Incorporating breeding and genetics as part of enhancing, harmonizing and applying models

- Why is this action item important/ why should it be addressed?
    - Genetics and plant breeding are technological ways of adapting to climate change
    - Cultivars will be developed with tolerance to high temp, drought, salinity, diseases, insects, etc.., and we need models that can include these technologies.
    - Modeling has been underused due to data access, perceptions of inaccuracy… that have recently been less severe.
    - Progress in breeding is less than desired. Models can assist with complex responses of G to E x M.
    - De-complex G x E x M
    - To use models more effectively for projecting climate change impacts
    - Models are one of many efficient tools to harmonize complex data to derive some actionable item/ decision. How else one could harmonize such issues, so I consider use of models as one of the tools.
    - Genetics are rapidly advancing and new possibilities for adaptation will likely result.
    - Breeding gains could be further maximized with these efforts.
    - Increase fundamental understanding of crop physiology.
    - Availability of genetic, weather and soil data has greatly improved, making it more realistic/practical to employ models in breeding.
    - May be able to help with abiotic stress tolerance
    - Increase efficiency of testing
    - Accurately constructing artificial selection environment for abiotic stress tolerance.
    - Increase gain from selection
    - Large gap between agronomic models and phenotype and genotype models.
    - Population increase
    - Feed the 10 billion with less natural resource extraction
    - Complex issue, needs lots of input from various experts.
    - Not currently being done, but could be effective.
    - Improve our image – Borlaug with Google Glasses – Plant breeding is cool.
    - Stakeholders have issued for more involvement from breeders
    - Need to engage private sector breeders in this effort.
    - Modeling climate change effects to target traits
    - Modeling changes of genetic effects on other organisms in system
- What needs to be addressed within this action item?
    - Get the agronomist involved in to make more understanding between crop modeling and genetic scientist.
    - Develop collaborative projects between breeders and modelers.
    - Need to identify plant breeders and geneticists that would like to integrate their work into crop models.
    - Develop team of breeders and crop modelers to incorporate genes into models.
    - Identify one or ensemble of models to do item listed in question one. How this could be achieved? What geographical locations to consider based on a priority.
    - Efficient ways to collect, store, and analyze data.
    - How are models updated as more information is generated.

- Votes
    - Unknown subject 1 = 10 votes
    - Unknown subject 2 = 6 votes
- Data- Additional added sheet
    - Steps
        - Identify case studies to start with
        - Standardize data collection and description
        - What type of population do you use
        - Collect data on management
    - When
        - Soon
    - Resources
        - People- $$
        - Time and talent
        - Genotyping
    - Communication
        - Enhance
    - Success
        - Prediction of traits (quantitative) (low h2)
        - Useful to breeder
- Collaboration – Additional added sheet
    - Needed for Progress?
        - Teams for collaboration in Wheat and Maize
        - Identify modelling and breeding scientists willing to collaborate
        - Private sector – public partnerships (Identify pre-competitive space)
    - By When? How long?
        - Sustainable funding- NSF
        - Several years to breakdown silos
    - Resources
        - Genetic resources
        - Mapping populations
        - I/U CRC
        - Funding
        - Access to public wheat data sets (T3)
    - What would success look like?
        - Current progress in yield 0.7%/yr
        - TPOC for collaboration 1. 4%/yr
- Additional Sheet
    - Genetics – 6 votes
        - Need better understanding of genetic control of traits used in models
        - Reduce error in yield trials with environmental covariation
        - Gene based information that can be "translated" physiological processes that can be modeled
        - Accessibility of data and germplasm. Freedom to operate

- - - Need efficient data pipeline to link data from breeding work with models G, E, M, and P.
    - o Money – 6 votes
      - - Determine how to influence funding agencies to recognize value of collaboration efforts between modeling community, climate scientists and breeders/crop physiologists/agronomists.
      - - Obtain financial resources for model improvement
    - o Phenomics – 8 votes
      - - Continuing education in spatial statistics relevant to TAIS topic
      - - Need to identify what characteristics we should be looking for in future plants
      - - Simplify selection
      - - Commitment by breeders and agronomists to standard phonological descriptors
      - - Need much better physiological data for lines. (Use phenotyping tools)
- Uncategorized Notes
  - o Predictive recommendation for use of cultivars
  - o Need models that are easily modified to consider traits of value for breeding
  - o Some best practices for environment monitoring of trial sites
  - o Improve data capture tools
  - o Automate image/sensor data capture
  - o Build predictive models for yield limiting factors
  - o What information needs to be collected to develop models.