

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

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# Modelos de transferencia radiativa

## 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 photosynthesis 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 (Iimbis-7, Meteo-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]

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SMARTS: Simple Model of the Atmospheric Radiative Transfer of Sunshine

The Simple Model of the Atmospheric Radiative Transfer of Sunshine, or SMARTS, predicts clear-sky spectral irradiances. 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?

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

```
'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:
=====
infil =      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
tauclu =      0.000   zbase =       4.000   ztop =       5.000
tauaer =      0.061   ssaaer =      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
=====
```

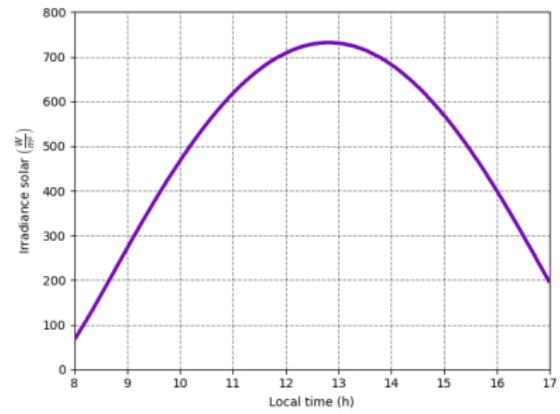
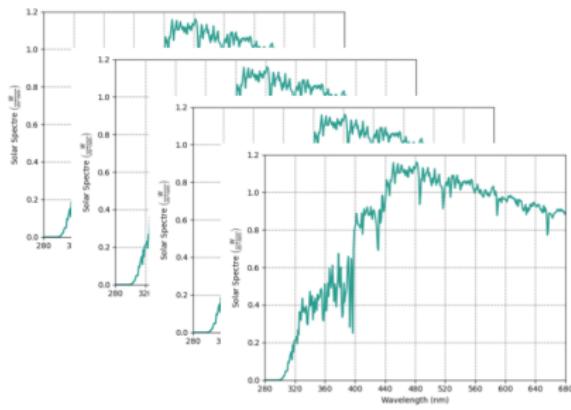
Figure 4: Archivo de inputs del modelo TUV

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.



An aerial photograph of Mexico City's skyline. In the foreground, the Angel of Independence monument stands prominently at the base of Paseo de la Reforma. The city extends into the distance, with numerous skyscrapers and lower buildings. A large, semi-transparent blue rectangular overlay covers the upper half of the image, containing the text.

# Mediciones in situ

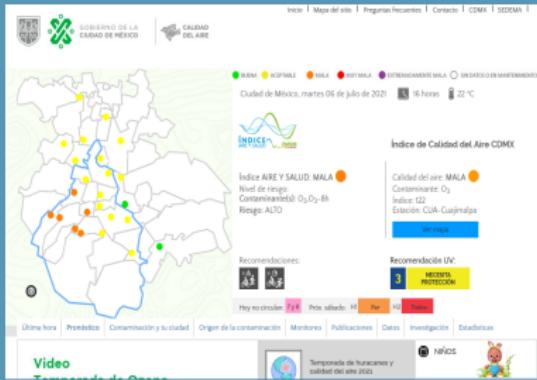


Figure 6: Página web de la SEDEMA. [4]



Figure 7: Página web del SIMA. [5]

UVB → [280nm, 320nm]

UVA → [320nm, 400nm]

UVB+UVA → [280nm, 400nm]

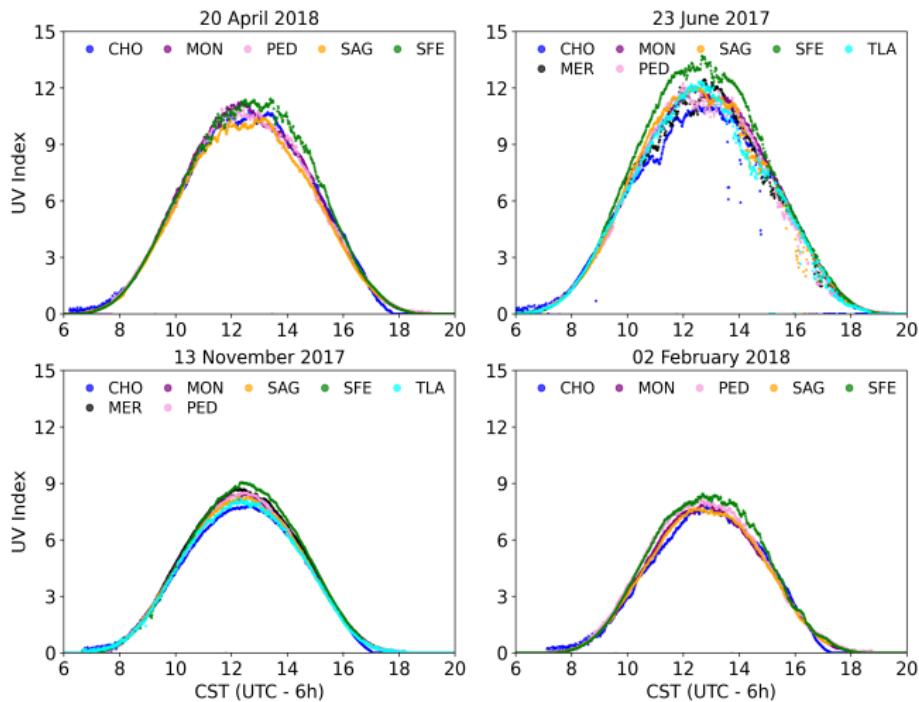


Figure 8: Mediciones de indice UV en las diferentes estaciones de monitoreo de la SEDEMA. [4]

# Recolección de datos

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=%27aKBhnml=%27&opcion=bQ==>.
- [5] SIMA, "Sistema integral de monitoreo ambiental." <http://aire.nl.gob.mx/>.