

LEDAPS



Landsat Ecosystem Disturbance Adaptive Processing System

LEDAPS Update

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10/27/2009

LEDAPS



Landsat Ecosystem Disturbance Adaptive Processing System

... descended from MODIS Adaptive Processing System (MODAPS)

LEDAPS as a Project

.... North American forest disturbance, 1990-2005

LEDAPS as a Processing System

... large-area, reflectance-based Landsat analyses

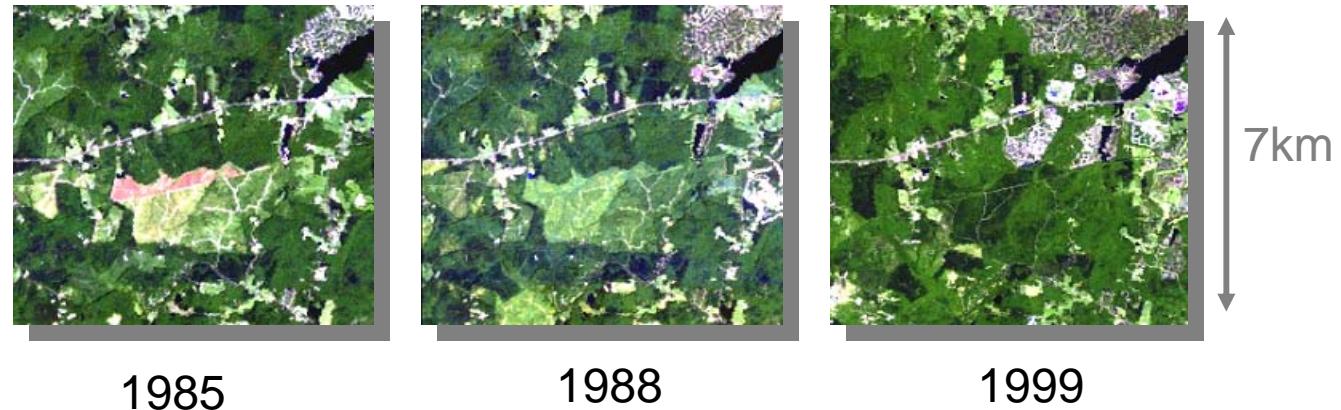
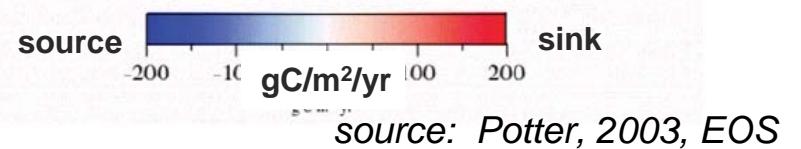
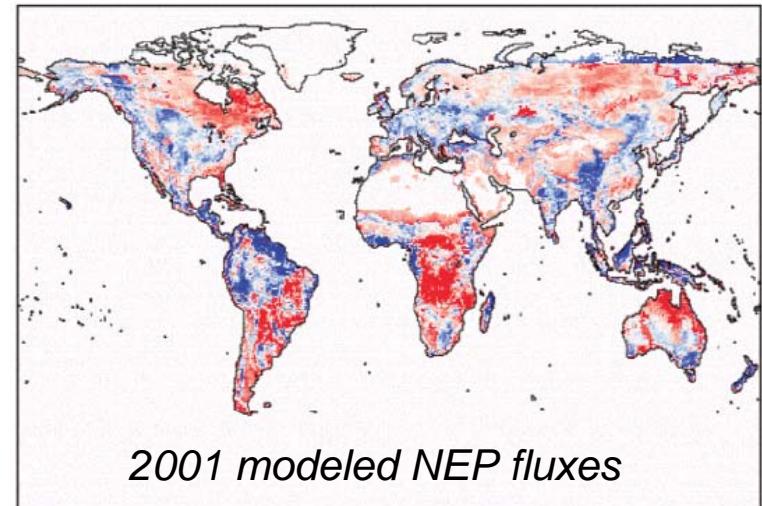


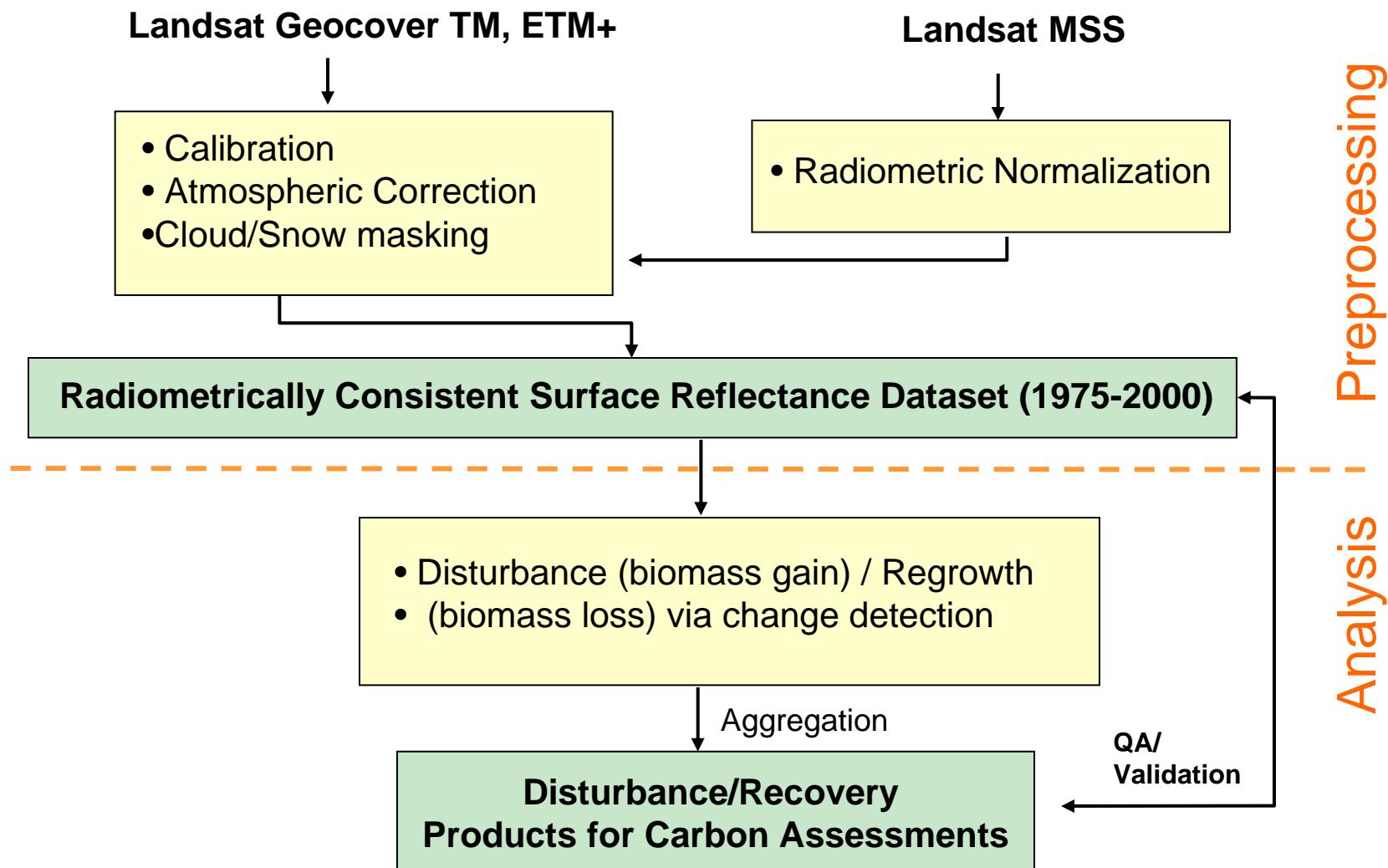
Background

Global estimates of carbon fluxes often exclude effects of land cover change and disturbance

