NextGen "climate-and-society" forecasts

Ángel G. Muñoz, Carmen González Romero
IRI – Columbia University
agmunoz@iri.columbia.edu

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

Outline

1. NextGen
2. NextGenMig: human migration
3. NextGenNut: food security

Some Context

As we all know, decision makers require tailored information:

- a wide range of predictands, well beyond rainfall totals and temperatures. E.g., onset, duration and demise of the rainy/monsoon/dry season(s), crop yield, planting *dates*, energy consumption, …
- a flexible format approach (e.g., use the entire PDF —forget about terciles until they're really needed).

Some Context

- Can we go beyond climate variables and target a set of (complementary) predictands of direct use for decision makers?
- What is the predictive skill and forecast horizons for those predictands?

climate forecasts are more relevant

climate forecasts are less relevant

#NextGen

NextGen is a systematic general approach for co-designing, implementing, producing and verifying objective forecasts *at multiple timescales*.

NextGen is designed by the user, and offers tailored probabilistic forecasts at multiple timescales, providing information on how the rainfall will be distributed: frequency of rainy/dry days in the target season, onset, demise and duration of the rainy season(s); as well as information on other variables of interest, such as min, mean and max temperatures.

NextGen CS

Some new papers on the cross-timescale NextGen methodology for climate and "climate-and-society" predictions:

- Muñoz et al., 2020 (Nature Sci Rep – *Aedes*-borne diseases)
- Goddard, González Romero et al., 2020 (WMO Bull. – ecosystem of Climate Serices)
- White et al., 2021 (BAMS – undernutrition)
- Pons et al., 2021 (WAF – coffee yield)
- DeMott et al. 2021 (EOS – ocean subseasonal forecasts and tools)
- Becker et al., 2021 (BAMS – NMME and NextGen)
- Domaisen et al. (BAMS, under revisions – compound volcano-rainfall extremes)

NextGenMig:
Can we predict "climate migrations"?

Ángel G. Muñoz, Carmen González Romero
IRI – Columbia University
agmunoz@iri.columbia.edu

Diego Pons
Colorado State University

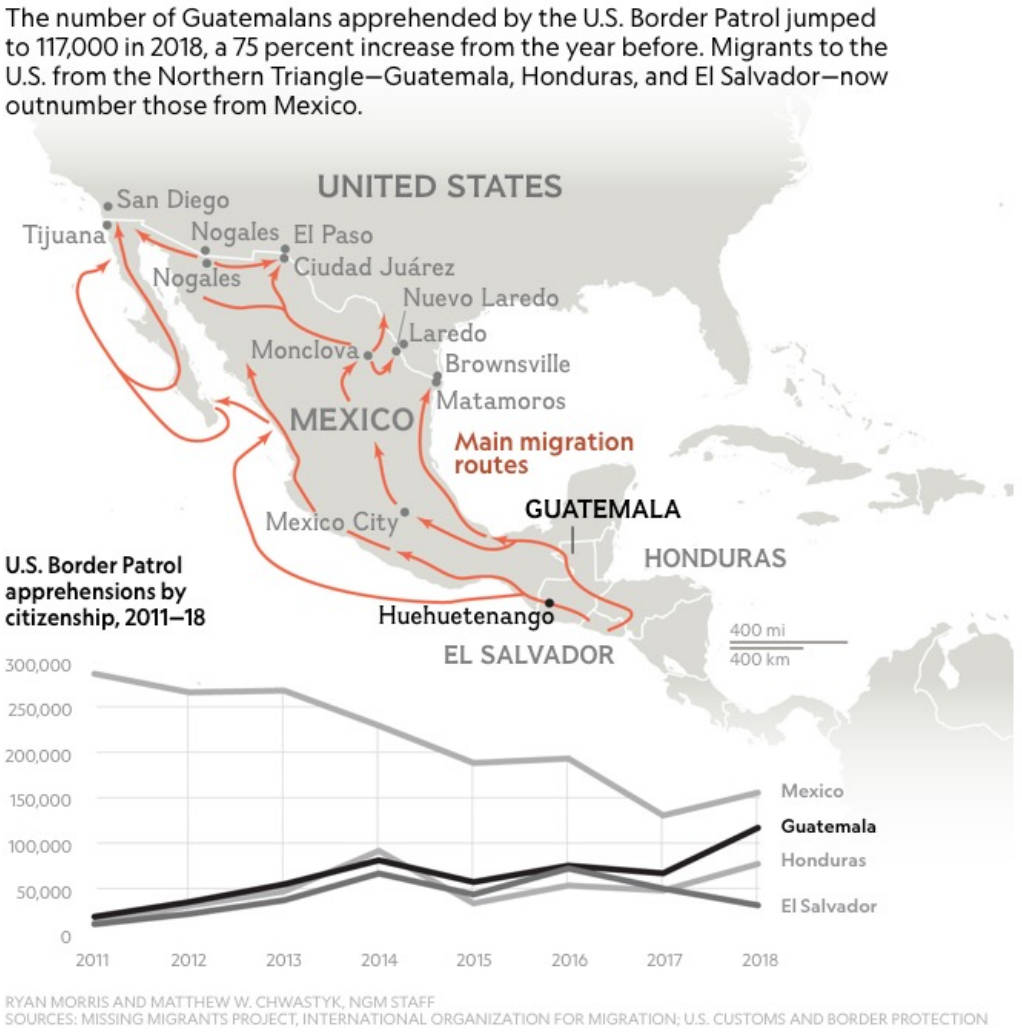
Diana C. Giraldo-Méndez
University of Reading and CIAT-CCAFS

Susana Adamo, Alex de Sherbinin
CIESIN – Columbia University

Why Guatemalans migrate?

"Better opportunities"

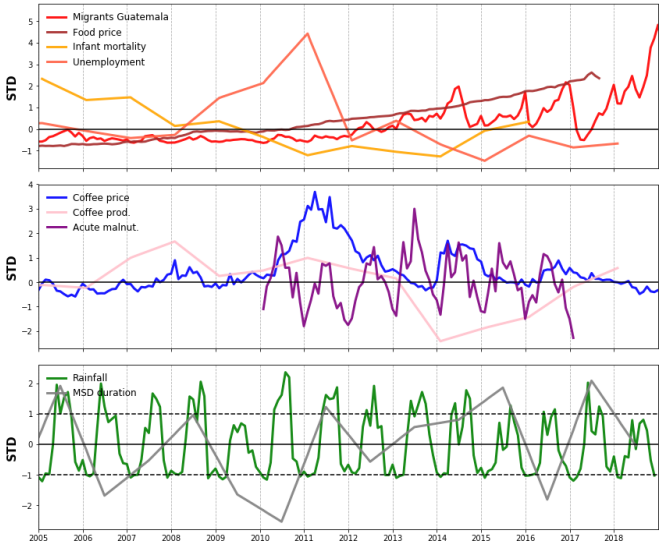
- Better jobs (seasonal to Mexico, long-term to the US and Canada)
- Pay debts (home, land, coyotes, …)
- *Increasing* infant mortality after 2012
- Family/friends abroad
- Violence
- Political instability
- Inequality
- Environmental conflict (e.g., dams in Ixquisís, Huehuetenango).

