Atmospheric Science Data Management / Opportunities for Transdisciplinary Collaboration

Dr. Andrew S. Jones
CSU / Cooperative Institute for Research in the Atmosphere (CIRA)

May 2, 2014

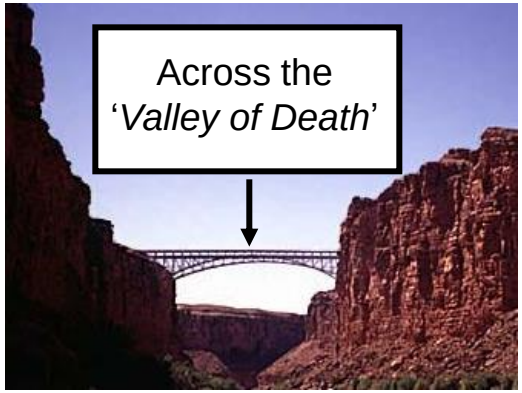
Talk Outline

- What I am doing with NOAA/NESDIS (redesigning their weather/climate satellite data architecture framework)
- What I am doing with the BMGF (OPS transition concept)
- CSU/CIRA Operational Transition Background
  - Joint Center for Satellite Data Assimilation
  - NOAA/NESDIS, NOAA/NWS
  - OSD, USAF (AFWA), Navy (NRL-Monterey, NRL-DC), Army (ARL, DAMI), Army Corps of Engineers (Numerous ERDC Labs / DoD OPS users)
  - Bill and Melinda Gates Foundation (BMGF)

CIRA Mission & Overview

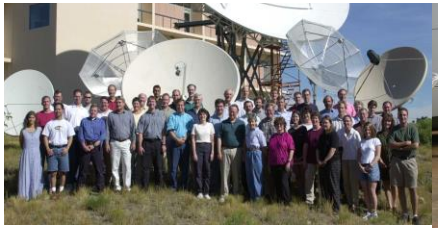
Serving as a Bridge

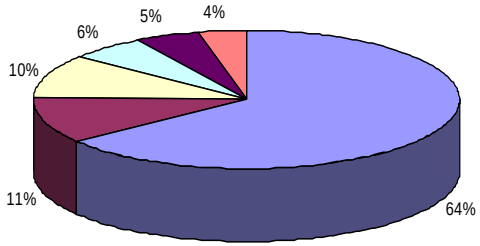
From the 'Ivory Towers' of Research…



…To Practical Applications for Operations

~150 scientists and support staff, distributed between Ft. Collins (CSU) and Boulder (NOAA/ESRL) offices.





