Subaqueous Melting of Store Glacier, West Greenland – 3D numerical modeling & ocean observations

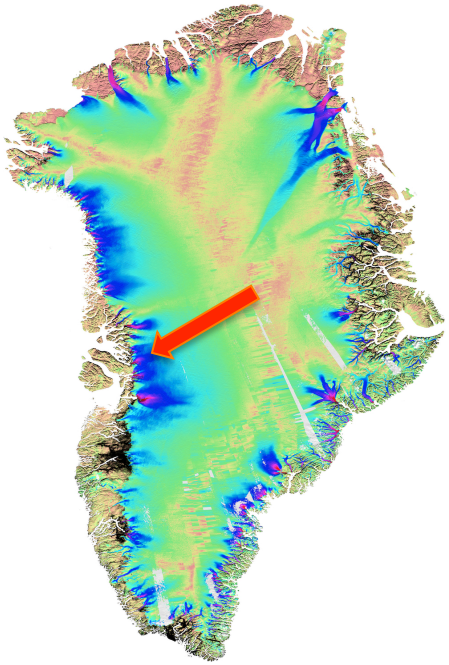
Yun Xu[1], Eric Rignot[1,2], Ian Fenty[2], Dimitris Menemenlis[2], M. Mar Flexas[2]

[1]Earth System Science, University of California Irvine, Irvine, CA, 92697

[2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, 91109

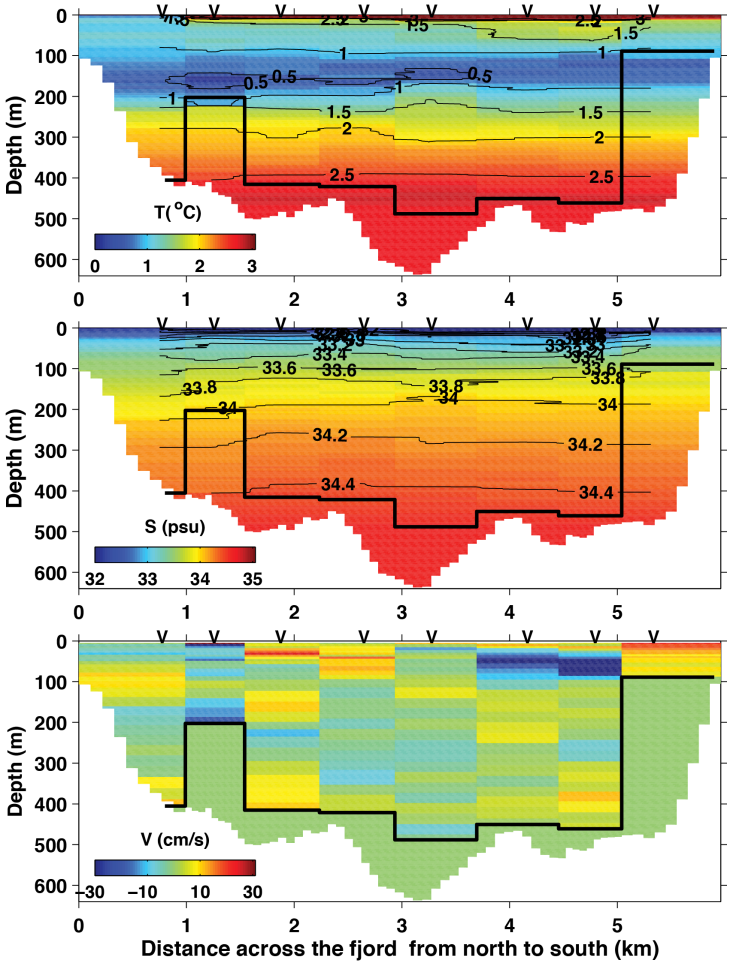
Objectives:

1. Resolve the turbulent subglacial plume in MITgcm
2. Simulate subaqueous melting of tidewater glaciers
3. Evaluate model results with ocean observations



