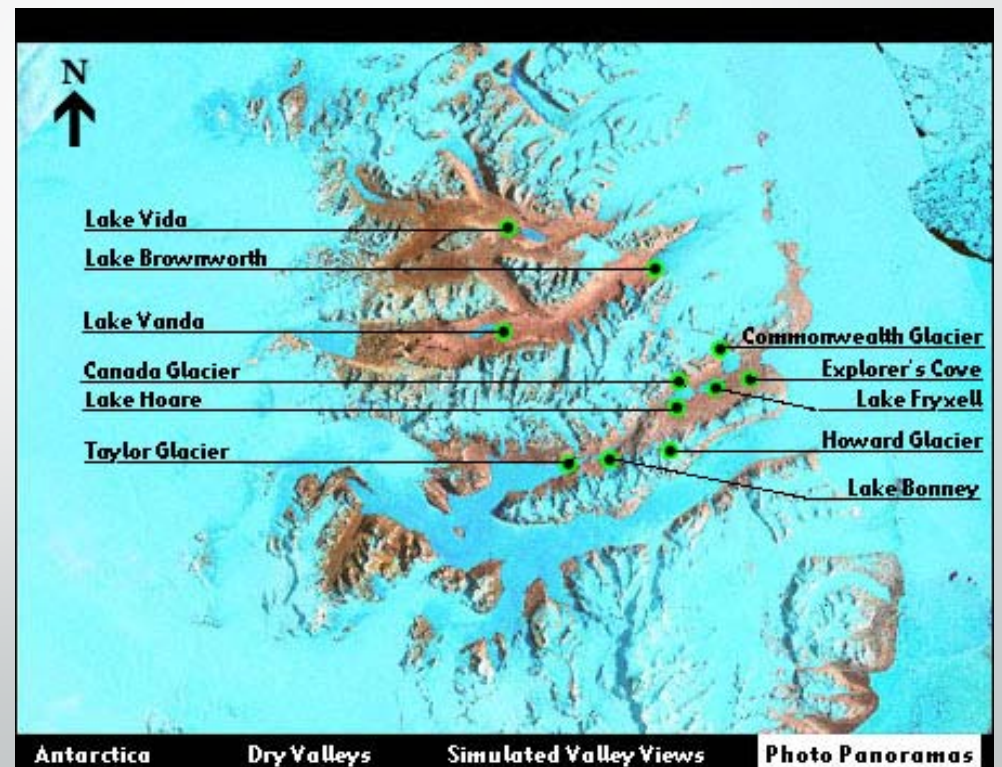
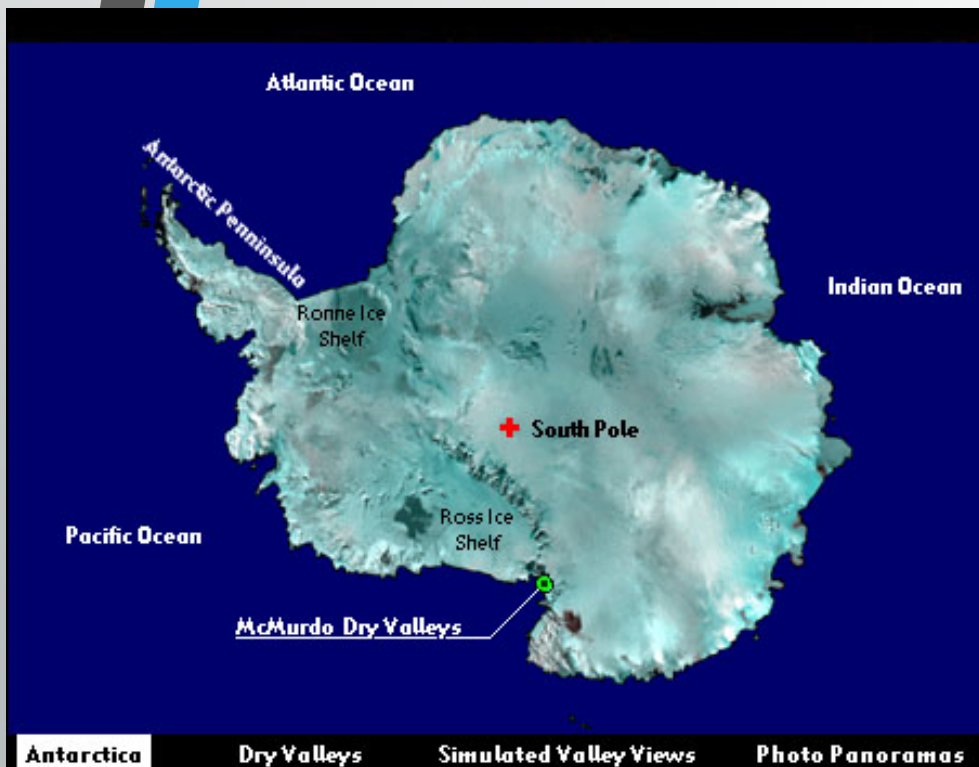


# Topographic change detection analysis of the Lake Hoare region and Canada Glacier in the McMurdo Dry Valleys of Antarctica using terrestrial LiDAR scans

