

e-Sensing: Big Earth observation data analytics for land use and land cover change information

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www.esensing.org



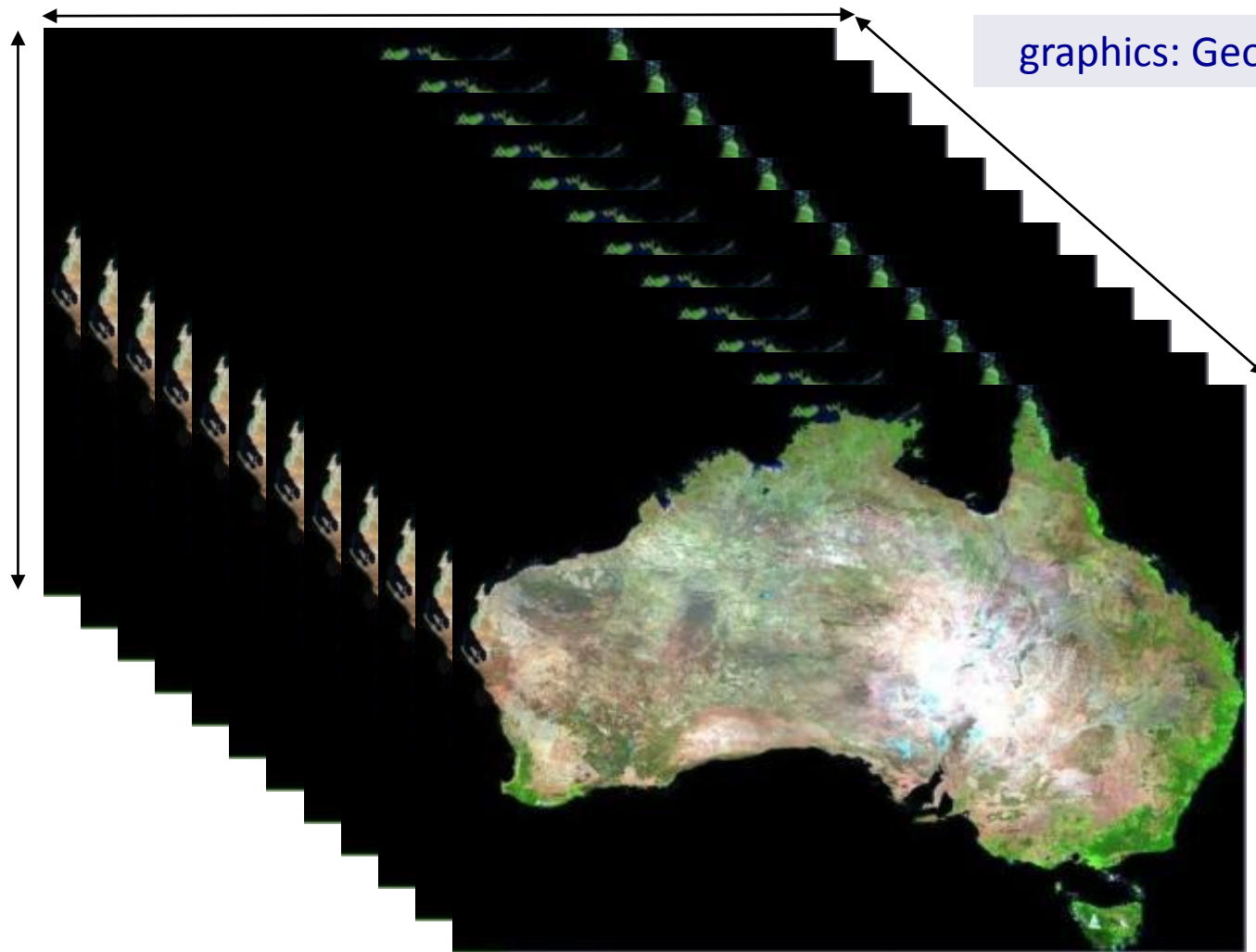
Earth Observation data is now free...and big

graphics: NASA



Sentinels + CBERS + LANDSAT + ...: > 10Tb/day

What changes with big geospatial data?



