航海氣象講座之八 地面天氣圖講解

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概述

本次講座主要介紹了如何看懂地面天氣圖,並詳細分析了一張北太平洋地面天氣圖。

北太平洋地面天氣圖分析

1. 阿留申群島和白令海:這裡有陸地阻隔,對風浪有一定緩解作用,類似內海環境。
2. 美國西海岸:洛基山脈橫亙其中,形成了從洛杉磯到滑雪勝地的高低差。山脈後是內華達沙漠,如拉斯維加斯。
3. 氣象資料來源:該圖由美國國家海洋和大氣管理局(NOAA)製作,時間為 2020 年 12 月 31 日。圖中有多條紅色虛線胞線,代表了一次強烈的溫帶氣旋過程。這個溫帶氣旋的中心氣壓低至 921hPa,創下歷史新高。
4. 風系分析:圖中有暖鋒、冷鋒、極地渦流等多種風系交織,形成了複雜的溫帶氣旋系統。其中,從蒙古分離出來的極地渦流是導致氣壓急劇下降的關鍵因素。
5. 等壓線分析:等壓線密集處風速較大,如溫哥華附近。等壓線間距越小,氣壓梯度越大,風速越快。

航線選擇建議

1. 溫帶氣旋的影響範圍廣,可橫跨 30 度緯度,遠遠超過熱帶氣旋。這給遠洋航線帶來了巨大挑戰。
2. 溫哥華附近是最危險的區域,因為這裡有強大的氣壓梯度和峽角效應,風浪極大。
3. 從白令海峽進出時相對安全,但從白令海到日本韓國的航段仍然很危險。
4. 航行時可考慮沿岸航行,利用陸地反射波浪來減小風浪影響,但也要注意可能出現的超級巨浪。
5. 無論選擇哪條航線,都存在一定風險,需要充分掌握知識,選擇最小損害的方案。

結論

通過對這張地面天氣圖的詳細分析,可以更好地理解溫帶氣旋的形成機理和特點,為遠洋航行提供有價值的參考。掌握充分的氣象知識,做出正確的航線選擇,是確保航行安全的關鍵。

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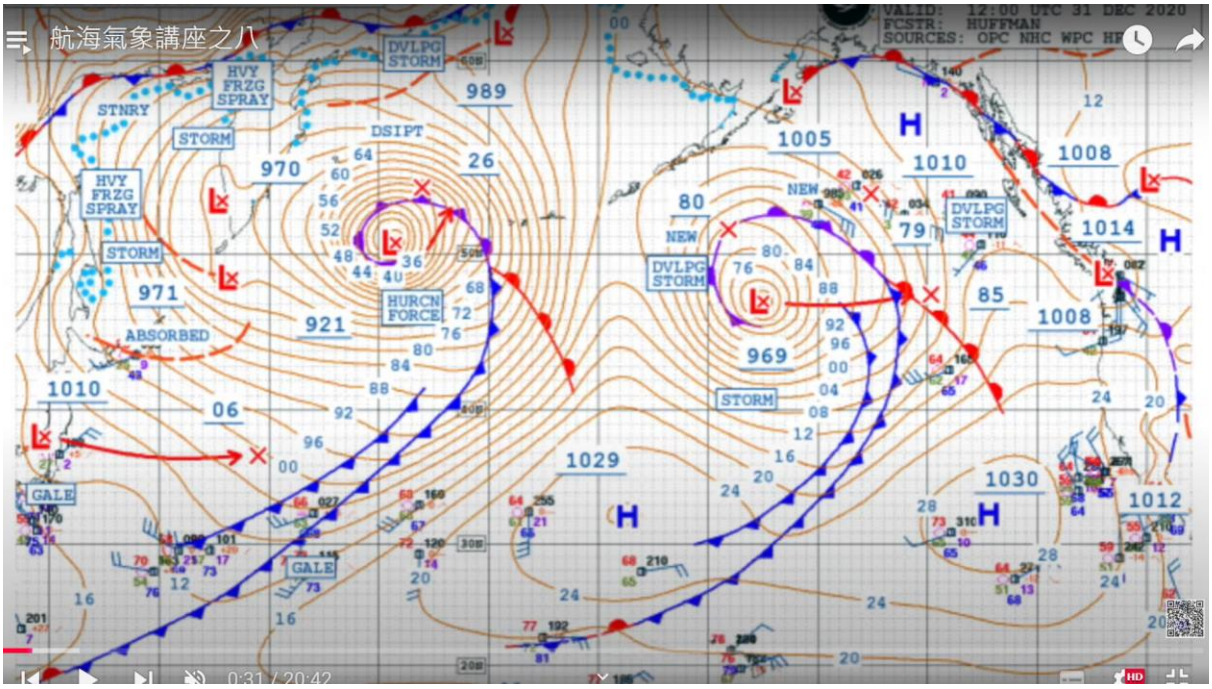
這是航海講座的第八講，前面講了這麼多，主要的就是希望各位能夠看懂地面天氣圖，因為這是最直接，就是現在天氣的狀況。首先看到這是一個北太平洋的地面天氣圖，這裡就是阿留森群島，裡面就是白令海，白令海被航海人士視為畏途,其實是錯的，因為這邊有陸地的阻隔，對風浪的影響有制衡的作用，等於像是內海一樣。請參照影片，有箭頭指示位置。



