REMOTE SENSING BASED MONITORING SYSTEM FOR LULUCF

National Institute for Environmental Studies

Yoshiki Yamagata

Global Carbon Balance

1.6 GtC/year

+

6.3 GtC/year

Atmosphere

45%

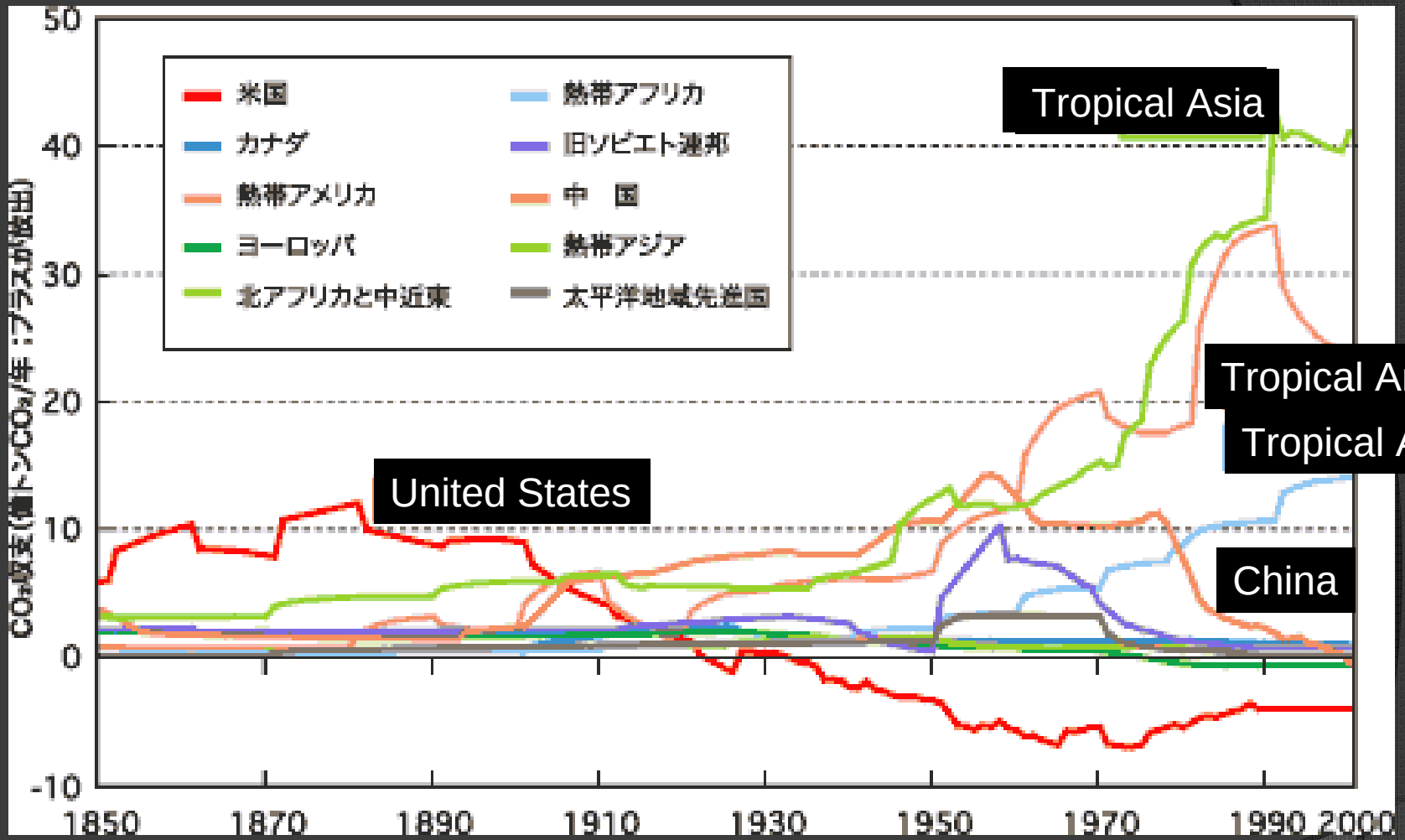
Terrestrial Ecosystem

30%

Ocean

25%

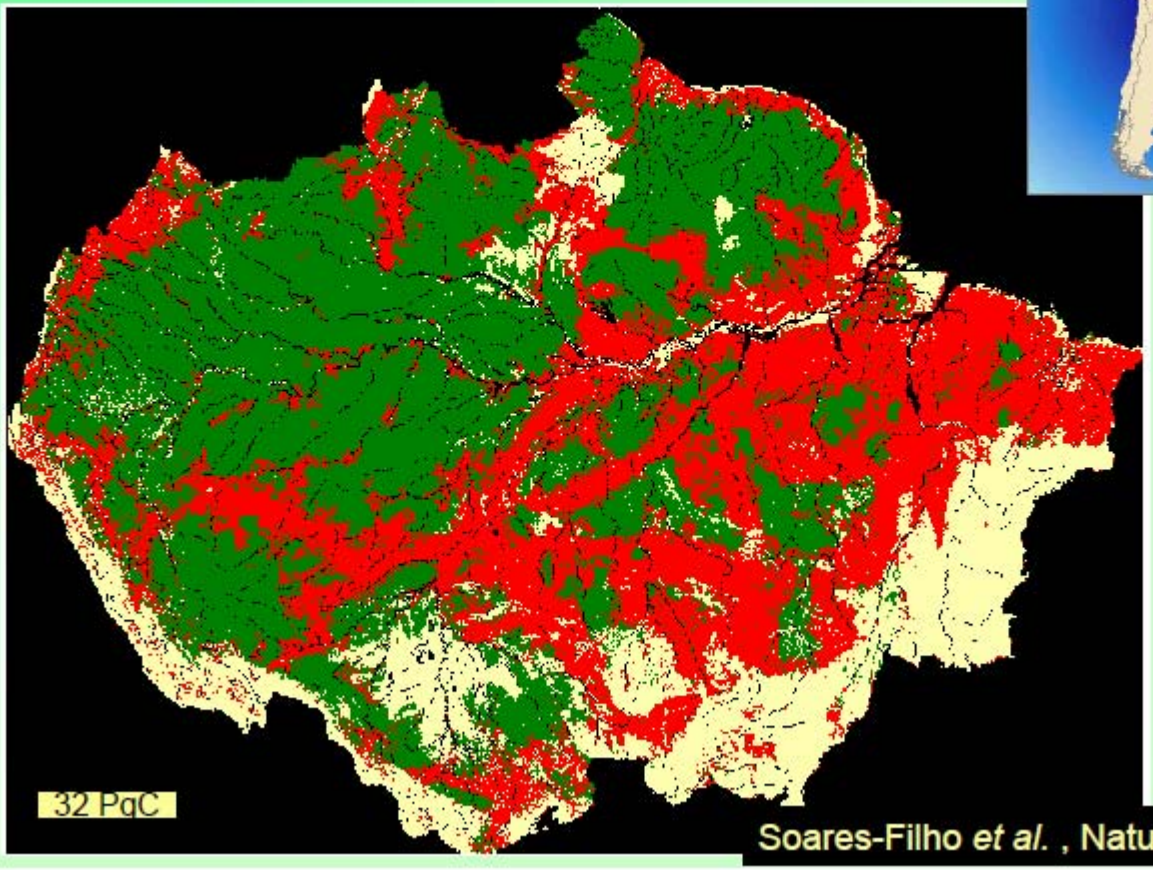
Canadell et al. 2007, PNAS



Emission of CO2 from Deforestation in the past 150 years
(created from Houghton's data)

2050 Business as Usual:

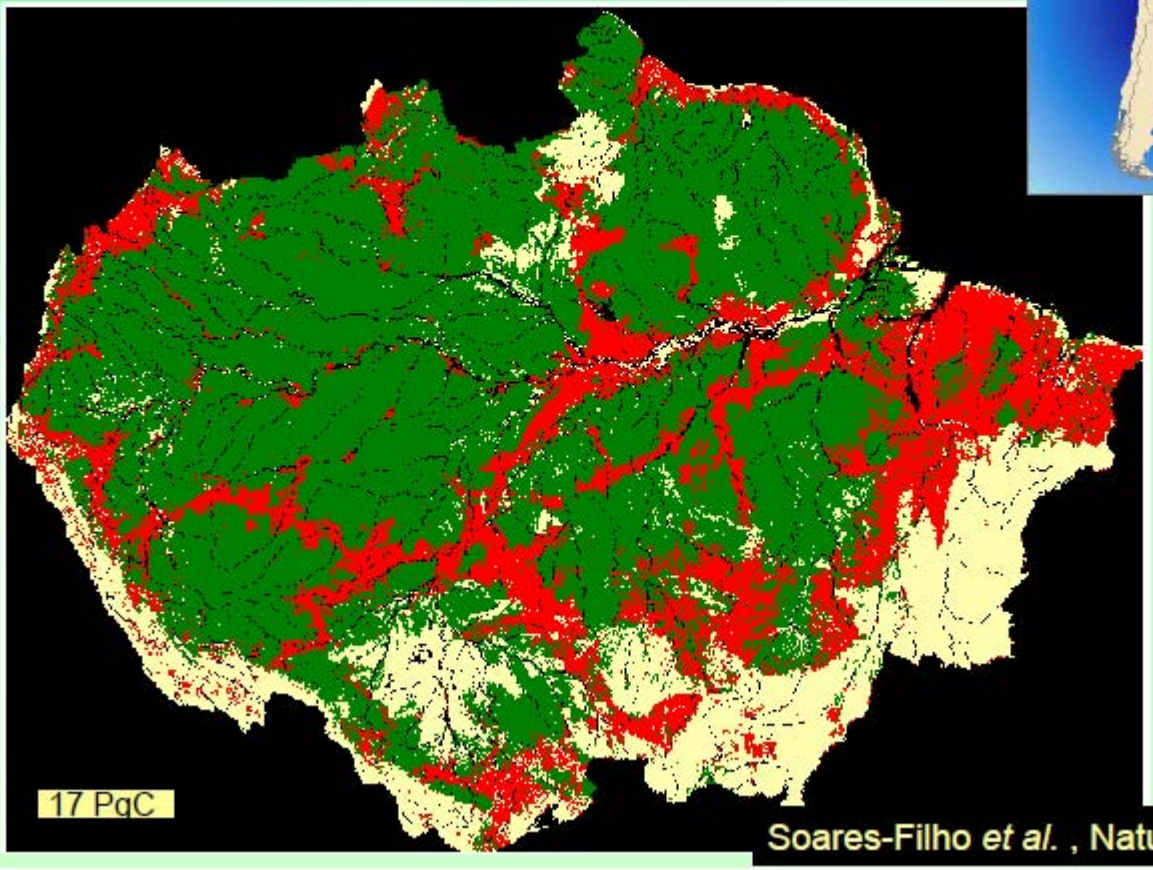
Deforested 2,698,735 km^2 (32 PgC emitted by 2050)
Forest 3,320,409 km^2
Non-forest 1,497,685 km^2



Soares-Filho *et al.* , Nature,2006

2050 Governance Scenario :

Deforested	1,655,734 km² (Reduction: 40%)
Forest	4,363,410 km²
Non-Forest	1,497,685 km²



Soares-Filho *et al.* , Nature,2006

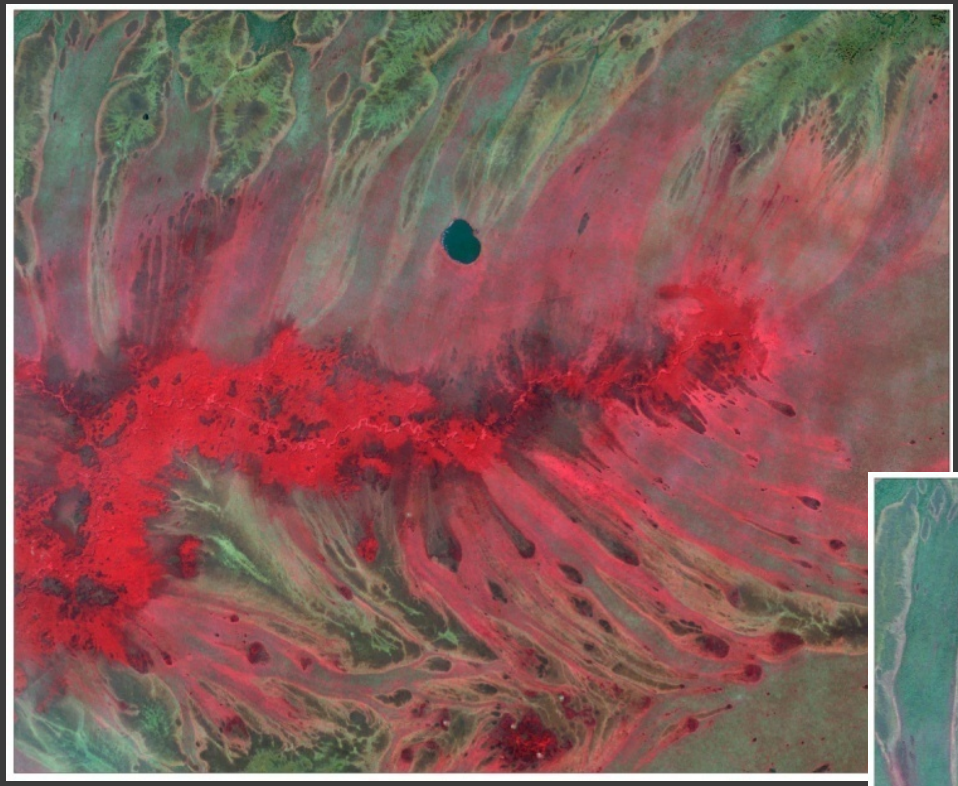
Emission reduction and forest conservation

