Making climate-related insurance work in Africa: targeting and monitoring micro-insurance programs

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Crop insurance is notoriously difficult to put into place due to its technical complexity

a. Willing risk carrier / insurance market
b. Qualified actuarial input
c. Historical data set
d. Cooperative farming body
e. Local project management

Typically desire 30-40 years of daily meteorological data
AND
10 year history of yields and any additional farmer behavior

PROBLEM Few accredited stations, very few farmers with 10 years of quality records.

Issue is compounded by a general data scarcity, farming is a complex of decisions, and the serious need to avoid asymmetric information amongst the parties.

Basic notion: What information is needed?

and thus what information is lacking (and where)…

TARGETING: 1) first areas with sufficient information

augmenting data sources to build information base towards "sufficient"

2) vulnerable populations

taking a long-term view and investing in the necessary information

Integrate the many data = what you know and ***when will you know…***

and at the same time, learn where you do not have sufficient data.

MONITORING: "…any limitations to the scope for **effective and economic crop insurance**, though real at any given moment, **can change over time**."

Farming enterprises and systems are dynamic. They present different patterns of risk and new ways by which farming technology, and farm management techniques, can cope with production and other risks.

New techniques of ascertaining that loss-causing perils have occurred, together with more efficient and economical methods for measuring losses, mean that new types of insurance products can be developed.

INFORMATION DRIVEN

Targeting and Monitoring require spatial / temporal information systems

The technology of '**Geographic Information Systems**' has come a long way. Agile mapping technology is needed to manage the variety of information to support crop insurance schemes.

Symmetry of information is critical.

Both Spatial and Temporal data are necessary.
… at the appropriate resolution

Climate change compounds the need for
location specific spatial / temporal data.

Vulnerable populations will require long-term investment

For ALL areas where a crop insurance scheme is under consideration, basic information:

KEY PERILS/RISKS

List of all risks for agricultural production = too long

Let's focus on major concerns AND group these

- **Production risks;**
- **Natural resource risks;**
- financial risks;
- marketing and price risks.

Production risks

- Adverse climate conditions: drought, excessive rain, flood, windstorm, frost, hail, sunburn, snow;
- pest and disease attack;
- fire.

Natural Resource Risks

- Adverse soil conditions, e.g. salinity, erosion of topsoil and loss of soil nutrients;
- deterioration in water quality e.g. due to pollution of the water table or natural water courses;
- lack of water from the irrigation source.

From a purely underwriting point of view:

Drought poses great difficulties especially if a **yield guarantee**.
Large number growers in same area – even whole country
Droughts can extend longer than one growing season
Magnitude of the risk = high calculated premiums

index insurance involves using a meteorological measurement as the trigger for indemnity payments.

A drought index would likely be a series of indemnity steps, each step corresponding to a given level of rainfall deficit.

Further specificity includes shortage of precipitation at key parts of the growing season….

Monitoring information is critical for all parties.

Weather index insurance, Malawi – **20km radius** from accredited weather station

Weather station: Chitedze Research Station (a single location).

three major growth stages of a groundnut plant (vegetative, flowering, pod filling).
Soils: table below shows trigger rainfall amounts for the typical soil

If the amount of rainfall received at the weather station is below 60 mm for the first phase, the insurer will pay MWK 28.5 per each mm below 60. However when the amount is below 30mm, which is given as the limit, the crop is expected to have suffered from too much water stress that even if there are good rains thereafter, the crop will not recover. Thus at and below this level, the total sum insured is payable. The interpretation is the same for all phases.

Growth period	No of days in the growth period	Trigger (mm)	Limit (mm)	Payout rate per mm below the trigger.(MWK)	Sum insured per acre. (MWK)
Establishment and vegetative growth	30	60	30	28.5	5701
Flowering and pod formation	50	160	30	16.9	5701
Pod filling and maturity	60	100	20	16.9	5701

A major area of difficulty in setting indemnity and premium levels is the **lack of data linking** the incidence of adverse weather events and actual losses in the field (agronomics).

Technically, a weather index must:

Be easily understood and the trigger event for payment be clearly defined

Take account of crop sensitivity at different growth stages

Take account of the soil texture on the effectiveness of rainfall

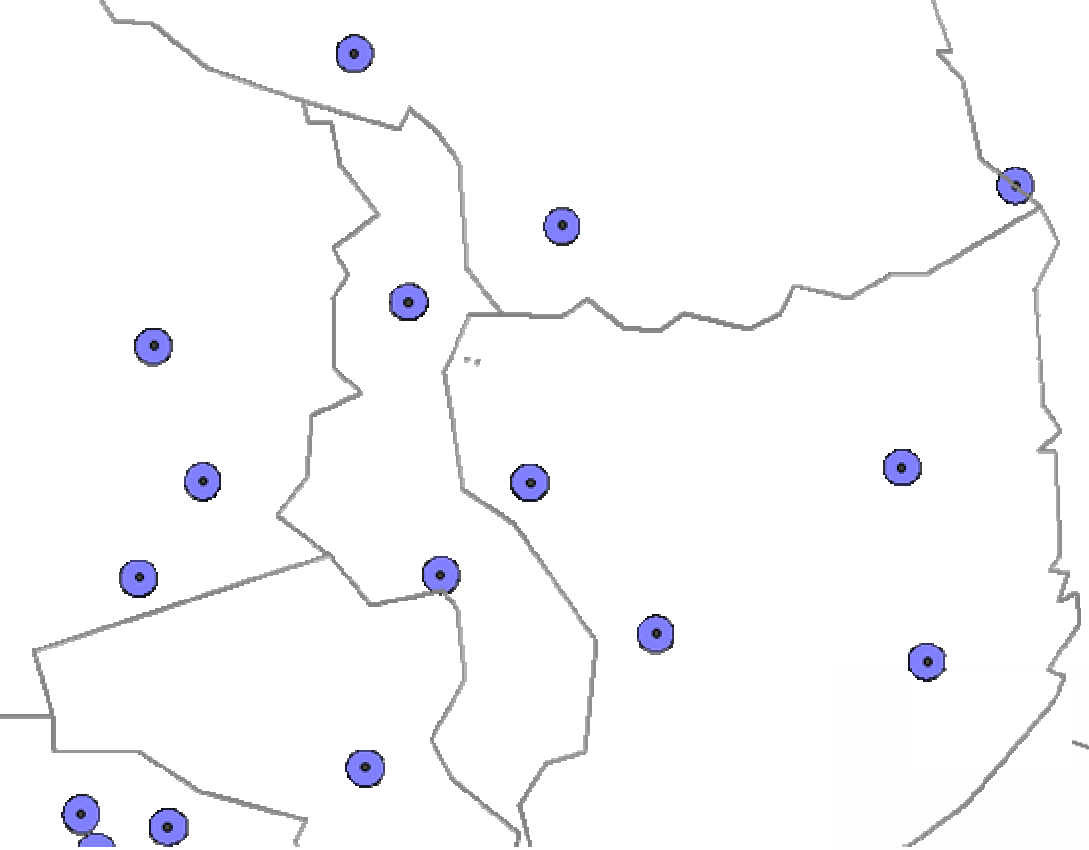
Be tailored to crop variety

Define a protocol that reflects actual planting date

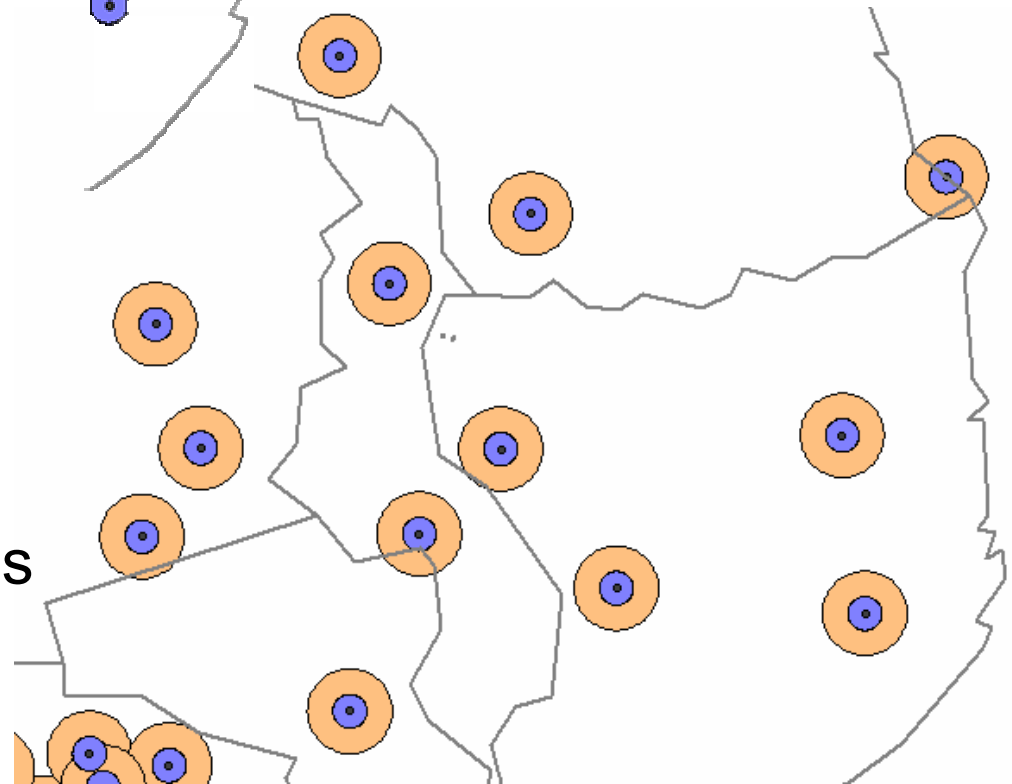
Ensure that the insured pays the price of the spatial variation in risk

Enable accurate estimation of the probability of the risk event

Again… Information driven

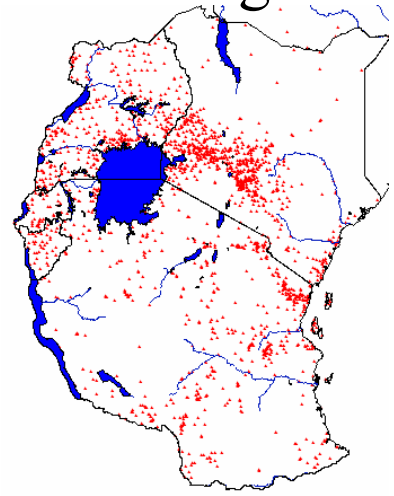


To calibrate your eye, a 20 kilometer radius around a set of accredited meteorological stations…
(~1250 square km)



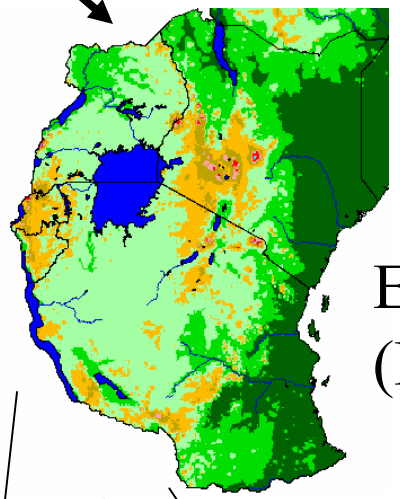
Here, a 50 kilometer radius
(~7850 square km)

Meteorological Stations

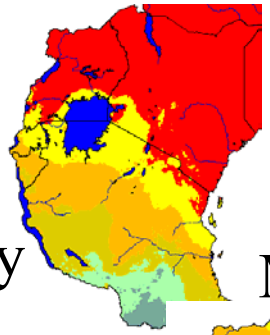


$$\sum_{i=1}^{n}\left[\frac{z_i - f(x_i, y_i, h_i)}{d_i}\right]^2 + \lambda\ \mathrm{J(f)}$$

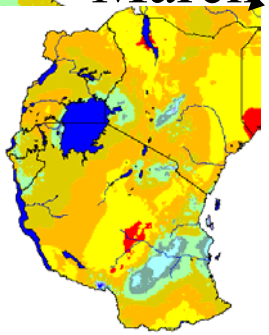
Produce daily
'gridded' surfaces



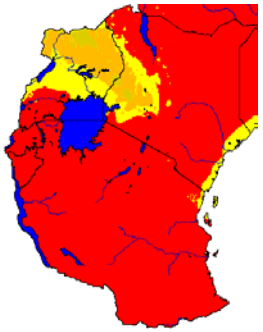
Elevation
(DEM)



