



TU WIEN  
DEPARTMENT OF GEODESY  
AND GEOINFORMATION  
RESEARCH GROUP  
MICROWAVE REMOTE SENSING

# Satellite soil moisture for yield prediction in water limited regions

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**Disaster Risk Financing  
& Insurance Program**



# Drought monitoring and vegetation impact

Monitoring and impact assessment often done with crop models and meteorological data



Rainfall

**Driver** of crop development  
**Excludes evaporation**



Soil Moisture

**Missing link...?**



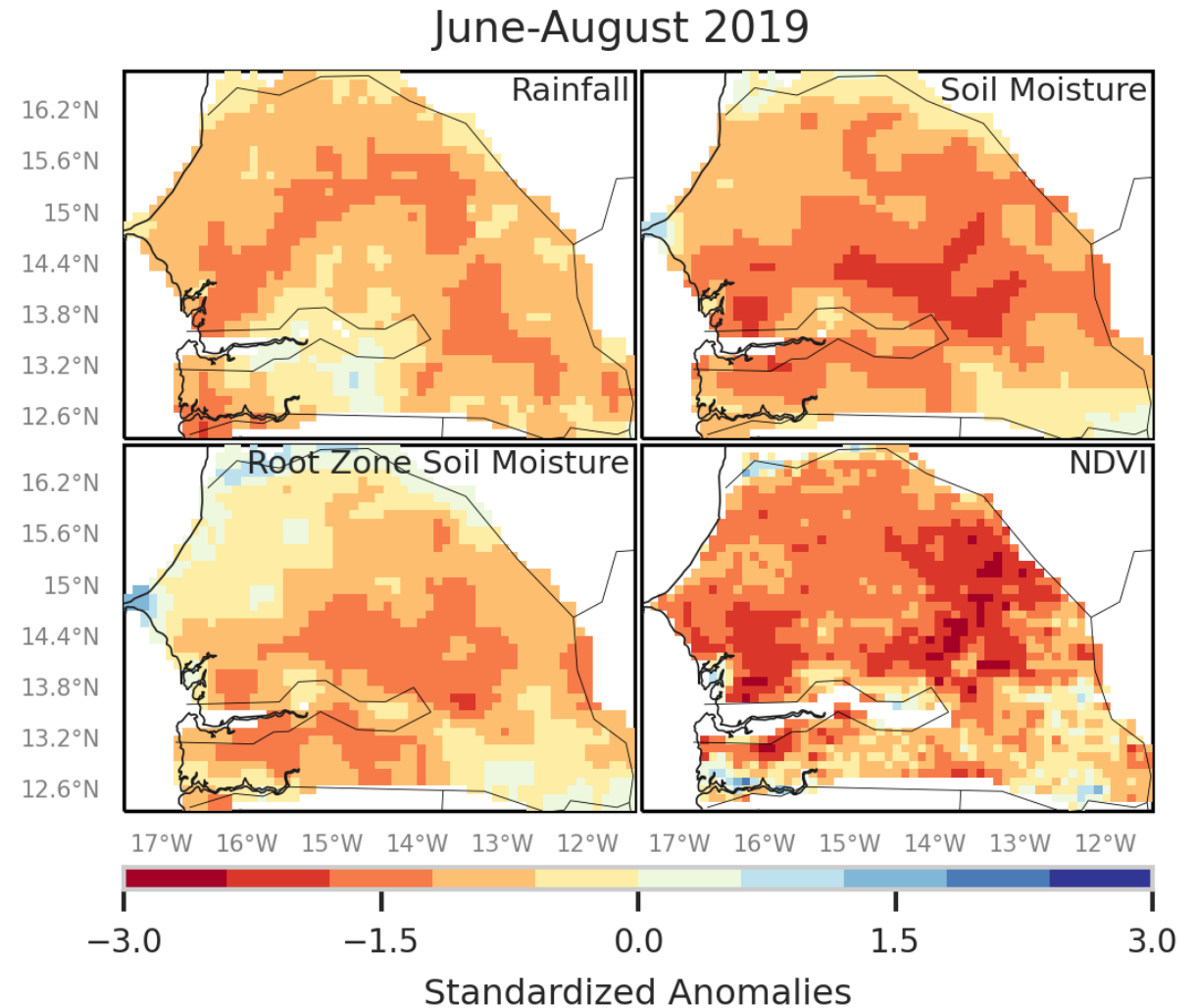
NDVI

**Indicator** of crop development  
Late response

