FLUSSHYGIENE

Hygienisch relevante Mikroorganismen und Krankheitserreger in multifunktionalen Gewässern und Wasserkreisläufen

(engl. river hygiene) or
„When can we finally swim in rivers again?“

Pascale Rouault, Wolfgang Seis and all involved partners

KOMPETENZZENTRUM WasserBerlin

GEFÖRDERT VOM

Bundesministerium für Bildung und Forschung

FONA Nachhaltiges Wassermanagement BMBF

NaWaM Nachhaltiges Wassermanagement

ReWaM Regionales Wasserressourcen-Management für den nachhaltigen Gewässerschutz in Deutschland

Motivation

Bathing water quality in Germany

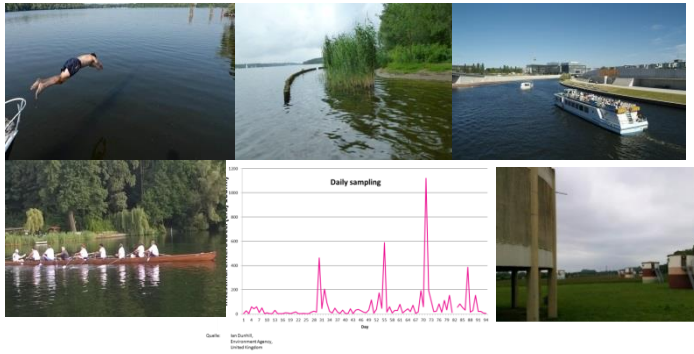
- 2000 official EU bathing water sites in Germany
- 90% in excellent quality; 7,5 % in good quality

But

- only 32 official bathing water sites are located at rivers

Reasons

- Multiple uses of rivers (shipping, habitat protection,…)
- Strong currents
- Hygienic water quality+ vulnerable to short term pollution events
- Duties of new bathing water directive (2006/7/EG) (detailed bathing water profiles including sources of pollution, and measure in case of vulerability to short term pollution events)



Limmat Zürich

Donauinsel in Wien

Flaucher Isar

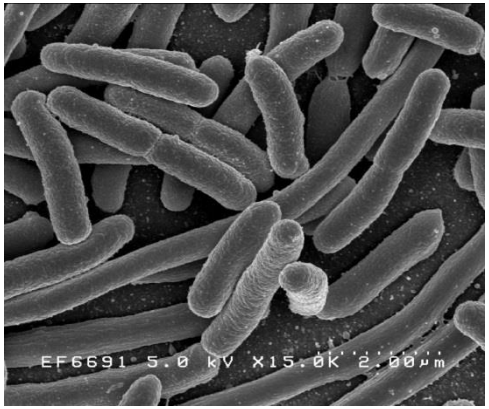
Foto: Margit Schade

Rhein in Basel

Hainbad in Bamberg

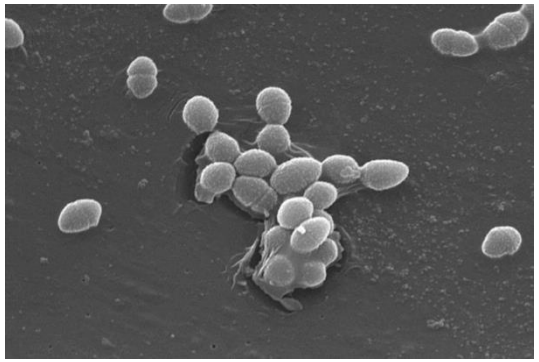
Important parameters for bathing waters

Indicator organisms indicate fecal pollution



Escherichia Coli

Credit: Rocky Mountain Laboratories



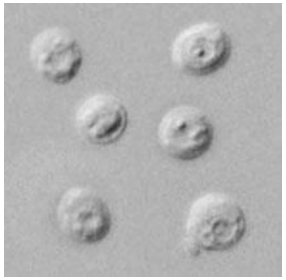
Intestinal enterococci

Von Photo Credit: Janice Haney CarrContent Providers(s): CDC/ Pete Wardell - This media comes from the Centers for Disease Control and Prevention's Public Health Image Library (PHIL), with identification number #258.Note: Not all PHIL images are public domain; be sure to check copyright status and credit authors and content providers.English | Slovenščina | +/−, Gemeinfrei, https://commons.wikimedia.org/w/index.php?curid=1669200

