New insights in transport processes by applying emerging contaminants as indicators

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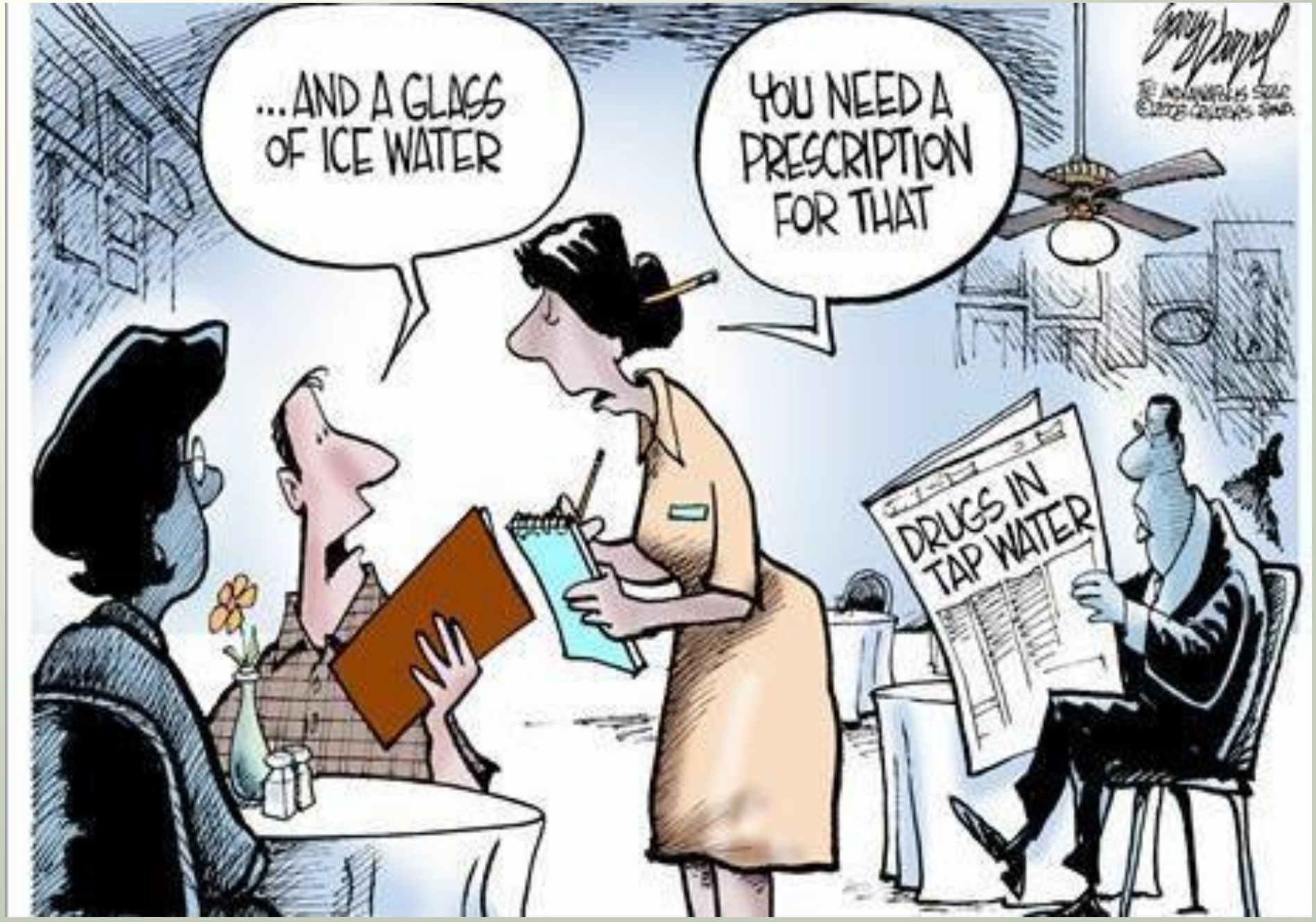

...AND A GLASS OF ICE WATER
YOU NEED A PRESCRIPTION FOR THAT
DRUGS IN TAP WATER

Emerging contaminants in the aquatic system

No question, emerging organic contaminants (even in very low concentrations) in tap water are not desirable.

But now that they occur in the aquatic system, can we make use of them otherwise?

Tracer (e.g. dye tracer)	**Indicator**
Introduced intentionally	Already in the system
Detailed study	System behavior
Local scale	Regional scale

What to expect from indicators

Source indicators: Compounds that are specific for an input source, e.g. sewage effluent, herbicides

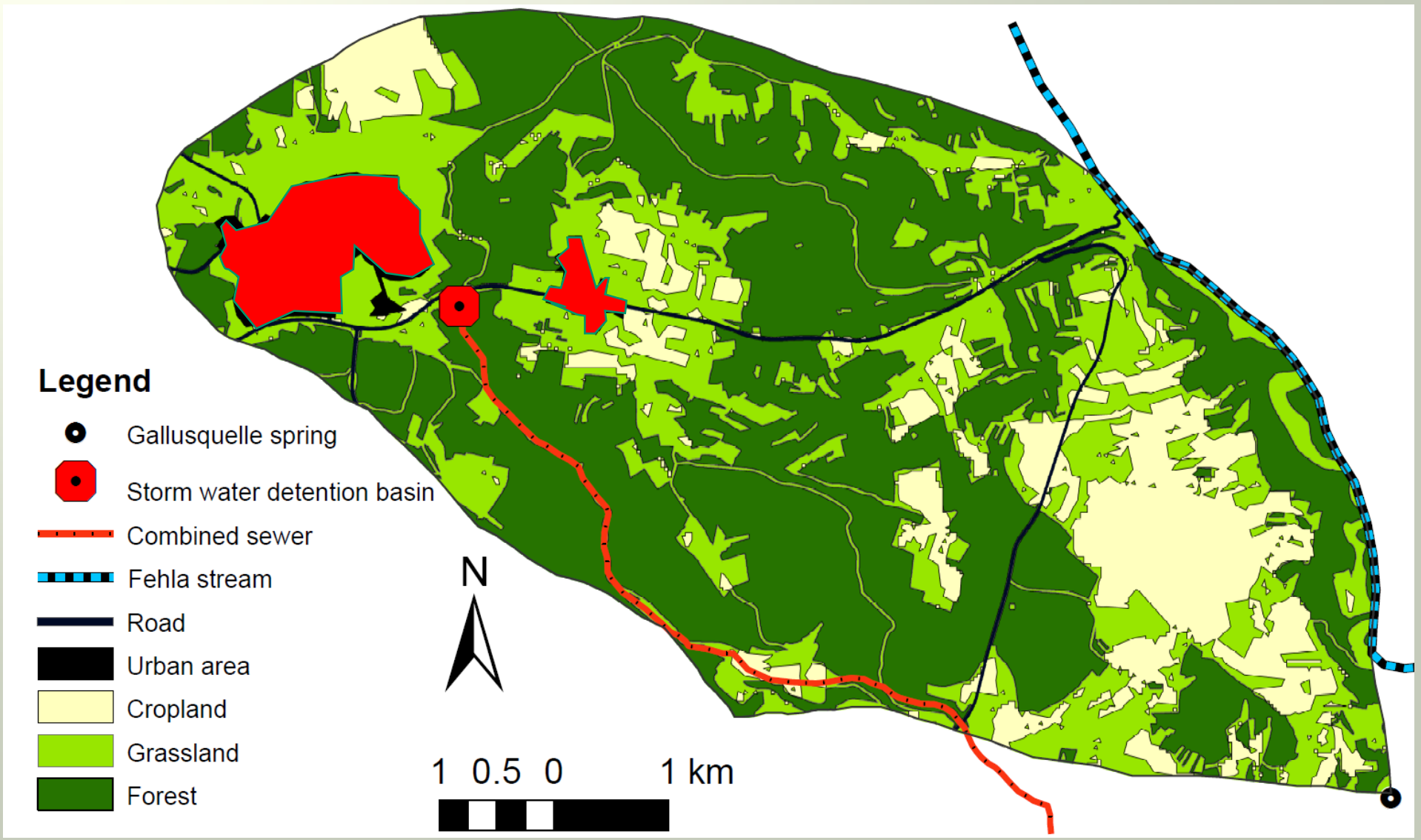
Residence time indicators: Compounds that help to elucidate travel time or age of groundwater

Collection of suitable candidates

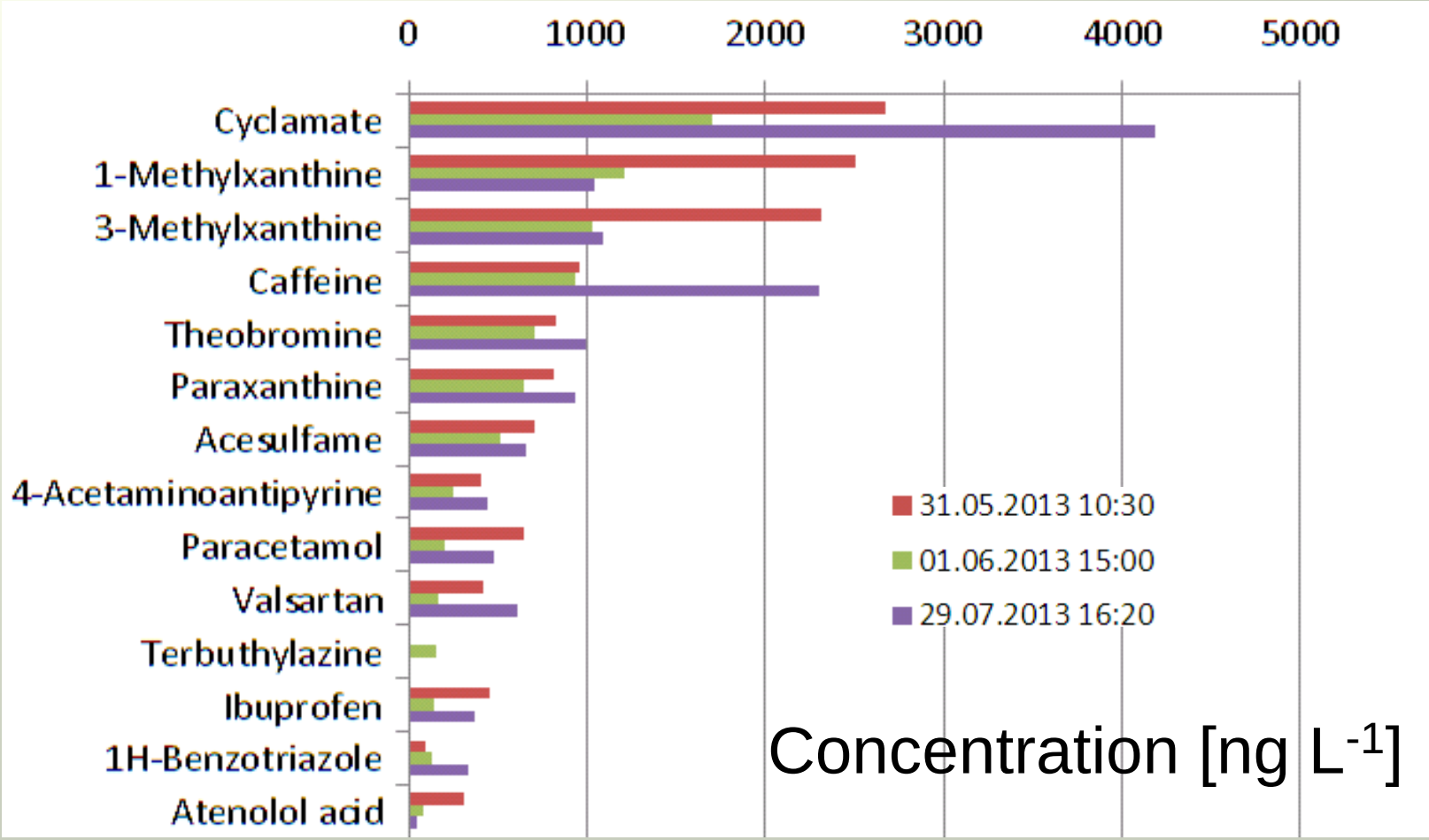
	Application	*log P_{ow} **	*Sorption*	*Elimination*
Caffeine	Stimulant	-0.07	**no**	**Very high**
Cyclamate	Artificial sweetener	-2.6		**High**
Acesulfame		-1.3		**Very low**
Atrazine	Herbicide	2.6	**(yes)**	**Low**
Isoproturon		2.9		**High**
Metazachlor		2.1		**High**

* SRC PhysProp Database (http://esc.syrres.com/fatepointer/search.asp)

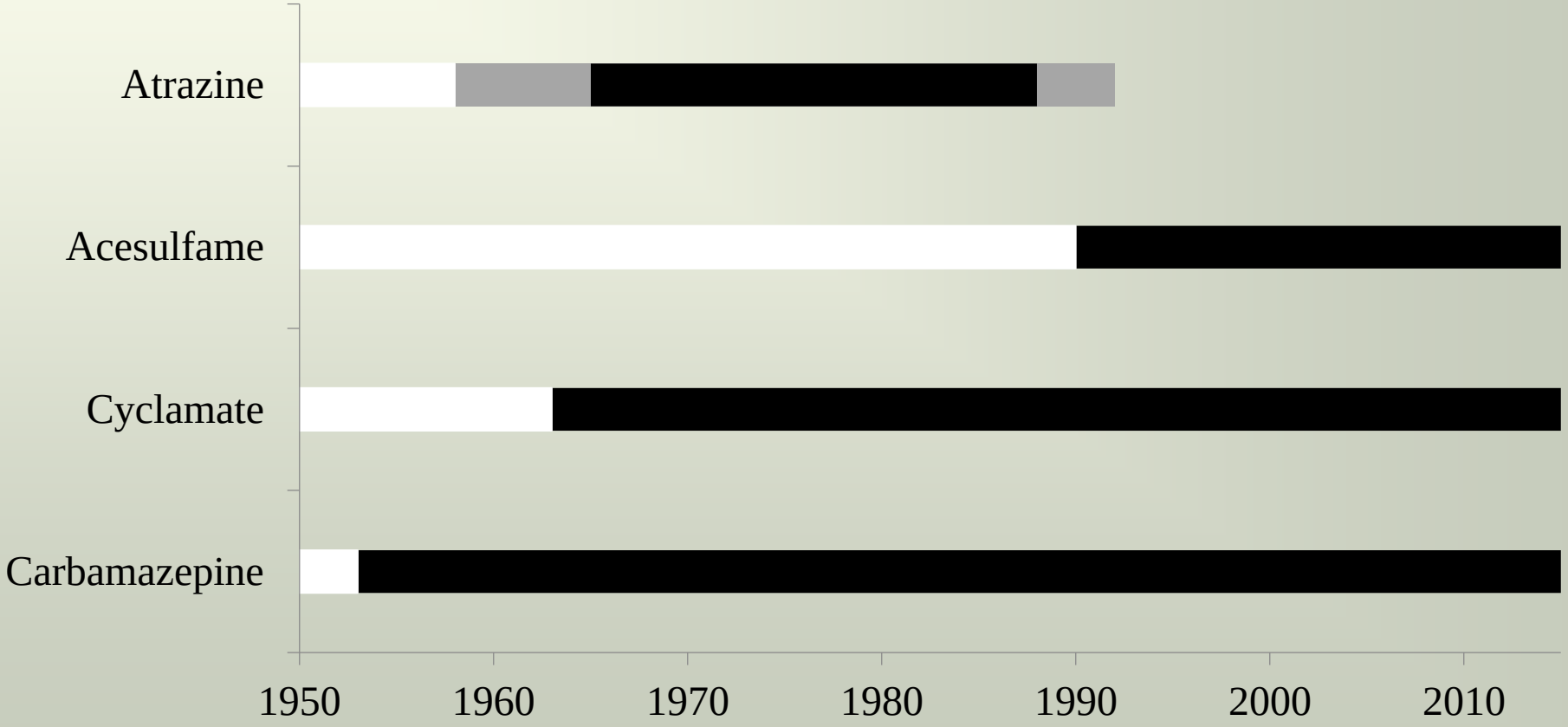
Catchment of karst spring Gallusquelle



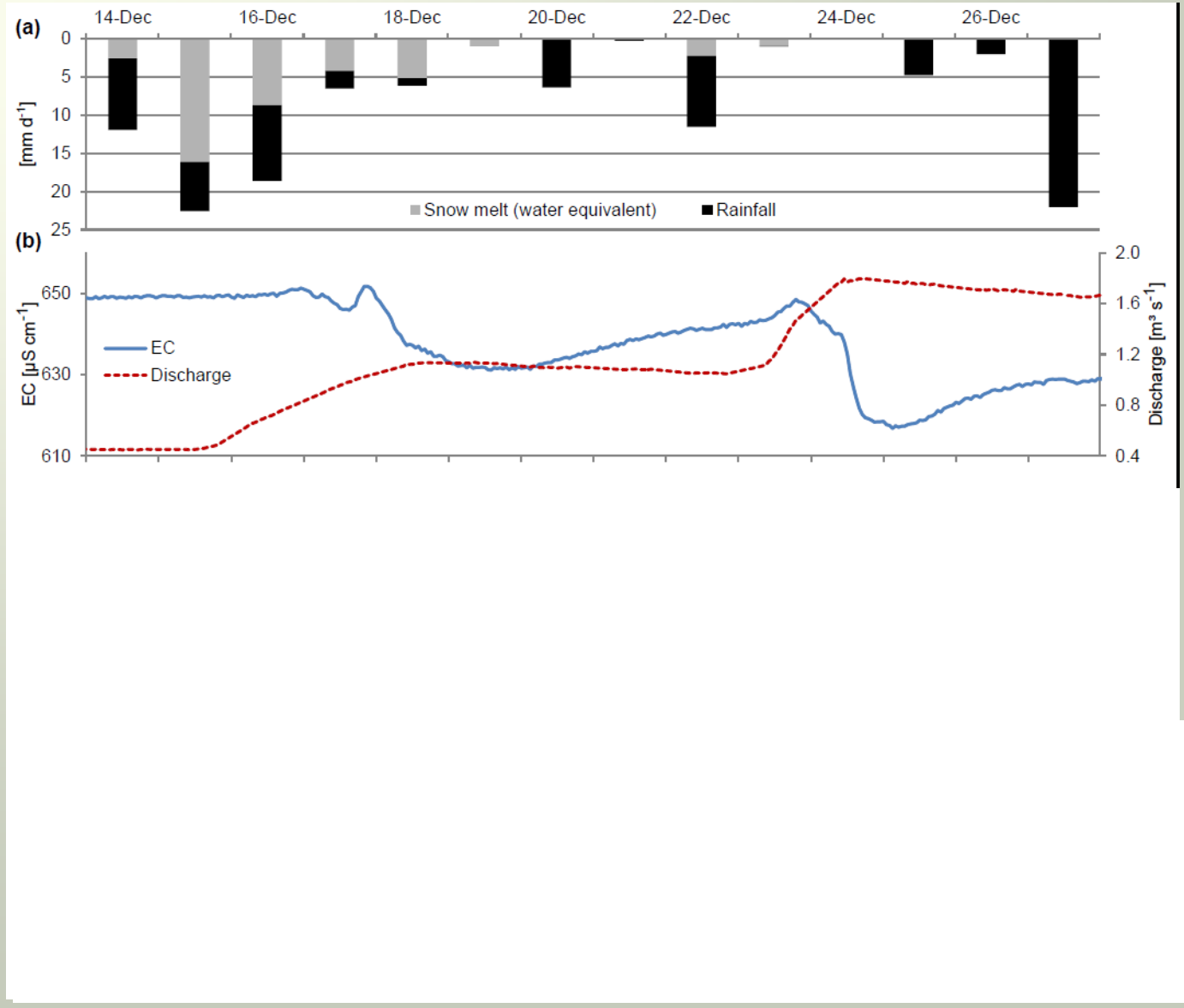
Micropollutants at storm water detention basin



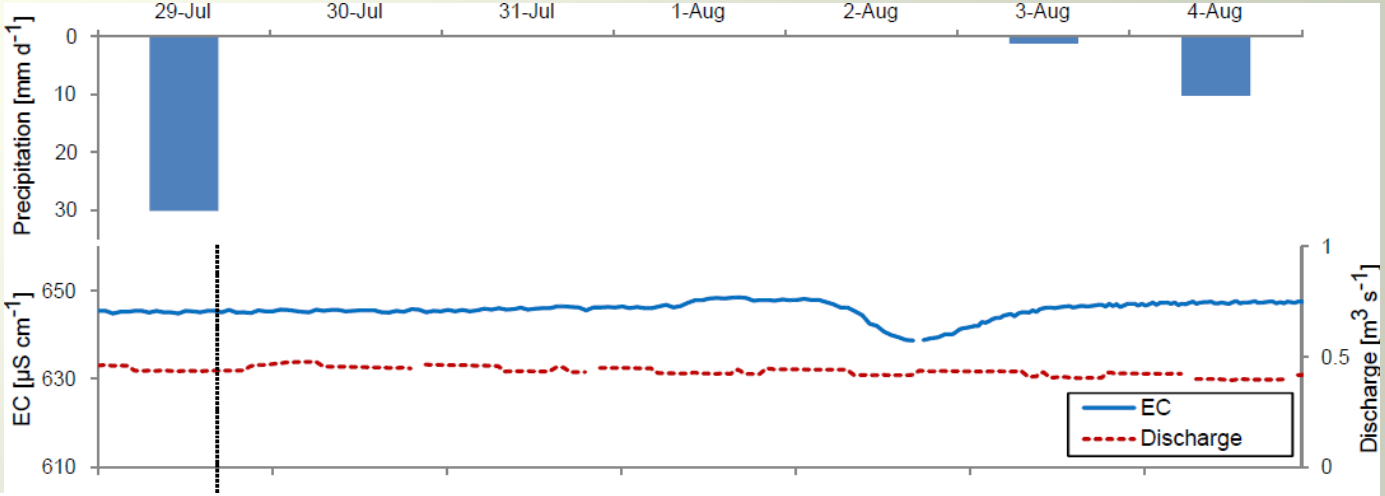
Application history for selected micropollutants



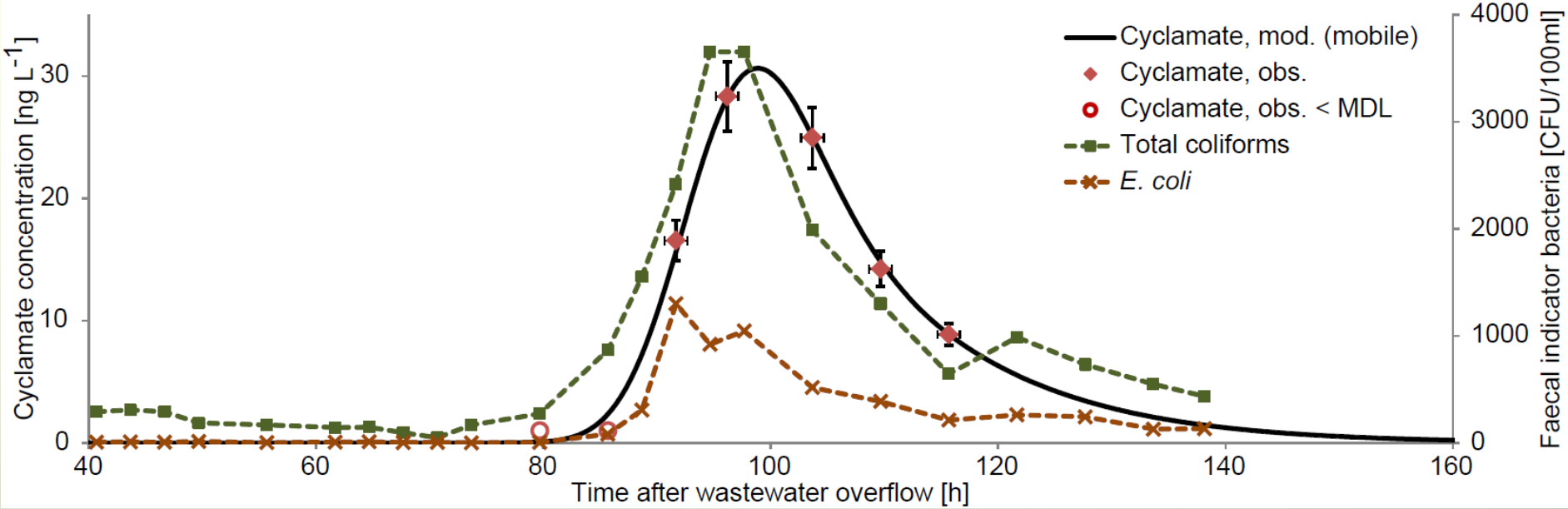
Snow melt around Christmas 2012



Heavy rainfall on July 29th 2013



Newly introduced sewage effluent – An example for quantification



Mean velocity: 87 [m h^{-1}]

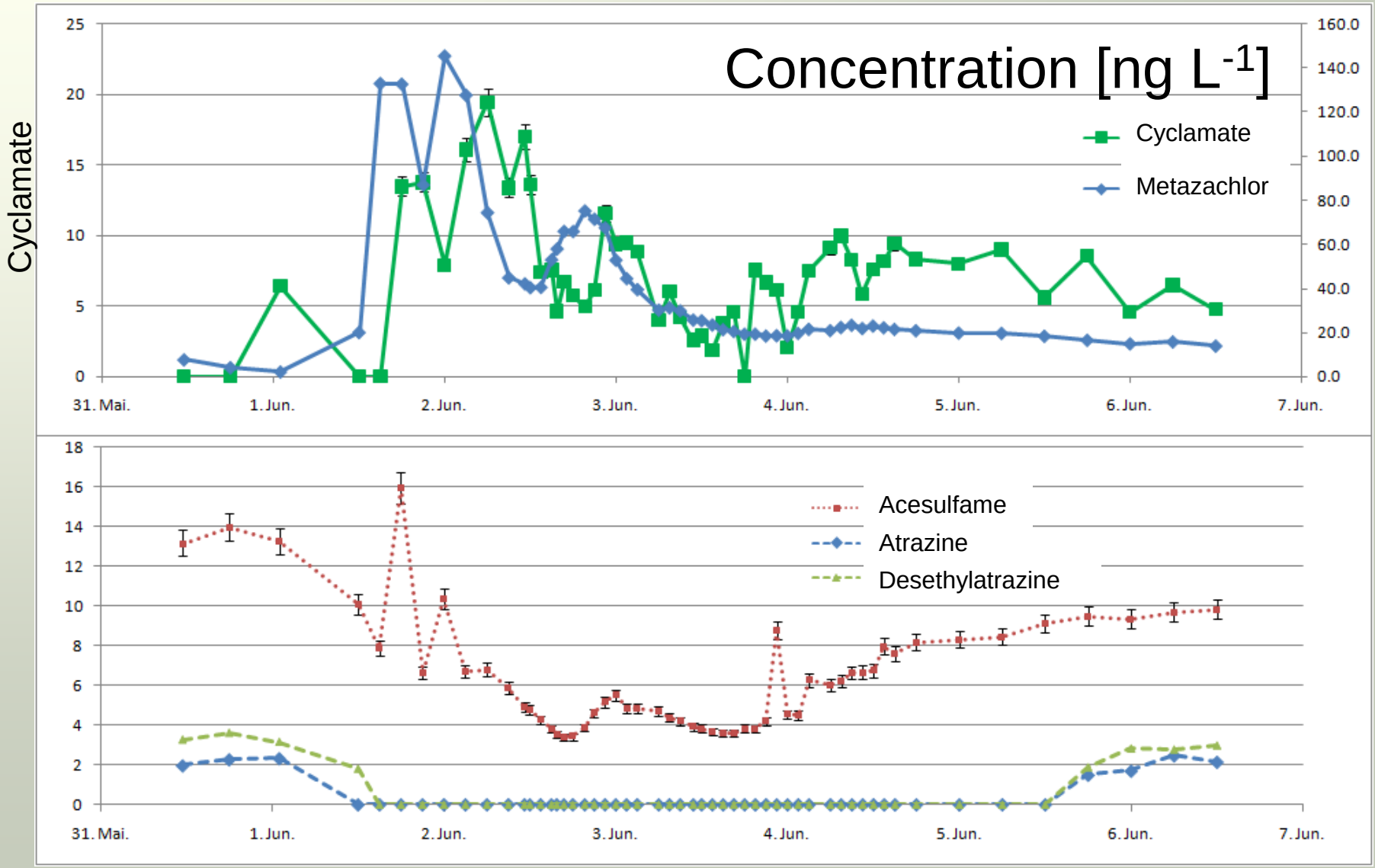
Peak velocity: 93 [m h^{-1}]

Mass of Cyclamate: 1.1 g

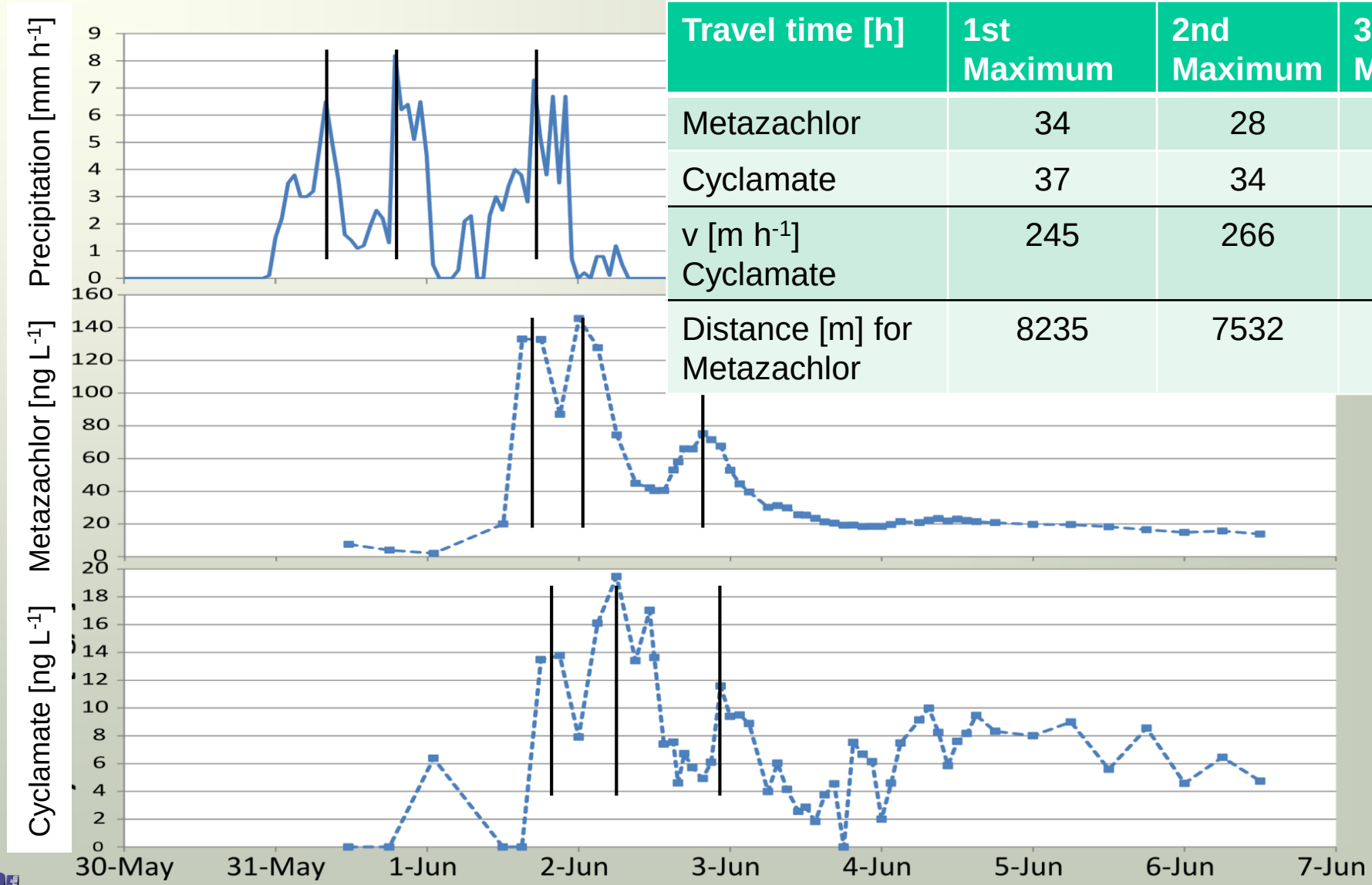
Volume of detention basin: 260 m^3 ≅ 25% of overflow

Leading to **0.7% of sewage water in the spring water** at Gallusquelle

Flooding 2013

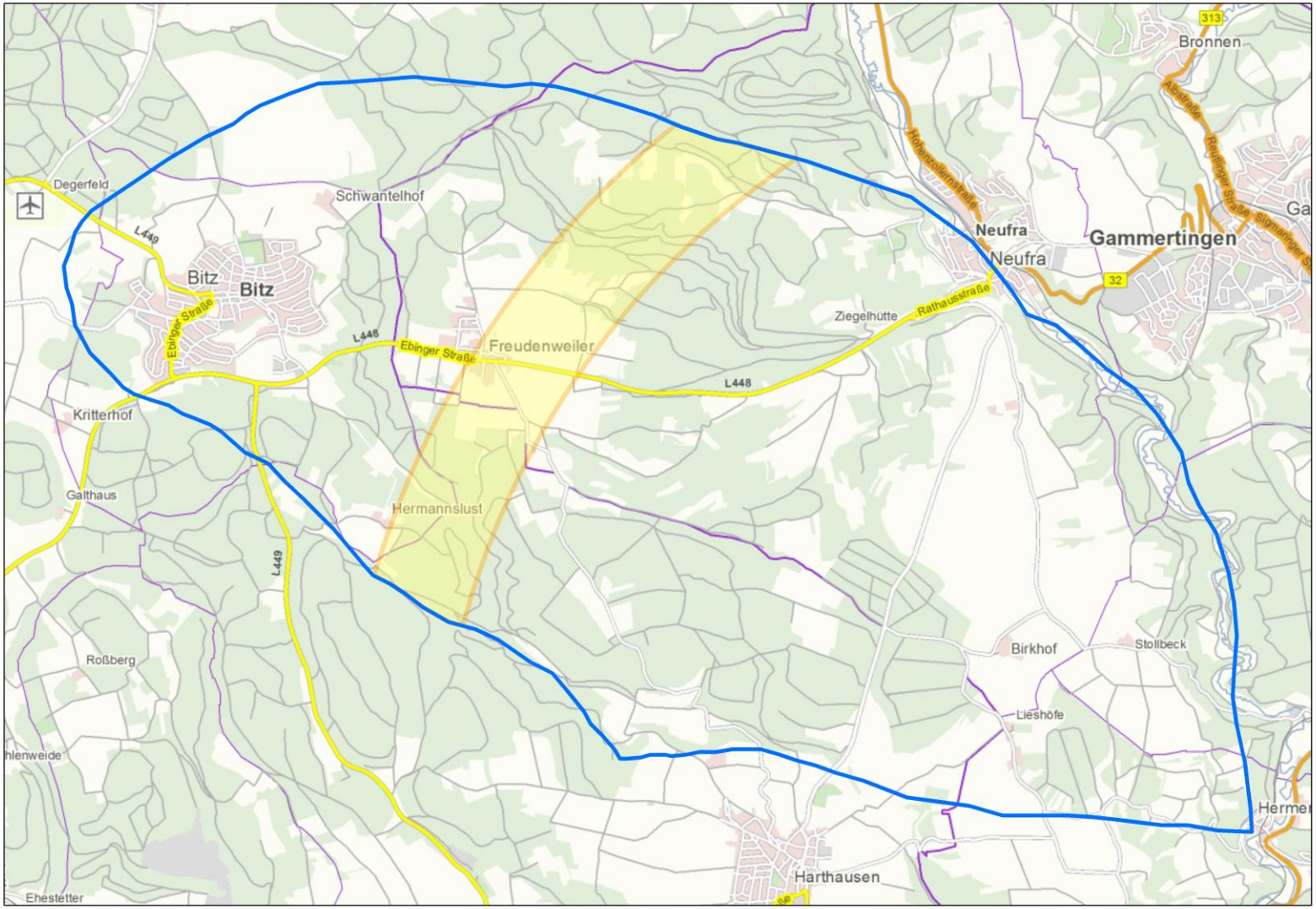


Flooding 2013



Travel time [h]	1st Maximum	2nd Maximum	3rd Maximum
Metazachlor	34	28	26
Cyclamate	37	34	31
v [m h^{-1}] Cyclamate	245	266	286
Distance [m] for Metazachlor	8235	7532	7540

Origin of metazachlor during flooding 2013



Summary and conclusions

Micropollutants are promising as indicators for processes in the aquatic system.

Due to their specific chemical properties and transport behavior micropollutants can be used not only for input related information but also for processes within the aquifer.

The combination of a set of compounds with specific properties is most effective.

For use as indicators, the properties are most important and the goal may be reached with completely different classes of micropollutants.