THE PREVAILING WIND TOOL

Expanding on the Wind Speed and Direction Tool

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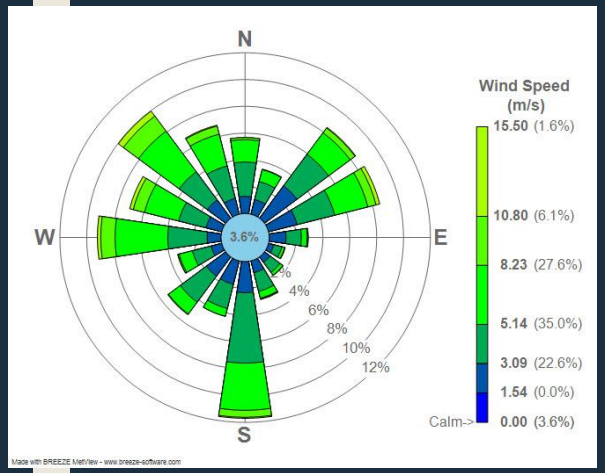
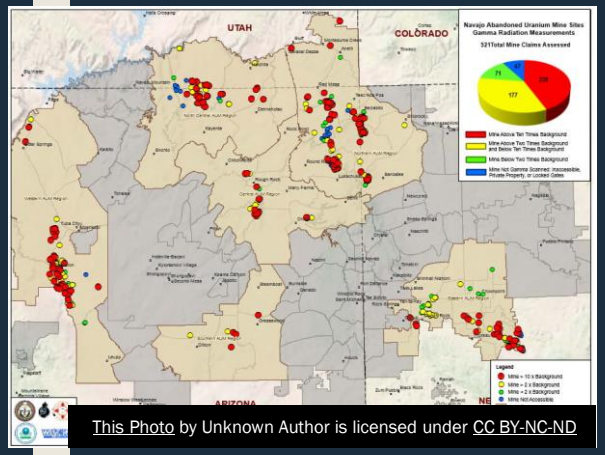
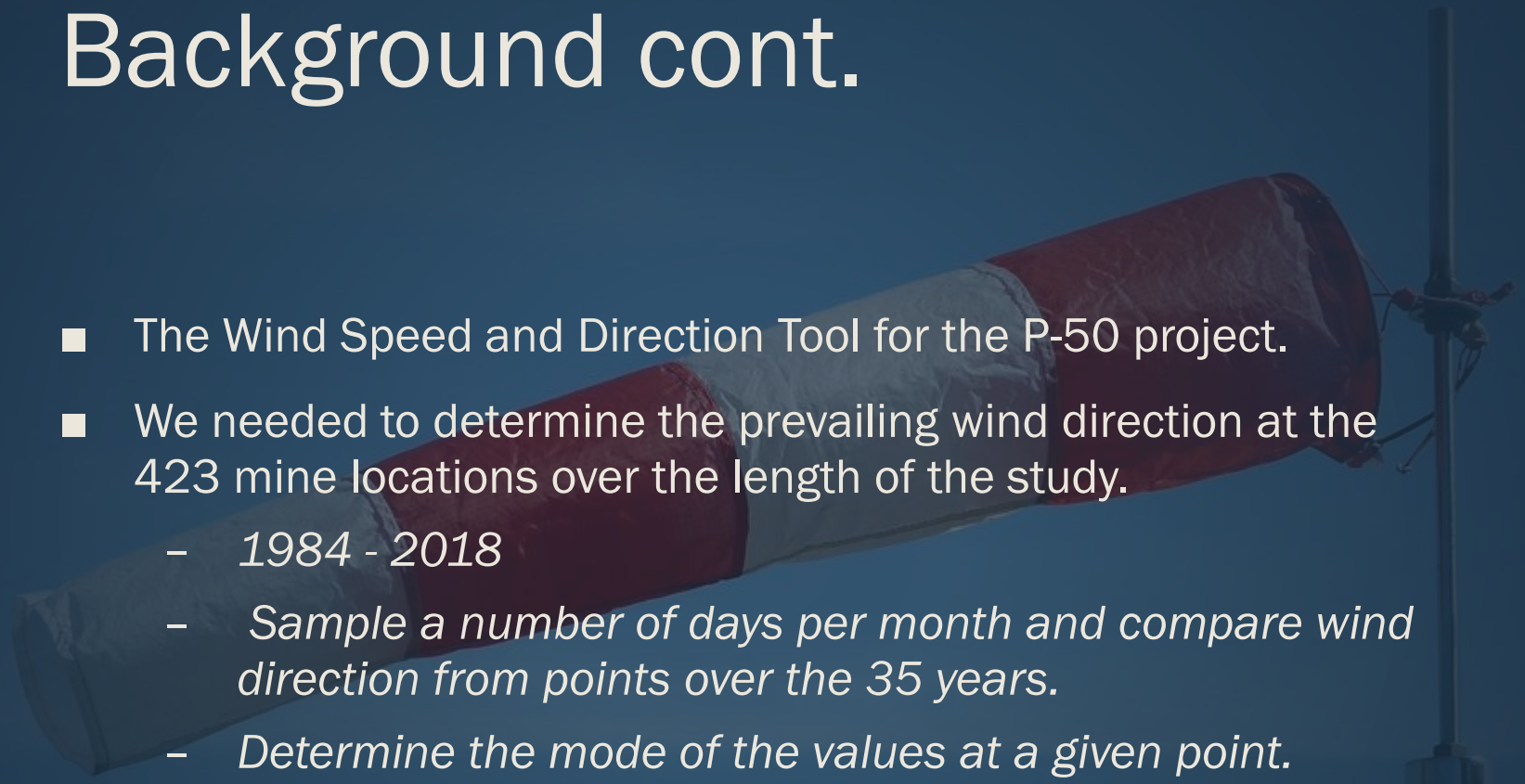
Background/Introduction





