HELP text (12/01/2017):

This interface lets you compute and plot IRI parameters varying with height, latitude, longitude, year, month, day of month, day of year, and hour of day. You can choose geographic or geomagnetic latitudes or longitudes and Universal Time or Local Time for the time of day. Please acknowledge the IRI Working Group for use of this model and interface.

*** SELECT DATE AND TIME:**

Year(y1-y2): The program uses solar and magnetic indices from indices files (ig_rz.dat, apf107.dat) that are updated regularly. The available time span for the solar indices is given by y1 and y2 and for the magnetic indices in the NOTE below the Year entry frame.

Hour of day: The hour should be given in decimal hours, e.g. 1.5 for 1:30.

Height: The recommended upper limit is 1500 km. But extrapolation to 2000 km should produce reliable profiles in most cases.

Select a Profile type and its parameters: The selected profile will override the prior choice of parameters, e.g., LATITUDE profile parameters will override the LATITUDE input from two lines up. Your LATITUDE AND LONGITUDE profiles are Geographic of Geomagnetic depending on your selection in the **Coordinate Type** field and your HOUR profile is for Universal or Local Time depending on your choice in the **Time** field.

*** OPTIONAL INPUT is not required (defaults are shown where applicable)**

Sunspot number(Rz12): 13-month-running mean of sunspot number. You can enter your own index value here and not rely on the internal index file ig_rz.dat.
If IG12 is entered (see next item) but not Rz12 then an empirical relationship is used to calculate Rz12: if IG12 < 178.006 then Rz12 = 247.29 - 17.96 * sqrt(178.0066 - IG12) else Rz12 = 247.29

Ionospheric index (IG12): Index based on foF2 measurements from a dozen ionosondes correlated with the CCIR foF2 maps (R. Liu, P. Smith, and J. King, Telecommunications Journal, 50, 408-414, 1983).
You can enter your own index value here and not rely on the internal index file ig_rz.dat.
If Rz12 is entered (see previous item) but not IG12 then an empirical relationship is used to calculate IG12: IG12 = -11.5634 + 1.5332 * Rz12 - 0.0031 * Rz12 * Rz12

F10.7 radio flux, daily: Daily index based on full disc solar flux measurements at 2800MHz (10.7cm wavelength) first made at the Algonquin Radio Observatory, near Ottawa, Canada (1947 until May 31, 1991) and then from the Dominion Radio Astrophysical Observatory, near Penticton, British Columbia at local noon (1700UT at Ottawa and 2000UT at Penticton). The flux values are expressed in solar flux units (1 s.f.u. = 10-22 W*m-2*Hz-1). Indices are tabulated in two forms: the "observed flux" (S), and the "adjusted flux" (Sa). The former are the actual measured values, and are affected by the changing distance between the Earth and Sun throughout the year, whereas the latter are scaled to a standard distance of 1 AU. The "observed flux" values are used in IRI.
You can enter your own index value here and not rely on the internal index file apf107.dat.

F10.7 radio flux, 81-day day: The 81-day running mean of the daily F10.7 value. 81 days are about 3 solar rotations and statistical studies have found good correlation between this parameter or PF10.7=(F10.7_daily + F10.7_81day)/2 and ionospheric parameters.
You can enter your own index value here and not rely on the internal index file apf107.dat.
If a value is entered for F10.7_81 then it is also used for F10.7_365 which otherwise will be taken from apf107.dat.

Electron content: Upper boundary: The electron content is the vertical electron content (vTEC) calculated using numerical integration from a lower to an upper boundary. You must enter a value for the upper boundary if you want to obtain electron content values. The value should not be higher than 2000 km because this is the upper limit of the IRI validity range for electron density profiles. The lower boundary is set to the starting height of the IRI validity range (60km during the day and 80km during the night).

Ne Topside: The user has three options here. **IRI2001:** The IRI-2001 model that was based primarily on Alouette 1 topside sounder data with some AE-C, AEROS, and DE-2 in situ data (Bilitza et al.,Radio Sci. 41, RS5S15, 2006). **IRI01-corr:** A correction of the 2001 model with the help of Aloutte 2, ISIS 1 and 2 topside sounder data (Bilitza, Adv. Space Res. 33/6, 838-843, 2004). **NeQuick:** The model developed by Radicella and his group at ICTP using Intercosmos 19 topside sounder data in addition to the ISIS 1 and 2 data (Coisson et al., Adv. Space Res., 37/5, 934-937, 2006).
NeQuick is the Default.