- Carbon stored in above and below ground biomass, and soil. After harvest, decay of biomass occurs in a few years time
- CO2 emission from deforestation is around 20% of global fossil fuel emission. Deforestation is increasing due to global rapid economic growth
- Consideration for the inclusion of reducing deforestation (REDD) is currently discussed as a new mitigation measures
- Forest conservation is also critically important for preserving Biodiversity (inter-linkage of UNFCCC, CBD, RAMSAR) and as an adaptation measures

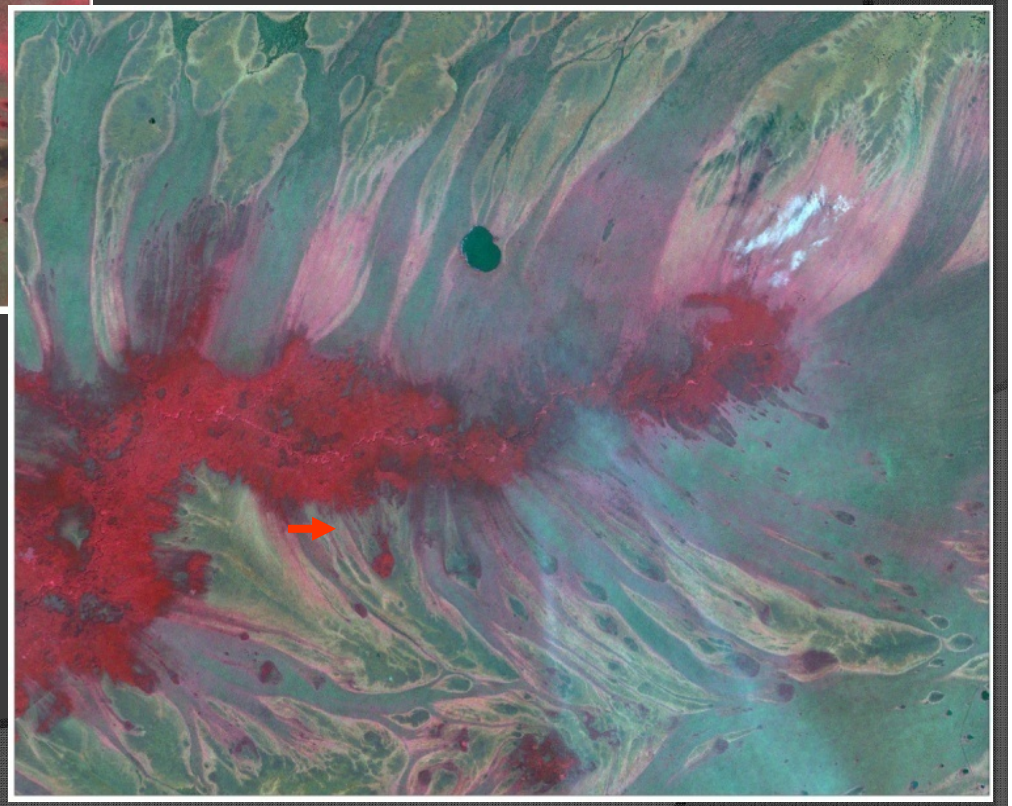
Forest-Wetland change (due to climate change?) in western Siberia

From Anna Peregon (NIES)

LANDSAT TM, 1989/08/01



LANDSAT ETM, 2001/08/02



In 12-years:

Forested peatlands are gradually transformed to open peatlands.

Upland forests are replaced by forested swamps.

IPCC *Good Practice Guidance for LULUCF*: reporting tier options for UNFCCC Annex I country reporting

- **Tier 3** - higher order methods including models and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by high-resolution activity data and disaggregated at sub-national to fine grid scales
  - may be GIS-based combinations of age, class/production data systems with connections to soil modules, integrating several types of monitoring

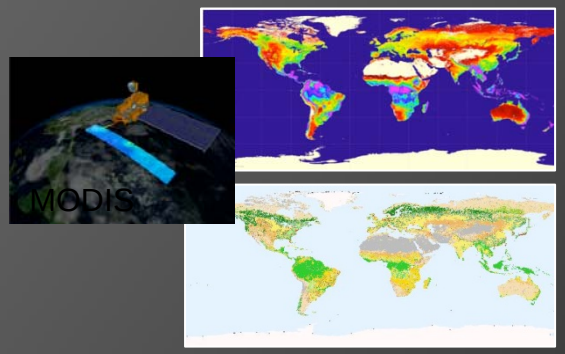
LULUCF monitoring issues

1. **How to define Deforestation and Forest degradation (Land use/ Land cover?)**
2. **Remote sensing can monitor Land Use/Land Cover change?**
3. **Is the global Forest Carbon Monitoring System for evaluating CO2 emission/absorption due to Land Use and Land Cover changes is possible?**

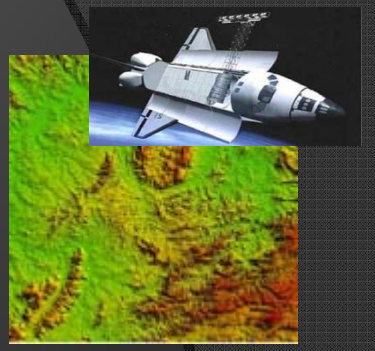
NEW RESEARCH PROJECT : FOREST CARBON MONITORING SYSTEM

Remote Sensing
- NOAA/AVHRR
- Landsat, SPOT
- TRMM etc.

Land Cover

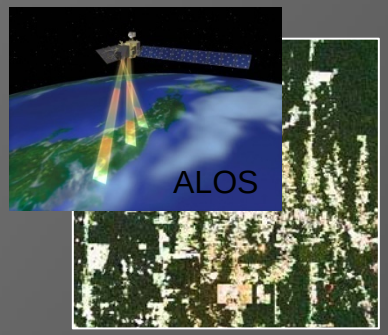


DEM



cf. ASTER

Forest changes

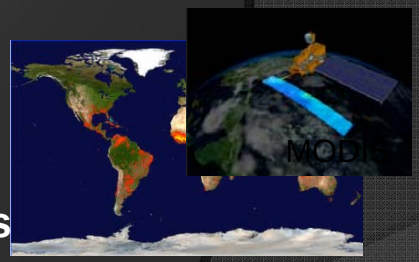


伐採

LAI, Canopy, etc.

Slopes

Disturbances

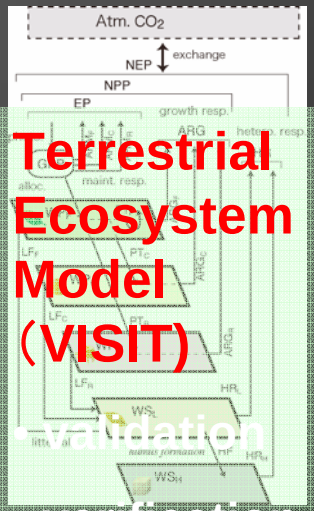


Fires
Harves
Etc.

GHG concentration

cf. SCIAMACHY, OCO

CO_2

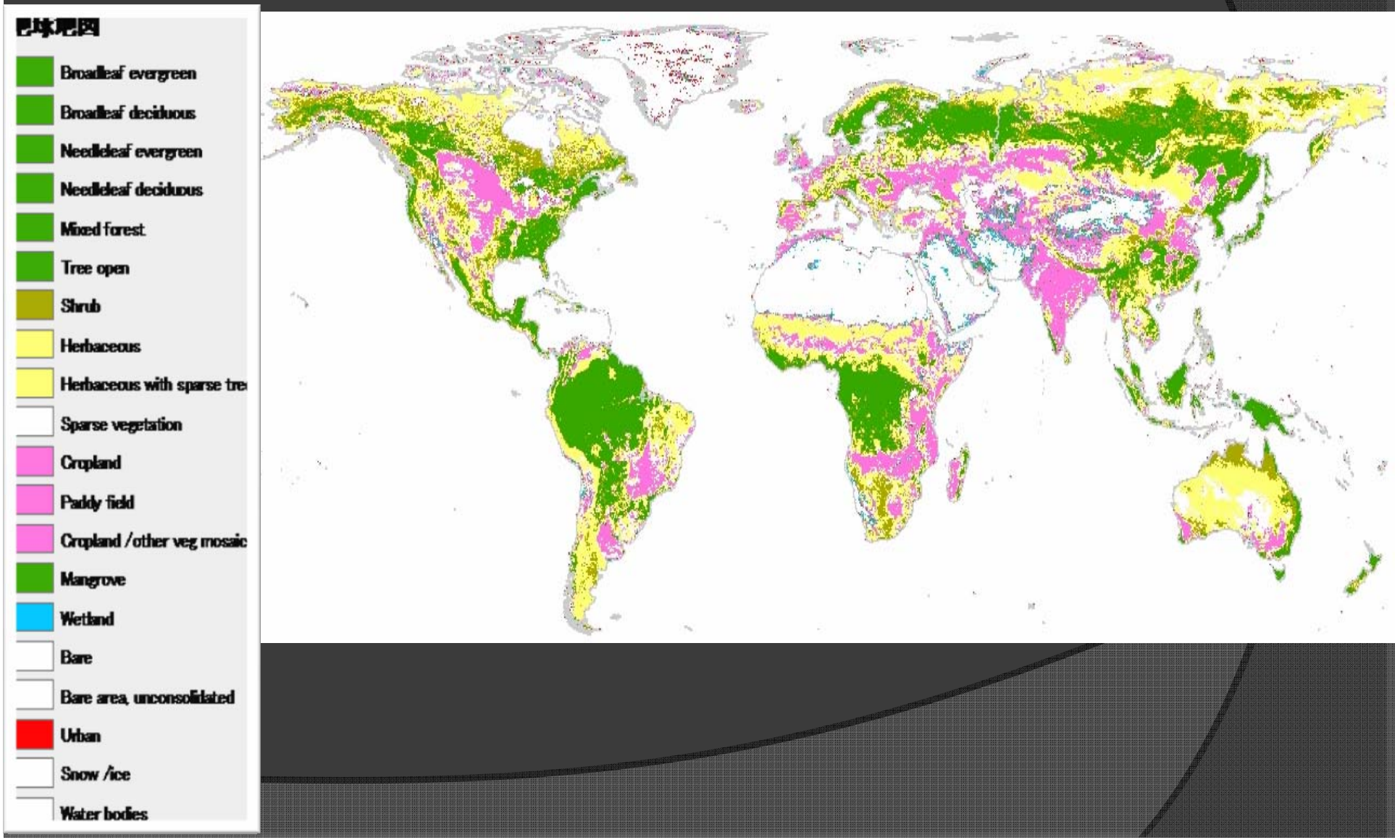


Terrestrial Ecosystem Model (VISIT)

