Stanford



# Umran Inan

Professor of Electrical Engineering, Emeritus

Curriculum Vitae available Online

## Bio

### BIO

Through measurements in space and at multiple remote sites in Antarctica, Alaska, and the continental United States, Professor Inan studies the Earth's ionosphere and upper atmosphere. Of particular interest are ionospheric effects of lightning discharges and the recently discovered phenomena of electrical discharges and luminous glows at high altitudes above thunderstorms. He also studies physical processes in the Earth's near-space environment, including space weather effects on navigation and communication signals, electrodynamic coupling of the ionosphere to the magnetosphere, wave-induced precipitation of particles out of the radiation belts, and cyclotron resonant interactions between electromagnetic waves and energetic electrons. He is also involved in the development of ultra-low-power and miniaturized radio receivers for use in remote polar regions and on micro-satellites.

### ACADEMIC APPOINTMENTS

- Professor Emeritus, Electrical Engineering

### HONORS AND AWARDS

- Appleton Prize, International Radio Science Union (URSI) (2008)
- Allan Cox Medal for Faculty Excellence in Fostering Undergraduate Research, Stanford University (2007)
- Fellow, American Geophysical Union (2007)
- Fellow, Institute of Electrical and Electronics Engineers (2006)
- Group Achievement Award (CLUSTER), NASA (2005)
- Most Outstanding Paper Award, Ionospheric Effects Symposium (2004)
- Tau Beta Pi Award for Excellence in Undergraduate Teaching, Stanford University (1999)
- Group Achievement Award (POLAR), NASA (1998)
- Antarctic Mountain Named Inan Peak (78.333 S, 162.633 E) in Recognition of Service, Advisory Committee on Antarctic Names (1998)
- Antarctic Service Medal, NSF and Department of the Navy (1994)
- Young Scientist Award, International Union of Radio Science (URSI) (1993)
- Group Achievement Award (Dynamics Explorer), NASA (1984)
- Outstanding Service Award, EE Department for Excellence in Teaching (1978)

### PROFESSIONAL EDUCATION

- PhD, Stanford University (1977)

### LINKS

- http://www-star.stanford.edu/~vlf/umran.html: http://www-star.stanford.edu/~vlf/umran.html

## Publications

### PUBLICATIONS

- **A CubeSat receiver for the study of VLF-waves at LEO**
  Ramos, D., Wilson, G., Sousa, A., Marshall, R., Brunetto, K., Ballenthin, J., Kay, R., Patton, J., Quigley, S., Judy, F., Starks, M., Willet-Gies, T., Tullino, et al
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- **Broadband longwave radio remote sensing instrumentation.** *The Review of scientific instruments*
  Cohen, M. B., Said, R. K., Paschal, E. W., McCormick, J. C., Gross, N. C., Thompson, L., Higginson-Rollins, M., Inan, U. S., Chang, J.
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- **Early/fast VLF events produced by the quiescent heating of the lower ionosphere by thunderstorms** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*
  Kabirzadeh, R., Marshall, R. A., Inan, U. S.
  2017; 122 (12): 6217–30

- **Identifying the occurrence of lightning and transient luminous events by nadir spectrophotometric observation** *JOURNAL OF ATMOSPHERIC AND SOLAR-TERRESTRIAL PHYSICS*
  Adachi, T., Sato, M., Ushio, T., Yamazaki, A., Suzuki, M., Kikuchi, M., Takahashi, Y., Inan, U. S., Linscott, I., Hobara, Y., Frey, H. U., Mende, S. B., Chen, et al
  2016; 145: 85-97

- **Horizontal distributions of sprites derived from the JEM-GLIMS nadir observations** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*
  Sato, M., Mihara, M., Adachi, T., Ushio, T., Morimoto, T., Kikuchi, M., Kikuchi, H., Suzuki, M., Yamazaki, A., Takahashi, Y., Inan, U., Linscott, I., Ishida, et al
  2016; 121 (7): 3171-3194

