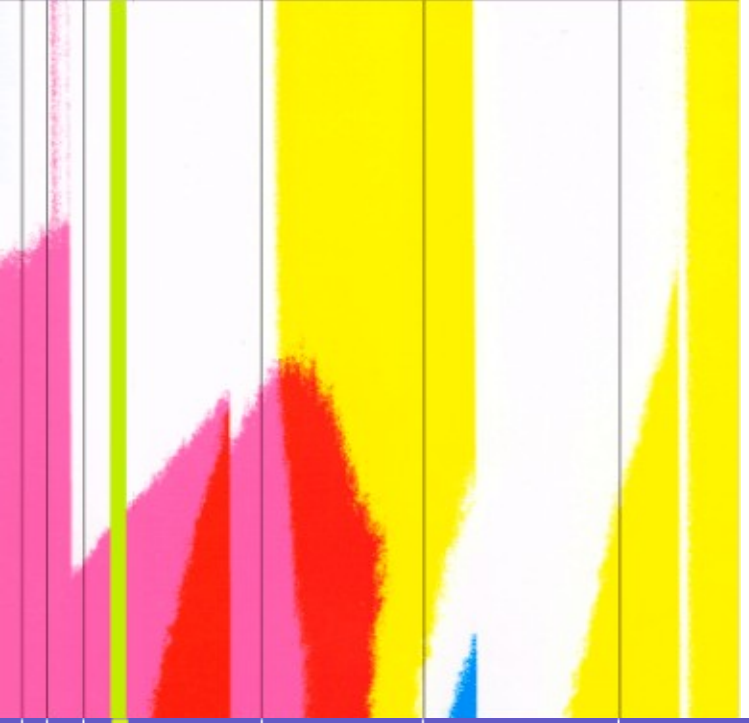


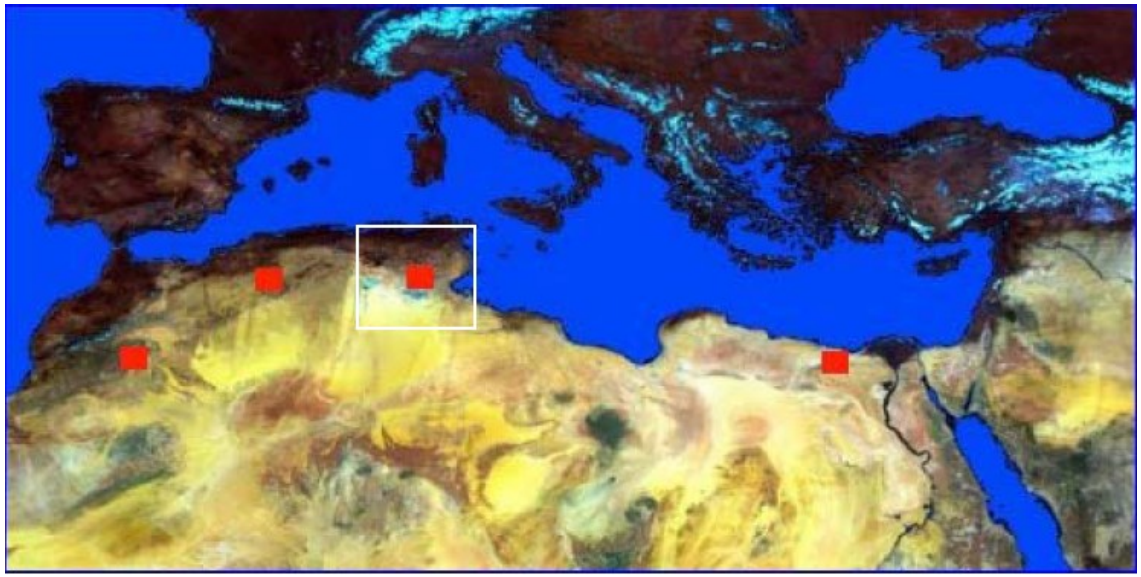
DESMED
TUNISIAN SITE

May 2007

INSTITUT NATIONAL
DE RECHERCHE
EN INFORMATIQUE
ET EN AUTOMATIQUE

INRIA
ROCQUENCOURT

Tunisian study area



Menzel Habib site: N34° 02’ to N34° 20’, E9° 33’ to E9° 58, app. 100,000ha.

Pilot observation site for desertification (ROSELT long term ecological monitoring observatories network).

Soil characteristics

Dominant soil: deep sandy soil, good for retaining water but highly prone to wind erosion.

Vegetation:

- Sandy steppes: trees and herbaceous species used for pastoral purposes.
- Crop (cereals) and trees (olives, almond, date palm, fig) cultivations.

Main causes of desertification:

- Extension of crops and cultivations against natural steppes.
- Overgrazing.
- Erosion.

Desertification examples on the pilot site

Erosion

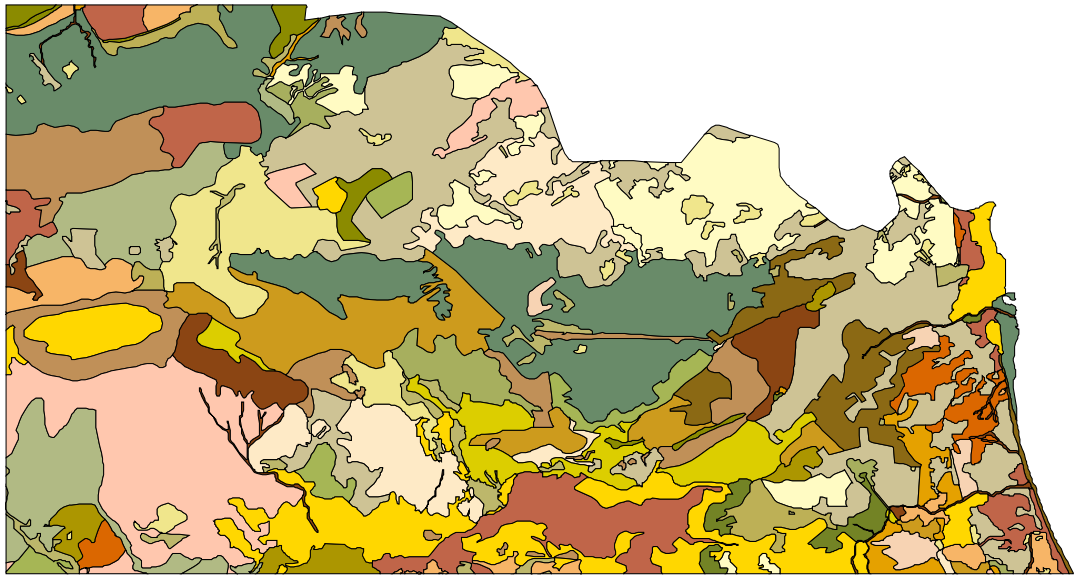
Overgrazing

Available data: high resolution classification

Origin: CNT Tunis (Nat. Centre. Of Remote Sensing, Tunis), from Landsat and field work.

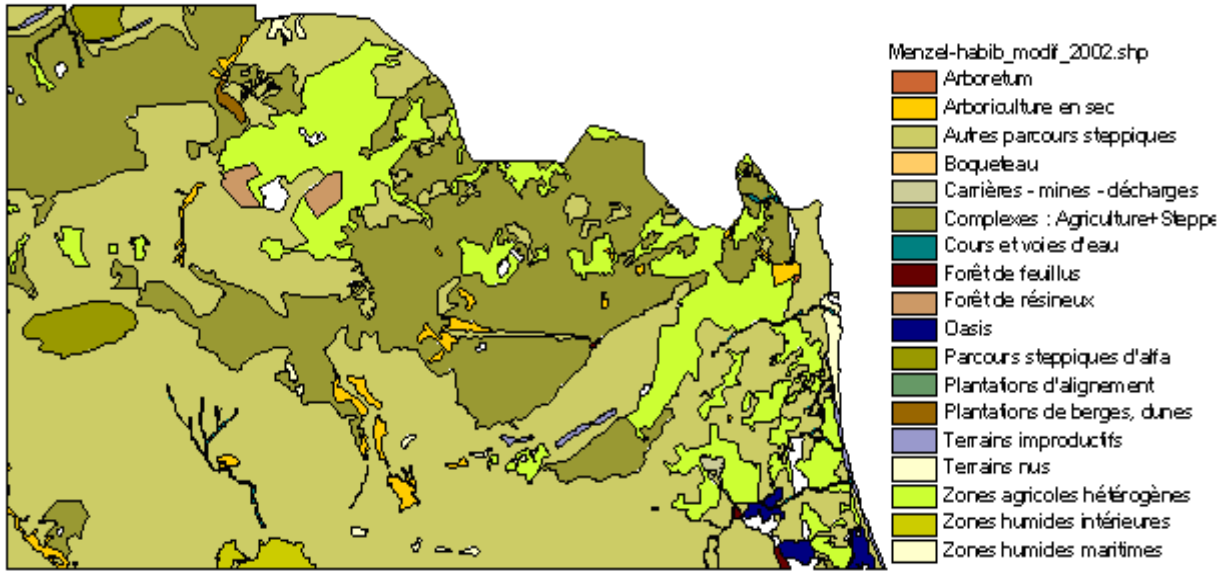
Typology: 95 land cover/use classes.

Date: 2002



Classification: class merging

Down-sampling from 95 to 22 classes: (arboretum, tree dry cultiv., steppes, bushes, mines & swamps, mixed steppes & agriculture, water, deciduous forest, permanent forest, oasis, alfa steppes, line plantations, cultivations on dunes, unproductive land, bare soil, heterogeneous agricultural areas, inland and maritime wet zones, different urban/constructed classes).

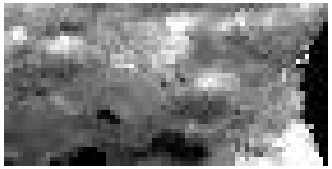


Available data: LANDSAT image

Aug 30, 2002, in “natural colors”. Super-imposable to the classification (but registration is not very accurate)

Available data: NOAA-NDVI

- Provided by CNR ISAC from DLR archive.
- Date spanned: 1995-2006, weekly data.
- Irregular temporal sampling.
- Example image (subsetted to the site and reprojected to UTM)



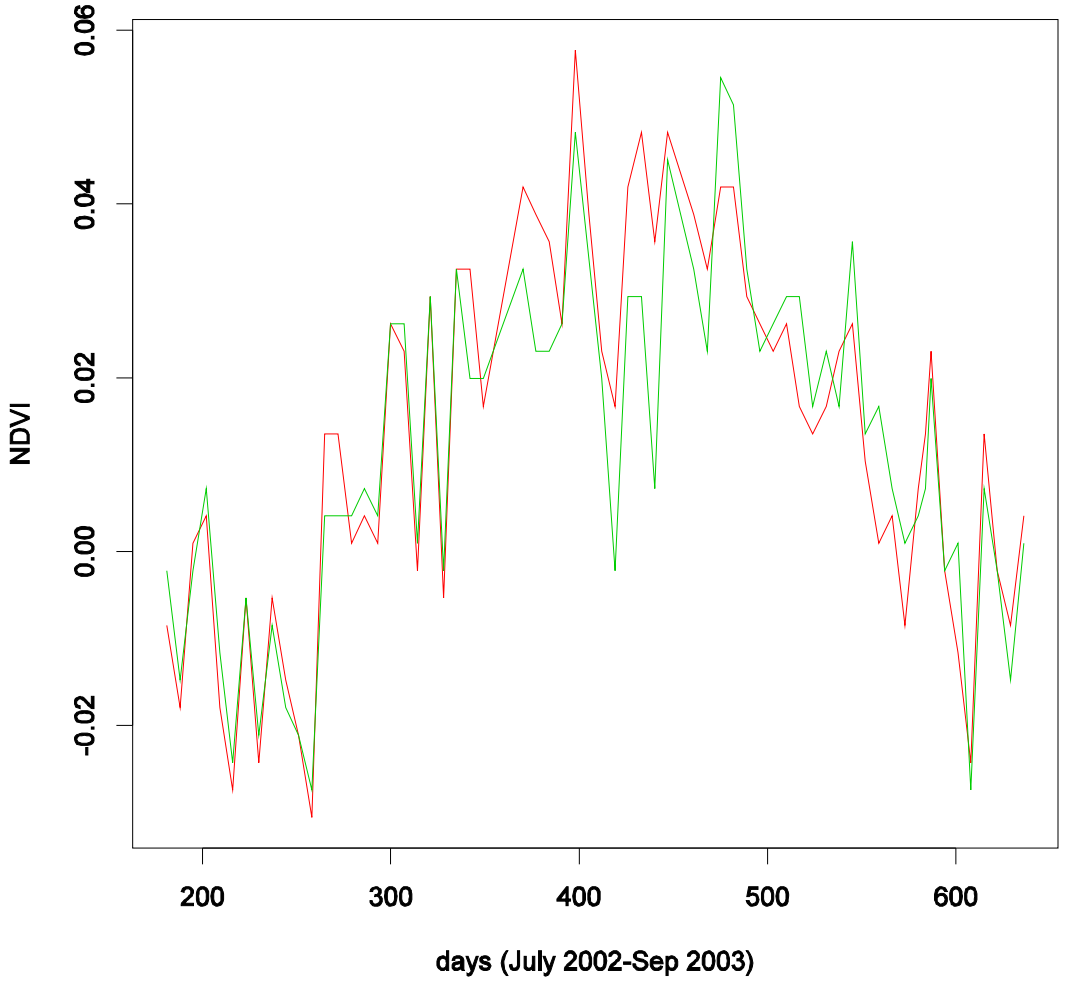
Year	#images	Start	End
1995	43	20/02	25/12
1996	24	06/05	21/10
1997	25	05/05	20/10
1998	38	05/01	19/10
1999	28	04/01	26/07
2000	49	05/01	25/12
2001	38	01/01	24/09
2002	42	04/03	16/12
2003	52	06/01	26/12
2004	44	26/01	20/12
2005	51	03/01	19/12
2006	30	02/01	24/07

NOAA-NDVI preprocessing

- Re-projection to match land use classification.
- Filtering of temporal pixels:
  - In the original data, the grey level 255 corresponds to clouds, and 0 to sea water (not considered as outside the region of interest).
  - Masked values (clouds) are discarded (e.g. considered as NO DATA) and temporally interpolated.
  - Still some “abnormal” NDVI values remain.

