ALOS1/ALOS2による
アラスカ/ユーコン域の
サージ型氷河の動態

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Surge-type glacier

Quiescent (10~100 yrs) | Repeat cycle | Active phase (1~10 yrs)

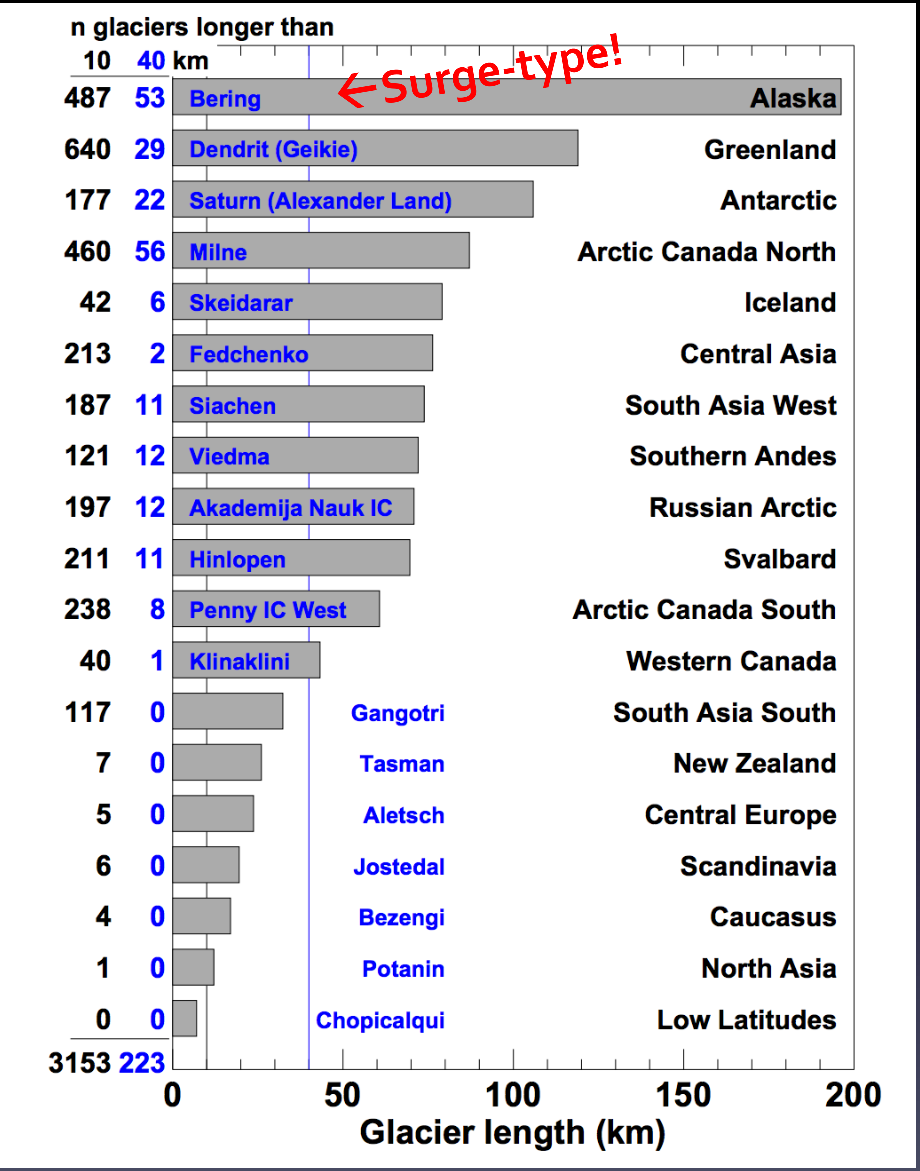
Few detailed observations → Generation mechanisms are uncertain.

Surge-type glaciers are rare but significant!

"Less than 1% of the glaciers are surge-type" (Jiskoot et al. 1998)

Long glaciers (>10 km) are 1.5 % of ~200 000 glaciers worldwide.

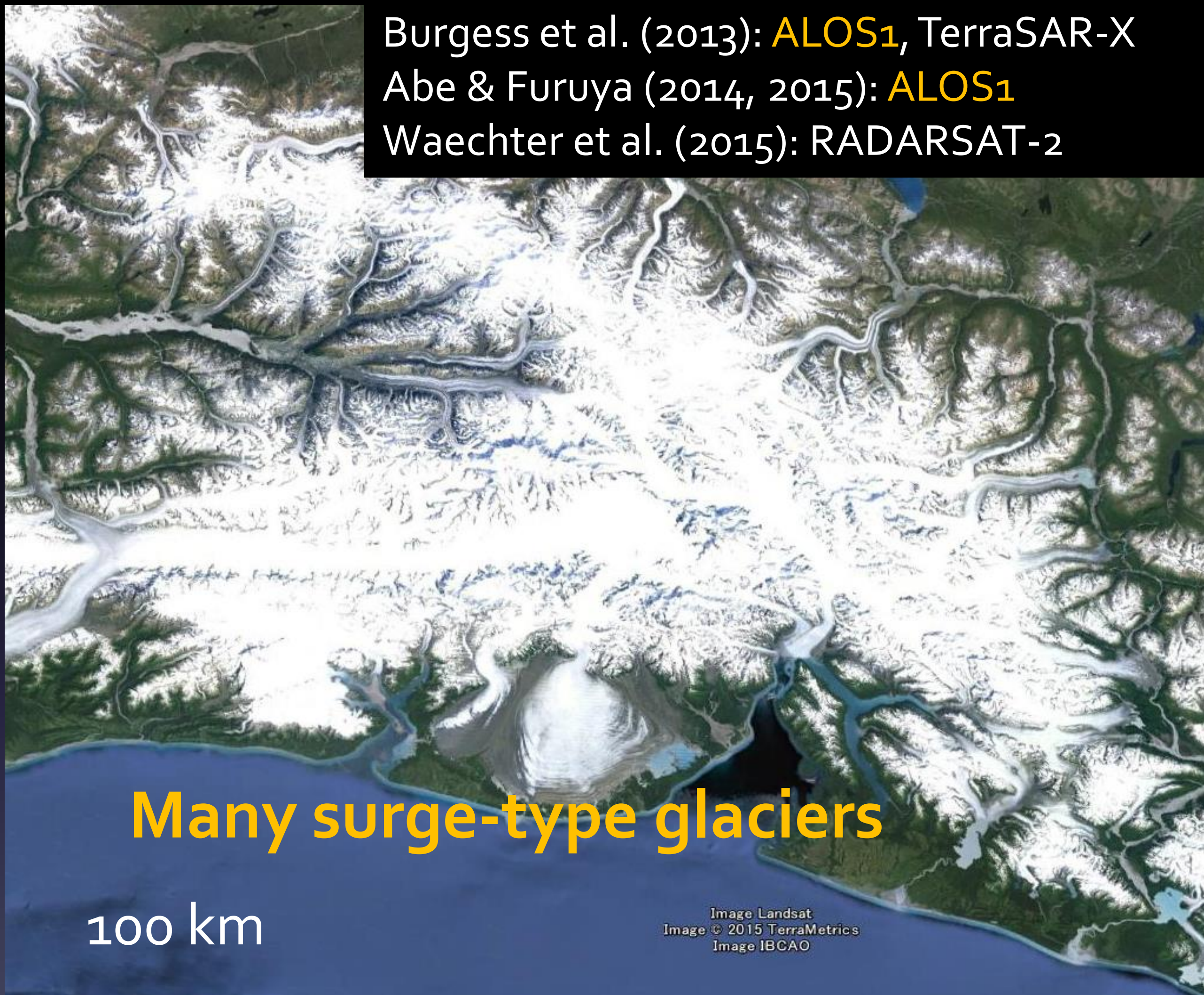
"The surge probability increases … for long glaciers (10-75km)" (Clarke et al. 1986)

