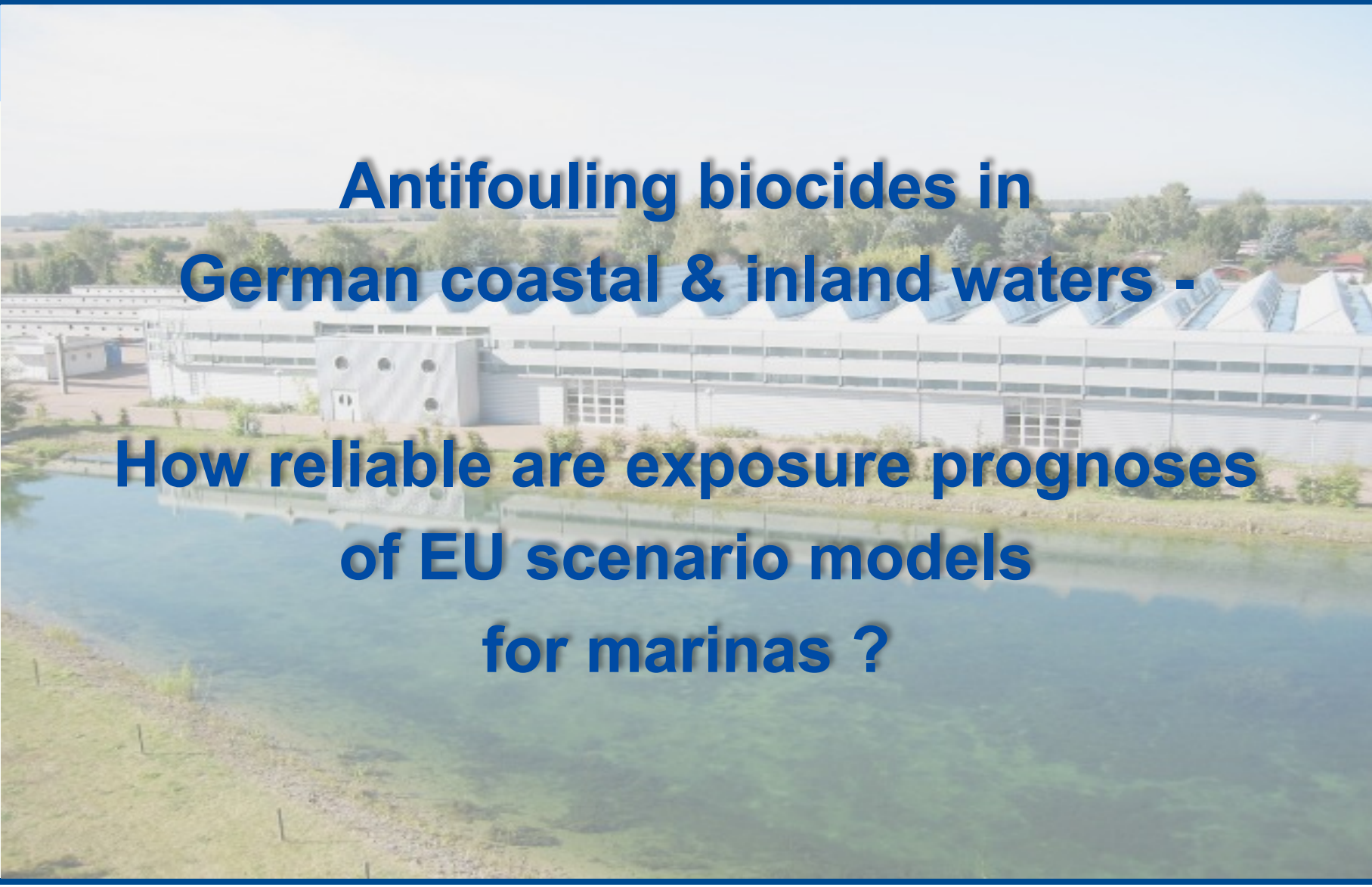
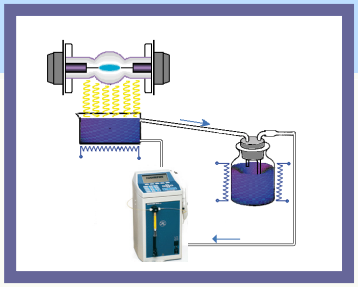