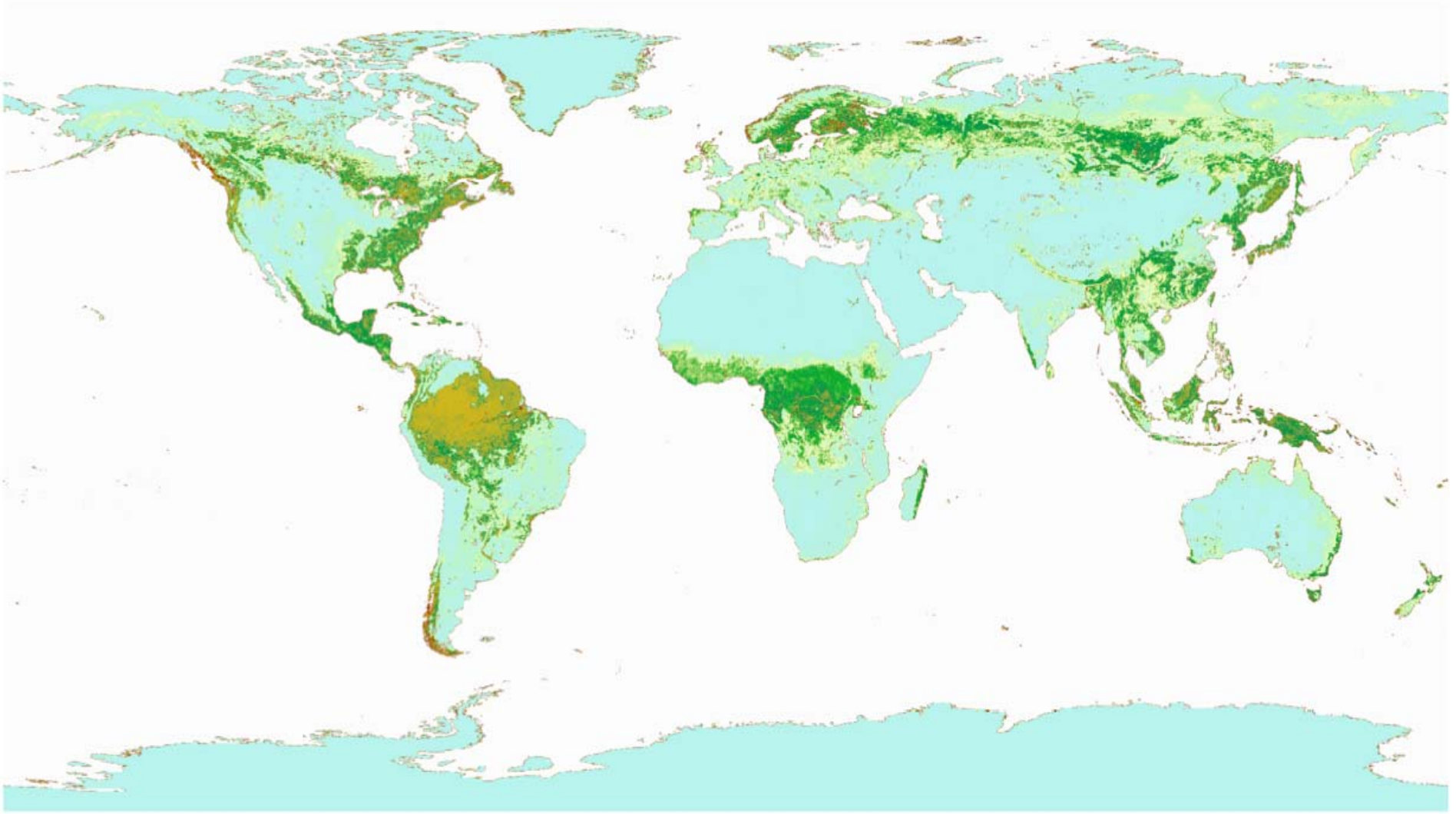
- validation
- verification
- assimilation

Future sensors
- GCOM etc.

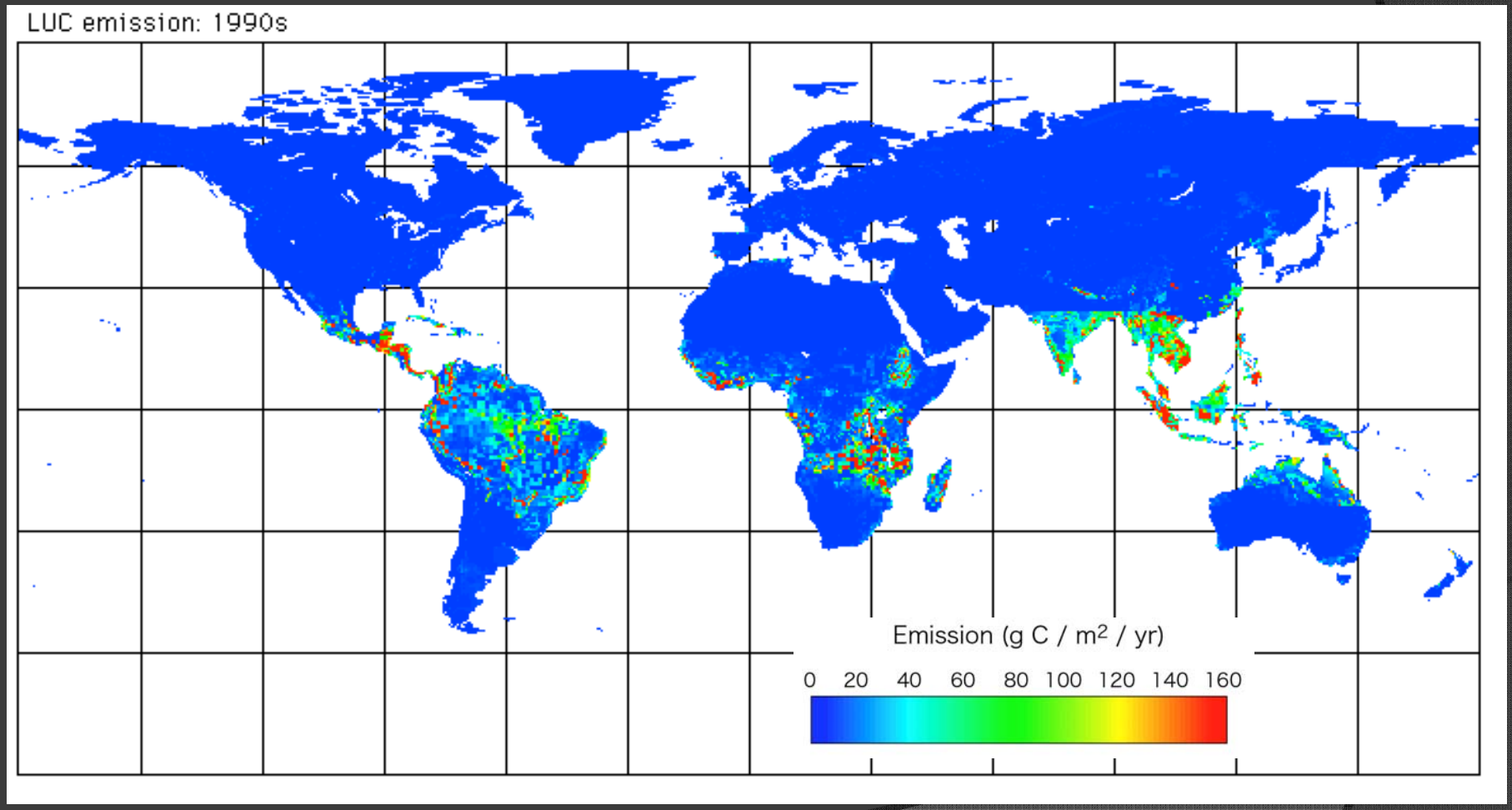
Global Mapping (Land Cover)



GLOBAL MAPPING (TREE COVER)



Model estimate: CO2 emission during 19

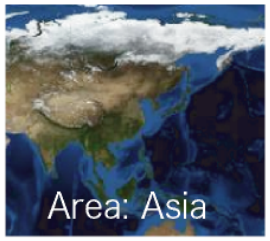


NIES

Needs for an Remote Sensing data for monitoring

- Remote sensing can provide the objective means to observe land use /land cover changes
- Especially for the tropical forests monitoring, cloud-penetrating radar imaging is a key tool
- Coordinated use of latest R/S sensors with in-situ measurements and model will be crucial for LULUCF monitoring

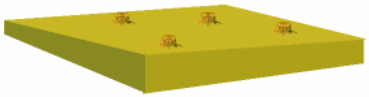
Carbon Accounting Method



afforestation, growth, succession

deforestation and degradation

C emission



① Default method

area-based

carbon stock decrease

② Ecosystem model

temporal dynamics

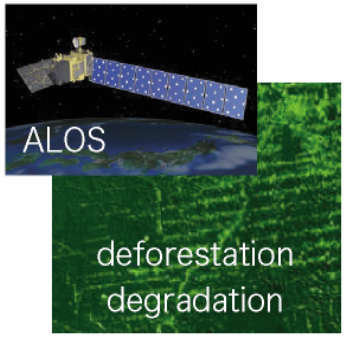
③ Economic evaluation of environmental benefits

Ecosystem service
- hydrological
- food, fibre, etc.
- biodiversity etc.