- Prevailing wind is the most common direction in which the wind blows over a given location.
- There are limited locations for wind rose datasets available at the NRCS National Water and Climate Center website.
- In the P-50 project we are studying the distribution of hazardous materials by natural phenomenon in the Navajo Nation.
- The hazardous materials are believed to originate from the abandoned uranium mines and have been moved by wind and water overtime. By analyzing this data to view the areas where these factors meet. The temporal scope of the studying is from the mines closure in 1984 to present day.

Background cont.

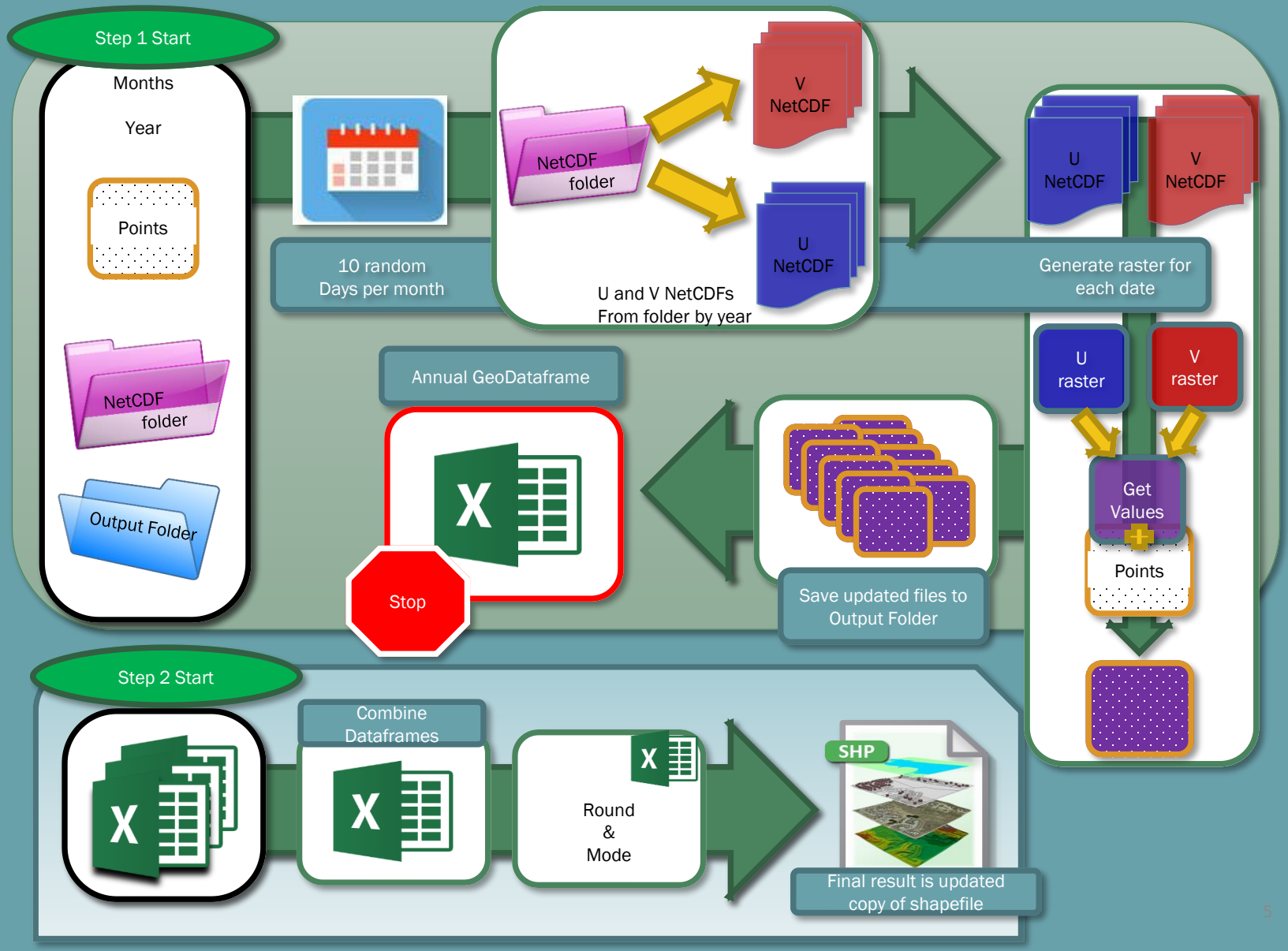


- The Wind Speed and Direction Tool for the P-50 project.
- We needed to determine the prevailing wind direction at the 423 mine locations over the length of the study.
  - *1984 - 2018*
  - *Sample a number of days per month and compare wind direction from points over the 35 years.*
  - *Determine the mode of the values at a given point.*
  - *Export as shapefile for use in study.*

RESEARCH QUESTION

Can the wind speed and direction tool be upgraded to determine the prevailing wind from a given point?

General Design



Design Details

Step 1

Gain user properties.

#For-loop the months selected in parameters.

Generate 10 days at random dates.

Define method for iterating through NetCDF selected time dimensions.

Build raster and export values to points shapefile.