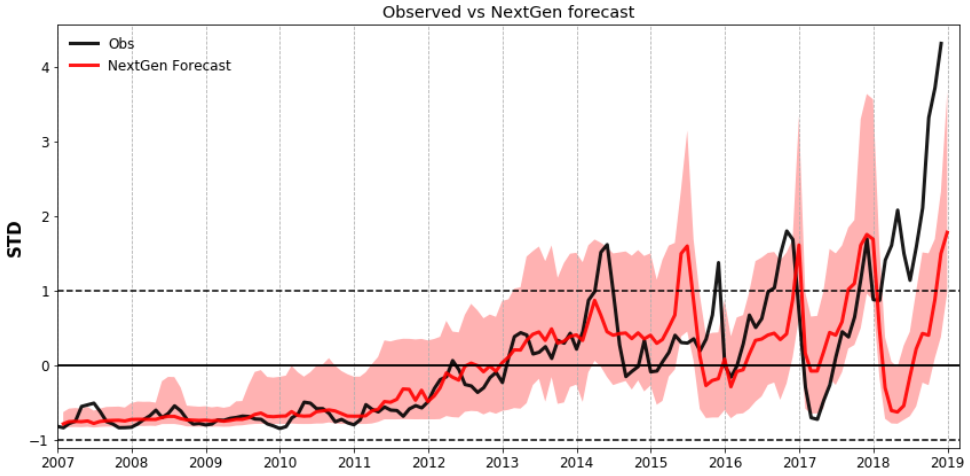


NextGen Methodology for Migration

Conceptual Model

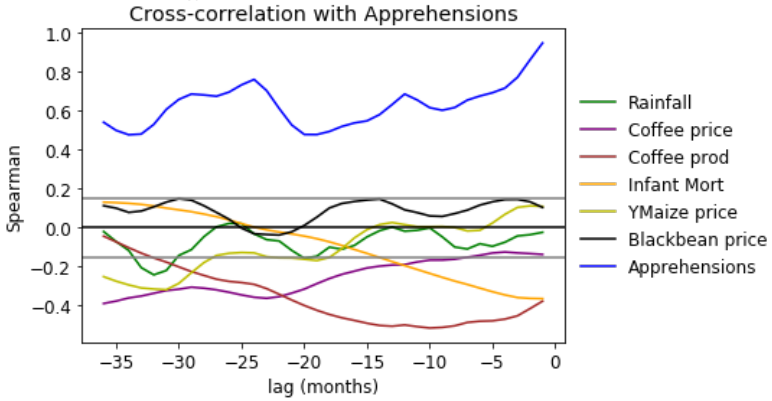
Analysis of evidence supporting or not the conceptual model (hypothesis)





Ensemble (combination) of multiple, cross-validated forecast models for migration

Candidate predictors and models selection



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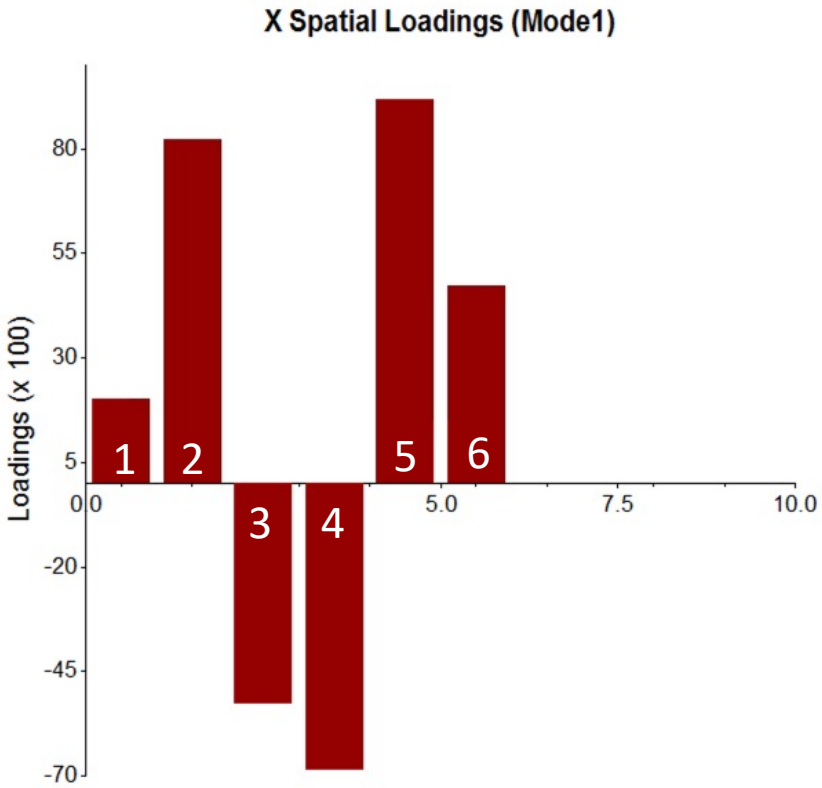
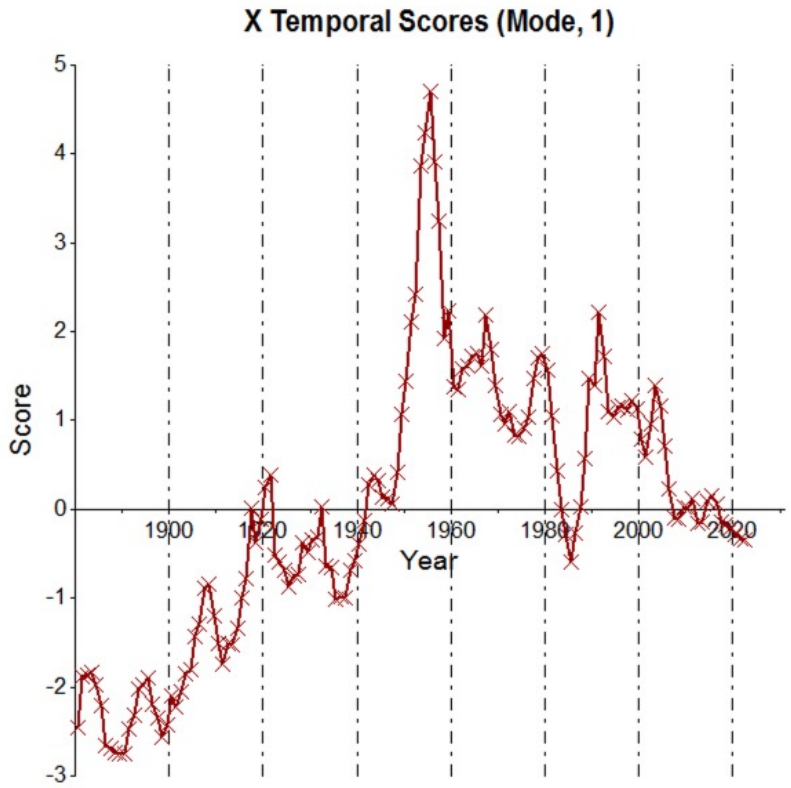
Candidate predictors?

