5 petabytes of data and is expected to grow in excess of 150 petabytes, with data dissemination rates presently in excess of 30 terabytes a day, increasing to over a 100 terabytes by 2015.

Using Amazon S3, our engineers implemented phase 1 of a prototype to assess performance for cloud stored data. Further, because of security issues, GST designed and installed a small private cloud to support National Oceanographic Data Center (NODC) research. The objective of the private cloud is to determine whether such an architectural strategy would reduce security issues associated with storing data in the public Amazon S3 storage server. GST is presently supporting phase 2 of the effort to determine how cloud computing could be used to reprocess archived environmental data. Phase 2 is expected to be completed by the middle of 2014.

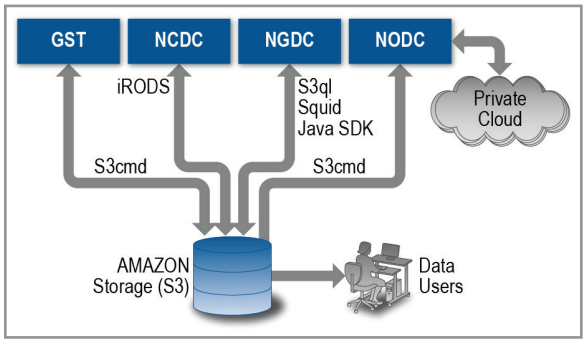

Figure 3: *CLASS Cloud Storage Prototype Architecture*

Project: NWS National Mesonet Program — GST developed Mesonet computing services to support the reception, collection, and processing of large amounts of sensor data to support the National Weather Service. Cloud computing services provided by GST include inputting data from sensors via cellular and internet connections to a storage server where the data is collected prior to processing. When sufficient data has been received and stored, the data is moved to a temporary staging area where is it held for processing. Once processing is complete, the data is formatted, packaged, and sent to the National Weather Service (NWS) for use in forecasting.

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CLOUD COMPUTING FOR SPACE AND EARTH SCIENCE APPLICATIONS

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The intelligent application of cloud computing technologies and architectures to an organization's data system offers innovative strategies for improving and evolving services at a lower cost with the opportunity for enhancing both performance and operational quality. Global Science & Technology, Inc. (GST) has been at the forefront of pioneering the engineering of advanced scientific data systems for over twenty years. During this time, GST has developed a reputation for solving the complex data system challenges faced by our customers in the space and Earth sciences community.

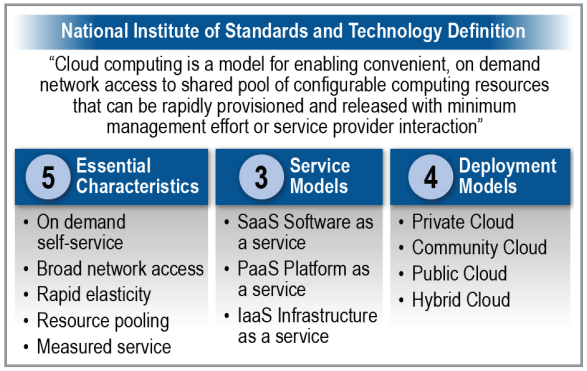

Figure 1: *The Definition of Cloud Computing and How Cloud Computing Services are Structured*

GST is involved in several advanced data system development projects that utilize cloud computing services driven by constantly evolving, large volume, complex multidimensional data technology environments. Project activities include:

- Processing direct broadcast satellite data using a full range of cloud computing services to support regional weather forecasting
- Assessing and prototyping cloud storage services and supporting an extremely large data archive for remote delivery of large volumes of instrument data that can be easily accessed by users
- Mesonet processing services involving the collection and processing of instrument data from large numbers of mobile and fixed site weather sensors using cloud computing communications and storage and processing services

Although each project has a different objective and agenda, each used all or part of the available cloud computing elements and pushed the boundaries of their IT services.

Any data system can use one or more cloud computing service, depending on its economical, performance, and functional need. Further, cloud computing means using IT infrastructure as a service, and that service may be anything from renting raw hardware to using third-party application programming interfaces (APIs).

GST's Advanced Data System Development Projects Using Cloud Computing Services

Project: NASA SBIR Phase II — Using GST's own internal research and development resources with the help of additional funding through NASA's Small Business Innovation Research (SBIR) grants program, GST engineers and scientists have developed near-real-time data processing solutions for environmental satellite data. Our low-cost, solution is based on the power and flexibility of Amazon Web Services (AWS), which includes Amazon Simple Storage Service (Amazon S3), Amazon Elastic Block Store (EBS), Elastic Cloud Compute (EC2) service, supporting data servers, and map servers. The system was configured to enable scalable parallel processing on multiple virtual servers to perform just-in-time processing without the need for a dedicated and costly computing infrastructure. A simple diagram of the SBIR product generation cloud implementation is presented in Figure 2.

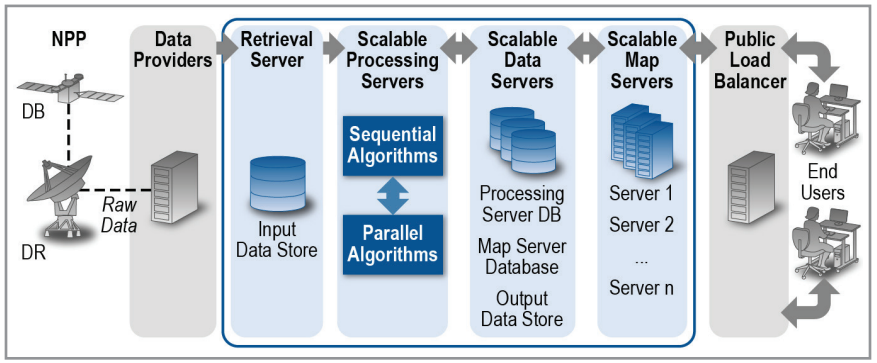

Figure 2: *NPP Product Generation Cloud Computing Architecture*

Project: NOAA CLASS — As the prime contractor for NOAA's Comprehensive Large Array-data Stewardship System (CLASS), GST is responsible for the design, development, and implementation of a big data archive for all of NOAA's environmental data. GST engineers were asked to evaluate and then prototype using cloud computing services to remotely store selected data holdings for access by its user base of scientists. CLASS is NOAA's primary sensor data archive. It presently stores more than