The relationship between Easterly Surge and the feasibility of stargazing in Kinmen.

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Team photos

Abstract

When making astronomical observations, the stars are often not visible because of the cloud cover. We noticed that the evening clouds are related to the possibility of stargazing at night. We photographed the afternoon clouds to analyzed the cloud species, recorded whether the stars could be seen at night, and compared the temperature and rainfall data in the IVSS report last year . We found that summer evening clouds are not directly related to the possibility of stargazing at night, while winter evening clouds may be directly related to nighttime stargazing. After half a year of observation, we found that in summer, because the southwest air flow(西南氣流) which is brought by the southwest monsoon(西南季風) which brought abundant water vapor from the South China Sea, the water vapor condensed into clouds to cover the sky, and it is impossible to observe the stars. In winter, the weather system is stable, and due to the influence of the "Easterly Surge"(東風潮), clouds are not easy to form near the Taiwan Strait, then stargazing is possible in the Kinmen area.

Whether the sky has cloud cover or not at night has a great impact on stargazing at the observatory.

1.The figure on the left shows that clouds pass by during observation. The telescope will receive the Noise which is released by clouds and shown as the white dots in the figure.

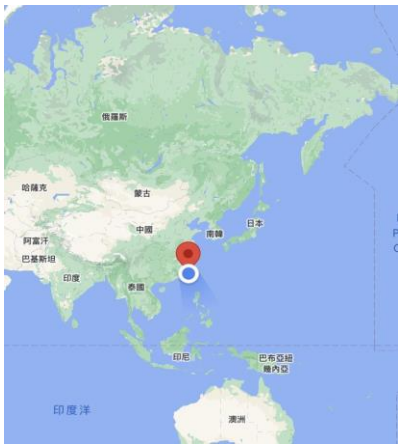
2.The image on the right shows a cluster taken in the none-cloud sky, with less noise. Therefore, the figure and astronomical data have less impact(fewer white dots) .

Research purposes

By observing the clouds and weather conditions in the evening and analyzing Kinmen's special geographical location's factors, we want to know the feasibility of stargazing at night in winter and summer in Kinmen.

Geographical location

↓Asia



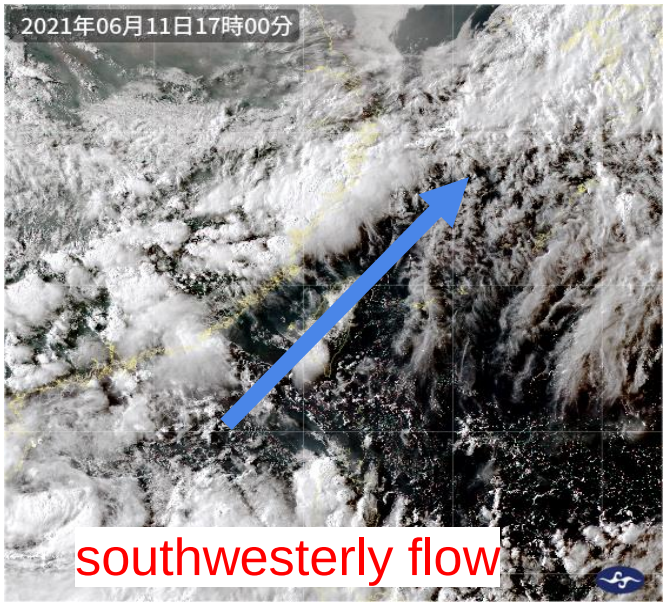
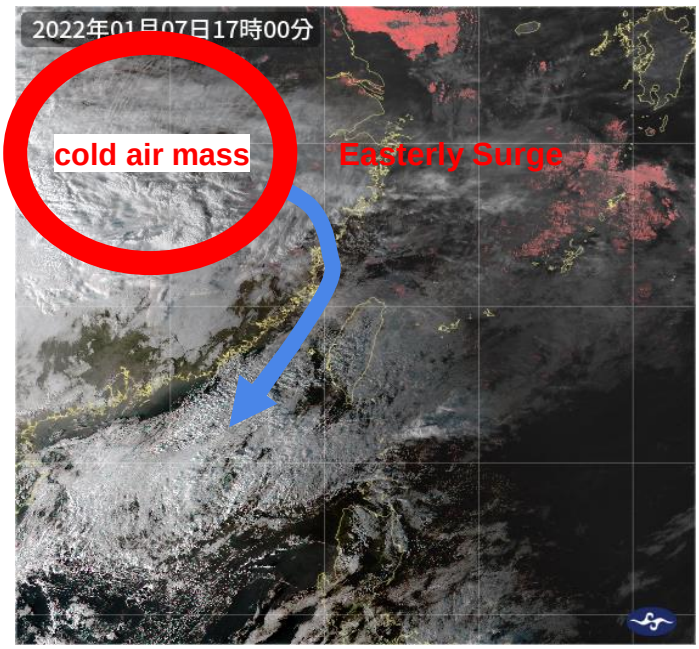
↓Taiwan

↓Kinmen

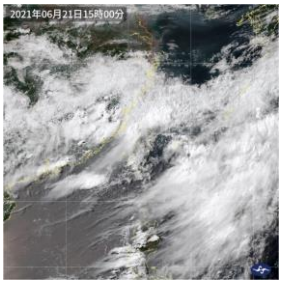
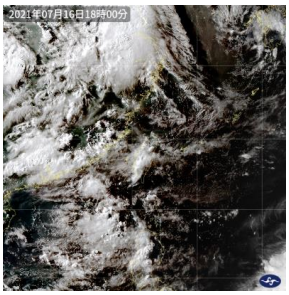
↓Observatory in Kinmen senior high school

