Animal Disease Spread Model

An Overview

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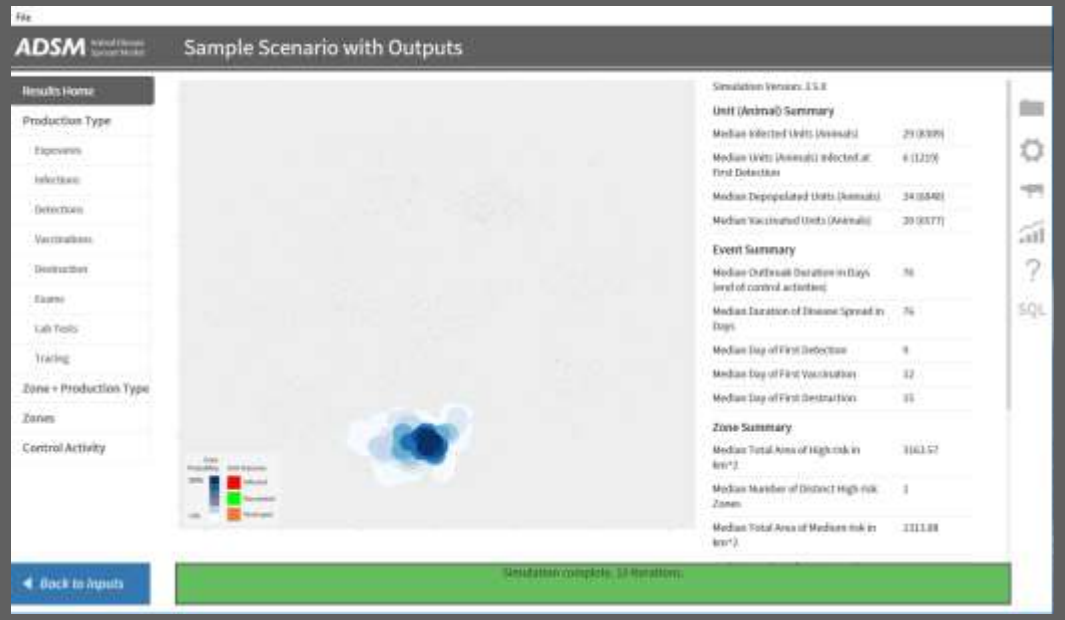
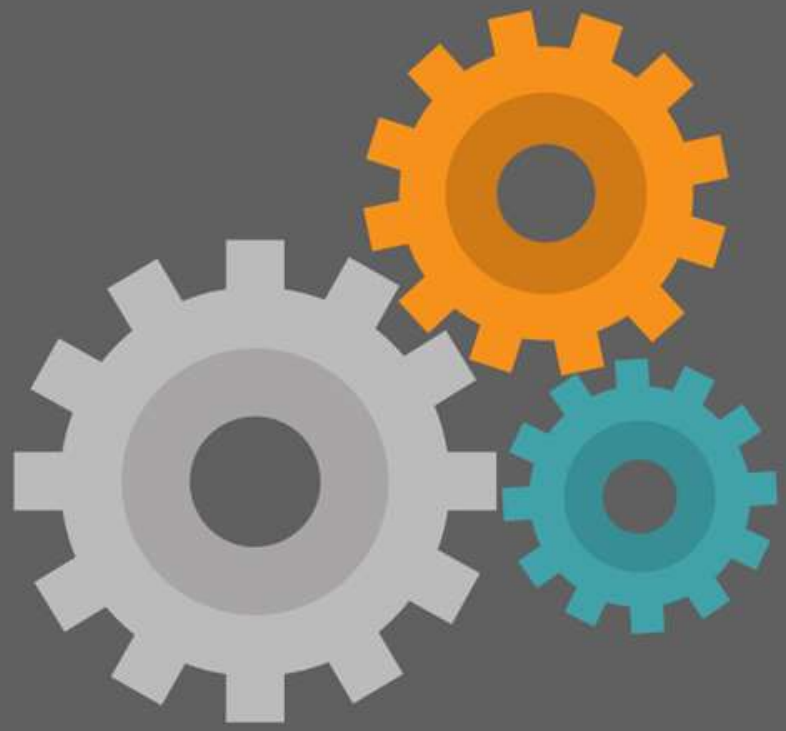
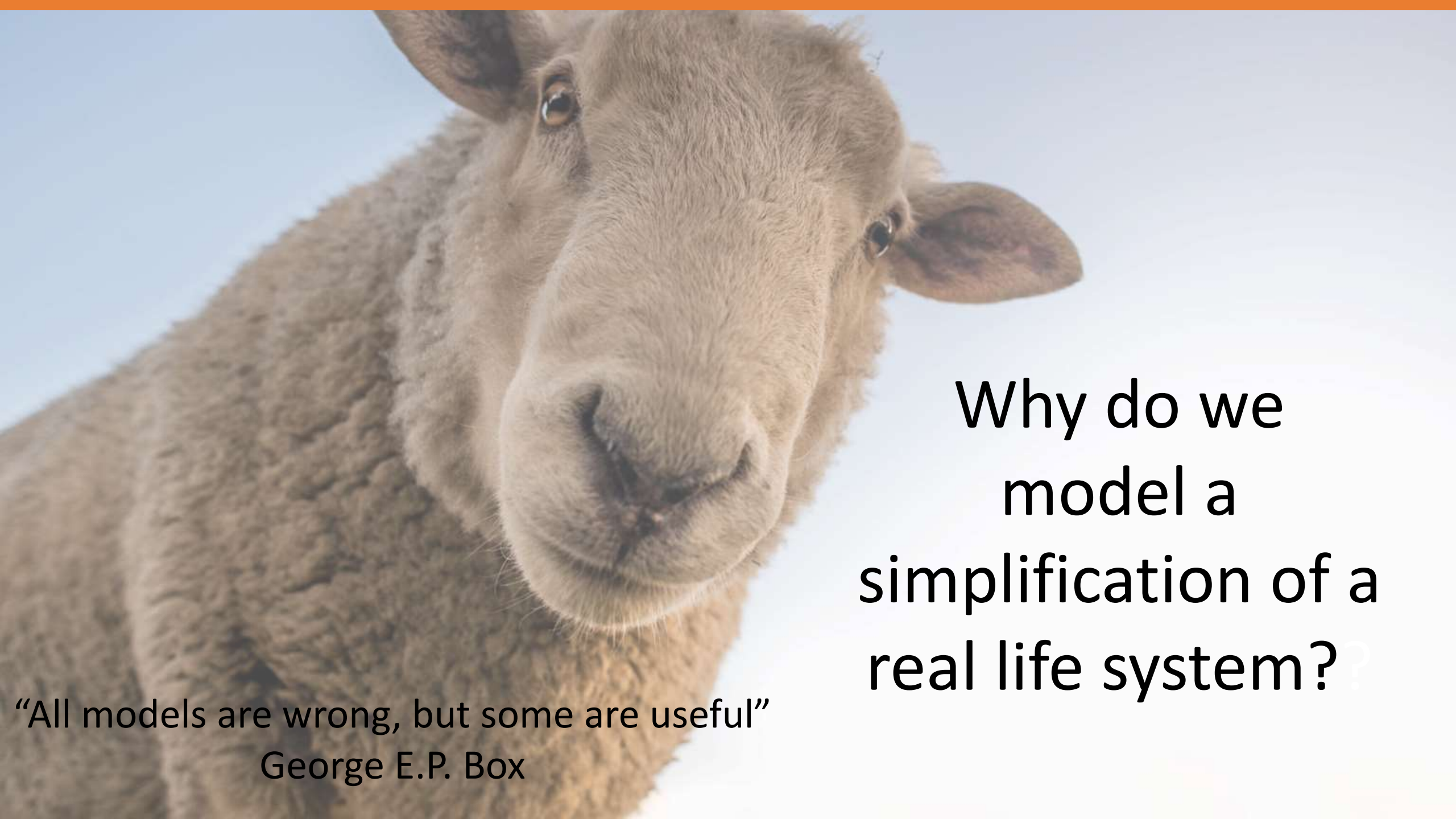


