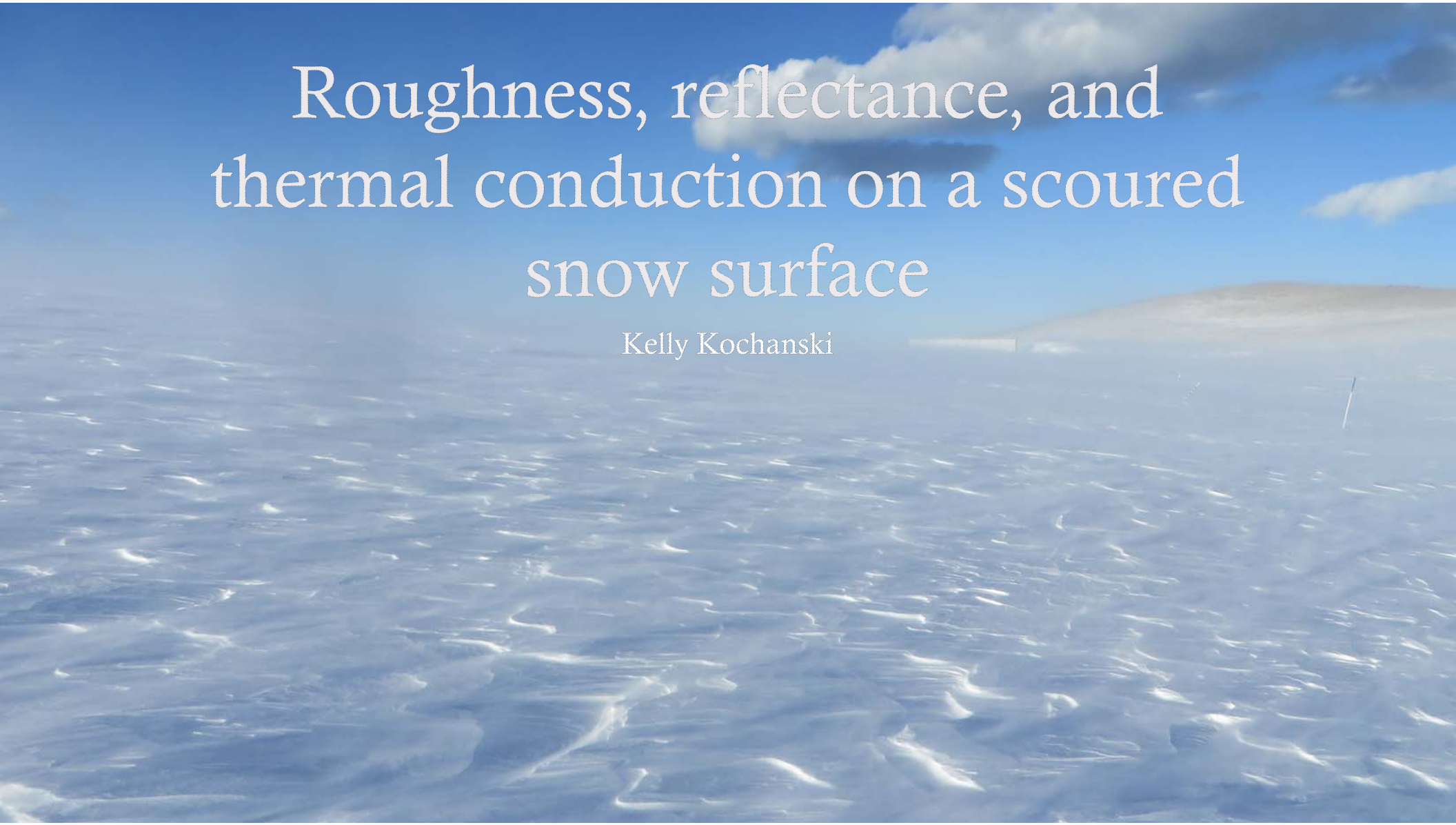
