



NASA Earth Exchange (NEX)

www.nasa.gov

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Moffett Field, CA**

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NASA EARTH EXCHANGE (NEX)



OVERVIEW

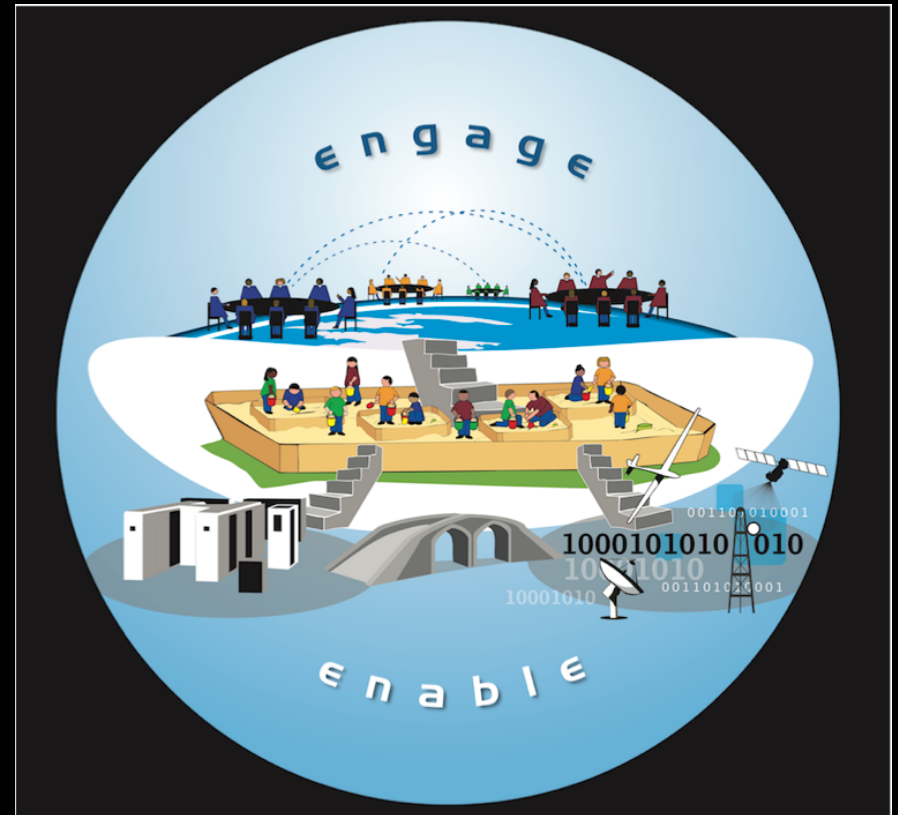
+ NEX is virtual collaborative that brings scientists together in a knowledge-based social network and provides the necessary tools, computing power, and access to bigdata to accelerate research, innovation and provide transparency.

VISION

To provide “**science as a service**” to the Earth science community addressing global environmental challenges

GOAL

To improve efficiency and expand the scope of NASA Earth science technology, research and applications programs





