ICON at AGU 2020 Fall Meeting

AGU Fall Meeting - Online Everywhere 1-17 December 2020

#AGU20 Fall Meeting will be one of the world's largest virtual scientific conferences, with exciting programming and events. This will be our most diverse, engaging and dynamic Fall Meeting to date.

#AGU20 is scheduled from 1-17 December to accommodate over a thousand hours of virtual content to minimize conflicts while maximizing global engagement. Scientific program content will be available on-demand, with pre-recorded oral presentations and virtual posters available for attendees to view and peruse outside of the scheduled live Q&A sessions during the meeting.

Schedule at a Glance
Online Experience

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Below are ICON or GOLD science-related sessions, posters and the SPA Town Hall on Wednesday night December 9, listed chronologically with page-breaks between the days.

All times are Pacific Standard Time (PST) (UTC–8)

Monday, 7 December 2020

[SA003-04 - Traveling Atmospheric Disturbances in the Midlatitude Thermosphere: Coordinated Ground- and Space-Based Observations]

17:42 - 17:46 Virtual

Jonathan J Makela et al

Traveling atmospheric disturbances (TADs) are one of the most effective mechanisms for plasma transport in the mid latitude ionosphere, and its effects are important for a better understanding of the midlatitude electrodynamics. They can be generated by different sources mostly due to geomagnetic effects (Joule heating, sub-auroral polarization streams among others) or to effects coming from below (sudden stratospheric warming, etc) from which only the longer wavelength waves reach the mid-latitude region. Their signatures in the thermosphere and ionosphere have been extensively studied mostly using ionospheric sounding techniques and through density observations. We present the analysis of a large TAD event occurring over North America on January 2, 2020 which showed oscillations in the thermospheric winds with magnitudes larger than 100 m/s in the east-west direction. Signatures were observed by a Fabry-Perot Interferometer (FPI) at the Urbana Atmospheric Observatory in Illinois (UAO; 40.17°N, 88.16°W) showing these oscillations and an apparent east to west propagation direction. We compare these ground-based observations with corresponding neutral wind measurements from the Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) instrument on NASA's Ionospheric CONnection (ICON) Explorer satellite. We also present an analysis of the possible sources for such an event.

[SA003-06 - A Report on the Small-Scale Variations in the Ionospheric Connections Explorer (ICON) Wind Data]

17:50 - 17:54 Virtual

Colin Charles Triplett et al

NASA's latest explorer mission, the Ionospheric Connections Explorer (ICON), was launched on 10 October 2019. ICON has a suite of instruments capable of measuring temperatures, winds, and composition in the Mesosphere-Lower Thermosphere (MLT) simultaneously. These data are critical to understanding the large-scale temporal and spatial dynamics of the MLT. As data has been collected, however, the ICON team has noticed nearly ever-present, small-scale variations (1000-2000 km horizontal scales, tens of km vertical scales, and persistence > 5-8 minutes) in the wind data attributed to the thermospheric wind field. We report on our current understanding of these small-scale variations.

[SA003-07 - The Quasi-2-Day Wave (Q2DW) and Q2DW-Tide Interactions as Viewed in ICON/MIGHTI Winds]

17:54 - 17:58 Virtual

Jeffrey M Forbes et al

It is now widely accepted that planetary waves (PW) and tides propagating upward from the lower atmosphere play an important role in determining the longitudinal and day-to-day variability of the ionosphere. Additional levels of spatial and temporal complexity are introduced into atmosphere-ionosphere coupling by nonlinear interactions between these wave fields, which give rise to secondary

waves with wave periods and zonal wavenumbers different than the primary interacting waves. The aggregate combination of primary waves and secondary waves for even a single PW-tide interaction gives rise to longitudinal structures and day-to-day variability much different than linear superposition of the primary waves alone. In this paper, winds measured by the MIGHTI instrument on ICON between 96-110 km altitude and 12S-42N during January-April, 2020, are used to delineate the temporal evolution of the Q2DW in terms of its 44h-56h period and dominant zonal wavenumber (s = +2 or s = +3), as well as those of the secondary waves that arise from Q2DW-tide interactions. The high temporal resolution needed to define the Q2DW period is made possible through use of a "longitude subdivision method (LSM)", whereby, e.g., the longitude structure of the s = +3 Q2DW is collapsed onto 0-120^{o} longitude, thereby tripling the number of points per day at a given height and latitude from 2 (ascending plus descending) to 6. In the context of secondary waves, the potential influences of aliasing are discussed, and additional evidence for Q2DW modulation of solar tides in the time domain is presented.

