

# Effects of climate change on bioconcentration, metabolization and elimination of pharmaceuticals and endocrine disrupting compounds in mussels (*Mytilus galloprovincialis*)

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# Climate change



Atmosphere



Increase of temperature:  
**Global warming**



Decrease of pH:  
**Ocean acidification**



CO<sub>2</sub> pollution



Ocean

Impact of climate change to  
the contaminants present in  
the environment



# Pharmaceuticals and EDCs pollution



Landfill

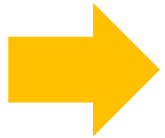
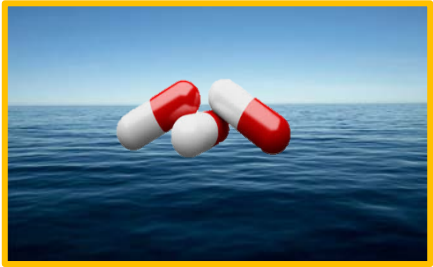
Animal waste

Aquaculture

Hospital waste

Industrial

domestic waste



- Chronic exposure
- Bioaccumulation in organisms
- Designed to be pharmacologically active (pharmaceuticals)
- Can alter the normal functioning of organisms



Effects of Phacs and EDCs to the aquatic community



**Mussels (*Mytilus galloprovincialis*)**

They are filter feeding organisms, which are likely to bioaccumulate contaminants

# Objectives

## Experiment:

In-vivo exposure of mussels to 5 pharmaceuticals (sotalol, sulfamethoxazole, venlafaxine, carbamazepine and citalopram) and 2 EDCs (methylparaben and triclosan)

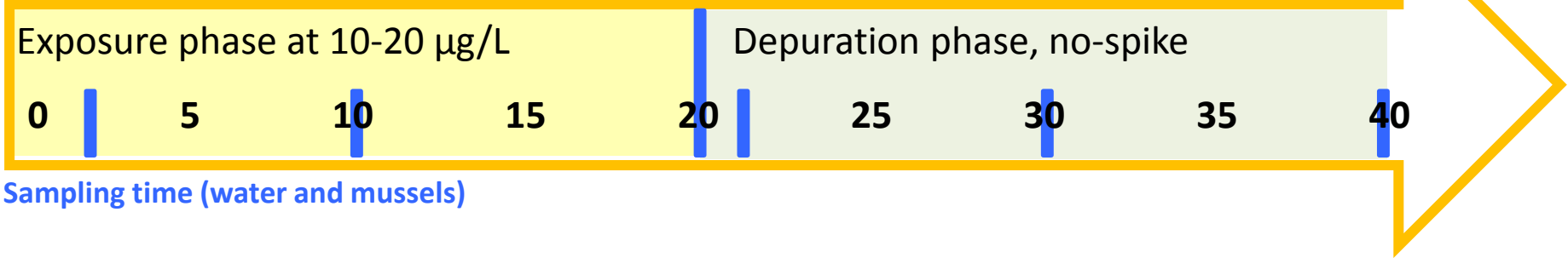
Under different conditions of water temperature and water pH.



- The accumulation of pharmaceuticals and EDCs in marine mussels (*Mytilus galloprovincialis*).
- To assess if the expected climate change effects (water warming and acidification) alter the bioconcentration and elimination of these contaminants in mussels.
- To identify the main metabolites of some of the studied compounds and their concentration changes under the tested climate change conditions.

# Experimental design

10 days of acclimation, followed by:



Sampling time (water and mussels)

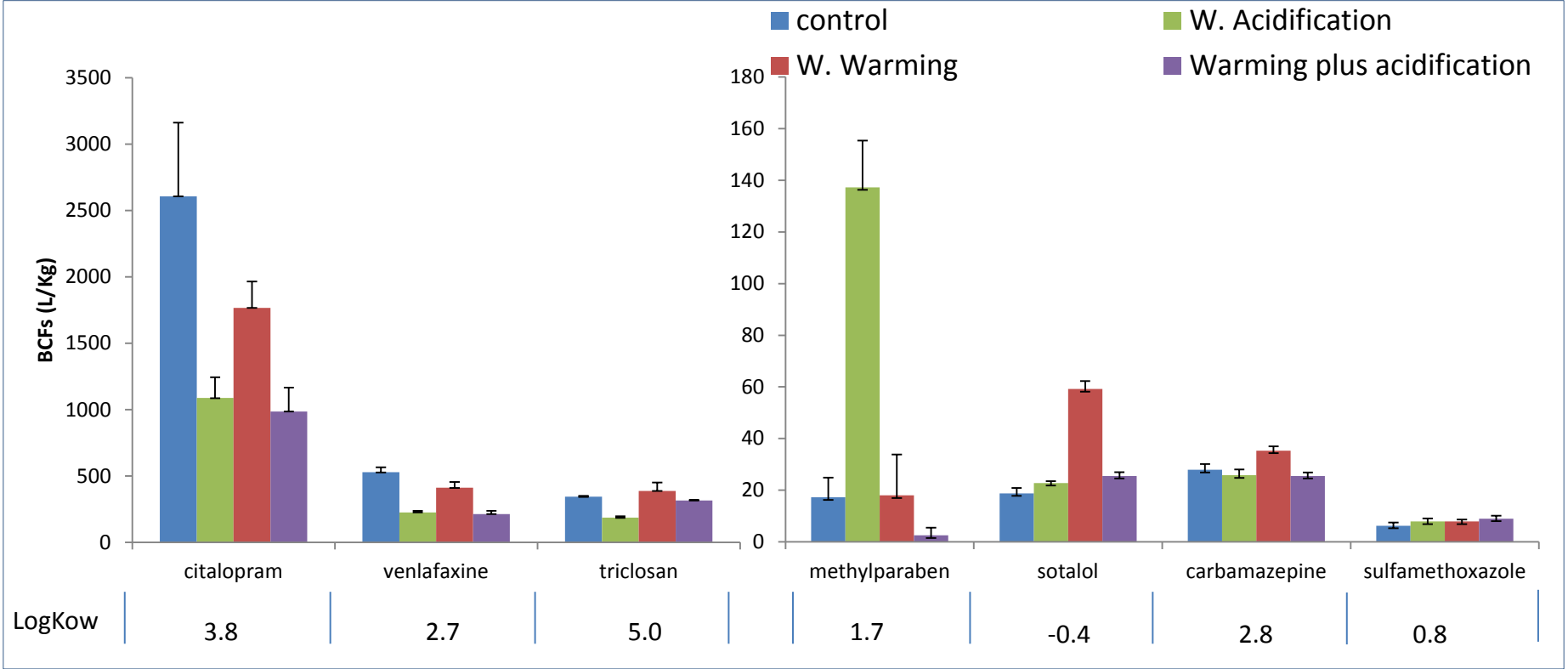
Treatments	Temperature	pH
Control	18°C	8.0 units
Water Warming	↑ 4°C	=
Water Acidification	=	↓ 0.4 units
Warming plus acidification	↑ 4°C	↓ 0.4 units