Earth Science Data Operations

Mission Operations

Science Operations

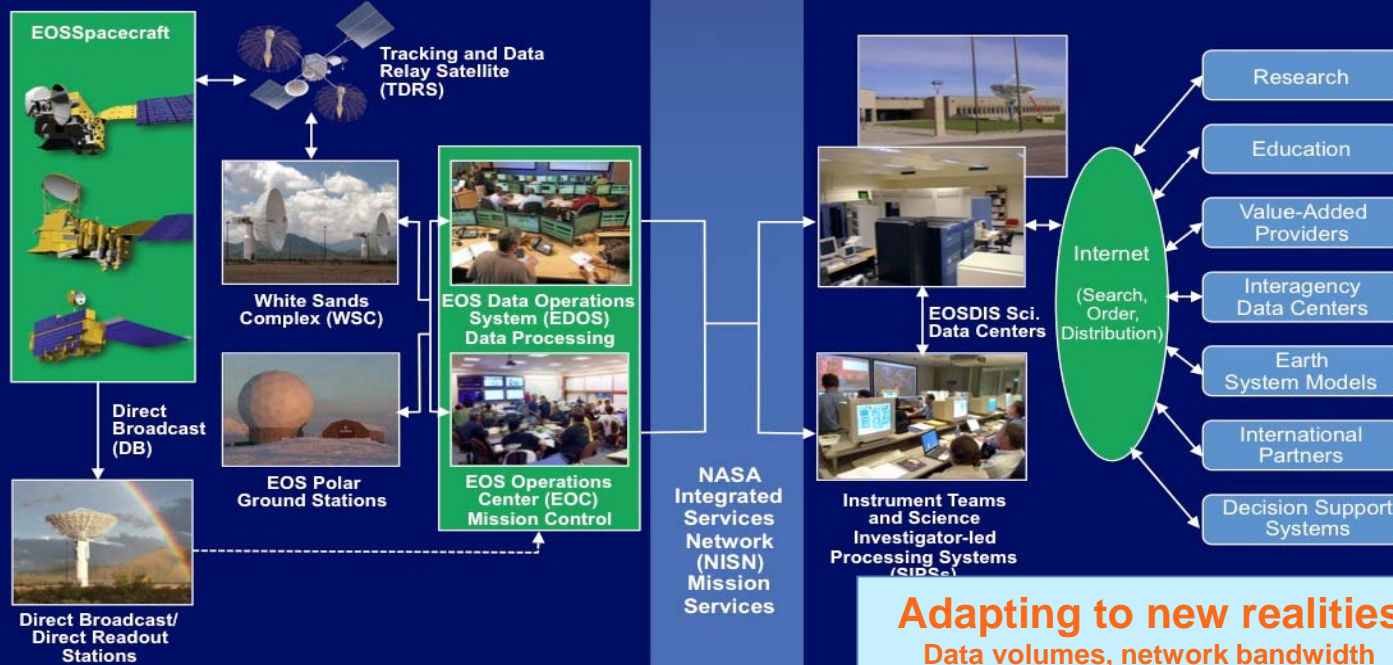
Data Acquisition

Flight Operations, Data Capture, Initial Processing, Backup Archive

Data Transport to Data Centers/SIPs

Science Data Processing, Data Management, Interoperable Data Archive, and Distribution

Distribution and Data Access





Need for an Earth Science Collaborative

- **Earth science at NASA is a community effort**
- 100s of investigators spend a majority of their time dealing with data
- Redundant storage and processing facilities result in larger overall computing budgets
- Moving data sets that are getting larger each year is expensive & time-consuming
- Sharing knowledge (codes, intermediate results, workflows) is difficult

NEX Provides a Complete Work Environment "Science As A Service"



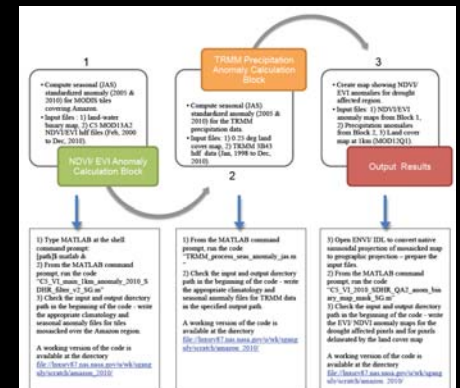
COLLABORATION

Over 500 Members



CENTRALIZED DATA REPOSITORY

Over 1300 TB of Data



KNOWLEDGE

- Workflows
- Machine Images
- Model codes
- Re-usable software



COMPUTING

- Scalable
- Diverse
- Secure/Reliable

NEX Resources



Portal

- Web server
- Database server
- 543 registered members

Sandbox

- 96-core server, 264GB memory, has 320 TB storage
- 135 users

HPC

- 720-core dedicated queue + access to rest of Pleiades (211,000 cores)
- 65 users
- 2.3 PB storage

