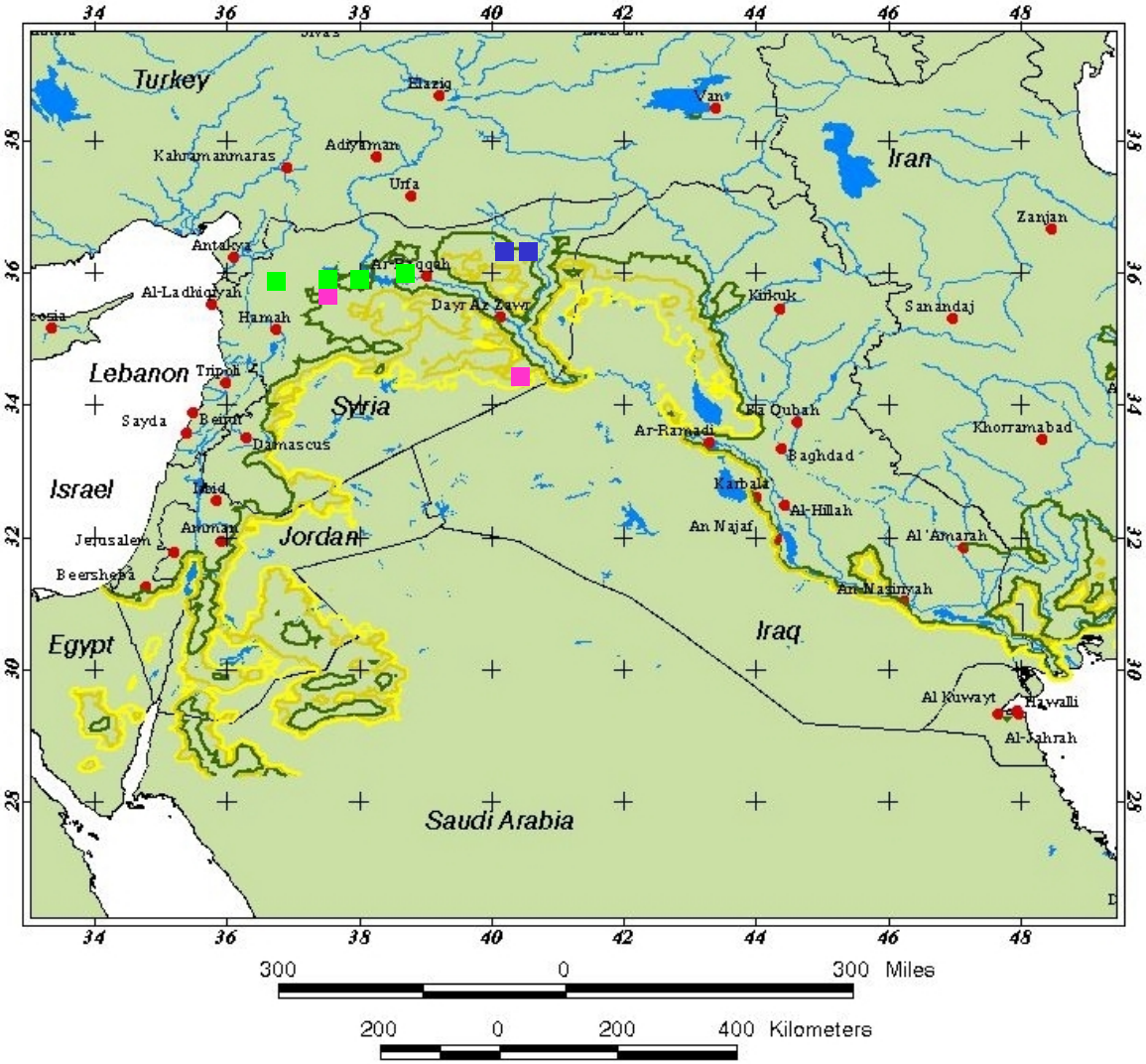
Project Title:

Changing Landscapes in the Middle East

Funded by:

NASA's Earth Science Enterprise

Keywords: Landscape monitoring, climate change, degradation of dry-lands, range management, irrigated agriculture, hydrology



Green periods calculated from AVHRR 8km NDVI time series 1981-1999
Threshold value chosen: NDVI = 0.1

- 45 days green period
- 90 days
- 150 days

IKONOS Image Locations and ongoing Studies

- Farmland
- Rangeland
- Farmland/ Rangeland/ Archaeological

Objectives

Assessing Range Condition: (Degradation/Desertification)

Composition of Range Vegetation
Soil Erosion or its Depletion in certain Components

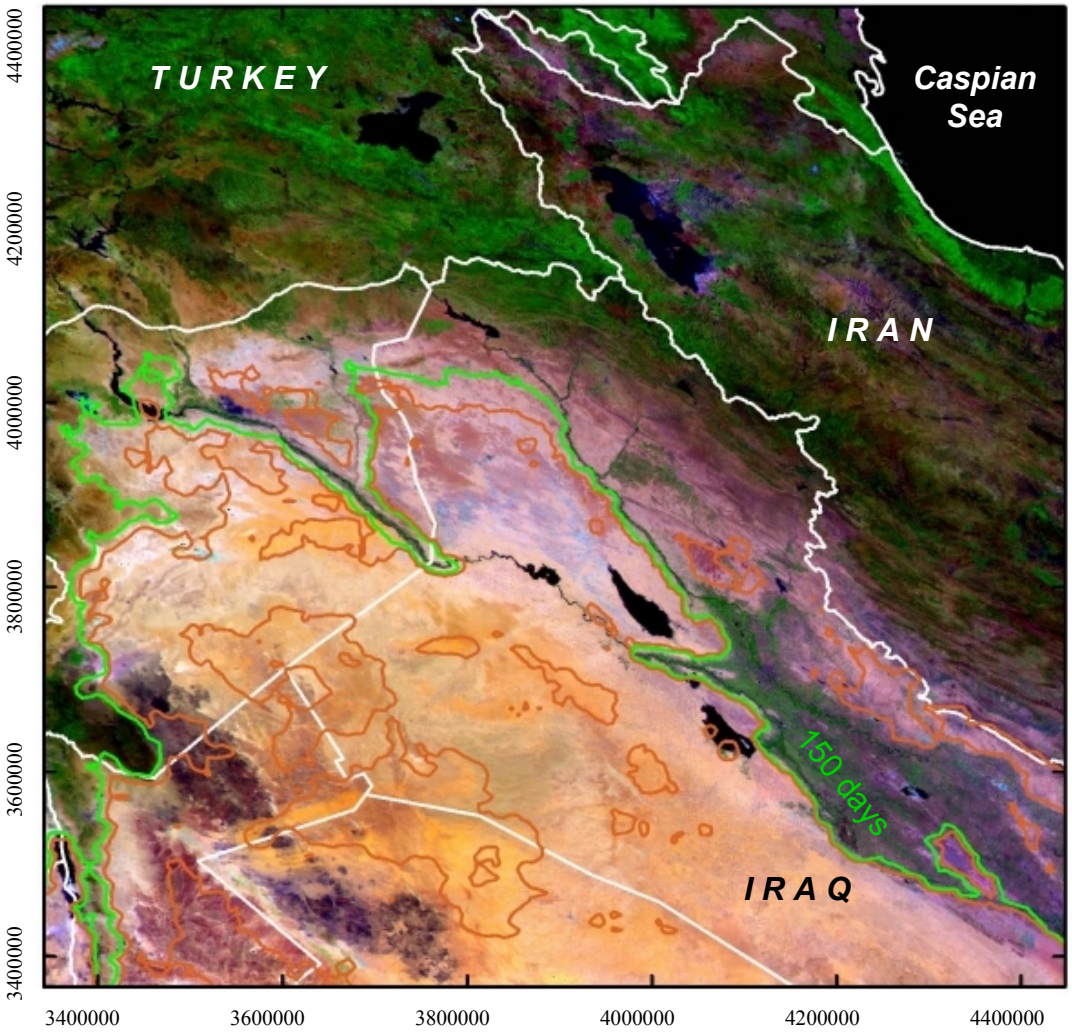
Causes of Degradation/Desertification:

Human Activities (Type, Distribution, Pressure)
Other Influences (Climate, Physical, Social, Economic, Political, others)

Range Management:

Correlation of biophysical parameters and spectral field measurements to spectral signatures in satellite data of different spectral and spatial resolutions.
Biophysical parameters of interest are: Grazing limits/potential, Carryability and the way its triggered by climatic parameters.

Subproject "Rangeland"



MODIS Image

Compositing Period: 09/06 – 15/06/2000
Scene Location: h25, v05
Bands: 7,2,3 > RGB

Projection: Sinusoidal

Steppe Vegetation

Perennial Shrubs:

Feed Stuff	palatable shrubs
Fire Wood	palatable and unpalatable (invader)
Soil Fixation/Stabilization (Wind and Water)	palatable and unpalatable (invader)
Preferred Growing Sites for Annuals	palatable and unpalatable (invader)
Carbon Sequestration over the entire year	palatable and unpalatable (invader)

Annual Grasses:

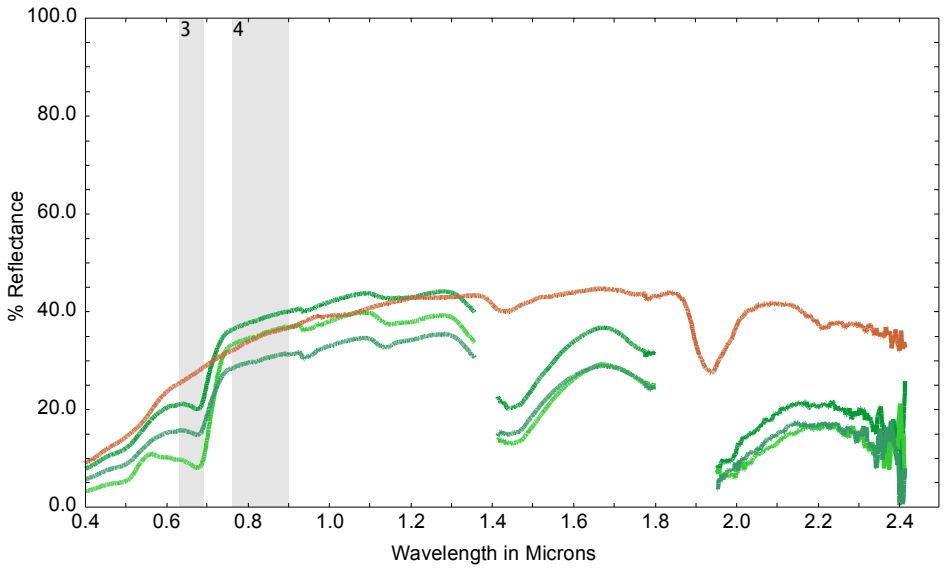
Feed Stuff

Soil Fixation (Water Runoff)

Seasonal Spectral Changes in a Degraded Area

Landsat TM 5 bands / IKONOS bands 3 and 4

- Silty soil
- Annual Grasses, low density
- Annual Grasses, medium density
- Annual Grasses, high density



Spectra of Annuals, Perennials and Soils

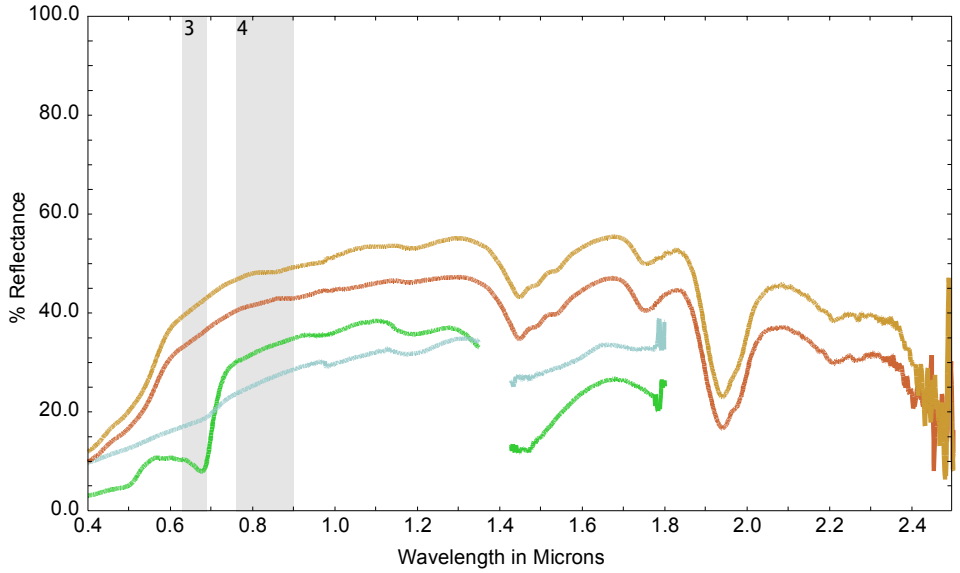
Landsat TM 5 bands / IKONOS bands 3 and 4

