NCICS / CICS-NC Overview

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NCSU/ORIED
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NCICS (NC Institute for Climate Science)

- *Inspire* cutting-edge research and collaboration

- *Advance* understanding and communicate the current and future state of the climate

- *Engage* with business, academia, government, and the public to enhance decision-making

- Current NCICS support is from NOAA, NASA, NSF, DoD/SERDP, and private industry

- Primary activity is the operation of the NOAA Cooperative Institute for Climate and Satellites-NC (CICS-NC)

ncics.org
ncsu.edu

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CICS-NC: a focus of NCICS, does the following…

- Collaborative research into the use of in situ and remotely sensed observations in climate research and applications

- Innovates new products and create new methods to understand the state and evolution of the full Earth system

- Prepares the next generation of the workforce needed to address climate science and its applications

- Engages with corporate leaders to develop climate-literate citizens and a climate-adaptive society

- Facilitates regional economic development through engagement activities

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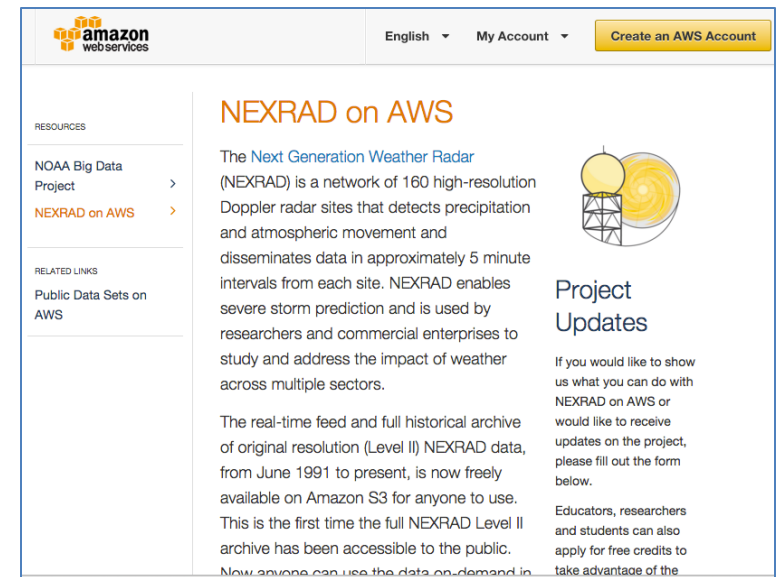## *CICS-NC – Seven Streams of Effort*

- Administration
- Access and Services Development
- Assessments
- Reference Environmental Data Records & Data Stewardship
- Climate Literacy, Outreach, Engagement, & Communications
- Surface Observing Networks
- Workforce Development

Plus Consortium and Other Projects

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Support improvements to access mechanisms for NCEI's data and product holdings

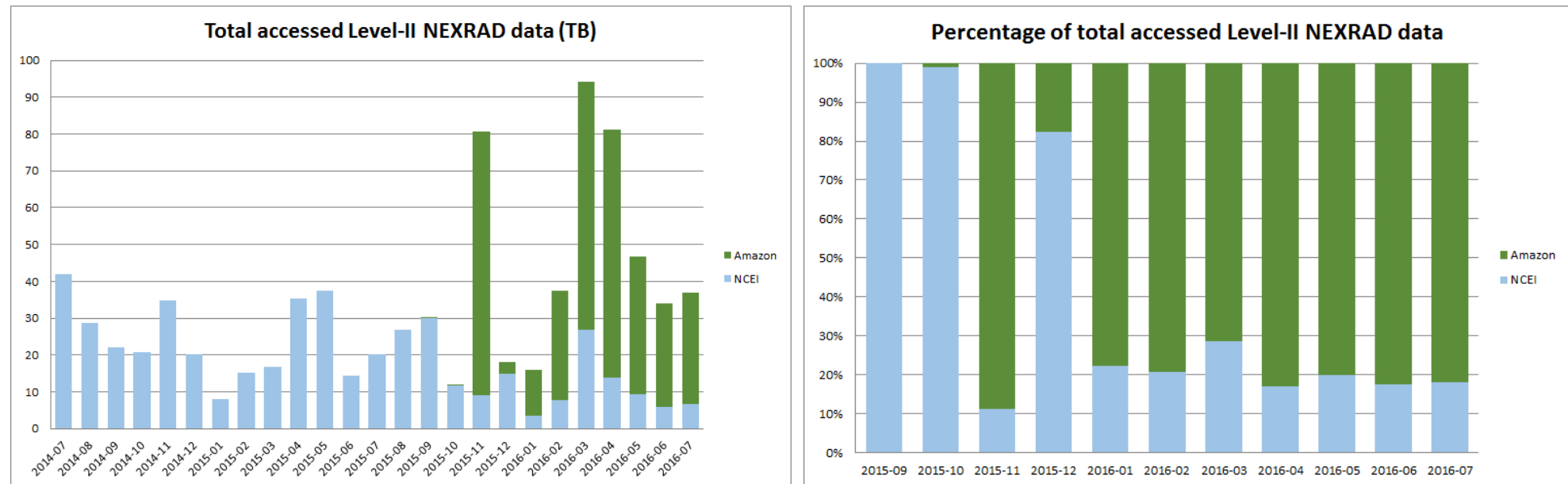## NOAA Big Data Project (BDP)

- Delivering environmental data via cloud providers (Amazon, Microsoft, Google, IBM, and Open Cloud Consortium)

- Required the Institute's high-performance computing infrastructure and its technical, scientific, & data expertise

- NEXRAD Level 2 live on AWS on Oct. 27th, 2015

  - Led to 2.3 times access with 80% from AWS

- GOES-16 near real-time distribution prototype in operation – June 2017

  - ~100K granules per day to each provider

NEXRAD on AWS

The Next Generation Weather Radar (NEXRAD) is a network of 160 high-resolution Doppler radar sites that detects precipitation and atmospheric movement and disseminates data in approximately 5 minute intervals from each site. NEXRAD enables severe storm prediction and is used by researchers and commercial enterprises to study and address the impact of weather across multiple sectors.

The real-time feed and full historical archive of original resolution (Level II) NEXRAD data, from June 1991 to present, is now freely available on Amazon S3 for anyone to use. This is the first time the full NEXRAD Level II archive has been accessible to the public. Now anyone can use the data on-demand in

Project Updates

If you would like to show us what you can do with NEXRAD on AWS or would like to receive updates on the project, please fill out the form below.