Model Concepts



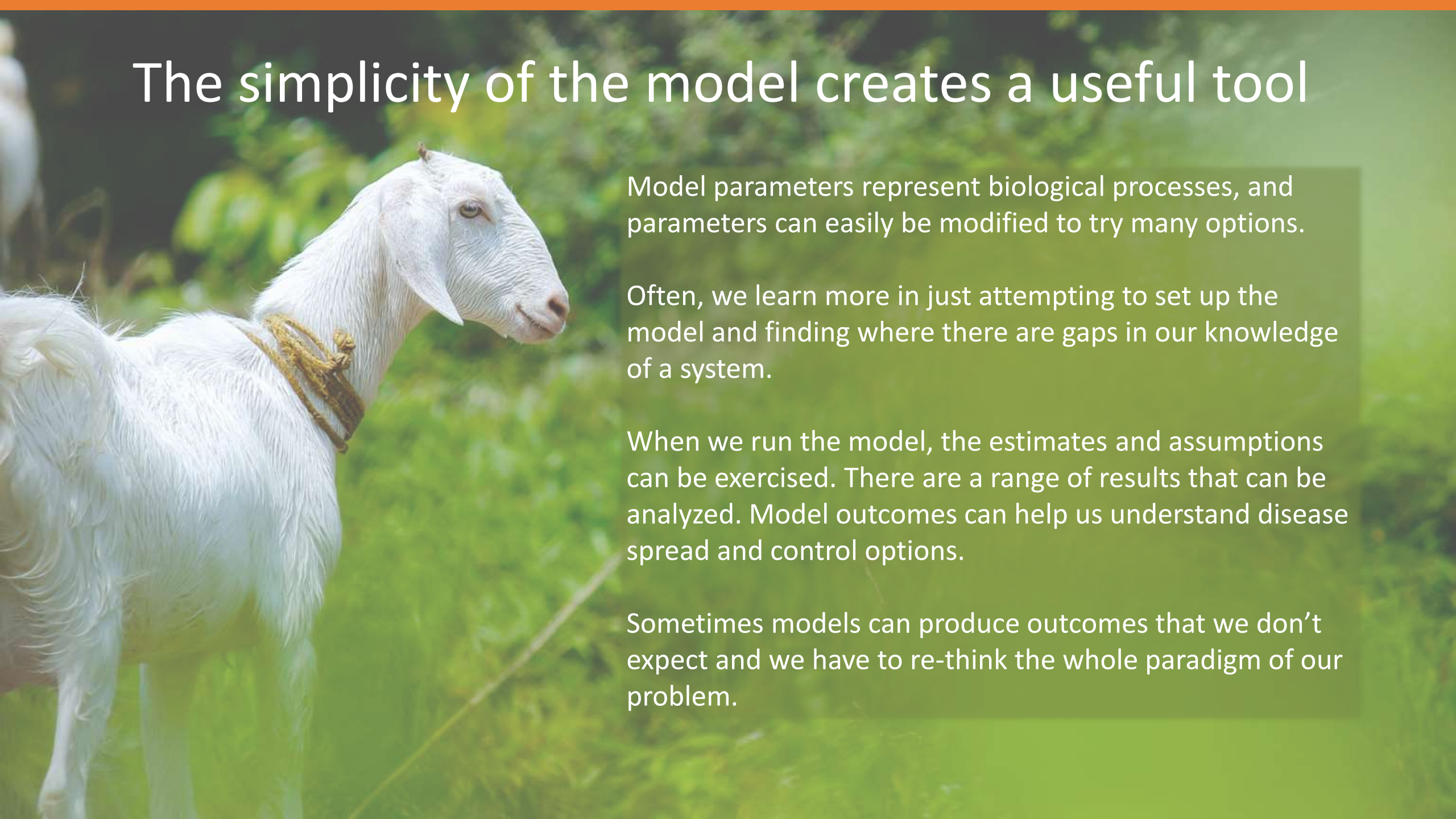

Models simplify complex systems to represent them
in ways we can understand and analyze



Why do we model a simplification of a real life system?

"All models are wrong, but some are useful"
George E.P. Box

The simplicity of the model creates a useful tool



Model parameters represent biological processes, and parameters can easily be modified to try many options.

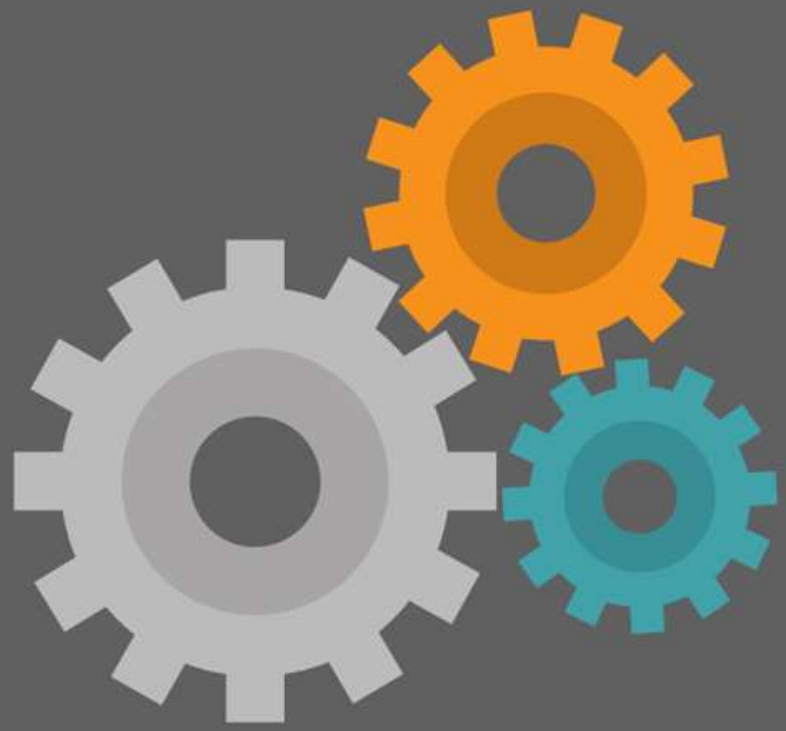
Often, we learn more in just attempting to set up the model and finding where there are gaps in our knowledge of a system.

When we run the model, the estimates and assumptions can be exercised. There are a range of results that can be analyzed. Model outcomes can help us understand disease spread and control options.

Sometimes models can produce outcomes that we don’t expect and we have to re-think the whole paradigm of our problem.

Simulation modeling is a well-established and essential tool that can be used to study the dynamics of disease spread. It is also valuable to evaluate a variety of mechanisms for disease control. There are many times the real life observation of disease spread is impractical, undesirable, or impossible. A simulation environment allows customized parameterization and exercise of assumptions in a low risk environment.

About ADSM



What is ADSM?

ADSM is a software application to simulate an outbreak of a highly contagious animal disease. The software allows a variety of control measures to be implemented.

