GeoNet Chloride Results (for spill paper)

Remarks:

1. Significant spills based on the collective decision from three tests are highlighted in red.
2. Significant p-values for the three tests for downstream close at 0.05 level and for downstream far at 0.1 level after FDR correction (using Benjamini Hochberg method) are starred.
3. We conduct following three types of tests:
   1. Upstream temporal tests: We conduct one sided t test for mean and one sided Wilcoxon test for median for concentrations before vs. after spill date (within one year) upstream to the polluter location. Significant one-sided test results specifically points to cases when the concentrations post-spill are greater than pre-spill for upstream observations. We conduct this test to check if the concentration increase due to natural reasons is significant or not.
   2. Downstream temporal tests: We conduct one sided t test for mean and one sided Wilcoxon test for median for concentrations before vs. after spill date (within one year) downstream to the polluter location. Significant one-sided test results specifically points to cases when the concentrations post-spill are greater than pre-spill for downstream observations. We conduct this test to check if the concentration increase due to the presence of polluter/natural reasons is significant or not.
   3. Upstream vs. Downstream spatio-temporal test: We conduct one sided t test for mean and one sided Wilcoxon test for median for concentrations upstream vs. after spill date (within one year) downstream to the polluter location. Significant one-sided test results specifically points to cases when the concentrations downstream are greater than upstream. If the results in (a) are significant, we only consider before spill observations for upstream in this spatio-temporal test.
4. We declare the spill as significant if upstream temporal test (a) gives non-significant results and the other two tests ((b) and (c)) give significant results. This is to ensure that only the spill event is responsible for increase in concentrations and natural factors don’t play any significant role.
5. Spills with insufficient no. of observations upstream and/or downstream to conduct tests have been removed from the tables.
6. Polluter to intersection distance: 0-5 km for Dowstream close and 0-45 km for Downstream far
7. Upstream distance: 0-5 km
8. Downstream far distance: 10-50 km
9. Downstream close distance: 0-10 km

Table 1: Mean for Downstream Far

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Affected Water Body | County | Date | Upstr. Mean | Downstr.Mean | No. of Obs.Upstr. | No. of Obs. Downstr. | t test (up) p values | t test (down) p values | t test (updown) p values |
| Bob's Creek | Blair | 2010-05-24 | 3868 | 7750.73 | 5 | 41 | NA | 0.95 | 0.01\* |
| UNT to South Branch Sugar Creek | Bradford | 2009-06-10 | 11794.53 | 23167.93 | 53 | 29 | NA | 0.69 | 0\* |
| Webier Creek | Bradford | 2009-11-23 | 5157.84 | 6640 | 69 | 3 | NA | 0.13 | 0.1 |
| Towanda Creek | Bradford | 2011-03-19 | 18221.72 | 7354.71 | 415 | 17 | 1 | 0.85 | 1 |
| Towanda Creek | Bradford | 2011-04-22 | 18221.72 | 7543.53 | 415 | 17 | 1 | 0.85 | 1 |
| UNT to Thorn Creek | Butler | 2012-12-13 | 8000 | 84642.17 | 2 | 23 | NA | 0.34 | 0\* |
| Alex Branch | Clearfield | 2009-10-14 | 7087.3 | 1421.67 | 37 | 6 | NA | 1 | 1 |
| UNT to Smokehouse Run | Clinton | 2011-01-07 | 19669.99 | 1000 | 206 | 6 | 0.57 | 1 | 1 |
| UNT to Blacklick Creek | Indiana | 2012-10-26 | 38381750 | 33239.17 | 4 | 12 | NA | 0.97 | 0.92 |
| Beauty's Run | Lycoming | 2009-06-01 | 8109.77 | 12900 | 128 | 2 | 0.49 | 0.8 | 0\* |
| UNT to Sugar Run | Lycoming | 2010-08-12 | 5725.88 | 8501.67 | 165 | 12 | 1 | 0.6 | 0.1 |
| Larry's Creek | Lycoming | 2011-10-18 | 8697.85 | 7413.33 | 248 | 6 | 0.99 | 0.9 | 0.84 |
| Slacks Run | Lycoming | 2012-10-09 | 3332.92 | 9475 | 257 | 6 | 0.91 | 0.81 | 0\* |
| Brion Creek | Lycoming | 2012-12-27 | 2175.5 | 3483.21 | 84 | 28 | 0.97 | 0.49 | 0\* |
| Pine creek | Lycoming | 2012-01-06 | 5020.67 | 8179.63 | 168 | 27 | 0.99 | 0.92 | 0\* |
| UNT to Sugar Run | Lycoming | 2010-11-16 | 5725.88 | 5941.54 | 165 | 13 | 1 | 1 | 0.36 |
| Trout Run | Lycoming | 2012-07-24 | 3549.1 | 9273.33 | 536 | 6 | 0.95 | 0.82 | 0\* |
| Pine Creek | Lycoming | 2010-03-13 | 5020.67 | 9565.91 | 168 | 22 | 1 | 0.85 | 0\* |
| UNT to Mill Creek | Sullivan | 2012-09-10 | 3244.62 | 3262.31 | 13 | 26 | NA | 0.92 | 0.48 |
| Big Bottom Run | Sullivan | 2013-01-29 | 3244.62 | 3896.84 | 13 | 19 | NA | 0.84 | 0.03\* |
| UNT to Mill Creek | Sullivan | 2012-08-21 | 3244.62 | 3263.46 | 13 | 26 | NA | 0.92 | 0.48 |
| Wellmans Creek  Salt Lick Creek | Susquehanna | 2012-12-19 | 6059.76 | 17614.55 | 42 | 11 | NA | 0\* | 0\* |
| Laurel Lake Creek | Susquehanna | 2011-07-29 | 14956.25 | 6616.15 | 16 | 13 | NA | 1 | 1 |
| Laurel Lake Creek | Susquehanna | 2011-08-10 | 14956.25 | 6616.15 | 16 | 13 | NA | 1 | 1 |
| Stevens creek | Susquehanna | 2009-09-16 | 9504.52 | 14500 | 73 | 2 | NA | 1 | 0\* |
| Stevens creek | Susquehanna | 2009-09-22 | 9504.52 | 14500 | 73 | 2 | NA | 1 | 0\* |
| Jacobs Creek | Westmoreland | 2009-10-30 | 27134.19 | 30400 | 74 | 10 | NA | 0\* | 0.25 |
| Taques Creek | Wyoming | 2013-03-13 | 21806.34 | 27664.67 | 41 | 15 | NA | 0.85 | 0.06 |
| Meshoppen Creek | Wyoming | 2013-04-30 | 10344.07 | 27717.5 | 135 | 16 | 0\* | 0.86 | 0\* |
| UNT to Sugar Run | Lycomng | 2012-10-16 | 7673.89 | 5822.5 | 36 | 12 | 0.68 | 0.97 | 1 |

