

1 THE PROBLEM



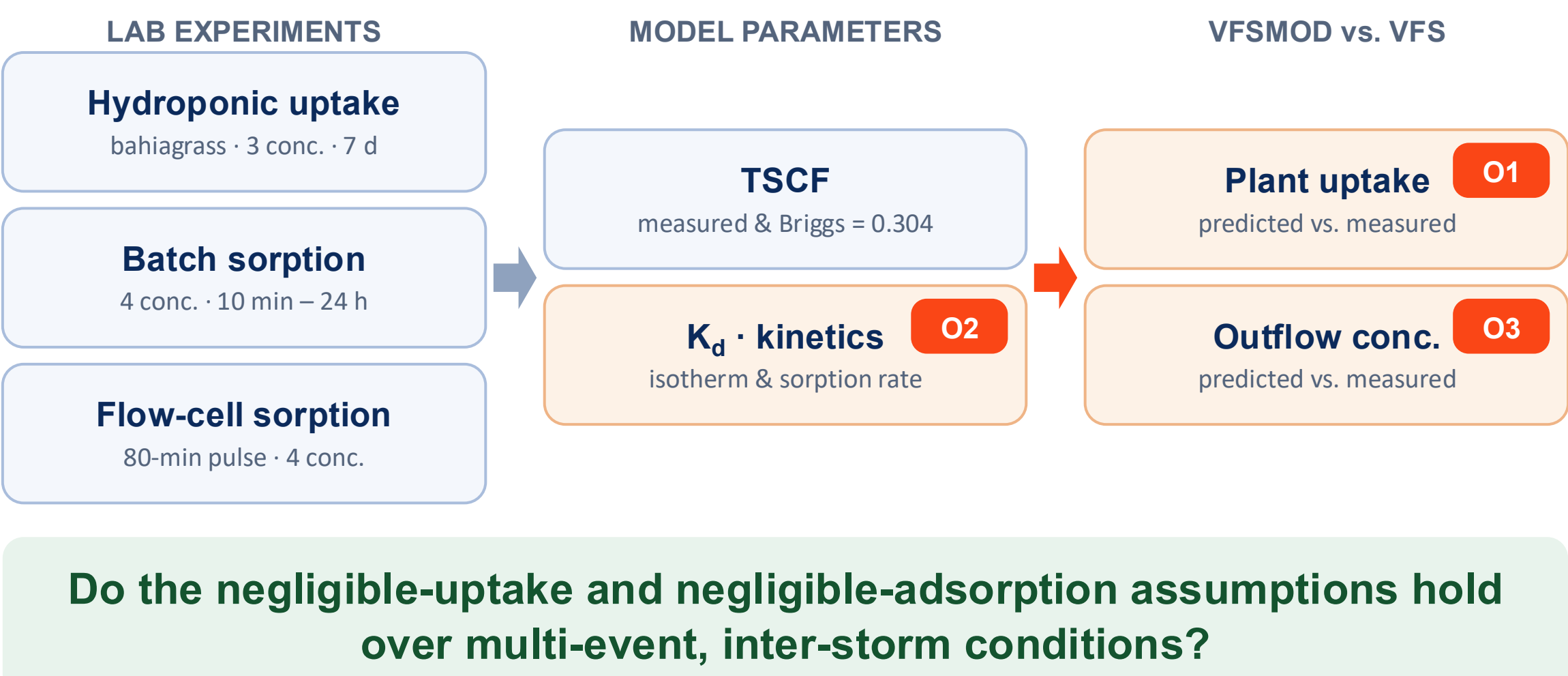
- **Vegetative filter strips (VFS)** are planted grass buffers that mitigate pesticide transport from urban and agricultural runoff.
- **VFSMOD**, the storm-based VFS design model, is now used for **long-term regulatory exposure assessment** — but it carries two single-event assumptions never tested across multiple events:

- A1** Plant uptake is **negligible** — storms are short and high humidity suppresses transpiration
- A2** Adsorption to vegetation is **negligible** — small contact area between biomass and surface flow

Inter-storm dry periods last **days to weeks** at much lower humidity — transpiration can then drive uptake.

