Stakeholders Webinar

15 & 16 June 2020
2 - 5pm CET

Webex Sessions
Links for : Day 1 & Day 2

Organizers:

The World Bank
Finance Competitiveness & Innovation Global Practice
and
The European Space Agency
Centre for Earth Observation ESA/ESRIN

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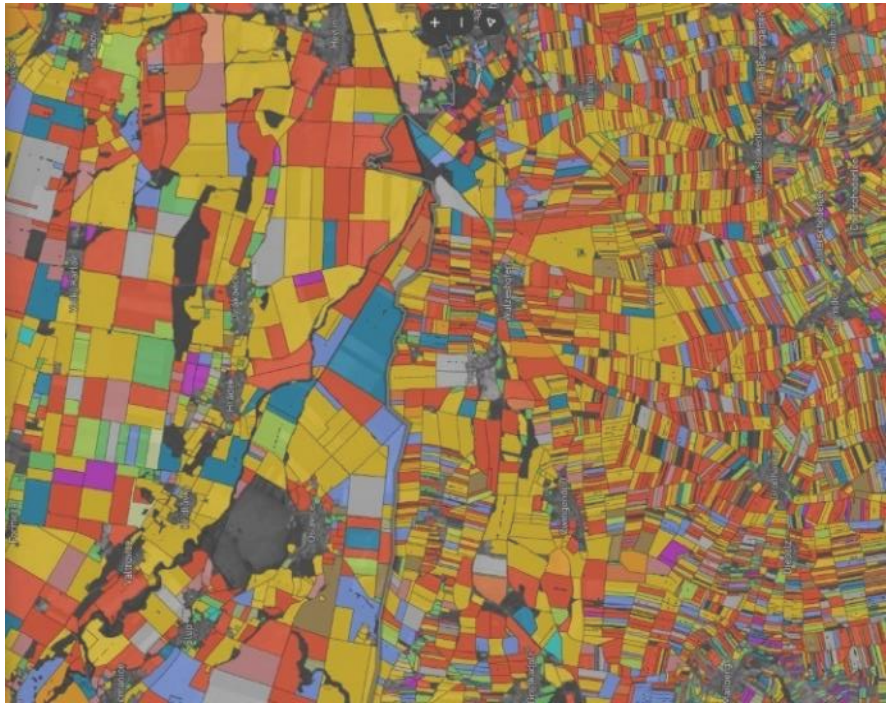
Why and how we should rethink drought indicators



Disaster Risk Financing & Insurance Program

SUPPORTED BY WORLD BANK GROUP

esa
European Space Agency
Agence spatiale européenne

Next Generation Drought Index Project

In Partnership with

IRI
International Research Institute for Climate and Society
EARTH INSTITUTE | COLUMBIA UNIVERSITY

AIR

IWMI
International Water Management Institute

With support from

European Commission

Global Risk Financing Facility

GFDRR
Global Facility for Disaster Reduction and Recovery

OVERVIEW OF THE NEXT GEN. DROUGHT INDEX DESIGN APPROACH

International Research Institute
for Climate and Society
Earth Institute | Columbia University

BACKGROUND

Anticipatory financing mechanisms are becoming popular mechanisms for drought risk management

Major challenges remain:

- Basis risk: do payouts happen when people need them?
- Robustness: are the payouts vulnerable to measurement or parameter error?
- Sustainability: can it continue?
- Local risk ownership: can local stakeholders take control of their own risk management?

We need the next generation of solutions!

WIDE RANGE OF APPLICATIONS, ONE THING IN COMMON: ALL INFO "NOT PERFECT"

01 ***Remote sensing data often used because there are few other data sources, raingauges sparse, error prone***

Paucity of validation/calibration data, incorrect estimates, lack of knowledge of extent of errors

02 ***Sometimes crowdsourcing farmer recollection only source of historical information***

Production datasets may not relate to farmer experiences

- Problem may be costs to maintain production, not production level
- May be cost of failing to repay loan, low production or shifting to food crops without loan better vs medium production of cash crop inadequate to cover costs

03 ***Models may miss key local features***

Phenology (crop timing) may be assumed incorrectly by couple of weeks

- Eg due to elevation, temperature, availability of inputs, labor.
- Couple of weeks off can lead to very different water stress results, missing major events

04 ***Yield data sparse, short, inaccurate, contradictory***

05 ***Co-Production essential***

Data validation must be 2 way: farmers must understand quality of remote sensing data used so that they know how well risks addressed, and what gaps they are exposed to

RESPONSIBLE USE OF IMPERFECT EVIDENCE

What years were droughts and why?

Convergence of evidence: Do multiple, independent sources of information verify key drought years?

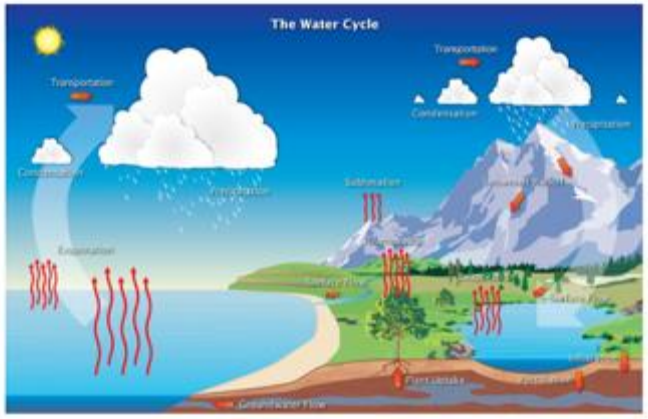
Science: does the water cycle help us understand independent data on

- Rainfall
- Soil Moisture
- Agricultural cycle
- Vegetation Response

Crowdsourcing: Do the drought years that farmers remember reinforce observation data or flag issues?

Co-Design: Do drought years from index reflect identified drought years? If not, how do we fix it?

Earth's water moves over the land surface and underground, into the ocean and then through the atmosphere.