Ocean observations

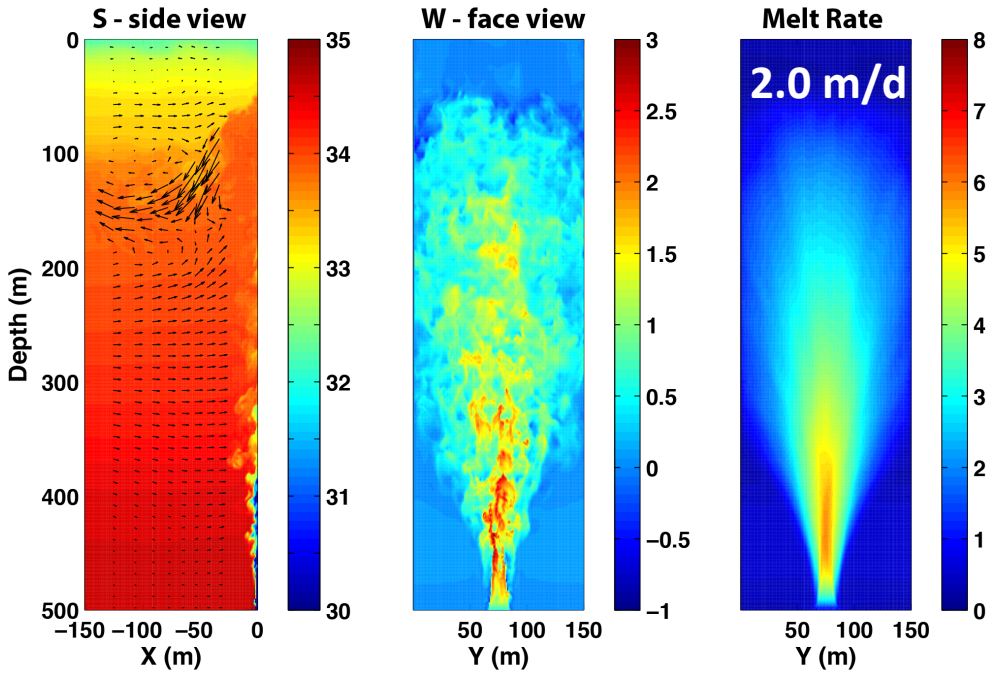
August 2010

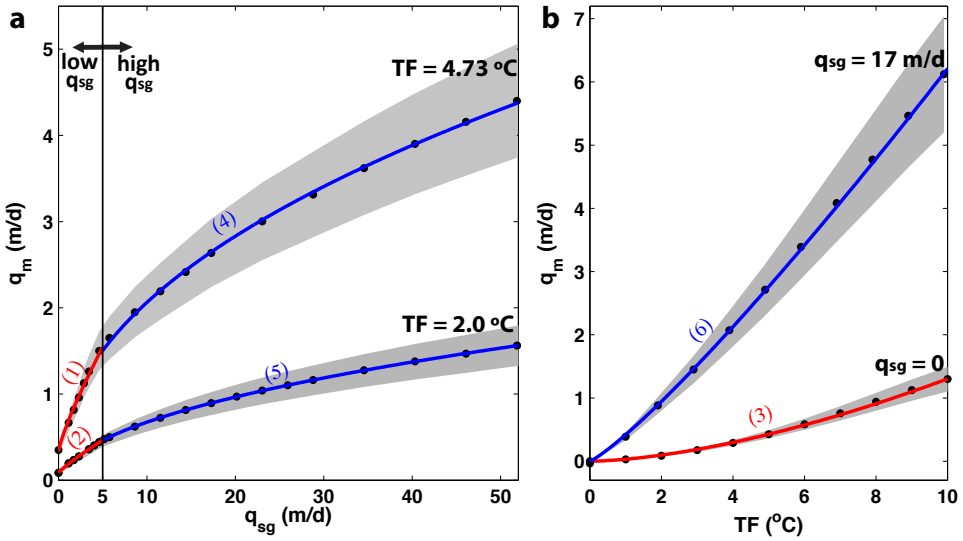


Melt rate 1.5 ± 0.8 m/d

Subglacial discharge 236 ± 38 m³/s

MITgcm





Fitting function: $q_m = (A \cdot q_{sg}^{\alpha} + B) \cdot TF^{\beta}$

Conclusion

- MITgcm resolves turbulent plume with 3D 1m-resolution.
- Vigorous melting occurs at depth above subglacial channels, undercutting the calving face.
- The simulated melt rate compares well with that derived from oceanographic data.
- Melt rates increase below linear with the subglacial water flux and above linear with ocean thermal forcing.
- The relationship is expressed by fitting function: $q_m = (A \cdot q_{sg}^{\alpha} + B) \cdot TF^{\beta}$ can be used to estimate year-around melt rates at Store Glacier.
- As surface melting increases in a warmer climate, glacier melting by the ocean will increase even at constant ocean temperature.