Ionosphere Lab:
Chapman Layers Module
The Vertical Structure of the Ionosphere

Introduction

In this module you will use the model results from the CITPe model (http://ccmc.gsfc.nasa.gov/models/modelinfo.php?model=CTIPe) to explore the vertical structure of the ionosphere.

After you are finished you should understand:

- *the components of the atmosphere that are important to the formation of the ionosphere*
- *the vertical structure of the electron density*
- *which ions contribute to the electron density*
- *the composition of the Chapman Layers*

Getting Started

- On the CCMC Education page (http://ccmc.gsfc.nasa.gov/support/HSS_2012.php), navigate to the ionosphere "artificial conditions" runs at the bottom of the page. Choose the CTIPe_Solstice_quiet (low altitude: 80 - 500 km) run.
- Click on "Update Plot". You should see a world map showing the a color map of the electron density at a fixed altitude.
- **Record the latitude and longitude of the maximum in electron density.**
- Scroll down and make the following selections:
  - under "Plot Mode" choose "Vertical Line(1D)"
  - under "Choose Plot Area" change the longitude (lon1) and latitude (lat1) to the values you recorded above
  - click on the radio button next to "H1"
    (this will generate a plot as a function of altitude rather then pressure)
  - click "update plot"

Identify the layers

Can you identify the layers

- **Record the altitude of the local maximums in electron density.**
- **How many layers can you identify in this plot?**
- **Can you identify the "E" and "F" layers?**

Exploring Composition

- Scroll down to “Plot Mode” and click on the “Q2” menu.
  - **Which ion densities can you choose from? (Densities are represented by the variable names “N_X” where “X” is the species”. Ions have a “+” after them.)**
- Choose an ion density for Q2 and update the plot.
  - **Does this ion account for any portion of the electron density?**
- You may need to lock the scale in order to compare the to values. Under “Plot Options” / “Color Contour, (Vertical) Line” click on “Lock Color Range”.
- Set the “Min” value and choose a “Max” value that fits your range.
- For each ion in the list, record the altitude of the peak in the ion density and the fraction of the electron density that ion accounts for.

Ion Species	Density Peak Altitude Range	Fraction of electron density
NO+		
N2+		
NO2+		
O2+		
O+		
H+		

- **Which ion species contribute to the electron density for the E layer?**
- **....for the F layer?**