For DITF SZA $\xrightarrow{Use}$ *SZA*
For DITF I1356P $\xrightarrow{Use}$ *I1356P*
For DITF VI1356P $\xrightarrow{Use}$ *VI1356P*
For DITF ILBH1P $\xrightarrow{Use}$ *ILBH1P*
For DITF VILBH1P $\xrightarrow{Use}$ *VILBH1P*
For DITF ILBH2P $\xrightarrow{Use}$ *ILBH2P*
For DITF VILBH2P $\xrightarrow{Use}$ *VILBH2P*
For DITF ALTGRID $\xrightarrow{Use}$ *ALTGRID*
For DITF VALTGRID $\xrightarrow{Use}$ *VALTGRID*

Calculate the variance associated with the Neutral Density Profiles (VNDP).

VNDP = The variance associated with the NDP value calculated by the Discrete Inverse Theory Function (DITF) (see Appendix).

2.3.2.3.3 End

2.3.5 The Ratio of O and N_2 Column Density ROVCDN2VCD

2.3.5.1 Required Input to the Derivation

N2DP	The N_2 density profile (cm^{-3}). The N2DP is a product of the Dayside Limb N2DP derivation.
VN2DP	The variance associated with N2DP $(cm^{-3})^2$. The VN2DP is a product of the Dayside Limb N2DP derivation.
ODP	The O volume density profile (cm^{-3}). The ODP is a product of the Dayside Limb ODP derivation.
VODP	The variance associated with ODP $(cm^{-3})^2$. The VODP is a product of the Dayside Limb ODP derivation.
ALTGRID	The altitude grid corresponding to the measured 1356 A intensity profile, the measured LBH1 (1400-1500 A) intensity profile, and the measured LBH2 (1650-1800 A) intensity profile (km). The vector ALTGRID is assumed to be monotonically decreasing.
VALTGRID	The variance associated with ALTGRID $(km)^2$.

2.3.5.2 Calculated Output of the Derivation

ROVCDN2VCD	The ratio of O and N_2 vertical column densities (dimensionless).
VROVCDN2VCD	The variance associated with ROVCDN2VCD (dimensionless).

2.3.5.3 Internal Data-Items Used by the Derivation

N2VCDREF — The reference N_2 vertical column density.
N2VCDREF = 1.0×10^{17} (cm^{-2})

2.3.5.4 The Derivation

2.3.5.4.1 Begin

2.3.5.4.2 Calculate the N_2 vertical column density profile (N2VCDP)

Note: Each element of the vector N2VCDP is calculated in the same manner with the exception of the first element. For the first element, the value of N2VCDP is

N2VCDP[1] = 0.0

Note: For the ith element ($i \neq 1$), the value of N2VCDP is calculated as the sum of the N_2 vertical column density at ALTGRID[i-1] and the integral of the N_2 volume density from ALTGRID[i-1] to ALTGRID[i]. The N_2 vertical column density should be calculated at each element of ALTGRID until N2VCDP[i] $\geq$ N2VCDREF. For the ith element of N2VCDP ($i \neq 1$), the integral of the N_2 volume density from ALTGRID[i-1] to ALTGRID[i] is calculated as (TempC below)

$$TempA = (ALTGRID[i-1] - ALTGRID[i])*1.0E5$$

$$TempB = N2DP[i-1] + N2DP[i]$$

$$TempC = 0.5*TempA*TempB$$

$$N2VCDP[i] = N2VCDP[i-1] + TempC$$

Calculate the variance of the N_2 vertical column density profile (VN2VCDP).

Note: Each element of the vector VN2VCDP is calculated in the same manner with the exception of the first element. For the first element, the value of VN2VCDP is:

VN2VCDP[1] = 0.0

Note: For the ith element ($i \neq 1$), the value of VN2VCDP is calculated by applying the error propagation formula to the expression for N2VCDP[i] above. The uncertainty in the ith element of N2VCDP is due to uncertainties in the ith and ith-1 elements of the vectors ALTGRID and N2DP (we assume that the relative contribution of all covariance terms is insignificant).

$$VTempA = (VALTGRID[i-1] - VALTGRID[i])*1.0E10$$

VTempB = $VN2DP[i-1] + VN2DP[i]$

VTempC = 0.25*($TempB^2 * VTempA + TempA^2 * VTempB$)

VN2VCDP[i] = $VN2VCDP[i - 1] + VtempC$

2.3.5.4.3 Calculate the O vertical column density profile (OVCDP)

Note: Each element of the vector OVCDP is calculated in the same manner with the exception of the first element. For the first element, the value of OVCDP is

