

# Monitoring Namibian rangelands from space: Developing a system with farmers

21 June 2016

GEOGLAMRAPP WORKSHOP

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Namibia Rangeland Monitoring Project

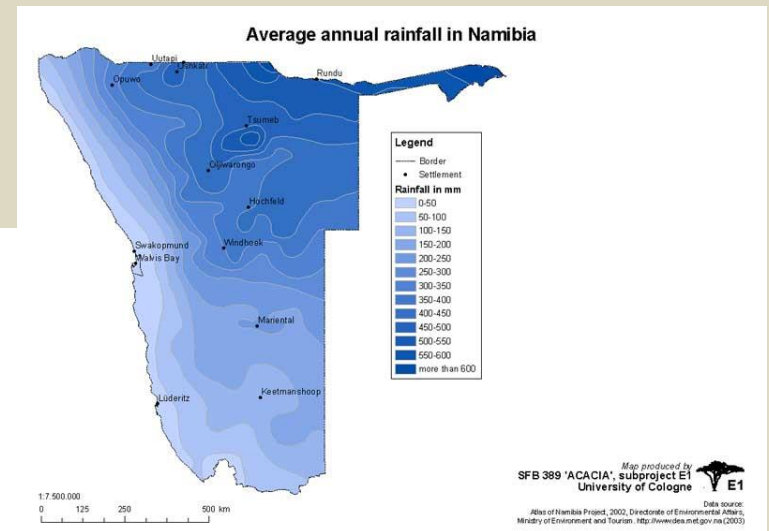
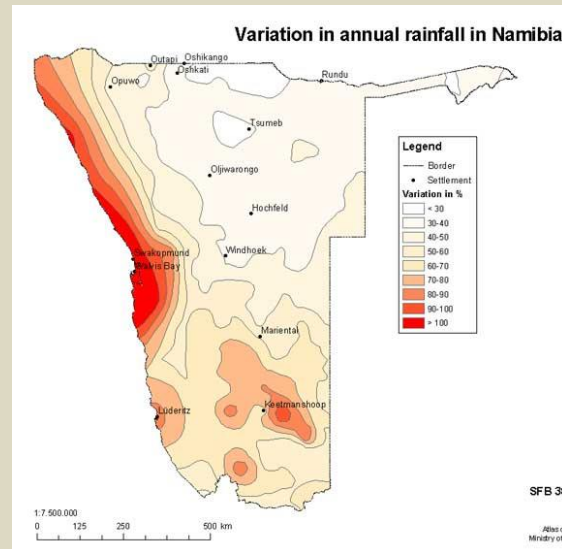
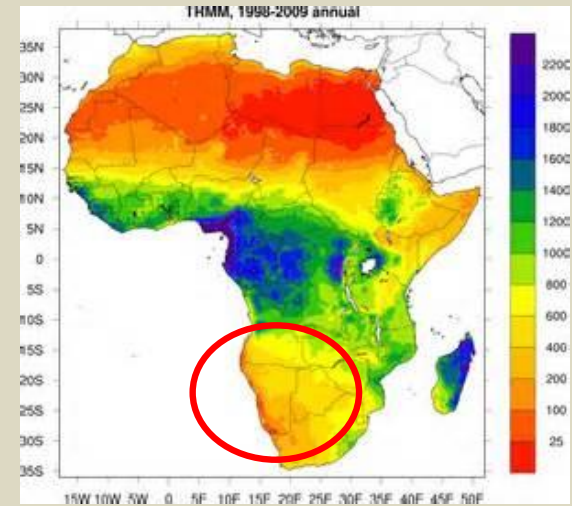
Delegation of the European Union to Namibia

Climate Change Adaptation and Mitigation, including Energy



# Introduction

- Namibia most arid African country south of equator
- Animal production systems dominant landuse

