

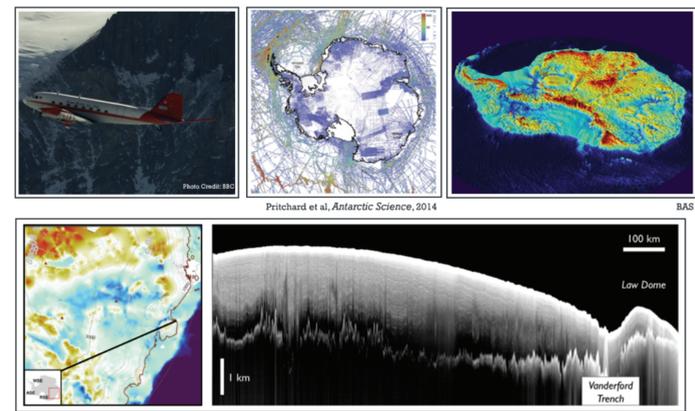


# Observing Evolving Subglacial Conditions with Multi-Temporal Radar Sounding

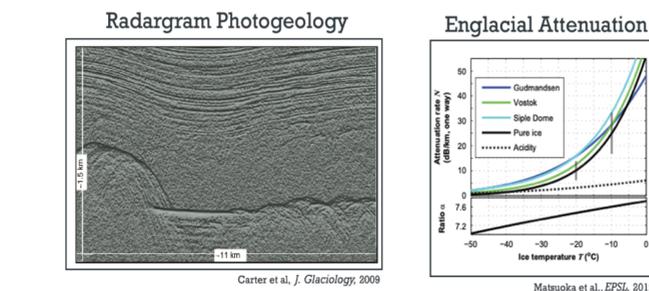
Dustin M. Schroeder

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## Airborne Radar Sounding Process-Scale to Continent-Scale Geophysical Glaciology



## Information & Uncertainty in Radar Sounding Data Echo Strength, Reflectivity, and Englacial Attenuation

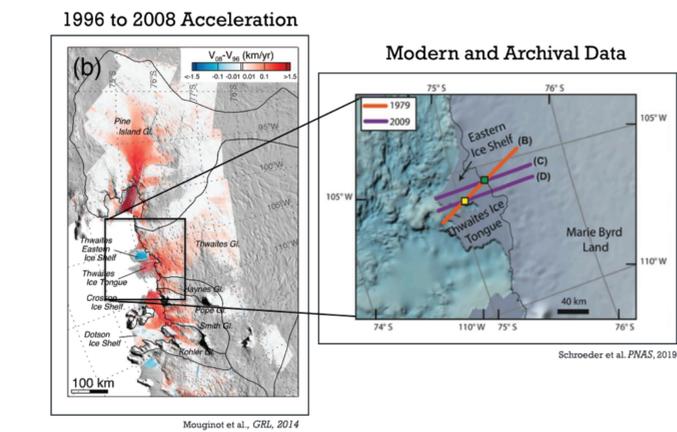


**Bed Reflectivity**

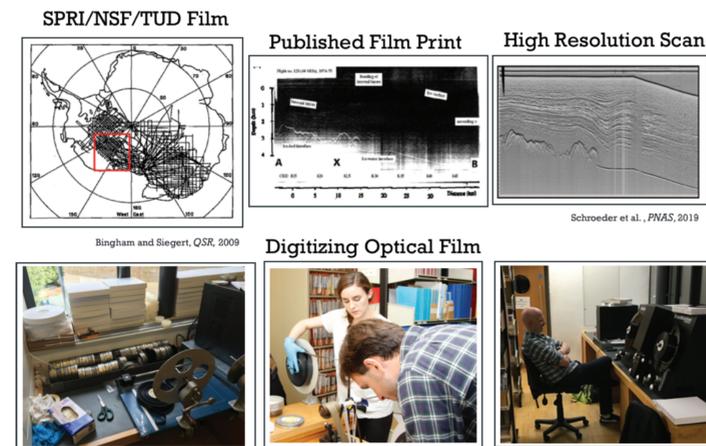
Subglacial Material	$\epsilon_r$	$\tan \delta$	$ \bar{R}_{21} ^2$ , dB
Seawater	77	11.3	-1
Groundwater (gw)	80	1.4	-2
Fresh water	80	0.002	-3
Unfrozen till (40% gw)	18	0.82	-6
Unfrozen bedrock (15% gw)	6.6	0.41	-13
Frozen till (40% gw ice)	2.8	0.035	-30
Frozen bedrock (15% gw ice)	2.7	0.022	-28
Marine ice	3.43	0.05	-33