Real pathogens cause illness (e.g. gastroenteritis)

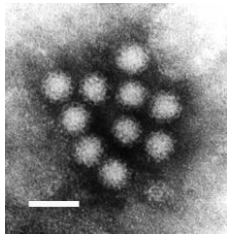
Parasites

Giardia intestinalis

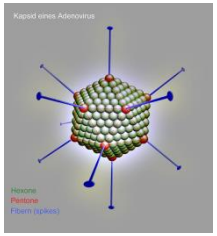


Oocysten *C. parvum*

Viruses



Norovirus

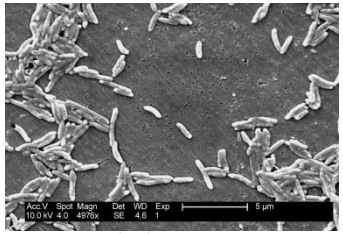


Adenovirus

Von Gleiberg - Eigenes Werk, CC BY-SA 2.0 de, https://commons.wikimedia.org/w/index.php?curid=11869453

Von Neitram - Eigenes Werk, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=14982570

Bacteria



Campylobacter jejuni

Questions to be answered…

Which interests and stakeholders have to be considered?

Are *E. Coli* and intestinal enterococci suitable indicators assessing the risk of infection ?

What about costs and benefits of measures?

Can we identify unknown diffuse source via microbial source tracking?

What role plays microzoopankton on the hygienic water quality?

How can we model hygienic contaminations?

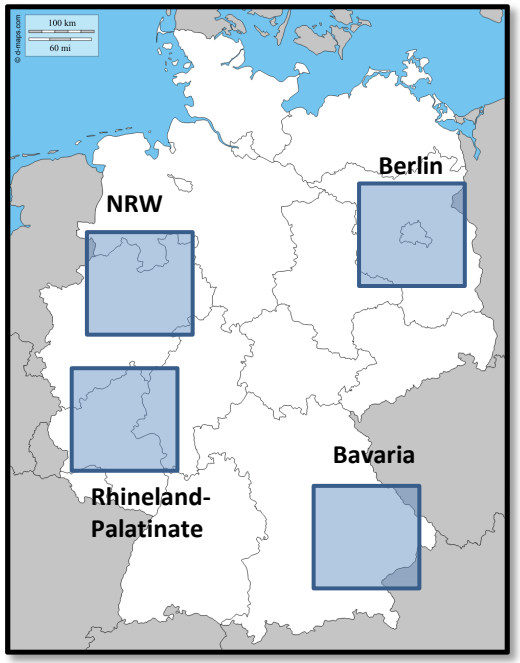
How does an effective early warning system look like?

What are effective measures to reduce microbial contamination?

How can we transfer results to other regions?

