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Relation between the river Meuse and Rhine discharge and water quality problems related to drinking water preparation

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Problem definition

Drinking water companies consider a warm summer with low discharges very risky:

- water temperatures rises
- salt pressure increases
- the same load of polluted materials have to be distributed over less water, resulting in higher concentrations.
- the effects of a calamity will last longer.

The KNMI climate scenarios indicate that in future low water situations will occur more often and last longer. This makes the system more vulnerable!

Goal

To gain more insight in the relation between Rhine and Meuse discharges and water quality problems to produce drinking water in the past 20 years

- Intake Meuse-water
- Intake Rhine-water
- Intake Mix
- Measurement location

Historical intake stops

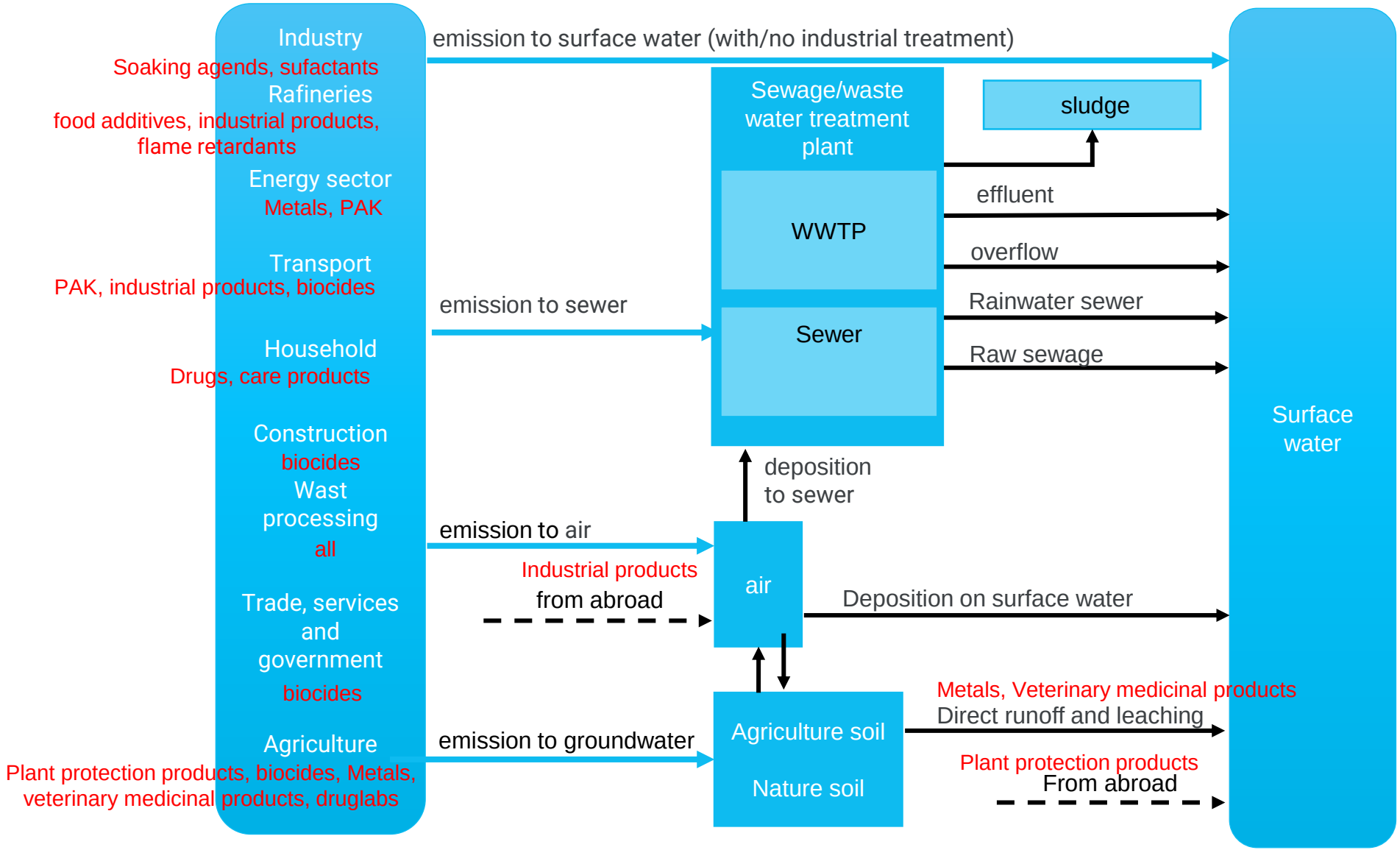
Intake stops during low water conditions in the past 20 years:

- Most intake stops were related to calamities or the exceeding of standards for natural parameters (temperature, external salinity and the biomonitor).
- Only a few were caused by organic micro pollutants. Some examples are plant protection products Isoproturon (Nieuwegein, 2013 and 2014), Diuron (Heel, 2008), tributyl phosphate (Biesbosch, 2010).

