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Determination of in-situ biodegradation rate constants of nonylphenolic compounds in the Seine River

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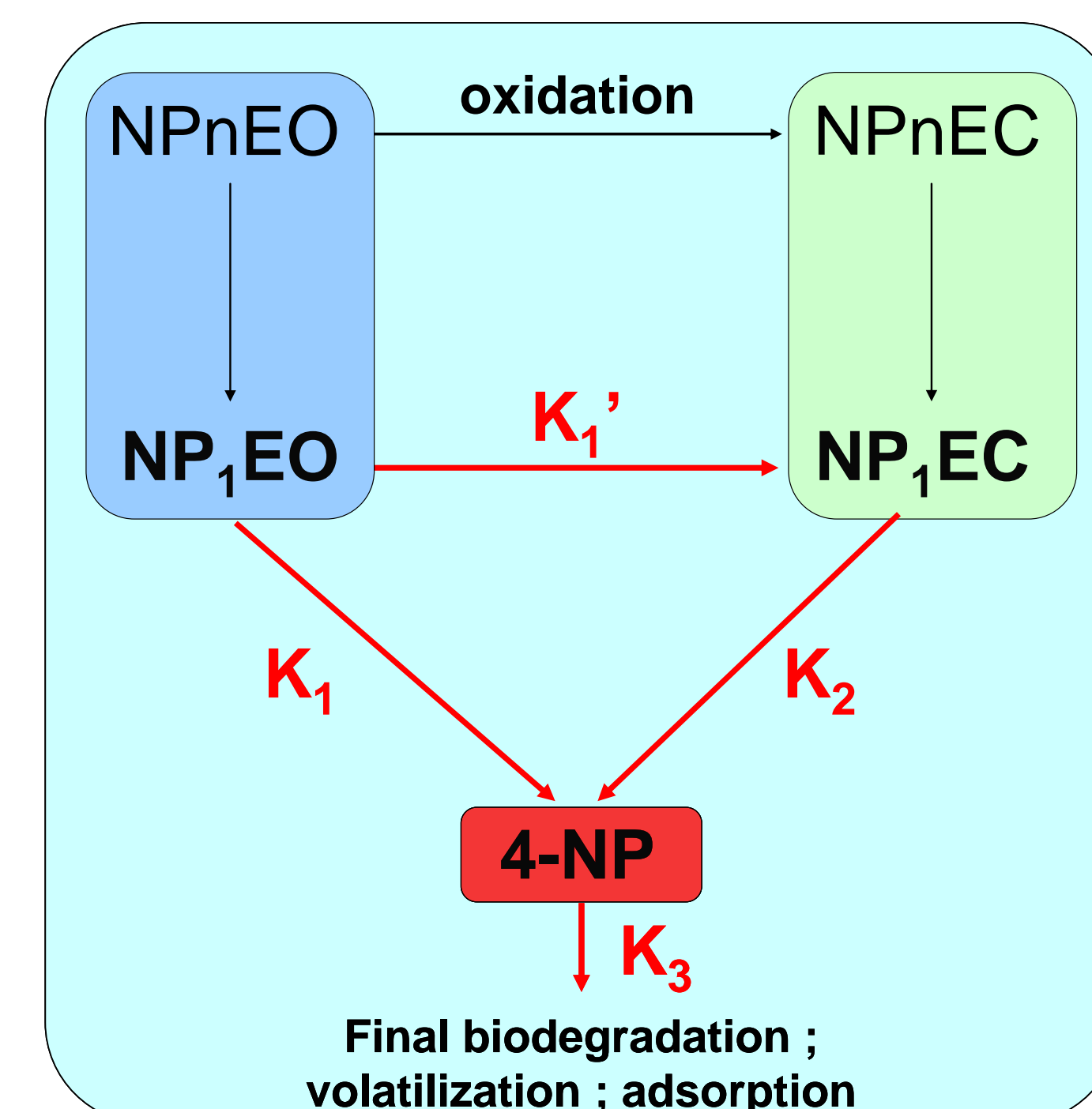
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1- INTRODUCTION

Assessing the fate of endocrine disrupting compounds (EDC) in the environment is currently a key issue for determining their impacts on aquatic ecosystems. The 4-nonylphenol (4-NP) is a well known EDC as well as its precursors, the nonylphenol monoethoxylate (NP₁EO) and the nonylphenol acetic acid (NP₁EC). they result from the biodegradation of surfactant nonylphenol ethoxylates (NPnEO). To date, the biodegradation rate constants of nonylphenolic compounds have been mostly studied in laboratory and only Jonkers et al. (2005) focus on *in-situ* rate constants but in estuarine salt water. Therefore data on *in-situ* biodegradation of nonylphenolic compounds in river water are scarce or not up to date.

