Swath_plot_elevation_between_two_points

August 1, 2019

1 Make line plots to show and compare ice surface elevation for different years

[2]:
```
import numpy as np
import xarray as xr
import matplotlib.pyplot as plt
import utm as utm
from pyresample import kd_tree, geometry, bilinear
import glob as glob
```

2 Swath 002 10m

[68]:
```
grd_dir = '/Users/ifenty/Documents/Work/My Projects/2019_omg_intern_tmp/002/
 ↪002_greenl_mine_t003_r015e/002_greenl_29101_greenl_29100_netCDF/'
#grd_dir = '/Users/ifenty/Documents/Work/My Projects/2019_omg_intern_tmp/002/
 ↪002_greenl_mine_t025_r200e/002_greenl_29101_greenl_29100_netCDF/'
g = np.sort(glob.glob(grd_dir + '/*nc'))
g
```

[68]:
```
array(['/Users/ifenty/Documents/Work/My Projects/2019_omg_intern_tmp/002/002_gre
enl_mine_t003_r015e/002_greenl_29101_greenl_29100_netCDF/15m_greenl_29100_17031_
002_170314_ALTTBB_HH_04testing3.nc',
       '/Users/ifenty/Documents/Work/My Projects/2019_omg_intern_tmp/002/002_gre
enl_mine_t003_r015e/002_greenl_29101_greenl_29100_netCDF/15m_greenl_29100_18010_
015_180308_ALTTBB_HH_01testing3.nc',
       '/Users/ifenty/Documents/Work/My Projects/2019_omg_intern_tmp/002/002_gre
enl_mine_t003_r015e/002_greenl_29101_greenl_29100_netCDF/15m_greenl_29101_16027_
004_160321_ALTTBB_HH_03testing3.nc'],
      dtype='<U186')
```

3 pay attention to which item of g has which year

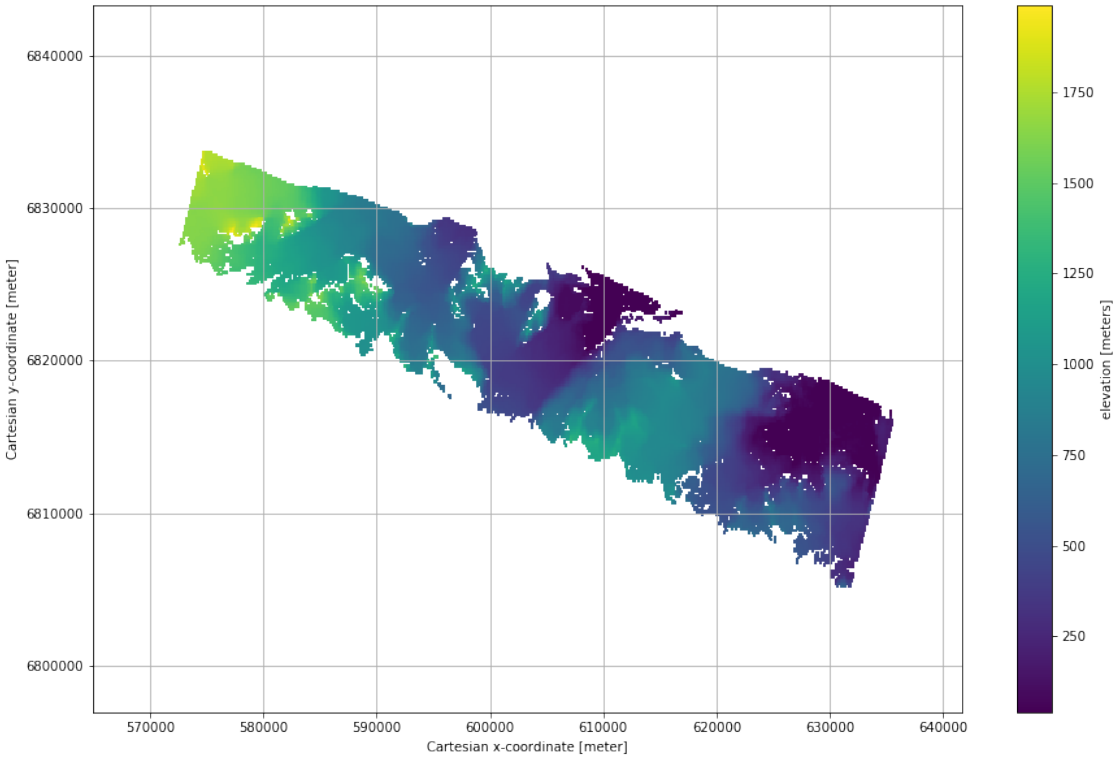
[69]:
```
s_002_2016 = xr.open_dataset(g[2])
s_002_2017 = xr.open_dataset(g[0])
s_002_2018 = xr.open_dataset(g[1])
```