Patch size often small – requires Landsat-type data analysis

North American Carbon Program Science Plan calls for analysis of disturbance from satellite data

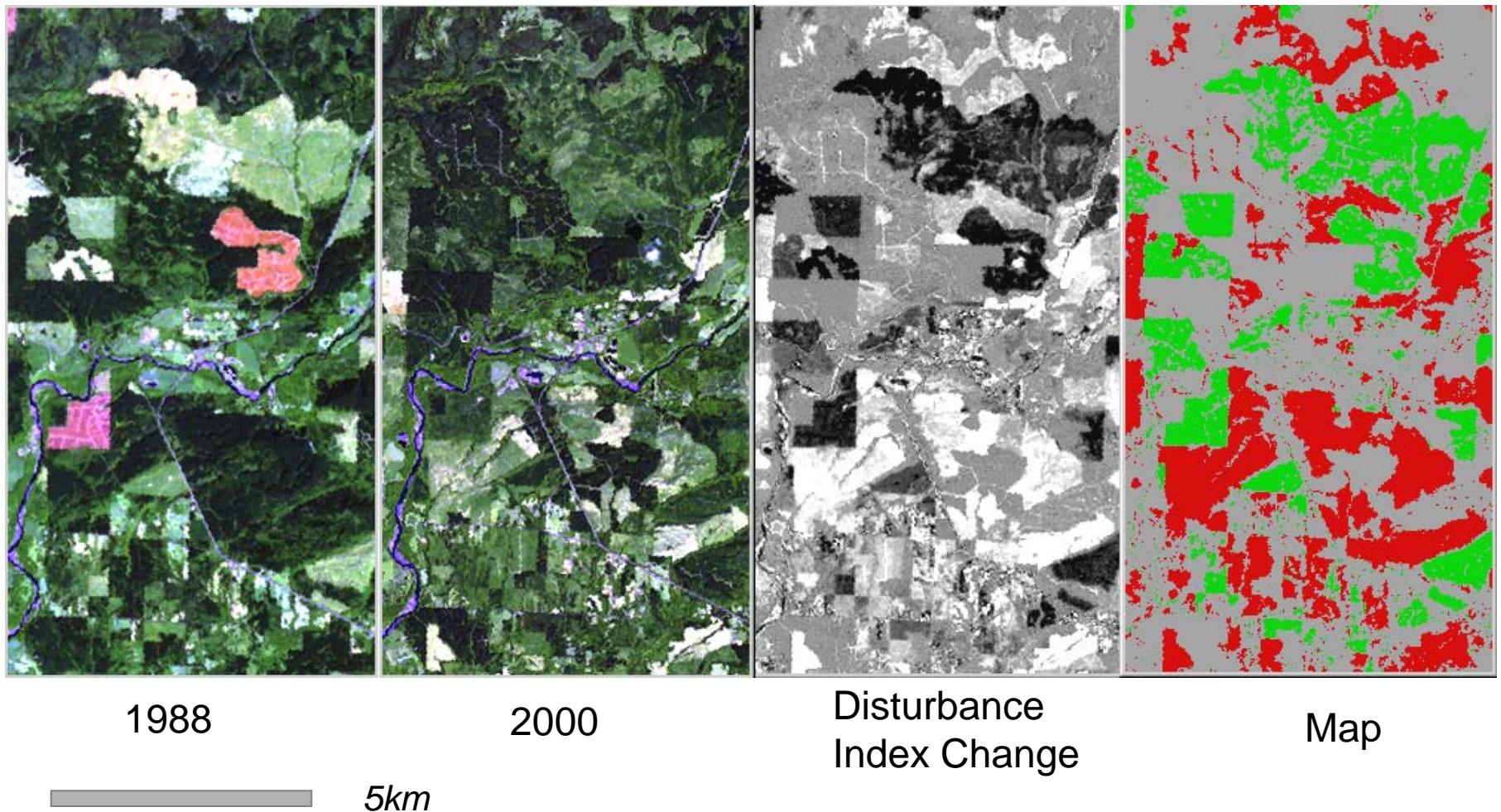


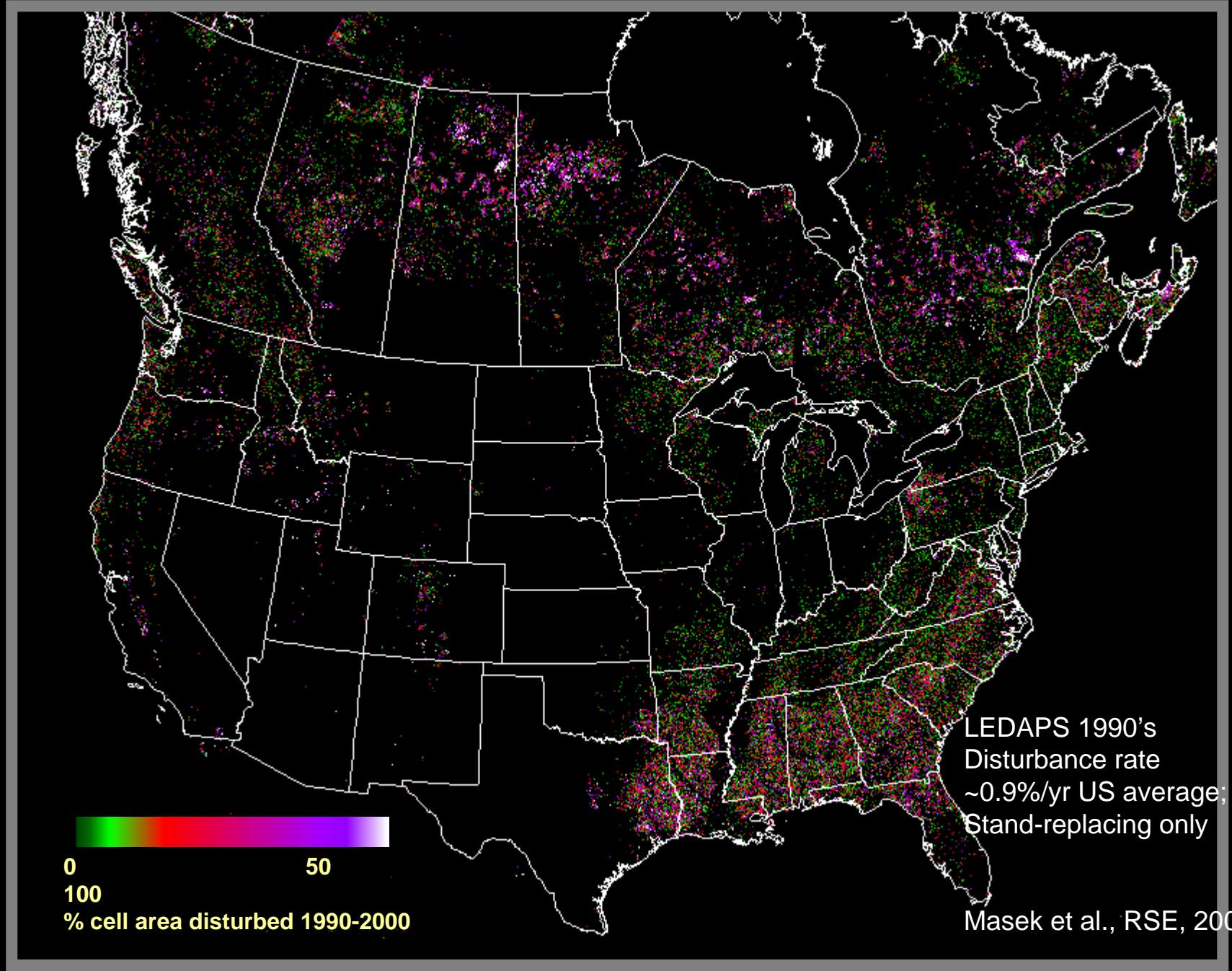




Disturbance Index Example

Olympic Peninsula

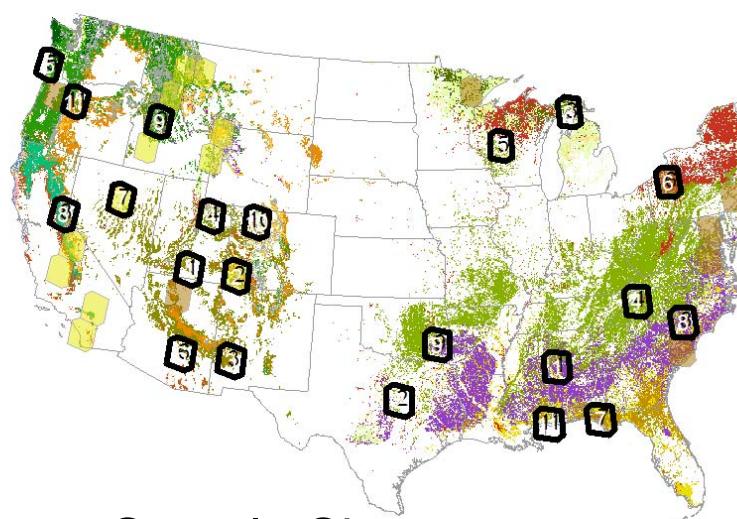






Sampling Approach

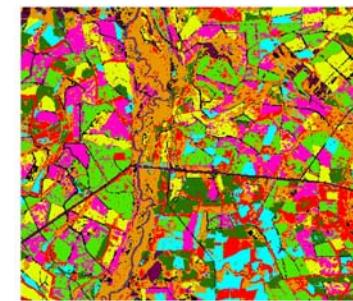
S.N. Goward, “*North American Forest Disturbance and Regrowth since 1972*“