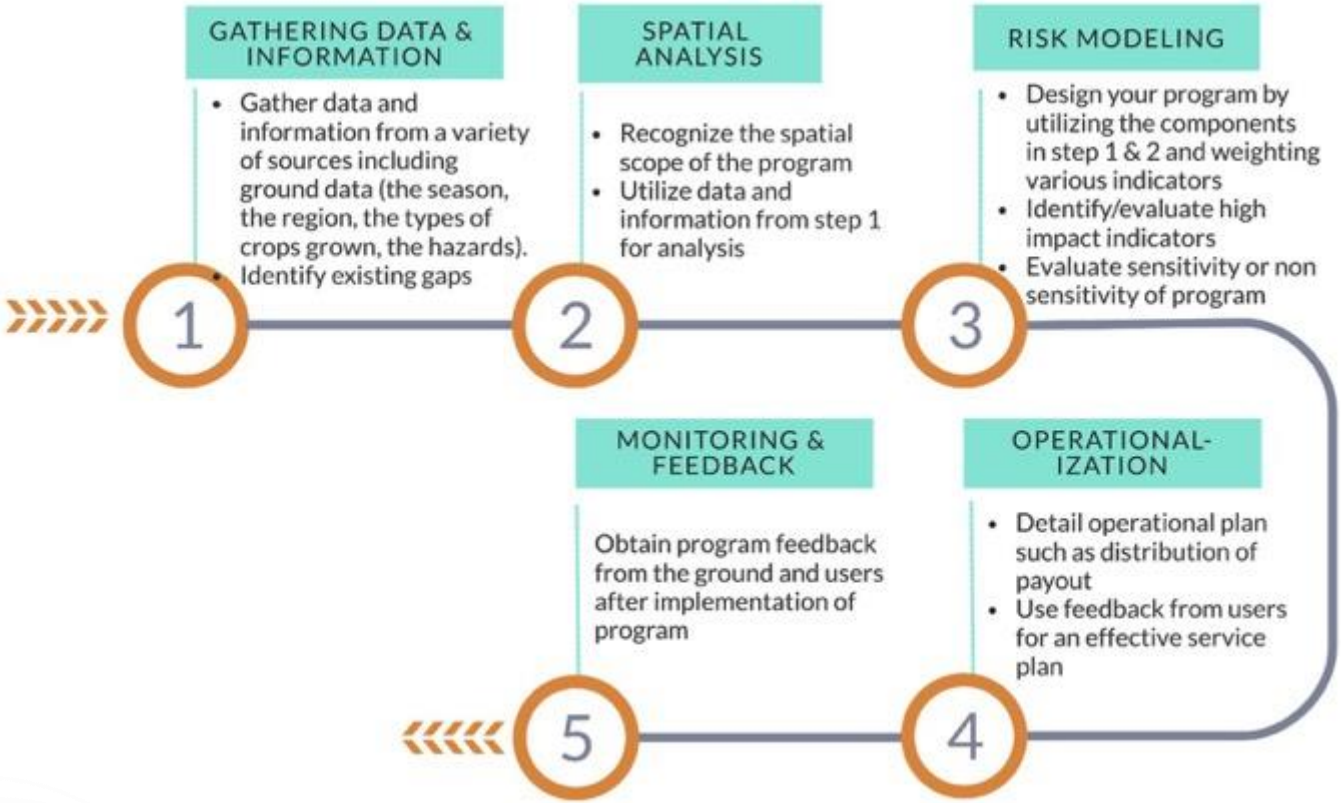
(Image courtesy NOAA National Weather Service Jetstream)

NEXT GENERATION DROUGHT INDEX PROJECT

The World Bank contracted a research consortium lead by IRI and including IWMI and AIR worldwide to develop a conceptual framework for a set of indices or indicators which will better monitor and trigger financial responses to severe drought events.

NOVEL CODESIGN PROCESS TO STRENGTHEN RISK OWNERSHIP IN TARGET COUNTRIES

A data-driven logical design process that starts with an inventory of available data and ends with a feedback process



BENCHMARK STRATEGY

- The project follows an open platform co-design strategy, the datasets, tools and modeling are not intended to be the final solutions, but to provide a concrete starting point
- We have started with some initial datasets and indexes
- These are used as a benchmarking tool to identify better datasets and indexes, national government, appropriate ESA solutions
- The goal is to have a co-design process in which the appropriate data, experts, and index solutions are identified
- Decision Tree driven by Key Performance Indicators
- Please be thinking about data, models, experts, partners that should be explored

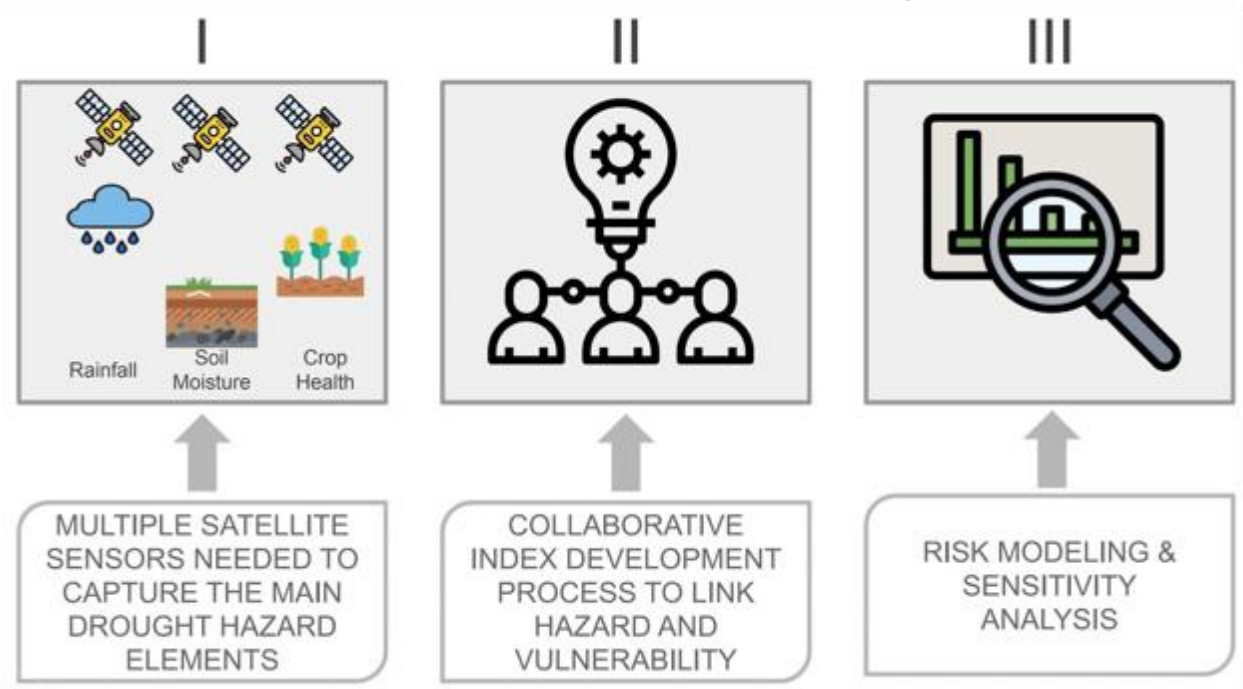
THREE TYPES OF QUESTIONS

I) **Datasets and drought extent**: Which satellite-based variables perform best with regard to capturing historical drought impacts? Where are 'clusters' (e.g areas with similar moisture characteristics) that can help to decide how many different indices are needed to cover large areas? How can rainfall deficits be confirmed via soil moisture anomalies and information about the response of the land surface or specific crops?