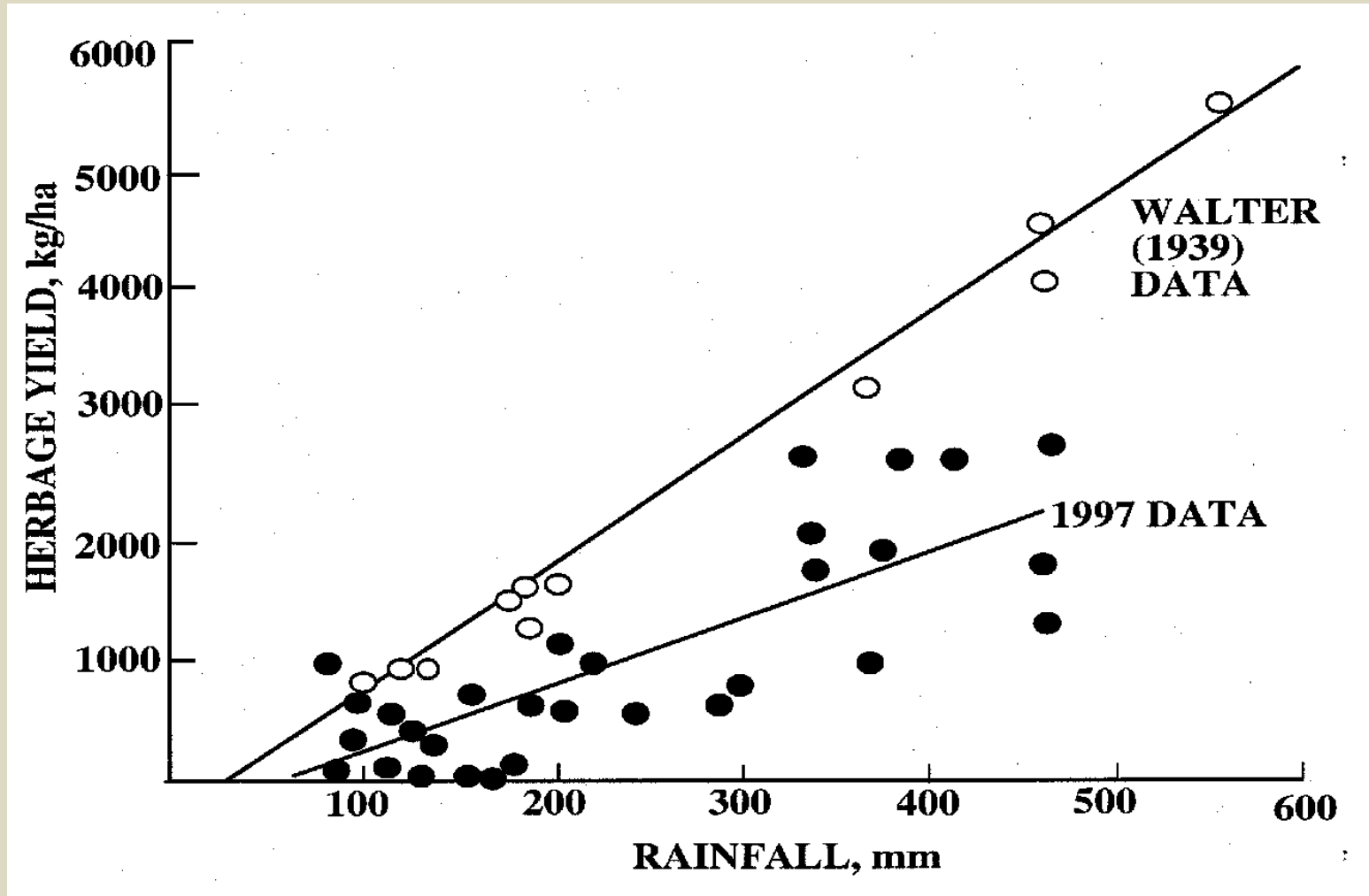


7/1992

# Rangelands under pressure

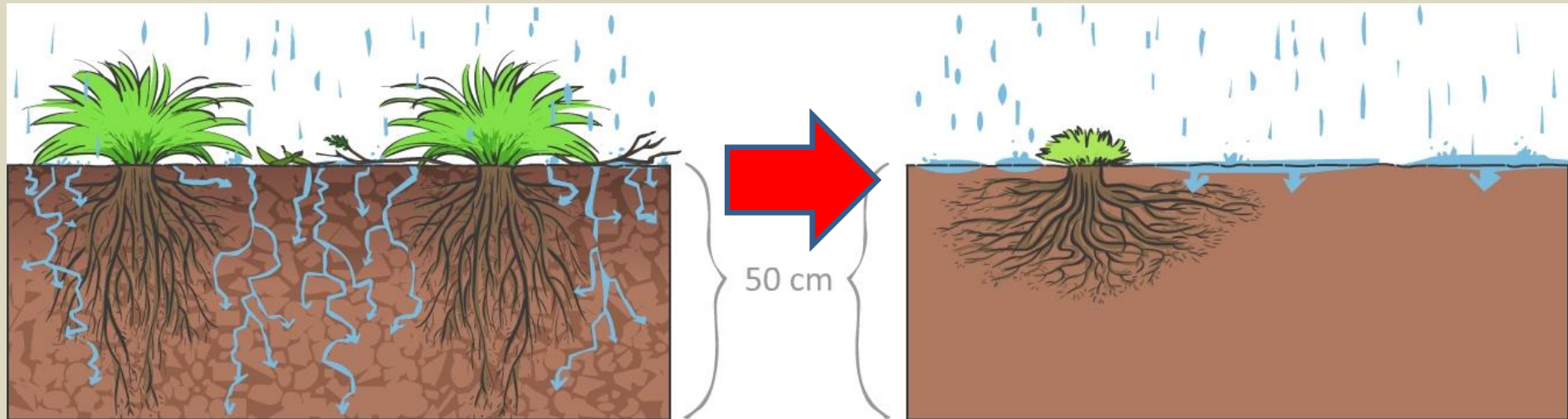


# Commercial areas Decline in grass production

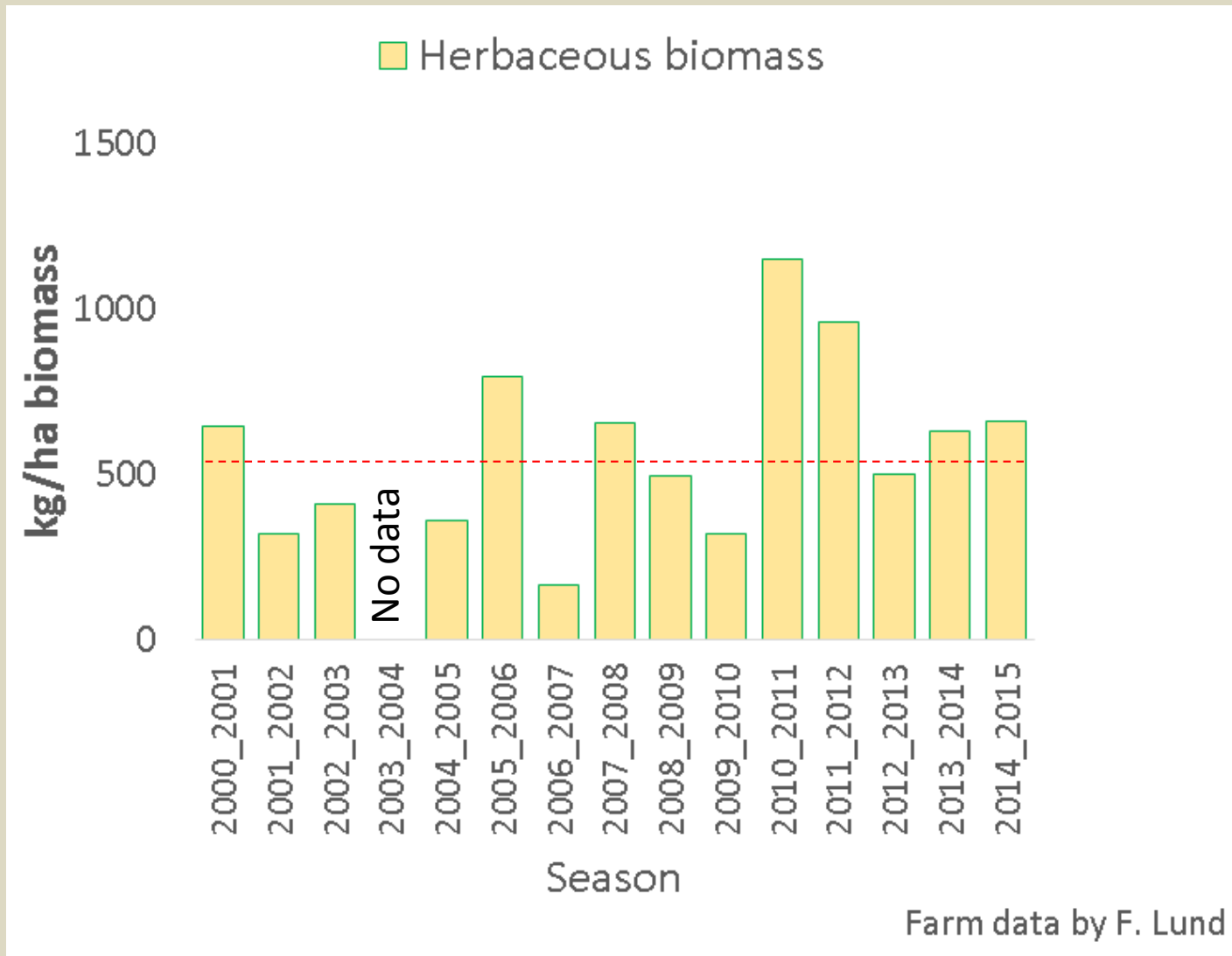


Ward & Ngairorue 2000

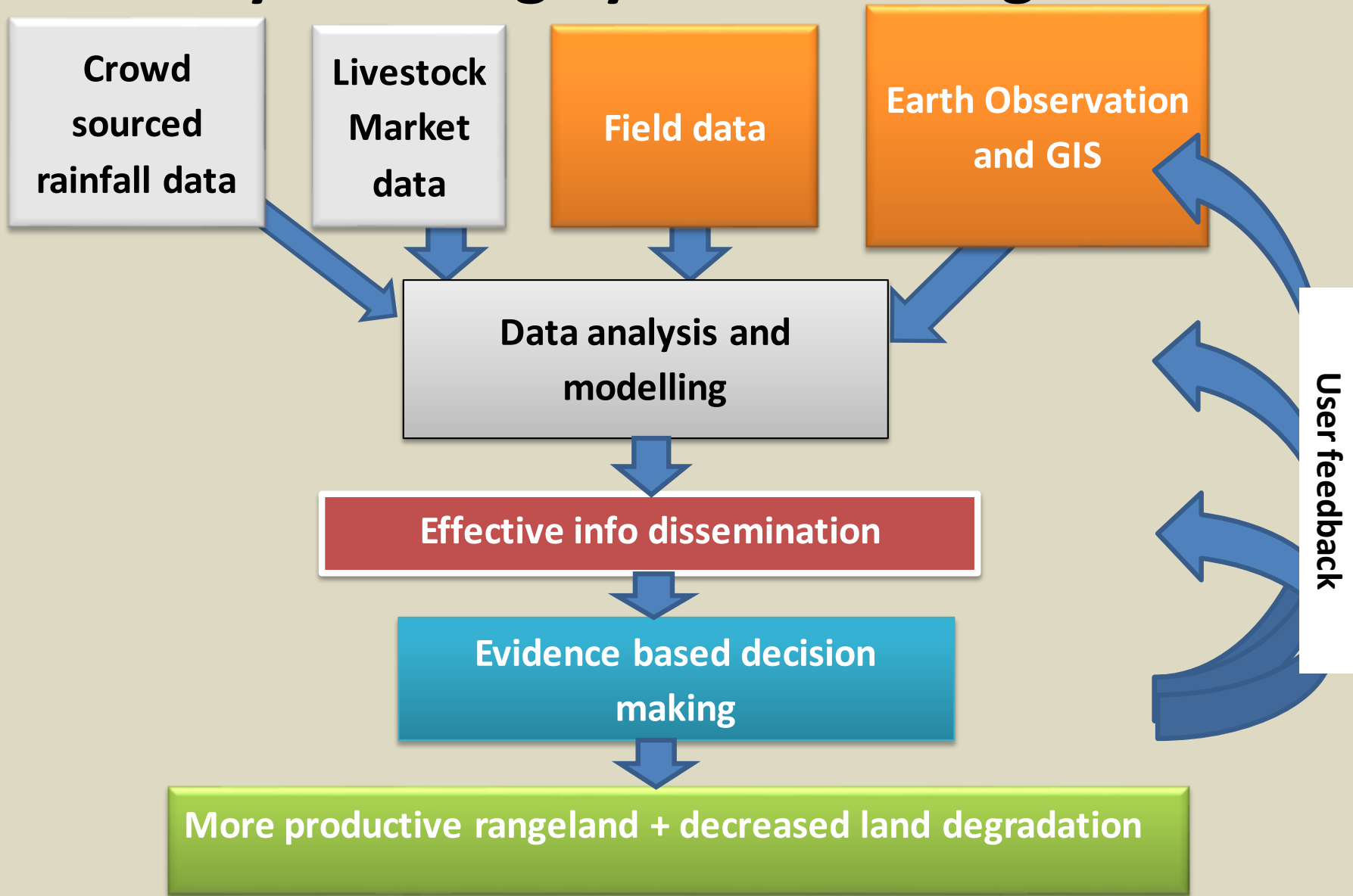
# Drought + high stocking rates kill perennial grasses



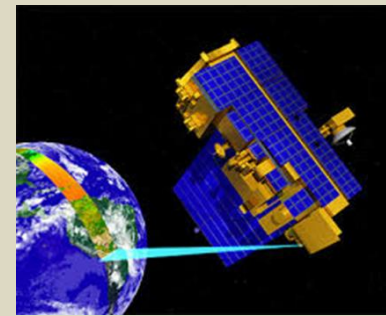
# Rangeland management challenge - Large variability in forage production



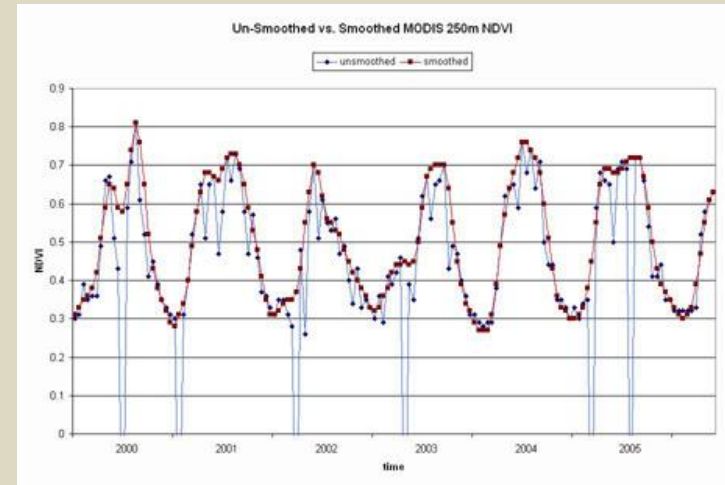
# Early Warning System for rangelands



# Remote sensing



- Use eModis NDVI product accessed through FEWS NET website (southern African tile)
- Process NDVI based products every 2 weeks during growing season



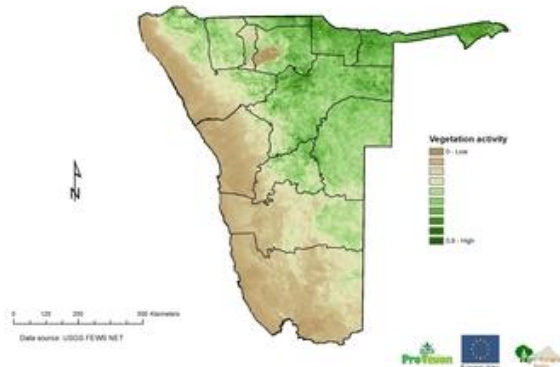
# Namibia Rangeland Monitoring

Welcome to the early warning system

Select Date  Select Region  Select Type  [Start Slide Show](#)