- **Global occurrence rate of elves and ionospheric heating due to cloud-to-ground lightning** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Blaes, P. R., Marshall, R. A., Inan, U. S.
  2016; 121 (1): 699–712

- **Ship-borne LF-VLF oceanic lightning observations and modeling** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*
  Zoghzoghy, F. G., Cohen, M. B., Said, R. K., Lehtinen, N. G., Inan, U. S.
  2015; 120 (20): 10890–902

- **Predicting conditions for the reception of one-hop signals from the Siple transmitter experiment using the Kp index** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Li, J. D., Spasojevic, M., Inan, U. S.
  2015; 120 (10): 8440–47

- **An empirical profile of VLF triggered emissions** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Li, J. D., Spasojevic, M., Inan, U. S.
  2015; 120 (8): 6581–95

- **Latitudinal dependence of static mesospheric Efields above thunderstorms** *GEOPHYSICAL RESEARCH LETTERS*
  Kabirzadeh, R., Lehtinen, N. G., Inan, U. S.
  2015; 42 (10): 4208-4215

- **Overview and early results of the Global Lightning and Sprite Measurements mission** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*
  Sato, M., Ushio, T., Morimoto, T., Kikuchi, M., Kikuchi, H., Adachi, T., Suzuki, M., Yamazaki, A., Takahashi, Y., Inan, U., Linscott, I., Ishida, R., Sakamoto, et al
  2015; 120 (9): 3822-3851
- **Preferential amplification of rising versus falling frequency whistler mode signals** *GEOPHYSICAL RESEARCH LETTERS*
  Li, J. D., Harid, V., Spasojevic, M., Golkowski, M., Inan, U. S.
  2015; 42 (2): 207–14
- **The effect of electron and ion temperature on the refractive index surface of 1-10 kHz whistler mode waves in the innermagnetosphere** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Kulkarni, P., Golkowski, M., Inan, U. S., Bell, T. F.
  2015; 120 (1): 581–91
- **Return stroke speed of cloud-to-ground lightning estimated from elve hole radii** *GEOPHYSICAL RESEARCH LETTERS*
  Blaes, P. R., Marshall, R. A., Inan, U. S.
  2014; 41 (24): 9182-9187
- **Finite difference modeling of coherent wave amplification in the Earth's radiation belts** *GEOPHYSICAL RESEARCH LETTERS*
  Harid, V., Golkowski, M., Bell, T., Li, J. D., Inan, U. S.
  2014; 41 (23): 8193-8200
- **Lightning activity following the return stroke** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*
  Zoghzoghy, F. G., Cohen, M. B., Said, R. K., Basilico, S. S., Blakeslee, R. J., Inan, U. S.
  2014; 119 (13)
- **Theoretical and numerical analysis of radiation belt electron precipitation by coherent whistler mode waves** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Harid, V., Golkowski, M., Bell, T., Inan, U. S.
  2014; 119 (6): 4370-4388
- **Differing current and optical return stroke speeds in lightning** *GEOPHYSICAL RESEARCH LETTERS*
  Liang, C., Carlson, B., Lehtinen, N., Cohen, M., Marshall, R. A., Inan, U.
  2014; 41 (7): 2561–67
- **Analysis of magnetospheric ELF/VLF wave amplification from the Siple Transmitter experiment** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Li, J. D., Spasojevic, M., Harid, V., Cohen, M. B., Golkowski, M., Inan, U.
  2014; 119 (3): 1837-1850
- **RECENT RESULTS ON EFFECTS OF LIGHTNING DISCHARGES ON THE IONOSPHERE AND THE RADIATION BELTS**
  Inan, U. S., IEEE
  IEEE.2014
- **On the Spatial Scale of Streamers**
  Lehtinen, N. G., Inan, U. S., Ostgaard, N., IEEE
  IEEE.2014
- **Extended lateral heating of the nighttime ionosphere by ground-based VLF transmitters** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Graf, K. L., Spasojevic, M., Marshall, R. A., Lehtinen, N. G., Foust, F. R., Inan, U. S.
  2013; 118 (12): 7783–97
- **Highly intense lightning over the oceans: Estimated peak currents from global GLD360 observations** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*
  Said, R. K., Cohen, M. B., Inan, U. S.
  2013; 118 (13): 6905–15
- **Analysis of experimentally validated trans-ionospheric attenuation estimates of VLF signals** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*

Graf, K. L., Lehtinen, N. G., Spasojevic, M., Cohen, M. B., Marshall, R. A., Inan, U. S.
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- **Statistical patterns in the location of natural lightning** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*
  Zoghzoghy, F. G., Cohen, M. B., Said, R. K., Inan, U. S.
  2013; 118 (2): 787-796
- **Utilizing nonlinear ELF generation in modulated ionospheric heating experiments for communications applications** *RADIO SCIENCE*
  Jin, G., Spasojevic, M., Cohen, M. B., Inan, U. S.
  2013; 48 (1): 61-68
- **Modulation of auroral electrojet currents using dual modulated HF beams with ELF phase offset, a potential D-region ionospheric diagnostic** *Journal of Geophysical Research: Space Physics*
  Inan, U., Gołkowski, M., Cohen, M. B., Moore, R. C.
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- **The spectral extent of chorus in the off-equatorial magnetosphere** *Journal of Geophysical Research: Space Physics*
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- **The History of Very Low Frequency (VLF)Radio Research at Stanford**
  Inan, U., Carpenter, D. L.
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- **Dayside auroral hiss observed at South Pole Station** *Journal of Geophysical Research: Space Physics*
  Inan, U., Yan, X., LaBelle, J., Haerendel, G., Spasojevic, M., Bunch, N.
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- **EMIC waves growth and guiding in the presence of cold plasma density irregularities** *Geophysical Research Letters*
  Inan, U., de Soria-Santacruz, M., Spasojevic, M., Chen, L.
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- **Highly intense lightning over the oceans: Estimated peak currents from global GLD360 observations** *Journal of Geophysical Research: Atmospheres*
  Said, R. K., Cohen, M. B., Inan, U.
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- **The VLF fingerprint of elves: Step-like and long-recovery early VLF perturbations caused by powerful ±CG lightning EM pulses** *Journal of Geophysical Research: Space Physics*
  Inan, U., Haldoupis, C., Cohen, M., Arnone, E., Cotts, B., Dietrich, S.
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- **On the Relationship Between Lightning Peak Current and Early VLF Perturbations** *Journal of Geophysical Research: Space Physics*
  Inan, U., Salut, M. M., Cohen, M. B., Ali, M. A., Graf, K. L., Cotts, B. R.
  2013
- **Extended lateral heating of the nighttime ionosphere by ground-based VLF transmitters** *Journal of Geophysical Research: Space Physics*
  Craf, K. L., Spasojevic, M., Marshall, R. A., Lehtinen, N. G., Foust, F. R., Inan, U.
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- **Chorus functional dependencies derived from CRRES data** *Geophysical Research Letters*
  Inan, U., Spasojevic, M., Shprits, Y. Y.

2013

- **100 days of ELF/VLF generation via HF heating with HAARP** *Journal of Geophysical Research: Space Physics*
  Inan, U., Cohen, M. B., Gołkowski, M.
  2013
- **MAGNETOSPHERIC WAVE POWER DENSITY FROM GROUND-BASED VLF TRANSMITTERS** *US-National-Committee-of-URSI National Radio Science Meeting*
  Lauben, D. S., Cohen, M., Lehtinen, N. G., Inan, U. S.
  IEEE.2013
- **Models of ionospheric VLF absorption of powerful ground based transmitters** *GEOPHYSICAL RESEARCH LETTERS*
  Cohen, M. B., Lehtinen, N. G., Inan, U. S.
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- **Very low latitude (L=1.08) whistlers** *GEOPHYSICAL RESEARCH LETTERS*
  Singh, R., Cohen, M. B., Maurya, A. K., Veenadhari, B., Kumar, S., PANT, P., Said, R. K., Inan, U. S.
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- **Harmonic minimization waveforms for modulated heating experiments at HAARP** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Jin, G., Spasojevic, M., Cohen, M. B., Inan, U. S.
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- **Nighttime D region electron density measurements from ELF-VLF tweek radio atmospherics recorded at low latitudes** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Maurya, A. K., Veenadhari, B., Singh, R., Kumar, S., Cohen, M. B., Selvakumaran, R., Gokani, S., PANT, P., Singh, A. K., Inan, U. S.
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- **Spatial dependence of banded chorus intensity near the magnetic equator** *GEOPHYSICAL RESEARCH LETTERS*
  Haque, N., Inan, U. S., Bell, T. F., Pickett, J. S.
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- **Long-lasting D-region ionospheric modifications, caused by intense lightning in association with elve and sprite pairs** *GEOPHYSICAL RESEARCH LETTERS*
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- **Terrestrial VLF transmitter injection into the magnetosphere** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
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  Cohen, M. B., Golkowski, M., Lehtinen, N. G., Inan, U. S., McCarrick, M. J.
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- **Morphological features of tweeks and nighttime D region ionosphere at tweek reflection height from the observations in the low-latitude Indian sector** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Maurya, A. K., Singh, R., Veenadhari, B., Kumar, S., Cohen, M. B., Selvakumaran, R., PANT, P., Singh, A. K., Siingh, D., Inan, U. S.
  2012; 117
- **An Image Frequency Rejection Filter for SAW-Less GPS Receivers** *IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS I-REGULAR PAPERS*
  Barth, C., Linscott, I. R., Inan, U. S.
  2012; 59 (5): 1085-1092
- **Robert Arthur Helliwell obituary** *PHYSICS TODAY*
  Carpenter, D., Inan, U.
  2012; 65 (1): 55-56

- **Robert Helliwell, pioneer of whistler-mode research** *HISTORY OF GEO-AND SPACE SCIENCES*
  Carpenter, D. L., Inan, U. S.
  2012; 3 (1): 73–74
- **Off-equatorial chorus occurrence and wave amplitude distributions as observed by the Polar Plasma Wave Instrument** *Journal of Geophysical Research*
  Inan, U., Bunch, N. L., Spasojevic, M., Shprits, Y. Y.
  2012
- **ELF/VLF wave generation from the beating of two HF ionospheric heating sources** *Journal of Geophysical Research*
  Inan, U., Cohen, M. B., Moore, R. C., Gołkowski, M., Lehtinen, N. G.
  2012
- **Statistical modeling of in situ hiss amplitudes using ground measurements** *Journal of Geophysical Research*
  Inan, U., Golden, D. I., Spasojevic, M., Li, W., Nishimura, Y.
  2012
- **A waveguide model of the return stroke channel with a “metamaterial" corona** *Radio Science*
  Inan, U., Lehtinen, N. G.
  2012
- **Statistical modeling of plasmaspheric hiss amplitude using solar wind measurements and geomagnetic indices** *Geophysical Research Letters*
  Inan, U., Golden, D. I., Spasojevic, M., Li, W., Nishimura, Y.
  2012
- **ELF/VLF recordings during the 11 March 2011 Japanese Tohoku earthquake** *Geophysical Research Letters*
  Inan, U., Cohen, M. B., Marshall, R. A.
  2012
- **Long recovery VLF perturbations associated with lightning discharges** *Journal of Geophysical Research*
  Inan, U., Salut, M. M., Abdullah, M., Graf, K. L., Cohen, M. B., Cotts, B. R.
  2012
- **PENGUIn/AGO and THEMIS conjugate observations of whistler mode chorus waves in the dayside uniform zone under steady solar wind and quiet geomagnetic conditions** *Journal of Geophysical Research*
  Inan, U., Keika, K., Spasojevic, M., Li, W., Bortnik, J., Miyoshi, Y.
  2012
- **An empirical model of magnetospheric chorus amplitude using solar wind and geomagnetic indices** *Journal of Geophysical Research*
  Inan, U., Golden, D. I., Spasojevic, M., Li, W., Nishimura, Y.
  2012
- **An improved model of the lightning electromagnetic field interaction with the D-region ionosphere** *Journal of Geophysical Research*
  Inan, U., Marshall, R. A.
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- **On the altitude of the ELF/VLF source region generated during “beat-wave” HF heating experiments** *Geophysical Research Letters*
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- **Morphological features of tweeks and nighttime D-region ionosphere at tweek reflection height from the observations in the low-latitude Indian sector** *ournal of Geophysical Research*
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  Lehtinen, N. G., Bell, T. F., Qiu, L., Cohen, M. B., Inan, U. S.
  IEEE.2012: 195–198
- **Metamaterial Waveguide Model of a Return Stroke Channel** *International Conference on Electromagnetics in Advanced Applications (ICEAA) / IEEE-APS Topical Conference on Antennas and Propagation in Wireless Communications (IEEE APWC) / URSI Electromagnetic Environment and Interference Symposium (EEIS)*
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- **A 9mW Direct RF Sampling GPS Receiver Front-End in 0.13 mu m BiCMOS** *IEEE International Symposium on Circuits and Systems*
  Barth, C., Linscott, I. R., Inan, U. S.
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- **Transmitter-induced modulation of subionospheric VLF signals: Ionospheric heating rather than electron precipitation** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
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  2011; 116
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  Lee, H. K., Lilja, K., Bounasser, M., Linscott, I., Inan, U.
  IEEE-INST ELECTRICAL ELECTRONICS ENGINEERS INC.2011: 3026–32
- **A tribute to Robert Helliwell (1920-2011)** *SPACE WEATHER-THE INTERNATIONAL JOURNAL OF RESEARCH AND APPLICATIONS*
  Carpenter, D. L., Inan, U. S.
  2011; 9
- **Longitudinal dependence of lightning-induced electron precipitation** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Cotts, B. R., Inan, U. S., Lehtinen, N. G.
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- **D-region ionosphere response to the total solar eclipse of 22 July 2009 deduced from ELF-VLF tweek observations in the Indian sector** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Singh, R., Veenadhari, B., Maurya, A. K., Cohen, M. B., Kumar, S., Selvakumaran, R., PANT, P., Singh, A. K., Inan, U. S.
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- **Cluster observations of whistler mode ducts and banded chorus** *GEOPHYSICAL RESEARCH LETTERS*
  Haque, N., Inan, U. S., Bell, T. F., Pickett, J. S., Trotignon, J. G., Facsko, G.
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- **Discontinuous Galerkin particle-in-cell simulation of longitudinal plasma wave damping and comparison to the Landau approximation and the exact solution of the dispersion relation** *PHYSICS OF PLASMAS*
  Foust, F. R., Bell, T. F., Spasojevic, M., Inan, U. S.
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- **On the occurrence of ground observations of ELF/VLF magnetospheric amplification induced by the HAARP facility** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
  Golkowski, M., Cohen, M. B., Carpenter, D. L., Inan, U. S.
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- **Determination of solar cycle variations of midlatitude ELF/VLF chorus and hiss via automated signal detection** *JOURNAL OF GEOPHYSICAL RESEARCH-SPACE PHYSICS*
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- **A Double Notch RF Filter Architecture for SAW-less GPS Receivers** *IEEE International Symposium on Circuits and Systems (ISCAS)*
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  2011
- **A tribute to Robert Helliwell** *Space Weather*
  Carpenter, D. L., Inan, U.
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