右邊的就是美國，美國這邊的地形就是洛基山脈，所以從洛杉磯經常在靠的碼頭，號稱一個鐘頭就能開到山上的滑雪勝地，山脈就跟我們的中央山脈一樣，是由太平洋板塊擠壓出來的。翻過這座山，就是內華達的沙漠，也就是經常去的拉斯維加斯，就是坐落於沙漠裡面的地方。看到製作地面氣象圖的單位是 NOAA，就是美國的氣象局。這裡有寫 Pacific Surface Analysis 太平洋的地面天氣圖時間，是 12 月 31 號 2020 年，2020 年的年底過新年的時候，發生了有史以來最大的溫帶氣旋。

首先看左上角像是紅色的虛線？叫做胞線，也就是刮大風下大雨的地方，因為什麼，因為前面應該是有提到啦，就是冷空氣，從北邊南下的冷空氣，切到南方的下方後，暖空氣被快速提升到高空後，結冰/下雨/下雪/下冰風暴，所以叫做胞線。

當然，這在溫帶比較可能發生，所以這一個氣旋有好幾條颮線，一條兩條三條，每一條颮線代表冷氣團再一次的入侵，這是前面的第一波的冷氣團，受到地表的溫度溫暖以後，就不再這麼冷了，第二波冷氣團又來了，就把它抬升，所以胞線？ 是隨著冷氣團南下的路徑產生的。紅線上面有跟饅頭一樣的鋒面？這叫暖鋒。

暖鋒的來源？就是西南方/東南方來的暖空氣，靠自己的動能吹到冷空氣上方(比冷空氣輕)，造成的是綿綿細雨。

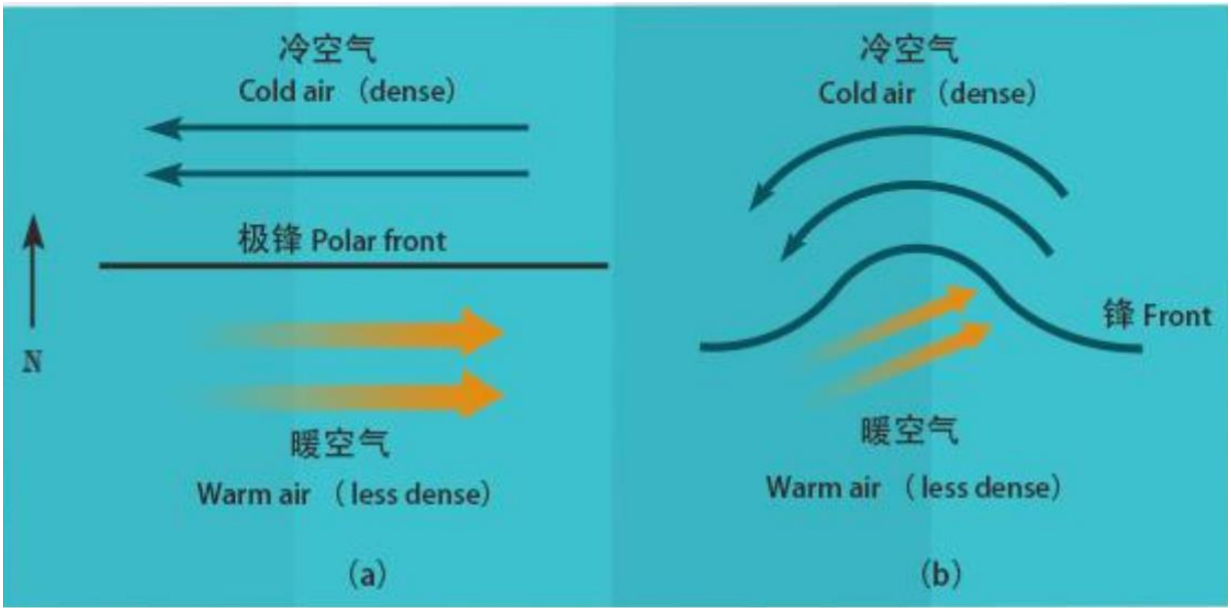
北緯 30 度是馬緯度無風帶，從赤道上升的熱空氣在北緯 30 度附近下降，還沒有介紹完地理，是美國，在太平洋的西邊？ 這裡就是日本跟韓國，在日本跟俄國之間，就是霍克次克海，這邊看到這裡是國際換日線，東京 180 度跟西京 180 度交接的地方。所以經常跑美國的話，開到這邊就要撥慢一天，如果是由西往東開，則是撥快一天，

