Spatially Complete Global Spectral Surface Albedos: Value-Added Datasets Derived From *Terra* MODIS Land Products

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$$\text{Albedo} = \frac{\text{Reflected Radiation}}{\text{Incoming Radiation}}$$

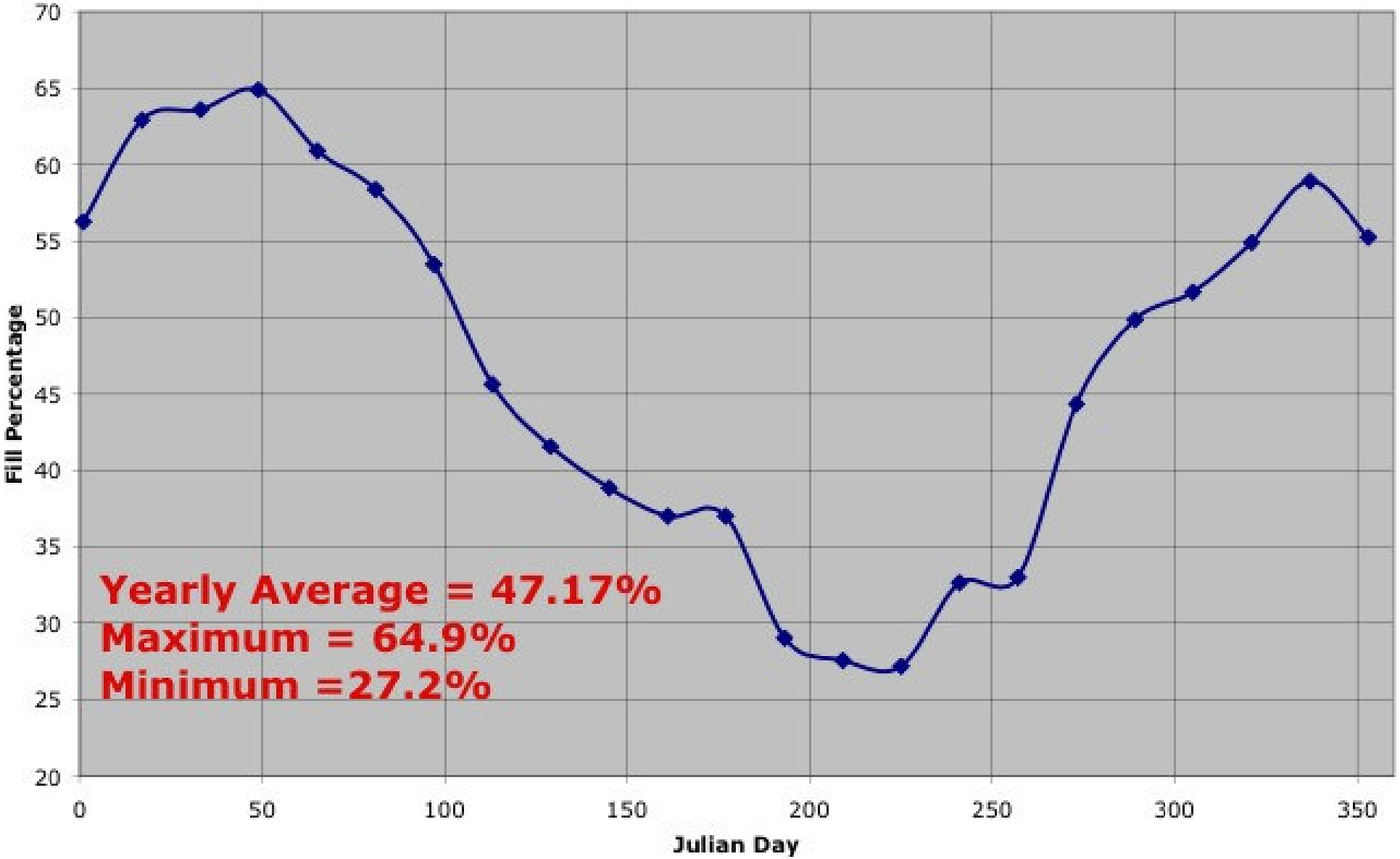
- Spectral, Spatial, Temporal Dependence
  - Inherent Ecosystem Class Dependency
- Ancillary input for:
  - Ground, Airborne, and Remote Sensing Radiative Transfer Applications.
  - Land Surface and Climate Modeling.
  - Global Change Research Projects.

MOD43B3 - MODIS Land Surface Albedo

QuickTime™ and a
Video decompressor
are needed to see this picture.

- 0.47, 0.555, 0.67, 0.858, 1.24, 1.64, 2.1 µm
- 0.3-5.0, 0.7-5.0, 0.3-0.7 µm.
- 16-day periodicity (001, 017, …, 353).
- Sinusoidal Projection Tiled Storage.

Percentage of Year 2001 MOD43B3 Land Pixels that are Fill.



MOD43B3

0.858µm

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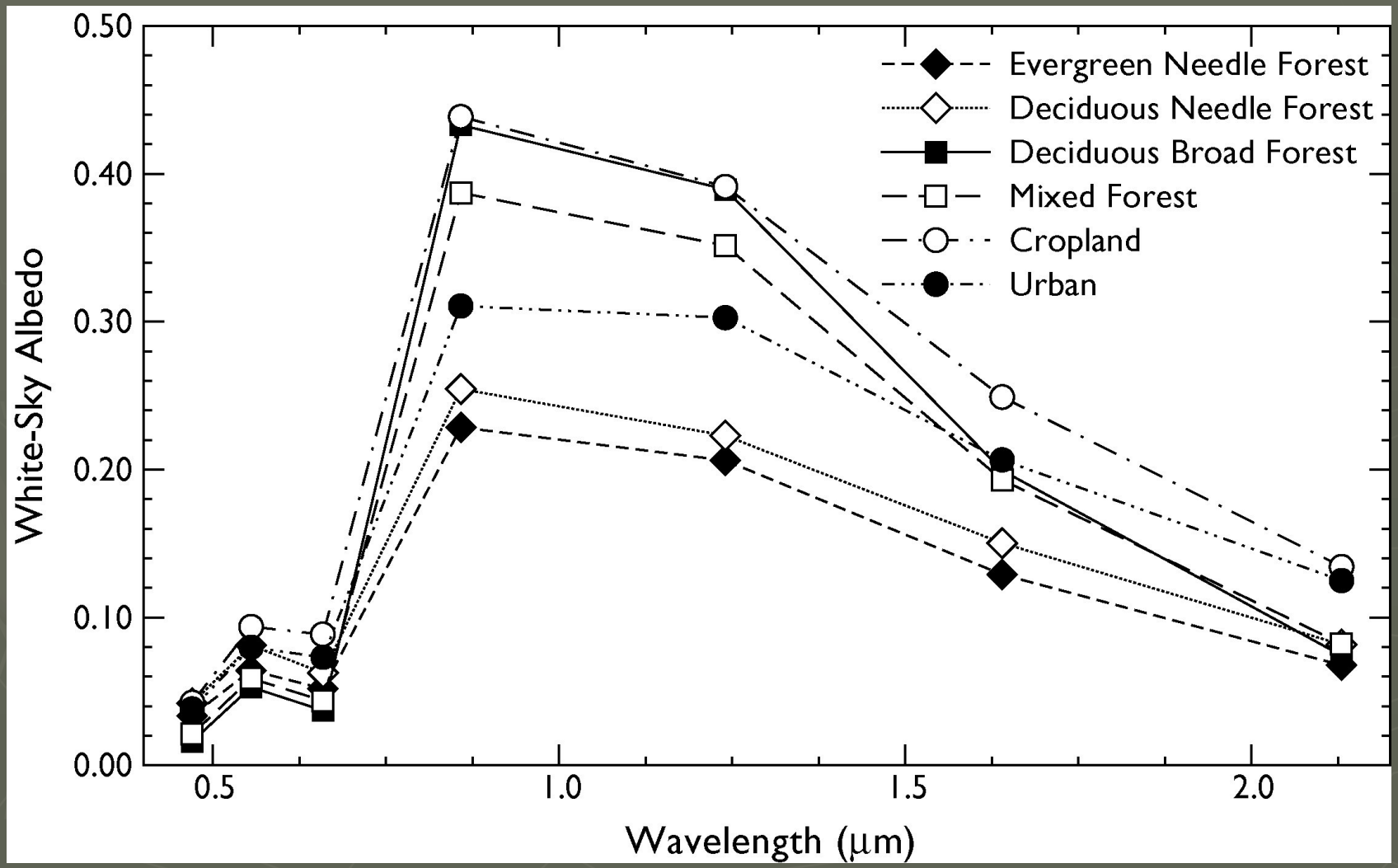
Filled Map

