

National Aeronautics and Space Administration
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**ENVIRONMENTAL DOCUMENT AND
FINDING OF NO SIGNIFICANT AND NOT MORE THAN
MINOR OR TRANSITORY ENVIRONMENTAL IMPACT**

Aircraft Over-flights of the Antarctic Sea Ice of the Weddell, Bellingshausen and Amundsen Seas and Land-Ice of the Antarctic Peninsula and the Thwaites, Pine Island and Abbot Glaciers

I. Finding

The National Aeronautics and Space Administration (NASA) has prepared an Initial Environmental Evaluation (IEE) and an Environmental Assessment (EA) as a combined environmental document for the Operation Ice Bridge (OIB) campaign over the Weddell, Bellingshausen and Amundsen Seas and the Thwaites, Pine Island and Abbot glaciers. Based on the analyses in the environmental document (IEE/EA), the NASA Office of the Earth Observing System/Earth Science Enterprise has determined that the implementation of OIB is not a major federal action that would have significant effect on the Antarctic marine environment, within the meaning of the National Environmental Policy Act (NEPA) of 1969. The action is also not one that would have more than a minor or transitory effect on the Antarctic environment, within the meaning of NASA's implementing regulation for the Protocol on Environmental Protection to the Antarctic Treaty. Therefore, an environmental impact statement and/or a comprehensive environmental evaluation will not be prepared.

The selected Alternative B provides for the means to achieve the scientific goal of OIB while protecting the well being of native birds and marine mammals as well as the state of the Antarctic environment.



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10/05/2009
Date

II. Purpose and Need for the Proposed Action

The Ice, Cloud and land Elevation Satellite (ICESat I) was launched on January 12th, 2003, for a 3-5 year mission, by the Cryospheric Sciences Branch at Goddard Space Flight Center (GSFC). The satellite is the benchmark Earth Observing System (EOS) mission for measuring ice sheet mass balance, cloud and aerosol heights as well as land topography and vegetation characteristics. ICESat I is currently past its mission lifespan, running on extremely low power and may soon expire. ICESat II is scheduled for launch in the 2014-2015 time frame. The time gap between the end of ICESat I and the launch of ICESat II creates a critical data gap in laser observations of the changes of ice sheets, glaciers and sea ice, which will be filled in part by the Operation Ice Bridge (OIB) Mission described below. For the ice sheets and glaciers, the ICESat I laser acquires critical ice thickness data that allows determination of the properties of the rapidly changing ice streams. For the sea ice, the laser measures ice freeboard, from which ice thickness can be inferred.

OIB will employ aircraft resources, with a suite of instruments, to acquire essential data that will allow for continuous monitoring of ice thicknesses in the most sensitive and critical areas of the sea ice, ice sheets and glaciers. The most sensitive and critical areas include coastal Antarctica, the Antarctic Peninsula and sub-glacial lakes and certain fast moving glaciers in Antarctica's interior. The aircraft resource to be used for the Western Antarctica segment of OIB is a NASA DC-8. The suite of instruments includes OIB's highest priority instrument, the NASA Airborne Topographic Mapper (ATM), the NASA Laser Vegetation Imaging Sensor (LVIS), The University of Kansas' (KU) Center for Remote Sensing of Ice Sheets (CReSIS) Multichannel Coherent Radar Depth Sounder/Imager (MCoRDS II), Snow Radar and Ku-band radar, Columbia University's Lamont-Doherty Earth Observatory Gravimeter, the NASA Atmospheric Vertical Observations of CO₂ in the Earth's Troposphere (AVOCET), the NASA Diode Laser Hygrometer (DHL), the NASA Differential Absorption CO Measurement (DACOM) and the University of California, Irvine, Whole Air Sampler (WAS). All of these systems gather their data through passive means and, as such, have no direct impact on the environment. The ATM acquires data through the use of a scanning Light Detection and Ranging (LIDAR), Global Positioning System (GPS) receivers and Inertial Navigation System (INS) sensors. The LVIS is a scanning laser altimeter that also includes data from integrated GPS and INS systems. The MCoRDS II is a system that measures radar reflectivity through ice and determines ice thickness, ice internal layer maps and underlying bed maps. The Snow Radar measures snow thickness over sea and land ice. The Ku-band radar measures altitude, surface backscatter and depth profiles in snow and ice. The Gravimeter measures spatial changes in the gravity field.