Research result

(1) The difference between summer and winter Kinmen Cloud

Summer (6/11)

unable to stargazing
Winter(1/07)

able to stargazing

(2) Description of the difference between summer and winter weather systems

<table>
<tr><td rowspan="6">Summer</td><td>  </td><td>  </td></tr>
<tr><td colspan="2">2021/6/21</td></tr>
<tr><td>  </td><td>  </td></tr>
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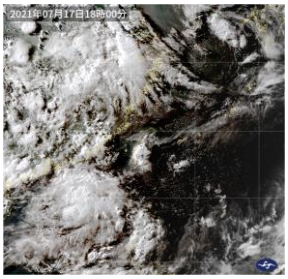
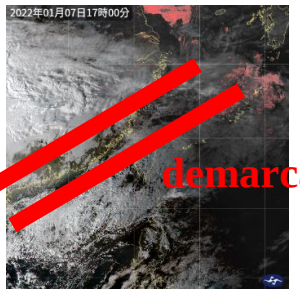
<tr><td>  </td><td>  </td></tr>
<tr><td colspan="2">2021/7/17</td></tr>
<tr><td rowspan="2">Winter</td><td> 
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	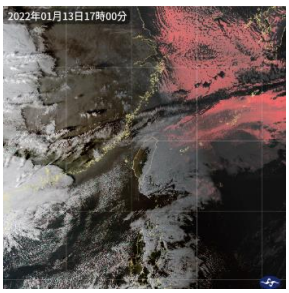	
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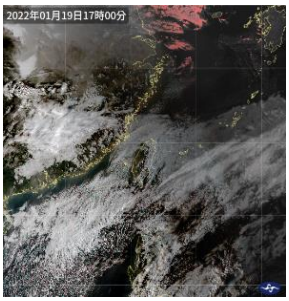
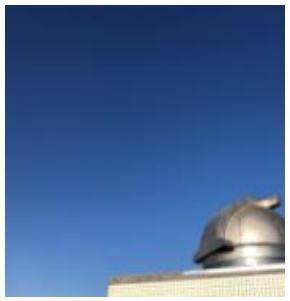
		
	2022/1/19	

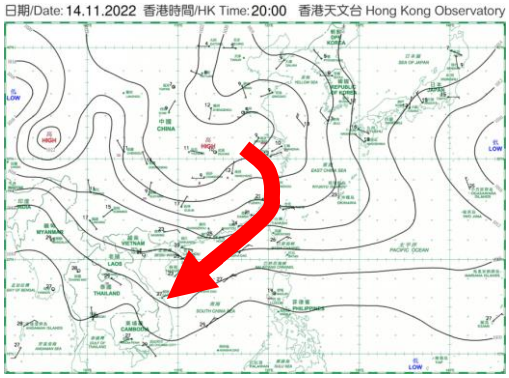
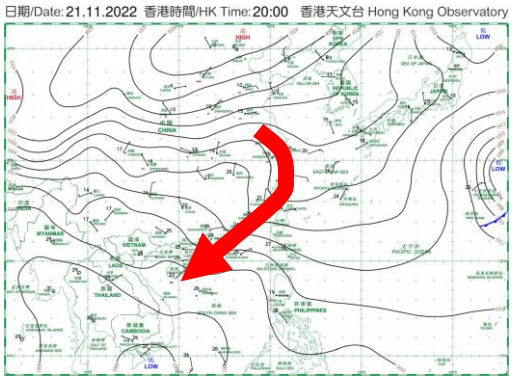
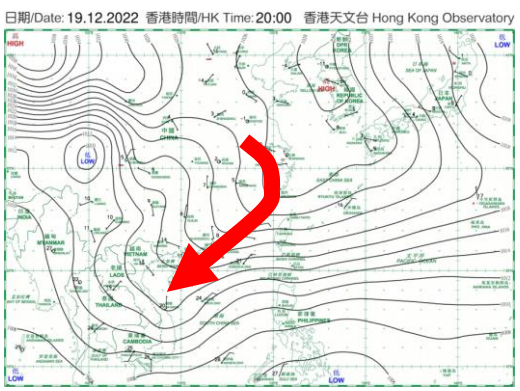
Summer

In June, satellite cloud images can be seen that the southwest monsoon(西南季風) carries water vapor in the South China Sea to the northeast, forming a “southwesterly airflow”(西南氣流). The abundant and warm vapor in the southwest air flow(西南氣流) is the main factor that makes it easy for clouds to form, and the clouds are chaotic and irregular, with many obvious broken clouds covering the sky over Kinmen. So summer’s atmosphere is not stable. It is difficult for Kinmen to observe the stars.

Winter

In winter, under the influence of the "Easterly Surge"(東風潮) near the Taiwan Strait, a dry and cold air flow moves along the Chinese coast, leaving the Kinmen area with almost no cloud cover. And it can be seen that there is a clear cloud demarcation along the Chinese coast. In the picture on the right, because the Cold Air Mass is weak and cannot cross the Wuyi Mountain Range and the Nanling Mountain Range, there are many clouds (water) accumulated in these two mountain ranges, and the accumulated cold air forms a high pressure, and the air flow rotates clockwise out along the coast of China, forming dry and cold air through East China coast, and the Easterly Surge make the Taiwan Strait (Kinmen) clear and cloudless.

