Model	Model Developers	Reference	Model Type	Input	Output
IRI	D. Bilitza (NASA/GSFC) URSI/COSPAR Working Group on IRI	https://ccmc.gsfc.nasa.gov/models/modelinfo.php?model=IRI https://iri.gsfc.nasa.gov/	Empirical	• F10.7 (daily, 81-day running mean of the daily F10.7 value, PF10.7) • R12 (13-month-running mean of sunspot number) • Ionospheric index (IG12): Index based on foF2 measurements from a dozen ionosondes correlated with the CCIR foF2 maps • ap (history over the preceding 33 hours)	• Electron density, • electron temperature, • ion temperature, • ion composition (O+, H+, He+, NO+, O+2), • ion drift, • TEC
SWIF	I. Tsagouri and A. Belehaki (NOA/Greece)	Tsagouri and Belehaki (2008); Tsagouri et al. (2009) Running in DIAS system: http://dias.space.noa.gr	Empirical	• IMF total magnitude • IMF-Bz component (at L1 point from ACE spacecraft)	• F2-layer critical frequency: foF2
IFM	Robert W. Schunk et al. (USU)		Physics-Based Ionosphere Model	• F10.7 • Kp	• Electron density • NmF2 • hmF2 • TEC (Total Electron Content)
SAMI3	Joseph Huba, Glenn Joyce, Marc Swisdak Plasma Physics Div., NRL and Icarus Research, Inc.	https://ccmc.gsfc.nasa.gov/models/modelinfo.php?model=SAMI3	Physics-Based Ionosphere Model	• F10.7 (1 day and 3 months average) • AP Index • ExB Drift velocity	• Ion density • Ion temperature • Ion velocity • Electron temperature • NmF2 • hmF2 • TEC (Total Electron Content)
CTIPe	Timothy Fuller-Rowell et al NOAA SEC	https://ccmc.gsfc.nasa.gov/models/modelinfo.php?model=CTIPe	Physics-based Coupled Ionosphere-Thermosphere Model	• Fixed or time-dependent Hemispheric Power in gigawatts • Hemispheric Power Index (activity level) during the simulated time interval interpolated on 12 minute temporal grid. • Ionospheric electric fields: At the present time the CTIPe model is coupled with the Weimer ionosphere electrodynamics model which calculates ionospheric electric fields for solar wind parameters (density, solar wind velocity magnitude, IMF magnitude and clock angle) • F10.7 cm	• Neutrals: The three components are wind vector, temperature, the number density of the three major species O, O2, N2, and mean molecular mass. • Ion and electron: H+, O+, electron number densities and temperatures over height range from 140 km to 2,000 km, plus N2+, O2+, N+ below about 500 km. Height and electron number density of ionospheric F2 peak.

GITM	A.J. Ridley et al. Department of Atmosphere, Oceanic and Space Sciences, University of Michigan	https://ccmc.gsfc.nasa.gov/models/modelinfo.php?model=GITM	Physics-based Coupled Ionosphere-Thermosphere Model	• F10.7 • Hemispheric Power Index (HPI) • Interplanetary Magnetic Field • Solar wind velocity • Solar irradiance (for event runs)	• Temperatures: neutral, ion, electron (K) • Neutral winds: zonal, meridional, vertical (m/s) • Plasma velocities: zonal, meridional, vertical (m/s) • Neutral mass density (kg/m3) • Number densities: neutral (O, O2, N(2D), N(2P), N(4S), N2, and NO), ion (O+(4S), O+(2D), O+(2P), O2+, N+, N2+, and NO+), and electron (m-3)
TIE-GCM	R. G. Roble et al. High Altitude Observatory, National Center for Atmospheric Research	https://ccmc.gsfc.nasa.gov/models/modelinfo.php?model=TIE-GCM	Physics-based Coupled Ionosphere-Thermosphere Model	• Solar EUV inputs: F107 (current daily F10.7 solar index) and F107A (81-day center-averaged F10.7 solar index) • Particle precipitation: Hemispheric Power in GW, obtained either from 3-hour Kp index or from IMF Bz and solar wind speed • Ionospheric electric fields at high latitudes: Provided by Heelis model and Weimer model. • Inputs for Heelis model: Cross polar cap potential in kV, obtained from 3-hour Kp index Hemispheric Power in GW, obtained from 3-hour Kp index Optional (not implemented): y-component of the interplanetary magnetic field (By) in nT • Inputs for Weimer model: Interplanetary magnetic field, By and Bz, in nT Solar wind density and speed, ρ and v, in cm-3 and km s-1 • Inputs for lower boundary: Diurnal and semi-diurnal migrating tides, specified by the GSWM	• Primary timed-dependent output fields, specified in latitude, longitude, and pressure level: Geopotential height: Height of pressure surfaces (cm) Temperatures: Neutral, ion, electron (K) Neutral winds: zonal, meridional, (cm s-1), vertical (s-1) Composition: O, O2, NO, N(4S), N(2D) (mass mixing ratios - dimensionless) Ion and electron densities: O+, O2+, Ne (cm-3), (NO+ is calculated from Ne - (O+ + O2+)) Electric potential: (V) • Other fields are available as secondary histories which can be set as needed.

USU-GAIM	R.W. Schunk, L. Scherliess, J.J. Sojka, D.C. Thompson, L. Zhu Center for Atmospheric & Space Sciences, Utah State University	https://ccmc.gsfc.nasa.gov/models/modelinfo.php?model=USU-GAIM	Physics-based Data Assimilation Model	• The IFM model uses F10.7, average F10.7, daily Ap and eight 3-hour Kp indices. The IFM also uses empirical inputs for the neutral atmosphere and magnetosphere parameters needed by the model, e.g., neutral wind, electric field, auroral precipitation, solar EUV, and resonantly scattered radiation. • The USU GAIM 2.3 model accepts data from multiple sources, including slant TEC from GPS ground stations via RINEX files, a-priori bias information for GPS satellites and ground-stations, true-height electron density profiles from DISS ionosondes via SAO formatted files, SSULI UV radiances via SDF2 files, and DMSP IES in-situ electron densities via EDR files. At present, the automated CCMC runs on request system only uses GPS observations from up to 400 ground receivers spread around the world. Data from other sources will be added at later times when they become available for automatic acquisition.	The primary output from the USU GAIM 2.3 model is a time-dependent 3-dimensional global electron density distribution. Vertical Equivalent Total Electron Content (TEC) obtained from the leveled, bias corrected, slant TEC values assimilated by the model and GPS stations coordinates are also provided.