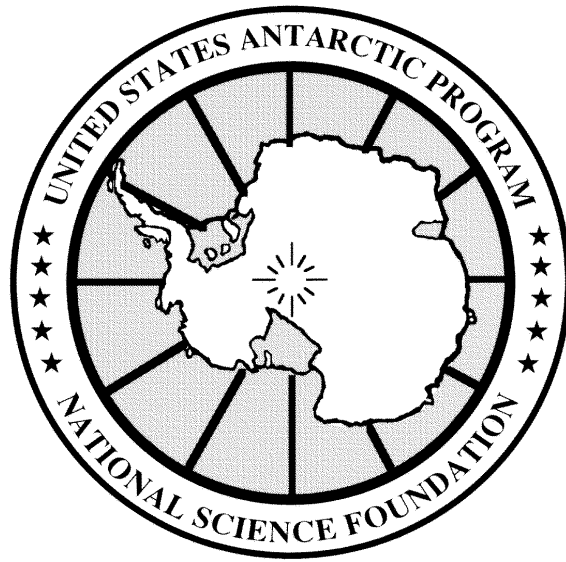


Appendices



A1. Errata

There are no known errors in data of Volumes 7-12, which have not been reported in the Operations Reports complementing these volumes. For known errors in data of Volumes 1-6, please refer to the Operations Reports of Volumes 7-11.

A2. References

Note: * References that utilize NSF UV Spectroradiometer Network data.

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A3. Code Fragments for Dose Weightings and Integrations

To show how the dose weighting and spectral integrals were calculated, the following code fragments were reproduced. The new software was written in Visual Basic 5.0 for 32-bit Windows development.

All functions designed to calculate different spectral integrals use three major arrays: *Irradiance()*, calculated irradiances (or weighted irradiances) at certain wavelengths; *Wavelength()*, where corrected wavelengths from all items are stored; and *Points()*, which references the location of the data from a particular item. To be more specific, *Points()* is a two-dimensional array, where the first index is 1 for item start or 2 for item stop, and the second index is item. For example,

```

Points(1,1) - beginning of Item 1 (= 1),
Points(2,1) - end of Item 1,
...
Points(1,item) - beginning of item item (= Points(2,item-1) + 1),
Points(2,item) - end of item item,
...
Points(1,last_item) - beginning of item last_item (= Points(2,last_item-1) + 1),
Points(2,last_item) - end of item last_item (and total number of points in the scan).

```

Also $(Points(2,item) - Points(1,item) + 1)$ is the number of points in a particular item. Generally speaking, *CalculateIntegral* is the main function, while other functions derive weighted irradiance from *Irradiance()* and the given weight function, and reference to *CalculateIntegral*.

A3.1. Spectral (Non-weighted) Integrals

The function *CalculateIntegral* uses the three arrays mentioned above as well as three other input parameters - *wStart*, *wStop* and *Item* - as a definition of integration limits and source of data (Item 1, 2 or 3). If, for some reason, data from a requested item are not available, this function returns -999 (indicating missing data).

Function *CalculateIntegral* (wStart, wStop, Item, Points() As Integer, Wavelength() As Single, Irradiance() As Single) As Single

```

Dim i As Integer, iStart As Integer, iStop As Integer
Dim Wav As Single, Irr As Single, Integr As Single

If UBound(Points, 2) < Item Then CalculateIntegral = -999: Exit Function
iStart = Points(1, Item): iStop = Points(2, Item)

While (Wavelength(iStart) <= wStart) And (iStart < iStop): iStart = iStart + 1 : Wend
If (iStart = Points(1, Item)) Or (iStart = Points(2, Item)) Then CalculateIntegral = -999: Exit Function

While (Wavelength(iStop) >= wStop) And (iStop > iStart): iStop = iStop - 1 : Wend
If (iStop = Points(2, Item)) Or (iStart = iStop) Then CalculateIntegral = -999: Exit Function

i = iStop
Irr = InterpolateIrradiance(i, wStop, Item, Points(), Wavelength(), Irradiance())
If Irr < -998 Then CalculateIntegral = -999: Exit Function
Integr = (Irradiance(iStop) + Irr) / 2 * (wStop - Wavelength(iStop))

i = iStart
Irr = InterpolateIrradiance(i, wStart, Item, Points(), Wavelength(), Irradiance())
If Irr < -998 Then CalculateIntegral = -999: Exit Function

Wav = wStart
For i = iStart To iStop
    If Irradiance(i) < -998 Then CalculateIntegral = -999: Exit Function
    Integr = Integr + (Irradiance(i) + Irr) / 2 * (Wavelength(i) - Wav)
    Wav = Wavelength(i): Irr = Irradiance(i)
Next i
CalculateIntegral = Integr
End Function

