OFFICE OF
POLAR PROGRAMS

Astrophysics in the Polar Regions

Jean Cottam, Acting Director of the NSF Office of Polar Programs

Astronomy and Astrophysics Advisory Committee – September 20, 2024

U.S. National Science Foundation
WHERE DISCOVERIES BEGIN

Arctic and Antarctic Platforms

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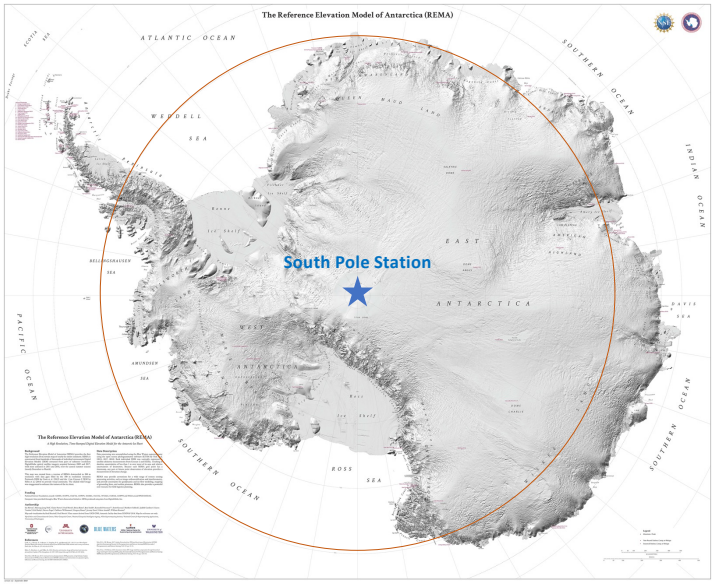

NSF South Pole Station

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Science Station in an Extreme Environment

- 9300 feet elevation
- Temperatures range from minus 70ºC to minus 20ºC
- ~0.5 inches annual snowfall
- Katabatic Winds
- Snow build-up ~1 ft/year
- Half the year Dark Night
- Accessible only from November through mid-February
- 150 people in austral summer, 40-45 people in austral winter

Credit: NSF

Multi-Disciplinary Scientific Platform

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Physics & Astronomy

- IceCube Neutrino Observatory
- South Pole Telescope
- BICEP Array

Atmospheric & Geospace Science

- Atmospheric Research Observatory
- SuperDARN

Seismology

- SPRESSO
- CAREER Seismology Investigation

Glaciology

- COLDEX
- ICESat-2 88 South


Credit: Benjamin Eberhardt


Credit: Alexander Pollak


Credit: Yuya Makino


Credit: D. Michalik


Credit: Weisen Shen

Logistics Overview

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Port Hueneme, CA

- Cargo transported by ship → Christchurch, NZ

Christchurch, New Zealand

- Cargo transported by ship → NSF McMurdo Station
  - U.S. Coast Guard icebreaker enables 1-2 cargo ships per year and 1 fuel tanker every other year. Arrives in January
  - Limited cargo transported by plane → McMurdo
- People transported by plane → NSF McMurdo Station
  - U.S. Air National Guard flights on C-17 and LC-130 planes

NSF McMurdo Station

- Overland traverse of cargo and fuel → NSF South Pole Station
- Cargo and fuel transported by LC-130 → NSF South Pole Station
- People transported by LC-130 → NSF South Pole Station

NSF South Pole Station

Logistics Constraints to SPS

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Credit: NSF


Credit: Stephen Allinger

Credit: Michael Rayne

NSF McMurdo Station

- Construction of new Lodging Building is expected to be completed in 2026
- During peak of Austral summer only LC-130s can land

Traverses

- 3 to 4 week traverse covers 1600 km over Ross Ice Shelf and Transantarctic Mountains
- Tows fuel bladders and some cargo, but not suitable for large equipment or all items

Aircraft

- Aging LC-130 fleet
- Efforts underway to identify alternatives

Weather

NSF SPS Current Status

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COVID Impacts

Station Infrastructure

- Snow removal & Building Lifts
- Refurbishment of aging infrastructure

* South Pole Station Master Plan

Access Limitations

- Aircraft
- NSF McMurdo Station

Resources Limitations

- Fuel
- Beds

NSF South Pole Station Priorities

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Priorities for NSF South Pole Station:

- Meet our current science commitments
- Refurbish critical station Infrastructure

NSF is committed to continuing significant meritorious science at reduced levels during South Pole Station recapitalization.

NSF Summit Station

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Science Station on Greenland Icesheet

- 10,500 feet elevation
- Temperatures range from minus 68ºC to plus 1ºC,
- Winter winds can exceed 80mph
- ~2.3 feet annual snowfall
- Snow build-up can be significant due to storms
- 75 days of Polar Night
- Accessible April-September, and three times in the winter
- 50 people in summer, 5 people in winter

Credit: NSF

Multi-Disciplinary Scientific Platform

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Glaciology
- Greenland Ice Sheet Project 2 (GISP2)
- Atmospheric H_2 Ice Coring

Atmospheric
- ICECAPS
- NOAA Global Monitoring Laboratory site

Physics & Astronomy
- Radio Neutrino Observatory - Greenland
- Radar Echo Telescope

