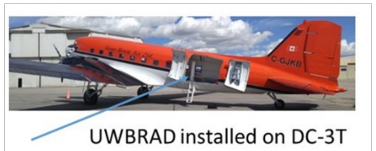
# UWBRAD: Ultra-Wideband Software-Defined Microwave Radiometer for Ice Sheet Subsurface Temperature Sensing

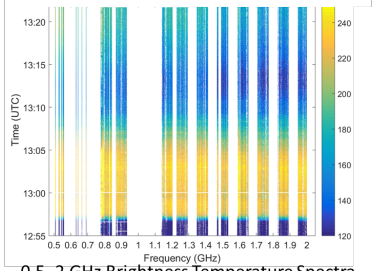
PI: Joel T. Johnson, The Ohio State University

## Objective

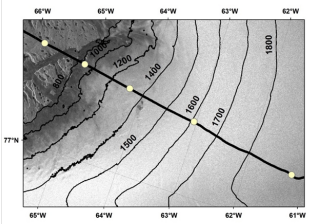
- Design, develop, test and validate an ultra-wide band, 0.5-2.0 GHz software defined microwave radiometer for sensing ice sheet internal temperature at depths up to 4 km to address key NASA climate variability and change issues
  - Includes 12 x 100 MHz fully digitized channels for RFI detection and mitigation
  - Includes forward modeling and retrieval studies for retrieving ice sheet temperatures and understanding ice sheet brightness temperature signatures
- Assess adaptation of UWBRAD to air and space platforms
- Develop software defined algorithms for real time RFI mitigation enabling operation outside protected bands
- Conduct ground based and airborne demonstrations
- Conduct science demonstration/validation of UWBRAD results



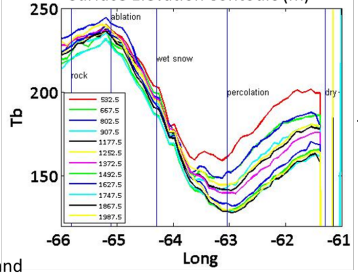
UWBRAD installed on DC-3T
Antenna deployed using "Periscope"




0.5- 2 GHz Brightness Temperature Spectra on flight from Thule, AFB to Camp Century, Greenland




Flight line overlaid on Sentinel C-band backscatter 9/13/16 (surface elevation contours)




TB vs. frequency along flight line with varying ice sheet composition

## Accomplishments

- Designed and built an ultra-wideband microwave radiometer operating 0.5-2 GHz for measuring emission spectra from ice sheets, sea ice, the sea surface, and other land regions
- Validated the instrument through airborne field campaigns in Greenland in September 2016 and 2017 and matchup with 1.4 GHz measurements of the SMOS satellite
- Showed potential to use 0.5-2 GHz portion of spectrum opportunistically through the application of RFI detection and mitigation strategies for these bands
- Demonstrated sensitivity of emission spectra to physical properties of differing portions of the Greenland ice sheet
- Developed forward models and retrieval algorithms for retrieval of subsurface temperature profiles in ice sheets and matched up with in-situ measurements
- Instrument preparing for use in 2018-19 Antarctic season through collaboration with CNR (Italy) project partners

**Co-Is/Partners:** : K. Jezek, C. Chen, M. Durand, The Ohio State University; L. Tsang, University of Michigan

**$TRL_{in}$= 3** **$TRL_{out}$= 5**



ESTO Earth Science Technology Office