

The relation between Kinmen fog and ENSO

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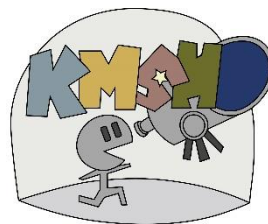
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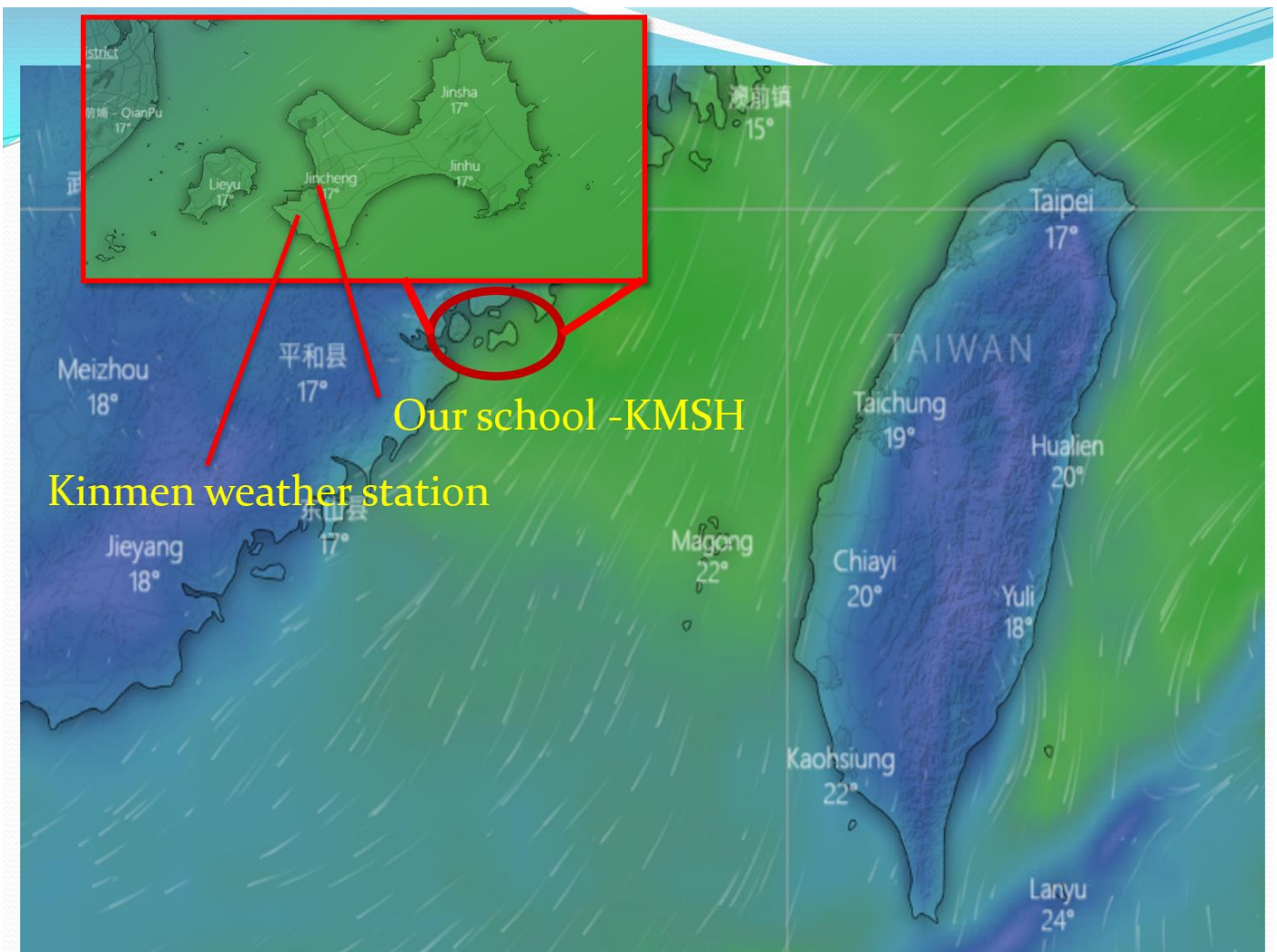
**National Kinmen Senior High School
Taiwan Partnership**



Our Team Photos



Abstract



Some people said that fog is a cloud on the ground. When people want to explore upwards, we choose to stay where we are and want to understand this mysterious situation. From a scientific perspective, we work hard at the computer desk to integrate the data of fog .Then, after a comparison, we made an unexpected discovery.

