1. **GNSS Radio Occultation Technique:**

   - With a Global Navigation Satellite System (GNSS) receiver on board a low-Earth orbiting (LEO) satellite, the amplitude and phase of GNSS radio signals can be measured very precisely as the GNSS satellite is occulted by Earth’s ionosphere and atmosphere, which can be used to derive ionospheric electron density information and atmospheric temperature and water vapor.

2. **COSMIC Mission:**

   - The joint Taiwan–United States FORMOSAT-3/COSMIC (Constellation Observing System for Meteorology, Ionosphere, and Climate) mission, hereafter called COSMIC, is the first satellite constellation dedicated to remotely sense Earth’s atmosphere and ionosphere using GPS radio occultation technique with near real-time data delivery. The occultations yield abundant information about neutral atmospheric temperature and moisture as well as space weather estimates of slant total electron content, electron density profiles, and an amplitude scintillation index, S4.

3. **Ionospheric Data Assimilation based on COSMIC Observations:**

   - COSMIC RO data has been used in the data assimilation systems by the community. We have done a global ionospheric electron density reanalysis during 2002-2011 by assimilating almost all the available data specifically LEO based RO data simultaneously. The output of the reanalysis are 3-D gridded ionospheric electron densities with temporal and spatial resolutions of 1 h in universal time, 5° in latitude, 10° in longitude, and ~30 km in altitude.

4. **COSMIC-2 Mission:**

   - With the success of COSMIC, the United States and Taiwan are moving forward with a follow-on RO mission named FORMOSAT-7/COSMIC-2 (COSMIC-2), which will ultimately place 12 satellites in orbit with two launches in 2016 and 2019. COSMIC-2 satellites will carry an advanced GNSS RO receiver that will track both GPS and Russian GLONASS signals, with capability for eventually tracking other GNSS signals from the Chinese BeiDou and European Galileo systems. COSMIC-2 will provide 4-6 times (10-15° in the low latitudes) the number of atmospheric and ionospheric observations that were tracked with COSMIC. The first launch of COSMIC-2 will each have two other space weather payloads, a Ultra High Frequency (UHF)/L-band RF Beacon payload and the Ion Velocity Meter (IVM) instrument to measure in-situ ion and electron density information and atmospheric temperature and water vapor, respectively. Ionospheric measurements are made by the IVM using dual-frequency (10-15 kHz) by the two POD antennas, which are canted slightly upward relative to the velocity direction. The IVM sensor steering to increase measurement quantity in the lower atmosphere. Ionospheric measurements are made by the IVM using dual-frequency (10-15 kHz) and high-gain antennas that observe line-of-sight slant electron density information and atmospheric temperature and water vapor, respectively. Ionospheric measurements are made by the IVM using dual-frequency (10-15 kHz) and high-gain antennas that observe line-of-sight slant electron density information and atmospheric temperature and water vapor, respectively.

5. **References:**