Managing the risk of agricultural drought in Africa

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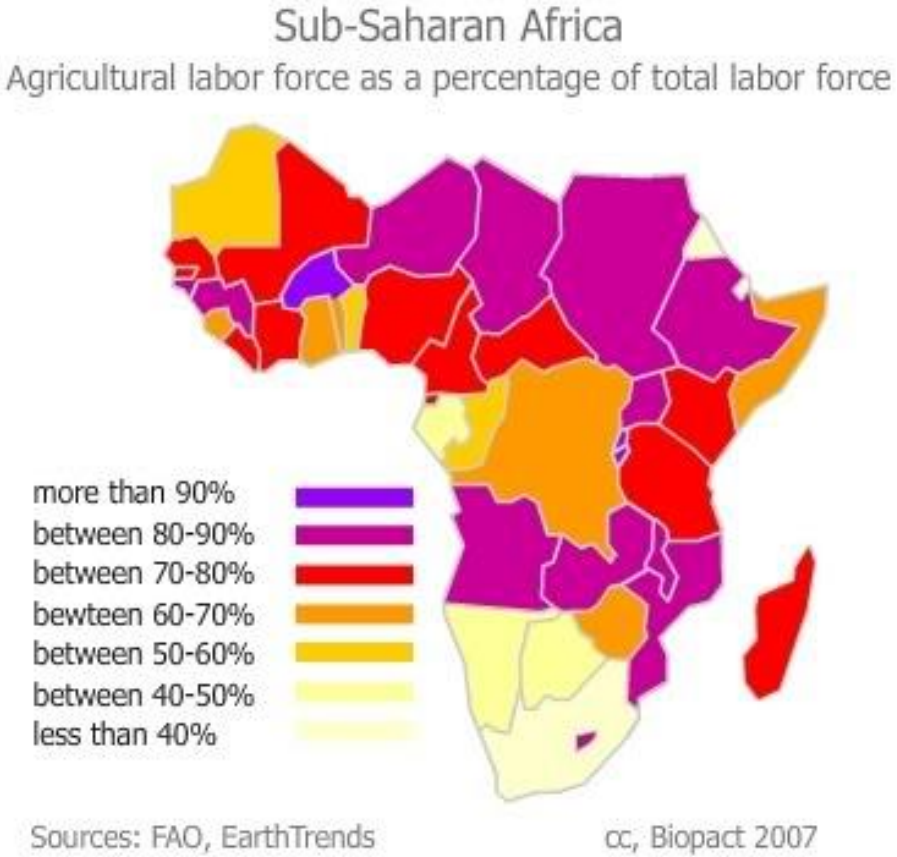
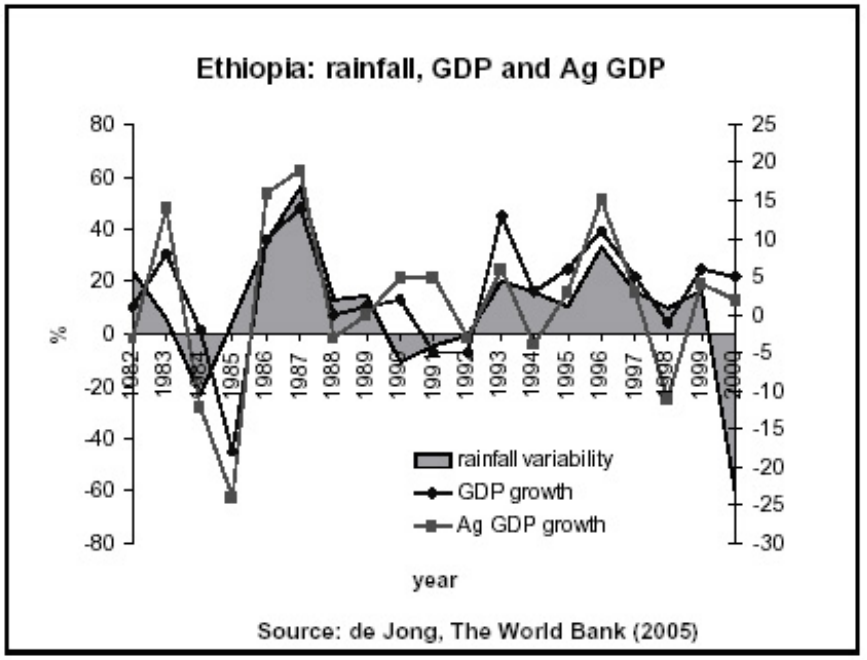
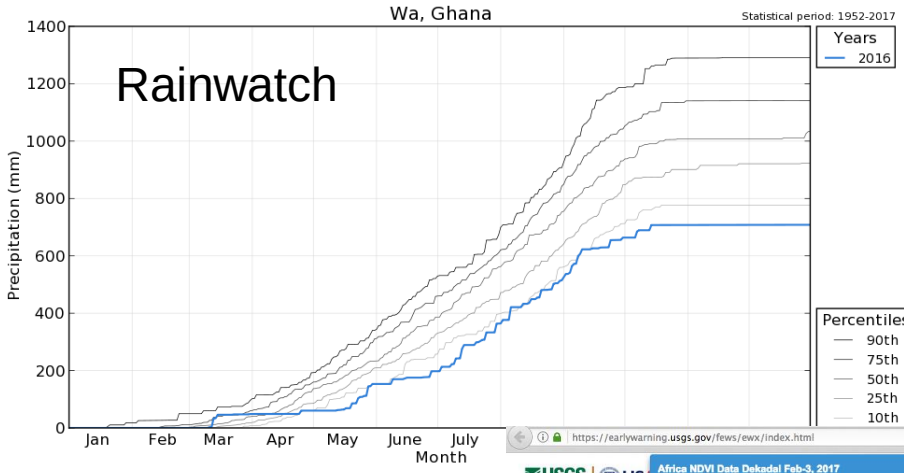
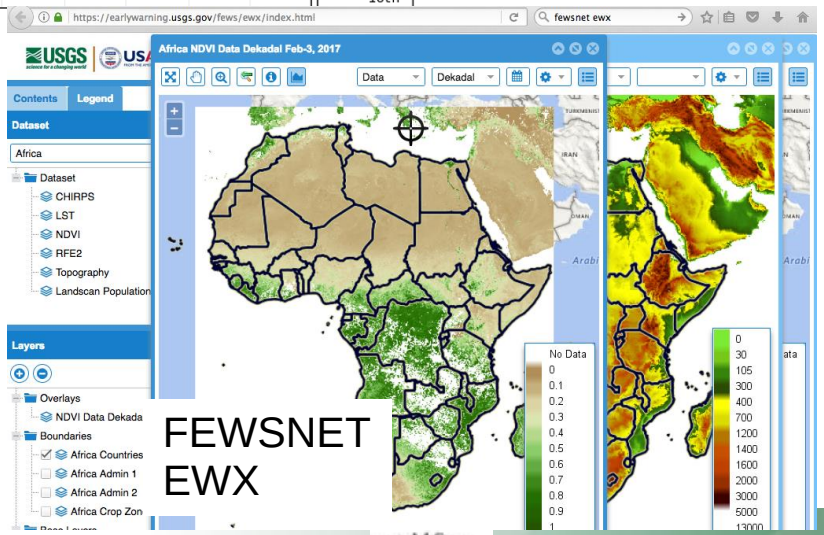
Vulnerability