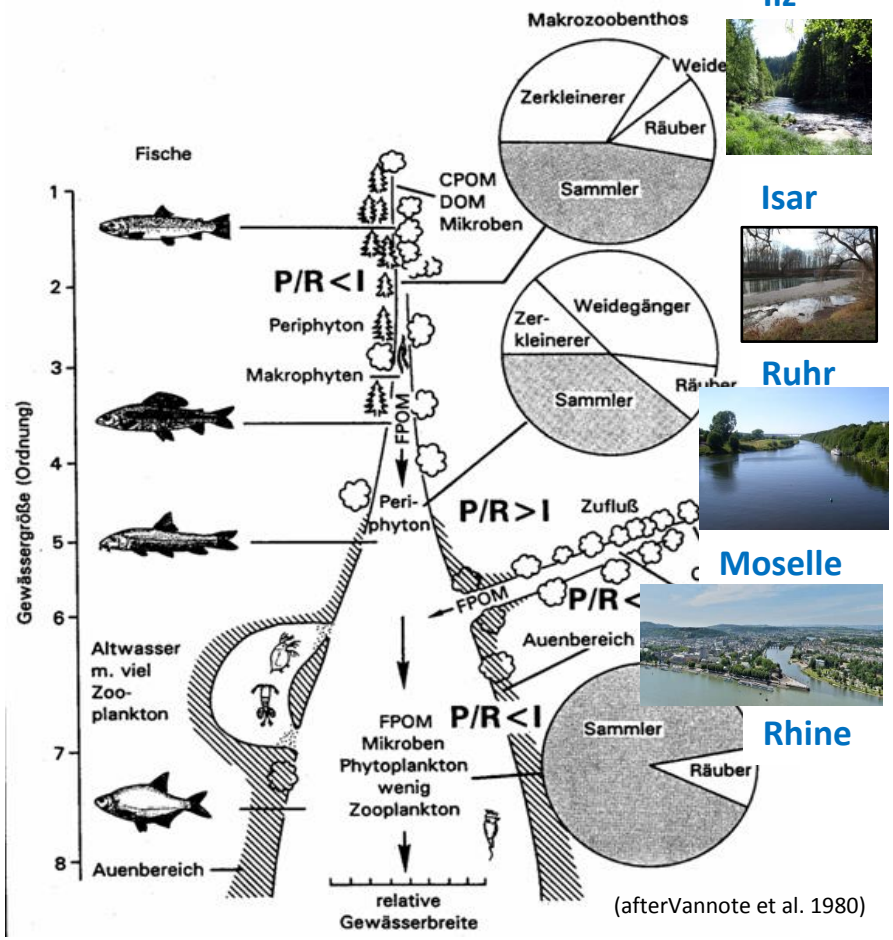
Strategy

Investigation at 7 rivers of very different characteristics



Spree & Havel

River continuum concept



(afterVannote et al. 1980)