(3) Comparison of Surface Weather Chart

date	Observations of Surface Weather Chart of the Hong Kong Observatory	Photos of Kinmen Sky
2022/ 11/14		
2022/ 11/21		
2023/ 1/19		

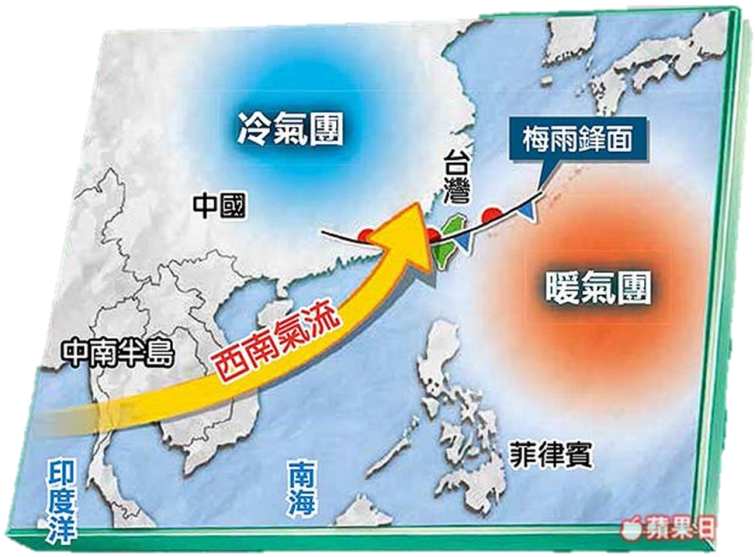
Discussion

(1) Climate and weather factor

At first, we tried to explain the difference between summer and winter clouds from the convection.But from the satellite cloud image (17:00), we found that the sea near Kinmen has less clouds formed by convection uplift in summer. Stargazing may not be affected. Convection is not the factor in the difference between summer and winter clouds.

So we analyze from the specific heat of the sea and land, in the summer evening, the land is colder than the sea surface, forming a high pressure, the land wind blows from the Chinese mainland to Kinmen, but we found that the land wind will be blocked by the mountains along the coast of China (Nanling and Wuyi Mountains), so the land wind won't impact the weather in evening.So this factor doesn't impact the difference between summer and winter clouds, either.

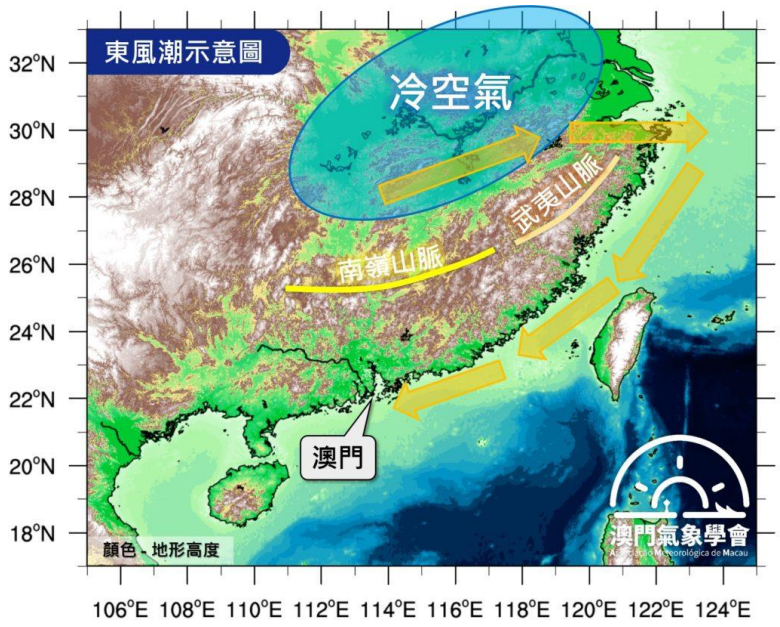
Summer



↑Schematic diagram of the southwest airflow. Taken from Apple News (2016)

1. In summer (May, June and July), the heating mass becomes larger and the cold air mass intersects to form a residual front at this time the southwest monsoon strengthens, and the warm and humid water vapor of the South China Sea is carried to Taiwan with the front (along the edge of high pressure). So the cloud covers the Taiwan Strait.