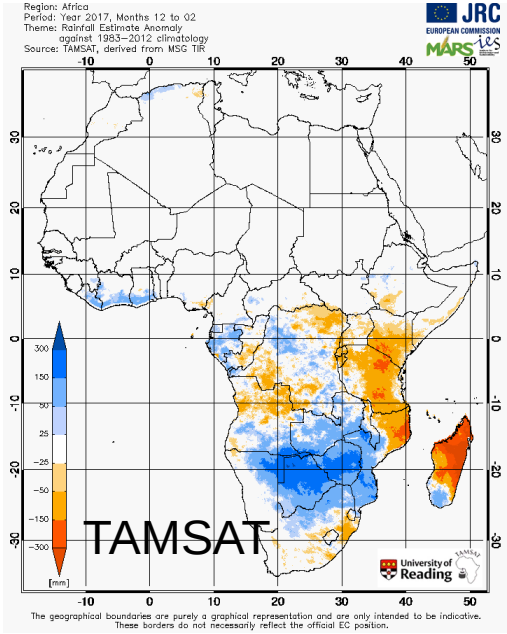




Early warning by monitoring environmental conditions







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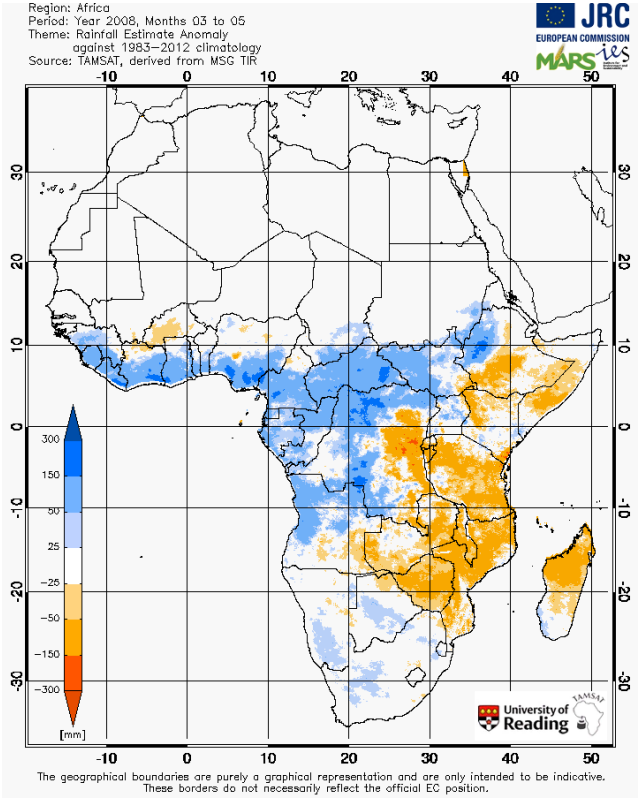
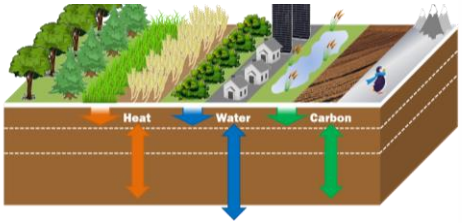
Assessing risk using a snapshot of soil moisture

