

Nighttime Plasma Depletion Bay observed by FORMOSAT-3

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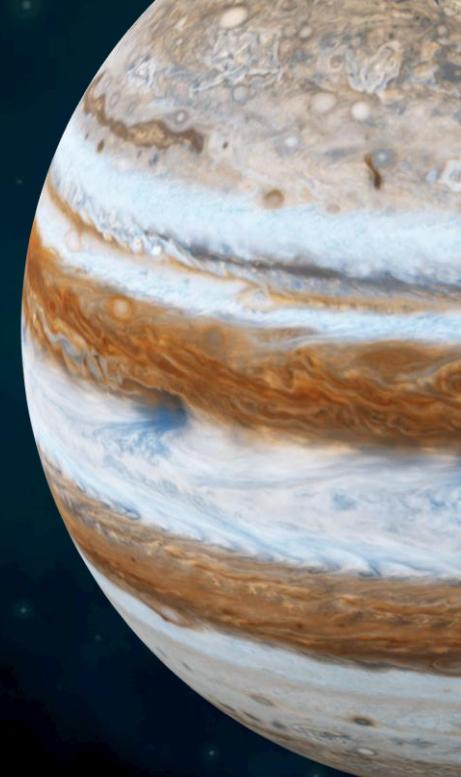
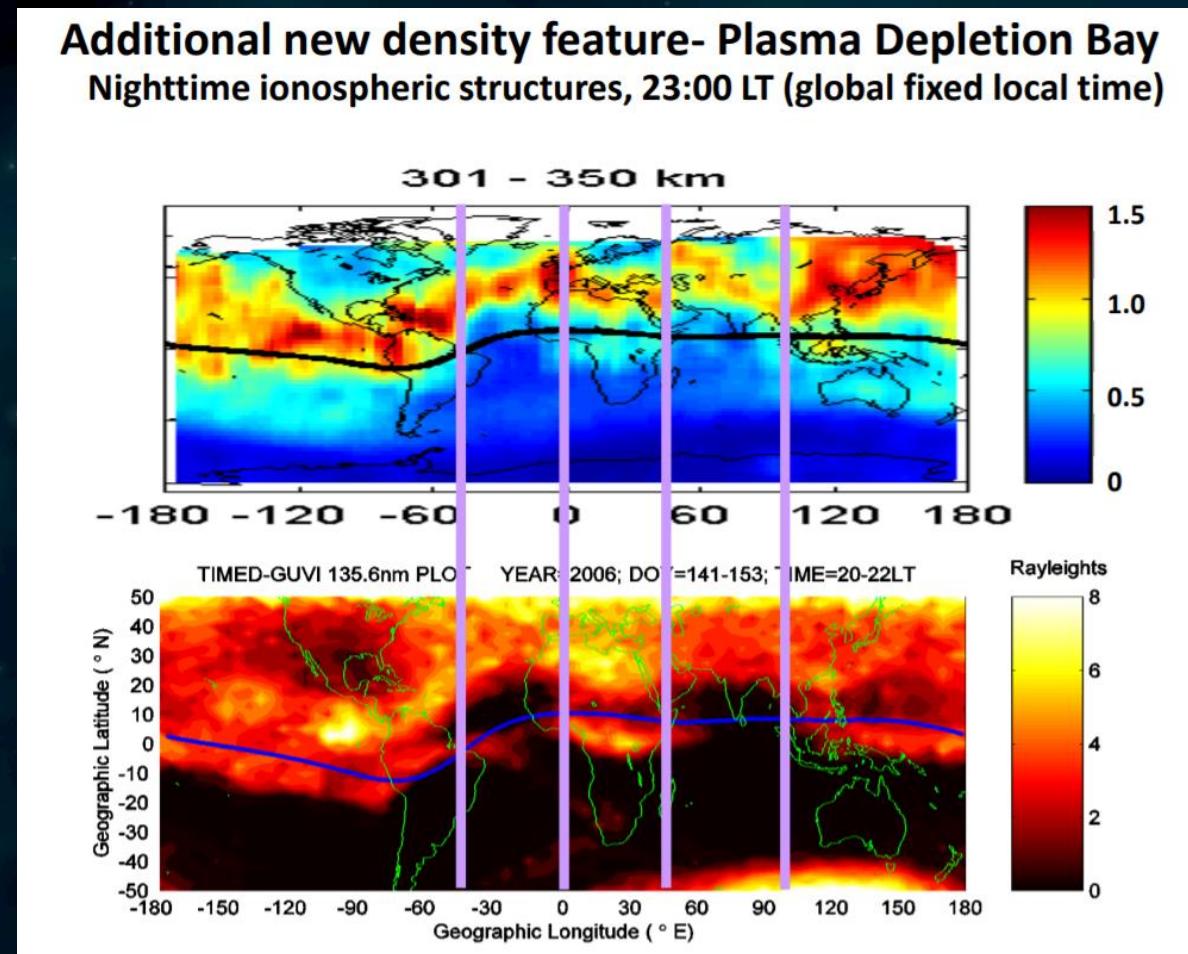


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Plasma Depletion Bays

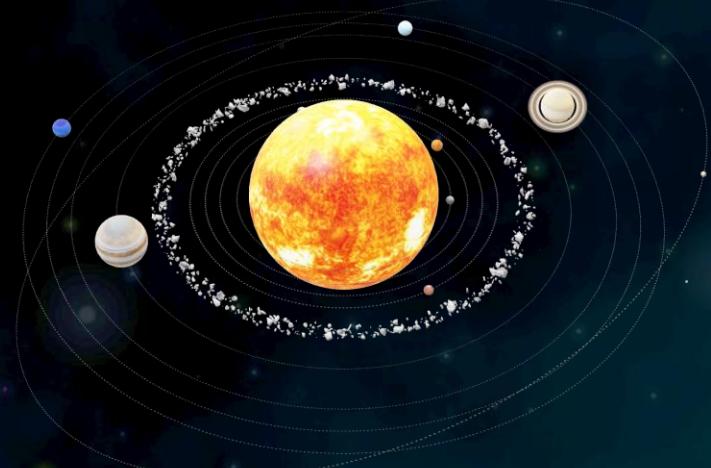
- Position
 - North Atlantic
 - Indian Ocean
 - Southeast Asia
- Time
 - mid-night (maybe)
 - 2000 ~ 2200 LT





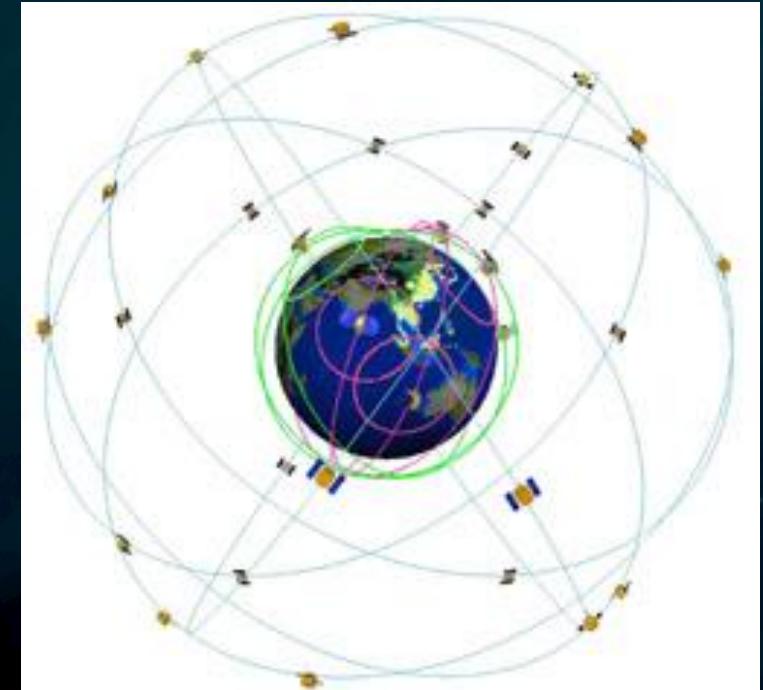
Using methods

1. Using FORMOSAT-3 data
 - 2007 and 2008 data
2. Language - Julia



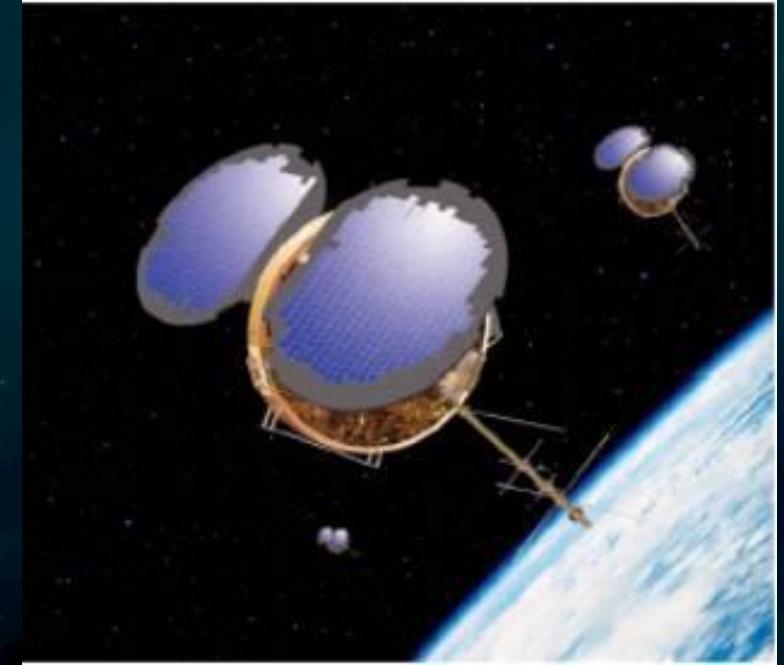
FORMOSAT-3

- NSPO and UCAR cooperate to execute
- Consists of six microsatellites
- Launched on April 15, 2006
- Main mission
 1. Research on the phenomenon of climate change
 2. Ionospheric dynamic monitoring
 3. Global space weather forecast
 4. Earth gravity research



Characteristic

- Consists of six microsatellites
- weight : One about 62 kg
- orbit : Round orbit, angle 72 °
- height : 700 ~ 800 (km)
- One cycle : 100 minute
- Design life: 5 years
- Retire : 2020/5/1





