Glaciological and hydrological sensitivities in the Hindu Kush - Himalaya

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Motivation

Snow and ice melt contributions to streamflow will be affected by climate change. In the Hindu Kush - Himalaya region, this can adversely affect hydroelectric power generation, irrigation, and drinking water supplies.
The potential increase in streamflow or change in the timing of peak flows due to increased melt depends in part on the current distribution of glaciers, and the sensitivity of the equilibrium line altitude (ELA) to temperature change.
This study presents a basin-scale approach to estimate glaciological and hydrological sensitivities to future climate change, and future work will estimate the increases in glacier melt in response to climate change.

Data and Methods

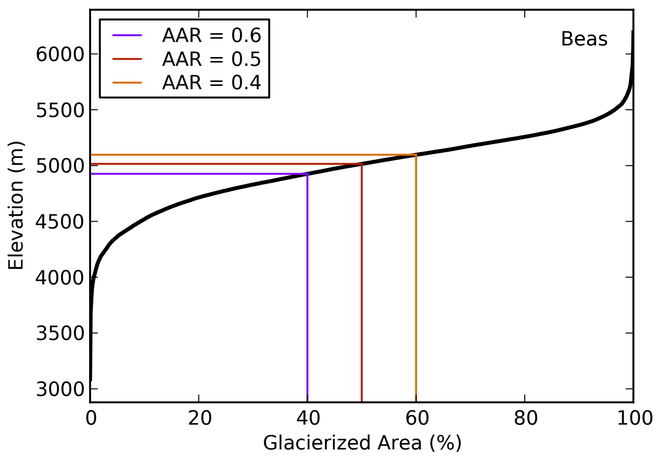

Figure 1. For each sub-basin, steady-state ELAs are derived from glacier inventory data (Bajracharya et al., 2014) and SRTM DEMs.

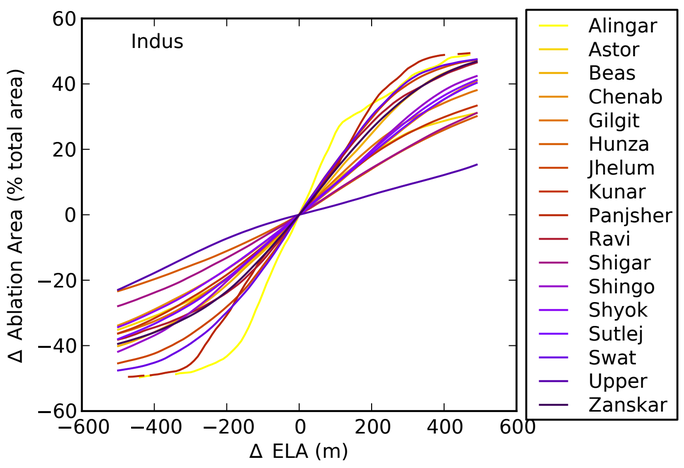

Figure 2. Relative and absolute change in ablation area versus change in ELA (+/- 100 m) is calculated for each sub-basin. and mapped.

