POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH

Estimating crop yields in West Africa with Remote Sensing input

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I will present an attempt to estimate crop yields – why?

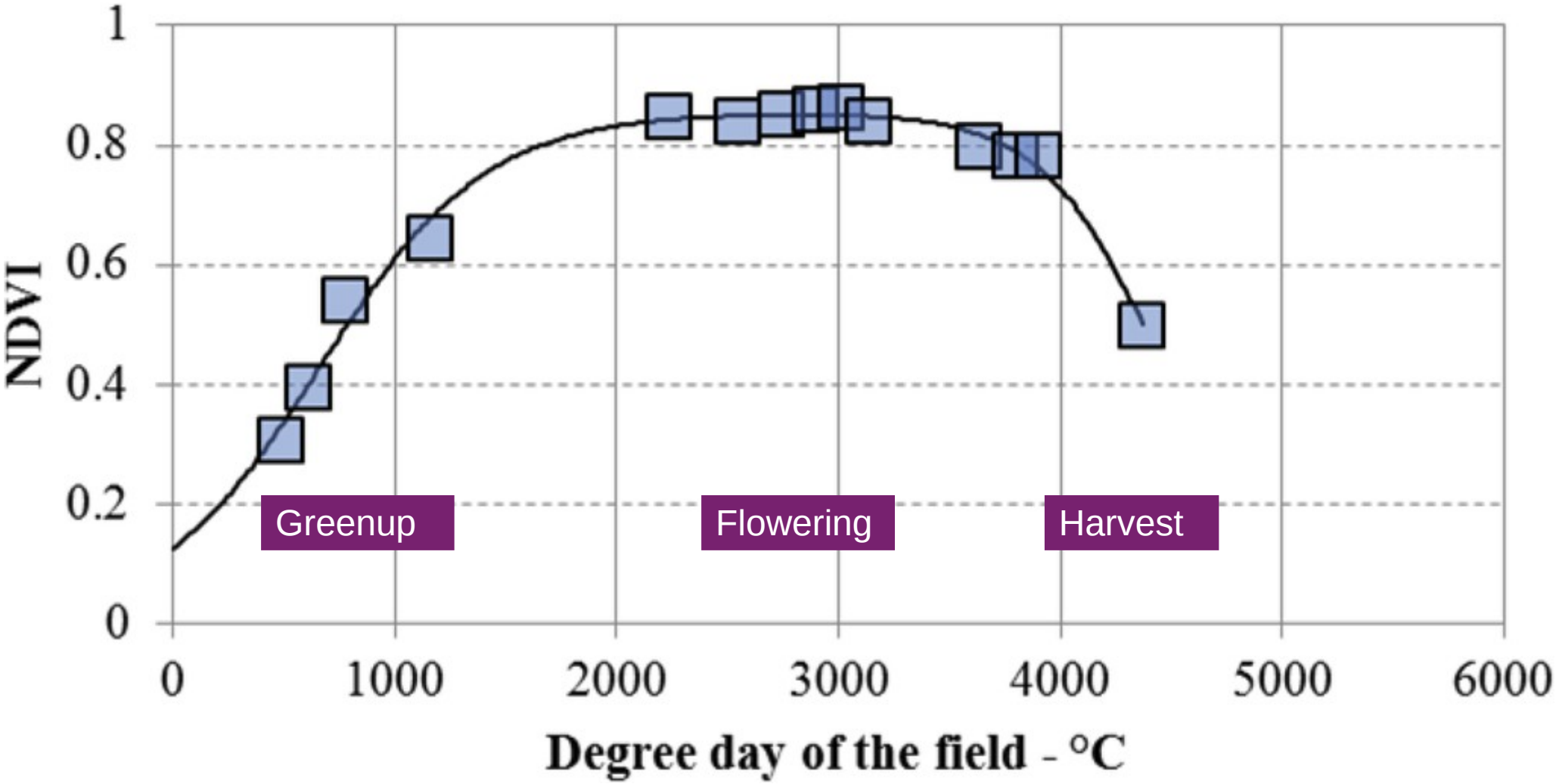
Farmers, governments, logistics or insurance companies are highly interested in knowing available crop harvests in real time, and maybe even before the harvest actually occurs.