Data processing

2007
2008

- 2007.001
- 2007.002
- 2007.003
- 2007.004
- 2007.005
- 2007.006
- 2007.007

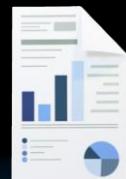
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ionPrf_C001.2007.001.00.23.G03_2013.3520_nc	2020/4/8 下午 05:31	3520_NC 檔案	10 KB
ionPrf_C001.2007.001.00.23.G13_2013.3520_nc	2020/4/8 下午 05:31	3520_NC 檔案	12 KB
ionPrf_C001.2007.001.00.25.G16_2013.3520_nc	2020/4/8 下午 05:31	3520_NC 檔案	13 KB



csv_2007
csv_2008

- 2007.001.csv
- 2007.002.csv
- 2007.003.csv
- 2007.004.csv
- 2007.005.csv
- 2007.006.csv
- 2007.007.csv

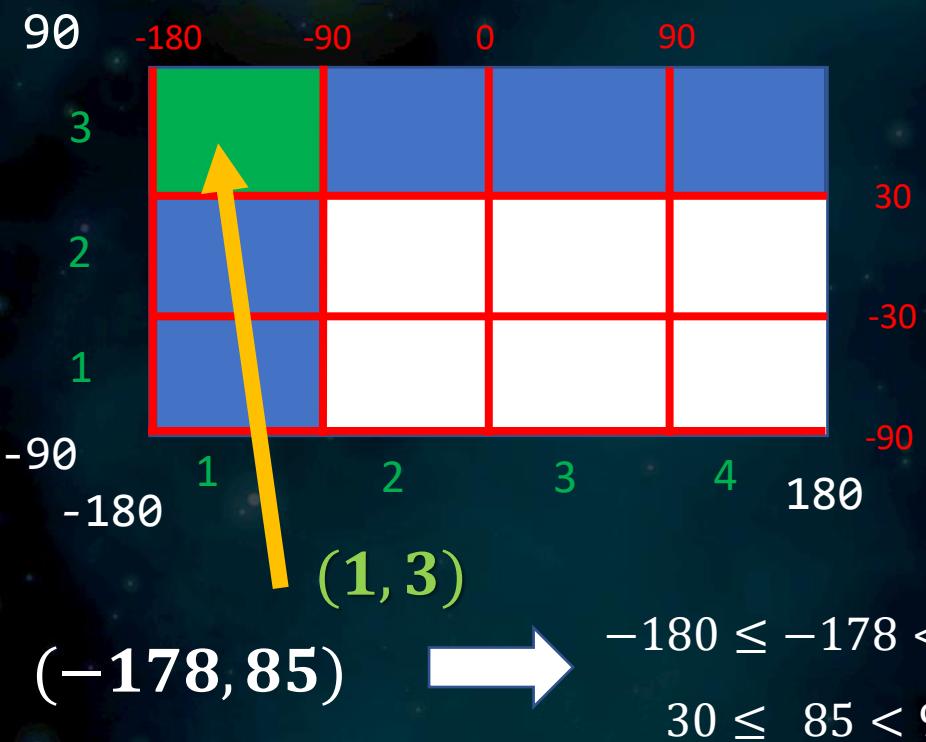
	A	B	C	D	E
1	MSL_alt	GEO_lon	GEO_lat	ELEC_der time	
2	47.53889	136.1132	0.314327	85062.35	00:05
3	49.74984	136.1034	0.296943	568.414	00:05
4	51.95641	136.0937	0.279562	-11464.9	00:05
5	54.15859	136.0839	0.262185	-8139.84	00:05
6	56.35637	136.0741	0.244811	-8843.85	00:05
7	58.54975	136.0644	0.227441	-8842.95	00:05
8	60.73873	136.0546	0.210074	-9263.68	00:05
9	62.9233	136.0448	0.192711	-7739.99	00:05



Ion Density distribution

$$\begin{aligned}\Delta x &= 90 \\ \Delta y &= 60\end{aligned}$$

$$\begin{aligned}x_{length} &= \frac{360}{90} = 4 \\ y_{length} &= \frac{180}{60} = 3\end{aligned}$$



```
lon_boundary = range(-180, 180-Δx, length=lon_len)  
lat_boundary = range(-90, 90-Δy, length=lat_len)
```

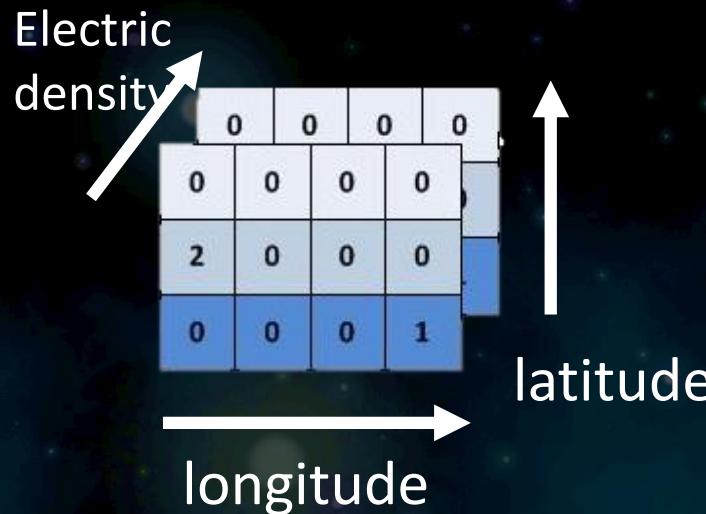
```
julia> collect(lon_boundary)  
4-element Array{Float64,1}:  
-180.0  
-90.0  
0.0  
90.0
```

```
julia> collect(lat_boundary)  
3-element Array{Float64,1}:  
-90.0  
-30.0  
30.0
```

```
x_index = findall(x->x<=-178, lon_boundary)[end]  
y_index = findall(x->x<= 85 , lat_boundary)[end]
```

```
julia> x_index = findall(x->x<=-178, lon_boundary)[end]  
1
```

```
julia> y_index = findall(x->x<= 85 , lat_boundary)[end]  
3
```



```
global pre_z = []
for i = 1:lon_len
    this = []
    for j = 1:lat_len
        append!(this,[[]])
    end
    append!(pre_z,[this])
end #end for
```

```
julia> pre_z
4-element Array{Any,1}:
 Any[Any[1000, 1000], Any[], Any[]]
 Any[Any[], Any[], Any[]]
 Any[Any[], Any[], Any[]]
 Any[Any[], Any[], Any[]]
```

```
append!(pre_z[x_index][y_index],n)
```

```
julia> append!(pre_z[1][1],1000)
```

```
global z = Array{Float64,2}(undef,lon_len,lat_len)
```

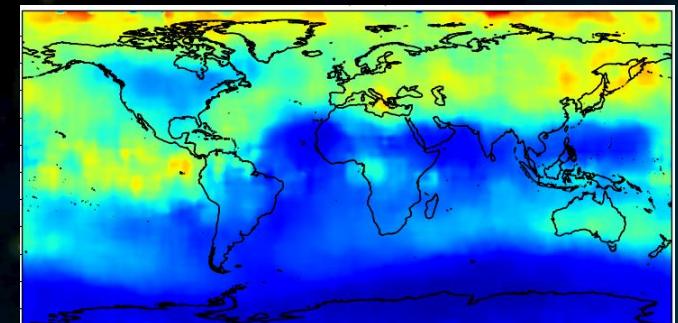
```
julia> size(pre_z[1][1])
(28,)
```

```
julia> (pre_z[1][1])
28-element Array{Any,1}
122684.25
134241.27
133235.88
144383.2
149585.03
156188.61
163862.14
173829.89
```

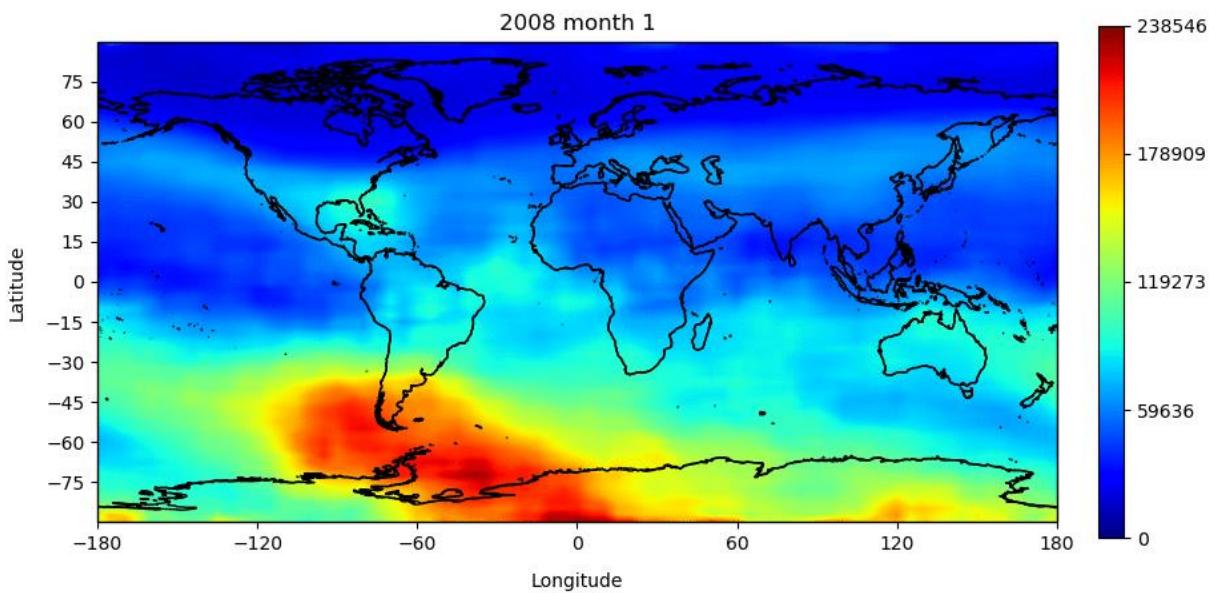
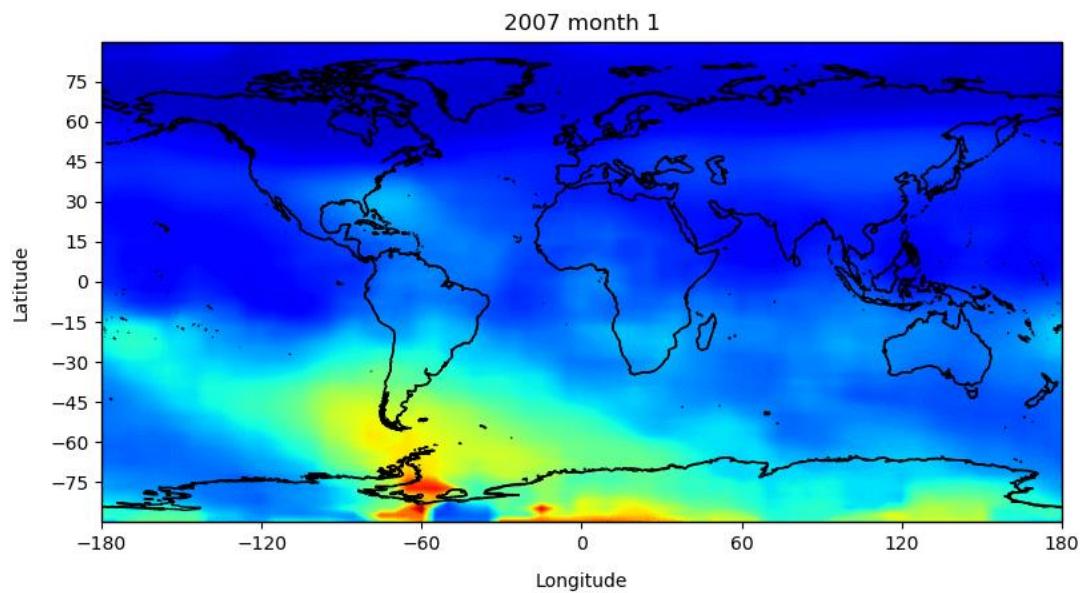
```
julia> z
4x3 Array{Float64,2}:
 1.57758e-315 1.57758e-315 1.57758e-315
 1.57758e-315 1.57758e-315 1.57758e-315
 1.57758e-315 1.57758e-315 1.57758e-315
 1.57758e-315 1.57758e-315 2.122e-314
```

```
for i = 1:lon_len
    for j = 1:lat_len
        z[i,j] = median(pre_z[i][j])
    end
end
```

