

# Arctic Coastal Dynamics (ACD)

Volker Rachold and the ACD Group

Alfred Wegener Institute, Research Unit Potsdam  
PO Box 60 01 49, 14401 Potsdam, Germany  
vrachold@awi-potsdam.de  
www.awi-potsdam.de/www-pot/geo/acd.html



## Background and Objectives

Complex land-ocean interactions in the Arctic coastal environment play an important role in the balance of sediments, organic carbon and nutrients of the Arctic Basin. In the past, contribution of coastal erosion to the material budget of the Arctic seas has been underestimated, but recent investigations have underlined its importance (Reimnitz et al. 1988; Are 1999; Rachold et al. 2000).

The Arctic Coastal Dynamics (ACD) program is a multi-disciplinary, multi-national forum to exchange ideas and information. The overall objective of ACD is to improve our understanding of circum-Arctic coastal dynamics as a function of environmental forcing, coastal geology and cryology and morphodynamic behavior. Figure 1 schematically summarizes the relevant parameters and processes. In particular, the ACD program proposed to:

- establish the rates and magnitudes of erosion and accumulation of Arctic coasts;
- develop a network of long-term monitoring sites including local community-based observational sites;
- identify and undertake focused research on critical processes;
- estimate the amount of sediments and organic carbon derived from coastal erosion;
- refine and apply an Arctic coastal classification (includes ground ice, permafrost, geology, etc.) in digital form (GIS format);
- compile, analyze and apply existing information on relevant environmental forcing parameters (e.g. wind speed, sea level, fetch, sea ice etc.);
- develop empirical models to assess the sensitivity of Arctic coasts to environmental variability and human impacts;
- produce a series of thematic and derived maps (e.g. coastal classification, ground-ice, sensitivity etc.);