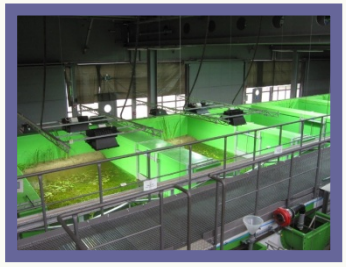
Antifouling biocides in German coastal & inland waters -

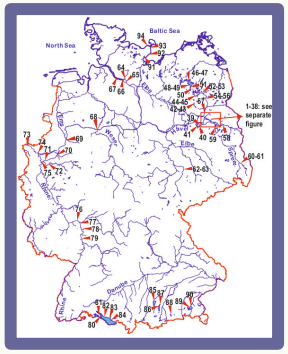
How reliable are exposure prognoses of EU scenario models for marinas ?

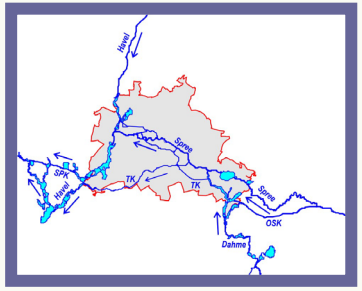
Background

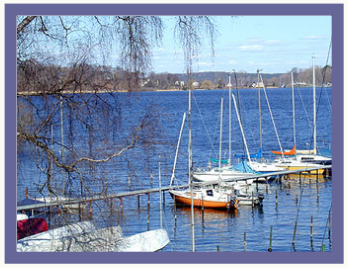
- **Lab tests on photo- & biodegradation** (2006-07)
- **Outdoor fate study** (2 streams) (2004-05)
- **Indoor fate & effect study** (8 ponds) (2005)
- **Field study** (Germany) (2005-08)
- **Regional study** (Berlin) (2007-08)
- **Local study** (Single Lake) (2007-08)







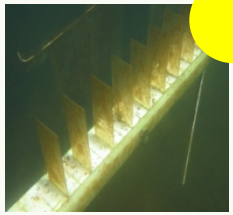




Irgarol study: Exposition & Effects

EC_{10}: nominal concentration

135-d EC_{10}: 7 ng/L
Periphyton - green algae



78-d EC_{10}: 10 ng/L
Cycl. copepodits

Berlin (rivers, channels; N=20)

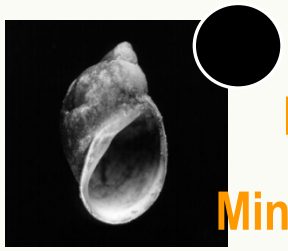
150-d EC_{10}: 119 ng/L
Berlin (lake; N=23)
Macrophytes total FW

M-VP (lake Müritz; N=12)

Brandenburg (river Havel; N=8)

S-H (Baltic Sea; N=4)

