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IMPROVED SOLUTION METHODS FOR INSTREAM WATER QUALITY SIMULATIONS IN SWAT

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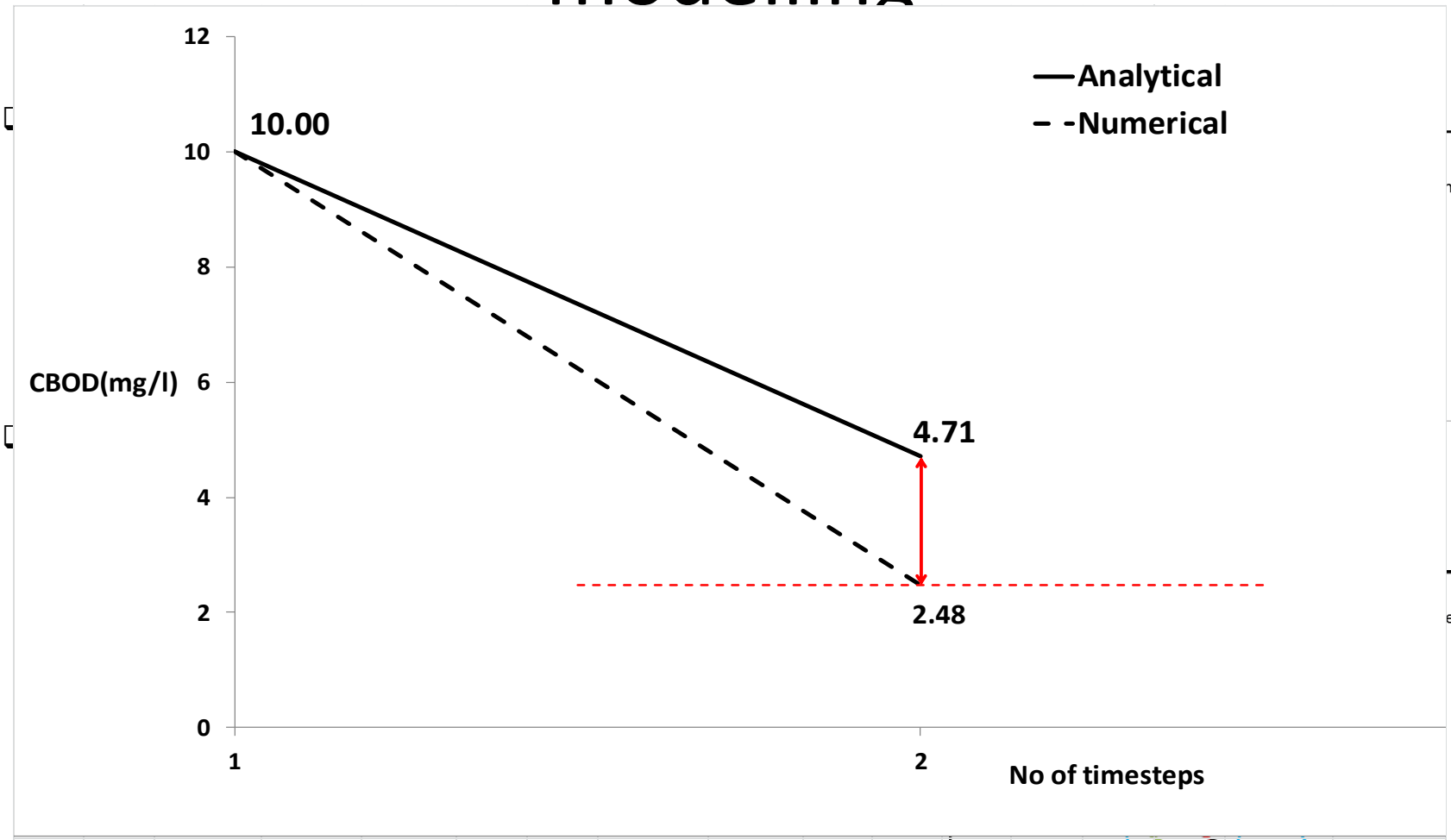
SWAT for instream water quality modelling