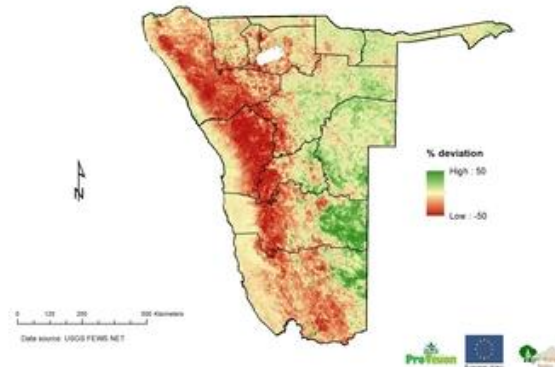
## Current NDVI

NDVI for the period 1 to 15 April 2016



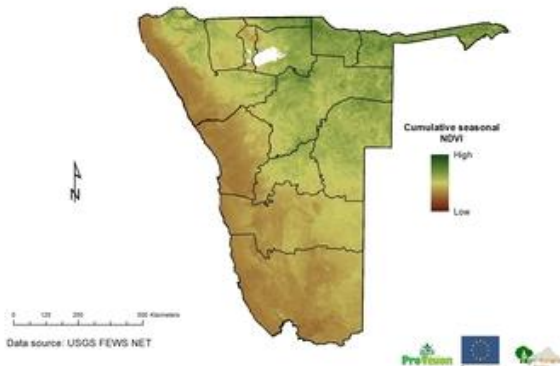
## Current NDVI Deviation

NDVI: Period 1 to 15 April 2016 deviation from long-term mean



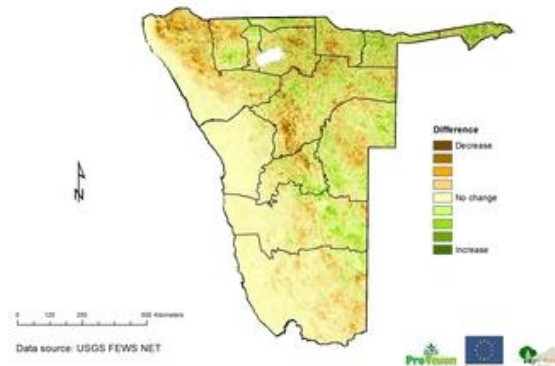
## Cumulative Seasonal NDVI

Cumulative seasonal NDVI for 1 September 2015 to 15 April 2016

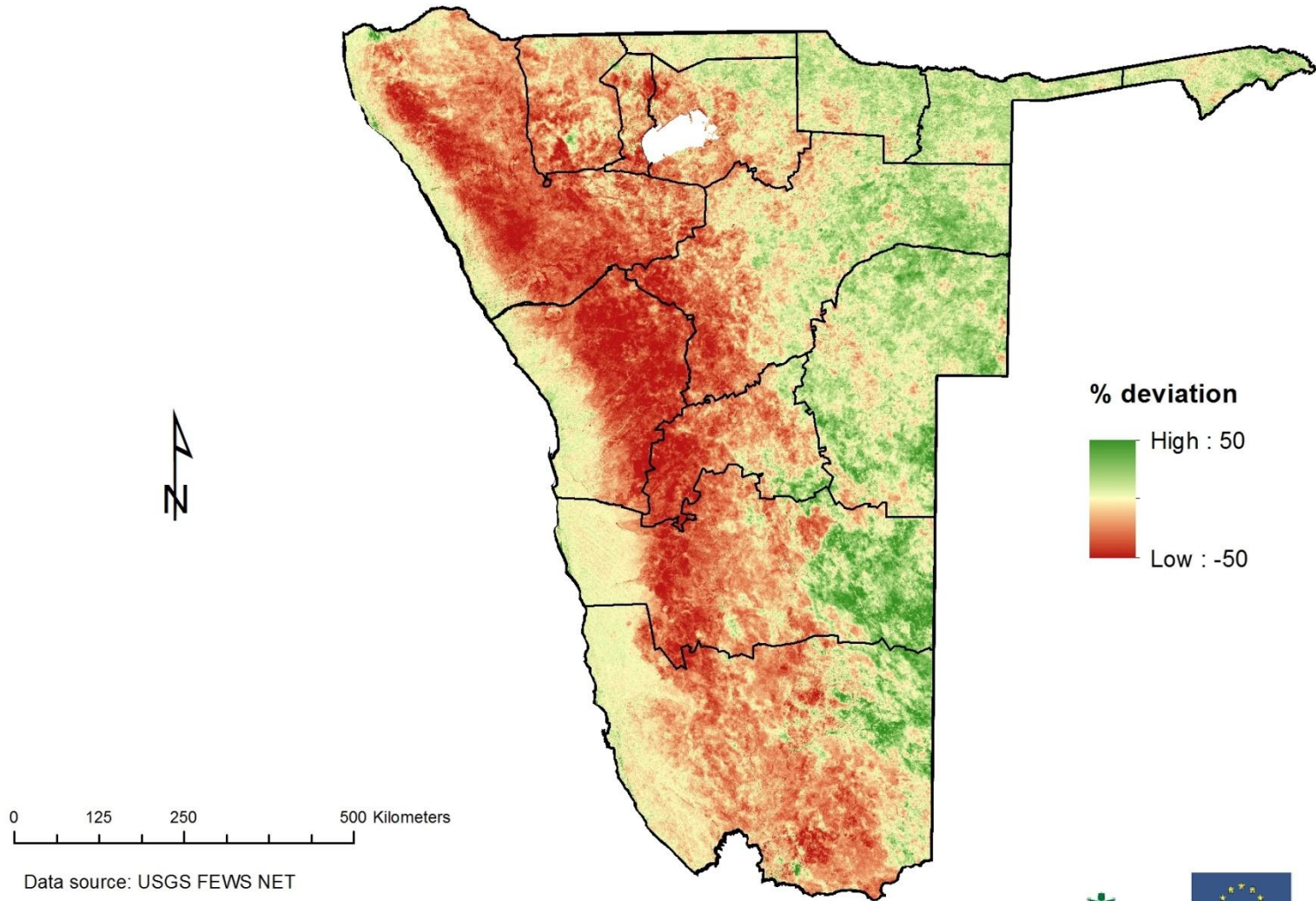


## NDVI Difference from Previous

NDVI difference map for 1 to 15 April 2016 compared to 16 to 31 March 2016



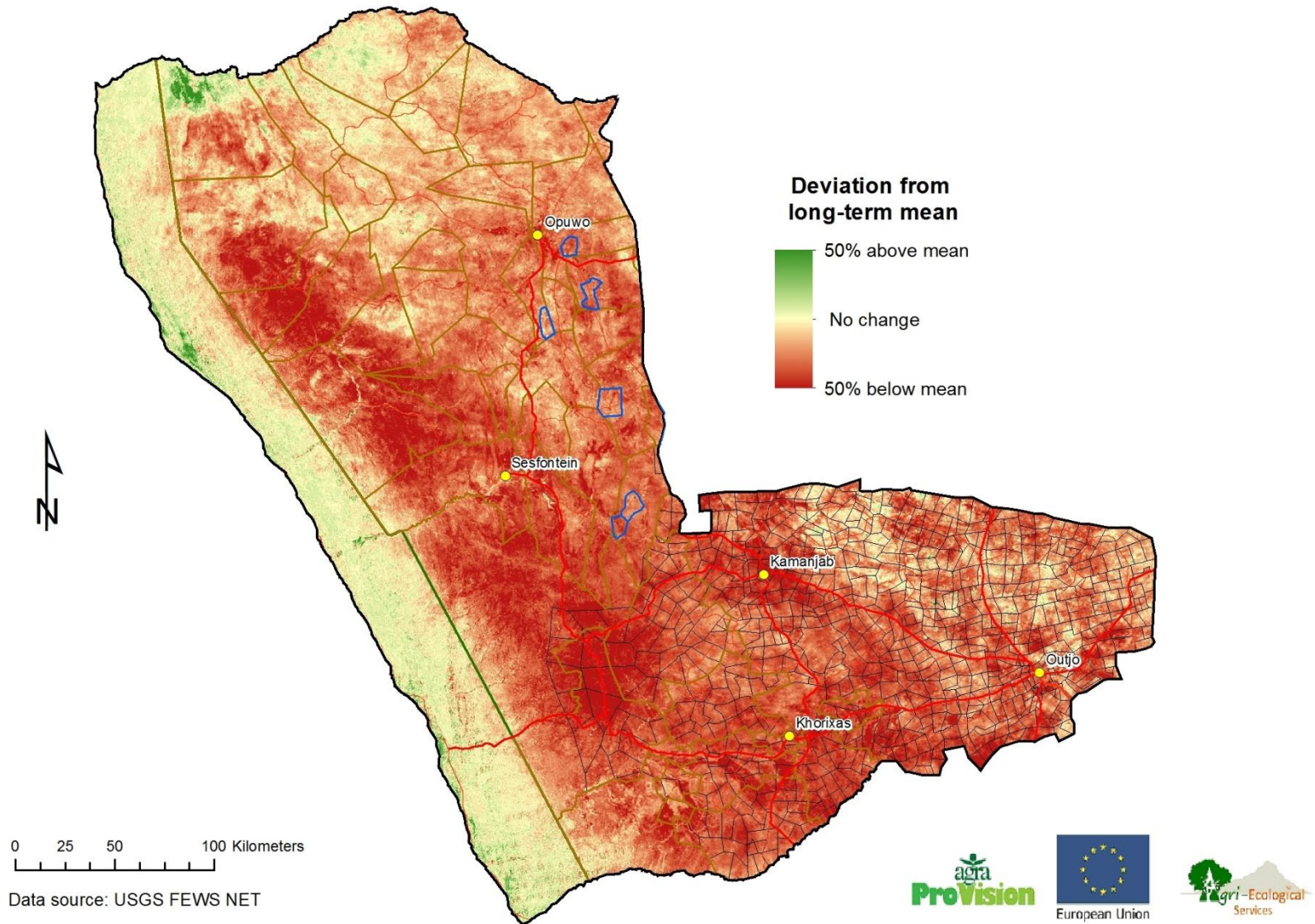
# NDVI: Period 16 to 30 April 2016 deviation from long-term mean