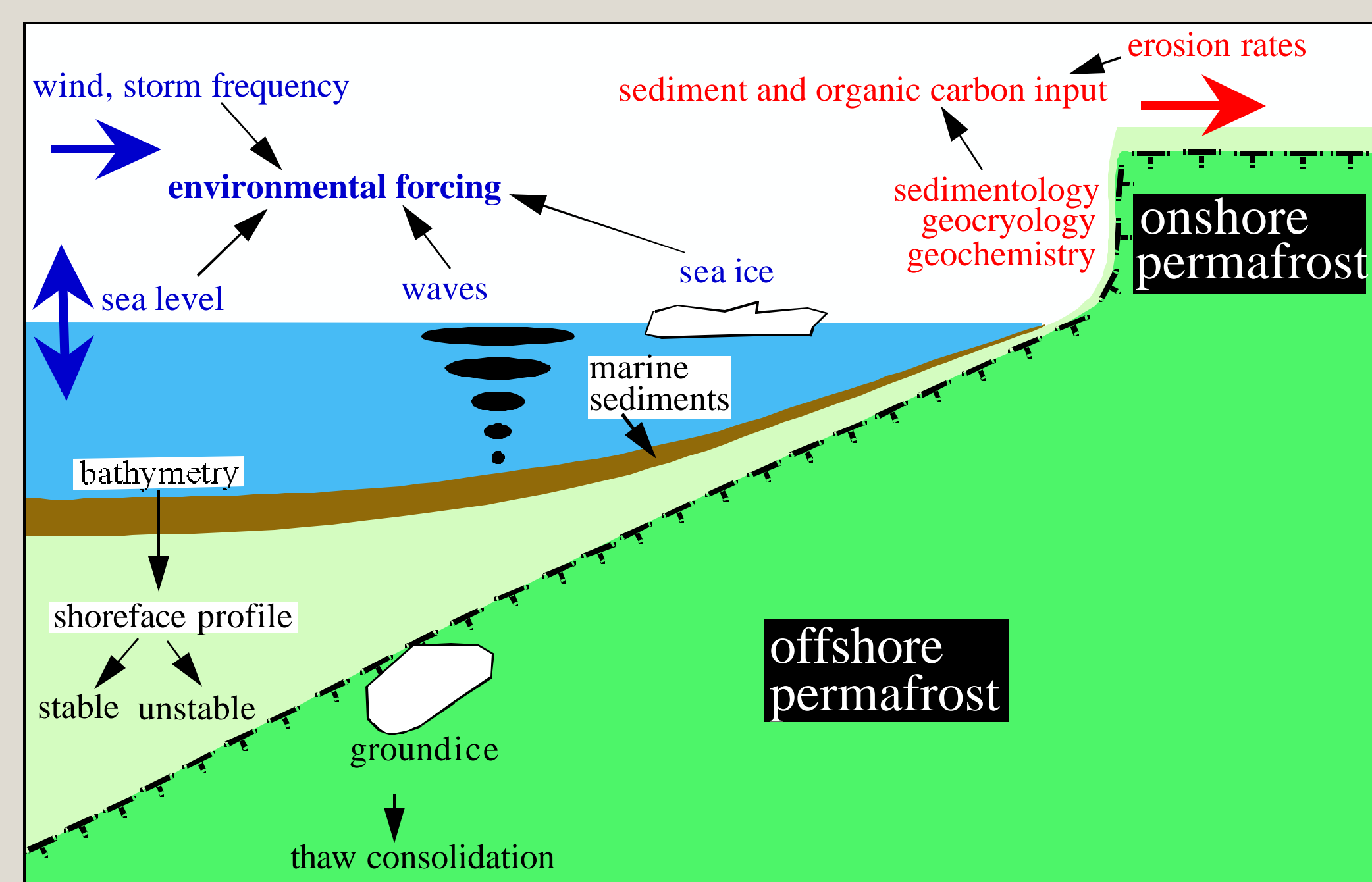


Figure 1. Coastal dynamics as a function of environmental forcing, coastal morphology, and onshore and offshore permafrost characteristics.

## Current Focus of ACD

Emphasis is currently on developing a circum-Arctic estimate of sediment and organic carbon input from coastal erosion to inner shelf. Several papers on this topic have recently been completed (Brown et al. in press; Grigoriev and Rachold in press; Jorgenson et al. in press; Rachold et al. in press [b]). The studies indicate that coastal erosion forms a major source not only of the sediment input but also of the total organic carbon (TOC) input to the Arctic seas. The comparison between riverine and coastal TOC input, based upon a combination of detailed field studies carried out in the Laptev and East Siberian Seas during the last several years (Grigoriev and Rachold in press) and on a review of the existing literature, is shown in Figure 3 (Rachold et al. in press [b]). It has to be noted that the data given in Figure 3 are the best currently available estimates, but may include errors ranging from ca. 30 % for the Laptev and East Siberian Sea (Grigoriev and Rachold in press) to one order of magnitude for the other seas.

The development of a reliable assessment of the sediment and organic carbon input involves classifying and segmenting the entire circum-Arctic coastline into common elements based primarily on morphology, ground-ice composition and erosion rates. Accordingly, a coastal mapping template, which allows coastal scientists to record information about Arctic coasts, was developed. Regional expert teams to perform the segmentation for the major Arctic seas were identified. The segmented data will be entered into the PANGAEA data system (<http://www.pangaea.de>) which is the core database for "raw" data needed in the calculations of sediment and organic input. For analyses and other scientific purposes within the project the raw data will be exported from this system into different GIS and other processing software.

Figure 4 shows the areas by major seas and the length of their shorelines. For the Laptev Sea a first version of the segmentation has already been completed (Rachold et al. in press [c]). Most parts of the other Arctic Seas could be classified during the Oslo Workshop and the final version of the segmentation and classification will be available at the next ACD workshop (to be organized in St. Petersburg (Russia), November 2003).

