

Introduction

The National Snow and Ice Data Center (NSIDC) Atlas of the Cryosphere is a dynamic web mapping site, designed to be user-friendly, that allows the visitor to explore and interact with the frozen regions of Earth. Viewed from a polar perspective, information that can be displayed includes snow cover, sea ice extent and concentration, glaciers, ice sheets, permafrost, and other critical components of the Earth's cryosphere. The user can zoom in to a specific region on the Earth as well as overlay country borders, major cities, and other geographic information.

In addition to providing an interactive web interface, maps and data sources contained in the Atlas of the Cryosphere are also accessible via the Open Geospatial Consortium (OGC) Web Map Service (WMS), Web Feature Service (WFS), or Web Coverage Service (WCS). These international specifications provide a framework for sharing maps and geospatial data over the internet.

To visit the Atlas, go to: <http://nsidc.org/data/atlas>

"Without geography, you're nowhere!"



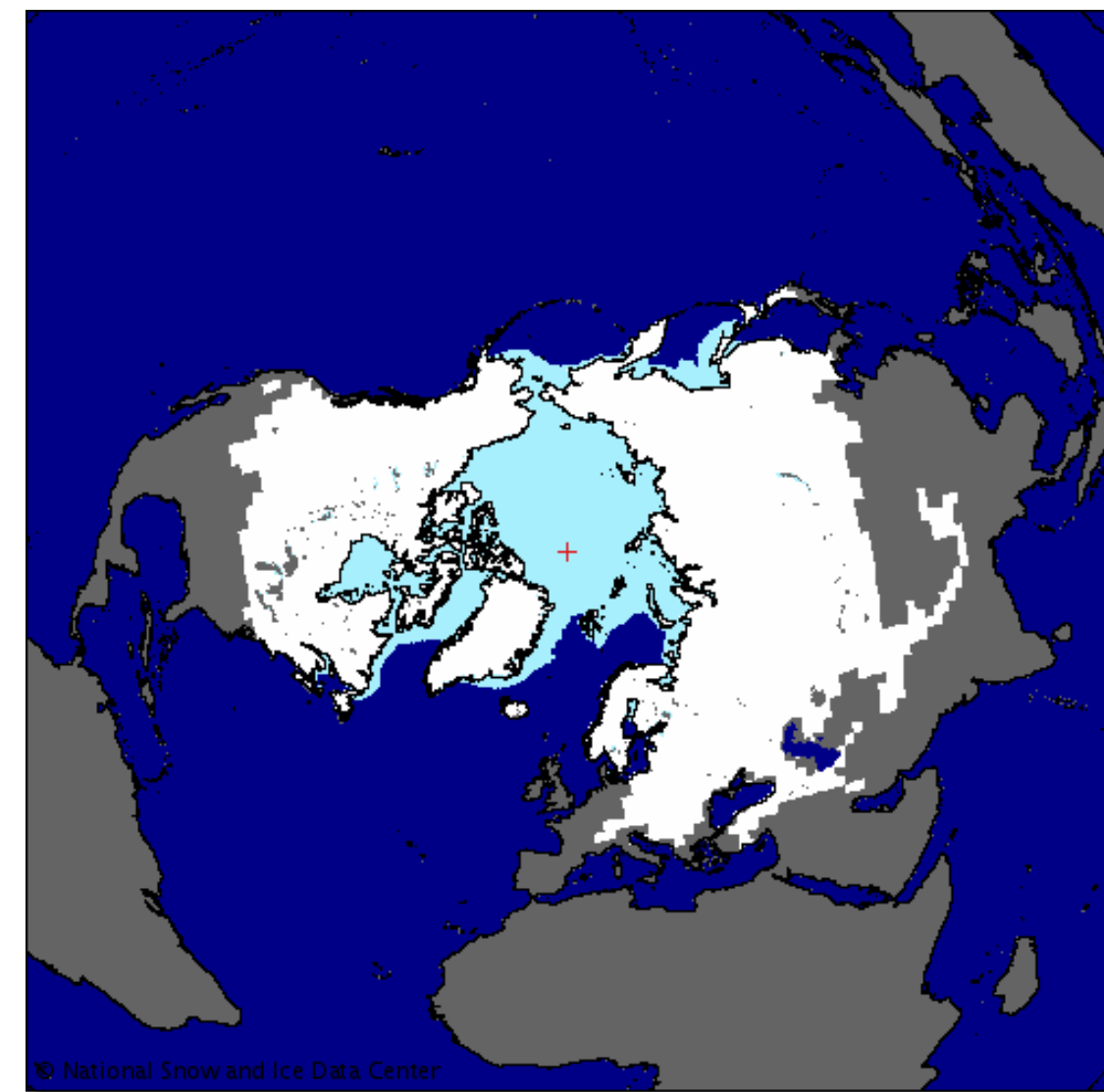
Selectable Parameters

Cryosphere:

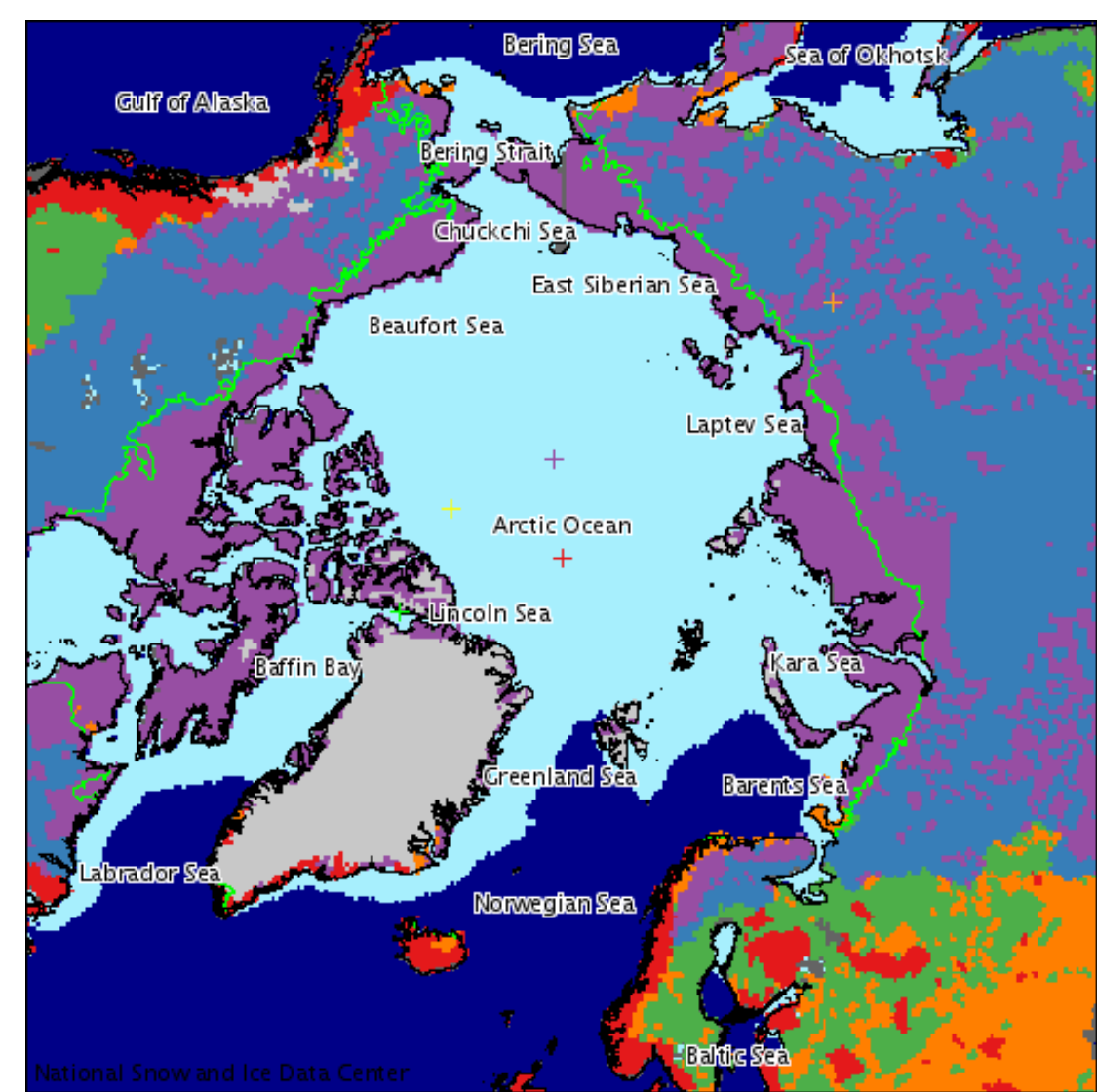
- glacier locations
- glacier outlines
- ice core locations
- ice sheet accumulation
- ice sheet elevation
- permafrost extent
- permafrost ice content
- sea ice concentration
- sea ice extent
- seasonal snow classification
- snow extent
- snow water equivalent
- treeline (northern limit of forests) and more...

Other:

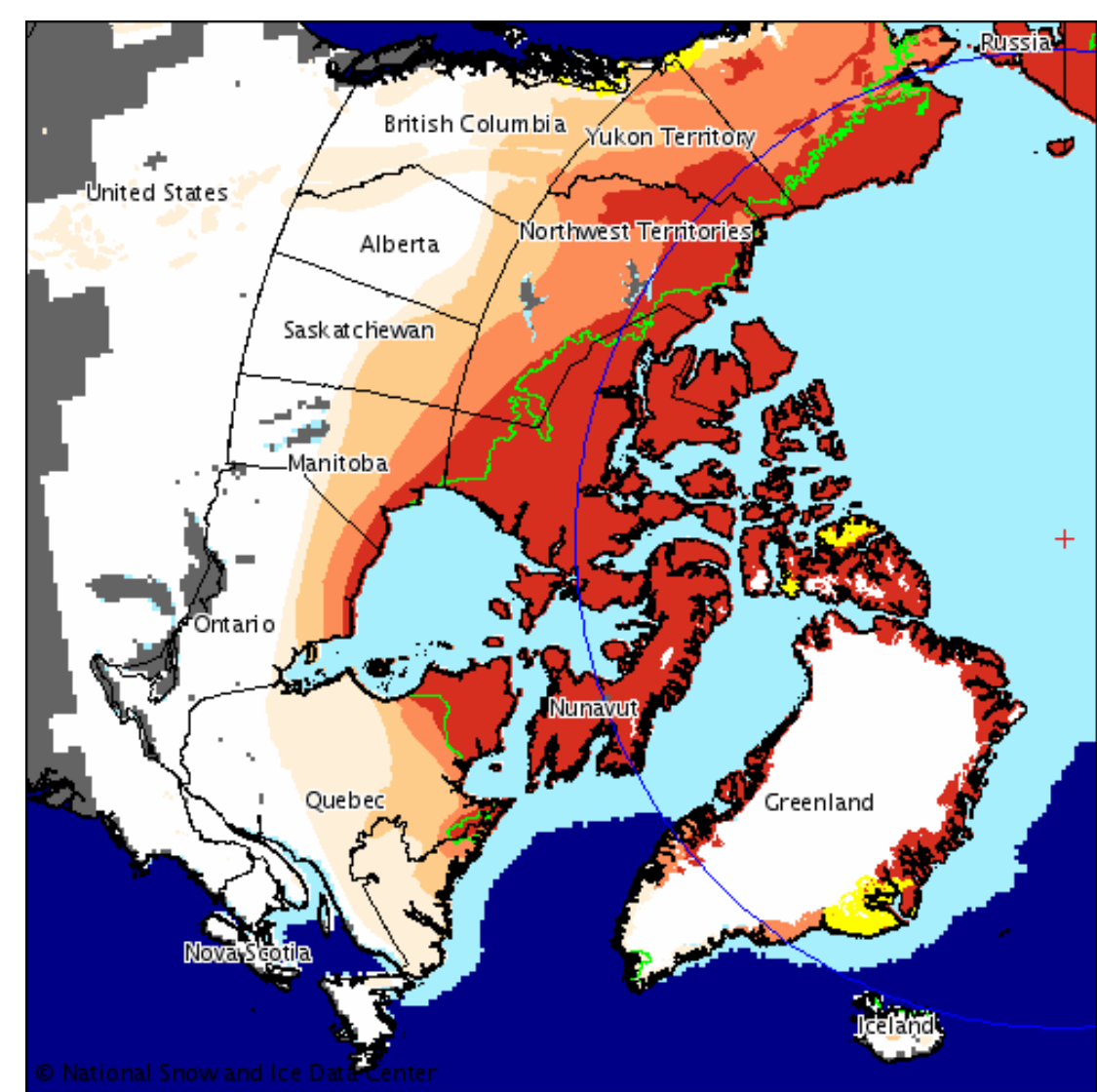
- Antarctic Circle
- Arctic Circle
- cities
- countries
- Equator
- geographic features (land, sea, and ice)
- International Date Line
- latitude and longitude
- North Pole
- South Pole
- Tropic of Cancer
- Tropic of Capricorn
- U.S. states and more...



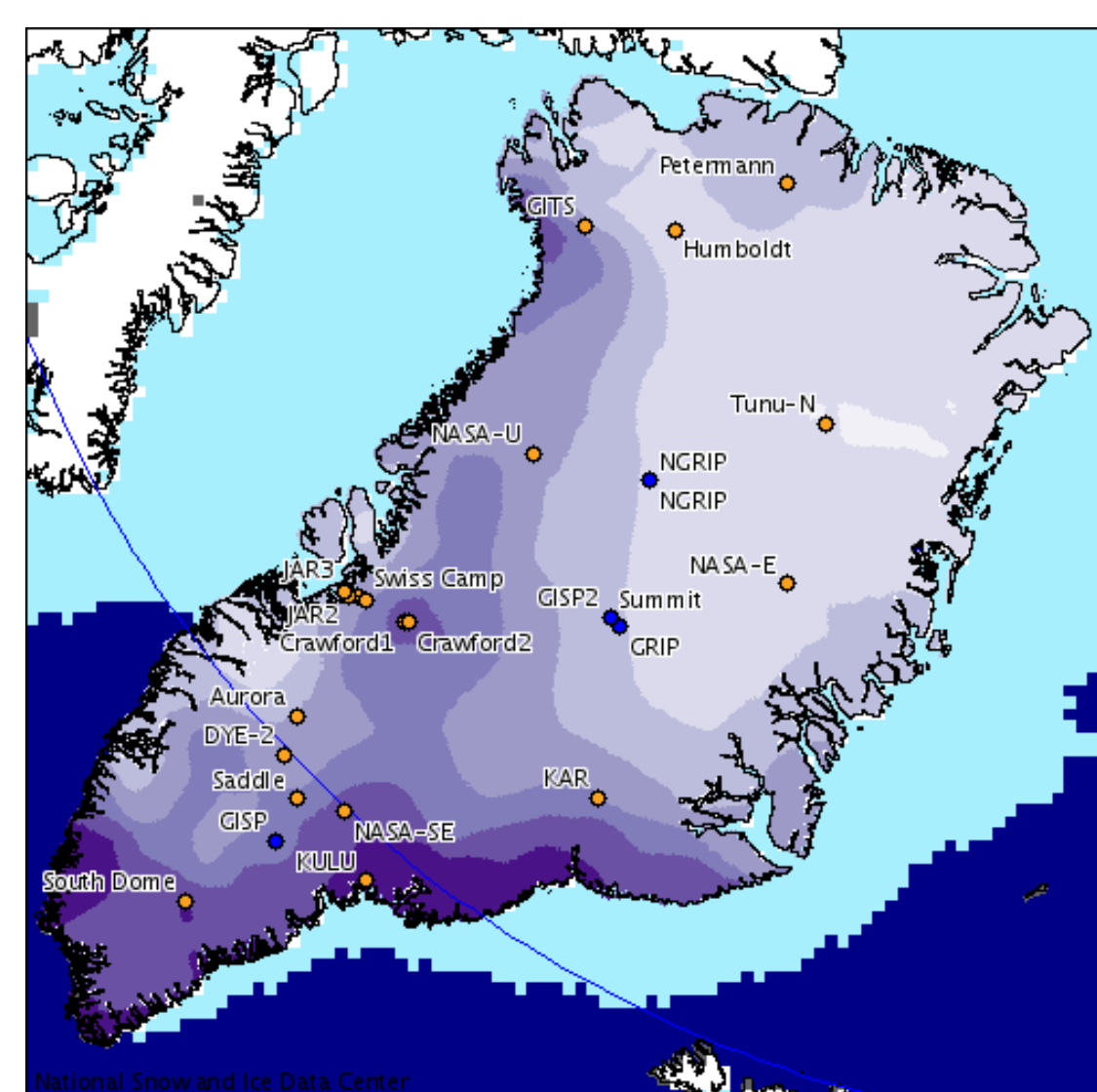
January climatology of Northern Hemisphere sea ice (1979-2005) and snow extent (1967-2005) with North Pole referenced (cross).



