

# Dst (Disturbance Storm Time) Index

Dst is derived from the average of H (northward) component disturbances of the geomagnetic field measured hourly at four low-latitude magnetic observatories and is expressed in nanoteslas.

Dst is a geomagnetic index which monitors the world-wide magnetic storm level and has long been used as an indirect measure of the ring current.

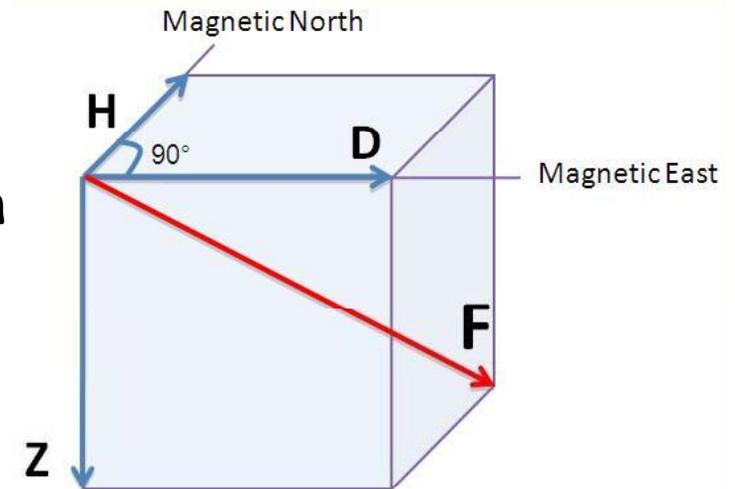


TABLE 1 - Coordinates of the Observatories

Observatory	Geographic		Geomagnetic	
	Longitude (E)	Latitude	Dipole latitude	
Hermanus	19.22°	-34.40°	-33.3°	
Kakioka	140.18°	36.23°	26.0°	
Honolulu	to April 1960	201.90°	21.30°	21.0°
	after April 1960	201.98°	21.32°	21.1°
San Juan	to January 1965	293.88°	18.38°	29.9°
	after January 1965	293.85°	18.01°	29.9°

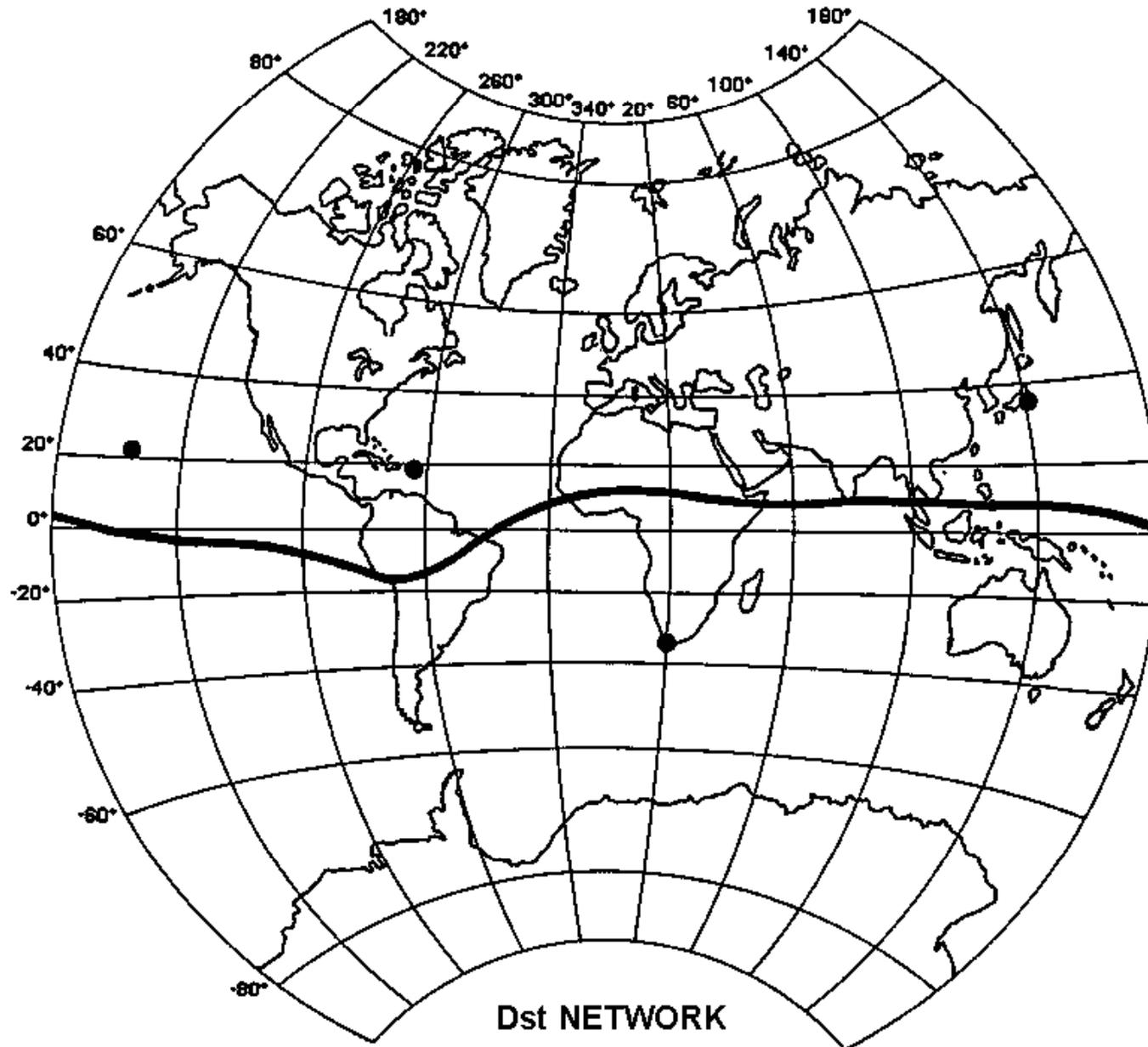
<http://wdc.kugi.kyoto-u.ac.jp/dstdir/dst2/onDstindex.html>

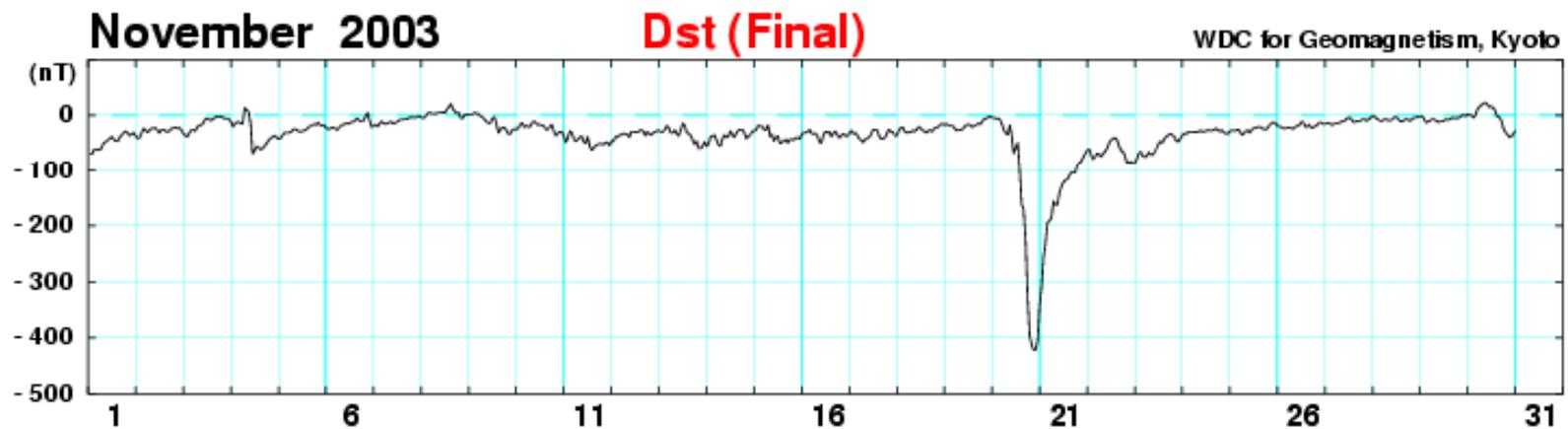
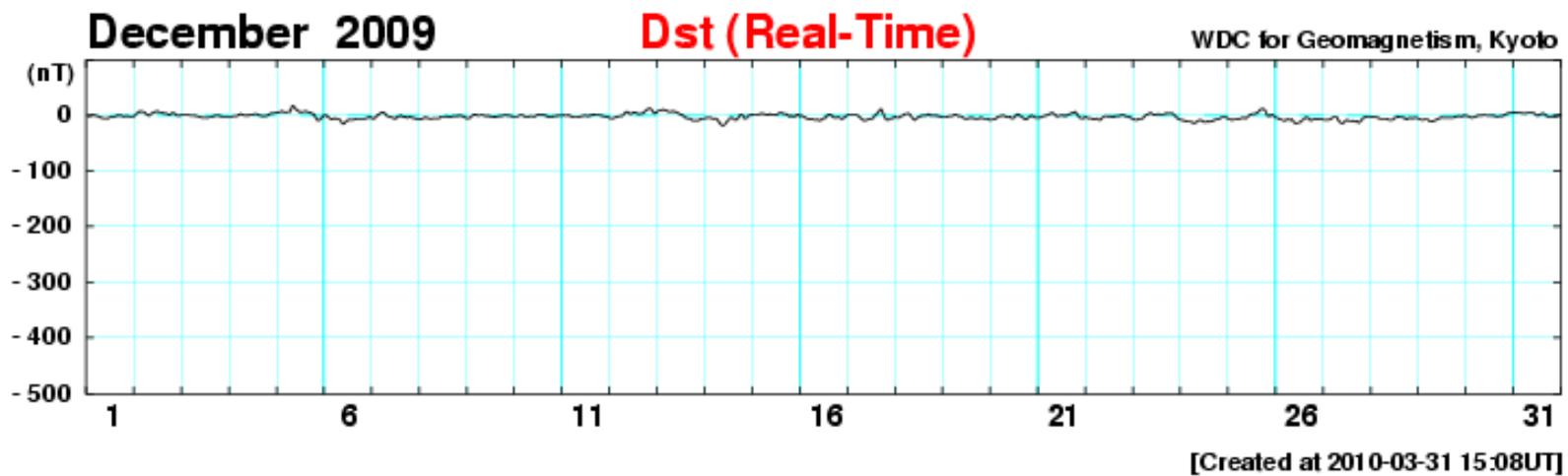
<https://wiki oulu.fi/display/SpaceWiki/Magnetic+activity+indices>

<http://pluto.space.swri.edu/image/glossary/dst.html>

[http://roma2.rm.ingv.it/en/themes/23/geomagnetic\\_indices/27/dst\\_index](http://roma2.rm.ingv.it/en/themes/23/geomagnetic_indices/27/dst_index)

# Dst (Disturbance Storm Time) Index



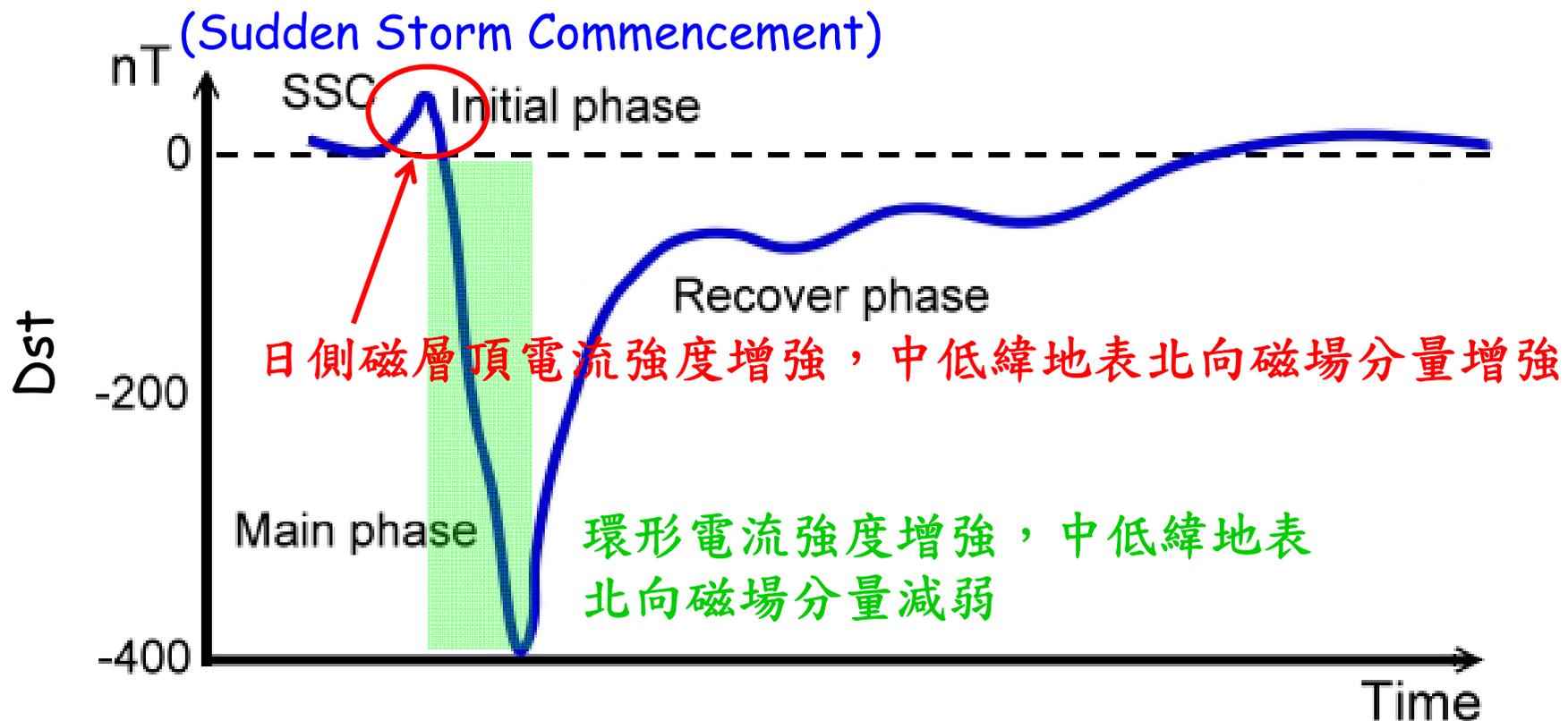


# Dst (Disturbance Storm Time) Index

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Super storms	$Dst < -200 \text{ nT}$
Intense storms	$-200 \text{ nT} < Dst < -100 \text{ nT}$
Moderate storms	$-100 \text{ nT} < Dst < -50 \text{ nT}$
Weak storms	$-50 \text{ nT} < Dst < -30 \text{ nT}$

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# 磁暴(magnetic storm)