contourf

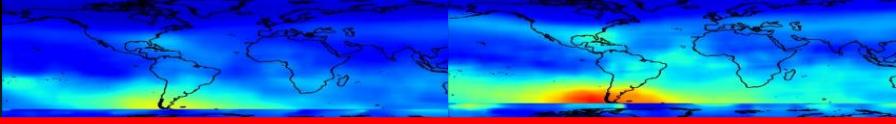


Month variation

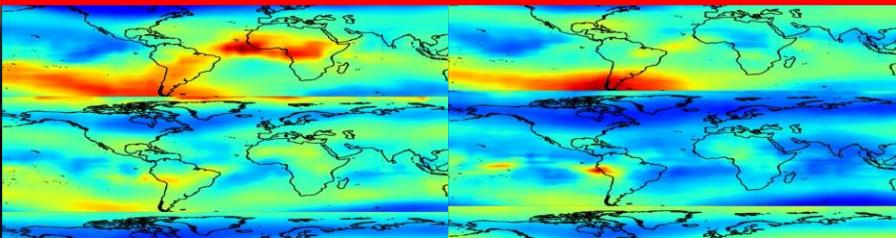


Time : (0~7) Height : 250~400

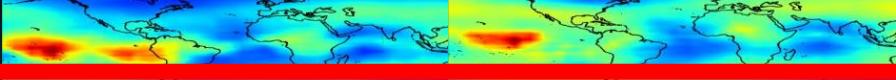
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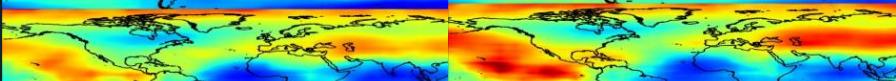
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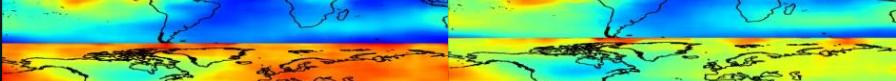
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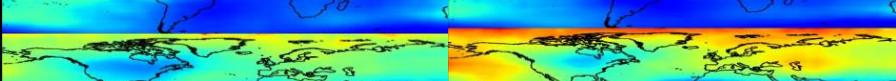
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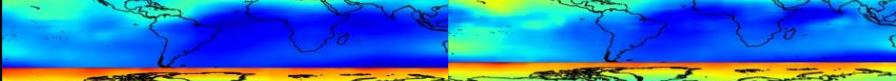
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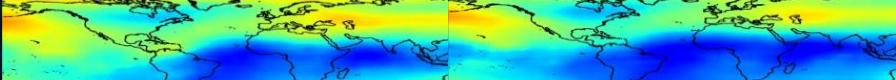
6



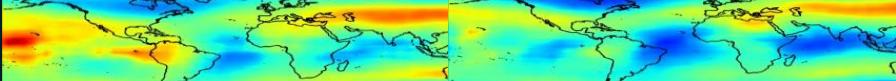
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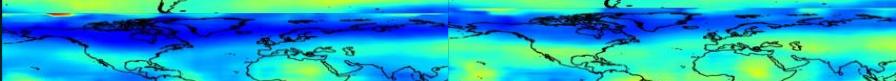
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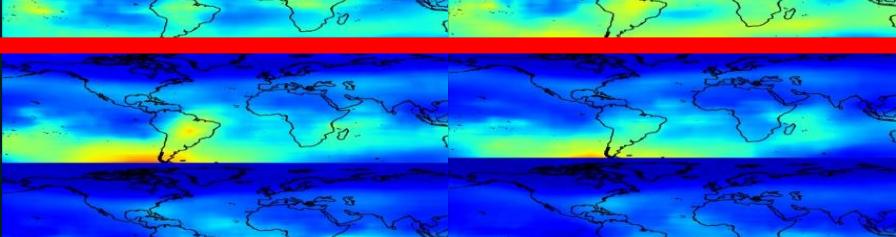
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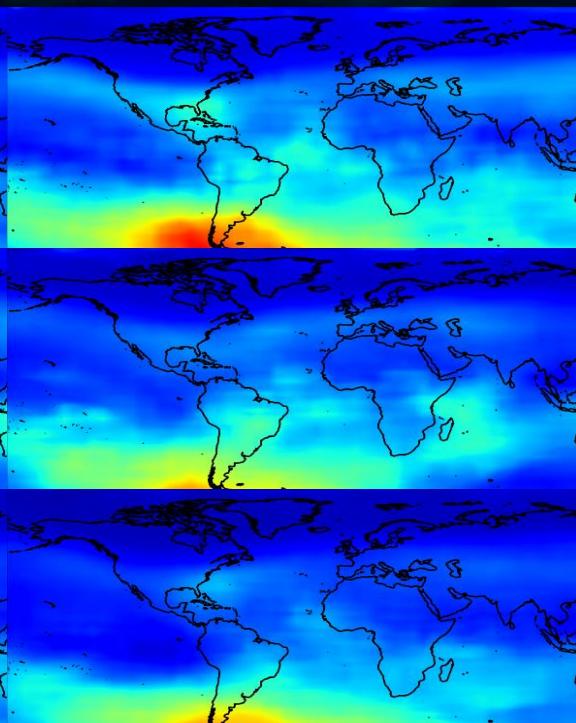
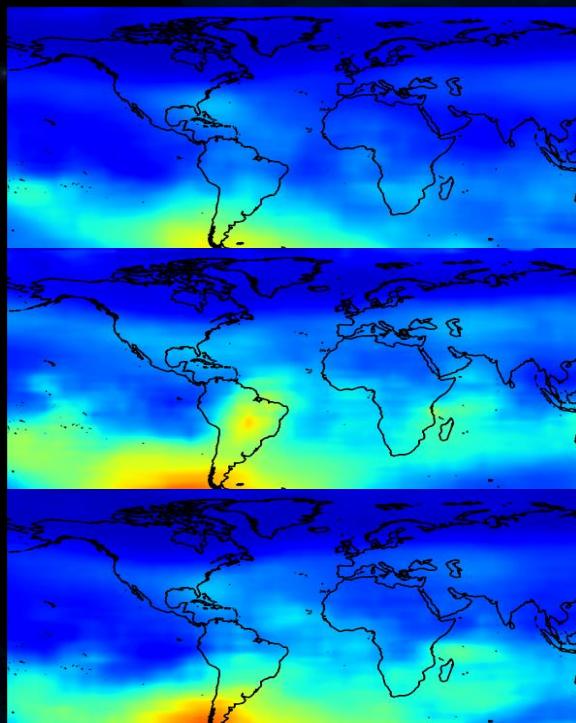
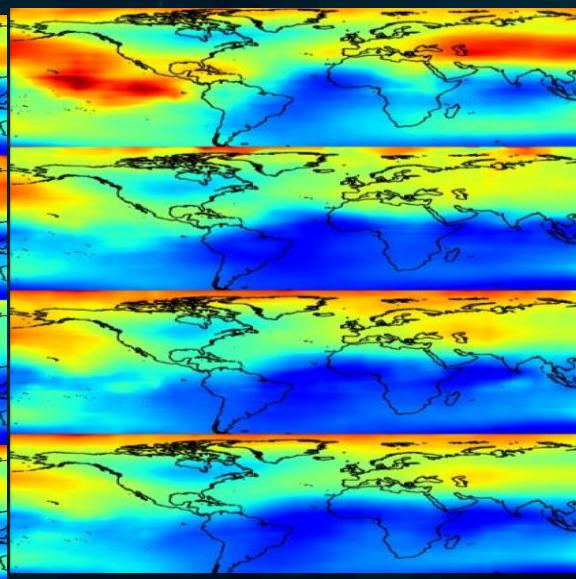
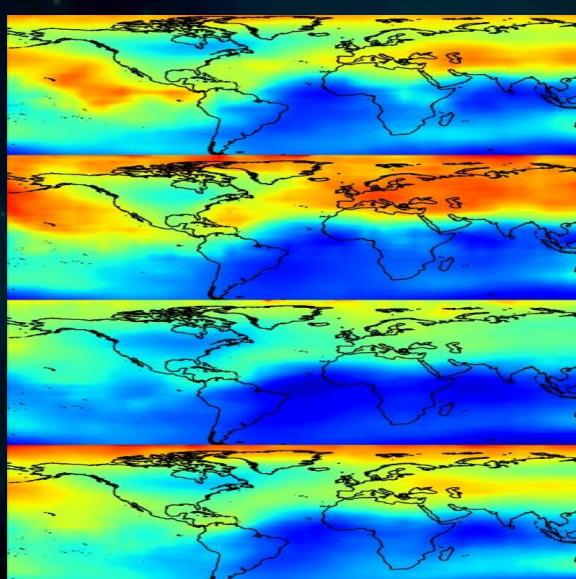
10