[70]:
```
s_002_2018
```

[70]:
```
<xarray.Dataset>
Dimensions:    (x: 5111, y: 3089)
Coordinates:
  * x          (x) float64 5.65e+05 5.65e+05 5.65e+05 ... 6.416e+05 6.417e+05
    lon        (y, x) float64 ...
    lat        (y, x) float64 ...
  * y          (y) float64 6.797e+06 6.797e+06 6.797e+06 ... 6.843e+06 6.843e+06
Data variables:
    elevation  (y, x) float64 ...
Attributes:
    xmin:                               565007
    ymax:                               6843327
    spacing:                            15
    no_data:                            nan
    proj4text:                          +proj=utm +zone=23.0 +ellps=WGS84 +datu...
    proj4string:                        +proj=utm +zone=23.0 +ellps=WGS84 +datu...
    Projection:                         UTM 23N 002_greenl_29101_greenl_29100
    proj4:                              +init=epsg:32623
    Insitution:                         JPL
    Mission:                            Oceans Melting Greenland
    Mission website:                    https://omg.jpl.nasa.gov/portal/
    DOI:                                10.5067/OMGEV-ICEGA
    Citation:                           OMG Mission. 2016. Glacier elevation da...
    Mission Citation:                   10.5670/oceanog.2016.100
    author:                             Matthew Gonzalgo & Forrest Graham
    Date created:                       2019-08-01 00:37:44.963907
    Processessing code repository:      https://github.com/matthewGonzalgo/OMG
    Original data source URL:           https://uavsar.jpl.nasa.gov/cgi-bin/dat...
    File naming convention document:    https://uavsar.jpl.nasa.gov/science/doc...
    Note on swath ID number:            Started numbers from Cape Farewell and ...
    nx:                                 5110
    ny:                                 3088
    _FillValue:                         nan
    _CoordinateTransformType:           Projection
    _CoordinateAxisTypes:               GeoX GeoY
    cdm_data_type:                      Grid
    geospatial_lat_units:               degree_north
    geospatial_lon_units:               degree_east
    geospatial_x_units:                 meters
    geospatial_y_units:                 meters
```

```
geospatial_bounds_crs:          +proj=utm +zone=23.0 +ellps=WGS84 +datu...
geospatial_x_resolution:        15 meters
geospatial_y_resolution:        15 meters
```