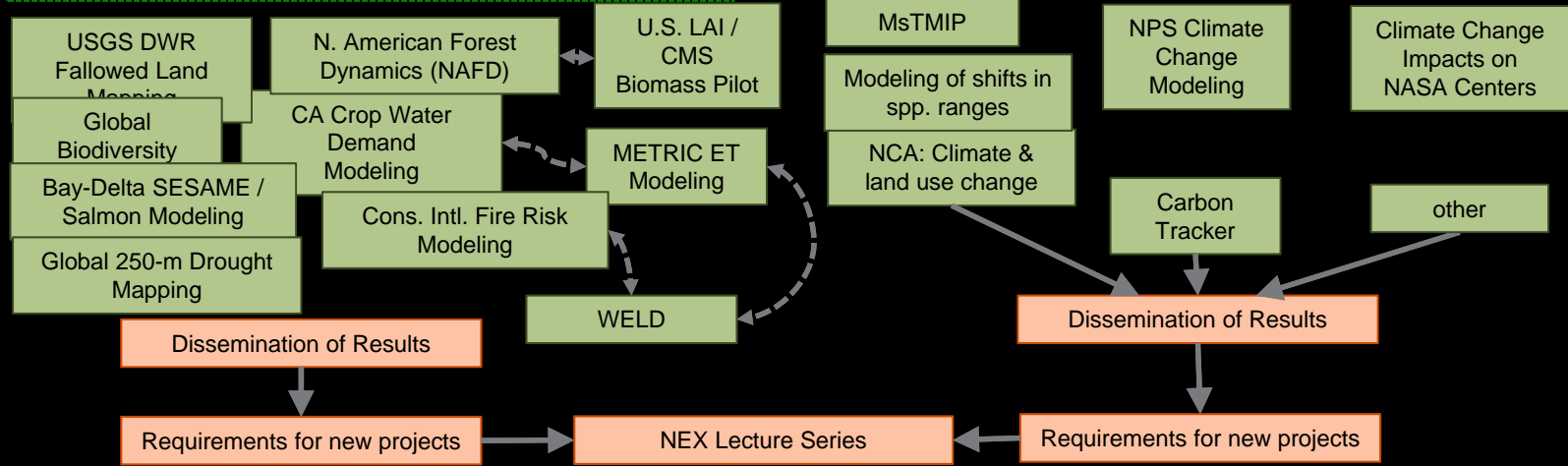
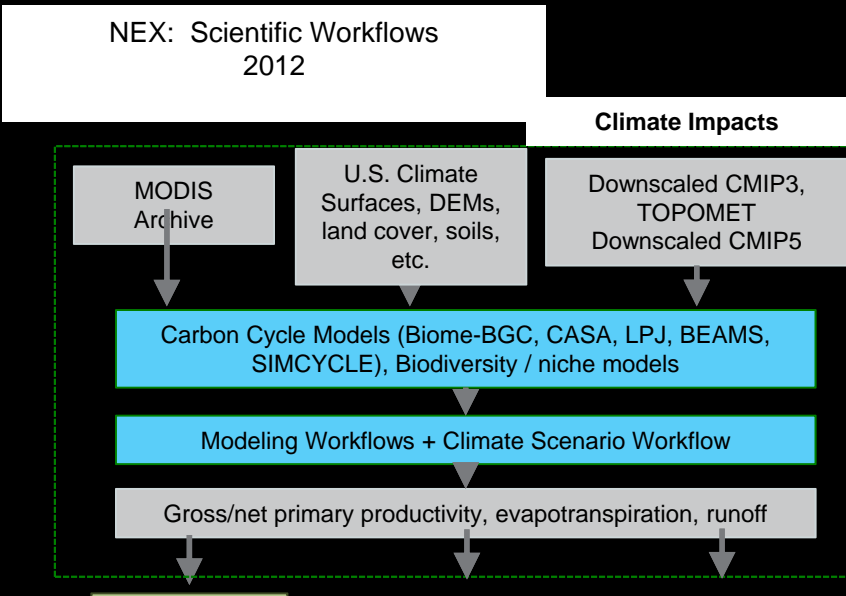
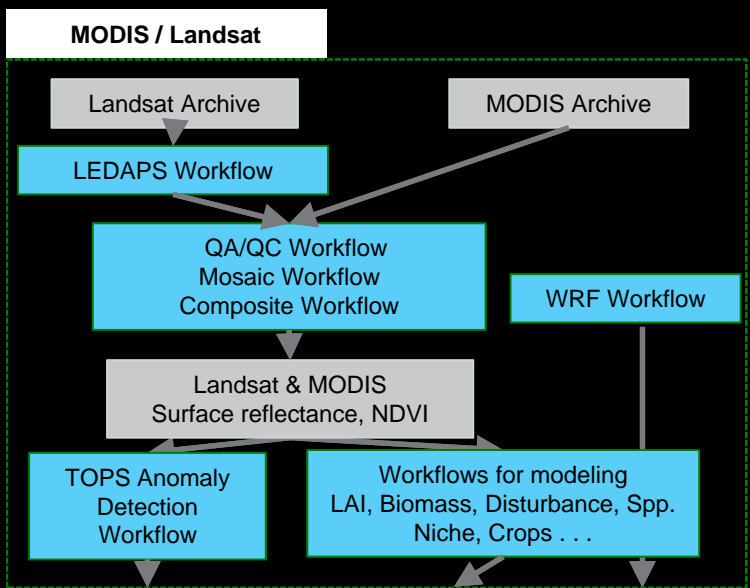
Models/Tools/Workflows used by NEX User Community

- GEOS-5
- CESM
- WRF
- RegCM
- VIC
- BGC
- LPJ
- TOPS
- BEAMS
- Fmask
- METRIC
- LEDAPS for new sensors (L8SR, Sentinel-2)
- DART
- RHESSys
- STILT

...