→持續時間約3天至一個多星期

→影響地表中低緯度區域

→過程：

**initial phase:**

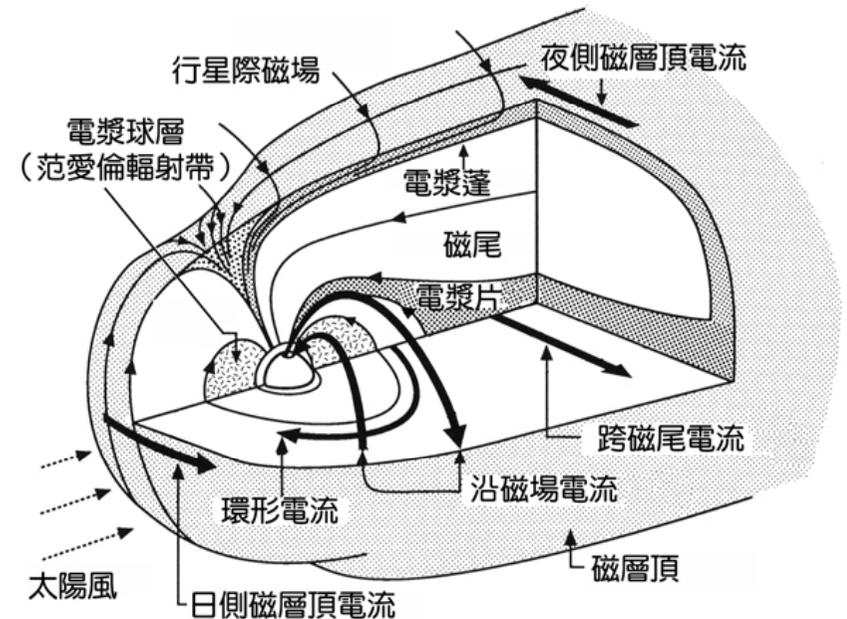
日側磁層頂內移，日側磁層頂電流強度增強，中低緯地表磁場增強

**main phase:**

電漿球層頂內移，范愛倫輻射帶的高能粒子數目增多，環形電流強度增強，中低緯地表磁場減弱

**recovery phase:**

磁層頂與電漿球層頂還原到安靜期的位置

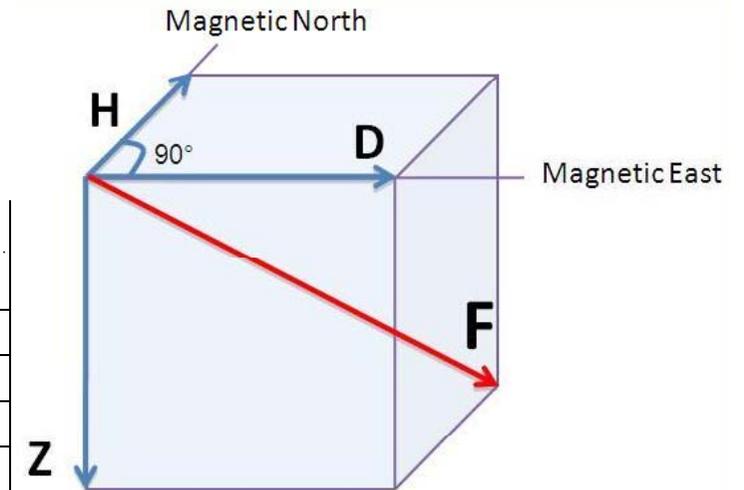


# AE (Auroral Electrojet) Index

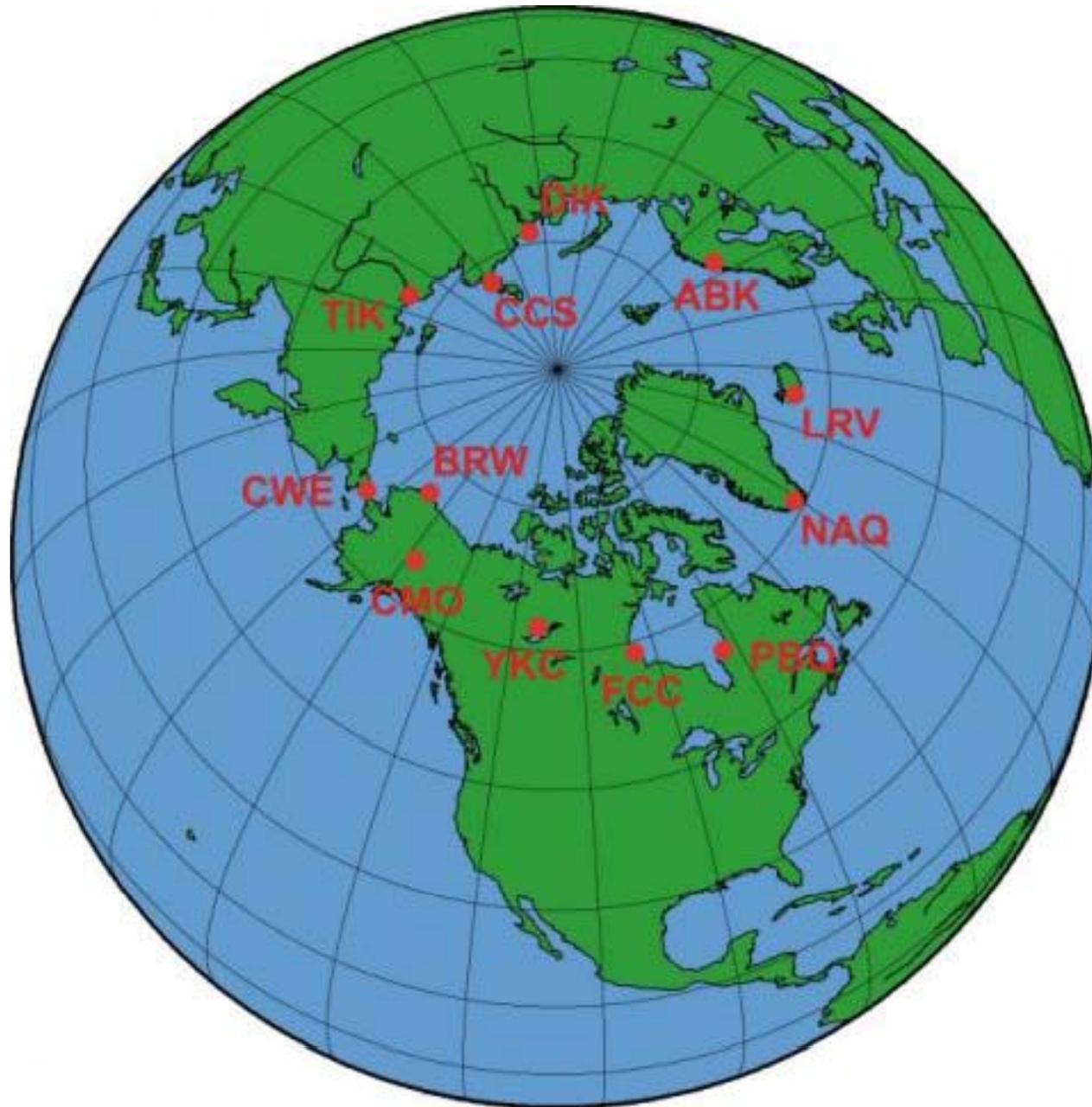
The AE indices (AU, AL, AO, and AE) are derived from geomagnetic variations in the horizontal component during one-minute interval observed at selected observatories along the auroral zone in the northern hemisphere.

TABLE 1 - List of AE(12) Stations.

Observatory	IAGA Code	Geographic Coord.		Geomagnetic Coord.	
		Lat.(°N)	Long.(°E)	Lat.(°N)	Long.(°E)
Abisko	ABK	68.36	18.82	66.04	115.08
Dixon Island	DIK	73.55	80.57	63.02	161.57
Cape Chelyuskin	CCS	77.72	104.28	66.26	176.46
Tixie Bay	TIK	71.58	129.00	60.44	191.41
Cape Wellen	CWE	66.17	190.17	61.79	237.10
Barrow	BRW	71.30	203.25	68.54	241.15
College	CMO	64.87	212.17	64.63	256.52
Yellowknife	YKC	62.40	245.60	69.00	292.80
Fort Churchill	FCC	58.80	265.90	68.70	322.77
Poste-de-la-Baleine	PBQ	55.27	282.22	66.58	347.36
Narsarsuaq (Narssarssuaq)	NAQ	61.20	314.16	71.21	36.79
Leirvogur	LRV	64.18	338.30	70.22	71.04



# AE (Auroral Electrojet) Index

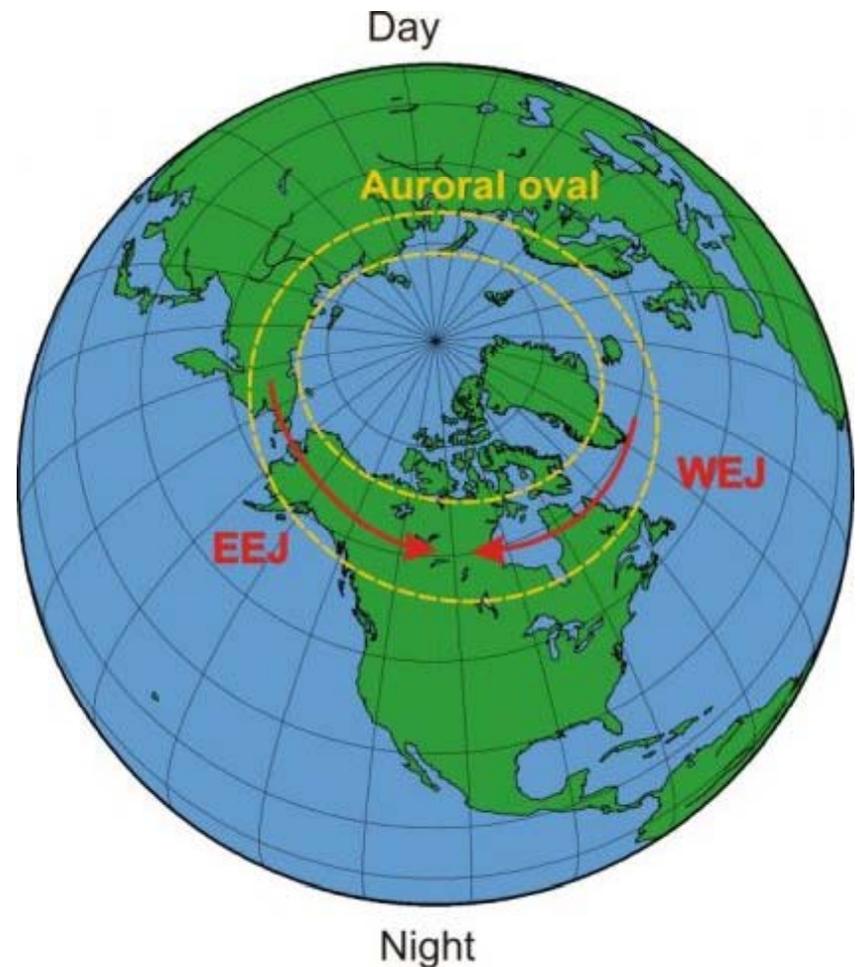


# AE Index (Auroral Electrojet)

AU (Auroral Upper) is the uppermost envelope of the superposed H-component perturbations at auroral latitudes

AL (Auroral Lower) is the lowest envelope of the superposed H-component perturbations at auroral latitudes

$$AO = (AU + AL) / 2; AE = AU - AL$$



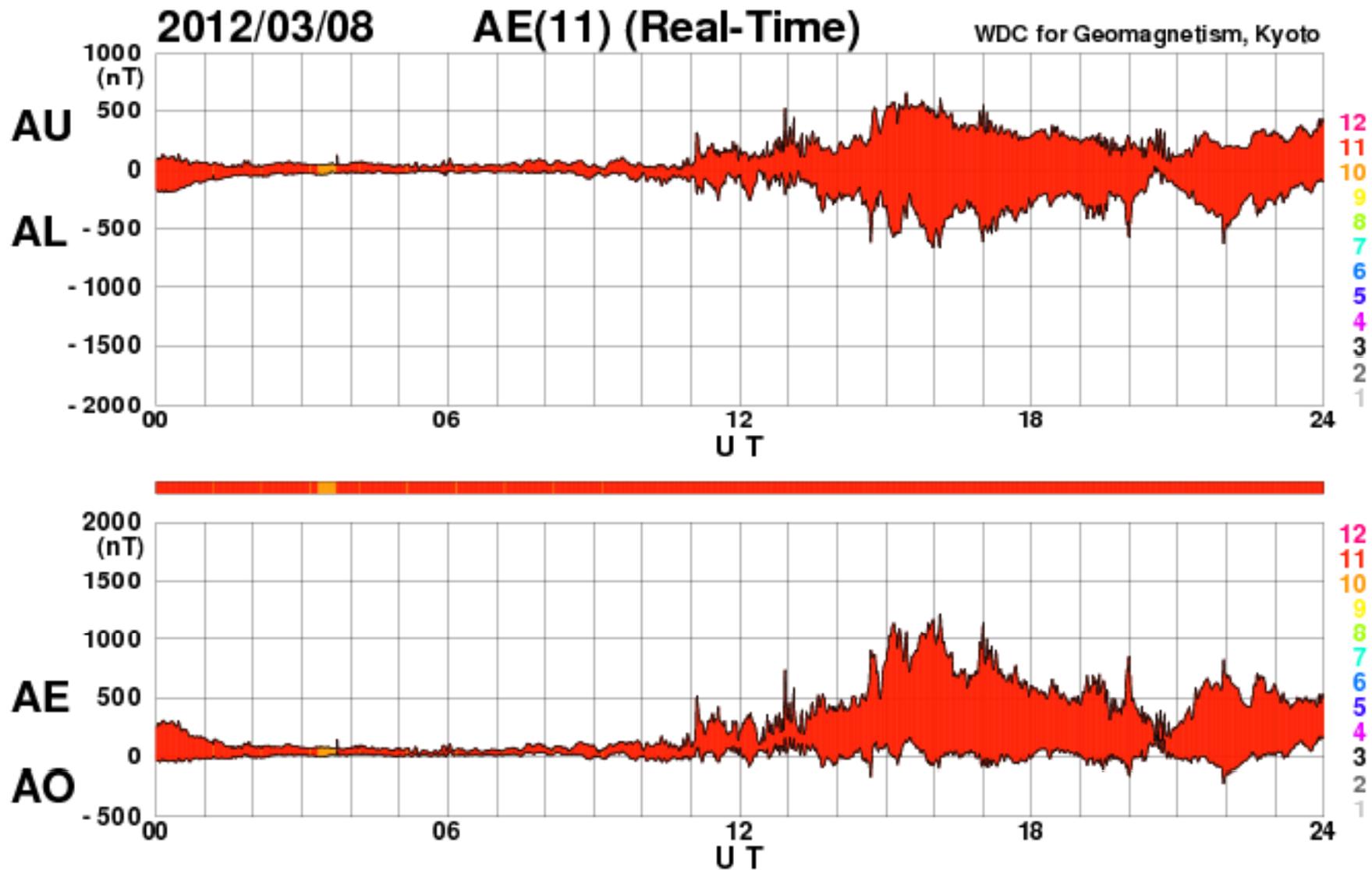
→ AU is a measure of the eastward auroral electrojet (EEJ).

→ AL is a measure of the westward auroral electrojet (WEJ).

→ AO is a measure of the equivalent zonal current.

