**Detection of spatial and temporal hydro-meteorological trends in Lake Michigan, Lake Huron and Georgian Bay**

**[Supporting Information]**

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**Table S1a.** Mann-Kendall statistics for over-lake precipitation (mm) data ranging from 1900-2015 (1948-2015 for Lake Huron and Georgian Bay).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.02 | -0.06 | -0.10 | 0.19\* | -0.05 | 0.09 | 0.07 | 0.18\* | -0.02 | 0.09 | 0.09 | 0.09 | 0.05\* |
|  τ | 0.03 | -0.09 | -0.10 | 0.17 | -0.04 | 0.06 | 0.06 | 0.14 | -0.02 | 0.06 | 0.07 | 0.11 | 0.17 |
|  Autocorrelation | 0.11 | -0.06 | 0.11 | 0.07 | 0.05 | 0.04 | 0.19 | 0.00 | -0.10 | 0.03 | -0.06 | 0.04 | 0.01 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.15 | -0.22 | -0.20 | -0.11 | 0.17 | 0.13 | -0.11 | 0.03 | 0.07 | 0.35\* | -0.18 | -0.20 | -0.07 |
|  τ | -0.06 | -0.16 | -0.11 | -0.08 | 0.11 | 0.05 | -0.05 | 0.02 | 0.02 | 0.17 | -0.09 | -0.09 | -0.07 |
|  Autocorrelation | 0.20 | 0.02 | 0.13 | 0.02 | 0.00 | 0.12 | 0.26 | -0.10 | -0.18 | -0.04 | -0.04 | 0.24 | 0.26 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.31 | -0.22 | -0.21 | -0.13 | 0.04 | 0.02 | 0.00 | -0.13 | -0.15 | 0.37 | -0.24 | -0.33 | -0.08 |
|  τ | -0.13 | -0.13 | -0.10 | -0.05 | 0.03 | 0.01 | 0.00 | -0.06 | -0.08 | 0.15 | -0.11 | -0.12 | -0.08 |
|  Autocorrelation | 0.10 | 0.01 | 0.20 | 0.17 | 0.03 | 0.13 | 0.14 | 0.13 | -0.14 | -0.12 | 0.09 | 0.31 | 0.42 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.01 | -0.07 | -0.12 | 0.12 | -0.02 | 0.07 | 0.05 | 0.15\* | 0.03 | 0.07 | 0.03 | 0.04 | 0.03 |
|  τ | 0.01 | -0.09 | -0.12 | 0.12 | -0.02 | 0.05 | 0.03 | 0.15 | 0.03 | 0.05 | 0.02 | 0.05 | 0.10 |
|  Autocorrelation | 0.08 | -0.04 | 0.11 | 0.05 | 0.01 | 0.10 | 0.24 | 0.01 | -0.17 | 0.01 | -0.04 | 0.10 | 0.03 |