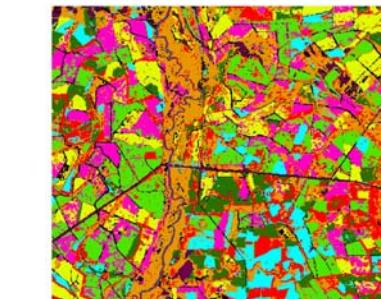
~25 Sample Sites

- random sample stratified by forest type
- constrained by forest cover per scene and geographic dispersion
- Known sampling probability per scene

Biennial Image Time Series (1972-2004)



Disturbance history

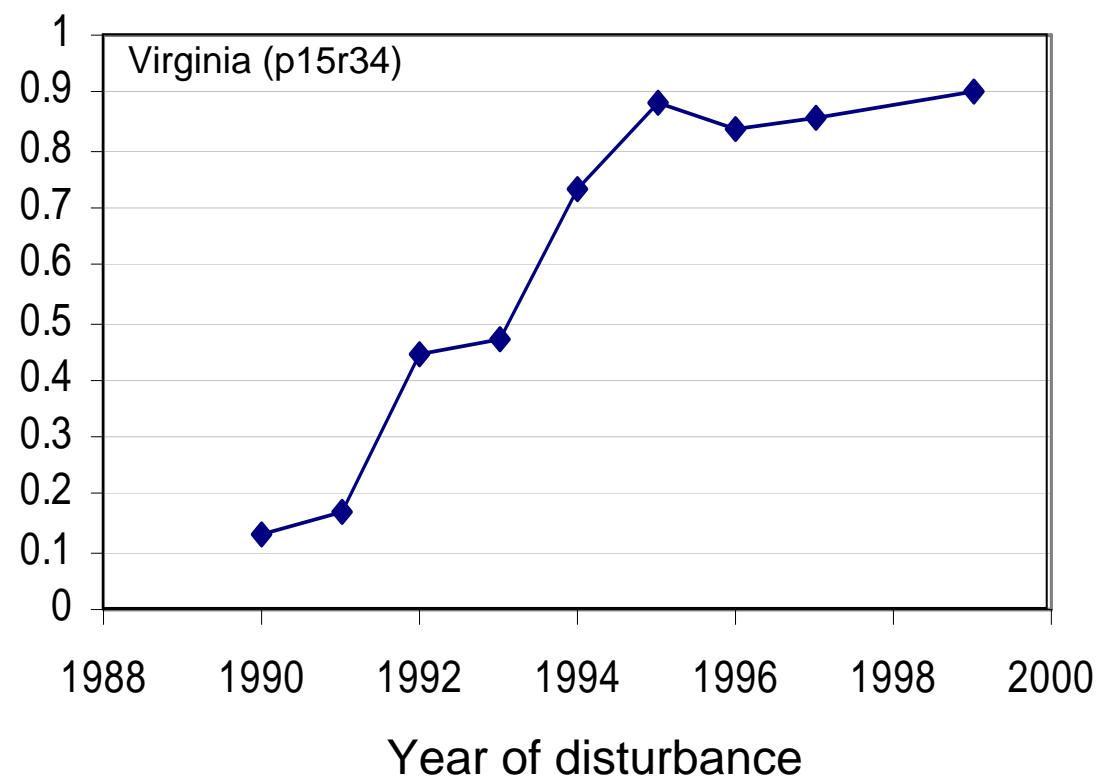


Regrowth dynamics

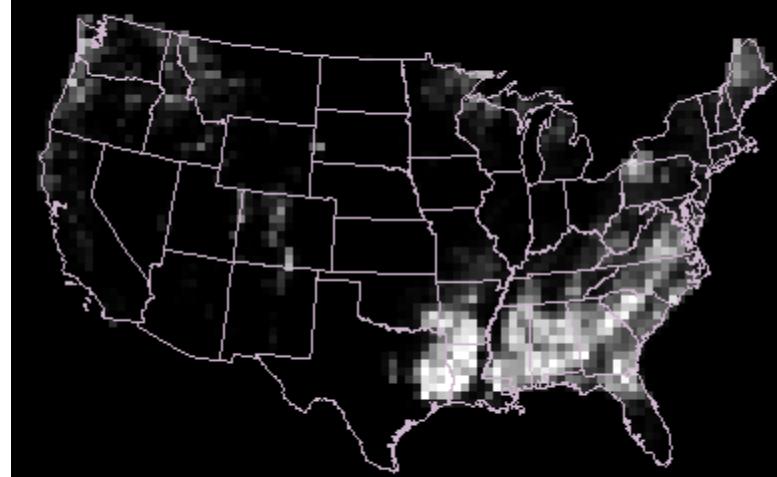


10-year revisit intervals are too long for mapping disturbance with Landsat-type data

