ESTIMATION OF GLACIERS CHANGE IN THE GLACIER BAY NATIONAL PARK, ALASKA

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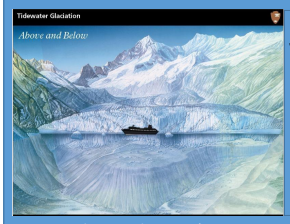
Introduction

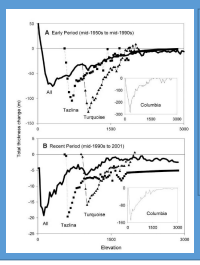


Tidewater glaciers are glaciers that terminate in the ocean at either a grounded terminus or floating ice tongue.

Fig. 1. Tidewater glaciation (Image source: National Park Service).

Discharge large amounts of ice in a short period highlights their potential hazard to shipping traffic.

Fig. 2. A big ice piece split off from glacier (Image source: National Park Service).



Average global sea level (SLE) rises and falls in response to climate change (IPCC 2007).

Extrapolated annual volume loss from Alaska glaciers equal to –96 35 km3 /year, or 0.27 0.10 mm/year SLE, during the past decade (Arendt et al. 2002)..

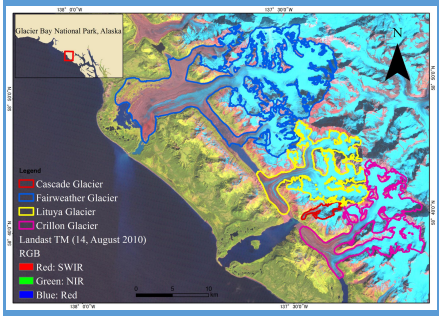
These recent losses are nearly double the estimated annual loss from the entire Greenland Ice Sheet during the same time period (Arendt et al. 2002).

Fig. 3. Thickness change versus elevation during the early (A) and recent (B) periods based on Alaska Glaciers (Arendt et al. 2002).

Objective

Estimate glaciers (Fairweather Glacier, Lituya Glacier, Crillon Glacier, and Cascade Glacier) area and elevation changes in Glacier Bay national park during 2000-2012.

Study area



Data

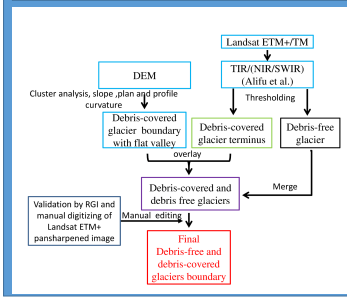
Type	Date (Y/M/D)	Resolution
Landsat ETM+* Landsat TM	2001/8/13 2010/8/14	VNIR 30 m SWIR 30 m TIR 120 m
SRTM V4*	2000/2	30 m
Interferometric Synthetic Aperture Radar (IFSAR) Alaska*	2012/8/14	5 m

	Time period	Source
Randolph Glacier Inventory(RGI)^	~2010	Vector maps based on the Satellite images

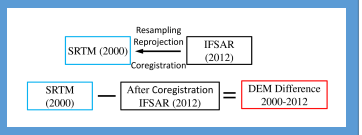
*Were downloaded from USGS EarthExplorer;
^ was downloaded from GLIMS.

Methodology

Glacier mapping

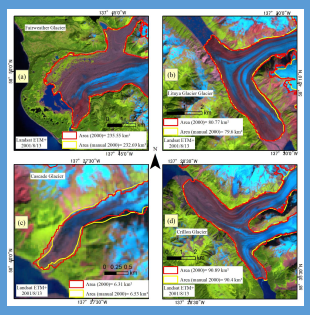


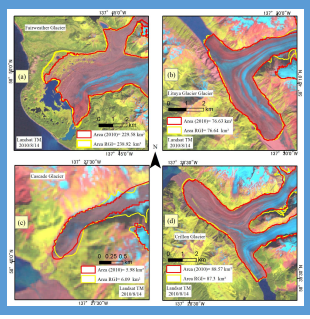
Elevation change



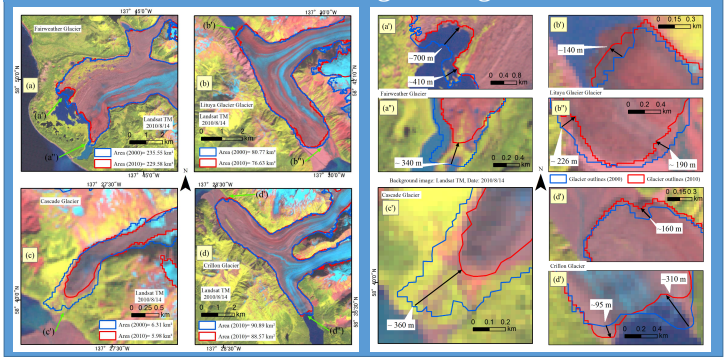
Validation of glacier maps

Fig. 4. Comparisons of glacier maps derived from this study with reference maps.

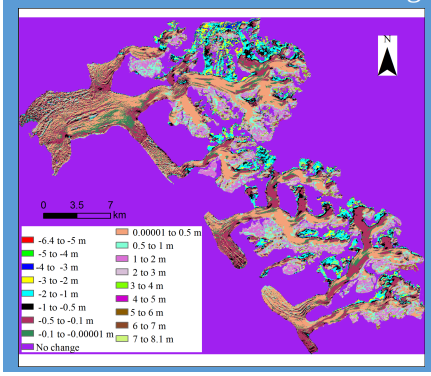




Results - Glacier area change during the 2001-2010



Results - Glacier elevation change during the 2000-2012



In generally, surface thickness change of glaciers terminus region were in various degrees.
North part of Lituya Glacier and Crillon Glacier terminus region showed that incresing their thicnknes (0.0001~0.5 m).

Most large thinning glacier surface was occurred in the accumulation region in the North direction (-1 ~ 6.4 m).

In contrast, thickening of glacier surface was occurred in the accumulation region in the Southeast direction(1 ~ 8.1 m).

Conclusions

In this study, we experimentally estimated the glacier change using Landsat images and DEM.
The result of glacier area change indicated that glacier area in this region showing the low retreating speed (0.03 ~ 0.6 km²/year) during the 2001-2010. In contrast, of glacier area change, result of glacier elevation change indicated that maximum surface lowering of – 6.4 m and rising about 8.1 m in the accumulation area which were observed during 2000 - 2012.
However, result of glacier elevation change needs to future analysis error causes, which may be caused by differential, signal penetrations through the snow, and therefore probably reflect a seasonal artifact, due to the deep winter snow layer.

Refereces
1). Solomon, Susan, et al. "IPCC, 2007: summary for policymakers." *Climate change* (2007): 93-129.
2). McNabb, R. W., and R. Hock (2014), Alaska tidewater glacier terminus positions, 1948–2012, *J. Geophys. Res. Earth Surf.*, *119*,153–167, doi:10.1002/2013JF002915.
3). Arendt, Anthony A., et al. (2002), "Rapid wastage of Alaska glaciers and their contribution to rising sea level." *Science* 297.5580: 382-386.
4). Alifu, H., Tateishi, R. and Johnson, B. (2015), A new band ratio technique for mapping debris-covered glaciers using Landsat imagery and a digital elevation model, International Journal of Remote Sensing, 36:8, 2063-2075.
5). Alifu, H. and Tateishi, R. (2015), Delineation of debris-covered glaciers using morphometric analysis and band ratio method, Proceedings 58th The Remote Sensing Society of Japan conference, Chiba, Japan, Jun 2-3, 2015.