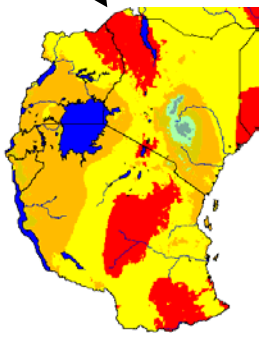
January



March



July



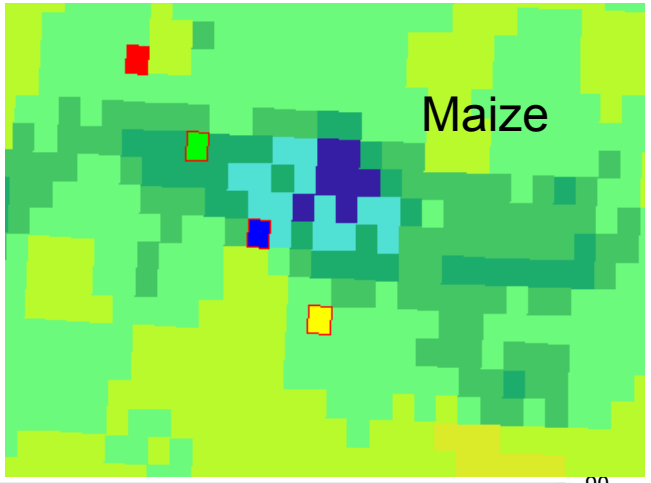
November

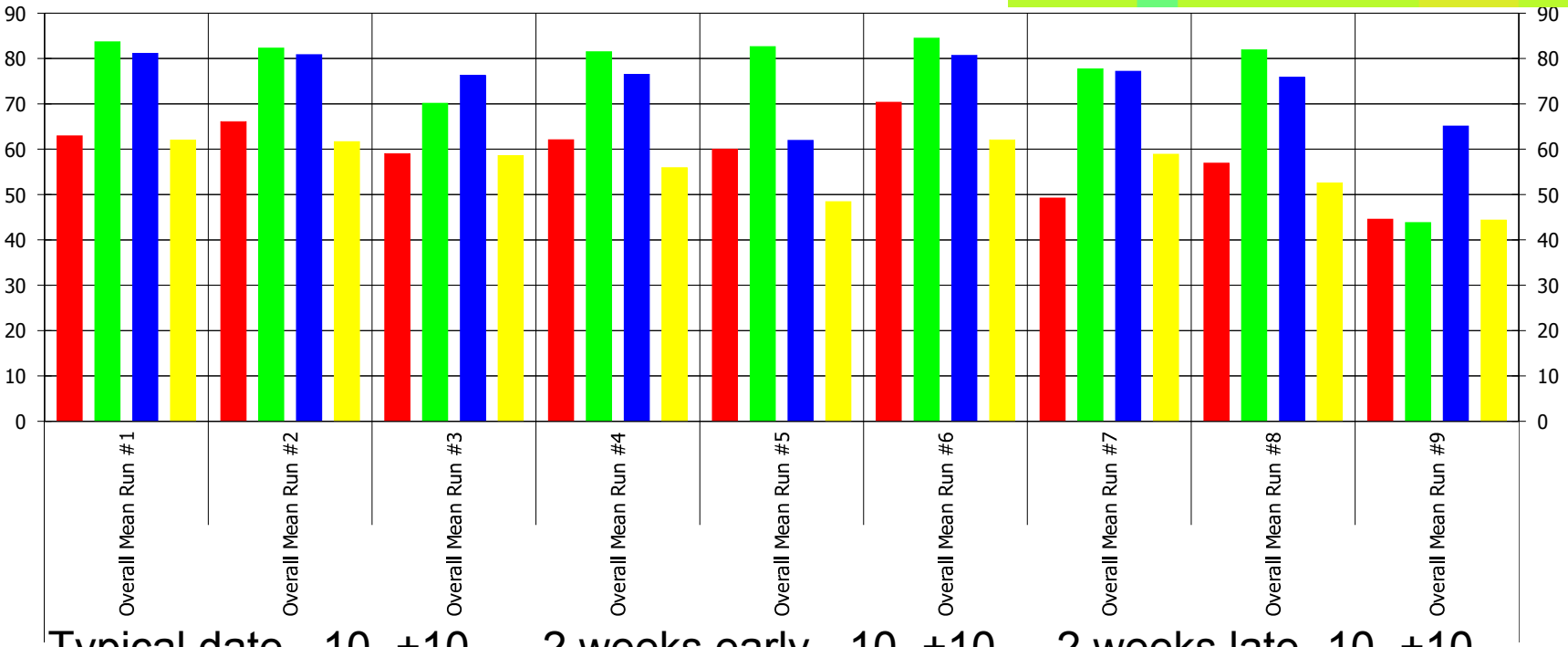
From meteorological stations
(e.g., Chitedze) to daily weather 'surfaces'
= space / time capacity that is location specific

TARGETING: Analysis to determine risk probability estimate

Transect across the target area: examine the consequences of plant-date and variety selection with rainfall during the key flowering/grain-fill period.