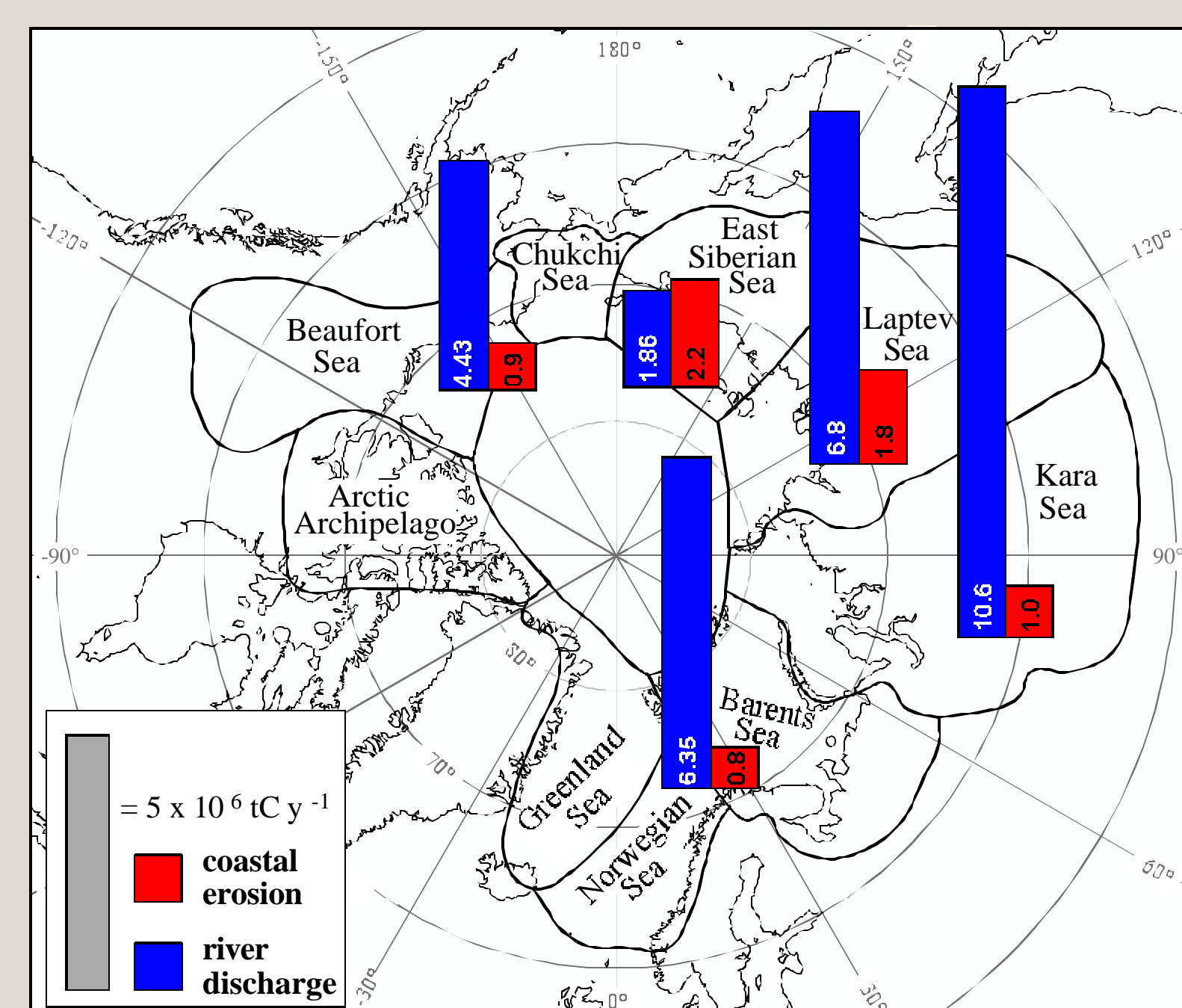


Figure 3. Riverine and coastal organic carbon input ( $10^6 \text{ t C yr}^{-1}$ ) to the Arctic Ocean (Rachold et al. in press [b]). Note that the sum is shown for Beaufort and Chukchi Sea and that Barents Sea input data include White Sea. The drainage systems are taken from <http://www.R-ArcticNET.sr.unh.edu/>.

## Acknowledgements

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## History and Development of ACD

The project elements were formulated at a workshop in Woods Hole in November 1999 carried out under the auspices of the International Permafrost Association (IPA), its working group on Coastal and Offshore Permafrost and its Coastal Erosion subgroup (Brown and Solomon 2000).

During the Arctic Science Summit Week in April 2000 in Cambridge, UK, the Council of the International Arctic Science Committee (IASC) approved funding for a follow up workshop to develop a Science and Implementation Plan for ACD. The resulting international workshop, held in Potsdam (Germany) on 18-20 October 2000, produced a phased, five-year Science and Implementation Plan (IASC Arctic Coastal Dynamics 2001, Figure 2). The participants selected Volker Rachold to be the official IASC Project Leader and an ACD project office was established at AWI-Potsdam with a secretariat to maintain international communications including the web site and an electronic newsletter. The secretariat is assisted by the International Steering Committee consisting of

- Felix Are, St. Petersburg State University of Means and Communication
- Jerry Brown, International Permafrost Association, Woods Hole
- George Cherkashov, VNIIOkeangeologia, St. Petersburg
- Mikhail Grigoriev, Permafrost Institute, Yakutsk
- Hans Hubberten, AWI, Potsdam
- Volker Rachold, AWI, Potsdam
- Johan Ludvig Sollid, Oslo University
- Steven Solomon, Geological Survey of Canada, Dartmouth

At the Council Meeting during the Arctic Science Summit Week in Iqaluit, Canada (April 22-28, 2001), IASC officially accepted the ACD project and provided funding for the 2<sup>nd</sup> ACD workshop which was held in Potsdam (November 26-30, 2001). The results of the workshop including ca. 30 extended abstracts were published in a workshop report (Rachold et al. 2002).