graphics: Geoscience Australia

Searching for changes instead of searching for objects

Tropical rainforest





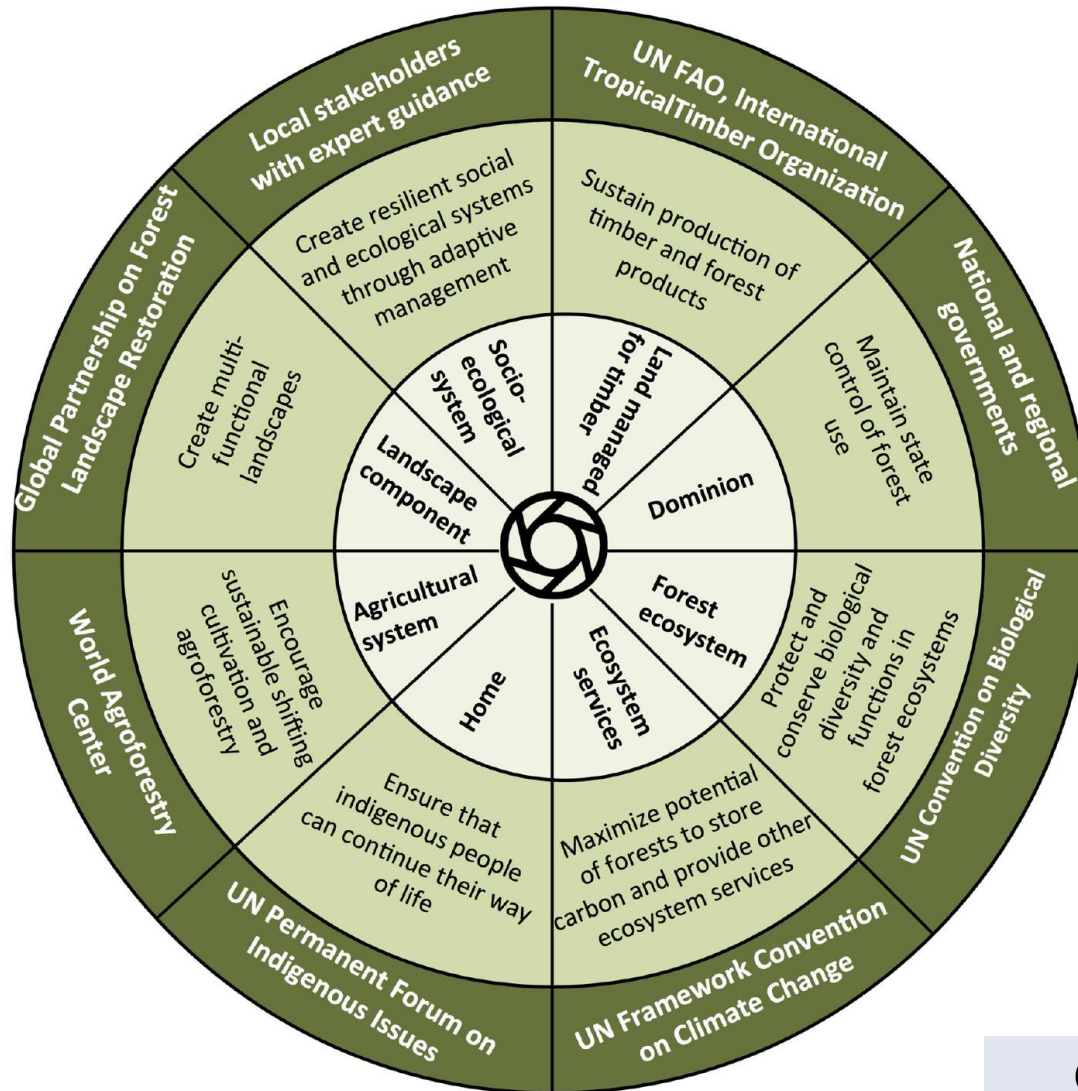
Taiga (boreal forest)



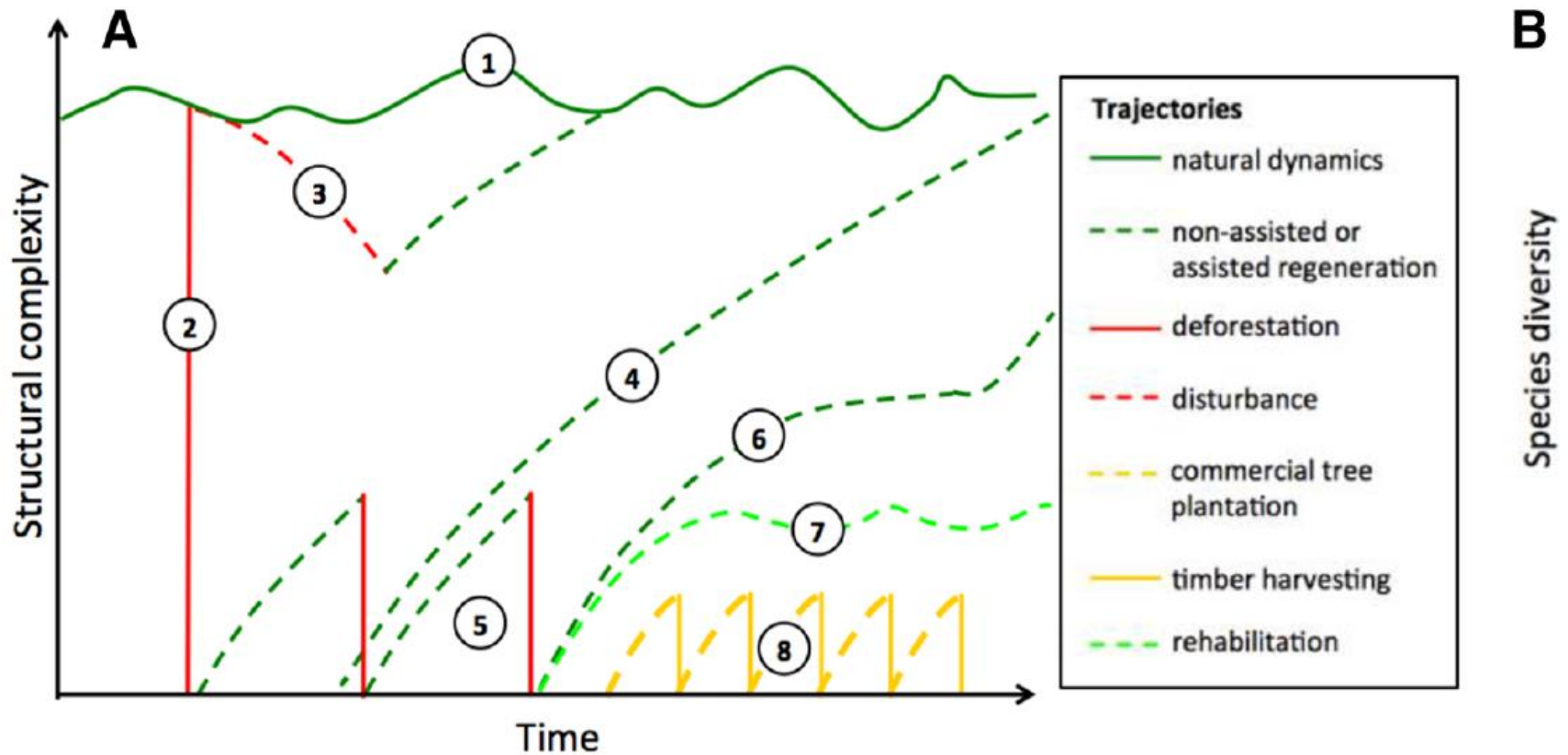
Tropical dry forest (caatinga)