OVCDP[1] = 0.0

Note: For the ith element (i ≠ 1), the value of OVCDP is calculated as the sum of the O vertical column density at ALTGRID[i-1] and the integral of the O volume density from ALTGRID[i-1] to ALTGRID[i]. The O vertical column density should be calculated at each element of ALTGRID. For the ith element of OVCDP (i ≠ 1), the integral of the O volume density from ALTGRID[i-1] to ALTGRID[i] is calculated as (TempC below)

TempA = ($ALTGRID[i - 1] - ALTGRID[i]$)*1.0E5

TempB = $ODP[i - 1] + ODP[i]$

TempC = 0.5*$TempA*TempB$

OVCDP[i] = $OVCDP[i - 1] + TempC$

Calculate the variance of the O vertical column density profile (VOVCDP).

Note: Each element of the vector VOVCDP is calculated in the same manner with the exception of the first element. For the first element, the value of VOVCDP is:

VOVCDP[1] = 0.0

Note: For the ith element (i ≠ 1), the value of variance of OVCDP[i] is calculated by applying the error propagation formula to the expression for OVCDP[i] above. The sources of uncertainty in the ith element of OVCD are uncertainties in the ith and ith-1 elements of the vectors ALTGRID and ODP (we assume that the relative contribution of all covariance terms is insignificant).

VTempA = ($VALTGRID[i-1] - VALTGRID[i]$)*1.0E10

VTempB = $VODP[i-1] + VODP[i]$

VTempC = 0.25*($TempB^2 * VTempA + TempA^2 * VTempB$)

VN2VCDP[i] = $VOVCDP[i - 1] + VtempC$

2.3.5.4.4 Calculate the O vertical column density at N2VCDREF (OVCDREF)

Note: The O vertical column density at N2VCDREF is calculated by interpolating on a vector containing the natural logarithm of OVCDP. Interpolation yields the natural logarithm of the value of OVCDP which corresponds to the natural logarithm of the value N2VCDREF (TempA below) within a vector containing the natural logarithm of N2VCDP. The natural logarithm of each element of the vectors OVCDP and N2VCDP are calculated in the same manner. For the ith element, the natural logarithm of OVCDP and N2VCDP are calculated as (TempB and TempC respectively)

TempA = ln (N2VCDREF)

TempB[i] = ln (OVCDP[i])

TempC[i] = ln (N2VCDP[i])

where

ln = The natural logarithm function.

TempD = The value calculated by the Interpolation Function INTERPOLATE (see Appendix). The following values should be used as input to the Interpolation Function:

For INTERPOLATE Y $\xrightarrow{Use}$ *TempB*
For INTERPOLATE X $\xrightarrow{Use}$ *TempC*
For INTERPOLATE U $\xrightarrow{Use}$ *TempA*

OVCDREF = exp (TempD)

where

exp = The exponential function.

Calculate the variance of the O reference vertical column density (VOVCDREF)

Note: The variance of OVCDREF (VOVCDREF) is calculated from the percent uncertainty of the element of the vector OVCDP which is closest to the interpolated value OVCDREF.

INDEXOVCDREF = The index corresponding to the element of the vector OVCDP which is closest to the input value OVCDREF. The value INDEXOVCDREF is calculated by the Search Function (SEARCH). The following values should be used as inputs to the Search Function:

$$\text{For SEARCH X} \xrightarrow{Use} OVCDP$$
$$\text{For SEARCH U} \xrightarrow{Use} OVCDREF$$

$$\text{VOVCDREF} = \left(\frac{VOVCDP[INDEXOVCDREF]}{OVCDP[INDEXOVCDREF]^2} \right) * OVCDREF^2$$

2.3.5.4.5 Calculate the ratio of O and N_2 vertical column densities (ROVCDN2VCD)

$$\text{ROVCDN2VCD} = \left(\frac{OVCDREF}{N2VCDREF} \right)$$

Calculate the variance of the Vertical Column Density Ratio (VROCDN2VCD).

Note: The variance of ROVCDN2VCD (VROVCDN2VCD) is obtained by applying the error propagation formula to the expression for ROVCDN2VCD above. The only source of uncertainty in ROVCDN2VCD is uncertainty in OVCDREF. Uncertainty in the reference N_2 vertical column density (N2VCDREF) is insignificant relative to the uncertainty in the derived O vertical column density.