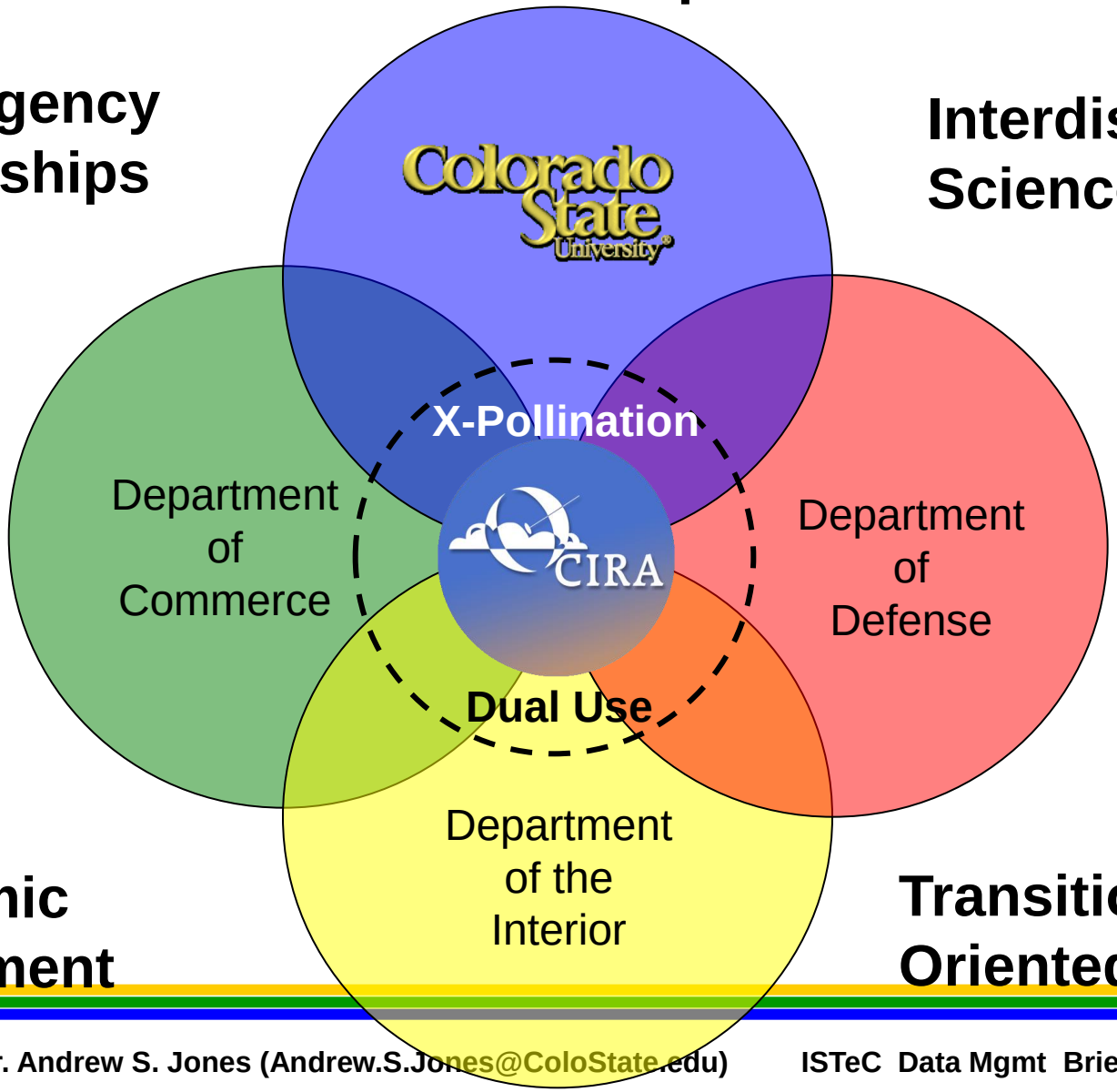
Total Budget ~17 Million

Roughly 2/3 of active CIRA projects (and 2/3 funding) tied to NOAA, with DoD and NPS support comprising ~20% of total activity.

CIRA Federal Cooperative Partnerships

Multi-Agency Partnerships

Interdisciplinary Science



Academic Enrichment

Transition-Oriented Research

Research Themes

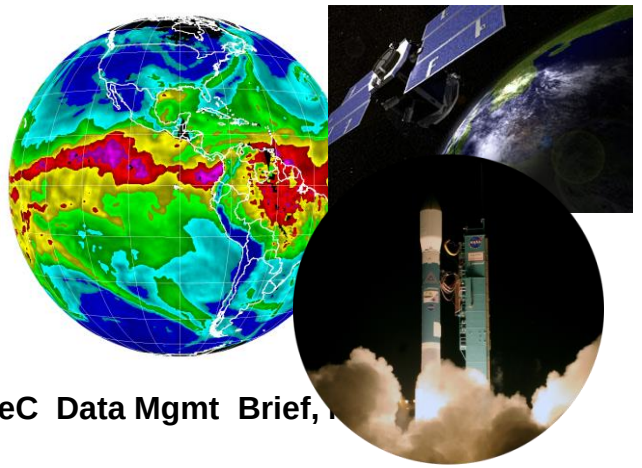
- Global and Regional Climate Studies
- Satellite Application Development
- Local/Mesoscale Weather Forecasting and Evaluation
- Modeling and Data Assimilation
- Air Quality and Visibility Studies
- Cloud Physics and Processes
- Education, Training, and Outreach
- Societal and Economic Impacts

