



Goals of the Project

1. To extract DEMs and orthophotos from aerial photographs from two different data sets, 1979 & 1990
2. Subtract these DEMs from the 2010 LiDAR DEM to determine the spatial distribution of volume change and to obtain a volume change estimate.

Collier Glacier & Three Sisters Volcanoes



Glacier outlines are from the 1:24,000 USGS quadrangle from 1957

- Volcanoes located 25 miles west of Bend Oregon
- Three Volcanoes all over 3060 meters in elevation
- 14 named glacier with Collier being the largest
- Collier - North aspect glacier between Middle and North Sister
- Most studied glacier on the volcanoes

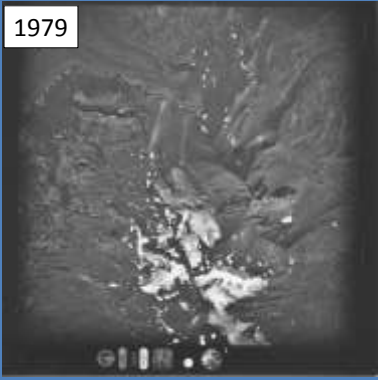
Qualitative Repeat Photography



Photo R. Simms


Photo Weiprecht USGS

1979



Data

1990

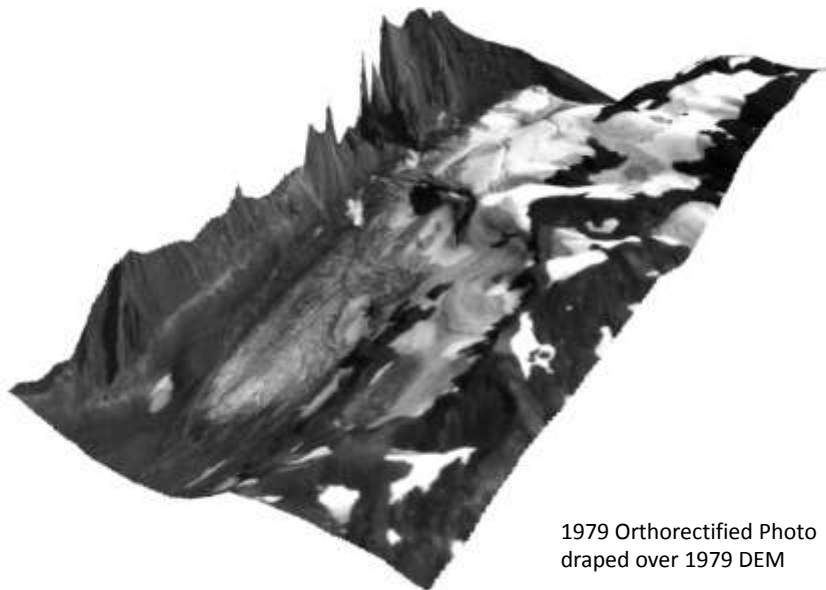
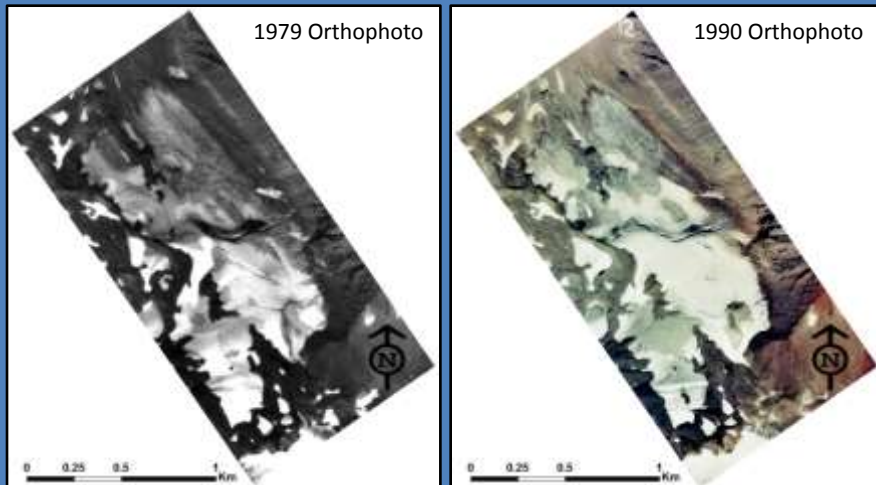