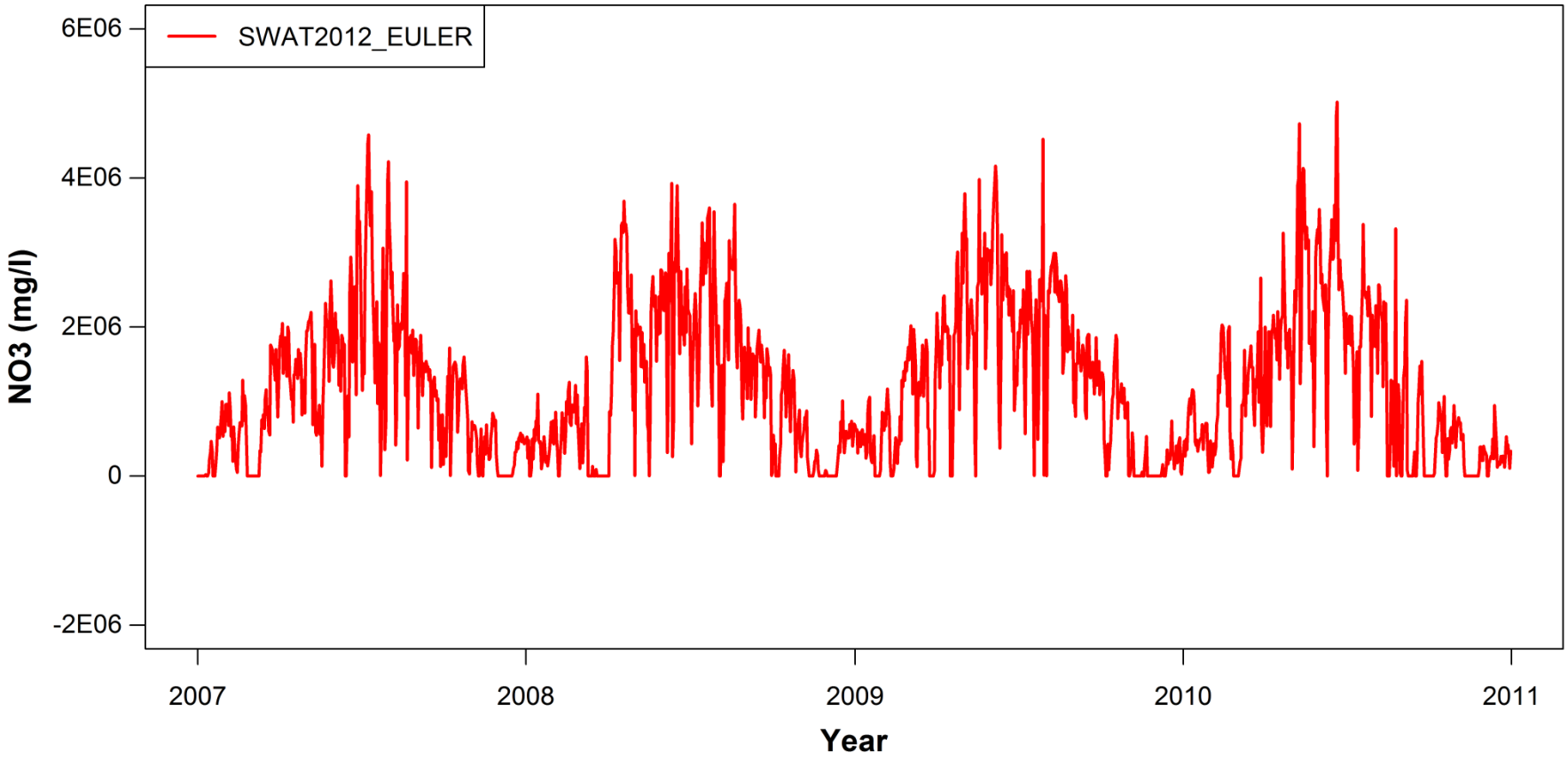


Outline

- Instabilities in SWAT2012 WQ module
- Improved quasi-analytical solution method for instream WQ simulation of SWAT
- Results from case study (Zenne River, Belgium)

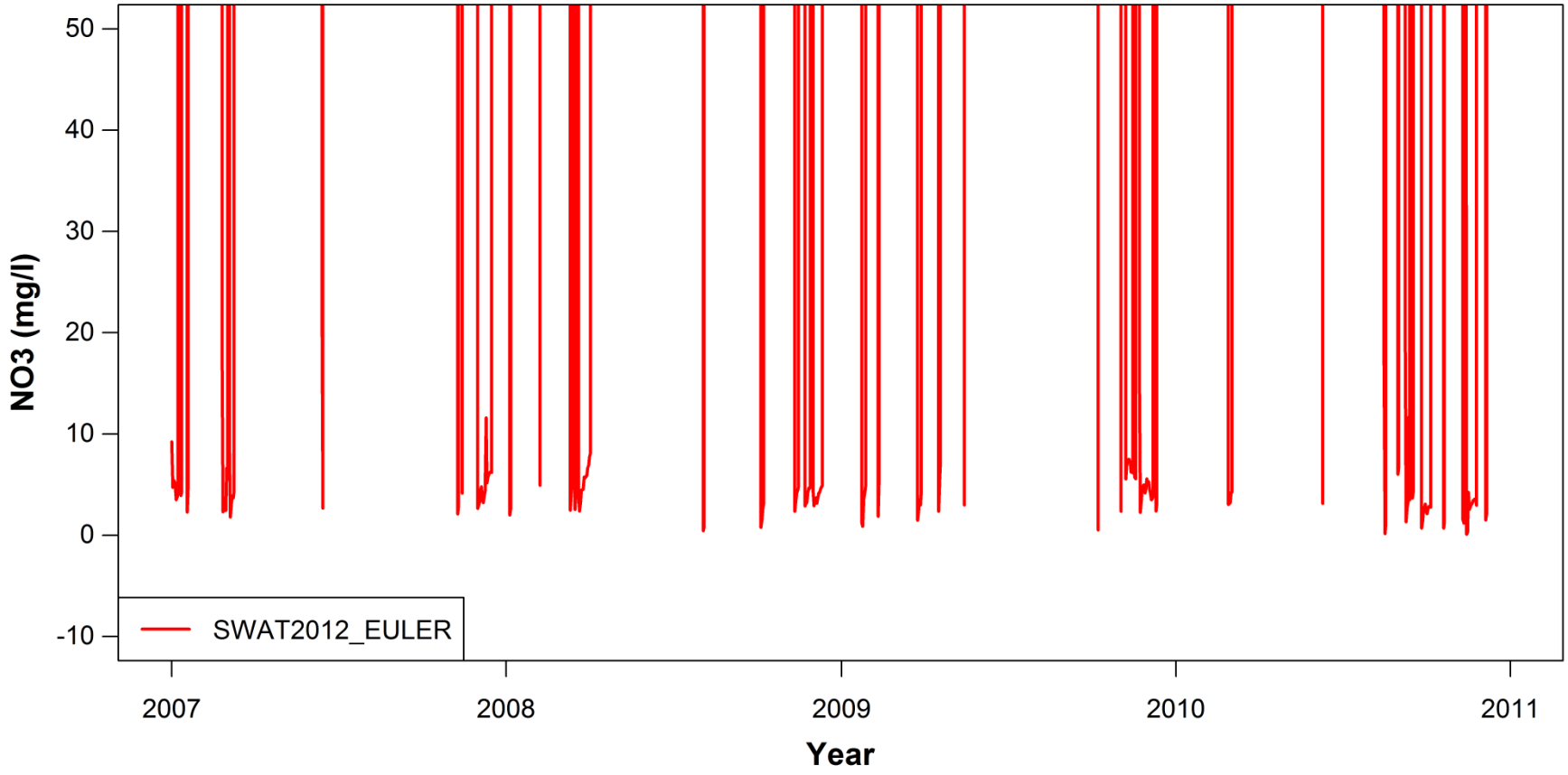
Instabilities/inaccuracy of Euler approach in SWAT WQ module

