

Evaluation of Uncertainties on Annual Nutrient Load Induced by Time Proportional Composite Sampling Strategies

François Birgand

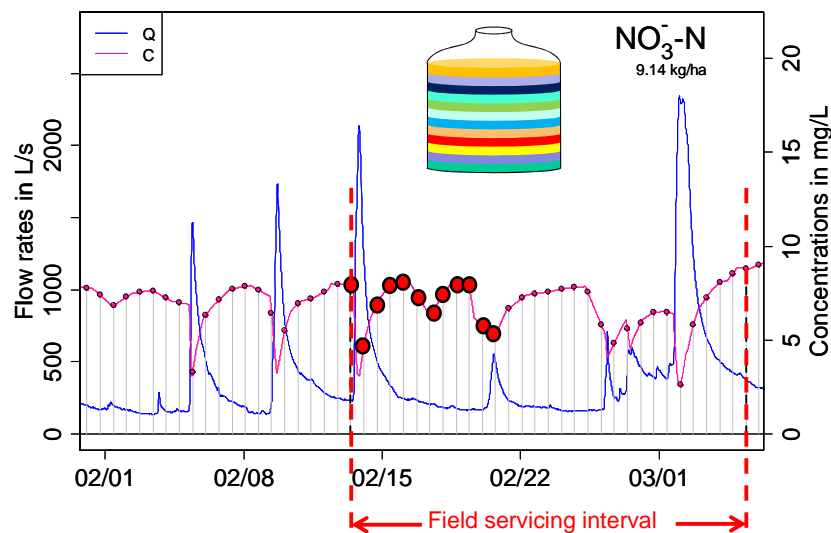
Biological and Agricultural Engineering

Introduction



- Automatic samplers have revolutionize water quality monitoring techniques and abilities
- One feature of these samplers is to sample water *at regular intervals* into a composite bottle, technique herein referred to as **Time Composite Sampling (TCS)**
- Annual nutrient load are sometimes calculated using this monitoring technique

Hydrograph and Chemograph at PigeonBlanc in 01-02



Objectives

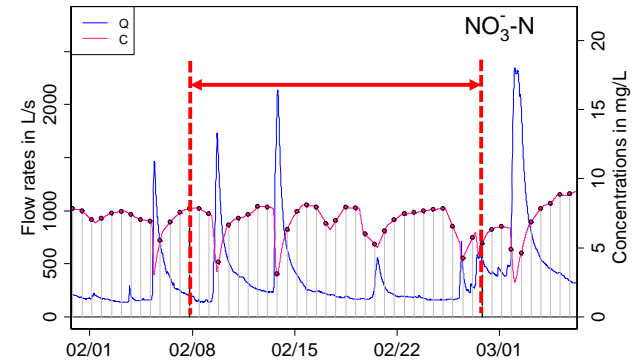
- The objectives are to evaluate the potential error induced by TCS on the estimate of annual pollutant load at the outlet of small rural watersheds

Method

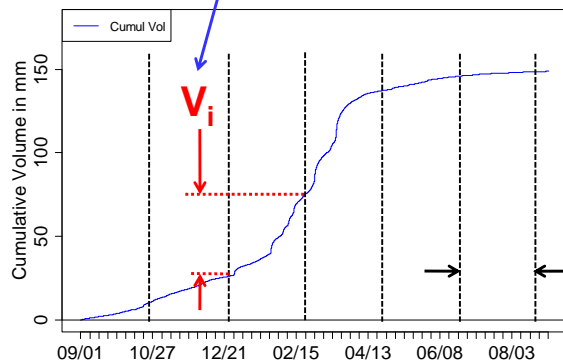
- Use *reference data* where available *continuous data* on flow rates and pollutant concentrations
- Numerically simulate sampling for
 - different field servicing intervals and
 - number of samples per bottle and
- *compare* the estimated load to the reference one

Load Calculation

$$C_i \times V_i = L_i$$



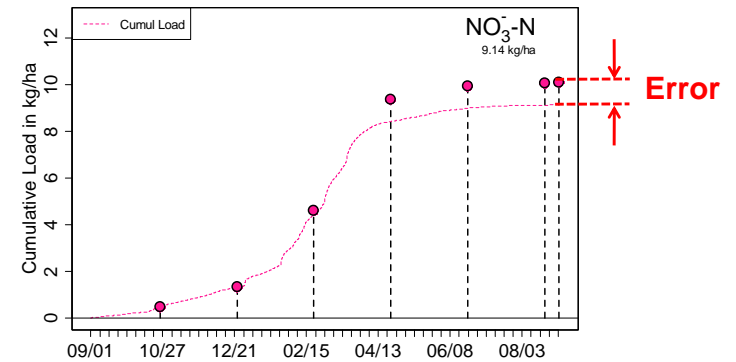
Cumulative Flow Volume between consecutive field servicing dates



