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## 1. INTRODUCTION

The Arctic remains one of the least explored, studied and understood places on earth. Yet change in the Arctic may play a substantial role in climate change throughout the globe, and global change, particularly climate change, may have its most pronounced effects in the Arctic. Complex environmental changes are occurring in the Arctic. Permafrost temperatures are rising, shrubs are starting to appear, sea ice volume is decreasing, stratospheric winds are increasing, Northern Europe is warming (winter), Northern North America is warming (spring), and ecosystem shifts are impacting fisheries, land, and marine mammals.

Effectively communicating Arctic change information to a broad audience, including scientists, students, teachers, decision makers, and the general public, is a challenging task. Our approach meets the needs of Arctic scientists for quick access to content and the needs of program managers, staffers, and decision makers for general information and easily assimilated, credible, analytical results. Credibility requires clarity and transparency of the methodology without sacrificing recognition of the underlying complexity of the ecosystem. Our goal leads naturally to providing the larger Global Change community with a clear understanding of the complex changes that are occurring in the Arctic.

Our goal is a natural sequence that starts with providing an authoritative, comprehensive, easily understood information resource, adding access to real-time and historical data, real-time forecasts, analyses, and scientific journal articles, and finally creating a distillation of the analyses for presentation to decision makers. At every step, credibility is enhanced by clarity and transparency of the methodology, without sacrificing recognition of the underlying complexity of the ecosystem.

## 2. A COMPREHENSIVE ARCTIC INFORMATION RESOURCE

NOAA's Arctic Theme Page (Soreide, 2001) is a comprehensive source of Arctic information for a wide audience, including scientists, students, teachers, decision makers, and the general public. Features include educational material, photographs (including the North

Pole Web Cam), maps, links to forecasts, real-time and retrospective data, and expert essays on key Arctic issues, ranging from changes in sea level, ice extent, and climate indices, to changes in Polar bear and Arctic wolf populations.

The Arctic Theme Page is already proving useful to a wide audience, including scientists, students, teachers, decision makers, and the general public. Clear indications of this success include recognition by USA Today, Science magazine, Scientific American, Yahoo, etc. Sponsored by NOAA's Arctic Research Office, the website is available at <http://www.arctic.noaa.gov>.

## 3. ONE-STOP SHOPPING FOR ARCTIC CHANGE DATA FROM MANY SCIENTIFIC DISCIPLINES

The Unaami Data Collection (Soreide, 2002) is a carefully selected, diverse set of 86 multi-disciplinary time series which quantify complex, interrelated, pan-Arctic changes. This unique collection of Arctic change time series includes good geographic coverage of the northern polar regions across diverse disciplines, including fisheries, biological, terrestrial, oceanic, sea ice, atmospheric, and climate index data, from 1970 to the present. This does not replace information at data centers, but rather, pulls together an important subset into one location. This time period includes the major atmospheric change noted near 1989. Basic physical meteorological and oceanographic data and impact data such as fisheries, marine mammals, ozone, and plant changes are included. For example, fur seals and beluga whales are thought to be indicator species in the Western Arctic. Examples of physical variables are pressure at the North Pole, the Arctic Oscillation and North Atlantic Oscillation pressure indices, sea ice extent in five sub-basins, snow cover and cloud amount in different subregions, surface and upper air temperatures at selected observing stations, and ice and ocean transports through the Bering and Fram Straits. Many of these datasets are being obtained through personal contact with their originators or owners.<sup>1</sup>

The web site makes this unique collection of carefully selected diverse Arctic time series, and our analyses of

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<sup>1</sup>If you know of any time series that represents any aspect of Arctic change, please contact us: James E. Overland, NOAA/Pacific Marine Environmental Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115, Phone: 206-526-6795. E-mail: [James.E.Overland@noaa.gov](mailto:James.E.Overland@noaa.gov).

