Supplementary Material: Influence of recent warming and ice dynamics on glacier surface elevations in the Canadian High Arctic, 1995–2014

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The following figures and text present data and that support, but are not essential to the manuscript "Influence of recent warming and ice dynamics on glacier surface elevations in the Canadian High Arctic, 1995–2014". Patterns of *dh*/*dt* for the epochs 1: 1995–2000, 2: 2000–2005/06, and 3: 2005/06–2012/14 are described and presented in Figures S1–S3.

(a) *dh*/*dt*: 1995–2000

Surface elevation changes of glaciers in the QEI during the period 1995–2000 were reported by Abdalati and others (2004). This time interval is included here to allow evaluation of spatial and temporal patterns of *dh/dt* over the entire 1995–2012/14 period. Briefly, from 1995–2000, thinning occurred at lower elevations around the margins of the ice masses as well as along the Thompson (Mueller Ice Cap), and Strand (Steacie Ice Cap) glaciers on Axel Heiberg Island, the Otto Glacier (northwest Ellesmere Island), and the Leffert Glacier (Prince of Wales Icefield) (Fig. S1). Either thickening or no change in surface elevation (*dh/dt* $\geq$ -0.02 m a^{-1}) was observed at higher elevations in the interior regions of most ice masses. Thickening was especially pronounced (> +0.2 m a^{-1}) on the northern Grant Ice Cap, northwest Ellesmere Island, at low elevations (< ~ 750 m a.s.l.), along the east-facing slopes of the Prince of Wales Icefield (mean *dh/dt*: ~ +0.34 m yr^{-1}), and along the lower 5–18 km of the Antoinette Glacier, Agassiz Ice Cap (mean *dh/dt*: ~ +0.37 m a^{-1}).

