

# **Regional Scale Forest Mapping with Medium Resolution Satellite Data**

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# Russia's Forests

## Dominating Forest Types and Their Canopy Density



### LEGEND

	Forest tree type	Canopy density (%)	Canopy density (%)
<b>Spruce-Fir Forest</b> Spruce, fir and larch are pine dominants, often with presence of birch, aspen, pine and larch. Other treeless deciduous species and flower pine are present along the southern border of European Russia and in the south of the Russian Far East.		10-30%	40-50%
<b>Pine Forest</b> Softwood pine dominants, usually with presence of spruce, birch and aspen and/or larch at the southern border edge.			
<b>Larch Forest</b> Larch of different species dominants, often with presence of birch and aspen. Other treeless deciduous species, birch and larch may be present along the southern and western borders of Russia. In the mountains of the Russian Far East larch species often have undergrowth of mountain pine.			
<b>Broadleaved Deciduous Forest</b> Broadleaved deciduous species dominants (oak, elm, ash, maple, alder) and in southern European Russia also birch, chestnut and hornbeam. In mountainous areas (Caucasus, Southern Ural, Siberia-Ural) with high larch presence of conifers such as spruce, fir and flower pine.			
<b>Stone Birch Forest</b> Stone birch dominants, often with presence of larch, larch or patches of larch. In mountainous forest the undergrowth of spruce is present, and in the mountains of Far East and Sakhalin with presence of spruce and fir.			
<b>Dauric Pine Forest</b> Dauric pine dominants in patches or shrubby forest, often with a sparse aspen shrubby larch or stone birch.			
<b>Birch-Aspen and Mixed Forest</b> Birch, aspen and grey alder dominants, with presence of coniferous trees or patches of moss. In most cases, this forest follows logging, clearing or forest fire.			
<b>Areas of Forests of Forest</b> Agricultural and other non-forest occupations in which stands and soils are suitable for forest growth.			

Barilovskiy A., Entov D.V., Izrael A.S., Pribitov P.V., Tukanov S.A., Vorobeyko A.V.  
**Russia's Forests**  
Dominating Forest Types and Their Canopy Density  
Scale: 1:14,000,000  
Moscow, 2004

Forests are defined as areas with at least 10% tree cover, according to the Global Forest Tree Cover map (Reference 2). Areas with 10% to 30% are considered open canopy forests, while closed canopy forests have greater than 40% tree cover. Dominating species and species groups are shown according to the map of the forests of the USSR (Reference 3), published in 1980, except for those places where a comparison with the best cover map of Northern Eurasia (Reference 1), published in 2003, indicates that the species composition has changed. Areas where deciduous or mixed forest has replaced coniferous forest are categorized as "birch-aspen and mixed forest". Areas with other types of species change (rare in comparison with the previous case) are classified based on expert interpretation of the two compared maps (References 1 and 2).

Potential forest areas, consisting mainly of agricultural and other non-forest managed ecosystems, are shown according to the map "Vegetation of the USSR" (Reference 4). Boundaries of this category are uncertain and determined based on expert opinion. The map is intended for educational use.

List of names of trees, that are mentioned in legend:  
Fir - Picea sp., aspen - Populus tremula, birch - Betula sp., larch - Larix sibirica, stone birch - Betula pendula, oak - Quercus sp., maple - Acer sp., ash - Fraxinus sp., chestnut - Castanea sativa, hornbeam - Cornus alba, larch - Larix sibirica, pine - Pinus sp., maple - Acer sp., alder - Alnus sp., pine - Pinus sp., larch - Larix sibirica, spruce - Picea sp., birch - Betula sp., aspen - Populus tremula.  
Photo: D. Entov, V. Izrael, A. Vorobeyko, E. Pribitov, S. Tukanov, P. Barilovskiy.



Scale: 1:14,000,000  
Aerial projection

- References:
1. Barilovskiy A.S., Entov D.V., Izrael A.S. A New 2004 GEOSTAR (Global Forest Tree Cover) Map of Northern Eurasia - International Journal of Remote Sensing - 2005 - Vol. 26 - No. 23 - P. 1377-1382.
  2. Hansen M.C., Stehman H.V., Treubek R., Soergel K., Soergel R. A Global Forest Tree Cover at a Spatial Resolution of 500 Meters: First Results of the MODIS Vegetation Continuous Fields Algorithm (VCF) products and validation results.
  3. The Forests of the USSR Map Scale 1:20,000,000 prepared by the Department of the Forest of the USSR Ministry of Forestry and Park Affairs, Moscow, USSR, 1980.
  4. Vegetation of the USSR (Scale 1:20,000,000) and USSR, 1980.
  5. Digital chart of the world's Environmental Geographical Institute, 1980.

# Minimum set of information includes:

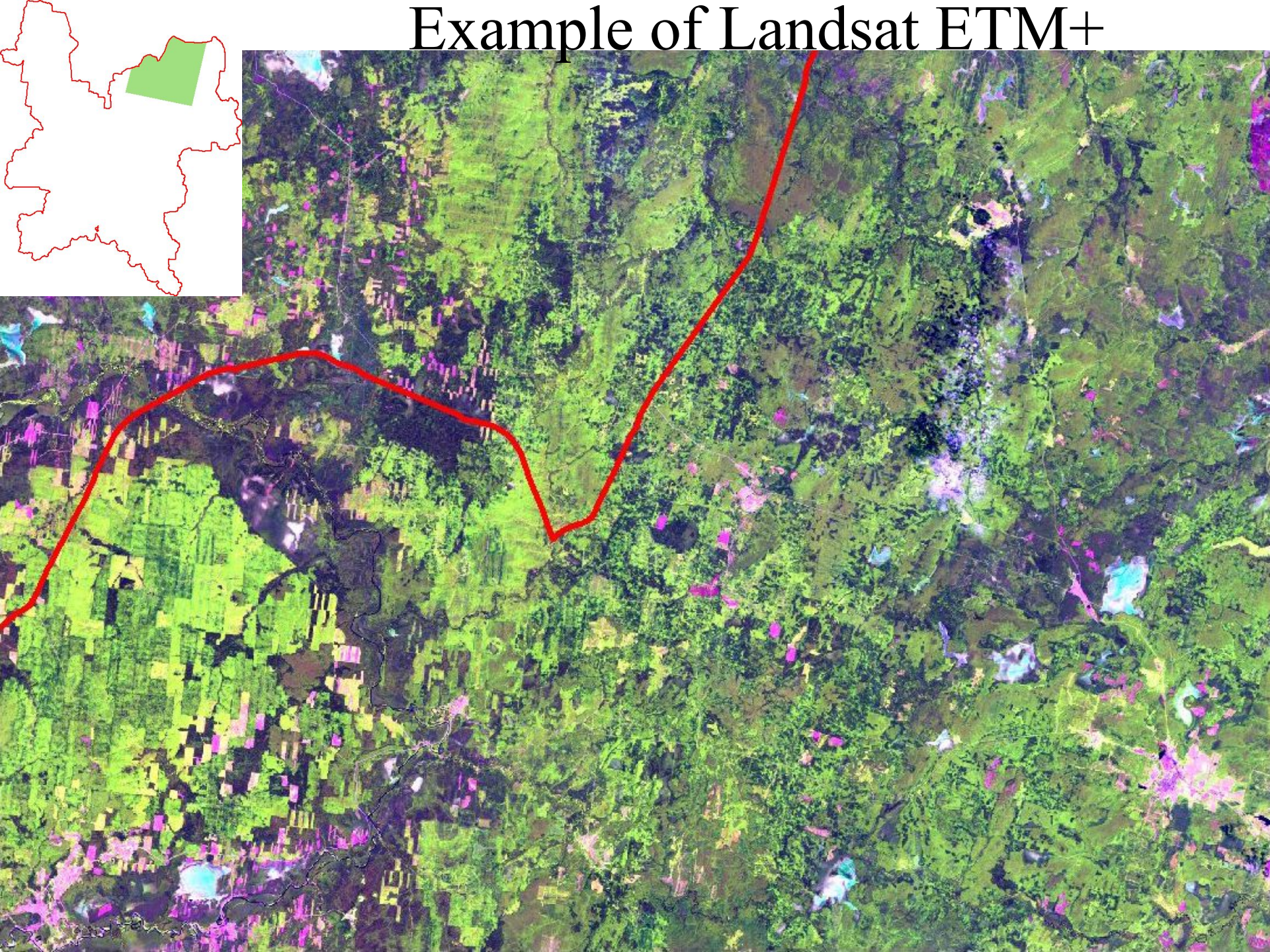
- Forest cover
- Dominant tree species
- Age of the upper canopy
- Productivity / growing stock estimation

# Options for the forest cover and tree species:

- Modis data (like UMD TreeCover) + official forest survey data (lesoustroistvo)
- Landsat TM/ETM+ classification
- IRS-P6 AWiFS classification

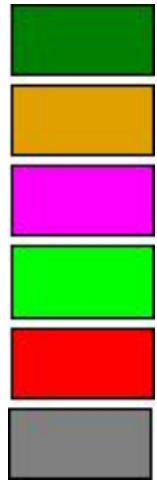


# Example of Landsat ETM+





# ...and its classification by tree species



dark coniferous (spruce, fir)

