Using online UV / VIS spectroscopy

to monitor the raw water quality of the Viennese water supply

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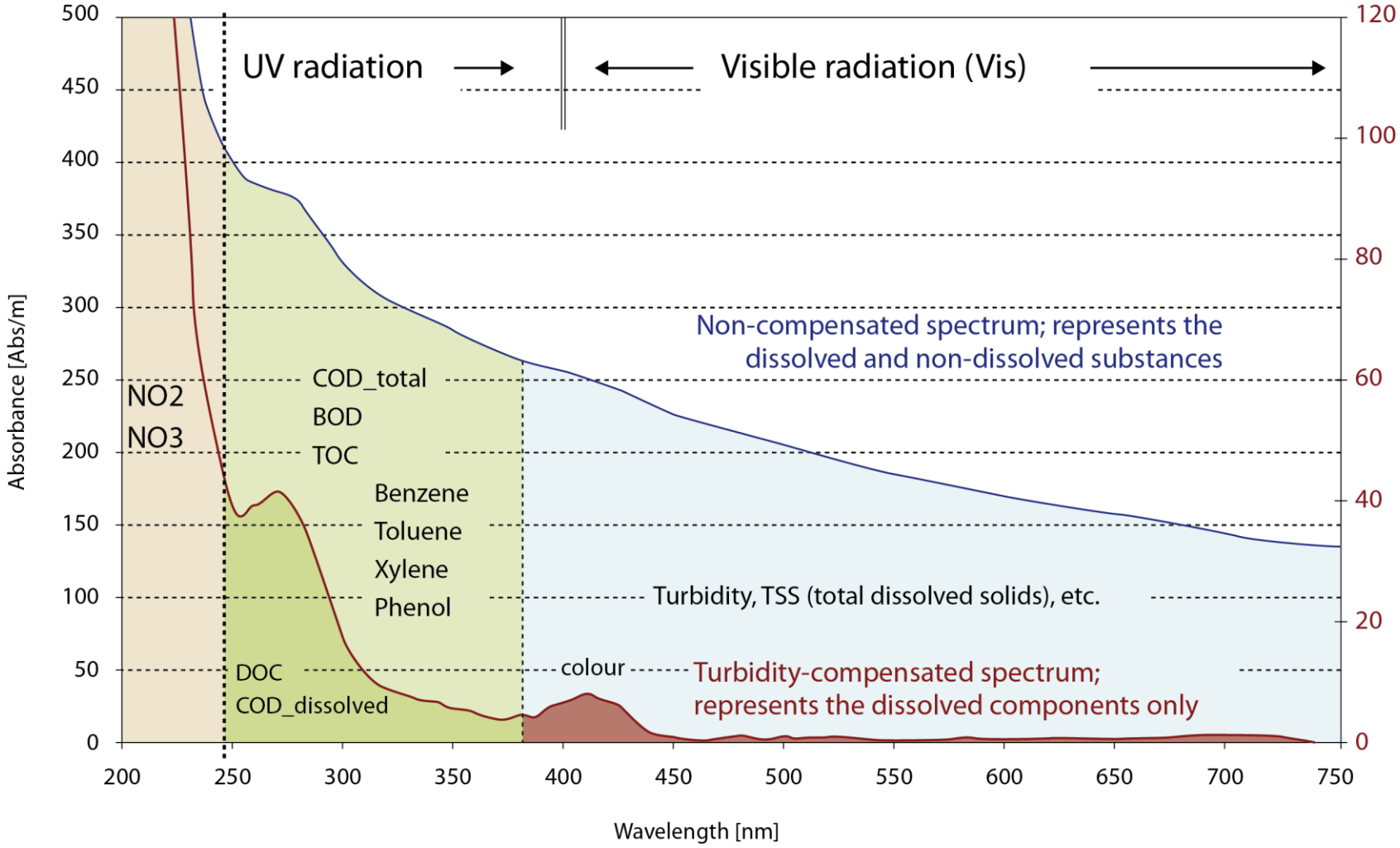
What is UV / VIS spectroscopy

