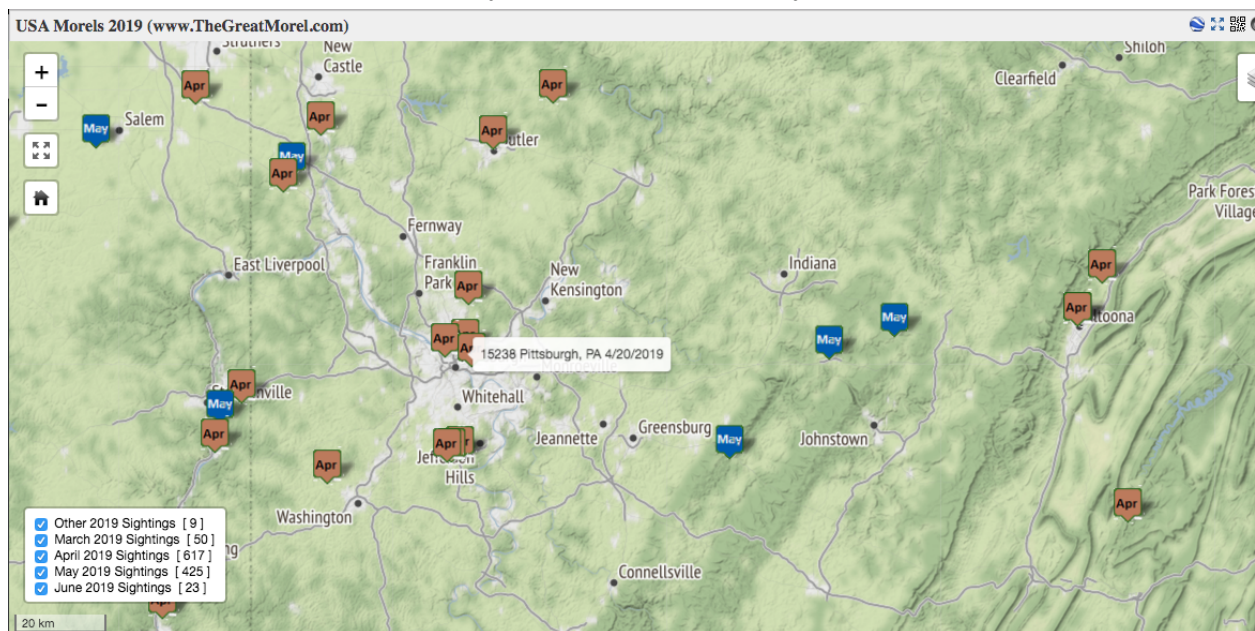


Research Question: When should we travel to Ohiopyle for our best chance of finding morels?

Historic Fruiting Observations - Citizen Science Sources

- Inaturalist info from past few years indicates that morel blooms start mid april and go through May. **Black Morels** are first, **yellows** are after, usually. Earliest black morel log was mid April (april 17, 2017).
- **Trillium** bloom dates for ohiopyle, and this tracks. Later April is the best time to catch them. Earliest observed was April 18 in 2014.
- [The Great Morel](http://www.TheGreatMorel.com) lists April/May for our area historically.



