# Observations of sea ice and ice sheet interaction in Greenland and the Antarctic Peninsula

Twila Moon[1,2], Ted Scambos[1], Mark Fahnestock[3], Ian Joughin[2], Ben Smith[2], Terry Haran[1], Marin Klinger[1], Michiel van den Broeke[4], Willem Jan van de Berg[4], Brice Noël[4]

*[1] National Snow and Ice Data Center, Cooperative Institute for Research in Environmental Science, University of Colorado, Boulder*

*[2] Polar Science Center, Applied Physics Lab, University of Washington*

*[3] Geophysical Institute, University of Alaska, Fairbanks*

*[4] Institute for Marine and Atmospheric Research, Utrecht University*

CIRES

NSIDC National Snow and Ice Data Center University of Colorado Boulder

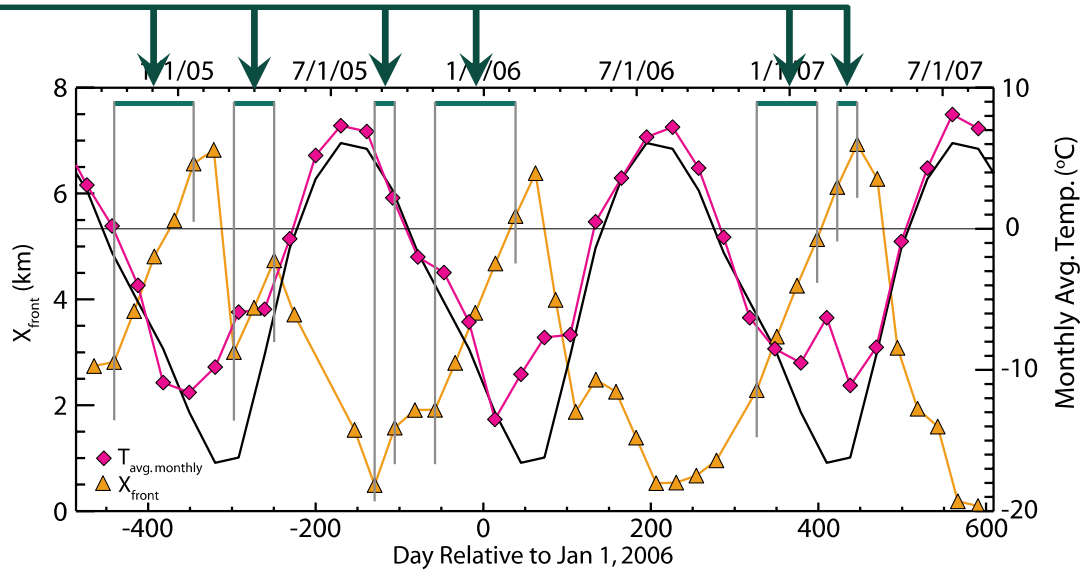
Polar Science Center AIR • SEA • ICE

NASA

NSF

# Potential link among ice mélange, terminus, & velocity

Rigid mélange




[Joughin et al., 2008]


[NASA Earth Observatory]

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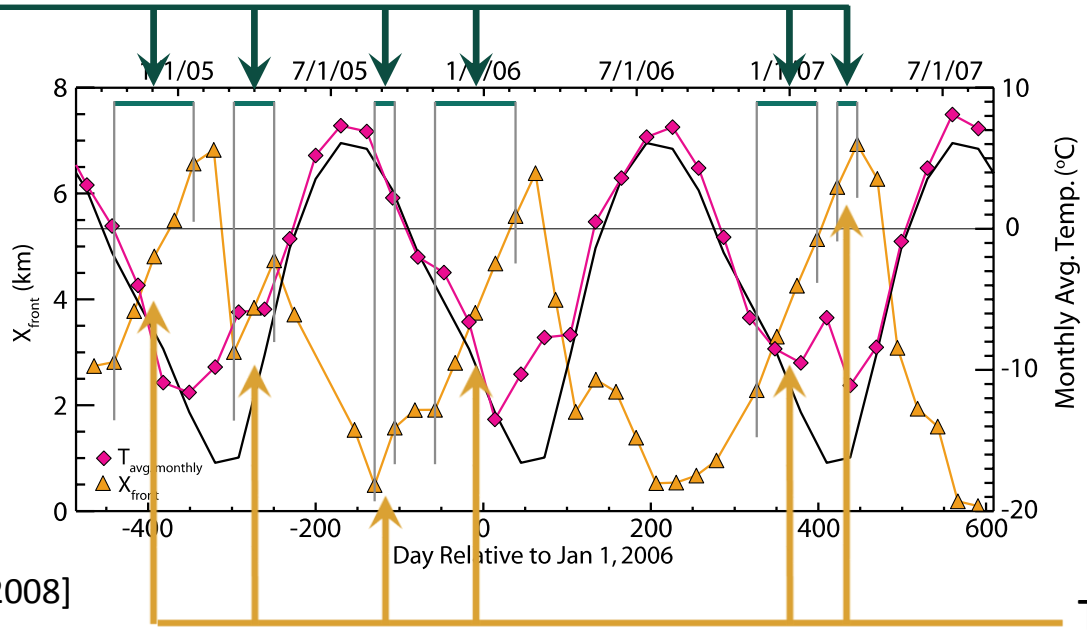


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Terminus advance


[NASA Earth Observatory]

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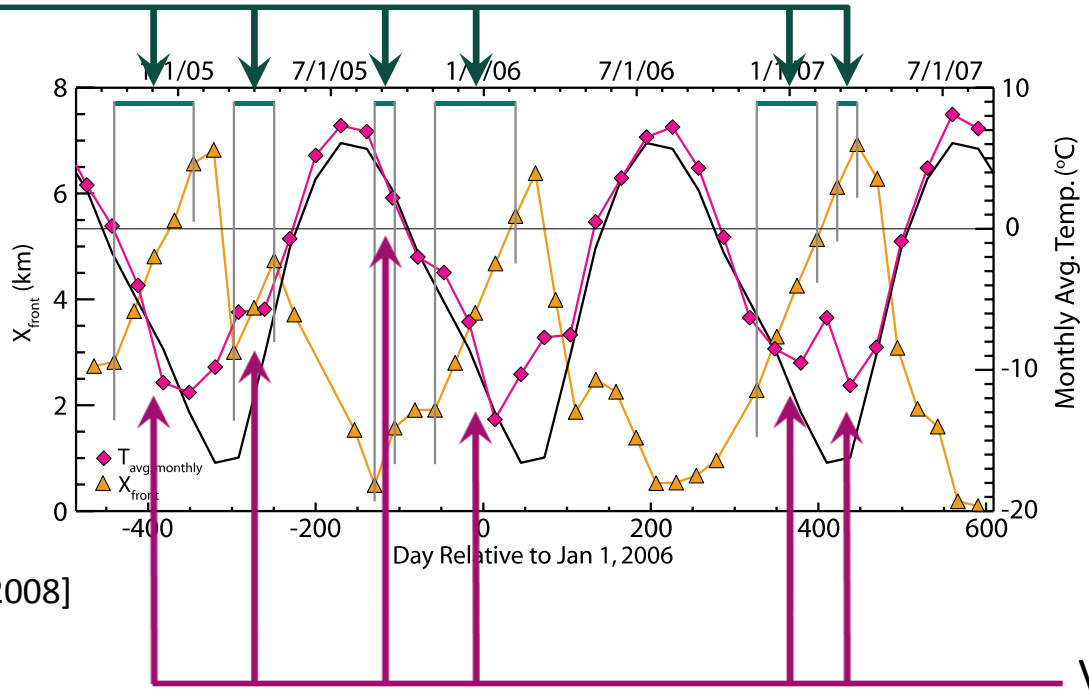


[Joughin et al., 2008]

Velocity slowing


[NASA Earth Observatory]

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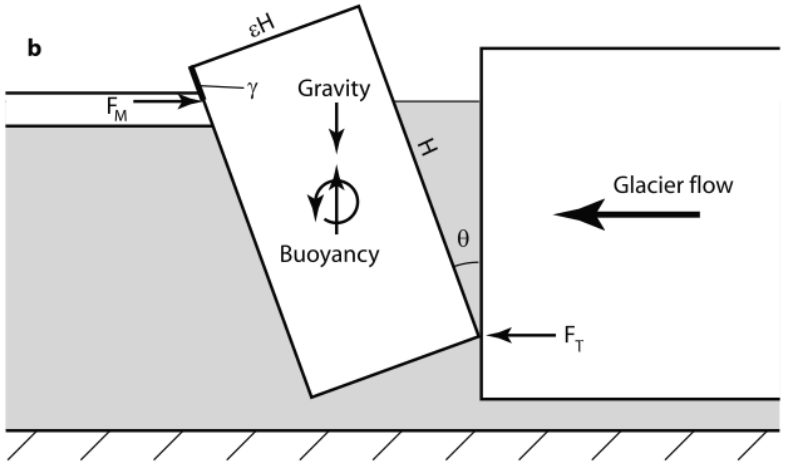


[Amundson et al., 2010]

- Force balance: sea ice may suppress calving with little force


[NASA Earth Observatory]

