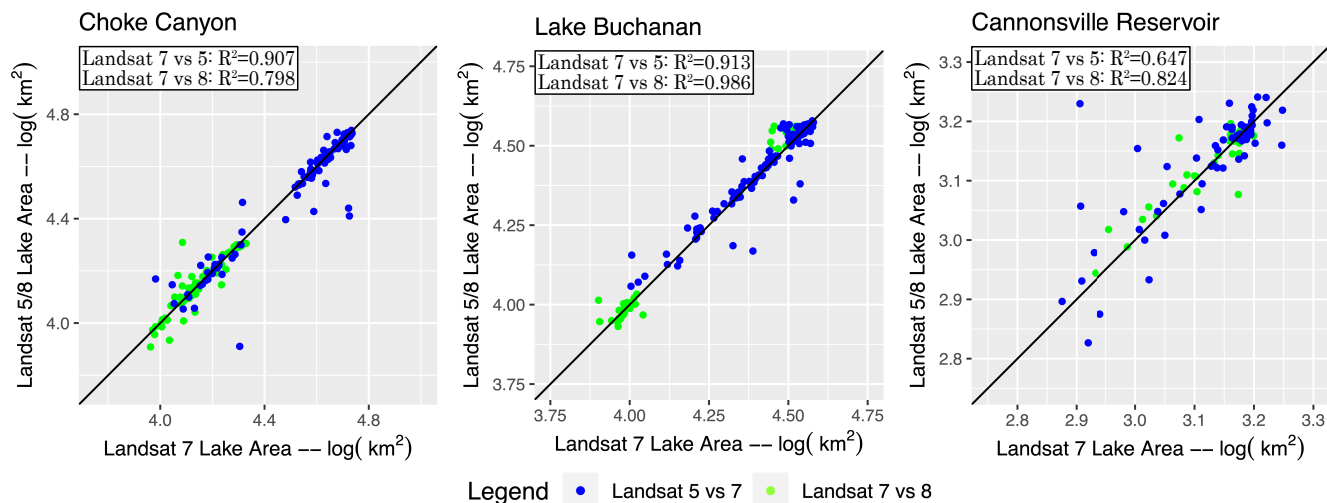


## S1 Landsat 5/7/8 Comparison for Validation Sites



**Figure S 1.** Scatter-plot of Landsat 5/8 against Landsat 7 water extent estimates for all of the validation sites (Choke Canyon, Lake Buchanan and Cannonsville Reservoir).  $R^2$  on normal scale.

## S2 Validation sites in situ data

### S2.1 Lake Buchanan and Choke Canyon Reservoir

5 Daily water surface elevation readings were performed with a gauge by USGS from 1999 (Choke Canyon Reservoir) and 1938 (Lake Buchanan) to present according to the NGVD 1929 datum. The Texas Water Development Board (TWDB) did bathymetric surveys each site, Lake Buchanan in 2006 and Choke Canyon Reservoir in 1999 and 2012 to create Elevation-Area-Capacity curves. The TWDB combined both data sources to calculate daily averaged water surface areas. These values were then translated to monthly averaged water surface areas so they could match the temporal scale of the composites in our model.

### 10 S2.2 Cannonsville Reservoir

15 From 2013 to 2015, bathymetric surveys of New York City's six West of Hudson reservoirs (Ashokan, Cannonsville, Neversink, Pepacton, Rondout, and Schohaire) were done by USGS to provide updated capacity tables and bathymetric maps Survey and Nystrom (2018). Contours were mapped at 2-foot intervals and capacity was calculated at 0.01-foot intervals. An area-capacity curve based on NAVD88 was created from the elevation-area-capacity table using polynomial curve fitting. The area-capacity curve was then used in conjunction with historical surface-water monthly statistics by USGS for Cannonsville Reservoir to produce monthly water surface area. Since the historical surface-water data was only available based on NGVD29 datum the elevations were converted to NAVD of 1988 by subtracting 0.60 ft (VERTCON).

### S3 Google Earth Engine Cloud Detection Algorithm

To score Landsat pixels by their relative cloudiness, Google Earth Engine utilizes a rudimentary cloud scoring algorithm that is called by the following function:

*ee.Algorithms.Landsat.simpleCloudScore()*

The method takes as input, a cloudy Landsat scene for analysis. A cloud score band is added automatically and called 'cloud.'  
20 The cloud band contains the cloud score from 0 (not cloudy) to 100 (most cloudy) for a given pixel. Cloud score is determined based on several indicators of cloudiness of which it takes the minimum of them. They are as follows:

- Clouds are reasonably bright in the blue band.
- Clouds are reasonably bright in all visible bands.
- Clouds are reasonably bright in all infrared bands.
- 25 – Clouds are reasonably cool in temperature.
- Clouds are not snow.

Next you can mask can be created from a determined cloud score threshold and combined with a given scene to remove pixels deemed cloudy.

## References

- 30 Survey, U. S. G. and Nystrom, E. A.: Bathymetry of Ashokan, Cannonsville, Neversink, Pepacton, Rondout, and Schoharie Reservoirs, New York, 2013–15, Tech. rep., Reston, VA, <https://doi.org/10.3133/sir20175064>, <http://pubs.er.usgs.gov/publication/sir20175064>, 2018.