2 HYPOTHESES · OBJECTIVES

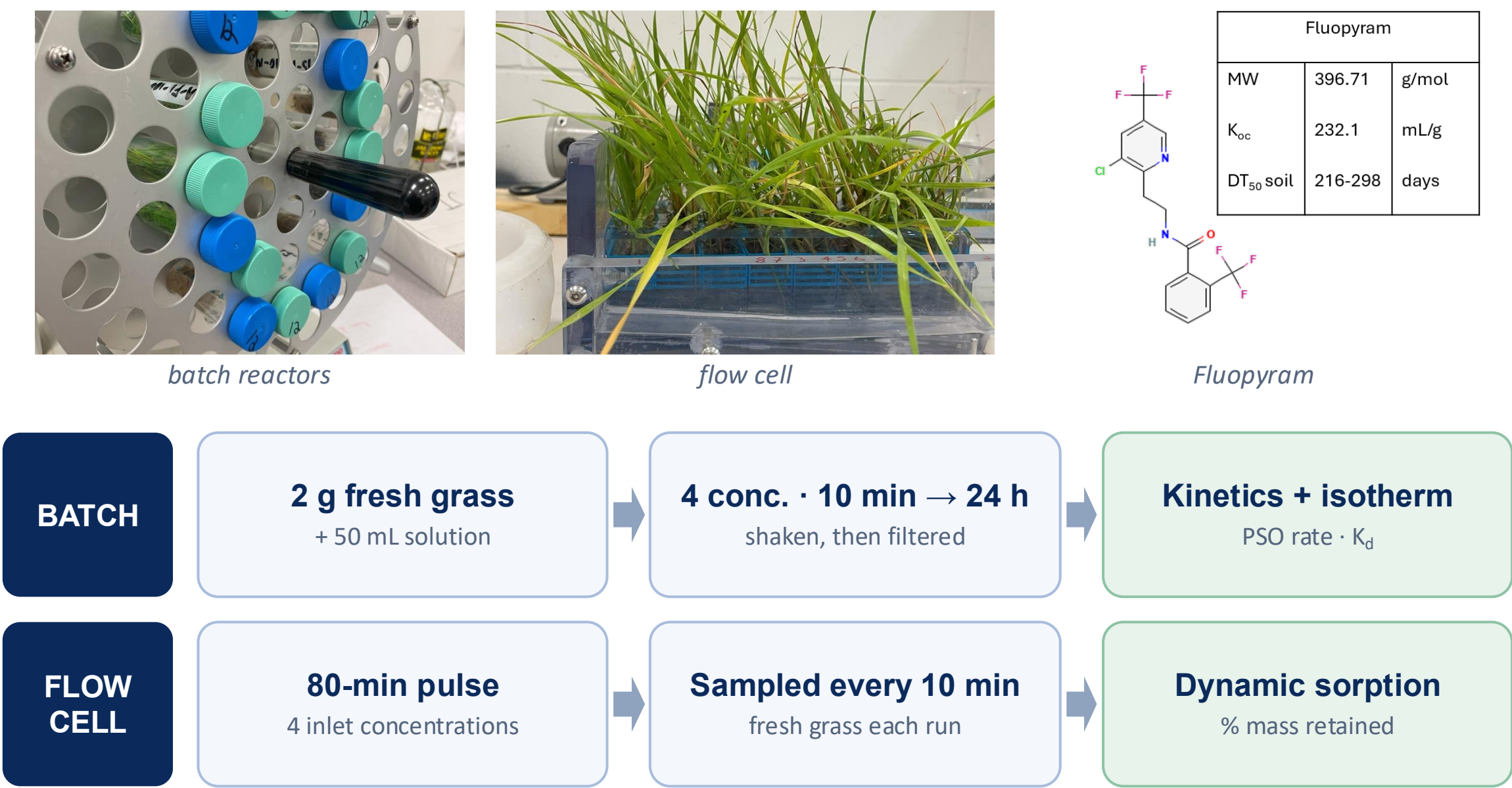
- H1** Negligible **uptake** still holds through inter-storm dry periods
- H2** Vegetation **adsorption** is not a substantial mass sink in surface flow