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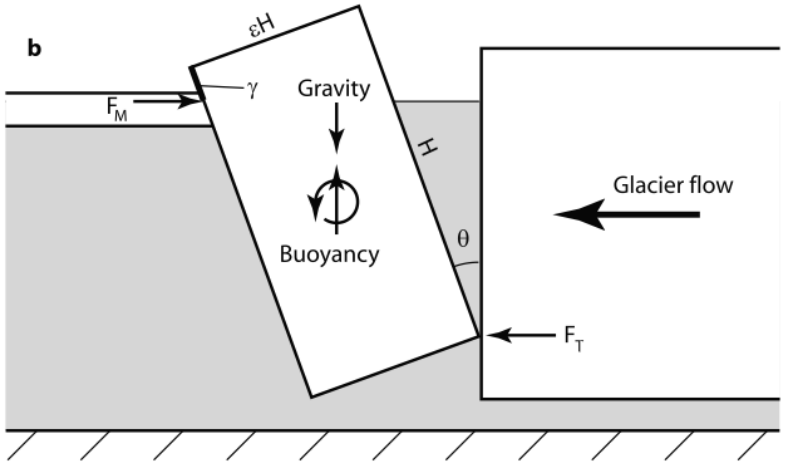


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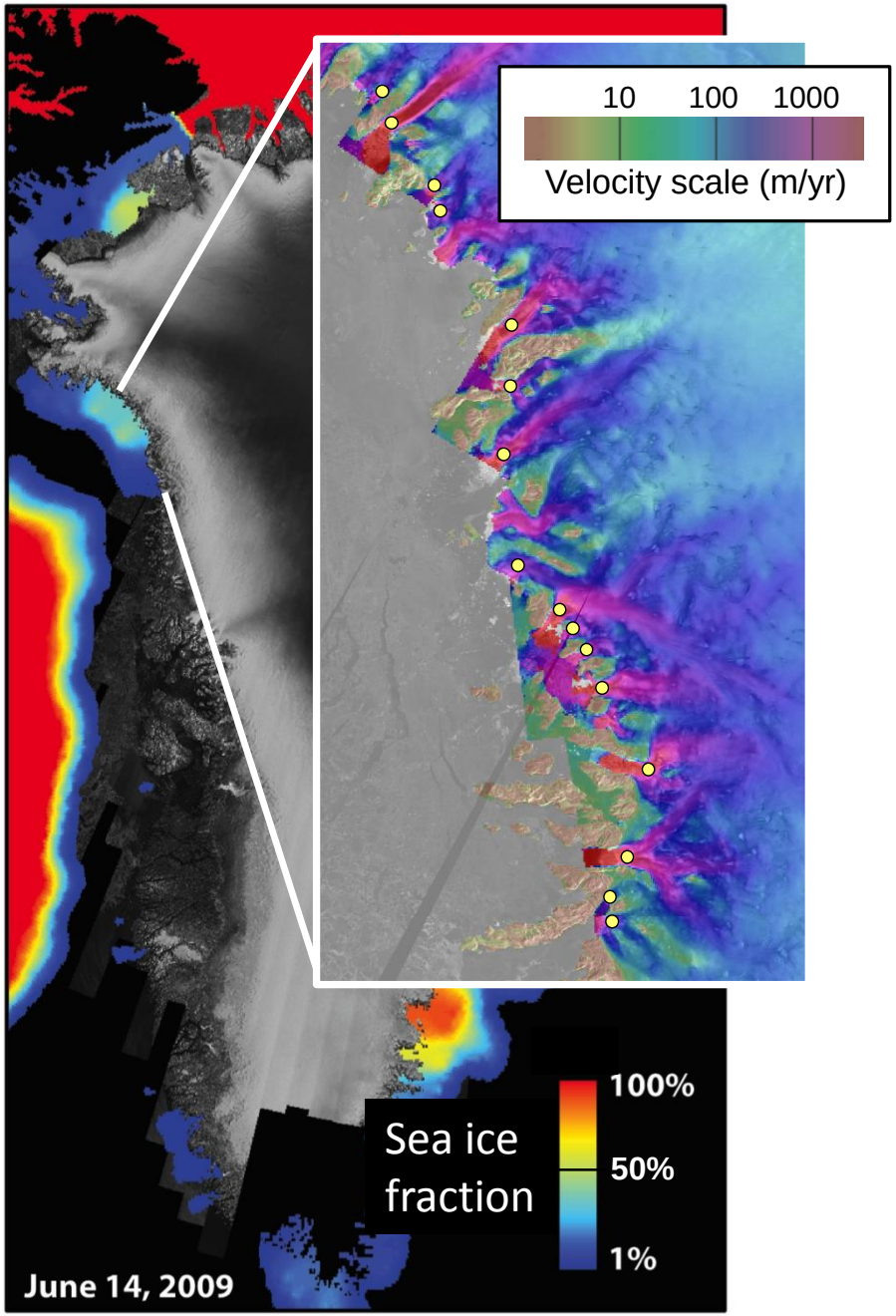
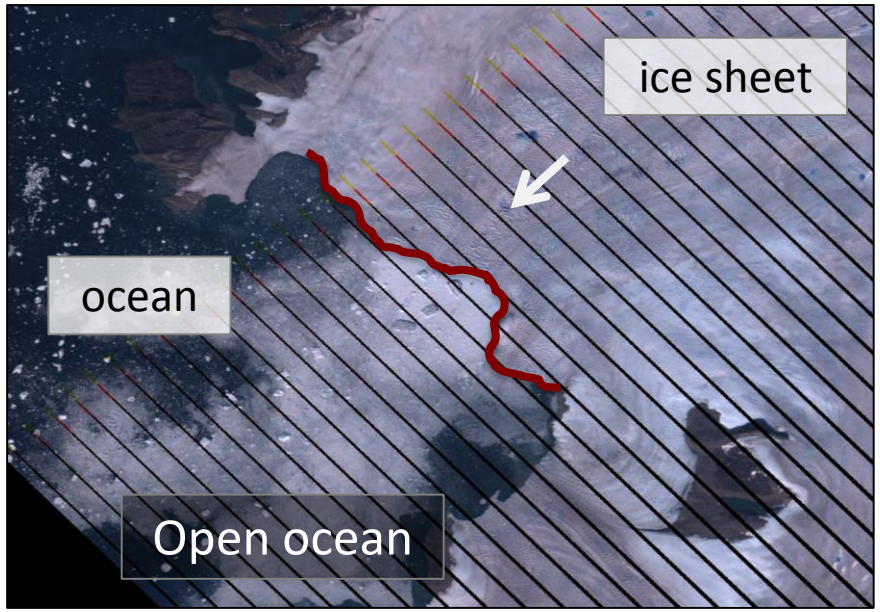
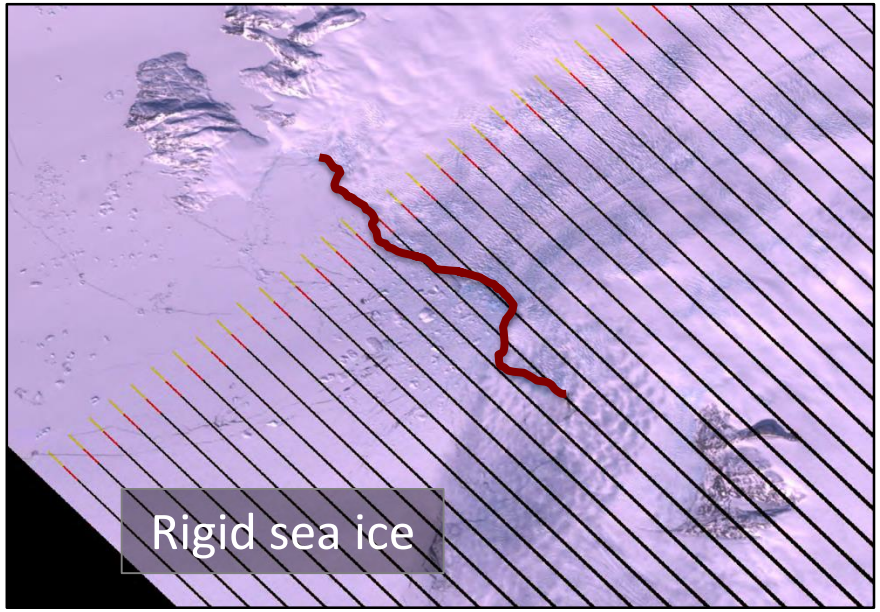
Narrow, extended fjord


[NASA Earth Observatory]

# Northwest Greenland case study



# Sea ice conditions influence seasonal terminus position


**Open ocean** periods: 73% coincide with **retreat** >50 m

[Moon et al., *in prep*, 2014]

# Sea ice conditions influence seasonal terminus position

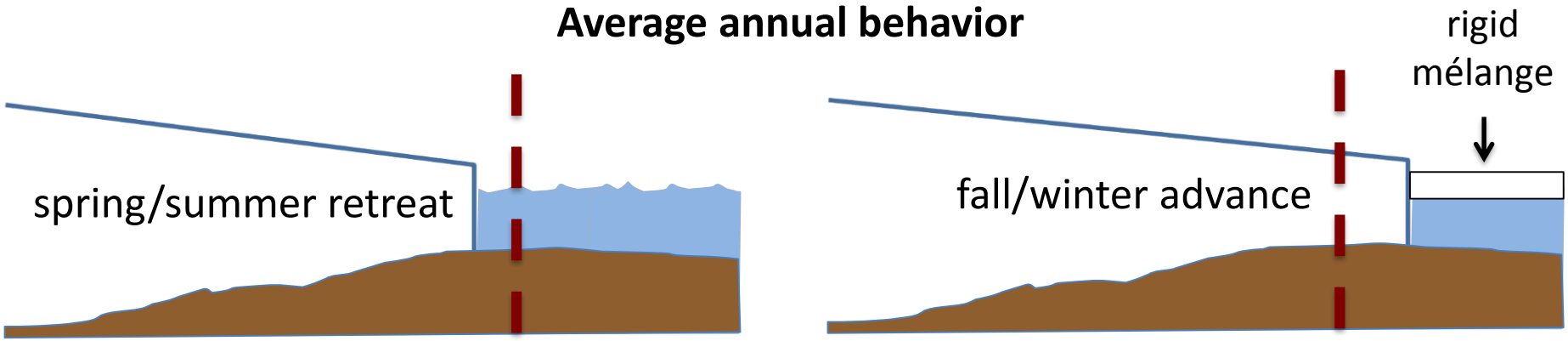

**Open ocean** periods: 73% coincide with **retreat** >50 m

**Rigid mélange** periods: 56% coincide with **advance** >50 m

[Moon et al., *in prep*, 2014]