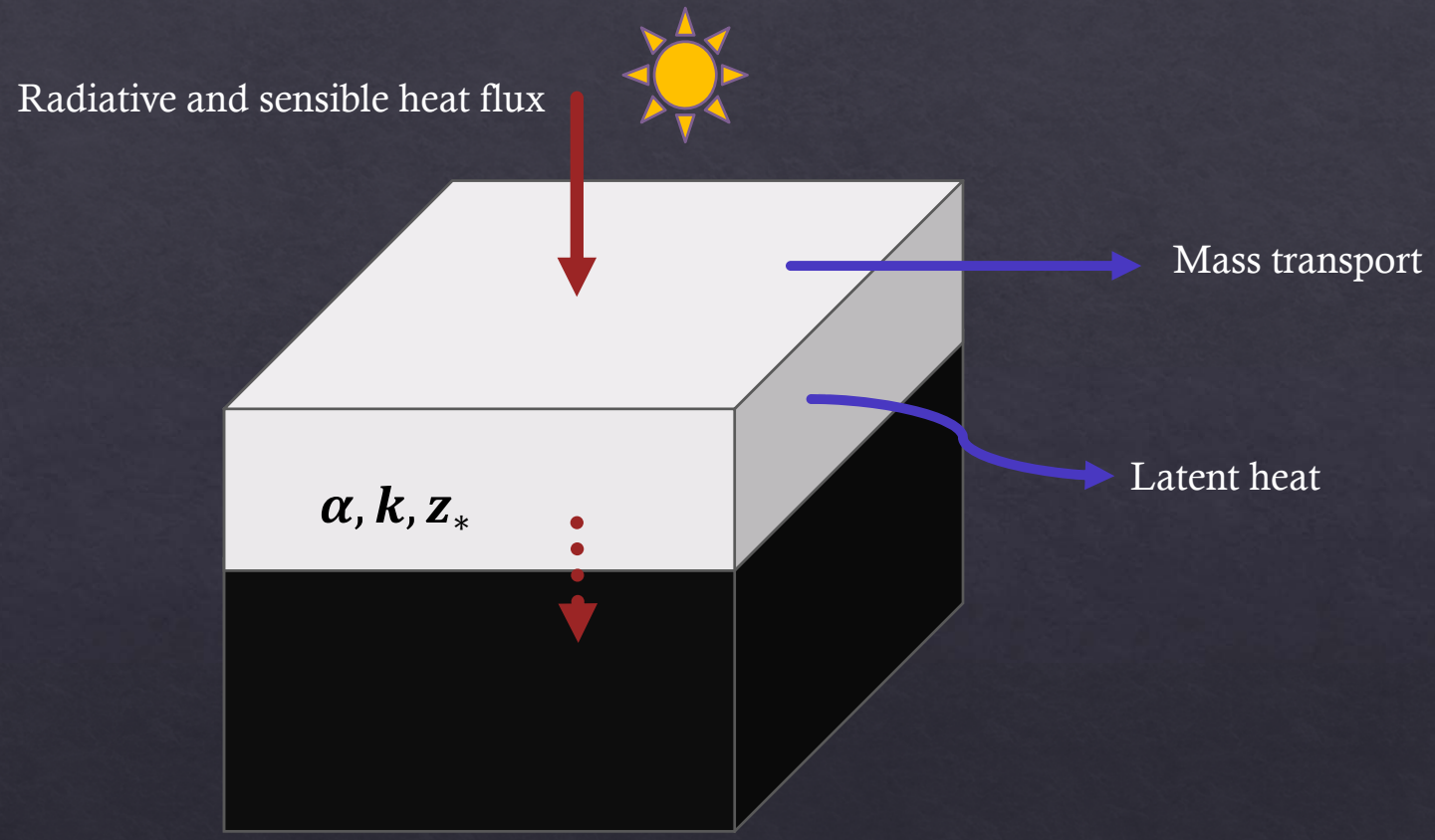