- Default parameters



Instabilities/inaccuracy of Euler approach in SWAT WQ module

- Default parameters-zoomed



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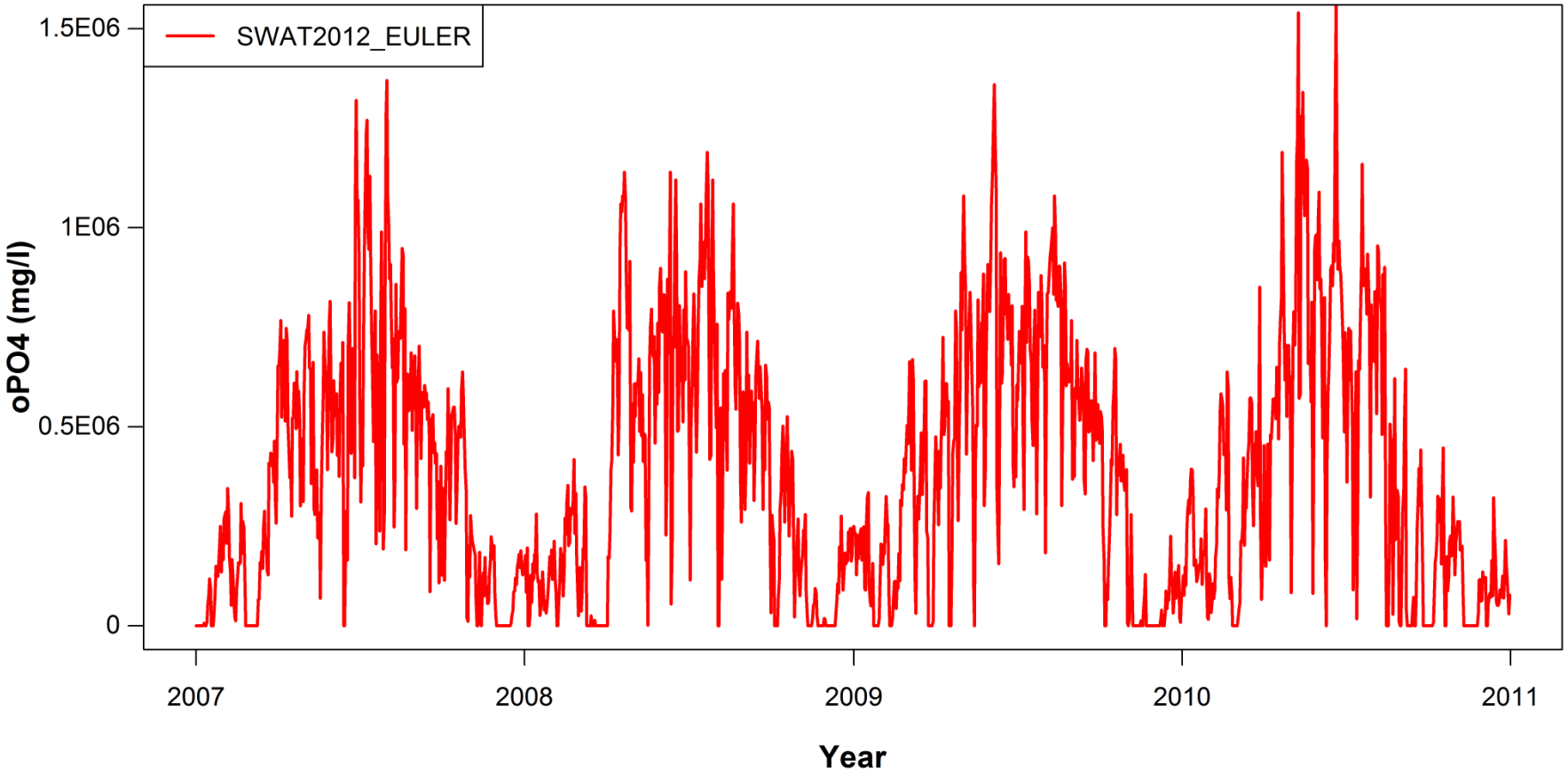
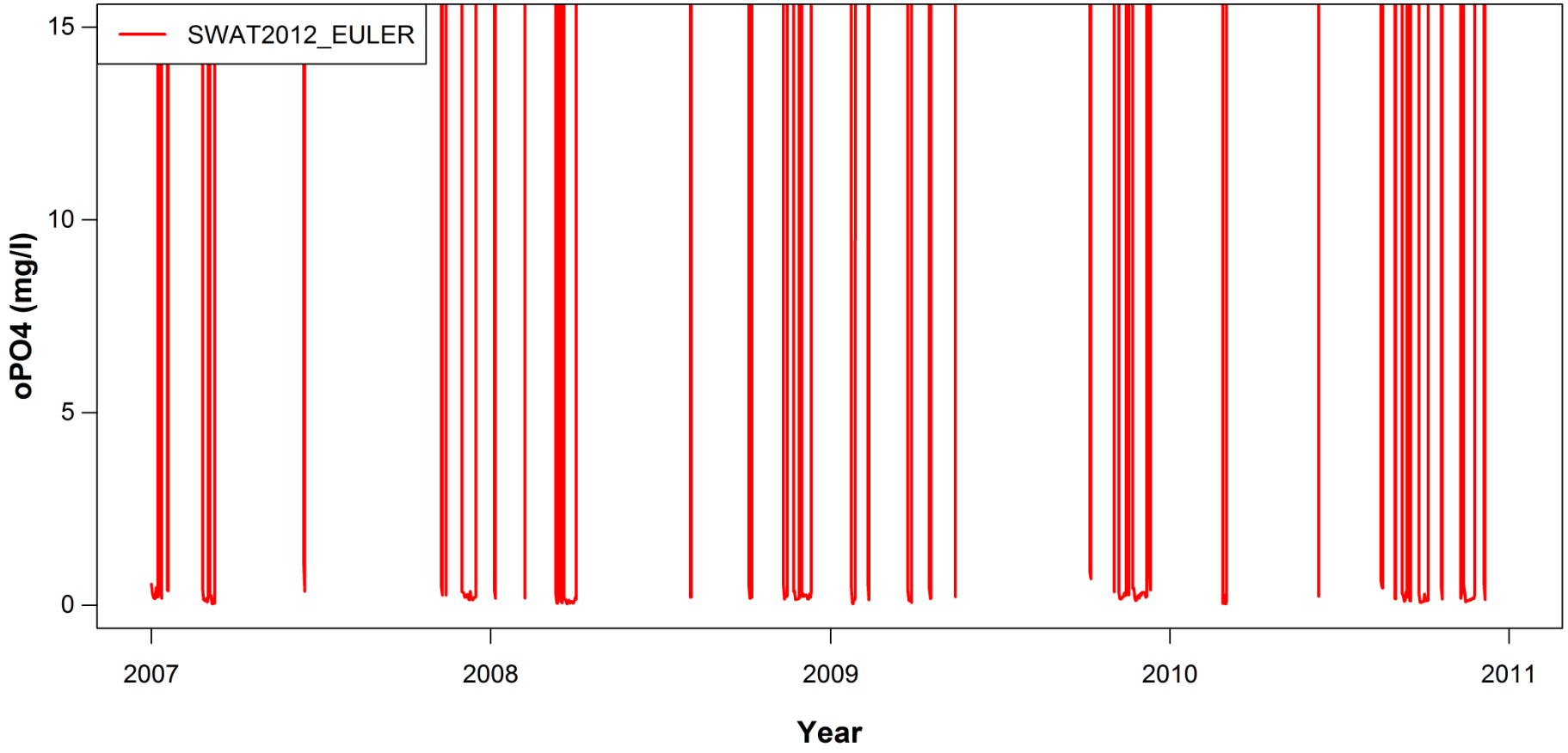


