# Methane Flow to the Atmosphere from South Carolina Wetlands

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## Abstract

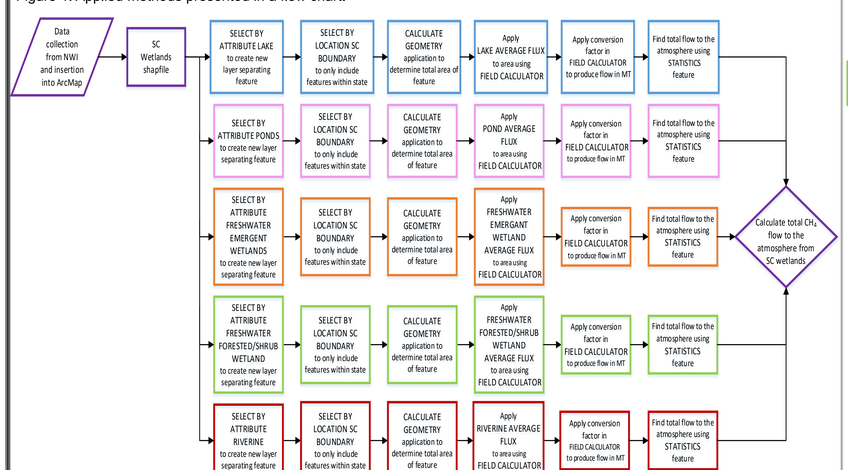
Current research shows that wetlands and other bodies of freshwater are the largest natural atmospheric source of methane in the global budget. Global wetlands are estimated to emit 115-237 Tg of methane to the atmosphere annually, making it the second most important greenhouse gas next to carbon dioxide (Christensen et al. 2003). The rate of methane emission is highly sensitive to changes in global temperature and precipitation, a common consequence of increasing occurrences of climate change (Shindell et al. 2004). Specifically in the state of South Carolina, the U.S. Fish and Wildlife Service has measured 14,708 square kilometers of which accounts for almost 18% of South Carolina's total area. Little research has been presented on this topic within the southeastern United States leading the purpose of this study to utilize GIS techniques in an effort to calculate the flow of methane to the atmosphere from wetlands located across South Carolina.

This study required various types of wetlands and their corresponding fluxes of methane to be taken into account. A series of calculations were conducted on the projected maps in order to approximate the total area and the overall contribution of methane to the atmosphere form the various types of wetlands located within the study area. Ultimately, this research shows that bodies of freshwater in South Carolina emit 2,325.1 mega tons (MT) of methane per day, over 800,000 MT per year. Because of methane's shorter mean residence time in relation to that of carbon dioxide and its economic benefit of capture, the results of this research may provide valuable evidence in the further mitigation of methane with intensions of reducing the effects of global climate change in the near future.

## Methods

This study utilized ArcMap 10.6 Desktop App for all GIS analysis. Figure 1 provides an in-depth description all applied methods. After retrieving data from the appropriate sources, wetlands were separated by type. The National Wetlands Inventory (NWI) includes five classifications of wetlands within South Carolina. In order to determine the average flux of methane, these classifications were compared to those included in Bartlett et al. 1993. Table 3 in Bartlett et al. 1993 thoroughly separates temperate and subtropical wetlands by type and provides a range of expected methane emissions for each. The results and conclusive classifications of this comparison for each wetland type can be seen in Table 1.

Figure 1. Applied methods presented in a flow chart.




## Results

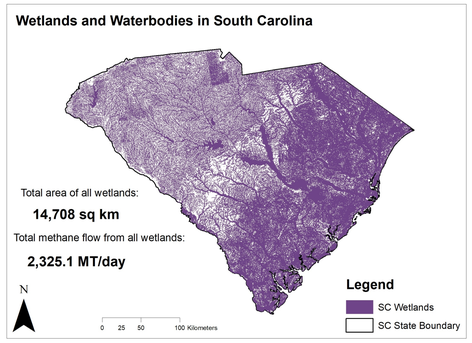



Figure 2. The above map geographically represents the location of all wetlands and bodies of freshwater within the state of South Carolina. Accordingly, wetlands are most densely located in the costal plains and decrease in abundance moving towards the piedmont with the most sparsity occurring in the sandhillls.

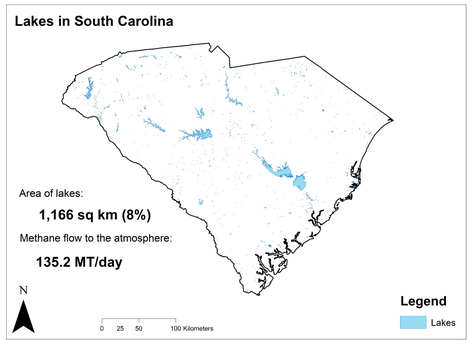



Figure 3. A geographic depiction of all lakes located in South Carolina. Major features are primarily situated throughout the center of the state and are the second largest wetland classification according to total surface area.

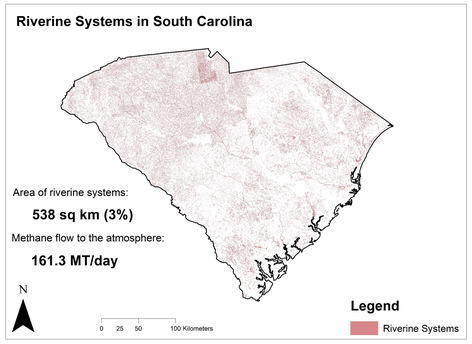



Figure 4. All riverine systems in the state of South Carolina. These have the greatest abundance in the piedmont region and are characterized by flowing water.

