Nearshore Water Temperature Measurements and Monitoring

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August 2, 2006

Overview

- Review recent nearshore and backwater data collection efforts (2004 & 2005)
- Identify water temperature trends associated with steady and fluctuating flows
- Future nearshore temperature data collection efforts

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Nearshore Aquatic Environments

- Low velocity, warm water habitats
- Refugia and nursery habitats for young, native fish
- Potential aquatic foodbase hot spots
- Link between aquatic and terrestrial ecosystems

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Data Reports

- "Effects of Air and Mainstem Water Temperatures, Hydraulic Isolation, and Fluctuating Flows From Glen Canyon Dam on Water Temperatures in Nearshore and Backwater Environments in the Colorado River in Grand Canyon"
  Korman, Kaplinski, and Buszowski, 2005

- August – October 2004

- Examined effects of hydraulic isolation and air-water temp gradient on vertical and lateral temperature regimes in nearshore environments

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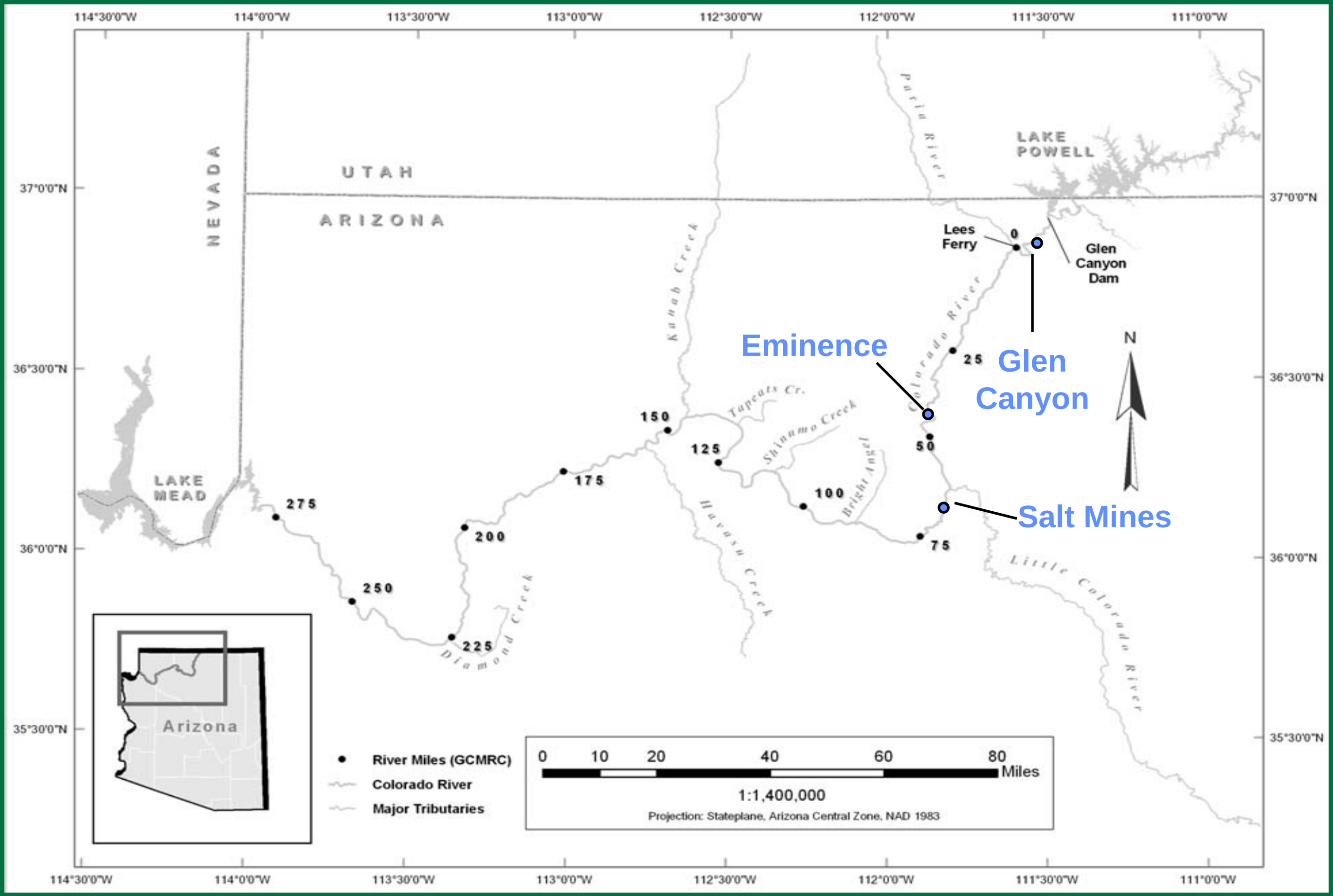
Study Sites