**Table S1b. Mann-Kendall statistics for the recent over-lake precipitation (mm) data (1970-2015).**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.09 | 0.19 | -0.28 | 0.22 | 0.61 | 0.31 | 0.00 | -0.25 | -0.24 | 0.52 | 0.07 | 0.05 | 0.15 |
|  τ | 0.04 | 0.13 | -0.11 | 0.10 | 0.18 | 0.11 | 0.00 | -0.07 | -0.07 | 0.16 | 0.01 | 0.01 | 0.18 |
|  Autocorrelation | 0.16 | -0.11 | -0.01 | 0.05 | 0.02 | -0.03 | -0.16 | -0.24 | -0.11 | -0.04 | -0.14 | 0.11 | -0.01 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.17 | -0.01 | -0.43 | 0.33 | 0.30 | 0.21 | 0.00 | 0.05 | -0.04 | 0.67\* | 0.23 | -0.12 | 0.00 |
|  τ | -0.04 | -0.01 | -0.18 | 0.14 | 0.15 | 0.07 | 0.00 | 0.02 | -0.01 | 0.23 | 0.06 | -0.04 | 0.00 |
|  Autocorrelation | 0.28 | 0.02 | 0.07 | 0.02 | -0.02 | 0.20 | 0.19 | -0.19 | -0.16 | -0.10 | -0.19 | 0.33 | 0.37 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.55 | -0.32 | -0.63 | 0.35 | -0.12 | 0.19 | 0.12 | -0.13 | -0.31 | 0.59 | 0.03 | -0.51 | 0.02 |
|  τ | -0.13 | -0.11 | -0.18 | 0.12 | -0.05 | 0.06 | 0.05 | -0.05 | -0.11 | 0.18 | 0.01 | -0.08 | 0.00 |
|  Autocorrelation | 0.30 | 0.03 | 0.11 | 0.18 | 0.00 | 0.21 | 0.17 | 0.17 | -0.17 | -0.11 | 0.05 | 0.42 | 0.53 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.14 | 0.09 | -0.43 | 0.36 | 0.38 | 0.25 | -0.17 | -0.17 | -0.15 | 0.58 | 0.11 | -0.10 | 0.07 |
|  τ | -0.03 | 0.04 | -0.16 | 0.15 | 0.11 | 0.09 | -0.07 | -0.08 | -0.05 | 0.20 | 0.04 | -0.03 | 0.07 |
|  Autocorrelation | 0.21 | -0.05 | 0.01 | -0.01 | 0.02 | 0.08 | -0.02 | -0.24 | -0.22 | -0.01 | -0.22 | 0.28 | 0.22 |

\* *p* < 0.05

Table S2a. Mann-Kendall statistics for minimum air temperature (oC) data ranging from 1948-2014.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.03 | 0.02 | 0.03\* | 0.02 | 0.02\* | 0.02\* | 0.03\* | 0.04\* | 0.04\* | 0.02 | 0.03\* | 0.03\* | 0.03\* |
|  τ | 0.13 | 0.09 | 0.20 | 0.16 | 0.19 | 0.17 | 0.28 | 0.35 | 0.37 | 0.15 | 0.24 | 0.17 | 0.30 |
|  Autocorrelation | 0.03 | 0.20 | -0.07 | 0.08 | -0.06 | -0.10 | -0.03 | 0.01 | 0.14 | -0.05 | -0.03 | -0.11 | 0.13 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.02 | 0.01 | 0.03 | 0.01 | 0.02\* | 0.01 | 0.03\* | 0.04\* | 0.04\* | 0.02\* | 0.02 | 0.03 | 0.02\* |
|  τ | 0.09 | 0.03 | 0.16 | 0.12 | 0.17 | 0.09 | 0.26 | 0.34 | 0.38 | 0.21 | 0.16 | 0.15 | 0.26 |
|  Autocorrelation | 0.03 | 0.30 | -0.19 | 0.03 | -0.03 | 0.01 | 0.04 | -0.03 | 0.15 | 0.04 | -0.01 | -0.15 | 0.18 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.01 | 0.01 | 0.03 | 0.01 | 0.02\* | 0.03\* | 0.04\* | 0.04\* | 0.04\* | 0.02 | 0.00 | 0.01 | 0.02\* |
|  τ | 0.03 | 0.04 | 0.14 | 0.07 | 0.21 | 0.23 | 0.43 | 0.39 | 0.33 | 0.15 | 0.01 | 0.05 | 0.20 |
|  Autocorrelation | 0.03 | 0.31 | -0.17 | 0.11 | -0.02 | 0.02 | -0.18 | -0.08 | 0.22 | 0.04 | -0.03 | -0.08 | 0.24 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.02 | 0.02 | 0.03\* | 0.01 | 0.02\* | 0.02 | 0.03\* | 0.04\* | 0.04\* | 0.02\* | 0.02 | 0.03 | 0.02\* |
|  τ | 0.11 | 0.07 | 0.18 | 0.13 | 0.19 | 0.16 | 0.34 | 0.36 | 0.39 | 0.18 | 0.16 | 0.14 | 0.29 |
|  Autocorrelation | 0.02 | 0.26 | -0.15 | 0.06 | -0.03 | -0.04 | -0.11 | -0.04 | 0.15 | -0.02 | 0.01 | -0.15 | 0.13 |

Table S2b. Mann-Kendall statistics for the recent minimum air temperature (oC) data (1970-2014).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.06 | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.04\* | 0.03\* | 0.03 | 0.03 | 0.05 | 0.04\* |
|  τ | 0.17 | 0.08 | 0.07 | 0.10 | 0.09 | 0.16 | 0.18 | 0.27 | 0.21 | 0.16 | 0.20 | 0.16 | 0.27 |
|  Autocorrelation | 0.02 | 0.20 | -0.15 | 0.15 | -0.09 | -0.17 | 0.04 | -0.09 | 0.15 | -0.02 | 0.00 | -0.12 | 0.07 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.06 | 0.03 | 0.03 | 0.01 | 0.02 | 0.04 | 0.04\* | 0.03\* | 0.05\* | 0.04\* | 0.02 | 0.05 | 0.04\* |
|  τ | 0.15 | 0.06 | 0.13 | 0.10 | 0.10 | 0.19 | 0.24 | 0.21 | 0.30 | 0.21 | 0.12 | 0.15 | 0.29 |
|  Autocorrelation | 0.02 | 0.30 | -0.21 | 0.11 | -0.01 | 0.01 | -0.07 | 0.03 | 0.18 | 0.02 | -0.11 | -0.15 | 0.11 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.03 | 0.04 | 0.04 | 0.02 | 0.02 | 0.05\* | 0.05\* | 0.04\* | 0.04\* | 0.04 | 0.01 | 0.02 | 0.03 |
|  τ | 0.07 | 0.07 | 0.12 | 0.12 | 0.15 | 0.27 | 0.35 | 0.24 | 0.28 | 0.20 | 0.03 | 0.06 | 0.19 |
|  Autocorrelation | 0.07 | 0.30 | -0.18 | 0.19 | 0.01 | -0.04 | -0.12 | -0.02 | 0.19 | 0.02 | 0.03 | -0.07 | 0.22 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.06 | 0.03 | 0.03 | 0.02 | 0.02 | 0.03 | 0.04\* | 0.04\* | 0.04\* | 0.04 | 0.02 | 0.04 | 0.04\* |
|  τ | 0.14 | 0.06 | 0.12 | 0.10 | 0.10 | 0.20 | 0.26 | 0.24 | 0.27 | 0.19 | 0.14 | 0.14 | 0.29 |
|  Autocorrelation | 0.03 | 0.26 | -0.20 | 0.13 | -0.04 | -0.08 | -0.04 | 0.01 | 0.14 | -0.02 | -0.06 | -0.15 | 0.06 |

\* *p* < 0.05

Table S3a. Mann-Kendall statistics for maximum air temperature (oC) data ranging from 1948-2014.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.00 | -0.01 | 0.01 | -0.02 | -0.04\* | -0.05\* | -0.03\* | -0.02\* | -0.02 | -0.04\* | 0.00 | 0.01 | -0.02\* |
|  τ | -0.02 | -0.05 | 0.06 | -0.14 | -0.30 | -0.43 | -0.27 | -0.20 | -0.13 | -0.30 | -0.01 | 0.03 | -0.23 |
|  Autocorrelation | 0.05 | 0.17 | -0.17 | 0.11 | -0.03 | -0.09 | 0.02 | -0.05 | 0.13 | -0.10 | 0.07 | -0.27 | 0.23 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.00 | -0.01 | 0.01 | -0.02 | -0.05\* | -0.06\* | -0.04\* | -0.03\* | -0.01 | -0.03\* | -0.01 | 0.00 | -0.02\* |
|  τ | -0.01 | -0.02 | 0.07 | -0.14 | -0.26 | -0.39 | -0.29 | -0.22 | -0.09 | -0.23 | -0.04 | 0.02 | -0.26 |
|  Autocorrelation | 0.10 | 0.23 | -0.22 | 0.01 | 0.05 | 0.11 | -0.01 | -0.04 | 0.14 | -0.01 | -0.06 | -0.26 | 0.21 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.02 | -0.01 | 0.01 | -0.02 | -0.02 | -0.03\* | -0.02 | -0.02 | 0.00 | -0.03\* | -0.01 | -0.01 | -0.01 |
|  τ | -0.07 | -0.05 | 0.05 | -0.10 | -0.13 | -0.20 | -0.15 | -0.13 | 0.03 | -0.21 | -0.08 | -0.04 | -0.11 |
|  Autocorrelation | 0.14 | 0.25 | -0.18 | 0.06 | 0.00 | 0.12 | 0.00 | -0.04 | 0.07 | -0.02 | 0.00 | -0.06 | 0.28 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.00 | -0.01 | 0.01 | -0.02 | -0.04\* | -0.05\* | -0.03\* | -0.02\* | -0.01 | -0.03\* | 0.00 | 0.00 | -0.02\* |
|  τ | -0.02 | -0.04 | 0.06 | -0.14 | -0.26 | -0.40 | -0.28 | -0.21 | -0.09 | -0.27 | -0.03 | 0.00 | -0.24 |
|  Autocorrelation | 0.08 | 0.20 | -0.21 | 0.06 | -0.03 | -0.02 | -0.03 | 0.03 | 0.12 | -0.07 | 0.01 | -0.27 | 0.20 |

Table S3b. Mann-Kendall statistics for the recent maximum air temperature (oC) data (1970-2014).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.03 | 0.00 | 0.00 | -0.01 | -0.04 | -0.05\* | -0.04 | -0.02 | 0.00 | -0.02 | 0.01 | 0.02 | -0.01 |
|  τ | 0.11 | 0.00 | 0.00 | -0.02 | -0.19 | -0.25 | -0.19 | -0.13 | -0.02 | -0.09 | 0.04 | 0.05 | -0.08 |
|  Autocorrelation | 0.07 | 0.18 | -0.18 | 0.17 | 0.00 | 0.05 | 0.18 | -0.16 | 0.12 | -0.03 | 0.05 | -0.29 | 0.24 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.02 | 0.01 | 0.01 | 0.00 | -0.03 | -0.04 | -0.03 | -0.03 | 0.01 | 0.00 | 0.01 | 0.01 | -0.01 |
|  τ | 0.07 | 0.04 | 0.05 | 0.01 | -0.13 | -0.17 | -0.13 | -0.16 | 0.06 | 0.03 | 0.02 | 0.03 | -0.09 |
|  Autocorrelation | 0.12 | 0.25 | -0.24 | 0.02 | 0.10 | 0.08 | 0.15 | -0.17 | 0.16 | -0.03 | -0.10 | -0.31 | 0.19 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.01 | -0.01 | 0.01 | -0.01 | -0.03 | -0.02 | -0.02 | -0.02 | 0.03 | 0.00 | 0.00 | -0.01 | -0.01 |
|  τ | -0.03 | -0.02 | 0.04 | -0.04 | -0.17 | -0.11 | -0.11 | -0.11 | 0.16 | -0.01 | 0.01 | -0.05 | -0.06 |
|  Autocorrelation | 0.19 | 0.27 | -0.21 | 0.18 | -0.05 | 0.08 | 0.14 | -0.24 | 0.08 | 0.00 | 0.02 | -0.08 | 0.30 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.03 | 0.00 | 0.01 | 0.00 | -0.04 | -0.04\* | -0.04 | -0.02 | 0.01 | -0.01 | 0.01 | 0.01 | -0.01 |
|  τ | 0.07 | 0.00 | 0.03 | -0.01 | -0.17 | -0.21 | -0.16 | -0.15 | 0.03 | -0.03 | 0.05 | 0.01 | -0.09 |
|  Autocorrelation | 0.10 | 0.22 | -0.22 | 0.11 | 0.01 | 0.05 | 0.15 | -0.21 | 0.12 | -0.05 | -0.01 | -0.31 | 0.20 |

\* *p* < 0.05

Table S4a. Mann-Kendall statistics for runoff (mm) data ranging from 1902-2015 (1916-2015 for Georgian Bay and MHG).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.09 | 0.09\* | 0.07 | -0.12 | -0.14 | -0.05 | -0.06 | -0.02 | -0.02 | 0.04 | 0.06 | 0.12\* | -0.02 |
|  τ | 0.11 | 0.13 | 0.05 | -0.08 | -0.12 | -0.05 | -0.08 | -0.03 | -0.03 | 0.05 | 0.06 | 0.15 | -0.02 |
|  Autocorrelation | 0.22 | 0.14 | 0.25 | 0.09 | 0.11 | 0.23 | 0.31 | 0.27 | 0.16 | 0.27 | 0.36 | 0.31 | 0.49 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.11 | 0.07 | -0.18 | -0.15 | -0.03 | 0.04 | 0.02 | 0.05\* | 0.04\* | 0.07\* | 0.09 | 0.08 | -0.03 |
|  τ | 0.11 | 0.10 | -0.08 | -0.11 | -0.04 | 0.08 | 0.06 | 0.17 | 0.14 | 0.18 | 0.12 | 0.10 | -0.03 |
|  Autocorrelation | 0.20 | 0.08 | 0.34 | 0.04 | 0.04 | 0.08 | 0.07 | 0.30 | 0.18 | 0.05 | 0.22 | 0.15 | 0.45 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.86\* | 0.63\* | 0.47\* | -0.48 | -0.68 | -0.29 | -0.36\* | -0.25\* | -0.16 | 0.21 | 0.49\* | 0.97\* | 0.13 |
|  τ | 0.39 | 0.35 | 0.17 | -0.08 | -0.12 | -0.09 | -0.18 | -0.17 | -0.11 | 0.09 | 0.16 | 0.38 | 0.07 |
|  Autocorrelation | 0.05 | 0.15 | 0.08 | 0.10 | 0.01 | 0.09 | 0.09 | 0.18 | 0.02 | -0.10 | -0.08 | -0.11 | 0.15 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.27\* | 0.23\* | 0.02 | -0.15 | -0.18 | 0.01 | -0.03 | 0.03 | 0.03 | 0.13\* | 0.20\* | 0.29\* | 0.08 |
|  τ | 0.27 | 0.25 | 0.02 | -0.08 | -0.11 | 0.01 | -0.03 | 0.07 | 0.08 | 0.19 | 0.20 | 0.30 | 0.10 |
|  Autocorrelation | 0.10 | 0.10 | 0.15 | 0.08 | 0.02 | 0.18 | 0.18 | 0.17 | 0.05 | 0.00 | 0.01 | 0.02 | 0.27 |

Table S4b. Mann-Kendall statistics for the recent runoff (mm) data (1970-2015).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.07 | -0.04 | -0.34 | -0.69\* | -0.14 | -0.03 | -0.07 | -0.16 | -0.30\* | -0.15 | -0.11 | -0.14 | -0.25 |
|  τ | -0.04 | -0.02 | -0.13 | -0.24 | -0.05 | -0.02 | -0.04 | -0.16 | -0.26 | -0.07 | -0.06 | -0.07 | -0.19 |
|  Autocorrelation | 0.30 | 0.04 | 0.00 | -0.16 | -0.01 | -0.13 | 0.12 | 0.38 | -0.03 | 0.19 | 0.28 | 0.08 | 0.17 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.37 | 0.18 | -0.38 | -0.54\* | 0.18 | 0.17\* | 0.05 | 0.08 | 0.00 | 0.06 | 0.07 | 0.02 | -0.03 |
|  τ | 0.19 | 0.14 | -0.15 | -0.22 | 0.11 | 0.22 | 0.12 | 0.19 | 0.00 | 0.05 | 0.05 | 0.02 | -0.03 |
|  Autocorrelation | 0.28 | -0.02 | 0.02 | -0.09 | -0.07 | -0.02 | 0.02 | 0.02 | 0.11 | -0.07 | -0.05 | -0.26 | 0.11 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.69 | -0.01 | -0.54 | -0.70 | -1.35 | 0.12 | -0.09 | -0.07 | -0.42 | -0.37 | 0.49 | 0.71 | -0.08 |
|  τ | 0.16 | -0.01 | -0.09 | -0.07 | -0.09 | 0.01 | -0.01 | -0.02 | -0.15 | -0.08 | 0.08 | 0.13 | -0.02 |
|  Autocorrelation | 0.04 | 0.09 | -0.14 | -0.09 | 0.05 | 0.08 | 0.02 | 0.18 | 0.07 | -0.15 | -0.24 | -0.37 | -0.04 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.21 | 0.11 | -0.40 | -0.60 | -0.24 | 0.01 | 0.02 | -0.04 | -0.26\* | -0.15 | 0.01 | 0.06 | -0.10 |
|  τ | 0.11 | 0.07 | -0.12 | -0.16 | -0.05 | 0.00 | 0.02 | -0.06 | -0.21 | -0.08 | 0.00 | 0.03 | -0.07 |
|  Autocorrelation | 0.19 | 0.04 | -0.04 | -0.20 | -0.02 | -0.03 | 0.06 | 0.29 | 0.01 | -0.06 | -0.07 | -0.25 | -0.02 |

\* *p* < 0.05

Table S5a. Mann-Kendall statistics for cloud cover (%) data ranging from 1948-2011.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.10\* | -0.14\* | -0.29\* | -0.36\* | -0.26\* | -0.30\* | -0.39\* | -0.26\* | -0.27\* | -0.14 | -0.21\* | -0.08 | -0.27\* |
|  τ | -0.22 | -0.25 | -0.35 | -0.32 | -0.29 | -0.25 | -0.22 | -0.19 | -0.18 | -0.11 | -0.28 | -0.15 | -0.26 |
|  Autocorrelation | 0.15 | -0.01 | 0.31 | 0.24 | 0.11 | 0.37 | 0.64 | 0.37 | 0.43 | 0.18 | 0.14 | 0.22 | 0.70 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.06 | -0.10\* | -0.24\* | -0.31\* | -0.24\* | -0.28\* | -0.29\* | -0.26\* | -0.24\* | -0.05 | -0.19\* | -0.05 | -0.20\* |
|  τ | -0.12 | -0.21 | -0.32 | -0.28 | -0.26 | -0.33 | -0.24 | -0.19 | -0.18 | -0.05 | -0.30 | -0.10 | -0.29 |
|  Autocorrelation | 0.03 | 0.00 | 0.19 | 0.26 | 0.21 | 0.20 | 0.49 | 0.55 | 0.41 | 0.15 | 0.10 | 0.27 | 0.65 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.01 | 0.01 | -0.18\* | -0.20\* | -0.09 | -0.15\* | -0.08 | -0.16\* | -0.28\* | -0.09 | -0.16\* | -0.03 | -0.11\* |
|  τ | -0.01 | 0.01 | -0.22 | -0.30 | -0.13 | -0.19 | -0.13 | -0.20 | -0.32 | -0.11 | -0.29 | -0.03 | -0.31 |
|  Autocorrelation | 0.14 | 0.16 | 0.13 | 0.03 | 0.07 | 0.17 | 0.23 | 0.33 | 0.15 | 0.18 | 0.08 | 0.34 | 0.45 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.07 | -0.11\* | -0.25\* | -0.34\* | -0.23\* | -0.27\* | -0.31\* | -0.24\* | -0.26\* | -0.10 | -0.20\* | -0.06 | -0.19\* |
|  τ | -0.15 | -0.23 | -0.35 | -0.33 | -0.30 | -0.31 | -0.24 | -0.20 | -0.20 | -0.11 | -0.31 | -0.12 | -0.31 |
|  Autocorrelation | 0.08 | -0.03 | 0.21 | 0.19 | 0.09 | 0.23 | 0.55 | 0.42 | 0.38 | 0.16 | 0.07 | 0.25 | 0.63 |

