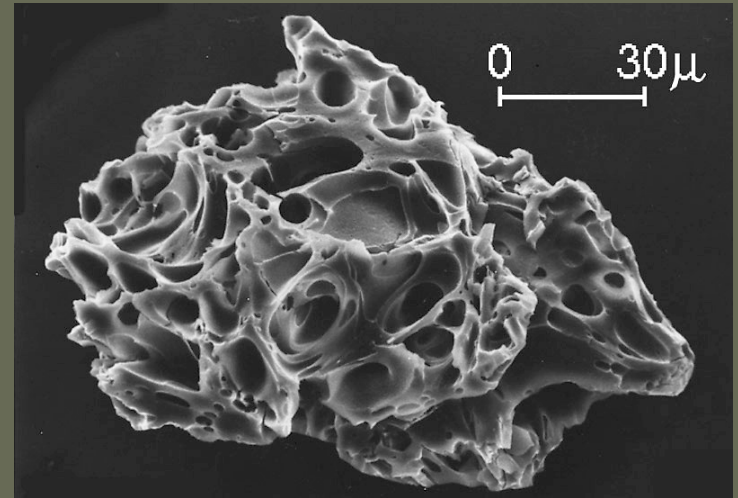


# Glacial Till





# Ash Soil





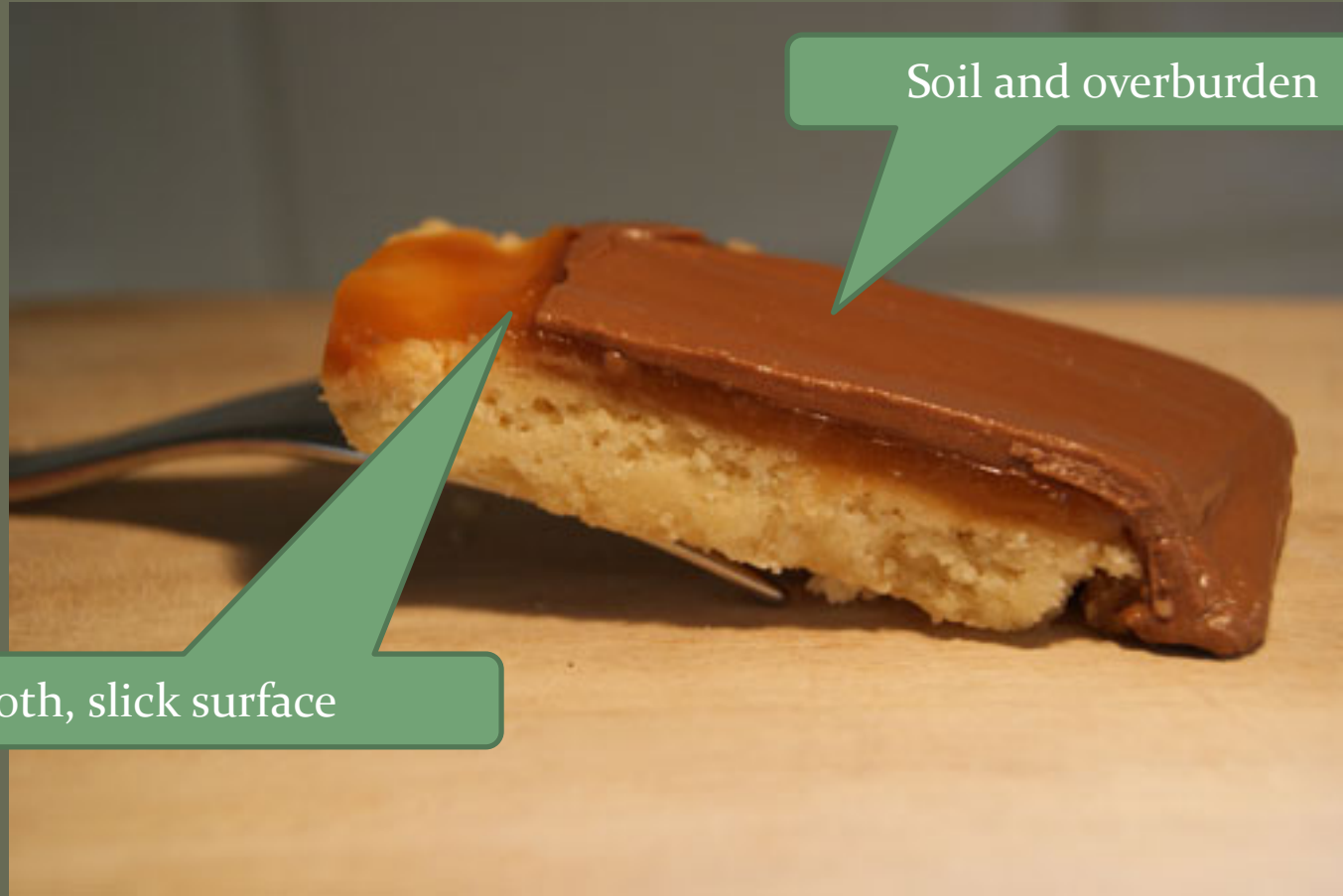
# Ash Soil





# Initiation

Slip plane - where water meets a smooth, slick surface



Soil and overburden

Smooth, slick surface

# Recent Sitka Area Slides



# Redoubt





# Starrigavan





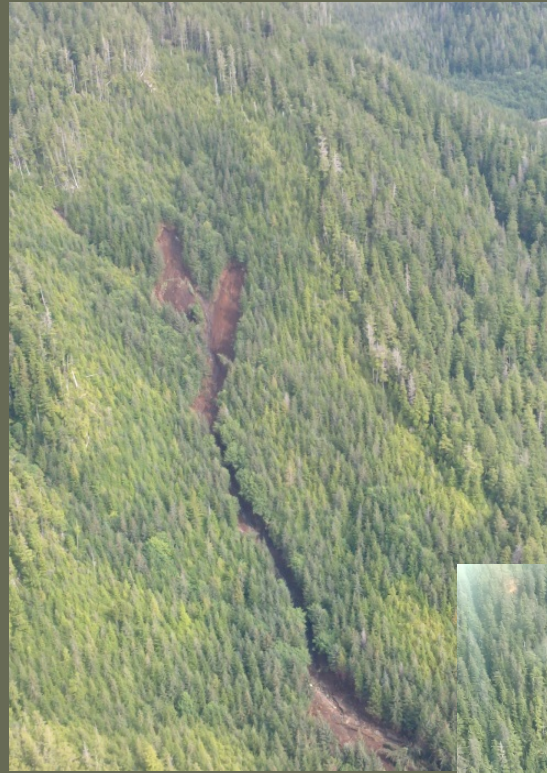
# Landslides Happen

- Southern Southeast Alaska, November 1988 - 100's
- Prince of Wales, October 1993 - 100
- Prince of Wales, January 2014 - 35
- Sitka Area-Khaz Peninsula August 2015 - 67

