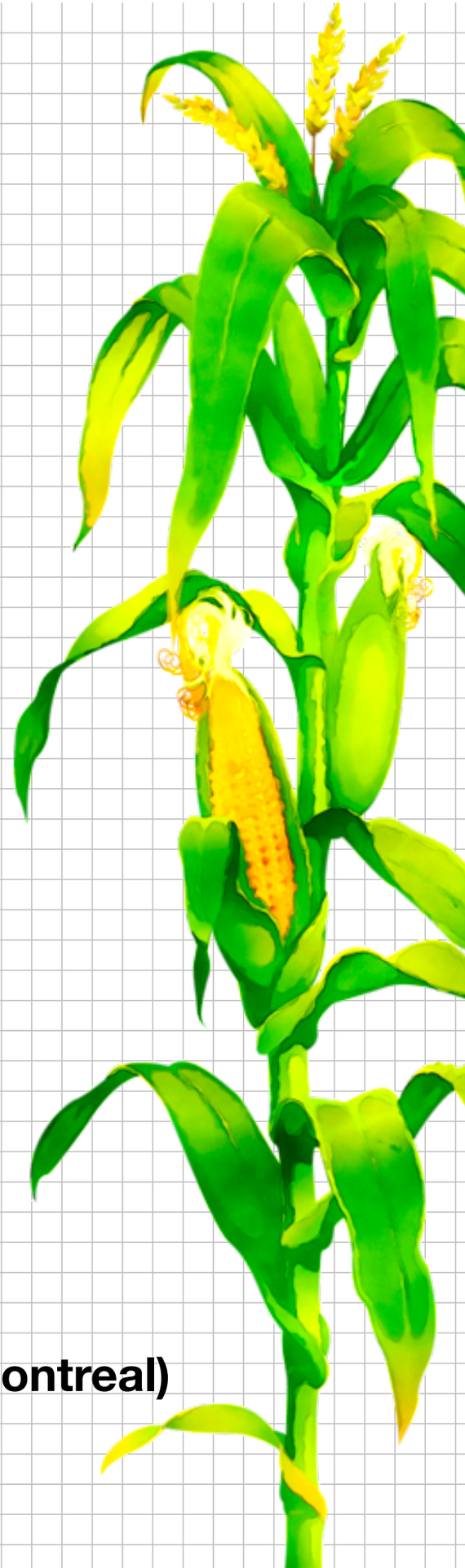
# You Forgot it in the Genotype

## Modeling towards adaptation of food crops under climate change threat

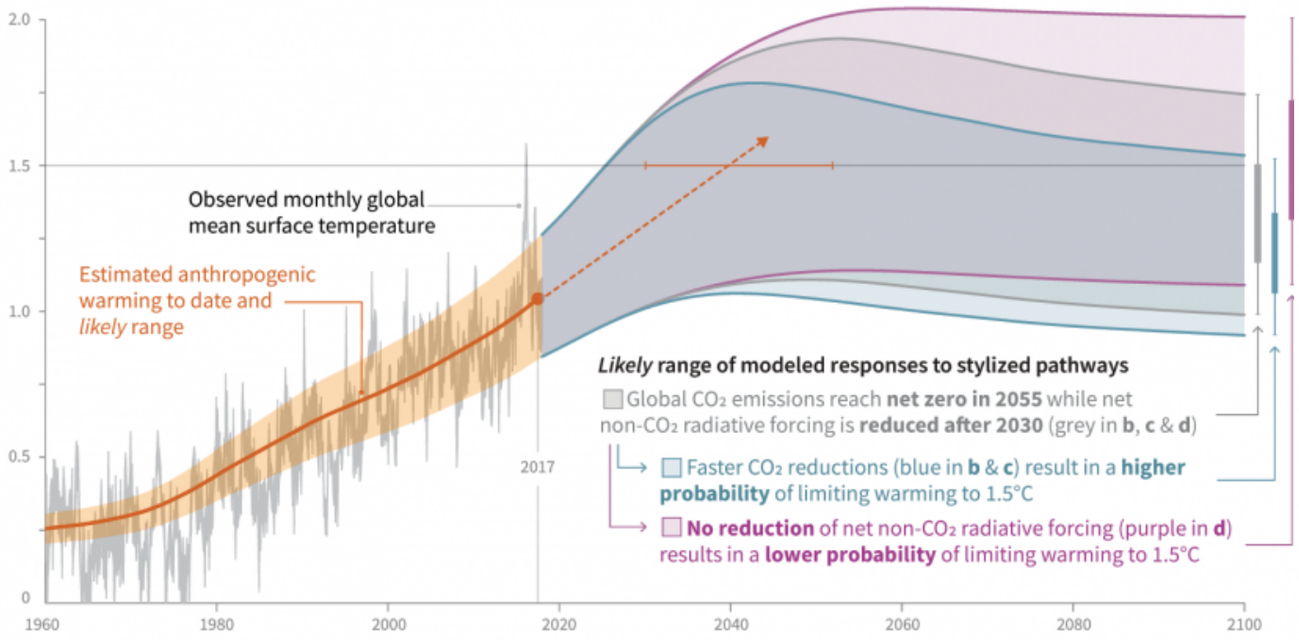
**Olivia Mendivil Ramos (CSHL - NY) & Linda Petrini (Google Brain - Montreal)**