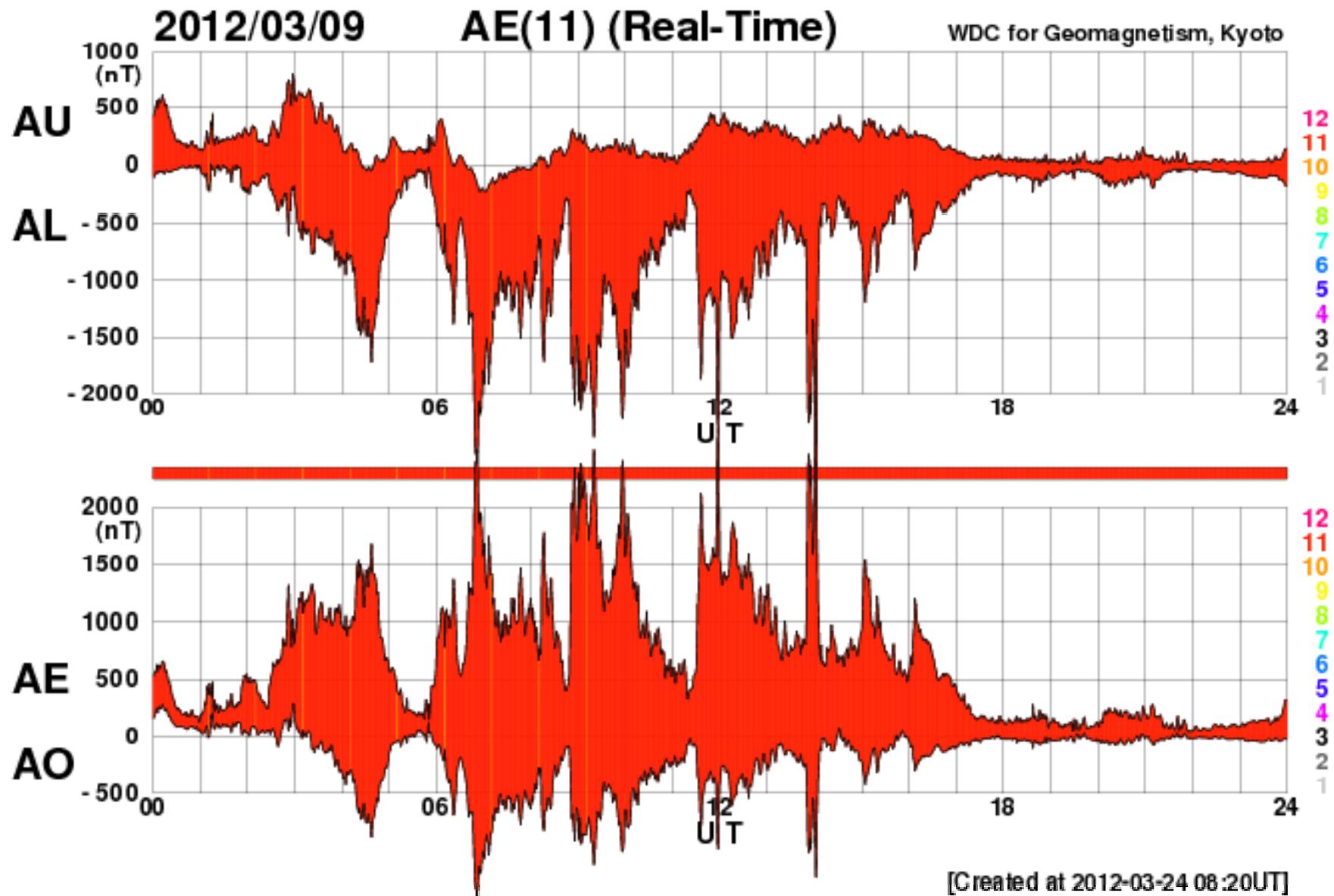
→ AE is the integrated effect of different current systems and not necessarily quantify specific physical processes occurring in the magnetosphere-ionosphere coupling system.

# AE (Auroral Electrojet) Index

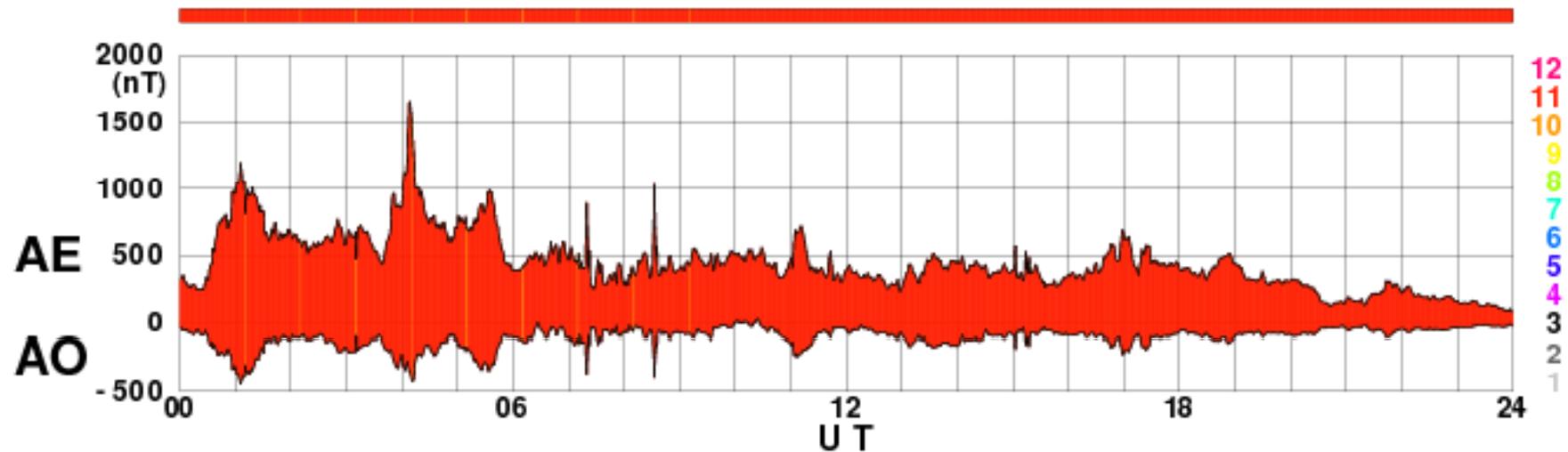
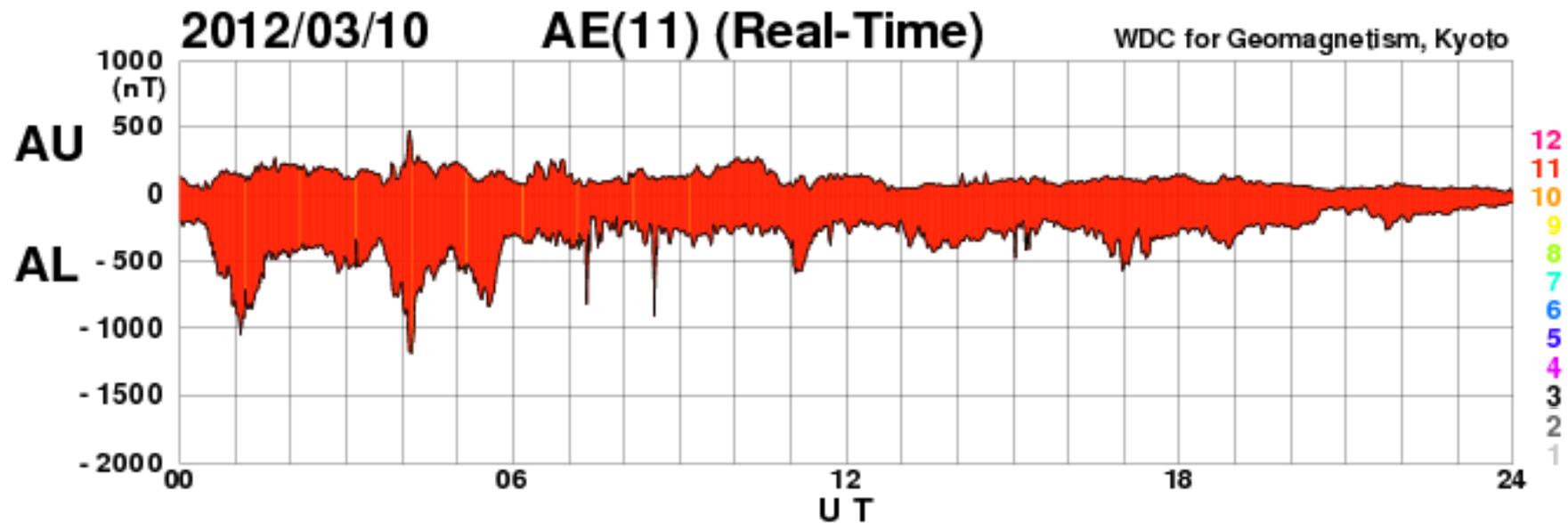


[Created at 2012-03-24 08:20UT]

# AE (Auroral Electrojet) Index



# AE (Auroral Electrojet) Index



[Created at 2012-03-24 08:20UT]

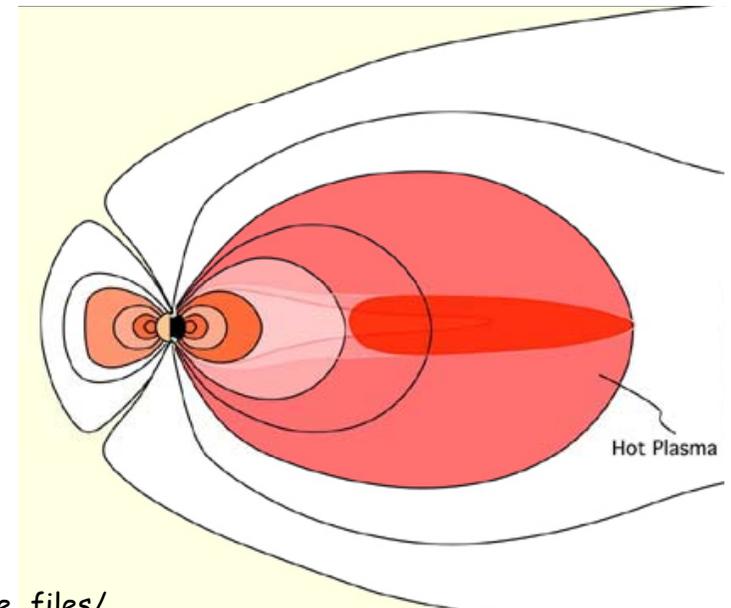
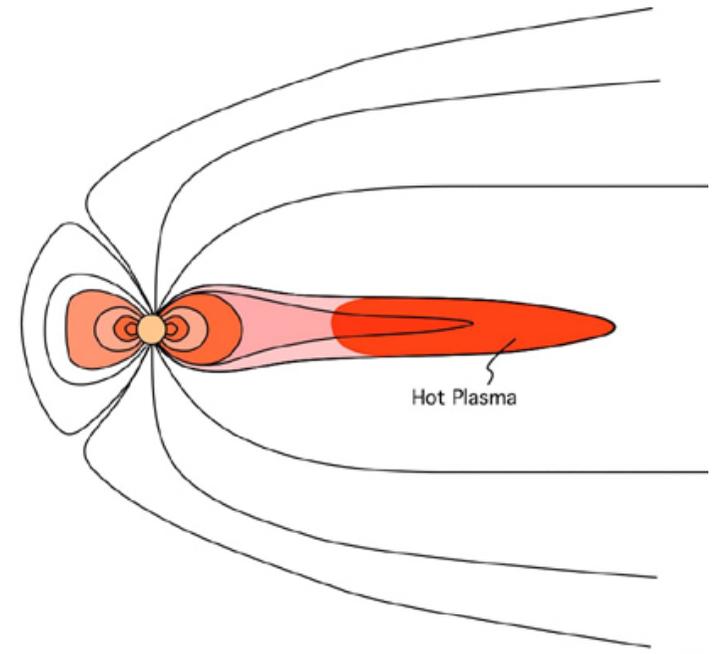
# 磁副暴(magnetic substorm)

- 持續時間約3小時
- 影響地表高緯度區域
- 過程：

## grow phase:

磁尾電漿片變薄，連原來接近磁偶極場區域的磁場也被拉長成磁尾的形狀，跨磁尾電流逐漸增強

expansion phase: 磁尾電漿片變厚，磁場變成比較像磁偶極場的結構。

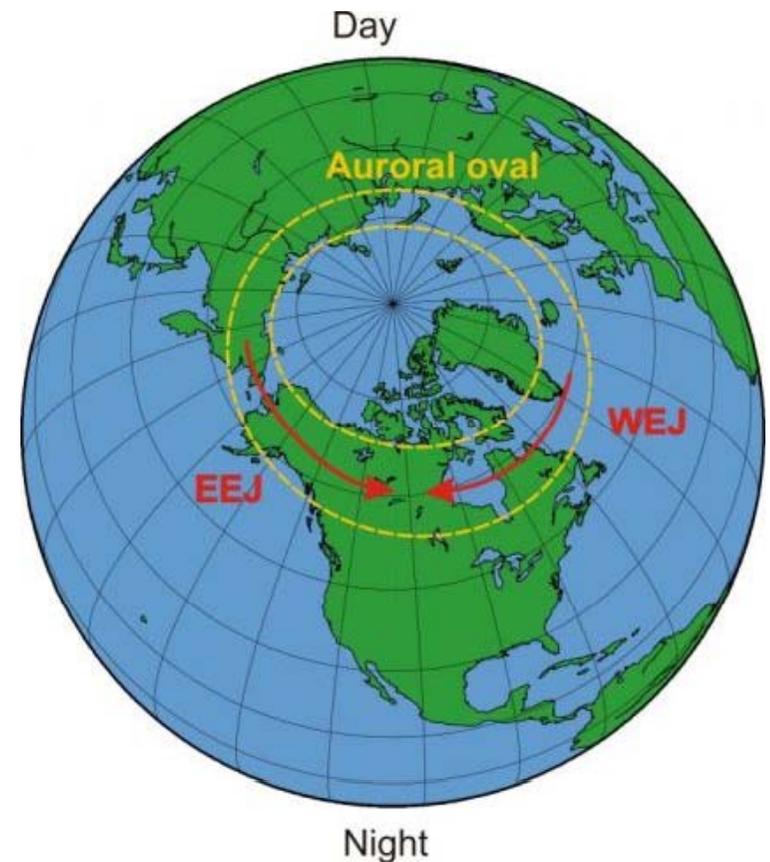


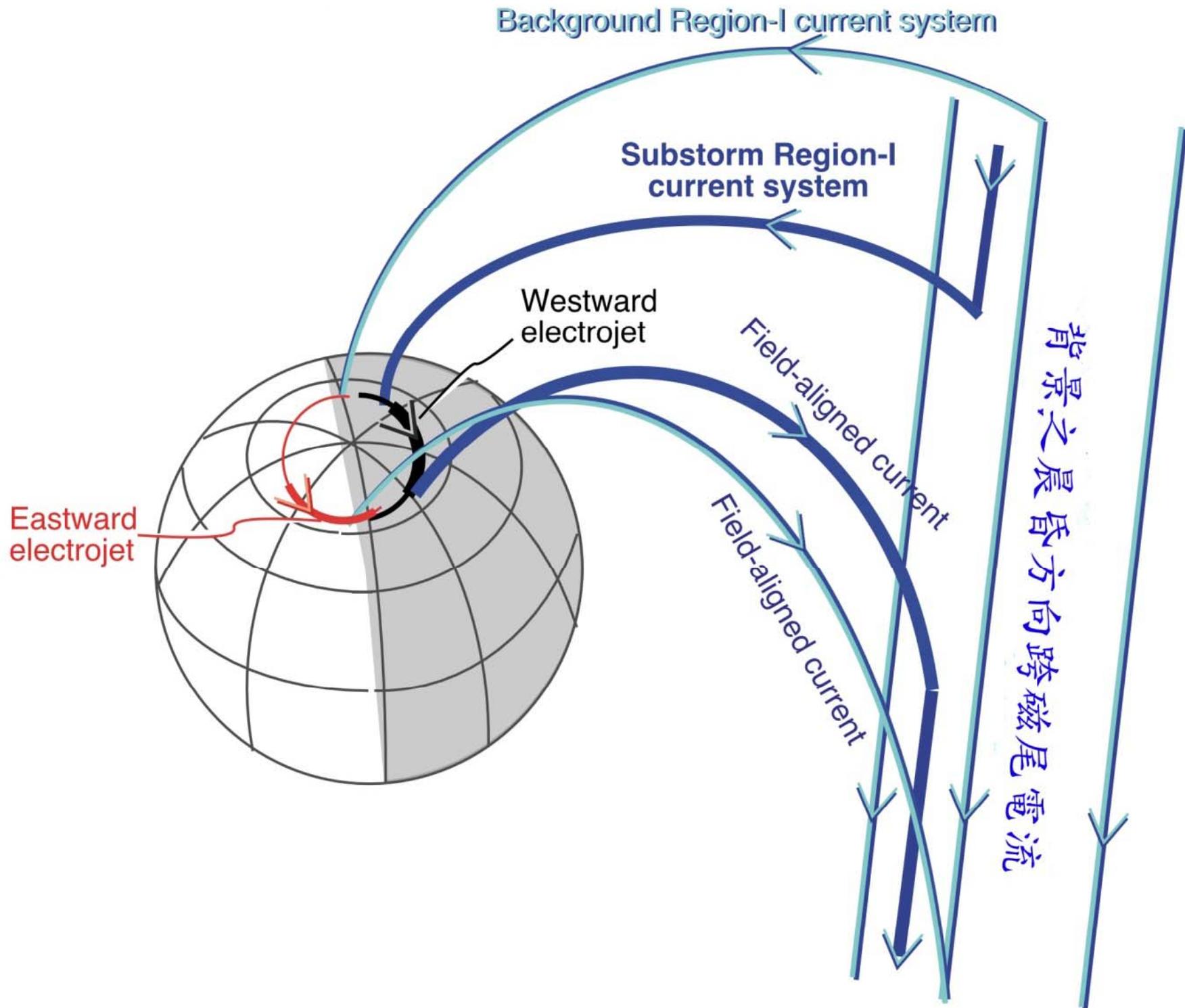
# 磁副暴(magnetic substorm)

expansion phase: 原來應該經由磁尾電漿片由晨到昏的電流被迫改道，先沿磁場線流入晨側電離層，再經由西向電噴流以及東向電噴流由黃昏側流出電離層，再沿磁場線流入黃昏側磁尾。

