NOAA Technical Services Publication NOS CO-OPS 002

NOTICE OF SERVICES UPDATE: NOAA DAILY MAXIMUM AND MINIMUM WATER LEVELS

Silver Spring, Maryland
May 2025

noaa National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF COMMERCE
National Ocean Service
Center for Operational Oceanographic Products and Services

Center for Operational Oceanographic Products and Services
National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

The National Ocean Service (NOS) Center for Operational Oceanographic Products and Services (CO-OPS) provides the National infrastructure, science, and technical expertise to collect and distribute observations and predictions of water levels and currents to ensure safe, efficient and environmentally sound maritime commerce. The Center provides the set of water level and tidal current products required to support NOS' Strategic Plan mission requirements, and to assist in providing operational oceanographic data/products required by NOAA's other Strategic Plan themes. For example, CO-OPS provides data and products required by the National Weather Service to meet its flood and tsunami warning responsibilities. The Center manages the National Water Level Observation Network (NWLON), a national network of Physical Oceanographic Real-Time Systems (PORTS®) in major U.S. harbors, and the National Current Observation Program consisting of current surveys in near shore and coastal areas utilizing bottom mounted platforms, subsurface buoys, horizontal sensors and quick response real time buoys. The Center: establishes standards for the collection and processing of water level and current data; collects and documents user requirements, which serve as the foundation for all resulting program activities; designs new and/or improved oceanographic observing systems; designs software to improve CO-OPS' data processing capabilities; maintains and operates oceanographic observing systems; performs operational data analysis/quality control; and produces/disseminates oceanographic products.

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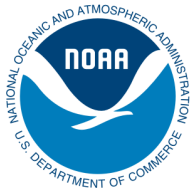
May 2025



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OVERVIEW

NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) is the authoritative source for accurate, reliable, and timely tides, water levels, currents, and other coastal oceanographic and meteorological information. Its mission is to support the nation's economy and safeguard coastal communities with coastal oceanographic information accessible by anyone, at any time.

Quality controlled water level observations ("verified") and a variety of derived products are publicly available through CO-OPS's website and through the CO-OPS data APIs[1]. These verified water level data serve as the foundation for several derived products across NOAA's National Ocean Service (NOS):

1. Tidal analysis, including determination of tidal datums[2] (CO-OPS, 2001), prediction of tides[3] (Parker, 2007), and harmonic analysis[4] (Parker, 2007).
2. Sea level trends and projections, including but not limited to relative sea level trends (Zervas, 2009) and sea level changes (Sweet et. al., 2022), extreme water level analysis (Zervas, 2013; Sweet et. al., 2022; Callahan et. al., 2025), mean sea level projections (Sweet et al., 2022), and support planning and decision support tools like the Sea Level Calculator[5].
3. Coastal Flooding, including high tide flooding statistics (Sweet et. al., 2014), annual high tide flooding outlook[6] (Sweet et. al., 2018) and projections, inundation analysis, storm peak totals, and identification of top 10 water level events.
4. Model integration, including storm surge forecast and validation (CO-OPS' Operational Forecast Systems models[7], Office of Coast Survey's surge models[8]), assimilation and validation of historical analyses of water level data, such as in CORA (Keeney et al., 2025).

Several of the products above depend on a maximum daily water level derived from six-minute/ hourly heights, with some depending on longer time series data. Computation and integration of daily maximum water levels into many of these products is often done through the CO-OPS APIs. However, data retrieval through the API is limited to 1 month for six-minute water level data (or approximately 7,200 data points) and 1 year for hourly heights (approximately 8,760 data points). This limitation forces analysts, product owners, and end users interested in longer time series to invest additional effort, time, and expertise to get the needed data. Often, this adds unnecessary loads to API calls impacting their computational performance. In addition, users may also have to manually quality control the daily max values in cases where complete sets of observations aren't available in a given day (i.e. 240 six-minute values or 24-hourly height water level values).

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[1] https://tidesandcurrents.noaa.gov/api-helper/url-generator.html

[2] https://tidesandcurrents.noaa.gov/stations.html?type=Datums

[3] https://tidesandcurrents.noaa.gov/tide_predictions.html

[4] https://tidesandcurrents.noaa.gov/stations.html?type=Harmonic+Constituents

[5] https://coast.noaa.gov/sealevelcalculator

[6] https://tidesandcurrents.noaa.gov/pub.html#popular

[7] https://tidesandcurrents.noaa.gov/forecast_info.html

[8] https://www.nauticalcharts.noaa.gov/learn/storm-surge-modeling.html#:~:text=The%20Office%20of%20Coast%20Survey,coastal%20vulnerability%20to%20natural%20disasters.

1. NEW DATA SERVICE

A new daily maximum (hereafter referred to as "max") and minimum ("min") water level product is available to mitigate these issues and increase reliability and reproducibility of many derived products. Daily max/min data have been computed for more than 12 million data points for 1,733 stations and stored in both local and GMT time zones (Appendix I). The data API has been enhanced to allow public data calls for the new min/max product and is now readily available for the public.

The min/max product also now includes percent completeness as part of the quality control metadata (equation 1). This change improves the performance of derived computational products, quality, and usability for stakeholders. Enhanced metadata of these new daily values can improve performance of machine learning/deep learning applications. This advancement helps planners and decision makers gain a better understanding of the extremes of daily max/min water levels, inter-annual variability, and trends.

$$pc = \frac{o_a}{o_e} \times 100 \qquad \text{..... Equation 1}$$

Where: pc is the percent completeness of the daily max/min in a given day, o_a is the number of available observations in a given day and o_e is the number of complete sets of expected observations in a given day.

The daily mx/min will be computed and stored through an automated and scheduled process following the routine monthly processing, tabulation and verification of all water level data for all active stations. This one-time effort saves product owners and end users tremendous amount of time and effort.

This data will serve as a consistent product for all the derived products and the percent completeness will serve as a quality control parameter that allows product owners to refine and improve the skill of their models, scripts, and codes.

Data API Query Parameters

Daily max/min water levels can be queried using the data API based on the following parameters:

- **station**: 7-character station ID parameter. Please refer to the water level station page[9] to identify the station ID of interest.
- **begin_date/end_date**: the date/time range of retrieval in yyyyMMdd format
- **datum**: vertical reference point desired[10]
- **time_zone**: data retrieval time zone (Greenwich Mean Time (gmt) or Local Standard Time (lst))
- **units**: data retrieval unit (english (feet) or metric (meters))
- **format**: data output format (Extensible Markup Language (xml) or Javascript Object Notation (json) or Comma Separated Values (csv))
- **max_min_type**: optional parameter for daily extreme data of interest (max or min)
- **interval**: an optional parameter for data point interval (six-minute (6) or hourly (h))

[9] https://tidesandcurrents.noaa.gov/stations.html?type=Water+Levels

[10] https://tidesandcurrents.noaa.gov/stations.html?type=Datums

The data API query format is as follows:

https://API.tidesandcurrents.noaa.gov/API/prod/datagetter?begin_date={begin_date}&end_date={end_date}&station={station}&product=**daily_max_min**&datum={datum}&time_zone={time_zone}&units={units}&format={format}&max_min_type={max_min_type}&interval={interval}(Appendix II, Appendix III).

If a user doesn't specify the 'interval' and /or 'max_min_type', the default output is hourly height derived daily max.