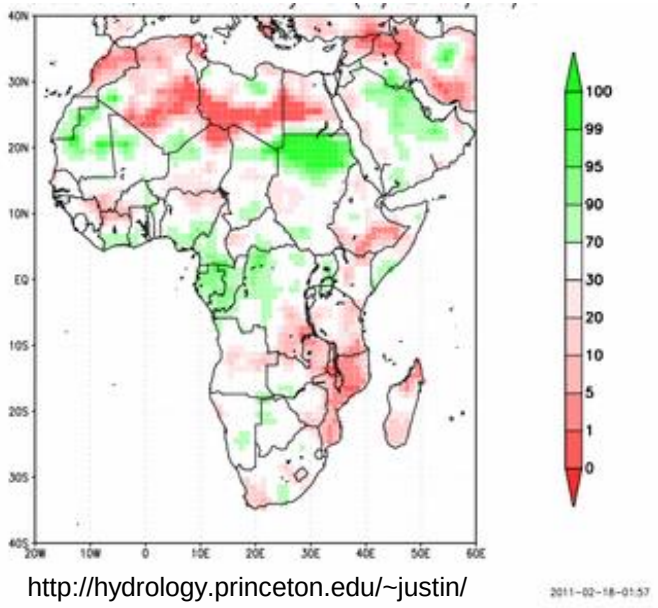
Meteorological input



Land surface model



Soil moisture based drought metric



http://hydrology.princeton.edu/~justin/

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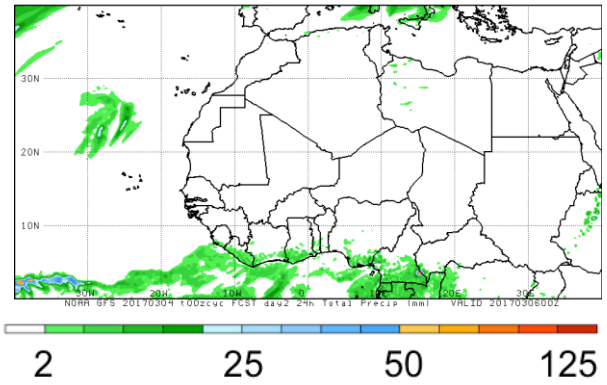
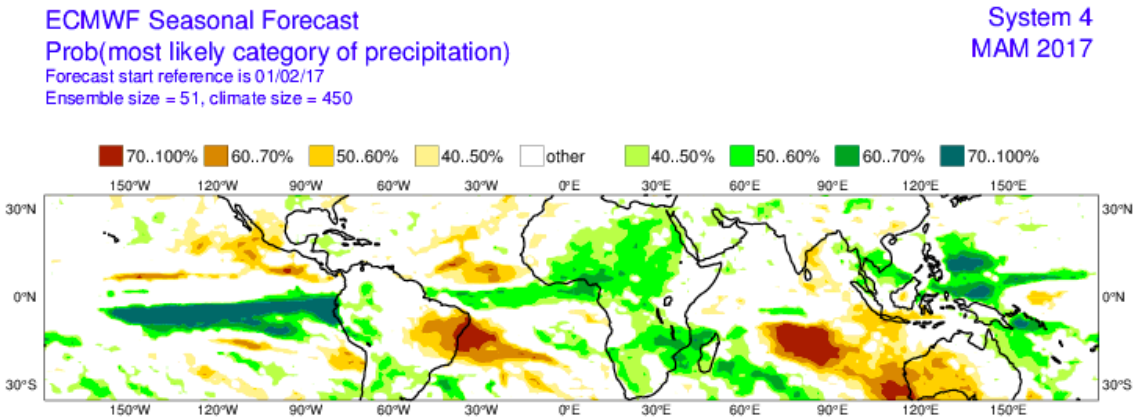
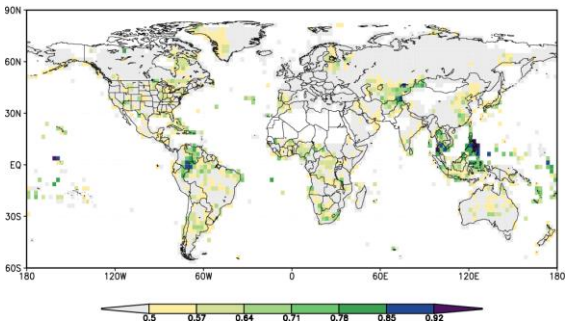
Meteorological forecasts: days to months ahead

Met office 24-hour forecast



ECMWF seasonal forecast





IRI seasonal forecast skill (precipitation, MAM, 3-month lead)

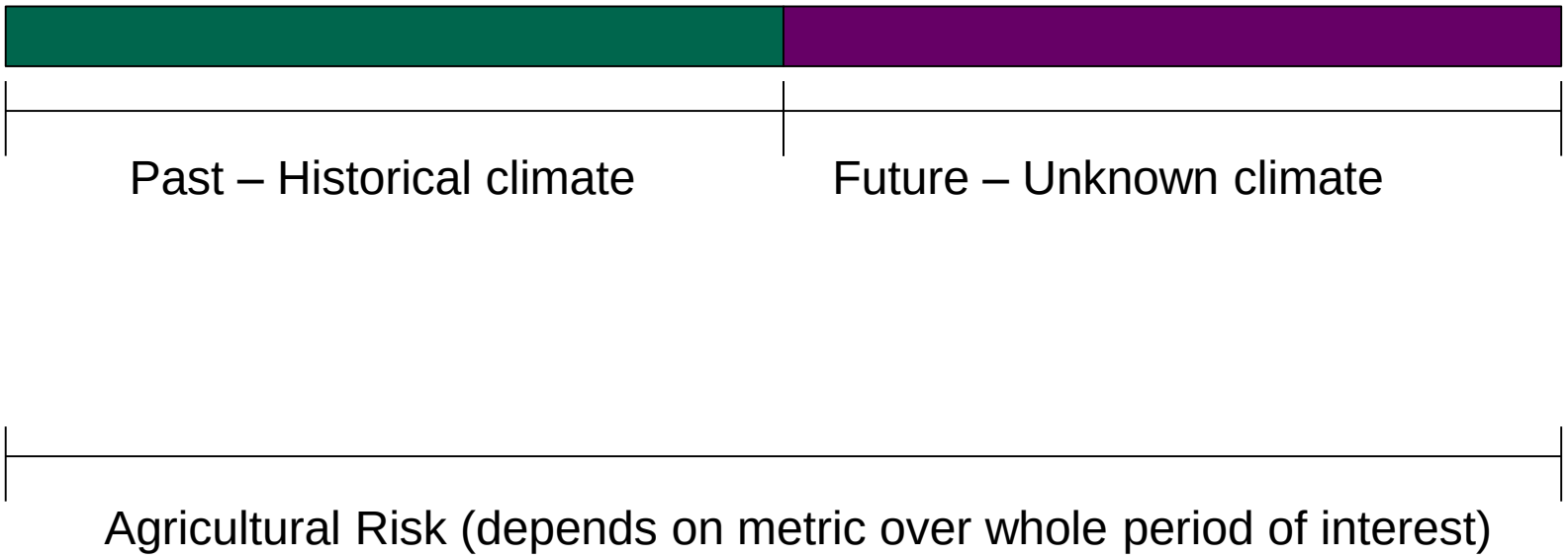
Concept

Given the:

- climatology
- state of the land surface
- stage of the rainy season
- meteorological forecast /climate regime

What is the likelihood of some adverse event?
…low soil moisture, low yield, seedling death, late start to the rains

