Calibration and Validation sites

Gregory Stensaas

USGS

Geneva Workshop Outcome

- ***Cal/Val site characterisation & classification session agreement***
  - The strong need for establishment, definition, and characterisation of CEOS/GEO endorsed calibration sites
  - Site characterisation requirements varied between expert groups but the desire was to establish a global set of CEOS-endorsed sources of cal/val data
  - The need for calibration requirements, associated sites, data definition and understanding, and data sharing
  - IVOS would provide example template and documentation and examples for the WGCV subgroups

Scope of test sites

- Test sites are core to any future QA/QC strategy
- Test sites provide a convenient means of obtaining information to verify sensor performance
- Test sites are the only practical means of deriving knowledge on biases between sensors
- Test sites allow, at some level, a means of bridging anticipated data gaps caused by lack of measurement continuity, due to lack of co-existent in-flight sensors

Characteristics of sensors which can benefit from test sites

- Gain
- Linearity
- Stability
- MTF
- Uniformity (Flat field)
- Stray light (Adjacency effects)
- Polarization
- Spectral
- SNR
- Algorithms

- Geo location
- Camera model
- Band-to-band

Distribution of 36 Radiometric Sites

USGS On-line Catalog

http://calval.cr.usgs.gov/sites_catalog_map.php

Online Catalogue Example: Railroad Valley Playa, North America

Site Location: Railroad Valley Playa

Radiometric ◀ PREV NEXT ▶

Location (City, State, Country):	Ely, Nevada, USA, North America
Altitude above sea level (meters):	1435
Center Latitude,Longitude (Degrees):	+38.5, -115.69
Landsat WRS-2 Path/Row:	40 / 33
Size of Usable Area (km):	10 x 10
Owner:	Bureau of Land Management (BLM)
Researcher:	Dr. Kurtis J. Thome Email Researcher

Download L7 ETM+ GeoTIF Data

Download Google Earth KMZ File

View Additional Photos

Purpose:	Radiometric, vicarious calibration test site, with large homogenous regions
Description:	Dry-lake playa, spatially homogeneous, consisting of compacted clay-rich lacustrine deposits forming a relatively smooth surface compared to most land covers, although it has a lower spatial uniformity compared to the Ivanpah and Lunar Lake sites. The surface composition is comparable to those of Ivanpah and Lunar Lake; however, all three sites suffer from the presence of iron absorption (Fe3+) in the visible part of the spectrum, characteristic of playas in this region of the US. Google Earth : Slightly patchy (in colour and intensity) across the playa.
Support Data:	Strong linear road features and oil drilling structures (no lat/long available)
Suitability:	Recommended for 15m GSD and larger, VisibleUV to SWIR Solar reflective and emissive, sub-meter to 2km GSD
Limitations:	Soft surface composition, spatial and spectral variation, possible hot spot effects, periodic snow and water, cloud cover increases in winter, remote location for ground-based studies

Choose A Radiometric Site

Choose A Geometry Site

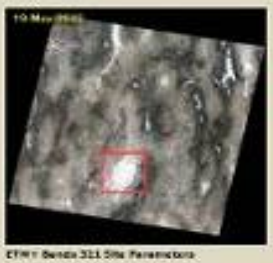
Home

Radiometry Sites

Geometry Sites

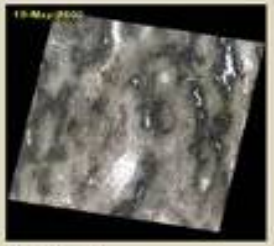
Acronyms

References



ETM+ Bands 321 Zoomed

ETM+ Bands 321 Site Parameters

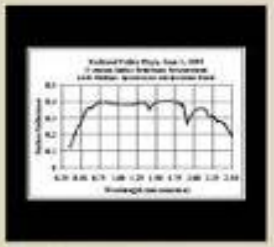


ETM+ Bands 321

Google Earth Zoomed

Ground Picture 1

Ground Picture 2



Railroad Valley Reflectances

CEOS WGCV Subgroups

WGCV Chair: Dr. Changyong Cao (NOAA/NESDIS)

- Infrared and Visible Optical Systems (IVOS)
  Dr. Nigel Fox (NPL)
- Terrain Mapping (TMSG)
  Prof. Jan-Peter Muller (UCL)
- Synthetic Aperture Radar (SAR)
  Dr. Satish Srivastava (CSA)
- Microwave Sensors (MSSG)
  Christopher Buck (ESA)
- Land Product Validation (LPV)
  Dr. Fred Baret (CNES)
- Atmospheric Chemistry (AC)
  Dr. Bojan Bojkov (UMBC/NASA)