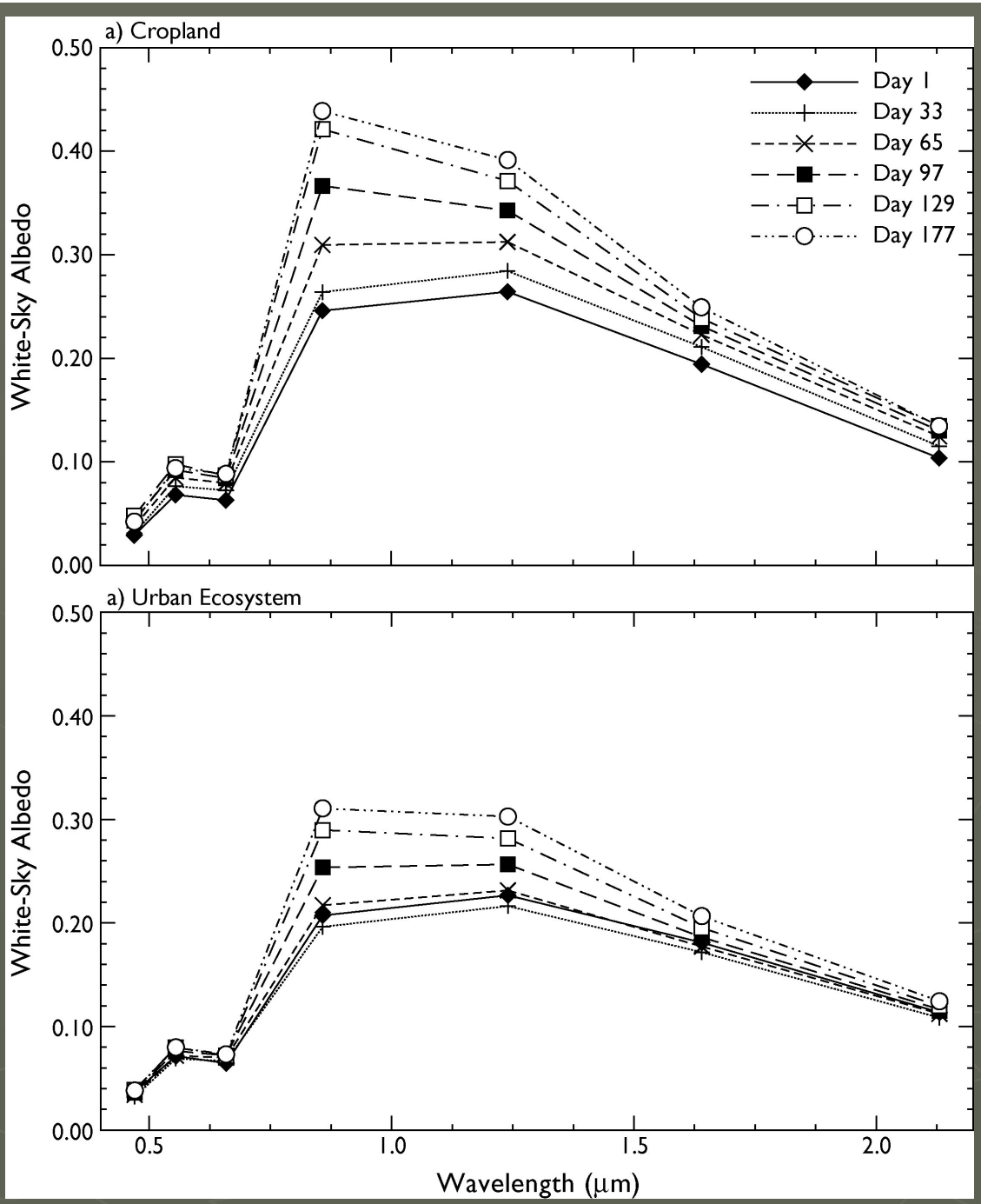
Spectral Variability by Ecosystem Class.



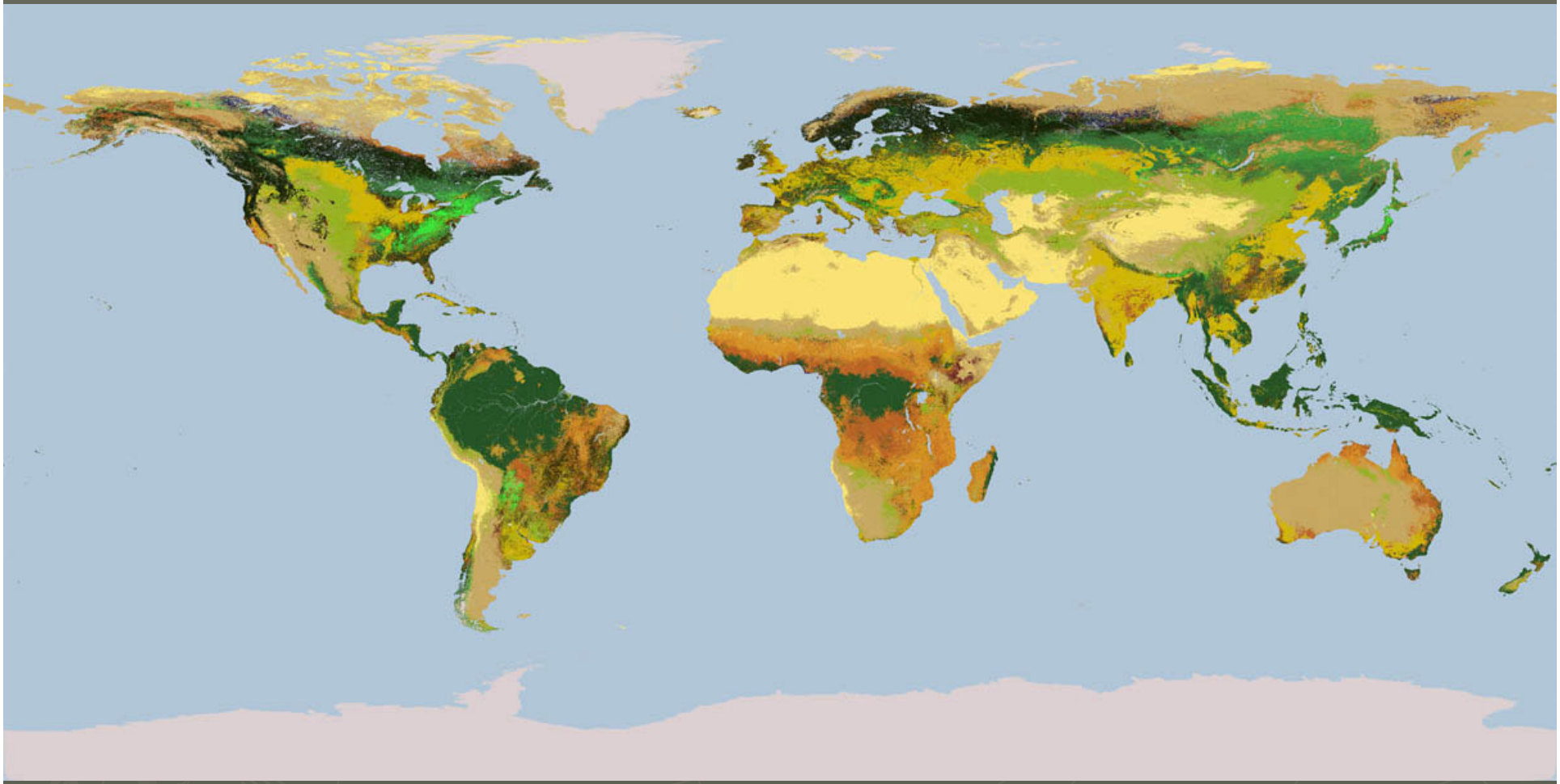
Temporal Variability.