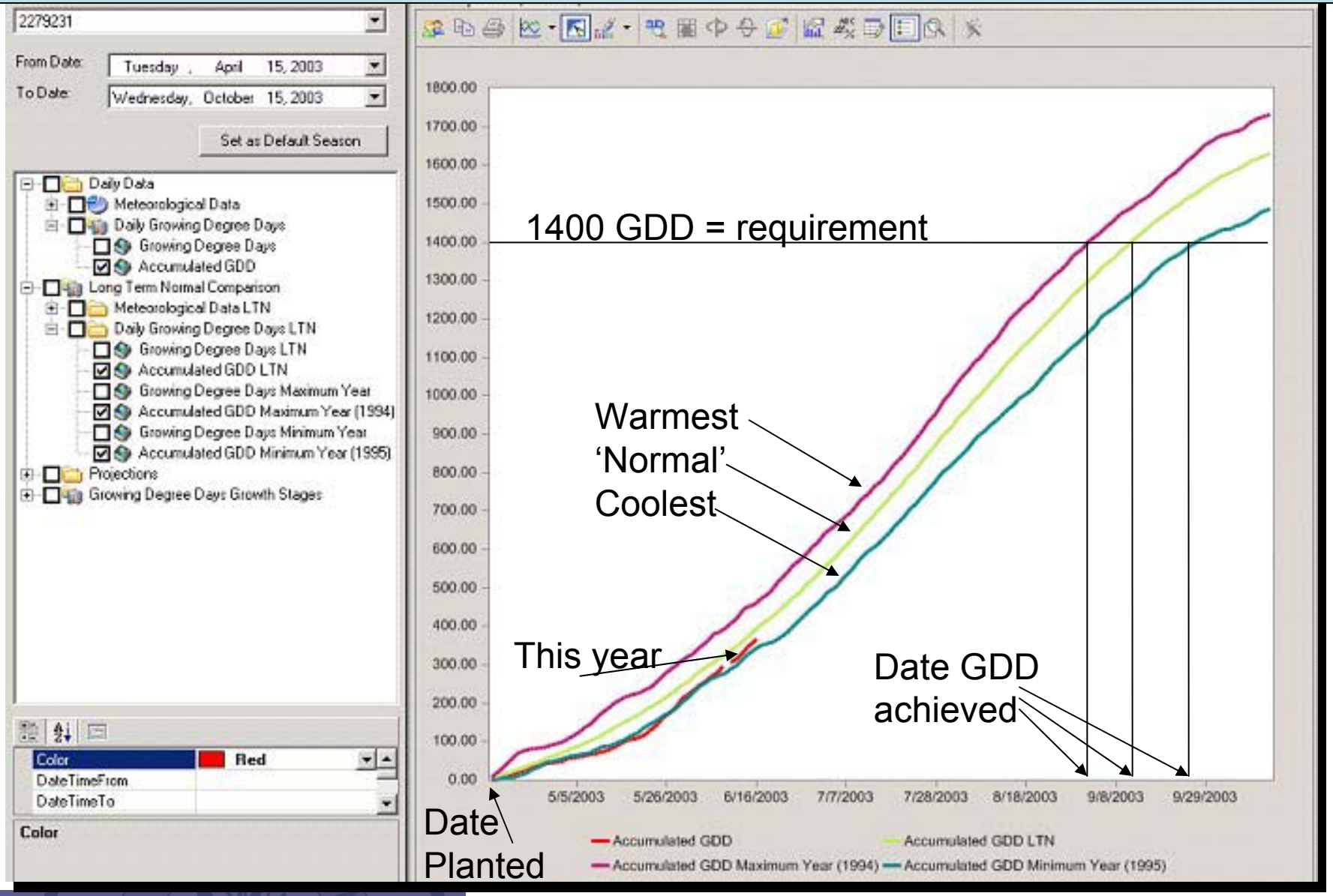
Maximum Temperature is also monitored as pollen is sterile > 37C