Monitoring agricultural drought: Evolving risk



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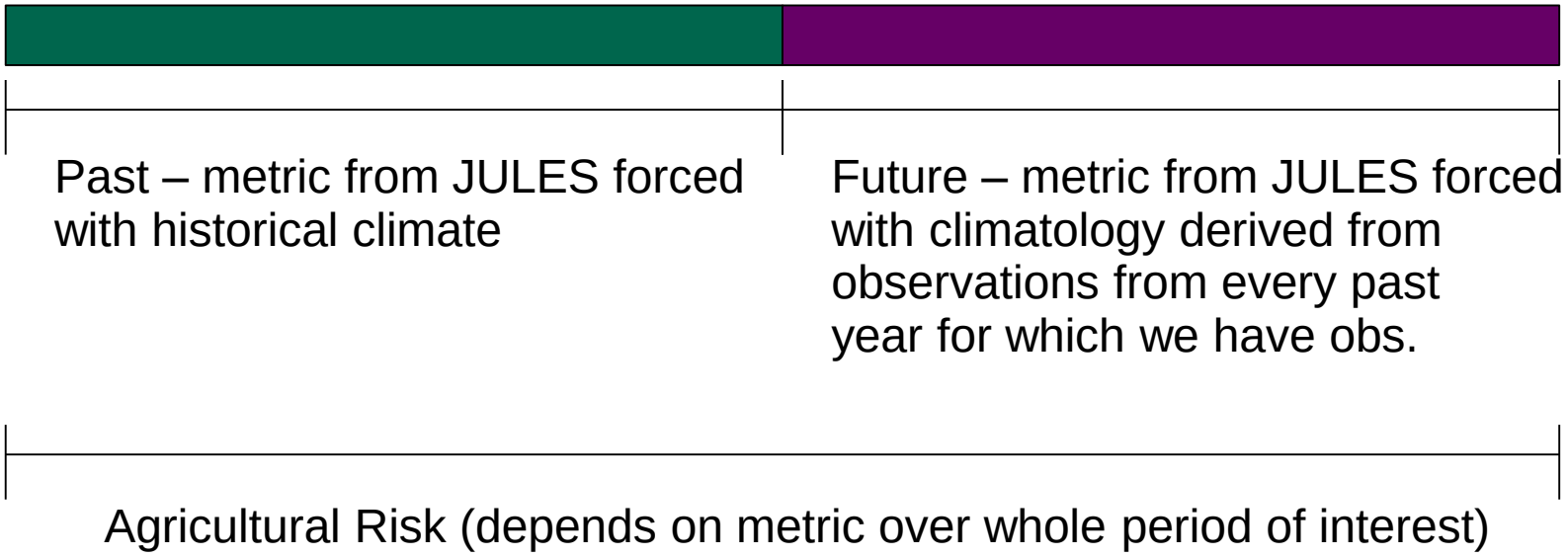


What is the likelihood of some adverse event?
…low soil moisture, low yield, seedling death, late start to the rains

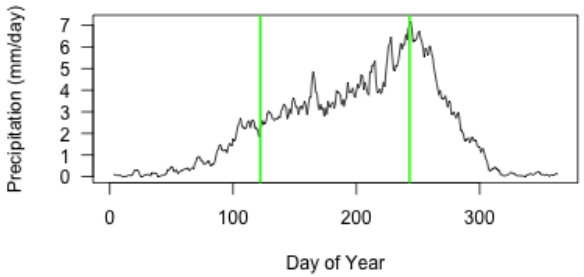
Concept

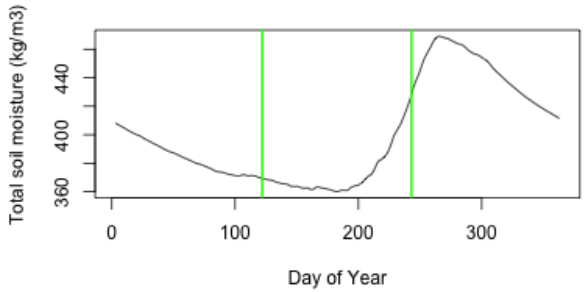
Complementary approach to ‘direct’ forecasts of e.g. soil moisture:

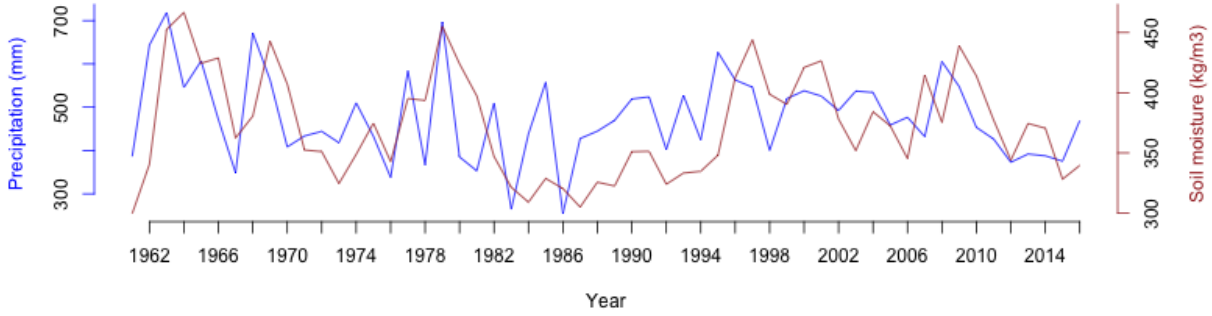
- Downscaled to driving rainfall data
- Bias correction on driving data is implicit
- Lightweight: can be run in house at met services
- Easily interfaced with impacts models (e.g. GLAM)

What is the likelihood of some adverse event?
…low soil moisture, low yield, seedling death, late start to the rains

Case study: soil moisture memory and predictability northern Ghana







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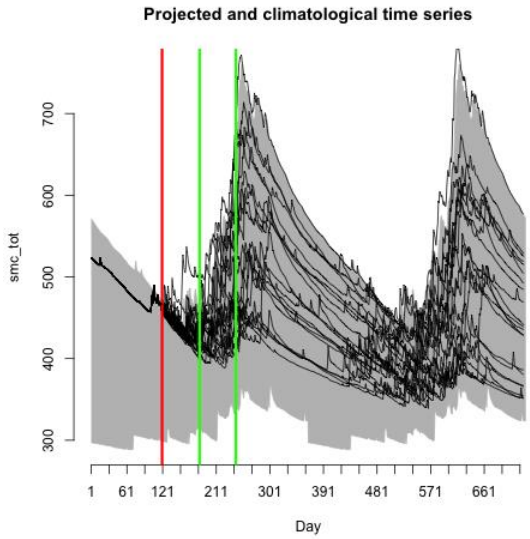
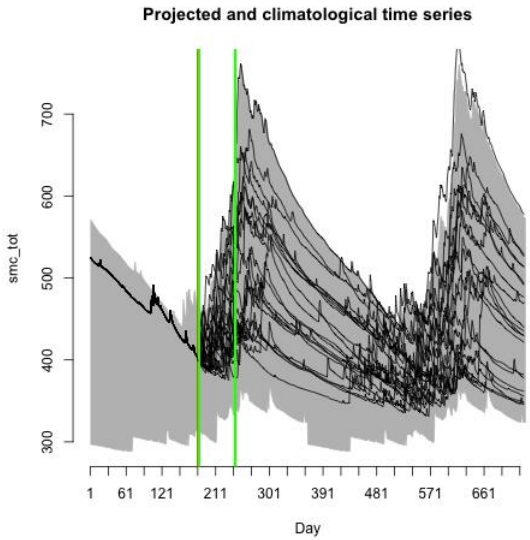
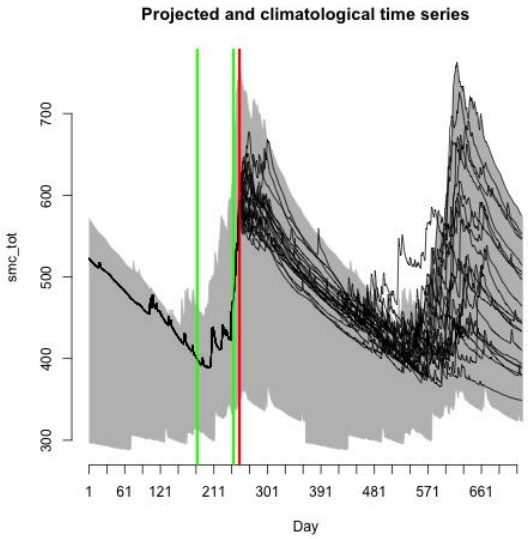