change in

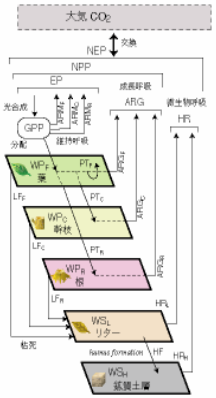
ecosystem services

Advanced satellite monitoring system



forest monitoring

Improved ecosystem model

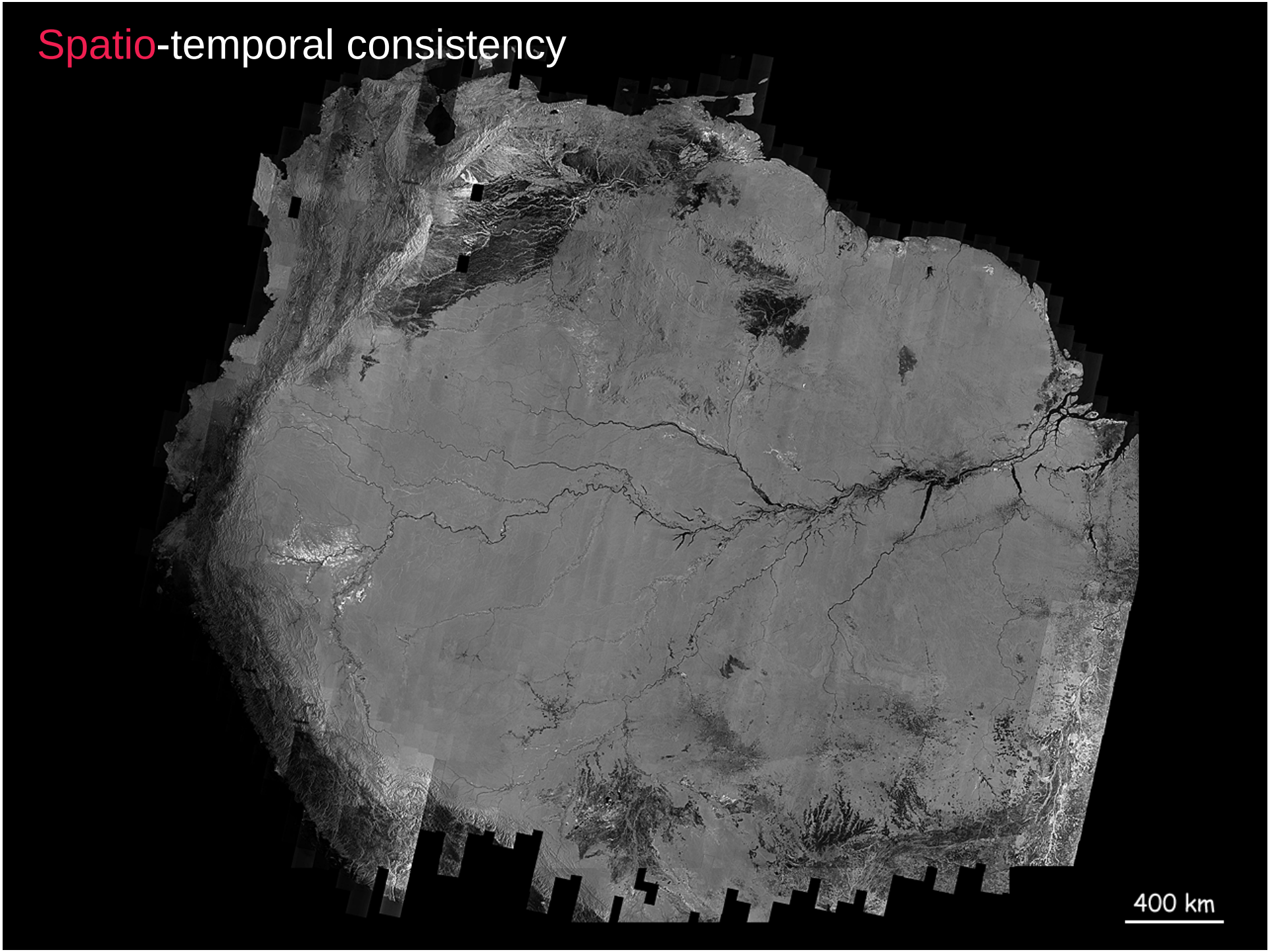


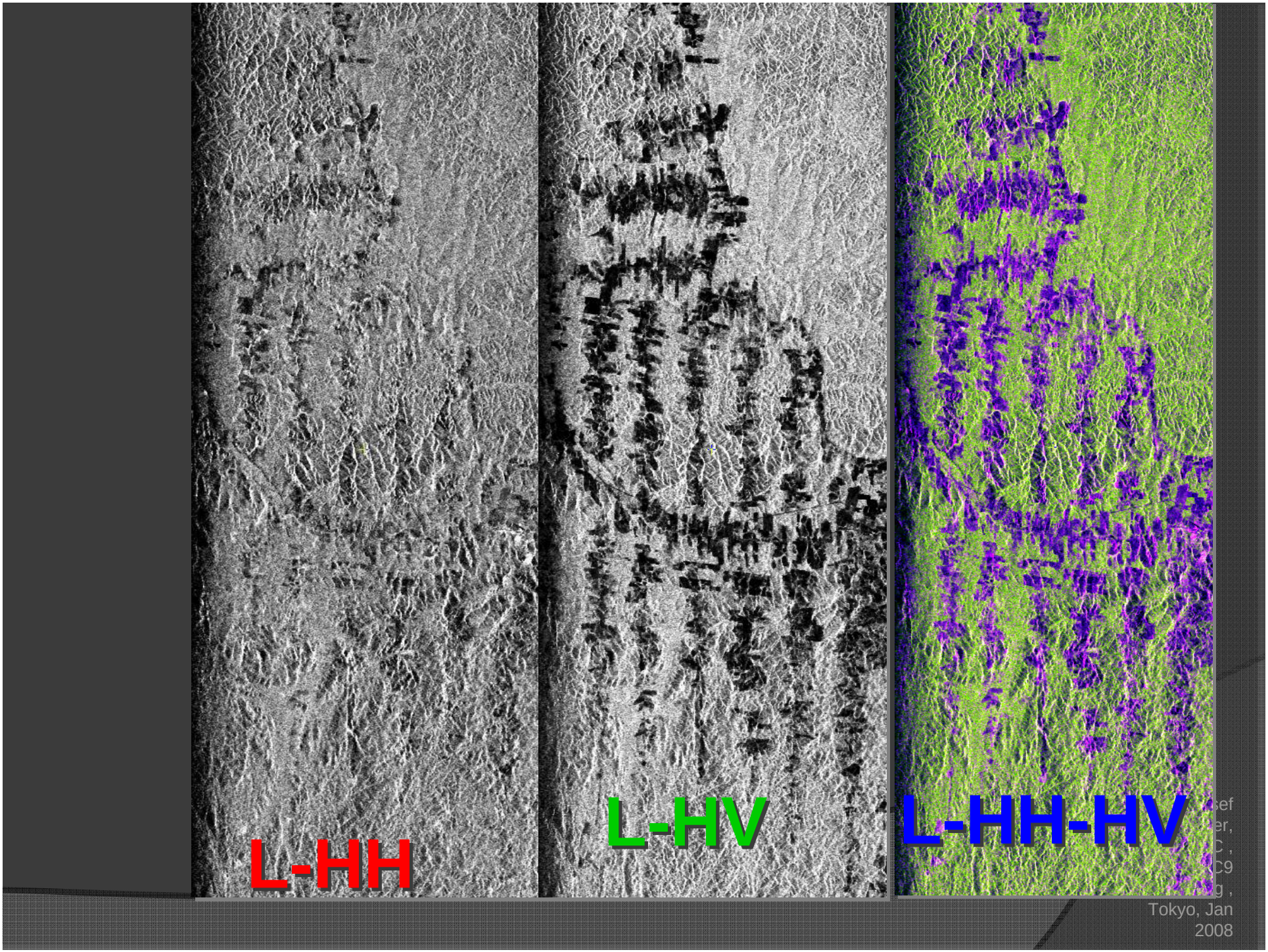
simulation

International Carbon Monitoring System

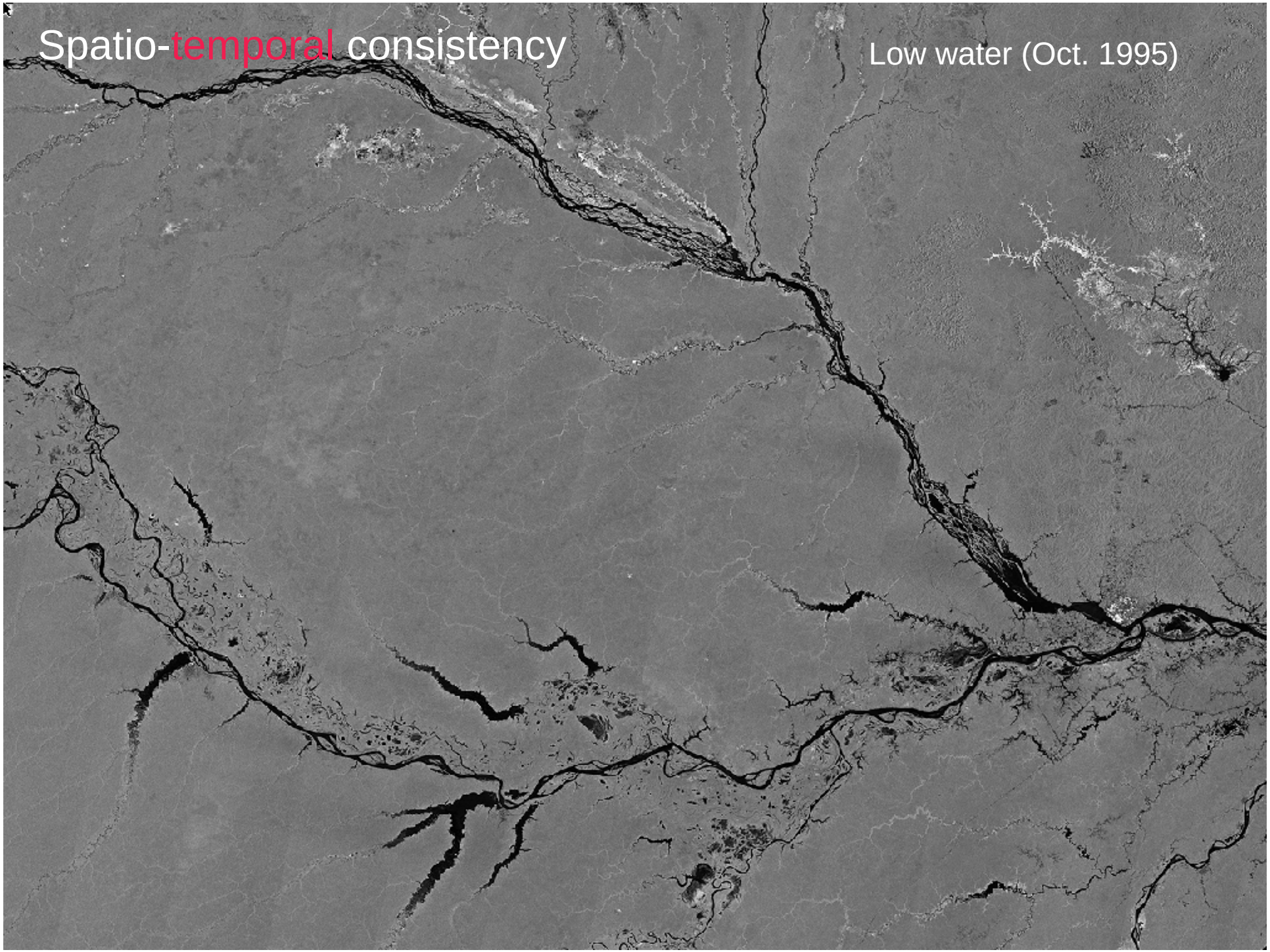
results

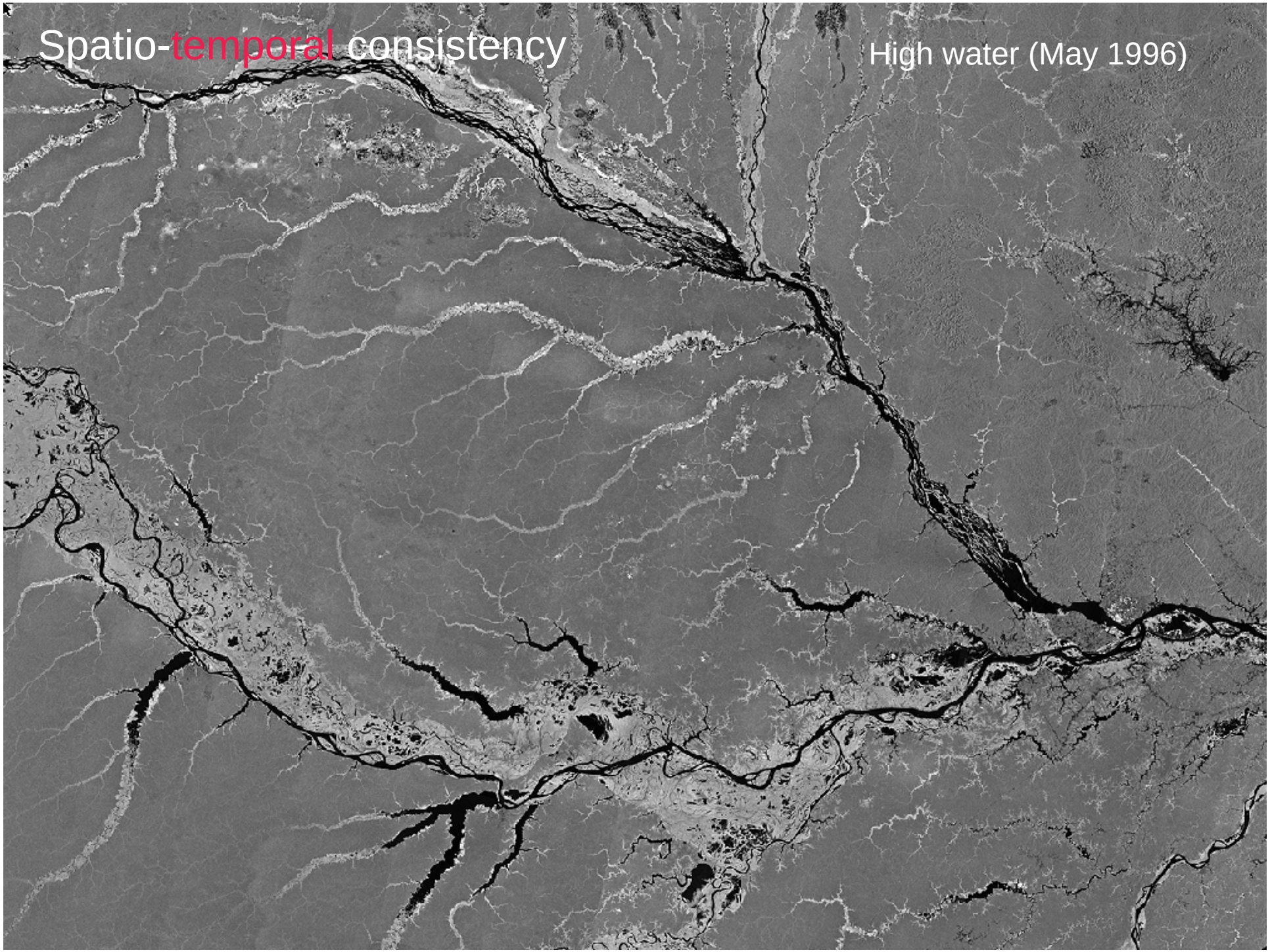
Spatio-temporal consistency

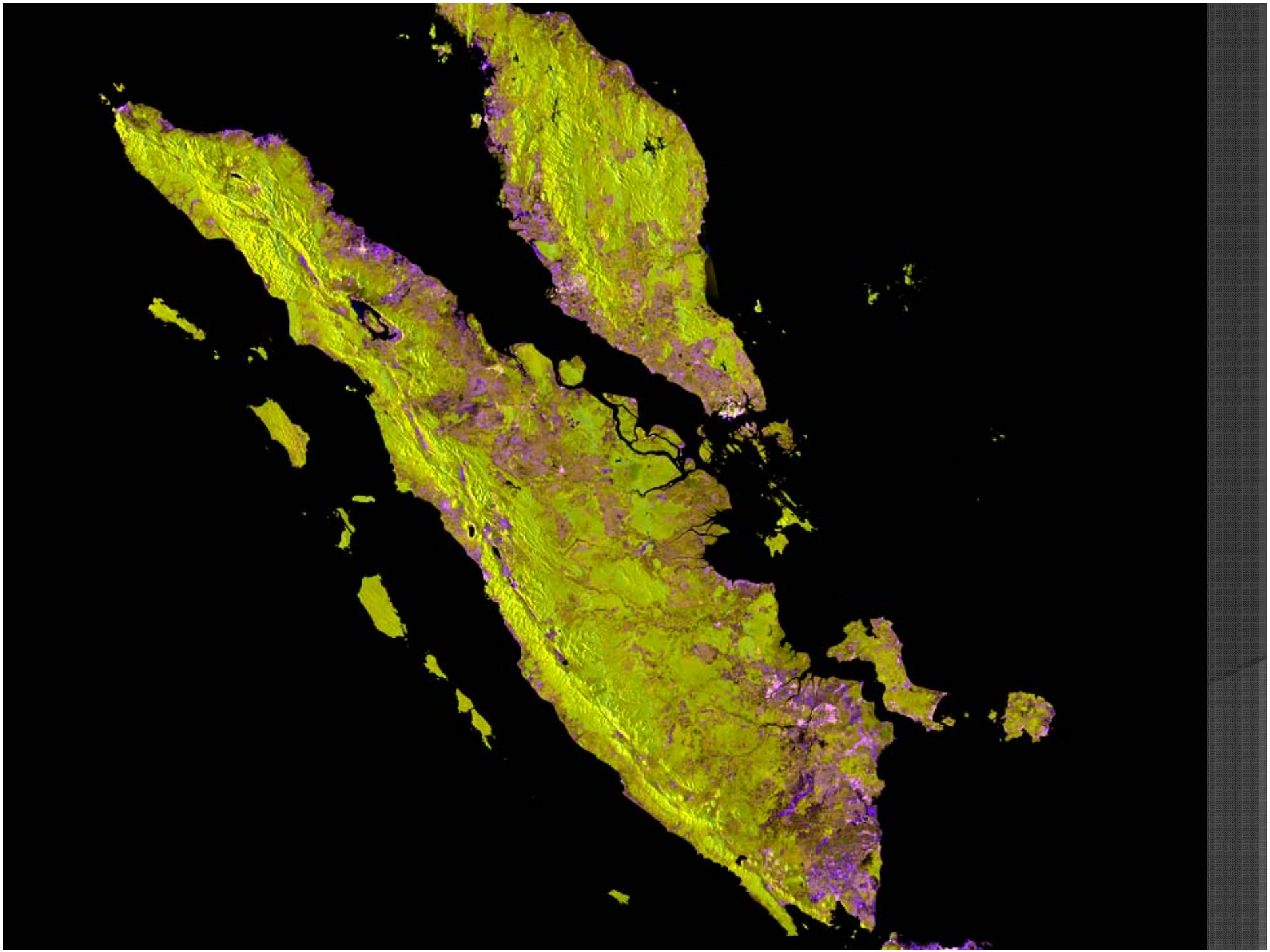




Tokyo, Jan
2008


Spatio-temporal consistency
Low water (Oct. 1995)

