Spatially Complete Global Surface Albedos Derived from MODIS Data

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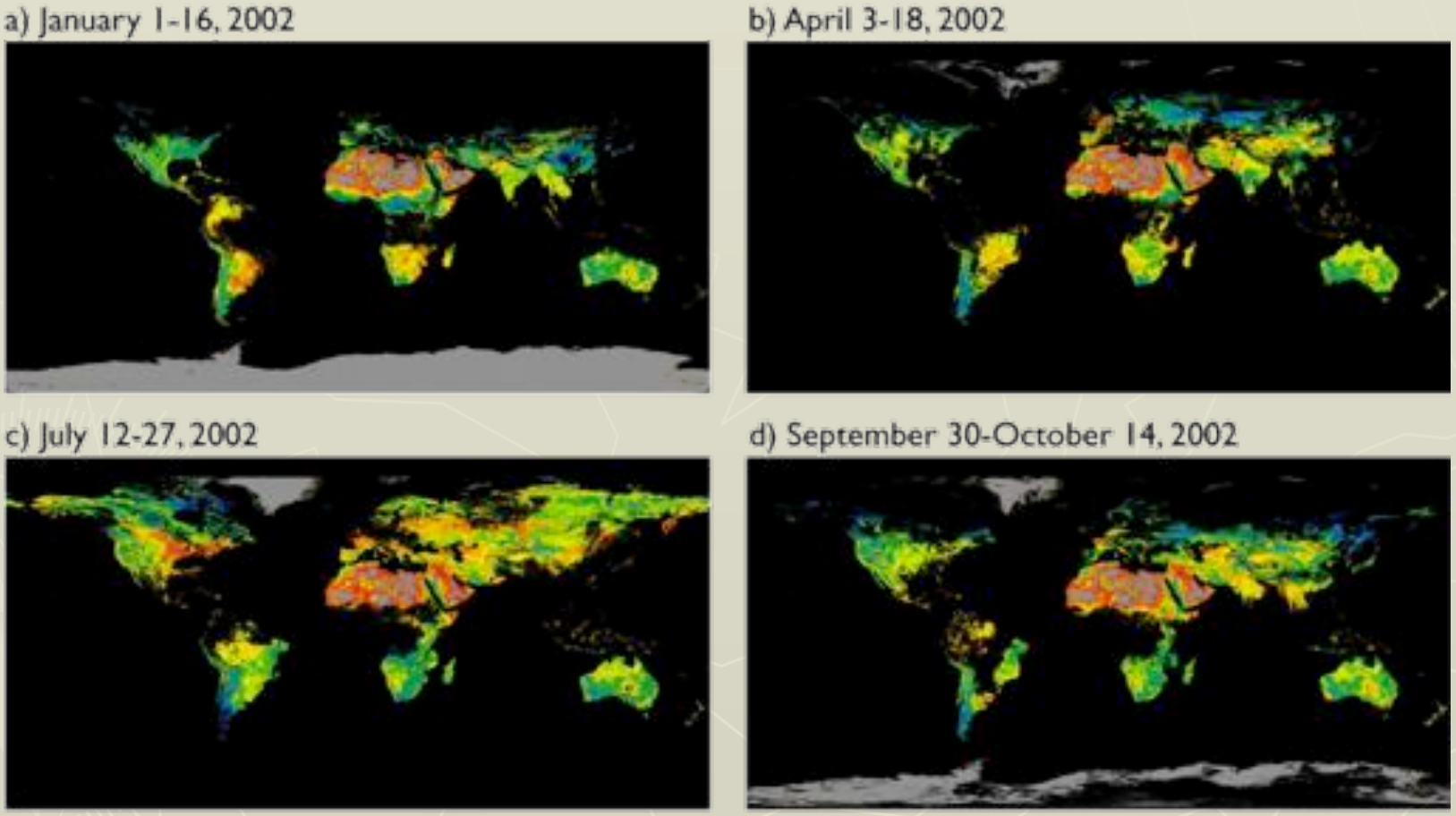
- Operational MODIS surface albedo data product (MOD43B3/MCD43B3)
  - 0.47, 0.56, 0.67, 0.86, 1.24, 1.64, 2.1, 0.3-0.7, 0.7-5.0, 0.3-5.0
  - 1 arc min (~2 km) latitude-longitude spatial resolution (C004)
  - 16-day periodicity (001, 017, …, 353) (C004)
- Limitations
  - Spatial and temporal gaps due to cloud cover and seasonal snow
- Motivation
  - Ancillary input for ground-based (AERONET), airborne, and satellite remote sensing
  - Land surface and climate modeling
  - Global change research projects

