Quantifying solute mixing – Laboratory Development using Artificial Vegetation

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Laboratory Tests

Two tracer detection methods compared in fully vegetated conditions:
- Point probe fluorometry
- Laser Induced Fluorometry (LIF)
- Artificial vegetation as a test case
- Temporal and spatial observations of tracer elucidate mixing characteristics
- Quantify transverse and longitudinal dispersion coefficients.

1. Point Probe Fluorometry

- Pulse injections made mid-vegetation
- Single point green LED emission
- Fluorescence of dye recorded
- Dye concentration tracked over time at 2x locations
1. Point Probe Fluorometry - Results

![Graph showing concentration over time for upstream, downstream, and downstream predicted data.](image)

- **Continuous Vegetation Point Source**

1. Point Probe Fluorometry - Error

![Graph showing concentration over time with mean concentration ± SD.](image)

- **Concentration/ppb**
- **Time from arrival (s)**

1. Point Probe Fluorometry - Issues

- Low mixing causes observation difficulties
- Intrusive and disruptive
- Large spread in data
- Spatially variable mixing properties cannot be extensively recorded e.g. poor spatial resolution

2. Laser Induced Fluorometry (LIF)

![Diagram showing experimental setup for LIF detection.](image)

- **DEFLECTION**
- **MEANDER**
- **POOR MIXING**
- **Fluorometer**
- **Injection**
- **Constant head**
- **Trace injection**
- **Emergent cylinder**
- **Photo detector**
- **0.06m**
- **0.5m**
2. LIF Results – Full vegetation

- Spatial variation in drag
- Velocity Shear leads to vortex driven turbulence
- Spatially variable mixing properties ($D_y = f(y)$)
- How does the density affect pollutant exchange and overall retention time?
- LIF allows for extensive measurements

3. Partial Vegetation

- Interface Injection
- Transverse profiles of velocity
- Concentration distribution recorded at 2 sites
- Repeat for different discharges
3. Partial Vegetation – Preliminary results in artificial vegetation

4. Conclusion

- Point probe detection inappropriate
- Laser Induced Fluorometry spatially extensive
- Mixing characteristics of partial vegetation are spatially variable
- Artificial vegetation used to develop method
- Real vegetation tests are beginning to compare to artificial cases