A total of 15 flights over Antarctica, from October 15, 2009 through November 21, are currently scheduled. The flights are organized into three categories: High altitude land ice, low altitude land and sea ice. Each flight will depart from Punta Arenas, Chile, fly

pre-defined flight lines over Antarctica, then return to Punta Arenas. The pre-defined flight lines consist predominantly of flight lines that are coincident with either ICESat tracks or flight lines that have been flown previously with the ATM instrument. It is essential that these ICESat tracks and previously flown ATM flight lines be duplicated. The ATM data is used to determine changes, from previous measurements, in ice thickness. If the ATM is not flown over tracks and flight lines for which previous data exists the continuity of the ice thickness measurements in the most sensitive and critical parts of Antarctica will be lost. Once over Antarctica, flights will occur over the Thwaites, Pine Island and Abbot glaciers to acquire land-ice data and over the Weddell, Bellingshausen and Amundsen Seas, to acquire sea-ice data. Flights will also occur over Recovery, Foundation, Willans/Mercer and MacAyeal Lakes. The 15 flights are each currently scheduled for 11-hour durations. The beginning of the typical flight profile calls for transit from Punta Arenas to near the Antarctic Peninsula at a speed of 440 knots and an altitude of 30,000 ft Above Ground Level (AGL). The three high-altitude land ice flights are designed specifically for LVIS data acquisition and will be flown over the Antarctica continent at altitudes of approximately 30,000 ft AGL. The other 12 are designed specifically for ATM and Ku-Band radar data acquisition and will be flown at altitudes of approximately 1,500 ft AGL over both land and sea ice. The transition from transit to data acquisition flight will require the aircraft to slow to a speed of approximately 250 knots and descend to an altitude of 1,500 ft AGL. The aircraft will fly at 1,500 ft AGL for the duration of the data acquisition. This flight altitude is below that set forth in "Resolution 2 (2004) – ATCM XXVII – CEP VII, Capetown", which states: "Penguin, albatross and other bird colonies are not to be over-flown below 2000ft (~ 610 m) Above Ground Level, except when operationally necessary for scientific purposes." The 1,500 ft AGL altitude is operationally necessary for OIB's highest priority instrument, the ATM and Ku-Band radar. The ATM lasers have insufficient power to acquire data, of the required accuracy, at higher altitudes and thus must be used at an altitude of 1500' AGL. The Ku-Band radar has been optimized for operation at an altitude of 1500' AGL for this mission so it can acquire the highest accuracy data possible at the optimum ATM operating altitude.

The issue that this document concerns is the environmental impact on the native birds and mammals that these flights may have. October is the beginning of the formation of breeding colonies of Antarctic birds. The impact of low flying aircraft on the fauna of the region has been a major concern, especially during the last few decades in which the operation frequency of such aircraft has been on the rise. Of primary concern is the apparent impact to penguin and seal colonies. Such low altitude flights over colonies are known to cause panic, disrupt breeding and cause the loss of penguin eggs.

III. Alternatives

Alternative A: No flights below 2000 feet (~ 610m)

Alternative A would involve no flights lower than 2000 feet. As a result, the main science objectives of OIB would not be met.

Alternative B: Inclusion of carefully planned low altitude flights.

The science requirements for the sea-ice and land-ice data require flights at 1500 feet (~ 457m) AGL. As the next section describes, the impact to native birds and mammals will be minimized by flight planning and mitigating maneuvers.

IV. Environmental Effects and Mitigating Measures

- A. There would be no environmental effect on birds and mammals with Alternative A.
- B. The environmental effects on birds and mammals with Alternative B will be minimized through the following measures:

Flight Planning

With assistance from the National Science Foundation and one of their contractors, Environmental Research and Assessment, intended flight lines have been drawn and superimposed with the locations of known breeding wildlife colonies (See Map 1, Appendix A). In addition the project has acquired the "Wildlife Awareness Manual, Antarctic Peninsula, South Shetland Islands, South Orkney Islands". The flight lines and their proximity to the known breeding wildlife colonies will be reviewed by the flight crew prior to take-off as will the Wildlife Awareness Manual. Flight lines for high altitude land ice flights will have no impact on breeding colonies as the aircraft will be at approximately 30,000 feet AGL. Flight lines for low altitude sea and land ice flights that pass over locations of known colonies will observe the minimum 3281 feet (1000m) buffer, as prescribed by the SCAR Bird Biology Sub-group recommendation for four engine aircraft separation distances from bird colonies. This altitude change from the data acquisition altitude of 1500 feet AGL to 3281 feet AGL will be incorporated into the flight lines that traverse the known breeding colony locations. Currently there are only two areas of potential conflict; Madder Cliffs on Joinville Island and Eden Glacier on the Antarctic Peninsula (See Maps 2 and 3, Appendix A).

