Evaluation of heavy metals, pesticides and emergent pollutants content in the Tula river, Mexico.

Eva C. Serrano Balderas, Corinne Grac, Laure Berti-Equille, Ma. Aurora Armienta Hernandez, J.-C. Desconnets

IRD, Institut de Recherche pour le Développement, Espace DEV
Institut of Geophysics, National Autonomous University of Mexico, UNAM
ENGEES, Ecole National de Génie de l'Eau et de l'Environnement de Strasbourg

SEFS10, 2.7 – 7.7, Olomouc CZ

Alarming data related to water pollution

- **Human health risk :** ~ 2.2 millions deaths / year (WHO, 2016)

- **Impacts on biodiversity :**

  - ➤ > 20 % of species of invertebrates are endangered
                                                    (Vörösmarty *et al.,* 2010)
  - ➤ ~32 % of species of amphibians are threatened with extinction   (Dudgeon *et al.,* 2006)
  - ➤ Increasing extinction of species of amphibians
                                    (Groombridge and Jenkins, 2000)

       **Importance of continuous monitoring
       of the quality of water**

Water pollution problems in Mexico

- **Urban wastes**

- Discharge of urban waste into rivers
  - Hormones
  - Pharmaceutical products

- **Mining activities**

- Pollution by mining activities
 - Heavy metals

- **Agricultural activities**

- Not or very little control in the use of pesticides

Objectives

- Quantify the content of heavy metals, pesticides and emergent pollutants in the water of the Tula river

- Identify principal sources of emergent pollutants

- Highlight the usefulness of biomonitoring metrics on the assessment of water quality of Mexican rivers

Monitoring water quality of the Tula river, Mexico
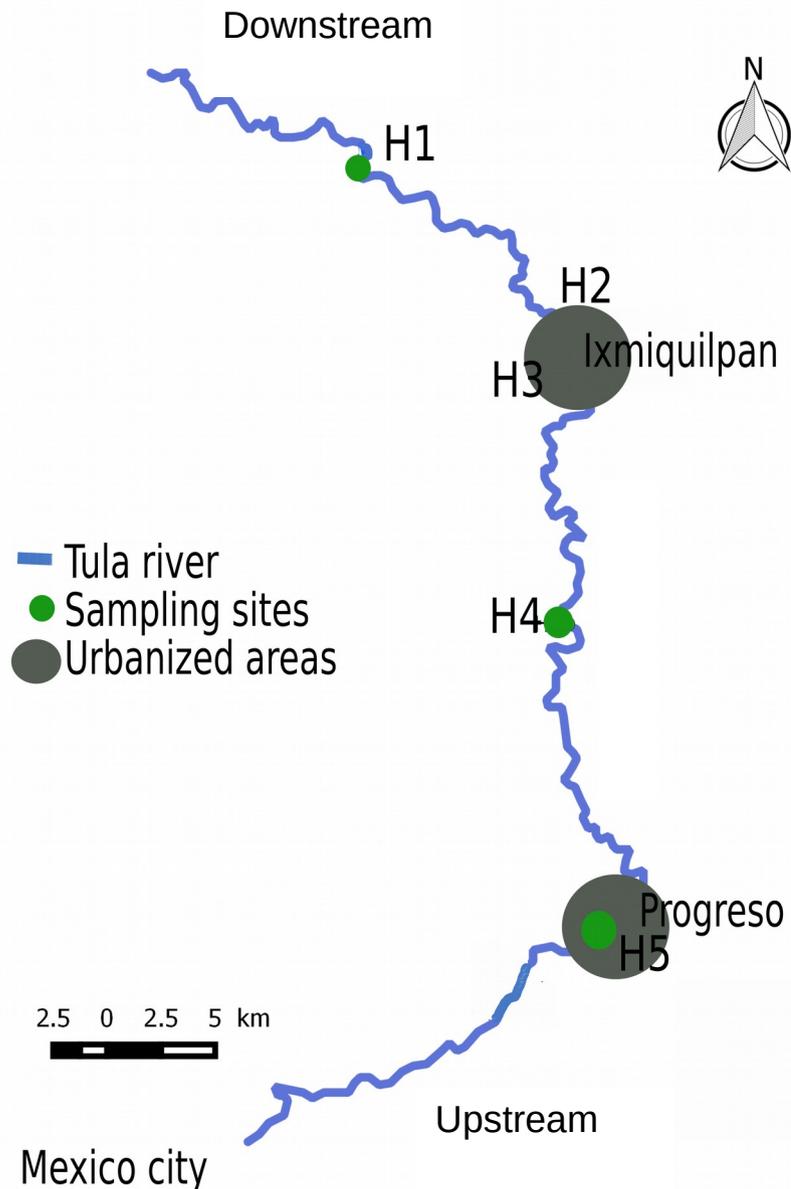
- 5 sampling sites
- 2 seasons (dry & rainy)