Peters et al., JGR, 2005

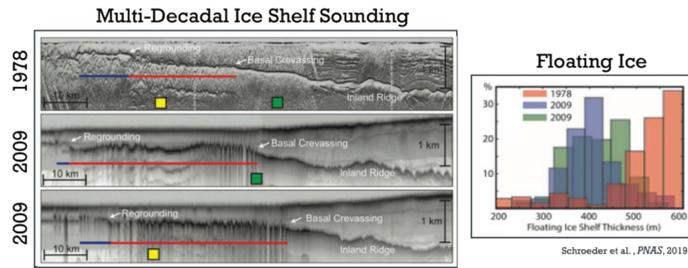
## The Thwaites Eastern Ice Shelf The Only Decelerating Spot on the Walgreen Coast



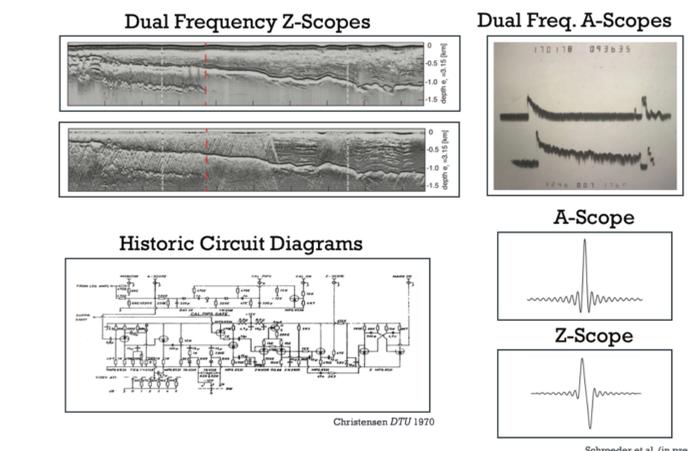
## Digitizing Radar Observations from the 60s and 70s Extending the Record of Antarctic Bed Conditions by Decades



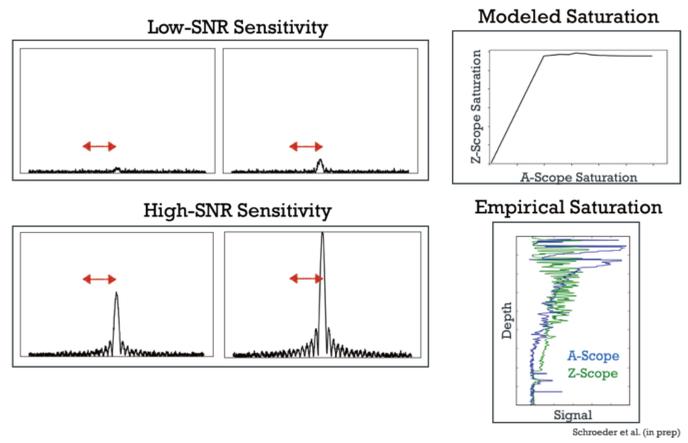
## Subsurface Evolution of the Eastern Ice Shelf 30 Years of Melting, Unpinning, and Increasing Ocean Access



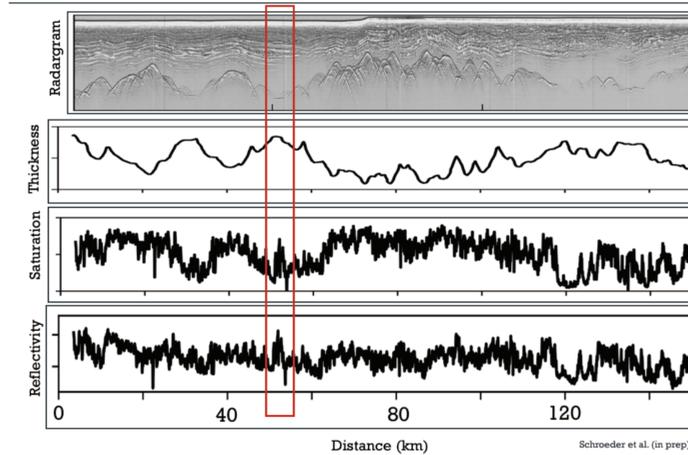
## Multi-Frequency Information on Radar Film Simultaneously Acquired 60 MHz and 300 MHz data



