

CFR Biodiversity Loss Project

C.A.P.E. Implementation Committee

18 November 2009

Project aims

- To track biodiversity loss in the CFR
- With a view to evaluating the impact of the C.A.P.E. programme
- To develop a method that can be used for other bioregional programmes and nationally

Proposed method

- To track loss of natural habitat
- By developing time-series land cover for the CFR, using MODIS data
- Initially for 2000, 2005 and 2008

Outputs

- Initial outputs (by May 2010):
 - Trends in habitat loss
 - Drivers of habitat loss
- Potential to develop the analyses further:
 - Loss in critical biodiversity areas and threatened ecosystems relative to other areas
 - Loss in particular biodiversity corridors
 - Degradation
 - Invasives

Why is this significant?

- If we get this right...
- First time series land cover in the country
 - Current National Land Cover does not provide a time series – 1996 not comparable with 2000
- Will feed directly into key indicators for national biodiversity monitoring and reporting framework
- Will provide important opps for capacity building in SANBI
- Synergies with BIOTA degradation mapping project
- In line with international standards for land cover mapping

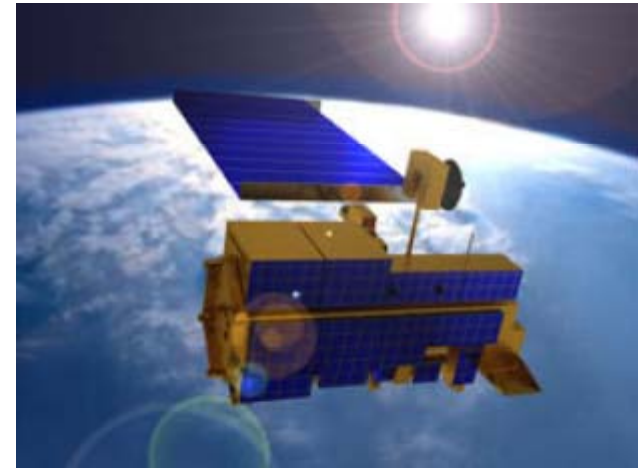
The technical part...

Sensors for Time Series Generation

	Meteosat, (MSG)	NOAA AVHRR	SeaWiFS	SPOT VEGETAT ION	MODIS	MERIS- ENVISAT	AWIFS- IRS-P6	Rapid Eye (5 sat.)	Sentinel 2 (2 sat.)
Spatial [m]	2.5-5 km, (1-3 km)	1,100	1,100	1,000	250, 500, 1,000	300	60	6.5	10, 20, 60
Spectral bands	3, (12)	5	8	4	36	15	4	5	13
Temporal	30, (15) minutes	Daily	Daily	Daily	1-2 days	3	24 days, overlap at high lat.	Daily	Daily
Swath [km]	Hemi- sphere	3,000	2,800	2,200	2,300	1,150	740	77, pointable	285, pointable
period	Since 1977, (2004)	Since 1981	Since 1997	Since 1998	Since 2000	Since 2002	Since 2003	Planned 2008	Planned 2012

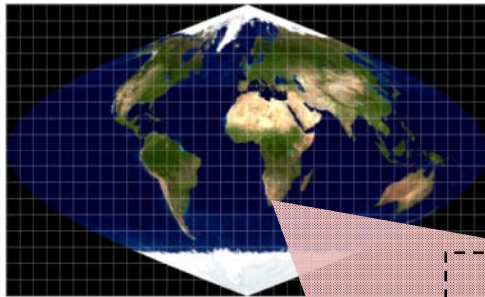
MODIS Sensor

- **MOD**erate resolution **Imaging Spectroradiometer**
- Onboard Terra (EOS-AM, Dec 1999) and Aqua (EOS-PM, May 2002)
- Swath: 2,300km, global
- Resolution
 - Spatial: 250 to 1,000m spatial resolution
 - Radiometric: 12 bit radiometric resolution
 - Temporal: 1-2 days
 - Spectral: 36 bands from visible to thermal infrared
- Standardized preprocessing: radiometric, geometric, atmospheric correction
- Standardized processing of value-added products
- Extensive data quality indicators



Terra platform
(<http://terra.nasa.gov/About/index.php>)