Location: Hidalgo state at the center of Mexico. It crosses the Veracruz state to finally reach the sea in Golf of Mexico.

River collects residuals from :
→ Agricultural activities
→ Untreated waste-water from Mexico city and nearby municipalities
→ Industrial and Domestic wastes

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Analytical methods
Chemistry

- 18 organochloride pesticides

  Solid Phase Extraction (SPE)

  Gaz Chromatography with Electron Capture Detection (GC-ECD)

- 5 Pharmaceutical and Personal Care products (PPCPs)

  Micro-Solid Phase Extraction (mSPE)

  Gaz Chromatography with Mass Spectrometer (GC-MS)

- 7 Heavy metals

  Atomic Absorption Spectroscopy (AAS)

Analytical methods

Hydrobiology

- Novel approach through the use of aquatic macroinvertebrates
- Use of 35 biomonitoring metrics (Serrano Balderas et al., 2016)

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Review

Potential application of macroinvertebrates indices in bioassessment of Mexican streams

Eva Carmina Serrano Balderas[a,b,*], Corinne Grac[c], Laure Berti-Equille[a,d], Ma. Aurora Armienta Hernandez[b]

● Macroinvertebrates samples

Count of macroinvertebrates   **+**   Identification of species

Coenagrionidae   Velidae   Corixidae

Physidae   Pyralidae

Two different habitats