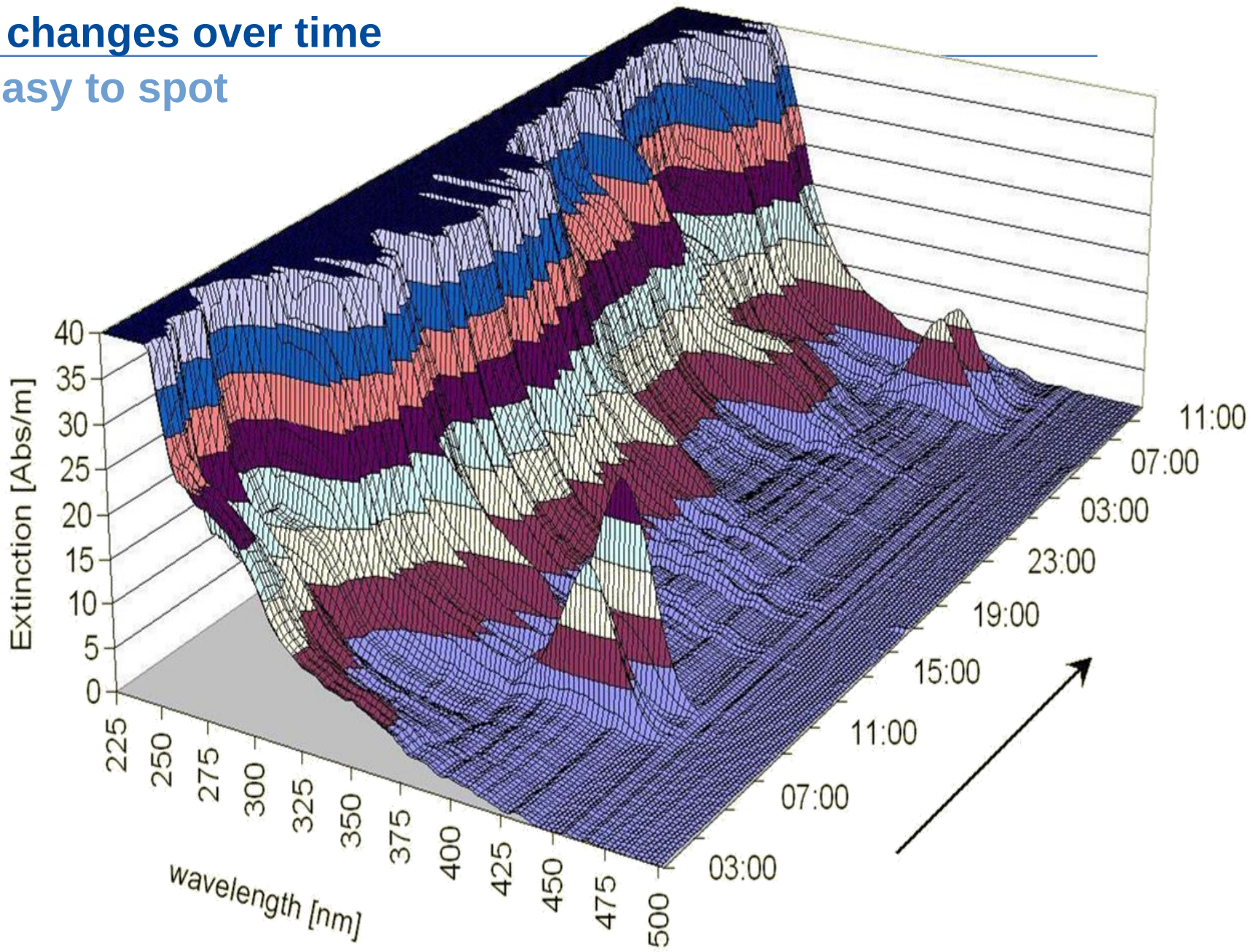
And what parameters can be measured



- Turbidity
- Colour
- Organics
  - TOC, DOC, COD, BOD
- UV254 / UVT
- Nitrate / Nitrite
- Special Parameters
  - Disinfection by Products
  - Chlorine Demand
  - Chloramines