# Results

# Bioconcentration of Phacs and EDCs

$$\text{Bioconcentration Factor (BCF)} = \frac{\text{Concentration of contaminant in biota } (\mu\text{g/Kg})}{\text{Concentration of contaminant in water } (\mu\text{g/L})}$$

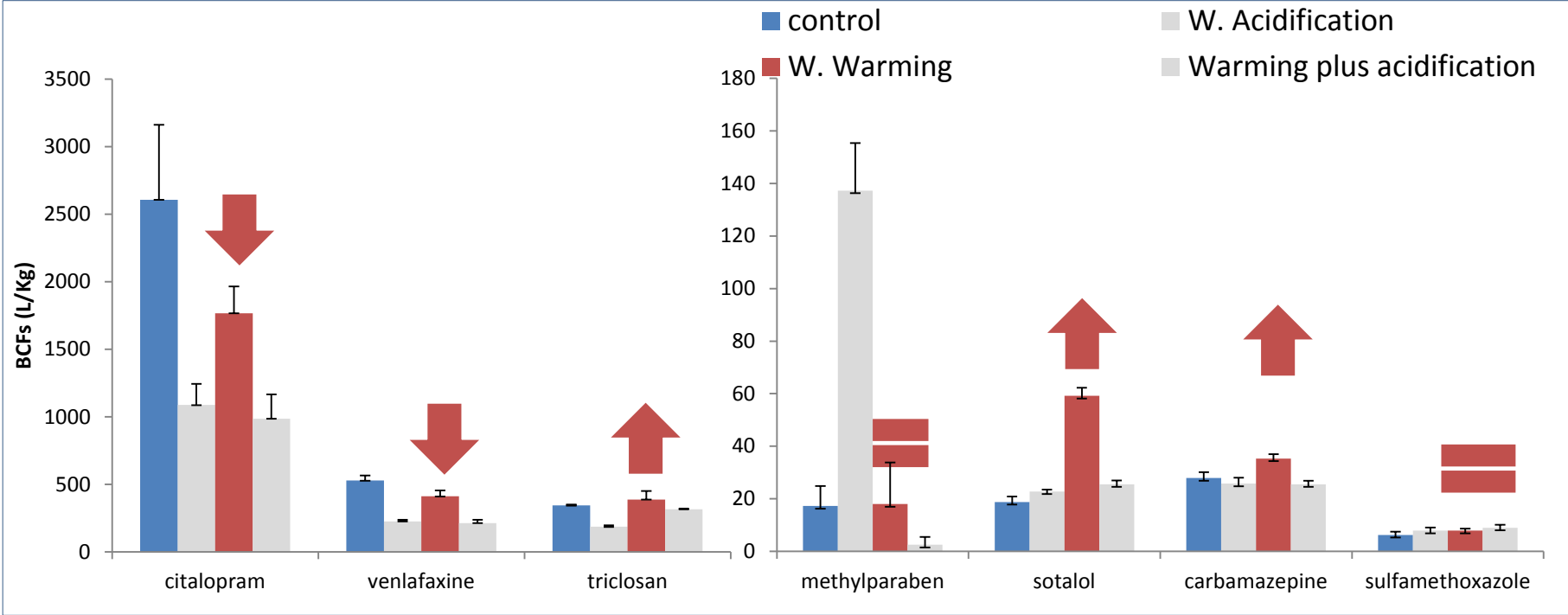
Bioconcentration factors calculated at the end of the exposure phase (day 20)



# Bioconcentration of Phacs and EDCs

## Effects of **Water Warming** in bioconcentration of contaminants

Bioconcentration factors calculated at the end of the exposure phase (day 20)

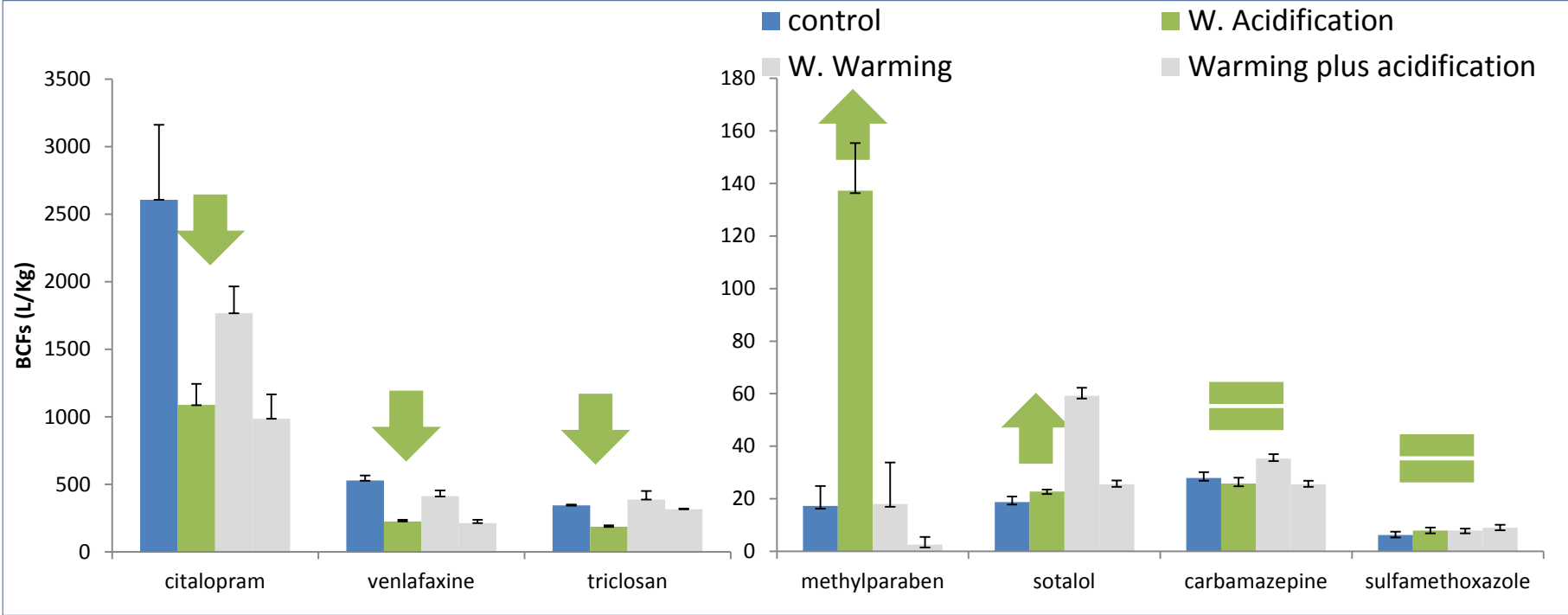




# Bioconcentration of Phacs and EDCs

## Effects of **Water Acidification** in bioconcentration of contaminants

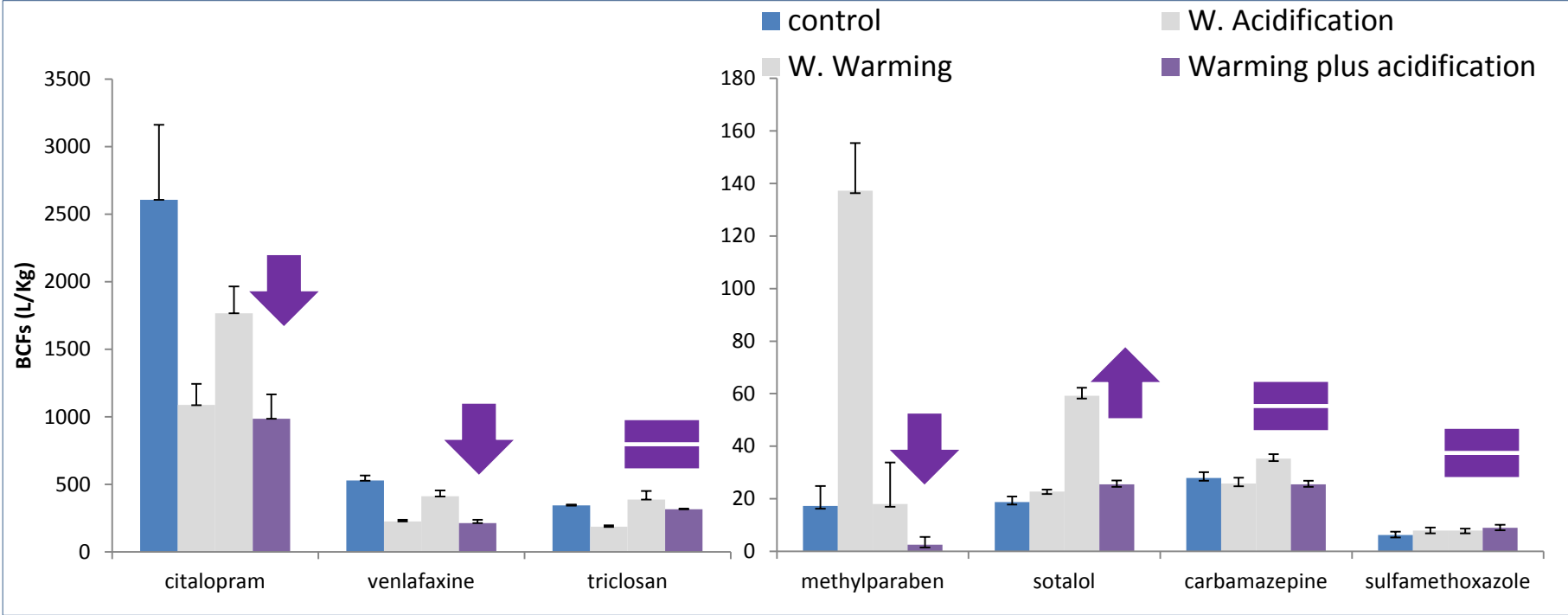
Bioconcentration factors calculated at the end of the exposure phase (day 20)



# Bioconcentration of Phacs and EDCs

## Effects of **Warming plus Acidification** in bioconcentration of contaminants

Bioconcentration factors calculated at the end of the exposure phase (day 20)