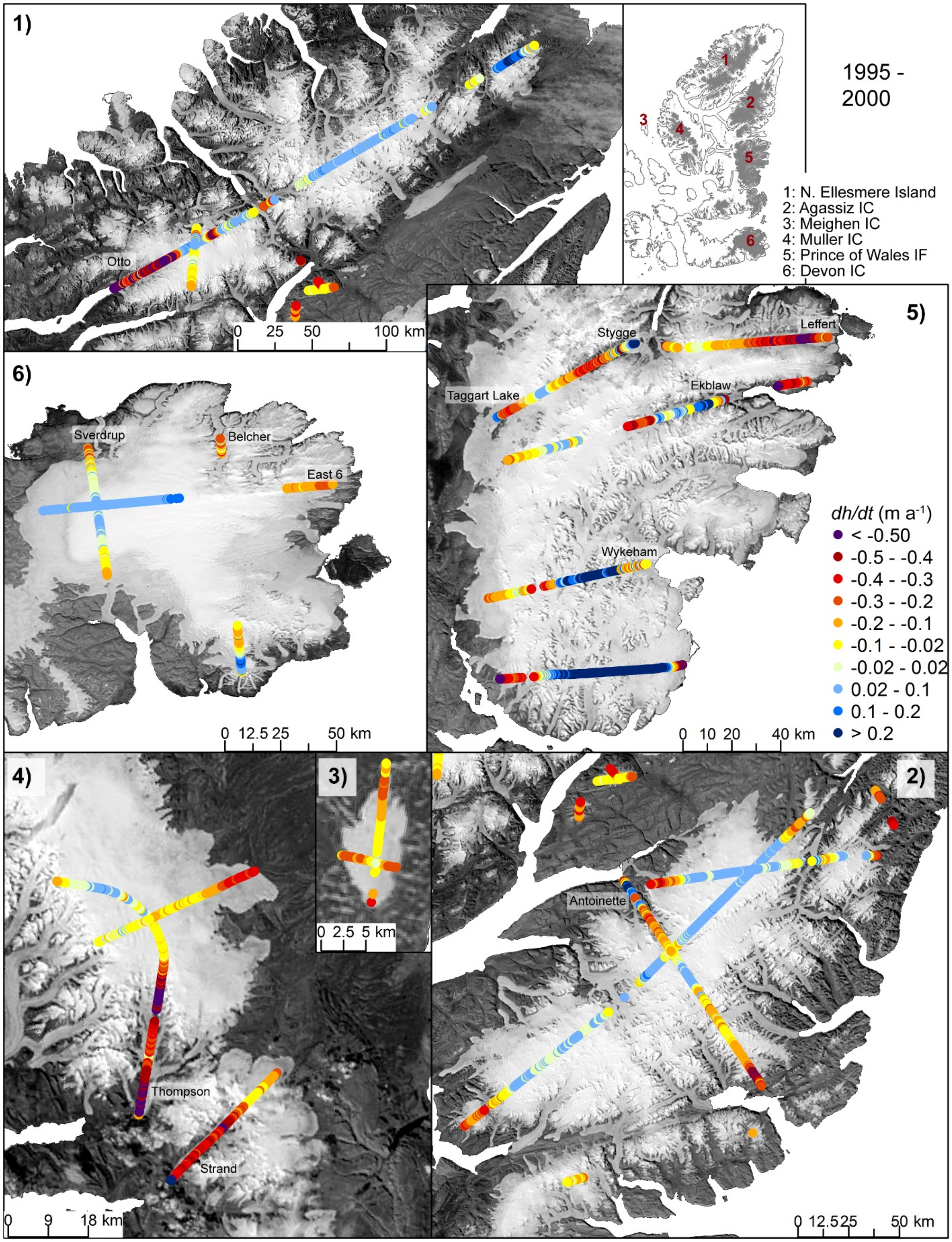

Figure S1: Rate of surface elevation change (m a^{-1}) over glaciated regions of the QEI between 1995 and 2000 (see Abdalati and others, 2004) from repeat airborne altimetry data (IDHDT4), elevation contours from CDED DEM 1:50k.

(b) *dh/dt*: 2000–2005/06

The period 2000–2005/06 was also characterized by thickening at higher elevations and thinning at lower elevations (Fig. S2). A spatial pattern of *dh/dt* similar to that of the previous epoch was observed over much of the Prince of Wales Icefield, with the exception of the Ekblaw Glacier which thickened at an average rate of +0.33 m a^{-1} along its lower ~40 km. Thickening along Ekblaw Glacier is consistent with a marked decrease in the glacier's near-terminus surface velocities between 2000 (~500 m a^{-1}) and 2015 (~150–200 m a^{-1}) (van Wychen and others, 2016), which would have resulted in longitudinally compressive flow and thickening. During the previous epoch, *dh/dt* along the lower ~40 km of Ekblaw Glacier ranged from ~ -0.2 to +0.2 m a^{-1}.

Either thinning or no change in surface elevation (*dh/dt* ≤ +0.02 m a^{-1}) occurred across the northwest sector of the Devon Ice Cap above ~1250 m a.s.l. where thickening (mean *dh/dt*: +0.04 m a^{-1}) occurred during the previous epoch. On the Agassiz Ice Cap, thickening (mean *dh/dt*: ~+0.05 m a^{-1}; local *dh/dt* > 0.1 m a^{-1}) occurred at higher elevations, while thinning (mean *dh/dt*: ~ -0.08 m a^{-1}) was observed in the north-northeast –a region that experienced thickening (mean *dh/dt*: ~ +0.04 m a^{-1}) during the previous epoch. In the western QEI, thickening was observed across much of the interior of the Mueller Ice Cap, where thinning (up to ~ -0.2 m a^{-1}) occurred during the previous epoch. Thinning (< -0.2 m a^{-1}) was observed across the southern portion of northwest Ellesmere Island's ice masses which, in general, thickened (by up to +0.1 m a^{-1}) during the previous epoch. The only exception to this was the Otto Glacier which thinned throughout its lowermost ~ 45 km during the first two epochs (mean 1995–2000 *dh/dt*: -0.47 m a^{-1}; mean 2000–06 *dh/dt*: -0.41 m a^{-1}).

