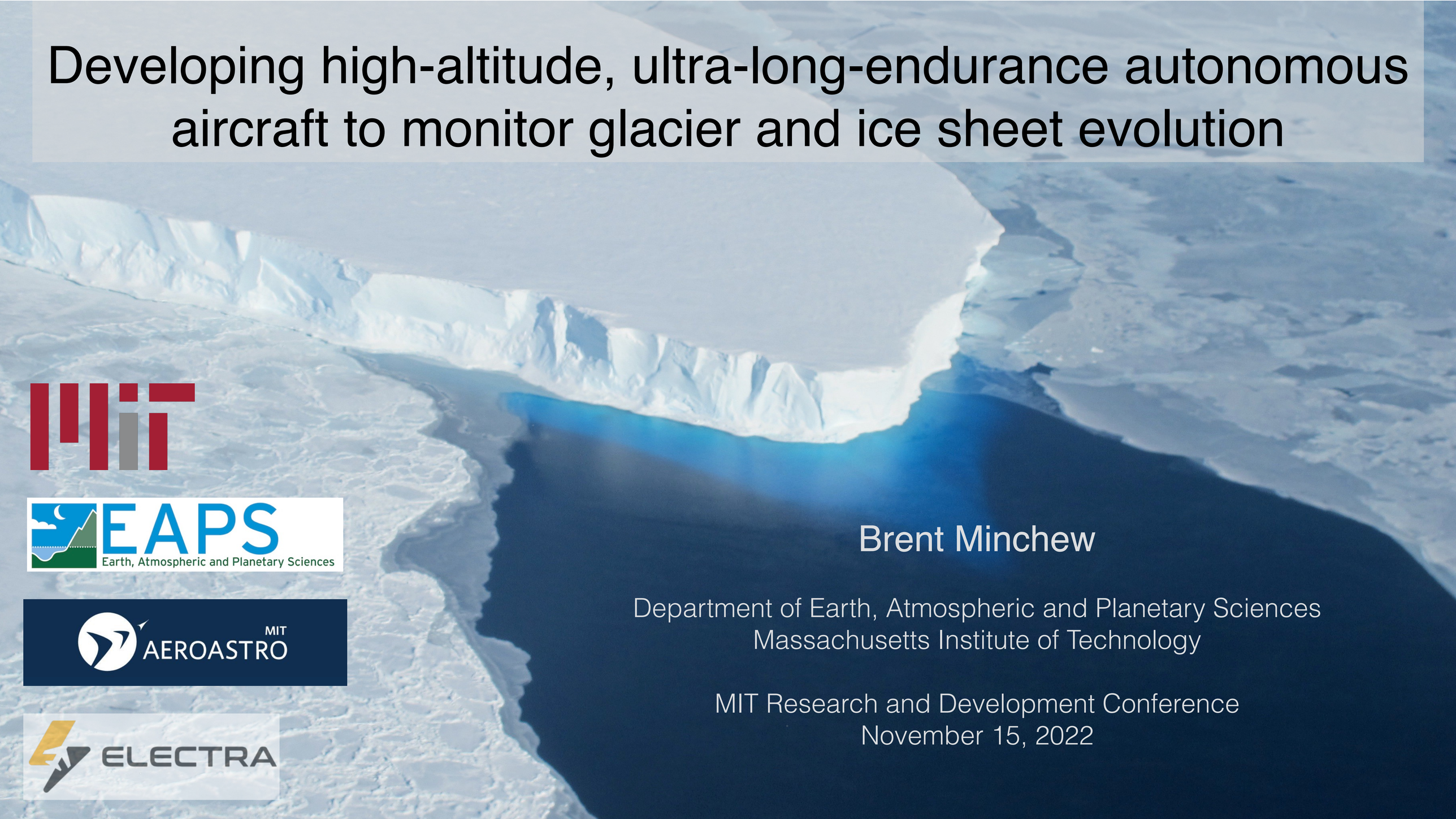
Developing high-altitude, ultra-long-endurance autonomous aircraft to monitor glacier and ice sheet evolution



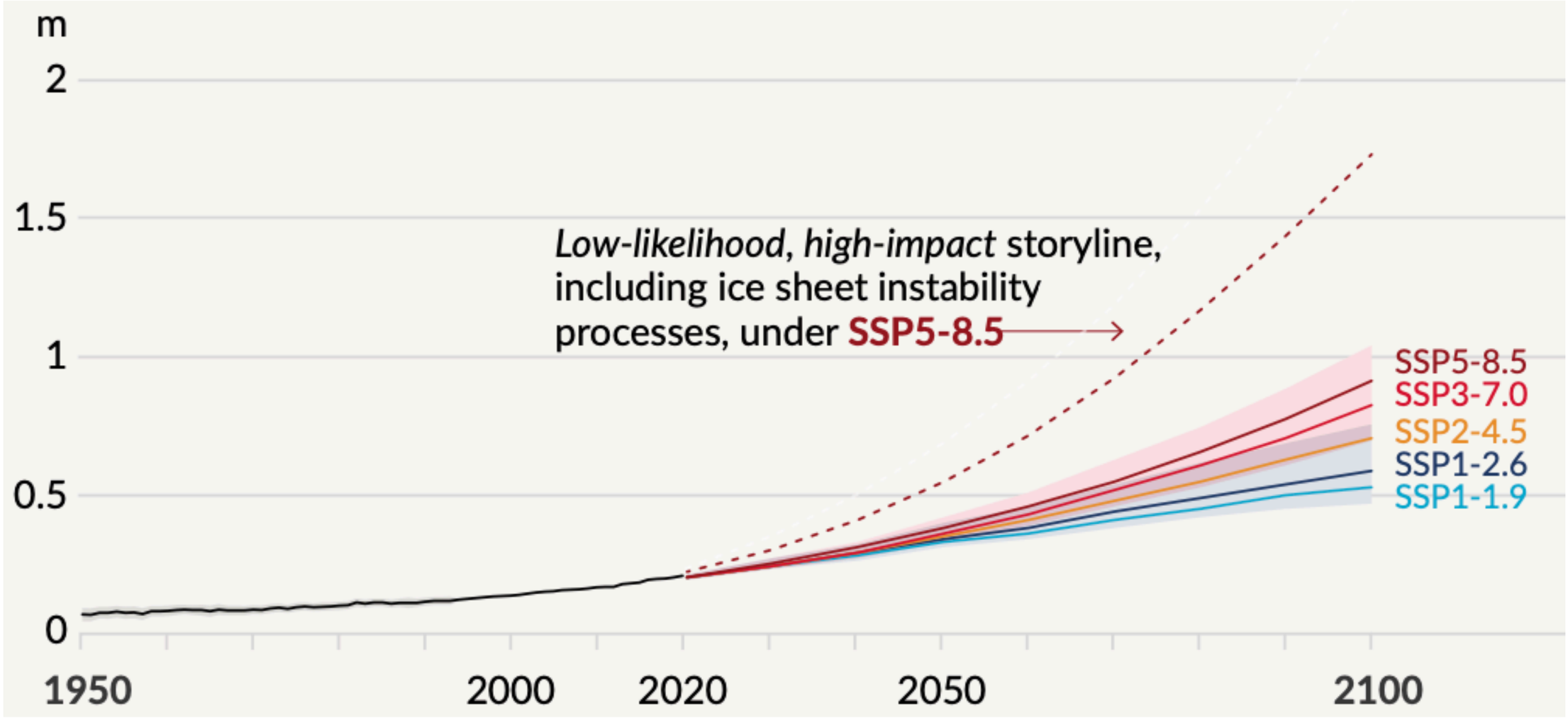
Brent Minchew

Department of Earth, Atmospheric and Planetary Sciences
Massachusetts Institute of Technology