Soil crust, sandy, gypsiferous

Soil, sandy, gypsiferous

Annual grasses

Noaea mucronata



25/02/01

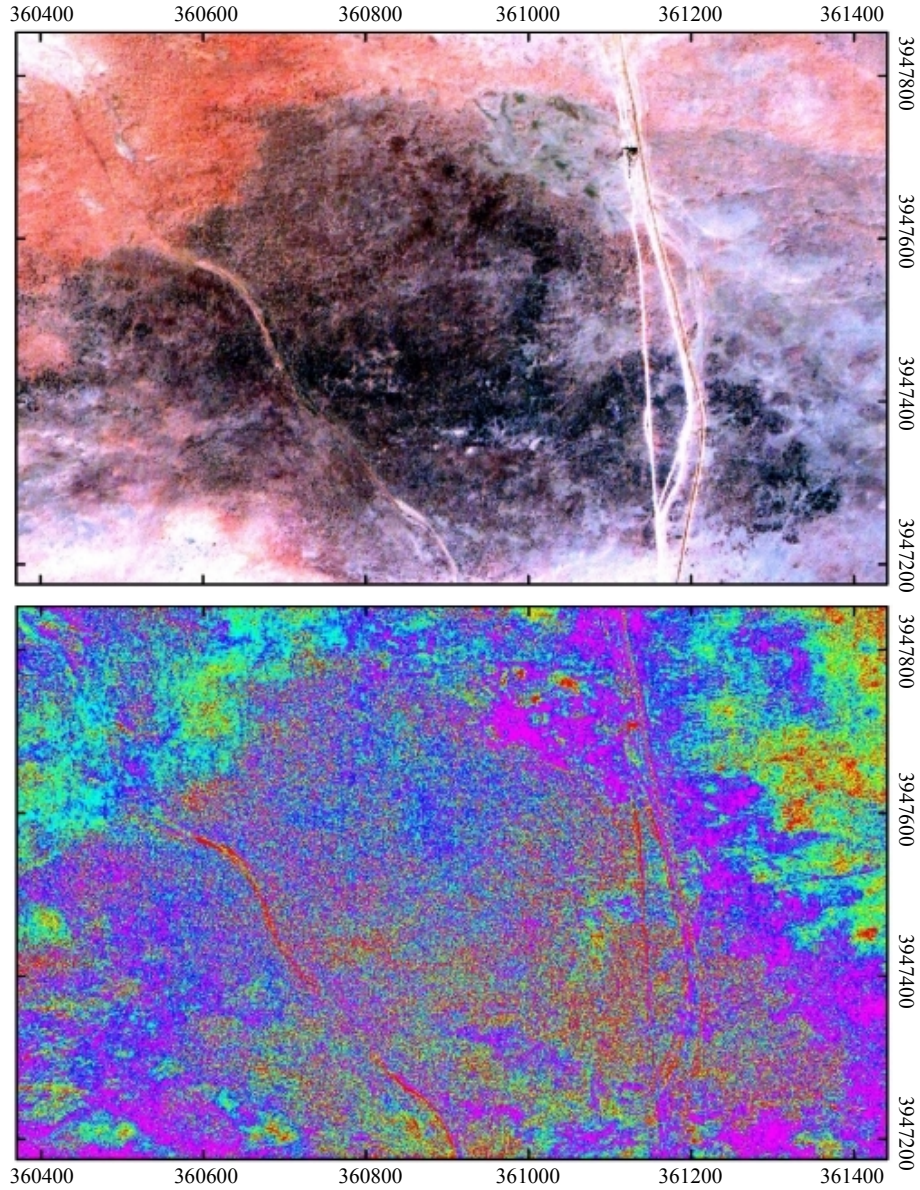
Change Vector Analyses

From IKONOS subsets, 4 bands:

27th Mar 2000
05th Oct 2000

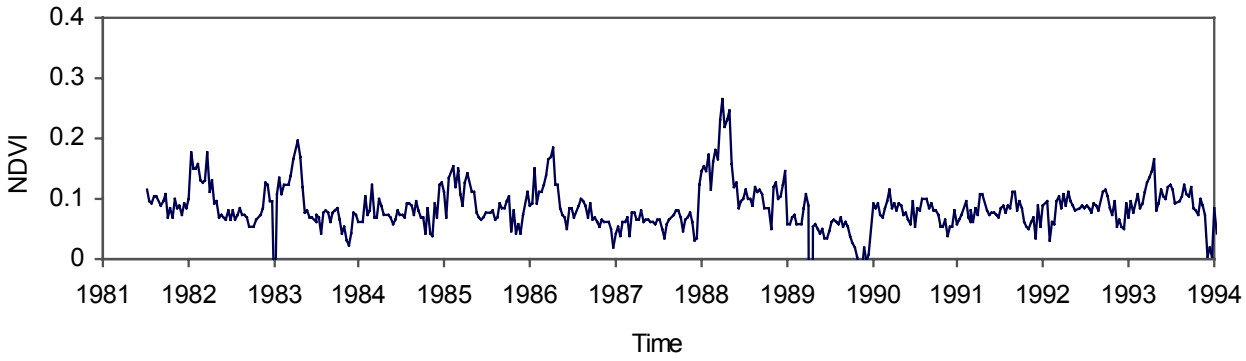
400 200 0 400

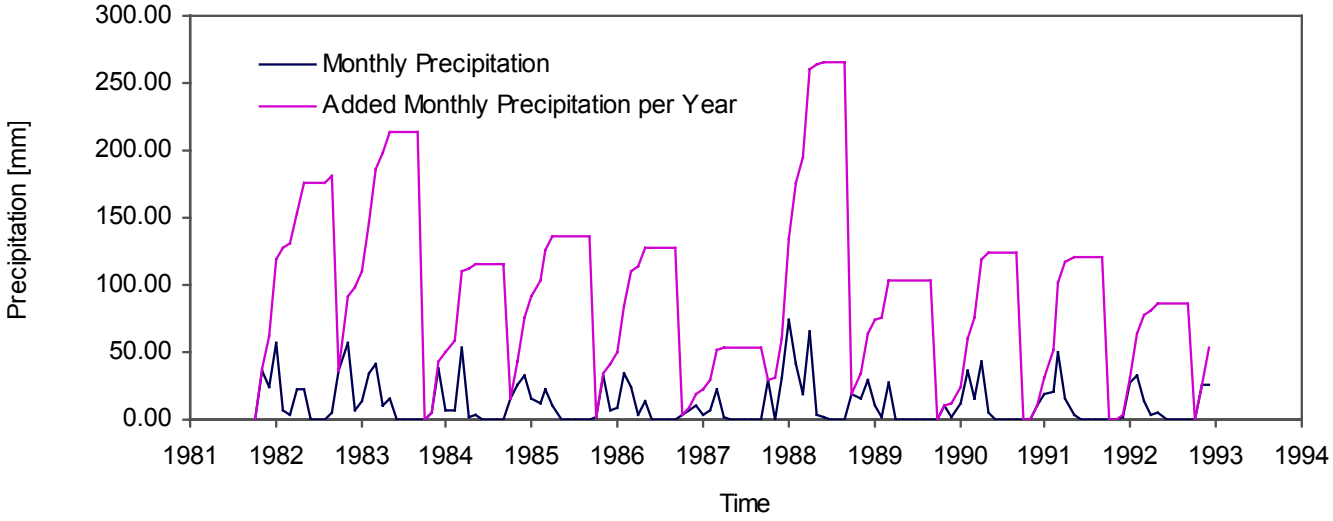
Color Composite: 4,3,1 > RGB
27th Mar 2000