Educators, researchers and students can also apply for free credits to take advantage of the

https://aws.amazon.com/noaa-big-data/nexrad/

NOAA Big Data Project (BDP) [continued]
Changing the paradigm

Ansari *et al.*, 2017 Unlocking the potential of NEXRAD data through NOAA's Big Data Partnership, *Bull. Amer. Meteor. Soc.,*
https://doi.org/10.1175/BAMS-D-16-0021.1

Common Ingest system at NCEI-NC

- Develop a Common Ingest system for NCEI-NC to replace exisiting fragmented and difficult to maintain ingest systems

- Common Ingest deployed in the production environment at NCEI-NC

- Operations personnel trained in use of Common Ingest system

- 170 Data Streams configured and tested

- Initial Deployment July 2017

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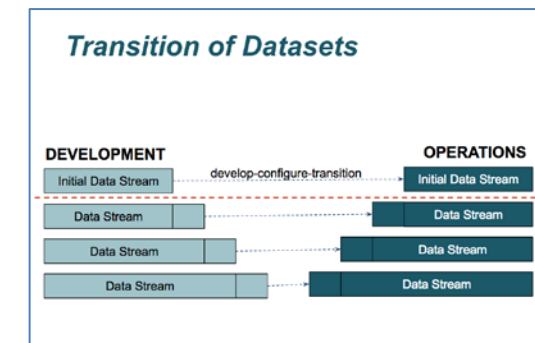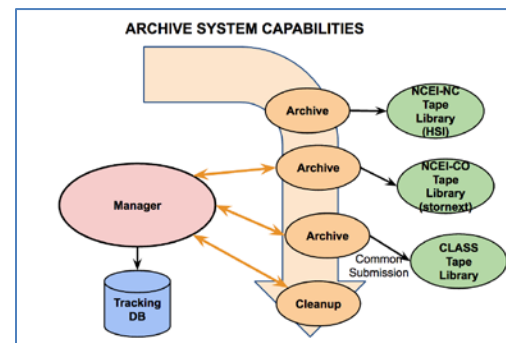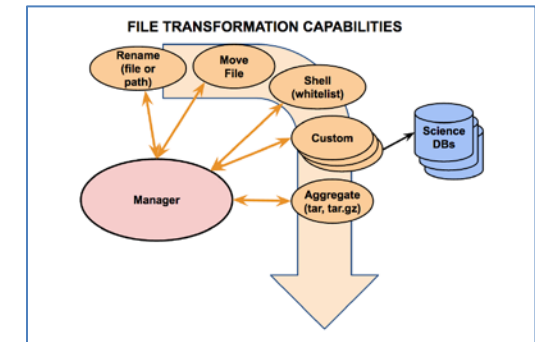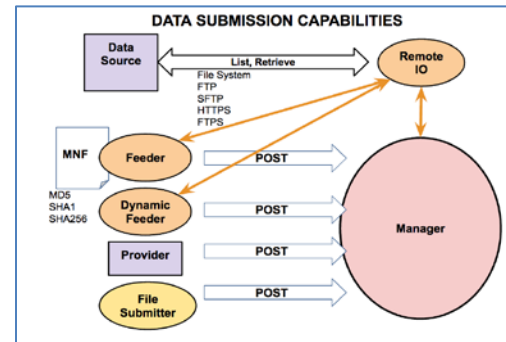
*Fourth National Climate Assessment (NCA4) Volume 1:
The Climate Science Special Report (CSSR)*

- USGCRP Climate Science Special Report, released November 3, 2017.
https://science2017.globalchange.gov/

- Provides scientific foundation for NCA4, including observed and projected changes. US-focused. Includes new info on attribution, potential surprises.
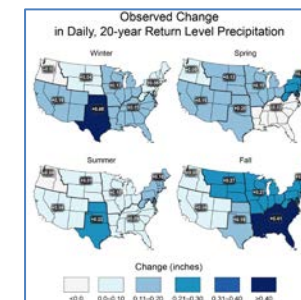
**Climate Science Special Report**

Projected US Temp Changes

Global Temp Change
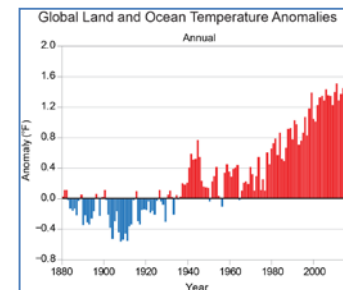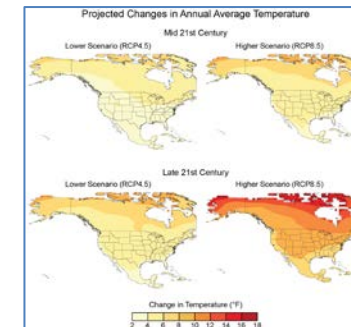
Observed Increases in Heavy Precip

Fourth National Climate Assessment (NCA4) Volume 2:
Climate Change Impacts, Risks, and Adaptation in the United States.

- Draft for public comment &
  National Academies Review,
  released November 3, 2017.
  https://review.globalchange.gov/

- Assesses climate impacts,
  adaptation efforts, mitigation
  options. New in NCA4:
  Expanded regional focus,
  international context, etc.

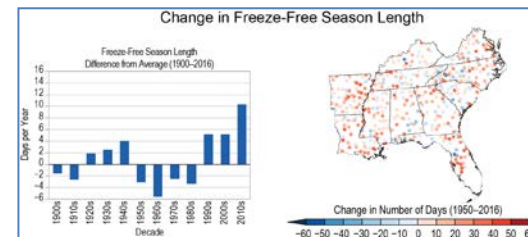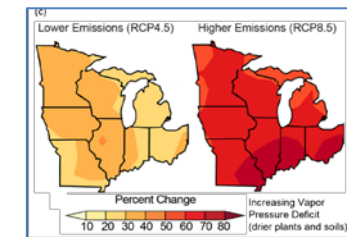**Cities: Projected Very Hot Days**
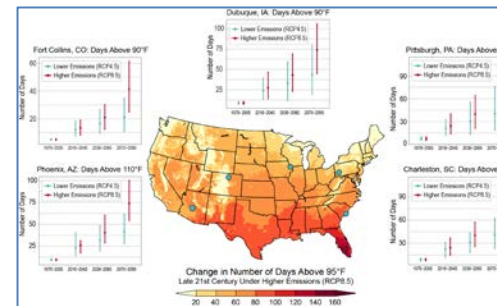
**Projected US Temp Changes**
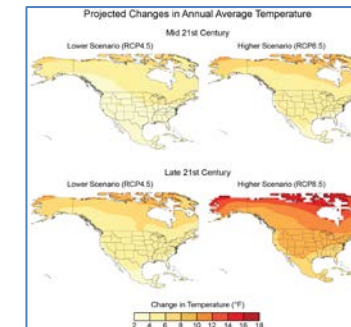
Changes in Freeze-Free Season