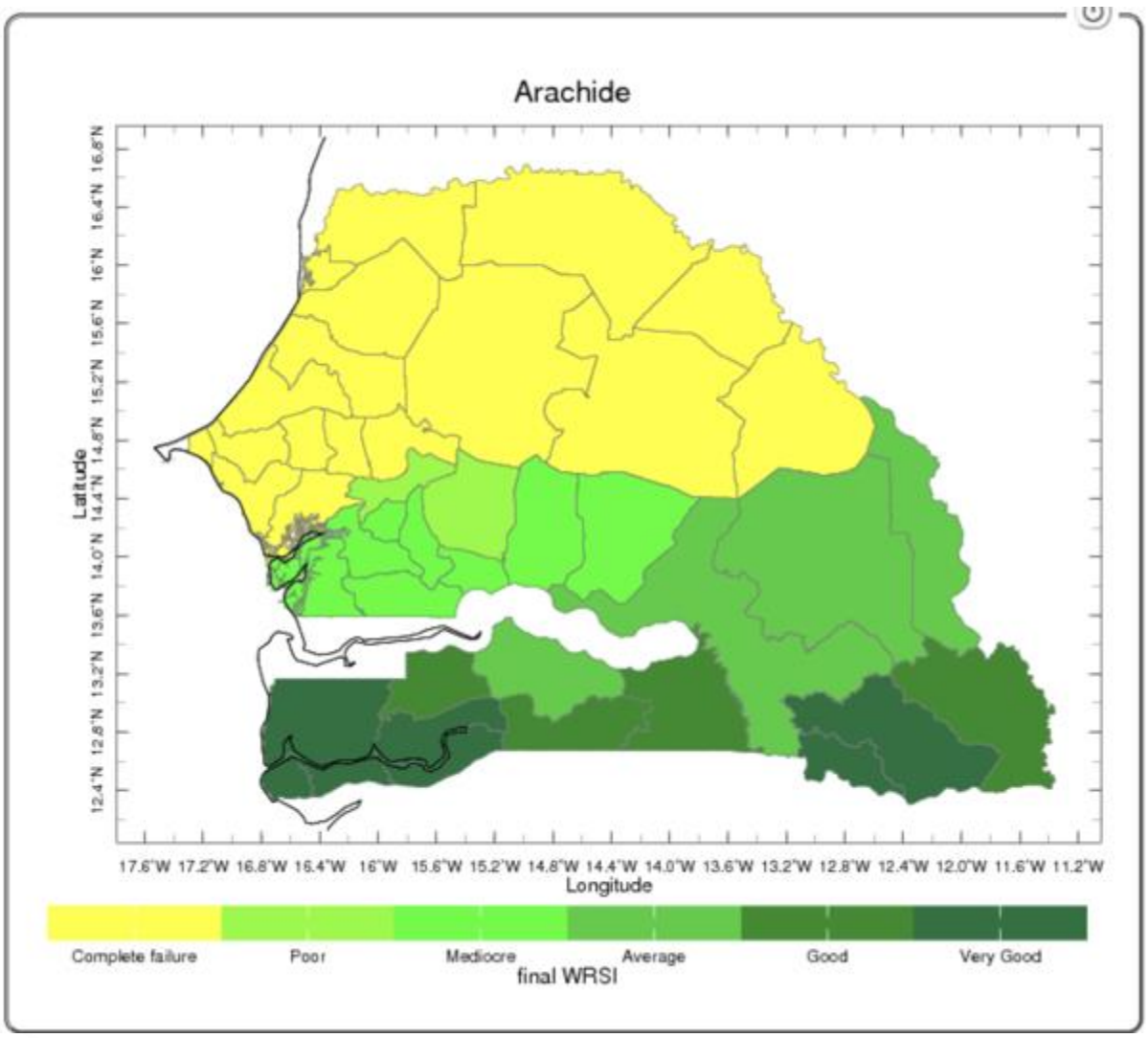
II) **Socioeconomic information**: Which socioeconomic data are available to close the gap between drought hazard and impact information? How does vulnerability analysis fit into the index design, calibration and validation process?

III) **Robustness and Stability**: Which methods are best suited to quantify the robustness of an index? How do decisions related to the index design process (e.g. datasets, payout frequencies, insurance windows) affect the overall sensitivity?

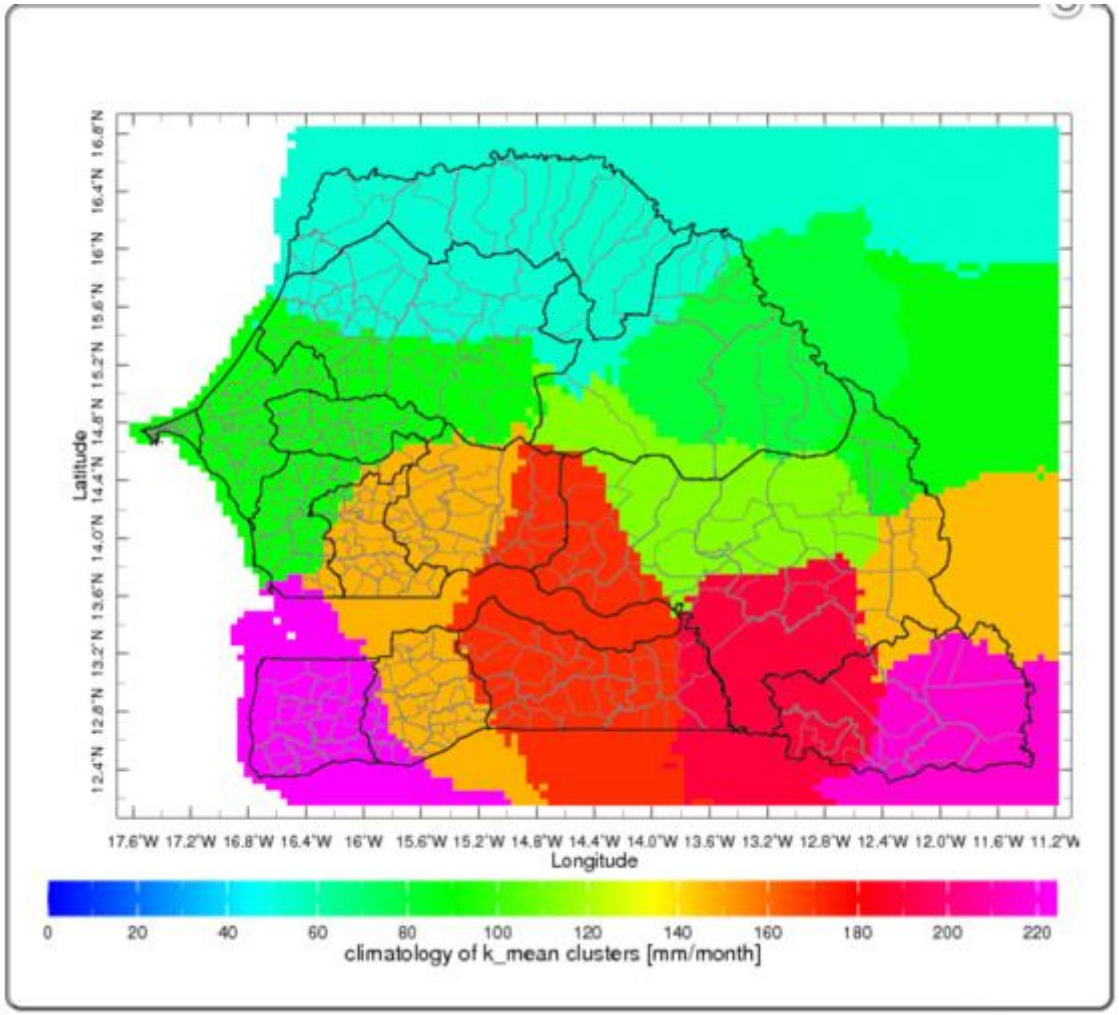
How do we address these kinds of questions?