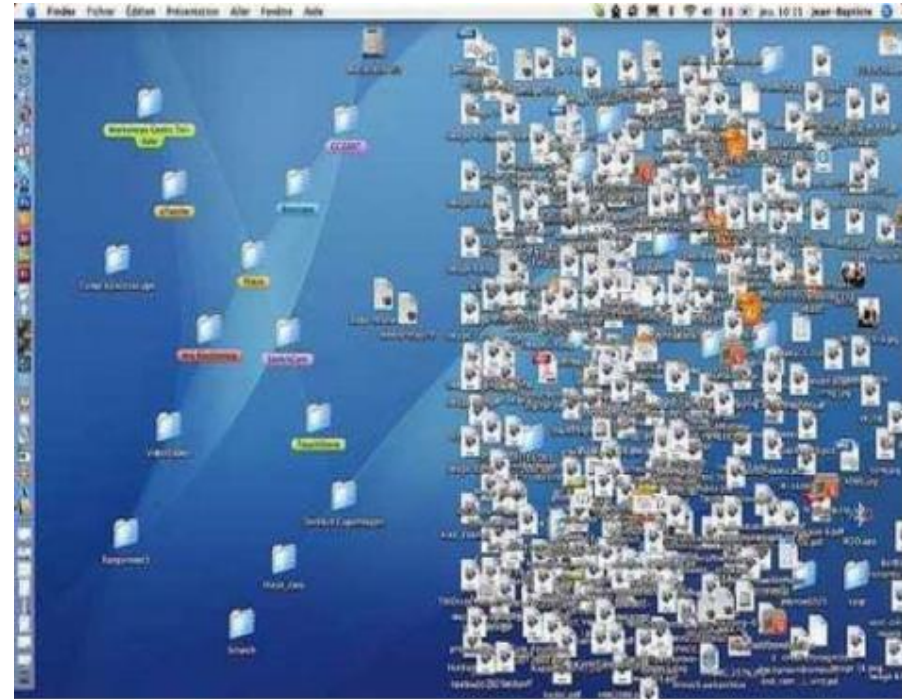
When is a forest a forest?



Distinguishing forests by temporal evolution

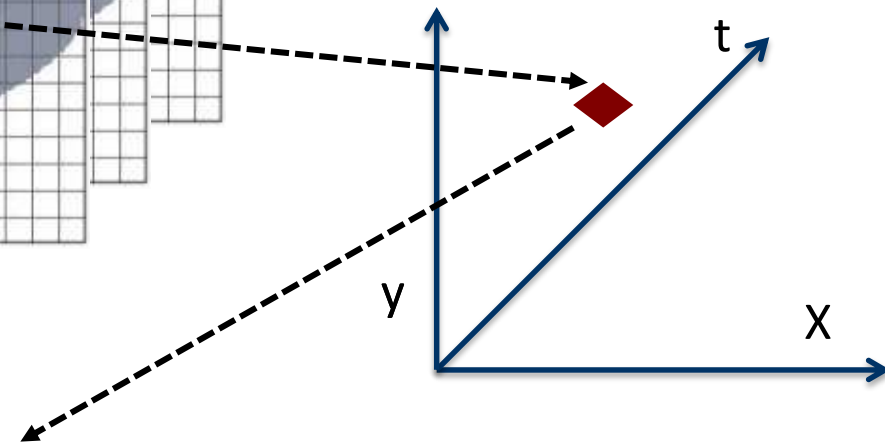
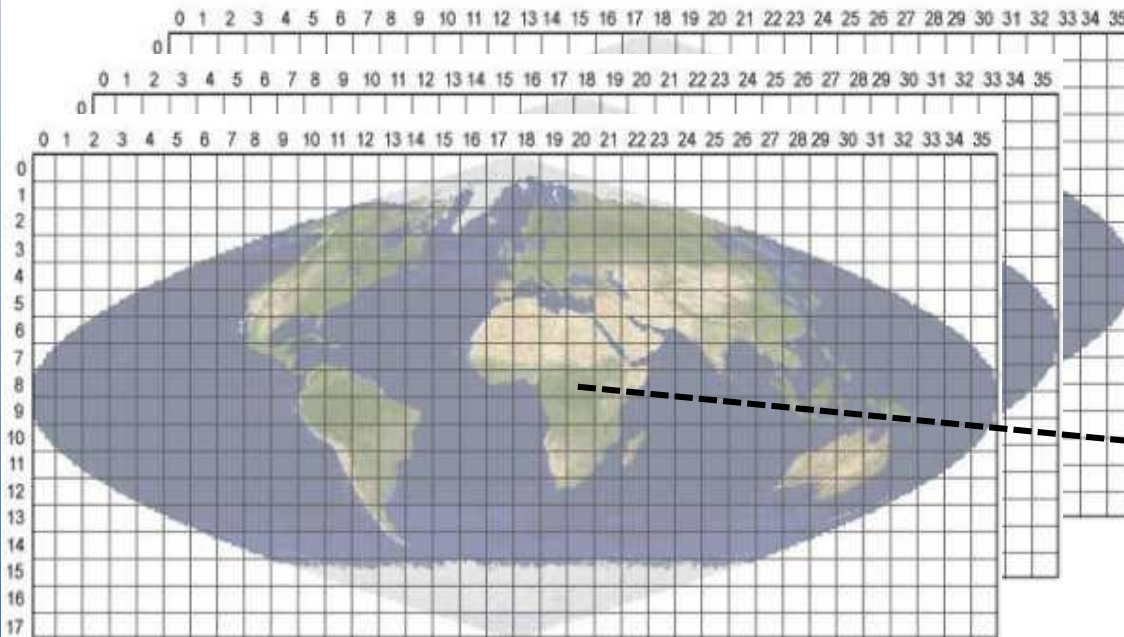


Big data = lots of files?



