Particle tracking as a vulnerability assessment tool for drinking water production

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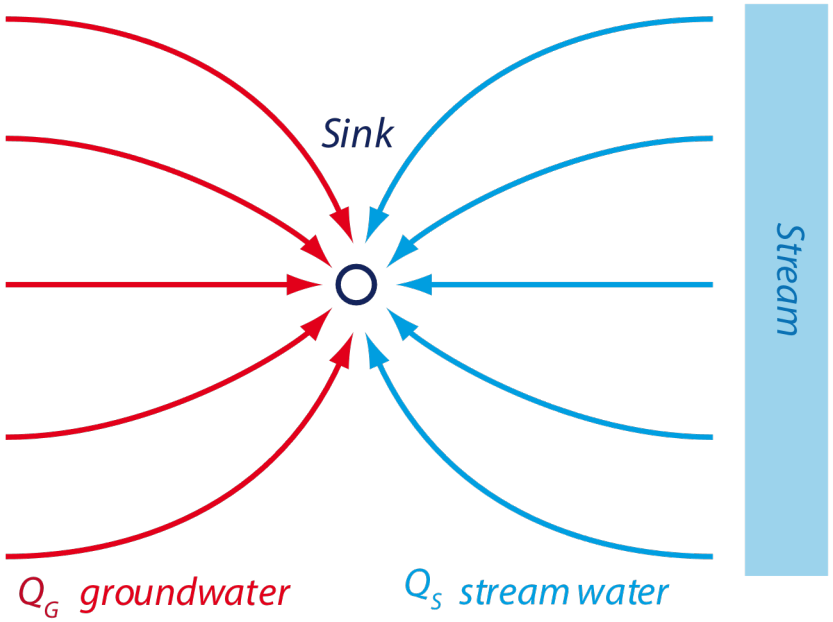
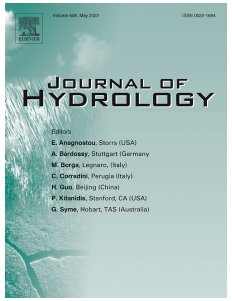
HS3.8 : Rapid, reproducible, and robust hydrosystem modeling for decision support: worked examples and open-source software tools

Part I : Methodology



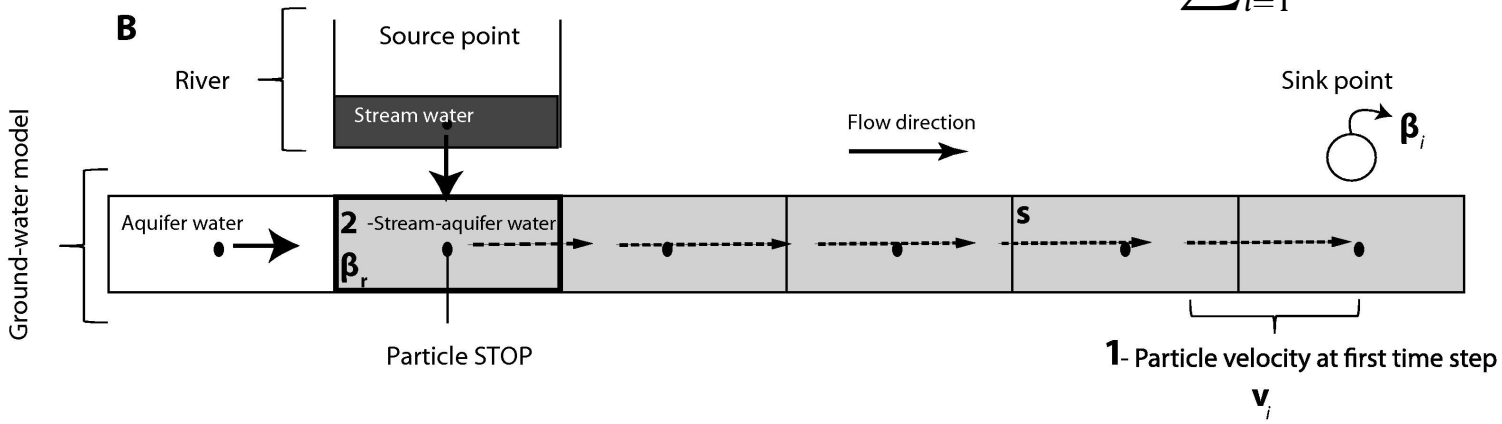


Cousquer, Y., Pryet, A., et al. (2018).
Developing a particle tracking surrogate model to improve inversion of ground water–Surface water models.
Journal of hydrology, *558*, 356-365.

