

# Optimización de la búsqueda de parámetros atmosféricos en modelos de transferencia radiativa

- Gamaliel López-Padilla • giovannilopez9808@gmail.com

# Modelos de transferencia radiativa

The screenshot shows the NCAR UCAR Atmospheric Chemistry Observations & Modeling website. At the top, there's a banner for the Tropospheric Ultraviolet and Visible (TUV) radiation model. Below the banner, there's a section titled "CLIMATOLOGY OF ERYTHEMAL ULTRAVIOLET RADIATION, 1979-2000" which includes a map and some text. Further down, there's a "DOWNLOADS AND TOOLS" section with a link to "TUV source code".

**NCAR | National Center for Atmospheric Research  
UCAR | Atmospheric Chemistry Observations & Modeling**

NCAR is sponsored by  
National Science Foundation

**Modeling**

**TROPOSPHERIC ULTRAVIOLET AND VISIBLE (TUV) RADIATION MODEL**

Tropospheric ultraviolet (UV) radiation is the driving force for all tropospheric photochemical processes. Photons in the UV wavelength have the potential to break usually fairly stable molecules into very reactive fragments (photolysis) and thus initiate reaction chains otherwise unlikely or even impossible. UV radiation is also harmful to living organisms and detrimental to human health. High doses of UV radiation are considered the major contributing factor for the development of skin cancer or cataracts. UV radiation can weaken the human immune system and can affect crop yields and phytoplankton activity (to only name a few effects).

Some questions of interest might be: What factors influence the amount of UV radiation available? What is the vertical structure of the radiative field? What sort of feedbacks (e.g., increased/decreased photolysis rates) can be expected from perturbations that - directly or indirectly - affect UV radiation? What are some of the health-related effects that can be expected from changes in atmospheric composition?

**CLIMATOLOGY OF ERYTHEMAL ULTRAVIOLET RADIATION, 1979-2000**

The monthly climatological distribution for the period 1979-2000 of daily total erythemal (skin-redening) ultraviolet radiation at Earth's surface, calculated with the TUV model using satellite-based (Nimbus-7, Meteor-3 and Earth Probe) TOMS (Total Ozone Mapping Spectrometer) observations of atmospheric ozone. The effects of clouds and scattering aerosols are accounted for using TOMS reflectivity at 380 nm.

**DOWNLOADS AND TOOLS**

\* [TUV source code](#) at NCAR Atmospheric Chemistry Observations & Modeling

Figure 1: Tropospheric Ultraviolet and Visible (TUV) radiation model. [1]

The screenshot shows the NREL website. At the top, there's a banner for the Grid Modernization section. Below the banner, there's a section titled "SMARTS: Simple Model of the Atmospheric Radiative Transfer of Sunshine" which includes a map and some text. There's also a sidebar with various links related to solar energy.

**NREL**  
Transforming ENERGY

Grid Modernization

Research ▾ Publications Data & Tools Facilities Work with Us

SMARTS: Simple Model of the Atmospheric Radiative Transfer of Sunshine

OptGrid  
Modeling Tools  
Solar Integration Data Sets  
Wind Integration Data Sets  
Solar Resource Data & Tools

Earth's atmosphere is a continuously changing filter that modifies the sunlight that travels through it. SMARTS computes how changes in the atmosphere affect the distribution of solar power or photon energy for each wavelength of light.

SMARTS is a versatile, complex model that requires significant experience and knowledge of basic physics and meteorology, climatology, or atmospheric sciences. It is therefore used primarily by researchers and engineers. Solar energy researchers use SMARTS to test the performance of spectroradiometers, develop reference spectra, establish uniform testing conditions for materials research, optimize daylighting techniques, and verify broadband radiation models. Researchers also use SMARTS in the fields of architecture, atmospheric science, photobiology,

Figure 2: Simple Model of the Atmospheric Radiative Transfer of Sunshine. [2]