“...by the time a file system can deal with billions of files, it has become a database system” (Jim Gray)

Array databases: all data from a sensor put together in a single array



result = analysis_function (points in space-time)



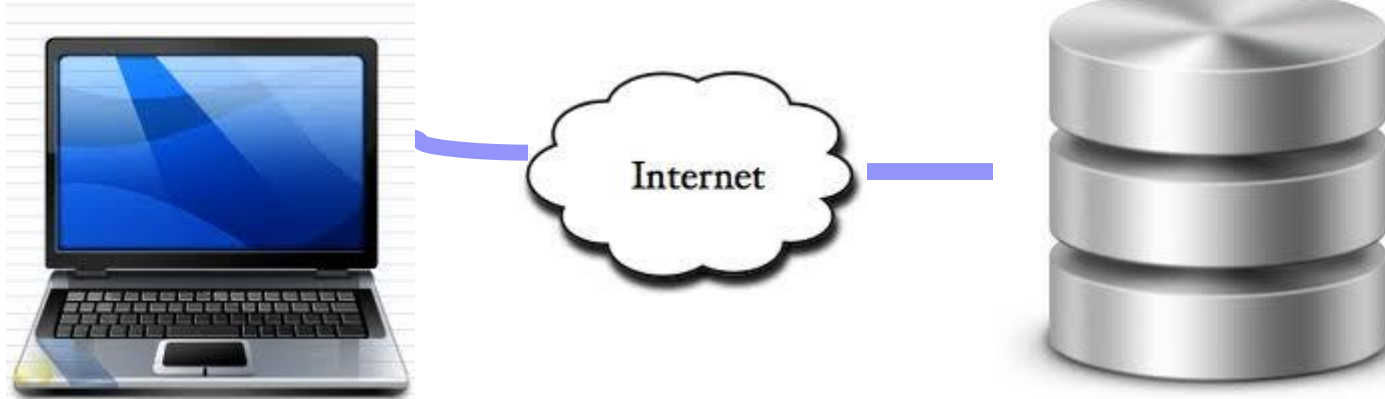
Data Access Hitting a Wall



How do you download a petabyte?
You don't! Move the software to the archive



Where we want to get to

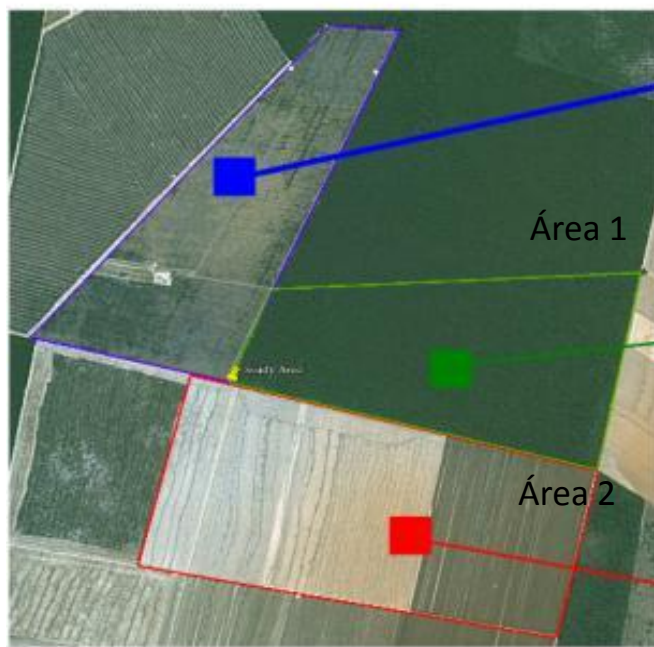


**Remote visualization and
method development**

**Big data EO
management and
analysis**

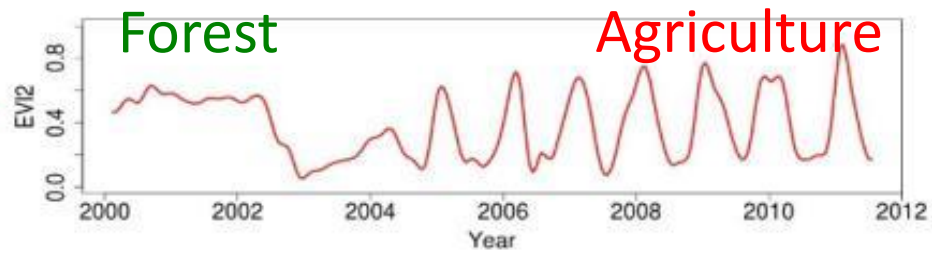
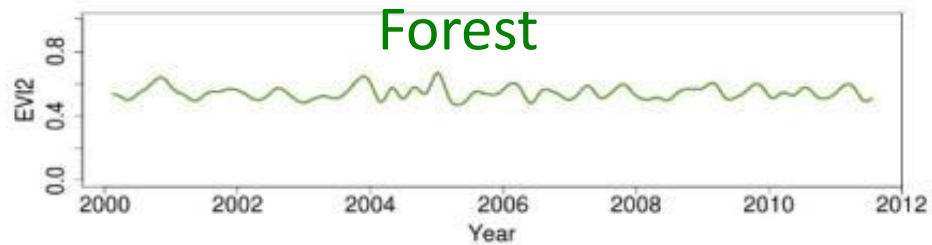
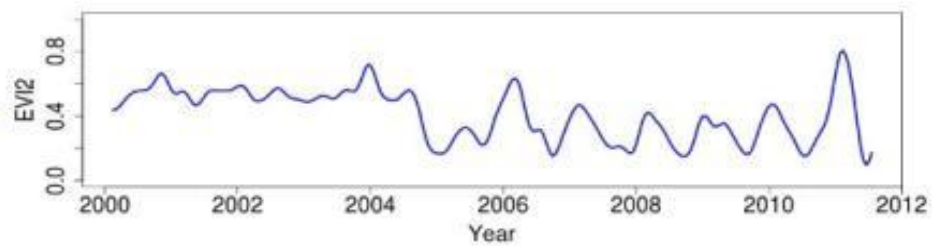
40 years of Earth Observation data of land change
accessible for analysis and modelling.