這是國際換日線南邊來的風，是暖空氣造成的暖鋒，北邊來的是冷空氣造成的是冷鋒，就是藍色帶尖刺的，就是冷鋒。冷鋒在溫帶氣旋裡，就跟胞線一樣，被一波一波的冷氣南下推升，所以經常有第 1 道的冷鋒面，跟著第 2 道的冷鋒面，這兩道峰面的距離很近，就是冷空氣就是非常強大，因為現在看到的溫帶氣旋的氣壓是 921，跟個臺灣 921 大地震一樣，在這裡面還有一些文字的標注。

這裡寫的是 developing storm 就是發展中的風暴，上面這線上面有饅頭的/也有尖椎的，這冷暖鋒交界的地方，叫做滯留鋒，就是冷空氣下不來，熱空氣也上不去，暖空氣跟冷空氣在對峙，為什麼氣旋下面，還有麼多冷空氣跑出來，這就是俗話說的分離冷高壓，冷氣團因為太重了，就從原來的發源地蒙古脫離出來。

看到這上面一條一條橘色的線，不紅(暖鋒)也不藍(冷鋒)是橘色的平行線，叫等壓線。等壓線一般是每四毫巴，作為一個間隔，所以這裡就看到 00 還有什麼 96，92，88 毫巴，一直畫下去，等壓線最密的是中心是 921 毫巴，再來就是飆到 36，40，44，48 毫巴，一般溫帶氣旋氣壓經常吹到多少?以前是 970，北太平洋的熱帶氣壓大概 960 毫巴也不到。

氣壓到 960 毫巴以後，裡面到底是多少毫巴? 對我們來講是沒有意義，為什麼沒有意義，船跑進去就是找死，對不對，就是製造麻煩。看到等壓線在這邊，因為氣壓實在太低，所以看起來好像不痛不養，其中有一條線是 1010 豪巴，這條線就是高壓跟低壓的分界線，普通都會畫的比較粗啊，為什麼? 因為 1013 毫巴，就是標準的大氣壓，所以 1013 毫巴，不是高壓也不是低壓，



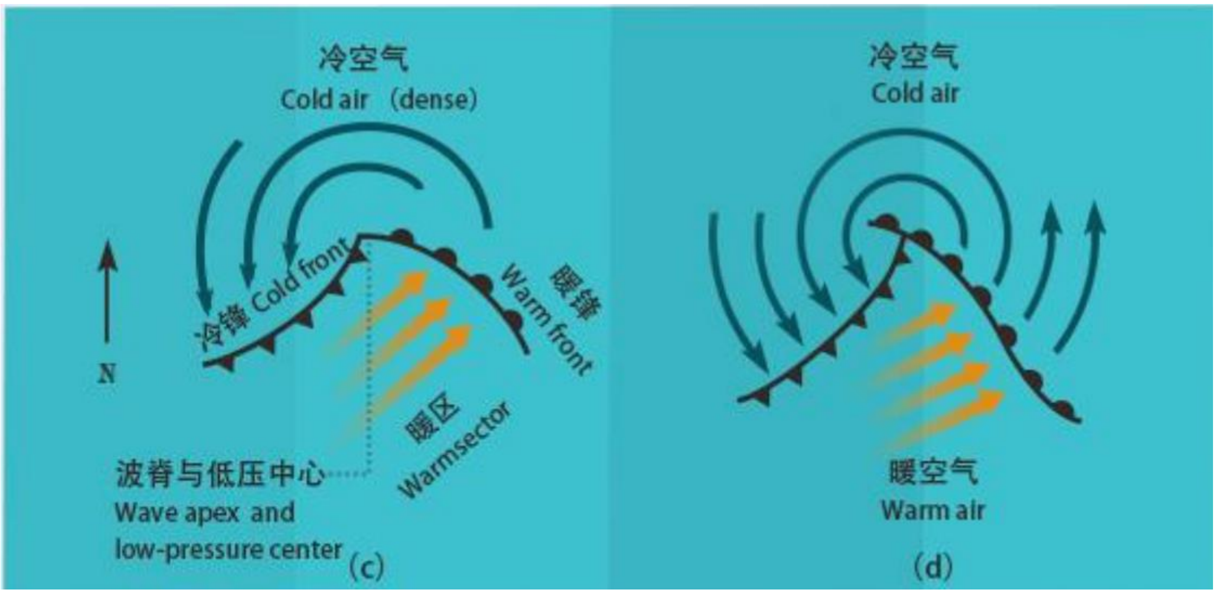
普通在熱帶氣旋就是以一條粗線來代表，看到中間這裡有一個暖心高壓，暖心高壓的強度是 1029，實際上，最高的高壓在在哪裡? 在蒙古，從蒙古出來的冷高壓，可以到 1060 豪巴。暖鋒，冷鋒，可以講溫帶氣旋是有四種風啊，第一種是暖空氣，第二種冷空氣，第三種從極地