Maybe we can even predict “fog” in the future.

Interduction

January 26, 2020, 9 am, weather conditions haze, basketball star Kobe Bryant died unfortunately as a result of the crash, as fans, we are saddened by this, but this is not the first time that it has resulted from poor sight. The crash will not be the last. So we started to study, and understand the cause for “fog”, and hope to apply it to life.

Research Purposes

- (1) Is Kinmen fogging related to the ENSO phenomenon?
- (2) Is Kinmen fogging directly related to nearby sea temperature?
- (3) Is there a direct correlation between Kinmen fogging and wind direction?

Research method

- (1) The foggy days are regular due to the season, but the number of foggy days changes every year
- (2) Collect fogging statistics from various websites and convert them into charts and graphs
- (3) Discuss the relevance, and finally apply it to daily life.

Methods and Materials

Computer and Microsoft Excel software

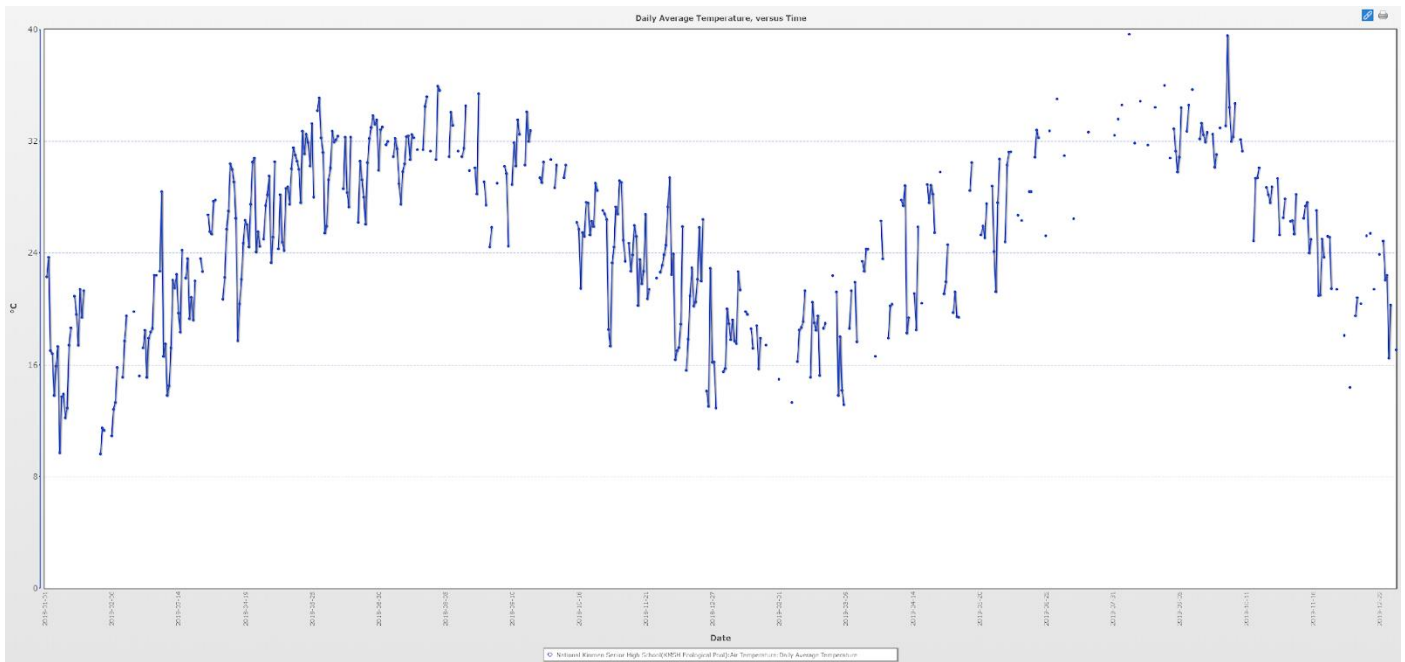
Research Process and Results

ObsTime	StrnPres	SeaPres	Temperature	dew point	RH	WS	WD	WSGust	WDGust	Precp	PrecpHour	SunShine	GlobRad	Visb	UVI	loud Amou
1	1016.4	1020.7	14.4	12.8	90	1.8	260	2.2	270	0	0	...	0	...	0	...
2	1015.8	1020.1	14.6	13	90	1.7	260	2.1	250	0	0	...	0	...	0	...
3	1015.1	1019.4	14.2	12.8	91	1.3	150	1.9	270	0	0	...	0	...	0	...
4	1014.6	1018.9	14.6	13.4	93	0.3	240	2	140	0	0	...	0	...	0	...