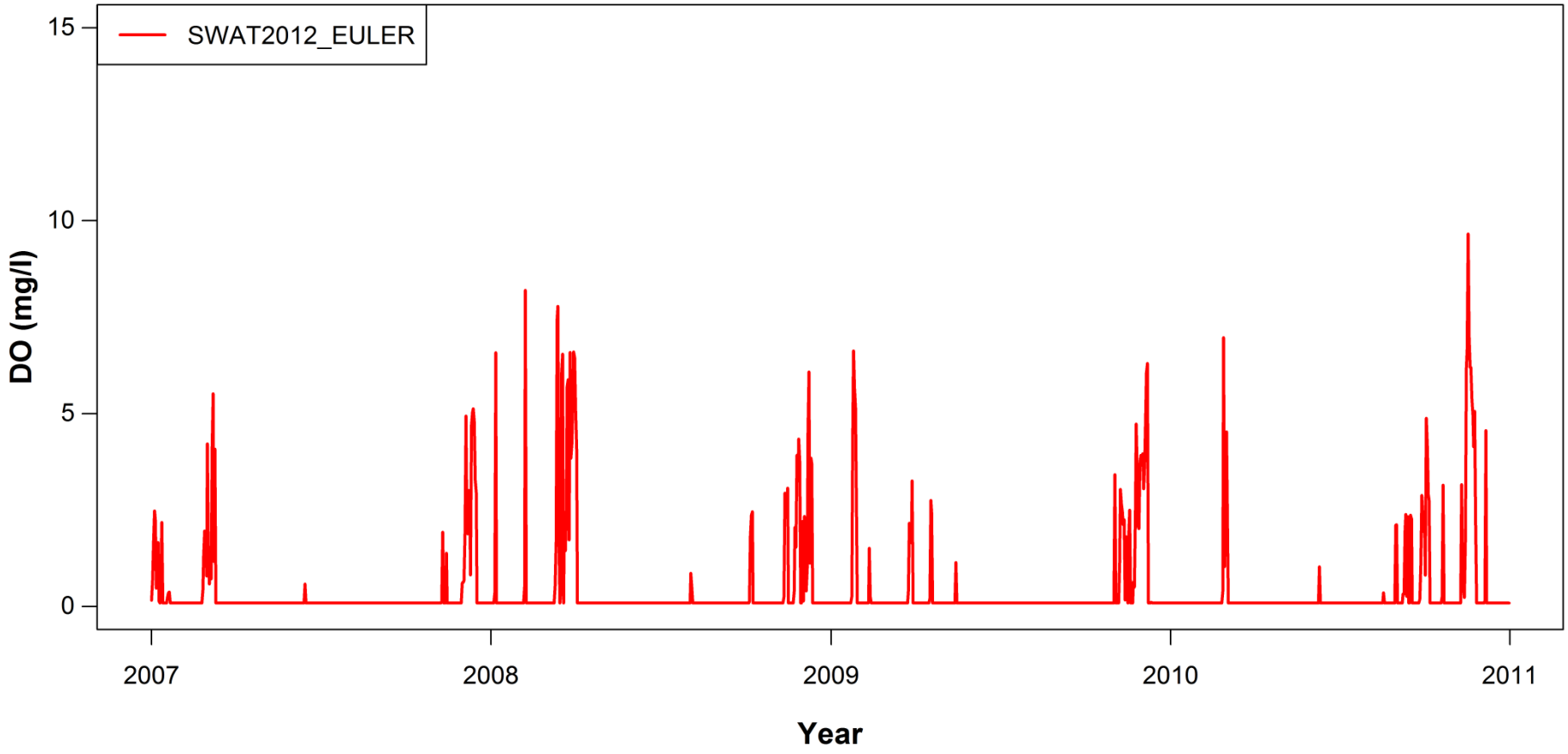
Instabilities/inaccuracy of Euler approach in SWAT WQ module

