The geocorona is a hydrogen (H) cloud around Earth that extends from about 500 km to >10,000 km in the exosphere and resonantly scatters solar irradiance at 121.6 nm (Lyman-α). The extent and density distribution of the geocorona varies with space weather and is important for observing short term variability of the terrestrial upper atmosphere. However, the dynamics of the H density in this region are currently not well-understood. Therefore, the purpose of this study is to use extreme ultraviolet (EUV) measurements of solar irradiance from GOES satellites to derive daily H density distributions of the terrestrial atmosphere using new absorption techniques.

**Methods**

1. **SATELLITE LOCATION**
   - An IDL program was created to read in satellite location data (in geocentric solar ecliptic coordinates) for a specific year.
   - Two different data sets of spacecraft locations were compared.

2. **EUV ABSORPTION**
   - The 1-minute GOES EUV irradiance was read in from the NGDC website. (Fig 3)
   - A baseline value was created for the daytime irradiance. (Fig 4)
   - Night-time absorption dips were created by subtracting the baseline in order to eliminate solar variability. (Fig 5)

3. **HYDROGEN DENSITY FIT**
   The absorption technique estimates a H density profile in the equatorial plane based on the dip in the Lyman-α irradiance [W/m²] measured by the GOES satellite as it traverses the anti-solar side of Earth. The total scattering loss along the line of sight through the atmosphere is:

   \[ \text{Fscattering} = \frac{\text{protons} / \text{cm}^2}{\text{s} \cdot \text{cm} \cdot \text{m}^2} \cdot \int \frac{\partial n}{\partial z} \int \frac{n}{\partial r} \int r \, dr \, dz \, d\theta \]

   Following Bailey, a simple spherical power law for the H distribution, \( n(r) \approx r^a \), was assumed. The data was then fitted to determine constants \( a \) and \( b \) with the Levenberg-Marquardt non-linear least squares algorithm.

**Part A – Integral Method:**

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<td>Total absorption is given by: ( F = \int \int \int \frac{n(r) dr}{r} )</td>
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The regimes considered were:

- \( r > 3 \text{R}_e \)
- \( r < 3 \text{R}_e \)

\( \Delta F = F(\text{day}) - F(\text{night}) \)

3B. **HYDROGEN DENSITY FIT: DIFFERENTIAL METHOD:**

Because the integral method did not provide a reasonable fit, a differential method was tested. Results showed that the exponents were fairly consistent for the years of 2011 and 2012, and the calculated density agreed with expected values of about -3 for \( 3 \text{R}_e \) (Fig 11).

**Future Work**

Possible next steps include:

- Determine source of phase shift between satellite location data.
- Test \( b \) from second fit by numerical integration of \( n(r) = ar^{-a} \).
- Try other improvements on integral fit, such as better smoothing.
- Estimate how close to the Earth can we get good estimates.
- Include measurements from other satellites.
- Try to fit data with a 2D model.

**References**