$$\text{VROVCDN2VCD} = \left(\frac{VOVCDREF}{N2VCDREF^2} \right)$$

2.3.5.4.6 End

2.3.6 The F_2-Region Peak Density (NmF2)

2.3.6.1 Required Input to the Derivation

ROVCDN2VCD	The ratio of O and N_2 vertical column densities (dimensionless). The ROVCDN2VCD is a product of the Dayside Limb ROVCDN2VCD derivation.
VROVCDN2VCD	The variance associated with ROVCDN2VCD (dimensionless). VROVCDN2VCD is a product of the Dayside Limb ROVCDN2VCD derivation.
QEUV	The solar EUV flux below 450 A (erg cm^{-2} s^{-1}). The QEUV is a product of the Dayside Disk QEUV derivation.
VQEUV	The variance associated with QEUV (erg cm^{-2} $s^{-1})^2$. The VQEUV is a product of the Dayside Disk QEUV derivation
MONTH	The month of the year (dimensionless).
GMLT	The geomagnetic local time of the current pixel (hours).
Ap	The magnetic index (dimensionless).
GMLAT	The geomagnetic latitude of the current pixel (radians).

GMLON The geomagnetic longitude of the current pixel (radians).

2.3.6.2 Calculated Output of the Derivation

NmF2	The F_2-Region peak density (cm^{-3}).
VNmF2	The variance associated with NmF2 $(cm^{-3})^2$.

2.3.6.3 The Derivation

2.3.6.3.1 Begin

2.3.6.3.2 Calculate the F_2-region peak density (NmF2)

NmF2 = The value calculated by the EDPP Data Table Function (EDPPDTF) (see Appendix). The following values should be used as input into the EDPP Data Table Function:

$$\begin{aligned}
&\text{For EDPPDTF ROVCDN2VCD} \xrightarrow{Use} \text{ROVCDN2VCD}\\
&\text{For EDPPDTF VROVCDN2VCD} \xrightarrow{Use} \text{VROVCDN2VCD}\\
&\text{For EDPPDTF QEUV} \xrightarrow{Use} \text{QEUV}\\
&\text{For EDPPDTF VQEUV} \xrightarrow{Use} \text{VQEUV}\\
&\text{For EDPPDTF Ap} \xrightarrow{Use} \text{Ap}\\
&\text{For EDPPDTF MONTH} \xrightarrow{Use} \text{MONTH}\\
&\text{For EDPPDTF GMLT} \xrightarrow{Use} \text{GMLT}\\
&\text{For EDPPDTF GMLAT} \xrightarrow{Use} \text{GMLAT}\\
&\text{For EDPPDTF GMLON} \xrightarrow{Use} \text{GMLON}
\end{aligned}$$

Calculate the variance of the F_2-Region Peak Density (VNmF2).

VNmF2 = The variance associated with the NmF2 value calculated by the EDPP Data Table Function (EDPPDTF) (see Appendix).

2.3.6.3.3 End

2.3.7 The Height of the F_2-Region Peak Density (hmF2)

2.3.7.1 Required Input to the Derivation

ROVCDN2VCD	The ratio of O and N_2 vertical column densities (dimensionless). The ROVCDN2VCD is a product of the Dayside Limb ROVCDN2VCD derivation.
VROVCDN2VCD	The variance associated with ROVCDN2VCD (dimensionless). VROVCDN2VCD is a product of the Dayside Limb ROVCDN2VCD derivation.
QEUV	The solar EUV flux below 450 A (erg cm^{-2} s^{-1}). The QEUV is a product of the Dayside Disk QEUV derivation.

VQEUV	The variance associated with QEUV (erg cm^{-2} $s^{-1})^2$. The VQEUV is a product of the Dayside Disk QEUV derivation
MONTH	The month of the year (dimensionless).
GMLT	The geomagnetic local time of the current pixel (hours).
Ap	The magnetic index (dimensionless).
GMLAT	The geomagnetic latitude of the current pixel (radians).
GMLON	The geomagnetic longitude of the current pixel (radians).

2.3.7.2 Calculated Output of the Derivation

hmF2	The height of the F_2-Region peak density (km).
VhmF2	The variance associated with hmF2 $(km)^2$.

2.3.7.3 The Derivation

2.3.7.3.1 Begin

2.3.7.3.2 Calculate the height of the F_2-region peak density (hmF2)

hmF2 = The value calculated by the EDPP Data Table Function (EDPPDTF) (see Appendix). The following values should be used as input into the EDPP Data Table Function:

For EDPPDTF ROVCDN2VCD $\xrightarrow{Use}$ *ROVCDN2VCD*
For EDPPDTF VROVCDN2VCD $\xrightarrow{Use}$ *VROVCDN2VCD*
For EDPPDTF QEUV $\xrightarrow{Use}$ *QEUV*
For EDPPDTF VQEUV $\xrightarrow{Use}$ *VQEUV*
For EDPPDTF Ap $\xrightarrow{Use}$ *Ap*
For EDPPDTF MONTH $\xrightarrow{Use}$ *MONTH*
For EDPPDTF GMLT $\xrightarrow{Use}$ *GMLT*
For EDPPDTF GMLAT $\xrightarrow{Use}$ *GMLAT*
For EDPPDTF GMLON $\xrightarrow{Use}$ *GMLON*

Calculate the variance of the height of the F_2-Region peak density (VhmF2).

