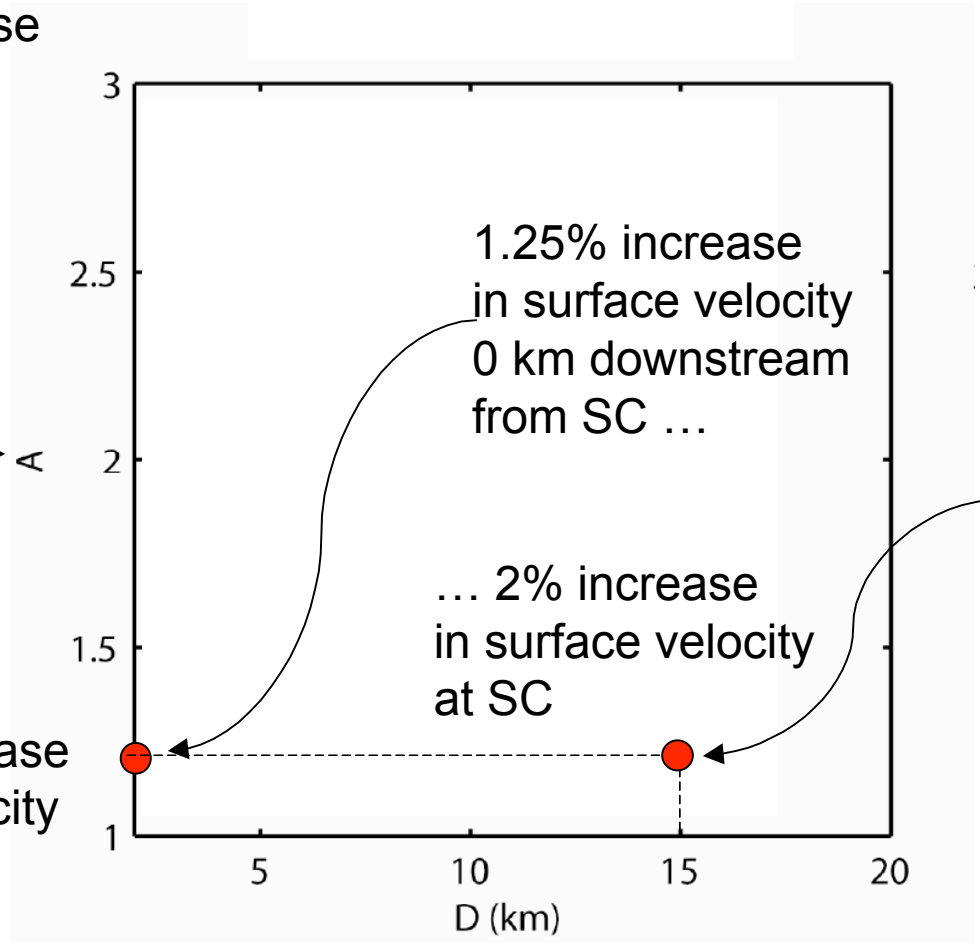
Plotting the results in D-A parameter space

