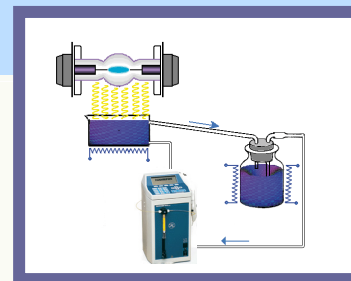


Antifouling biocides in German coastal & inland waters -

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



Background

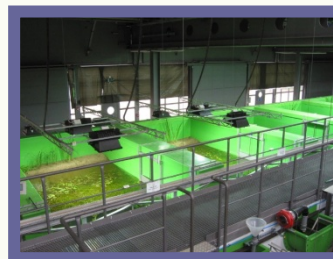


➤ **Lab tests on photo- & biodegradation (2006-07)**

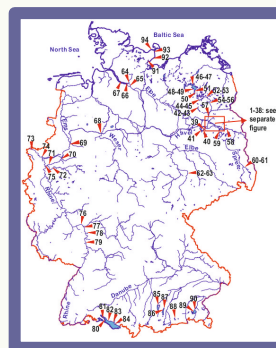


➤ **Outdoor fate study (2 streams) (2004-05)**

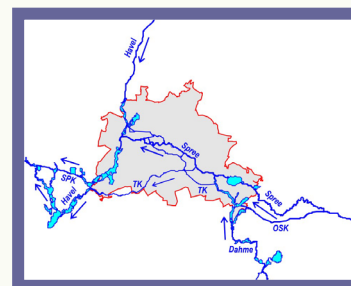
➤ **Indoor fate & effect study (8 ponds) (2005)**



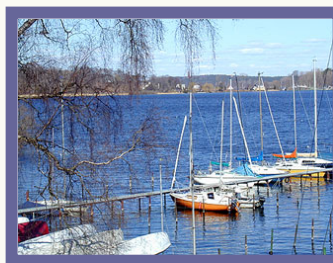
➤ **Field study (Germany) (2005-08)**



➤ **Regional study (Berlin) (2007-08)**



➤ **Local study (Single Lake) (2007-08)**

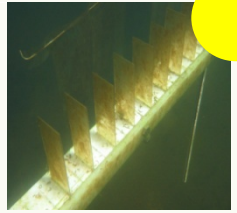


Irgarol study: Exposition & Effects

EC₁₀: nominal concentration

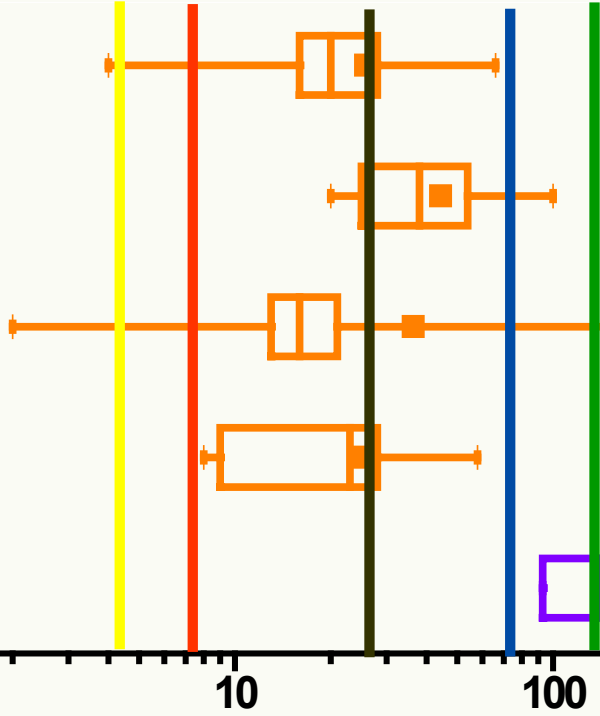
135-d EC₁₀:
7 ng/L

Periphyton -
green algae



78-d EC₁₀:
10 ng/L

Cycl. copepodits



Berlin (rivers, channels; N=20)