Such crop estimation works very well in the US and some other Western countries, but there is little to no research in developing nations.

Yet global food security depends a lot on small-scale farmers.

Therefore we tried.

Biomass – and thus partly also yield – can be traced from the sky

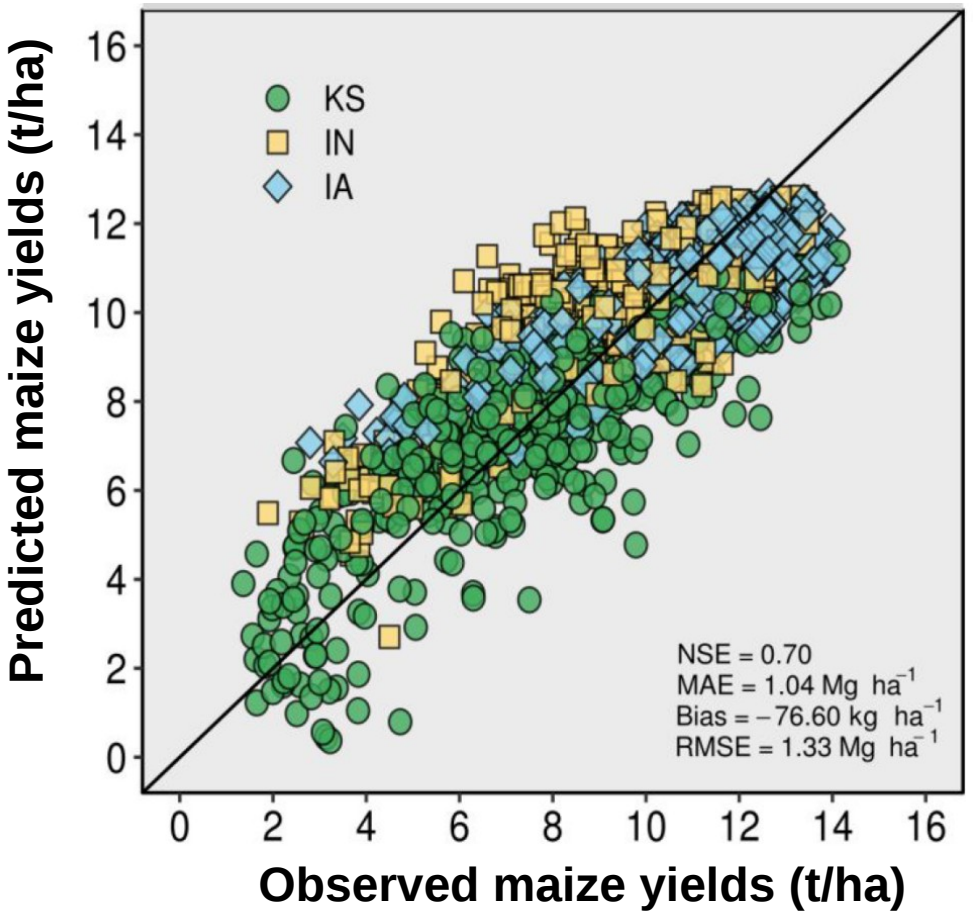


Morel et al., Remote Sensing 2014

The NDVI (Normalized Difference Vegetation Index) is a proxy for the chlorophyll content of an area and thus its green plant biomass.
NDVI is routinely measured by MODIS, Landsat, Sentinel and many other satellites.