```

A3.2. Dose Weightings

Several alterations to the code were performed to accommodate changes in the data and response scans. In previous software releases, the highest resolution scan (Item 1) was used for calculations below 310 nm, the medium resolution scan (Item 2) – between 310 and 340 nm, and the lowest resolution scan (Item 3) – above 340 nm. No data beyond 400 nm was utilized. With the new version, these limits have changed: interval (285, 340) nm is covered by Item 1 and interval (340, 400) nm is covered by Item 2. If data are not available (or only partially available), doses are not determined and the corresponding functions return “-999.” Keeping in mind that there are 1-minute pauses between the items and that items with smaller subsequent numbers are performed at higher resolution, the new calculation appears to be more precise.

In order to generalize the determination of wavelength segments and simplify accommodation of any future changes, two new functions were added to the code. One of them – **DoseItem** – defines what scan item can be used for dose calculation and the other one – **DoseBreak** – determines what wavelength segment might be utilized from this particular item. If a certain wavelength segment is available from various items, higher resolution data are preferred. Assuming that a few beginning points of each item might be compromised by monochromator backlash, and because items overlap by at least 10 nm, it is possible to improve data quality by engaging only “middle” points. Variable *OverlapWavelength* determines the size of the segment that will be sacrificed.

The two-dimensional structure *Header(item, scan)* contains information about scan parameters, such as start wavelength, stop wavelength, etc., and variable *scan = 3* for data scan. Array *Items(scan)* defines the numbers of items in the scan, e.g., *Items(3)* is the number of items in a particular data scan.

Function **DoseItem** (Wav As Single, Points() As Integer, Wavelength() As Single) As Integer

```

Dim i As Integer, item As Integer

item = 0
For i = 1 To UBound(Points, 2)
    If (Wavelength(Points(1, i)) <= Wav) And (Wav < Wavelength(Points(2, i)) - OverlapWavelength) Then
        If item = 0 Then
            item = i
        ElseIf Header(i, 3).Conditions.StepW1 < Header(item, 3).Conditions.StepW1 Then
            item = i
        End If
    End If
Next i
DoseItem = item
End Function

```

Function **DoseBreak** (Wav As Single, item As Integer, Points() As Integer, Wavelength() As Single) As Single

```

Dim i As Integer

If Wav < Wavelength(Points(2, item)) Then
    DoseBreak = Wav
Else
    i = Points(2, item) - Int(OverlapWavelength / Header(item, 3).Conditions.StepW1)
    While (Wavelength(i) < Wavelength(Points(2, item)) - OverlapWavelength)
        i = i + 1
        If i = Points(2, item) Then
            DoseBreak = Wavelength(Points(2, item)) - OverlapWavelength: Exit Function
        End If
    Wend
    DoseBreak = Wavelength(i)
End If
End Function

