

*Emerging Pollutants: Protecting Water Quality for the Health of People and the Environment* 

# Understanding the Prevalence and Occurrence of Antimicrobial Resistance in Urban Karst Groundwater Systems

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## 17 January 2023 at 17:05 CET

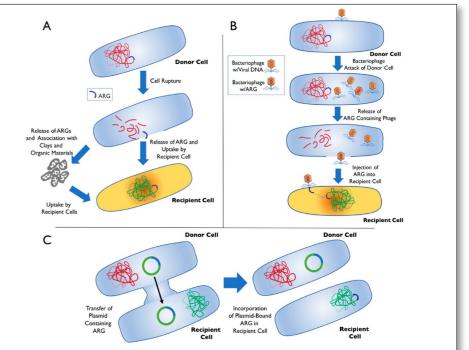






#### Introduction

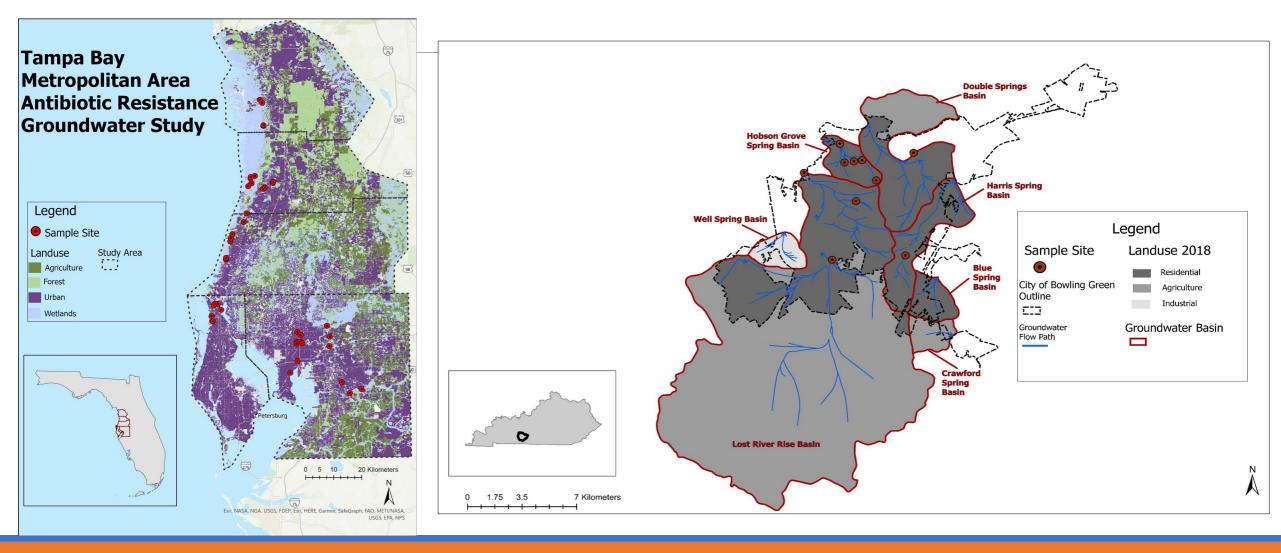
- •Antimicrobial resistance is a global crisis significantly impacting human health
  - 700,000 annual deaths and \$100 trillion in productivity losses globally
- •Water resources are considered the primary environmental reservoir and dissemination pathway
- •Groundwater is a global reservoir for antimicrobial resistance
- •Karst groundwater supplies 1.18 billion people (16.5% of the global population) with drinking water
- •Understanding the occurrence and dissemination of antimicrobial resistance in urban karst groundwater systems



Mechanisms of horizontal gene transfer (HGT). (A) Transformation, (B) Transduction, and (C) Conjugation. Transformation is possible when cells are injured and release DNA. This extracellular DNA can be taken up by a competent recipient cell. In some cases, extracellular DNA associates with and is protected by clay or environmental macromolecules prior to uptake. Transduction involves a bacteriophage intermediary that mistakenly acquires bacterial DNA following cell lysis. If this DNA encodes for antibacterial resistance and is injected into a recipient cell it can combine with recipient cell DNA. Conjugation requires bacterium-bacterium conjugation. During conjugation, a plasmid (shown) or another mobile genetic element that encodes for resistance is transferred between cells.

### Study Area







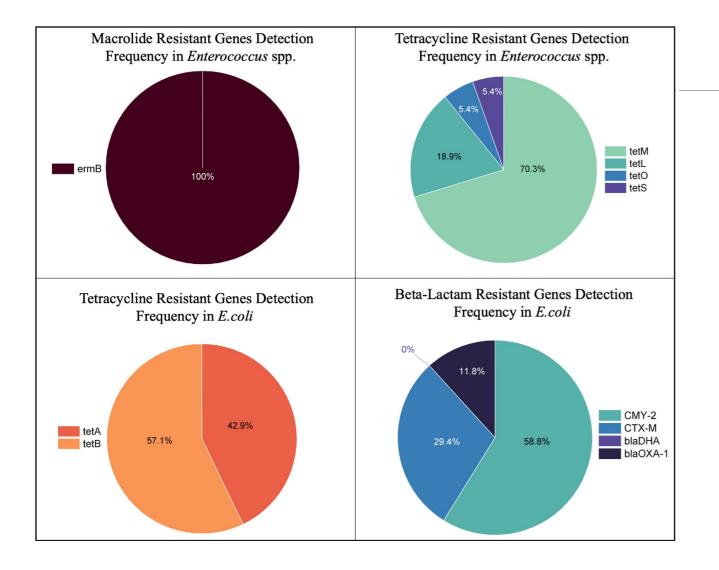


#### **Kentucky Study Area**

- Ubiquitous presence of antibioticresistant *Enterococcus* spp. and *E. coli* indicator bacteria
- ARGs detected here are primarily associated with urban practices and clinically relevant antibiotic classes