Spatial Coverage of MODIS Time Series Data



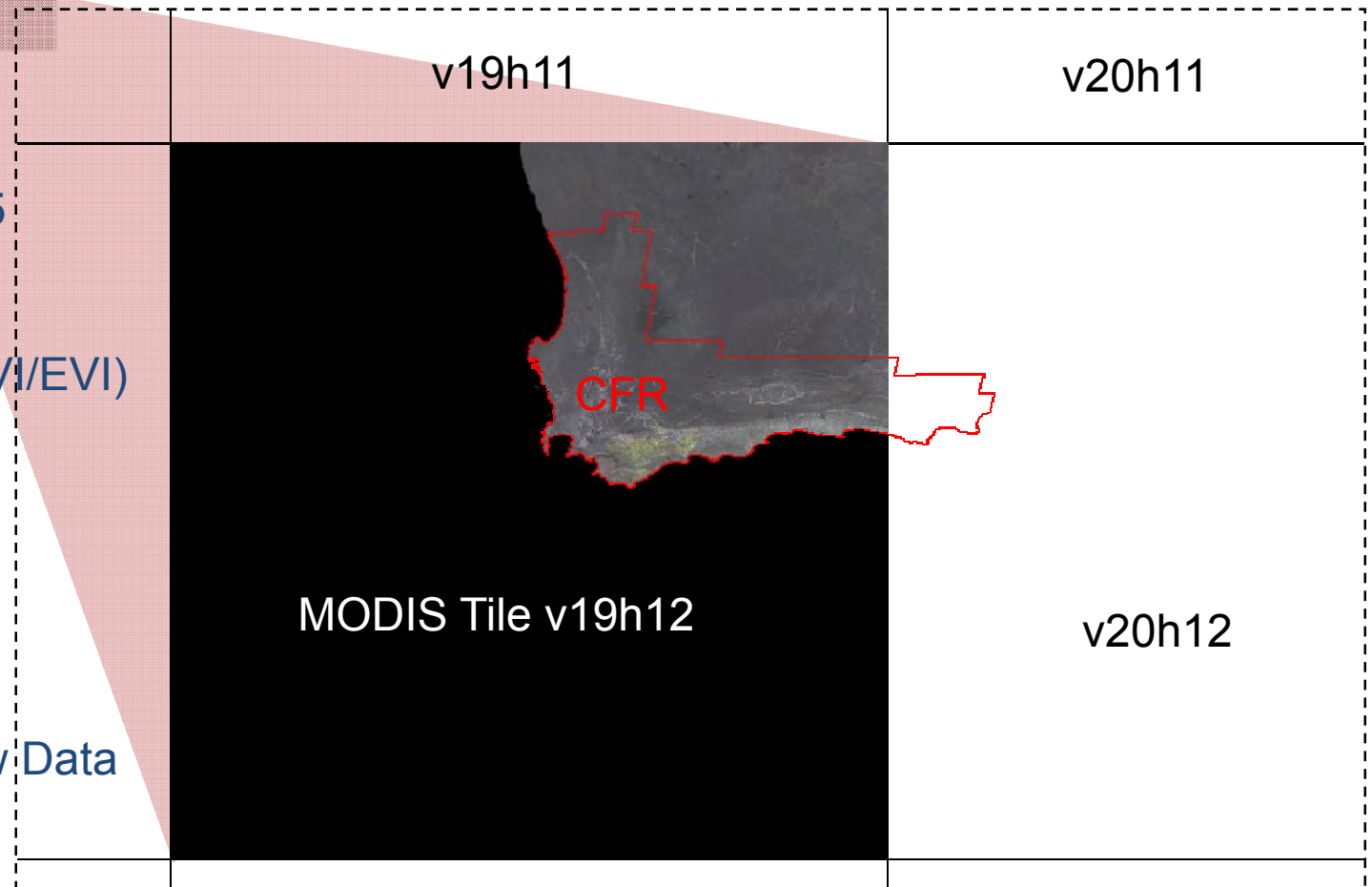
MODIS Collection 5 World Sinusoidal Grid