Conditioned MOD43B3 Albedo Maps

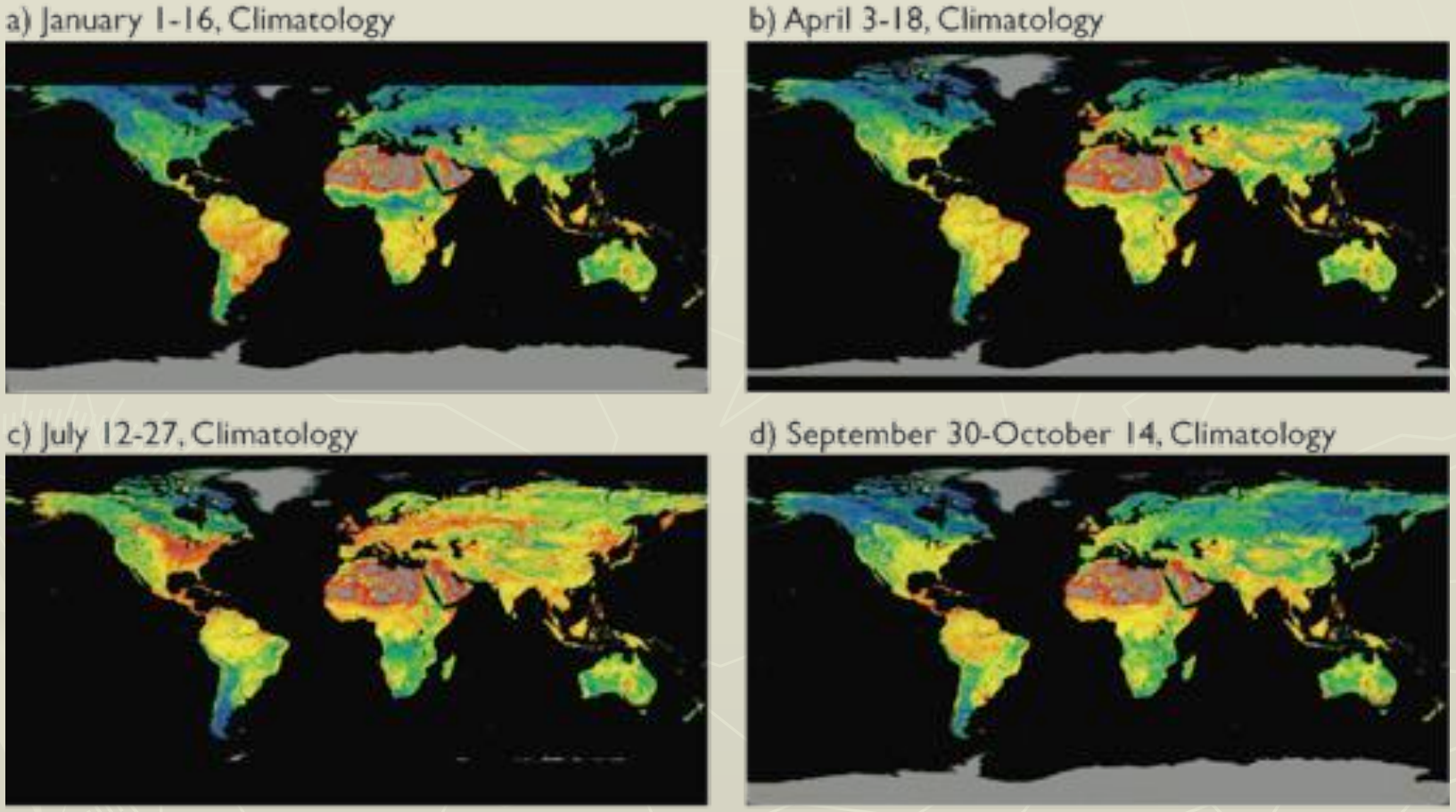
λ = 0.858 μm



Moody et al. (2005)