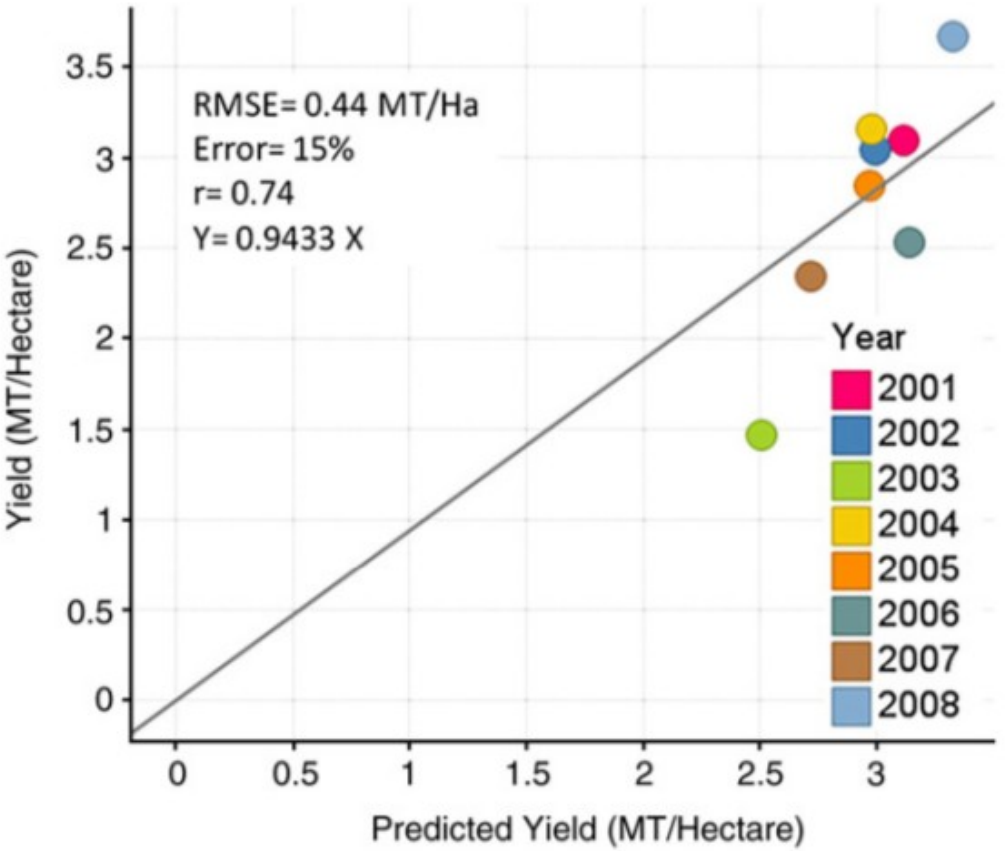
There are many successful examples for estimating yields with RS

Maize, USA



Schwalbert et al., 2019

Wheat, Ukraine
(with a model trained in the US)

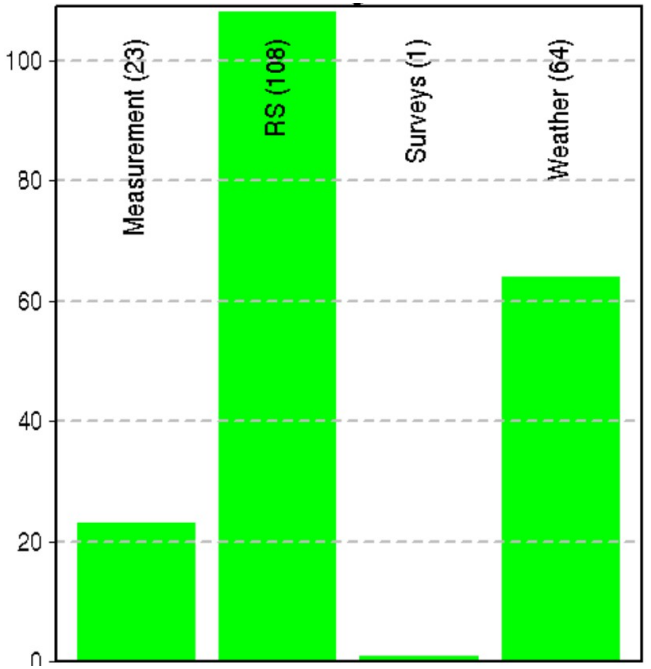


Becker-Reshef et al., 2010

Both examples show estimations around six weeks *before* the harvest.