ADSM is currently available at
https://github.com/NAVADMC/ADSM/releases/latest

Concepts central to understanding ADSM




ADSM is unit based

Disease manifestation and transmission are represented at the level of a herd/flock or group of animals (unit), rather than at the individual animal level




ADSM is spatial-temporal

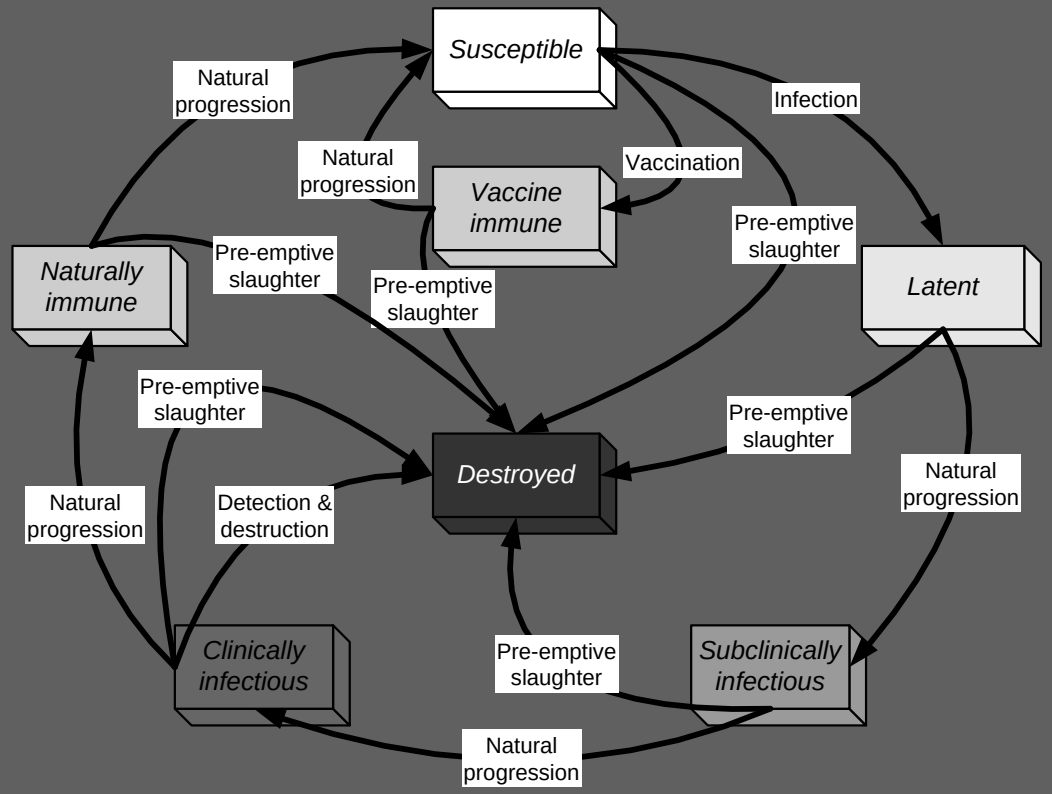
Each unit in a scenario is assigned a physical location, and disease progression occurs in a time step. The application uses a distance between units during simulations.

ADSM is not geospatial in the same way a geographic information system (GIS) would be in recognizing layers such as bodies of water or road networks. However, some distance-based features may be represented in other ways using parameters.

ADSM is stochastic

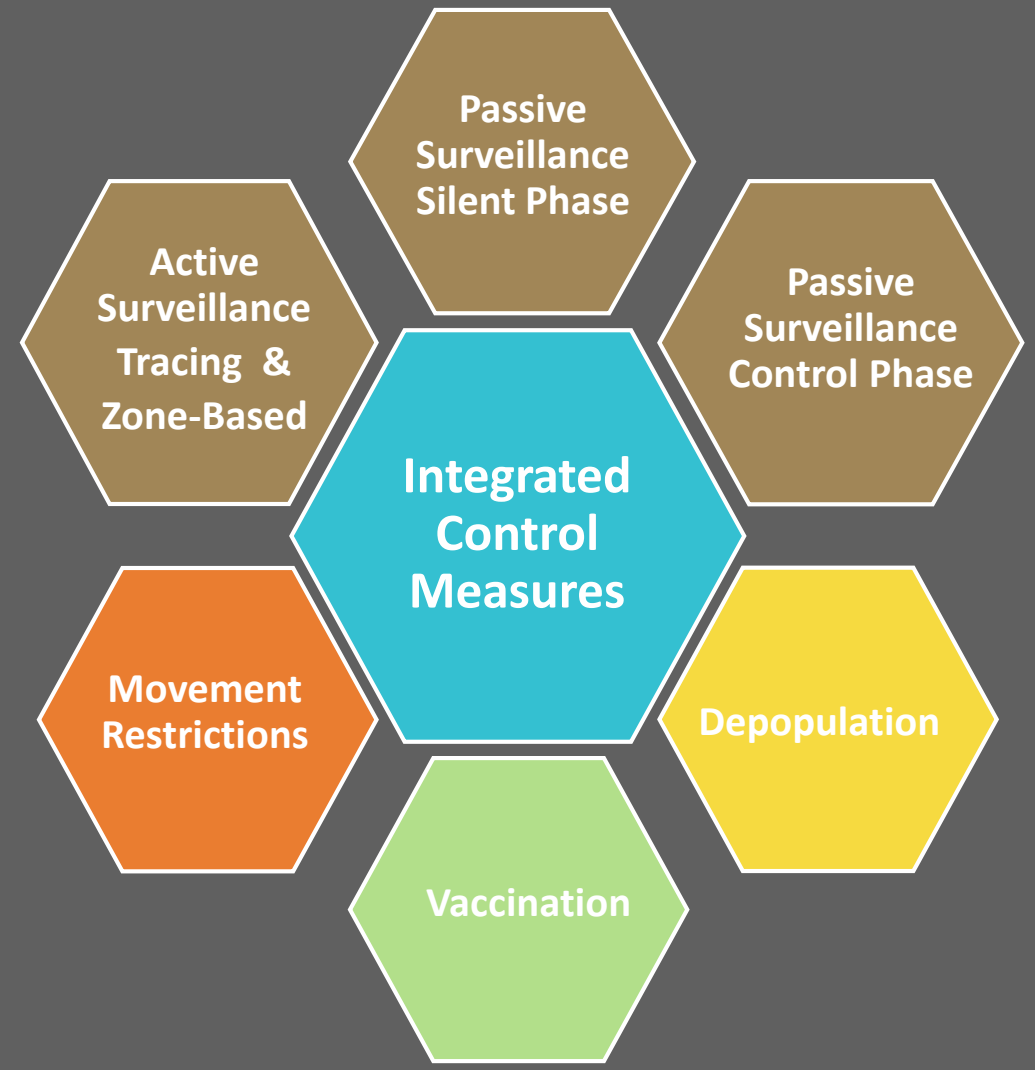
The model accounts for variability in input parameters and chance through the running of multiple iterations

ADSM is a state transition model



In ADSM, units move through the natural progressions of disease states. The model is considered to be compartmental, since a unit can only be in one disease state at a time. This is similar to the concepts in a S-L-I-R epidemiological framework.

ADSM can use a variety of control measures that may be combined and applied in specific ways to modify the disease outbreak



ADSM can simulate “what-if” questions

Some questions might include:

In a given environment, what management practices result in decreased disease spread?

What are the potential impacts of resource limitations, such as vaccination capacity or depopulation capacity on our ability to control a disease outbreak?