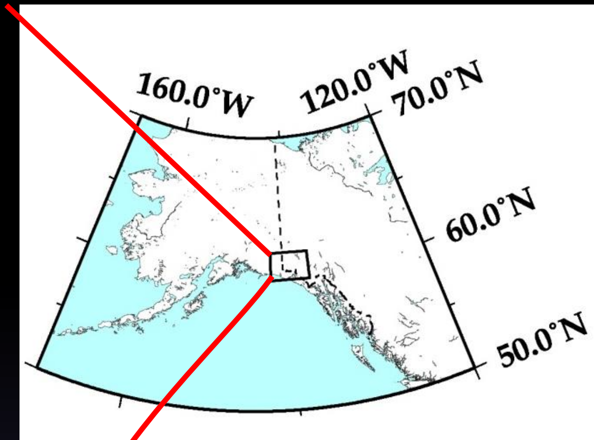


Machguth & Huss (2014, TC)

Study area: Alaska/Yukon

Burgess et al. (2013): ALOS1, TerraSAR-X
Abe & Furuya (2014, 2015): ALOS1
Waechter et al. (2015): RADARSAT-2



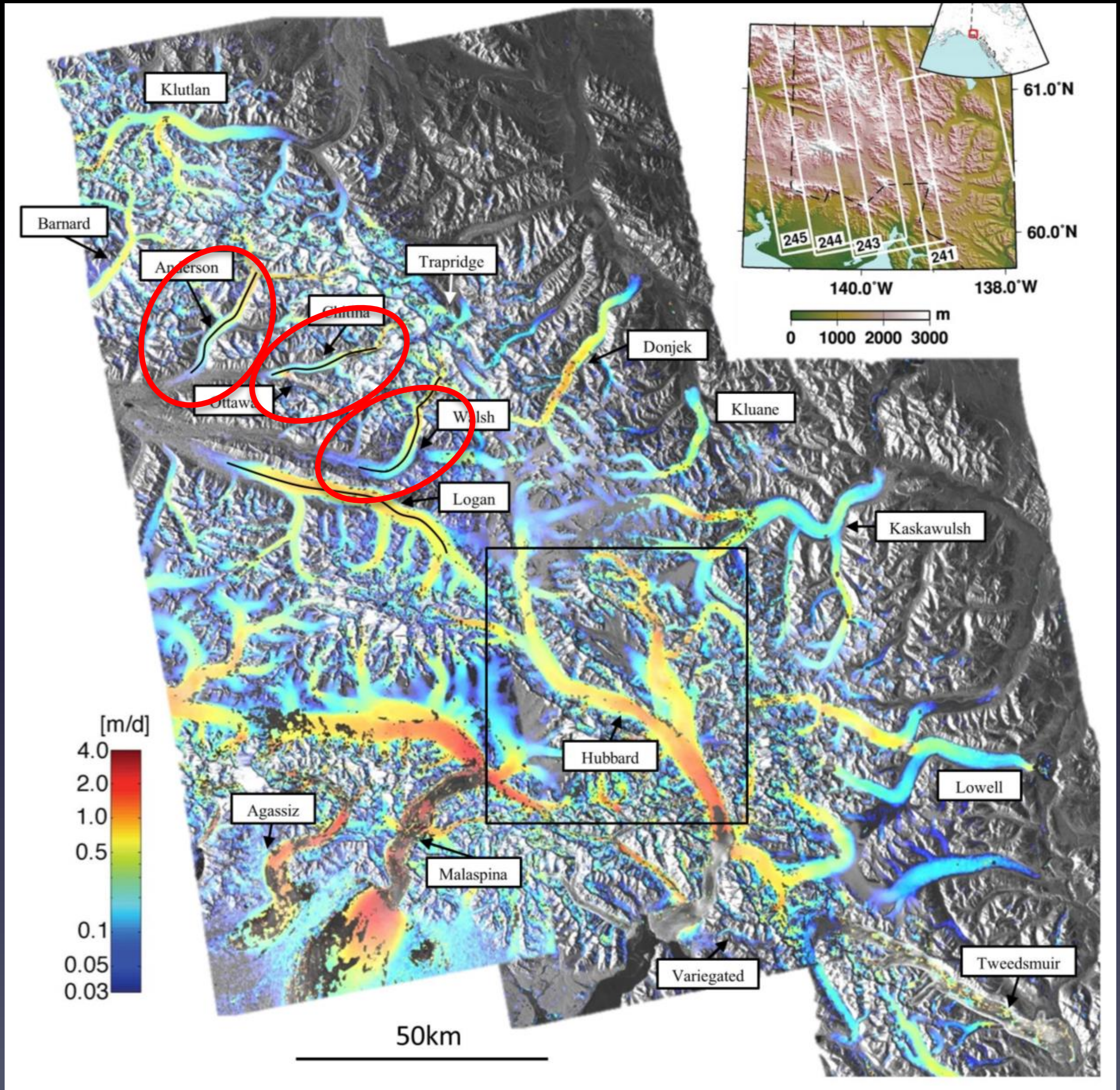


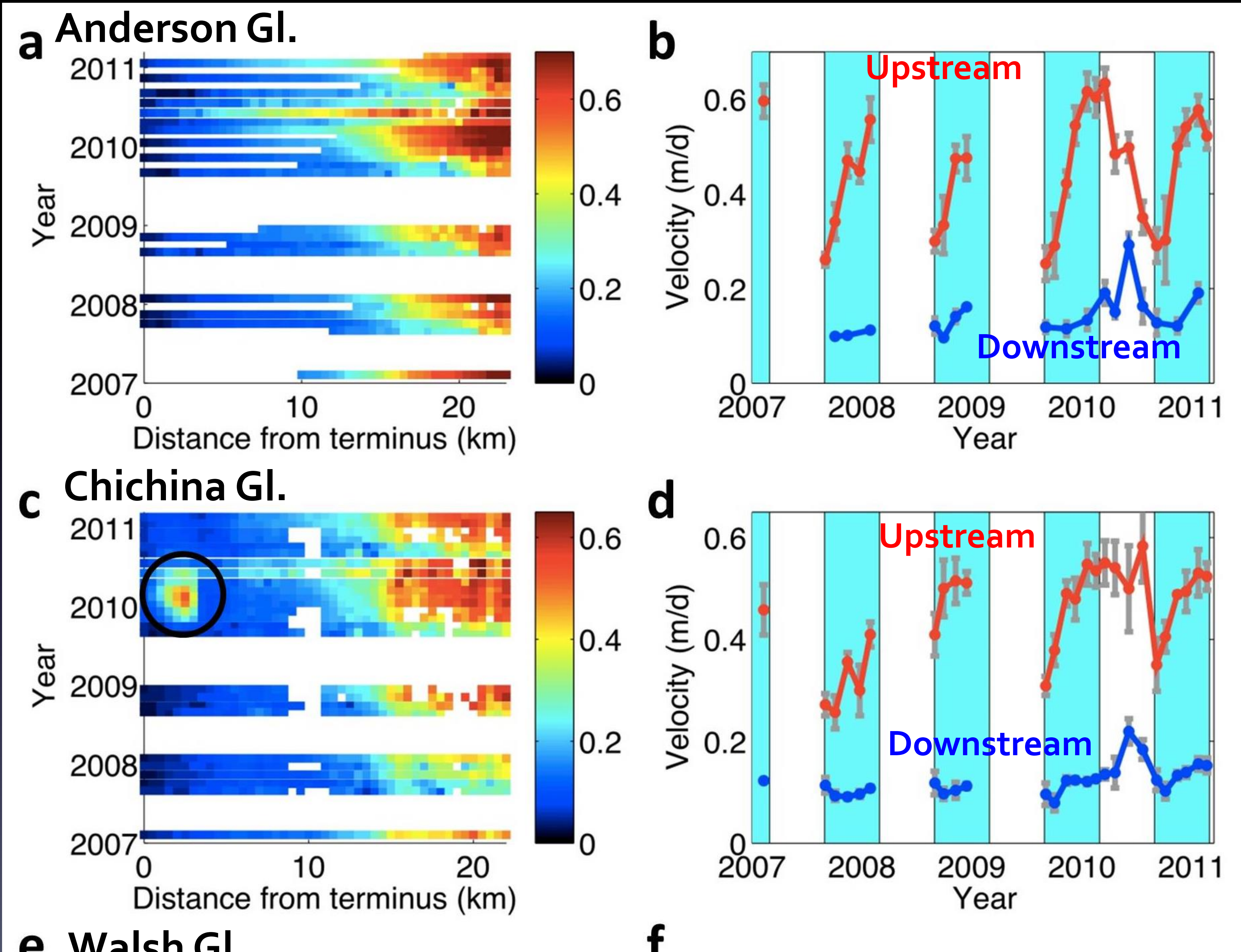
Software: Gamma
Method: Offset tracking

Mapping the spatial-temporal velocity changes to better understand the surge dynamics

Velocity Evolution during the quiescent surge-type glaciers

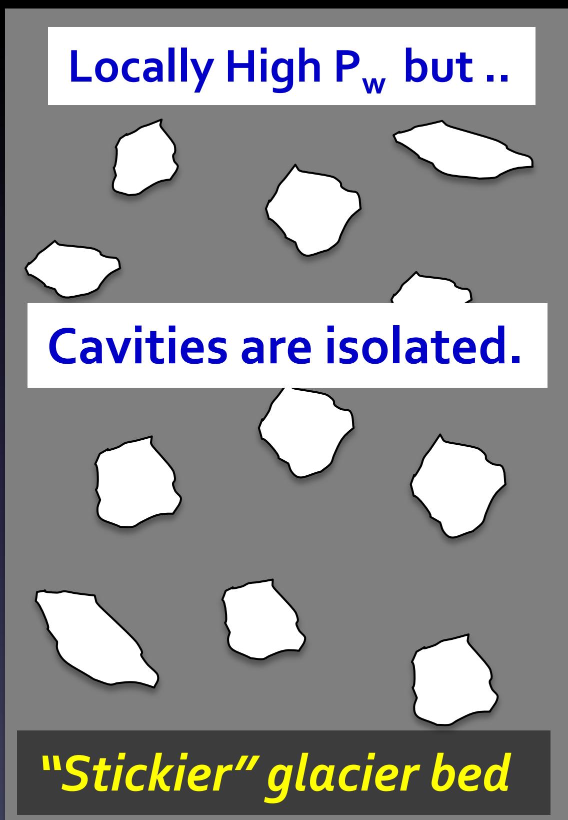
Abe & Furuya (2015, TC)




a
Anderson Gl.
2011
2010
2009
2008