Water quality

- The water quality of the Rhine and Meuse is dependent on the organic micro pollutants in the water and some natural parameters. The relation of the organic micro pollutants with the river discharge at the drinking water intake locations depends on:
  - the emission routes;
  - location of emission;
  - the type of the discharge (continuous/seasonal/incidental);
  - the persistence (half-life-time);
  - the adsorption properties.

Emission routes



Source: Noorman-project

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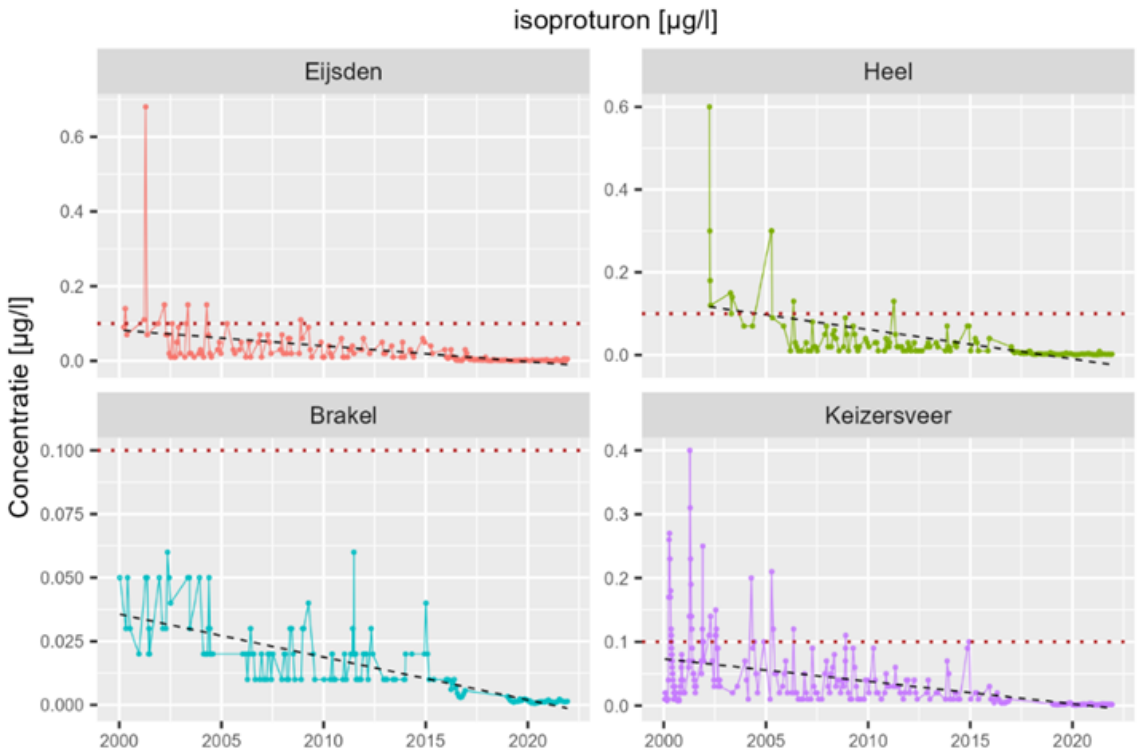
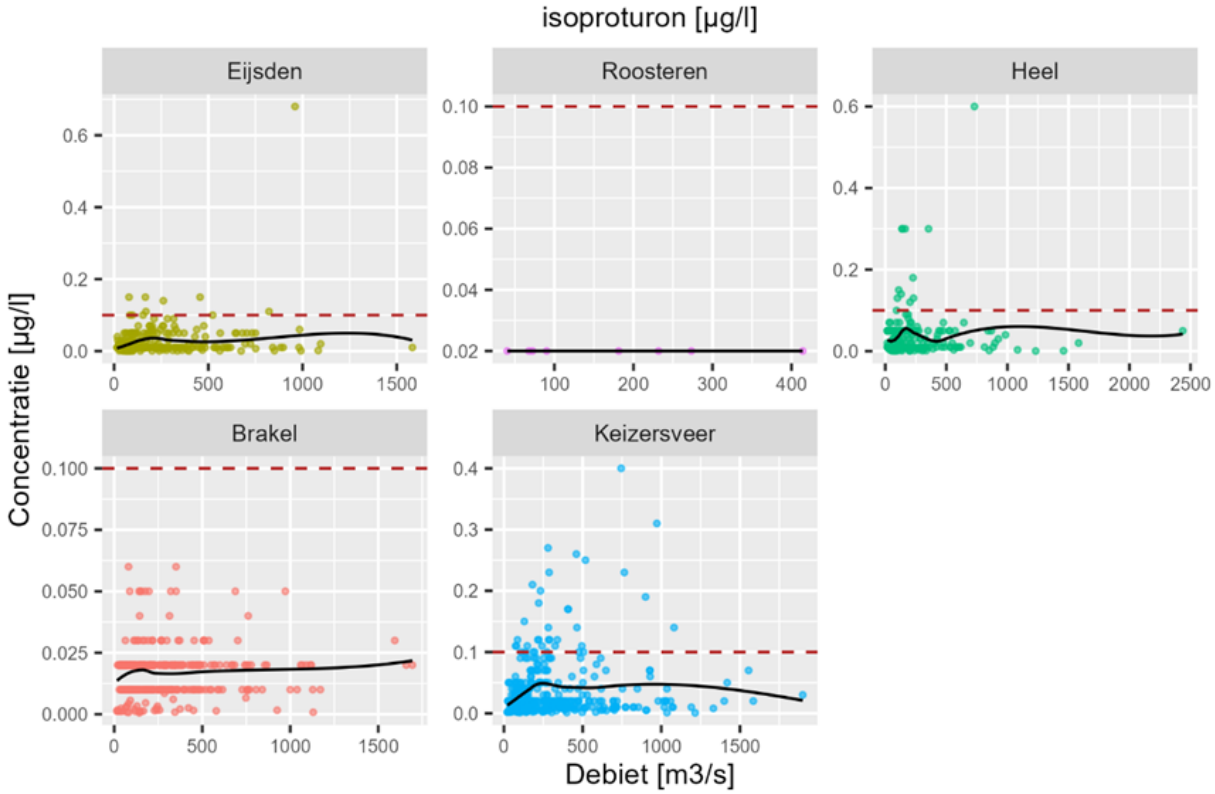
Selection of materials & parameters