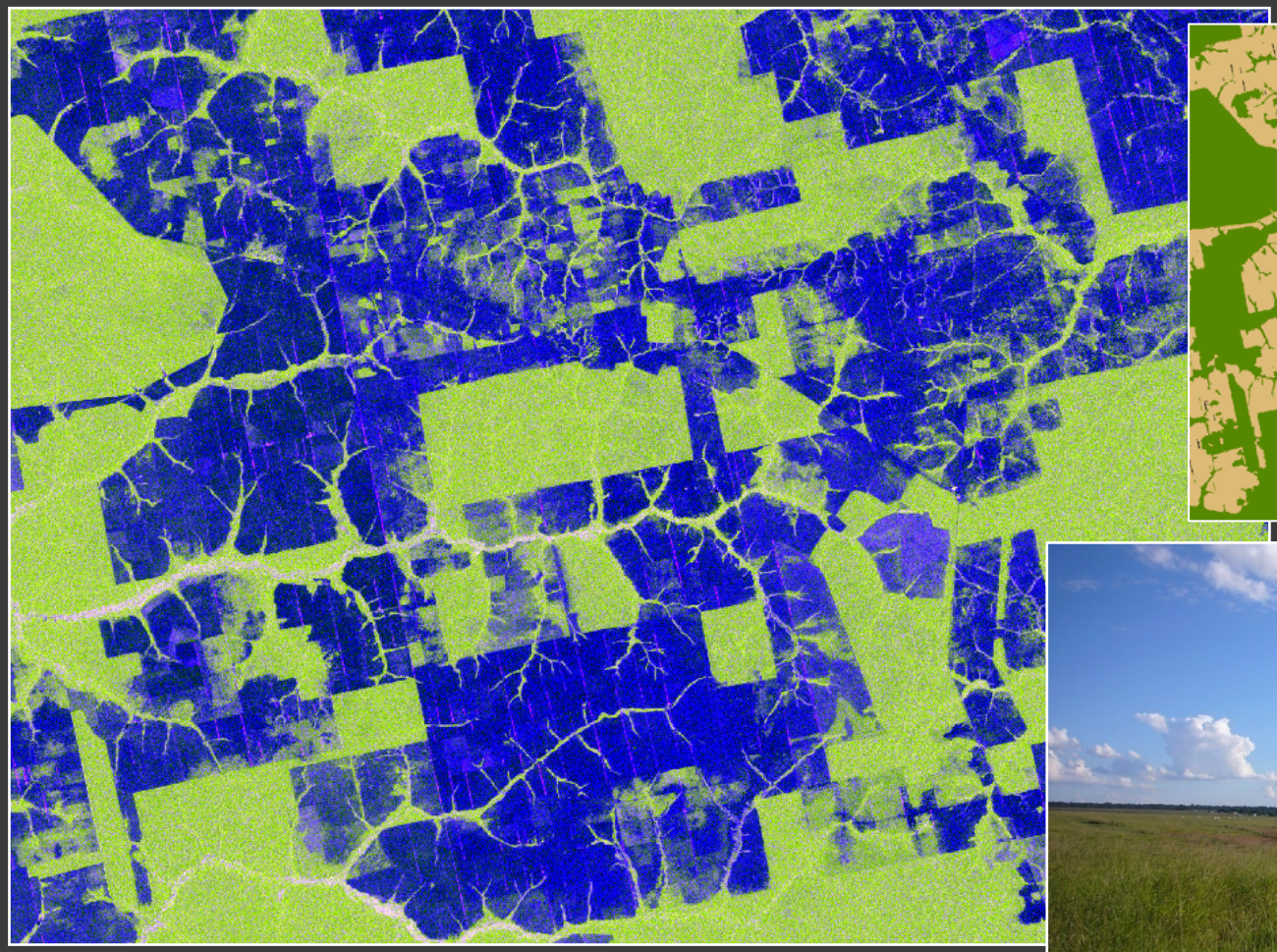

Spatio-temporal consistency
High water (May 1996)

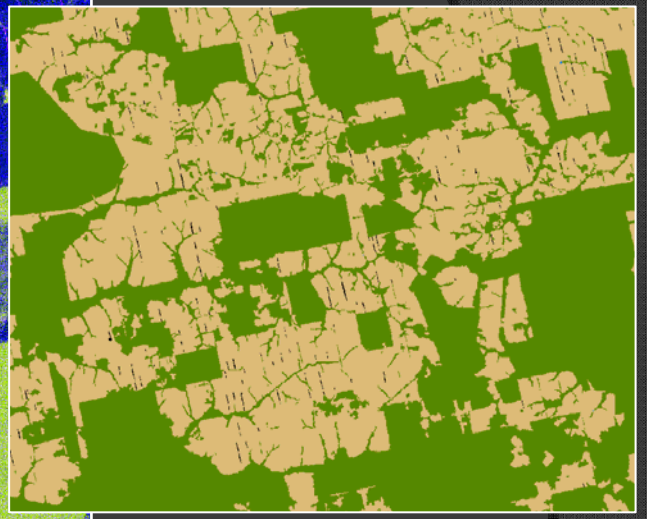


Change Detection ALOS-JERS

- Can Japanese SAR sensors ALOS (2006~) and JERS (1992~1998) historical data be used jointly to establish decadal deforestation rates?
- What types of changes are detected? What types are not detected?
- Forest, Grassland, Agricultural land, and Wetland

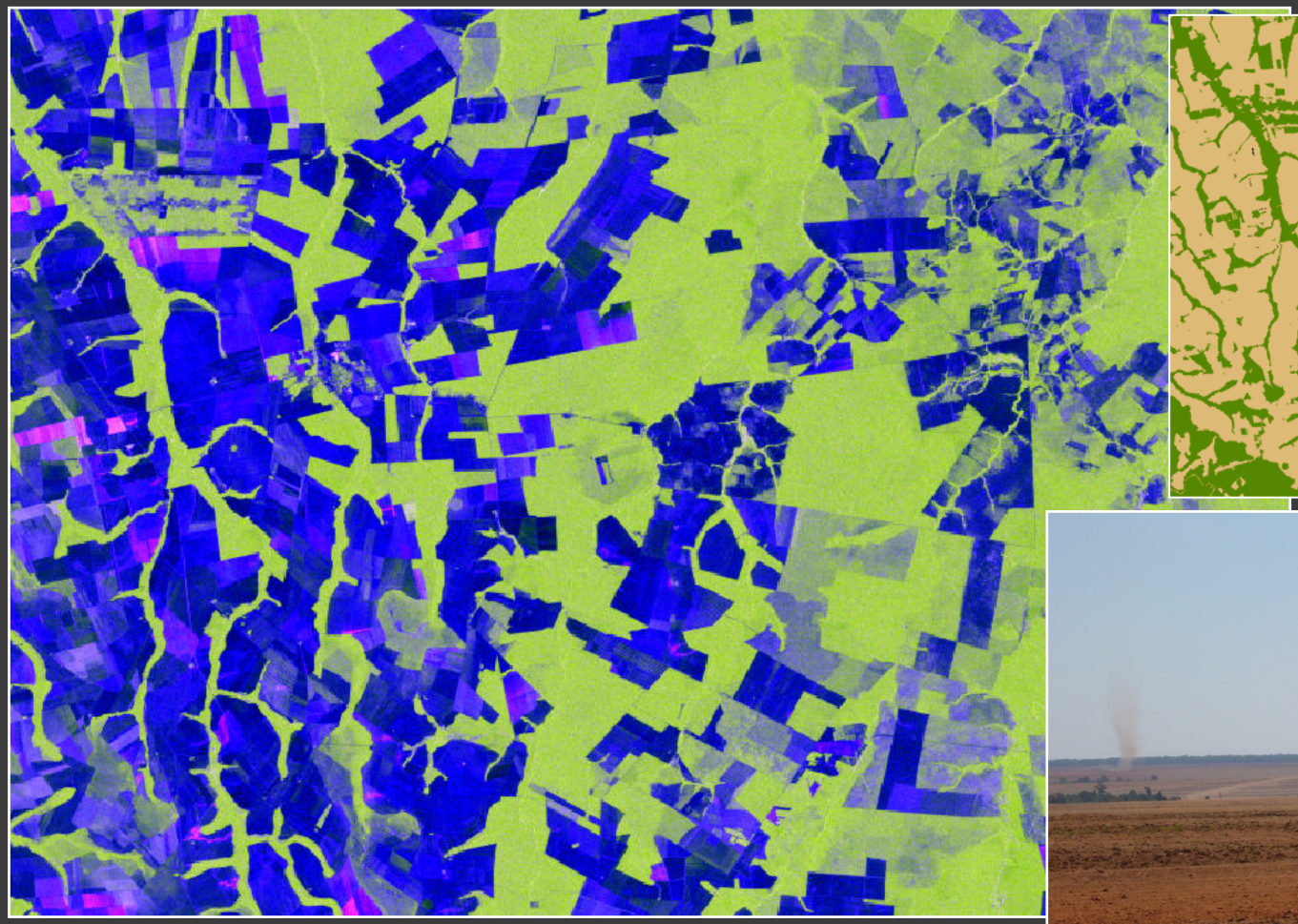
Large-Holder Pasture Expansion as seen by ALOS/PALSAR