Projected Changes in Vapor Pressure Deficit

State Summaries Project

https://statesummaries.ncics.org/

- Four-page climate summaries for each state

- Observed and projected changes for key climate variables

- Almost 500 primary figures created, along with 1,000 supplemental figures that will be available on the website

- Comments and inputs from Regional Climate Centers, state climatologists

- NOAA-led peer-review process

- Released January 2017

Interactive website for State Climate Summaries

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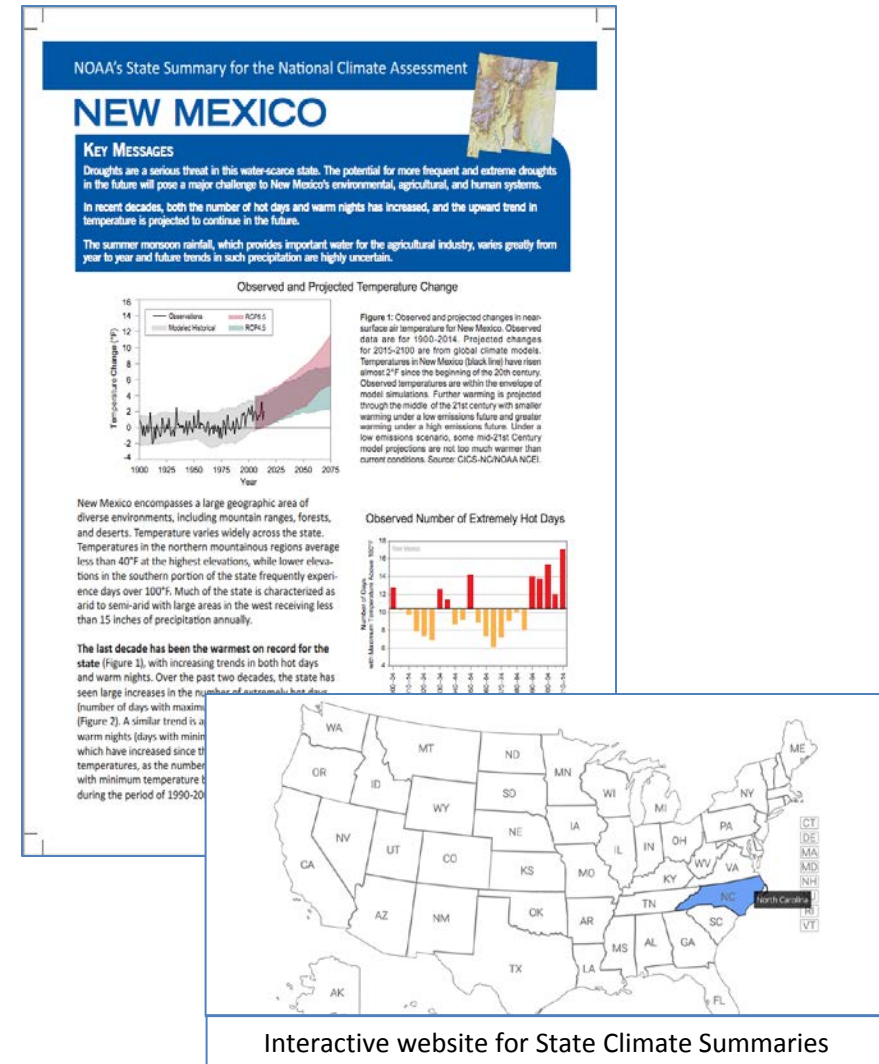
Climate and Health

- USGCRP Climate and Health Assessment – released 2016
  https://health2016.globalchange.gov/

- Identification of relationships between soil moisture, drought, and human health

- Create climate and environmental data records for health studies
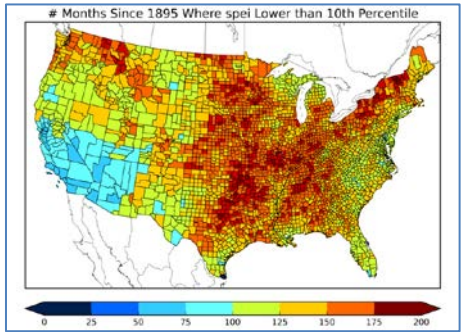
Climate and Health Report
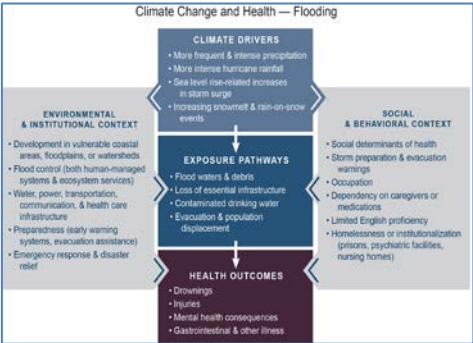
Mental Health and Drought
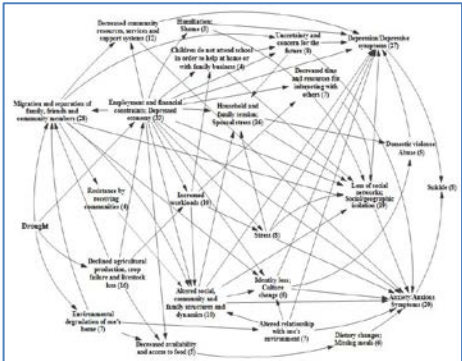


Valley fever and Soil Moisture


Climate data for health

Satellite and in situ observing datasets to document the Earth's climate

- Development of a Climate Data Record for the High-Resolution Infrared Radiation Sounder (HIRS) satellite atmospheric temperature and humidity profile

- Initial processing complete for 1995–2015 GOES-E and GOES-W

- Investigating use-inspired application of land surface data (drought monitoring, pollen monitoring, etc.)