MODIS Collection 5
Land Product

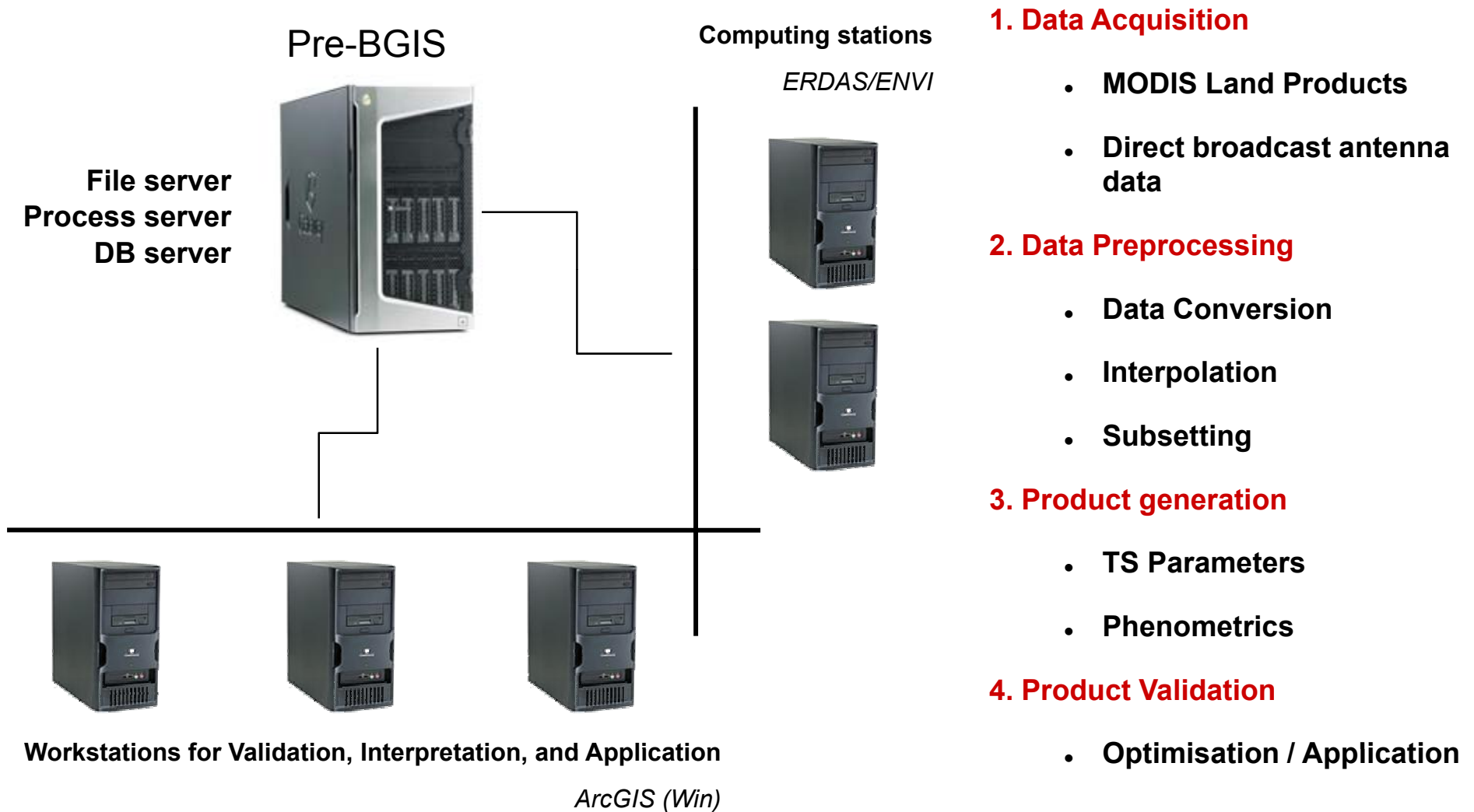
MOD13 (250m NDVI/EVI)
Tile v19h12
03/2000 - recent

