KCZ
Working Group 6

Ecosystem services (climate change, land use change, hydrology)

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How do carbonate landscapes affect how society interacts with the critical zone?

- Across CZ research and the geosciences more broadly, we lack an overarching framework for CZ-society interactions.

- Needs/next steps: Develop a (preliminary but comprehensive!) catalogue of social-technological-environmental relations surrounding CZ and identify those most sensitive to carbonate mineralogy
  - Examples: sinkhole risk management, water extraction and treatment, mollusk conservation, maple farming, distribution of agriculture and urban development, flood control, recreation, cultural artifacts

- Adapt existing frameworks (ecosystem services, vulnerability and resilience) to emphasize geophysical structure and processes

- Where and when does decision-making account for or overlook CZ variation?
  - Examining this question for carbonate CZs might inform CZ research across geologies.

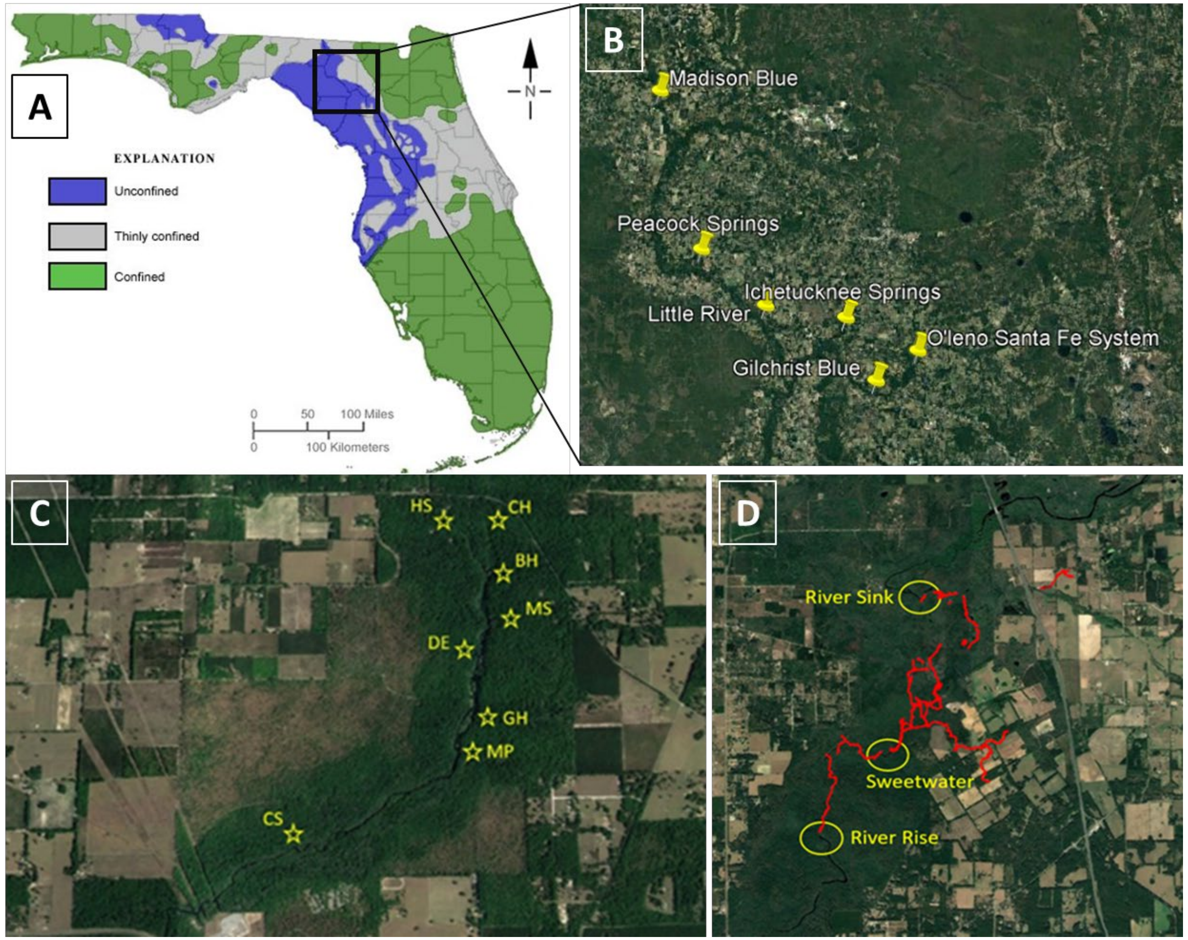
What is the magnitude of greenhouse gas (N_2O, CH_4) emissions from carbonate landscapes?

Rationale: GHG emissions (CO_2, CH_4, N_2O) are sensitive to physical and chemical conditions of soil (moisture regimes, pH, OM content). Carbonate minerals may shape land management and its effects on these properties. Little is known about GHG emissions from karst terrain (esp. springs).