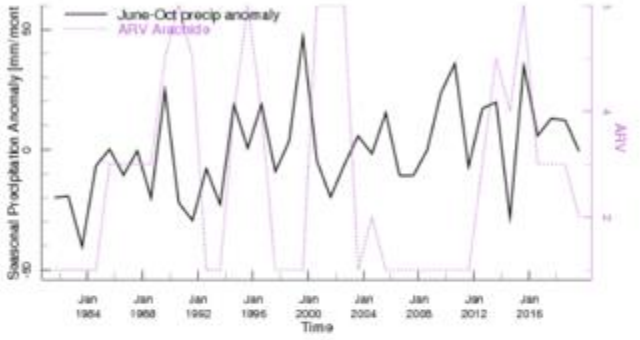
WHERE ARE CROPS AFFECTED BY DROUGHT?



HOW LARGE AN AREA DO DROUGHTS COVER?

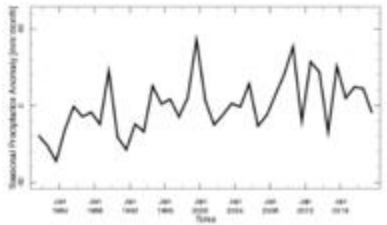


Observations for **Tambacounda, Tambacounda, Senegal**

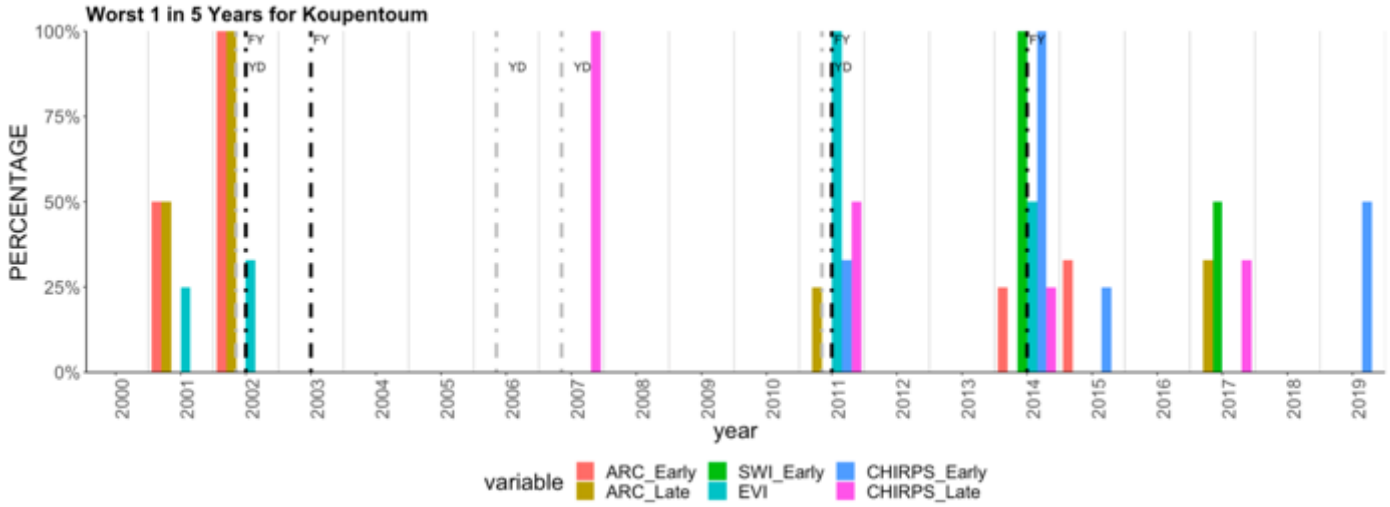


Arachide

Observations for **Tambacounda**



DOES THE EVIDENCE CONVERGE TO IDENTIFY DROUGHT YEARS?