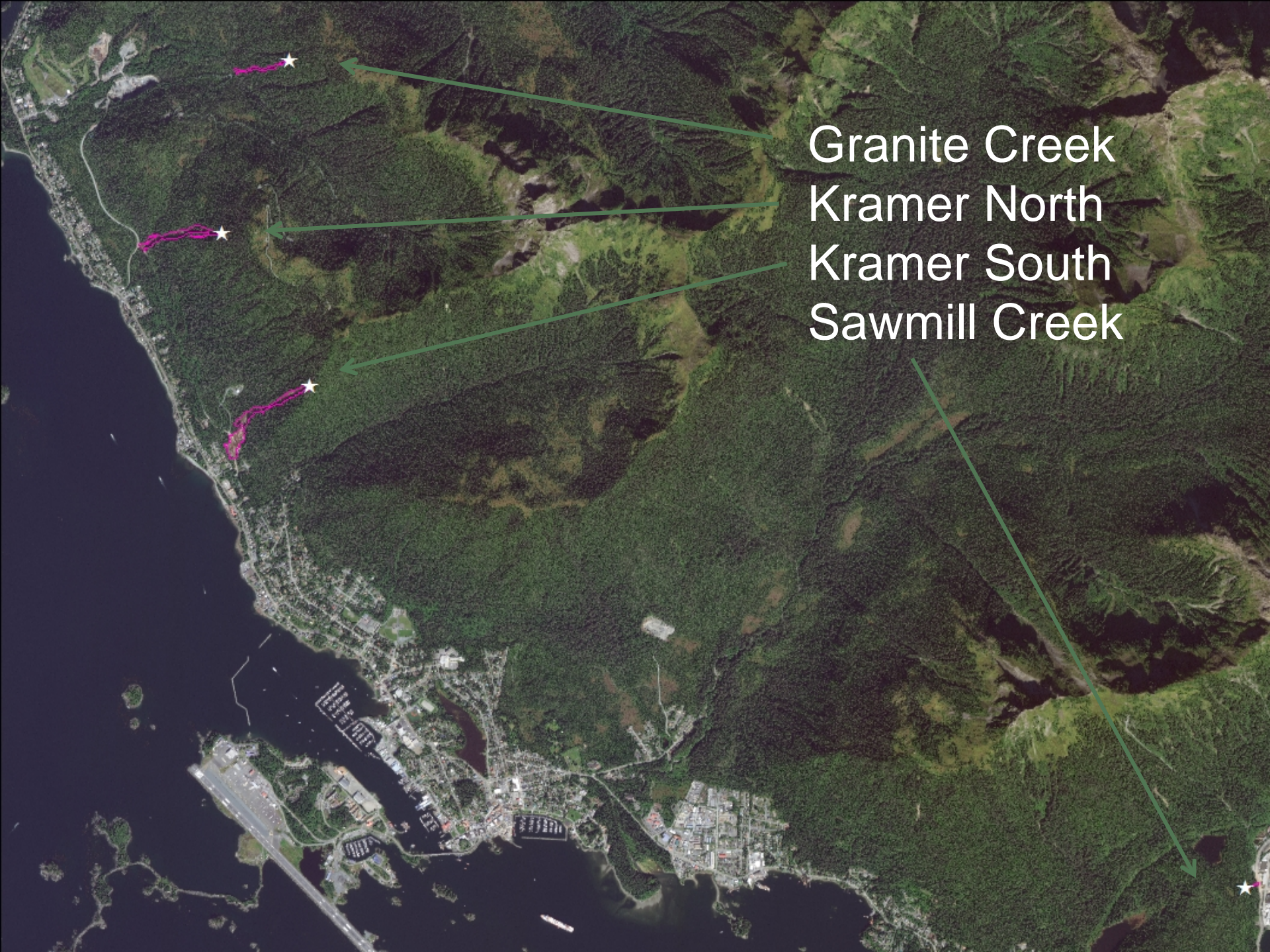


The August 18<sup>th</sup>, 2015, storm resulted in about 67 landslides between Khaz Peninsula and south of Sitka.









Granite Creek  
Kramer North  
Kramer South  
Sawmill Creek



# Sawmill Creek





# Sawmill Creek

Ash to ash contact



Ash to till contact





# Granite Creek





# Granite Creek





# Granite Creek





# Kramer North





# Kramer North





# Kramer North





# Kramer South



Runout Zone of South Kramer Avenue Slide  
10 foot contours and August 26, 2015 imagery





# Kramer South









# Kramer South





# Kramer South





# Kramer South





# Kramer South





# Kramer South





# Kramer South





Past slides on hillslope  
between north and  
south Kramer









# GeoTask Force Efforts



# Geo taskforce

*Who is involved?*

Local, state and federal agencies, universities, non-profit organizations and individuals—coordinated by the Sitka Sound Science Center