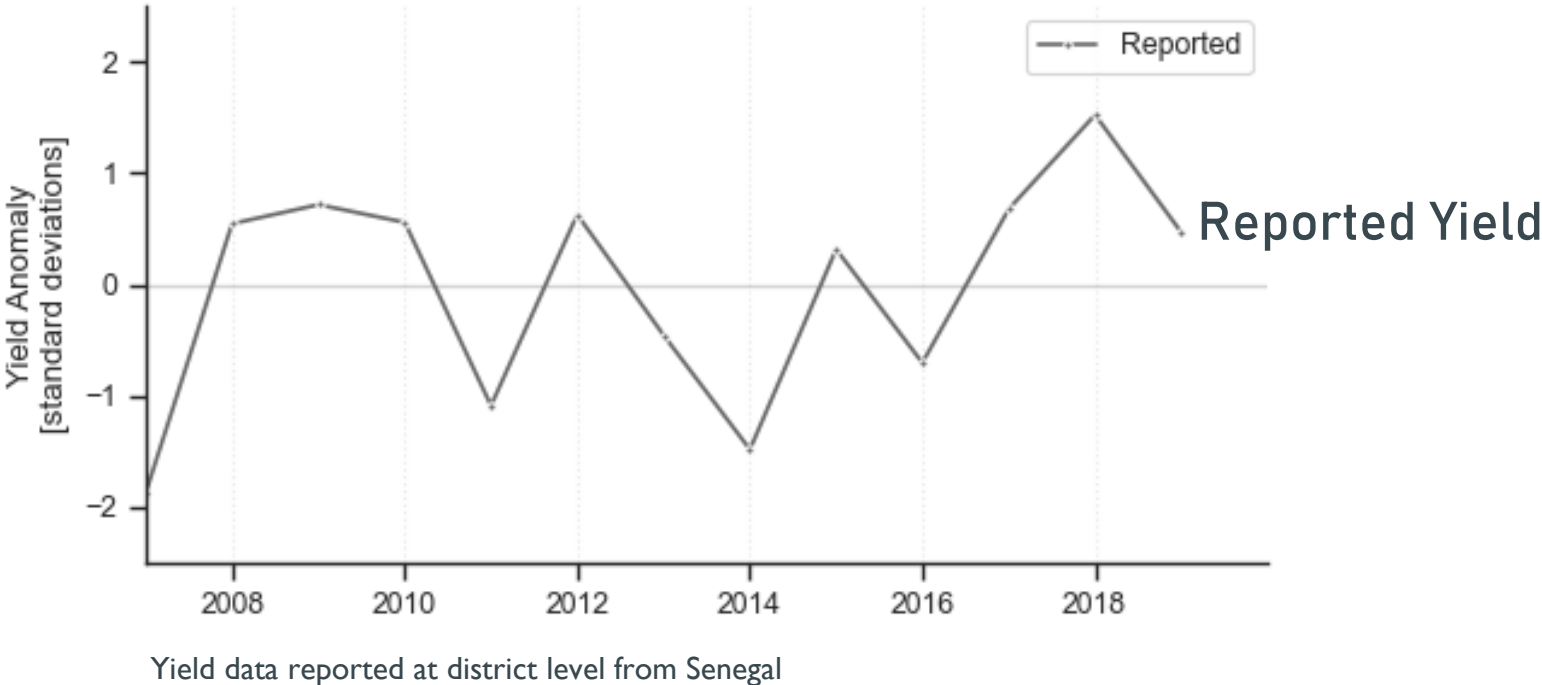
# Datasets and pre-processing

## Can we use satellite observations for drought assessment and early warning?

- Precipitation
  - Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) 0.05°
- **Soil Moisture**
  - HSAF Surface Soil Moisture 12.5km
  - ESA CCI Soil Moisture 0.25°
- **Root Zone Soil Moisture**
  - Copernicus Global Land Service 0.1°
- Copernicus Global Land Service NDVI
  - 1km



## Millet



# Yield early warning

## Millet

Use early season satellite data to model spatial and temporal variability in yield anomalies



