Translating Weather and Satellite Data into Actionable Climate Information: A Framework and Overview
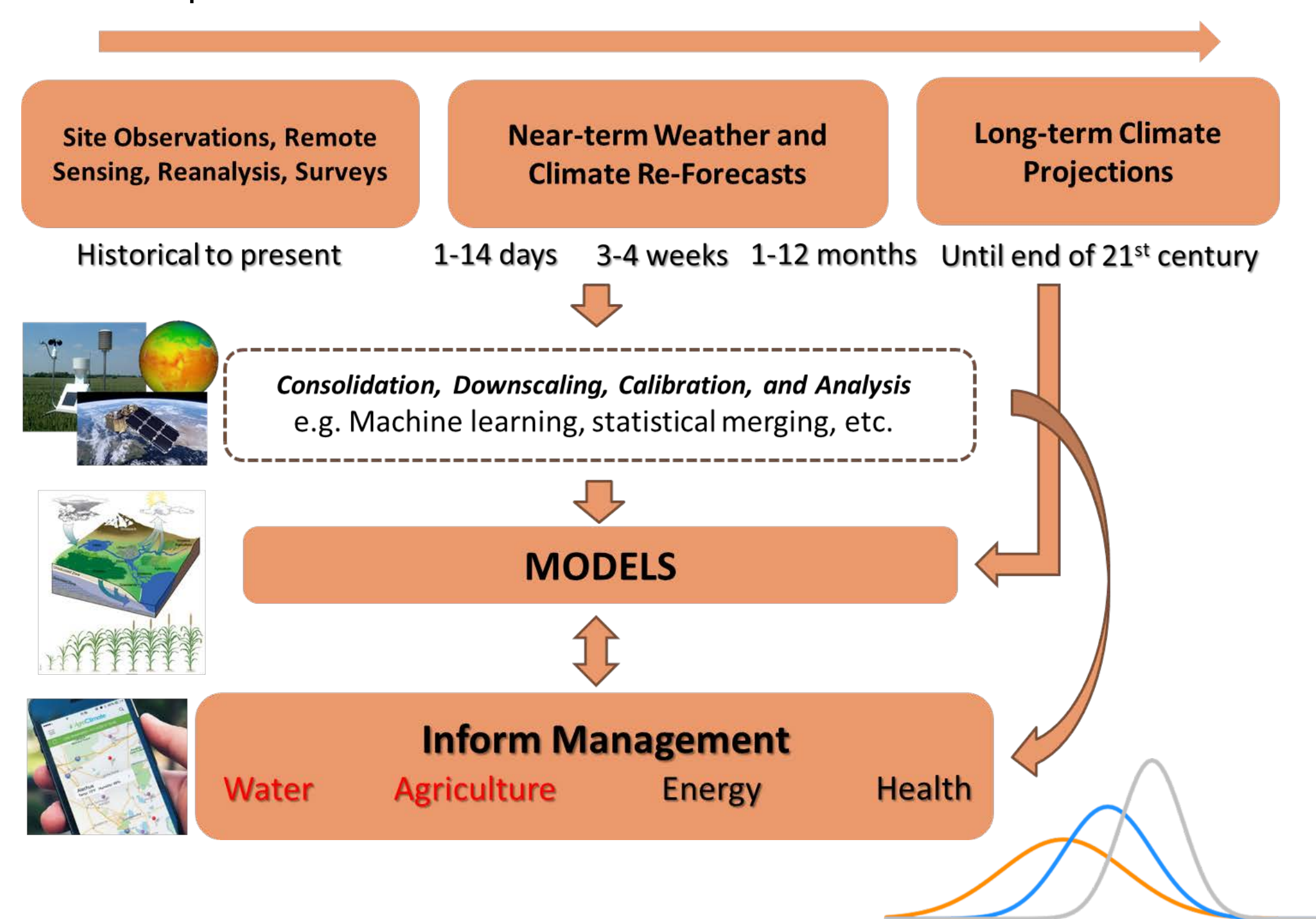
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Department of Biosystems Engineering, Auburn University, AL

A General Framework

- Developing innovative methods and solutions to support sustainable agricultural and environmental management in response to **climate risks**

Current Projects and Results

Project 1. Multi-Model Daily Reference Evapotranspiration Forecasts in the U.S.

