Glacier-Ocean Interactions on Short Timescales: can observations of tidal and calving impacts on near-terminus ice flow inform us about controls on terminus stability?

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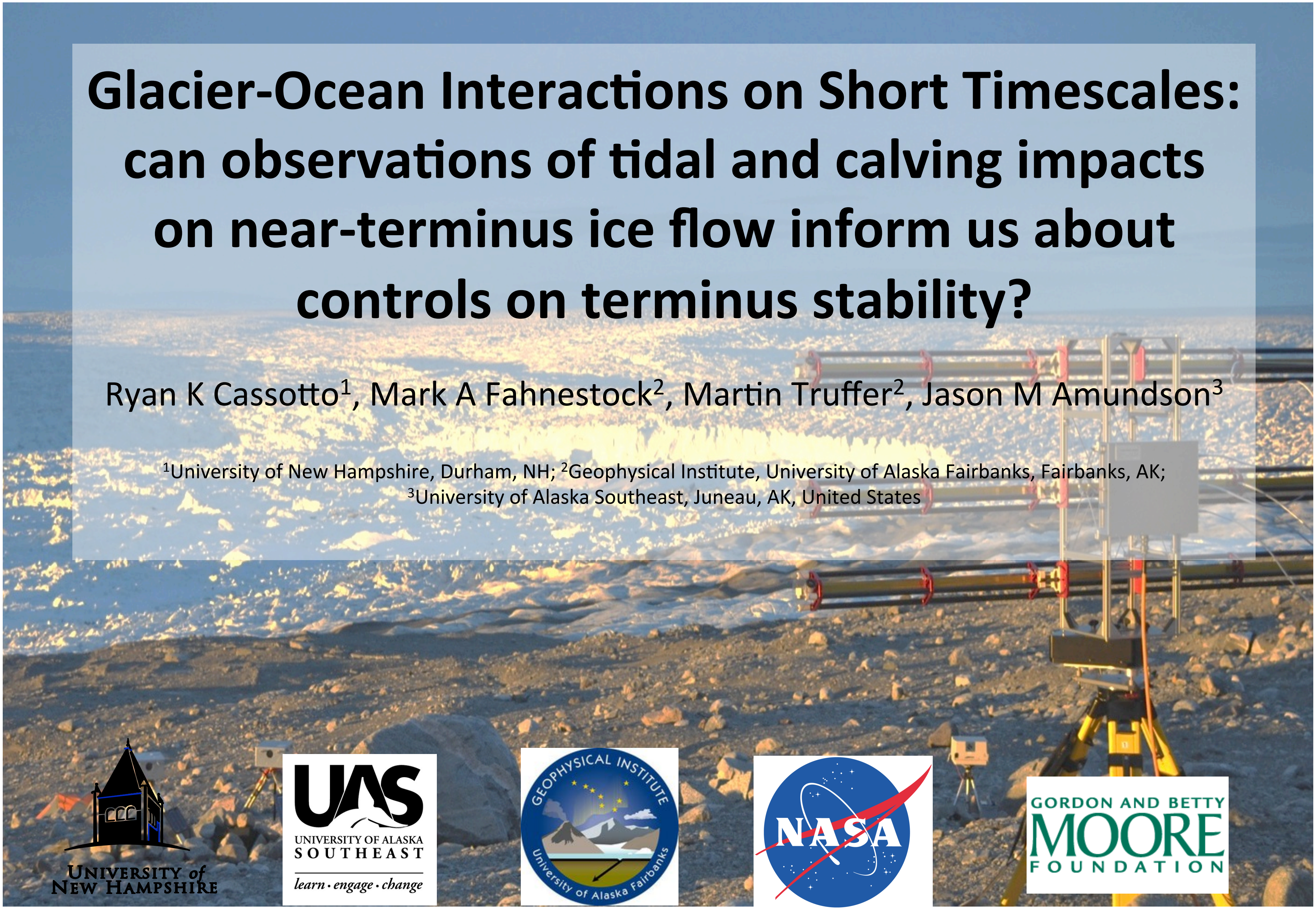
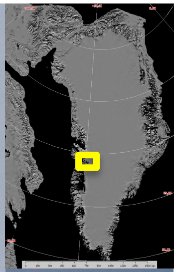




Objectives:

- Observe change in surface deformation at the glacier terminus to gain a better understanding of the controls of ice dynamics during short-term perturbations