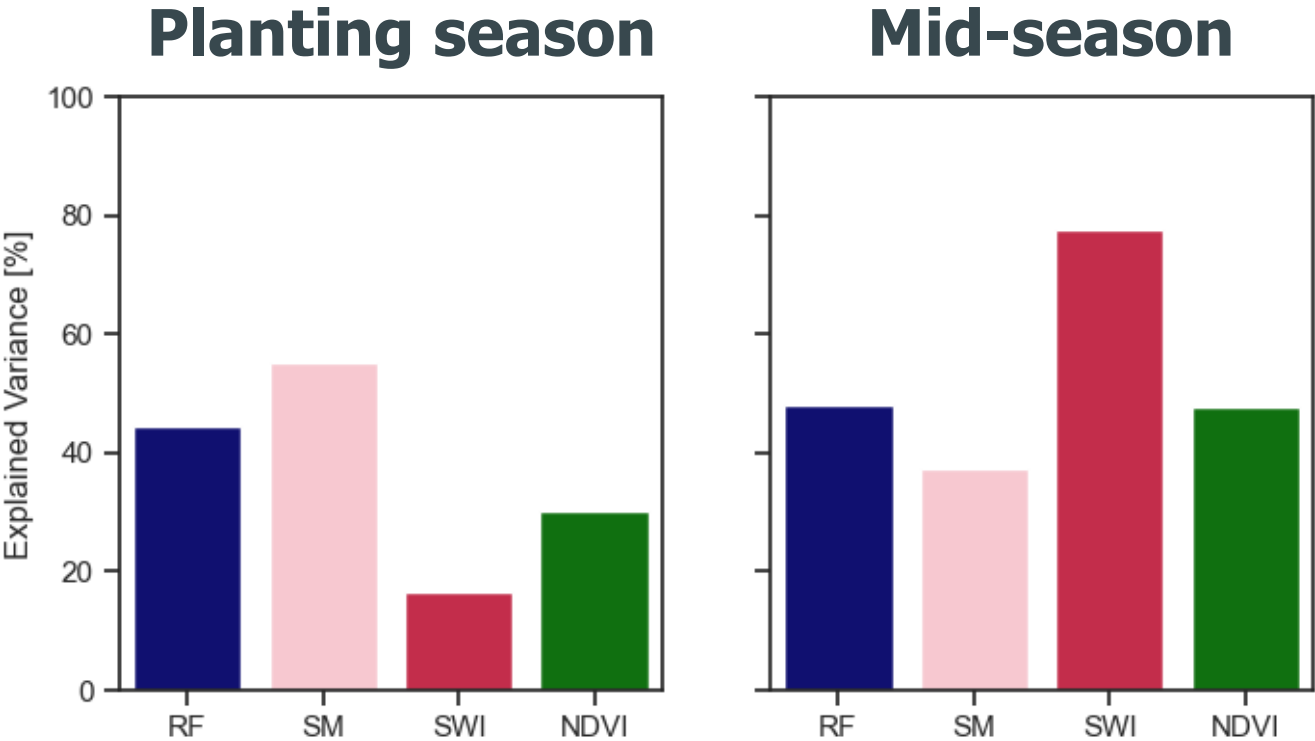
Source: FAS/GMA/IPAD

With two input scenarios:

1. Satellite based rainfall and NDVI
2. Satellite based rainfall, **soil moisture, root zone soil moisture and NDVI**

# Sensitivity of observations to yield

## Millet



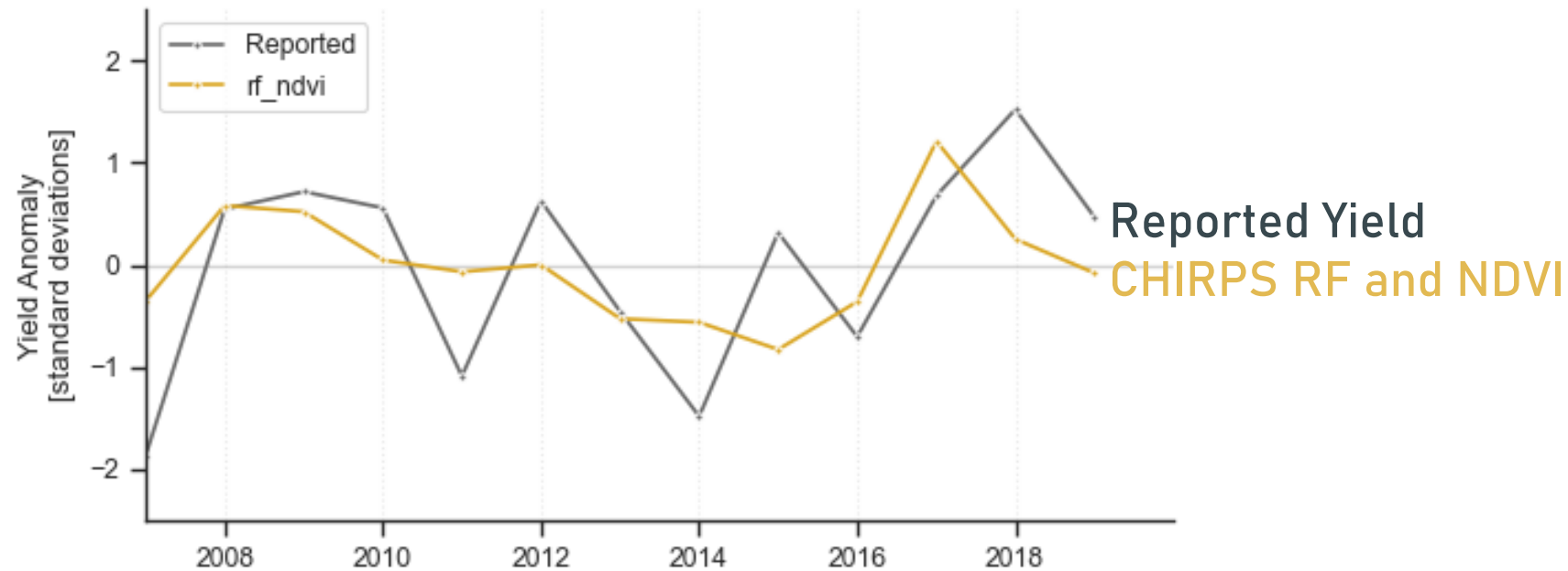
Explained variance in end of season yield for rainfall, soil moisture, root zone soil moisture and NDVI using EO data from the planting season (may-july) or mid-season (july-October).

# Yield deficiency indicator

## Millet

Predicted yield anomaly from:

I. Planting season satellite based rainfall and NDVI

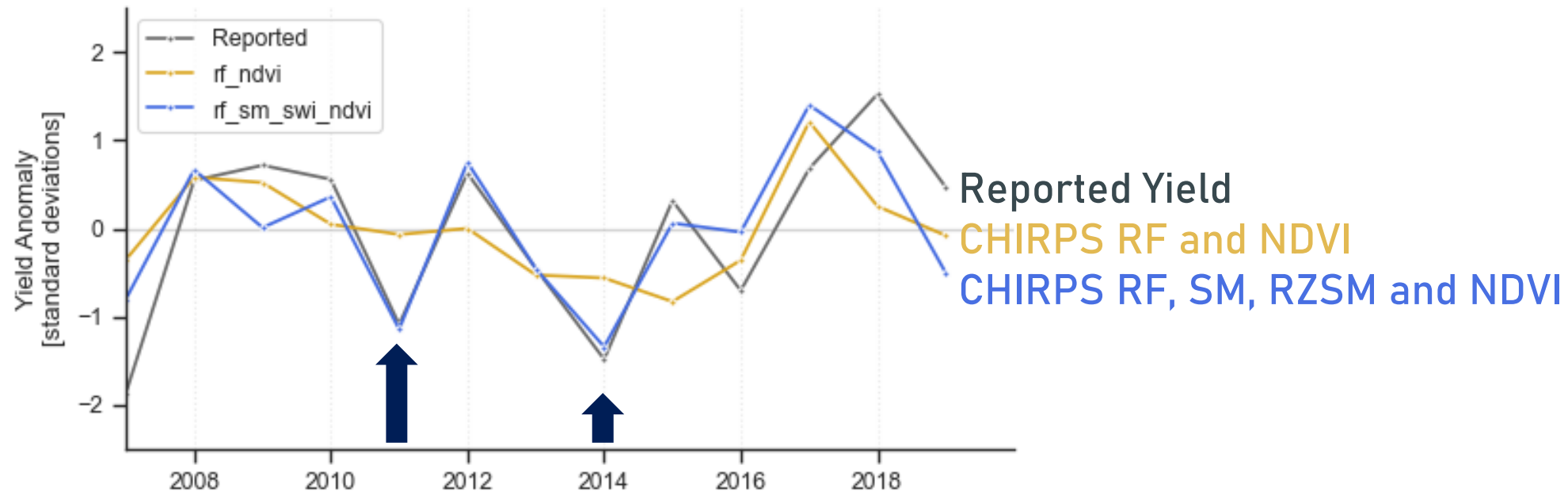


# Yield deficiency indicator

## Millet

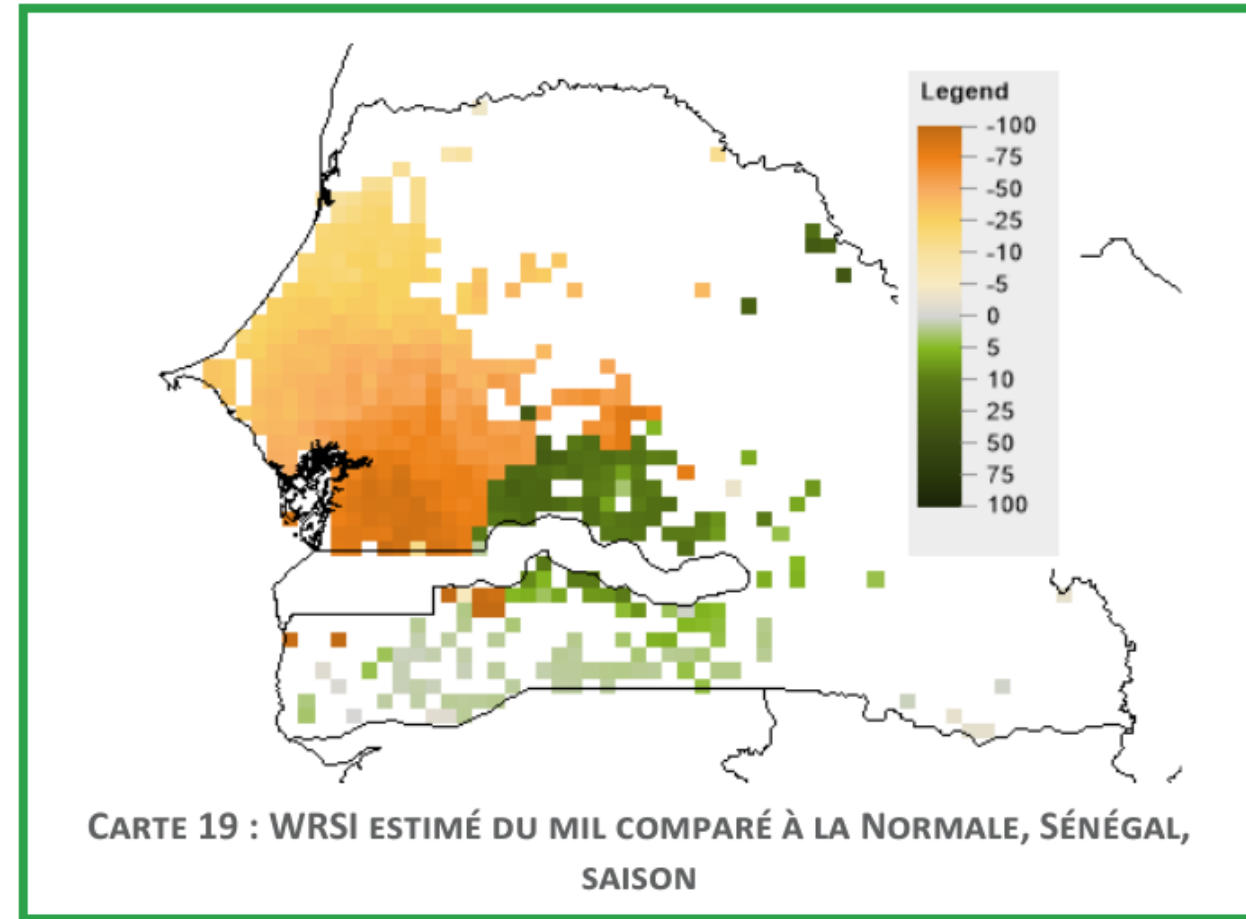
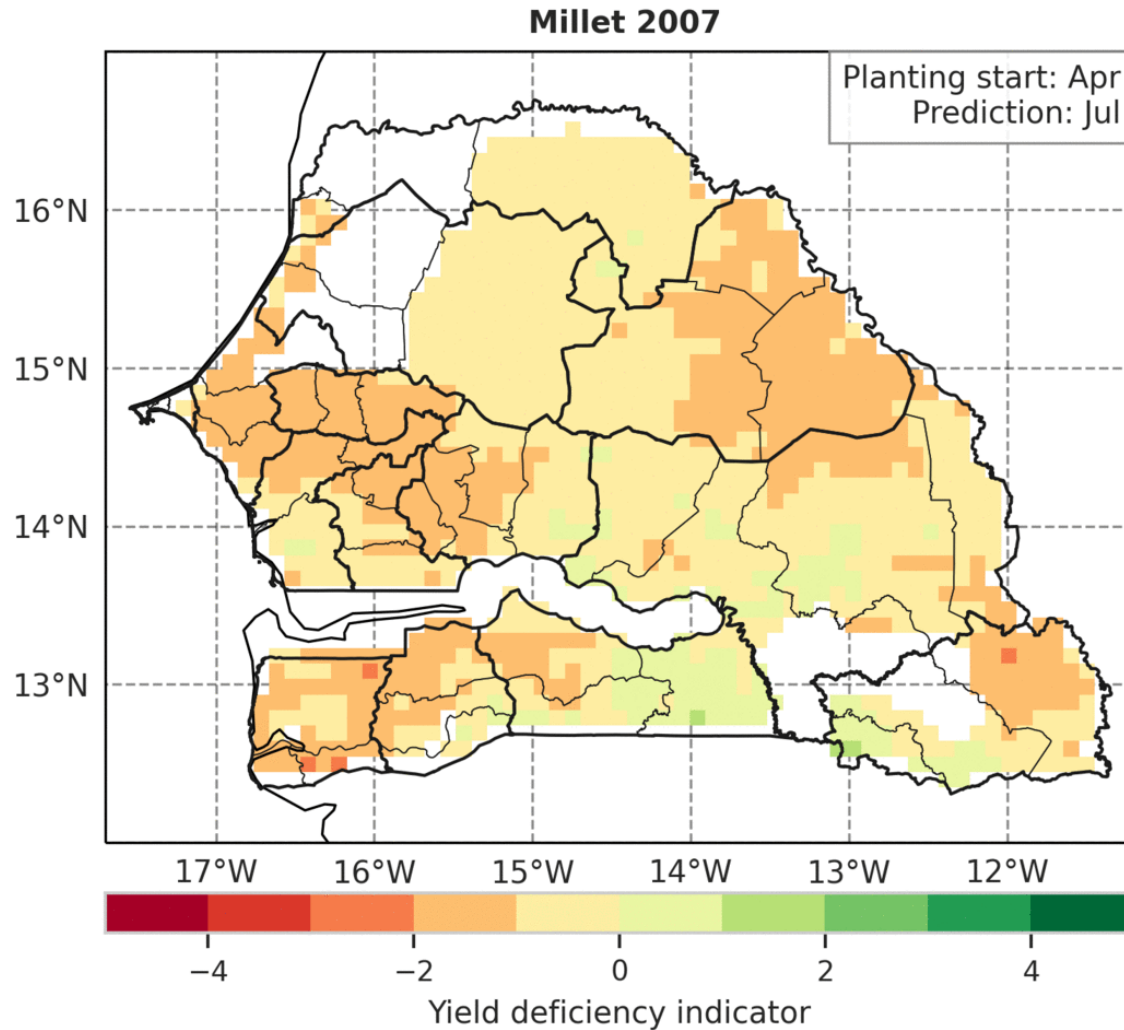
Predicted yield anomaly from:

2. Planting season satellite based rainfall, **soil moisture**, **root zone soil moisture** and NDVI



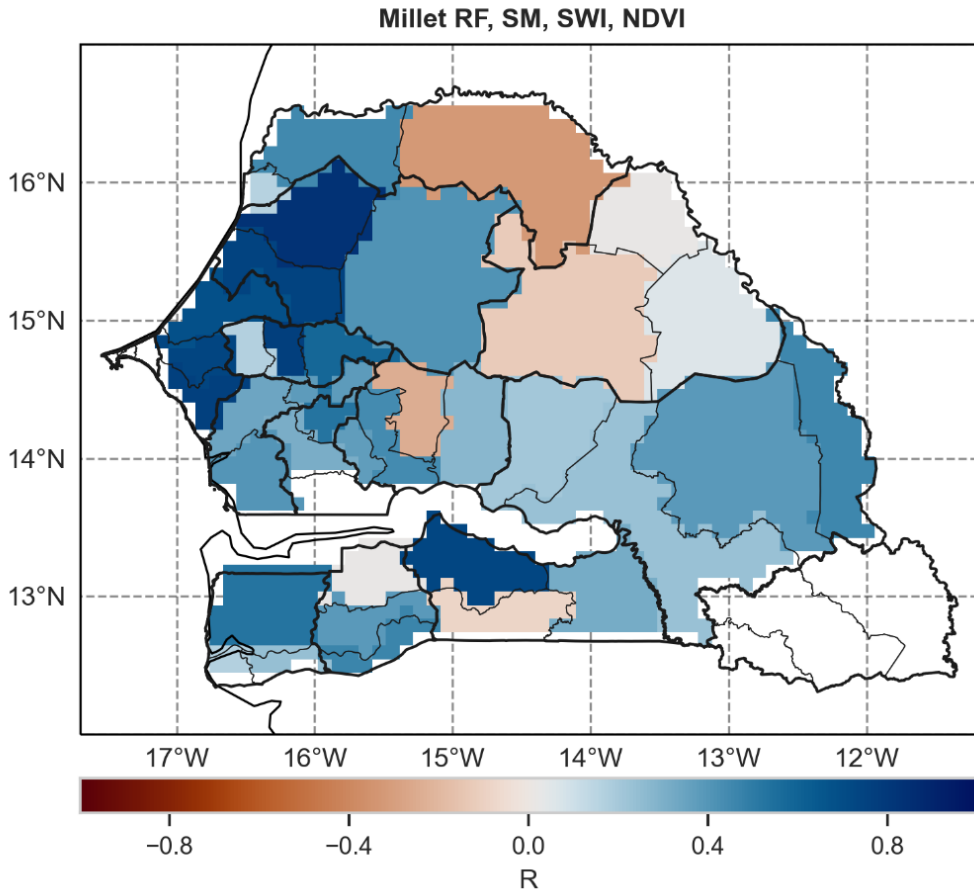
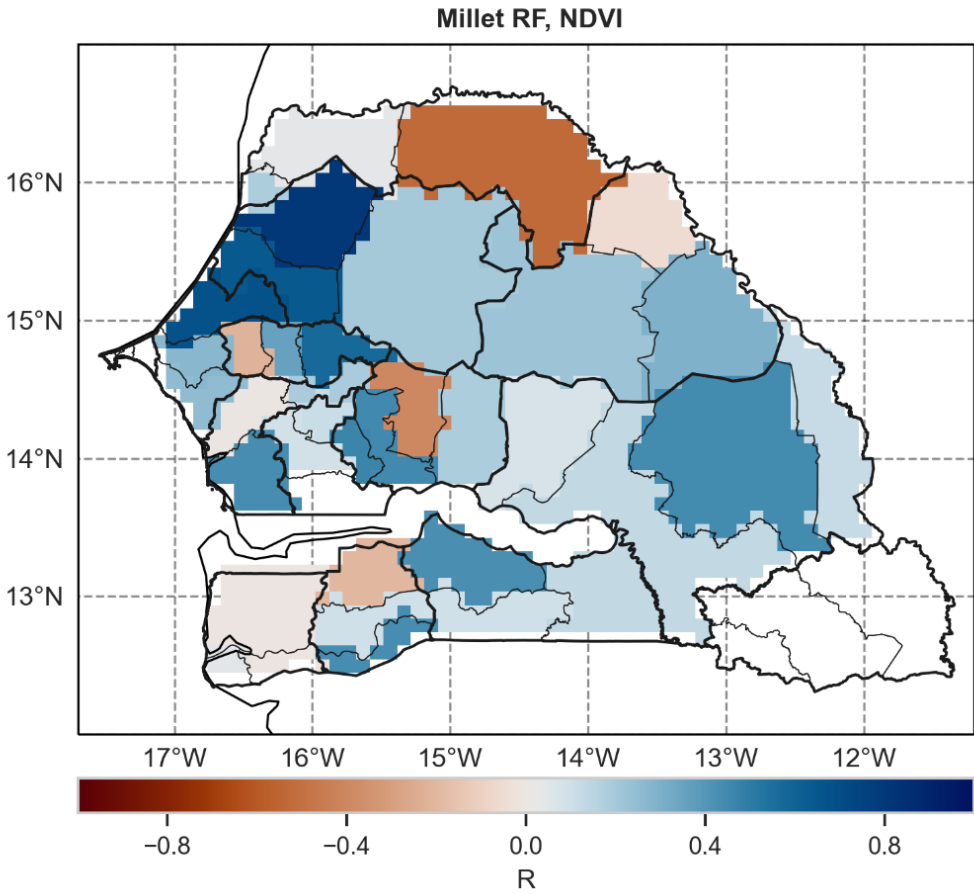


# Spatial yield deficiency prediction made in July

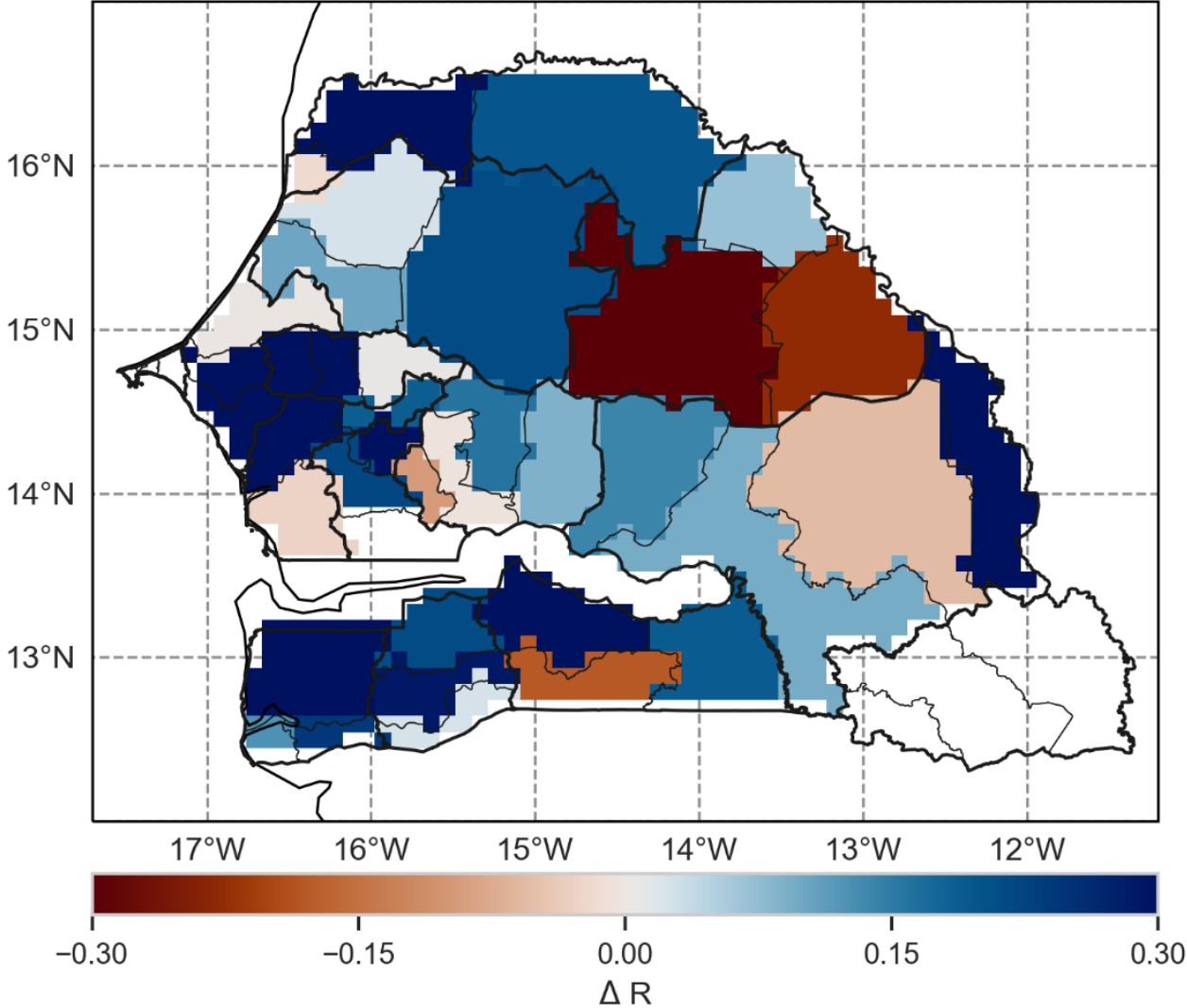


Water Requirement Satisfaction Indicator from African Risk View end of season report 2019