Fig. ETo Forecasting Scheme based on NWPs

Fig. Differences between calibrated and raw ETo ensemble forecasts

Medina, H., D. Tian, P. Srivastavab, A. Pelosic, G. B. Chiricod. 2018. Medium-range reference evapotranspiration forecasts for the contiguous United States based on multi-model numerical weather predictions. Journal of Hydrology. 562, pp.502-517.

Medina, H., D. Tian. Submitted. Probabilistic-based post-processing schemes for improving multimodel ensemble daily reference evapotranspiration forecasting.

Current Projects and Results

Project 2. Ensemble Precipitation Forecasts Over Brazil: A Comparison Between GEFS, ECMWF, and Post-processing Methods
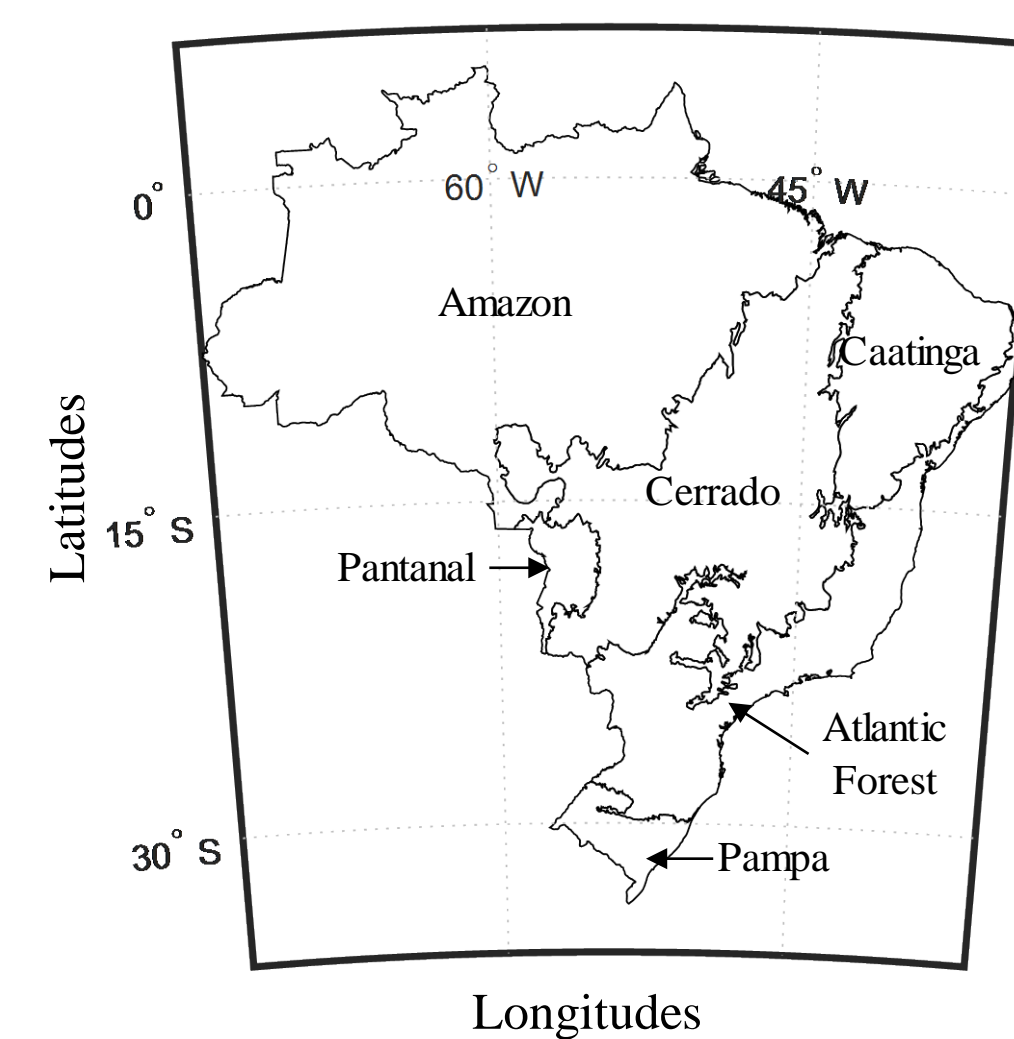

*Fig. Regions of Brazil involved in this study corresponding to the six major natural biomes.*

Table. Number of experiments where the alternative analog approaches performed the best and worse in terms of different metrics.

