

CONTAMINAÇÃO DA ÁGUA POR COMPOSTOS QUÍMICOS EMERGENTES

Cassiana C. Montagner

LABORATÓRIO DE QUÍMICA AMBIENTAL - DQA

INSTITUTO DE QUÍMICA - UNICAMP

VI SEMINÁRIO DE SAÚDE AMBIENTAL

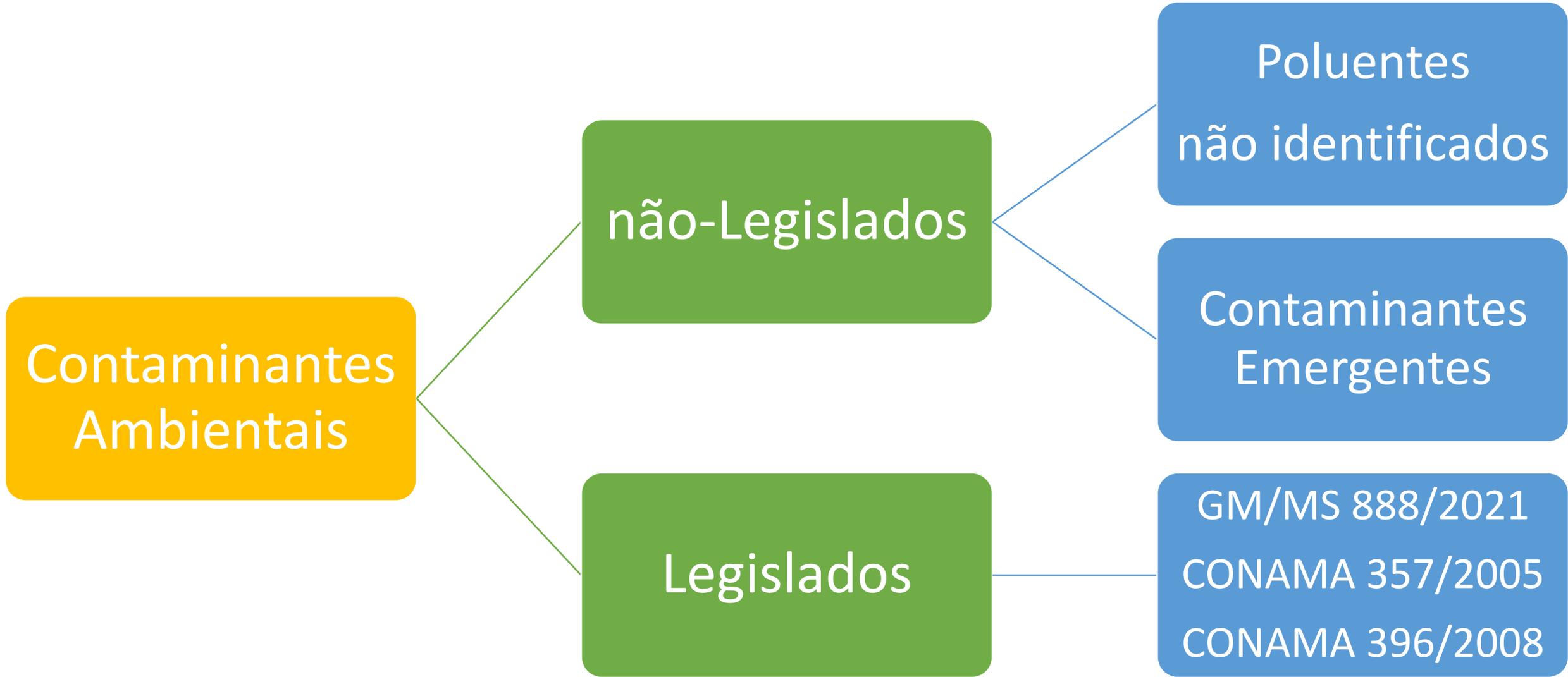
“ÁGUA POTÁVEL: DESAFIOS E SOLUÇÕES PARA A GARANTIA DESSE DIREITO HUMANO”

FT-UNICAMP 27/06/2023



UNICAMP





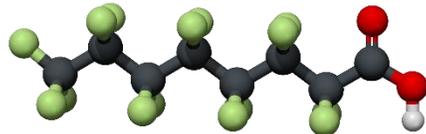
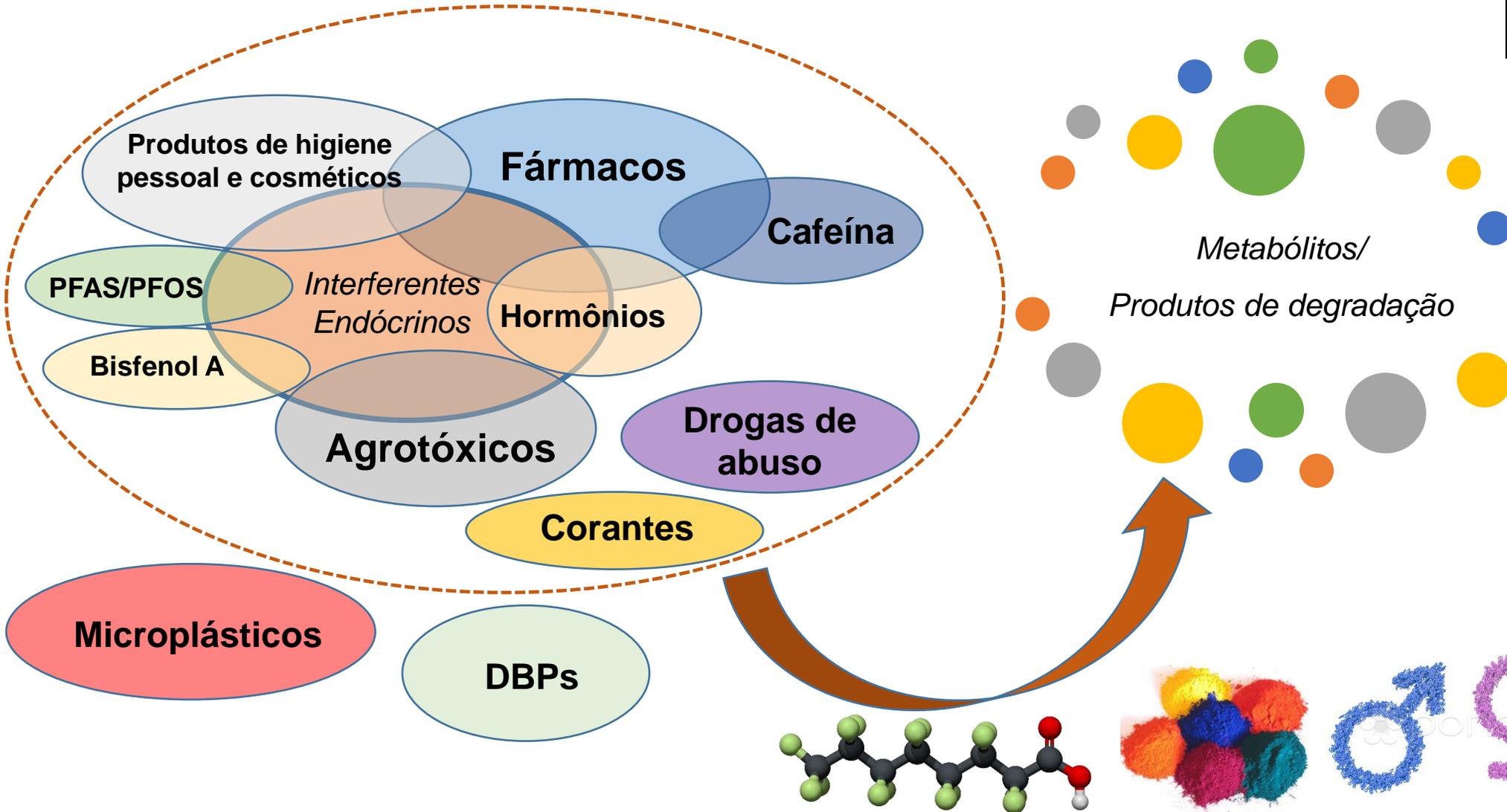
CONTAMINANTES EMERGENTES

MICROCONTAMINANTES / CONTAMINANTES DE PREOCUPAÇÃO EMERGENTE / POLUENTES EMERGENTES...



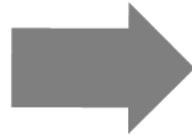
CE

3



UM CICLO QUE PRECISA SER REVISTO COM URGÊNCIA

Impacto das atividades antrópicas nos corpos d'água



ETA convencional e a prática de reuso indireto não planejado da água



Qualidade do manancial refletida na qualidade da água potável

WHAT'S IN A GLASS OF TAP WATER THESE DAYS?



CONTAMINANTES EMERGENTES EM MATRIZES AQUÁTICAS DO BRASIL

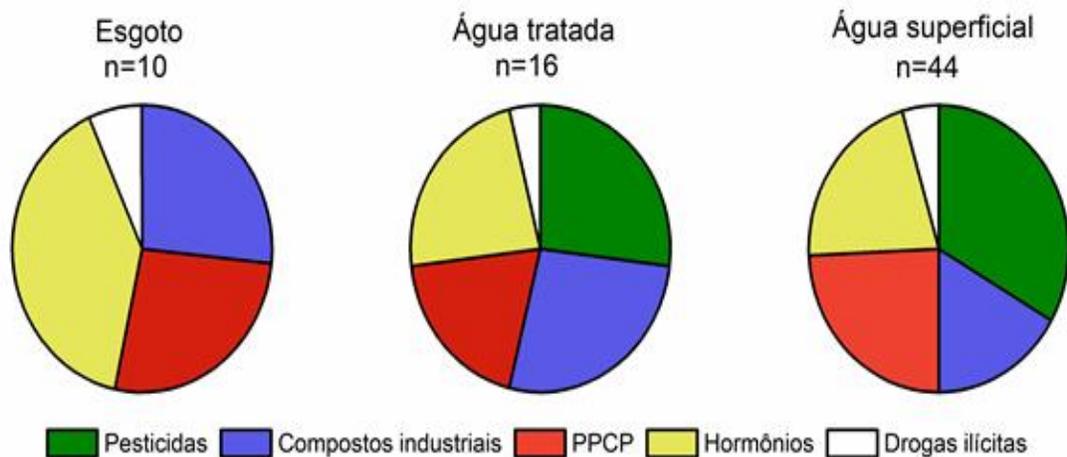


Figura 1: Distribuição das classes dos compostos estudadas nas matrizes aquáticas brasileiras: esgoto*, água tratada e águas superficiais, onde n representa o total de trabalhos publicados em revistas indexadas por matriz ambiental, dentro dos critérios estabelecidos.

