

Operation IceBridge

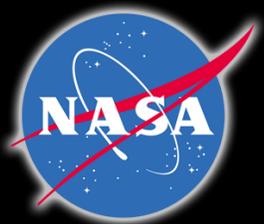


NASA Earth Science Division



Image: M. Studinger

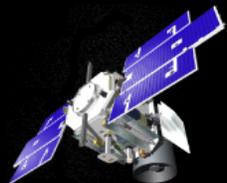
**Universidad de Magallanes en Punta Arenas
3 November 2011**



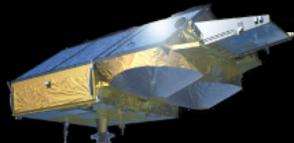
Operation IceBridge



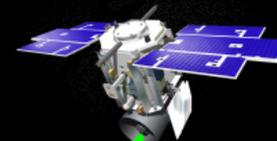
ICESat
2003 - 2009



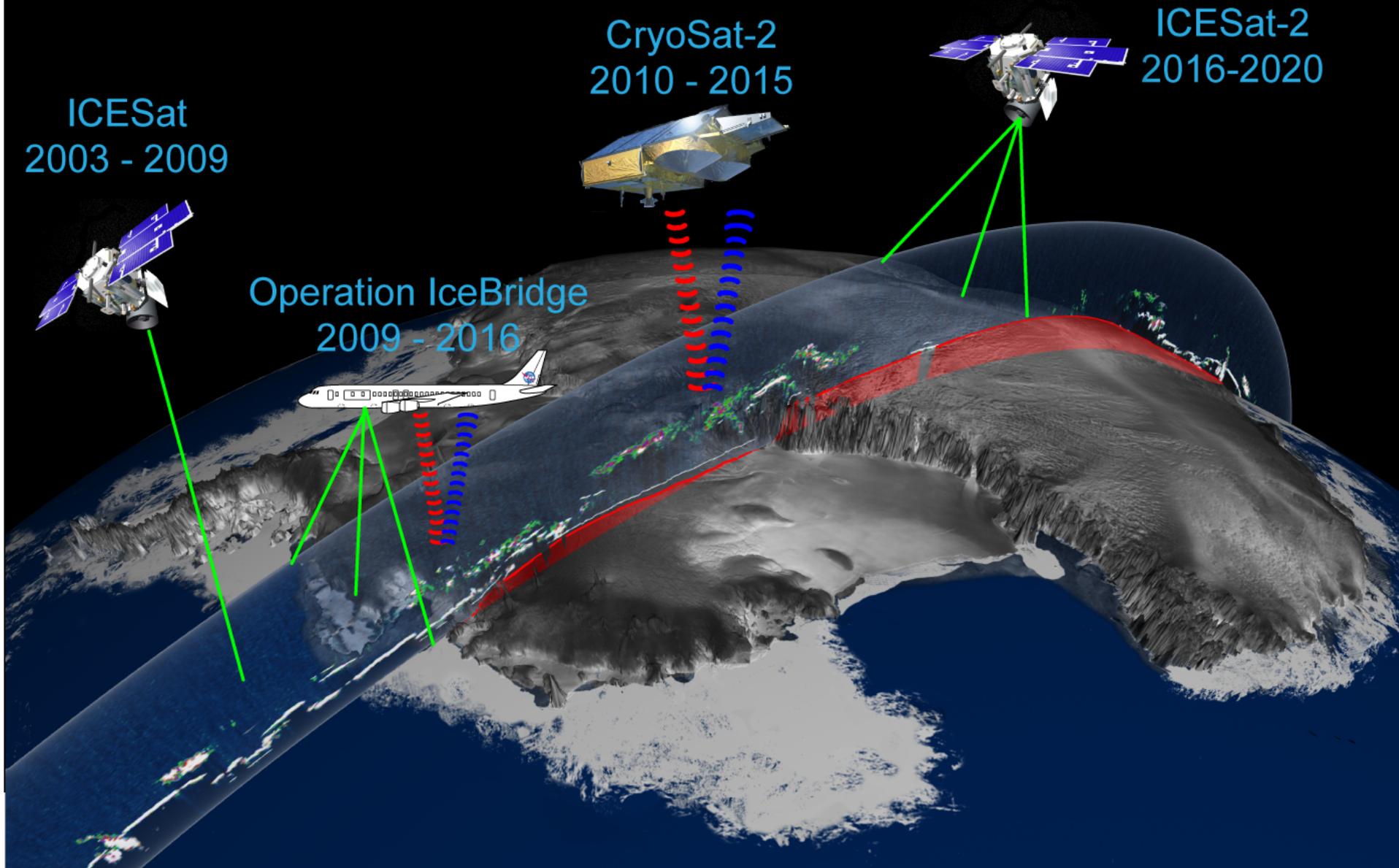
CryoSat-2
2010 - 2015

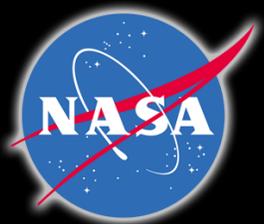


ICESat-2
2016-2020

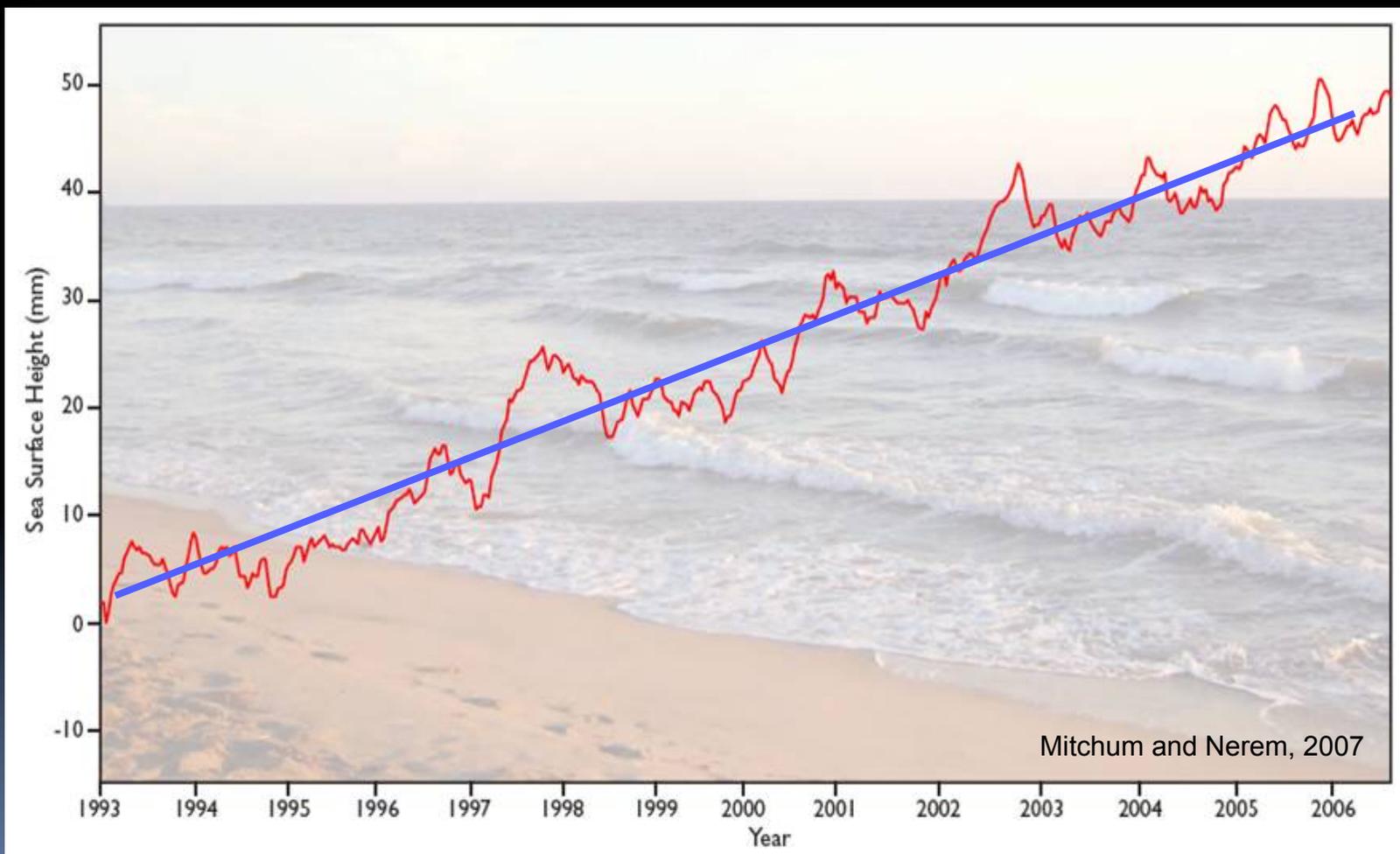


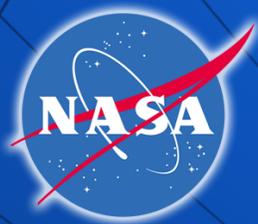
Operation IceBridge
2009 - 2016



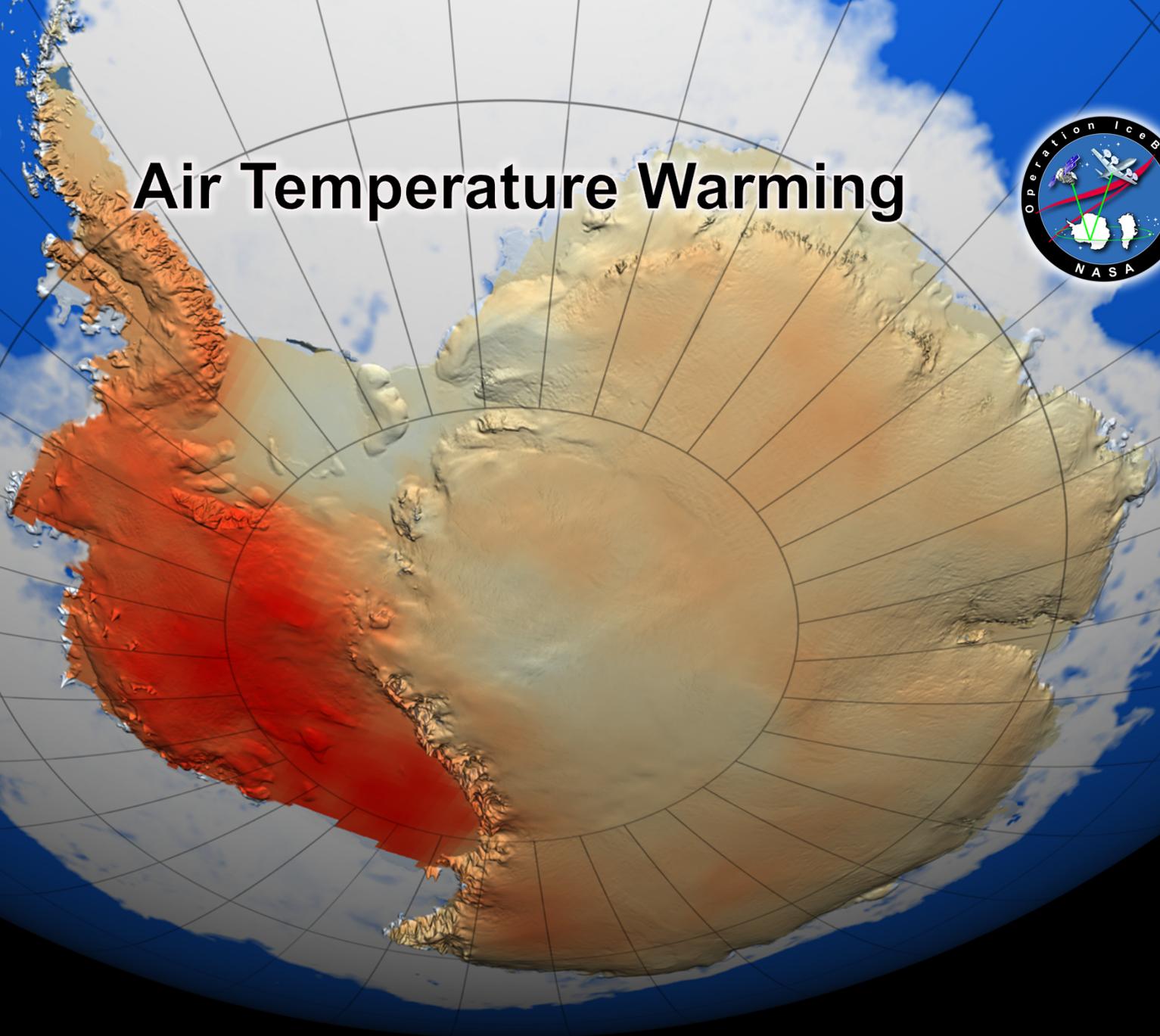


Sea Level Rise (1993-2007)