MIT Research and Development Conference
November 15, 2022

Sea-level scenarios for the coming decades

Global mean sea level relative to 1900



IPCC 6th assessment

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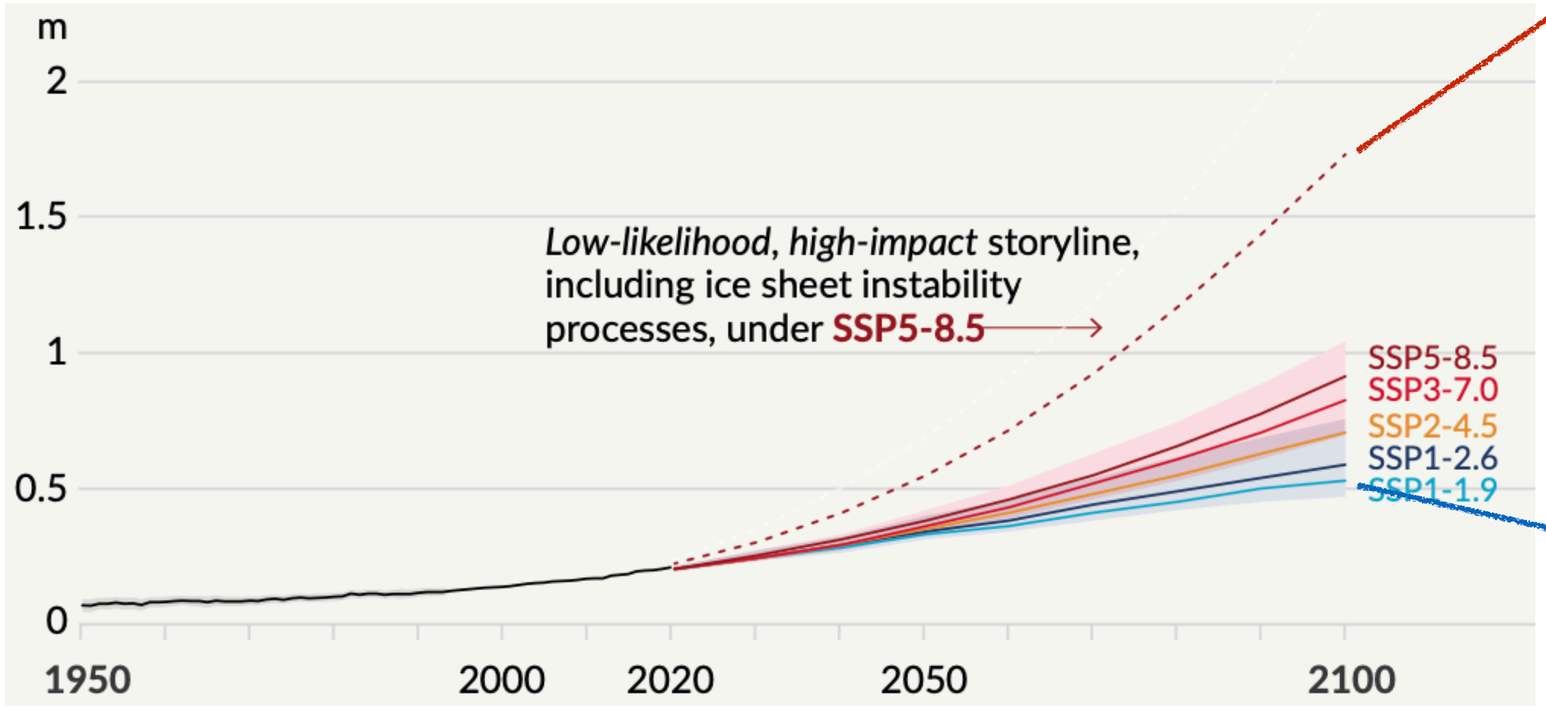

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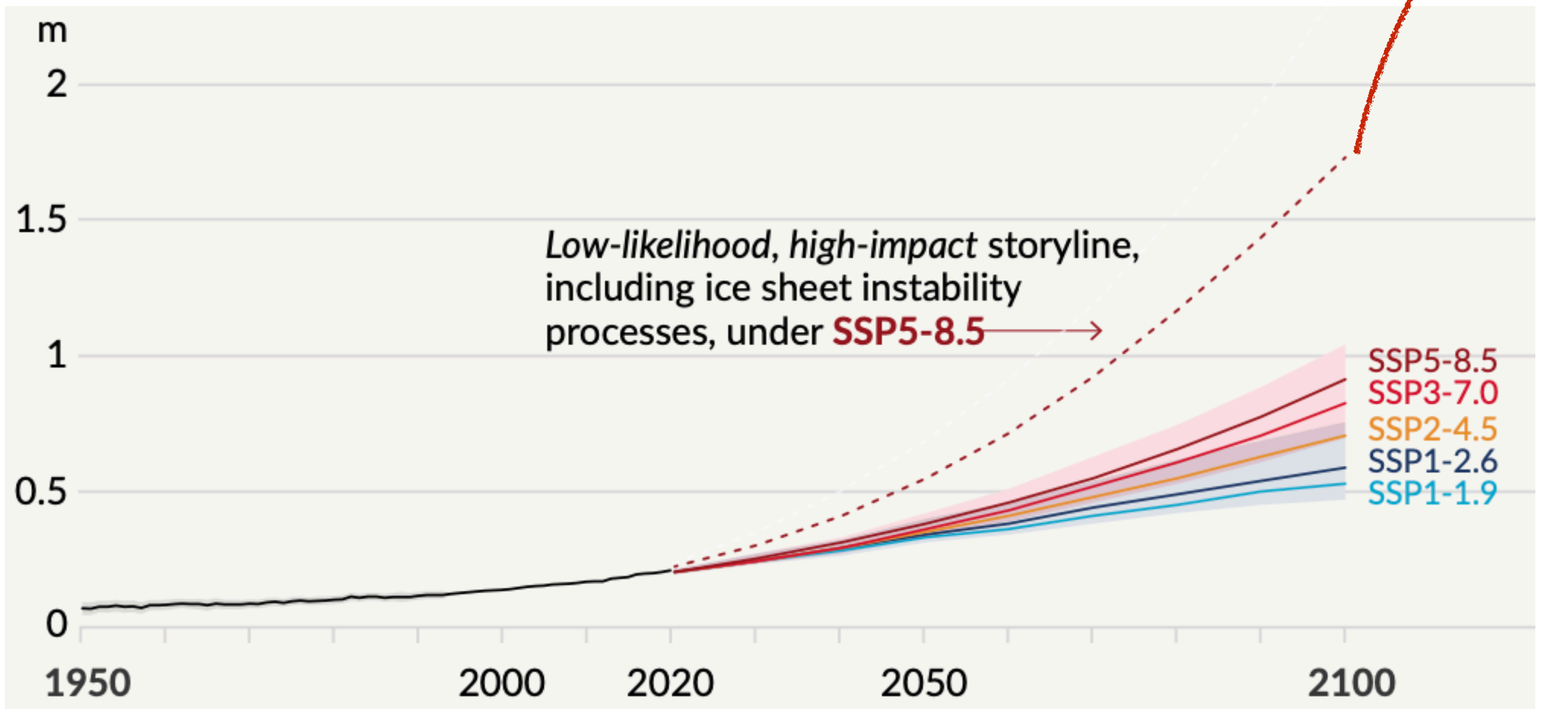

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Global consequences:

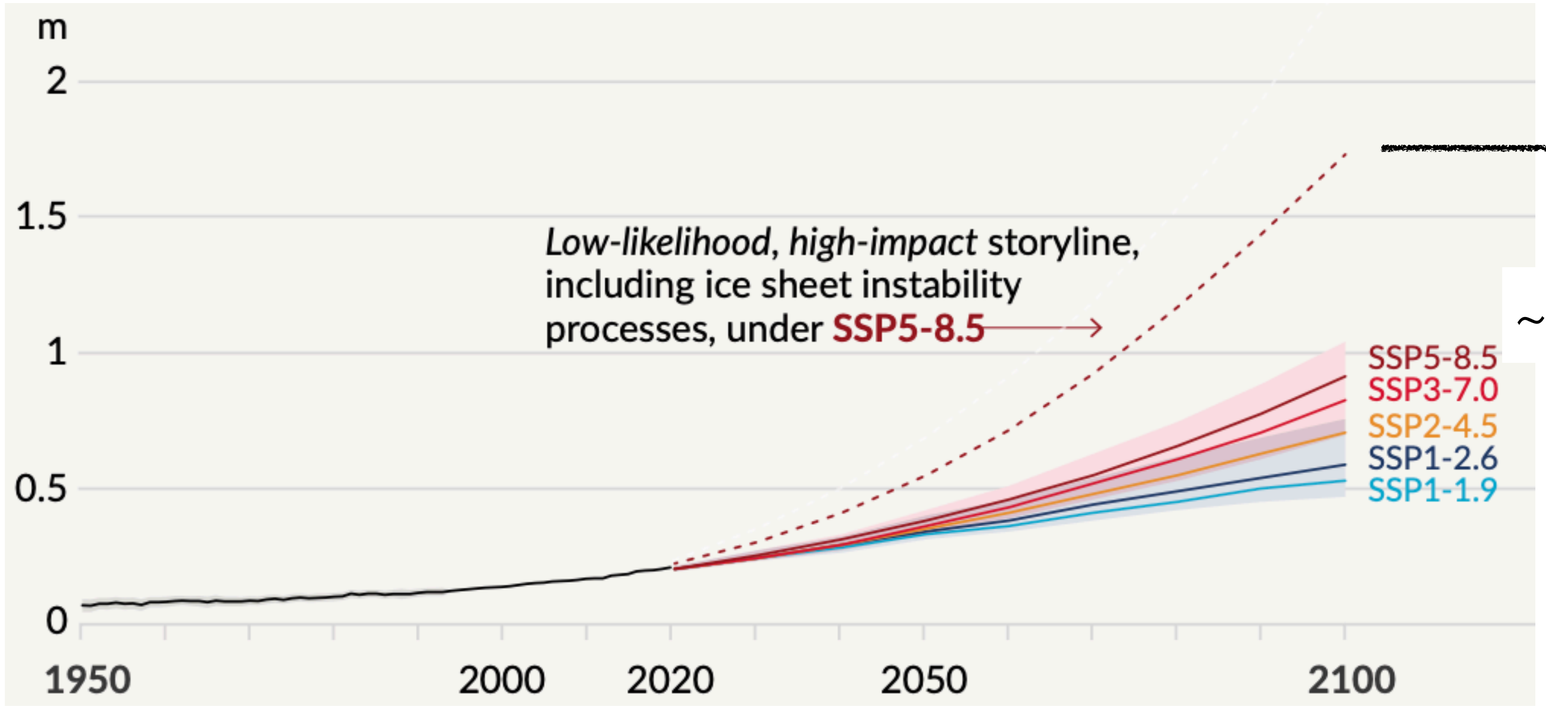
* Trillions $$ in infrastructure

* Hundreds of millions of people displaced

* Tens of millions of homes inundated…

Sea-level scenarios for the coming decades

Global mean sea level relative to 1900



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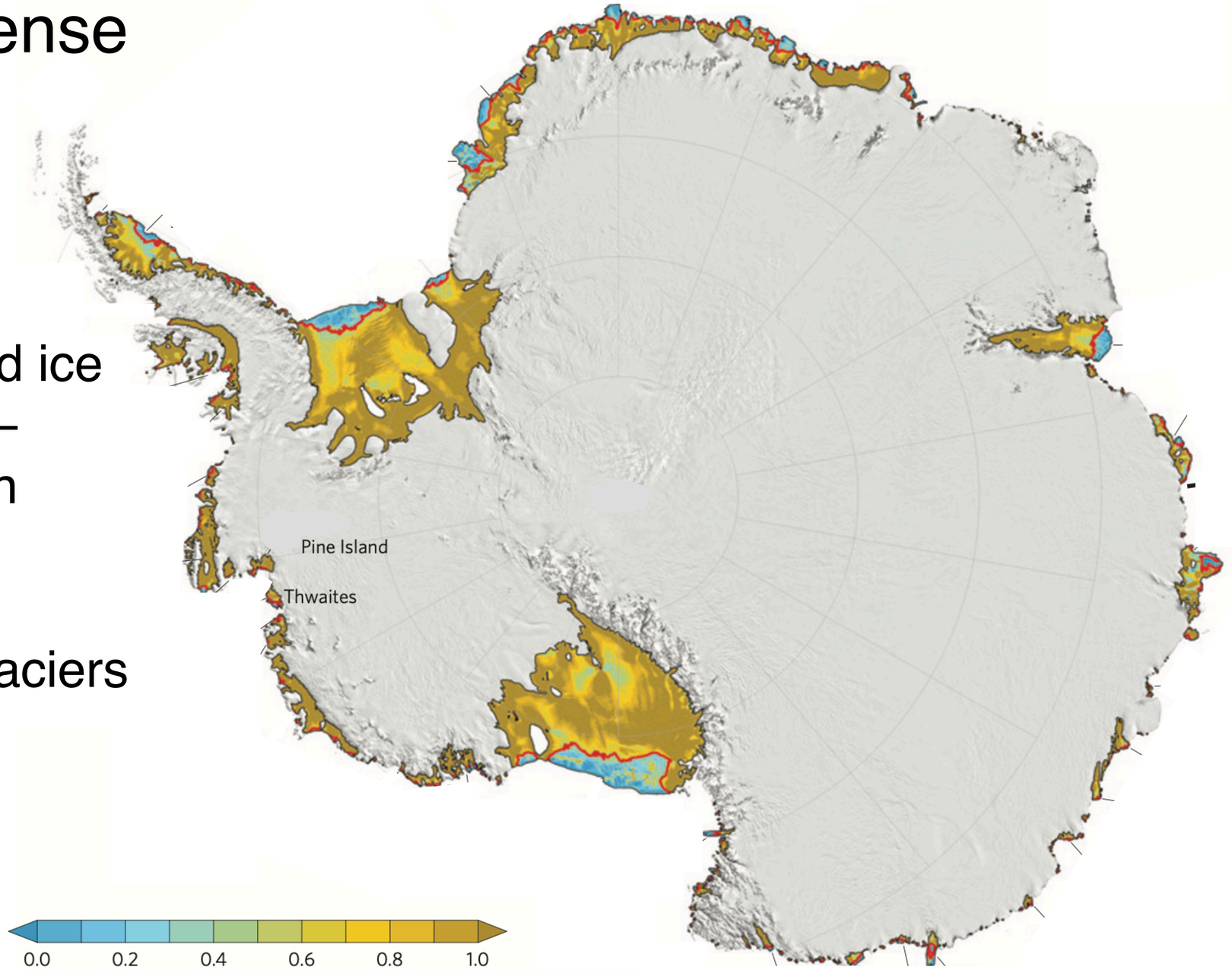
West Antarctica — Ice sheet perched on the seafloor

NASA/JPL

The last line of defense

Floating sections — called ice shelves (colored areas) — provide primary control on rates of sea-level rise