NDVI temporal profiles (NOAA)

- Two pixels' profiles after interpolation of cloudy dates.
- Period: 07/02 to 09/03.
- The peaks and valleys can be filtered by a median filter.



Temporal profiles of main land use classes (NOAA)

Among the 22 classes, analysis of those for which “pure” NOAA pixels are available:

Class	#pure NOAA pixels	% of total surface
Perm. forest	4	0.5
Alfa steppes	11	1.4
Other steppes	581	53
Mixed steppes & agriculture	248	28
Tree dry cultivation	2	1.3
Oasis	1	0.4
Heterogeneous agriculture	53	13
Mines, swamps	1	0.1
Inland wet zone	3	0.5

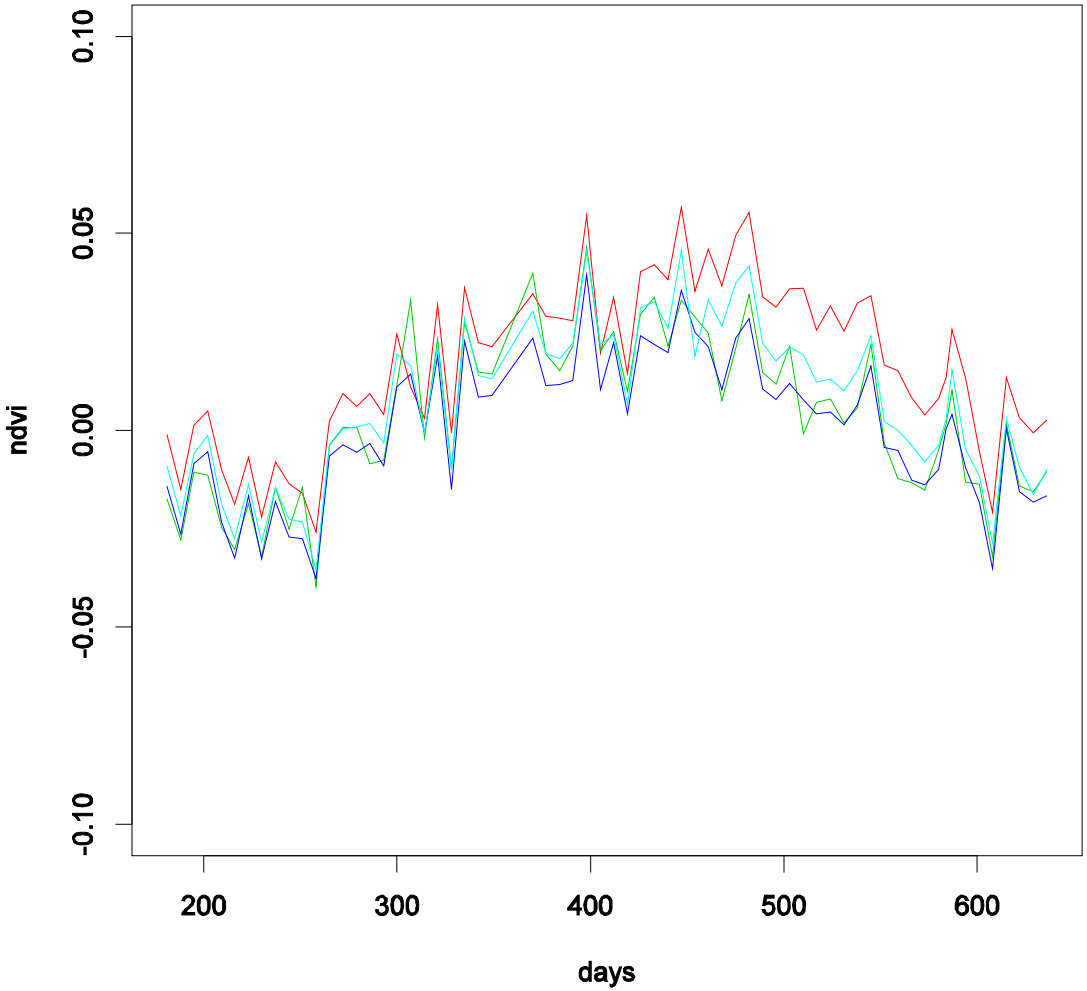
NOAA Temporal profiles

Heterogeneous agriculture.

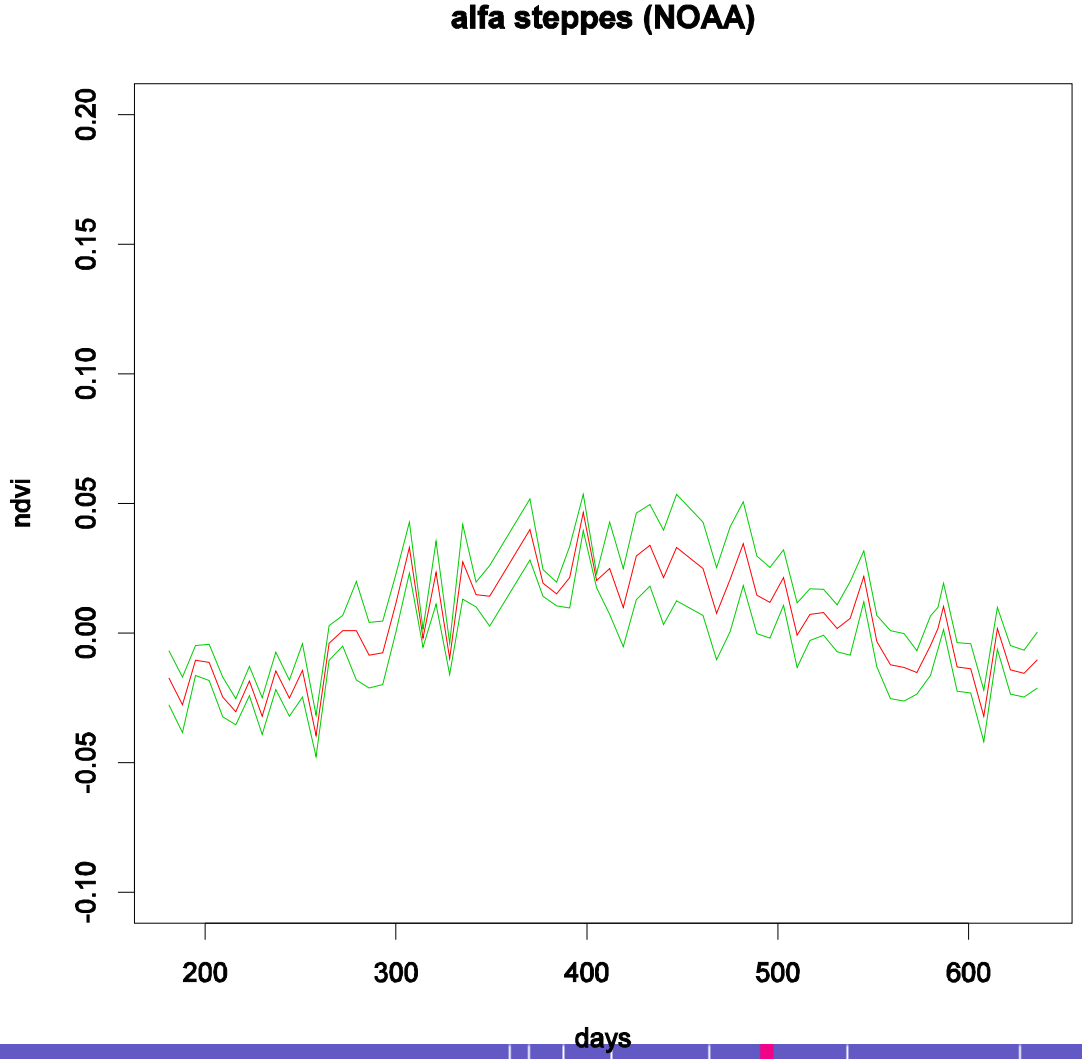
Alfa steppes.

Other steppes.

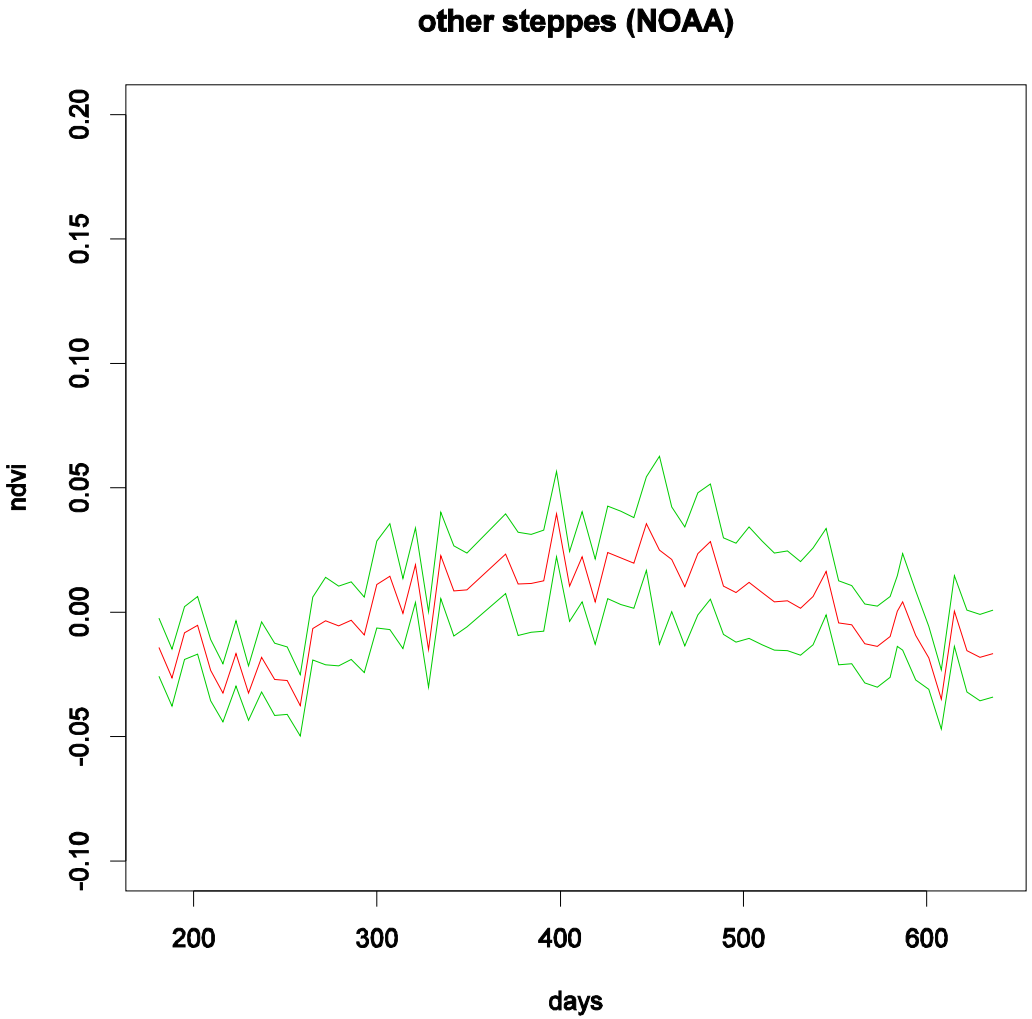
Mixed steppes + agriculture.