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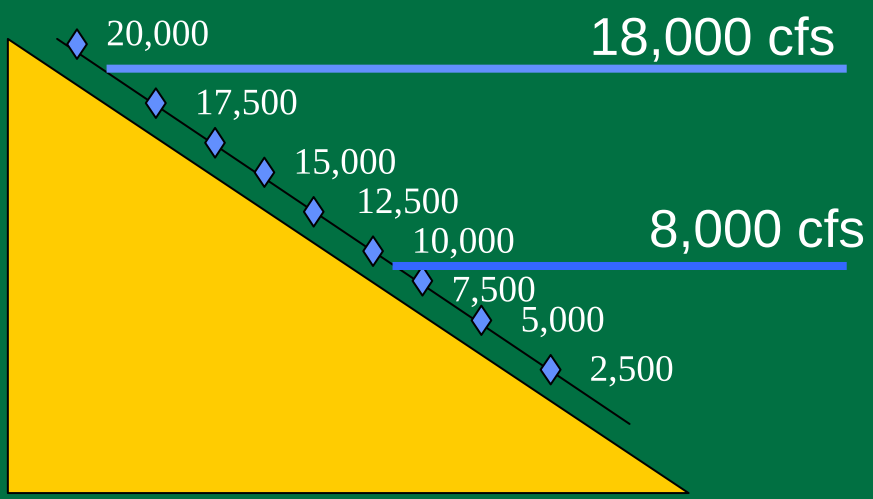
Sensor Configuration and Deployment



- Replicate lines at steep talus shoreline, low angle sandy shoreline, and backwater habitats

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Major Findings

- Nearshore temps maximum 2-3 °C warmer than mainstem.
- Greater warming under 5-10 kcfs regime
- Greater discharge fluctuations = reduced warming
- Strong effect of site isolation with backwaters showing greatest warming. Inconsequential warming in talus habitats.
- Vertical stratification in backwaters (max difference 3-7 °C). However, differences typically only for short duration, isolated locations, and within fluctuating zone.

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Recommendations

- Supplement mainstem monitoring network
  - Continuous stage and temperature sensors
  - $400 per unit
- Modify temperature sensor line design to provide more consistent performance with fluctuating flows

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Design Limitations

- Sensor exposure in fluctuating zone
- Sensor stability during high flows (~18-20 kcfs)
- Datalogger and power failures
- Floatation visibility issues

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Data Delivery Report

- "Nearshore Water Temperature Data: August 12 to November 14, 2005" – Matt Kaplinski, 2006
- Measured nearshore water temperatures in two aquatic habitats during the 2005 low-volume flow experiment.
- Examined vertical and lateral water temperature gradients at 10 sites