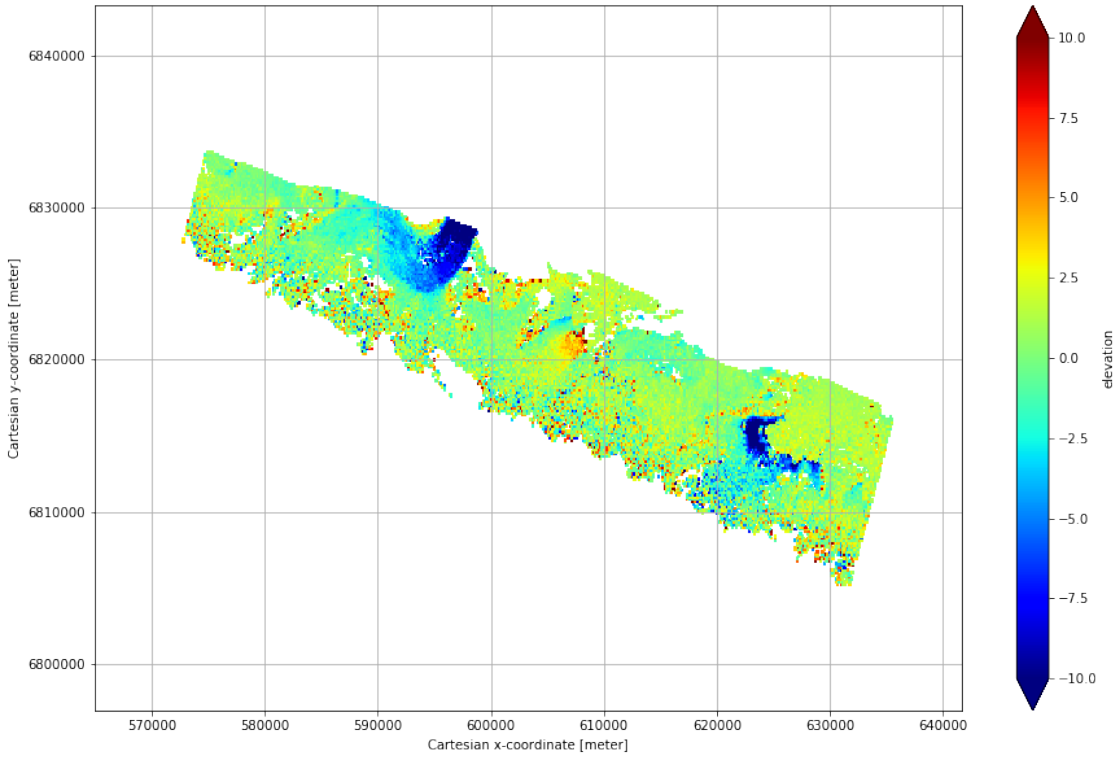
[131]:
```
plt.figure(figsize=(15,10));s_002_2018.elevation[::10,::10].plot()
plt.grid()
```



3.1 Difference 2018 and 2017

[71]:
```
delta_z_18_minus_17 = s_002_2018 - s_002_2017
```

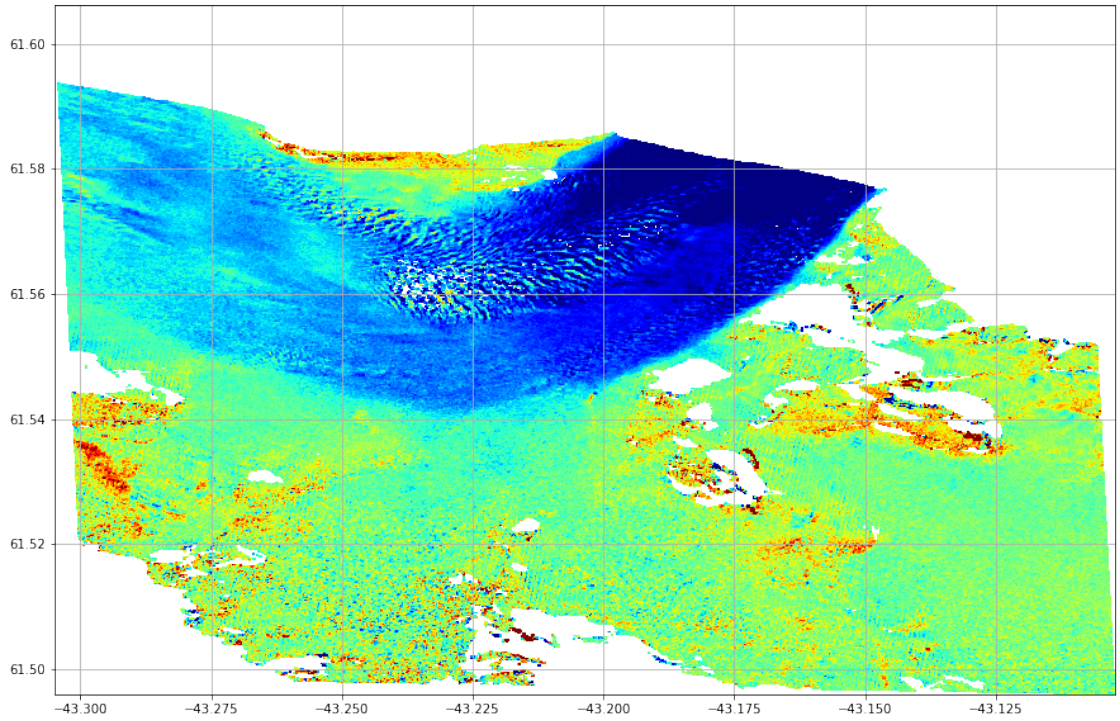
[72]:
```
plt.figure(figsize=(15,10));delta_z_18_minus_17.elevation[::10,::10].
↪plot(vmin=-10, vmax=10, cmap='jet')
plt.grid()
```