Cropland Ecosystem

Urban Ecosystem



IGBP Ecosystem Classification Map



- MOD12Q1. *Friedl, Hodges, et al.*

Phenological Concept

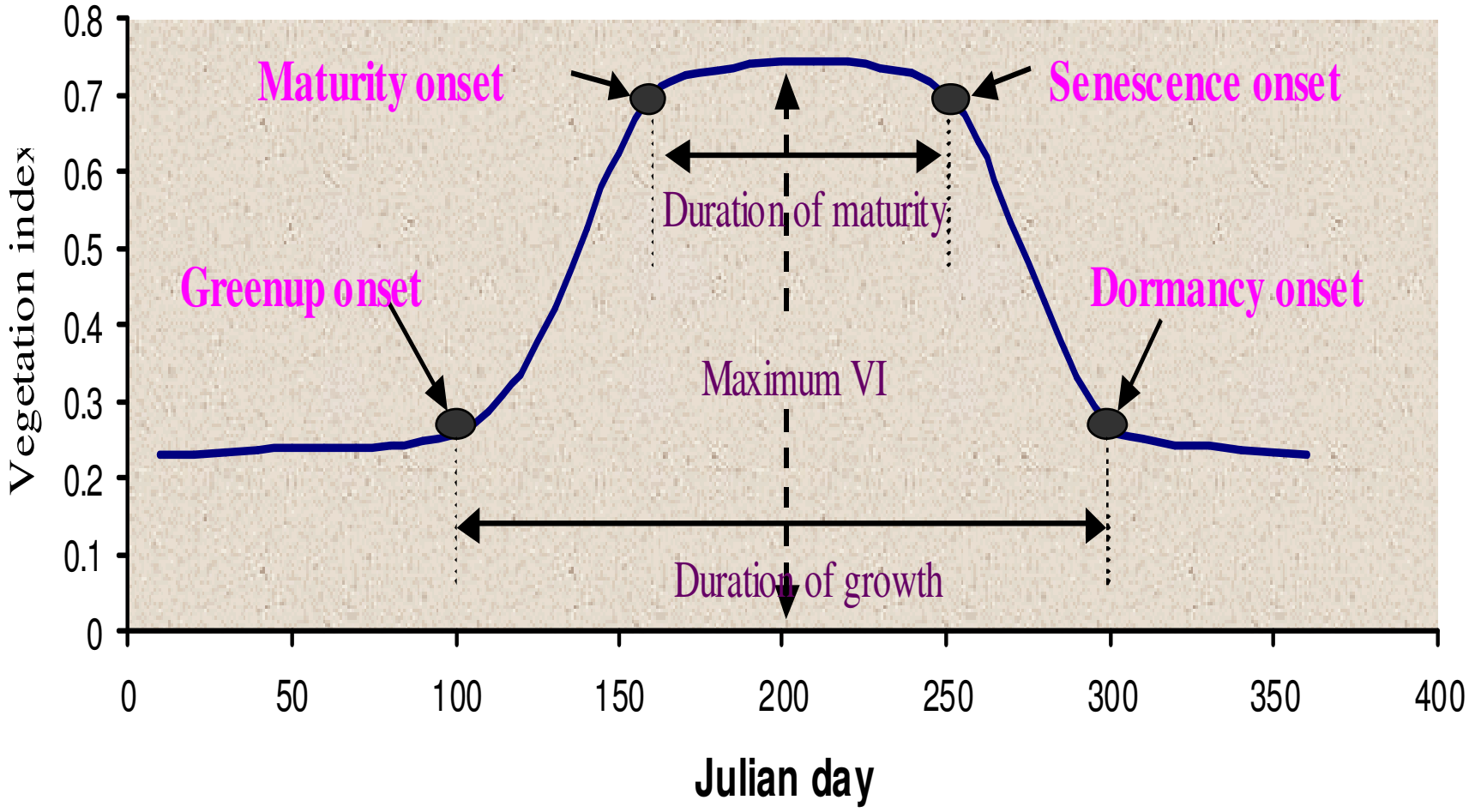
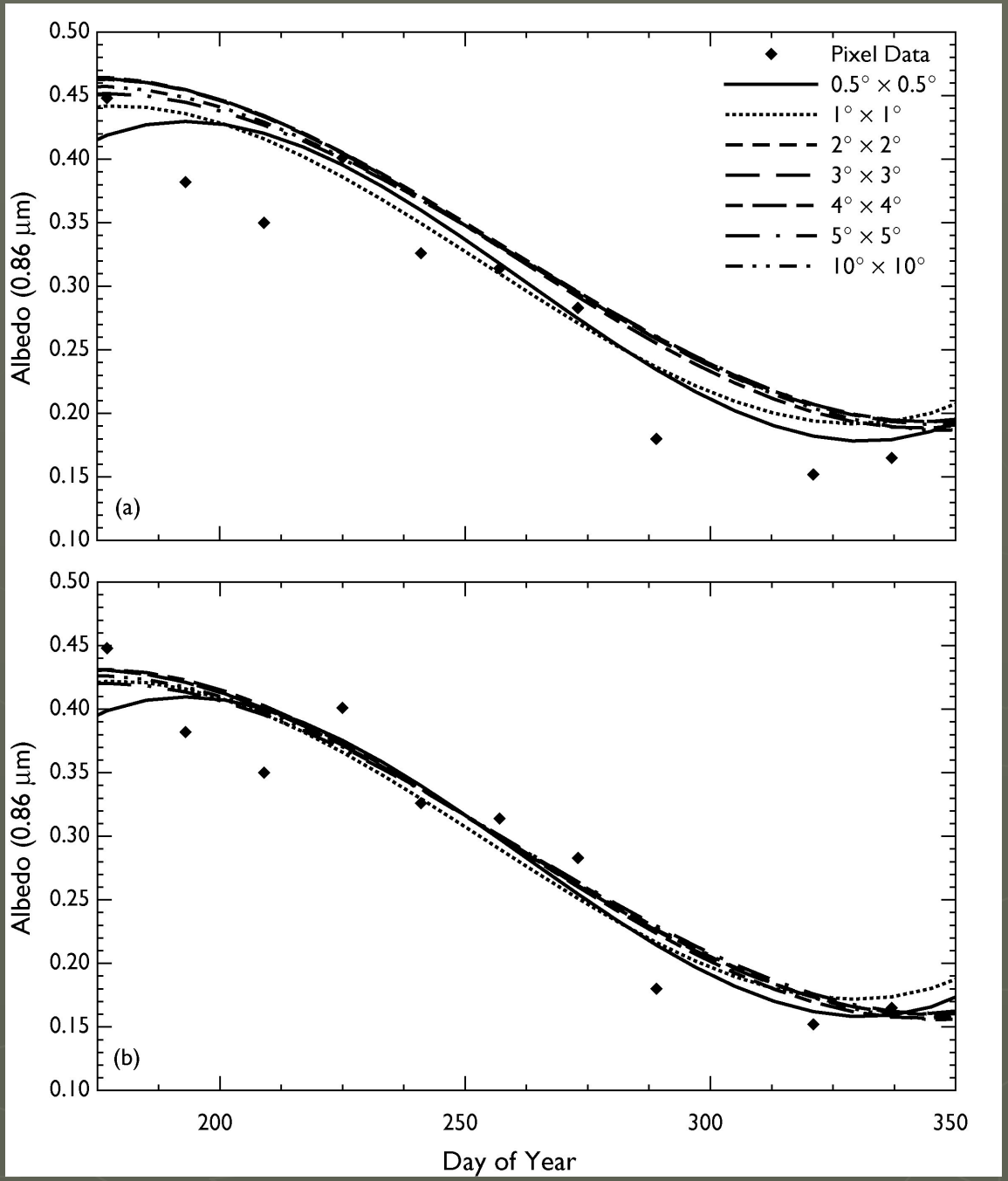