Tuesday, 8 December 2020

Posters

Astrid I Maute et al
04:00 - 20:59

SA004-0009 - How wrong is the model and how can it still be useful?

The neutral wind dynamo is important for generating low-latitude ionospheric variability and space weather. During the daytime, the upward drift causes the plasma to rise, which then diffuses downward forming the characteristic equatorial ionization anomalies. Observations and modeling studies have indicated large variability of the plasma drift on time scales from days to seasons associated with the wind dynamo at low and middle latitudes. In addition, the neutral winds in the lower thermosphere is highly variable due to upward propagating tides and waves from the lower atmosphere. The relationship of the ionospheric drift variability to the neutral wind at different altitudes and regions is still not fully understood. The Ionospheric Connection explorer (ICON) mission is designed to focus on the low to middle latitude region and measures key parameters, such as the plasma drift and density and neutral temperatures and winds, to address the question of vertical coupling.

In this presentation, we will focus on the ICON observations and compare to general circulation model (GCM) results with the focus on determining what are “mice” and “tigers” depending on our goals. We will specifically focus on how models can support the interpretations of observations with respect to relating neutral wind variations to low latitude plasma drift changes. We will conclude with some thoughts on “useful” paths to advance modeling capabilities.

Wednesday, 9 December 2020

SA038-01 - The Ionospheric Connection Explorer: Results from Year #1 on Orbit

10:00 - 10:06 Virtual
Thomas J Immel et al

The NASA Ionospheric Connection Explorer has provided a full year of coordinated measurements of the ionosphere and thermosphere, with excellent performance of its instruments and the observing platform. Its measurements support ICON's specific mission objectives to 1) determine the source of strong day-to-day variability in ionospheric densities, 2) determine how large-scale atmospheric waves propagate upward and interact with the ionosphere, and 3) understand how these effects interact with and modify geomagnetic storm phenomena. We will discuss some of the more remarkable effects observed by ICON, and how the analysis of these data is leading to new understanding of the behavior of the ITM system. This will include a brief review of comparisons to other measurements and a summary of validation efforts that have improved the ICON data products.

SA012-04 - E- and F-region Wind Influences on the Topside Equatorial ionosphere Observed by ICON

Rod Heelis et al
19:12 - 19:16 Virtual

In the topside equatorial-ionosphere the plasma composition and temperature are strongly influenced by the dynamo action of E-region winds producing plasma drifts perpendicular to the magnetic field, and by the F-region winds that move plasma parallel to the magnetic field and modify the diffusive motions. Under solar minimum conditions both the O+ and H+ concentrations are modulated by the wind induced dynamics and by seasonal variations in the photoionization rates. The ICON mission provides measurements of all the relevant parameters, allowing the driving winds in the E region and the F region, the topside plasma motions, the plasma composition and the ion temperature to be connected. Here we report on the nature of these connections for different seasons during the solar minimum period in 2020.

Posters
04:00 - 20:59

SA009-0002 - The Response of the Ionosphere-Thermosphere System from Large-Scale Waves Associated with Geomagnetic Storms as Seen from the Ionospheric Connection Explorer

Andrew Wang et al

Increases in auroral activity can generate significant disturbances in wind, temperature and composition of the upper atmosphere, with an accompanying set of effects in the ionosphere. One of the first manifestations of these disturbances are large-scale waves that propagate out of the auroral zones and travel around the planet near the local sound speed. The NASA Ionospheric Connection Explorer carries observational capabilities for both the neutral and plasma environments above 100 km, and is sensitive to perturbations propagating to middle and low latitudes from the regions of enhanced Joule heating near the poles. Here we will review the effects of large-scale waves in the atmosphere in the ionosphere observed during the first year of the mission. One of the larger events of 2020 was a moderate geomagnetic storm in April, which was observed in the Northern Hemisphere to drive a traveling wave with a signature disturbance in meridional winds > 100 m/s.