Data source: USGS FEWS NET

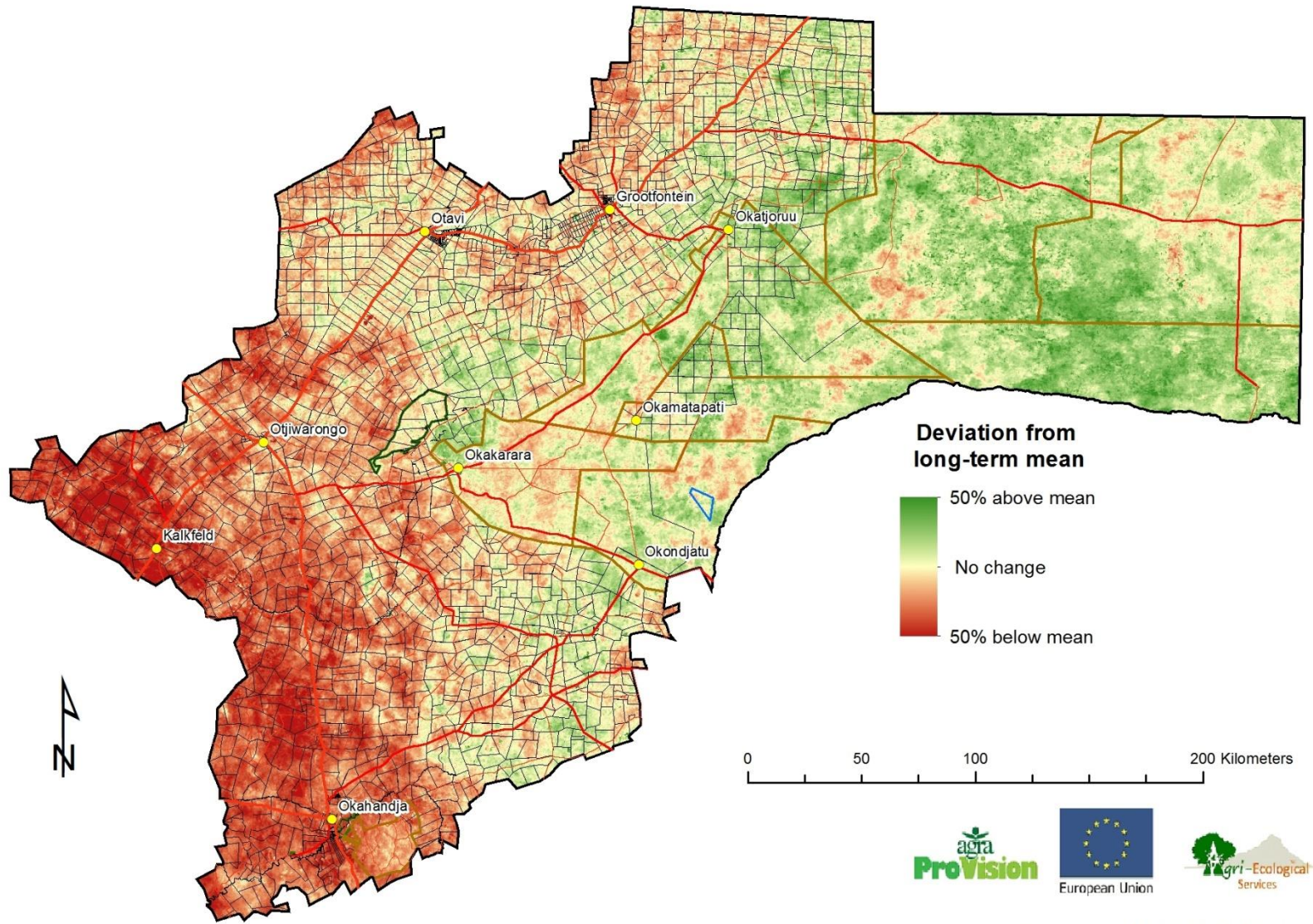
# NDVI: Period 16 to 30 April 2016 deviation from long-term mean

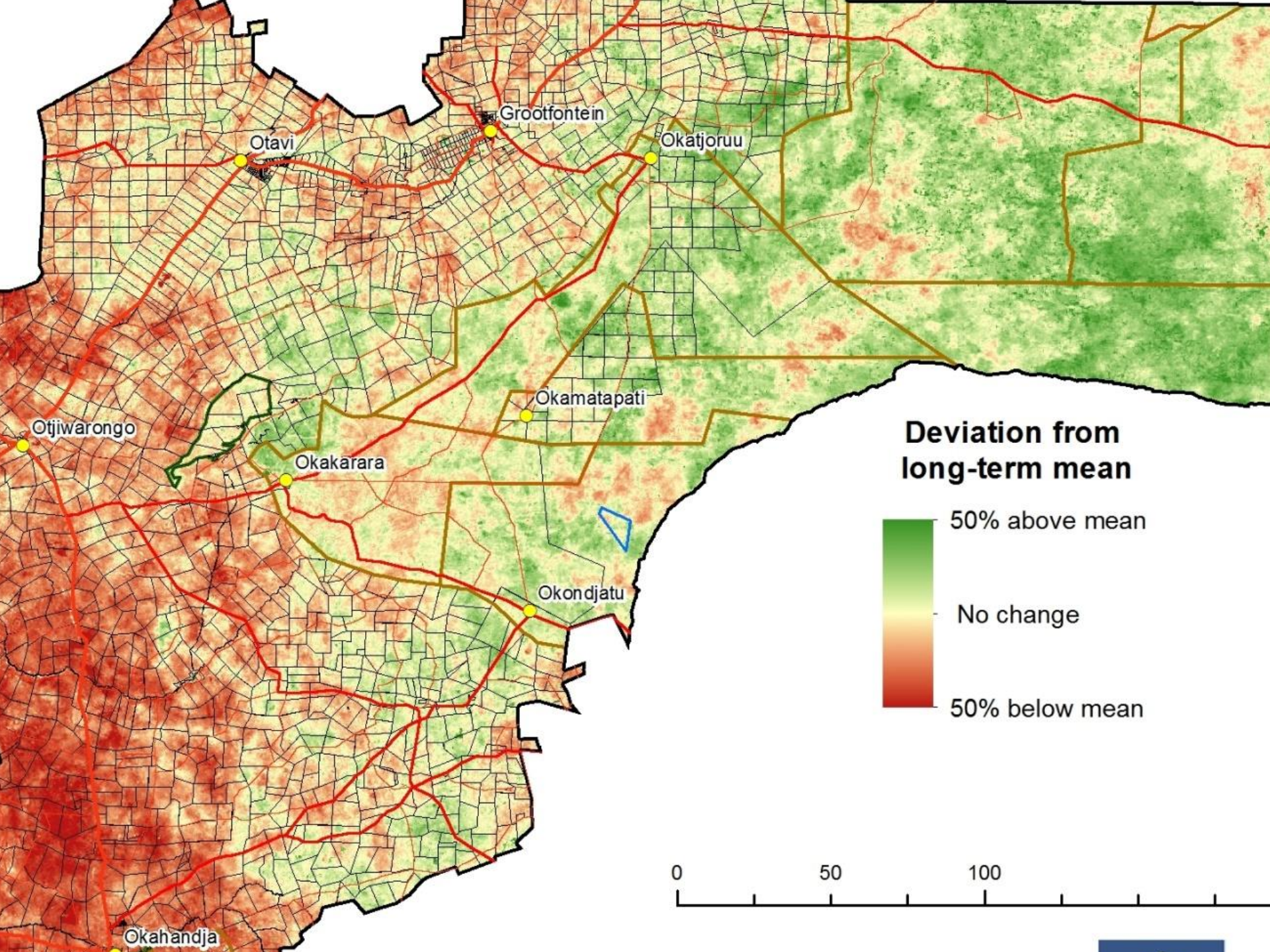
## Kunene region



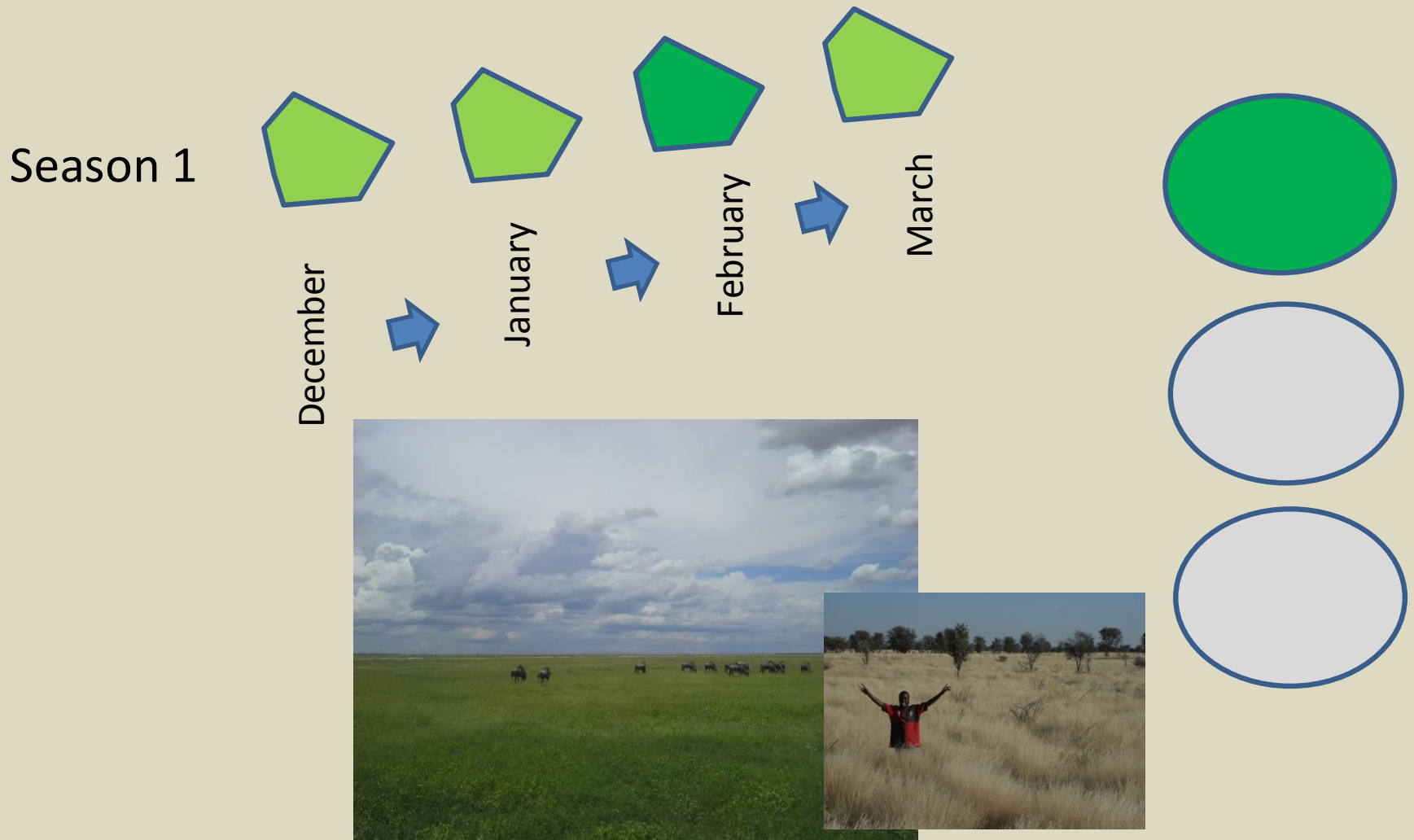
# NDVI: Period 16 to 30 April 2016 deviation from long-term mean