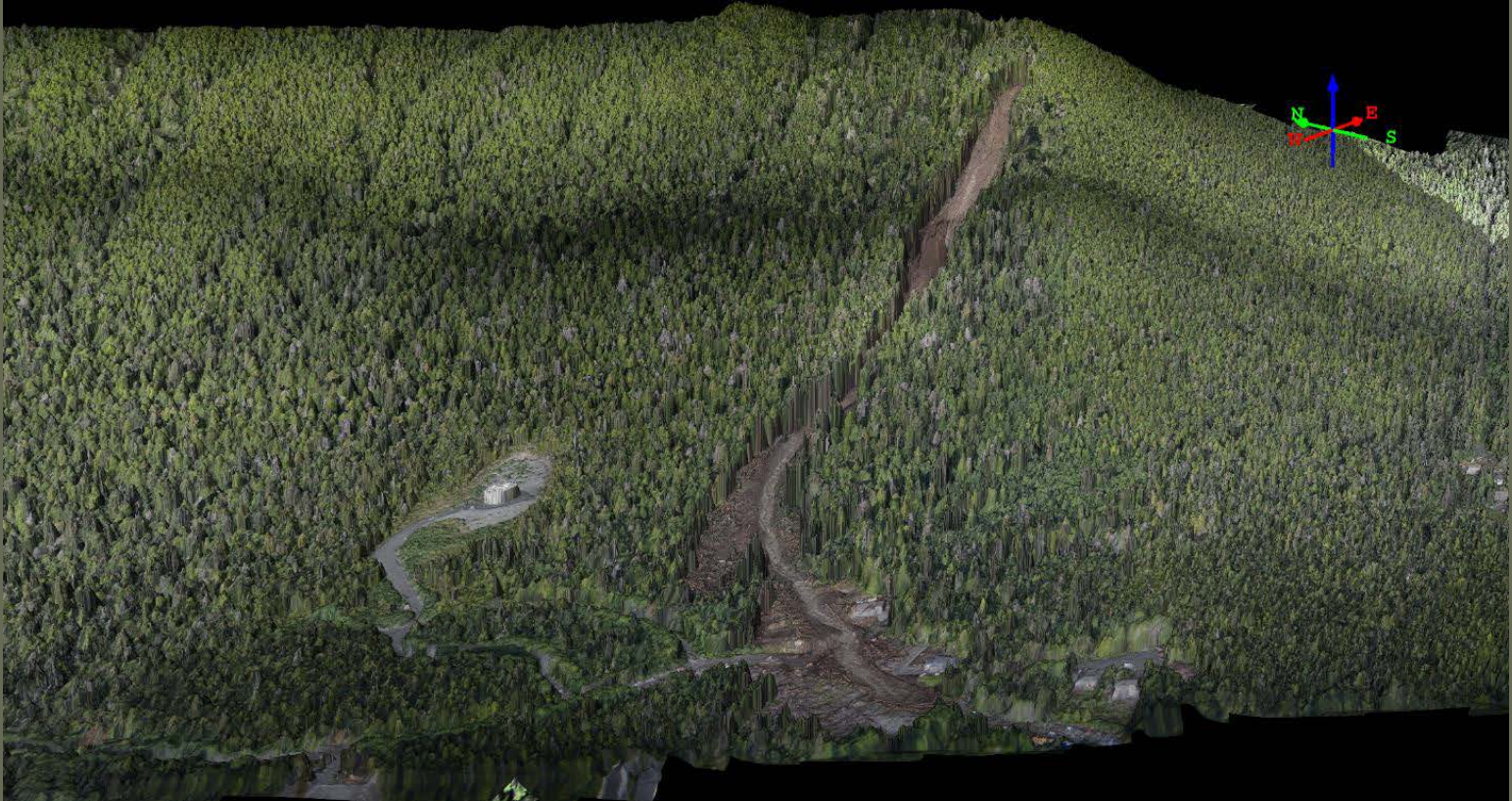
*What are doing?*

Gathering and sharing information on landslide science and management

*Why?*