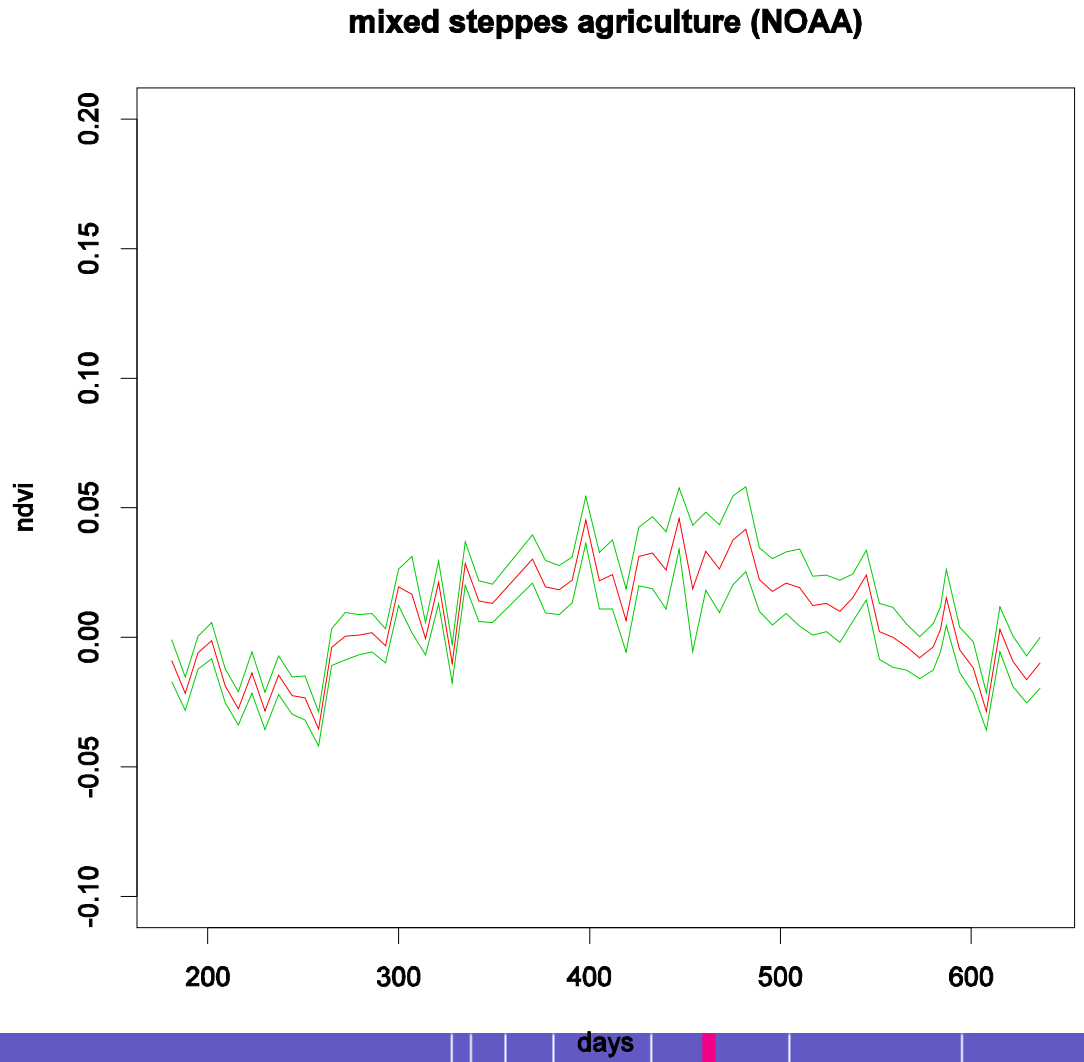
NOAA Temporal profile, alfa steppes



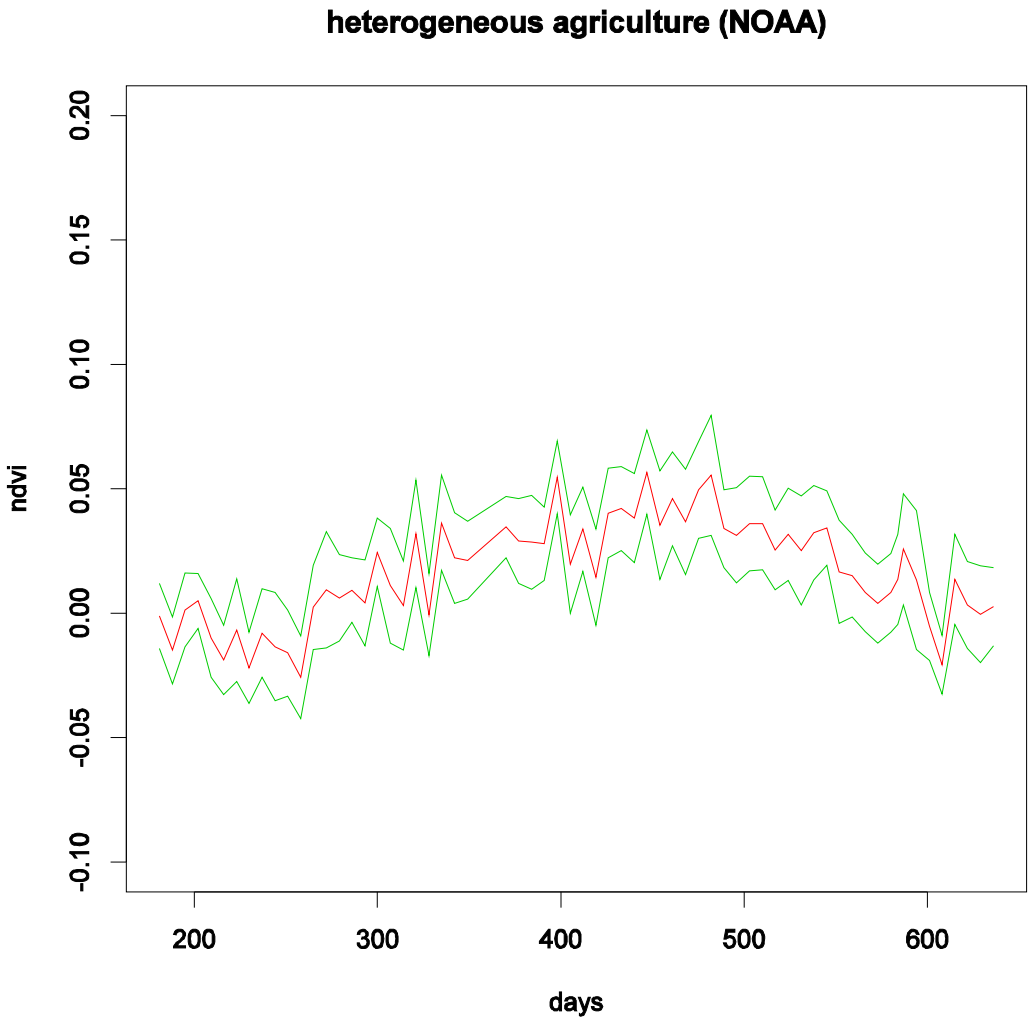
NOAA Temporal profile, other steppes



NOAA Temporal profiles, mixed steppes & agriculture



NOAA Temporal profiles, heterogeneous agriculture



Comparison between NOAA and MODIS

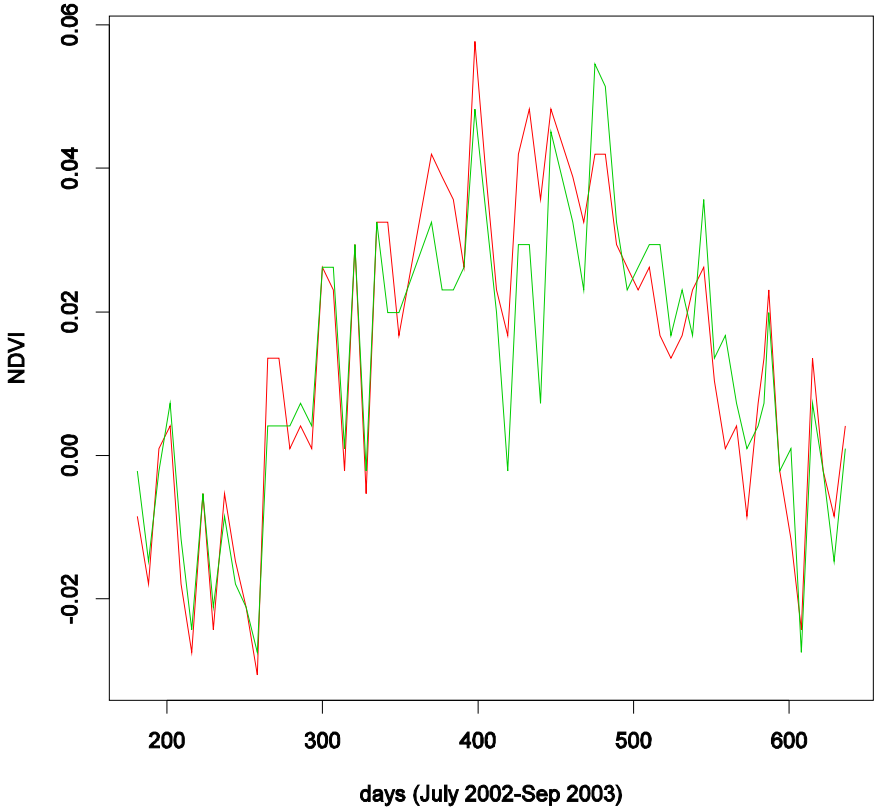
Objective:

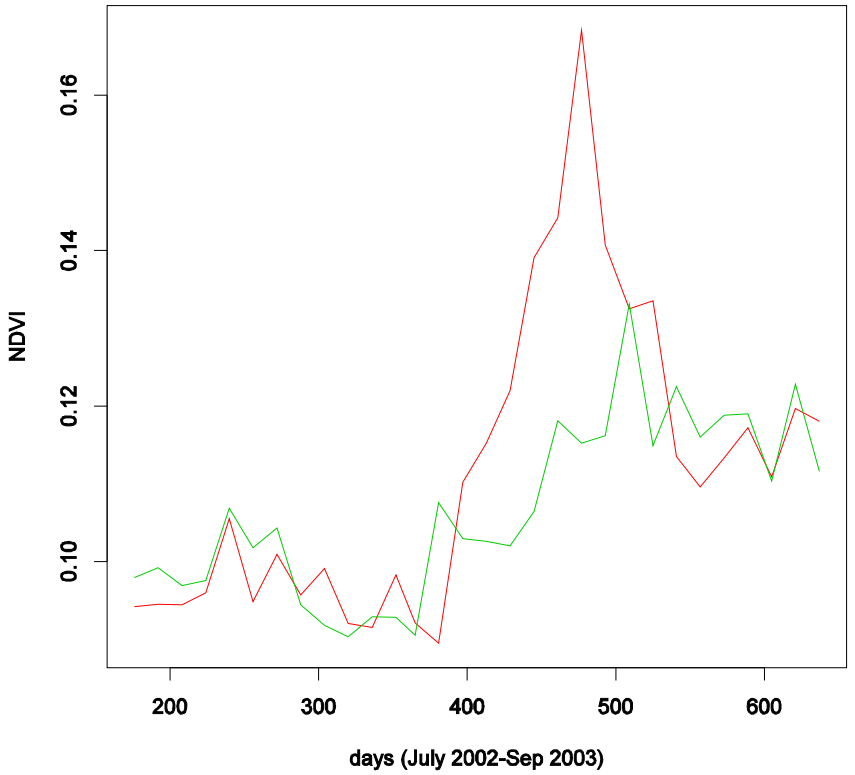
- Compare profiles (pixel and class profiles) obtained from MODIS and from NOAA.
- Try to “learn” characteristics on MODIS data thanks to the better spatial resolution (250m instead of at least 1100m) and better SNR.
- Then analyze the NOAA archive.

Available data: MODIS-NDVI

- MODIS Vegetation Indices Product, 250m, 16 days. This product provides:
  - R and NIR reflectances.
  - NDVI.
  - EVI (Enhanced Vegetation Index, supposed better for low vegetation).
- Preprocessing performed by USGS: for each pixel, the best acquisition (in terms of viewing angles and atmospheric conditions) during a 16 days period is kept.
- Some cloudy/bad quality pixels can however remain, for instance in case of persistent bad weather. These pixels are identified in quality metadata.

Comparison of MODIS and NOAA NDVI temporal profiles





Left: two NOAA profiles, right: two MODIS profiles, all in the same area (but not exactly collocated).

MODIS-NDVI preprocessing

- Straightforward preprocessing:
  - Discard bad quality pixels.
  - Interpolate them in time. Caution: interpolation across one cloudy date means interpolating over a one month interval.
  - As compared with NOAA, a supplementary filtering (e.g. median) is less required since profiles are less noisy.