Calculate wind speed and direction.

save updated version of points shapefile for each date.

```
for m in months:
    print m
    days = [random.randrange(1,28)for d in range(10)]
    vet_list = []
    lenny = len(days)
    stat = False
    while stat == False:
        for num in days:
            # print num
            if vet_list.count(num) > 0:
                print "NO GO"
            else:
                vet_list.append(num)
                stat = True
        if len(vet_list) < lenny:
            vet_list = []
            days = [random.randrange(1,28)for d in
range(10)]
            stat = False
    for r in sorted(vet_list):
        date = "{}/{}/{}".format( m, r, year)
        # print date
        datelist.append(date)
```

```
def GetNameOutputFile(dimension_value):
    lst1 = dimension_value.split(' ')
    if '/' in dimension_value:
        lst2a = lst1[0].split('/')
        lst2a = CorrectList(lst2a)
        name = 'd{}{}{}'.format(lst2a[2], lst2a[1], lst2a[0])
    else:
        name = 'd17760704_t0000'
    return name

def GetYear(dimension_value):
    lst1 = dimension_value.split(' ')
    print lst1

def CorrectList(lst2a):
    lst = []
    for a in lst2a:
        if len(a) == 1:
            lst.append('0{}'.format(a))
        else:
            lst.append(a)
    return lst
if __name__ == '__main__':
    main()
```

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Details Cont.