# ¿Qué hacen estos modelos?

$$\frac{dE}{dAdt} = I_\nu(\hat{k}, \vec{r}, t) \vec{k} \cdot \vec{n} d\Omega d\nu \quad [3]$$

```
'AOD=0.041 '
2
25.750 0.476 0
1
'USSA'
1
0
1 0.2740
0
3
390
0
'S&F_URBAN'
5
0.041 2
18
1
51 37.0 180.0
285 2800 1 1366.1
2
285 2800 1
1
4
1
0 2.9 0
0
0
1
3
2015 1 11 8.2167 25.75 -100.255 -6
```

```
TUV inputs:
=====
inpfil =      CDMX    outfitl =      cdmx    nstr =      -2
lat =        19.420   lon =       -99.145   tmzone =     -6.0
iyear =       2016    imonth =       1      iday =       9
zstart =      2.245   zstop =       80.000   nz =       81
wstart =      280.000  wstop =      400.000   nwint =     120
tstart =      10.000   tstop =       15.000   nt =       61
lzenit =        F      alsurf =      0.080   psurf =     -999.0
o3col =       228.380   so2col =      0.000   no2col =      0.100
taucl =        0.000   zbase =       4.000   ztop =       5.000
tauuaer =      0.061   ssaauer =     0.800   alpha =      1.000
dirsun =       1.000   difdn =       1.000   difup =      0.000
zout =        2.245   zaird =     -9.990E+02  ztemp =     -999.000
lirrad =        T      laflux =       F      lmmech =      F
lrates =        T      isfix =        0      nms =        2
ljvals =        F      ijfix =        0      nmj =        0
iwfix =         0      itfix =        0      izfix =        0
=====
```

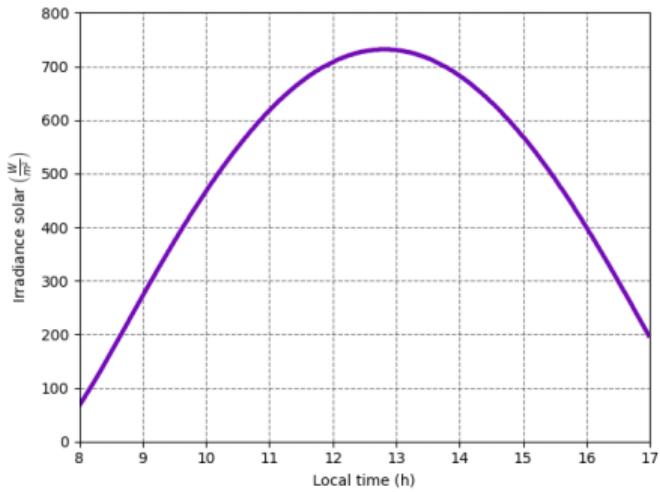
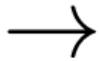
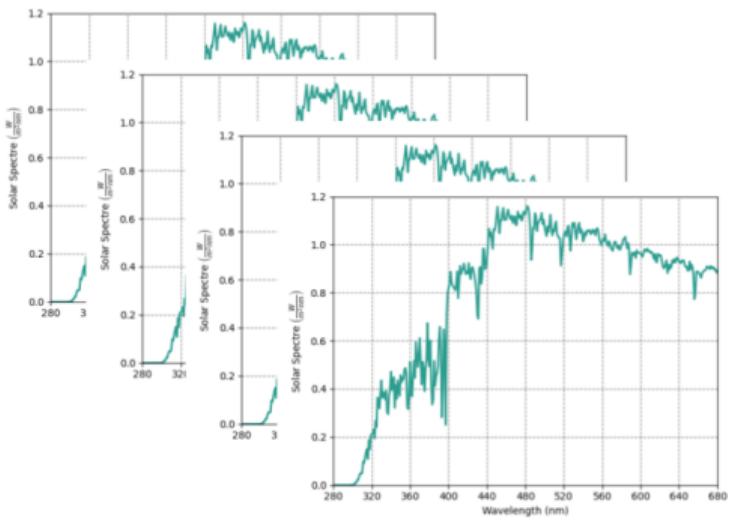
Figure 4: Archivo de inputs del modelo TUV

Figure 3: Archivo de inputs del modelo SMARTS

$$I(t) = \int_{\lambda_0}^{\lambda_i} E(\lambda, t) d\lambda \quad (1)$$

```
# Calculo de la irradiancia solar a partir de los resultados del
# modelo SMARTS
size = np.size(irradiance)
integral = irradiance[0]
for i in range(1, size):
    integral += irradiance[i]*(wavelength[i]-wavelength[i-1])
```

Figure 5: Implementación de la ecuación 1.