Land use classes with both NOAA and MODIS pure pixels.

Class	#pure MODIS pixels	#pure NOAA pixels
Permanent forest	132	4
Alfa steppes	381	11
Other steppes	14614	581
Mixed steppes & agriculture	7421	248
Dry tree cultivation	147	2
Oasis	86	1
Heterogeneous agriculture	3106	53
Mines, swamp	13	1
Inland wet areas	125	3

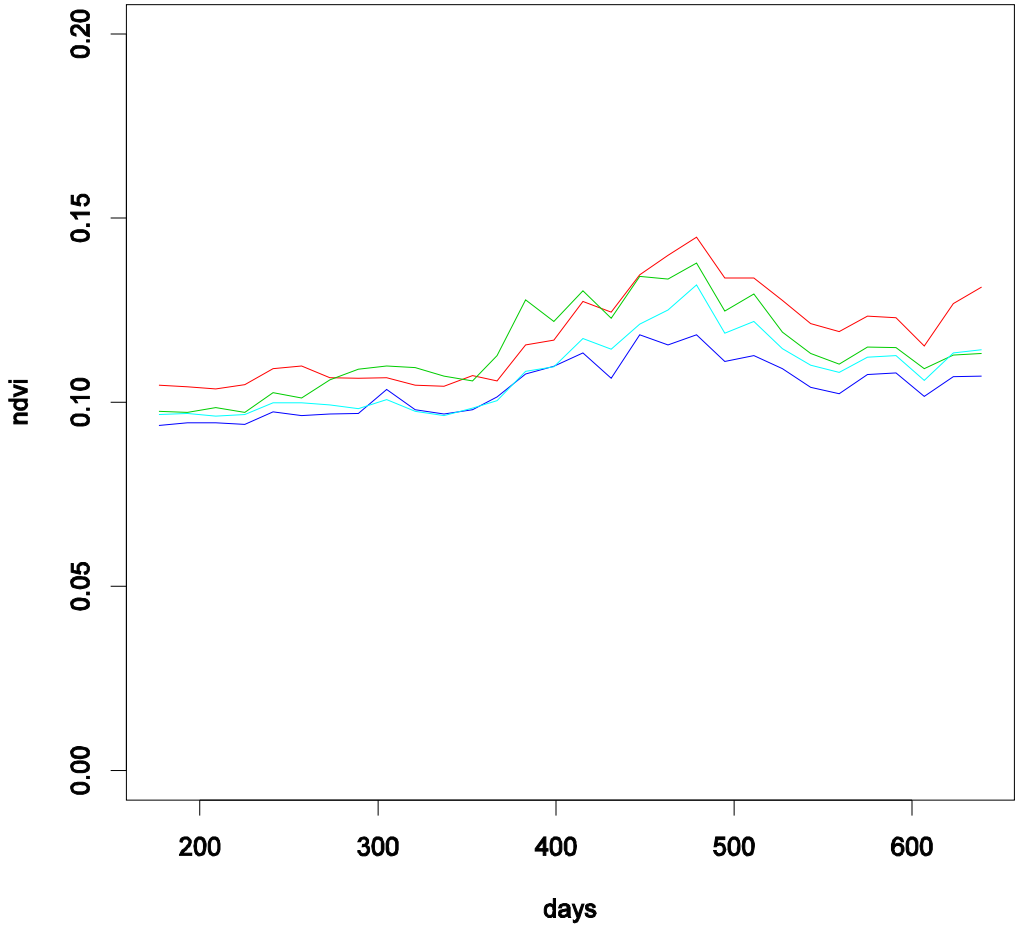
MODIS Temporal profiles

Heterogeneous agriculture.

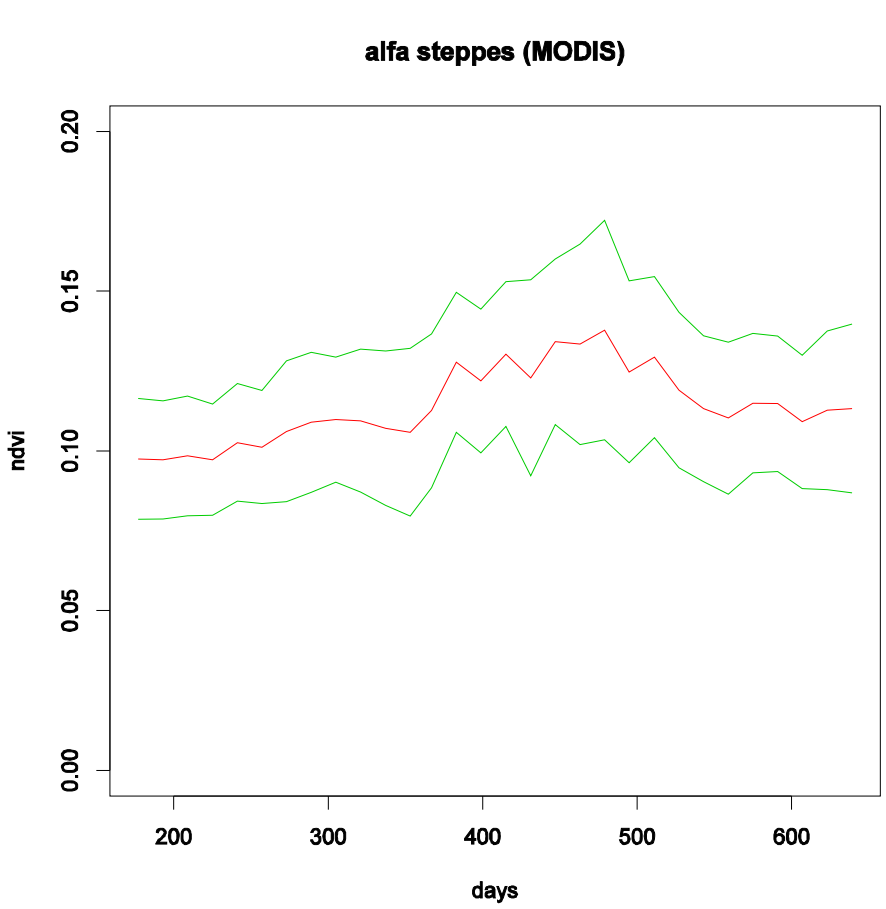
Alfa steppes.

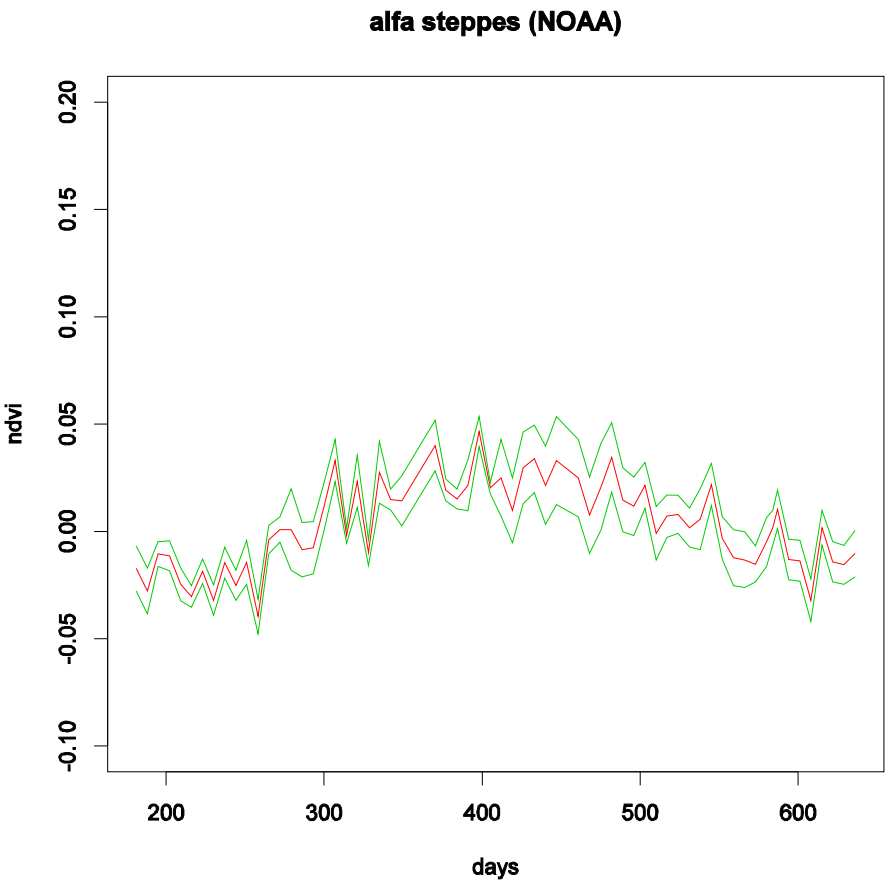
Other steppes.

Mixed steppes + agriculture.