11



12

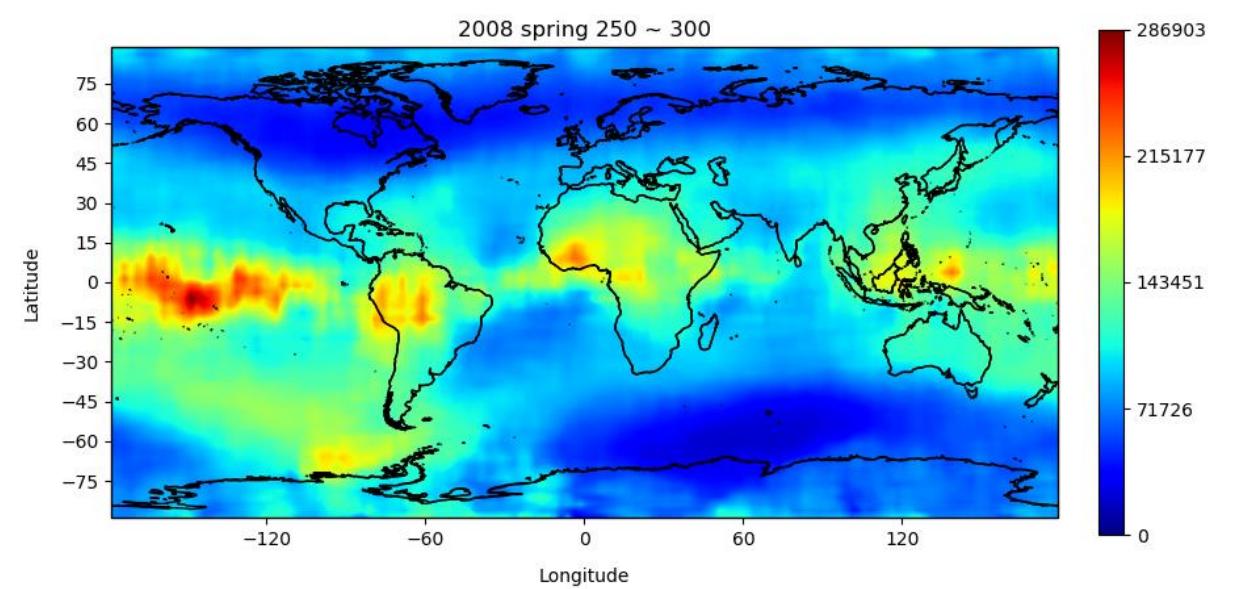
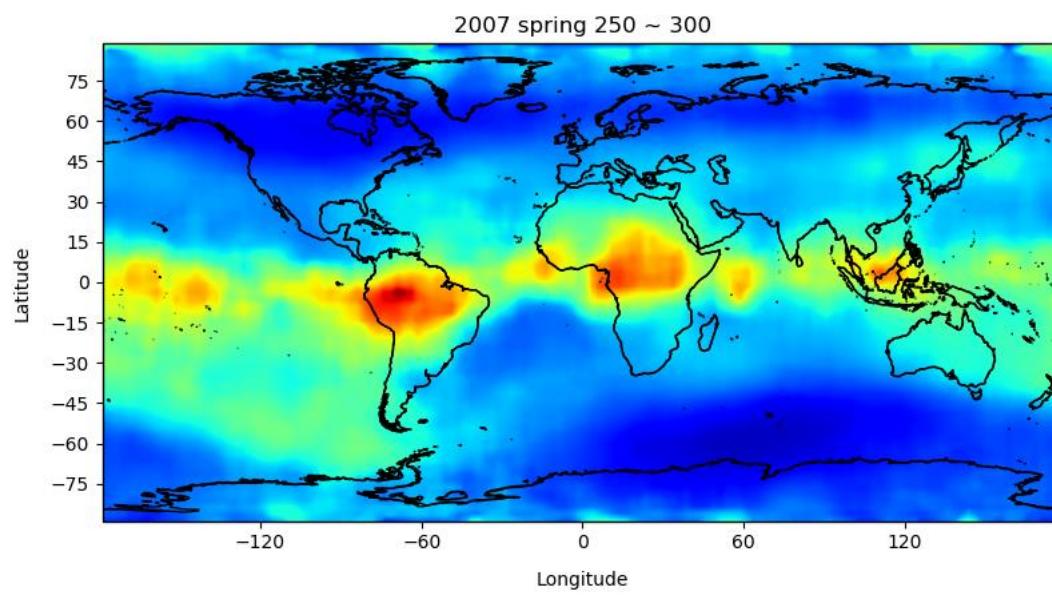


Four seasons ion density distribution

Taking before and after 45 days

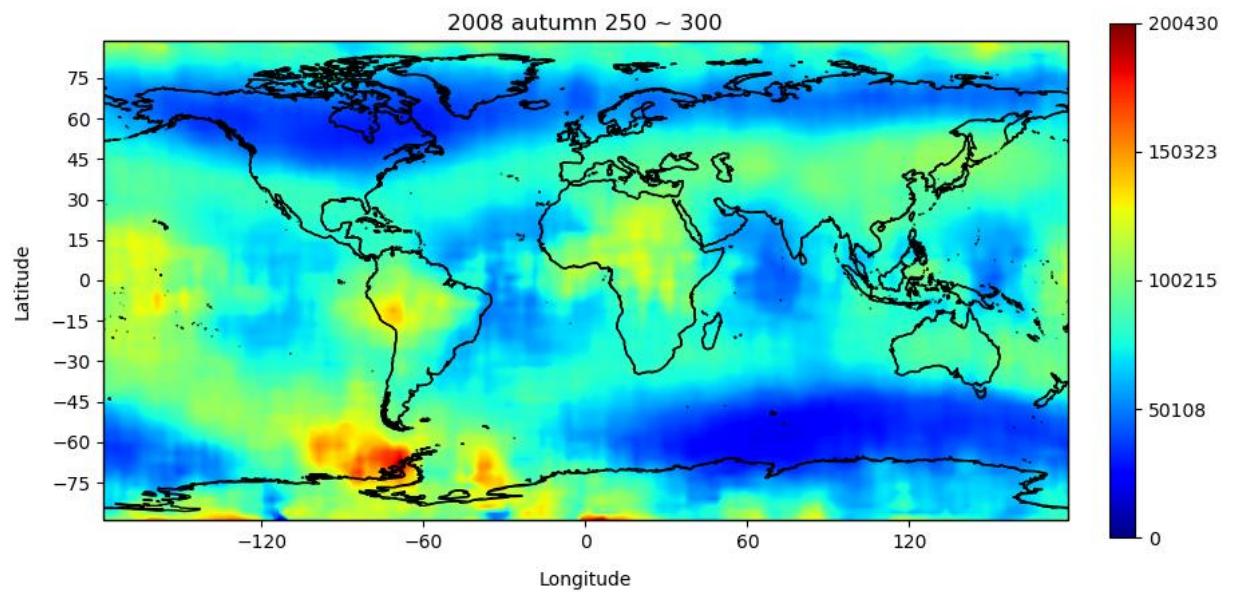
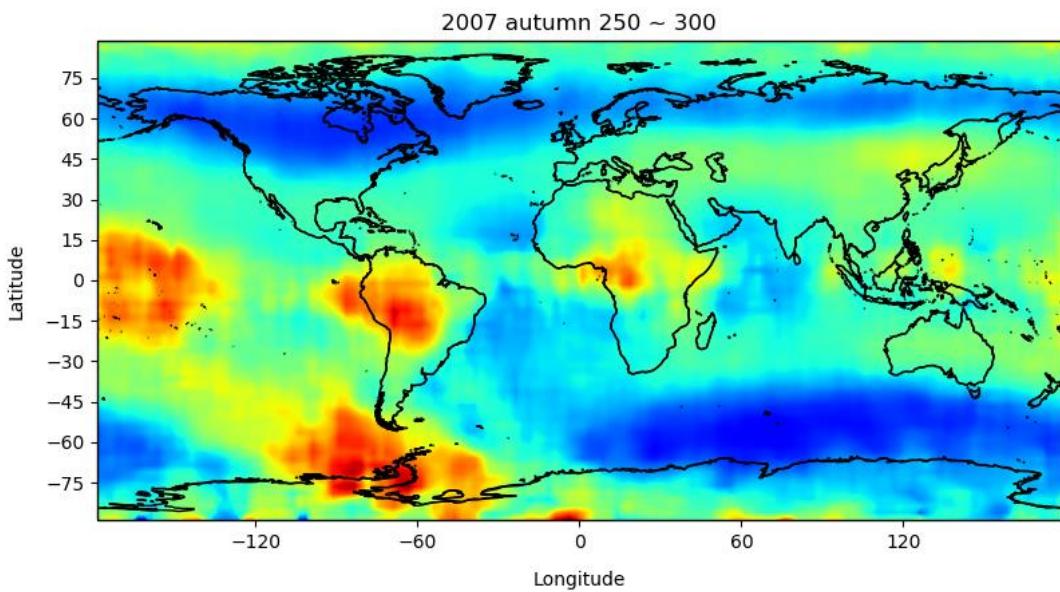
- *march equinox* 3/21 DAY 36 ~ 127
- *june solstice* 6/21 DAY 128 ~ 219
- *september equinox* 9/21 DAY 220 ~ 311
- *December solstice* 12/21 DAY 311 ~ 365 + DAY 1~33