By resisting the flow of glaciers



Furst et al., 2018

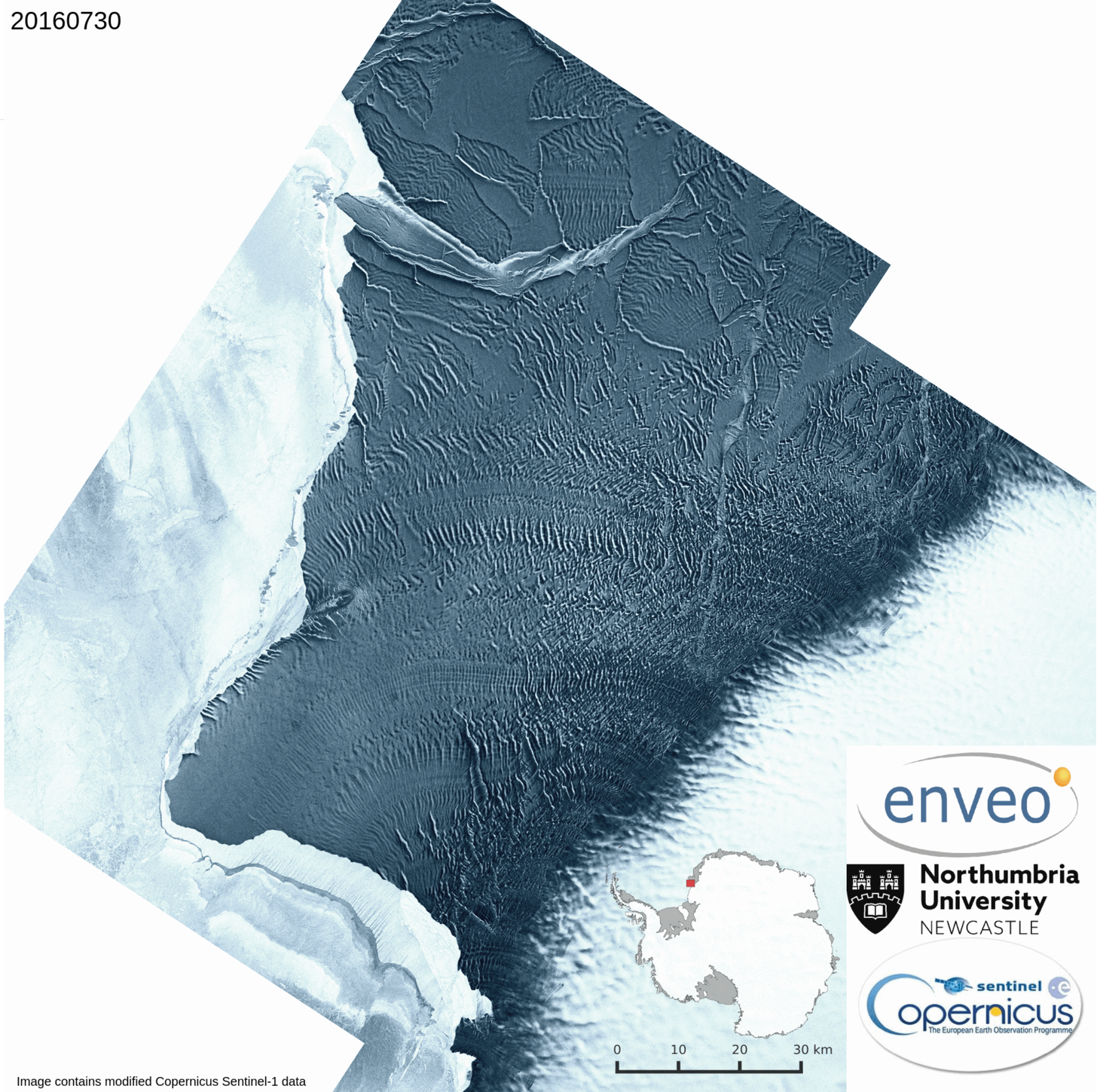
Ice shelves breaking up

* Variety of mechanisms cause ice shelves to fracture and collapse

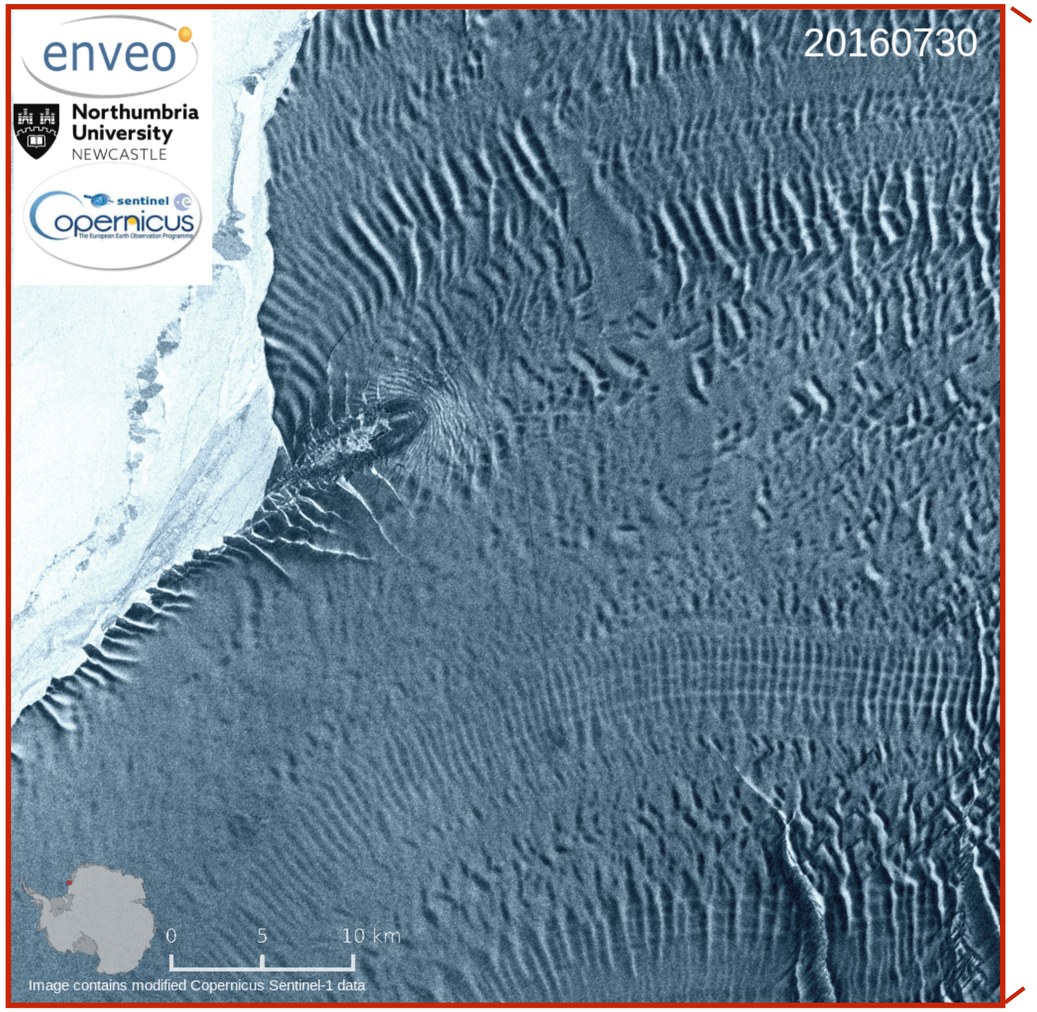
* These mechanisms govern rates of sea-level rise