```

Erythema Dose1

Unfortunately, in previous software versions **Dose1** was calculated incorrectly. Thanks to Sari Kalliskota, this problem was noticed and fixed in the latest software revision. Precisely, weighted function

$$W(\lambda) = \frac{0.04485}{1 + \frac{\exp\{\lambda - 311.4\}}{3.13}} + \frac{4 \cdot 0.9949 \cdot \exp\left\{\frac{\lambda - 296.5}{2.692}\right\}}{1 + \exp\left\{\frac{\lambda - 296.5}{2.692}\right\}^2}$$

was coded instead of $W(\lambda) = \frac{0.04485}{1 + \frac{\exp\{\lambda - 311.4\}}{3.13}} + \frac{4 \cdot 0.9949 \cdot \exp\left\{\frac{\lambda - 296.5}{2.692}\right\}}{\left\{1 + \exp\left\{\frac{\lambda - 296.5}{2.692}\right\}\right\}^2}$.

Function Dose1 (Points() As Integer, Wavelength() As Single, Irradiance() As Single) As Single

```

Dim i As Integer, item As Integer
Dim Wav As Single, Wav1 As Single, Wav2 As Single
Dim integrI As Single, integr As Single
Dim WeightedIrrr() As Single: ReDim WeightedIrrr(Points(2), Items(3)))

Wav2 = 286: integr = 0
While Wav2 < 400
    Wav1 = Wav2: item = DoseItem(Wav1, Points(), Wavelength()): If item = 0 Then Dose1 = -999: Exit Function
    Wav2 = DoseBreak(400, item, Points(), Wavelength())
    For i = Points(1, item) To Points(2, item)
        Wav = Wavelength(i)
        If (Wav1 - 1 <= Wav) And (Wav <= Wav2 + 1) Then
            WeightedIrrr(i) = Irradiance(i) * (0.04485 / (1 + Exp((Wav - 311.4) / 3.13))) + 4 * 0.9949
                * Exp((Wav - 296.5) / 2.692) / (1 + Exp((Wav - 296.5) / 2.692) ^ 2)
        End If
    Next i
    integrI = CalculateIntegral(Wav1, Wav2, item, Points(), Wavelength(), WeightedIrrr())
    If integrI < -998 Then Dose1 = -999: Exit Function
    integr = integr + integrI
Wend
Erase WeightedIrrr
Dose1 = integr
End Function

```

Erythema Dose2

Function Dose2 (Points() As Integer, Wavelength() As Single, Irradiance() As Single) As Single

```

Dim i As Integer, item As Integer
Dim Wav As Single, Wav1 As Single, Wav2 As Single
Dim integrI As Single, integr As Single, Weight As Single
Dim WeightedIrrr() As Single: ReDim WeightedIrrr(Points(2), Items(3)))

Wav2 = 286: integr = 0
While Wav2 < 400
    Wav1 = Wav2: item = DoseItem(Wav1, Points(), Wavelength()): If item = 0 Then Dose2 = -999: Exit Function
    Wav2 = DoseBreak(400, item, Points(), Wavelength())
    For i = Points(1, item) To Points(2, item)
        Wav = Wavelength(i)
        If (Wav1 - 1 <= Wav) And (Wav <= Wav2 + 1) Then
            Select Case Wav
                Case Is < 295: Weight = 10 ^ (-1.215837 + (Wav * 0.004728))
                Case 295 To 300: Weight = 10 ^ (10.73862 + (Wav * -0.035795))
                Case 300 To 305: Weight = 10 ^ (17.54579 + (Wav * -0.058486))
                Case 305 To 310: Weight = 10 ^ (50.49061 + (Wav * -0.166502))
                Case 310 To 320: Weight = 10 ^ (27.87686 + (Wav * -0.093554))
                Case 320 To 335: Weight = 10 ^ (15.3893 + (Wav * -0.054531))
                Case 335 To 365: Weight = 10 ^ (1.703584 + (Wav * -0.013555))
                Case 365 To 380: Weight = 10 ^ (8.365825 + (Wav * -0.031808))
                Case Is > 380: Weight = 10 ^ (-1.705338 + (Wav * -0.005305))
            End Select
            WeightedIrrr(i) = Irradiance(i) * Weight
        End If
    Next i
    integrI = CalculateIntegral(Wav1, Wav2, item, Points(), Wavelength(), WeightedIrrr())
    If integrI < -998 Then Dose2 = -999: Exit Function