Combining RS and weather data works even better for forecasting

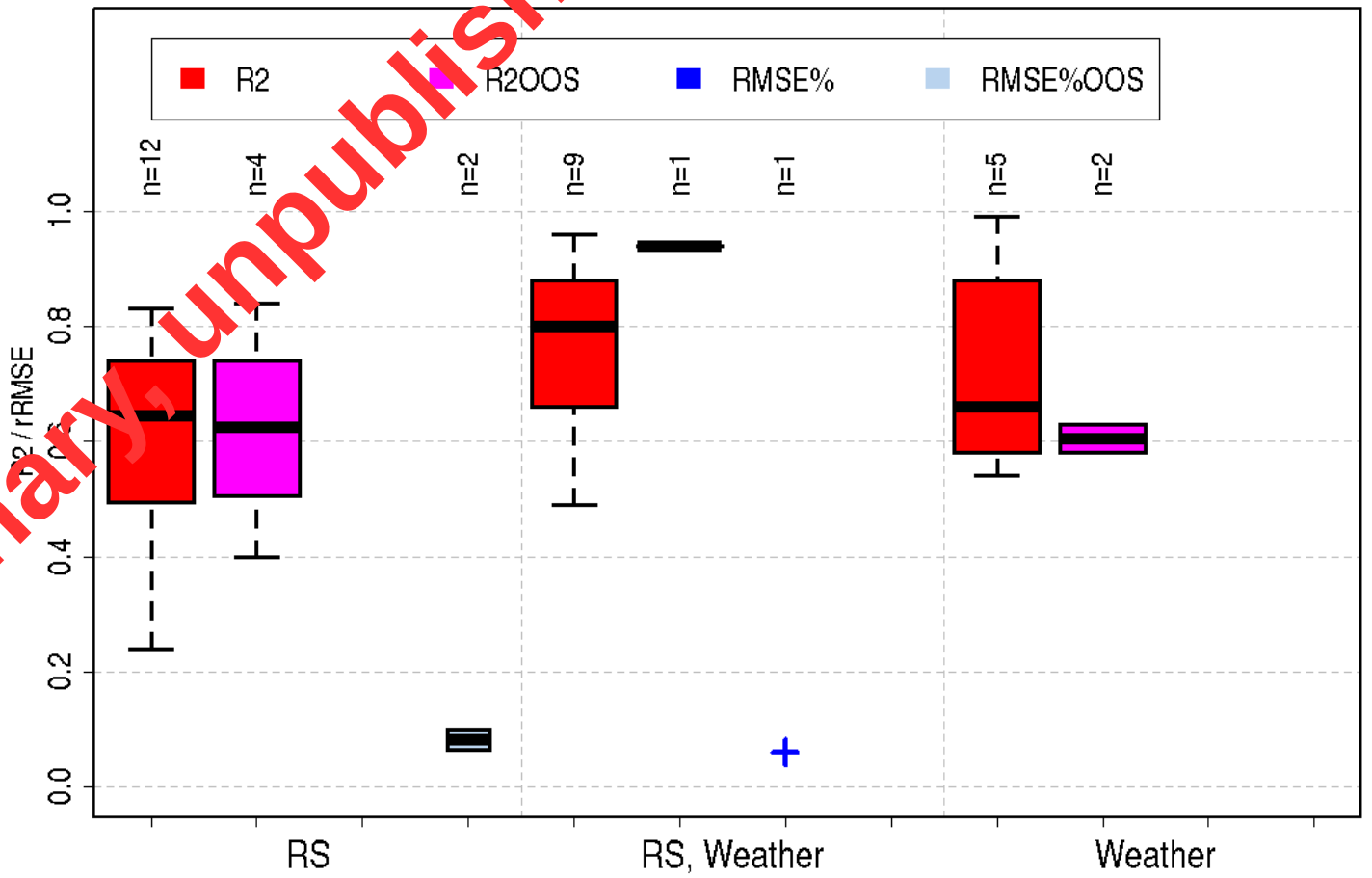
Remote Sensing data are most often used for yield forecasting.



Schauberger et al., under prep.

A sample of 307 studies was evaluated. RS & weather data combined are used in 58 studies.

The performance of yield forecasts <u>one month before harvest</u> increases when RS and weather data are combined.



Schauberger et al., under prep.