[73]:
```
delta_z_18_minus_17
```

[73]:
```
<xarray.Dataset>
Dimensions:    (x: 5111, y: 3089)
Coordinates:
  * x          (x) float64 5.65e+05 5.65e+05 5.65e+05 ... 6.416e+05 6.417e+05
    lon        (y, x) float64 -43.77 -43.77 -43.77 ... -42.36 -42.36 -42.36
    lat        (y, x) float64 61.3 61.3 61.3 61.3 61.3 ... 61.7 61.7 61.7 61.7
  * y          (y) float64 6.797e+06 6.797e+06 6.797e+06 ... 6.843e+06 6.843e+06
Data variables:
    elevation  (y, x) float64 nan nan nan nan nan nan ... nan nan nan nan nan
```

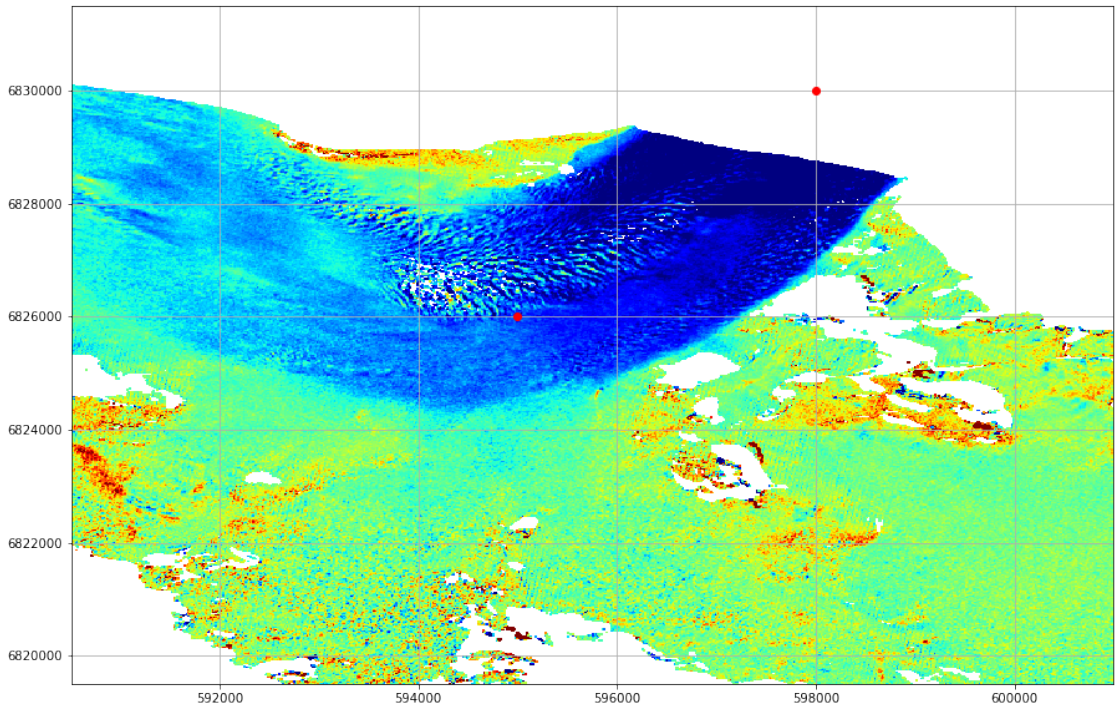
[133]:
```
plt.figure(figsize=(15,10));
start_r = 1500;end_r = 2300
start_c = 1700;end_c = 2400;

lon = delta_z_18_minus_17.lon[start_r:end_r, start_c:end_c]
lat = delta_z_18_minus_17.lat[start_r:end_r, start_c:end_c]
ele = delta_z_18_minus_17.elevation[start_r:end_r, start_c:end_c]
plt.pcolormesh(lon, lat, ele, vmin=-10, vmax=10, cmap='jet')
plt.grid()
```