Aircraft Observations and Mitigating Maneuvers

After the aircraft is in the air and as Antarctica is approached and over-flown, the flight crew will maintain a look-out for birds and mammals on the ground. Upon observation of unforeseen breeding colonies the aircraft altitude will be brought up to 3281 until the colony is passed. Realizing that the flight crew's primary responsibility is the safety of the aircraft and that flying a four engine aircraft the size of the DC-8 at 1500 ft. AGL demands a high degree of attentiveness the flight crew will assume this extra duty and carry it out to the best of their ability. This flight protocol for Operation Ice Bridge project will satisfy the guidelines of The Antarctic Conservation Act of 1978.

- C. Neither Alternative A nor Alternative B is expected to cause long term or cumulative effects. Alternative B has been designed to avoid any harmful interference to native birds and mammals while still satisfying the science requirements of OIB.

V. Consultation With Others

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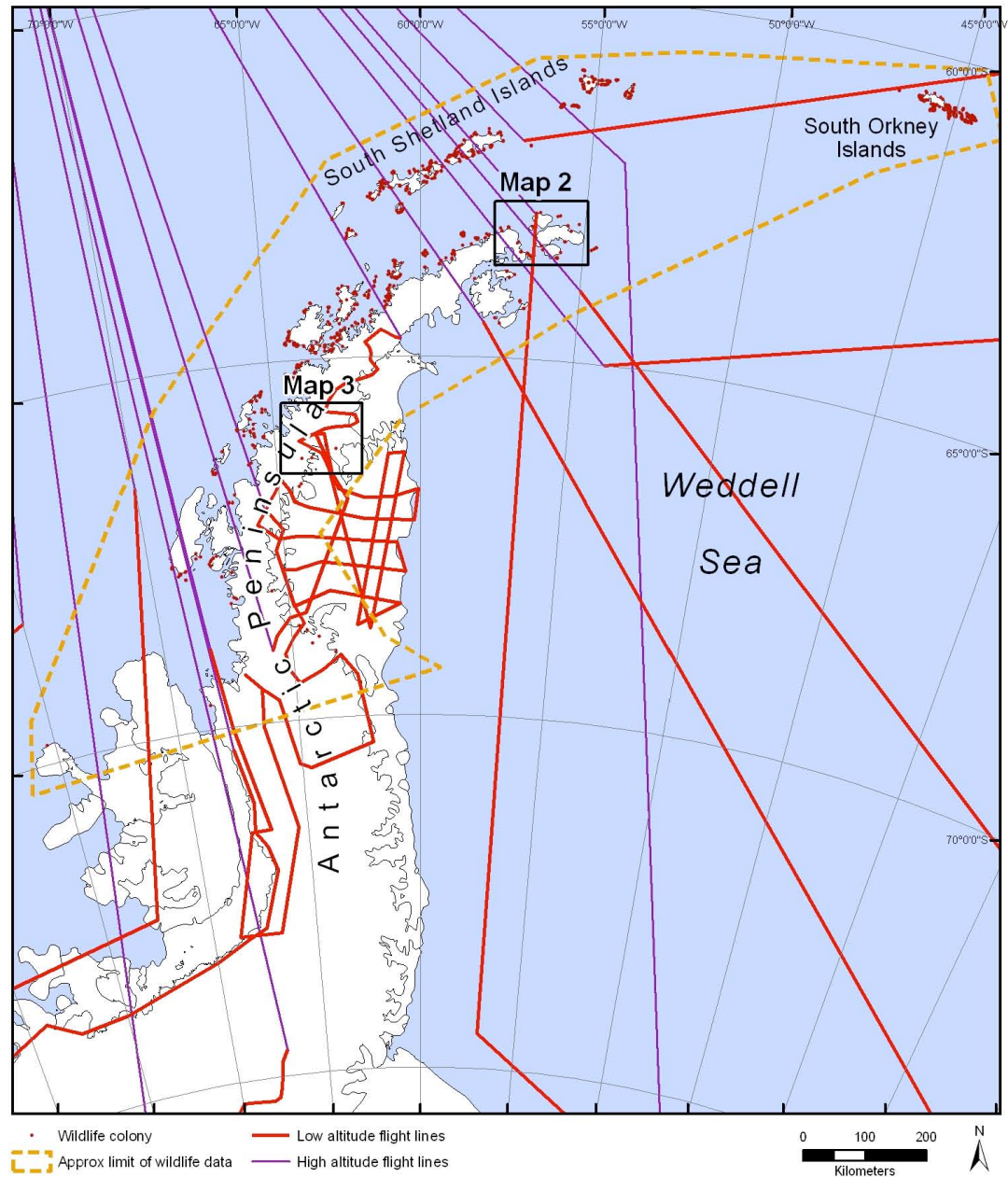
VI. References