Method	Correlation		ME		RMSE		BSS		Ranking
	Best	Worst	Best	Worst	Best	Worst	Best	Worst	
Control	2	3	0	3	2	1	1	1	4
Short_reg	1	22	3	2	2	4	0	9	5
100_Ens	57	1	0	33	8	16	37	1	2
LogF	7	1	60	0	48	2	24	0	1
Prec_water01	3	1	4	1	11	4	5	0	3
Prec_water05	2	44	5	33	1	45	3	28	6
LR							2	33	

- Analog-based GEFS forecasts were more skillful and reliable than both raw ECMWF and GEFS forecasts.
- The approach considering the logarithm of current and past reforecasts was identified as the best strategy.
- Analog methods with long-term reforecast archive improved forecasting skill more than using logistic regression with short-term reforecast archive.

Medina, H., D. Tian, F. Martin, and G. Chirico. 2019. Comparing GEFS, ECMWF, and post-processing methods for ensemble precipitation forecasts over Brazil. Journal of Hydrometeorology, In Press.

Project 3. Harnessing Weather and Satellite Data for In-Season Maize Yield Forecasting with Machine Learning
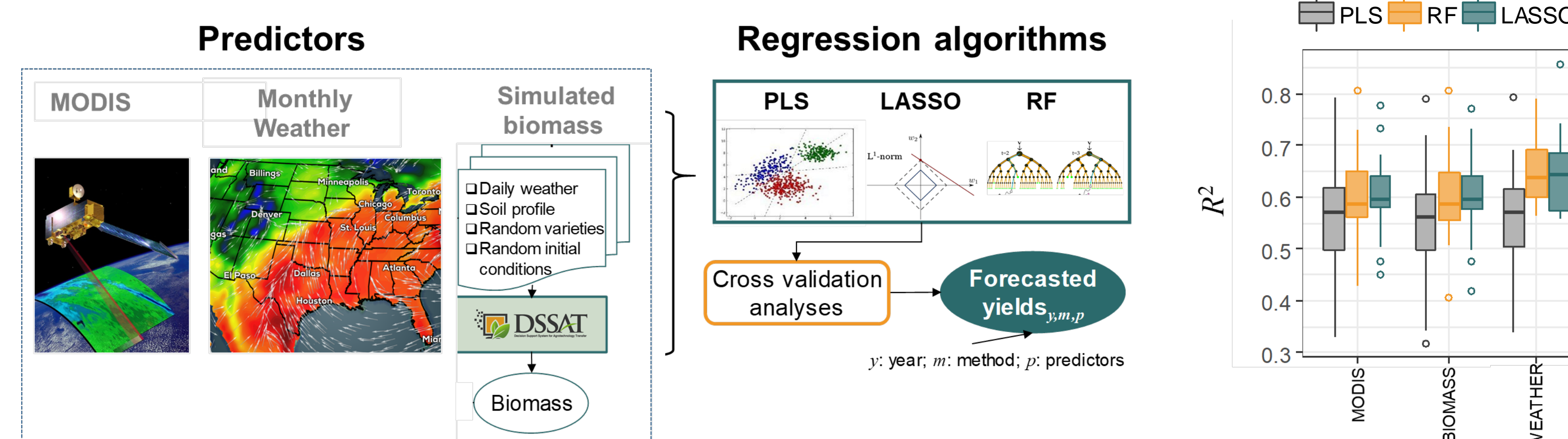
Medina, H., D. Tian. In preparation

Project 4. Linkages of Climate Variability with Changes and Predictability of Crop Yields and Failure Risks