The 3<sup>rd</sup> IASC-sponsored ACD workshop was held in Oslo, Norway, on December 2-5, 2002. The objective of the workshop was to review the status of ACD, with the main focus on the quantitative assessment of the sediment and organic carbon input to the Arctic Ocean through coastal erosion (Rachold et al. in press [a]).

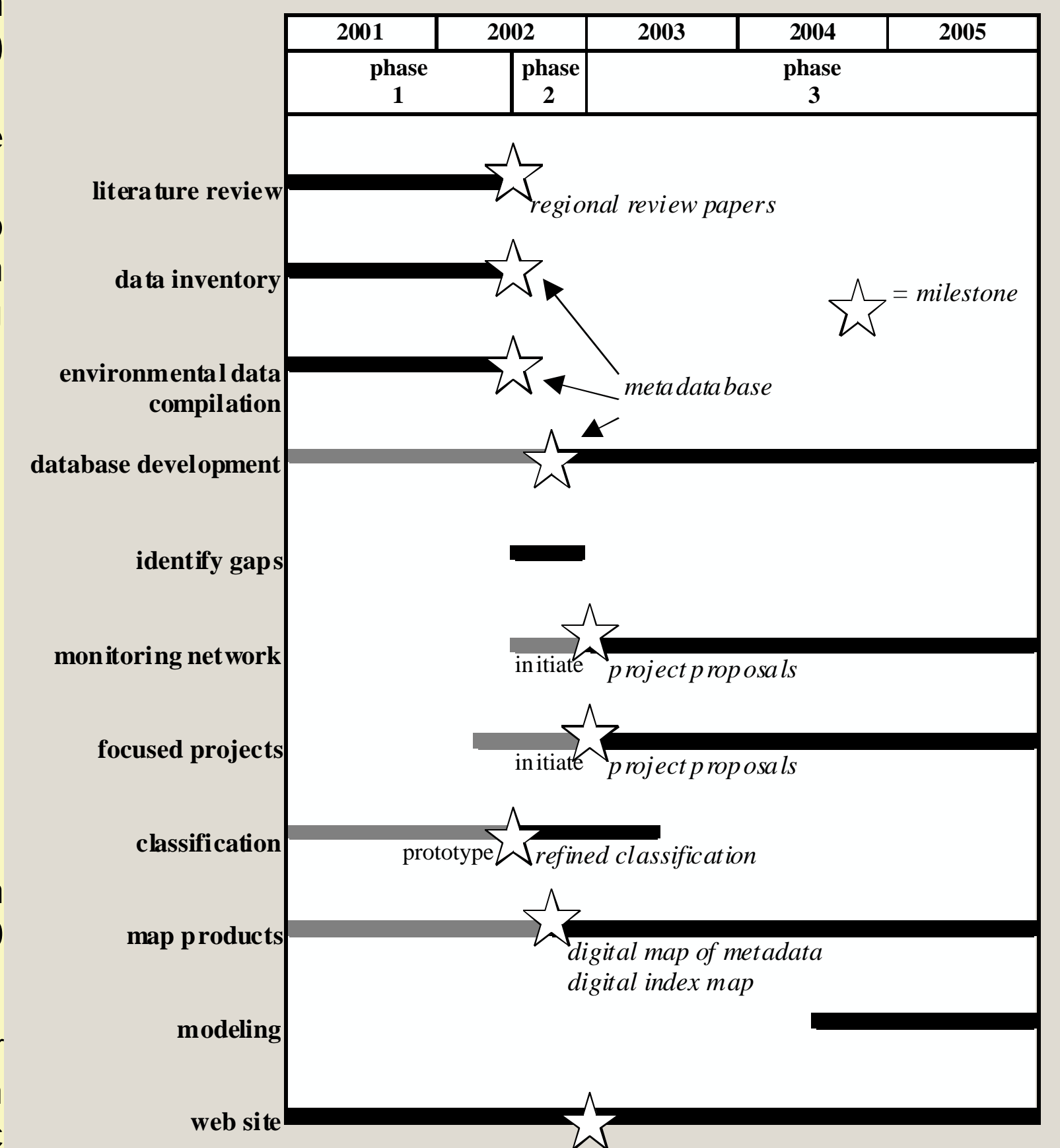


Figure 2. Main elements of the ACD Science and Implementation Plan, schedule and milestones.



Figure 4. ACD segmentation of the Arctic coastline by major seas. Terrain units are based on the digitized version of the IPA permafrost map (Brown et al. 1997). The photographs of the ACD key sites are taken from the circum-Arctic photo collection available at the ACD web site. The table shows the shoreline lengths of the Arctic Seas based on the World Vector Shoreline (excluding islands).

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