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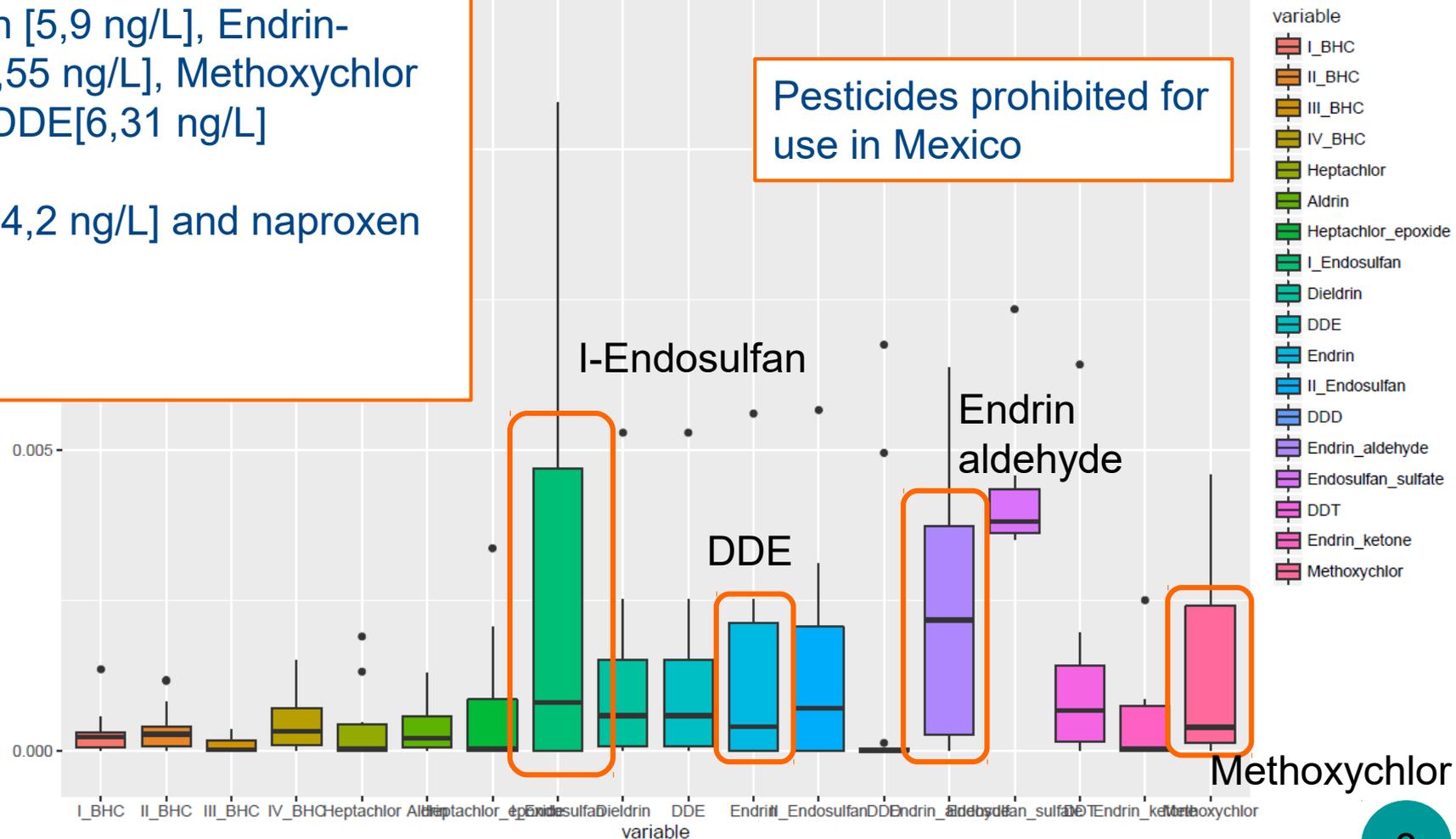
Pollutants above the permitted concentration limits

- Physico-chemical *
  - All except cadmium [0,01 mg/L] and pH [7,7]
- Pesticides with highest concentration *
  - I-Endosulfan [5,9 ng/L], Endrin-aldehyde [0,55 ng/L], Methoxychlor [120 ng/L], DDE[6,31 ng/L]
- PPCP's *
  - Ibuprofen [94,2 ng/L] and naproxen [263,7 ng/L]

Example of distribution of the 18 organochloride pesticides.

Pesticides prohibited for use in Mexico

I-Endosulfan

DDE

Endrin aldehyde

Methoxychlor

variable
- I_BHC
- II_BHC
- III_BHC
- IV_BHC
- Heptachlor
- Aldrin
- Heptachlor_epoxide
- I_Endosulfan
- Dieldrin
- DDE
- Endrin
- II_Endosulfan
- DDD
- Endrin_aldehyde
- Endosulfan_sulfate
- DDT
- Endrin_ketone
- Methoxychlor

* Average concentration on samples

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Correlation between physico-chemical variables and biological metrics

24/35 (69 %) metrics with correlation

Physico-chemical variables

16 biological metrics with negative correlation

8 biological metrics with positive correlation

Not a remarkable behavior with respect to heavy metals

Physico-chemical degradation

Correlation between emergent pollutants (pesticides and PPCP's) and biological metrics

18/35 (51 %) metrics with correlations.

