

**Supplementary Information for**

Disruption to Test Scores after Hurricanes in the United States

Gabriella Y. Meltzer1,2\*, G. Brooke Anderson3, Xicheng Xie4, Joan A. Casey5, Joel Schwartz6, Michelle L. Bell7, Yoshira Ornelas Van Horne1, Jared Fox8, Marianthi-Anna Kioumourtzoglou1,Robbie M. Parks1

1. Department of Environmental Health Sciences, Columbia University Mailman School of Public Health, New York, New York, USA
2. Department of Epidemiology, Columbia University Mailman School of Public Health, New York, New York, USA
3. Department of Environmental & Radiological Health Sciences, Colorado State University, Fort Collins, Colorado, USA
4. Department of Biostatistics, Columbia University Mailman School of Public Health, New York, New York, USA
5. Department of Environmental and Occupational Health Sciences, University of Washington School of Public Health, Seattle, Washington, USA
6. Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, Massachusetts, USA
7. Department of Environmental Health, Yale University School of the Environment, New Haven, Connecticut, USA
8. Fox EduConsulting, Chevy Chase, Maryland, USA

\*Gabriella Y. Meltzer, Department of Environmental Health Sciences, Mailman School of Public Health, Columbia University, 722 W. 168th Street, New York, New York, 10032

