Variations in Heavy Ion Composition with Geomagnetic Activity and Season

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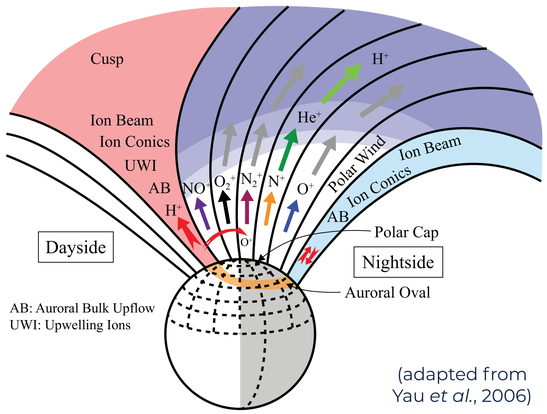
MOTIVATION

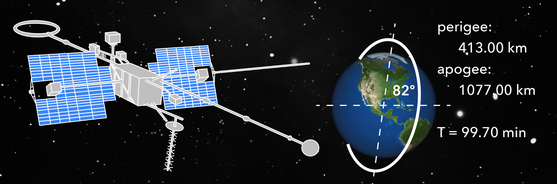
- Under various environmental conditions, such as solar activity, seasons, etc., the ion composition in the ionosphere may reflect the change.
- How does ion composition in the ionosphere vary with seasons?
- What is the response of ion composition during solar storms?
- Understanding the relation between these factors and heavy ion composition in the ionosphere provides us insight to heavy ion energization sources as well as the overall ionosphere–magnetosphere system.



(adapted from Yau *et al.*, 2006)

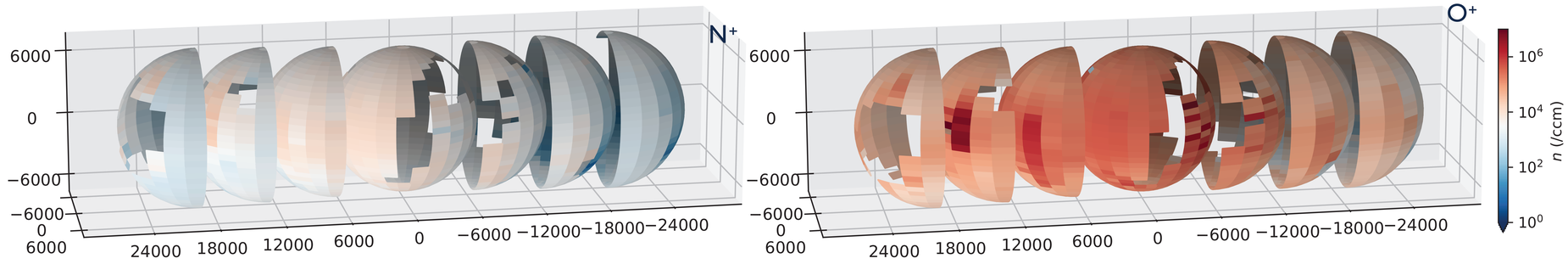
NASA's Orbiting Geophysical Observatory(OGO) 6

Operation : June 5, 1969 — March 1972
Purpose : study high-altitude plasma parameters (26 experiments)
BIMS : one of the first & few instruments to measure densities for 7 ion species



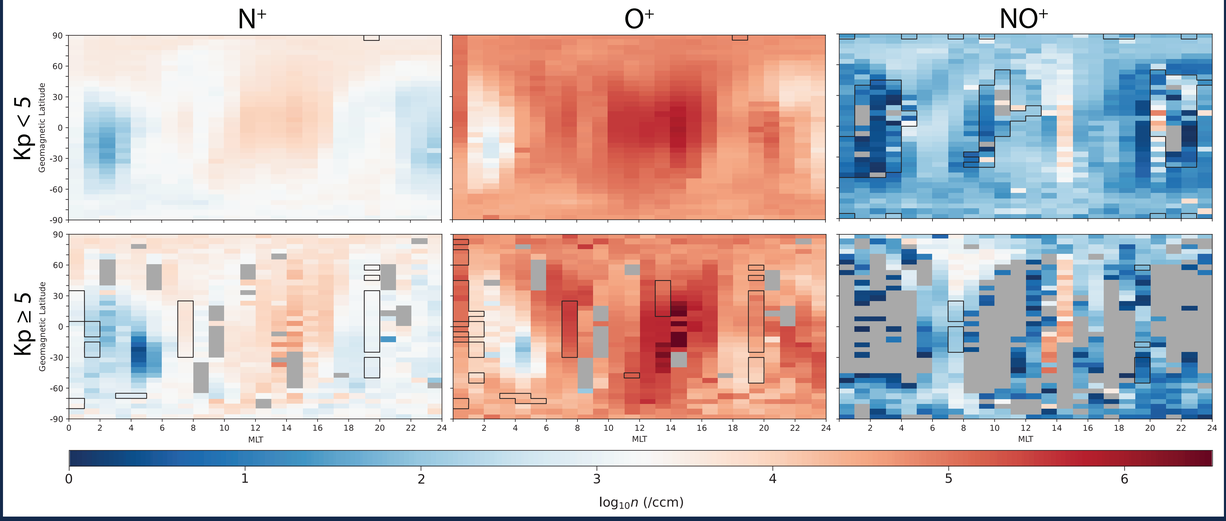
Ions : H^+, He^+, N^+, O^+, N_2^+, NO^+, O_2^+
Duration : June 12, 1969 — December 31, 1970
Mass Range : 1 — 45 amu
Resolution: 1 in 20 amu & 2° in latitude
Frequency: every 36.8 s
Sensitivity : 1.0×10^6 — 10 ions/ccm

