How are projections derived?

IPCC Global Climate Models

The Intergovernmental Panel on Climate Change (IPCC) uses a suite of 15 General Circulation Models (GCMs) when preparing its assessment reports. These models simulate changes that occur with the release of greenhouse gases into the atmosphere under a range of potential future scenarios. GCMs are the most widely used tools for projections of global climate change over timescales of decades to centuries.

Each model was created by a different nation or group using slightly different data and assumptions. Thus, a goal of GCMs is to capture a range of possible future variability at worldwide scales, but this results in varying degrees of accuracy in any particular region.

GCMs integrate multiple equations, which typically include:

- Atmospheric and oceanic pressure, temperature, velocity and convection
- Incoming and reflected radiation
- Hydrology, sea ice dynamics and cloud dynamics

Model Selection

GCM accuracy across a particular region can be evaluated by comparing model output for past years to observed climate data for the same historical time period.

SNAP investigators analyzed how well each model predicted monthly mean values for the period 1958–2000 for surface air temperature, precipitation and sea level air pressure.

These three variables were then compared over several northern regions from Alaska to Greenland and over the entire Arctic.

SNAP climate models rely on output from the five GCMs that provided the most accurate overall results for these northern regions.

Scaling Down Results

Because of the mathematical complexity of GCMs, they provide only large-scale output. To make this information useful for regional land managers and community planners, SNAP scaled down results to match local conditions.

SNAP researchers created gridded datasets at 2 km resolution by scaling down GCM outputs using PRISM, the Parameter-elevation Regression on Independent Slopes Model. PRISM is an analytical tool that uses a digital elevation model (DEM) and other spatial datasets to interpolate between point data from weather stations.
What data are available at SNAP?

Climate resources can be accessed on the SNAP website www.snap.uaf.edu as web-based maps and charts as well as geospatial data files for further analysis. Projections for over 4,000 communities across Alaska and western Canada can be explored in our community charts tool.

SNAP offers climate projections from the present to the year 2099, based on downscaled GCM outputs. Retrospective simulations from 1980 to the present are also available.

The five GCMs selected by SNAP are used to generate climate projections independently, as well as in combination through a composite model, in order to reduce error associated with any single model. In addition, SNAP uses three future climate scenarios that represent future atmospheric conditions. These emissions scenarios were developed by the IPCC for each of its most recent assessment reports.

Historical data are available from 1901 to 2009. These datasets are derived from the Climate Research Unit (CRU) data, which are based on weather station data interpolated into a gridded format. Like SNAP’s GCM datasets, historical climate has been downscaled to 2km resolution.

SNAP data include mean monthly temperatures and precipitation as well as derived values such as decadal and seasonal means, thaw and freeze dates, growing season length, potential evapotranspiration, snow fraction, and a growing list of other applicable research data.

Linking climate to resources

Estimating future temperature and precipitation are just the first steps toward planning for change.

Stakeholders who want more detailed information can create collaborative agreements with SNAP in order to work on projects that directly affect resources, ecosystems, livelihoods and quality of life.

Working with partners, SNAP can link climate data to variables such as:

- Permafrost thaw
- Forest fire frequency and extent
- Timing of autumn freezeup and spring breakup
- Summer season length
- Landscape water balance
- Frequency of flooding events
- Sea level change

These changes can in turn be linked to factors of direct concern to communities and land planners, such as ecosystem shifts, fire impacts, agricultural opportunities, movement of game animals and risks to infrastructure.