https://doi.org/10.1016/j.jhydrol.2018.01.043

$$\beta_r = \frac{Q_s}{\sum_{i=1} Q_i}$$

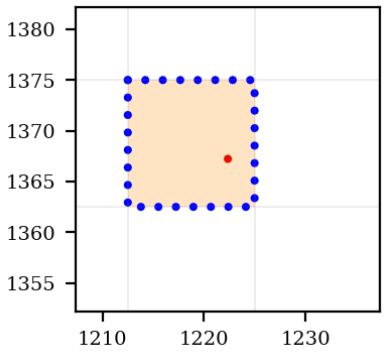
$$\beta = \frac{\sum_{i=1}(v_i \times \beta_i)}{\sum_{i=1} v_i}$$



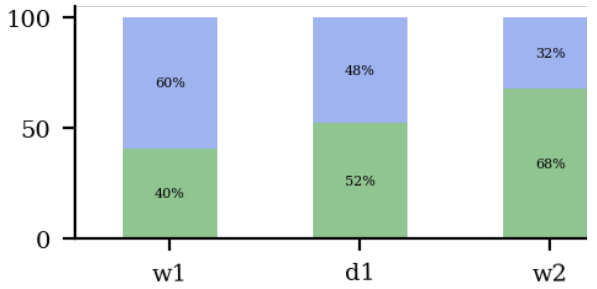
super fast transport model for :
non-reactive advective transport
with steady state flow

Part II

Tracktools



https://github.com/tracktools



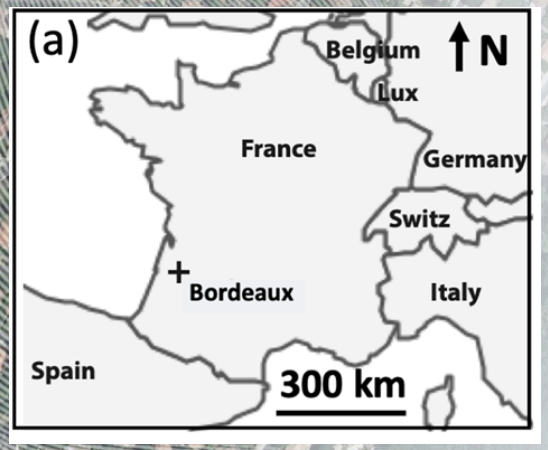
FloPy

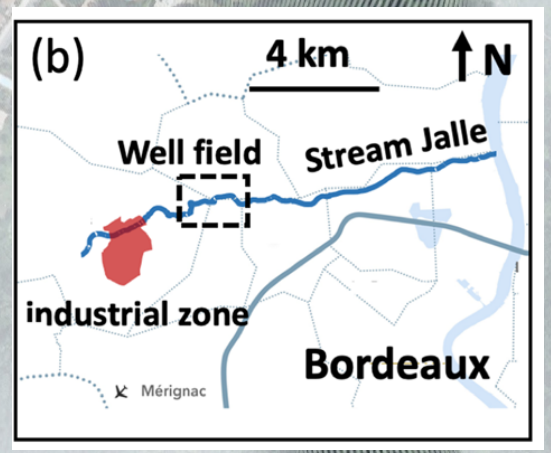
Particle generation → MODFLOW → MODPATH → Computation of mixing ratios

```
from tracktools import ParticleGenerator
pg = ParticleGenerator(ml = gwf)
w1_geom = shapely.geometry.Point(x,y)})
pg.gen_points({'w1':w1_geom}, n = 30)
```

```
from tracktools import TrackingAnalyzer
ta = TrackingAnalyzer(ml = gwf, mpsim =
mpsim)
mr_df = ta.compute_mixing_ratio(on='river')
```

Part III : Case study





Barbacanes

R21

R20

Galerie

Part III : Case study

https://github.com/tracktools/case_study

Model set up

- GIS data collection with *QGis* and gridding with *GridGen*
- Mdel implementation with *FloPy*