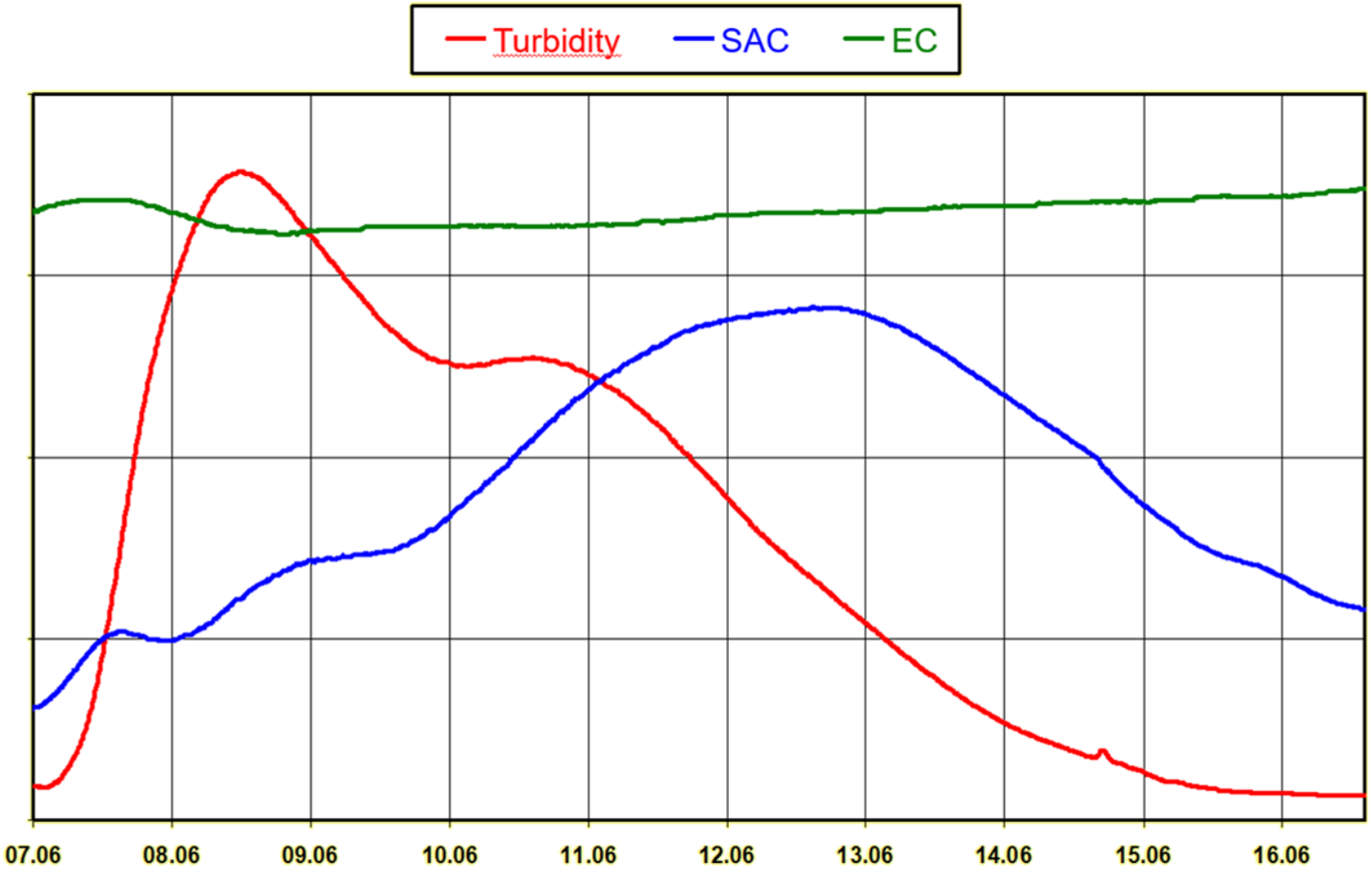
Spectral changes over time

Events easy to spot



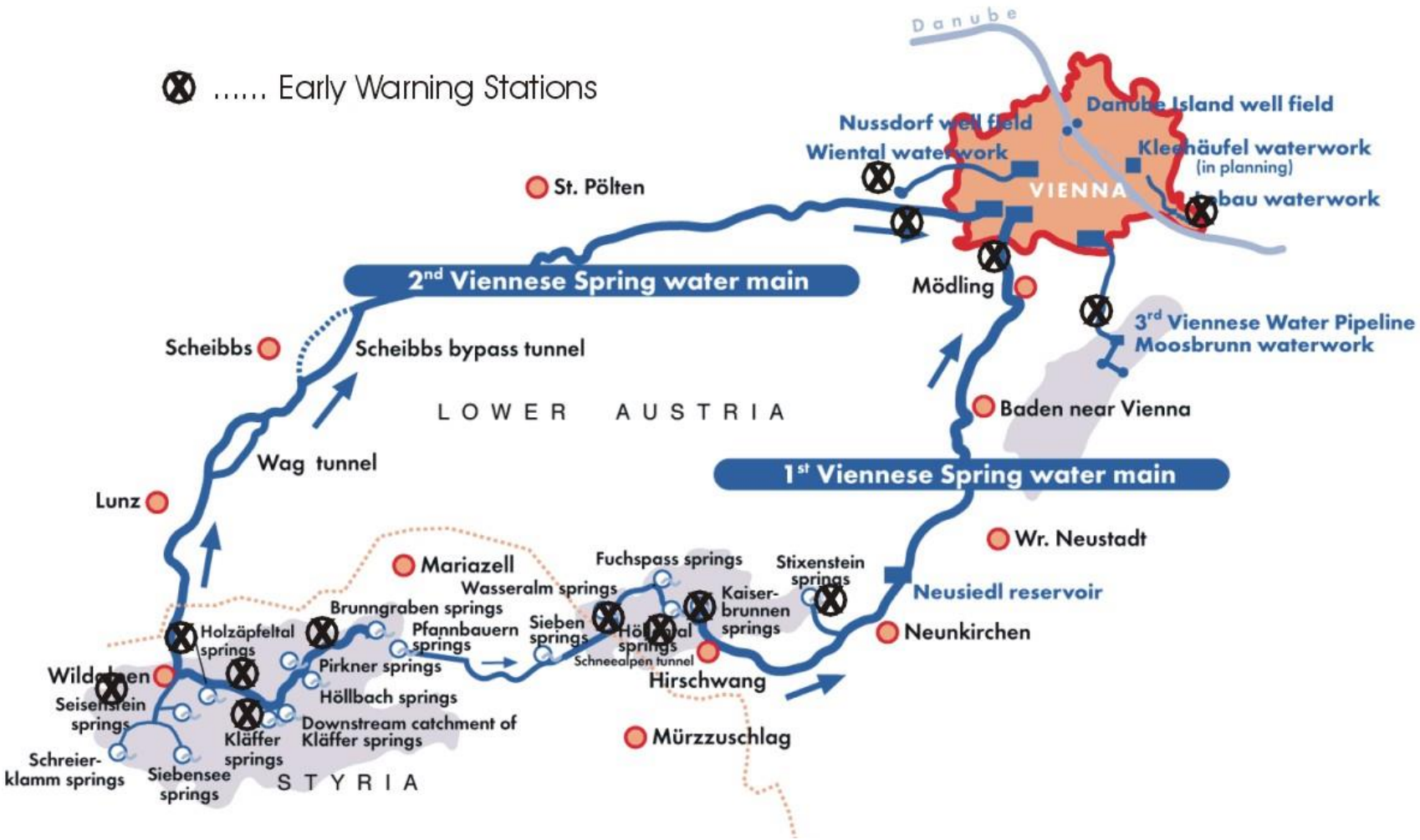
Additional Value of UV / VIS spectroscopy

Rainfall event in the catchment area of a spring



Where does the Viennese water come from

Springs in the mountains



- HQL 1
  - 150 km length
  - 220 Million liters / day
  - 24 hours
- HQL 2
  - 180 km length
  - 217 Million liters / day
  - 36 hours
- Bank filtrate of Danube
- Well field Moosbrunn
  - 64 Million liters / day
- 3000 km pipes
- 29 gravity reservoirs in Vienna
- 103.000 connections