SA008-0008 - Gravity Wave Study in the MLT using ICON-MIGHTI Temperature and Wind Observations

Shreya Nagpal et al

Atmospheric gravity waves have important roles in driving atmospheric coupling processes from the lower atmosphere to the mesosphere, thermosphere, and ionosphere. NASA's Ionospheric Connection Explorer (ICON) satellite was launched on 10 October 2019 and has been observing atmospheric temperatures and winds in the latitude range of 10S-40N. Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) is one of the instruments on ICON measuring temperatures and winds. Using both temperature and wind measurements from ICON-MIGHTI observations, small-scale perturbations (< wavenumber 6) are extracted and analyzed in the altitude range of 90-105 km and are considered
to be gravity waves in this work. Obtained gravity waves will be compared to other satellite observations including TIMED/SABER. Vertical profiles of ICON-MIGHTI winds and temperatures are further analyzed to study instabilities including Richardson numbers and Brunt Vaisala frequency. Relationship between these instabilities and gravity waves will also be briefly discussed in this work.

SA010-0004 - ICON observations of longitudinal variations from 95 km to the spacecraft altitude of 575 km

Yen-Jung Wu et al

NASA's Ionospheric Connection Explorer (ICON) was launched in October 2019 during the solar minimum between Solar Cycles 24 and 25. The science data products are now available (https://icon.ssl.berkeley.edu/Data). ICON is equipped with instruments that target the neutral drivers of the ionospheric dynamo and measure the response of the ionosphere to the neutral and external plasma drivers. In the altitude range between 95 km and 300 km, Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) provides measurements on neutral wind and temperature by remote sensing techniques. At the ICON spacecraft altitude, ~575 km, Ion Velocity Meter (IVM) measures the in-situ plasma parameters. EUV and FUV spectrographs provide the retrieved O^+ density from 200 km to the ICON orbit altitude in the daytime and nighttime, respectively. In addition, the daytime O-N_2 ratio derived from EUV measurements also reveals the dynamics of the upper atmosphere. In the altitude range from 250 km to 300 km, ICON provides simultaneous measurements of O^+ density and neutral wind at both daytime and nighttime, which allow to connect the observations of the neutral atmosphere below and the ionosphere above. In this study, we present the observed longitudinal variations in fixed local times of different parameters measured by all 4 instruments onboard ICON, connecting the wave patterns in the mesospheric and lower thermospheric neutral winds to the in-situ ion density at the ICON spacecraft altitude. Our preliminary results show that the same wave patterns that are found in the ion density at the altitude of ICON's orbit can also be found in the neutral zonal wind as low as 130 km, whereas the same wave pattern in the neutral meridional wind only starts from ~150 km. In order to interpret the interaction between different parameters measured by ICON, a TIEGCM run is performed to support the observations.

Town Hall

TH062 - Space Physics and Aeronomy Section Agency Night

19:00 - 20:00

Come meet with our NASA and National Science Foundation (NSF) representatives. During this one hour session current and pending programs as well as recent developments at both agencies will be described. The additional opportunity to ask questions and provide feedback makes this an hour well spent.

Wednesday, 16 December 2020

SA037 - Drivers and Prediction of Variability in Earth's Ionosphere and Thermosphere: New Observations from Missions I

08:30 - 09:30 Virtual
Primary Convener: Thomas J Immel

Conditions in the near-Earth space environment are observed to be remarkably variable. The number of potential sources of forcing is large, extending from the troposphere and middle atmosphere to high latitude auroral and magnetospheric regions. Quantifying the sources of variability, and how they combine and couple in the ITM system, is a goal of several new observational campaigns: ICON, GOLD, SWARM, and COSMIC-2. These missions in combination with extant assets including TIMED, upstream solar-wind monitors, and a growing network of ground-based sensors provide an unprecedented capability for research efforts that are revealing a host of new system-level behaviors. This session will present first light and recent discoveries from these mission, and related advances made possible by a range of computational models and new machine-learning approaches. These crucial activities promise to advance the field of space environment prediction.

SA037-01 - Low and Mid-latitude Ionosphere-Thermosphere Response to the April 2020 Storm

08:30 - 08:34 Virtual
Geoff Crowley et al

Solar minimum has historically been considered a time when the ionosphere and thermosphere are quiescent, with geomagnetic activity generally being less than during other parts of the solar cycle. However, the April 2020 storm, in which the Dst index reached a value of about -50 nT, produced a surprisingly large ionospheric and thermospheric response that was measured by various instruments. The ICON mission is focused on the middle and low latitudes, and provides measurements of thermospheric wind, temperature and composition, as well as the electron density and electric field. We describe the ICON data obtained during the April 2020 storm, and compare the measured response with that simulated by a global full-physics coupled thermosphere-ionosphere model. The global ionosphere is a driven system, beginning with the high latitudes and therefore those high latitude processes and their effects must be taken into account when trying to understand the global ionospheric variability. This is true for both geomagnetically quiet and active conditions. We explore possible explanations for the unexpectedly large ionosphere-thermosphere response during the April 2020 storm.