2007
Year
0
10
20
Distance from terminus (km)
0.6
0.4
0.2
0
b
Upstream
Downstream
Velocity (m/d)
0.6
0.4
0.2
0
2007
2008
2009
2010
2011
Year
c
Chichina Gl.
2011
2010
2009
2008
2007
Year
0
10
20
Distance from terminus (km)
0.6
0.4
0.2
0
d
Upstream
Downstream
Velocity (m/d)
0.6
0.4
0.2
0
2007
2008
2009
2010
2011
Year

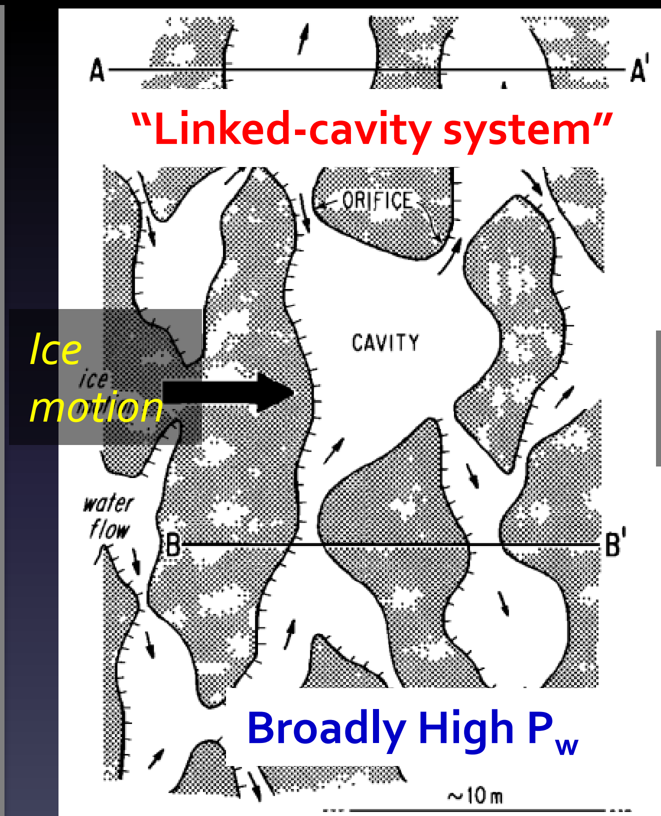
"Linked-cavity" subglacial drainage system as an explanation of spring/summer speed-up

No water influx
(Mid–winter)



Slowest

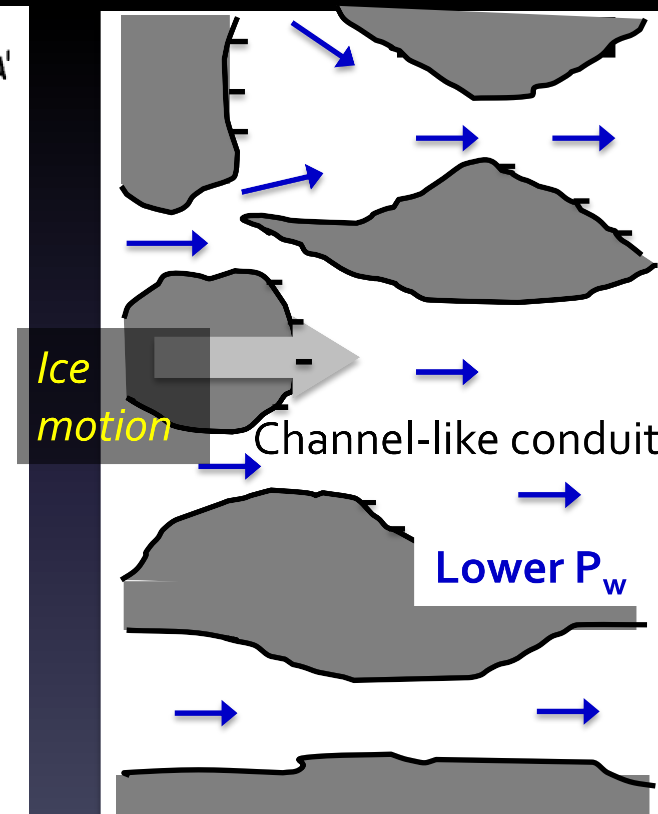
Low water influx
(Spring – Early summer)



Kamb (1987)