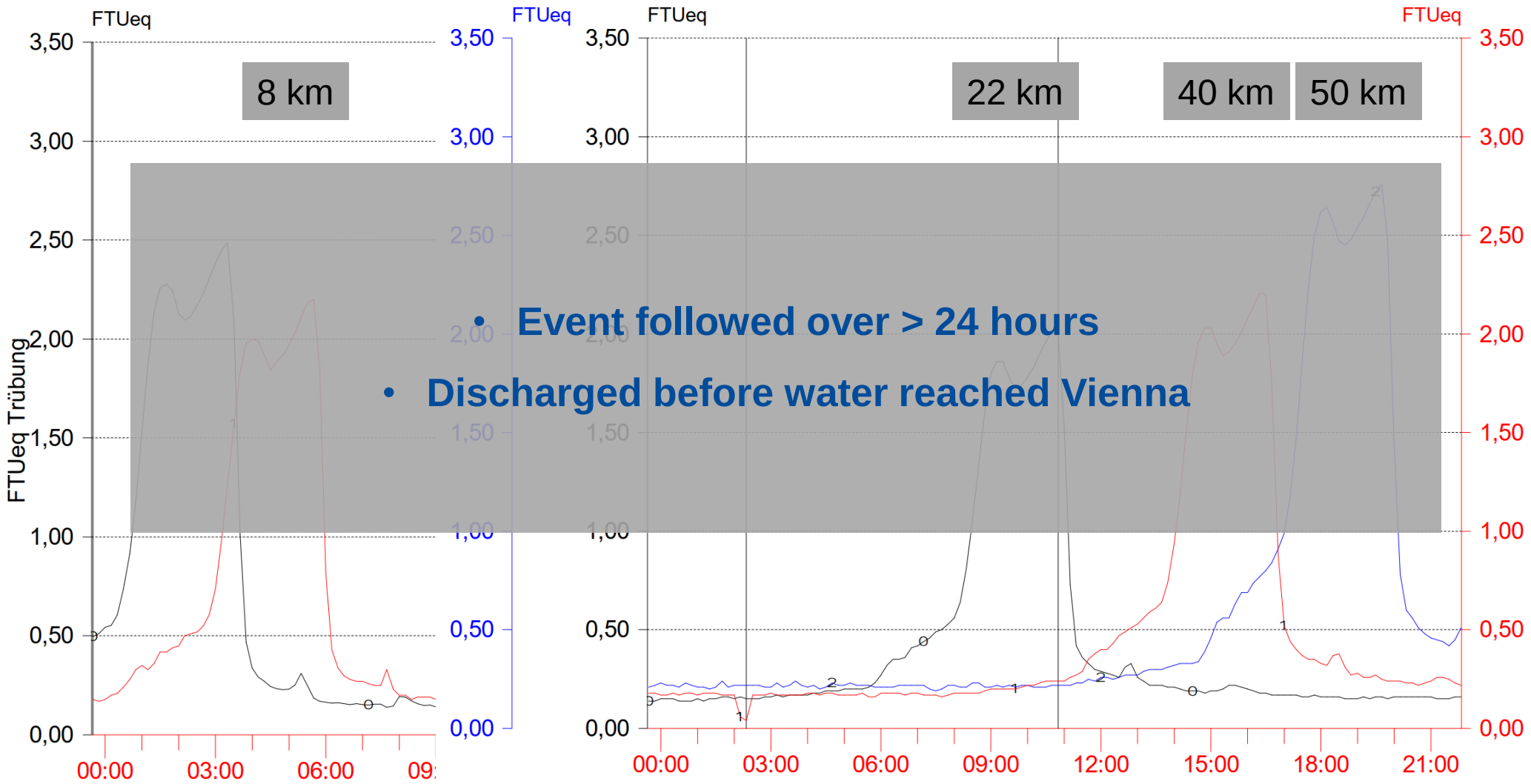
Installation pictures

Springs, Wells, Transport Lines

~70 stations at the springs, wells and along the transport lines

Event followed by tracking turbidity …

… along the 2nd Viennese spring water main



- **Event followed over > 24 hours**
- **Discharged before water reached Vienna**