Emergent pollutants

10 biological metrics with negative correlation

8 biological metrics with positive correlation

Degradation

10
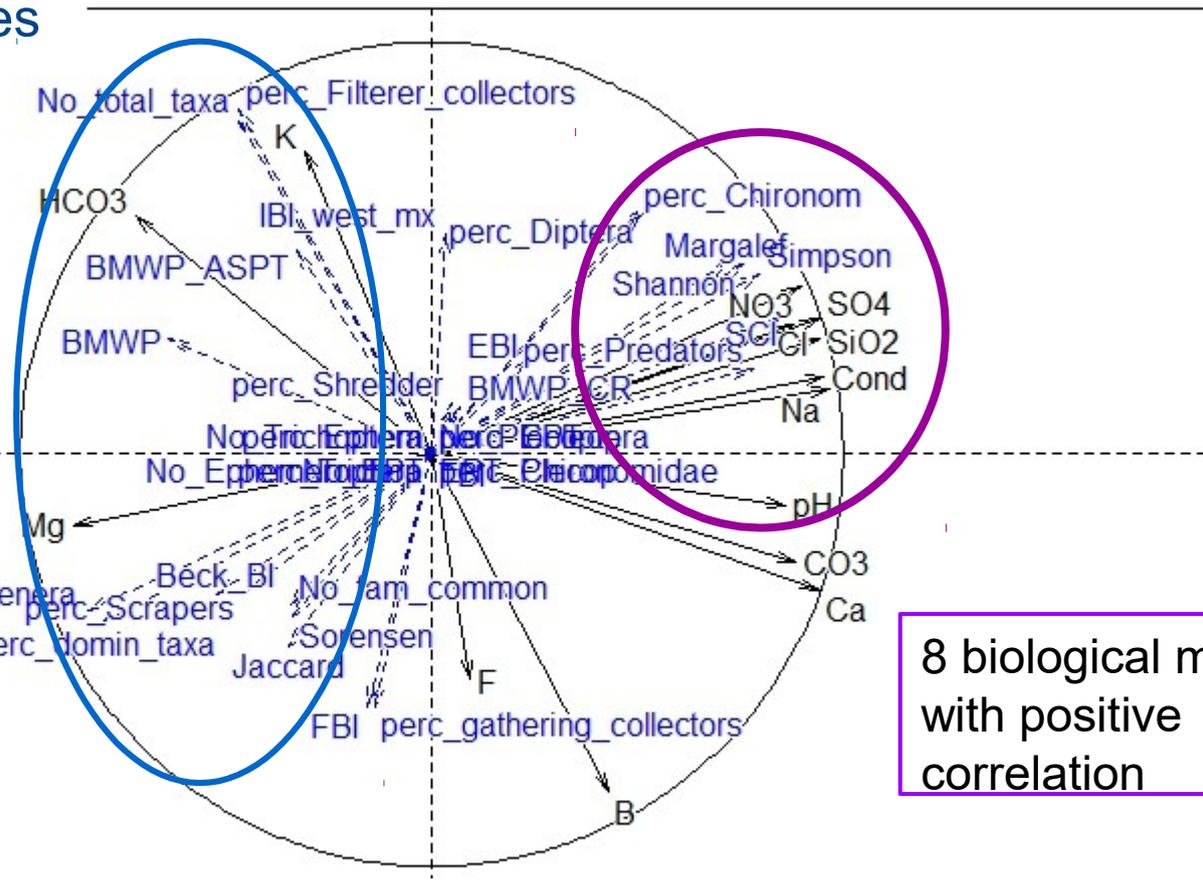
Degree of pollution by physico-chemical parameters