Ne F-peak: The **CCIR** model for the F peak plasma frequency foF2 was developed by Jones and Gallet (Telecomm. J. 29, 129, 1962 and 32, 18, 1965) using data from the worldwide network of ionosondes. It is the model recommended by the Comite Consultatif International des Radiocommunications (CCIR) of the International Telecommunications Union (Report 340-4, ITU, Geneva, 1967). The **URSI** model was developed by Rush et al. (Telecomm. J. 56, 179 - 182, 1989) using a physical model to obtain screen points over regions not covered by ionosondes instead of the extrapolation along magnetic field lines employed by Jones and Gallet. foF2 is related to the F-peak electron density NmF2 by NmF2/m-3 = 1.24E10 * (foF2/MHz)^2. The CCIR model is recommended over the continents and the URSI model over the oceans.
URSI is the Default in IRI.
NOTE: Changes here will also affect the height of the F peak hmF2 because the hmF2 model depends on the ratio foF2/foE where foE is the plasma frequency at the E peak.

F-peak storm model: The F peak storm model was developed by Fuller-Rowell et al. (Adv. Space Res. 22/6, 821-827, 1999 and 25/1, 139-148, 2000). It describes the average storm behavior in terms of the ratio foF2_storm/foF2_quiet based on the ap history over the preceding 33 hours. A large volume of ionosonde data for storms during the 1980-1990 time period were used to describe the most coherent and repeatable features of the ionospheric storm response. The user can turn the model **on** or **off**.
Default is **on**.
NOTE: The ratio foF2_storm/foF2_quiet can be selected as one of the OUTPUT parameters for listing or plotting.

F-peak height: The user can choose between three model options. The older **BSE-1979** option (Bilitza et al., Telecomm. J. 46, 549-553, 1979) that uses the correlation between hmF2 and the propagation factor M(3000)F2 and the CCIR-1965 model for the ionosonde-deduced M(3000)F2. The ionosonde-based **AMTB2013** model (Altadill et al., Adv. Space Res. 52, 1756-1769, 2013) or the **SHU-2015** model (Shubin, Adv. Space Res. 56, 916-928, 2015) that is based on radio occultation data from several GNSS satellite. **AMTB2013** is the current default option.

Bottomside Thickness: The bottomside thickness B0 is the height difference between the F peak height hmF2 and the height where the electron density profile has dropped down to half the F peak value (NmF2/2). **Bil-2000:** This (Table-)option is based on incoherent scatter data (Bilitza et al., Adv. Space Res. 25/1, 89-95, 2000). **Gul-1987:** This (Gulyaeva-)option is based on ionosonde data mostly from mid-latitudes (Gulyaeva, Adv. Space Res. 7/6, 39, 1987). **ABT-2009:** Altadill et al. (Adv. Space Res. 43/11, 1825-1834, 2009) used a large volume of ionosonde data to develop a much improved representation of latitudinal and solar cycle variation of B0 and B1. B1 is a parameter describing the bottomside profile shape.
ABT-2009 is the Default.
NOTE: The choice of B0 will also affect the value of B1.

F1 occurrence: This parameter describes the occurrence probability of an F1 layer. **IRI-95:** This option uses the ITU-recommended Ducharme et al (Radio Sci., 6, 369-378, 1971 and 8, 837-839, 1973) model that applies a simple cutoff solar zenith angle, so probability is either 0 or 1. **Scotto-1997 no L:** This option uses the model developed by Scotto et al. (Radio Sci. 33, 1763-1765, 1998) using only ionograms with clear F1 layer presence and excluding the more uncertain L condition cases. Ionograms often exhibit a Fl ledge rather than a fully developed cusp, primarily during the time period just before the Fl layer disappears. These cases are described as L condition according to the URSI standard nomenclature. **Scotto-1997 with L:** Here L-condition cases were included.
Scotto-1997 no L is the Default.
NOTE: No F1-layer in profile if the probability is lower than 0.5.

E-peak auroral storm model: The E peak auroral storm model was developed by Mertens et al. (Adv. Space Res.,in press, 2013) and Fernandez et al. (Adv. Space Res. 46/8, 1070-1077, 2010) using TIMED-SABER data. It describes the average storm behavior in terms of the ratio foE_storm/foE_quiet based on the ap index history. The user can turn the model **on** or **off**.
Default is **on**.
NOTE: The ratio foE_storm/foE_quiet can be selected as one of the OUTPUT parameters for listing or plotting.