Citizen Science Realtime Fruiting Observations 2020

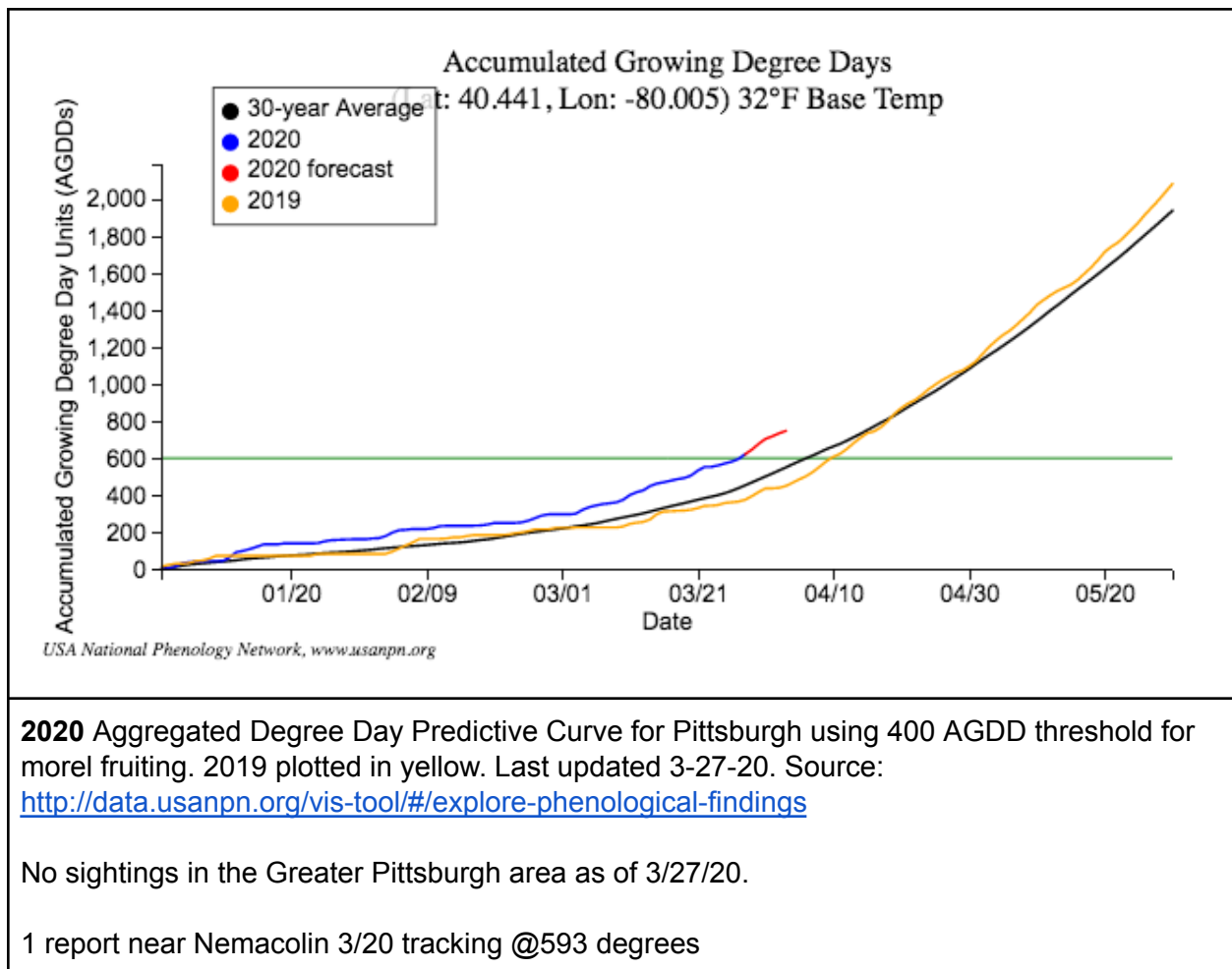
- Observation aggregators include:
 - The great morel
 - As of Feb 27 the great morel is reporting early morel observations in GA and AL. In the past 3 years, March is the beginning of observations in these areas. Pointing to an early season?
 - [iNaturalist](https://www.inaturalist.org)
 - As of Feb 27, no sightings reported for eastern seaboard