*matriz esgoto: está indicando os trabalhos publicados sobre esgotos bruto e tratado e sobre efluentes hospitalares do Brasil



Figura 2: Mapa do Brasil com destaque para as regiões em cinza escuro onde foram estudadas a presença de pelo menos uma classe de contaminantes emergentes nas matrizes: (♦) esgoto, (▲) água superficial, (●) água subterrânea, e (♠) água tratada

MANANCIAS E ÁGUAS DE ABASTECIMENTO PÚBLICO



Environmental Science Processes & Impacts

COMMUNICATION



Cite this: *Environ. Sci.: Processes Impacts*, 2014, 16, 1866

Caffeine as an indicator of estrogenic activity in source water

C. C. Montagner,^a G. A. Umbuzeiro,^a C. Pasquini^b and W. F. Jardim^b

Microchemical Journal 96 (2010) 92–98



Assessing selected estrogens and xenoestrogens in Brazilian surface waters by liquid chromatography–tandem mass spectrometry

Fernando F. Sodré^{a,*}, Igor C. Pescara^b, Cassiana C. Montagner^b, Wilson F. Jardim^b

^aInstitute of Chemistry, University of Brasília, P.O. Box 4478, 72919-910 Brasília, DF, Brazil
^bInstitute of Chemistry, University of Campinas, P.O. Box 6154, 13083-970, Campinas, SP, Brazil

Separation and Purification Technology 84 (2012) 3–8



An integrated approach to evaluate emerging contaminants in drinking water

Wilson F. Jardim^a, Cassiana C. Montagner^a, Igor C. Pescara^a, Gisela A. Umbuzeiro^{b,c}, Ana Marcela Di Dea Bergamasco^c, Melanie L. Eldridge^d, Fernando F. Sodré^{e,*}

^aChemistry Institute, University of Campinas, P.O. Box 6154, 13083-970 Campinas, SP, Brazil
^bFaculty of Technology, University of Campinas, Rua Pascoal Moreira Ramos, 13064-332 Limeira, SP, Brazil
^cFaculty of Pharmaceutical Sciences, University of São Paulo, Av. Prof. Lineu Prestes 580, 05508-000 São Paulo, SP, Brazil
^dCenter for Environmental Biotechnology, University of Tennessee, Knoxville, TN 37906, USA
^eChemistry Institute, University of Brasília, P.O. Box 4478, 72919-910 Brasília, DF, Brazil

Analytical Methods

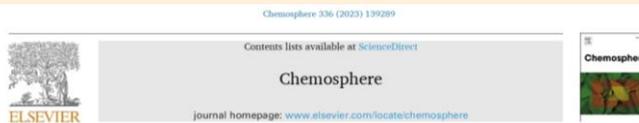
PAPER



Cite this: DOI: 10.1039/c4ay00782d

Trace analysis of pesticides and an assessment of their occurrence in surface and drinking waters from the State of São Paulo (Brazil)†

Cassiana C. Montagner,^a Cristiane Vidal,^b Raphael A. Acayaba,^a Wilson F. Jardim,^b Isabel C. S. F. Jardim^b and Gisela A. Umbuzeiro^a



Atrazine and its degradation products in drinking water source and supply: Risk assessment for environmental and human health in Campinas, Brazil

Beatriz De Caroli Vizioli, Giulia Silva da Silva, Jéssyca Ferreira de Medeiros, Cassiana Carolina Montagner^{*}

Department of Analytical Chemistry, Institute of Chemistry, University of Campinas, Campinas, SP, 13083-070, Brazil

Environmental Science and Pollution Research (2021) 28:32823–32830
<https://doi.org/10.1007/s11356-021-12998-4>

RESEARCH ARTICLE

Drinking water nitrosamines in a large metropolitan region in Brazil

Beatriz De Caroli Vizioli¹ · Leandro Wang Hantao¹ · Cassiana Carolina Montagner¹

Environ Monit Assess (2022) 194:637
<https://doi.org/10.1007/s10661-022-10288-1>

Impact of agricultural runoff and domestic sewage discharge on the spatial–temporal occurrence of emerging contaminants in an urban stream in São Paulo, Brazil

Vinicius S. Santos · Juliana S. X. Anjos · Jéssyca F. de Medeiros · Cassiana C. Montagner



Emerging contaminants in Brazilian rivers: Occurrence and effects on gene expression in zebrafish (*Danio rerio*) embryos

Juliana C.V. Sposito^a, Cassiana C. Montagner^b, Marta Casado^c, Laia Navarro-Martín^c, Julio César Jut Solórzano^d, Benjamin Piña^c, Alexeia B. Grisolia^{e,*}

Environmental Science Processes & Impacts

CRITICAL REVIEW



Cite this: *Environ. Sci.: Processes Impacts*, 2016, 18, 779

Pesticides in Brazilian freshwaters: a critical review

A. F. Albuquerque,^a J. S. Ribeiro,^a F. Kummrow,^{ab} A. J. A. Nogueira,^{ac} C. C. Montagner^d and G. A. Umbuzeiro^a



J. Braz. Chem. Soc., Vol. 22, No. 8, 1452–1462, 2011.
Printed in Brazil – ©2011 Sociedade Brasileira de Química
0103 - 5053 \$6.00+0.00

Article

Spatial and Seasonal Variations of Pharmaceuticals and Endocrine Disruptors in the Atibaia River, São Paulo State (Brazil)

Cassiana C. Montagner^{*} and Wilson F. Jardim

Institute of Chemistry, University of Campinas, CP 6154, 13083-970 Campinas-SP, Brazil

<http://dx.doi.org/10.21577/0100-4042.20170091>

Quim. Nova, Vol. 40, No. 9, 1094-1110, 2017

CONTAMINANTES EMERGENTES EM MATRIZES AQUÁTICAS DO BRASIL: CENÁRIO ATUAL E ASPECTOS ANALÍTICOS, ECOTOXICOLÓGICOS E REGULATÓRIOS

Cassiana C. Montagner^{a,*}, Cristiane Vidal^b e Raphael D. Acayaba^b
^aInstituto de Química, Universidade Estadual de Campinas, 13083-970 Campinas – SP, Brasil
^bFaculdade de Tecnologia, Universidade Estadual de Campinas, 13484-332 Limeira – SP, Brasil

Recebido em 11/04/2017; aceito em 03/05/2017; publicado na web em 11/07/2017



Revisão

Science of the Total Environment 575 (2017) 1307–1324



Nutrients, emerging pollutants and pesticides in a tropical urban reservoir: Spatial distributions and risk assessment

Julio C. López-Doval^{a,b,*}, Cassiana C. Montagner^c, Anjaína Fernandes de Albuquerque^d, Viviane Moschini-Carlos^e, Gisela Umbuzeiro^c, Marcelo Pompêo^a

Environ Sci Pollut Res (2014) 21:1850–1858
DOI 10.1007/s11356-013-2063-5

RESEARCH ARTICLE

Occurrence and potential risk of triclosan in freshwaters of São Paulo, Brazil—the need for regulatory actions

Cassiana C. Montagner · Wilson F. Jardim · Peter C. Von der Ohe · Gisela A. Umbuzeiro



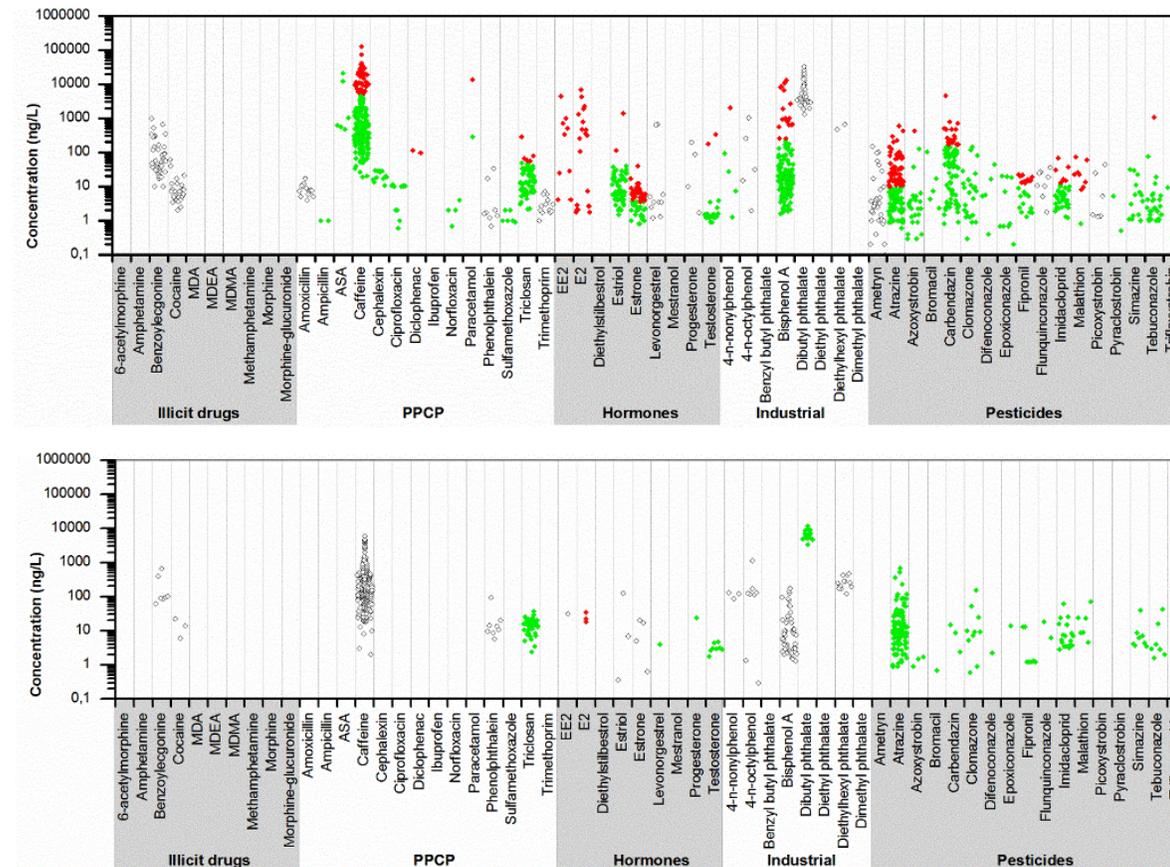
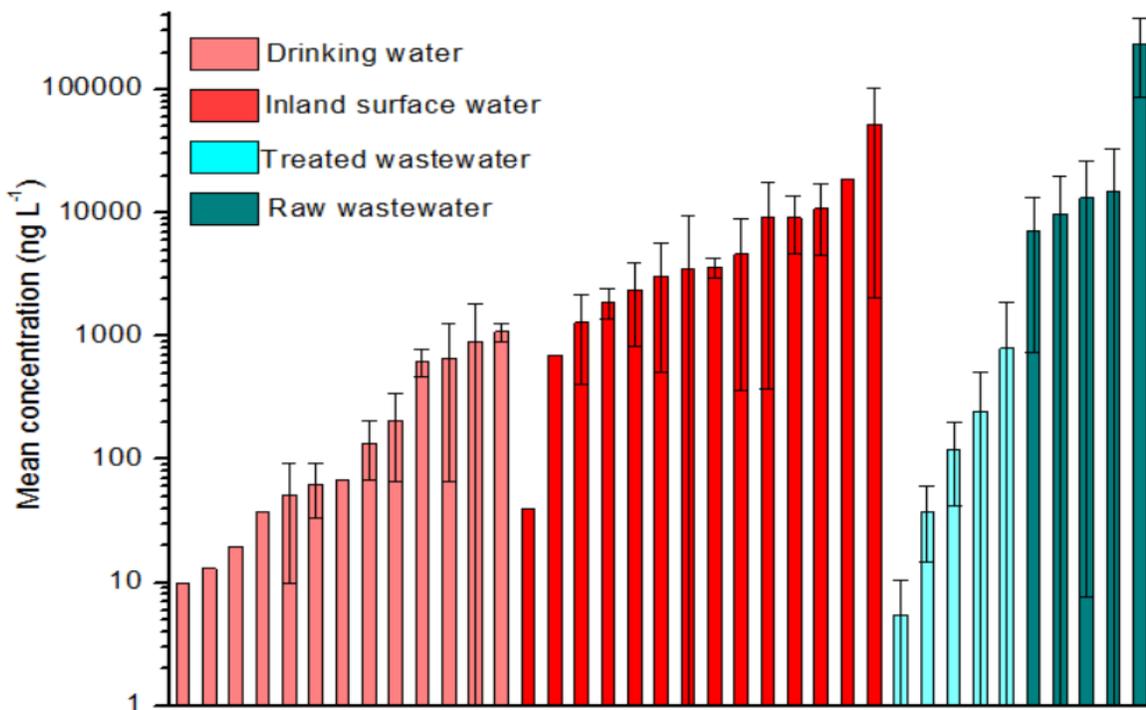
OCORRÊNCIA



