

Regional Scale Forest Mapping with Medium Resolution Satellite Data

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Russia's Forests

Dominating Forest Types and Their Canopy Density



LEGEND

	Canopy density	
	10-39%	40-99%
Spruce-Fir Forest 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.		
Pine Forest Softwood pine dominates, usually with presence of spruce, birch and aspen and/or larch at the southern border edge.		
Larch Forest Larch of different species dominates, often with presence of birch and aspen. Other treeless deciduous species, birch and larch are 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.		
Broadleaved Deciduous Forest Broadleaved deciduous species dominate (oak, elm, ash, maple, alder) and in southern European Russia also birch, chestnut and hornbeam. In mountainous areas (Caucasus, Southern Ural, Sikhotealin) with high larch presence of conifers such as spruce, fir and larch pine.		
Stone Birch Forest Stone birch dominates, often with presence of larch, larch or patches of tree. It characteristically forest has undergrowth of spruce pine, and in the mountains of Far East and Sikhotealin with presence of spruce and fir.		
Dauric Pine Forest Dauric pine dominates in patches or shrubby forest, often with a sparse aspen shrubby larch or stone birch.		
Birch-Aspen and Mixed Forest Birch, aspen and grey alder dominates, with presence of conifers tree or patches of tree. In mountainous areas forest has logging, mining or forest fire.		
Areas of Forests of Forest Agricultural and other non-forest occupations in which stands and soils are suitable for forest growth.		

Belikov S.A., Entov D.V., Izrael A.S., Pukhov P.V., Tukanov S.A., Vorobeyko A.Yu.
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 39% 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 1990, except for those places where a comparison with the best cover map of Northern Europe (Reference 4), published in 2000, 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 sp., stone birch - Betula nana, oak - Quercus sp., spruce - Picea sp., aspen - Populus tremula, grey alder - Alnus incana, hornbeam - Carpinus betulus, larch - Larix sp., pine - Pinus sp., maple - Acer sp., white spruce - Picea mariana, pine - Pinus sp., Siberian pine - Pinus koraiensis, P. koraiensis, Scots pine - Pinus sylvestris, dwarf pine - P. mitchellii, spruce - Picea sp.
Photo: D. Entov, G. Izrael, V.A. Vorobeyko, E.I. Vorobeyko, S.B. Pukhov, P.V.



- References:
1. Entov D.V., Izrael A.S., Pukhov P.V., Tukanov S.A., Vorobeyko A.Yu. A New (2004) Forest Cover Map of Northern Eurasia - International Journal of Forest Spacing - 2005 - vol. 21 - no. 2 - P. 137-140.
 2. Hansen M.C., Steiner K.E., Treubek J.R., Sober J., Sober R. A Global Forest Tree Cover at a 1 km Resolution of 500 Miles. First Results of the MODIS Vegetation Continuous Fields Algorithm (VCF) products areas and data produced forest.
 3. The Forests of the USSR Map Scale 1:2500000, prepared by the Department of the Forest of Geography of the USSR Academy of Sciences, Moscow, USSR, 1990.
 4. Vegetation of the USSR (the major atlas of natural history), Moscow, 1:400000.
 5. Luchinskaia, Irina G.A.M., 1990.
 6. Digital chart of the world's Environmental Geographical Institute, 1980.

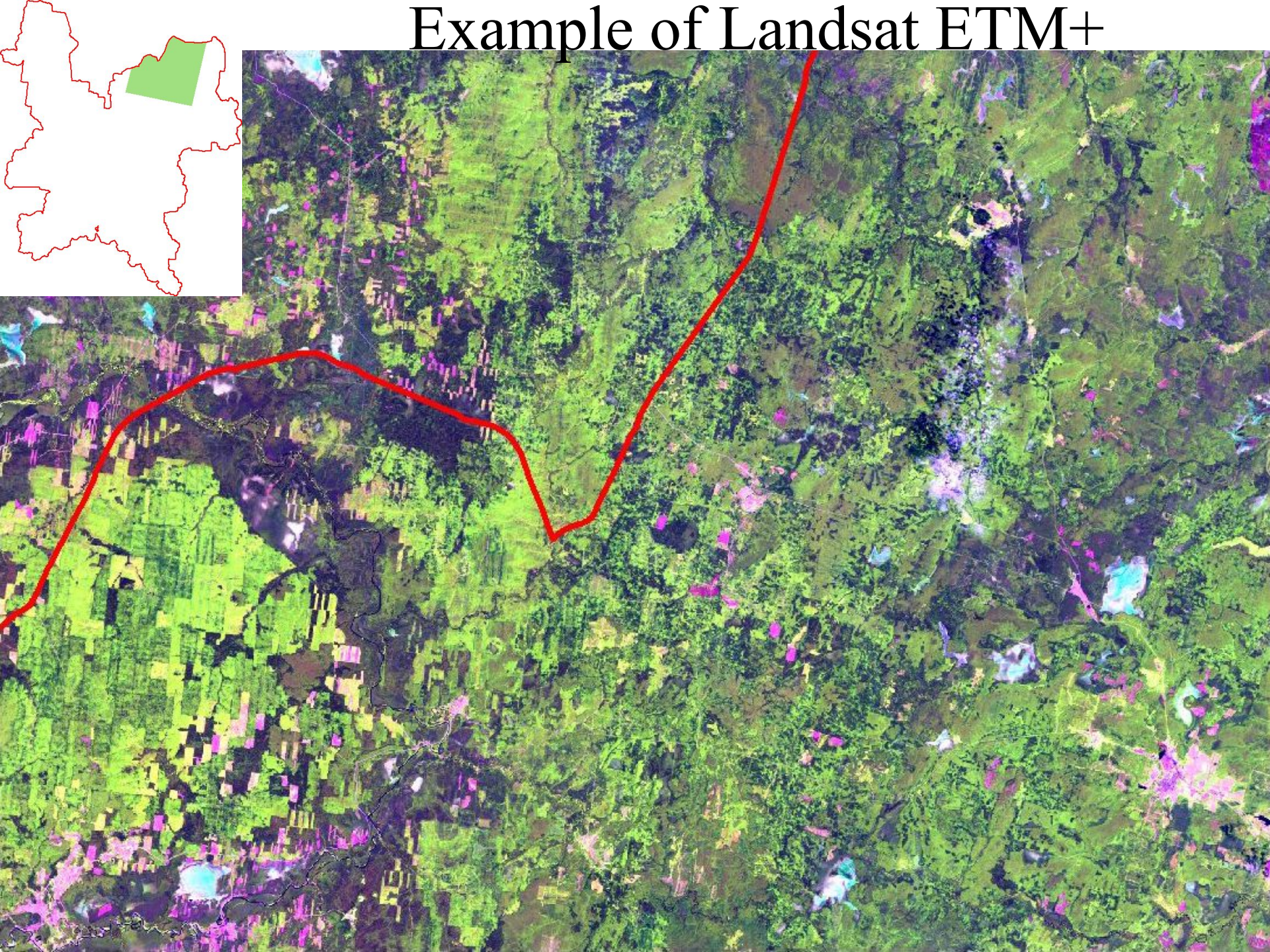
Minimum set of information includes:

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

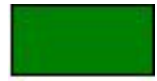
Options for the forest cover and tree species:

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

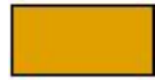
Example of Landsat ETM+



...and its classification by tree species



dark coniferous (spruce, fir)



pine



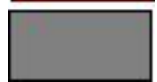
mixed deciduous – dark coniferous



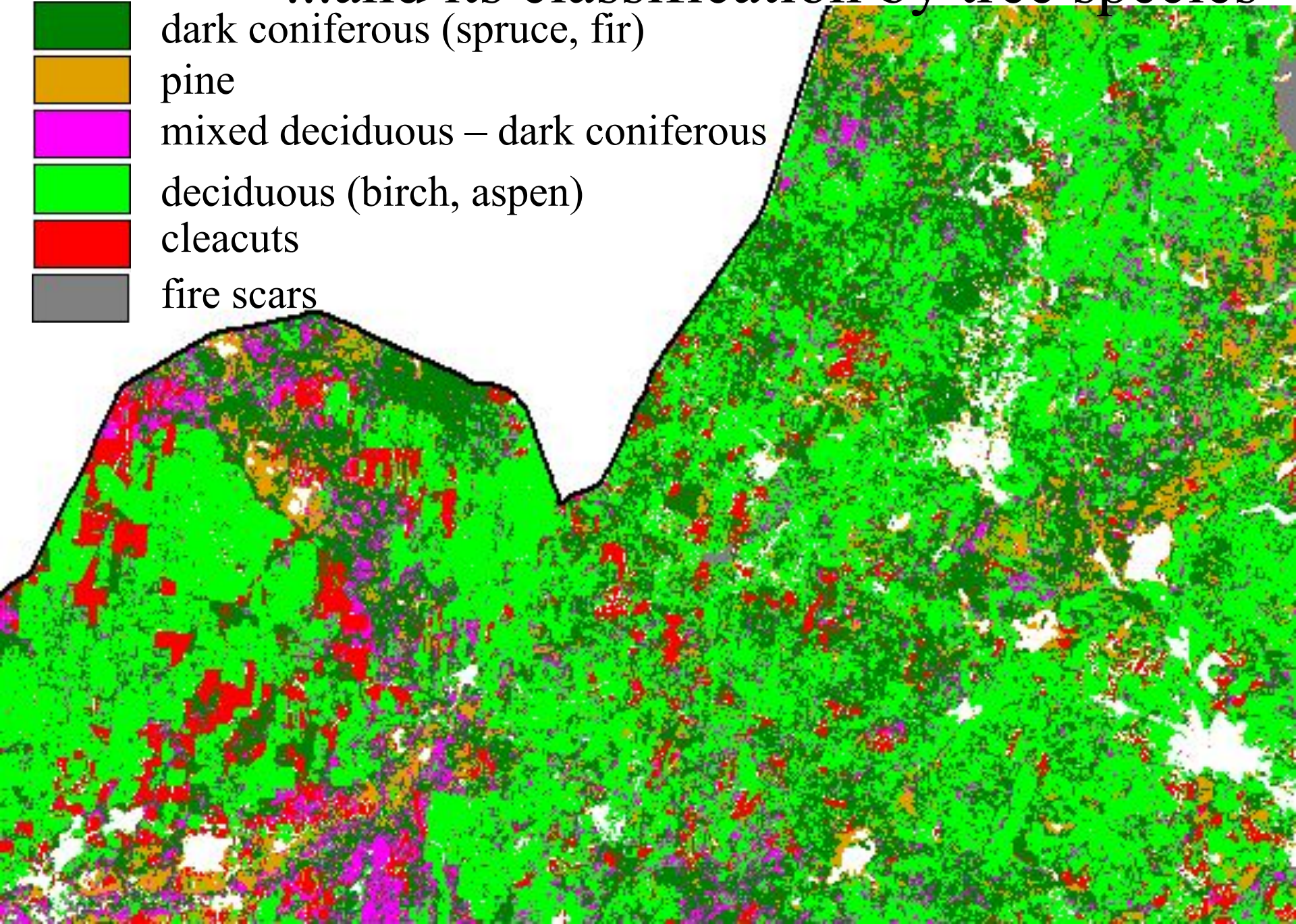
deciduous (birch, aspen)



