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Results from Mobile GPR during SnowEx 2017: Overview & Looking Forward

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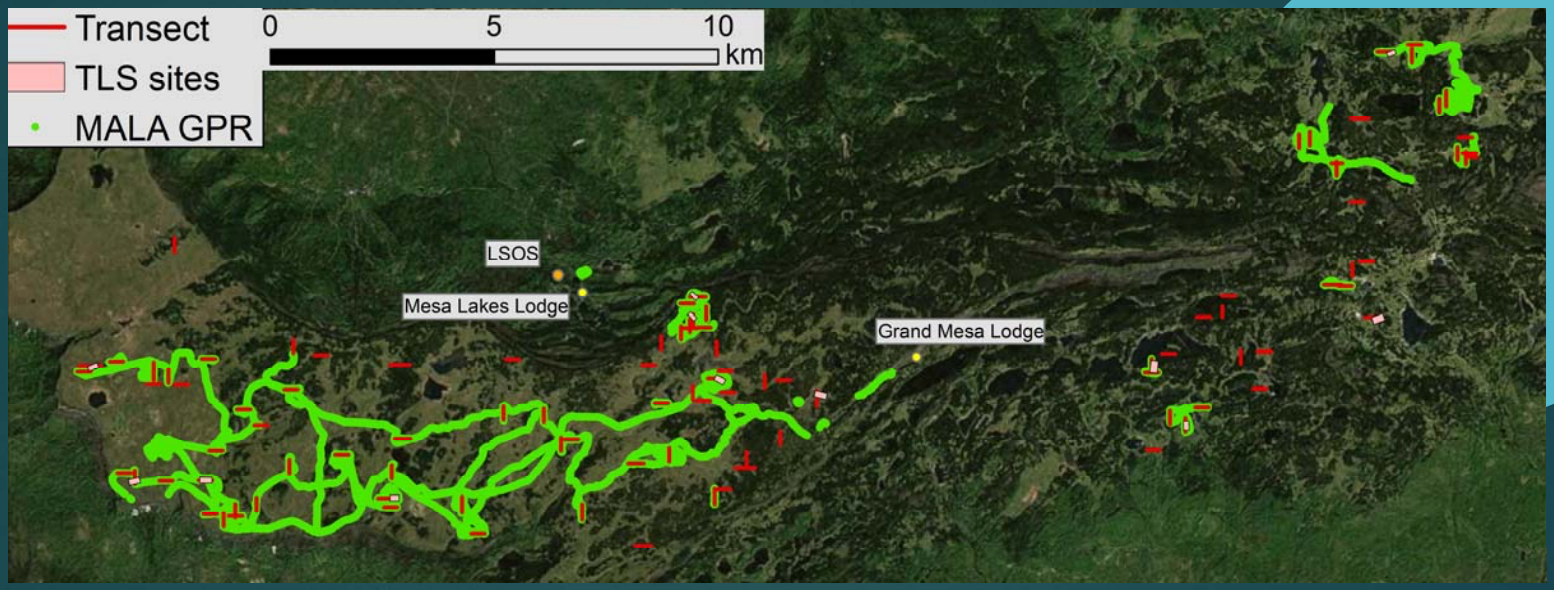
AUGUST 9, 2017

GPR Unit

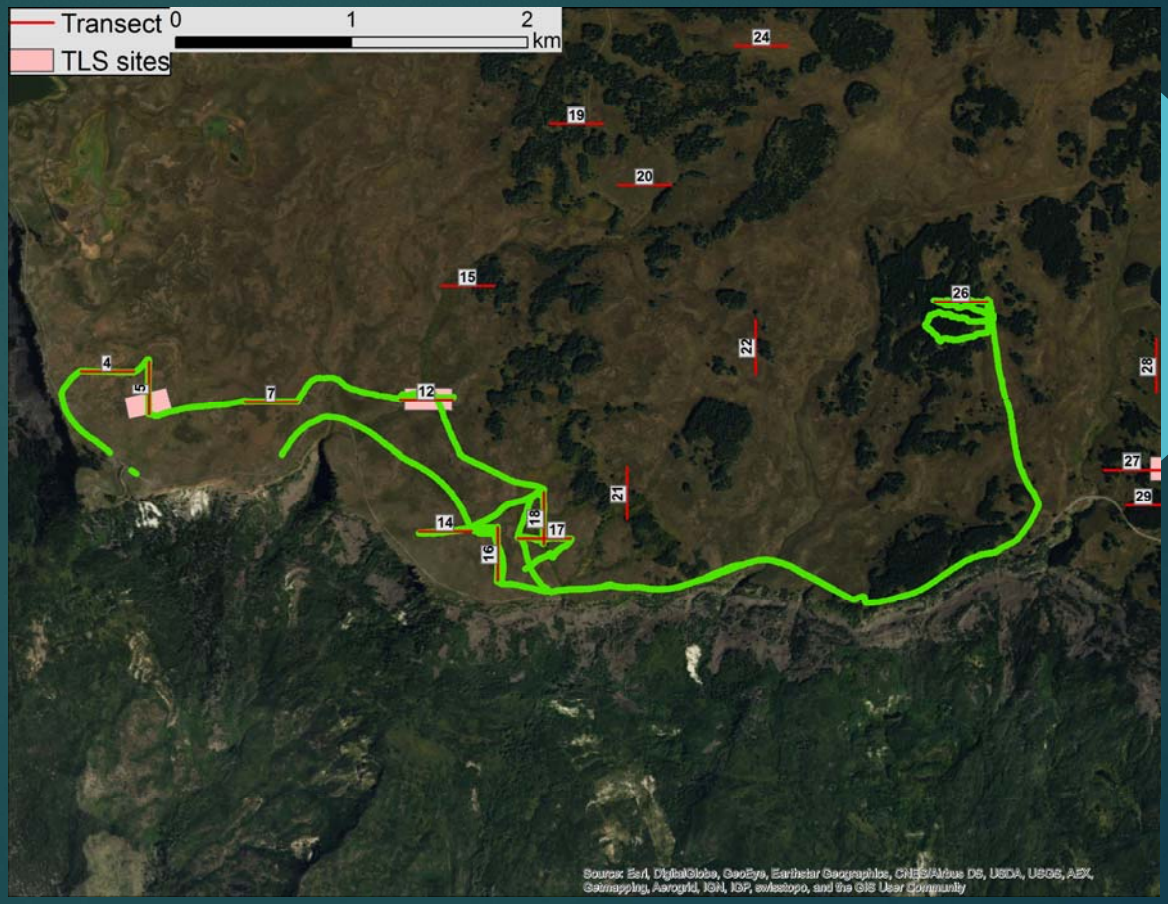
- Mala Geosciences Unit
- ~~0.8 GHz~~ & 1.6 GHz