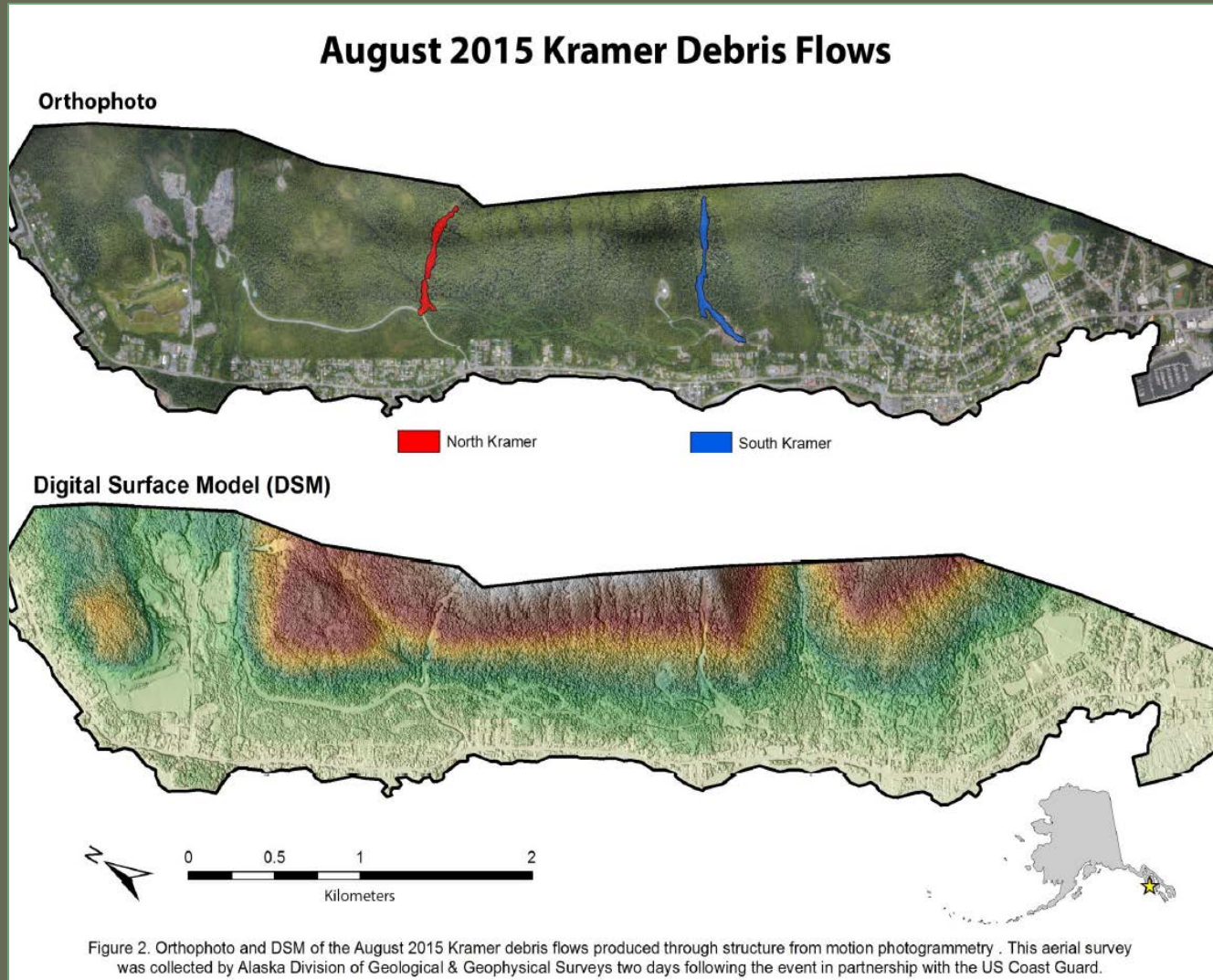
Mapping hillslopes and characterizing existing slides are essential to landslide studies, models, and prediction.