4 Pick two points on the UTM grid, A and B

[114]:
```
plt.figure(figsize=(15,10));
start_r = 1500;end_r = 2300
start_c = 1700;end_c = 2400;

x = delta_z_18_minus_17.x[start_c:end_c]
y = delta_z_18_minus_17.y[start_r:end_r]
ele = delta_z_18_minus_17.elevation[start_r:end_r, start_c:end_c]
plt.pcolormesh(x, y, ele, vmin=-10, vmax=10, cmap='jet')
#plt.plot(6830000, 596000,'ro')
plt.grid()
plt.plot(598000, 6830000,'ro')
plt.plot(595000, 6826000,'ro')
```

[114]:
```
[<matplotlib.lines.Line2D at 0x113d6b780>]
```



4.1 Interpolate height fields to line, AB, from fjord up a glacier

[168]:
```
## Define three points.  A in fjord, B up the glacier
A = ( 6830000, 598000)
B = ( 6826000, 595000)

dist_ab = np.sqrt( (A[0] - B[0])**2 + (A[1] - B[1])**2)
dist_ab # in meters
```

[168]:
```
5000.0
```

[171]:
```
## Create arrays of lats and lons between AB and AC
ab_y = np.linspace(A[0], B[0], 1000)
ab_x = np.linspace(A[1], B[1], 1000)
# distance along the line
d_line = np.linspace(0, dist_ab, 1000)
```

[170]:
```
## Turn arrays into data array objects
da_ab_y = xr.DataArray(ab_y, dims='d')
da_ab_x = xr.DataArray(ab_x, dims='d')
```

[173]:
```
## interpolate height fields to AB and AC
da_18_ab = s_002_2018.elevation.interp(x=da_ab_x, y=da_ab_y)
da_18_ab = da_18_ab.where(da_18_ab > -100, np.nan)

da_17_ab = s_002_2017.elevation.interp(x=da_ab_x, y=da_ab_y)
```

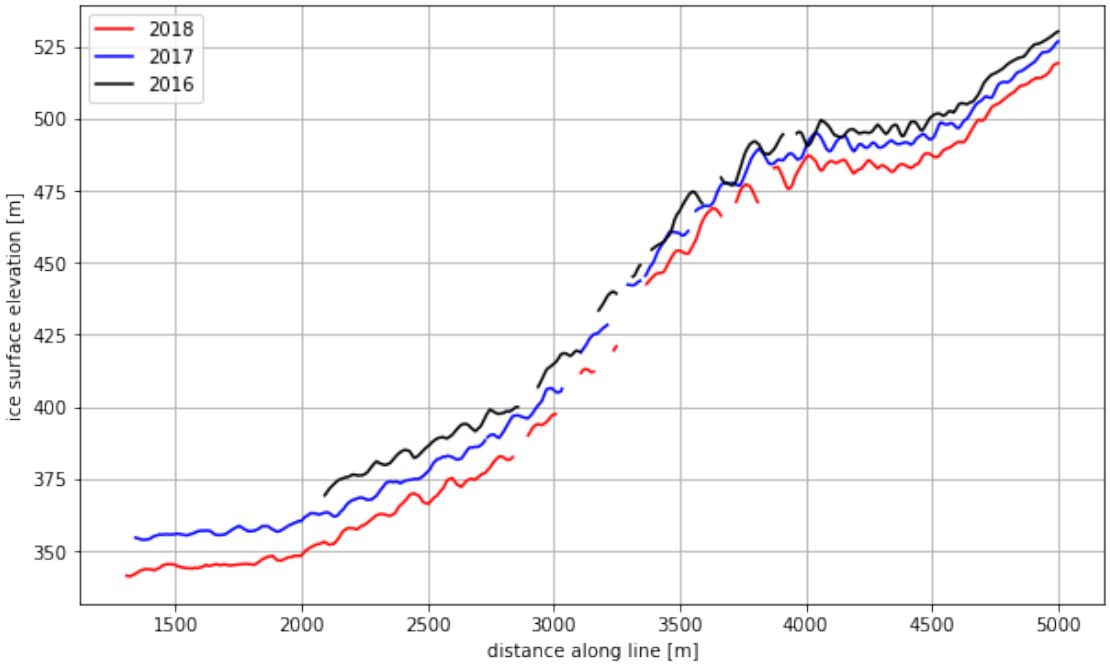
```
da_17_ab = da_17_ab.where(da_17_ab > -100, np.nan)

da_16_ab = s_002_2016.elevation.interp(x=da_ab_x, y=da_ab_y)
da_16_ab = da_16_ab.where(da_16_ab > -100, np.nan)
```