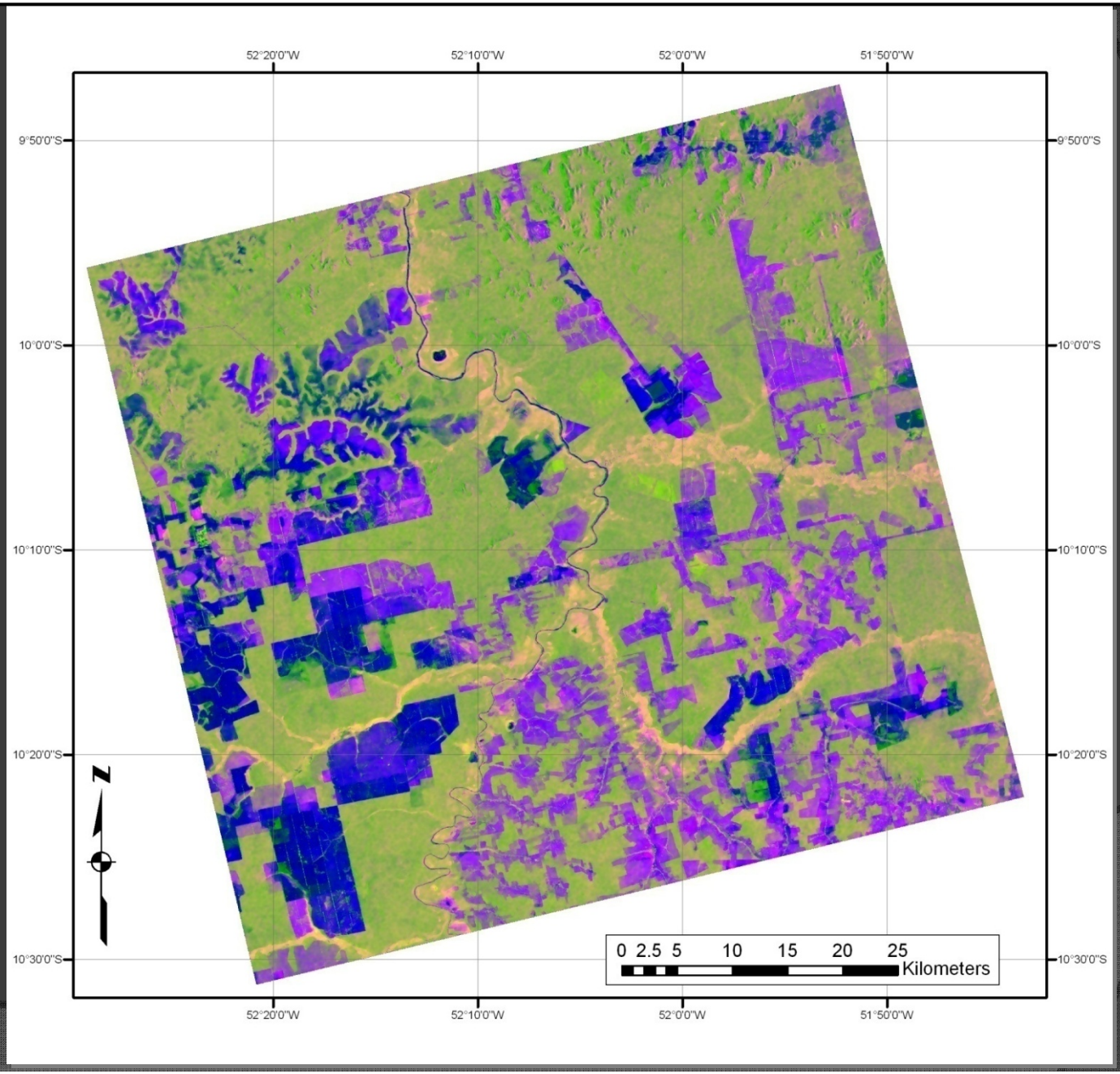
2008

Large-Holder Soy-Field Expansion as seen by ALOS/PALSAR

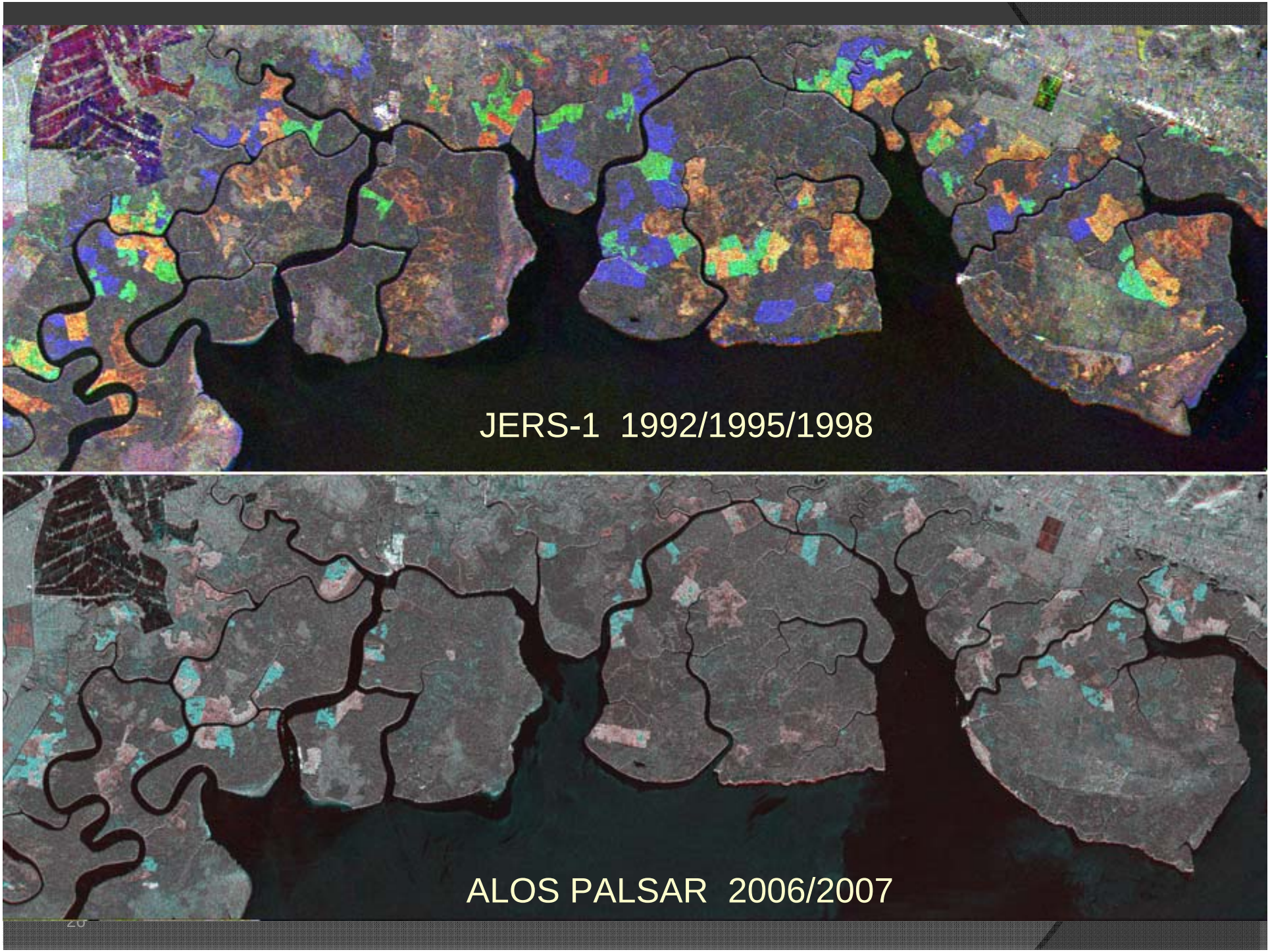


Tokyo, Jan 2008

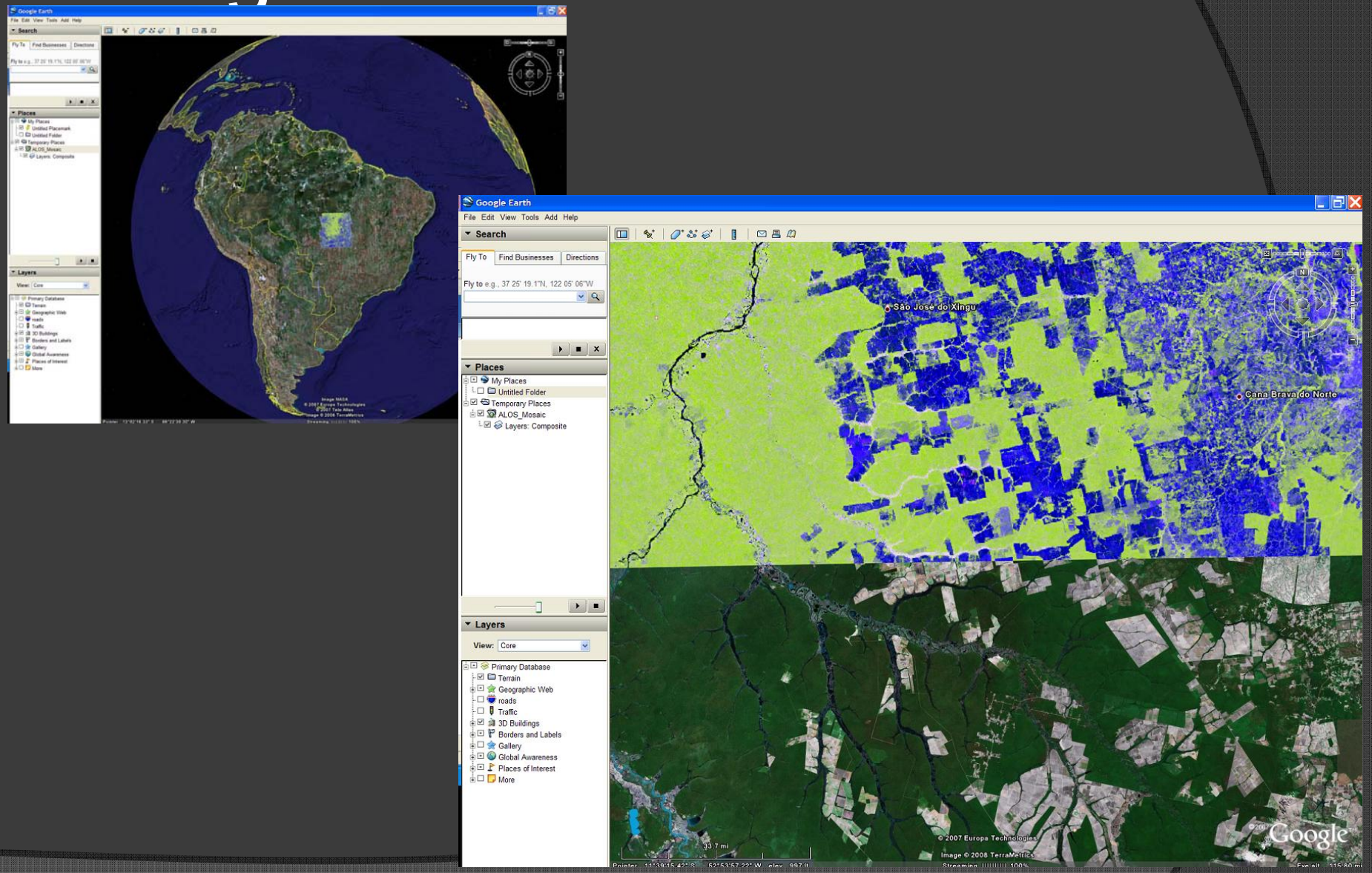
Color Composite Image (R-G-B = JERS-ALOS-Difference)

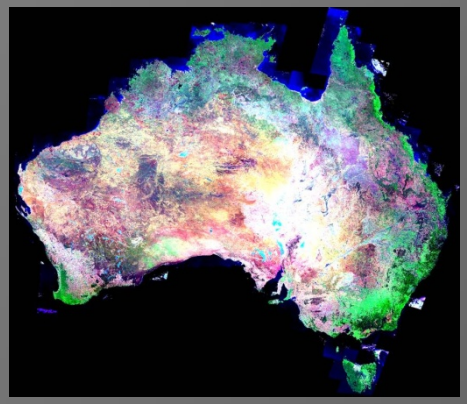


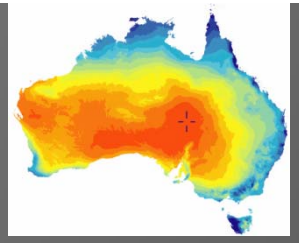
Josef Kellndorfer, WHRC , K&C9 Meeting , Tokyo, Jan 2008