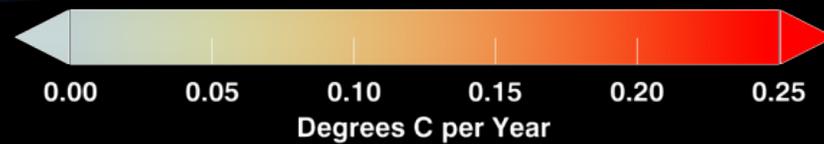


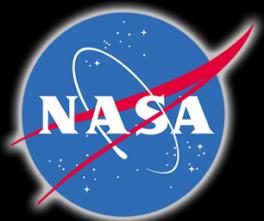


Air Temperature Warming

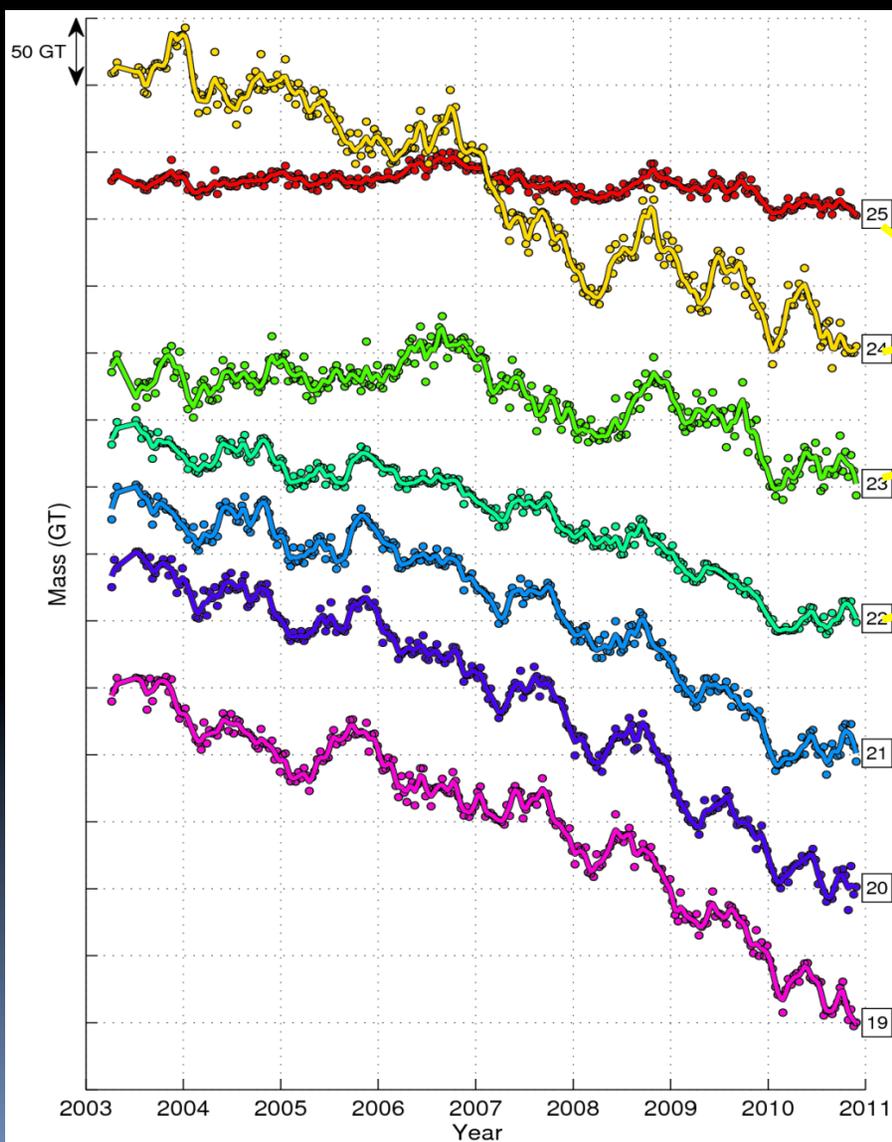


Eric Steig et al., Nature, 2009

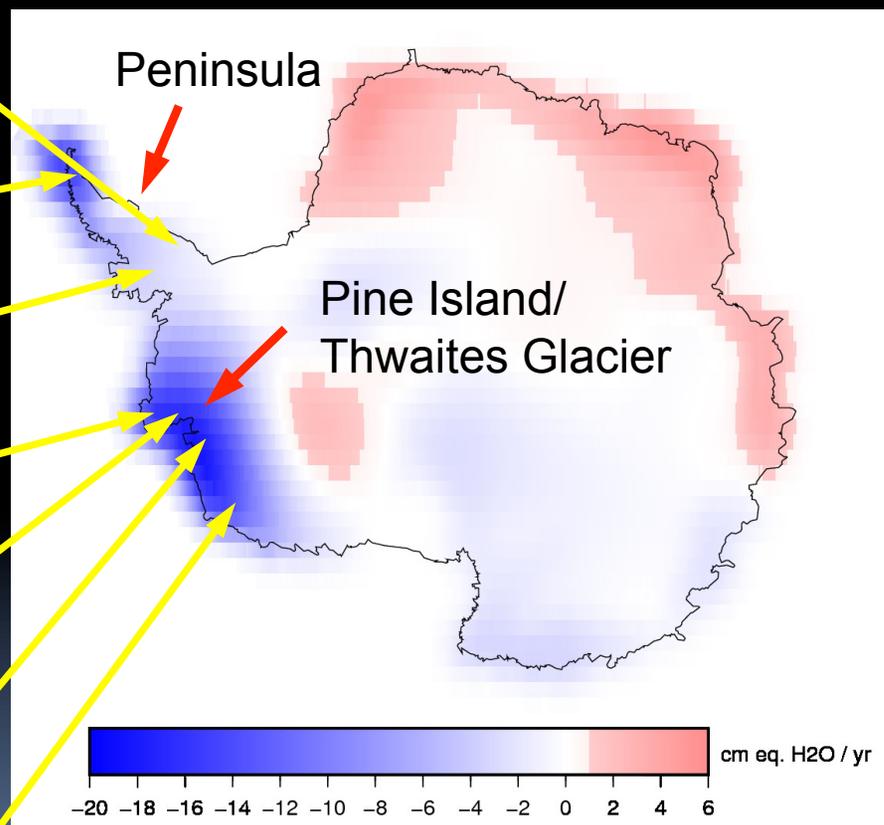




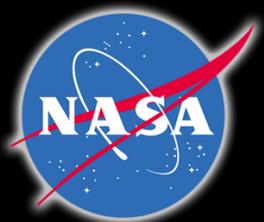
Ice loss from GRACE Satellite



Antarctic Ice Sheet Mass Evolution



Credit: Scott Luthcke, NASA/GSFC



Airborne Science Platforms



NASA DC-8 Flying Laboratory



DC-8 Science Instruments

- ATM laser altimeter (NASA/GSFC/WFF)
- MCoRDS radar sounder (CReSIS/KU)
- Snow radar (CReSIS/KU)
- Ku-band radar altimeter (CReSIS/KU)
- Digital Mapping System (NASA/Ames)
- Gravimeter (Sander Geophysics/CU)

survey altitude: 1500 ft (500 m) above ground

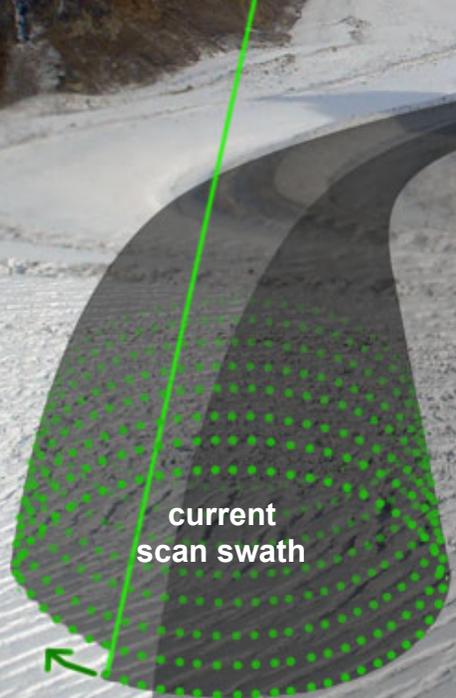
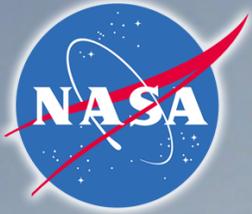
G-V Science Instruments

