

Accessing and mapping NOAA weather data using an interface developed in Python

For

EIA Map Users Group

April 17, 2018 | Washington, D.C.

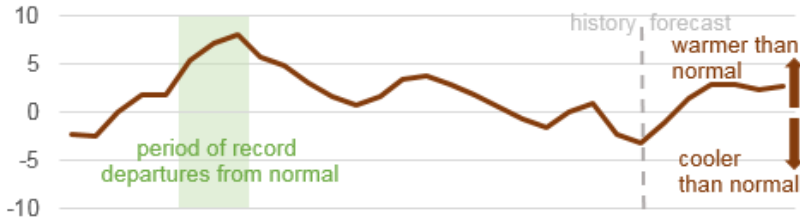
By

Jason Upchurch

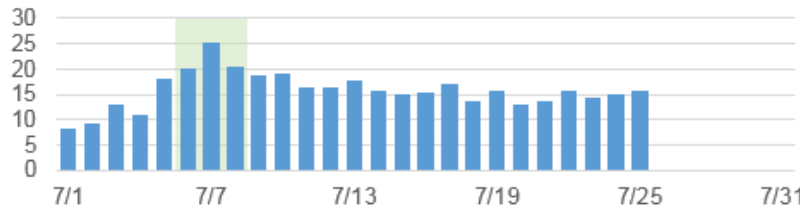
Why are we bothering to map weather?

- Weather is generally a key determinant of changes in electric and natural gas prices and loads

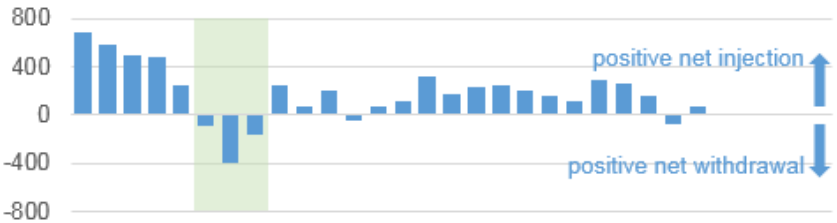
California daily departure from normal temperatures
cooling degree days



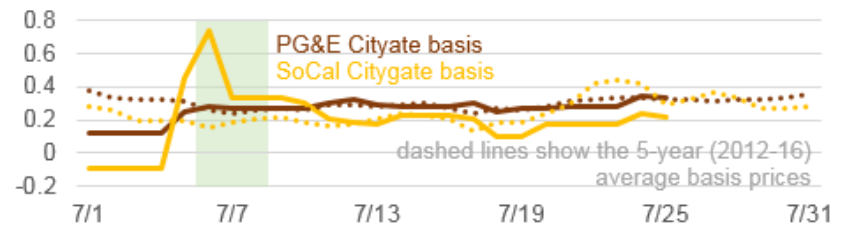
CAISO daily peak hour natural gas-fired electricity generation
gigawatt-hours



California daily net natural gas storage activity
million cubic feet



Natural gas spot price difference between regional hubs and Henry Hub
dollars per million British thermal units



Sources: NOAA (upper left), Ventyx (lower left), PointLogic (upper right), NGI (lower right)

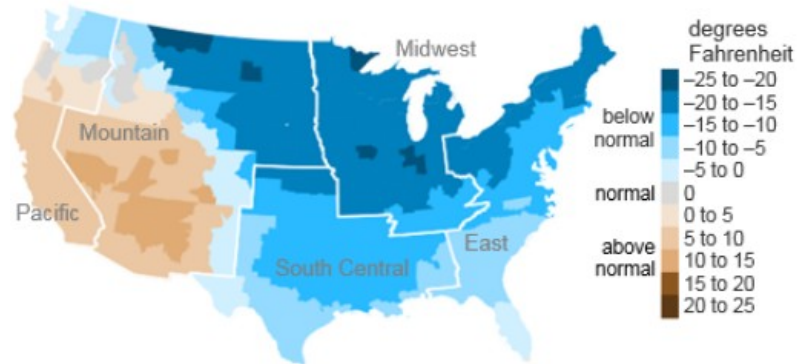
Examples of illustrating weather in our products