$$C_i \times V_i = L_i$$

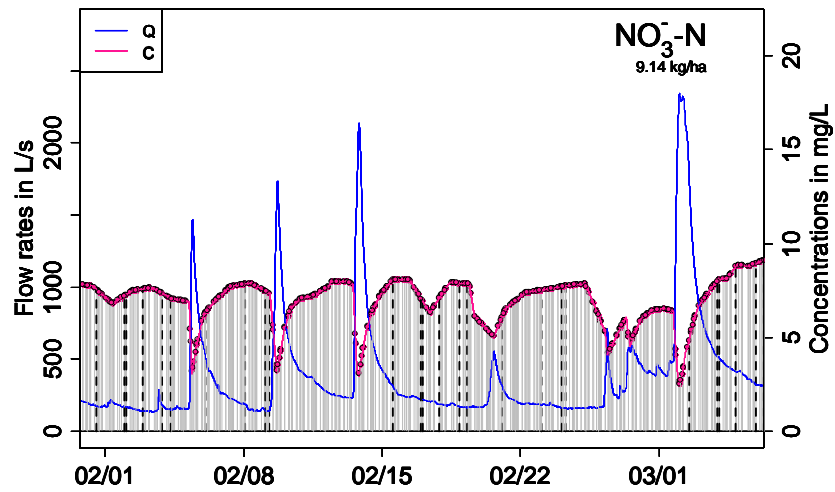
Field Servicing Interval

Error on annual loads



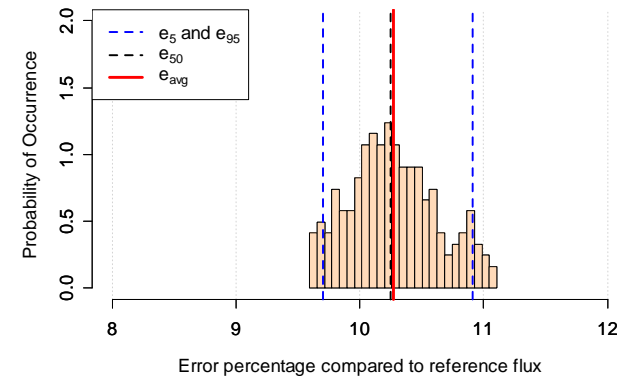
Infinite number of sampling possibilities

Hydrograph and Chemograph at PigeonBlanc in 01-02



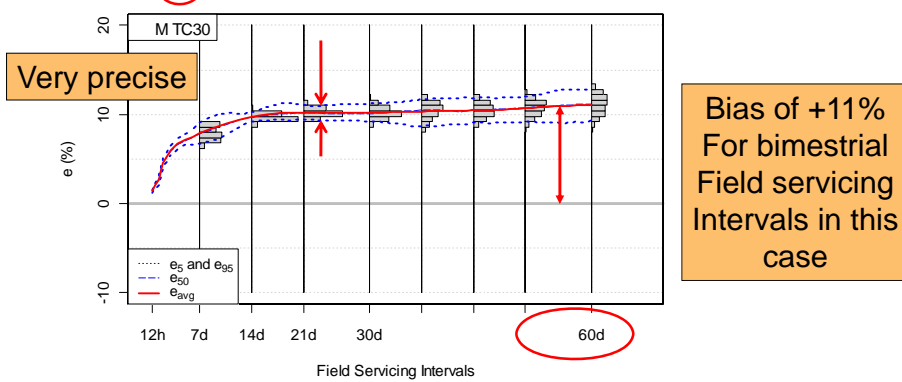
Error distribution

Load Error Range for NO3 in 01-02 - PigeonBlanc Method TC

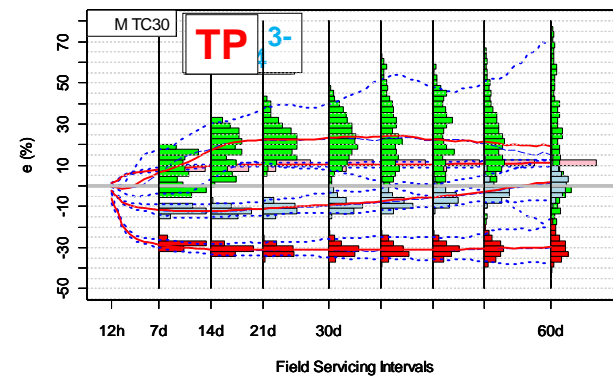


Results

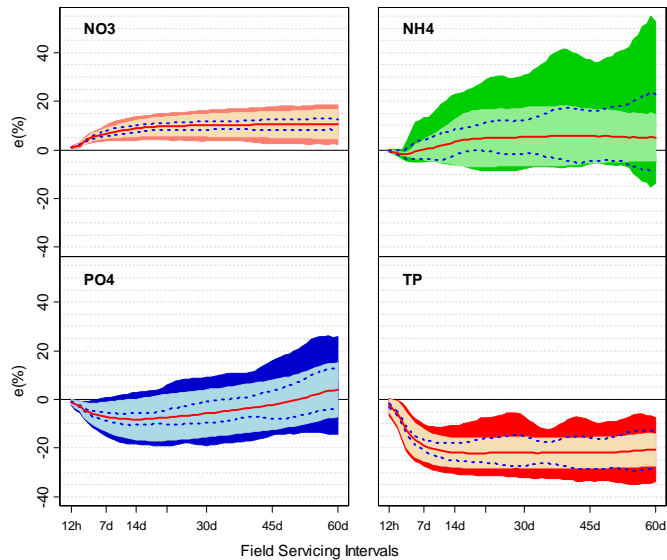
Annual NO3 Load Error Range in 01-02 - PigeonBlanc Method TC30



Annual NO3 Load Error Range in 01-02 - PigeonBlanc Method TC30



Pluriannual results



Results: bias and precision depend on the pollutants

- Number of samples (>30) per bottle has little impact in the results
- Bias and precision dramatically depend on pollutant
- Bias *negative* for pollutants which *conc. increase* during flow events (e.g. TSS)
- Bias *positive* for pollutants which *conc. decrease* during flow events (e.g. NO_3^-)

Conclusion

- The Time Composite Sampling method to evaluate annual nutrient loads is generally *not desirable*
- Although usually relatively precise, it induces large and unpredictable bias that may vary significantly over the years