Before the period of interest

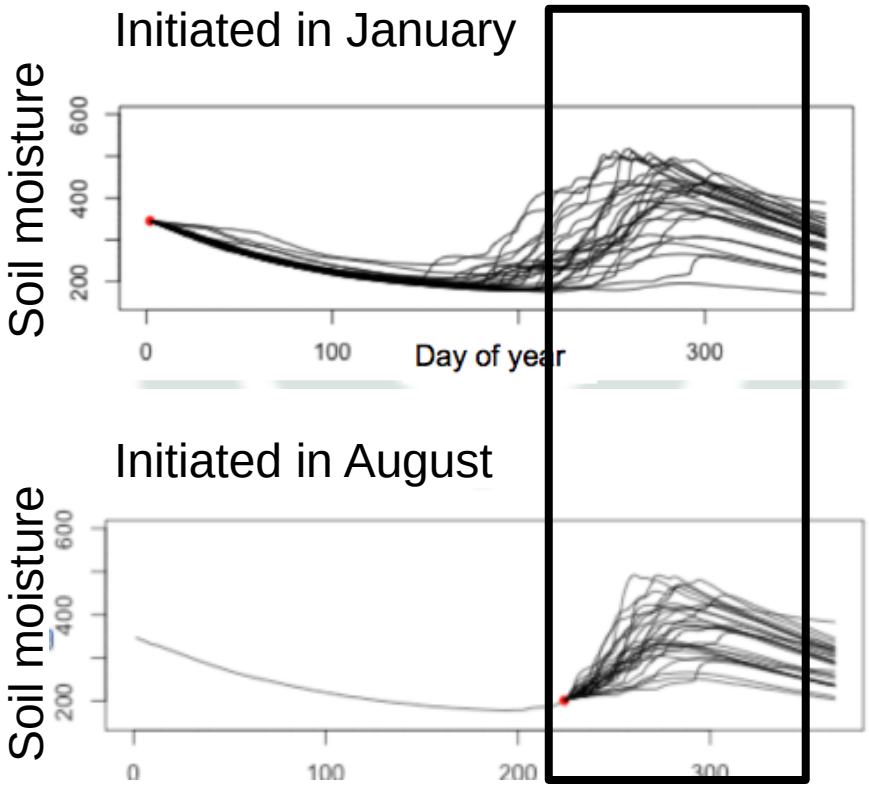


Outset of the period of interest

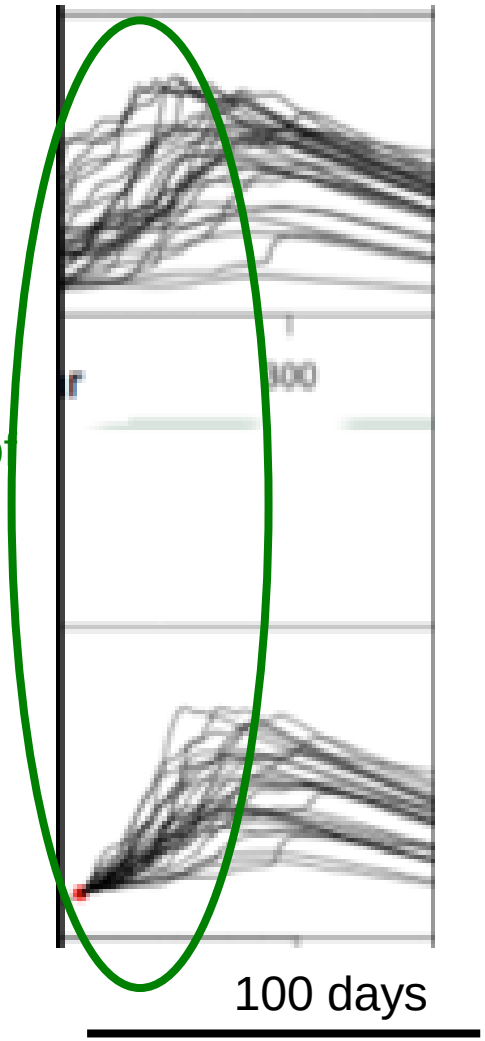


After the period of interest

Soil moisture memory