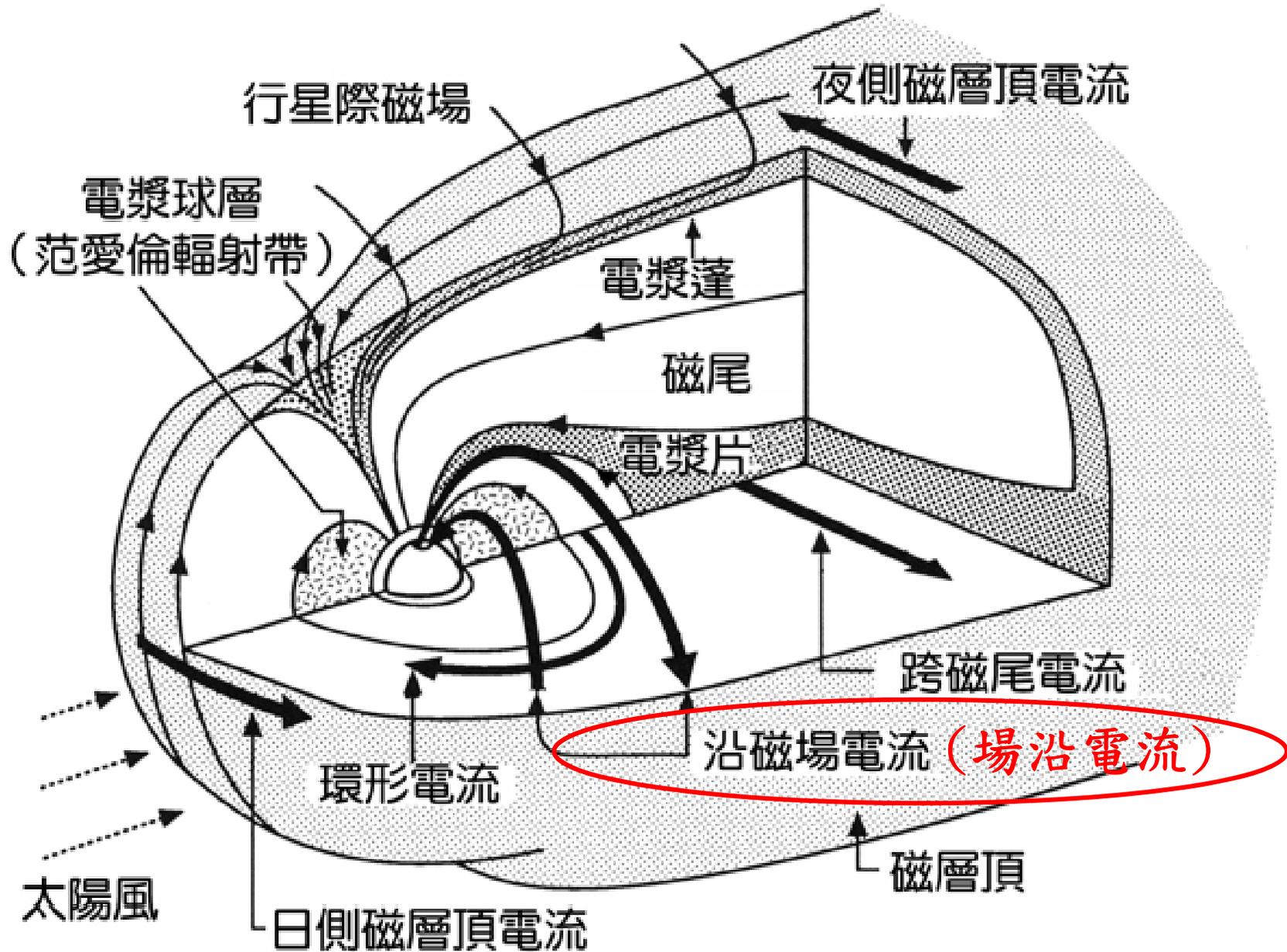
高緯地區日側電離層東向電噴流增強，造成高緯地區日側地表磁場增強(AU指數變化)。高緯地區夜側電離層西向電噴流增強，造成高緯地區夜側地表磁場減弱(AL指數變化)。

recovery phase: 磁層還原為成長期以前的模樣

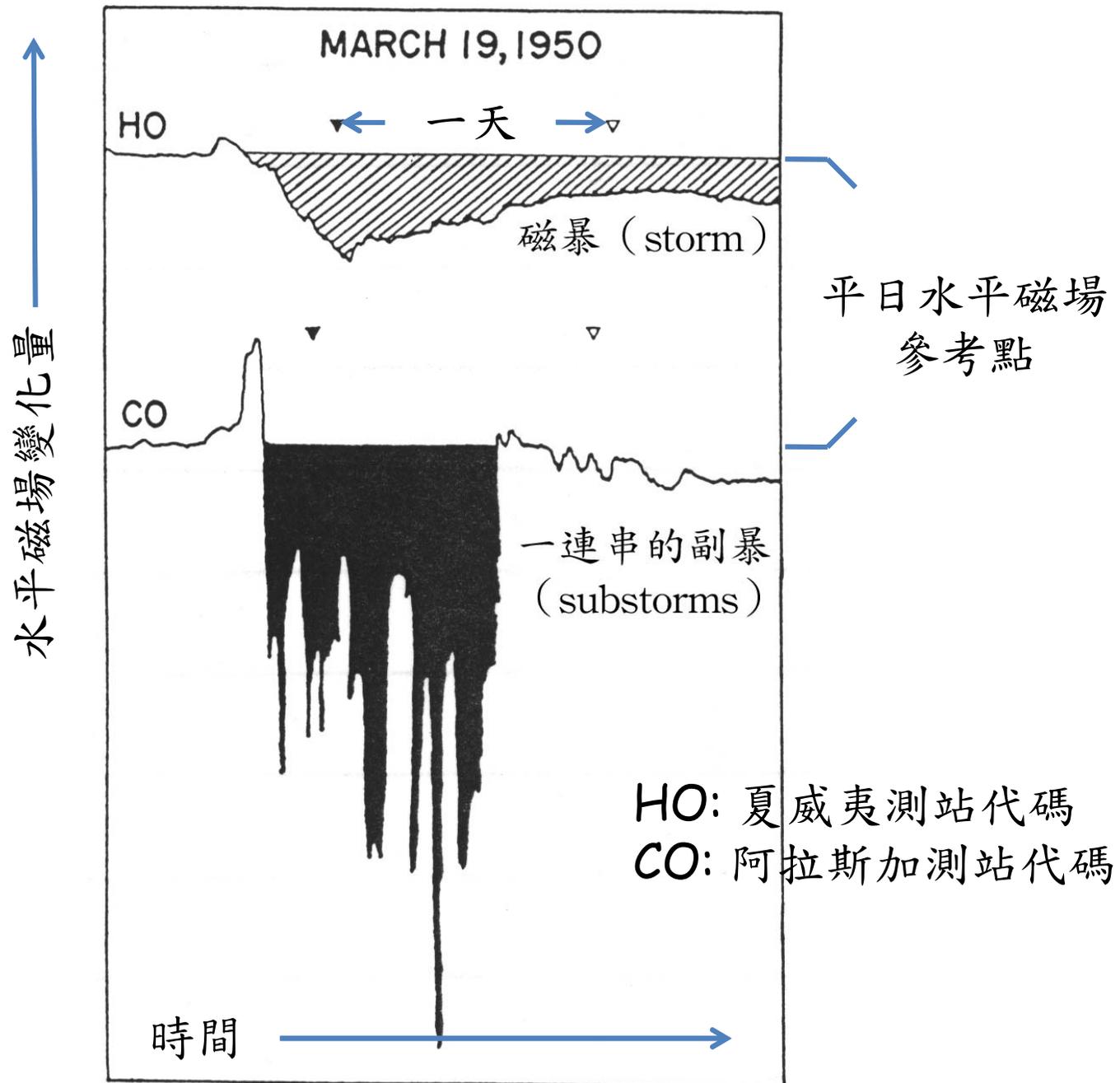




# 地球磁層電流系統



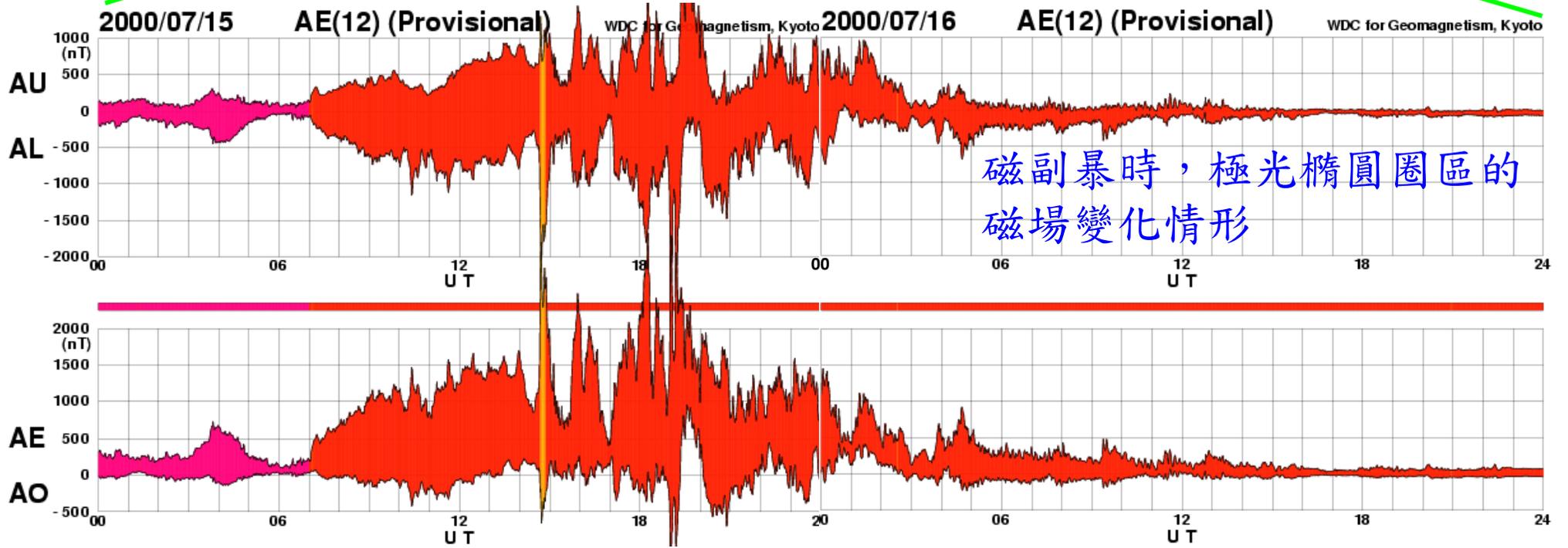
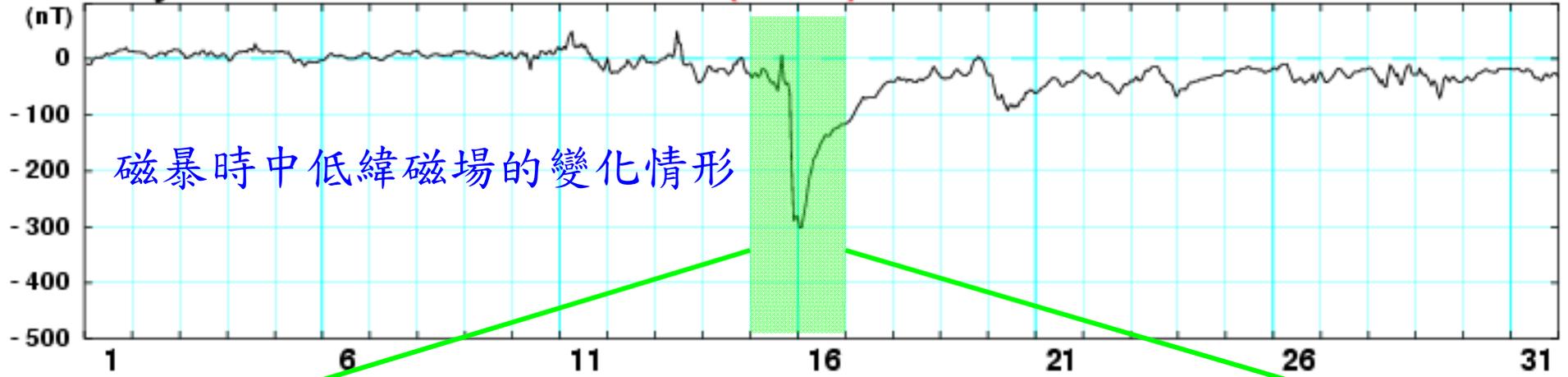
# 磁暴與磁副暴



July 2000

Dst (Final)