Fastest

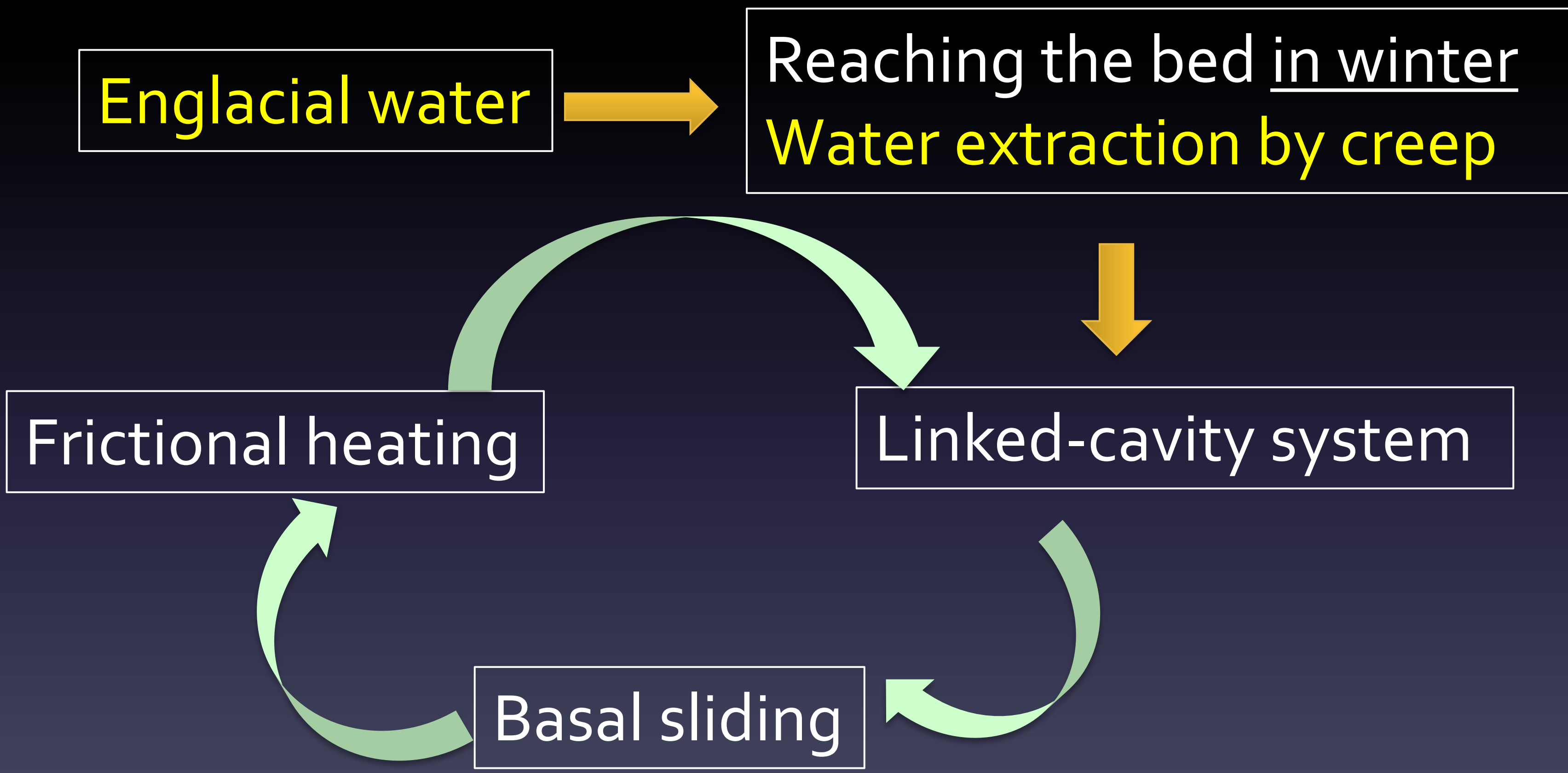
High water influx
(Mid–summer)



Slow-down

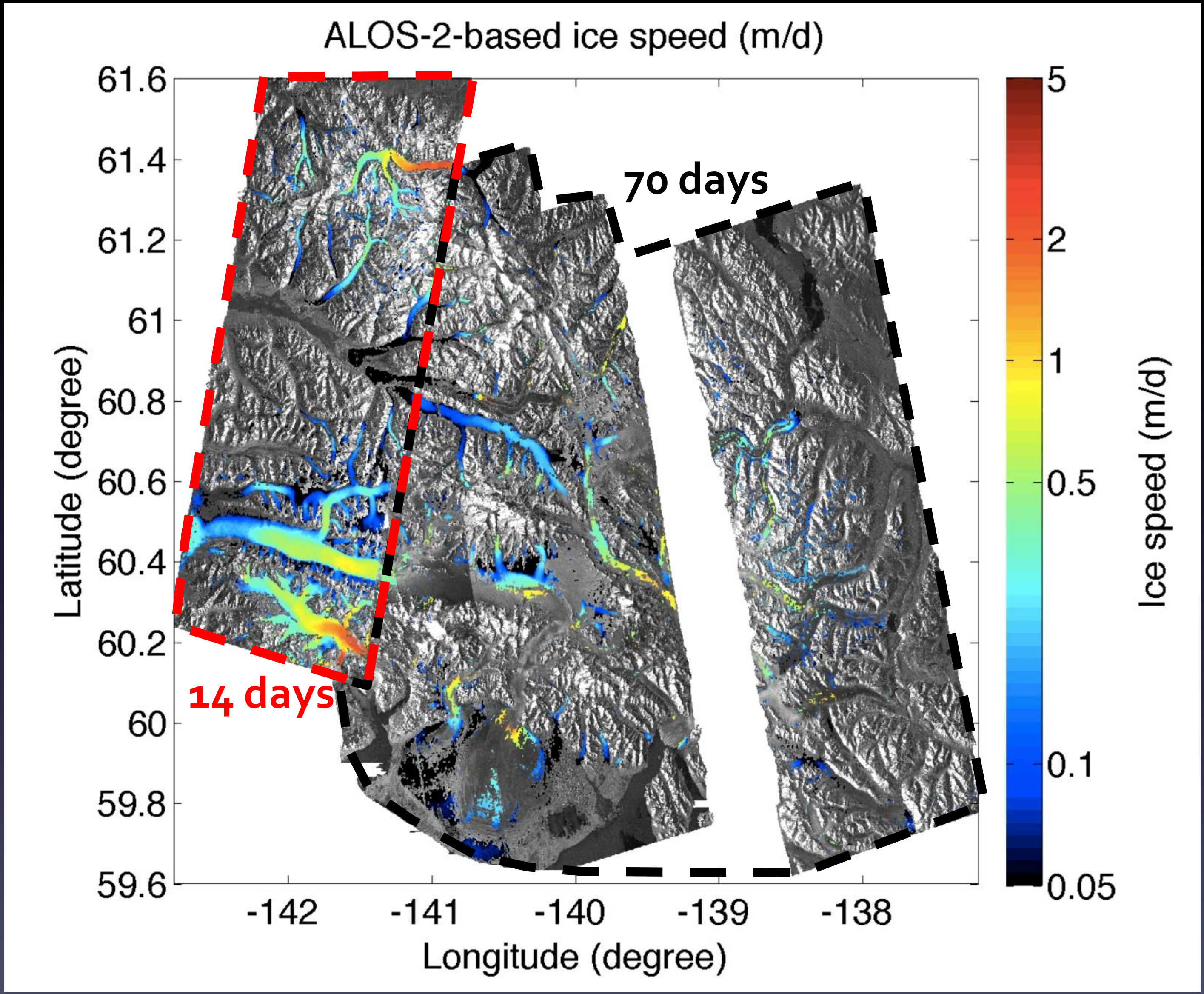
How can we explain the winter speed-up in the absence of surface melt?