Memory of the land surface



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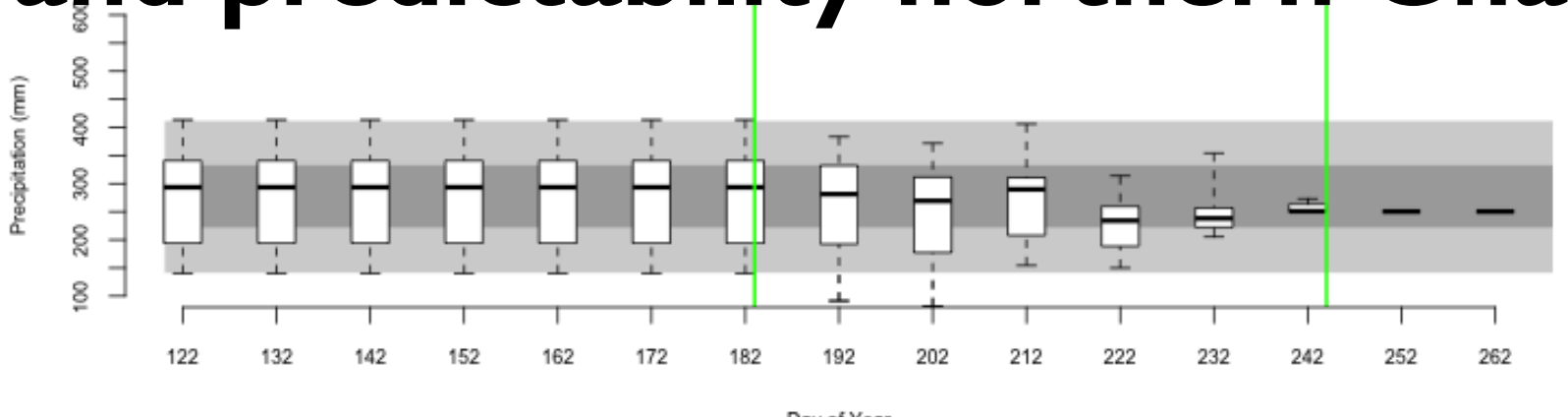
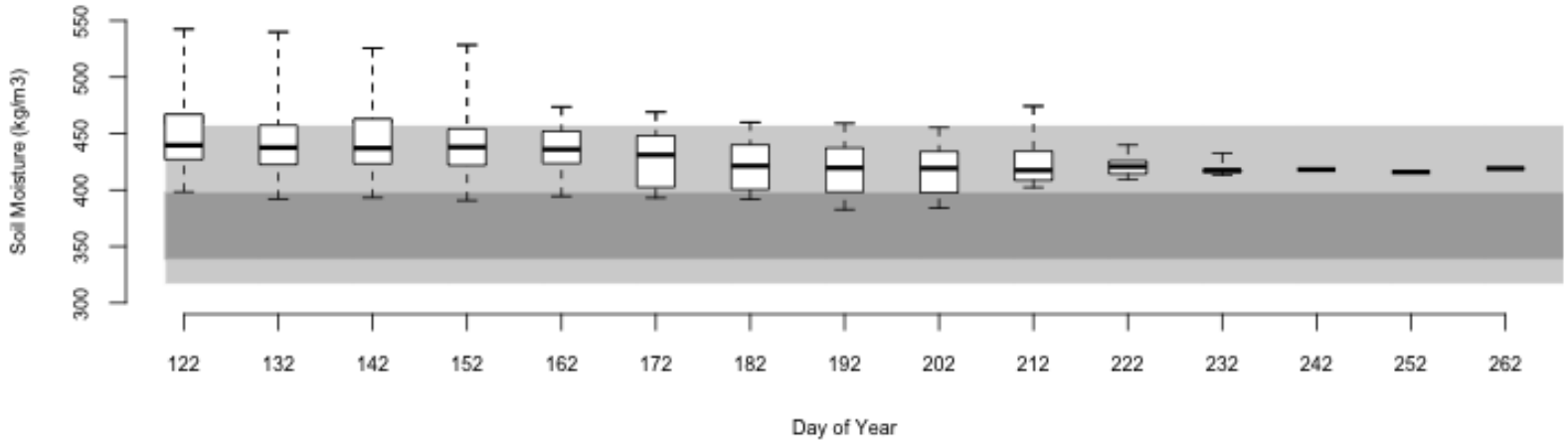
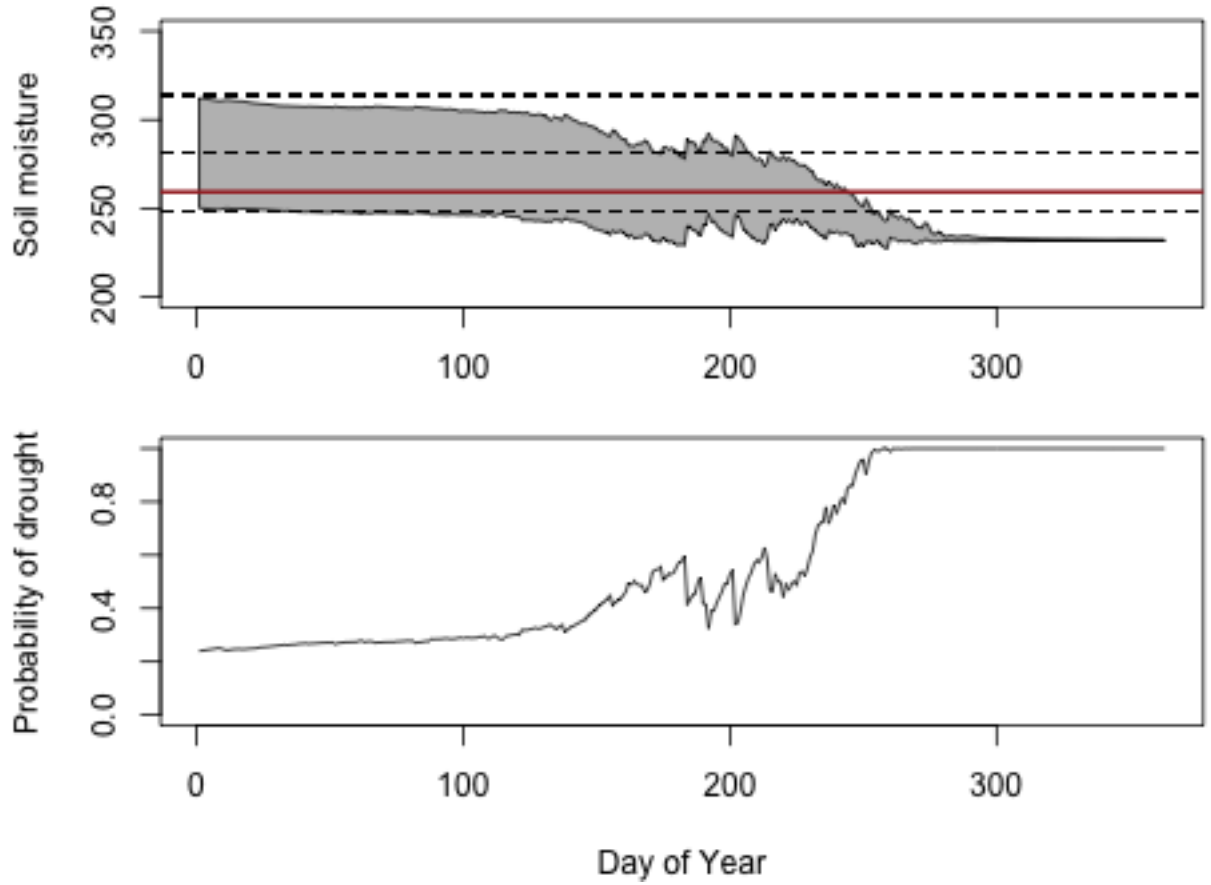