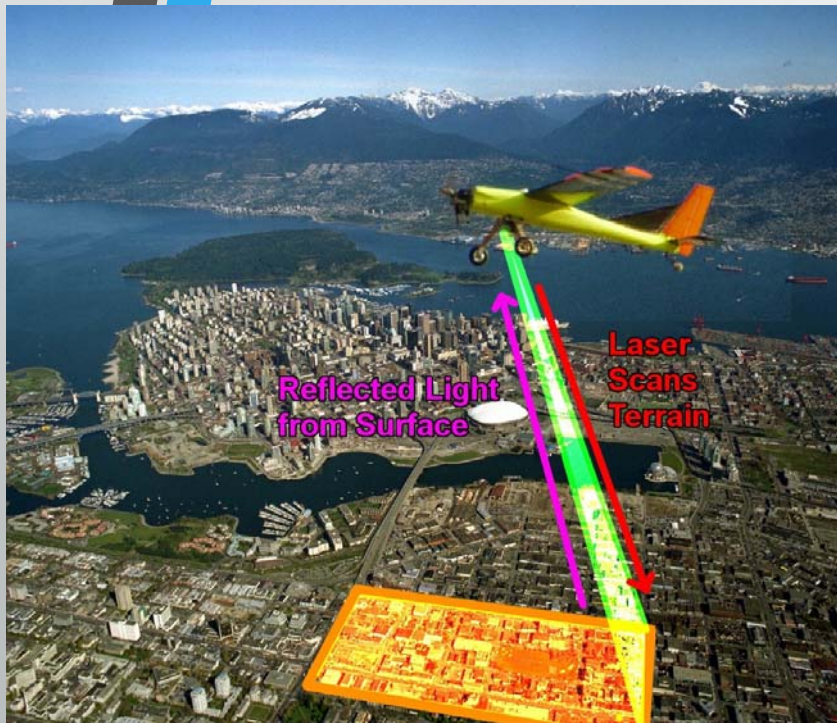
Anna Diewiger

# Welcome to the McMurdo Dry Valleys of Antarctica!



<http://glaciers.pdx.edu/Projects/Antarctica/McMurdoVT/index.html>

# LiDAR

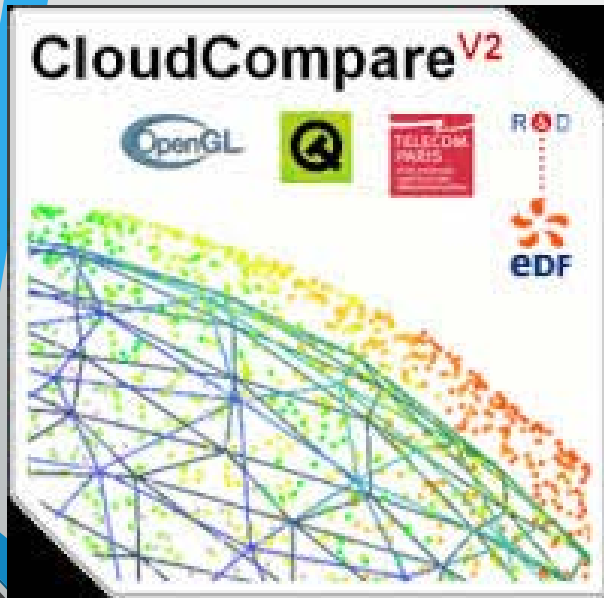


- “Light Radar”
- Maps the topography of large areas at high resolution

“LiDAR”. Stratus Areonautics. [http://stratus-aero.com/?page\\_id=106](http://stratus-aero.com/?page_id=106)

<http://rocksandwaterdotnet.files.wordpress.com/2011/03/scanner.jpg>

# CloudCompare



[http://commons.wikimedia.org/wiki/File:CloudCompareV2\\_logo.gif](http://commons.wikimedia.org/wiki/File:CloudCompareV2_logo.gif)

- 3-D point cloud processing software
- Alignment and merge of point clouds of same time period & different scanner position to increase density
- Alignment of 2 point clouds of same section at different times
- Tool for change detection analysis



# Lake Hoare



Levy (2013)



