KERRY LEE CALLAGHAN

ASSISTANT PROFESSOR

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RESEARCH INTERESTS

Palaeohydrologic modelling; long-term changes in lake and groundwater storage; water table; hydrologic connectivity; landscape analysis and evolution; inter-connections between water table, climate, sea level, ice, and landscape at a regional to global scale.

ACADEMIC POSITIONS

Assistant Professor – Department of Earth and Environmental Sciences, University of Illinois Chicago 2023 -

Postdoctoral Research Scientist – Lamont-Doherty Earth Observatory, Columbia University 2021 - 2022
Research topic: Using the Water Table Model (WTM) to understand past and present change in terrestrial water storage resulting from long-term changes in climate and topography. Understanding the impact of changing terrestrial water storage on Glacial Isostatic Adjustment (GIA).

Supervisor: Professor Jacqueline Austermann.

EDUCATION

Ph.D. Earth Sciences – University of Minnesota 2020
Research topic: Computing water flow and storage in complex landscapes.

Project Summary: I developed a coupled groundwater-dynamic lake model, the Water Table Model (WTM), for understanding change in water table elevation on a large (continental to global) scale. Model code is written in C++ and is available on Github. Pre- and post-processing of data is performed using GRASS GIS and Python. One of many applications of this model is assessment of changing terrestrial water storage volume (including both groundwater and lake storage) at and since the Last Glacial Maximum (LGM).

Advisor: Professor Andrew Wickert.

M.Sc. Geoinformatics – University of Stellenbosch 2014
Research topic: The use of Remote Sensing and GIS in the identification and vulnerability detection of coastal erosion as a hazard in False Bay, South Africa.

Project Summary: This project combined the use of Landsat TM images and aerial photographs to perform an analysis of coastal erosion and changes in erosion vulnerability. Techniques used included object-based image classification, post-classification change detection, image differencing, vegetation index differencing, Boolean change detection, and use of the Digital Shoreline Analysis System. The results of all techniques collaboratively showed increases in erosion susceptibility within the study region along with recession in the shoreline position. Software used during the completion of this project included ArcMAP, ENVI, PCI Geomatica, and Definiens Developer.

Advisor: Doctor Jaco Kemp.

B.Sc. Honours Geology – University of Stellenbosch (Cum Laude) 2011
Research topic: 3D visualisation of the Malmesbury Group-Cape Supergroup unconformity: the effects of the Permo-Triassic Cape Orogeny in the Western Cape.

Project Summary: The structure and form of the Malmesbury Group-Cape Supergroup unconformity were studied using topographic and geologic map data. It was found that there was a relationship between

folding in the Cape Supergroup and the nature of the underlying material (Malmesbury Group or granites). This was assessed using a 3D model created using Surfer modelling software.

Advisor: Professor Alexander Kisters

B.Sc. Earth Science – University of Pretoria (Cum Laude) 2010

ADDITIONAL QUALIFICATIONS

Introduction to Computer Science and Programming Using Python – MIT through edX 2015

Project+ Certificate in Project Management – CompTIA 2014

Certificate in Environmental Law and Policy – University of North Carolina through Coursera 2014

PUBLICATIONS

JOURNAL ARTICLES:

Callaghan, K.L., Wickert, A.D., and Barnes, R: Coupled groundwater and dynamic lake modelling using the Water Table Model (WTM). **In rev**.

Barnes, R, **Callaghan, K.L.**, and Wickert, A.D.: Computing water flow through complex landscapes – Part 3: Fill-Spill-Merge: Flow routing in depression hierarchies. *Earth Surface Dynamics*, 9, 105-121, https://doi.org/10.5194/esurf-9-105-2021, 2021.

Barnes, R, **Callaghan, K.L.**, and Wickert, A.D.: Computing water flow through complex landscapes – Part 2: Finding hierarchies in depressions and morphological segmentations. *Earth Surface Dynamics*, 8, 431-445, https://doi.org/10.5194/esurf-8-431-2020, 2020.

Callaghan, K.L., and Wickert, A.D.: Computing water flow through complex landscapes – Part 1: Incorporating depressions in flow routing using FlowFill. *Earth Surface Dynamics*, 7(3), 737-753, https://doi.org/10.5194/esurf-7-737-2019, 2019.

Callaghan, K., Engelbrecht, J., and Kemp, J.: The use of Landsat and aerial photography for the assessment of coastal erosion and erosion susceptibility in False Bay, South Africa. *South African Journal of Geomatics*, 4(2), 65-79, https://dx.doi.org/10.4314/sajg.v4i2.1, 2015.