From Natural Gas Weekly Update's *In the News*:

Below normal temperatures last week increased natural gas consumption

Average departure from normal temperatures

Dec 24, 2017–Jan 3, 2018

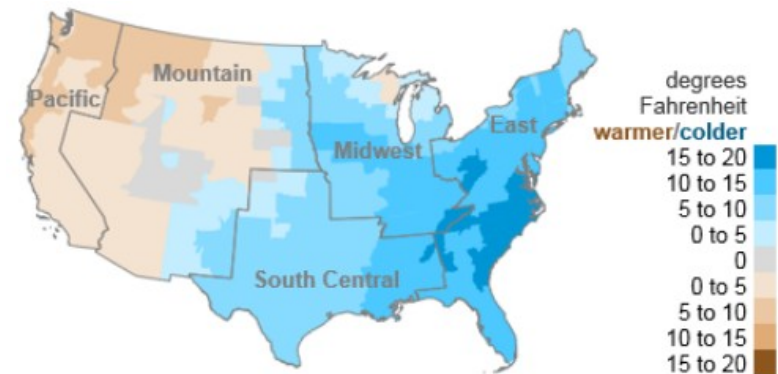


From Natural Gas Weekly Update's *In the News*:

Working gas stocks post all-time record weekly withdrawal

Weekly change in average temperature by EIA storage region

Dec 30, 2017–Jan 5, 2018 vs Dec 23–29



What benefits does the mapping interface offer?

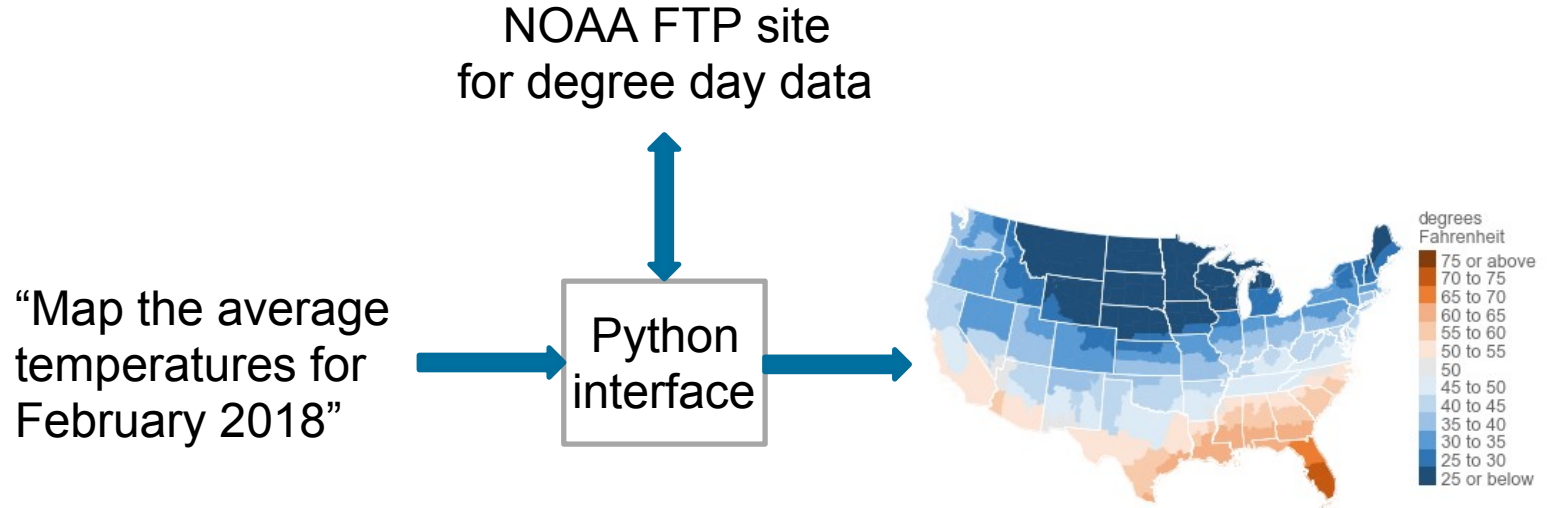
- The NOAA interface can be used as a template out of the box with very little programming experience and no mapping experience required
 - Produces consistent maps with no formatting required
- Or it can be customized by experienced users for a variety of other applications
 - e.g., raw data pulls, adding other templates like mapping cdd or hdd