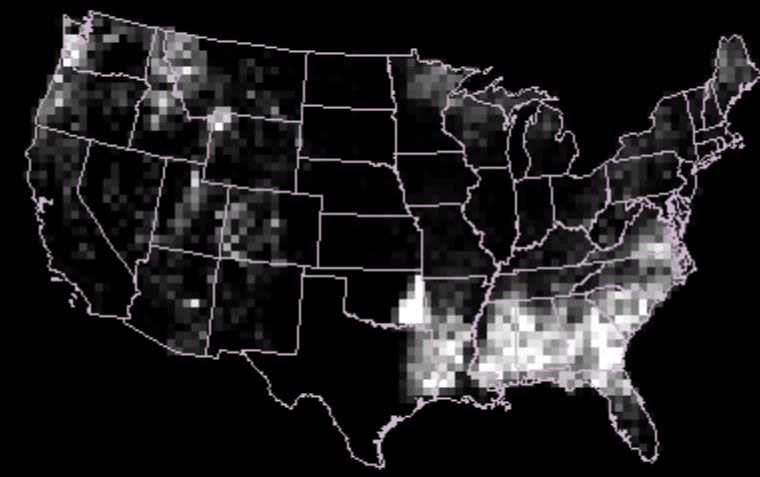
Fraction of
Disturbance
Detected by
LEDAPS



LEDAPS



0 0.4×10^5
LEDAPS Area Disturbed (ha)



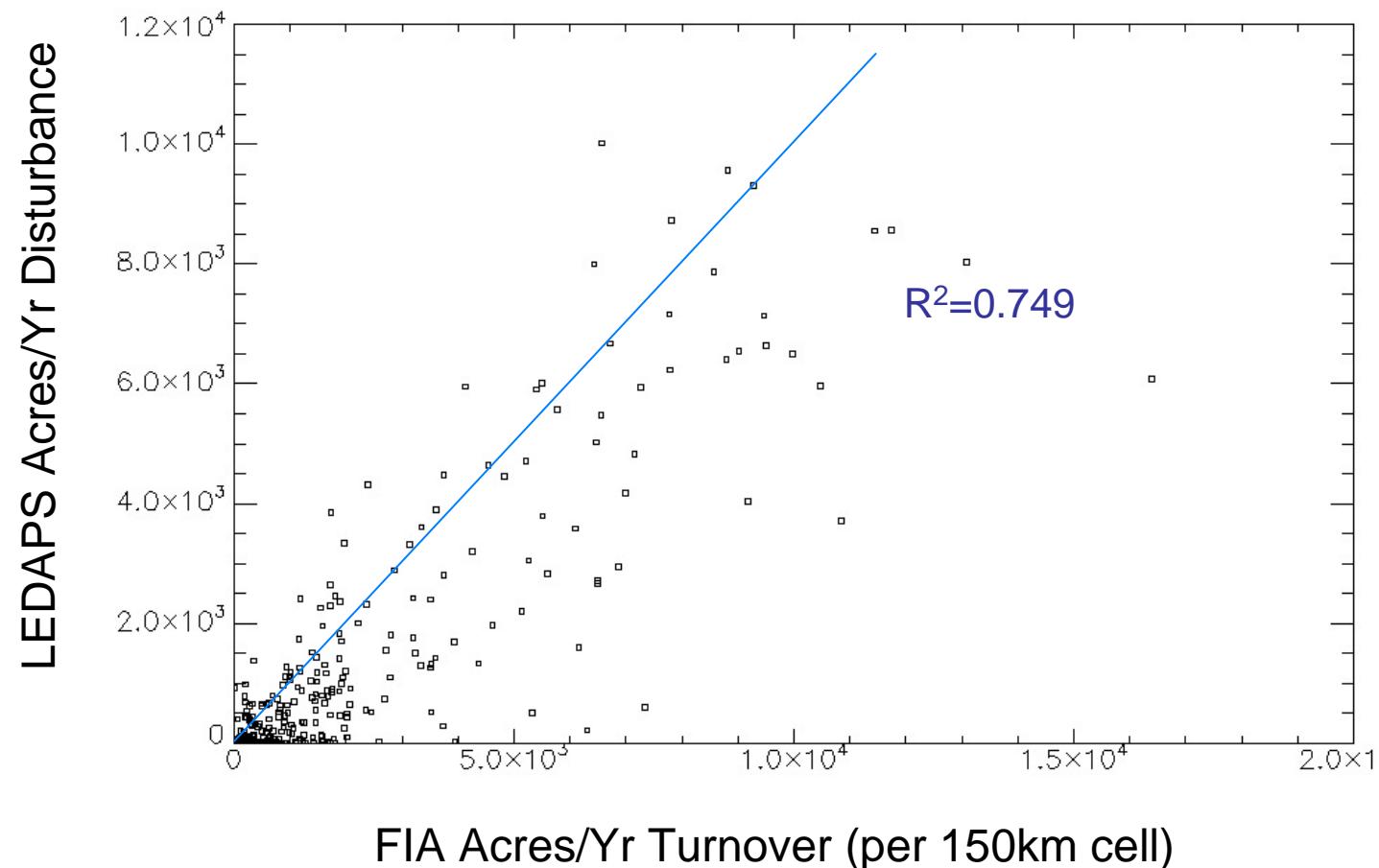
0 1.0×10^5
FIA Forests < 20 years (ha)

