UV Index estimation from global radiation and total column ozone

- **Paulo Fialho**
  - Diamantino Henriques
  - Fernanda Carvalho

Importance of UV-index

- The UV-index (*UVI*) pretends to quantify the damaging ultraviolet radiation at ground level,

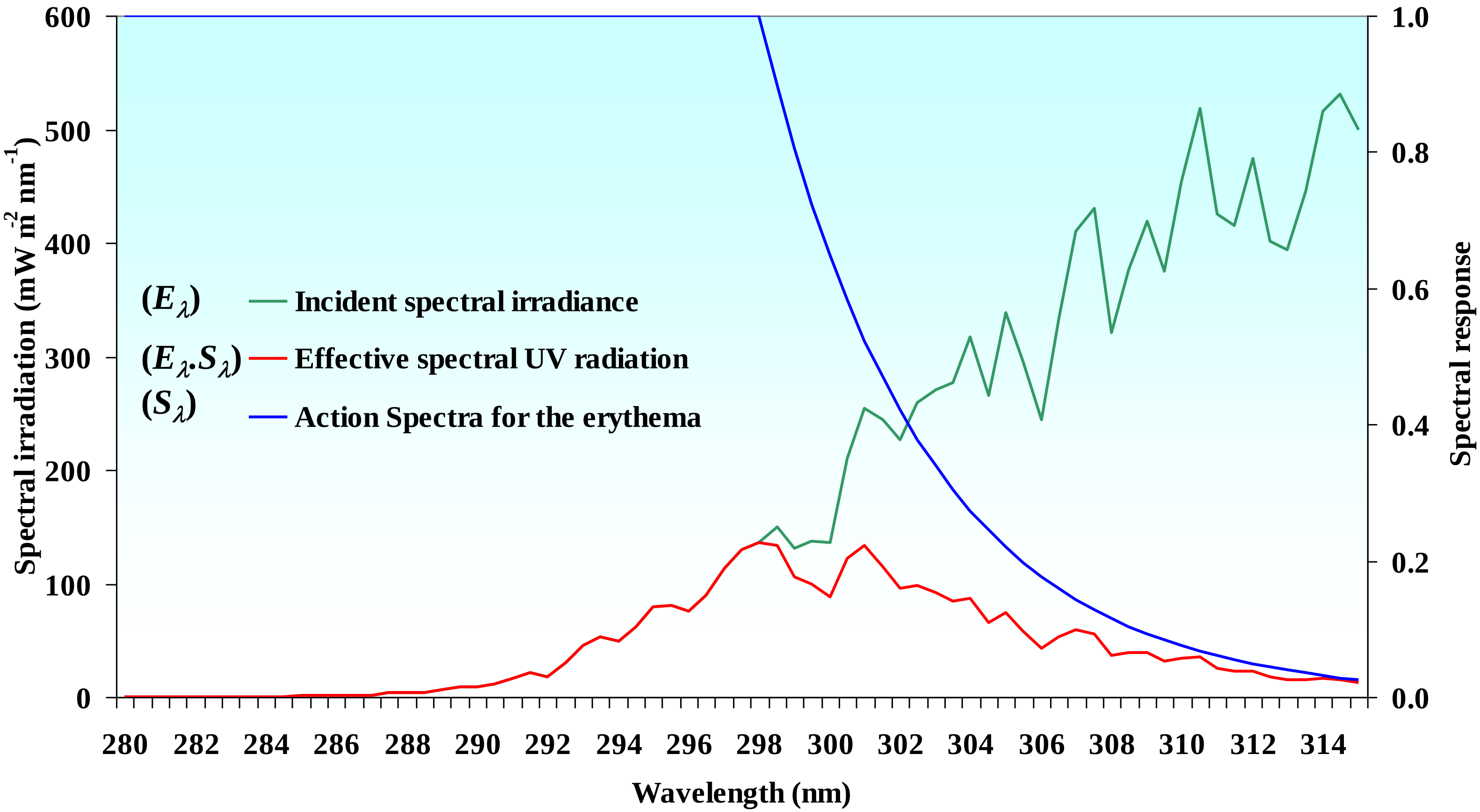
$$UVI = E_{eff}\left(W\ m^{-2}\right)\times 40$$

where, E_{eff}, is the effective radiation responsible for the appearance of an erythema (commonly call sunburn).

- *UVI* is expressed, to the population, by using one of the following qualitative/quantitative scales,
  - Low or values (1, 2) $\Rightarrow$ UVI [0, 2.5[
  - Moderate or values (3, 4, 5) $\Rightarrow$ UVI [2.5, 5.5[
  - High or values (6, 7) $\Rightarrow$ UVI [5.5, 7.5[
  - Very High or values (8, 9, 10) $\Rightarrow$ UVI [7.5, 10.5[
  - Extremely High or values ($\geq$ 11) $\Rightarrow$ UVI $\geq$ 10.5

Paulo Fialho
paulofialho@uac.pt

$$E_{eff} = \int_{290nm}^{400nm} E_\lambda . S_\lambda d\lambda$$



Problem

- UV dependence on clouds is difficult to model together with its effect on daily variability.

- UV measurements availability are scarce and expensive.

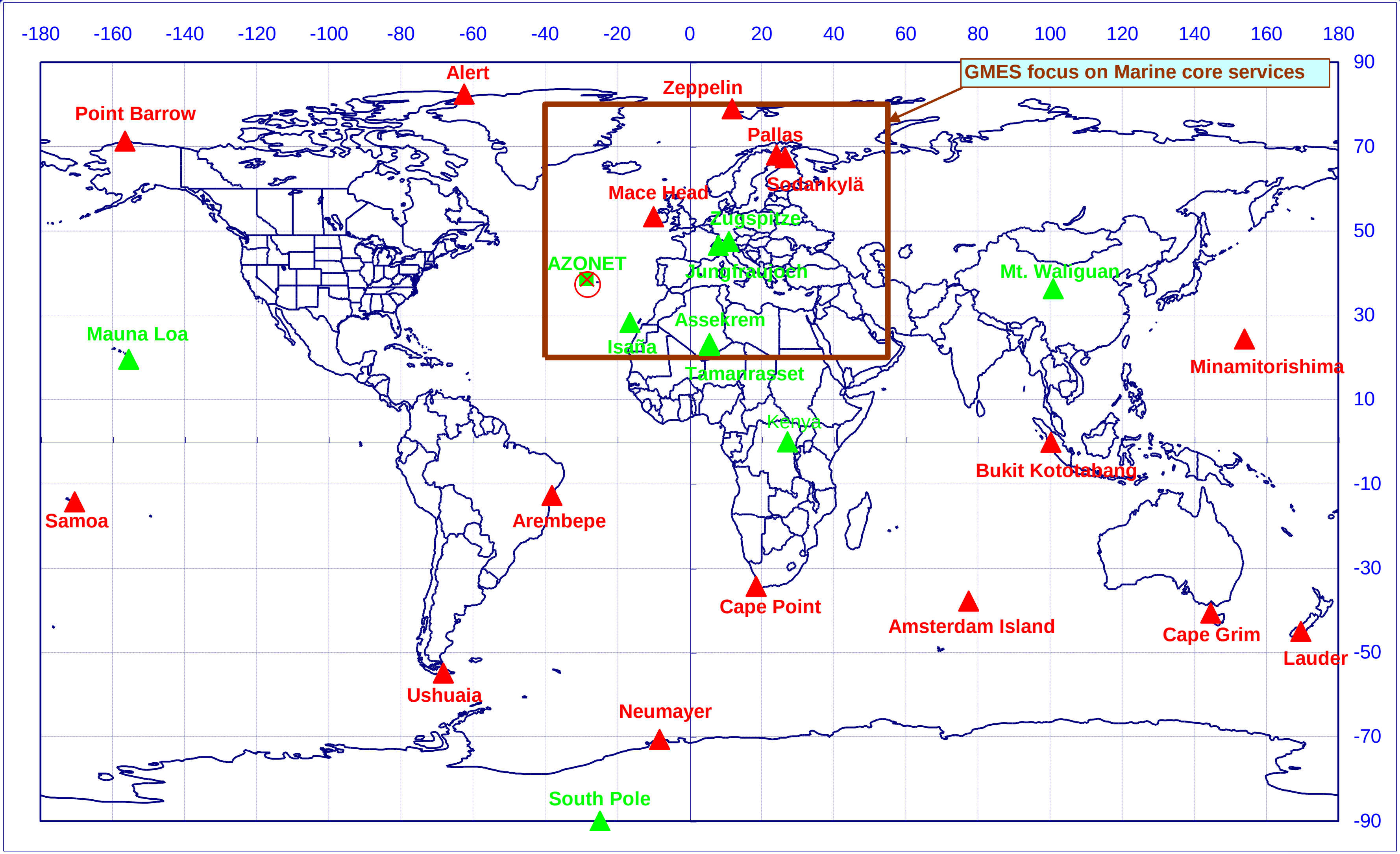
Proposed solution

- Use of global radiation measurements to correct a simple radiative transfer model for clear sky conditions with respect to the actual cloudiness.
- Use of this corrected model to estimate the *UVI*, from global radiation and total ozone measurements, with acceptable error (≤0.5) for public awareness.

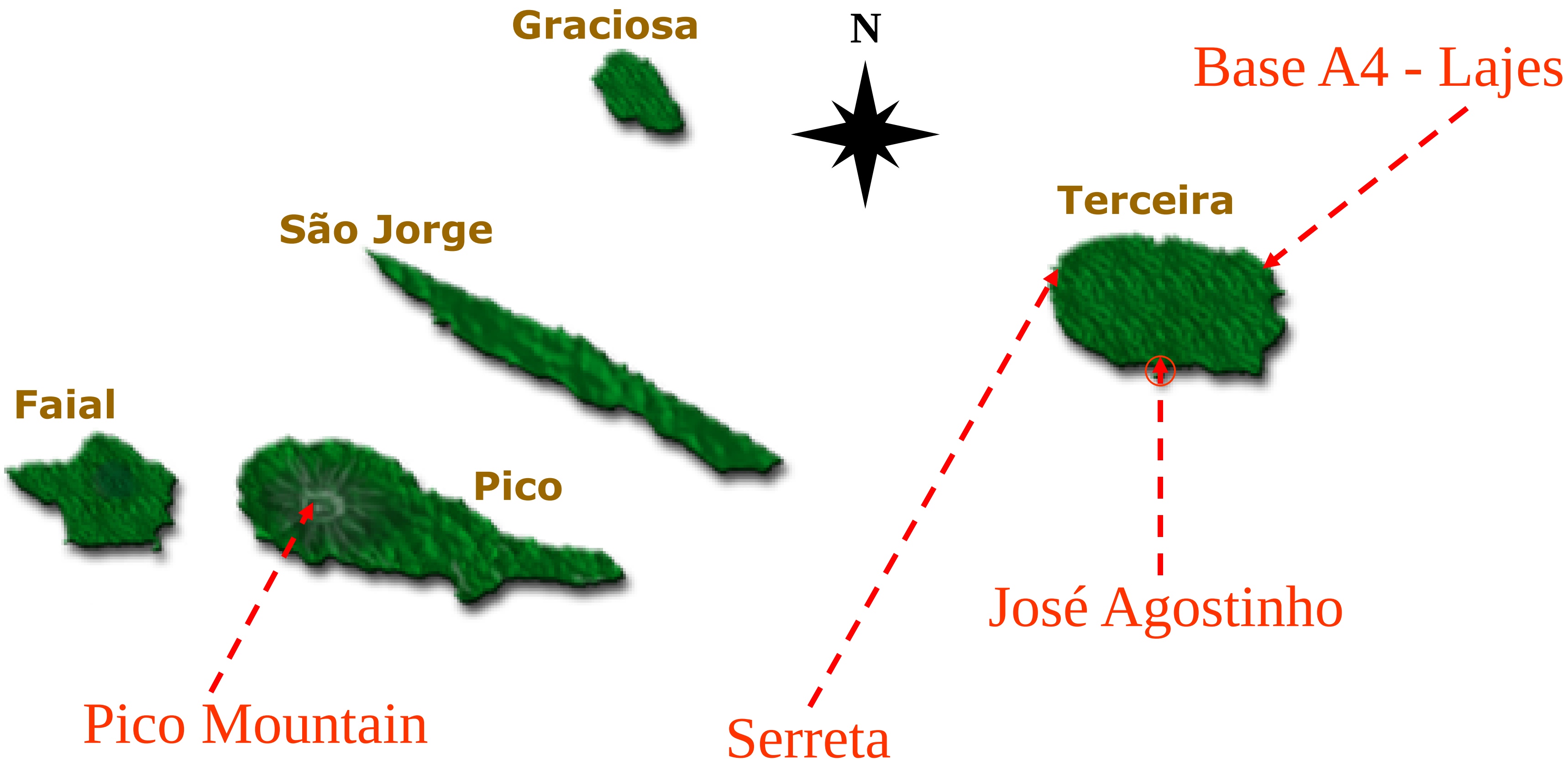
Advantages

- UV dependence on Ozone is well understood and easy to model.
- Global radiation is much less dependent on ozone, and its variability depends essentially on cloud coverage.
- Global radiation measurements are much easier to make and much less expensive then UV.
- Access to mean values for ozone coverage is relatively easy to get from satellite data and even from the UV spectrometer network.

Universidade dos Açores
Grupo de Química e Física da Atmosfera
Paulo Fialho
paulofialho@uac.pt



Central Group



José Agostinho Observatory
(38º39’36”N, 27º13’26”W, 90 m)

Paulo Fialho
paulofialho@uac.pt

Method approach

- In the estimation of *UVI* from global radiation, *G*, measurements it is assumed that the presence of clouds affect in the same way the *UVI* and the global radiation,

$$\frac{UVI}{UVI_0} \propto \frac{G}{G_0}$$

the use of the subscripts, $_0$, represents the values of *UIV* and global radiation in the absence of clouds.