- V2015 of HIRS profile data highlighted by a 2016 manuscript. V2016 is forthcoming
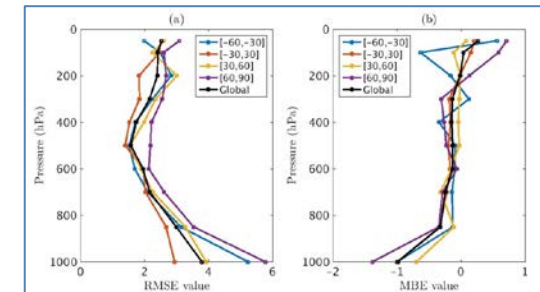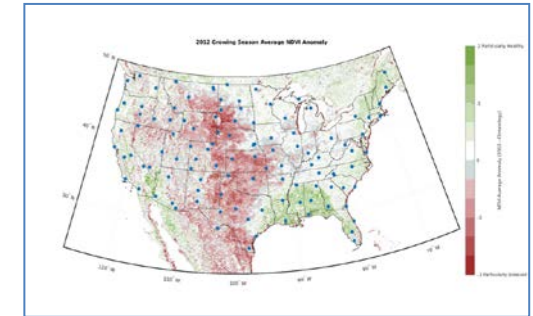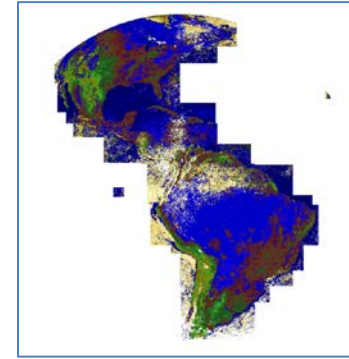
- Extensive support for the transition of the ISCCP satellite cloud dataset to NCEI.

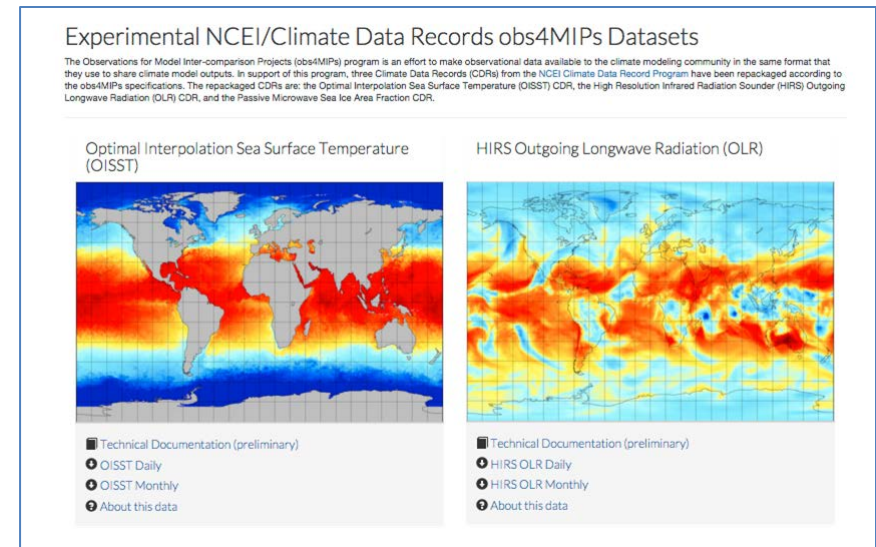- Research and expertise for calibration, validation, algorithm development, and quality control.

- Next generation H-series ISCCP product released in August 2017.

- Spatial-temporal data fusion of land surface albedo products (collaboration with NCSU Statistics Department)
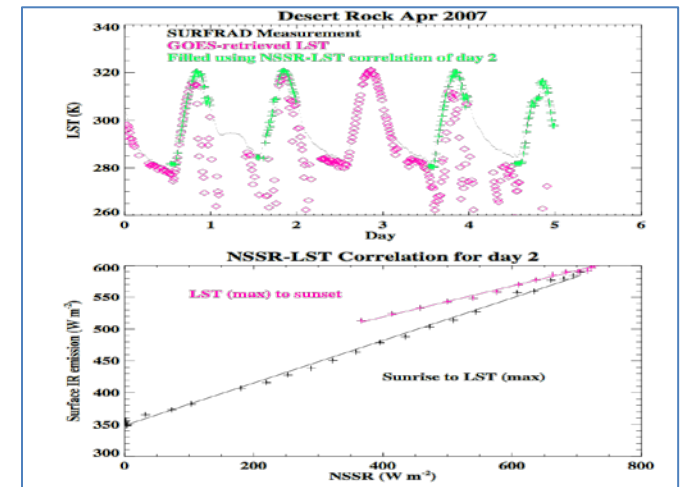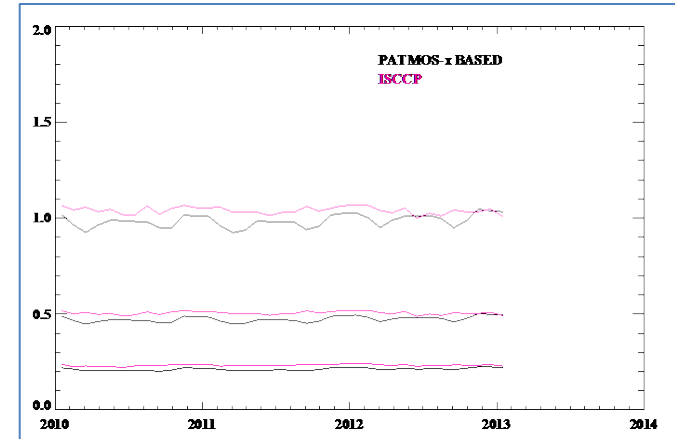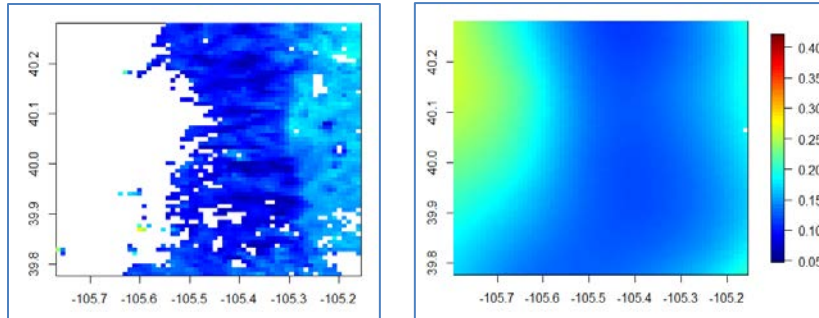
Improve data use by international modeling and analysis communities

- obs4MIPs: making observational data more accessible for climate model comparisons.