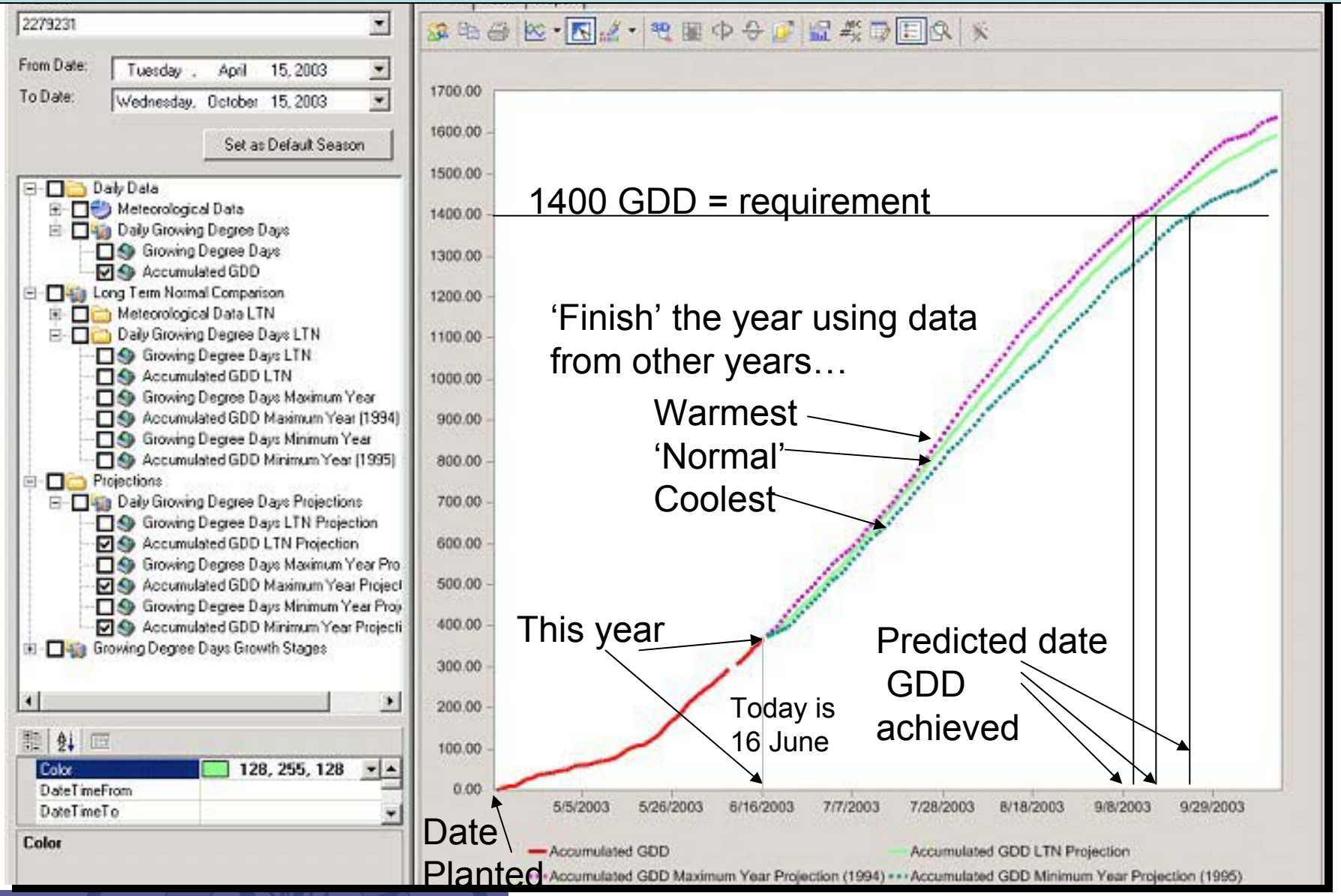


Typical date, -10, +10 2 weeks early, -10, +10 2 weeks late -10, +10

Identify the dates of the key period based on planting data and crop variety



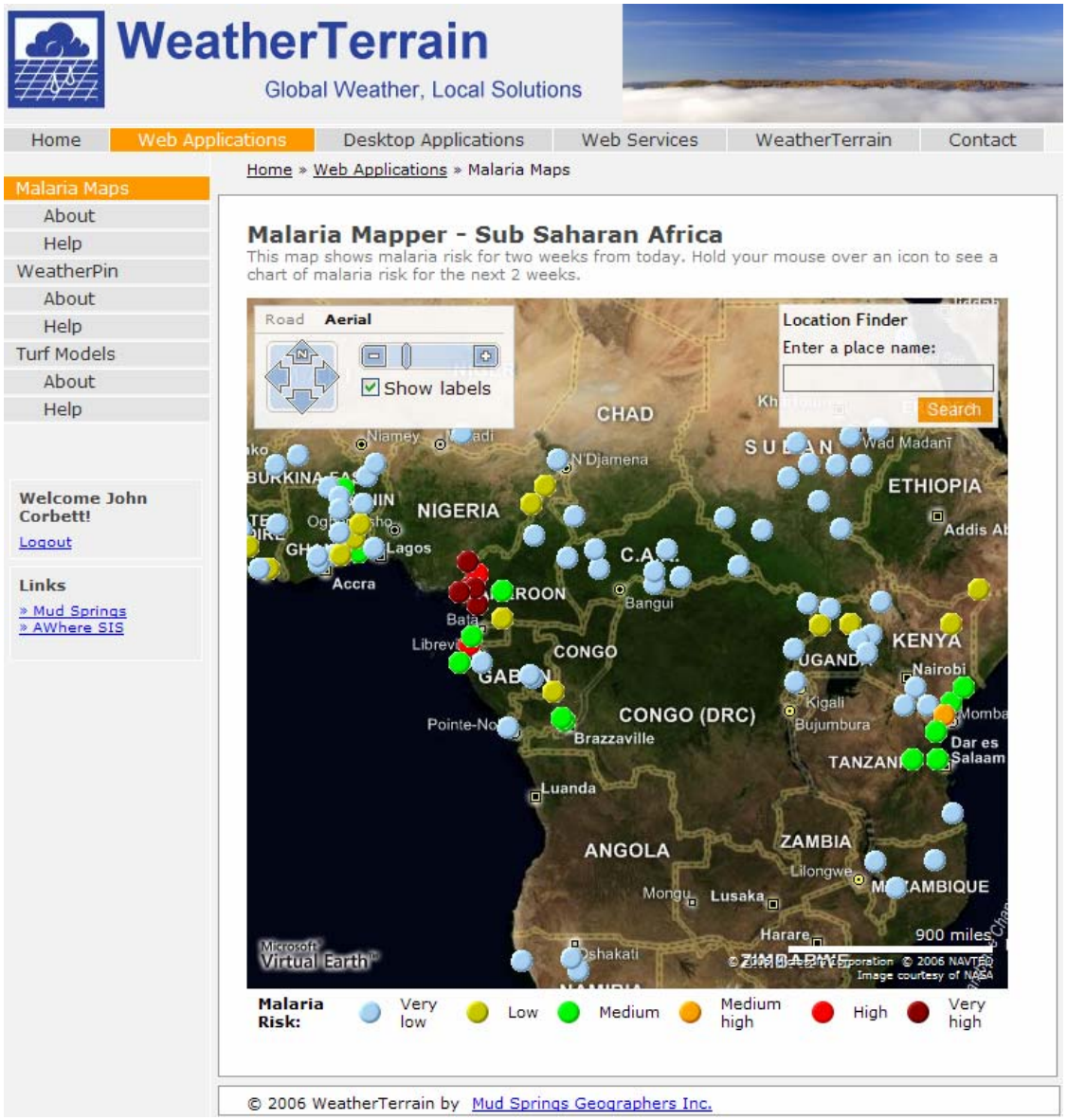
As the season progresses, predict more precisely when key period will occur. Monitor weather index for this period.