5	1014.8	1019.1	14.4	13	91	0.7	190	1.8	190	0	0	...	0	2	0	10
6	1014.8	1019.1	14.8	13.7	93	1.8	360	2.5	320	0	0	0	0	...	0	...
7	1015.8	1020.1	15.8	14	89	1	340	2.4	360	0	0	0	0	...	0	...
8	1016.1	1020.4	16.4	14.5	89	1.3	30	2.5	30	T	0.1	0	0.14	2	0	10
9	1016.3	1020.6	17.2	15	87	1.4	20	2.9	40	T	1	0	0.6	2	1	10
10	1016.2	1020.5	18	15	83	1.4	360	3.7	350	T	0.3	0	0.6	...	2	...
11	1015.7	1020	18.3	16.7	90	0.4	300	3.2	360	T	0.8	0	0.8	2	3	10
12	1015	1019.3	17.8	15.4	86	1.2	280	2.1	10	0.1	1	0	0.89	...	4	...
13	1014.2	1018.5	17.5	15.1	86	2.9	280	4.4	280	0.7	1	0	0.6	...	2	...
14	1013.3	1017.6	17.6	15.8	89	1.3	320	3.7	270	2.6	1	0	0.49	0.2	2	...
15	1012.5	1016.8	18.6	17.7	95	0.2	0	2.5	20	1	1	0	0.66	...	2	...
16	1012.4	1016.7	18.4	18.1	98	0.2	0	1.8	360	T	0.2	0	0.46	...	1	...
17	1012.4	1016.7	18	17.5	97	0.1	0	1.8	130	0	0	0	0	0.2	0	...
18	1012.4	1016.7	17.4	17	97	0.4	190	1.7	170	0	0	0	0	...	0	...
19	1012.1	1016.4	17.7	17	96	1.3	140	2.1	140	0	0	0	0	...	0	...
20	1012.5	1016.8	15.8	15.3	97	1.7	180	2.4	170	0	0	...	0	0.2	0	...
21	1012.6	1016.9	15.5	15.2	98	1.7	180	2.3	170	0	0	...	0	0.3	0	...
22	1012.8	1017.1	15.8	15.4	97	1.2	210	2.2	180	0	0	...	0	...	0	...
23	1012.8	1017.1	15.9	15.4	97	1.2	190	2.4	200	0	0	...	0	...	0	...
24	1012.9	1017.2	15.9	15.6	98	1.4	210	1.9	230	0	0	...	0	...	0	...

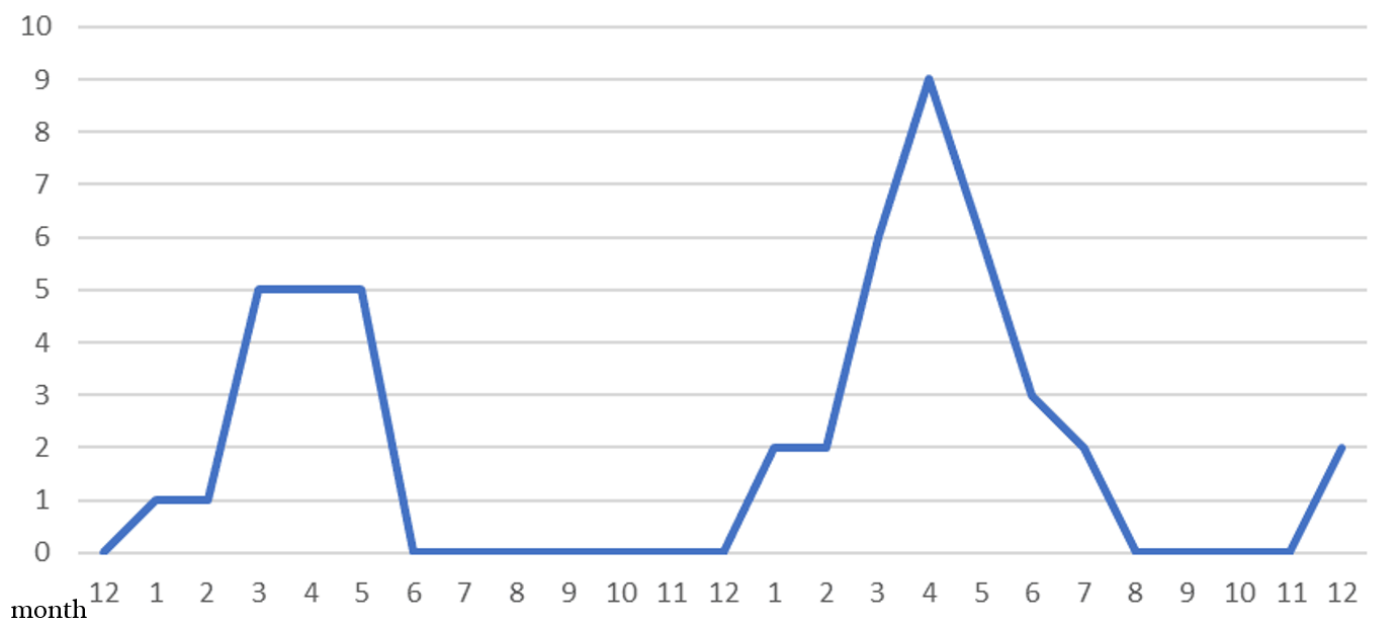
We downloaded the data from the website of the Central Weather Bureau, and counted the total days with visibility less than 1 km.

