Week 2

Louis Nass

Monday 6/5

Met with Dr. Spiller, decided to choose the Lorenz '96 equations as the higher dimensional non-linear system to study. The equations go as follows:

$$\frac{dx_i}{dt} = x_{i-1}(x_{i+1} - x_{i-2}) - x_i + F - \frac{hc}{b} \sum_{j=J(i-1)+1}^{iJ} y_j \tag{1}$$

$$\frac{dy_j}{dt} = -cby_{j+1}(y_{j+2} - y_{j-1}) - cy_j + \frac{hc}{b} x_{floor[(j-1)/J]+1} \tag{2}$$

[Leib-Lappen]
The first goal is to solve the system, similarly to Leib-Lappen and Danforth in their paper. I additionally continued to read and annotate Morgan Frank, Lewis Mitchell, Peter Dodds, and Christopher M. Danforth's article from last week. In preparation for weeks to come, I found additional articles referring to Kalman Filters, they are "Ensemble-Based Atmospheric Data Assimilation: A Tutorial" by Thomas M. Hamill and "Introduciton to Ensemble Kalman Filters and the Data Assimilation Research Testbed" by Jeffrey Anderson, Tim Hoar, and Nancy Collins.

Tuesday 6/6

Attended the Ethical Research (RCR) Seminar given by Dr. Dennis Brylow. I learned many important aspects of ethical research practices that will protect me as I continue my research here at Marquette and potentially in the future.
Continued reading and thinking about the solutions to the Lorenz '96 equations.

Wednesday 6/7

Spent time drawing out and attempting to solve the Lorenz '96 equations using MatLab. From Leib-Lappen and Danforth, I discovered that they used the Runge-Kutta method. I found and read the following articles regarding the Runge-Kutta method:

- "Error estimates for Runge-Kutta type Solutions to systems of ordinary differential equations" by R. England
- $http://lpsa.swarthmore.edu/NumInt/NumIntFourth.html$ by Eric Cheever
- $https://math.okstate.edu/people/yqwang/teaching/math4513_fall11/Notes/rungekutta.pdf$ by unknown

Thursday 6/8

Continued to read and try to understand the Runge-Kutta method. Referred to Dr. Spiller who believes that I should try to solve the system using the MatLab function ODE-45, so the knowledge is not entirely needed. Began the coding for the system. Spent time writing the system by hand to discover the problematic equations i=1,2,I and j=1,IJ-1,IJ and saw the cyclic relationships

Friday 6/9

Continued studying and toying with the system on paper and on MatLab, did not yield results that I was expecting. Tried first by coding a program for only the x_i equations, without the summation of the y_j's. Was unsuccessful. Planning on seeking guidance from Dr. Spiller in the upcoming week.