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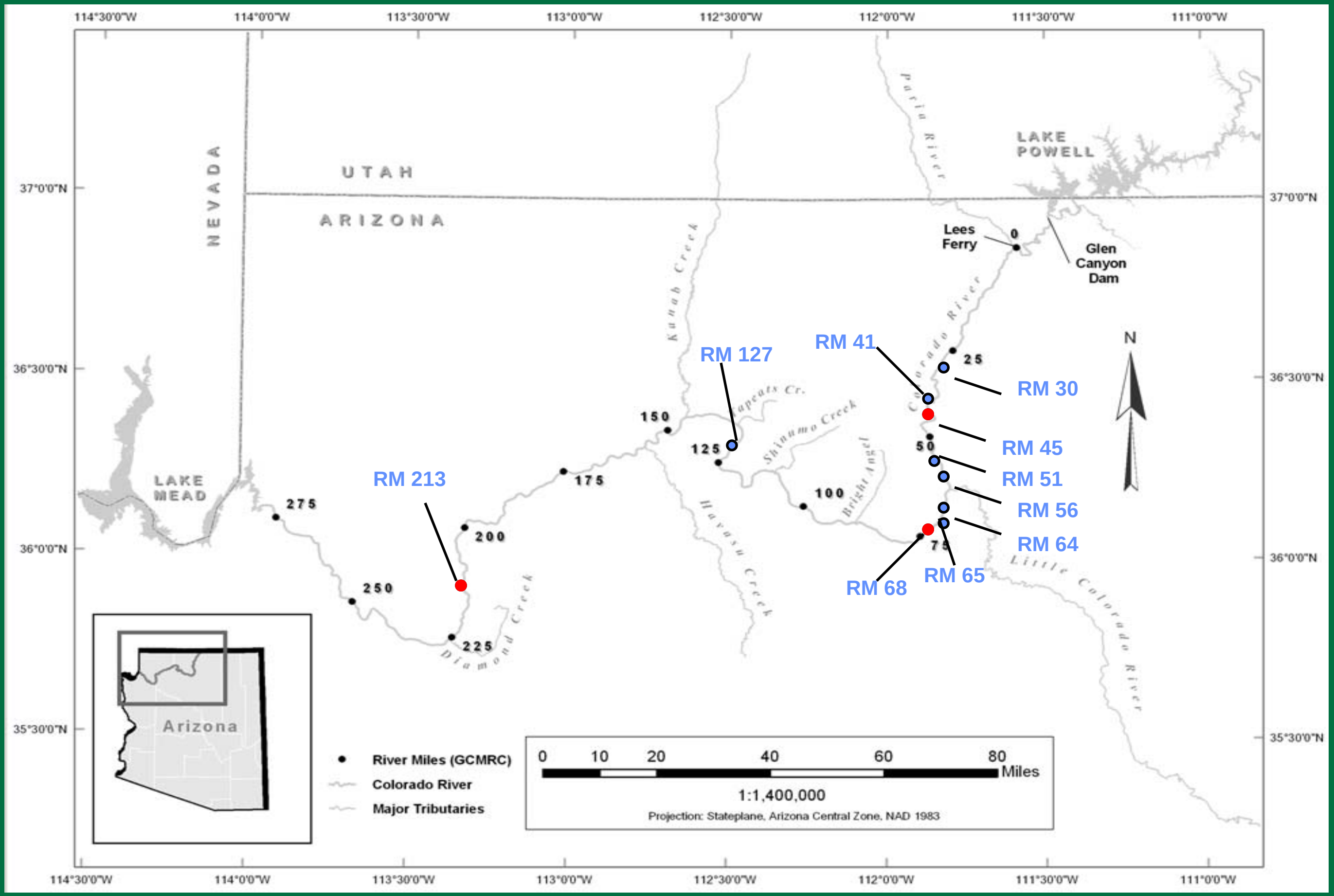
Study Sites