(e.g., Kamb et al., 1985; Kamb, 1987; Lingle and Fatland, 2003)



The observation supports the presence of englacial water in winter.

Ice velocity map from ALOS-2



Composite map of Five paths' data

Ascending

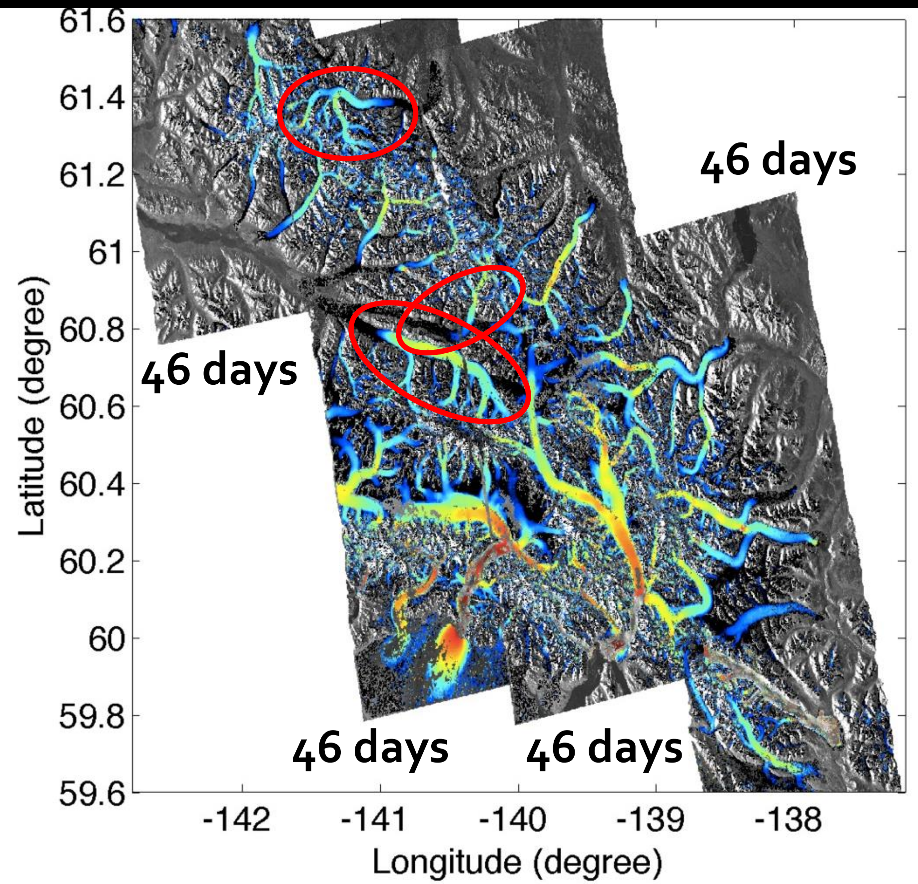
P73: 70 days
20140920_20141129
P74: 70 days
20141204_20150212
P75: 70 days
20140930_20141209
P76: 70 days
20141116_20150125

Descending

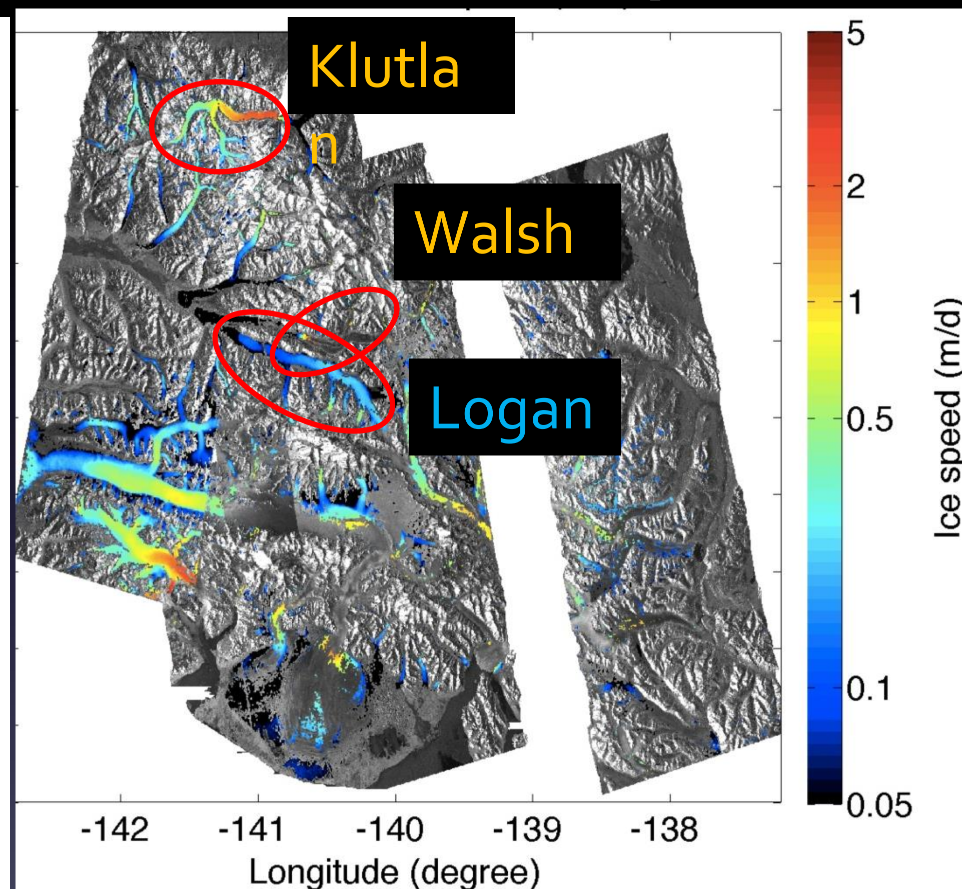
P185: 14 days
20150307_20150321

Recent status at St. Elias Mountains

PALSAR1 (2007-2010)