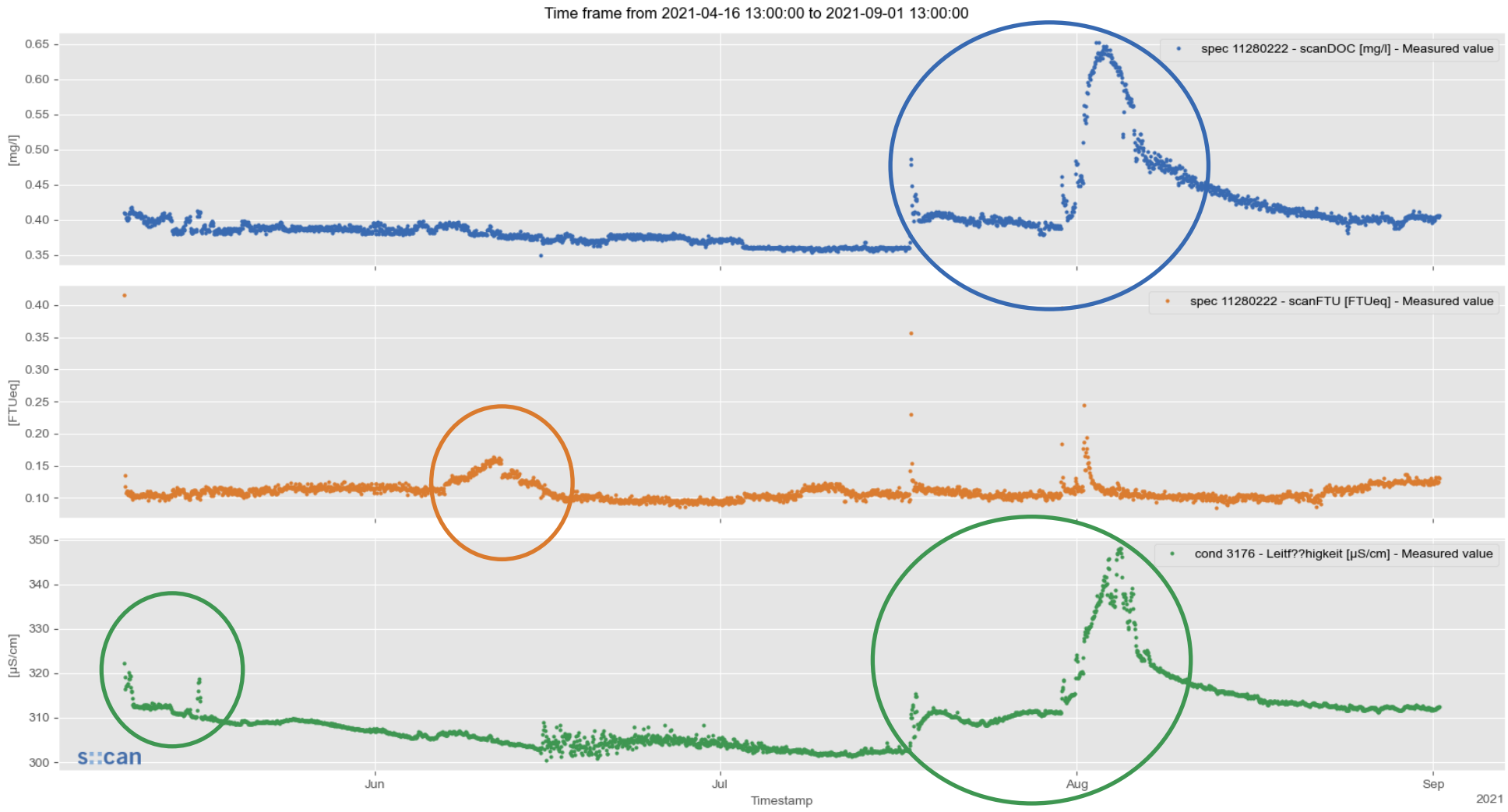
Spring in Styria

Three events but different effects

DOC

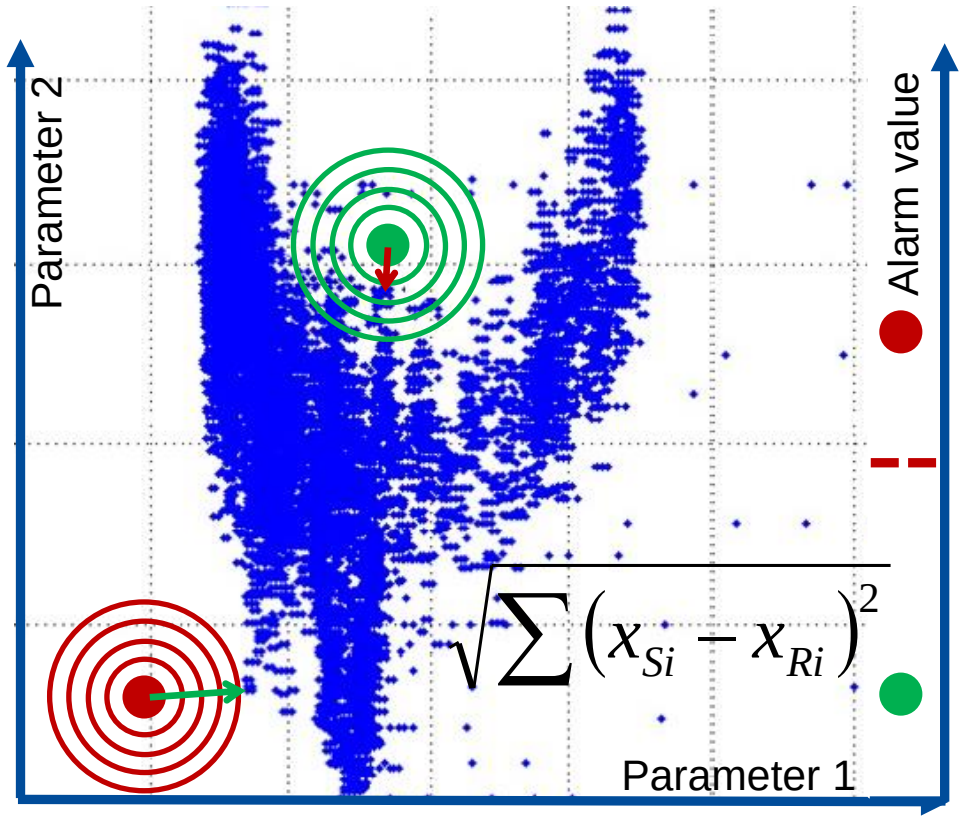
Turbidity

Conductivity



Detecting events – the smart way

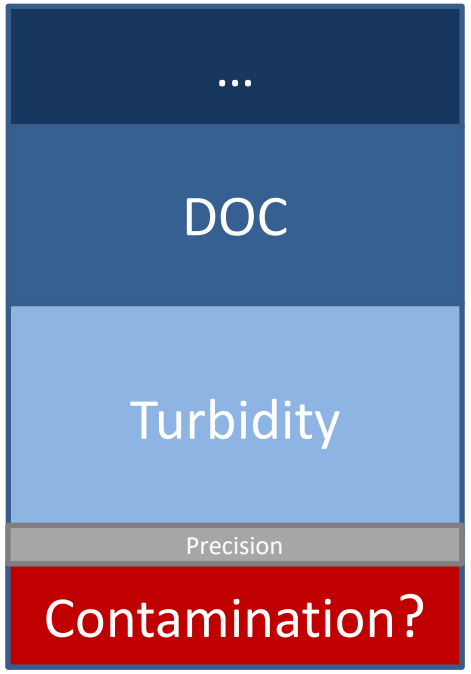
Pattern of multiple parameters