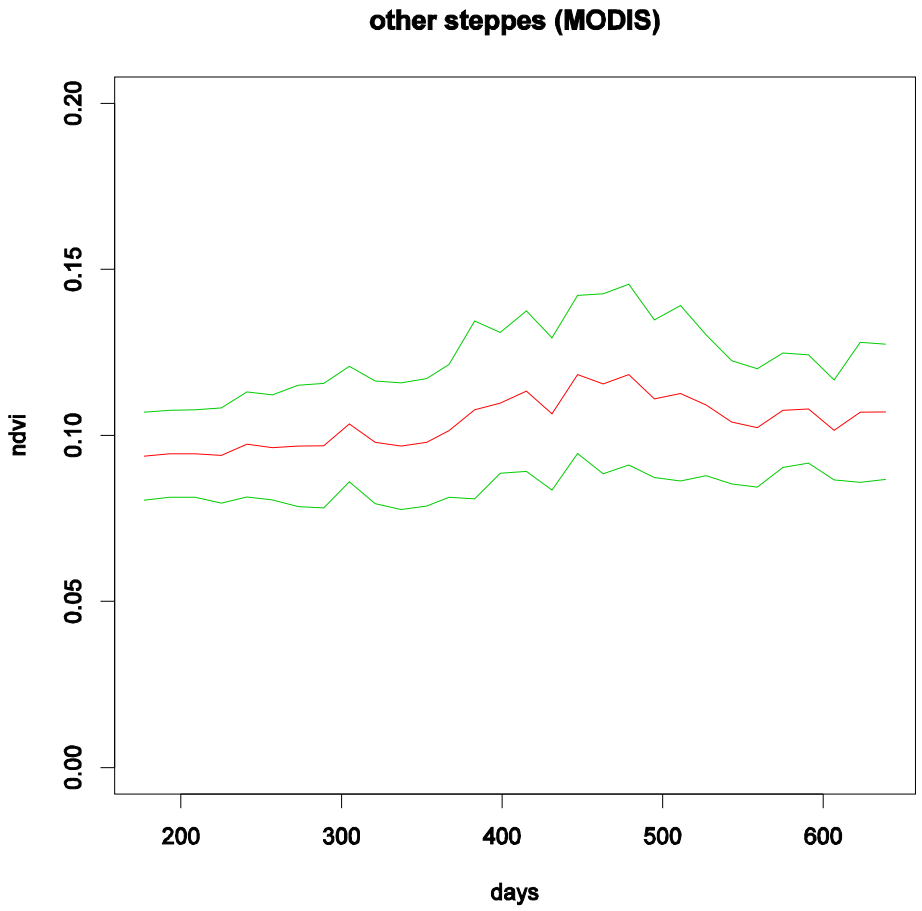


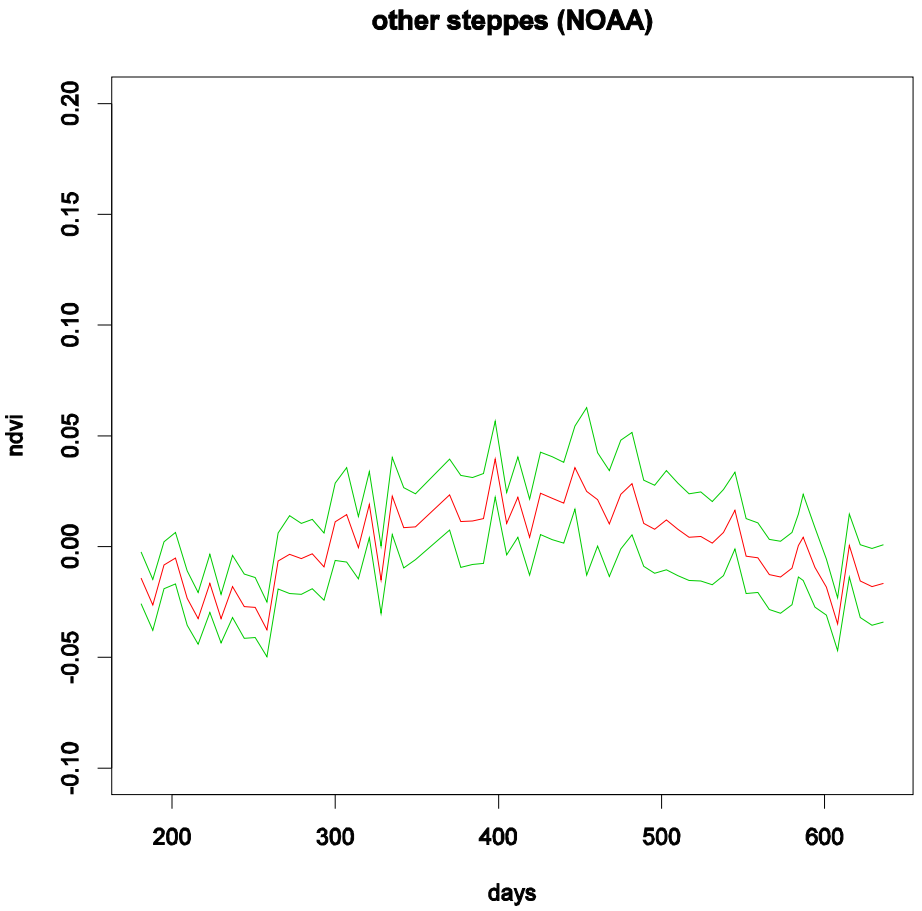
Alfa steppes



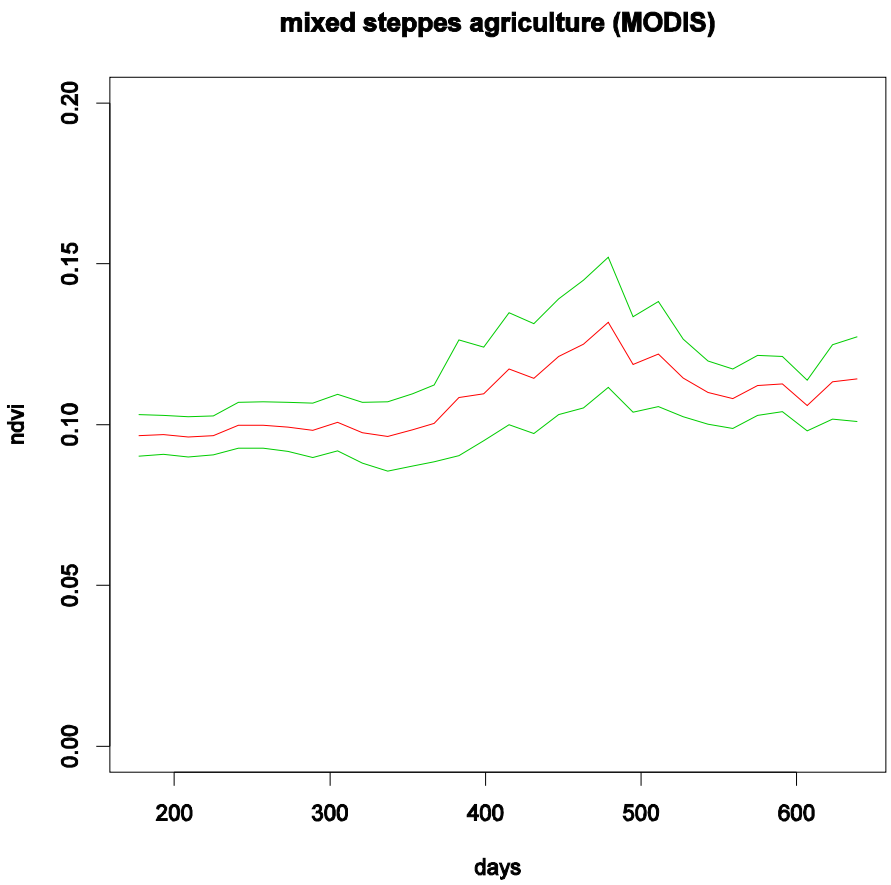


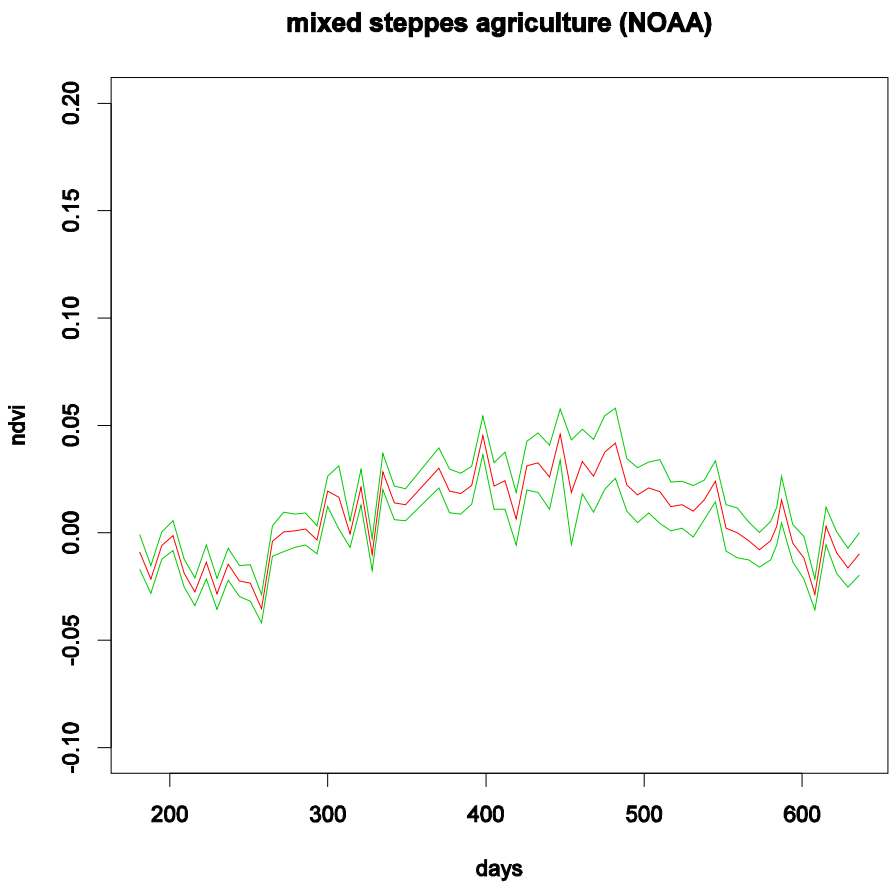
Other steppes



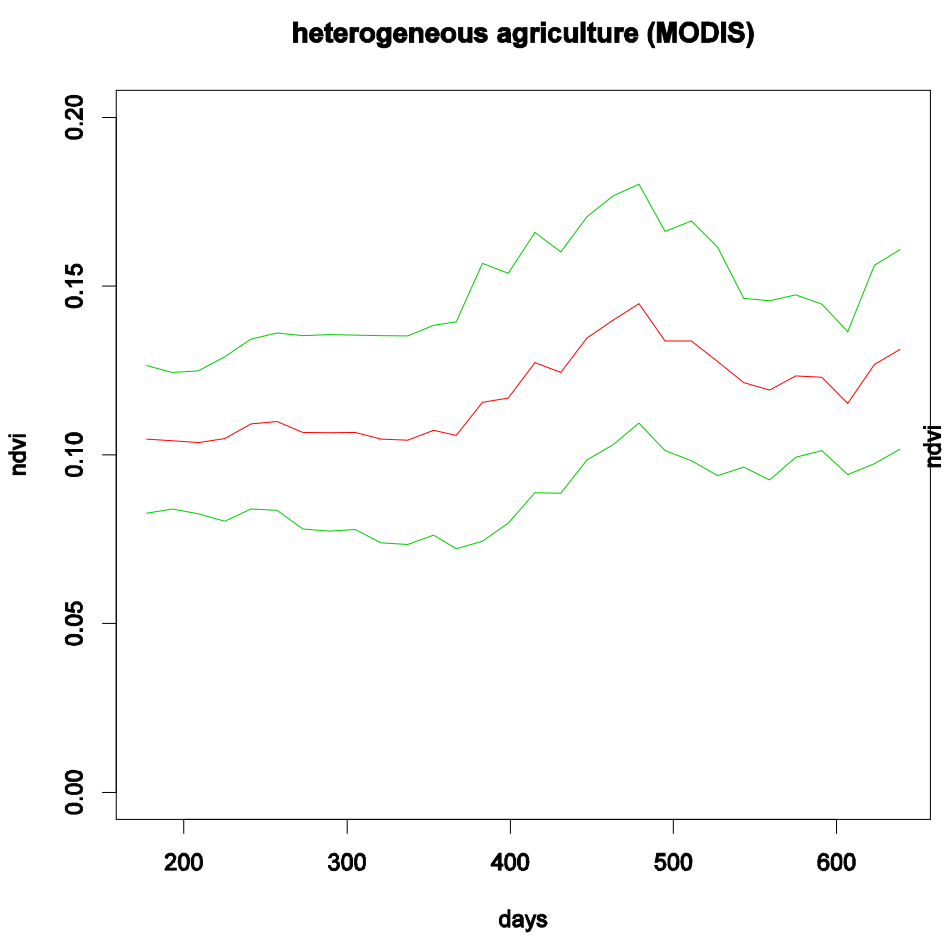


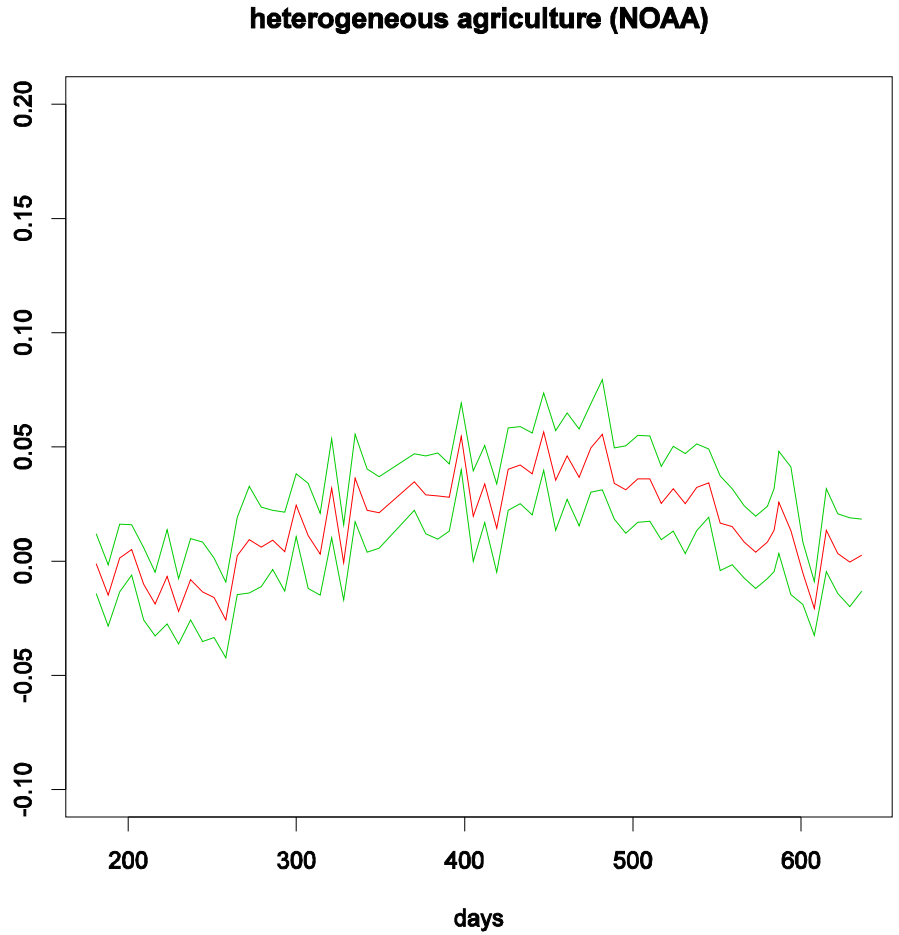
Mixed steppes & agriculture



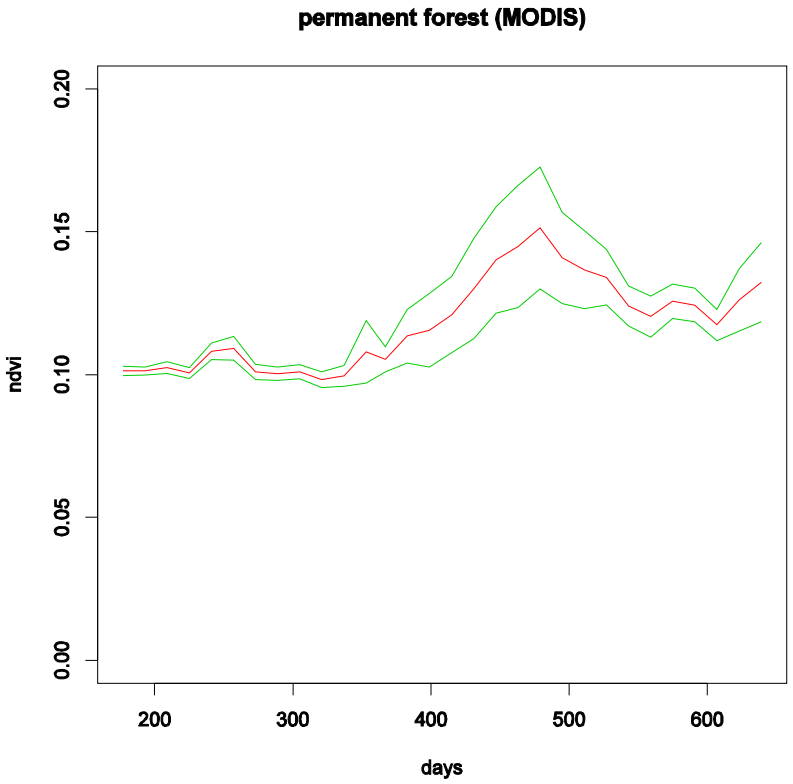


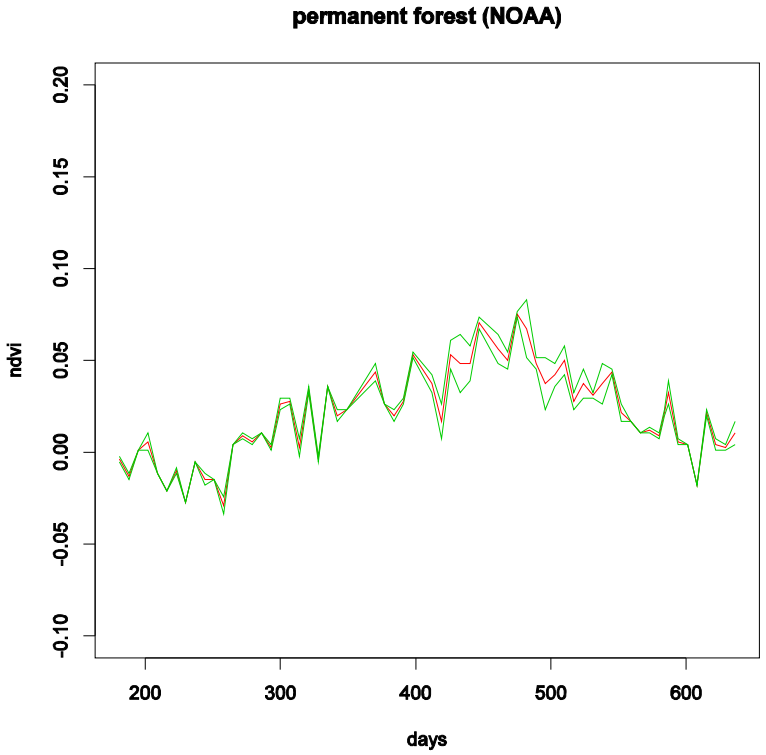
Heterogeneous agricuture