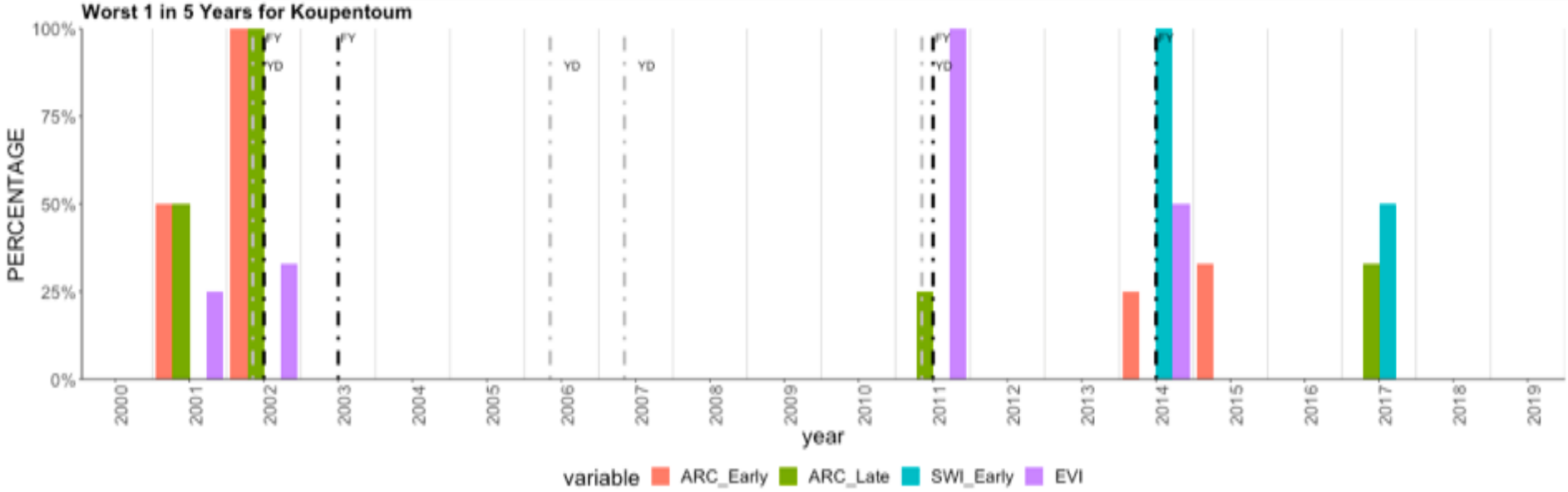
Matching Analysis

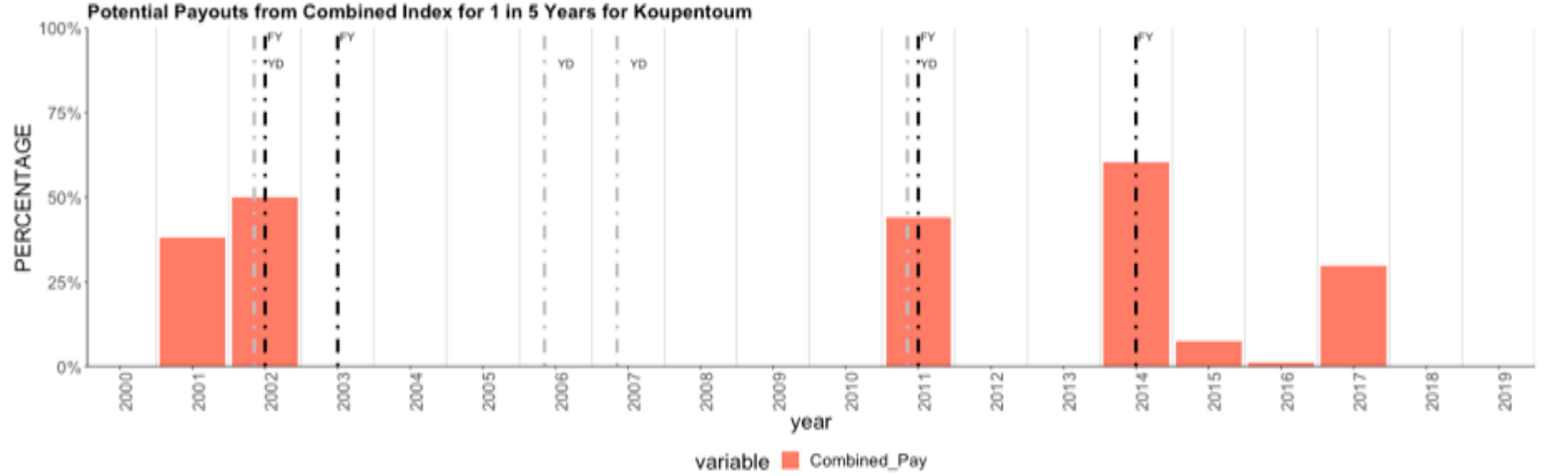
Performance Metric

% of Matching

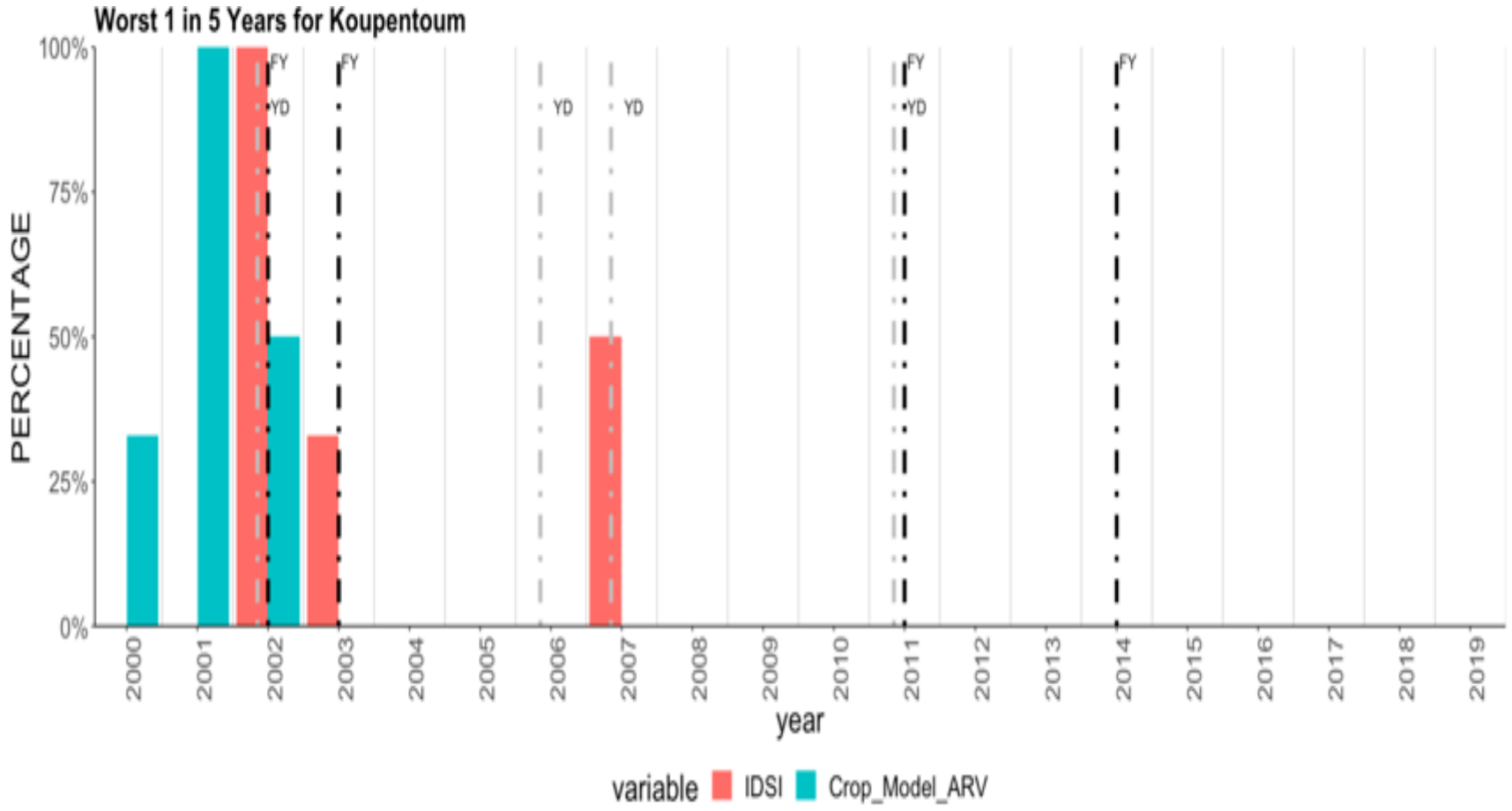
	ARC_Early	ARC_Late	SWI_Early	EVI	CHIRPS_Early	CHIRPS_Late	Farmer_Bad_Years	Yield_Data
ARC_Early	1	0.5	0.5	0.75	0.5	0.25	0.5	0.25
ARC_Late	0.5	1	0.5	0.75	0.25	0.5	0.5	0.5
SWI_Early	0.25	0.25	1	0.25	0.25	0.5	0.25	0
EVI	0.75	0.75	0.5	1	0.5	0.5	0.75	0.5
CHIRPS_Early	0.5	0.25	0.5	0.5	1	0.5	0.5	0.25
CHIRPS_Late	0.25	0.5	1	0.5	0.5	1	0.5	0.5
Farmer_Bad_Years	0.5	0.5	0.5	0.75	0.5	0.5	1	0.5
Yield_Data	0.25	0.5	0	0.5	0.25	0.5	0.5	1

WHICH/HOW MANY DATA SOURCES SHOULD BE IN AN INDEX?