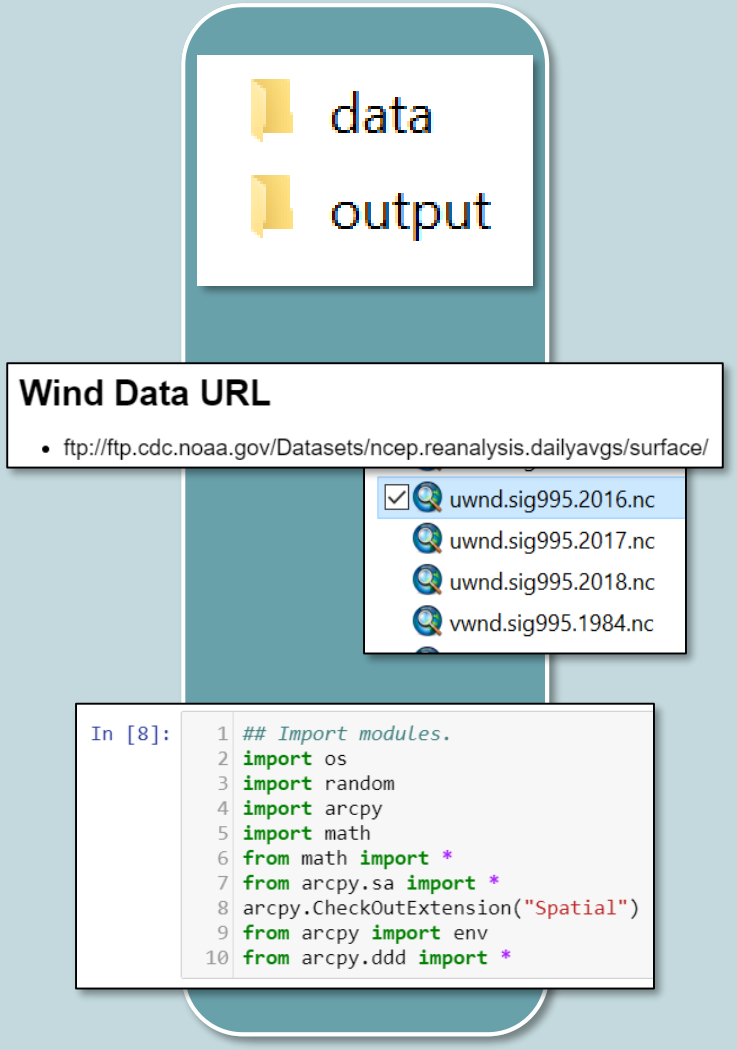
Step 2

```
while count > 0:
    spliced = str(file_path) +
r"\Feb{}_rounded.xlsx".format(date)
    start = pd.DataFrame(pd.read_excel(spliced))
    start = start.iloc[:,1:]
    end = df.merge(start, left_on='geometry',
right_on='geometry', how = 'outer')
    df = end
    count -= 1
    date += 1
print "Done!"
```

```
# Enter parameters
# Loop and compile dataframes
        to master dataframe
        # Round values to tens
        # Determine mode of rows
# Save as Shapefile
```

Demonstration

1. Create two new folders in file explorer.
   - *Name folders or use examples folders*
2. Download wind data from NOAA url in the description to data folder.
   - *The data should be placed in the same folder.*
3. Run the first cell for import libraries.