Coverage in 2017



Combined with other Data

Acknowledgement:
Kelly, Ludo, Chris, HP



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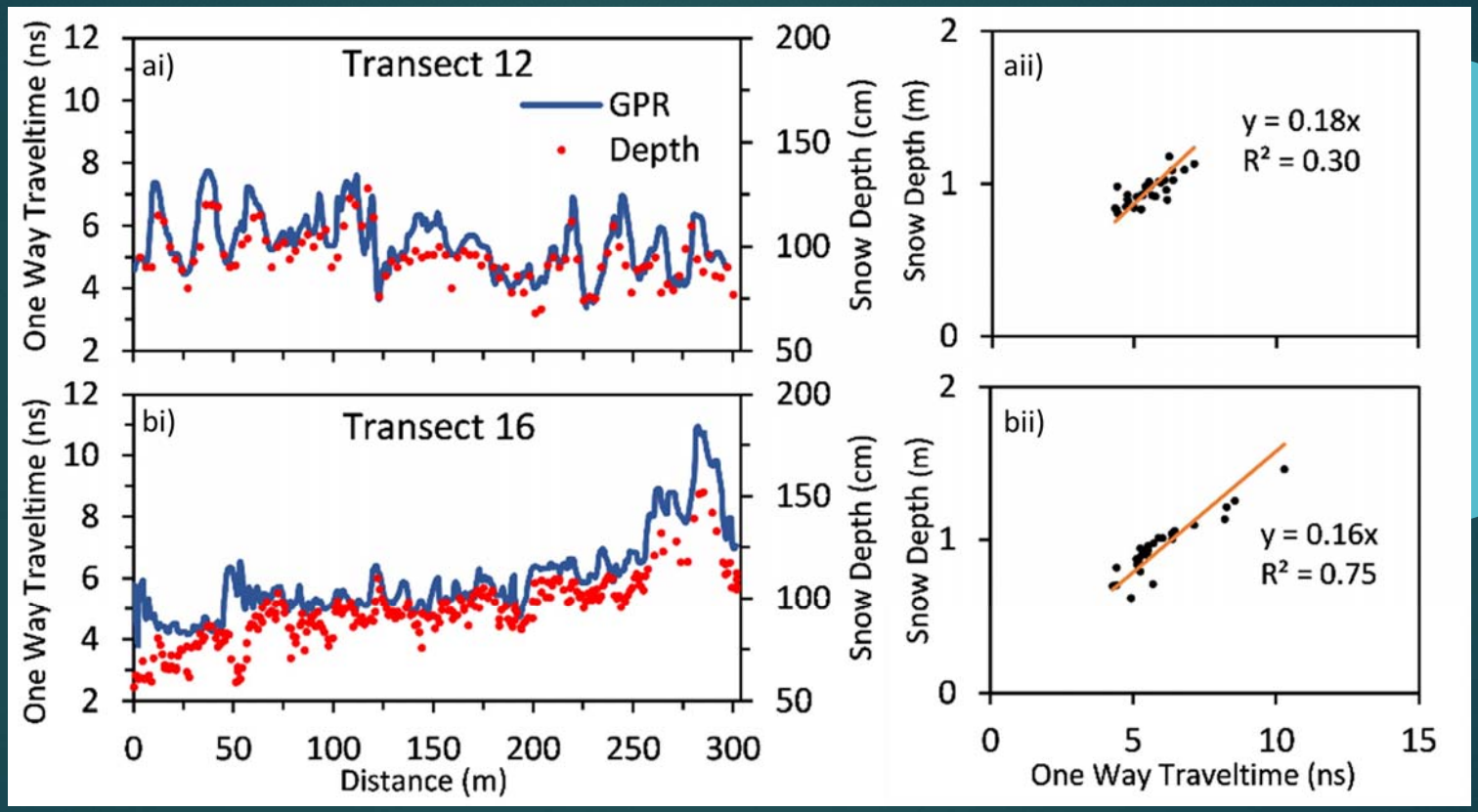
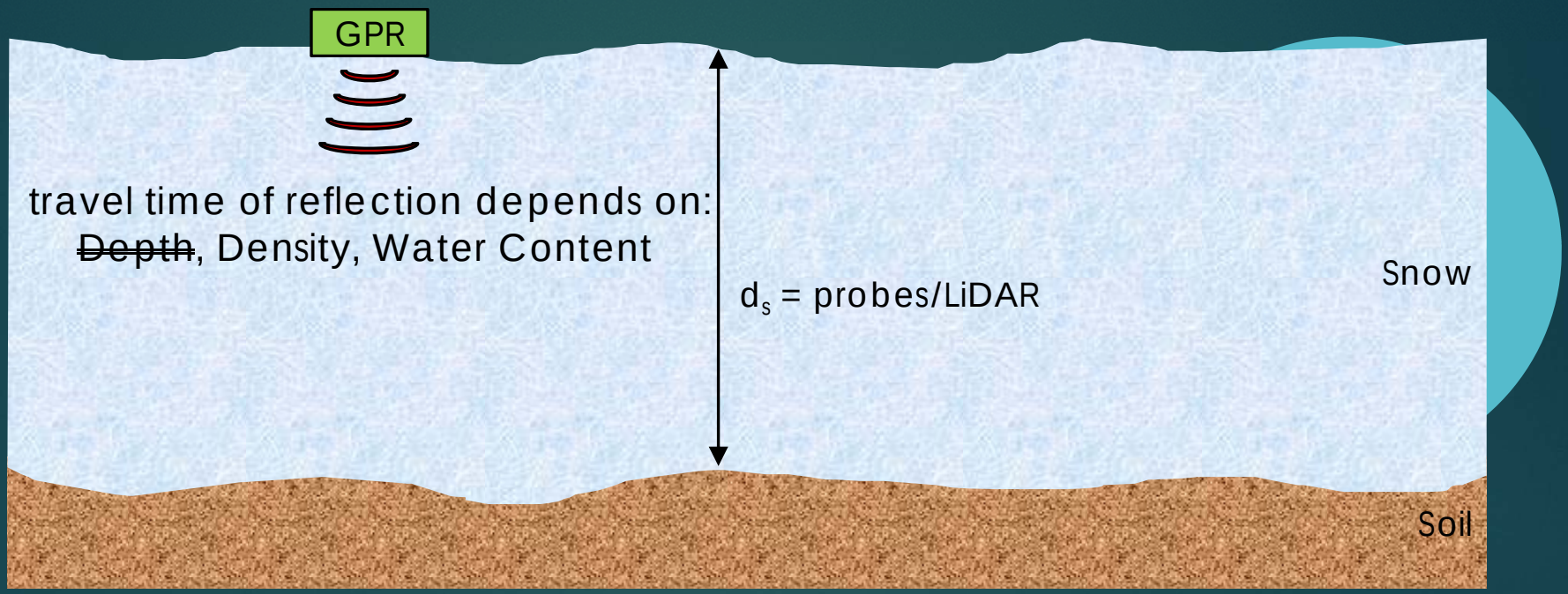
Combined with other data

