Model Assisted River Discharge Estimates

Benjamin Hudson[1], Irina Overeem[1], Andreas Mikkelsen[2], Jason Kean[3], Ethan Welty[4], James P.M. Syvitski[1]

1) CSDMS/INSTAAR, University of Colorado Boulder, 2) University of Copenhagen, 3) U.S. Geological Survey, 4) INSTAAR, University of Colorado Boulder

PROBLEM

In remote river locations, building accurate stage - discharge relationships can be difficult and time prohibitive.

For example, we installed stage sensors on two remote rivers in Greenland. These rivers were only accessible to us for one week each summer, meaning that we could only observe the river at a narrow range of stages and discharges.


STRATEGY

We could survey:

- The river's cross section (within safety limitations)
- Channel roughness
- slope of the water surface
- surface velocity

With this information we used a fluid mechanically based model (Kean and Smith, 2005; Kean et al., 2009; Kean and Smith, 2010) to construct a stage discharge relationship useful in translating our stage measurements into discharge.
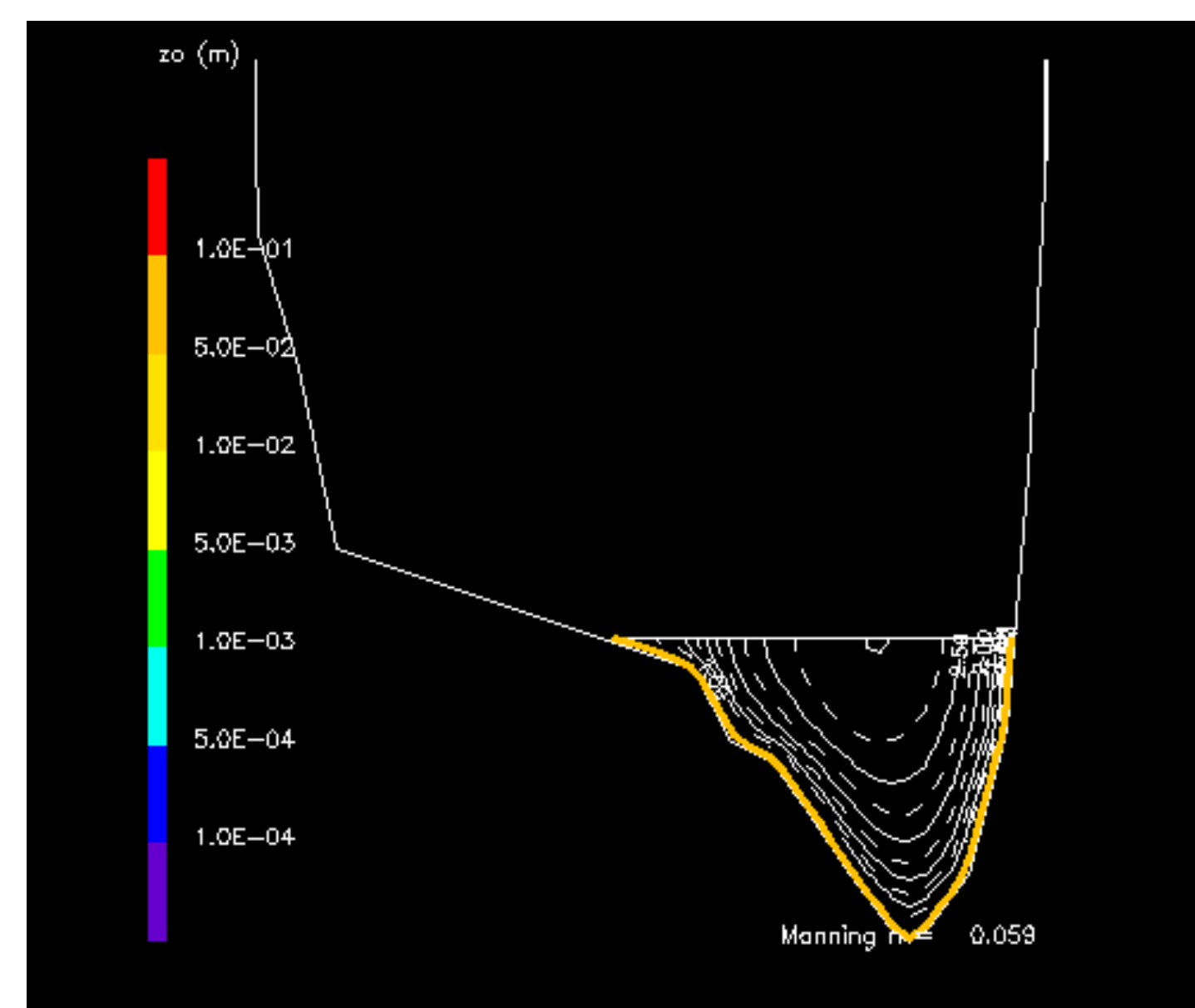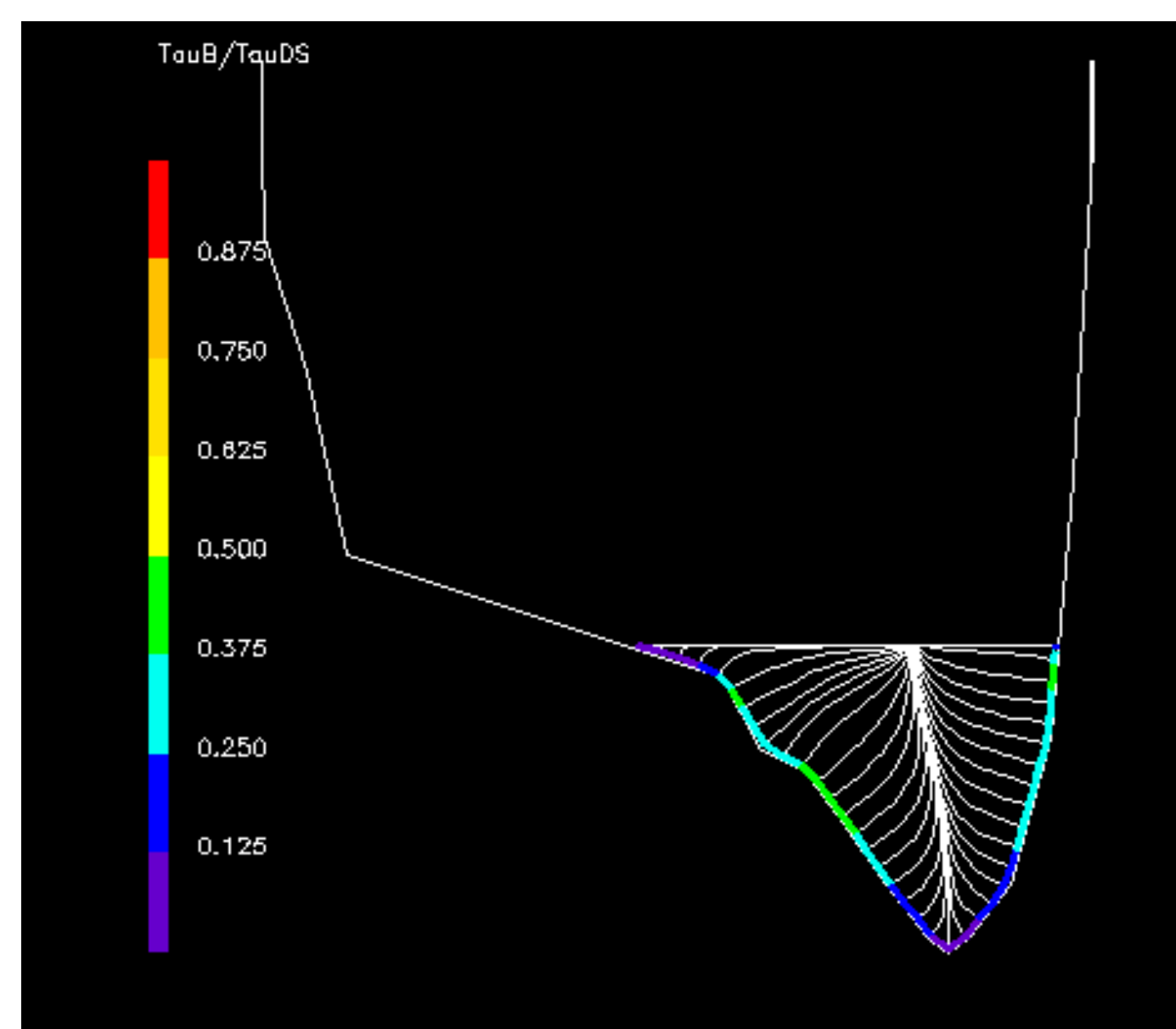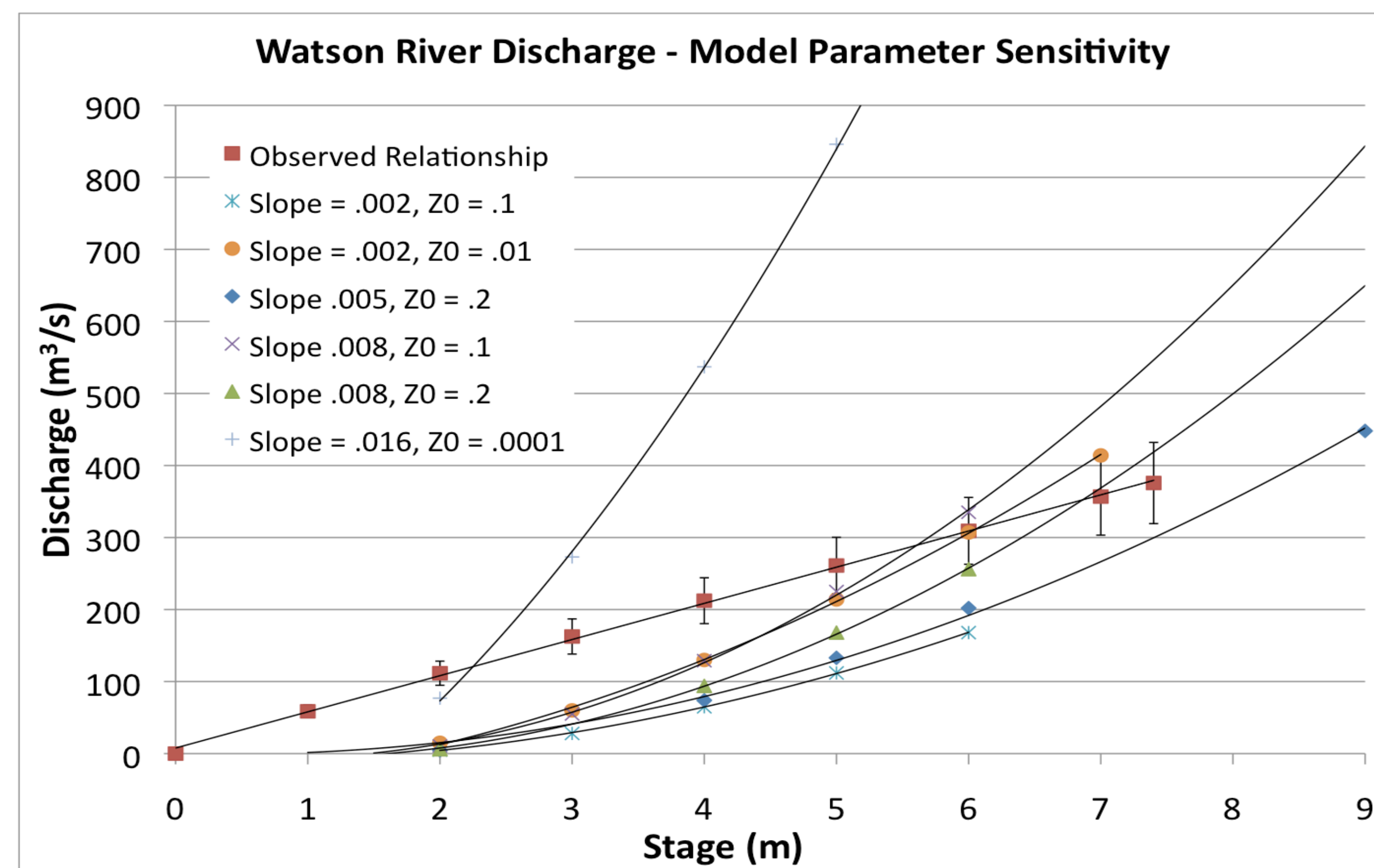

