Comparative Analysis of IceBridge

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Introduction

NASA's IceBridge mission is an important scientific endeavor within the realm of Earth's polar extremes. The mission was to understand the connections between polar ice regions and the global climate system (MacGregor, 2024). IceBridge was a vital link between the Ice, Cloud, and Land Elevation Satellite (ICESat) missions, providing more observations on the polar landscape. This report will dive deeper into the mission's main goals, examine stakeholder involvement, explain the instrumentation used, and analyze another possible platform that could have been implemented.

Mission

NASA's IceBridge airborne mission was launched in 2009 to understand the intricacies of polar ice dynamics. The data collected from IceBridge was able to "describe annual changes in ice surface elevation, topography of bedrock under ice sheets, glacier and ice shelf grounding lines, snow and ice thickness, sea ice distribution, sea ice freeboard, ice temperature, and meteorological observations." (Icebridge). The data collected in this mission was further linked to the measurements taken by ICESat, ICESat-2, and CryoSat-2. All the data collected helped achieve the scientific goals of the mission, which were to document all findings and measurements in polar regions. IceBridge is an Earth-based mission that focuses on collecting data related to Earth's polar regions rather than exploring celestial bodies or deep space. This is furthered by the fact that the instrumentation of the mission was deployed on an aircraft flying over the polar ice.

Stakeholder and Impact

The stakeholders of NASA's IceBridge mission are diverse; they include scientists, policymakers, and the general public. Researchers involved in climate science and Earth sciences

benefit significantly from the detailed information of the data provided by IceBridge. This data aids in understanding the dynamics of polar ice sheets, creates more accurate models of glacier contribution to sea level rise, and predicts climate change ((*NASA Scientific Visualization Studio* 2019). Decisions related to environmental policies will be made by policymakers using the mission's findings. Finally, the general public will benefit due to being aware of the climate change impacts on polar regions. This entire mission was funded by the government through NASA, showing how resources are allocated to advance scientific discoveries that address global challenges.

Instrumentation

NASA's IceBridge mission had two main scientific instruments to precisely collect data and analyze polar ice. The Airborne Topographic Mapper (ATM), developed at Wallops Flight Facility, played a crucial role in measuring changes in ice surface elevation, the thickness of glaciers, the volume of glaciers, and the distribution of polar ice caps (MacGregor, 2024). The Land, Vegetation, and Ice Sensor (LVIS), a laser altimeter, was able to map large areas of sea ice and glacier zones from a high altitude (MacGregor, 2024). These instruments were detrimental to achieving the objectives of the IceBridge mission because they were able to assess ice dynamics, monitor climate change impacts, and make several detailed observations. Scientists were able to come up with a comprehensive picture of the polar ice environment and understand our Earth better as a result of these instrumentations.

Secondary Platform Analysis

An alternative platform that could have replaced the IceBridge mission is scientific balloons. Scientific balloons, especially super-pressure balloons, have both their advantages and drawbacks. Super-pressure balloons can remain in the air for many days at a time, which will

allow for prolonged data collection of the polar regions. Another advantage is that scientific balloons are significantly cheaper compared to airborne missions, which may allow for more data collection. On the other hand, the trajectory of scientific balloons are hard to control and highly depend on weather conditions. Also, another disadvantage is the rocking movement of the payload carrying the instrumentation, impacting the accuracy of measurements.

Conclusion

NASA's IceBridge airborne, Earth-based mission was very important in the documentation of a variety of important measurements, helping us understand Earth's polar regions. Scientists, policymakers, and the public were able to benefit in many ways as a result of this government-funded mission. The entire mission was possible due to the ATM and LVIS, two instruments on the aircraft that mapped ice surface levels and large areas of sea ice, respectively. Finally, super-pressure scientific balloons could have been an alternative mission platform. However, the analysis of the pros and cons of using the balloons proved that the airborne mission platform was best due to trajectory control and accurate measurements. Overall, the IceBridge mission ties back to NASA's vision, which is to explore the secrets of the universe for the benefit of all.

References

Icebridge. National Snow and Ice Data Center. (n.d.). https://nsidc.org/data/icebridge

IG-17-003 - NASA's Earth Science Mission Portfolio. NASA'S EARTH SCIENCE MISSION PORTFOLIO. (2016, November 2). https://oig.nasa.gov/docs/IG-17-003.pdf

MacGregor, J. (2024a, March 8). Airborne Topographic Mapper (ATM) " operation icebridge. NASA. https://icebridge.gsfc.nasa.gov/?page_id=118

MacGregor, J. (2024b, March 8). Land, Vegetation and Ice Sensor (LVIS) " operation ice bridge. NASA. https://icebridge.gsfc.nasa.gov/?page_id=120

MacGregor, J. (2024c, March 8). Operation icebridge. NASA. https://icebridge.gsfc.nasa.gov/

NASA. (2019, August 20). NASA Scientific Visualization Studio. NASA. https://svs.gsfc.nasa.gov/gallery/oib/#:~:text=The%20extensive%20data%20IceBridge%20has,contribution%20to%20sea%20level%20rise.