Temperature Record

Then we immediately thought that we are members of GLOBE and usually record the temperature, so we compared the charts drawn by the GLOBE web automatically. Here is our result.



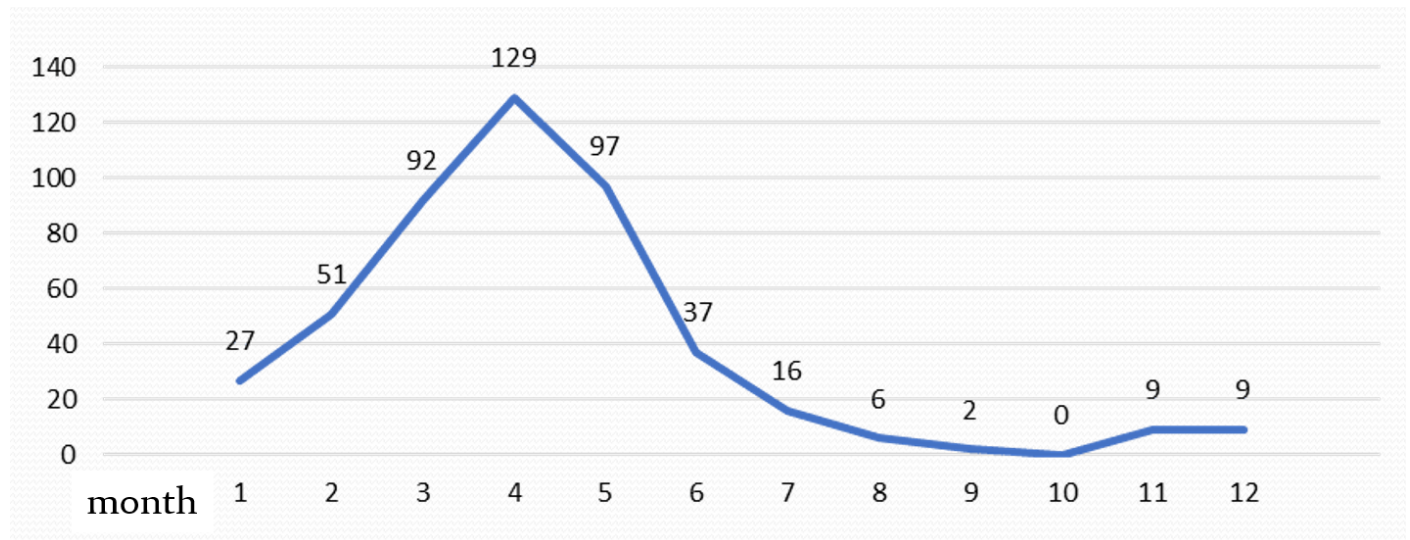
Our GLOBE Records from 2018~2019



GLOBE Foggy Days 2018-2019

From these two pictures, we can see a clear positive correlation. The higher the temperature, the more the foggy days. However, the comparison of two years alone seems not enough to prove what the relationship between fogging and the weather

factors, we search the website of the Central Weather Bureau again and integrated the data from the past fifteen years (the Kinmen weather station was set up in 2003), and made the following chart with Excel.