Ten Years-Snapshot of the Occurrence of Emerging Contaminants in Drinking, Surface and Ground Waters and Wastewaters from São Paulo State, Brazil

Montagner et al. J. Braz. Chem. Soc., Vol. 30, No. 3, 614-632, 2019 - <http://dx.doi.org/10.21577/0103-5053.20180232>

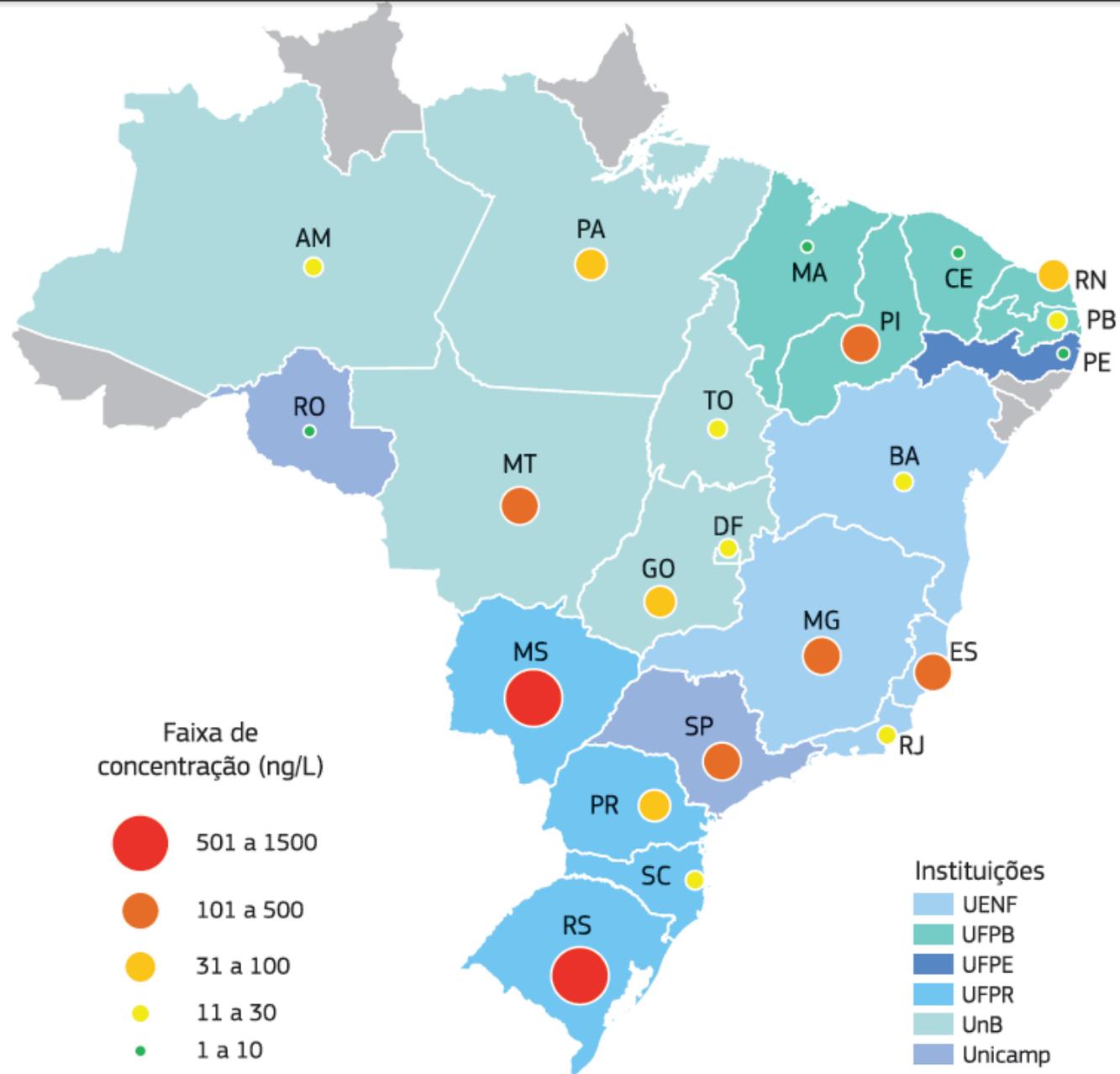
CAFEÍNA



Concentrations (ng L⁻¹) of illicit drugs, pharmaceuticals and personal care products, hormones, industrial compounds and pesticides in surface and drinking water samples collected in São Paulo State between 2006 and 2015. Green represents the concentration above Water Quality Criteria (WQC), red represents the concentrations higher than the WQC and grey the concentrations of compounds without WQC.

Maria Cristina Canela
Wilson F. Jardim
Fernando Fabriz Sodré
Marco Tadeu Grassi
(editores)

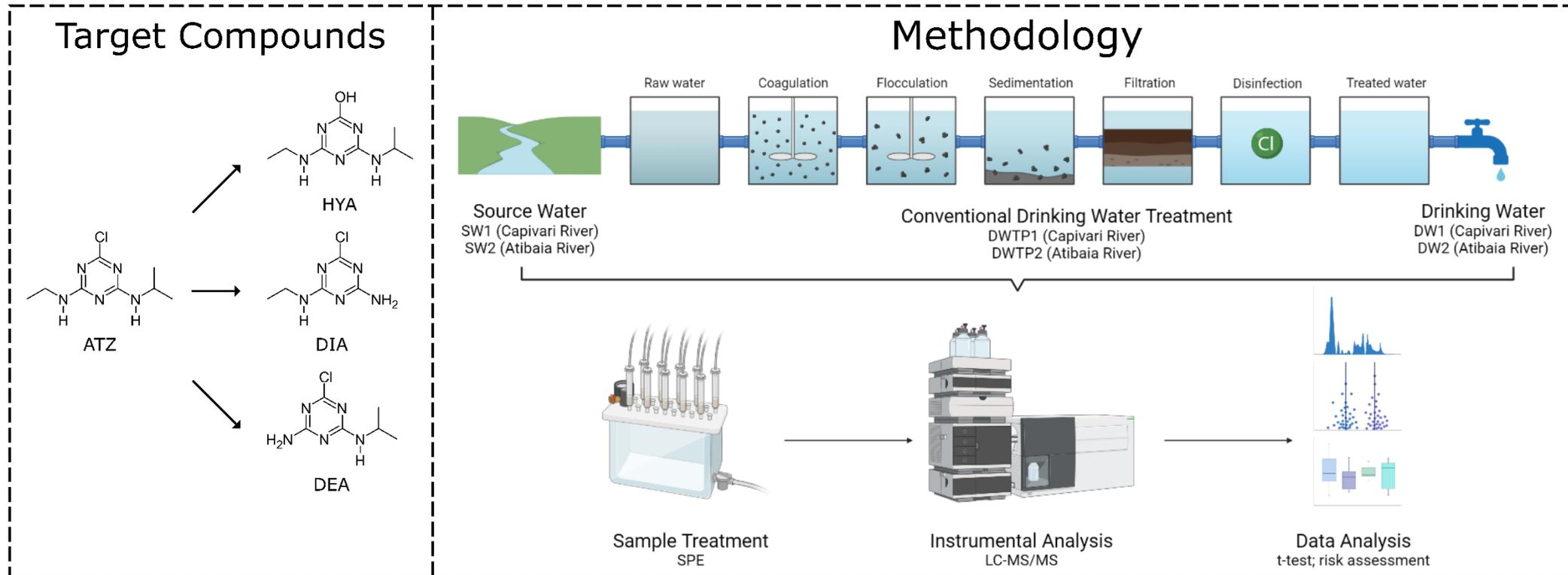
CAFEÍNA EM ÁGUAS DE ABASTECIMENTO PÚBLICO NO BRASIL



ATRAZINA E SUBPRODUTOS EM MANANCIAL E ÁGUA TRATADA

Atrazine and its degradation products in drinking water source and supply: Risk assessment for environmental and human health in Campinas, Brazil

Beatriz DC Vizioli, Giulia Silva da Silva, Jéssyca F. de Medeiros, Cassiana C. Montagner; Chemosphere 336 (2023) 139289; <https://doi.org/10.1016/j.chemosphere.2023.139289>