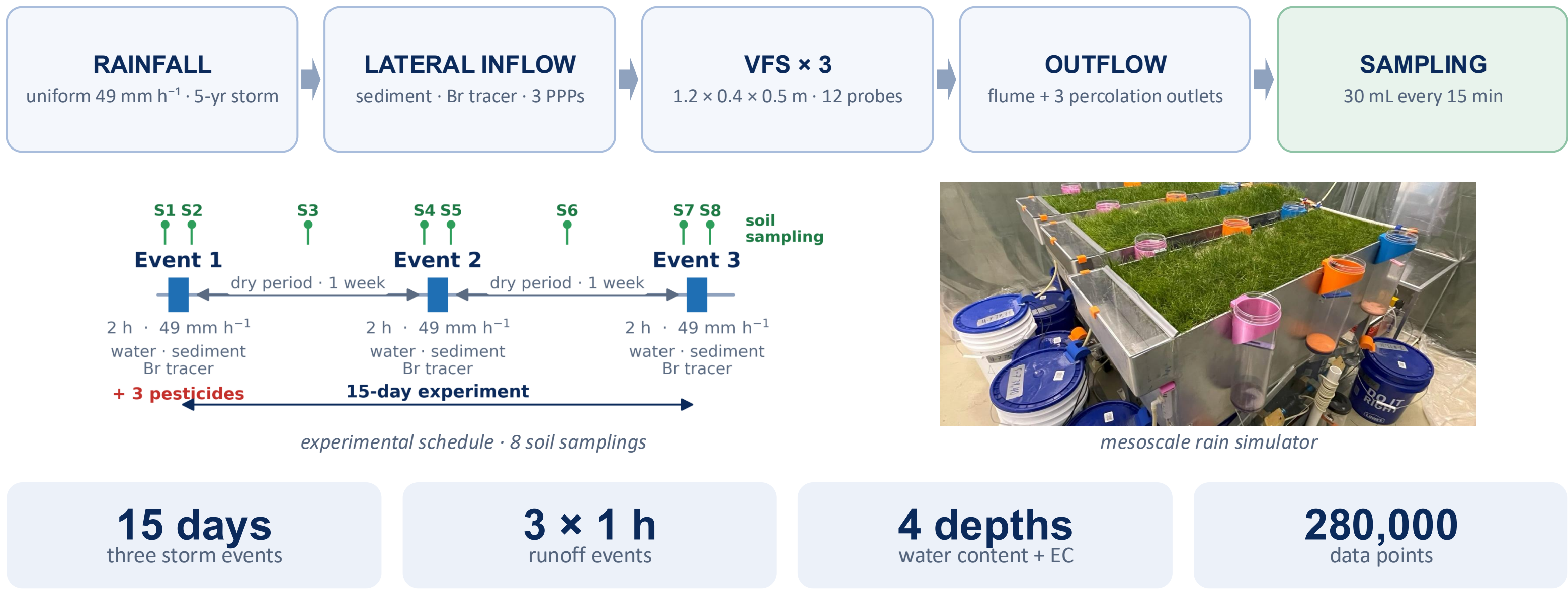
3 METHODS · PLANT UPTAKE



4 METHODS · SORPTION



5 METHODS · MESOSCALE MULTI-EVENT VFS



6 RESULTS · PLANT UPTAKE MASS BALANCE

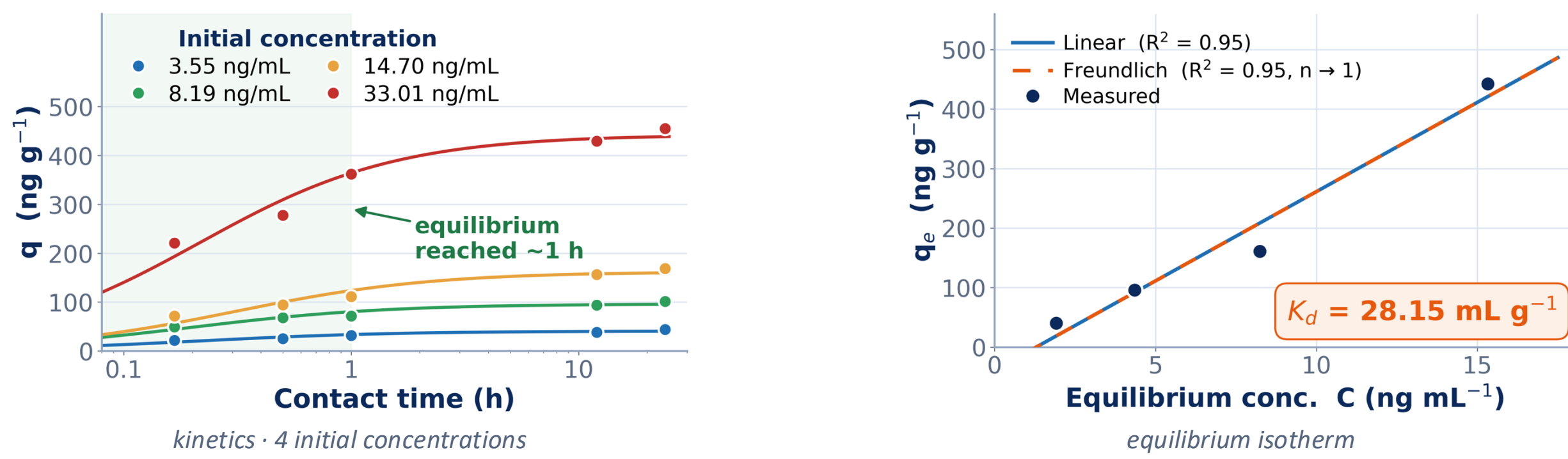
	C1	C2	C3
Initial mass (ng)	923.4	1663.8	3378.3
Final mass in solution (ng)	310.4	302.1	853.9
Aboveground mass (ng)	449.4	970.2	1410.0
Belowground mass (ng)	106.7	269.3	835.2
Adsorbed mass (ng)	53.2	121.0	267.5
Final mass (ng)	919.7	1662.5	3366.6
Error (%)	0.39	0.08	0.35

- Mass-balance error < **0.5 %** — all mass accounted for; degradation negligible.
- Measured TSCF of **1.2 – 1.35** is physically impossible: more mass in the shoots than was present in the water transpired.

The **Briggs TSCF = 0.304** was used instead for all model comparisons.

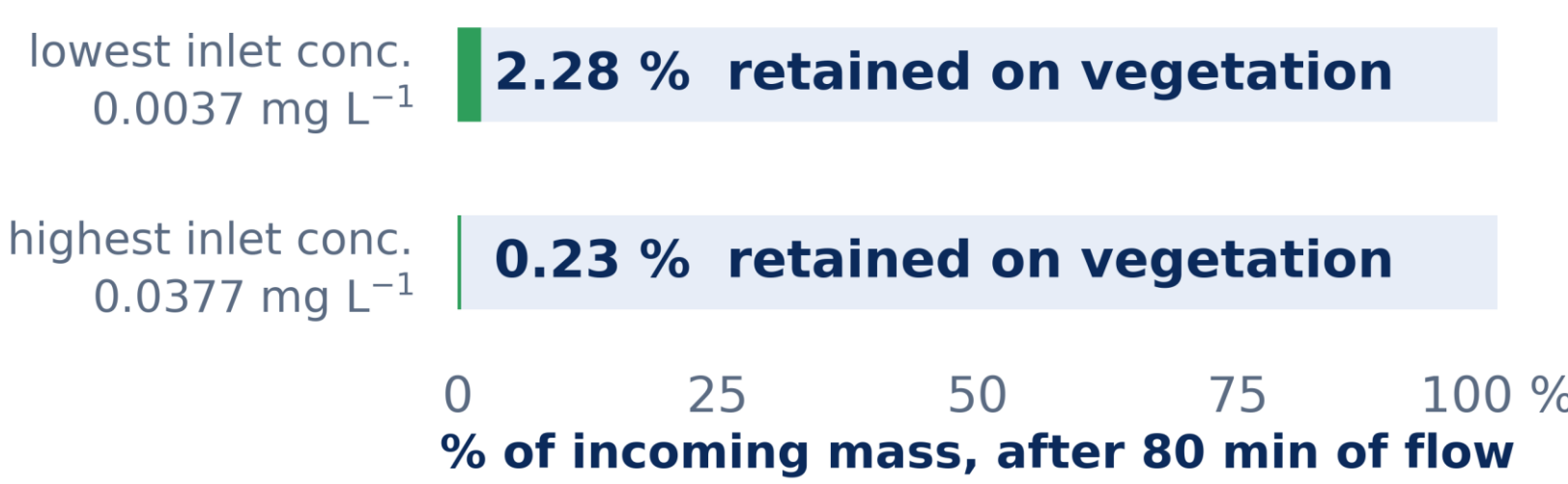
$$TSCF_{Lamshoeft} = \frac{\ln\left(1 - \frac{M_{shoots}^f}{M_{shoots}^f + M_s^f}\right)}{\ln\left(\frac{V_s^f}{V_s^i}\right)}$$
$$TSCF_{Briggs} = 0.7 e^{-\frac{(\log K_{oc} - 1.78)^2}{2.44}}$$