Technology testing
- Robotics
- New drill technology


Credit: ARCUS


Credit: Caleigh Warner


Credit: RNO-G Team


Credit: A. Bradley

Logistics Overview for Summit

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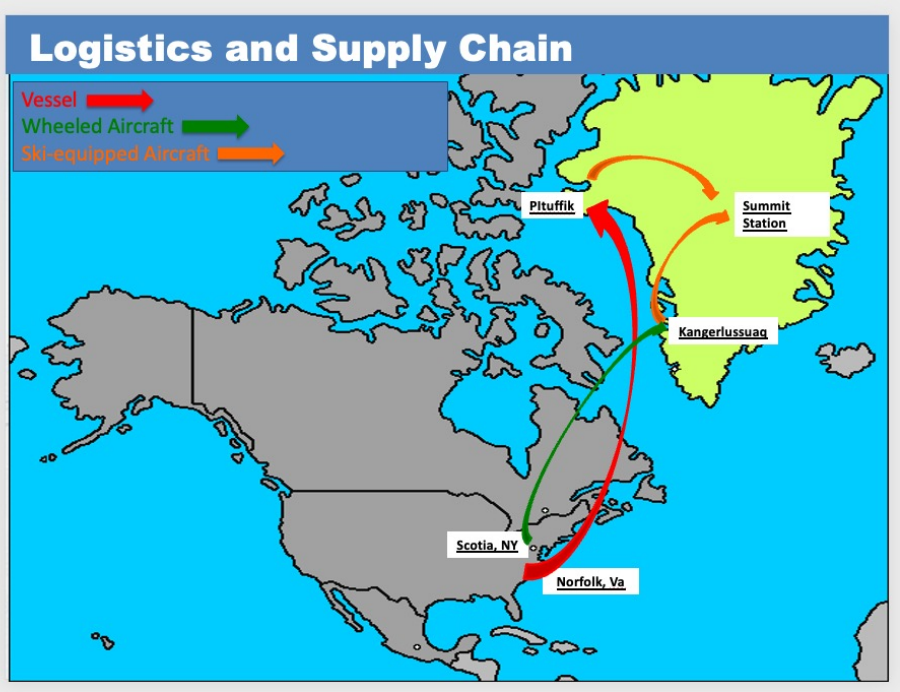

Stratton Air Base, NY

- Cargo and passengers transported by LC-130, C-130, or C-17→ Kangerlussuaq, Greenland

East Coast ports

- Cargo transported by commercial vessels to Kangerlussuaq or Military resupply to Pituffik

Kangerlussuaq and Pituffik Space Base, Greenland

- People and Cargo transported by ski-equipped aircraft → Summit Station
- Currently experimenting with airdropping cargo via military

Future Directions

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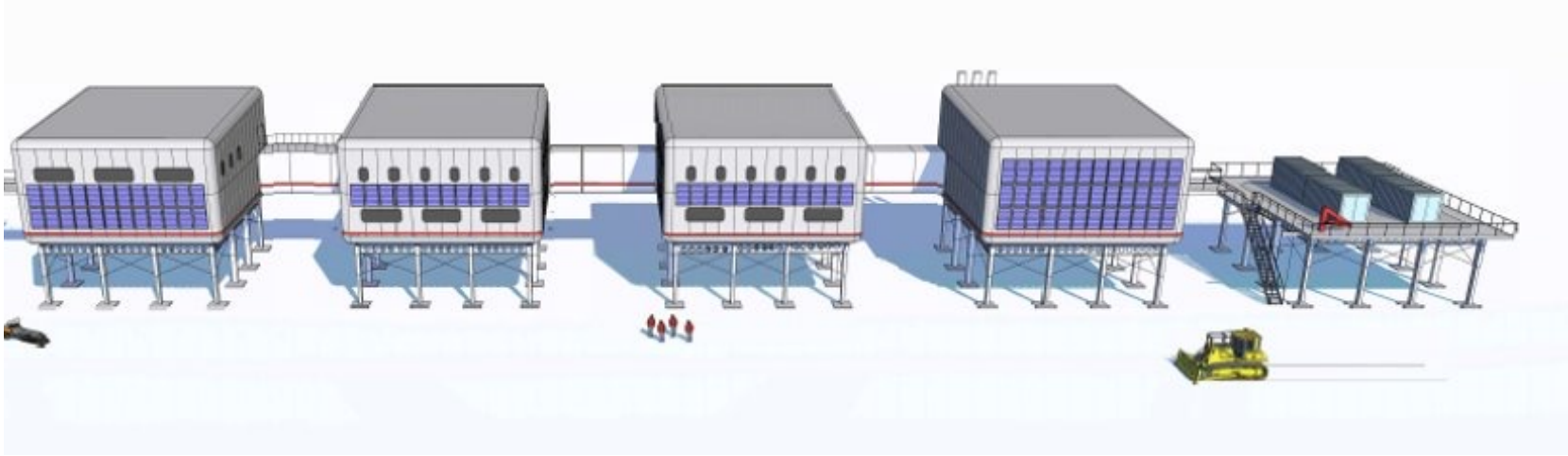
Summit Modernization and Recapitalization (SuMR)

- Accepted into NSF Major Facilities Design process at Preliminary Design
- SuMR will enable innovative year-round science and replace aging infrastructure with modern, efficient, flexible, scalable facilities
- Estimated completion: 2032-2033



Thank you