## Otzondjupa region



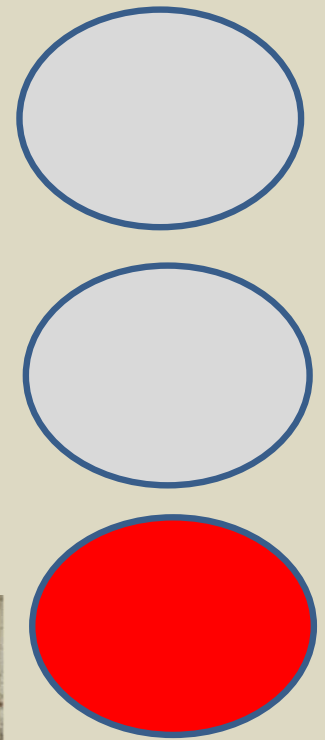
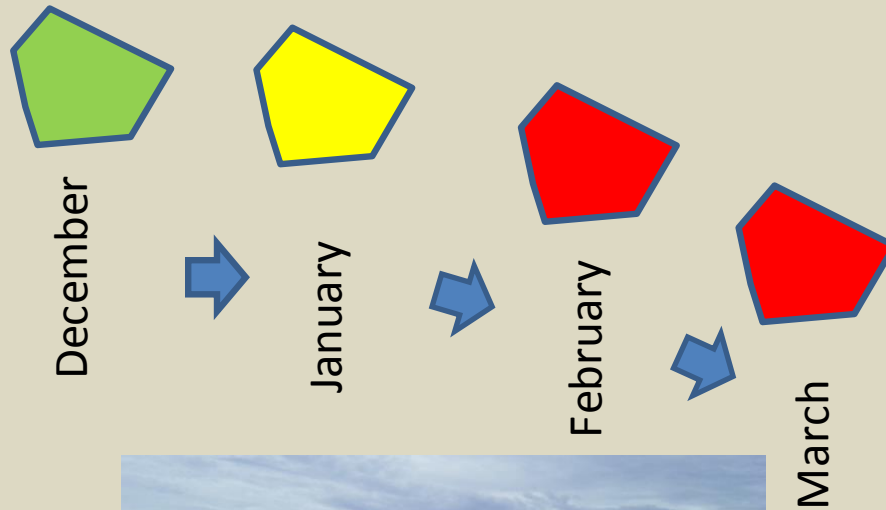


# Monitoring tool – risk reduction



# Monitoring tool – risk reduction

Season 1



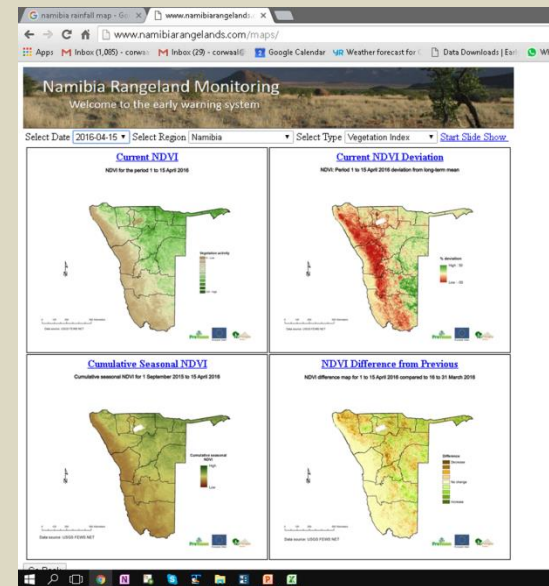
# Support communal development project

| Grazing area/farm   | 2015_09_15 | 2015_09_30 | 2015_10_15 | 2015_10_31 | 2015_11_15 | 2015_11_30 | 2015_12_15 | 2015_12_31 | 2016_01_15 | 2016_01_31 | 2016_02_16 | 2016_02_28 | 2016_03_15 | 2016_03_31 | 2016_04_15 | 2016_04_30 | 2016_05_15 | 2016_05_31 |
|---------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Okanandjira         | 34.8       | 26.9       | 12.5       | 11.9       | 14.8       | 12.5       | 9.7        | 10.4       | 37.9       | 50.4       | 46.5       | 29.2       | 15.7       | 13.8       | 13.3       | 10.9       | 8.1        | 7.4        |
| Ankunya             | 36.2       | 34.6       | 28.7       | 28.2       | 24.5       | 14.3       | 12.3       | 11.8       | 14.8       | 16.7       | 14.8       | 5.0        | 9.2        | 42.0       | 51.4       | 22.6       | 5.8        | 4.3        |
| Elago               | 10.2       | 17.1       | 8.2        | 6.1        | 3.6        | 8.7        | 12.9       | 21.2       | 53.6       | 44.4       | 34.0       | 19.9       | 40.0       | 56.2       | 53.2       | 30.5       | 6.7        | 1.4        |
| Otjovanatje         | 21.0       | 23.0       | 19.8       | 12.2       | 11.8       | 8.2        | 33.2       | 50.8       | 80.1       | 84.5       | 72.4       | 54.5       | 46.1       | 48.4       | 41.9       | 17.9       | 5.7        | 3.8        |
| Omisema             | 32.9       | 32.2       | 18.4       | 16.9       | 17.4       | 17.3       | 26.5       | 64.0       | 63.7       | 41.8       | 47.3       | 42.6       | 20.8       | 16.7       | 16.1       | 12.9       | 5.9        | 7.1        |
| Marema              | 35.0       | 29.3       | 16.5       | 10.4       | 5.8        | 2.3        | 3.0        | 4.5        | 28.2       | 44.6       | 58.3       | 45.8       | 12.2       | 46.3       | 78.4       | 86.5       | 63.4       | 39.6       |
| Nsindi              | 20.3       | 11.6       | 10.3       | 9.0        | 5.1        | 1.2        | 0.2        | 0.3        | 8.2        | 22.5       | 61.4       | 66.5       | 51.8       | 74.1       | 83.3       | 76.9       | 51.4       | 29.4       |
| Kakekete            | 76.2       | 28.0       | 15.8       | 15.4       | 18.2       | 6.5        | 18.3       | 27.2       | 39.4       | 38.6       | 50.7       | 46.8       | 15.2       | 23.2       | 43.5       | 78.1       | 80.2       | 84.5       |
| Outokotorua         | 38.6       | 35.0       | 9.8        | 6.1        | 11.8       | 17.4       | 24.1       | 31.0       | 27.9       | 21.5       | 23.5       | 18.9       | 6.1        | 5.0        | 3.3        | 2.4        | 1.2        | 2.1        |
| Nangolo Dhamutenya  | 8.1        | 10.0       | 2.5        | 1.5        | 1.0        | 0.9        | 0.7        | 1.0        | 3.2        | 3.1        | 6.7        | 13.6       | 13.4       | 18.1       | 16.0       | 7.0        | 2.5        | 2.6        |
| Okathakompo         | 63.4       | 64.9       | 53.0       | 39.0       | 34.7       | 23.1       | 30.3       | 46.1       | 85.4       | 82.4       | 71.3       | N/A        | 64.7       | 78.5       | 72.8       | 44.5       | 27.9       | 20.1       |
| Wangolo             | 56.7       | 36.2       | 20.4       | 10.2       | 5.2        | 0.3        | 0.1        | 2.7        | 35.0       | 58.4       | 67.6       | 67.9       | 16.1       | 24.1       | 48.3       | 82.5       | 80.0       | 64.1       |
| Olwiingo Lwosino    | 28.3       | 31.9       | 19.8       | 9.8        | 7.3        | 9.8        | 17.6       | 18.9       | 36.1       | 35.0       | 23.1       | 12.4       | 15.3       | 47.2       | 64.2       | 47.7       | 18.4       | 0.9        |
| Mangundu            | 80.7       | 65.6       | 47.0       | 35.6       | 25.3       | 8.6        | 5.5        | 11.2       | 57.8       | 57.4       | 64.2       | 46.6       | 32.4       | 54.1       | 84.0       | 79.3       | 56.2       | 49.2       |
| Nyege               | 42.4       | 50.8       | 39.2       | 20.7       | 6.6        | 0.5        | 2.8        | 3.0        | 47.4       | 68.6       | 75.3       | 68.2       | 66.0       | 53.2       | 55.2       | 53.7       | 36.7       | 17.1       |
| Mungomba            | 21.4       | 15.3       | 16.4       | 14.2       | 8.4        | 2.4        | 0.6        | 6.1        | 56.0       | 83.3       | 84.8       | 77.0       | 59.4       | 78.3       | 91.4       | 90.3       | 69.5       | 45.8       |
| Otjjarua            | 6.2        | 3.2        | 2.4        | 0.7        | 6.4        | 10.3       | 27.9       | 36.5       | 59.9       | 42.9       | 15.0       | 0.8        | 1.3        | 1.1        | 1.2        | 1.3        | 1.0        | 0.7        |
| Nghishongwa         | 42.1       | 28.2       | 21.7       | 17.4       | 18.4       | 20.1       | 18.0       | 12.9       | 26.1       | 45.6       | 36.4       | 24.3       | 6.6        | 14.3       | 29.1       | 54.6       | 50.0       | 33.1       |
| Erora               | 27.8       | 22.7       | 13.4       | 5.4        | 12.4       | 11.2       | 33.8       | 52.6       | 89.4       | 89.0       | 53.0       | 15.5       | 9.3        | 9.5        | 9.9        | 3.7        | 0.9        | 0.9        |
| Otjitunganane       | 16.5       | 12.5       | 6.0        | 3.9        | 4.4        | 2.8        | 8.0        | 24.7       | 72.1       | 74.2       | 56.3       | 33.5       | 20.2       | 38.8       | 41.7       | 28.7       | 12.1       | 8.9        |
| Ekulo Lyananzi      | 35.3       | 26.9       | 13.4       | 7.1        | 9.0        | 7.8        | 7.6        | 16.1       | 33.7       | 28.9       | 23.8       | 9.2        | 16.6       | 32.4       | 28.7       | 14.1       | 3.5        | 2.8        |
| Omushila Gwondjimba | 68.7       | 55.2       | 36.8       | 29.1       | 20.0       | 15.6       | 20.1       | 23.0       | 42.8       | 34.1       | 9.4        | 0.3        | 0.2        | 8.3        | 21.0       | 19.2       | 8.2        | 6.5        |
| Ekulu               | 37.8       | 25.7       | 17.2       | 9.8        | 6.4        | 2.9        | 2.0        | 3.2        | 19.2       | 37.8       | 35.5       | 34.0       | 20.4       | 32.3       | 42.7       | 43.7       | 33.7       | 19.8       |
| Omayi               | 50.7       | 34.4       | 20.9       | 11.0       | 5.9        | 3.4        | 4.8        | 5.8        | 16.5       | 35.7       | 48.9       | 55.4       | 33.4       | 34.9       | 59.4       | 77.6       | 73.7       | 46.8       |
| Otjetjekua SSCFA    | 36.7       | 34.0       | 26.5       | 23.7       | 26.1       | 22.7       | 17.6       | 17.3       | 34.3       | 28.7       | 12.7       | 4.2        | 8.2        | 29.5       | 39.9       | 30.5       | 19.9       | 10.2       |
| Twahangana          | 54.6       | 41.1       | 25.0       | 10.1       | 3.2        | 2.3        | 1.1        | 1.0        | 3.2        | 13.1       | 26.8       | 50.5       | 42.9       | 25.4       | 42.1       | 81.5       | 85.3       | 72.6       |
| Nashinyongo         | 46.1       | 35.7       | 23.6       | 13.4       | 8.4        | 5.4        | 4.6        | 3.0        | 12.6       | 29.4       | 35.8       | 43.3       | 31.0       | 15.9       | 23.8       | 69.8       | 75.1       | 51.1       |