Giulia S. Silva
PIBIC 2017/2018



Beatriz Vizioli
doutoranda

ATRAZINA E SUBPRODUTOS EM MANANCIAL E ÁGUA TRATADA

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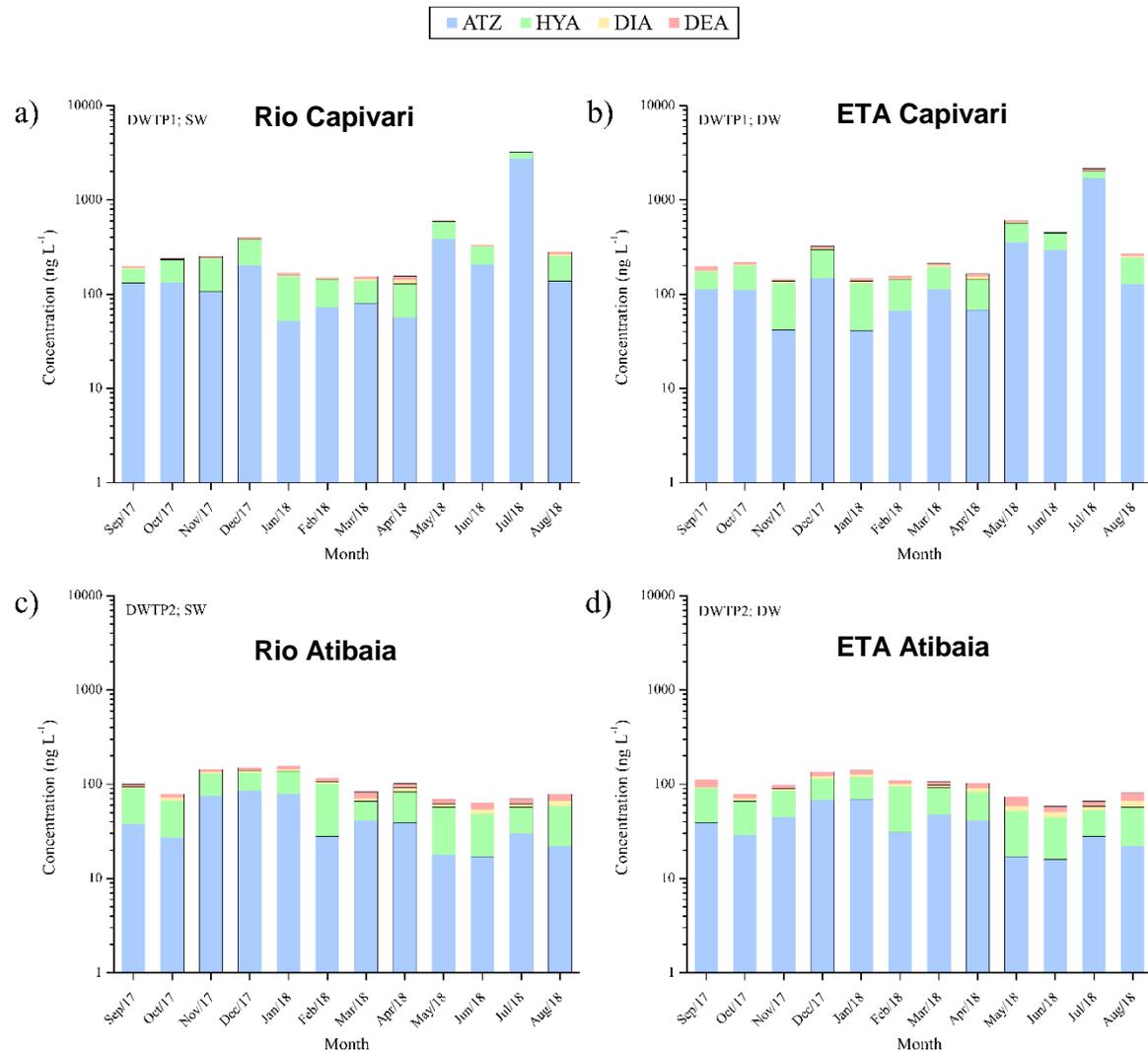


Fig. 1. Monthly concentrations (ng L⁻¹) of ATZ (blue), HYA (green), DIA (yellow), and DEA (red) for:

- DWTP1 in surface water (SW) (Capivari River);
- DWTP1 in drinking water (DW) (Capivari River);
- DWTP2 in surface water (SW) (Atibaia River);
- DWTP2 in drinking water (DW) (Atibaia River).

ATRAZINA E SUBPRODUTOS EM MANANCIAL E ÁGUA TRATADA

Atrazine and its degradation products in drinking water source and supply: Risk assessment for environmental and human health in Campinas, Brazil

Beatriz DC Vizioli, Giulia Silva da Silva, Jéssyca F. de Medeiros, Cassiana C. Montagner; Chemosphere 336 (2023) 139289; <https://doi.org/10.1016/j.chemosphere.2023.139289>



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Beatriz Vizioli
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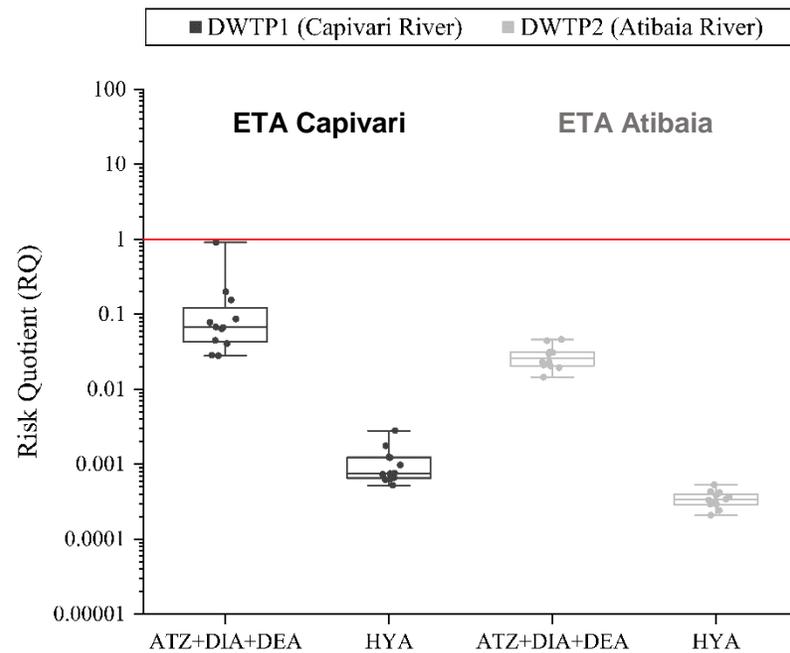


Fig. 2. Human health risk assessment by the Risk Quotient (RQ) approach for the sum of ATZ + DIA + DEA and HYA for DWTP1 (dark gray) and DWTP2 (light gray), according to the **Brazilian drinking water standards**. RQ values > 1 indicate risk (red line).

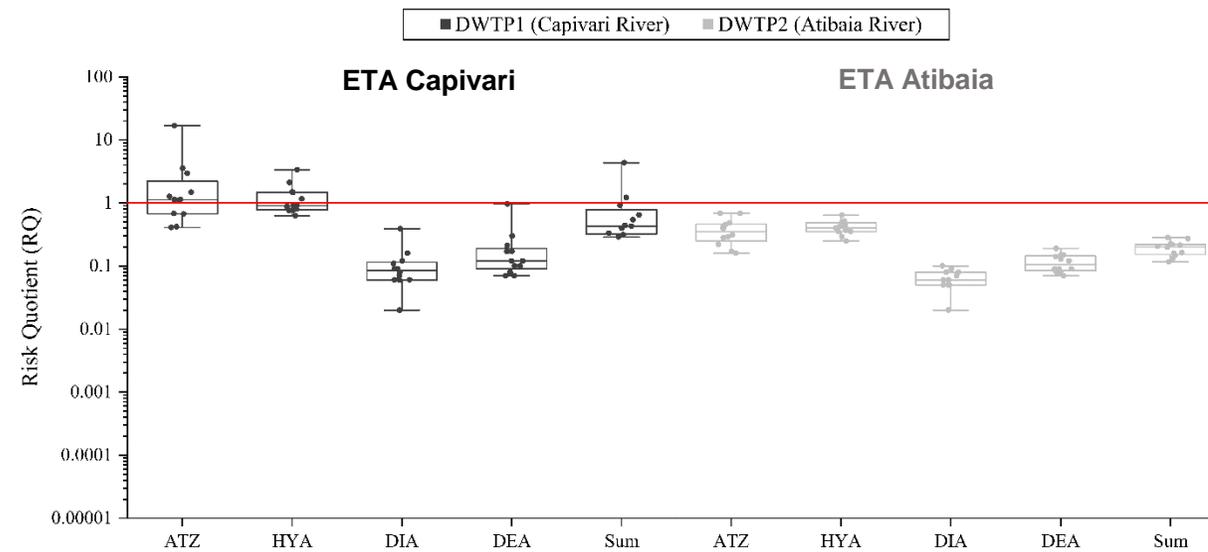
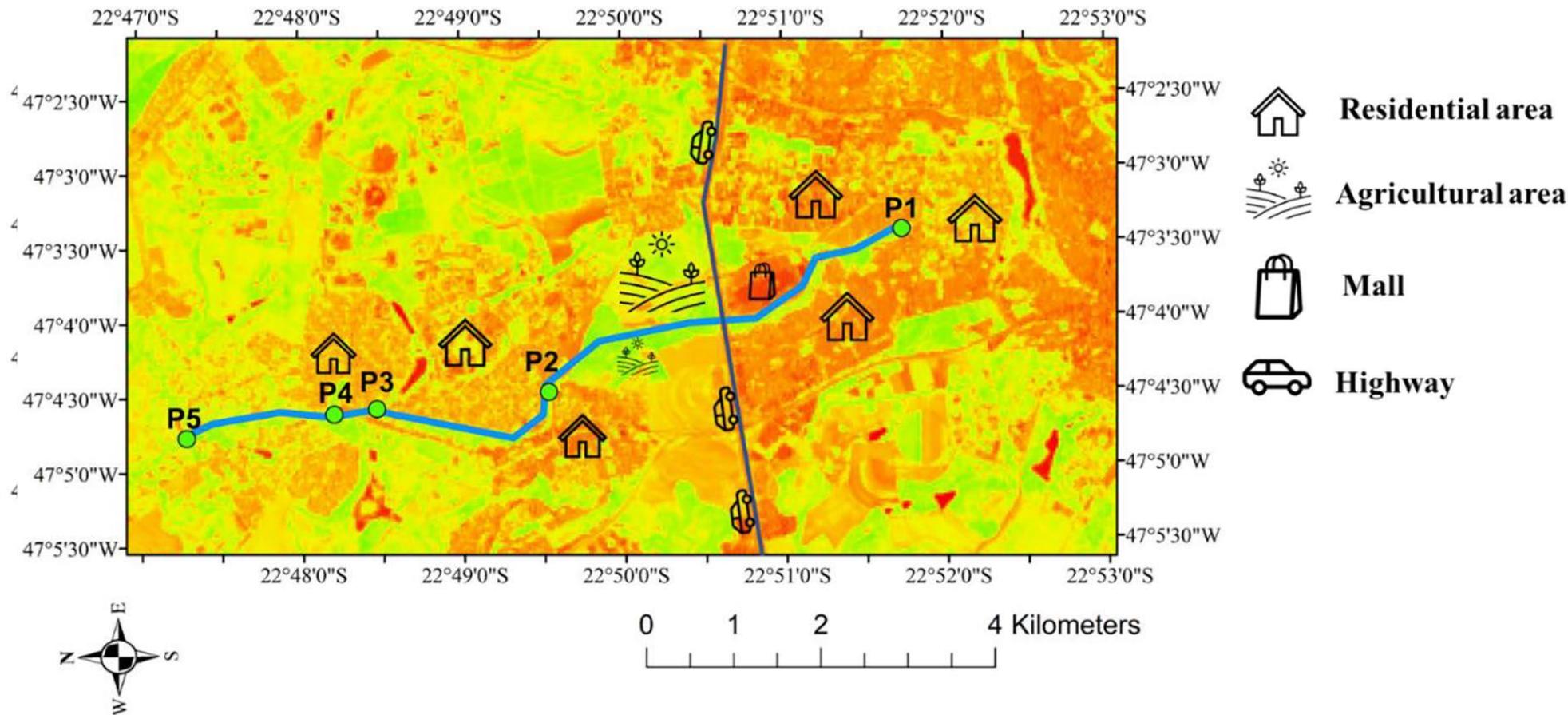


Fig. 3. Human health risk assessment by the Risk Quotient (RQ) approach for ATZ, HYA, DIA, DEA, and Sum for DWTP1 (dark gray) and DWTP2 (light gray), according to the **European Directive**. RQ values > 1 indicate risk (red line).