March equinox



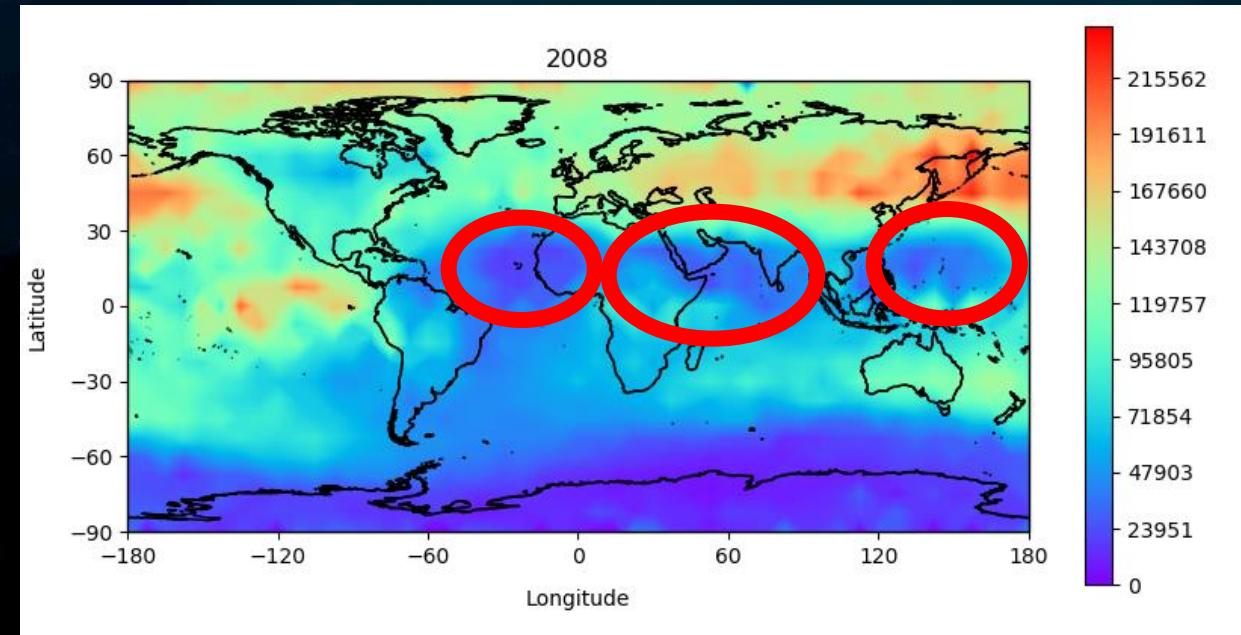
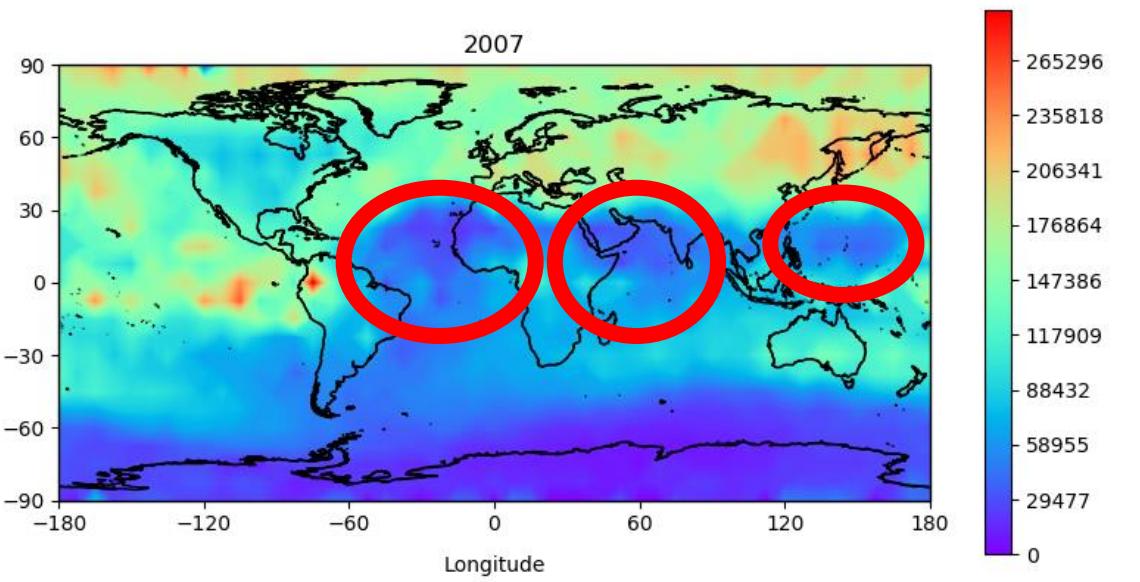
Time : (23,0,1) Height : 250~300

September equinox



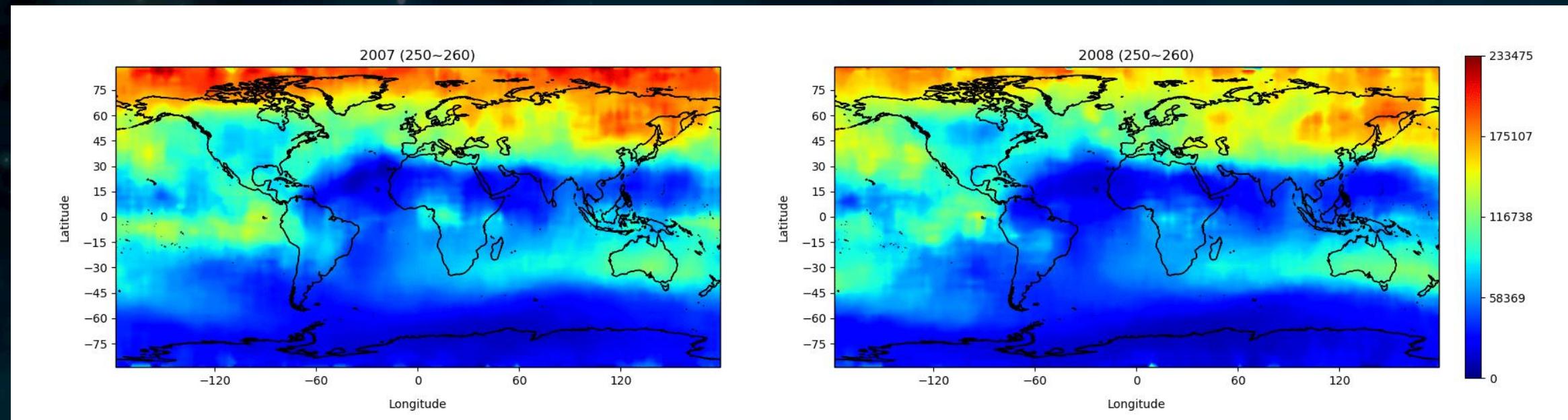
Time : (23,0,1) Height : 250~300

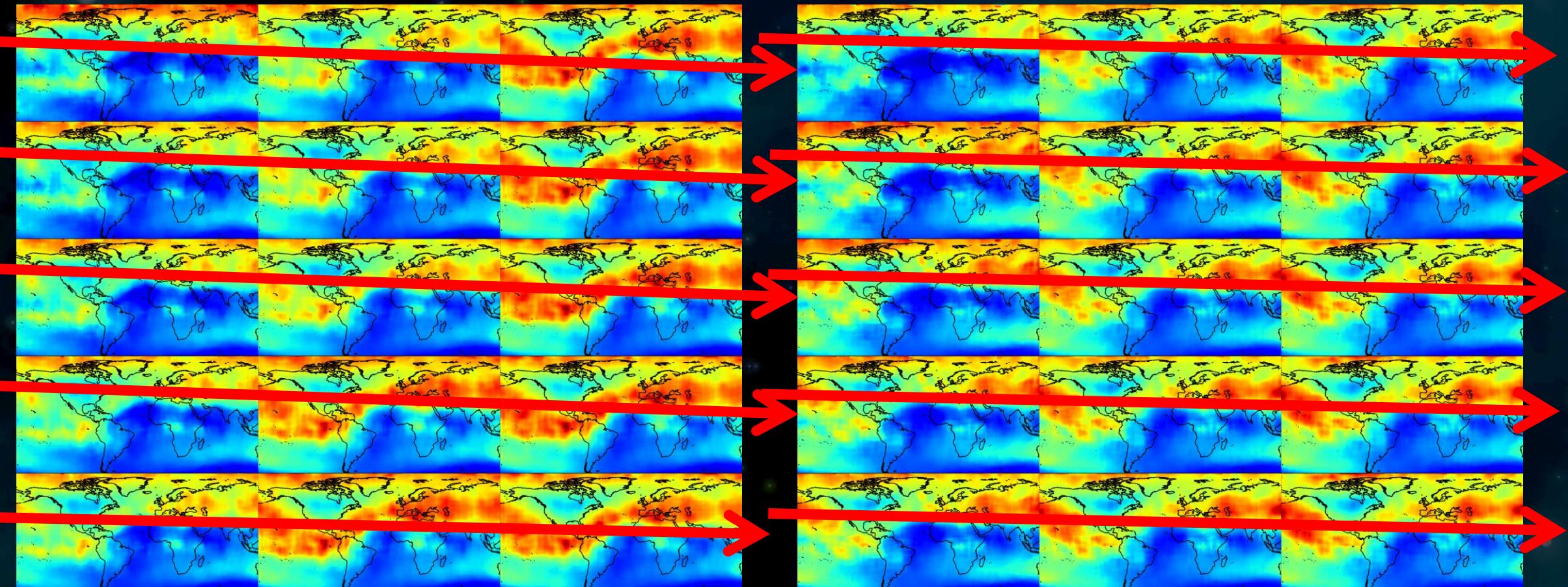
June solstice



Time : (23,0,1) Height : 250~300

altitudinal variation(northorn Summer)