# Longer sea ice free periods produce sustained retreat

**Average annual behavior**



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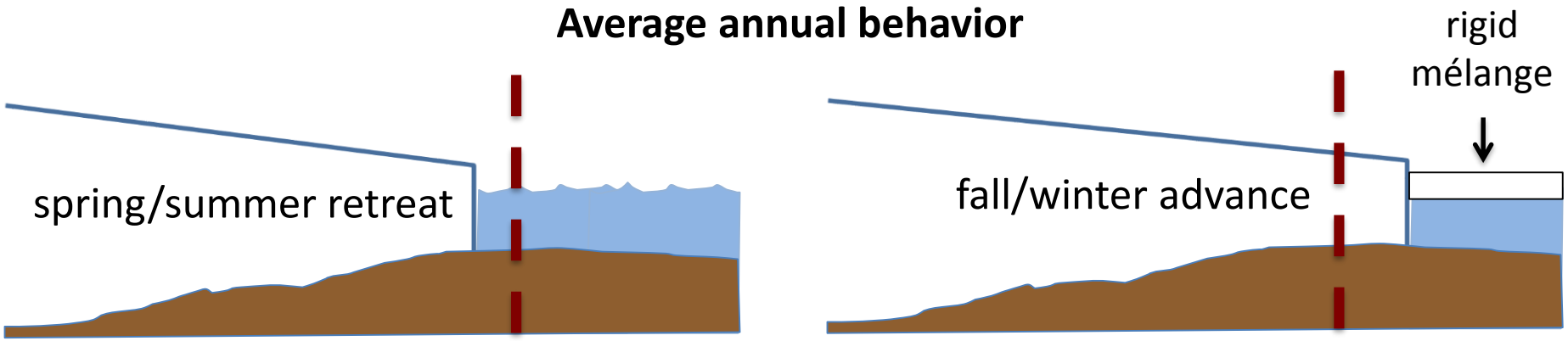


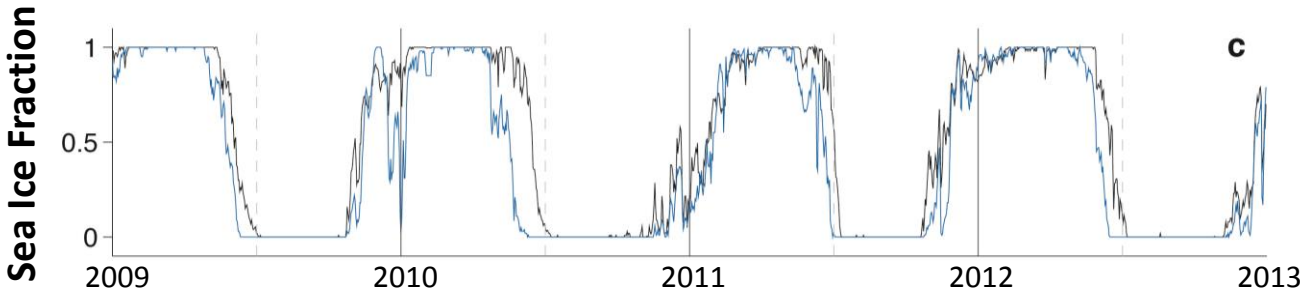


North = black

South = blue

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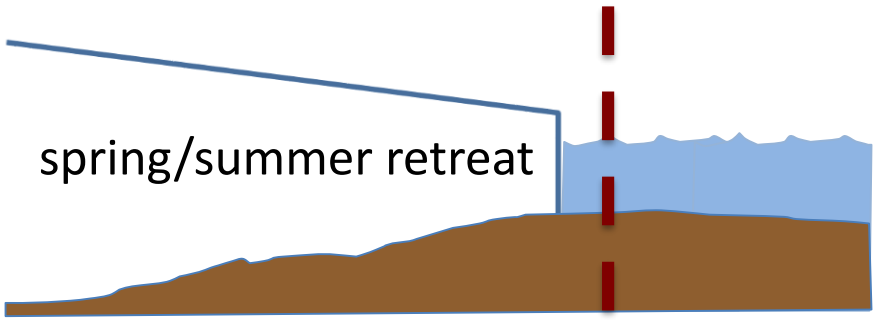


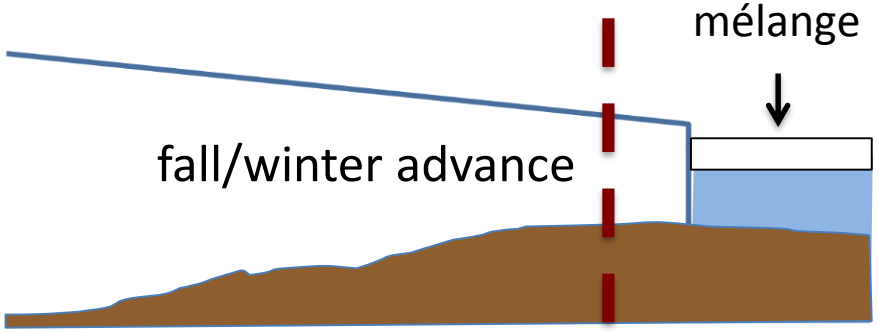


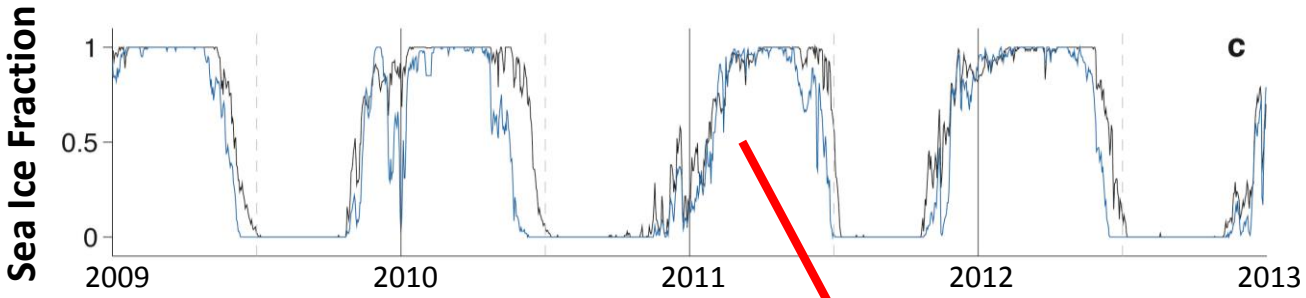


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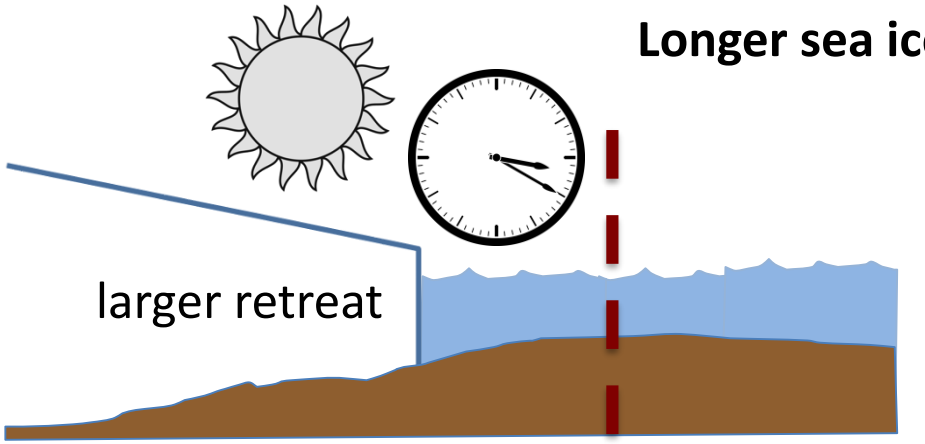