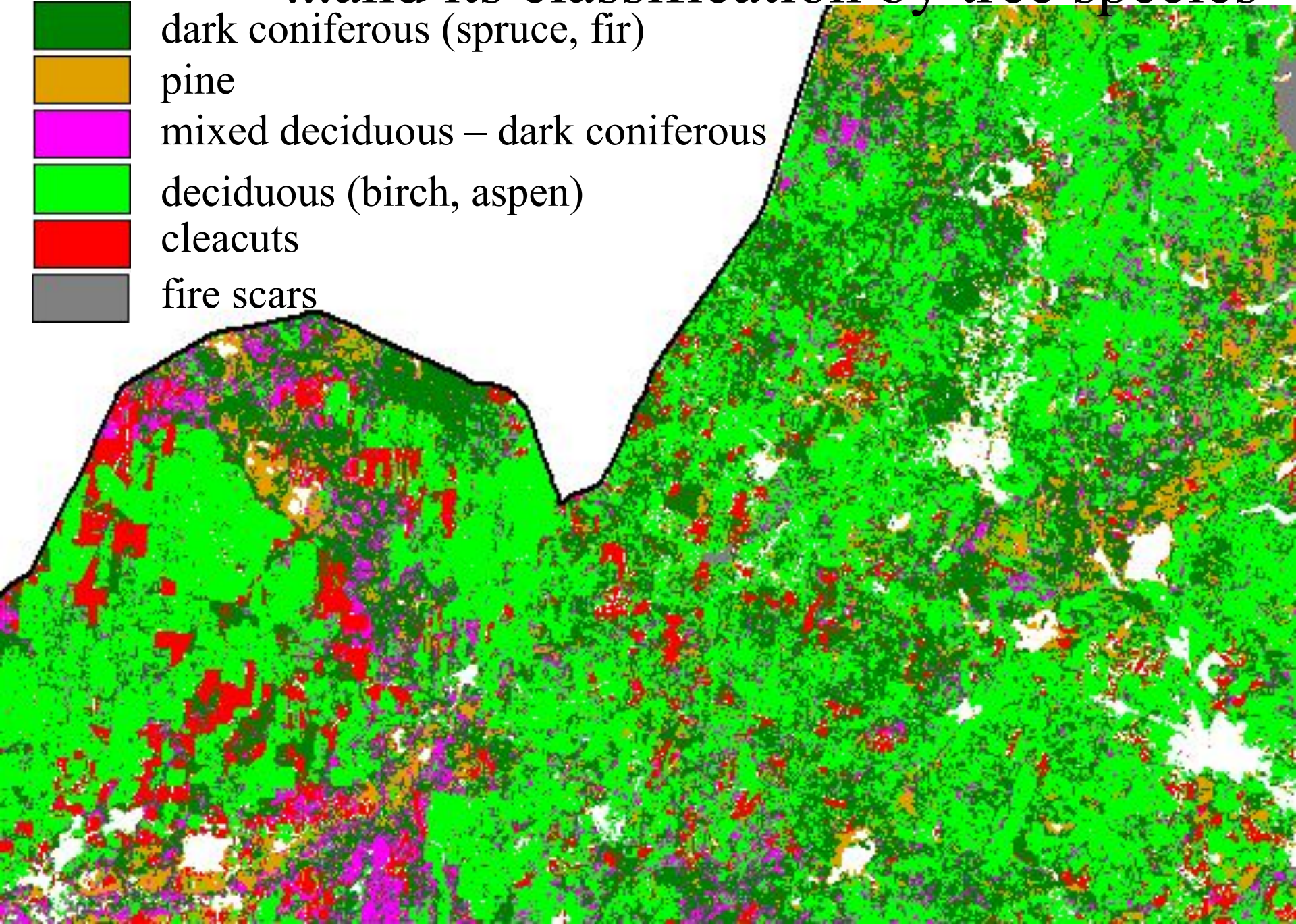
pine

mixed deciduous – dark coniferous

deciduous (birch, aspen)