Ilz

Isar

Ruhr

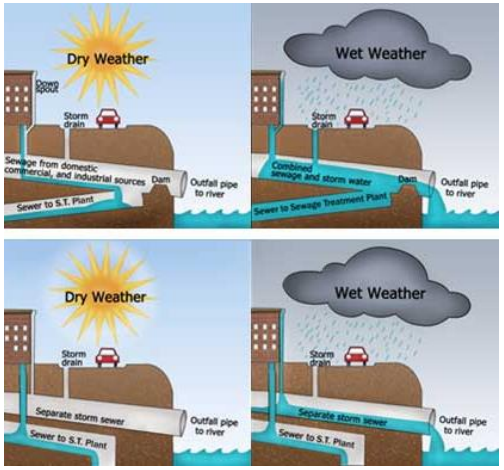
Moselle

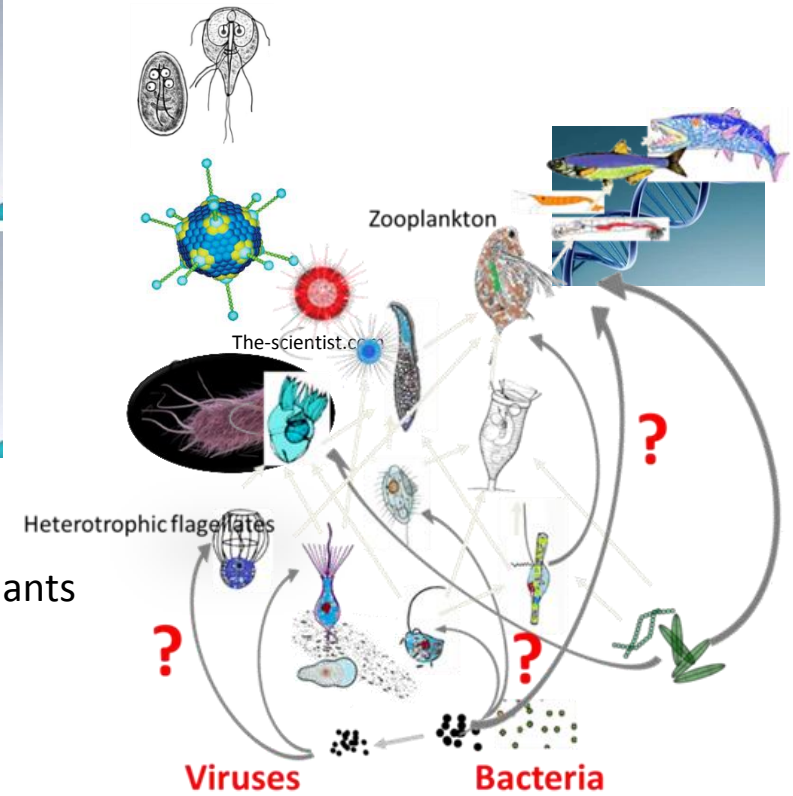
Rhine

Bild: Ilz
Von Aconcagua - Eigenes Werk, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=2129691

Bild Rhein:
Von Taxiarchos228 - Eigenes Werk, FAL, https://commons.wikimedia.org/w/index.php?curid=40888776

Monitoring of sources, events and processes





Sources:

- Wastewater treatment plants
- Raw wastewater
- Stormwater
- Surface runoff
- Agriculture
- Unknown sources

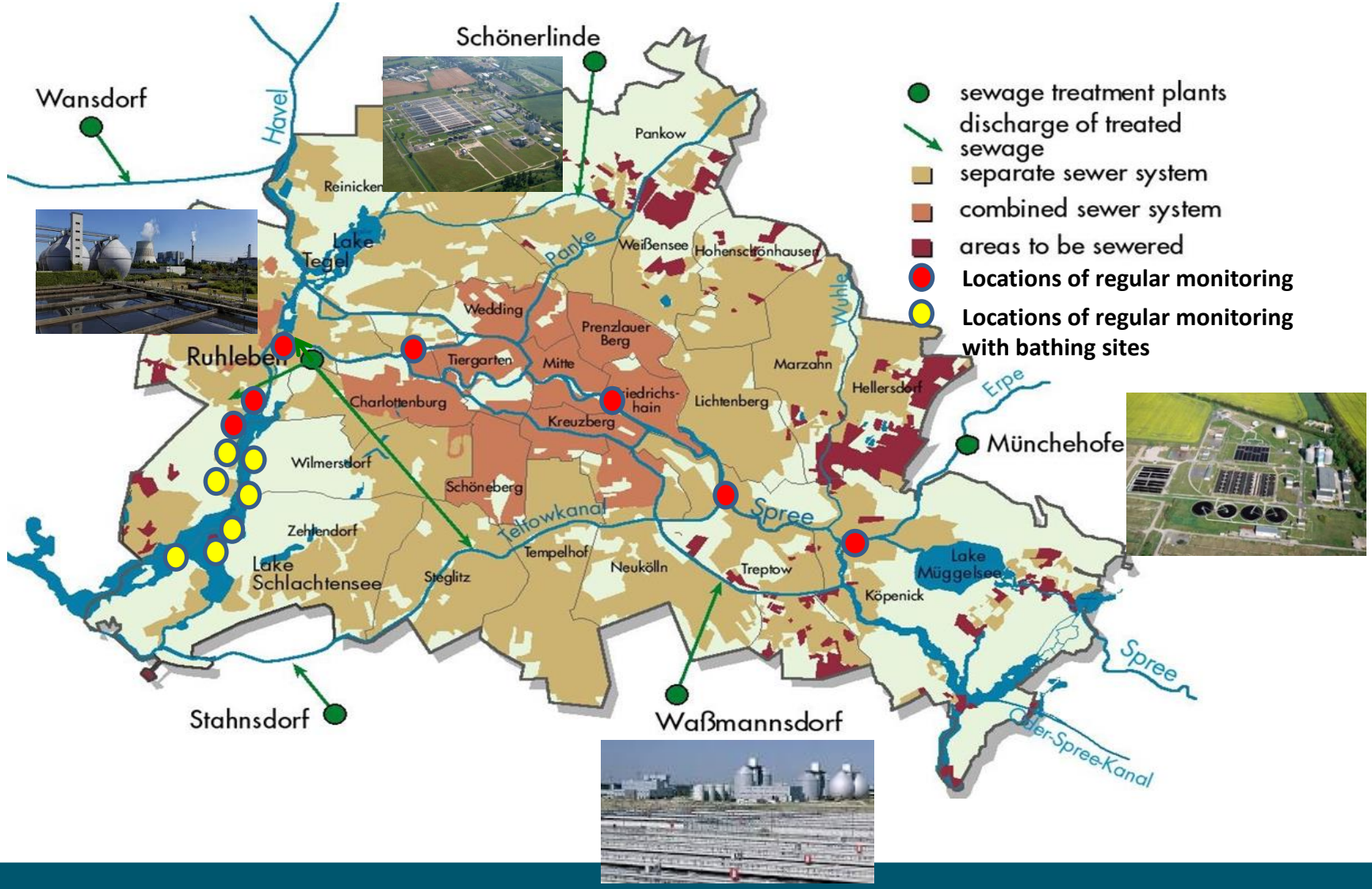
…

Event based process monitoring

