

Science Data Systems for Satellite and Airborne LIDAR Data

Annual Report

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Submitted to

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NASA/NSSC, Grants Officer**

Project Overview

The goal of this project (the NASA LiDAR ACCESS System or NLAS) is to enhance user access to, and understanding of, existing NASA satellite LiDAR data hosted at the National Snow and Ice Data Center (NSIDC) DAAC and high altitude Laser Vegetation Imaging Sensor (LVIS) data from Goddard Space Flight Center. Standardized web services are being developed to connect archives hosting these data to the OpenTopography portal at the San Diego Supercomputer Center (SDSC). The OpenTopography portal has proven to be an effective interface for thousands of users of UNAVCO EarthScope and other low altitude airborne LiDAR data products. OpenTopography provides interactive access to LiDAR point cloud data, custom digital elevation models, and other derived data products and visualizations. The OpenTopography system is based on a Service Oriented Architecture (SOA) which allows modular components, databases and other resources, regardless of physical location, to communicate and be chained together into data access and processing workflows. The Earth science data system that is being assembled as part of this project is based on the SOA model and thus will provide integrated and seamless access to satellite and low- and high-altitude LiDAR data from distributed archives in a manner not previously possible. Both the science and hazards applications communities will benefit from the timely, easy access to higher level data and summary quality control products that will be provided in common data formats via simple to navigate web-interfaces.

Project Accomplishments

The NLAS project development has to date closely followed the proposed schedule and milestones. The teams from UNAVCO, NSIDC, SDSC, GSFC, and the University of Maryland have been assembled, have met in a face-to-face meeting at UNAVCO in Boulder, and participate in monthly teleconferences. A public website for NLAS has been created at OpenTopography (<http://www.opentopography.org/index.php/about/nlas>) and a collaborative team project wiki and document exchange system has been created on Google Sites/Docs to facilitate project management and interactions. Among the accomplishments of the NLAS team for the first year have been refinement of the NLAS architecture, initial data format and enhanced QC parameter definition, development of data translation services, sample LVIS to OpenTopography data transfer and ingestion, and prototyping of the data repository and web service. One significant enhancement to the proposed NLAS design is use of "RAMADDA," a data repository system developed at UNIDATA/UCAR. RAMADDA will be used for both LVIS and GLAS data repositories and modified to meet specific NLAS project requirements. The primary developer of RAMADDA was hired by UNAVCO to work on the NLAS project, which greatly facilitates new development. Finally, abstracts were submitted for the Fall AGU meeting and demonstrations of the prototype NLAS system are planned for the OpenTopography and NASA booths. We present below additional details on the contributions from each of the NLAS teams.

NSIDC Activities

- Helped plan and run the team kickoff meeting, and gave briefing on the GLAS products and archive at NSIDC.
- Began developing software which will extract GLAS files from NSIDC DAAC Data Pool, collect and align parameters from different products, define new derived parameters and output in a one-shot-per-record binary format. This work is expected to be completed by the end of the second quarter.

- Working with David Harding from GSFC we are defining a simplified, more user-accessible ICESat data records, derived from the final altimetry data product release. This includes new derived parameters, such as a signal-to-noise measure, and additional quality assurance parameters, made similar to LVIS QA data where possible. An initial version of the product specification for both a long subset, for use by high-end users, and a short subset, for use by those wanting basic elevation data, has been sent to the ICESat Science Team for comment.
- Briefed Ice Bridge team at NSIDC on NLAS. There is an ongoing exploration of possibilities for cooperative efforts.
- Drafted and submitted for the Fall AGU meeting an abstract describing NLAS
- Drafted and submitted an application to demonstrate NLAS at the NASA booth in the exhibition hall at AGU.
- Met with team members from UNAVCO to discuss strategy for incorporating RAMADDA into NLAS.

UNAVCO Activities

The 2 major activities at UNAVCO are the development of a Java-based library and framework for reading and writing point observation data files and the development of a suite of web services based on the data framework.

- Organized and hosted the 2-day NLAS project kickoff meeting in Boulder.
- Organized and hosted project teleconferences.

To date, we have implemented I/O support for the following data formats:

- LVIS – Support is provided for the 3 major LVIS formats (LCE, LGE and LGW) including providing access to the waveform data in the LGW format.
- LAS – All versions of LAS are supported. Furthermore, there is support for writing out LAS files (version 1.2) from other LiDAR data file formats (e.g. LVIS).
- PTX – This is a text-based format often written out by Terrestrial LiDAR Scanners (TLS).
- ICESat/GLAS: All of the GLAS products are supported (GLAS record formats 5, 6, 12, 13, 14, 15)
- Various IceBridge formats, e.g., ATM, PARIS, MCORDS, etc.
- Various custom point cloud formats, e.g., CSV, Point Cloud Binary, etc.

A suite of web services has been developed as a plugin to the RAMADDA data repository framework. [RAMADDA](#) is an extensible digital content management system for geo-science data and provides a broad range of facilities and services. The NLAS/RAMADDA plugin provides a number of interactive services including mapping, time series charts, waveform charts and metadata listings. Data subsetting, conversion and product generation services are also provided. A user can decimate and spatially subset one or more LiDAR files. The result formats include the native data format, LAS, and various CSV formats. Gridded products such as hill-shaded images and ARC ASCII Grids are also generated. Examples of these services can be viewed at <http://motherlode.ucar.edu/repository/alias/lidar>. UNAVCO also performs primary NLAS project management tasks.

LVIS/GSFC Activities

Project Activities:

- Participated in project teleconferences.
- Defined a new comprehensive LVIS data format based upon current LVIS formats and anticipated new sensor requirements. This new format will be used in the back end data file repository accessed by RAMADDA.
- Provided technical and scientific input to NLAS development.

Open Topography/SDSC Activities

Project Activities:

- Attended 2-day NLAS project kickoff meeting in Boulder.
- Participated in monthly NLAS project calls where various project issues and tasks have been discussed, including:
 - Methodology and data formats for ingestion of LVIS data - as discrete return point cloud - into the OpenTopography system.
 - Data schemas and file formats (LAS 1.2 vs. LAS 1.3 vs. non-LAS format) for handling LVIS discrete return and full waveform data.
 - GLAS and LVIS master data product lists.
 - NLAS service definition and preliminary architecture.
- Contributed to NLAS AGU abstract submitted to session IN08: "Interoperability Barriers for Earth Science Data Systems".

Accomplishments and Deliverables:

- Established public NLAS project overview page on OpenTopography site (<http://www.opentopography.org/index.php/about/nlas>). Note: internal project wiki is hosted at <http://sites.google.com/site/nlaswiki/>.
- Loaded sample LVIS dataset (2008 LVIS Sierra Nevada, CA collection) in LAS format into OpenTopography system and integrated with full OT data processing and visualization capabilities. These data may be accessed through the beta Open Topography portal.

ESDSWG Activities

SiriJodha Singh Khalsa (NSIDC) is an active participant in the Standards Process Group of the ESDSWG. In the past year he has served on two Technical Working Groups reviewing RFCs, commented on other draft RFCs and has participated in telecons and Face-to-Face meetings. The RFCs he helped with were: Climate and Forecast (CF) Metadata Conventions, Mapping HDF5 to DAP2, ECHO Metadata Model and most recently, a preliminary review of Updates to GCMD Directory Interchange Format (DIF).