UV Radiation Climatology and Trends

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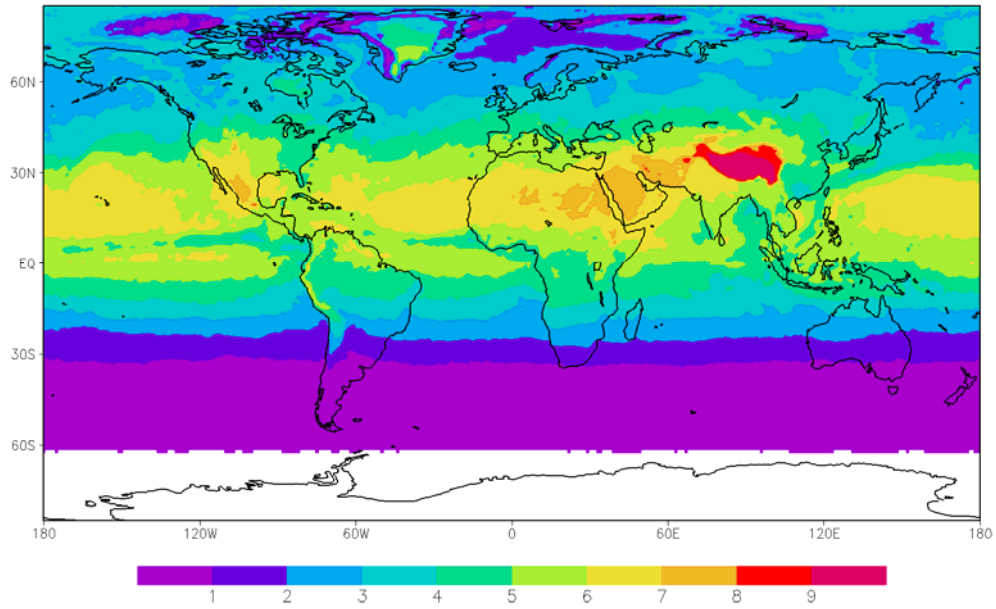
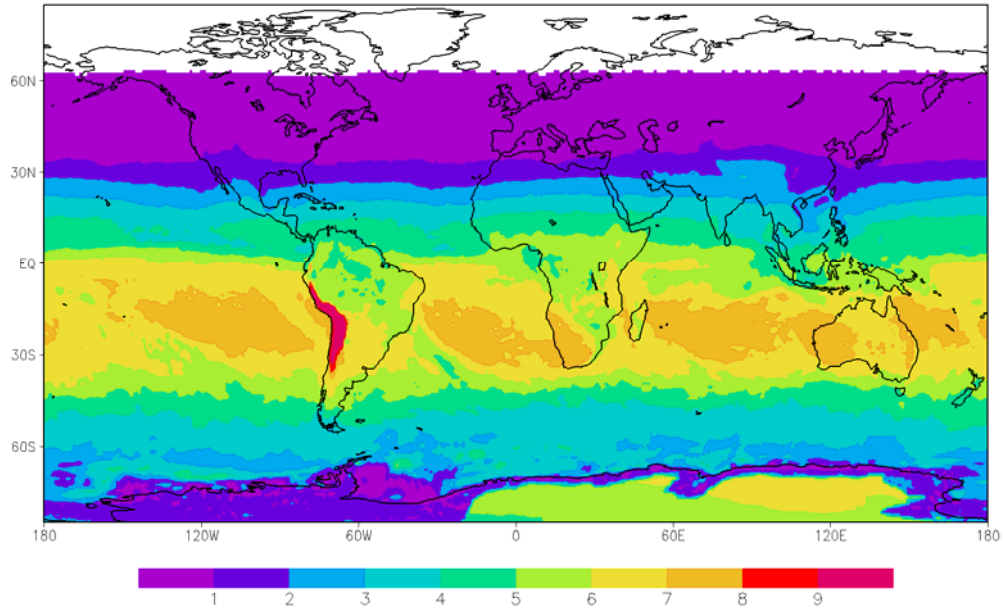
Outline