Image provided by Xiaoyang Zhang, Boston University

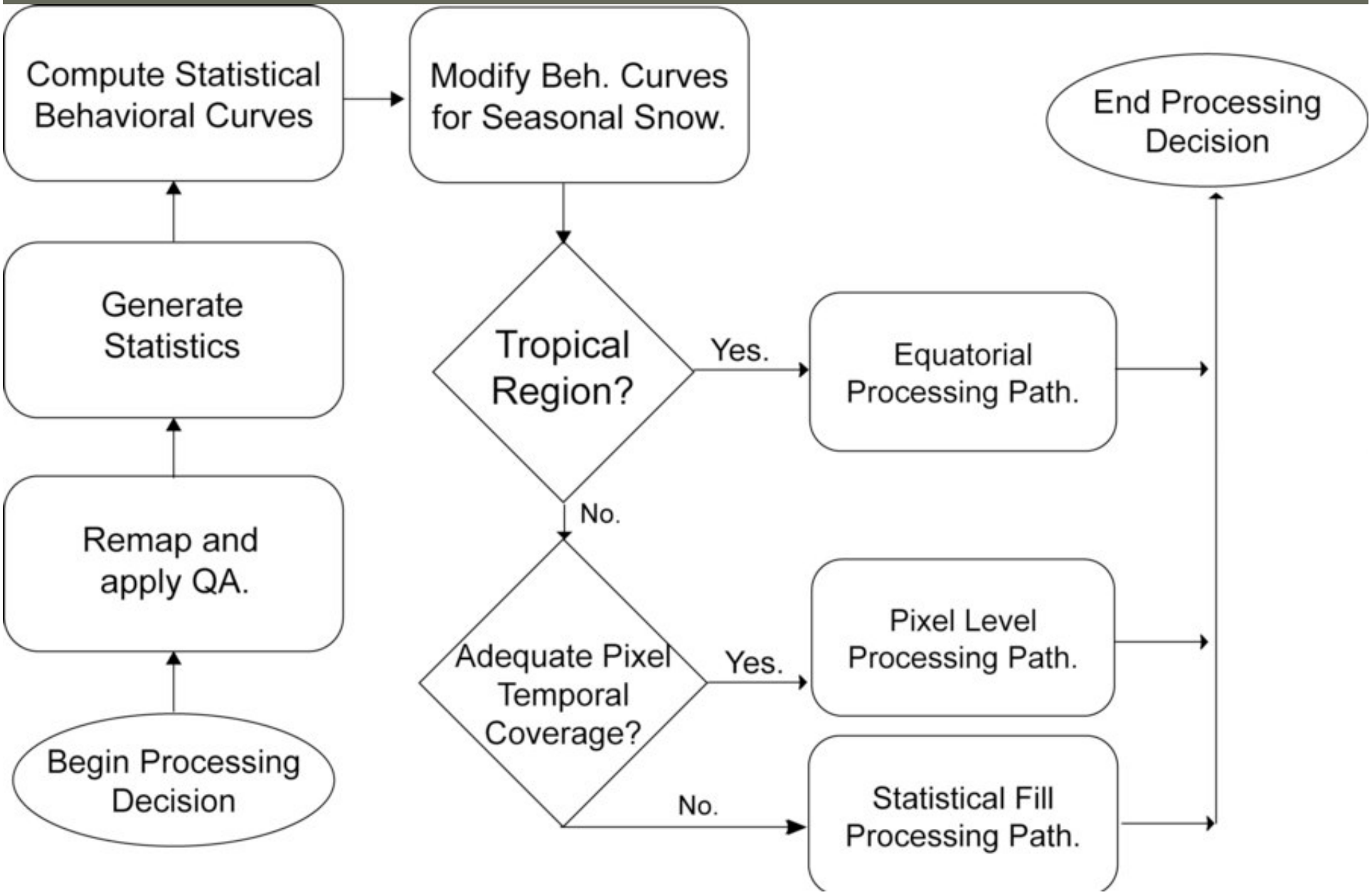
Deciduous Broadleaf Forest, Vermont US.

Phenological Curves

Phenological Curves with Offset Applied



Processing Path.



General Methodology

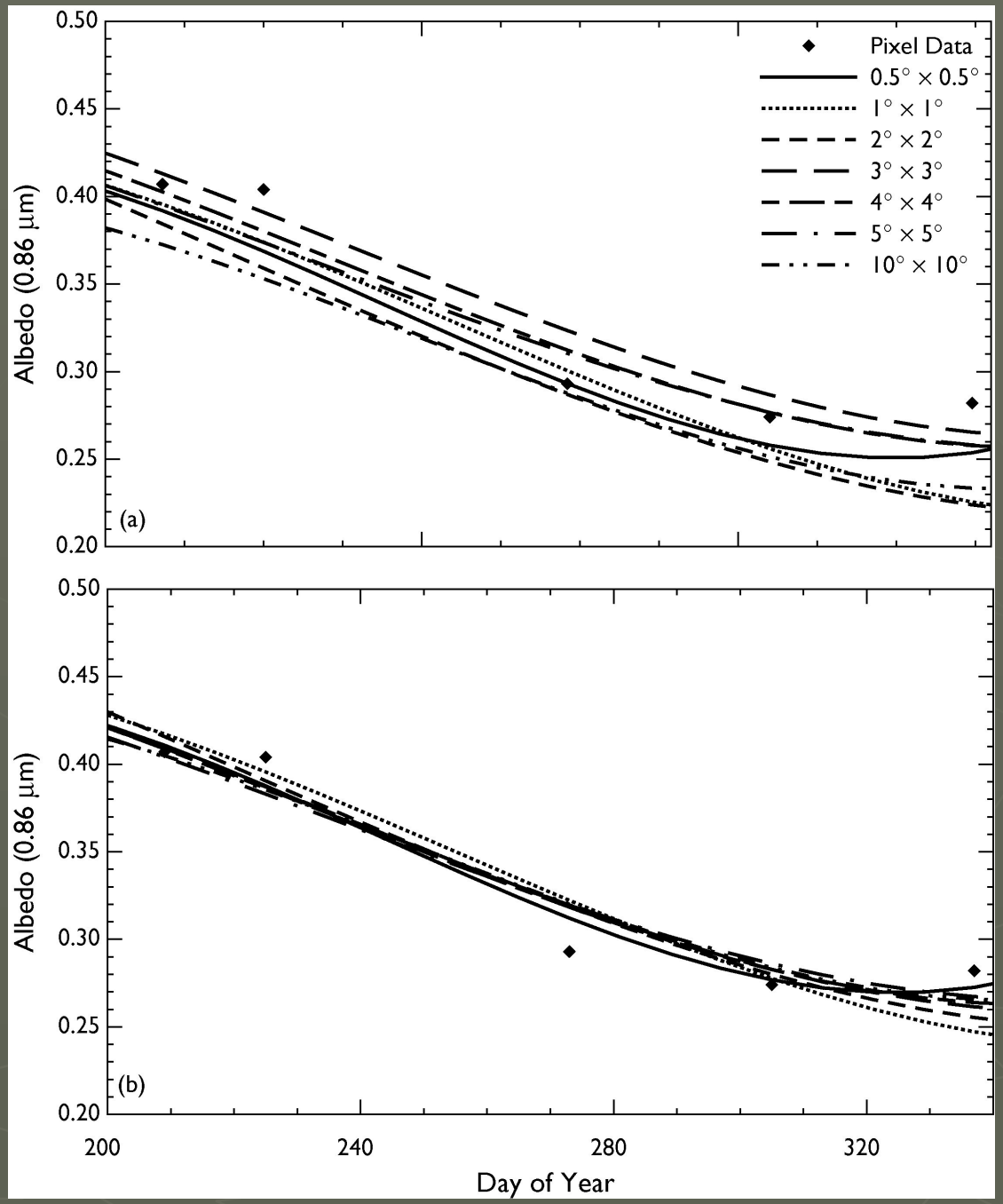
- Temporally Interpolate using Pixel-level or Regional Ecosystem Statistical Data.

