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Supplemental Material

Spatial Modeling to Identify Sociodemographic Predictors of Hydraulic Fracturing Wastewater Injection Wells in Ohio Census Block Groups

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Table S1. Odds ratios (posterior means) and 95% credible intervals for the associations between sociodemographic factors and presence of Class II injection wells at the block group level in Ohio (2010-2016), based on Sparse SGLMM ($q = 250$) using three new outcome definitions in addition to our primary definition, "Within Block Group (BG)".

Characteristic	**≤ 5 km BG Centroid**	**High Volume BG**	**Within Rural BG**	**Within BG**
N with; without CII injection well in group	N=718; 8,487	N=90; 0	N=152; 3,085	N=156; 9,049
UNG Well (per 1 count)	0.905 (0.856, 0.944)*	0.976 (0.947, 0.996)*	0.967 (0.938, 0.989)*	0.967 (0.939, 0.989)*
Median Age (per 1 year)	0.994 (0.979, 1.01)	1.00 (0.970, 1.04)	0.987 (0.960, 1.02)	0.984 (0.959, 1.01)
% ≥ High School Educated (per 1%)	1.01 (0.995, 1.03)	1.00 (0.972, 1.03)	1.02 (0.988, 1.04)	1.01 (0.988, 1.04)
Median Income (per $10,000)	0.812 (0.750, 0.885)*	0.934 (0.783, 1.10)	0.793 (0.669, 0.931)*	0.837 (0.719, 0.961)*
% White (per 1%)	1.03 (1.02, 1.03)*	1.02 (0.983, 1.06)	1.01 (0.982, 1.05)	1.02 (0.990, 1.05)
% Voter Turnout (per 1%)	0.974 (0.954, 0.993)*	0.974 (0.934, 1.02)	1.00 (0.966, 1.05)	0.994 (0.959, 1.03)
Population Density (per 1,000 person/mi^2)	0.949 (0.894, 1.01)	0.037 (0.007, 0.096)*	0.011 (0.001, 0.038)*	0.030 (0.008, 0.072)*
Water Area (per 1 km^2)	0.681 (0.535, 0.839)*	0.928 (0.780, 1.01)	0.905 (0.757, 1.00)	0.904 (0.761, 1.00)
Utica Shale (Yes vs. No)	33.7 (18.3, 56.2)*	10.1 (4.25, 20.7)*	6.38 (3.13, 11.7)*	5.06 (2.76, 8.36)*
Marcellus Shale (Yes vs. No)	3.74 (2.21, 5.85)*	1.37 (0.577, 2.78)	2.08 (0.946, 3.96)	2.58 (1.29, 4.45)*

* Indicates statistical significance (95% credible interval does not include 1.0)

All posterior summaries were generated using models that included all of the predictors shown in Table S1.

Sparse SGLMM: sparse version of spatial generalized linear mixed model, q: model complexity, UNG: hydraulically-fractured unconventional natural gas well.

≤ 5 km BG centroid: CII injection well present within a 5-kilometer buffer region from the block group's centroid, high volume BG: block group with CII injection well(s) receiving a cumulative volume ≥ 141,367 barrels from quarter 3, 2010 to quarter 1, 2016, rural BG: block group with population density < 1,000 person/mile^2, within BG: the primary model.

Table S2. Odds ratios (posterior means) and 95% credible intervals for the associations between sociodemographic factors and presence of Class II injection wells at the block group level in Ohio (2010-2016) based on Sparse SGLMM using three different values of *q*. (Block groups with CII injection well, n = 156; block groups without CII injection well, n = 9,049)

Characteristic	**Sparse SGLMM (*q*=50) (DIC: 1085.62, p_D: 19.99)**	**Sparse SGLMM (*q*=150) (DIC: 1057.85, p_D: 35.12)**	**Sparse SGLMM (*q*=250) (DIC: 1049.71, p_D: 47.50)**
UNG Well (per 1 count)	0.967 (0.940, 0.986)*	0.970 (0.944, 0.990)*	0.967 (0.939, 0.989)*
Median Age (per 1 year)	0.984 (0.961, 1.01)	0.983 (0.958, 1.007)	0.984 (0.959, 1.01)
% ≥ High School Educated (per 1%)	1.01 (0.990, 1.04)	1.01 (0.988, 1.03)	1.01 (0.988, 1.04)
Median Income (per $10,000)	0.839 (0.720, 0.957)*	0.845 (0.727, 0.968)*	0.837 (0.719, 0.961)*
% White (per 1%)	1.01 (0.987, 1.04)	1.02 (0.990, 1.05)	1.02 (0.990, 1.05)
% Voter Turnout (per 1%)	0.995 (0.963, 1.03)	0.996 (0.963, 1.03)	0.994 (0.959, 1.03)
Population Density (per 1,000 person/mi^2)	0.021 (0.005, 0.050)*	0.028 (0.008, 0.067)*	0.030 (0.008, 0.072)*
Water Area (per 1 km^2)	0.919 (0.782, 1.00)	0.912 (0.763, 1.00)	0.904 (0.761, 1.00)
Utica Shale (Yes vs. No)	5.39 (3.19, 8.27)*	4.85 (2.70, 7.92)*	5.06 (2.76, 8.36)*
Marcellus Shale (Yes vs. No)	1.98 (1.18, 3.03)*	2.59 (1.44, 4.47)*	2.58 (1.29, 4.45)*

*Indicates statistical significance (95% credible interval does not include 1.0)

All posterior summaries were generated using models that included all of the predictors shown in Table S2. Estimates with *q* = 250 represent the primary model.

Sparse SGLMM: sparse version of spatial generalized linear mixed model, DIC: deviance information criterion, p_D: effective number of parameters, *q*: model complexity, UNG: hydraulically-fractured unconventional natural gas well.