Land trajectories



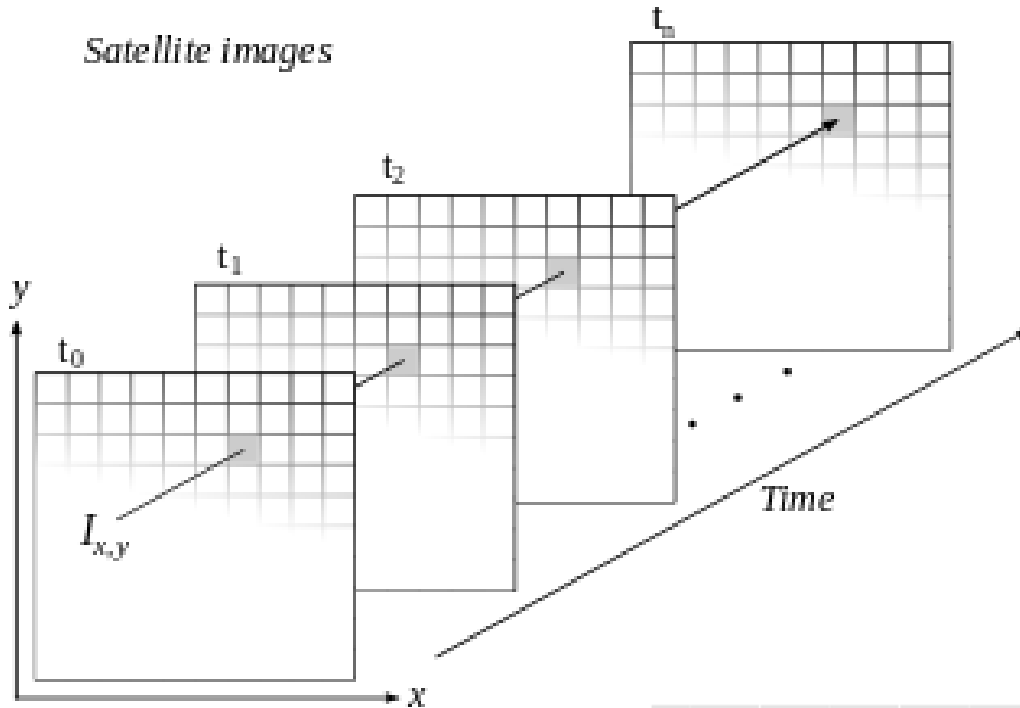
Área 3

Forest Pasture Agric



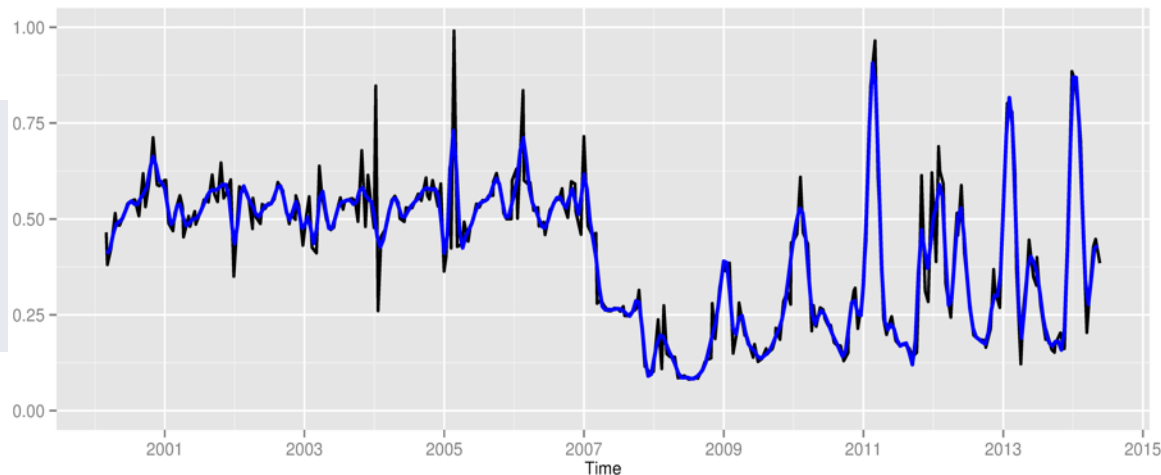
“The transformations of land cover due to actions of land use”

Space first, time later or time first, space later?