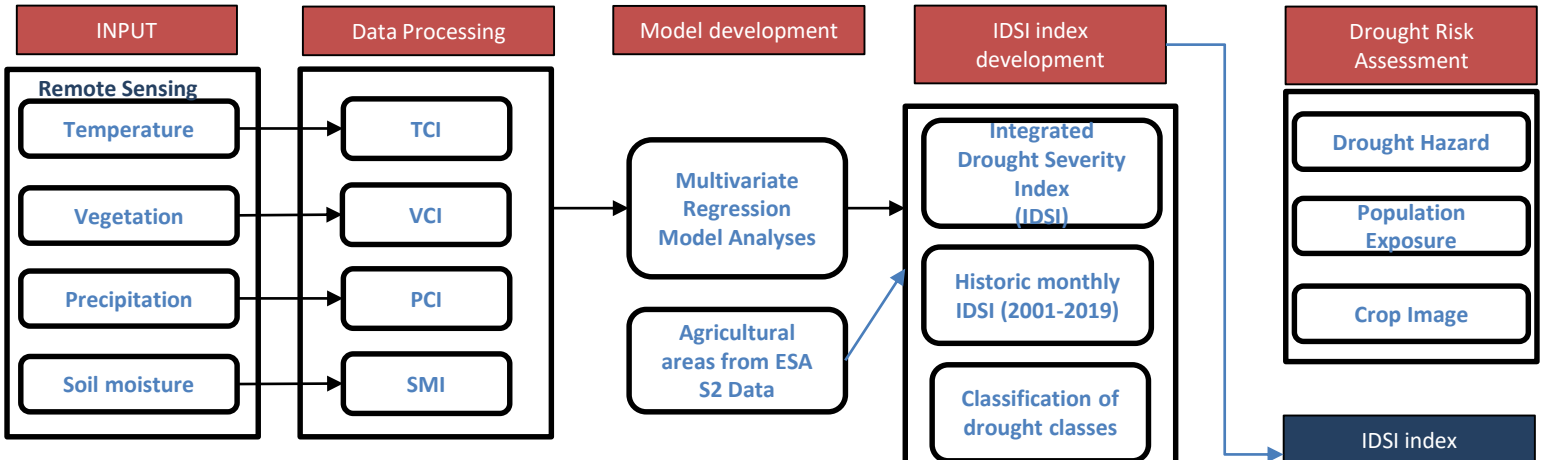




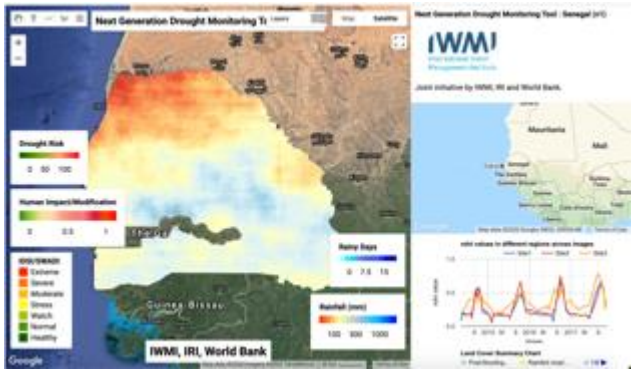
HOW MUCH SHOULD WE MODEL CROP WATER STRESS IN THE INDEX?



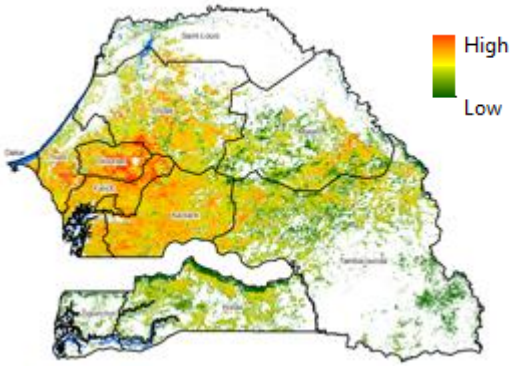
HOW SHOULD WE INTEGRATE DATA IN A DROUGHT SEVERITY INDEX?



Visualization Data and Tools in GEE

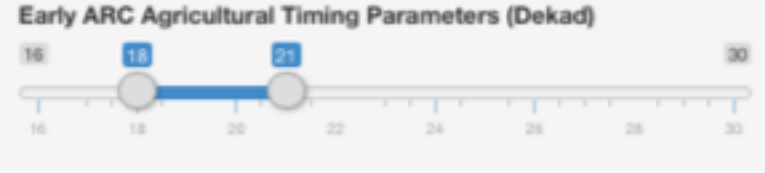


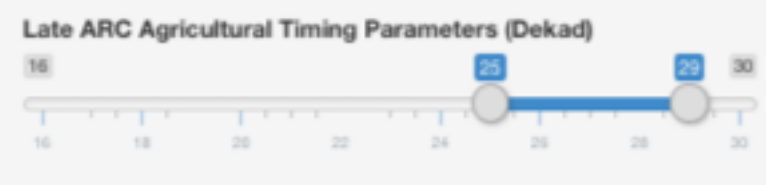
Drought Risk Map

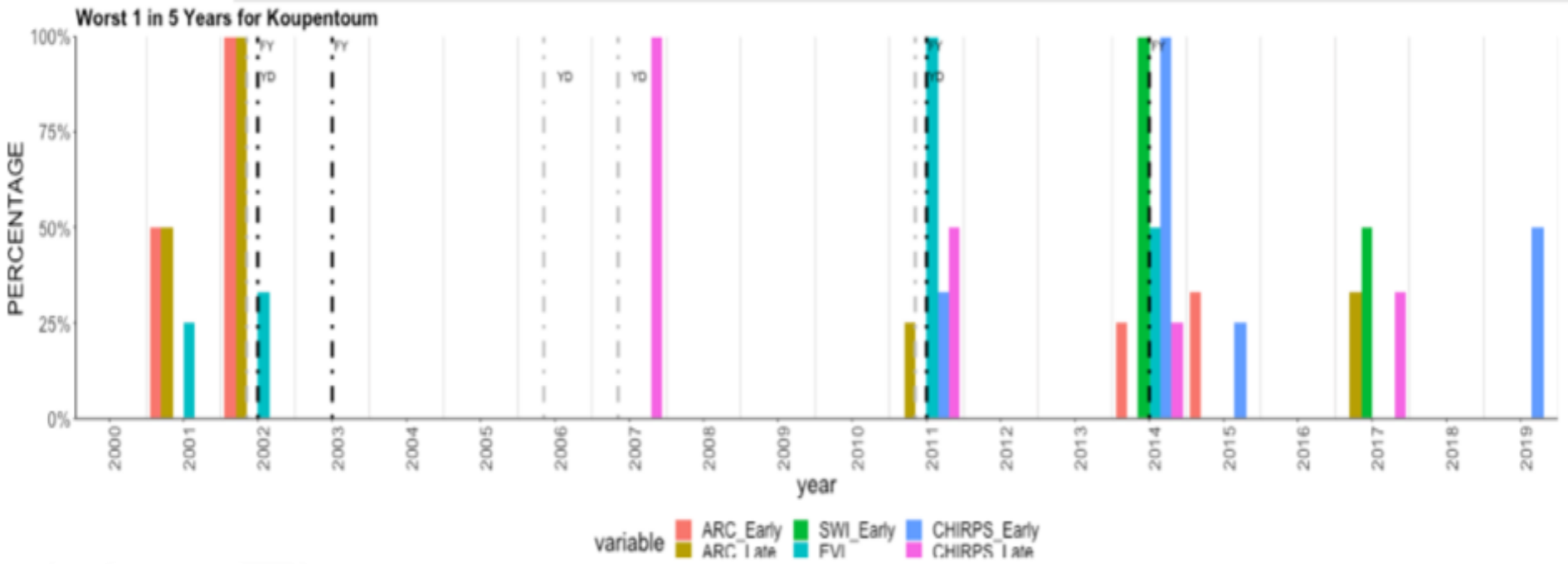


International Water Management Institute

WHICH COVERAGE DATES PROVIDE PAYOUTS IN THE YEARS THAT MOST NEED PAYOUTS?