- Default parameters-zoommed



Instabilities/inaccuracy of Euler approach in SWAT WQ module

- Default parameters



New improved quasi-analytical method

- Basis
  - Continuity
  - CSTR
  - Dynamic

$$\frac{dC}{dt} + \frac{Q_{in}}{V} C(1 - r) + Ck - m = \frac{Q_{in}}{V}(C_{in} - rC)$$

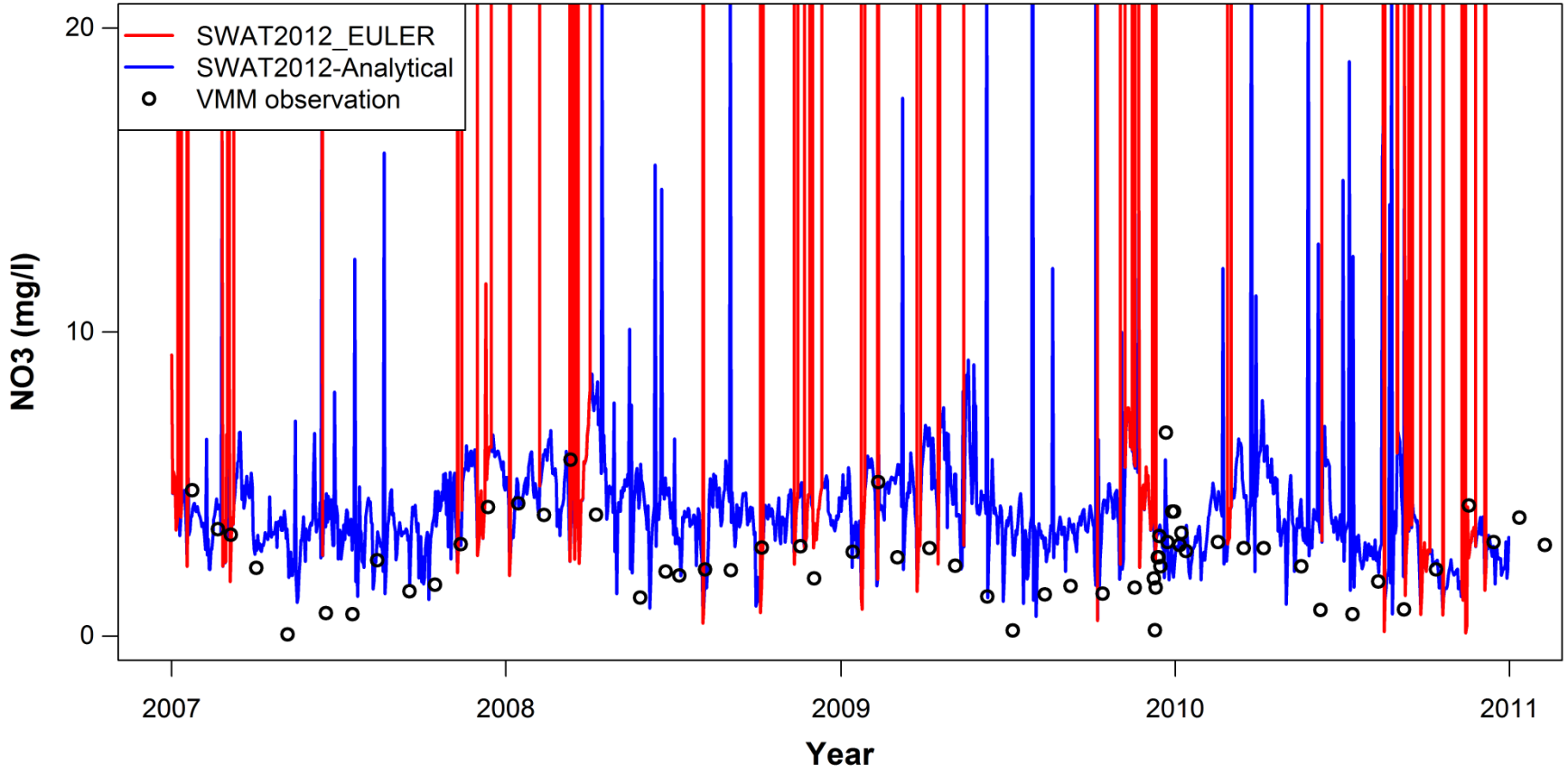
- Analytical solution
  - First order ordinary differential equation
  - Assumptions

$$C_{t+\Delta t} = C_t e^{-\Delta t * \left(\frac{1}{t_{res}} + k\right)} + \left(\frac{C_{in,t+\Delta t}}{t_{res}} + m\right) * \frac{1}{\left(\frac{1}{t_{res}} + k\right)} \left[1 - e^{-\Delta t * \left(\frac{1}{t_{res}} + k\right)}\right]$$

- Stability ??
- Accuracy??