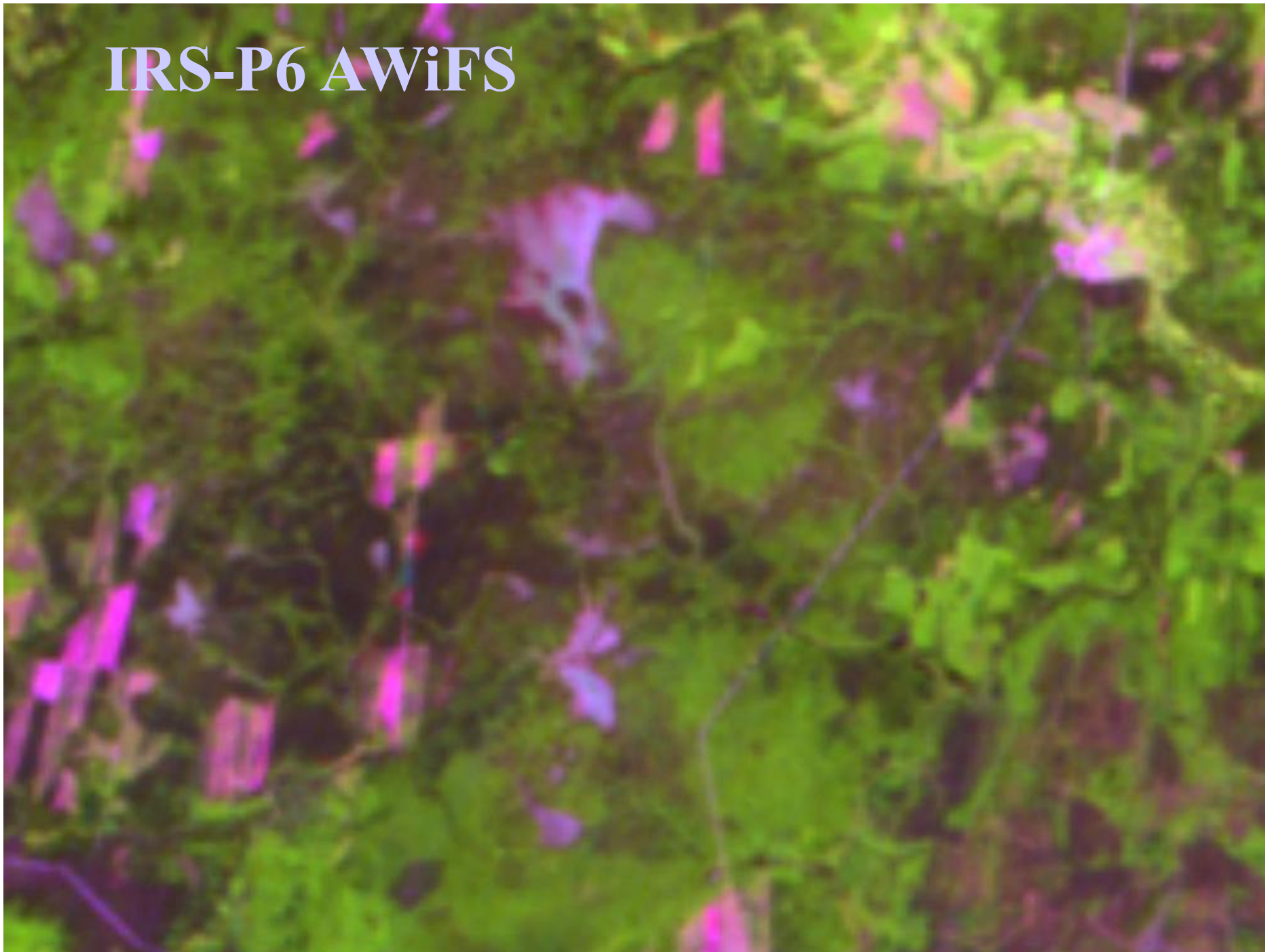
clearcuts



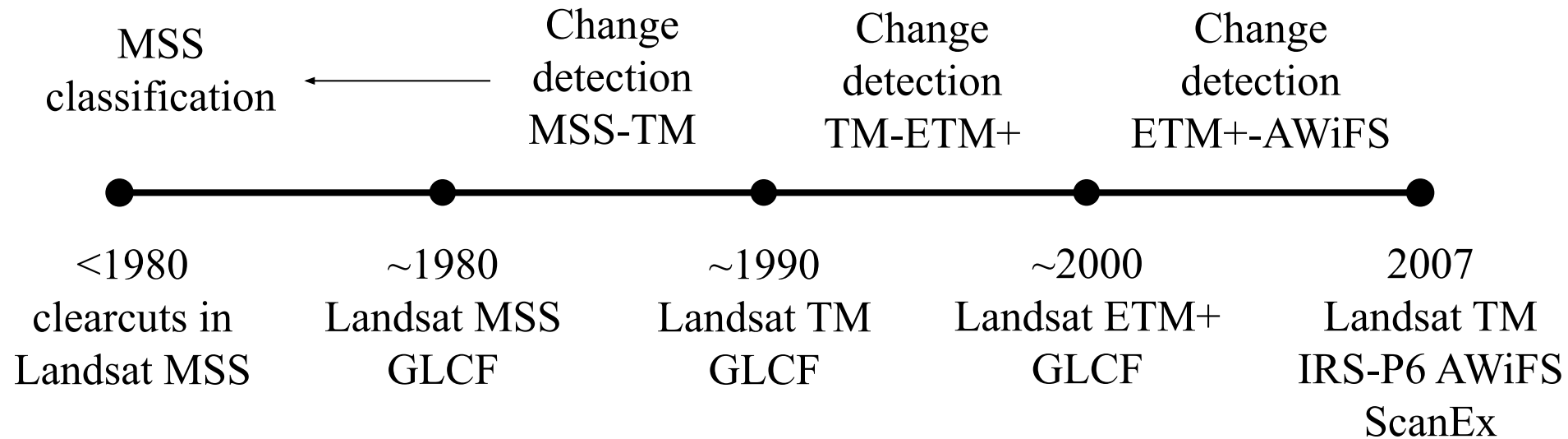
fire scars



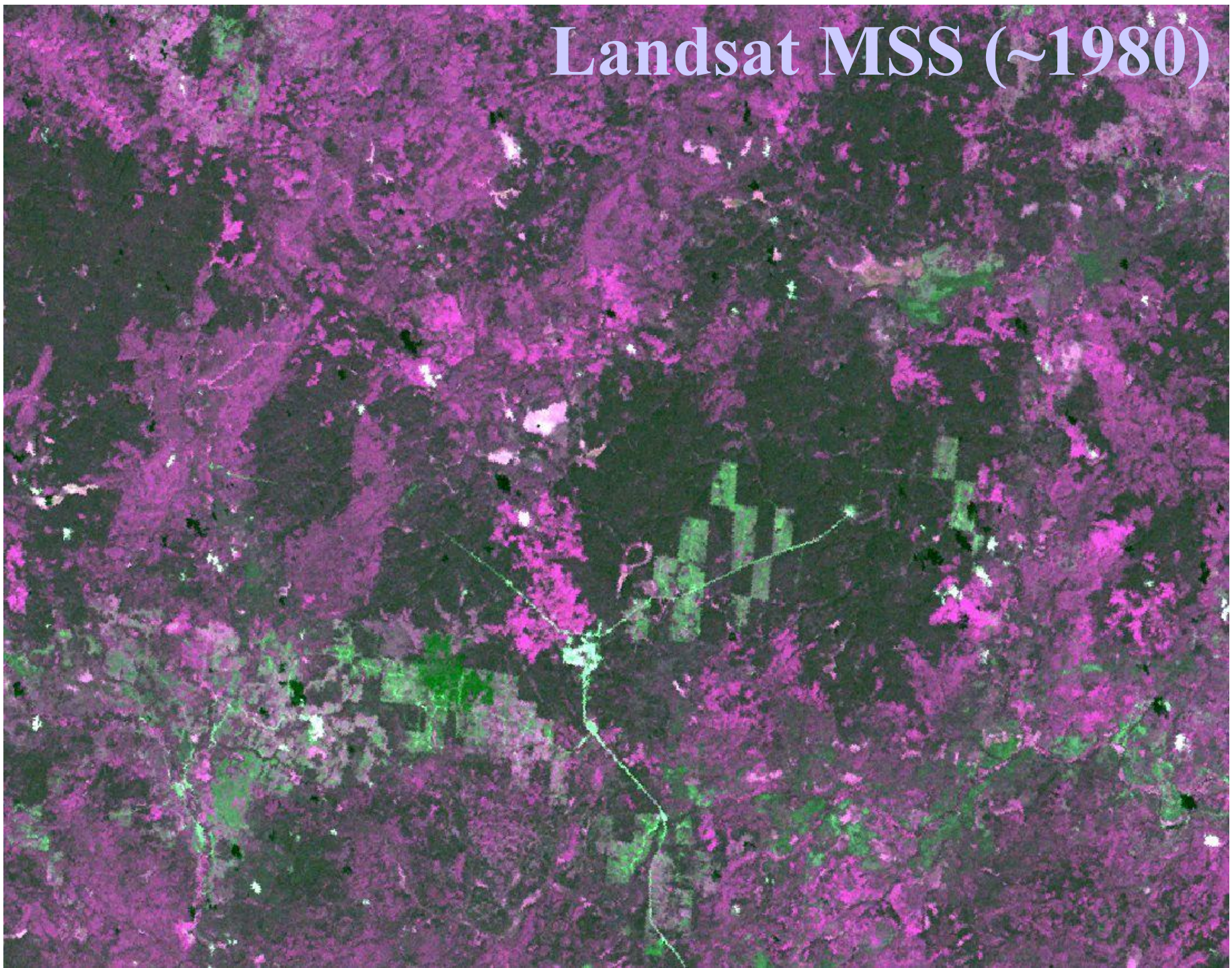
IRS-P6 AWiFS