- If statistical data:
  - Compute behavioral curve and apply offset.
    - 1/2º, 1-5º, 10ºx10º, and 10ºx20º, 10ºx30º resolution.
    - Least Squares Polynomial Fit.
      - 1st - 3rd degree, with standard deviation weighting.
  - Select statistical size based on:
    - Temporal coverage.
    - Representation of pixel data.
    - Bias towards smaller box sizes.
  - Fill in only missing days.

Cropland, Midwestern US.

Phenological Curves

Phenological Curves with Offset Applied



- MOD43B3
- 0.858µm
- Filled Map

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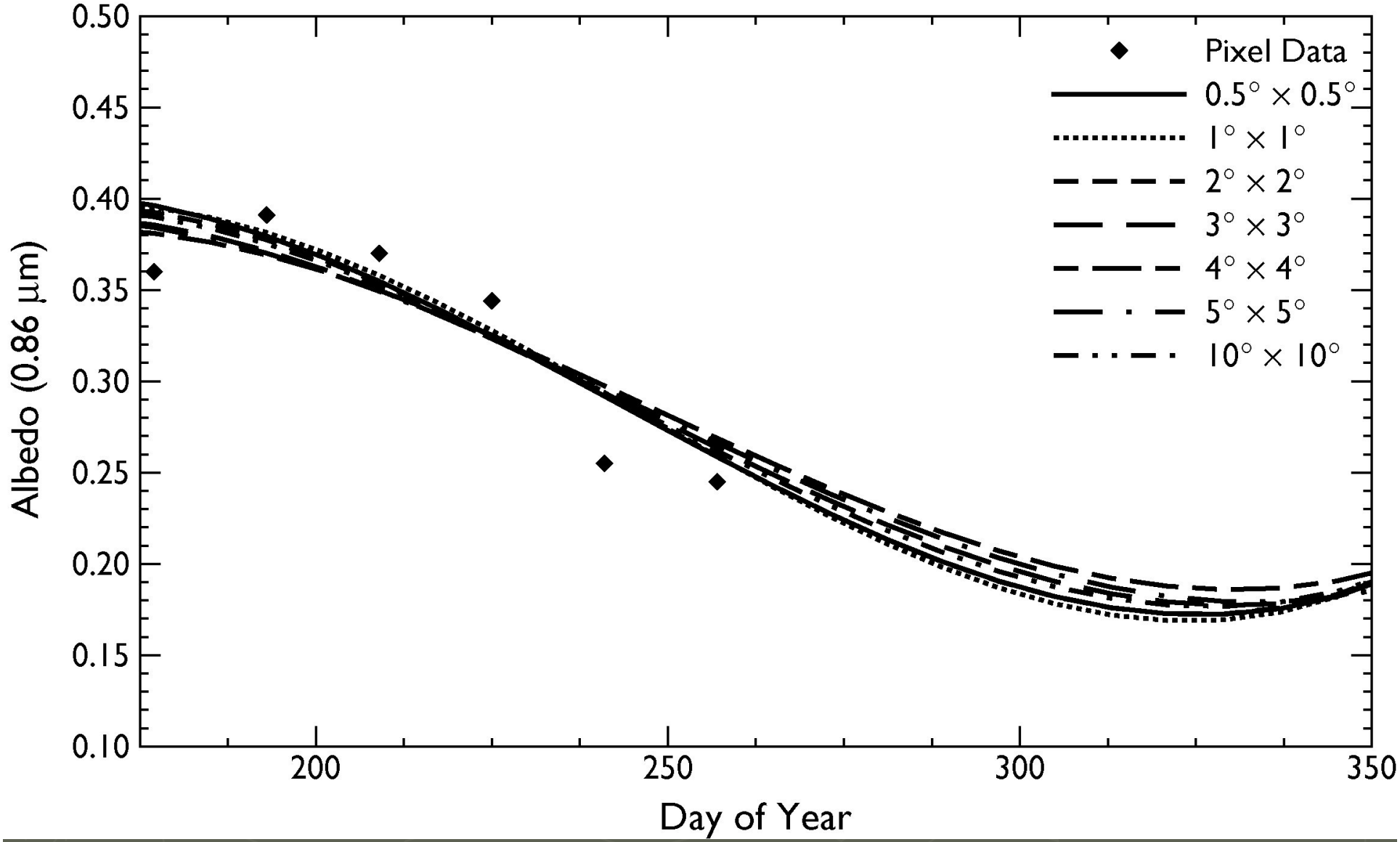
Seasonal Snow Methodology

- Cloud and snow cover obscure full decay state.
- Over Hemisphere Average of High Latitudes:
  - Unique ecosystem and wavelength extrema percent change.
  - Compute % change from pixels with adequate representation.
- For each Pixel/Statistical Curve:
  - Summer extrema known.
  - Compute winter extrema from
    - Percent change.
    - Summer extrema.
  - Pin winter endpoints with computed value.

Mixed Forest, Northern Russia. Seasonally Snow Impacted.