- LVIS laser altimeter (NASA/Goddard)

survey altitude: 40000 ft above ground

NSF/NCAR Gulfstream-V High Altitude Research Aircraft





current scan swath

previous year's scan swath

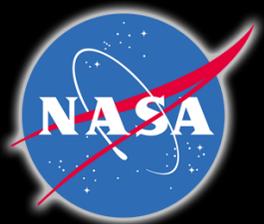




NASA DC-8 Cockpit during Weddell Sea Mission



Photo: M. Studinger



Airborne Topographic Mapper (laser altimeter)

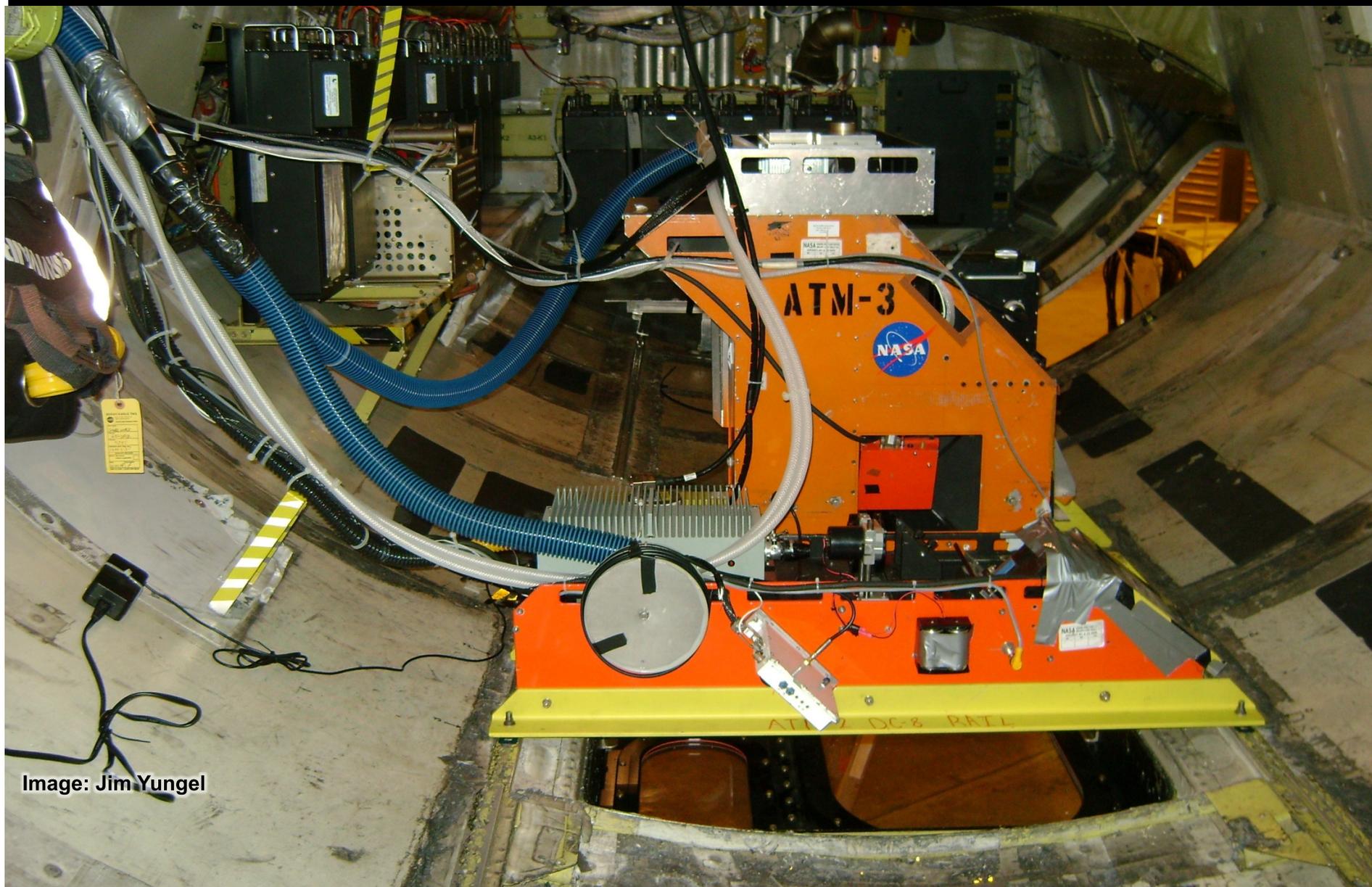


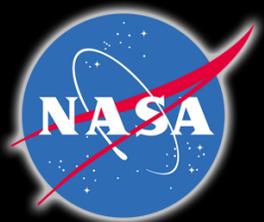
Image: Jim Yungel

**Ice Penetrating Radars contained in fairing below hull
(snow-depth radar antennas in wing roots)**