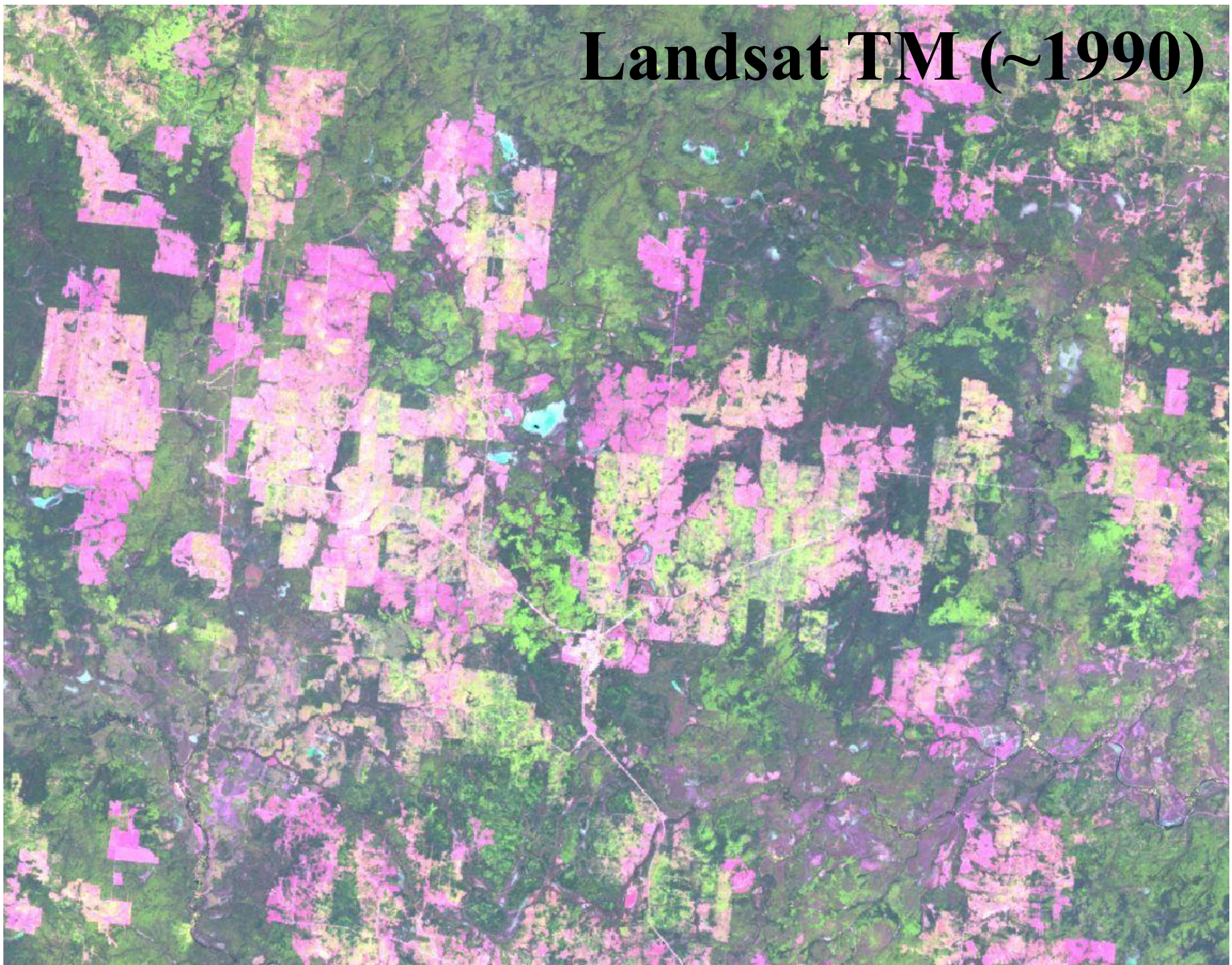
Retrospective data allow age classification



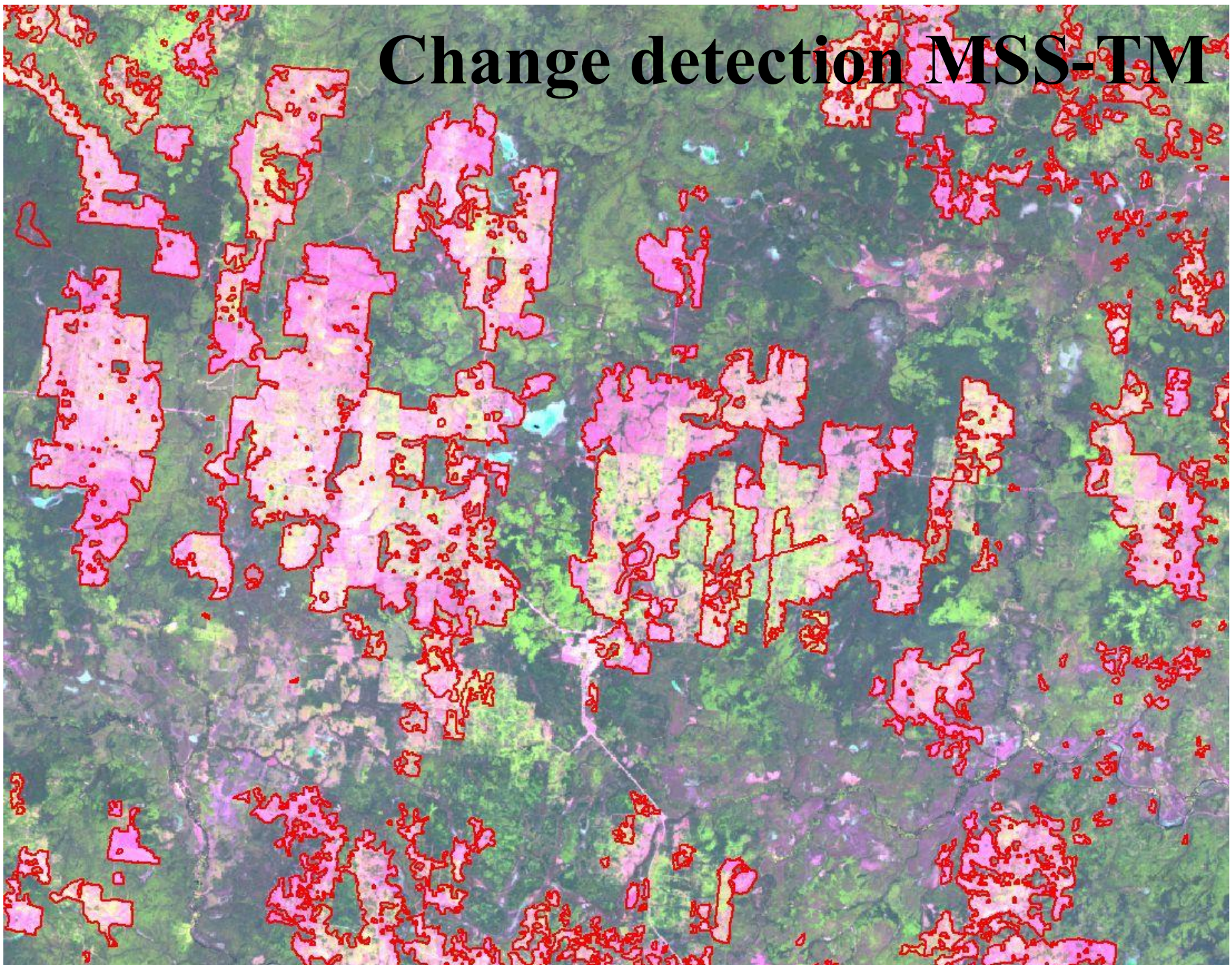
Landsat MSS (~1980)