Approx. 200 MB /
16-Day Composite

Approx. 42 GB Raw Data

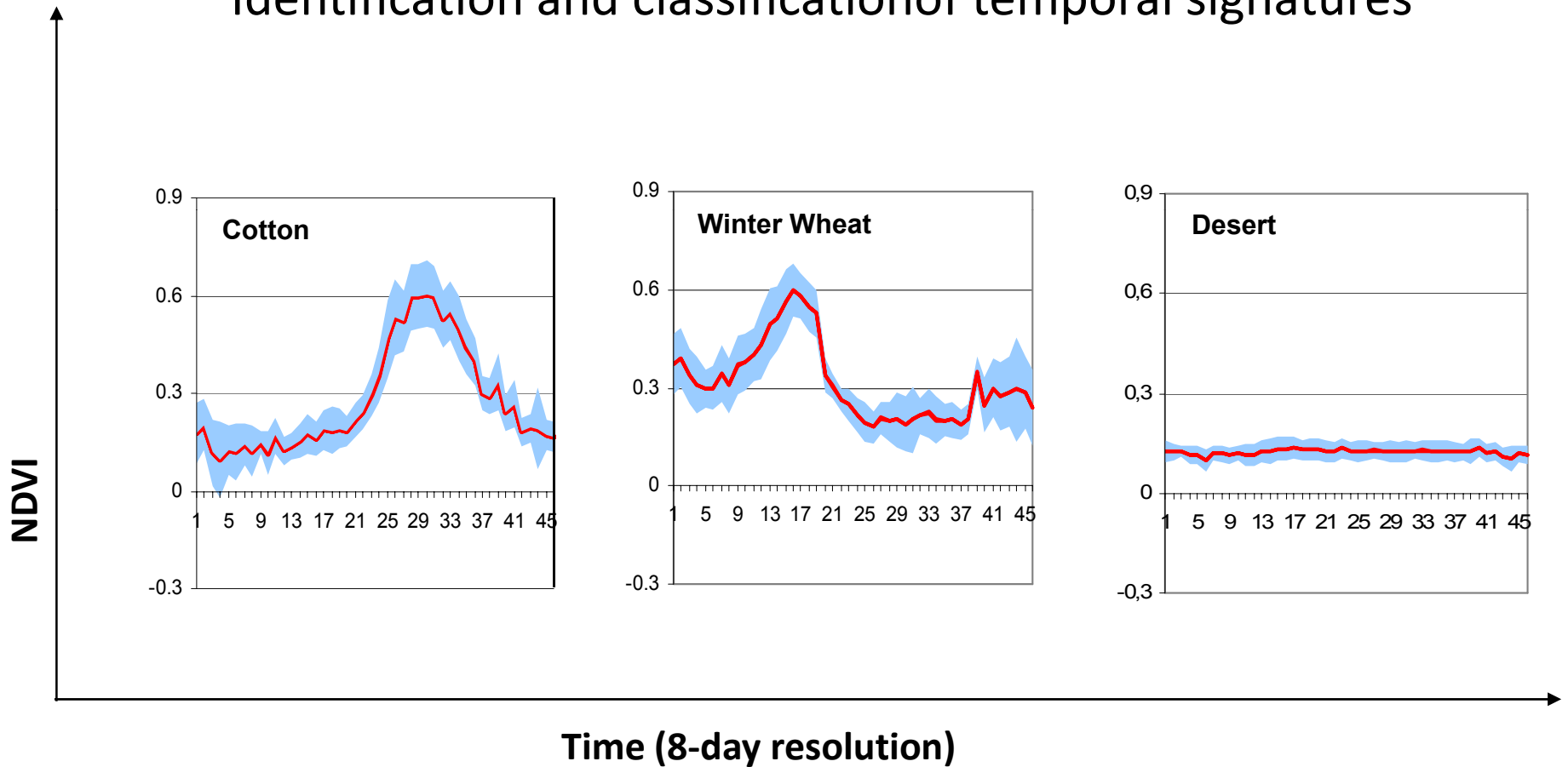


Storage and Pre-Processing of Time Series Data



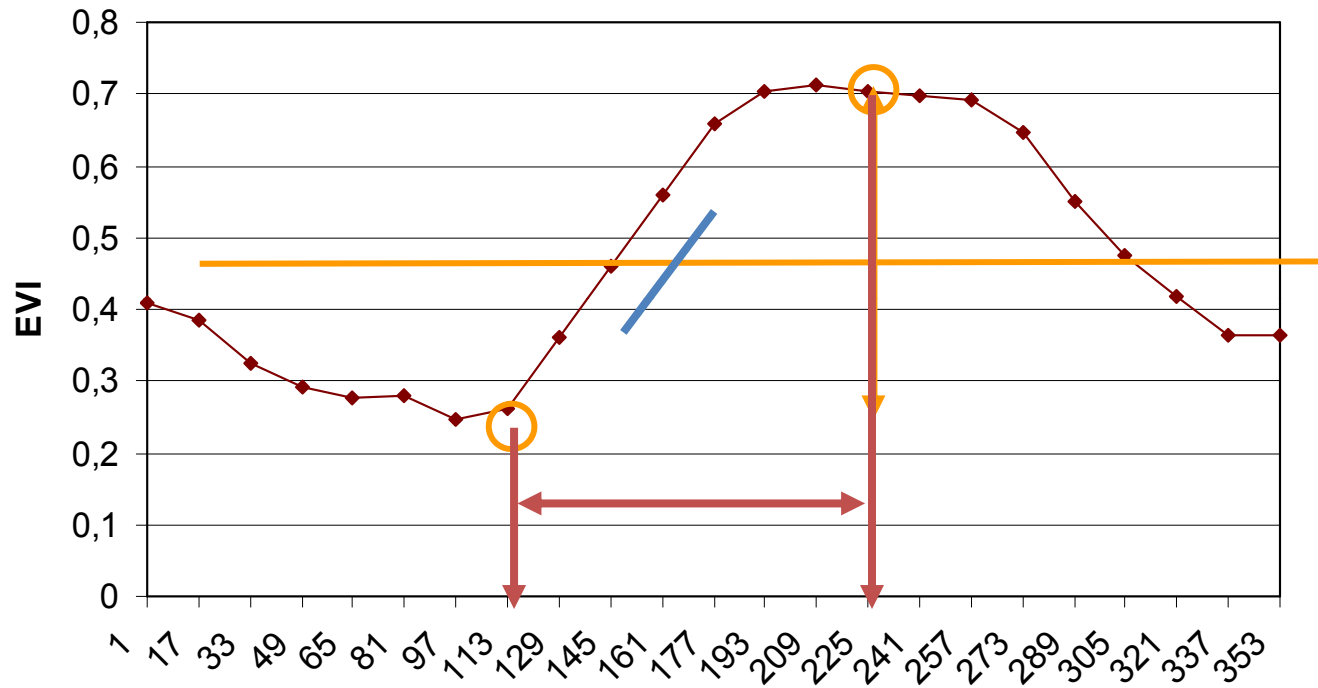
Time Series Analysis Techniques