Subgroups

- WGCV has six subgroups, each with requirements
- Discussed different sites requirements per group
- Provide currently used sites and future test sites
- Provide calibration requirements and best practices
- Provide instrumentation requirements

CEOS IVOS-19 Test sites Discussion Summary

- Two sets of test sites
  1. Core “instrumented" sites - LANDNET
  2. “Invariant” sites
- Special Methods
  - Extraterrestrial (moon, stars)
  - Rayleigh Scattering
  - Sun Glint
  - Clouds

Core "Instrumented" IVOS Sites (Total=8) LANDNET

1. Railroad Valley Playa, NV, USA, North America
   - Dr. Kurtis J. Thome (kthome@email.arizona.edu) – University of Arizona, USA
2. Ivanpah, NV/CA, USA, North America
   - Dr. Kurtis J. Thome (kthome@email.arizona.edu) – University of Arizona, USA
3. Lspec Frenchman Flat, NV, USA, North America
   - Mark C. Helmlinger (mark.helmlinger@ngc.com) – NGST, USA
4. La Crau, France, Europe
   - Patrice Henry (patrice.henry@cnes.fr) – CNES, France
5. Dunhuang, Gobi Desert, Gansu Province, China, Asia
   - Fu Qiaoyan (fqy@cresda.com) – CRESDA, China
6. Negev, Southern Israel, Asia
   - Arnon Karnieli (karnieli@bgu.ac.il) – Ben Gurion University, Israël
7. Tuz Golu, Central Anatolia, Turkey, Asia
   - Selime Gurol (selime.gurol@uzay.tubitak.gov.tr) – TUBITAK UZAY, Turkey
8. Dome C, Antartica
   - Dr. Stephen Warren (sgw@atmos.washington.edu) – University of Washington, USA

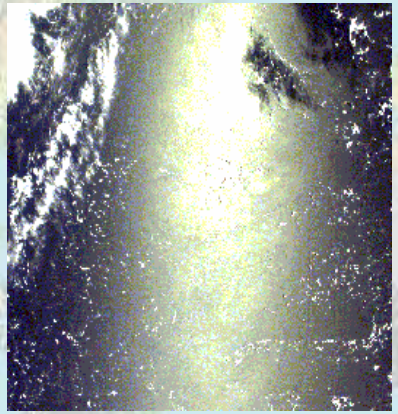
Core "Instrumented" IVOS Sites (Total=8)

"Invariant" IVOS Sites (Total=5)

- Libya 4
- Mauritania 1/2
- Algeria 3
- Libya 1
- Algeria 5

Special Methods

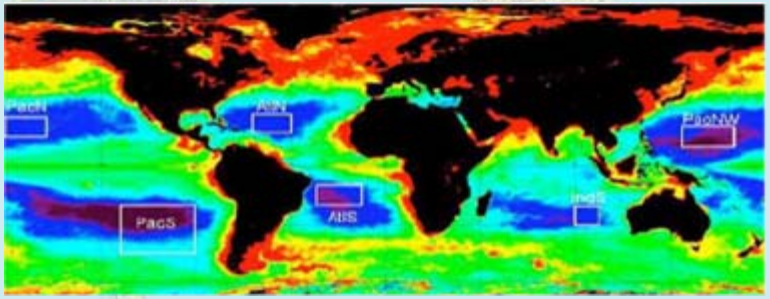
Moon



Sun glint

Rayleigh

Clouds



Rayleigh Calibration Sites – Choice of oligotrophic areas with 2 years of SeaWiFS data made in 2001 with ACRI and LOV (CLIMZOO zones)

Terrain Mapping Subgroup (TMSG)

- Montagne Sainte-Victoire
  - France referred to as Aix-en-Provence
  - 5.528-5.685ºE, 43.502-43.560ºN
  - mixed arable, forest, limestone
- Barcelona, Spain
  - 1.5-2.75ºE, 41.25-41.82ºN
  - urban, mixed arable, forest
- North Wales,
  - UK3-5ºW, 52-53.5ºN
  - urban, pasture, forest
- Three Gorges, China
  - 108.252-111.302ºE, 30.638-31.229ºN
  - forest, arable, limestone
- Puget Sound, WA, USA
  - -121.397 to -123.897ºW, 46.364-48.864ºN
  - forest, urban, wetlands