Image/DEM Name	Type	Date	Source	Resolution
790929_USGS138.tif	Vertical Aerial	September 29, 1979	USGS	600DPI
790929_USGS141.tif	Vertical Aerial	September 29, 1979	USGS	600DPI
091490_236.tif	Vertical Aerial	September 14, 1990	USDA	600DPI
091490_237.tif	Vertical Aerial	September 14, 1990	USDA	600DPI
091490_238.tif	Vertical Aerial	September 14, 1990	USDA	600DPI
091490_239.tif	Vertical Aerial	September 14, 1990	USDA	600DPI
2005_orthophoto.img	Orthophoto	2005	NAIP	.5 meter
LiDAR_DEM	DEM	2010	DOGAMI	1 meter

Methods & Error Analysis

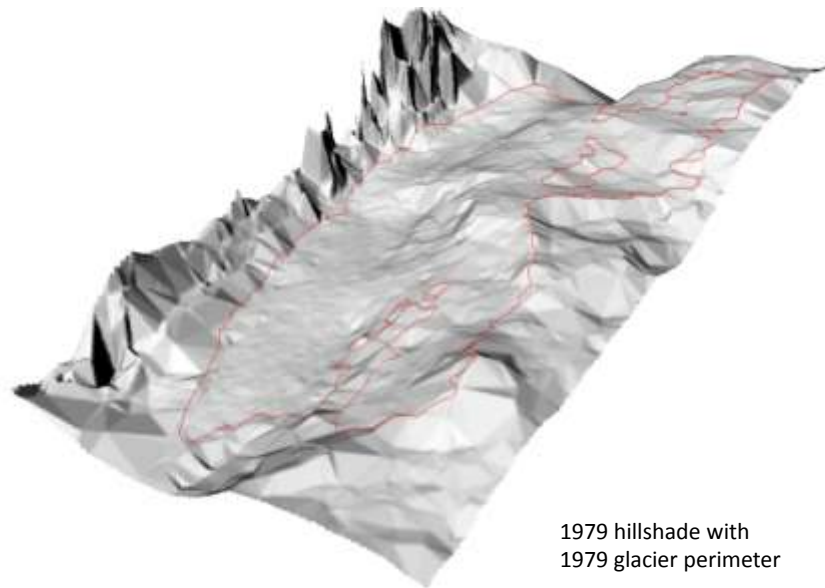
- Software
 - ERDAS LPS
 - Orthorectification and DEM creation
 - ArcGIS
 - Volume change analysis
 - Hillshade
 - Raster math
 - Cut and fill
 - Longitudinal profiles
- Triangulation (RMSE)
 - 1979
 - 1.616 pixels
 - 1990
 - 1.479 pixels
- No tie points were used if on glacier surface.
- GCP were selected from 2005 NAIP Orthorectified Imagery and 2010 LiDAR DEM
- 5 meter resolution for all DEMs