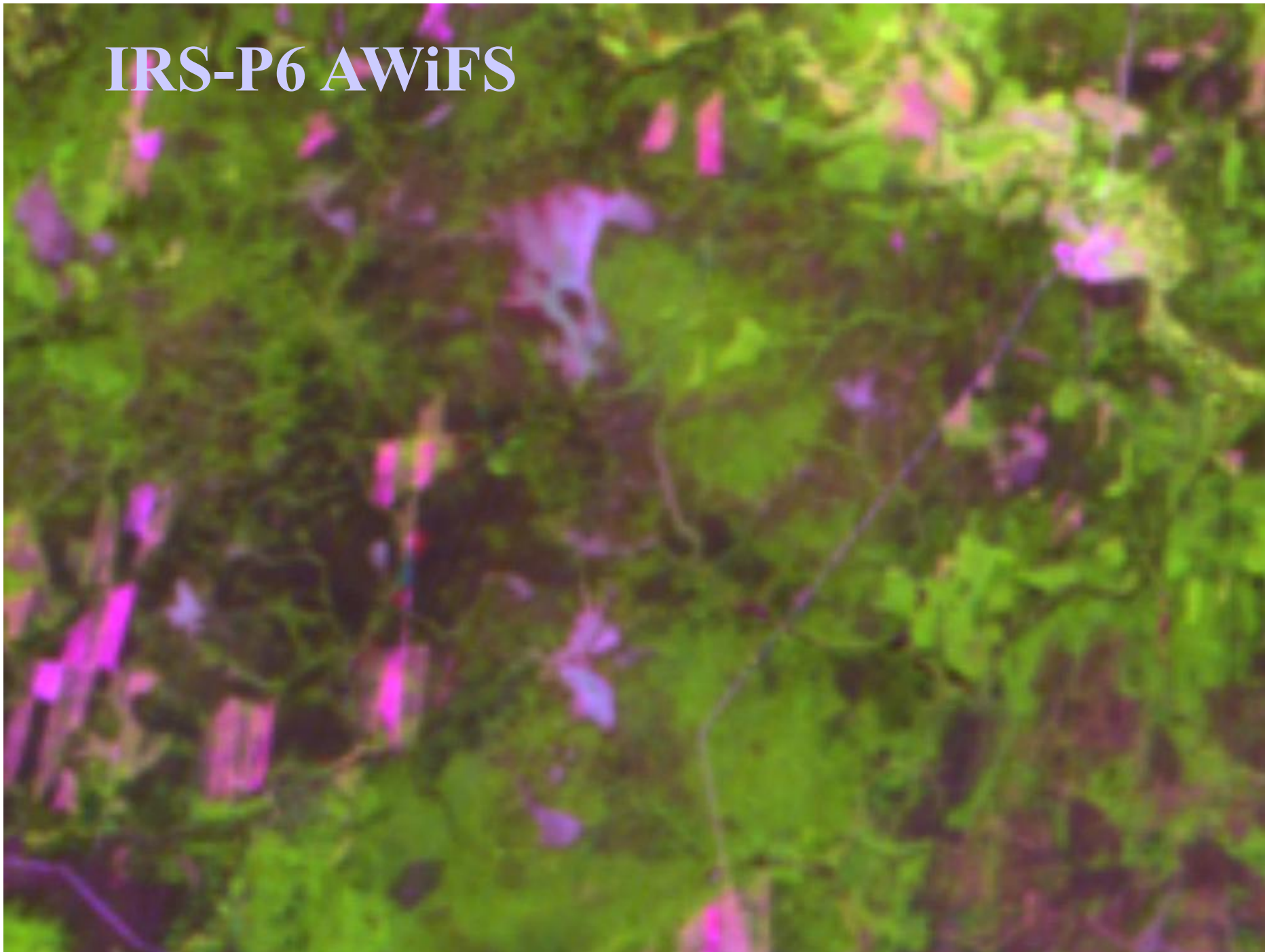
cleacuts

fire scars

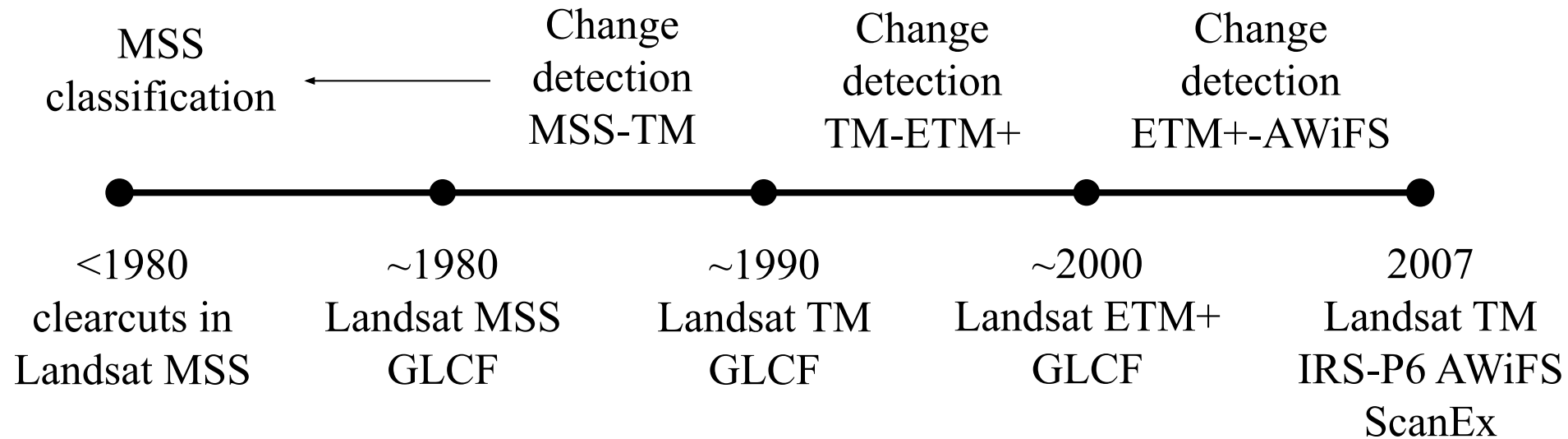




# IRS-P6 AWiFS

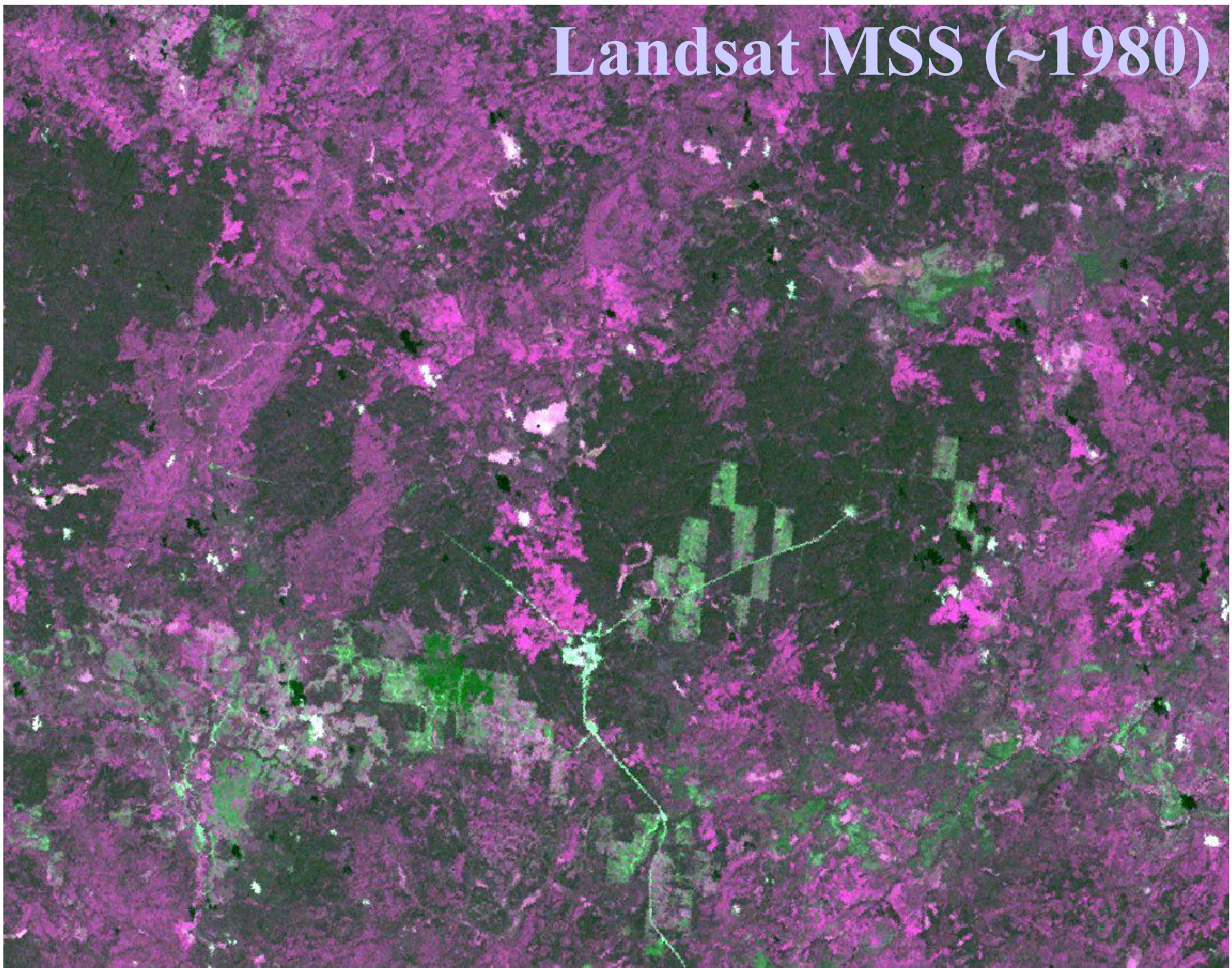


# Retrospective data allow age classification



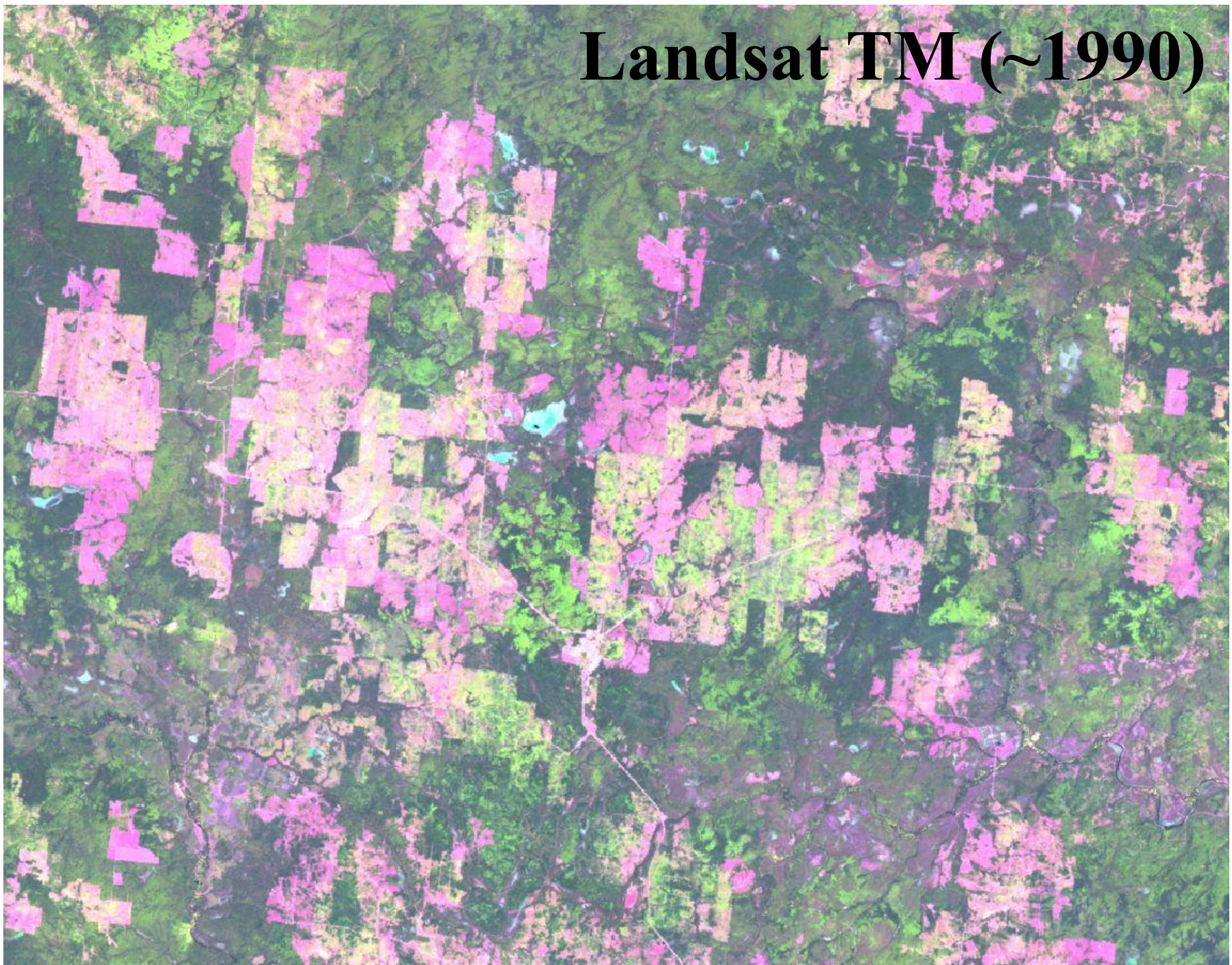


# Landsat MSS (~1980)



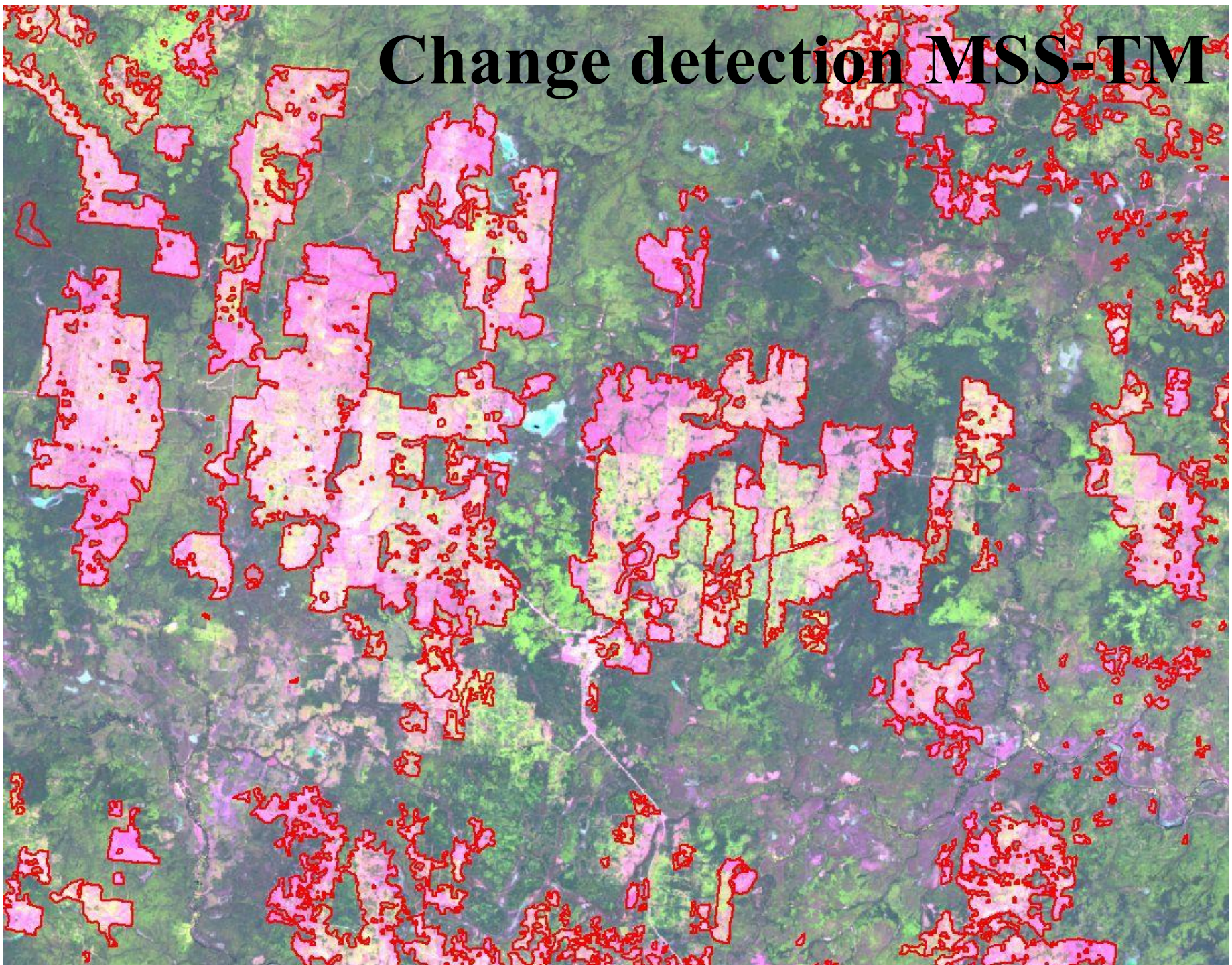


# Landsat TM (~1990)



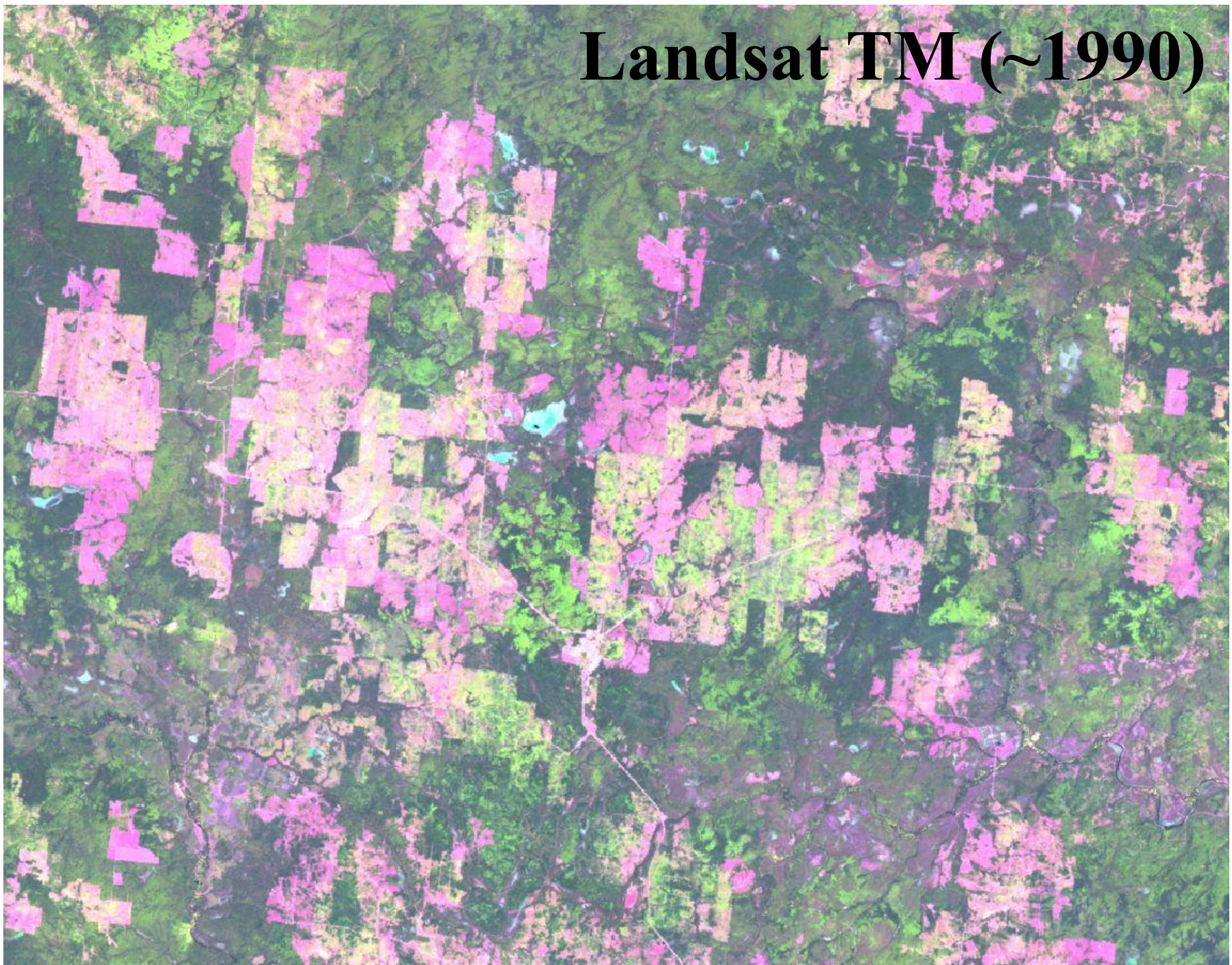


# Change detection MSS-TM



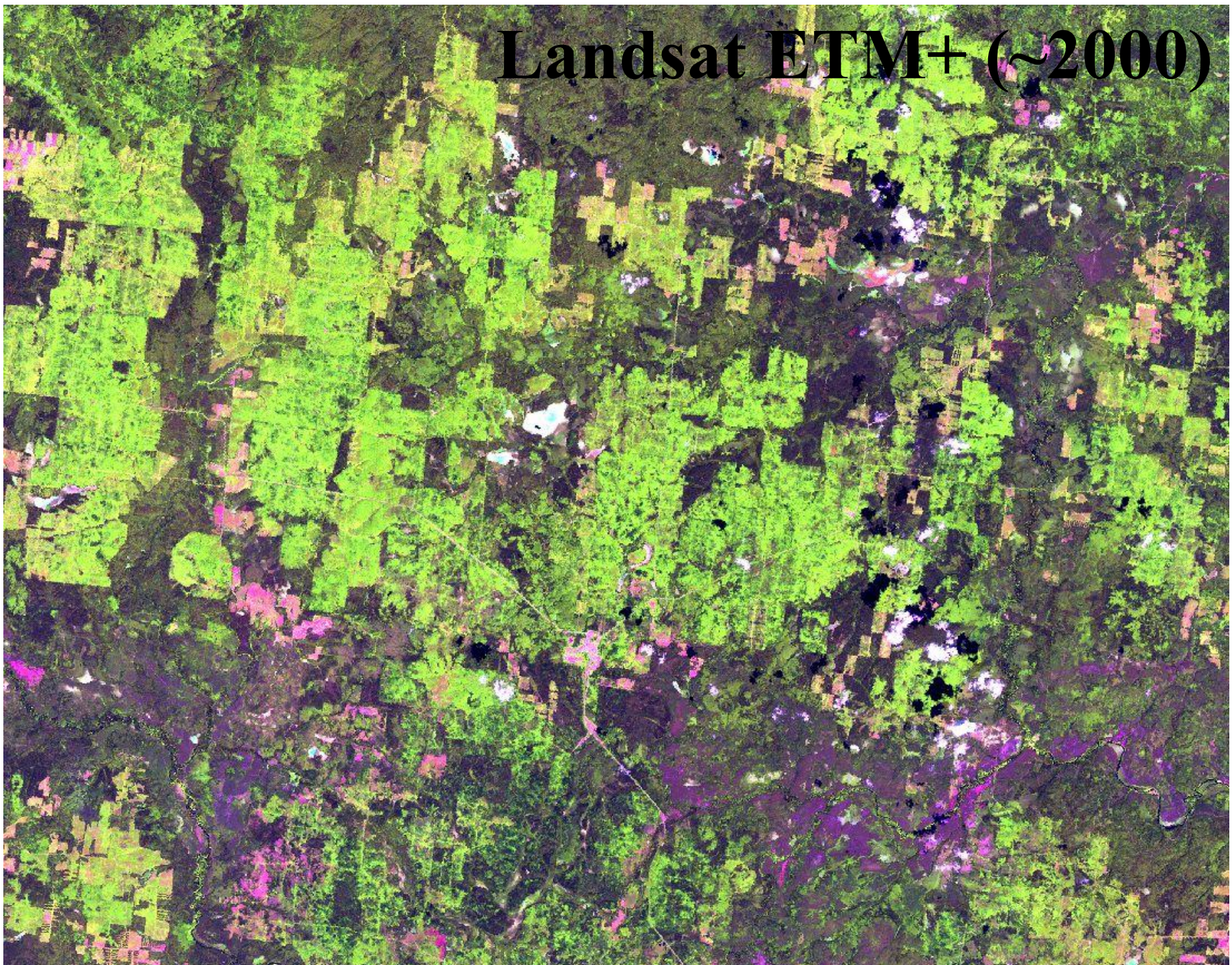