Photo: M. Studinger



Sea Ice Research

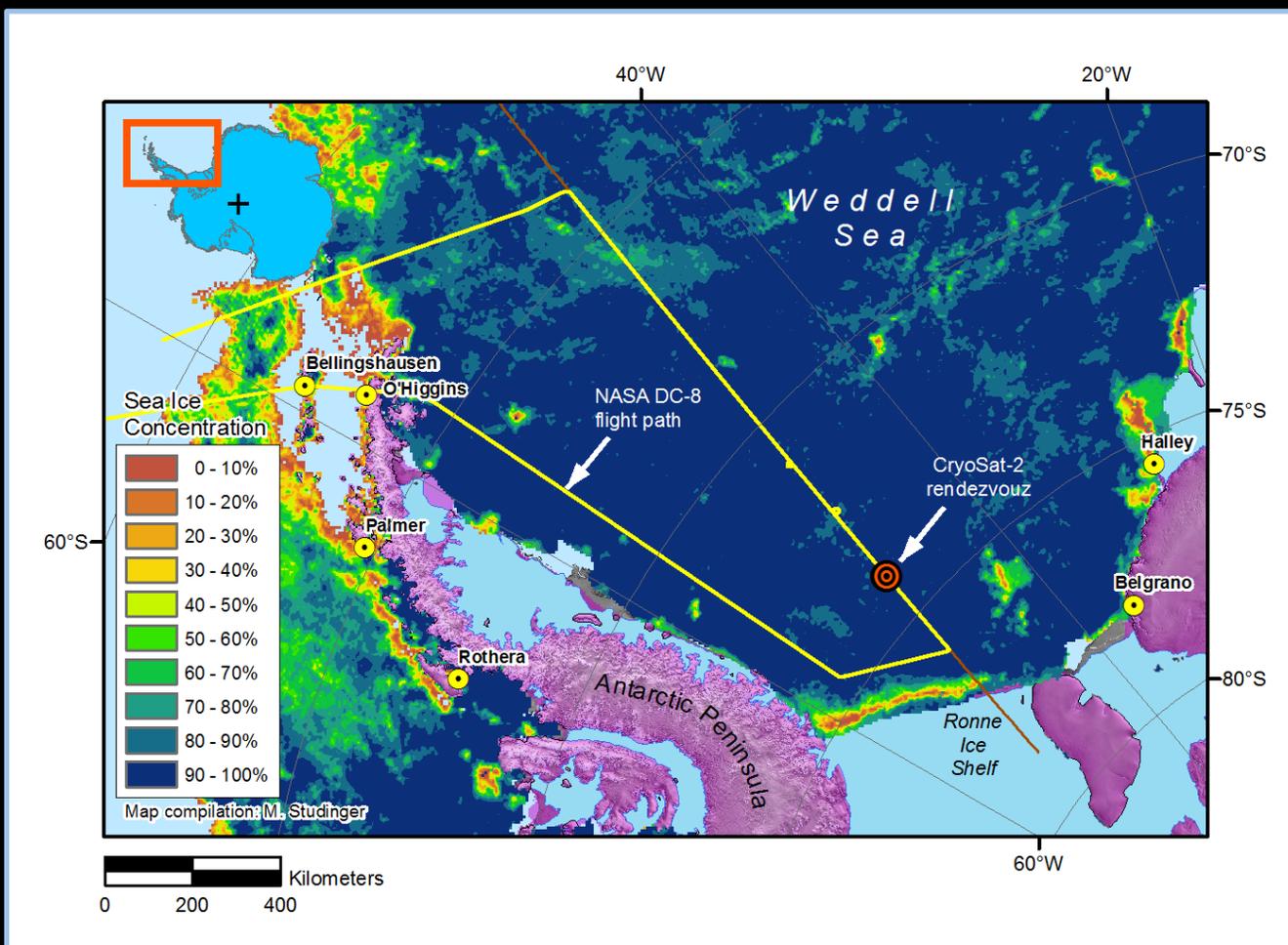


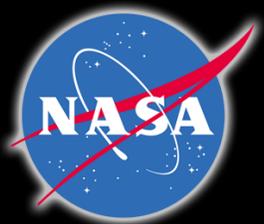
IceBridge Measurements:

sea ice thickness determined from laser altimeter and snow radar measurements

Validation of satellite Measurements:

Oct 13, 2011:
sea ice mission over Weddell Sea with ESA's CryoSat-2 underflight





Sea Ice Conditions along Weddell Sea CryoSat Profile

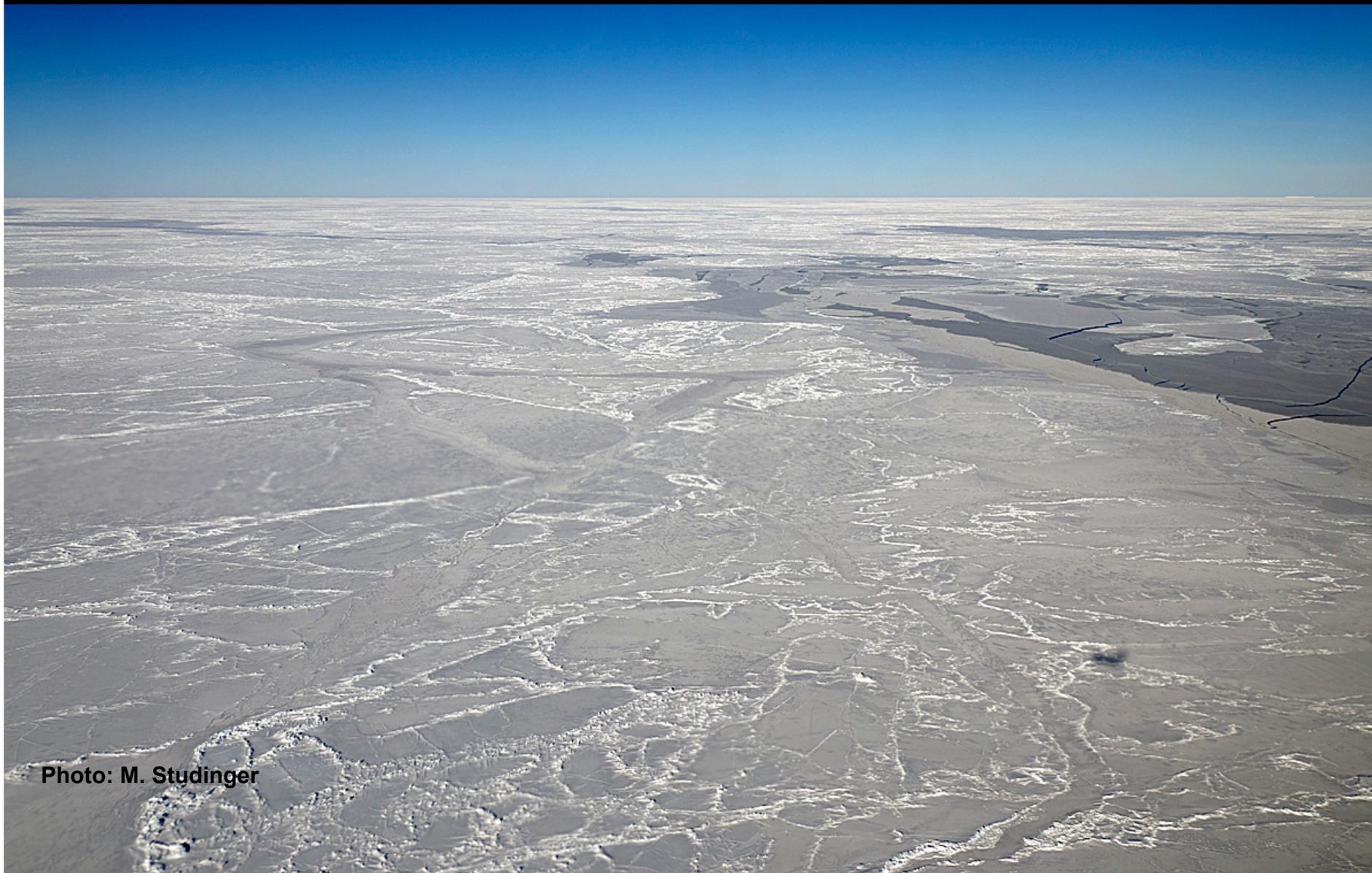
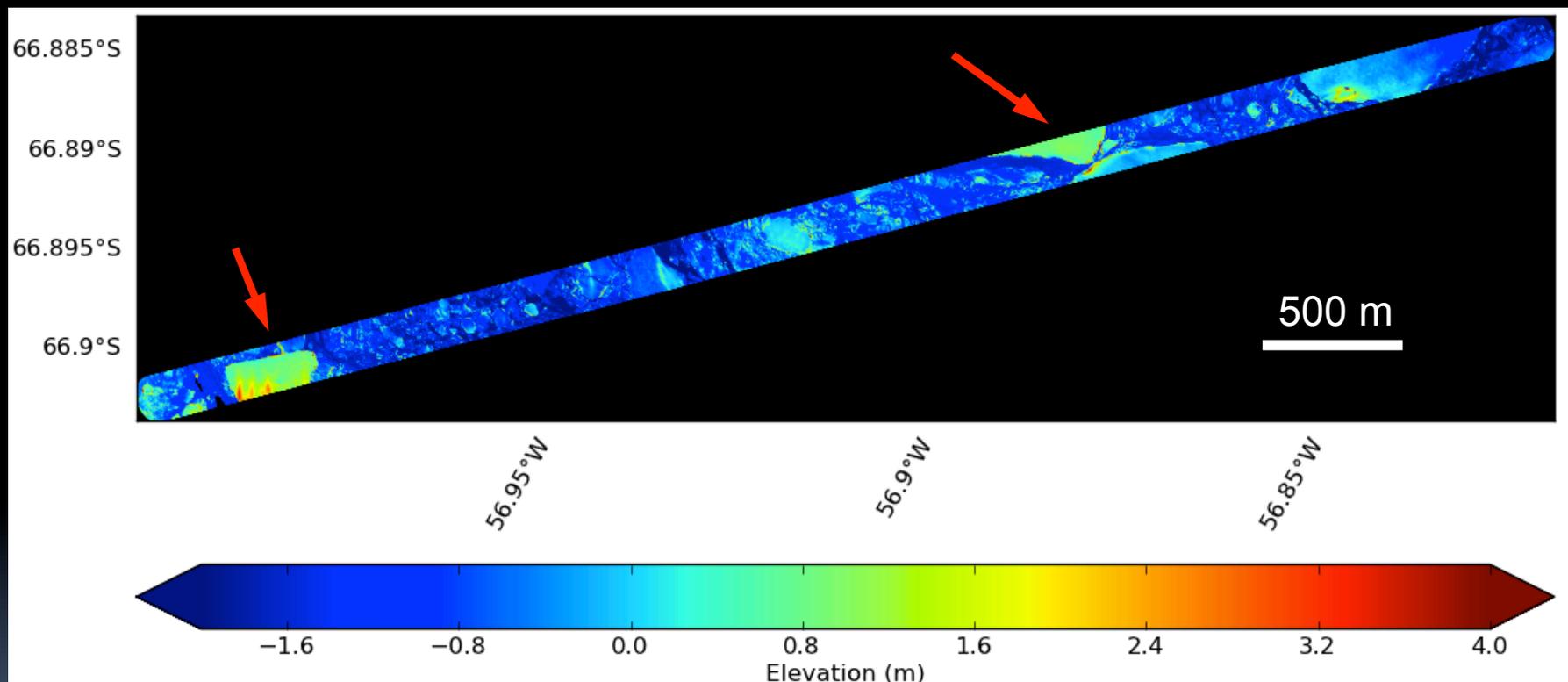