Identification and classification of temporal signatures



Time Series Analysis Techniques

Extraction of temporal Metrics



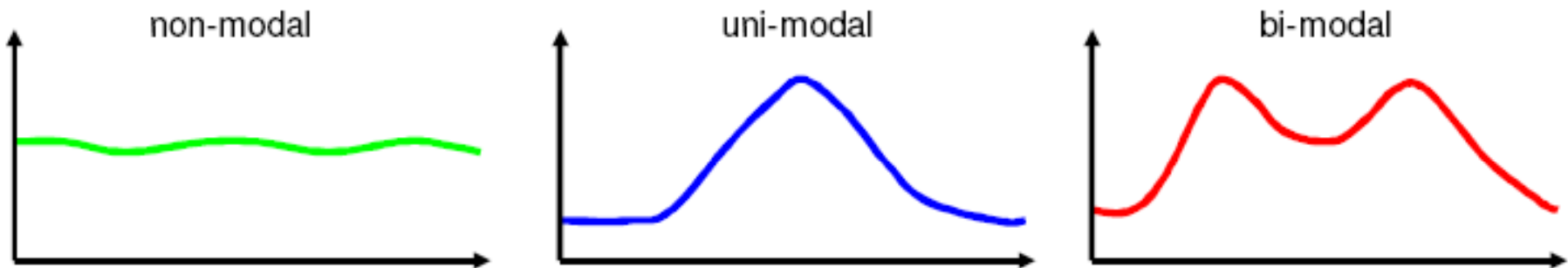
Minimum value
Maximum value
Mean value
Range