北極蒙古出來的北極渦流，北極渦流經常是什麼由西往東，這是在研究行星風時候看到的，真正可怕的是什麼？是從蒙古出來，繞過低氣壓中心又向上的，是高空氣流。高空氣流一來，就把原來的冷空氣暖空氣(囚錮鋒)都混在一起，當成陀螺一樣在打轉，陀螺越轉越快的時候，氣壓就急劇下降，風浪就很快的加高，就是溫帶氣旋的成因。

所以看高空氣流，就要看高空的 500 毫巴的流線圖啊，如果是從從低氣壓的左邊南下，右邊北上，高空氣流跟跟地面低氣壓中心一重合的話，中間就變成陀螺，中心氣壓就會急劇的下降，從這裡看看到流線可能是什麼？高空氣流可能又跟另外一個冷高壓重合，

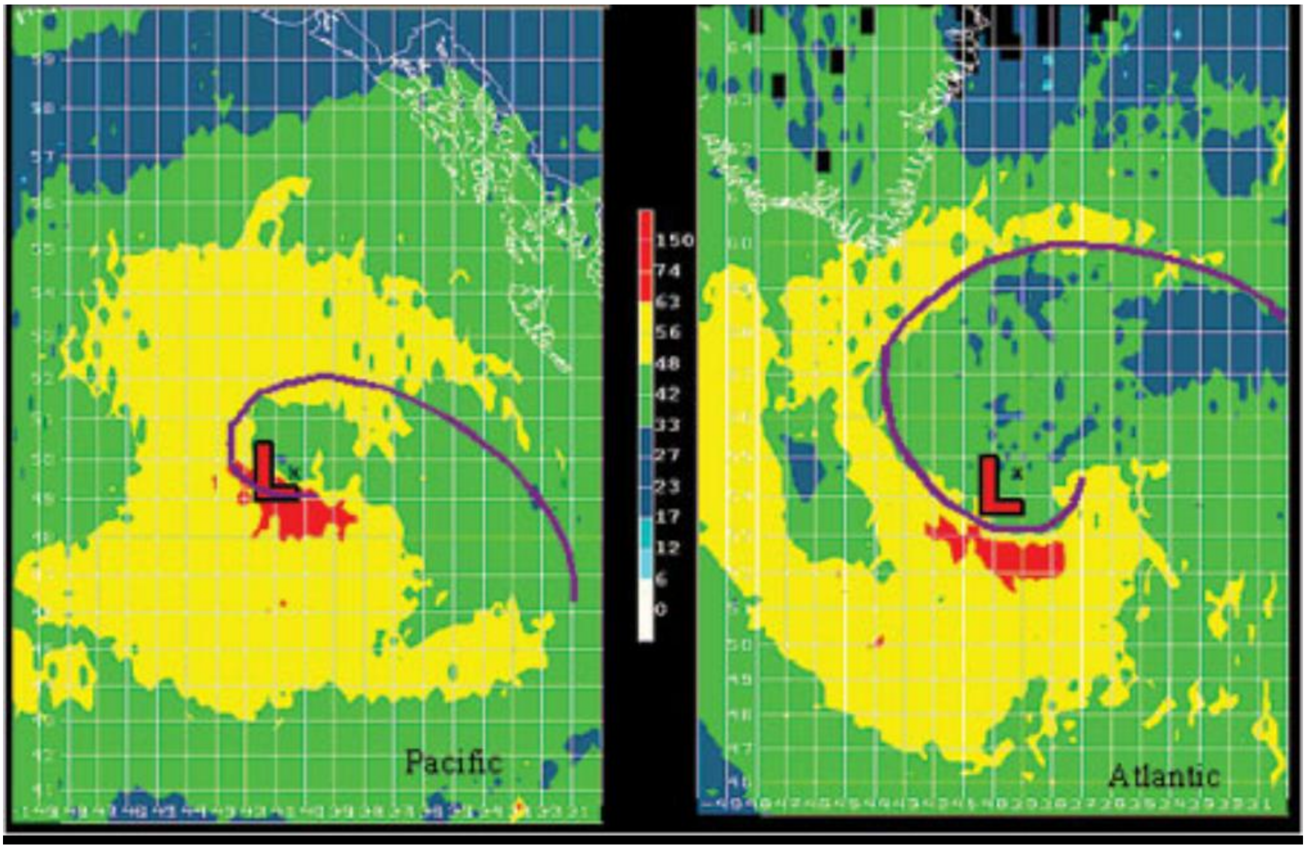
事實上，可能也沒有重合啦，因為 921 低壓這麼大，移動速度慢，是可能跟高空氣流重合，這一個高空氣流，可能在他前面。所以新增加的能量會把低氣壓非常快的向前移動，因為他要去追前面的，其實也不是他去追，就是天空的噴射氣流推動他快速向前，所以研究溫帶氣旋的時候，不能只看地面天氣，因為如果只看地面天氣，看到的就是地面這一塊跟颱風一樣，只是颱風都還沒有這麼複雜。颱風就是只有暖空氣，沒有冷空氣，所以溫帶氣旋是比較複雜。好，介紹到這裡，應該對地面天氣圖，有所瞭解，還要講講風力的大小跟波浪的來向？