SA037-02 - Exploring the Near-Earth Space Environment by Swarm and Mission Data of Different Scales (Invited)

Claudia Stolle et al
08:34 - 08:38 Virtual

Describing the coupled Thermosphere/Ionosphere system requires observations on multiple scales and different parameters of the neutral and ionized gas. The special benefit can currently be drawn from simultaneous missions allowing these combinations. The GOLD mission regularly provides ultraviolet nightglow observations of the ionosphere above the South-Atlantic/South-American region with spatial resolution in the E-W and N-S directions for near nadir observations of about 93 km. During conjunctions with the polar-orbiting Swarm mission providing in situ observations of electron density, magnetic field and plasma drift with sampling rates of 1 Hz (7.5 km) or higher, we can compare large and medium scale structures related to post-sunset plasma depletions with their surroundings as seen from GOLD. We found, e.g., that not all depletions detected by Swarm are reflected in GOLD images and that the difference of the Swarm altitude and the reference altitude of GOLD scans need to be considered during interpretation.

Another example is provided by the combination of Swarm observations of the equatorial electrojet and MLS/Aura geopotential height data that revealed a burst of a quasi-6-day wave after the September 2019 Southern sudden stratospheric warming (SSW) event. These results suggest that an Antarctic SSW can lead to ionospheric variability through wave forcing from the middle atmosphere.

Furthermore, a multitude of satellites in Low Earth Orbit (LEO) carry avionics magnetometers for satellite attitude determination and control, such as Cryosat-2 and GRACE-FO, among others. These magnetometers, by design, do not meet high precision scientific requirements but have been shown to add valuable information in characterizing the Earth's magnetic environment after appropriate calibration. First results obtained from these data will be presented and compared with Swarm results.

New opportunities arise from newly released data from the low inclination ICON mission. Possible benefits of Swarm-ICON comparison for expanding the topics mentioned above will also be discussed.

SA037-03 - Whistlers in the ELF recorded by Swarm satellites: results from recent regular ASM burst sessions

Pierdavide Coisson et al
08:38 - 08:42 Virtual

Every month since August 2019 the ASM instrument onboard one of the Swarm satellites has been operated in burst mode during one week. ASM measures the intensity of the magnetic field at the satellite position, at about 450 km height for Swarm A and 500 km for Swarm B. From the nominal 1 Hz, the sampling frequency has been increased to 250 Hz, to observe Extremely Low Frequency (ELF) signals.The most remarkable phenomena observable in this part of the electromagnetic spectrum are whistlers, generated by the lightning activity occurring in the troposphere.

Due to the local time drift of Swarm high-inclination satellites, this is the first time that a collection of whistlers in the ELF is recorded worldwide at any local time by a single satellite mission.

A large variability in the number of events has been observed, and comparison with the very limited ASM burst dataset available for high solar activity, seems to indicate a strong solar activity dependence on the occurrence of these events.

Whistler dispersion as received at the satellite's position depends on the propagation through the ionospheric plasma, increasing with an increase of electron density.

A selection of remarkable whistlers events have been analysed. We identified the originating lightning strike recorded on the ground by the World ELF Radiolocation Array (WERA) and characterised the wave propagation through the ionosphere. For that purpose, events recorded within 600 km from a ground ionosonde have been analysed, providing electron density profiles needed for ray-tracing calculation of the propagation path up to the satellite location. The in-situ measurements of electron density made by Swarm were used to adjust the topside profile. Comparisons with the IRI model, constrained or not with experimental data indicate that whistler dispersion is sensitive to the F2 peak electron density.

SA037-04 - Thermospheric Wind Observations from MIGHTI on ICON: An Overview of Instrument Performance and Data Characteristics

Christoph R Englert et al
08:42 - 08:46 Virtual

The Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) is one of the four instruments on the Ionospheric Connection (ICON) Explorer, launched in October 2019. MIGHTI uses the atomic oxygen green and red lines and the molecular oxygen A-band to observe thermospheric wind and temperature profiles, respectively. Here, we present an overview of the wind observations and key characteristics of the data-set. The discussion of the available data-set includes on-orbit calibrations, data coverage and limitations, and quality indicators. A brief look at the retrieved wind profiles provides insight into the richness of the spatial and temporal features of the observations.