A: fractional increase in velocity, U/U_0, at location D km from SC



1.25% increase in surface velocity 0 km downstream from SC …

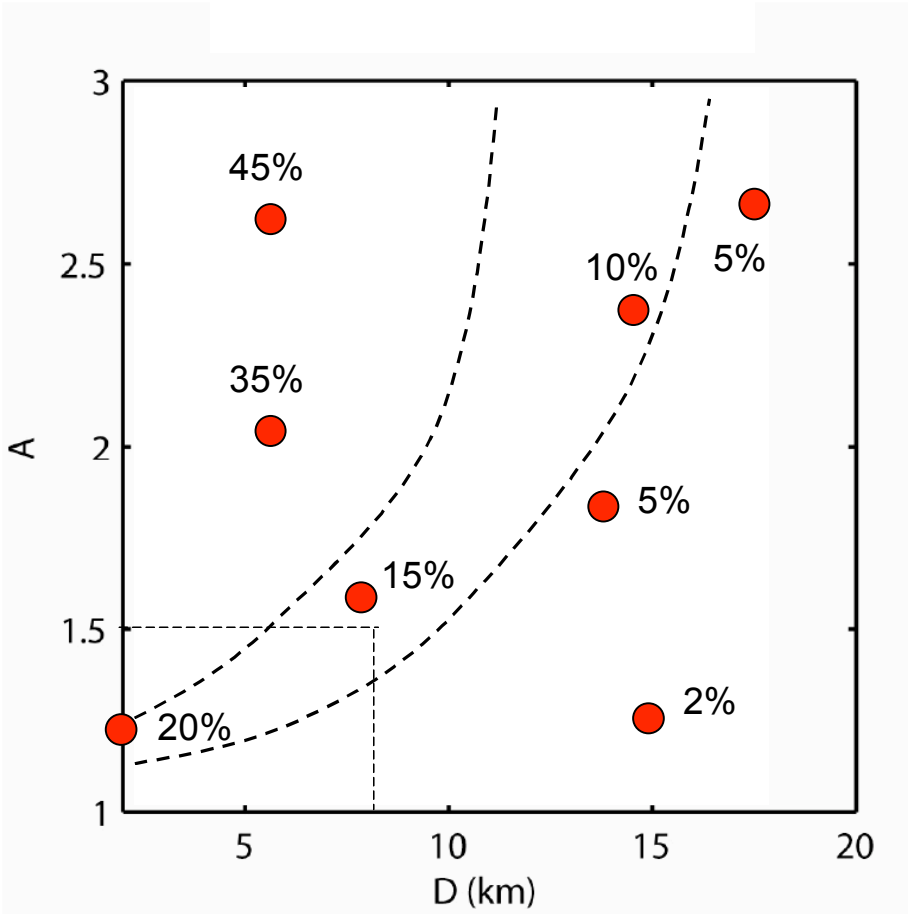
… 2% increase in surface velocity at SC

25% increase in surface velocity 15 km downstream from SC …

… 1.25% increase in surface velocity at SC

D: distance in km downstream from SC acceleration is initiated

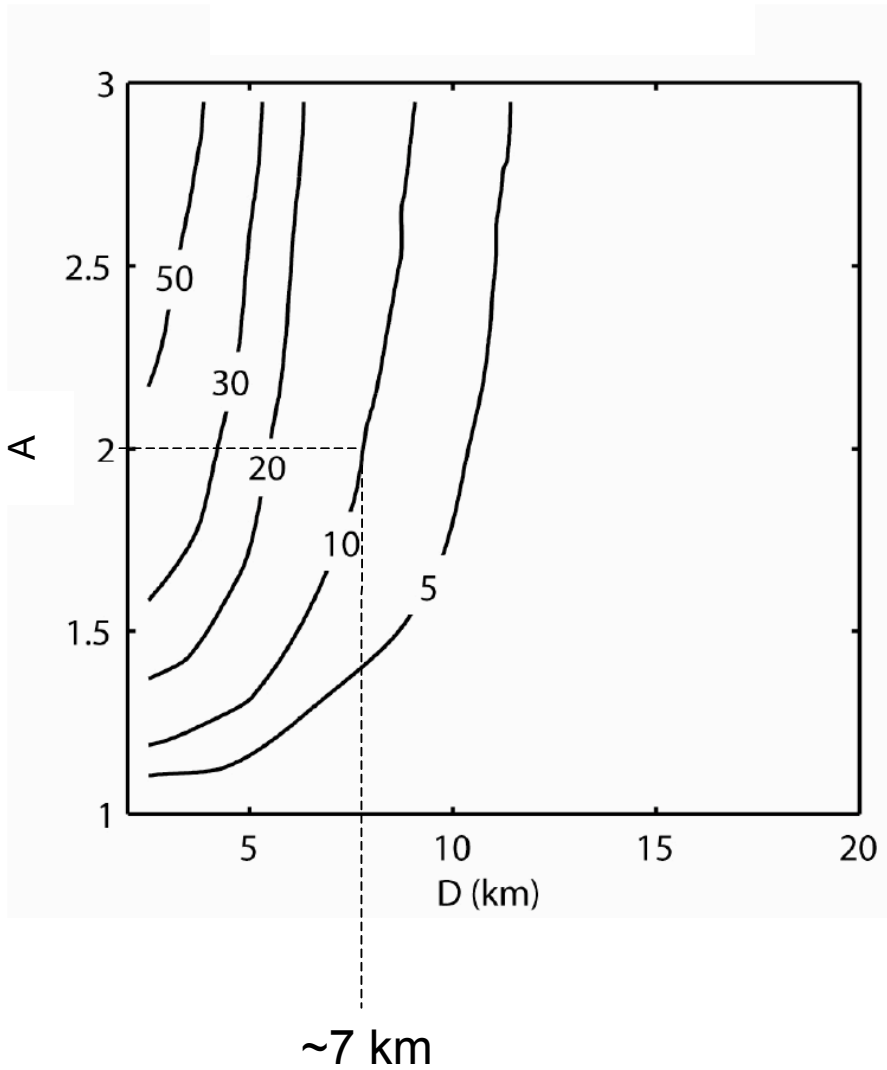
Plotting the results in D-A parameter space