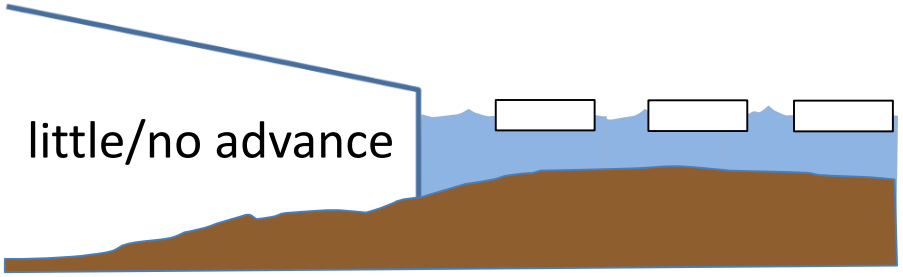

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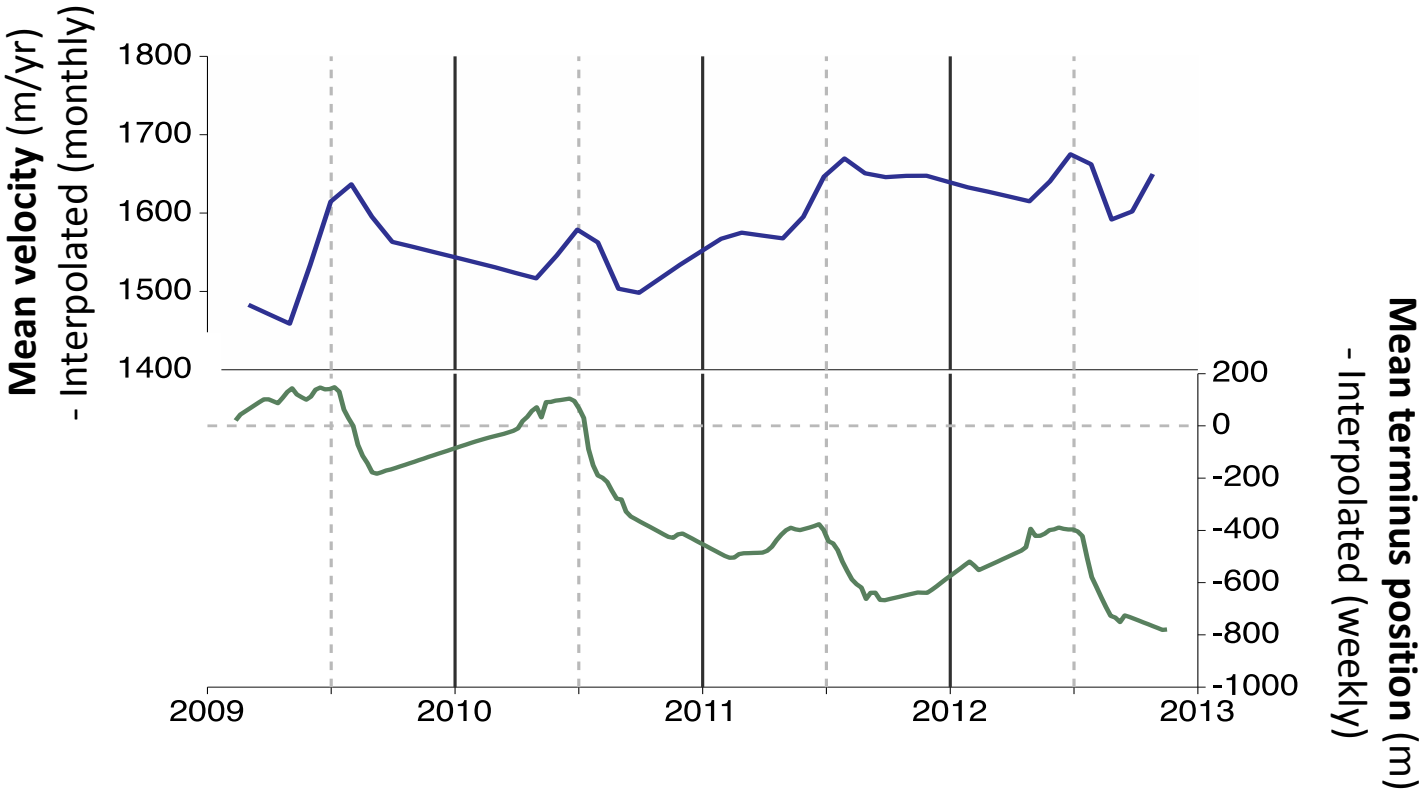


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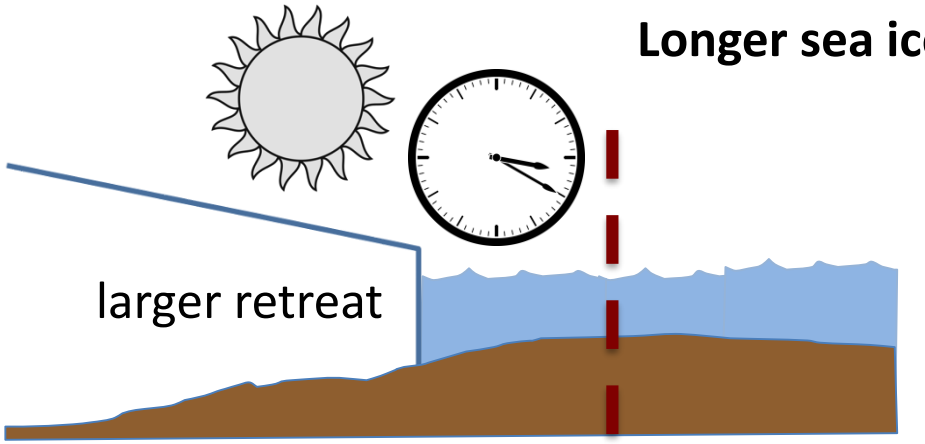
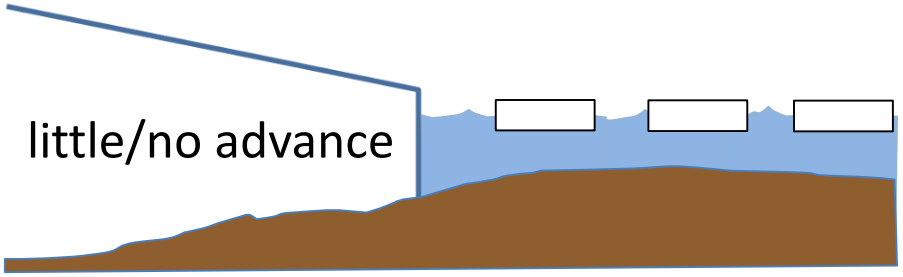
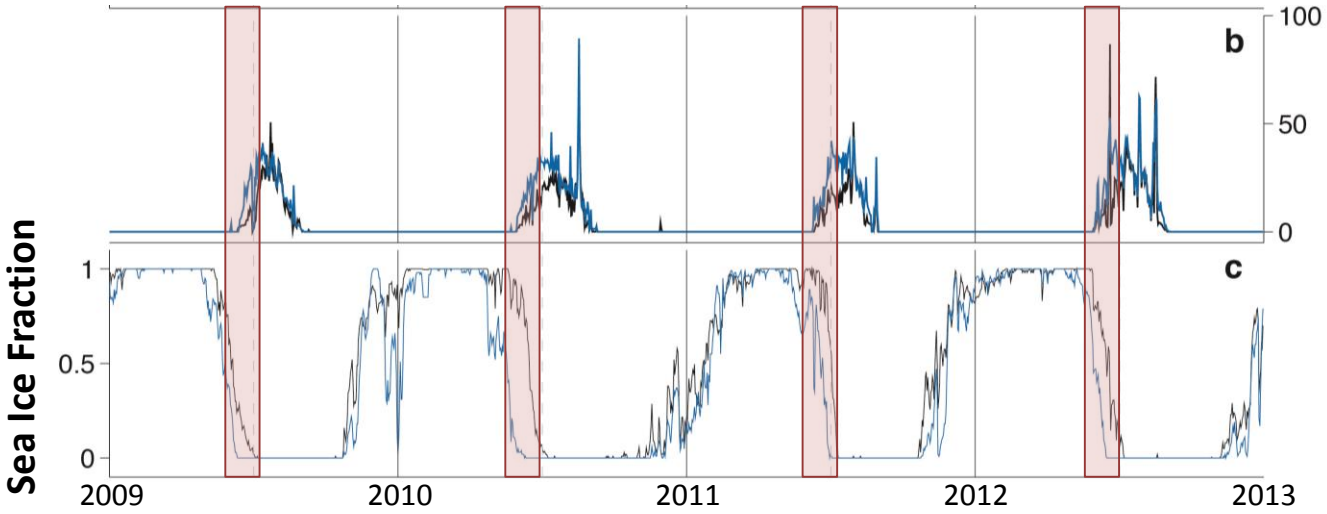


# Surface meltwater is a complicating factor in Greenland




**Meltwater Runoff**
(kg/m$^2$ per day)

*from RACMO2*

[Moon et al., *in prep*, 2014]

- Seasonal development of surface meltwater runoff coincides with loss of sea ice

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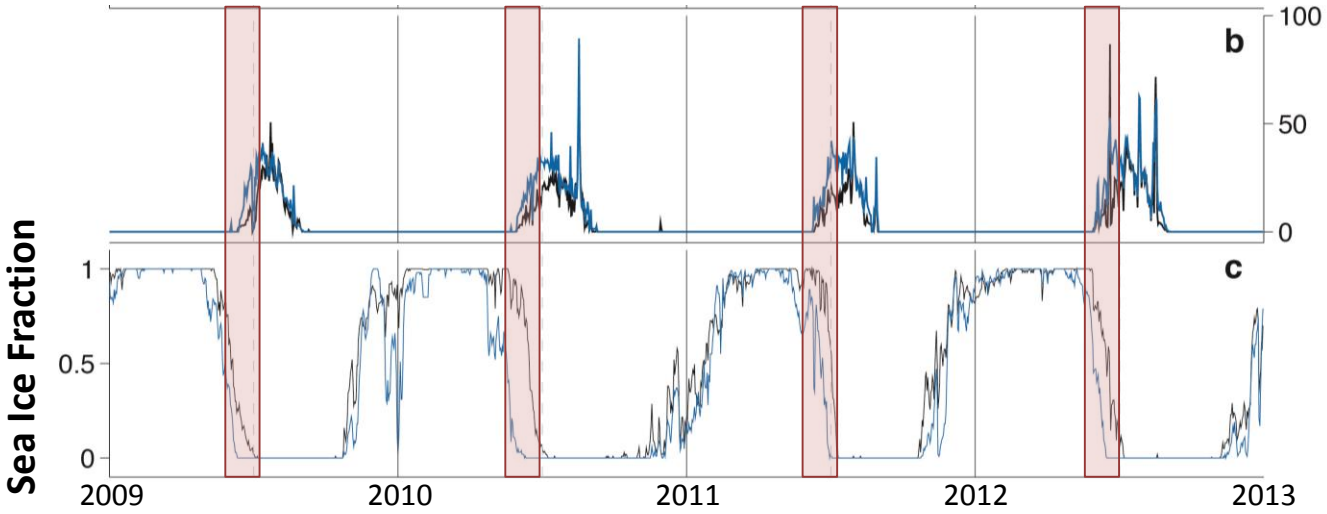


