Inferring photolysis rates from solar radiation measurements at Cape Grim

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Cape Grim

- Site chosen for sampling air from the southern ocean
Instruments cleaned Mon - Fri

Contamination of front window Sat – Mon morning.
Data used Monday pm – Friday pm

Solar Radiation and a bit of atmospheric chemistry
OH – UV production

![Graph showing OH UV production with labels for Quantum yield, O₃ absorption cross section, and Flux.]
UV-B Instrument

  - global and diffuse irradiance
Actinic Flux density (F) estimation from irradiance (E)

\[ F = F_0 + F_\downarrow + F_\uparrow \approx F_0 + F_\downarrow \]

\[ E = E_0 \cos \theta + E_\downarrow \]

\[ F \approx E_0 + \alpha E_\downarrow \]

\[ \alpha = \frac{F_\downarrow}{E_\downarrow} \]
Need:

- $E_0$ and $E_{\downarrow}$
  - Measured routinely
- At 305 – 310 nm

$$2.01 \times \frac{0.052}{\cos q} \text{ (clear sky)}$$

$$1.73 \text{ (cloud)}$$

More relevant for Cape Grim
From actinic flux $F$ to $J$

Uncertainties

$$J(O^1D) = \tilde{F}(\ ) \ o_3(\ ) \ o_3(\ ) \ d$$

$$\tilde{F}(\ ) = \frac{F(\ )}{hc}$$

$o_3(\ ) = \text{ozone absorption cross section}$

$o_3(\ ) = \text{Quantum yield of production}$

~10% 10%
Derived $J(\text{O}^\text{1D})$
\( J (O ^{1D}) \) – Cape Grim

Model Calcs – clear sky low aerosol
TUV (Madronich)

\[
J (O^{1D}) = f(sza) \times (O_3 \text{col}/300)^{-0.143 \pm 0.01} \text{ (all sky)}
\]

RAF = Radiation Amplification Factor
Models: 1.4 – 1.5 (clear sky)
• Multiple processes can be estimated (e.g. NO$_3^-$ photolysis) from such data sets provided there is appropriate wavelength coverage.
• New system uses a detector array so that all wavelengths are captured simultaneously.

• Thanks to the Cape Grim/Bureau of Meteorology staff that have made these measurements possible.
Thank you…
Centre for Atmospheric Chemistry
$J \ O(1D)$ and cloud

Modelled cloud impact
Liu et al, JGR, 2009