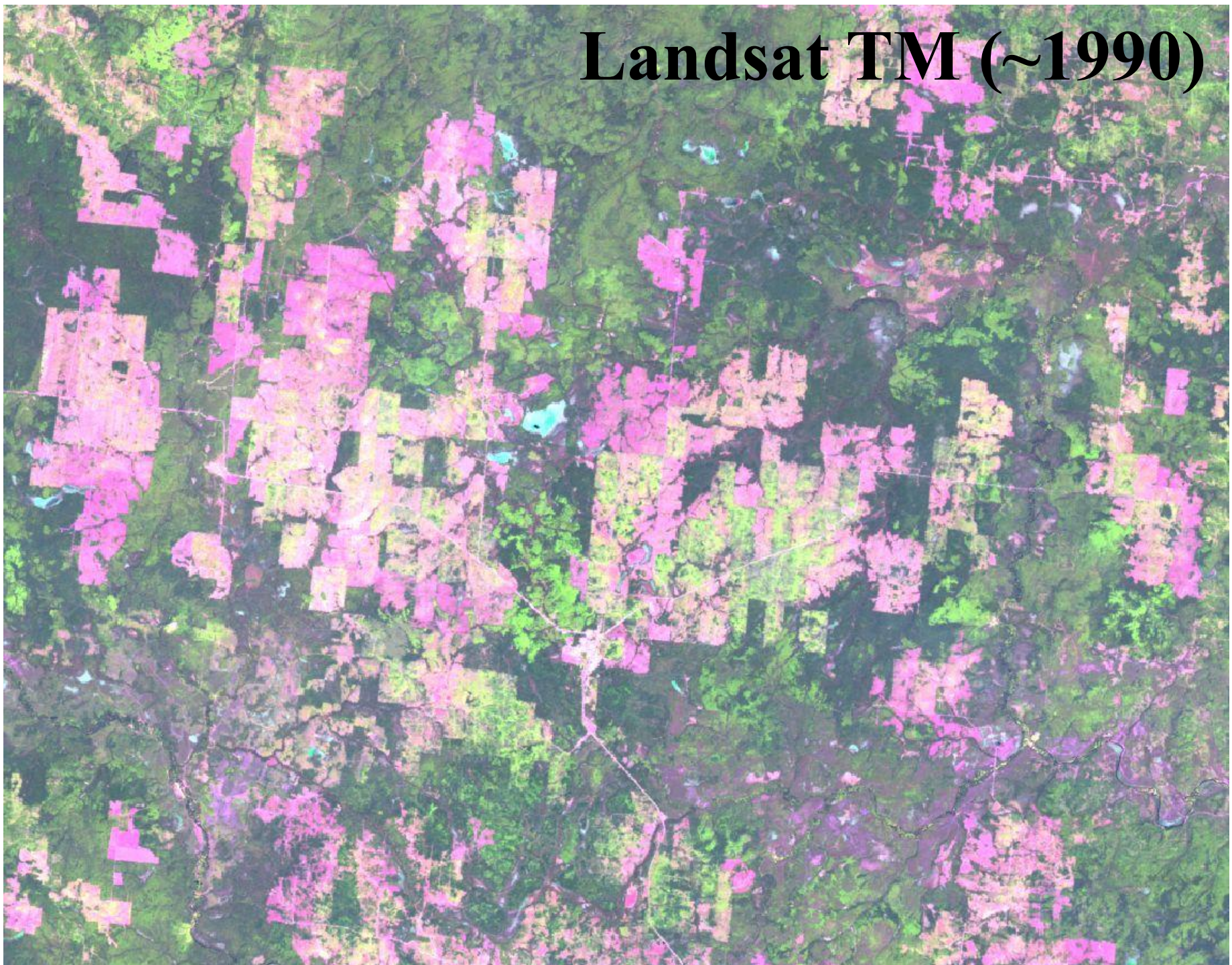
Landsat TM (~1990)



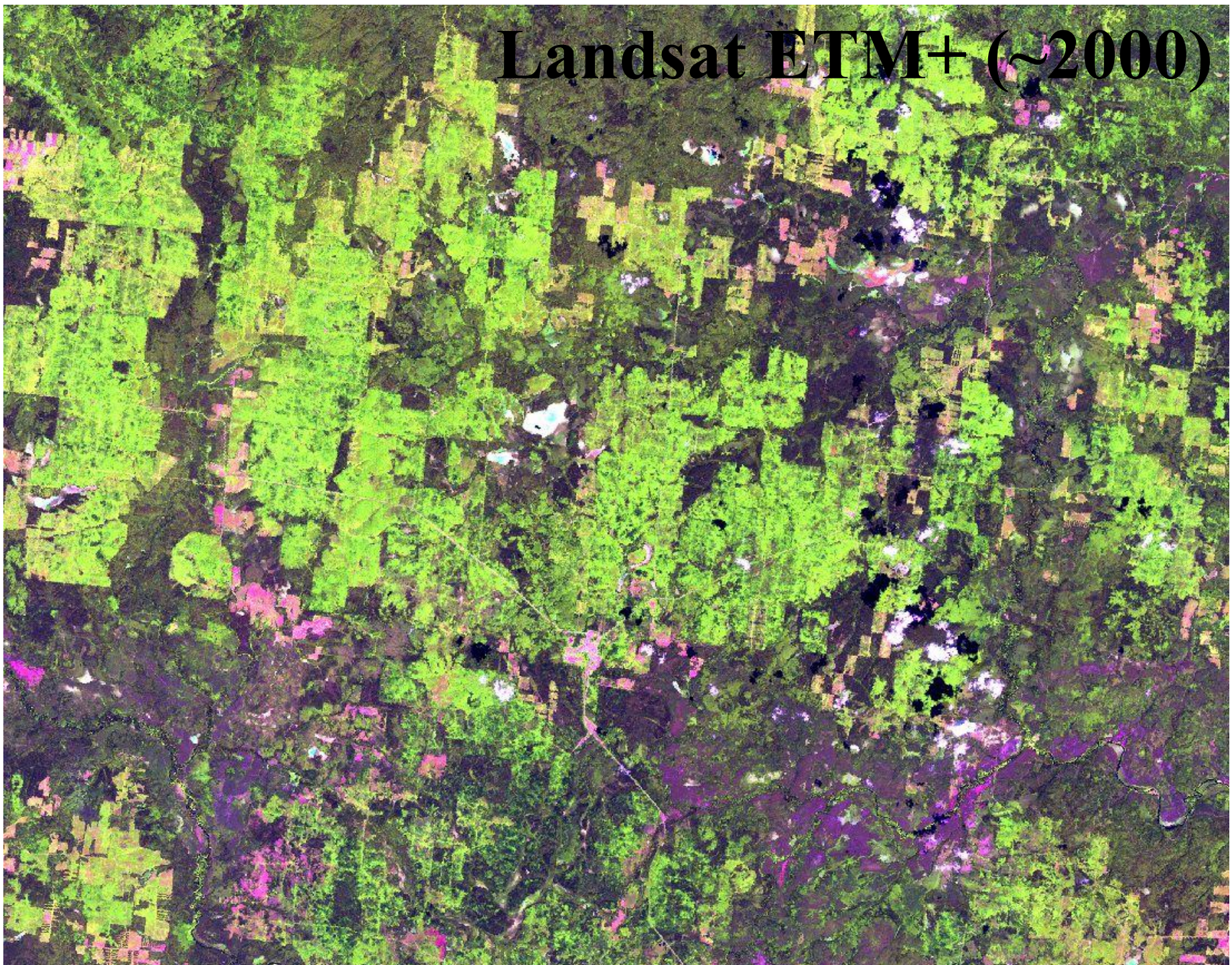
Change detection MSS-TM



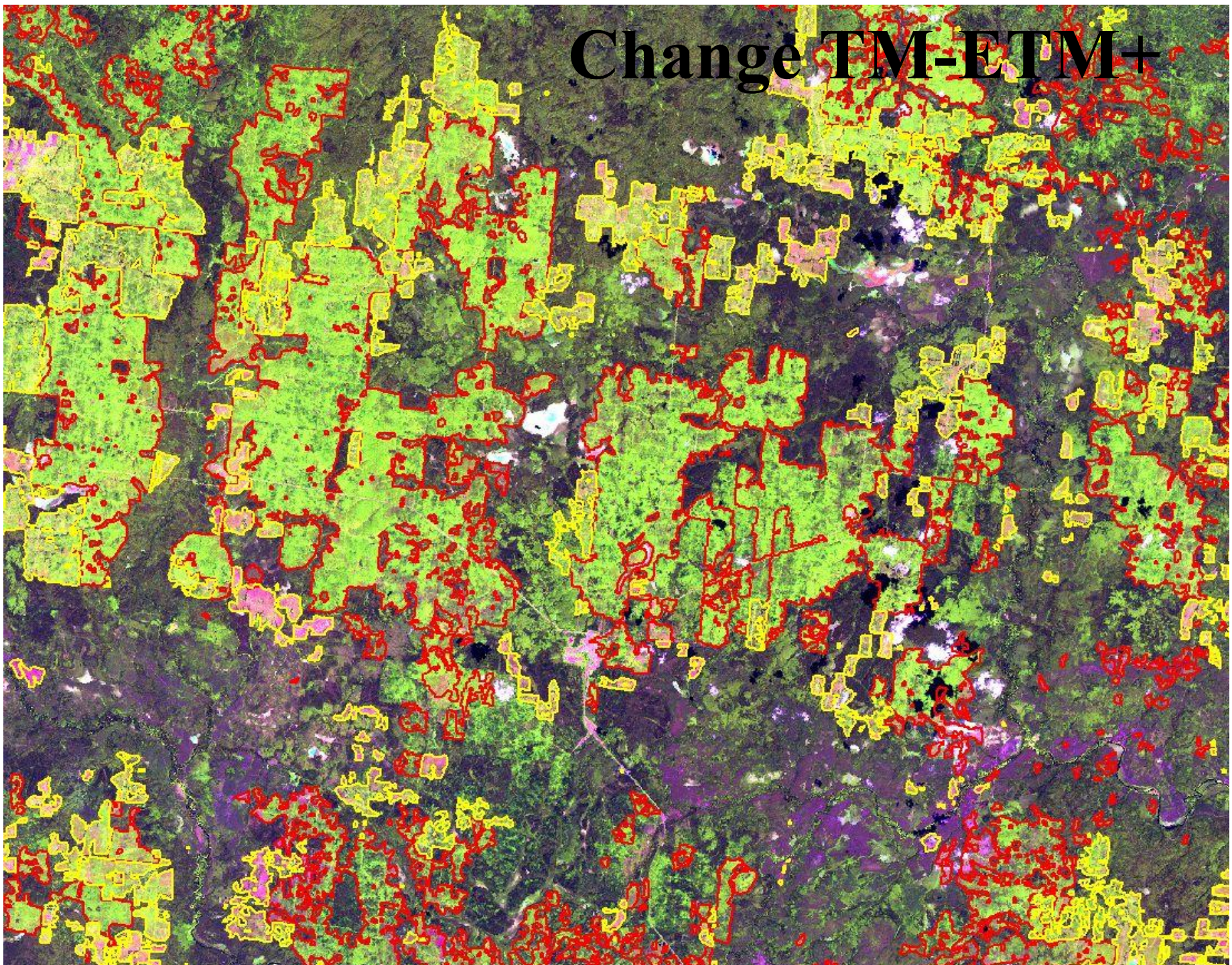
Landsat TM (~1990)