- Food cost
- Maize and beans prices
- Coffee (cash crop) price
- Coffee (cash crop) yield
- Rainfall
- Infant mortality
- "Recent" migration

Actual Predictor Analysis for Migration





1: Rainfall 2: Coffee price 3: Coffee product 4: Infant Mort 5: Yellow Maize Price 6: Past apprehensions

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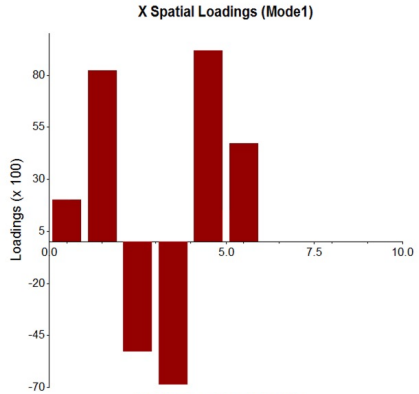
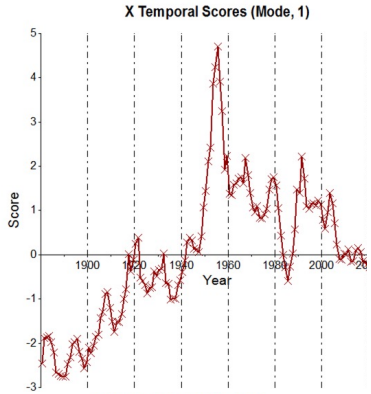
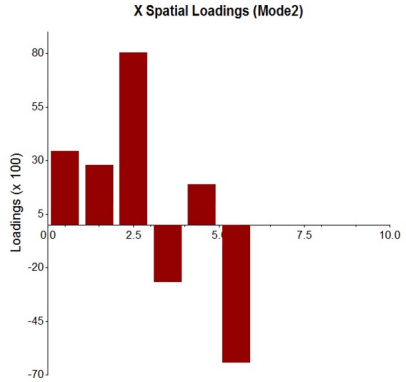
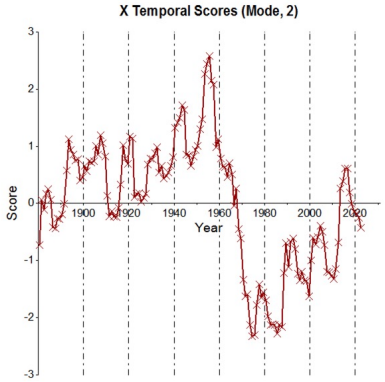
Actual Predictor Analysis

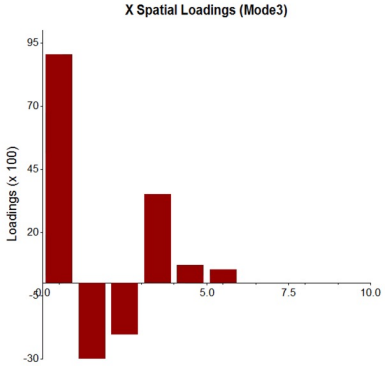
1: Rainfall | 2: Coffee price | 3: Coffee product | 4: Infant Mort | 5: Yellow Maize Price | 6: Past apprehensions