I want to map weather using NOAA data over arbitrary dates

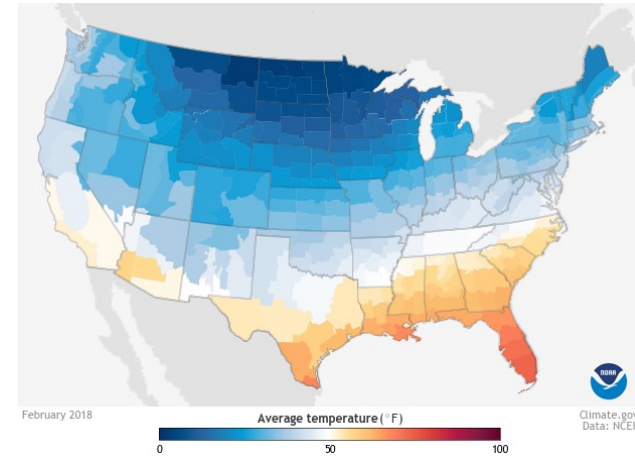
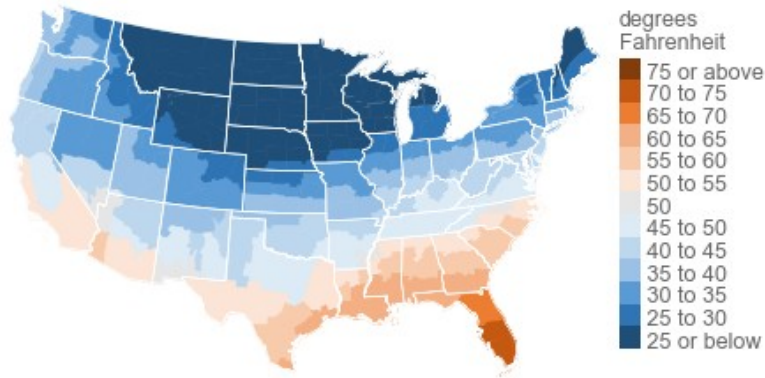
```
Product: Daily Heating Degree Days
Regions: Regions::StatesCONUS
Weights: Population
Region|19900101|19900102|19900103|19900104|19900105|19900106|19900107|19900108|19900109|19900110|19900111|19900112|19900113|19900114|19900115|19900116|19900117|19900118|19900119|19900120|19900121|19900122|19900123|19900124|19900125|19900126|19900127|19900128|19900129|19900130|19900201|19900202|19900203|19900204|19900205|19900206|19900207|19900208|19900209|19900210|19900211|19900212|19900213|19900214|19900215|19900216|19900217|19900218|19900219|19900220|19900221|19900222|19900223|19900224|19900225|19900226|19900227|19900228|19900229|19900301|19900302|19900303|19900304|19900305|19900306|19900307|19900308|19900309|19900310|19900311|19900312|19900313|19900314|19900315|19900316|19900317|19900318|19900319|19900320|19900321|19900322|19900323|19900324|19900325|19900326|19900327|19900328|19900329|19900330|19900331|19900401|19900402|19900403|19900404|19900405|19900406|19900407|19900408|19900409|19900410|19900411|19900412|19900413|19900414|19900415|19900416|19900417|19900418|19900419|19900420|19900421|19900422|19900423|19900424|19900425|19900426|19900427|19900428|19900429|19900430|19900501|19900502|19900503|19900504|19900505|19900506|19900507|19900508|19900509|19900510|19900511|19900512|19900513|19900514|19900515|19900516|19900517|19900518|19900519|19900520|19900521|19900522|19900523|19900524|19900525|19900526|19900527|19900528|19900529|19900530|19900601|19900602|19900603|19900604|19900605|19900606|19900607|19900608|19900609|19900610|19900611|19900612|19900613|19900614|19900615|19900616|19900617|19900618|19900619|19900620|19900621|19900622|19900623|19900624|19900625|19900626|19900627|19900628|19900629|19900630|19900701|19900702|19900703|19900704|19900705|19900706|19900707|19900708|19900709|19900710|19900711|19900712|19900713|19900714|19900715|19900716|19900717|19900718|19900719|19900720|19900721|19900722|19900723|19900724|19900725|19900726|19900727|19900728|19900729|19900730|19900801|19900802|19900803|19900