# Recolección de datos





# Mediciones in situ



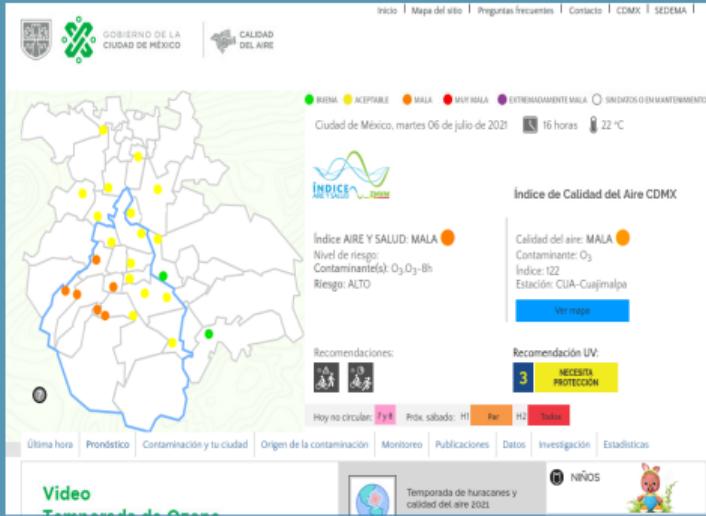


Figure 6: Página web de la SEDEMA. [4]



Figure 7: Página web del SIMA. [5]

UVB → [280nm, 320nm]

UVA → [320nm, 400nm]

UVB+UVA → [280nm, 400nm]

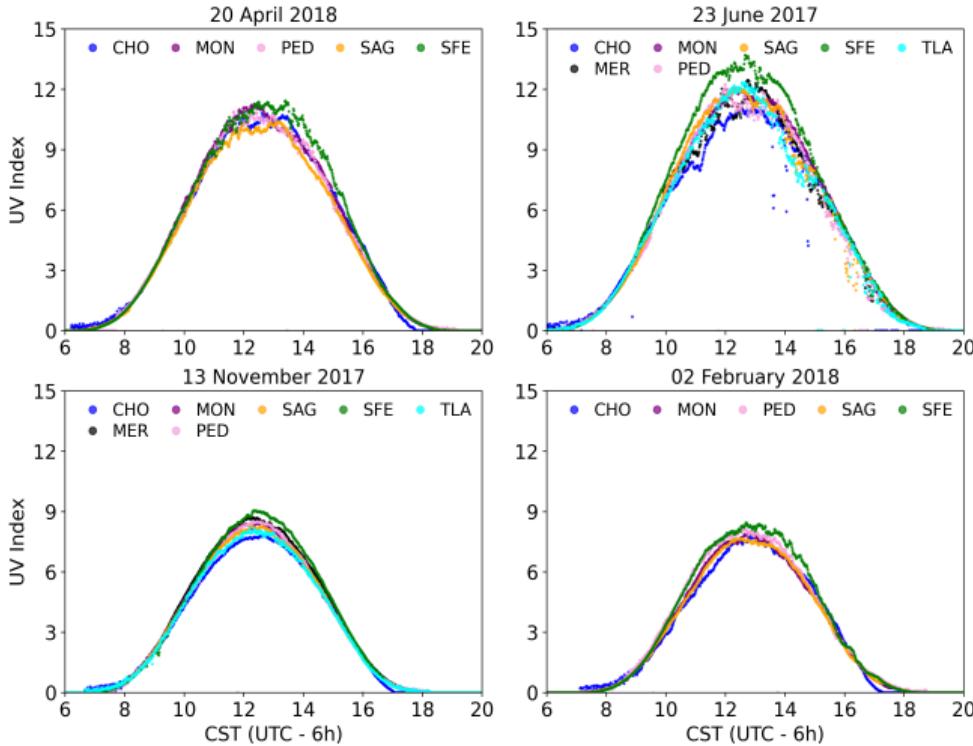


Figure 8: Mediciones de indice UV en las diferentes estaciones de monitoreo de la SEDEMA. [4]

A photograph of a satellite in orbit around Earth. The satellite is a rectangular structure with various equipment and solar panels deployed. It is positioned in front of a view of Earth's atmosphere, showing clouds and blue oceans. The background is the dark void of space with a few distant stars.

# Mediciones satelitales

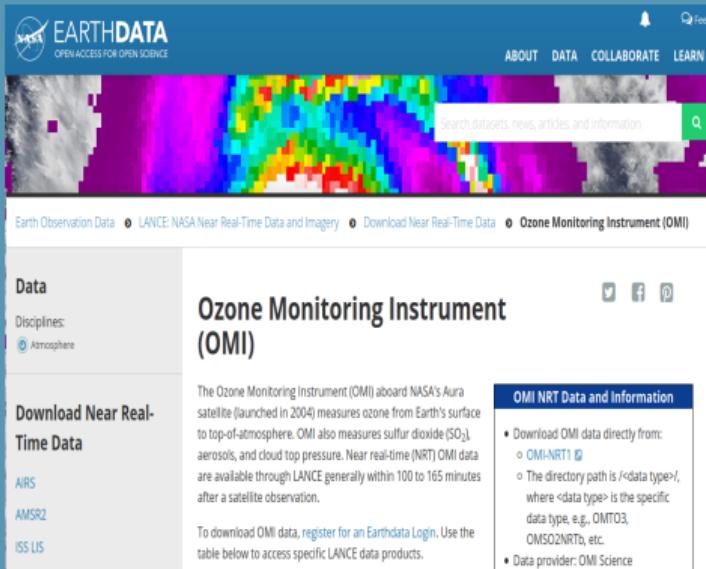


Figure 9: Página web del proyecto OMI. [6] Figure 10: Página web de los datos OMI. [7]

