



The Agricultural
Model Intercomparison
and Improvement Project

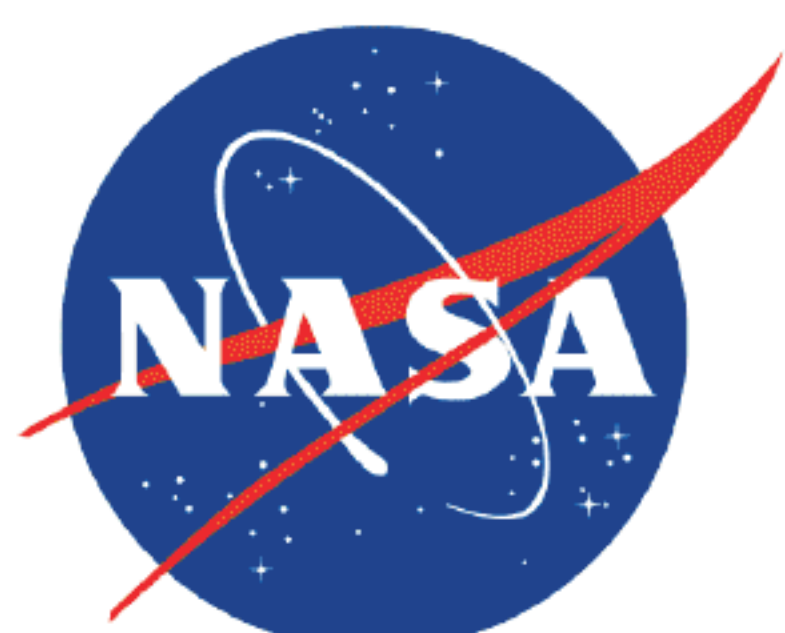
AVAIL

A Virtual Agriculture
Innovation Lab

Project Description

Farmers are constantly adapting to changing environmental, climate, market, and policy conditions. Developing new farm and land management practices to adjust to these changes can be expensive, time-consuming, and risky. AVAIL is being developed as a collaborative initiative among farmers and scientists to harness modeling with historical and near-real-time data from satellites and field measurements, to develop a virtual “digital twin” of farm operations so farmers can try out and test new management practices in a virtual setting. AVAIL will help farmers explore future systems that might work best in their dynamic context before having to incur the expenses and risks of implementing new practices.

AVAIL is a project being developed as a collaborative effort of the Iowa Corn, Iowa State University, Columbia University, NASA, and AgMIP (the Agricultural Model Intercomparison and Improvement Project), a global affiliation of over 1,200 crop and climate modelers. AVAIL is being developed as a pilot project in Iowa focusing on corn; in time, AVAIL will expand its coverage to more systems across the U.S Midwest, the U.S., and the world.