Data (>1300 TB on & near-line)

- Landsat (> 2M scenes, including OLI)
- MODIS
- TRMM
- GRACE
- ICESAT
- CMIP5
- NCEP
- MERRA
- NARR
- PRISM
- DAYMET
- NAIP
- Digital Globe
- NEX-DCP30
- WELD (revised)
- NEX-GDDP
- LOCA
- NAFD-NEX
- Sentinel-2



ACCESS TO NEX



Portal

(available to Earth scientists through OpenID)

Sandbox

(available to Earth science community through Symantec validation)

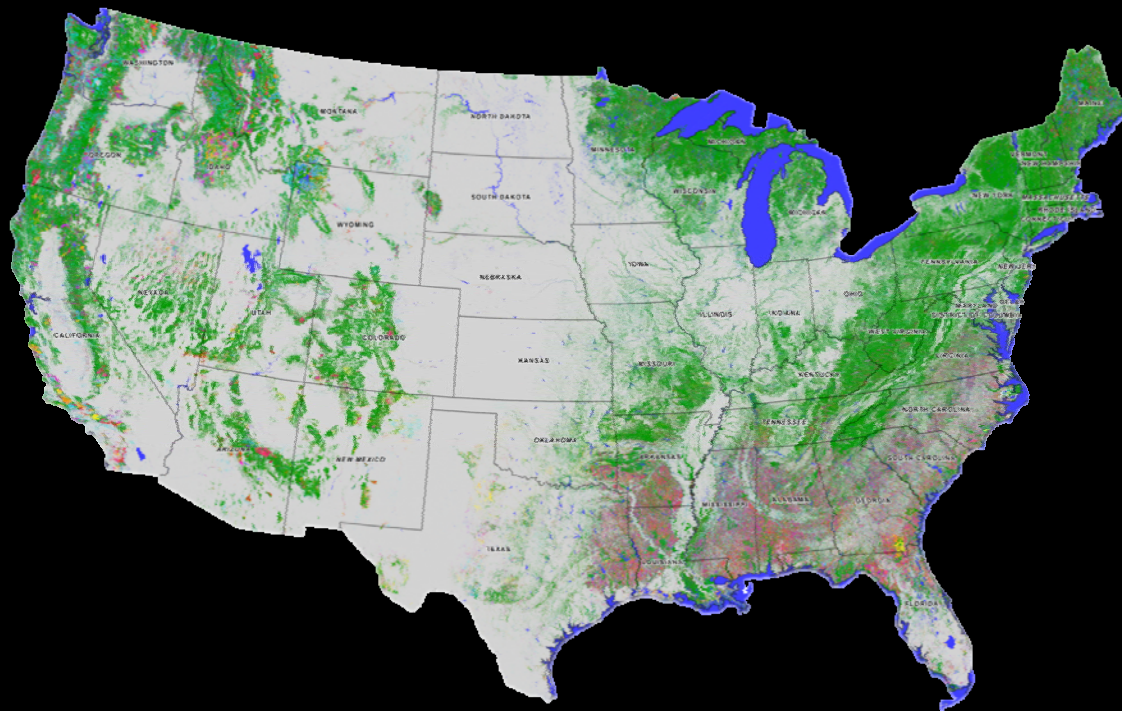
Supercomputing

(only for NASA-supported teams through NASA security)

OpenNEX

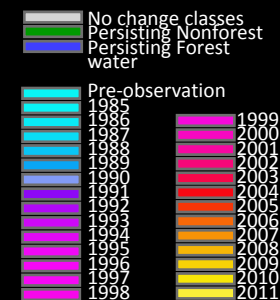
(on Amazon Web Services, open to the world)

North American Forest Dynamics Phase III (U of Maryland, Goward/Huang et al.)



Forest disturbance tracking with Landsat with implications for carbon cycle modeling

NAFD-NEX research dataset archived for future use by the community at ORNL – released October 29

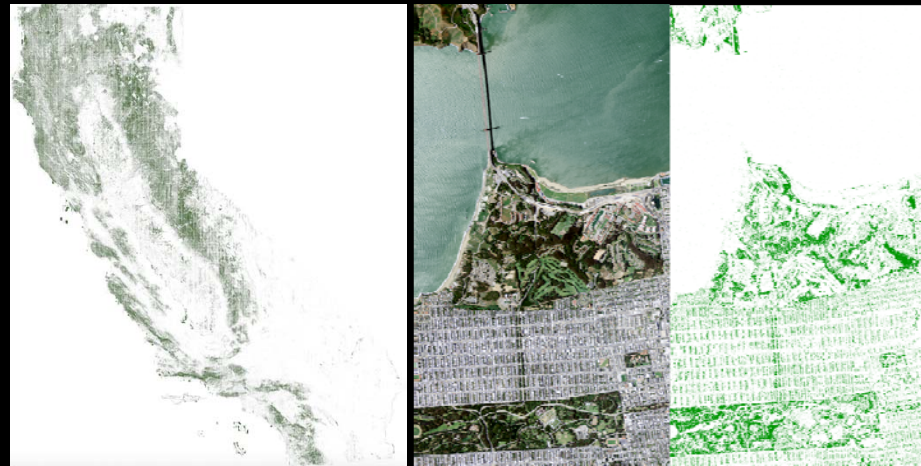


Carbon Monitoring System (Ganguly et al.)

