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Research Interests :

I am an ionospheric physicist who uses radio techniques to study the Earth's and Planetary ionospheric & atmospheric system. My research interest involves :

- Use of **Radio Occultation (RO)** technique to study Planetary and the Earth's Ionosphere & atmosphere
- Use of **Radio signals from GSAT** and GPS signals to study the Earth's ionospheric system and its response to the space weather events
- Development of **ionospheric model** (both the first-principle, and data based semi-empirical models) for Indian low latitude region.
- Use of **coherent backscatter VHF/ HF radar** to study the Earth's electrodynamics
- Study of **atmospheric dynamical processes** like QBO, ENSO**,** gravity waves, convection processes etc to study coupling between the Earth's different atmospheric regions.

Educations :

1. **Ph.D.** University of Delhi, New Delhi, India, 1999
   Work at National Physical Laboratory(NPL-CSIR), New Delhi
   Thesis title: A Study of the tropical E-region field aligned irregularities using Indian MST radar.
2. **M.Sc.** (Physics) University of Delhi 1991
3. **B.Sc.** (Physics), Ranchi University, Ranchi, Jharkhand 1988

Professional Experience :

- Jan 2014 - till date Scientist/Engr SF, SPL, VSSC
- Dec 2007 – Dec 2013 Scientist/Engr. SE, SPL, VSSC
- Aug 2004 – Nov 2007 Professional Research Associate, ISAS, Sakkatoon, Canada
- Jan 2002 - July 2004 Postdoctoral Fellow, Univ. of Western Ontario, London, Canada

- Dec 1999 – Dec 2001 Research Associate, NPL, New Delhi
- Dec 1998 – Nov 1999 Extended SRF (CSIR), NPL, New Delhi
- Nov 1997 – Nov 1998 Project Associate, NPL, New Delhi
- Nov 1994 – Oct 1997 SRF (CSIR), NPL, New Delhi
- Nov 1992 – Oct 1994 JRF (CSIR-NET), NPL, New Delhi

New Initiatives after joining ISRO :

- Initiated, for the first time in India, the **use of satellites' radio signals** in **Radio Occultation** mode to study the ionosphere and atmosphere at Moon and other planets :
  - ✔ successfully demonstrated how the single frequency **S-band radio signals can be used to study the ionosphere at the Moon**. Results were published in a prestigious journal "Geophysical Research Letters (GRL)" of American Geophysical Union
  - ✔ **RAMBHA-DFRS,** a dual frequency radio science experiment **on Chandrayaan-II Orbiter and Lander**. I am the Principal Investigator of this payload
  - ✔ As a co-investigator of **Akatsuki (Japanese Satellite)** Radio Science team, initiated observations of ionosphere and atmosphere at Venus using Indian Deep Station Network (IDSN), Byallau, Bangalore.

- Initiated a new science program in SPL to study and model the impact of space weather events over Indian ionospheric region. The science program, called **InSWIM** (Indian network for Space Weather Impact Modeling), has currently ten established stations at Trivandrum, Bangalore, Hyderabad, Bhopal, New Delhi, Hanle, Pune, Kadapa, Port-blair, and Kavaratti where multi-channel, maulti-frequency GPS/ GSAT receiver systems are monitoring round-the-clock variations in the Indian ionospheric region.

- Initiated a science program, called **EcSES** (Energetc coupling between Sun-Earth System), to study the impact of solar dynamics on the near Earth space environment. Under this plan, multi-channel, multi-frequency GPS/GSAT receiver system has been placed at Bharti, in Antarctica. A similar system is planned to be established at Himadri, in Arctic region as well.

- Initiated the development of a first-principle ionospheric model suitable for the Indian low latitude ionospheric region. In its first phase, a quasi-two dimensional ionospheric model has been developed which includes photochemical and energetic plasma impacts on the production of ions. Work on the development of a three dimensional model has started. Over last six decades of ionospheric research in India, this is the first time that an attempt has been made to develop a theoretical model suitable for Indian ionospheric region

Professional Responsibilities :

- **Principal Investigator** : **RAMBHA-DFRS** (Dual Frequency Radio Science) experiment on the Chandrayaan-II Lander and Orbiter
- **Co- Investigator** : **Akatsuki (Japanese mission to Venus) Radio Science**

experiment for the study of ionosphere and atmosphere of Venus

- **Principal Investigator** : **InSWIM** (Indian network for Space Weather Impact Modeling), a science project of SPL, VSSC
- **Principal Investigator** : **EcSES** (Energetic coupling between Sun-Earth system)

Academic Responsibilities :