WDC for Geomagnetism, Kyoto

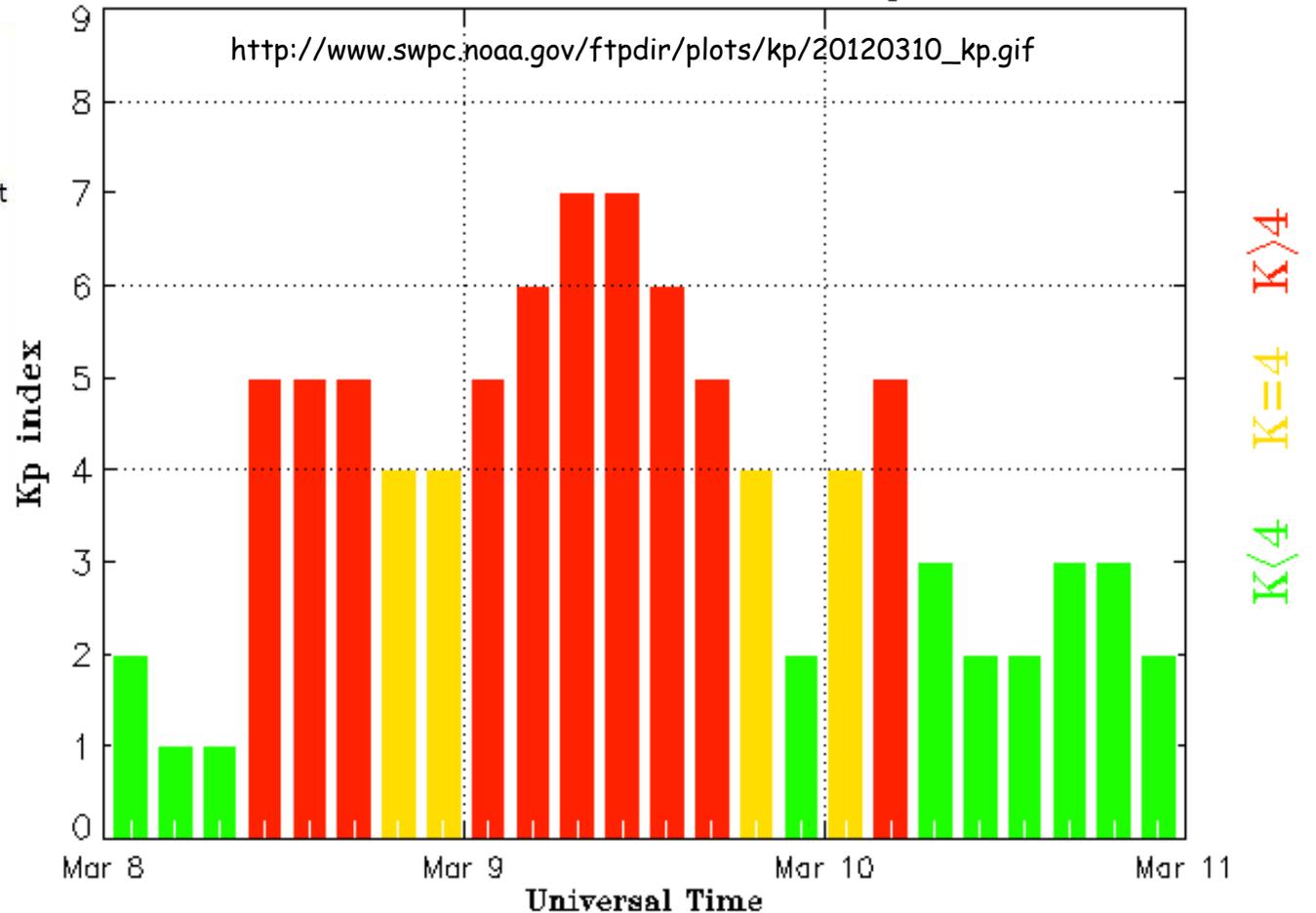
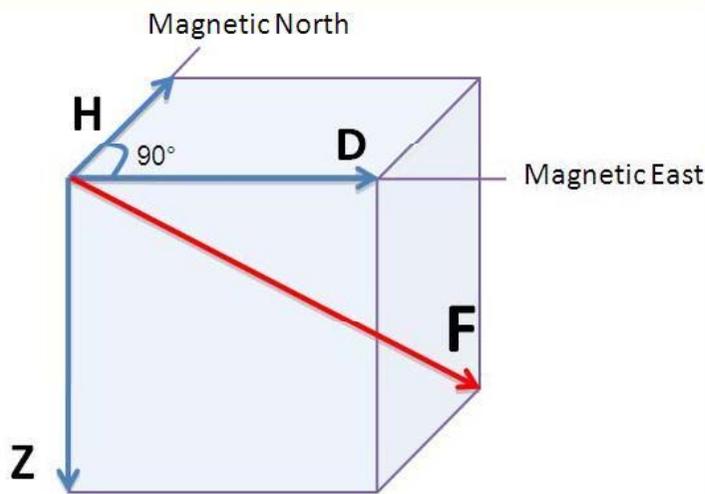


# Kp Index

The Kp index is estimated from the average of the disturbance levels in the most disturbed horizontal magnetic field component (H or D) at 13 selected mid-latitude stations during three-hour period.

0o, 0+, 1-, 1o, 1+, 2-, 2o, 2+, ... , 8o, 8+, 9-, 9o

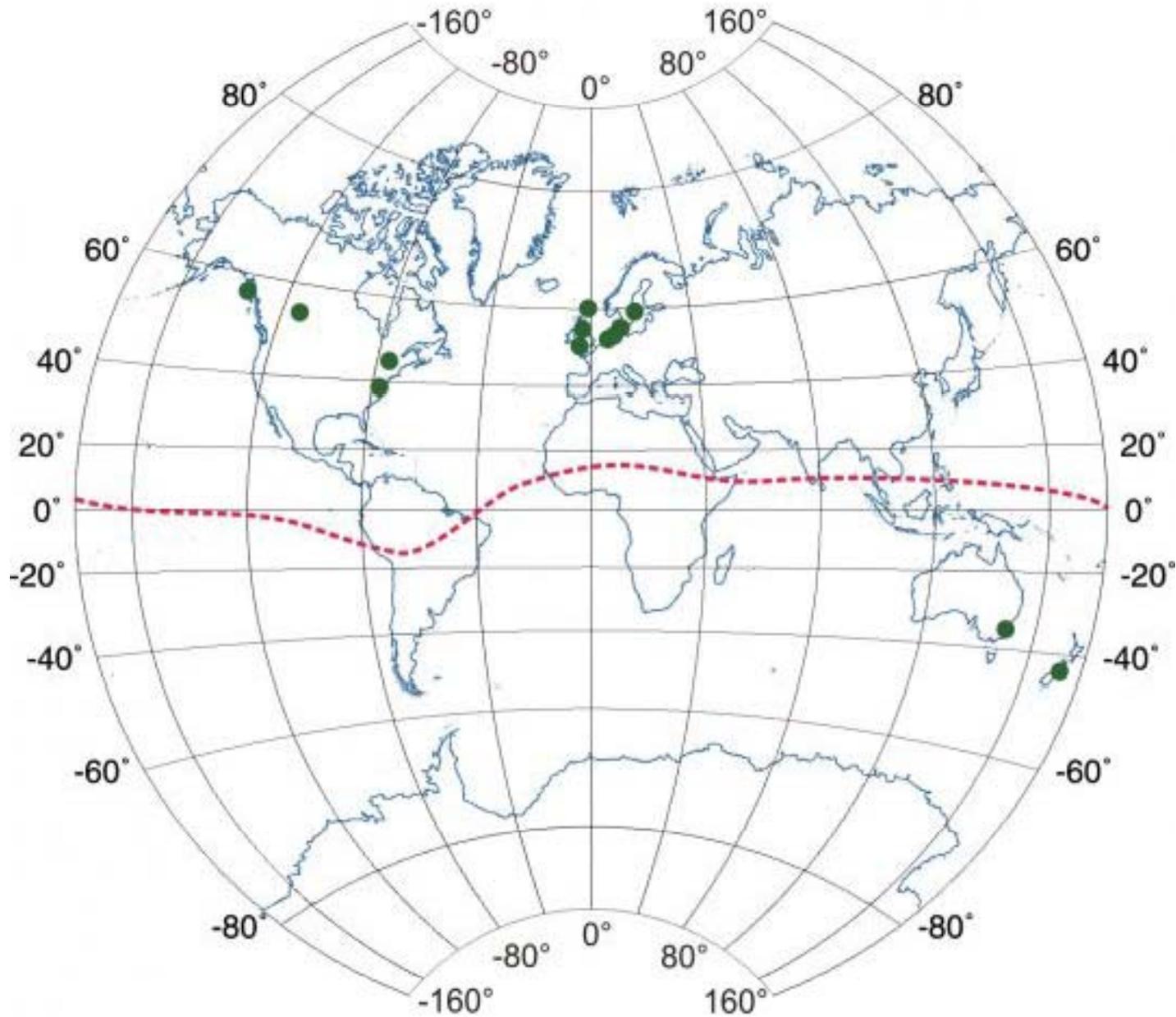
Estimated Planetary K index (3 hour data) **Begin:** 2012 Mar 08 0000 UTC



Updated 2012 Mar 11 02:55:05 UTC

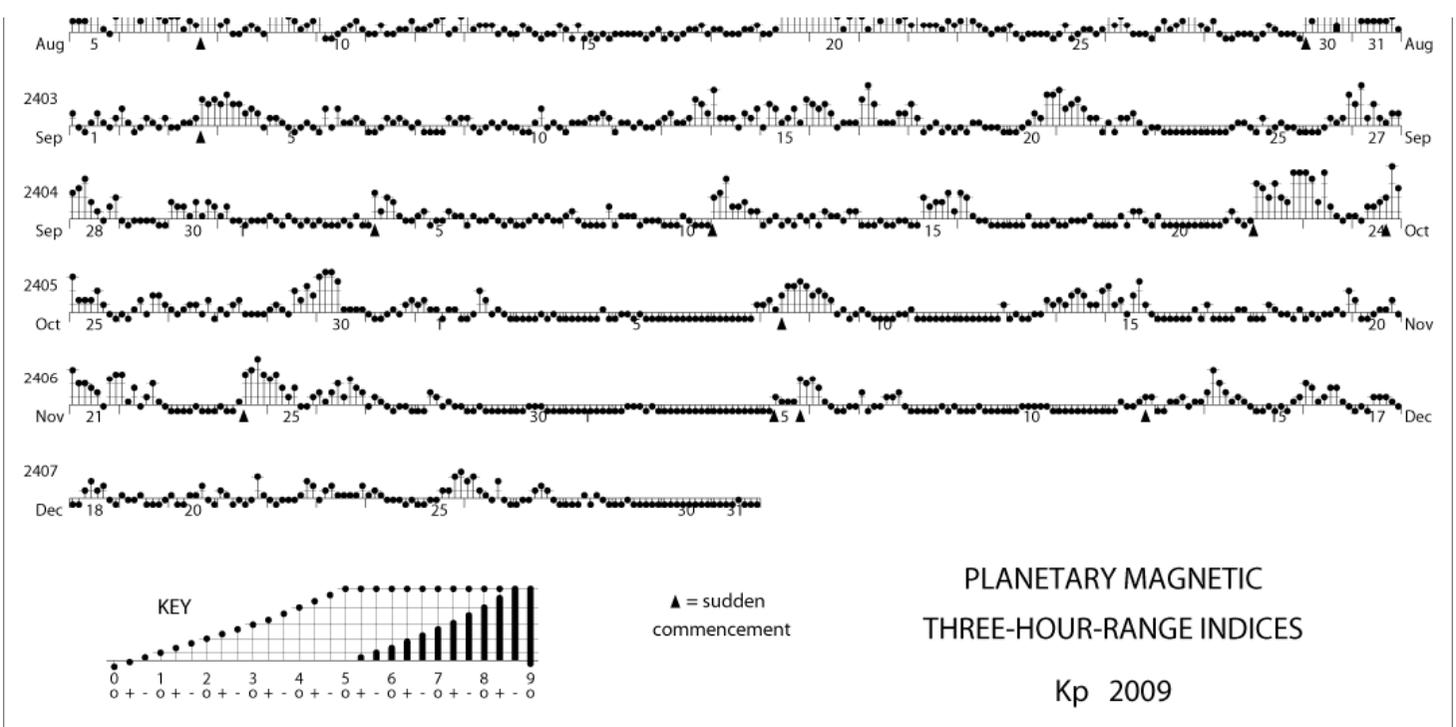
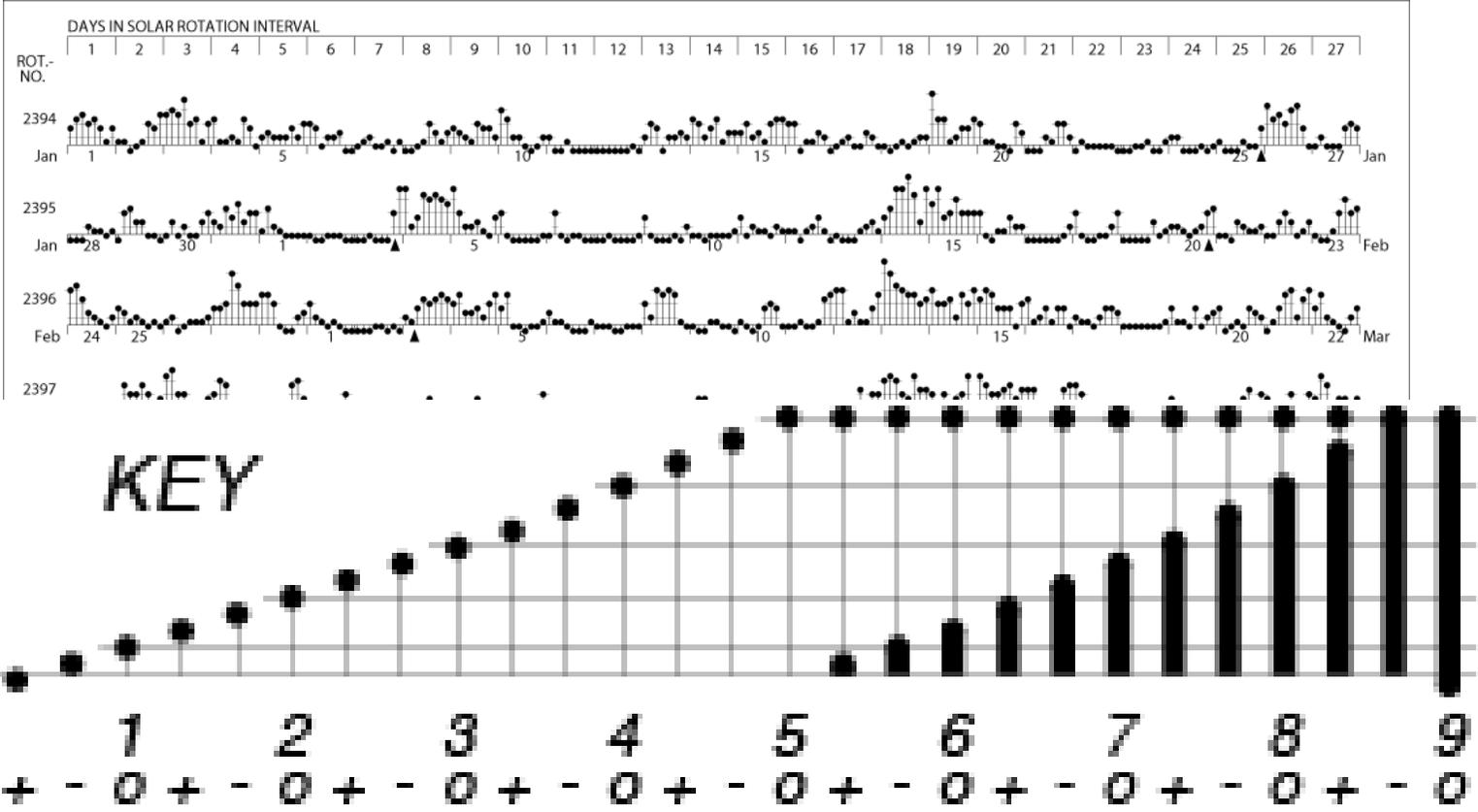
NOAA/SWPC Boulder, CO USA

