Apitz/Ianuzzi group

What do we know?

- What is known about changing environmental conditions?
  - Sediments will change
  - There will be impacts
  - Systems are complex and heterogeneous
- Can take these things we know and build a conceptual model to predict how these changes might manifest as impacts
  - Heterogeneity is not an insurmountable challenge
  - Change may not require us to develop ‘new’ models, but to shift the elements of the models we currently consider most important ... Shift the drivers

Static is bad

- Better to assess / measure adaptability and function than specific conditions.
- May need new tools to do this
- Baselines are a bad concept
- Reference envelopes are better; still based on structure, rather than function ... We need functional / service based reference envelopes ... What do we want to maintain in a waterway
- Standard methods would help

What we don’t know

- Can never correlate sediment composition with biological properties ... Triad approach came from this reality
- Chemicals may not be the most important pressure, and may be even less important going forward if our objectives are to preserve functioning ecosystems ... Means regulators may have to ask different questions, look at multiple stressors (not only contaminants)
- Don’t necessarily have the ability to measure adaptability at the moment
- Changes to variables over time have not been considered in many current models
- Link between measures and models, between biology and chemistry
- Need to understand dominant processes in a changing environment ... The ‘master’ variables that will enable predictions of the impacts of change
- Predictions in different types of sediment environments will also be important (e.g. Fluvial, estuarine, marine, etc)

- Baseline conditions
- Restoring a specific condition may not be as important as restoring or maintaining the adaptive qualities of a site or system
- Change is not inherently bad
- We’re not managing static sites, we’re managing dynamic systems
- Restoring something to today’s condition 50 years from now may create a threat
- Why climate change as a focus? Many basic mechanisms are not understood – will we understand them when we see what climate change does? Climate change brings research funds! Really, change is inherent even without climate change
- Understanding the fundamentals will improve our ability to characterize risk, and to predict what change will do in a system
- Measurement should be the basis for risk assessment – standard methods for measurement (chemistry, toxicity, benthic community) are needed
- Standards will help regulators to adapt over time
- Consensus based values for PECs etc
- Necessary to conduct toxicity tests or only measure these 28 compounds, then say sediment is high or low risk?
- Consensus based values are really averages of data ... Not consensus at all
- Dose response curve effect values are often much higher than PEC values
- Maybe, with more does response data, could use PEC values in future as screening tools – shouldn’t be used as stand alone decision making points; just, below this level, there is no risk to organisms in contact with sediment
- How many contaminants are enough? What about mixtures?

- Do we need more toxicity tests if we have tEL/PEL values? Yes!
- Bioassays that are more sensitive, perhaps not on the organism scale ... Even though these tests will be less ecologically relevant
- Often a push toward more sensitive bioassays ... Then to regulate based on these ... Is this really the most relevant? What makes a particular test sensitive?
- Increase period of time tested, and what happens beyond a direct effect / exposure ... When do organisms recover? Should assays look at spp? No, ecological traits ... Benthic community, carbon cycle ...
- Resistance and resiliance as a function of stressors over time
- Functioning of ecosystems must be evaluated by identifying key functions / traits; must also look at time ... Longer time periods are needed to evaluate ecosystem functions
- Short term experiments (e.g. On young fish) are not enough ... Tells us nothing about adult fish and lifetime / community effects; also, lab mimics ideal conditions (single temperature) whereas the real world is not so stable
- Is this functional benthic community – may be a better question than whether the community is the same as it used to be
- May lose some species over time, but unless they are keystone species, it might not matter
- Field organisms are often adapted to elevated contamination or other local stresses - not reflected in laboratory toxicity tests
- PICT (pollution induced community tolerance)
- There are genetic adaptations as well
- Well adapted to a particular environment does not mean adaptable to change
- From an engineering perspective, can model transport, but biological components are harder to model; need to know which mechanism is responsible for the resuspension, and how to extrapolate these micro scale processes can be extrapolated to larger system scales

- Reality is that process heterogeneity is out there in any system (even among replicates) ... Idea isn't to measure everything at every scale forever, but to get enough to be able to put error bars on our cores ... To generate more reaslistic, less idealistic estimates ... i.e. Determine what the 'master' variables are at particular sites
- Getting better at predicting particle behaviour on the bottom and in the water column ... Can't truly predict at the catchment scale, but can come up with better estimates (we now many of our current models are over simplistic ... Better to start with understanding how complex reality is, then simplifying with our eyes open
- Complexity versus simplification is a perpetual conflict ... Difficult to resolve
- How does biological activity impact physical systems ... You cannot always predict the system (e.g. From pesticide runoff ... Impossible to predict impacts by modelling ... Decided to look at source control instead)
- If modelling is insufficient, or system is too heterogeneous, use model on a larger scale (e.g. For water quality) ... Applying models to larger scales magnifies error / uncertainty caused by local deviances from model assumptions ... Over a large scale, these differences may even out
- Biologists always problems with measuring ... Need more quanitification ... E.g. Measure total biomass and genetic diversity – compare to physical problems
- Biologists are never happy!
- Microbial biomass, part of DNA diversity can be measured, but not all of it corresponds to 'active, living' beings / ecosystem functions
- How scaleable is the concept of ecosystem function to larger, longer scales?
- If you can make a link between function and system (e.g. River basin, estuary system, etc) – can identify functions of a system at any scale based on properties of organisms (how they eat, breathe, move etc).
- But how do changes in benthic community get reflected in the food web - need a conceptual model of ecosystem change based on systems we konw that have changed ... From there start to predict what changes on larger scale systems might be