Winter



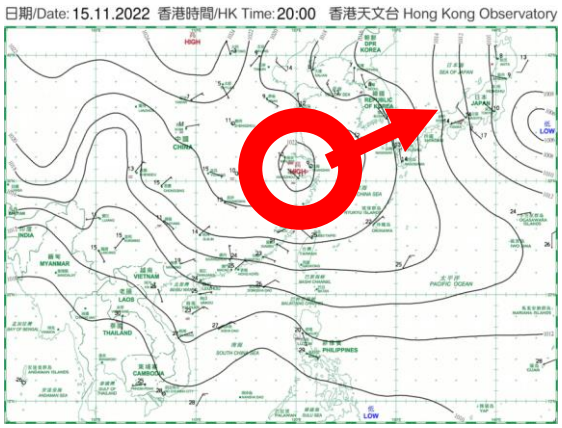
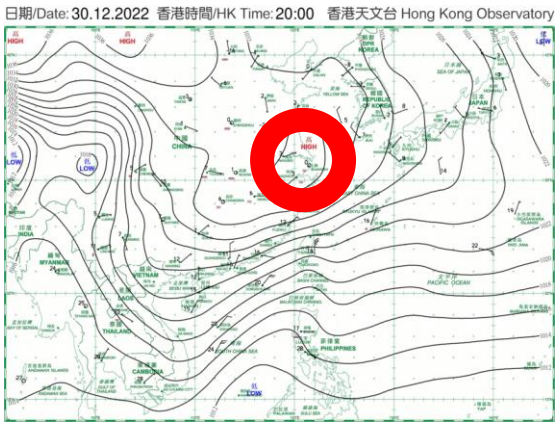
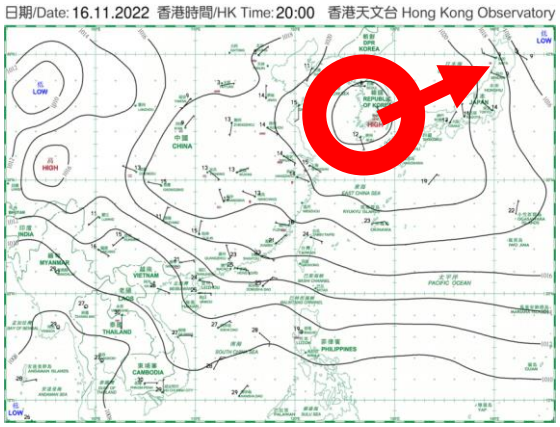
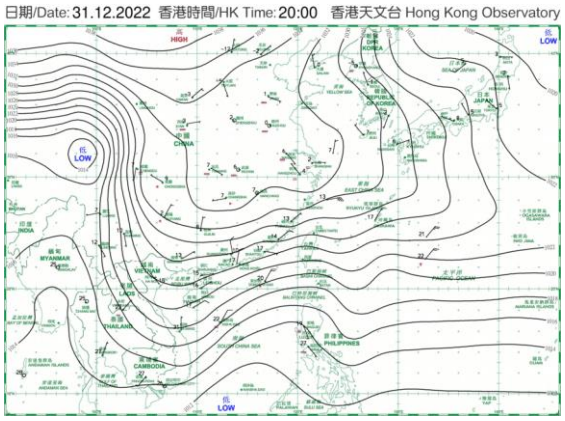
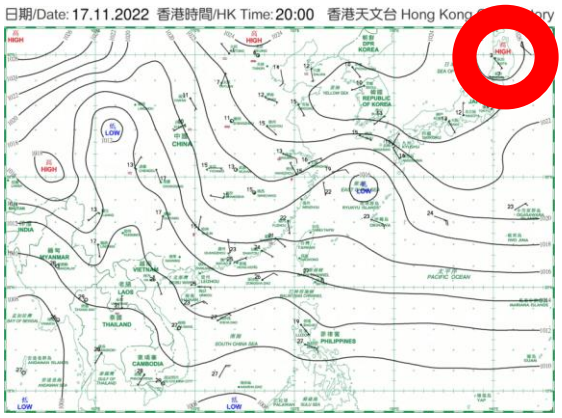
↑Schematic map of Easterly Surge, taken from Macao Weather Station (2021)

2. Whenever in late winter and early spring, the temperature is not high. The cold air mass is weak, cannot cross the Wuyi Mountain Range and the Nanling Mountain Range, the cold air mass accumulates near the mountain range to form a high pressure, and the high pressure air flow through East China along the southeast coast of China spiral out. Because the path passes through the land (East China), so the air flow is dry and cold air flow, not easy to form clouds, making the coast of China clear and cloudless.Its path passes through the sea, because the friction on the sea surface is smaller than that on land, and the Taiwan Strait area is relatively narrow, a Valley effect will form strong winds, while Hong Kong and Macao will be affected by strong easterly winds, so it is called "Easterly Surge"(東風潮). Kinmen is also affected by this dry and cold air flow, forming a good weather without clouds and easy stargazing.

