Weather Variability: The Impact on Agriculture

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The Problem:
The Earth’s Atmosphere is a Heat Engine... In transition

1°C warming of atmosphere...
Triples weather variance

Hot gets hotter • Cold gets colder
Dry gets dryer • Wet gets wetter

Agriculture Impact...
Yield and production risk

5.5 Quadrillion Ton Heat Engine

Extreme weather events (heatwaves / extreme precipitation)
1/1,000 days → now 1/200 days with atmospheric warming
Impact of a Warming Atmosphere on Agriculture: Events

- Increased rain variability
- Drought events
- Warmer night temperatures
- More extreme weather events

Less predictability and greater risk

More variable!
Warmer Air Holds More Moisture and Energy

4% per °F or 7% per °C

Global warming=

More heat

More drying

More evaporation

More moisture

More rain

More drought

Warmer / hotter and more humid...

ALERT!

For agriculture:
Challenges = increase in plant diseases, night respiration

...and more rainfall in fewer events
Impact of a Warming Atmosphere on Agriculture

Traditional knowledge and practices challenged

- Pest and disease migration
- Heavier rain events
- Changing seasonal rains
- More extreme weather events

Extensive droughts

- Less predictability and greater risk
- Pocket droughts
- Warmer temperatures
- Overwintering pests and diseases

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Ground Weather Station

- Wind, solar, relative humidity, temperature, & rainfall
- Soil moisture (5 depths)
- Data logger (cellular)

Potential Evapotranspiration (PET or PE)

- The amount of evaporation that would occur if a sufficient water source were available
- The environmental demand for water
To monitor the weather, we construct a weather station’s worth of data every 9km across the planet.
Agronomic Weather

• Agricultural Earth Coverage
  • >1.5 million aWhere weather stations (virtual)

• Daily Observed (10-20+ years)
  • Precipitation
  • Min/Max Temperature
  • Min/Max Relative Humidity
  • Max/Mean Wind speed
  • Solar Radiation

• Hourly Forecast
  • 8-15 days of hourly forecast (updated 4x daily)

Field-level Agronomic Data

• Accumulated factors
• Pest and disease indices
• PET & Crop stress indices
• Soil moisture, net water
• Plant growth / harvest date indicators
• Crop suitability
• Yield & Production

>7 billion data points processed each day

Current, Correct, Consistent, Complete
When to irrigate?
How much to irrigate?
When to plant?
What pests to scout for?
When and what to spray?
When and how much to fertilize?
When to harvest?
What is the expected yield and production?

Better *Information* enables *Field Insight*
Aggregating 1,000s of ‘field insight’ assessments enables delivery of national, regional and global production with unprecedented specificity.

Across the agricultural value chain, symmetrical environmental information helps optimize decisions:

- Policy
- Research
- Inputs
- Production
- Markets

Predictive analytics – insight!
An agriculture intelligence company

The most complete ag-weather data and insight for real-time agricultural decisions

We help feed the world, one insight at a time
Trusted by leading companies and innovative startups since 1999.

We are a certified B Corporation.
aWhere solutions apply across the agricultural value chain

Government+NGO

Policy → Development → Research → Input Supply → Production → Financing → Markets → Consumption

Agribusiness

SET NATIONAL AND BUSINESS PRIORITIES

IN-SEASON ACTIONABLE INSIGHTS

Commodities

ANTICIPATE NEEDS AND MOVEMENTS BASED ON TRENDS AND FORECASTS
Insight Analytics: Crop Health Index

Green: Good 20%
Yellow: Okay 60%
Red: Poor 20%

Probability of Purchasing Crop Protection
• Areas with a healthy crop: strongly likely
• Areas with yield impacting stresses: less likely
• Areas with poor crop: unlikely

Help Answer Key Operational Questions:
• Where to staff sales people?
• Where to stock – or move – inventory?
Atmospheric warming is causing traditional growing areas to trend towards being less suitable.