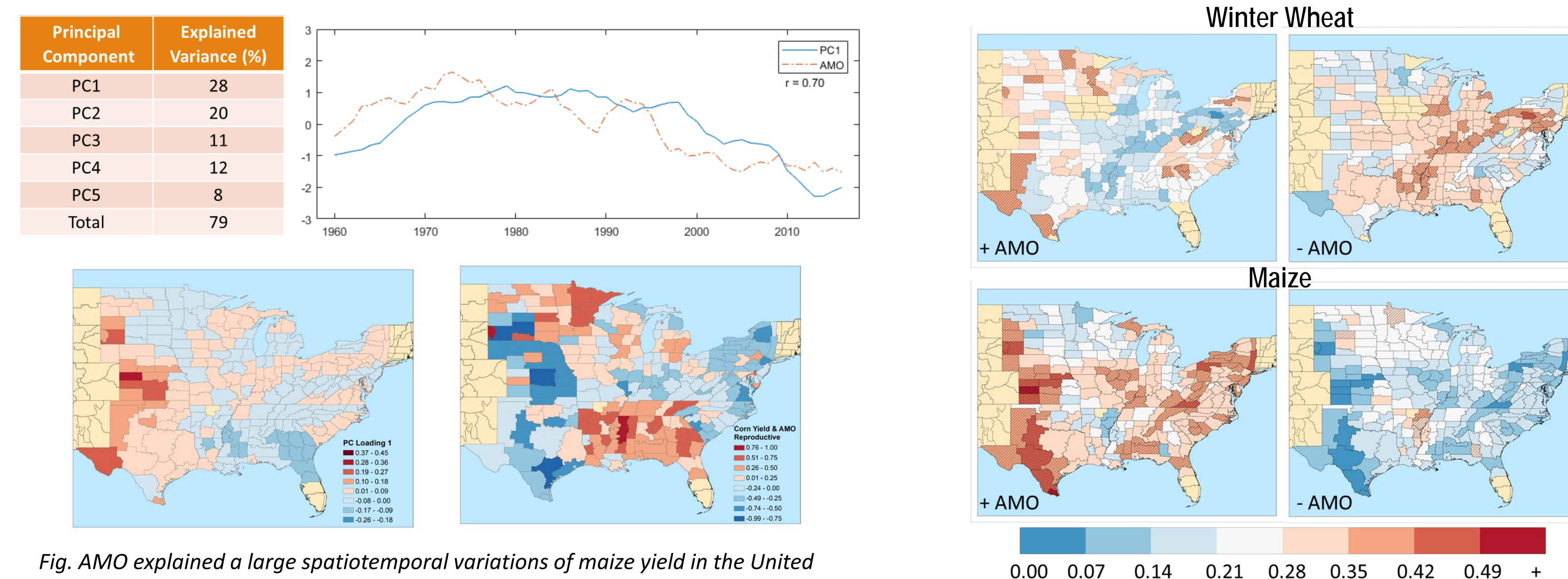| Principal Component	Explained Variance (%)
PC1	28
PC2	20
PC3	11
PC4	12
PC5	8
Total	79

Fig. AMO explained a large spatiotemporal variations of maize yield in the United States

Schillerberg, T., D. Tian, and R. Miao. Minor Revisions. Spatiotemporal patterns of maize and winter wheat yields in the United States: predictability and impact from climate oscillations. Agricultural and Forest Meteorology.

Fig. AMO influenced crop failure risks in the United States

Schillerberg, T., D. Tian. In preparation. Assessing changes of crop failure risks in the United States: The Impact from Large-Scale Climate Circulation.