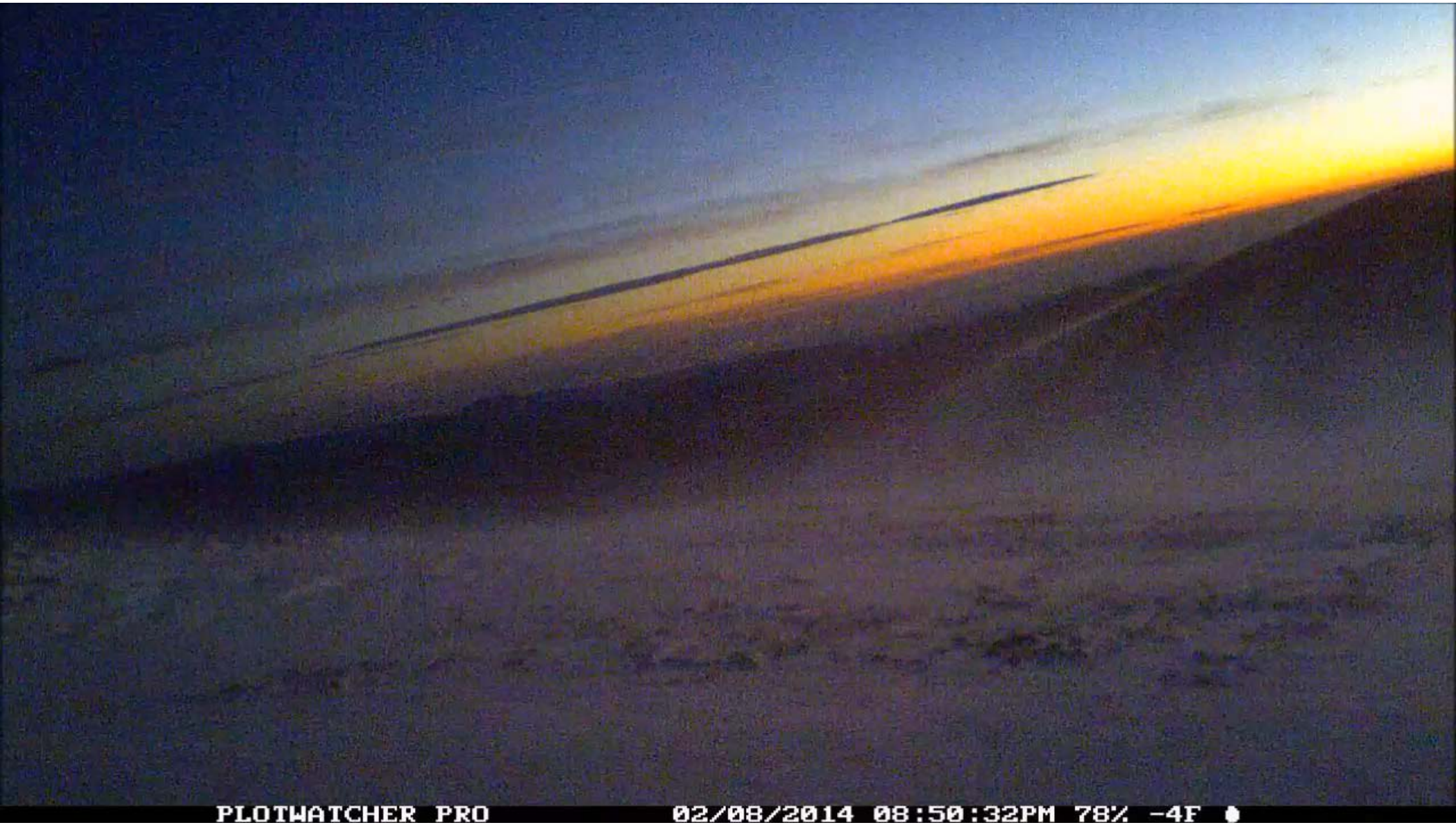
Roughness, reflectance, and thermal conduction on a scoured snow surface