1 arc min (~2 km)

Spatially Complete Albedo Maps
λ = 0.858 μm



Moody et al. (2008)

1 arc min (~2 km)

New Improvements to Land Surface Albedo (Collection 5)

- Enhanced spatial resolution
  - 30 arc sec (~1 km) latitude-longitude spatial resolution
    - ✓ Based on reprojected averages of the underlying 500 m data
- Increased resolution of time sampling
  - 8-day periodicity (001, 009, 017, …, 361), based on 16-days of observations
  - Utilizes both Terra & Aqua data for increased number of angular samples
- Performed phenological gap-filling on BRDF model parameters
  - RossThickLiSparse Reciprocal model
    - ✓ Kernel-driven linear model that relies on the weighted sum of an isotropic parameter and two functions (or kernels) of viewing and illumination geometry

$$BRDF\left(\theta_S, \theta_V, \Delta\phi, \lambda\right) \cong R\left(\theta_S, \theta_V, \Delta\phi, \lambda\right)$$
$$= f_{iso}\left(\lambda\right) + f_{vol}\left(\lambda\right)K_{vol} + f_{geo}\left(\lambda\right)K_{geo}$$

    - ✓ Phenology established on a per pixel basis (using 20 months of data – 4 months before and 4 months after a year)

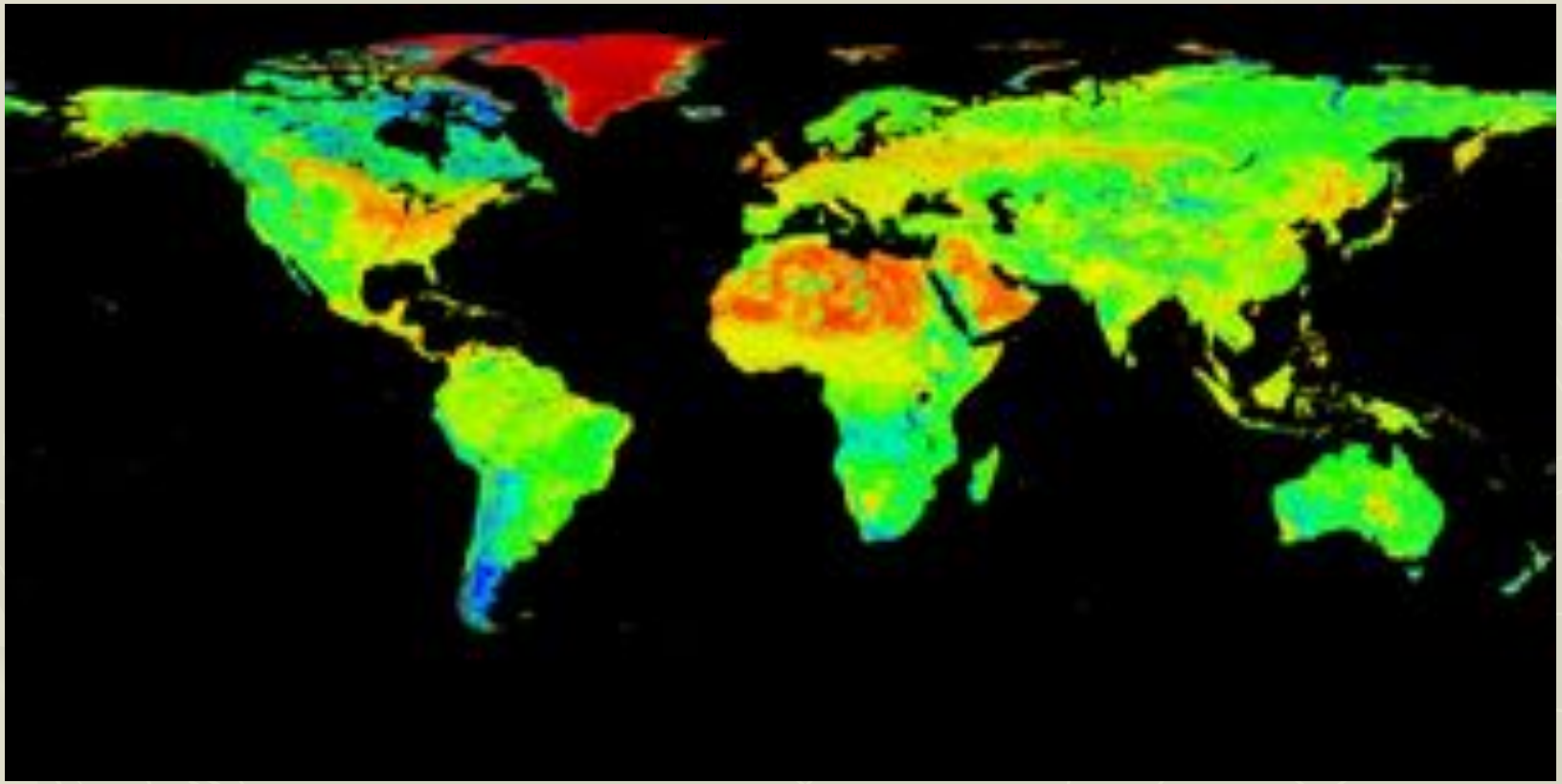
New Improvements to Land Surface Albedo (Collection 5)