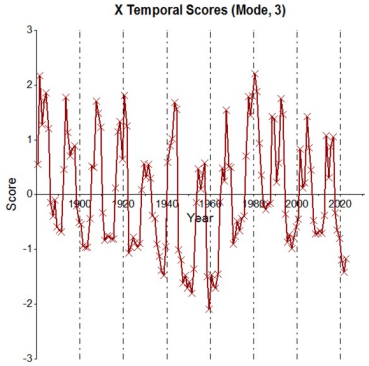


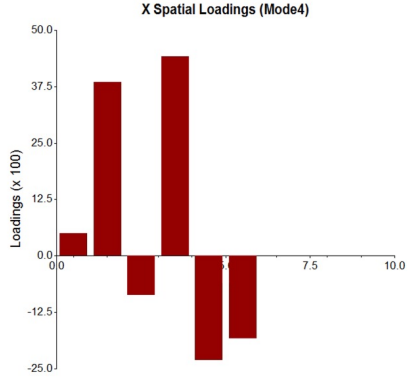


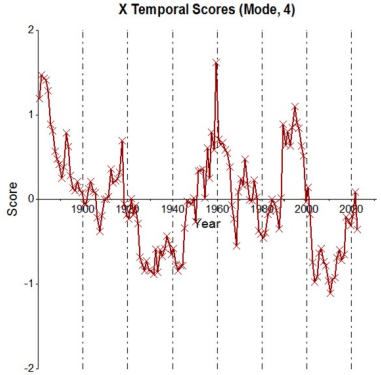


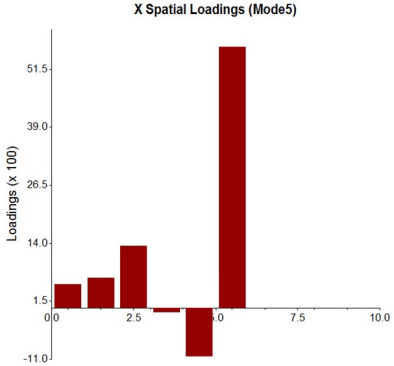


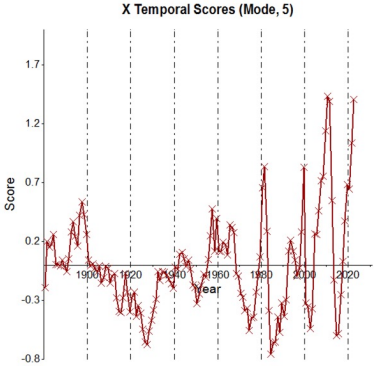


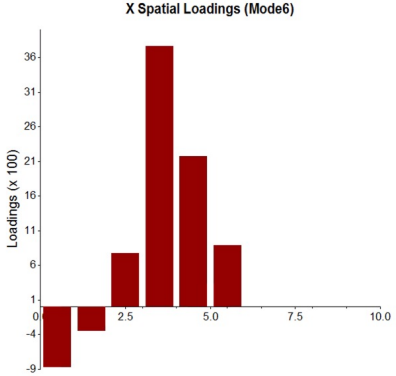


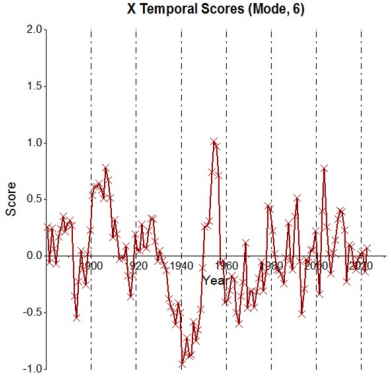




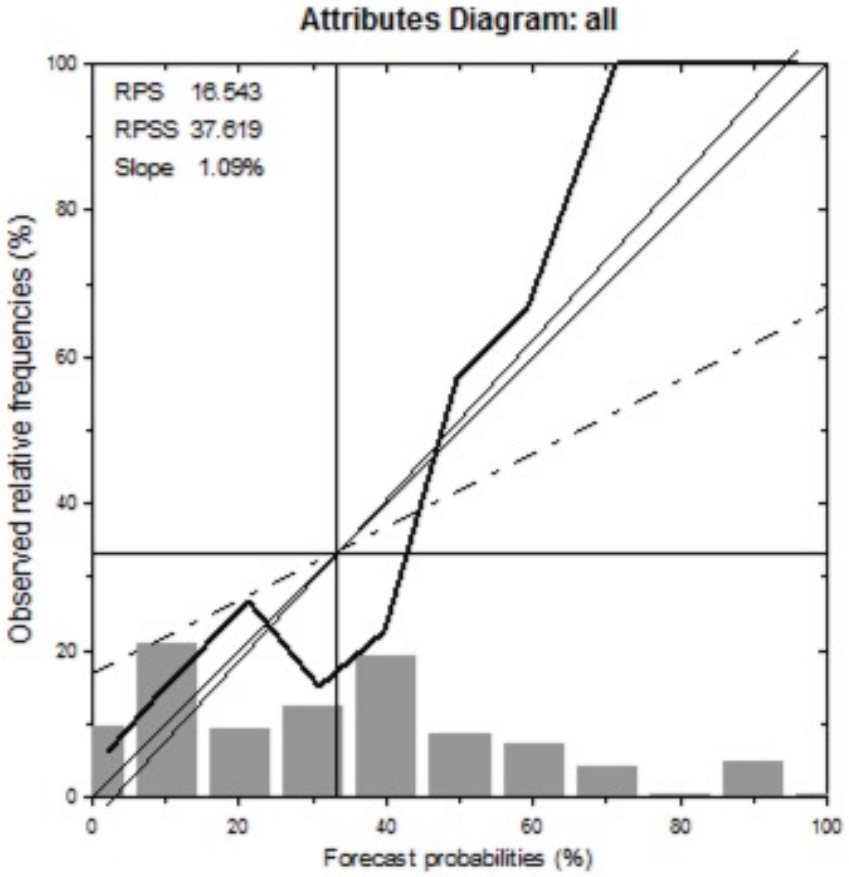