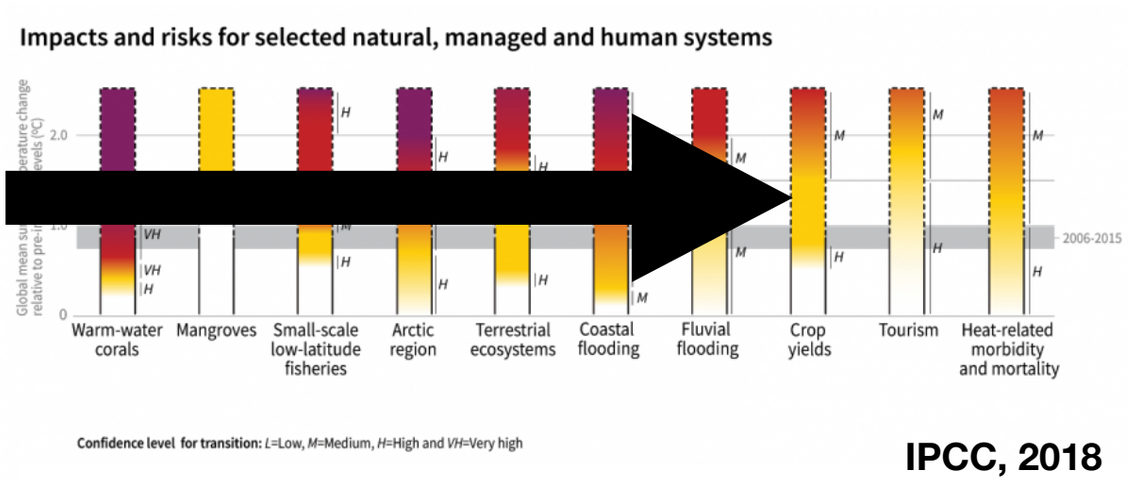
**4/26/2020**



# Why modeling in agriculture?

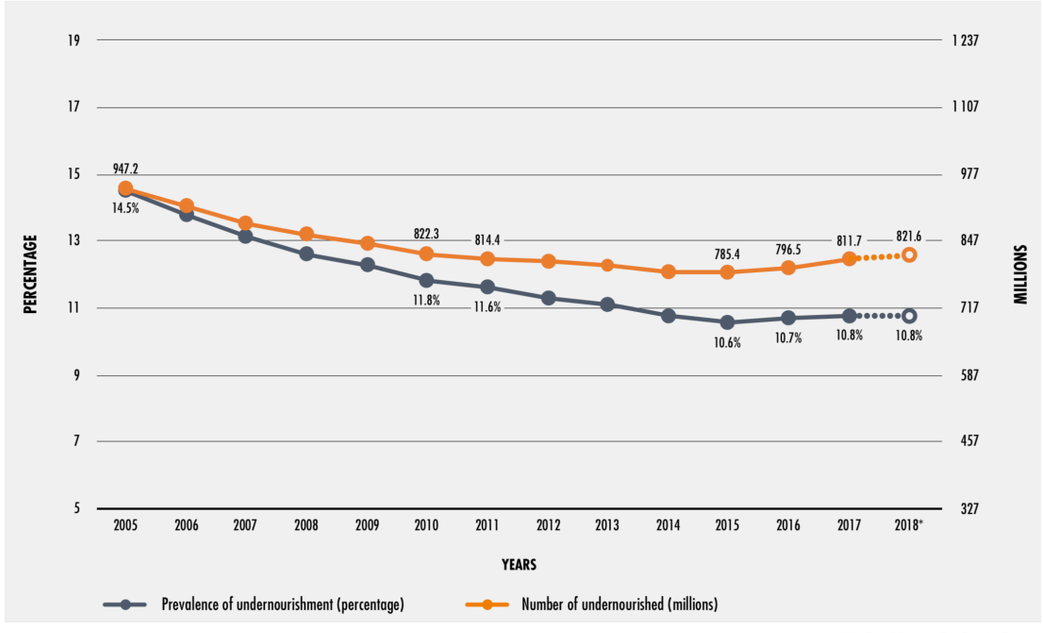
## Global warming history and rate of increasing temperature its impact in agriculture