# Kp Index



# Kp Index

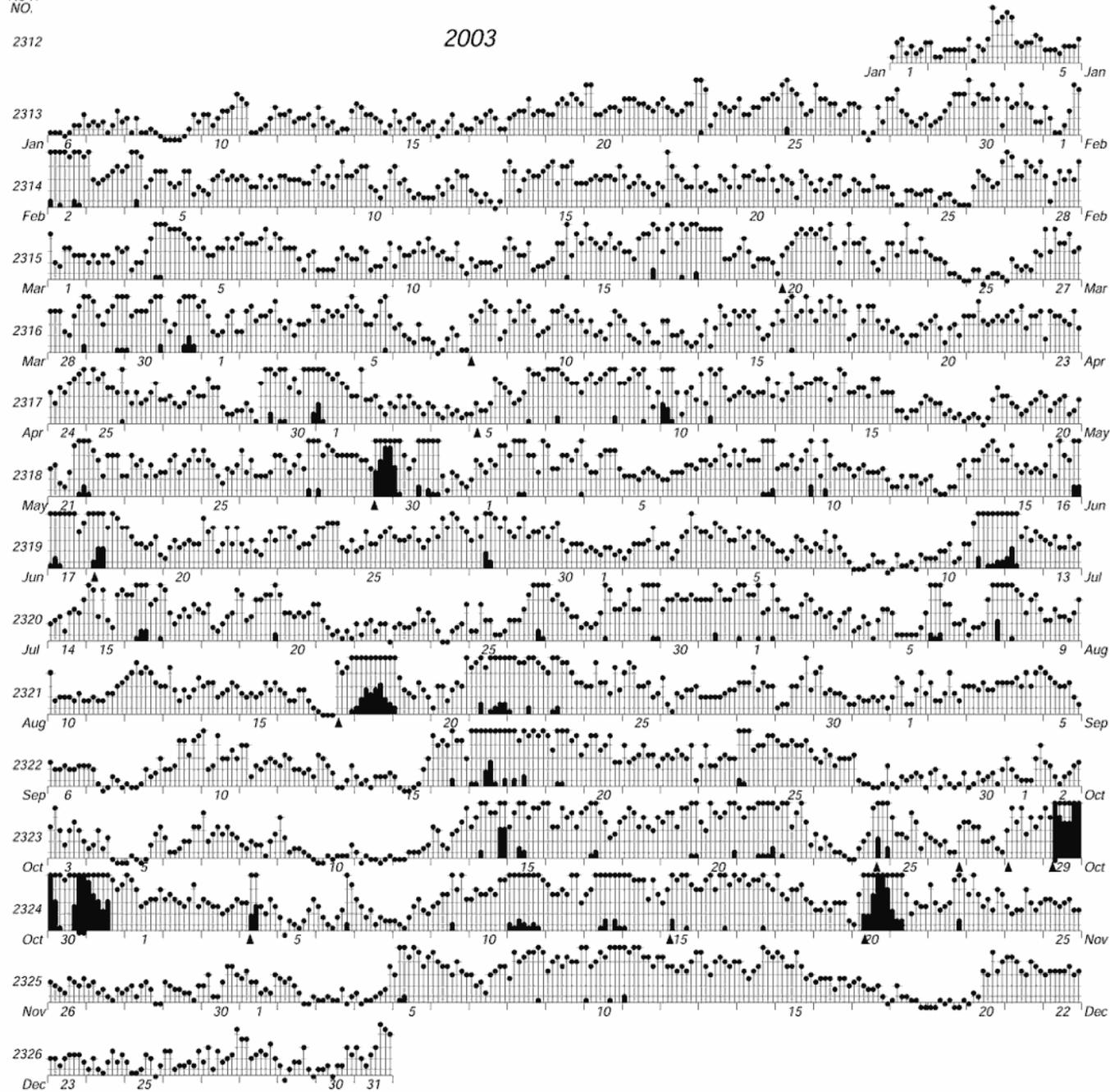
#	Observatory				Geographic		Geomagnetic		K=9 (nT)
	Code	Name	Location	Active	Lat.	Long.	Lat.*	Long.*	
1	LER	Lerwick	Scotland	1932-actual	60°08'	358°49'	62.0°	89.2°	1000
2	MEA	Meanook	Canada	1932-actual	54°37'	246°40'	61.7°	305.7°	1500
3	SIT	Sitka	Alaska (US)	1932-actual	57°03'	224°40'	60.4°	279.8°	1000
4	ESK	Eskdalemuir	Scotland	1932-actual	55°19'	356°48'	57.9°	83.9°	750
5	LOV	Lovö	Sweden	1954-2004	59°21'	17°50'	57.9°	106.5°	600
	UPS	Uppsala	Sweden	2004-actual	59°54'	17°21'	58.5°	106.4°	600
6	AGN	Agincourt	Canada	1932-1969	43°47'	280°44'	54.1°	350.5°	600
	OTT	Ottawa	Canada	1969-actual	45°24'	284°27'	55.8°	355.0°	750
7	RSV	Rude Skov	Denmark	1932-1984	55°51'	12°27'	55.5°	99.4°	600
	BFE	Brorfelde	Denmark	1984-actual	55°37'	11°40'	55.4°	98.6°	600
8	ABN	Abinger	England	1932-1957	51°11'	359°37'	53.4°	84.5°	500
	HAD	Hartland	England	1957-actual	50°58'	355°31'	54.0°	80.2°	500
9	WNG	Wingst	Germany	1938-actual	53°45'	9°04'	54.1°	95.1°	500
10	WIT	Witteveen	Netherland	1932-1988	52°49'	6°40'	53.7°	92.3°	500
	NGK	Niemegk	Germany	1988-actual	52°04'	12°41'	51.9°	97.7°	500
11	CLH	Cheltenham	USA	1932-1957	38°42'	283°12'	49.1°	353.8°	500
	FRD	Fredericksburg	USA	1957-actual	38°12'	282°38'	48.6°	353.1°	500
12	TOO	Toolangi	Australia	1972-1981	-37°32'	145°28'	-45.6°	223.0°	500
	CNB	Canberra	Australia	1981-actual	-35°18'	149°00'	-42.9°	226.8°	450
13	AML	Amberley	New Zealand	1932-1978	-43°09'	172°43'	-46.9°	254.1°	500
	EYR	Eyrewell	New Zealand	1978-actual	-43°25'	172°21'	-47.2°	253.8°	50



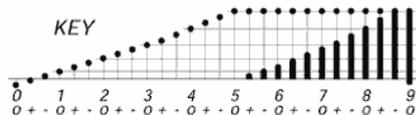
ROT. NO.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

2003



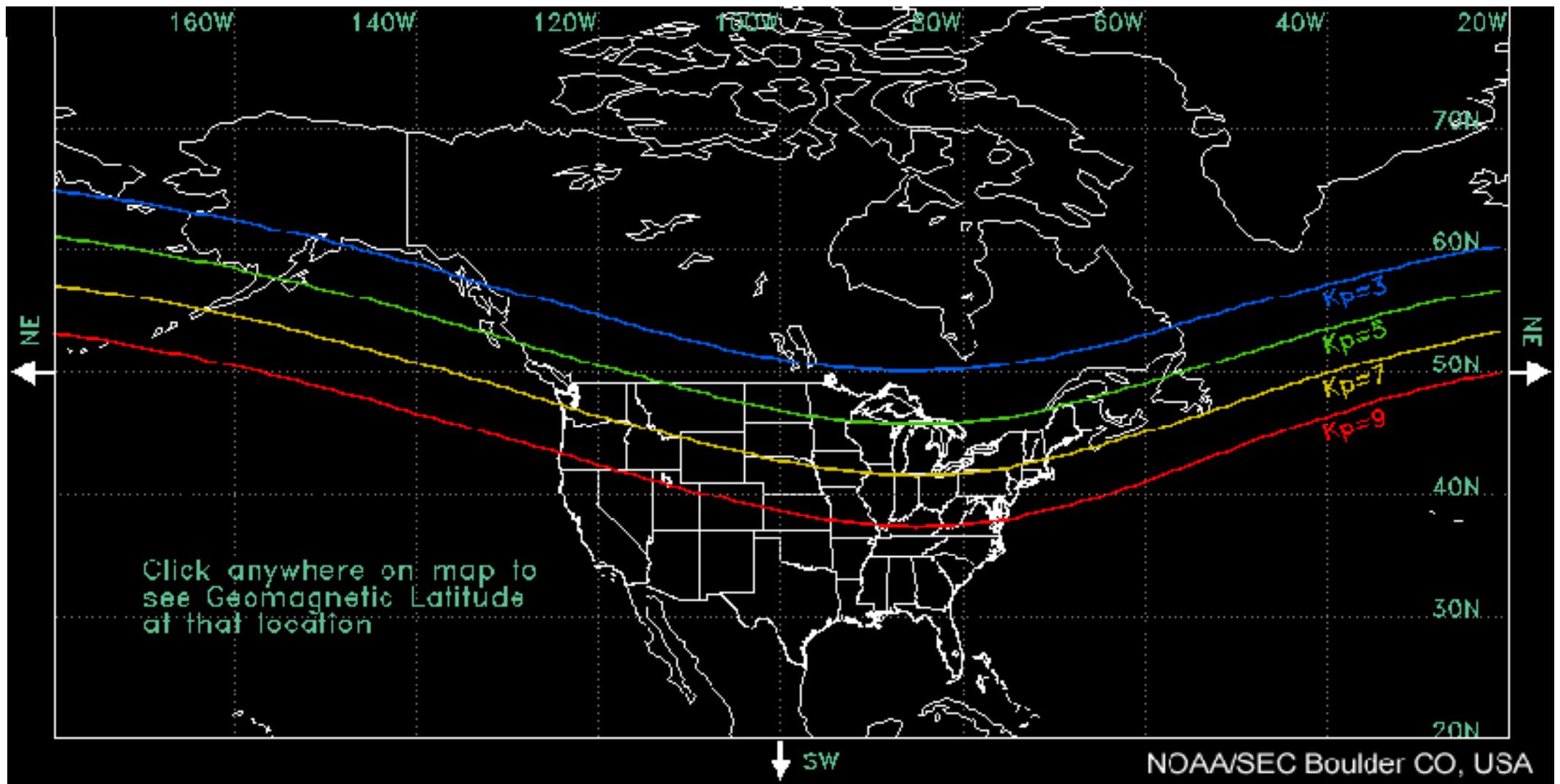
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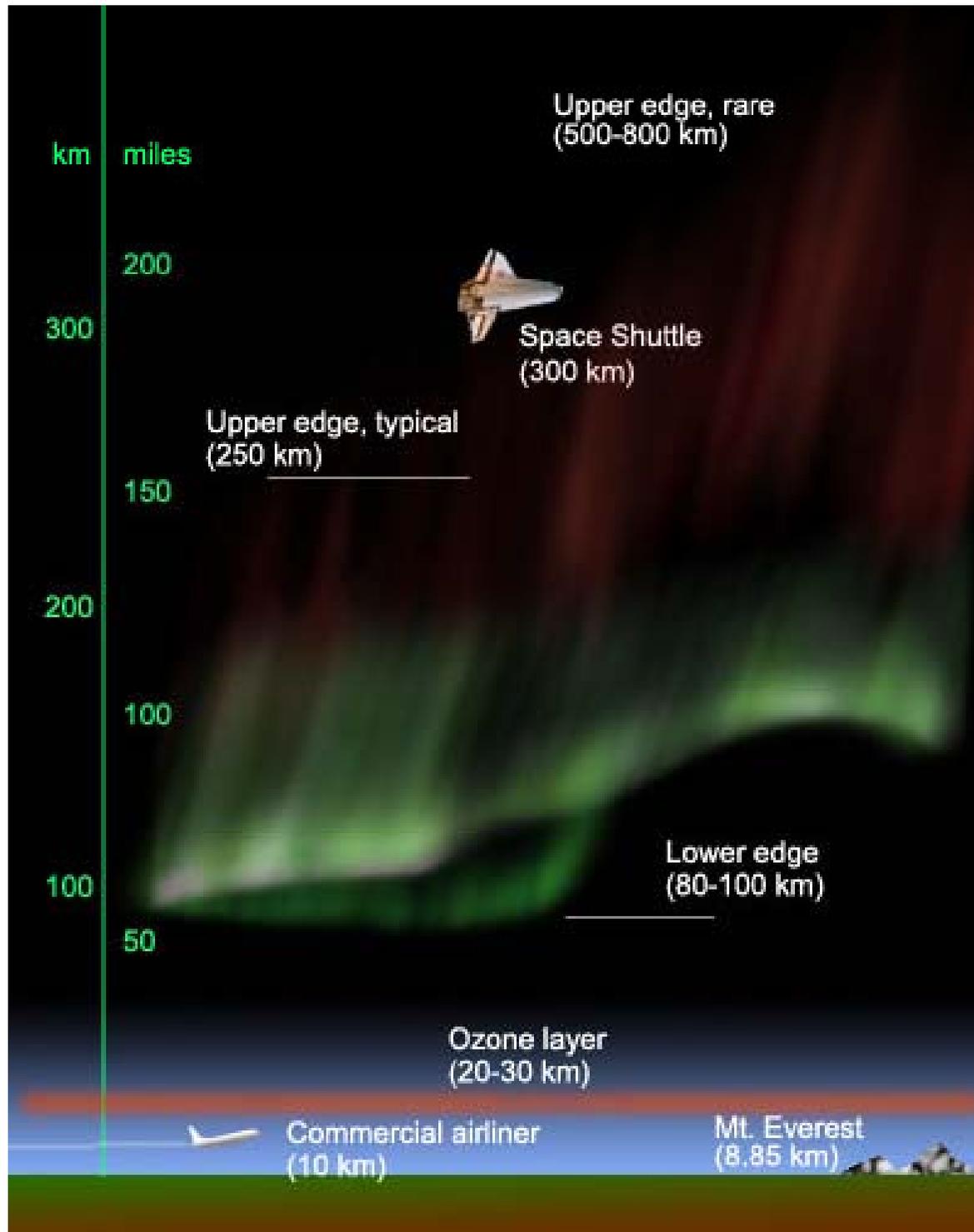


▲ = sudden commencement

PLANETARY MAGNETIC  
THREE-HOUR-RANGE INDICES

Kp 2003





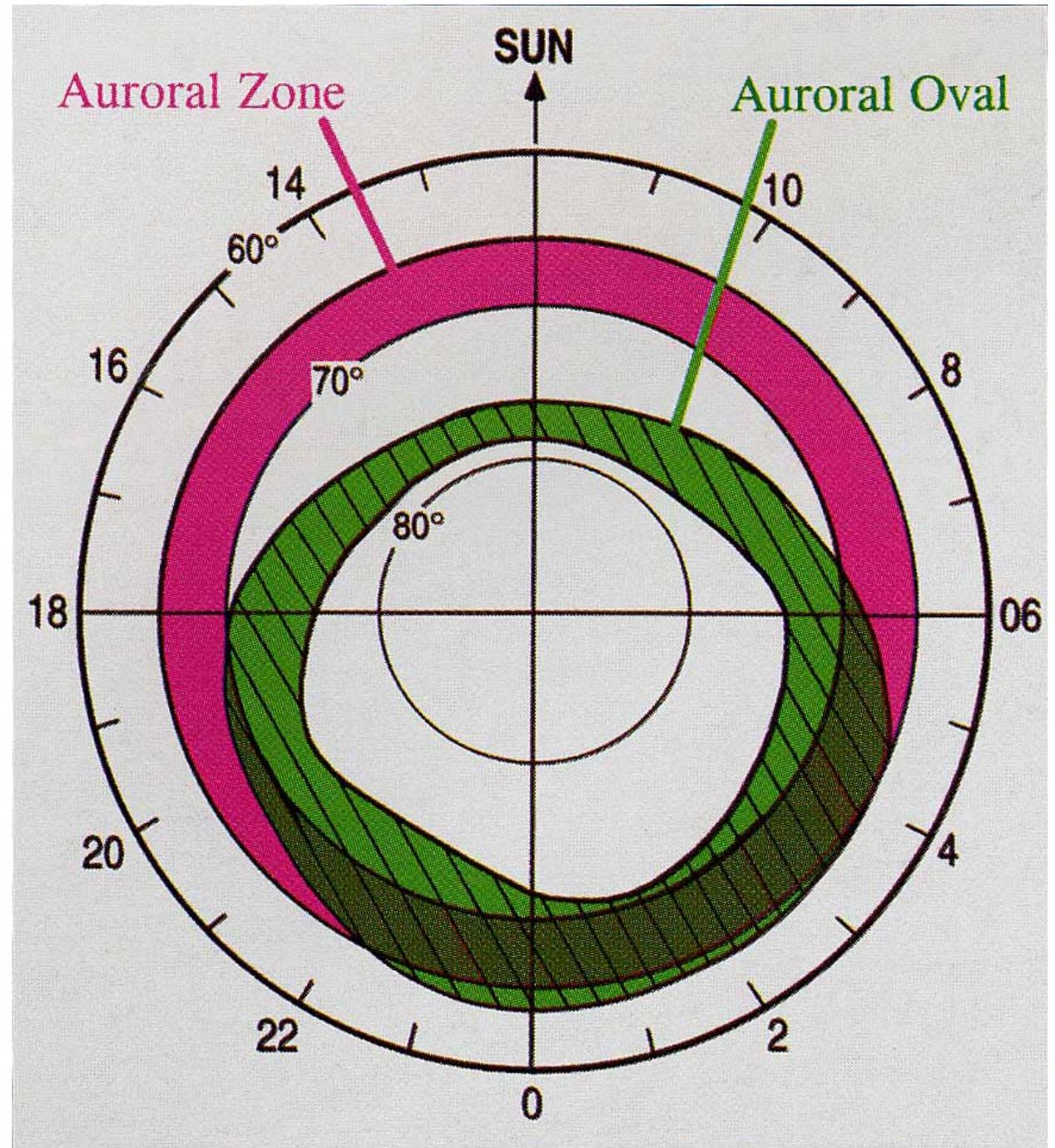
# 觀賞極光的時機與地點

- 大部分極光出現在高緯度地區的極光橢圓圈(auroral oval)裡，所以高緯地區(例如：阿拉斯加、加拿大、芬蘭、挪威、冰島、瑞典)極光橢圓圈內的晴朗天空夜晚最適合看極光。
- 就季節來說，在北半球看極光的最佳時間為8月底至隔年4月底，期間夜晚的長度較長，看到的機率一定比夏季時分高，尤以9月的秋分和3月的春分前後一個月左右的時間是值得推薦的絕佳觀賞時間。
- 一天之中，極光最佳觀賞時間通常是午夜前後1、2個小時之內，以及清晨3、4點鐘左右。
- 以阿拉斯加為例，位於中部內陸的費爾班克斯出現多雲甚至下雨的日子，會比南方較靠近海洋的安克拉治少，而且費爾班克斯一年平均有243天的夜晚可能看到極光，而位於南邊相距7、8小時車程遠的安克拉治，一年平均只有100天。

Auroral Zone is a circular region around the magnetic north and south poles between 65 and 75 degrees latitude. However, the Aurora is actually distributed about an oval-shaped band that rotates about the auroral zone. This band is called Auroral Oval.