This study aims at evaluating the *in-situ* biodegradation of 4-NP, NP₁EC and NP₁EO in the Seine River downstream of Paris City.

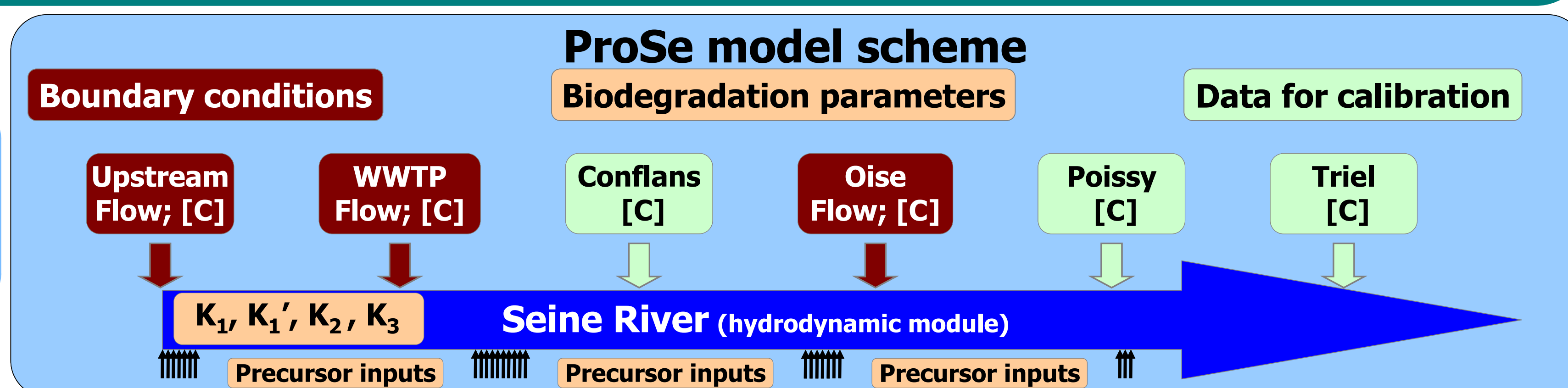


2- METHODOLOGY

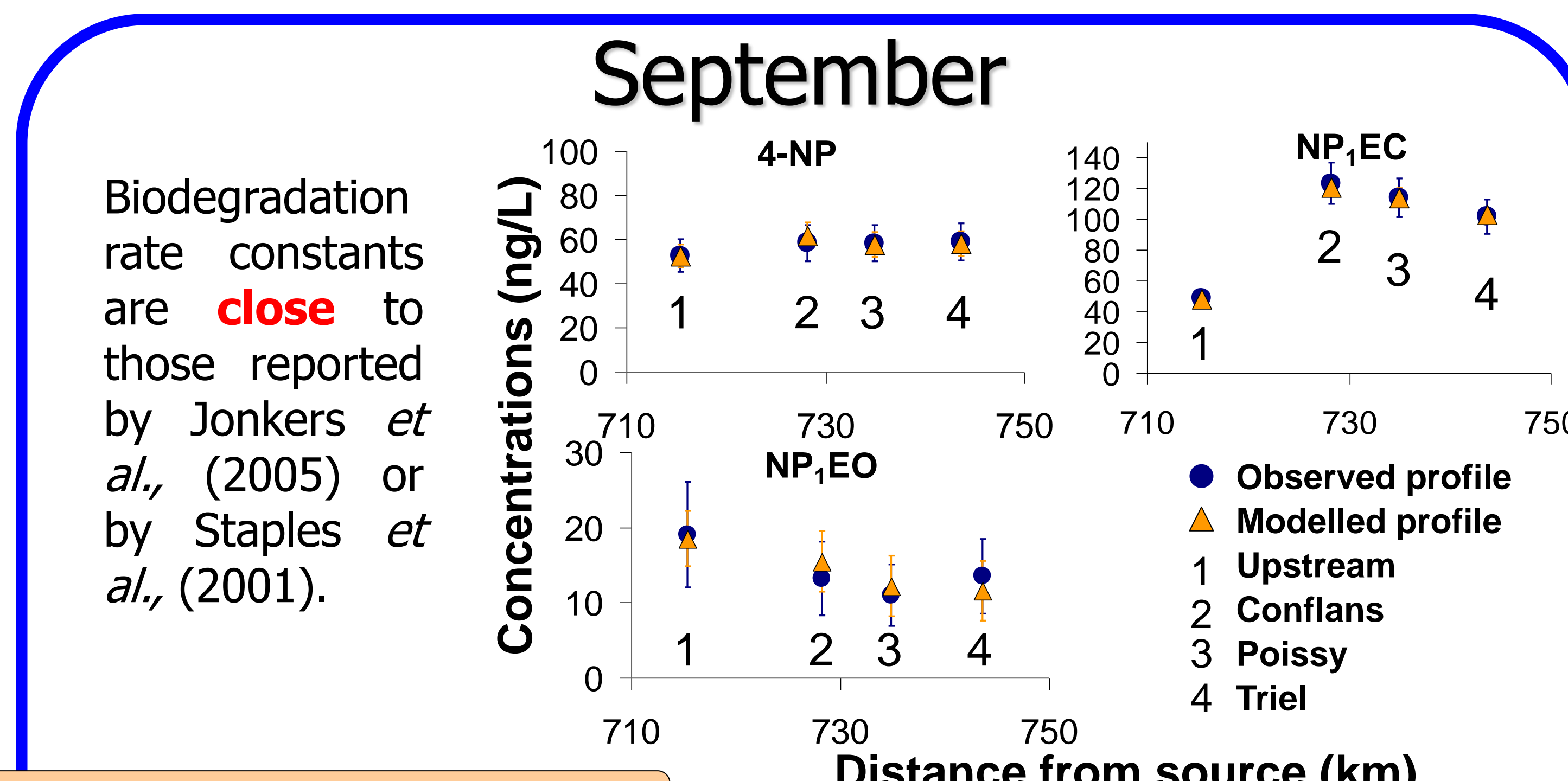
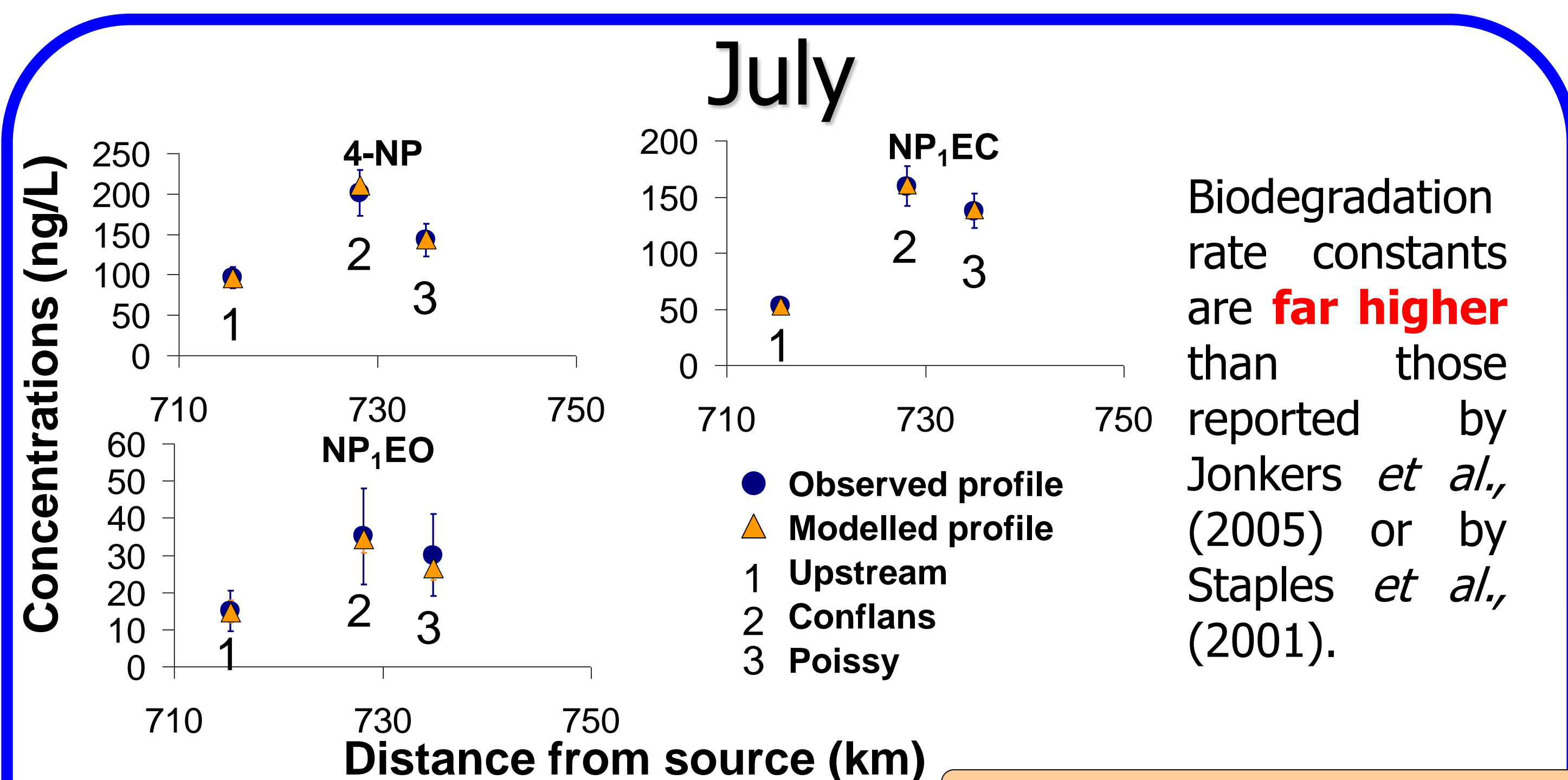