```

```

        integr = integr + integrI
    Wend
    Erase WeightedIrr
    Dose2 = integr
End Function

```

Erythema Dose3

Function **Dose3** (Points() As Integer, Wavelength() As Single, Irradiance() As Single) As Single

```

    Dim i As Integer, item As Integer
    Dim Wav As Single, Wav1 As Single, Wav2 As Single
    Dim integrI As Single, integr As Single, Weight As Single
    Dim WeightedIrr() As Single: ReDim WeightedIrr(Points(2), Items(3)))

    Wav2 = 286: integr = 0
    While Wav2 < 400
        Wav1 = Wav2: item = DoseItem(Wav1, Points(), Wavelength()): If item = 0 Then Dose3 = -999: Exit Function
        Wav2 = DoseBreak(400, item, Points(), Wavelength())
        For i = Points(1, item) To Points(2, item)
            Wav = Wavelength(i)
            If (Wav1 - 1 <= Wav) And (Wav <= Wav2 + 1) Then
                Select Case Wav
                    Case Is < 298: Weight = 1
                    Case 298 To 328: Weight = 10 ^ (0.094 * (298 - Wav))
                    Case Is > 328: Weight = 10 ^ (0.015 * (139 - Wav))
                End Select
                WeightedIrr(i) = Irradiance(i) * Weight
            End If
        Next i
        integrI = CalculateIntegral(Wav1, Wav2, item, Points(), Wavelength(), WeightedIrr())
        If integrI < -998 Then Dose3 = -999: Exit Function
        integr = integr + integrI
    Wend
    Erase WeightedIrr
    Dose3 = integr
End Function

```

Setlow Dose

Function **Setlow** (Points() As Integer, Wavelength() As Single, Irradiance() As Single) As Single

```

    Dim i As Integer, item As Integer
    Dim Wav As Single, Wav1 As Single, Wav2 As Single
    Dim integrI As Single, integr As Single, Weight as Single
    Dim WeightedIrr() As Single: ReDim WeightedIrr(Points(2), Items(3)))

    Wav2 = 286: integr = 0
    While Wav2 < 340
        Wav1 = Wav2: item = DoseItem(Wav1, Points(), Wavelength()): If item = 0 Then Setlow = -999: Exit
Function
        Wav2 = DoseBreak(340, item, Points(), Wavelength())
        For i = Points(1, item) To Points(2, item)
            Wav = Wavelength(i)
            If (Wav1 - 1 <= Wav) And (Wav <= Wav2 + 1) Then
                Select Case Wav
                    Case Is < 290: Weight = 10 ^ (13.04679 + (Wav * -0.047012))
                    Case 290 To 295: Weight = 10 ^ (20.75595 + (Wav * -0.073595))
                    Case 295 To 300: Weight = 10 ^ (30.12706 + (Wav * -0.105362))
                    Case 300 To 305: Weight = 10 ^ (42.94028 + (Wav * -0.148073))
                    Case Is > 305: Weight = 10 ^ (45.24538 + (Wav * -0.15563))
                End Select
                WeightedIrr(i) = Irradiance(i) * Weight
            End If
        Next i
        integrI = CalculateIntegral(Wav1, Wav2, item, Points(), Wavelength(), WeightedIrr())
        If integrI < -998 Then Setlow = -999: Exit Function
    Wend

```

```
        integr = integr + integrI
    Wend
    Erase WeightedIrr
    Setlow = integr
End Function
```