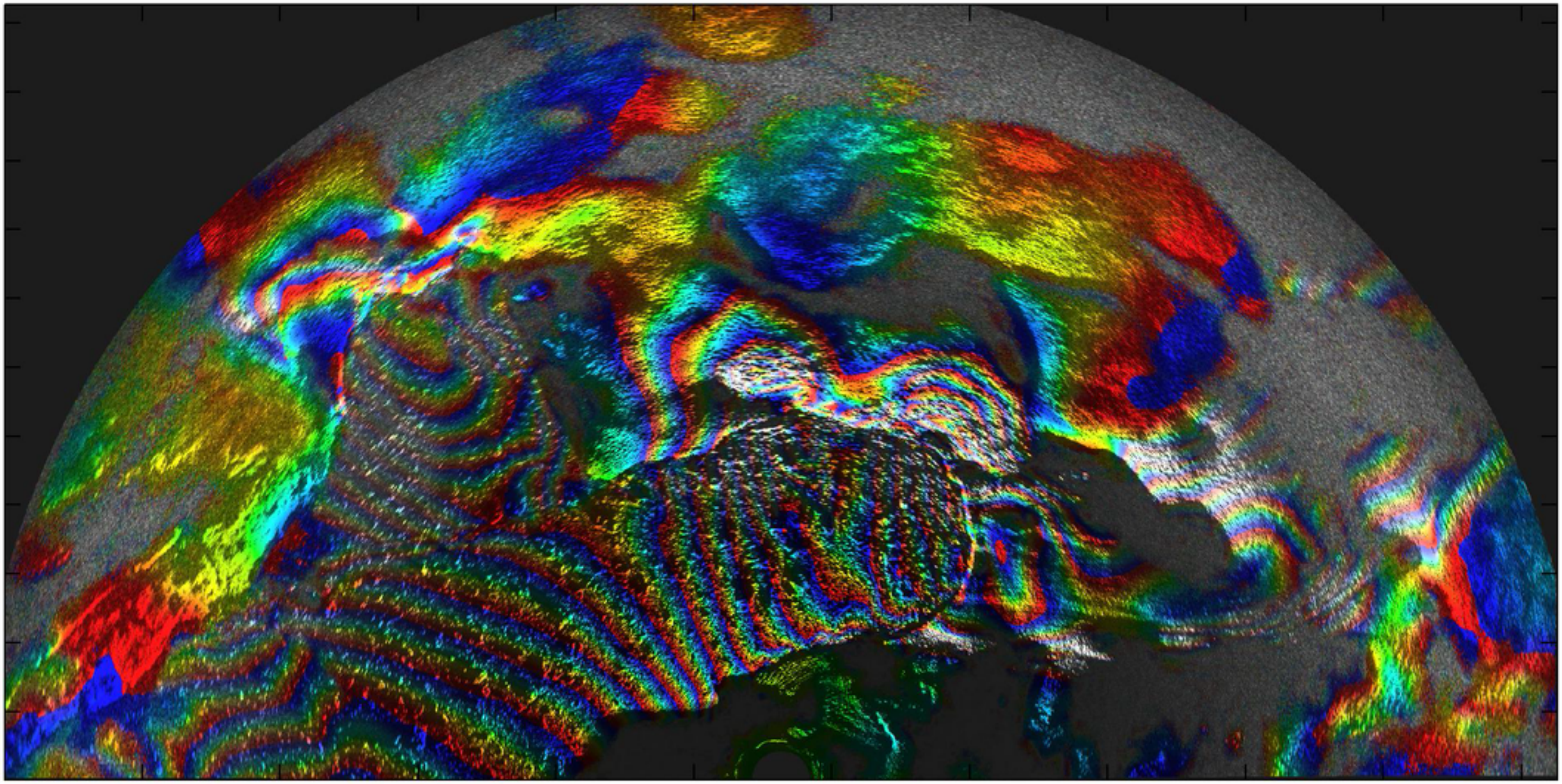
Scientific Questions

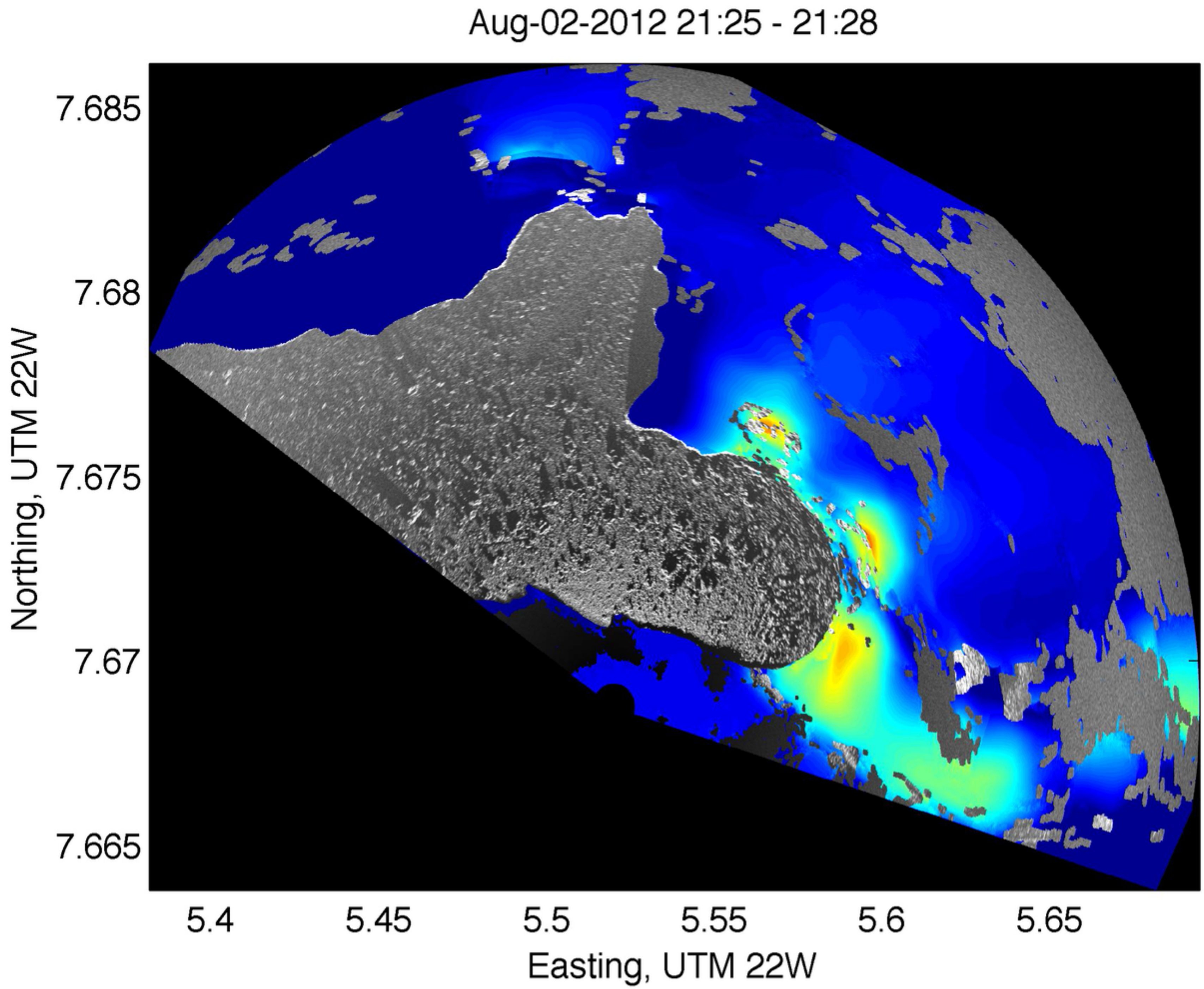
- 1. How do short-term perturbations at the glacier's calving front affect the terminus stability
    - How does velocity vary through a calving event?
    - How does the mélange affect velocity and/or strain rate at the terminus?
    - Can we constrain the spatial extent of tidal influence on terminus dynamics?
- 2. How do GPRI observations compare with satellite based Synthetic Aperture Radar (SAR) and GPS measurements?

Methods:

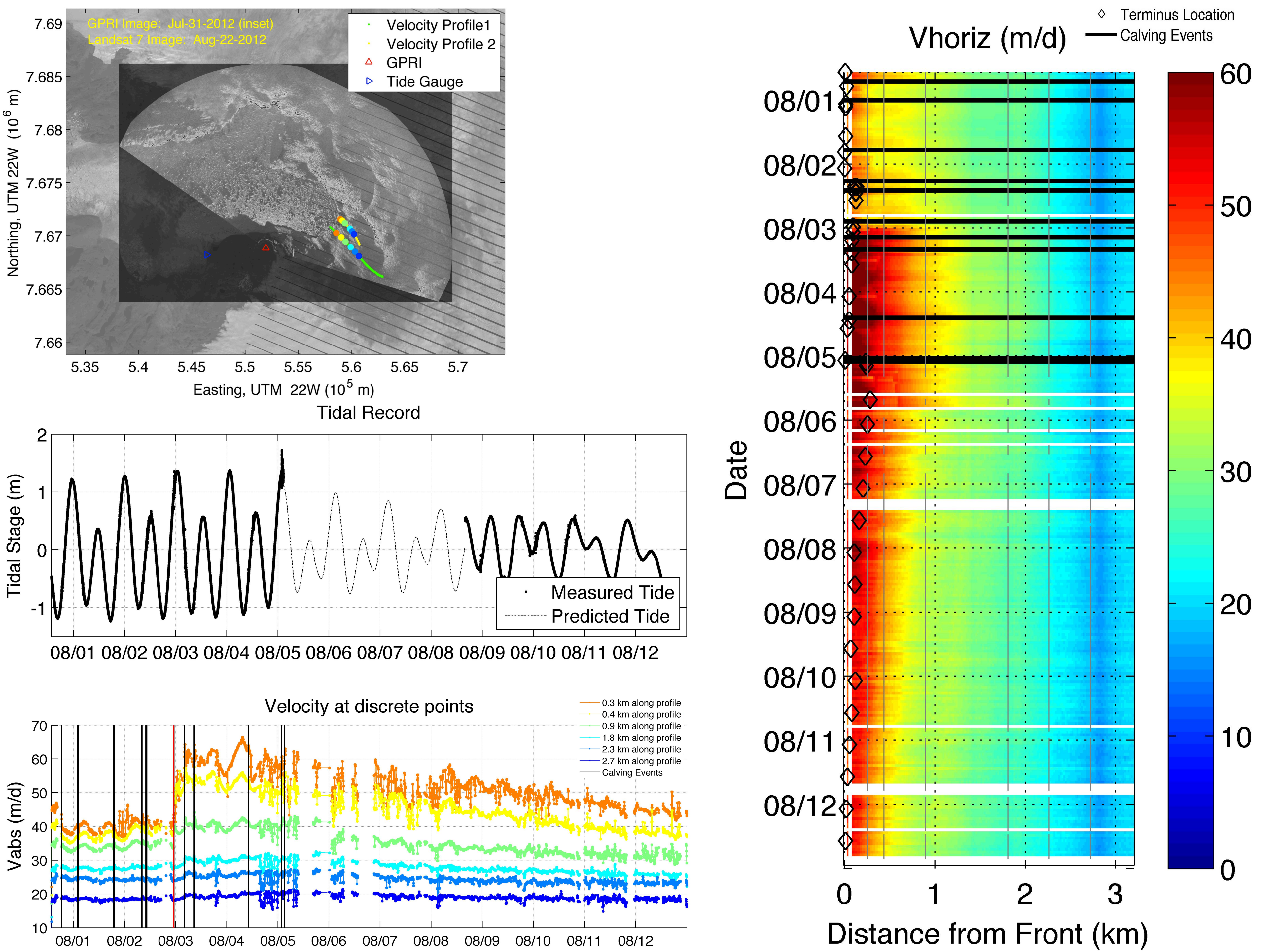
- Two week field study at Jakobshavn Isbrae in August 2012
- Instruments: GPRI-II, Tide Gauge, time-lapse cameras, Satellite SAR