7 RESULTS · BATCH SORPTION



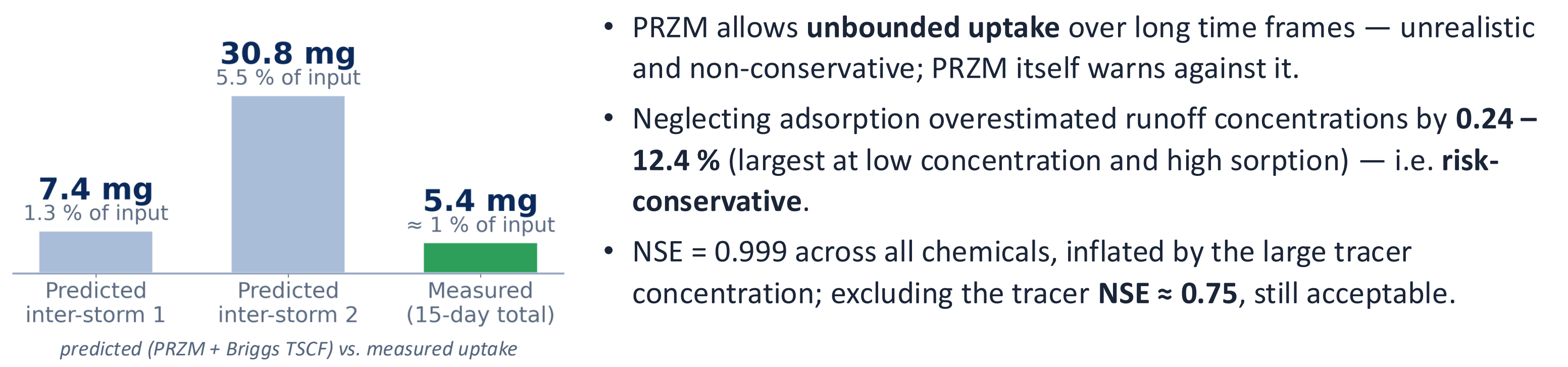
- **Pseudo-second-order** kinetics fit best (R² = 0.97 – 0.98) versus pseudo-first-order (0.91 – 0.94) → sorption is limited by **site availability**, not by diffusion.
- Equilibrium in **~1 h**, far shorter than the 6 – 12 h storms used in ERA → sorption is **instantaneous** for runoff models. Linear and Freundlich fit equally well (R² = 0.95, n → 1): **no site saturation**.
- K_d = **28.15 mL g⁻¹** (3 – 9 × published). With f_{oc} ≈ 0.44 the apparent K_{oc} is **62 – 66** vs. 230 – 460 mL g⁻¹ → only **13 – 28 %** of the plant's organic carbon is accessible for sorption.

8 RESULTS · DYNAMIC SORPTION



- Retained mass **did not increase** with inlet concentration → the sorbent, not the solute, controls uptake.
- Vegetation is a **minor sink** under dynamic hydraulic conditions; percentages are not transferable to the mesoscale system, whose geometry and hydraulics were not scaled.

9 RESULTS · MESOSCALE VALIDATION



CONCLUSIONS · KEY TAKE-HOME MESSAGES

- ✓ Over 15 days and three events, < **1 % of incoming Fluopyram** was recovered in grass biomass — below the uncertainty of the other fate and transport processes.
- ✓ Neglecting uptake and adsorption **overestimates** runoff concentration by at most ~12 % — a **risk-conservative** simplification.
- ✓ Sorption to fresh grass is **fast (~1 h) and linear** (K_d ≈ 28 mL g⁻¹) — instantaneous in event-based runoff modelling.
- ✓ Adding both processes explicitly would raise model complexity **without improving accuracy**: VFSMOD stays valid for multi-event ERA.