Kelly Kochanski

Snow in a climate model




PLOTWATCHER PRO
01/22/2016 11:33:10 75% -14C


PLOTWATCHER PRO
02/08/2014 08:50:32PM 78% -4F

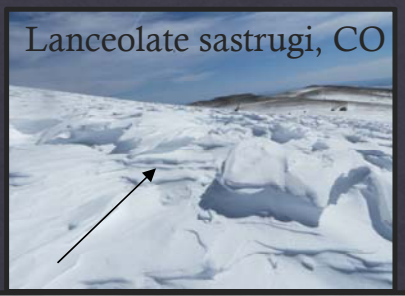

PLOTWATCHER PRO
01/17/2016 06:31:24 75% -18C


PLOTWATCHER PRO
25/03/2016 09:59:06 82% -4C

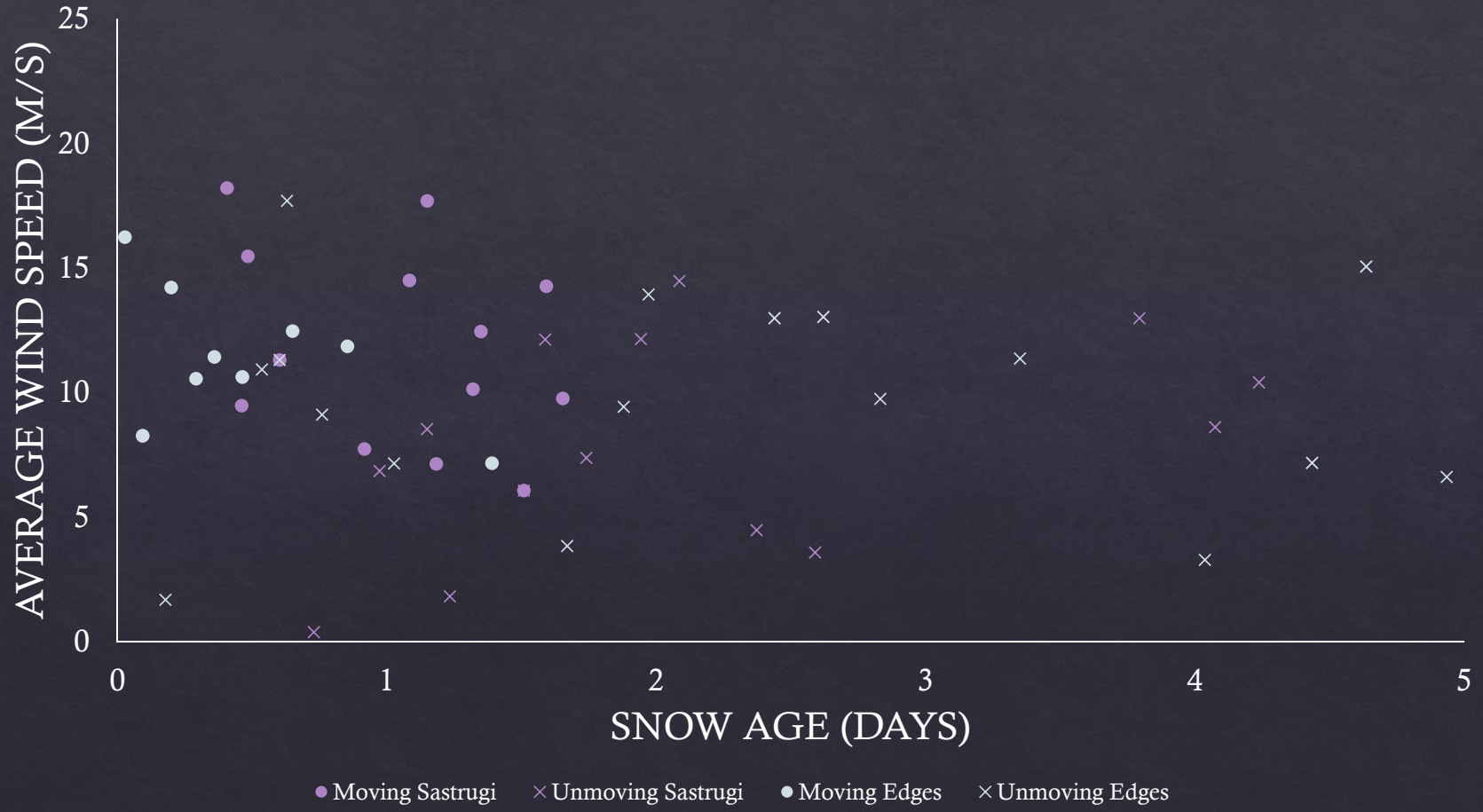
Depositional bedforms → time → Erosional bedforms