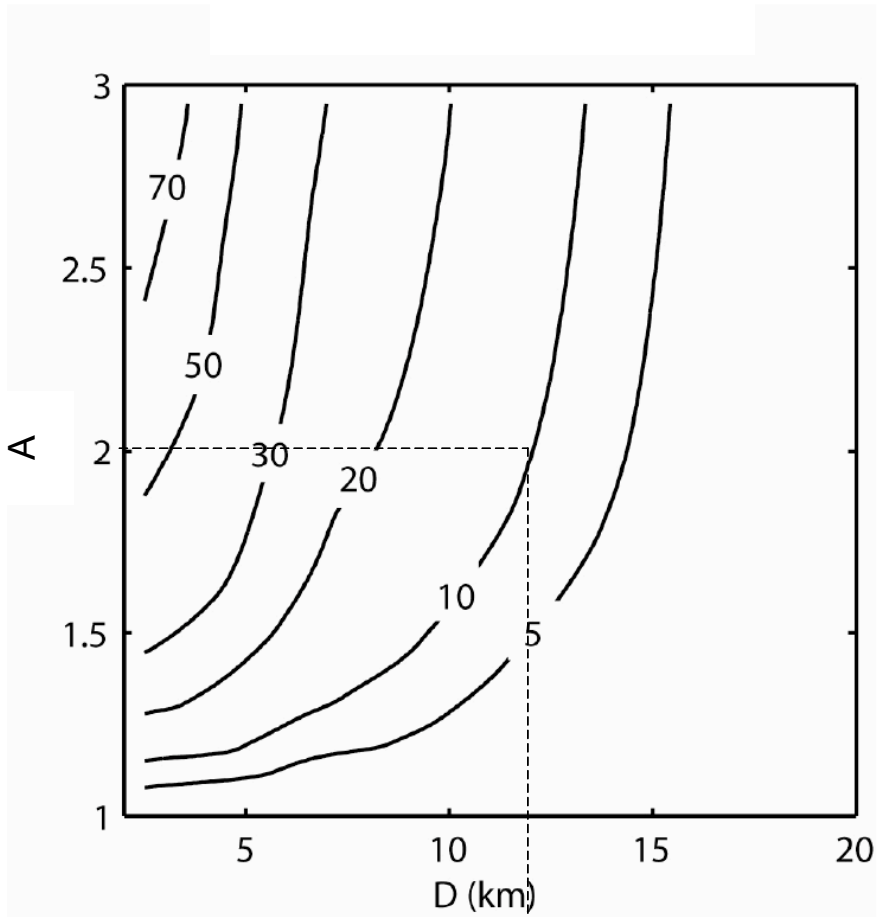
… dashed lines, contours of 10-20% acceleration at SC, enclose region for which the Zwally et. al observations are satisfied by the model …

Here, for example, an acceleration of 1.5x initiated at ~ 7 km downstream from SC will satisfy the observations at SC