Orthorectified Photographs

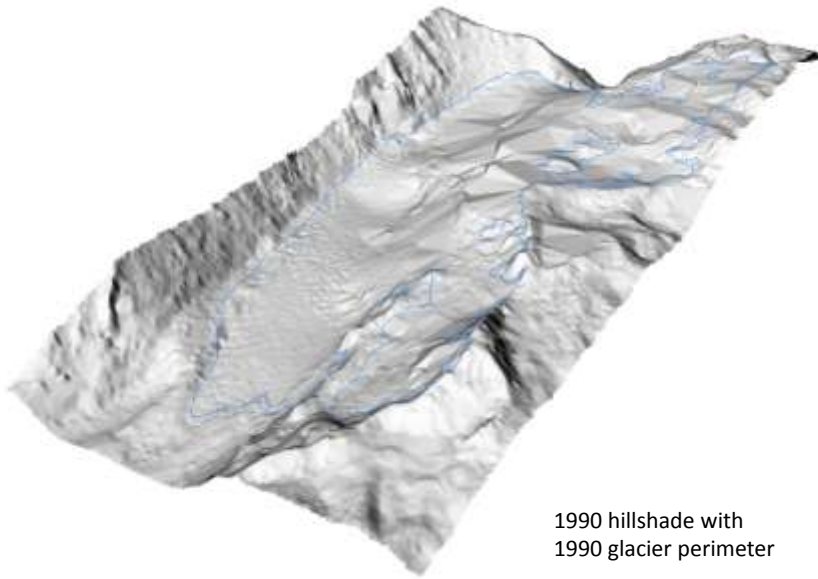




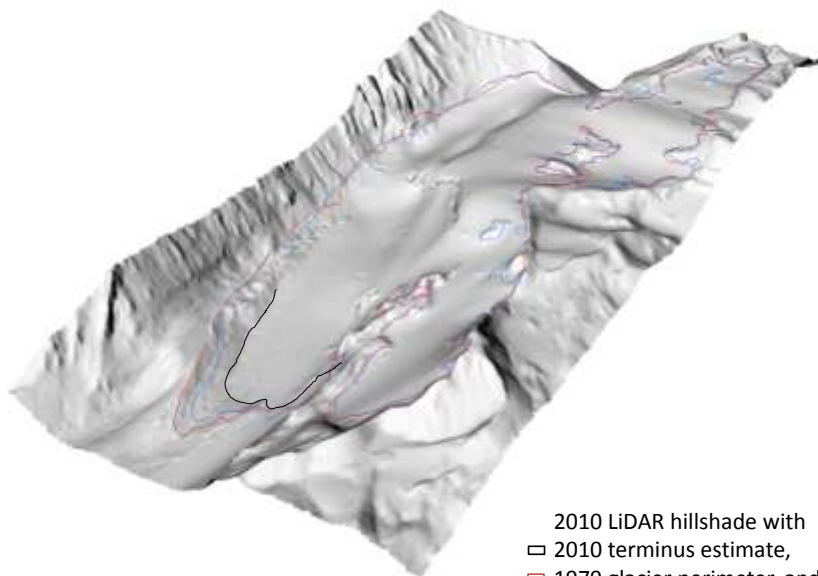
1990 Orthorectified Photo
draped over 1990 DEM



1979 hillshade with
1979 glacier perimeter



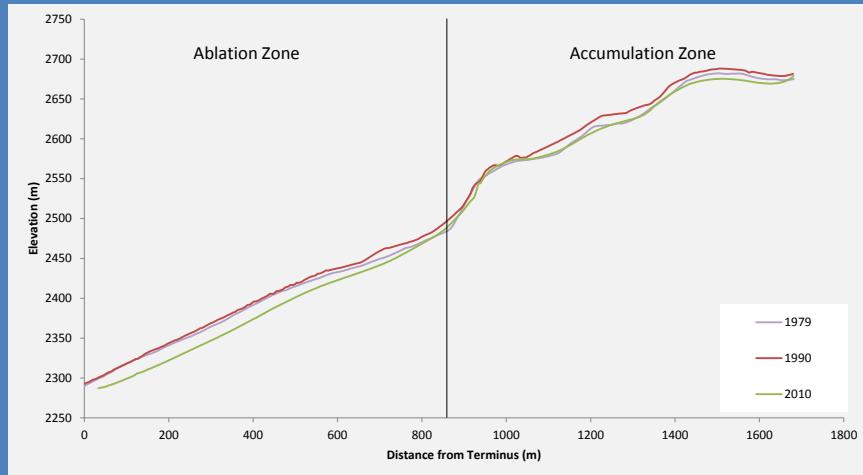
1990 hillshade with
1990 glacier perimeter



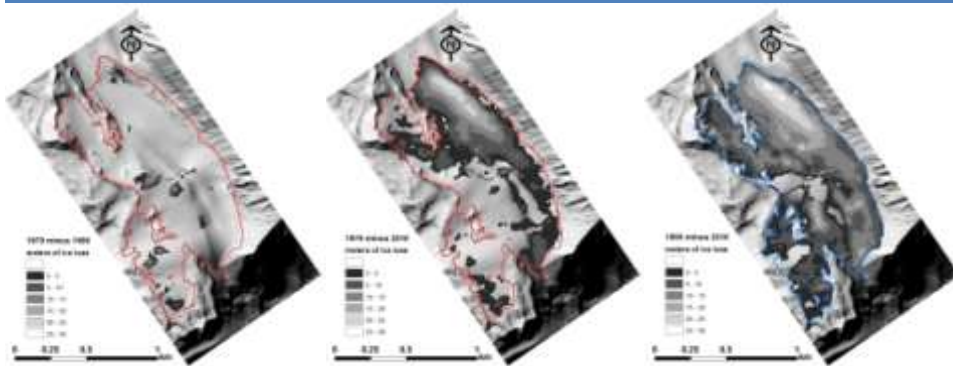
2010 LiDAR hillshade with
2010 terminus estimate,
1979 glacier perimeter, and
1990 glacier perimeter

Thickness Change

Longitudinal Profile



Spatial Distribution of Volume Change



	Δ Volume (km ³) Total Glacier	Δ Volume (km ³) Ablation Zone	Normalized Height Change (m)
1979 to 1990	0.0068	0.0033	6.32
1979 to 2010	-0.0021	-0.0029	-1.95
1990 to 2010	-0.0088	-0.0061	-8.37

Conclusion and Discussion

- 1979 DEM was not trusted
- ΔVolume from 1990 to 2010 was $-.0088\text{km}^3$ which equates to a 8.37 meter drop across the glacier.
- Ablation zone of the glacier showed most volume change
- Accumulation zone elevation should be roughly the same height over time except for seasonal snow changes
- Error analysis needs to be conducted by comparing bedrock points

Questions?

