Light Field Modeling in *Saccharina Latissima* Cultivation Near Wastewater Effluents Using Radiative Transfer and Mie Scattering

**Part I**

1. Introduction
   1. Why grow kelp? – Bioenergy, food, water purification, high-value chemical derivatives, etc.
   2. Context – MacroSea project in Northern Europe is seeking to industrialize kelp growth, Shane Rogers is investigating growing kelp near ocean outfalls from wastewater treatment plants
   3. Objectives - Create physically based & efficient model for light field, predict kelp biomass yield in clear water vs. various types of effluent
2. Literature Review
   1. SINMOD & Ole Jacob Broch’s kelp model
   2. Other kelp models
   3. Radiative Transfer Theory in Ocean Optics – Curtis Mobley
   4. Mie Scattering Theory
   5. Experimental results – Absorption & scattering coefficients, volume scattering function

**Part II**

1. Light Model Description
   1. Fundamental assumptions
   2. Frond geometry
   3. Domain geometry & boundary conditions
   4. Numerical solution technique
   5. Simplified model & implementation
2. Experimental Investigation
   1. Experimental Design
   2. Data Analysis & Parameter Determination
3. Kelp Simulation
   1. Run Ole Jacob’s kelp model w/ my light model - results & comparison to previous light model

**Part III**

1. Mie Scattering to Determine Inherent Optical Properties
   1. Objective - Try to determine absorption & scattering coefficients and volume scattering function (scattering phase function) based on water quality parameters (turbidity, particulate matter content, etc.)
   2. Pick a few specific examples to use based on effluent quality regulations (e.g., NYC, Trondheim, small municipality)
   3. Approach & calculations
2. Effluent Simulation
   1. Run Ole Jacob’s model with my light model with the calculated optical properties for each example location & predict biomass yield
   2. Briefly describe economic feasibility

**Part IV**

1. Conclusion
2. References