好，看等壓線說的是每四毫巴為一個間隔，所以在比較空曠的地方，就標了 92，96. 88，等壓線的密度代表的是氣壓梯度，也就是在這條線上面的地面的大氣壓力是 992，這邊是 988，這邊是 988，這邊是差了 4 毫巴，如果說像等壓線越密的話，可能多少啊，在 100 海浬之內，他的等壓線可以差到 50 毫巴，50 毫巴相當於是 50 公克的壓力，



就會把這些風，地面風造成快速的旋轉，所以等壓線越密的地方，就是風速越大的地方，像高氣壓等壓線非常寬，就叫太平洋，這就是沒什麼風啊。因為兩邊壓力沒有多大的差別，像下麵兩個高壓之間，這整塊都是整塊都是 1024，大家壓力一樣，你也不必擠我，我也不必推你，這邊，只要有低壓產生，所有的風都快速往低壓中心的流入，造成了氣象炸彈，就是去年的最大的溫帶風暴。

H就是高壓，L就是低壓，這裡還有可能生成新的低氣壓1010生成，移動到這邊，就是真正969，在平常就算是很大的溫帶氣旋，跟熱帶氣旋不一樣的地方，是溫帶氣旋可以橫跨30度的經度，在在熱帶氣旋經常只有兩三百海浬，60海裡一度的話，只有四五度的經度。