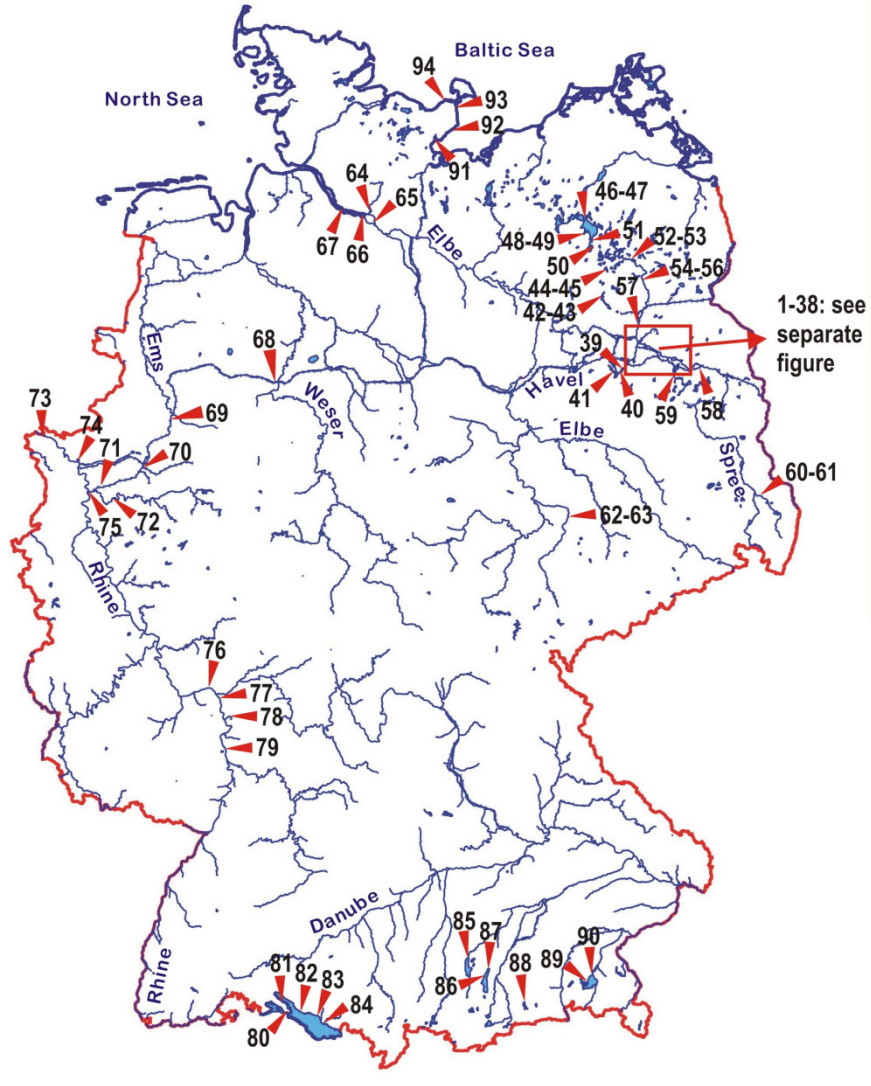
50-d EC_{10}: 32 ng/L
Radix balthica, endocrine: spermatogenesis