## Radiometric Information in Z-Scope Records Tracks A-Scopes for Low SNRs but Saturates at High

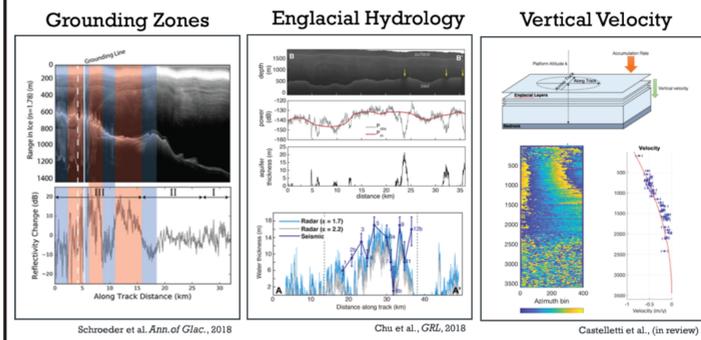


## Naive Z-Scope "Reflectivity" Sure Seems to Include the Signature of a Subglacial Lake

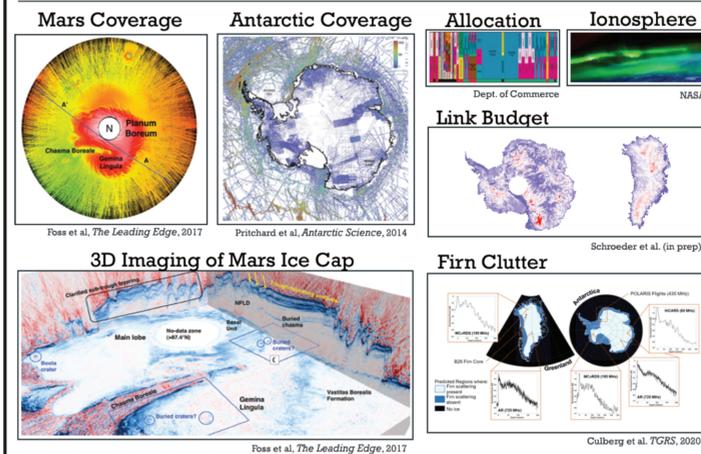


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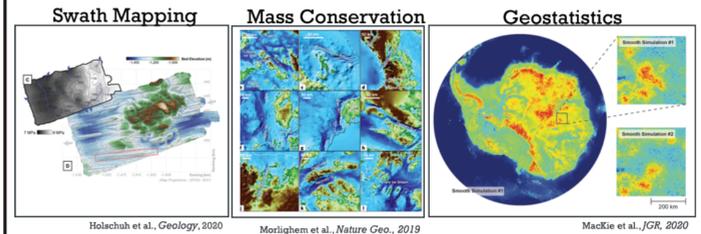
## Missions of Mapping, Monitoring, or Discovery Capturing Geometric, Interferometric, and Radiometric Change



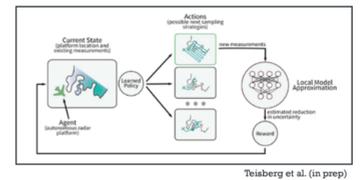
## Orbital Radar Sounding of Terrestrial Ice Sheets We're Doing it at Mars, Why not Earth?



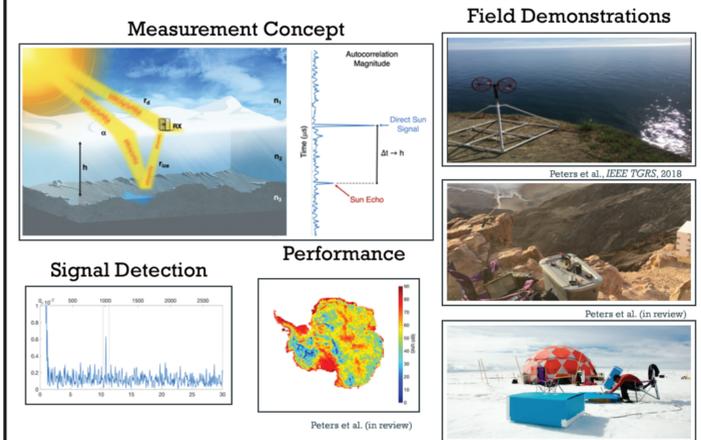
## Drones: Platforms, Surveys, & Architectures For Optimally Reducing Topographic Sea Level Uncertainty



## Adaptively Surveying Based on the Value of Information



## Ice-Sheet Passive Radio Sounding For Extremely Low Resource Glaciological Sensor Networks



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