- Generated obs4MIPs datasets for 3 different Climate Data Records:
  - HIRS Outgoing Long-wave Radiation REDR (CDR)
  - Optimum Interpolation Sea Surface Temperature (OISST) REDR (CDR)
  - Sea Ice Concentration REDR (CDR)

- Datasets available on ESGF (Earth System Grid Federation: http://esgf.llnl.gov/)

- Analyzed other NCEI holdings for possible use in the obs4MIPs effort

Experimental NCEI/Climate Data Records obs4MIPs Datasets

The Observations for Model Inter-comparison Projects (obs4MIPs) program is an effort to make observational data available to the climate modeling community in the same format that they use to share climate model outputs. In support of this program, three Climate Data Records (CDRs) from the NCEI Climate Data Record Program have been repackaged according to the obs4MIPs specifications. The repackaged CDRs are: the Optimal Interpolation Sea Surface Temperature (OISST) CDR, the High Resolution Infrared Radiation Sounder (HIRS) Outgoing Longwave Radiation (OLR) CDR, and the Passive Microwave Sea Ice Area Fraction CDR.

Optimal Interpolation Sea Surface Temperature (OISST)

HIRS Outgoing Longwave Radiation (OLR)

- Technical Documentation (preliminary)
- OISST Daily
- OISST Monthly
- About this data

- Technical Documentation (preliminary)
- HIRS OLR Daily
- HIRS OLR Monthly
- About this data

Scientific Stewardship of Reference Environmental Datasets

Stewardship is essential to ensuring and improving quality and usability of environmental data.

Activities Include
- Development of sea ice extent dataset to help understand and monitor the system, consistently curating and providing data quality information to users for enhanced transparency and usability.

- Development and application of a stewardship maturity evaluation process. Applied to 700+ NOAA datasets to date. Ratings will be integrated into NCEI ISO metadata records and used for data search relevance ranking.
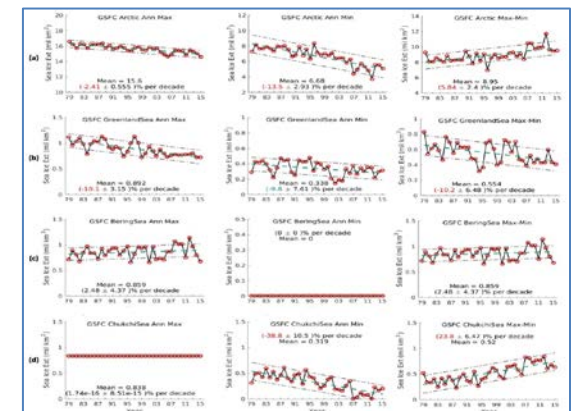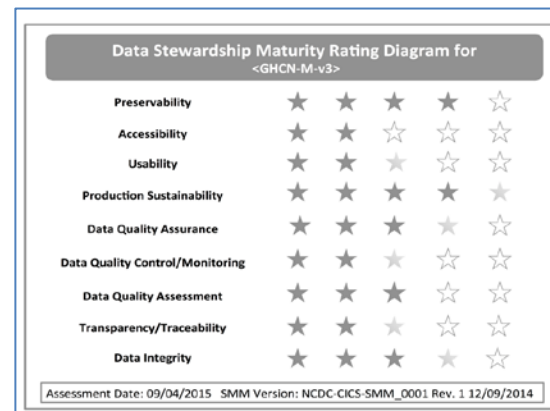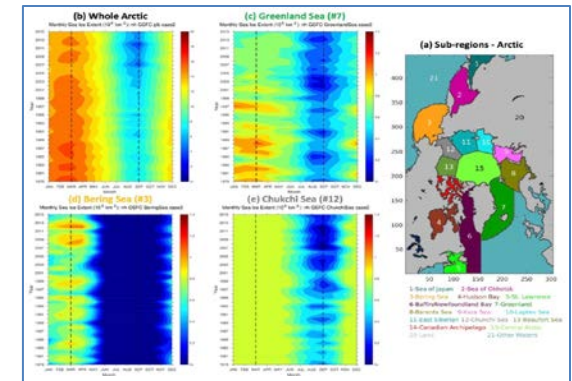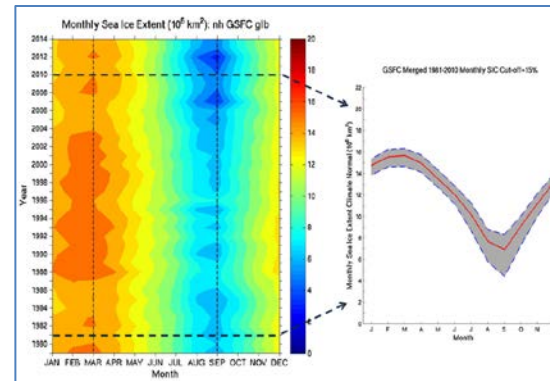
GHCN, ISTI, Snowfall, Drought, and Heat

- Interact with Global Historical Climatology Network (GHCN) and International Surface Temperature Initiative (ISTI) teams on development of improved land surface temperature records

- Supporting software development for next version of GHCN-Monthly (version 4)

- Updated climatology of snowfall extremes used by FEMA for determining assistance.

- Created database of county level drought, comparing with CDC health data.