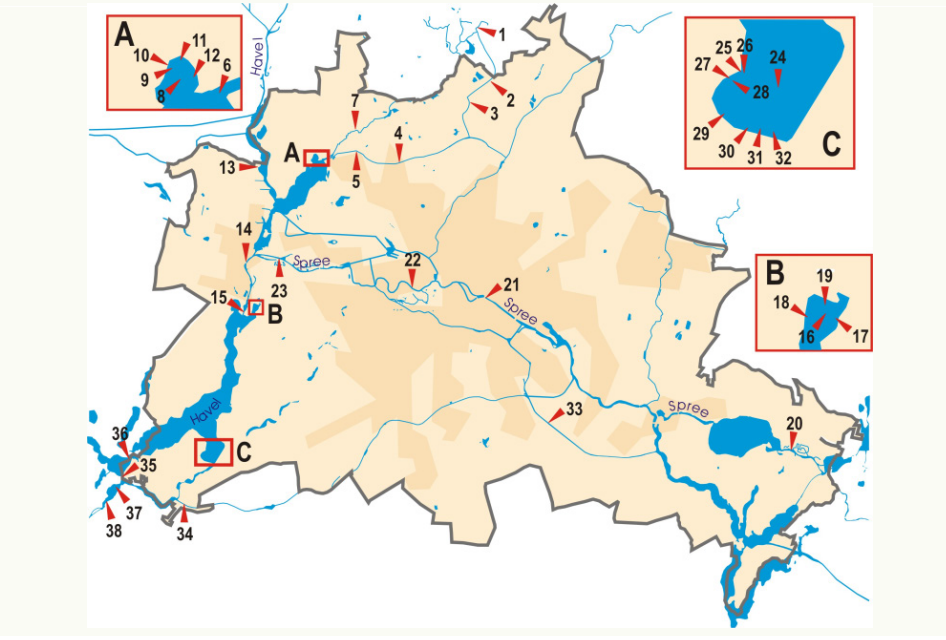


P25 P50 P75
Min
Max
Mean

150-d EC_{10}: 64 ng/L
Myriophyllum

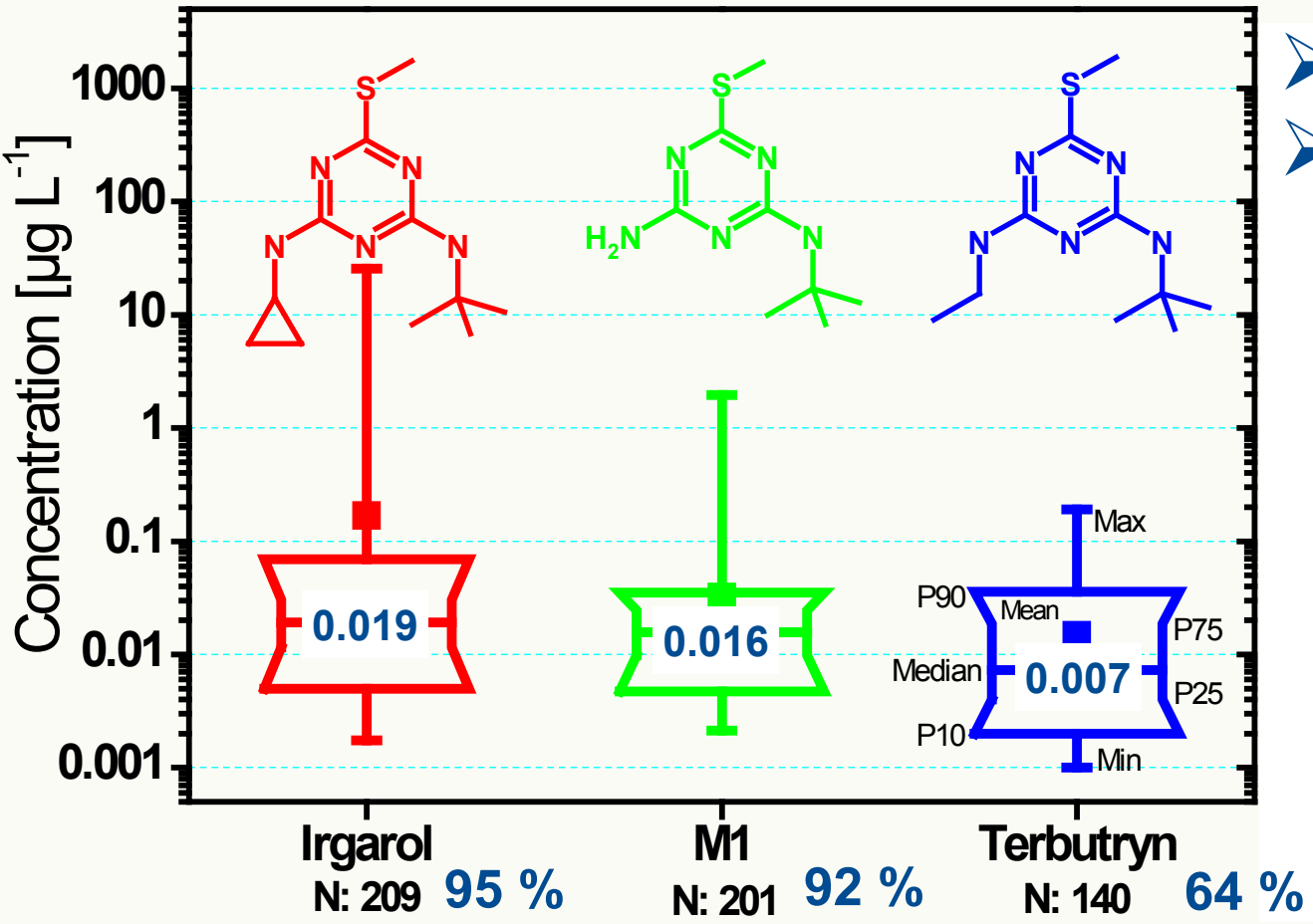
Screening - Germany





- 94 sites, 2005 - 08
- Sampling: in general biannual (Su/Wi), some sites only once (Su/Au), samples taken at c. 0.5 m water depth

