

Airborne Platforms Help Answer Questions in Polar Geosciences

International Workshop on Airborne Geodesy and Geophysics with Focus on Polar Applications; Dresden, Germany, 19–21 April 2017



The polar research aircraft Polar 6 of the Alfred Wegener Institute (Bremerhaven, Germany) is ready for takeoff near Princess Elisabeth Station, Sør Rondane, eastern Dronning Maud Land, Antarctica. Besides an airborne gravimeter and other devices stowed in the cabin's interior, the aircraft is equipped with magnetometers (nose and tail boom) and a radio echo sounding (RES) system. The RES antennas are mounted under the wings. Attendees at a workshop earlier this year discussed advances and research needs for airborne techniques in polar geosciences. Credit: Graeme Eagles.

By Mirko Scheinert, Graeme Eagles, and Kirsty Tinto © 29 September 2017

The polar regions, with their continental ice sheets and partly ice covered oceans, play a

crucial role in the Earth system. They are critical to understanding and predicting climate evolution and global sea level change. Airborne platforms offer the most amenable and powerful means of surveying these regions.

To explore the current status and future of airborne polar research, about 40 participants from six countries attended the third in a series of workshops (<https://scar.org/event-archive/227-events/168-geodesy-workshop/>). They discussed airborne techniques in polar geosciences during six oral sessions, one poster session, and a small technology display. The workshop was supported by the German Research Foundation, the International Association of Geodesy, the Scientific Committee on Antarctic Research, and the German Society for Polar Research.

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For any scientific endeavor, the choices of research methods and equipment should be driven primarily by science questions, and polar science is no exception. The panel discussion that concluded the workshop quickly confirmed this view: Panel members made it clear that airborne techniques and equipment remain the leading choice for addressing the tremendous range of questions in polar regions. They built on this assertion by noting that modern airborne geoscience can and should design surveys with a range of platforms in mind, from long-range aircraft to lightweight unmanned aerial vehicles (<https://eos.org/project-updates/drones-in-a-cold-climate>).

Gravity data, which are required from global to regional scales and over a range of resolutions, were a particular focus of the meeting. In spite of recent improvements in coverage, it is clear that new surveys are still needed, especially over the Antarctic Ocean and continent-ocean transition zones. Here gravity data allow bedrock topography, sub-ice shelf bathymetry, and grounding line locations to be inferred where techniques such as radio echo sounding (RES (<https://eos.org/research-spotlights/cosmic-muons-reveal-the-land-hidden-under-ice>)) or conventional bathymetric sounding (<https://eos.org/project-updates/sounding-northern-seas>) are prohibitively expensive or impossible. Attendees emphasized that regions with inferior data density or quality need to be resurveyed.

Airborne surveys that enable inferences of ice sheet elevations are especially valuable in studies of those regions where satellite altimetry (<https://eos.org/research-spotlights/a-comparison-of-surface-thinning-in-west-antarctic-glaciers>) provides conflicting results. In this respect, the inner East Antarctic plateau is the region with the worst signal-to-noise ratio. Attendees agreed that the low quality of the data here impedes both the altimetric and input-output

approaches to ice sheet mass balance studies.

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Studies that use ice sheet modeling in particular have much to gain from better knowledge of the englacial (https://link.springer.com/referenceworkentry/10.1007%2F978-90-481-2642-2_135) and subglacial properties that serve as boundary conditions. Here, again, airborne methods provide the only tool for lateral correlation of high vertical resolution information between existing and planned deep ice cores.

Attendees also agreed it is desirable to overcome the largely artificial distinctions that have led to different treatments and understanding of the East and West Antarctic ice sheets. They agreed that it is necessary to strengthen efforts toward integrating the different models being produced and used around both of the poles to achieve a deeper understanding of processes linking the cryosphere, solid Earth, and ocean.

More details about the workshop can be found on the Institute of Planetary Geodesy's website (https://tu-dresden.de/bu/umwelt/geo/ipg/gef/forschung/geowissenschaften-auf-halo#ck_HALO_Box).

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