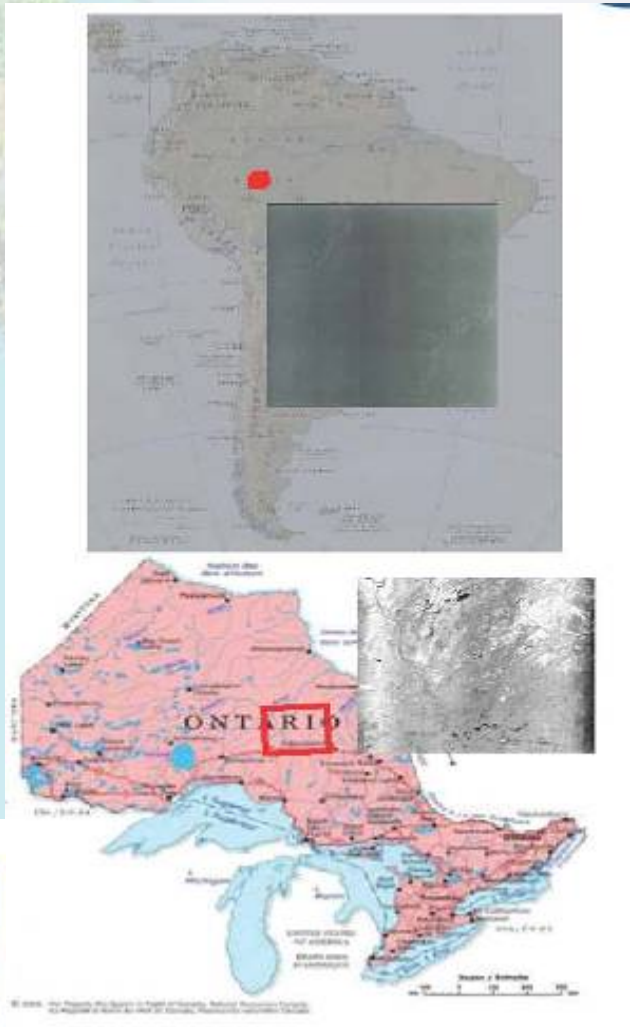
N.B. screenshots from ICEDS extracts

Microwave Sensors Subgroup (MSSG)

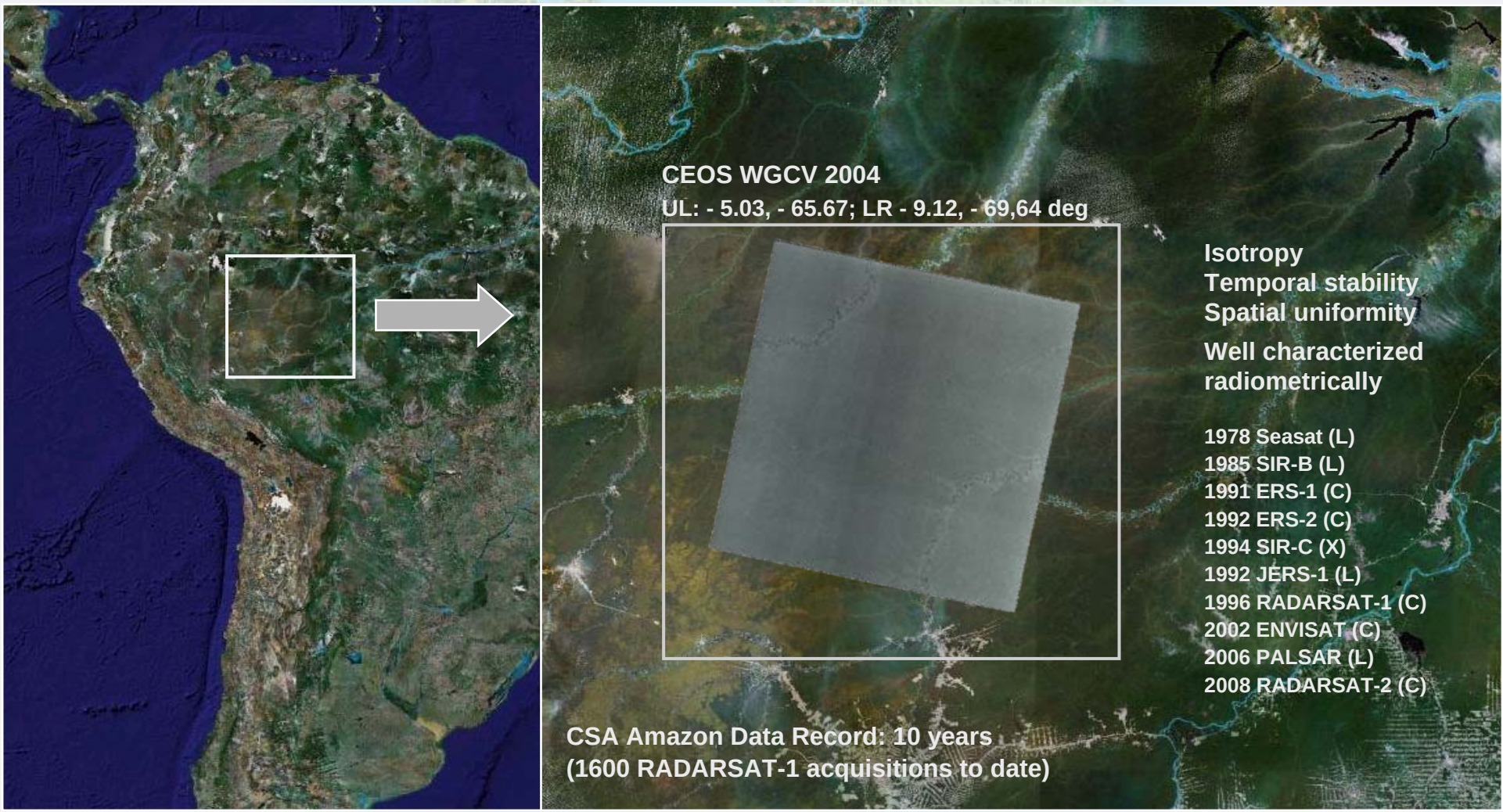
- Sandy desert (e.g. Sahara)
  - Deep penetration depth, temporal stability of the Tb, underground structure TBD
- Rocky/mixed desert (e.g. Gobi)
  - Shallow penetration depth, azimuthal effects and vegetation
- Rainforest (Amazon)
  - Volume scatter, effects of rain cells on the canopy equivalent moisture TBD
- Stable ocean areas
  - Effects of the wind/salinity at L-band TBD
- Antarctica
  - Dry atmosphere, large penetration depth & temporally stable, low azimuthal anisotropy