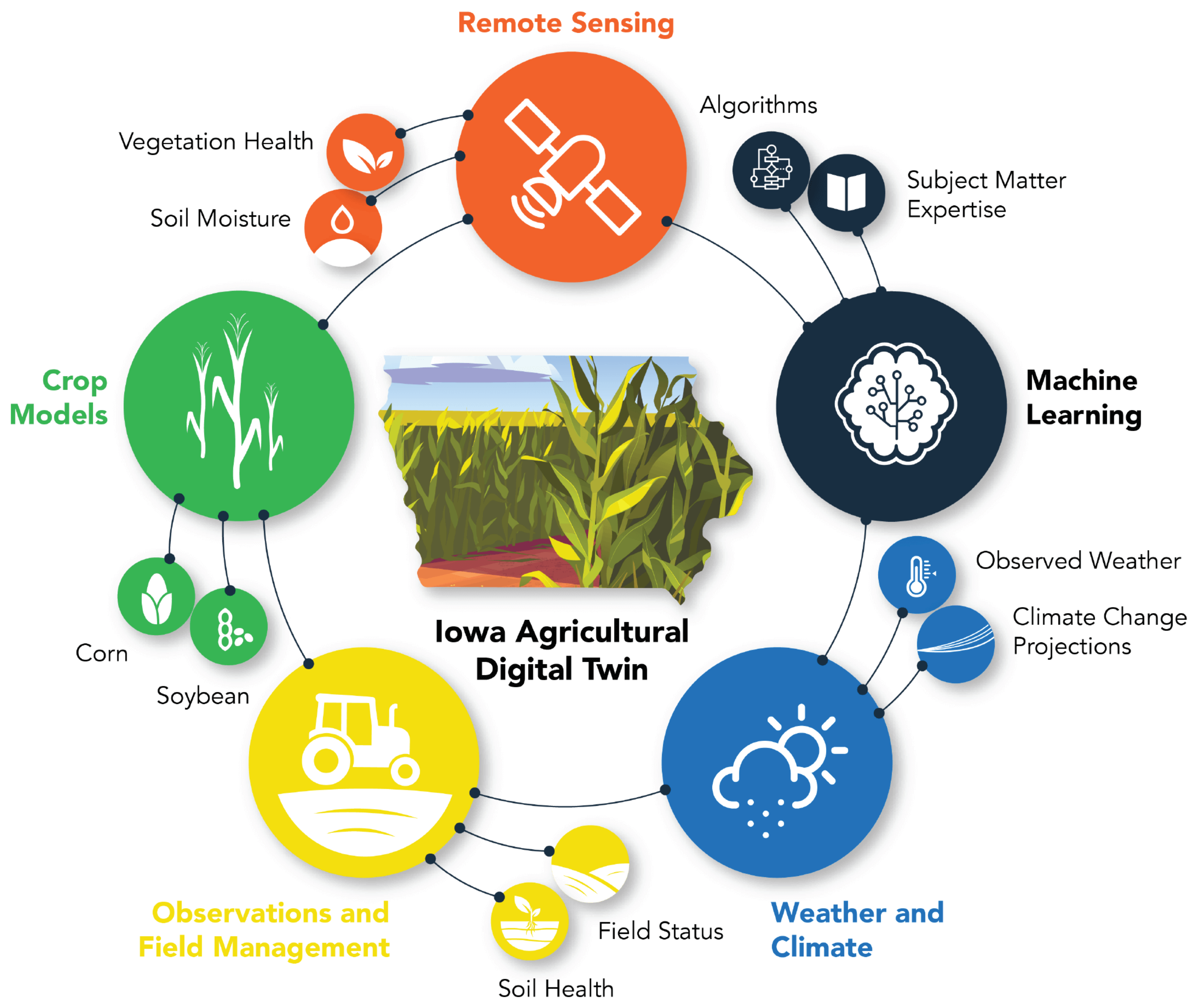
IOWA STATE
UNIVERSITY



Key Research Areas

“Digital Twins” and Integrated Data

AVAIL will integrate farmer data with satellite and remote sensing data in crop models in a way that is “usable, useful, and used.” Creating a “digital twin” goes beyond modeling by integrating diverse data resources and near-real-time data streams into the modeling framework. AVAIL will make it possible to bring together farm and field data generated and shared by farmers with a wide array of crop, climate, and economic models. AVAIL links these data streams into a decision and management framework that will then be used to implement the most promising regenerative practices. AVAIL will leverage emerging Artificial Intelligence and Machine Learning technologies to learn from historic responses and trends, near-real-time data, and forecasts of future trends so that farmers can identify priority opportunities to build the resilience and profitability of Iowa farms.

