Understanding the lonosphere: NASA'S CON MISSION

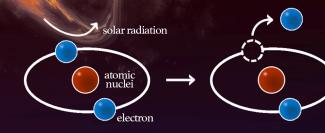
NASA is gearing up to launch its latest space mission, the Ionospheric Connection Explorer, otherwise known as ICON, this November. The spacecraft will investigate the characteristics of the ionosphere - a unique region of Earth's atmosphere that makes radio and GPS communications possible. Space and Earth weather effects, like solar flares, gamma ray burst radiation, or geomagnetic storms, drive extreme and unpredictable variability in this region. Understanding the forces at play in this zone will offer insight to the types of disturbances that interfere with radio communications and GPS signaling.

F2

F1

'Space and Earth Weather Events, like Coronal Mass Ejections and Stratospheric Warming Events"

Propagation



IONIZATION

When solar flares and/or cosmic rays enter the Earth's atmosshere, molecules lose electrons to form positively charged ions. This process, known as ionization, creates a unique region in the Earth's atmosphere called the ionosphere, and it contains a variety of ionized molecule species.

SKYWAVE PROPOGATION

Skywave propagation is the behavior of radio waves when they are transmitted, or propagated, back toward Earth from the ionosphere. The curvature of the Earth has no limitations on skywave propogation, so it is possible to send signals far beyond the horizon, traversing intercontinental distances. However, since the ionosphere is a continuously changing area influenced by the sun and altitude, radio communications change from one day to the next, and sometimes even from one hour to the next. Generally, layers with higher electron densities, such as the F or E layers, will propagate transmitted signals.

IONOSPHERE

The ionosphere is a region of Earth's upper atmosphere, from about 60 km (37 miles) to I, 000 km (620 miles) altitude. It owes its existence primarily to ultraviolet radiation from the Sun ionizing particles at different altitudes. These altitudes form separate layers of the ionosphere with varying species and amounts of ionized molecules (right; Figure 1). Since ionization depends primarily on the Sun and its activities, the amount of ionization in the ionosphere is controlled by diurnal and seasonal effects (Figure 3).

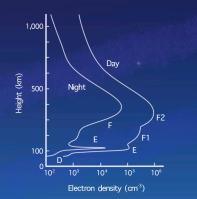
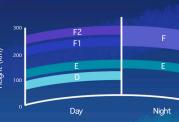


Figure I: The density of electrons changes with altitude in daylight and nighttime The F layer is generally the most dense ionospheric layer.

MISSION TIMELINE





A radio signal is transmitted from a radio tower on Earth. Radio signals that are lower in frequency tend to project shorter distances than high frequency radio waves. The limit to which a radio signal can be sent is determined by the ionization of the atmosphere, and is called a maximum usable frequency (MUF).

 $(\mathbf{1})$



Earth's surface (ground or water) then diffusely reflects the incoming wave back towards the ionosphere. This is called "skipping" or hopping", much like a rock skipping" across wate

Instrument Delivery

Science Payload Delivery

Observatory Ships

ICON Launches

ICON Science Operations Begin

in space



Ionospheric Connection Explorer

The Ionospheric Connection Explorer mission is a 2-year mission that will bring new insight to the dynamic nature of the ionosphere. The boundary where Earth and space weather systems meet in the ionosphere can create a turbulent mixture of neutral and charged particles, and this can interfere with radio and GPS communications. Headed by Dr. Thomas Limmelat the University of Berkeley, California, the ICON mission several U.S. institutions, and aims to launch

November 2017.

Isn't this part of the **FUV** instrument

LEOSTAR-2 BUS

This spacecraft bus is the body of the launch vehicle and houses multiple scientific instruments pertaining to the mission.

If the frequency of the transmitted signal is weak compared to the ionosphere, the signal is reflected back towards Earth. If it is greater, the signal travels through the ionosphere and is

Both MIGHTI and IVM have two identical sensors

(ION VELOCITY METER)

The ICP is hidden behind this

panel and star tracker

Developed by UT Dallas. TX The IVM measures the motion, temperature, and total ion number nsity of ionized gases at the ocation of the spacecraft. There e two on the ICON spacecraft.

SOLAR PANEL

the optimal field of view possible.

One solar panel was chosen in order to e

the science payload instruments could obtain

Radio signals may skip between Earth's surface and the ionosphere multiple times (multihop propogation) and effectively travel ranscontinental distances. Signals as far as 3500 km can be sent in one sequence of multihop propagation.

MIGHTI

(MICHELSON INTERFEROMETER FOR GLOBAL HIGH RESOLUTION IMAGING OF THERMOSPHERE AND IONOSPHERE)

esearch Lab DC The MIGHTI interferometer determines the altitude profiles of atmospheric wind and temperature in the Earth's upper atmosphere. There are two on the ICON spacecraft

IMAGING SPECTROGRAPH) Developed by UC Berkeley, CA The FUV imager determines

the daytime thermospheric omposition and altitude profiles of nighttime jor

EUV

(EXTREME ULTRAVIOLET SPECTROGRAPH) Developed by UC Berkeley, C The EUV spectrograph measures the ensity of ionized gases during the daytime

Poster Designed by: Mark Belan (www.artscistudios.com)

Science Operations End