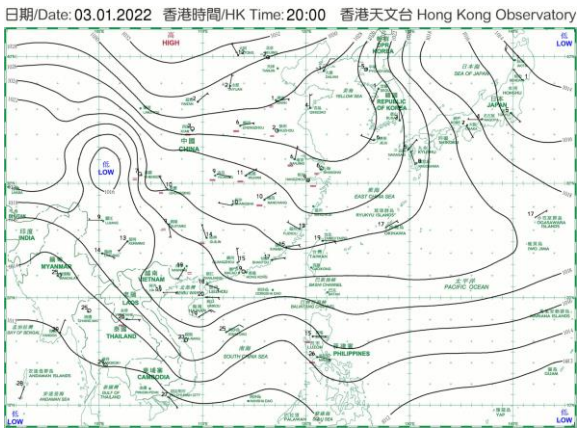
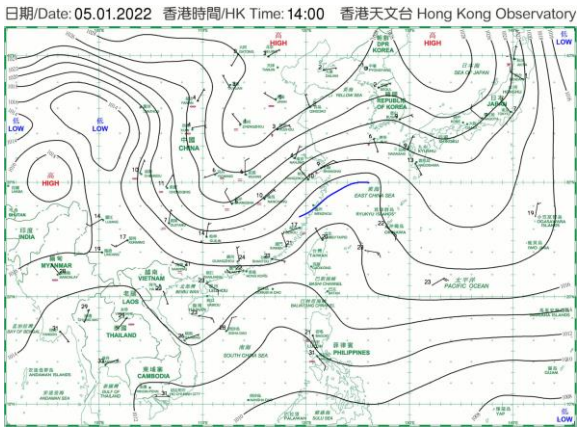
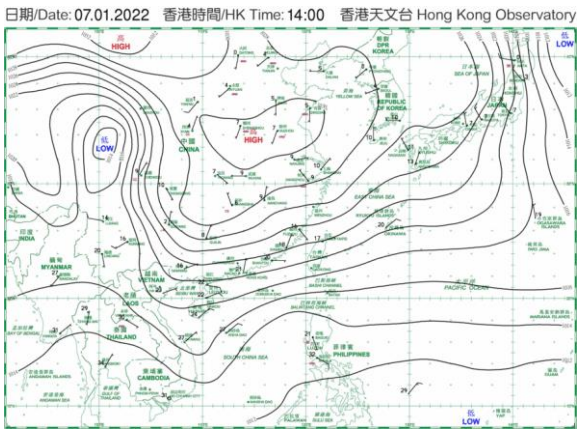
(2) Easterly Surge

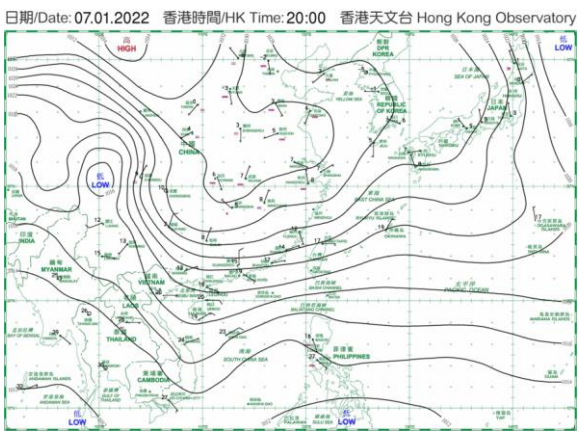
1. Cause: High atmospheric pressure comes from Mongolia
2. Path :
    a. going to sea from northeast China, and directly goes south to form the Easterly Surge(東風潮).
    b. Weaker cold air masses are blocked by mountains or terrain, and some Easterly Surge(東風潮) are turned from the low-flat terrain of northeast China to the sea along the coast of China to the Taiwan Strait.

c. The formation of the Easterly Surge(東風潮) is related to the high pressure, and the position or state of the high pressure will affect the condition of the Easterly Surge.

High pressure moves north	The terrain affects the high pressure and disappears
	
	
	The high pressure went south, because of the mountain terrain, the high-pressure structure was damaged, the high pressure gradually disappeared, and the Easterly Surge(東風潮) disappeared, too.
Start from the Bohai Sea. Because it passes through the sea surface and there is no topographic damage, and with the influence of the Coriolis force,	

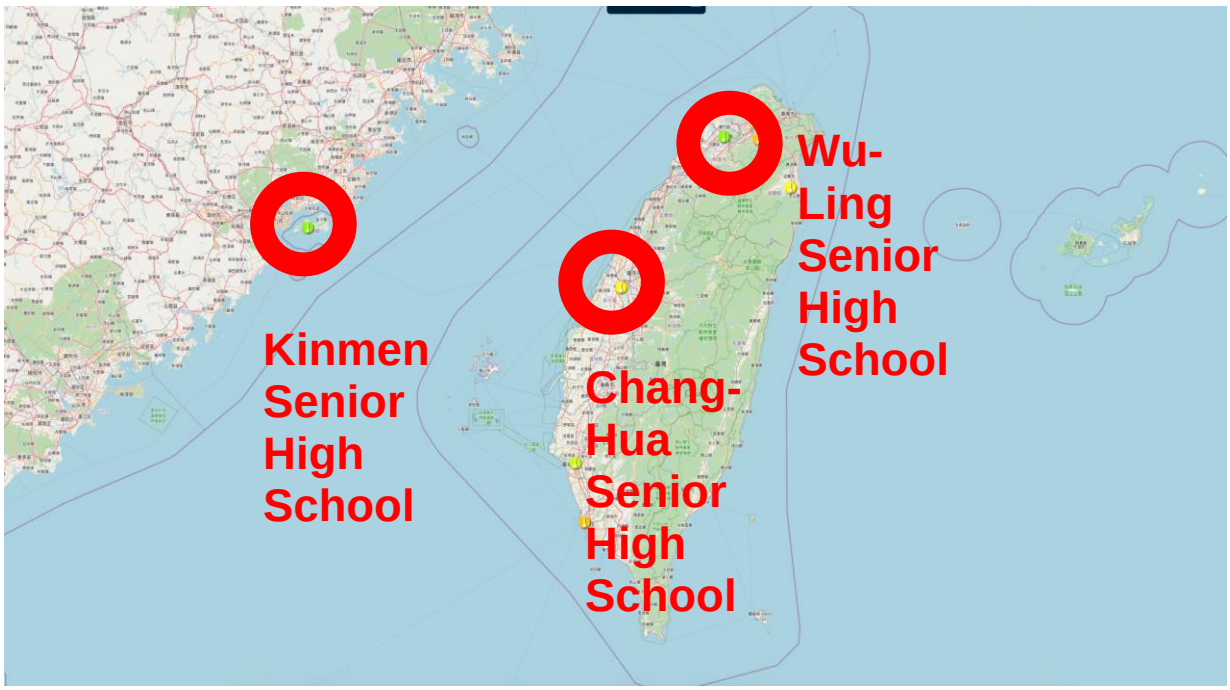
the high pressure will move to the northeast, and the Easterly Surge(東風潮) will disappear. Most of the Easterly Surge's high pressure is this path.	

