A Comparative Study of Evapotranspiration Measurements in a Wetland

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INTRODUCTION

Evapotranspiration is the return of water to the atmosphere through the process of evaporation and transpiration. It is often a key source of water loss in a wetland, thus properly representing it is essential when calculating a water budget. The ways to determine evapotranspiration range from simple physical methods to complex mathematical models. Taking place in a small coastal wetland in Woodlawn Beach State Park, Blasdell, New York, this two year study seeks to compare the various methods of finding evapotranspiration with the objective of determining if complex, cumbersome equations are truly necessary to provide accurate results.


Weather station in wetland-B.


Atmometer in wetland-A.


Class-A pan next to wetland-A.


Weather station in wetland-B.


Turbine construction just north of the study site.

METHODS

Five calculations and two physical devices, a C & M Model-A Atmometer and a Class-A pan, were used in this study. Meteorological data used was aggregated from two field weather stations, Buffalo State College's weather station and the NWS in Buffalo, NY. The following lists the measured variables needed for each method, ranked from simplest to most complex:

Atmometer:
- None

Type-A Evaporation Pan:
- Daily precipitation

Thornthwaite:
- Mean monthly air temperature
- Latitude for a correction factor

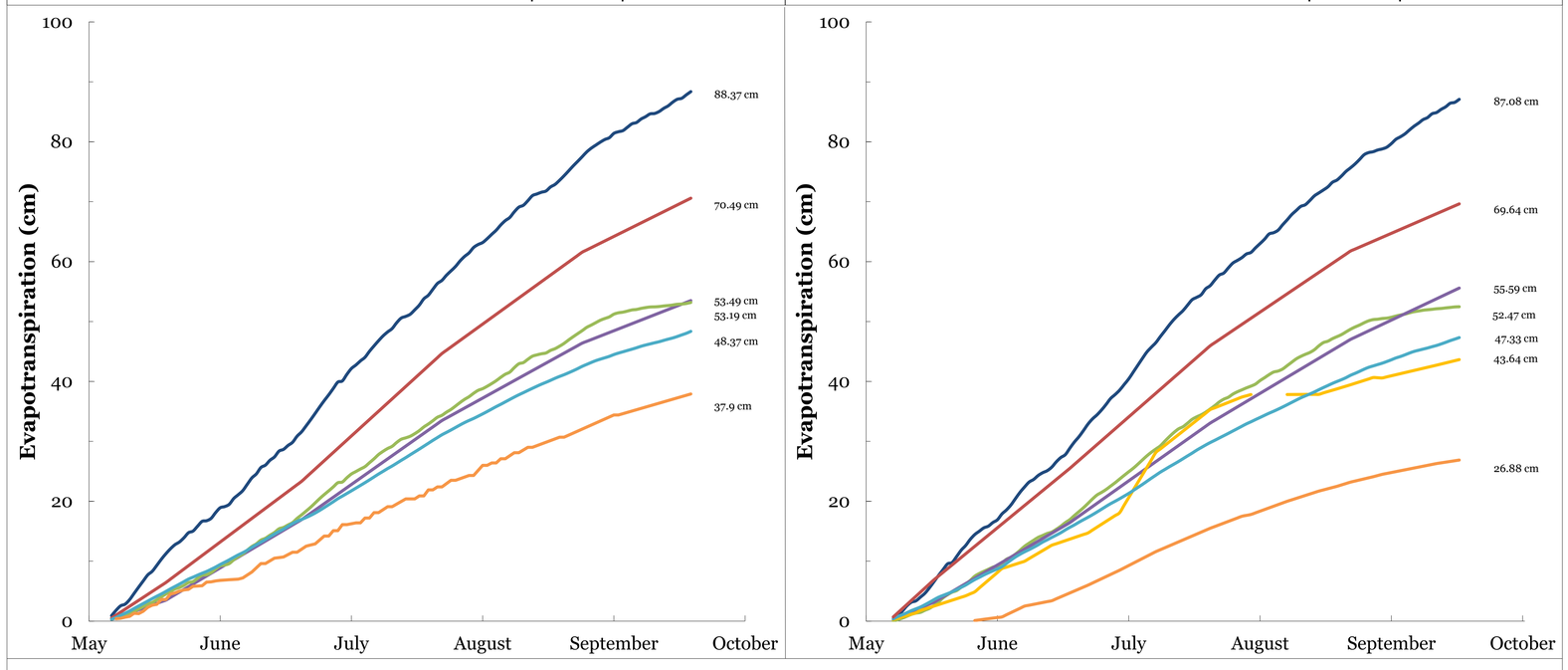
Hamon:
- Monthly average of daylight hours
- Daily mean temperature

Priestley-Taylor:
- Mean daily air temperature
- Daily net radiation

Penman:
- Mean monthly air temperature
- Mean monthly net radiation
- Mean monthly relative humidity
- Mean monthly wind speed

Modified Penman-Monteith:
- Mean hourly air temperature
- Mean hourly wind speed
- Mean hourly net solar radiation
- Mean hourly humidity
- Mean hourly Atmospheric pressure
- Cover coefficient (Kc) for a correction factor

RESULTS



2010	Mean Air Temperature (°C)	Mean Net Radiation (cal/cm²/day)	Mean Relative Humidity (%)
May	16.0	463.1	73.8
June	21.1	446.7	80.7
July	25.0	515.0	78.6
August	21.8	428.3	80.2
September	17.7	314.1	80.0
2011	Mean Air Temperature (°C)	Mean Net Radiation (cal/cm²/day)	Mean Relative Humidity (%)
May	20.7	444.0	70.9
June	21.9	477.2	78.3
July	25.2	491.8	77.5
August	22.1	394.3	78.5
September	18.4	337.1	80.5

DISCUSSION

The results for seasonal evapotranspiration between the various methods varied considerably and produced no general agreement. The seasonal totals of the different methods ranked in the same order from year to year, additionally the same four groupings occurred. While the ranking did not change, the Atmometer's total in 2011 is lower than 2010 due to a late deployment. The Thornthwaite, Modified Penman-Monteith, and Hamon calculations all produced totals in general agreement, and for both years it wasn't until mid-June that the values differentiated. The Type-A pan fits into this grouping for 2011, it also showed the most responsiveness to the seasonal environmental changes – especially a stretch of hot days in July. The data gap for the Type-A pan was due to vandalism. The Priestley-Taylor method had the largest seasonal total for both years: 20% greater than the second largest, Penman.

The most complex equation, Modified Penman-Montheith, and the simplest, Thornthwaite, produced the most similar results. The Thornthwaite method, the simplest calculation, is the best to use if weather data is unavailable.