# Landsat TM (~1990)



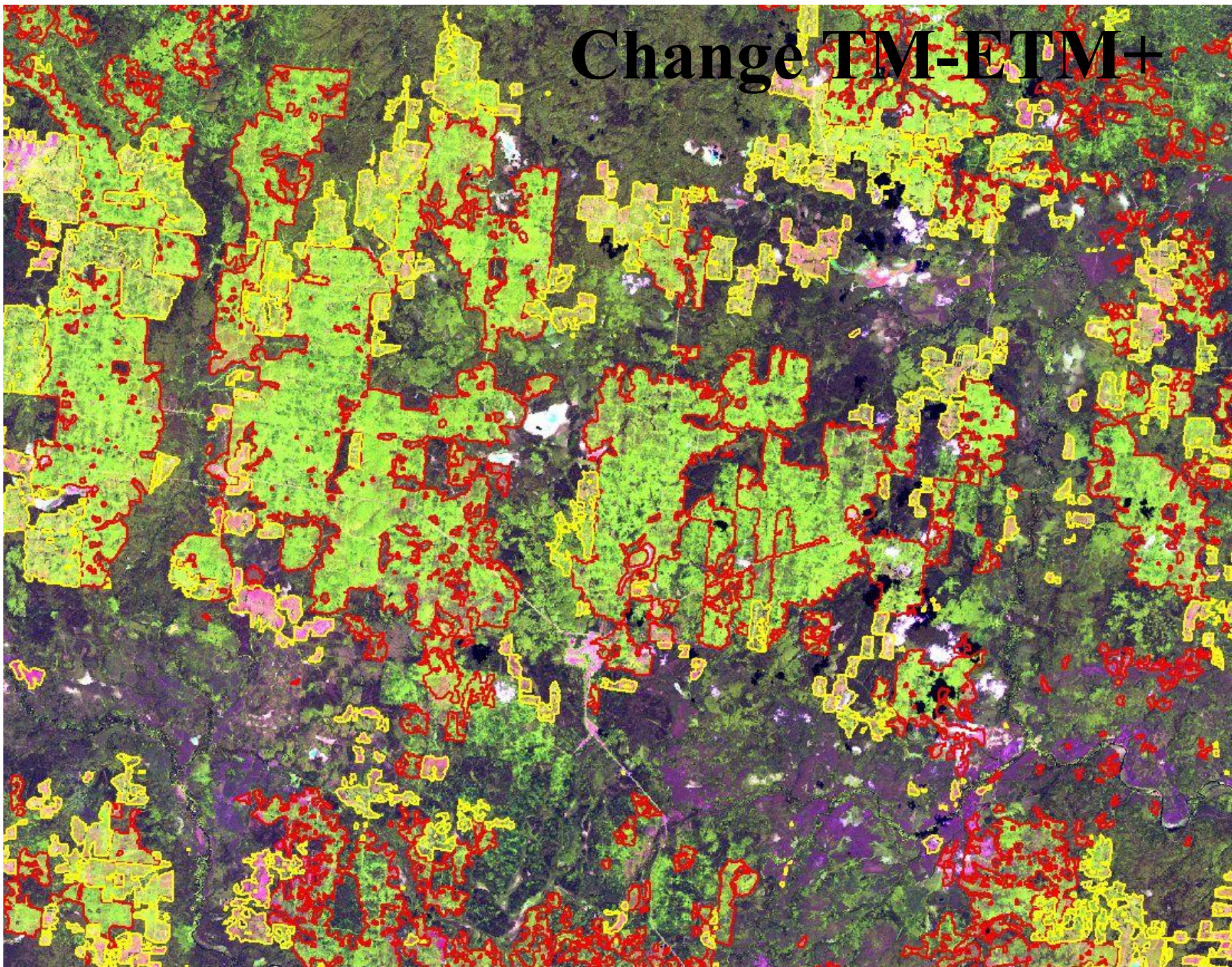


# Landsat ETM+ (~2000)



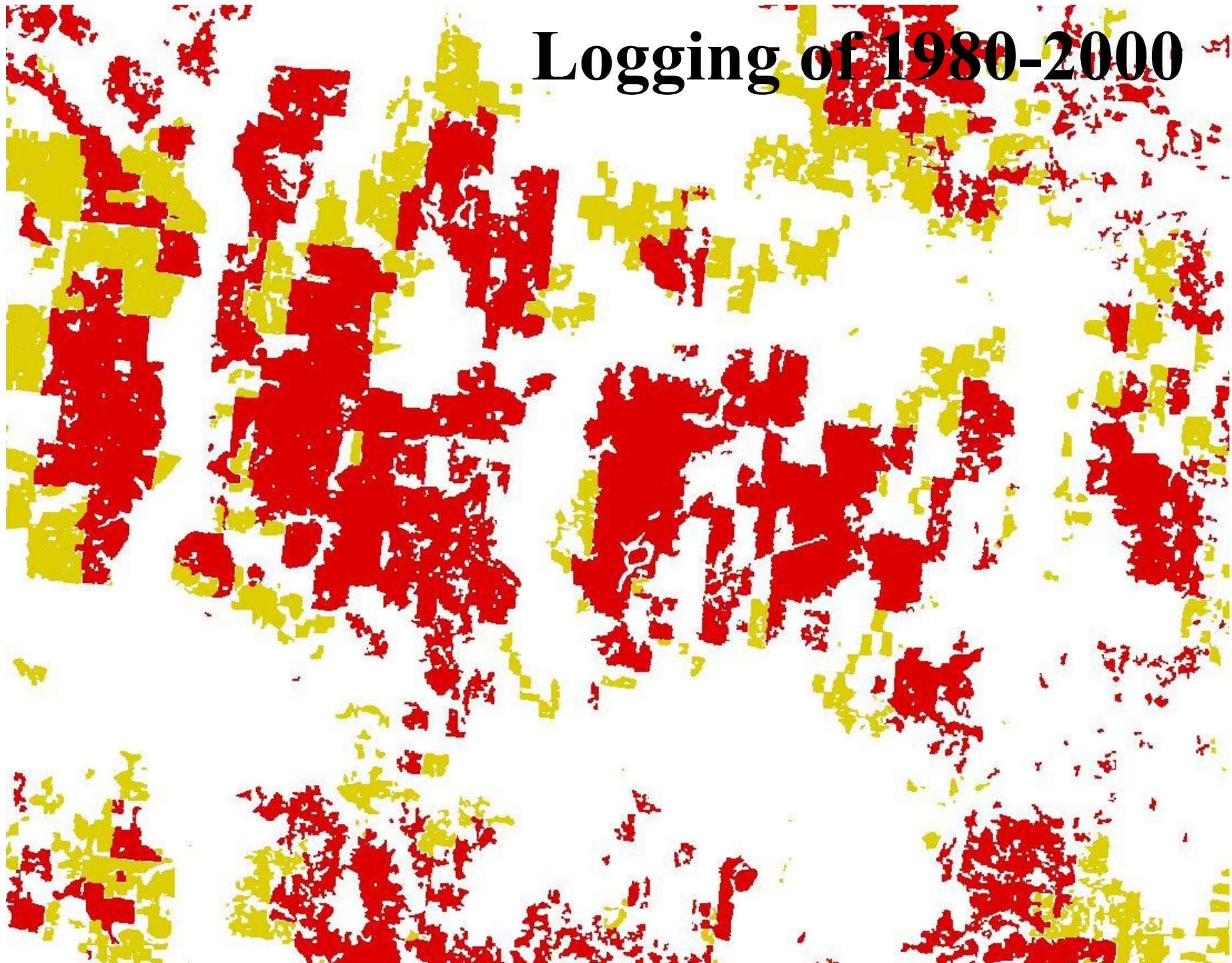


# Change TM-ETM+





# Logging of 1980-2000





# **Productivity / growing stock is still a problem**

- NDVI in combination with official data?
- Radar data for sparse forests?
- Landsat imagery classification in combination with ground data (kNN-method)?







# Kirov Oblast Mapping (2004-2006)

MSS  
classification ←