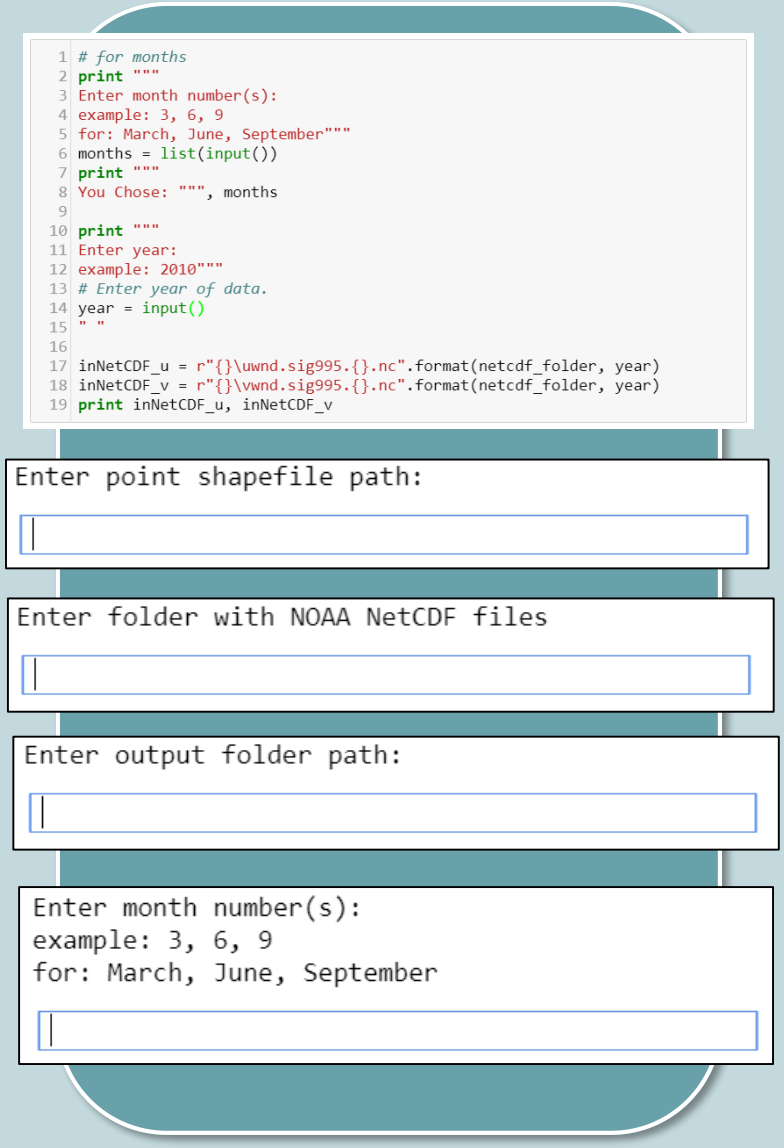


Demonstration Cont.

```
# for months
print """
Enter month number(s):
example: 3, 6, 9
for: March, June, September"""
months = list(input())
print """
You Chose: """, months

print """
Enter year:
example: 2010"""
# Enter year of data.
year = input()
" "

inNetCDF_u = r"{}\uwnd.sig995.{}.nc".format(netcdf_folder, year)
inNetCDF_v = r"{}\vwnd.sig995.{}.nc".format(netcdf_folder, year)
print inNetCDF_u, inNetCDF_v
```



4. Run the second cell to activate parameter entry.
5. Enter Point shapefile path.
6. Enter output folder path.
7. Enter NetCDF file path.
8. Enter number of the month(s) of study.
   ex: 1, 2, 3
   for January, February, March

Demonstration Cont.

Repeat For Each Year

8. Run third cell and enter parameters
9. Enter the year of the netcdf file.
10. Run all cells below designated cell.

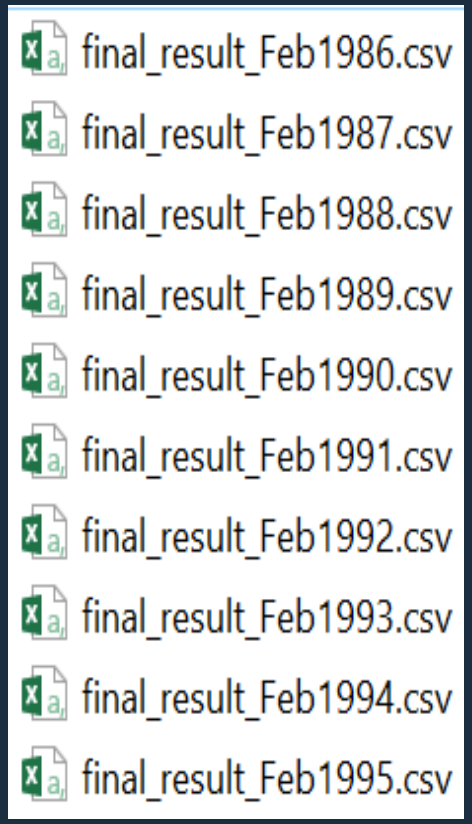
```
9
10 print """
11 Enter year:
12 example: 2010"""
13 # Enter year of data.
14 year = input()
15 " "
16
17 inNetCDF_u = r"{}\uwnd.sig995.{}.nc".format(netcdf_folder, year)
18 inNetCDF_v = r"{}\vwnd.sig995.{}.nc".format(netcdf_folder, year)
19 print inNetCDF_u, inNetCDF_v
```

```
Enter year:
example: 2010
```

'Cell' > 'Run All Below' from this cell.