Date of minimum
Date of maximum
Length of greening period

> Date of minimum
> Date of maximum
> Large integral
> Small integral

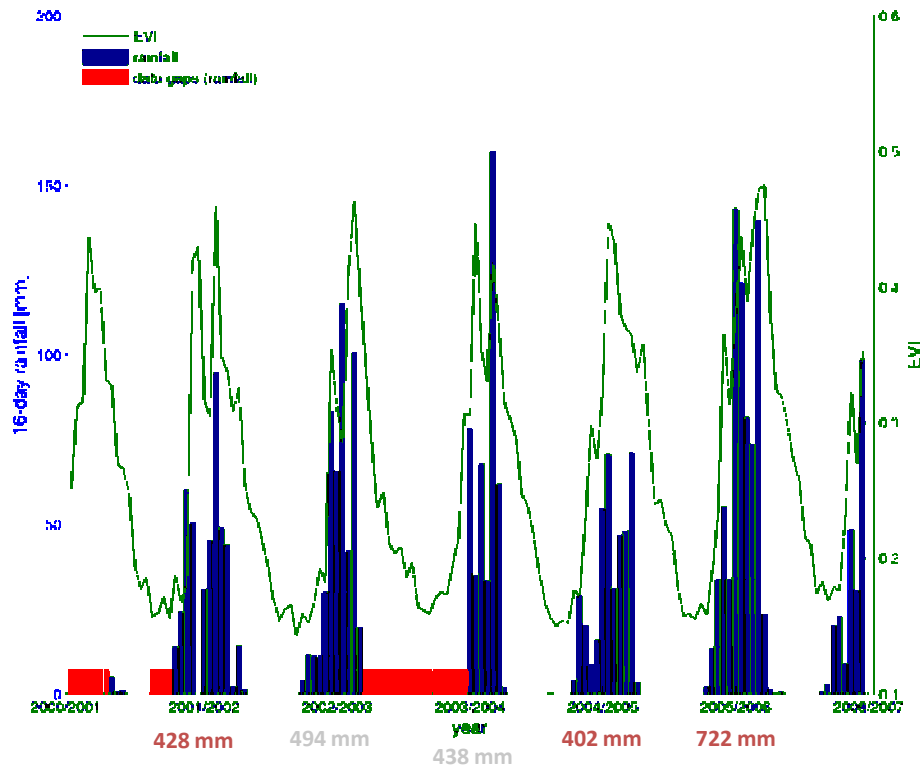
Time Series Analysis Techniques

- Classifying the seasonality
- Harmonic analysis (Fourier transformation)
 - Calculation of explained variance for each harmonic
 - Selection of harmonic with highest (weighted) explained variance

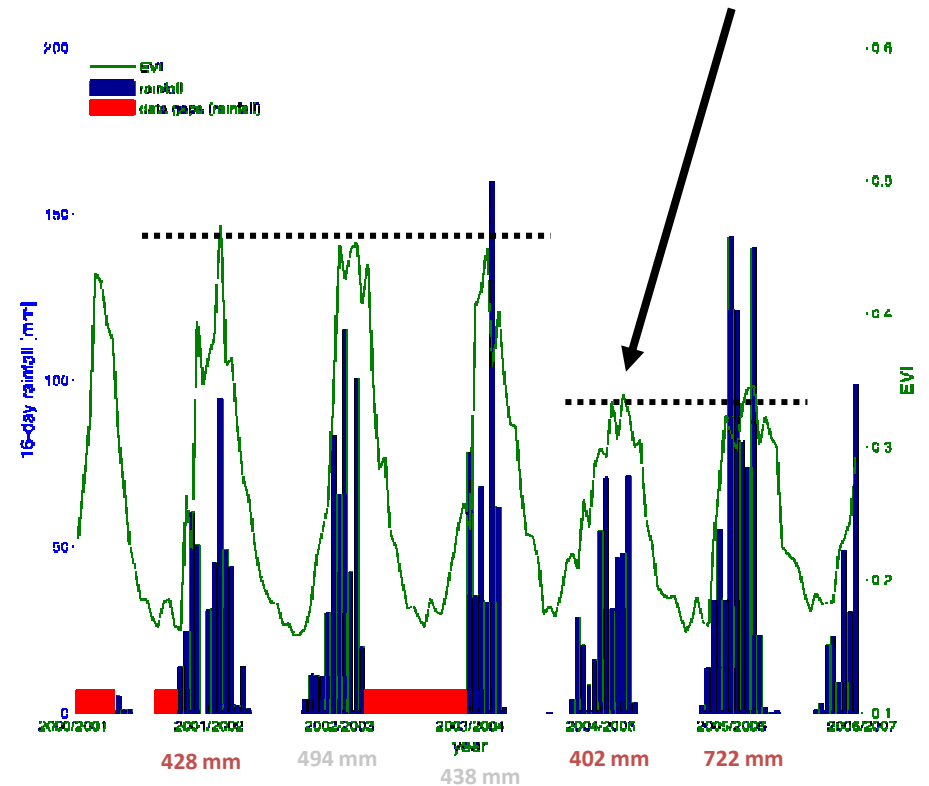


Change Detection using Time Series

Transformation to Cultivation



Closed Shrubland (Kalahari)



Closed Shrubland -> Agriculture (Kalahari)

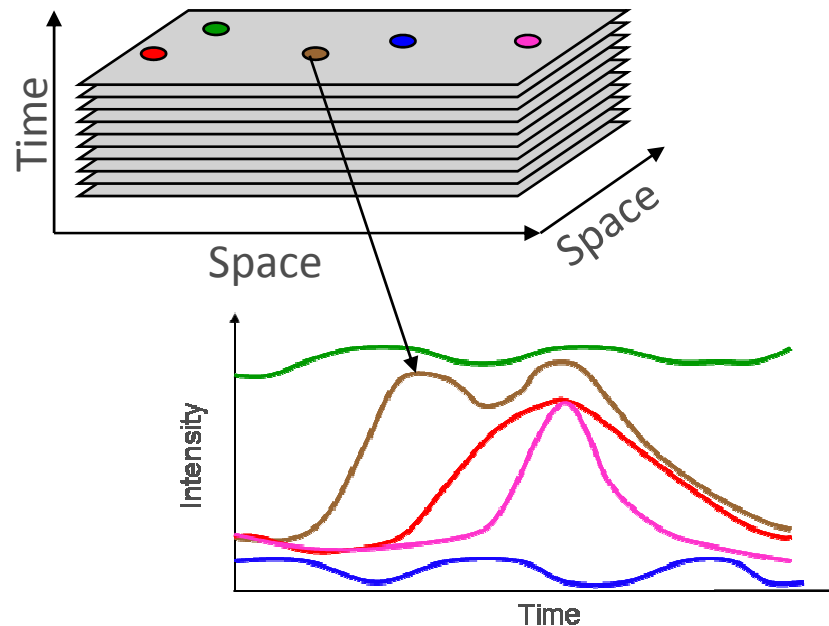
Pros and cons of MODIS time-series data

Pros

- Repeatable, comparable, analysis and product generation through time
- Serve as alarm/change indicator
- Data availability key to successful monitoring