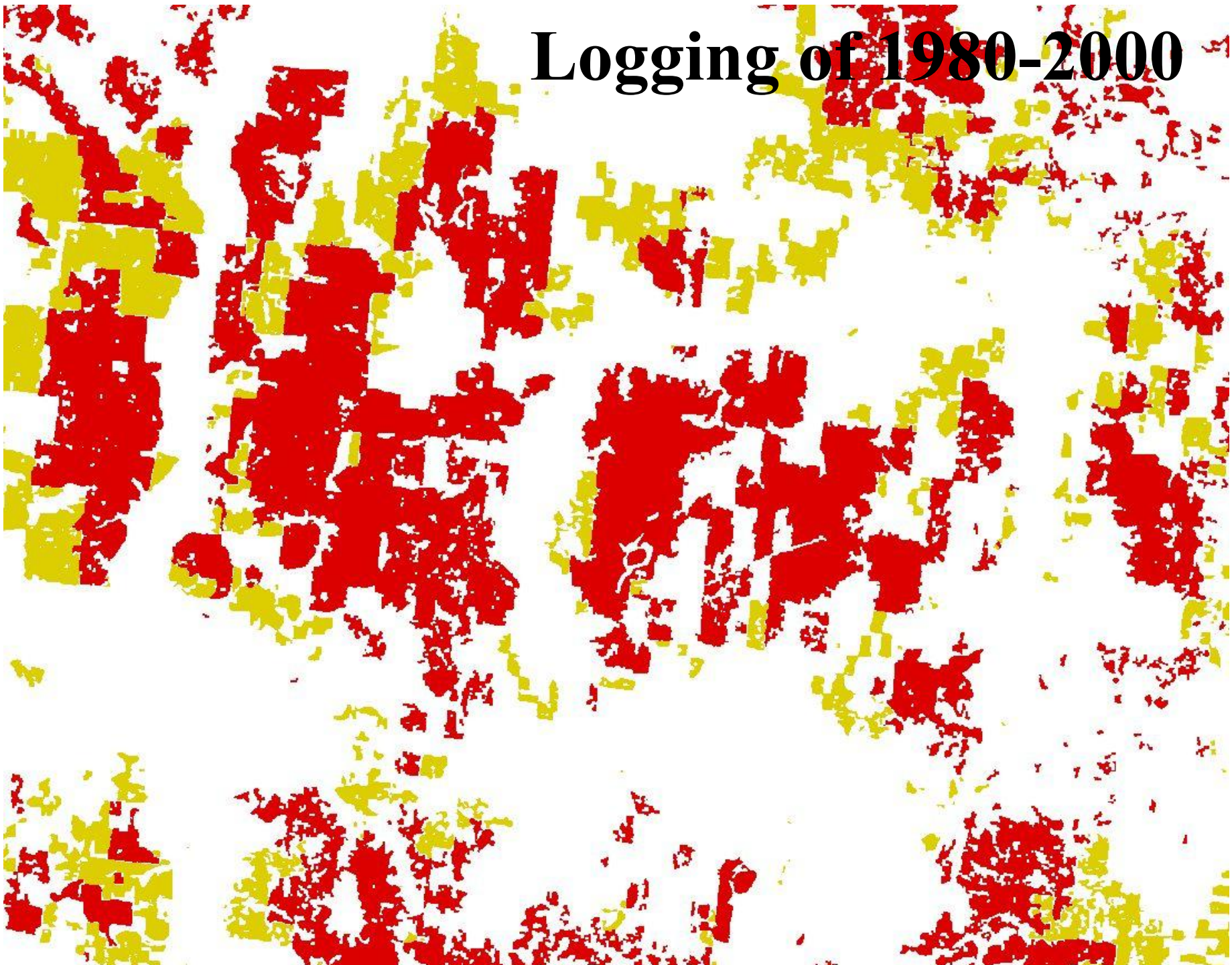
Landsat ETM+ (~2000)



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**

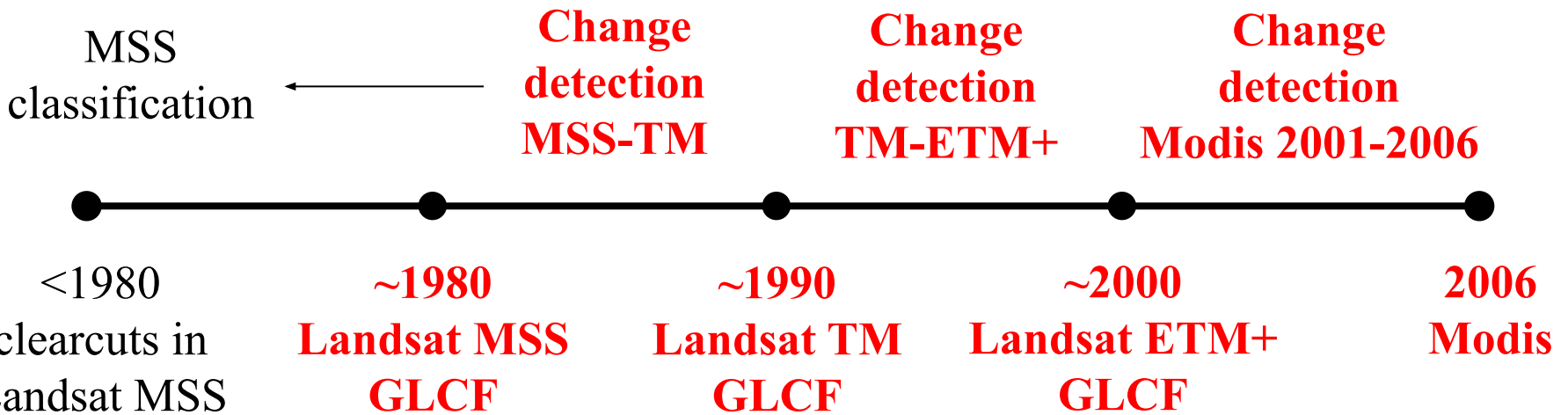
**Landsat TM
GLCF**

**Landsat ETM+
GLCF**

Landsat TM
IRS-P6 AWiFS
ScanEx

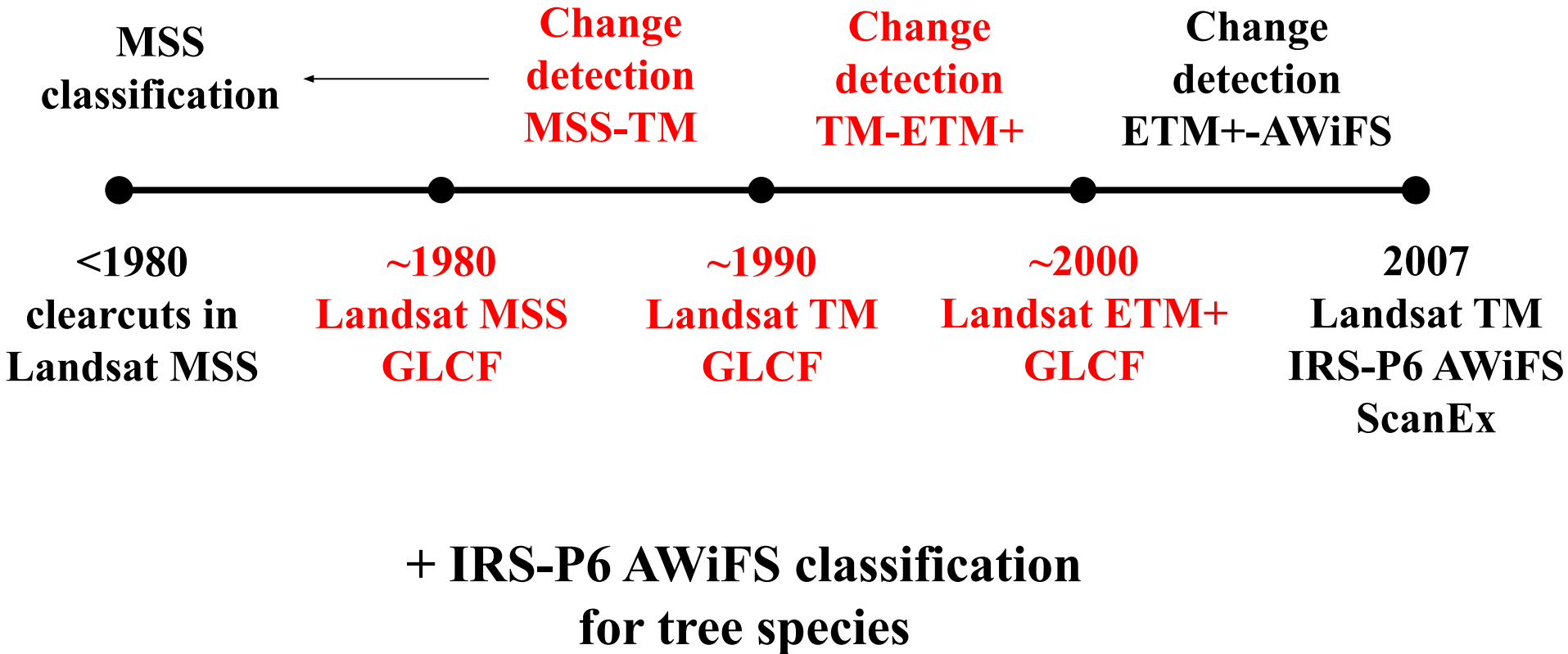
**+ Landsat ETM+ classification
for tree species**