- Discuss the global range of UV radiation and its implications
- Discuss past UV trends and expectations for the future
- Discuss geographical & seasonal variabilities in UV
- Compare and contrast patterns erythemally weighted UV and vitamin D weighted UV radiation

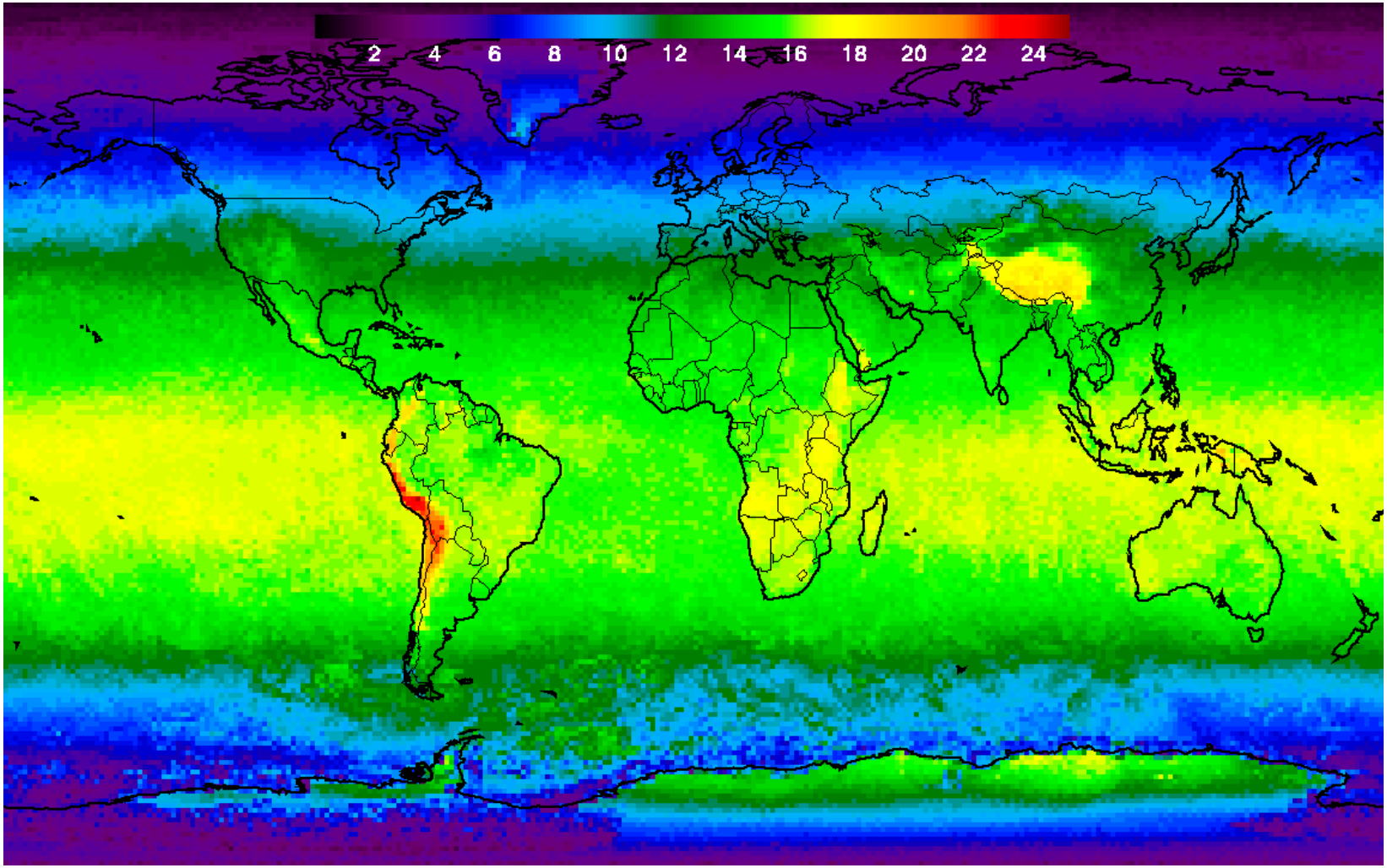




Global distribution of the average erythemal daily dose (in kJ m-2) for June 2005 (above) and Dec 2005 (below) derived from OMI measurements..