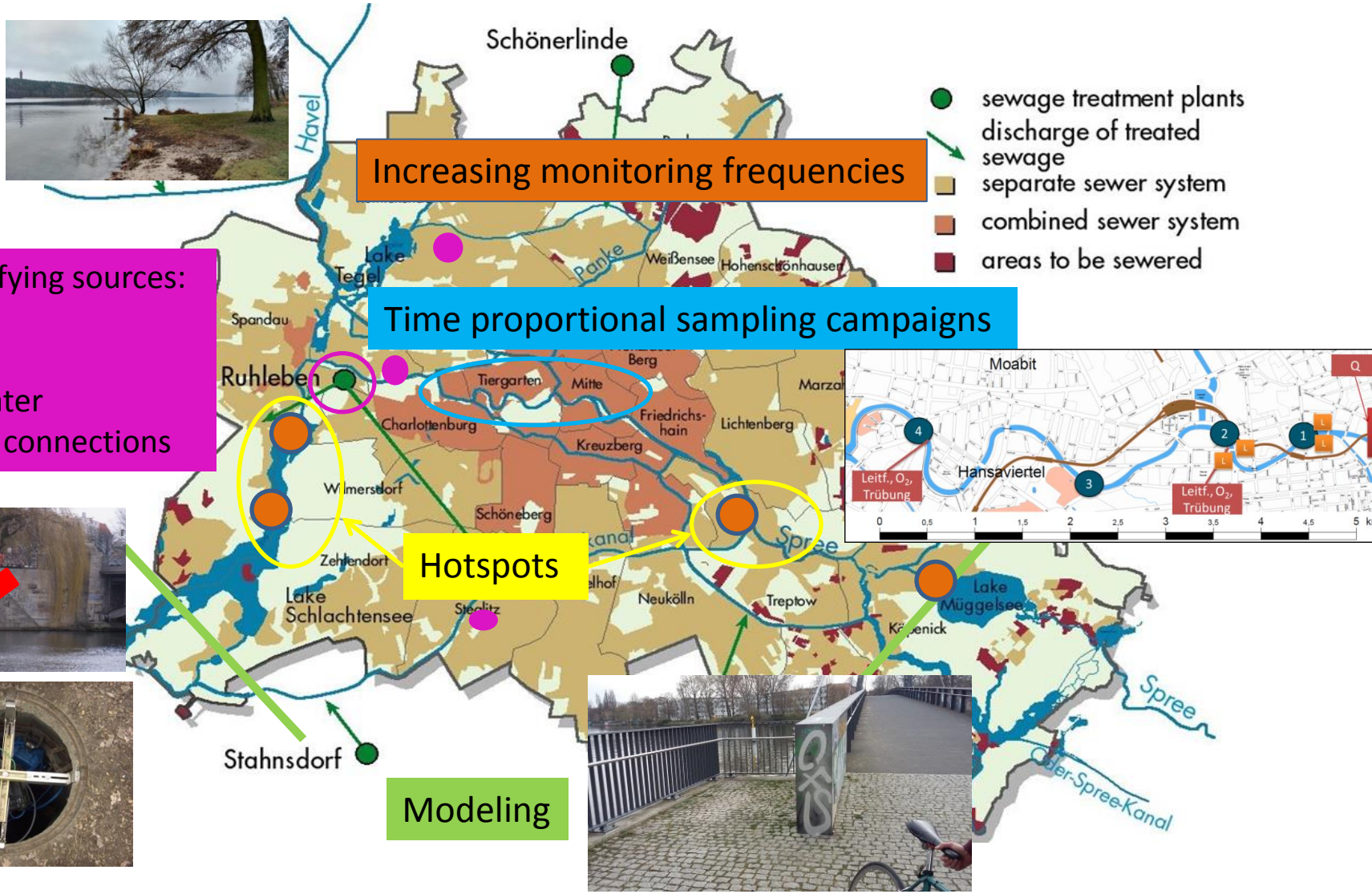
Hotspots (bathing and bank filtration sites)

