# Ph.D. Defense Announcement
# William Lassman
# December 17, 2019 at 9:30 a.m.

**William Lassman**
**Ph.D. Defense**

Tuesday, December 17, 2019
9:30 a.m.

Defense
ATS Large Classroom (101 ATS)

Post Defense Meeting
Riehl Conference Room (211 ACRC)

Committee:
Jeffrey Pierce (Advisor)
Jeffrey Collett (Co-advisor)
Emily Fischer
Jay Ham (Soil and Crop Sciences)

Using modelling tools to advance understanding of ammonia dry-deposition and bidirectional flux processes next to large animal feeding operations

Ammonia is the most abundant alkaline species in the atmosphere, and an important source of reactive nitrogen to the environment. While ammonia is naturally produced by microbe-catalyzed chemical reactions in soils, plant roots, and oceans, this natural ammonia formation has been eclipsed by anthropogenic production in the industrial Haber-Bosch process. Synthetic ammonia is used as fertilizer in agricultural operations, and is incorporated into biomass that is used to produce crops. When these agricultural products undergo digestion, excretion, and decomposition, the ammonia can escape back to the environment. Consequently, biomass and animal waste operations can be sources of ammonia to the environment. Large Animal Feed Operations (AFOs) are some of the largest point sources of ammonia to the environment, and can have large impacts on regional reactive nitrogen deposition and air quality.

Ammonia can stick to surfaces, and is absorbed and emitted by plant matter in a bidirectional flux process, which depend on the environmental conditions, surface properties, as well as the ambient ammonia concentration. While these surface interactions are complex and difficult to study, the deposition rate is known to be high downwind of AFOs, where the surface concentrations are 4 orders of magnitude above typical ambient concentrations. However, surface concentrations rapidly decrease due to dilution, in addition to deposition, and the fraction of total ammonia emissions that undergoes deposition near (i.e., within 10 km) of the AFO is highly uncertain. First, I will present modelling results using a coupled K-Epsilon Lagrangian-Stochastic Ammonia Bidirectional flux modelling system to simulate dispersion and bidirectional flux processes downwind of an AFO. This modelling framework is used to estimate the relative effect of different land surface types on the amount of ammonia deposition near the AFO, and to identify the critical parameters and environmental conditions that can impact these results. Next, I will show results from a study where we use Large-Eddy Simulations of ammonia and methane dispersion from a cattle AFO to develop a novel approach for quantifying the ammonia deposition using UAV-based measurement systems. Finally, I will briefly share some measurement results of PM2.5 concentrations and composition from Botswana, a country where beef and livestock production is an important economic activity, but with very different management practices, and against a different backdrop for air quality and emissions.