Glaciological Sensitivity

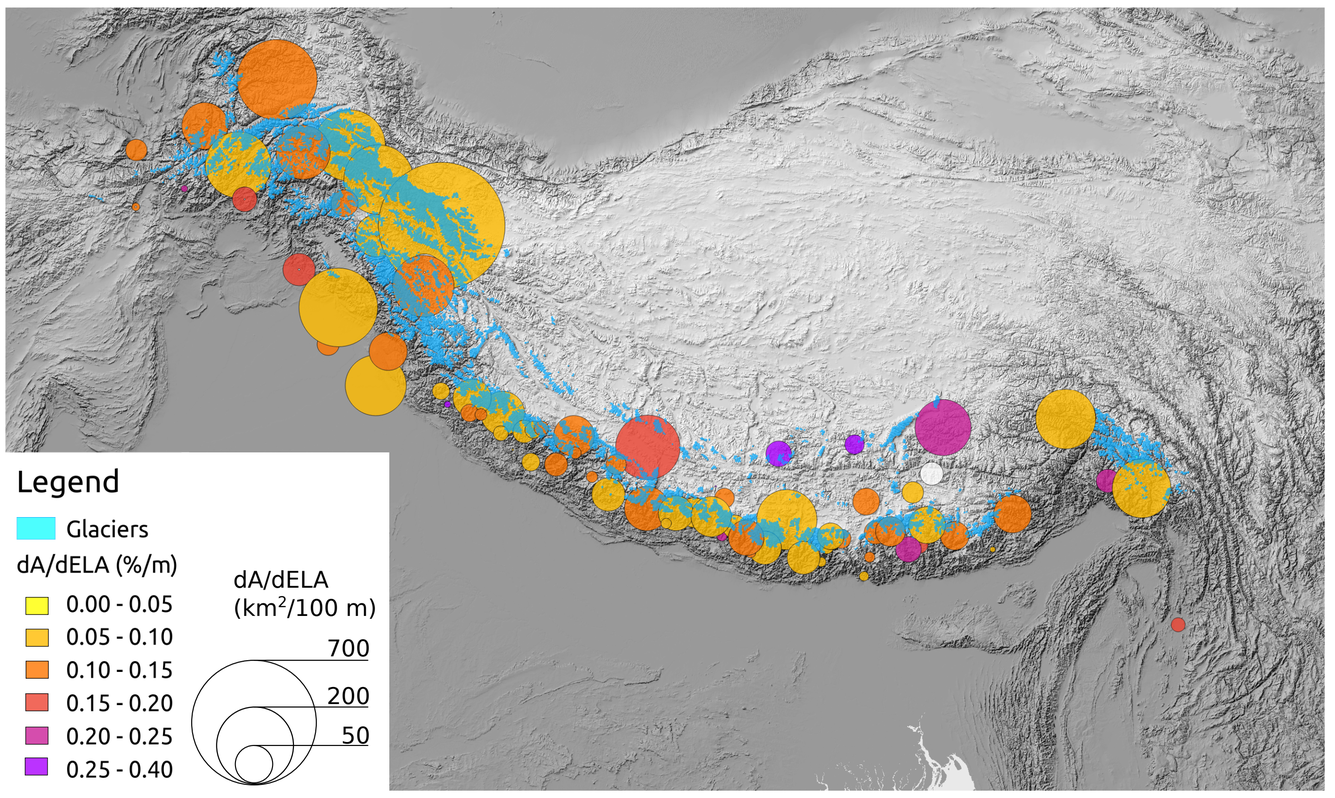

Figure 3. Relative (colour) and absolute (size) glaciological sensitivities in the HKH.