For example, Figure 1 was queried using the following:
https://api.tidesandcurrents.noaa.gov/api/prod/datagetter?begin_date=20240101&end_date=20241231&station=8727520&product=daily_max_min&datum=MHHW&time_zone=gmt&units=english&format=json&max_min_type=max&interval=6

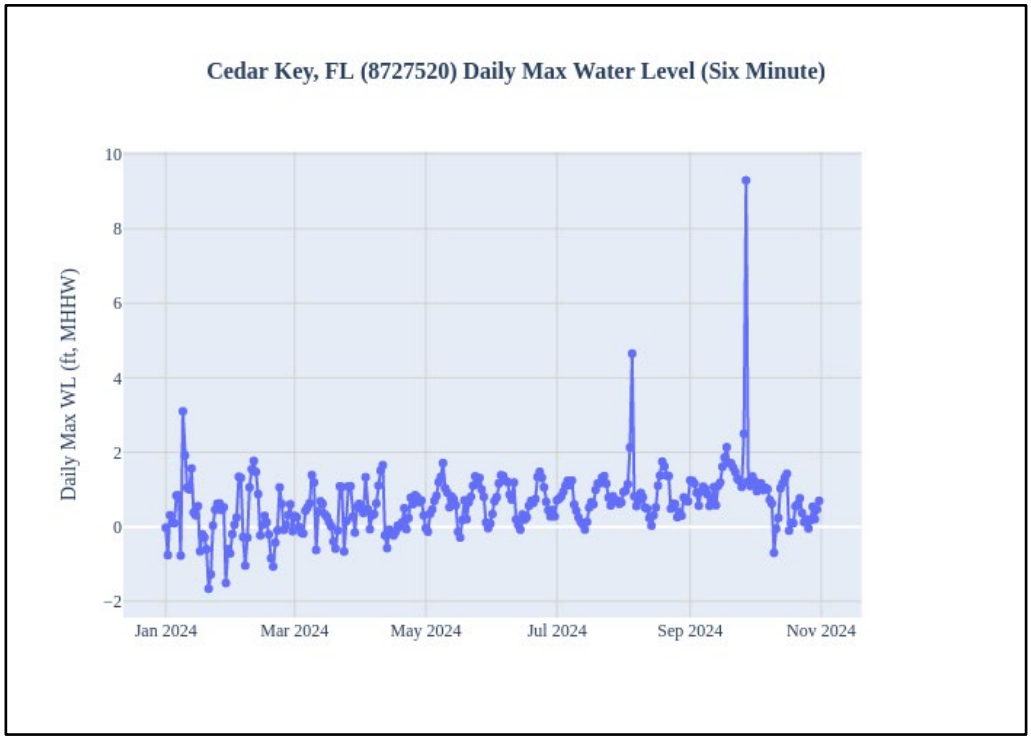

Figure 1. Daily maximum water level spanning Jan 2024 to Nov. 2024 queried through the data API and derived from six-minute observations.

Data API Output Field Descriptions

Daily max/min water levels derived from six-minute data (Figure 1)

- **date6Min**: date of the max or min six-minute water level record
- **time6Min**: time of the max or min six-minute water level record
- **value6Min**: the measured max or min six-minute water level height

- **pcComplet6Min**: Percent Completeness - Percentage of the available six-minute water level data per day (number of six-minute records ÷ the expected 6-minute records in 24 hours which is 240) × 100)
- **flag6Min**: a data flag that is set to 1 to indicate the max or min six-minute water level value has been inferred

Daily max/min water levels derived from hourly data

- **dateHourly**: date of the max or min hourly water level record
- **timeHourly**: time of the max or min hourly water level record
- **valueHourly**: the measured max or min hourly water level height
- **pcCompleteHourly**: Percent Completeness - Percentage of the available hourly water level data per day ((number of hourly records ÷ the expected hourly records in 24 hours which is 24) × 100)
- **flagHourly**: a data flag set to 1 to indicate the max or min hourly water level value has been inferred.

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APPENDIX

I. Water level and percent completeness across multiple stations

A. Daily Maximum Hourly Water Level

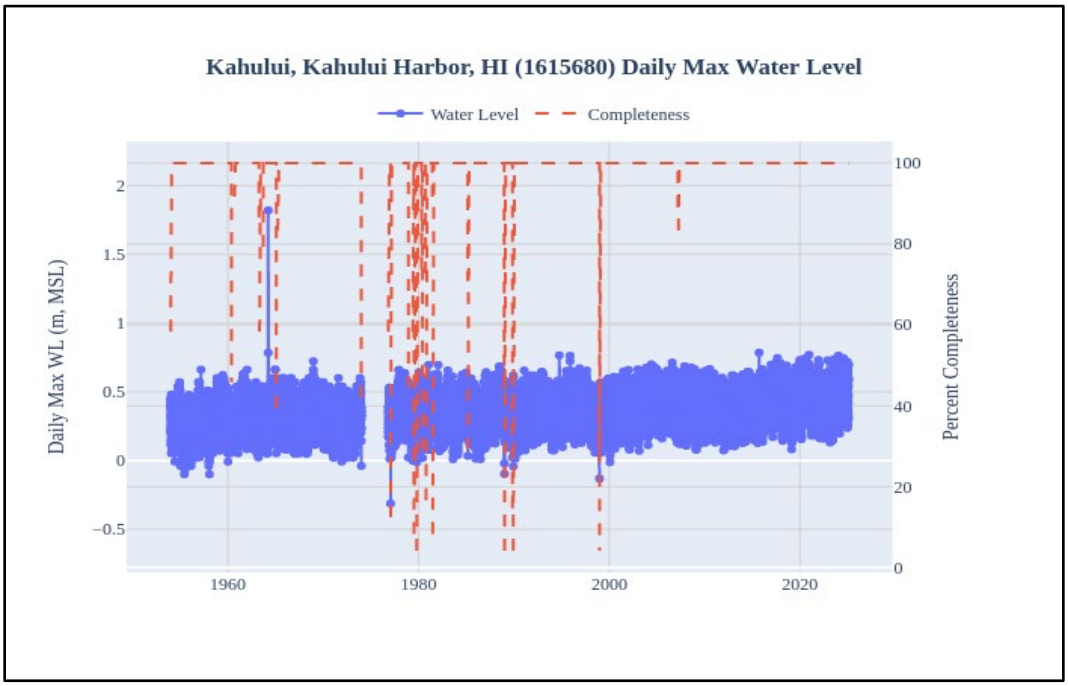

Figure 2. Period of record daily max hourly water levels and percent completeness for Kahului, Kahului Harbor, HI (1615680)

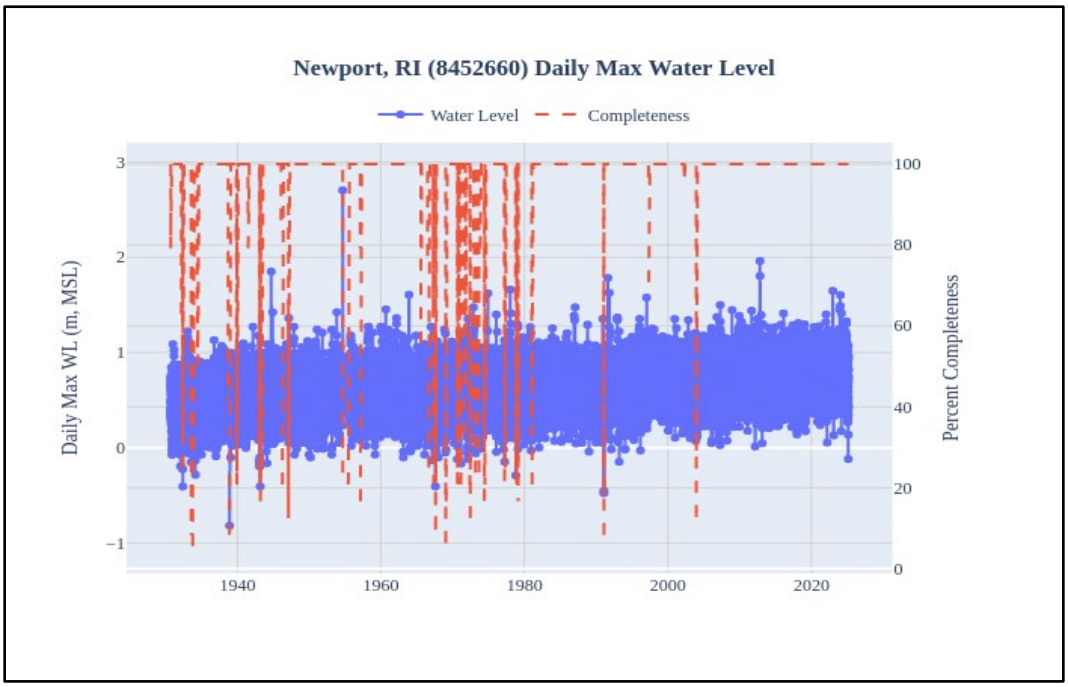

Figure 3. Period of record daily max hourly water levels and percent completeness for Newport, RI (8452660)