➡ Highly polluted and polluted sites

Sampling sites classed into two groups

Polluted sites

Highly polluted sites
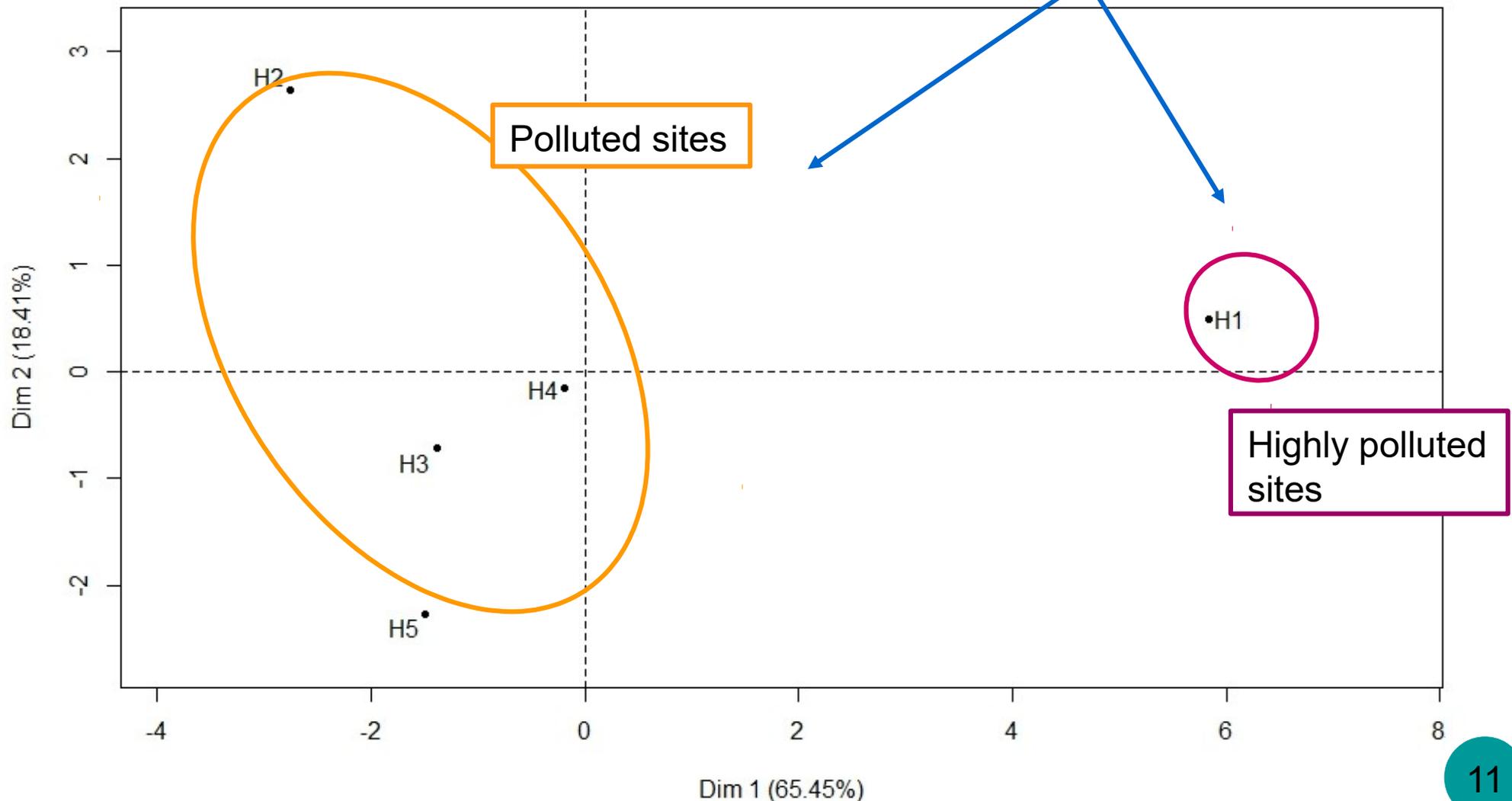
Degree of pollution by physico-chemical parameters

➡ Sites situated nearby urbanized areas and agricultural crops. Results suggest pollution due to anthropogenic activities

Polluted sites
H2
H3
H4
H5

Highly polluted site : H1

Urbanized areas

Mexico city

Source : «Tula »20°03'07,96"N 99°20'39,30"O. **Google Earth.** August 5, 2016.