Table S5b. Mann-Kendall statistics for the recent cloud cover (%) data (1970-2011).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.10 | -0.27\* | -0.59\* | -0.59\* | -0.48\* | -0.65\* | -0.81\* | -0.81\* | -0.71\* | -0.53\* | -0.44\* | -0.19 | -0.49\* |
|  τ | -0.11 | -0.36 | -0.58 | -0.33 | -0.31 | -0.44 | -0.32 | -0.51 | -0.43 | -0.50 | -0.40 | -0.20 | -0.44 |
|  Autocorrelation | 0.25 | -0.02 | 0.04 | 0.37 | 0.09 | 0.15 | 0.67 | 0.07 | 0.23 | -0.18 | -0.04 | 0.21 | 0.58 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.07 | -0.22\* | -0.53\* | -0.51\* | -0.46\* | -0.56\* | -0.57\* | -0.70\* | -0.67\* | -0.38\* | -0.36\* | -0.10 | -0.39\* |
|  τ | -0.13 | -0.30 | -0.46 | -0.29 | -0.34 | -0.52 | -0.35 | -0.43 | -0.38 | -0.42 | -0.43 | -0.08 | -0.52 |
|  Autocorrelation | 0.03 | -0.05 | 0.05 | 0.35 | 0.10 | -0.05 | 0.53 | 0.39 | 0.24 | -0.09 | -0.06 | 0.32 | 0.45 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.03 | 0.08 | -0.29 | -0.14 | -0.12 | -0.15 | -0.10 | -0.37\* | -0.49\* | -0.23\* | -0.14 | 0.09 | -0.10 |
|  τ | 0.04 | 0.07 | -0.21 | -0.13 | -0.10 | -0.13 | -0.10 | -0.27 | -0.36 | -0.22 | -0.17 | 0.09 | -0.18 |
|  Autocorrelation | 0.18 | 0.21 | 0.14 | 0.18 | 0.05 | 0.11 | 0.32 | 0.38 | 0.12 | 0.08 | 0.05 | 0.42 | 0.49 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.08 | -0.21\* | -0.50\* | -0.50\* | -0.40\* | -0.55\* | -0.65\* | -0.66\* | -0.66\* | -0.43\* | -0.33\* | -0.09 | -0.40\* |
|  τ | -0.13 | -0.30 | -0.51 | -0.31 | -0.34 | -0.51 | -0.33 | -0.50 | -0.43 | -0.49 | -0.43 | -0.10 | -0.50 |
|  Autocorrelation | 0.09 | -0.07 | 0.01 | 0.31 | 0.02 | -0.04 | 0.60 | 0.16 | 0.19 | -0.16 | -0.09 | 0.30 | 0.43 |

\* *p* < 0.05

Table S6a. Mann-Kendall statistics for wind speed (m s-1) data ranging from 1948-2011.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.01\* | -0.01 | -0.02\* | -0.01\* | 0.00\* | 0.00 | 0.01\* | 0.00 | -0.01 | 0.00 | -0.01 | -0.01 | -0.01\* |
|  τ | -0.18 | -0.17 | -0.31 | -0.20 | -0.22 | -0.08 | 0.21 | 0.12 | -0.16 | -0.01 | -0.15 | -0.14 | -0.18 |
|  Autocorrelation | 0.11 | 0.08 | 0.05 | 0.05 | -0.04 | 0.15 | 0.25 | 0.09 | 0.09 | 0.26 | 0.28 | 0.23 | 0.45 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.00 | 0.00 | -0.01 | 0.00 | 0.00\* | 0.00\* | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
|  τ | -0.01 | 0.02 | -0.08 | -0.02 | -0.21 | -0.27 | -0.03 | 0.07 | -0.16 | 0.13 | 0.02 | 0.06 | -0.02 |
|  Autocorrelation | 0.01 | 0.25 | 0.33 | 0.00 | -0.12 | -0.05 | 0.31 | 0.26 | 0.00 | 0.06 | 0.25 | 0.08 | 0.37 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.02 | -0.01 | -0.01\* | -0.01\* | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 | 0.00 | -0.01 | -0.01 | -0.01 |
|  τ | -0.16 | -0.06 | -0.18 | -0.19 | -0.14 | -0.14 | -0.04 | -0.02 | -0.17 | 0.03 | -0.08 | -0.12 | -0.09 |
|  Autocorrelation | 0.48 | 0.29 | 0.34 | 0.13 | 0.16 | 0.31 | 0.38 | 0.23 | 0.19 | 0.31 | 0.61 | 0.45 | 0.74 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.01\* | -0.01 | -0.01\* | 0.00 | 0.00\* | 0.00\* | 0.00 | 0.00 | -0.01\* | 0.00 | -0.01 | 0.00 | 0.00\* |
|  τ | -0.19 | -0.11 | -0.21 | -0.15 | -0.24 | -0.19 | 0.09 | 0.07 | -0.17 | 0.06 | -0.11 | -0.13 | -0.19 |
|  Autocorrelation | 0.00 | 0.12 | 0.20 | 0.03 | -0.08 | 0.05 | 0.30 | 0.08 | 0.04 | 0.10 | 0.29 | 0.07 | 0.35 |