So let us try such estimation techniques for West Africa.

We merged several data sources to estimate maize yields in Ghana

Official yield data from the Ministry of Food & Agriculture (districts)

The data range between 1993 and 2017.

Satellite data

Landsat-8

Sentinel-2A

We used data between 2013 and 2018.

AMPLIFY

Received: 5 October 2016 | Revised: 7 April 2017 | Accepted: 10 April 2017
DOI: 10.1111/gcb.13738

PRIMARY RESEARCH ARTICLE

WILEY Global Change Biology

Global evaluation of a semiempirical model for yield anomalies and application to within-season yield forecasting

Bernhard Schauberger[1,2] | Christoph Gornott[1] | Frank Wechsung[1]

AMPLIFY is a statistical crop model.

APSIM

Contents lists available at ScienceDirect
Environmental Modelling & Software
journal homepage: www.elsevier.com/locate/envsoft

APSIM – Evolution towards a new generation of agricultural systems simulation

Dean P. Holzworth [a,*], Neil I. Huth [a], Peter G. deVoil [b], Eric J. Zurcher [a],

APSIM is a bio-physical crop model.

RHoMIS

CGIAR RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security CCAFS

Info Note

The Rural Household Multi-Indicator Survey (RHoMIS)

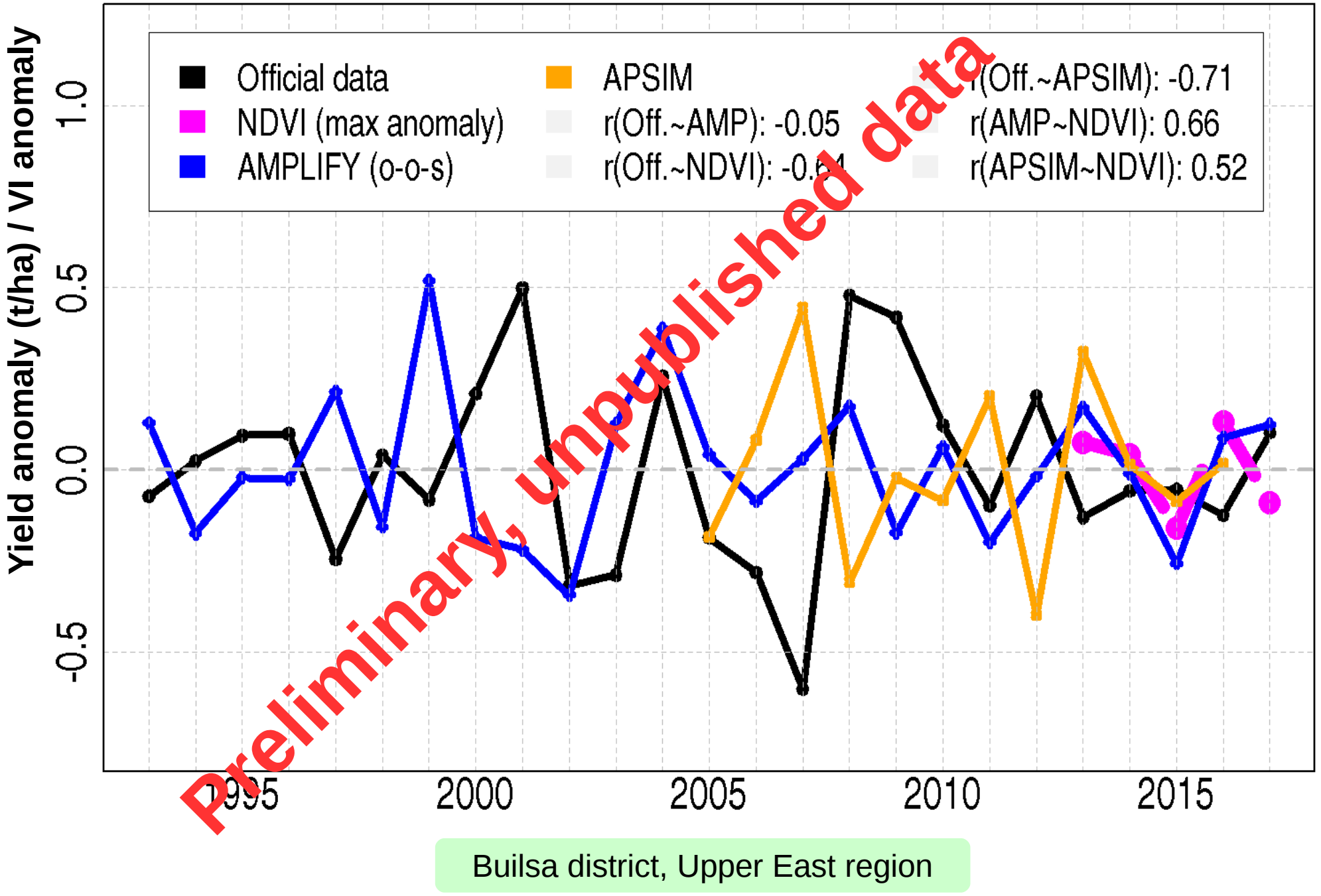
A rapid, cost-effective and flexible tool for farm household characterisation, targeting interventions and monitoring progress towards climate-smart agriculture