USO E OCUPAÇÃO DO SOLO

Impact of agricultural runoff and domestic sewage discharge on the spatial-temporal occurrence of emerging contaminants in an urban stream in São Paulo, Brazil
Santos et al.; Environ Monit Assess (2022) 194:637 <https://doi.org/10.1007/s10661-022-10288-1>



Juliana S X Anjos
IC-LQA 2018-2019



Vinicius S Santos
mestrando

USO E OCUPAÇÃO DO SOLO

Impact of agricultural runoff and domestic sewage discharge on the spatial-temporal occurrence of emerging contaminants in an urban stream in São Paulo, Brazil
Santos et al., Environ Monit Assess (2022) 194:637 <https://doi.org/10.1007/s10661-022-10288-1>

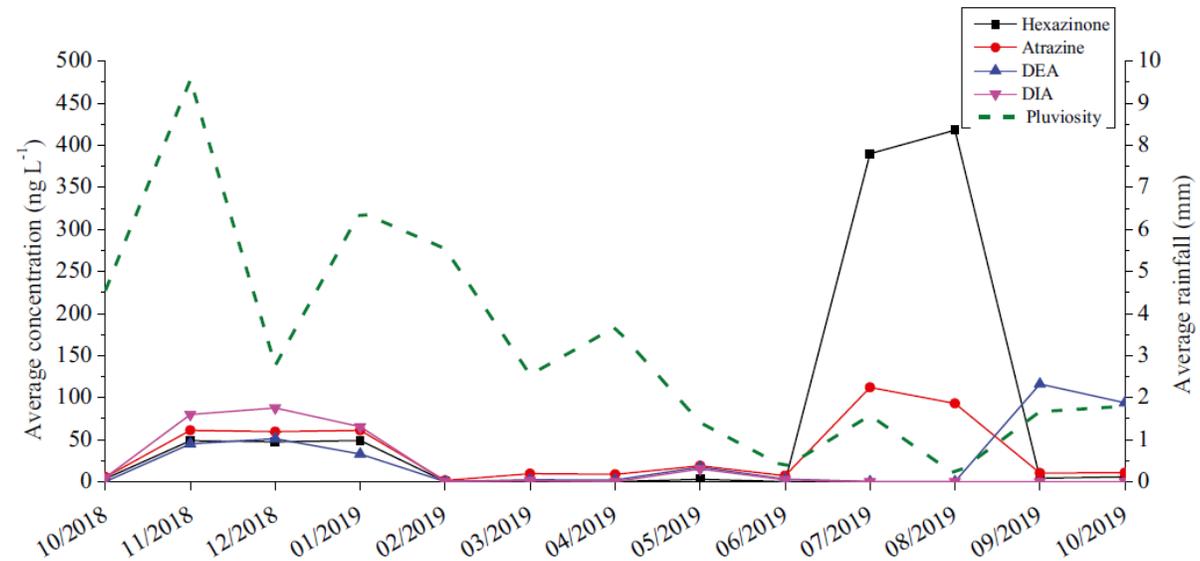
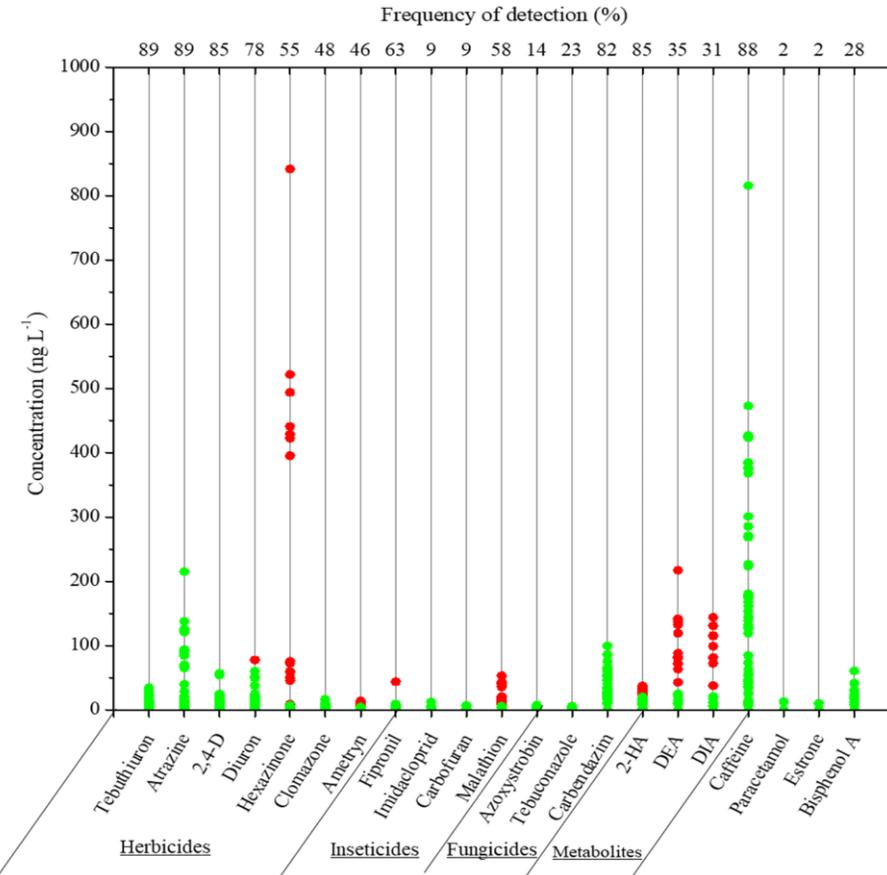


Fig. 5 Monthly average rainfall (mm) and average monthly concentrations (ng L⁻¹) of hexazinone, atrazine, DEA, and DIA



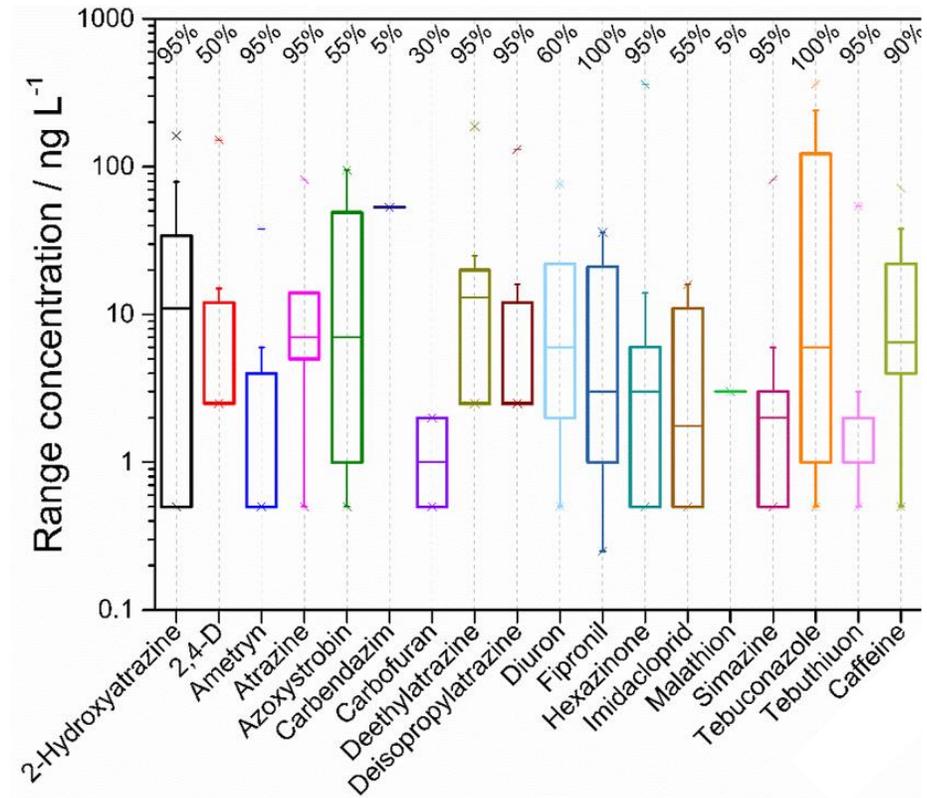
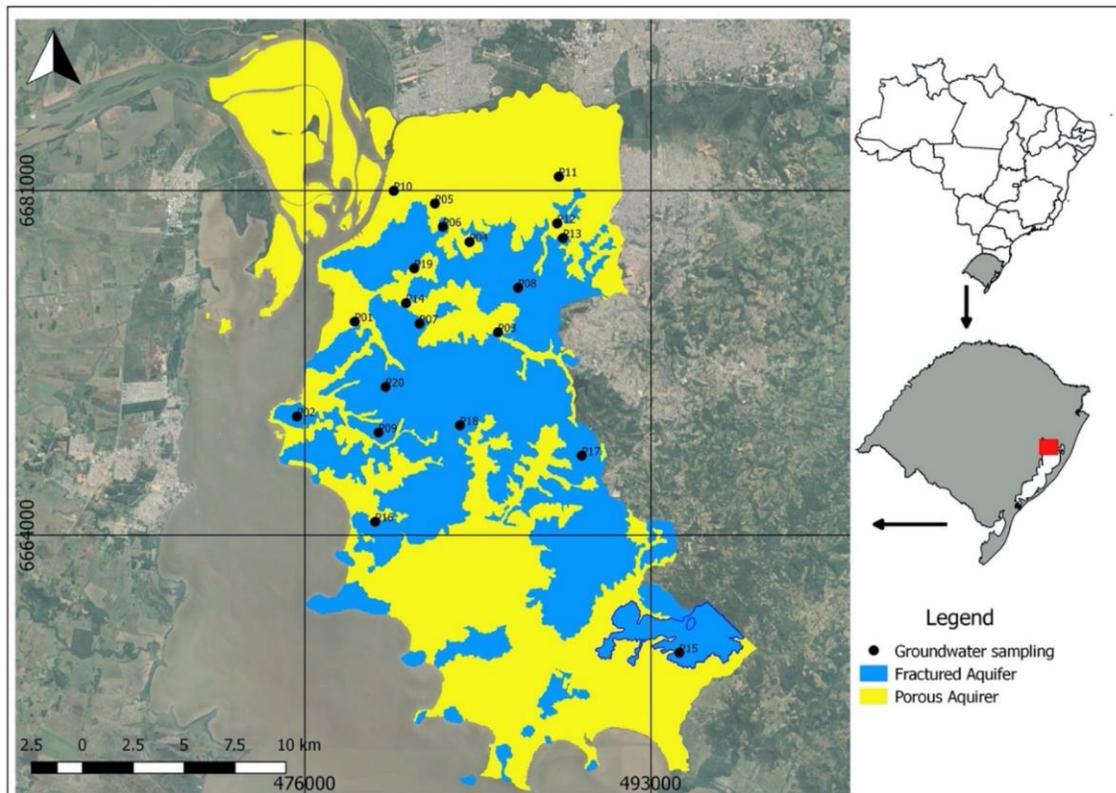
Juliana S X Anjos
IC-LQA 2018-2019



Vinicius S Santos
mestrando

PESTICIDAS E CAFEÍNA EM ÁGUA SUBTERRÂNEA

- ✓ Porto Alegre, RS, Brazil;
- ✓ 23 CEC were determined by LC-MS/MS ;
- ✓ A total of 20 samples were collected in 2 aquifers;



Paulo Stefano
PhD Project

- ✓ The CEC most frequently detected were atrazine and degradation products, fipronil, simazine, tebuconazole, hexazinone, and caffeine in concentrations up to 300 ng L⁻¹.

Unraveling the occurrence of contaminants of emerging concern in groundwater from urban setting: A combined multidisciplinary approach and self-organizing maps

Paulo H. P. Stefano, Ari Roisenberg, Matheus R. Santos, Mariana A. Dias, Cassiana C. Montagner
Chemosphere (2022) 299; 134395; <https://doi.org/10.1016/j.chemosphere.2022.134395>



PESTICIDAS EM ÁGUA SUPERFICIAL E SUBTERRÂNEA

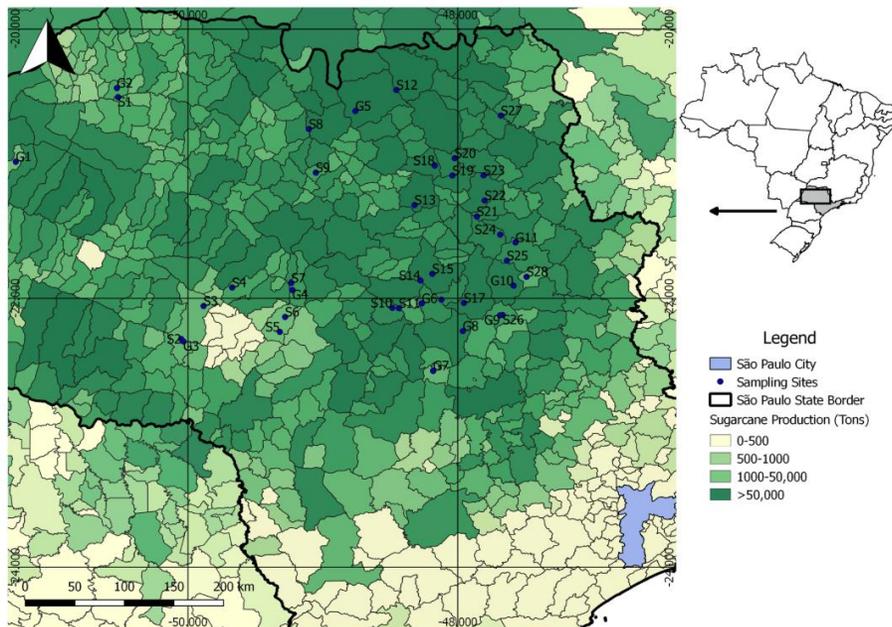
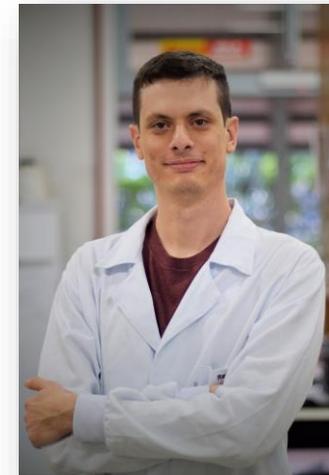
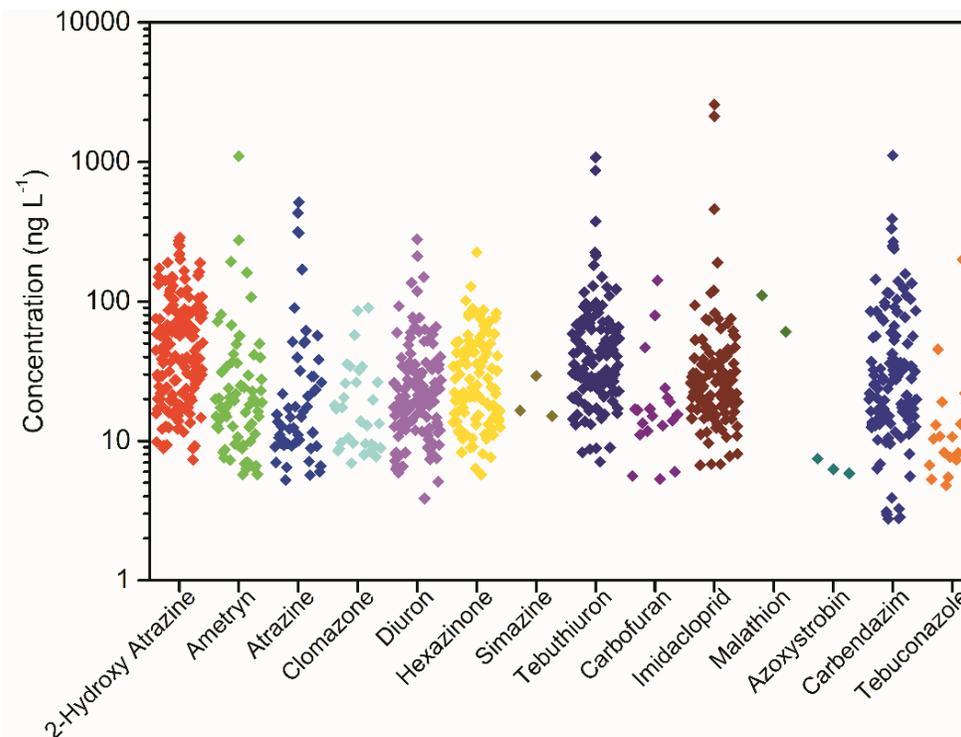


Fig. 1 Sampling sites, denoted as S, for surface water and G, for groundwater in mask for São Paulo state sugar cane production areas



Raphael D. Acayaba
Master project

- ✓ 175 surface water samples from 28 samplings points
- ✓ 21 groundwater samples from 10 sampling points
- ✓ Sampling between 2015/2016
- ✓ Analysis by SPE – LC-MS/MS

- ✓ In surface water, all 14 compounds studied were detected in at least one sample.
- ✓ Diuron, hexazinone, tebuthiuron, 2-OH-ATZ and carbendazim - detection frequencies >90%.



Occurrence of pesticides in waters from the largest sugar cane plantation region in the world

Acayaba RD, Albuquerque AF, Ribessi RL, Umbuzeiro GA, Montagner CC;

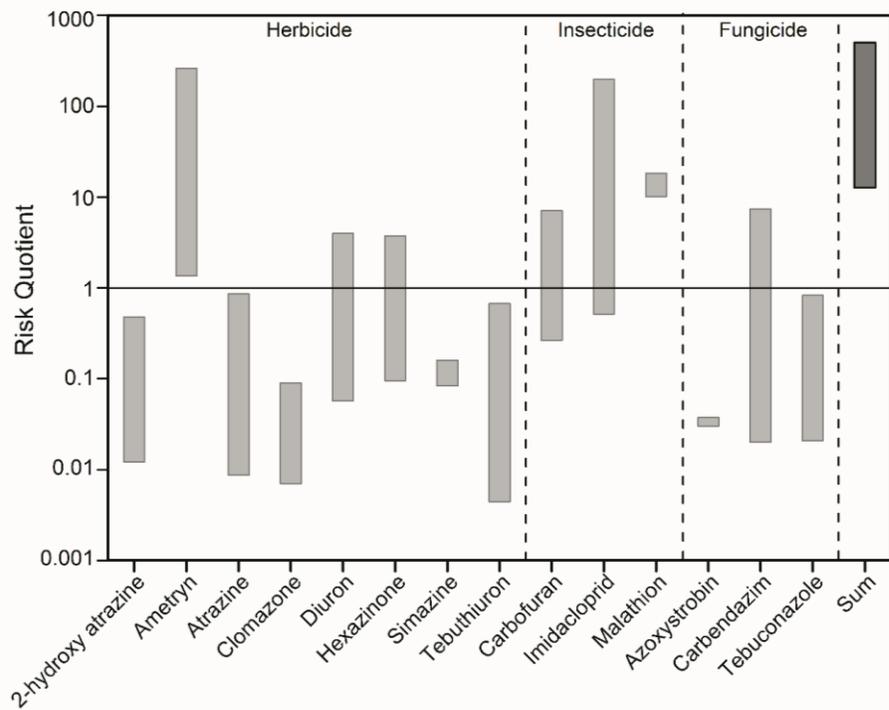
Environmental Science and Pollution Research (2021) 28(8) 9824, <https://doi.org/10.1007/s11356-020-11428-1>