Ghana (below right) for example is becoming a more challenging environment to grow Cacao (red areas), whereas Ecuador (below left) is becoming a more favorable environment to produce Cacao (green areas).
Crop Performance and Production: Coffee National to Global

Coffee price, through 5 January 2017

Brazil:
- Coffee: 2,948 aWS
- Sugar: 3,358 ""
- Soybean: 7,516 ""
- Corn: 6,646 ""
aWhere supports BMGF grantees, mobile network operators, farmer organizations, entrepreneurs, and students because these groups *go to scale...*

Farmers in Zimbabwe

iShamba are pushing weather to over 400,000 farmers 3-5 times per week.
Farmer Information Service

aWhere, through partners, sends some 20,000 messages per day in Ghana through the Vodaphone Farmers Club. Farmers receive agronomic tips timed to the traditional crop calendar for their crop and market prices. They also receive a short term weather forecast from aWhere.
Every day we can see where farmers’ crops are under stress. This map shows mid-Sept to mid-Oct – the total precipitation, compared to what normally occurred over the past 10 years. When aligned this with the Ghanaian crop calendar, this is a critical growth period for second season maize. The farmers in the red areas are at risk of drought stress and reduced yields.
Where are farmers under stress?

Analysis shows which farmers have had water stress during Season 1 and Season 2 this year. Target these farmers for relief or interventions - consider alternative drought resilient varieties.

Similar analysis show areas that have performed well – which would be information that buyers, traders and agribusinesses need.
Pocket droughts 2016

3rd month of 3 month rainy season:
Significant crop failure

Rolling 4 week look at P/PET:
A general crop water stress indicator

Mali to Nigeria 2016
P/PET Diff from LTN [08/04-09/02]

Mali to Nigeria 2016
P/PET Diff from LTN [04/28-05/27]

~30,000 aWS

24% of this region significantly drier than expected;
42% water stressed

Precipitation to Potential Evapotranspiration
Crops stress based on agronomic insight =
Food Security indicator. With population density
(i.e., Landscan at 1km resolution) = we can predict
in- and out- migration areas. Displaced civilians.
Pocket droughts 2016

There’s no foreseeable relief in the near future.

- Luigi Romolo, regional climatologist with the Southern Regional Climate Center at Louisiana State University in Baton Rouge

November 4, 2016
The five years from 2011 through 2015 were the warmest on record, a trend that’s increasing the prevalence of extreme weather, including flooding and drought...

Vietnam's Mekong Delta hit with worst drought in 90 years

Super typhoon Haima causes widespread destruction in Philippines

Houses are destroyed as communities take shelter from sustained winds of more than 225km/h

Drought and rising temperatures 'leaves 36m people across Africa facing hunger'
aWhere creates 4,029 virtual weather station’s worth of data for the State of Colorado.

- A full ag-met station worth of data every 5 arc-min or about every 7x9 km
Rainfall, June 13, 2016

Wray: March – Sept 2012    hot and dry

Olney: March – Sept 2016    wet

Delta: March – Sept 2011    cool and wet

Daily observed and forecast weather data for researchers, students, ag-business – and farmers.
Data Access

Developer Portal

API
RESTful Application Programming Interface (API) allowing programmatic access to ag-weather data anywhere across the Agricultural Earth

Explore Tool (Beta)

Code Samples and

R-Studio Package

Forecast Tool (Beta)
Outreach: Hackathons

Introducing tech innovators, local agribusinesses, young programmers and researchers to the depth, value and possibilities of agriculture-meteorology and big data. Addressing local problems, through collaboration, using innovative solutions. Enabling ROI by including corporate sponsors and local innovation hubs.
In a world with a more energetic atmosphere

Expect Increasing

- Rain variability
- Temperatures
- Insect and disease pressure
- Pocket droughts
- Seasonal shifts

What we need:
Adaptive, Agile Agriculture
Monitoring agriculture in real time informs and guides appropriate, targeted, responses.

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