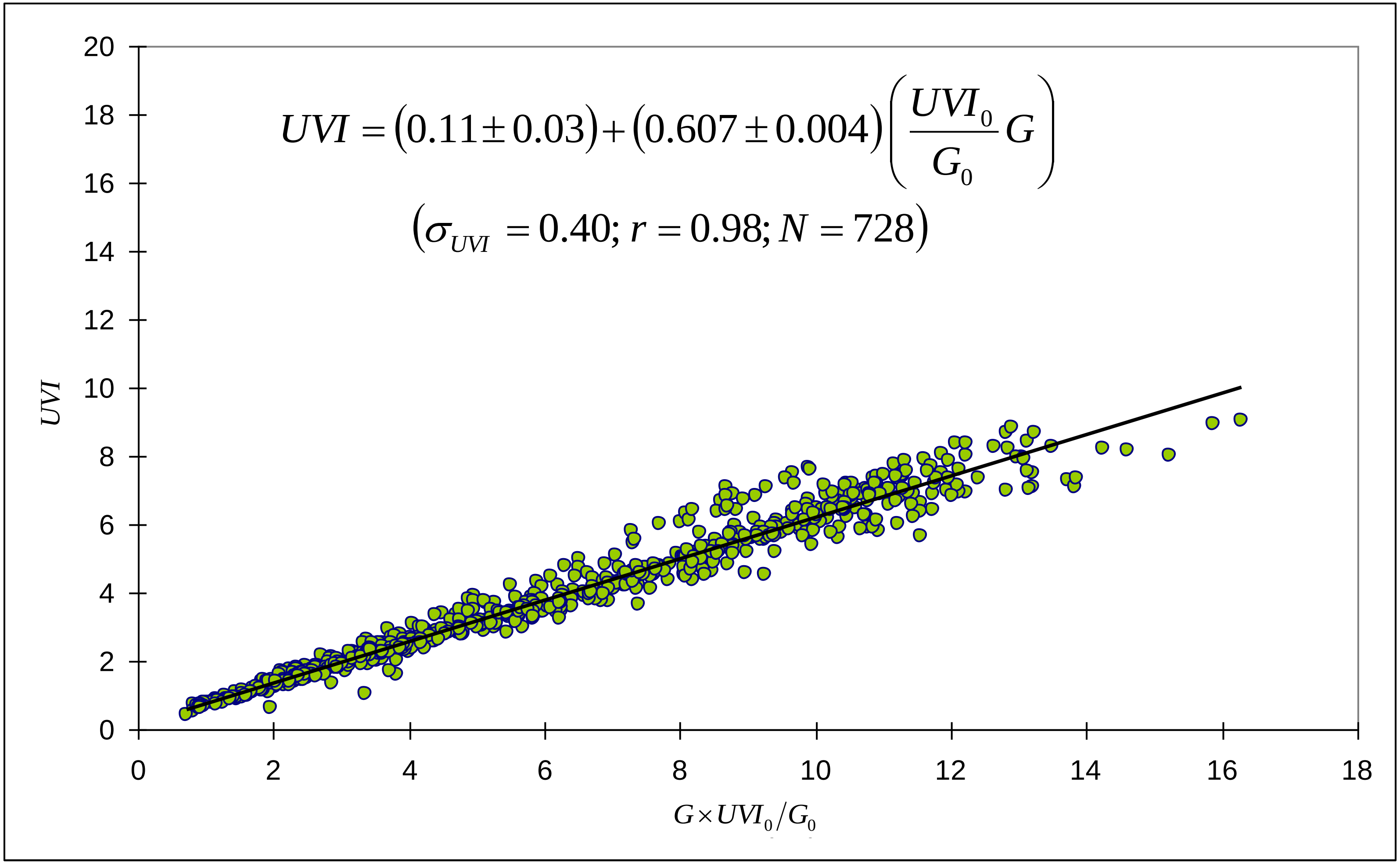
Paulo Fialho
paulofialho@uac.pt

Method approach

- To test this approach, the values of UVI_0 and G_0 were computed from a simple radiative transfer model for clear sky conditions (MESTRad – Carvalho, F., 2000), using observed total ozone column and assuming constant conditions for the other attenuation variables.