- Data use high quality results primarily
  - If there are large stretches of missing data the poorer quality results are considered (but weighted very low)
  - High quality data are used primarily (replacing temporal data)
  - Temporal fits are used secondarily
  - If missing data remains, use regional curves per latitude band and continent
  - Spatial smoothing fills in remaining gaps
  - Temporal fits are used secondarily
- Data available for 2001,…,2009 completed

Spatially Complete White-sky Albedo Maps

λ = 0.858 μm

July 12-27, 2004

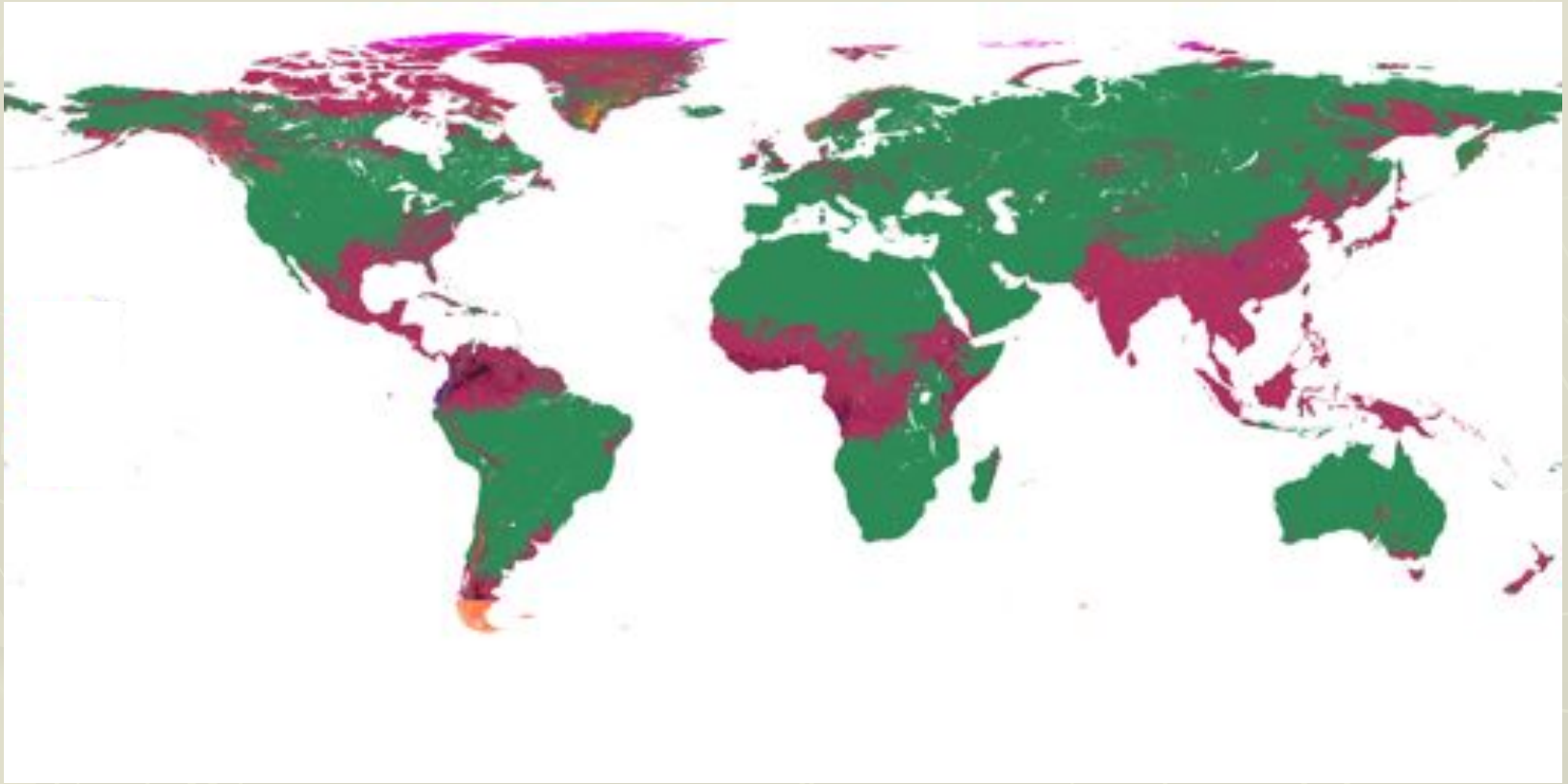


Crystal Schaaf

30 arc sec (~1 km)