Tree cover for Continental United States at 1-m spatial resolution

- Data from NAIP for CONUS successfully staged on NEX (~330,000 scenes)
- Deep Learning architecture and statistical region merging implemented to do tree cover classification and segmentation
- Successfully processed the state of California (~11,000 scenes) – end-to-end processing time is 48 hours.
- Processing 60TB/year, 240TB for 4 years and performing extensive validation (more than million square blocks of homogeneous pixels across different forest landscapes)

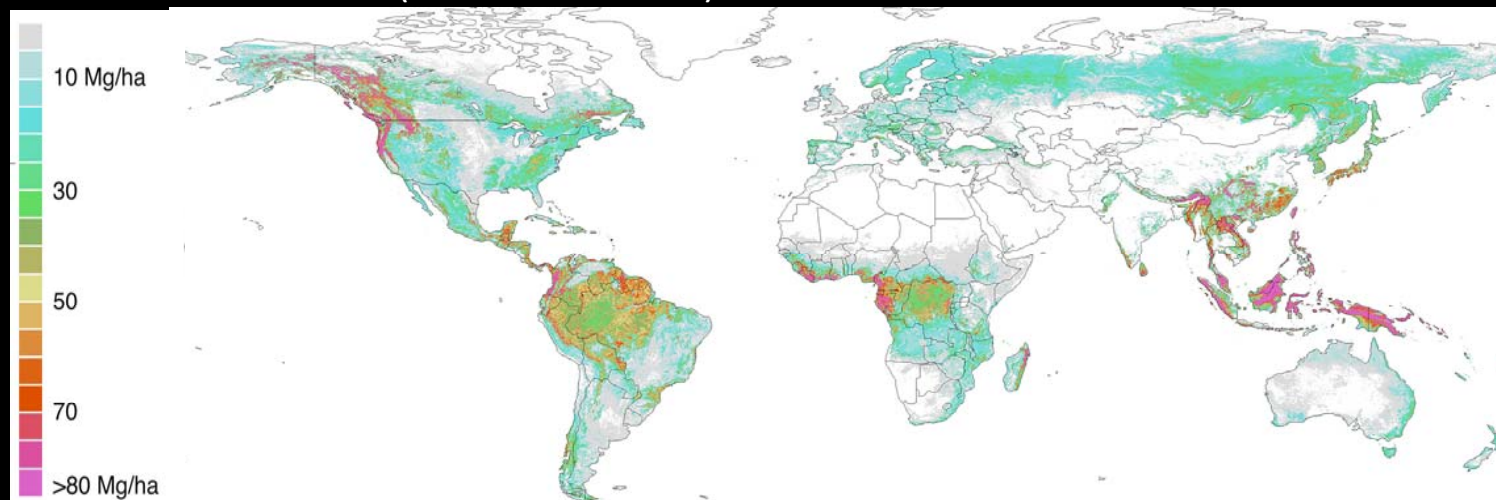
		Actual Class			
		Tree	Non-tree	Total Pixels	User's Accuracy
Predicted Class	Tree	14832	317	15149	97.9%
	Non-tree	3168	17683	20851	84.8%
	Total pixels	18000	18000	36000	
	Producer's Accuracy	82.4%	98.23%		90.31%



Global vegetation biomass estimates at 100m using multi-sensor data fusion and machine learning (JPL, Saatchi et al.)

The global algorithm make use of the several medium resolution satellite data uploaded on the NEX platform:

- ALOS PALSAR (25 m resolution) 2007-2010
- SRTM DEM (30 m resolution)
- Landsat TM, ETM, etc. (30 m resolution)
- MODIS (250 m resolution)