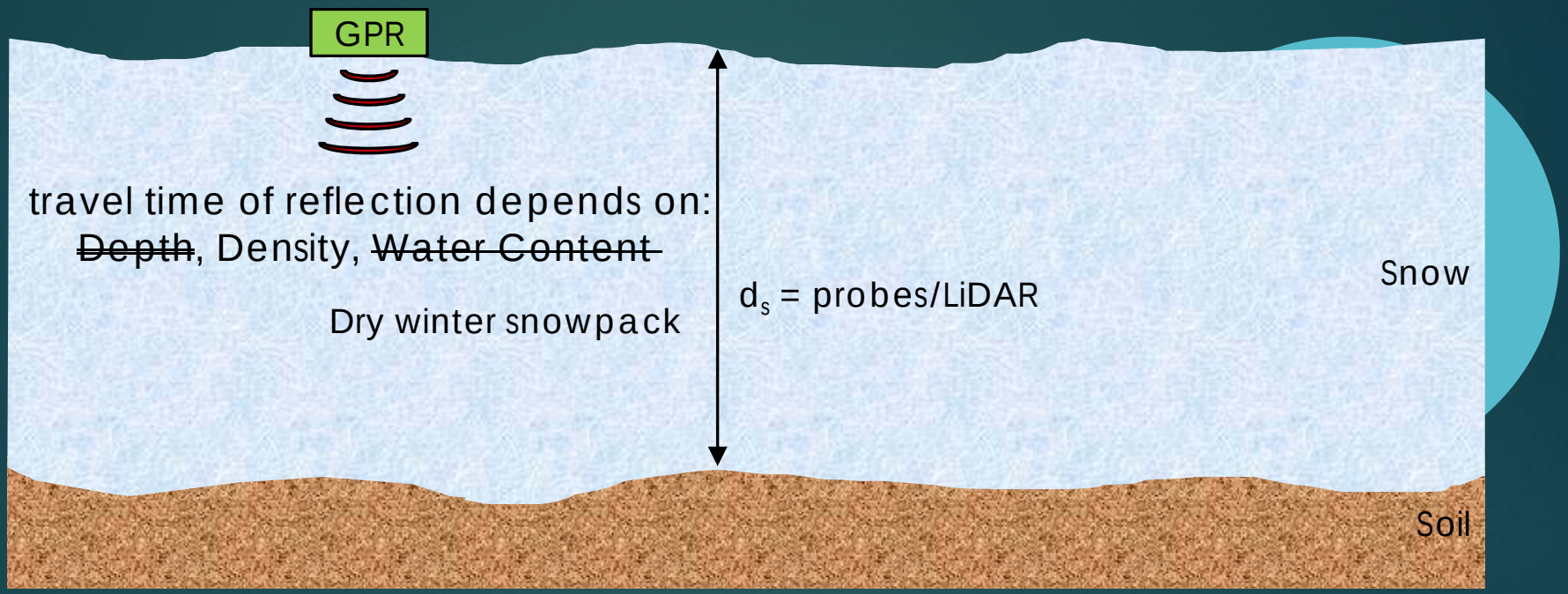
- Feb. 9 is unique for GPR data because:
  - Followed directly behind G. Liston & C. Vuyovich w/ MagnaProbe
  - Tracked directly over probe holes
  - Hot day with some surface melt on west end of Mesa

Combined with other data



GPR
travel time of reflection depends on:
Depth, Density, Water Content
Snow
Soil


GPR
travel time of reflection depends on:
~~Depth~~, Density, Water Content
d_s = probes/LiDAR
Snow
Soil


GPR
travel time of reflection depends on:
~~Depth~~, Density, ~~Water Content~~
Dry winter snowpack
d_s = probes/LiDAR
Snow
Soil

Combined with other data

- Roth et al. (1990) mixing model equation:

$$velocity\ (known\ from\ TWT\ \&\ ds) = \frac{c}{\sqrt{\varepsilon_r}}$$

$$\varepsilon_r = \left(0.01\theta_w \varepsilon_w^{0.5} + \frac{\rho_{ds}}{\rho_i}\varepsilon_i^{0.5} + \left(1 - \frac{\rho_{ds}}{\rho_i} - 0.01\theta_w\right)\varepsilon_a^{0.5}\right)^2$$