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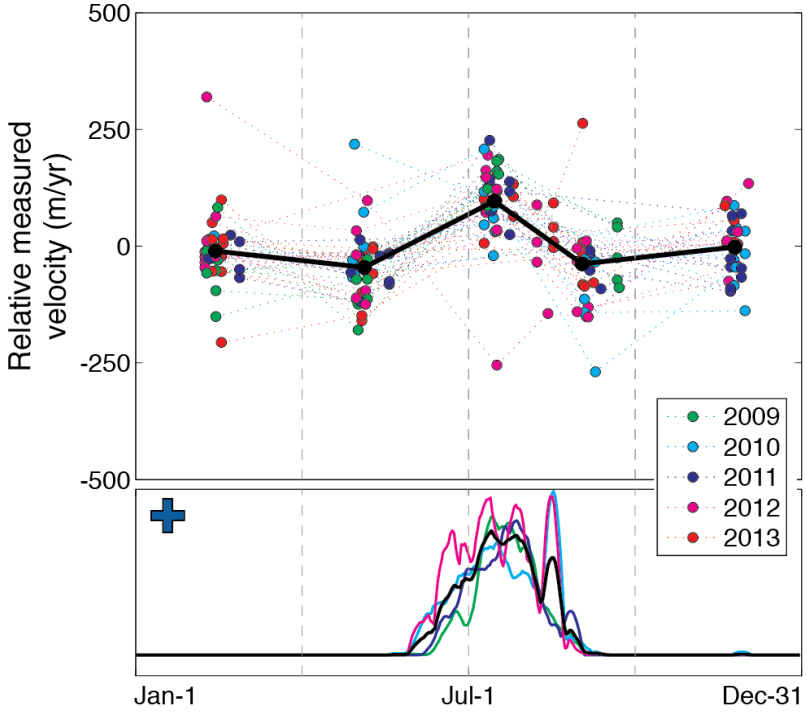
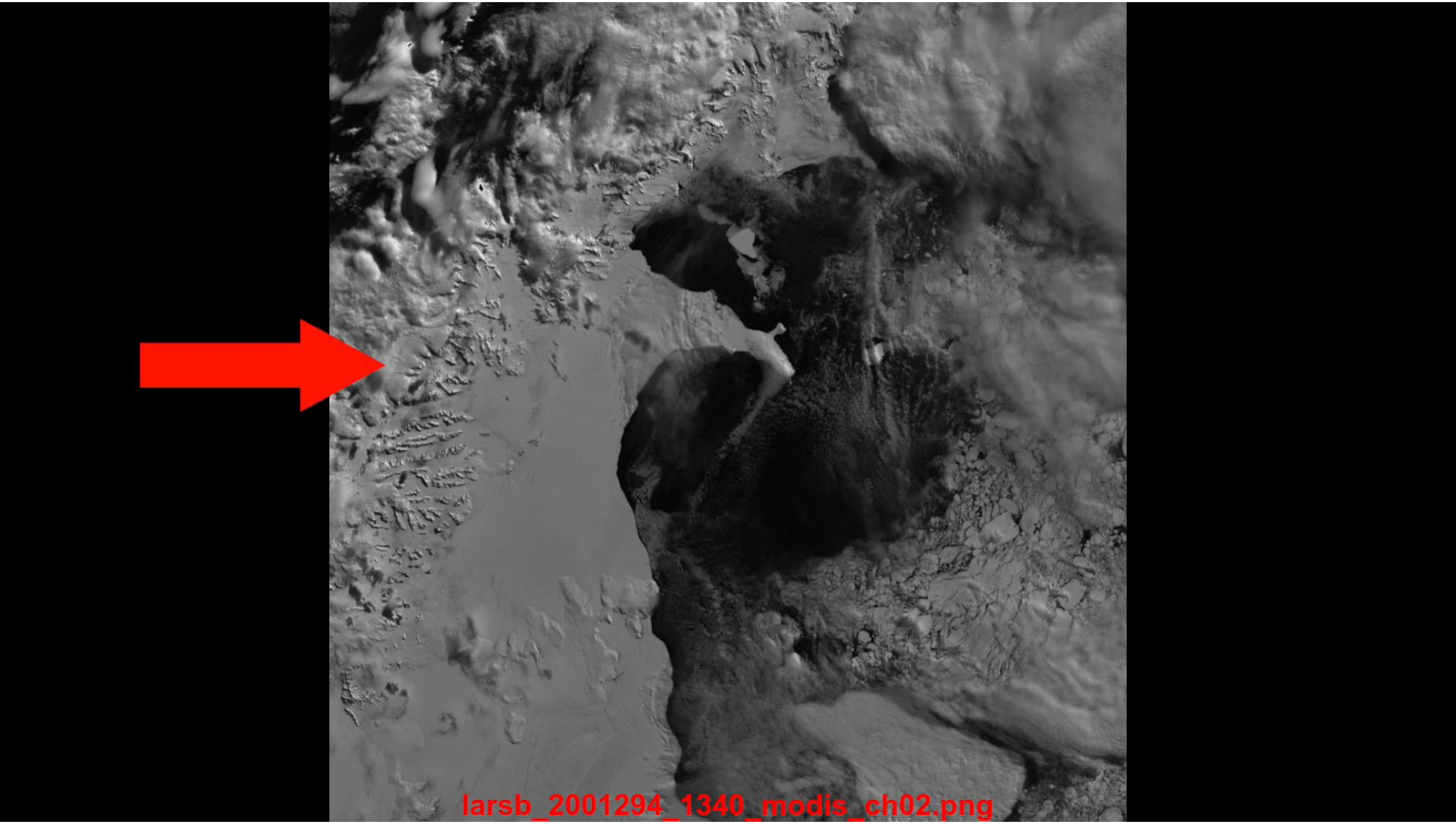



[Moon et al., *in review*, 2014]

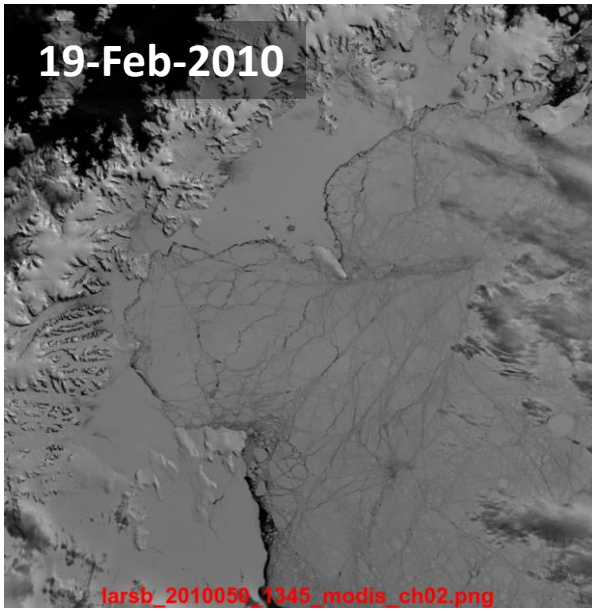
- Seasonal development of surface meltwater runoff coincides with loss of sea ice

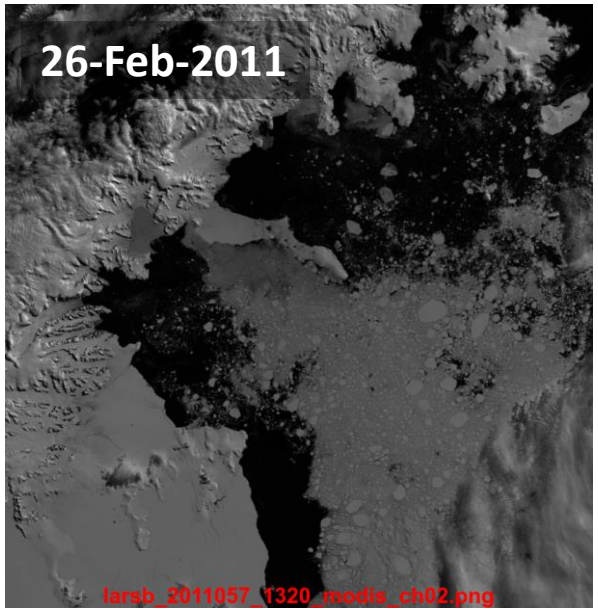
- Seasonal velocity changes for most northwestern Greenland glaciers appears more responsive to runoff than terminus change

