



# Climate Trends App: When Climatology, Geospatial, and Technology Mix It Up

State of Minnesota – Minnesota IT Services

**CATEGORY:**

Digital Government: Government to Citizen

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## Executive Summary

Minnesota IT Services (MNIT) and our business partners at the Department of Natural Resources (DNR) collaborated to create an interactive [climate change data application](#) to access climate change data and graphs. The project was sponsored by the Department of Natural Resources and funded by their Climate and Renewable Energy Steering Team (CREST). MNIT provided application development and IT project management expertise. Beneficiaries and stakeholders include: Minnesotans; state and federal governments; Minnesota Department of Natural Resources leadership, staff, operations, and program teams; the Minnesota State Climatology Office.

The application is available to the public on the Climate Change website. It is also used by Department of Natural Resources staff to prepare plans and reports, and to address questions from citizens. The application addressed a business need rooted in criticism that climate change data was difficult to find on the Department of Natural Resources website. Staff also spent an inordinate amount of time answering questions because people could not locate the data they needed.

Users can explore available data on historic temperature and precipitation trends throughout the state with the new [Minnesota Climate Trends map](#). The Climate App gathers monthly climate data dating back to 1895 from multiple sources. This data exploration tool allows users to select, retrieve, graph, and analyze year-to-year variations and longer-term trends in Minnesota's climate. The changes can be graphed across a variety of spatial levels ranging from the entire state, to specific cities and counties, to major watersheds and even state parks, forests and wildlife management areas.

The tool works by creating a *time series* of data, consisting of a single value each year, based on the area, range of months, range of years, and climate variable selected. For example, a user can retrieve *total precipitation for the five months ending in September*, for each year in the period *1980 to 2018*, valid for the *Cottonwood River Watershed*.

The collaborative nature of this project between MNIT and the DNR resulted in achieving the business objectives to educate Minnesotans about climate changes in our state, the impacts of climate change on our natural resources, and how the DNR is addressing climate change issues. The effort helps MNIT's DNR business partner demonstrate and affirm their leadership on climate change issues in Minnesota. It provides a geographically relevant, engaging, up-to-date, easily accessible online space for Minnesotans to access this information. They have seen an increase in visibility and usage. Analytics show an average of nearly 2,000 site visits per month.

The project and technical teams adhered to common values. They followed scientific rigor and factual accuracy, validating content at every stage, building accessibility, usability, and plain language into every aspect.

MNIT is committed to the success of our business partners, as evidenced in this timely project that is part of a global conversation. We partner with Minnesota state agencies every day to deliver technology solutions that transform how government provides services for the people of Minnesota.

## Exemplar

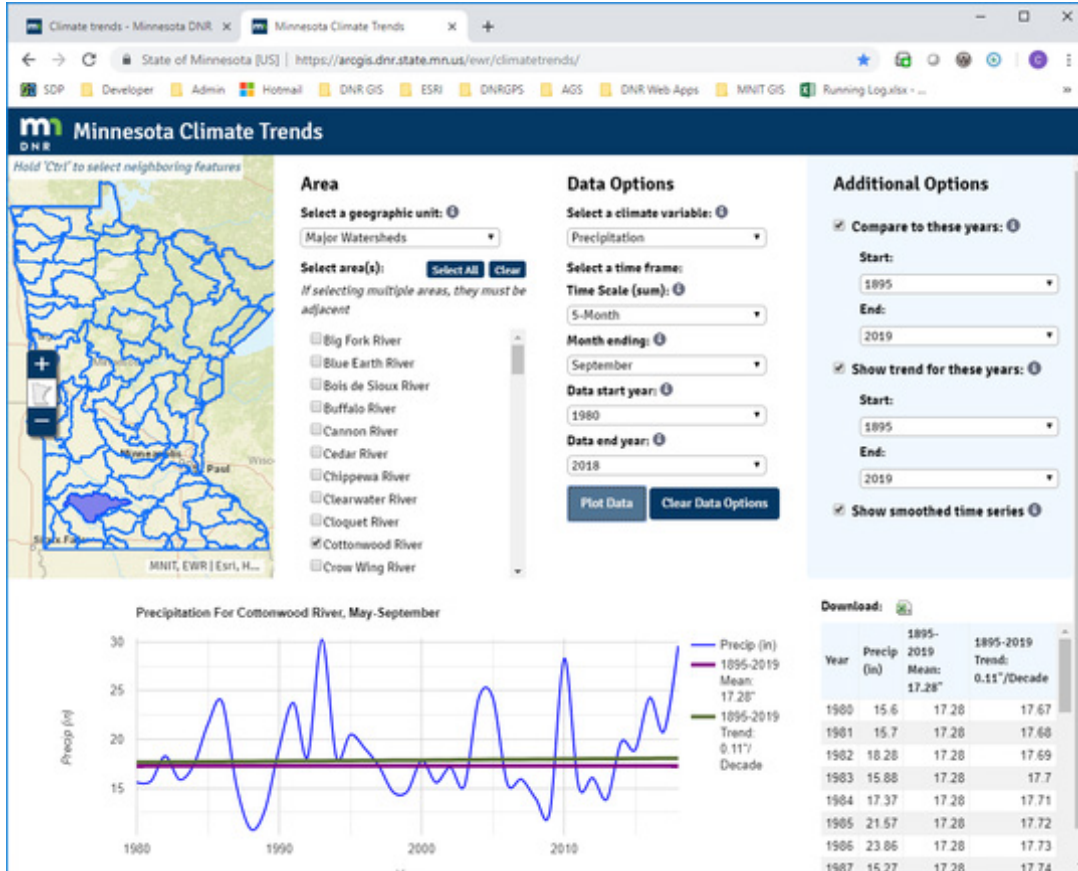
This project was built on a solid foundation of the custom web map application framework that MNIT uses for the Department of Natural Resources. What takes this effort to the **next level** is that the project integrates a very large amount of federal data (which is updated monthly) and brings it into a local NoSQL database environment where is optimized for very fast spatial query and historic trends analysis. Using our mapping framework, we were able to offer end-users 10 different geographic units (e.g., watersheds, deer permit areas) by which they can analyze climate trends. This has never been done before in Minnesota state government.