- Developed tool to assess current and past extreme heat events.
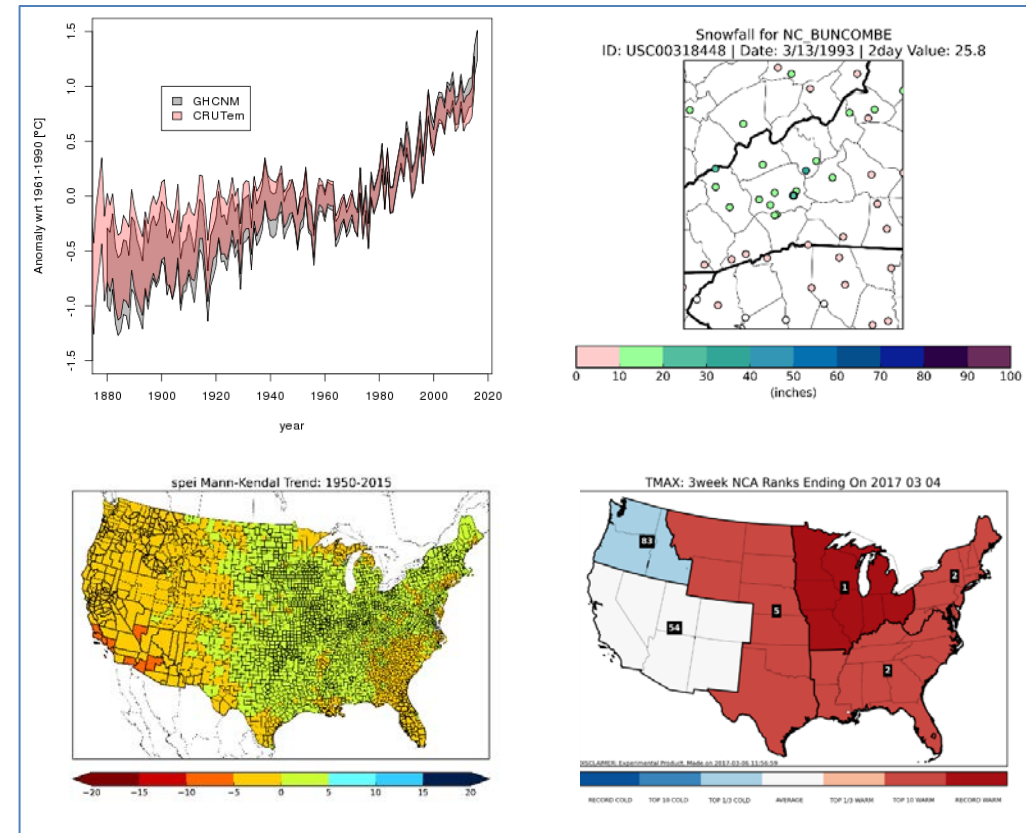
Top Left: Temperature anomaly, plus uncertainty estimates, for both GHCN-M version 4 and CRUTEM. *Top Right*: 2 day snowfall totals for Western North Carolina during the 1993 Superstorm. *Bottom Left*: Mann-Kendall Z-Scores of SPEI drought data from 1950-2015. *Bottom Right:* 3 week temperature ranks for NCA regions ending on 3/4/17.

The Urban Resilience to Extremes Sustainability Research Network

Objective

- Compute and analyze climate extreme indices based on state-of-the-art downscaled global climate model simulations for each pilot city in the Urban Resilience to Extremes Sustainability Research Network (UREx SRN).

- Communicate projected future changes in extreme weather and climate to city practitioners, non-scientific decision makers, and interdisciplinary researchers across the network.

Results

- Extreme climate indices computed for a suite of global climate model simulations, downscaled by the Localized Constructed Analogs (LOCA) methodology over the United States and Mexico, and by the Asynchronous Regional Regression Model (ARRM) for the city of Valdivia.

- Summary "*Scenarios Lite*" documents were produced for seven of the UREx network pilot cities: Baltimore, Hermosillo, Miami, New York City, Phoenix, Portland and Syracuse.

- Results were presented to city practitioners across a variety of sectors in Portland, with prospects for future engagement.
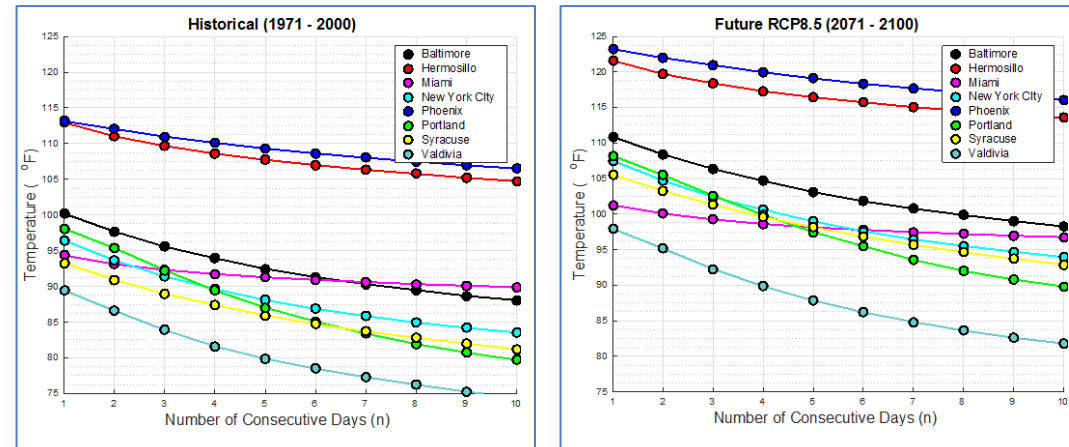
Plots show the projected changes in heatwave intensity over the pilot cities within the UREx network. Historical simulations, 1971–2000 (left panel); and future simulations under the RCP8.5 emissions scenario, 2071–2100 (right panel).

Circles indicate the multimodel ensemble average annual maximum temperature that is exceeded for a period of *n* consecutive days during each of the climatological periods.

Precipitation and Traffic Fatalities

Leverage power of NEXRAD radar reanalysis to investigate relationship between precipitation and traffic fatalities

- Measurable effect of precipitation on incidence of traffic fatalities
- Stronger during daytime
- Stronger with heavier precipitation