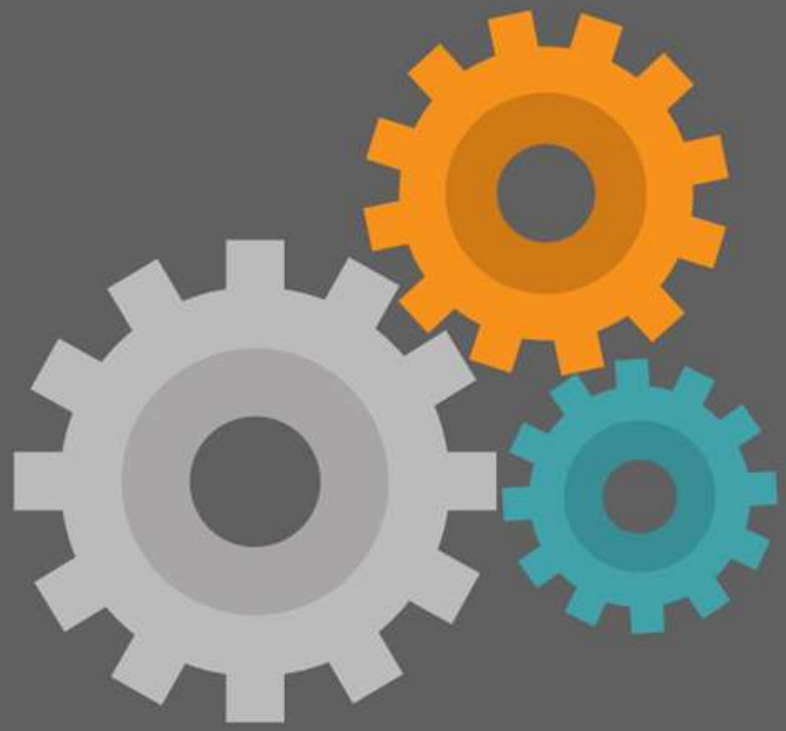
What are the potential consequences of the introduction of a foreign animal disease into a population?

What might be the most cost-effective response to an outbreak?

What parameters is the model most sensitive to that would identify data collection needs?

What might the silent spread phase of a disease outbreak look like?

Resources



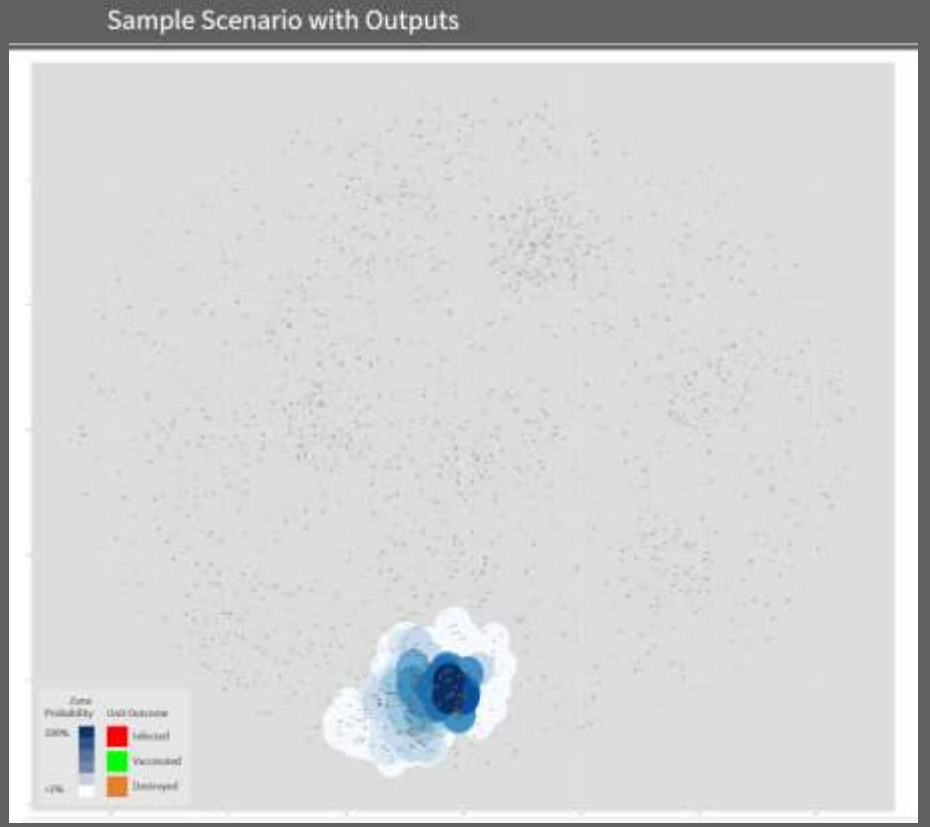
Resources for ADSM

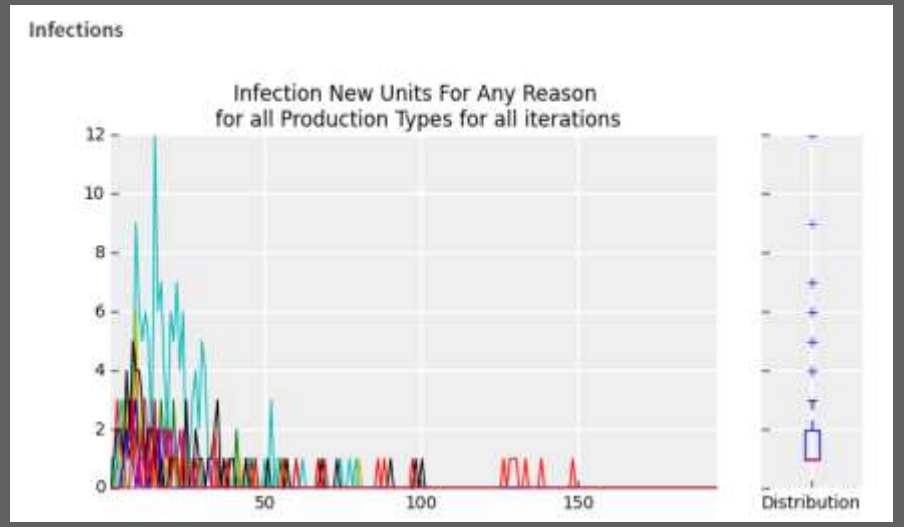
Sample Scenarios

ADSM is installed with example scenarios, named Sample Scenario and Sample Scenario with outputs. These simple examples have a circular population that is located in an unlikely location for disease spread. As indicated by the name, one scenario has been run and already has results in the database.

A variety of relational functions and probability density functions are included in the Sample Scenario. These functions are also just examples and not intended as scientific inputs into a specific simulation modeling question.

Parameters have been named to give you an example of the importance of following a consistent naming strategy throughout the application. Parameter names are all user-defined.



