# Categorizing of GPS TEC Data for Task 2 - Ionospheric Analysis

Jong-Kyun Chung

Korea Astronomy & Space Science Institute

Asia-Pacific Ionospheric Sector

- **The Asia-Pacific sector has middle and low ionospheric status and northern and southern hemispheres.**

- **Ionosphere has similar reactions according to solar and geomagnetic activities, and different characteristics according to chemical reaction with thermospheric neutral components (O, O_2, N_2) and neutral wind in different regions.**
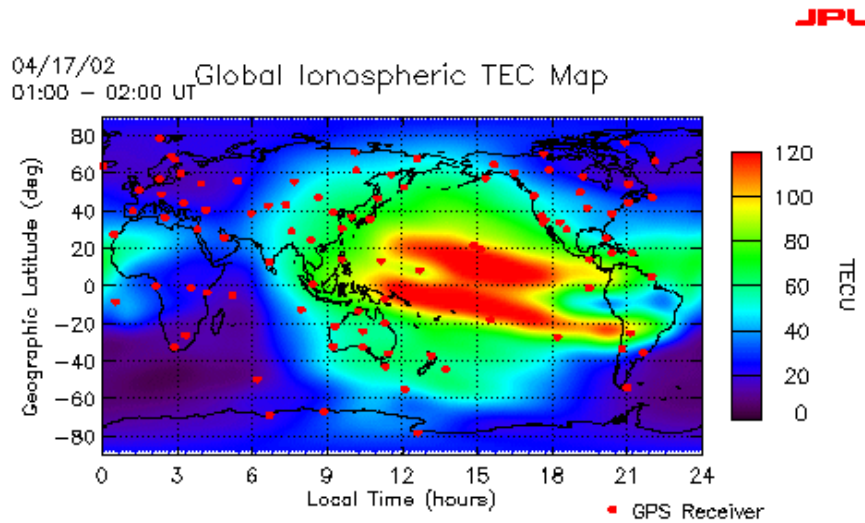
GPS TEC GIM Model (JPL)

GPS TEC Analysis

- **It is needed that long-term GPS TEC above 11 years cover the full solar cycle.**

- **Measurement time of GPS TEC is local noon time.**

- **GPS TEC can be analyzed with below criteria on solar fluxes according to geomagnetic activities by month or season.**

Solar minimum :   F10.7 $<$ 100
Solar Moderate : 100 $\leq$ F10.7 $<$ 200
Solar Maximum :   F10.7 $\geq$ 200

Geomagnetic Quiet   :   Kp $<$ 3
Geomagnetic Moderate   : 3 $\leq$ Kp $<$ 5
Geomagnetic Disturbance :   Kp $\geq$ 5

9 Criteria for GPS TEC Analysis

With Month or Season on noon time (12~01 hour)

Low Solar Activity Geomagnetic Quiet	Low Solar Activity Geomagnetic Moderate	Low Solar Activity Geomagnetic Disturbance
Mid Solar Activity Geomagnetic Quiet	Mid Solar Activity Geomagnetic Moderate	Mid Solar Activity Geomagnetic Disturbance
High Solar Activity Geomagnetic Quiet	High Solar Activity Geomagnetic Moderate	High Solar Activity Geomagnetic Disturbance

4 Cases for GPS TEC Analysis

- **If temporal coverage of GPS TEC data is below or almost 11 years, 9 criteria can changed into 4 cases with season due to number of data**

Low Solar Condition : F10.7 $<$ 150
High Solar Condition : F10.7 $\geq$ 150

Geomagnetic Quiet   : Kp $<$ 3
Geomagnetic Disturbance : Kp $\geq$ 3

With Season on noon time (12~01 hour)

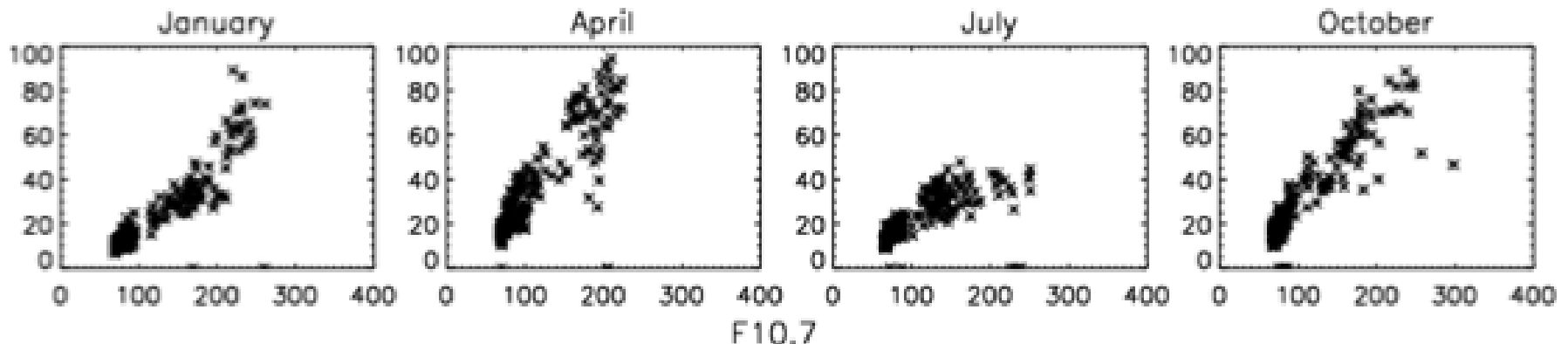| Low Solar Activity Geomagnetic Quiet	Low Solar Activity Geomagnetic Disturbance
High Solar Activity Geomagnetic Quiet	High Solar Acitivty Geomagnetic Disturbance

Correlation with Solar Activities

- **We can do three of correlation equation below**

  (1) **Linear correlation** : $y_{GPS\ TEC} = ax_{F10.7} + b$
  (2) **Quadratic correlation** : $y_{GPS\ TEC} = ax^2_{F10.7} + bx_{F10.7} + c$
  (3) **Saturation correlation**

- **Quadratic correlation is good because eq. (2) is the same with (1) in case of $a \ll 0$ in eq. (2), and eq. (2) can represent saturation correlation in case of $a < 0$.**

- **So, Quadratic equation is good for GPS TEC correlation with solar activities.**

Thank you !