4.2 Plot 2016, 2017, 2018 along AB

4.2.1 AB

[178]:
```
plt.figure(figsize=(10,6));
plt.plot(d_line, da_18_ab.values, 'r')
plt.plot(d_line, da_17_ab.values, 'b')
plt.plot(d_line, da_16_ab.values, 'k')
plt.grid()
plt.xlabel('distance along line [m]')
plt.ylabel('ice surface elevation [m]')
plt.legend(('2018','2017','2016'))
```

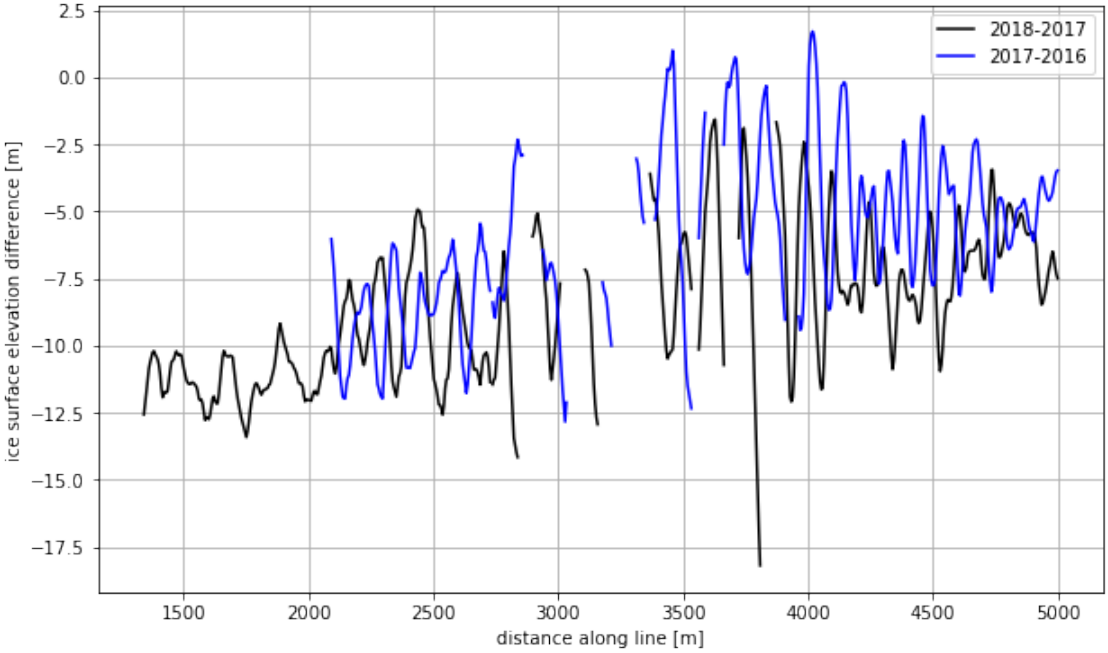
[178]:
```
<matplotlib.legend.Legend at 0x2132c2fd0>
```



[177]:
```
# plot difference
plt.figure(figsize=(10,6));
plt.plot(d_line, da_18_ab.values-da_17_ab.values, 'k')
plt.plot(d_line, da_17_ab.values-da_16_ab.values, 'b')
plt.grid()
plt.legend(('2018-2017', '2017-2016'))
```

```
plt.xlabel('distance along line [m]')
plt.ylabel('ice surface elevation difference [m]')
```

[177]:
```
Text(0, 0.5, 'ice surface elevation difference [m]')
```



4.2.2 do more of these for different glaciers

[ ]: