Oregon Climate Data Standard

By

Oregon Framework Implementation Team Climate Subcommittee
George Taylor, Chairman

November, 2003

1.0 Introduction

It has been estimated that 85% to 90% of all information collected and used by government agencies and utilities is geographically related. Advances in the use of computerized geographic tools, known as geographic Information Systems (GIS) have enabled nearly every such agency to have access to geographic information for planning and decision-making. The Oregon Geographic Information Council (OGIC) was established to encourage and support the use of GIS in Oregon, and to develop guidelines and standards to make the collection, sharing and use of geographic information more efficient and less expensive.

Part of OGIC's role was to establish a geographic data Framework, a consistent, standardized set of digital geospatial data and supporting services that will:

- provide a geospatial foundation to which an organization can add detail and attach attribute information
- provide a base on which an organization can accurately register and compile other themes of data, such as zoning, permits, assessment data, accident data, hazardous waste site data, etc.
- orient and link the results of an application to the landscape.

OGIC assigned an Oregon Framework Implementation Team (FIT) to carry out the development tasks. A number of individual technical subject areas were identified for specific emphasis; among those is climate. FIT has delegated the development of a Climate Framework Implementation Plan and a prototype Climate Data Standard to the Framework Implementation Team Climate Subcommittee (FIT-CLIM). The Climate Framework includes a variety of elements, including precipitation, snowfall, temperature, and growing season, among others.

This document, the Oregon Climate Data Standard, describes the first component of the Climate Framework Implementation plan. It is the result of several collaborative meetings involving state and federal representatives that occurred in 2003.

2.0 Body of the Standard

2.1 Scope and Content of the Standard

The scope of the climate standard includes the state of Oregon as well as nearby portions of adjacent states. Climate does not “end” at state boundaries but is continuous across a domain, so inclusion of areas near, but beyond, the state border is necessary for some analyses.

Both raster (grid) and vector (lines, polygons, and shape files) are used by GIS professionals, and thus both types of data, and their respective metadata, should fall under the standard.

2.2 Need for the Standard

As GIS has come under broader use, its use by environmental professionals has grown significantly. The development of several spatial climate tools in the 1990s (PRISM, ANUSPLIN and MTCLIM in particular) brought climate data to the GIS environment.

The federal government has recognized the need for a spatial climate standard. In 2002, a new subcommittee of the Federal geographic data Committee (FGDC) was formed – the Spatial Climate Subcommittee (see below). That group was tasked with creating federal standards for data and metadata for climate data. The three Oregon scientists who are members of the Federal committee and also members of FIT-CLIM.

2.3 Current Standards Development

A significant need has been identified for Federal and state coordination in the development, production and distribution of spatial climate data. There are numerous needs for spatial climate information within many Federal and state agencies, as well as outside the government sector. During the past several years there has been an increase in the number of spatial climate datasets available via the Internet, and elsewhere. However, many of these datasets have not been coordinated for content for metadata standards using established FGDC protocols. In order to provide clear and certified spatial climate information to a wide variety of Federal, state, local and private sector users, the FGDC Subcommittee on Spatial Climate Data was established The purpose of this subcommittee is to coordinate spatial climate data and information activities among all levels of government, as well as in the private sector.

Responsibilities for the development and distribution of spatial climate datasets presently rest among several Federal agencies within different Federal departments. The agencies involved principally are the U.S. Department of Agriculture's Natural Resources Conservation Service (USDA-NRCS), whose National Water and Climate Center (NWCC) is coordinating a national climate mapping effort, in coordination with Oregon State University (OSU); and the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (USDC-NOAA), whose National Climatic Data Center (NCDC) is developing a new, electronic national climate atlas, also in cooperation with OSU. There has been significant communication between NWCC, NCDC and OSU on this project, including extensive peer-review and adherence to

FGDC standards since inception more than five years ago. Project information can viewed at this web site: www.ocs.orst.edu/prism/prism_new.html. There may be other Federal and non-Federal efforts in spatial climate mapping, and this subcommittee could serve as a coordination point for all of these various efforts.

Spatial climate data under the purview of the subcommittee are envisioned to include information about atmospheric elements, surface temperature, dewpoint/humidity, precipitation, snow, wind, radiation, and a host of derived variables; and soil temperature and moisture, and others specified.

The subcommittee functions much like other FGDC subcommittees. Specific purposes could include these three identified by the Spatial Water Data Subcommittee, as well as others: 1) facilitating the exchange of information and the transfer of data; 2) the establishment and implementation of standards for quality, content and transferability; and 3) the coordination of the identification of requirements and the collection of spatial data to minimize duplication of effort where practicable and economical.

Dr. Greg Johnson of USDA-NRCS is chairman of the subcommittee. Johnson and two other subcommittee members, George Taylor and Christopher Daly, are members of FIT-CLIM.

2.4 Integration with Other Standards

The Oregon Climate Data Standard will specify several data formats. Basic climate information obtained from climate models such as PRISM is delivered in ASCII grid format, generally at a resolution of 1-4 km. Vector files, including contours, polygons, and shape files, are often used as well, but these are usually created from the original grid files. Grid files are generally in GEO (latitude-longitude) projection, but reprojection can be done (it is recommended, however, than reprojection by confined primarily to vector files, since raster reprojection can introduce significant errors).

2.5 Technical and Operation Context

2.5.1 Data Environment

The data environment for Oregon spatial climate data includes both raster (grid) and vector data. The exchange media for the data sets are typically as follows:

Raster: ASCII grid files with both Arc/Info and GRASS headers
Vector: shape files and/or polygons (ESRI format)

2.5.2 Reference Systems

The coordinate reference systems are as follows:

Raster: latitude-longitude (“GEO”)
Vector: Albers or other equal-area format

Vector files are easily reprojected to other reference systems; rasters, however, should not be reprojected because this introduces inaccuracies.