**Change  
detection  
MSS-TM**

**Change  
detection  
TM-ETM+**

Change  
detection  
ETM+-AWiFS



<1980

**~1980**

**~1990**

**~2000**

2007

clearcuts in  
Landsat MSS

**Landsat MSS  
GLCF**

**Landsat TM  
GLCF**

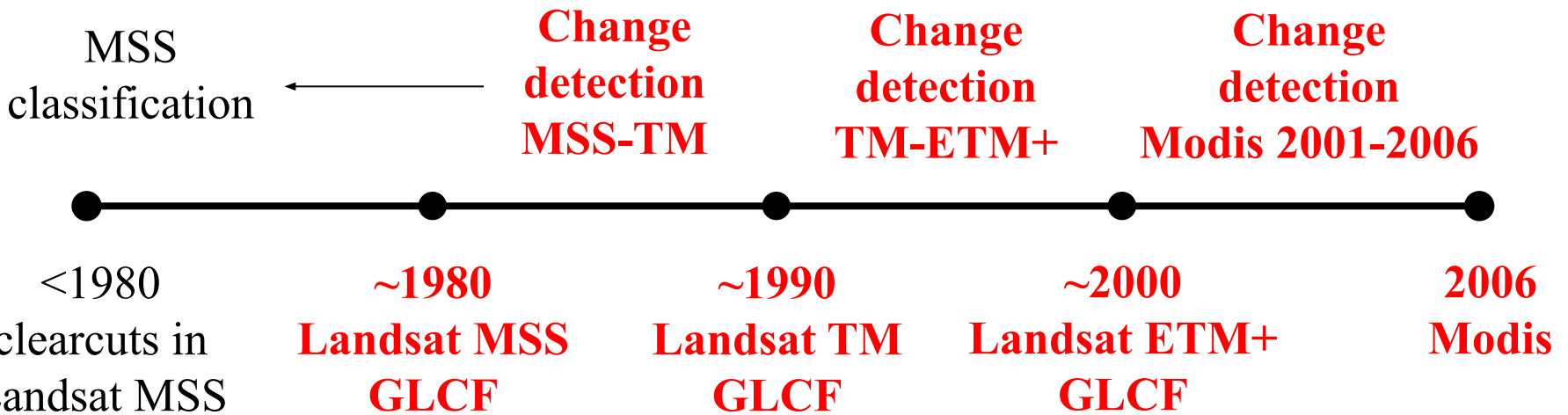
**Landsat ETM+  
GLCF**

Landsat TM  
IRS-P6 AWiFS  
ScanEx

**+ Landsat ETM+ classification  
for tree species**



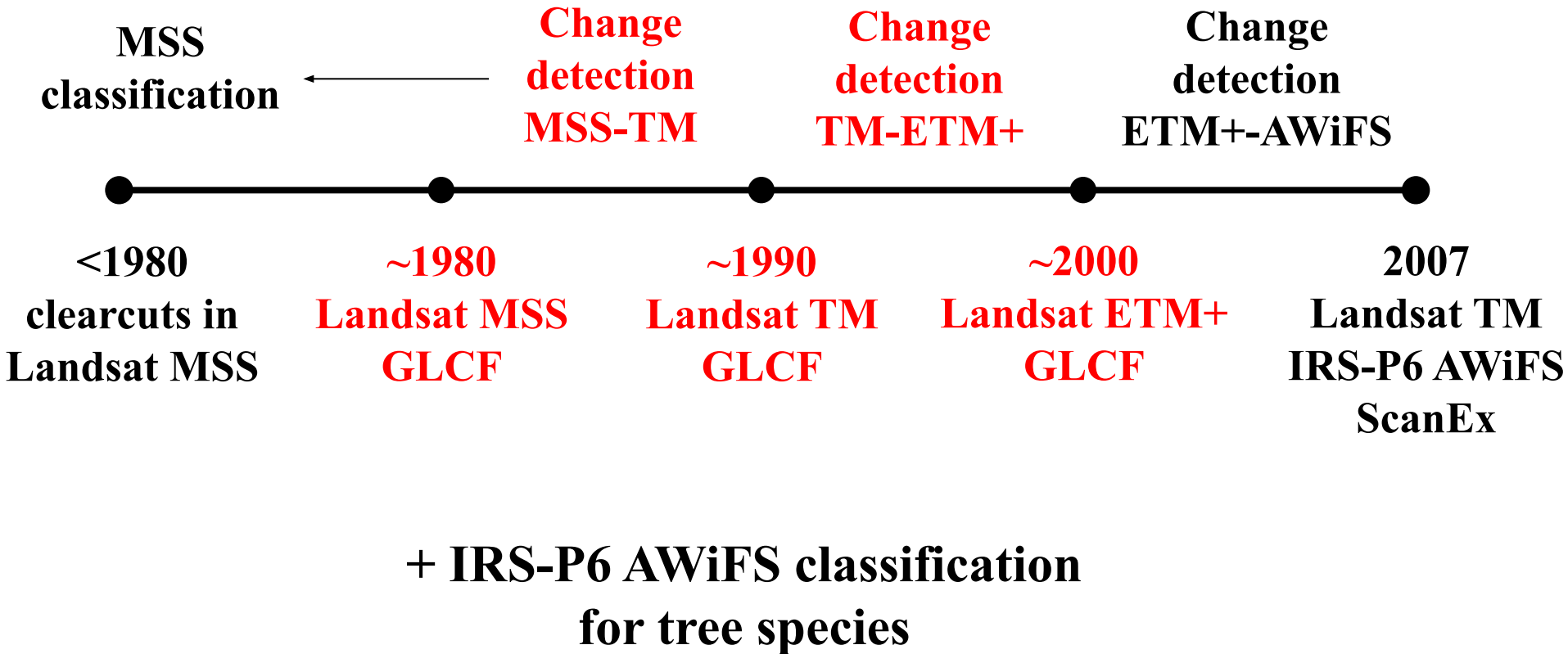
# European Russia Mapping (2006-2007)