"Aurora Borealis": the aurora in the northern auroral oval

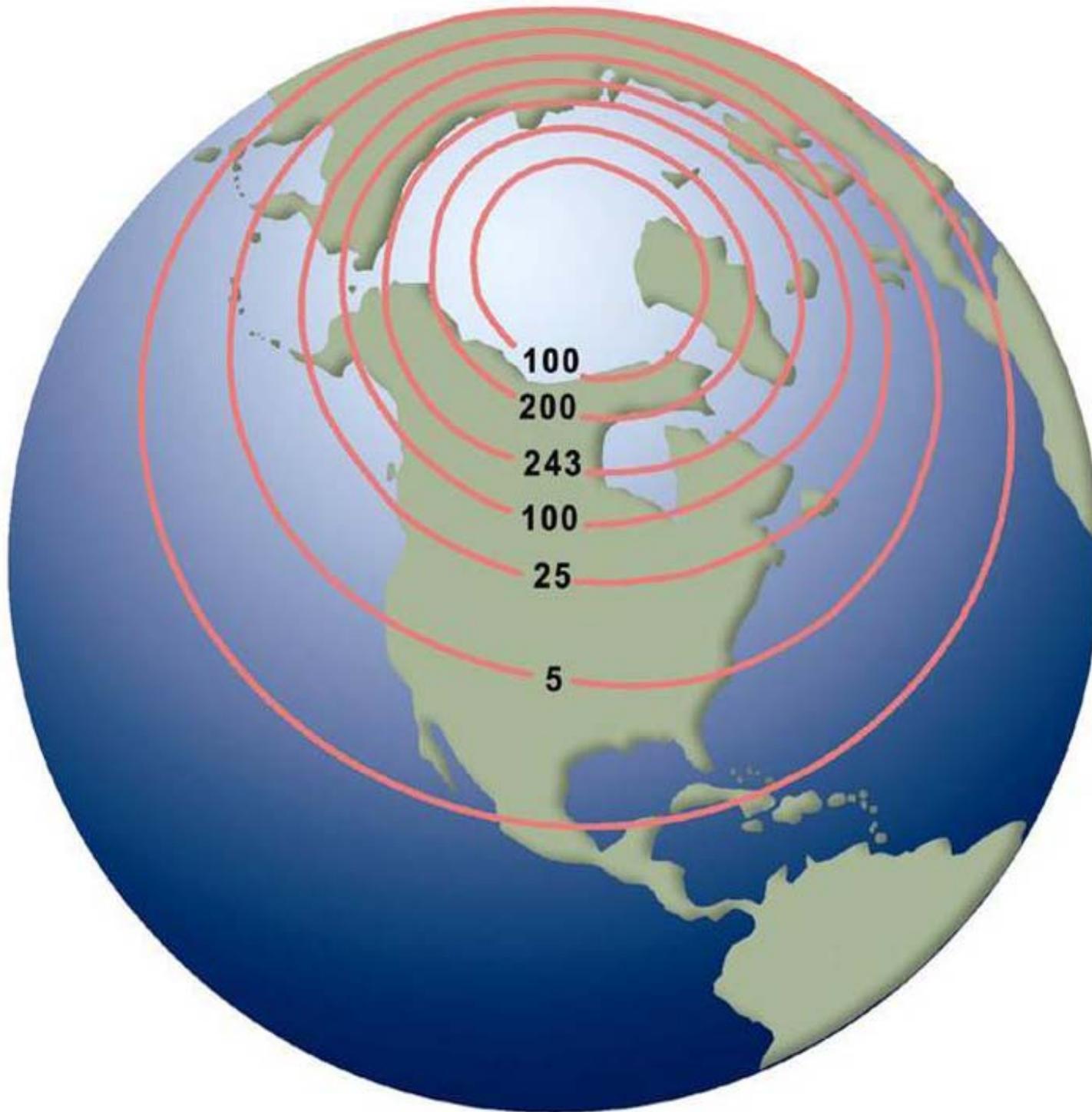
"Aurora Australis" : the aurora in the southern auroral oval



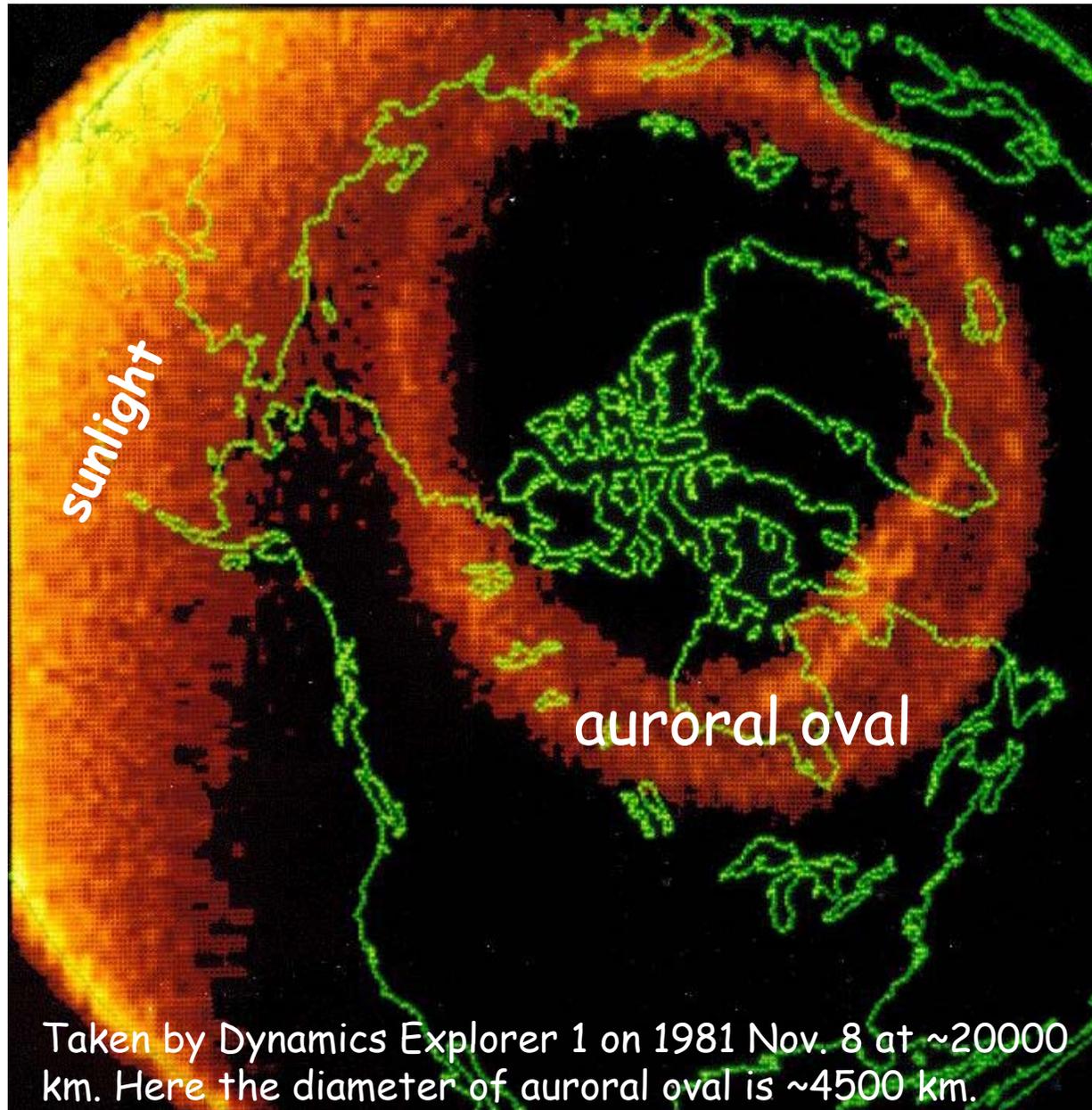
# Auroral Zone (極光帶)

---統計上最常出現極光的區域

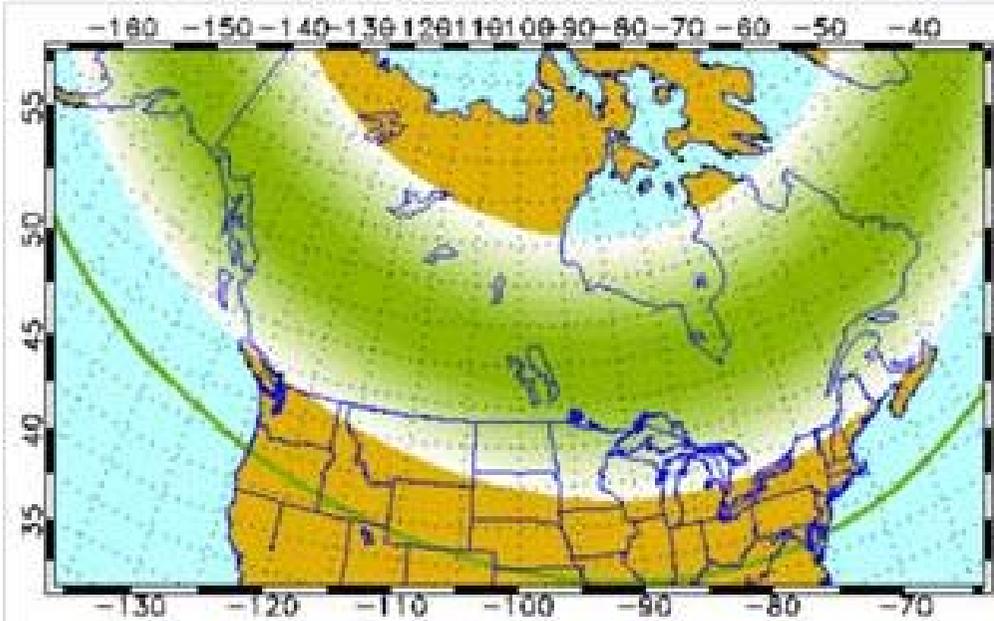




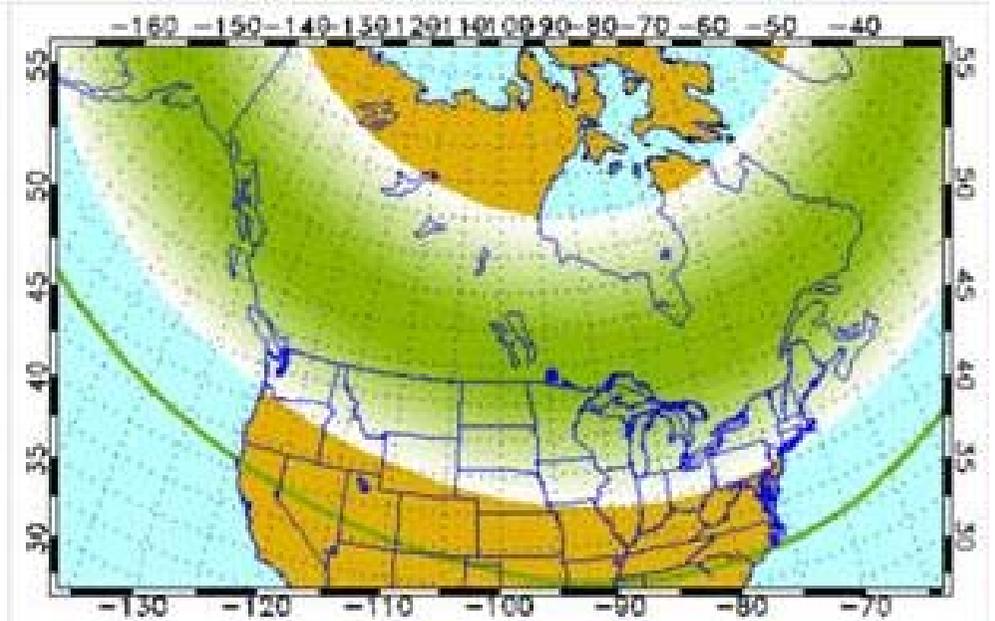
# Auroral Oval (極光橢圓圈)



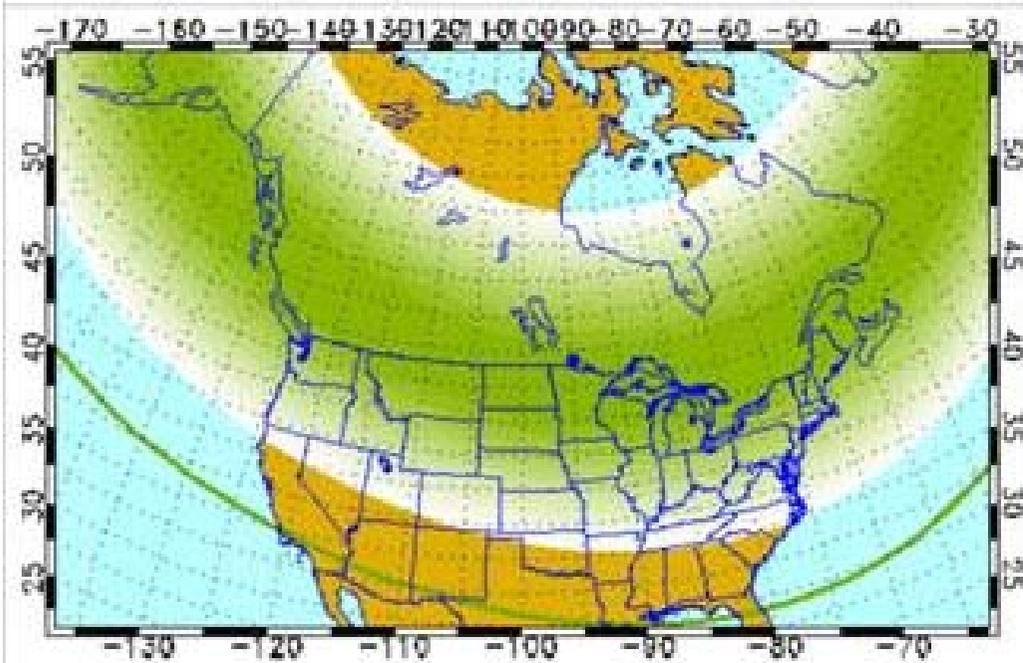
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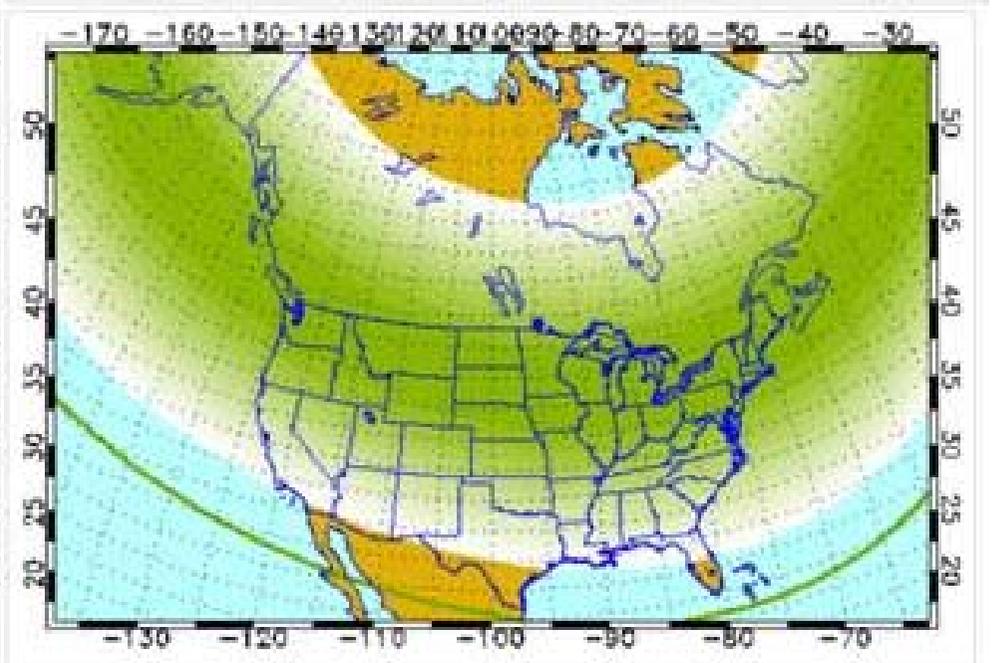
Kp = 7