Aug-02-2012 21:19 - 21:22

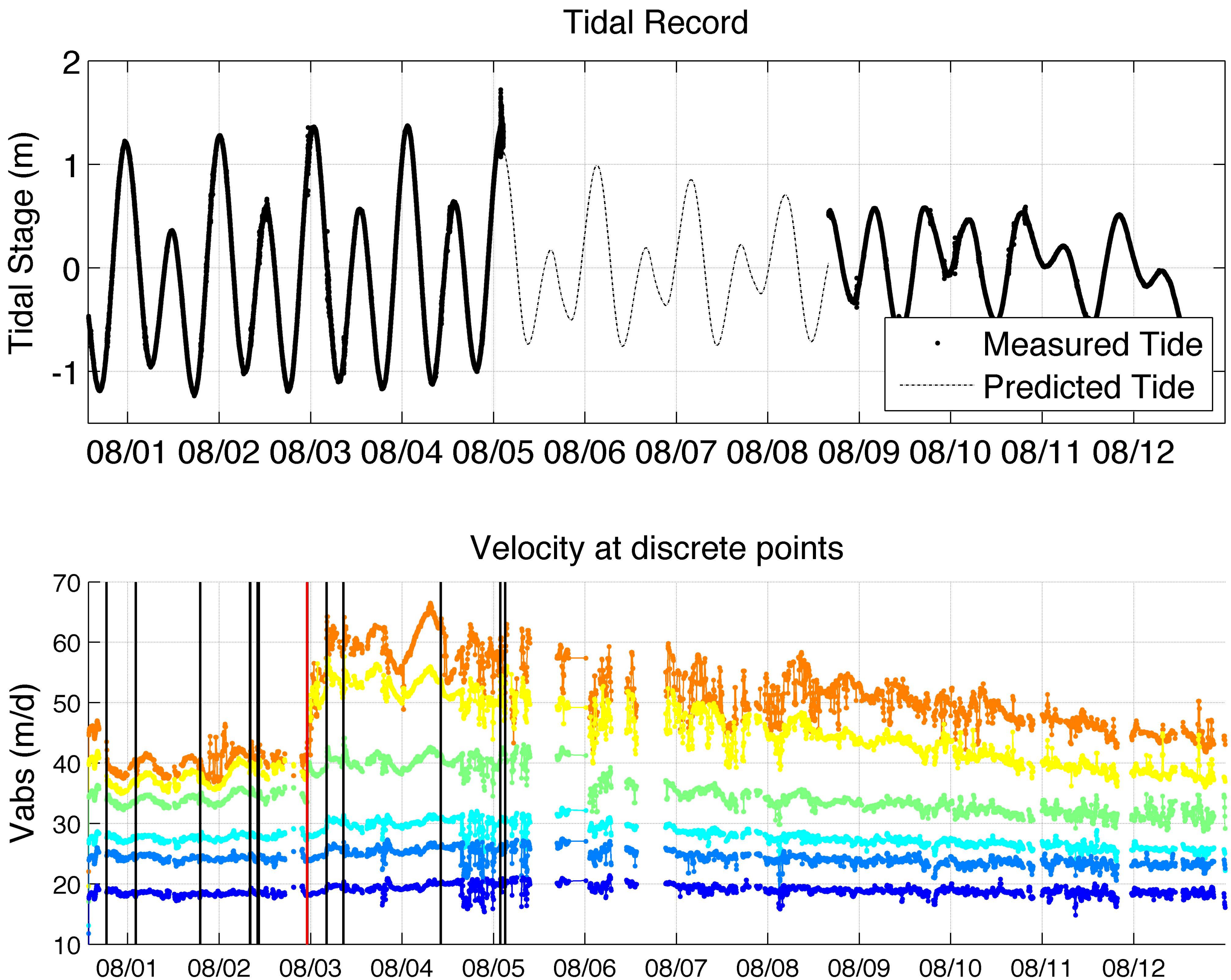




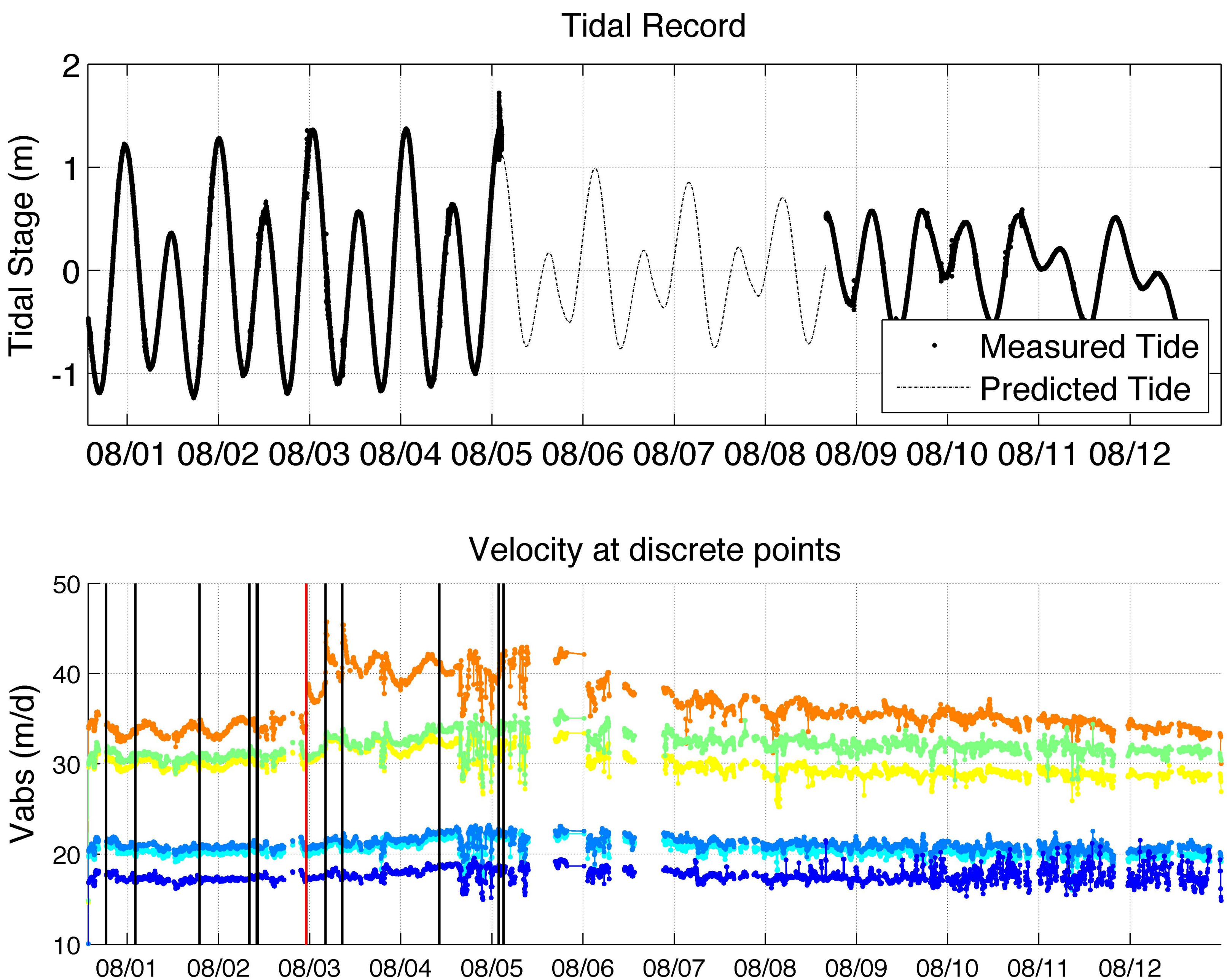
Aug-02-2012 21:25 - 21:28
7.685
7.68
7.675
7.67
7.665
Northing, UTM 22W
5.4
5.45
5.5
5.55
5.6
5.65
Easting, UTM 22W


GPRI Image: Jul-31-2012 (inset)
Landsat 7 Image: Aug-22-2012
Velocity Profile1
Velocity Profile 2
GPRI
Tide Gauge
Northing, UTM 22W (10^6 m)
Easting, UTM 22W (10^5 m)
Tidal Record
Tidal Stage (m)
Measured Tide
Predicted Tide
08/01 08/02 08/03 08/04 08/05 08/06 08/07 08/08 08/09 08/10 08/11 08/12
Velocity at discrete points
Vabs (m/d)
0.3 km along profile
0.4 km along profile
0.9 km along profile
1.8 km along profile
2.3 km along profile
2.7 km along profile
Calving Events
Vhoriz (m/d)
Terminus Location
Calving Events
Date
Distance from Front (km)

- Results:
  - Of the 12 calving events that occurred during the field study, only 1 caused significant change in the glacier's stability;
    - Velocities increased for the lower 4.5 km of the glacier increased by as much as 33%
    - Speed-up remained high but gradually returned to pre-event values over more than 10 days.
  - JI velocities showed diurnal variability 180° out of phase with tidal modulations, the amplitude of the variability increased following the calving event
- Future Work
  - Improve unwrapping techniques
  - Develop a robust atmospheric correction
  - Derive strain rates to gain a better understanding of the controls on ice dynamics near the glacier terminus



Tidal Record
Tidal Stage (m)
2
1
0
-1
Measured Tide
Predicted Tide
08/01 08/02 08/03 08/04 08/05 08/06 08/07 08/08 08/09 08/10 08/11 08/12
Velocity at discrete points
Vabs (m/d)
70
60
50
40
30
20
10
08/01 08/02 08/03 08/04 08/05 08/06 08/07 08/08 08/09 08/10 08/11 08/12


Tidal Record
Tidal Stage (m)
2
1
0
-1
Measured Tide
Predicted Tide
08/01 08/02 08/03 08/04 08/05 08/06 08/07 08/08 08/09 08/10 08/11 08/12
Velocity at discrete points
Vabs (m/d)
50
40
30
20
10
08/01 08/02 08/03 08/04 08/05 08/06 08/07 08/08 08/09 08/10 08/11 08/12