804|19900805|19900806|19900807|19900808|19900809|19900810|19900811|19900812|19900813|19900814|19900815|19900816|19900817|19900818|19900819|19900820|19900821|19900822|19900823|19900824|19900825|19900826|19900827|19900828|19900829|19900830|19900831|19900901|19900902|19900903|19900904|19900905|19900906|19900907|19900908|19900909|19900910|19900911|19900912|19900913|19900914|19900915|19900916|19900917|19900918|19900919|19900920|19900921|19900922|19900923|19900924|19900925|19900926|19900927|19900928|19900929|19900930|19901001|19901002|19901003|19901004|19901005|19901006|19901007|19901008|19901009|19901010|19901011|19901012|19901013|19901014|19901015|19901016|19901017|19901018|19901019|19901020|19901021|19901022|19901023|19901024|19901025|19901026|19901027|19901028|19901029|19901030|19901101|19901102|19901103|19901104|19901105|19901106|19901107|19901108|19901109|19901110|19901111|19901112|19901113|19901114|19901115|19901116|19901117|19901118|19901119|19901120|19901121|19901122|19901123|19901124|19901125|19901126|19901127|19901128|19901129|19901130|19901201|19901202|19901203|19901204|19901205|19901206|19901207|19901208|19901209|19901210|19901211|19901212|19901213|19901214|19901215|19901216|19901217|19901218|19901219|19901220|19901221|19901222|19901223|19901224|19901225|19901226|19901227|19901228|19901229|19901230|19910101|19910102|19910103|19910104|19910105|19910106|19910107|19910108|19910109|19910110|19910111|19910112|19910113|19910114|19910115|19910116|19910117|19910118|19910119|19910120|19910121|19910122|19910123|19910124|19910125|19910126|19910127|19910128|19910129|19910130|19910201|19910202|19910203|19910204|19910205|19910206|19910207|19910208|19910209|19910210|19910211|19910212|19910213|19910214|19910215|19910216|19910217|19910218|19910219|19910220|19910221|19910222|19910223|19910224|19910225|19910226|19910227|19910228|19910229|19910230|19910301|19910302|19910303|19910304|19910305|19910306|19910307|19910308|19910309|19910310|19910311|19910312|19910313|19910314|19910315|19910316|19910317|19910318|19910319|19910320|19910321|19910322|19910323|19910324|19910325|19910326|19910327|19910328|19910329|19910330|19910331|19910
```