HEMISPHERIC ASYMMETRY



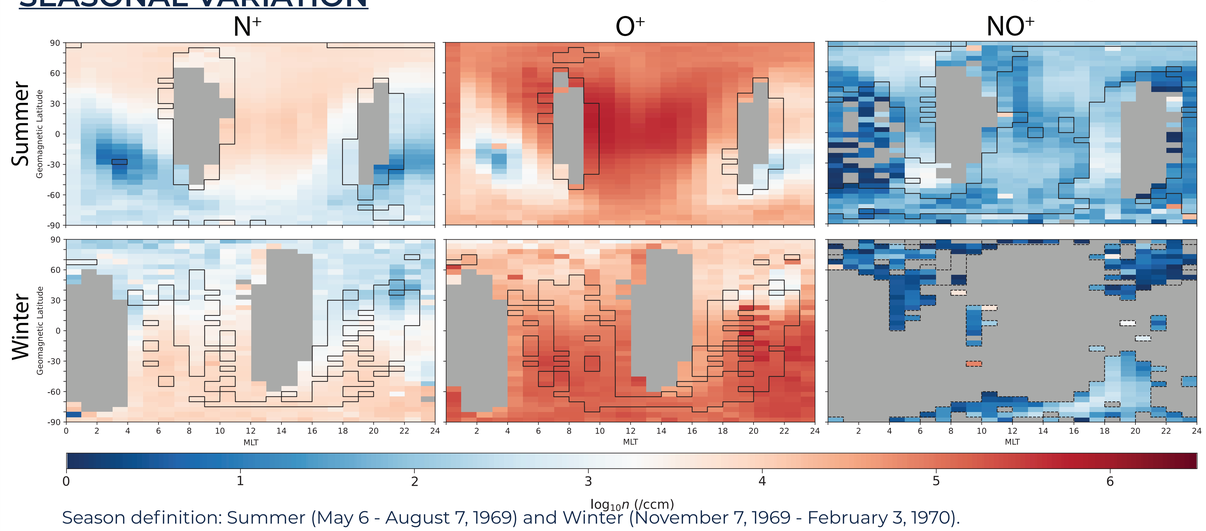
GEOMAGNETIC-ACTIVITY VARIATION

boxed regions: ≥ 25 passes; gray regions: no data



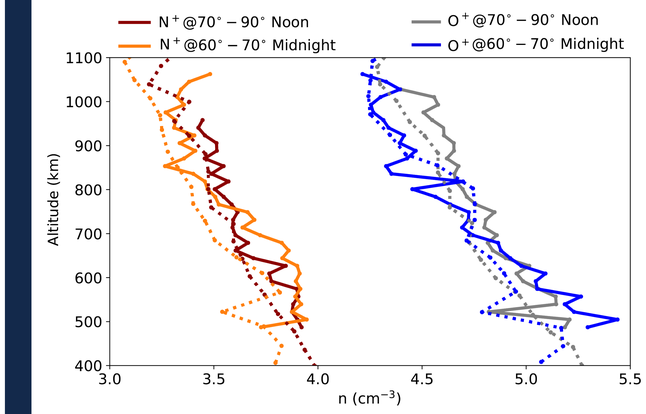
SEASONAL VARIATION

boxed regions: ≥ 25 passes; gray regions: no data



Season definition: Summer (May 6 - August 7, 1969) and Winter (November 7, 1969 - February 3, 1970).

DATA VALIDATION



n(N+) are consistently 1 order of magnitude less than n(O+) during the summer, validated with Craven et al., 1993 (dotted line).

CONCLUSIONS

- **Hemispheric asymmetry:**
  - $n(N^+)$ and $n(O^+)$ are higher in the northern than the southern hemisphere.
- **Geomagnetic-activity variation**
  - $n(N^+)$, $n(O^+)$ and $n(NO^+)$ are observed to increase ~1 order of magnitude during storm times.
  - Measurements for NO^+ are sparse, but it is evident that the $n(NO^+)$ perform strong day-night asymmetry at all times.
- **Seasonal variation**
  - N+/O+ density ratio shows the larger variation during winter than summer seasons.

ACKNOWLEDGMENTS

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