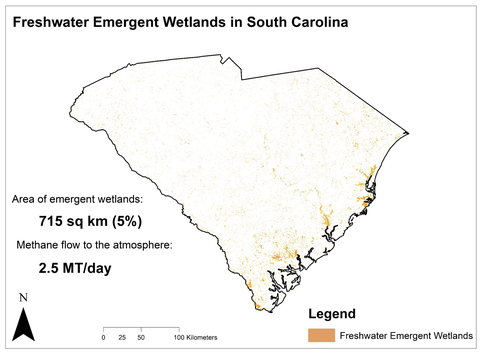



Figure 5. All wetlands classified as freshwater emergent wetlands in South Carolina. Primarily located near the coast, these features contribute the least to the global methane budget.

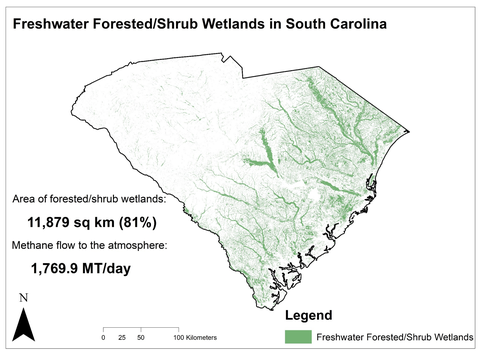



Figure 6. Pictured are freshwater forested wetlands and shrub wetlands which occupy a large portion of all South Carolinian wetlands, both in terms of area and methane flow to the atmosphere.

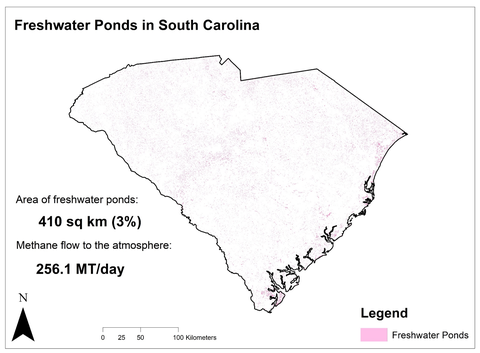



Figure 7. Wetlands categorized as freshwater ponds contribute the least amount of area in comparison to all other wetland types in South Carolina.

Table 1. Comprehensive summary of final results.

| Wetland Type | NWI Description | Bartlett et al. 1993 Classification | Average Flux (mg/sq m/day) | Area (sq. km) | Methane Flow (MT/day) |
|---|---|---|---|---|---|
| Lakes | Lake or reservior basin | Lakes | 115.9 | 1166 | 135.2 |
| Freshwater Ponds | Pond | Pond open water | 624 | 410 | 256.1 |
| Freshwater Emergent Wetlands | Herbaceous marsh,fen, swale or wet meadow | Minerotrophic fen | 3.56 | 715 | 2.5 |
| Freshwater Forested/Shrub Wetlands | Woody wetlands, forested swamp, shrub bog | Shrub swamp | 149 | 11879 | 1769.9 |
| Riverine Systems | River or stream channel | Running stream | 300 | 538 | 161.3 |
| | | | Total | 14708 | 2325.1 |

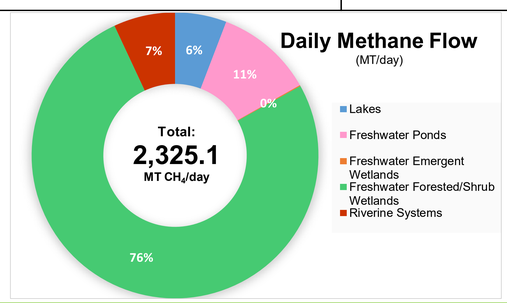



Figure 8. Proportional representation of daily methane flow to the atmosphere from each wetland type.

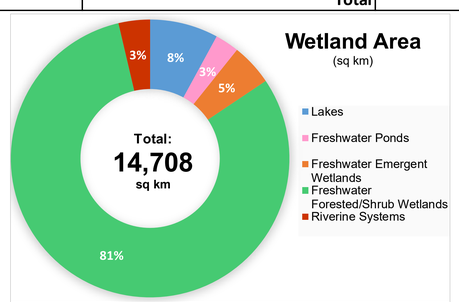



Figure 9. Proportional representation off area in square kilometers of each defined wetland type.

## Conclusions

The results of this study conclusively state that South Carolina's 14,708 square kilometers of wetlands emit 2,325.1 Mega Tons of methane to the atmosphere per day. Of the five classifications of wetlands in question, freshwater forested and shrub wetlands account for the largest area and consequently emit the largest volume of methane. While freshwater ponds occupy the least square kilometers, it is freshwater emergent wetlands that contribute the least to the global methane budget by supplying less than 1% to the daily atmospheric flow. On a larger scale, the amount of methane derivative of wetlands in South Carolina elucidate 0.74% of Christensen's estimation of annual global emissions (Christensen et al. 2003). While this percentage seems insignificant, this study only includes 0.01% of Earth's total surface area.

## Acknowledgments

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Bartlett, Karen & Harriss, Robert. Review and Assessment of Methane Emissions from Wetlands. Chemosphere. 26. 261-320. 1993.

Christensen, Torben R., et al. "Factors Controlling Large Scale Variations in Methane Emissions from Wetlands." Geophysical Research Letters, vol. 30, no. 7, 2003.

Shindell, Drew T., et al. "Impacts of Climate Change on Methane Emissions from Wetlands." Geophysical Research Letters, vol. 31, no. 21, 2004.