CULLEN
COLLEGE OF ENGINEERING
UNIVERSITY of HOUSTON

DOCTORAL
DISSERTATION DEFENSE ANNOUNCEMENT
AT THE CULLEN COLLEGE OF ENGINEERING

Name Dynamics of Antarctic Glaciers Using Differential Interferometric Synthetic Radar Remote Sensing Observations and Ice-Sheet Models

Natalya Ross

June 24th, 2025, 1:00 to 3:00 p.m. (CST)

Location: UH Technology Bridge Building 4, 2nd floor, NCALM Conference Room

Virtual link: Natalya Ross' Dissertation Defense

Committee Chair:

Dr. Pietro Milillo, Ph.D.

Committee Members:

Dr. Craig L. Glennie, Ph.D. | Dr. Hyongki Lee, Ph.D. | Dr. Julia S. Wellner, Ph.D. | Dr. Shuhab D. Khan, Ph.D.

Abstract

Grounding lines, which mark the boundary where a glacier transitions from resting on bedrock to floating in the ocean, are key indicators of glacier stability and ice sheet dynamics. In Antarctica, which holds approximately 58 m of sea level equivalent, grounding lines are crucial for investigating processes governing glacier behavior and evaluating climate change impacts. While long-term glacier retreat has been studied over decades, grounding lines also experience tide-driven short-term movements, which are less studied due to limited data and an incomplete understanding of the physics of the process. To address this gap, improved datasets with high temporal and spatial resolution, along with better observation-based modeling, are needed to refine predictions of Antarctic ice loss and its impact on global sea level rise.

This dissertation advances grounding line research by utilizing a unique COSMO-SkyMed Differential Interferometric Synthetic Aperture Radar (DInSAR) dataset, enabling precise mapping even in areas not accessible with other techniques. This dataset facilitates continuous monitoring of grounding line changes over nearly two years (2020 – 2022) and

allows for the extrapolation of long-term retreat rates spanning more than 25 years. Given that manual delineation is labor-intensive, this work explores two automated approaches for grounding line mapping: a deep learning-based method and a phase-gradient-based method. These approaches are compared in terms of accuracy, limitations, and applicability, offering guidance on choosing the most suitable method for different research needs, streamlining the mapping process. To explore short-term grounding line dynamics, this dissertation uses viscous and viscoelastic modeling frameworks to simulate tide-driven movements, comparing model predictions with DInSAR-derived measurements. Additionally, based on DInSAR-derived grounding line records, this dissertation analyzes the relationship between short-term grounding line movements and key glacier parameters, and links these findings to long-term glacier retreat rates.

This dissertation offers new insights into primary physical mechanisms behind glacier movement, helping the cryosphere community refine future models. Its outcomes contribute to enhanced monitoring of grounding lines, provide automation tools to reduce mapping time, and improve understanding of physical processes governing short-term glacier behavior.