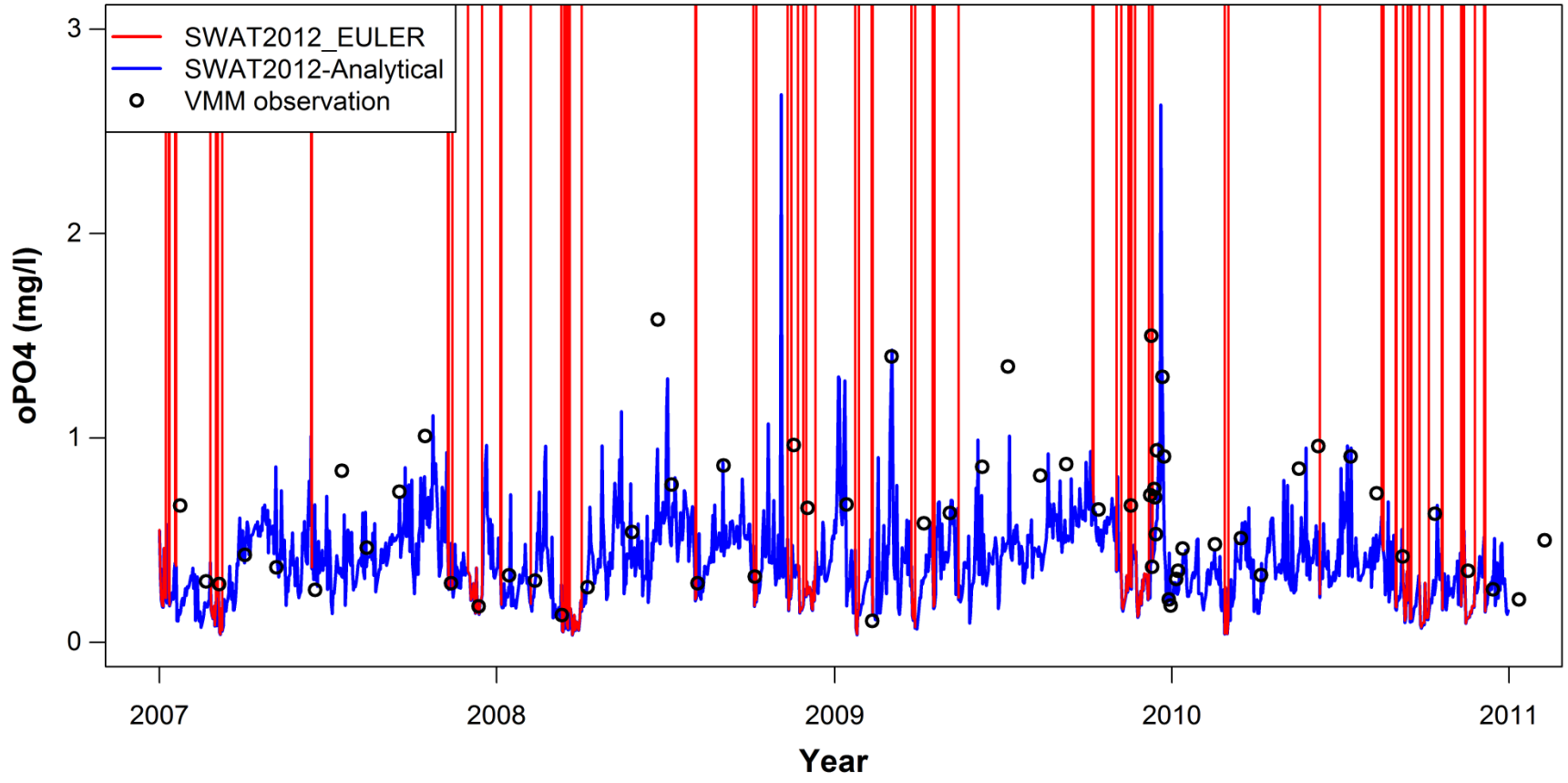
Better simulation/pattern by quasi-analytical method than EULER