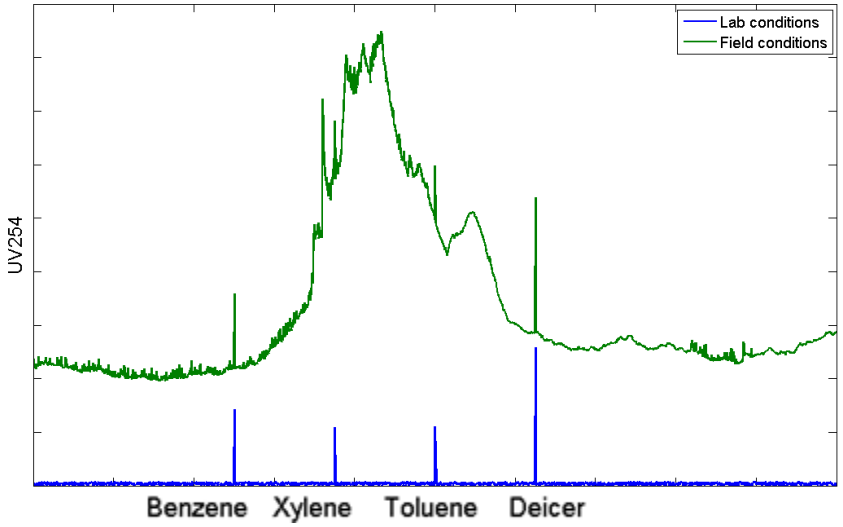
- Compare current measurement with set of reference data representing normal water quality
- Distance to reference data = alarm value
- Alarm value > tolerance value = alarm
- Reference continuously updated during training