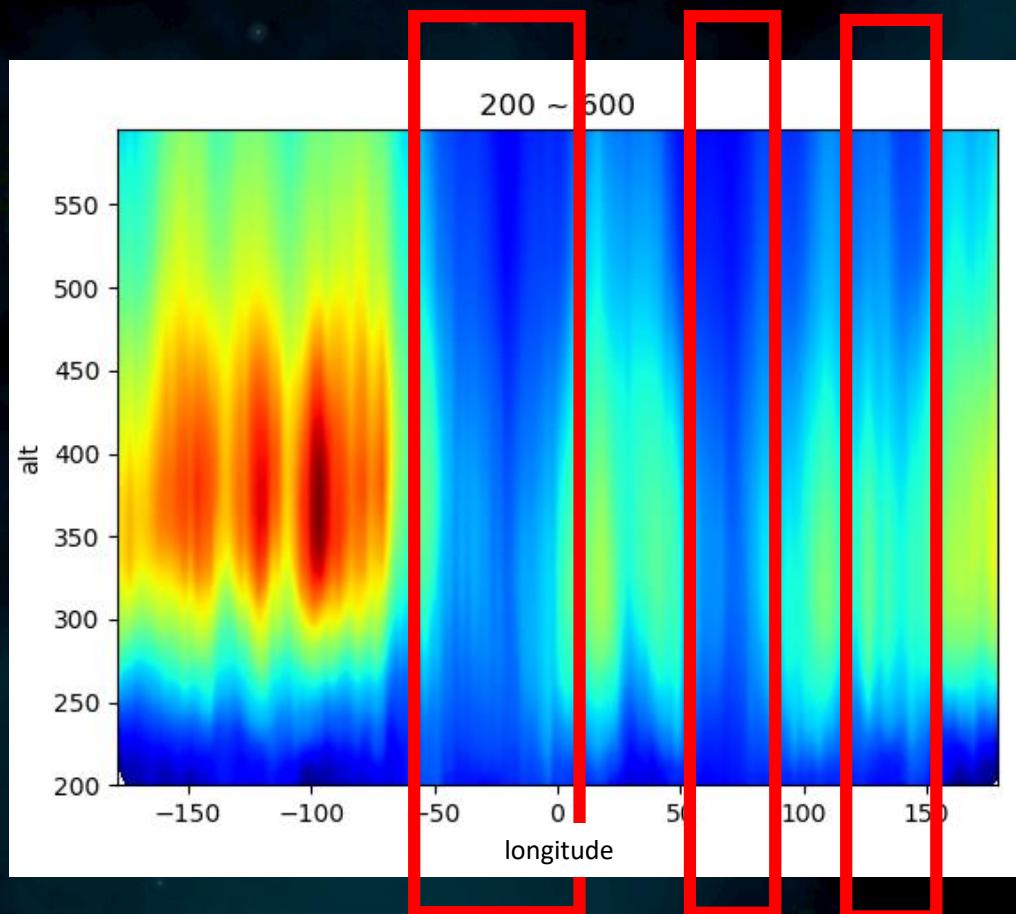


2007

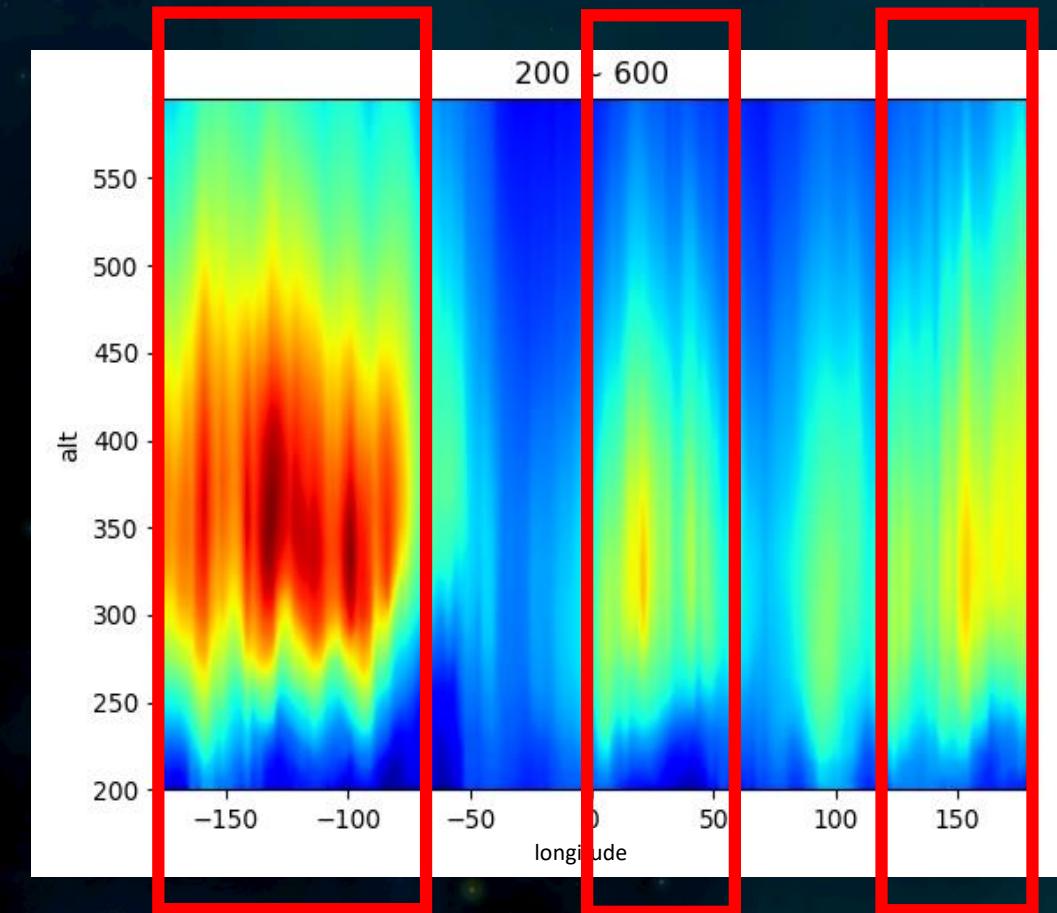
2008



alt – longitude Plot

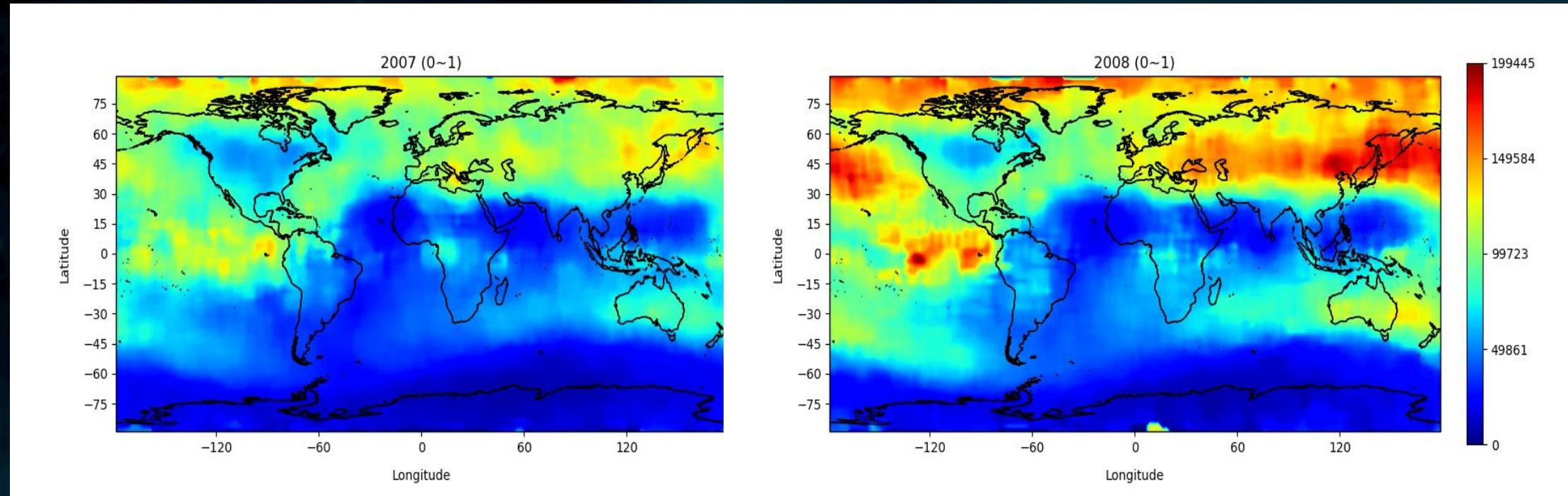


2007

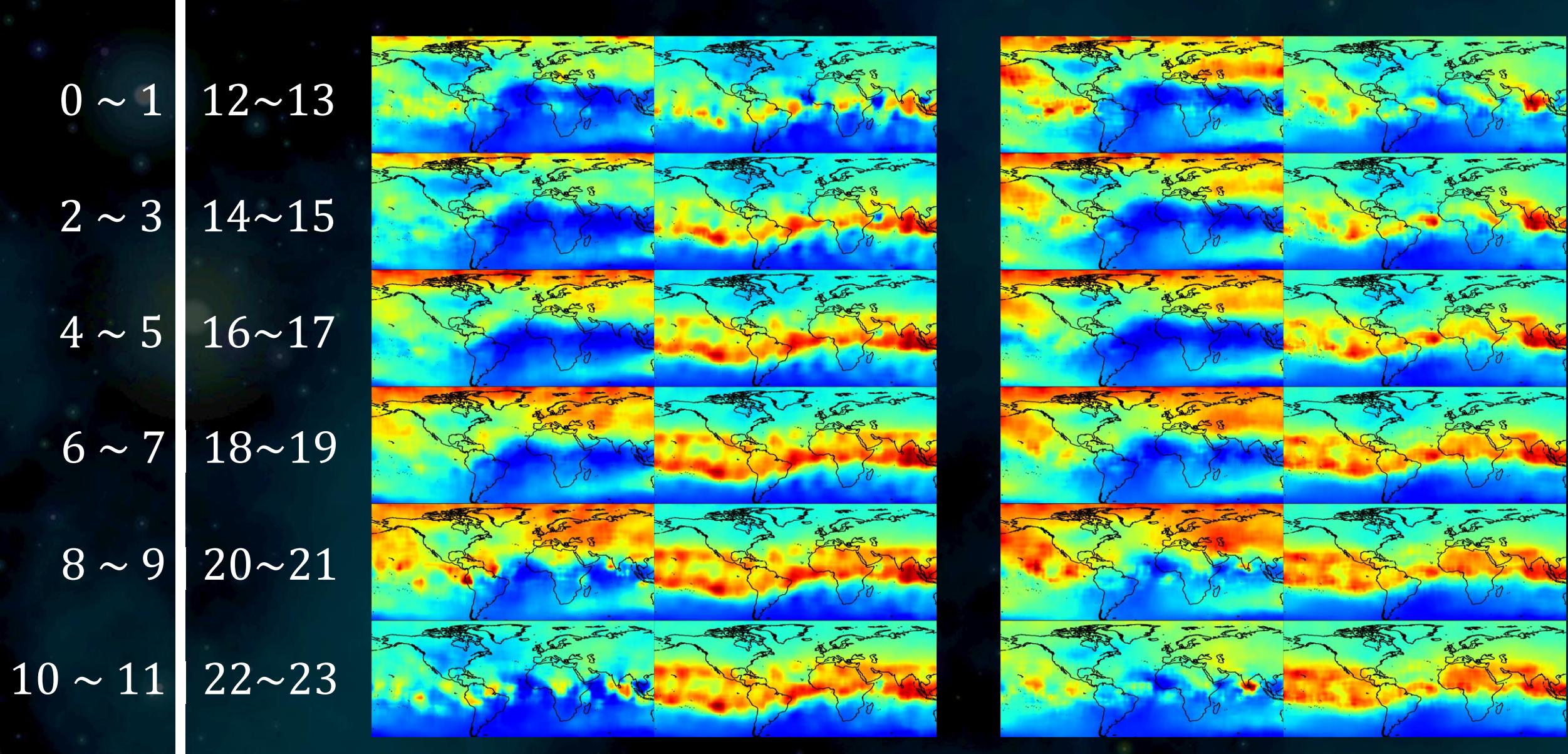


2008

One day Variety



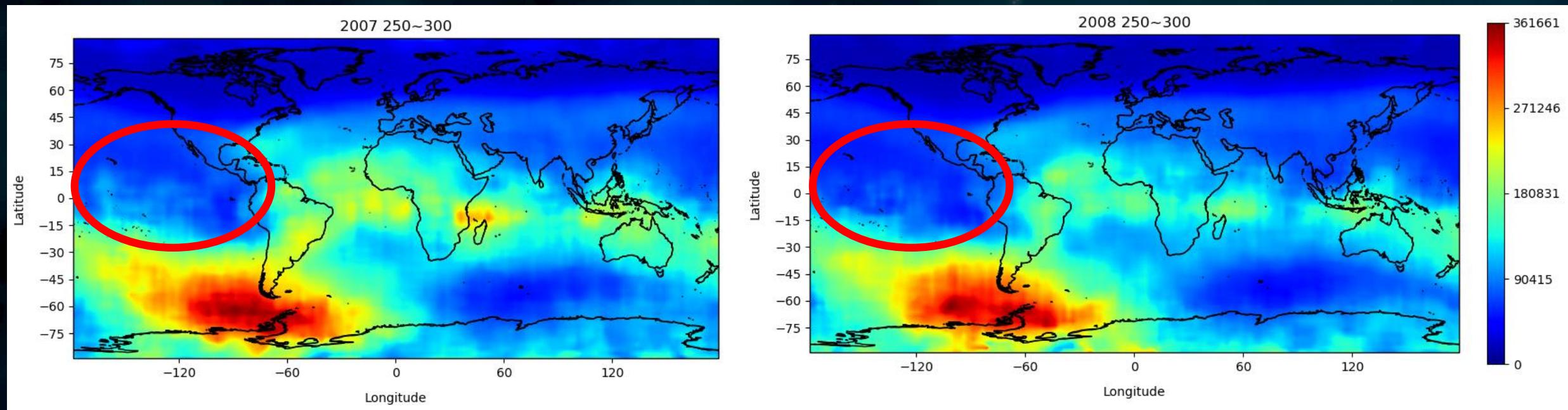