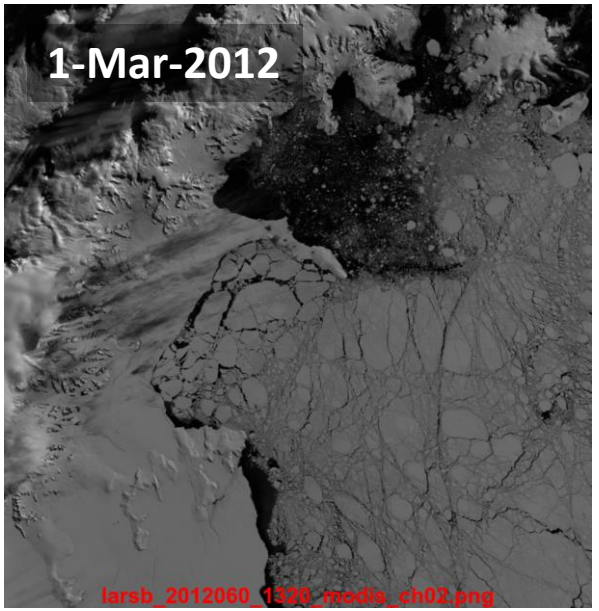
# Changes in fast ice for Larsen B

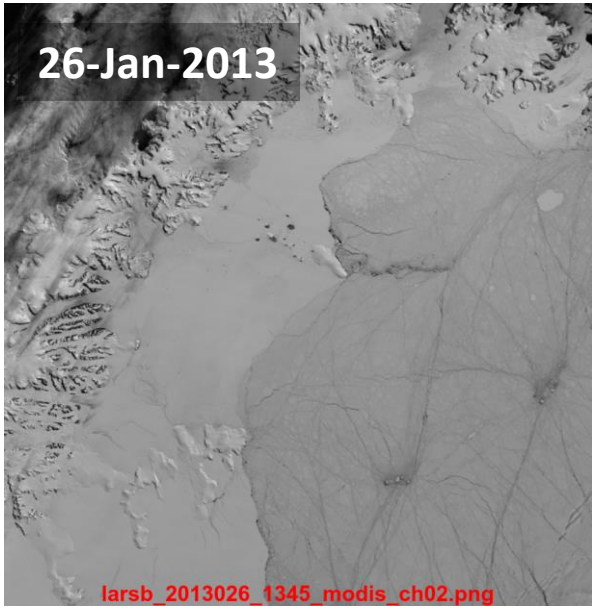


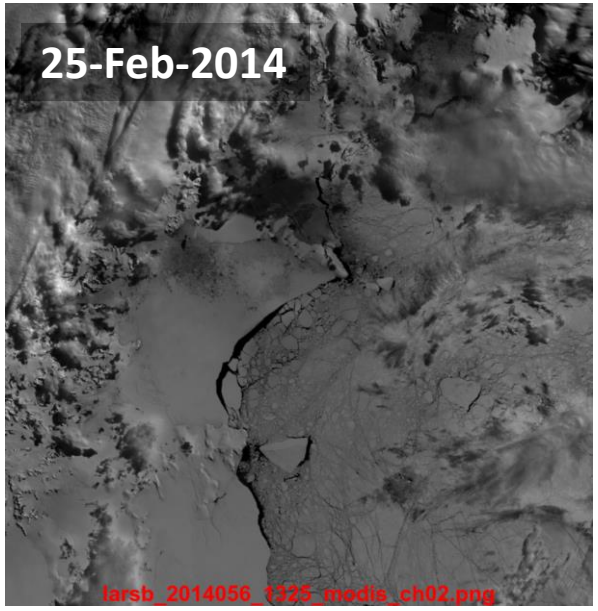
# Sustained and variable fast ice conditions

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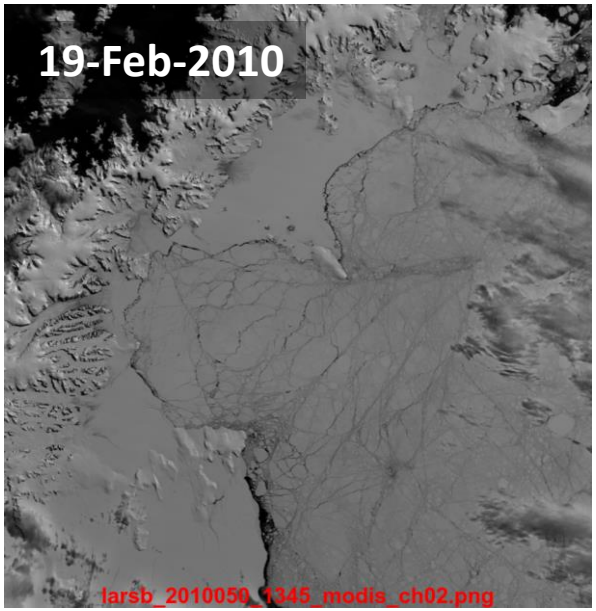


