

RAJ KUMAR CHOUDHARY

Sci/ Engr. SG

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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 2020 – till date , Scientist/ Engr. SG, SPL, VSSC
- Jan 2014 – Dec 2019, 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, multi-frequency GPS/ GSAT receiver systems are monitoring round-the-clock variations in the Indian ionospheric region.
- Initiated a science program, called **EcSES** (Energetic 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
- **Principal Investigator** : **RAVI** (Radio Anatomy of Venus Ionosphere) experiment

- **Co- Investigator** : shortlisted for Venus Orbiter Mission, ISRO
: **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 : 02

M. Phil thesis supervision

Completed : 01

M. Tech Project supervision

Completed : 03

M. Sc. Project supervision

Completed : 07

Ph.D. Students :

- Dr Ambili K.M. (2008 – 2013) Scientist, SPL, VSSC
- Dr Shreedevi P.R. (2012-2017) PDF, Beihang University, Beijing, China
- Mr Harikrishnan V. (2016-2017) Scientist, BARC
- Mr Keshava R. Tripathi (2018 - Ongoing)
- Ms Richa N. Jain (2020 - Ongoing)

Other Responsibilities :

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

Awards and Honors :

<u>Name of Award</u>	<u>Organization</u>	<u>Year awarded</u>
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 **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** (Indian **network for Space Weather Impact Modeling**) 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** (**NAVigation with Indian Constellation**).
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 signals** 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 obscuration 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-sunrise 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**. Demonstrated, 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 **Radiosondes**, 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**.

List of Publications of R.K. Choudhary:

- 2020
- ✓ Geomagnetic storm induced plasma density enhancements in the southern polar ionospheric region : a comparative study using St. Patrick's day storms of 2013 and 2015, Shreedevi P.R, R. K. Choudhary, et al., **Space Research** (under review)
 - ✓ One Dimensional Photo-Chemical Model (1D-PCM) for the Venusian Ionosphere, Ambili, K.M., Sneha S. Babu, and R.K. Choudhary; **MethodsX**, (Under review).
 - ✓ Reverse fountain and the nighttime enhancement in the ionospheric electron density over the equatorial region: A case study; Yadav, Sneha, R. K. Choudhary, Jyoti Kumari, Surendra Sunda, P. R. Shreedevi, and Tarun K. Pant. **Journal of Geophysical Research: Space Physics**: e2019JA027286.
 - ✓ Mid-latitude Spread-F structures over the geomagnetic low-mid latitude transition region: An observational evidence; Sivakandan, M., S. Mondal, S. Sarkhel, D. Chakrabarty, M. V. Sunil Krishna, P. Pavan Chaitanya, A. K. Patra et al. **Journal of Geophysical Research: Space Physics**: e2019JA027531.
 - ✓ Thermal structure of the Venusian atmosphere from the sub-cloud region to the mesosphere as observed by radio occultation; Ando, H., Imamura, T., Tellmann, S., Pätzold, M., Häusler, B., Sugimoto, N., Takagi, M., Sagawa, H., Limaye, S., Matsuda, Y. and Choudhary, R.K., ; **Nature Scientific reports**, 10(1), pp.1-7.
 - ✓ A comparative study of non-thermal parameters of the X-class solar flare plasma obtained from cold and warm thick-target models; error estimation by Monte Carlo simulation method; Kumar, P., Choudhary, R.K., Sampathkumaran, P. and Mandal, S., 2020. **Astrophysics and Space Science**, 365(1), p.18.
 - ✓ Dual Frequency Radio Science experiment onboard Chandrayaan-2: a radio occultation technique to study temporal and spatial variations in the surface-bound ionosphere of the Moon; Choudhary, R.K., Bindu, K.R., Harshit, K., Karkara, R., Ambili, K.M., Pant, T.K., Shenoy, D., Kumar, C., Reddy, N., Rajendran, T.K. and Nazer, M., 2020. **Current Science (00113891)**, 118(2).
- 2019
- ✓ The role of the phase of QBO in modulating the influence of the SSW effect on the Equatorial Ionosphere, Sneha Yadav, C. Vineeth, K. Kishore Kumar, R.K. Choudhary, T.K. Pant, and S. Sunda; **Journal of Geophysical Research**, 124, 6047-6-63, 2019
 - ✓ Morphological study on the ionospheric variabilities at Bharati, a polar cusp station in the southern hemisphere. Shreedevi P. R., and R. K. Choudhary, **Journal of Atmospheric and Solar-Terrestrial Physics**, 193,105018, 2019
- 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**, 321, 661-670, 2018
 - ✓ Variation of the TEC at a dip equatorial station, Trivandrum and a mid latitude station, Hanle during the descending phase of the solar cycle 24 (2014–2016). Shreedevi, P.R., R.K. Choudhary, S. Yadav, S. Thampi, and A. Ajesh; **Journal of**