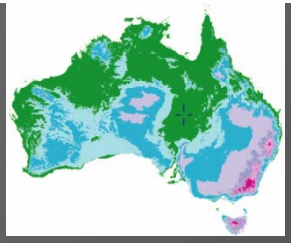

JERS-1 1992/1995/1998
ALOS PALSAR 2006/2007

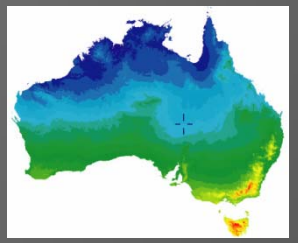
Google Earth will

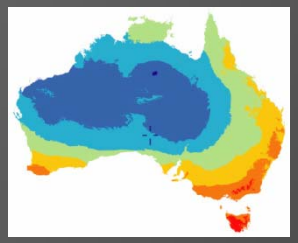


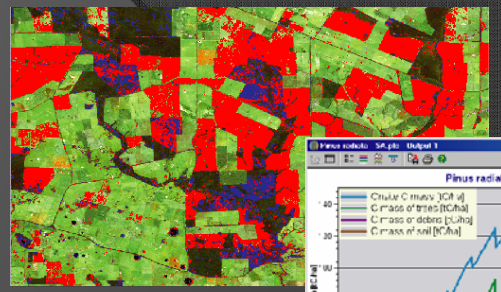


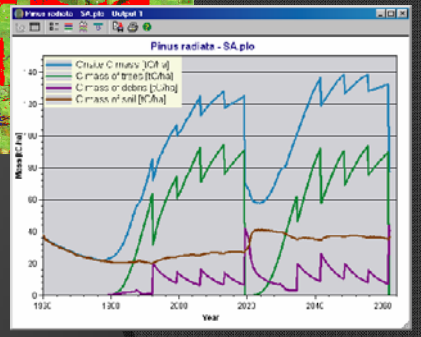












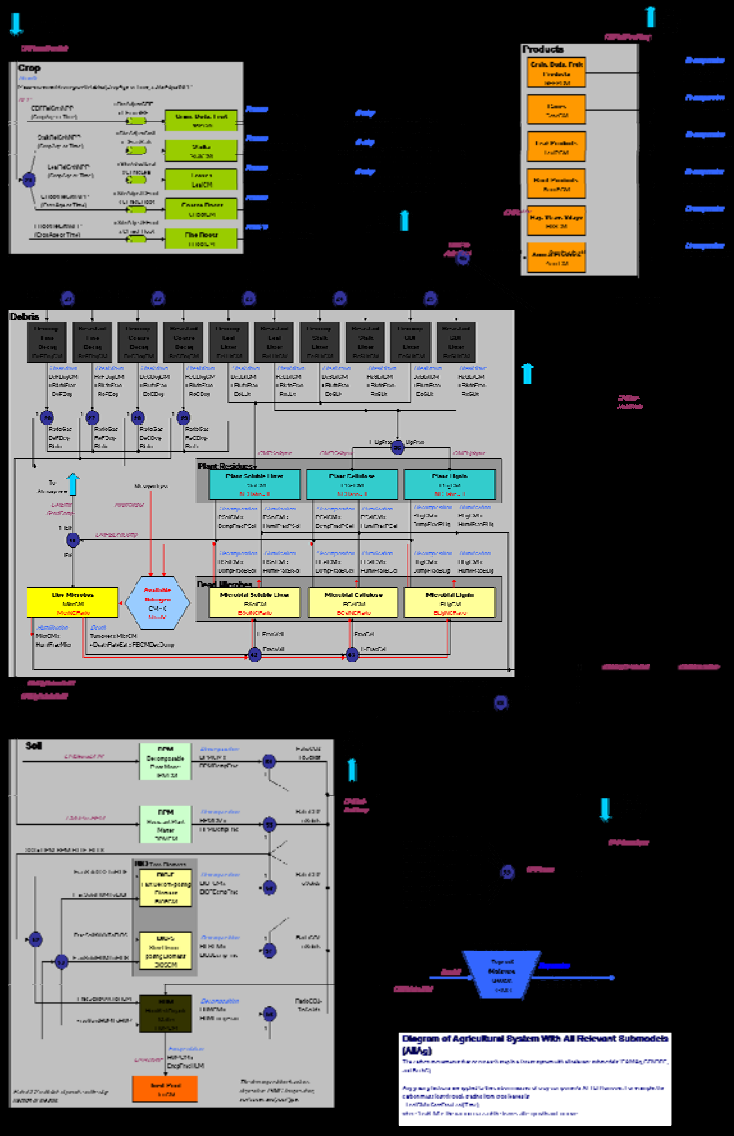
AUSTRALIA'S NATIONAL CARBON ACCOUNTING SYSTEM

Australian Government

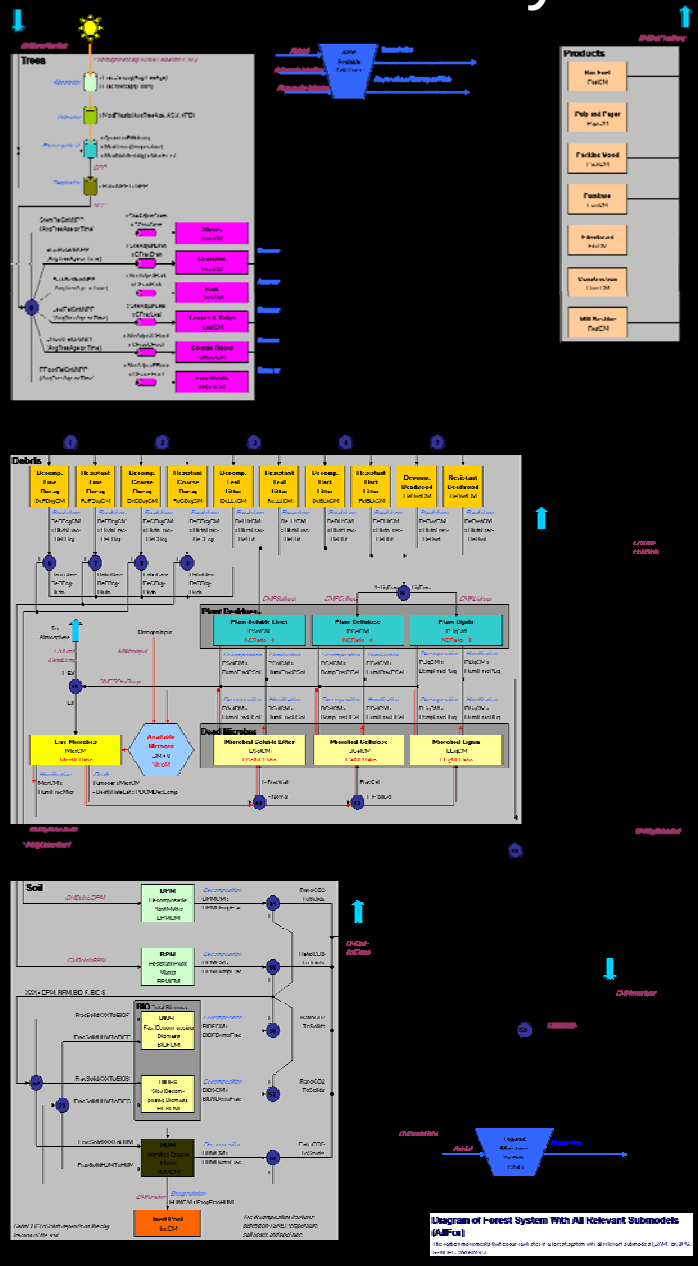
Department of the Environment and Water Resources

ncas
national carbon accounting system

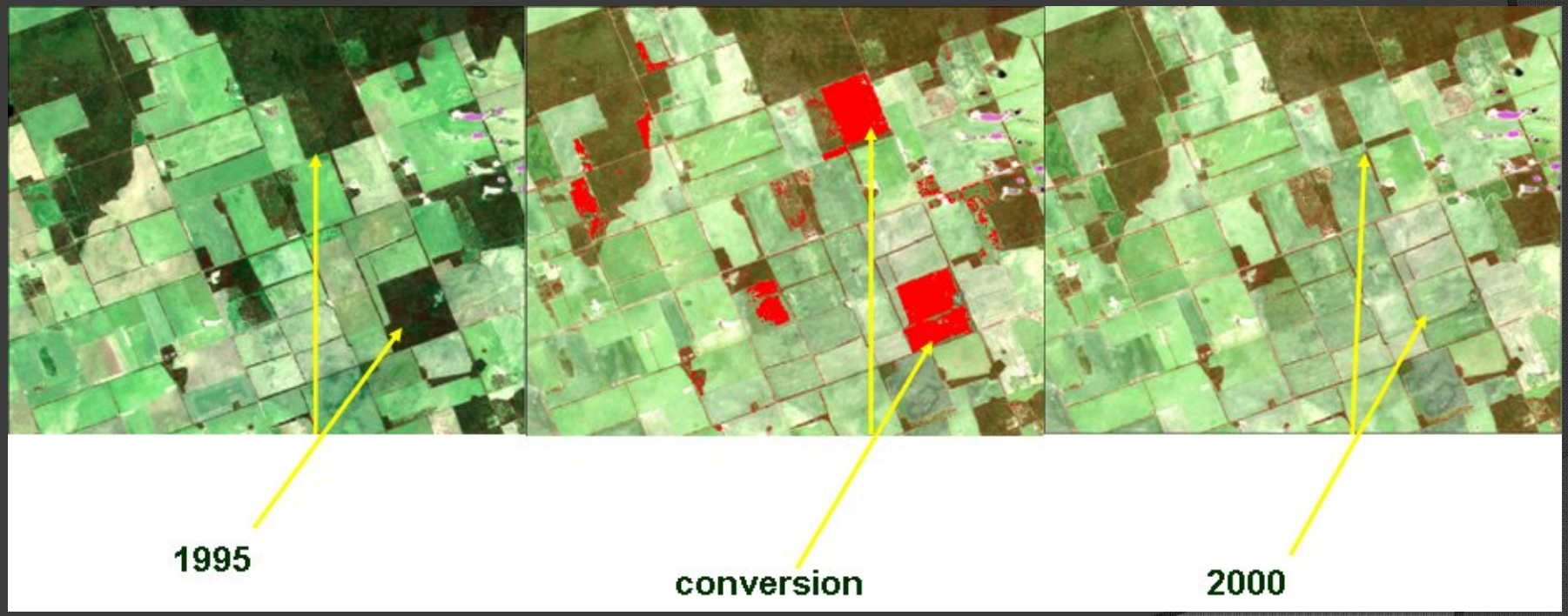
Agriculture



Forestry



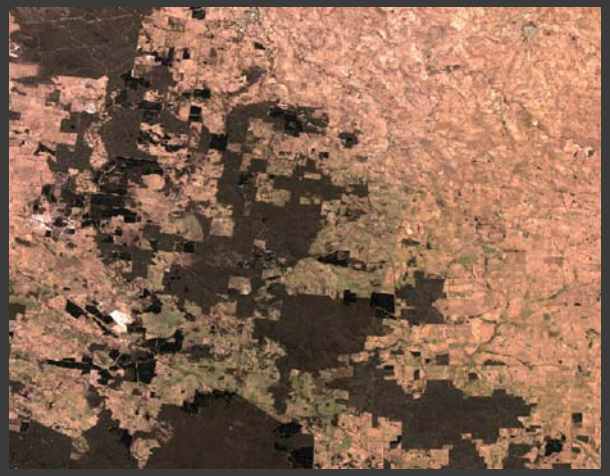
Deforestation



Annual national updates – most recent 2005

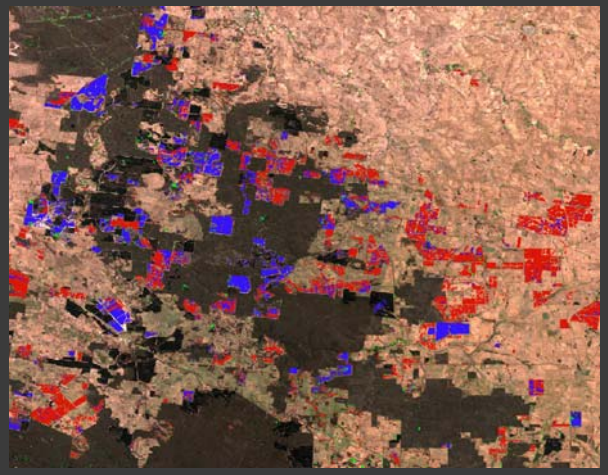
Reforestation

1989

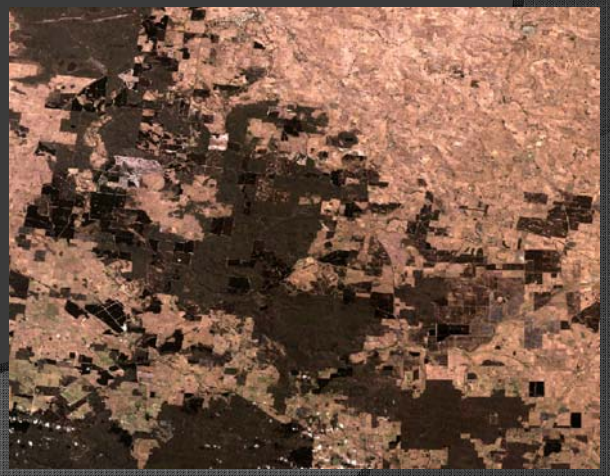


3 forest types; conifer, hardwood, other ‘native’