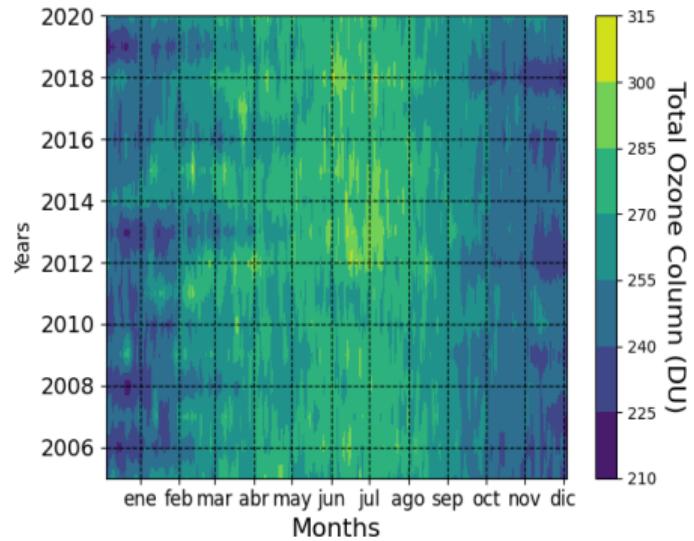


Figure 11: Datos de columnas de Ozono en CDMX.

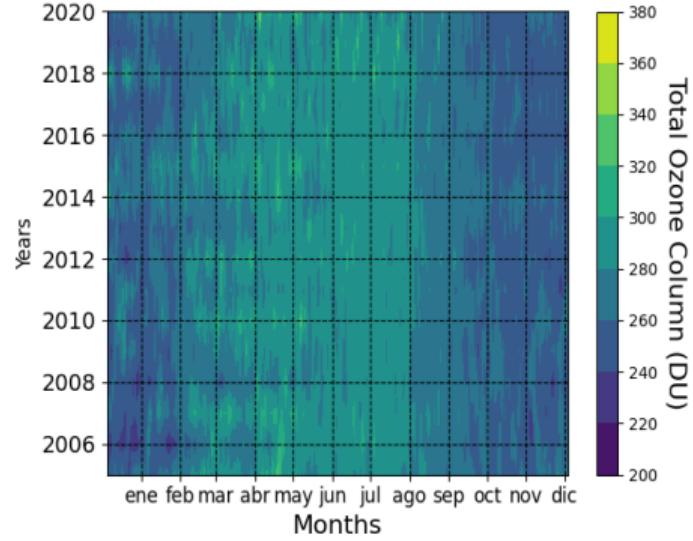


Figure 12: Datos de columnas de Ozono en Monterrey.



THANK YOU

- [1] NCAR, "Atmospheric chemistry observations & modeling."  
<https://www2.acom.ucar.edu/modeling/tropospheric-ultraviolet-and-visible-tuv-radiation-model>, 7 2021.
- [2] NREL, "Smarts: Simple model of the atmospheric radiative transfer of sunshine."  
<https://www.nrel.gov/grid/solar-resource/smarts.html>, 7 2021.
- [3] A. Carramiñana, *Transferencia radiativa*, ch. 2, pp. 1–24.  
INAOE, 8 2020.  
<https://www.inaoep.mx/~alberto/cursos/radiacion/cap2.pdf>.
- [4] SEDEMA, "Sistema de Monitoreo Atmosférico,Ciudad de México."  
<http://www.aire.cdmx.gob.mx/default.php?opc=%27aKBhnMI=%27&opcion=bQ==>.
- [5] SIMA, "Sistema integral de monitoreo ambiental." <http://aire.nl.gob.mx/>.
- [6] EarthData, "Ozone Monitoring Instrument (OMI)." <https://earthdata.nasa.gov/earth-observation-data/near-real-time/download-nrt-data/omi-nrt>.
- [7] Goddard Space Flight Center, "Aura Validation Data Center."  
<https://avdc.gsfc.nasa.gov/pub/data/satellite/Aura/OMI/V03/L2OVP/OMTO3/>.