Weather Forecast Model Development and Evaluation

- **New weather model data assimilation methodologies.**
- **Weather Research Forecast (WRF) model development and validation**
- **Use of satellite observations with weather models**
- **Weather applications:** severe weather, tropical storms, fire weather, aviation, droughts, and flash flood problems
- **Numerous operational satellite product developments**
- **NOAA Earth Systems Research Laboratory (ESRL)** at Boulder has approx. 70 CIRA staff (or about half of us)
- **We have numerous Federal collaborations:** NCAR, NASA, FAA, DOE, NSF, DoD, etc.

Satellite Research Highlights

- NASA CloudSat Mission and Data Processing Center
- CIRA Earthstation: Global environmental satellite ingest and archive
- NASA Orbiting Carbon Observatory (OCO)
- GOES-R Risk Reduction, JPSS VIIRS Readiness, synthetic data, and interface with operational-users (e.g., Satellite Proving Ground)
  - DoD Soil Moisture Active Passive (SMAP) SM Applications Consortium (SMAC) and DoD SM Working Group (SMWG) using multisensor AMSR-2 and WindSat data sets and the USAF land surface model
  - Air Force Weather Agency Cloud Analysis and Assimilation Team
  - CIRA Blended Satellite Products Team for NOAA OPS Constellations of 8+ LEO MW sensors dynamically intercalibrated for global rainfall rate and water vapor
- Multi-spectral/sensor characterization
- Development of satellite training materials
- Future sensor concepts (e.g., NASA GPM, PATH) for enhanced global precipitation monitoring
- We have many hydrometeorological activities



Wx/Climate Data (1 of 2)

- Traditionally the US Govt. owns the sensor hardware, provides the data to federal labs, universities and contractors, and then runs the production codes in a secured federalized 24/7 operational environment
- We also employ advanced, high-dimensional, low-signal mathematical data assimilation systems to tease out the extra hidden information for use within complex weather forecasting systems
  - We are extending these math concepts to much more generalized concepts (non-Gaussian / lognormal distributions), that could be useful to the biosecurity simulation community

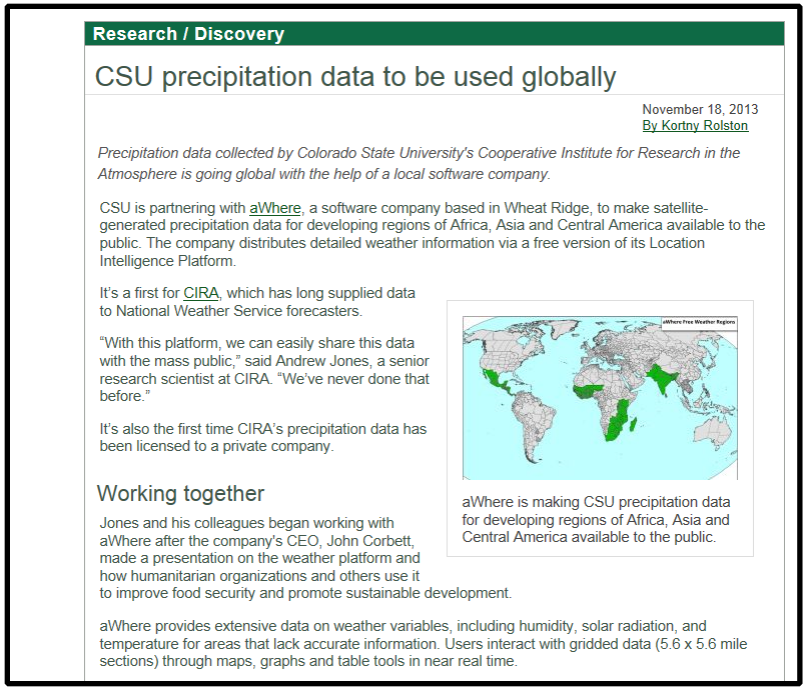
Wx/Climate Data (2 of 2)