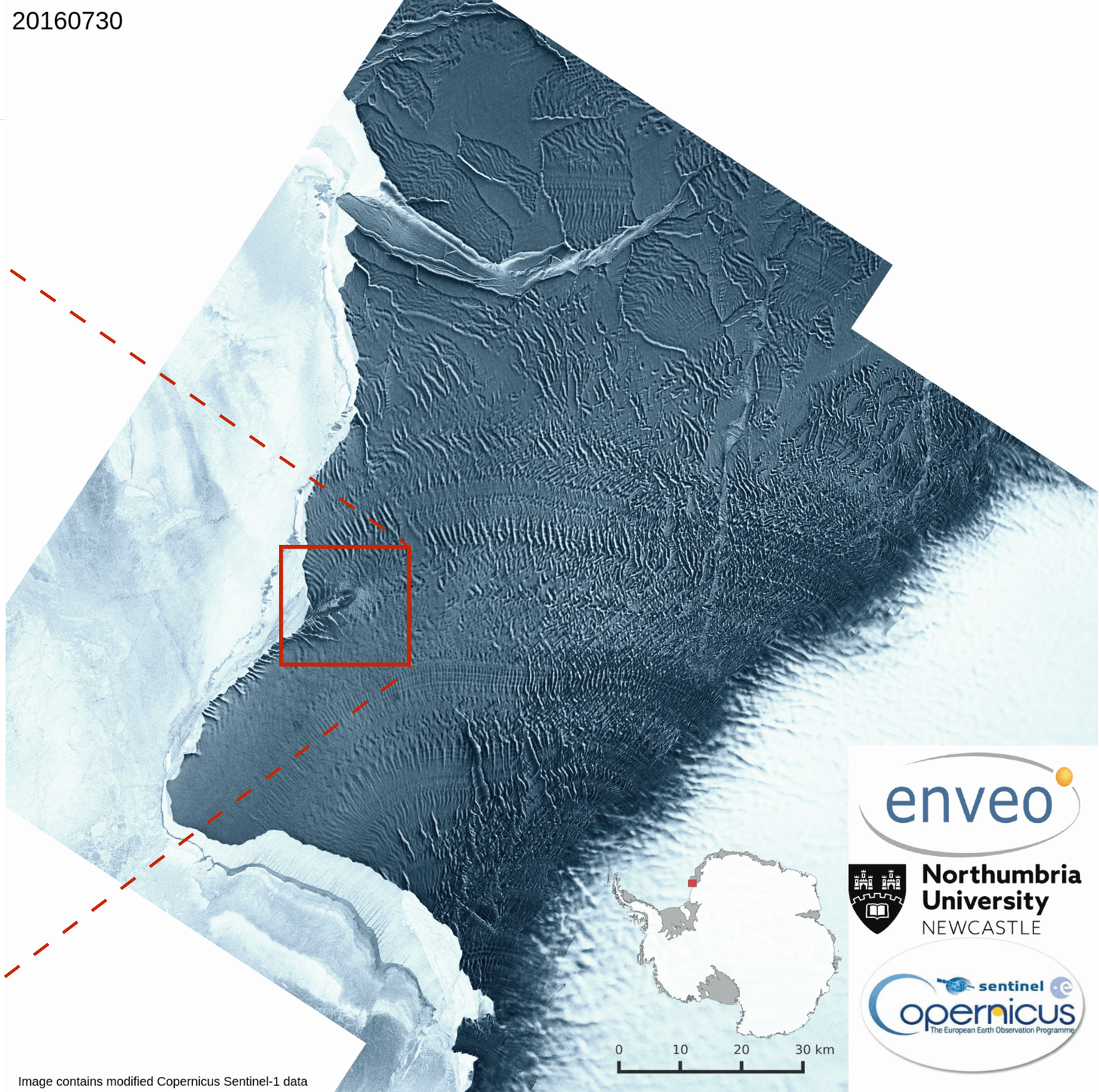
* But are poorly understood

* And not accounted for in projections of sea-level rise



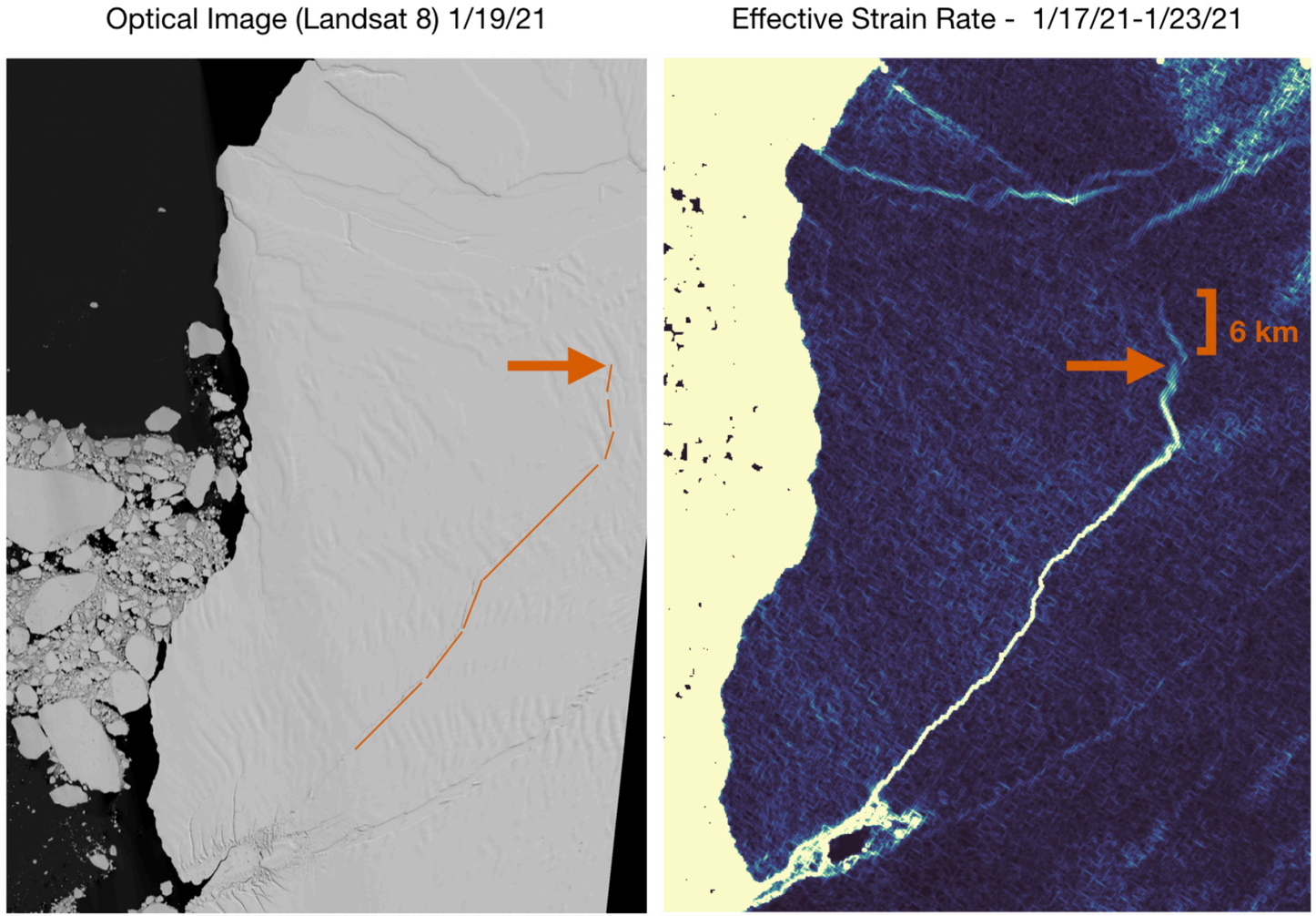
Formation of icebergs



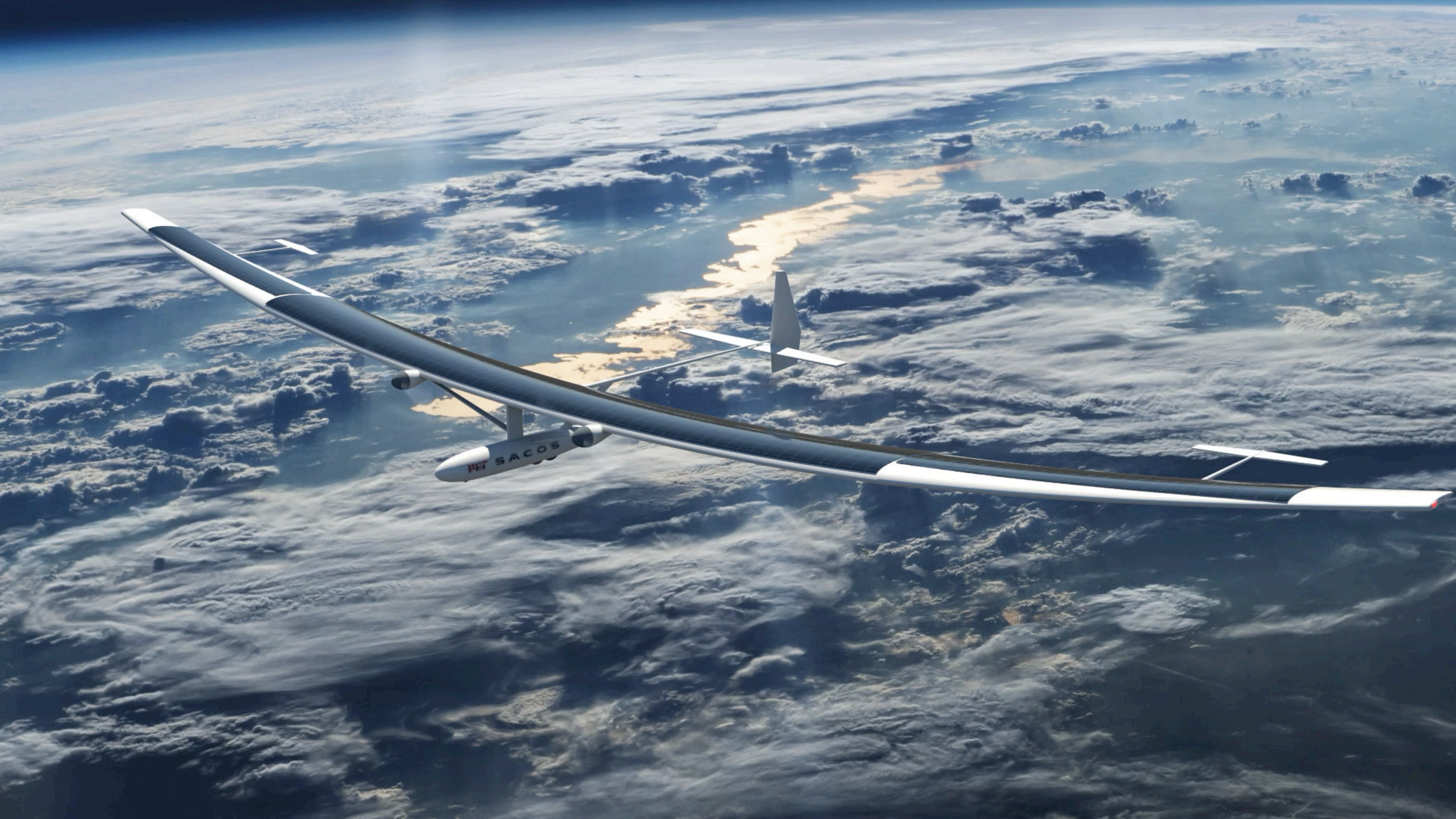


We do not know how to account for iceberg calving in projections of sea-level rise

- Limitation of our understanding of the relevant physics