**Wet patches** on topographic highs aren't associated with streams and have no apparent connectivity to surface waters.

<http://phys.org/news/2012-02-antarctic-salty-soil-atmosphere-mars.html>



**Water tracks** carry a greater amount of solutes than the seasonal streams.

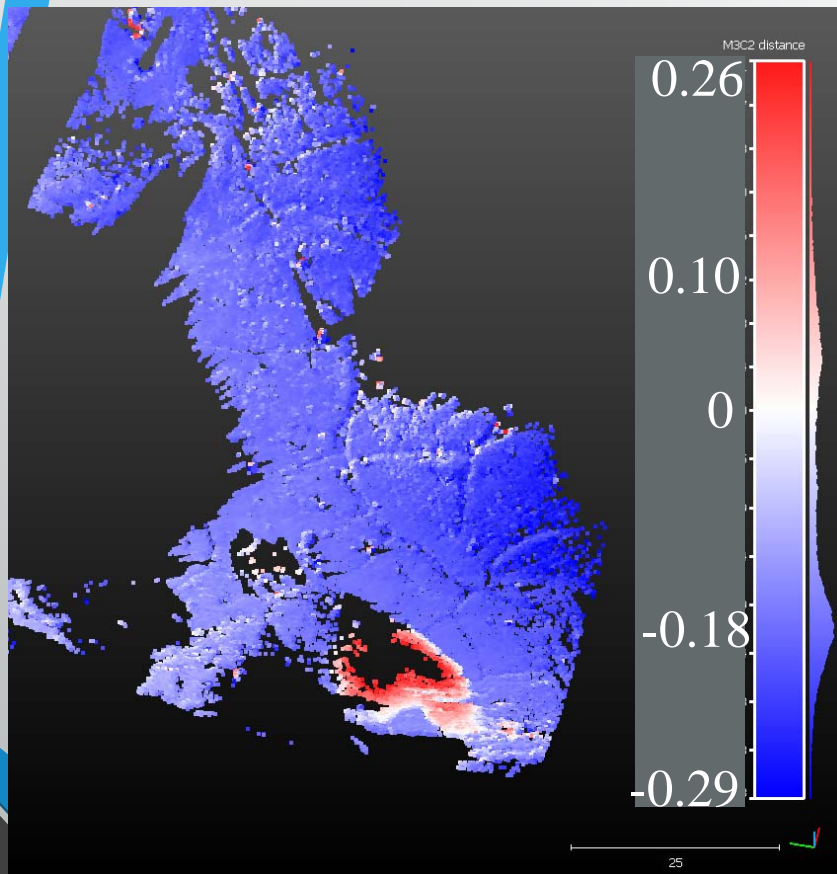
[http://www.glaciers.pdx.edu/Thesis/Hughes/KellyHughes\\_webpage.html](http://www.glaciers.pdx.edu/Thesis/Hughes/KellyHughes_webpage.html)



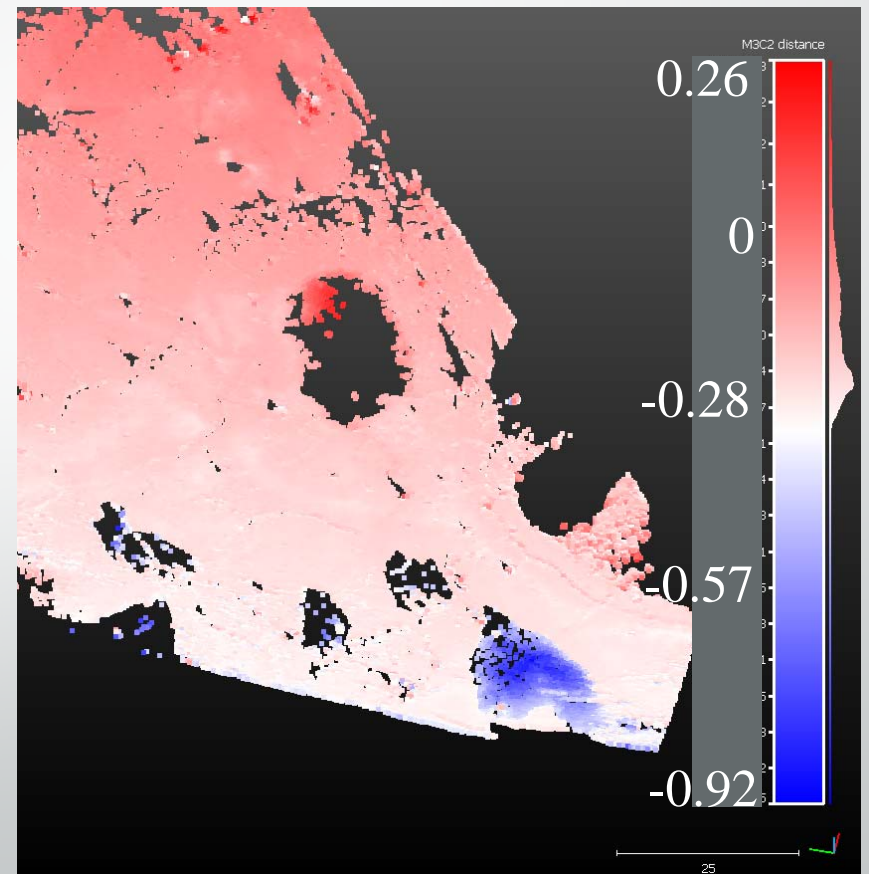
# Using LiDAR to detect snow patch and pond changes