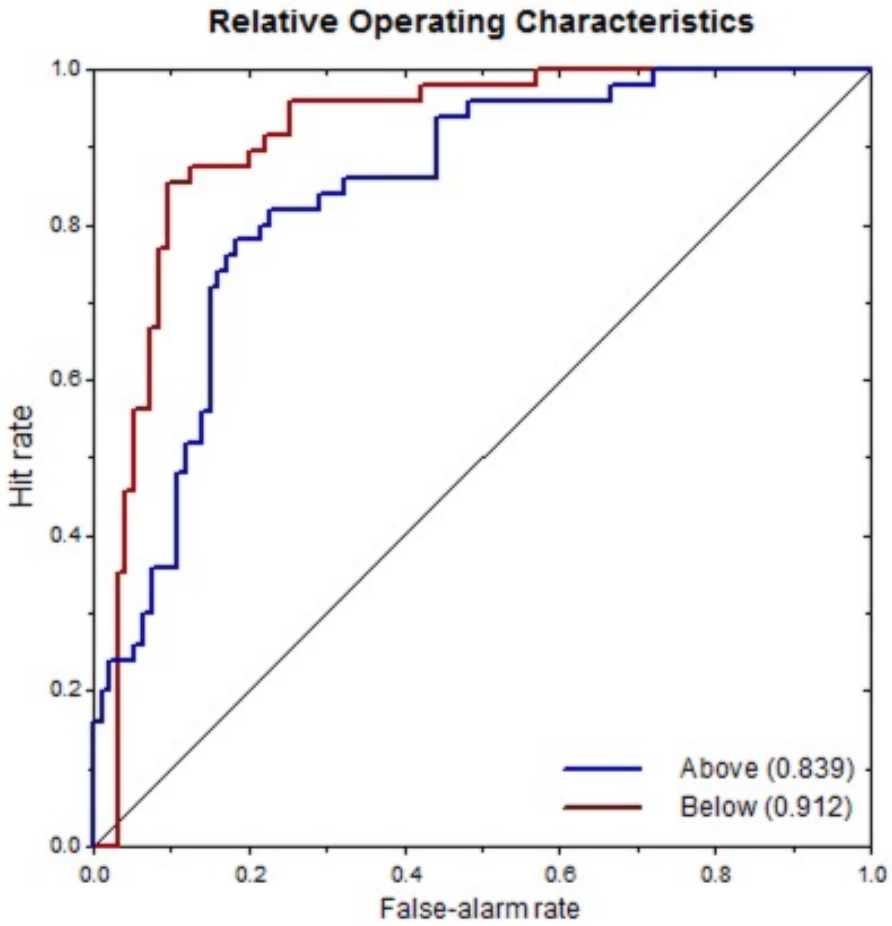




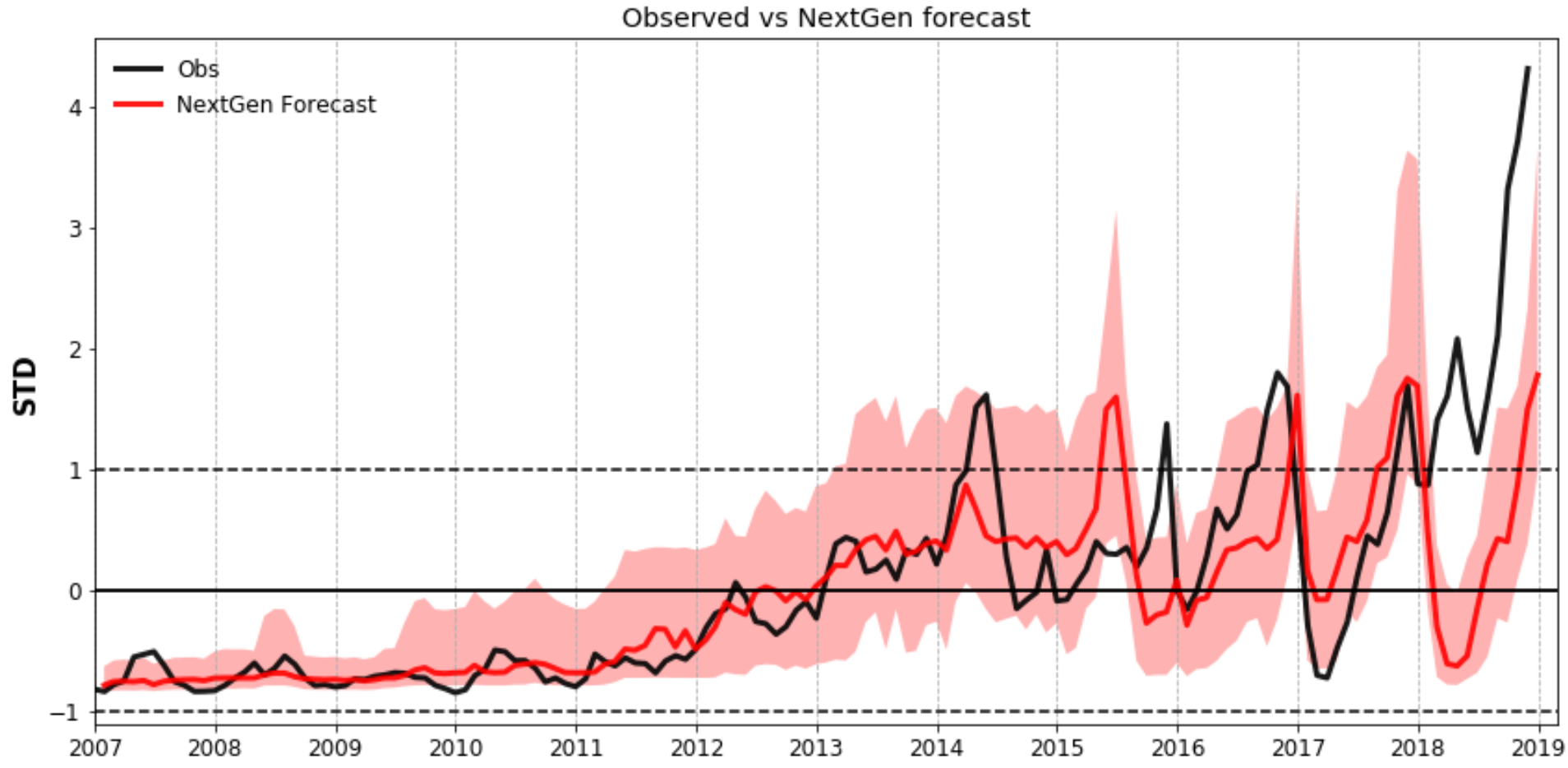


Predictive Skill for Human Migration





NextGen Multi-Model Ensemble for Migration



When hunger meets rainfall in Guatemala

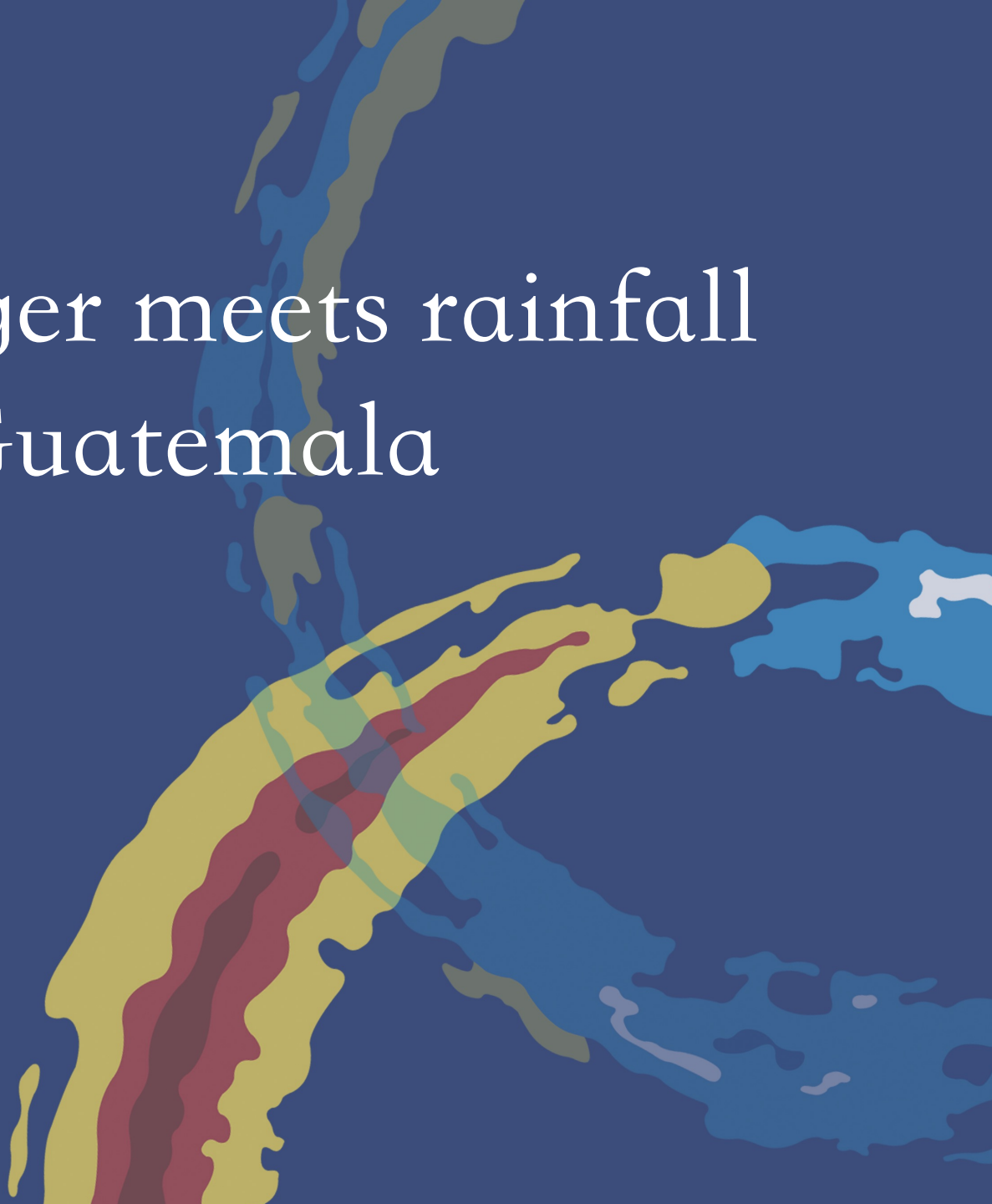
Carmen González Romero
carmengr@iri.columbia.edu

Co-authors:

Ángel G. Muñoz,

Simon Mason,

Juan Roberto Mendoza.