Combined with other data

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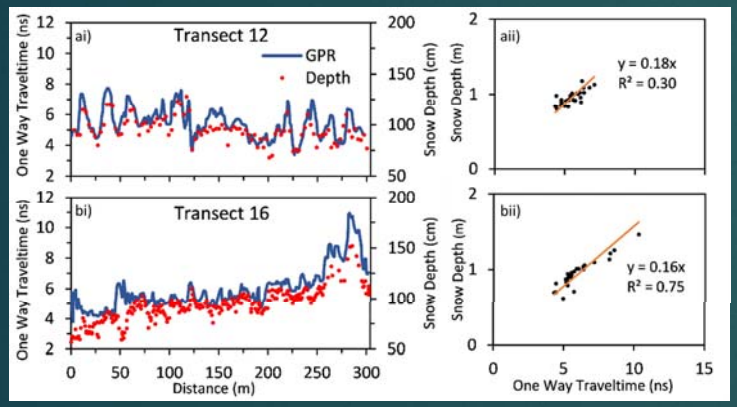
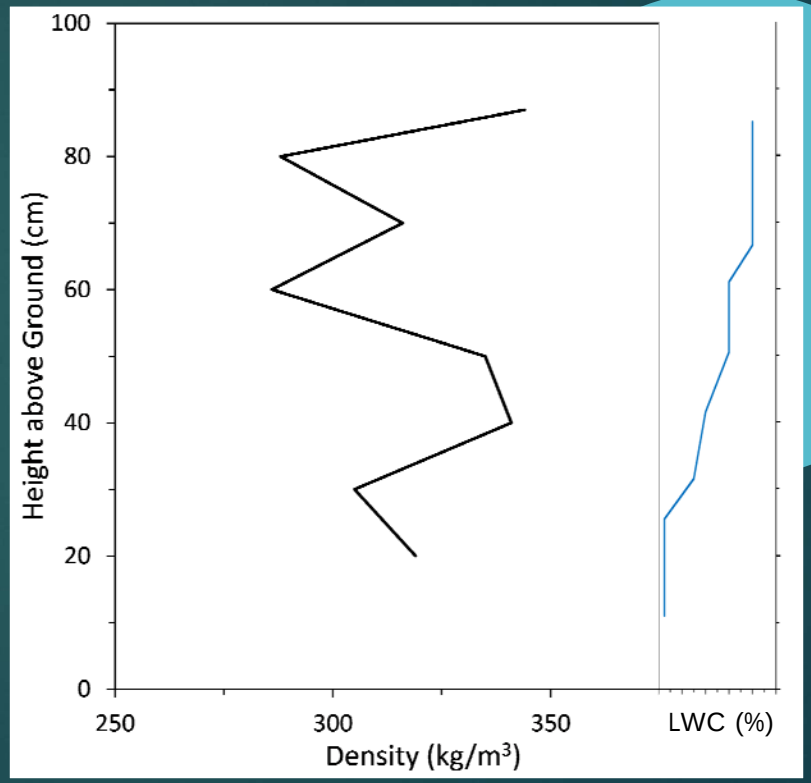
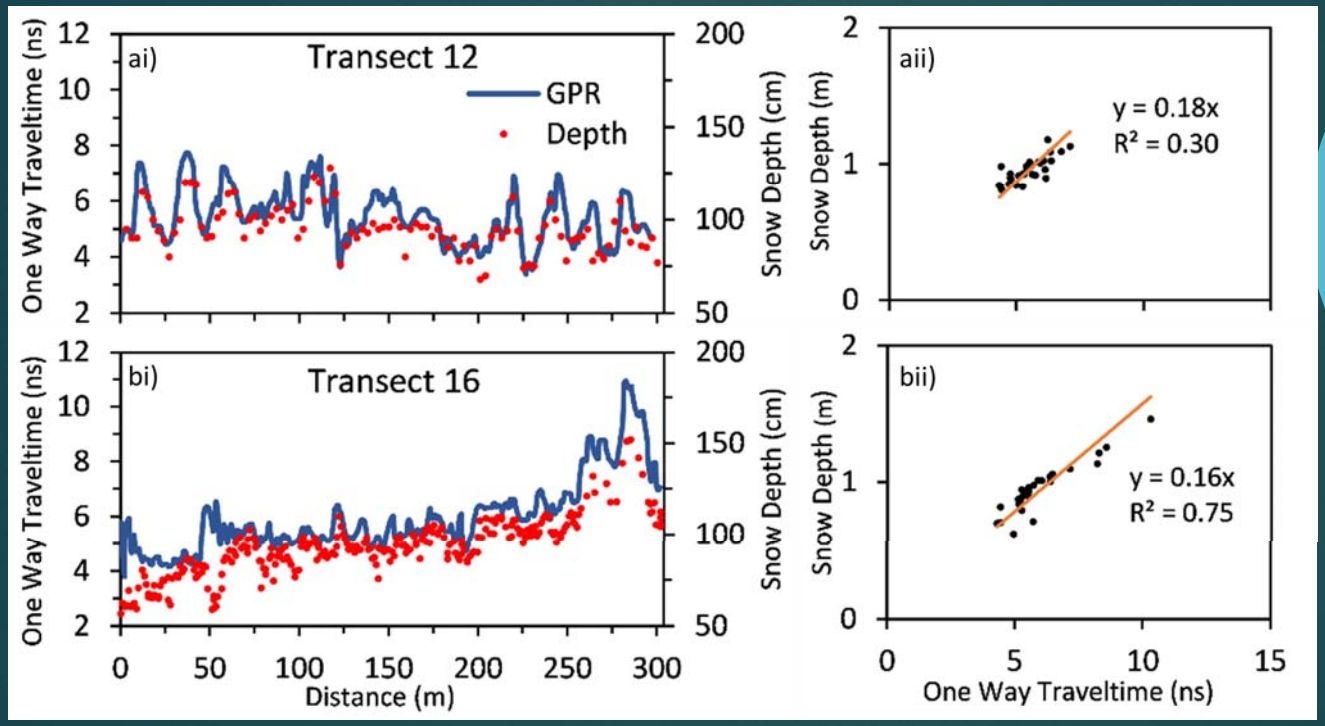
Liquid Water in Snow Pit