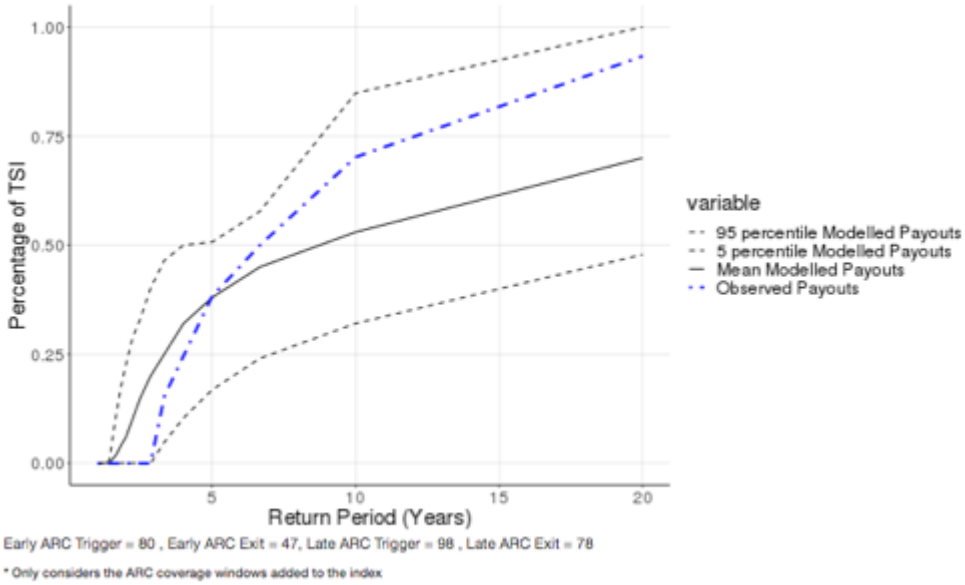






HOW DO WE CHECK IF OUR INDEX IS NOT OVERFIT BUT IS INSTEAD STABLE, ROBUST?

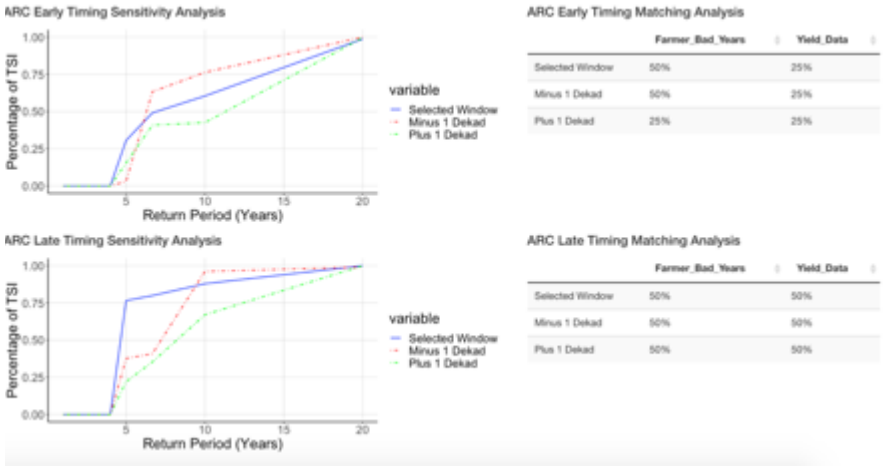
Data sensitivity



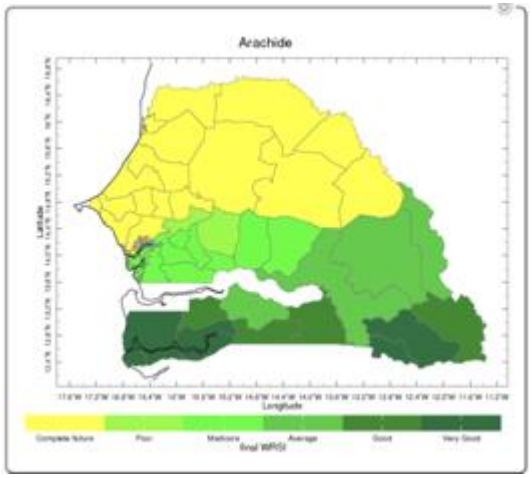
Early ARC Trigger = 80 , Early ARC Exit = 47, Late ARC Trigger = 98 , Late ARC Exit = 78

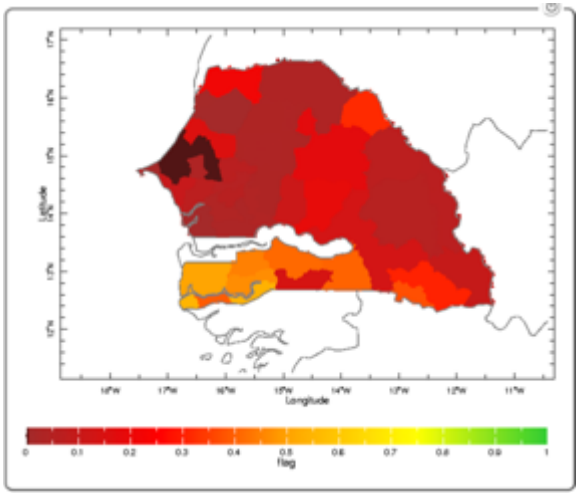
* Only considers the ARC coverage windows added to the index

Parameter Sensitivity



HOW DO WE LINK TO VULNERABILITY?

