UTILIZING LIDAR DATA FOR DETECTION OF CHANNEL MIGRATION TAYLOR VALLEY, ANTARCTICA ID: C34A-05 M. Camille Barlow, Jennifer W. Telling, Craig Glennie, National Center for Airborne Laser Mapping University of Houston Andrew Fountain Porland State University



OUTLINE

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 - b. Channel Migration
 - c. Stream Complexity
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INTRODUCTION





<u>IMPORTANCE OF CHANNEL</u> <u>GEOMORPHOLOGY IN TAYLOR VALLEY</u>

- New methods are needed
 - McMurdo Dry Valleys (MDV) are remote and expensive
 - Short summer months = insufficient data
- Provides information on regional climate change
 Precipitation is minimal (<100 mm/yr)
 - Runoff is temperature dependent



Taylor Valley, McMurdo Dry Valleys, Antarctica



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U.S. Geological Survey, 2007, Landsat Image Mosaic of Antarctica (LIMA): U.S. Geological Survey Fact Sheet 2007-3116, 4 p.

DEM DATASETS

- 2001 dataset: NASA, Airborne Topographic Mapper (ATM)
 - 0.37 points/m² (1 point/2.7 m²)
- 2014 dataset: NCALM, Optech Titan Sensor
 - 5-10 points/m² (>10x avg. point density!)

Point clouds resampled to a 1x1 meter DEM



SITE 1, LOST SEAL STREAM





Google earth V 7.3.0.3832. (January 17, 2010). 77° 35' 08.95" S, 163° 14' 32.97" E, Eye alt 1.37 km. DigitalGlobe 2017. http://www.earth.google.com [November 30, 2017]

SITE 1, LOST SEAL STREAM





SITE 2





Google earth V 7.3.0.3832. (January 17, 2010). 77° 35' 23.45" S, 163° 27' 54.64" E, Eye alt 915 feet. DigitalGlobe 2017. http://www.earth.google.com [November 30, 2017]

GEONET 2.2

• Used for automatic extraction of channel networks (Passalacqua, P. et al., 2010)



GeoNet extraction of the Rio Col Duro river basin in the Eastern Italian Alps and comparison to the surveyed network (results obtained with GeoNet 1.0.1) [Passalacqua, Tarolli and Foufoula-Georgiou, WRR, 2010].



Passalacqua, P., Trung, T.D., Foufoula-Georgiou, E., Guillermo, S., and Dietrich, W.E. (2010), A Geometric Framework for Channel Extraction from LiDAR: Nonlinear diffusion and geodesic paths, *Journal of Geophysical Research*, vol. 115, F01002, 18 p.

CHANNEL MIGRATION TOOLBOX

Site 2 - 2001 and 2014 Channel Migration, Taylor Valley, Antarctica



• Measures average lateral channel migration (Legg, N.T., et al., 2014)



Legg, N.T., Heimburg, C., Collins, B.D., and Olson, P.L. (2014), The Channel Migration Toolbox: ArcGIS Tools for Measuring Stream Channel Migration, Department of Ecology State of Washington, no. 14-06-032, <u>14 p.</u>_____

Site 1 - 2001 and 2014 Channel Networks, Taylor Valley, Antarctica





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Site 2 - 2001 and 2014 Channel Networks, Taylor Valley, Antarctica



Site 2 - 2001 and 2014 Channel Networks, Taylor Valley, Antarctica



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LAW OF V'S AND CROSS SECTION QUALITY CHECK





AVERAGE CHANNEL MIGRATION - SITE 1

\bigvee	Average Channel Migration			
	Channel Number	Channel Migration Area (m ²)	Average Channel Migration (m)	
	5	711.2	0.7	
	8	293.7	1.0	
	9	893.7	2.9	
2014 Channel				
Migration Area	10	1200.6	1.0	



AVERAGE CHANNEL MIGRATION - SITE 1



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SITE 1- STREAM COMPLEXITY

	200	2001		2014		
Channel Number	Total Channel Length (m)	Number of Branches	Total Channel Length (m)	Number of Branches	Change in Channel Length (m)	Change in # of Branches
1	308.2	6	305.6	3	-2.6	-3
2	431.8	6	400.4	2	-31.4	-4
3	1248.7	14	1244.8	10	-3.9	-4
4	292.0	3	293.6	4	1.6	1
5	1336.3	16	1450.1	15	113.7	-1
6	341.6	4	278.9	6	-62.6	2
7	195.7	1	214.3	5	18.6	4
8	636.3	6	661.3	6	24.9	0
9	839.5	7	1010.4	7	171.0	0
10	657.6	3	574.7	2	-82.9	-1
Total	6287.8	66	6434.1	60	146.3 (+2.3%)	-6 (-10%)



AVERAGE CHANNEL MIGRATION - SITE 2





AVERAGE CHANNEL MIGRATION - SITE 2



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RESULTS: SITE 2- STREAM COMPLEXITY

	20()1	201	4		
Channel Number	Total Channel Length (m)	Number of Branches	Total Channel Length (m)	Number of Branches	Change in Channel Length (m)	Change in # of Branches
1	524.3	3	870.2	5	345.9	2
2	760.1	7	758.0	8	-2.1	1
3	290.1	3	309.2	4	19.2	1
4	416.0	4	392.0	4	-24.0	0
5	119.6	0	153.2	1	33.6	1
6	486.6	4	451.1	4	-35.5	0
7	481.0	4	466.3	6	-14.8	2
8	1270.3	14	1165.3	19	-105.0	5
Total	4348.0	39	4565.4	51	217.4 (+4.8%)	12 (+23.5%)



<u>RESULTS: STREAM COMPLEXITY</u> <u>COMPARISON</u>



Channel	Change of Channel	Change of Number of
Year	Length (m)	Branches
	146.3	-6
Site 1	(+2.3%)	(-10%)
	217.4	12
Site 2	(+4.8%)	(+23.5%)



CONCLUSIONS

- GeoNet is an efficient alternative to manual extraction of channel networks
- Low migration rates due to hyper-arid cold, polar desert climate
- Site 1 had decrease in channels. Site 2 had an increase in channels
- Lengthening of channels in Site 1 and 2
 - \succ May not represent the whole MDV



FUTURE WORK

- Extract networks for the entire valley
- Automate channel migration
- Additional Analyses:
 - 1. Slope
 - 2. Microclimate Zones
 - 3. Outcrop Geology
 - 4. Soil Salinity
 - 5. Soil Temperatures





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QUESTIONS

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Photo taken by <u>Darren Hauser</u>