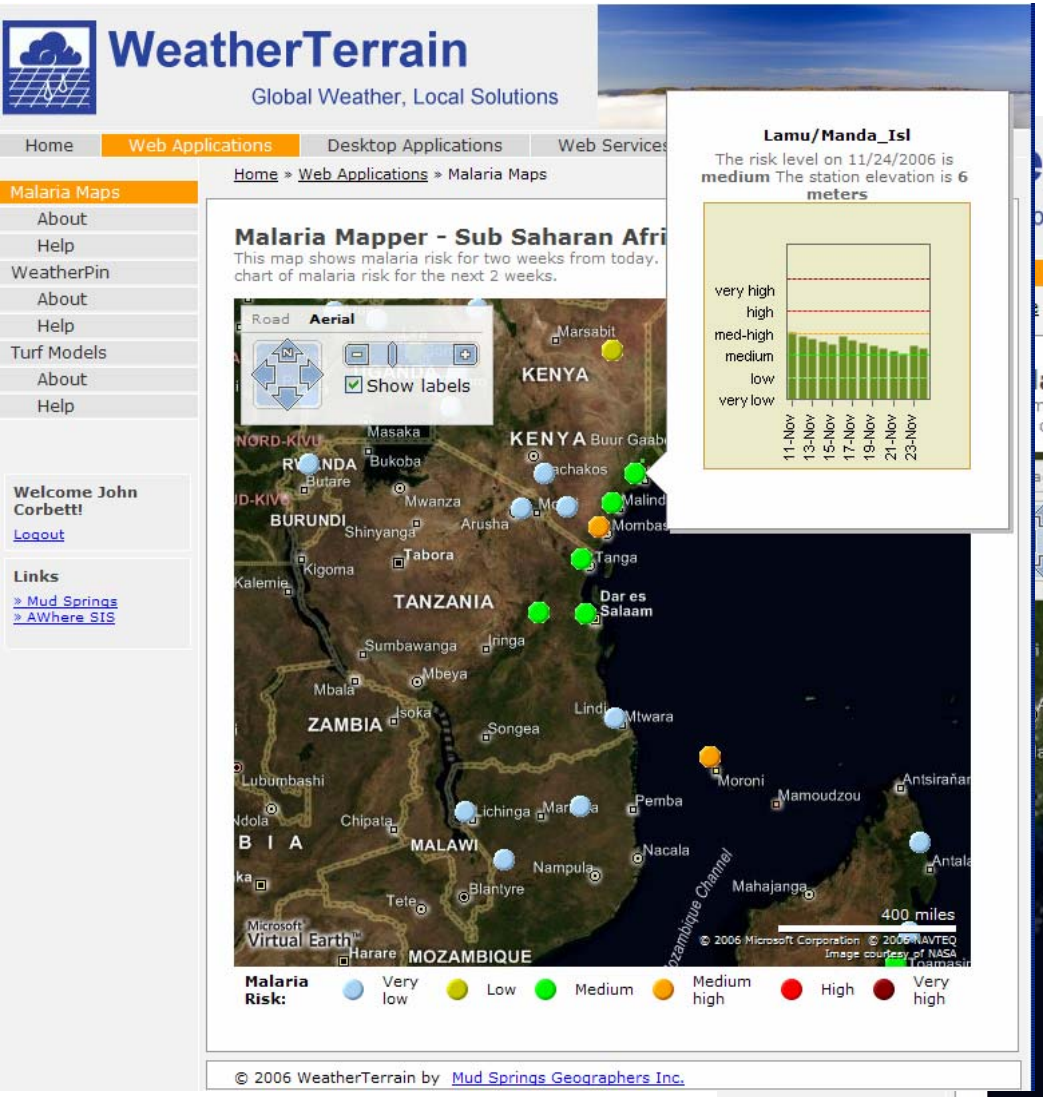
Monitoring: a real-time example from Public Health (malaria)

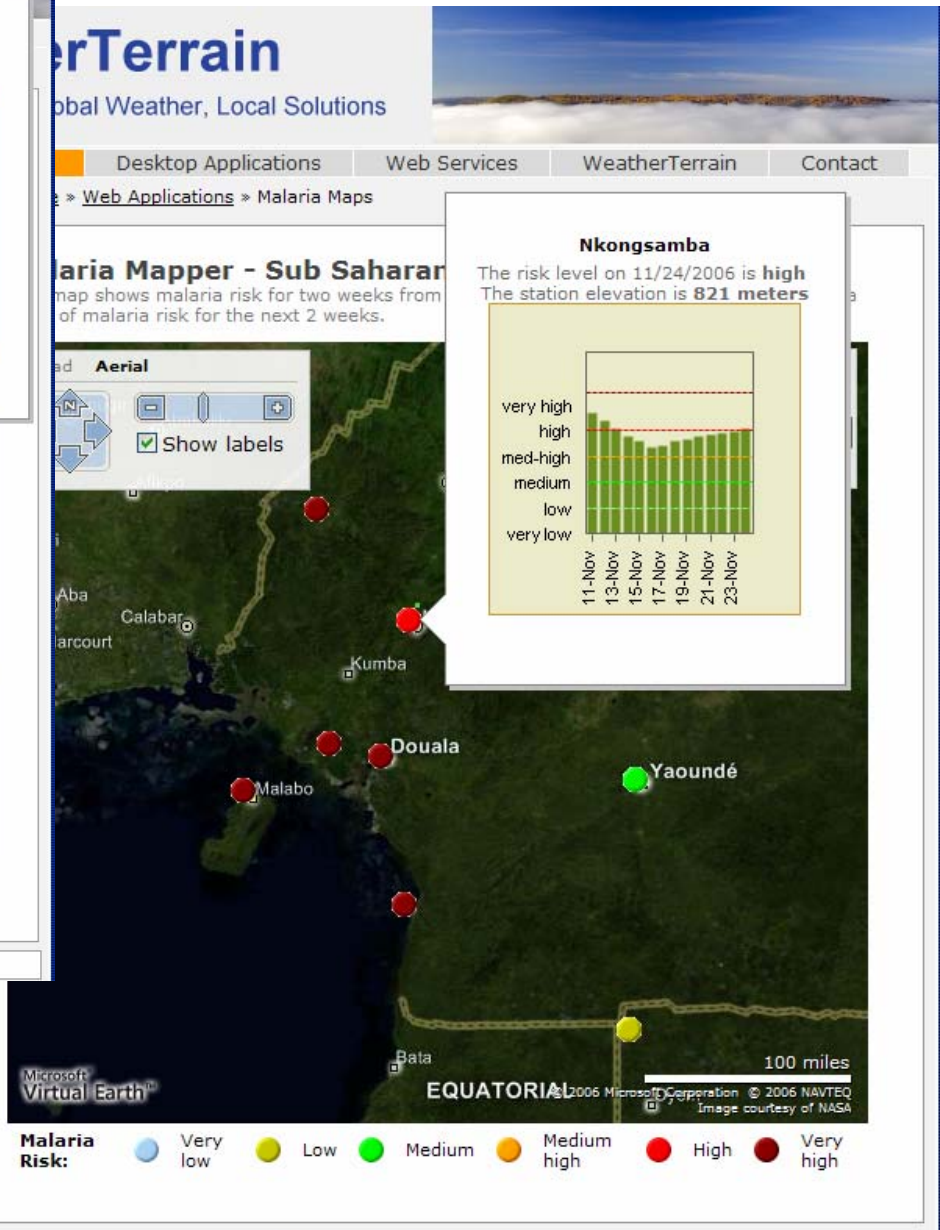
The growing capacity for location-based tools to facilitate both targeting and monitoring (for crop insurance) presents a tremendous opportunity.

Here, real-time weather data monitor conditions conducive for local malaria transmission.