150-d EC₁₀:

119 ng/L

Berlin (lake; N=23)
Macrophytes
total FW

M-VP (lake Müritz; N=12)

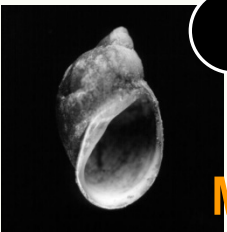
Brandenburg (river Havel; N=8)



S-H (Baltic Sea; N=4)

50-d EC₁₀:
32 ng/L

Radix balthica,
endocrine:
spermatogenesis



P25 P50 P75

Min



Max

150-d EC₁₀:
64 ng/L

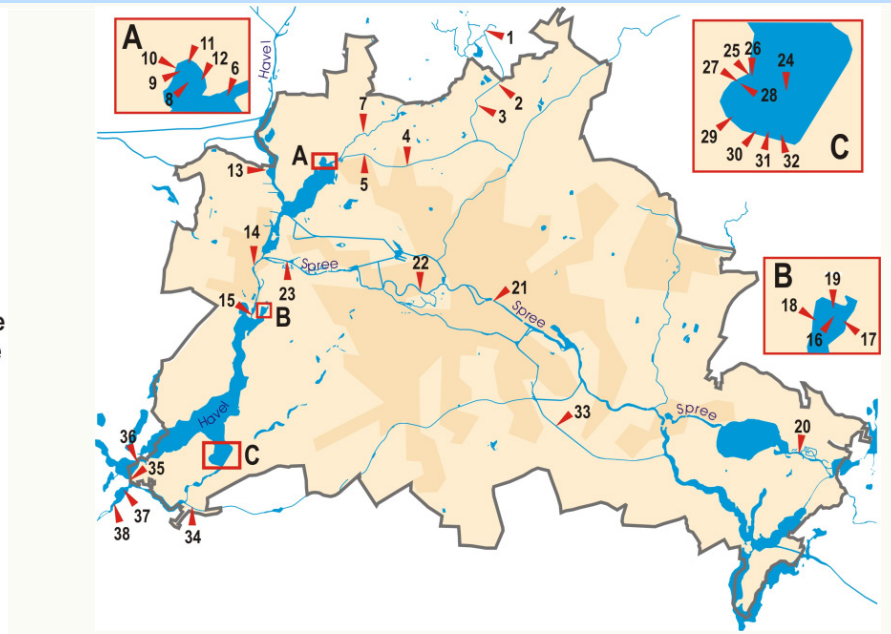
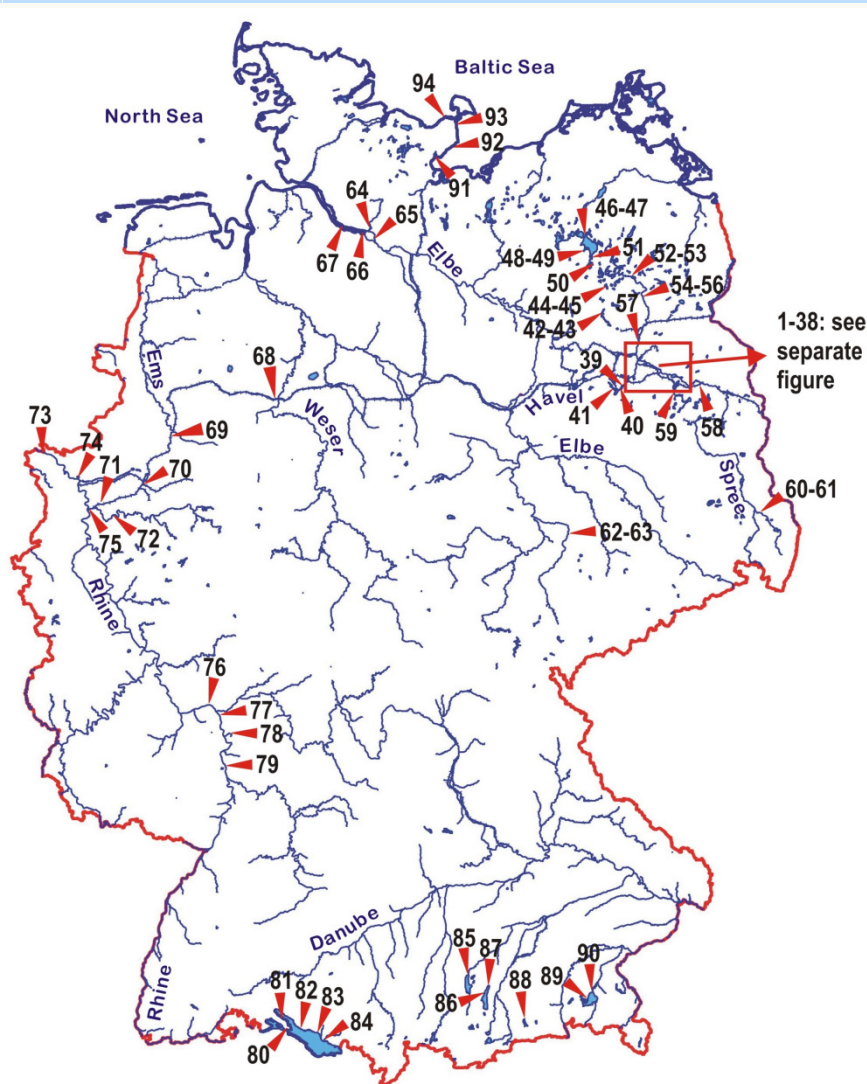
Myriophyllum