European Russia Mapping (2006-2007)

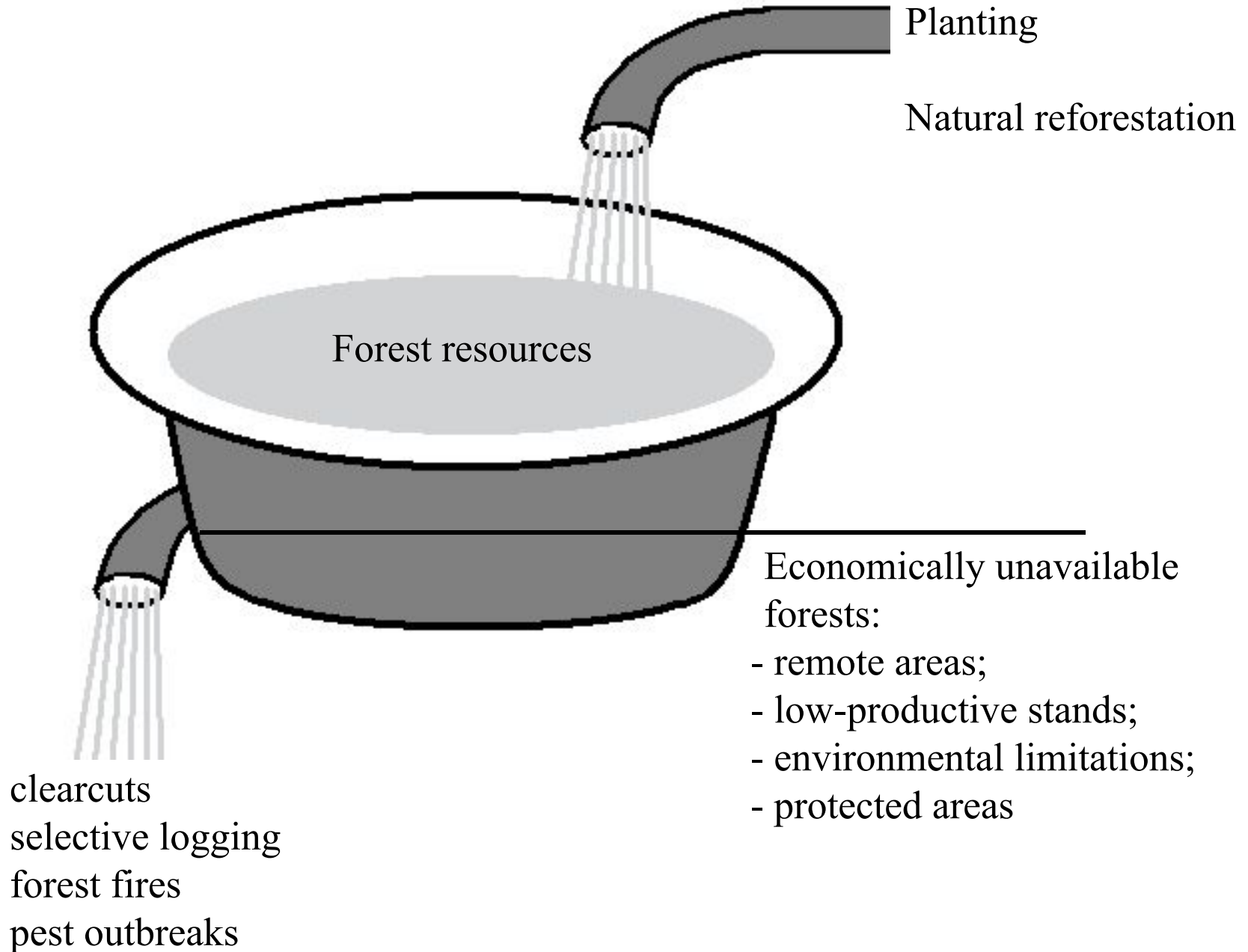


+ UMD Treecover
Forest of the USSR (1990)
Modis classification (Bartalev et al.)

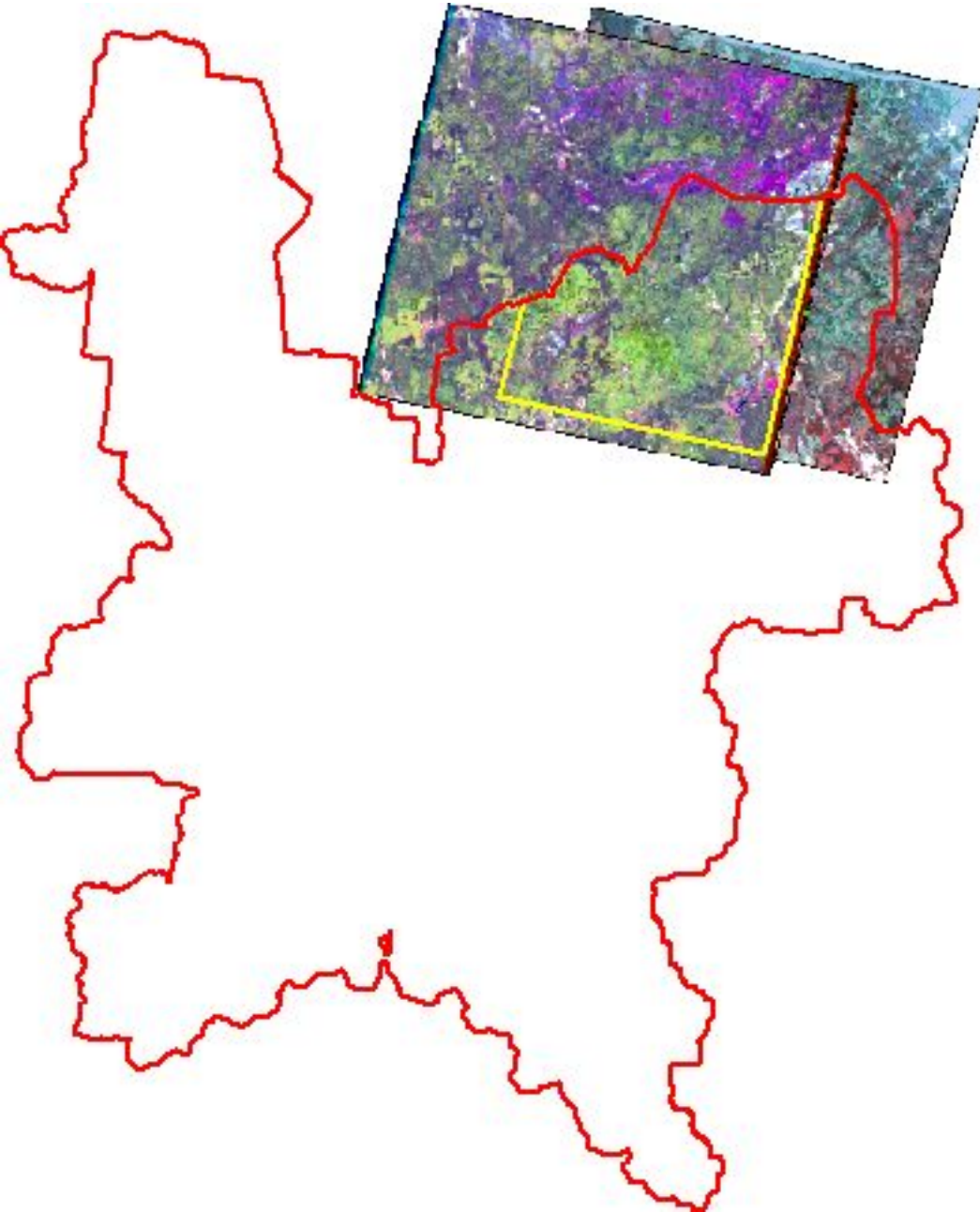
European Russia Mapping (plans for 2008)