COMPUTER CODE:

Callaghan, K. L., Barnes, R., and Wickert, A. D. (2020). Water Table Model (WTM): Source Code. Zenodo. https://doi.org/10.5281/zenodo.4265369

Barnes, R., and **Callaghan, K. L.** (2020). Fill-Spill-Merge Source Code. Zenodo. https://doi.org/10.5281/zenodo.3755142

Barnes, R., and **Callaghan, K. L.** (2019). Depression Hierarchy Source Code. Zenodo. https://doi.org/10.5281/zenodo.3238558

INVITED TALKS:

Callaghan, K.L., Austermann, J., and Wickert, A.D., (2022). Long-term continental-scale change in groundwater,

lakes, and sea level. *Lehigh University, Earth and Environmental Sciences Seminar Series.*

Callaghan, K.L., Austermann, J., and Wickert, A.D., (2022). The Water Table Model: global hydrology and sea level in the past and present. *University of California, Santa Cruz, Whole Earth Seminar.*

Callaghan, K.L., Wickert, A.D., and Barnes, R. (2021). Coupled groundwater and dynamic lake modelling using the Water-Table Model (WTM). *CSDMS Annual Meeting*.

Callaghan, K.L., Austermann, J., and Wickert, A.D., (2021). Incorporating lake and groundwater volumes into global sea-level estimates during the deglaciation. *PALSEA-SERCE joint meeting.*

CONFERENCE ABSTRACTS:

Callaghan, K.L., Wickert, A.D., Austermann, J., and Creel, R. (2022). The Water Table One Hundred Years From Now: A Range of Scenarios for the United States. *AGU Fall Meeting Abstracts, GC52H-0244*.

Austermann, J., Wickert, A.D., Pico, T., Kingslake, J., **Callaghan, K.L.**, and Creel, R. (2022). Glacial isostatic adjustment shapes proglacial lakes around the Laurentide ice sheet over the last glacial cycle. *AGU Fall Meeting Abstracts, C45A-05*.

Callaghan, K.L., Austermann, J., and Wickert, A.D. (2021). Quantifying Changes in Lakes, Groundwater, and Sea Level Over the Deglaciation. *AGU Fall Meeting Abstracts, GC55K-0550*.

Callaghan, K.L., Wickert, A.D., and Barnes, R. (2021). Coupled groundwater and dynamic lake modelling using the Water-Table Model (WTM). *CSDMS Annual Meeting*. **Invited speaker**.

Callaghan, K.L., Austermann, J., and Wickert, A.D., (2021). Incorporating lake and groundwater volumes into global sea-level estimates during the deglaciation. *PALSEA-SERCE joint meeting.* **Invited speaker.**

Callaghan, K.L., Wickert, A.D., Barnes, R., and Fan, Y. (2020). Terrestrial water storage change in the Great Basin from the Last Glacial Maximum to the present day. *AGU Fall Meeting Abstracts*, H163-0009.

Barnes, R., **Callaghan, K.L.**, Wickert, A.D. (2020). Efficient techniques for incorporating standing surface water into hydrological models. *AGU Fall Meeting Abstracts*, H215-0005.

Wickert, A.D., Schildgen, T.F., Tofelde, S., Savi, S., Rojo, Y., Fleagle, S., **Callaghan, K.L.**, Barnes, R., Penprase, S.B., Larson, P., Roth, D.L. (2020). Self-consistently matching sediment supply, water discharge, and channel slope: Lane's balance at the catchment scale. *AGU Fall Meeting Abstracts*, EP014-06.

Callaghan, K.L., Wickert, A.D., and Barnes, R. (2019). Continental-scale coupled groundwater-surface-water modelling. *AGU Fall Meeting Abstracts*, H53B-02.

Callaghan, K.L., and Wickert, A.D. (2019). Computing more realistic flow-routing surfaces using FlowFill. *CSDMS Annual Meeting.*

Wickert, A.D., Williams, C., **Callaghan, K.L.**, Ivanovic, R.F., Valdes, P.J., Gregoire, L.J., Vetter, L., Breckenridge, A.J., and Jennings, C.E. (2019). Coupled oscillations of the Laurentide Ice Sheet and AMOC during the last deglaciation. *AGU Fall Meeting Abstracts*, PP53D-1468.

Callaghan, **K.L.**, Wickert, A.D., Fan, Y, Miguez-Macho, G., and Barnes, R. (2018). Coupled groundwater-surface water level modelling on a global scale. *AGU Fall Meeting Abstracts*, H11O-1647.

Callaghan, K.L., Wickert, A.D., Reinfelder, Y.F., and Miguez-Macho, G. (2018). Coupled groundwater and surface water modelling to visualise lake extent and total terrestrial water storage under a changing climate. *CSDMS Annual Meeting.*

Callaghan, K.L., Wickert, A.D., Michael, L., Fan, Y., Miguez-Macho, G., Mitrovica, J.X., Austermann, J., and Ng, G-H.C. (2017). Changing groundwater and lake storage in the Americas from the Last Glacial Maximum to the present day. *AGU Fall Meeting Abstracts*, PP33D-05.

Callaghan, K.L., Wickert, A.D., Reinfelder, Y.F., Miguez-Macho, G., Ng, G-H. C. (2017). Groundwater storage contributions to sea level at and since the Last Glacial Maximum. *CSDMS Annual Meeting*.

Callaghan, K.L., Wickert, A.D., Edwards, R.L., and Mitrovica, J.X. (2017). Reconstruction of the Amazon drainage basin, river discharge, and basin-scale erosion rates since the Last Glacial Maximum. *GSA Annual Meeting in Seattle, Washington*, USA-2017.

Callaghan, K.L., Wickert, A.D., Fan, Y., Miguez-Macho, G., Mitrovica, J.X., Austermann, J., Ng, G-H.C., and He, F. (2016). Groundwater and lake storage contributions to global mean sea level at the Last Glacial Maximum. *AGU Fall Meeting Abstracts*, PP51B-2306.

TEACHING AND OTHER EXPERIENCE

TA: Hydrogeology Field Camp - Department of Earth Science, University of Minnesota 2017/18
I assisted in student instruction and grading of work during a high intensity 3-week field camp in northern Minnesota.

TA: Hydrogeology – Department of Earth Science, University of Minnesota 2017
I graded student labs and problem sets, assisted in lab instruction, held office hours, and assisted on a weekend field trip.

TA: Glacial Geology – Department of Earth Science, University of Minnesota 2017
I graded student labs and problem sets, and assisted on several afternoon and overnight field trips.

TA: Sedimentology and Stratigraphy – Department of Earth Science, University of Minnesota 2016
I prepared and independently presented labs, held office hours, and graded student submissions.

TA: Introduction to Physical Geology – Department of Earth Science, University of Minnesota 2015, 2018
I independently presented labs, performed demonstrations, answered student questions and graded labs and exams.

Assistant Cartographer – University of Pretoria Cartographic Unit 2010
I used ArcMAP and free or University-owned map data to create maps to order as requested by students or staff of the university. I also used Coral Draw software for completing map layouts and preparing maps for large format printing.

TA: Various first- and second-year level modules – Department of Geography, Geoinformatics and Meteorology, University of Pretoria 2009-2010
I conducted labs and demonstrations with students, and graded assignments. Courses taught included Geoinformatics, Geomorphology, Remote Sensing, Introductory Geology and Cartography.

FUNDING, ACHIEVEMENTS AND AWARDS

Community Surface Dynamics Modeling System (CSDMS)

Syvitski Student Modeler Award (runner-up) 2021

Saint Anthony Falls Laboratory, University of Minnesota

Alvin Anderson Award 2020

Department of Earth Sciences, University of Minnesota

HE Wright Footsteps Award 2016, 2018, 2019

Junior F Hayden Fellowship 2018

RC Dennis Graduate Fellowship 2017

Thomas F Andrews Fellowship 2016

Geological Society of America

Graduate student research grant 2018

American Geophysical Union

Student conference travel grant 2016

Council for Geoscience 2012-2013

MSc bursary for research in Remote Sensing for geological hazard assessment.

NRF (National Research Foundation, South Africa) 2011

Funding for my research project at the University of Stellenbosch in the Earth Sciences.

Department of Geology, University of Pretoria

Roelof van der Merwe Prize – best second year student in Structural Geology, University of Pretoria 2009

Jan F Cilliers Book Prize – best first year student in Geology, University of Pretoria 2008

PROFESSIONAL DEVELOPMENT

Teaching Assistant and Postdoc Professional Development Program, Center for Educational Innovation, University of Minnesota 2020

COMMUNITY BUILDING AND VOLUNTEER WORK

Ward representative – University of Minnesota Commonwealth Terrace Cooperative (CTC)

October 2015 – August 2019

Liaison between management and residents within a ward at CTC graduate student housing. Duties included assigning residents to rotational duty weeks, coordinating annual clean-ups, and mediating member questions and disputes.

Science fair judge – Twin Cities Regional Science Fair 2021

Reviewer – Journal of Open Source Software; Computers and Geosciences; Geoscientific Model Development; NSF proposal review.