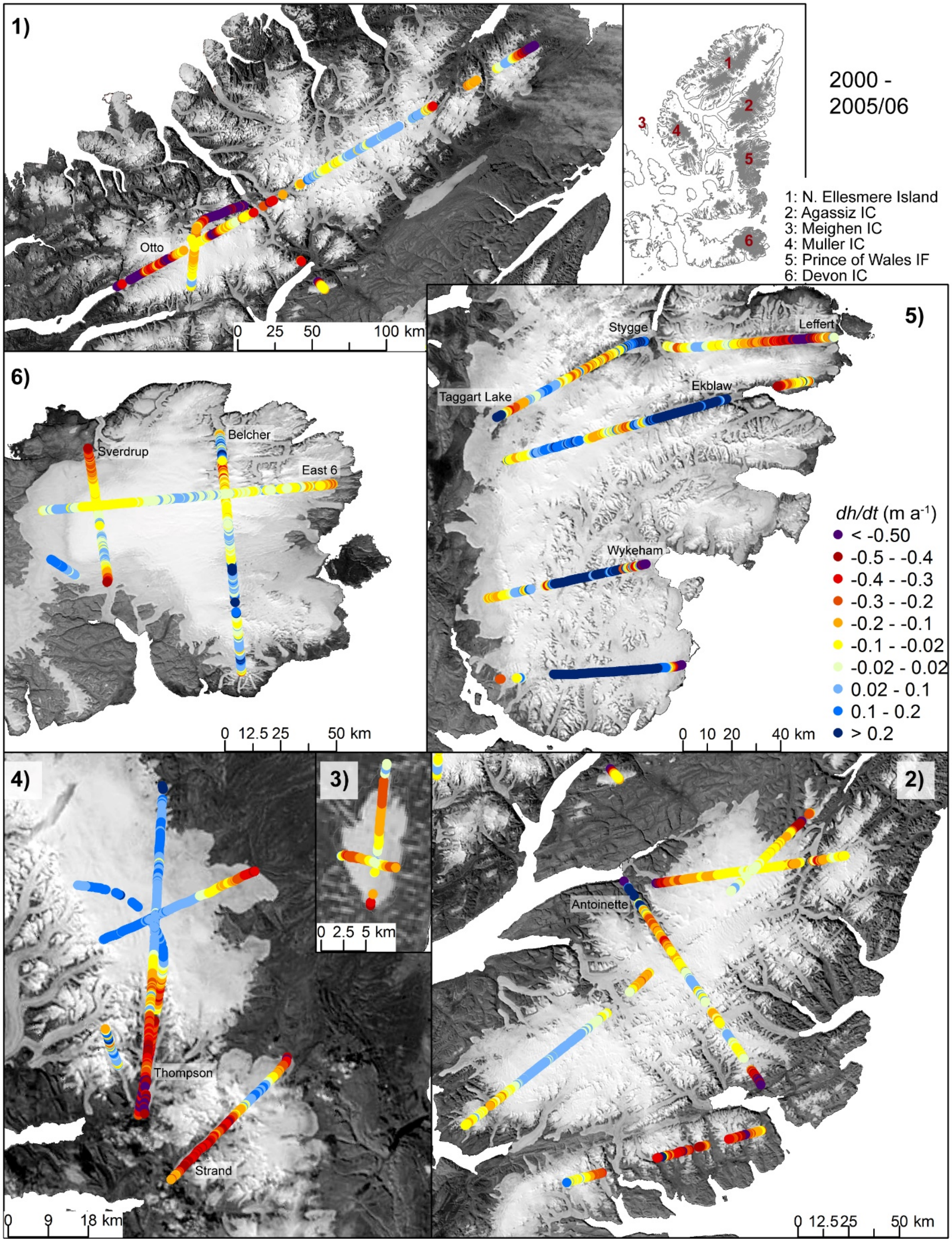

Figure S2: Rate of surface elevation change (m a^{-1}) over glaciated regions of the QEI between 2000 and 2005/06 from repeat airborne altimetry data (IDHDT4), elevation contours from CDED DEM 1:50k.

(c) *dh/dt*: 2005/06–2012/14

With a few exceptions, namely the Southeast 1 and 2 glaciers (Devon Ice Cap) which thickened by ~0.35 and 0.17 m a^{-1}, respectively, thinning occurred nearly everywhere during the period 2005/06–2012/14 (Fig. S3). Thickening along the middle sections of the Southeast 1 and 2 glaciers is consistent with previously identified dynamically-induced thickness changes attributed to slow, down-glacier propagation of a surge front (Burgess and Sharp, 2008). Overall, during the period 2005/06–2012/14, rates of thinning decreased from < -0.6 m a^{-1} around the margins of most ice masses to between ~ -0.4 and -0.2 m a^{-1} in their interiors. Lower rates of thinning (0.2 m a^{-1} or less) and/or no detectable changes ($|dh/dt| < 0.02$ m a^{-1}) in surface elevation were observed over the interior regions of the Devon and Agassiz Ice Caps, and along the southernmost transect across the Prince of Wales Icefield between ~400 and 750 m a.s.l..