Synthetic Aperture Radar (SAR)

- International Amazon Rainforest Site
  - A CEOS radiometric calibration reference site
  - Data routinely collected and analyzed for calibration monitoring of SAR satellites including RADARSATs
  - Radiometry of the site remains stable
- Canadian Boreal Forest Site
  - Radiometric characterization completed at C-band using RADARSAT-1 data
  - Site seasonally dependent
  - Can be used as a complimentary site to the Amazon but with reduced radiometric accuracy
- Calibration Transponder Sites

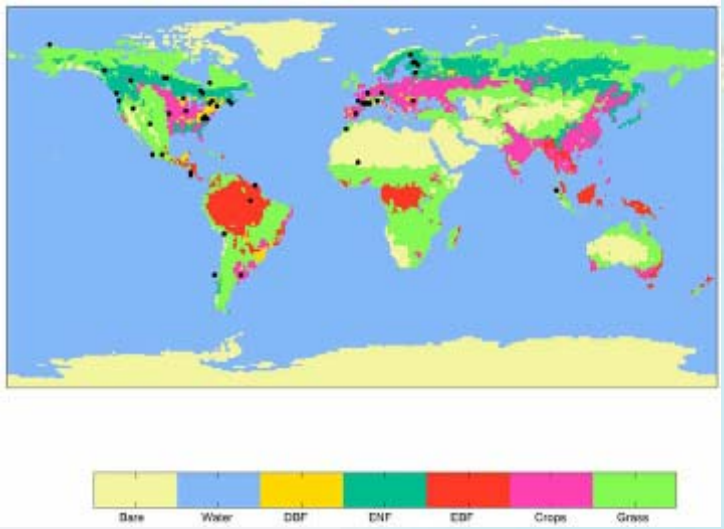


SAR Cal/Val Test Site: Amazon Rainforest



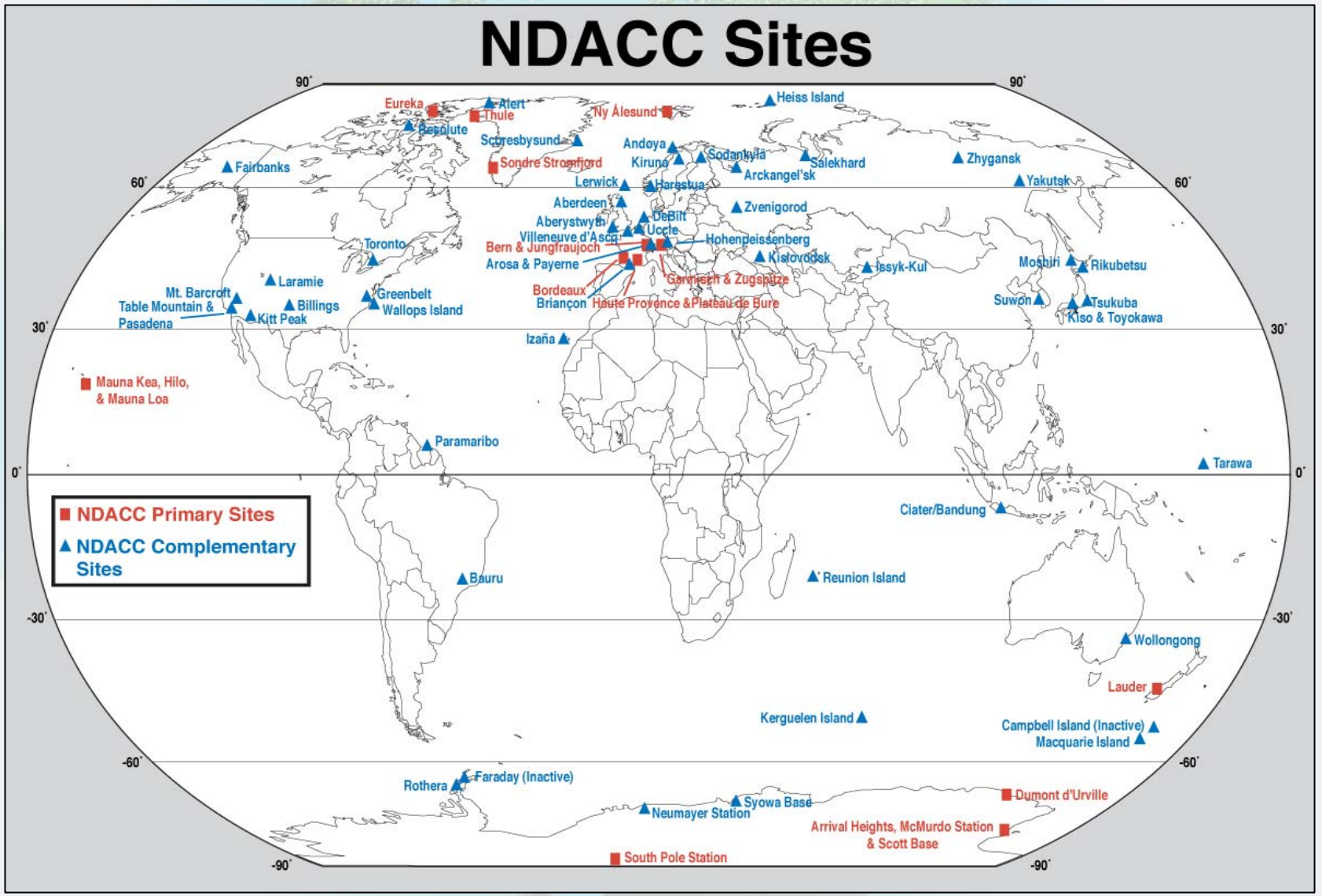
Land Product Validation (LPV)

- **CEOS Benchmark Land Multisite Analysis and Intercomparison of Products (BELMANIP) -** http://lpvs.gsfc.nasa.gov/



- Direct' sites
  - No necessity for high spatial homogeneity (non linearity as a function of heterogeneity), but homogeneity at medium resolution (geometrical accuracy, PSF)
  - Flat site
  - Element of an ensemble to sample different vegetation types and conditions
  - Currently about 100 sites identified, but only a fraction with accessible information… List under compilation
- 'Intercomparison' sites
  - Homogeneity at medium spatial resolution
  - Flat site
  - Sampling all conditions (BELMANIP accessible at LPV web site, but must be revised)

Atmospheric Chemistry (AC)



Proposed Future Plans

- Refine the selection of recommended primary sites
  - Gather complete site characterization data and information
  - Define core measurements (eg. Instruments)
  - Develop protocols and fund pilot projects
  - Create a “calnet” or “landnet”
- Agencies should acquire and archive imagery of all primary sites
  - Develop online calibration data access infrastructure
  - Create tools to identify the potential co-incident image pairs
- Extend the list to include snow fields, vegetation targets and water targets
- Integrate the catalog into the CEOS EO Cal/Val portal
- Establish traceability chain for primary site data