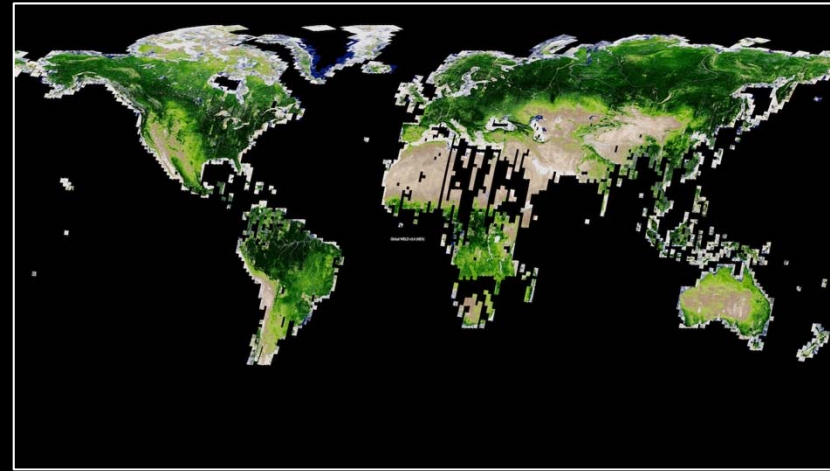
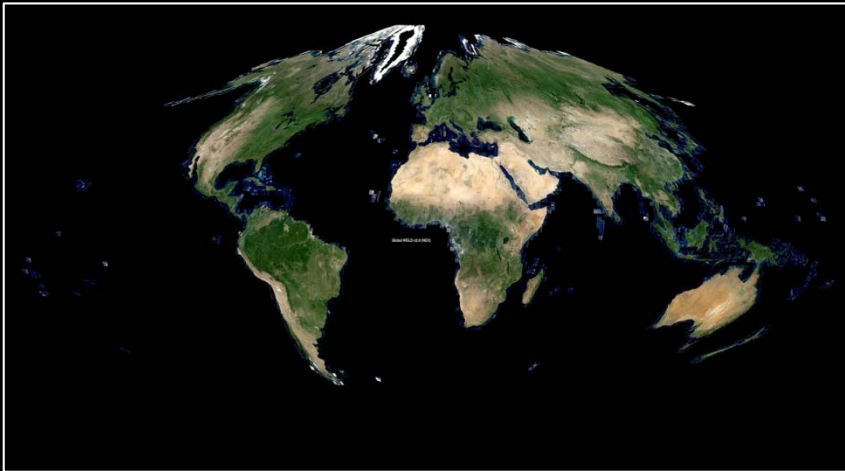


Web Enabled Landsat Data (WELD, Roy et al.)



New version 3.0 to be released in December

- Atmospherically and BRDF corrected Landsat 5+7 monthly and annual composites
- 30-stage pipeline with QA/QC, performance metrics
- Separate image processing for EOSDIS Global Imagery Browse Services (GIBS)
- Processing 100TB/monthly composite, 25PB for all 18 years



12/15/2015



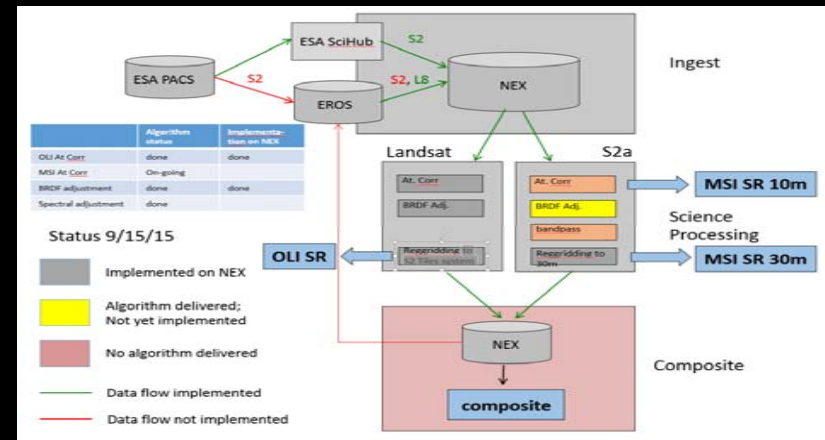
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L8-SENTINEL Processing Flow (GSFC, Masek et al.)



NEX Supporting the pilot Sentinel-2 Processing Architecture. Modules implemented are:

- BRDF adjustment
- Atmospheric correction
- Cross-calibration
- Spectral adjustment
- Reprojecting/ reprojection

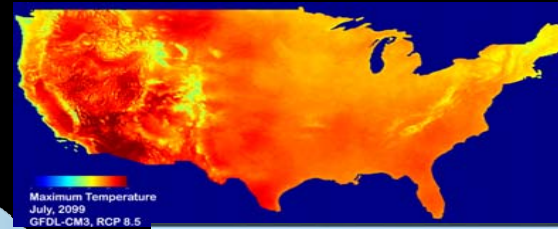
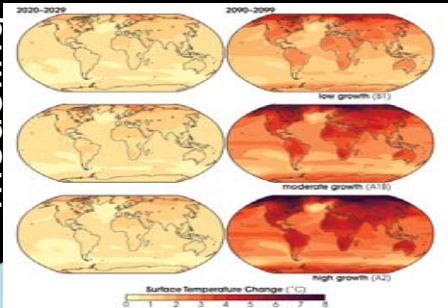


Goal: Harmonized Landsat/Sentinel reflectance products for new S-2 image acquisitions, followed by Leaf Area Index retrievals

NEX for the National Climate Assessment

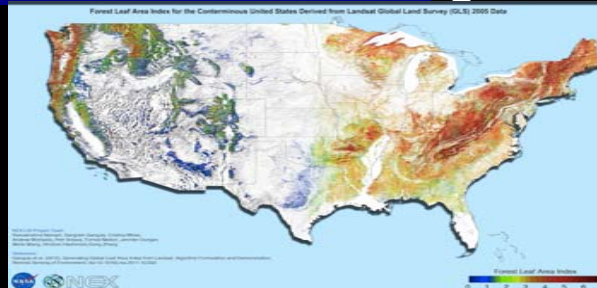
Promoting consistency, repeatability, and transparency in global change science