# Dissemination of information

- Currently disseminate information via email service (2000+ addresses)
- Dedicated website ([www.namibiarangelands.com](http://www.namibiarangelands.com))
- Feedback from users encouraging

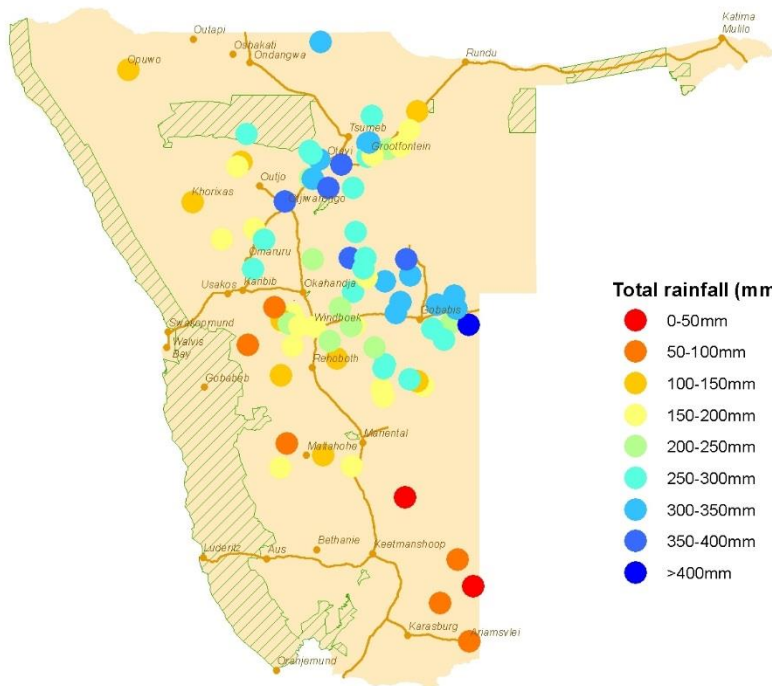
Engage users!