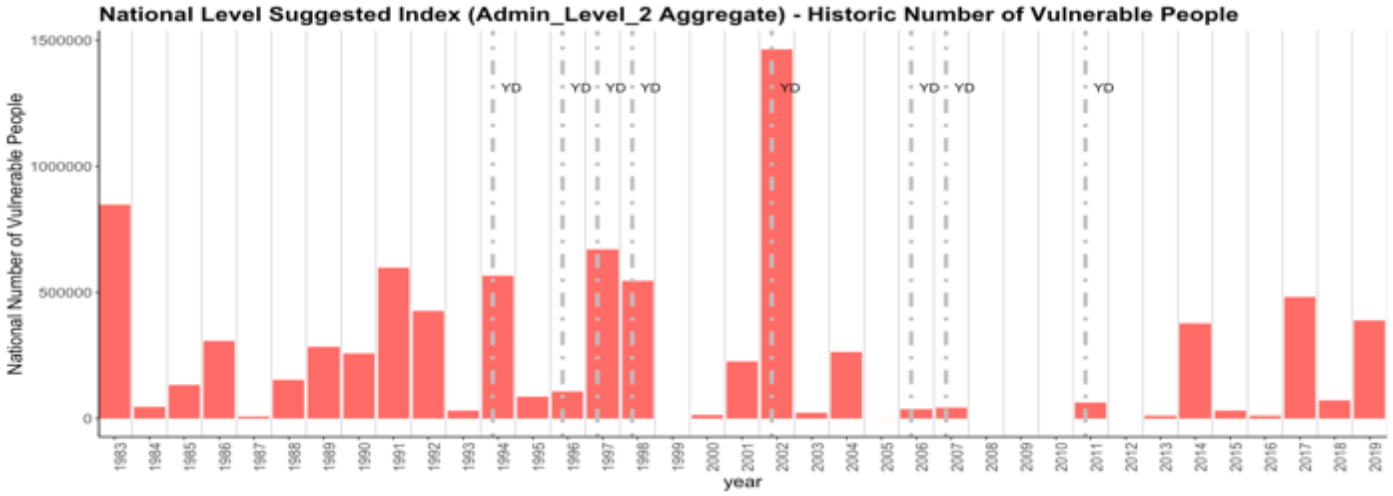




Fixed Effects Model Summary with National Benchmark Index as predictor

* The Estimates of the model can be used to guide your Percentage of People Affected Multiplier

```
Oneway (individual) effect Within Model

Call:
plm(formula = FCS ~ National_Benchmark_Payouts, data = panel_nat_ben,
    model = "within", index = c("Department", "Year"))

Unbalanced Panel: n = 45, T = 2-3, N = 132

Residuals:
     Min.   1st Qu.    Median   3rd Qu.      Max.
-0.323741 -0.055289  0.000000  0.051056  0.447893

Coefficients:
                           Estimate Std. Error t-value Pr(>|t|)
National_Benchmark_Payouts 0.193890   0.097974   1.979  0.05102 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    1.6607
Residual Sum of Squares: 1.5884
R-Squared:      0.043556
Adj. R-Squared: -0.45691
F-statistic: 3.91638 on 1 and 86 DF, p-value: 0.051017
```



NGDI PROVIDES METHODS TO ADDRESS THESE QUESTIONS

1.3.1 Look at the black line in the time series plots for the two departments. What are the four years with the lowest rainfall anomalies for Goudiry department? for Tambacounda department?

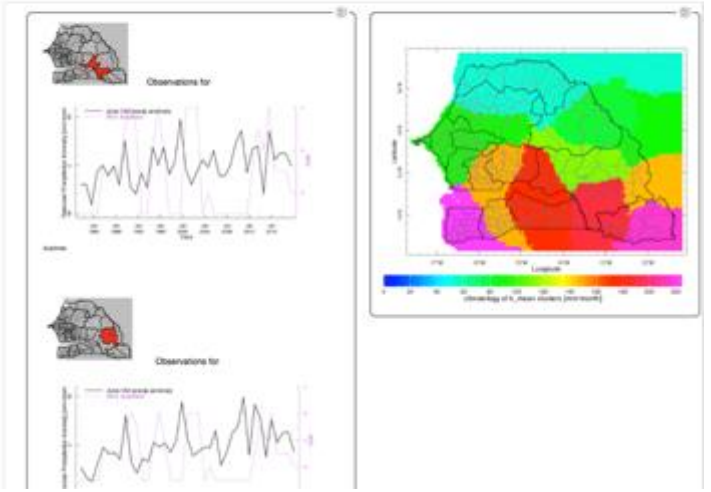
Your answer

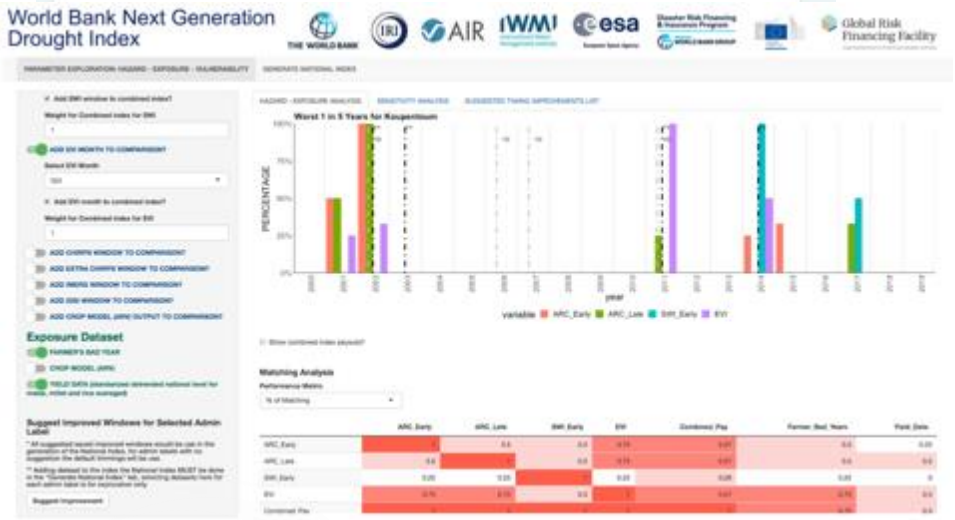
1.3.2 How many of the lowest anomalous years are similar between the two departments?

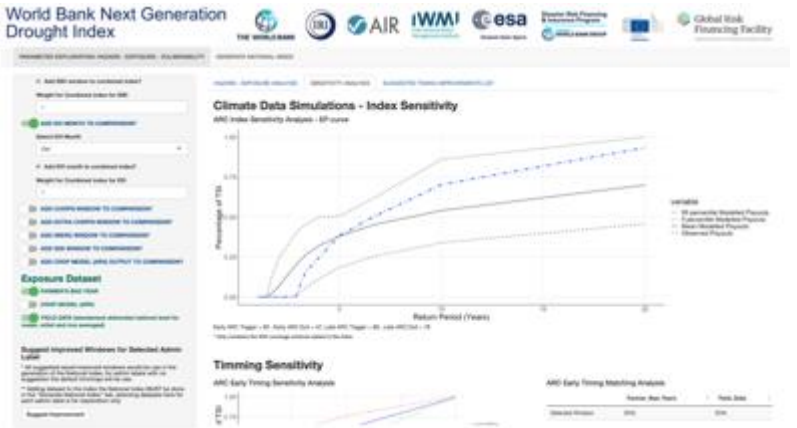
Your answer

1.3.3 Based on your analysis so far, what recommendations would you make to disaggregate the Tambacounda region into subdivisions or not? *

Your answer







Main Project Outcomes and Added-Value

Project Outcome	Added-value
Inventory of EO data and drought indices	Overview of strengths and weaknesses
'Convergence of evidence' approach applied to EO data	Additional level of confidence; No need to rely on a single data source
Interactive online dashboard	Immediate visual feedback to changes in index parameters
Integrated risk modeling and detrending of climate data	Simplification of complex relationships; KPIs; increased robustness of index design
Guided expert assessment process	Hybrid risk design process relying on quantitative EO data and expert knowledge
Low-cost data collection framework for mobile technologies	Complementation of historical socioeconomic surveys with up-to-date information

Thank You!