SA037-05 - COSMIC-2, GOLD, and ICON Observations of Plasma Bubbles and Vertical Ion Drifts

Qian Wu et al
08:46 - 08:50 Virtual

COSMIC-2, GOLD, and ICON are now providing unprecedented coverage of the equatorial ionosphere. COSMIC-2 GNSS observations provide information on the vertical structure of the ionosphere electron density as well as scintillation. GOLD gives the morphology of the ionosphere and plasma bubbles in the American sector with continuous UV images from geostationary orbit. At the same time, COSMIC-2 and ICON IVM observations provide vertical ion drifts, which is a direct measure of the equatorial dynamo. In addition, ICON measures the thermospheric winds, which drive the dynamo. By combining all these observations, we can have a better understanding of the equatorial ionosphere and the ionospheric condition under which the plasma bubbles occur. The vertical ion drift during the pre-reversal enhancement is directly related to the growth rate of the Rayleigh Taylor instability (R-T), which is responsible in large part for the occurrence of plasma bubbles. GOLD observes plasma bubbles regularly and the vertical ion drifts from ICON and COSMIC-2 can shed more light on the occurrence of the plasma bubbles. The GOLD bubble observations are also useful for validation of the geolocation of irregularities from the COSMIC-2 GNSS signal scintillation observations. We will give an overview of recent progress on this equatorial ionosphere study using these three missions and, on the effort, to validate the localization of irregularities with GNSS using the GOLD data.

SA037-06 - Observations of Atmospheric Waves in the Thermosphere with ICON (Invited)

Scott England
08:50 - 08:54 Virtual

Atmospheric waves play a key role in coupling different regions of the Earth's atmosphere. Clear evidence of wave coupling from the troposphere to the thermosphere and from the thermosphere to the ionosphere have previously been reported. Observations from both ground and space have previously revealed significant perturbations to the ionosphere that result from atmosphere waves in the lower thermosphere region, where coupling to the ionosphere via the E-region dynamo can play a significant role. However, observations of atmospheric waves both in the dynamo region and above are comparatively rare and much about the nature of waves and their impacts at these higher altitudes is not known. This is important as both the degree of coupling between the neutrals and ions varies with altitude, as well as the nature of the waves themselves as diffusive separation and ion drag become increasingly important at higher altitude. New results of atmospheric waves at altitudes above the lower thermosphere from observations with ICON will be presented.

SA037-07 - Direct evidence of ionospheric variability driven by the neutral wind dynamo

Brian Joseph Harding et al
08:54 - 08:58 Virtual

We present results from the first year of NASA's Ionospheric Connection Explorer (ICON) mission to study the sources of ionospheric variability. ICON is the first mission to make simultaneous, coincident measurements of ion drifts and the neutral winds that drive them. Once per orbit, the ion drift velocity is measured at ~600 km altitude within a few minutes of remote observations of neutral wind profiles along the same magnetic field line (90 - 300 km altitude). About 100 times per year, a "conjugate" maneuver is performed, observing the wind profiles at both the northern and southern magnetic footpoints. These measurements provide an unprecedented opportunity to study the neutral-wind-driven dynamo. In this work we describe the day-to-day and longitudinal variations of the vertical plasma drift and quantify their relationship to the neutral wind drivers.

SA037-08 - A preliminary result of ICON MIGHTI data assimilation using the Whole Atmosphere Community Climate Model with thermosphere and ionosphere eXtension Data Assimilation Research Testbed system

08:58 - 09:02 Virtual
Chih Ting Hsu et al

This study aims to assess the impact of the assimilating thermospheric winds on the ionosphere and mesosphere in order to investigate the possibility of improving upper atmospheric weather predictability. The Ionospheric Connection Explorer (ICON) Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) provides meridional and zonal wind profile in the thermosphere. We expected these data can provide us a better thermospheric specification and further affect the mesosphere and ionosphere through an ensemble data assimilation. In the ensemble data assimilation, how to update the model state is highly related to the correlation between each variable which is computed statistically from a limited number of the model ensemble. Therefore, in order to get a reasonable correlation, this study focuses on assessing a reasonable impact region of the ICON MIGHTI wind profile by analyzing the data assimilation result. The ICON MIGHTI winds data is assimilated into the Whole Atmosphere Community Climate Model with thermosphere and ionosphere eXtension(WACCM-X)/ Data Assimilation Research Testbed (DART) system, and the impact region of ICON MIGHTI winds data is evaluated using an empirical localization function according to the observation error covariance and background error covariance before and after data assimilation.

