Global Learning and Observations to Benefit the Environment (GLOBE)
- Worldwide hands-on primary and secondary school-based science and education program
- Promotes and supports students, teachers and scientists to collaborate on inquiry-based investigations of the environment and Earth system
- Environmental measurements in Atmosphere/Climate, Hydrology, Land Cover/Biology, soils, and Phytology
- Began Earth Day 1995 as partnership between NASA, NOAA, NSF
- Grew to more than 48,000 trained teachers, 24,000 schools, 1.5 million students

GLOBE Data and Information System (DIS)
Top Functional Requirements
1. Provide training and material on the use of GLOBE, including measurement protocols
2. Receive, check, accept member observation entries compliant with protocols
3. Ingest data from automated weather stations and other data sources
4. Maintain records across protocols (over 127 Million since 1995)
5. Visualize observations on a map
6. Provide data analysis tools, graphs and data access tools via search and filtering
7. Export observations recorded across protocols
8. Enable data entry from mobile Apps
9. Recognize contributions of teachers and students and schools
10. Administer workshops, science blog, Help Desk, Email, Mass Mailing

GLOBE DIS Modernization
- In 2010, NASA Goddard was asked to lead the evolution of the GLOBE DIS to a new architecture; evolving software and internet technologies to achieve program goals.
- The Goddard GLOBE DIS Team was formed and partnered with UCAR to develop a new enterprise portal, web application framework, and modern visualization and graphing features.
- Migration to new system completed July, 2012

GLOBE Team and Organization circa 2013
UCAR GLOBE System Development and Operations
- UCAR vegetation
- Meteorology
- Water Resources
- Ecosystems
- Earth Science Technology Group
- GLOBE Program
- GLOBE Science and Education

GSFC GLOBE Software Engineering Services Task
- UI/UX Design
- Standards and Requirements Development
- End User Training
- System Development
- Deployment
- Telecommunication
- Virtualization
- Monitoring and Visibility
- Production Planning, testing and Validation

GLOBE Transition Objective, Tasks, Milestones
In 2013, NASA Goddard Science Data Systems was asked to transition the GLOBE DIS from UCAR to ensure its long-term stability, integrity and continued improvement.

Critical Milestones
- September
  - UCAR provides snapshots of the as-is Data Entry protocols and tools.
  - GSFC requests enhancements, brings prototyping to the as-is DIS (V1.1, 1.2).
- November
  - UCAR completes implementation and big bang of high priority DIS protocols in Red Hat RHEL 6.0. New snapshot provided (2.0).
  - GSFC requests snapshot of DIS (red hat system) a Migration period and some Data Entry capability for test.
  - Production snapshot now includes all new tools, all images functional. Finding that security review is timing critical.
- February
  - UCAR provides new environment (2.1).
  - GSFC licenses new environment (3).

Infrastructure Architecture Trade, Estimates, Drivers
- The UCAR GLOBE DIS hardware was near end-of-life and a trade study was prepared to evaluate alternative infrastructures.
- 480 Hours of estimated labor for both alternatives involve similar tasks.
- Flash and Local Facility
  - Initial DC configuration
  - Configuration of VMs and image/transfer protocol
  - VM image backup
  - Storage configuration and testing
  - Initial DC configuration
  - Follow-on planning, testing and validation
- Amazon Web Services
  - Amazon service request, setup & configuration
  - Configuration of VMs and image/transfer protocol
  - VM image backup
  - Storage configuration and testing
- Follow-on planning, testing and validation

Launch Readiness Checklist and Responsibilities

Final Production Architecture

Amazon Specific Findings
IPVS
- Classic Elastic Load Balancers (ELB) entry; no support for newer Virtual Private Cloud architecture
- Load balancer properties are set by Amazon
  - Wartc to extend instruments to handle long queues
  - Hosting model – scalable by Amazon
  - DNS domain name required. SOAP Amazon ELB-IP may change at any time – impact to hand-coded social media external users
difficult to trace
- HTTP/HTTPS gateway is redirected to www.amazon.com whenever IPVS does not require, separate server redirect
- Handshake is refilled automatically at any time
- 1 to 2 week notice, lasts a few hours
- Requires monitoring services based on image
  - Includes IP changes and DNS changes.
- Database instance taken longer because of size

AWS has default limits dependent on service level
  - Number of instances, servers, IP addresses.
- Not always aware you’re up against a limit.

Changes from the Original Plan
Labor Hours Revised
- 30% over original labor estimate (468 hours grew to 625):
  - Systems upgrades, additional tools, AWS to prototyping to production
- Changes to System Environment
  - New larger instance for database, application servers in production, smaller instances in staging (net ~1.5K)
  - Focus on security and reliability
- Changes to Application Environment
  - Add DB and Ruby instances dedicated to training (~5/1K)
  - Weekly backup data center transfers (~300K)
- Estimate 2 months of prototype environment ("pay by the drink") prior to final production environment commitment (~$10K)
- Cost changes over time reduced actually 3-10% depending on service, typically come with increases in capabilities.e.g., MS server cost more than $4M.

Availability and Uptime
No quarterly 1 day power cycle outage (previous UCAR facility)
- Infrastructure uptime including planned code regression outages
  - Jul 2011 - Aug 2016: 99.999% uptime
  - Aug 2014 - Aug 2016: 97.8% uptime
  - Aug 2016-Aug 2018 (12 months): 1 server crash not en related

Staff Skills & Level
- UCAR support existed Feb 2014
- No significant change in GSFC staffing due to transition

Skills change in transition to GSFC
- Developers
  - Maintain knowledge of AWS Services.
  - Focus on Postgres and database performance.
- System Administrators
  - Focus on Ruby on Rails and Data Services
- Staff End-Users
  - CNR/AMS GSFC.

Skills change in transition to AWS
- System Administrators
  - Response to database instance failures.
  - Monitor and analyze instance performance.
  - Identify/Proactive database instance failures.
- View project architecture changes in anticipation of growing loads.

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