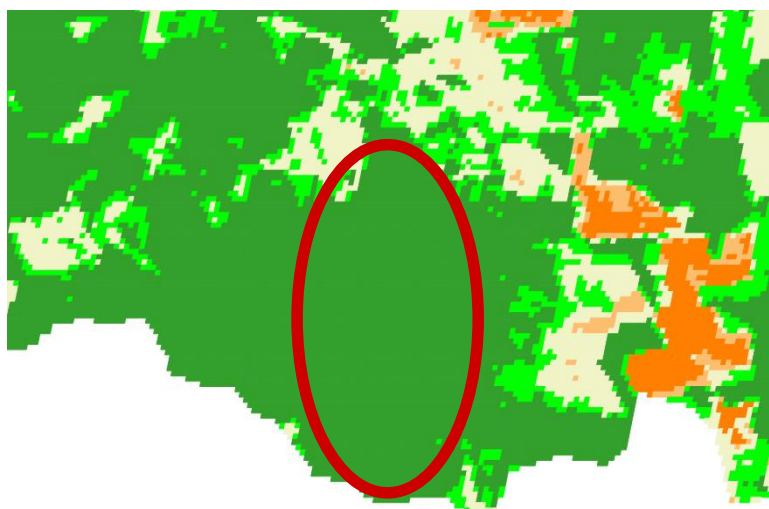
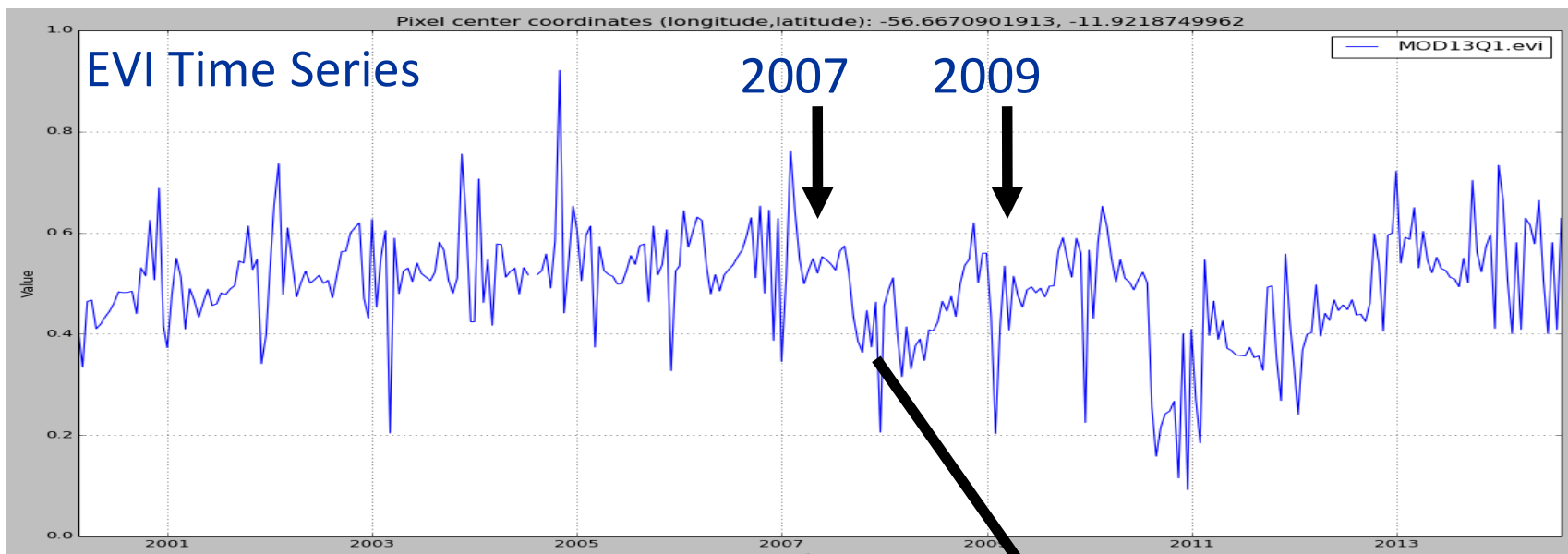


Space first: classify images separately
Compare results in time

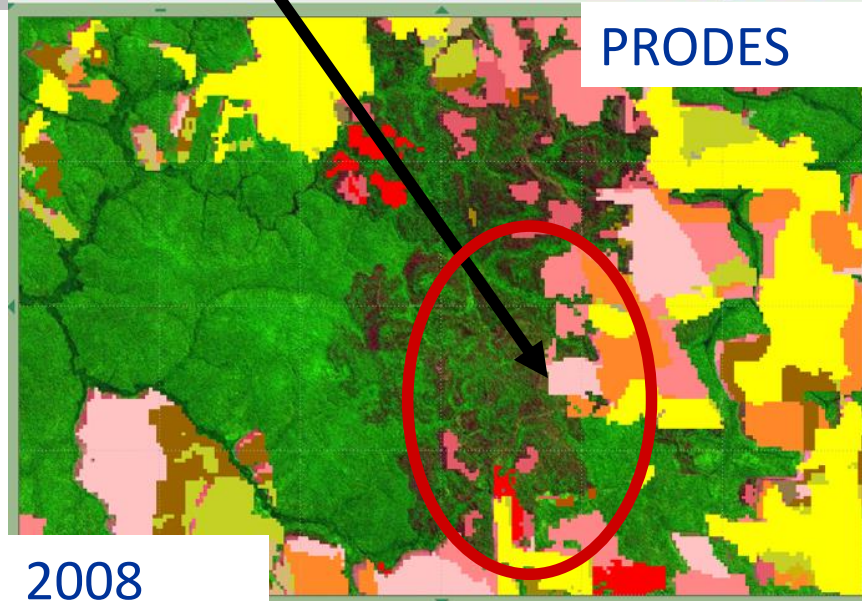
Time first: classify time series separately
Join results to get maps



