**Use case 1: How much would fertilizer subsidies improve maize production in Ethiopia?**

A domain modeler, Matilda, has been asked to create a series of simulations to explore the benefits of increased fertilizer use on production of maize in Ethiopia. She wants to select a range of values of fertilizer and look at yield improvement and total production increase over baseline conditions resulting from each level of fertilizer application rate increase. She realizes that weather can impact the effectiveness of fertilizer usage, so she chooses to run these simulations for a number of years using historical weather data. (The fertilizer amounts used in the simulations represent increases to the amounts of fertilizer that farmers currently use. The outputs will represent a distribution of potential yield and production increases for each fertilizer level. These are properties of the exposed user interfaces, i.e., the tunable knobs.)

Matilda makes the following selections for the DSSAT-pythia model:

1. Crop of interest: maize
2. Season of interest: meher
3. Fertilizer rates of 10, 25, and 50 kg/ha, expressed as elemental N. (These will always be compared against a baseline condition. If the baseline has not already been simulated, a value of 0 must be added to the array of fertilizer offset values.)
4. Weather years selection is the full period of record, including all complete years of weather data.
5. Area of interest: Ethiopia (We can’t currently clip the simulations to a smaller area. We can, however, subset the output data to a sub-area.)

Simulations are done using baseline conditions, perturbed by the three levels of fertilizer increase. The DSSAT-pythia outputs in csv format are stored in a data cube (with the baseline outputs) and are ready for analysis. (Alternate ending: outputs are provided as yield difference maps and the increase in total production by Region for each fertilizer level.)

**Processing workflow**

* 1. **SuperMaas pre-processor:** Modify the pythia config file to use the array of fertilizer application offsets.
  2. **DSSAT-pythia container:** Run the model using modified pythia config file
  3. **SuperMaaS post-processor:**

SuperMaaS must provide some post-processing of outputs outside the DSSAT-pythia container because some of the analysis may include previously archived simulated outputs. Some post-processing will be specific to the DSSAT-pythia output formats and structure (e.g., aggregation over the 4 SPAM management regimens), but some methods may be common with other models.

Post-processer outputs for this use case:

* 1. DSSAT-pythia per pixel outputs – no post-processing
  2. Average yield diff maps for the area of interest. Each pixel shows mean difference in yield over all weather years.
  3. Production diff maps for the area of interest
  4. Increase (or decrease) in aggregated total production for the area of interest under each scenario. This is either a single number (i.e., mean value) per fertilizer scenario, or could be presented as statistical summaries (e.g., percentiles).
  5. Increase (or decrease) in yields for the area of interest. As with production, these could be expressed as averages or as statistical distribution.
  6. Total amounts of total and additional fertilizer applied (tonnes [N]).
  7. Other variables could be explored (e.g., if environmental concerns are important, N leaching could be output). We would need a simple interface to make flexible selection of output variables.