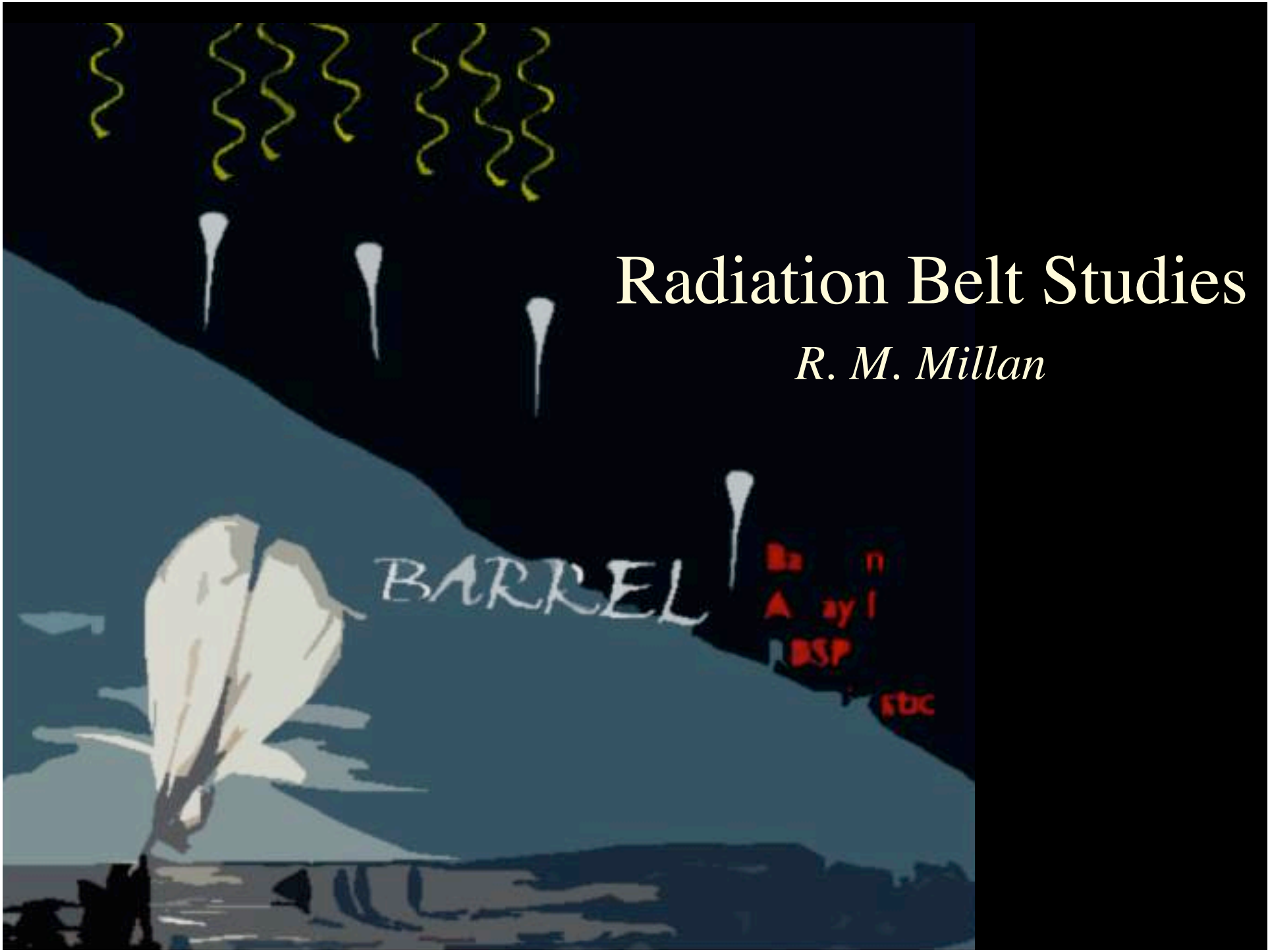
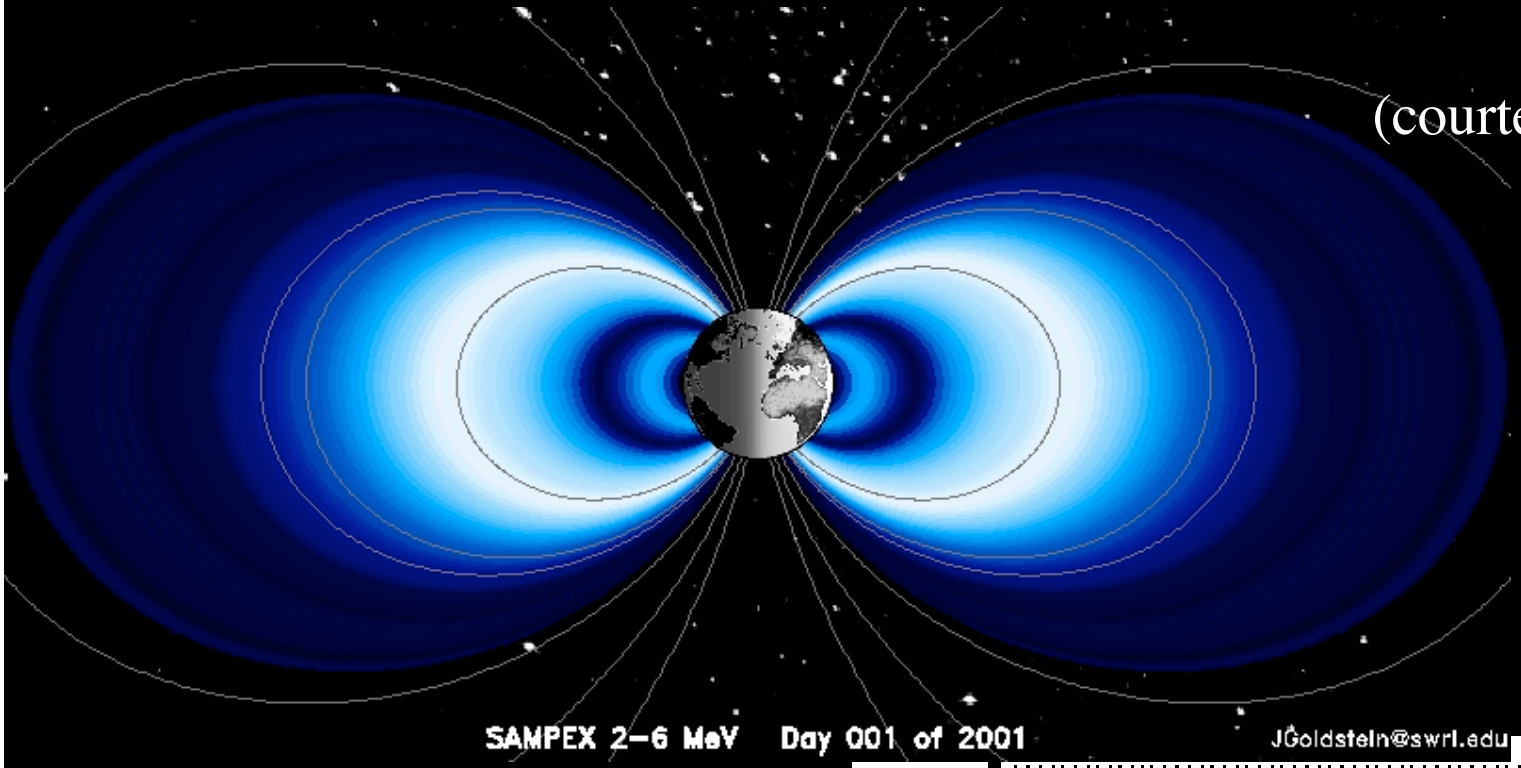
Radiation Belt Studies

R. M. Millan

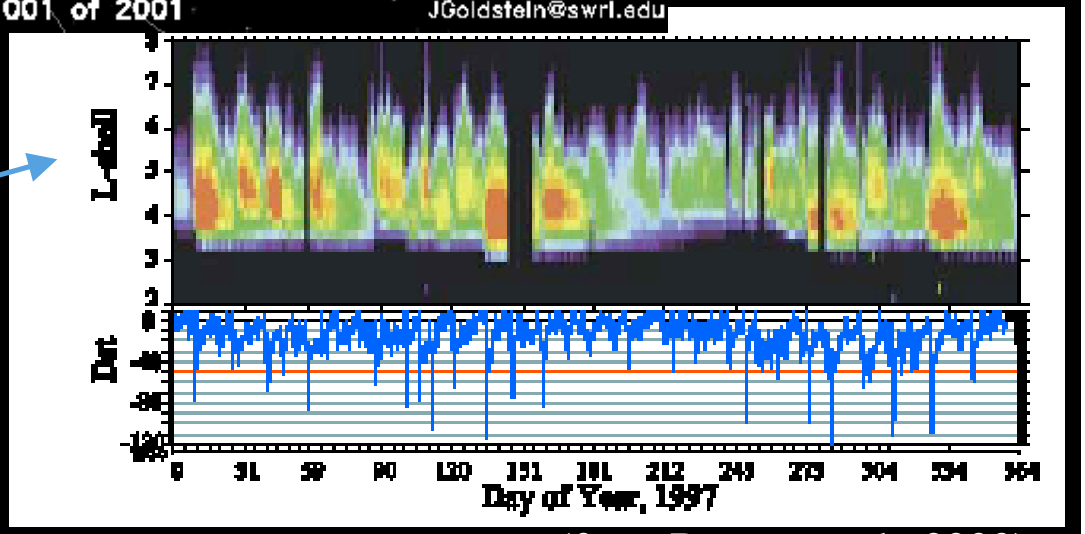


Relativistic Electron Variability

(courtesy J. Goldstein)



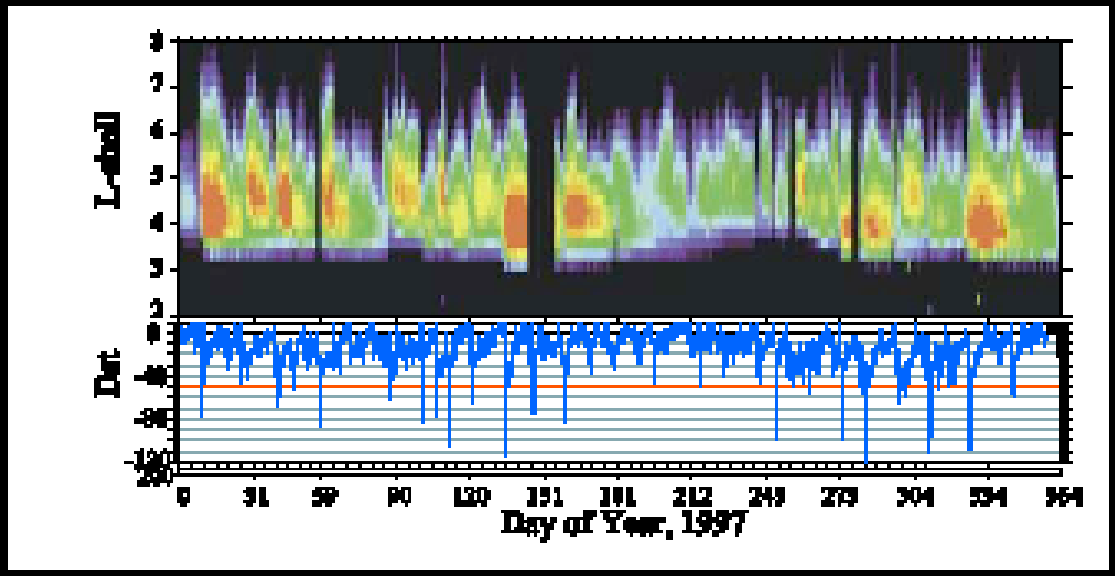
1.2-2.4 MeV electron flux
for Year 1997 (Polar s/c)



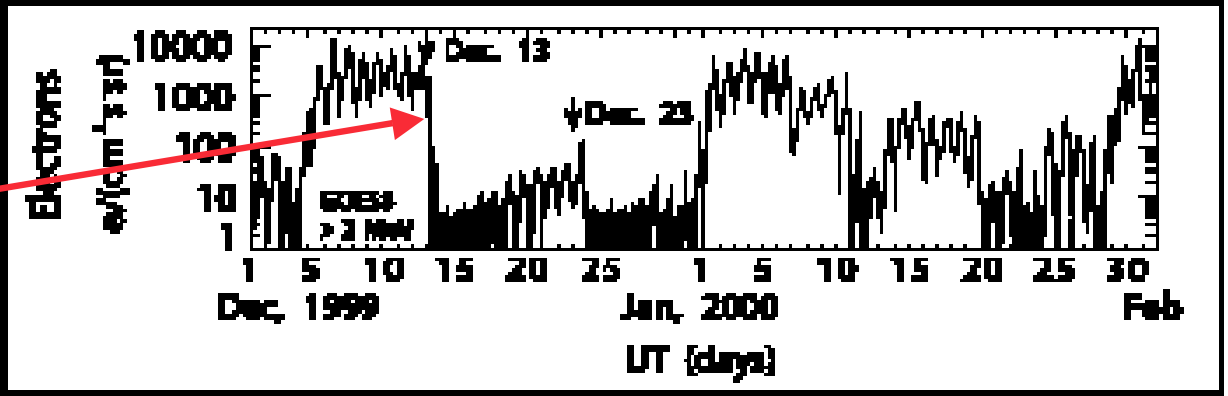
(from Reeves et al., 2003)

Striking a Balance

- Variability is controlled by a balance between acceleration and loss



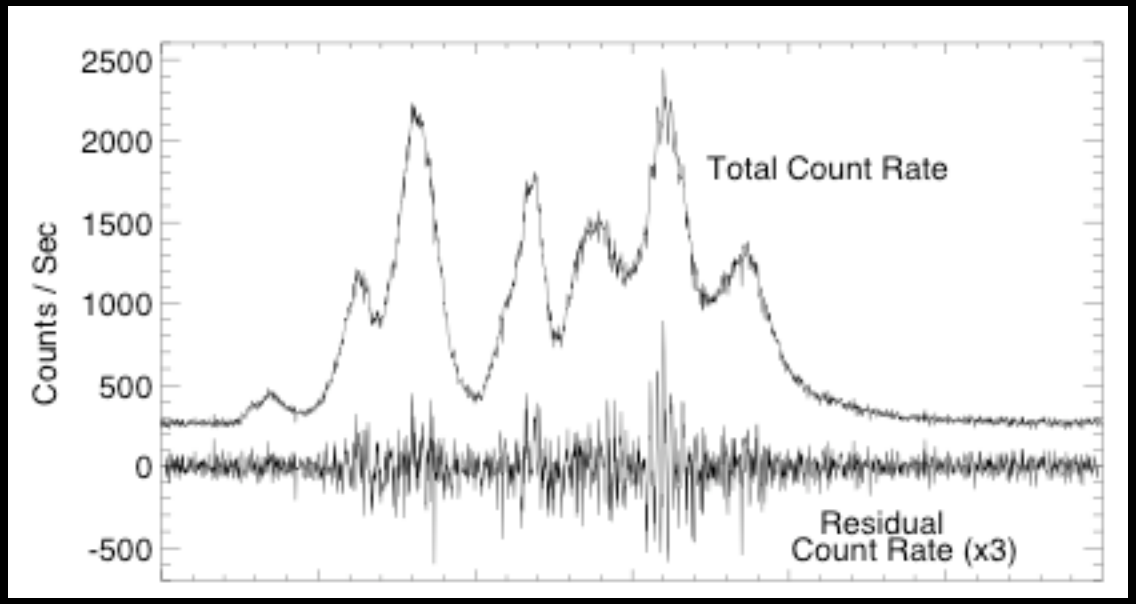
Depletions in >2 MeV electron flux measured by GOES

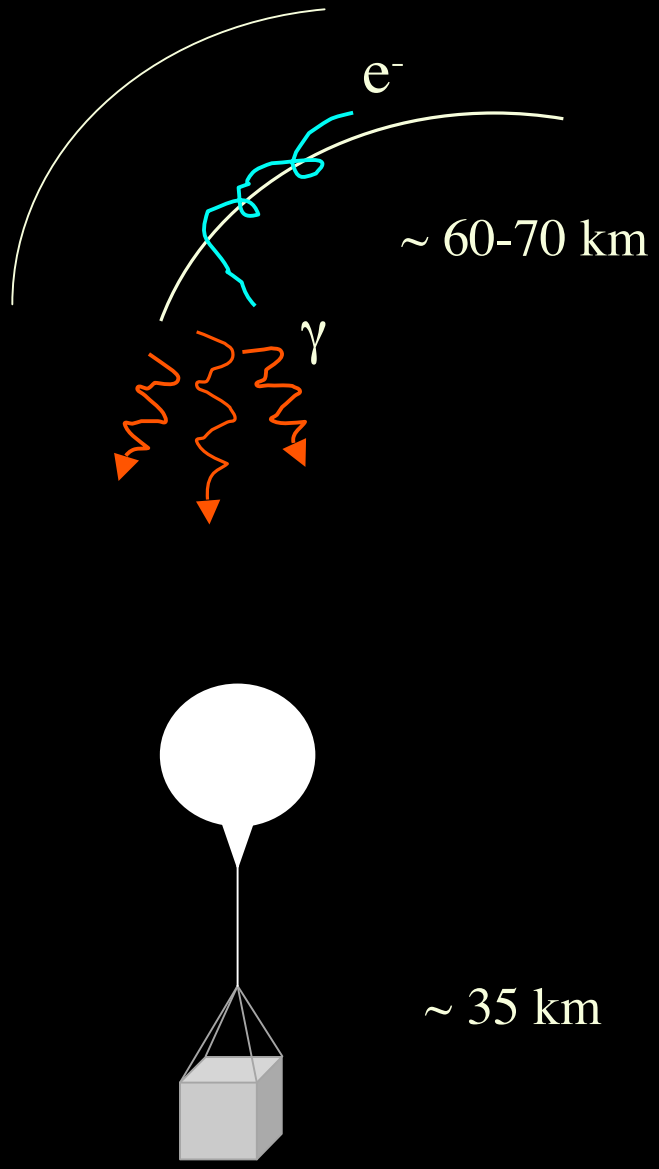


(from Onsager et al., 2002)

Balloon Observations of Precipitation

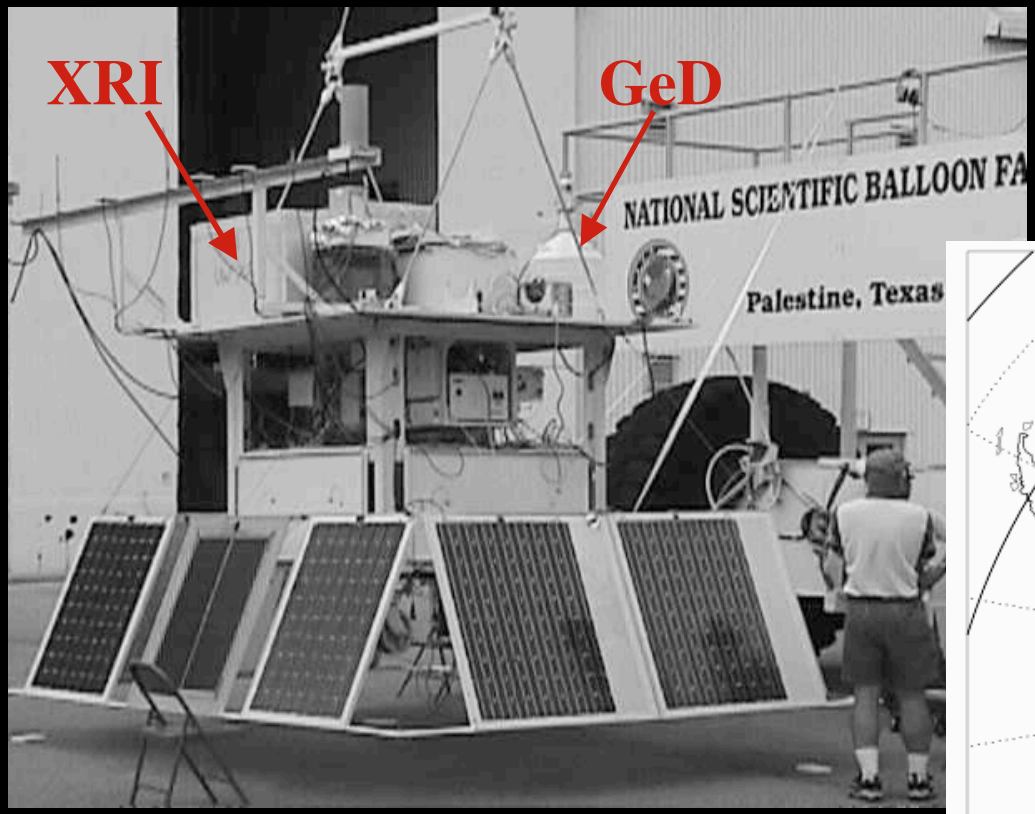
- Bremsstrahlung X-rays are produced as precipitating electrons collide with atmospheric neutrals

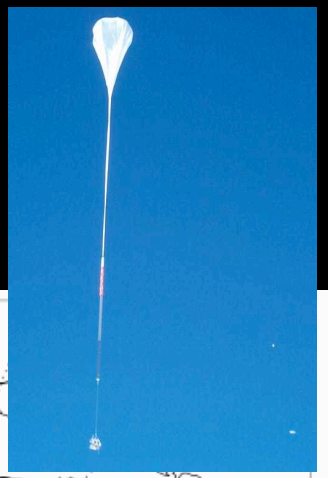


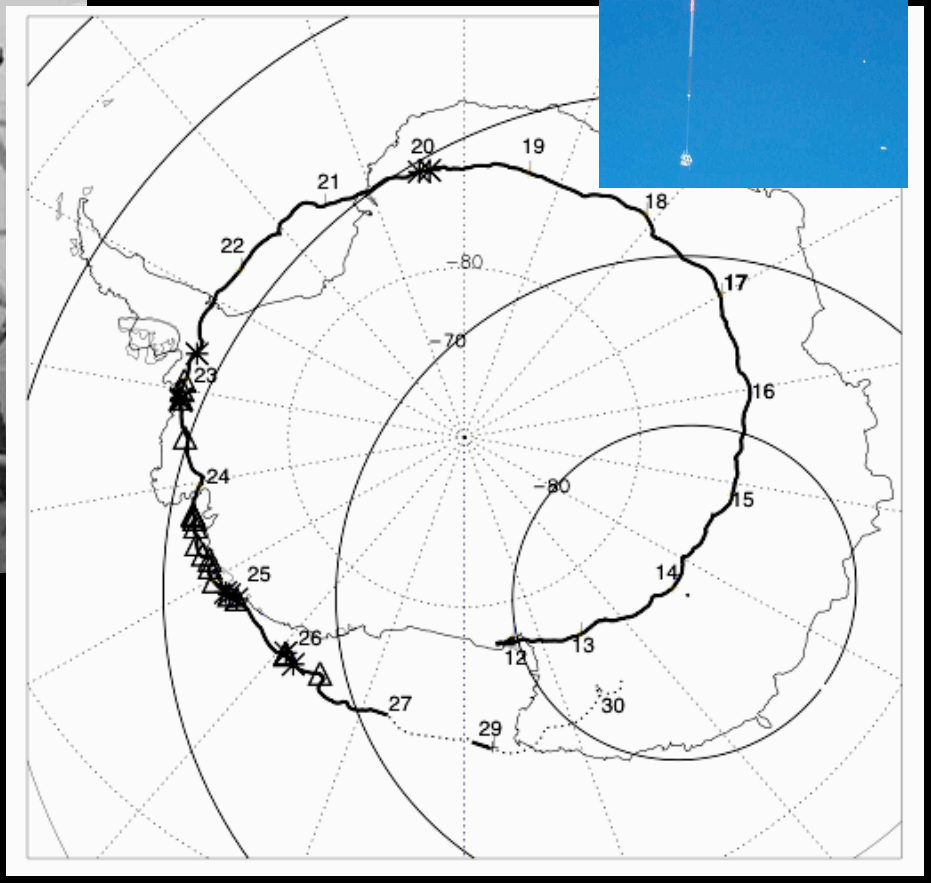


- The X-rays are measured from stratospheric balloons

MAXIS 2000 LDB Campaign



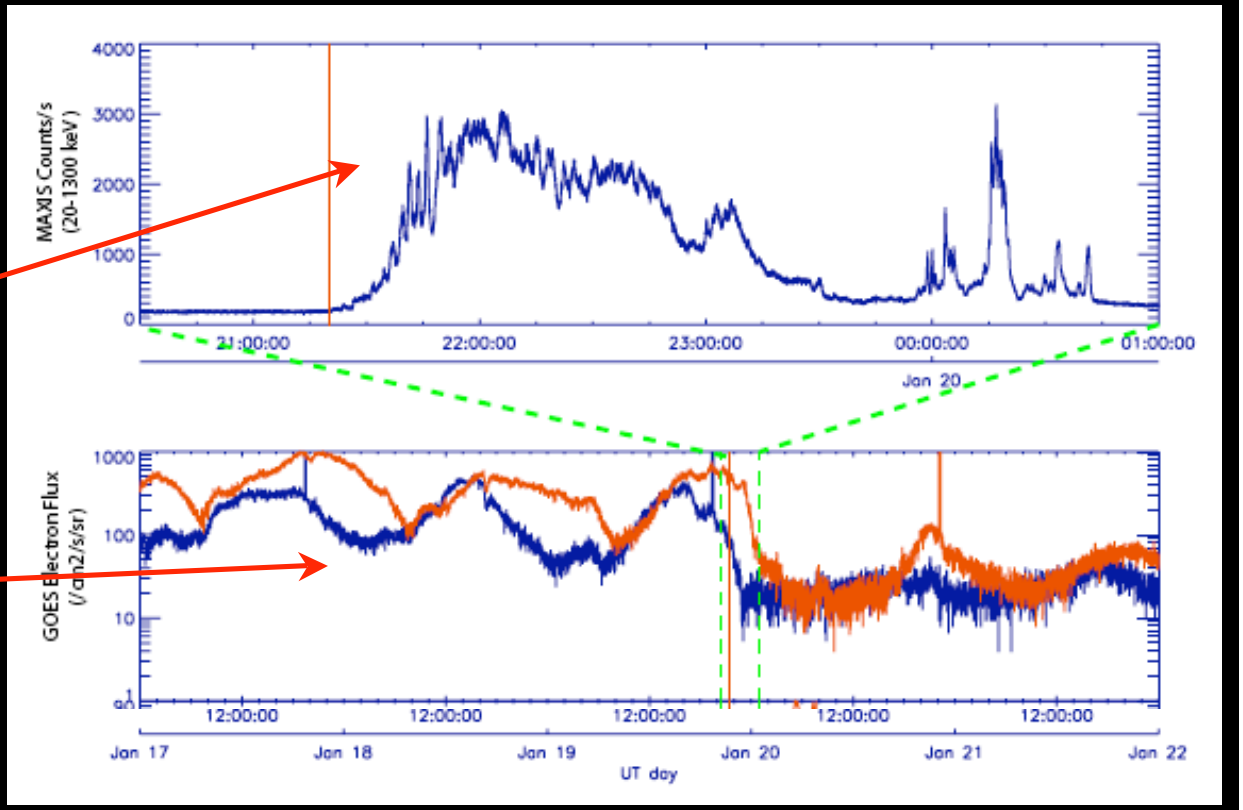




Strong Electron Losses

- Strong precipitation observed during radiation belt depletion event

- REP observed on January 19, 2000 during a relativistic electron depletion observed by GOES



(from Millan et al., 2007)

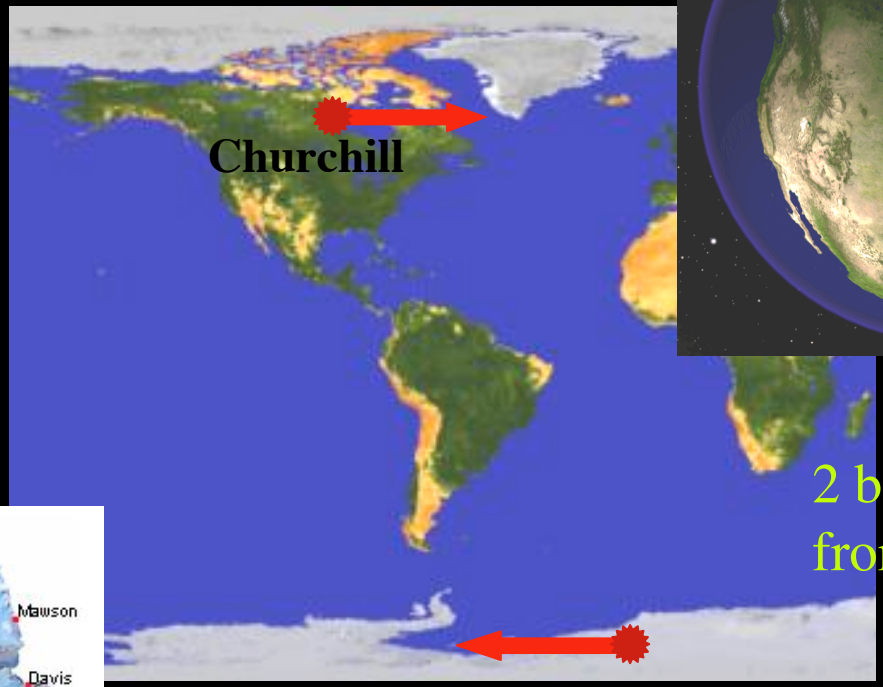
MINIS Balloon Campaign

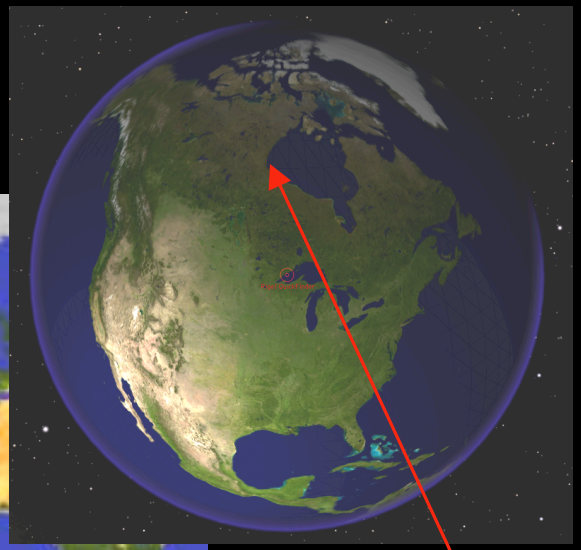
- Multi-point measurements of REP with 6 balloons
- Observations from Jan. 16-Jan 31, 2005