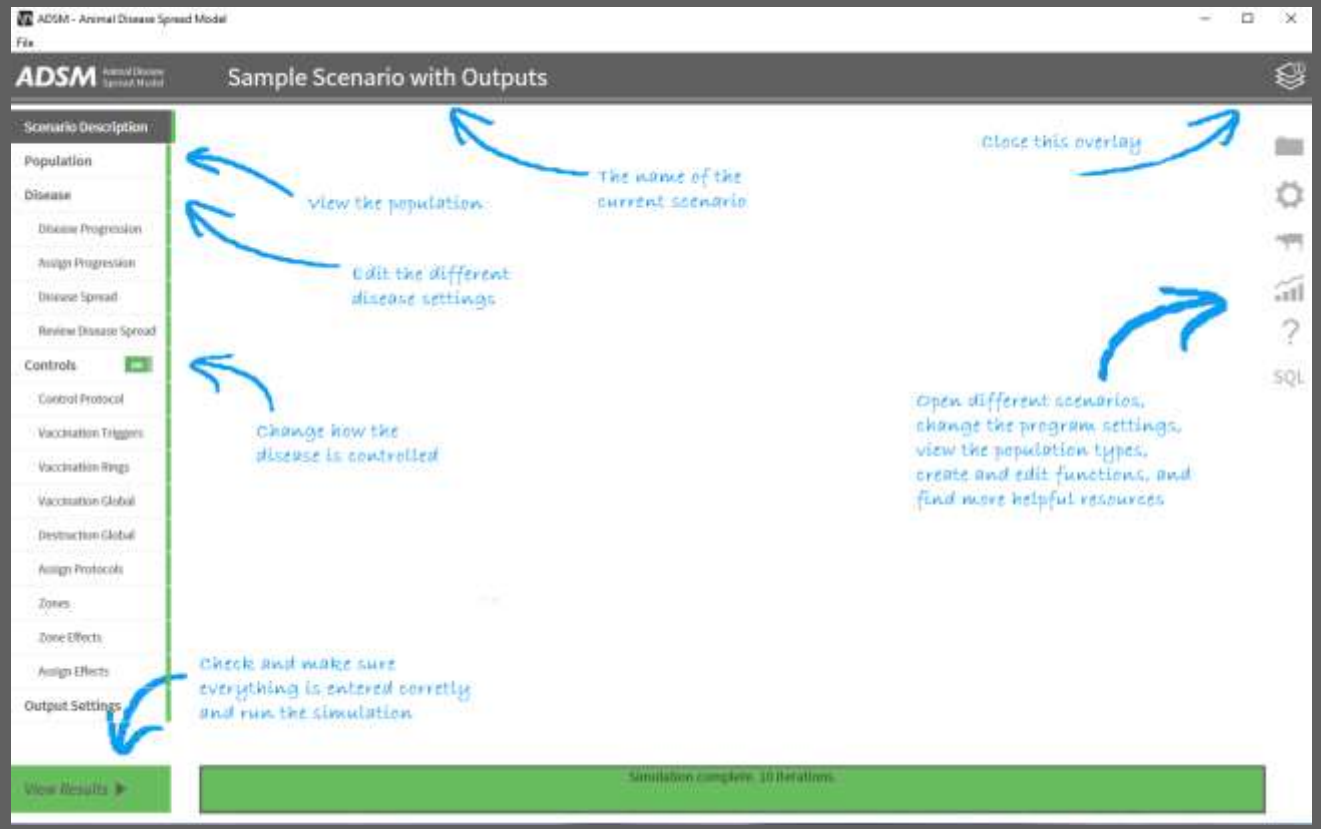


Resources for ADSM

Overlay

The overlay is to help first-time users become familiar with the different parts of the ADSM screen.

Once you know your way around, toggle the overlay off with the stacked pages button in the top right corner.

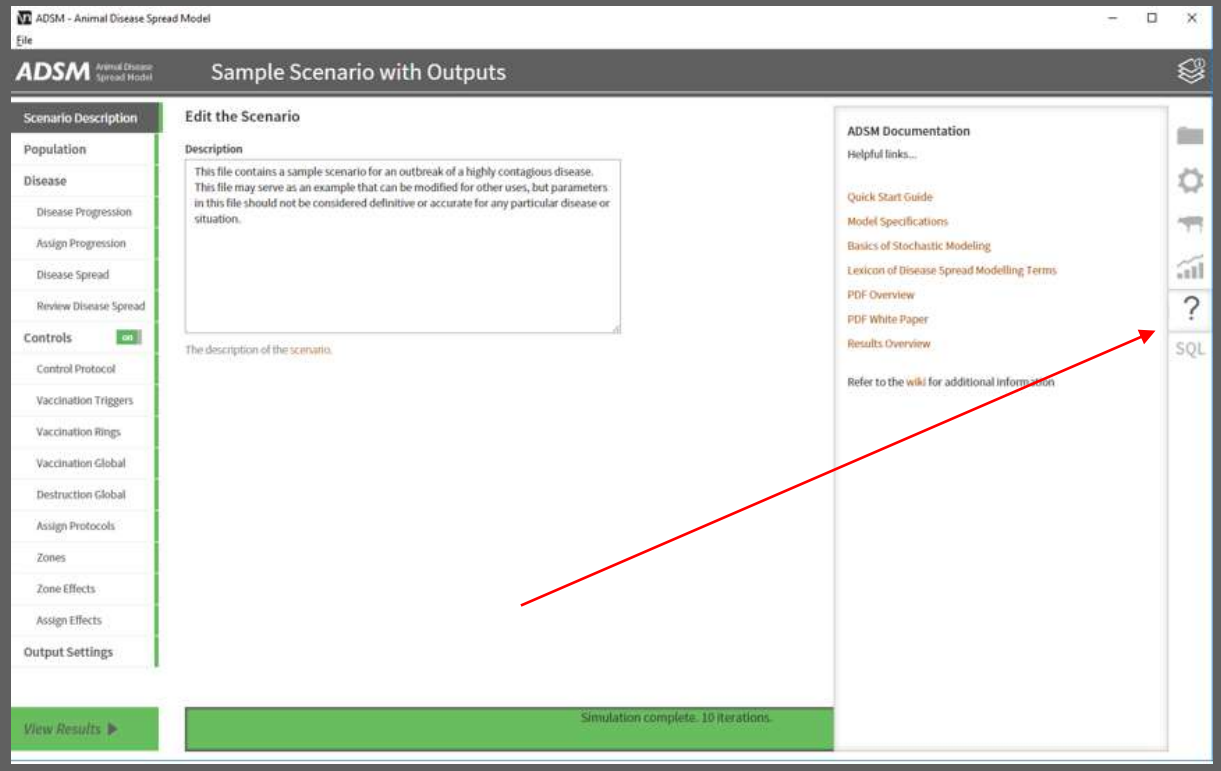


Resources for ADSM

Documentation Panel

The Documentation Panel will fly out from the right side of the application when you push the ? button.

The Documentation Panel includes links to the top items to help users get started using ADSM. It also contains a link to the general wiki pages.