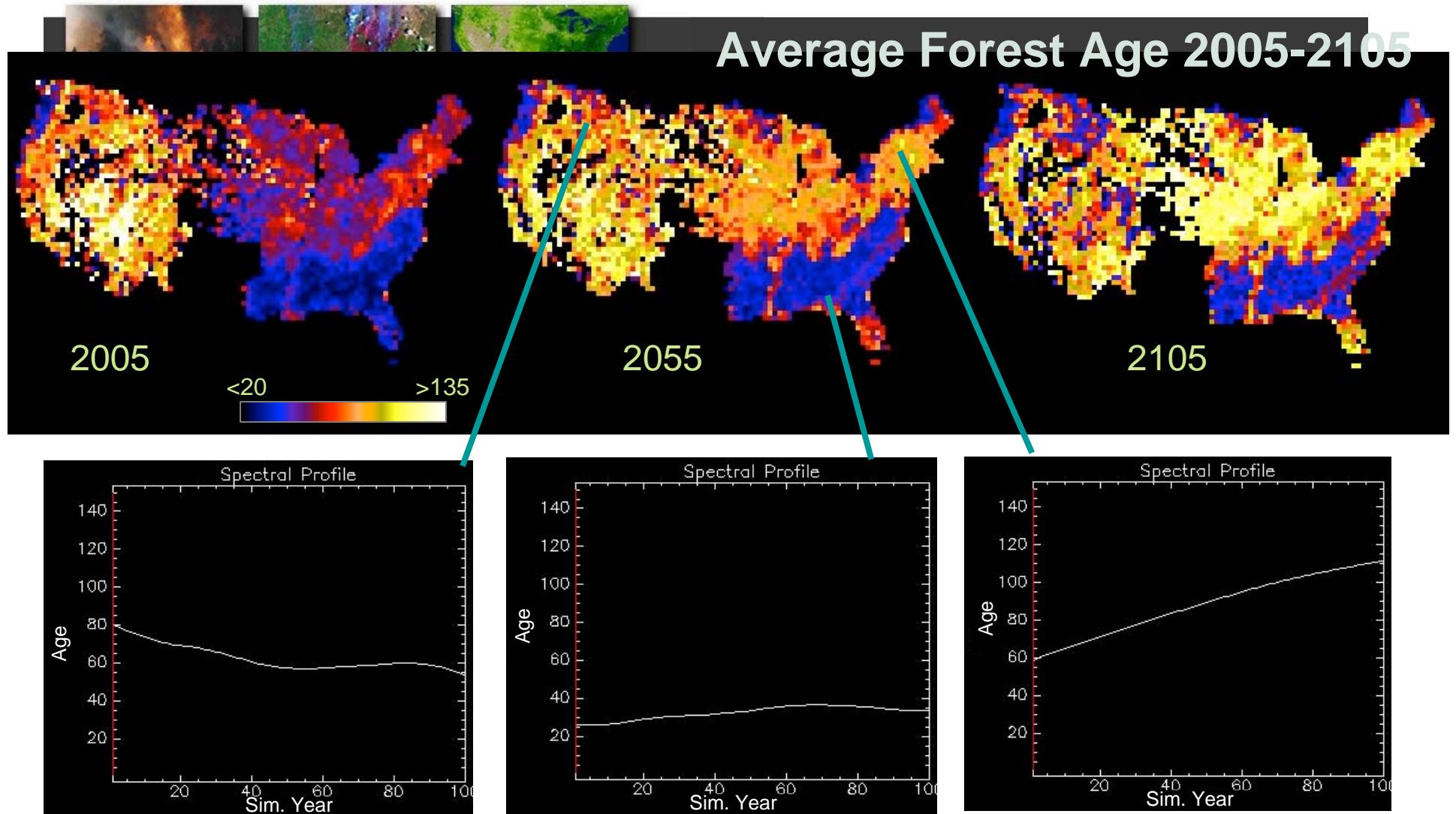


FIA Forest Age vs. LEDAPS disturbance (150km cells)

FIA Area < 20 years / 20.0 = Stand-scale turnover area per year (~1985-2005)

LEDAPS = stand-clearing disturbance (~1990-2000)

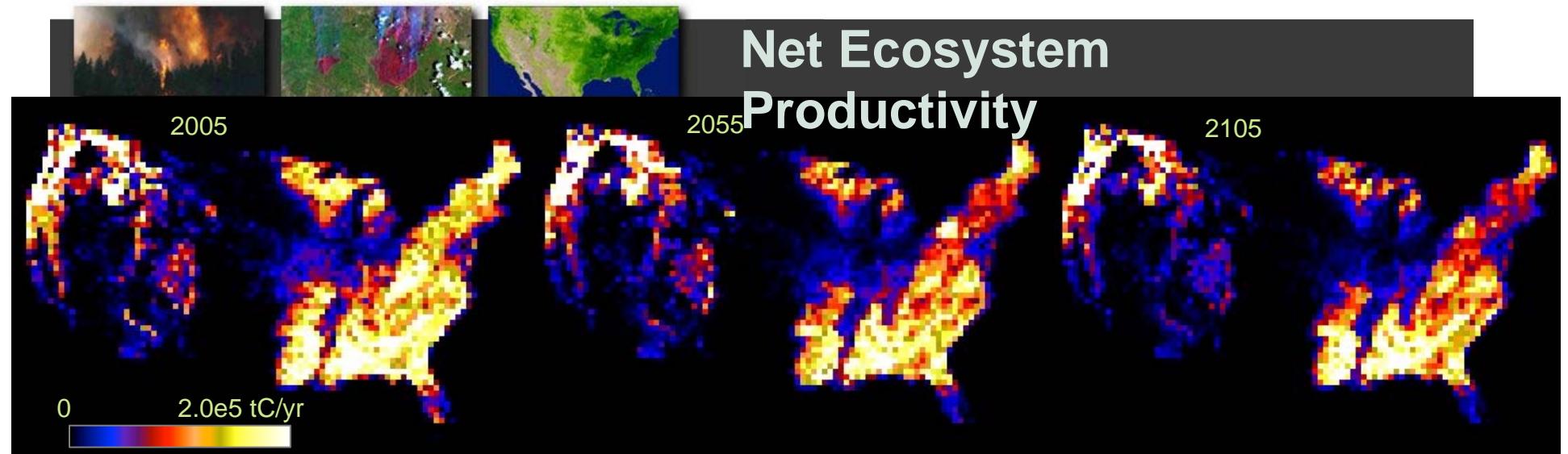




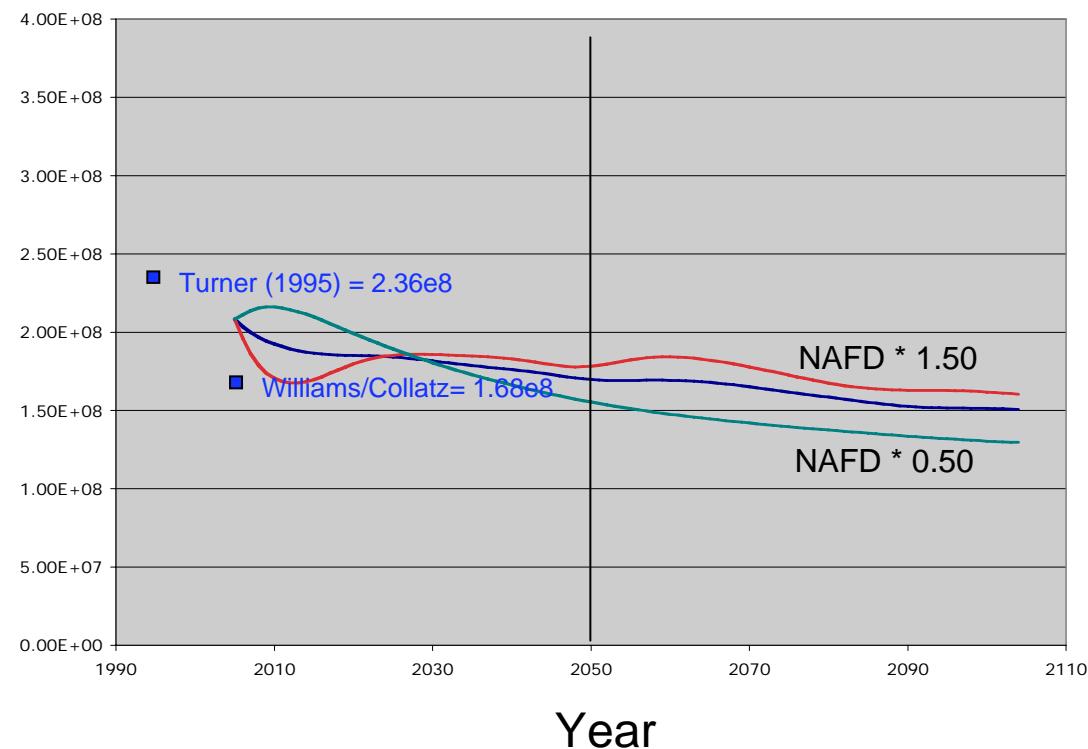
Most US Forests are not in equilibrium with current disturbance rates

- SE, PNW nearly in equilibrium - some future aging
- Northern forests get older (lower disturbance)
- Rocky Mountain forests get younger (higher disturbance)

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US Forest
Sink
(tC/yr)