Spatially Complete Albedo QA Maps

July 12-27, 2004



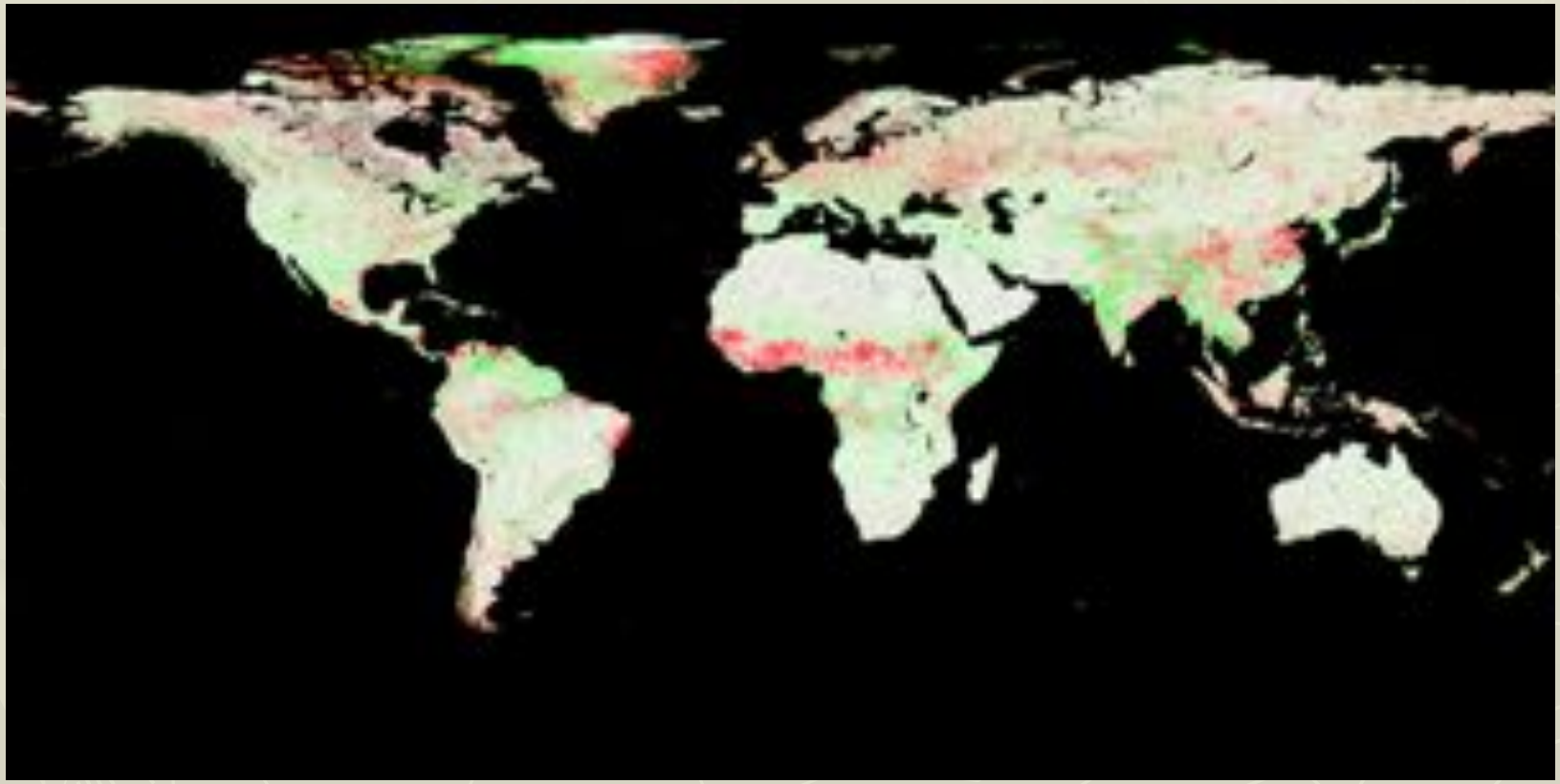
- High quality data
- Temporally fitted pixels
- Spatially fitted pixels
- Two part spatial fitting with temporal averages
- Spatially smoothed pixels
- Spatially fitted pixels between 80°N-90°N
- Solar zenith angle between 70° and 82°

Crystal Schaaf

30 arc sec (~1 km)