Higher wind speeds

Lower wind speeds



Snow surfaces take 24-48 hours to stabilize

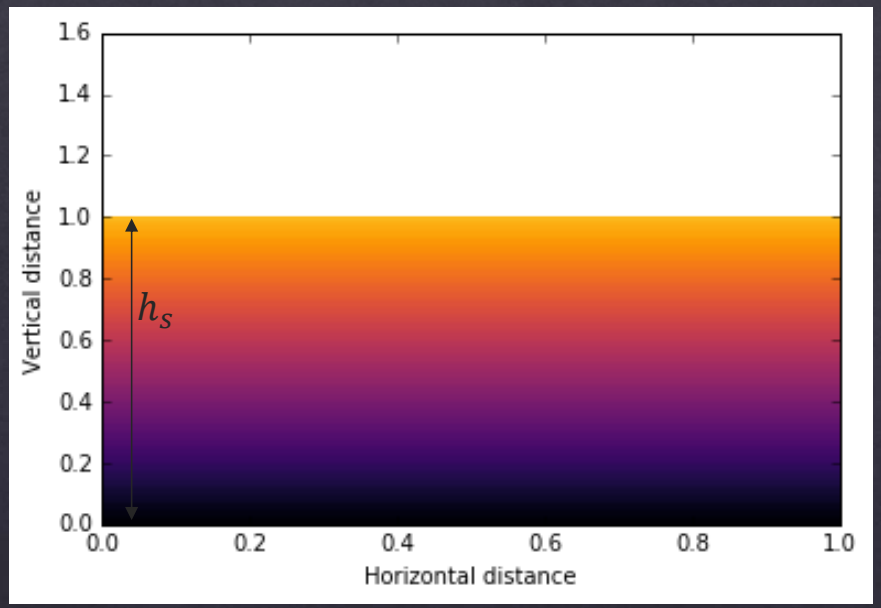


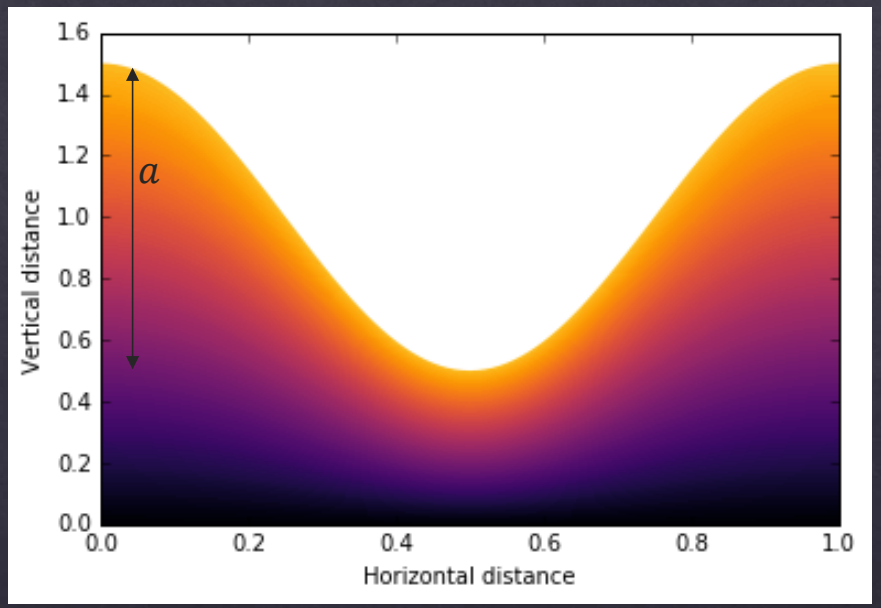
Properties of a sastrugi-covered surface