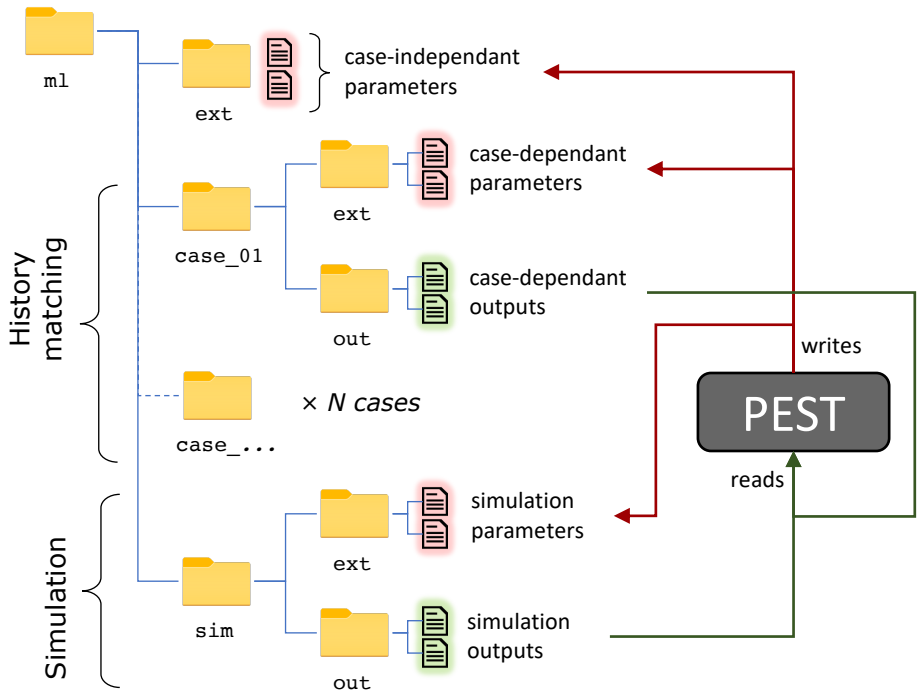
Parameter estimation

- Parameter data collection
- Observation processing
- *PESTPP-GLM*

Optimization

- Simulation setup
- FOSM uncertainty
- *PESTPP-OPT*

11 pseudo steady states + 1 simulation



Part III : Case study

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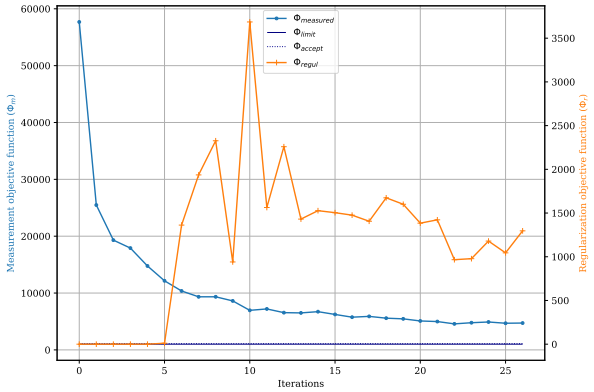
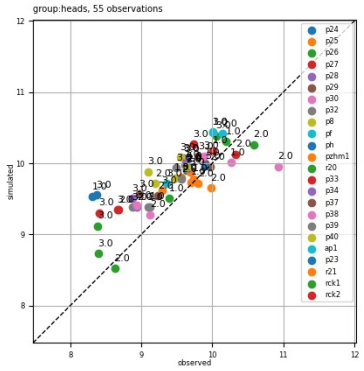
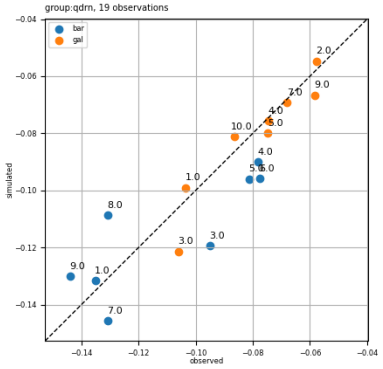
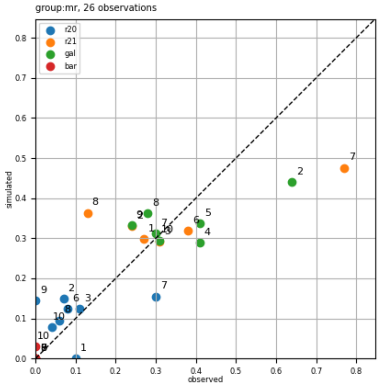
PESTPP-GLM









PESTPP-OPT

$$\max_{Q_i, h_i} \quad = \sum_{i=1}^{N} Q_i$$

$$\text{s.t.} \quad \alpha = \frac{1}{\sum_i Q_i} \sum_{i=1}^{N} Q_i \alpha_i \leq \alpha_{\text{crit}}$$

More in the upcoming paper of the Frontiers SI