Table S6b. Mann-Kendall statistics for the recent wind speed (m s-1) data (1970-2011).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WATER BODY  | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANN |
| **Lake Michigan** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.03\* | -0.01 | -0.02\* | -0.01 | 0.00 | 0.00 | 0.01 | 0.01 | -0.01 | -0.01 | -0.01 | -0.01 | -0.01 |
|  τ | -0.34 | -0.08 | -0.27 | -0.17 | -0.09 | -0.15 | 0.16 | 0.15 | -0.19 | -0.10 | -0.11 | -0.11 | -0.19 |
|  Autocorrelation | 0.02 | 0.23 | -0.08 | 0.24 | -0.36 | 0.12 | 0.21 | 0.05 | 0.14 | 0.32 | 0.18 | 0.40 | 0.40 |
| **Lake Huron** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01\* | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
|  τ | -0.07 | 0.14 | -0.02 | -0.02 | -0.07 | -0.18 | 0.10 | 0.29 | -0.09 | 0.10 | 0.04 | 0.00 | 0.11 |
|  Autocorrelation | -0.04 | 0.28 | 0.09 | -0.03 | -0.28 | -0.05 | 0.27 | 0.05 | 0.04 | -0.01 | 0.13 | -0.01 | 0.03 |
| **Georgian Bay** |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.02 | 0.02 | -0.01 | -0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 |
|  τ | -0.12 | 0.12 | -0.07 | -0.11 | 0.02 | -0.01 | 0.11 | 0.13 | -0.01 | 0.07 | 0.02 | 0.03 | 0.05 |
|  Autocorrelation | 0.57 | 0.36 | 0.40 | 0.31 | 0.12 | 0.42 | 0.42 | 0.18 | 0.19 | 0.32 | 0.67 | 0.46 | 0.77 |
| **MHG** |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  Trend | -0.01\* | 0.00 | -0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | -0.01 | 0.00 | 0.00 | -0.01 | 0.00 |
|  τ | -0.22 | 0.00 | -0.16 | -0.11 | -0.09 | -0.14 | 0.15 | 0.20 | -0.16 | -0.02 | -0.04 | -0.07 | -0.06 |
|  Autocorrelation | 0.01 | 0.24 | 0.02 | 0.07 | -0.33 | 0.07 | 0.29 | -0.02 | 0.02 | 0.12 | 0.23 | 0.19 | 0.33 |

\* *p* < 0.05

**Figure S1:** Annual time series analysis for over-lake evaporation, over-lake precipitation, maximum air temperature, minimum air temperature, cloud cover, wind speed, and runoff. Black, red, green, and blue lines represent smoothed data for Michigan-Huron-Georgian Bay (MHG), Lake Michigan (M), Lake Huron (H), and Georgian Bay (G), respectively. The gray lines in the background of each colored line represent the original time series data. All presented time series were smoothed using a 13-data point filter.