Land trajectories: forest degradation



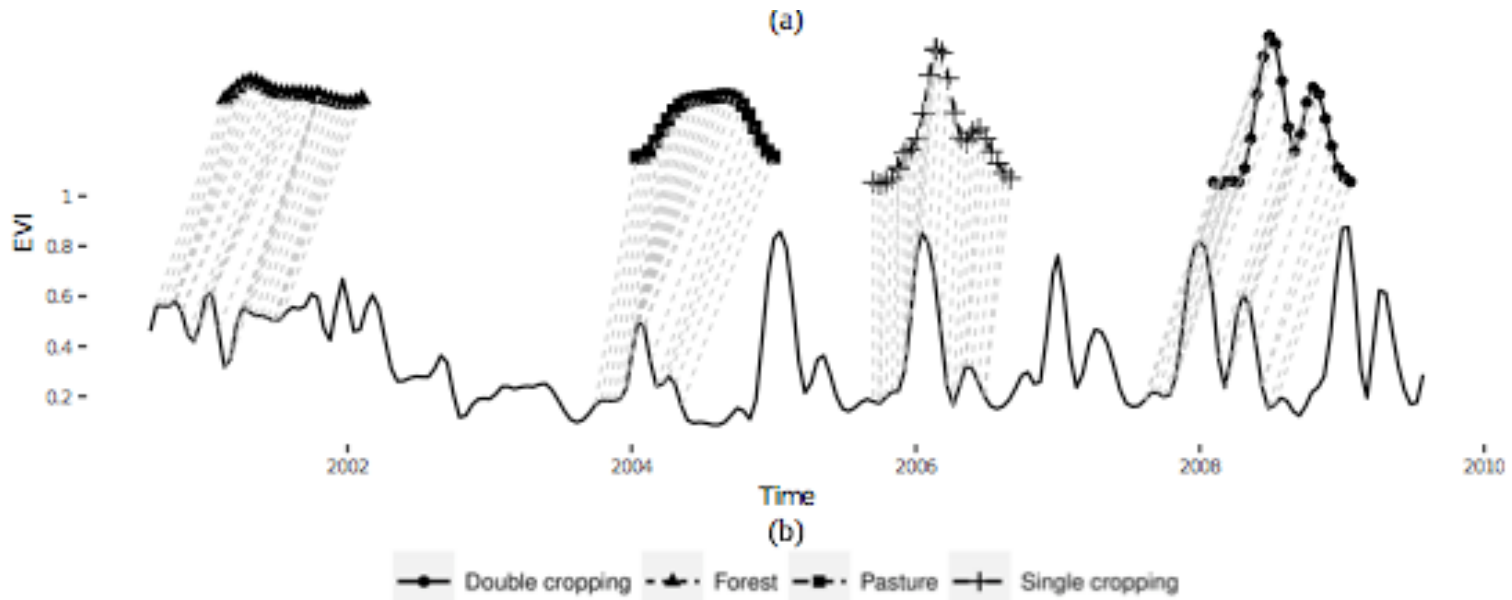
2007



2008



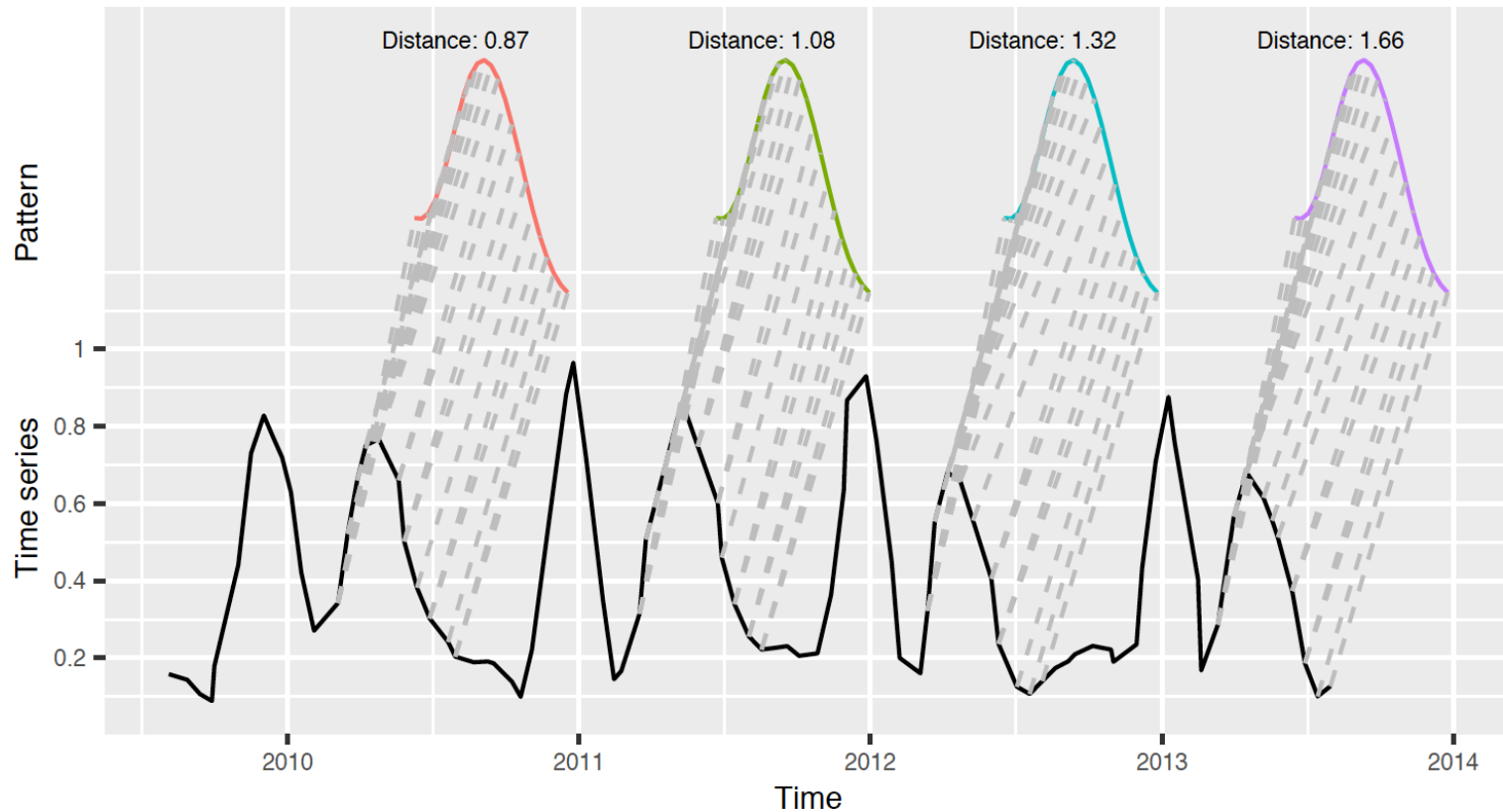
How to match land use patterns in a remote sensing time series?