VhmF2 = The variance associated with the hmF2 value calculated by the EDPP Data Table Function (EDPPDTF) (see Appendix).

2.3.7.3.3 End

2.3.8 The F_2-Region Total Electron Content (TEC)

2.3.8.1 Required Input to the Derivation

ROVCDN2VCD	The ratio of O and N_2 vertical column densities (dimensionless). The ROVCDN2VCD is a product of the Dayside Limb ROVCDN2VCD derivation.
VROVCDN2VCD	The variance associated with ROVCDN2VCD (dimensionless). VROVCDN2VCD is a product of the Dayside Limb ROVCDN2VCD derivation.
QEUV	The solar EUV flux below 450 A (erg cm^{-2} s^{-1}). The QEUV is a product of the Dayside Disk QEUV derivation.
VQEUV	The variance associated with QEUV (erg cm^{-2} $s^{-1})^2$. The VQEUV is a product of the Dayside Disk QEUV derivation
MONTH	The month of the year (dimensionless).
GMLT	The geomagnetic local time of the current pixel (hours).
Ap	The magnetic index (dimensionless).
GMLAT	The geomagnetic latitude of the current pixel (radians).
GMLON	The geomagnetic longitude of the current pixel (radians).

2.3.8.2 Calculated Output of the Derivation

TEC	The F_2-Region Total Electron Content (10^{16} e^- m^{-2}).
VTEC	The variance associated with TEC (10^{16} e^- $m^{-2})^2$.

2.3.8.3 The Derivation

2.3.8.3.1 Begin

2.3.8.3.2 Calculate the F_2-region total electron content (TEC)

TEC = The value calculated by the EDPP Data Table Function (EDPPDTF) (see Appendix). The following values should be used as input into the EDPP Data Table Function:

$$\begin{aligned}
&\textit{For EDPPDTF ROVCDN2VCD} \xrightarrow{Use} \textit{ROVCDN2VCD} \\
&\textit{For EDPPDTF VROVCDN2VCD} \xrightarrow{Use} \textit{VROVCDN2VCD} \\
&\textit{For EDPPDTF QEUV} \xrightarrow{Use} \textit{QEUV} \\
&\textit{For EDPPDTF VQEUV} \xrightarrow{Use} \textit{VQEUV} \\
&\textit{For EDPPDTF Ap} \xrightarrow{Use} \textit{Ap}
\end{aligned}$$

For EDPPDTF MONTH $\xrightarrow{Use}$ *MONTH*
For EDPPDTF GMLT $\xrightarrow{Use}$ *GMLT*
For EDPPDTF GMLAT $\xrightarrow{Use}$ *GMLAT*
For EDPPDTF GMLON $\xrightarrow{Use}$ *GMLON*

Calculate the variance of the F_2-Region Total Electron Content (VTEC).

VTEC = The variance associated with the TEC value calculated by the EDPP Data Table Function (EDPPDTF) (see Appendix).

2.3.8.3.3 End

2.3.9 The F_2-Region Plasma Frequency (foF2)

2.3.9.1 Required Input to the Derivation

NmF2	The F_2-Region Peak Density (cm^{-3}). The NmF2 is a product of the Dayside Disk NmF2 derivation.
VNmF2	The variance associated with NmF2 $(cm^{-3})^2$. The VNmF2 is a product of the Dayside Disk NmF2 derivation.

2.3.9.2 Calculated Output of the Derivation

foF2	The F_2-Region plasma frequency (s^{-1}).
VfoF2	The variance associated with foF2 $(s^{-1})^2$.

2.3.9.3 The Derivation

2.3.9.3.1 Begin

2.3.9.3.2 Calculate the F_2-region plasma frequency (foF2)

$$\text{foF2} = 8.98 \times 10^{3} \sqrt{\text{NmF2}}$$

Calculate the variance associated with the Plasma Frequency (VfoF2).

Note: The variance of the derived foF2 value is obtained by applying the error propagation formula to the expression for foF2 above. The only source of uncertainty in foF2 is the uncertainty in NmF2.

$$\text{VfoF2} = 2.02 \times 10^{7} (\text{NmF2})^{-1}\ \text{VNmF2}$$

2.3.9.3.3 End