Climate modeling

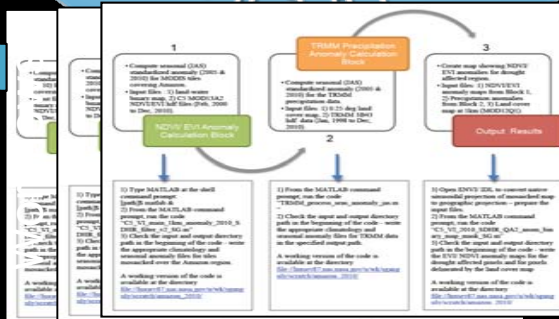


Downscaling

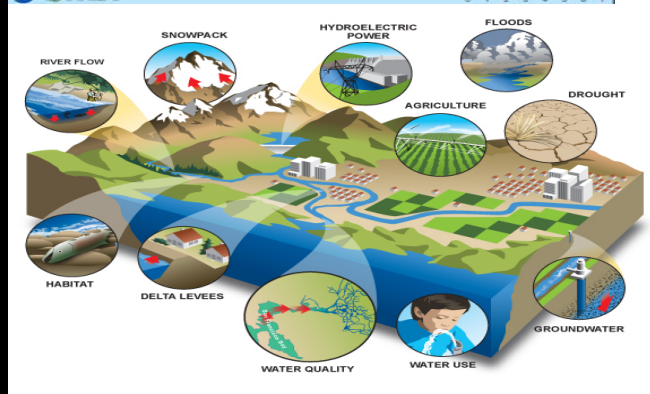
Every 4 years



Long-term
Satellite
data
analysis

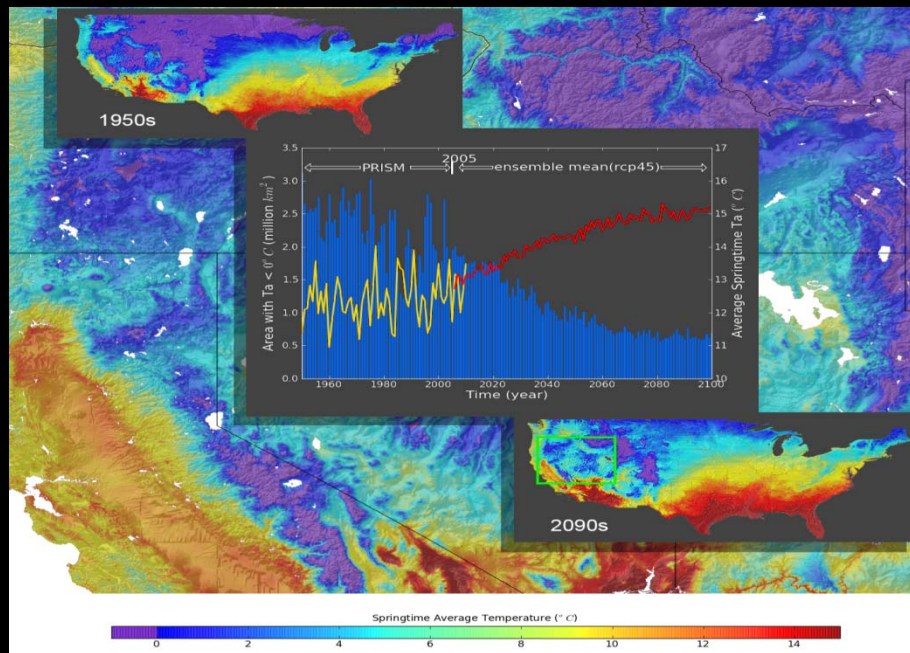


Workflows



Modeling
impacts

Creating NEX-DCP30 Downscaled Climate Projections at 30 arc-second resolution



Changes in springtime (March-April-May) mean temperature over the conterminous US from 1950 to 2099.

- 33 CMIP5 models available
- All 4 RCPs (2.6, 4.5, 6.0, 8.5) and Historical runs
- 30 arc-second (800m) spatial resolution, monthly time-step, 1950-2099
- Max/min temperature and precipitation
- Statistical downscaling (bias-corrected spatial disaggregation; Maurer et al., 2007)