Spatially Complete White-sky Albedo Maps
λ = 0.858 μm

Moody 16-day – Schaaf 8-day
July 12-27, 2004



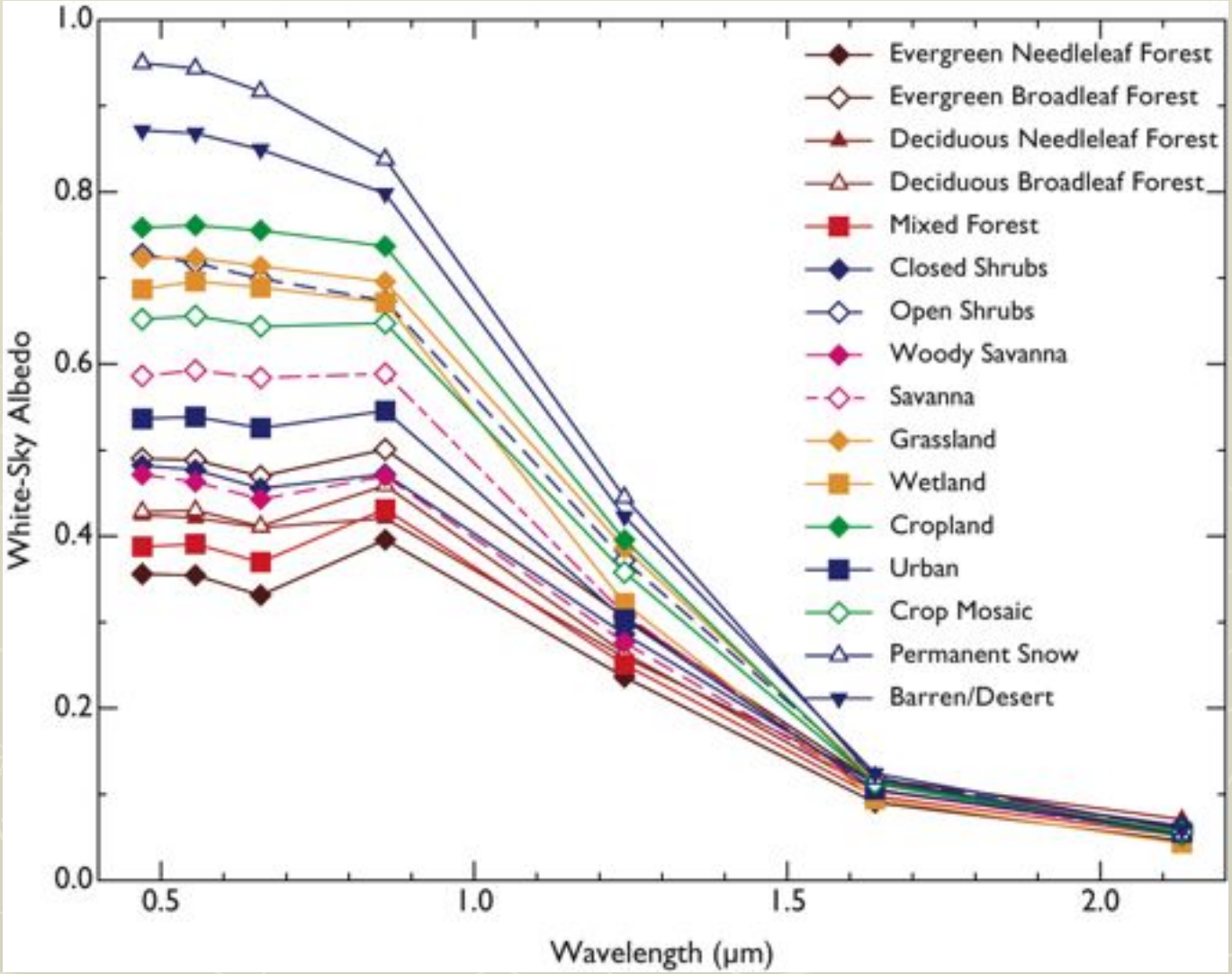
Plans for Cloud Optical Properties
(Collection 6)

- 1 arc min (~2 km) latitude-longitude spatial resolution
  - Average 30 arc sec files to reduce file size
- Use 8-day periodicity (production rules)
  - Direct broadcast needs yet to be evaluated
    - ✓ May want to use every other 8-day file (since they are based on 16-days) to reduce the number of files to be served
- Extension of gap-filled albedo dataset to solar zenith angle of 81.4° necessary for cloud team, but is beyond angles preferred by Boston University
  - If we make these files available on the MODIS atmosphere web site (as currently for Moody et al.'s data), we may 'redact' this extended range
- May use a representative year (subject to discussion)
  - Enables one set of files to be used for both forward processing and reprocessing
- Effect of this new gap-filled dataset on cloud optical properties not yet evaluated

Spectral Albedo of Snow

- Used near real-time ice and snow extent (NISE) dataset
  - Distinguishes land snow and sea ice (away from coastal regions)
  - Identifies snow
    - ✓ Projected onto an equal-area 1′ angle grid
- Aggregate snow albedo from MOD43B3 product
  - Surface albedo flagged as snow
    - ✓ Aggregate only snow pixels whose composite NISE snow type is >90% and flagged as snow in any 16-day period
  - Hemispherical multiyear statistics
    - ✓ Separate spectral albedo by ecosystem (MOD12Q1)
- Results represent 'average' snow conditions
  - Additional sources of variability include snow depth, snow age, grain size, contamination (soot), and, in the case of black-sky albedo, solar zenith angle

Snow Albedo by IGBP Ecosystem
Northern Hemisphere Multiyear Average (2000-2004)



Spatially Complete White-Sky Albedo
January 1-16, 2002