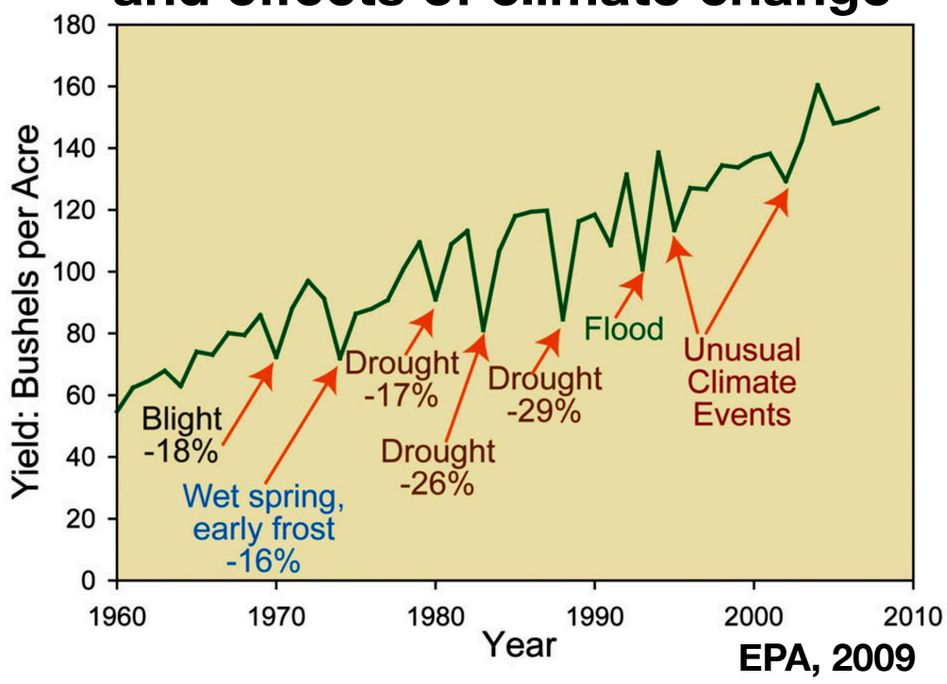

IPCC, 2018

## Global rate of undernourshiment




FAO, 2018

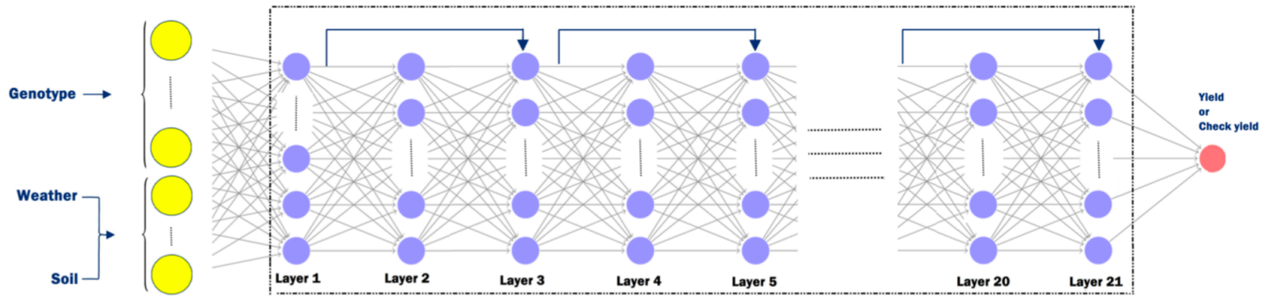
## trend of crop yield in the US and effects of climate change



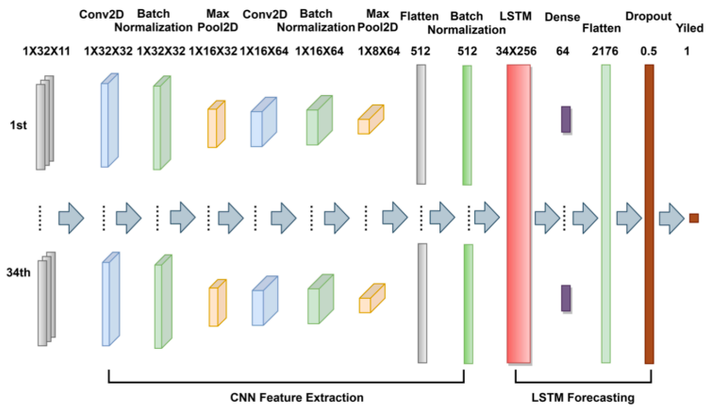

EPA, 2009

# State-of-the-Art models of crop yield prediction in food-crop plants as a start

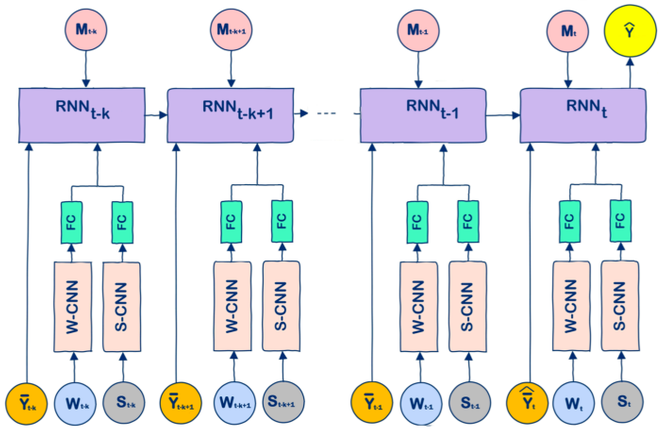
**Perceptron model on grain yield prediction - Khaki & Wang 2019**



