
Preface

Although it is generally understood that the Antarctic Ice Sheet plays a critical role in the changing global system, there is to date still a lack of generally available information on the subject. Climatic change and the role of the polar areas are often discussed in the media. Much of our knowledge depends on models, and basic things such as maps are missing. The generally used geophysical atlas of Antarctica is still the one published by Drewry twenty years ago, with literally huge “white areas” on the maps (Drewry, D.J. (editor), 1983, Antarctic Glaciological and Geophysical Folio, Cambridge, Scott Polar Research Institute). While there are maps of specific areas of Antarctica available (usually where field research is undertaken), there is not one comprehensive work.

Antarctica is a remote continent. — Despite about 200 years of Antarctic exploration, many places in the Antarctic have not been visited by mankind, because Antarctica is hard to reach from inhabited places, a foreboding place to travel because of glaciated terrain and harsh climate, and the fact that the continent is surrounded by a frozen ocean for a large part of the year. Information on the remote continent is available today from satellite data.

Antarctica is a frozen continent. — It contains over 90% of the Earth’s ice mass, and most of its area is covered by ice.

Antarctica is a fascinating continent. — The same geographic properties that make Antarctica difficult to visit draw our imagination to this wild and different place. In 1984, I interrupted my dissertation project in mathematics for the chance to participate in an Antarctic expedition, with the German Research Vessel POLARSTERN, willing to work on more or less anything that would be

asked of me to get down south to the Antarctic. As it turned out, I got to work on least-squares prediction and collocation, a method used in geodesy for interpolation, which led me into a new field of science — geostatistics — which would become the centerpiece of my mathematical research; but the expedition did not lead me to Antarctica, ending in South America after crossing the Atlantic. In 1987/88 I “finally” set foot on the icy continent, during a $3\frac{1}{2}$ month expedition to Antarctica, also with the POLARSTERN and the Alfred-Wegener-Institute for Polar Research (Bremerhaven, Germany), to the Weddell Sea sector of Antarctica. In those days, expeditions were planned and staffed in a way that helping hands were always needed, scientists helped to establish stations, transport loads and clean up fuel barrels; marine biologists needed help in counting species in huge piles of biomass dumped on the deck; geophysicists needed help for around-the-clock watch at instruments; trace-chemical stations needed to be established far away from the main stations, and glaciologic data needed to be processed. This provided a great way to learn about many aspects of the Antarctic environment as well as a fun way to interact and collaborate. Quickly I noticed that who volunteered first got to set up remote sampling locations, approached by helicopter or snowcat tracks, while who volunteered last may end up pumping Arctic diesel ... Whatever the tasks, the Antarctic holds a grip on almost anyone who has ever visited it. Expeditions to places without the ICE are just not the same, as I came to discover in later seagoing expeditions.

Our society’s knowledge on Antarctica is still far less than knowledge about any other continent, despite decades of exploration of Earth from space and publications in scientific journals. A school

teacher who does not know what distinguishes Antarctica from the Arctic is not an exception. Books on Antarctica that are available to a general readership are commonly coffee-table picture books, compiled by photographers on voyages to the Antarctic, often with a focus on wildlife. In contrast, the Atlas is focused on snow and ice research, relationship of ice and climate, geography, cartography and geodesy, geomathematics and satellite geophysics — on revealing the seventh continent from space. As such, the Atlas of Antarctica will fill an information gap.

Today's educators want to teach children exciting facts about remote places, and tourism increases in an adventure and exploration component. Together with this there is a growing interest in Antarctica, and, often related to the cost of travel to remote places, the knowledge-desiring public has a high level of education. An increasing public interest in Global Change and Climate-related questions also creates a need for books that convey facts at a level that lies between that of picture books and science treatises.

The Atlas of Antarctica is written with state-of-the-art scientific accuracy, so that it is hoped that it may be useful for students and researchers of glaciology, geophysics, remote sensing, cartography and Antarctic research, and at the same time introduce to the complex of questions and facts outlined above in a way that is informative and fun for the general reader interested in Antarctica.

Information about the frozen continent, Antarctica, is not only accessible by expeditions, without the availability of satellite data, there would still be large "white areas" on the map.

The "Atlas of Antarctica" utilizes satellite data — more precisely, radar altimeter data from SEASAT, GEOSAT, ERS-1 and ERS-2. Other than the better known satellite images, altimeter measurements provide information on elevation and, as such, may be the basis of topographic maps. The Atlas of Antarctica covers the entire Antarctic continent in a collection of accurate topographic maps, each with 3 km by 3 km grid resolution, surface elevation in grey shades and contours, and place names of glaciers, ice streams, and ice shelves, as well as of other major geographic features. Other than satellite images, the

Atlas maps provide elevation which is geophysically useful and accurate information. As such the Atlas maps are the highest-resolution elevation maps available today, derived from satellite radar altimeter data by application of a geostatistical method, which was specifically designed by the author for the problem of ice-sheet mapping. Part II (chapter (D)) forms the center piece of the Atlas.

In part I "Motivation and Methods", introductory chapters concern the following topics: (A) The Antarctic Ice Sheet and its role in the Global System, (B) Satellite Remote Sensing, and (C) Data analysis methods applied in the Antarctic Atlas production and map construction. These sections may serve as introductions to the realm of ice and climate, Antarctic geography, to satellite observations of the cryosphere, principles of satellite radar altimeter observations and data processing, and geostatistical estimation or interpolation applied in cartography.

Applications presented in part III include monitoring changes in Antarctic glaciers, ice streams and ice shelves (chapter (E)) and detailed regional studies of outlet glaciers of the inland ice that are particularly exciting (chapter (F)). Combination and integration of digital elevation models from radar altimeter data and Synthetic Aperture Radar (SAR) data, which show surface structures and flow features of glaciers and ice streams, is given as an example of employing data from two sources in glaciologic research (chapter (G)). The Atlas contains a total of 145 maps, 25 figures, index maps and diagrams, 5 tables, and furthermore references on related subjects in glaciology, geomathematics, remote sensing and geodesy (chapter (H)), a glaciologic glossary, an index of the Antarctic place names shown, and a list of Antarctic expeditions (chapter (I)).

The Atlas is for educators, glaciologists, researchers, students, tourists, anyone interested in Antarctica. It is my hope that the reader may share some of my enthusiasm for Antarctica and enjoy "discovering" some of its many fascinating geographic and glaciologic features.

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Atlas of Antarctica

Topographic Maps from Geostatistical Analysis of
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Herzfeld, U.C.

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