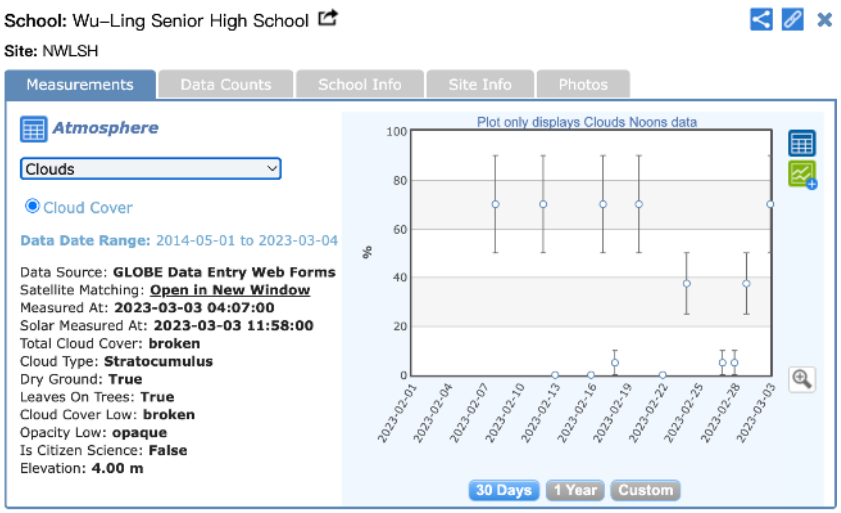
Take the Easterly Surge on January 07, 2022 as an example	
	2022/1/03,the high pressure had formed.
	2022/1/05，The high pressure of cold air mass was moving to the Bohai Sea, and the Easterly Surge was forming.
	2022/1/07,The high pressure of cold air mass was weak so it was blocked in the Wuyi Mountain Range. The Easterly Surge formed. .

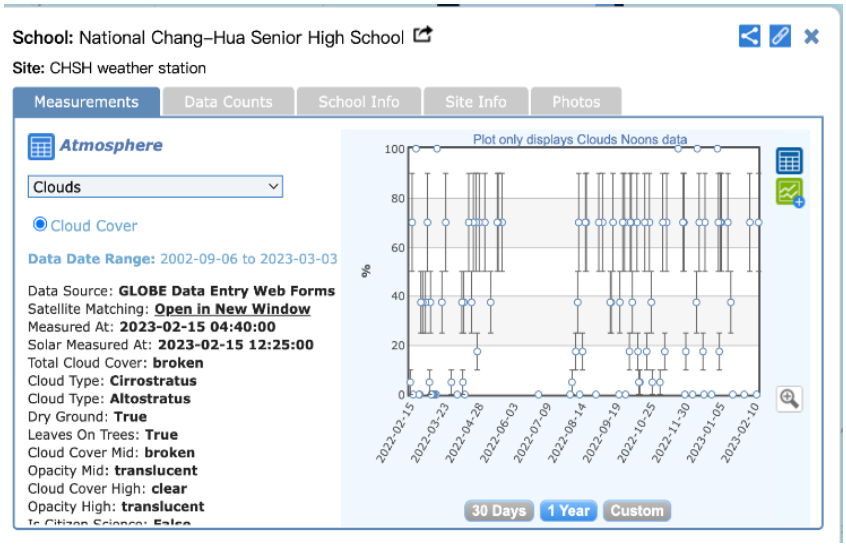
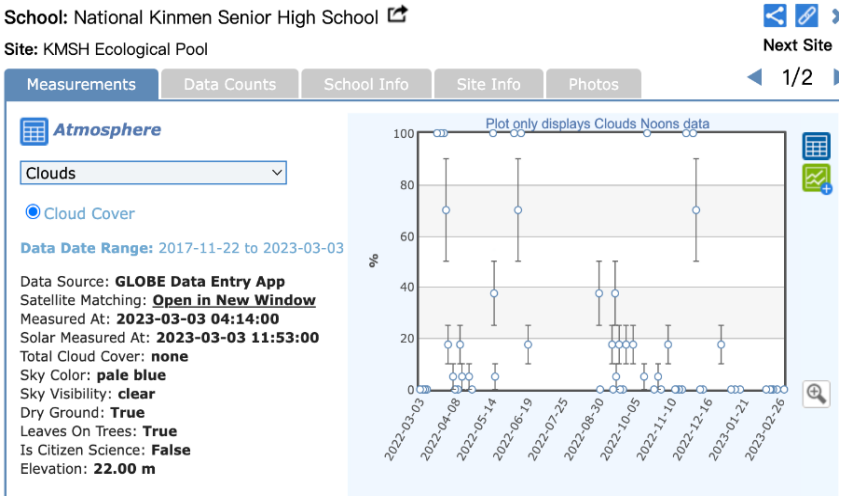


The high pressure of cold air mass was damaged by the Wuyi Mountain Range. Therefore, The high pressure of cold air mass gradually became weak, and the Easterly Surge disappeared.