Table 2: Mean for Downstream Close

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Affected Water Body | County | Date | Upstr. Mean | Downstr.Mean | No. of Obs.Upstr. | No. of Obs. Downstr. | t test (up) p values | t test (down) p values | t test (updown) p values |
| Pine creek | Clinton | 2009-09-01 | 7100 | 9087.5 | 2 | 16 | NA | 0.68 | 0.22 |
| Beauty's Run | Lycoming | 2009-06-01 | 15650 | 5580 | 2 | 2 | NA | 0.43 | 0.86 |
| Slacks Run | Lycoming | 2012-10-09 | 3363.33 | 3026.54 | 3 | 26 | NA | 0.84 | 0.6 |
| Pine creek | Lycoming | 2012-01-06 | 4431.13 | 4168.42 | 134 | 19 | 0.29 | 0.82 | 0.76 |
| Pine Creek | Lycoming | 2010-03-13 | 4431.13 | 4237.65 | 134 | 17 | 0.54 | 0.96 | 0.67 |
| UNT to Sugar Run | Lycomng | 2012-10-16 | 6425 | 6925 | 4 | 4 | NA | 0.38 | 0.39 |

Table 3: Median for Downstream Far

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Affected Water Body | County | Date | Upstr. Median | Downstr.Median | No. of Obs.Upstr. | No. of Obs. Downstr. | Wilcox (up) p values | Wilcox (down) p values | Wilcox (updown) p values |
| Bob's Creek | Blair | 2010-05-24 | 3040 | 7100 | 5 | 41 | NA | 0.07 | 0\* |
| UNT to South Branch Sugar Creek | Bradford | 2009-06-10 | 10000 | 22100 | 53 | 29 | NA | 0.14 | 0\* |
| Webier Creek | Bradford | 2009-11-23 | 2400 | 7400 | 69 | 3 | NA | 0.12 | 0.07 |
| Towanda Creek | Bradford | 2011-03-19 | 13330 | 5000 | 415 | 17 | 1 | 0.99 | 1 |
| Towanda Creek | Bradford | 2011-04-22 | 13330 | 5640 | 415 | 17 | 1 | 0.97 | 1 |
| UNT to Thorn Creek | Butler | 2012-12-13 | 8000 | 87200 | 2 | 23 | NA | 0.26 | 0.01\* |
| Alex Branch | Clearfield | 2009-10-14 | 3800 | 1765 | 37 | 6 | NA | 0.99 | 0.98 |
| UNT to Smokehouse Run | Clinton | 2011-01-07 | 16420.5 | 500 | 206 | 6 | 0\* | 1 | 1 |
| UNT to Blacklick Creek | Indiana | 2012-10-26 | 33011000 | 30735 | 4 | 12 | NA | 0.42 | 1 |
| Beauty's Run | Lycoming | 2009-06-01 | 7200 | 12900 | 128 | 2 | 0.5 | 0.08 | 0.04\* |
| UNT to Sugar Run | Lycoming | 2010-08-12 | 4680 | 7600 | 165 | 12 | 1 | 0.93 | 0\* |
| Larry's Creek | Lycoming | 2011-10-18 | 7952 | 6280 | 248 | 6 | 0.97 | 0.84 | 0.77 |
| Slacks Run | Lycoming | 2012-10-09 | 1590 | 7675 | 257 | 6 | 0.04 | 0.13 | 0\* |