（QuikSCAT拍下兩個溫帶氣旋的圖像，顯示溫帶氣旋的最大風力在錮囚峰的外圍。）

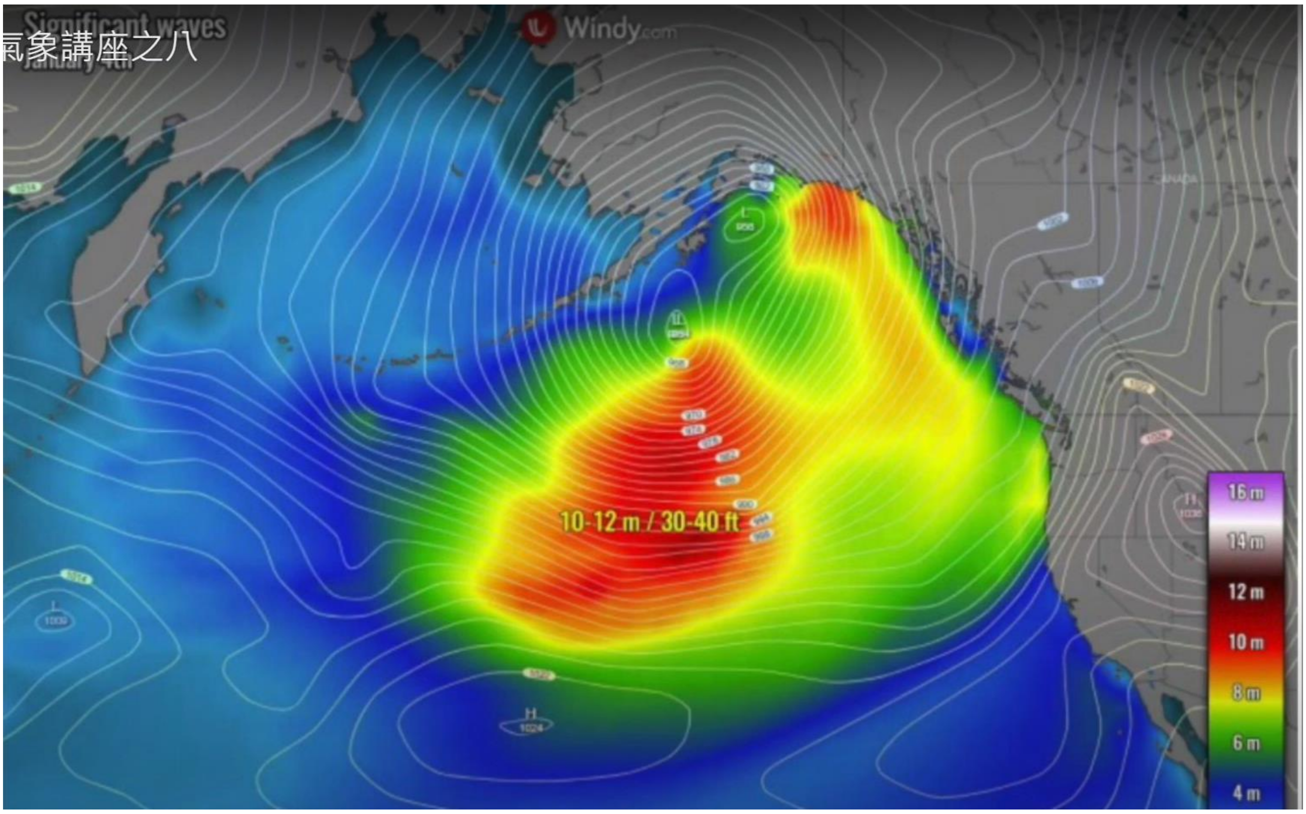
溫帶氣旋就是跑遠洋航線最大的挑戰，如果船開美國要10天嘛，船跨了三四十度的經度，要三四天，就是說你這三四天都很難過，看這裡美國西岸上面，這裡是溫哥華1008的地方JUAN DE FUCA，從溫哥華出來就是風浪最大的時候，因為看到這裡是有很強的氣壓梯度，這些氣壓雖然是往氣壓中心流，可是他吹過去的時候引起的風浪，直接就吹到這邊，溫哥華的JUAN DE FUCA這裡的出口，哥倫比亞河流從洛基山脈中間流出來，就產生了一個峽谷效應，兩邊的風就是在隘口上面吹，這裡風出來很大，遇到從太平洋來的波浪，像這邊的波浪也是向著什麼溫哥華方向移動，這邊吹西南風，這邊也吹西南風，這裡也吹西南風，所以西南風一路從這邊吹吹一天，兩天，三天，四天，五天，六天到上面，JUAN DE FUCA這裡就是很大的湧，冬天最大的挑戰，尤其是跑北太平洋西航，美國西岸到日本韓國的航線，就是從JUAN DE FUCA的出口進到白令海前的Unimark，這有幾天的水路，一天，兩天，三天，要有三天的時間啊，就會受到強大的浪湧影響。

進了白令海峽啊，你就可以喘一口氣了，即使是有低氣壓來，也不會這麼可怕。同樣的，從白令海峽出來，要到清津海峽，還是霍克次克海，要從這庫頁島這邊穿出去的話，就是在出

口這一段，就是比較危險的。

遇到危險的時候，航線的選擇可能是沿著岸邊下來，只要水深足夠，這樣子借著反射的波浪，搖晃可能會好一點，如果前面已經來了一個低氣壓，你這三天怎麼跑都跑不過，也許可以考慮沿著上面的陸地滑下來，就是借著陸地的對波浪的折射跟反射，來減少一些浪湧，當然也有可能會造成什麼？就是超級巨浪或是前面講的三姐妹。