- Greater number of days = more time to complete
- A tone will signal the tools completion

Step 1 Output



- The first part of the Prevailing Wind Tool will generate one .csv file per year.

The .csv files are used as dataframes in the next step.

RESULTS .CSV IN EXCEL

Polar degrees

	B	C	D	E	F	G
1	geometry	2/3/1984	2/4/1984	2/5/1984	2/8/1984	2/14/1984
2	POINT (-12	156.005	186.597	209.872	262.77	63.9011
3	POINT (-12	156.005	186.597	209.872	262.77	63.9011
4	POINT (-12	156.005	186.597	209.872	262.77	63.9011
5	POINT (-12	156.005	186.597	209.872	262.77	63.9011
6	POINT (-12	156.005	186.597	209.872	262.77	63.9011
7	POINT (-12	156.005	186.597	209.872	262.77	63.9011
8	POINT (-12	156.005	186.597	209.872	262.77	63.9011
9	POINT (-12	156.005	186.597	209.872	262.77	63.9011
10	POINT (-12	156.005	186.597	209.872	262.77	63.9011
11	POINT (-12	156.005	186.597	209.872	262.77	63.9011
12	POINT (-12	156.005	186.597	209.872	262.77	63.9011
13	POINT (-12	156.005	186.597	209.872	262.77	63.9011
14	POINT (-12	156.005	186.597	209.872	262.77	63.9011
15	POINT (-12	156.005	186.597	209.872	262.77	63.9011
16	POINT (-12	156.005	186.597	209.872	262.77	63.9011
17	POINT (-12	156.005	186.597	209.872	262.77	63.9011
18	POINT (-12	156.005	186.597	209.872	262.77	63.9011
19	POINT (-12	156.005	186.597	209.872	262.77	63.9011
20	POINT (-12	156.005	186.597	209.872	262.77	63.9011
21	POINT (-12	156.005	186.597	209.872	262.77	63.9011
22	POINT (-12	156.005	186.597	209.872	262.77	63.9011
23	POINT (-12	156.005	186.597	209.872	262.77	63.9011
24	POINT (-12	156.005	186.597	209.872	262.77	63.9011
25	POINT (-12	156.005	186.597	209.872	262.77	63.9011
26	POINT (-12	156.005	186.597	209.872	262.77	63.9011

Demonstration

Step 2

```
print """
Enter path to result .csv file folder:
ex: C:/428/Test/output"""
file_path = raw_input()

print """
Enter first year of study:
ex: 1984"""
first = input()

print """
Enter last year of study
ex: 2018"""
last = input()
```

```
Enter path to result .csv file folder:
ex: C:/428/Test/output
```

```
Enter first year of study:
ex: 1984
1984
```

```
Enter last year of study
ex: 2018
2018
```

1. Open the Prevailing Wind Tool (2 of 2) notebook.
2. Run the first cell to activate parameter entry.
3. Enter the path to the output folder of part 1.
4. Enter first year of study.
5. Enter last year of study.