**Email:**  gm3085@cumc.columbia.edu

**This PDF file includes:**

Table S1

Table S2

| **State** |  | **Grade** | **2009 percentiles** | | | | | **2018 percentiles** | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Florida |  |  | 5th | 25th | 50th | 75th | 95th | 5th | 25th | 50th | 75th | 95th |
| Mean Standardized Math Score | 3 | 2.71 | 3.08 | 3.33 | 3.67 | 4.14 | 2.84 | 3.50 | 3.82 | 4.13 | 4.50 |
| 4 | 2.93 | 3.87 | 4.11 | 4.51 | 4.81 | 3.68 | 4.08 | 4.48 | 4.81 | 5.46 |
| 5 | 3.71 | 4.60 | 4.89 | 5.25 | 5.70 | 3.88 | 4.63 | 5.15 | 5.49 | 6.12 |
| 6 | 4.88 | 5.34 | 5.83 | 6.31 | 6.93 | 4.91 | 5.53 | 6.17 | 6.73 | 7.37 |
| 7 | 5.54 | 6.28 | 6.65 | 7.17 | 7.84 | 5.15 | 5.93 | 6.75 | 7.37 | 8.18 |
| 8 | 6.21 | 7.21 | 7.65 | 8.12 | 8.79 | 5.70 | 6.78 | 7.39 | 8.12 | 9.20 |
| Mean Standardized RLA Score | 3 | 3.04 | 3.52 | 3.90 | 4.35 | 4.95 | 2.46 | 3.31 | 3.69 | 4.13 | 4.58 |
| 4 | 3.15 | 4.15 | 4.58 | 4.91 | 5.51 | 3.36 | 3.92 | 4.43 | 4.86 | 5.28 |
| 5 | 4.29 | 4.76 | 5.25 | 5.56 | 6.20 | 3.67 | 4.73 | 5.21 | 5.63 | 6.22 |
| 6 | 5.16 | 5.66 | 6.14 | 6.52 | 7.30 | 4.86 | 5.70 | 6.22 | 6.72 | 7.15 |
| 7 | 5.70 | 6.64 | 6.96 | 7.33 | 8.02 | 5.71 | 6.45 | 6.97 | 7.47 | 7.90 |
| 8 | 6.43 | 7.55 | 7.96 | 8.23 | 8.88 | 6.67 | 7.54 | 7.93 | 8.46 | 9.07 |
| Louisiana | Mean Standardized Math Score | 3 | 0.80 | 1.35 | 1.88 | 2.33 | 2.89 | - | - | - | - | - |
| 4 | 2.17 | 2.50 | 2.96 | 3.34 | 3.97 | - | - | - | - | - |
| 5 | 2.74 | 3.39 | 3.78 | 4.25 | 4.91 | 1.68 | 3.34 | 3.90 | 4.40 | 5.12 |
| 6 | 3.94 | 4.47 | 4.92 | 5.47 | 6.14 | 2.48 | 4.15 | 4.78 | 5.52 | 6.11 |
| 7 | 4.60 | 5.34 | 5.95 | 6.49 | 7.39 | 3.97 | 5.01 | 5.80 | 6.32 | 7.04 |
| 8 | 5.56 | 6.60 | 7.15 | 7.61 | 8.29 | 4.32 | 6.02 | 6.72 | 7.30 | 8.25 |
| Mean Standardized RLA Score | 3 | 0.67 | 1.22 | 1.97 | 2.27 | 3.05 | - | - | - | - | - |
| 4 | 1.95 | 2.33 | 2.98 | 3.41 | 4.00 | - | - | - | - | - |
| 5 | 2.67 | 3.35 | 3.82 | 4.38 | 4.92 | 2.08 | 3.51 | 4.11 | 4.73 | 5.41 |
| 6 | 4.04 | 4.54 | 4.99 | 5.41 | 6.10 | 2.62 | 4.56 | 5.06 | 5.69 | 6.36 |
| 7 | 4.63 | 5.53 | 6.12 | 6.48 | 7.08 | 4.20 | 5.52 | 6.28 | 6.74 | 7.46 |
| 8 | 5.65 | 6.59 | 7.17 | 7.48 | 7.98 | 5.76 | 6.64 | 7.13 | 7.72 | 8.74 |
| New Jersey | Mean Standardized Math Score | 3 | 2.50 | 3.03 | 3.51 | 3.82 | 4.19 | 2.82 | 3.14 | 3.43 | 3.99 | 4.48 |
| 4 | 3.78 | 4.07 | 4.54 | 4.94 | 5.50 | 3.72 | 4.01 | 4.51 | 5.10 | 5.73 |
| 5 | 4.46 | 5.08 | 5.64 | 5.93 | 6.93 | 4.61 | 5.26 | 5.54 | 6.29 | 6.82 |
| 6 | 5.63 | 6.14 | 6.81 | 7.31 | 8.14 | 5.60 | 6.17 | 6.68 | 7.28 | 8.06 |
| 7 | 6.63 | 7.19 | 7.91 | 8.33 | 9.21 | 6.68 | 7.05 | 7.55 | 8.37 | 9.33 |
| 8 | 7.92 | 8.43 | 9.00 | 9.48 | 10.23 | 7.64 | 8.15 | 8.62 | 9.34 | 10.50 |
| Mean Standardized RLA Score | 3 | 2.16 | 2.85 | 3.65 | 4.04 | 4.56 | 2.98 | 3.48 | 3.86 | 4.34 | 5.11 |
| 4 | 3.39 | 3.41 | 3.93 | 4.62 | 5.03 | 3.92 | 4.45 | 4.75 | 5.29 | 6.24 |
| 5 | 4.25 | 4.97 | 5.57 | 6.09 | 6.97 | 4.73 | 5.29 | 5.64 | 6.36 | 7.20 |
| 6 | 5.41 | 5.95 | 6.66 | 7.07 | 7.85 | 5.78 | 6.37 | 6.52 | 7.27 | 7.99 |
| 7 | 6.50 | 6.95 | 7.56 | 8.11 | 8.93 | 6.51 | 6.96 | 7.49 | 8.12 | 8.97 |
| 8 | 7.48 | 8.11 | 8.64 | 9.15 | 9.91 | 7.73 | 7.92 | 8.49 | 9.01 | 10.11 |
| North Carolina | Mean Standardized Math Score | 3 | 2.11 | 2.78 | 3.37 | 3.61 | 4.13 | 1.96 | 2.63 | 3.05 | 3.42 | 3.82 |
| 4 | 2.96 | 3.73 | 4.20 | 4.63 | 5.12 | 2.65 | 3.45 | 3.98 | 4.49 | 5.05 |
| 5 | 3.66 | 4.55 | 5.05 | 5.60 | 6.23 | 3.29 | 4.47 | 4.93 | 5.51 | 5.95 |
| 6 | 4.75 | 5.64 | 6.15 | 6.59 | 7.33 | 4.75 | 5.64 | 6.15 | 6.59 | 7.33 |
| 7 | 5.54 | 6.44 | 7.02 | 7.64 | 8.28 | 5.12 | 6.12 | 6.84 | 7.34 | 8.25 |
| 8 | 6.10 | 7.32 | 8.15 | 8.83 | 9.62 | 5.69 | 7.20 | 7.67 | 8.43 | 9.35 |
| Mean Standardized RLA Score | 3 | 1.49 | 2.40 | 2.93 | 3.40 | 3.92 | 1.97 | 2.80 | 3.28 | 3.64 | 4.35 |
| 4 | 2.29 | 3.36 | 3.86 | 4.28 | 5.00 | 3.03 | 3.67 | 4.17 | 4.63 | 5.40 |
| 5 | 3.13 | 4.18 | 4.62 | 5.13 | 5.87 | 3.75 | 3.99 | 4.56 | 5.09 | 5.63 |
| 6 | 4.16 | 5.04 | 5.68 | 6.18 | 6.79 | 4.41 | 5.28 | 5.88 | 6.40 | 7.14 |
| 7 | 4.90 | 5.95 | 6.50 | 7.04 | 7.78 | 5.57 | 6.37 | 6.82 | 7.29 | 8.04 |
| 8 | 5.79 | 6.95 | 7.44 | 8.11 | 8.73 | 6.24 | 7.01 | 7.58 | 8.15 | 8.79 |
| South Carolina | Mean Standardized Math Score | 3 | 0.37 | 1.59 | 2.22 | 2.59 | 3.15 | 0.79 | 1.71 | 2.07 | 2.62 | 3.30 |
| 4 | 1.49 | 2.39 | 3.31 | 3.71 | 4.19 | 1.37 | 2.35 | 2.94 | 3.57 | 4.39 |
| 5 | 1.95 | 3.19 | 4.24 | 4.82 | 5.26 | 2.21 | 3.40 | 3.76 | 4.50 | 5.43 |
| 6 | 3.38 | 5.00 | 5.37 | 5.81 | 6.36 | 3.08 | 4.32 | 4.84 | 5.56 | 6.64 |
| 7 | 4.35 | 5.50 | 6.18 | 6.80 | 7.29 | 3.85 | 5.19 | 6.03 | 6.61 | 7.26 |
| 8 | 5.90 | 6.55 | 7.33 | 7.77 | 8.55 | 5.01 | 6.10 | 7.03 | 7.58 | 8.36 |
| Mean Standardized RLA Score | 3 | 0.59 | 1.51 | 2.12 | 2.71 | 3.32 | 0.06 | 1.31 | 1.85 | 2.47 | 3.41 |
| 4 | 1.29 | 2.30 | 3.03 | 3.68 | 4.22 | 1.12 | 1.99 | 2.76 | 3.69 | 4.36 |
| 5 | 2.38 | 3.01 | 3.93 | 4.63 | 4.99 | 2.08 | 3.14 | 3.62 | 4.53 | 5.41 |
|  | 5th | 25th | 50th | 75th | 95th | 5th | 25th | 50th | 75th | 95th |
| 6 | 2.95 | 4.11 | 4.96 | 5.48 | 5.94 | 3.64 | 4.30 | 4.97 | 5.77 | 6.28 |
| 7 | 3.93 | 5.10 | 5.83 | 6.45 | 6.94 | 4.53 | 5.50 | 6.02 | 6.66 | 7.22 |
| 8 | 5.47 | 5.97 | 6.58 | 7.39 | 7.91 | 5.81 | 6.43 | 7.05 | 7.66 | 8.22 |
| Texas | Mean Standardized Math Score | 3 | 1.47 | 2.27 | 2.68 | 3.01 | 3.65 | 1.80 | 2.47 | 2.98 | 3.33 | 4.08 |
| 4 | 2.34 | 3.22 | 3.67 | 4.04 | 4.68 | 2.31 | 3.15 | 3.73 | 4.25 | 5.06 |
| 5 | 3.66 | 4.31 | 4.81 | 5.19 | 5.91 | 3.14 | 4.11 | 4.73 | 5.16 | 6.24 |
| 6 | 4.57 | 5.45 | 5.85 | 6.33 | 7.08 | 4.13 | 5.02 | 5.63 | 6.13 | 7.43 |
| 7 | 5.55 | 6.47 | 6.96 | 7.40 | 8.21 | - | - | - | - | - |
| 8 | 6.63 | 7.50 | 8.05 | 8.51 | 9.44 | - | - | - | - | - |
| Mean Standardized RLA Score | 3 | 1.25 | 2.09 | 2.63 | 3.02 | 3.86 | 0.93 | 1.80 | 2.33 | 2.76 | 3.60 |
| 4 | 2.08 | 2.89 | 3.28 | 3.68 | 4.47 | 1.81 | 2.78 | 3.25 | 3.71 | 4.53 |
| 5 | 3.02 | 3.96 | 4.44 | 4.84 | 5.54 | 2.88 | 3.60 | 4.13 | 4.52 | 5.43 |
| 6 | 4.09 | 5.08 | 5.45 | 5.90 | 6.55 | 3.76 | 4.65 | 5.06 | 5.43 | 6.54 |
| 7 | 5.17 | 5.85 | 6.34 | 6.75 | 7.45 | 4.86 | 5.61 | 6.14 | 6.64 | 7.53 |
| 8 | 6.19 | 6.91 | 7.34 | 7.70 | 8.39 | 6.02 | 6.75 | 7.18 | 7.63 | 8.55 |