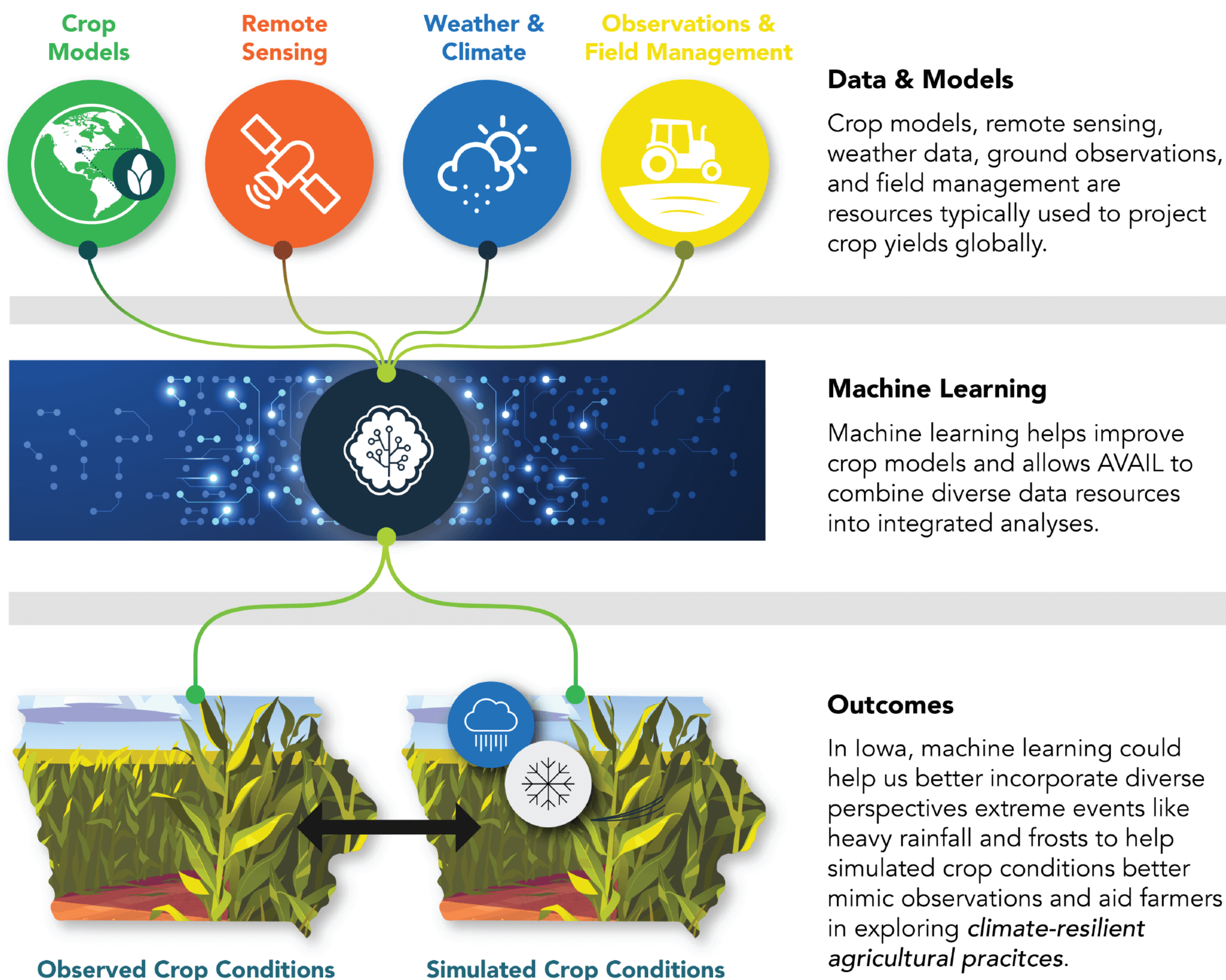


Integrated Modeling and Decision-Making Framework

No single crop or climate model is the best under all conditions and situations. AgMIP is the recognized global leader in developing common protocols for data handling and comparing, improving, and combining multiple agricultural models into ensembles for integrated regional assessments. AVAIL will create a new paradigm of agricultural practice exploration built on a foundational system open to other researchers, which can help break the current cycle of “re-inventing the wheel” for US agricultural model configurations. This foundational model approach will make it possible to utilize the multi-model, high data-fidelity configurations needed for decision support that truly enables scaling up of regenerative practices to respond to current and future climate challenges.