group	Main emission route	Hypothesis; relation with river discharge	Components/parameters
Plant protection products	Reaches surface water after precipitation via groundwater.	Weak correlation	AMPA Glyphosate Isoproturon
Industrial organic micro pollutants	Direct emission to surface water	correlation	MTBE EDTA 1,4-dioxaan PFAS
Human medicines	Emission via WWTP to surface water	correlation	Total Metformine Jomeprol
Natural parameters	Temperature: -	Correlation but no causal connection (Temperature: has strong relation with air temperature. Also the air temperature and low discharges are related)	Temperature
	Chloride-background: constant emission direct to surface water	correlation	Chloride
	Extern salinization: inflow from the sea	Correlation	Chloride
	Biomonitor: -	Correlation	biomonitor

Data analysis -isoproturon





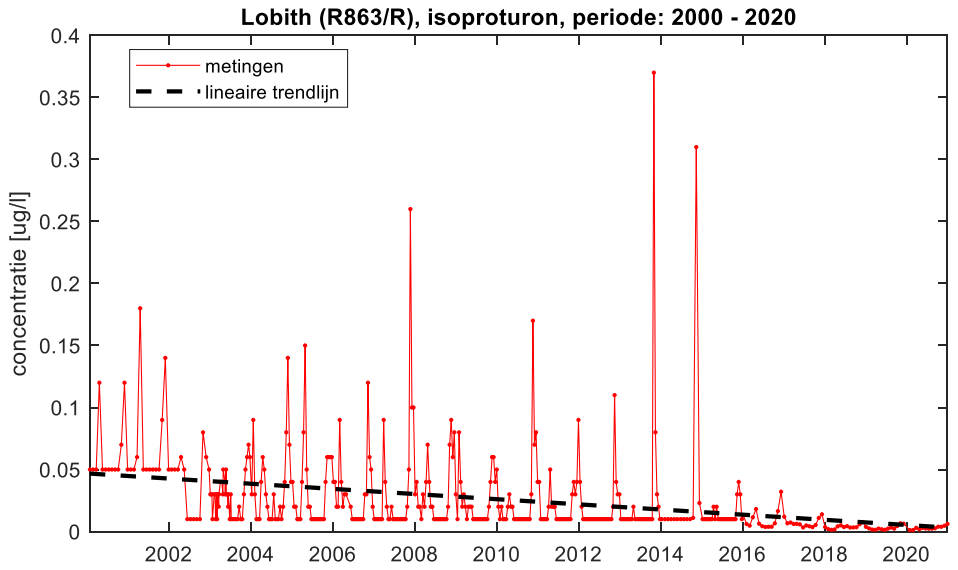
Data analysis

The data analysis in this report shows that it is complicated to demonstrate the relation between organic micro pollutants and the river discharge. Often the possible relation is disrupted by reporting limits, restrictions on use (trends in the data), calamities and seasonal fluctuations in emissions.

Most materials follow the following path:

1. discover components in surface water;
2. research;
3. measurement techniques improved (reporting limit);
4. restrictions on use;
5. decrease concentrations;
6. alternative products

Future organic micro pollutants will also follow this same path! And the discharge were problems occur will change in time.