Mean



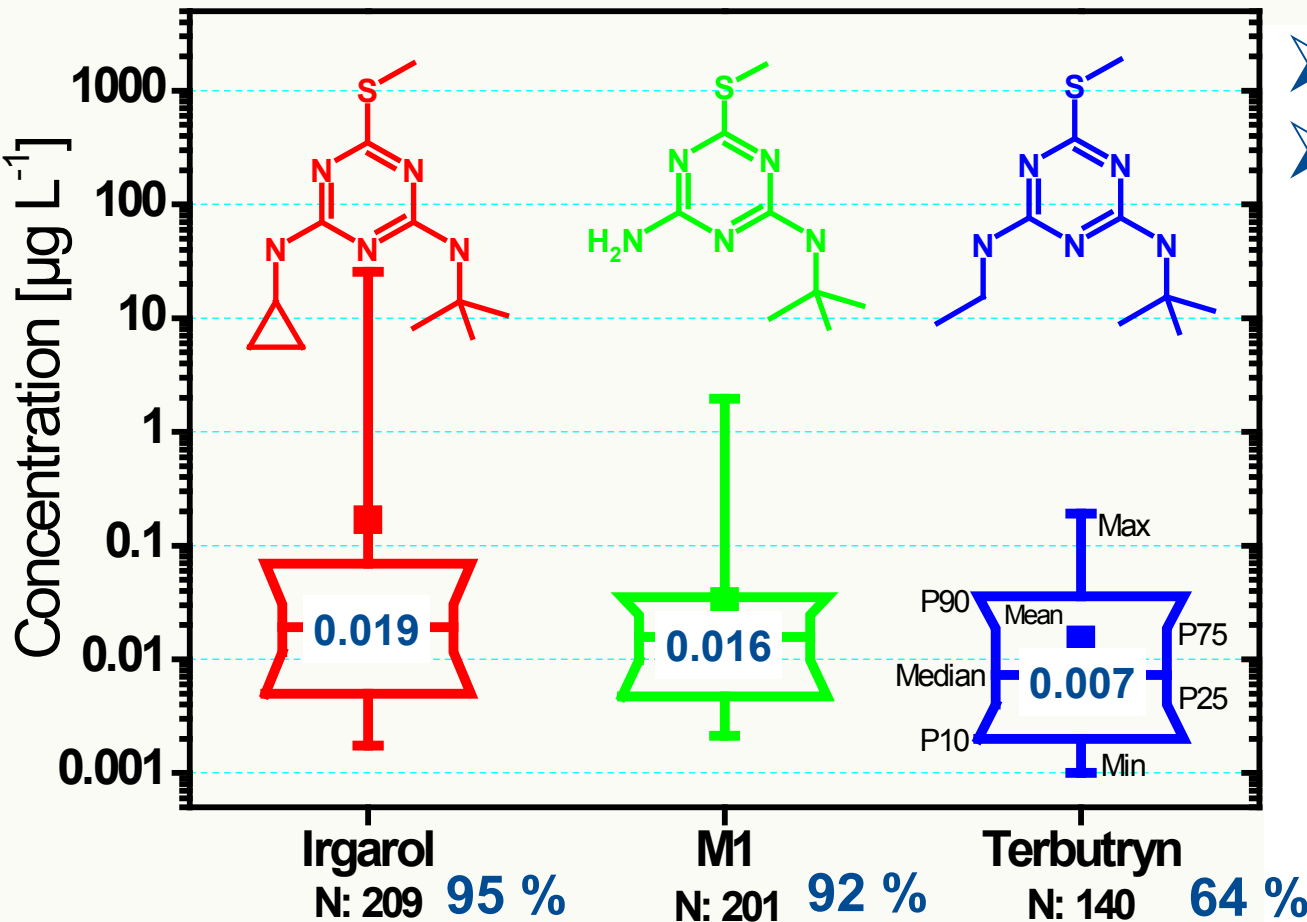
Screening - Germany



- 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

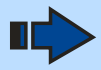
Difficulties:

- **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**

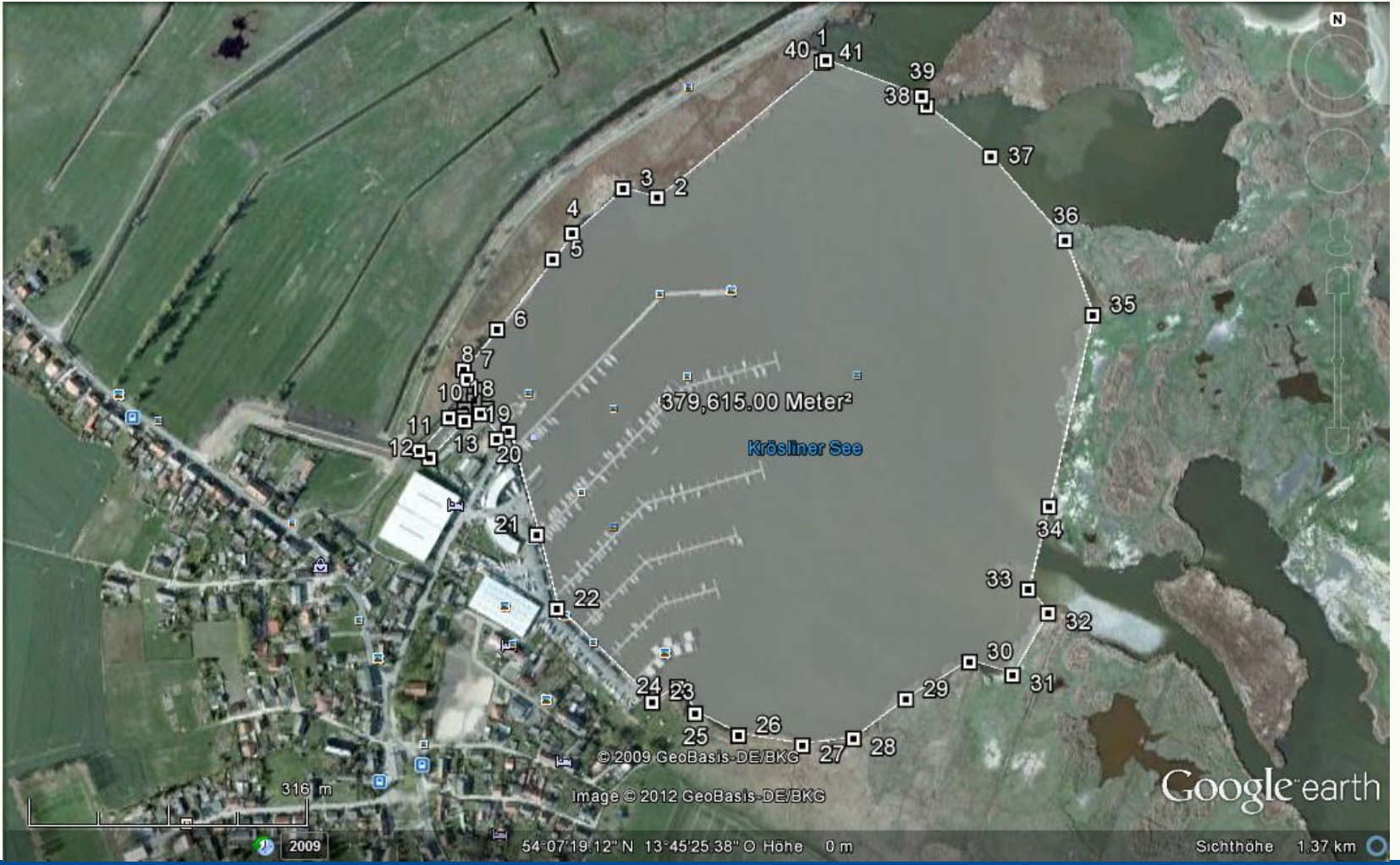


Work Package 1