Current Projects and Results

Project 5. Leaf Wetness Duration Modeling Using Machine Learning with Climate Reanalysis
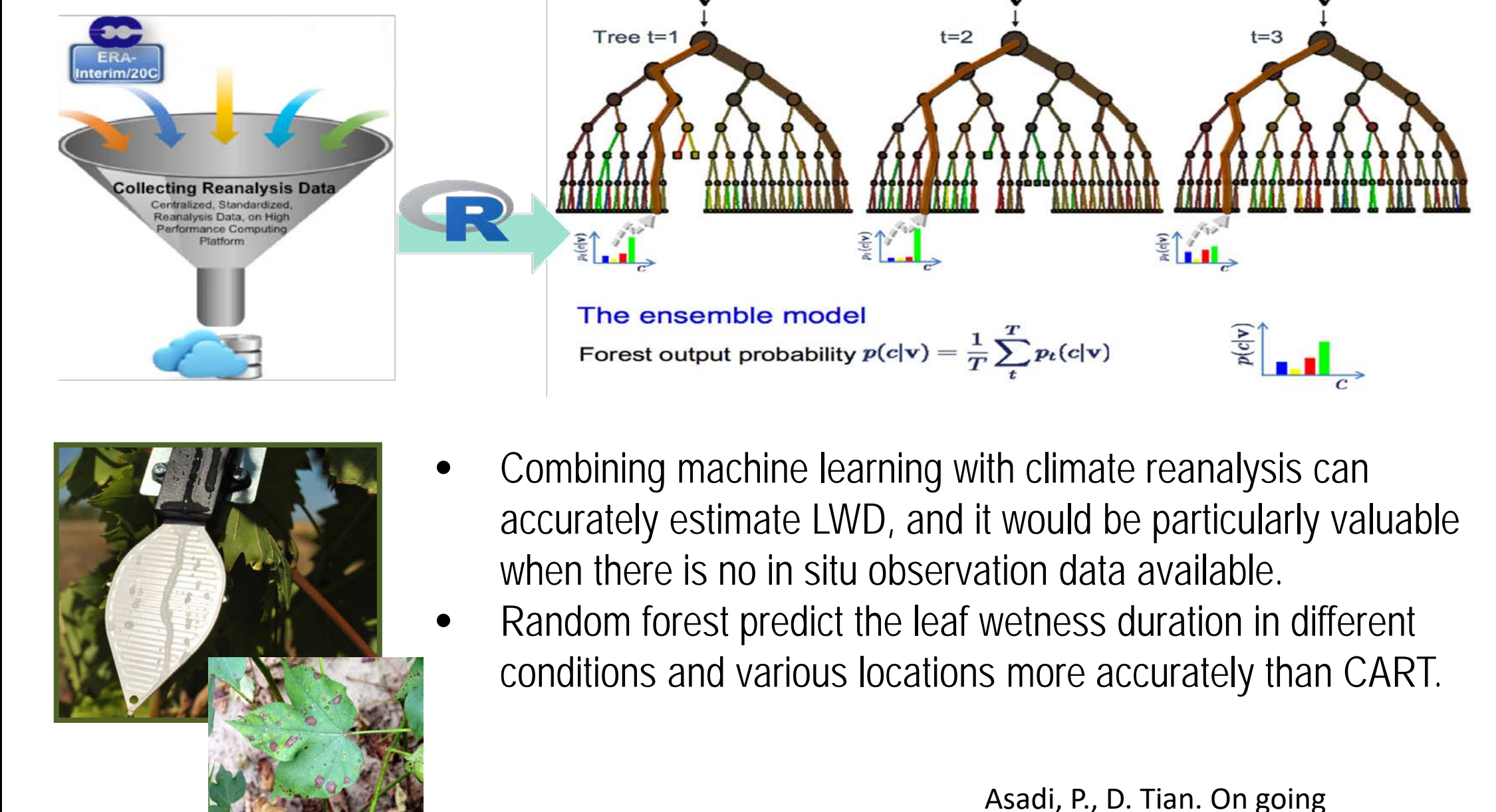
- Combining machine learning with climate reanalysis can accurately estimate LWD, and it would be particularly valuable when there is no in situ observation data available.
- Random forest predict the leaf wetness duration in different conditions and various locations more accurately than CART.