Isothermal model, $U_{bed} / U_{sfc} = 0.3$



polythermal model, $U_{bed} / U_{sfc} = 0.8$

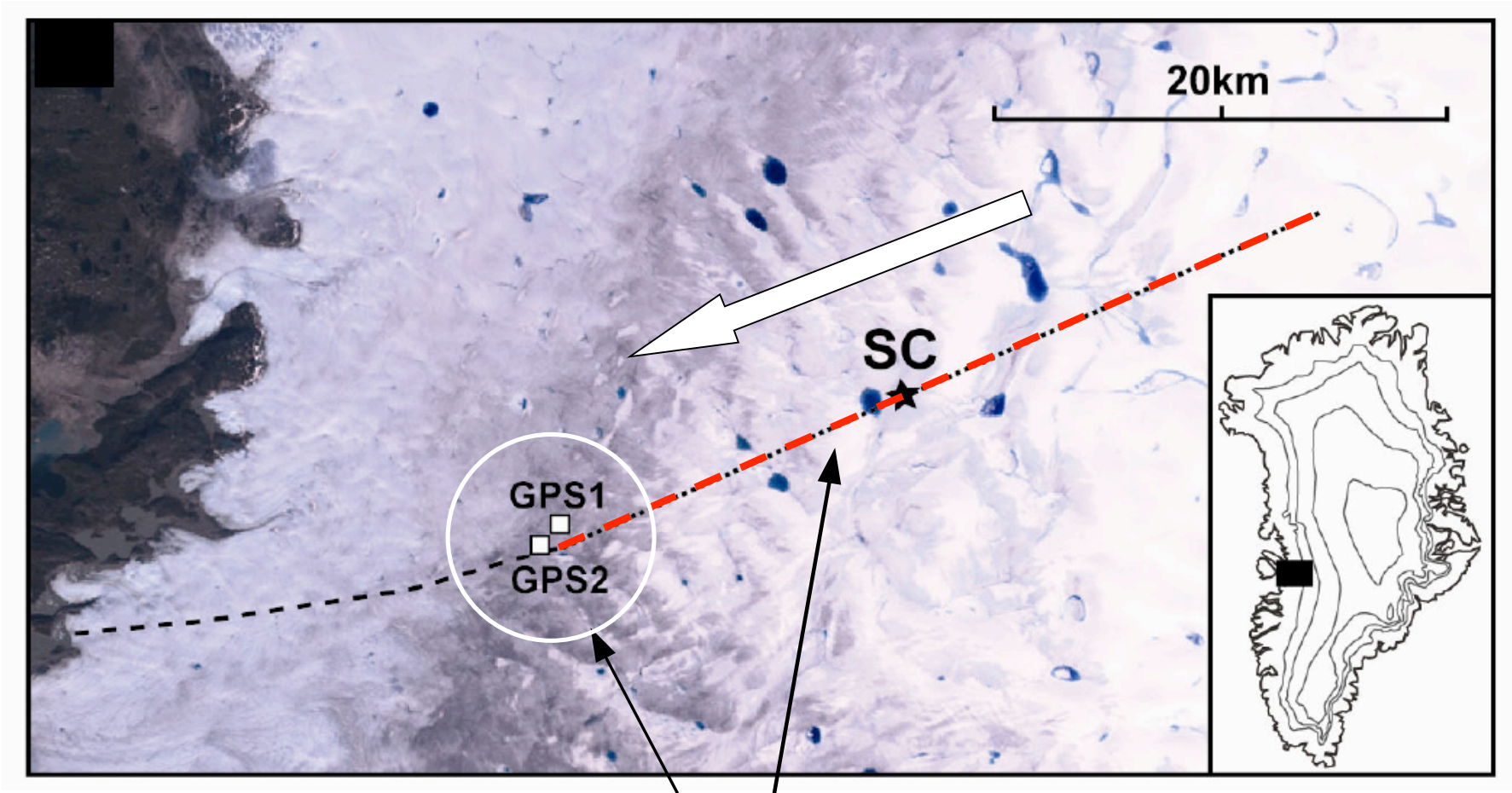


**From model, we conclude that 2x acceleration initiated 7-12 km downstream from SC could be responsible for the accelerations observed at SC **