**+ UMD Treecover**  
**Forest of the USSR (1990)**  
**Modis classification (Bartalev et al.)**

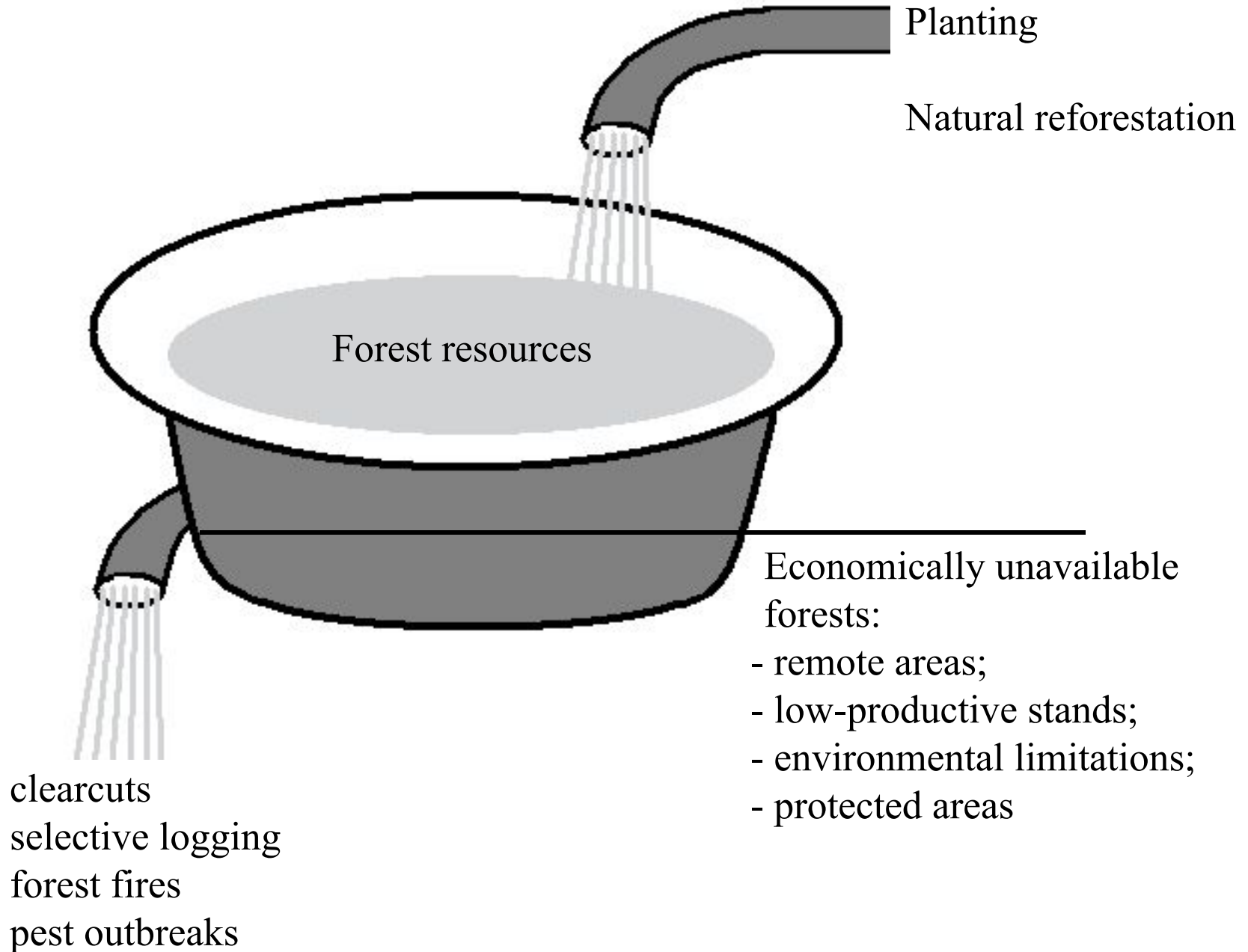


# European Russia Mapping (plans for 2008)



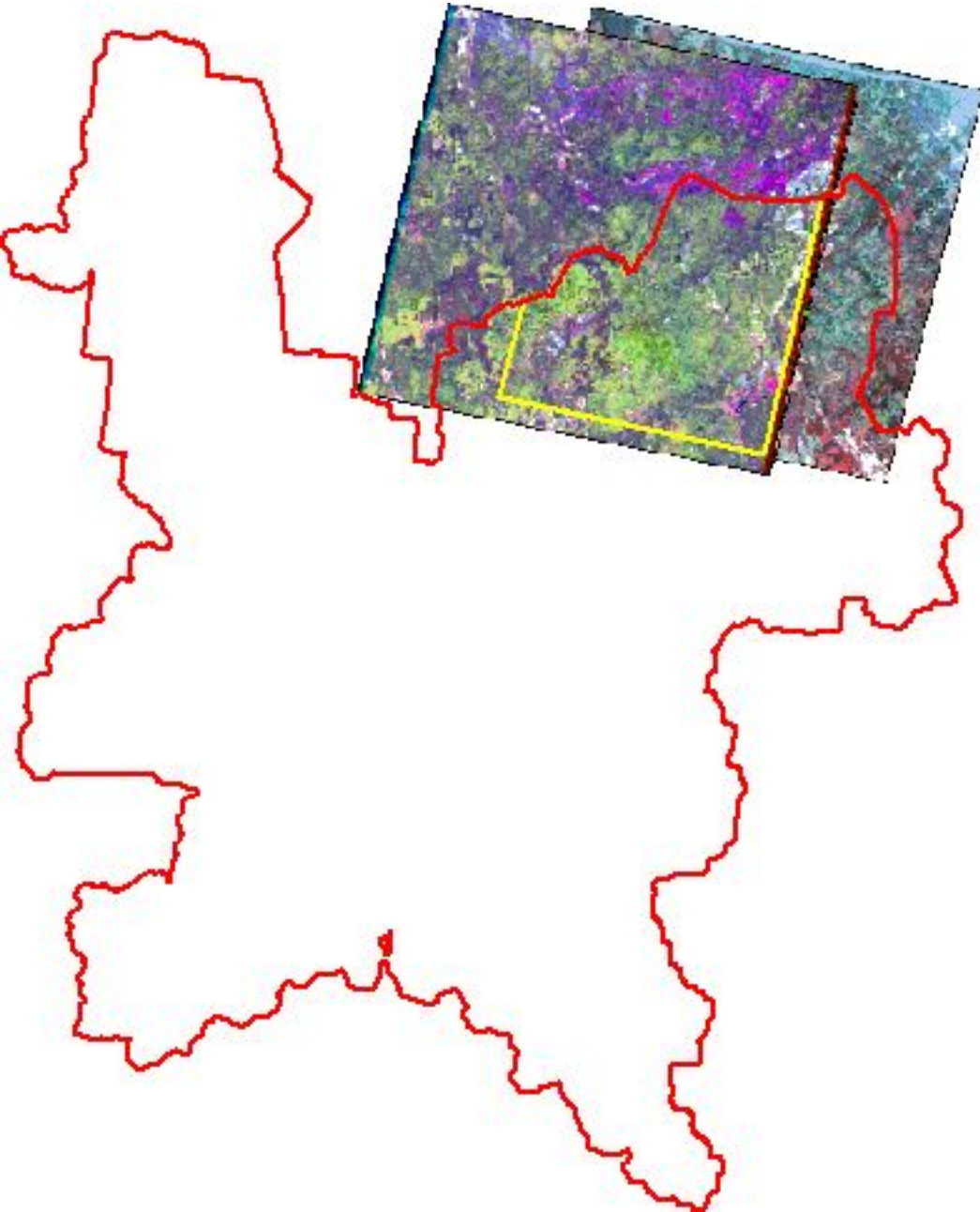


# Logging sustainability





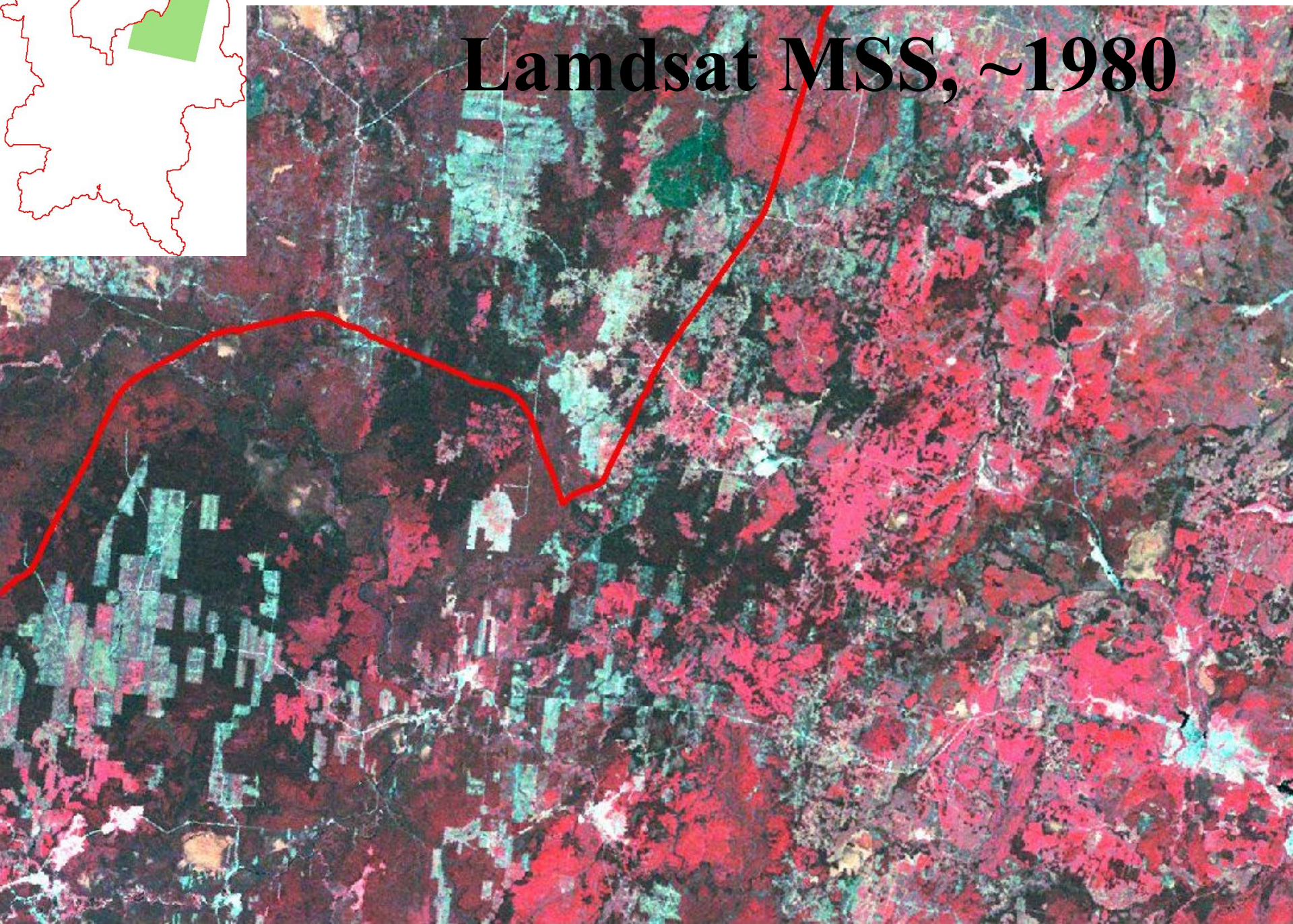