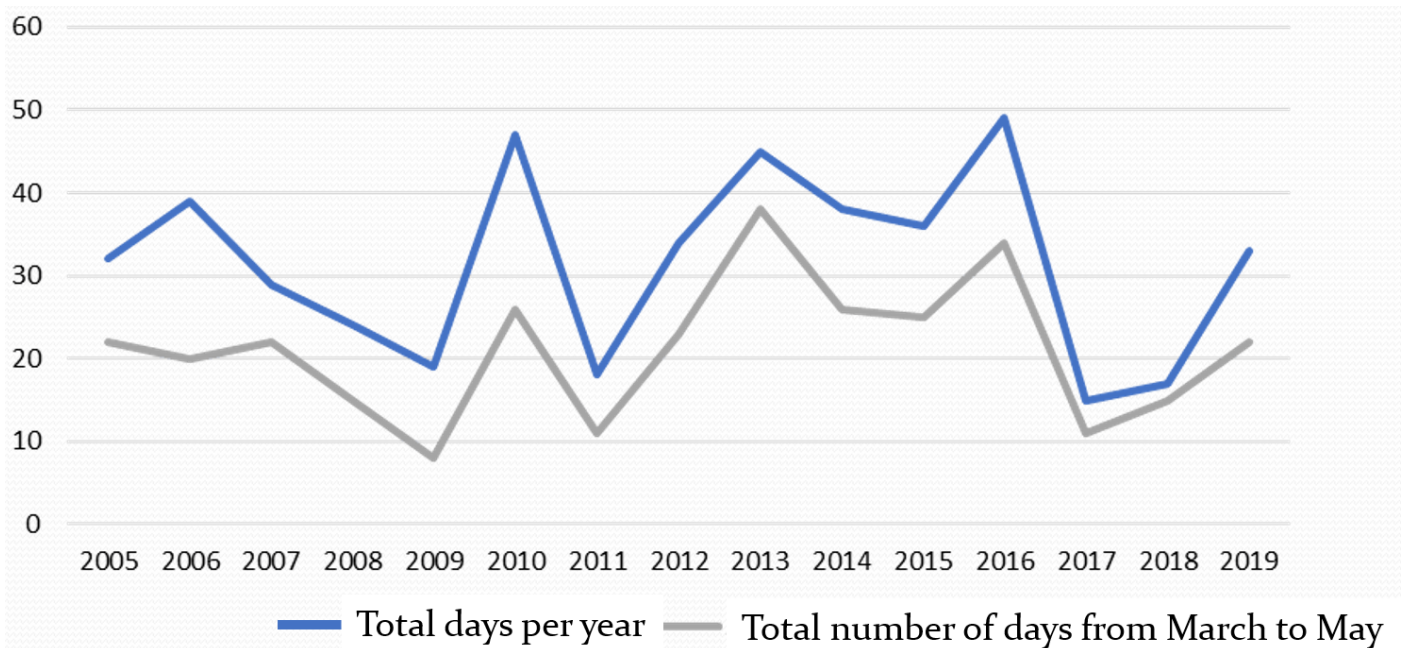


2005-2019 Visibility < 1km days

In order to ensure that the day is foggy rather than hazy, we added a new criterion. In addition to visibility less than 1km, the humidity must be higher than 70% on the day before we can count.

From this table, we can see that there are the most foggy days in March, April, and May each year. We speculate that this may be related to the frontal fog and advection fog of Kinmen. Then we integrated the changes over the years to draw a new picture.

Collect visibility, take off and landing data



Line Chart of Foggy Days 2005-2019

From this figure, we can clearly know that there is no certain regulation in terms of the year. In addition, we made a comparison with the sum of days in March, April, and May, and found the foggy days are occurred mainly in from March to May every year.

Therefore, in order to better understand the relationship between the number of foggy days and other weather phenomena, we examined the ENSO index.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2003	0.9	0.6	0.4	0	-0.3	-0.2	0.1	0.2	0.3	0.3	0.4	0.4
2004	0.4	0.3	0.2	0.2	0.2	0.3	0.5	0.6	0.7	0.7	0.7	0.7
2005	0.6	0.6	0.4	0.4	0.3	0.1	-0.1	-0.1	-0.1	-0.3	-0.6	-0.8
2006	-0.8	-0.7	-0.5	-0.3	0	0	0.1	0.3	0.5	0.7	0.9	0.9
2007	0.7	0.3	0	-0.2	-0.3	-0.4	-0.5	-0.8	-1.1	-1.4	-1.5	-1.6
2008	-1.6	-1.4	-1.2	-0.9	-0.8	-0.5	-0.4	-0.3	-0.3	-0.4	-0.6	-0.7
2009	-0.8	-0.7	-0.5	-0.2	0.1	0.4	0.5	0.5	0.7	1	1.3	1.6
2010	1.5	1.3	0.9	0.4	-0.1	-0.6	-1	-1.4	-1.6	-1.7	-1.7	-1.6
2011	-1.4	-1.1	-0.8	-0.6	-0.5	-0.4	-0.5	-0.7	-0.9	-1.1	-1.1	-1
2012	-0.8	-0.6	-0.5	-0.4	-0.2	0.1	0.3	0.3	0.3	0.2	0	-0.2
2013	-0.4	-0.3	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.3	-0.2	-0.2	-0.3
2014	-0.4	-0.4	-0.2	0.1	0.3	0.2	0.1	0	0.2	0.4	0.6	0.7
2015	0.6	0.6	0.6	0.8	1	1.2	1.5	1.8	2.1	2.4	2.5	2.6
2016	2.5	2.2	1.7	1	0.5	0	-0.3	-0.6	-0.7	-0.7	-0.7	-0.6
2017	-0.3	-0.1	0.1	0.3	0.4	0.4	0.2	-0.1	-0.4	-0.7	-0.9	-1
2018	-0.9	-0.8	-0.6	-0.4	-0.1	0.1	0.1	0.2	0.4	0.7	0.9	0.8
2019	0.8	0.8	0.8	0.7	0.6	0.5	0.3	0.1	0.1	0.3	0.5	0.6

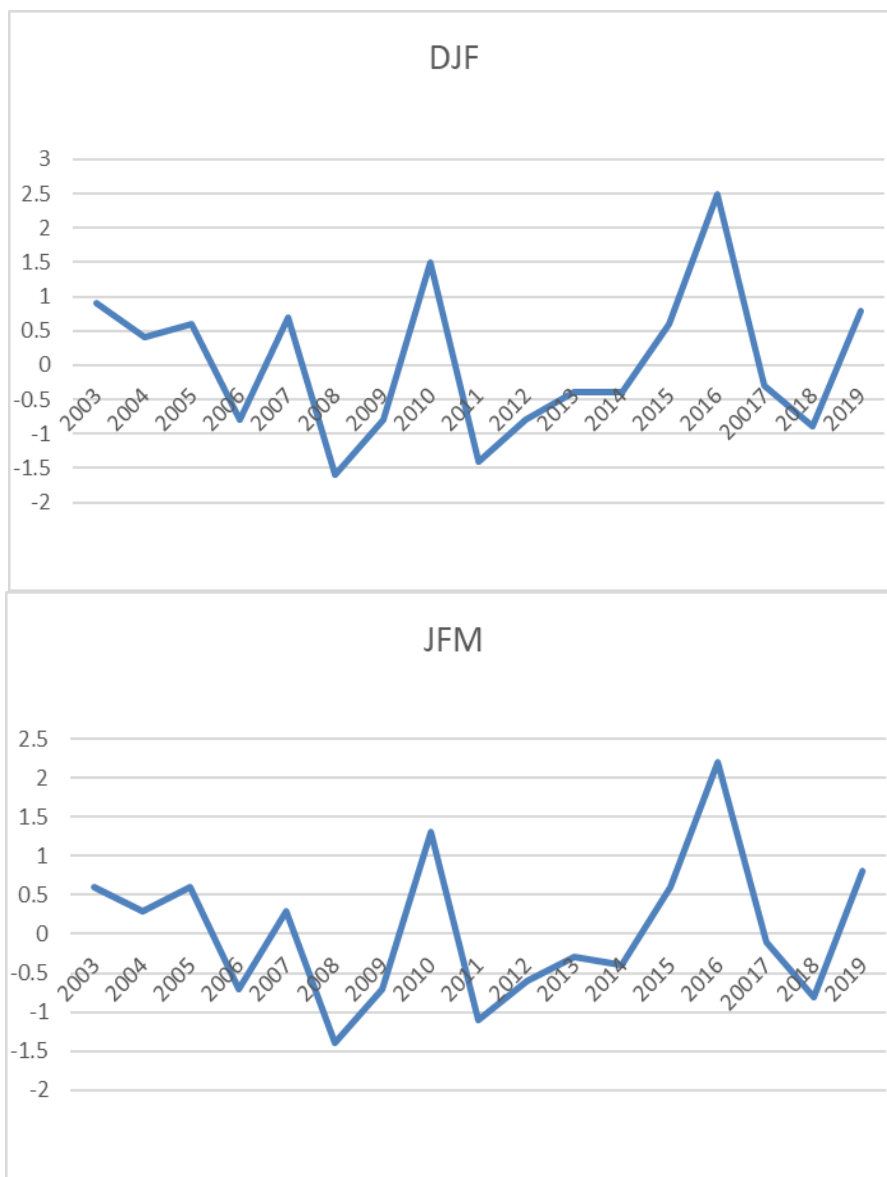
In the statistical process, I just thought that the phenomenon of ENSO taught in the freshmen of high school is not regular.