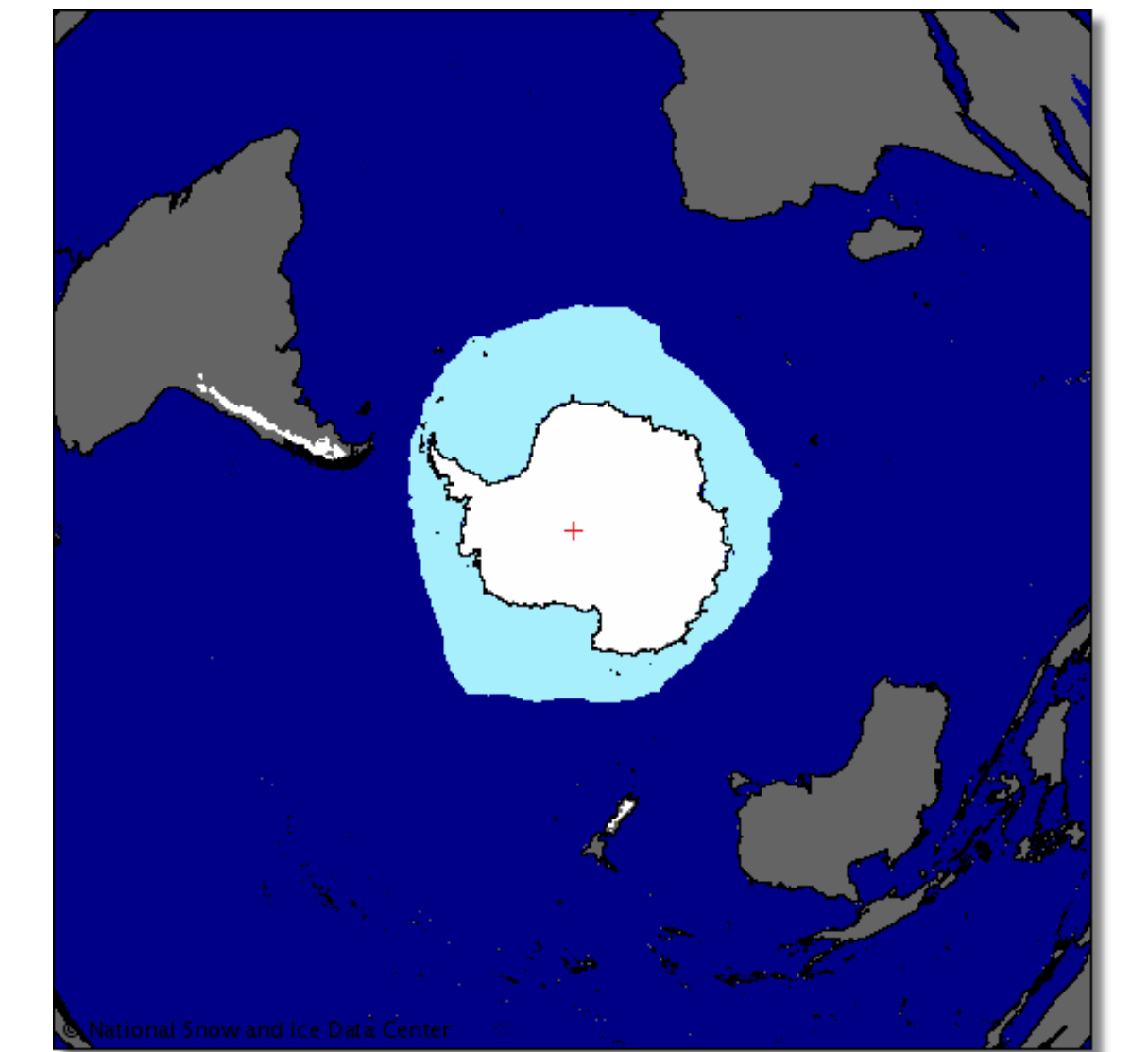
Arctic view of January sea ice climatology (1979-2005); seasonal snow classification on land; northern limit of forests (green line); and various types of North Poles referenced (crosses); geographic (red), geomagnetic (green), magnetic (yellow), cold pole (orange), and pole of inaccessibility (purple).