| Brion Creek | Lycoming | 2012-12-27 | 1490 | 3115 | 84 | 28 | 0.14 | 0.01 | 0\* |
| Pine creek | Lycoming | 2012-01-06 | 4210 | 7380 | 168 | 27 | 0.89 | 0.84 | 0\* |
| UNT to Sugar Run | Lycoming | 2010-11-16 | 4680 | 5410 | 165 | 13 | 1 | 1 | 0.04\* |
| Trout Run | Lycoming | 2012-07-24 | 2825 | 7675 | 536 | 6 | 0.99 | 0.16 | 0\* |
| Pine Creek | Lycoming | 2010-03-13 | 4210 | 8200 | 168 | 22 | 0.99 | 0.43 | 0\* |
| UNT to Mill Creek | Sullivan | 2012-09-10 | 3000 | 3410 | 13 | 26 | NA | 0.75 | 0.19 |
| Big Bottom Run | Sullivan | 2013-01-29 | 3000 | 3900 | 13 | 19 | NA | 0.03 | 0.02\* |
| UNT to Mill Creek | Sullivan | 2012-08-21 | 3000 | 3410 | 13 | 26 | NA | 0.67 | 0.19 |
| Wellmans Creek  Salt Lick Creek | Susquehanna | 2012-12-19 | 4875 | 17500 | 42 | 11 | NA | 0\* | 0\* |
| Laurel Lake Creek | Susquehanna | 2011-07-29 | 14200 | 6550 | 16 | 13 | NA | 1 | 1 |
| Laurel Lake Creek | Susquehanna | 2011-08-10 | 14200 | 6550 | 16 | 13 | NA | 1 | 1 |
| Stevens creek | Susquehanna | 2009-09-16 | 10300 | 14500 | 73 | 2 | NA | 0.63 | 0.04\* |
| Stevens creek | Susquehanna | 2009-09-22 | 10300 | 14500 | 73 | 2 | NA | 0.63 | 0.04\* |
| Jacobs Creek | Westmoreland | 2009-10-30 | 25165 | 24450 | 74 | 10 | NA | 0\* | 0.31 |
| Taques Creek | Wyoming | 2013-03-13 | 18900 | 27600 | 41 | 15 | NA | 0.02 | 0.02\* |
| Meshoppen Creek | Wyoming | 2013-04-30 | 10700 | 28080 | 135 | 16 | 0\* | 0.1 | 0\* |
| UNT to Sugar Run | Lycomng | 2012-10-16 | 7050 | 5550 | 36 | 12 | 0.8 | 0.85 | 0.99 |

Table 4: Median for Downstream Close

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Affected Water Body | County | Date | Upstr. Median | Downstr.Median | No. of Obs.Upstr. | No. of Obs. Downstr. | Wilcox (up) p values | Wilcox (down) p values | Wilcox (updown) p values |
| Pine creek | Clinton | 2009-09-01 | 7100 | 8575 | 2 | 16 | NA | 0.49 | 0.32 |
| Beauty's Run | Lycoming | 2009-06-01 | 15650 | 5580 | 2 | 2 | NA | 0.42 | 0.98 |
| Slacks Run | Lycoming | 2012-10-09 | 4300 | 2670 | 3 | 26 | NA | 0.7 | 0.75 |
| Pine creek | Lycoming | 2012-01-06 | 3865 | 3500 | 134 | 19 | 0.22 | 0.65 | 0.67 |
| Pine Creek | Lycoming | 2010-03-13 | 3865 | 3700 | 134 | 17 | 0.29 | 0.93 | 0.55 |
| UNT to Sugar Run | Lycomng | 2012-10-16 | 6450 | 5650 | 4 | 4 | NA | 0.4 | 0.9 |