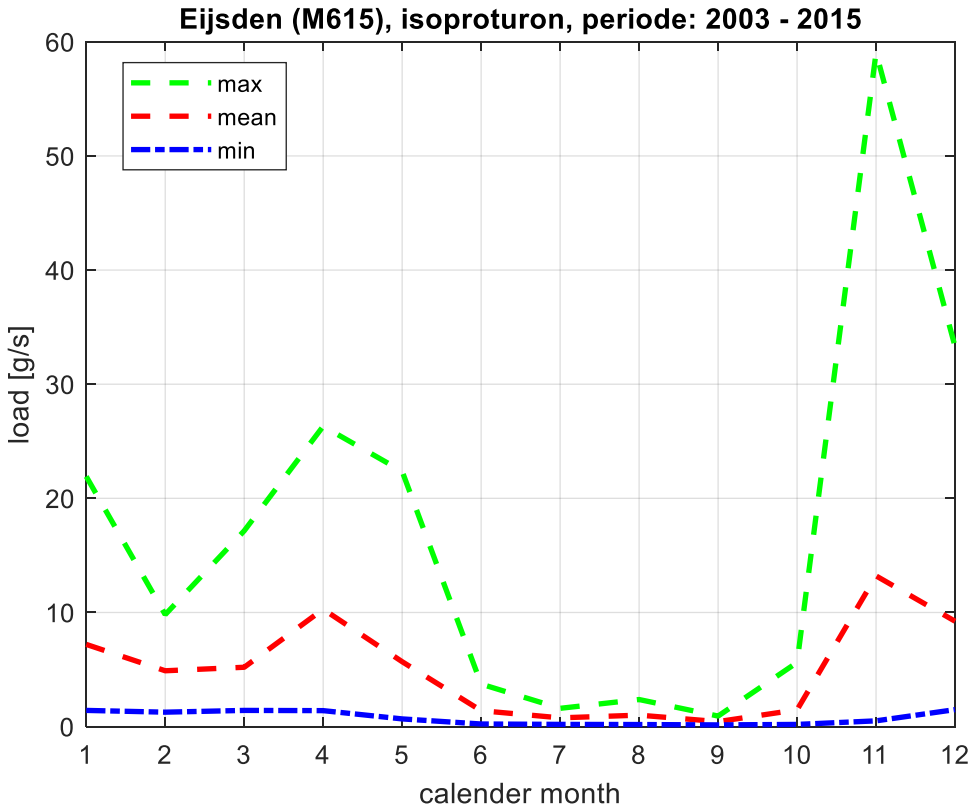
Hypothesis check

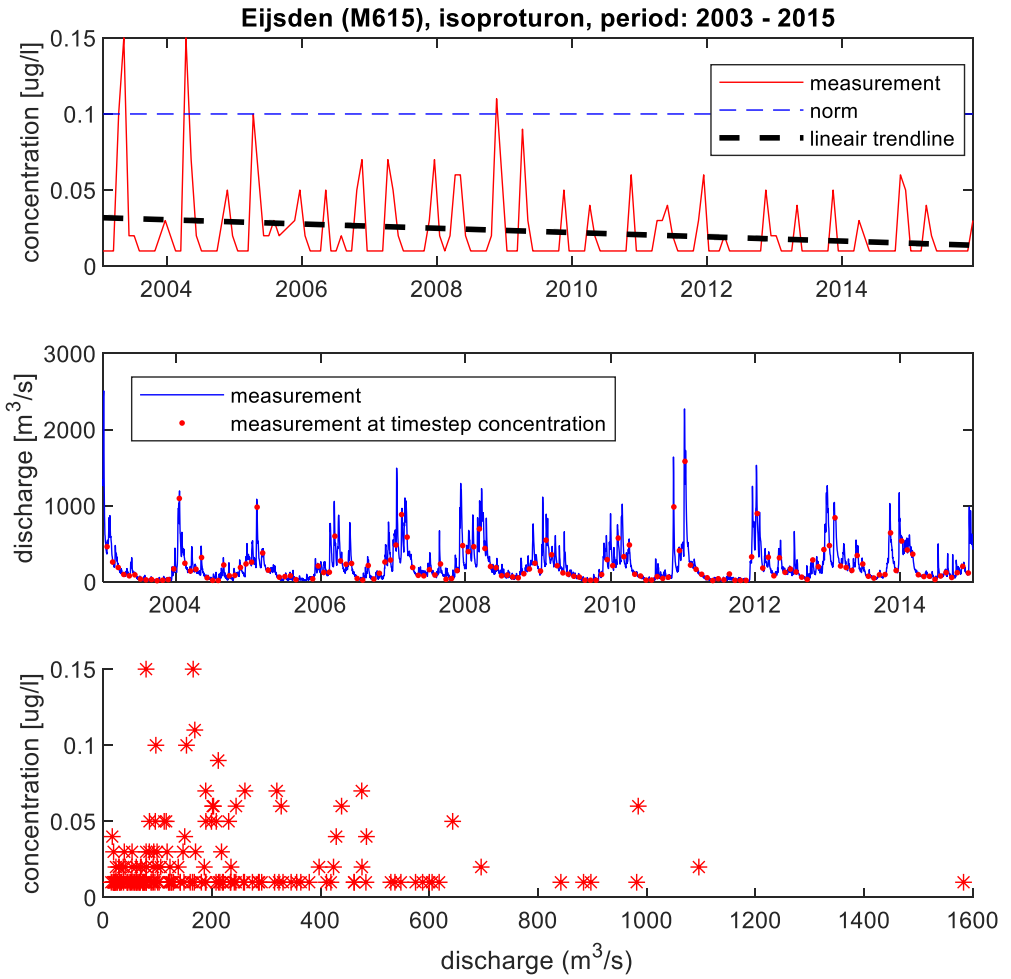
Substance group	Main emission route	Hypothesis; relation with river discharge	Components/parameters	Hypothesis check
Plant protection products	Reaches surface water after precipitation via groundwater.	Weak correlation	AMPA Glyphosate Isoproturon	√
Industrial organic micro pollutants	Direct emission to surface water	correlation	MTBE EDTA 1,4-dioxaan PFAS	√
Human medicines	Emission via WWTP to surface water	correlation	Total Metformine Jomeprol	x
Natural parameters	Temperature: -	Correlation but no causal connection (Temperature: has strong relation with air temperature. Also the air temperature and low discharges are related)	Temperature	√
	Chloride-background: constant emission direct to surface water	correlation	Chloride	√
	Extern salinization: inflow from the sea	Correlation	Chloride	√
	Biomonitor: -	Correlation	biomonitor	√

Human medicines

- This emission route runs via WWTP. As medicines use is generally not linked to a season, a constant load is expected, and therefore a relatively constant discharge into the river.
- This hypothesis is not supported for the materials Jomeprol and Total Metformin. Weak correlations have been found.
- Literature shows that this material degradation process of both organic micro pollutants already starts in the sewer system. As in summer this process is faster than in winter, the load is not constant over the year. This seasonal pattern disturbs the correlation.

Application period is important





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Recommendations

- Mapping seasonal fluctuations of organic micro pollutants based on application periods and/or dependence on temperature in the degradation process.
- In the past, measurements of PFOA and PFOS have been strongly subject to reporting limits. Future measurements with lower reporting limits are important.
- Visualize running times per material and location with Delwaq water quality model based on the National Sobek Model

Questions?

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