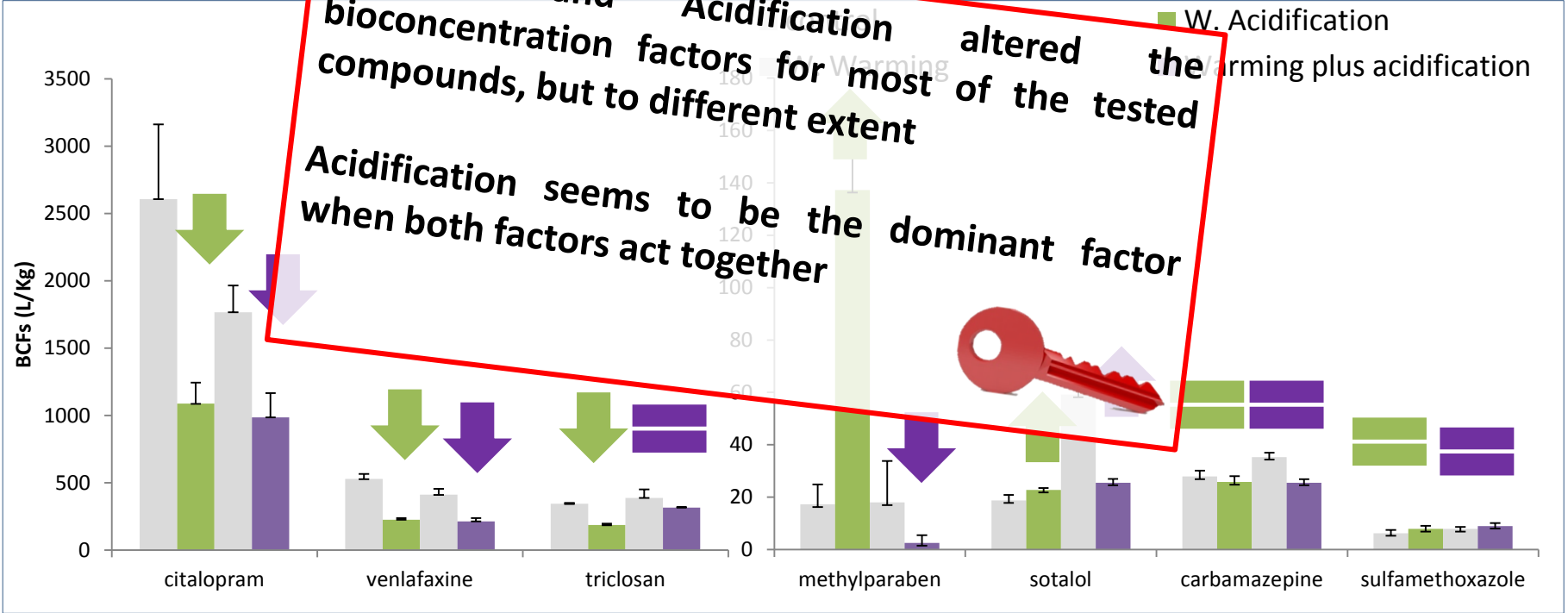
# Bioconcentration of Phacs and EDCs

## Effects of **Warming plus Acidification** in bioconcentration of contaminants

Bioconcentration factors

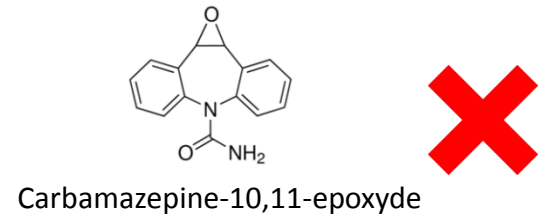
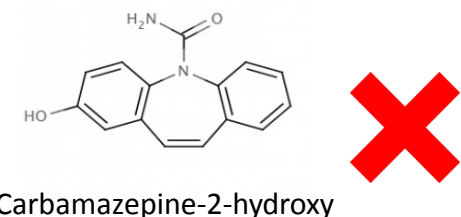
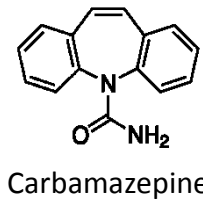
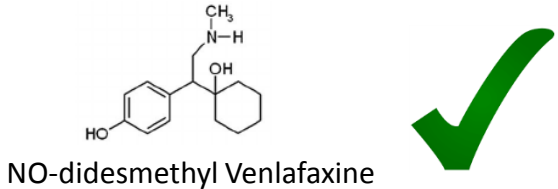
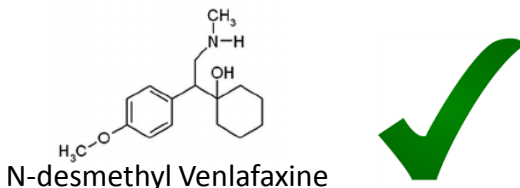
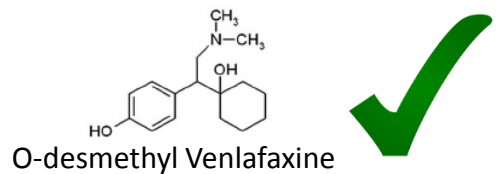
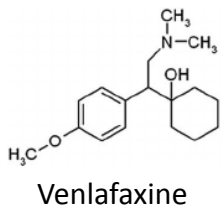
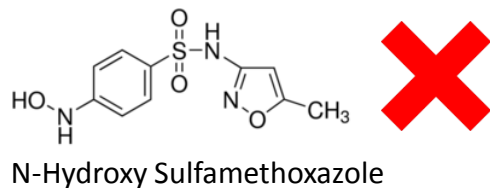
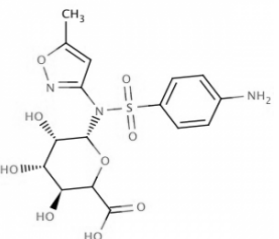