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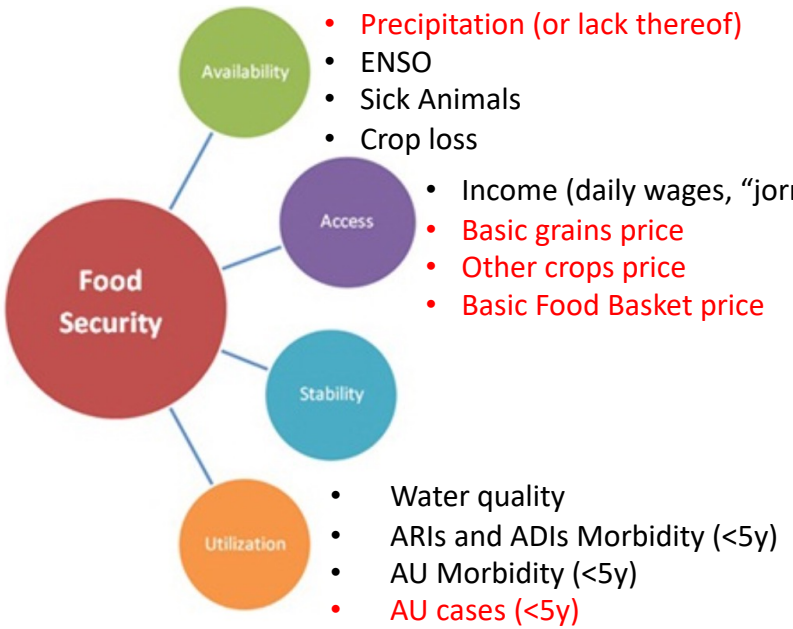
Understanding food insecurity and its drivers in Guatemala



- Grain reserves
- Precipitation (or lack thereof)
- ENSO
- Sick Animals
- Crop loss

- Income (daily wages, "jornales")
- Basic grains price
- Other crops price
- Basic Food Basket price

- Water quality
- ARIs and ADIs Morbidity (<5y)
- AU Morbidity (<5y)
- AU cases (<5y)

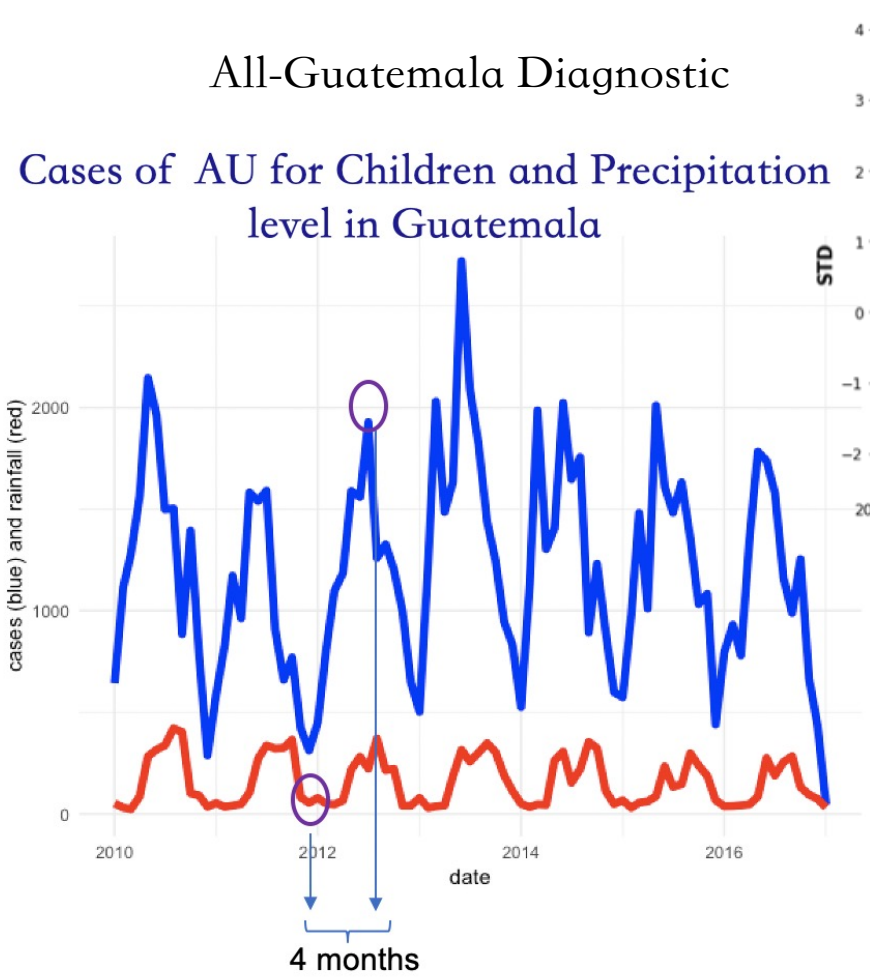
Image courtesy of Tufts University
http://cfarnutrition.tufts.edu/food-insecurity.htm

IRI aimed to create an **objective, operational** Early Warning System:

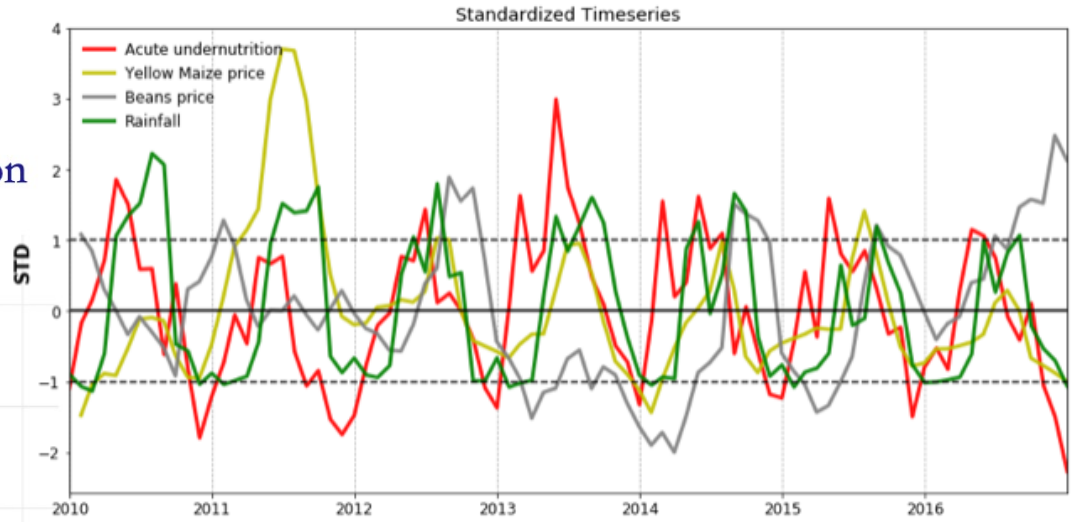
- Starting from SESAN's conceptual model
- Limitations of the model (e.g. number of variables, some of them are correlated)
- Data limitations and restrictions

Testing SESAN's conceptual model for acute undernutrition

All-Guatemala Diagnostic



White et al., BAMS sub-judice, Gonzalez Romero et all (in prep)



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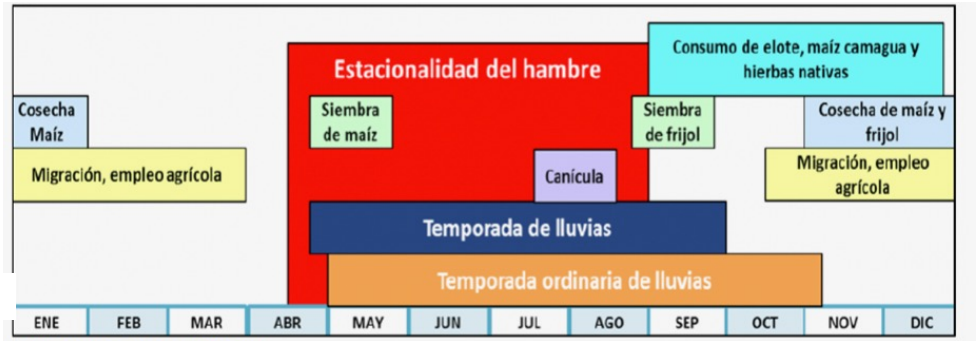

Image courtesy of FEWSNET

Can we skillfully forecast acute undernutrition?