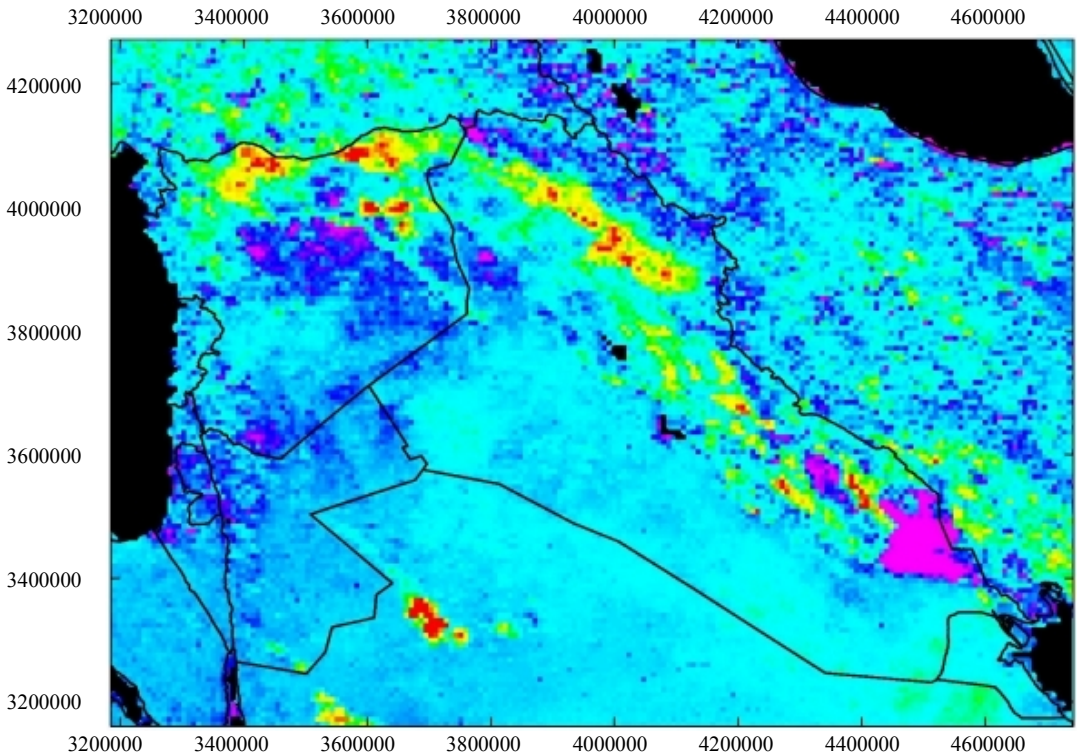
Change Magnitude

NDVI Cycles

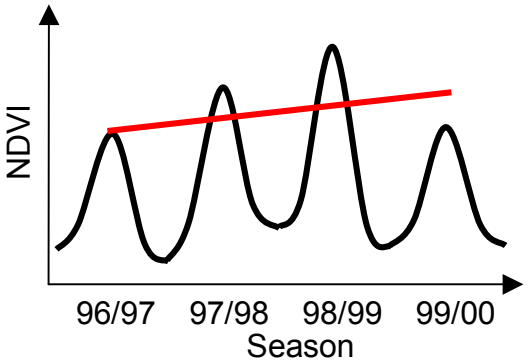

0.4
0.3
0.2
0.1
0
NDVI
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
Time

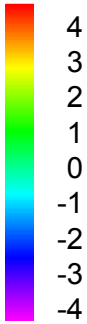

300.00
250.00
200.00
150.00
100.00
50.00
0.00
Precipitation [mm]
Monthly Precipitation
Added Monthly Precipitation per Year
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
Time

Trend of $NDVI_{max}$ calculated from Seasons 81/82-98/99



Projection: Sinusoidal





Slope of Regression Linear

Composite Signature of Shrub Grown Areas

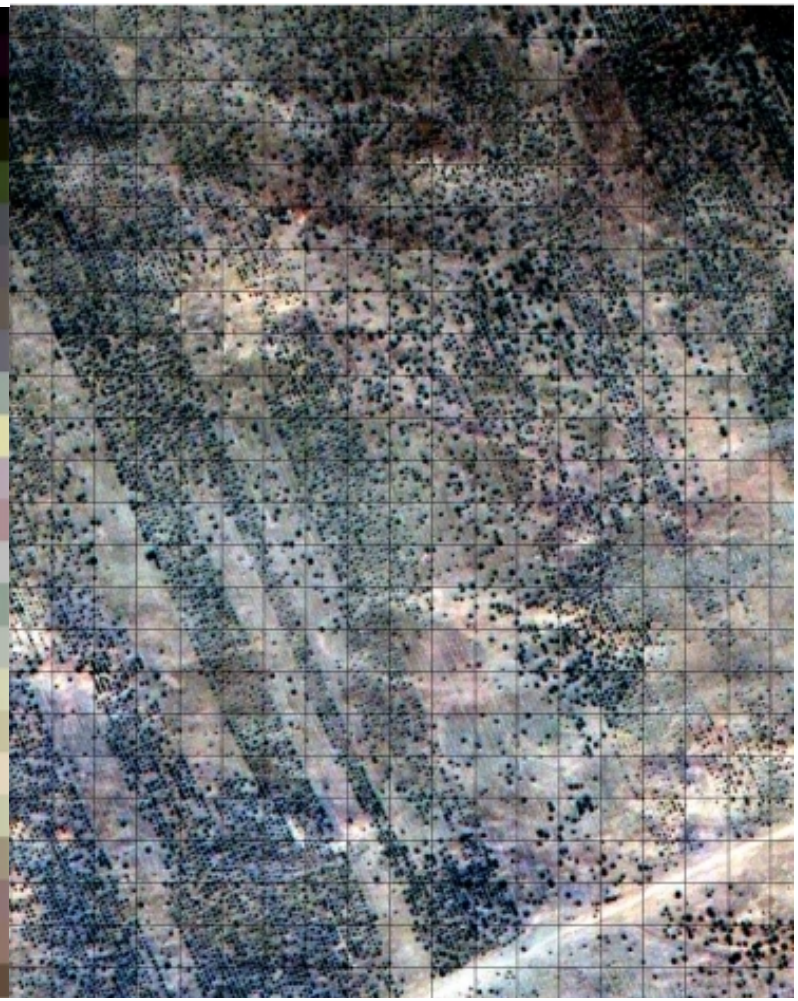
Triggered by:

- Shrub Species
- Shrub Density
- Background Reflectance
  - Soil, Outcrops, Annual Grasses, Pebbles, and Variations in these Components
- Seasonality