Season : summer Height : 250~300



2007

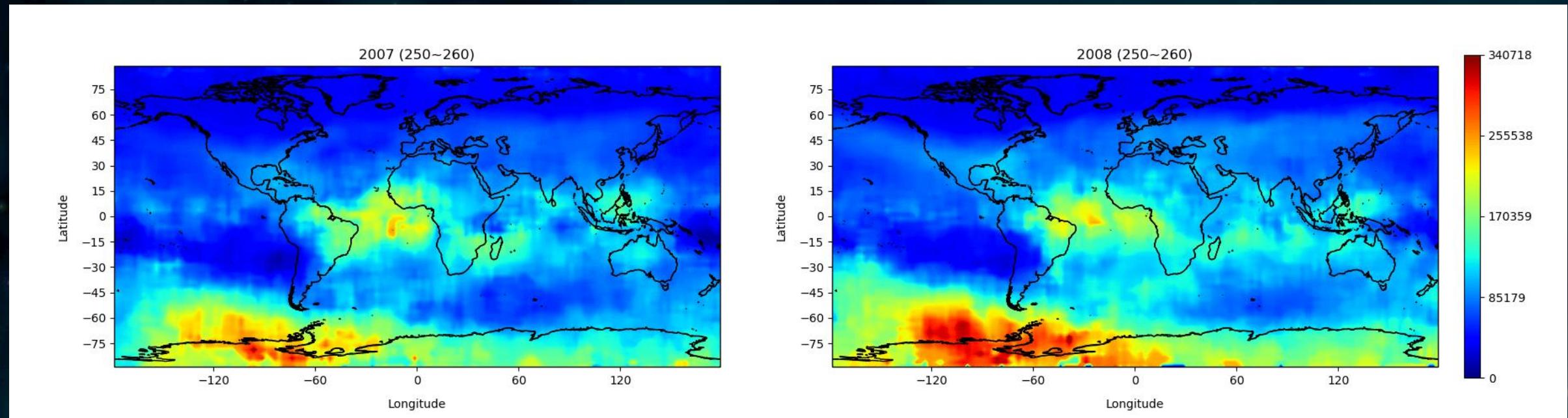
2008

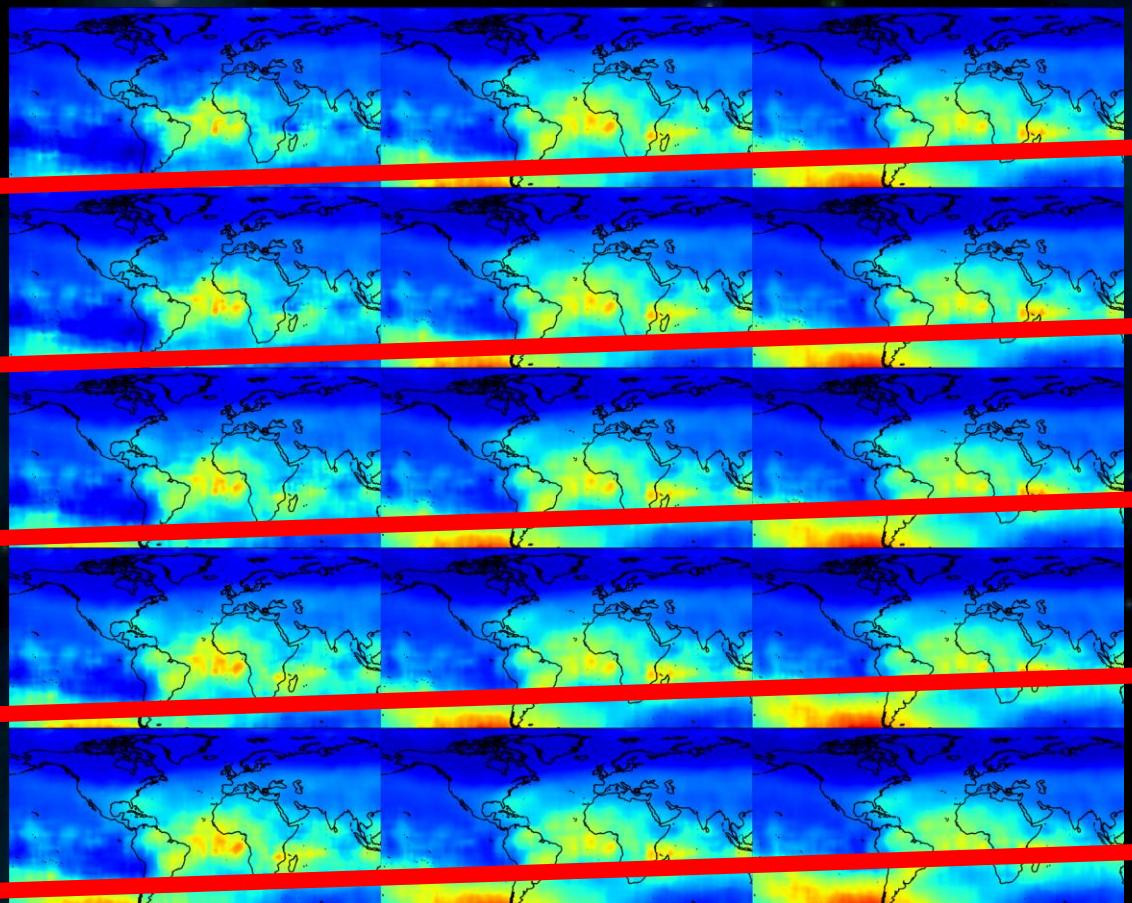
December solstice



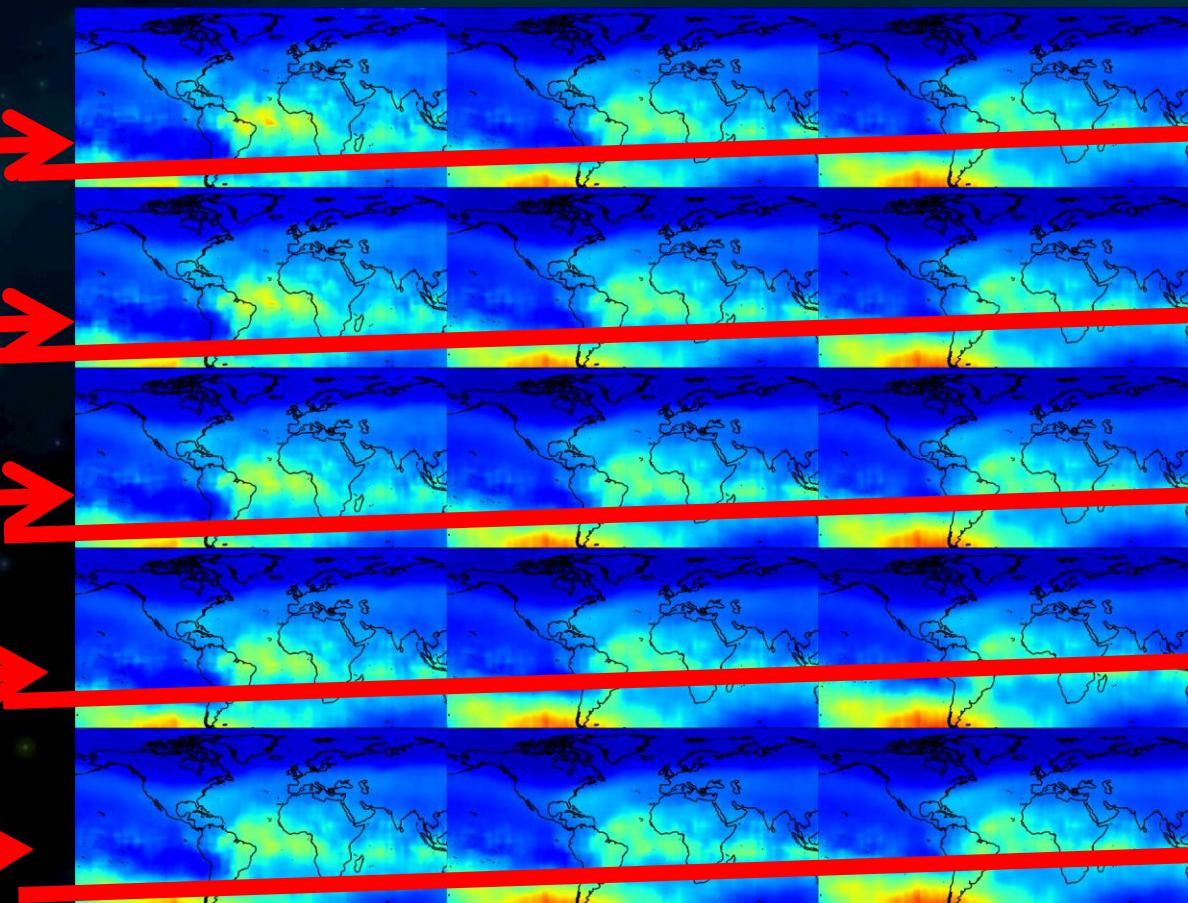
Time : (23,0,1) Height : 250 ~ 300

altituinal variation(Southorn Summer)