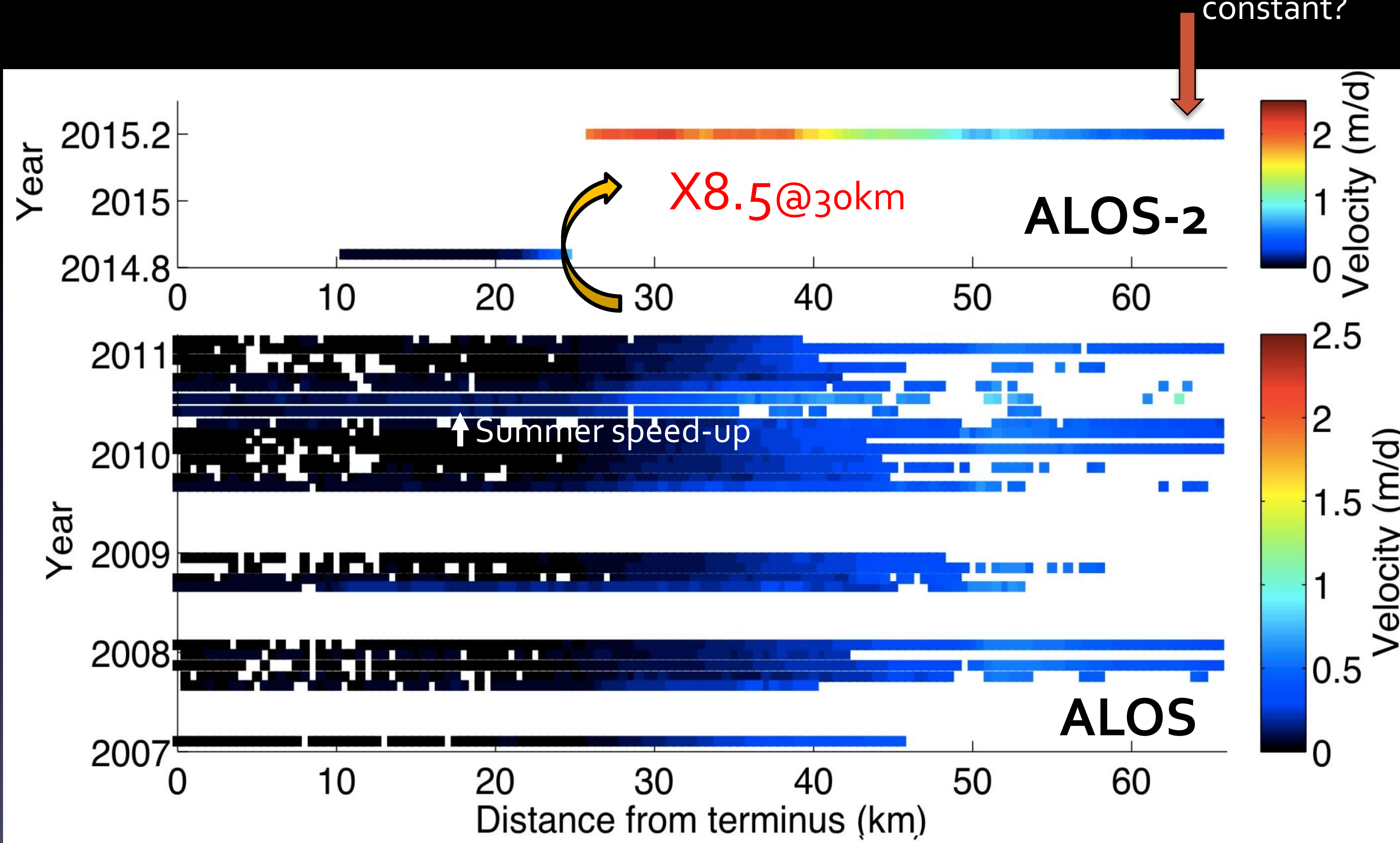


PALSAR-2 (2014-)

