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**GAIL S. K. WOLKOWICZ**, McMaster University  
*Analysis of a Symplified Model of Anaerobic Digestion*

Anaerobic digestion is a complex naturally occurring process used for waste and wastewater treatment to produce biogas as a renewable source of energy. The detailed Anaerobic Digestion Model No. 1 (ADM1) includes 32 state variables and is not mathematically tractable. Bornhoft, Hanke-Rauschenbach, and Sundmacher [Nonlinear Dyn., 73 (2013)] introduced a qualitative simplification of the this model. The global dynamics of this simplified model will be obtained by first analyzing the limiting system, a model of single species growth in the chemostat in which the response function is non-monotone and the species decay rate is included to complete the theory for the chemostat in this case. Using a Lyapunov function argument and the theory of asymptotically autonomous systems, it will be shown that even in the parameter regime where there is bistability, no periodic orbits exist and every solution converges to one of the equilibrium points. Then two algorithms for stochastically perturbing the parameters of the model will be described. Simulations done with these two algorithms will be compared with simulations done using the Gillespie and tau-leaping algorithms. Finally the dynamics will be compared with the dynamics predicted by the ADM1 model and other simplifications of the ADM1 model.

This is joint work with Tyler Meadows and Marion Weeder mann.