Monthly temporal resolution at the country level

Model	Predictor(s)	lag (mo)	BIC	τ
1	R	-4	144357734.0	0.540
2	FDD	-4	144359058.6	0.491
3	YMaize	-4	144382235.2	0.267
4	BBeans	-4	144383270.7	0.294
5	Coffee	-3	144396520.4	0.099
6	R,YMaize	-4,-4	144352354.3	0.550
7	R,BBeans	-4,-4	144350579.0	0.571
8	R,Coffee	-4,-3	144354089.7	0.554
9	R,YMaize,BBeans	-4,-4,-4	**144344286.5**	**0.590**
10	R,BBeans,Coffee	-4,-4,-3	144347540.8	0.573
11	R,YMaize,Coffee	-4,-4,-3	144352071.6	0.556
12	R,YMaize,Beans,Coffee	-4,-4,-4,-3	**144344240.3**	**0.587**

Table 1: Simple and multiple linear regression model configurations, selection and skill assessment. Lag is indicated in months. Model selection is conducted using the Bayesian Information Criterion (BIC). Forecast skill is assessed using Kendall's τ (forecast discrimination), via a retroactive forecast approach, using the first 50% of the period for training, and 50% for out-of-sample verification.

Gonzalez Romero et all (in prep)

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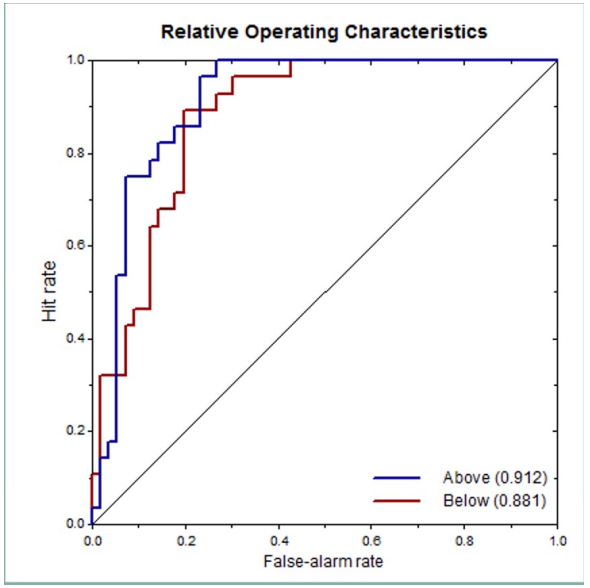
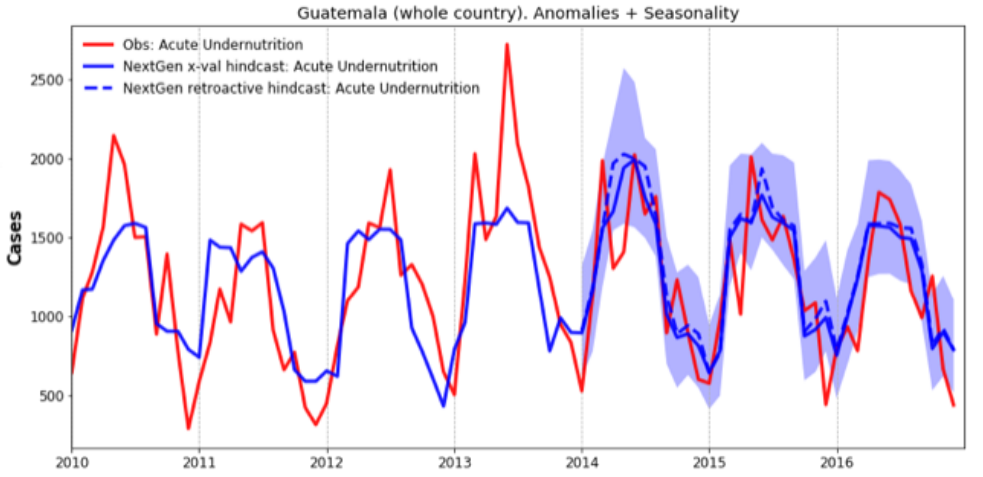


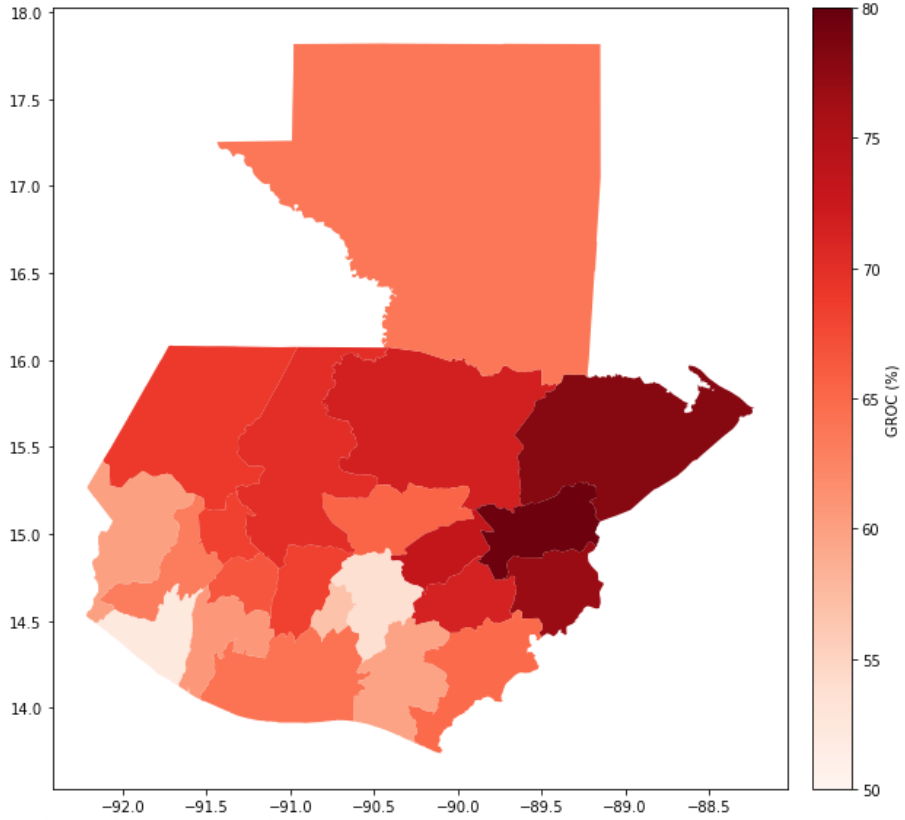


Gonzalez Romero et all (in prep)

… And now it's the time for a NextGen Forecast!!