Hunter Dose

Function **Hunter** (Points() As Integer, Wavelength() As Single, Irradiance() As Single) As Single

```
    Dim i As Integer, item As Integer
    Dim Wav As Single, Wav1 As Single, Wav2 As Single
    Dim integrI As Single, integr As Single
    Dim WeightedIrr() As Single: ReDim WeightedIrr(Points(2), Items(3)))

    Wav2 = 290: integr = 0
    While Wav2 < 340
        Wav1 = Wav2: item = DoseItem(Wav1, Points(), Wavelength()): If item = 0 Then Hunter = -999: Exit
    Function
        Wav2 = DoseBreak(340, item, Points(), Wavelength())
        For i = Points(1, item) To Points(2, item)
            Wav = Wavelength(i)
            If (Wav1 - 1 <= Wav) And (Wav <= Wav2 + 1) Then
                WeightedIrr(i) = Irradiance(i) * Exp(61.1381 - 0.21551 * Wav)
            End If
        Next i
        integrI = CalculateIntegral(Wav1, Wav2, item, Points(), Wavelength(), WeightedIrr())
        If integrI < -998 Then Hunter = -999: Exit Function
        integr = integr + integrI
    Wend
    Erase WeightedIrr
    Hunter = integr
End Function
```

Caldwell Dose

Function **Caldwell** (Points() As Integer, Wavelength() As Single, Irradiance() As Single) As Single

```
    Dim i As Integer, item As Integer
    Dim Wav As Single, Wav1 As Single, Wav2 As Single
    Dim integrI As Single, integr As Single
    Dim WeightedIrr() As Single: ReDim WeightedIrr(Points(2), Items(3)))

    Wav2 = 286: integr = 0
    While Wav2 < 313
        Wav1 = Wav2: item = DoseItem(Wav1, Points(), Wavelength()): If item = 0 Then Caldwell = -999: Exit Function
        Wav2 = DoseBreak(313, item, Points(), Wavelength())
        For i = Points(1, item) To Points(2, item)
            Wav = Wavelength(i)
            If (Wav1 - 1 <= Wav) And (Wav <= Wav2 + 1) Then
                WeightedIrr(i) = Irradiance(i) * 2.618 * (1 - (Wav / 313.3) ^ 2) * Exp((300 - Wav) / 31.08)
            End If
        Next i
        integrI = CalculateIntegral(Wav1, Wav2, item, Points(), Wavelength(), WeightedIrr())
        If integrI < -998 Then Caldwell = -999: Exit Function
        integr = integr + integrI
    Wend
    Erase WeightedIrr
    Caldwell = integr
End Function
```

Weighted TSI (Dose4)

Function **WeightedTSI** (Points() As Integer, Wavelength() As Single, Irradiance() As Single) As Single

```

Dim i As Integer, item As Integer
Dim Wav As Single, Wav1 As Single, Wav2 As Single
Dim integr1 As Single, integr As Single
Dim WeightedIrr() As Single: ReDim WeightedIrr(Points(2), Items(3)))

Wav2 = 320: integr = 0
While Wav2 < 392
    Wav1 = Wav2: item = DoseItem(Wav1, Points(), Wavelength()): If item = 0 Then WeightedTSI = -999: Exit Function
    Wav2 = DoseBreak(392, item, Points(), Wavelength())
    For i = Points(1, item) To Points(2, item)
        Wav = Wavelength(i)
        If (Wav1 - 1 <= Wav) And (Wav <= Wav2 + 1) Then
            If Wav < 367 Then
                WeightedIrr(i) = Irradiance(i) * (0.005598382 + Wav * -0.00004901834
                    + Wav * Wav * 0.0000001420638 + Wav * Wav * Wav * -1.361036E-10)
            Else
                WeightedIrr(i) = Irradiance(i) * (-0.08228739 + Wav * 0.0006492523 + Wav
                    * Wav * -0.00000170513 + Wav * Wav * Wav * 0.000000001490757)
            End If
        End If
    Next i
    integr1 = CalculateIntegral(Wav1, Wav2, item, Points(), Wavelength(), WeightedIrr())
    If integr1 < -998 Then WeightedTSI = -999: Exit Function
    integr = integr + integr1
Wend
Erase WeightedIrr
WeightedTSI = integr
End Function

```