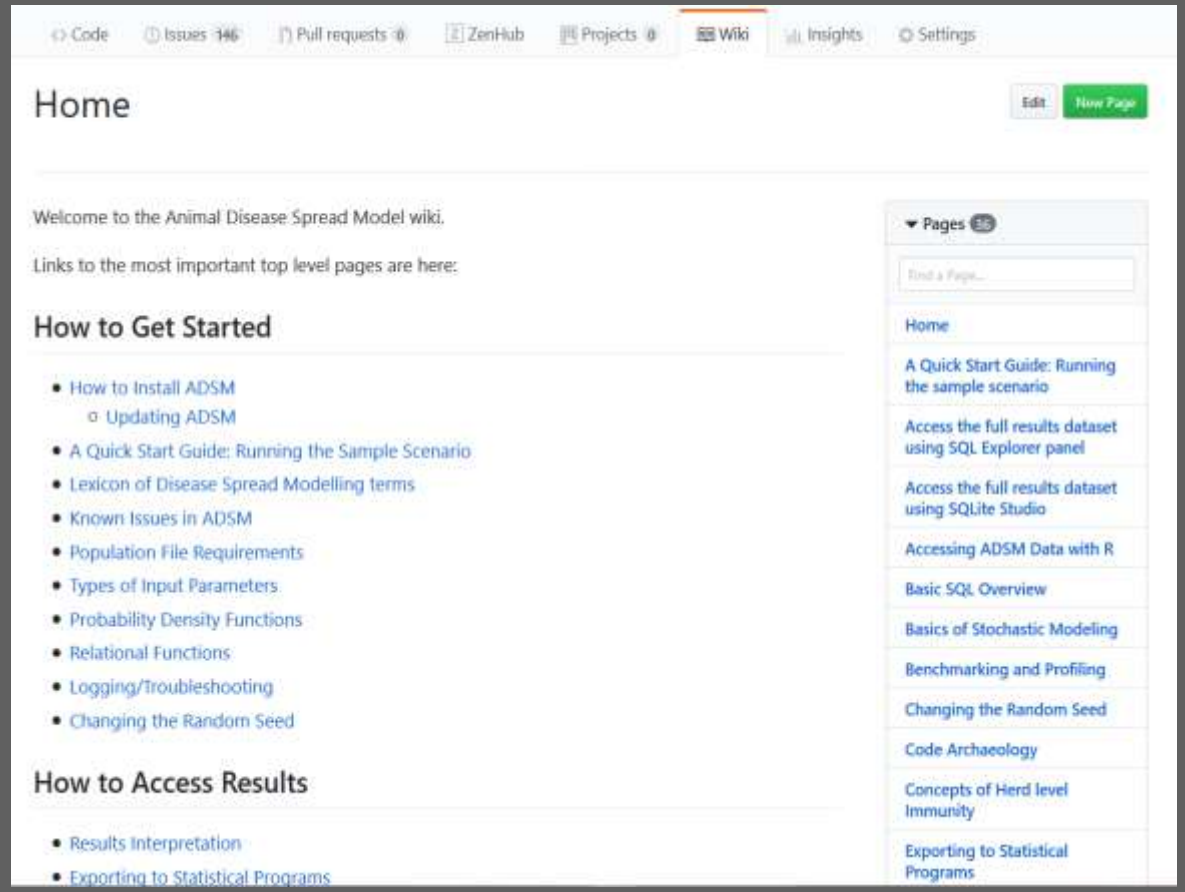
Resources for ADSM Wiki Pages

The ADSM Github site hosts the ADSM Wiki.
https://github.com/NAVADMC/ADSM/wiki

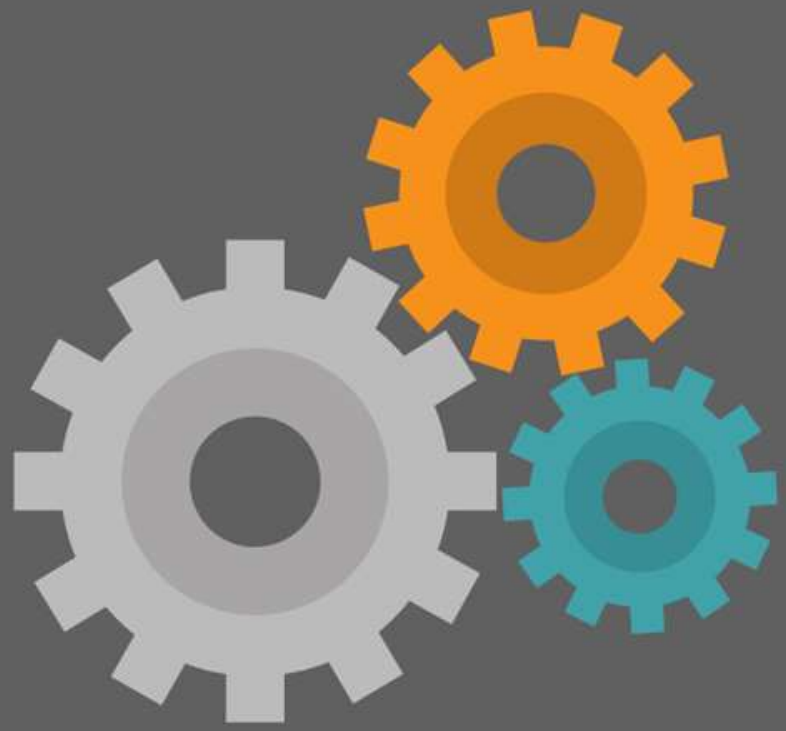
The wiki is the first location where documentation is posted. The documentation includes items for end users of the application. It also includes technical documentation that supports the developers and technical team that works behind the scenes on ADSM.

The in-line help that is within the ADSM application is hosted from the wiki site.

There is also useful information to help understand some of the complex concepts, such as the Model Specifications. We will never be able to fit everything into training materials, so please dig into the wiki to learn more.

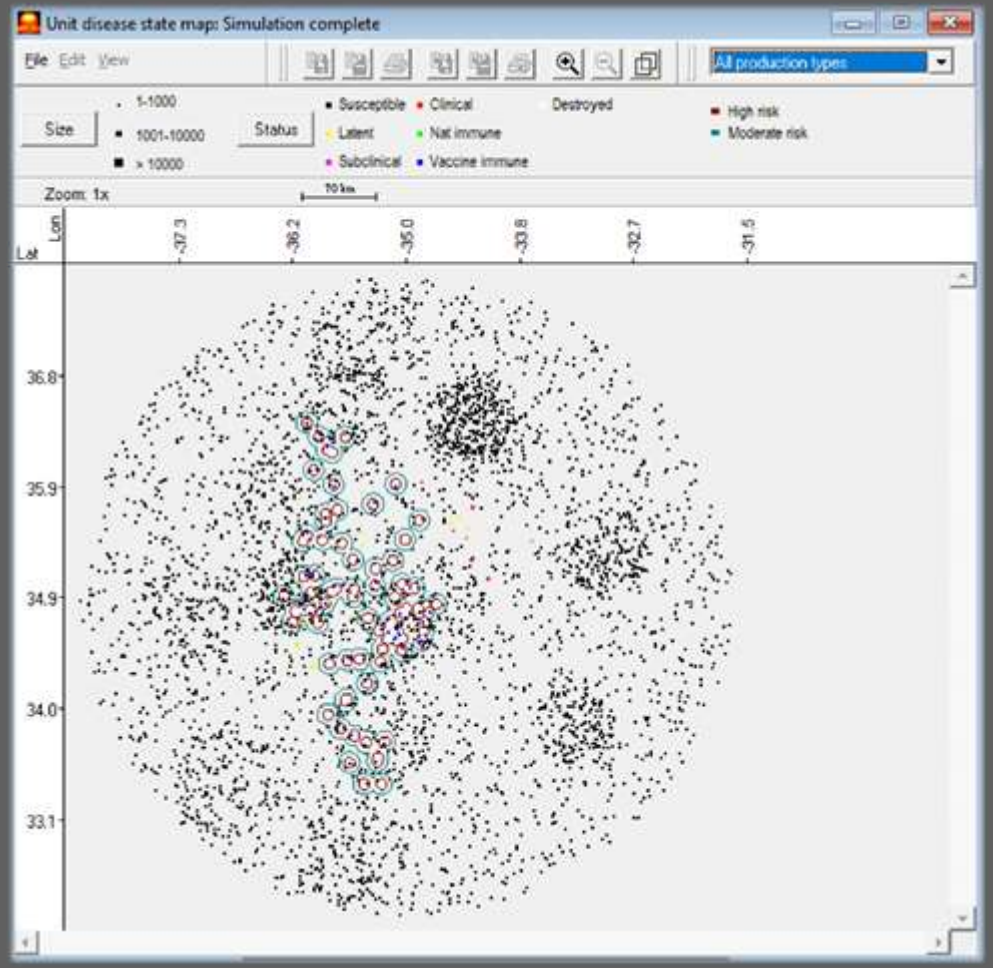


History



The History of ADSM

ADSM is based on the North American Animal Disease Spread Model (NAADSM). The models share the same logic engine to drive the spread and control of highly contagious animal disease.



