Lucas PASI Lecture Outline---Implications on Water Quality

I. Transport-Reaction Equation for water quality constituents
    a. Starting with a conceptual model
    b. General equation
    c. Reducing general equation to salient terms for different kinds of problems/systems
        i. 1D vertical
        ii. Depth-averaged
        iii. 1D longitudinal
        iv. etc
II. Net horizontal transport: Transport time scales and implications for water quality
    a. Different kinds of transport timescales (e.g. residence time, flushing time, age, …), their calculation and assumptions *(if it makes sense for an earlier lecturer to cover this, that is fine)*
    b. Timescales describing biological or chemical processes
    c. Implications of transport timescales for reactive water quality components
        i. Idealized conceptual model of flushing, sources and sinks for reactive constituent in a net advective system (e.g. phytoplankton as a function of residence time, growth, and grazing)
            1. Derive it
            2. Plot it
            3. Examine trends
        ii. Why there can be different kinds of relationships between things like phytoplankton and residence time
        iii. How/why real, esp. tidal systems deviate from conceptual model, but why the conceptual model is useful anyway, for any reactive constituent
III. Vertical variability and transport processes: stratification and turbulent mixing
    a. Different kinds and timescales of stratification
        i. Periodic
        ii. Persistent
    b. Implications for phytoplankton dynamics & dissolved oxygen
    c. Scaling to better understand physical-biological interactions
        i. Estimating and combining timescales for physics and biology
        ii. Peclet number
IV. High-frequency variability: hourly scale physical-biological interactions and water quality flux
    a. Tidal dispersion
        i. Mathematical representation, assumptions
        ii. Measurement
        iii. Examples
            1. Salt transport
            2. Phasing of tides with biological processes controls flux of phytoplankton
    b. Tidal sloshing
    c. Implications for monitoring
V. Modeling transport and reactions of water quality *(if I have ample time)*
    a. Why do we use models?
    b. How do we use models? (philosophies, connections with field and lab)
    c. How do we build a model?
    d. How hard is it to get “good” answers?