# Alaska Geological and Geophysical Survey (DGGGS)





# Alaska Geological and Geophysical Survey (DGGS)

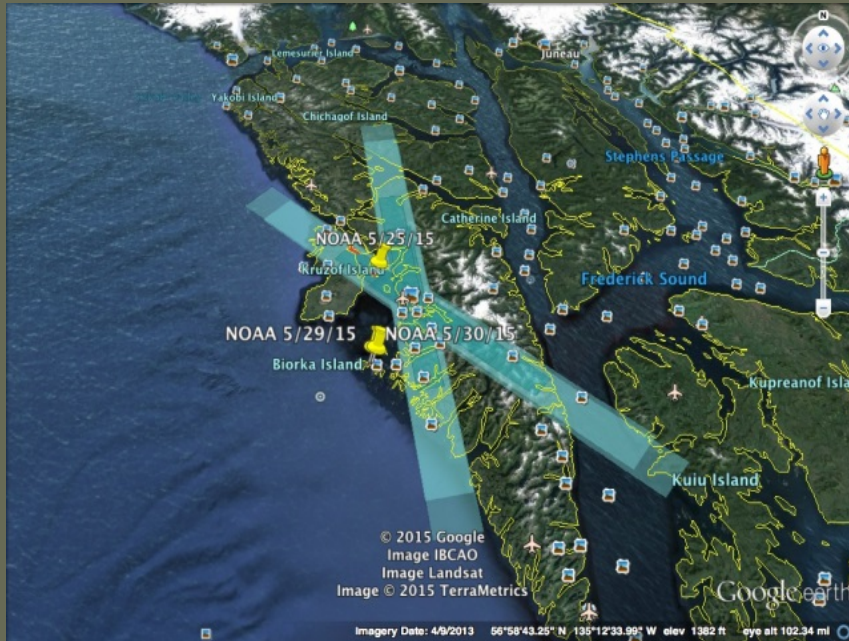


# City of Sitka - Lidar/Imagery

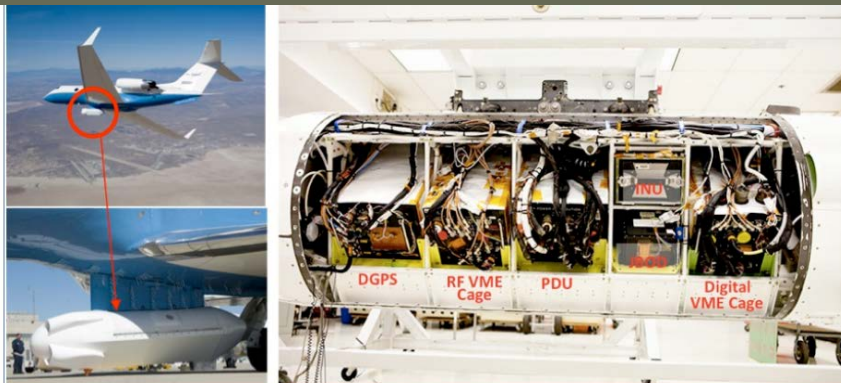




# NASA – Jet Propulsion Lab

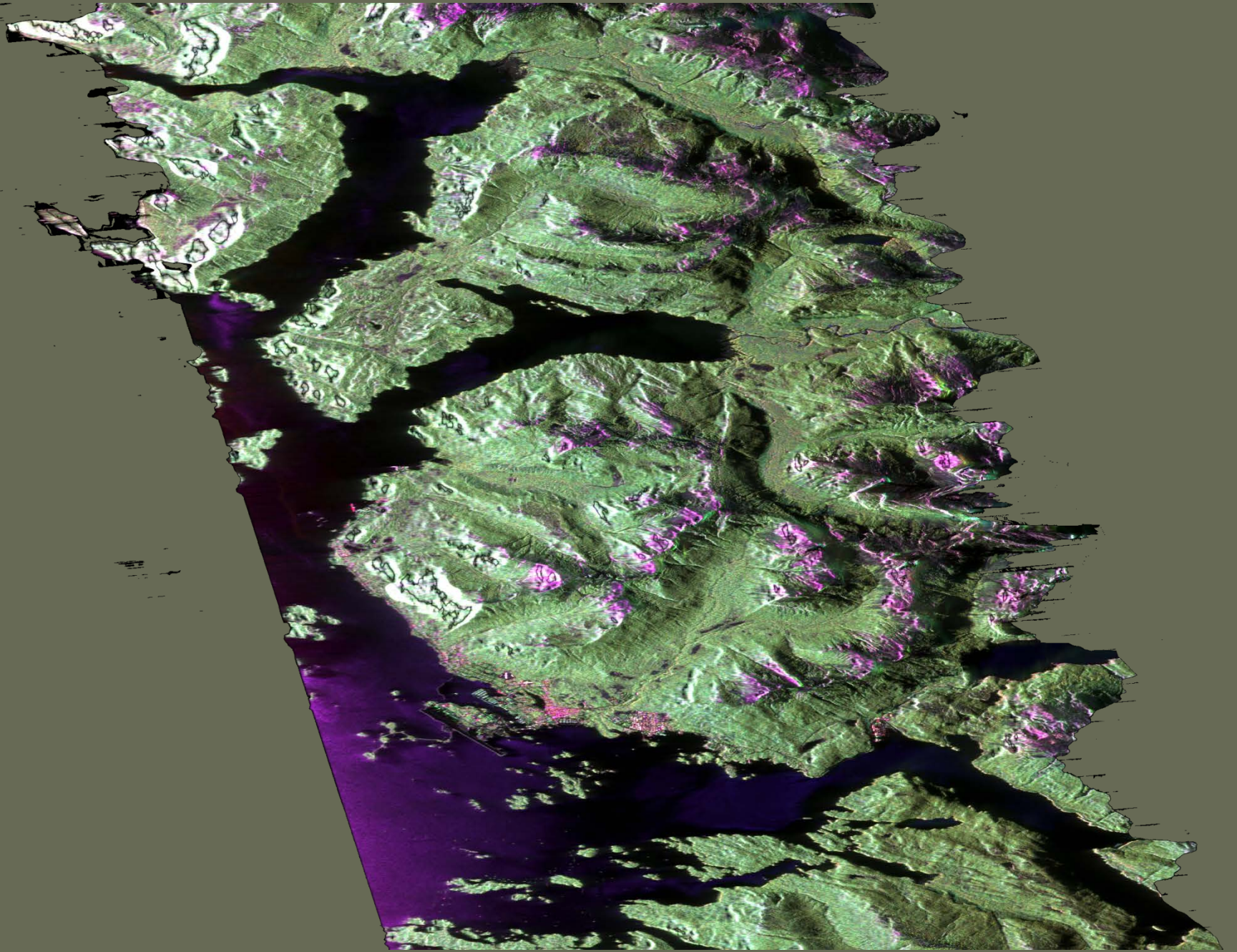


- NASA JPL Gulfstream III UAVSAR
- Airborne Radar
  - Interferometric Synthetic Aperture Radar
- Flew over Sitka 3 times
- Motion Detection - none
- Challenging environment
  - Not a good lab for this work



UAVSAR pod under the Gulfstream-III (G-III) aircraft (left) and the modular design of the pod electronics bay, which enables us to adapt the radar to operate in different frequencies with ease.