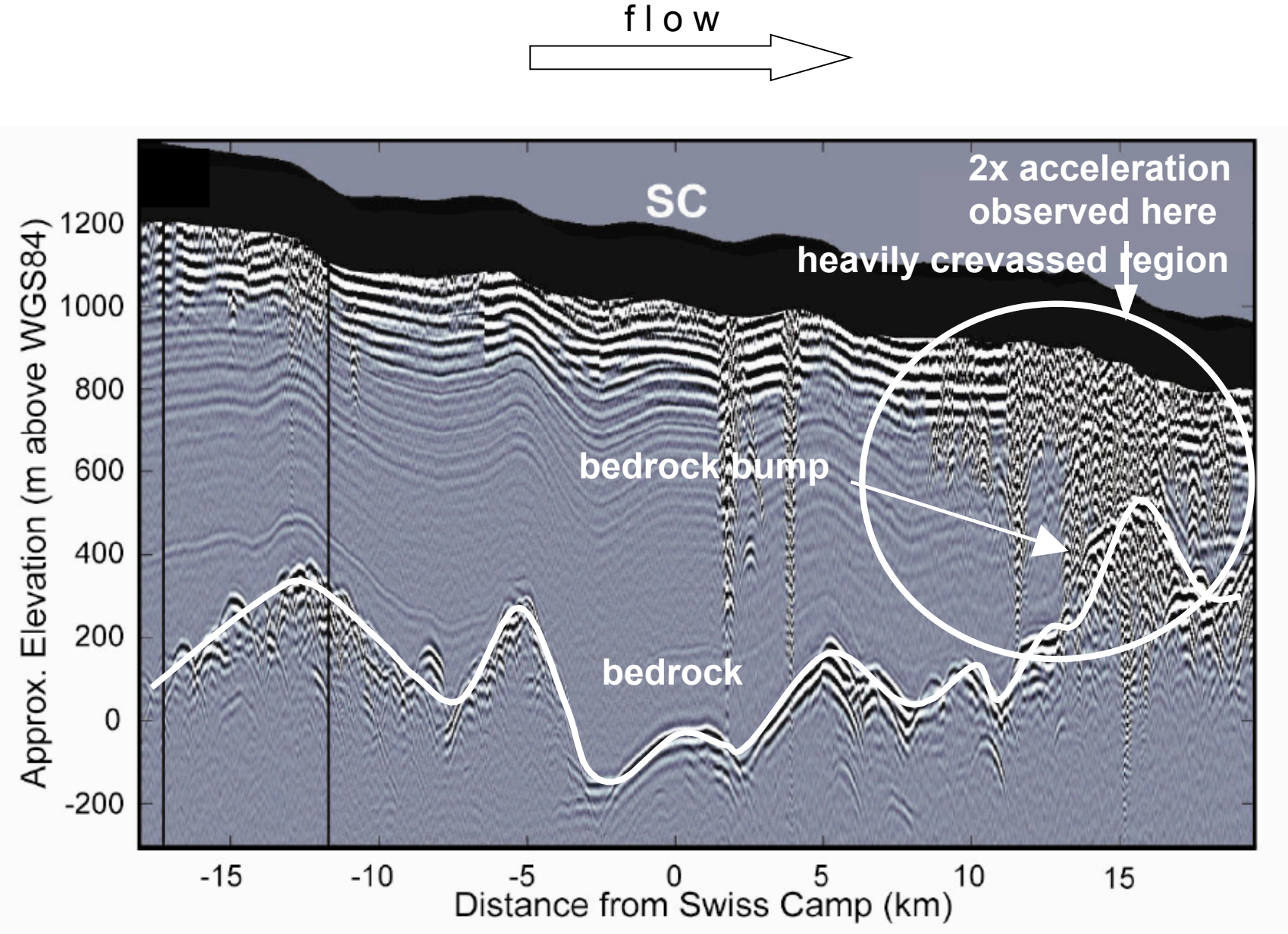
Outline

- brief background on Greenland ice sheet (GIS)
- background on seasonal flow acceleration along the western flank of the GIS (the “Zwally effect”)
- a more general hypothesis for explaining the ZE
- **testing this hypothesis using:**
    - flow modeling
    - **recent observations**
- summary and conclusions

field camp, central Greenland



~2x, seasonal velocity acceleration observed here,
Radio-Echo Sounding (RES) profile line
in summer of 2006 (Rumrill and others, 2006)


flow
SC
2x acceleration
observed here
heavily crevassed region
bedrock bump
bedrock
Approx. Elevation (m above WGS84)
1200
1000
800
600
400
200
0
-200
-15
-10
-5
0
5
10
15
Distance from Swiss Camp (km)

Interpretation from observations and modeling

Who cares? What did we show here?

Summary and Conclusions

- seasonal accelerations observed along the flank of the GIS can be explained by larger magnitude accelerations initiated from downstream
- additional glaciological factors also favour the region downstream, nearer to the margin, as being the location at which accelerations are initiated
- as the “source” for the accelerations gets closer to the margin and farther from the ice sheet interior, flow dynamics and other glaciological characteristics become more “glacier like” and less “ice sheet like”
- as the “source” for the accelerations gets closer to the margin and farther from the ice sheet interior, the implications of the Zwally et. al (2002) observations become somewhat less exciting w.r.t. the ice sheet’s response to a warming climate

sunset, Ilulisat, Western Greenland

Summary and Conclusions

- This work suggests taking greater caution when interpreting observations of change before using those observations to make predictions about future changes.

- Other recent work[1], which reports on deceleration and thickening of GIS outlet glaciers after dramatic acceleration, thinning, and retreat, also suggest caution.

- Does this mean that we (the authors of this work) believe that the GIS is not in "danger" in the face of future climate warming, or that recent observations of change are not important to understand?

- We are only now starting to understand that ice sheet marginal regions behave similar to other smaller, temperate bodies of ice[2], and this realization will have significant implications for how ice sheets respond to future climate forcing

[1]Howat and others (2007), [2]Truffer and Fahnestock (2007)

sunset, central Greenland