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

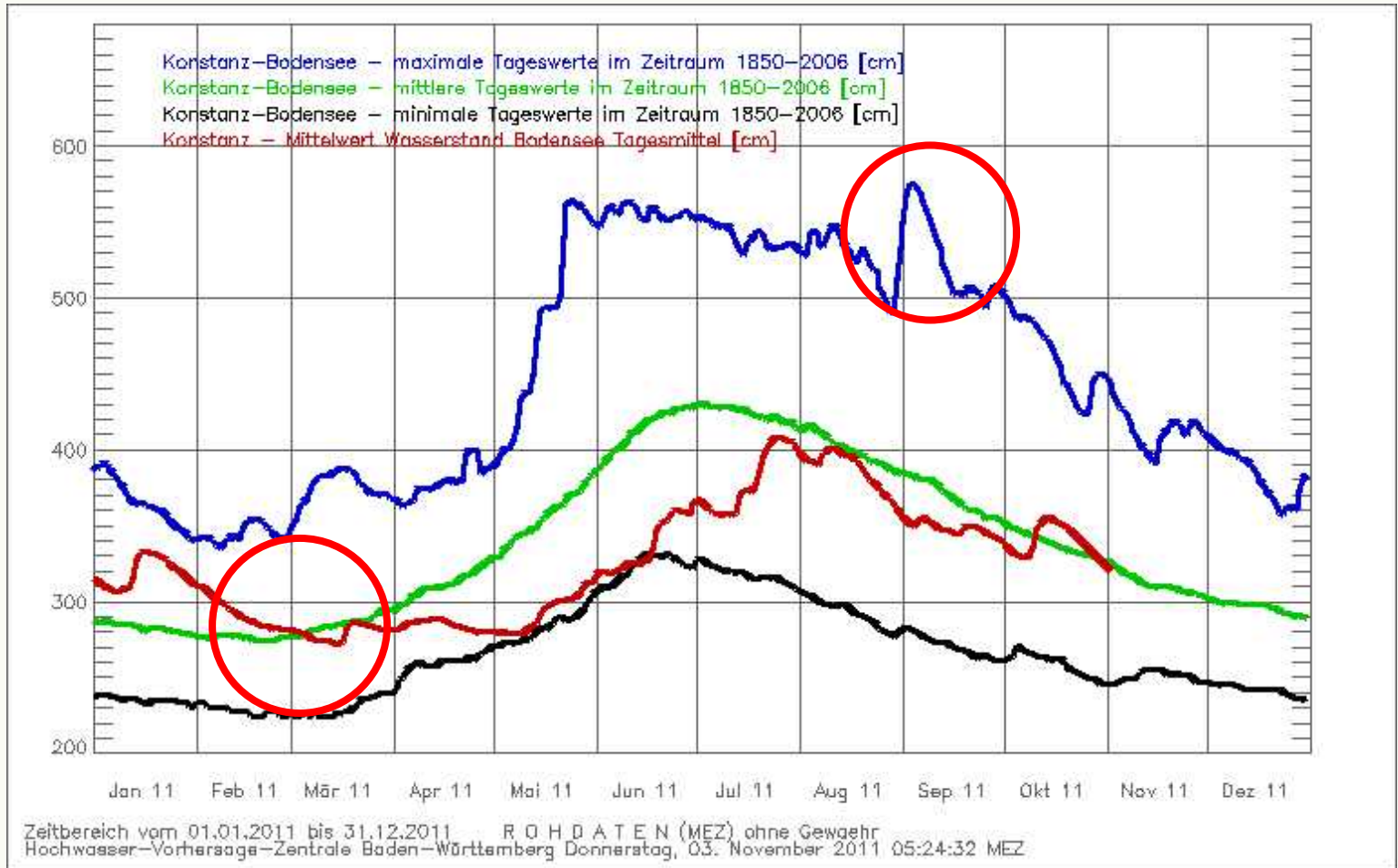
**Field of anchor buoys,
Lake Constance**