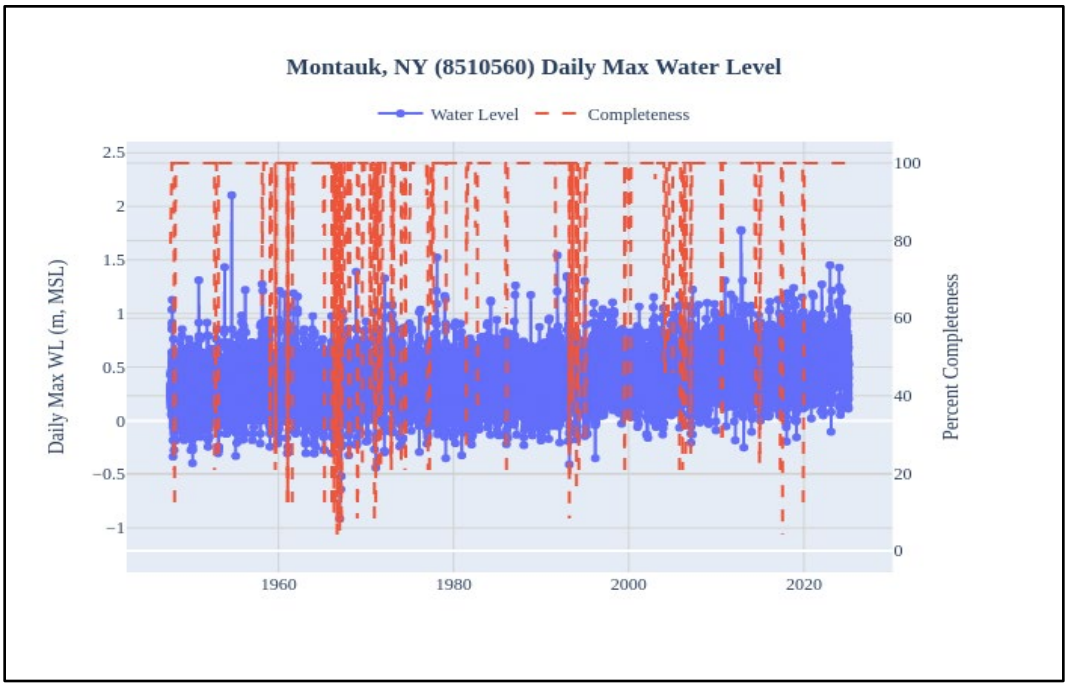

Figure 4. Period of record daily max hourly water levels and percent completeness for Montauk, NY (8510560)

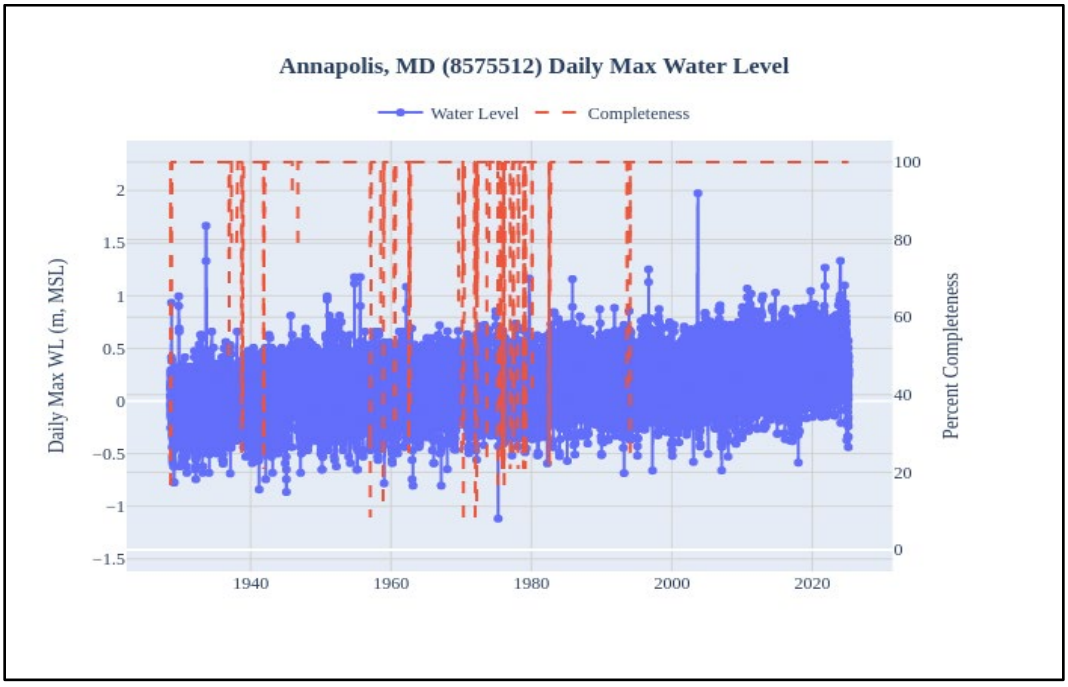

Figure 5. Period of record daily max hourly water levels and percent completeness for Annapolis, MD (8575512)

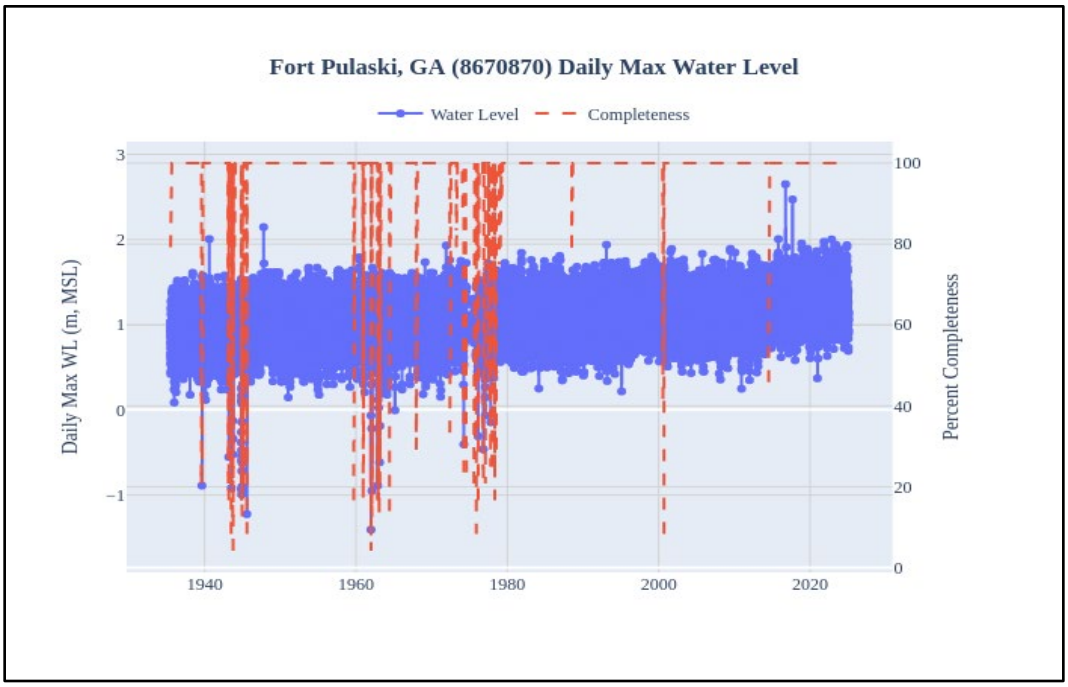

Figure 6. Period of record daily max hourly water levels and percent completeness for Fort Pulaski, GA (8670870)