Asadi, P., D. Tian. On going

Project 6. Does Cover Crop Mitigate Impacts of Climate Extremes on System Water Use Efficiency in a Maize-Soybean Cropping System?
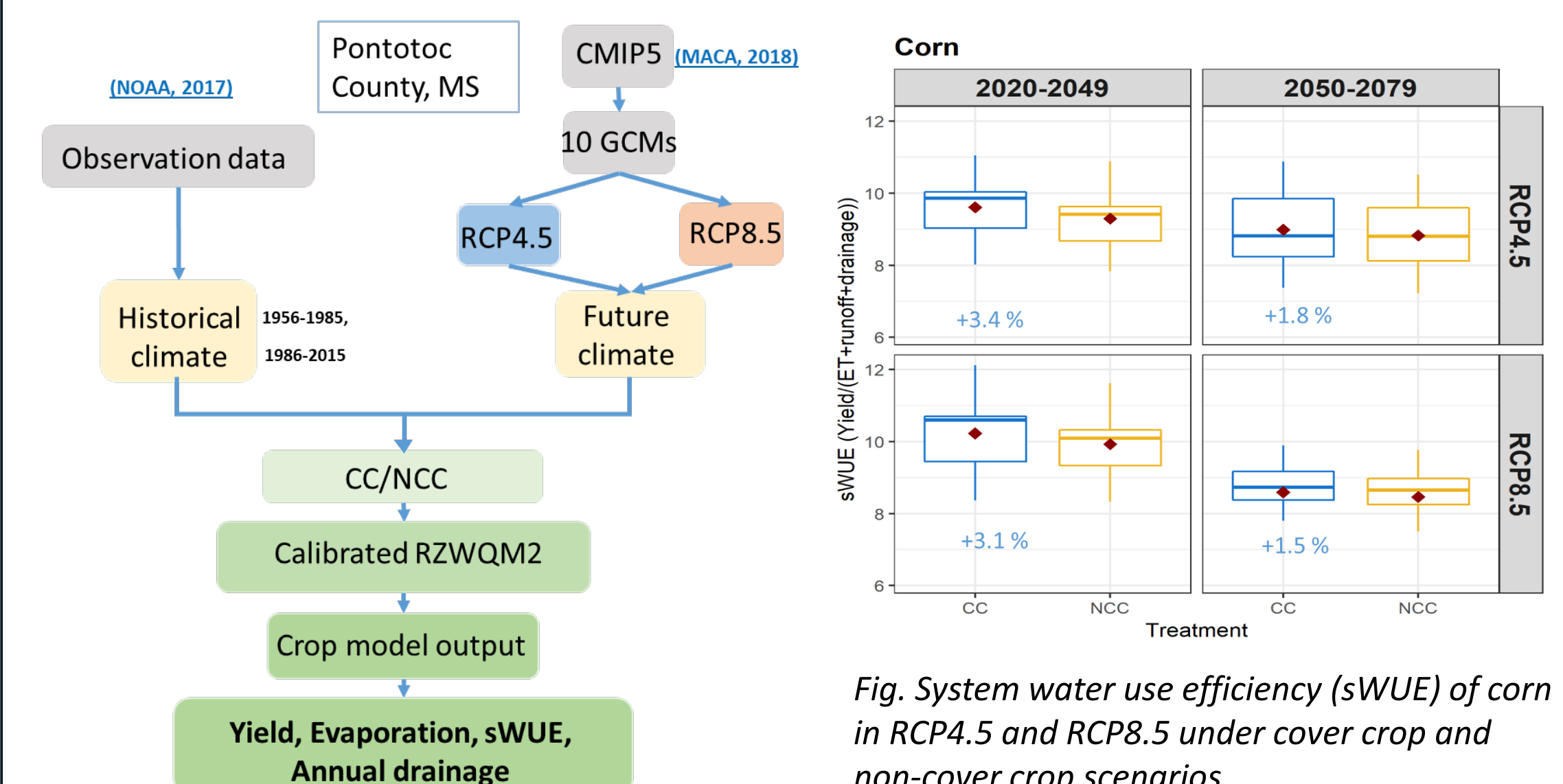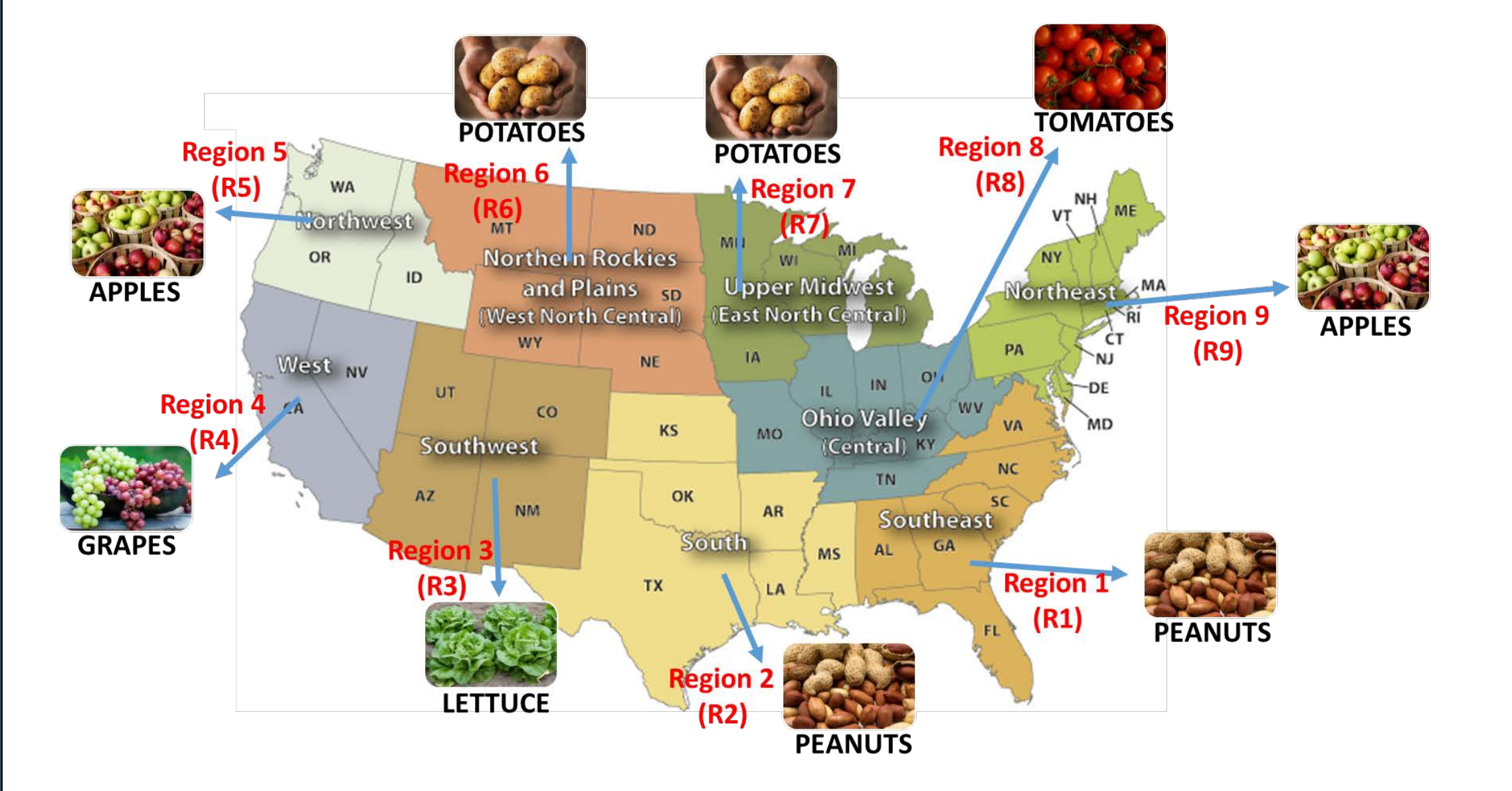

Fig. System water use efficiency (sWUE) of corn in RCP4.5 and RCP8.5 under cover crop and non-cover crop scenarios.

Li, Y., D. Tian, G. Feng, et al. In prep.

Project 7. Climate Impacts on Storage Conditions for Major Agricultural Commodities in the U.S.

Lesinger, K., D. Tian, C. Leisner, A. Sanz-Saez. On going