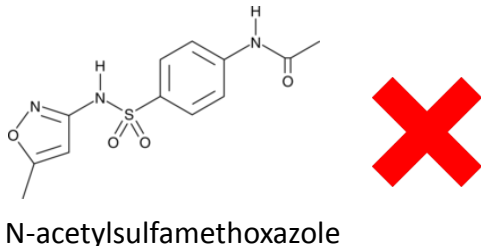
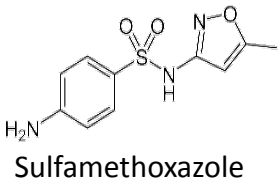
**Warming and Acidification altered the bioconcentration factors for most of the tested compounds, but to different extent**

**Acidification seems to be the dominant factor when both factors act together**

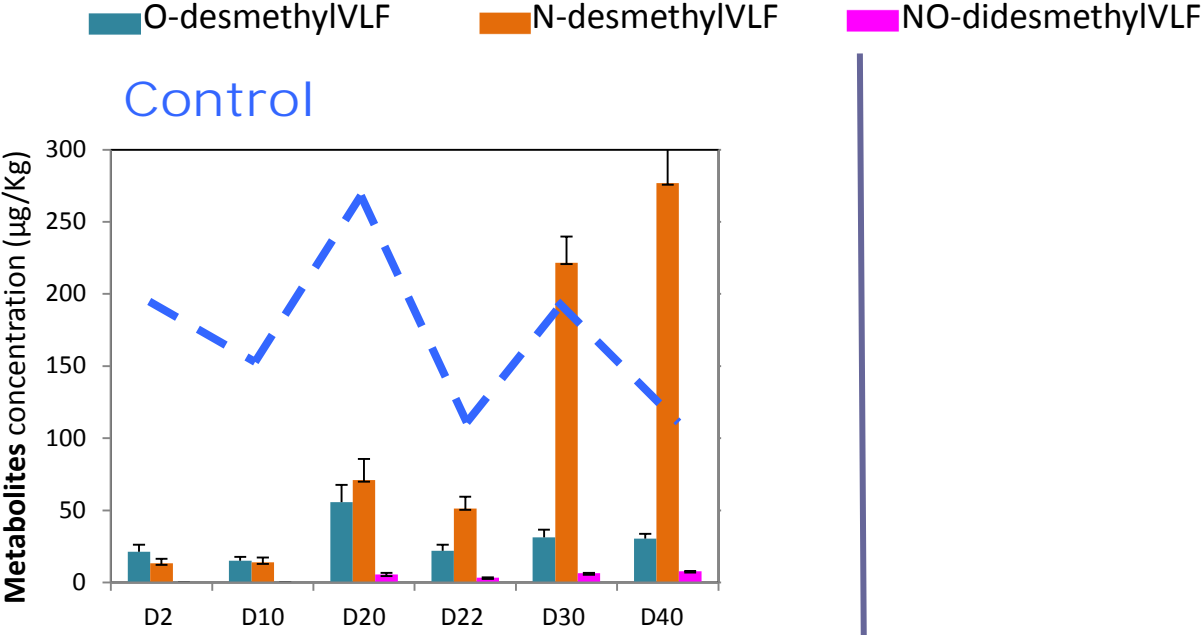


Water warming and acidification may affect **organisms physiological state**, and/or change **contaminants physicochemical parameters** which may provoke changes in BCFs of Pharmaceuticals and EDCs