Screening - Germany



- 218 samples
- High levels of Irgarol + M1: marina, effluent industrial park electrical power plant

The Project

Generation of reliable data:

- Survey of leisure boats in marinas and other locations of inland and coastal waters
- Analytical screening of AF biocides in selected water bodies
- Comparison of measured and calculated AF concentration predicted by exposure models
- Specification of statistical background data to apply emission scenario for German marinas situated at coast and inland

Work Package 1

2012: Survey of leisure boats in marinas and other locations in inland and coastal waters

Sources:

- **Marina guides, leisure boat guides/maps (DOP services like http://gdz.bkg.bund.de/)**
- **Local authorities, personal contact to leisure boat associations and harbors**

Work Package 1

Record of local data:

- Geographical references
- Postal address, email, homepage, etc.
- Type of harbor
- Extension and area of the water body
- Number of boats at berth during the sailing season

Work Package 1

Difficulties:

- Aerial photos mostly taken at wintertime
- Strong season-dependent variation in number of boats
- A lot of harbors don’t fit to simple structured harbors types used in exposure models

Work Package 1

Work Package 1

Work Package 1

Source: geo-view

**Exclusive recording of boats at berth,
as dinghies are not coated with antifouling paints**

Work Package 1

Additional record of data:

- Characteristics of adjacent water bodies of the marina
- Boatyards, slipways, boatlifts
- Shipyards, industry, professional shipping
- Variation in water level

Based on these data, local and regional hot spots will be identified and statistically evaluated

Work Package 1

Source: Marina Constance

Slipways: Input of biocides at the end of the sailing season and due to optional cleaning before racings

Work Package 1

Source: LimnoMar

Harbor: Input of biocides at the end of the sailing season due to cleaning all around the harbor