- Default parameters



Stability comparison of the methods in SWAT2012

- Default parameters



Stability comparison of the methods in SWAT2012

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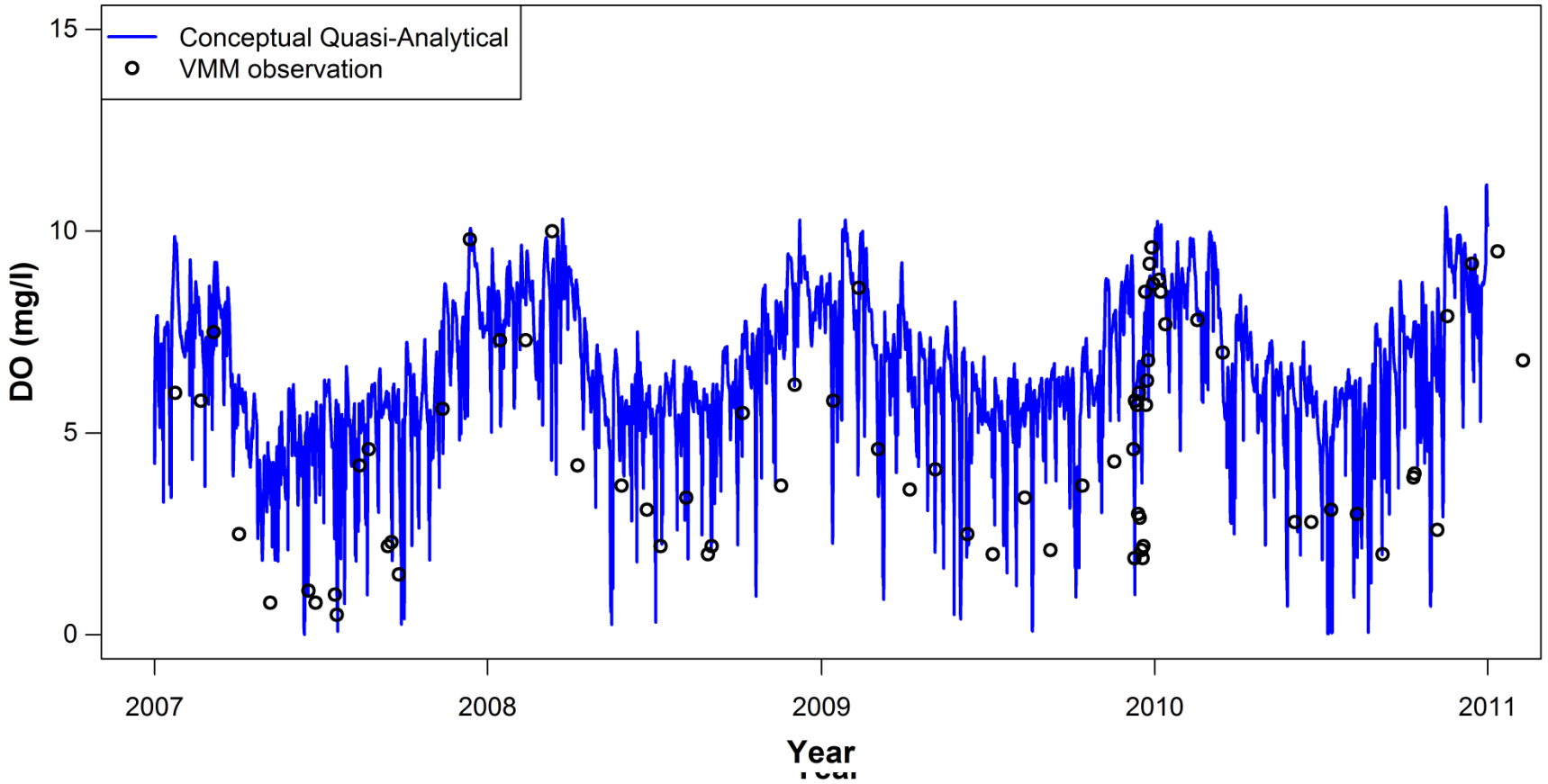
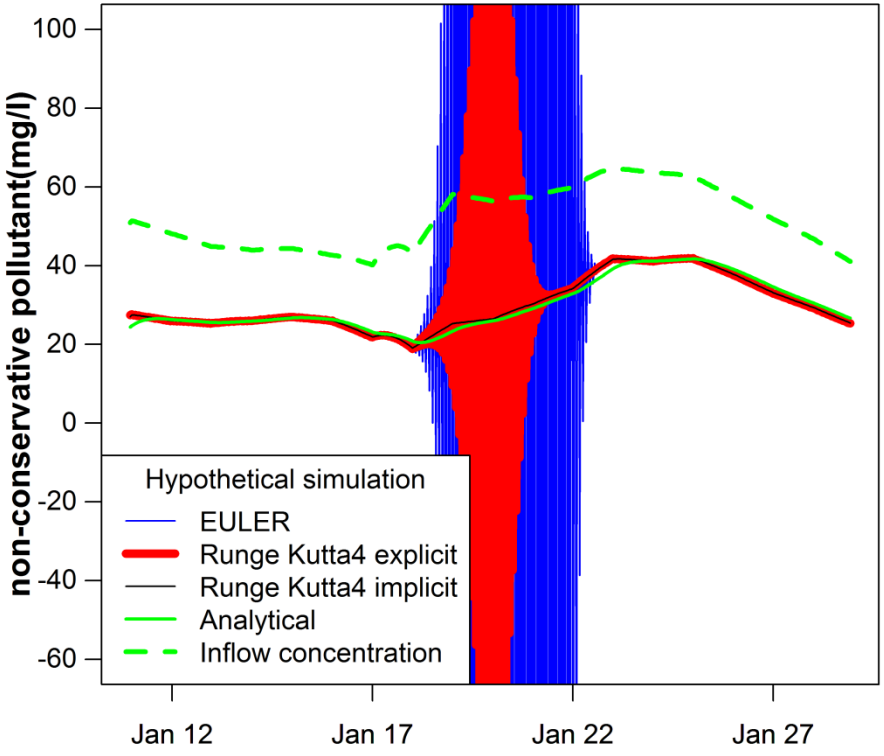
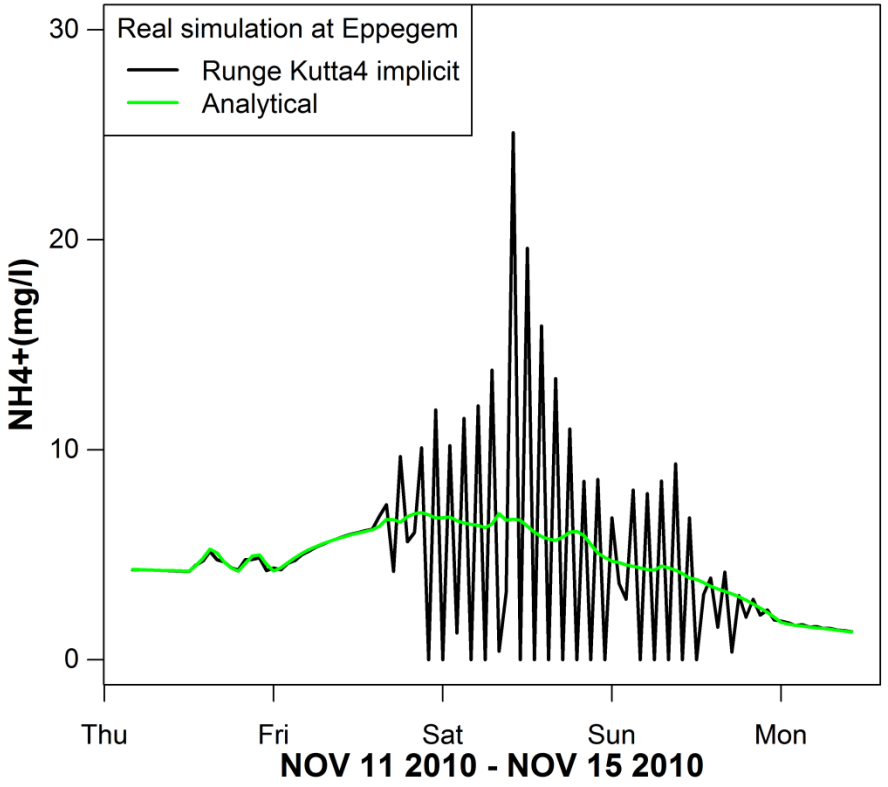