- Limited by observations
- Better resolution in space and time will help make rapid progress

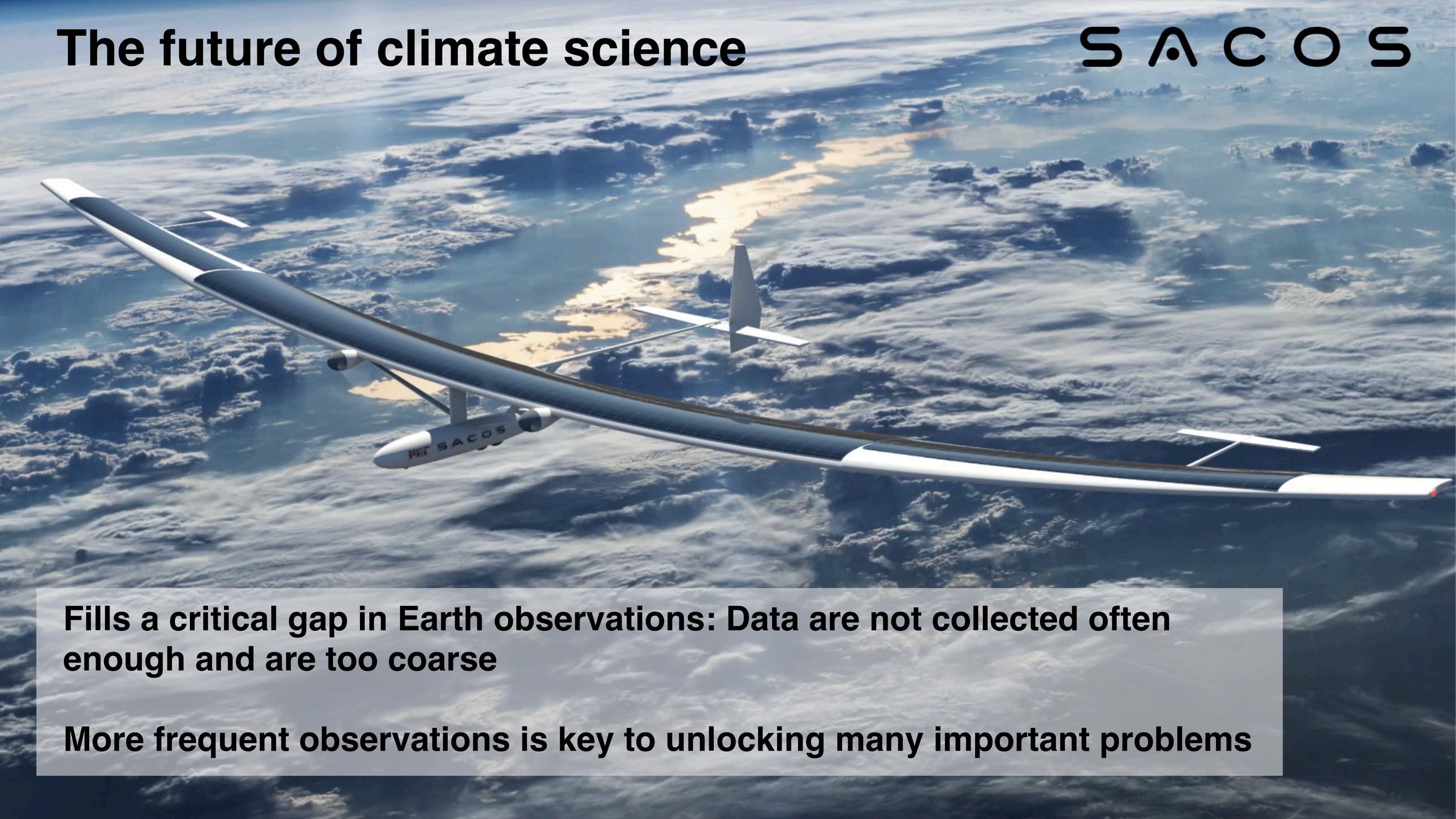


Millstein and Minchew


SACOS

The future of climate science

SACOS

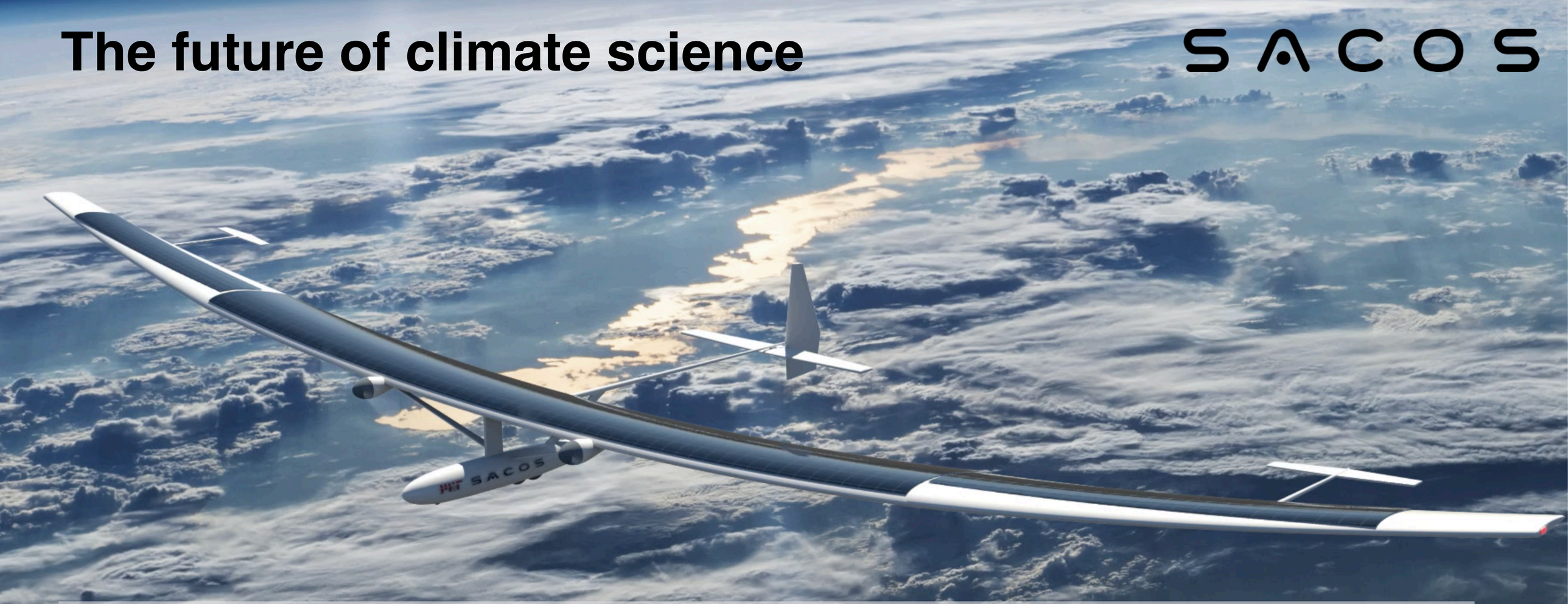


Fills a critical gap in Earth observations: Data are not collected often enough and are too coarse