The **project scope** included:

- Documented requirements for the project.
- A cost estimate to fulfill the requirements.
- Automated processes to pull up-to-date data from NOAA and the West Wide Drought Tracker repositories.
- Integration of data from national datasets, tailored for Minnesota geographies used by the application.
- Changes/Updates to the DNR public Climate Change webpages (shown below).

The screenshot displays the Minnesota Department of Natural Resources website. The header includes the logo and navigation menu with categories like RECREATION, DESTINATIONS, NATURE, EDUCATION & SAFETY, LICENSES, PERMITS & REGULATIONS, EVENTS & SEASONS, and ABOUT DNR. A search bar is also present. The main content area is titled "Climate trends" and features a large graphic with arrows and icons representing temperature, precipitation, and snow. Below the graphic, there is a paragraph explaining that Minnesota's climate is changing rapidly, with temperatures increasing and extreme precipitation events occurring more frequently. It also mentions that substantial warming during winter and at night, along with increased precipitation and heavier downpours, have affected natural resources. A link is provided to explore available data on historic temperature and precipitation trends through the "Minnesota Climate Trends map". At the bottom, there is a section titled "Explore climate changes in Minnesota" with three bullet points: "Minnesota keeps getting warmer and wetter", "More damaging rains", and "Cold weather warming".

- An interactive climate change data map application which is mobile friendly (shown below).



## Concept

**Climate change data was difficult to find** on the Department of Natural Resources website, and the agency has received criticism for this. The current administration supported climate change communication, and the project had to be completed by end of CY 2018 to align with current administration. The team used **waterfall methodology** for project management.

**The biggest challenges** with this project were the short timeline and the limited budget. When the technical team realized that the budget did not allow for all of the desired functionality, they worked with the business sponsor to identify essential functionality. They agreed to a limited scope focused on a working application that met accessibility standards and allowed for future enhancements. The project was delivered on time, within budget, and within the revised scope.

The development used **best practices to meet the business requirements**. The Climate App gathers monthly climate data dating back to 1895 from multiple sources. This web application supports querying by multiple custom geographic segmentations, charting the results, and exporting the data for further analysis. Technical specifications include:

- Python scripts load temperature, precipitation data from NOAA, and drought severity index data from the West Wide Drought Tracker into a local NoSQL (Mongo) database. This local data is automatically updated as the source datasets change.
- The application itself uses a JavaScript front-end combined with server-side Python web services to support the database queries.
- This combination allows fast querying while enabling custom spatial queries based on watersheds, state parks, counties, cities, etc.

The tool automatically graphs a time series of the data and provides a table, with data also available as comma-separated values. Users can choose to add a linear trend calculation, expressed as a change in units per decade, and values averaged from a comparison period (along with annual departures from that comparison period). The project follows the **standard accessibility guidelines** for all Minnesota public website pages. The information used in this project is all public, so there were no information security requirements for this project.

**Costs for the project** were estimated through the MNIT Project Management Office and the application development team after an initial requirements analysis. The project involved two DNR staff (DNR Project Lead, Senior Climatologist) whose time was included as part of their normal job responsibilities. The project involved four MNIT staff (Project Manager, Business Analyst, Database Developer, and Application Developer). Costs for their services totaled \$18,336.00, paid through a professional service level agreement.