(Arndt & Monsonís 2015)

Background on the Berlin situation



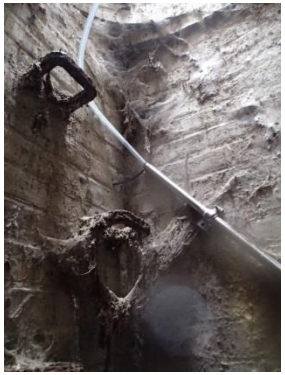
Monitoing of sources, events and processes



Event based monitoring of rainwater, combined sewer overflows and at bathing waters

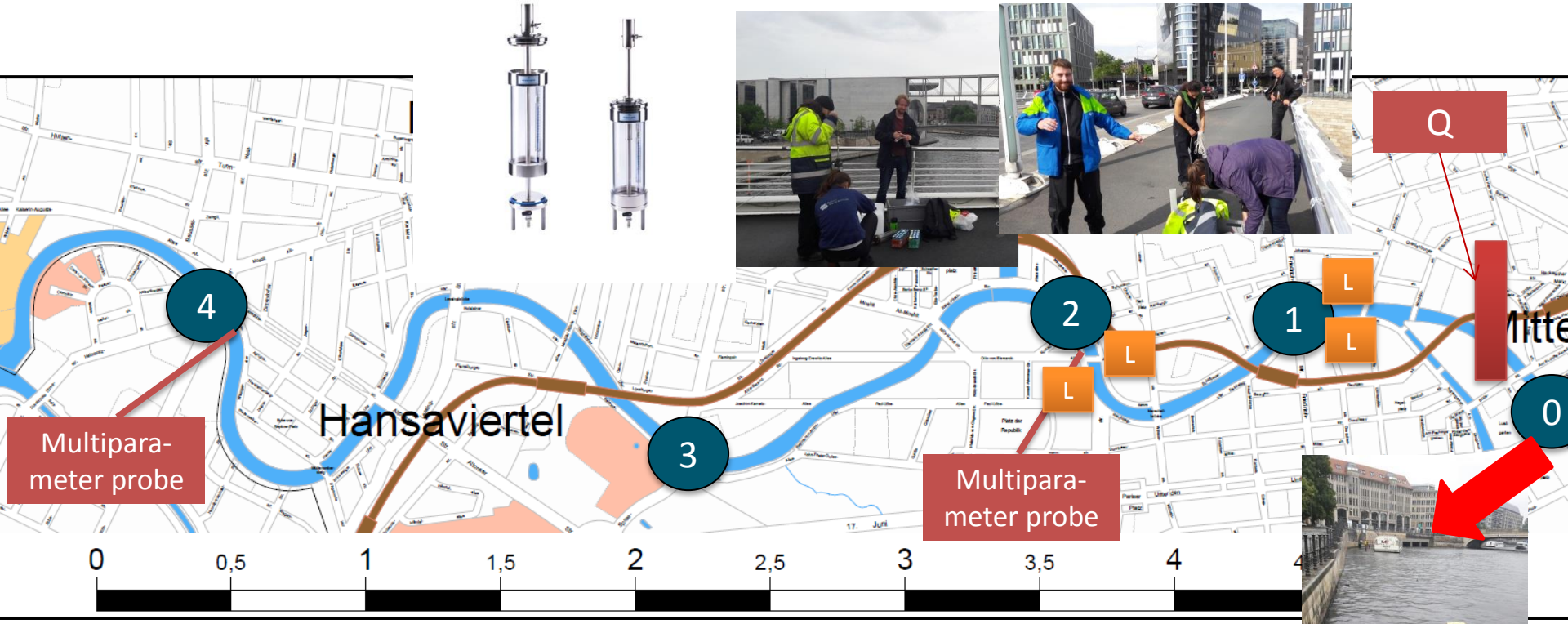
Rainwater sewers

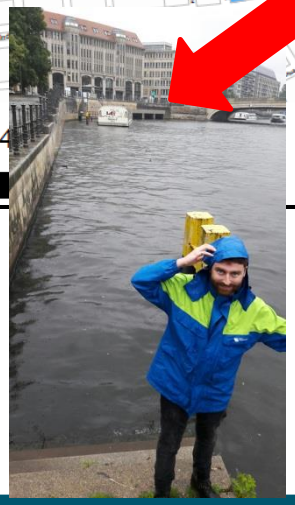
Combined sewer overflows



Automatic samplers at bank filtration and bathing sites

Time proportional sampling from bridges

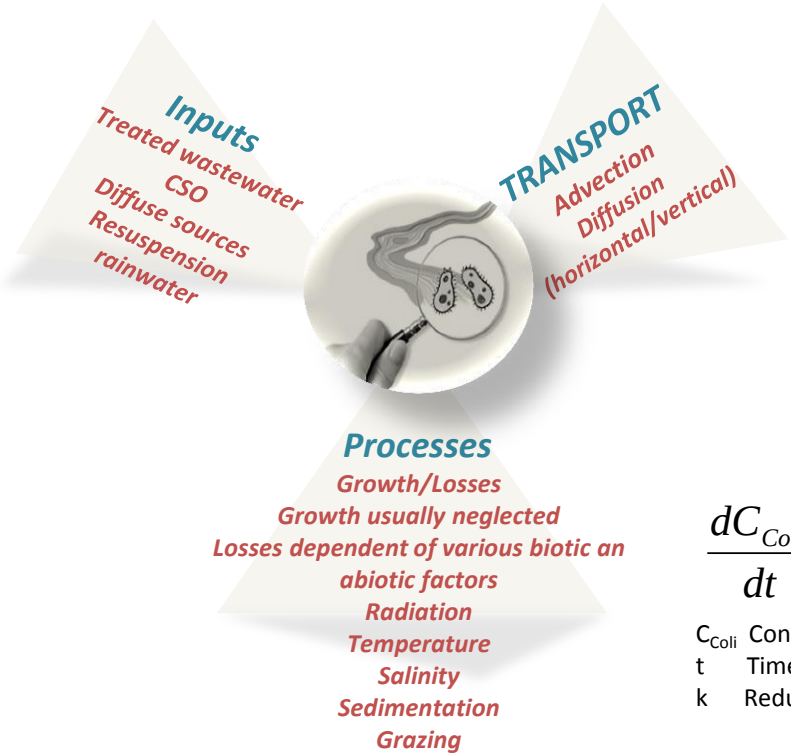




- Q: Starting point at CSO
- 1-4: Sampling locations
- L: Locations of conductivity probes