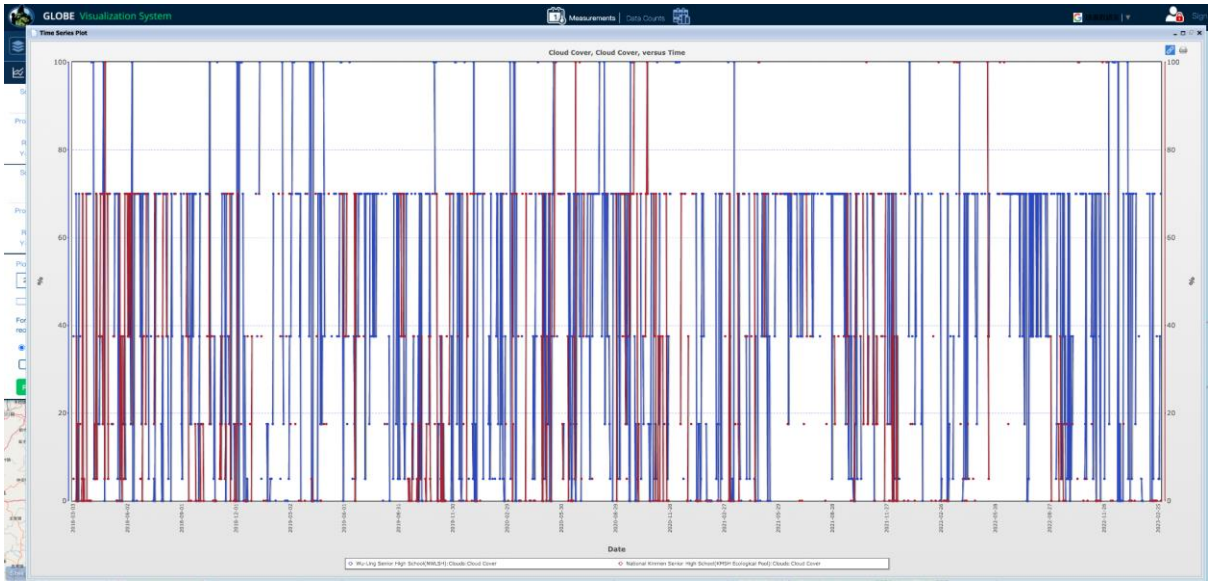
(3)Comparison of imformation



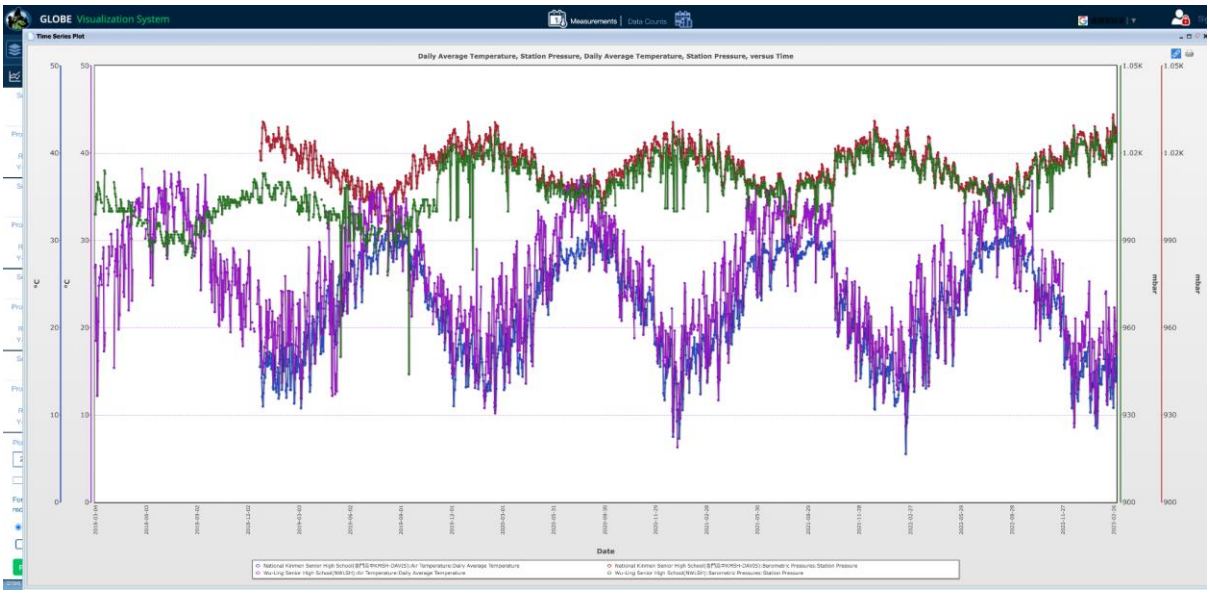
Cloud cover		**Wu-Ling Senior High School**

		**Chang-Hua Senior High School**
		**Kinmen Senior High School**

The cloud observation data and locations from our school, Wuling High School, and Changhua High School over the past year show that our school has a lower cloud cover rate (0-40% more) compared to Wuling High School (40-80% more) and Changhua High School (40-70% more), and a higher rate of clear skies. Although our latitude and climate conditions are similar to those of Wuling, the cloud cover over Kinmen is less. We speculate that this is due to our proximity to mainland China, which is affected by cold air masses and high pressure systems in winter. Another factor is the Easterly Surge we have studied, which bring in dry and cool air, making it more difficult for clouds to form over Kinmen.