Fractional Attributable Risk
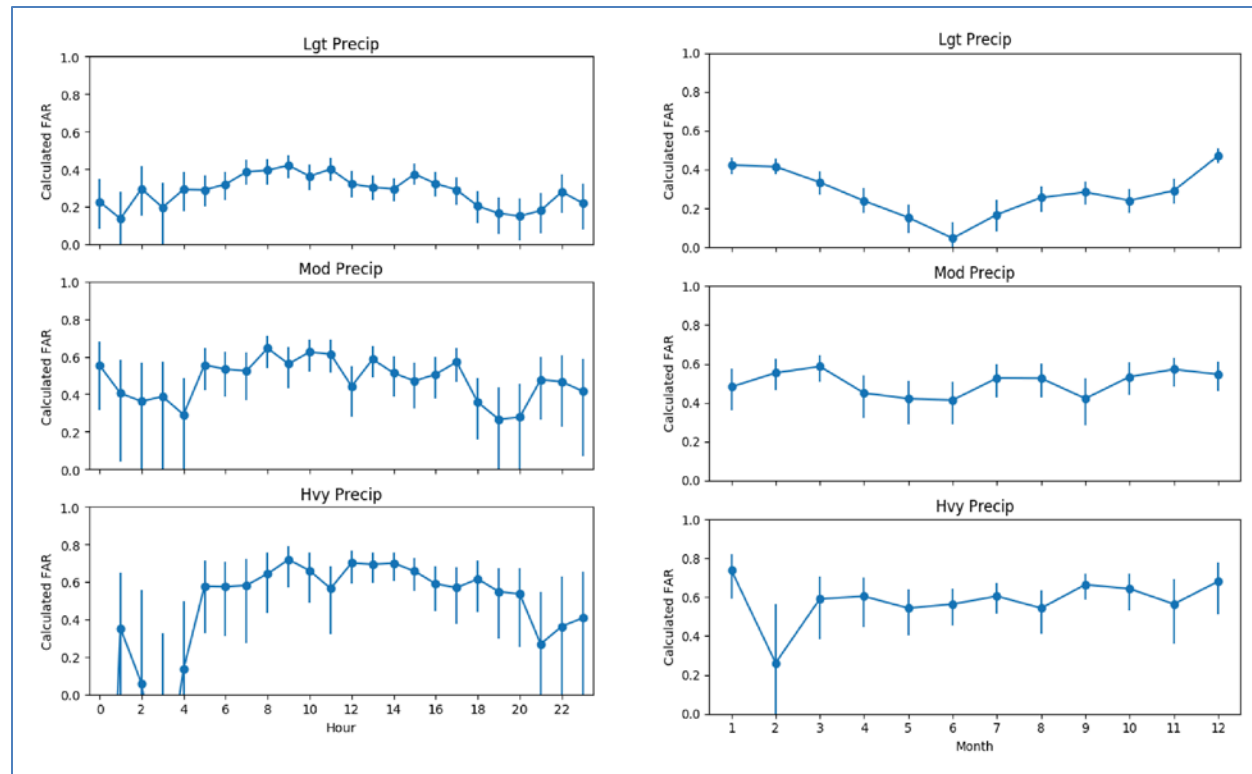
Applying Deep Learning to Front Detection

Analysis of future changes in precipitation associated with weather fronts requires an automated way to find fronts in model data

- Trained a *Deep Learning Network* to detect fronts using NWS reanalysis data and human-drawn fronts

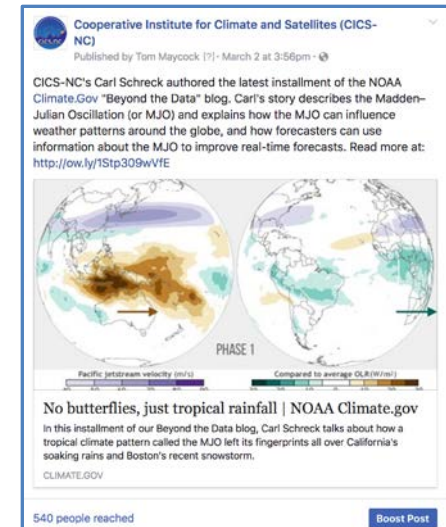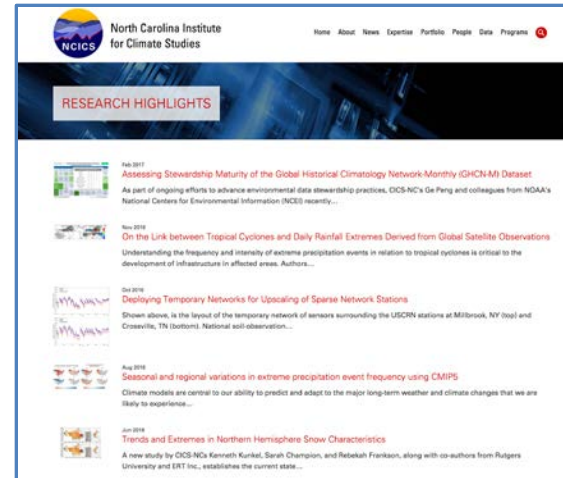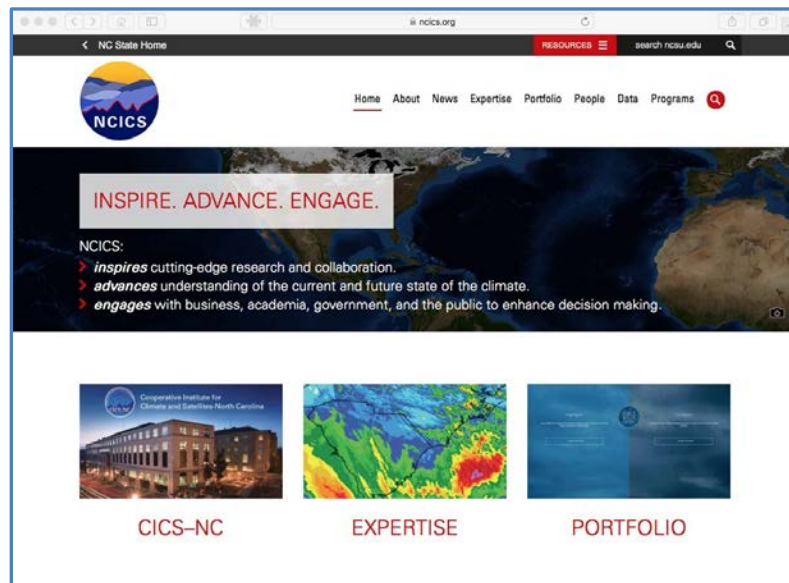- Extracted front lines