**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	
Tolyfluanid	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

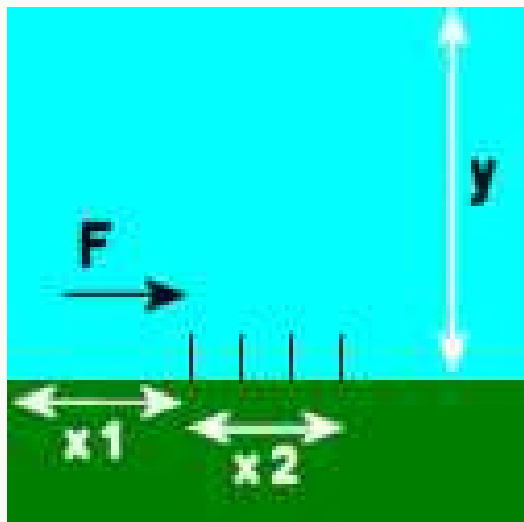
2014: Comparison of measured concentrations with those calculated from emission scenarios (MAMPEC, REMA) for selected marinas

- **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**

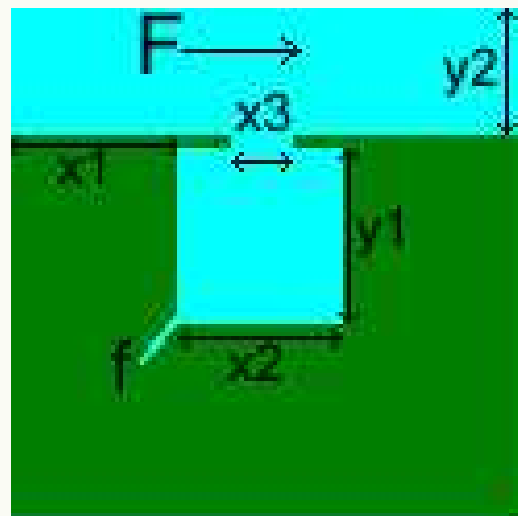


Emission Scenario

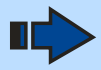
MAMPEC Assumed Berth Types



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 !