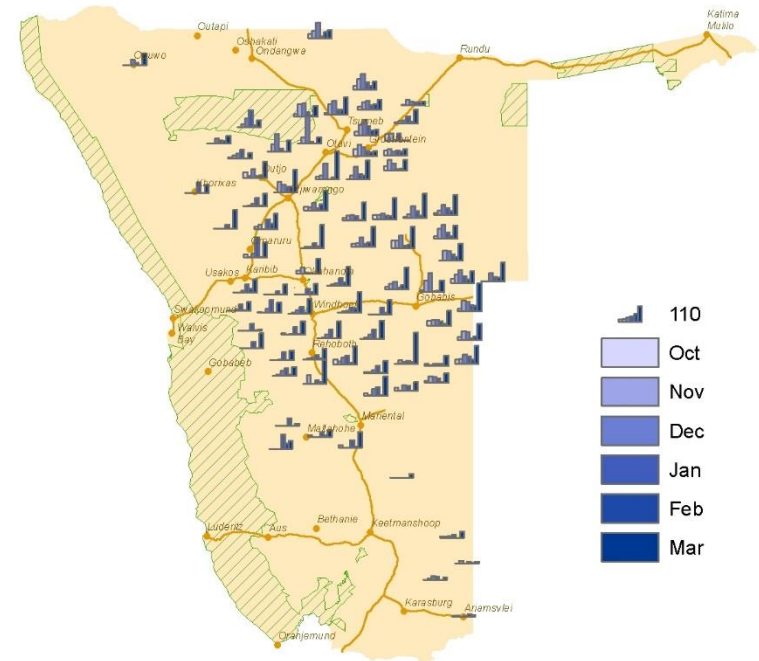
# Rainfall statistics

- Users supply data

Total rainfall for October 2014 to March 2015

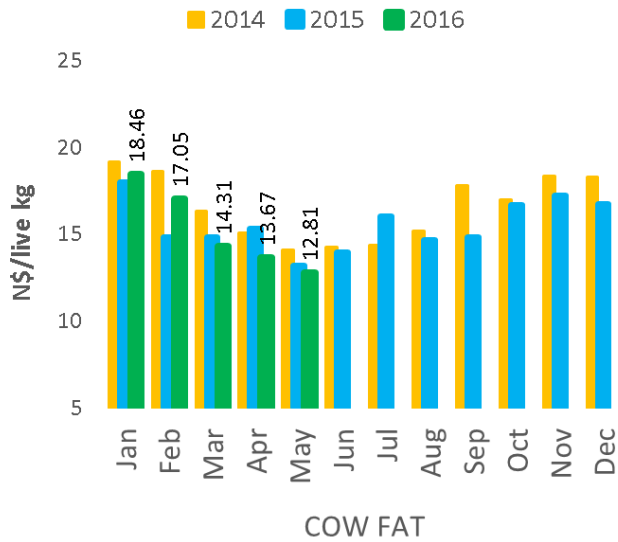


Monthly rainfall for October 2014 to March 2015

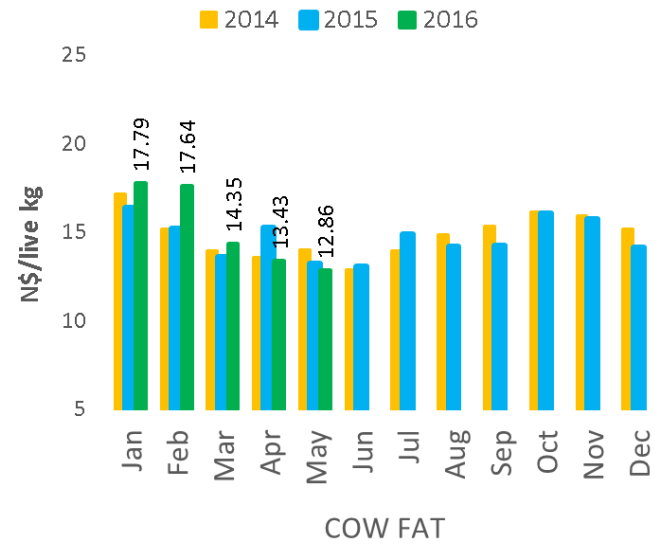


# Livestock market trends

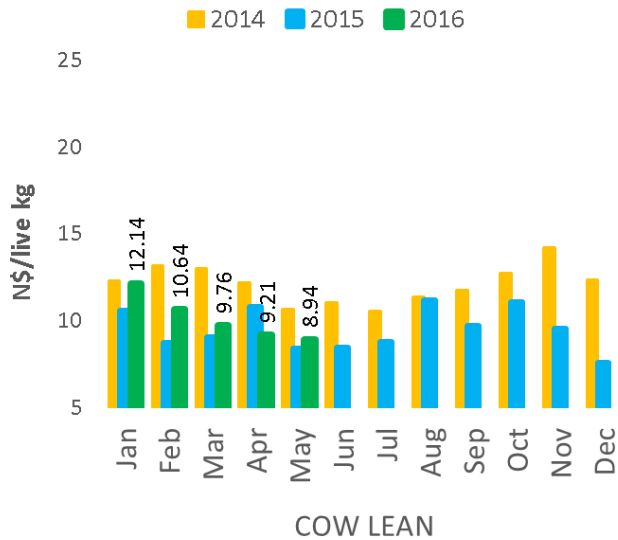
## Kunene and Otjozondjupa regions



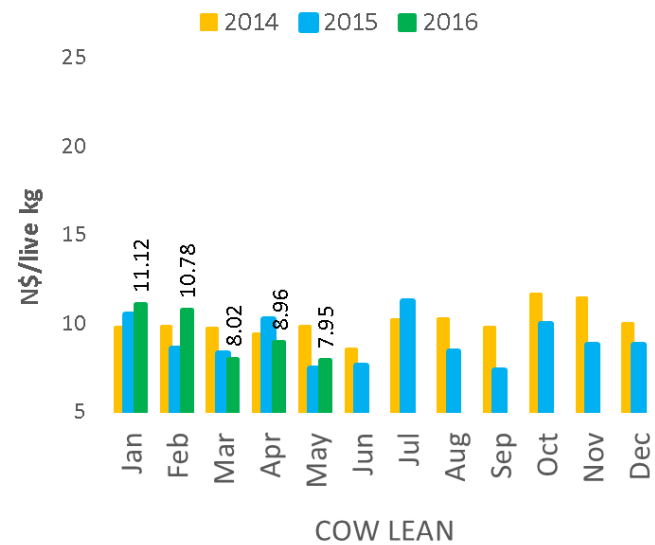
## Omaheke and Khomas regions



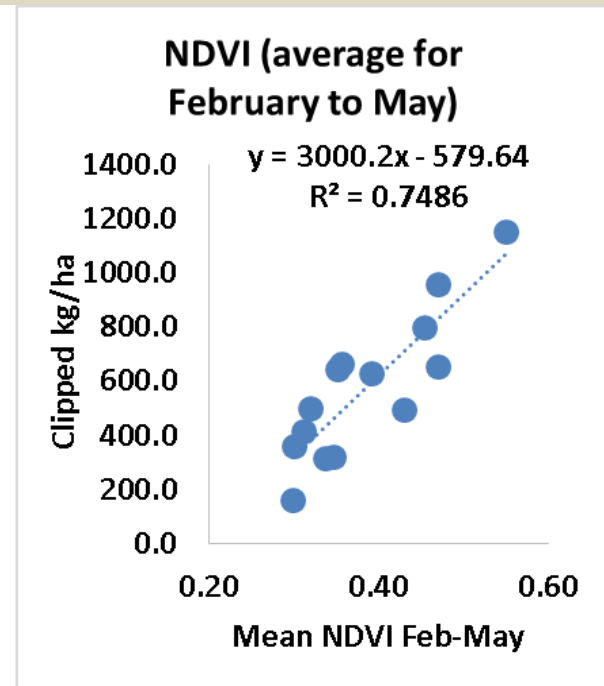
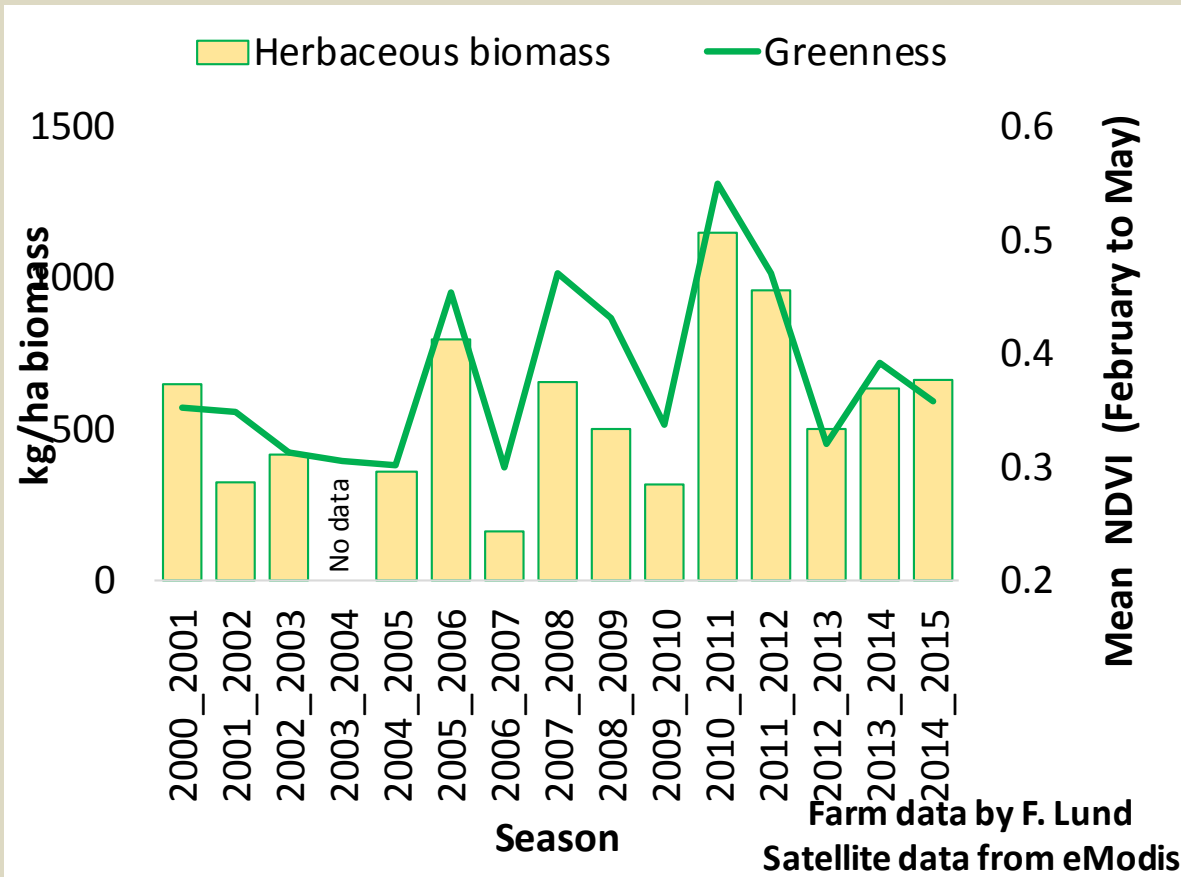
## Kunene and Otjozondjupa regions



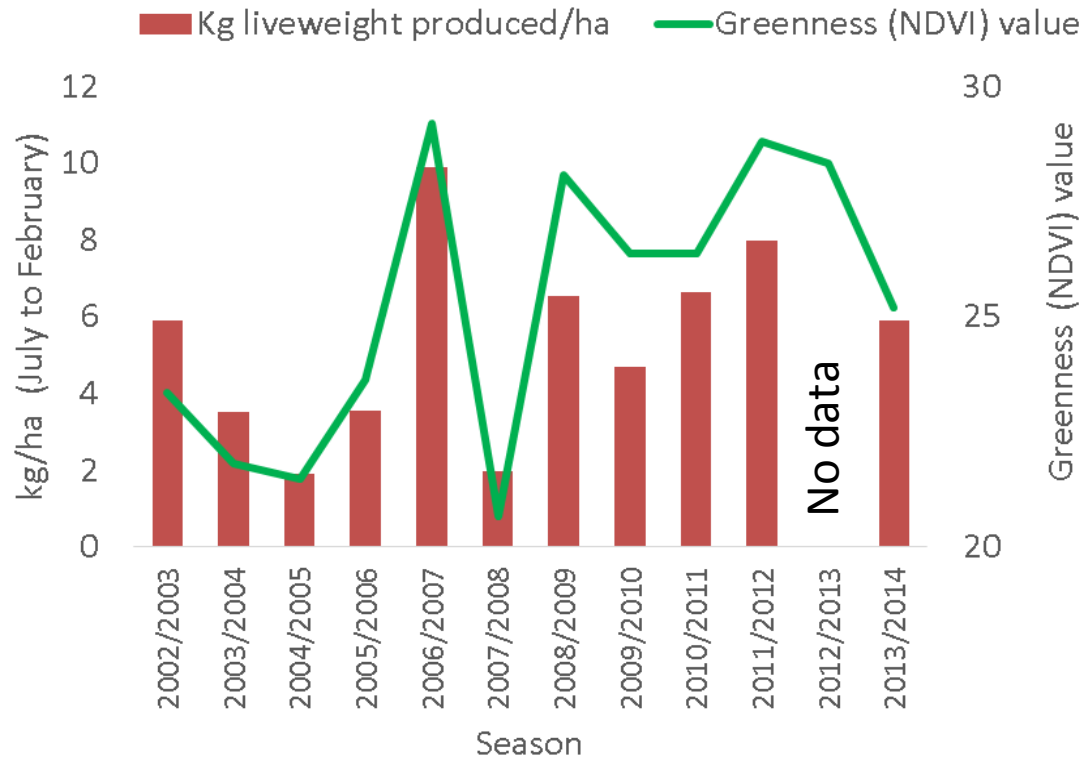
## Omaheke and Khomas regions



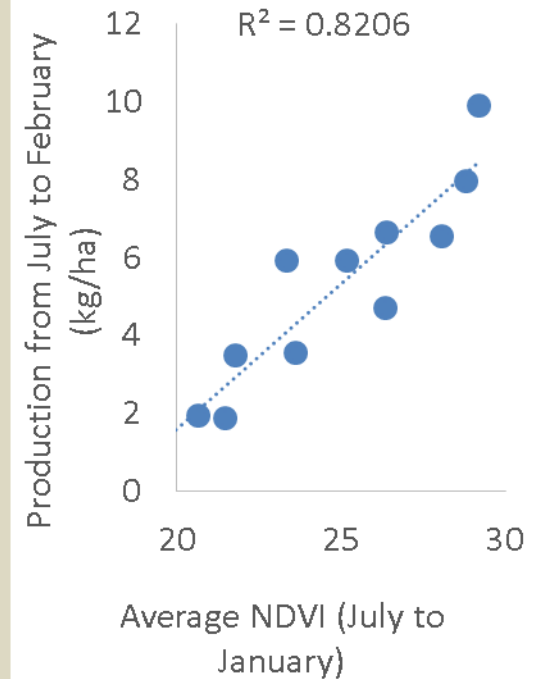
# Case study 1: Herbaceous standing crop on farm Kamombonde Ost