SA037-09 - A comparison of thermospheric FUV radiance and composition from TIMED, GOLD and ICON

Yongliang Zhang et al
09:02 - 09:06 Virtual

Far Ultraviolet (FUV) imagers on a satellite are used to observe thermospheric and ionospheric parameters, such as density (O, N_2, O_2, O/N_2, H), temperature (neutral and plasma) and auroral precipitation (characteristic energy and flux). The NASA TIMED, GOLD and ICON missions are now making concurrent observations, offering a unique opportunity to monitor the thermospheric variation in O/N_2 more comprehensively than is possible individually. However, the FUV radiances and thermospheric products from the missions need to be inter-calibrated or inter-compared. At the time of the writing of this abstract, a preliminary comparison shows that the morphology of the radiances and composition (O/N_2) are consistent between GOLD and TIMED/GUVI. But there are differences in their absolute values. The possible sources of the differences will be discussed. This intercomparison is an important and necessary step. By connecting GOLD and ICON measurements to TIMED/GUVI we can create a contiguous record of the behavior of the thermosphere.

SA037-10 - New Characteristics of Quasi-6-Day Wave Modulations in Ionosphere during the 2019 Antarctic Sudden Stratospheric Warming by Using Global Ionosphere Specification

Jia-Ting Lin et al
09:06 - 09:10 Virtual

This study investigates new characteristics of ionospheric variations driven by quasi-6-day wave (Q6DW) burst following a rare and intense Antarctic sudden stratospheric warming (SSW) in

September 2019. Local-time and vertical variations of amplitude and phase of Q6DW modulations of ionosphere during SSW are examined for the first time by using data-assimilated three-dimensional Global Ionosphere Specification (GIS) electron density. The GIS assimilates both FORMOSAT-7 radio occultation and ground-based GPS slant total electron content (TEC) to construct hourly electron density. The results show maximum amplitudes of Q6DW sit symmetrically ±20° off the magnetic equator ~12 LT followed a secondary peak at 17 LT. At 15 LT, the weakened amplitude and sudden phase shift of Q6DW suggests the ionosphere variations driven by multiple dynamo processes. Altitude-latitude structure shows Q6DW modulations extending beyond equatorial ionization anomaly, which indicates the dynamo effect should occur at higher latitudes off the equator. A plausible explanation is discussed based on interactions between Q6DW and other tidal winds leading to the phase differences and dynamo modulation.

Discussion
09:10 - 09:30 Virtual

Posters

SA036 - Drivers and Prediction of Variability in Earth's Ionosphere and Thermosphere: New Observations from Missions II Posters

Primary Convener: Thomas J Immel
04:00 - 20:59

Conditions in the near-Earth space environment are observed to be remarkably variable. The number of potential sources of forcing is large, extending from the troposphere and middle atmosphere to high latitude auroral and magnetospheric regions. Quantifying the sources of variability, and how they combine and couple in the ITM system, is a goal of several new observational campaigns: ICON, GOLD, SWARM, and COSMIC-2. These missions in combination with extant assets including TIMED, upstream solar-wind monitors, and a growing network of ground-based sensors provide an unprecedented capability for research efforts that are revealing a host of new system-level behaviors. This session will present first light and recent discoveries from these mission, and related advances made possible by a range of computational models and new machine-learning approaches. These crucial activities promise to advance the field of space environment prediction.

SA036-0001 - Atmospheric Tidal Study using ICON/MIGHTI Observations

Chihoko Y Cullens et al

Atmospheric tides have important roles in driving atmospheric coupling process from the lower atmosphere to the mesosphere, thermosphere, and ionosphere. NASA's Ionospheric Connection Explorer (ICON) satellite was launched on 10 October 2019 and has been observing atmospheric temperatures and winds in the latitude range of 10S-40N. Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI) is one of the instruments on ICON measuring temperature and winds. In this work, the first year of ICON/MIGHTI tidal observations will be presented for both migrating tides and non-migrating tides. In addition, results of Hough Mode

Extension (HME) using ICON tides in the latitude range of 10S-40N will be presented here. Results are compared to SD-WACCM-X simulations and also SABER observations.