Cons

- Quality - needs attention
- Large amounts of data
- Low spatial resolution - 250m

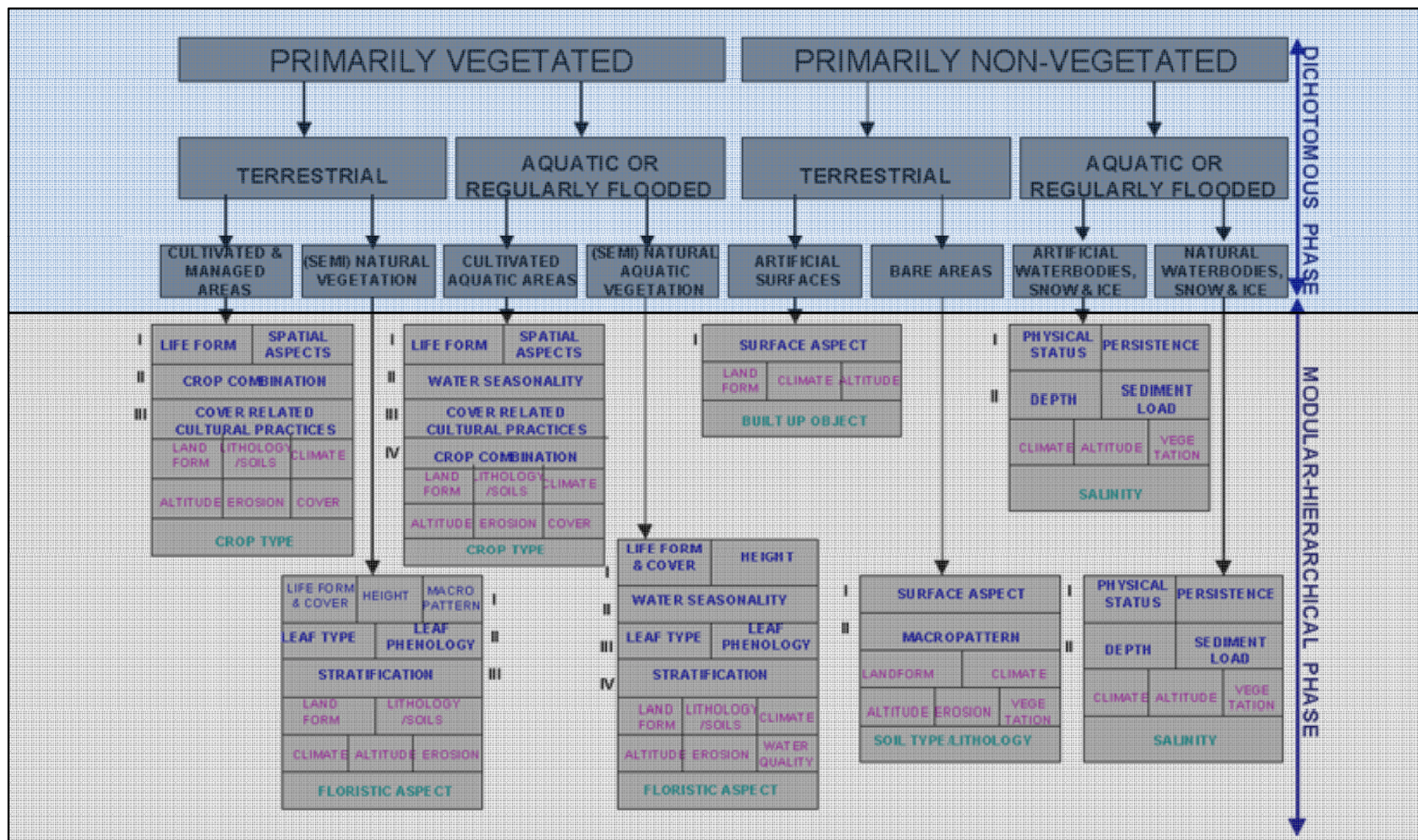


Analysis in space AND time

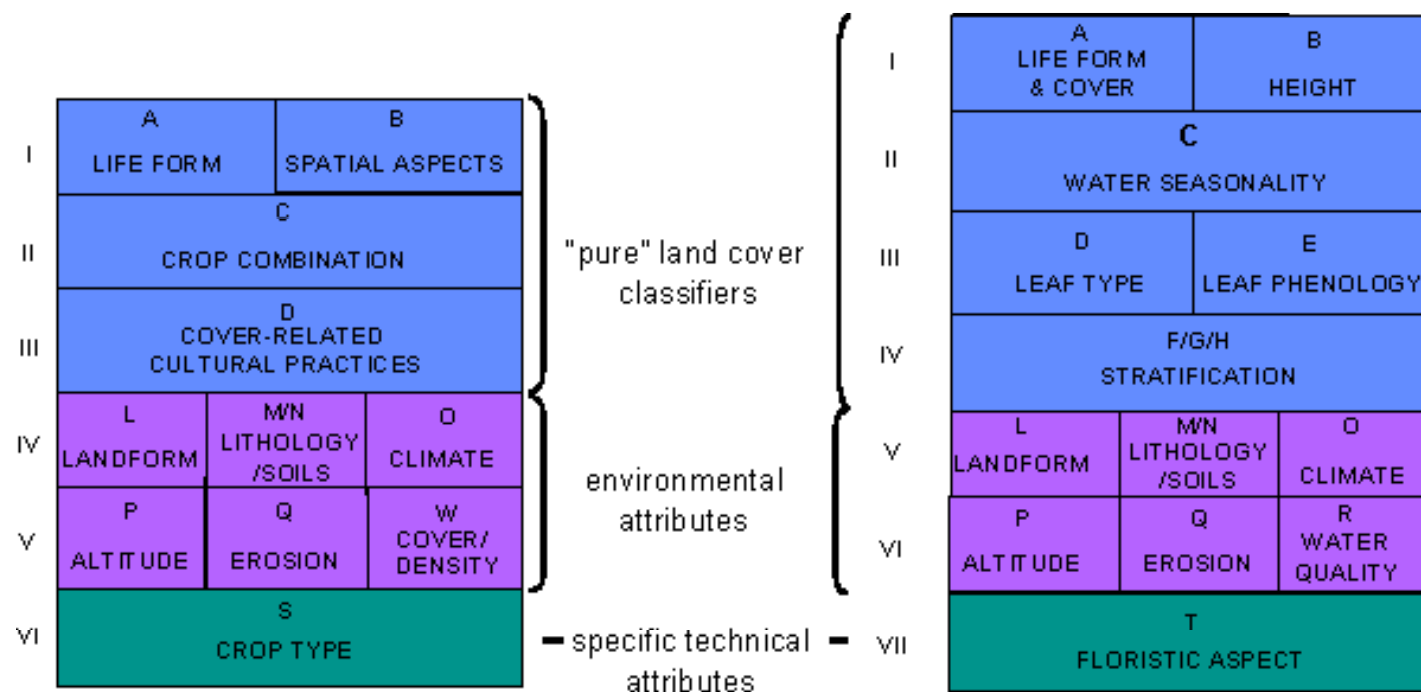
Land Cover Classification and Change Detection using Time Series: **Input Data**

- Satellite data
 - MODIS Vegetation Indices Time Series Data
- Ancillary data
 - Digital elevation model: elevation, slope, aspect
 - Temperature: minimum, average, maximum
 - Precipitation: total, days
 - Soil Moisture
- Secondary data for post-processing – used to verify
 - Masks to correct for urban and wetland (eg ESKOM building data)
 - Masks for water, certain types of vegetation (eg invasive alien maps)

Land Cover Classification and Change Detection using Time Series: **FAO LCCS Classification System**

