Canada, Greenland, and the United States. Because of the economies of scale, and the fact that data acquisition is one of the most expensive parts of the study, map production efforts would be more efficient if concentrated at one facility.

The EROS (Earth Resources Observation Systems) Alaska Field Office (AFO) in Anchorage is a modern scientific facility with a highly experienced staff, state-of-the-art hardware and software, and supplemental map data (Shasby and Carnegie 1986; Fleming 1988; Markon 1995). The AFO also has the capability to efficiently communicate and transfer information to Canada and Greenland, and has at its disposal the staff and facilities of the US Geological Survey's EROS Data Center in Sioux Falls, South Dakota, US.

The AFO could accomplish this task in partnership with the University of Colorado and the US Fish and Wildlife Service. Specialists with a strong background in the vegetation of arctic Canada, Greenland, and Alaska would supplement the process by providing maps from their respective countries and their field knowledge. This would require travel of two or three individuals from Canada and Greenland (Denmark) to the AFO during the mapping process for one or more brief periods of time.

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A Statewide Vegetation Map of Alaska Using Phenological Classification of AVHRR Data

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Obtaining sufficient data to describe the characteristics of vegetation over large geographic areas has traditionally been difficult. However, during the last decade, substantial progress has been made by using Advanced Very High Resolution Radiometer (AVHRR) satellite data for land-cover characterization on a global scale. Instead of analyzing the spectral response of the earth's surface from a single point in time with several bands, a maximum Normalized Difference Vegetation Index (NDVI) is calculated from daily observations for a series of periods extending through an entire growing season.

The data are summarized over a period of time instead of using the daily values in order to remove, or at least minimize, any clouds that might hinder determining the maximum NDVI value for that period. In studies in various parts of the world, the length of the periods has varied between 10 days and a month, depending on the amount of cloud cover and rate of change of the vegetation condition. The span of time over which the data are acquired also varies, and can be as short as seven months, as in Alaska, to an entire year in equatorial regions. The data sets currently being developed for the Global Change community have periods one month long and extend for an entire year, 1 April to 31 March.

Loveland *et al.* (1991) have produced a detailed land characterization of the conterminous United States using time-series AVHRR data and digital image processing techniques. Their work demonstrated that regional patterns may be effectively mapped in conjunction with ancillary data. The unique spatial and temporal qualities of the AVHRR data provide information that leads to a better understanding of regional biophysical characteristics of vegetation communities and patterns. The data provide synoptic views of the landscape and depict phenological diversity, temporal vegetation phenology (green-up, peak of green, and senescence), photosynthetic activity, and regional landscape patterns. In this study, NDVI data derived form the AVHRR satellite were 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