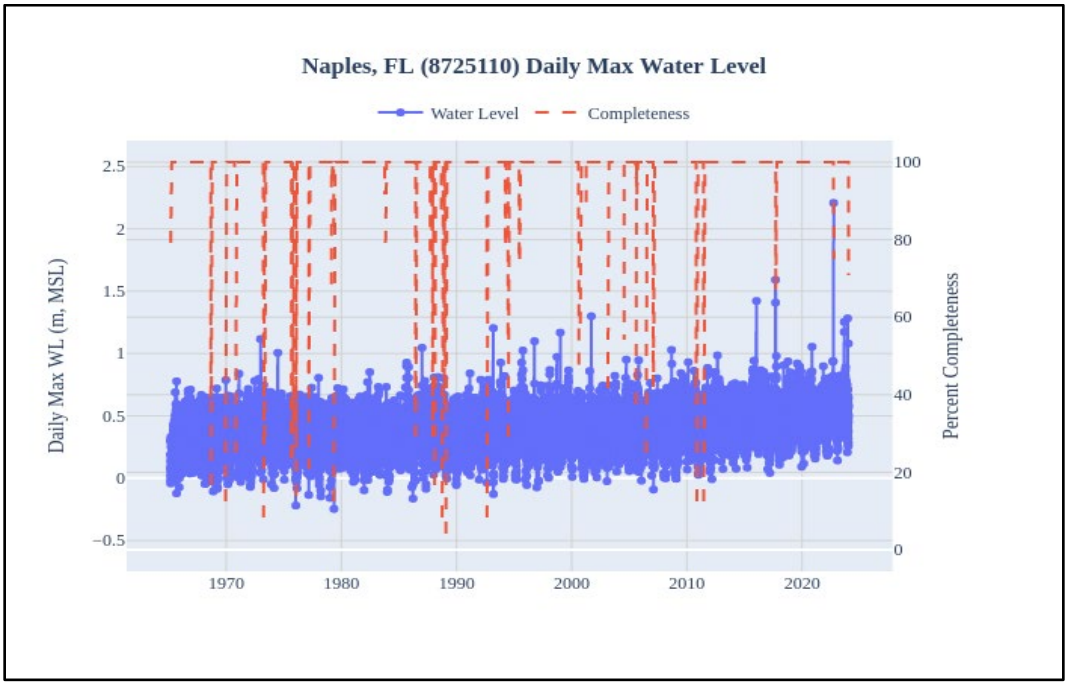

Figure 7. Period of record daily max hourly water levels and percent completeness for Naples, FL (8725110)

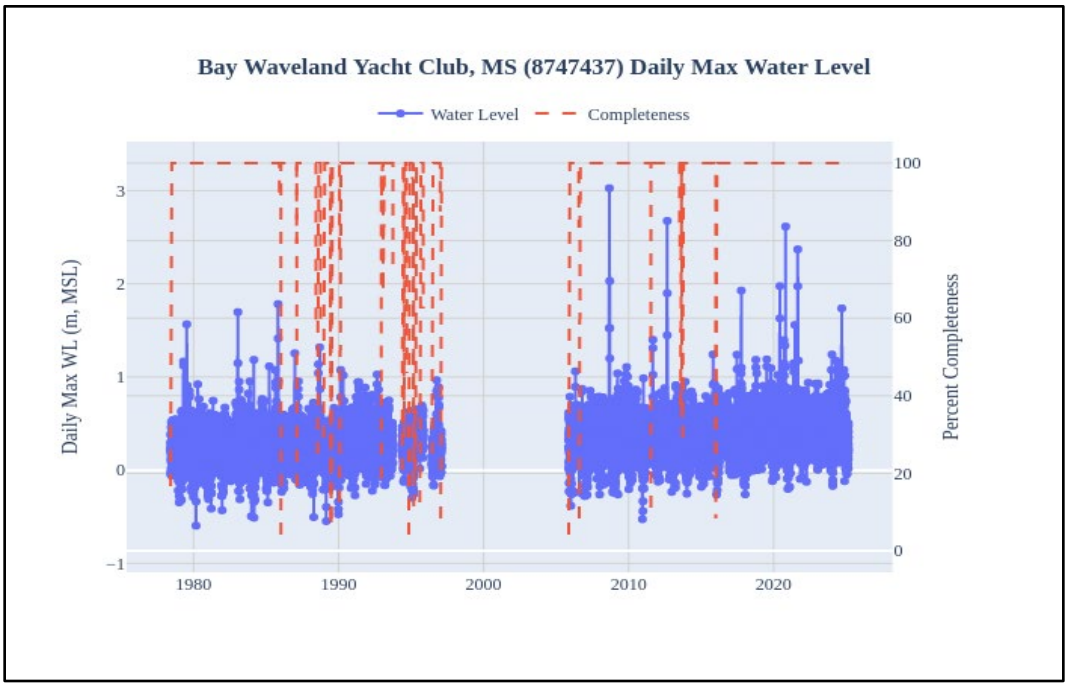

Figure 8. Period of record daily max hourly water levels and percent completeness for Bay Waveland Yacht Club, MS (8747437)

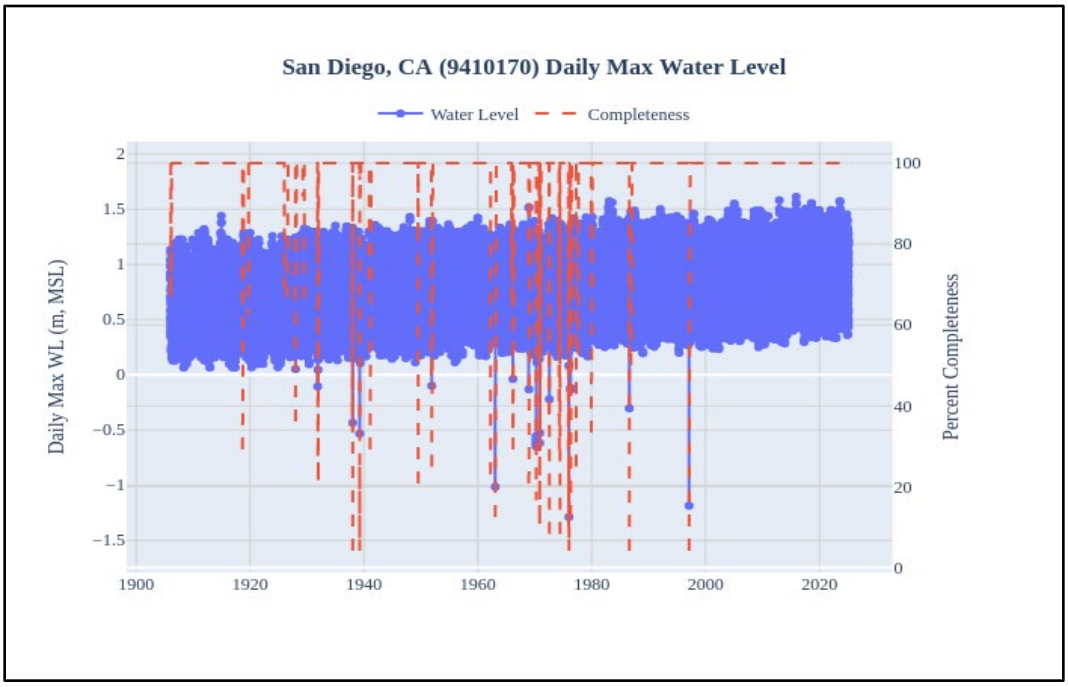

Figure 9. Period of record daily max hourly water levels and percent completeness for San Diego, CA (9410170)