Atmospheric and Solar-Terrestrial Physics, 179, pp.425-434, 2018

- ✓ 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, **Journal 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 electrodynamic; 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.
 - ✓ Ionospheric impact on the geopotential height profile of the temperature by balloon-borne GPS radiosondes, Choudhary, R. K., K. Rajeev, K. Krishna Moorthy, and R. Sridharan, **Geophys. Res. Lett.**, 40, 239–244, doi:10.1029/2012GL054359, 2013.
 - ✓ 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 Geophys.**, 29, 275 - 282, 2011.
- ✓ Local electrodynamics of a solar eclipse at the magnetic equator in the early afternoon hours, J.P. St.-Maurice, K. M. Ambili, and R. K. Choudhary, **Geophys. Res. Lett.**, 38, L04102, doi:10.1029/2010GL046085, 2011.
- 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.
 - ✓ Daytime low latitude quasi-periodic echoes at gadanki: Understanding of their generation mechanism in the light of their Doppler Characteristic, A.K. Patra, N.V. Rao, and R. K. Choudhary, **Geophys. Res. Lett.**, 36, doi: 10.1029/2008GL036670, 2009
- 2007
- ✓ The influence of non-isothermal electrons and neutral wind structures on the Doppler properties of vertical m-size field aligned irregularities in the low latitude E-region; J.P. St.-Maurice and R.K. Choudhary, **Revisita Brasileira de Geofísica**; 25(2), 95-103, 2007.
- 2006
- ✓ Gadanki radar observations of daytime E Region echoes and structures extending down to 87 km; A.K. Patra, S. Sripathi, P.B. Rao, and R.K. Choudhary; **Annales Geophys.**, 24, 1861-1869, 2006
 - ✓ East-west and vertical spectral asymmetry associated with equatorial type-I waves during strong electrojet conditions: II. Theory; J.-P. St.-Maurice, and R.K. Choudhary; **J. Geophys. Res.**, 111, doi: 10.1029/ 2006JA011843, 2006
 - ✓ East-west and vertical spectral asymmetry associated with equatorial type-I waves during strong electrojet conditions: I. Pohnpei radar observations; R.K. Choudhary, J.-P. St.-Maurice, W.L. Ecklund and R.T. Tsunoda; **J. Geophys. Res.**, 111, doi: 10.1029/ 2006JA011842, 2006
 - ✓ Local ionospheric electrodynamics associated with neutral wind fields at low latitudes: Kelvin-Helmholtz billows; J. P. St.-Maurice, and R. K. Choudhary; **Annales Geophys.**, 24, 1367-1374, 2006
- 2005
- ✓ Quasi-periodic backscatters from the E-region at Gadanki: evidence for Kelvin-Helmholtz billows in the lower thermosphere? ; R.K. Choudhary, J.-P. St.-Maurice, L. Kagan and K K Mahajan; **J. Geophys Res.**, 110, doi:10.1029/2004JA010987, 2005.
- 2004
- ✓ Observation of coherent echoes with narrow spectra near 150 km altitude during daytime away from the dip-equator; R.K. Choudhary, J.-P. St-Maurice, and K K Mahajan; **Geophys. Res. Lett**, 31, L19801, doi: 10.1029/ 2004GL 020299, 2004.
- 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.
 - ✓ Fast type-I waves in the equatorial electrojet: evidence for non-isothermal ion-acoustic speeds in the lower E region; J.-P. St.-Maurice, R.K. Choudhary, W.L. Ecklund and R.T. Tsunoda; **J. Geophys. Res.**, 108, A5, 1170, doi: 10.1029/

2002JA009648, 2003

- 2002 ✓ Observable signatures of convectively generated wave field over tropics using Indian MST radar at Gadanki (13.5° N, 79.2° E); S.K. Dhaka, R.K. Choudhary, S. Malik, Y. Shibagaki, M.D. Yamanaka, and S. Fukao, **Geophys. Res. Lett.**, 29 (18), doi: 10.1029/2002GL014745, 2002
- ✓ Revisiting the Stratospheric Fountain hypothesis using UARS/HALOE data., J. Kar, R.K. Choudhary, and K.K. Mahajan, **Advances in Space Res.**, 29 (11), 1725-1729, 2002.
- < 2001 ✓ Indian MST radar observations of Gravity wave activities associated with tropical convection., S.K. Dhaka, P.K. Devrajan, Y. Shibagaki, R.K. Choudhary, and S. Fukao, **J. Atmos. Sol. Terr. Physics**, 63, 1631 - 1642, 2001.
- ✓ Detection of Kelvin-Helmholtz instability with the Indian MST radar: a case study. Sachchidanand Singh, K.K. Mahajan, R.K. Choudhary and O.P. Nagpal **J. Geophys. Res.**, 104, 3937 - 3945, 1999.
- ✓ Tropical E-region field aligned irregularities: Simultaneous observations of continuous and quasi-periodic echoes., R.K. Choudhary, and K.K. Mahajan, **J. Geophys. Res.**, 104, 2613 - 2619, 1999.
- ✓ First VHF radar observations of tropical latitude E-region field aligned irregularities. R.K. Choudhary, K.K. Mahajan, Sachchidanand Singh, K. Kumar and V.K. Anandan., **Geophys. Res. Lett.**, 23, 3683-3686, 1996
- ✓ A study of wind velocity in lower troposphere using the Indian MST radar., Sachchidanand Singh, K. Kumar, R.K. Choudhary, K.K. Mahajan and O.P. Nagpal, **Ind. J. Radio Space Phy.**, 23, 30-35, 1994