Photo: M. Studinger

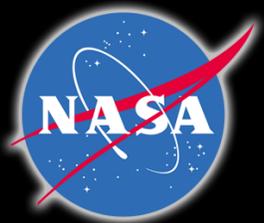


ATM Airborne Laser Altimeter Scan of Sea Ice

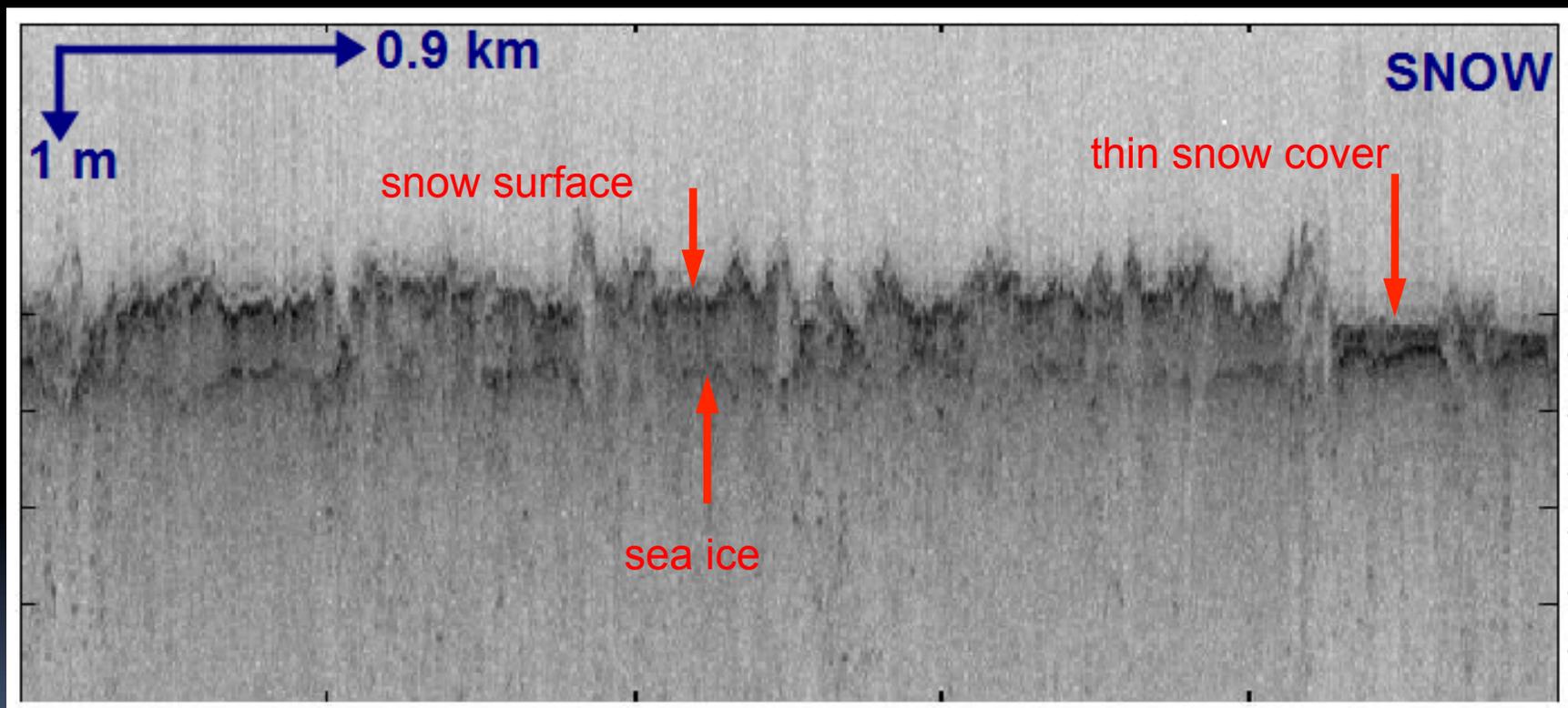


Freeboard measurement
of sea ice for
ice thickness estimation

Credit: ATM team
October 18, 2010 – Weddell Sea

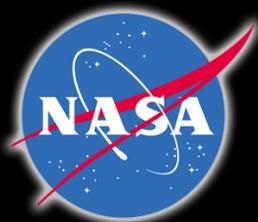


Measuring Snow Thickness over Sea Ice with Radar



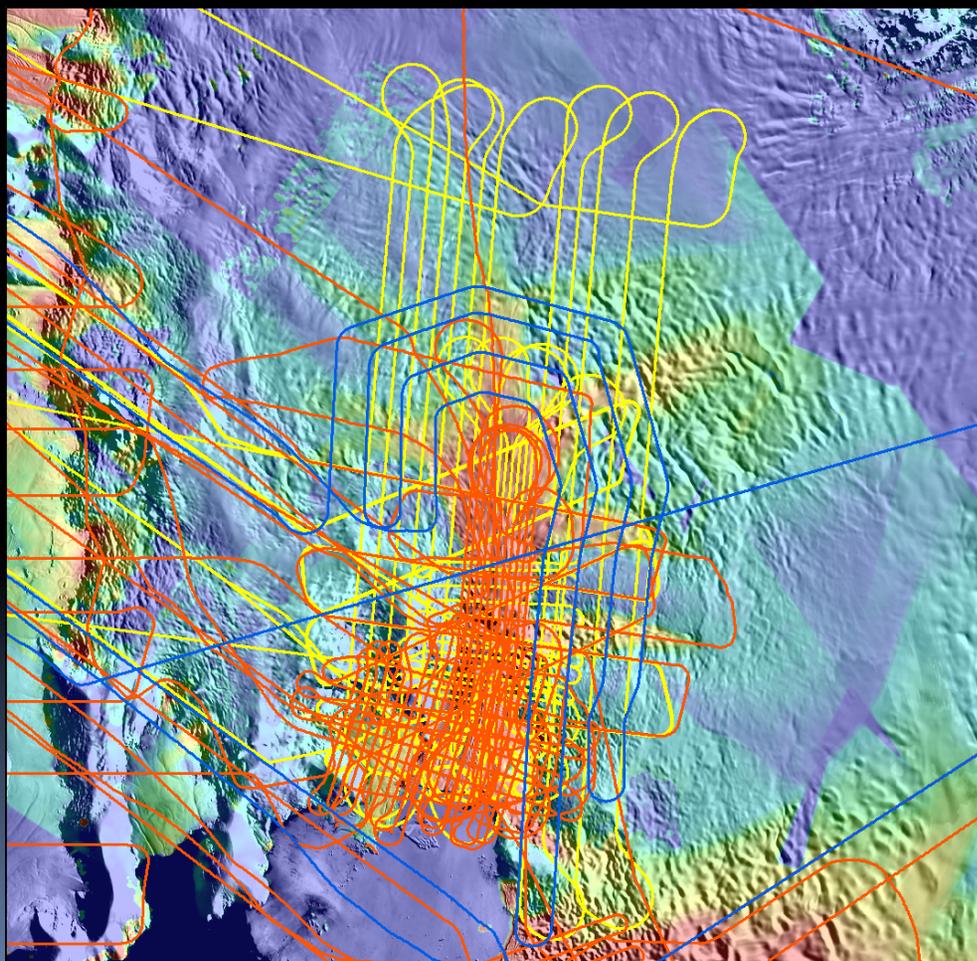
Credit: Ben Panzer/CReSIS U Kansas

October 13, 2011 – Weddell Sea



Ice Sheets and Glaciers

Pine Island Glacier



0 15 30 60 90 120 150 Kilometers

Map compilation: M. Studinger

Pine Island Glacier:

- one of the largest and fastest-moving glaciers in Antarctica
- rapid thinning
- drains about 10 percent of the West Antarctica ice sheet
- bedrock below sea level

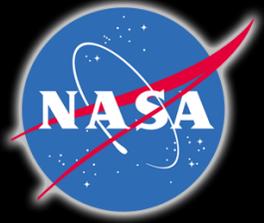
Monitoring of Pine Island Glacier:

IceBridge Flights

2009: DC-8

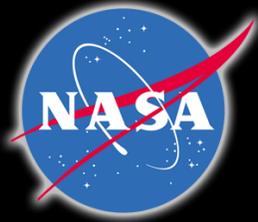
2010: DC-8

2011: DC-8 and G-V



Monitoring Ice Loss of Pine Island Glacier





IceBridge discovers new rift Pine Island Glacier

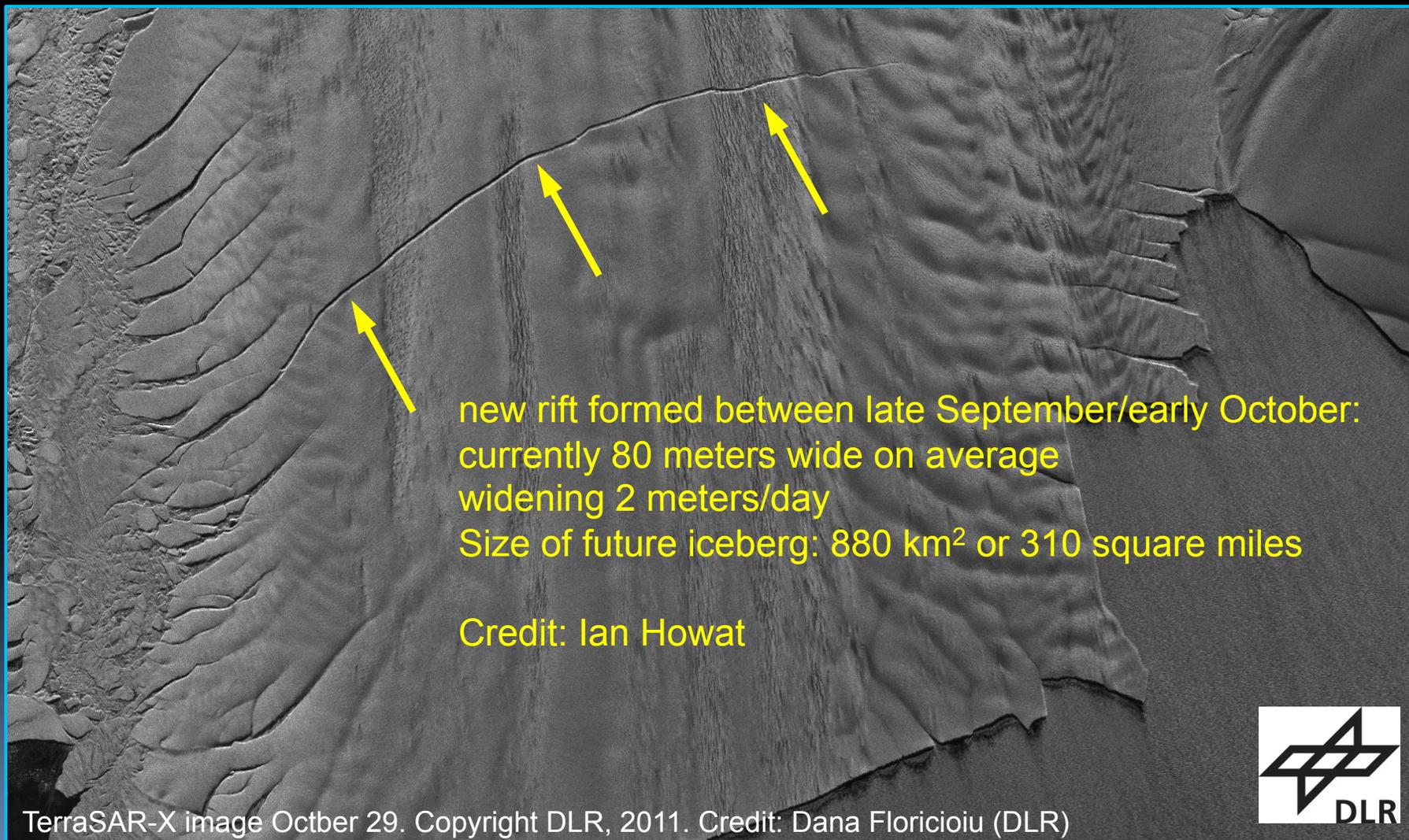


IceBridge observed new crack on the DC-8's Oct. 14 flight.

- last big calving event occurred in 2001
- part of natural cycle
- cyclical events that are occurring every few years, very similar in size
- cyclical events are not part of ice-shelf disintegration caused by climate change.



IceBridge discovers new rift in Pine Island Glacier



new rift formed between late September/early October:
currently 80 meters wide on average
widening 2 meters/day
Size of future iceberg: 880 km² or 310 square miles

Credit: Ian Howat