TM5, 30m

Acq. Date 01/05/98, Bands 4,3,1 > RGB

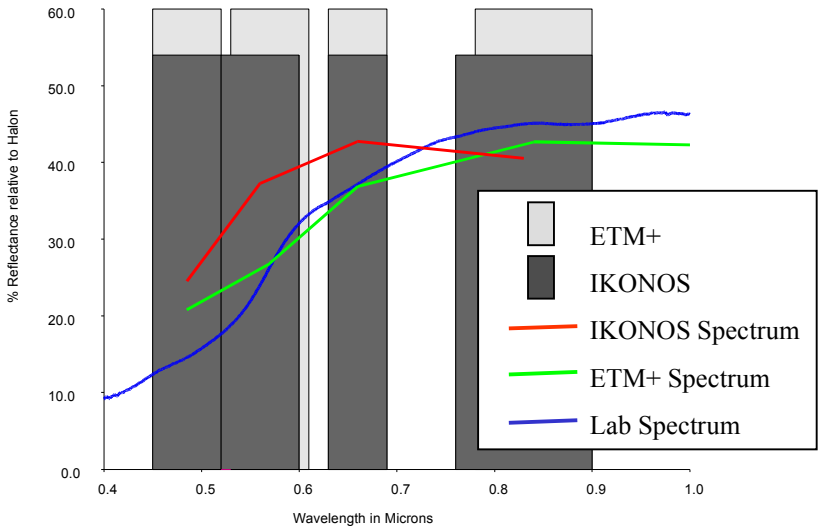
IKONOS pan-xs merge 1m

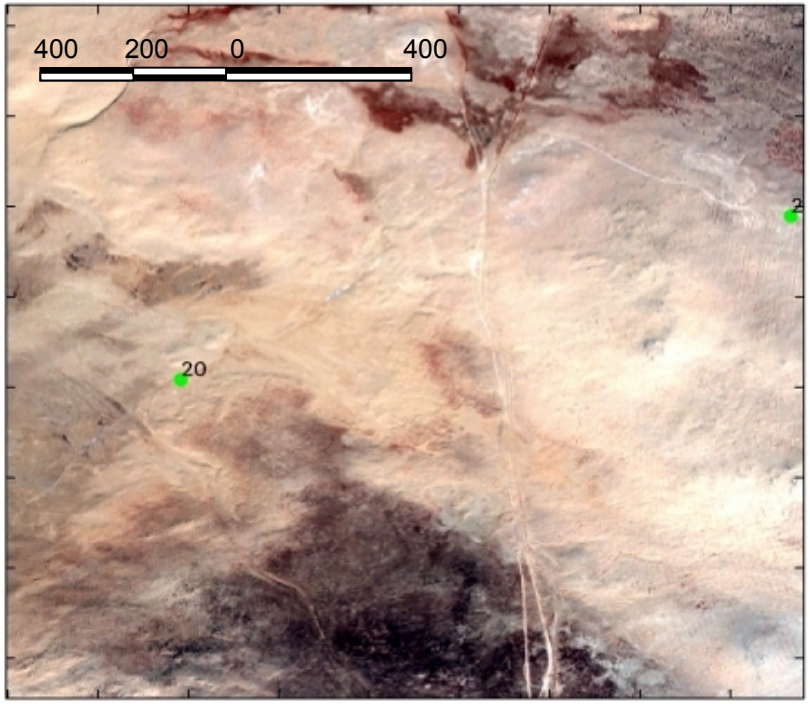


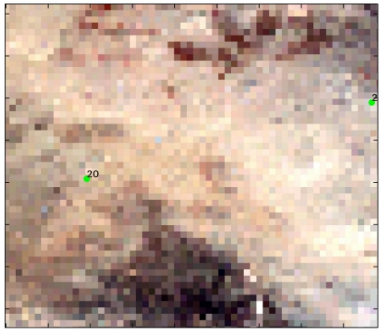
Acq. Date 27/03/00, Bands 4,3,1 > RGB

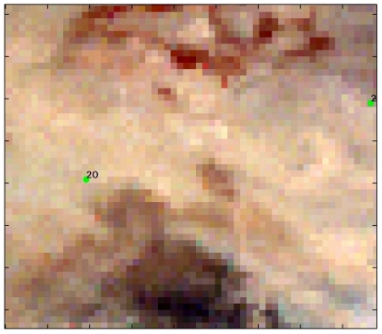
Spectral Signatures

IKONOS xs (Up):	4,2,1 > RGB
	05th Oct 2000
IKONOS xs (LL):	degraded 30x30m
	4,2,1 > RGB
ETM+ (LR):	4,2,1 > RGB









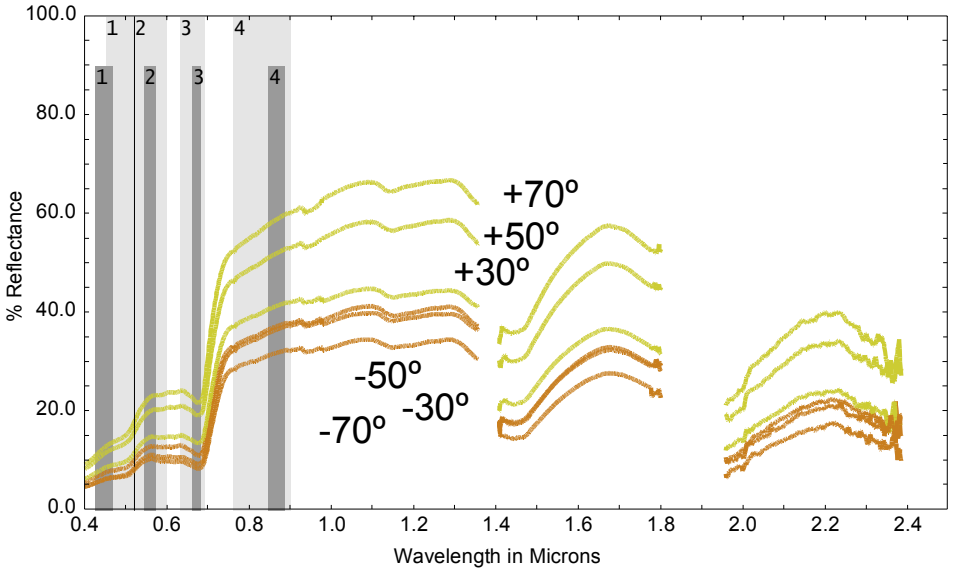
Angular spectral measurements

Landsat TM 5 bands / IKONOS bands 1 to 4

MISR bands

Into sun

Into shadow



Causes of Desertification/Degradation

Human Impact:

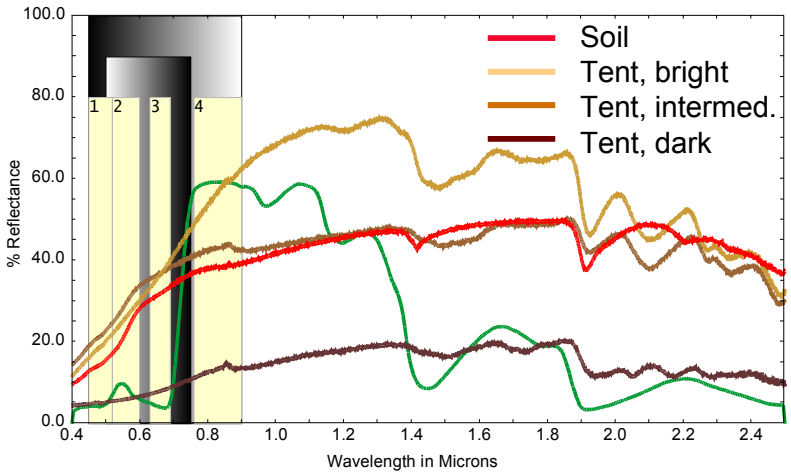
Rainfed Agriculture
Overgrazing
Shrub Uprooting for Firewood
Cross Country Driving

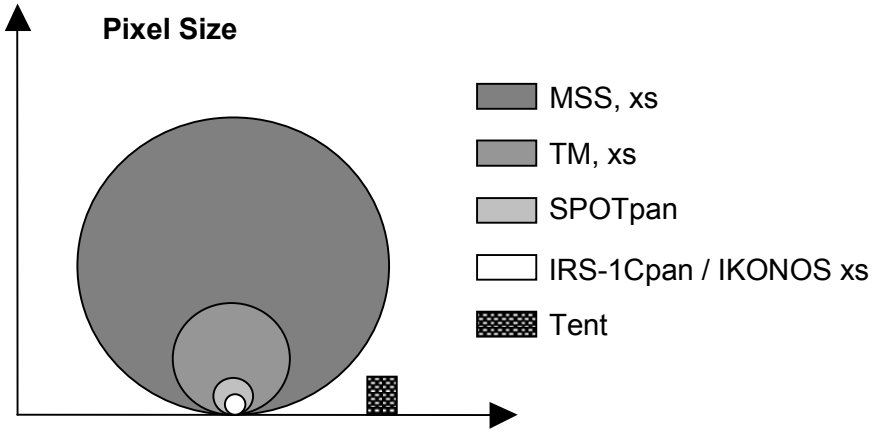
Climate:

May Enhance or Mask Degradation Trends
Initiated by the above Activities

To make responsible ministries and organisations act requires sufficient evidence about causes and effects of degradation.