More frequent observations is key to unlocking many important problems

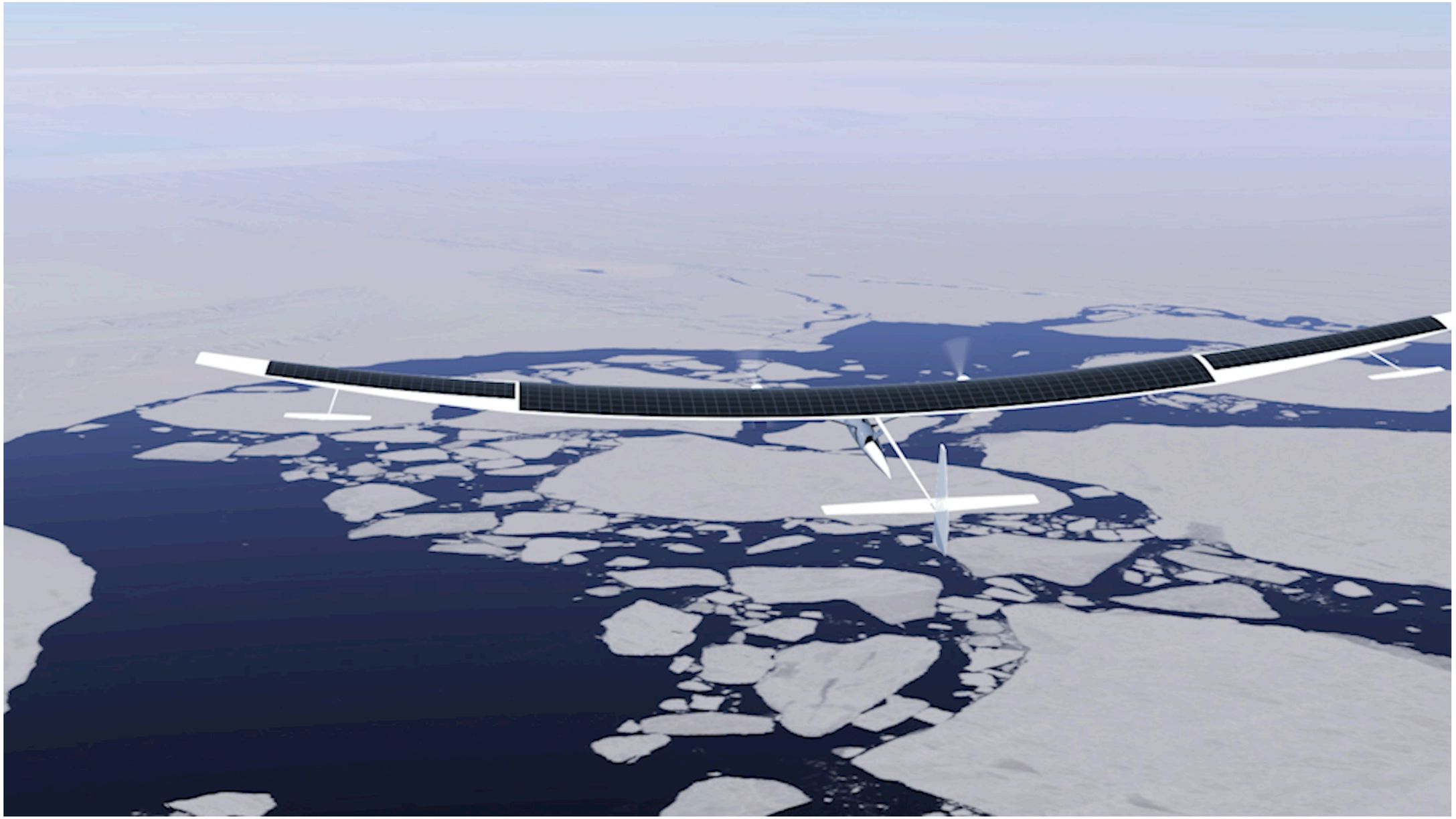
The future of climate science

SACOS



* Flies for months at a time ⟶ unprecedented, radical improvement over current technology
* Collects data scientists need (where, when, how, and how often)
* Flexible flight plans

A major milestone



Few facts about the plane

SACOS
Stratospheric Airborne Climate Observatory System

Cost per aircraft: ~$1M + sensor

Wingspan: 27.3 m
Total length: 8 m
Total weight: 131 kg (289 lbs)

This is the aircraft that will carry a SAR into the stratosphere over Antarctica and Greenland