Jan. 2012 to  
Dec. 2012

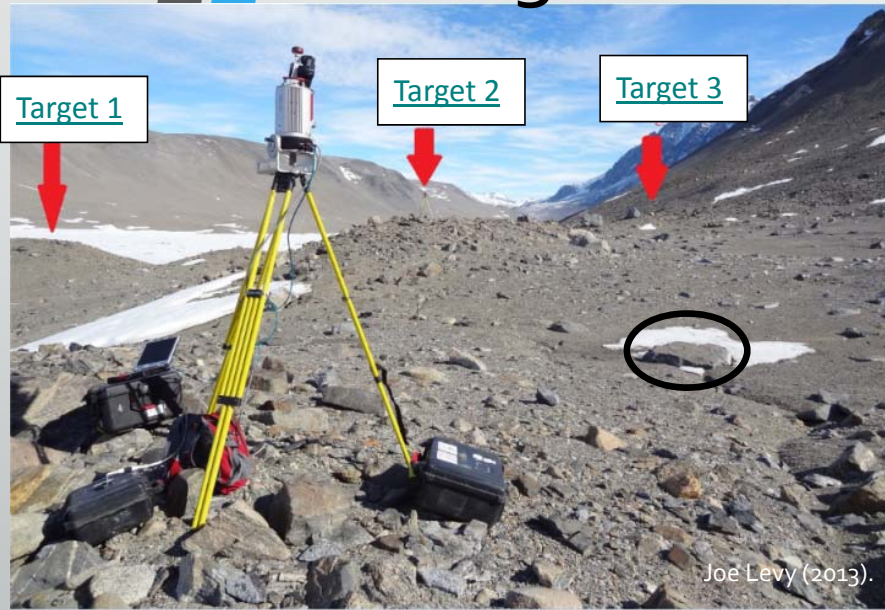


Jan. 2012 to  
Jan. 2014

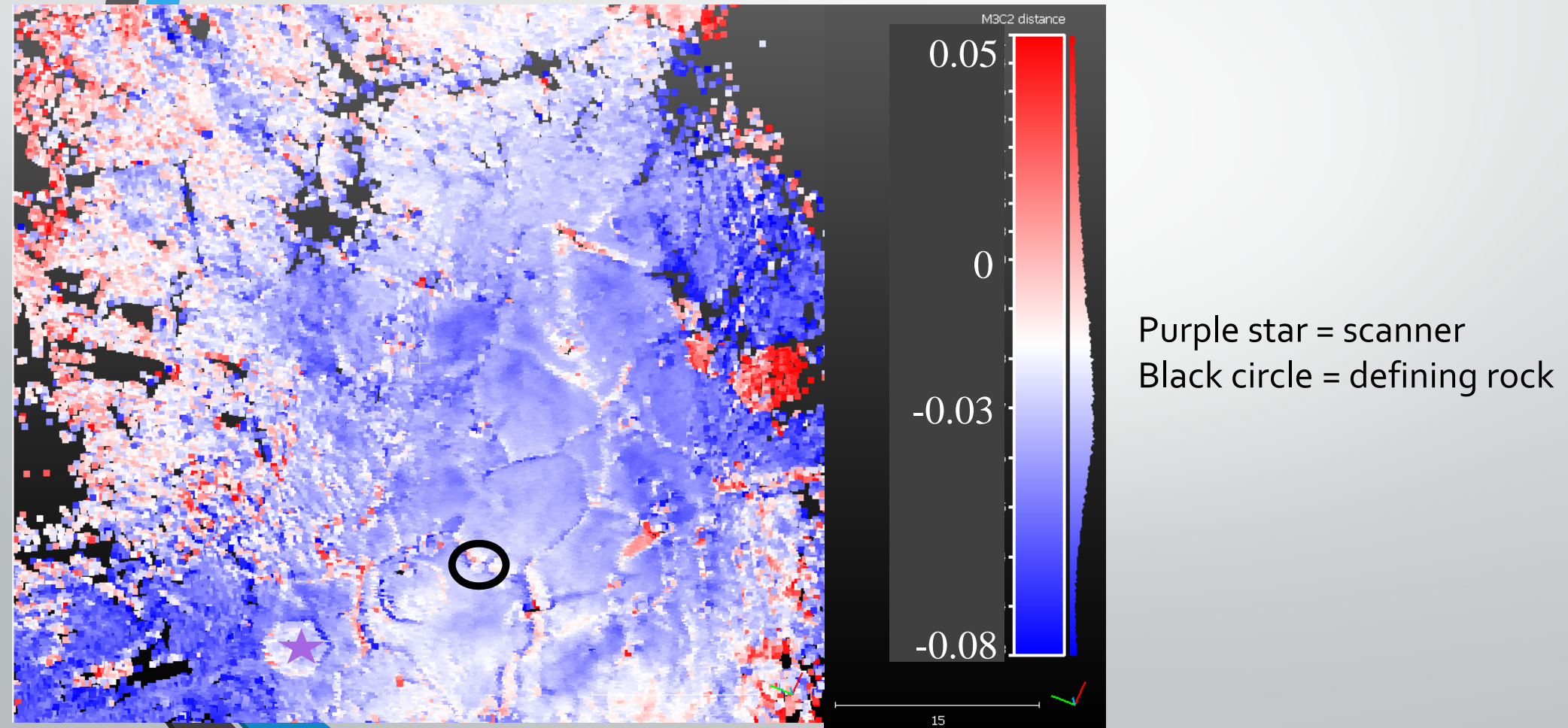




# Target Positions and Area of Interest



# Changes from Jan. 2012 to Jan. 2014





# Canada Glacier Cliff



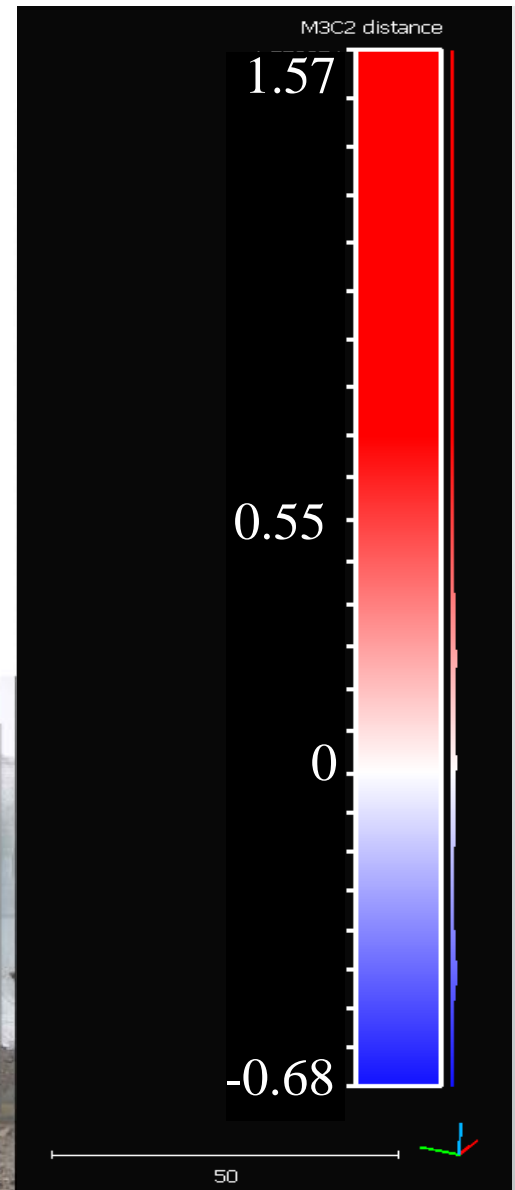
Levy (2013).