Resulting Density

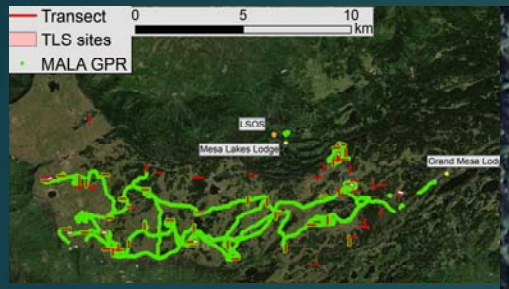


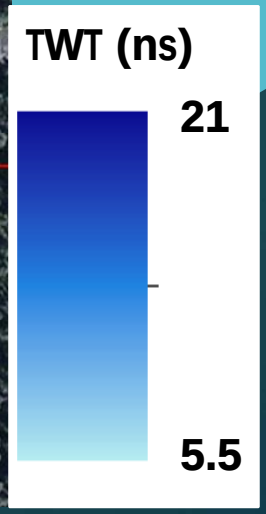
~430 kg/m³

~280 kg/m³

Grids within TLS sites

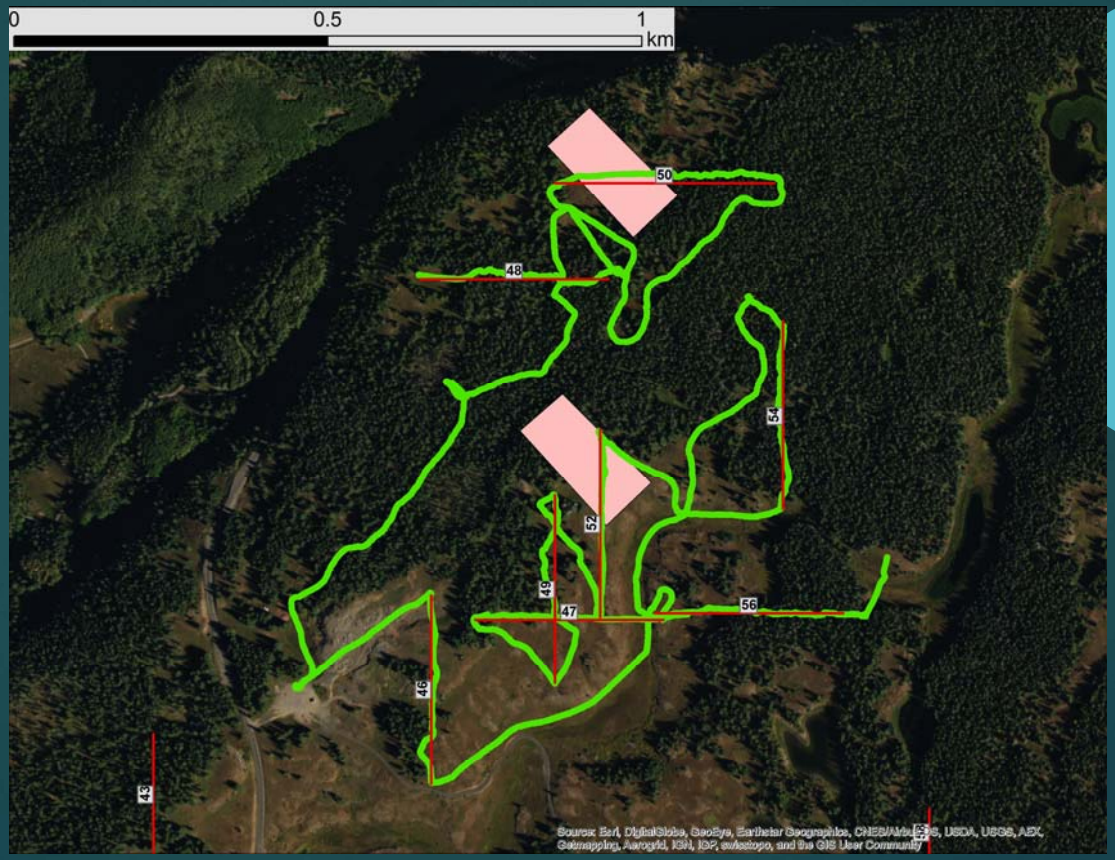
(example of site J)





Same Day as ASO flight

- Map of Skyway coverage, snowmobiles not allowed.