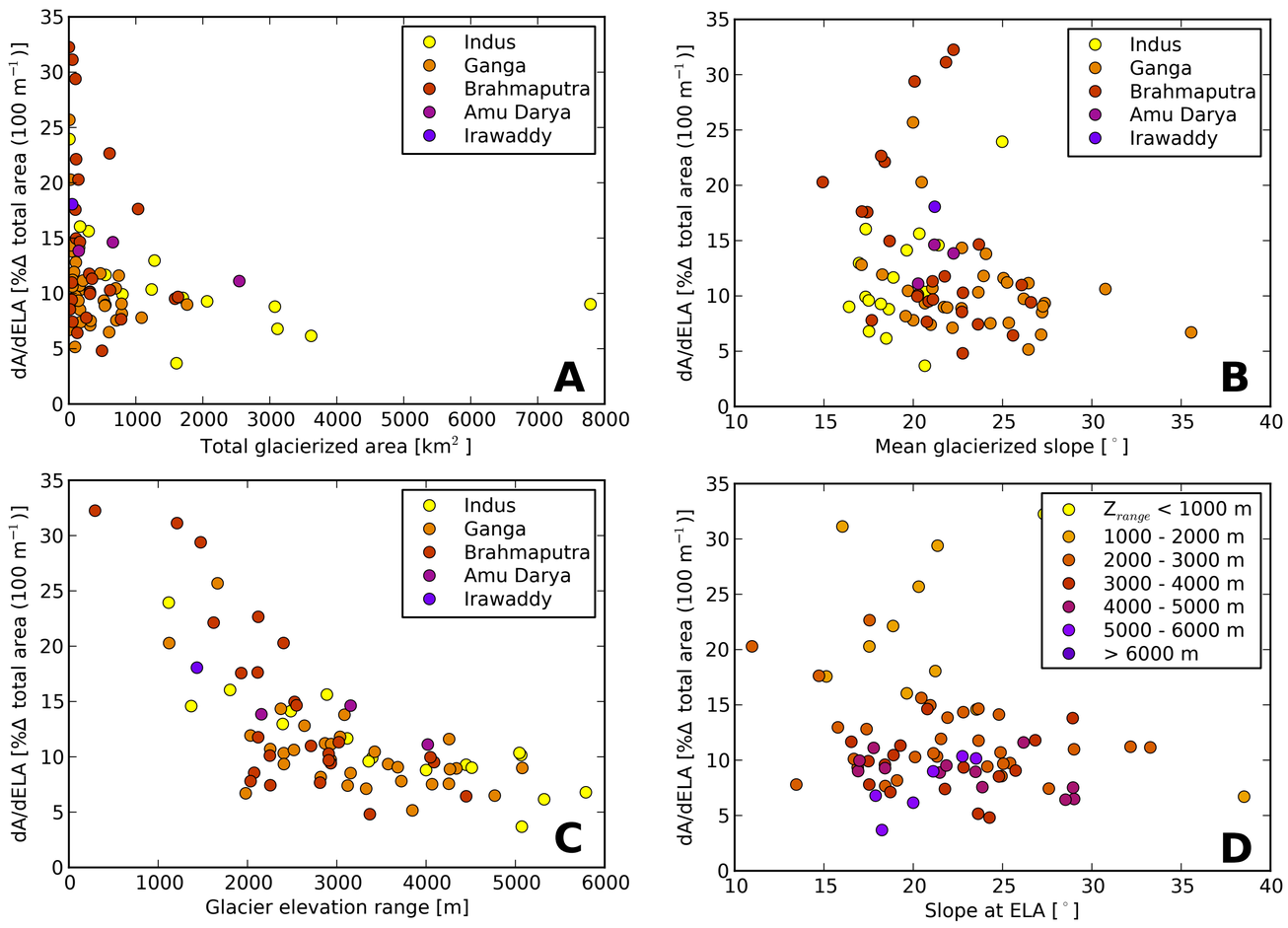

Figure 4. Relations between dA/dELA and (A) total glacierized area, (B) Mean glacierized slope, (C) glacier elevation range, and (D) slope at ELA.

Hydrological Sensitivity

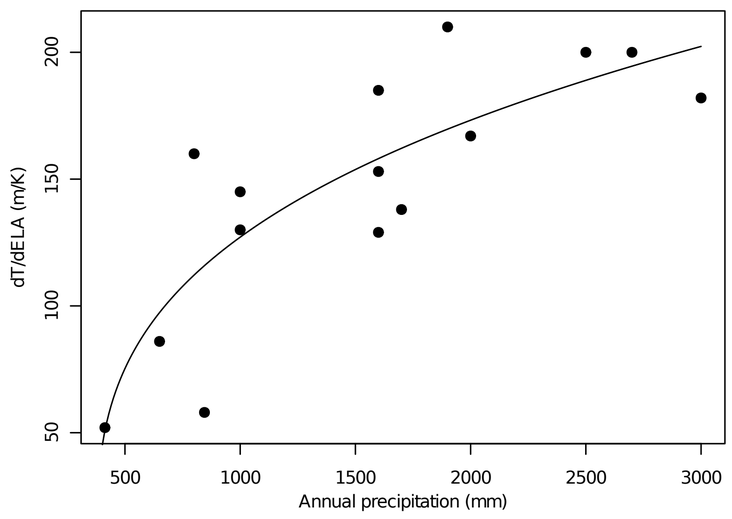

Figure 4. ELA temperature sensitivity versus mean annual precipitation for tropical and sub-tropical sites (see references)