風浪大就是要減速改變航向，跑船，不管你是跑東邊，跑西邊，跑南邊航線，都是具有相當的風險，一定要具有足夠的知識，做了選擇以後，只能減低最大的傷害，兩害全其輕。



Okay, everyone, hello, this is the eighth lecture of our maritime lecture series. In our previous lectures, the main focus was for everyone to understand the surface weather map because it directly shows the current weather conditions. First of all, what we see here is a surface weather map of the North Pacific Ocean. Here is the Aleutian Islands, and inside there is the Bering Sea. The Bering Sea is mistakenly referred to by mariners as a map, but in reality, the presence of land here affects the impact of winds and waves, acting as a kind of balance, like an inland sea. On the right side, this is the U.S., and the terrain here is the Rocky Mountains. In Los Angeles, we often rely on a pier that can reach a skiing destination on the mountain within an hour, and this mountain range is similar to our Central Mountain Range, formed by the compression of the

Pacific tectonic plate.
Crossing this mountain range, we have the Nevada desert, which is where we often go to Las Vegas, situated in the desert. We can see that the organization responsible for producing this surface weather map is NOAA, the U.S. National Weather Service. Here it says Pacific Surveys Analysis, a surface weather map of the Pacific Ocean, dated December 31st of the year 20, happened at the end of last year during the New Year period, the largest extratropical cyclone ever recorded. First, let's look at this red dashed line. This is called the front, where strong winds and heavy rain occur. Why is that? Well, we may have mentioned it before; it is because cold air from the north clashes with warm air from the south. The warm air rises in the upper atmosphere, causing ice, rain, snow, and hail, hence it's called a front.
Of course, extratropical areas are more likely to experience this, and a cyclone may have several fronts, one, two, three, each front? Represents the invasion of cold air masses once again. This is the first wave of cold air masses from the surface, which may warm up after encountering the warm surface, so it's not as cold. Then the second wave of cold air masses comes in and lifts it up, creating this front? It is created along the path as the cold air masses move south. What about the red line we see here? The red cover that looks like a steamed bun? Where does the warm wind come from? It's warm air coming from the southwest and southeast, then we talk about the horse latitude at around 30 degrees north, where the windless zone ascends hot air from the Arctic and descending hot air from the equator, we haven't finished introducing the geography yet, this is the United States, to the west of the Pacific?
This is Japan and South Korea we see here? Between Japan and Russia here? Is this the Okhotsk Sea or something? What do we see here? It's the place where the International Date Line intersects at 180 degrees east of Tokyo and 180 degrees west of Kyoto, so? If we often travel to the United States? When we reach here, we have to adjust the time by one day, if traveling from east to west in the United States, you adjust the time by one day, this is the International Date Line, the wind coming from the south? It's warm wind caused by warm air, what about the wind coming from the north? It's caused by warm air, right? The cold wind, this blue band with sharp tips is the cold wind, what about this?
The cold wind in the temperate cyclone? Just like this front line, waves of cold air come down, so? Often there are the first cover and the second cover, these two covers are very close, so? It's cold air? It's very powerful, because what we see now? This The pressure of this temperate cyclone is 921, just like the 921 earthquake in Taiwan, there are also some text annotations inside, it says

'developingstorm' which means developing storm, on top of these there's a line with bends and sharp tips, this is the boundary where the cold and warm winds meet, it's called the stagnant wind, where the cold air cannot come down and the hot air cannot rise, here
the warm and cold air are in confrontation, why there are so much cold air running out from the lower cyclone, this is what we call the polar oscillation, the cold air mass is so heavy that it separates from its original source in Mongolia, and we see all these orange lines on top, not red or blue, they are orange, these are called isobars, we see that they are generally spaced at intervals of every four and eight hectopascals, so here we see 00 and what else 969288, and they continue down, the denser isobars like here at 921, then it goes up to 36414448, actually 64. Generally, the typhoon we often encounter blows at around 970 before, and in the North Pacific, the tropical pressure is about 960, not reaching 921.
So, what is the significance of this circle for us? It is meaningless. Why is it meaningless? Going in there is like seeking death, right? It creates trouble. When we see this isobar over here, because the air pressure is too low, it looks ordinary, but among them, there is a line called 10. This line is the boundary between high pressure and low pressure, usually drawn thicker. Why? Because of 10. 13 is the standard atmospheric pressure, so 10. 13, is it high pressure? No, it's low pressure. Normally, in tropical cyclones, a thick line represents this high pressure. Here, we see a high pressure with a strength of 10. Actually, where is the highest high pressure? It is in Mongolia. The high pressure coming out of Mongolia, the warm wind, the cold wind, we can say that the temperate cyclone has four kinds of winds.
The first is warm air, the second is cold air, the third is the polar vortex coming from the Arctic out of Mongolia. The Arctic vortex usually moves from east to west. This is what we see when studying planetary winds. What is truly terrifying is from Mongolia, circling around the center of low pressure and then rising up, the jet stream. When this jet stream arrives, it mixes the original cold and warm air together, like a spinning top spinning faster and faster. As the top spins faster, the air pressure drops sharply, and the waves quickly rise. This is the cause of temperate cyclones. So, if a jet stream aligns with the center of low pressure, it becomes a spinning top, and the air pressure drops sharply. From this perspective, we may see this stream as a jet stream, potentially aligning with another cold high pressure. In fact, it may not align because the movement speed of 921 is slow. It is possible that the jet stream overlaps ahead of it, so its added energy will rapidly advance the low pressure