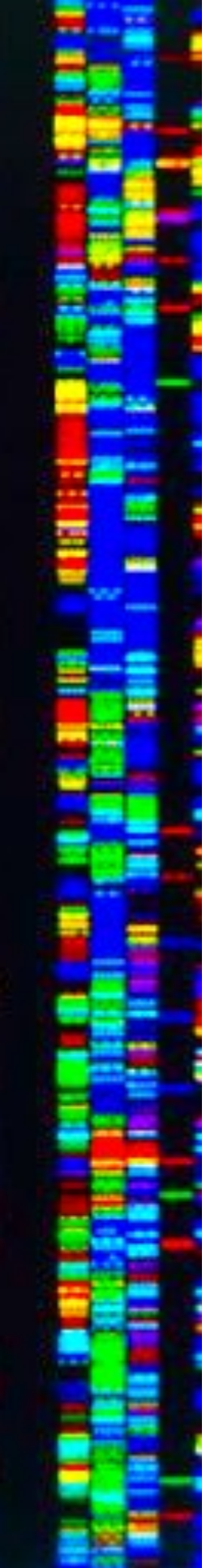

**CNN-LSTM hybrid model on grain yield prediction - Sun *et al.* 2019**




**RNN model on grain yield prediction - Khaki *et al.* 2020**

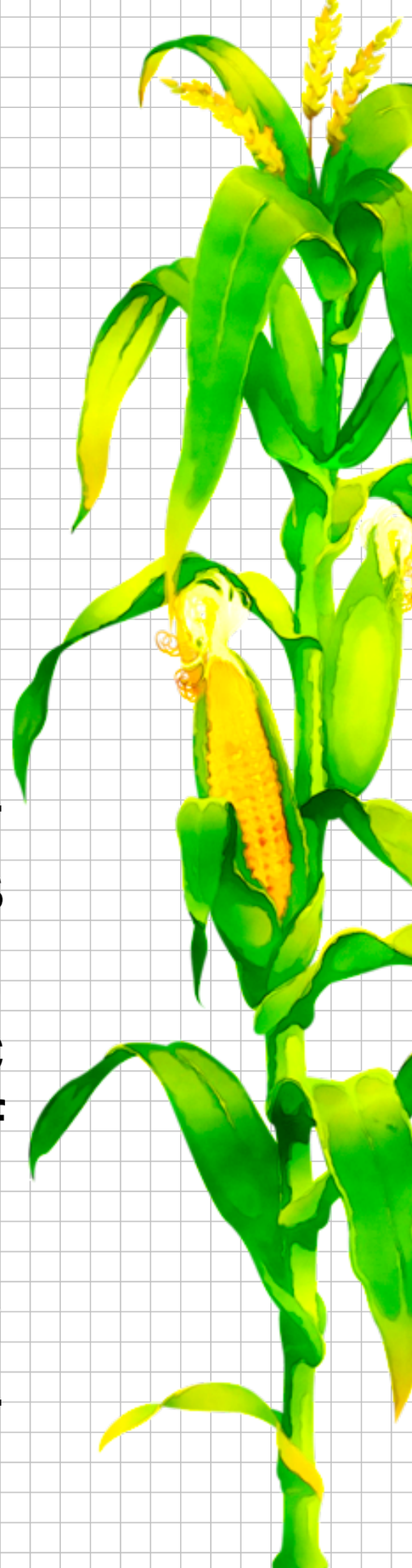



**3 common components:**
**Genotype**
**Weather**
**Soil**



## Preprocessing of the biological signal (Genotype) in these models:

- Imputation based on non-biological rationale
- Retain 3% of this data



## Phenotypic plasticity and genotype:

- A recent study on genotype-by-environment variation in maize cultivars showed the artificial selection on maize, constitute a loss of the genotypic variability of the plant at the expense of high productivity in crop yield.
- Fst biological measure computed from genotype as a proxy of stable and non-stable cultivars

# Proposal

the Genomes to Fields initiative

## Time-series dataset:

- 2014-2019
- 3 components: Raw Genotype, Soil Management and Weather data
- 1577 hybrid of Maize cultivars
- 77 environments
- 94000 field plots (12 states in the US and Ontario in Canada)

**Based on Fst measures, we split the data:**

- stable
- non-stable

**Deployed on models:**

- Perceptron
- CNN-LSTM hybrid
- RNN

**Performance measurements:**

- MSE
- MAE

“We aim to contribute with this modeling to the adaptation of agriculture and precision agriculture powered by genomics and leveraged by deep learning”

# Questions?

**Olivia Mendivil Ramos (CSHL - NY) & Linda Petrini (Google Brain - Montreal)**
**4/26/2020**