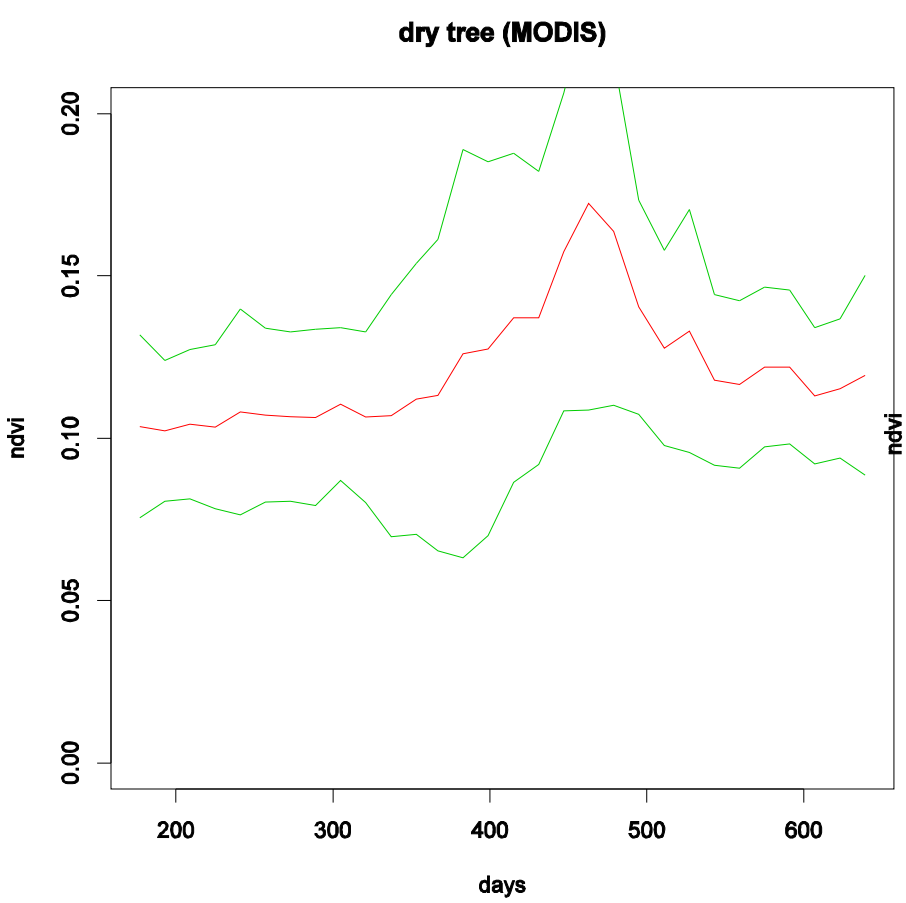


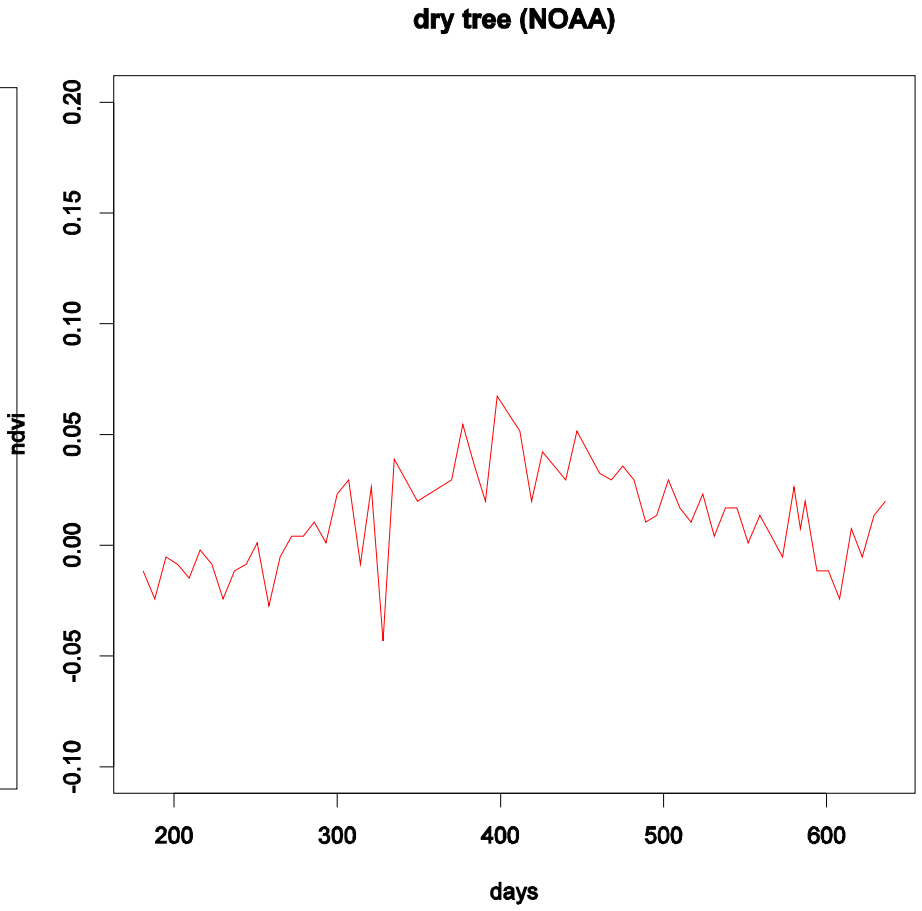
Permanent forest



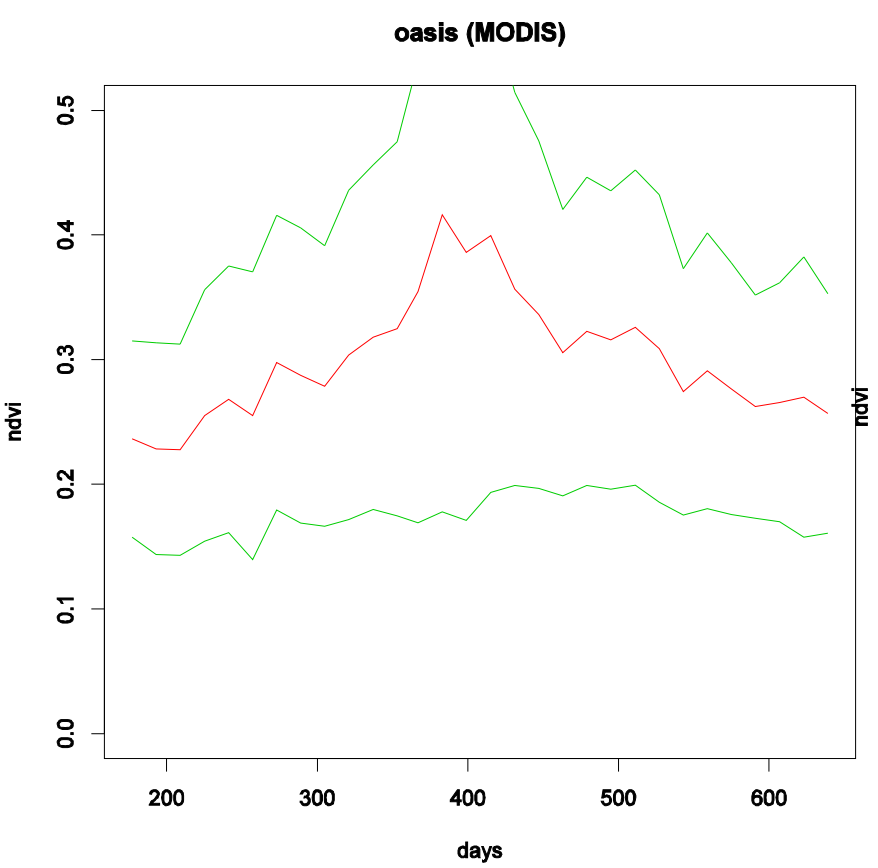


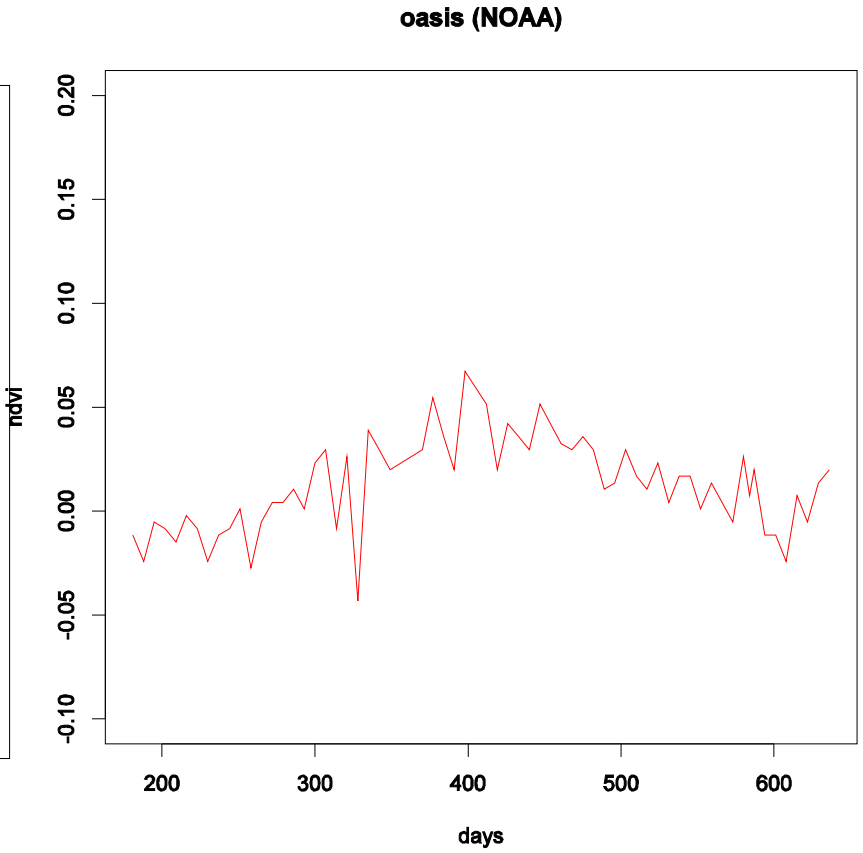
Dry trees cultivations



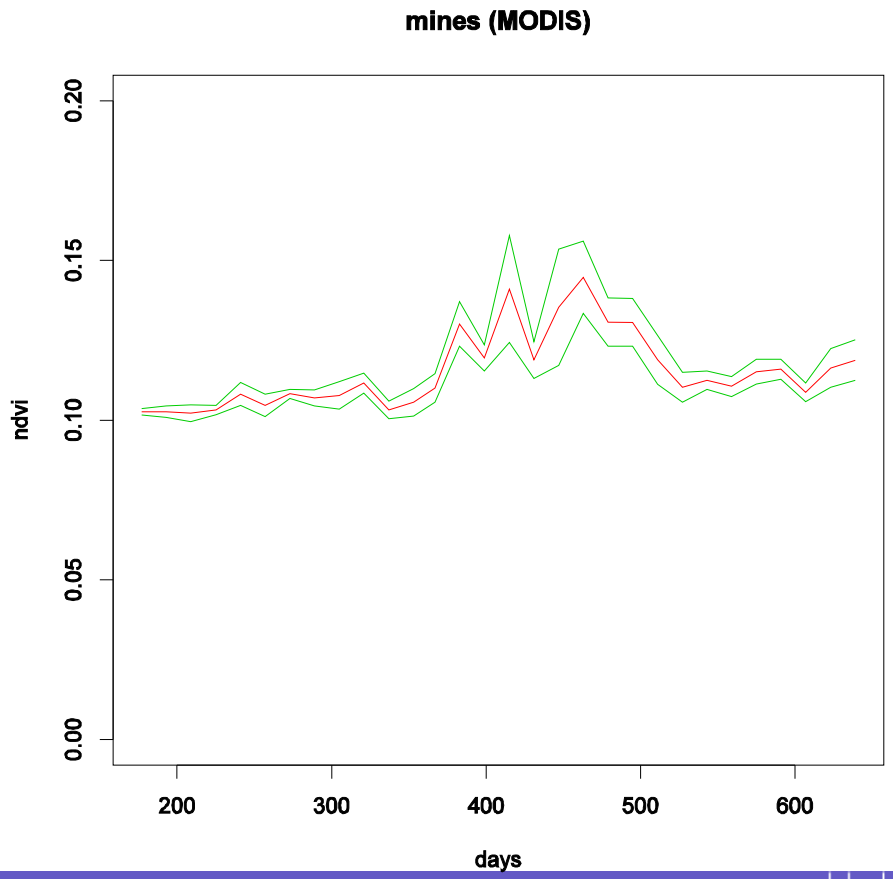


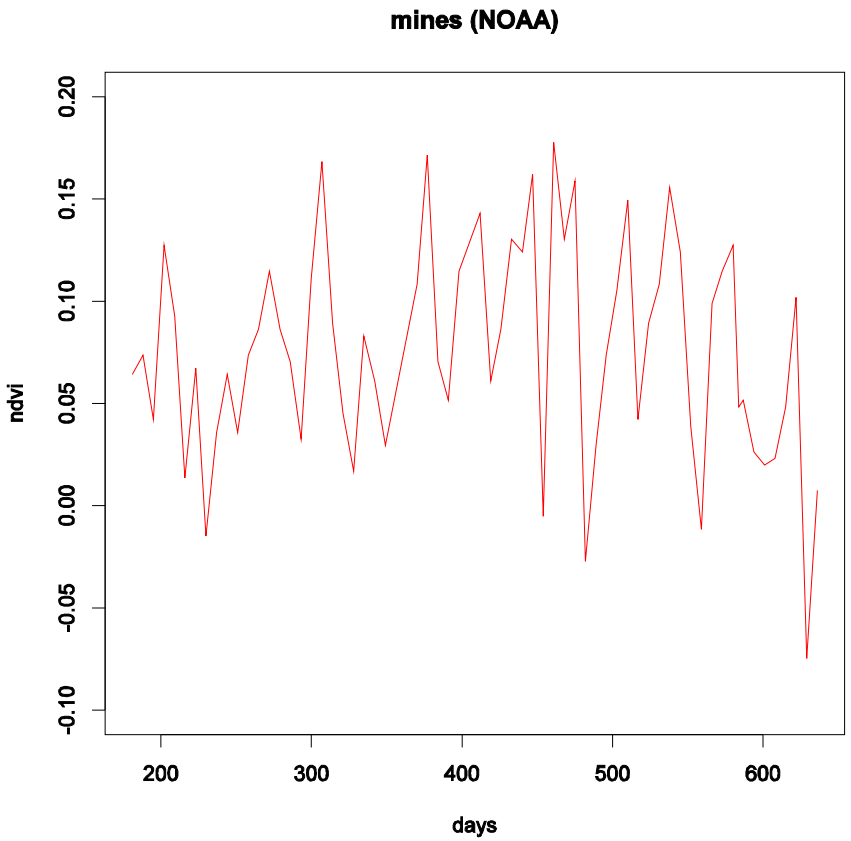
Oasis


oasis (MODIS)
ndvi
0.0
0.1
0.2
0.3
0.4
0.5
200
300
400
500
600
days

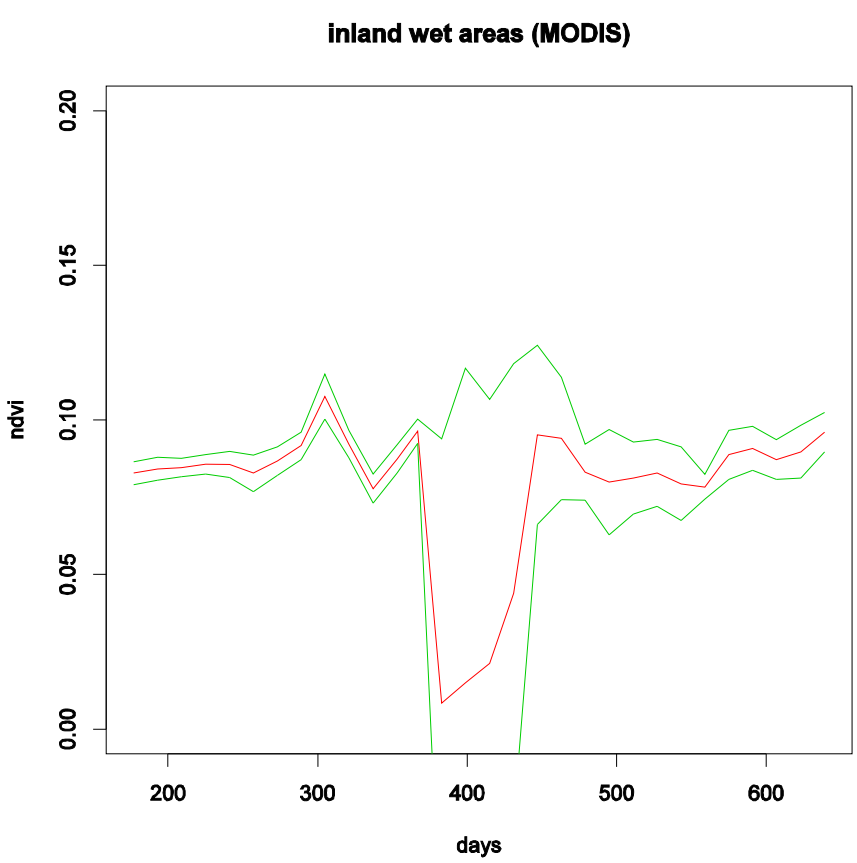