Leveraging Current Farm Programs and Data

Iowa Corn will provide data allowing AVAIL to represent existing systems and farm-based programs supportive of regenerative agricultural practices. This will allow models to establish baselines for conventional and regenerative management practices. In combination with satellite data, Iowa farm programs and field and survey data that may be leveraged in this effort include: the Iowa Nutrient Reduction Strategy, the Soil Health Partnership, the Iowa Agriculture Water Alliance, and farmer surveys conducted by the Iowa Nutrient Research & Education Council. The regenerative agricultural practices that will be identified, assessed, and tested will be relevant to improving sustainability, profitability, soil health, nutrient management, and water quality as well as climate benefits.



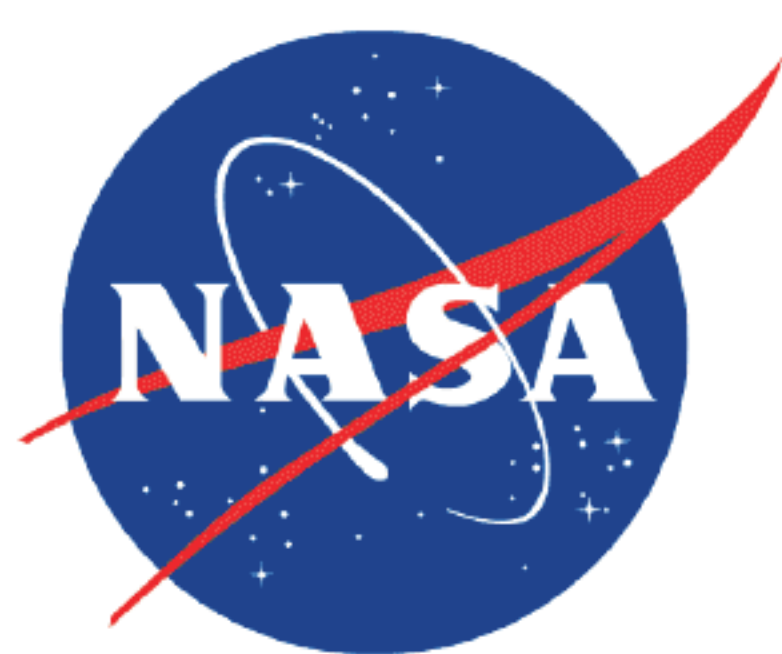
Farmer-Defined Scenarios

AVAIL development will be kick-started with working sessions with Iowa Corn to identify barriers to the adoption of regenerative, climate-smart agriculture practices and farmers' top concerns about the potential impacts of weather and climate on their current and future operations. AVAIL will interactively develop a range of scenarios representing the future of farming systems and a changing climate. Scenarios will be framed to address genotype-by-environment-by-management (GxExM) interactions under projected possible future climate/weather patterns. Genotypes (G) may include variety selection for short-, medium- and long-term maturity. Management (M) choices may include a range of planting dates, fertilizer, and tillage strategies. Environment (E) may include historic, current, and projected future patterns in temperature, precipitation, radiation, humidity, wind, and carbon dioxide concentration. Economic analysis will be integrated to assess trade-offs under each scenario. AVAIL will associate the farmer-generated scenarios with levels of risk and rank regenerative agricultural solutions for adapting to projected weather/climate patterns. Model outputs for the selected scenarios will include yields, soil organic carbon, GHG emissions, and climate-driven changes in farm profitability.



On-Farm Assessments and Trials

The project will begin by identifying and using data from existing farm programs that support regenerative agricultural practices. These data will be used to calibrate models and establish baseline conditions. AVAIL will evaluate current practices against counterfactuals representing what would have happened under different practices, and then extend into the future to see how current practices hold up in a changing world. Farmers will identify their highest priority production/climate scenarios and AVAIL will simulate and assess their management and genotype preferences across production environments and climatic conditions. AVAIL will help farmers identify a more manageable subset of promising options for consideration in on-farm tests. AVAIL will assess the potential environmental and economic benefits of expanding resilient agriculture practices for individual farms and across counties and the state.



Infographics developed by Natalie Kozlowski, Maria Dombrov (Columbia University Center for Climate Systems Research), and Alex Ruane (NASA Goddard Institute for Space Studies) and excerpted from Views on Agriculture Magazine, Corteva Agriscience
Photos provided by David Ertl and Lance Lillibridge (Iowa Corn)