Ph. D. thesis supervision
Completed : 02
Ongoing : 01

M. Phil thesis supervision
Completed : 01

M. Tech Project supervision
Completed : 03

M. Sc. Project supervision
Completed : 05

Ph.D. Students :

- Dr Ambili K.M. (2008 – 2013) Scientist, SPL, VSSC
- Dr Shreedevi P.R. (2012-2017) PDF, SPL, VSSC
- Mr Harikrishnan V. (2016-2017) Scientist, BARC
- Mr Keshava R. Tripathi (Ongoing)

Other Responsibilities :

1. **Convener,** Inter – Center Experts' Committee for VHF Radar at SPL
2. **Member, Technical Review committee**, GPS-ROS for Megha-Tropiques (ROSA)
3. **Member, Algorithm Working Group**, GAGAN
4. **Member, Technical Review Committee**, GROS for Megha-Tropiques
5. **Member, Technical Review Committee**, Operationalization of GPS radiosonde for GSLV-PSLV
6. **Member, Academic Committee**, SPL
7. **Chair, Indian National URSI Commission - E**

Awards and Honors :

Name of Award	Organization	Year awarded
National Merit Scholarship	Govt. of Bihar	1981
CSIR/UGC NET	CSIR, India	1991
Post-Doctoral Fellowship	NSERC, Canada	2002

Highlights of the scientific work :

1. Initiated in India the use of **satellite TTC radio signals** to study **planetary ionosphere** and atmosphere using Using **Radio Occupation technique**. Using measurements from Chandrayaan-I S band radio signals, proved the existence of ionosphere at Moon and proposed them to be of molecular origin (*GRL, 2016*).
2. Developed a novel Ionospheric Total Electron Content (TEC) model, **known as the ISRO-TEC model,** which was successfully used to accurately predict the temporal variations in TEC over the Indian region and **generate super-truth data for the GPS Aided Geo-Augmented Navigation (GAGAN) system for application in civil aviation sector**
3. Initiated a national level program **InSWIM** (**I**ndian **n**etwork for **S**pace **W**eather **I**mpact **M**odeling) to study impact of the space weather events on Indian low latitude ionospheric region. This program will be in great aid to India's own Satellite navigation program **NAVIC (NAV**igation with **I**ndian **C**onstellation**)**.
4. Used Indian MST Radar, Gadanki, to study the field aligned irregularities in the E-region of the Earth's ionosphere at low latitudes. Some of important results, discovered for the first time, were
    - the existence of **Field aligned irregularities** at the low latitudes E-region during daytime (*GRL, 1996*). It was earlier believed that such irregularities during daytime existed only in the electrojet region.
    - **Quasi-periodic** (**QP**) occurrence of field aligned irregularity **echoes** at low latitude regions during night. Such irregularity structures were earlier believed to be a mid latitude specific phenomenon (*JGR, 1999; 2005*)
    - daytime existence of meter scale size plasma irregularities at the F1 region of the Earth's ionosphere (**150-km echoes**). It was earlier believed be an exclusive **the dip-equator** phenomena (GRL, 2004).
    - demonstrated how the **VHF radar returned signal**s observed outside the electrojet belt can **provide useful means to study the metallic ion layer** variability in the earth's ionosphere (GRL,2008).
5. Used observations from VHF Radar at Phonpei, an equatorial station located in the Pacific Ocean, to study the phase velocity of radar echoes from the electrojet region (~100 – 110 km altitude). For the first time the theoretical explanation were given for the observations of **phase velocity of two-stream Farley-Bunmann waves exceeding 400 m/s**, well above the isothermal ion acoustic speed, during strong electrojet conditions (*JGR, 2003*).
6. During the annular solar eclipse event of 15 January 2010, used an ionosonde at Trivandrum to show, for the first time, experimental cum analytical evidence for the reversal of zonal electric within the electrojet region leading to the creation of a **reverse fountain effect which suppresses the Equatorial Ionization Anomaly (EIA).** Such reverse fountain led to the severe impacts on the distribution of plasma in entire low latitude ionospheric region (*JGR, 2011*).
7. Using measurements from Ionosonde at Trivandrum, during the solar eclipse of 2010, showed how the electrodynamical plasma processes lead to the occurrence of the double Pre-Reversal Enhancement (PRE) in the equatorial F-region at the time of maximum solar obscurity during an annular solar eclipse (GRL, 2011). PRE is a post-evening phenomena.
8. Using an Ionosonde at Trivandrum, and incoherent backscatter radar at Jicaramca, we

conclusively proved that the Pre-Reversal **Enhancement in the height of F-region Peak electron density during pre-sunrise** period is purely a **chemical effect** and electrodynamics plays only a secondary role, if any. Since last six decades, PRE during pre-surise period was believed to be an aftereffect of electrodynamics processes (GRL, 2013, 2014).