ugi, South Pole

Afee 2008

Flat snow cover provides more effective insulation



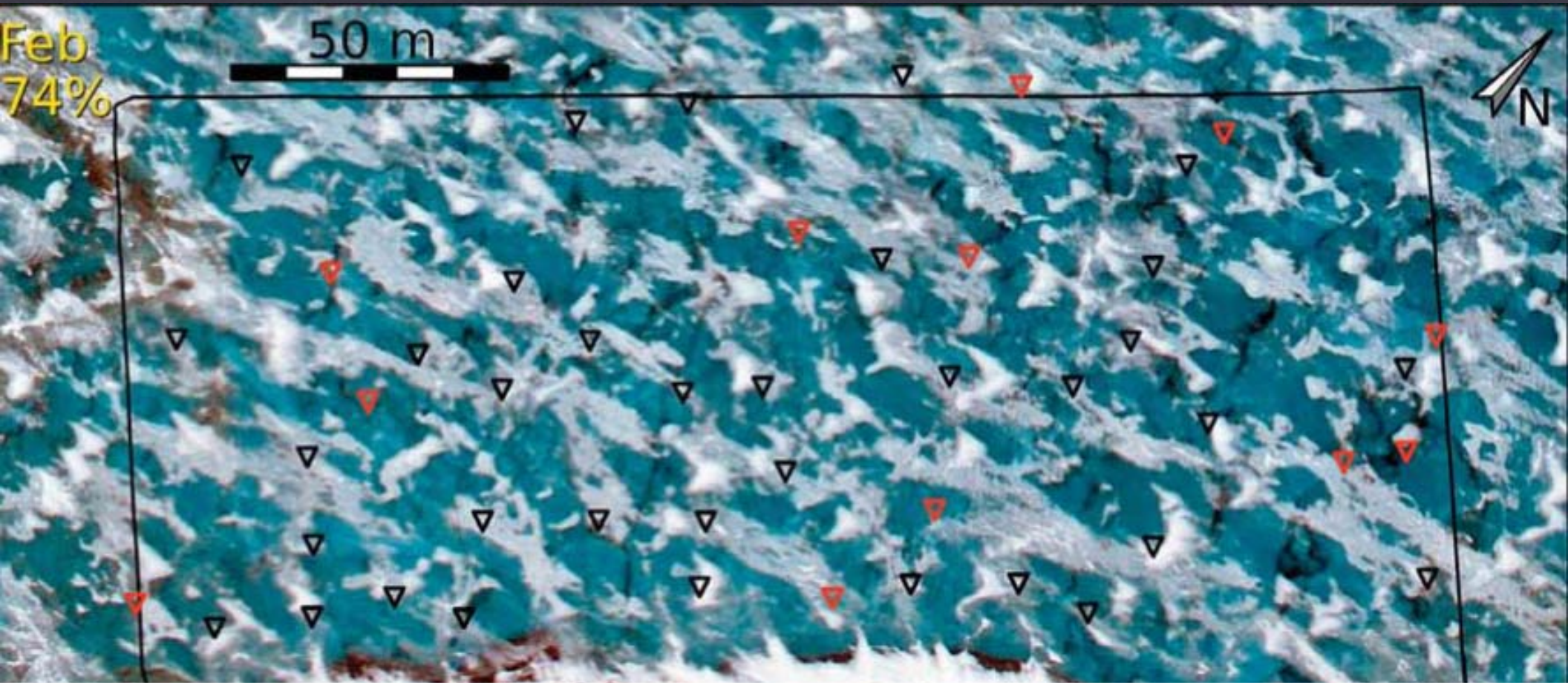


Increasing the variance of