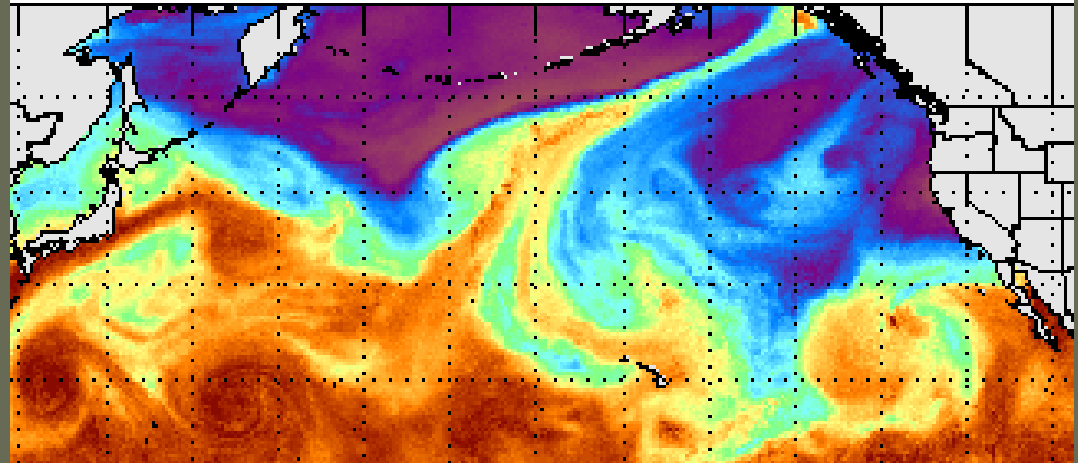


# National Park Service and US Forest Service – World View Imagery

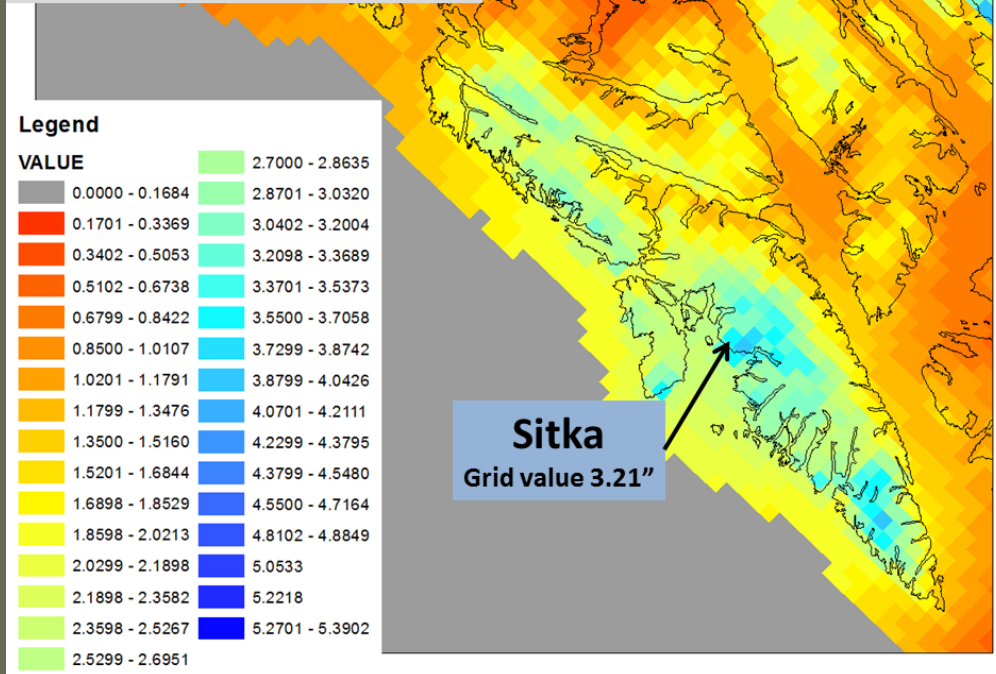


# National Weather Service (NWS)

Morphed composite: 2015-08-18 10:00:00 UTC



Quantitative Precipitation Estimate  
08/18/15 – 6hr period ending at 10am



Sitka Magnetic Observatory Climate Reference Station (CRN)