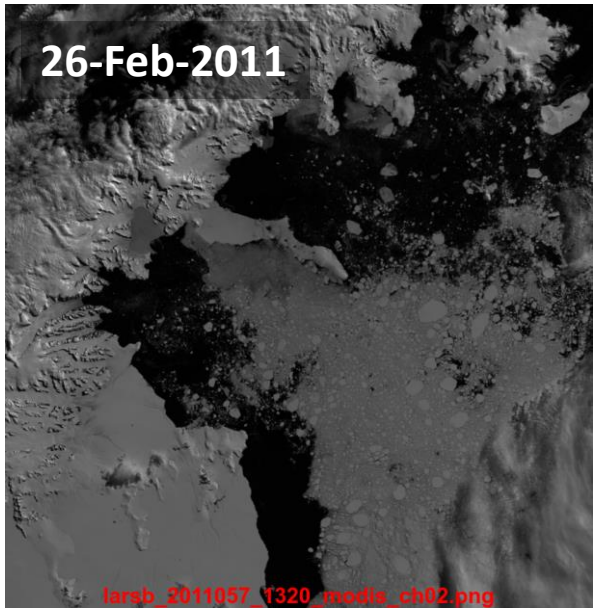


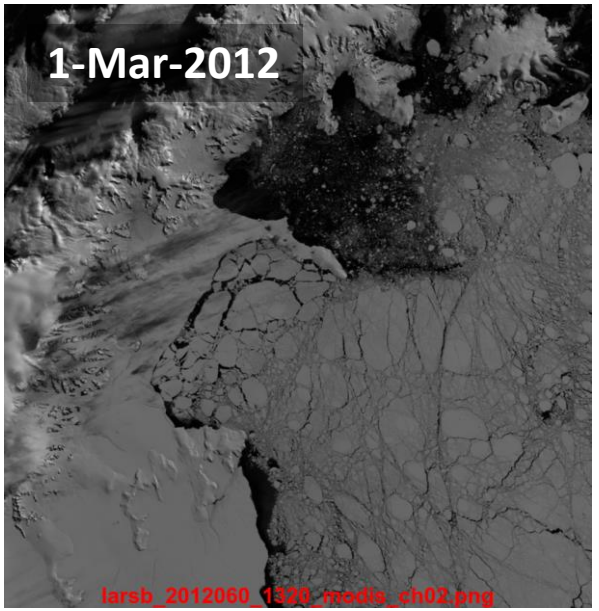


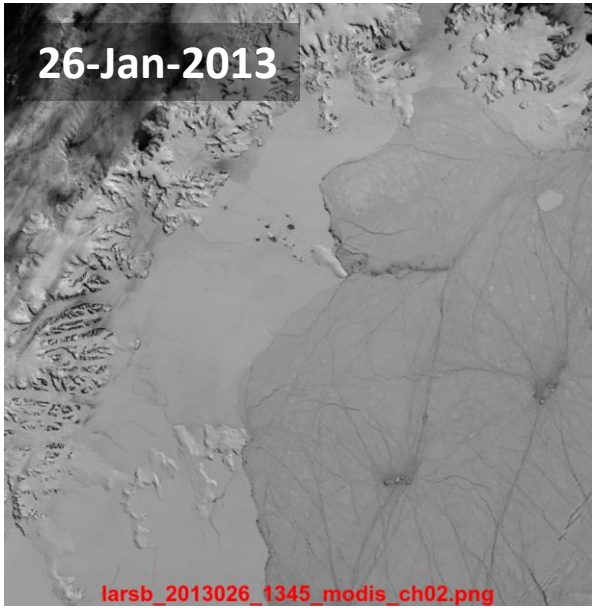


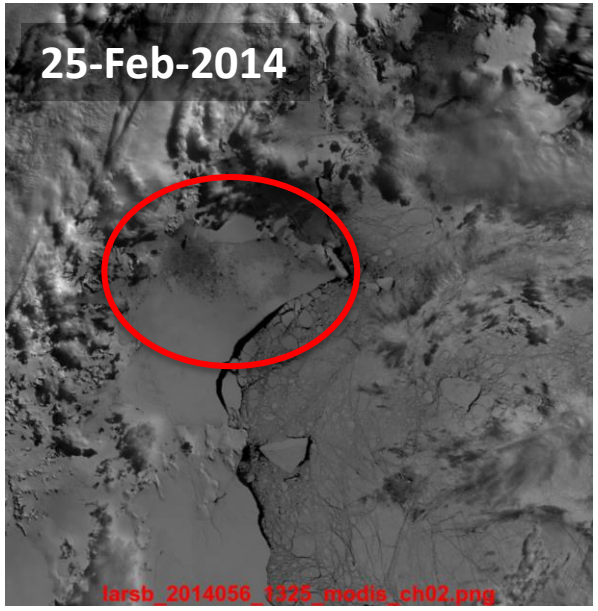


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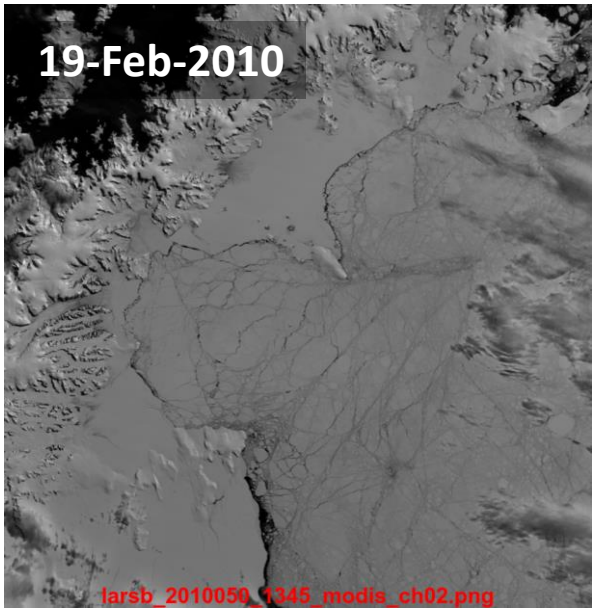
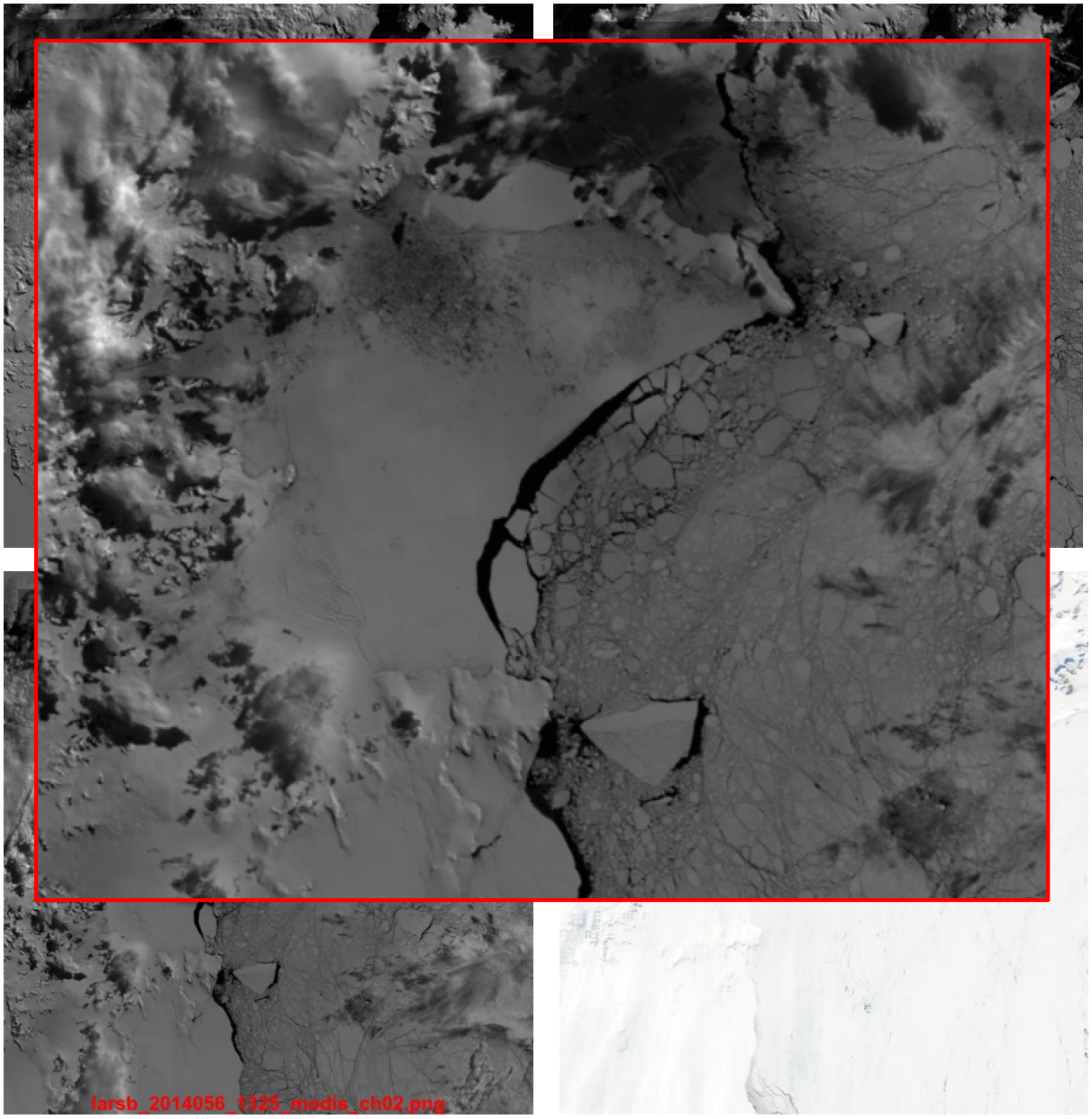
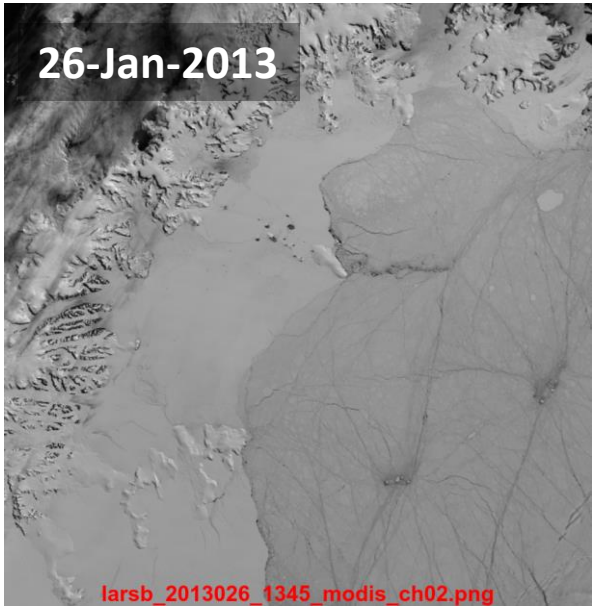
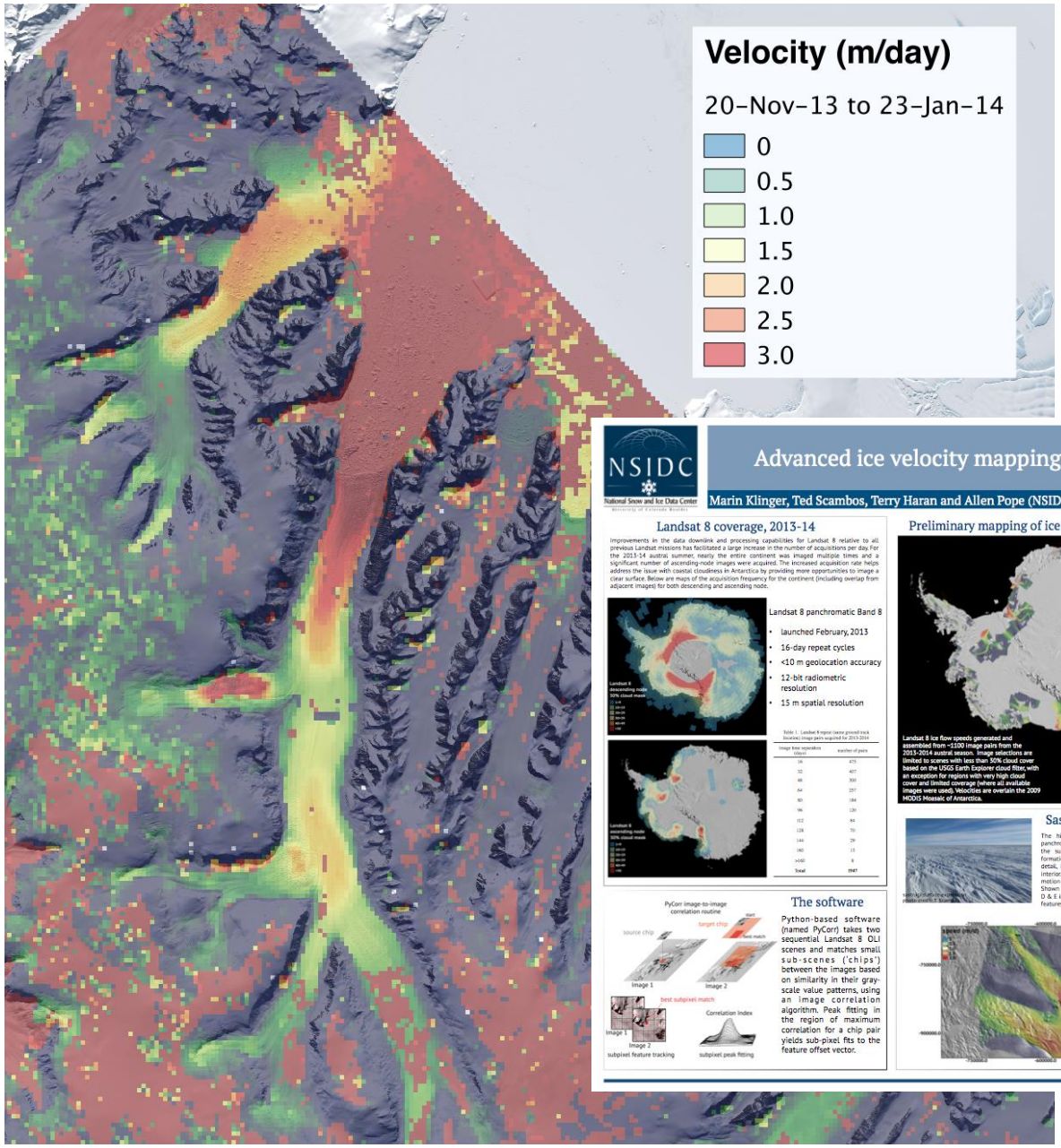