- Simultaneous measurements for spectral *UV* and global radiation were made in the calculation of *UVI* and *G*.
- *UVI* and *G* are plotted according to the proposed relation,

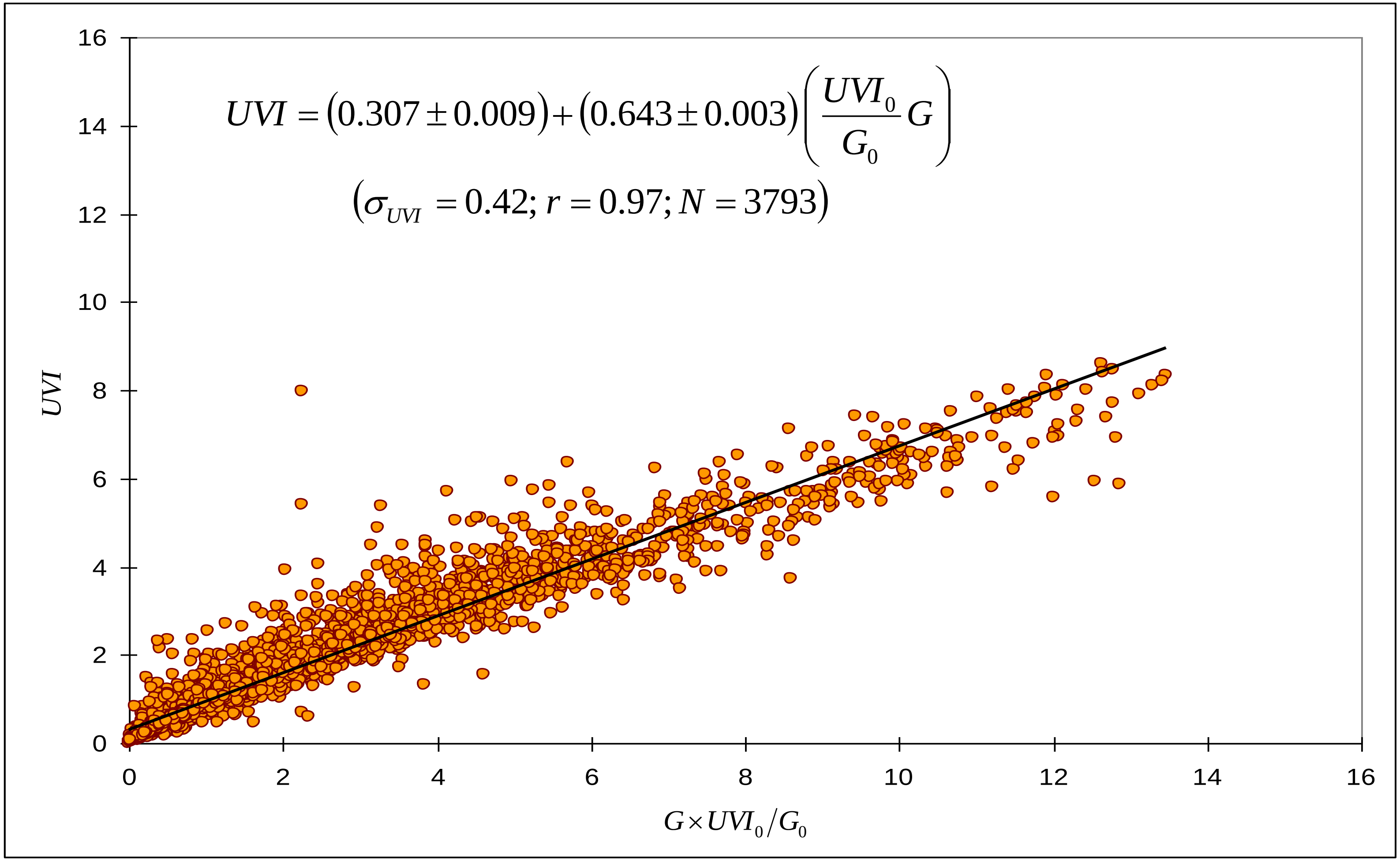
$$UVI \propto \left(\frac{UVI_0}{G_0} G \right)$$