- 40 km long transect downstream of Paris city
- 2 sampling campaigns: July and September 2011
- Hours of sampling estimated according to velocity of the Seine River
- Samples collected in the same volume of water
- Analysis: UPLC-MS-MS → quantification of 4-NP, NP₁EC and NP₁EO
- Results → calibrating a sub-model of NPnEO biodegradation of ProSe model
- The spatial and temporal variabilities of concentrations are considered for calibration
- Calibration of $K_1 = K_1'$, K_2 and K_3 based on first order kinetics equations
- Calibration of "precursor inputs" to symbolize biodegradation of NPnEO and NPnEC

The hydro-ecological ProSe model is especially design for the Seine River. Its biogeochemical module is updated to simulate the fate of nonylphenolic compounds downstream of Paris (Even et al., 1998).



2- RESULTS



Significant variability of biodegradation between July and September

Rate constants (d ⁻¹)		Min - opt - max
$K_1 = K_1'$		0.05 - 0.10 - 0.15
K_2		3.14 - 3.30 - 3.47
K_3		2.38 - 2.50 - 2.75

Min : minimum value; opt: optimized value; max: maximum value

Rate constants (d ⁻¹)		Min - opt - max
$K_1 = K_1'$		0.29 - 0.30 - 0.33
K_2		0.08 - 0.10 - 0.14
K_3		0.09 - 0.15 - 0.19

Min : minimum value; opt: optimized value; max: maximum value

3- DISCUSSION / CONCLUSION

The **variability** of bacterial biomass likely **induces** the **variance of biodegradation** rate constants of nonylphenolic compounds.

The **first-order kinetic approach** seems **reliable** to describe a **punctual state** of biodegradation but does **not** take into account the **variabilities generated by the fluctuation of bacterial biomass**.