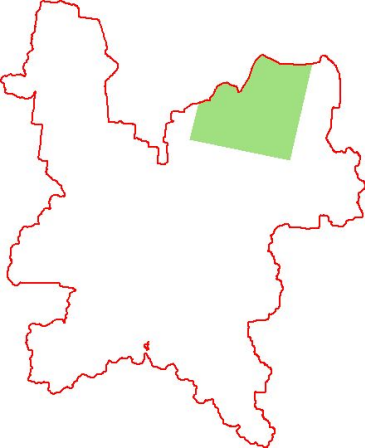
# MSS-TM-ETM+ change detection



Northern Kirov  
Oblast

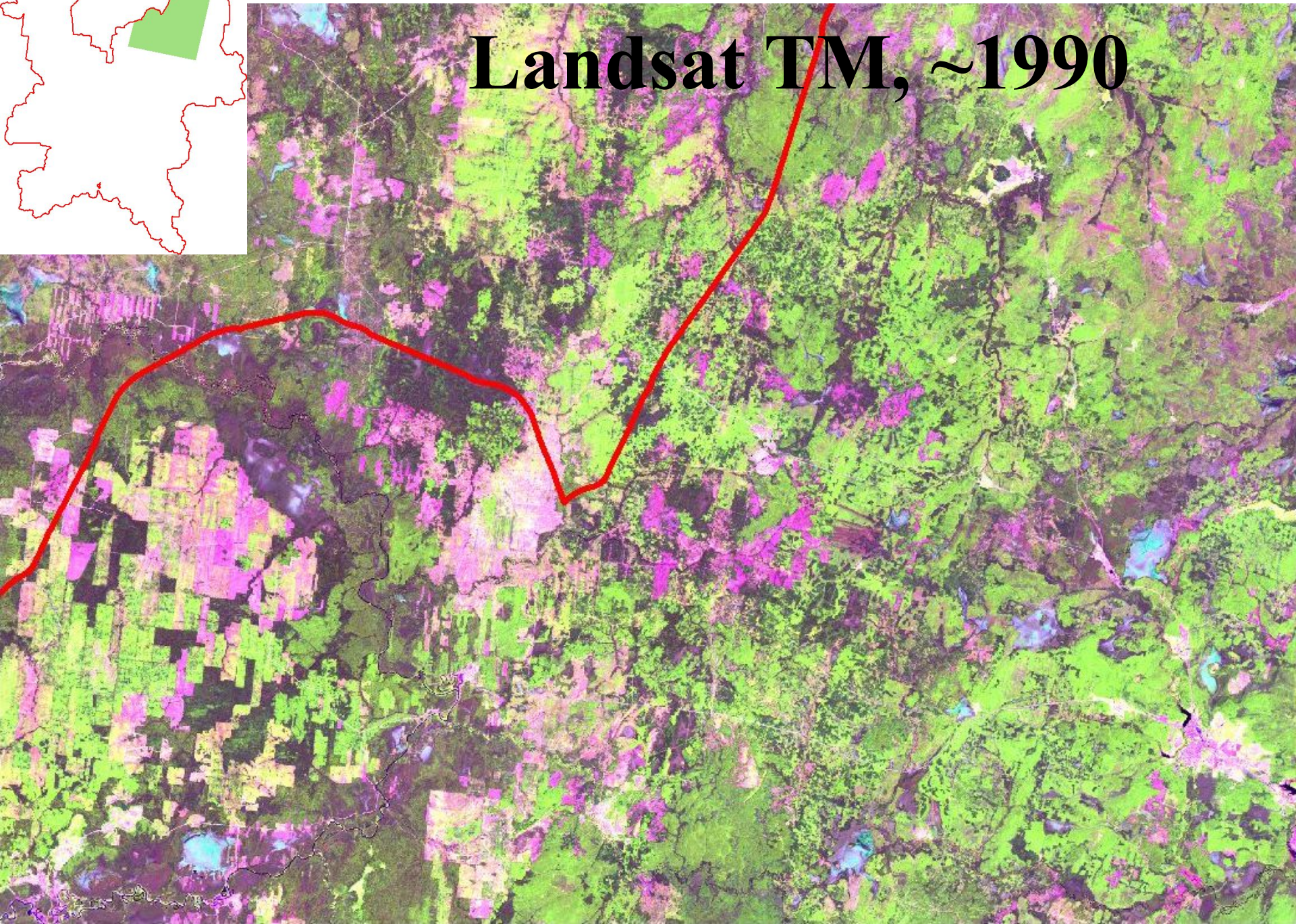
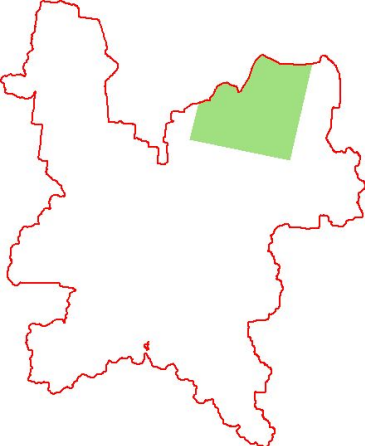


# Landsat MSS, ~1980



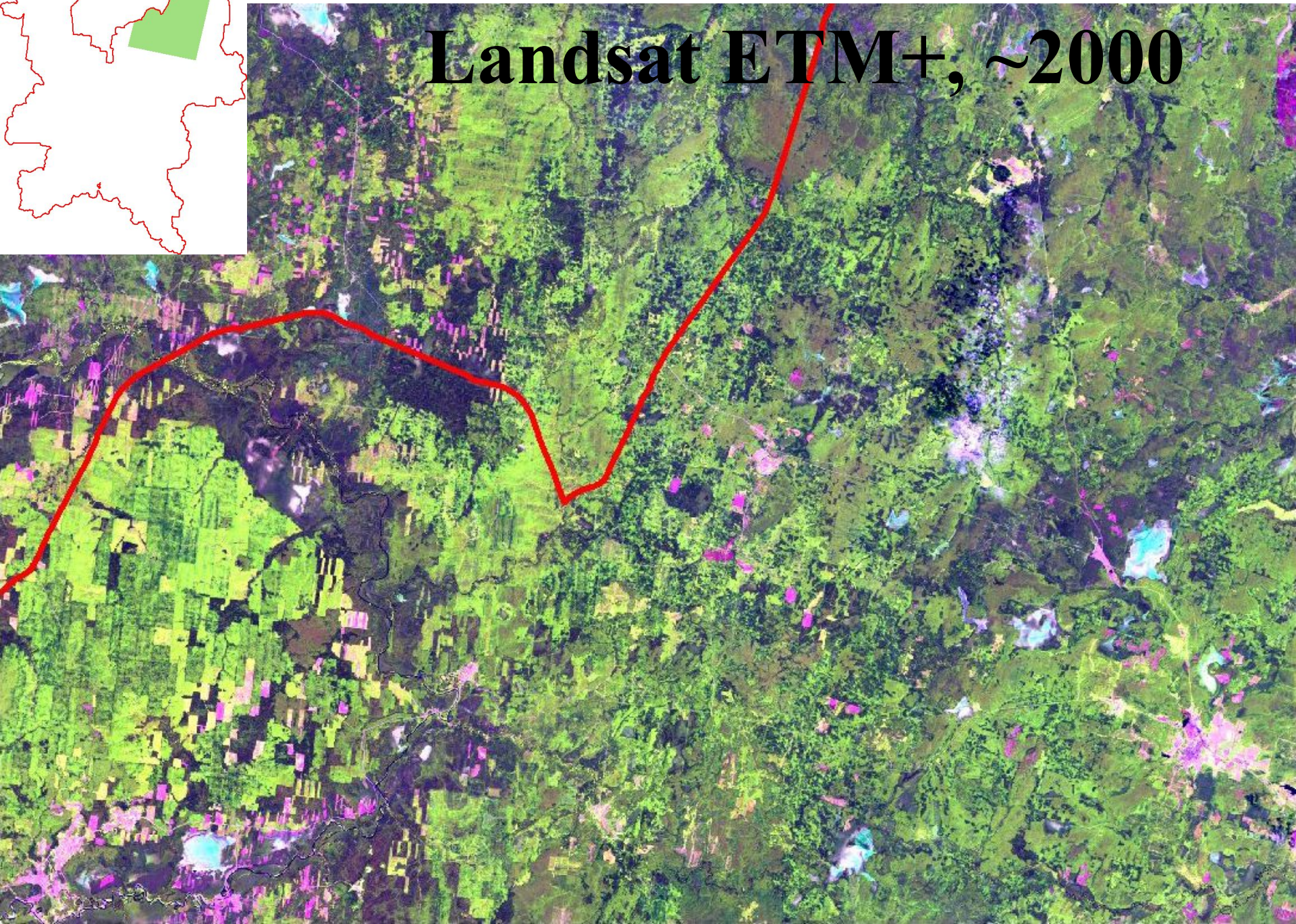
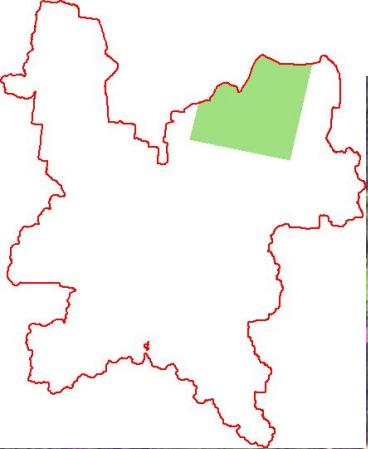


