Compact Probe for In-Situ Optical Snow Grain Size Stratigraphy

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Presented at the American Geophysical Union fall meeting, San Francisco, CA
December 13, 2010
Traditional Grain Size Measurement

- Hand lens grain size estimation
Radiative transfer from hand lens

Painter et al., *Journal of Glaciology* 2007
Traditional Grain Size Measurement

**Snow Grain Shapes**

- Rime on Plate Crystal
- Early Rounding
- Faceted Growth
- Early Sintering (Bonding)

- Wind-Blown Grains
- Melt-Freeze with No Liquid Water
- Melt-Freeze with Liquid Water
- Faceted Layer Growth
- Hollow, Faceted Grain (Depth Hoar)
Contact Spectroscopy

- Advantages
  - Less subjective
  - Repeatable
  - Faster
  - Data applicable to remote sensing

Painter et al., *Journal of Glaciology* 2007
Contact Spectroscopy

• optical equivalent grain size
• obtained by integrating absorption feature and comparing to RT model
• Painter et al., 2007; Nolin and Dozier, 2000.
Spectral Profiler Probe

- Send optics down bore hole
- Lateral reflectance spectra
- Fiber optic sends signal to surface
- No snowpit!
probe carrier body

drive tube

fiber optic to spectrometer

optical inspection camera

spectral reflectance probe

aluminum sleeve with machined slits for lateral viewing

nylon brush
Spectral Profiler
Probe Hardware

- drive tube
- clamp
- fiber optic to spectrometer
- aluminum sleeve
- base plate
- reflectance probe
Spectral Profiler Probe Hardware

- Optical inspection camera
- Spectral reflectance probe
- In-bore light source
- Nylon brush
2 configurations

fiber light

spectrometer

light source on

In-bore light

spectrometer

light source off
Probe stowed for transport
Field testing
Niwot Ridge April 2010 results
Storm Peak Lab Feb 2010 results
Future Work

• miniaturize probe
• add density measurement
• algorithm for on-site grain size retrieval
• take measurements over large geographic area
Acknowledgements

- Alex Arnsten
- Jennifer Petrzelka
- Part of this work was performed at the Jet Propulsion Laboratory/California Institute of Technology under contract from NASA.
supplemental
hole 4 grain size for 2 passes of in-bore light probe

- depth from surface (cm)
  - pass 1
  - pass 2

- optical grain diameter (um)
  - 200 to 1000

- range of depth from surface
  - -140 to 0 cm

- range of optical grain diameter
  - 200 to 1000 um