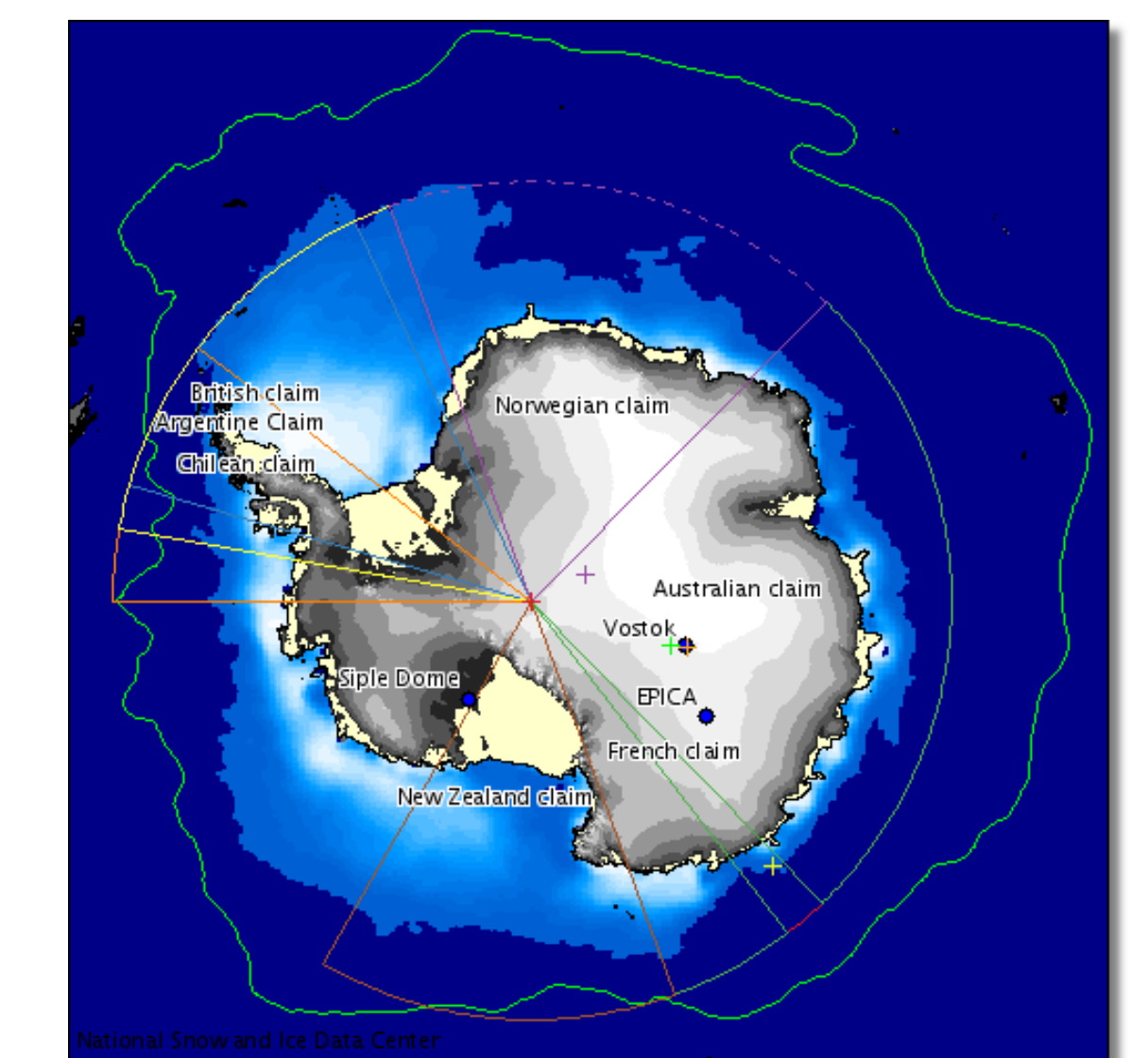
Northern Hemisphere view of permafrost extent, northern limit of forests (green line); glacier outlines (yellow); January climatology of sea ice (1979-2005) and snow extent (1967-2005); and Arctic Circle (blue line).