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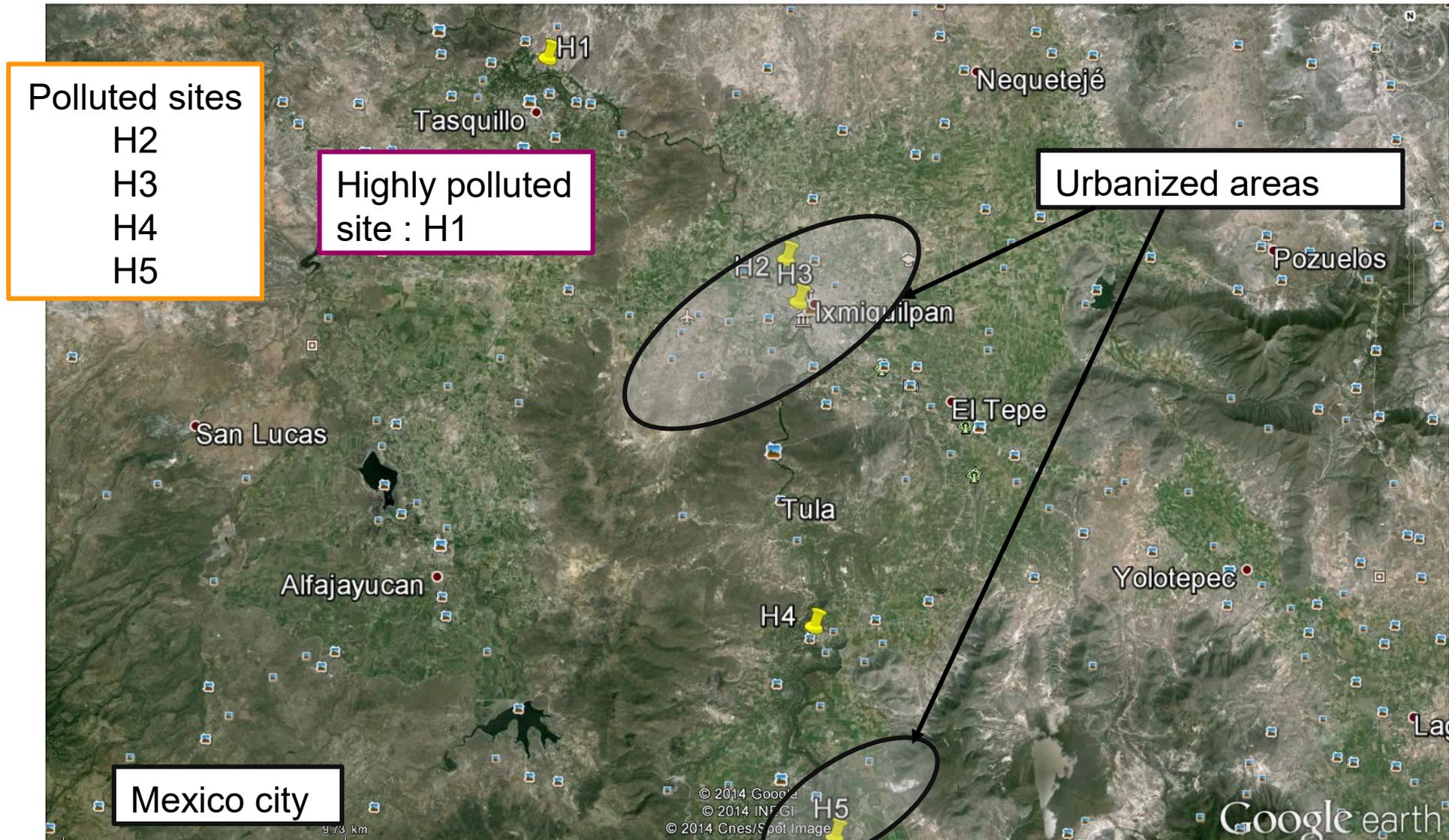
Conclusions

- Concentration levels of physico-chemical parameters indicates a high level of pollution on the Tula river

- Pesticides I-Endosulfan, Endrin aldehyde and Metoxychlor, and the PPCP's Ibuprofen and Naproxen showed high concentration values

- Presence of pollutants is due mainly to direct discharge of untreated waste-waters and runoff of pesticides.

- Biomonitoring metrics showed to be useful complementary tools for the physico-chemical water quality assessment of the Tula river.

Thank you for your attention