MODEL TESTING

We tested the model's performance against the stage discharge relationship of the Watson River, Kangerlussuaq, Greenland. This river is the most studied river in the entire country (and the only one with a published discharge record)
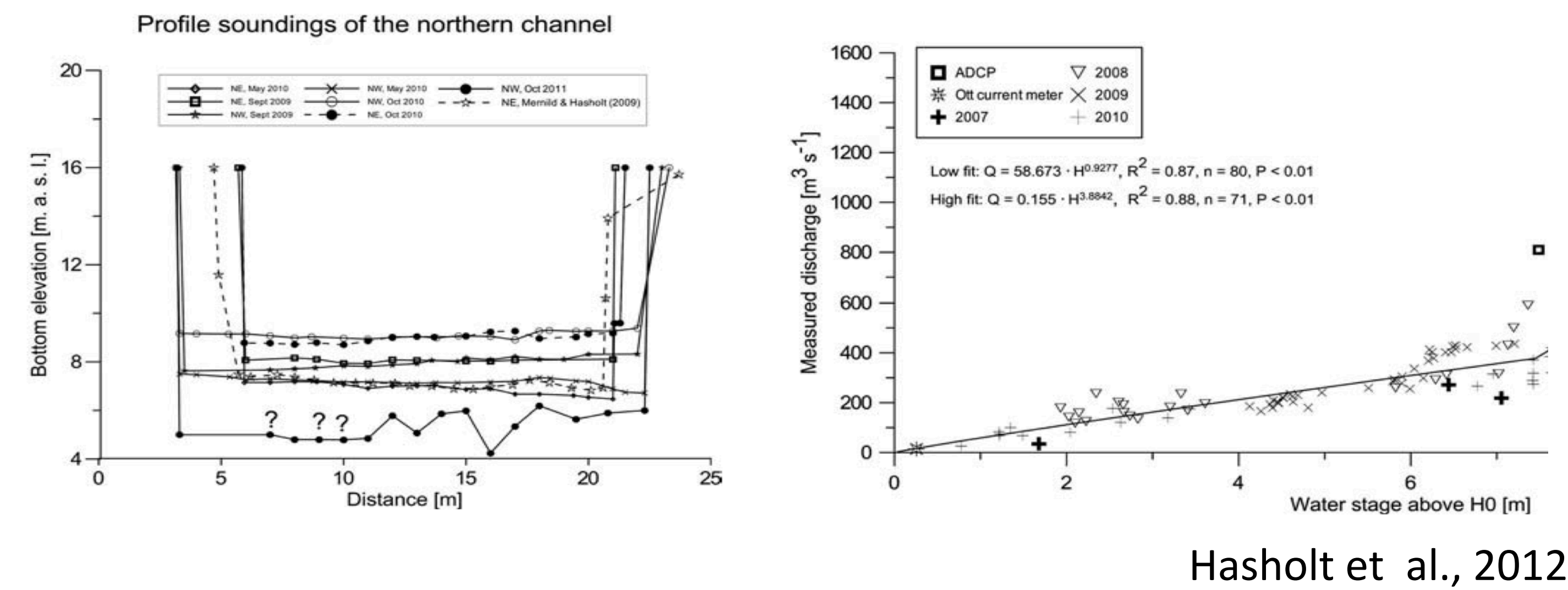

Hasholt et al., 2012

The model preformed acceptably given uncertainty in bed geometry and roughness

Watson River Discharge - Model Parameter Sensitivity

- Observed Relationship
- Slope = .002, Z0 = .1
- Slope = .002, Z0 = .01
- Slope .005, Z0 = .2
- Slope = .008, Z0 = .1
- Slope .008, Z0 = .2
- Slope = .016, Z0 = .0001

APPLICATION TO OTHER RIVERS

We then applied the model to two rivers with only stage data to calculate discharge. Model outputs were also calibrated to surface velocity and the discharge measurements available for each river.