Results



Clear sky conditions (Global radiation/Diffuse radiation ≥ 5)

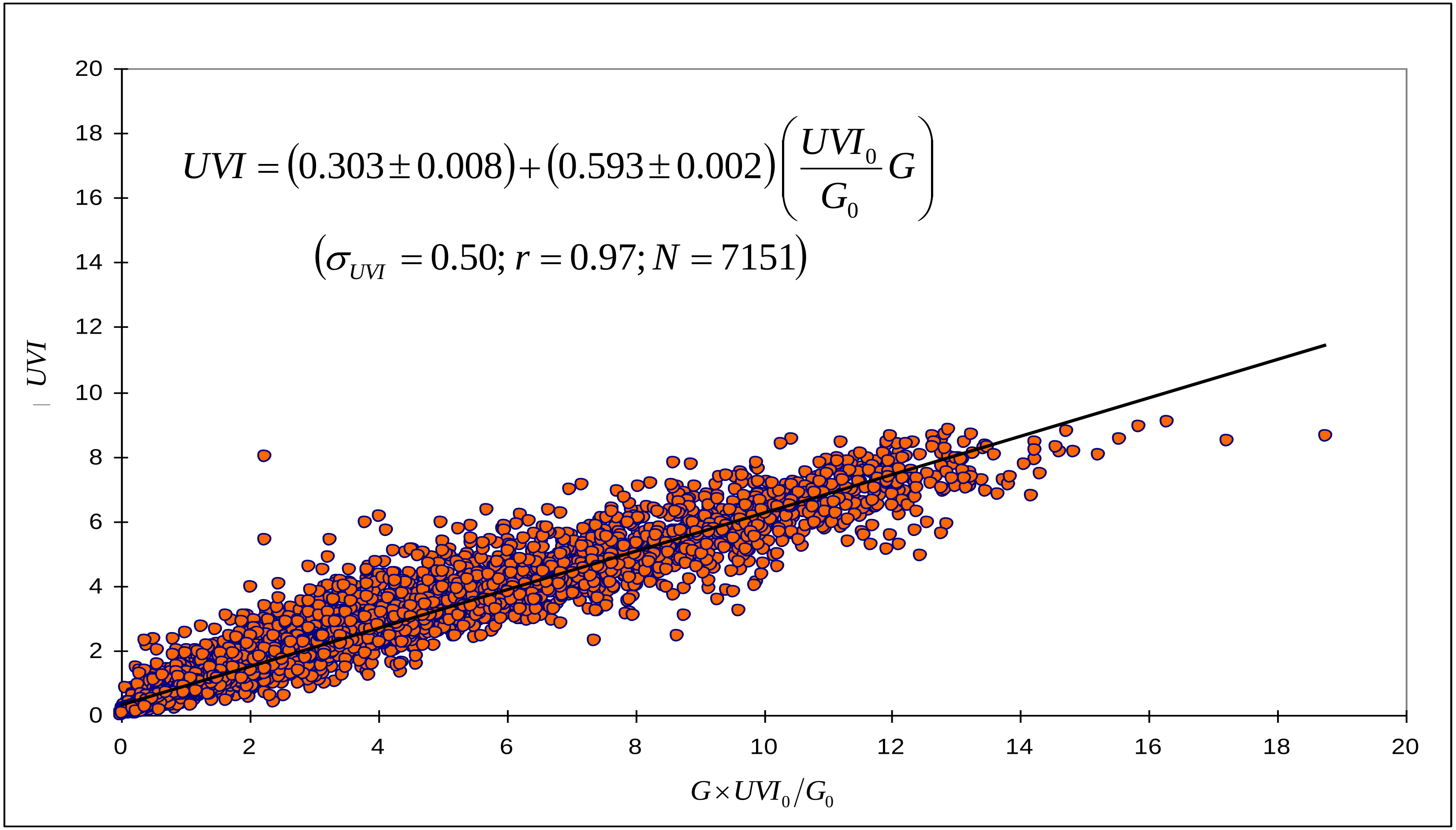
Results



Cloud sky conditions (Global radiation/Diffuse radiation < 1.1)

Paulo Fialho
paulofialho@uac.pt

Results



All information

Paulo Fialho
paulofialho@uac.pt

Conclusion

- A linear model can be used to determine the *UVI* from global radiation measurements and by using a simple radiative transfer model for clear sky conditions, taking the information of the ozone total column from satellite data or from a surface network of UV spectrometers.