ahead because it has to chase it.
In fact, it is not that the jet stream chases it, it is the jet stream in the sky that pushes it forward quickly. Therefore, when studying temperate cyclones, we cannot just look at the surface weather because if we only look at the surface weather, we will see only this area, which is similar to a typhoon, but even more complex. A typhoon has only warm air without cold air, so temperate cyclones are more complicated. So, we should have some understanding of the surface weather map here, and we should also further discuss the wind speed and the direction of the waves. When we talk about isobars, we say there is an interval of 4.8. Therefore, in this more open area, it has soared to 9,296.
88, the contour line represents the pressure gradient, which means that the atmospheric pressure on the ground above this line is 992, while here is 988, here is also 988, so there is a difference of 4 millibars. In a dense area like this, within 100 nautical miles, the contour lines can differ by up to 50 millibars, which is equivalent to 50 grams of pressure. This will cause the winds to rapidly rotate, so the denser the contour lines, the higher the wind speed. In areas with high pressure like this, the contour lines are very wide, this is called the Pacific, where there is not much wind because the pressure difference on both sides is not significant. Between these two high pressures below, the entire block is all 1024, everyone has the same pressure, so you don't need to rush, and I don't need to push you either.
As long as a low pressure is generated on this side, all winds will quickly flow into the center of this low pressure, causing a weather bomb. This is the largest extratropical storm from last year, and this H is high pressure. L is low pressure, and here there may also generate new low pressure 1010 moving to this side, this is truly 969, which is normally considered very large. The difference between extratropical cyclones and tropical cyclones is that extratropical cyclones can span up to 30 degrees of latitude, while tropical cyclones often have only two to three hundred nautical miles of 60 nautical miles per degree, only four to five degrees for tropical cyclones. So this is the biggest challenge for long ocean routes, because if your ship, like us going to the United States, takes 10 days, crossing 10 degrees, 20, 30, 40, 50, 60, 70, 80, 90, 100, it means that you have crossed three to four degrees of latitude, which means these three to four days will be very challenging.
As we can see here, on the west coast of the United States, this is Vancouver with a pressure of 1008, the wind and waves are strongest when leaving Vancouver because we can see there is a strong pressure gradient here. Although these pressures flow towards the center of the pressure, the winds and waves they cause

directly blow towards the exit of Vancouver, the Haida Gwaii here, where the river flows out of the mountains. This is the Rocky Mountains, which creates a canyon effect where the winds on both sides are strong at the mouth here. When they encounter the waves coming from the Pacific, the waves on this side also move towards Vancouver, blowing southwest winds here, blowing southwest winds on this side, here also blowing southwest winds.

So the southwest winds blow all the way from here for a day, two days, three days, four days, five days, six days, until above here, where there are very large waves. The biggest challenge in winter, especially running the North Pacific from the west coast of the United States to Japan and Korea, is from this desolate Dafuca's mouth enters this UniMark for a few days. One day, two days, three days, both Kyoto and Tohoku are one day's voyage. It will take three days, and you will be affected by strong winds entering the Bering Strait. You can finally breathe a sigh of relief, even if a low-pressure system comes, it won't be so scary. Similarly, coming

out from the Bering Strait to the Qingjin Strait or the Erkud Sea, if you have to pass through this area from Kuye Island, it is a more dangerous section on the way, encountering danger times, our choice may be to come down along the shore, as long as the water is deep enough, in this way, by using the reflected waves, it may be a little better. So, when you slide out from here, if a low-pressure system has already arrived ahead, no matter how you run for three days, you may consider coming down along the land above, sliding down by leveraging the refraction and reflection of the waves on the land to reduce some surges. Of course, this may also cause super big waves or what we talked about earlier, the three sisters, which means slowing down, changing course, then sailing, whether you run east, west, or south, all have considerable risks. We must have enough knowledge to make a choice, and after making a choice, we can only reduce the maximum damage. It is best to have enough knowledge and make a choice, and then we can reduce the maximum damage.