Watson, Naujat Kuat, and Pakitsup River Discharge: 2011
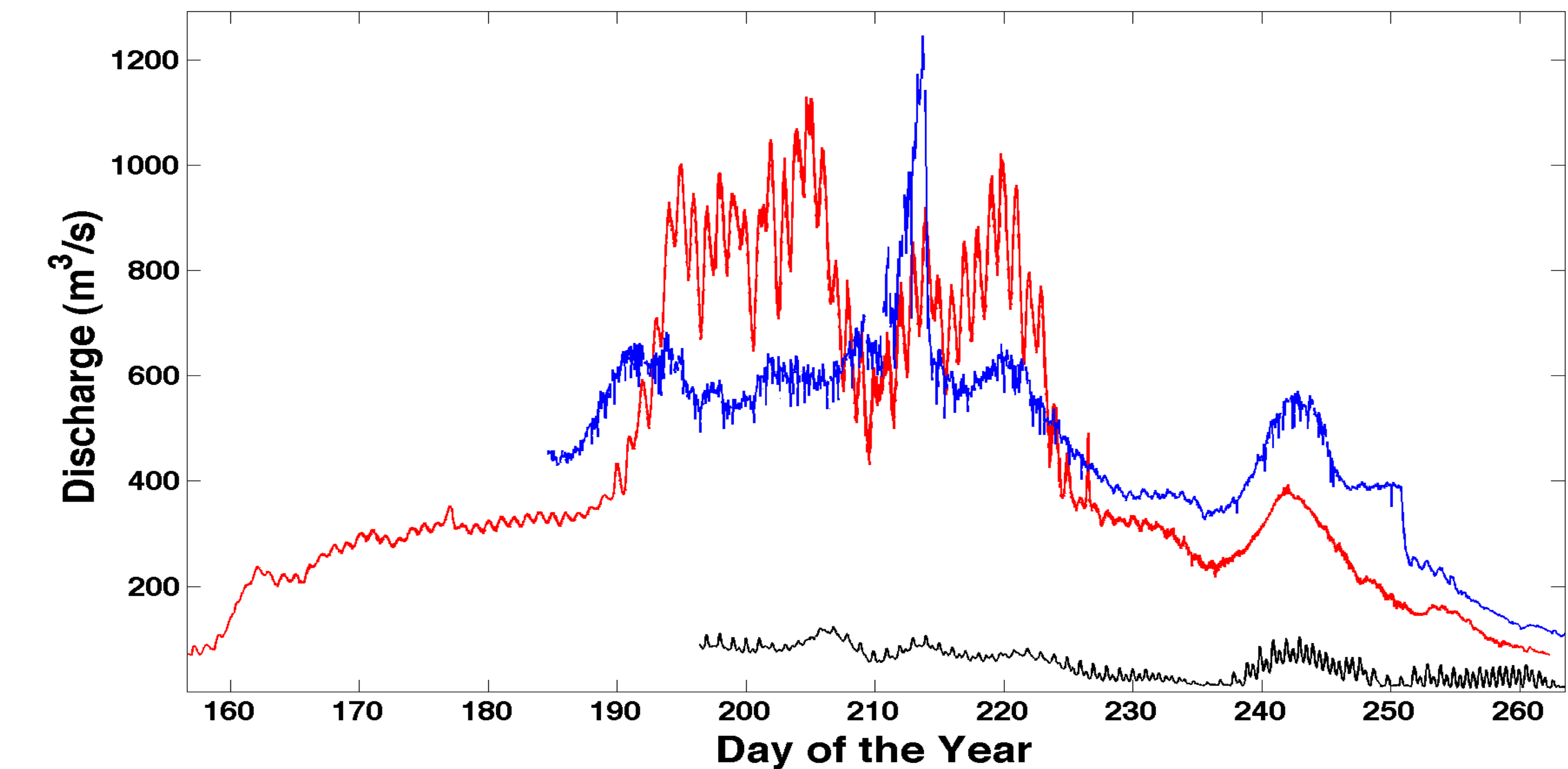
CONCLUSIONS

- Our work tripled the number of rivers in Greenland with discharge records

- The technique allowed exploratory gauging sites to be installed on rivers at low cost and with only a handful of days in the field.

-Future installations may be improved by making stage measurements at two locations on the same channel to allow for calculation of water surface slope at each hourly measurement

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