We began to think whether the change in fog was also related to ENSO, so we began to collect data of ENSO.

Among them, ASO is the most relevant. We compare it individually:

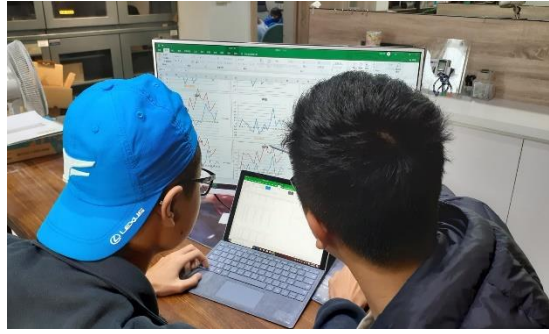
This is the change of ENSO index over the years. The part on the horizontal axis is every three months. We choose DJF and JFM for example as follow.

Abbreviation	Months	Correlation coefficient
DJF	12~2	0.585707
JFM	1~3	0.578183
FMA	2~4	0.557503
MAM	3~5	0.451996
AMJ	4~6	0.276366
MJJ	5~7	0.572399
JJA	6~8	0.660755
JAS	7~9	0.670568
ASO	8~10	0.67728
SON	9~11	0.664876
OND	10~12	0.647583
NDJ	11~1	0.62156



The abbreviation above represent months, and each figure is a unit of three months.