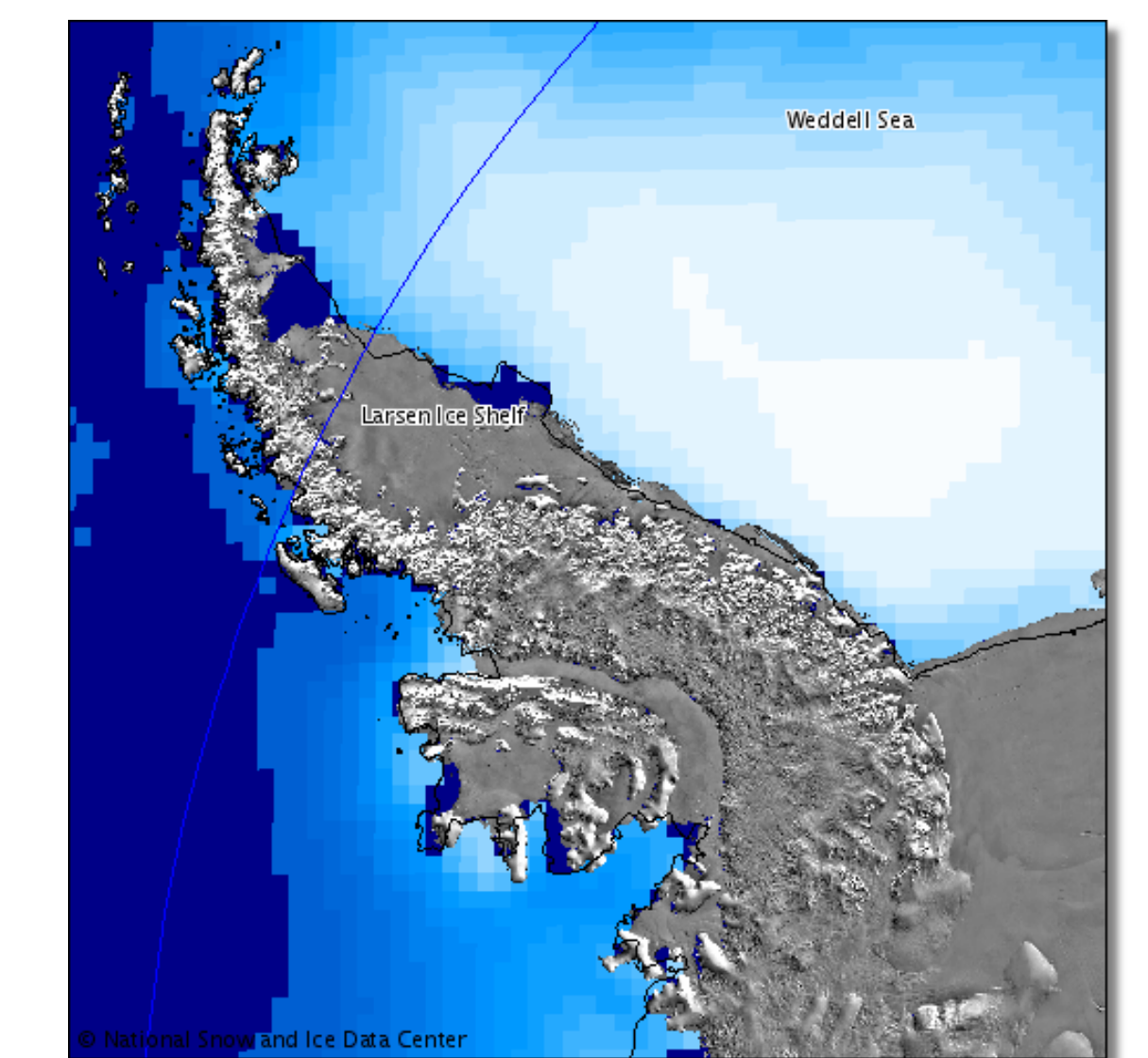
Greenland view of average annual snow accumulation (purples); January sea ice extent climatology (1979-2005); deep ice core locations (blue dots); Greenland Climate Network (GC-Net) Automatic Weather Station (AWS) locations (orange dots); and Arctic Circle (blue line).



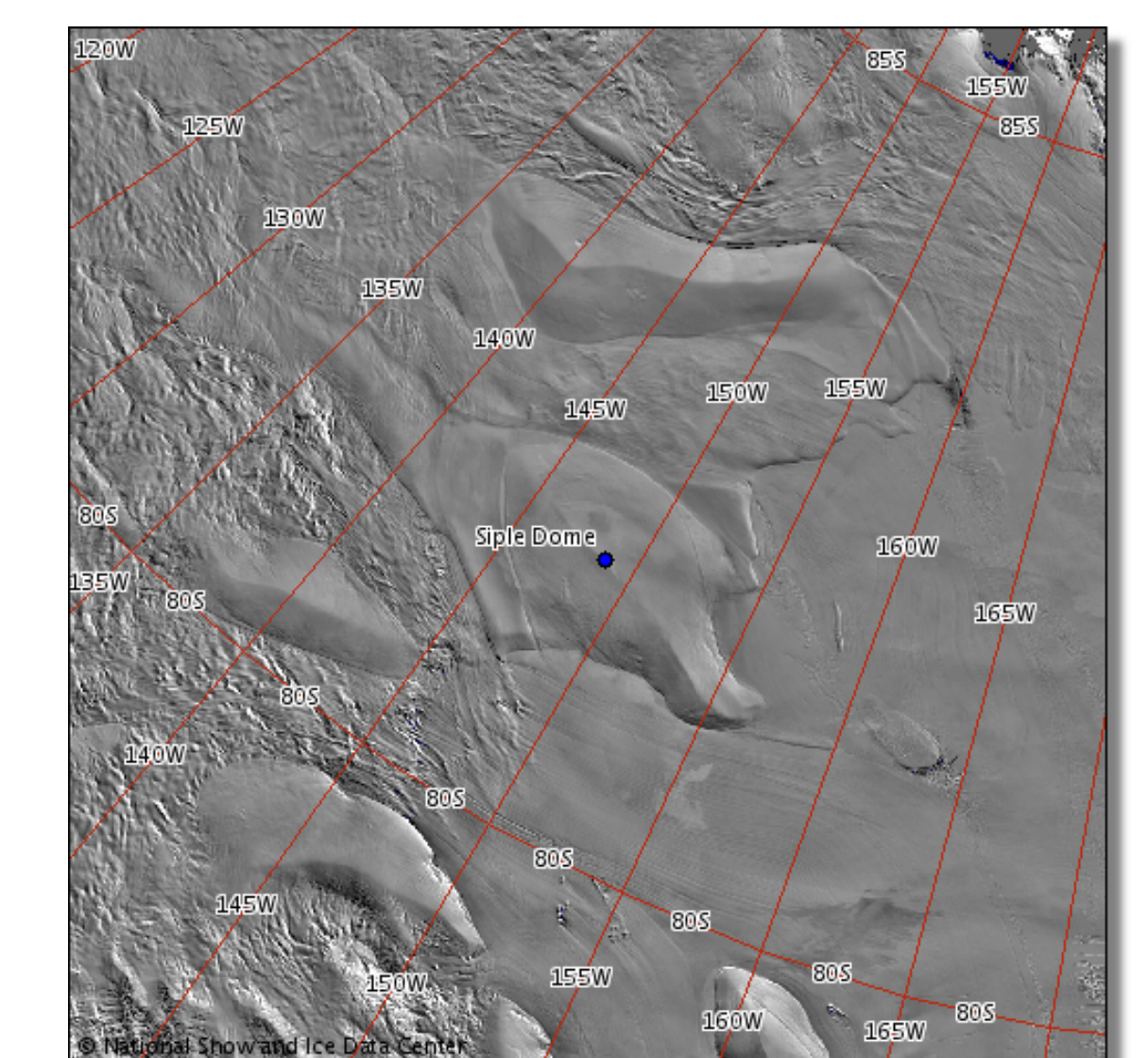
September climatology of Southern Hemisphere sea ice (1979-2003) and snow extent (1987-2002) with South Pole referenced (cross).