9. Used the Indian MST Radar in the discovery of **sporadic ionization associated with Kelvin-Helmholtz (KH) billows. D**emonstrated, for the first time, how the **breaking of an originally uniform sporadic E layer into pieces by the Kelvin Helmholtz billows resulted in the quasi-periodic alignments of field aligned irregularities** (*JGR 2005*).
10. Demonstrated **the ionospheric impact on the temperature** measured by GPS based **Radiosonde**s, particularly in the low latitude regions. It was shown that the atmospheric temperature, estimated by GPSsondes, were varying in unison with the Total Electron Content of the ionosphere (GRL, 2013). This result would have a **great impact on the studies related to climate change and global warming.**

Publications :

2018

✔ On the relative roles of the neutral density and photo chemistry on the solar zenith angle variations in the V2 layer characteristics of the Venus ionosphere under different solar activity conditions, Ambili K.M., Sneha Susan Babu, and R. K. Choudhary, **Icarus**, 2018 (under review)

✔ MAVEN observations of the response of Martian ionosphere to the interplanetary coronal mass ejections of March 2015, Thampi S.V, Krishnaprasad C., Anil Bhardwaj, Yuni Lee, R. K. Choudhary and T. K. Pant, J**ournal of Geophysical Research – Space Physics** , https://doi.org/10.1002/ 2018JA025444, 2018

2017

✔ Impact of oscillating IMF B z during 17 March 2013 storm on the distribution of plasma over Indian low-latitude and mid-latitude ionospheric regions. Shreedevi, P. R., & R. K. Choudhary, ***Journal of Geophysical Research: Space Physics*****,** 122, 11,607 –11,623. https://doi.org/10.1002/ 2017JA023980, 2017

✔ Impact of sudden stratospheric warming of 2009 on the equatorial and low-latitude ionosphere of the Indian longitudes: A case study. Yadav, S., T. K. Pant, R. K. Choudhary, C. Vineeth, S. Sunda, K. K. Kumar, and S. Mukherjee; ***Journal of Geophysical Research: Space Physics*****,** 122. https://doi.org/10.1002/2017JA024392, 2017

✔ A study on the evolution of plasma bubbles using the single station-multisatellite and multistation-single satellite techniques, Unnikrishnan, K., H. Sreekumar, R. K. Choudhary, V. M. Ashna, K. M. Ambili, P. R. Shreedevi, ***Journal of Geophysical Research : Space Physics*****,** 122, 3678–3688, doi:10.1002/2016JA023503, 2017

✔ Initial performance of the radio occultation experiment in the Venus orbiter mission. Imamura, T., Ando, H., Tellmann, S., Pätzold, M., Häusler, B., Yamazaki, A., Sato, T.M., Noguchi, K., Futaana, Y., Oschlisniok, J., Limaye, S., R. K. Choudhary, et al, ***Earth, Planets and Space***, *69* (1), p.137., 2017

2016

✔ On the origin of the ionosphere at the Moon using results from Chandrayaan-1 S-Band Radio Occultation Experiment and a photochemical model; R. K. Choudhary, K. M. Ambili, S. Choudhury, M. B. Dhanya, and A. Bhardwaj, **Geophys. Res. Letters,** 2016GL069557, 2016.

✔ On the latitudinal changes in ionospheric electrodynamics and composition based on observations over the 76-77°E meridian from both hemispheres during a geomagnetic storm*,* Shreedevi P.R., S.V. Thampi, D. Chakravorty, R. K. Choudhary, T. K. Pant, and A. Bhardwaj, **J. Geophys. Res. (Space Physics)***, 121,* doi:10.1002/2015JA021841*,* 2016

✔ Equatorial electrojet in the Indian region during the geomagnetic storm of 13–14 November 1998, H. Chandra, R. G. Rastogi, R.K. Choudhary, and S. Sharma, **Journal of Earth System Science**, *125*(3), pp.669-675, 2016.