Mark van Wijk, James Hammond, Jacob van Etten, Tim Pagella, Randall Ritzema, Nils Teufel and Todd Rosenstock

RhoMIS is a household survey with several hundred results in Ghana.

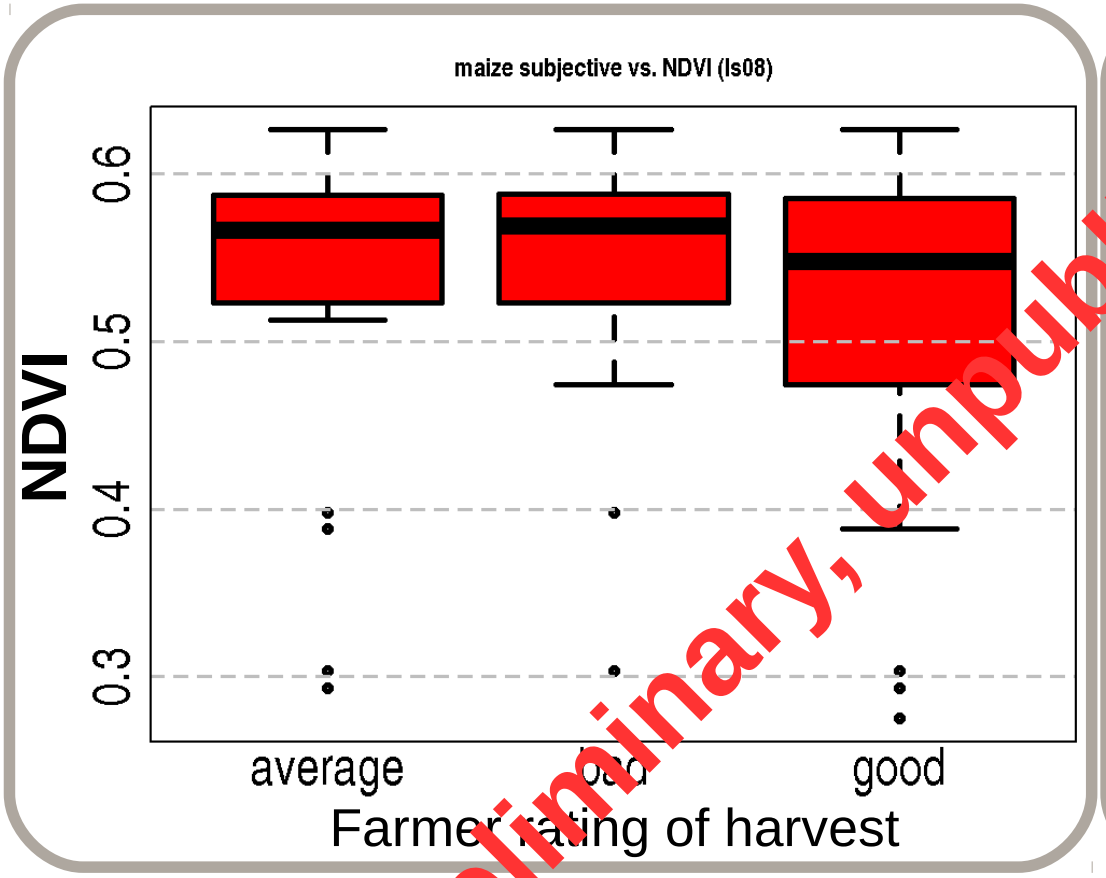
The research task is to estimate and, at best, forecast crop yields in Ghana.
We started with maize, but then shall follow sorghum, cassava, millet, wheat etc.