Advanced possibilities

With spectral alarms

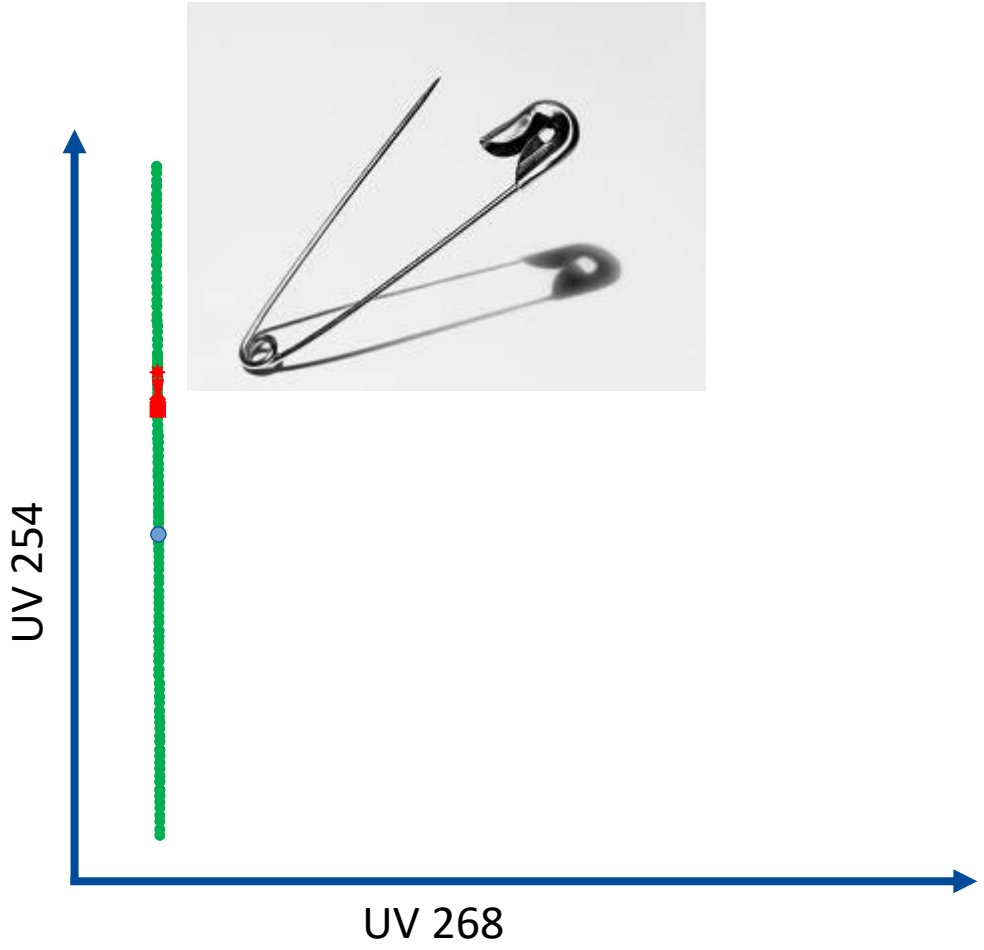


- Makes use of full information in absorption spectrum
- Under laboratory conditions, extremely small contaminations can be detected by a single parameter
  - Precision is limiting factor for detection capabilities
- Under field conditions, a contamination signal sits on top of large variety of influences
  - Ability to distinguish natural fluctuations from contaminations is limiting factor



Advanced possibilities with spectral alarms

Adding a second wavelength

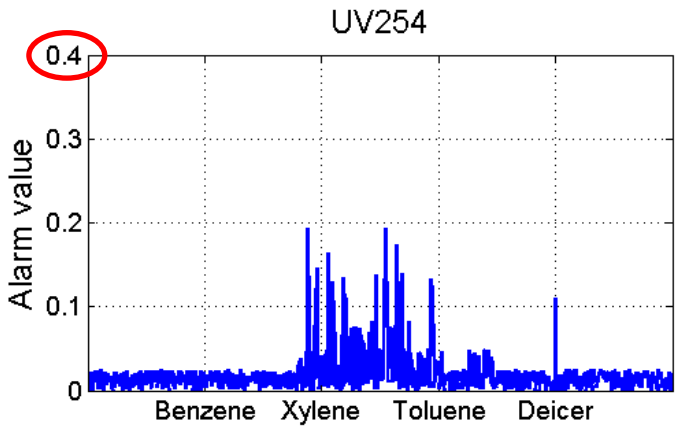


- Most contaminations fall within normal UV254 fluctuations
  - Need to look at dynamics of UV254 value
  - Need to look at inter-instrument parameter correlations
- What if we add just one additional wavelength?
- Contaminations identified by spectrum
- Adding more wavelengths brings more information and sensitivity

Advanced possibilities with spectral alarms

Adding more wavelength

- Spectroscopy for unambiguous detection of contaminations



Conclusion

Thank you!

- Comprehensive monitoring along the water supply lines protects Vienna

- Combination of parameters necessary
  - Not one sensor can see every event
  - Full UV / VIS spectra contain a lot of information complementary to classic parameters

- Using spectral information for Event Detection Systems allow to react on unkown contaminants
  - e.g. Pesticides, Oil, Diesel fuel
  - Followed by in-depth lab analysis