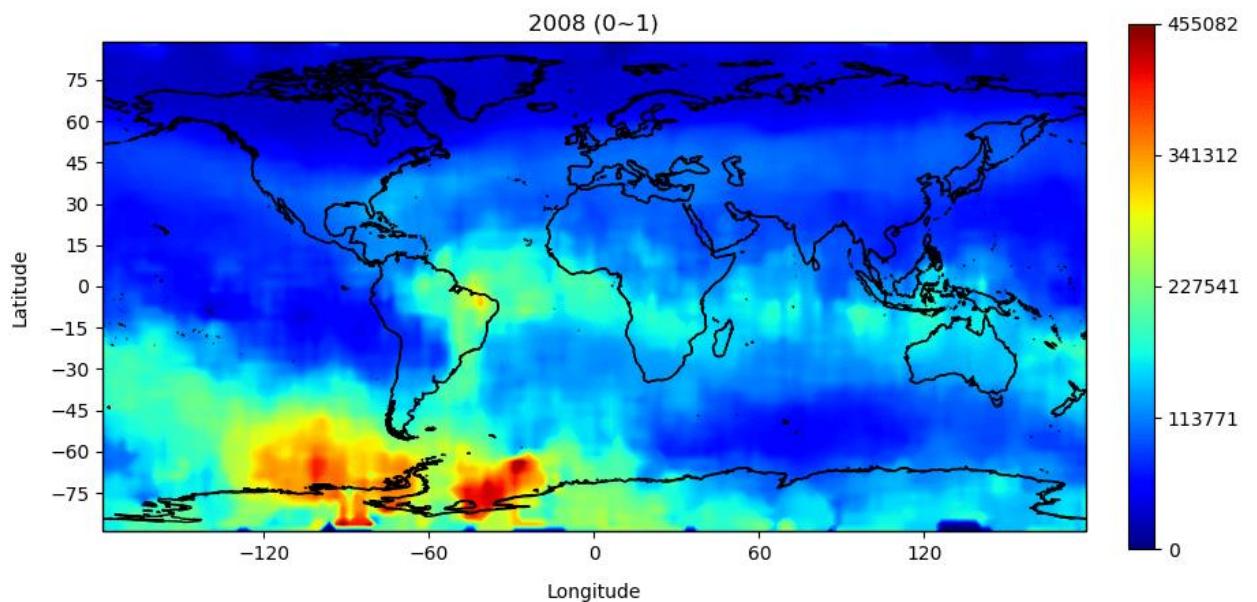
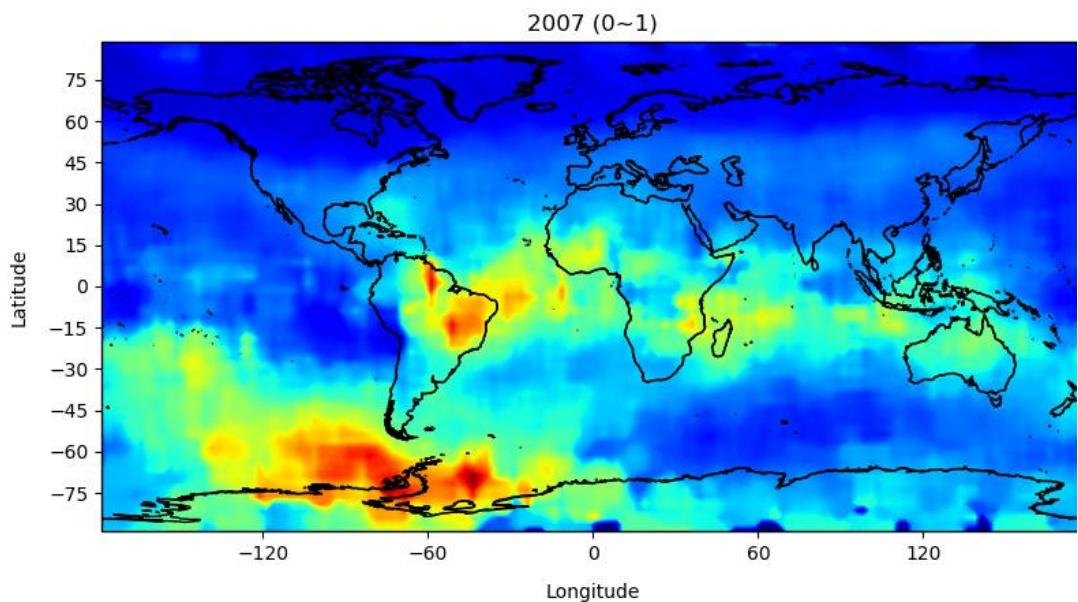
2007

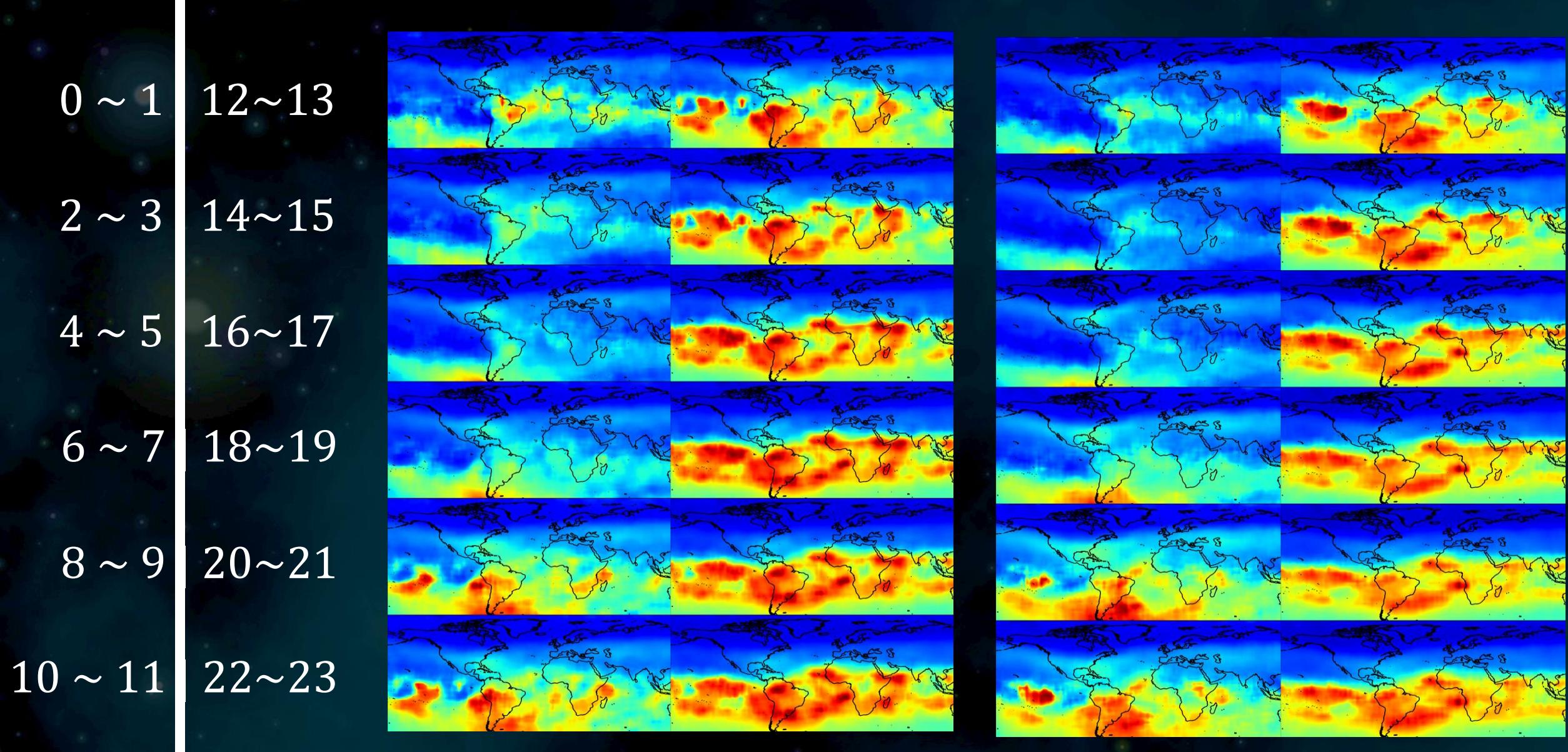


2008



One day variety





2007

2008

Conclusions

- PDB distributed in the **North Atlantic, Indian Ocean, and Southeast Asia** in the northern summer.
- It is distributed in the **pacific ocean** in the southern summer.
- It appears at 0000 ~ 0900 LT and disappears during the day.
- As the altitude becomes higher, the PDB will approach the equator.

Reference

- https://irsl.ss.ncu.edu.tw/media/course/107107年第1學期中央大學高等太空科學/2018_ASS_Ionosphere-converted.pdf



小問題

- Q. 在剛剛的簡報中，在背景有出現一些自轉的行星，請依照它們的前後順序講出來。
- A. 太陽 > 地球 > 木星 > 水星 > 火星。
- Q. 在上面其中一頁中，有一顆旋轉的UFO，上面有數個大燈，請問是幾顆？
- A. 3顆