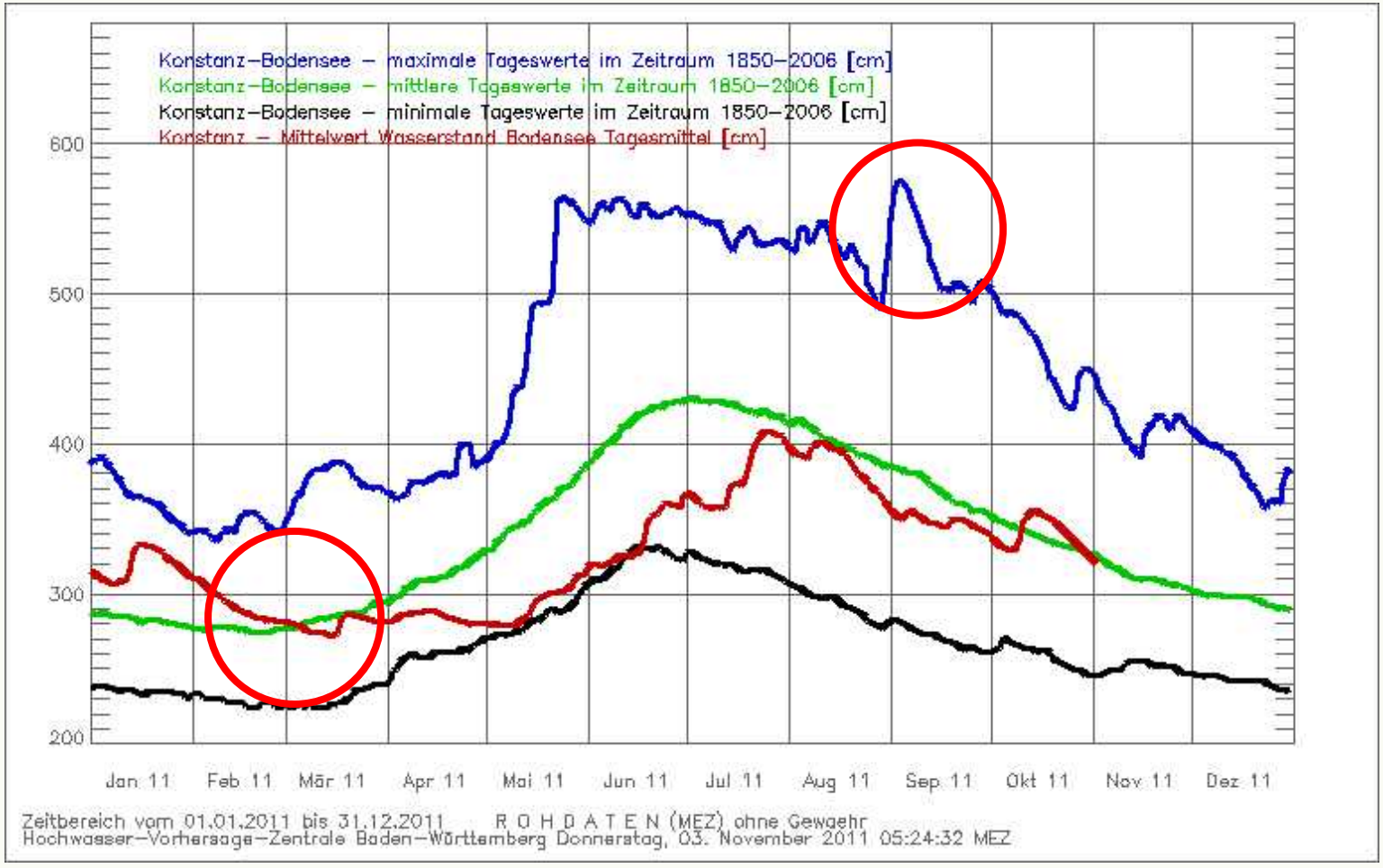
Mooring Sites and rafts

Source: geo-view

Field of anchor buoys, Lake Constance

Extended rafts, Chiemsee

Lake Constance with fluctuating water level



Work Package 2

2013: Analytical screening of antifouling biocides currently in use (water only)

I. Criteria for selection of harbors:

- Selection of 50 marinas in order to demonstrate the variety of biocide concentration found in German leisure boat harbors
- Selection of marinas fitting well into exposure models and those with essential deviations

Work Package 2

II. Criteria for selection of harbors:

- Coastal harbors with and without tides
- Freshwaters harbors with low and intense water exchange
- Seasonal variation of water levels in fresh- and brackish water harbors
- Water bodies with low and high content of suspended matter

Work Package 2

Biocide	EU-no	CAS-no	(organo)-metallic biocides
Di-copper oxide	215-270-7	1317-39-1	x
Copper thiocyanate	214-183-1	1111-67-7	x
Copper metal	231-159-6	7440-50-8	x
Zinc pyrithione	236-671-3	13463-41-7	x
Zineb	235-180-1	12122-67-7	x
Copper-pyrithione	238-984-0	14915-37-8	x
Dichlofluanid	214-118-7	1085-98-9	
Tolylfluanid	211-986-9	731-27-1	
Sea-Nine 211	264-843-8	64359-81-5	
Irgarol + metabolite M1	248-872-3	28159-98-0	
Tralopyril		122454-29-9	
Medetomidine		86347-14-0	
Diuron	206-356-5	330-55-2	
Chlorthalonil	217-588-1	1897-45-6	

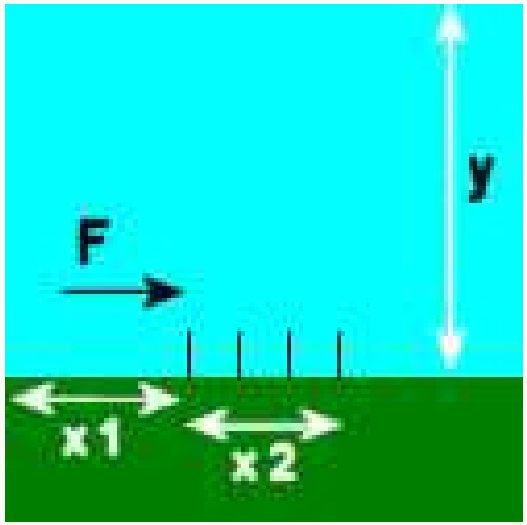
Work Package 3

2014: Comparison of measured concentrations with those calculated from emission scenarios (MAMPEC, REMA) for selected marinas