oasis (NOAA)
ndvi
-0.10
-0.05
0.00
0.05
0.10
0.15
0.20
200
300
400
500
600
days

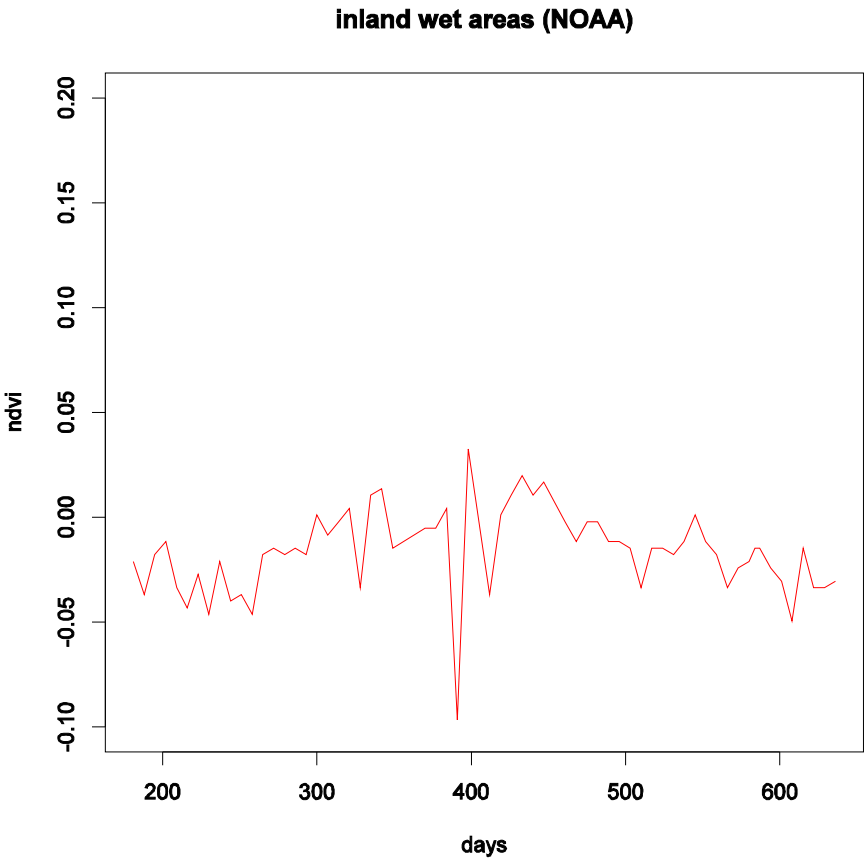
Mines, swamps





Inland wet areas

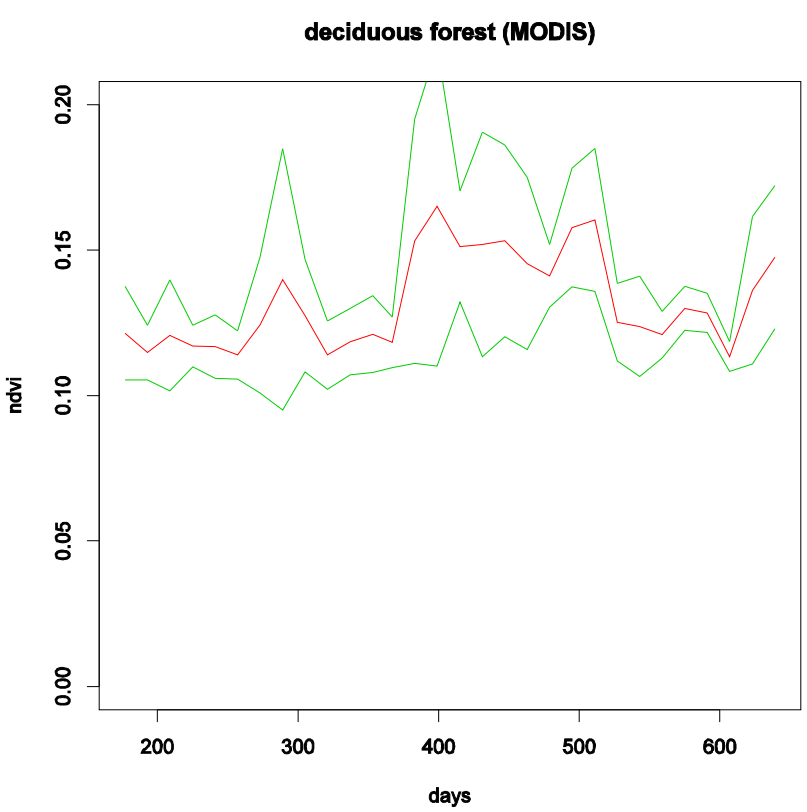


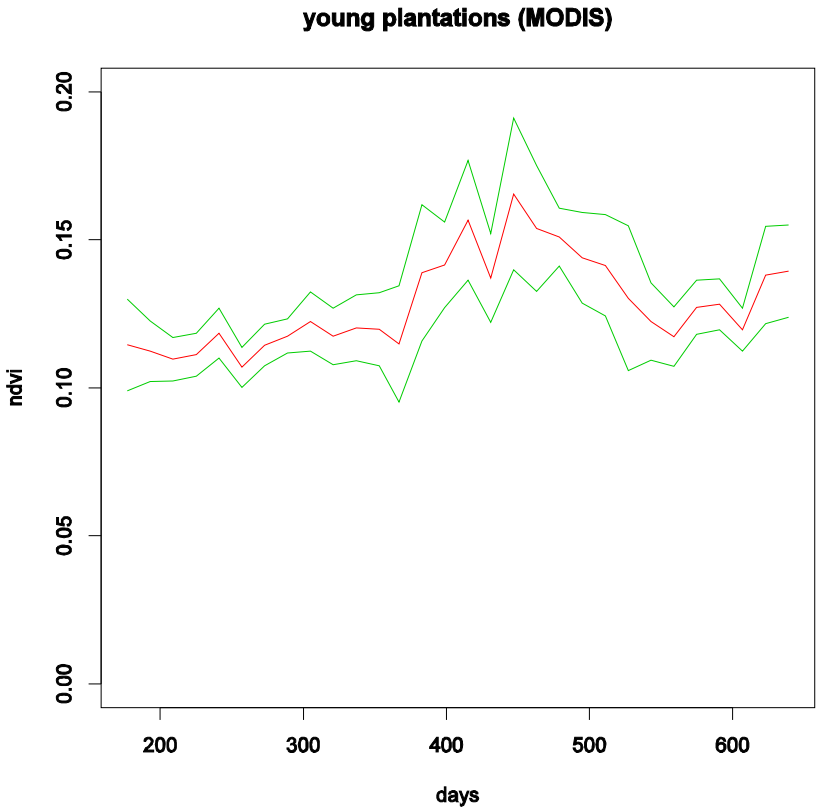


Classes with MODIS pure pixels but no NOAA pure pixels

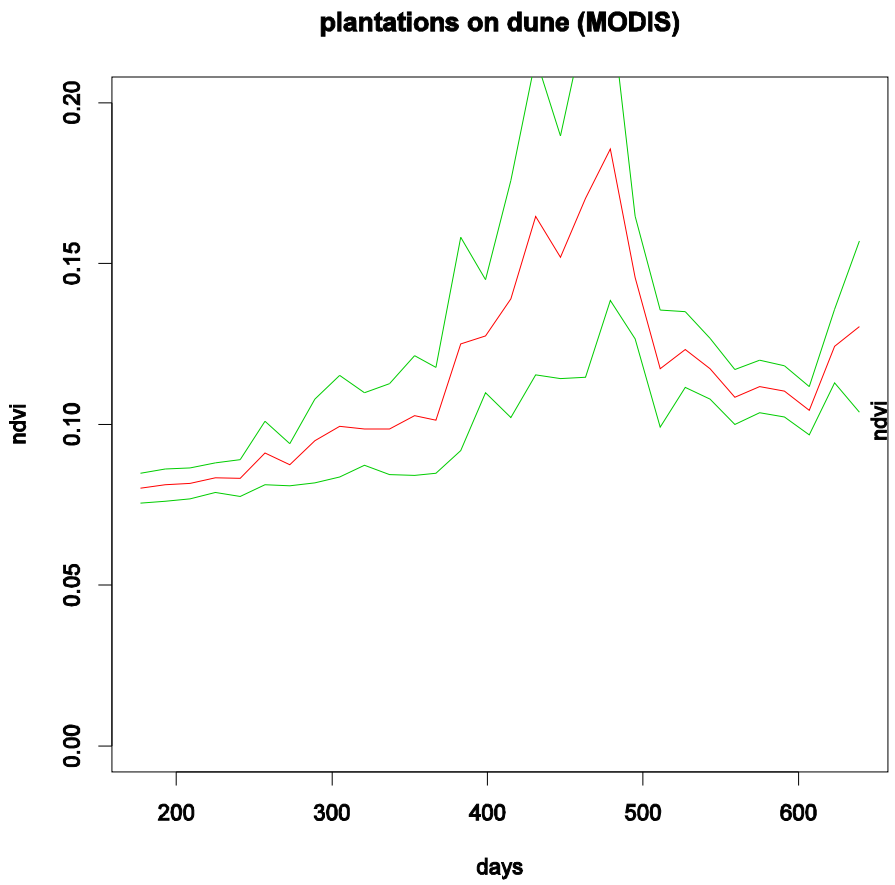
Class	#pure pixels
Deciduous forests	7
Young plantations	35