Instability comparison with other advanced numerical methods

- Hypothetical case
- Real case (Zenne, Belgium)

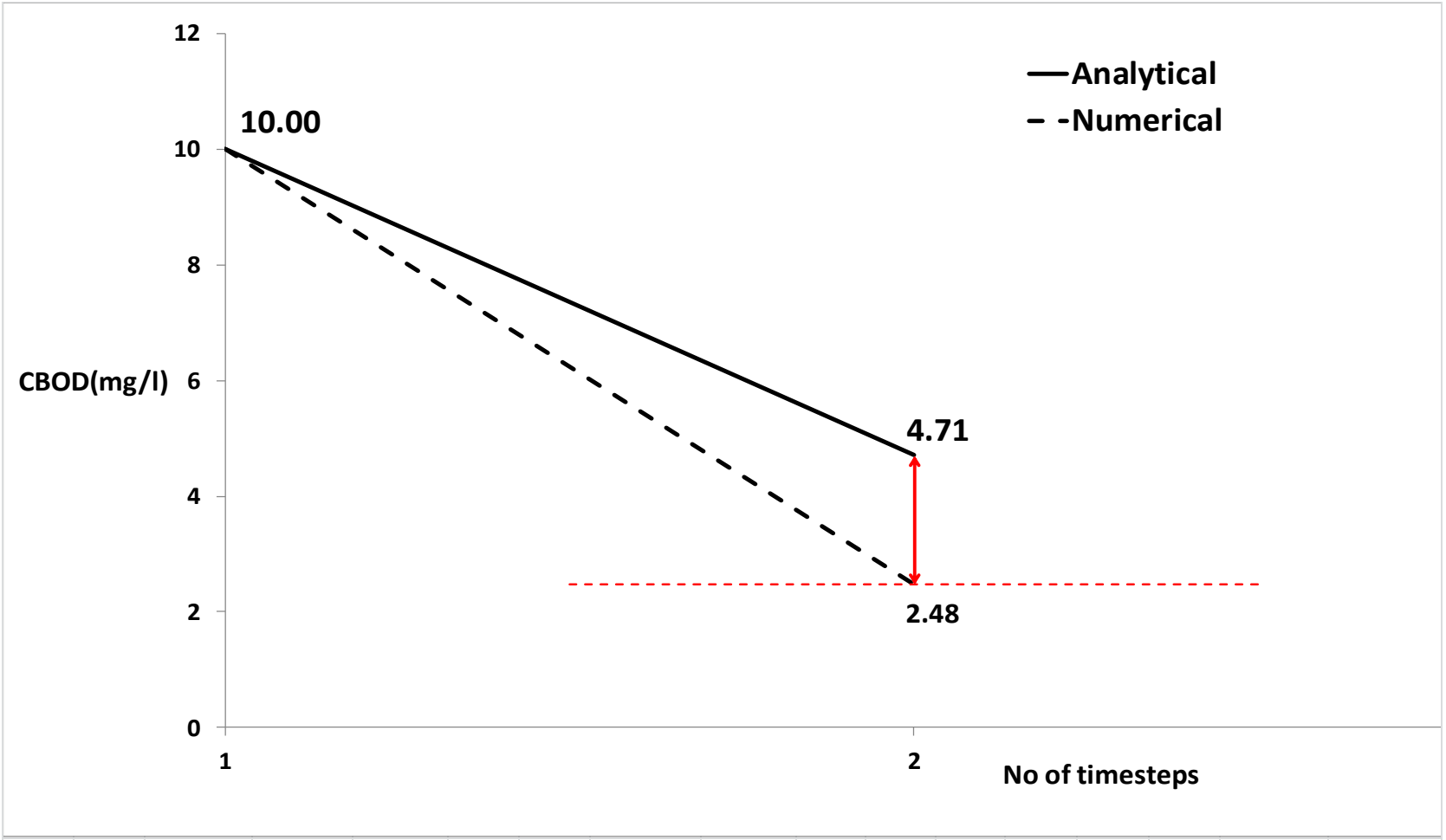




Conclusions

- The new Quasi-analytical approach:
  - Is unconditionally stable
  - Is better than or as good as the advanced numerical methods
  - Less calibration effort
  - Better accuracy for low flow simulations, navigation canals
  - Increases reliability of instream WQ simulation of SWAT

Instabilities in the numerical solution method



tt/delt=	1.000		K1+ K3 =	0.75		difference =	47.5 %

tt: residence time

Instabilities and residence time for Euler's method