All five sources tell us a different story – so which one is to trust?

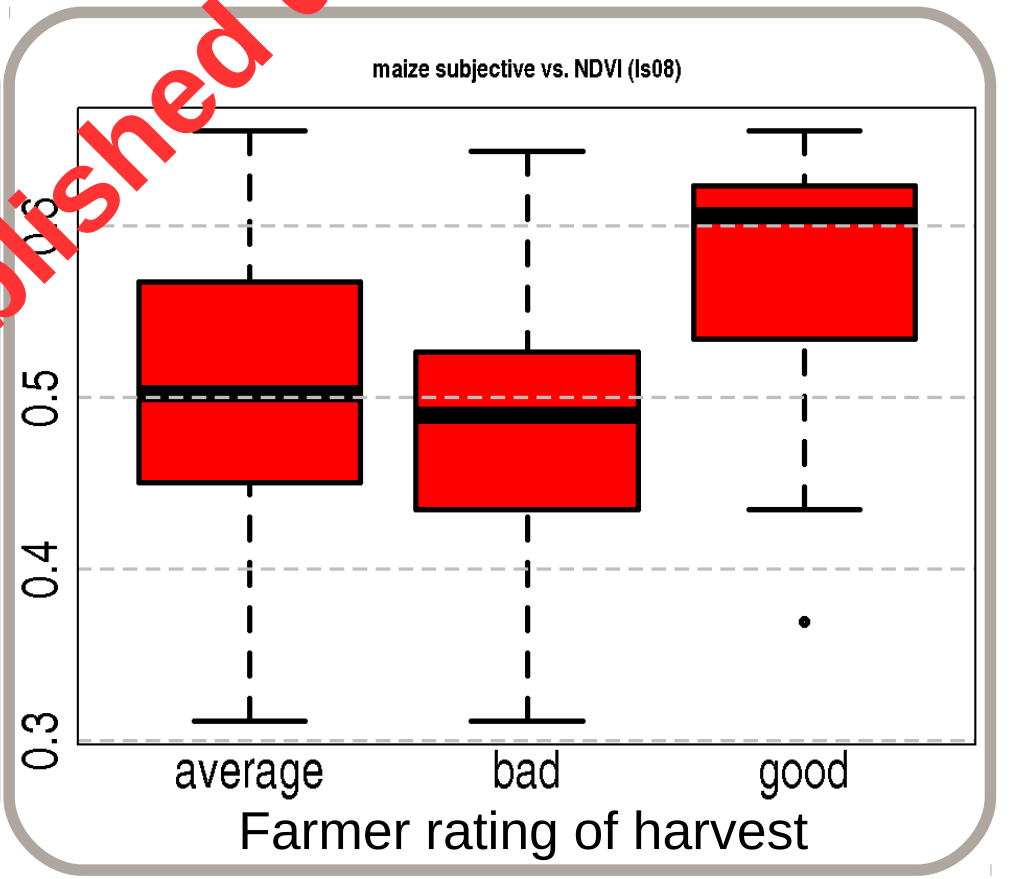


There seems to be a problem in Ghana, but not in Burkina Faso

Ghana



Burkina Faso



What could be the reasons for the disagreement?

Data quality could be poor. This can be the case for weather, yield or RS data (due to clouds or low coverage).

The crop mask could be wrong, as it dates back to 2000 and lacks the required small-scale resolution.

The processing and correlation methods could be inadequate.

Management information on the ground is lacking, yet would be key to gauge yields from the sky.

questions?