Solution:

the high-level interface requires very little programming experience, no mapping experience, and saves time



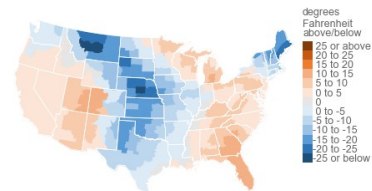
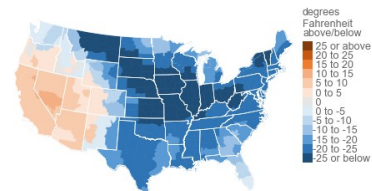
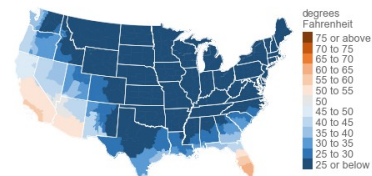
Validating the approach: a comparison to the monthly NOAA-produced version



Sources: U.S. Energy Information Administration based on NOAA (left); NOAA (right)

The high-level mapping interface provides three primary functions

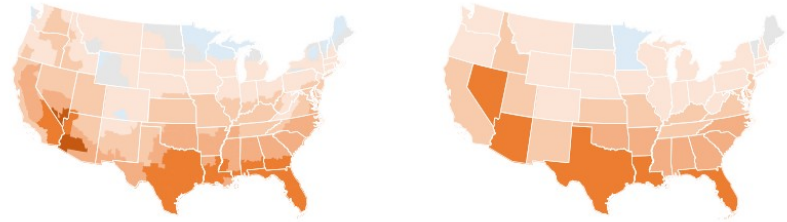
- Map average temperatures
 - What were average temperatures for January 1, 2018?
- Map departure from normal
 - How did temperatures on January 1, 2018 differ from the 1981–2010 normal?
- Map comparison of average temperatures
 - How did temperatures on January 1, 2018 differ from January 7, 2014?



What does the user have control over in the main interface?

- Resolution

- State climate division (default)
- State



- Intervals of time

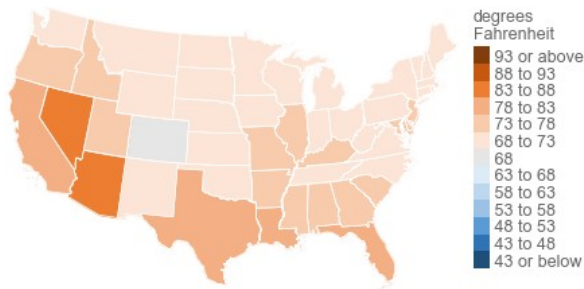
- Single day or ranges of days/years
- Definition of *normal*, e.g., previous 10 years, NOAA-defined 30-year normal 1981-2010

- Whether or not to include a legend

- Whether or not to save the map and the underlying data

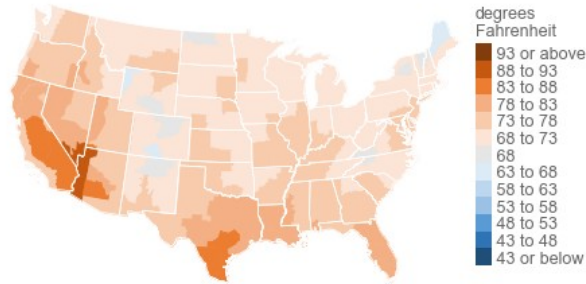
Example 1

```
'''  
map average temps  
'''  
  
email = 'jason.upchurch@eia.gov'  
date_start = datetime(2017,8,1).date()  
date_end = datetime(2017,8,31).date()  
plt_average_temps = map_average_temps(  
    date_start, date_end, email, split_on = 68, how= 'state', legend=True, savepath=False)  
plt_average_temps.show()
```



Example 2

```
'''  
map average temps  
'''  
  
email = 'jason.upchurch@eia.gov'  
date_start = datetime(2017,8,1).date()  
date_end = datetime(2017,8,1 ).date()  
plt_average_temps = map_average_temps(  
    date_start, date_end, email, split_on = 68, how = 'stcd', legend=True, savepath=False)  
plt_average_temps.show()
```



How do I get started mapping in Python?

- Obtain a distribution of Python
 - [Anaconda by Continuum](#) has a lot of additional libraries included, and includes an integrated development environment (Spyder)
- Install [Cartopy](#)
 - Installing cartopy from conda-forge using the command line should include all the dependent packages, e.g., geos, proj4, shapely
- Copy the Python interface files into a new Python project

Additional resources

- Python documentation:
 - <https://www.python.org/doc/>
- Cartopy documentation:
 - <http://scitools.org.uk/cartopy/>
- Help using the interface or bug reporting:
 - jason.upchurch@eia.gov