APPENDIX F

Model Exercise #1 Results
MODEL EXERCISE #1

Group 1

<table>
<thead>
<tr>
<th>Discipline/Model A</th>
<th>Discipline/Model B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical/Hydraulic Modeling</td>
<td>Fish Community Model (bioenergetics and age structure), spatially explicit</td>
</tr>
</tbody>
</table>

Example Problem
Predictions of fish populations in a seasonally flooded wetland

Inputs
- Precipitation/ET (temporal variation), temperature, topography, IC, AC moisture
- Initial population
- Location, life history characteristics, vegetation

Outputs
- Depth, areal coverage
- Fish biomass & location

Limitations
Fish community model is spatially explicit, topography uncertainty, topography accuracy, vegetation type and distribution (roughness)
- IC conditions, data availability, calibration, error propagation
- Limitations in linking: error propagation, spatial and temporal matching of scales

Other Issues
- Operations and regulations
- Large data requirements
- Difficult to calibrate

Group 1 / Model Exercise 1

Physical/Hydraulic Modeling
- Inputs:
  - Precipitation/ET (temporal variation)
  - Topo
  - IC
  - AC moisture
- Outputs:
  - Depth
  - Areal coverage

Fish Community Model
- (Bioenergetics and age structure)
- Inputs:
  - IC population
  - Location
  - Life history
  - Vegetation
- Outputs:
  - Fish biomass
  - Fish location

Limitations A:
- Topography accuracy
- Veg type and distribution (roughness)

Limitations B:
- IC conditions
- Data availability
- Calibration
- Error propagation
**Group 2**

<table>
<thead>
<tr>
<th>Discipline/Model A</th>
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<tbody>
<tr>
<td>Water resources systems</td>
<td>Fish population/growth models (bioenergetics)</td>
</tr>
</tbody>
</table>

**Example Problem**
- Klamath River: Diversion of flow for agriculture impaired water quality which led to decrease of salmon population
- Truckee River: similar problem of agricultural diversion versus quality of fish habitat

**Inputs**
- Temperature, diet, growth rates, initial biomass
- Water quality, flows, meteorological data

**Outputs**
- Biomass
- Growth rate

**Limitations**
- Calibration/verification of linked models is difficult
- Uncertainties with both types of models
- Scale issues (spatial and temporal)

**Other Issues**
- Short-term (seasonal) predictions from fish models often untested

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**Group 2 / Model Exercise 1**

![Diagram of the model exercise](image-url)
### Group 3

<table>
<thead>
<tr>
<th>Discipline/Model A</th>
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</tr>
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<tbody>
<tr>
<td>Snow hydrology (i.e. alpine, hydrochemical model)</td>
<td>Water quality</td>
</tr>
</tbody>
</table>

#### Example Problem
- Nitrogen contributions to Lake Tahoe from snowmelt $\rightarrow$ impacts to biota
- Lake Tahoe Eutrophication $\rightarrow$ contributions from snowmelt
- Nitrogen loading into Lake Tahoe $\rightarrow$ contributions from snowmelt

#### Inputs
- Snow depth, core samples (subject to lab/chemical analysis)
- Chemical data: nitrogen species present in snow
- Physical data: temperature, wind speed, humidity, elevation, slope, aspect, water content of snow, precipitation, DEM, land cover, remote sensing
- Graduate students, money

#### Outputs
- Snowmelt and N concentrations

#### Limitations
- A simplified model would have to bypass significant transformational loci/processes (in-stream, terrestrial) within the watershed
- Estimating effects on receiving waters would utilize this as input to a subsequent model

#### Other Issues
- Distributed versus lumped approach
- 80% of the chemistry is contributed by the first 20% of the melt

### Group 4

<table>
<thead>
<tr>
<th>Discipline/Model A</th>
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<tbody>
<tr>
<td>Economics (economic valuation, spatial optimization or least cost, cost-benefit analysis, hedonics)</td>
<td>Water Quality (streamflow, WASP)</td>
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</tbody>
</table>

#### Example Problem
- How to minimize the economic burden on the taxpayer due to non-point source pollution from agriculture.

#### Inputs
- Nutrients in/out of system, sediment loads, dissolved oxygen, crop types, TMDLs
- Management and mitigation costs, value of foregone water use (opportunity costs and hedonics), property values, tourist income, ecosystem values

#### Outputs
- Costs of various management options, least cost option

#### Limitations
- Political and watershed boundaries do not match
- Difficult/impossible to directly regulate agriculture
- Assigning prices to non-market goods (ecosystem values)

#### Other Issues
- Who pays for analysis and management costs
- How is the remediation accomplished?
- How do you get farmer buy-in?
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<tbody>
<tr>
<td>Atmospheric Model (global, regional, lake-scale)</td>
<td>Algal production (species)</td>
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</table>

**Example Problem**
Global carbon cycle impacting algal growth

**Inputs**
- Biomass
- Cloud cover
- CO2
- Temperature

**Outputs**
- Precipitation
- Motion of atmosphere
- Thermodynamics
- Radiation
- Nutrients

**Data Needed**
- Initial conditions (algal & atmospheric)
- Physical oceanography
- Loss terms (grazing)

**Limitations/Difficulties**
- Complexity
- Verification data
- 10,000+ species
- Discrete representation of continuous model
- Range of validity of parameterization
- Need ocean model?

**Other Issues**
- How long to run model?