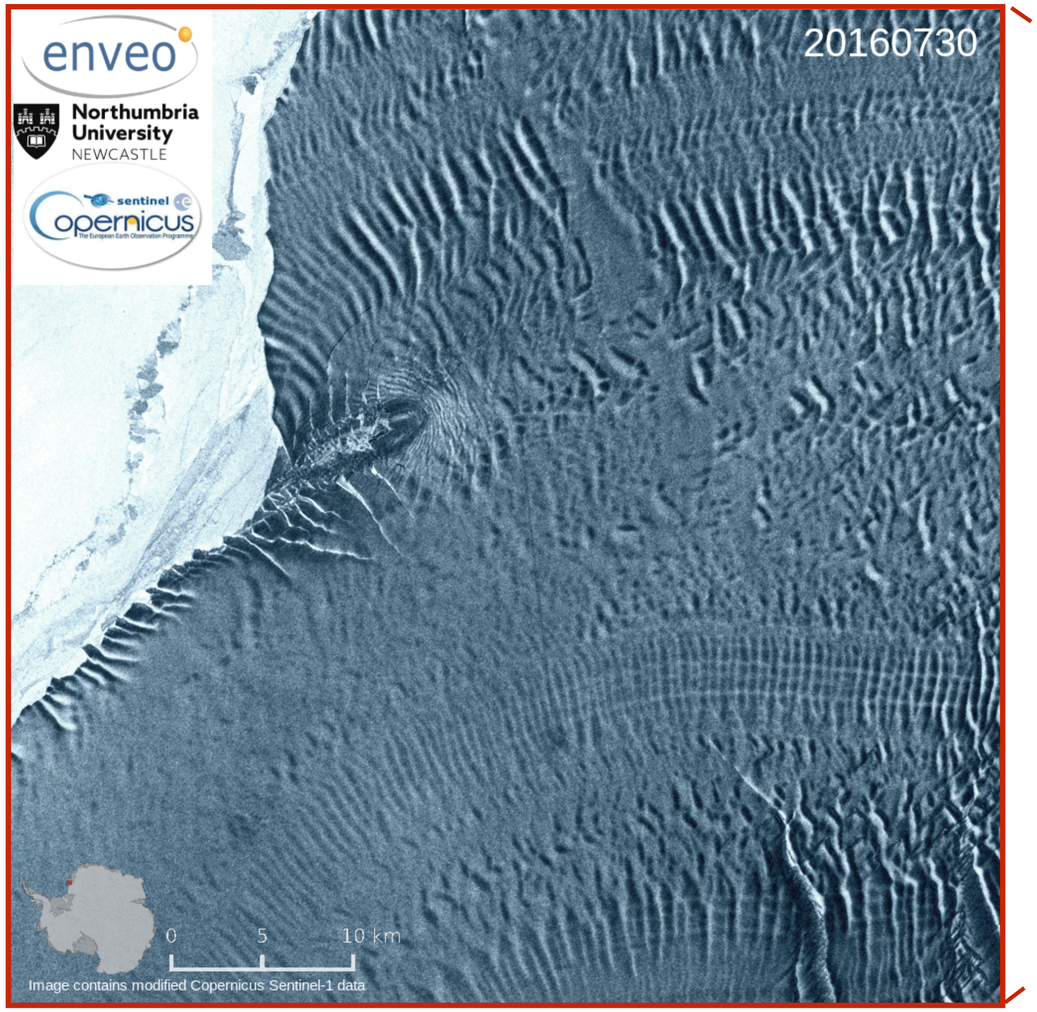
MIT
ELECTRA

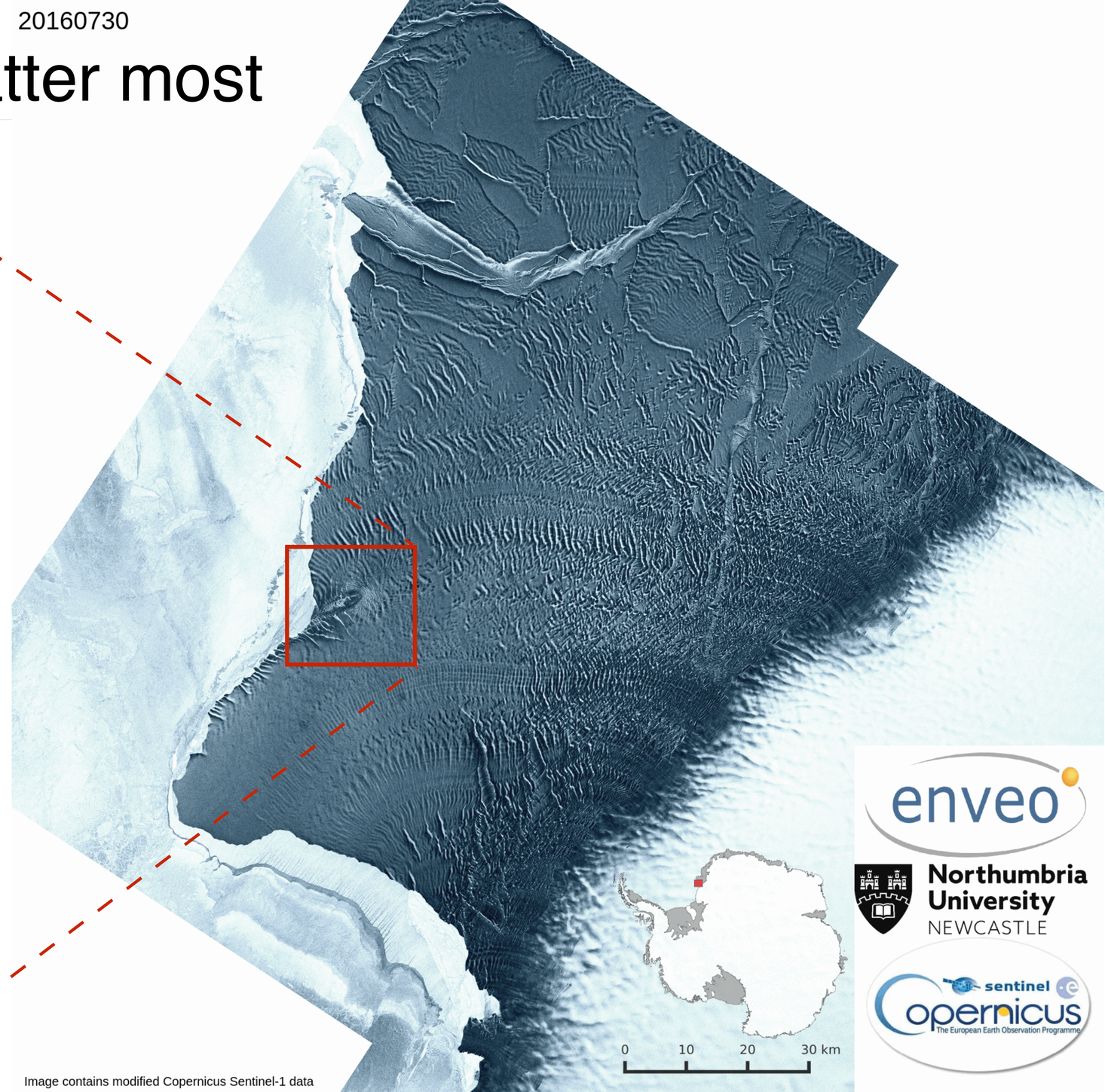
When do we start collecting data?

Timeframe can be accelerated with the right level of funding

20160730

Observe on scales that matter most

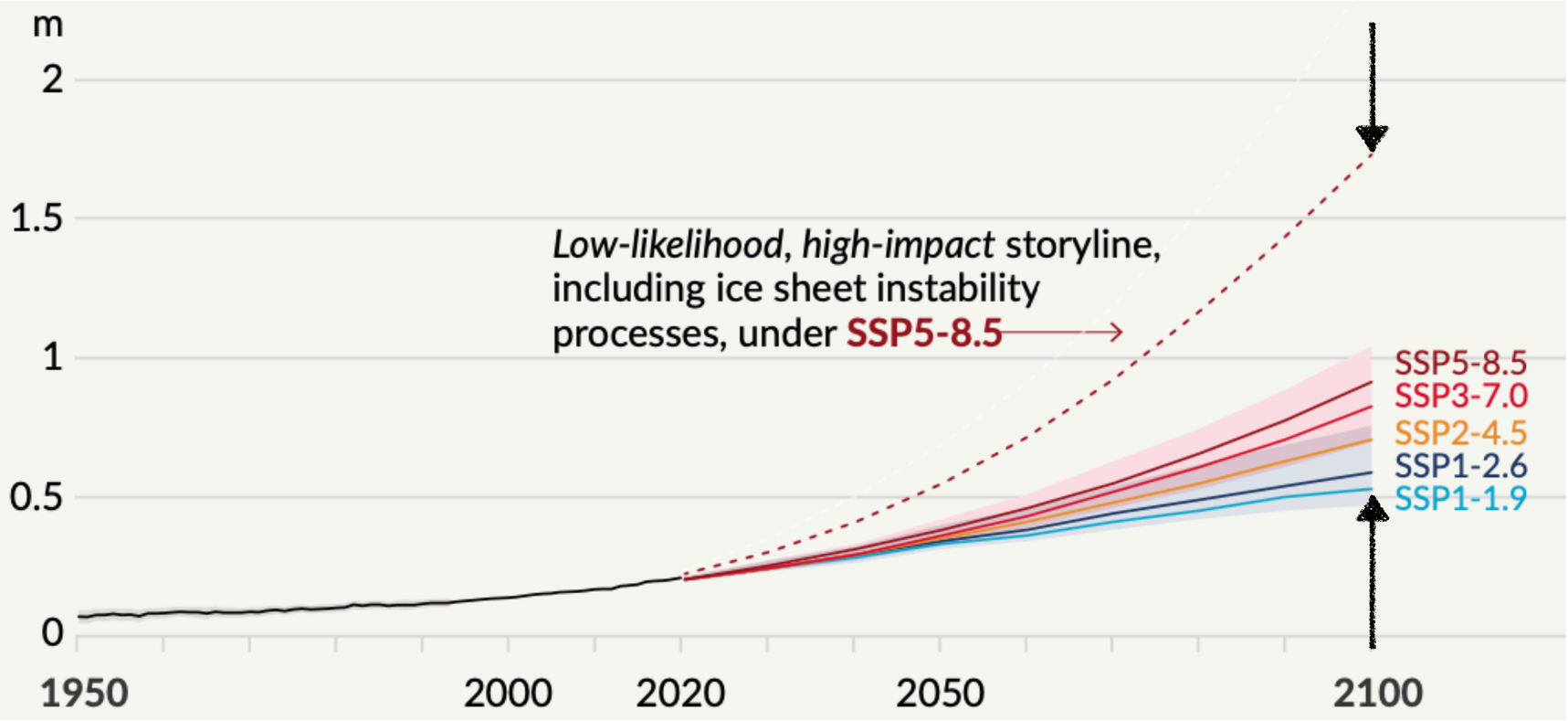




enveo
Northumbria University
NEWCASTLE
sentinel
Copernicus
The European Earth Observation Programme

To prepare for the future

Global mean sea level relative to 1900



Shrink and quantify uncertainties in projections of sea-level rise for the next generations

IPCC 6th assessment