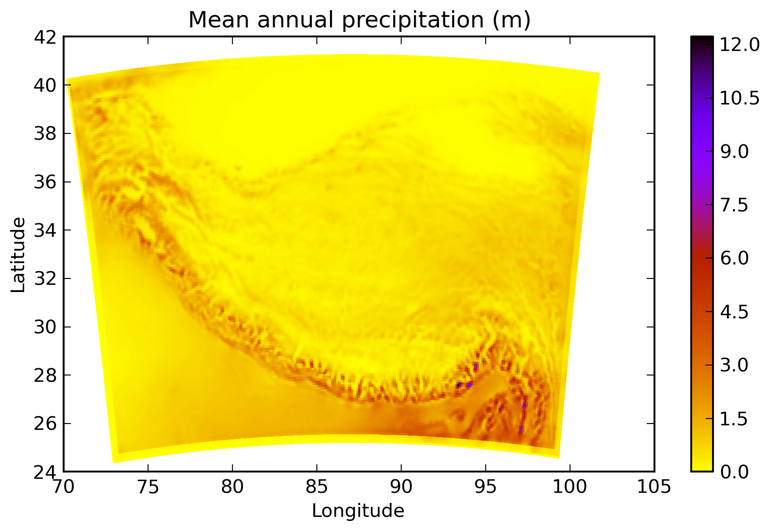

Figure 5. Mean annual precipitation (2001 - 2012) from the High Asia Reanalysis Project (Maussion et al., 2013)

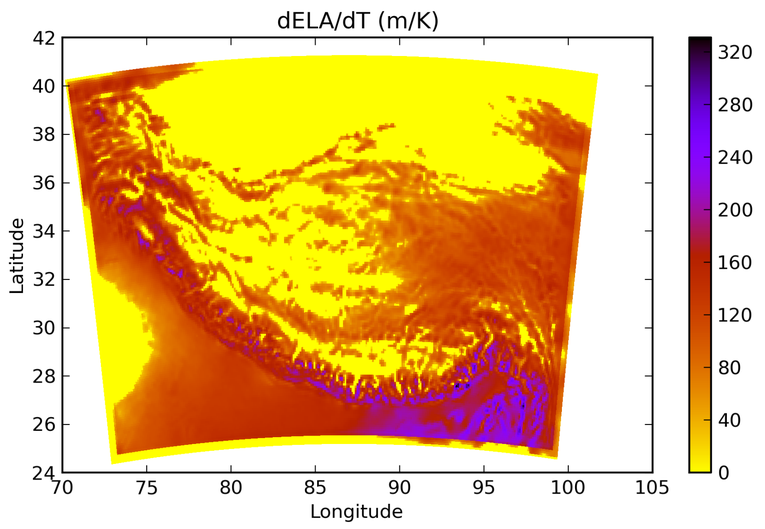

Figure 6. Estimated ELA temperature sensitivity (m/K) for the HKH Region, based on mean annual precipitation and curve fit in Figure 3.

Acknowledgments: This work is funded by the Norwegian Ministry of Foreign affairs through their support of the ICIMOD Cryosphere Program, and by ICIMOD core donations from regional member countries.

References: Bajracharya et al. (2014) ICIMOD; Maussion et al., (2014), J. Clim., 27(5), 1910-1927; Shi, Y., & Liu, S. (2000) Chi, Sci. Bull, 45(7), 668-672; Zhang, Y., et al. (1998), Bull. Glac. Res 16, 1-11; Stansell, N. D. et al. (2007). Quat. Res. 67(1), 115-127; Sagredo, E. A., et al. (2014). Quat. Res. 81(2), 355-366; SRTM data available at http://www2.jpl.nasa.gov/srtm/.