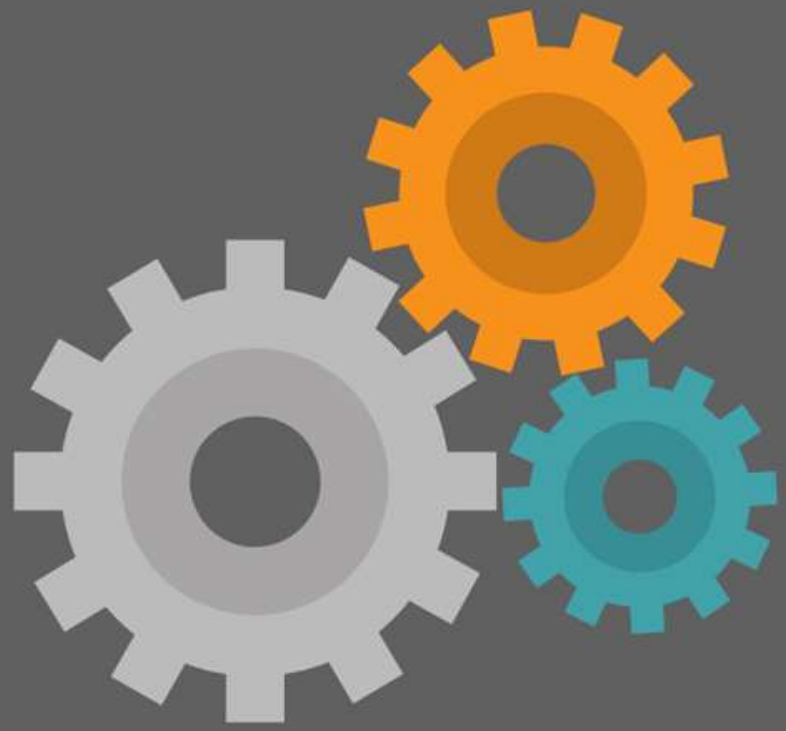
NAADSM has been used to simulate Avian Influenza, Foot-and-Mouth Disease (FMD), Classical Swine Fever and other highly contagious diseases. NAADSM has been featured in many publications since its release in 2006.

ADSM Focus

NAADSM and therefore ADSM were originally designed for North America, to simulate the highly contagious diseases that are of most interest to users based in Canada, the United States and Mexico. Users in other parts of the world may want to consider the complexity of the disease situation they are wanting to model before deciding if ADSM is the best tool for the questions they would like to answer.

It may also be that no other tools are available that remotely address the questions a researcher is attempting to answer. In that case, a tool that is informed by scientific inputs to represent aspects of the system of interest can be more informative than not having any information to address the question of interest. ADSM may be able to fill that role. For example, ADSM does not specifically address vectors or vector-borne diseases. However, ADSM could be used to follow the indirect spread of disease after the introduction of a vector-borne disease.

What’s Next



Join the flock!
Learn more about ADSM or try an example

ADSM is currently available at https://github.com/NAVADMC/ADSM/releases/latest

Try the sample scenario
https://github.com/NAVADMC/ADSM/wiki/A-Quick-Start-Guide:-Running-the-sample-scenario

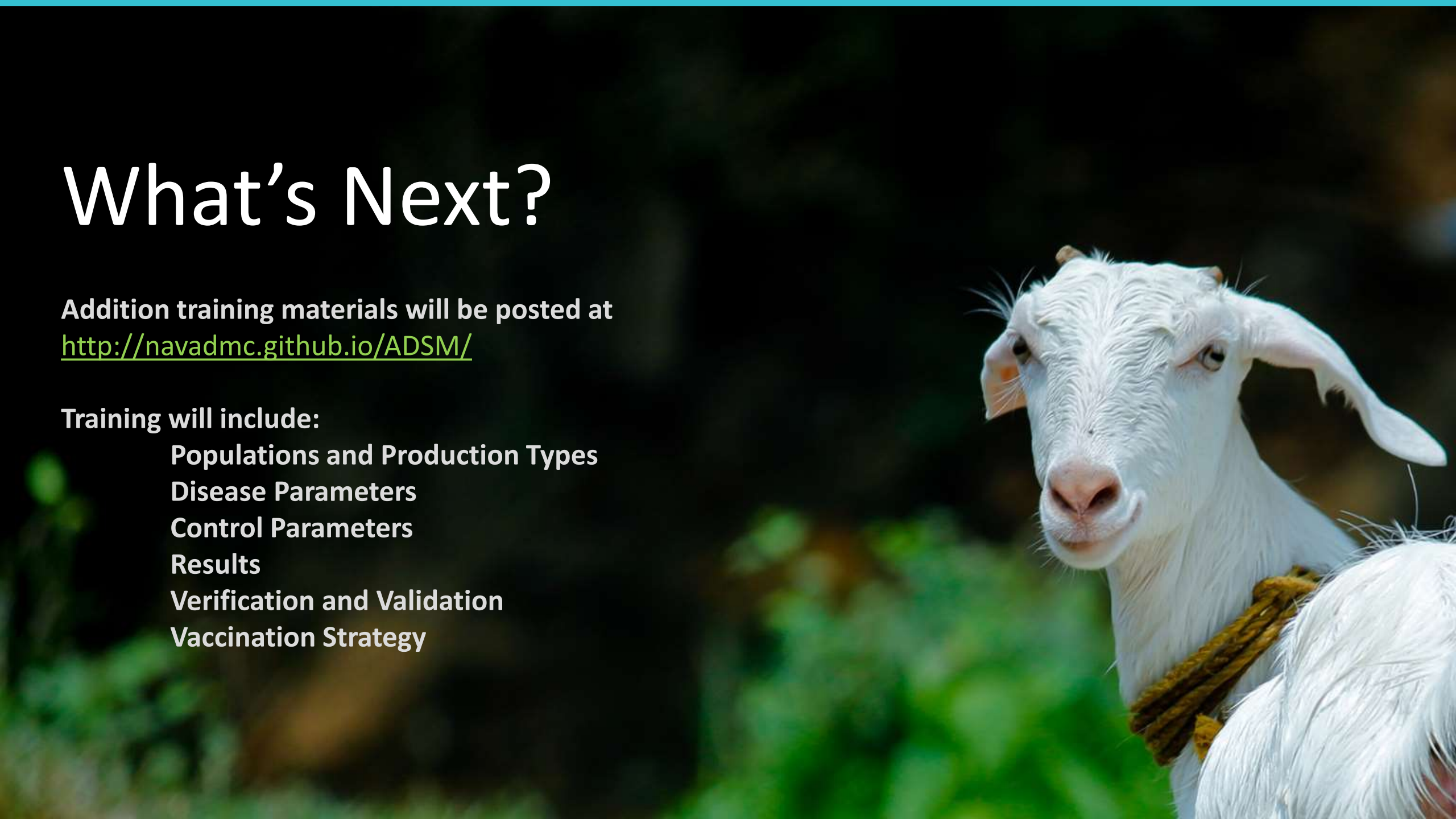
Read the wiki pages link
https://github.com/NAVADMC/ADSM/wiki

What's Next?

