DETERMINING THE UTILITY AND ADAPTABILITY OF REMOTE SENSING IN MONITORING AND ASSESSING RESERVOIR EUTROPHICATION AND TURBIDITY FOR TMDL ASSESSMENTS

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Can moderate spatial resolution multispectral satellite imagery and field-sampled data for selected reservoirs in Kansas be used to develop statistical models relating spectral reflectance to chlorophyll $a$, Secchi disk and turbidity?
OBJECTIVES:

- Develop statistical models between turbidity, Secchi disk, total suspended solids, chlorophyll \(a\), TP and spectral reflectance values;
- Evaluate and compare the models developed in this study with models described in the scientific literature;
- Examine both within-reservoir variability and between-reservoir variability in predicted water quality parameters;
- Sponsor one regional workshop
<table>
<thead>
<tr>
<th>Lake</th>
<th>Area (acres)</th>
<th>County</th>
<th>Impairment</th>
<th>TMDL Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinton Reservoir</td>
<td>7484</td>
<td>Douglas</td>
<td>EU</td>
<td>High</td>
</tr>
<tr>
<td>Hillsdale Reservoir</td>
<td>4826</td>
<td>Miami</td>
<td>EU</td>
<td>High</td>
</tr>
<tr>
<td>Louisburg-Middle Creek</td>
<td>252</td>
<td>Miami</td>
<td>EU</td>
<td>High</td>
</tr>
<tr>
<td>Centralia Lake</td>
<td>386</td>
<td>Nemaha</td>
<td>EU</td>
<td>Medium</td>
</tr>
</tbody>
</table>
FIELD STUDY APPROACH

- Data will be collected from twenty (20) GPSed locations in each of the two large reservoirs and ten (10) GPSed locations within the small reservoirs for two dates then:
- A less-intensive set of field samples will be collected from all four reservoirs (~5 samples/reservoir)
REMOTE SENSING APPROACH

- Mark, in 20 works or less?
in situ turbidity, DO, Ph, conductivity and water temperature at 0.5 meters using a Horiba water quality meter

6 inch Secchi disk used to measure water clarity

Water sample taken at 0.5 meters for lab determination of TP, chlorophyll a, pheophytin a, TSS and VSS
LAB METHODS

- Chlorophyll analyzed fluorometrically
- TP measured by digestion at 250° F then by analysis with Lachat QuikChem 8500
- Total suspended solids (TSS) by Standard Methods 2540D
- Volatile suspended solids (VSS) by Standard Methods 2540E
MODIS DATA

❌ ???
Not always what one would expect

- Reservoirs are responding to differing factors
- Reservoirs often showed high spatial variability in measured parameters including chlorophyll and turbidity
TP/CHLOROPHYLL RELATIONSHIP

CLINTON

NON-SIGNIFICANT RELATIONSHIP
**TP/CHLOROPHYLL RELATIONSHIP CENTRALIA**

**FAIR**

Significant Regression

$R^2 = 0.408$

**CHLOROPHYLL a (µg/L)**

**TOTAL PHOSPHORUS (µg/L)**
TP/CHLOROPHYLL RELATIONSHIPS
LOUISBURG-MIDDLE CREEK

FAIR to GOOD

Significant Regression but opposite of normal
$R^2 = 0.572$
**TURBIDITY, TSS AND SECCHI**

- All related
- Example: TSS vs Turbidity
TP AND TSS

- TP vs TSS relationship highly variable
- Large reservoir relationship very strong

<table>
<thead>
<tr>
<th>Location</th>
<th>Regression Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOUISBURG-MIDDLE CREEK</td>
<td>Non-significant regression</td>
</tr>
<tr>
<td>CENTRALIA</td>
<td>$R^2 = 0.240$</td>
</tr>
<tr>
<td>HILLSDALE</td>
<td>$R^2 = 0.839$</td>
</tr>
<tr>
<td>CLINTON</td>
<td>$R^2 = 0.907$</td>
</tr>
</tbody>
</table>
TP vs TSS RELATIONSHIPS FOR LARGE RESERVOIRS

- Clinton Lake
- Hillsdale Lake
Normal TP vs Chlorophyll a relationships were absent to weak
Secchi disk, turbidity and TSS relationships often strong
TP vs TSS relationships very strong for large reservoirs
Often large spatial and temporal variability within and between lakes