SA036-0003 - A Survey of Daytime Ionospheric O^+ From ICON

Andrew W Stephan et al

The NASA Ionospheric Connection Explorer (ICON) was launched in October 2019. ICON includes an Extreme Ultraviolet (EUV) imaging spectrograph that measures the daytime ionospheric O^+ via altitude profiles of the OII 83.4 and 61.7 nm airglow emissions. The method is based largely on an algorithm developed at NRL for the Special Sensor Ultraviolet Limb Imager (SSULI), and evolved based on data collected by the Remote Atmospheric and Ionospheric Detection System (RAIDS) and the Limb-imaging Ionospheric and Thermospheric EUV Spectrograph (LITES) that both flew aboard the International Space Station at an orbit altitude of ~410 km. The ICON data represent the first application of this technique to a comprehensive set of measurements made across all local daytime sectors from a vantage point (orbit altitude ~600 km) above the bulk of the ionospheric content. However, these are also the first such measurements made during solar minimum conditions, a decidedly challenging environment for such a remote sensing approach. We will present a survey and assessment of these ICON measurements and ionospheric retrievals that have been made to date, across local times and through seasons in this first year of operations.

SA036-0006 - Comparison of ICON O^+ density profiles with electron density profiles provided by COSMIC-2 and ground-based ionosondes

Gilles Wautelet et al

In October 2019, NASA-ICON was launched to observe the low-latitude ionosphere using in-situ and remote sensing instruments, from a LEO circular orbit at about 595 km altitude. The six satellites of the radio-occultation program COSMIC-2 were also successfully launched and currently provide up to 3000 electron density profiles on a daily basis since October 1, 2019. Besides, the network of ground-based ionosondes is constantly growing and allows retrieving very accurate measurements of the electron density profile up to the peak altitude. These three sources of scientific observation of the Earth ionosphere therefore provide a very complementary set of data.

We compare O+ density profiles provided during nighttime by the ICON-FUV instrument and during daytime by the ICON-EUV instrument against electron density profiles measured by COSMIC-2 and ionosondes. Co-located and simultaneous observations are compared on statistical grounds, and the differences between the several methods are investigated. Particular attention is given to the most important variables, such as the altitude and the density of the F-peak, hmF2 and NmF2. The time interval considered in this study covers the whole ICON data availability period, which started on November 16, 2019. Manual screening and scaling of ionograms is performed to ensure reliable ionosonde data, while COSMIC-2 data are carefully selected using an automatic quality control algorithm.

A particular attention has been brought to the geometry of the observation, because the line-of-sight integration of both airglow and radio-occultation measurements assimilates horizontal and vertical gradients. As a consequence, the local density profiles obtained by inversion of the ICON and COSMIC-2 observation cannot be exactly assimilated to vertical measurements, such as vertical incidence soundings from ionosondes. This slightly limits the reach of the interpretation of the comparison between data of different origin. However, using similar observing geometries, the comparison of ICON and COSMIC-2 data does nevertheless provide very reliable and valuable comparisons.

SA036-0012 - New Temperature Observations in the Mesosphere and Lower Thermosphere from the MIGHTI Instrument on ICON

Michael H Stevens et al

NASA's Ionospheric Connection Explorer (ICON) satellite was launched on 10 October 2019 in order to study the complicated region of the Earth's upper atmosphere that is affected by both the space environment from above and terrestrial processes from below. One of the four instruments on ICON is the Michelson Interferometer for Global High-resolution Thermospheric Imaging (MIGHTI), which measures winds and temperatures on the limb between 12 S and 42 N in the mesosphere and lower thermosphere (MLT). Temperature measurements are made by imaging the O_2 A Band near 763 nm at three discrete wavelengths as well as a background at two wavelengths on either side of the A band. Temperatures at the tangent point are determined between 90-115 km by measuring the relative variation of A band emission at each altitude. The retrieval uses an onion peeling retrieval algorithm that removes contributions from overlying altitudes in order to isolate the emission originating from the tangent point. Here we present early temperature results from MIGHTI along with comparisons against empirical model results and existing datasets. Emphasis is placed on where the results deviate from our current understanding of temperatures in the MLT region.