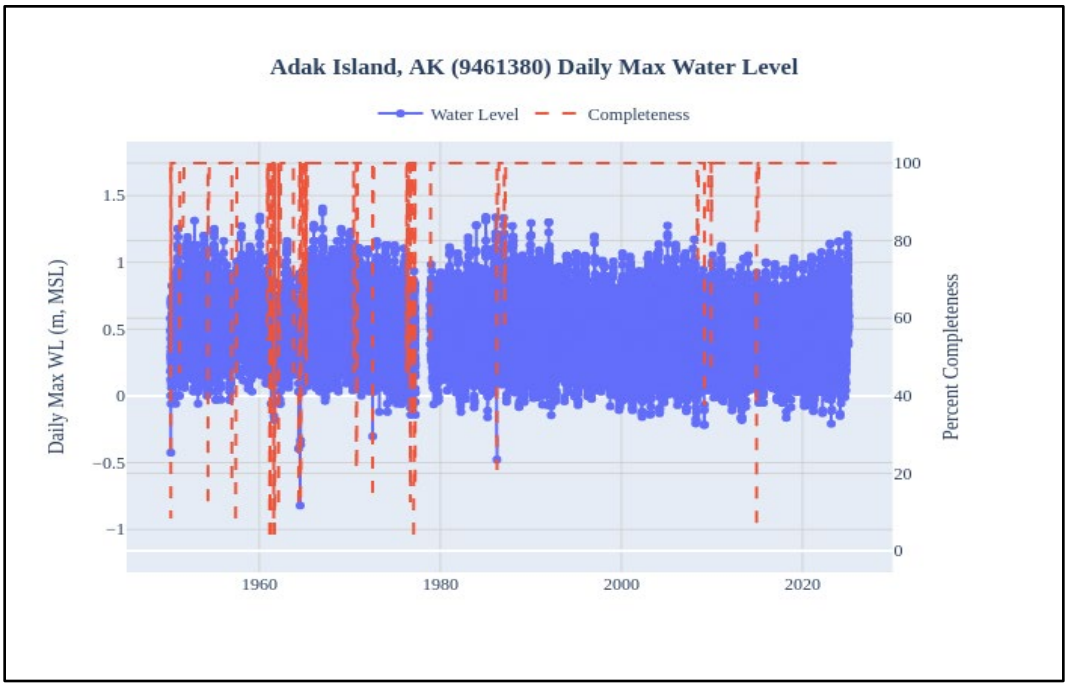

Figure 10. Period of record daily max hourly water levels and percent completeness for Adak Island, AK (9461380)

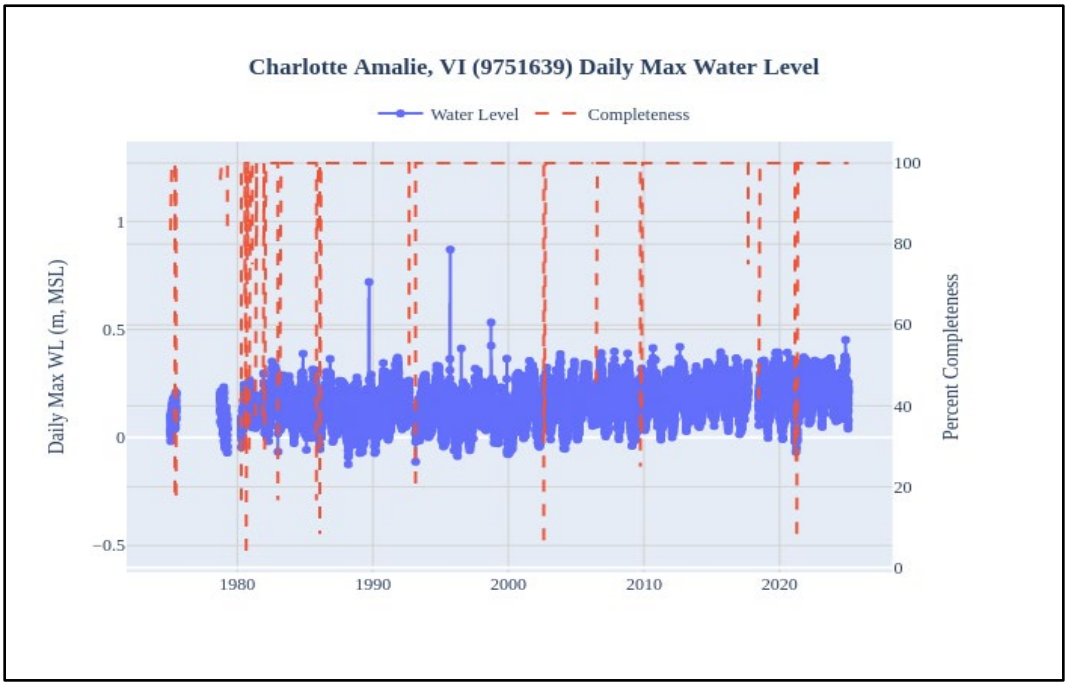

Figure 11. Period of record daily max hourly water levels and percent completeness for Charlotte Amalie, VI (97516390)

B. Daily Minimum Hourly Water Level

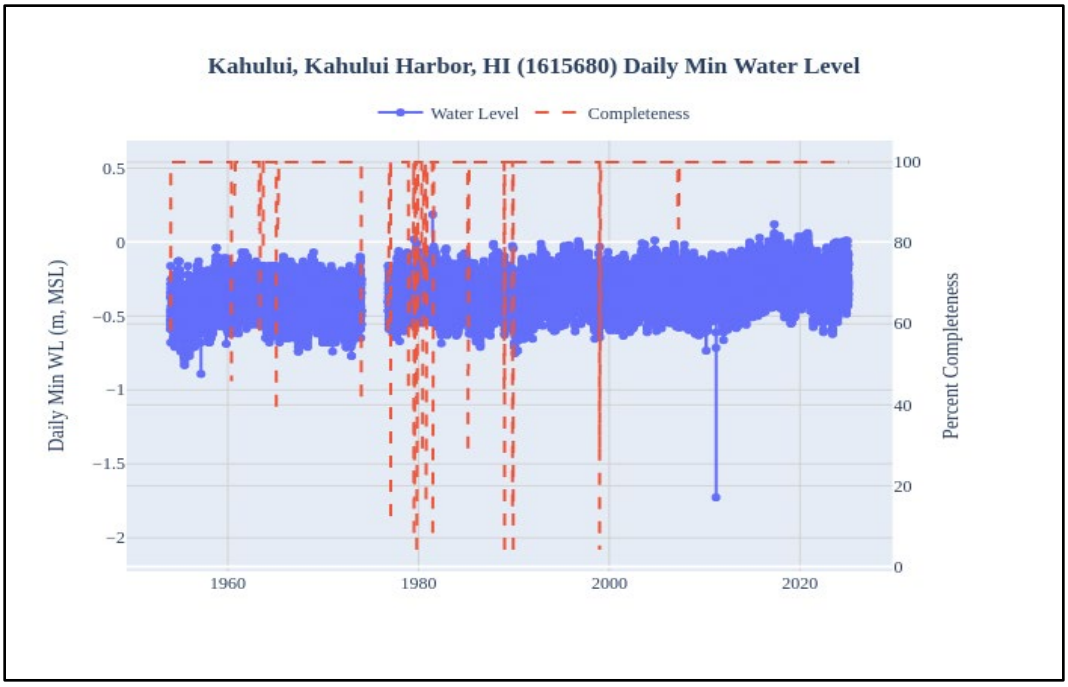

Figure 12. Period of record daily min hourly water levels and percent completeness for Kahului, Kahului Harbor, HI (1615680)