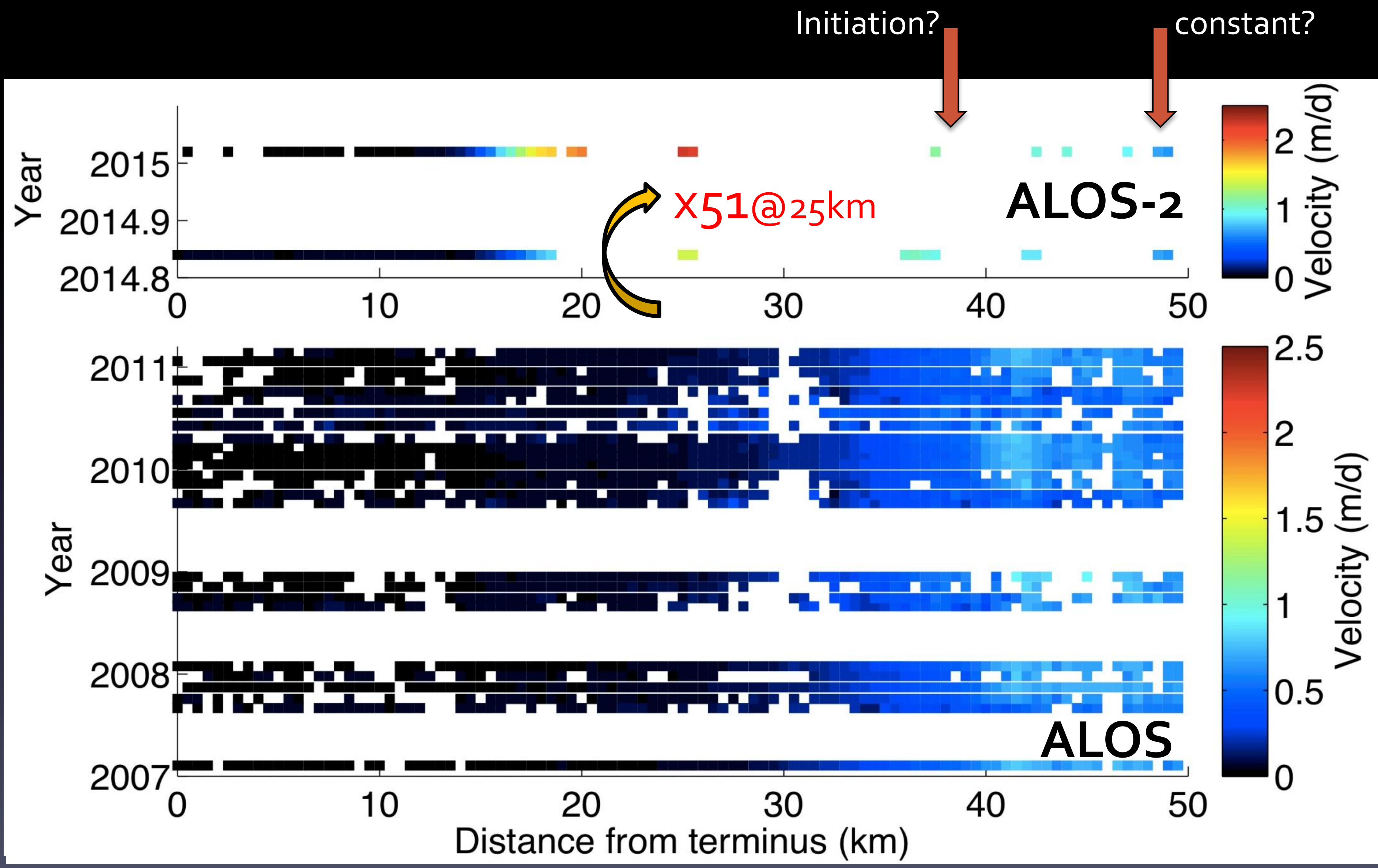


Speed-up (Klutlan, Walsh Gl.) **Slow down (Logan Gl.)**

Klutlan Glacier: now active

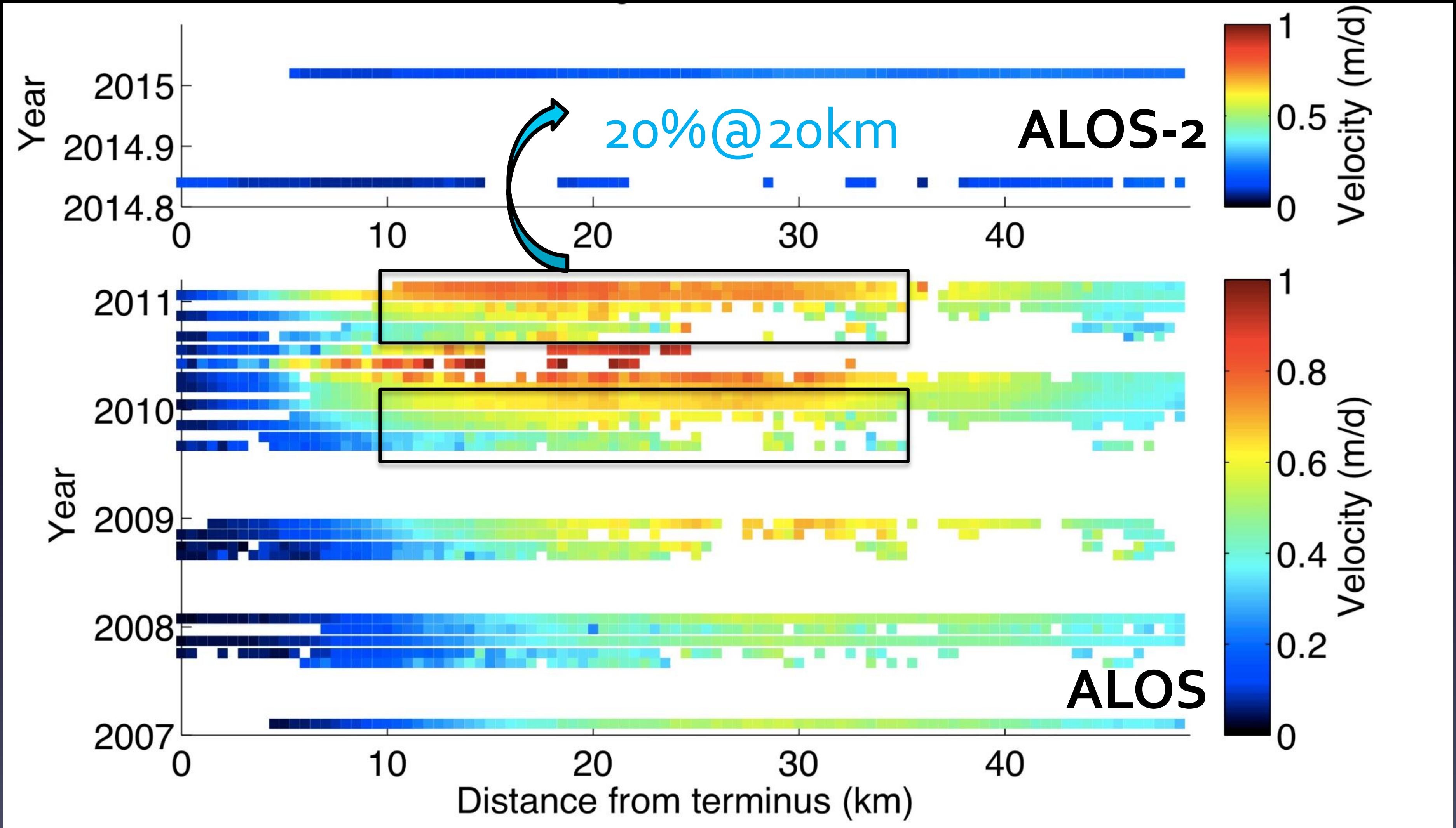


Walsh Glacier: now active

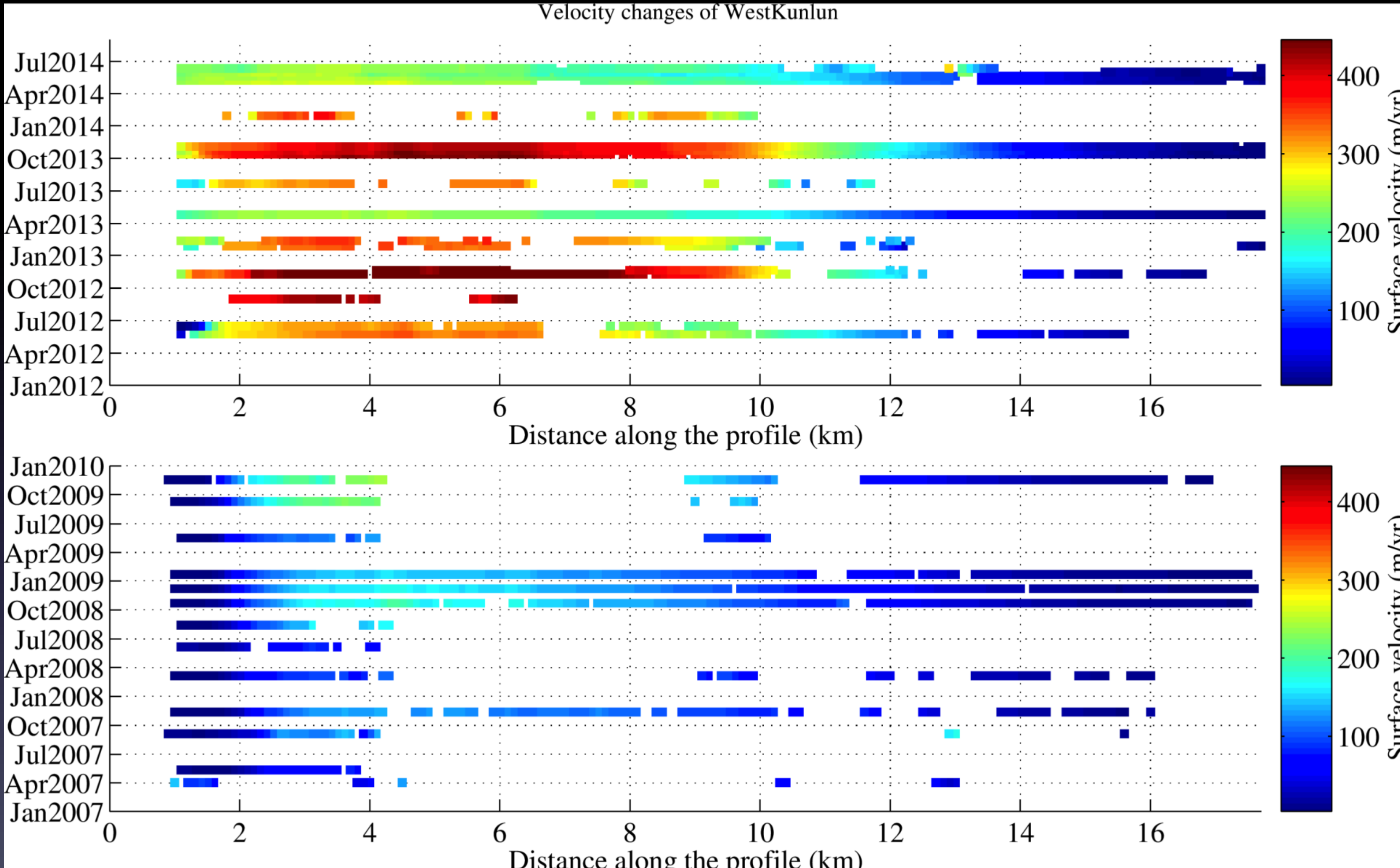


Logan Glacier: quiescent now

+Seasonal modulation during active phase with faster speeds in winter



Surge at West Kunlun Shan, NW Tibet (Yasuda & Furuya, 2015, JGR-ES)



~200 % faster in fall-winter than spring-summer during surging

0.1029/2002JB001906, 2003

a

5

Velocity (m d-1)

Quies

0

0

ıe”

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ım speed

K2 Quiescent

Time (years)

b

50

Velocity (m d-1)

Qu

0

0

e”