# Landsat TM, ~1990



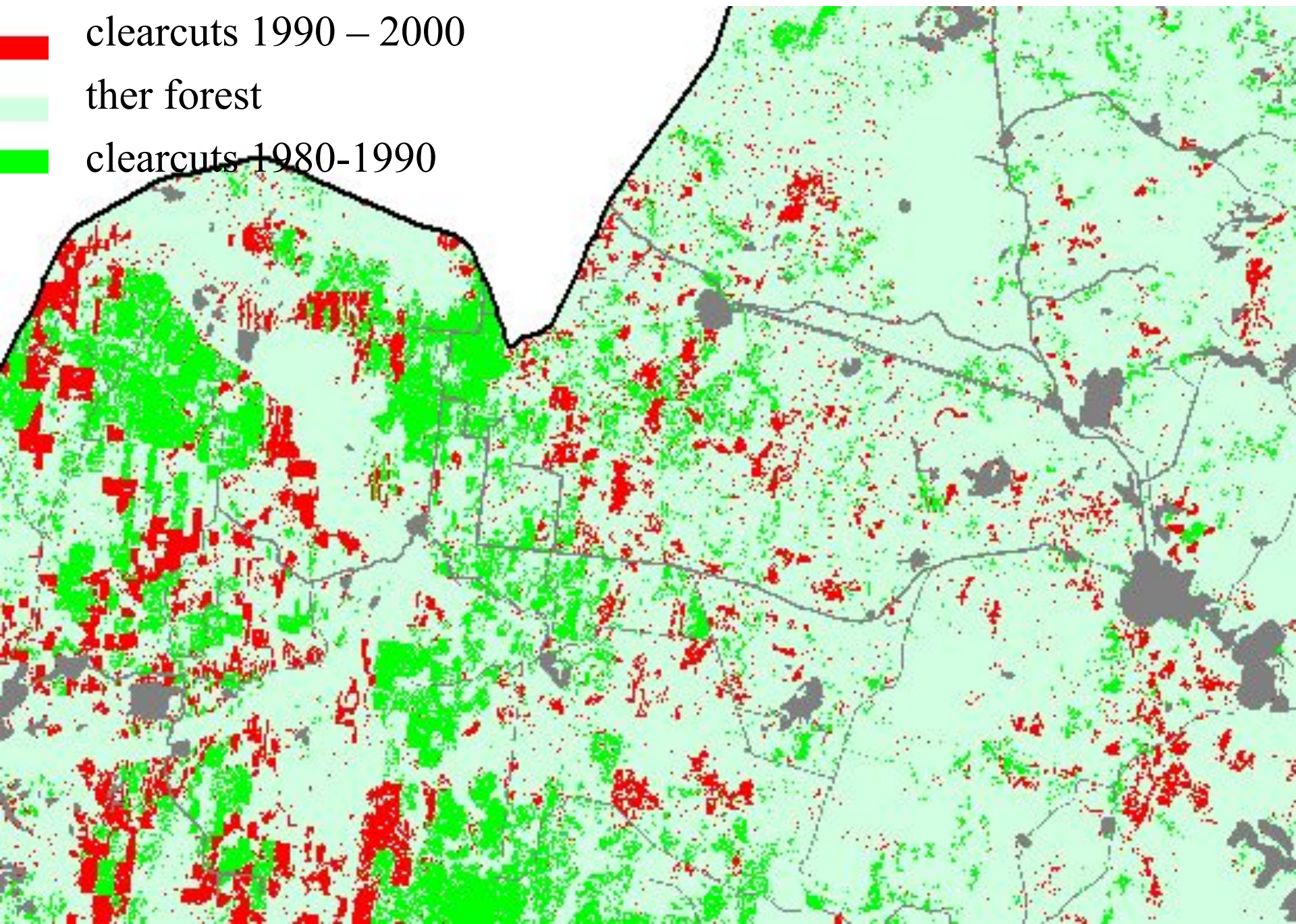


# Landsat ETM+, ~2000



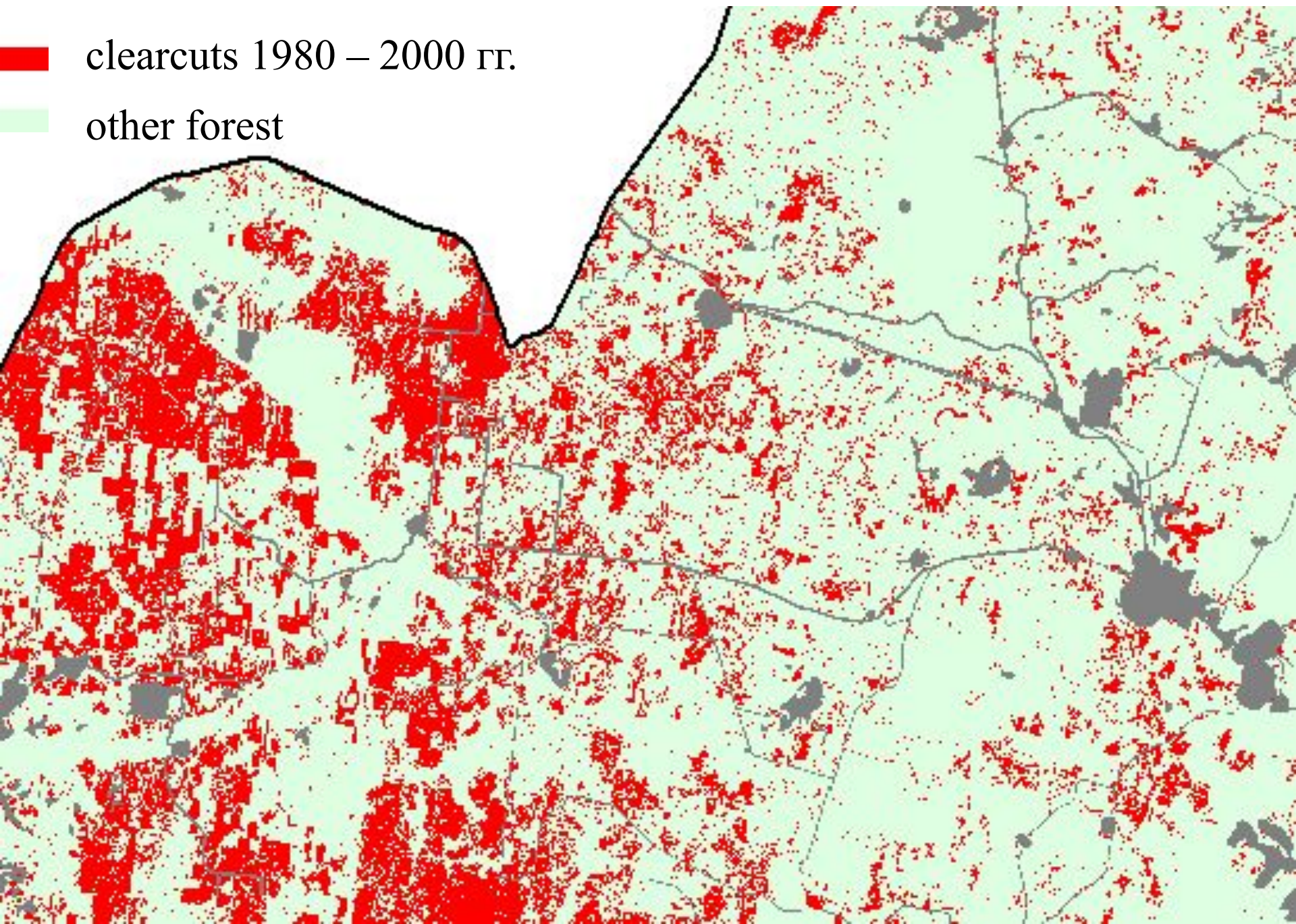


- non-forest areas
- clearcuts 1990 – 2000
- ther forest
- clearcuts 1980-1990





- non-forest areas
- clearcuts 1980 – 2000 гг.
- other forest





- non-forest lands
- old coniferous
- clearcuts 1980 – 2000
- other forest