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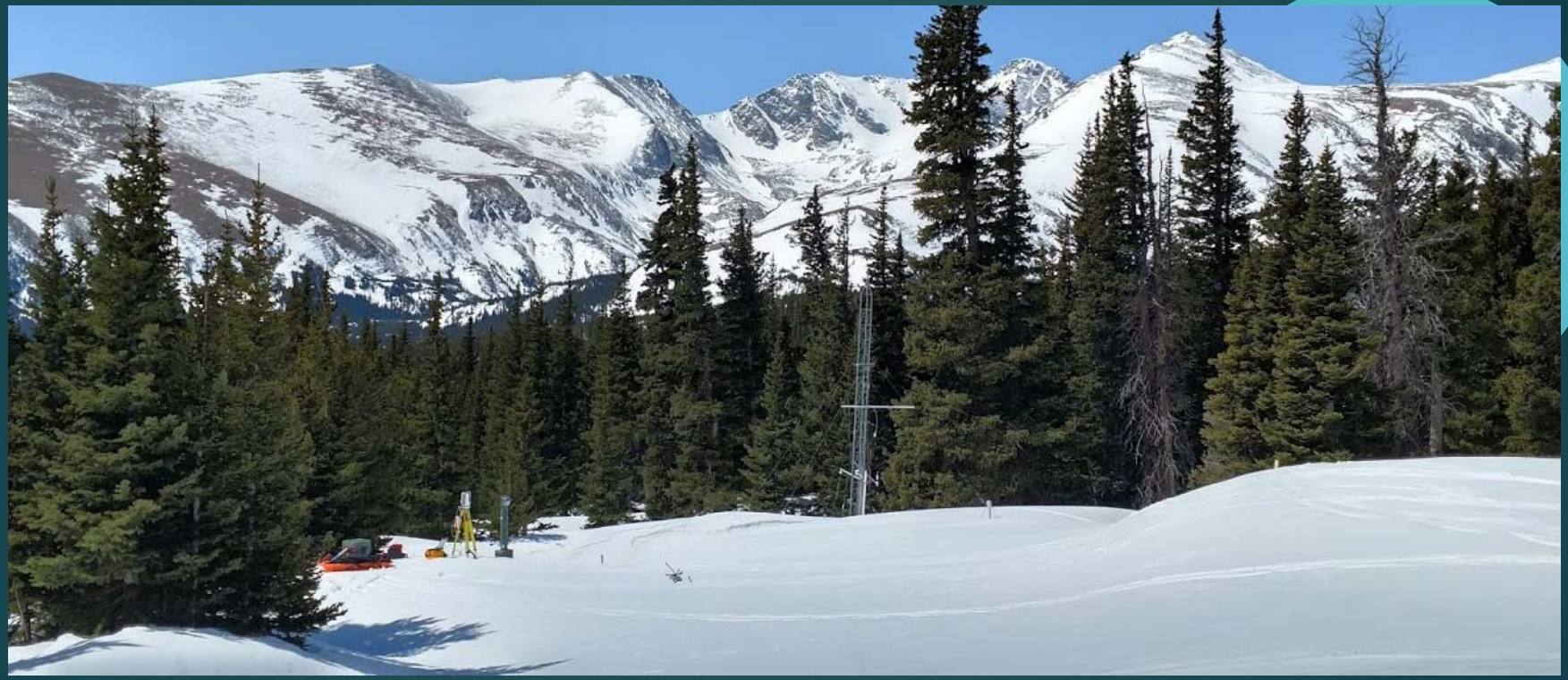
Looking Forward

- Reminder of the Ross mixing model

$$\varepsilon_r = \left(0.01\theta_w \varepsilon_w^{0.5} + \frac{\rho_{ds}}{\rho_i}\varepsilon_i^{0.5} + \left(1 - \frac{\rho_{ds}}{\rho_i} - 0.01\theta_w\right)\varepsilon_a^{0.5}\right)^2$$

Example Application
(Niwot Ridge, LWC)



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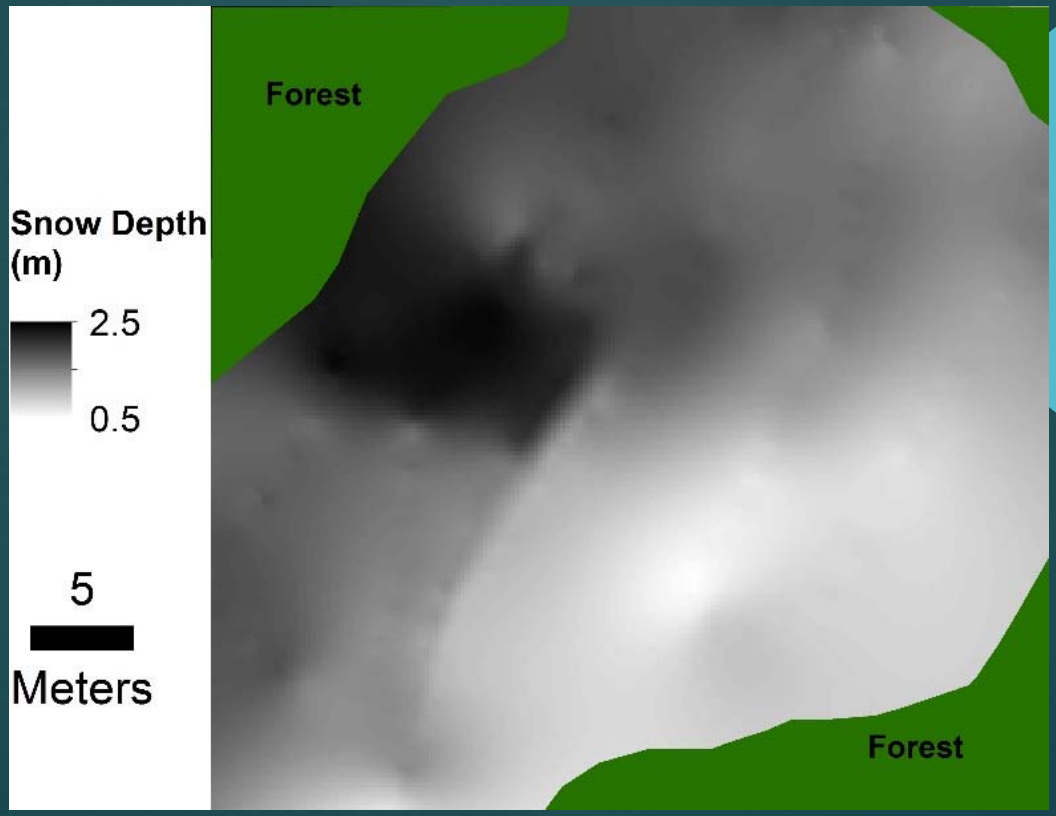