Criteria for Tent Identification



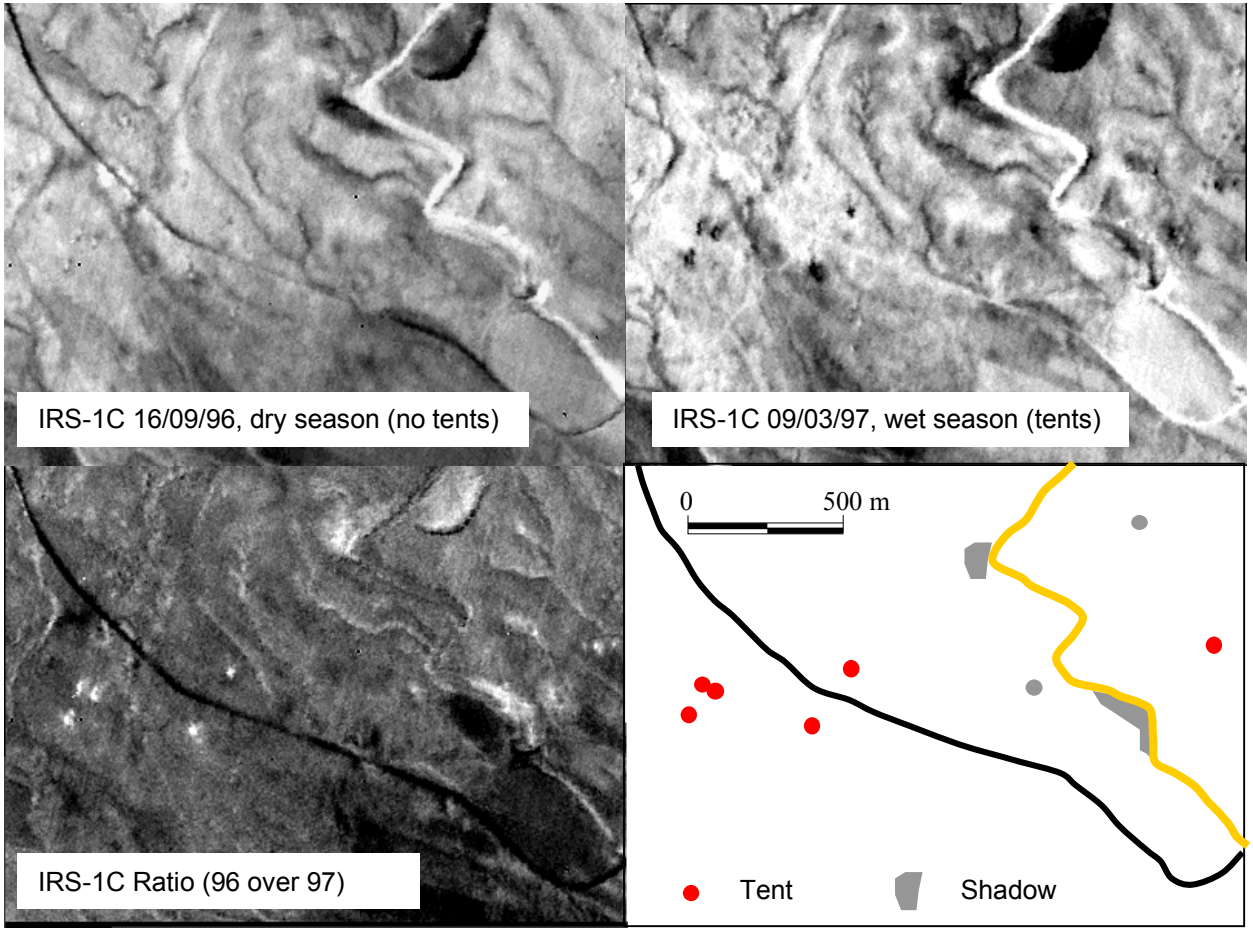


IRS-1C pan

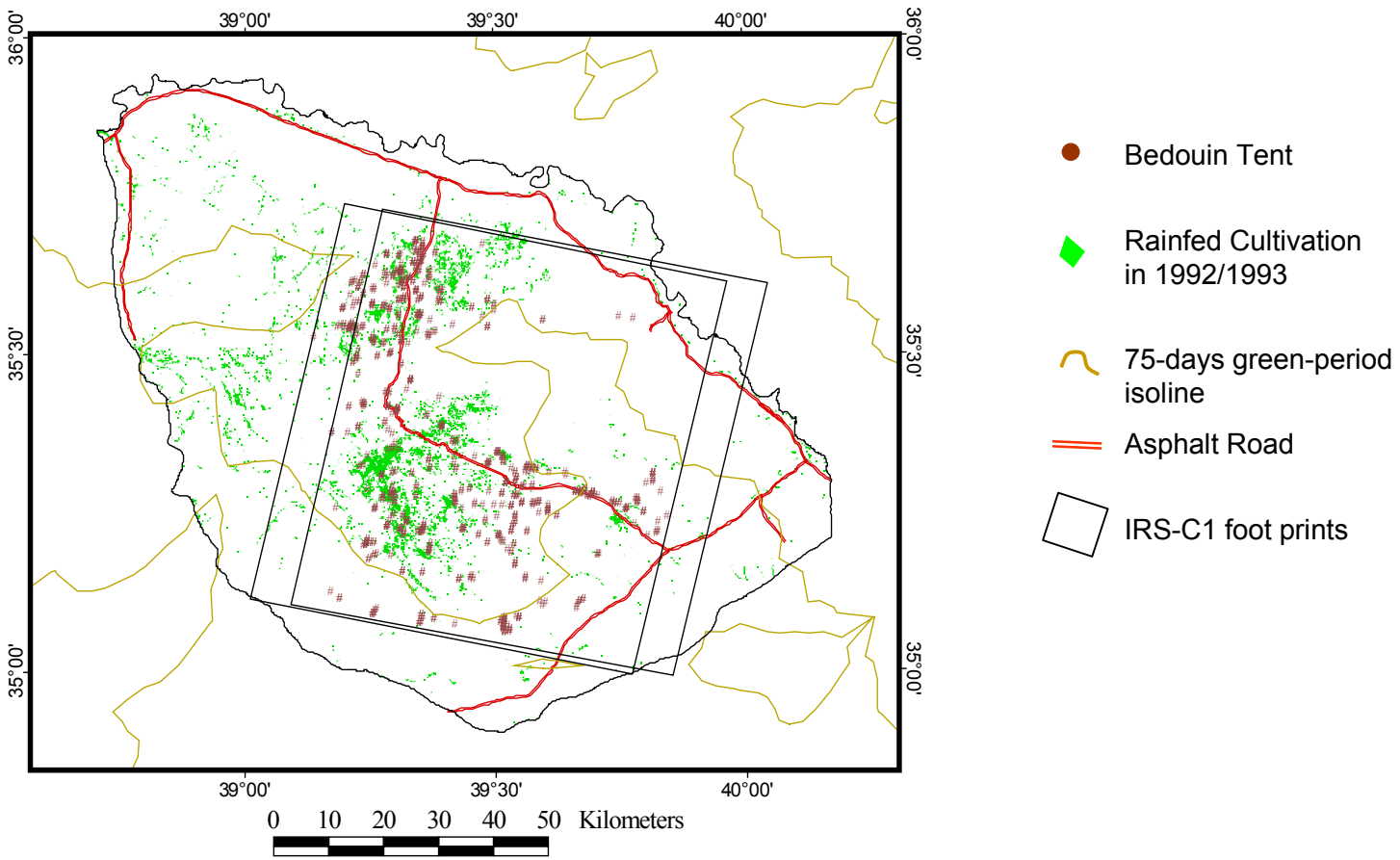
IKONOS pan

IKONOS xs

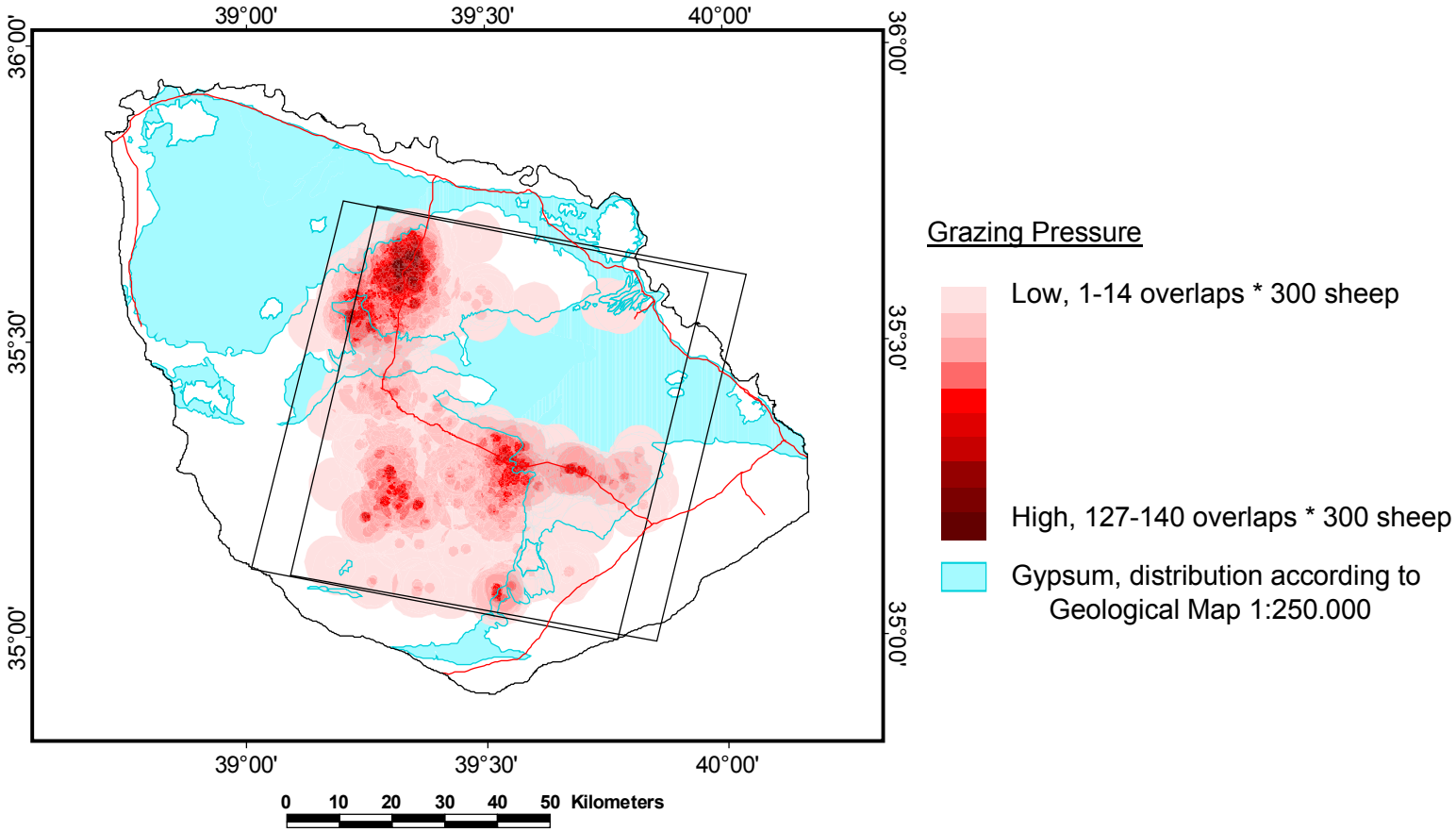
Tent Identification from *IRS-1C pan*



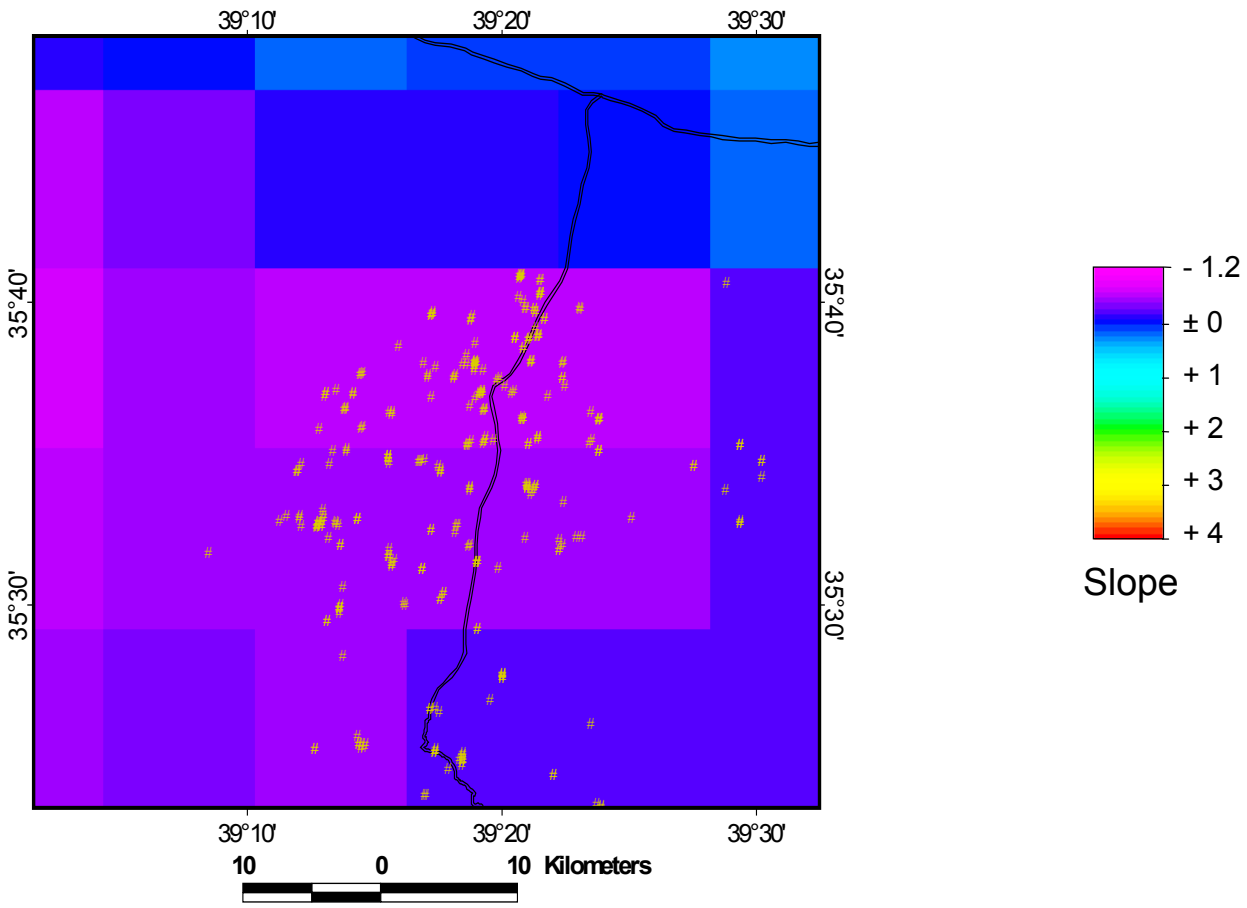
Tent Distribution



Grazing Pressure



Tent Distribution and Degradation

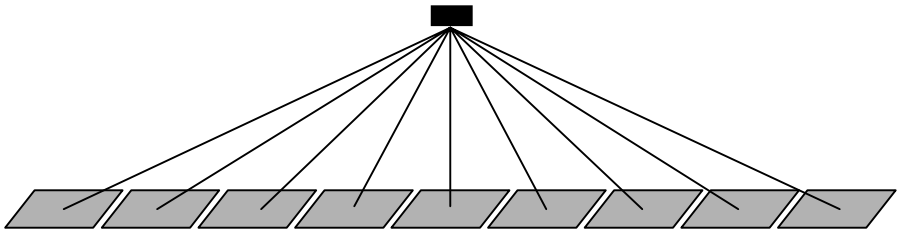


Bedouin Tents

IKONOS xs (4,3,1 > RGB)
IKONOS pan
IKONOS xs/pan merge

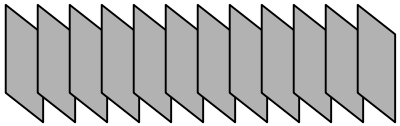
400 200 0 400

MISR Angular Measurements (250m)