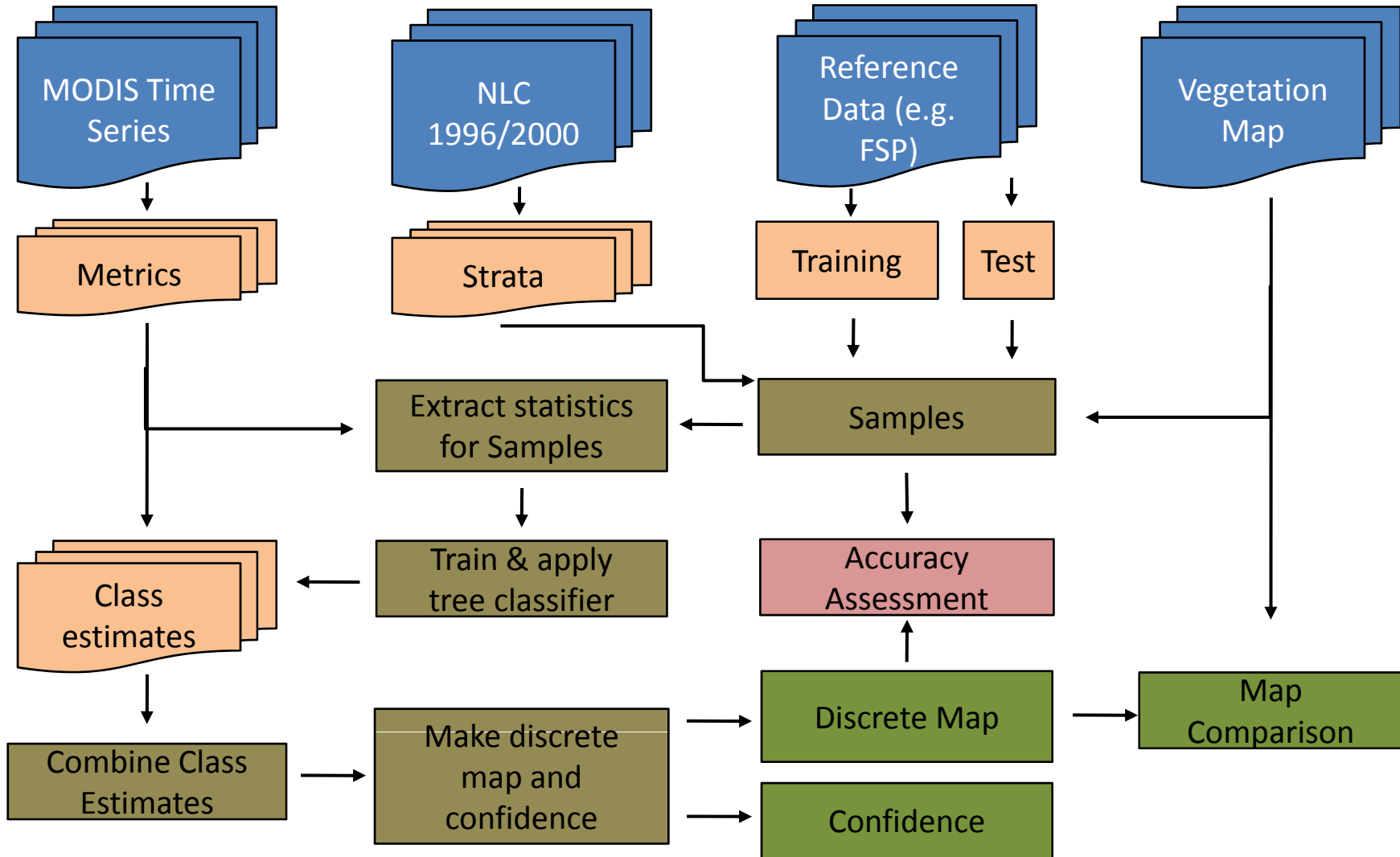


Land Cover Classification and Change Detection using Time Series: **FAO LCCS Classification System**



The Modular Hierarchical Phase

Land Cover Classification and Change Detection using Time Series: **Workflow**

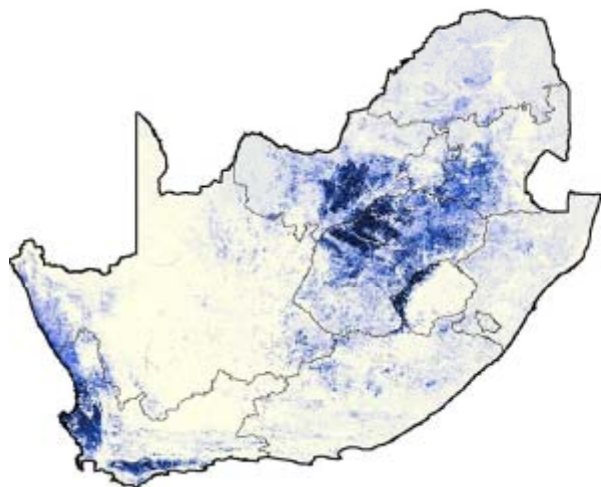


Land Cover mapping using Time Series

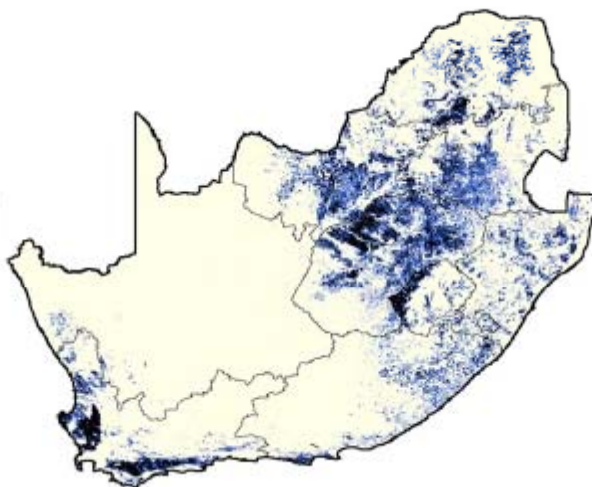
Example: Dryland Agriculture

(preliminary results – limited parameters)

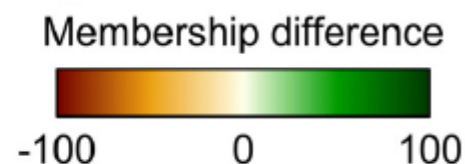
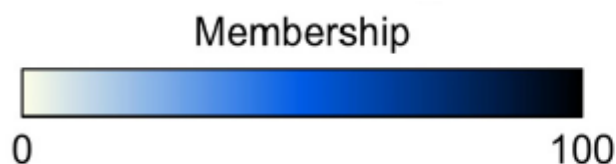
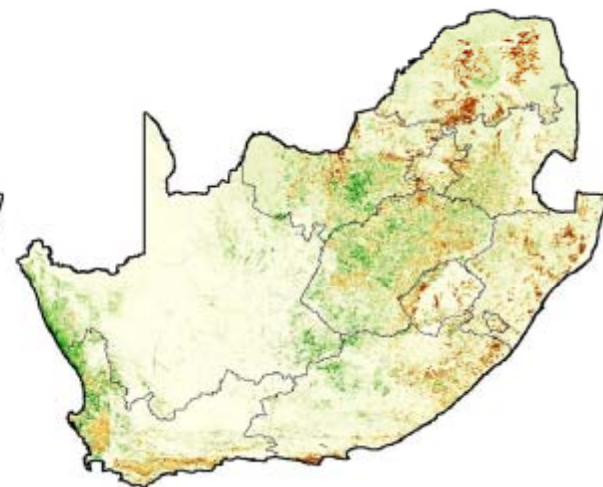
MODIS Time Series Classification
(2003-5)



Reference: NLC 1996



Difference



Reference: Colditz et. al 2007