SM31A-1509 Interhemispheric Similarities and Asymmetries in Geospace Phenomena II Posters SM31A-1509

Hemispheric Asymmetries in Substorm Recovery Time Scales

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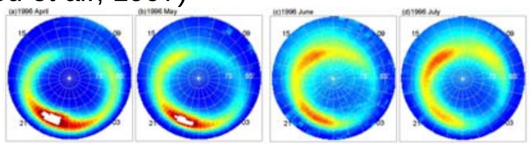
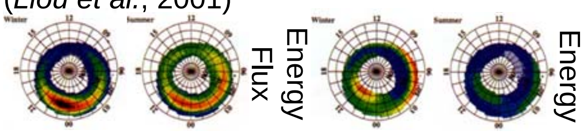
Motivation and Previous Work

Previous work has shown that the behavior of aurora is different in darkness versus sunlight:

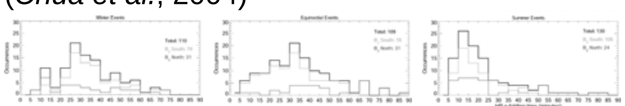
Aurora are more common in darkness
(*Liou et al.*, 1997)



Aurora are more energetic in darkness
(*Liou et al.*, 2001)



Substorms last longer in darkness
(*Chua et al.*, 2004)



What's the **difference** between darkness and sunlight? **Ionospheric conductivity!**
→ Influences (controls?) occurrence and energy of aurora and length of substorms

Implications for **auroral conjugacy**
→ More energy deposited in dark hemisphere

Previous work is based on **statistical results**
→ What about for **individual substorms?**

Methodology

Identify substorms when IMAGE FUV and Polar UVI are viewing opposite hemispheres

Focus on substorms near solstice and equinox

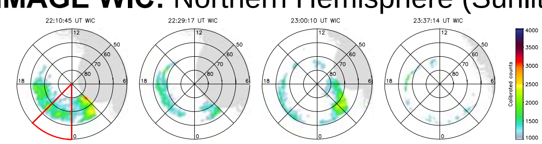
Determine substorm recovery times scales for both instruments by fitting the decay of the area-integrated photon flux to an exponential:

$$P(t) = P_{max}\, e^{-t/\tau} + P_o$$

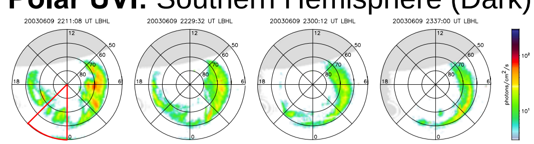
where τ is the **recovery time**

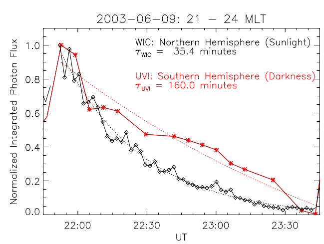
(Best Typical) Example

IMAGE WIC: Northern Hemisphere (Sunlit)



Polar UVI: Southern Hemisphere (Dark)





$\tau_{darkness}$ > 4 times longer than $\tau_{sunlight}$

long tail in darkness

Results

For individual substorms, we find…

Large variation in substorm time scale, τ
→ from 4 minutes to 2 ½ hours, $<\tau> \sim 43$ min

Recovery time scales **longer** in **darkness** with large variation in hemispheric difference of τ
→ $\tau_{darkness}/\tau_{sunlight}$ varies from > 4.5 to < 1.3 with an average of ~ 2 during solstice
$\tau_{north}/\tau_{south}$ ~ 1 during equinox

Consistent with previous statistical results
→ **Asymmetric substorm energy input**

Implication: **Ionospheric conductivity** plays an important role in **substorms dynamics**

In sunlit (higher conductivity) hemisphere, ambient plasma density is sufficient to carry imposed current [e.g., *Newell et al.*, 2001]
→ no or weak potential/particle acceleration

What about recovery time scales…?
Treat each hemisphere as a separate circuit; circuits have different resistance/time constant
If $\tau \sim R \sim 1/\boldsymbol{\sigma}$, as $\boldsymbol{\sigma}$ increases, τ decreases

Challenges/Complications

- Elusive "isolated" substorm – intensifications
- Differences in instrument responses
- Differences in spacecraft orbits/fields of view
→ Identical instruments in conjugate orbits