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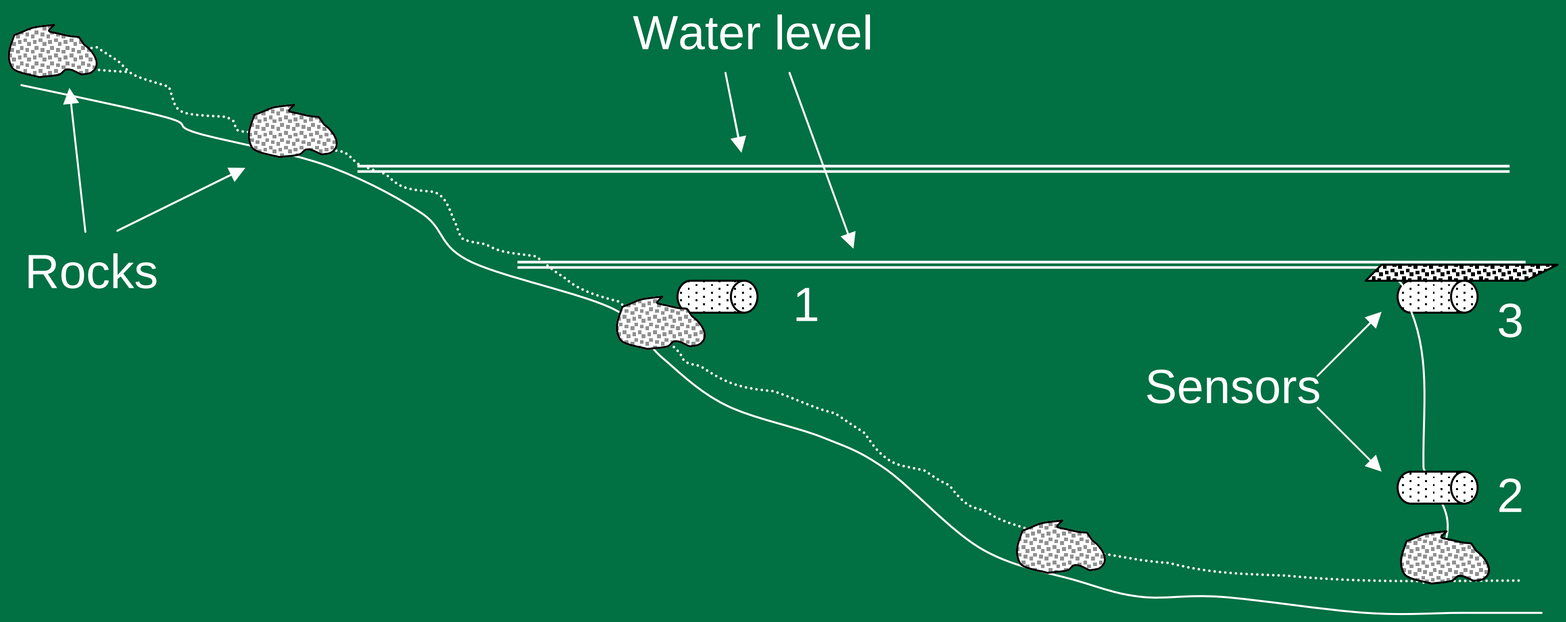