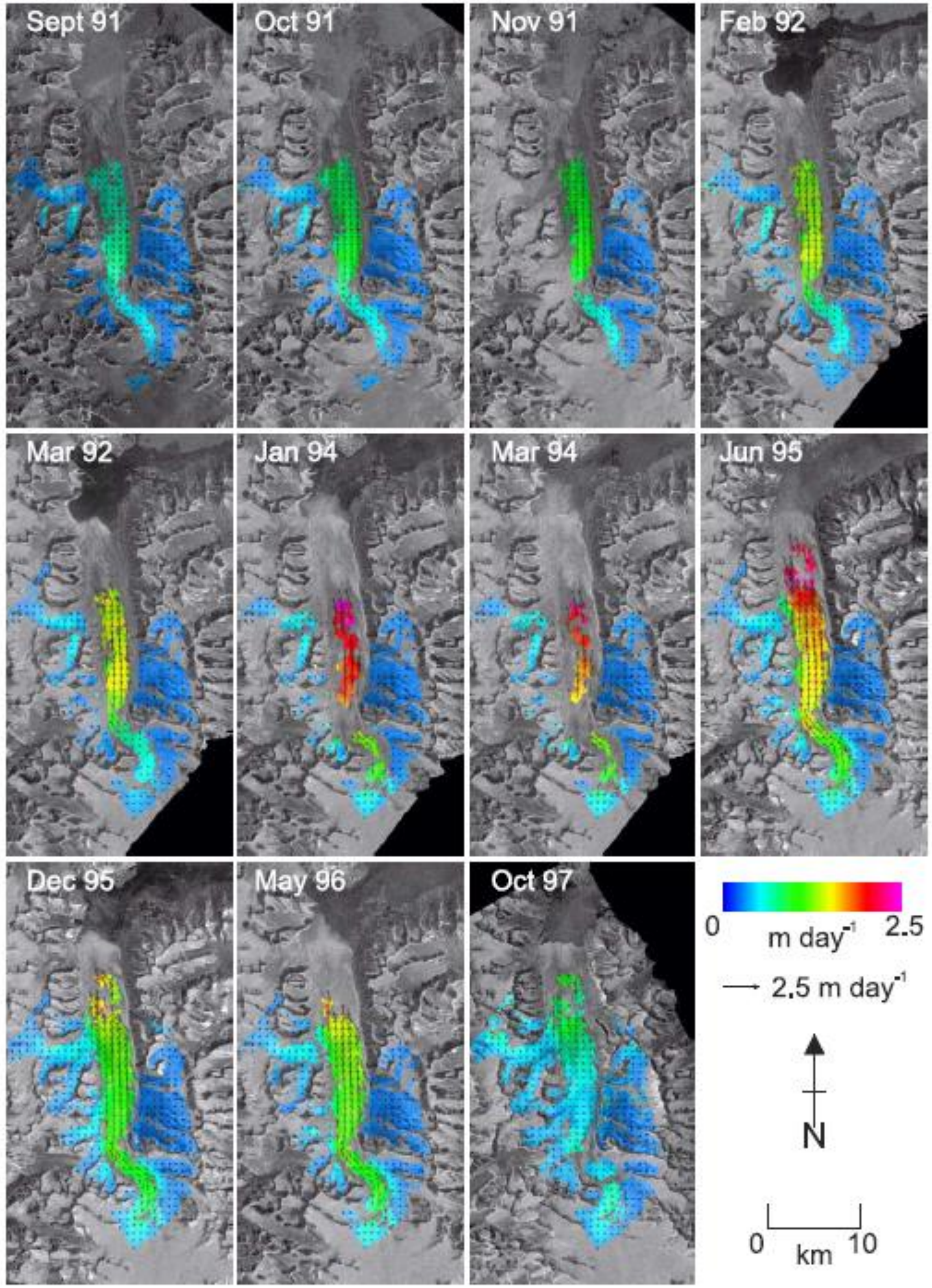
ɛ phase

rent interval

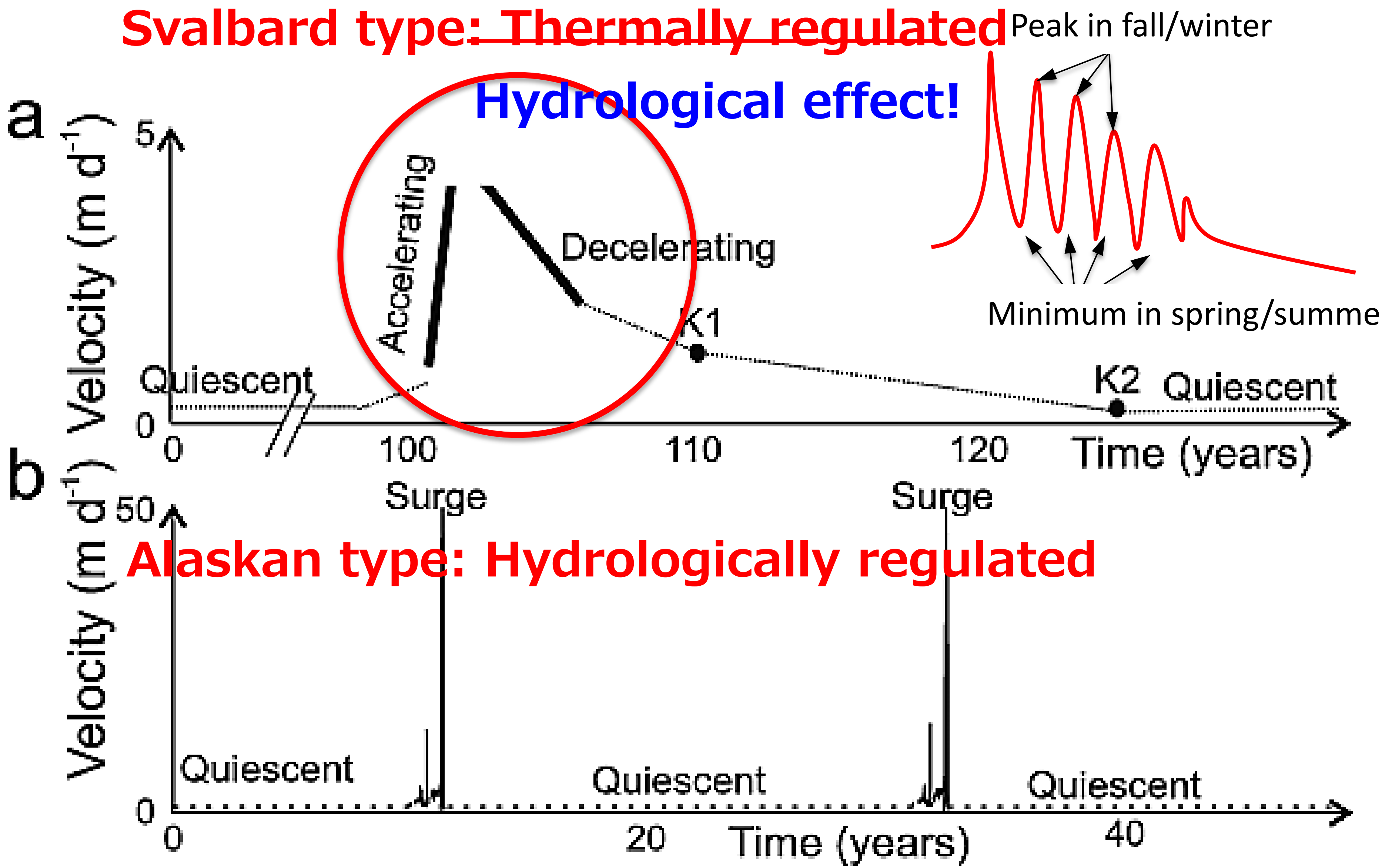
ım speed

Quiescent

40



by spatially … results with
those publis… ɛ cycle and
compare thi… ially those of
Variegated … there exist at
least two di… ce (1827); 0933



Two types of surging suggested by Murray et al. (2003)

まとめ & 展望/課題

- 冬季加速シグナルの検出(ユーコン域のサージ型氷河)
  -静穏期の上流部
  -3-4年続いたLogan氷河の活動期（季節変調）.
- 冬季間に持続する水の供給源(恐らく氷内部)を支持.
- ALOS-2による流動速度場
  -14日ペアによる明瞭なシグナル検出
  -70日ペアではダメ(decorrelation)→速いところは問題
  (アラスカだけの問題でない. 南極,グリーンランド等)
  -Klutlan氷河, Walsh氷河が活動期, Logan氷河は静穏化
  -活動期の観測を継続し, 季節変調の普遍性の実証
- 14 days' revisitは良いが, そういうペアは少ない. 仕方ないとしても「46日よりも長い」と時系列解析が…