- 80% accuracy compared with NWS maps

Human-drawn vs Network Fronts

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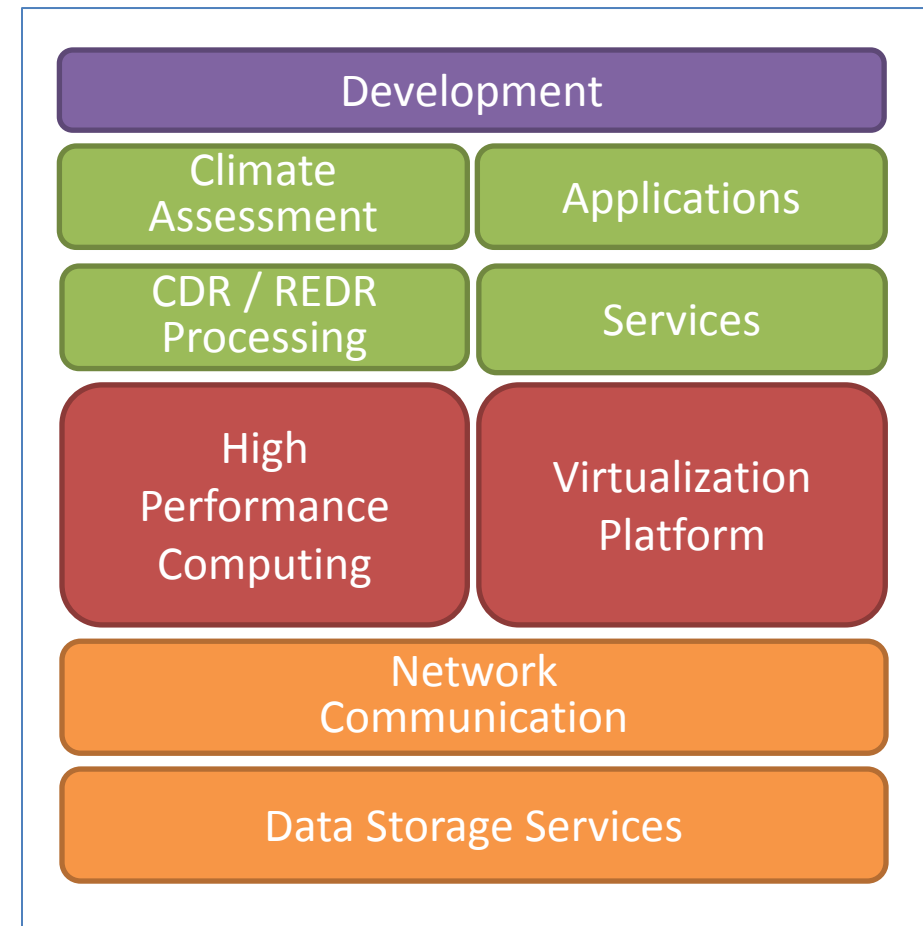
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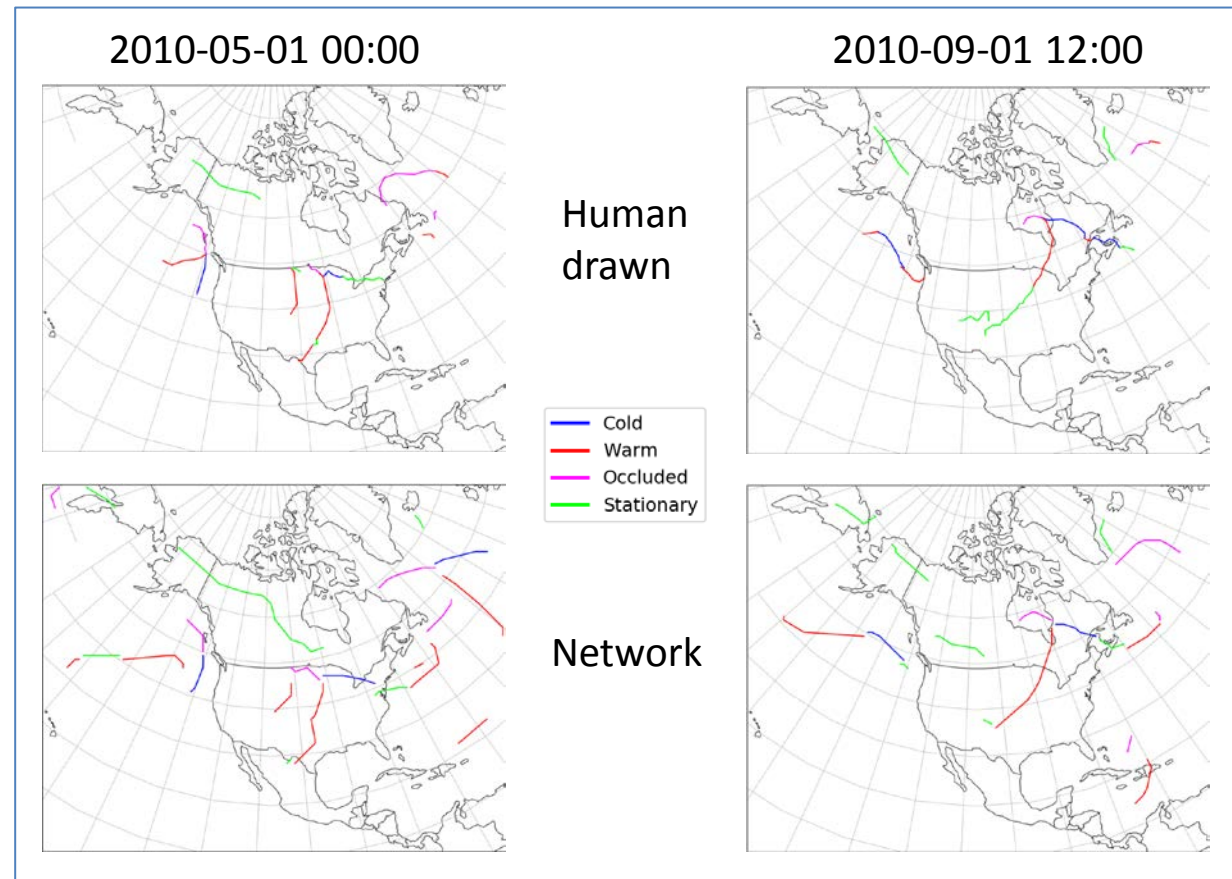
CICS-NC Communications

- Promote awareness of, and interest in, Institute activities, products, and research outcomes.

- Enhance science communication capabilities and reach of institute staff.

Supporting research, development and computational demands

IT Infrastructure

- High speed networking
  - 802.11 AC WIFI
  - Video Communications
  - 10 Gigabit Ethernet
- High-performance computing
  - 45 Nodes
  - 528Cores / 3.2TB RAM
- Virtual Machine Platform
  - 6 Hosts / 72 Cores / 640GB RAM
  - >30 virtualized systems
- Data services
  - Over 1.2 PB on disk
  - Over 2.25 PB on Tape
  - 8 Gigabit Fiber Channel

Development

Climate Assessment | Applications

CDR / REDR Processing | Services

High Performance Computing | Virtualization Platform

Network Communication

Data Storage Services

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