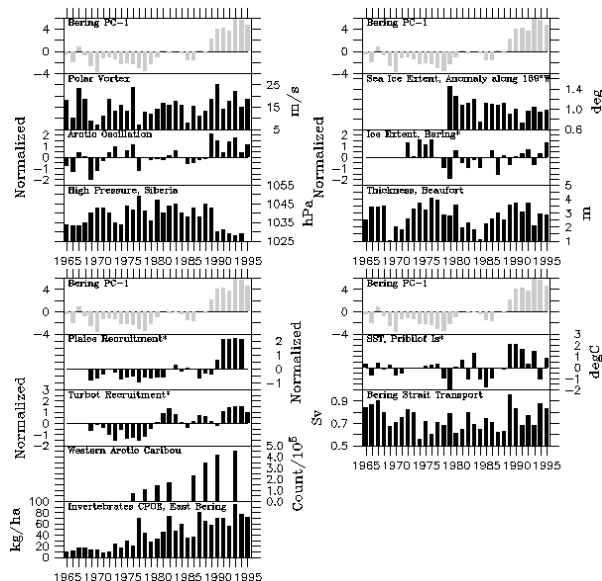


Figure 1. Typical scientific journal article illustration of Arctic data and analyses. Principal component analysis is shown with selected individual time series.

these time series, easily and freely available to the scientific research community. Sponsored by NSF, the Polar Science Center, and NOAA, the Unaami data collection is an activity of the SEARCH (Study of Environmental Arctic Change) Project office, and is available at <http://www.unaami.noaa.gov/>.

#### 4. SCIENTIFIC ANALYSES

The time series within the Unaami Data Collection quantify Arctic change across many scientific disciplines. The website allows modest analysis functions to be applied to the time series, and more detailed analysis results are provided. A publications section lists relevant publications and journal articles.

The complex information contained within a refereed journal article (Fig. 1) is challenging to present to a broad audience and methodologies for doing so are just beginning to emerge. The challenge is developing a clear presentation of this information for decision makers and a non-technical audience. In Fig. 2, the same analyses are presented so that the large changes in recent years across multiple disciplines and analyses are highlighted in red.

#### 5. FUTURE PLANS

The benefit of this effort is wide access, through the web, to the primary data and the ecosystem indicators and indices derived from it, along with supporting documentation and explanation. This will be the basis of a future "Arctic Climate Status" product. At the technical level, we provide access to the data and analysis

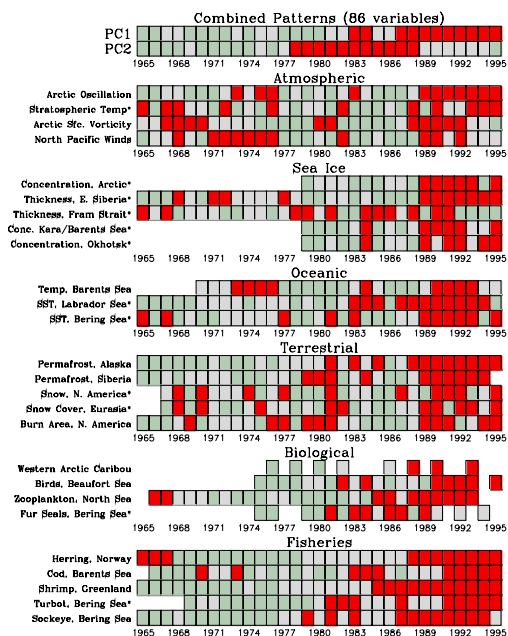


Figure 2. Preliminary illustration of Arctic variability designed for decision makers. Variability and dramatic changes in recent years can be seen at a glance (darkest gray). Details such as principal component analyses and physical-biological time series are revealed by closer inspection.

methods. For the management community, we will provide multiple indicators and an assessment of uncertainties. For the general public, we will provide several easily understood status measures. Finally, we will provide credible, authoritative information on complex Arctic change to the greater Global Climate community. The credibility of these products will be enhanced by clarity and transparency of the methodology, without sacrificing the recognition of the underlying complexity of the ecosystem. The clarity is enhanced by providing quality control, reproducibility of the analyses, and stating of uncertainties in the results.

#### 6. REFERENCES

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