2017 Workshop: Radar and optical observations

Long title
Using Radar and optical observations for studying the Earth’s upper atmosphere at low and mid latitudes
Conveners
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Description

This session will focus on new results from incoherent scatter radars, lidars and imagers to investigate coupling between different atmospheric regions and the influence of space weather events. Combined observations by incoherent scatter radars, active and passive optical instruments from Arecibo provide excellent opportunity to investigate ion-neutral interactions.. Furthermore, using data from instrumentation at geomagnetic conjugate points can help us to investigate how inter-hemispheric coupling occurs and potential differences based on seasonal conditions and asymmetries in the magnetic field characteristics With the upcoming NASA GOLD and ICON satellite missions, ground based support in the American sector from radars at Arecibo, Jicamarca, and Sao Luiz, and optical instruments will be key to complement the science goals of these space missions. We solicit short presentations that will address instabilities, ion-neutral coupling and dynamical processes in the E and F-region of the Earth’s atmosphere. Contributions dealing with physical and chemical processes in the low-/mid- latitudes are welcome.

Agenda

Mike Mendillo: Imaging Atmospheric Science at the Arecibo Observatory.

H. C. Carlson, F. T. Djuth, L. D. Zhang and S. Raizada: The Revolutionary new AO Plasma Line capability, plus optics, to tackle inter hemispheric coupling and thermal balance.

L. Waldrop, Y. Huang, and R. Kerr: Evidence for O+ radiative recombination as a source of 844.6 nm airglow emission at mid-latitudes.

Dave Hysell: Evidence for new ionospheric instabilities at middle latitudes. (pdf)

Q. Zhou and Y. Gong: Sudden stratospheric warming effects observed by the Arecibo incoherent scatter radar.

John Mathews: [[Media:2017CEDAR_MoPMworkshop_Mathews.pdf|The possible relationship between the meteoroid flux, sputtering, and high altitude metal layers}}.

T. Bullet and B. Isham, The Aguadilla Radio Array and the Puerto Rico Cubesat: Collaborators for Arecibo related science.

F. Rodrigues, Combing radar and optical observations for equatorial F-region irregularity studies .

E. Miller: MSTIDs over Puerto Rico.

Justification

1.Identify the relevant CEDAR Science Challenge that the workshop addresses:

The workshops aims at addressing (a) how the increase in the input energy during solar disturbances as in magnetic storms influences the topside and ionospheric regions of the Earth's atmosphere, (b) manifestations of ionospheric perturbations like Quasi-periodic echoes (QP) as seen in coherent and incoherent scatter radar and understanding the underlying physical mechanisms that drive these processes, (c) interaction between ion and neutrals in the mesosphere and the lower thermospheric region, (d) Influence of TIDs on the F-region, (e) significance of conjugate point observations • How the associated questions will be addressed: To address the above mentioned challenges recent progress made by the unique instrument cluster based on radio and optical techniques will be presented. The short talks will include observations using ISR, lidars, FPIs, and imagers that will sample different regions of the atmosphere.

• What resources exist, are planned and/or are needed: The most sensitive ISR at Arecibo along with lidars, FPIs and imagers at Arecibo have collected data from the E, F and topside region of the Earth's atmosphere. The results will be discussed to

advance our current knowledge regarding the coupling processes. • How progress should be measured: The progress will be measured by the data interpretation and analysis procedures.

2. Describe the relevance to the Strategic Plans and Decadal Survey

• 2011 CEDAR Strategic Plan

The instrument cluster at AO is being utilized to address the scientific goals as mentioned in Thurst 1 and 4 as listed below. Strategic Thrust 1. Encourage and undertake a systems perspective of geospace to understand global connectivities and causal relationships involving the SAIR and to determine their influences on the interaction region and the whole Earth system. Strategic Thrust 4. Develop observational and instrumentation strategies for geospace system studies capable of measuring system properties necessary to examine the coupling mechanisms and complexity within the Space-Atmosphere interaction region.

• 2012 Decadal Survey for Solar and Space Physics

The ISR data along with optical instruments at AO are well suited for investigation dynamical and coupling processes occurring in the different parts of the ionosphere/atmosphere. Data collected during solar/magnetic disturbed periods provide useful information regarding the response of the ionosphere and its neutral counterpart to external forcing as listed in the Key Science Goal 2. New and advanced ISR techniques developed recently at AO will shed new light on the fundamental processes in the Earth’s ionosphere, which fulfills key science goal 4 described below. Key Science Goal 2. Determine the dynamics and coupling of Earth’s magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs. Key Science Goal 4. Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe. The goals of the Workshop are also consistent with the scientific goals identified by the NRC Panel on Atmosphere-Ionosphere-Magnetosphere Interactions (AIMI). They are: AIMI Science Goal 1. Global Behavior of the Ionosphere-Thermosphere: How does the IT system respond to, and regulate magnetospheric forcing over global, regional and local scales? AIMI Science Goal 4. Plasma Neutral Coupling in a Magnetic Field: How do neutrals and plasma interact to produce multiscale structures in the AIM system?

• 2013 NSF Geospace Sciences Plan. The unique characteristics of Geospace (GS) and the complexities of the physical processes occurring in GS environment can be

studied with the combined radio and optical techniques. The workshops aims at focusing on short presentation that will address (a) fundamental plasma physics related processes occurring in the ionosphere that can ne studied using new plasma line techniques developed at Arecibo, (b) significance of continued observations using ISR, lidars and other optical instruments for understanding both short term and long scale processes influenced by solar events.

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