NASA Research Opportunities for NSF Big Data Principal Investigators

Apply NSF Big Data Research to NASA Research Objectives

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for
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21 April 2013 (v2)
Representative NASA Big Data Problem

Project Goal
• Using National Geospatial Agency (NGA) data to estimate tree and bush biomass over the entire arid and semi-arid zone on the south side of the Sahara

Project Summary
• Estimate carbon stored in trees and bushes in arid and semi-arid south Sahara
• Establish carbon baseline for later research on expected CO₂ uptake on the south side of the Sahara

Principal Investigators
• Dr. Compton J. Tucker, NASA Goddard Space Flight Center
• Dr. Paul Morin, University of Minnesota
• Dr. Tsengdar Lee, NASA HQ

Tree Crown

Approximately 120 TB of NGA 40 cm imagery representing tree & shrub automated recognition

Takes in small input and creates large output

- Using relatively small amount of observation data, models are run to generate forecasts
- Fortran, Message Passing Interface (MPI), large shared parallel file systems
- Rigid environment – users adhere to the HPC systems

Example: GEOS-5 Nature Run (GMAO)

- 2-year Nature Run at 7.5 KM resolution
- 3-month Nature Run at 3.5 KM resolution
- Will generate about 4 PB of data (compressed)
- To be used for Observing System Simulation Experiments (OSSE’s)
- All data to be publically accessible via FTP

Available Data Sets

• Too many to list

• Result of Google search for “NASA Data”
  - About 248,000,000 results (0.28 seconds)

• Some Resources
  - NASA Data Portal
  - NASA Earth Exchange (NEX)
  - Earth Data (EOSDIS)
  - Goddard Earth Sciences Data and Information Services Center
NASA Research Announcements

- NASA Research Competitions Managed through NSPIRES system
  - https://nspires.nasaprs.com/external/
  - Amendments provide individual Program announcements when released

- Space Technology Mission Directorate (STMD)
  - Space Technology Research, Development, Demonstration, and Infusion-2016 (SpaceTech REDDI)
  - Open annually Oct 01, 2015 through Sep 30, 2016

- Science Mission Directorate (SMD)
  - Research Opportunities in Earth and Space Science (ROSES)
    - Earth Science – Appendix A.1
    - Heliophysics – Appendix B.1
    - Planetary – Appendix C.1
    - Astrophysics – Appendix D.1
  - Open annually Feb 19, 2016 through April 28, 2017
  - Further background
    - http://science.nasa.gov/researchers/sara/grant-solicitations/
    - http://soma.larc.nasa.gov/
Advanced Information Systems Technology (AIST)

- **AIST Objectives (5-20 year timeframe for adoption)**
  - Reduce the risk, cost, size, and development time of Earth Science Division (ESD) space-based and ground-based information systems;
  - Increase the accessibility and utility of science data; and
  - Enable new observation measurements and information products.

- **Working with NSF in an informal collaboration to encourage application of basic research to solve NASA Earth Science technology problems**
  - Earth Science Information Partners (ESIP) Federation Testbed
  - Independent multi-organization evaluation of AIST Projects
  - NSF Earthcube Integration & Test Environment (ECITE) Program Assessment
  - Partnering with open source and ESRI’s ArcGIS to accelerate science
  - AIST-14 awarded 24 Projects totaling $25M for 2 years of work

- **Current schedule leads to start work in late Spring to early Summer 2017**
  - Draft AIST-16 Solicitation release April, 2016 for comment by June 1, 2016
  - Final Solicitation release September, 2016 and proposals December 1, 2016
  - Announcement in Spring, 2017 with work to start soon afterwards (2 years)
Research Needs for AIST-16

- Automation is the key to handling large volumes of Earth Science Data
  - Encourage science derived from 1000’s of events instead of 2-3 selected examples
- Information Life-cycle Phases
  - Flight Computing and Mission Management (planning & ops) Technologies
    - Science from sensor webs of smallsat/cubesats, in situ and airborne instruments
  - Data Exploitation
    - Data-driven modeling: validation and near real-time updating tools/techniques
    - Multi-sensor data fusion, uncertainty analysis overlaid on GIS tools
- Relevance:
  - Observing, understanding and reacting to the impacts of Climate Change
    - Biodiversity and ecological forecasting (ROSES15-A.6)
    - Effective Disaster Response with NASA (and other) assets and sources
  - Transient/transitional phenomena
    - Cryosphere, oceans, atmosphere, land surface, solid earth
- Special Considerations
  - Encouraging inclusion of Earth Science team member to demonstrate value to NASA
  - Limited to Technology Readiness Level (TRL) 2-6: Concept through Demonstration
  - Encouraging multi-site and multi-disciplinary collaborations
Relevant Reference Materials

- ESTO (and AIST) Website: https://esto.nasa.gov/
  - Further info on past projects from “Blue Button” on middle left side of screen
- Data Lifecycle Framework Study
- NASA Guidebook for Proposers:
  http://www.hq.nasa.gov/office/procurement/nraguidebook/
- ESIP Federation Website:
  http://www.esipfed.org/
- Current AIST Program Overview
- Previous AIST-14 Announcement
- AIST Program Manager: michael.m.little@nasa.gov