✔ Direct observational evidence for disturbance dynamo on the daytime low-latitude ionosphere: A case study based on the 28 June 2013 space weather event, Thampi, S. V., P. R. Shreedevi, R. K. Choudhary, T. K. Pant, D. Chakrabarty, S. Sunda, S. Mukherjee, and A. Bhardwaj, **J. Geophys. Res. (Space Physics),** 121, 10,064–10,074, 2016

✔ Space Weather Research: Indian Perspective; Bhardwaj, A., T. K. Pant, R. K. Choudhary, D. Nandy, and P. K. Manoharan, **Space Weather,** 14, 2016

2015

✔ Impact of the perturbation zonal velocity variation on the spatio/temporal occurrence pattern of L band scintillation — A case study, Bagiya, M. S., R. Sridharan, S. Sunda, L. Jose, T. K. Pant, and R. Choudhary. **J. Geophys. Res. Space Physics**, 120, 5882–5889, doi:10.1002/ 2015JA021322, 2015.

✔ Indications of a strong dynamical coupling between the polar and tropical regions during the sudden stratospheric warming event January 2009, based on COSMIC/FORMASAT-3 Satellite temperature data. **Atmospheric Research**, DOI:. doi:10.1016/j.jastp.2014.10.007, 2015

✔ Refinement of the background ionospheric conditions and plausible explanation based on neutral dynamics for the occurrence/non-occurrence of L-band scintillation patches against forecast. **Journal of Atmospheric and Solar-Terrestrial Physics**, *133*, pp.18-24, 2015

✔ Impact of the perturbation zonal velocity variation on the spatio/temporal occurrence pattern of L band scintillation—A case study. **Journal of Geophysical Research: Space Physics**, *120*(7), pp.5882-5889, 2015

2014

✔ Seasonal differences in the sunrise undulations at the dip equator at solar minimum at two distinct locations and their relation with post-sunset electrodynamics; Ambili K.M, R. K. Choudhary, and J.-P. St-Maurice, **J. Geophys. Res.**, doi:2014JA019783, 2014.

✔ First results on forecasting the spatial occurrence pattern of L-band scintillation and its temporal evolution. **Journal of Atmospheric and Solar-Terrestrial Physics,** 119, 53-62, 2014.

✔ Critical assessment of the forecasting capability of L-band scintillation over the magnetic equatorial region–Campaign results. **Journal of Atmospheric and Solar-Terrestrial Physics,** 110, 15-22, 2014.

2013

✔ Nighttime vertical plasma drifts and the occurrence of sunrise undulation at the dip equator: A study using Jicamarca incoherent backscatter radar measurements. Ambili, K.M., Choudhary, R.K., St-Maurice, J.P. and Chau, J.L., **Geophysical Research Letters**, *40*(21), pp.5570-5575, 2013.

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✔ Absence of streaming plasma waves around noontime over Thumba in recent times: Is it related to the movement of the dip equator?, R. Sekar et al, **J. Atmos. Sol.-Terr. Phys.**, 2013, http://dx.doi.org/ 10.1016/ j.jastp.2013. 02.005

2012

✔ Absence of streaming plasma waves around noontime over Thumba in recent times: Is it related to the movement of the dip equator?, R. Sekar et al, **J. Atmos. Sol.-Terr. Phys.**, 2013, http://dx.doi.org/ 10.1016/ j.jastp.2013. 02.005

✔ On the sunrise oscillation of the F region in the equatorial ionosphere, K. M. Ambili, J.-P. St.-Maurice, and R.K. Choudhary, **Geophys. Res. Lett.,** 39, L16102, doi:10.1029/2012GL052876, 2012.

2011

✔ Impacts of the January 15, 2010, annular solar eclipse on the equatorial and low latitude ionospheric densities; R.K. Choudhary, J.-P. St.-Maurice, K.M. Ambili,

Surendra Sunda, and B.M. Pathan, **J. Geophys. Res.**, 116, doi: 10.1029/ 2011JA016504, 2011.

✔ Temperature perturbations in the troposphere-stratosphere over Thumba (8.5◦ N, 76.9◦ E) during the solar eclipse 2009/2010 K. V. Subrahmanyam, G. Ramkumar, K. K. Kumar, D. Swain, S. V. Sunil Kumar, S. S. Das, R. K. Choudhary, K. V. S. Namboodiri, K. N. Uma, S. B. Veena, S. R. John, and A. Babu; **Annales Geophy**., 29, 275 - 282, 2011.

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2009

✔ Solar eclipse induced E-region plasma irregularities observed by the Gadanki Radar, A.K. Patra, R.K. Choudhary, and J.P. St. -Maurice, **Geophys. Res. Lett**., 36, doi: 10.1029/2009GL038669, 2009.

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2007

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2006

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2003

✔ Correction to : Fast type-I waves in the equatorial electrojet: evidence for non-isothermal ion-acoustic speeds in the lower E region; R. K. Choudhary, and J.-P. St.-Maurice; **J. Geophys. Res.**, 108, A8, 1325, doi: 10.1029/2003JA010072, 2003.

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