International Reference Ionosphere

BRIEF DESCRIPTION:
The International Reference Ionosphere (IRI) is an international project sponsored by the Committee on Space Research (COSPAR) and the International Union of Radio Science (URSI). These organizations formed a Working Group (**members list**) in the late sixties to produce an empirical standard model of the ionosphere, based on all available data sources (**Charter**). Several steadily improved editions of the model have been released. For given location, time and date, IRI provides monthly averages of the electron density, electron temperature, ion temperature, and ion composition in the ionospheric altitude range (see details below).

The major data sources are the worldwide network of ionosondes, the powerful incoherent scatter radars (Jicamarca, Arecibo, Millstone Hill, Malvern, St. Santin), the ISIS and Alouette topside sounders, and in situ instruments flown on many satellites and rockets. IRI is updated yearly during special **IRI Workshops** (e.g., during COSPAR general assembly). More information can be found in the workshop reports.

The IRI model and software is updated according to the decisions of the IRI Working Group. The software package includes the FORTRAN subroutines, model coefficients (CCIR, URSI, IGRF), indices files (IG_RZ.DAT, APF107.DAT) and README and LICENSE files. The IRI build-up and formulas are described in detail in a 158-page NSSDC report by Bilitza (1990) and more recently in a 65-page Reviews of Geophysics paper by Bilitza et al. (2022) (see REFERENCE section).

An IRI listserver keeps the community informed about model updates, workshops, publication, and other IRI-related matters. To subscribe send a message to **info@irimodel.org** with 'subscribe IRI your_email_address' in the SUBJECT line and your name, affiliation and mailing address in the body of the message.

PARAMETERS:
Electron density, electron temperature, ion temperature, ion composition (O^+, H^+, He^+, N^+, NO^+, O^+_2, Cluster ions), equatorial vertical ion drift, vertical ionospheric electron content (vTEC; a user can select the ending height for the integration along the electron density profile), F1 probability, spread-F probability, auroral boundaries, effects of ionospheric storms on F and E peak densities

INPUTS:
Required:
solar indices (F10.7 daily, 81-day, and 12-month running mean; sunspot number 12-month running mean)
ionospheric index (ionosonde-based IG index 12-month running mean)

magnetic index (3-h ap, daily ap)
The indices are found internally from indices files for the user-specified date and time. But a user can also input his/her own indices values if so desired.
Optional:
The user can provide a number of input parameters and the IRI profiles will than be adjusted to these input parameters:
F2-peak height (hmF2) or propagation factor M3000F2
F2-peak plasmafrequency (foF2) or electron density (NmF2)
Bottomside profile parameters B0 (thickness) and B1 (shape)
F1-ledge height (hmF1)
F1-ledge plasmafrequency (foF1) or electron density (NmF1)
E-peak height (hmE)
E-peak plasmafrequency (foE) or electron density (NmE)
D-ledge height (hmD)
D-ledge plasmafrequency (foD) or electron density (NmD)

HEIGHT RANGE:
Electron density: daytime: 65-2000km, nighttime: 80-2000km
Electron and ion temperature: 60-2500km (IRI-95 option: 60-3000km)
Ion composition: 75-2000km (DS95/DY85 option: 80-2000km)

AVAILABILITY:
* Fortran source code: IRI-2020 (10/29/2023),IRI-2016 (10/13/2021), IRI-2012, IRI-2007, IRI-2001, COMMON FILES for all versions
NOTE: Besides the files that come with each version you also need to download the COMMON FILES and INDICES FILES.
NOTE: The IRI output arrays are explained here
NOTE: The switches available in the IRI code to turn on/off certain dependencies are explained here
* Solar and Magnetic Indices (daily updates, 8:00 EST, provided by David Themens ECHAIM website): APF107.Data IG_RZ.DAT
* Solar and Magnetic Indices (updated twice a year): INDICES FILES (06/10/2023)
* Old indices files can be found here
Online computation and plotting at CCMC **(HELP)**: IRI-2016 (03/26/2018), IRI-2012, IRI-2007
NOTE: Please consult the HELP file for an explanation of the different inputs, outputs and options.
NOTE: Please use/customize the Fortran code for large volume computations, because overuse may result in service discontinuation.
NOTE: The program iritest.for can be easily adapted to a specific application.
NOTE: The IRI-2012 distribution also includes iriorbit.for and iriorbitmax.for for calculating IRI parameters along a satellite orbit.
* Real-time IRI foF2 & hmF2: IRTAM IRI Real-Time Assimilative Mapping with GIRO digisonde data
* MATLAB version: IRI-2012
* pyglow - Python wrappers for IRI-2012 and IRI-2016

FREQUENTLY ASKED QUESTIONS: FAQ

RELATED LINKS:
* MIT: Real-time IRI worldmaps and movies (last 24 hours) link

* IPS: Global and Regional Maps of real-time TEC using IRI link
* WDC Kyoto: Computation of ionospheric conductivities using IRI90 and CIRA72 models link
* SPENVIS: The SPace ENVironment Information System developed by the Belgian Institute for Space Aeronomy link

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IRI VIA FTP
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REFERENCES

LINKS
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