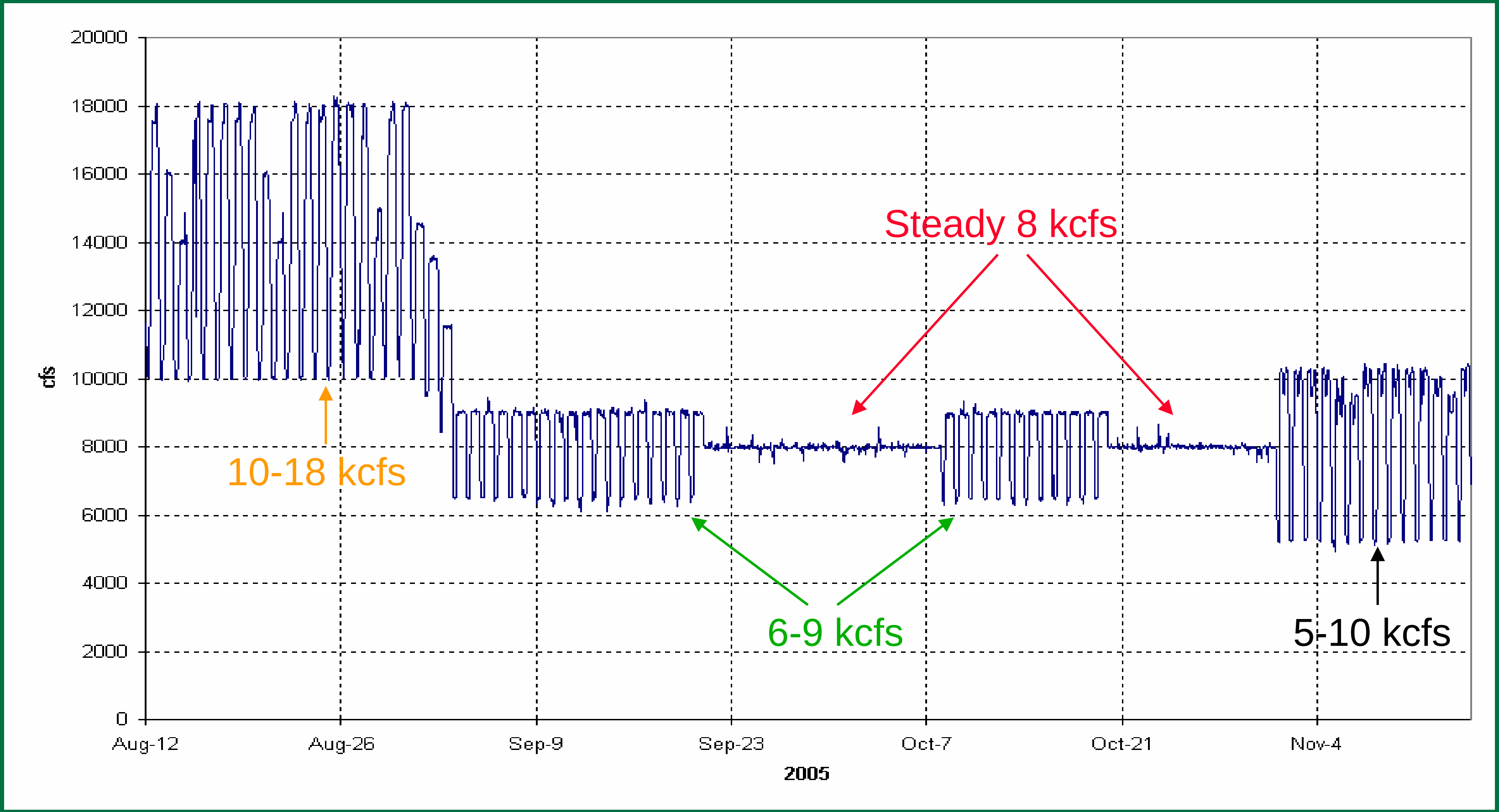
Sensor Configuration and Deployment