# Metabolization of Pharmaceuticals



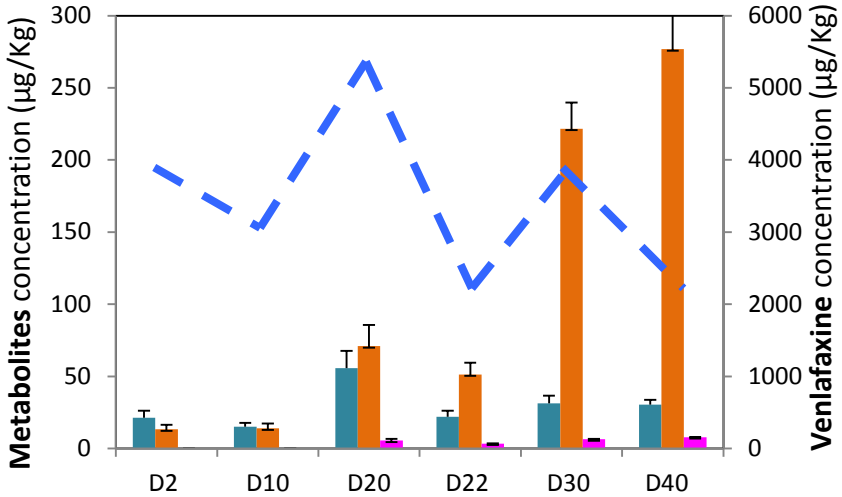
# Metabolization of Pharmaceuticals



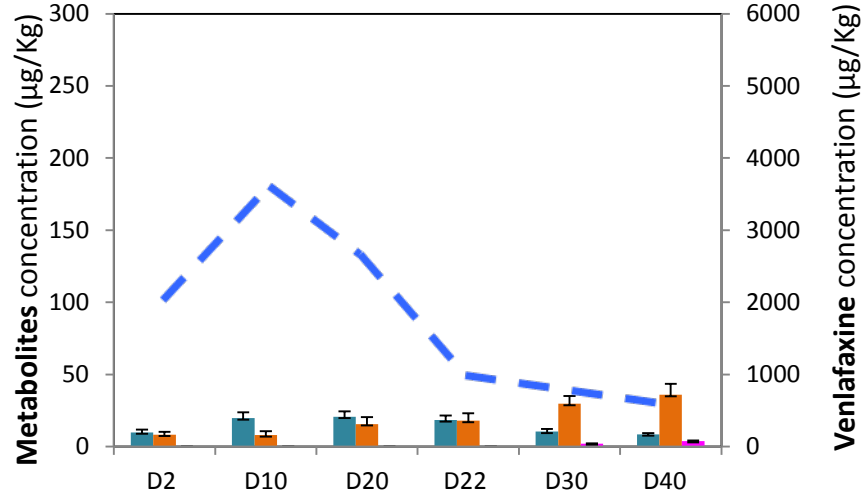
# Metabolization of Pharmaceuticals

O-desmethylVLF      N-desmethylVLF      NO-didesmethylVLF      Venlafaxine

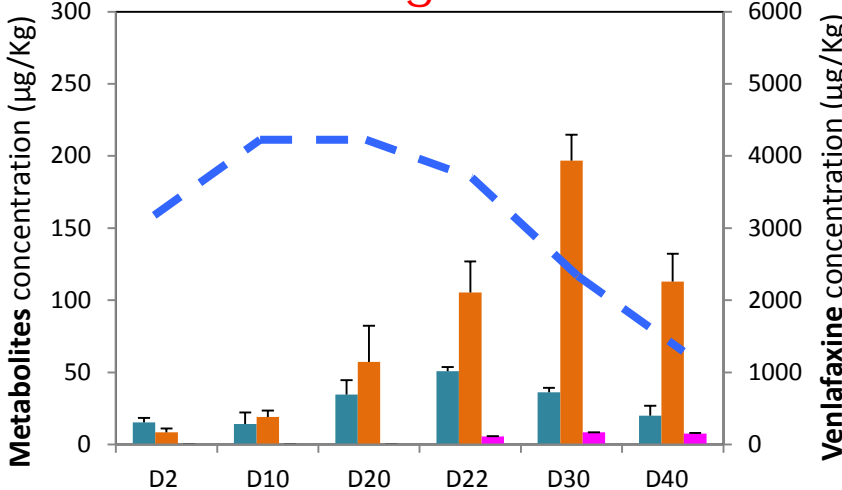
Control



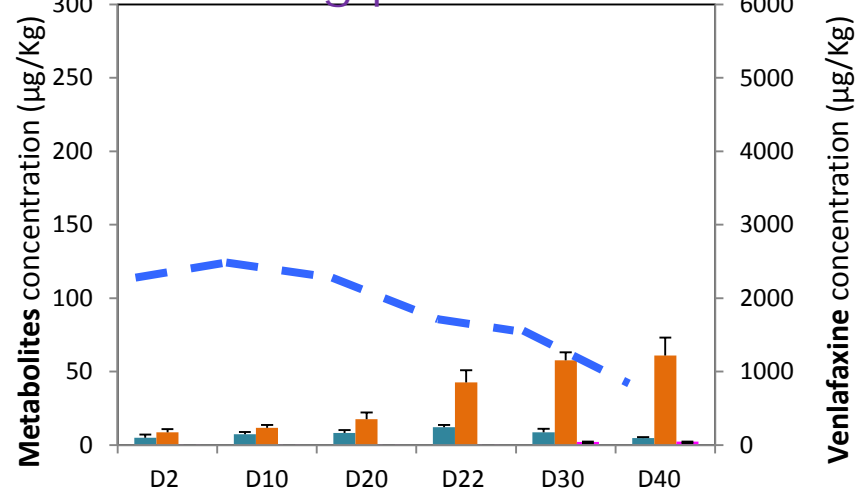
W. Acidification



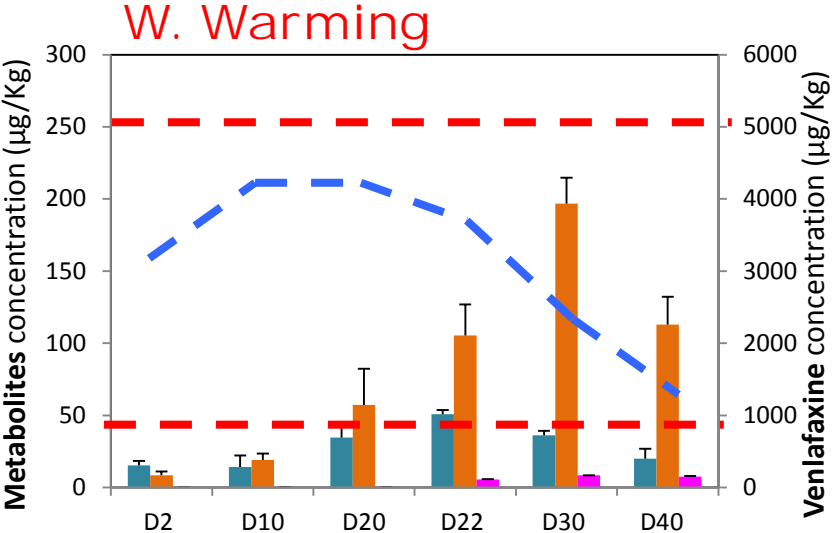
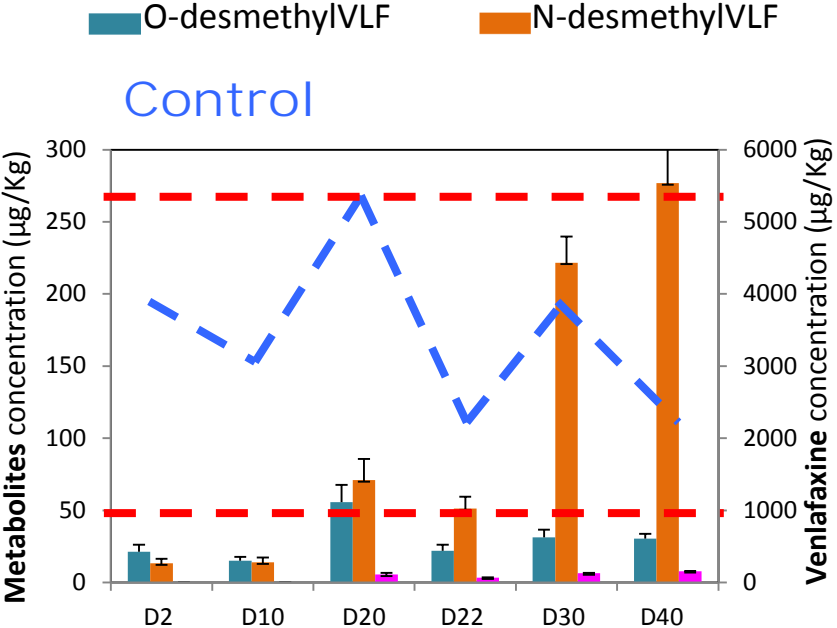
W. Warming