Sand & dune plantation	21
Infrastructures	37
Urban areas	30
Other constructed areas	17
Unproductive land	12
Bare soil	27
Maritime wet land	52

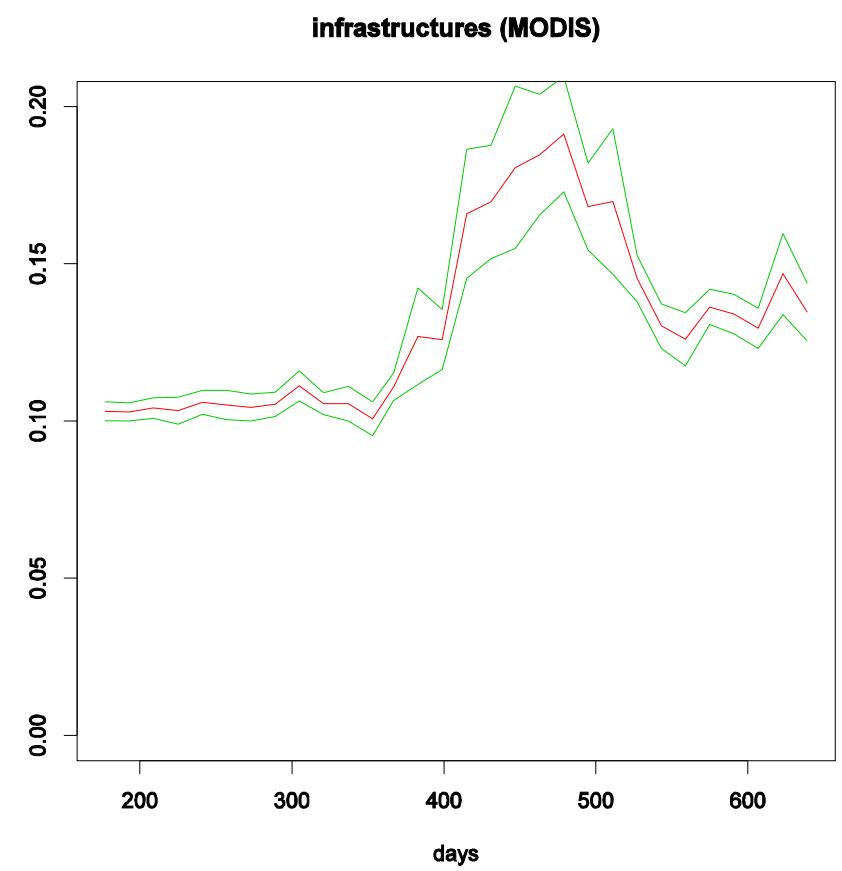
Deciduous forest, young plantations



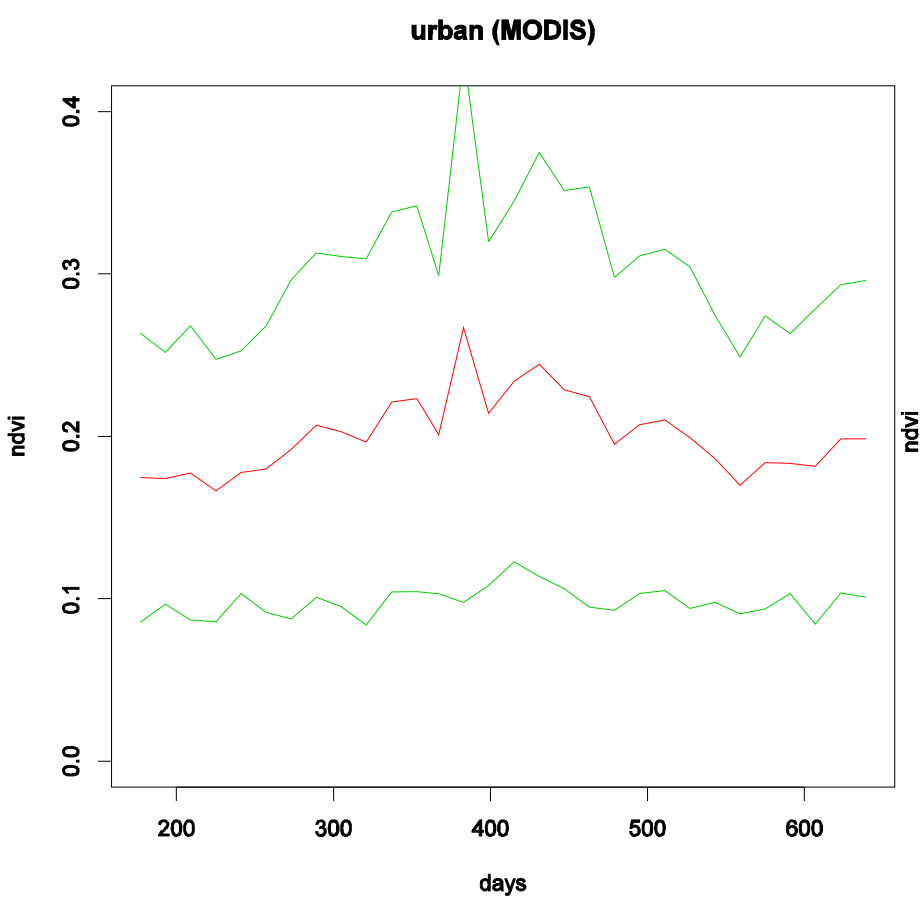


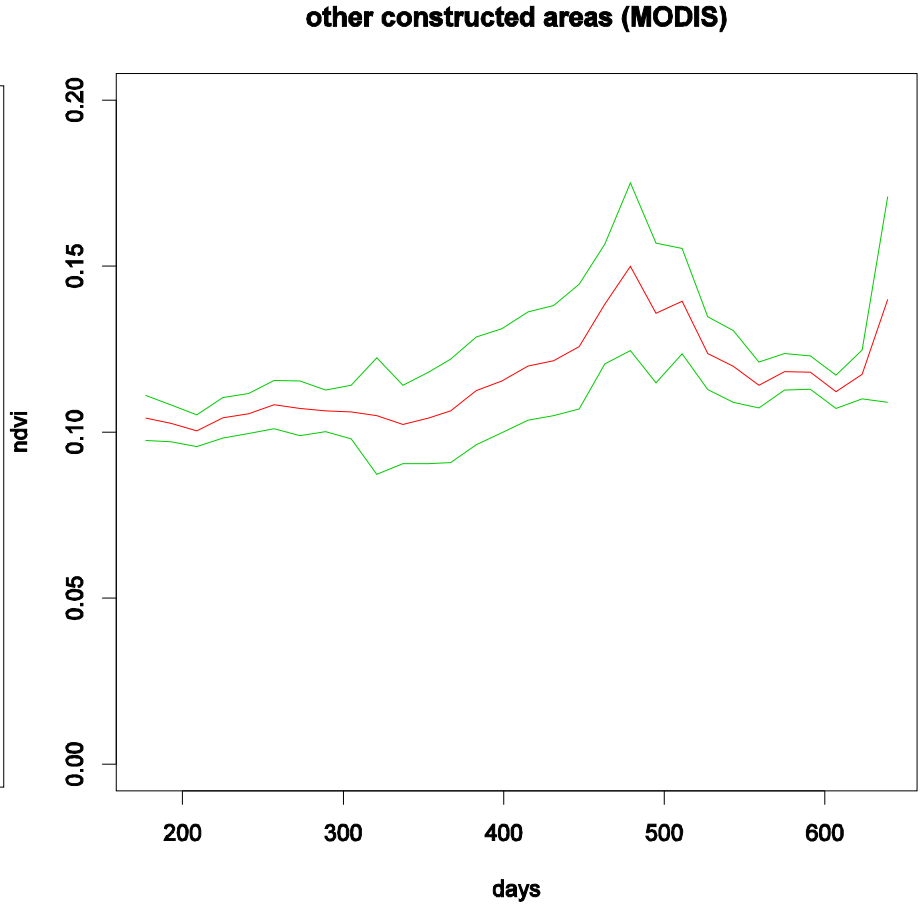
Cultivations on dunes, infrastructures





Urban, other constructed areas





Bare soil, maritime wet land