A 0.05 degree global climate/interdisciplinary long term data set from AVHRR, MODIS and VIIRS

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Land Long Term Data Record

- Develop and produce a global long term coarse spatial resolution (0.05°) data record from AVHRR, MODIS and VIIRS for use in global change and climate studies.
- Use a MODIS-like operational production approach including an operational QA team.
- Set up an advisory process.
- Make intermediate versions of the data sets available to the community through a web interface and solicit input from users.
- Hold community workshops for outreach and feedback.
- Prototype the development and production of a climate quality data record (CDR).
Data Sources
**AVHRR and MODIS Production Systems**

**AVHRR GAC L1B**
1981 - present
- Geolocation
- Calibration
- Cloud/Shadow Screening
- Atmospheric Correction

**Land products**
- Gridding

**AVHRR products**

**MODIS coarse resolution**
surface reflectance
2000 - present

**Land products**
- Gridding

**MODIS products**

**MODIS Level 0**
2000 - present
- Geolocation
- Calibration
- Cloud/Shadow Screening
- Atmospheric Correction

**MODIS standard products**
Full resolution and
Climate Modeling Grid (CMG)

**List of potential products:**
Surface Reflectance, VI,
Land surface temperature/emissivity,
Snow, BRDF/Albedo, Aerosols,
burned area, LAI/FPAR

**Format:**
HDF-EOS
Geographic projection 1/20° resolution
Daily, multi-day, monthly
Production of the Beta (Version 1) Data Set

- Algorithms:
  - Vicarious calibration (Vermote/Kaufman)
  - Cloud screening: CLAVR
  - Partial Atmospheric Correction:
    - Rayleigh (NCEP)
    - Ozone (TOMS)
    - Water Vapor (NCEP)

- Products:
  - Daily surface reflectance (AVH09C1)
  - Daily NDVI (AVH13C1)
  - 16-day composited NDVI (AVH13C3)
  - Monthly NDVI (AVH13CM)

- Format:
  - Linear Lat/Lon projection
  - Spatial resolution: 0.05°
  - HDF-EOS

- Time Period:
  - 1981 – 2000 completed (Beta = ver 1)

- Distribution:
  - ftp and web

NOAA-11 - 1992193 (7/11/1992) : Ch1, Ch2 and NDVI
Welcome to the Land Long Term Data Record Quality Assessment Web Page

The objective of LTDR QA is to evaluate and document the scientific quality of the global LTDRs (Long Term Data Records) made from remotely sensed data acquired using AVHRR (Advanced Very High Resolution Radiometer), MODIS (Moderate Resolution Imaging Spectroradiometer) and VIIRS (Visible/Infrared Imager Radiometer Suite). LTDRs are currently being produced as single global data record for each science parameter at a coarse resolution of 0.05 deg. Any discrepancy in the data records or QA-related issues identified by the QA process are posted on the Known Issues web page. These issues are updated as new versions of data records are produced using improved algorithms.
Data Set Evaluation

Land Long Term Data Record

Time

Series

A time series of summary statistics derived from all the LTDR locations is maintained and monitored by the LTDR QA program. The data is accessible via the internet. Time series statistics are extracted at all aerosol sites. Time series are important because they capture algorithm sensitivity to aerosol loading and remote sensing (e.g., surface/vegetation, aerosol loading) and changes in the instrument characteristics and calibration site (listed in alphabetical order) or tile and biome combinations.

First: Aerocn...
The calibration of the AVHRR has been thoroughly evaluated

Calibration of NOAA16 AVHRR over a desert site using MODIS data

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Abstract

This paper presents a new approach to AVHRR-sensors cross-calibration in the visible to shortwave infrared spectral domain using an optical, well-calibrated sensor (MODIS). The approach has been tested over a stable Sahara desert site and was initially applied to compare the absolute calibration coefficients of three different bands of the Terra and Aqua MODIS instruments. The observed agreement was better than 1% for bands 1 (0.67 μm), 2 (0.87 μm) and 3 (2.13 μm). The approach was then applied to cross-calibrate the AVHRR sensor onboard NOAA16. The absolute calibration coefficients derived for bands 1 and 3, using the Terra MODIS as a reference, were compared to the vicarious coefficients derived using the ocean and clouds method (Vermote E.F. and Kaufman Y.J., 1995). Absolute calibration of AVHRR visible and near-infrared channels using ocean and cloud views, International Journal of Remote Sensing, 16, 1337-2000. The coefficients were consistent within less than 1%.

Fig. 11. Comparison of the desert calibration trends for band 1 (black solid line) and band 2 (black interrupted line), with the trends obtained using the Ocean and Clouds method (Vermote and Kaufman, 1995) for band 1 (blue line and square) and band 2 (red line and square).

The coefficients were consistent within less than 1%
Comparison of PAL with LTDR at AERONET sites

PAL is not corrected for water vapor absorption

Different Calibration:

- **PAL**: Stable desert target vicarious calibration (Rao and Chen, 1996)
- **LTDR**: ocean-cloud vicarious calibration (Vermote and Kaufman, 1995)
Outreach workshop

- LTDR workshop held January 18, 2007 at the UMUC Conference Center
  - Held in conjunction with MODIS Collection 5 workshop
  - Most in C5 workshop stayed for LTDR Outreach Workshop
  - Goal was to present project status, receive feedback on products/schedule
- Approximately 140 attendees, including MODIS/AVHRR project personnel.
- Presentations from LTDR folks (algorithms, science, QA, data formats, evaluation, intercomparisons with existing AVHRR products)
- Also presentations from international AVHRR experts
  - A. Trischenko (CCRS) “Developing the AVHRR and MODIS Long Term Data Records at the CCRS”
  - P. Frost (CSIRO) “Integration of Sensors Applied on South African Ecosystems (ISAFE)”
  - M. Leroy (CESBIO) “African Monsoon Multidisciplinary Analysis (AMMA)”
- Good interaction and feedback.
Geolocations issues/bad ephemeris data
NOAA7: Geolocation accuracies based on ~ 100 chips

![Graph showing geolocation accuracies based on ~ 100 chips](image)
NOAA-7: Geolocation accuracies after filtering

Standard deviation: 0.36942
Mean bias = 0.152588
AVHRR BRDF/Albedo Product: Broadband Black-Sky Albedo (July 1999)

Albedo evaluation
2006 activities

• Produced an AVHRR surface reflectance and NDVI beta data set using Pathfinder 2 algorithms (vicarious calibration; Rayleigh, ozone and water vapor correction).

• Set up a web/ftp interface for data distribution.

• Identified a set of validation sites for use in the evaluation of the products.

• Evaluated data set and started operational QA activity (global browse, known issues, time-series monitoring and trends).
  – Identified problems with geolocation, cloud screening, water vapor correction, QA bits, etc. in Beta (version 1) data set
  – Fixes have been made and will be incorporated in version 2 data set.
2007 and beyond

• Produce improved (version 2) surface reflectance and NDVI data set for 1981-1999 and 2003 [May-June]
• Produce preliminary aerosol-corrected data set for 1999 and 2003 [June]
  – Use coincident MODIS and AVHRR data to improve aerosol retrieval and correction in AVHRR
• Release aerosol-corrected surface reflectance and NDVI data set (version 3) [August]
• Produce BRDF/Albedo [August]
• Produce/Release Land Surface Temperature [Sept/Dec]
• Produce Burned Area [December]
• Release version 4 surface reflectance/NDVI data set incorporating fixes identified since vers 3 release [January]
  – Workshop will be held in conjunction with version 4 release.