# Case study 2: Cattle live weight production/ha on farm Agagia



*Farm data supplied by H. Botha  
Satellite data from eMODIS*

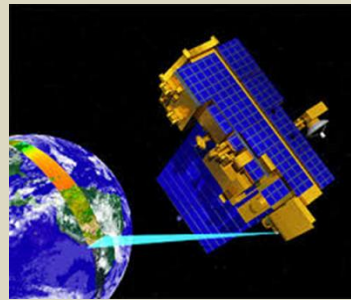


# Dry season forage budgeting model

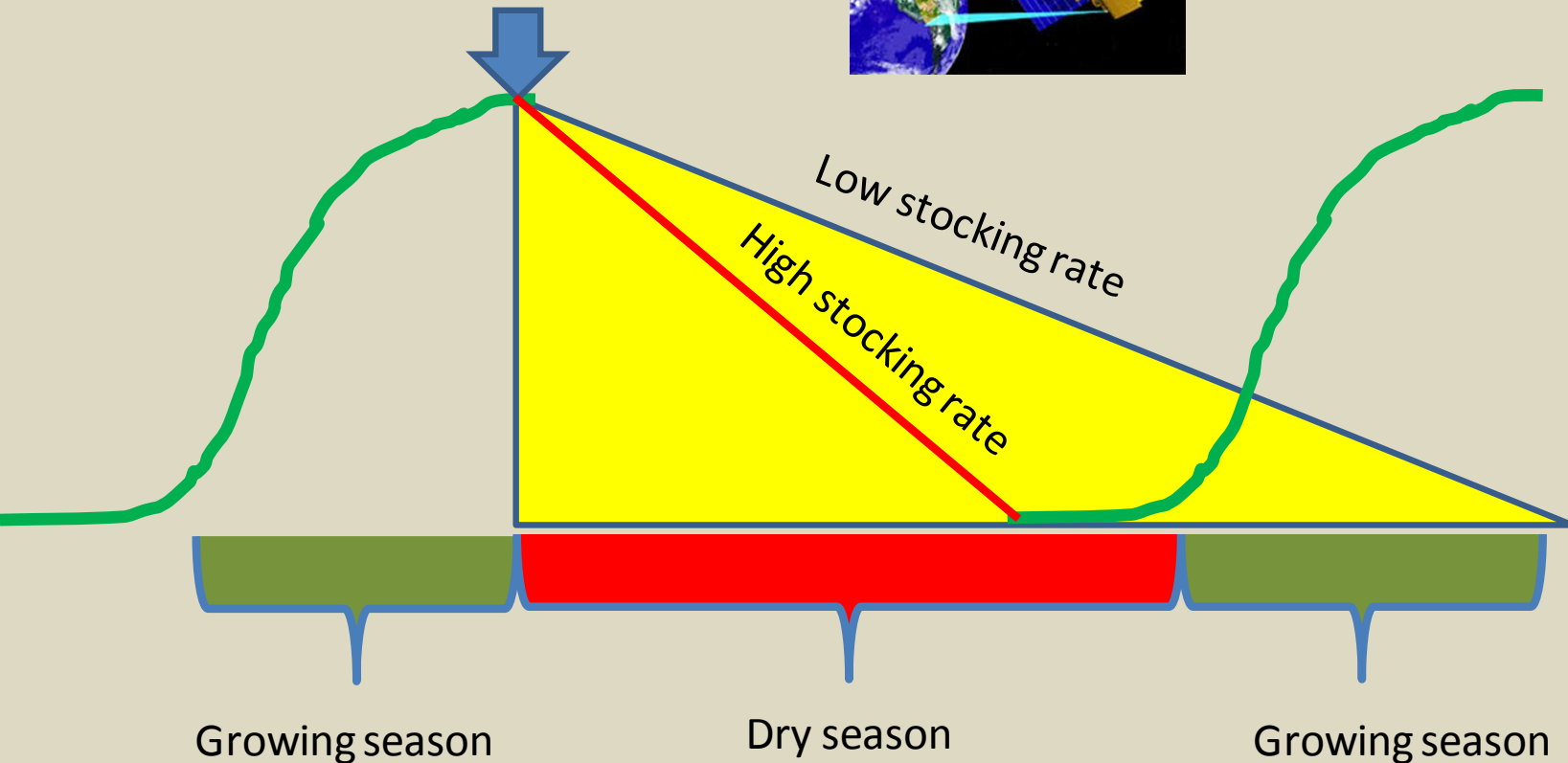
- Very long dry season (6-8 months dormant herbaceous layer)
- Grazers dependent on accumulated herbaceous biomass during the growing season to bridge dry season
- Aim: Predict end-of-growing season herbaceous biomass

# Dry season forage budgeting model

Forage standing crop  
assessment  
(end of growing season)



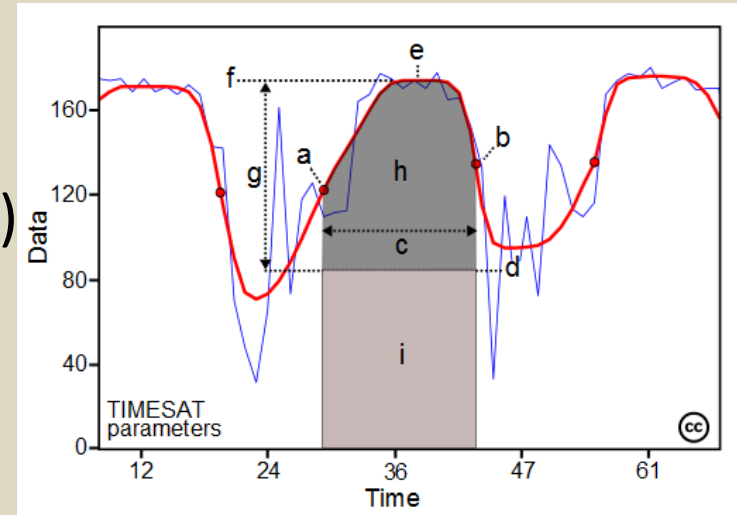
Stocking  
rate





# Different approaches to separate woody and Herbaceous components

- De-compositioning of Vegetation Index time series (phenological differences of herbaceous vs. woody) (Diouf et al. 2015)
- Fractional cover (Woody: Herbaceous: Bare ground)
- Use Synthetic Aperture Radar approach to account for woody component
- Combination....



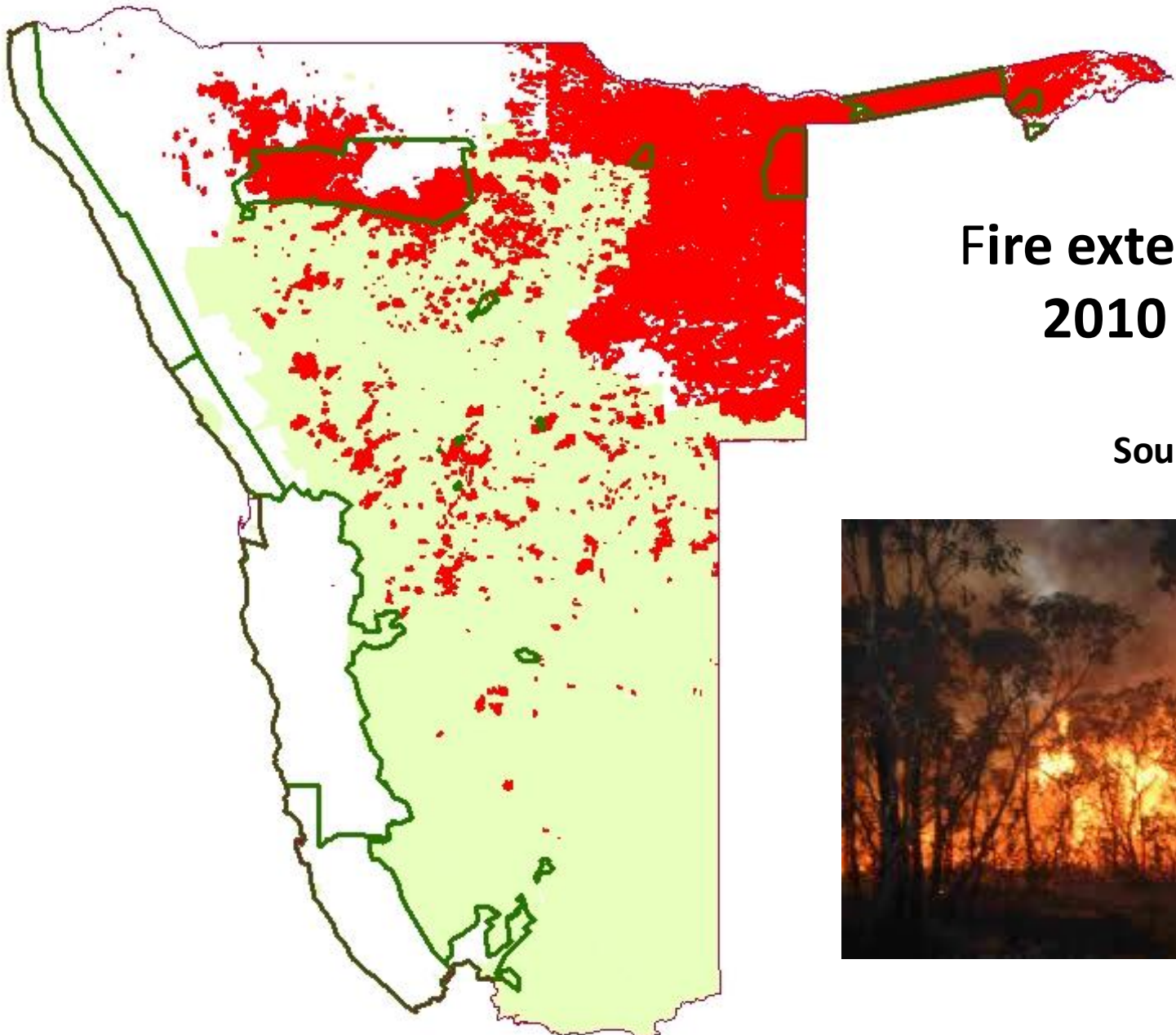
Thank you!









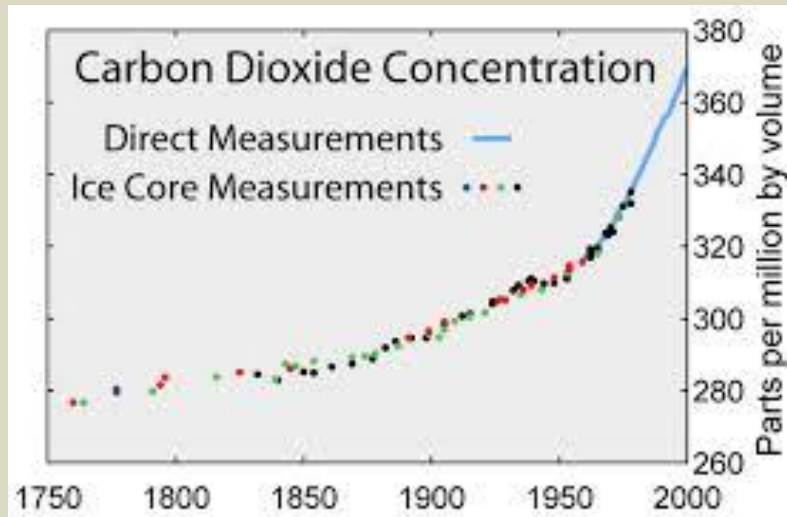


**Fire extent (red):  
2010 -2012**

Source: Dr J le Roux



# Increasing atmospheric CO<sub>2</sub> levels



**Grasses — efficient when CO<sub>2</sub> low (C<sub>4</sub> photosynthetic pathway)**

**Forbs, shrubs and trees — efficient when CO<sub>2</sub> high (C<sub>3</sub> photosynthetic pathway)**

**THUS: Shrubs and trees more competitive now than in the past!**

# Effect of adverse climatic conditions