- **One string within backwater and one string within same eddy system**

Aug 12 – Nov 14 GCD Discharge



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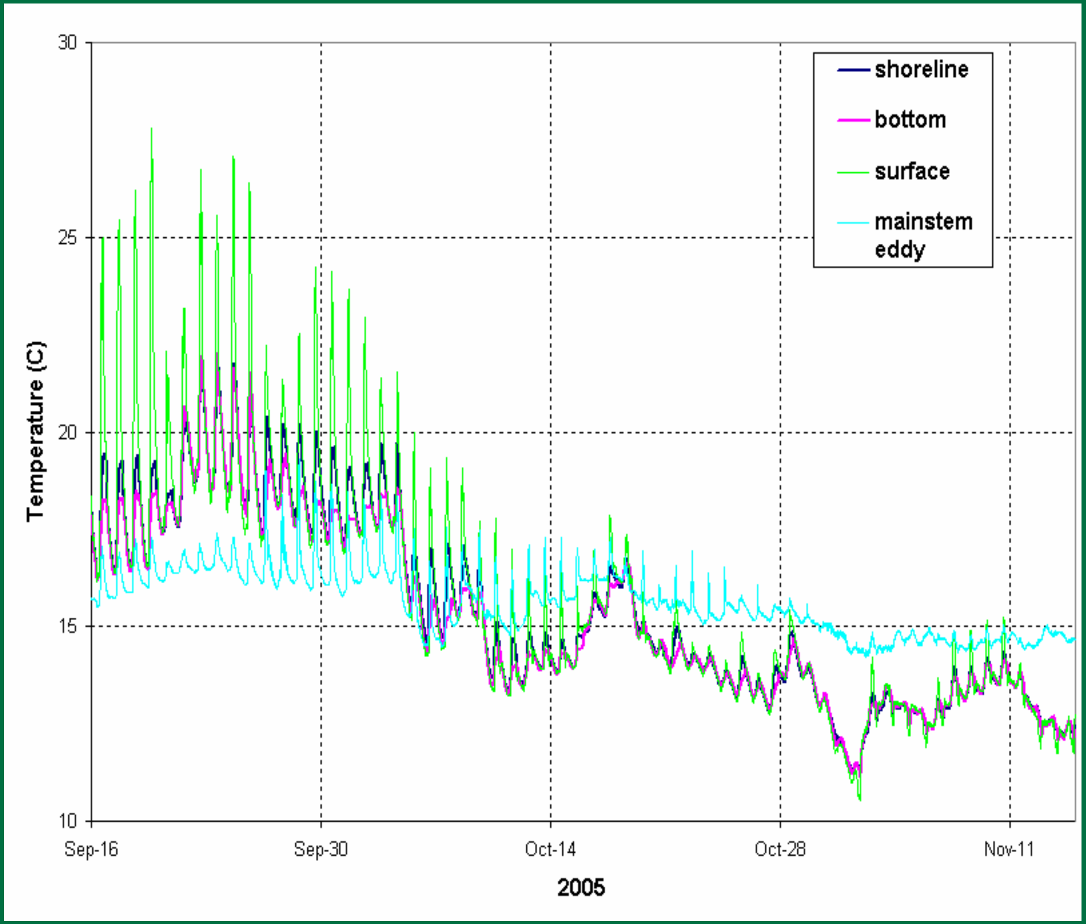
RM45 Backwater Temperatures



Lateral Gradient (°C):

- Sept steady = 0.4 (6.5)
- Sept 6-9 kcfs = 1.6 (9.2)
- Oct steady = 0.1 (0.9)
- Oct 6-9 kcfs = 0.1 (2.9)

Vertical Gradient (°C):

- Sept steady = 0.8 (6.3)
- Sept 6-9 kcfs = 1.9 (9.7)
- Oct steady = 0.1 (1.5)
- Oct 6-9 kcfs = 0.3 (3.6)