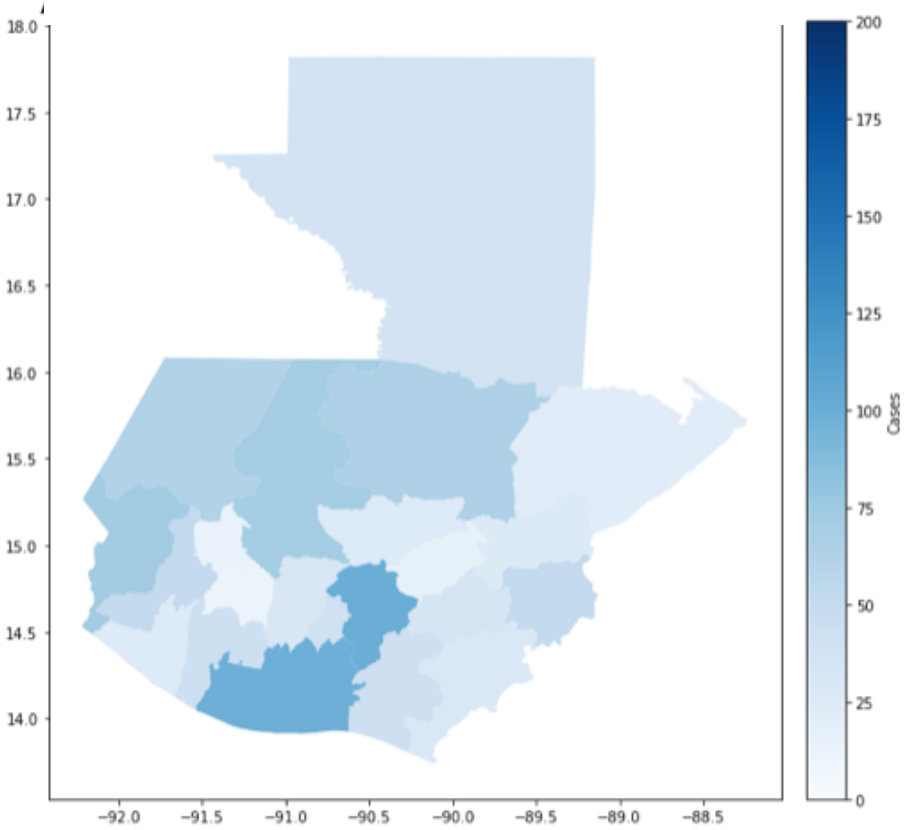
Gonzalez Romero et all (in prep)

Skill map (GROC)



Gonzalez Romero et all (in prep)

AU Forecast (June 2017)



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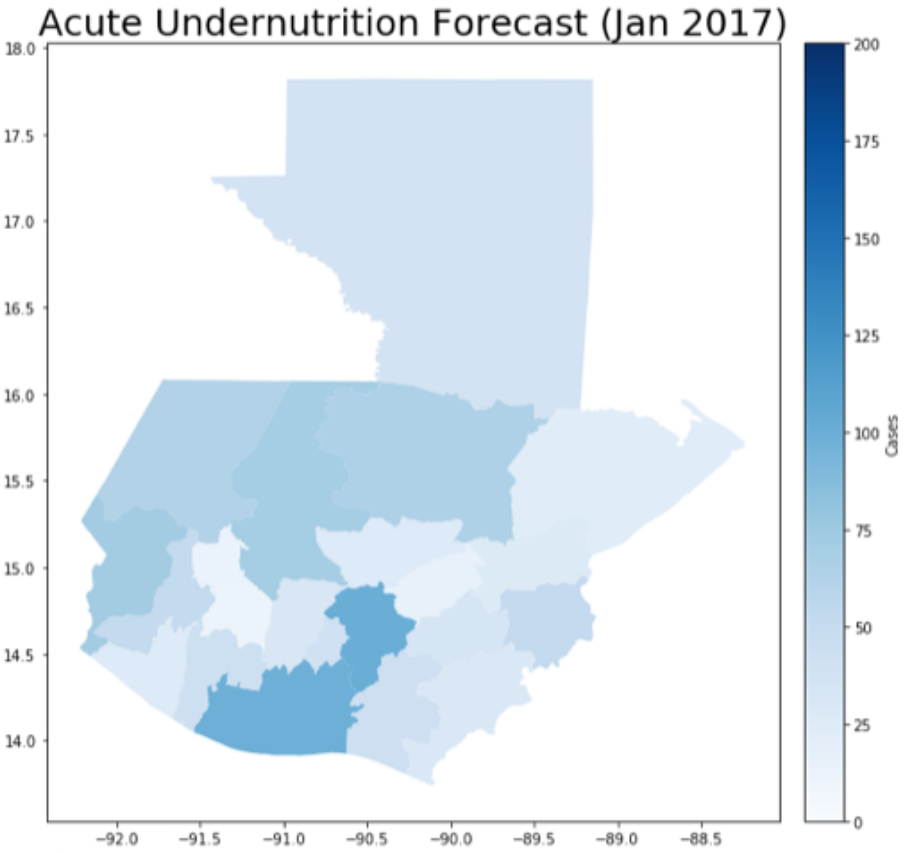

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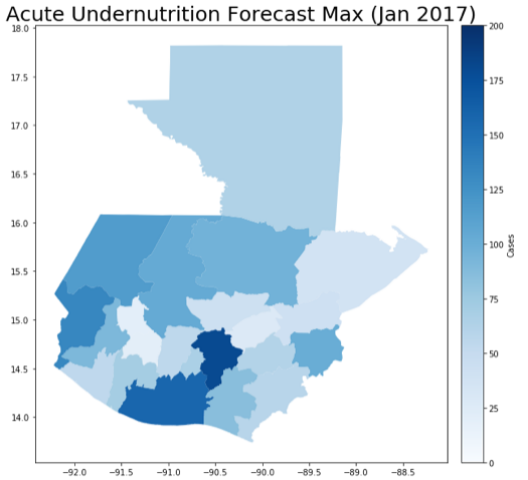

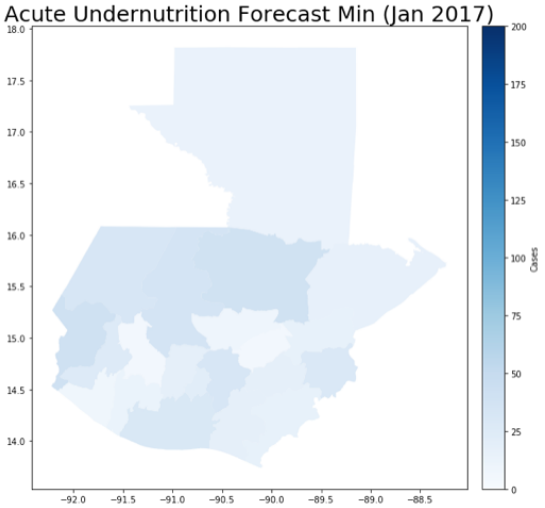

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