Monitoring risk during a drought year (2011 in Tamale)



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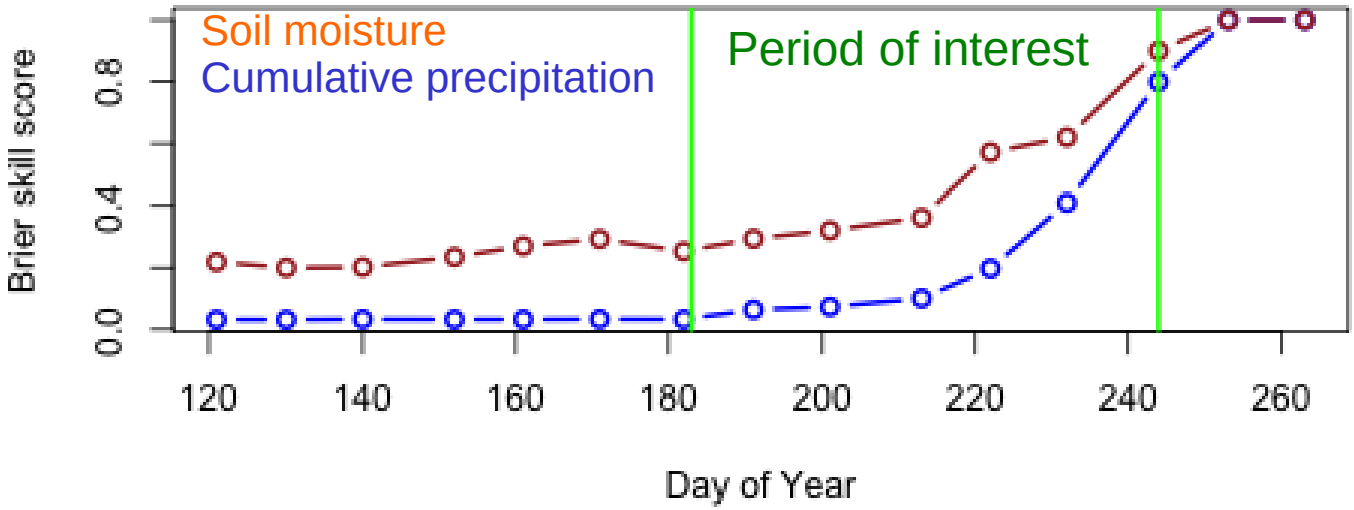
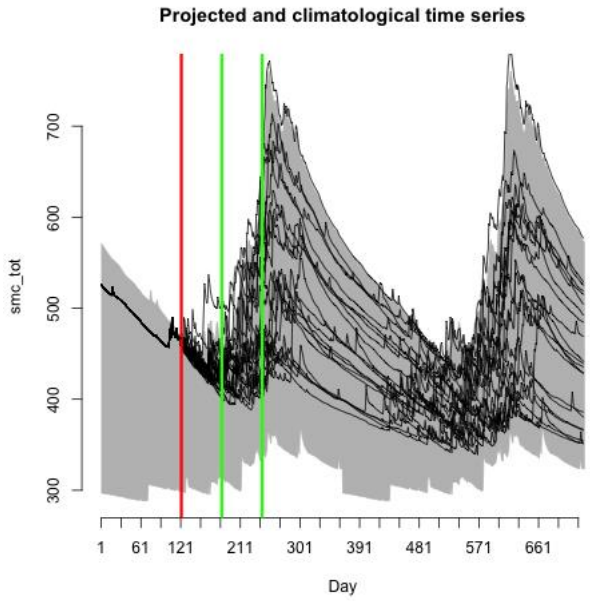


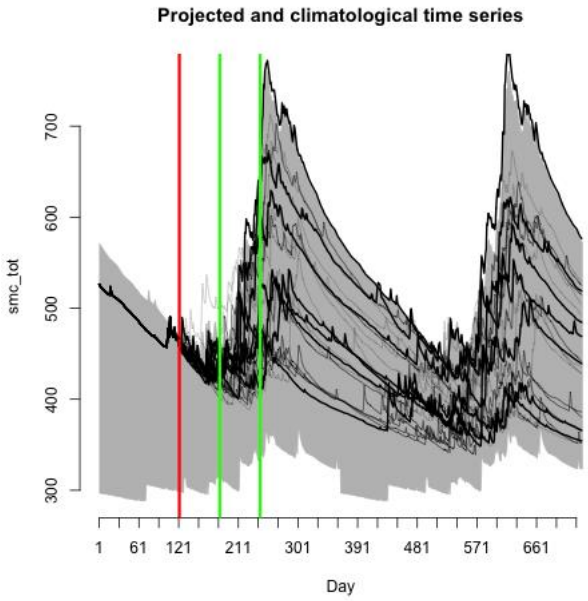
Brier skill score of 0 indicates same skill as climatology
Brier skill score of 1 indicates a perfect forecast

BSS calculated for all quintiles. More predictability for extremes.

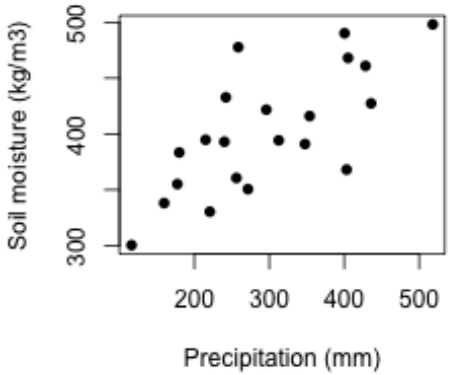
Incorporating seasonal forecast data



Unweighted



Weighted



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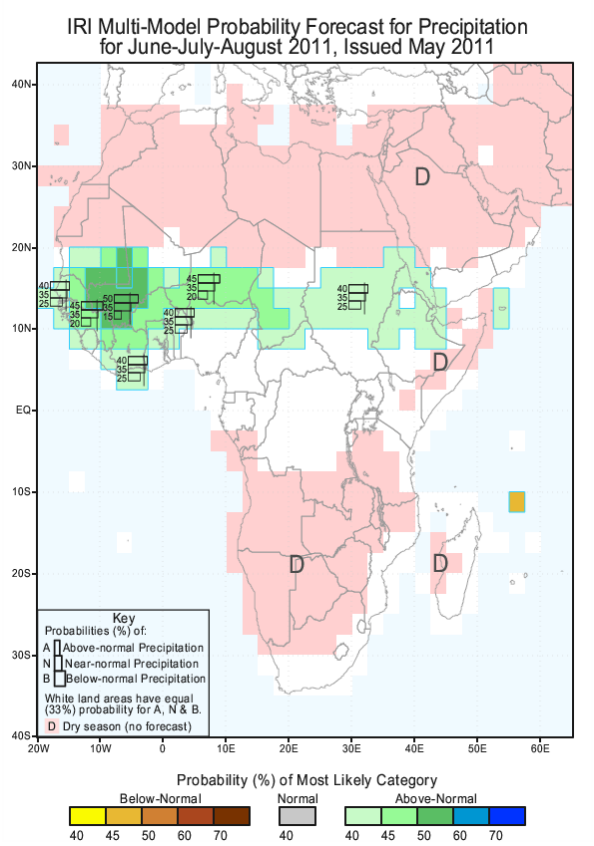
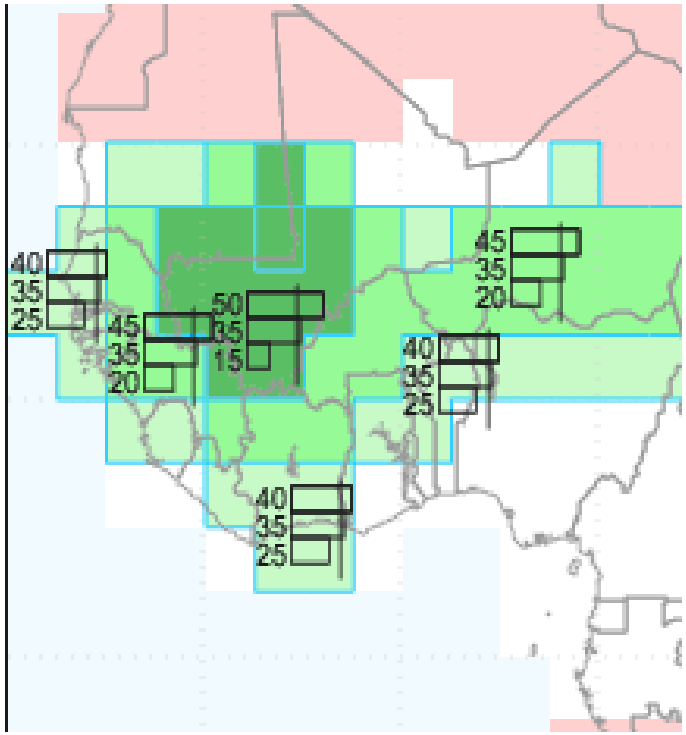
Incorporating seasonal forecast data

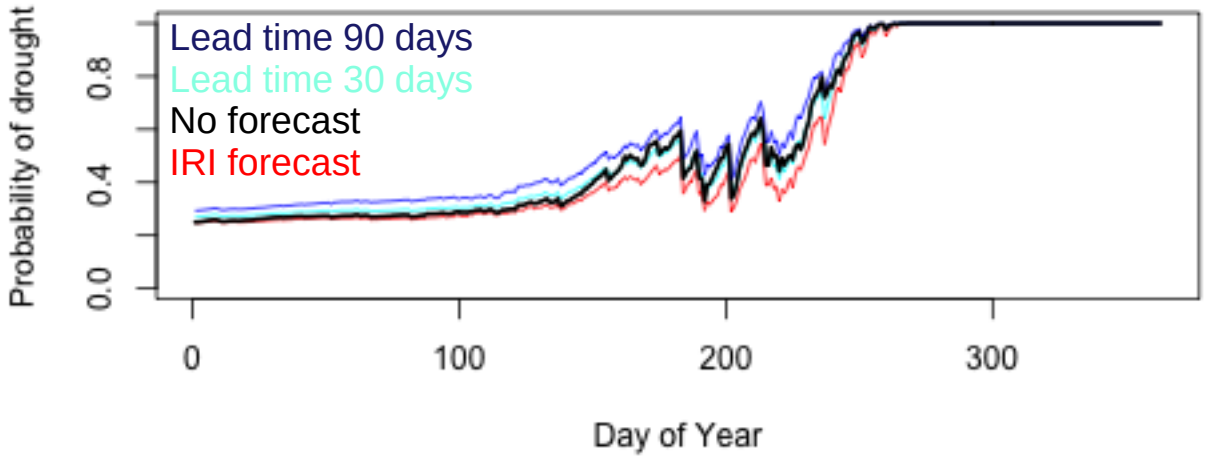




Incorporating seasonal forecast data

When the probabilities are calculated, the output data from each ensemble member is weighted by the tercile of the precipitation used to drive it.

Idealised case:
Tercile 1 (below average) = Probability of 0.6
Tercile 2 (average) = Probability of 0.3
Tercile 3 (above average) = Probability of 0.1



We present a simple, but flexible framework for assessment of seasonal agricultural risk

- Historical knowledge of the climate over the long term (climatology) and the short term (seasonal evolution) can be used to estimate the seasonal risk of drought
- Accurate knowledge of the contemporaneous wetness of the soil forms the basis of forecasts of soil moisture and robust early warning of agricultural drought
- Tercile seasonal forecasts of mean seasonal rainfall have some limited value for deriving metrics of risk

Next steps:
Development, evaluation and exploitation

Science questions:

<u>To what extent is agricultural drought predictable? And why?</u>

- Weighting probabilistic assessments on real seasonal forecast data and other metrics
- Comparing other regions, soil/vegetation types

<u>How are the factors governing agricultural risk changing?</u>

- Weight risk assessments on ‘proximity’ of climatological year
- Run with climate model output

Next steps:

Development, evaluation and exploitation

Applications/pilots (evaluation):

Seasonal risk assessments

- Ghana Meteorological Agency, Ethiopian CGIAR pilots
- Risk Shield index insurance
- Gates Foundation TAMASA experimental sites

Short time scale risk

- Rainwatch Alliance, Senegal Met service: rainy season onset
- One Acre fund (320,000 farmers): planting date decision support and other decision support products