Antarctic view of January sea ice concentration climatology (1979-2003); Polar Front (green line); ice sheet surface elevation (greys); ice shelves (light yellow); Antarctic territorial claims; deep ice core locations (blue dots); and various types of South Poles referenced (crosses); geographic (red), geomagnetic (green), magnetic (yellow), cold pole (orange), and pole of inaccessibility (purple).



Antarctic Peninsula view of MODIS satellite image of surface features; March climatology of sea ice concentration (1979-2003); and Antarctic Circle (blue line).



Antarctic close-up on MODIS satellite image of surface features on the ice sheet and the Ross ice shelf near the Siple Dome ice core (blue dot) with latitude and longitude referenced.

Open Source GIS

NSIDC has leveraged use of the following Open Source software packages for the development of the Atlas and for manipulation of its diverse data sources (e.g. reformatting, reprojecting, etc.):

- **MapServer**
a development environment for building spatially-enabled internet applications
- **Geospatial Data Abstraction Library (GDAL)**
a data translation and processing library for raster geospatial data formats
- **OGR Simple Features Library**
a data translation and processing library for vector geospatial data formats
- **PROJ.4**
a cartographic projections library for enabling reprojections
- **libtiff**
a TIFF library for reading, writing, and manipulating TIFF files
- **libgeotiff**
a GeoTIFF library for reading and writing GeoTIFF information tags

Atlas of the Cryosphere
Atlas Info :: Restart Map :: Southern Hemisphere :: View Map Legend :: Data Sources :: OGC Services (WMS, WFS, WCS)

Click on map to:
 re-center
 zoom in
 zoom out
 zoom factor: 2
 zoom to...
 Right-click to save image.
 View glossary for:
 select term...

Select information to overlay:
 Click and hold <Ctrl> key to select multiple items.
 geographic features, sea
 Greenland Climate Network
 Greenland elevation contours
 Greenland ice cores
 International Date Line
 latitude/longitude grid
 North Pole, Geographic
 Update Map