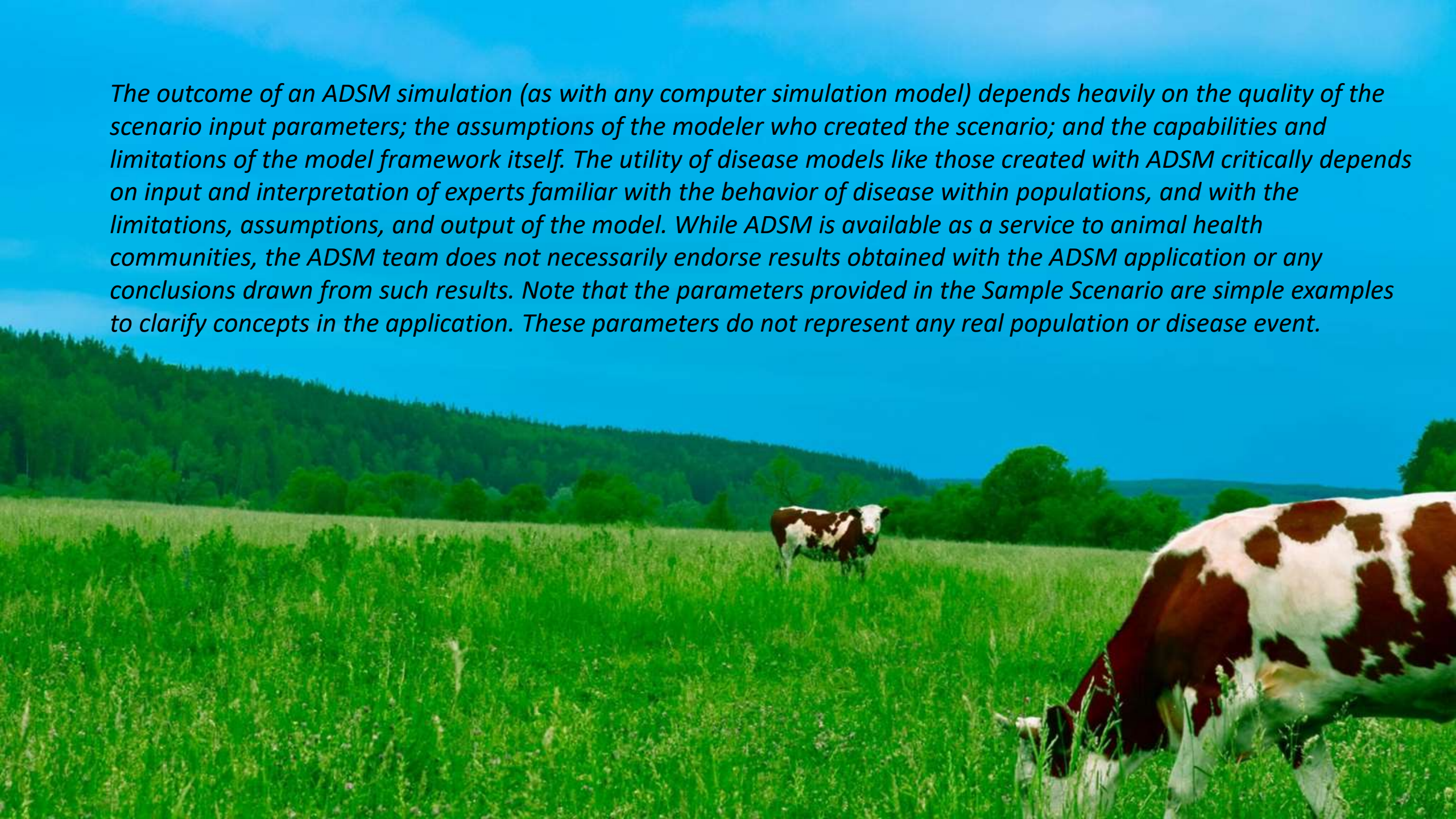
Addition training materials will be posted at
http://navadmc.github.io/ADSM/

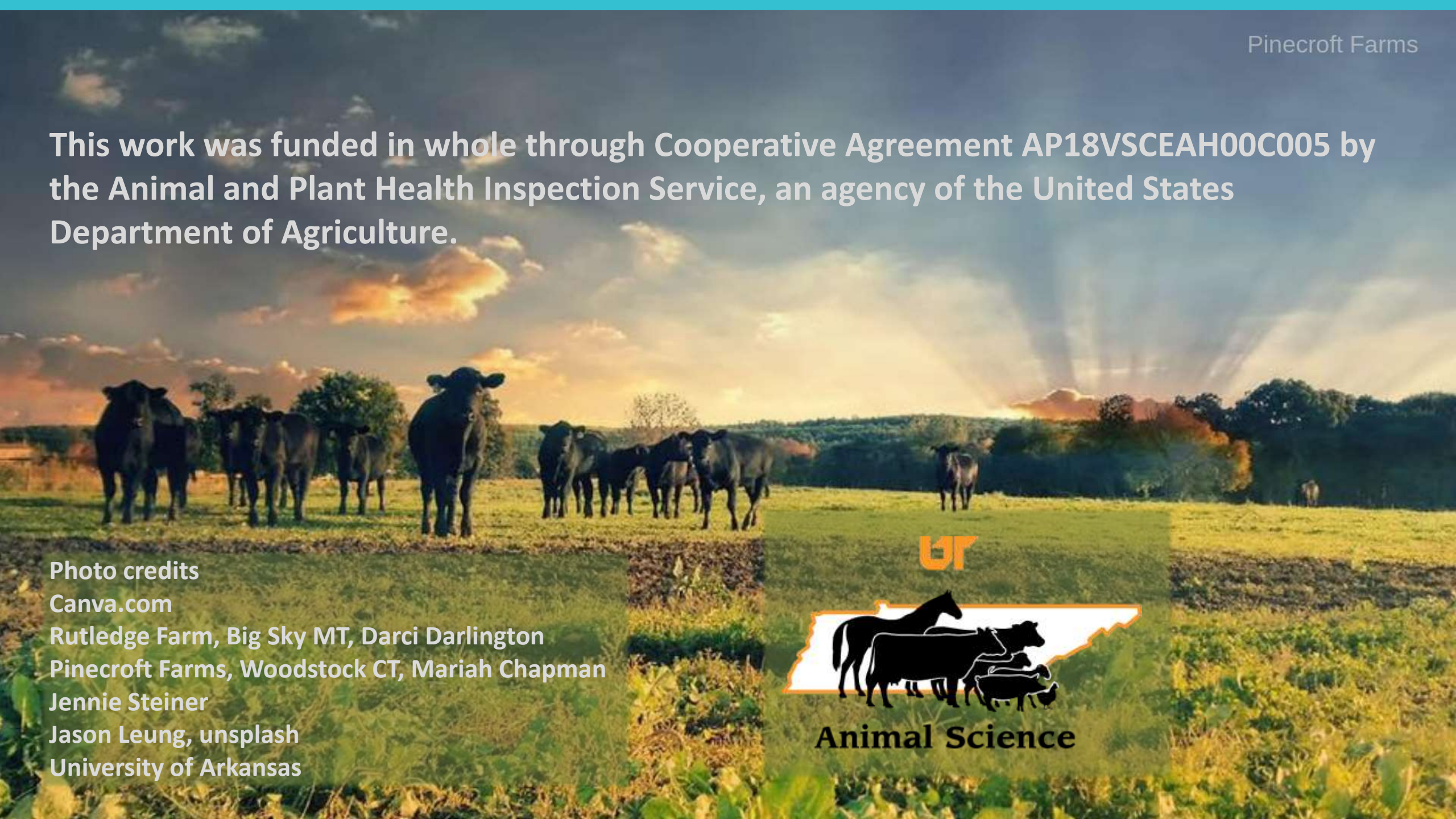
Training will include:

- **Populations and Production Types**
- **Disease Parameters**
- **Control Parameters**
- **Results**
- **Verification and Validation**
- **Vaccination Strategy**



The outcome of an ADSM simulation (as with any computer simulation model) depends heavily on the quality of the scenario input parameters; the assumptions of the modeler who created the scenario; and the capabilities and limitations of the model framework itself. The utility of disease models like those created with ADSM critically depends on input and interpretation of experts familiar with the behavior of disease within populations, and with the limitations, assumptions, and output of the model. While ADSM is available as a service to animal health communities, the ADSM team does not necessarily endorse results obtained with the ADSM application or any conclusions drawn from such results. Note that the parameters provided in the Sample Scenario are simple examples to clarify concepts in the application. These parameters do not represent any real population or disease event.





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