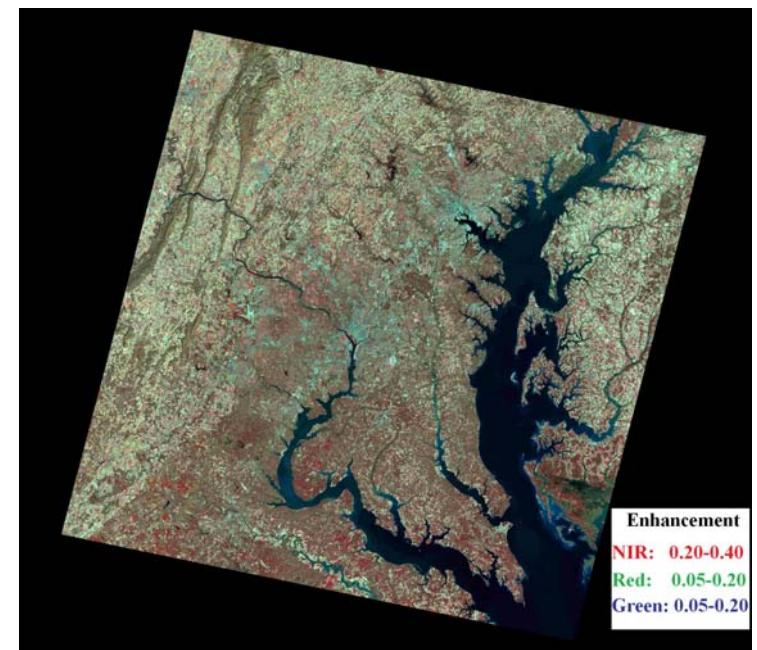
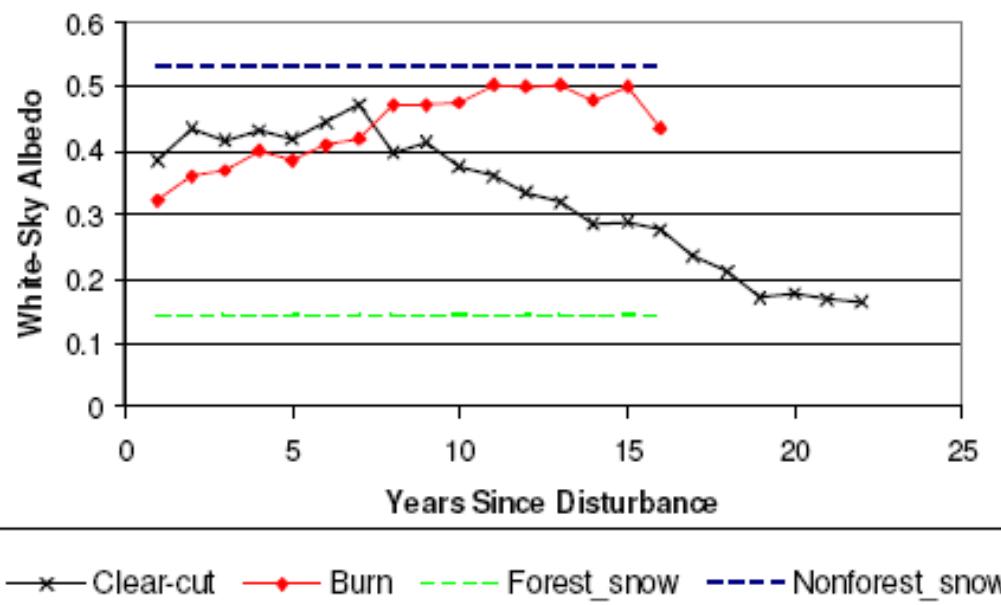




Landsat Disturbance Albedo

- Disturbance (fire) has been linked to albedo increase (cooling)
- What is the effect of harvest, forest management, etc?
- Initial study using MODIS Albedo product and space/time substitution
- Feng Gao/ Yanmin Shui leading effort to create Landsat albedo products

Snow-Covered Albedo (Visible)





LEDAPS Architecture

INGEST



Scene
RDBMS

Data

Metadata
parsing

PROCESSING

Job
Scheduling
&
Control

AROP

Indcal

Indcsm

Indsr

cloud.for

Automated registration
and orthorectification

Calibration,
TOA reflectance

Cloud/snow/
shadow mask

6S Atmospheric
Correction to SR

Revised reflectance-
based cloud mask

SR products

Individual science modules are available for download



Atmospheric Correction

Based on MODIS/6S radiative transfer approach

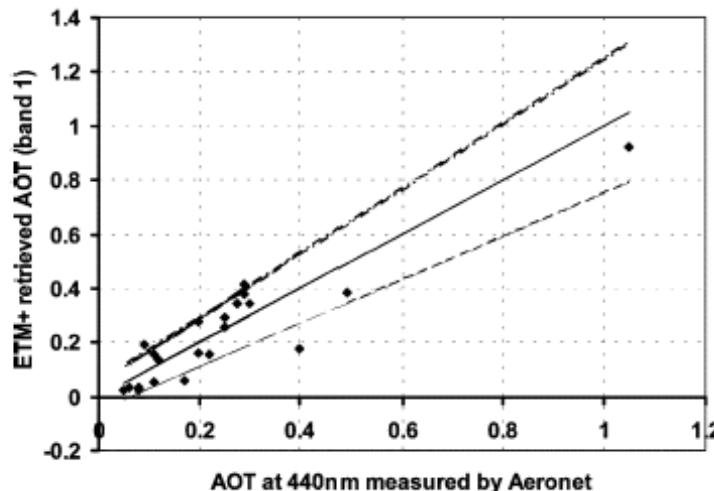
water vapor from NCEP re-analysis data

ozone from TOMS, EP-TOMS

topographic-dependent Rayleigh correction

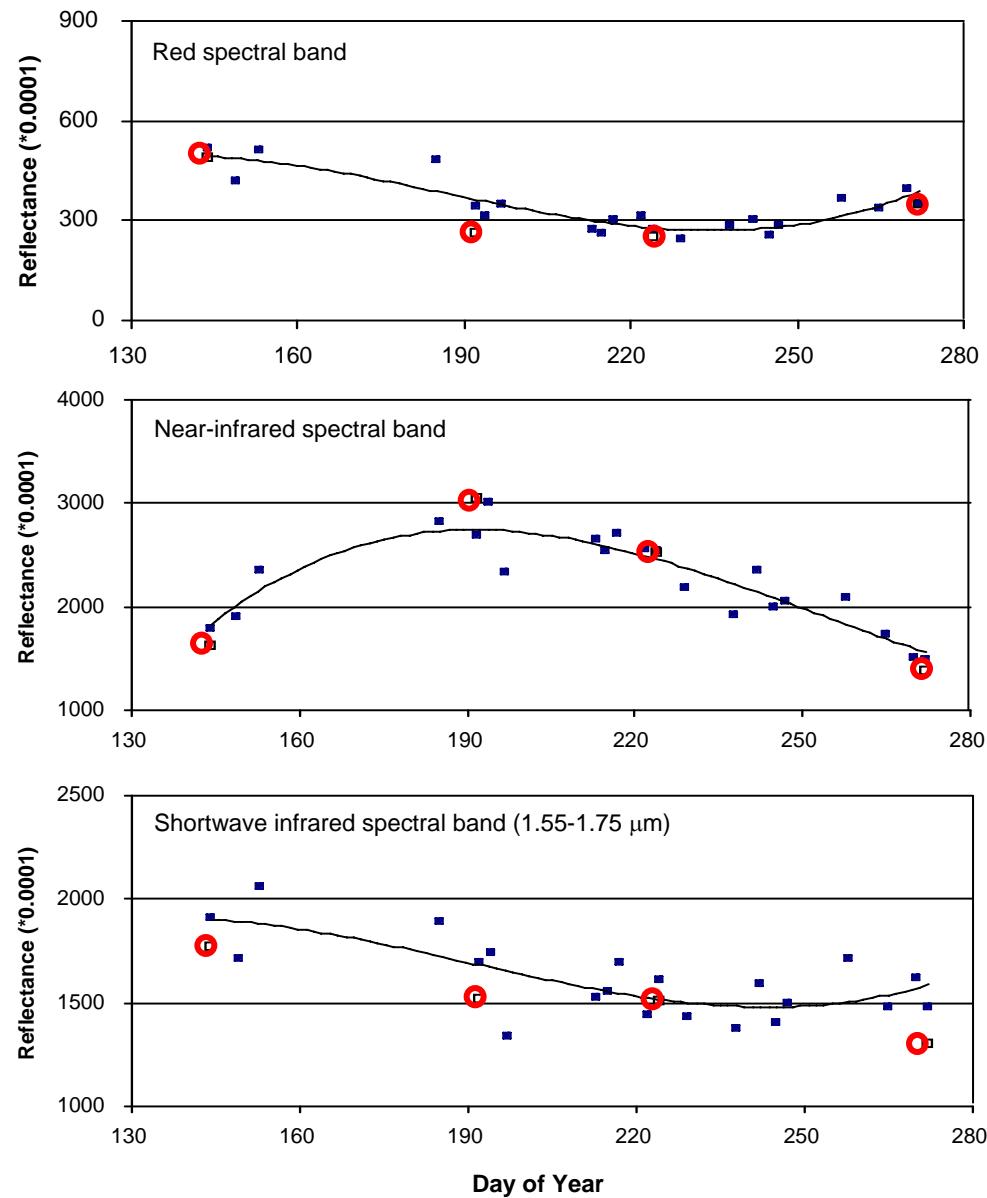
Aerosol optical thickness estimated from imagery using the Kaufmann et al (1997) “Dense, dark vegetation” approach