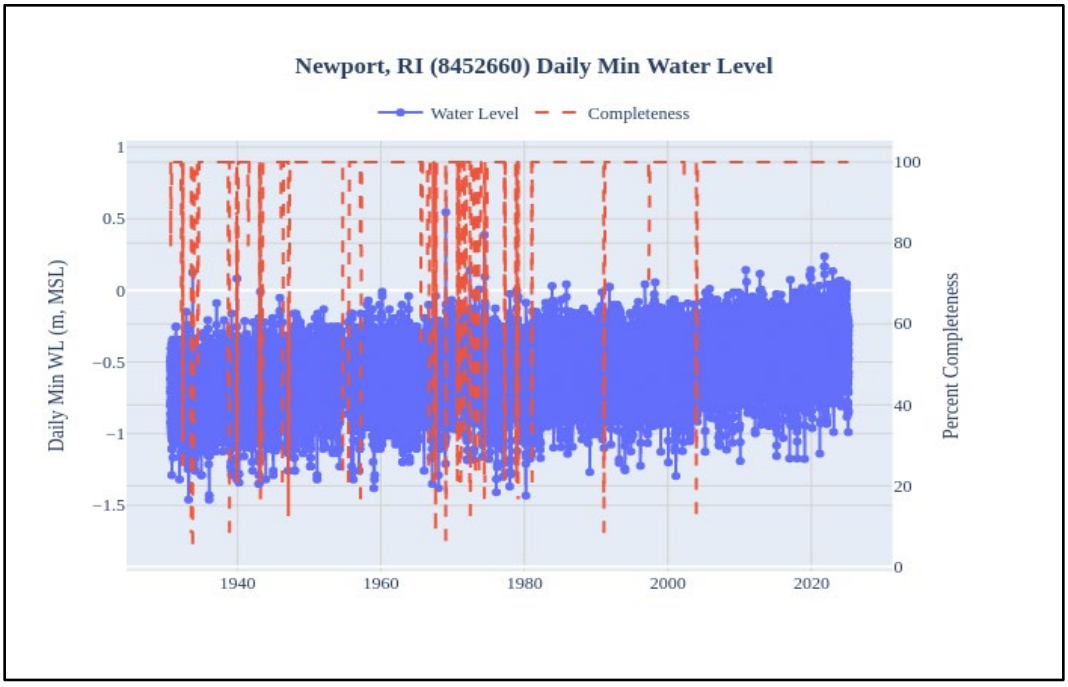

Figure 13. Period of record daily min hourly water levels and percent completeness for Newport, RI (8452660)

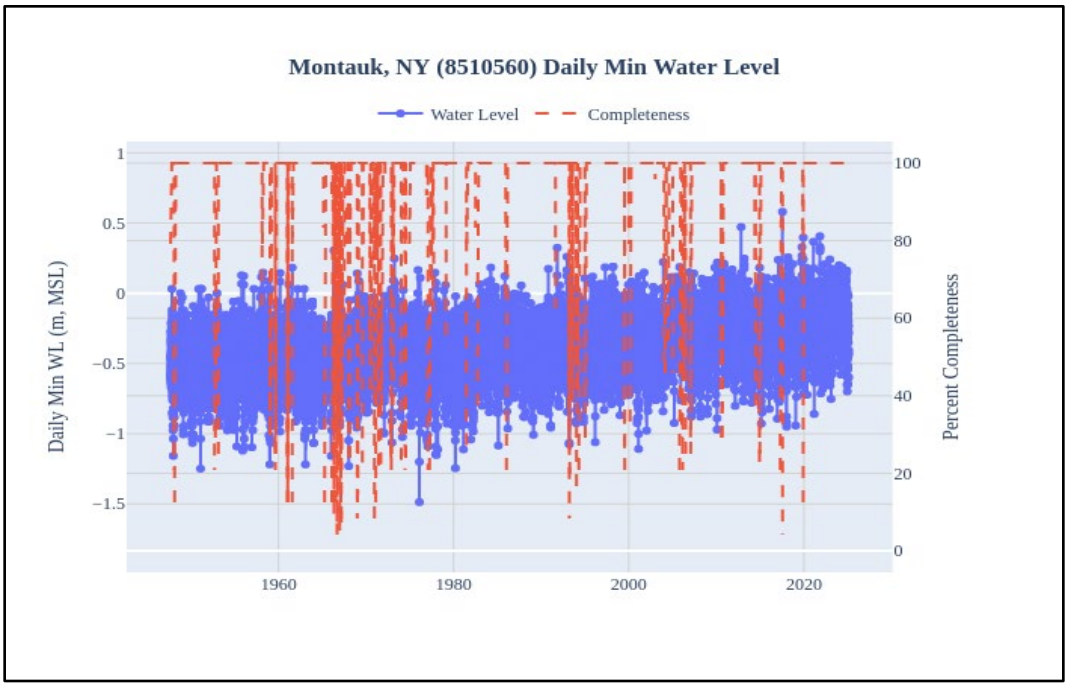

Figure 14. Period of record daily min hourly water levels and percent completeness for Montauk, NY (8510560)

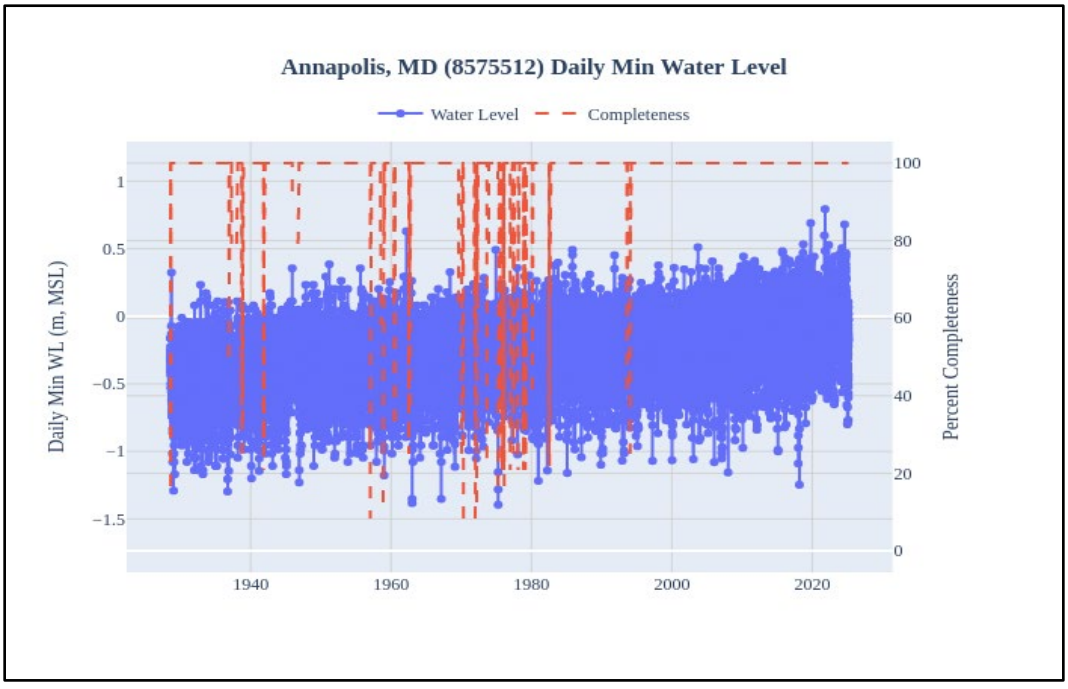

Figure 15. Period of record daily min hourly water levels and percent completeness for Annapolis, MD (8575512)

