used to characterize regional phenological vegetation patterns in Alaska.

The procedures used to collect the AVHRR data and generate the NDVI composites are described by Eidenshink (1992). The NDVI values are derived from a ratio of the visible and near-infrared spectral channels of the AVHRR sensor. For the Alaskan data set, the NDVI data were composed of 11 half-month periods, between 1 May 1991 and 15 October 1991. This 11-band set was used to develop the land characterization products that describe the vegetation characteristics of the Alaskan landscape. A 54-class phenological classification was derived using a combination of an unsupervised classification of the NDVI values over vegetated areas in the state, a reclassification dropping "bad dates" where cloud contamination was still a problem, stratification of the classes using reference data sets, and pooling of phenologically and geographically similar classes. Labeling and evaluation during the analysis was accomplished by using existing land cover classifications where available. This training data set was built from a series of Landsat MSS data classifications developed by the various land management agencies in the state over the last 15 years. The MSS classifications were resampled and reprojected into the 1-km statewide projection and the legend classes translated to a standardized statewide legend.

A detailed statistical description page was developed for each of the final 54 phenological classes summarizing the characteristics of the class. Many different types of data were used in the descriptions, including: (1) the NDVI curve for the 1991 season and data points for 1990 and 1992 NDVI values; (2) areal extent of the class; (3) geologic rock types and ages; (4) permafrost types; (5) soil sub-order classes; (6) average elevation, slope and precipitation; (7) vegetation classes; (8) hydrologic regions; (9) ecoregions; (10) and physiographic provinces. Other products generated from the data include; phenological composite maps (onset, peak, and duration of greenness), photosynthetic activity maps (mean and maximum greenness), and a regional vegetation classification. The regional vegetation classification was developed from the land characterization classes by combining the 54 classes that had similar vegetation, geographic distribution and phenological curve, resulting in 24 vegetated and 3 non-vegetated classes.

The most distinct classes in the classification were those that also identified the most significant disturbance to the area during the growing season, i.e. fire. The analysis demonstrates how the AVHRR data can be used in combination with other data sets to characterize the land cover and its changes over time. The time-series data provide opportunities to study phenological processes at small landscape scales over periods of weeks, months, and years. Regional patterns identified on some maps are unique to specific areas, others correspond to biophysical or ecoregional boundaries. The data provide new insights into landscape processes, ecology, and landscape physiognomy that allow scientists to look at landscapes in ways that were previously difficult to achieve.

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AN ELECTRONIC HIERARCHIC GEOBOTANICAL ATLAS FOR ARCTIC SYSTEM SCIENCE

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An electronic hierarchic geobotanical atlas is being developed through the Arctic System Science (ARCSS) Land-Atmosphere-Ice Interactions (LAII) Flux Study. ARCSS is part of the US Global Change Research Program. LAII is a component of ARCSS. The two main goals of ARCSS LAII are to: (1) understand the variables and processes controlling the fluxes of energy, water, CO_2 and CH_4 from arctic ecosystems to the atmosphere and ocean, and (2) determine how these fluxes will change in response to future variations in climate. Detailed and accurate geographic information is needed at a variety of scales to determine the spatial variability of key ecosystem processes.

The Hierarchic Geographic Information System (HGIS) is designed to address a wide variety of questions ranging from plant-level responses to the global distribution and function of tundra ecosystems. The area of focus for the atlas is the Kuparuk River basin in northern Alaska, but extrapolation is planned for subcontinental and eventually circumpolar scales. Access to the electronic atlas of the HGIS is via the World-Wide Web (http://www.colorado.edu/INSTAAR/ TEAML/atlas/).

FLORISTIC DIVISION AND VEGETATION ZONATION OF GREENLAND OF RELEVANCE TO A CIRCUMPOLAR ARCTIC VEGETATION MAP

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Greenland has the largest extension in south-north direction of all the arctic territories stretching from 60°N in the south to the northernmost land in the world at almost 84°N. Such a large area has a wide variation in climate, geology, soils, and consequently, differences in local flora and vegetation. Except for a few inland areas in southernmost Greenland all of the island is classified by most botanists as belonging to the Arctic and is subdivided into a low arctic section and a high arctic section.

Thanks to three major papers on the floristic phytogeography of South, West, and North Greenland (Bay 1992, Feilberg 1984, Fredskild 1996) published within the last decade we have a large updated knowledge on the distribution of the vascular plants and the regional flora plus information on the vegetation of Greenland. The present number of vascular plants in 1993 was 513 species (Bay 1993). Only very few species are considered endemic to Greenland and most of the plant species have migrated to Greenland mostly via three routes. Low Arctic and boreal species have either immigrated from eastern North America or from Europe via The Faeroe Islands and Iceland. High Arctic species have mainly immigrated from northern parts of North America as they have had an easy access to Northwest Greenland and have spread further into the high arctic parts of Greenland. When comparing species of the floristic provinces with either a North American or Eurasian distribution it appears that the number of western species exceed the number of eastern species in most parts of Greenland. The only place in Greenland where the eastern species are in the majority is in Southeast Greenland. Thus, Greenland is biogeographically more closely related to North America than to Europe.

With the substantial knowledge from the phytogeographical studies we have a basis for revising the delimitation of the floristic provinces and districts proposed nearly 40 years ago. This division is based on more than 120,000 herbarium specimens. There are three major changes: (1) The floristic province North Greenland is divided into two districts of which the coastal one comprises all the polar deserts of Greenland. (2) The border in West Greenland, which is a distinct phytogeographical border dividing West Greenland into the low and middle arctic zone, is revised. (3) The delimitation of the South Greenland province has been extended northwards. In addition, minor changes to the division of Northeast Greenland are proposed. The northern district of central East Greenland is divided into two districts giving a total of four district in this province, and the border between coastal and continental inland areas is moved eastwards leaving only minor areas in the coastal district. Areas in Southwest and Southeast Greenland hitherto considered coastal are now included in the continental provinces.

Contributions to Level 1

According to Yurtsev's phytogeographical zonation (Yurtsev 1994) no areas in northern Greenland are included in the High Arctic Tundra Subzone leaving Greenland as the only area without areas in this zone. Recent investigations in northern Greenland (Bay 1992, Bay in press, Bay and Fredskild 1997) showed that the coastal areas of North Greenland do belong to the High Arctic Tundra Subzone, giving this subzone a complete circumpolar distribution. Yurtsev includes the northern half of Greenland in the northern variant of Arctic Tundra Subzone. Most of this area (70°-80°N) should be included in the southern variant leaving only the area 80°-83°N in the northern variant of the Arctic Tundra Subzone. This is in agreement with the delimitation of the Middle Arctic Tundra Zone proposed by Elvebakk (1985) and the "Dwarfed and Prostrate Shrub Zone" of Edlund (1990).