PESTICIDAS EM ÁGUA SUPERFICIAL E SUBTERRÂNEA



Protection of aquatic life

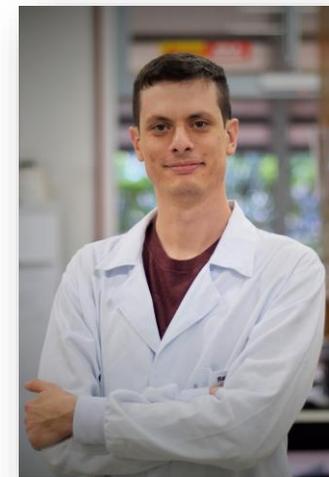
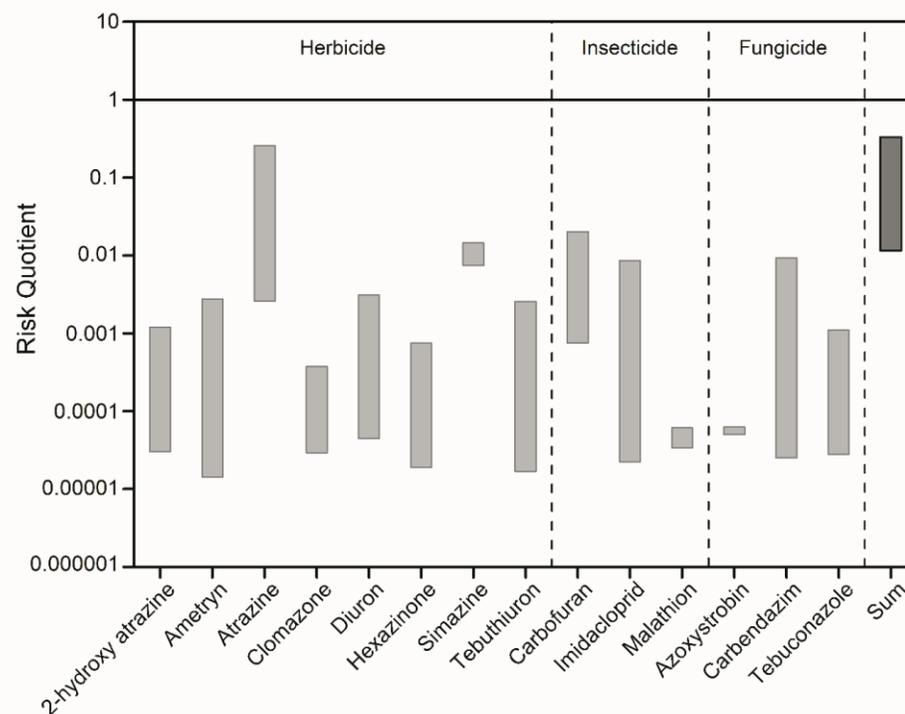
Surface waters: ametryn, diuron, hexazinone, imidacloprid, carbendazim, carbofuran and malathion presented a possible risk to aquatic life.



Human health



Groundwaters: No risk to human consumption was observed for the pesticides analyzed alone or in their mixtures



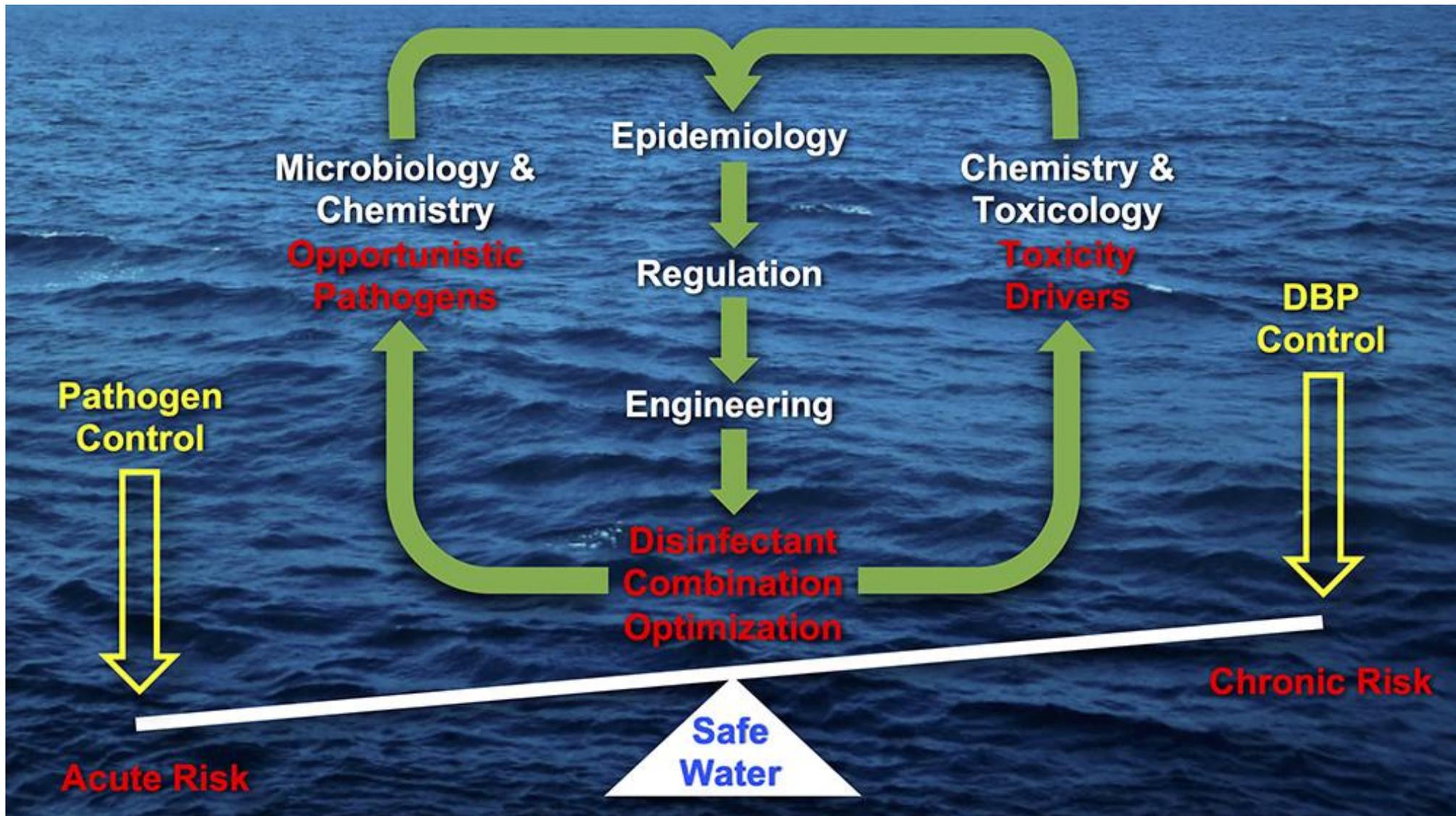
Raphael D. Acayaba
Master project



Occurrence of pesticides in waters from the largest sugar cane plantation region in the world

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Published in: Xing-Fang Li; William A. Mitch; *Environ. Sci. Technol.* **2018**, 52, 1681-1689.

DOI: 10.1021/acs.est.7b05440

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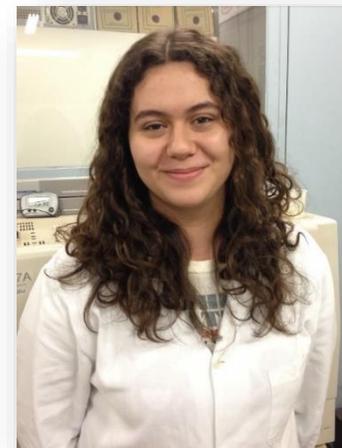


IMPACTO DOS SUBPRODUTOS DO PROCESSO DE DESINFECÇÃO NA QUALIDADE DA ÁGUA TRATADA

Questões regulatórias sobre a desinfecção da água e o impacto da geração de DBPs na qualidade da água tratada

Vizioli BC, Montagner CC;

Química Nova (2023) 28(8) 9824, <http://dx.doi.org/10.21577/0100-4042.20230029>



Beatriz Vizioli
doutoranda

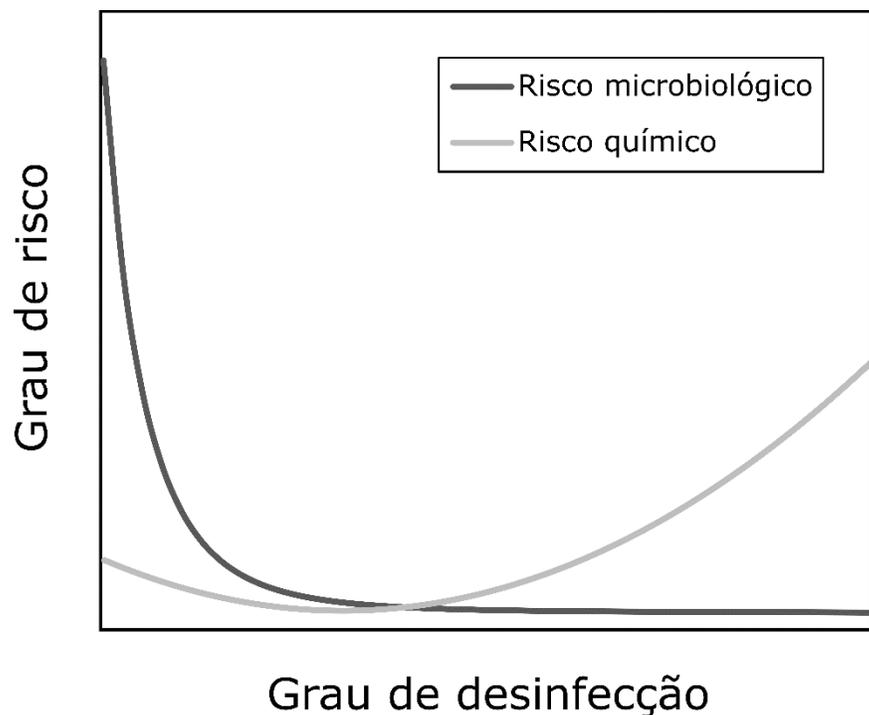


Figura 1. Relação entre nível de desinfecção e riscos associados.
Cinza escuro: risco microbiológico; cinza claro: risco químico

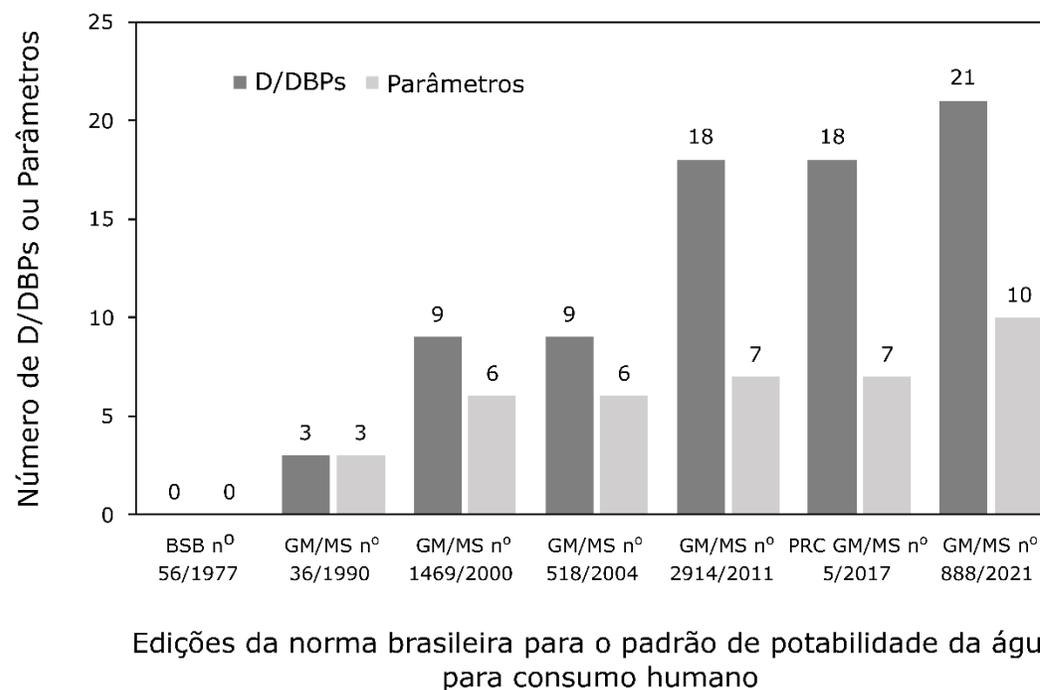


Figura 2. Evolução do padrão de potabilidade da água para consumo humano ao longo das edições da norma brasileira. Cinza escuro: número de D/DBPs contemplados na portaria; cinza claro: número de parâmetros previstos na portaria