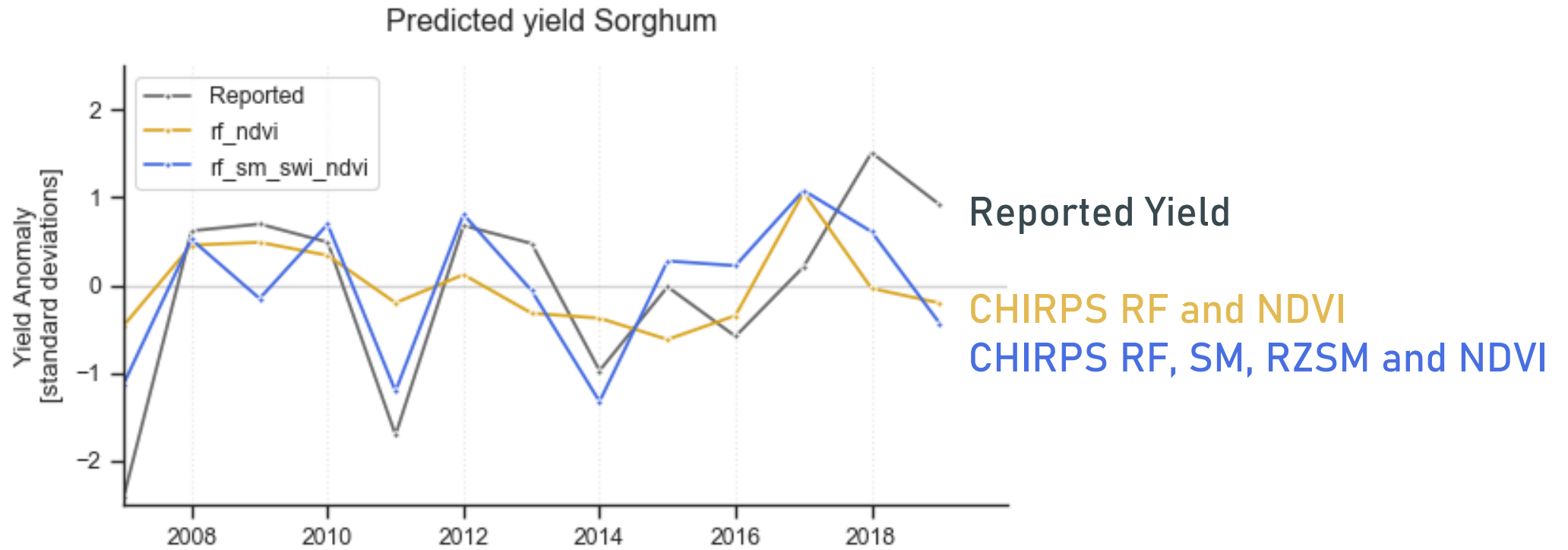
# Coorespondence to province level yield



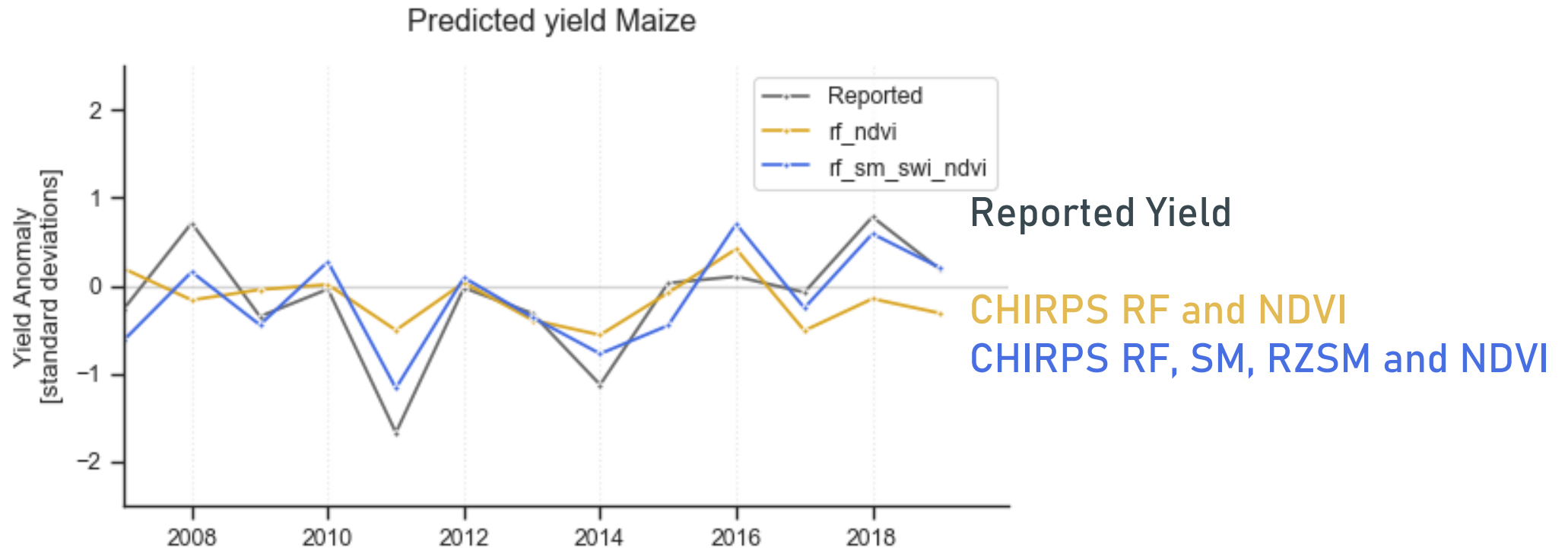
# Improvement



## Sorghum



## Maize



# Conclusions

- Reliable soil moisture during the growing season
  - Impact of sub-surface scattering during dry season
- Soil moisture is more capable of explaining yield variability early in the season
- Variations between districts