# Canada Glacier Cliff

Jan. 2012 to Dec. 2012

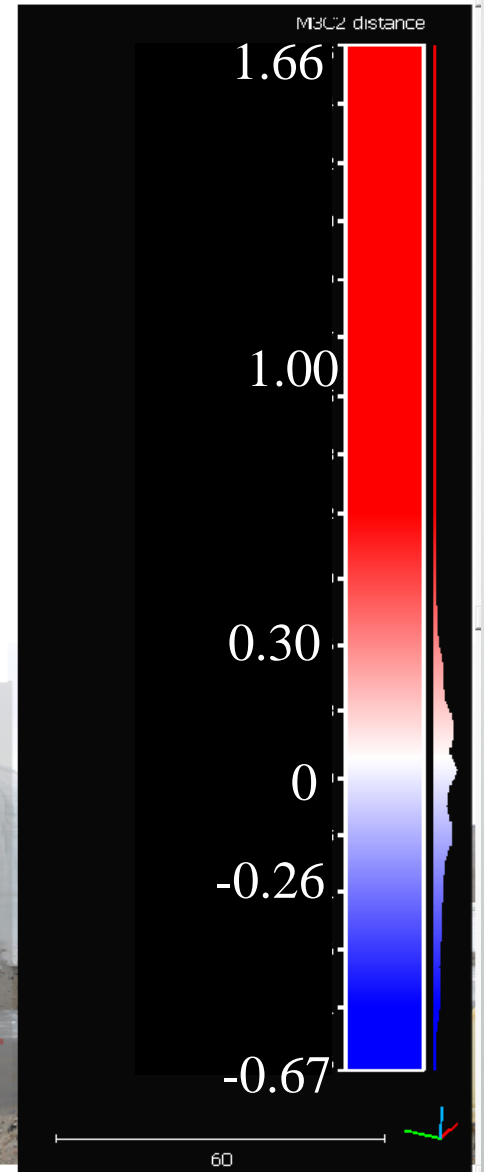
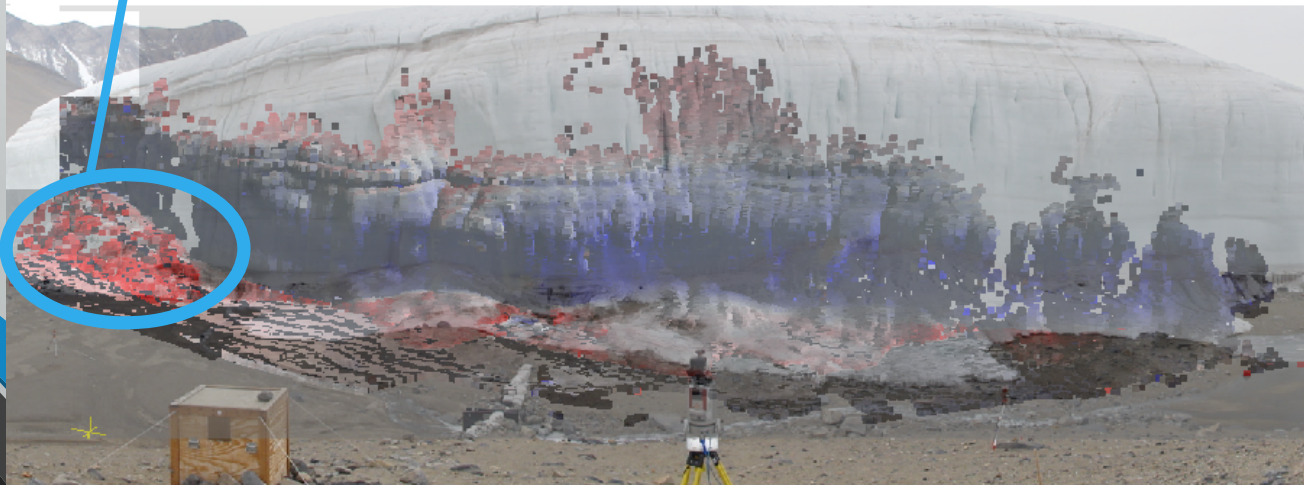
Calved Ice