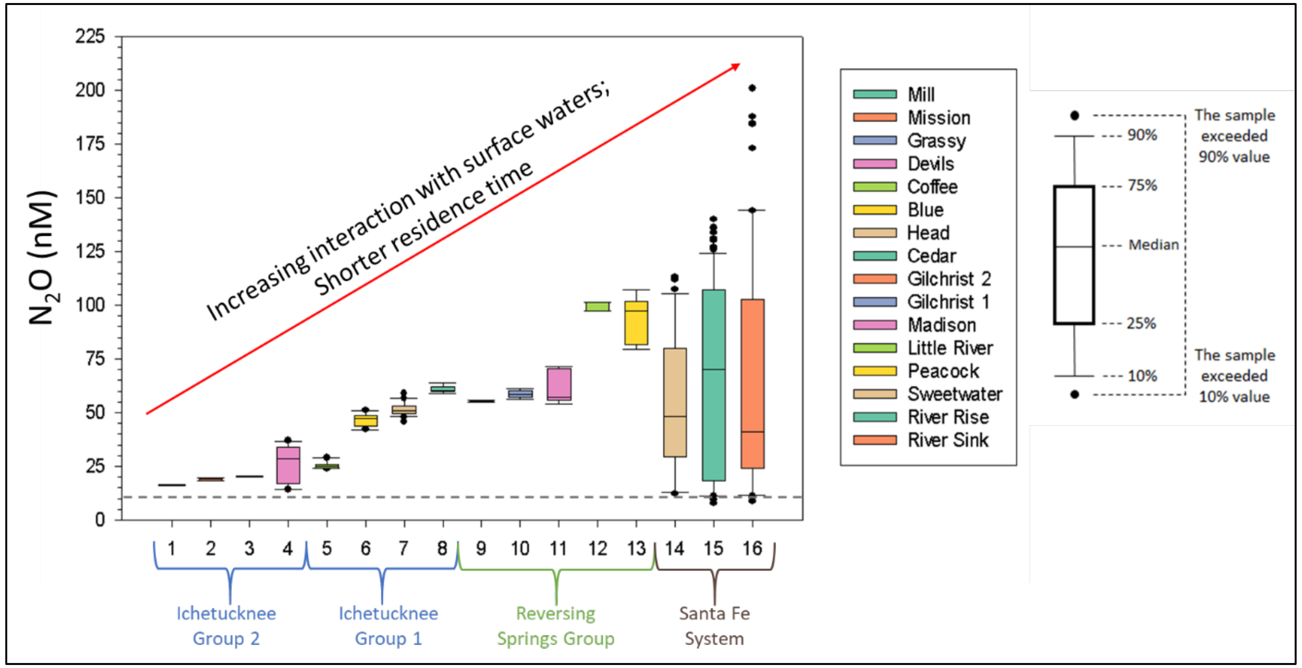
- How do these dynamics and emissions compare to those within and from siliciclastic systems?
- How do these dynamics and emissions vary in different carbonate settings:
  - Aquatic vs. soil?
  - Groundwater vs. surface water contributions?

- Potent greenhouse gases: N_2O and CH_4 100-year global warming potentials approximately 265 and 28 times that of CO_2, respectively; Atmospheric concentrations on the rise
- Ecosystem services: leaching and runoff of reactive N species from fertilizer and livestock waste may fuel N_2O production

- Atmospheric equilibrated water ~ 11nM N_2O (332 ppb)
- 13 springs discharging from the UFA sampled; all are a source of N_2O to the atmosphere



- Saturation levels range from 71 to 1,249 %
- Santa Fe River Rise (O'leno State Park) falls slightly below atm. equilibration during peak discharge
- Highest [N_2O] observed in river water at Santa Fe River Sink (1,738% saturation) - hyporheic or surface water production?



- Head space extraction method; N_2O concentrations calculated according to [Weiss and Price, 1980]

Do CZ differences contribute to inequitable provision of environmental goods?

Do aspects of social geography reflect underlying critical zone structure and processes?

Across CZ research and the geosciences more broadly, we lack an overarching framework for CZ-society interactions.

Rationale: CZ mineralogy and structure affect its function and value (e.g., reliable water supply, fertile soils). Disempowered communities may be pushed toward landscapes where CZ structure provides limited environmental goods (e.g., badlands reservations) or that facilitate depletion (e.g., karst springs in SW Florida).

Needs: Re-assessment of canonical environmental justice issues through a CZ lens, and creation of new case studies. <u>Actual social scientists to help shape CZ questions and approaches</u>

Exploratory geospatial studies of links between social and cultural geography and CZ characteristics (including mineralogy) – (ongoing led by Cory BlackEagle)