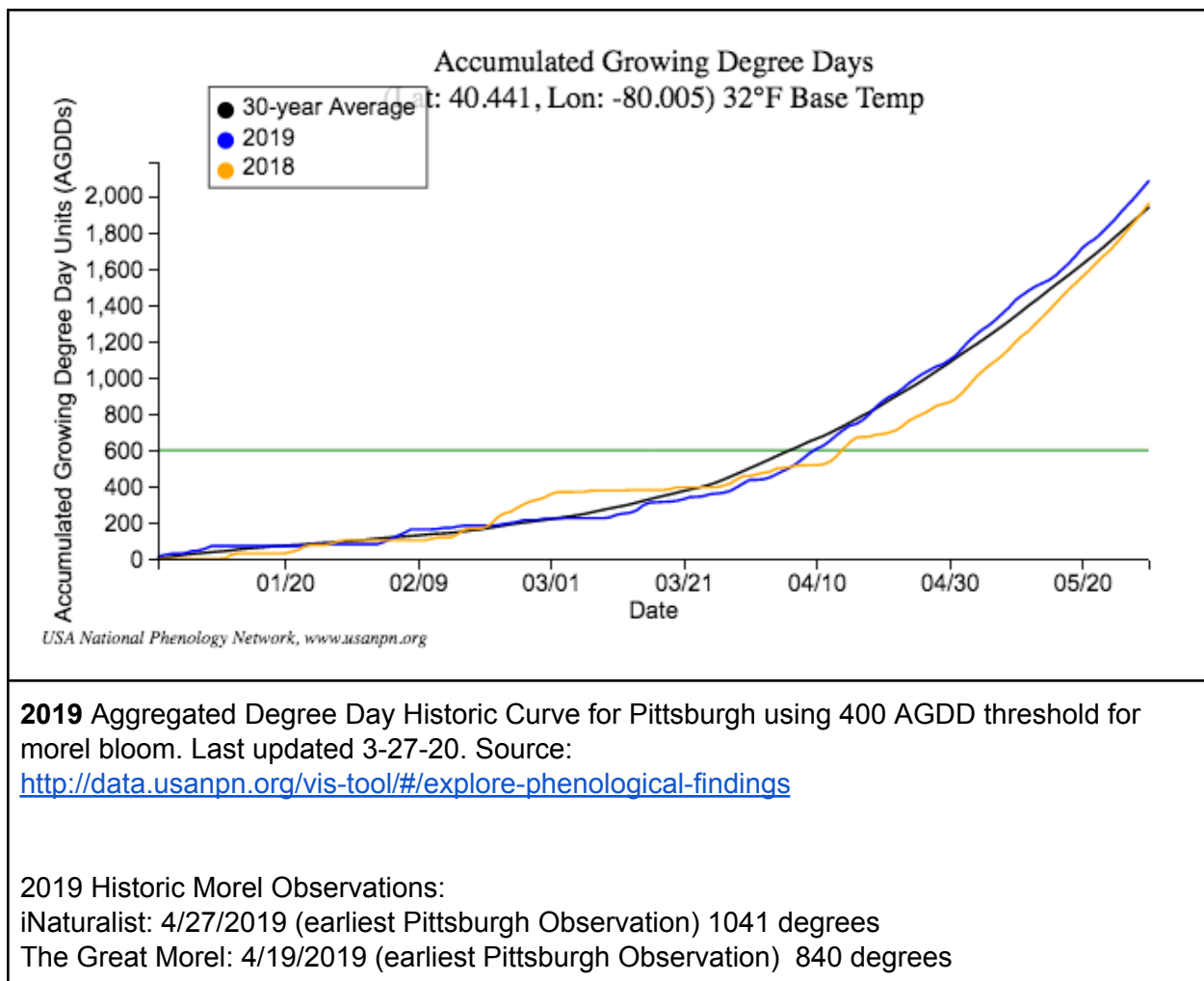
Degree Day Monitoring

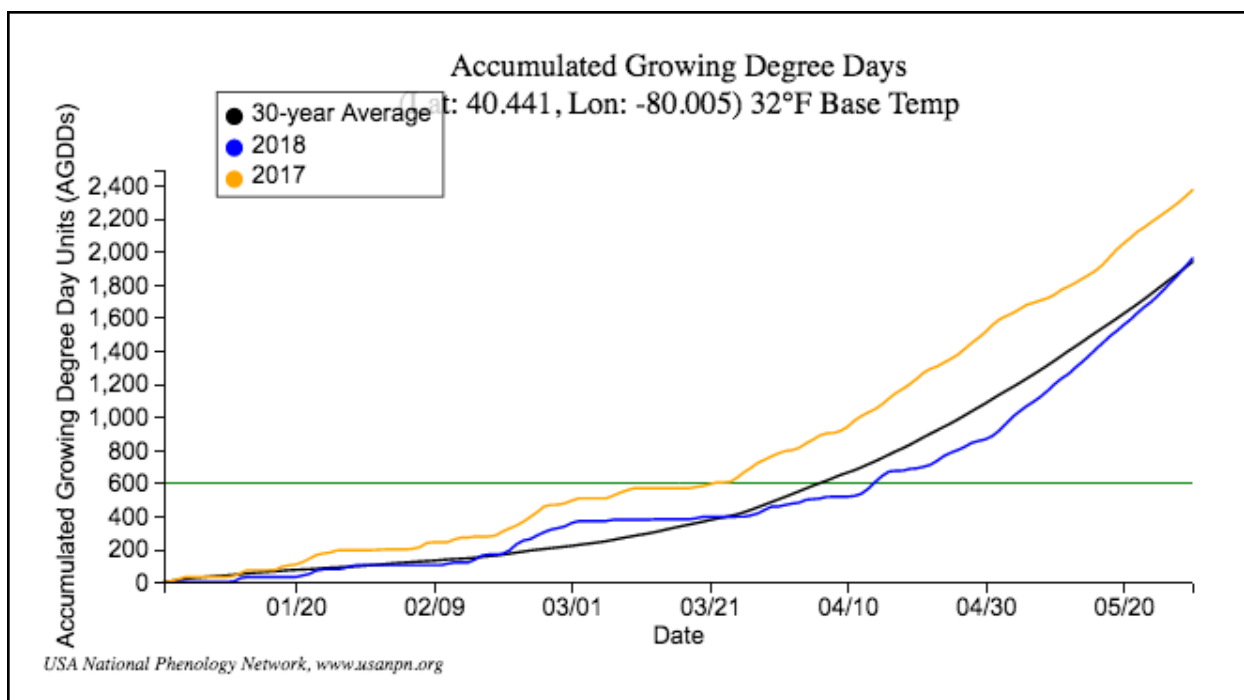
- Yellow Morels tend to emerge at 365-580 AGGD
- A general morel GDD range is 400-520 from [this source](#)
 - [This source](#) used base 32 for their degree day accumulations. Their models built namely for yellow morels and found the range to be 510-660