The Minnesota Department of Natural Resources sponsored the project, and is responsible for oversight and content. The application and website are maintained by MNIT. **The initiative will be assessed** regularly by the number of website visits and system requests for data by the public. Usage by state employees will help determine benefits due to increased productivity.

The Minnesota Climate Trends web map application is **promoted** on the Department of Natural Resources [Climate change and Minnesota](#) website. Department of Natural Resources staff are a primary user group for this tool and the agency has **promoted use of the tool** through their internal newsletter. Articles about the web application have also been **targeted at geographic information systems (GIS)** professionals in the organization and around the state via GIS user group newsletters.

## Significance

This project has **far-reaching benefits**. Because data is easier to update and access, there is increased staff capacity that can be dedicated to climate change issues. The site has seen an increase in public engagement in climate change science, **averaging nearly 2,000 visits per month**. Public visibility has increased engagement, because users can find links to the Department of Natural Resources climate page on the Minnesota State Portal website. The State Climatology Office has high visibility, and its online content is used by the public sector and other government entities.

This effort was the third phase of a three-phase program. In late 2017, the Climate and Renewable Energy Steering Team (CREST) undertook an effort to update the DNR's public-facing climate change website. Phase 1 was completed in January 2018 (basic update of old links, reorganization of resources based on DNR's 5 Key Messages on Climate Change). Phase 2, completed in April 2018, included creating subpages based on the five

key messages, with several Minnesota-specific stories to illustrate each page (climate changes, impacts on natural resources, DNR adaptation efforts, DNR mitigation efforts).

Phase 3 created an interactive climate change data map application which allowed users to customize their own graphical and statistical summaries of observed (historical) climate data. This project relies on data from NOAA and the West Wide Drought Tracker, and automatically pulls source data from that program's current repository in order to keep the app current.

The **business goals** are to:

- Educate the Minnesota public about climate changes in Minnesota, the impacts of climate change on Minnesota's natural resources, and how the DNR is addressing climate change issues in our work.
- Demonstrate/affirm DNR's leadership on climate change issues in Minnesota.
- Provide a geographically relevant, engaging, up-to-date, easily accessible online space for Minnesotans to access this information.

The project and technical teams adhered to **common values**. They followed scientific rigor and factual accuracy, validating content at every stage. State accessibility standards were incorporated into every aspect of the development. The site was built for usability, to withstand trends, and meet plain language guidelines so the content was understandable to everyone.

**Beneficiaries and stakeholders** include: Minnesotans; state and federal governments; Minnesota Department of Natural Resources leadership, staff, operations, and program teams; the Minnesota State Climatology Office.

**This initiative is innovative and distinct** because it allows the end-users to analyze a huge amount of climate data (1895 – 2019) over a variety of geographic units, such as state forests, watersheds, counties, etc. Users can also "build" their own custom geographic unit using the web map, allowing them to bundle more than one watershed or ecological subsection together to form a new area of interest. The ability of the user to download the raw data results for this custom area of interest for further analysis is also unique. Finally, the storage and optimization of a very large amount of Minnesota climate data in a NoSQL database to make the user queries extremely responsive is very different from past efforts to provide this information.

This project meets **priorities and initiatives** on many levels. It is part of a larger Department of Natural Resources effort to provide clear and helpful climate change information to the public. This project supports the agency's Conservation Agenda, which includes broad climate and renewable energy strategies. This project helps staff turn those strategies into operational principals and guidance to the public. It also meets NASCIO State CIO Top Priority for Digital Government, Data Management and Analytics. In providing the IT expertise, MNIT's guiding values and priorities were paramount in this project—to deliver quality IT solutions on time and on budget, and to modernize state government for citizens.

## Impact

**State government is better** as a result of this project because exact information is now available to state staff and to the public in an efficient, direct, and flexible manner. Before this initiative, **there was no source for**

**detailed climate data** specific to Minnesota. The public and Department of Natural Resources staff relied on federal databases and associated applications for climate data. These datasets and the interface were not Minnesota-focused and was limited to counties and municipalities in specific geographic data that could be queried. This was not helpful for the public or Department of Natural Resources staff, and as a result the State Climatologist got repeated requests for data that would be more pertinent to questions about climate change in Minnesota. That situation was unsustainable, and led to the initiation of this project.

The **immediate impact** of this initiative is that the people of Minnesota have access to decade's worth of climate data which was previously very difficult to work with. They can learn for themselves what the data says about trends over time, because the data is summarized in an easy to use interface, while the filtered raw data is also available for download. There are great educational applications for this tool as more educators become aware of it and learn how to use it.

In addition this project was **worthy of the investment** because it frees up the State Climatologist office to work on higher level projects and initiatives. Requesters can now get the data on their own, as demonstrated in the following metrics: Climate Web Site visits—9,990 from 7,112 unique devices in five months; Climate App visits—1,837 from 1,633 unique devices in four months.