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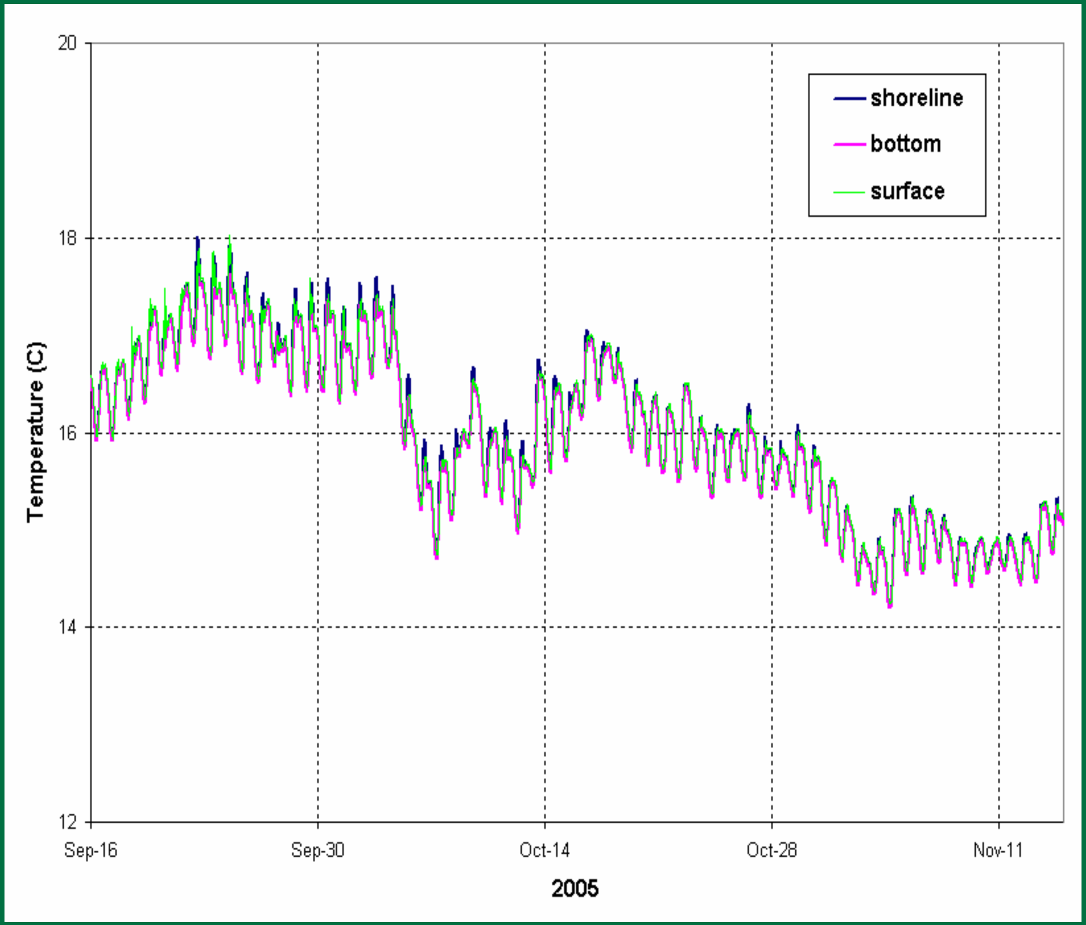
RM 68 Backwater Temperature



Lateral Gradient (°C):

- Sept steady = 0.01 (0.45)
- Sept 6-9 kcfs = 0.06 (0.59)
- Oct steady = 0.02 (0.12)
- Oct 6-9 kcfs = 0.0 (0.26)

Vertical Gradient (°C):

- Sept steady = 0.06 (0.69)
- Sept 6-9 kcfs = 0.09 (0.64)
- Oct steady = 0.05 (0.14)
- Oct 6-9 kcfs = 0.04 (0.07)