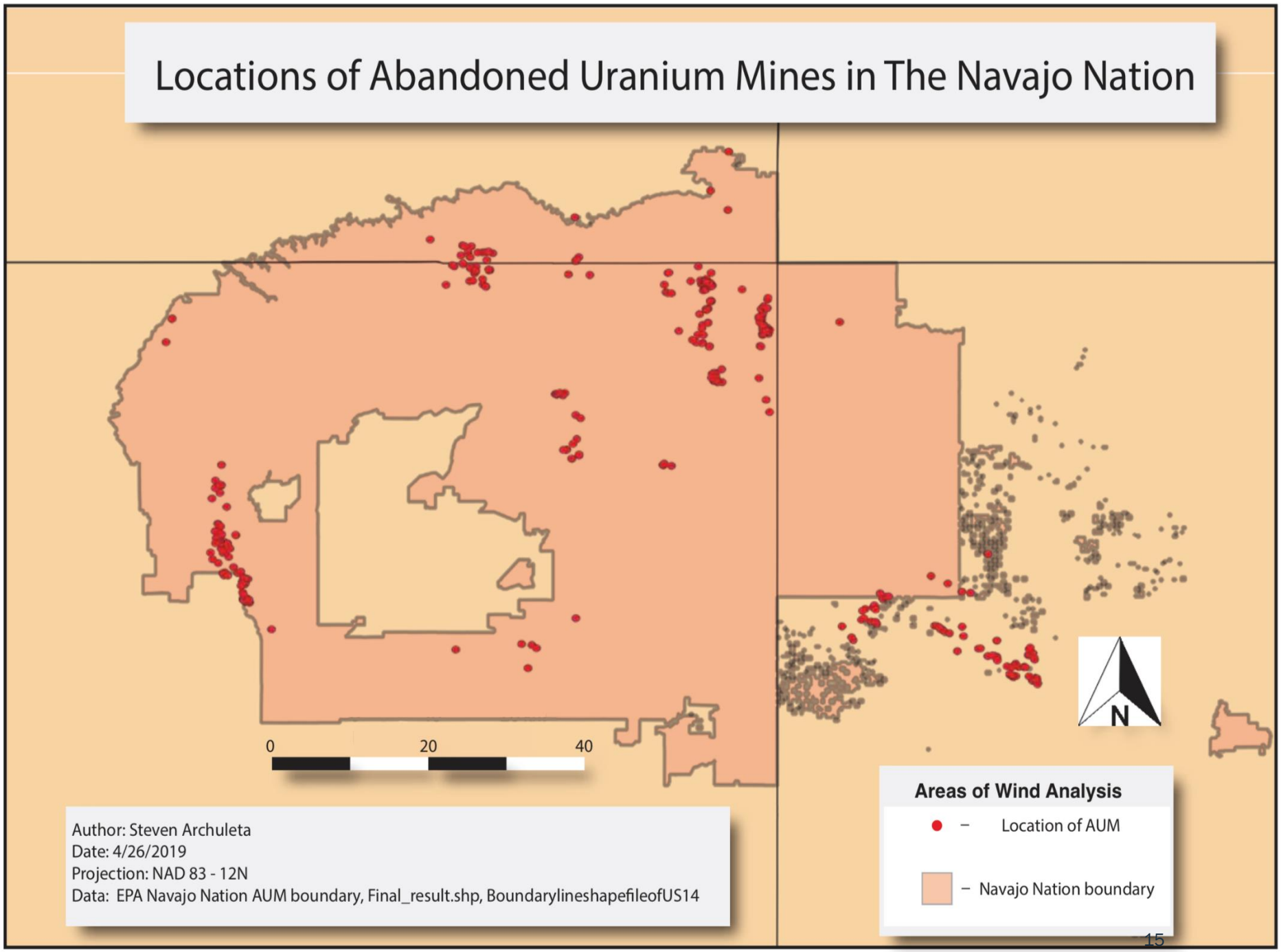
Demonstration Cont. Step 2

6. Select the “Cell” > “Run All Below”

'Cell' > 'Run All Below' from this cell.

	geometry	2/3/1984	2/4/1984	2/5/1984	2/8/1984	2/14/1984	2/20/1984	2/21/1984	2/22/1984
0	POINT (-12299449.94132217 4448629.52907002)	160	190	210	260	60	240	130	120
1	POINT (-12283748.42150378 4445454.396211855)	160	190	210	260	60	240	130	120
2	POINT (-12283571.8555572 4445367.059331894)	160	190	210	260	60	240	130	120
3	POINT (-12282737.00474494 4444992.839370243)	160	190	210	260	60	240	130	120
4	POINT (-12284524.06887607 4439967.188271545)	160	190	210	260	60	240	130	120