D-Region model Lets you use the FIRI model (**FT-2001**; Friedrich and Torkar, J. Geophys. Res., 106/A10, 21409-21418, 2001) that is based on Friedrich's compilation of reliable rocket data. The older **IRI-95** model is based on a much smaller selection of typical rocket profiles (Mechtly and Bilitza, Report IPW-WB1, Freiburg, Germany).
IRI-95 is the Default.
NOTE: The IRI-95 D-region profile is normalized to the E-peak, the FIRI profile is not!

Topside Te: BIL-1995 is using the global models at fixed altitudes developed by Brace and Theis (J. Atmos. Solar-Terr. Phys. 43, 1317-1343, 1981) based on their ISIS and AE-C electron temperature measurements. The model is described in *Bilitza et al., Adv. Space Res. 5/7, 53-58, 1985* and also in the *IRI-90 report* that is available as PDF document from the REFERENCES section of the IRI homepage. The newer **TBT-2012** model was developed by *Truhlik et al., Earth Planets Space 64, 531-543, 2012* using a large volume of satellite in situ measurements. The **TBT2012+SA** version of the model includes variations with solar activity and is the current Default.

Ion Composition: The **DS95/DY85** option uses the Danilov and Smirnova model (Adv. Space Res. 15/2, 171-178, 1995) based on their compilation of rocket data in the region below the F-peak and the Danilov and Yaichnikov model (Adv. Space Res. 5/7, 75-79, 1985) based on their compilation of Russian high-altitude rocket measurements. The **RBV10/TTS03** option is based on an adjustment of the ion composition from the

FLIP-model photochemistry to the IRI electron density profile in region below the F peak (Richards et al., Radio Sci. 45. RS5007, 2010). In the region above the F-peak the model of Triskova et al. (Adv. Space Res. 31/3, 653-663, 2003) based on satellite ion mass spectrometer measurements.
RBV10/TTS03 is the Default.

NmF2 or foF2, hmF2 or M(3000)F2, NmE or foE, hmE, and B0: Here the user can enter measured values to update the IRI profile to actual conditions.
NOTE: This option can only be used with Profile type HEIGHT

*** SELECT OUTPUT FORM:**

Here you can select various forms of output for the generated parameters that will be selected in the next section. You can **list** the data online or generate an **ASCII file** for downloading or **plot** the selected parameters.

*** SELECTE DESIRED OUTPUT PARAMETERS:**

Now you select the parameters that you would like to list, download, or plot. You can list as many parameters (INDEPENDENT or IRI MODEL) as you like. But if you selected the PLOT option than the first parameter will be along the x-axis and the second parameter along the y-axis.
Please note that selecting a PROFILE TYPE above does not automatically select the corresponding INDEPENDENT VARIABLE in the SELECT DESIRED OUTPUT PARAMETERS section. You need to select this variable, e.g. if you had selected the PROFILE TYPE: HOUR you should select HOUR OF DAY as your INDEPENDENT VARIABLE. But, of course, you could also choose SOLAR ZENITH ANGLE.
Each selected IRI MODEL PARAMETER will be listed in a separate column or plotted in a seperate panel.
At the bottom of the page you can change the format of the plot, e.g. using logarithmic instead of linear scales and many more plotting options.

*** IRI MODEL PARAMETERS:**

The **Neutral Temperature** is obtained with the NRLMSISE-00 model (*Picone et al., J. Geophys. Res. 107/A12, 1468, 2002*) that is the COSPAR sanctioned standard for the thermosphere.
The IRI **Ion Temperature** model is described in the IRI-90 report that is available as PDF document from the references section of the [IRI homepage].
The parameter **TEC top, percentage** is the precentage of the electron content that is above the F peak height hmF2 and up to the user-specified UPPER BOUNDRY.
The **Equatorial vertical ion drift** is computed with the Scherliess and Fejer model (*J. Geophys. Res. 104, 6829-6842, 1999*) that is based on a combined data set of radar and satellite observations.
The **CGM latitude of auroral oval boundary** is obtained with the model of Zhang et al. (*Adv. Space Res. 46/8, 1055-1063, 2010*) that was developed based on TIMED-GUVI data.
The parameters **Ratio of foF2 storm to foF2 quiet**, **Ratio of foE storm to foE quiet** and **F1 probability** are explained in the section OPTIONAL INPUT above.
The **Spread-F probability** is obtained with the model of *Abdu et al., Adv. Space Res. 31/3 703-716, 2003* that is based on ionosonde measurements from the Brazilian longitude sector.

*** INDICES USED BY THE MODEL**

Here you get the output option for some of indices that drive the IRI model.

*** ADVANCED PLOT SELECTIONS (OPTIONAL)**

Here you can customize your plot by selecting from several scale, size etc. options.

RESET: Resets all to their default options.

The IRI homepage is at http://irimodel.org