snow thickness makes it a less effective insulator

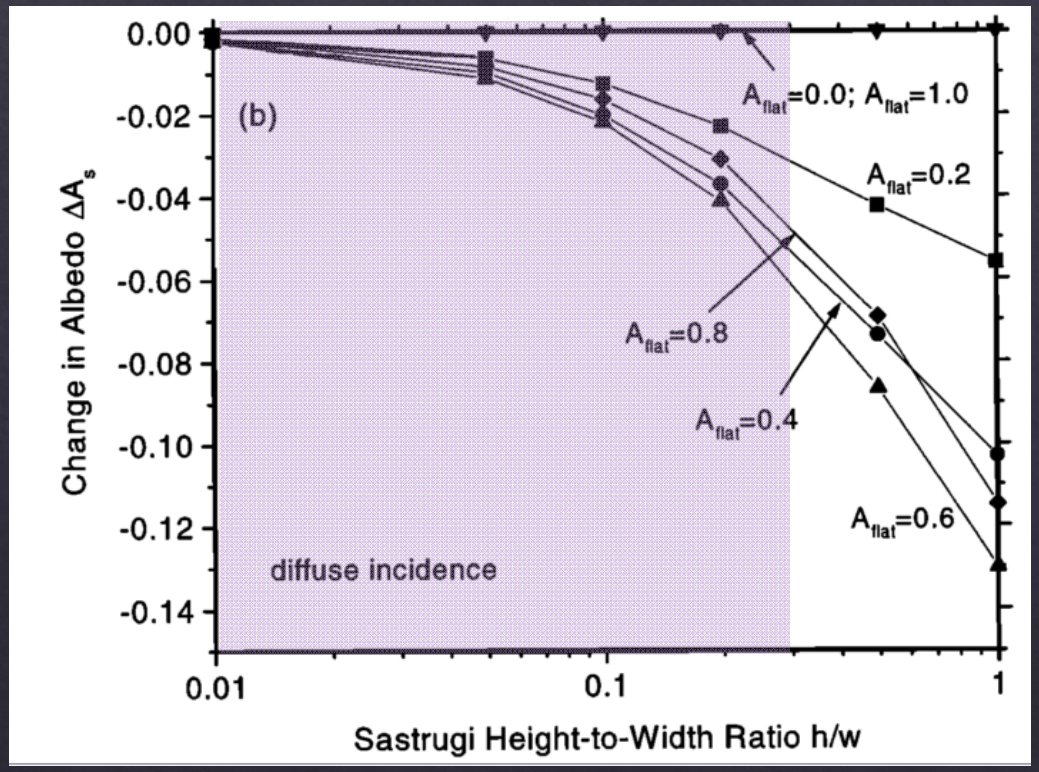
$$\frac{\Delta T}{\Delta T_{flat}} \geq \sqrt{1 - a^2}$$