- Literally thousands of employees and **$Billions** are used regarding the acquisition of weather and climate capabilities
- But in the end, only a few operational users gain full benefit of the Govt. sensor hardware and simulation abilities
- **We are now changing that…**

- NOAA is consolidating their many stove-piped satellite acquisition programs into a unified “Enterprise” system
- Cloud Computing will share needed data flows between Govt. and **Specialized User communities**
- Biosecurity and Food Security are examples
- Growth in transdisciplinary thinking is a major objective

BMGF and CSU, Big Data and Cloud Computing

- Collaborations are underway with aWhere, Inc. and the **Rocky Mountain Consortium for Global Development (RMCGD)** for food security and water limited environments
- CSU Primed the first pilot study with the BMGF
- Resulted in regionalized global multi-satellite precipitation coverage at 8 km resolution over BMGF-supported regions (green zones), available in near-real time and hourly
- **Intercalibration is updated every hour**



Research / Discovery

CSU precipitation data to be used globally

November 18, 2013
By Kortny Rolston

Precipitation data collected by Colorado State University's Cooperative Institute for Research in the Atmosphere is going global with the help of a local software company.

CSU is partnering with aWhere, a software company based in Wheat Ridge, to make satellite-generated precipitation data for developing regions of Africa, Asia and Central America available to the public. The company distributes detailed weather information via a free version of its Location Intelligence Platform.

It's a first for CIRA, which has long supplied data to National Weather Service forecasters.

"With this platform, we can easily share this data with the mass public," said Andrew Jones, a senior research scientist at CIRA. "We've never done that before."

It's also the first time CIRA's precipitation data has been licensed to a private company.

aWhere is making CSU precipitation data for developing regions of Africa, Asia and Central America available to the public.

Working together

Jones and his colleagues began working with aWhere after the company's CEO, John Corbett, made a presentation on the weather platform and how humanitarian organizations and others use it to improve food security and promote sustainable development.