**Table S1.** State-specific mean standardized test scores in math and reading and language arts in 2009 and 2018

| *Variable* | **Math**  (β, 95% CrI, probability) | **Reading/Language Arts**  (β, 95% CrI, probability) |
| --- | --- | --- |
| Storm Exposure by State |  |  |
| National | -0.04 (-0.11, 0.03), 85.0% | 0.00 (-0.06, 0.07), 55.5% |
| Florida | 0.14 (0.02, 0.26), 99.0% | 0.11 (0.02, 0.22), 99.2% |
| Louisiana | -0.05 (-0.30, 0.15), 69.9% | 0.00 (-0.15, 0.16), 50.2% |
| New Jersey | -0.11 (-0.31, 0.06), 88.7% | -0.04 (-0.18, 0.09), 71.1% |
| North Carolina | -0.16 (-0.29, -0.03), 99.4% | -0.05 (-0.15, 0.05), 82.4% |
| South Carolina | -0.12 (-0.35, 0.06), 90.0% | -0.01 (-0.15, 0.12), 54.5% |
| Texas | 0.03 (-0.09, 0.16), 66.0% | -0.04 (-0.14, 0.05), 81.2% |
| Grade-Cohort Percent Race/Ethnicity |  |  |
| American Indian/Alaska Native | -1.45 (-2.38, -0.51), 99.9% | -2.02 (-2.84, -1.19), 99.9% |
| Asian | 1.78 (0.70, 2.86), 99.9% | 1.79 (0.86, 2.71), 99.9% |
| Black | -1.71 (-1.93, -1.48), 99.9% | -2.27 (-2.46, -2.07), 99.9% |
| Hispanic | -0.96 (-1.14, -0.78), 99.9% | -1.66 (-1.81, -1.51), 99.9% |
| Percent Grade-Cohort Economically Disadvantaged | -0.49 (-0.59, -0.38), 99.9% | -0.98 (-1.06, -0.89), 99.9% |
| Percent Grade-Cohort Receiving Free Lunch | -0.45 (-0.53, -0.37), 99.9% | 0.02 (-0.05, 0.09), 71.6% |
| Percent County English Language Learners | 0.66 (0.14, 1.19), 99.2% | -1.61 (-2.05, -1.18), 99.9% |
| Percent County Special Education Students | -1.73 (-2.25, -1.20), 99.9% | 0.37 (-0.09, 0.82), 94.6% |
| Percent County College-Educated Adults | 1.64 (1.25, 2.03), 99.9% | 1.44 (1.12, 1.77), 99.9% |
| County Poverty Rate | -0.75 (-1.08, -0.42), 99.9% | 0.33 (0.06, 0.60), 99.4% |
| Percent County Single Mother Households | -0.12 (-0.50, 0.25), 73.5% | -0.27 (-0.57, 0.03), 96.1% |
| Percent County Urban Schools | 0.16 (0.00, 0.32), 97.8% | 0.24 (0.10, 0.38), 99.9% |

**Table S2.** National and State-Specific Associations between Hurricane-Force Tropical Cyclones and Standardized Test Scores; 95% CrI = 95% credible interval, probability = Posterior probability of positive/negative association