↑Cloud cover rates of two schools from Mar 2018 to Mar 2023, Wu-Ling High School (blue) and our school (red).



↑Temperature and pressure data from March 2018 to March 2023 for two schools: Wu-Ling High School (purple for temperature, green for pressure) and our school (blue for temperature, red for pressure).

↑It can be observed that the high pressure system in the north exerts significant pressure during the cold winter, resulting in a relatively high frequency of clear weather and a cloud cover percentage that is often below 40%, with most values falling between 0-70%.

Conclusion

1. In summer, the southwest monsoon brings abundant moisture from the South China Sea, the water vapor is easy to condense into clouds and cover the sky, and the unstable air flow makes stargazing be difficult at night in summer.
2. In winter, cold air is shallow, cold air mass can not Chinese mainland cross the coast of the north of the Nanling Mountain Range of Guangdong and the Wuyi Mountain Range of Fujian, cold air will accumulate for a period of time, through the East China generation along the southeast coast of China to arrive, at this time the air is cold and dry, not easy to form clouds, the atmosphere is stable, making stargazing easy in winter in the Kinmen area.
3. The Easterly Surge(東風潮) affects the chance of stargazing in winter in Kinmen. The high-pressure system originated in Mongolia, and moved to the east. Ultimately, it will be blocked in Wuyi Mountain Range. Because of the factor of the terrain, the Easterly Surge will form, and move southward along the east coast of China, affecting the cloud coverage in the area.
4. After the Easterly Surge blows down, the cold wind meets the warm sea, and there is a cloudless zone above the sea-land border.
5. We found that Kinmen is suitable for stargazing in November and December.

Badges

I am a collaborator:

1. Observe and photograph clouds, and record cloud covered
2. Record whether you can see stars at night
3. Organize photos and data
4. Collect satellite cloud images and Surface Weather Charts and make charts and tables
5.Comparison with data from partner schools
5. Write a report and summarize
We discuss what we observe and conclusion together

I am a data scientist:

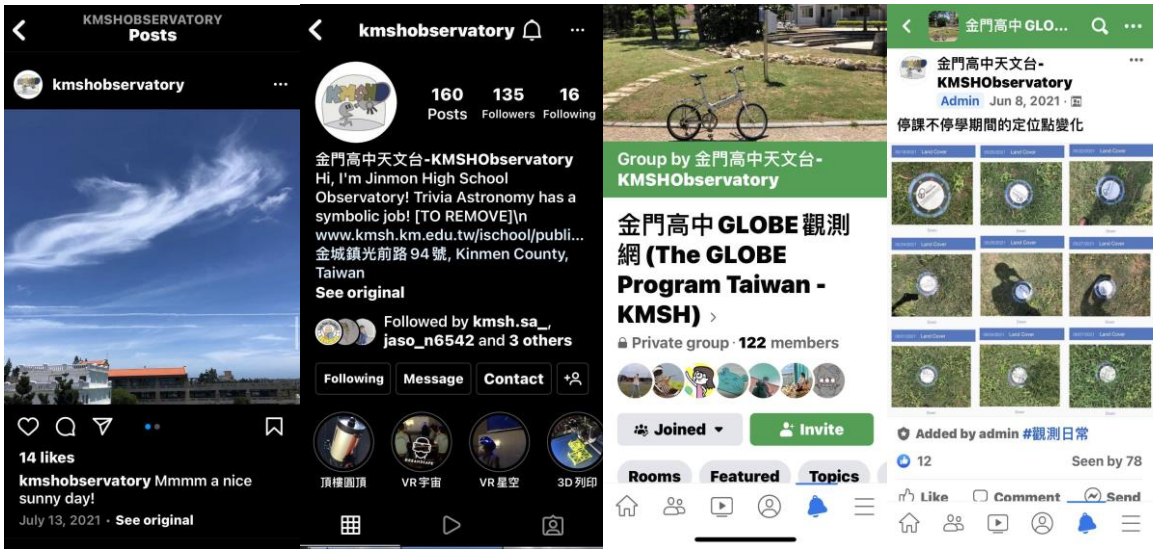
We record summer and winter stargazing possibilities and use the GLOBE observer App to observe and record clouds. We also obtain weather data from the school's observation equipment, such as the amount of clouds in the sky, and compare them with other schools, and organize these data into tables for analysis.

I am a STEM storyteller:

We have Facebook and Instagram accounts to upload and share what we observe. The accounts record our research process, and we upload and share what we have learned in our research.

Instagram:KMSHObservator

Facebook:The GLOBE Program Taiwan-KMSH



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1.Taiwan Meteorological Observation Data:
https://e-service.cwb.gov.tw/HistoryDataQuery/
2.Hong Kong Observatory Meteorological Observation Data:
https://www.hko.gov.hk/tc/index.html.
3.Reference materials ofEasterly Surge:

Macau Meteorological Societyhttps://www.mmets.org/?p=1106「東風潮」乜東東?

Hong Kong Observatoryhttps://reurl.cc/rLgnzx『氣象冷知識』：北風潮與東風潮