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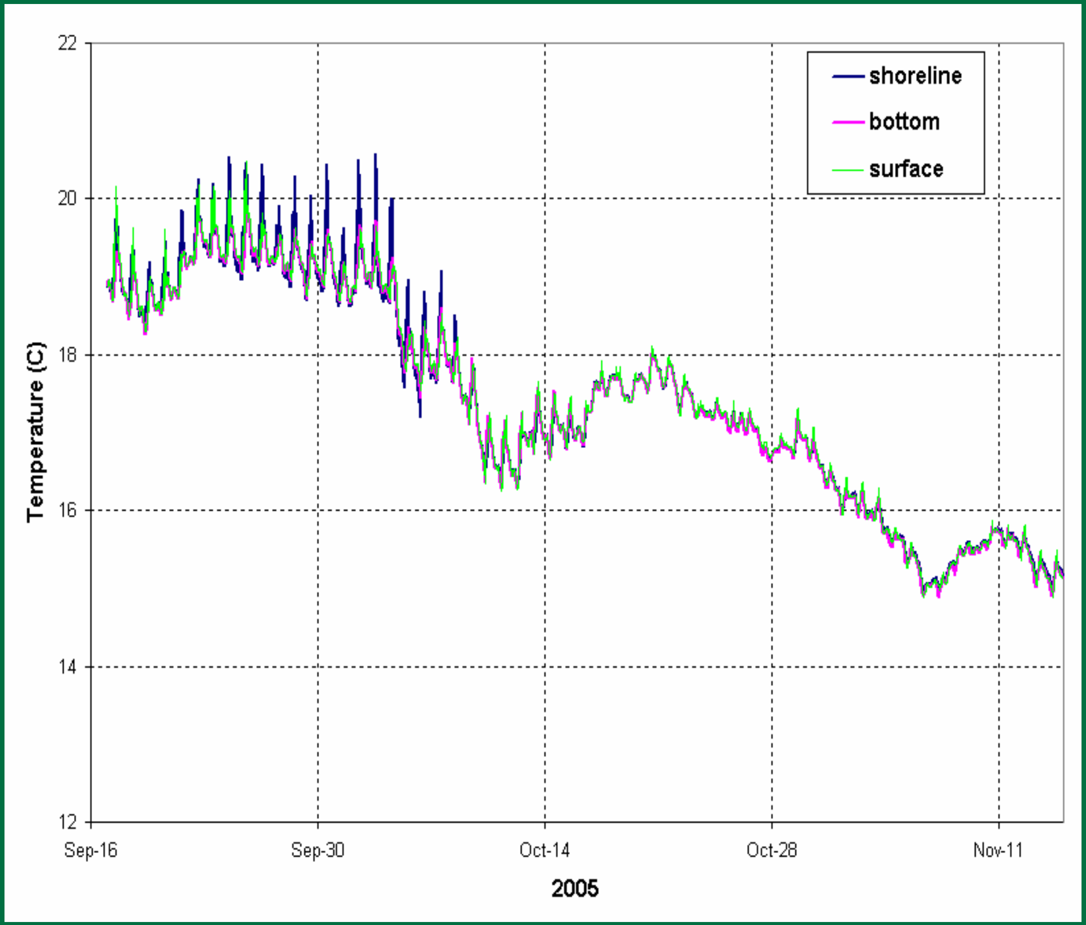
RM 214 Backwater Temperature



Lateral Gradient (°C):

- Sept steady = 0.04 (1.14)
- Sept 6-9 kcfs = 0.0 (0.55)
- Oct steady = 0.03 (0.17)
- Oct 6-9 kcfs = 0.03 (0.52)

Vertical Gradient (°C):

- Sept steady = 0.03 (0.93)
- Sept 6-9 kcfs = 0.08 (0.95)
- Oct steady = 0.04 (0.17)
- Oct 6-9 kcfs = 0.01 (0.27)

Preliminary Findings

- Backwater temps on average 2-4 °C warmer than associated eddies during summer months
- Similar temperature gradients at 6-9 kcfs fluctuations and steady 8 kcfs flows (slightly greater at 6-9 kcfs)
- However, individual backwaters exhibit different temperature trends as a function of geometry, isolation from the mainstem, and local insolation regimes

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Design Limitations

- Flotation camouflage and stability
- Nearshore sensor exposure during fluctuations
- Surface sensor drift during low discharge

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Future Nearshore Monitoring

- Campaign-based measurements
  - Intensive spot sampling at individual backwaters
  - Longitudinal, lateral and vertical transects
  - Better characterize spatial variability to determine degree of mixing
  - Identify optimal locations for long-term sensor deployments

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Future Nearshore Monitoring

- Long-term, continuous measurements necessary for:
  - Better understanding spatial and temporal variability
  - Examining the impact of nearshore temperature regimes on native fisheries, aquatic foodbase production, and overall ecosystem health
  - Downstream thermal model calibration and validation
- Modification of previously deployed sensor designs
- Feasibility experimentation
- System wide approach

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