Hydraulic, statistical and deterministic modeling (starting in autumn 2016)

Deterministic models



$$\frac{dC_{Coli}}{dt} = -k * C_{Coli}(t)$$

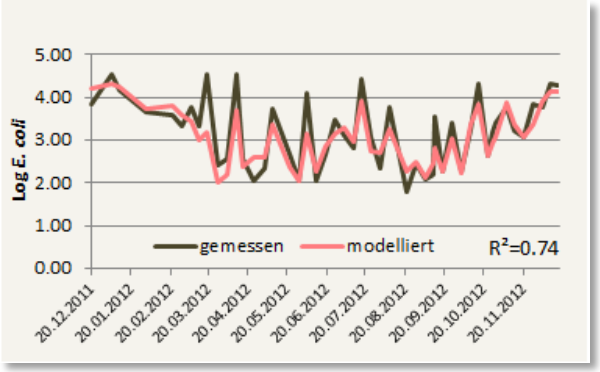
C_{Coli} Concentration [cfu 100 ml-1]
t Time [d]
k Reduction rate [d-1]

QSim

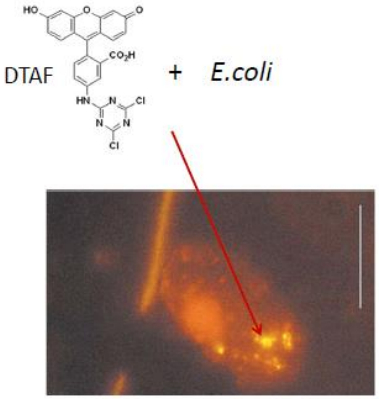
$$k = k_g - \boxed{k_d - k_l} - k_p - k_s$$

k_g Growth rate [d^{-1}]
k_d reduction rate in the dark (natural Mortality); Function of T, Salinity, and potentially pH [d^{-1}]
k_l reduction rate by radiation [d^{-1}]
k_p reduction rate by grazing [d^{-1}]
k_s reduction rate by Sedimentation [d^{-1}]

Regression models



Beispiel: Lahn (Herrig et al. 2015)



Diederichs Beardsley Cleven (2003)
Appl Syst Microbiol

Early warning and assessment of measures

Risk based early warning for short term pollution events

Strategies for medium and long term measures

Real time early warning system(UK)

Stromwater treatment

Wastewater disinfection

Other measures

Real time data

Prediction models for hygienic contaminations

Selection and assessment of measures

Long term data

Probabiliity of infection
P (Infection | exposure)

Quantitative microbial risk assessment
P (Illness | Infection) * Severity of the consequences

Decision: measures sufficient yes/no

Probabiliity of infection
P (Infection | exposure)

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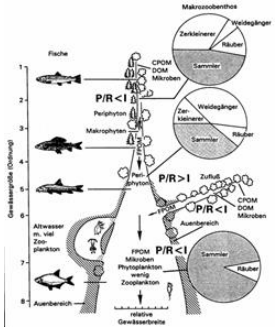
Transfer



Monitoring results

Predictions of short term pollution events

Early warning systems

Long term planning of measures

Strategy for opening of new river bathing sites

Guideline for manageing short term pollution events

Checklist for opening of new river bathing sites

Workshop of federal government and federal states

Involved partners

Partners

1. Kompetenzzentrum Wasser Berlin
2. Berliner Wasserbetriebe
3. Bundesanstalt für Gewässerkunde
4. Umweltbundesamt
5. Rheinische Westfälisches Institut für Wasserforschung
6. Ruhrverband
7. Dr. Schumacher - IWU
8. Bayerisches Landesamt für Umwelt
9. Inter3
10. Universität zu Köln

Associated Partners

1. Stadtentwässerung München
2. Bayerisches Landesamt für Gesundheit und Lebensmittelsicherheit
3. Senatsverwaltung für Stadtentwicklung und Umwelt Berlin
4. Stiftung Zukunft Berlin

+ Landesamt für Gesundheit und Soziales