# Examining long-term velocity changes for Crane







- PyCorr for feature-tracking velocity output from Landsat7 and Landsat8

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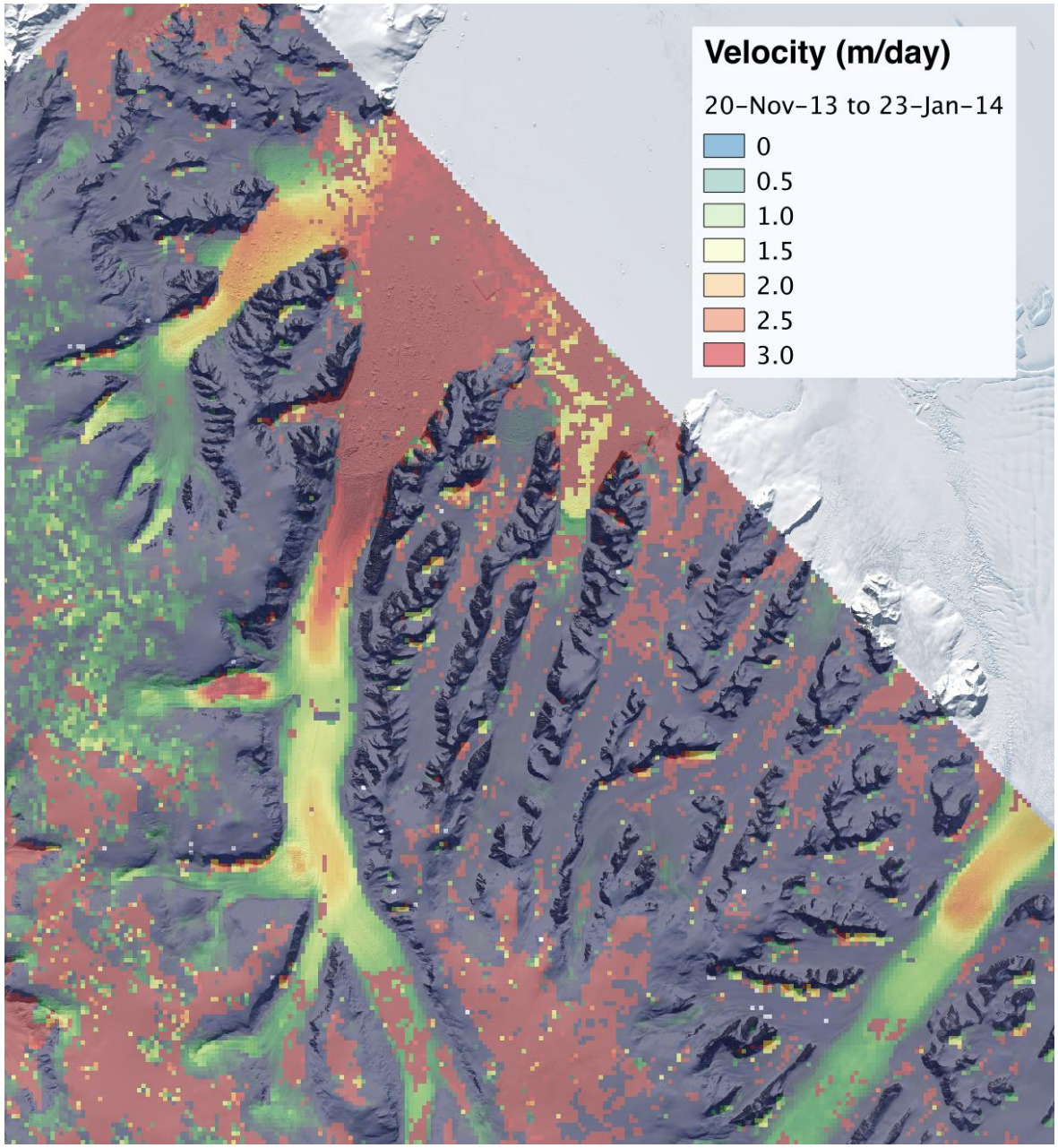
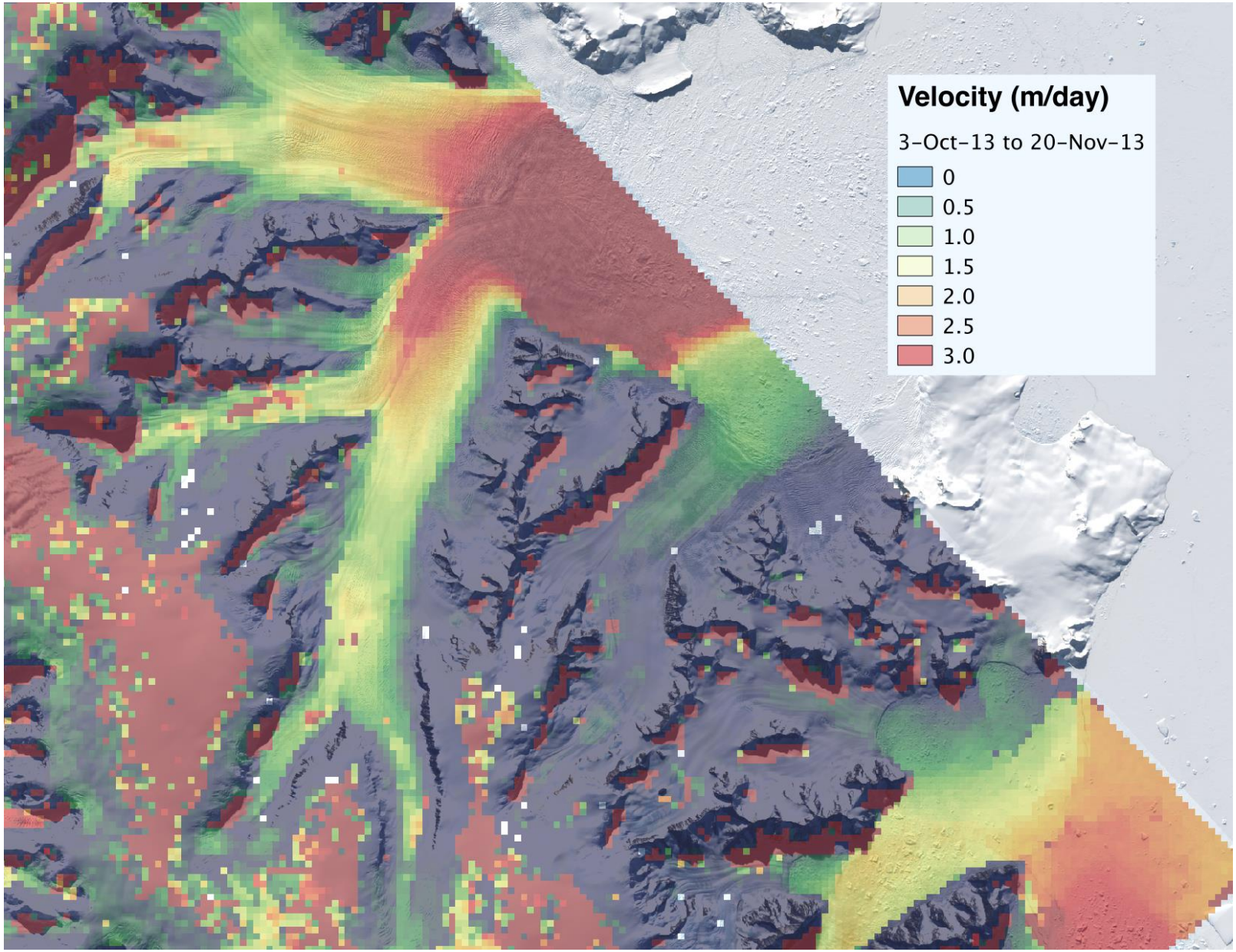



- PyCorr for feature-tracking velocity output from Landsat7 and Landsat8

- Able to look at glacier and sea ice/mélange velocities

- Interested in long-term (weeks to years) changes in glacier velocity signal

# Examining long-term velocity changes for Hektoria



**Greenland sea ice/mélange, terminus, and velocity**

- Ice mélange corresponds to terminus position

- Sustained retreat may be associated with longer sea ice free periods and induce multi-year speedup

- Runoff is a complicating factor and seasonal velocity appears more responsive to surface meltwater

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## Antarctic Peninsula sea ice/mélange and glacier interaction

- Since loss of Larsen B Ice Shelf, multi-year fast ice has developed at multiple periods near Crane, Hektoria, and Green Glaciers

- Periods of open water conditions have also persisted through several months

- The region may provide a more “simple” case study for understanding the interaction of sea ice and glacier dynamics

- Techniques for measuring surface velocity continue to improve: we use PyCorr with Landsat7 and Landsat8


Thank you