Logging sustainability

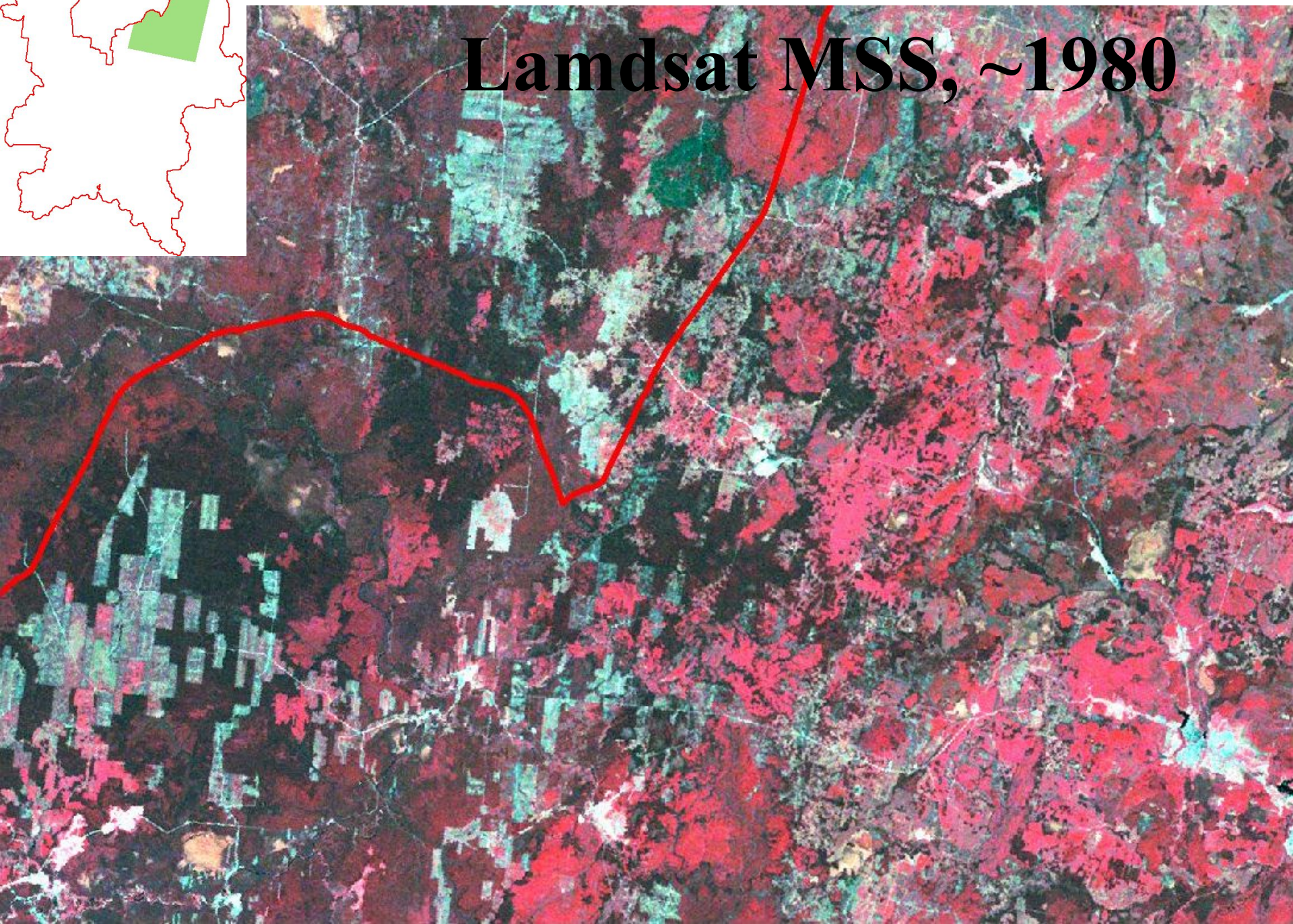
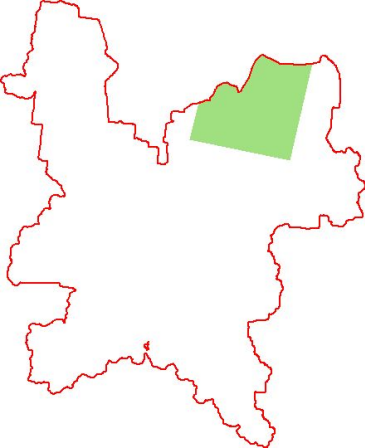


MSS-TM-ETM+ change detection

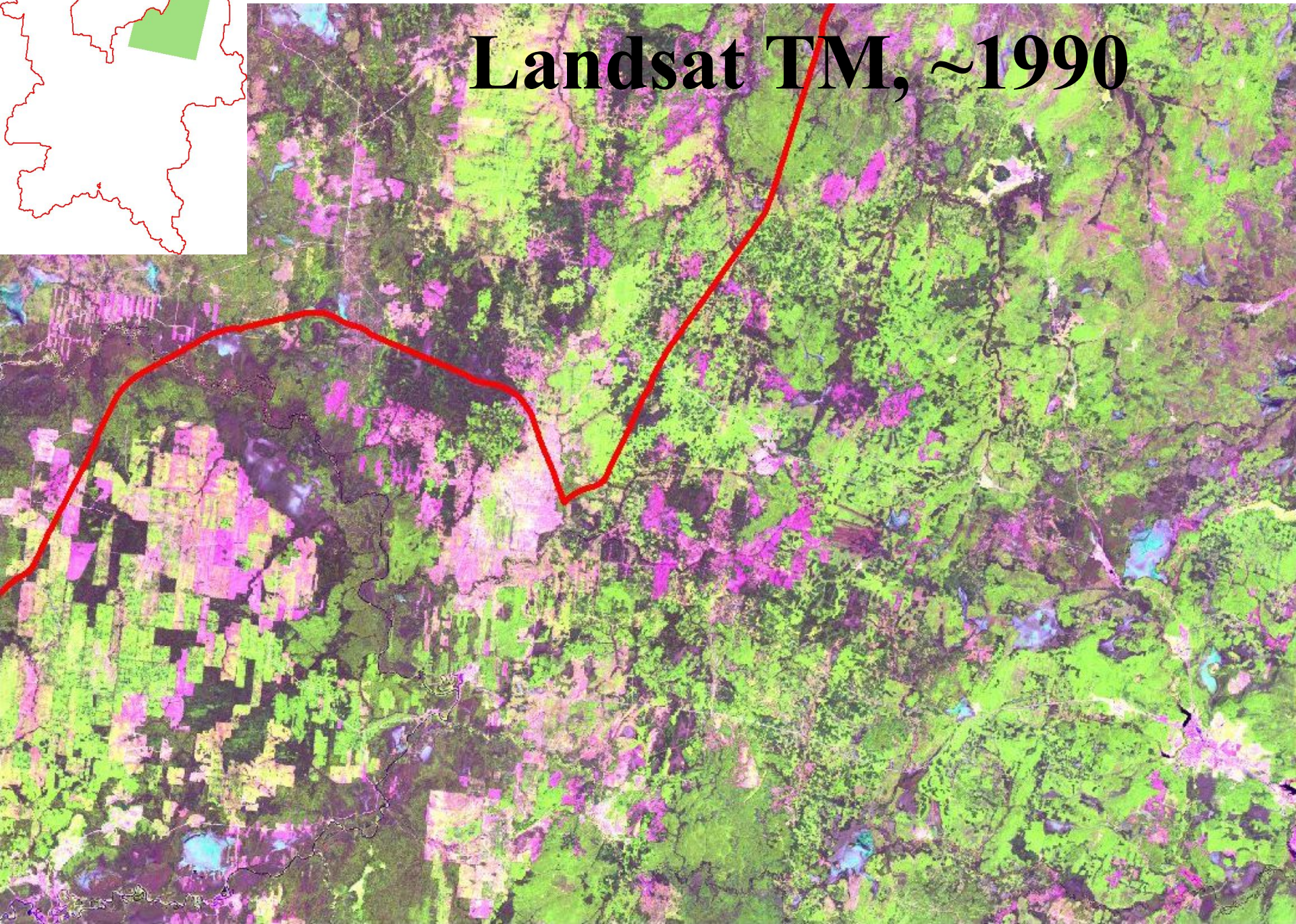
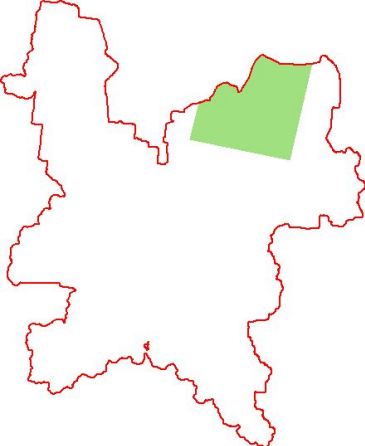


Northern Kirov
Oblast

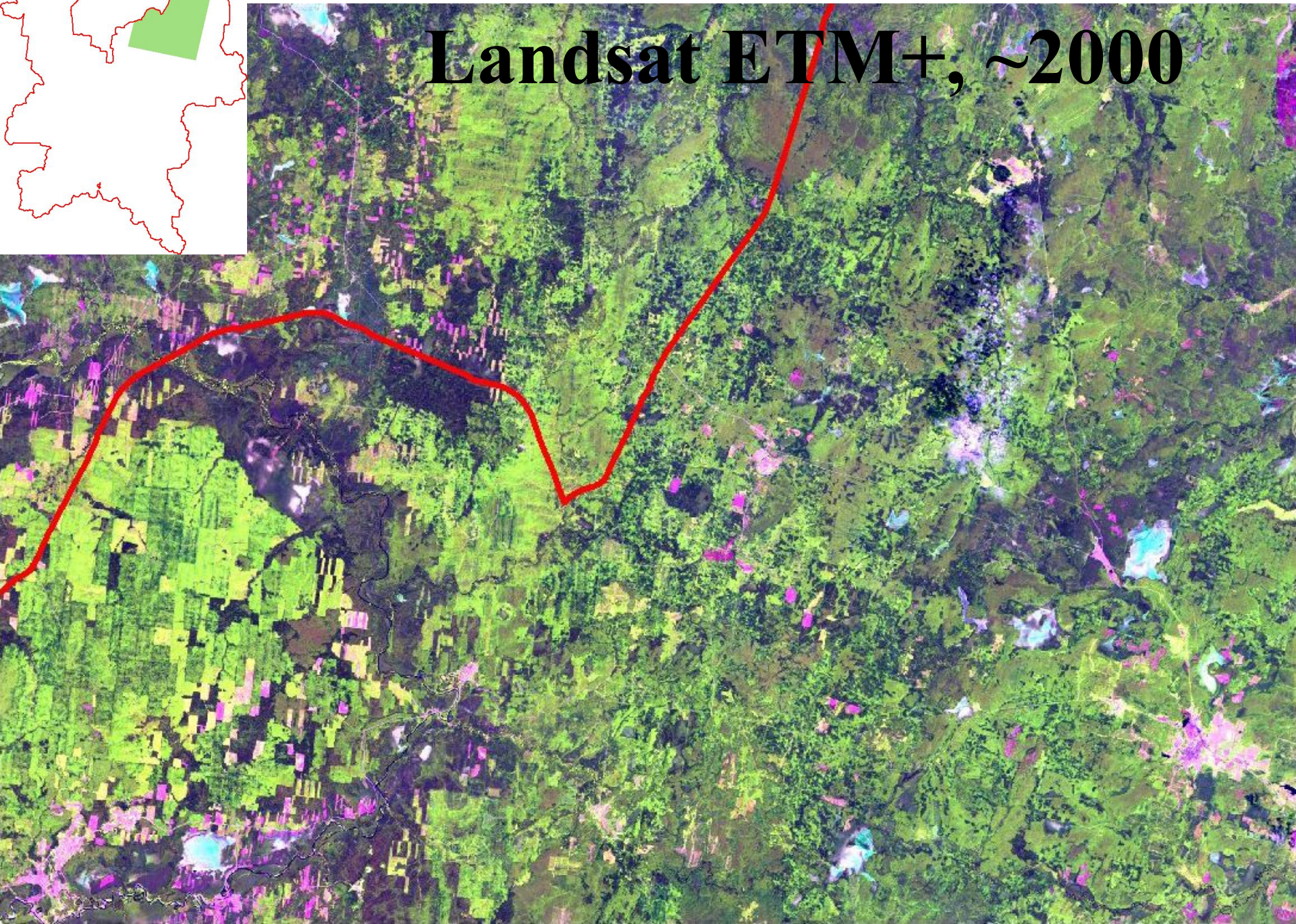
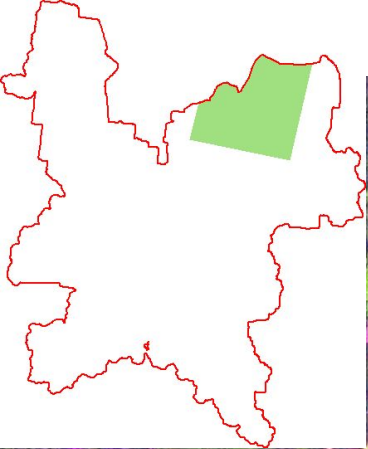
Landsat MSS, ~1980