South African National Antarctic Programme
SANAP
understand, develop, conserve

Churchill Northern Studies Centre
Subarctic Research and Education Since 1976

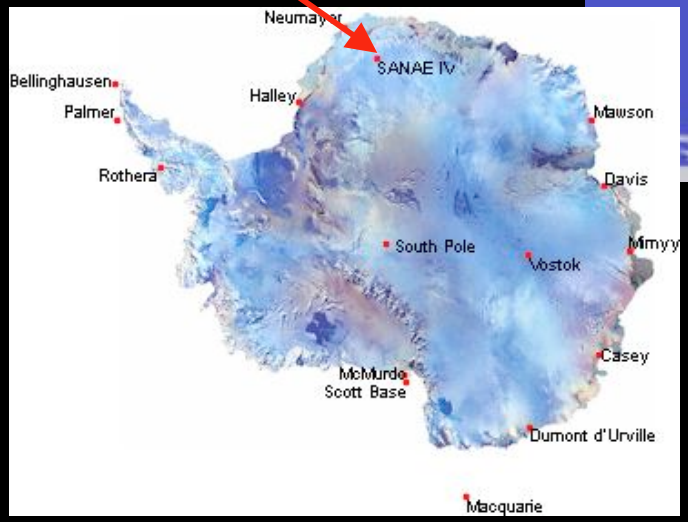
MINIS Launch Sites



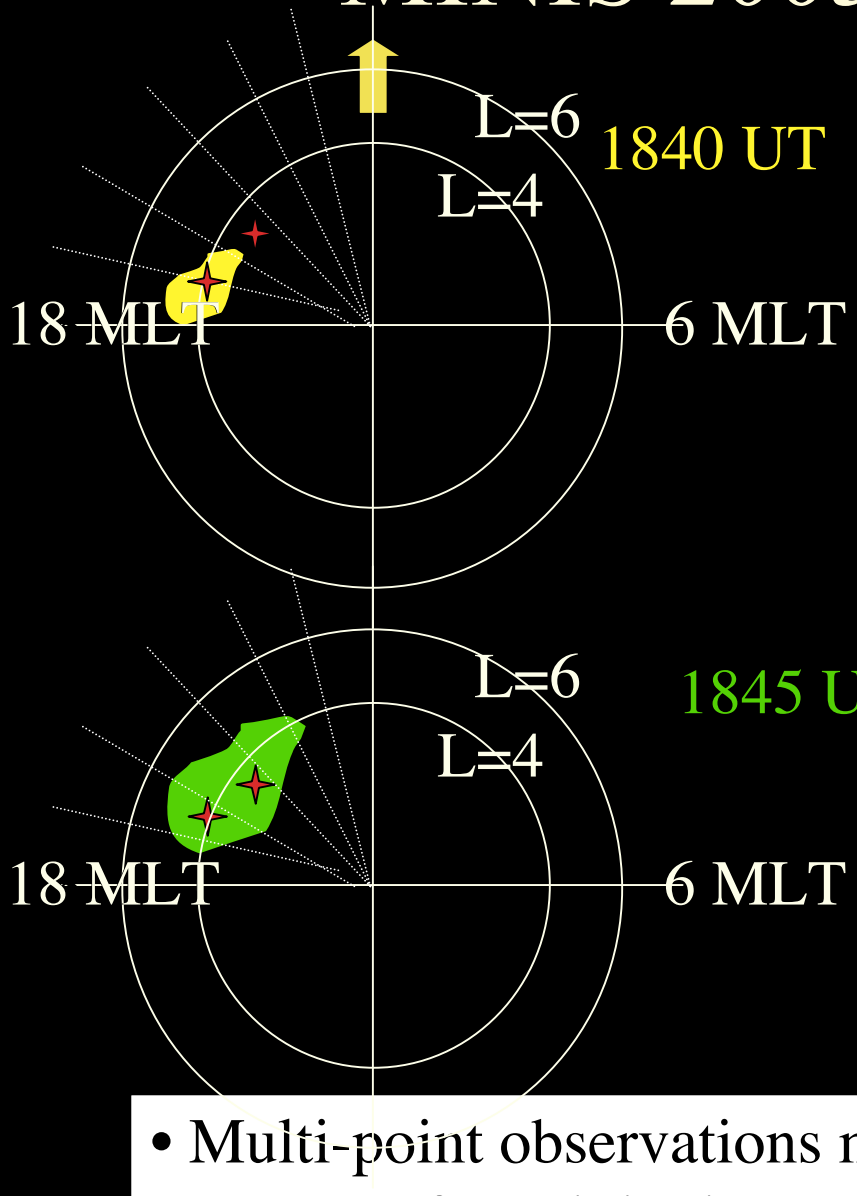


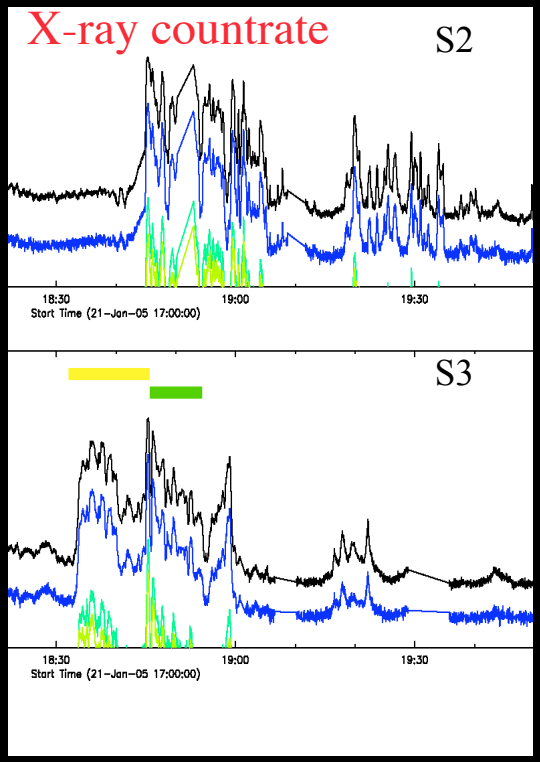
4 balloons launched from SANAE

2 balloons launched from Churchill

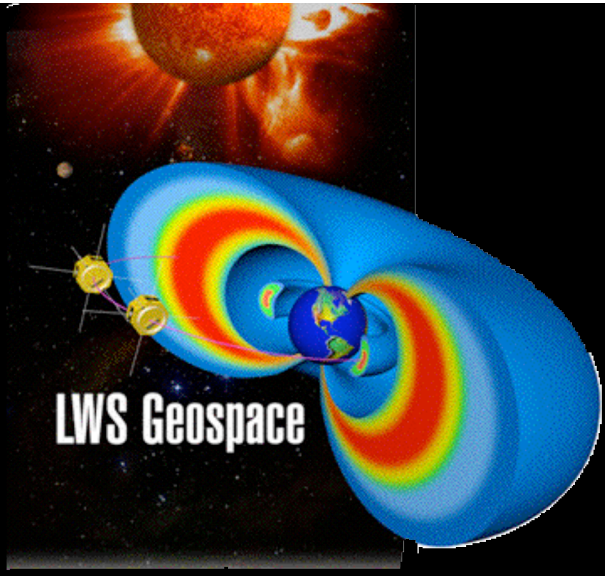


MINIS 2005 Observations



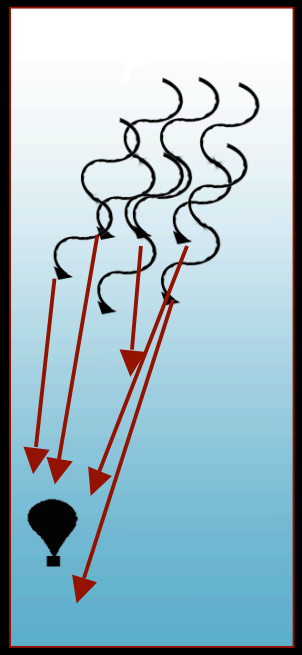


- Multi-point observations measure the spatial scale and structure of precipitation.
- Separate temporal and spatial variations



Global Monitoring of Relativistic Electron Precipitation with Balloon Networks

Balloon
Array for
RBSP
Relativistic
Electron
Losses

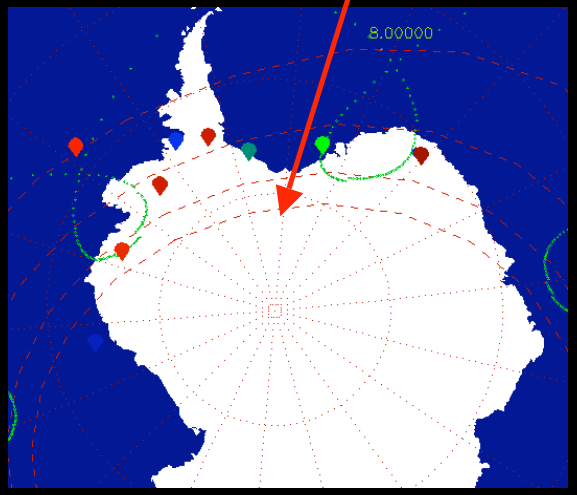


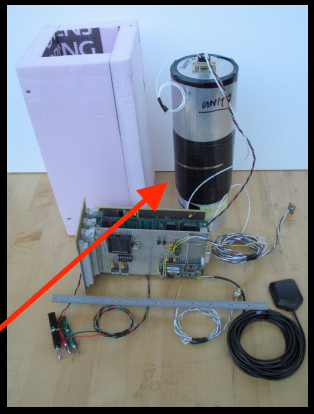
Key Elements

- Multi-point measurements => measure spatial extent of electron precipitation
- Combined with RBSP wave and particle measurements => directly test models of precipitation

Payloads based on MINIS design

Array of balloons achieves RBSP conjunctions





Primary Instrument: 3”X3” NaI scintillator

Concluding Remarks

- For some applications, instrumentation can be simple and have a large science impact!
- Frequent flight opportunities => potential for studying the statistical distribution
- Small balloons => frequent launches, balloon arrays to study spatial distribution
- Balloon investigations as missions of opportunity: can these opportunities be made more frequent?

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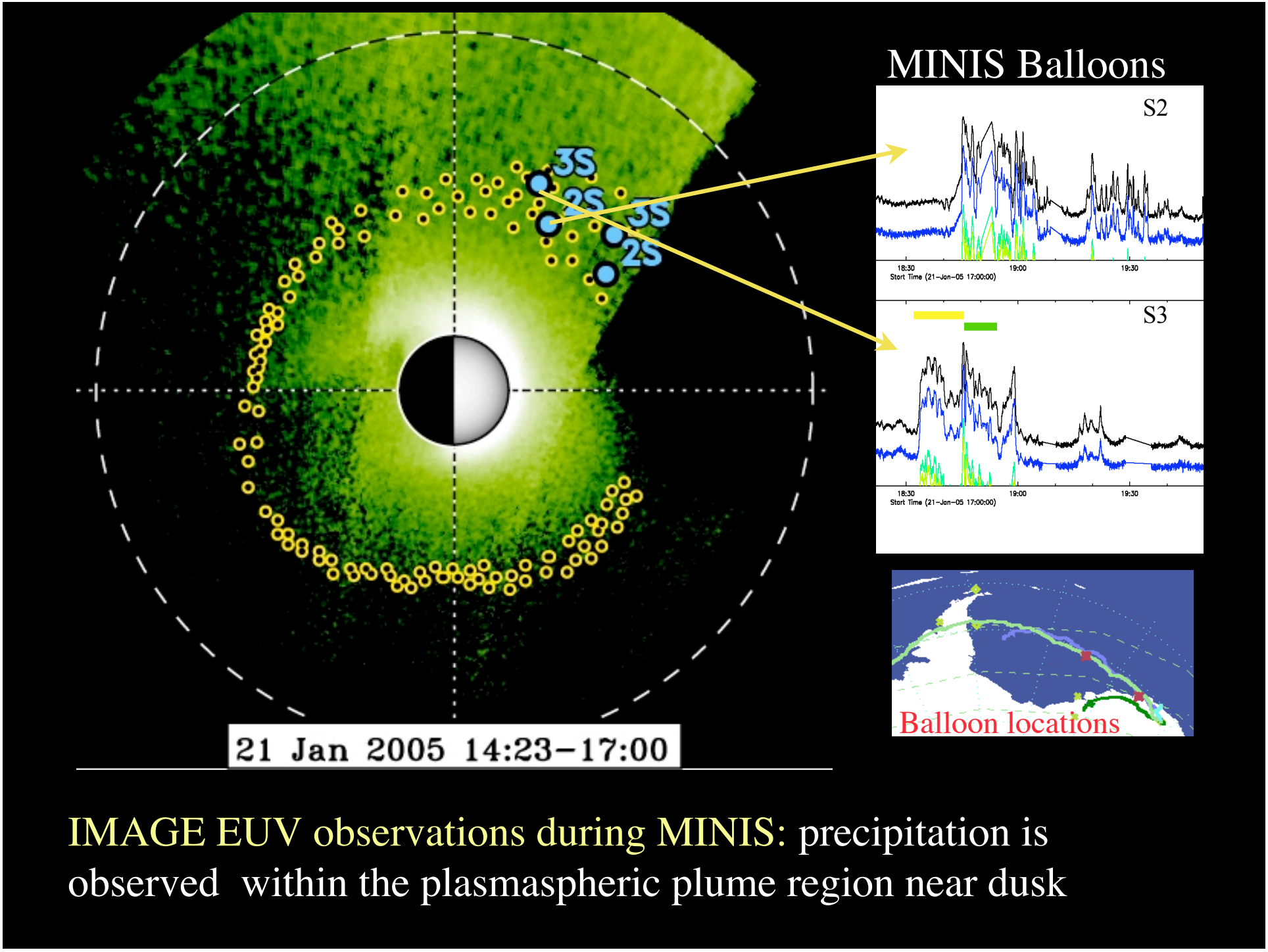
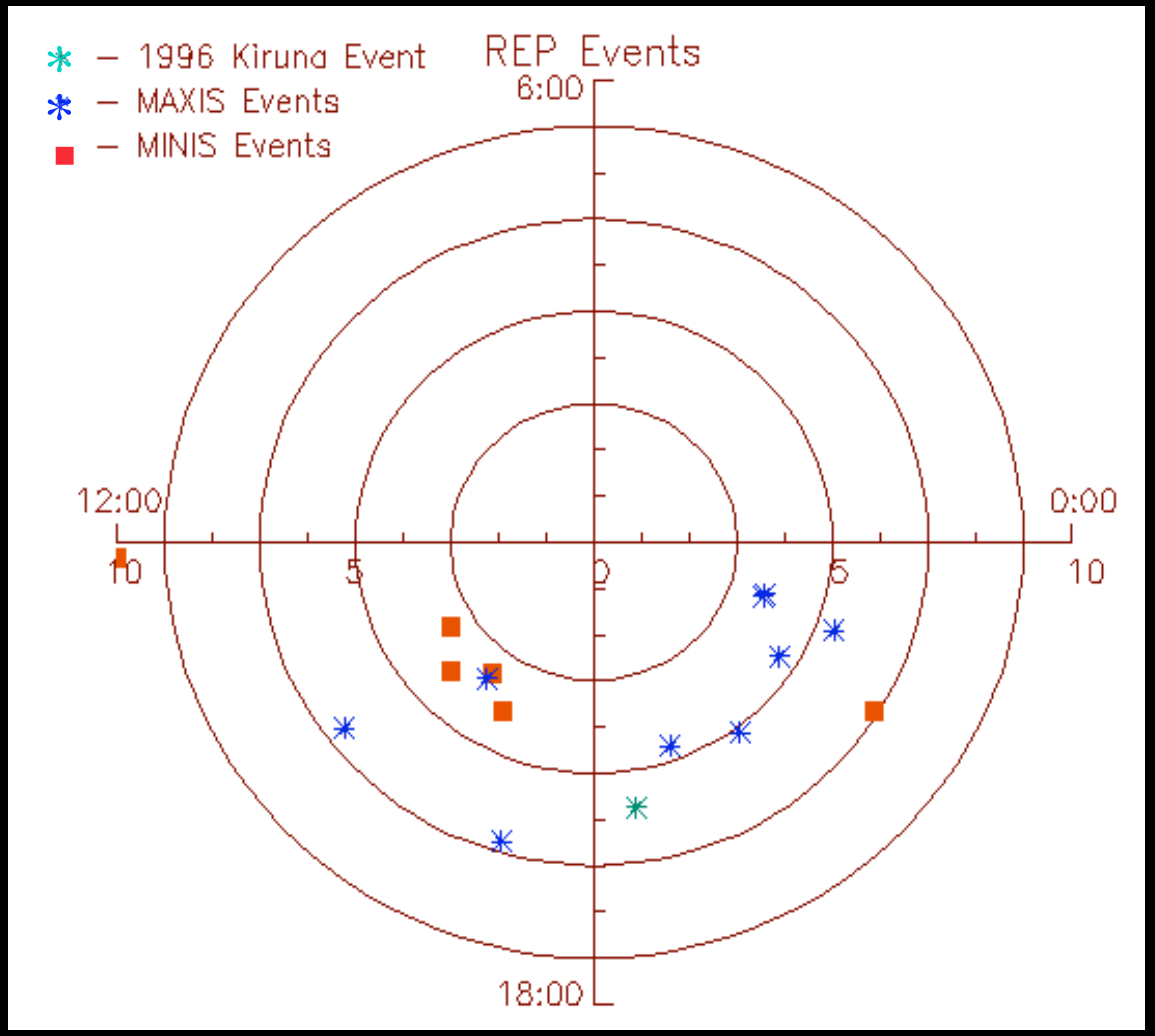


IMAGE EUV observations during MINIS: precipitation is observed within the plasmaspheric plume region near dusk

Local Time Distribution



- All events observed in afternoon/pre-midnight