OCORRÊNCIA DE NITROSAMINAS EM ÁGUA DE ABASTECIMENTO PÚBLICO

Drinking water nitrosamines in a large metropolitan region in Brazil

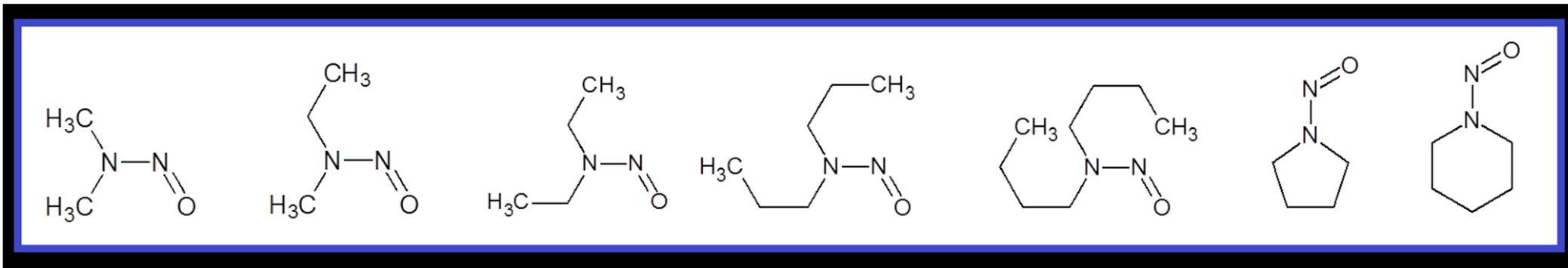
Vizioli BC, Hantao LW, Montagner CC;

Environmental Science and Pollution Research (2021) 28:32823–32830, DOI: 10.1007/s11356-021-12998-4

- **POSSUI CARATER CARCINOGENICO**
- **Subproduto do tratamento de água por cloração**
- **USEPA 10 ng/L na água tratada**
- **EU 40 ng/L na água tratada**
- **MS 888 100 ng/L na água tratada com cloramina**
- **USEPA 521 define 7 nitrosaminas como principais contaminantes emergentes de acordo com risco e incidência**



Beatriz Vizioli
Master Project



N-Nitrosodimetilamina

N-Nitrosometiletilamina

N-Nitrosodietilamina

N-Nitrosodipropilamina

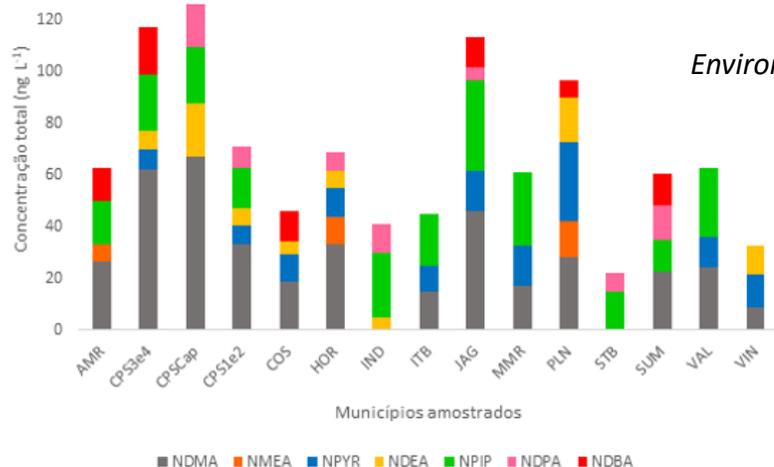
N-Nitrosodibutilamina

N-Nitrosopirrolidina

N-Nitrosopiperidina



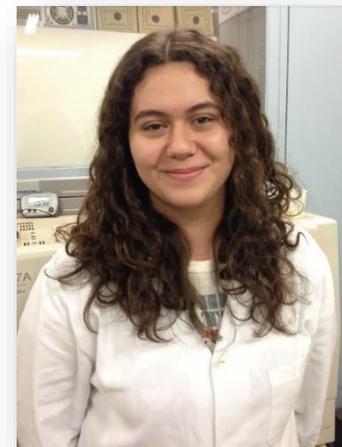
ESTUDO DE CASO – REGIÃO METROPOLITANA DE CAMPINAS (SP)



Drinking water nitrosamines in a large metropolitan region in Brazil
 Vizioli BC, Hantao LW, Montagner CC;
Environmental Science and Pollution Research (2021) 28:32823–32830, DOI: 10.1007/s11356-021-12998-4

Coleta em 13 municípios da RMC

- Cidades mais representativas e populosas
- Campinas amostrada em 3 regiões
- Água coletada de torneiras residenciais



Beatriz Vizioli
Master Project

Figura 28. Concentrações totais de nitrosaminas por município amostrado.

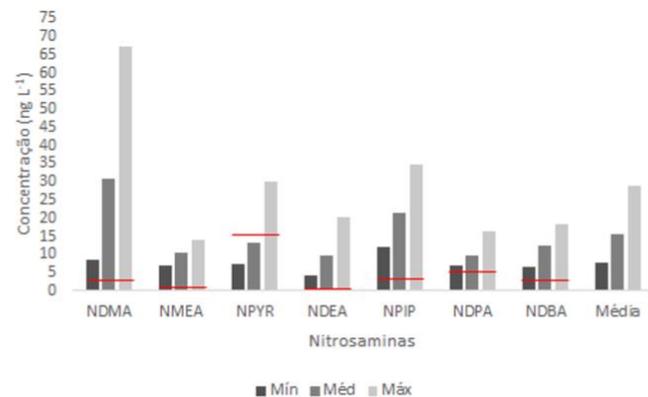
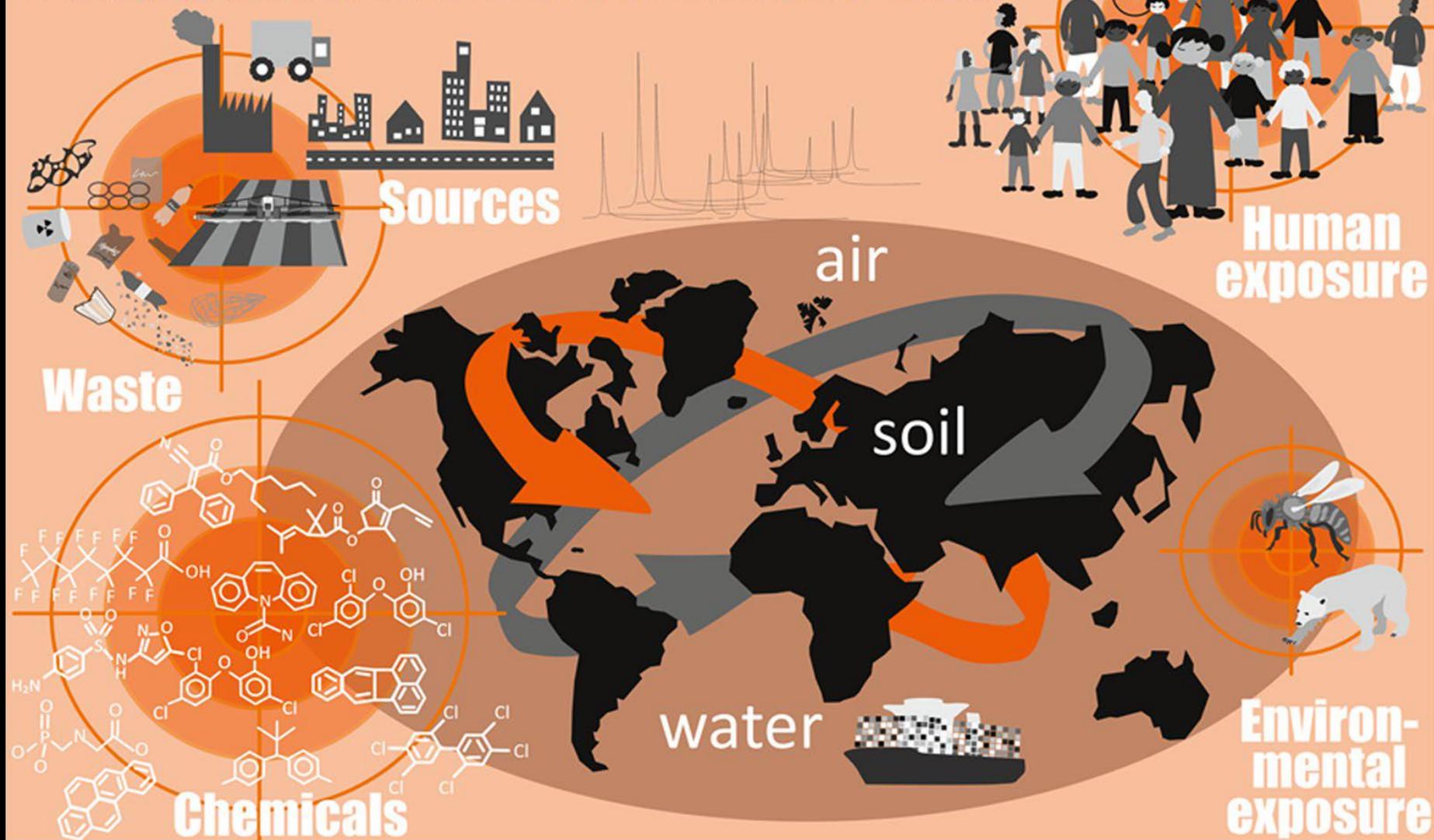


Figura 29. Concentrações mínima, média e máxima para cada nitrosamina. Valores de 10^{-6} Risk Level (California Water Boards) em vermelho.



One planet - one health

Global assessment of chemicals and waste



OBRIGADA PELA ATENÇÃO!

Cassiana C. Montagner

ccmonta@unicamp.br

 [@CassianaMontag1](https://twitter.com/CassianaMontag1)

<http://lqa.iqm.unicamp.br>

 [@lqa_iq_unicamp](https://www.instagram.com/lqa_iq_unicamp)

Agradecimento especial à Câmara Técnica de Saúde Ambiental (CT-SAM) dos Comitês PCJ pelo convite para participar desta mesa de discussões.

LQA Team, 2022-2023