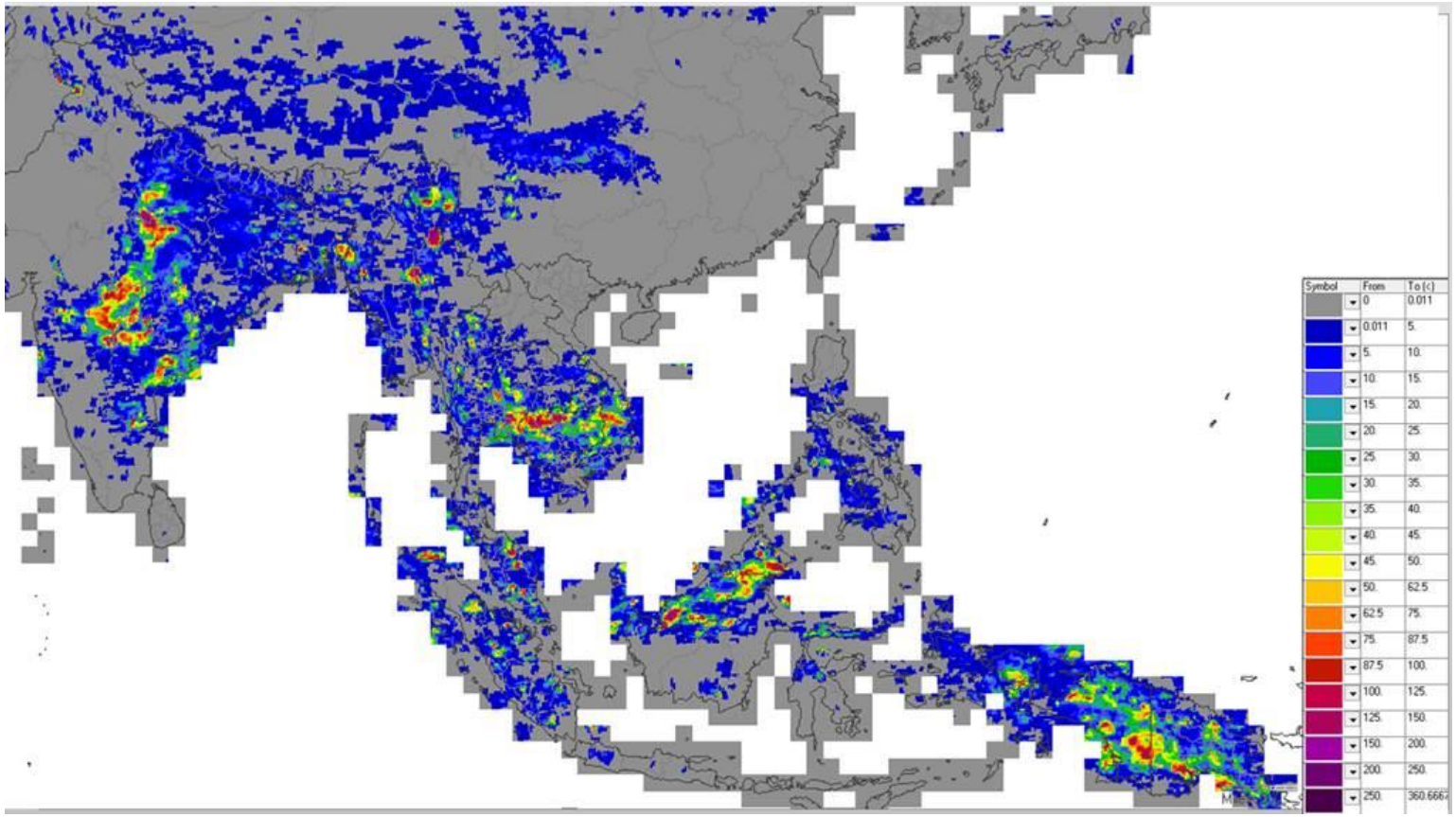
aWhere provides extensive data on weather variables, including humidity, solar radiation, and temperature for areas that lack accurate information. Users interact with gridded data (5.6 x 5.6 mile sections) through maps, graphs and table tools in near real time.

***CSU Today,* Nov. 18, 2013, news article**
http://www.today.colostate.edu/story.aspx?id=9387

Daily Aggregated Satellite-based Rainfall Data

(showing land regions only)

CSU Blended Rain Rate total rainfall (mm) for 2013-10-03



Additional CSU Partners

- In addition to the RMCGD we work with a variety of partnering organizations in the weather and energy space
  - Riverside, Inc.
  - Technology Services Corporation (TSC)
  - Schneider Electric
  - Weather Analytics (another Cloud Computing Co.)
  - … and many others (POC: Mark Wdowik)
  - Other NGOs and research foundations
  - DOE / NREL (Golden, CO)