A good match needs shape similarity and temporal coherence



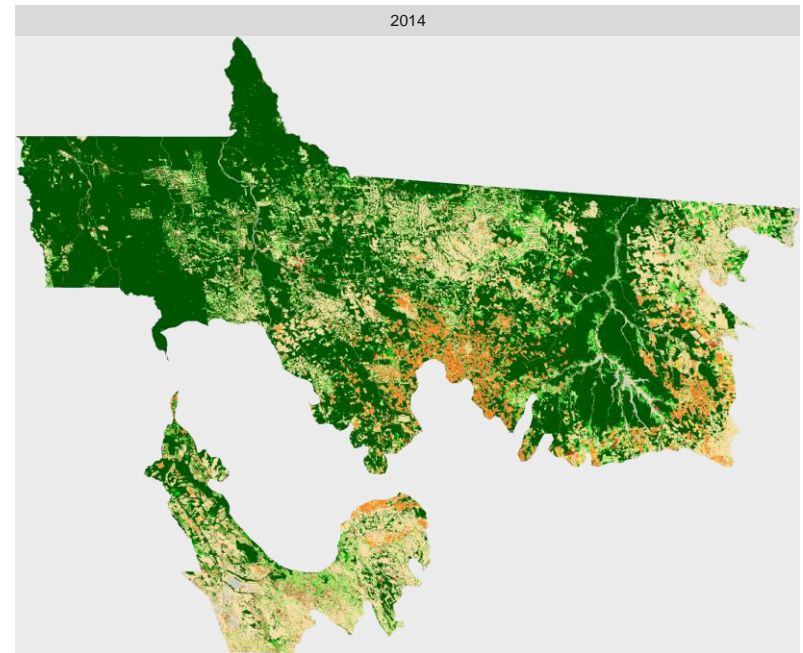
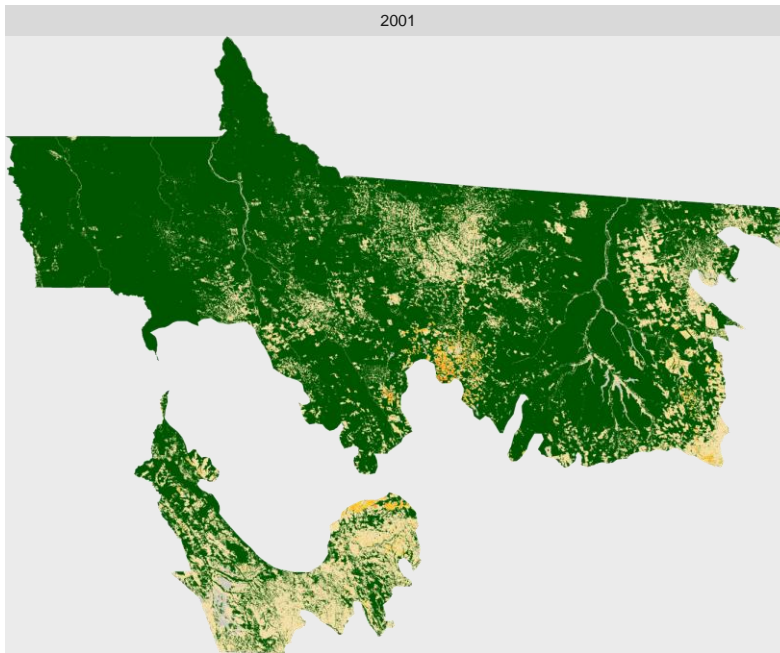
Time-weighted dynamic time warping (TWDTW) for remote sensing time series



TWDTW finds alignments of short templates in a long time series considering the agricultural calendar



Land use change trajectories in the Amazonian biome of Mato Grosso state (2001-2014)



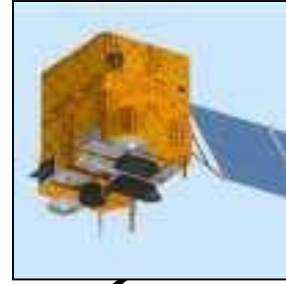
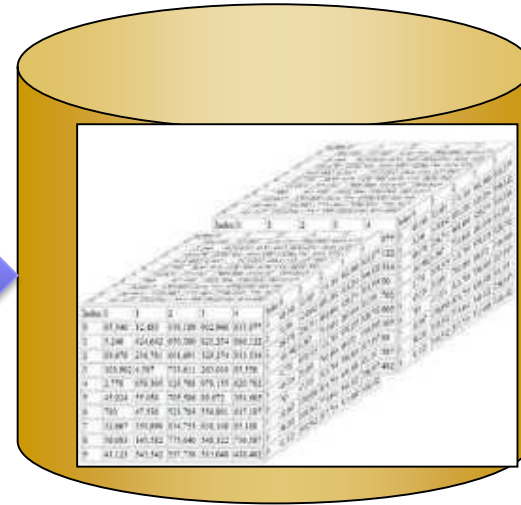
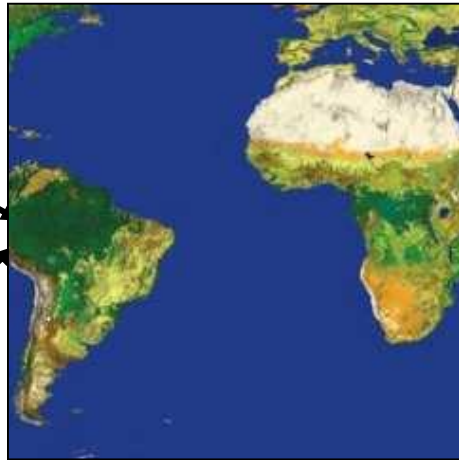
Class

- Primary forest
- Deforestation/Forest degradation
- Post-extraction/fire secondary forest
- Rehabilitated secondary forest
- Pasture
- Cotton
- Soybean
- Soybean-cotton
- Soybean-maize
- Unclassified

33 million time series



Global Land Observatory: describing change in a connected world



Methods for land change for forestry and agriculture uses

40 years of LANDSAT + 12 years of MODIS + SENTINELS + CBERS



Unique repository of knowledge and data about global land change



Challenges for big data analytics

1. *Model sharing*: How to share models?
2. *Analytical scaling*: How to adapt existing desktop methods to work with big data?
3. *Collaborative work*: How to build a scientific version of "Google Earth Engine"?