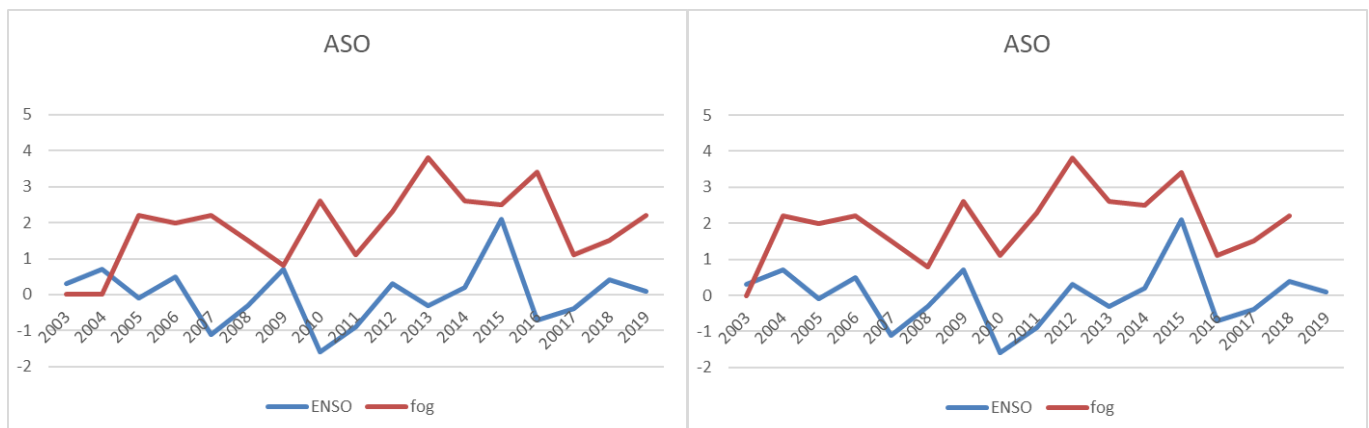
Discussion



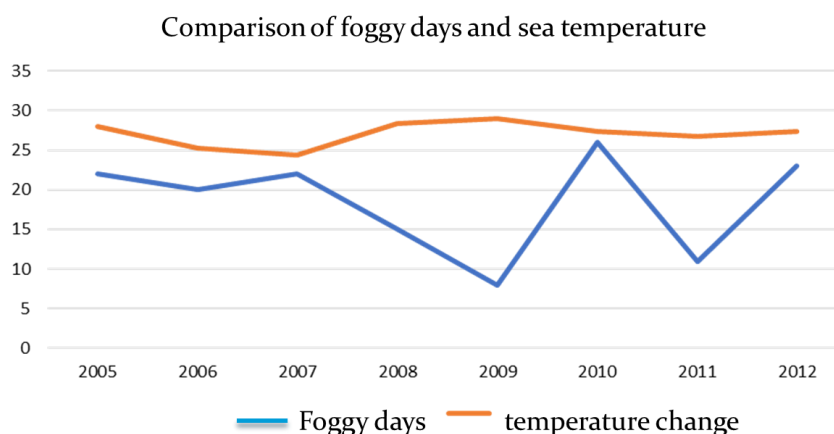
From the materials we just discussed, we are doing overlapping analysis. Putting together the line chart of the ENSO Year and the line chart of the total number of foggy days in March, April and May, we did not see the relationship .



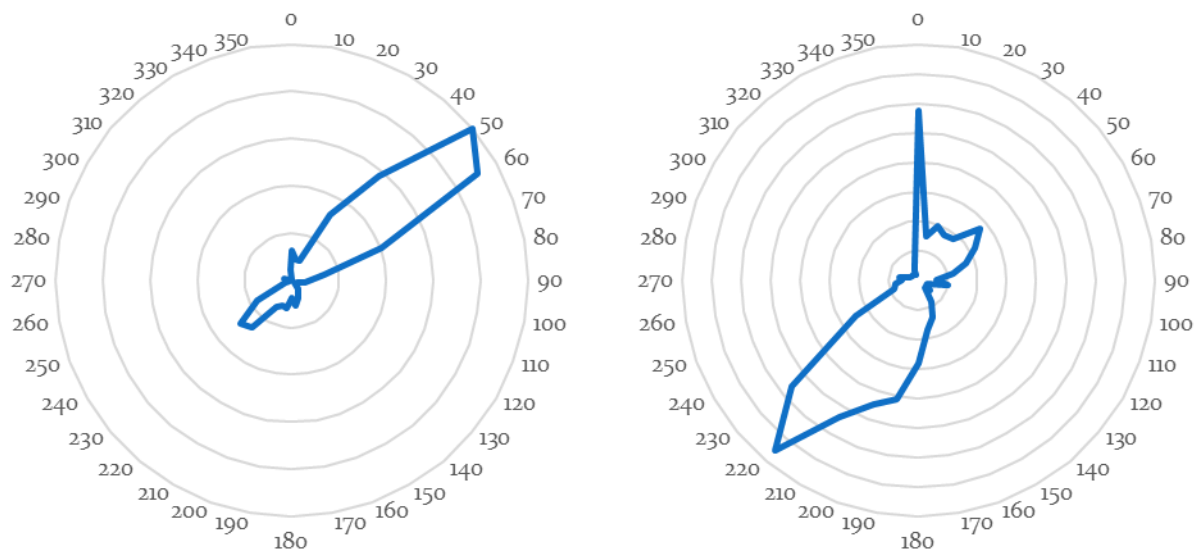
In the process of comparison, we found that the graphs of the fog seems to be delayed by half a year from the graphs of the ENSO phenomenon, so we postponed all the graphs by half a year and compared the most relevant ones.



This(Left) is what we saw at the beginning, it didn't seem to be relevant. In this way, it(Right) was postponed for a year. The positive correlation is obvious, and the undulated parts are almost the same, and the 0.67728 result in Excel confirms our conjecture.



Due to the lack of data on sea temperature, there is only data between 2005 and 2012, and there is a vague negative relationship after comparison, which indeed proves that the lower the sea temperature, the higher the number of foggy days.



(Left) Wind direction throughout the year
(Right) Foggy wind direction

Outlook

Although people can't control the weather, we can predict it. Although we can't use the fog forecasting very accurately at present, I believe that after comparing and observing more things, maybe we will develop new methods in the future.

Conclusion

- (1)The most foggy days in Kinmen each year occur in March, April and May.
- (2)There is a positive relationship between ENSO and fogging. When the ENSO occurs half a year later, foggy days will become 10 to 20 days more than usual.
- (3)There is a slight negative correlation between foggy days and sea temperature.
- (4)When the it is foggy in Kinmen , the wind direction is mostly southwest .

Reference(Bibliography/citations)

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