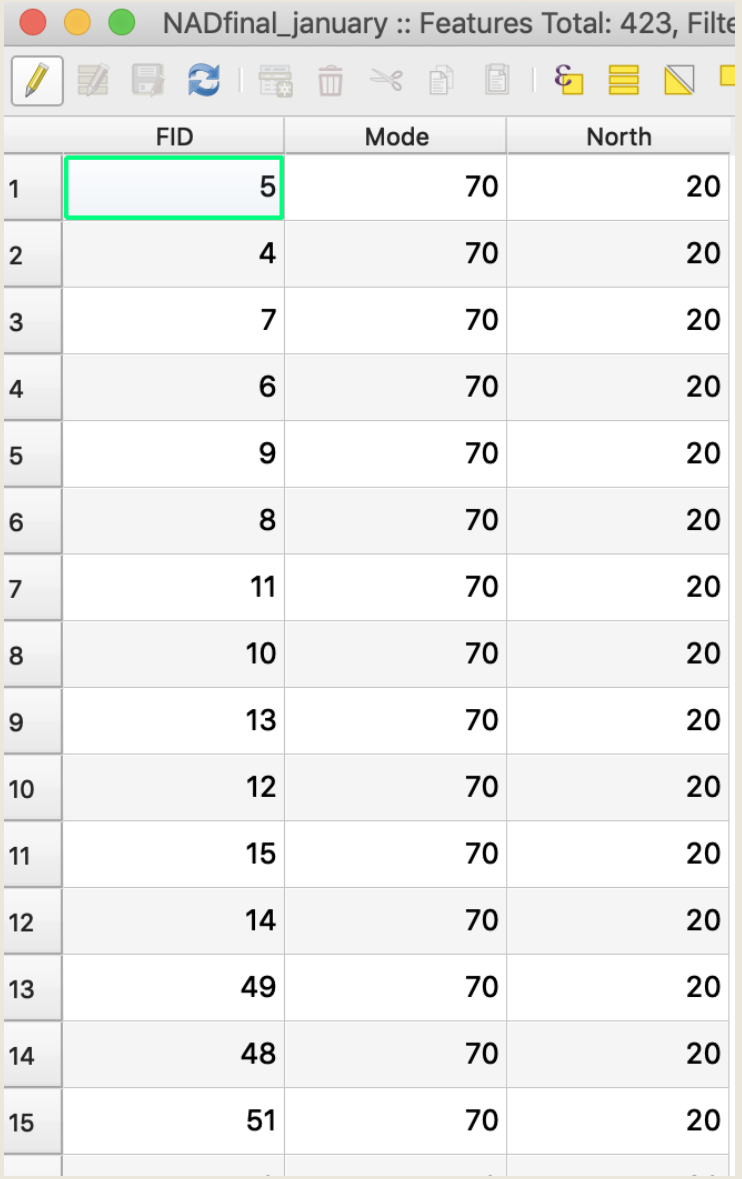
Locations of Abandoned Uranium Mines in The Navajo Nation



Author: Steven Archuleta
Date: 4/26/2019
Projection: NAD 83 - 12N
Data: EPA Navajo Nation AUM boundary, Final_result.shp, BoundarylineshapefileofUS14

Shapefile Attributes

- Mode = Polar Grid
- North = North Azimuth



	FID	Mode	North
1	5	70	20
2	4	70	20
3	7	70	20
4	6	70	20
5	9	70	20
6	8	70	20
7	11	70	20
8	10	70	20
9	13	70	20
10	12	70	20
11	15	70	20
12	14	70	20
13	49	70	20
14	48	70	20
15	51	70	20

Conclusion

The Prevailing Wind Tool saves time by iterating through multiple days and uses code for statistical analysis. This analysis would take a significant amount of time to complete without code. However, I have found that there is much room for improvement.

The tool can be improved by iterating through multiple years of the wind data in a single iteration. The tool also produces a large amount of intermediate files.

The tool is flexible because it can be used with any point shapefile. The NOAA url gives the user the direct path to the wind data needed for the tools operation. The tool is limited to the NOAA surface wind data.

References

- “Novel Geospatial Modeling to Inform Risk Assessment for Metal Contamination Research on Tribal Lands”, National Institutes of Health (NIH) and Environmental Protection Agency (EPA) P50 (Native Environmental Health Equity Research Center 2018 Pilot Project), PI: Yan Lin
- NOAA Surface wind data u, v- values.
- (March, June, September, December for 1984 – Present) https://www.ncdc.noaa.gov/societal-impacts/wind/v-comp/195003
- EPA ArcGIS REST services Region9/Navajo Nation AUM Site Screening
- https://geodata.epa.gov/arcgis/rest/services/Region9/NavajoNationAUMSiteScreening/MapServer