RMCGD Partners

Rocky Mountain Consortium

GLOBAL DEVELOPMENT ANALYTICS, INC.
Using data to create a healthier world

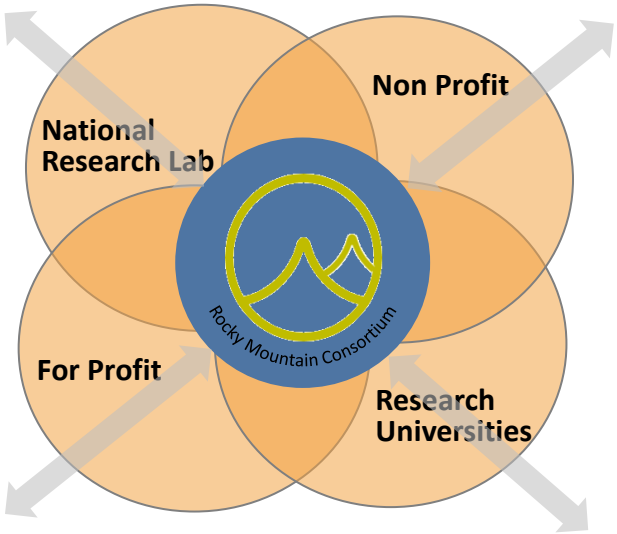
Colorado State University

NCAR

aWhere
Location Intelligence for Global Development

Research and development in areas targeting critical global development needs

Evidence-based operational outcomes using best available techniques and technology



Leading edge commercial techniques and technologies applied to global development challenges

Research and development in areas targeting critical global development needs

Synchronize our collective strengths

science, research, education and training, implementation capacity

RMCGD: CSU, aWhere, Inc., Global Development Analytics (GDA), UCAR, and other entities

- The aWhere platform provides *two-way* real-time data interactions (in situ ground data and satellite product generation/provisioning)
- GDA is a new non-profit 501(c3), focused on operational crop simulations driven by the BMGF real-time data feeds
- University Consortium for Atmospheric Research (UCAR) is the parent entity of the National Center for Atmospheric Research and represents > 70 Universities – Large NSF-based organization
- Other for-profit, non-profit, and Universities will soon be joining the Consortium, providing even more capacity

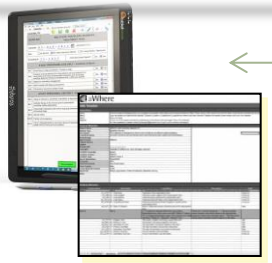
RMCGD: CSU, aWhere, Inc., Global Development Analytics (GDA), UCAR, and other entities

- Plans are to share analysis output with a large number of users: Foreign Govt. Ministries, BMGF NGO partners, other large Govt. efforts (USAID, etc.)
  - for free to end users (BMGF pays for this support)
- Impacts agri-business decision making, thus many people's lives
- Supports massive multi-disciplinary interactions for food security, infectious disease mitigation, *location-intelligent* agri-business decision making
- This particular data set has been formally licensed for global use via CSU Ventures (CSUV) – and we're in the process to expanding the data set time series.

RMCGD/aWhere LI Platform

Rocky Mountain Consortium

Data Collection



Dashboards, Publishing

Recommendations & Alerts

Other Data Systems

ESRI SpatialDev SAS tableau SOFTWARE

Farmers, Extension & on-the-ground Personnel

Organization, Ministry & Partner Personnel

Public, Private Sector, Donors

aWhere
Location Intelligence for Global Development

aWhere Smart Content

Delivery Mechanism Tailored to Local User

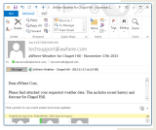
aWhere Platform

Last Mile Delivery

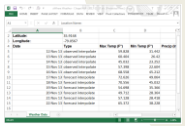
Direct from Platform or through 3rd Parties


Development Workers


Web Applications


Email


Scientists


Excel Spreadsheets (FTP, Dropbox etc.)