Forecast for 11 November 2006 through 23 November 2006





From Web to desktop client,
The technology is there to target and monitor crop situations

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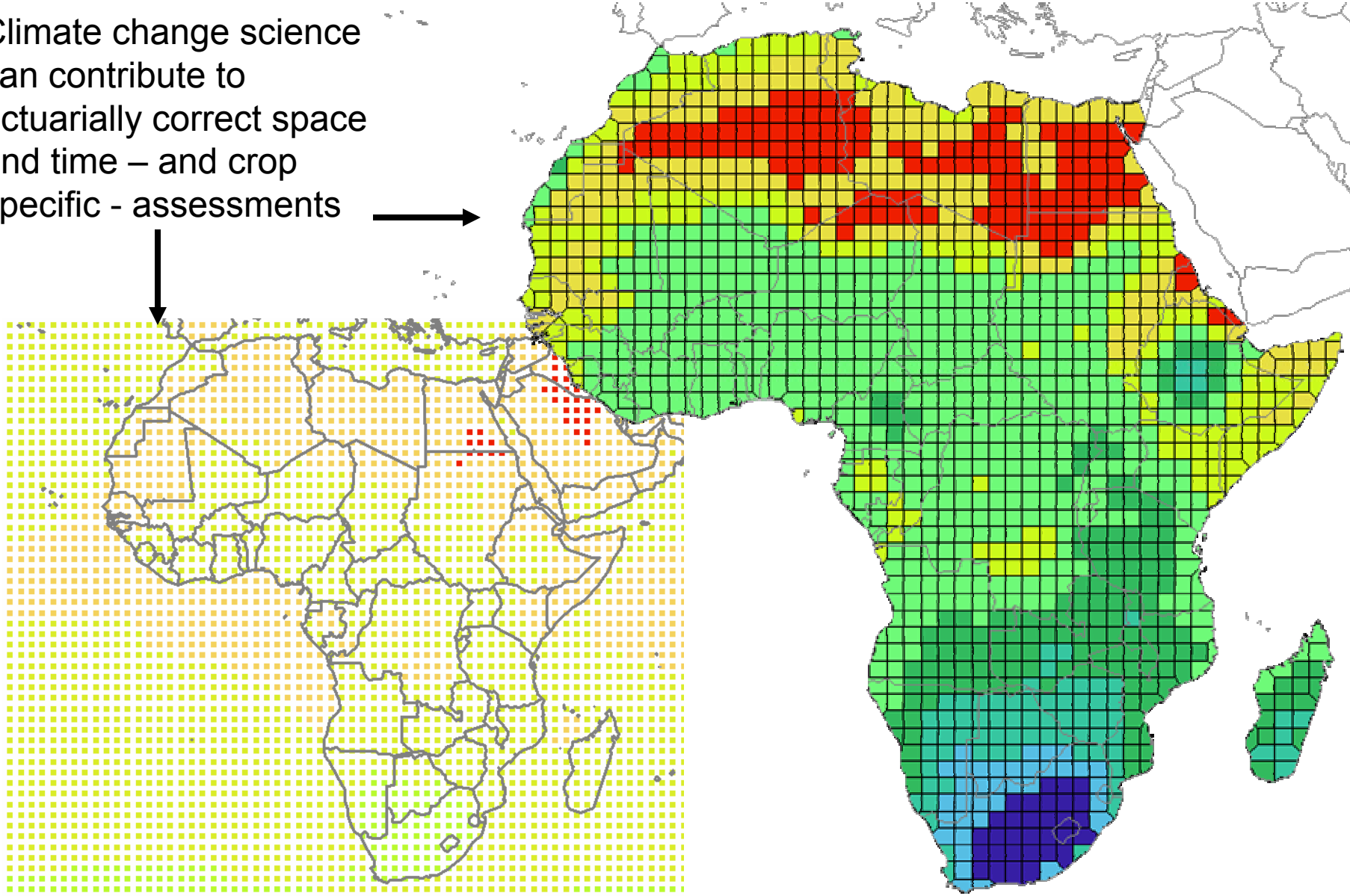
Whereas each crop insurance scheme will have its own special features, problems and opportunities, one general point can be made.

Product development is a highly skilled task, requiring both detailed knowledge of farming and/or forestry, coupled with a sound appreciation of the principles and operational imperatives of insurance. As such, ***this can be an expensive stage in the process.***

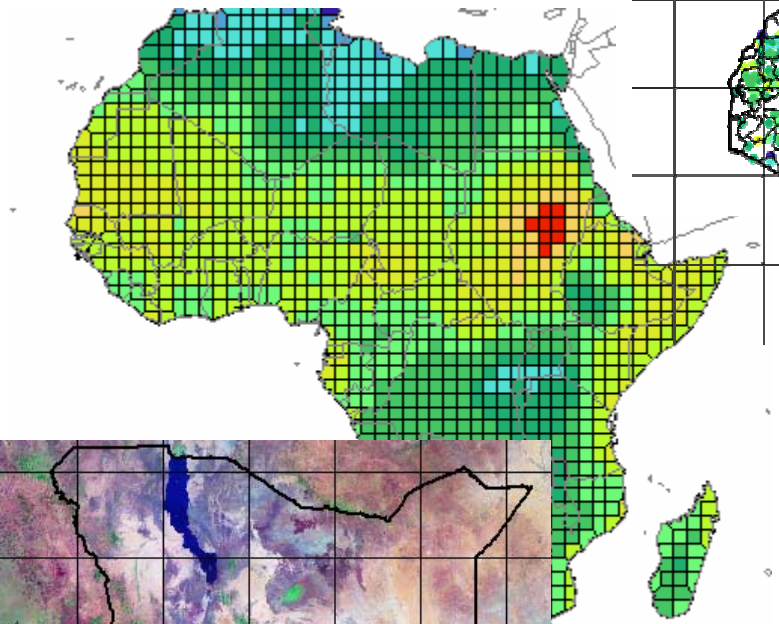
But as a knowledge platform, these analyses are scaleable – high cost to do the first one but data and methods easily transfer across geographies…

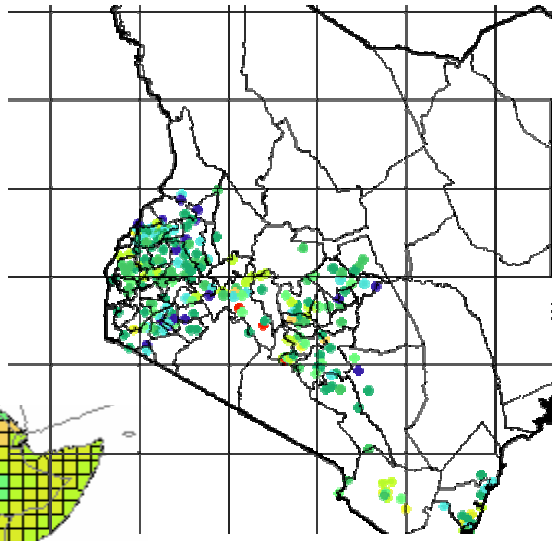
Integration with climate change data will help keep information symmetry...