Duration	Precipitation (inch)	Return Period
5 minute	0.09	< 1 year
30 minute (7:10am-7:35am)	0.45	~ 4 year
1 hour (7-8am)	0.8	~15 year
3 hour (6-9 am)	2.01	~45 year
6 hour (5-10 am)	2.98	~ 25 year

Sitka Airport

Duration	Precipitation (inch)	Return Period
1 hour (7-8am)	0.58	~ 4 year
3 hour (6-9 am)	1.7	~ 25 year
6 hour (5-10 am)	2.58	~ 18 year

Starrigavan rain gauge

Duration	Precipitation (inch)	Return Period
1 hour (7-8 am)	0.73	NA
3 hour (6-9 am)	1.9	NA
6 hour (5-10 am)	2.83	NA



# University of Alaska and others - Modeling



South Kramer Avenue Landslide:  
Jacobs Circle to Emmons Street  
Sitka, Alaska

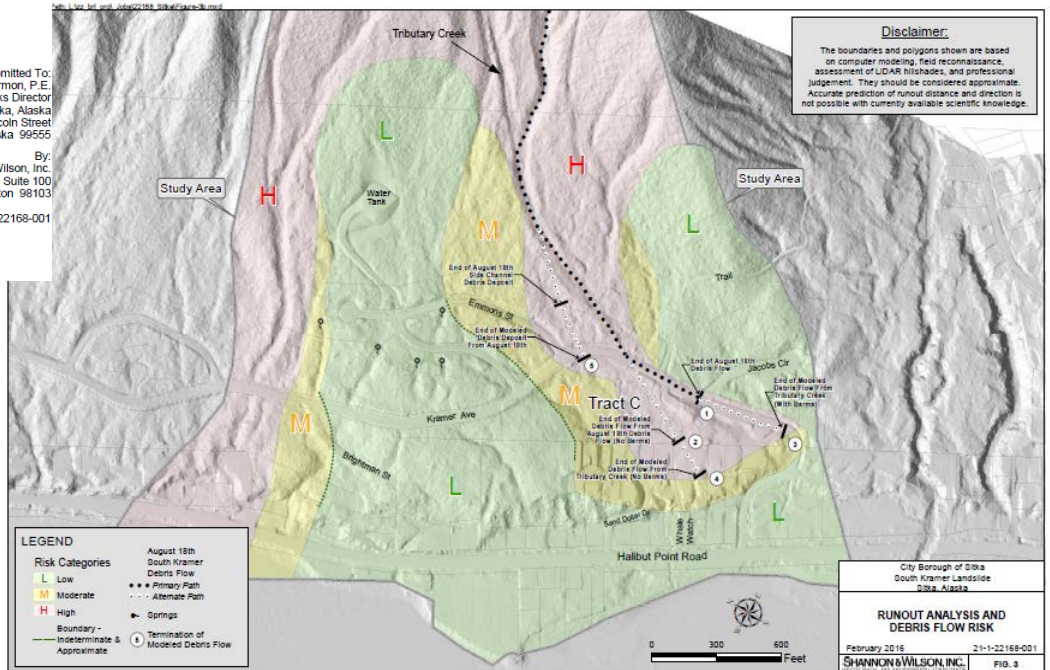
February 2, 2016



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Submitted To:  
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# In Summary

Landslides can happen when:

- Lots of rain
- Steep slopes
- Topography concentrates water

## Sitka Area Slides

- 4+ slides on the road system
- 67 slides from south of Sitka to the Khaz Peninsula Area
- One of several storms in recent history where a single storm resulted in numerous slides

## Geo Taskforce Effort

- An effort of information sharing and networking to bring information to the public and advance our understanding and knowledge of landslides.

# Resource Links

- KK Prussian and Jacquie Foss, Forest Service 747-6671
- Worldview imagery public license
  - <http://hddsexplorer.usgs.gov/> (Choose event: 201508\_Landslide\_AK)
- DGGS website:
  - <http://maps.dggs.alaska.gov/>
- City of Sitka Geotechnical Report for South Kramer
  - [http://www.cityofsitka.com/documents/Sitka\\_SKramerLandslideReport.pdf](http://www.cityofsitka.com/documents/Sitka_SKramerLandslideReport.pdf)
- Geotask report – soon – [sitkascience.org/research](http://sitkascience.org/research)