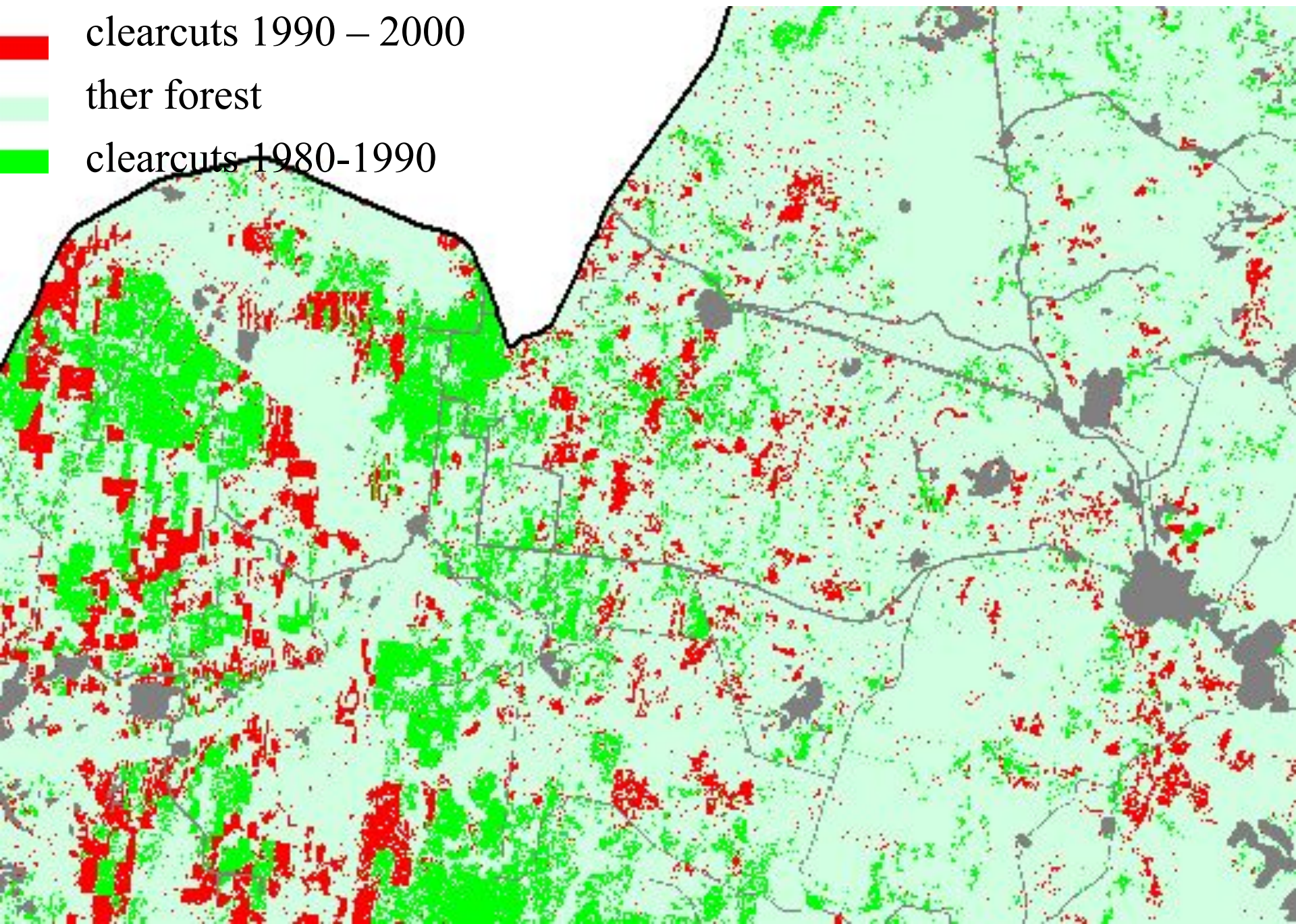
Landsat TM, ~1990



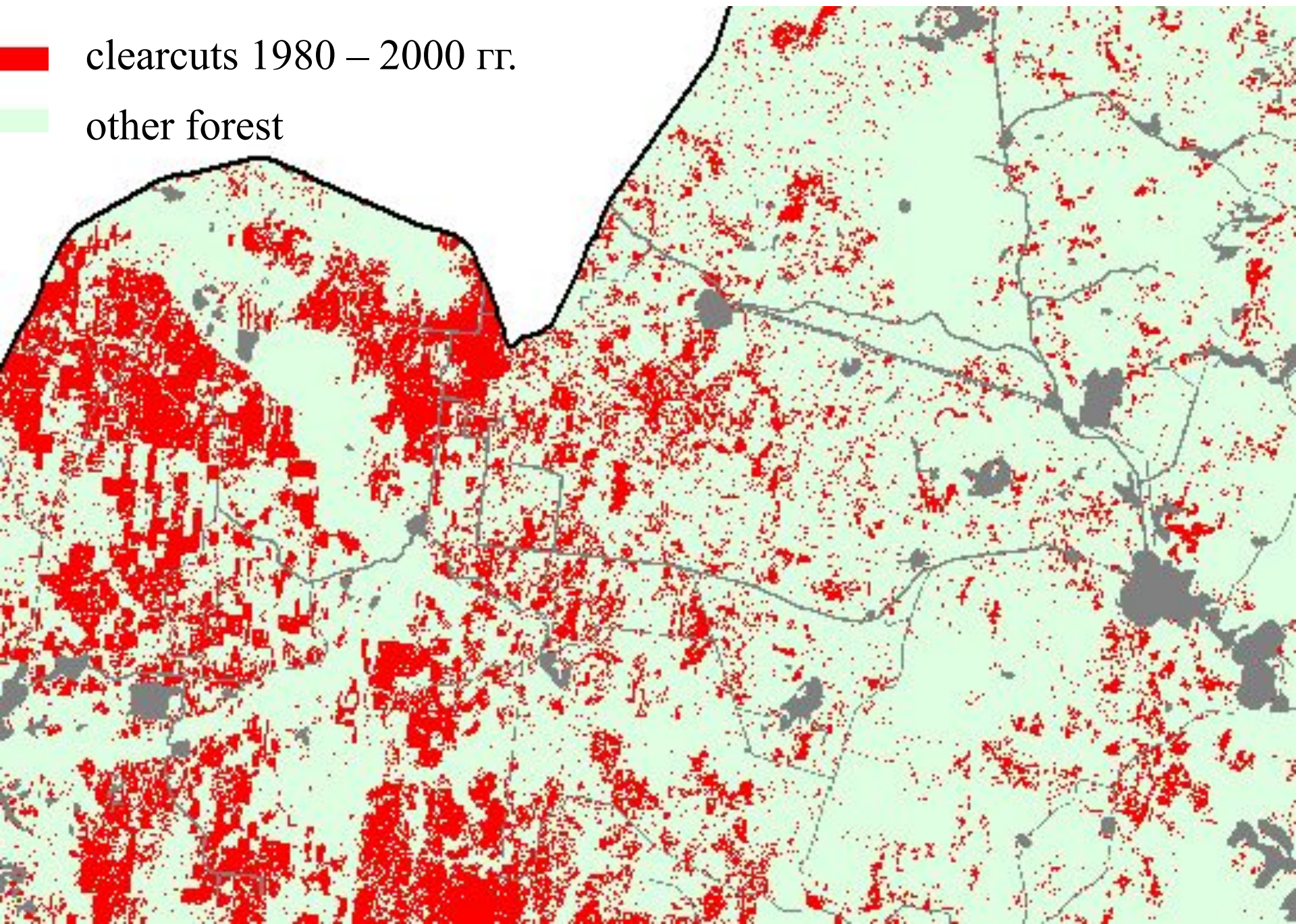
Landsat ETM+, ~2000



- 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