Glacier basemaps: (What is a glacier?)
 none

Greenland basemaps: (What is an ice sheet?)
 none

Permafrost basemaps: (What is permafrost?)
 none

Sea ice basemaps: (What is sea ice?)
 sea ice extent: Jan

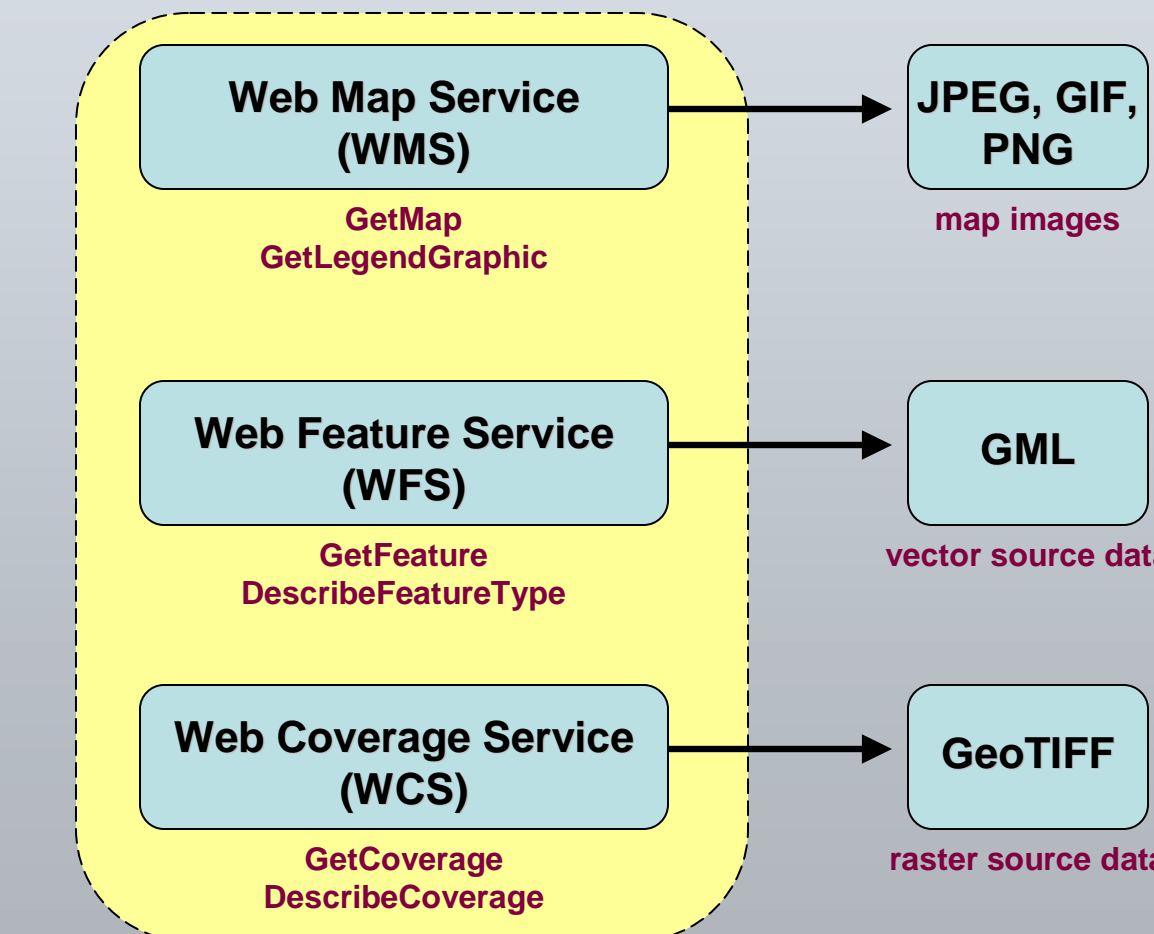
Snow basemaps:
 snow extent: Jan

Map Projection: Lambert Azimuthal Equal-Area
 Scale: 1:10245044.128574

Screenshot of the Atlas of the Cryosphere web interface for the Northern Hemisphere. Zoom options, a reference map, and glossary definitions on the left; selectable data layers and basemaps on the right.

Open Geospatial Consortium (OGC)

Interoperable and customizable data access to Atlas maps and source data are enabled via the following OGC specifications:



Using these services, maps and data can be accessed for your spatial region of interest. For more information, visit <http://opengeospatial.org>.

Interoperability

Maps can be generated through the provided Atlas of the Cryosphere web interface. Alternatively, maps and source data can be accessed remotely using Open Geospatial Consortium (OGC) web services and OGC-compatible clients, as demonstrated here:

ArcMap 9.2: User-friendly Desktop Internet GIS (uDig)

Quantum GIS (QGIS)

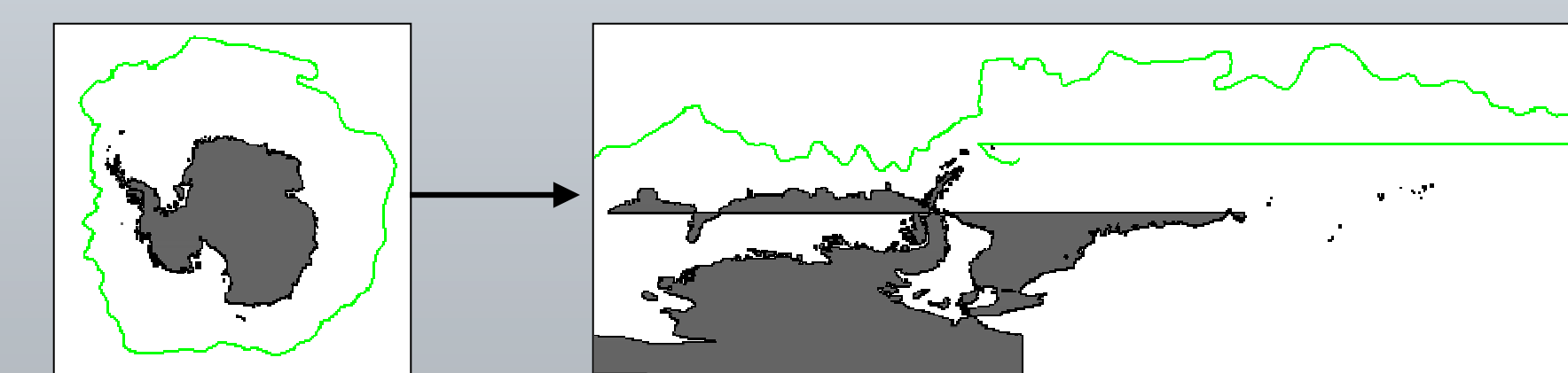
Google Earth 4

World Wind 1.4

ENVI Zoom 4.3.1

Lessons Learned

- Web mapping provides a more broadly accessible alternative to virtual globes such as **Google Earth** since it does not require desktop software and broadband internet speeds.
- MapServer provides much greater flexibility than **Google Maps**, which is limited to a global, latlong projection that poorly serves the polar community.
- Data that overlap $\pm 180^\circ$ longitude are distorted by a **wrap-around effect** when displaying polar data in a latlong projection or vice versa:



- OGC web services are limited to the European Petroleum Survey Group's (EPSG) Geodetic Parameter Dataset for their available map projections, which has very few polar projections. Although additional projections can be requested, this process is time-consuming. A more flexible framework such as **PROJ.4** would be beneficial to all.