Farmers


Radio


Feature Phone Text (Symbols)


Smart Phone Applications


Voice Messages


Smart Phone Text Messages


Cooperatives


Extension Agents


Agri-business

aWhere

We help people AND move our research into a real-time OPS mode

Rocky Mountain Consortium

CSU Real-time Multi-satellite Rainfall Rate / Daily Precipitation Estimate

- Synergies are made with local African Universities, focusing on specific local issues
- Provides a cutting edge large-scale multi-disciplinary platform
- Involves the CSU College of Ag. Sciences, Engineering, CVMBS, Infectious Disease SuperCluster (IDSC), and growing, …

- **TRANSFORMING SCIENCE:** Scientists and Ag Agents in the field can now provide back real-time analysis and conditions – for **a new era of large-scale cross-disciplinary interactions**
- **SYNERGIES** with many Govt. informational needs
- **REAL TEAM WORK:** DOS, USDA, USAID, DoD, Foreign Govts., NGOs, Small-stakeholder Farmers

RMCGD DPEAS and Cloud Computing

CSU Real-time Multi-satellite Rainfall Rate / Daily Precipitation Estimate

- Result of a NOAA/NESDIS Operational Blended Rainfall Rate for National Weather Service Users
- In collaboration with aWhere, Inc., the NESDIS product has been improved into a **High Resolution (5 arc-minute) product** for the Food Security uses in Africa and Mexico/Central America
- New near real-time satellite-based rainfall results are aggregated into daily precipitation totals for impactful agri-business decisions