- The association of *Morchella rotunda* (Pers.) Boudier with warming soils in France was quantified by Buscot (1989), who reported the first appearance of these morels when the accumulated average temperatures (i.e., degree days) had exceeded 800 to 1075 °F.

2020 Predictive:







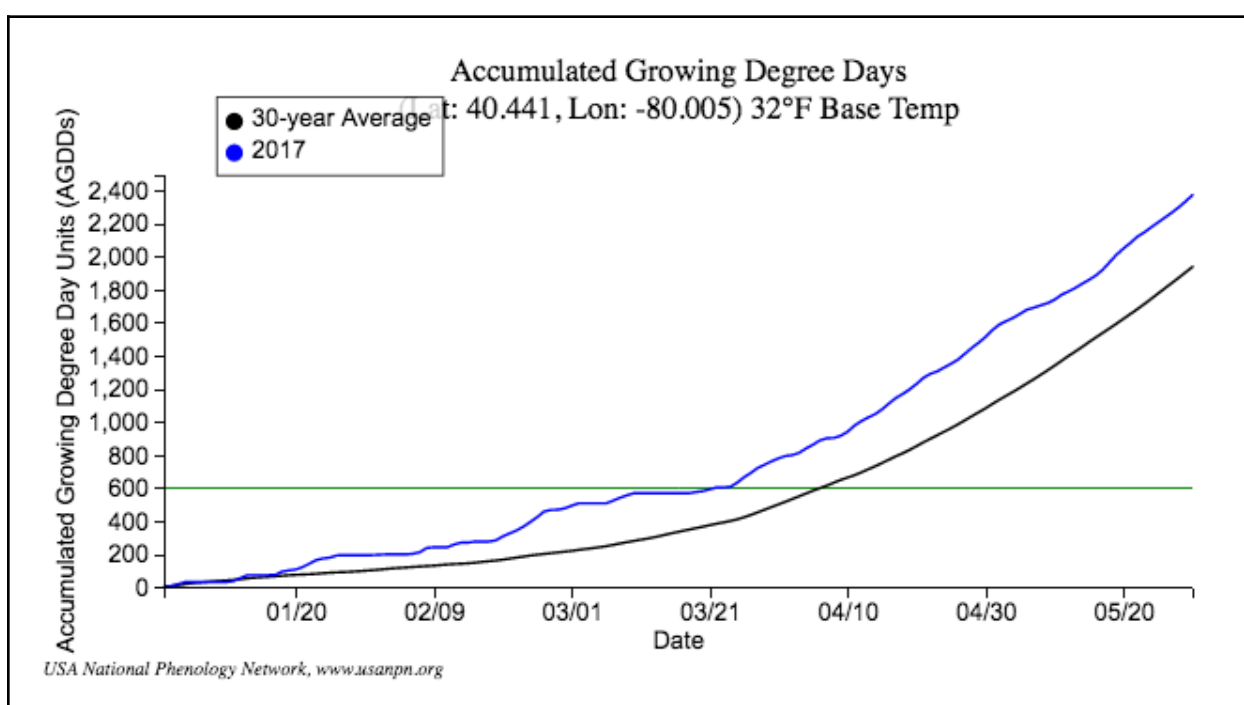
2018 Aggregated Degree Day Historic Curve for Pittsburgh using 400 AGDD threshold for morel bloom. Last updated 2-28-20. Source:

<http://data.usanpn.org/vis-tool/#/explore-phenological-findings>

2018 Historic Morel Observations:

iNaturalist: not data

The Great Morel: 5/15/2018 (earliest Pittsburgh Observation) 1369 degrees



2017 Aggregated Degree Day Historic Curve for Pittsburgh using 400 AGDD threshold for morel bloom. Last updated 2-28-20. Source:

<http://data.usanpn.org/vis-tool/#/explore-phenological-findings>

2017 Historic Morel Observations:

iNaturalist: 4/27/17 (earliest Pittsburgh Observation) 1412 degrees

The Great Morel: 4/13/17 (earliest Pittsburgh Observation) 1027 degrees

Multi-Species Strategy

- Might want to try to time trip so that we're hitting the **black morel/yellow morel** overlap period in Early May

Precision Timing

- Monitor "Spring Signals" Air temp monitoring for consistent daytime temps in the 60s
 - 2-3 week windows, given morels grow slowly..taking usually 15-20 days to mature.
 - This would seem to correspond to AGDD spikes in spring. Express this as some sort of warming rate (use derivatives to find rate).
 - An accumulation of 660 °F over the thirty days before first fruiting did somewhat better by successfully predicting four out of the seven cases. In Figure 4, success of this thirty-day air temperature prediction is indicated by the symbols within the confidence interval band of dotted lines in the graph. Symbols above the confidence interval band in 2010 and 2012 show the actual first day of morel fruiting was later than predicted by five and eleven days, respectively. [source](#)
 - Incorporate that as some kind of macro signal.
 - Maybe this sets the 15-30 day timer and after that the chill/warming and rainfall monitor kick in to more precisely hone predicted bloom.
 - "Chill/Warming Signals"
 - Cold temps followed by prolonged consistent warm temperatures signal morels to start blooming...expressed another way, this should be the part of the predictor that looks for temperature spikes, either up or down and adjusts the window accordingly.
 - From [this source](#) Aggregated degree days of 410 over 20 days is best predictor
 - Chilling periods in early spring can delay blooms. Ex: 2017 was trending to be an early bloom year in some areas (PA) but a cold snap in early April delayed it. Since it was already trending ahead, this chilling delay put the morel on a more normal schedule.
 - In this study, they found that premature spring signals in Jan and Feb in 2 separate years actually delayed the bloom, even though AGDD might have been ahead of schedule. (morels don't like to get faked out by the false start spring)

- Rainfall
 - Look for wet periods, up to 10 days.
 - Wet periods defined as consecutive daily rainfall event equal or greater than 0.5" rain
 - Loosely informed by [this source's](#) mid to low rainfall accumulation estimations.
 - Rainfall 2x more than the previous 10-15 days.
 - [This study](#) found that over 8 years and mapped rainfall events and over 30 year periods they observed that fruiting tended to coincide with rain periods that were heavier in the last 10 days, specifically days 10-5.

Notes:

Name idea "The Moracle"

Consider tailoring this to the yellow morel (species observations pending), since most AGDD figures expressed are for yellow morels. Filter observations by species if easy. One with specifically yellow morels another with all morel observations?

Could take a phenology approach for AGDD. Choose a few indicator species/phenological events like Trillium, Mayapples, oak bud burst, lilac, trout lily

- Tiffany et al. (1998) provided a detailed examination of the association of morel and plant species associations in Iowa.

Sources of truth - iNaturalist will export as csvs and the great morel will export as geojson (easy to convert to csv).

