Variability of *E. coli* in Rivers during base-flow conditions

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Introduction

Faecal microbe concentrations in rivers vary considerably
Not all related to flood events (2 orders of magnitude)
Base-flow conditions (3 orders of magnitude)

Samples are typically collected fortnightly or monthly
Some at different time-scales
No systematic studies across multiple time scales

Development of real-time or near-real-time measurement technologies?
Decision support

Interpretation of grab samples

Decision support tools

Meeting standards

E. coli (mpn 100mL⁻¹)
Decision support

Interpretation of grab samples

Decision support tools

Meeting standards

![Graph showing E. coli (mpn 100mL⁻¹) vs. Day]

Day 1: E. coli range 300-400
Day 2: E. coli range 500-700
Model calibration

daily average concentrations vs grab samples
What we did and hypotheses

Winter and Summer
3 Rivers
small (1\textsuperscript{st} order) to large (6\textsuperscript{th} order)
What we did and hypotheses

Winter and Summer
3 Rivers
   small (1\textsuperscript{st} order) to large (6\textsuperscript{th} order)

Lab replicates
   Colilert and Quanti-tray 2000 method

Temporal scales:
   minutes, hours, days

Compared: CoV = Stdev / Mean
Small Trib – winter

E. coli (mpn 100mL⁻¹)

- Lab
- Minutes
- Hours
- Days

Jun  Jul

MPN 100mL⁻¹
Small Trib

- **E. coli** (mpn 100mL⁻¹)
  - **Lab**
  - **Minutes**
  - **Hours**
  - **Days**

### Winter

- **E. coli** vs. **Lab**
- **E. coli** vs. **Minutes**
- **E. coli** vs. **Hours**
- **E. coli** vs. **Days**

- **X-axis**: Jun, Jul
- **Y-axis**: 1, 10, 100, 1000, 10000

### Summer

- **E. coli** vs. **Lab**
- **E. coli** vs. **Minutes**
- **E. coli** vs. **Hours**
- **E. coli** vs. **Days**

- **X-axis**: Dec, Jan, Feb
- **Y-axis**: 1, 10, 100, 1000, 10000
Large River – winter

![Graph showing E. coli levels over time with labels for Lab, Minutes, Hours, and Days. Y-axis is logged scale ranging from 1 to 10000.]
Large River

### Winter

- **E. coli (mpn 100mL⁻¹)**
- **Lab**
- **Minutes**
- **Hours**
- **Days**

### Summer

- **E. coli (mpn 100mL⁻¹)**
- **Dec**
- **Jan**
- **Feb**
24 hours

Silver Stream

E. coli (mpn 100mL\(^{-1}\))

0 5 10 15 20 25

Hour
24 hours
Coefficient of Variation

Time-scale for Sampling

% CV E. coli/100 mL

Winter

Summer

Tributary
Silver Stream
Taieri River
Implications: 95% confidence intervals

E. coli (mpn 100mL$^{-1}$)

- Lab: 650 (350-820)
- Minute: 670 (330-180)
- Hour: 820 (1100)
- Day: 1100 (E. coli concentration not shown)
Implications for model calibrations

E. coli (mpn 100mL⁻¹)
Conclusions

High natural variability under base-flow conditions
Variability increased with increasing time-scales
Some interactions with season and size of river
Variability is exaggerated in small streams
- effect of different sites
- implications for interpretation of grab samples
Challenges for model calibration
Final thoughts

Variability of pathogens will be even greater

Microbial WQ guidelines are based on data from large rivers
What are the Implications for applying these numbers to small streams?


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