2.5.3 Global Positioning Systems (GPS)
GPS data-capturing devices enable data collection systems on the ground and above the earth to determine precise X & Y coordinate values and derive a surface location for the device. GPS is slowly being introduced to climate monitoring, providing much more accuracy is specifying station locations (until recently, locations were specified only to the nearest degree and minute, giving a precision of about 1 mile; with new spatial analyses operating at a resolution of as few as several hundred meters, GPS-derived station location data will bring significant benefits.

2.5.4 Integration of Themes
Some climate themes stand alone and are useful independently. In other cases, multiple themes combine to create new ones. For example, it has been found that the best way to create snowfall data themes is by combining precipitation and temperature information rather than creating data layers and themes directly from snowfall data.

Climate themes also integrate effectively with themes from other disciplines, including hydrology, transportation, vegetation, and soils.

2.5.5 Resolution
Resolution varies depending on the domain of a data set, computing capabilities, and availability of data measurements. To date, most state and national climate themes have had resolutions of 1-4 km (for gridded data). However, for smaller domains (e.g., a county or watershed), resolutions as small as a few hundred meters are possible.

2.5.6 Accuracy
Accuracy of climate data themes have been limited by the accuracy of station locations, which has historically been to the nearest degree and minute. This provides an accuracy of +/- 0.5 mile. The increased advent of GPS measurements is permitting more widespread reporting of locations to the nearest arc-second (20-30 meters).

2.5.7 Edge Matching
Climate data themes should be seamless across Oregon. Similar data sets from adjacent states using the same projection and horizontal/vertical datum should merge with the Oregon data without gaps.

2.5.8 Feature Identification Code
The Feature Identification Code (FIC) is a unique identification code that is assigned to a feature and does not change unless the existence of the feature changes. Following Federal Geographic Data Committee definitions, a “feature” is “a defined entity and its object representation. A real world feature is used in framework discussions to

emphasize the goal that framework data should be based on the original encoding of an observation, or be removed from an observation by the fewest possible generations or interpretations."

2.5.9 Records Management

Versions of the Oregon climate data sets will be tracked using a relational database management system hosted by the data steward (Oregon State University).

2.5.10 Metadata

The OCDS standard follows the Oregon Core Metadata Standard for geospatial data. Metadata detailing the characteristics and quality of climate data must be provided. Metadata should make every effort to meet the more rigorous standards set forth in the Federal Metadata Content Standard, where feasible. Metadata must provide sufficient information to allow the user to determine if the data set will meet the intended purpose, as well as helping the user to access and interpret the data.

3.0 Data sets

3.1 Public domain GIS layers

Resolution: 2.5 minute lat-long (approx. 4 km)
Format: ASCII grid

Category	Data set
Precipitation	Mean monthly & annual precipitation, 1961-1990
	Monthly precipitation, 1895-1997 (single months)
	Total precipitation for three flood events in 1996-97
	2-in-10 year annual precipitation
Temperature	Monthly mean minimum temperature, 1895-1997 (single months)
	Monthly mean maximum temperature, 1895-1997 (single months)
	Median date of last 28F temperature in spring
	Median date of first 28F temperature in fall
	Length of growing season
	1-, 2-, and3-in-10 year extreme January minimum temperature
Fog	Fog occurrence in western Oregon
	Low stratus occurrence in western Oregon

3.2 Data layers available for purchase or license commercially

Resolution: 1.25 minute lat-long (approx. 2 km)
Format: ASCII grid

Category	Data set
Precipitation	Monthly & annual precipitation
	Monthly & annual # days with ppt >= 0.01"
	Extreme Maximum Precipitation
	Monthly & annual mean greatest daily precipitation
	Record greatest monthly & annual precipitation
Temperature	Monthly & annual mean temperature
	Monthly & annual mean minimum temperature
	Monthly & annual mean maximum temperature
Extreme Temperature	Mean extreme monthly & annual maximum temperature
	Record extreme monthly & annual maximum temperature
	Mean extreme monthly & annual minimum temperature
	Record extreme monthly & annual minimum temperature

Humidity	Monthly & annual mean dew point Monthly & annual mean relative humidity
Degree Days	Monthly & annual mean total heating degree days Record extreme monthly & annual maximum total heating degree days Monthly & annual mean total cooling degree days Record extreme monthly & annual maximum total cooling degree days 1951-80 monthly & annual total growing degree days, base 50F
Snow	Mean monthly & annual snowfall Mean annual # of days with snowfall >= 0.1", 1", 5", and 10" Median/Extreme date of first snowfall Median/Extreme date of last snowfall Monthly & annual record daily snowfall Record monthly (Oct-Apr) & seasonal snowfall Probability of receiving measurable snowfall during a winter season Probability of a White Christmas
Hot/Cold Days	Monthly & annual mean # of days min temp <= 32F Monthly & annual mean # of days max temp >= 90F
Freeze Dates	Mean/Median/Extreme date of last 32F temp in Spring Mean/Median/Extreme date of first 32F temp in Autumn Mean/Median length of freeze-free period
Temperature	Monthly & annual mean minimum temperature, 1961-1990 Monthly & annual mean maximum temperature, 1991-1990

3.3 Suggested future data layers

Resolution: 30 arc-second lat-long (approx. 0.8 km)
Format: ASCII grid

Category	Data set
Precipitation	Precipitation intensity (2- through 100-year return) Multi-day precipitation intensity (1- to 5-days) Historical daily precipitation
Temperature	Soil temperature Soil freeze depth Historical daily temperature
Snow	Snow water equivalent

Wind	Monthly wind flow in Oregon
Solar radiation	Monthly average solar radiation
Cloud cover	Monthly average cloud cover