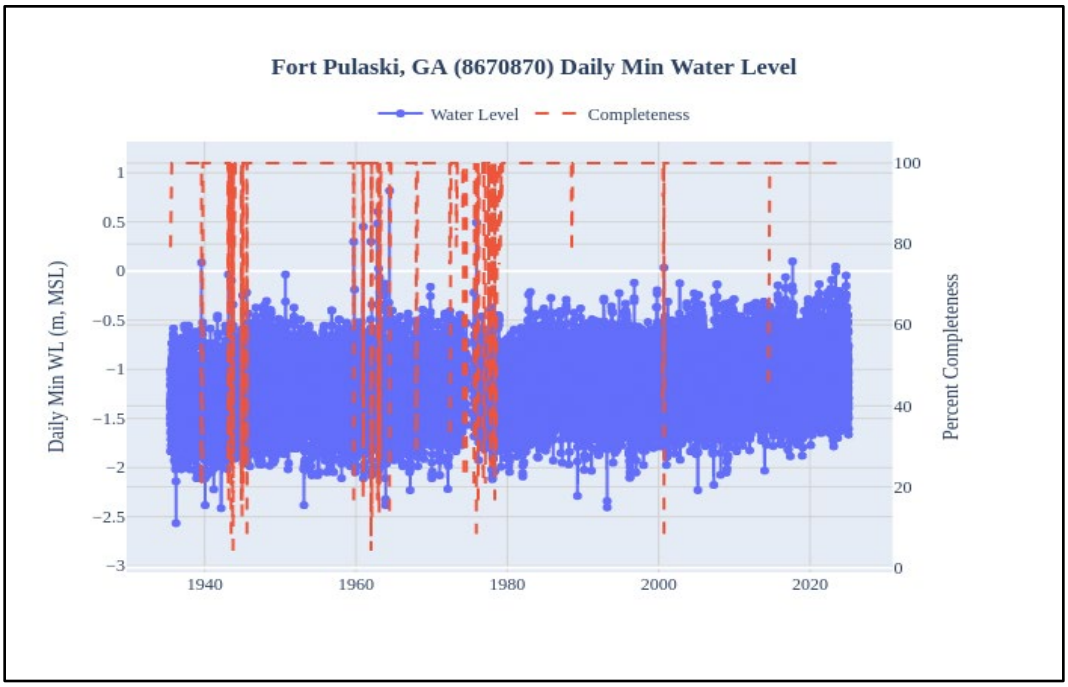

Figure 16. Period of record daily min hourly water levels and percent completeness for Fort Pulaski, GA (8670870)

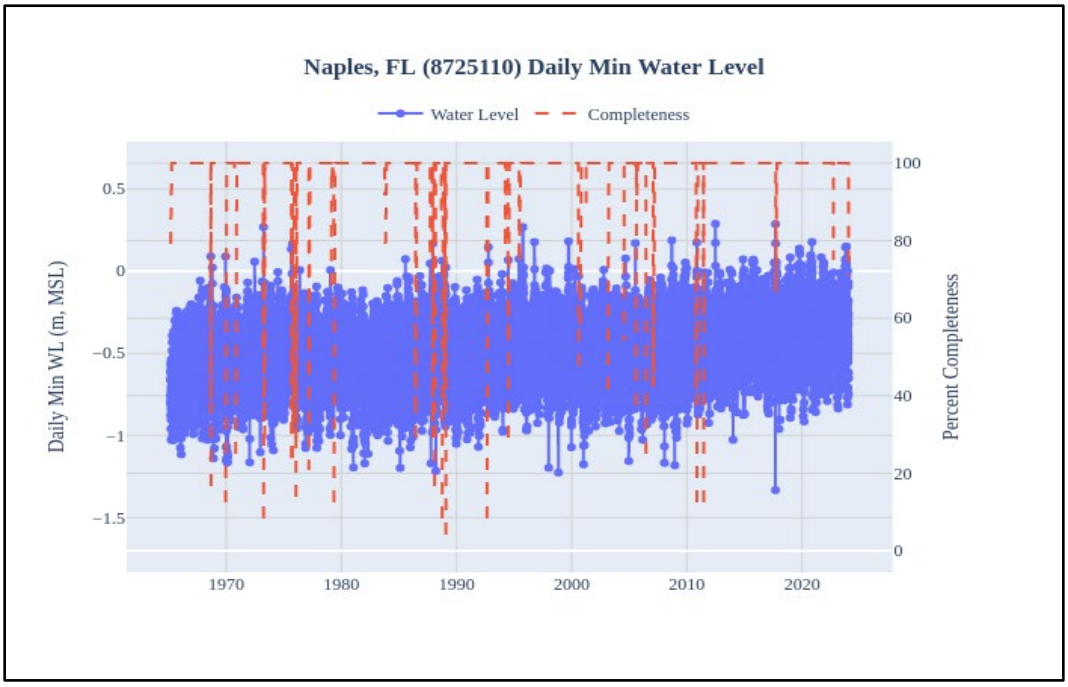

Figure 17. Period of record daily min hourly water levels and percent completeness for Naples, FL (8725110)

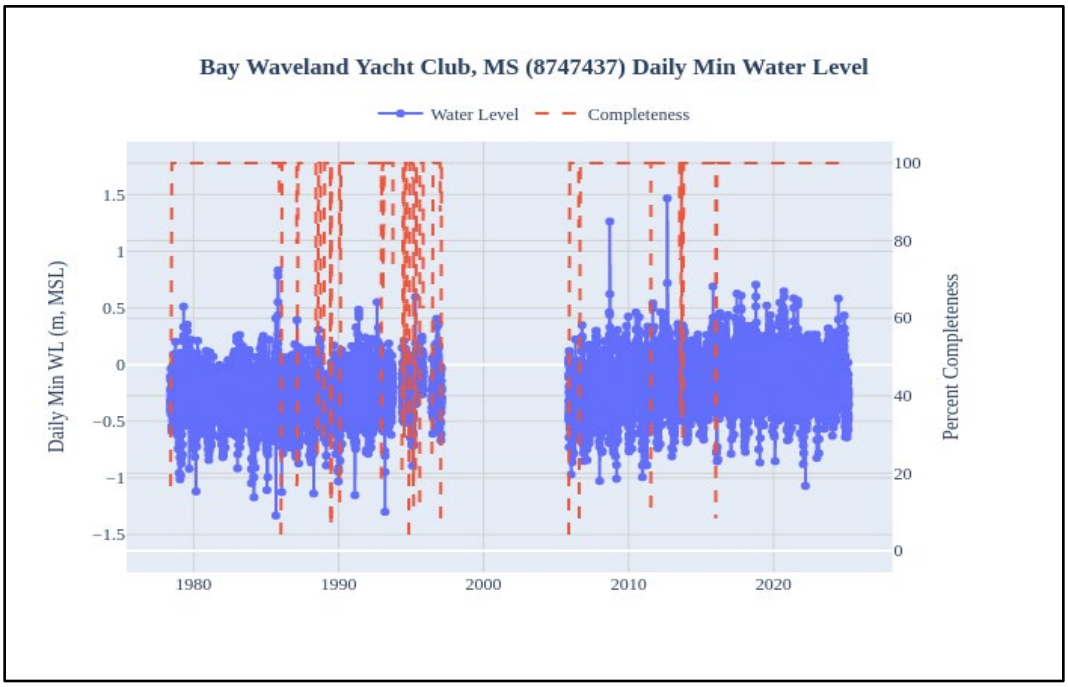

Figure 18. Period of record daily min hourly water levels and percent completeness for Bay Waveland Yacht Club, MS (8747437)