Warming plus acidification



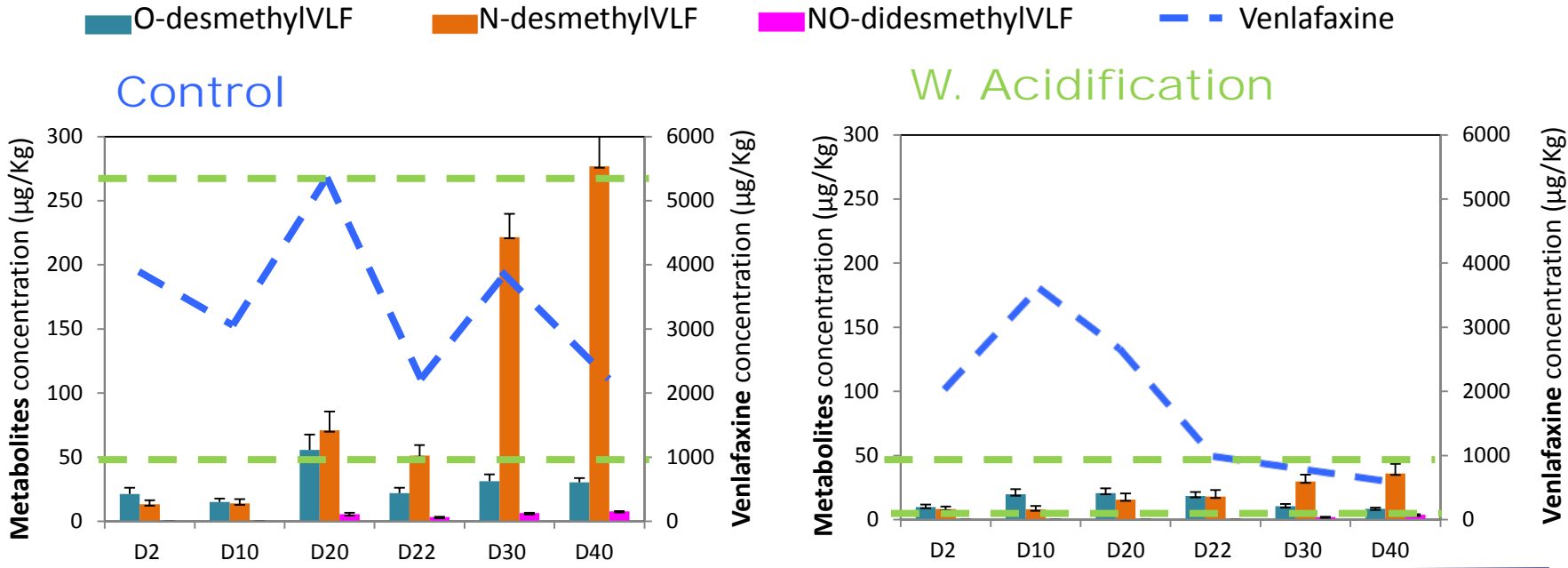
# Metabolization of Pharmaceuticals



Effects of **Water Warming** in venlafaxine metabolites concentration

W. Warming  $\approx$  VLF metabolites concentration

# Metabolization of Pharmaceuticals



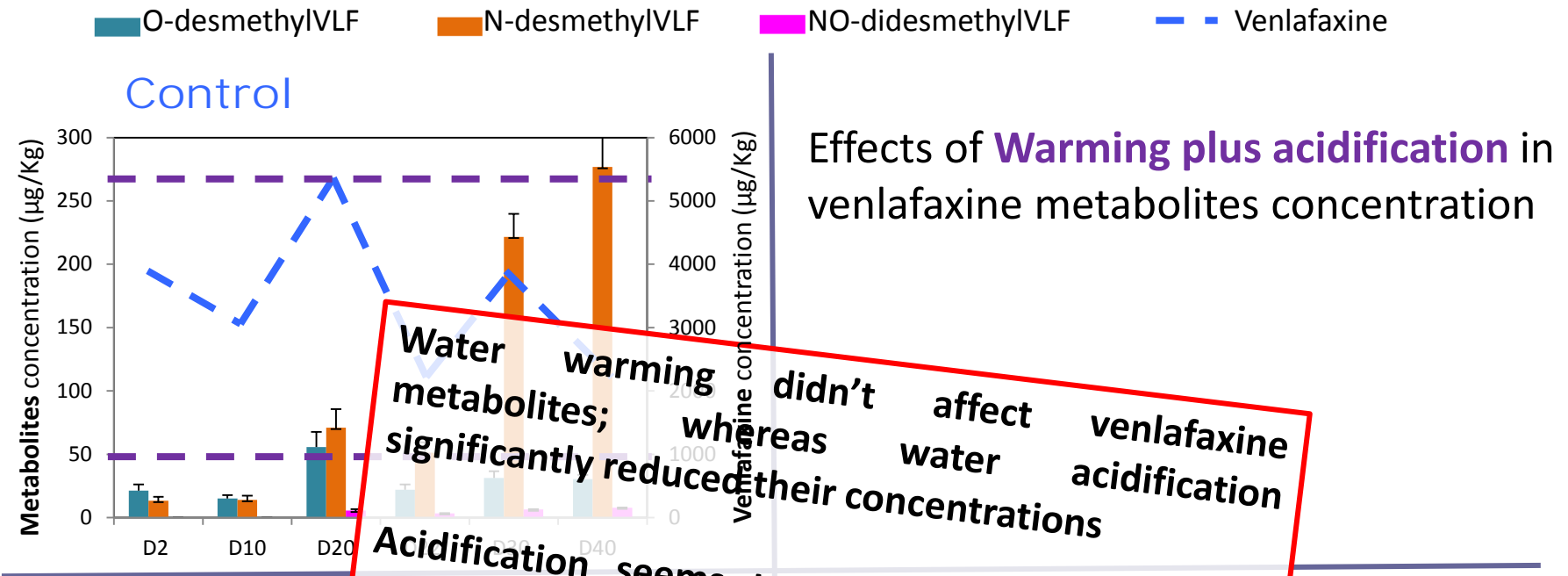
Effects of **Water Acidification** in venlafaxine metabolites concentration

**W. Acidification** ↓ **VLF** metabolites concentration

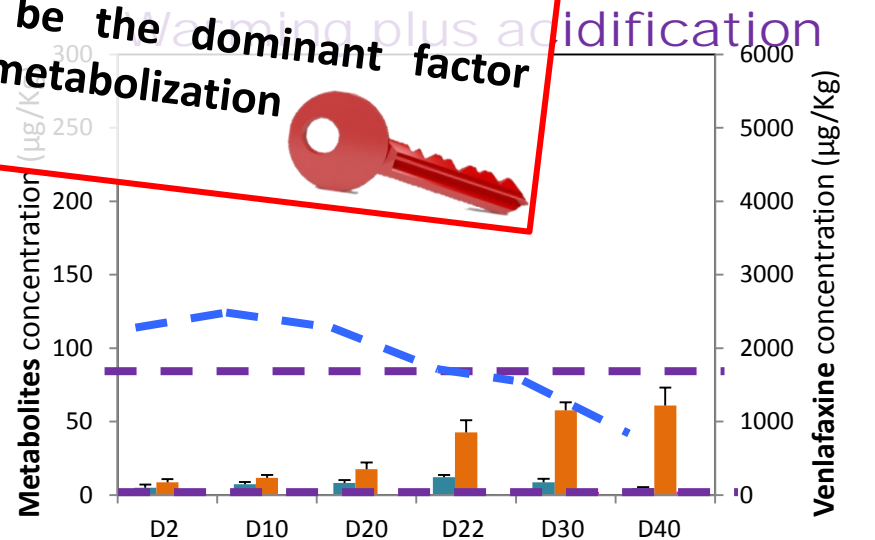
The concentrations of venlafaxine metabolites were related with those found for the parent compound in the different treatments