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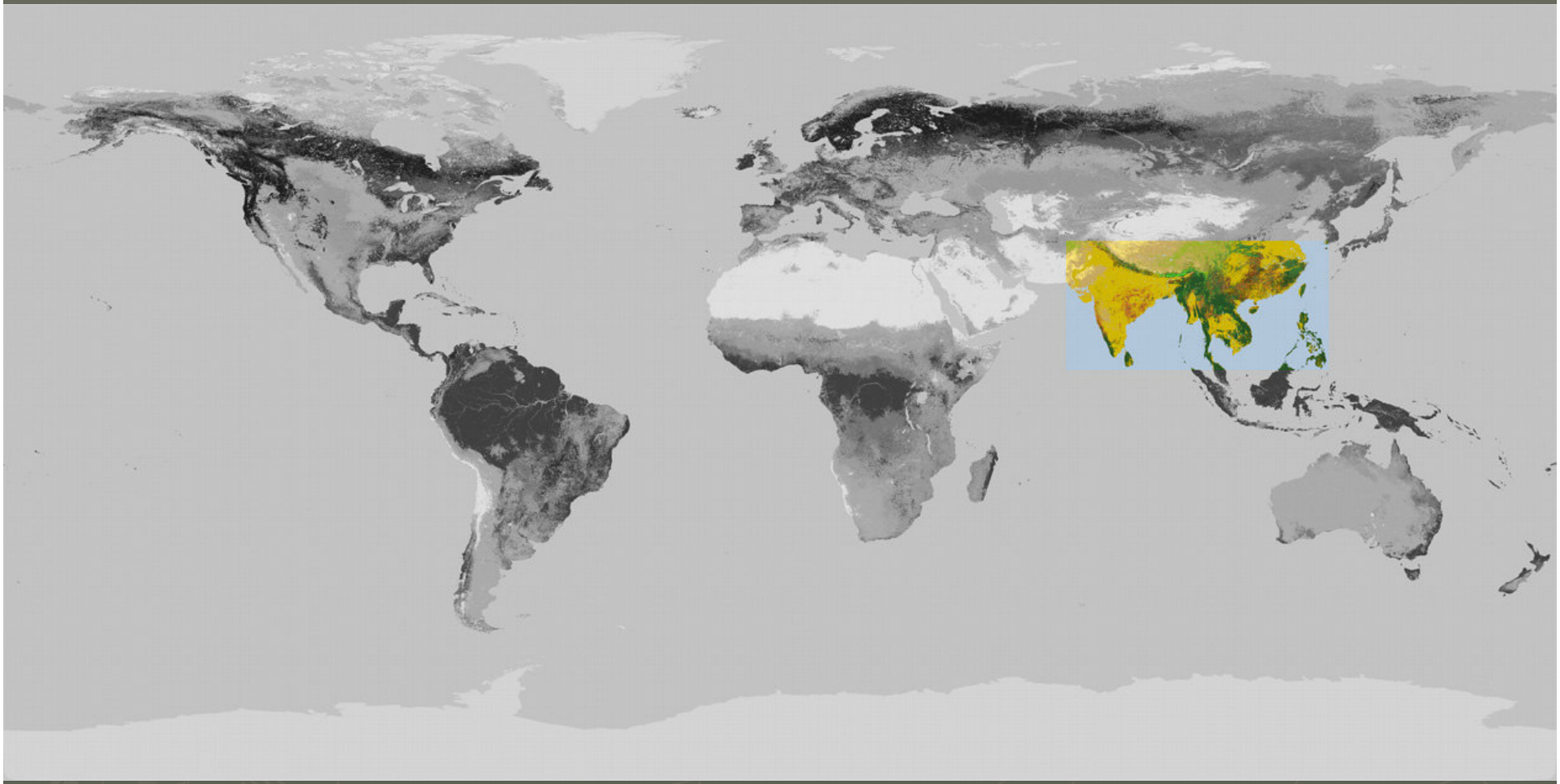
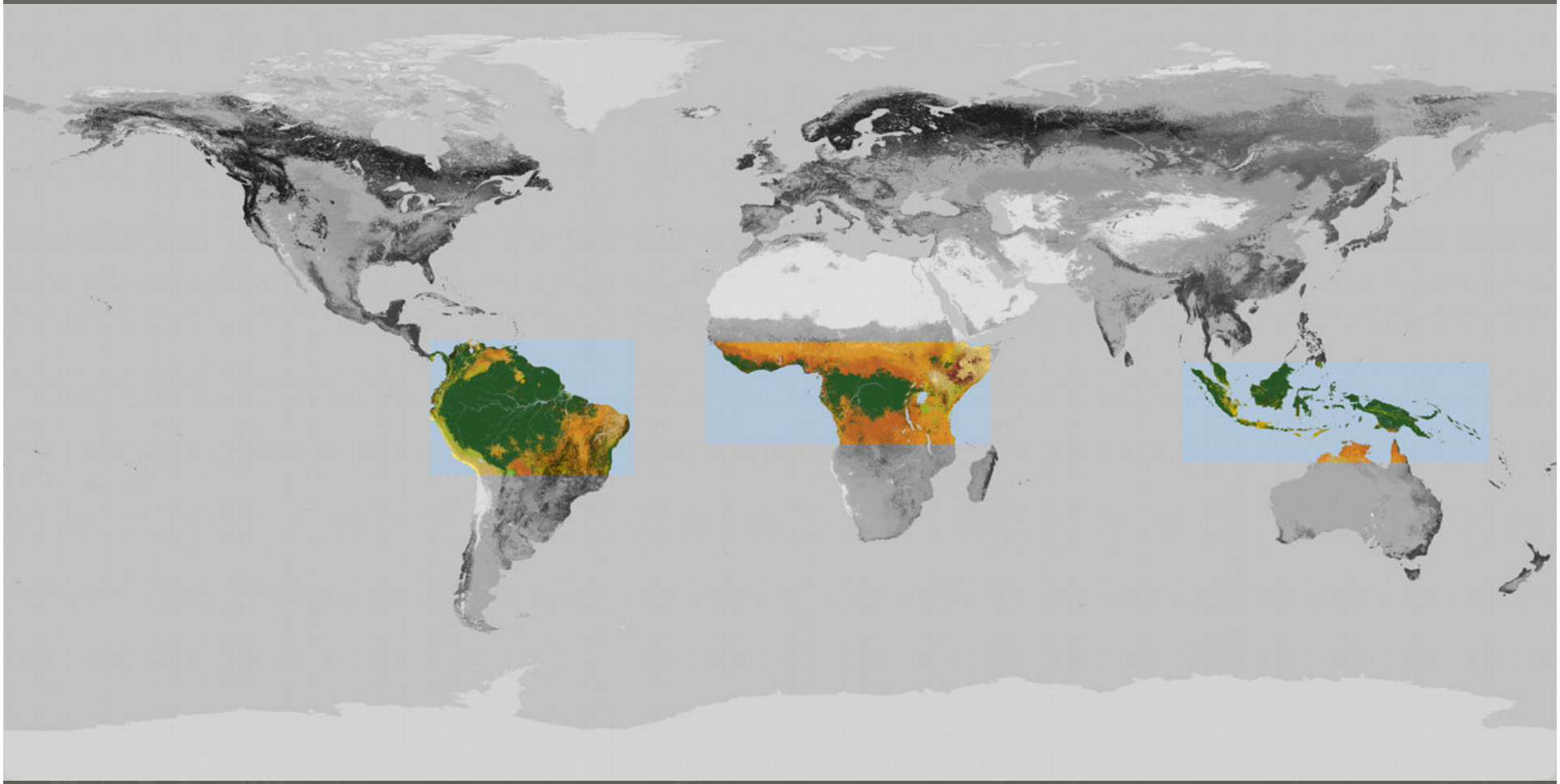
Special Case: Missing Season.



Special Case: Limited Yearly Data.



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Persistent Cloud Methodology

- Clouds obscure trends over large regions.
  - Usually full growth stage is obscured.
  - Even 10x30 may not observe complete temporal trend.
- Compute 1 statistical curve per ecosystem class.
  - 5-15° Latitude belts.
    - Centered around pixel's latitude.
  - Yearly phenological behavior curves
    - Instead of 2 half year curves.
- Impose shape of curve onto existing pixel data.

Pixel with No Temporal Points

- Substitute ecosystem statistics.
  - Smallest statistical box size that has some temporal data.
- Process pixel through one of the methodologies.