# Canada Glacier Cliff

Jan. 2012 to Jan. 2013

Calved Ice



# Canada Glacier Basin

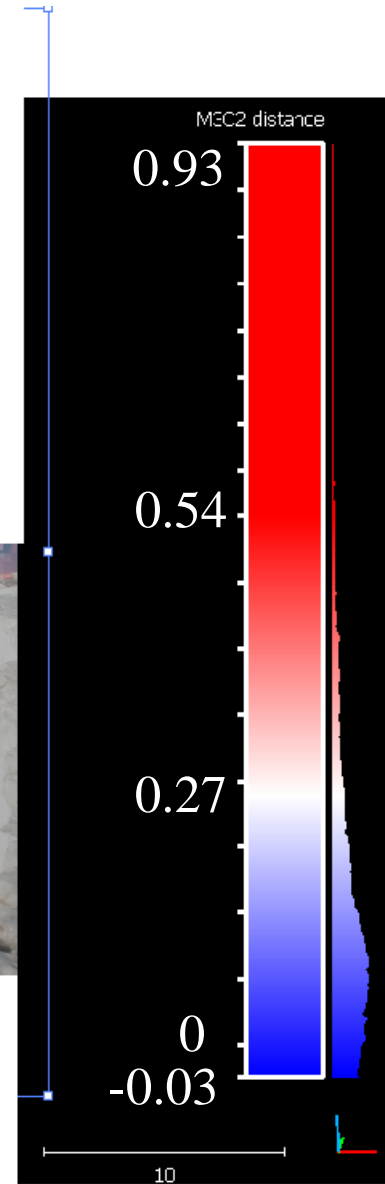
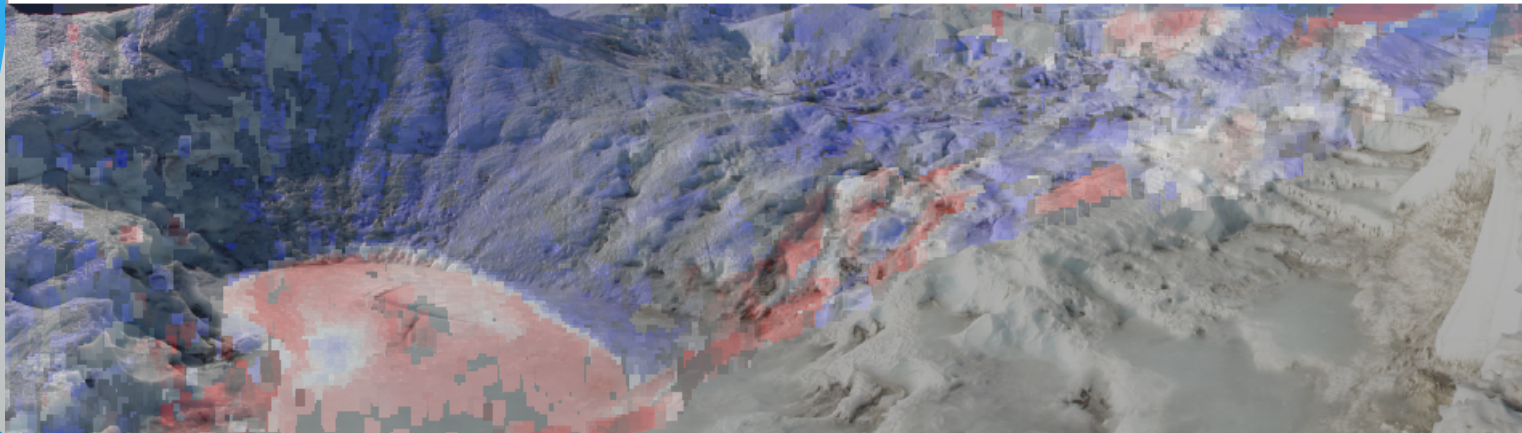


Andrew Fountain (2012).



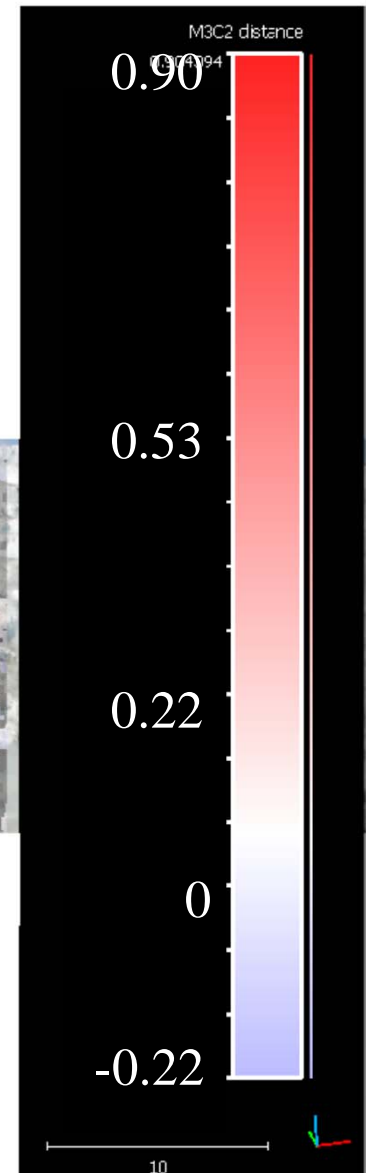
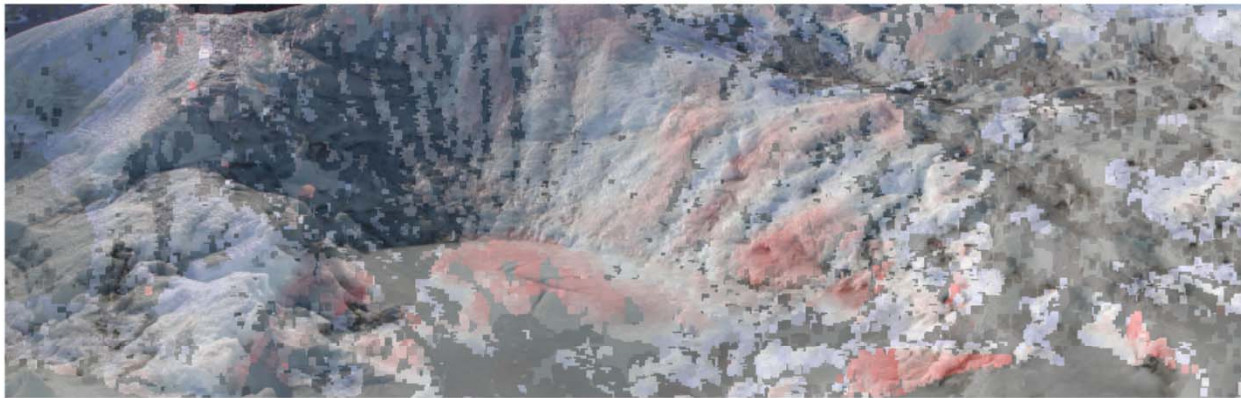
# Pond and Bowl