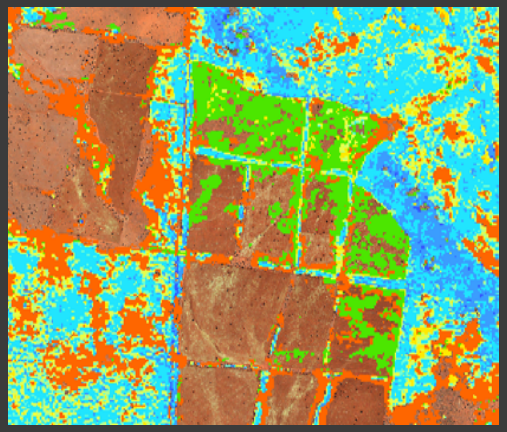
Establishment

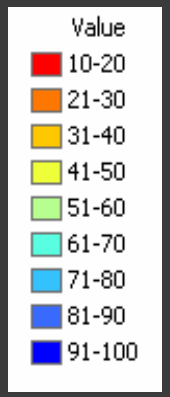


2004

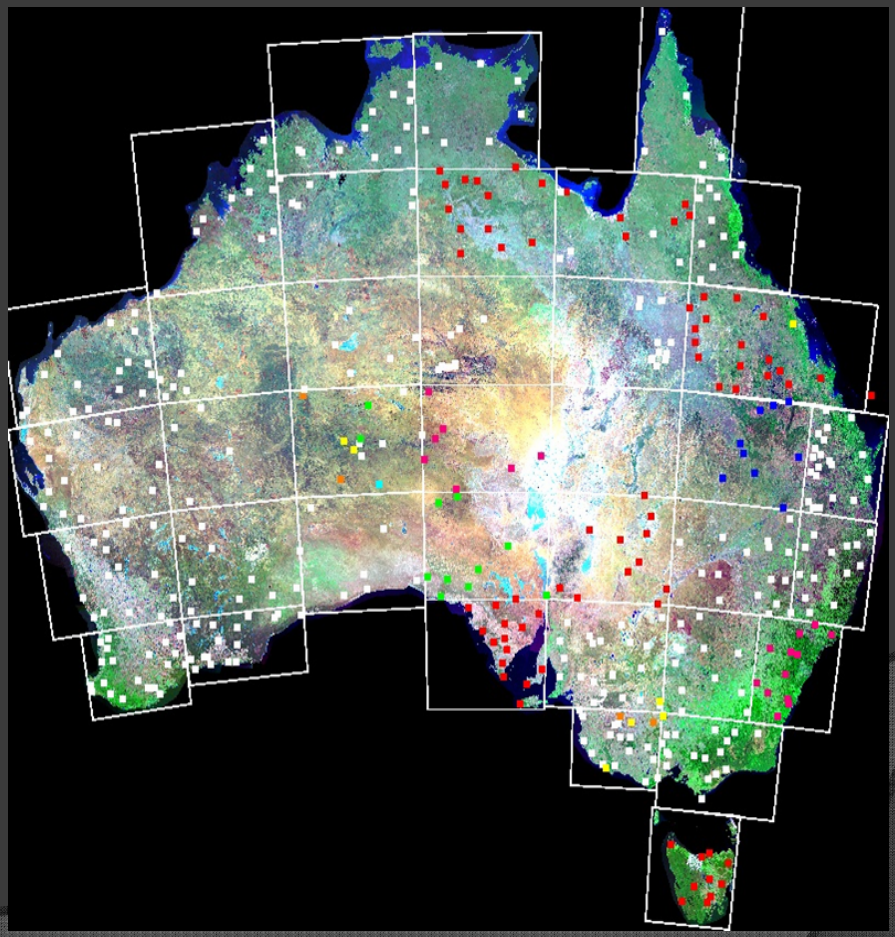


Remote Sensing - Verification



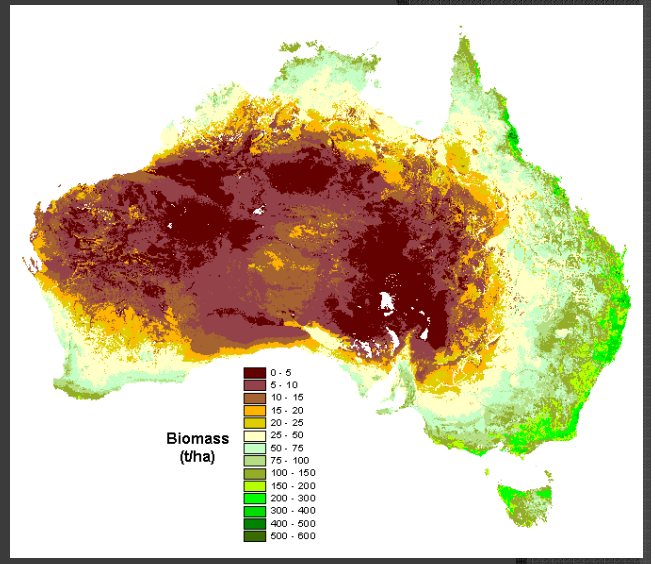


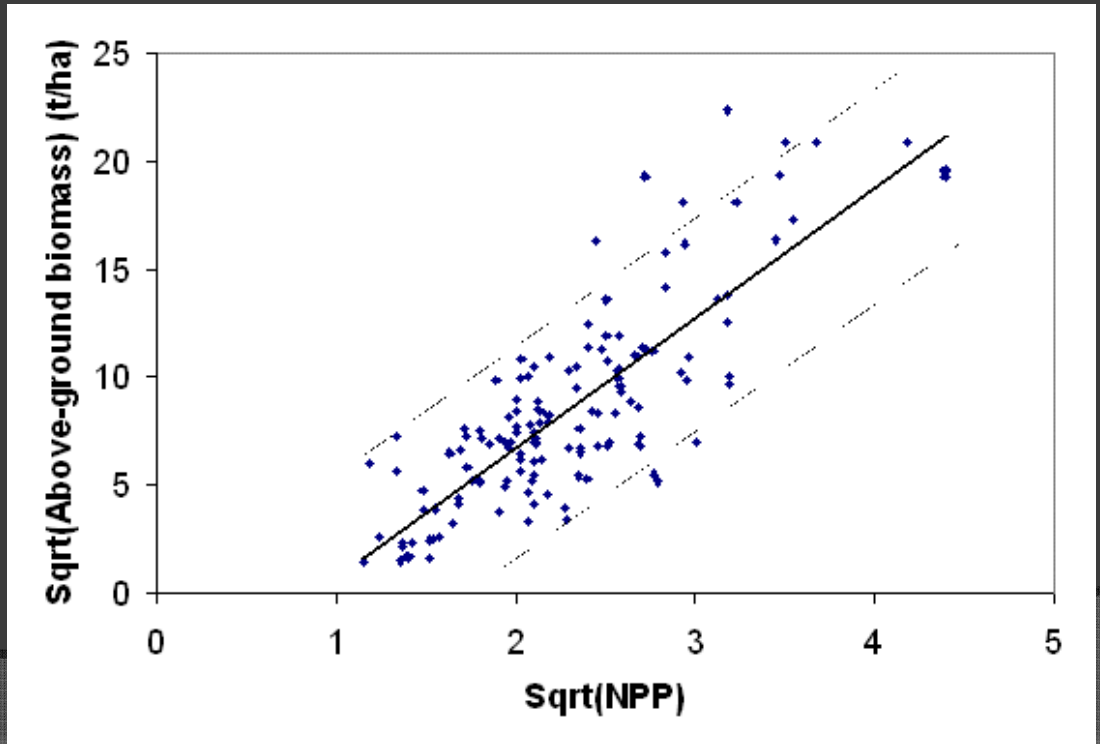
Recent clearing

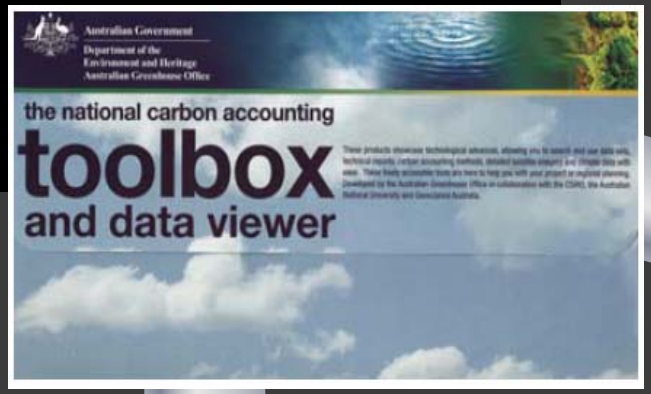


NCAS - biomass

- **Allows estimates of total biomass with relatively few ground plot samples**
- **Spatial regression techniques enable the estimation of the point value and probable range of likely biomass on any specific pixel.**



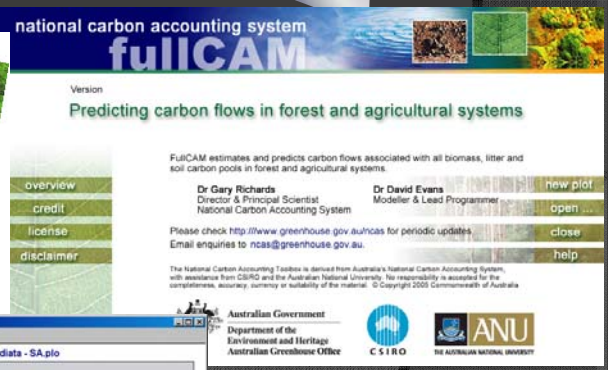


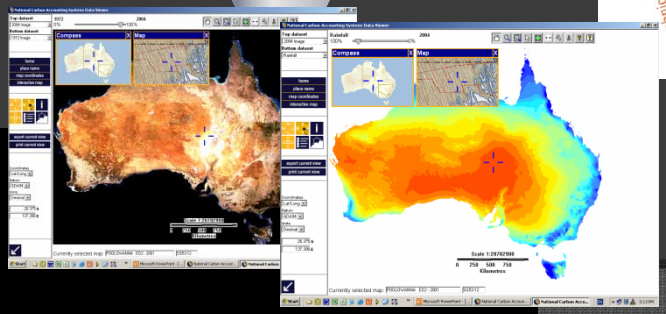

Australian Government
Department of the Environment and Heritage
Australian Greenhouse Office
the national carbon accounting
toolbox
and data viewer

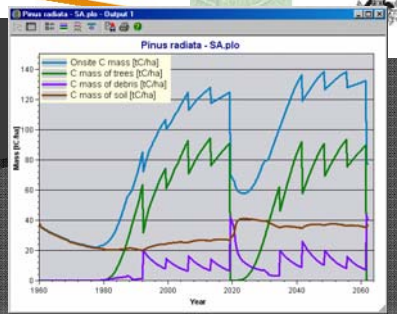
national carbon accounting
toolbox
Providing tools to enhance sustainable land management

National Carbon Accounting System Data Viewer
national carbon accounting system
data viewer
Records of Australia's landscape, vegetation & climate
start viewer
user guide
quick help
disclaimer
Australian Government
Department of the Environment and Heritage
Australian Greenhouse Office
CSIRO

technical report no. 5a
technical report no. 5b
technical report no. 17
technical report no. 25


national carbon accounting system
fullCAM
Predicting carbon flows in forest and agricultural systems
overview
credit
license
disclaimer
new plot
open ...
close
help
Australian Government
Department of the Environment and Heritage
Australian Greenhouse Office
CSIRO
ANU




Pinus radiata - SA.plo
Onsite C mass [tC/ha]
C mass of trees [tC/ha]
C mass of debris [tC/ha]
C mass of soil [tC/ha]
Year