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- 0.858µm
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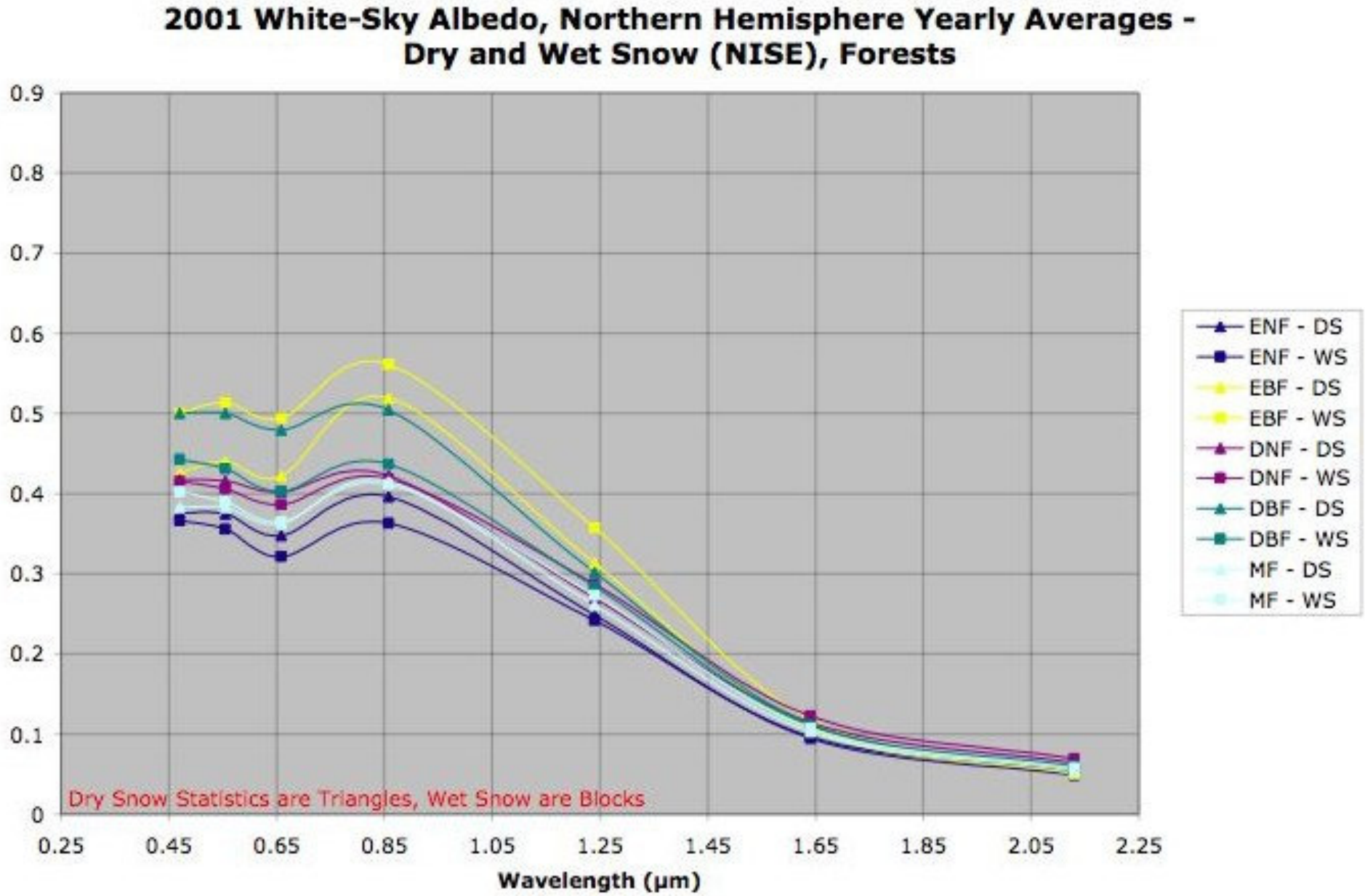
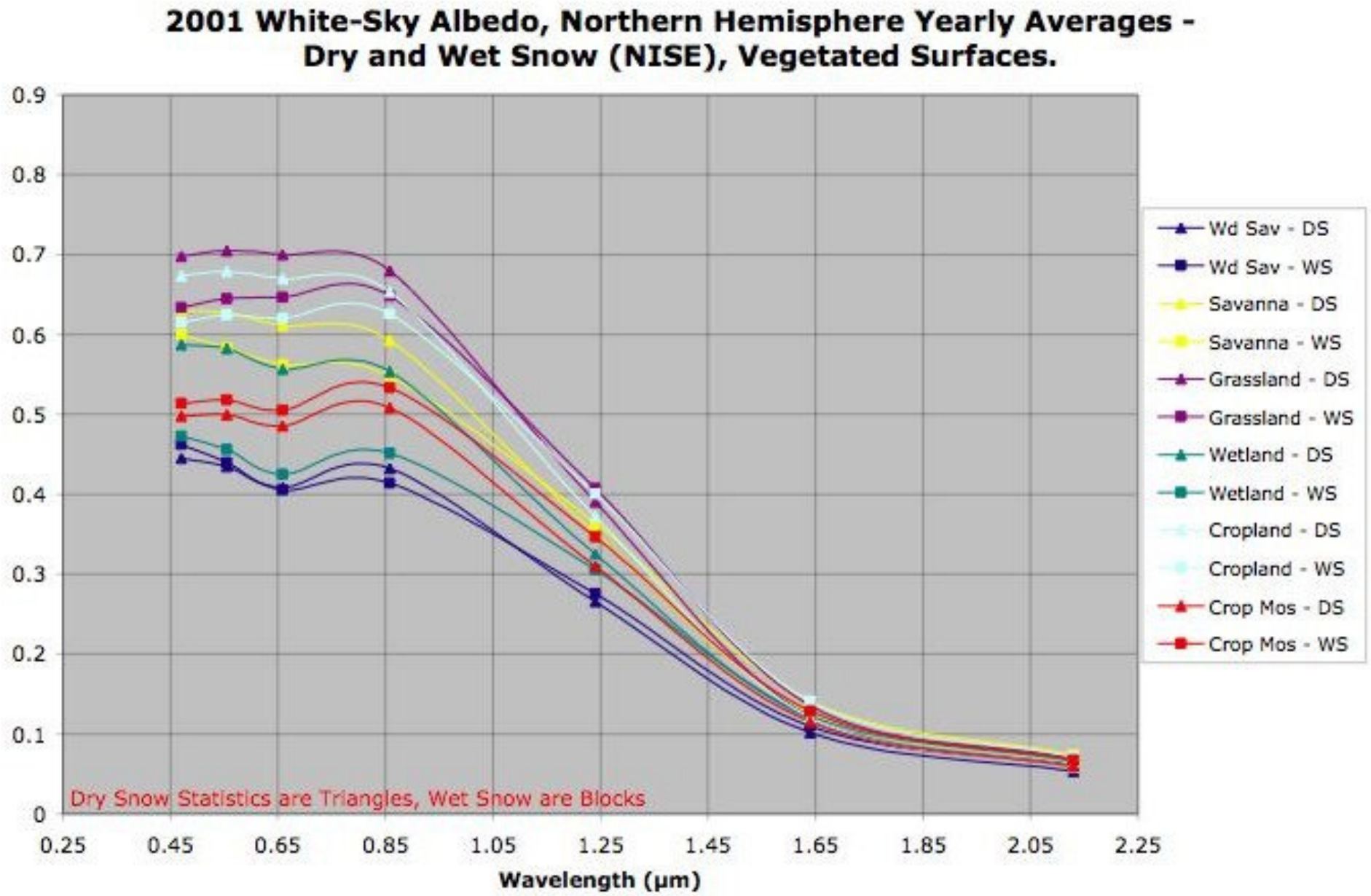
Snow Albedo By Forest Ecosystem Classes.



Snow Albedo By Vegetated Classes.