Grouping Observations

Allegheny county specific predictor

Butler County Specific Predictor

Bearing in mind that there is some margin of error between lat long of mushroom observation and lat long of nearest weather station calculating AAGD, so figures are unlikely to be as precise as in quoted studies.

Ideally I'd like to create a service that given GPS points and a date returns historic degree day total for that date and place -> AGDD Corresponded Observations csv can then run statistical treatments on this like Mode, Range etc.

Weather API research

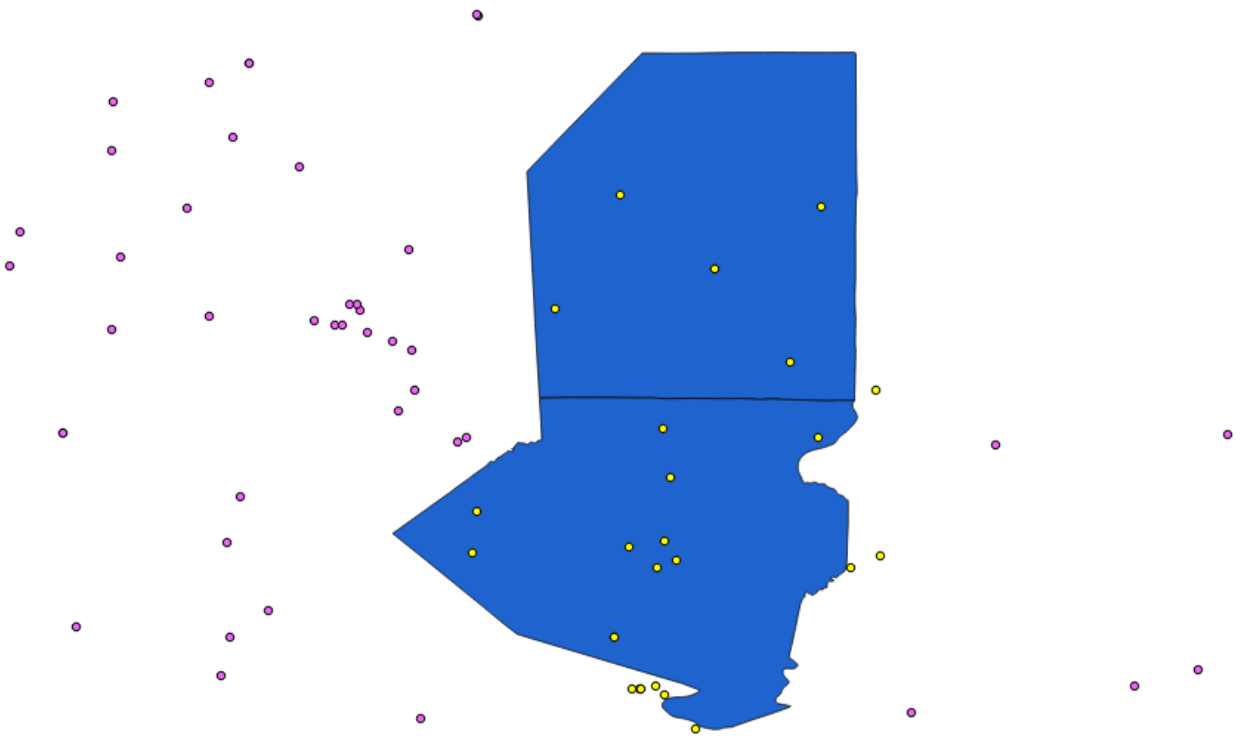
Ideally looking for some service to return AGDD given date and place, but might have to calculate it :-/. This proved too difficult to code and didn't want to pay for weather services so calculated by hand.