TerraSAR-X image October 29. Copyright DLR, 2011. Credit: Dana Floricioiu (DLR)



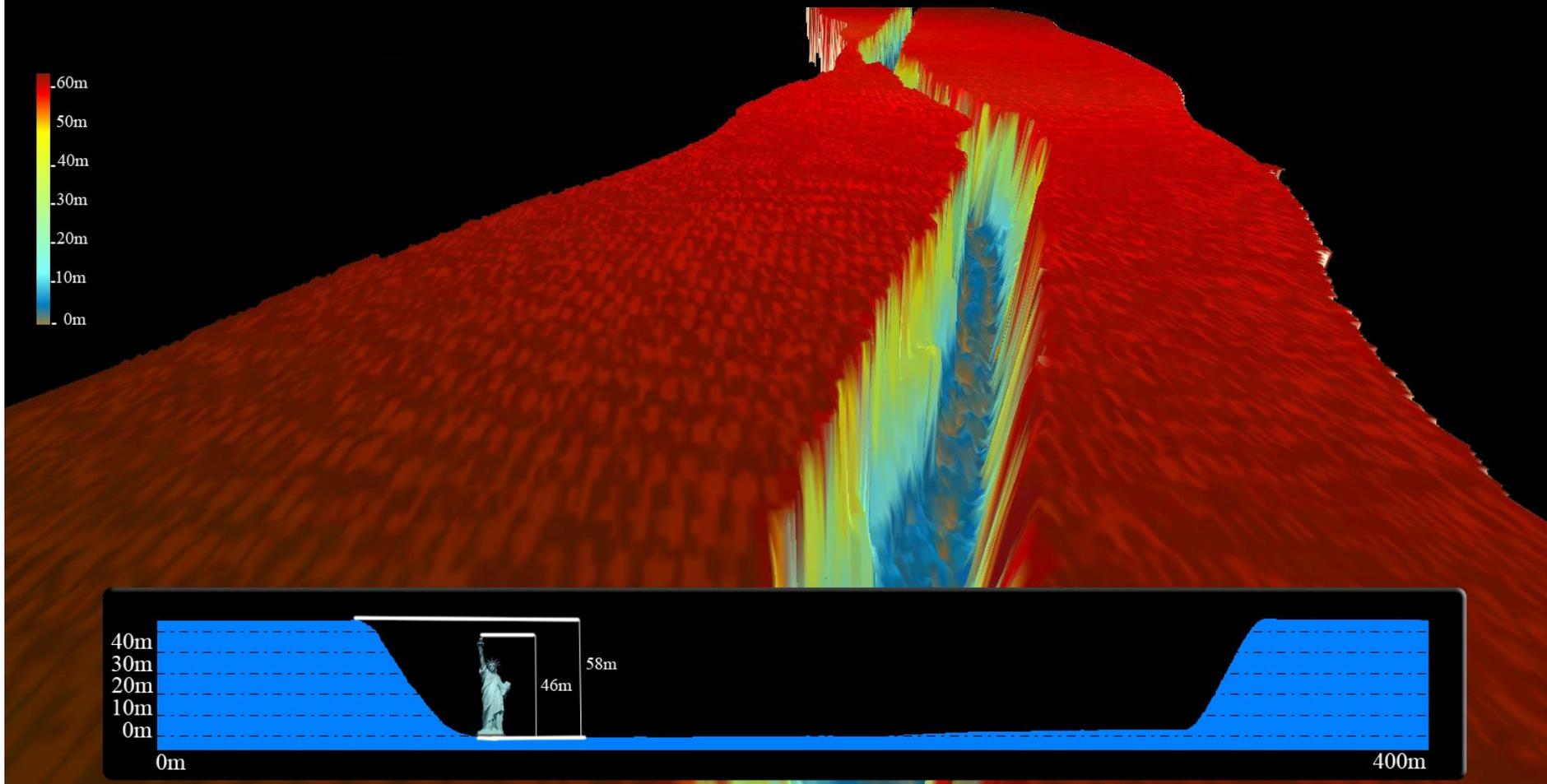
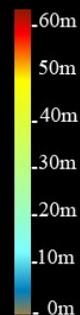
IceBridge discovers new rift in Pine Island Glacier



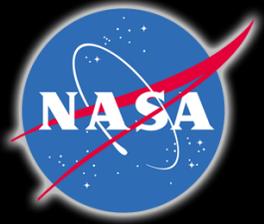
IceBridge Digital Mapping System image from flight over the rift on October 26th, 2011. Credit: DMS team



IceBridge laser scan of Pine Island rift



IceBridge ATM laser scan of the rift from October 26th, 2011. Credit: ATM Team



Operation IceBridge



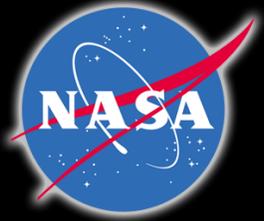
Operation IceBridge:

<http://www.nasa.gov/icebridge>

All IceBridge data is freely available at
National Snow and Ice Data Center (NSIDC)

<http://nsidc.org/data/icebridge/>

Backup Slides



Antarctic Survey Areas



map source: LIMA