Antarctic Conservation Act of 1978 as amended by the Antarctic Science,
Tourism, and Conservation Act of 1996 (Public Law 104-227)

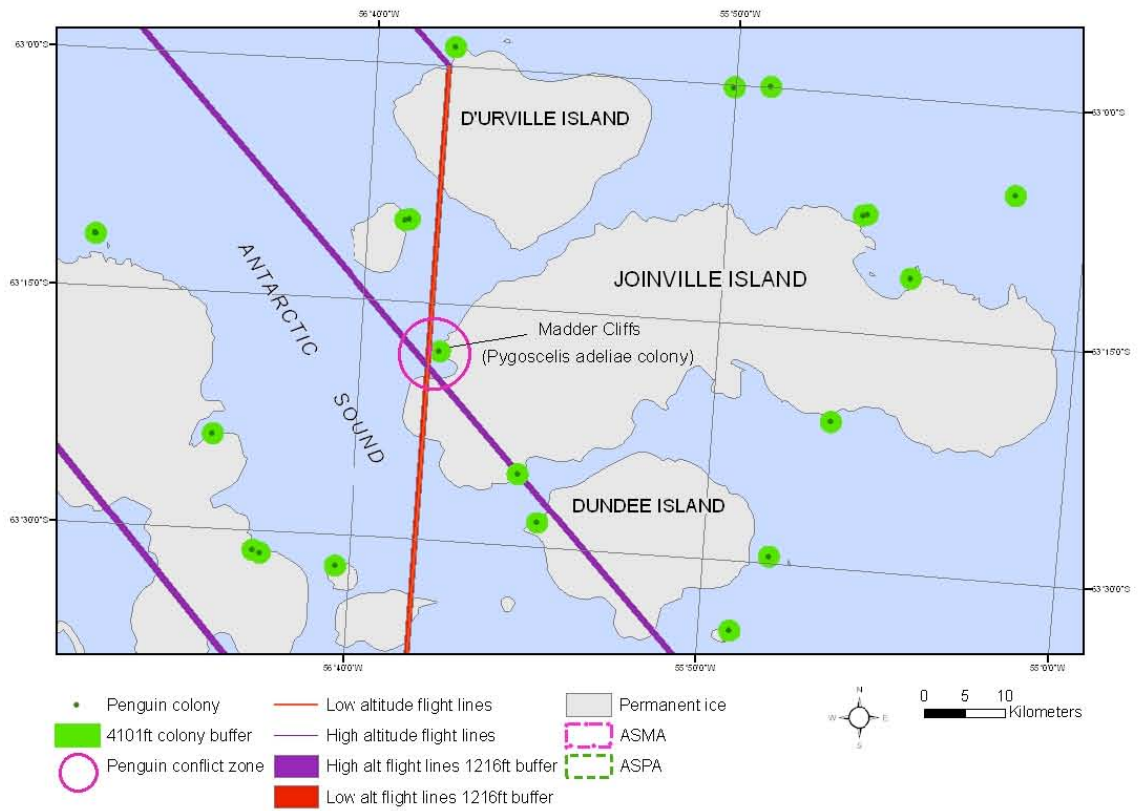
Harris, Colin M. Guidelines for the operation of aircraft near concentration of
birds, Information Paper IP-39, CEP IV, St Petersburg, Russia, 10 pp., 2001.

Appendix A

Map 1: Overview of OIB flight lines and breeding wildlife colonies in the Antarctic Peninsula region.



Map 2: Potential conflict zone: Low altitude flight lines over penguin breeding colony



Map 3: Potential conflict zone: Low altitude flight lines over flying bird breeding colony

