Sumedha Gupta

- ***Date of Birth:***

19th June 1989

- ***Field of research:***

1. Study of Earth's Ionosphere

(Ionospheric variability from below, due to metrological and lithospheric phenomena)

- Ionospheric precursor to Earthquake events during 2015-16
- Response to Sudden Stratospheric Warmings (2010 to 2015)

(Ionospheric variability due to space weather events)

- Response to Geomagnetic Storms across Indian latitudes

2. Study of Mars' Ionosphere

- ***Name of the institute:***

CSIR – National Physical Laboratory, New Delhi – India

- ***Pursuing degree:***

Ph.D. (Physical Sciences), August 2014 - Present

- ***Completed degree:***

M.Sc. Physics (Dept. of Physics & Astrophysics, University of Delhi), 2010-12

B.Sc. (H) Physics (Hindu College, University of Delhi), 2007-10

- ***Trainings:***

Project Associate at CSIR – National Physical Laboratory, New Delhi – India, in Department of Space's (Government of India) project entitled "Comparative study of Space Weather at Terrestrial Planets" (Nov 2012 – Aug 2014)

- ***Publications:***

Upadhayaya, A. K., **S. Gupta** and K. Mahajan, Observations of sudden large scale upward displacements of the Martian ionosphere, *Geophys. Res. Lett. (Communicated)*

Upadhayaya, A. K., **S. Gupta**, and P. S. Brahmanandam (2016), F2 region response to geomagnetic disturbances across Indian latitudes: O (^{1}S) dayglow emission, *J. Geophys. Res. Space Physics, 121, doi:10.1002/2015JA021366 (Accepted)*

Upadhayaya, A. K., **S. Gupta** (2014), A Statistical Analysis of Occurrence Characteristics of Spread-F Irregularities over Indian Region, *J. Atmos. Sol. Terr. Phys, 112, 1-9 (Published)*

Under Preparation

Anomalous Ionospheric variations prior to major Earthquakes during 2015-16 affecting Indian low latitude station Delhi

Reanalysis of morphology of Ionospheric F2 region variability related to Sudden Stratospheric Warmings 2010-2015

Ionospheric response to X class flares for low latitude Indian station Delhi

- ***Oral presentation***:

Oral presentation on "Martian Ionospheric Variability: Longitude Dependence" at **15th PLANEX Workshop** on "Mars and Moon: Remote Sensing and Analogue studies", *Physical Research Laboratory, Ahmedabad, India, during 04-10 January 2015.*

- ***Poster presentations***:

"Morphology of Ionospheric F2 region variability related to Sudden Stratospheric Warming events (2010-2015)", 19th National Space Science Symposium (**NSSS 2016**), *Thiruvanthapuram, Kerala, India, 9-12 February 2016.*

"Martian Ionospheric Variability: Longitude Dependence", **National Science Day**, *CSIR – National Physical Laboratory, New Delhi, India, 3rd March 2015.*

"Martian Ionospheric Variability: Longitude Dependence" at **15th PLANEX Workshop** on "Mars and Moon: Remote Sensing and Analogue studies", *Physical Research Laboratory, Ahmedabad, India, during 04-10 January 2015.*

"A Statistical Analysis of Occurrence Characteristics of Spread-F Irregularities over Indian Region", at 18th National Space Science Symposium (**NSSS 2014**), *Dibrugarh, Assam, India, 29th January to 1st February 2014.*

- ***Schools/Workshops Attended***:

Participant at CCMC "Introduction to Space Weather: Concepts and Tools" School, *Goa, India, 24-29 January 2016*.

Participant at International School on Equatorial and Low-latitude Ionosphere (ISELION 2015), *Bandung, Indonesia, 16-20 March, 2015*.

15th PLANEX Workshop on "Mars and Moon: Remote Sensing and Analogue studies", *Physical Research Laboratory, Ahmedabad, India, during 04-10 January 2015.*

- ***Purpose of study in the research field:***

Ionosphere, the ionized layer of the atmosphere extending from ~80 to 600 km, has various applications in the field of communication and navigation due to its ability to reflect back radio signals. Any variability introduced in the ionosphere, can greatly disrupt these systems, affecting the HF link and maximum useable frequencies (MUF) between the stations. Sun being the main driving force, shows peculiar spectrum irradiance. 90% of its flux, which is visible and IR, remains constant, whereas the other 10% of its flux, which is UV and X-ray, responsible for causing ionization at ionospheric levels, show high variability. This variability can be periodic (space climate) or transient (space weather), accordingly affecting the ionosphere. Solar wind can also perturb the ionosphere, as its particle density may increase 200 times and speed 5 times (200-1000 km/s) during high activity events. Though much has been studied about space climate, not many models are available to study space weather. Thus it becomes important to study the effect/response of ionosphere due to these geomagnetic storms and space weather events.

However, ionosphere is not constant. It shows normal day-to-day and hour-to-hour variability even under quiet solar and geomagnetic conditions. Some of this variability can be attributed to events originated in the lower atmosphere. Thus, apart from considering solar activity and solar phenomena associated with ionospheric variability, we also need to consider metrological (Sudden Stratospheric Warming) and lithospheric (Earthquake) events, which can equally perturb the ionosphere.