Global Daily Downscaled Climate Projections

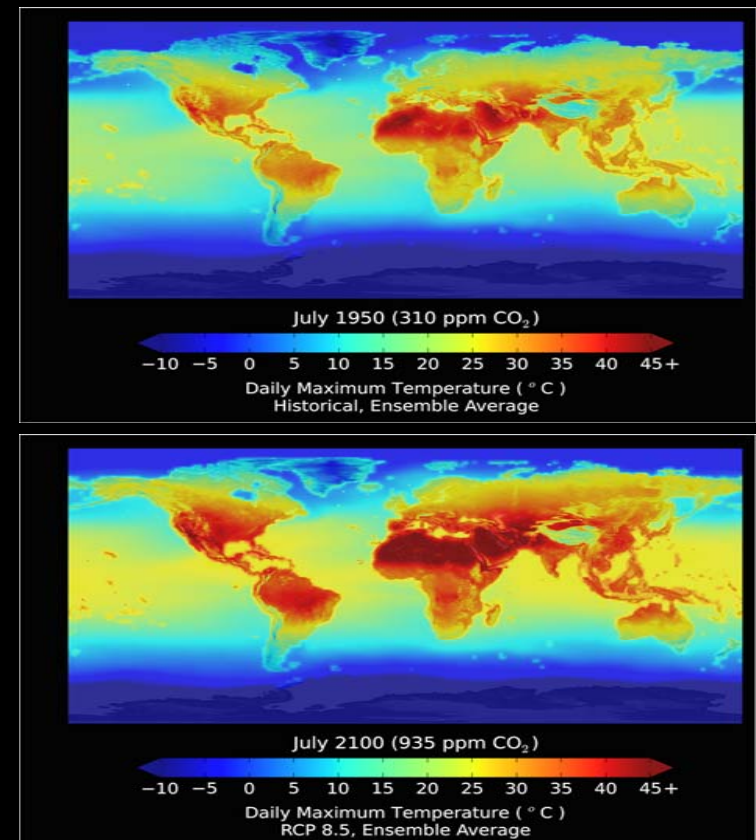
- CMIP5 archive downscaled using the Bias Correction and Spatial Disaggregation (BCSD) approach (Wood et al., 2002; Thrasher et al. 2012)
- Global daily temperature and precipitation scenarios from 1950-2100 at 0.25 degree spatial resolution (~25km x 25km)
- 21 coupled General Circulation Models (global climate models)
- 2 Representative Concentration Pathways (RCPs) - RCP 4.5 and RCP 8.5

12 terabyte dataset available via THREDDS at NCCS;
visualizations developed by OpenNEX community and
available at www.climateinternational.org

More information available at:

<https://cds.nccs.nasa.gov/nex-gddp/>

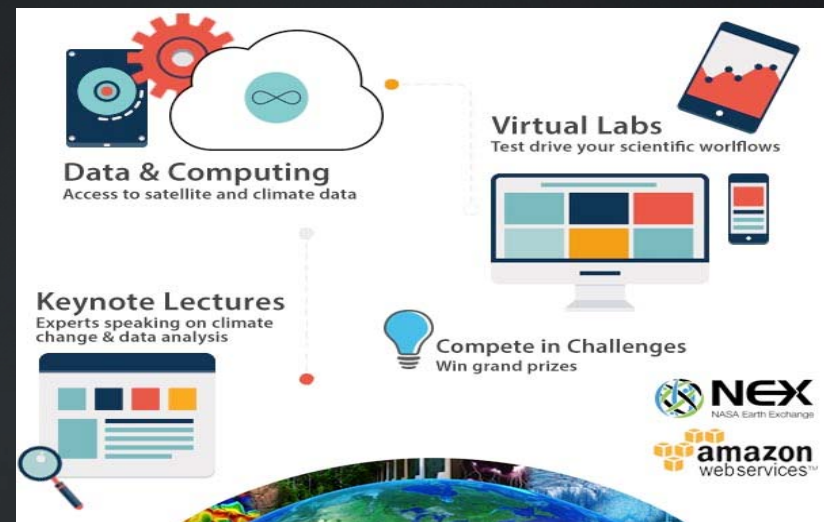
<https://nex.nasa.gov/nex/projects/1356/>



OpenNEX

Public-Private Partnership

- Collaborative Computing
- On-Demand Computing
- Hands-on Tutorials
- Virtual Labs
- Access to Satellite and Climate Data
- Lectures by Experts



ALL IN THE CLOUD !

nex.nasa.gov/opennex



NEX in the near future

Science Platform

*Access to science workflows, documentation,
publications, tutorials, videos
Workshops*

NEX Science and Outreach
Infrastructure independent

Data Platform

*Access to data and metadata
services*

Integration Platform

*Access to tools, utilities and
workflow components*

(Open)NEX Core



Infrastructure

NEX Summary

Lowers the barrier of entry (co-locating data, model codes, and compute resources).

Allows knowledge sharing (through workflows and virtual machines).

Provides a framework for transparency, reproducible/verifiable results.

Platform for prototyping or extending applications.

Enabling broader community access through public-private partnerships.

Thank you

<https://nex.nasa.gov>

<https://nex.nasa.gov/OpenNEX>