- estimate blue reflectance based on TOA SWIR 2
- difference between TOA_{blue} and SR_{blue} gives AOT
- interpolate valid targets across image





ETM+ Comparison with MODIS



Saskatchewan, Canada

- Landsat (LEDAPS) reflectance
- MODIS daily reflectance (highest QA observations)

LEDAPS



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Current Activities

- Extend LEDAPS disturbance mapping to 5-year epochs, 1990-2005 and integrate available ASTER imagery (thru 2011)
- Support Goward et al North America Forest Dynamics (NAFD) project (thru 2011)
- Support UMD MEASURES Forest Cover Change ESDR (thru 2013)
- Support Gitelson et al NACP project (corn/soybean NPP; thru 2011)
- Additional collaborations with Nemani/ARC; Roy/SDSU; Wulder/CFS, Wynne/VTU; Chen/UT



Major deliverables:

Global, Fine resolution (< 100 m) **forest cover change (FCC)
ESDR**

1990-2000

2000-2005

1975-1990 for southern South America

Global fine resolution (< 100 m) **surface reflectance ESDR**

1990, 2000, and 2005;

Global 250-m vegetation continuous field (**VCF**) based FCC ESDR
from 2000 to 2005;

Other Deliverables:

Fragmentation products derived from the fine resolution FCC products;

FCC ESDR products **aggregated** from the fine resolution and the 250 m FCC products to 250 m, 500 m, 1 km, and 0.05° grids for use by carbon, biogeochemical and hydrological modelers;

Subsets of the above products for **protected areas** of the world and their buffer zones.



Suggestions for Products

Landsat-based surface reflectance should be pursued

- facilitates biophysical applications (e.g. NDVI, LAI), integration with canopy reflectance models, data fusion, and robust time series analysis
- not inherently more difficult than MODIS, ASTER
- need validation over “special terrain” (ice, bright desert)

Accurate cloud mask probably more difficult

Great opportunities for integrating MODIS/VIIRS and Landsat

- direct radiometric fusion a la STAR-FM
- use MODIS to establish ‘expected’ seasonal signal (phenology pattern), compare to Landsat observation
- ARC, SDSU Measures projects as prototypes

How to move toward Global Land Cover / LCC / Disturbance?