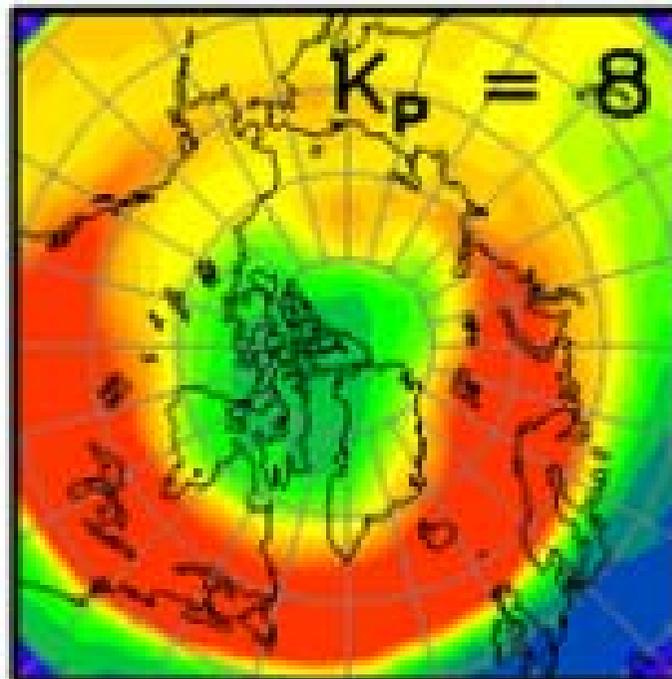
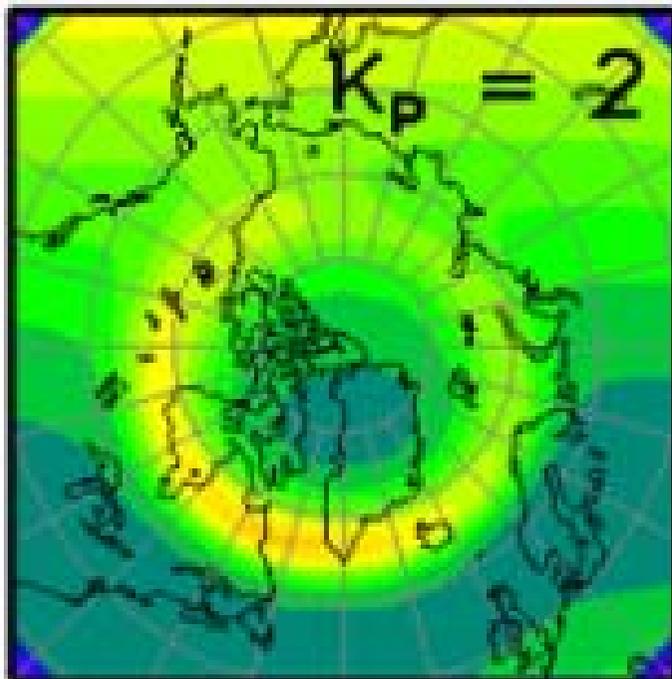
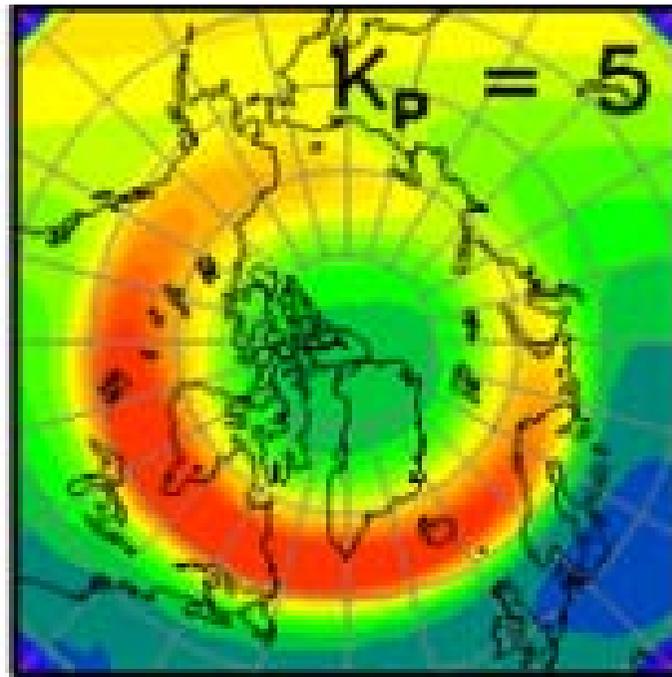
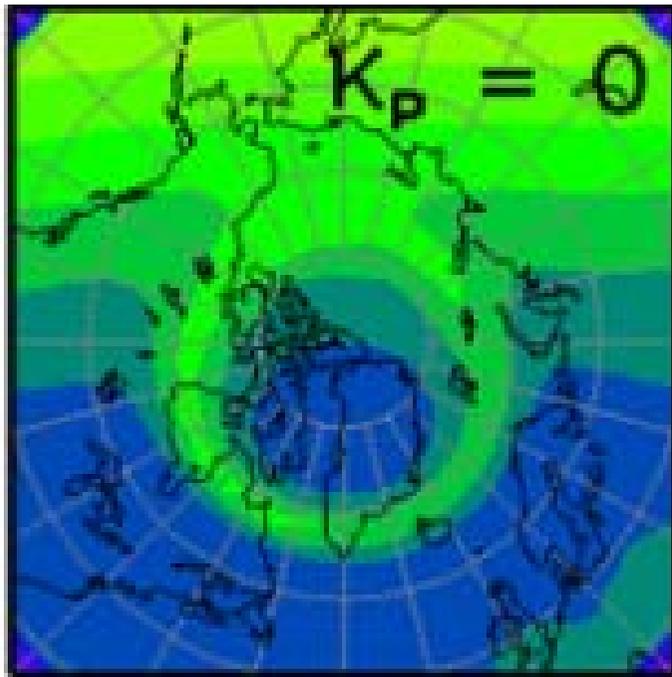


Kp = 8

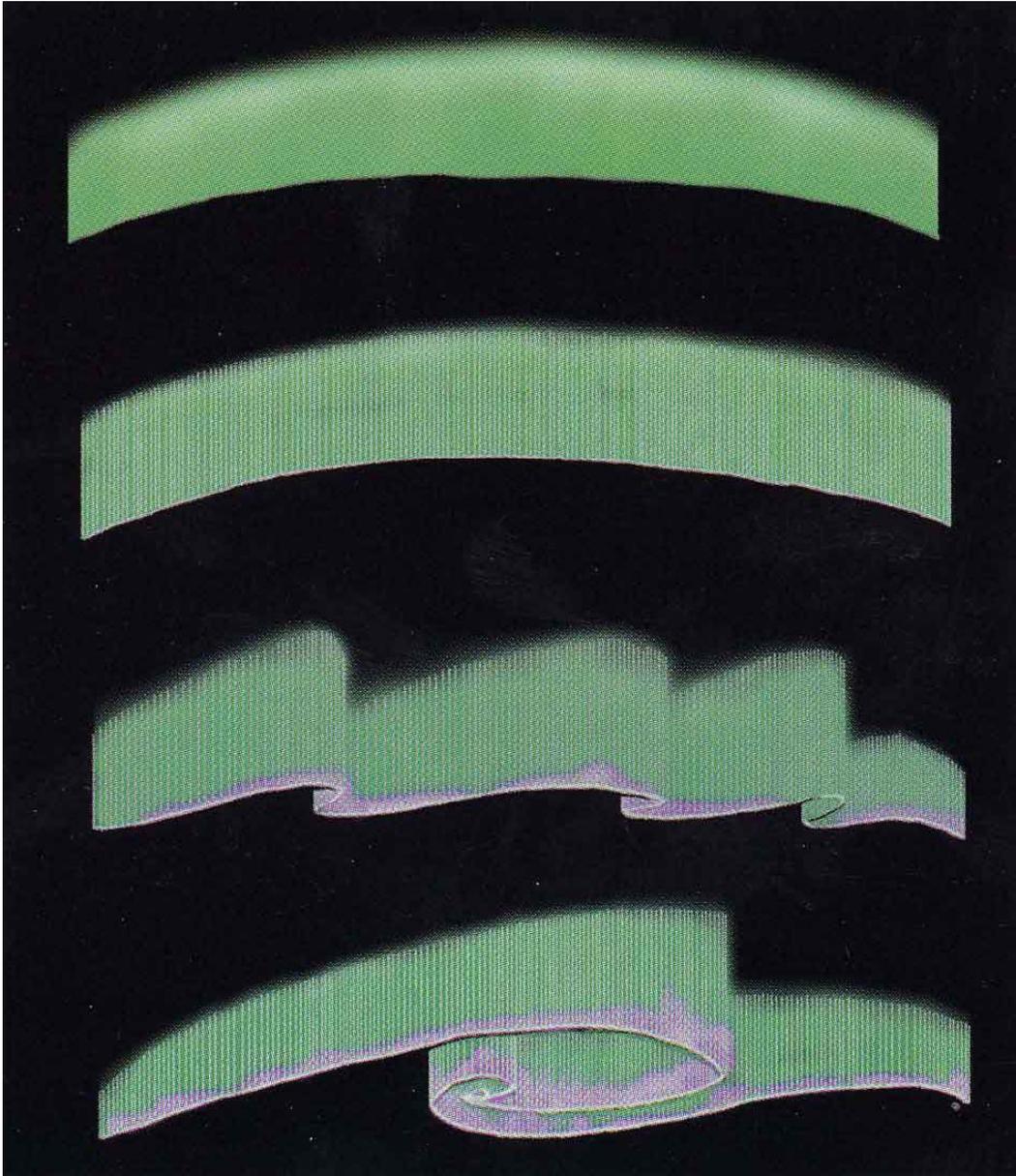


Kp = 9





# 極光



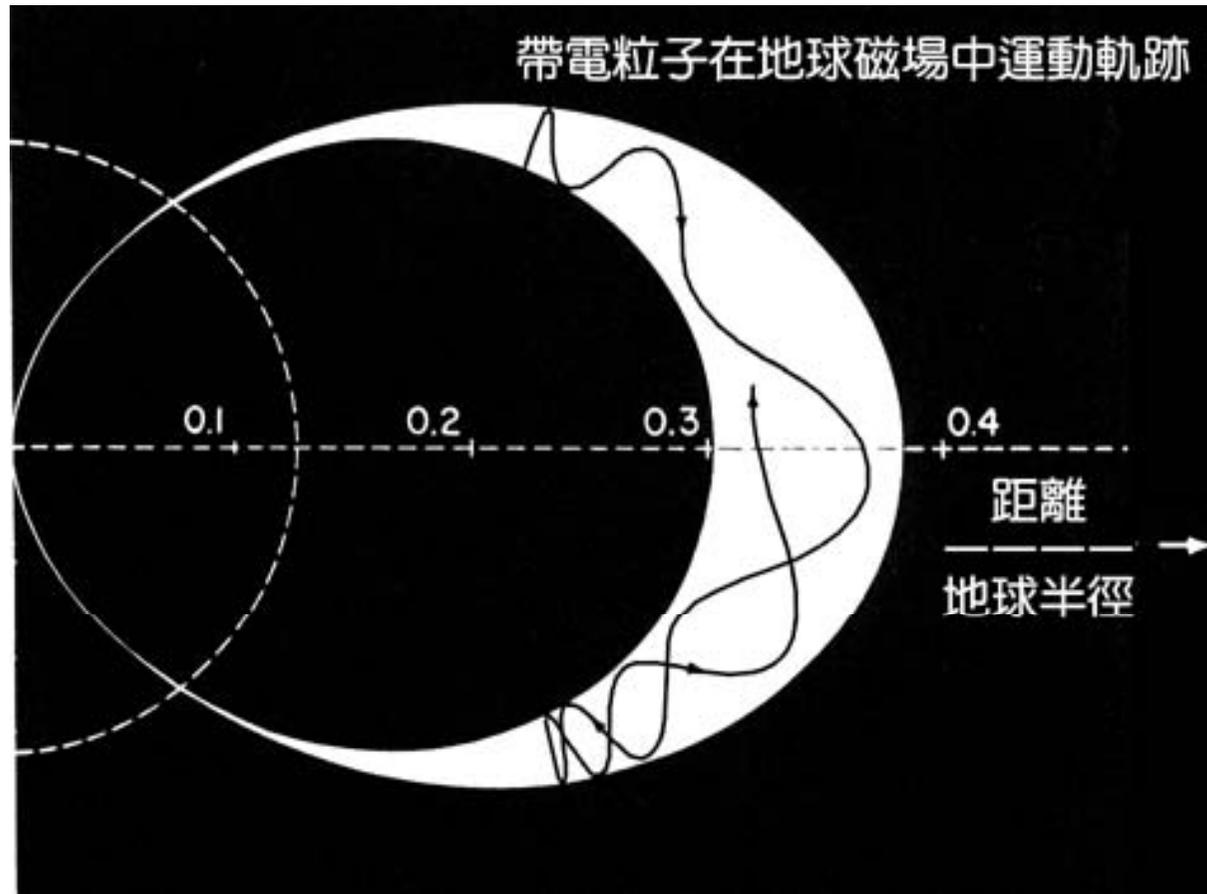
高緯度地區比較容易看到明亮的極光弧(極光弧又叫做分立極光(discrete aurora))。

中緯度地區比較常看到朦朧的擴散極光(diffuse aurora)。

磁副暴時會出現像舞龍一般壯觀的極光弧，分布的範圍涵蓋中緯與高緯度地區。

# 造成擴散極光的原因

地球的磁偶極場可以抓住電漿，故有磁瓶之稱。但是磁瓶中的電漿會產生電磁場波動，使得原來在內磁層中沿磁場線來回運動的高能電子，被擾動的電磁場散射後無法繼續來回運動，少量的高能電漿得以漏出磁瓶落入中緯區的夜空造成擴散極光。



# 造成分立極光的原因

當行星際磁場與地球磁場反向時，在日側磁層頂可能會發生磁力線重聯，使得來自太陽風的能量經由磁層頂進入磁層，這些電漿先被儲存在地球磁尾，等累積到一定程度後，或當磁副暴時磁尾的磁場發生變形時，電漿片中的熱電漿會被擠出來，沿著磁場線灌入高緯電離層的極光橢圓圈內，造成絢麗極光。