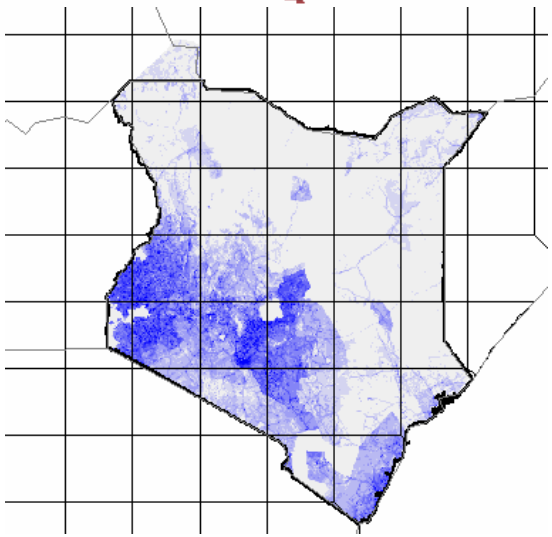
Climate change science can contribute to actuarially correct space and time – and crop specific - assessments

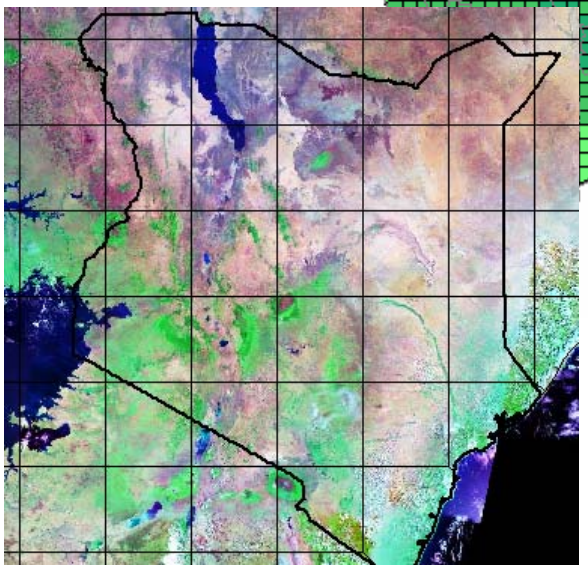


Monitor weather, combine with climate scenarios, integrate with household survey, examine land use via satellite images, link with population density, couple with models….



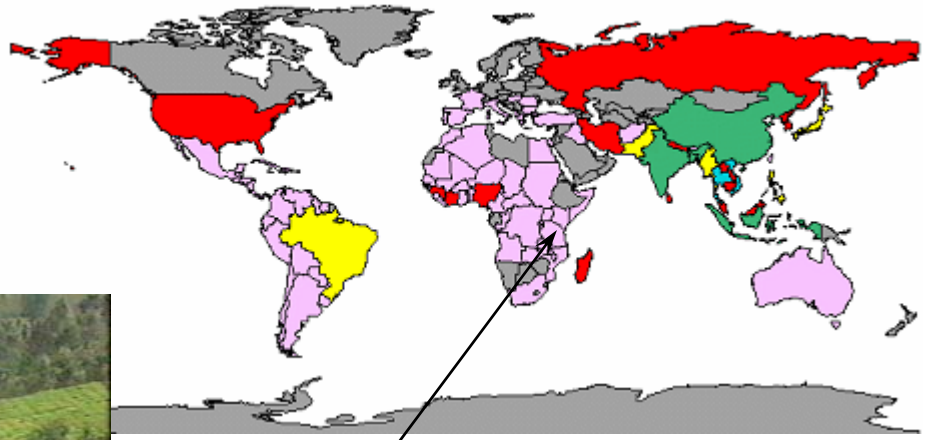






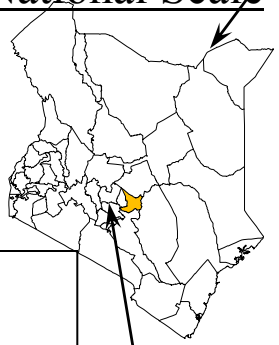
Experts in each discipline can share and interact with their colleagues across disciplines…

Space / Time and Scale Integration and Independence



Continental Scale

National Scale



Household

Site Scale

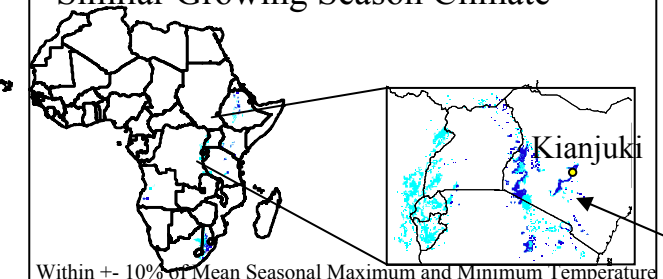
Research Site

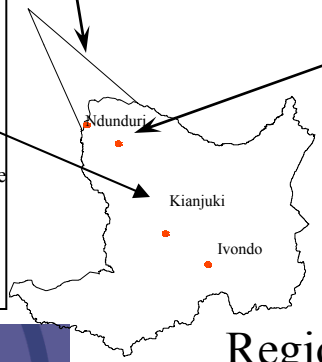
Local Scale

Land Parcels

Kianjuki, Embu, Kenya

Similar Growing Season Climate





Regional Scale

"…adaptation is a learning mechanism. Harvest the knowledge!"

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