Available Products

- Spatially Complete Albedo Maps
  - Maps and QA Stored in 1-minute Rectangular Coordinates.
  - First Seven MODIS Wavelengths and 3 Broadband.
  - White- and Black-sky albedo values.
- Statistics of Filled Albedo Maps
  - 1/2, 1, 2, 3, 4, 5, 10 Degree Box Sizes.
  - Statistics Computed in Boxes and by Ecosystem Class in Boxes.
- Statistics of Snow Albedos.
  - Hemispheric averages of MOD43B3 validated data.
  - Separated by Ecosystem class and NISE wet/dry classification.
- IGBP Ecosystem Classification Map
  - Maps and QA Stored in 1-minute Rectangular Coordinates.

Format and File Sizes.

- All data stored in HDF format with/without internal GZIP compression.
- Spatially Complete Albedo Maps
  - 1 file contains 1 band and either white- or black-sky albedo per 16-day period.
  - QA and data stored in separate files.
  - 1 data file ~ 60 MB gzipped, 445 MB non-zipped.
  - 1 QA file ~ 10-25 MB gzipped, 225-445 MB non-zipped.
- Statistics of Filled Albedo Maps
  - Only data, no QA.
  - Variable file size depending on resolution.
- Statistics of Snow Albedo
  - 1 file, ~16 KB.
- IGBP Ecosystem Classification Map
  - 1 static map ~ 90 MB gzipped, 1.1 GB non-zipped.

http://modis-atmos.gsfc.nasa.gov

MODIS Atmosphere: Land Surface Albedo Eight-Day Product

http://modis-atmos.gsfc.nasa.gov:16080/ALBEDO/index.html

MODIS Atmosphere

HOME PRODUCTS IMAGES VALIDATION NEWS STAFF FORUM REFERENCE TOOLS HELP

AEROSOL H2O VAPOR CLOUD PROFILE CLD. MASK JOINT (Level-2 Products)

DAILY EIGHT DAY MONTHLY (Level-3 Products) | ALBEDO ECOSYSTEM NDVI (Level-3 Ancillary)

LAND SURFACE ALBEDO

Introduction
INTRODUCTION
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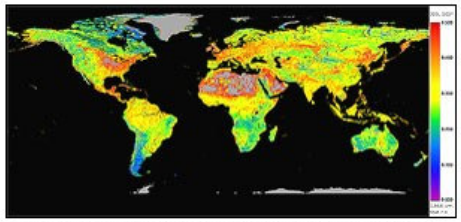
HDF FILENAMES
Investigation
ANALYSIS TOOLS
THEORETICAL BASIS
VALIDATION
Creation
FILE SPEC *
SUPPORT TEAM
* for the developer

Introduction

Product Description



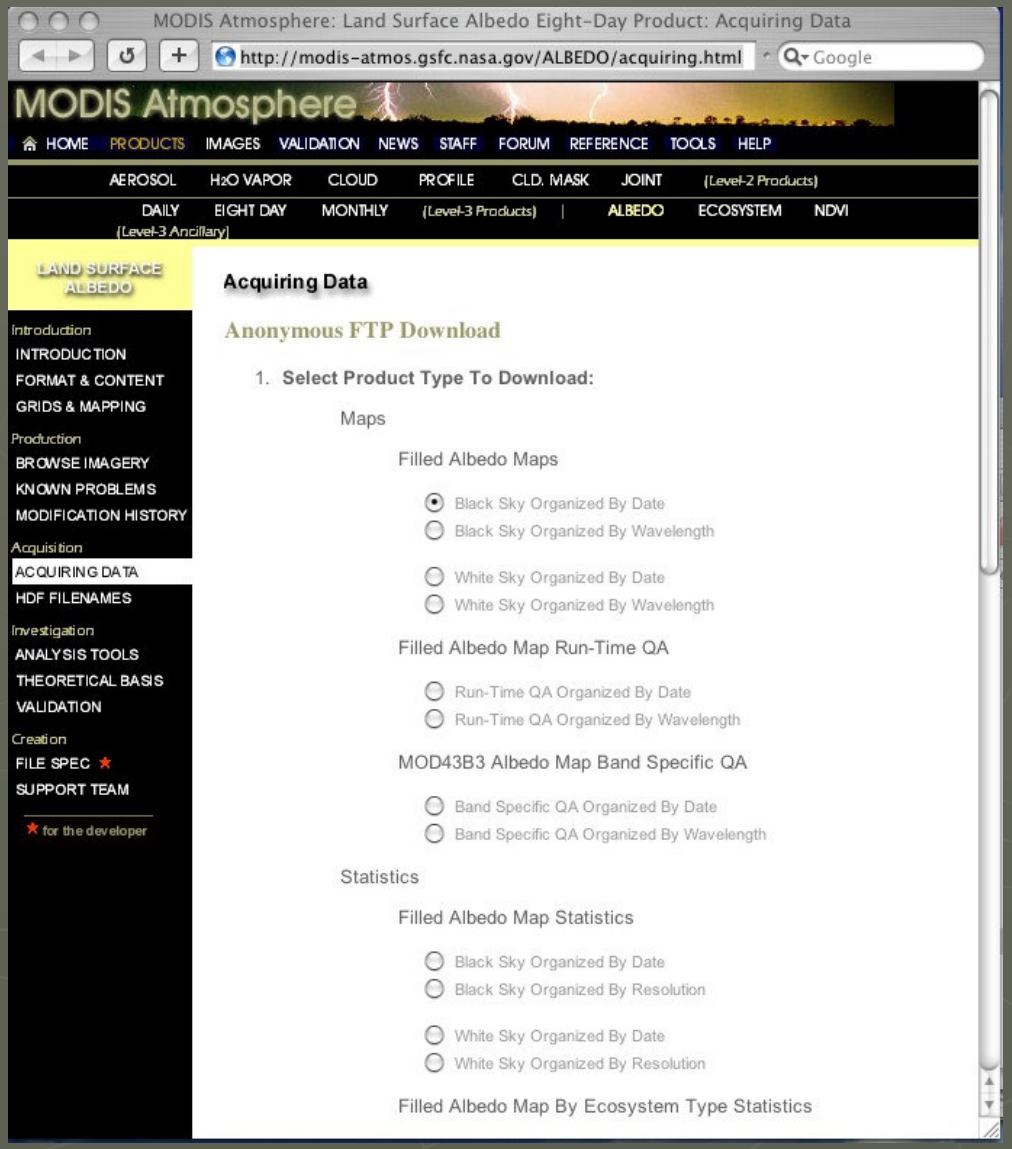
MODIS-derived land surface albedo map product is a global data set that consists of 23 sixteen-day periods per year (001, 017, ... 353) with spatially complete albedo maps computed for both "white-sky" and "black-sky" at 10 wavelengths (0.47μm, 0.55μm, 0.67μm, 0.86μm, 1.24μm, 2.1μm, 0.3-0.7μm, 0.3-5.0μm, and 0.7-5.0μm).

The data maps are stored in separate HDF files for each 16-day period, each wavelength, and each albedo type (white- and black-sky); in addition, the original MOD43B3 quality assurance and the processing quality assurance are also stored in separate HDF files. This format allows the user to have flexibility to download and store only the data absolutely needed.

In addition to the albedo map product outlined above, an albedo statistical product is also available. The statistical product contains the mean, standard deviation, and pixel counts generated at various resolutions (½, 1, 2, 3, 4, 5, and 10°); and are computed with and without an ecosystem classification dependency.

The MODIS-derived land surface albedo map product is generated from MOD43B3 (the official Terra/MODIS albedo product), while the statistical product is generated from the spatially filled MODIS-derived land surface albedo maps. It should be noted that these products currently exist for year 2001 (Terra) data only. Year 2002 data is being prepared for release in early 2004.

http://modis-atmos.gsfc.nasa.gov



NDVI

Computed from Filled Albedo Maps.

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