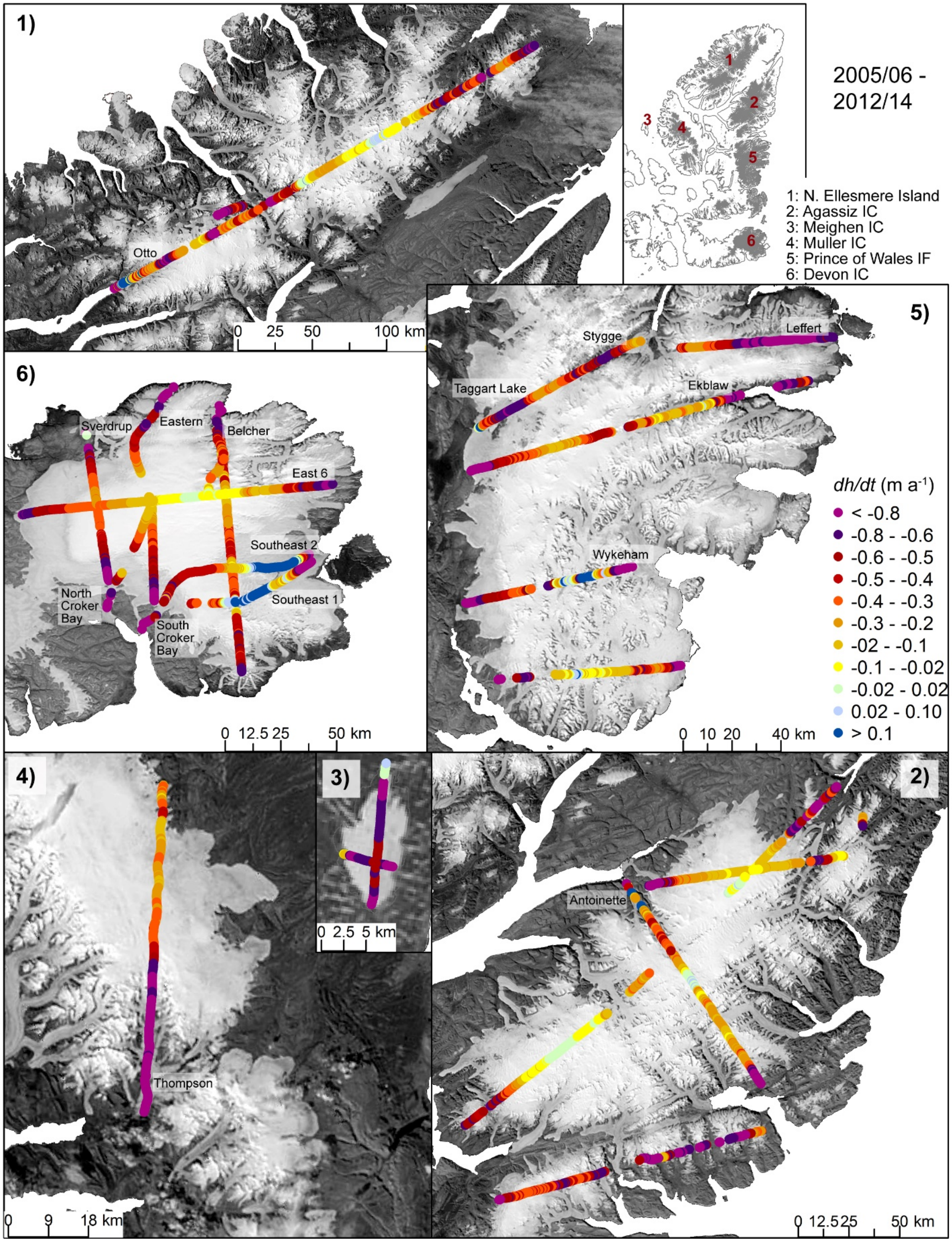

Figure S3: Rate of surface elevation change (m a^{-1}) over glaciated regions of the QEI between 2005/06 and 2012/14from repeat airborne altimetry data (IDHDT4), elevation contours from CDED DEM 1:50k.

References

Abdalati W and 9 others (2004) Elevation changes of ice caps in the Canadian Arctic Archipelago. *J. Geophys. Res.*, **109**(F04007), (doi: 10.1029/2003JF000045)

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