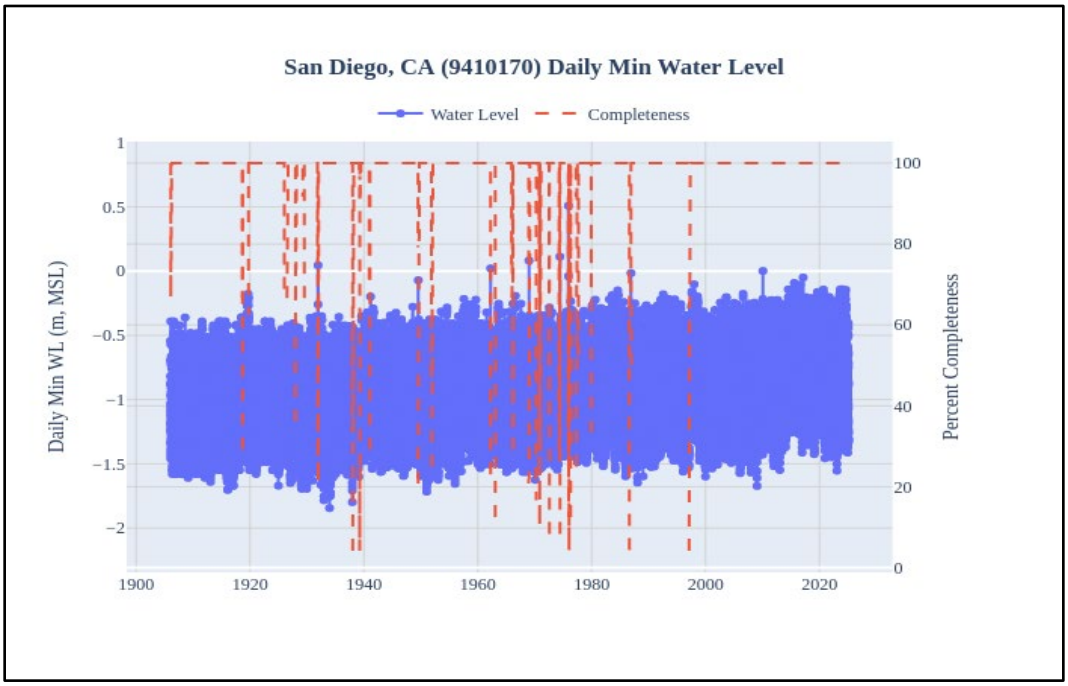

Figure 19. Period of record daily min hourly water levels and percent completeness for San Diego, CA (9410170)

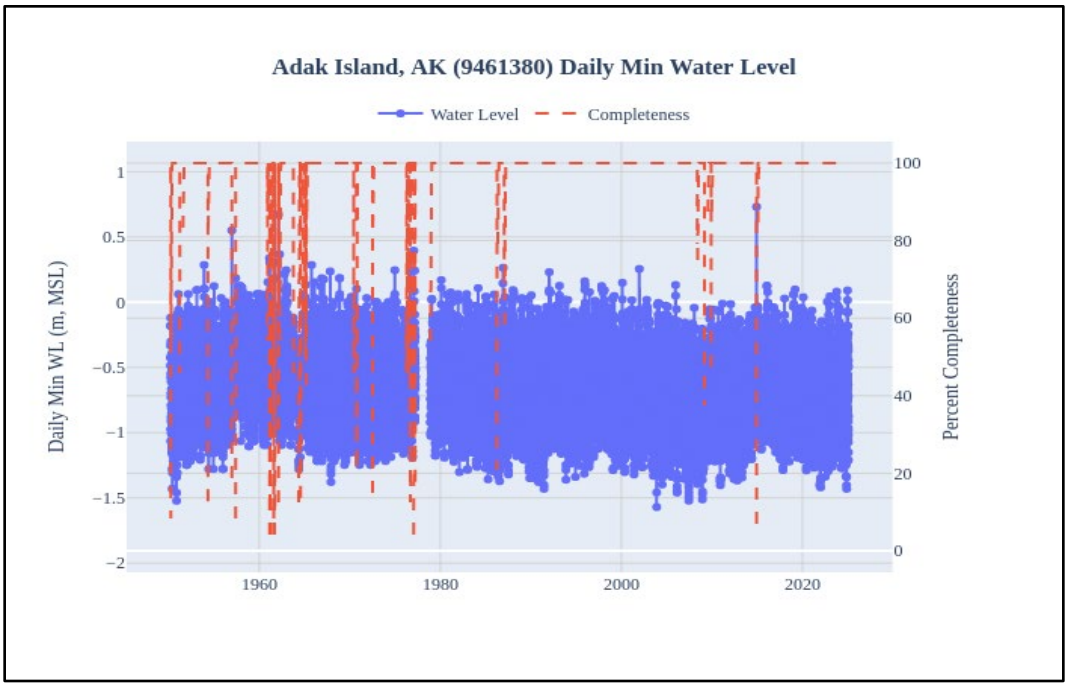

Figure 20. Period of record daily min hourly water levels and percent completeness for Adak Island, AK (9461380)

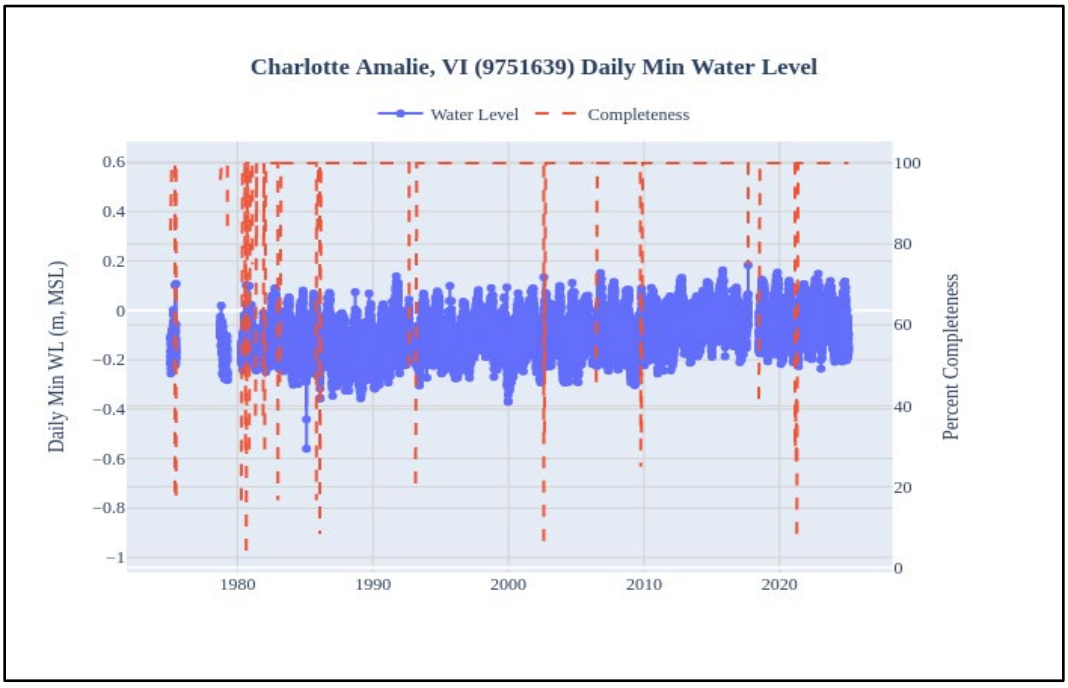

Figure 21. Period of record daily min hourly water levels and percent completeness for Charlotte Amalie, VI (9751639)

II. Example Daily Max/Min Water Level data API Queries

6 minute Maximum:
https://API.tidesandcurrents.noaa.gov/API/prod/datagetter?begin_date=20200101&end_date=20231231&station=8638610&product=daily_max_min&datum=MHHW&time_zone=gmt&units=english&format=json&max_min_type=max&interval=6

Hourly Height Maximum:
https://API.tidesandcurrents.noaa.gov/API/prod/datagetter?begin_date=20200101&end_date=20231231&station=8638610&product=daily_max_min&datum=MHHW&time_zone=gmt&units=english&format=json&max_min_type=max&interval=h

6 minute Minimum:
https://API.tidesandcurrents.noaa.gov/API/prod/datagetter?begin_date=20200101&end_date=20231231&station=8638610&product=daily_max_min&datum=MHHW&time_zone=gmt&units=english&format=json&max_min_type=min&interval=6

Hourly Height Minimum:
https://API.tidesandcurrents.noaa.gov/API/prod/datagetter?begin_date=20200101&end_date=20231231&station=8638610&product=daily_max_min&datum=MHHW&time_zone=gmt&units=english&format=json&max_min_type=min&interval=h

III. Example Daily Max/Min Water Level data API Response


```
{"metadata":{"id":"8638610","name":"Sewells
Point","lat":"36.9428","lon":"-76.3286"},
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        "dailyMaxHourly": [{
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            "timeHourly": "15:00",
            "valueHourly": 7.635,
            "pcCompleteHourly": 100,
            "flagHourly": "0"
          } ] }, {
          "dailyMinHourly": [{
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            "timeHourly": "09:00",
            "valueHourly": 5.033,
            "pcCompleteHourly": 100,
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          } ] }]}
```