## Findings



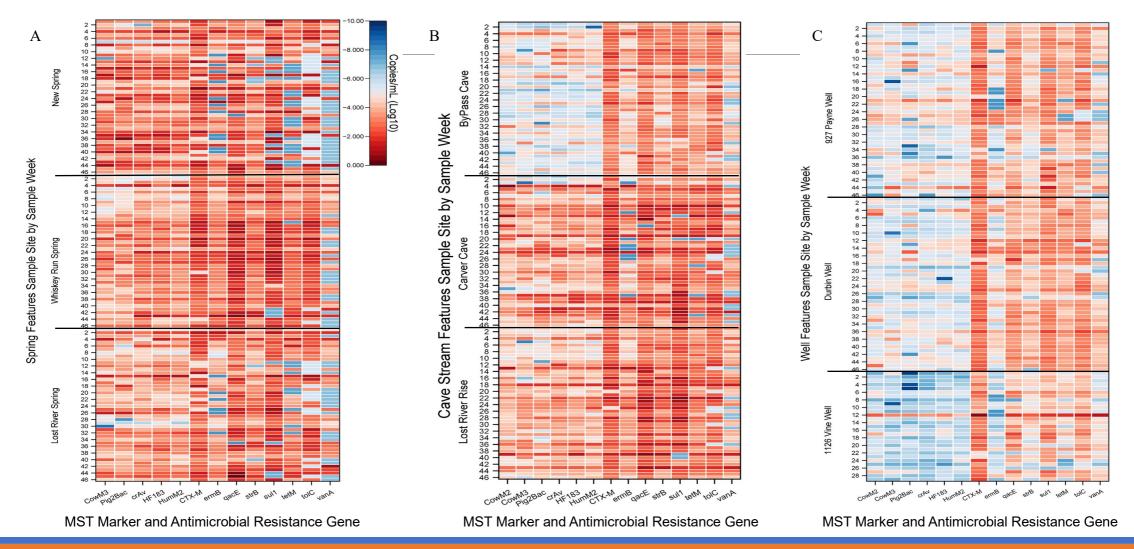


#### Florida Study Area

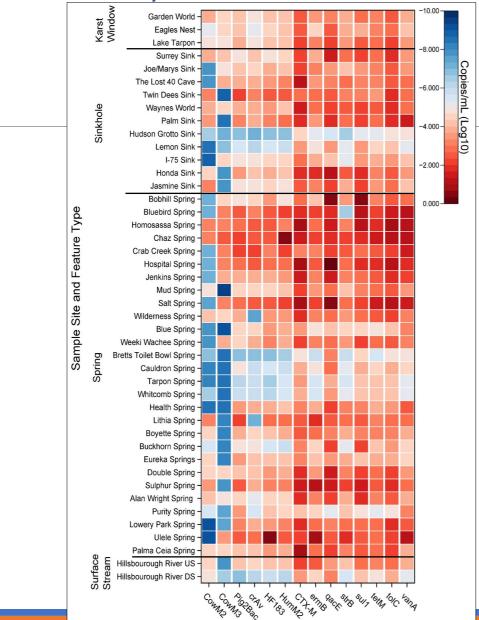
- Similar to Kentucky findings
- ARB are spread throughout the urban karst aquifer
- Regardless of mixed landuse, the urban associated genes exhibit a consistent prevalence



## Kentucky Study Area



## Florida Study Area



MST Marker and Antimicrobial Resistance Gene



- A prominent occurrence of human MST markers
- Highlighting the urban influence on this system regardless of mixed landuse within recharge basins
- Spring and cave stream features present higher percentage of occurrence regardless of landuse
  - Indicating a constant input of human waste



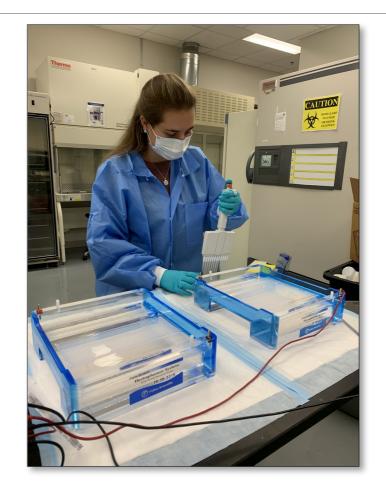
#### Findings

Antimicrobial resistance is disseminated throughout urban karst aquifers, threatening human health

The consistent occurrence of ARB and ARGs, despite seasonality, could be a result of the buffered groundwater environment

Karst feature type and temporal parameters are driving AMR development

There is a need to monitor and regulate resistance within urban karst groundwater





#### Questions

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