$$UVI = (0.303 \pm 0.008) + (0.593 \pm 0.002)\left(\frac{UVI_0}{G_0} G\right)$$

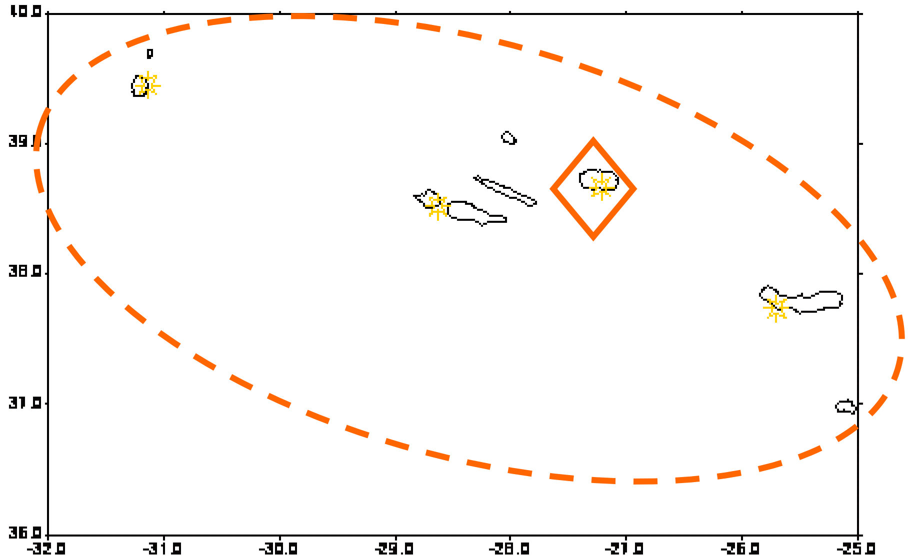
$$(\sigma_{UVI} = 0.50)$$

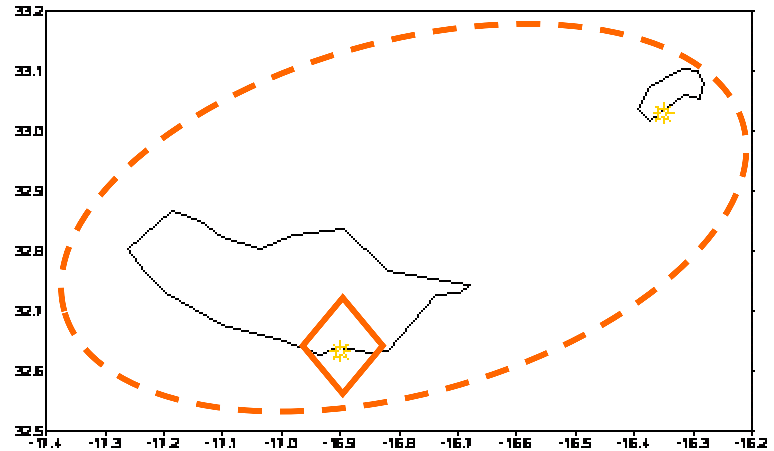
Universidade dos Açores

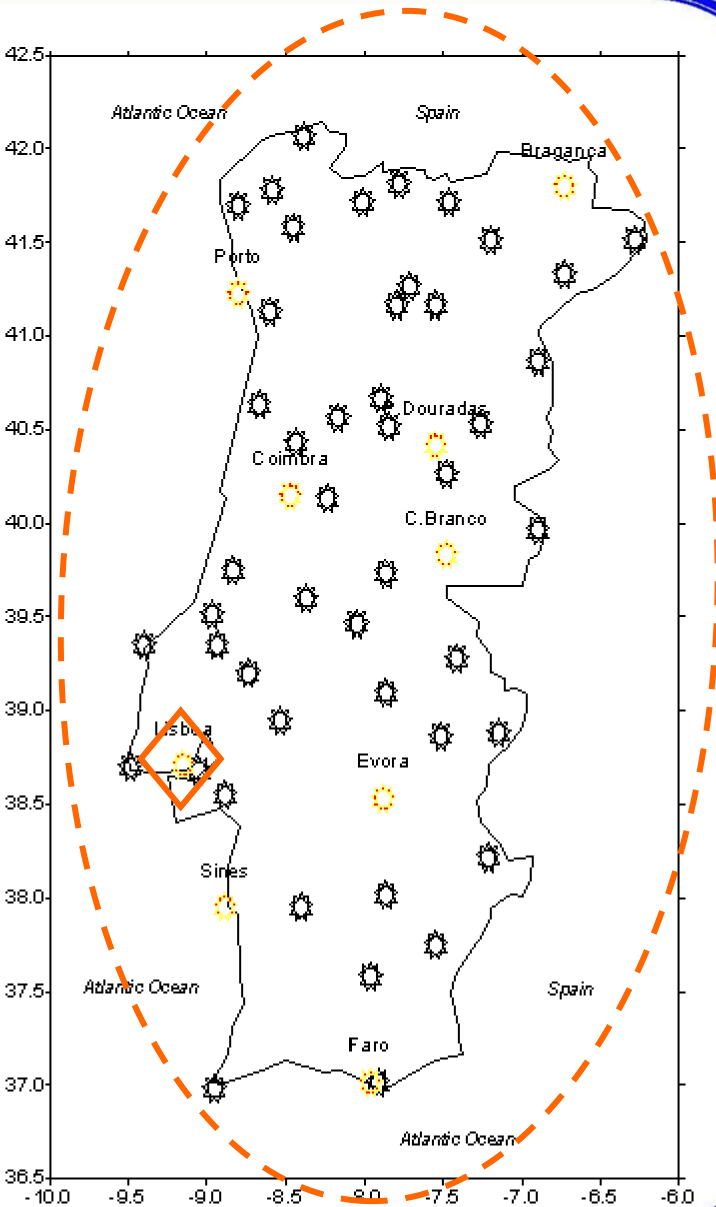
Grupo de Química e Física da Atmosfera

Paulo Fialho

paulofialho@uac.pt







Paulo Fialho
paulofialho@uac.pt

End

Centro do Clima, Meteorologia e Mudanças Globais

climarcost

Clima Marítimo e Costeiro
Sistema de Monitorização de Dados Meteo-oceanográficos
INTERREG_IIIB - Açores, Madeira e Canárias (05/MAC/2.3/A1)

INTERREG III B
AÇORES • MADEIRA • CANARIAS

www.climaat.angra.uac.pt

FEDER