MODIS / AVHRR High Temporal Resolution (500m)

Time Series



TM / ETM+ /Aster

Mapping Scale for
Regional Analysis (30m/10m)
Adequate Scale for the Definition
of Field Measures

Verification / Monitoring and Evaluation of
Benchmark Areas

IKONOS xs, pan High Spatial Resolution (1m/4m)

Studying IKONOS Images

Identification of spectral signatures of shrub grown areas for extrapolation using data of lower spatial resolution (TM / ETM+ / Aster).

Studying shrub densities and possibilities of extrapolation using MISR data.

Monitoring representative areas to study human impact on range lands

Upscaling and down scaling of spectral information between images of different resolution

Algorithms for texture identification

Results of “Range Land“ Subproject

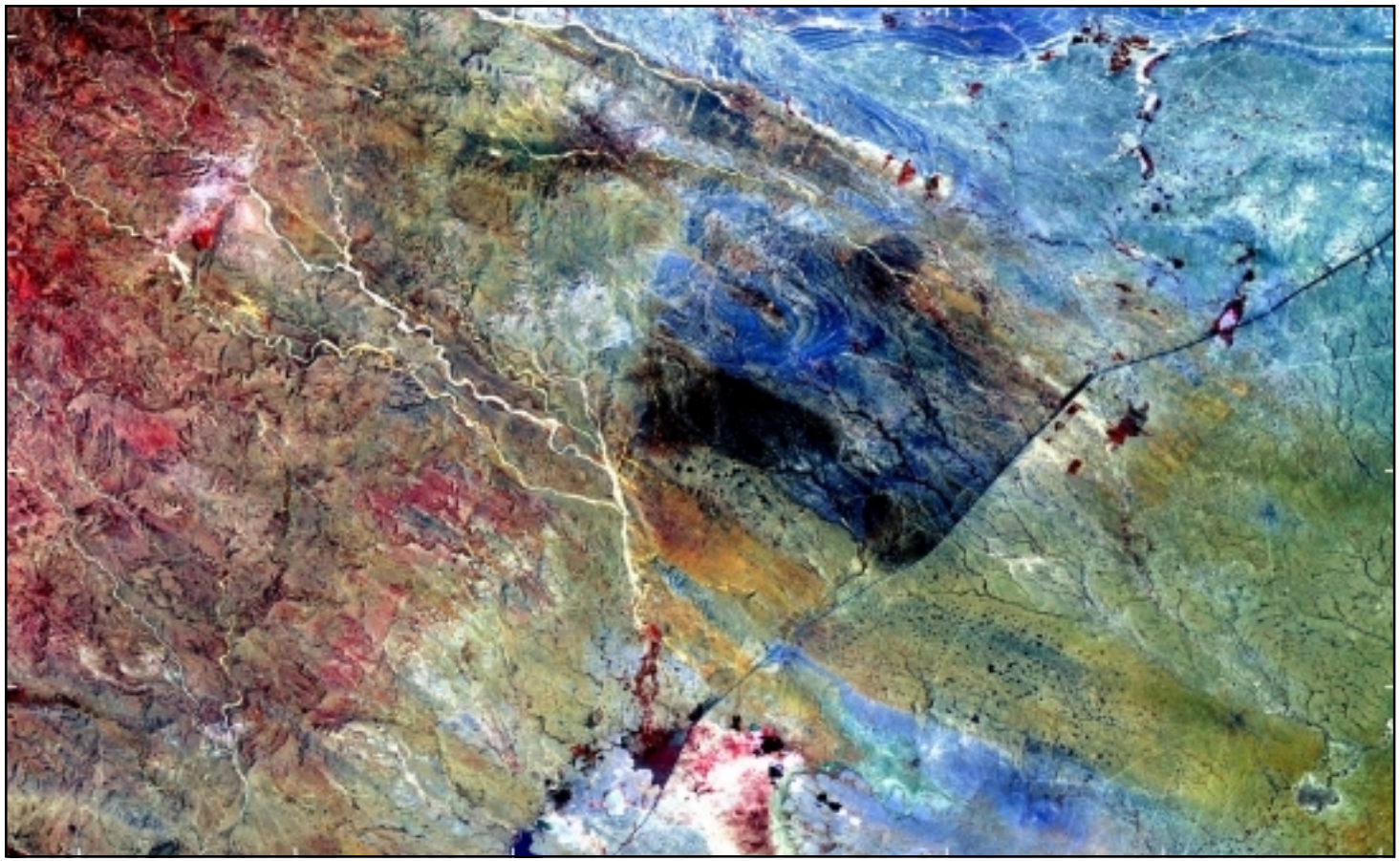
Separating Fluctuations from Degradation

Improved description of range lands

Managing rangelands: Establishing proper
Stocking Rates and Grazing Periods

Forecast Models for adapted land use: Timing of grazing

Definition of rehabilitation areas and rehabilitation activities

Improved monitoring and evaluation of degradation / rehabilitation

Shrub Identification from TM