Melt ponds form between sea ice

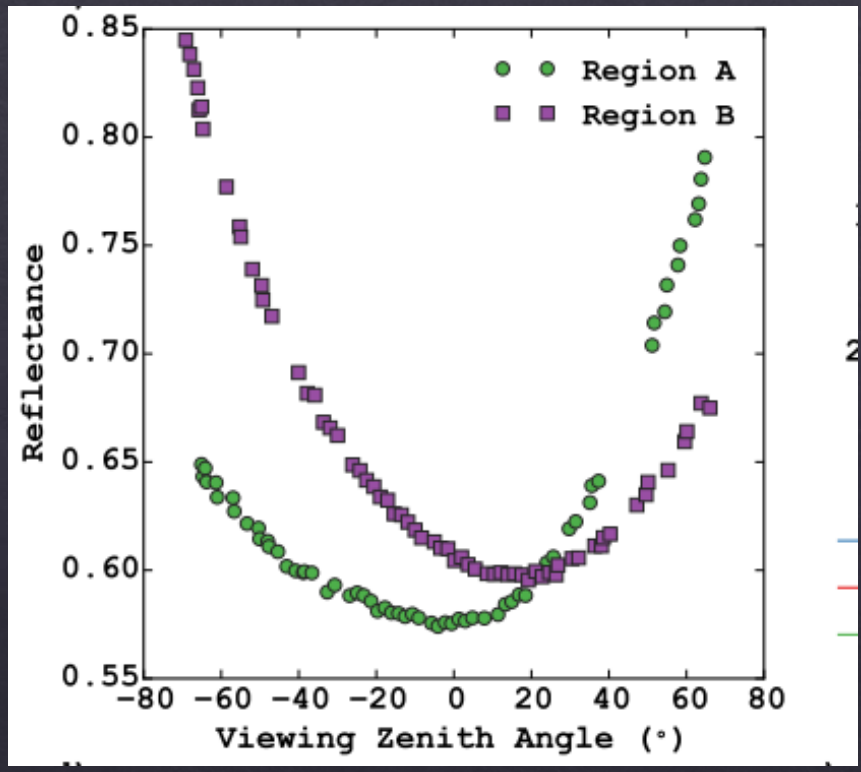
Petrich et al, 2012



Sastrugi modify the bidirectional reflectance of snow



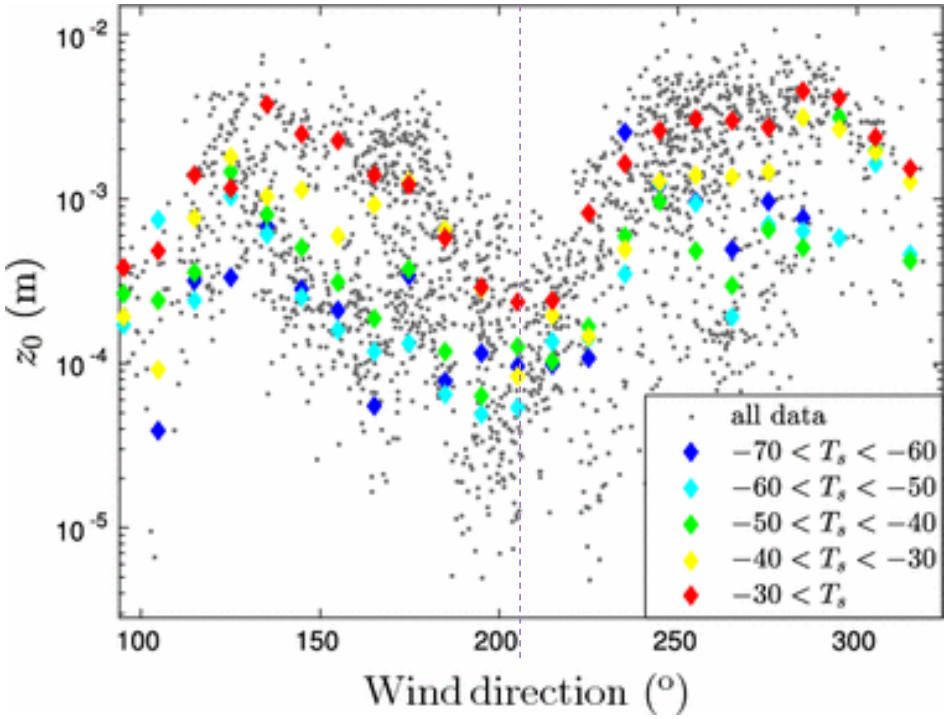
O'Rawe 1991



Corbett & Su, 2015
Instantaneous clear-sky CERES reflectance values

Surface roughness and aerodynamic roughness

Surface roughness length (m)



The roughness of aerodynamic surfaces increases by as much as two orders of magnitude across sastrugi

Vignon et al, 2016

Conclusions

- Flat, unsheltered snow surfaces are not stable under winds >5m/s
- Snow surfaces evolve continuously for 1-2 days after each storm
- The most common snow surface type is a sastrugi field, which
  - Provides less insulation than flat snow
  - Has a lower albedo (2-4%)
  - Reflects sunlight anisotropically
  - Has asymmetric roughness and reflectivity.

Questions?

Thank you: Robert Anderson, Greg Tucker, Clea Bertholet

DOE CSGF

Colorado Scientific Society

the AMERICAN ALPINE club

University of Colorado Boulder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