Nov. 2011 to Nov. 2012



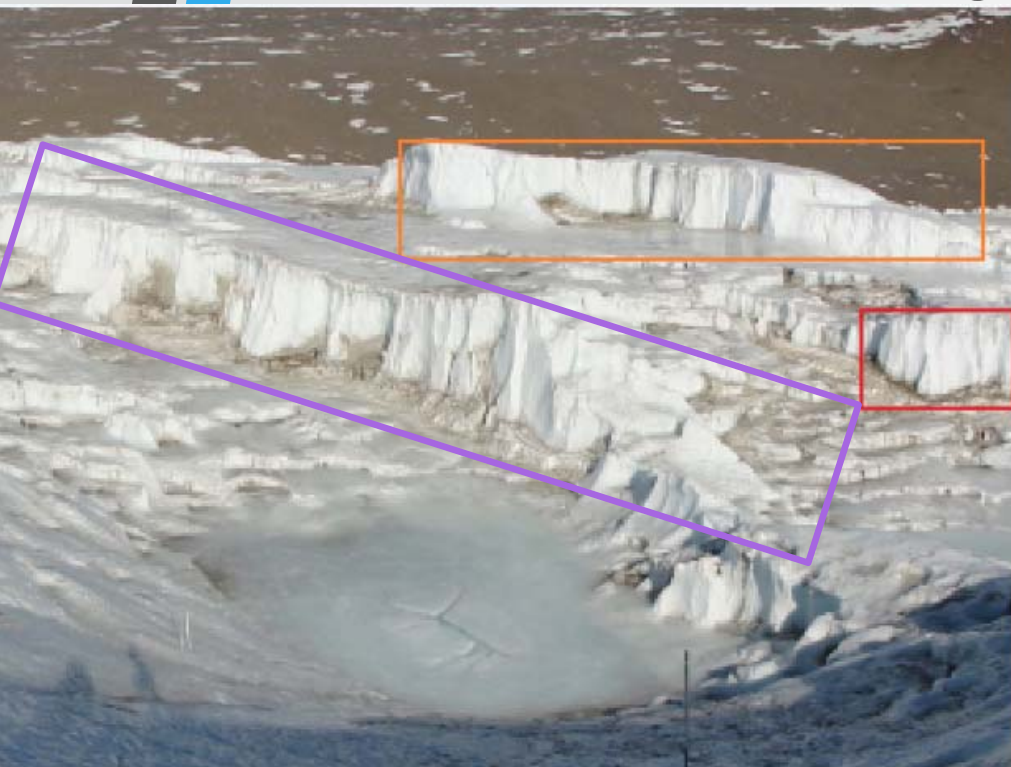
# Pond and Bowl

Jan. 2012 to Jan. 2013

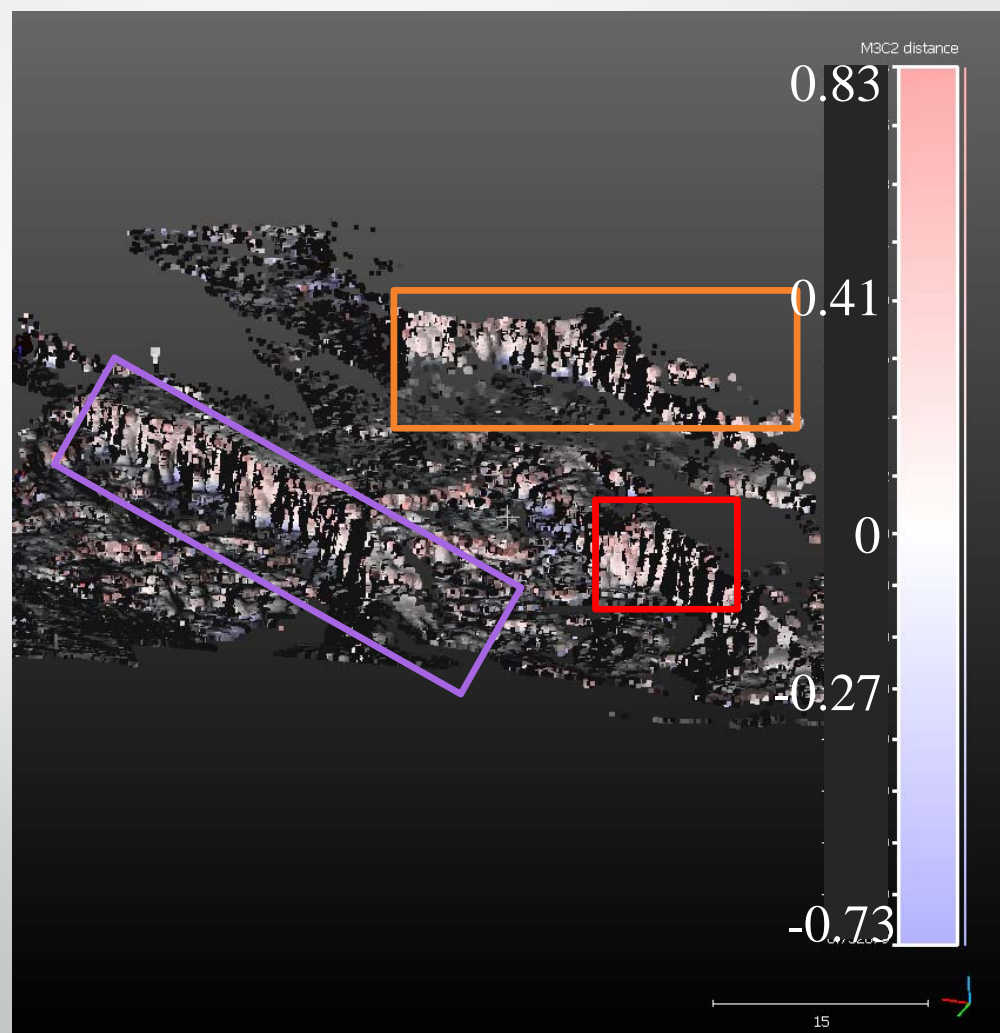


# Cliffs

Jan. 2012 to Jan. 2013



Fountain (2012).





# Summary

- **Lake Hoare**
  - CloudCompare shows ground is sinking, but this is probably due to alignment error
- **Canada Glacier Cliff**
  - Calved ice pile is accumulating while lower middle cliff face is receding
  - Upper cliff advancing due to density issues between scans
- **Canada Glacier Basin**
  - Pond is accumulating
  - Change in the bowl around the pond isn't consistent
  - Cliffs show a gradient of change, probably due to misalignment

# Future Work and Applications

- Continue scanning in future years
- Aim for consistent targets and more targets on glacier basin
- Aim for more similar densities in point clouds
- More photos of the area
- Aerial photos of the area
- Glacial change in MDV can serve as analogue to glacial change on Martian glaciers
- Better understanding of how climate change is affecting remote areas of our world

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- Van Everdingen, Robert, ed. "Multi-language glossary of permafrost and related ground-ice terms" Boulder, CO: National Snow and Ice Data Center/World Data Center for Glaciology (1998).




# Image Citations

- Slide 2: <http://glaciers.pdx.edu/Projects/Antarctica/McMurdoVT/index.html>
- Slide 3: "LiDAR". Stratus Areonautics. [http://stratus-aero.com/?page\\_id=106](http://stratus-aero.com/?page_id=106)