# Metabolization of Pharmaceuticals



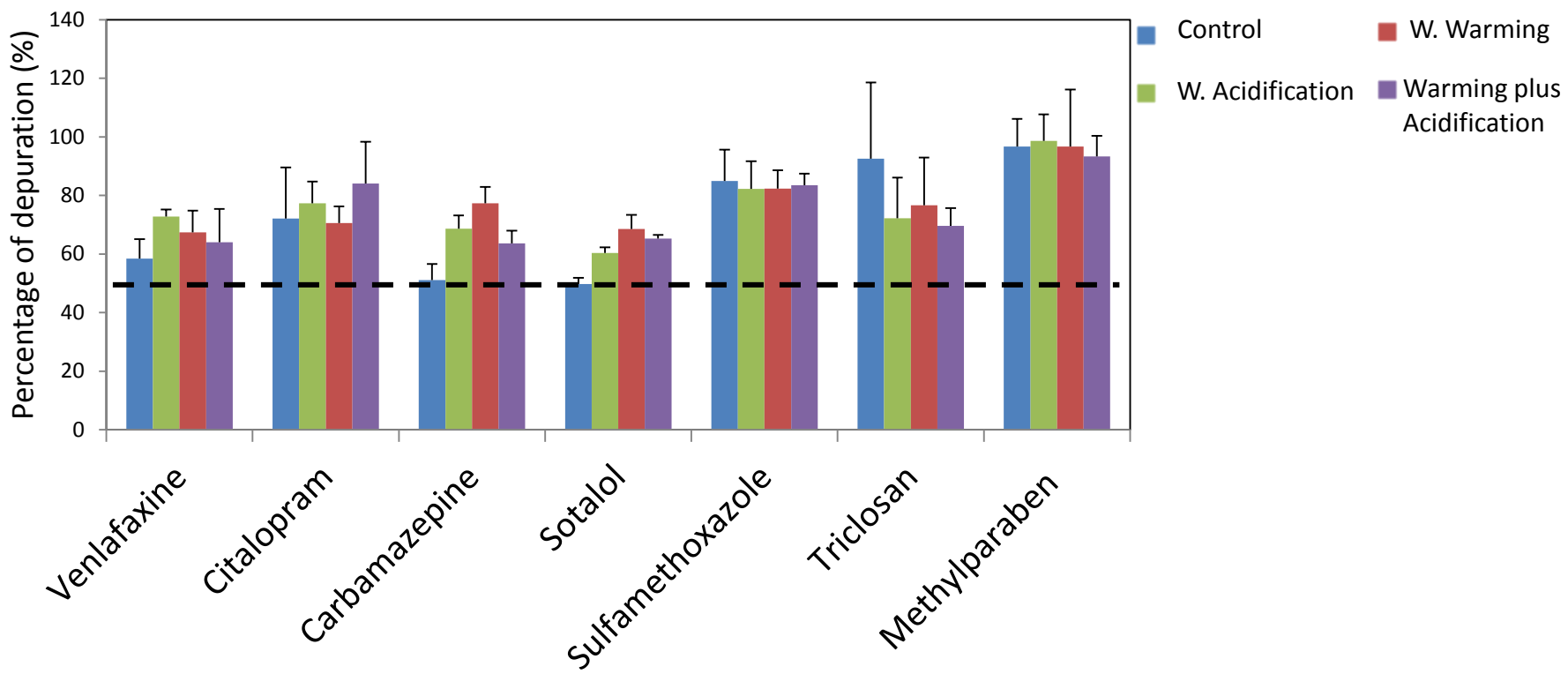
Warming plus acidification ↓ VLF metabolites concentration



# Elimination of Phacs and EDCs

Percentage of compounds elimination after 20 days of non-spiking

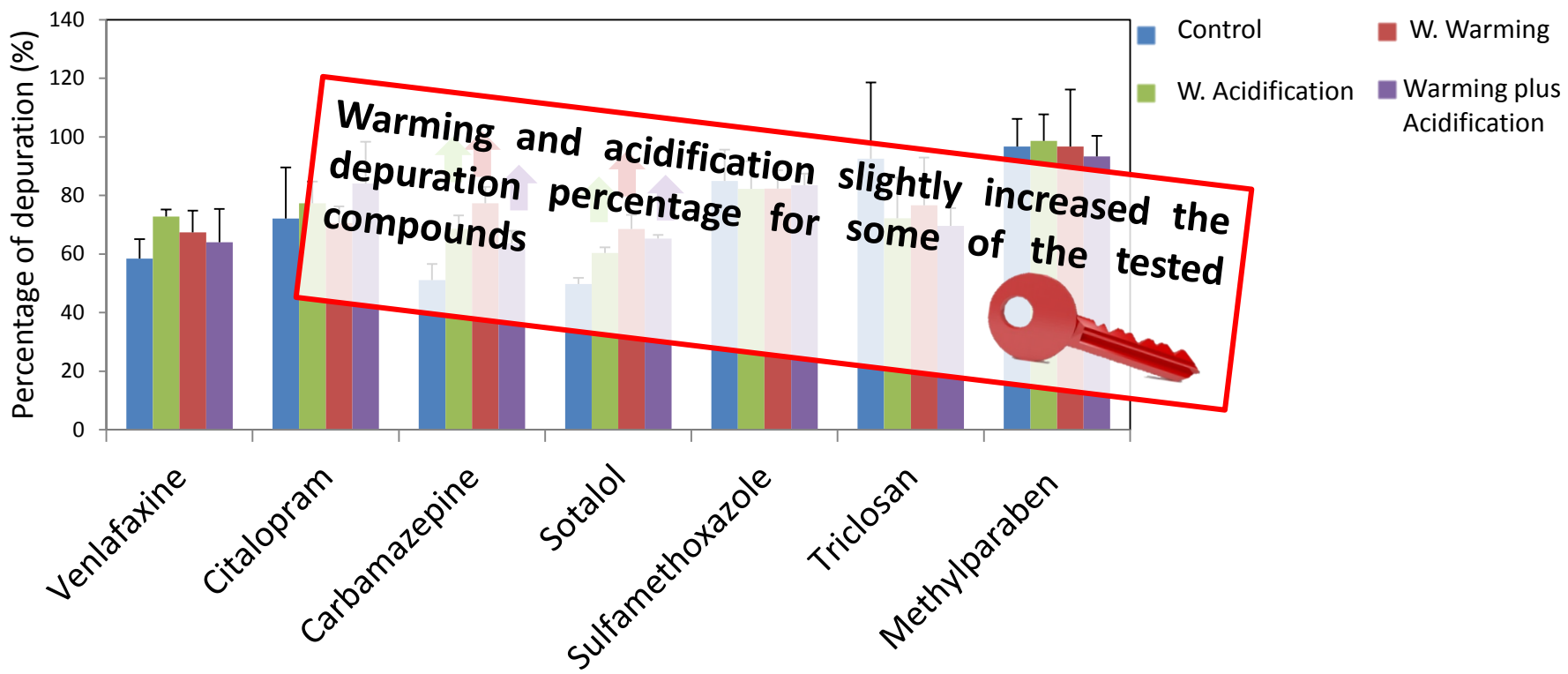
The majority of the compounds eliminated more than 50% of its concentration



# Elimination of Phacs and EDCs

Percentage of compounds elimination after 20 days of non-spiking

## Effects of **climate change** on contaminants elimination



# Conclusions

- All compounds accumulated in bivalves after 20 days of exposure, being the psychiatric drug Citalopram the one exhibiting the highest bioconcentration factor
- Water warming and acidification altered the bioconcentration of the tested compounds, however at different ranges depending on the compound
- When both stressors act together, acidification seems to be the dominant factor regarding bioconcentration of contaminants
- Water warming and acidification slightly increased the percentage of depuration of some of the tested compounds
- Water warming didn't alter significantly venlafaxine metabolites concentrations while acidification decreased them

**To all of you for your attention:**

**Gràcies · Gracias · Thank you · Merci · Takk**

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