- Landsat Project => USGS (NASA?) => Science Community

LEDAPS

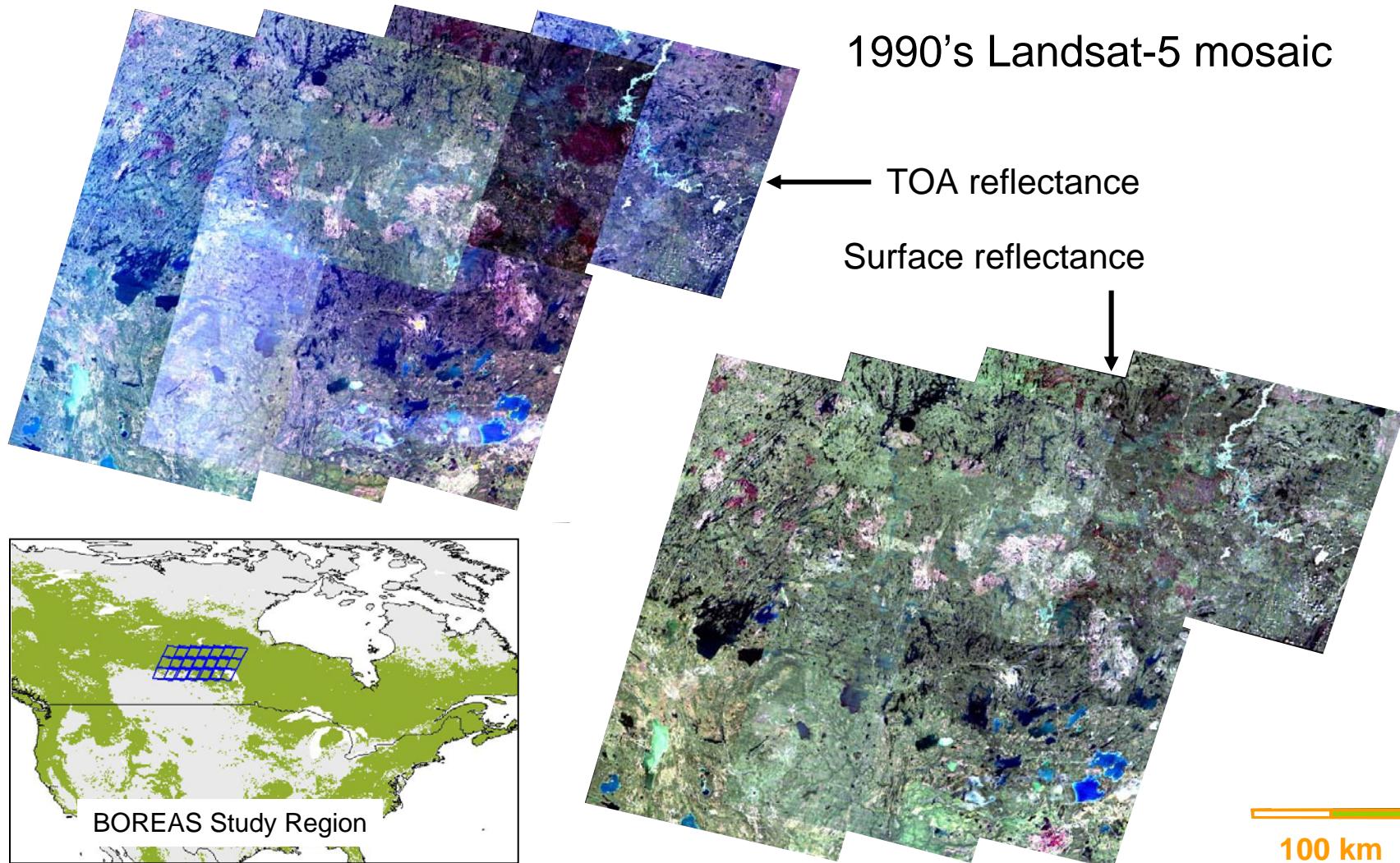




ETM+
Surface Reflectance
Mosaic



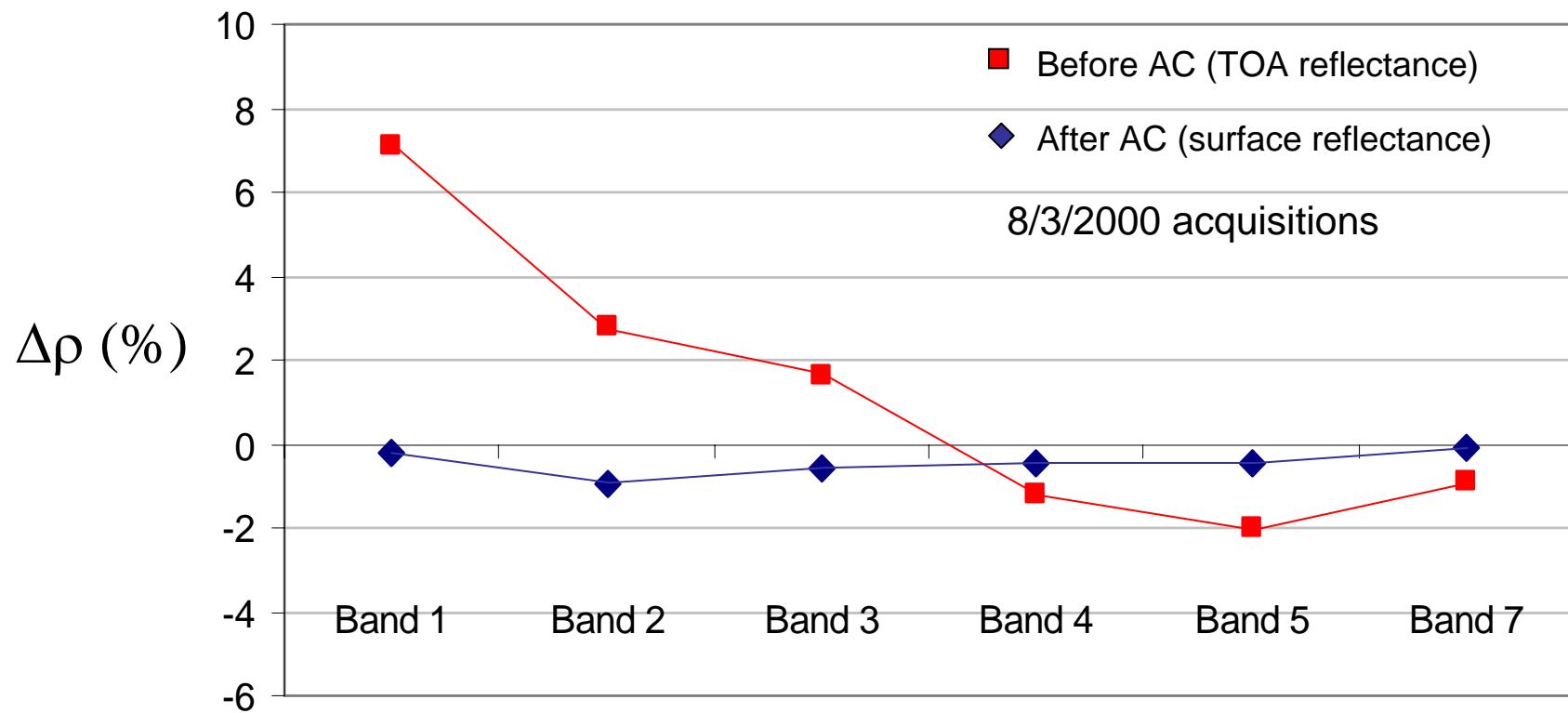
Atmospheric Correction

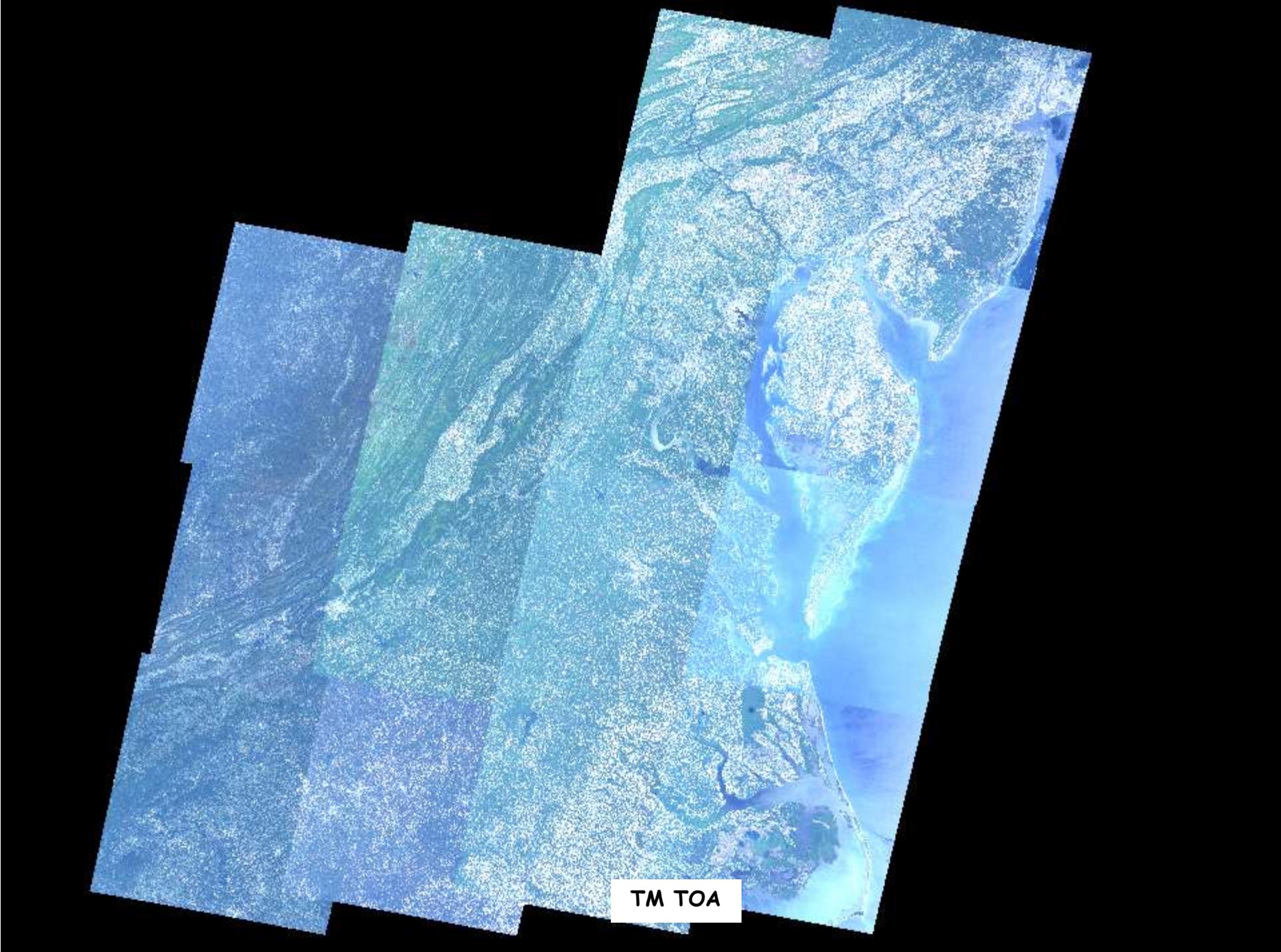




Effect of Atmospheric Correction

(MOD9A surface reflectance) – (ETM+ reflectance), 8/3/00





TM TOA



TM SR