While studying ionosphere and its variability introduced due to different factors, both from above and below, it also becomes important to understand how it behaves in the absence of a global intrinsic magnetic field. Since space weather agents at Earth influence its magnetosphere, while they directly interact with the ionosphere of Mars, Mars' ionosphere is more vulnerable, tenuous and dynamic, and presents a picture how ionosphere behaves if it's not protected by a magnetic field, like that present on Earth. In this respect, it becomes important to understand and examine the characteristics of Mars' ionosphere.

Combining all these factors (ionospheric variability due to space weather, metrological, lithospheric events, and also in the absence of a global intrinsic magnetic field), we will be able to provide inputs to the models, to better our predictions and to understand the characteristics and behavioural patterns of ionosphere under varied magnetic and solar conditions, along with contributions from below.

My research work involves:

Response to geomagnetic disturbances across Indian latitude

I am studying the morphology of ionospheric storms across equatorial (Thiruvananthapuram) and low latitude (Delhi) stations of Indian region. The deviation in ionosonde derived F2 region characteristic parameters (foF2 and h'F) along with changes in O/N_2 ratio and GLOW modelled O (^1S) greenline dayglow emission intensities, are examined during geomagnetic storm events. Values are also compared with IRI-2012 model. Changes in the neutral composition are examined, which affect the ionosphere during the storms.

Pre-earthquake ionospheric anomaly

I am studying the ionospheric response to earthquake events of 2015-16, which affected the low latitude Indian city, Delhi, using Digisonde data installed at this observing station. It is observed that the F2 layer critical frequency, foF2 showed anomaly within one week prior to these events, even for the case when the monitoring station was much outside the earthquake preparation zone. F2 layer peak electron density is found to increase by even 120%, showing that lithospheric events need to be considered while studying ionospheric behaviour and variations.

Sudden Stratospheric Warming

I am studying response of metrological phenomena like Sudden Stratospheric Warming (SSW) on ionosphere, using Delhi and Japanese ionosonde data. This study is performed by studying variations of F2 layer critical frequency (foF2) and

height (hF) during SSW events from 2010 to 2015. Since any such variation could not be attributed to SSW alone in view of normal day-to-day and hour-to-hour variability which exists in the F2 region even at times when there are no SSWs and solar and magnetic indices are quite stable and close to their lowest values, it becomes difficult to quantify the changes as well as the response times in the ionosphere due to these stratospheric warmings. I am studying such variation cycles and trends.

Martian Ionosphere

I am examining 5600 electron density profiles collected by Mars Global Surveyor, examining the response of Mars ionosphere to changes in solar wind conditions, the depressed nature of plasma density profiles and plasma density profiles of magnetic anomaly regions. The variability in peak parameters (height and density) on the same day for the same zenith angle is seen in these profiles, which requires investigation. The longitudinal variations of observed (Nm, Hm) and derived (TEC, Scale height) E and F layer parameters is also an important issue to be further investigated.

Other details:

- ***Awards & Honour (i.e.NET/SLAT/JEST/GATE/Any equivalent)***:

Qualified GATE (Physics) in 2013 with 400 score.

- ***Computer Operating and/or Programming Skill:***

Proficient in C, C++, Java, MS Excel, Sigmaplot.

Basic knowledge of IRAF, Latex.

- ***Language Skill:***

Fluent in English & Hindi.

- ***Permanent communication address:***

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Bareilly -243001

Uttar Pradesh, India

- ***Secondary communication address:***

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- ***Permanent e-mail address:***

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Sumedha Gupta is a research scholar at one of the prestigious R&D labs of India, CSIR – National Physical Laboratory, Delhi. With her B.Sc. (H) and M.Sc. degrees in Physics from University of Delhi, Sumedha is currently involved in the study of ionospheric variability at Earth and Mars. Apart from studying the space weather effects on these terrestrial ionospheres, she is also looking into the response of Earth's ionosphere to metrological phenomenon of Sudden Stratospheric Warming (SSW), and also to lithospheric event like Earthquakes, in view of the fact that variability exists in the ionosphere even under quiet solar and geomagnetic conditions, which could be attributed to events from below.

With proficiency in C, C++, Java languages, she is working on 5600 electron density profiles collected by NASA's Mars Global Surveyor Mission, to study the longitudinal characteristics of its ionosphere, magnetic anomaly regions and

depressed nature of its electron density profiles. She is working on the Digisonde system installed at New Delhi, India to study the variations in F2 layer critical parameters (fof2, h'F), to study the pre-earthquake ionospheric anomalies to earthquake events of 2015-16 which affected the low latitude Indian station, Delhi. Also, she is using it; along with the GUVI data (TIMED satellite) to study O/N_2 and GLOW model for O (^1S) greenline dayglow emission intensities, to understand neutral composition variation during these storms.

She has been a part of many national/international conferences/workshops, including CCMC's school "Introduction to Space Weather: Concepts and Tools", Goa, India, 24-29 January 2016. They have been helpful in extending her research further.