Colorado State University

Future products are in development at CSU/CIRA

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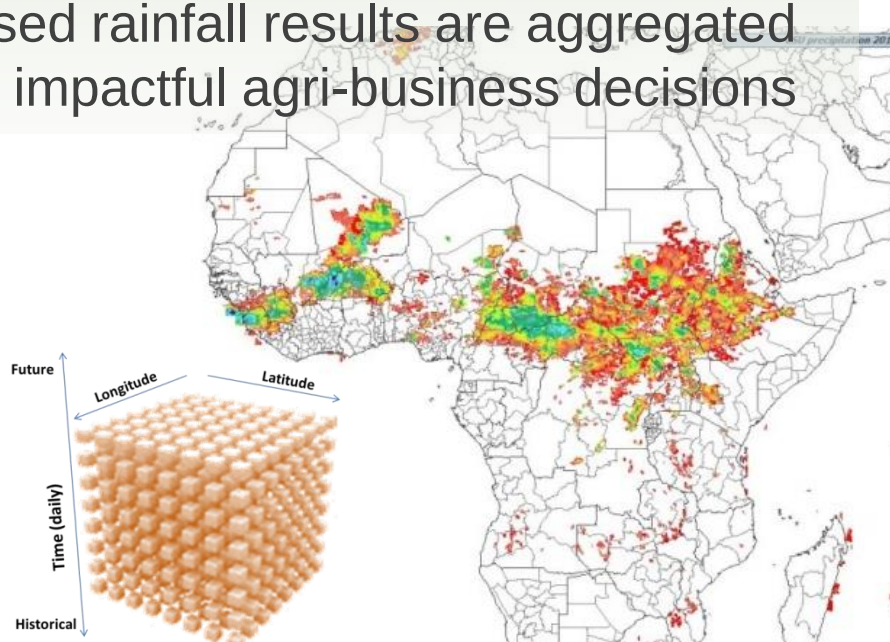
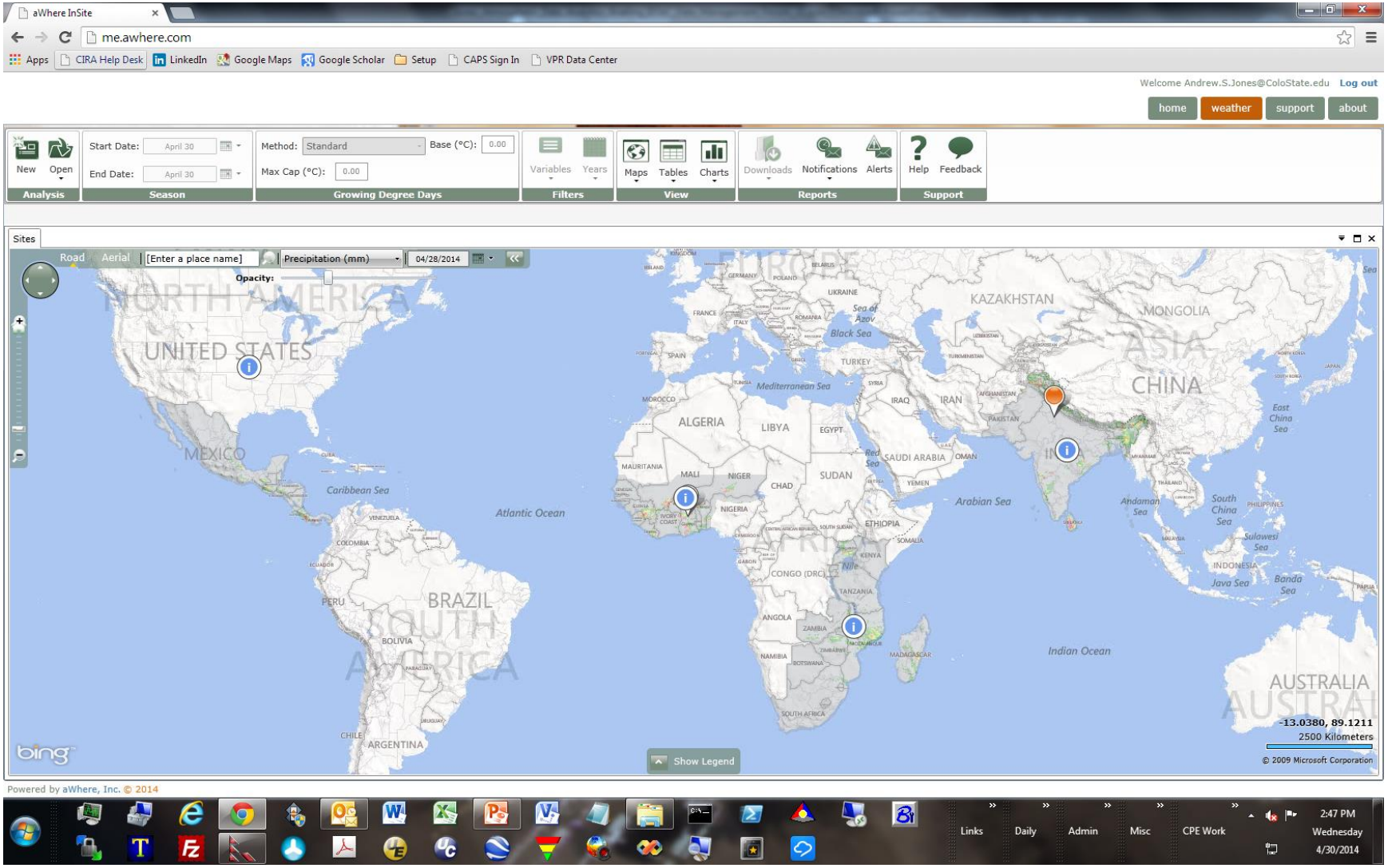


The aWhere platform GUI

Login at: me.awhere.com, instructions are on-line



The DoD Soil Moisture Working Group (SMWG)

- Army DAMI
- Army Research Laboratory
- Navy Research Laboratory
- Engineer Research Development Center (CRREL and GSL)
- 2 SBIR Phase I's (Riverside, Inc., Technology Service Corporation)
- Numerous other collaborations
- Focus is on DoD Applications – Downscaled soil moisture (10 - 30 meter spatial scales)

Conclusions

- **Robust and Demonstrated Advanced Multi-satelite OPS transition pathway**
- Shown to work with DoD, NOAA, NASA, NSF funded activities
- Lessons learned are being used to redesign the NOAA/NESDIS data architecture
- Our Govt. work can be reconfigured to feed large collaborative community applications
- We have substantial data fusion and data assimilation knowledge to do the work correctly, and then successfully transition it into the OPS production cycle