Open weather API recommended by Ethan

- Argo API offers an [aggregated temperature service](#), but must use polygons.
 - This is a possibility, but would need to create a piece of code to buffer a point and then envelope that to create a polygon from the buffer boundary
 - Nominating this one for use!
- [Weatherbit](#)
 - Not Free API
 - Can feed it a point, instead of a polygon
 - Needs a start date to begin aggregation, which will be constant based on the year, but this will be a little tricky to implement.
 - Lets you set the base temperature threshold (32 or 50 for example)
- NOAA offers degree days, but in base 65.
 - We need base 32 for this analysis

What to build

- (JSON, using Sublime Text) Write code that references morel observations.csv, takes each line as an observation point, converts it to a small polygon, then passes that polygon + constant start date (Jan-1 for that year) moreobservation.date/time as end date to the aggregated temperature service and returns the total aggregated temperature degrees for that record csv, ordered by date
 - json commands that would help with these
 - Point to polygon <https://terraformer-js.github.io/core/#terraformercircle>
- (not sure what to use) Use some statistical tools to create frequency distributions for aggregated degree days, in 50 degree buckets
- Converting from K to F might be challenging. Using conversion suggested on degree day wiki https://en.wikipedia.org/wiki/Degree_day
- **Fahrenheit to Kelvin:** $K = 5/9(F - 32) + 273.15$
- For the realtime version, use [inaturalist api](#). Use some implementation of Get taxa to run it on some schedule like weekly.
- Convert to UTC using js <https://medium.com/javascript-in-plain-english/it-is-really-easy-to-convert-local-time-to-utc-in-javascript-7e6a78460a7d>



observations in Allegheny/Butler County

Lat	Lon	Created On	AGGD
40.4495	-80.2445	4/15/17 10:50	988
40.509	-80.2392	4/17/17 8:19	1052
40.2527	-80.003	4/18/17 16:45	1158
40.8013	-80.1254	4/24/17 10:33	1194
40.4458	-79.6553	4/25/17 6:36	1305
40.1957	-79.9222	5/6/17 13:25	1713
40.9679	-80.0314	4/21/18 8:44	516
40.7242	-79.7856	4/26/18 6:57	630
40.615979	-79.745407	4/26/18 6:57	754
40.3276	-80.0395	4/30/18 9:12	1018
40.2523	-80.0028	4/30/18 9:45	1023
40.244827	-79.966507	4/30/18 16:54	1045
40.4284	-79.6976	5/1/18 13:17	854
40.3276	-80.0395	5/5/18 5:58	1022
40.6301	-79.9695	5/5/18 19:16	1088
40.6845	-79.6617	5/8/18 7:11	1053
40.428714	-79.977264	5/15/18 16:48	1389
40.861	-79.8952	5/16/18 9:37	1211
40.457513	-80.018158	4/14/19 7:11	723
40.2523	-80.0028	4/21/19 12:43	867
40.861	-79.8952	4/21/19 19:58	722
40.5595	-79.9587	4/23/19 10:30	870
40.256007	-79.981155	4/26/19 5:57	985
40.438934	-79.951324	4/26/19 19:20	988
40.252863	-80.013924	4/27/19 8:30	999
40.466336	-79.966888	4/30/19 16:29	1052
40.9504	-79.7413	4/30/19 16:39	853

AGGD for 2017-2019 in Allegheny and Butler Counties

Lat	Lon	Created On	AGGD
40.9679	-80.0314	4/21/18 8:44	516
40.7242	-79.7856	4/26/18 6:57	630
40.861	-79.8952	4/21/19 19:58	722
40.457513	-80.018158	4/14/19 7:11	723
40.615979	-79.745407	4/26/18 6:57	754
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40.2523	-80.0028	4/21/19 12:43	867
40.5595	-79.9587	4/23/19 10:30	870
40.256007	-79.981155	4/26/19 5:57	985
40.4495	-80.2445	4/15/17 10:50	988
40.438934	-79.951324	4/26/19 19:20	988
40.252863	-80.013924	4/27/19 8:30	999
40.3276	-80.0395	4/30/18 9:12	1018
40.3276	-80.0395	5/5/18 5:58	1022
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40.428714	-79.977264	5/15/18 16:48	1389
40.1957	-79.9222	5/6/17 13:25	1713

From these observations, **900-1100 range** seems to be the ideal time to hunt morels for Allegheny & Butler Counties. Most likely, these are observations of mostly yellow morels, as that AGGD profile better aligns with that species. Yellow morels are also easier to find than black morels. Personally, the first time I found morels in 2020 the AGGD figure for my area was 1525, which seems to be the upper limit of the morel range.

Because exact dates and locations of morel observations are not reported, the precision of this method is limited. Observations reliably happen Mid april to Mid-late may in this area.