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work supported by the National Science Foundation Award No. 1624853

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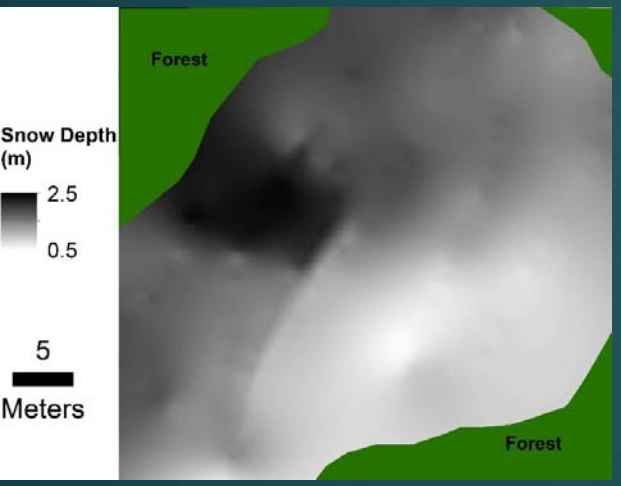

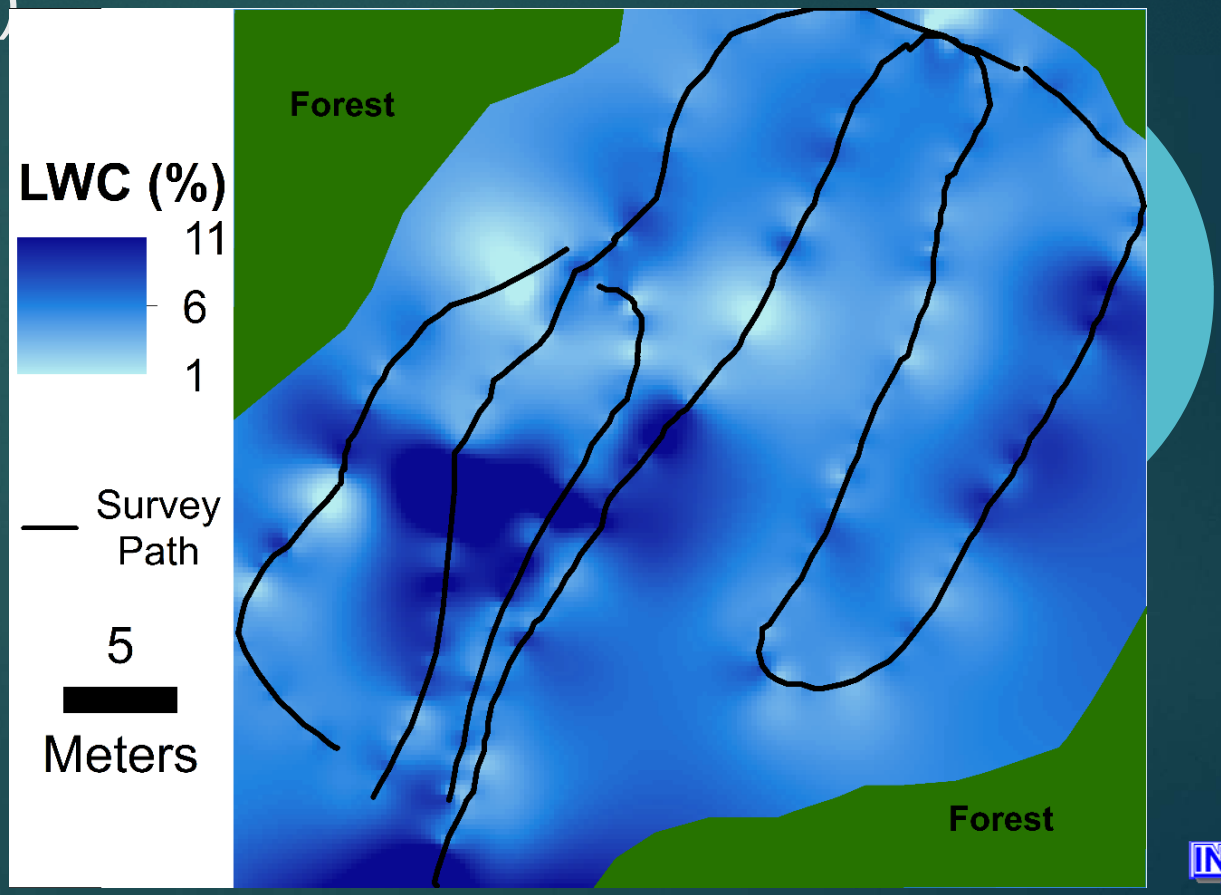

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Looking Forward

- Preliminary processing looks promising
- Good coverage with depth probes & LiDAR
- Will provide robust product for ground validation/calibration of instruments

Acknowledgements

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SNOWEX

NSF

NASA

Thank You!