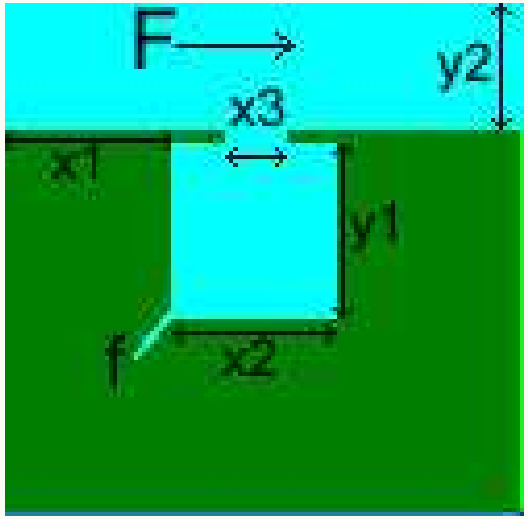
- Statistical evaluation of data in order to test the suitability of emission scenarios for German leisure boat areas in respect of
  - high boat density,
  - low water exchange, and
  - multiple uses

Emission Scenario

MAMPEC
Assumed Berth Types



Open harbor

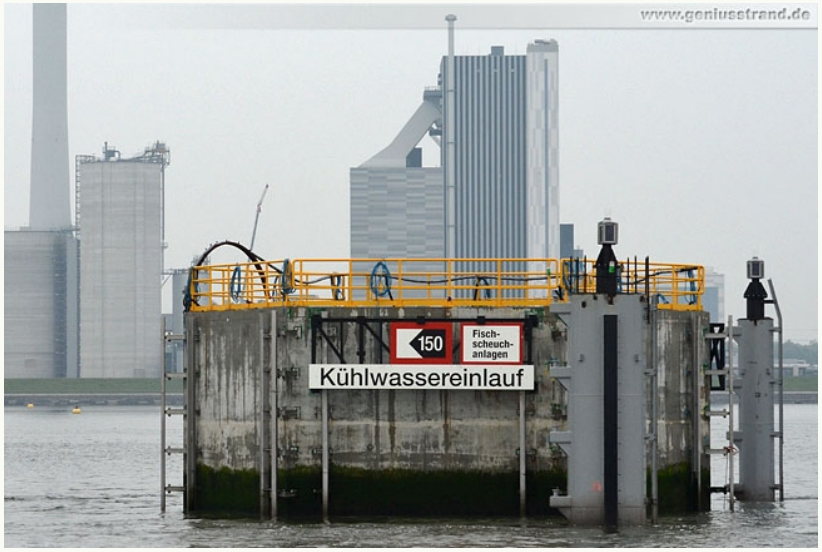


Closed marina

Multiple Uses

Source: tourismusverband-bodensee

Multiple Uses



Source:genussstrand.de

Outlets of (power-)plants

Source: ATT

Dams for drinking water supply

First Results

- Freshwater areas more extended in Germany than marine and brackish water areas
- More boats at berth along banks at rafts and pontoons than in closed marinas
- Difficulties in the demarcation of open harbors

Preliminary results

- **Total number of leisure boats at berth: 175.607**
- **Number of boats in freshwater: 111.140 (63.3%)**
- **Number of boats in brackish waters (<18‰): 58.543 (33,3%)**
- **Number of boats in marine waters (>18‰): 5.924 (3.4%)**

Final Results

- Midyear 2014 available
- Project realized on behalf of Federal Environment Agency
- Data mining, see: “Ufoplan 2011 (FKZ 3711 67 432)

The End

Thanks for your attention !