- Slide 3: <http://rocksandwaterdotnet.files.wordpress.com/2011/03/scanner.jpg>
- Slide 4: [http://commons.wikimedia.org/wiki/File:CloudCompareV2\\_logo.gif](http://commons.wikimedia.org/wiki/File:CloudCompareV2_logo.gif)
- Slide 5: Joseph Levy, Marianne Okal, Brendan, Kelly, Kathy "G-804 Lake Hoare watermarks December 2012 TLS meta-data" (2013).
- Slide 6: <http://phys.org/news/2012-02-antarctic-salty-soil-atmosphere-mars.html>
- Slide 6: [http://www.glaciers.pdx.edu/Thesis/Hughes/KellyHughes\\_webpage.html](http://www.glaciers.pdx.edu/Thesis/Hughes/KellyHughes_webpage.html)
- Slide 7: <http://phys.org/news/2012-02-antarctic-salty-soil-atmosphere-mars.html>
- Slide 8: Joseph Levy, Marianne Okal, Brendan, Kelly, Kathy "G-804 Lake Hoare watermarks December 2012 TLS meta-data" (2013).
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- Slide 10: Joseph Levy, Marianne Okal, Brendan, Kelly, Kathy "G-804 Lake Hoare watermarks December 2012 TLS meta-data" (2013).
- Slide 12: Joseph Levy, Marianne Okal, Brendan, Kelly, Kathy "G-804 Lake Hoare watermarks December 2012 TLS meta-data" (2013).
- Slide 15: Andrew Fountain, Marianne Okal, Thomas Nylén, Alia Kahn, Joe Levy "B-504 2011-2012 TLS meta-data" (2012).
- Slide 18: Andrew Fountain, Marianne Okal, Thomas Nylén, Alia Kahn, Joe Levy "B-504 2011-2012 TLS meta-data" (2012).

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Thank you!  
Questions?