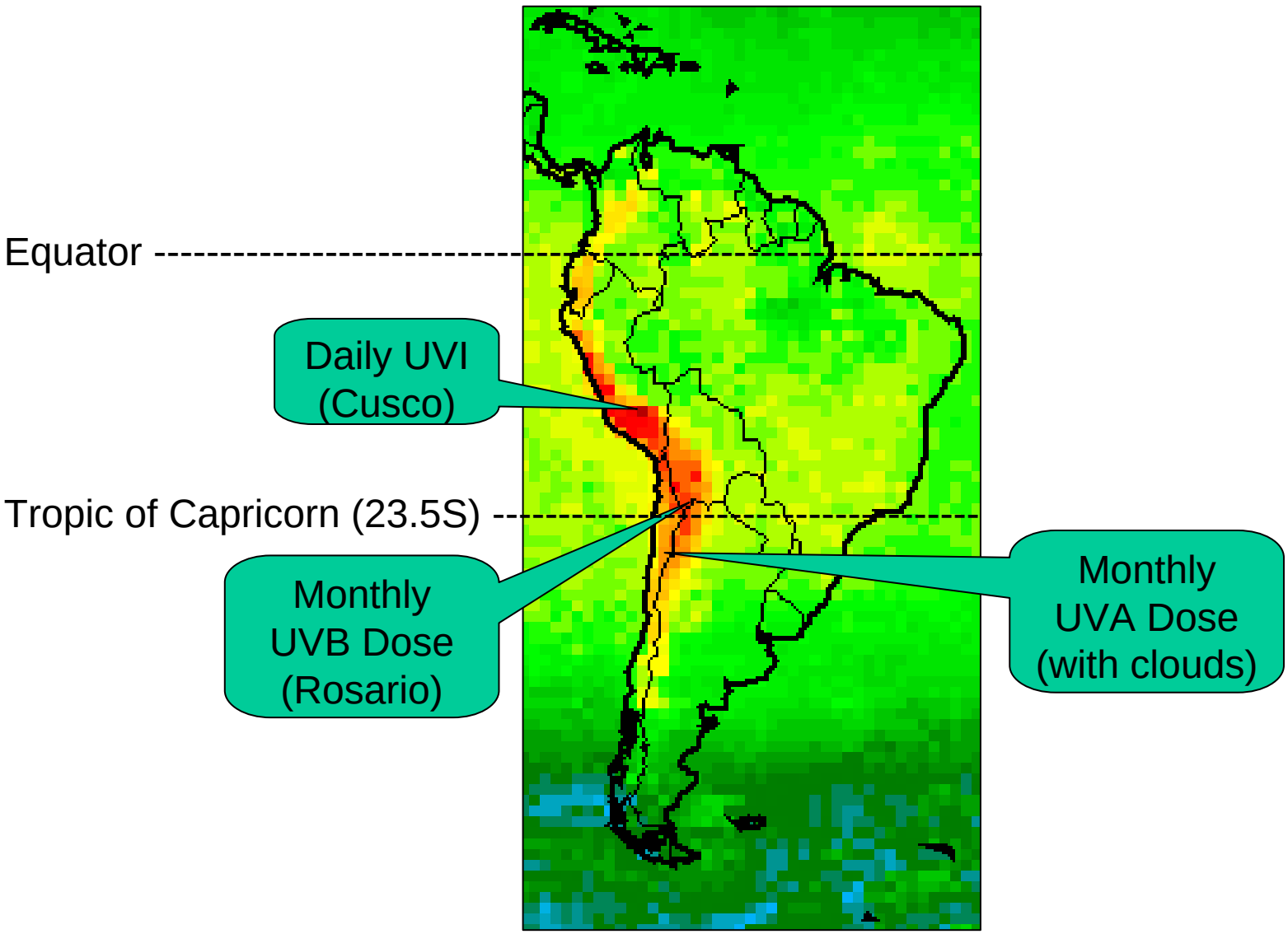
Ref: UNEP Assessment, 2006

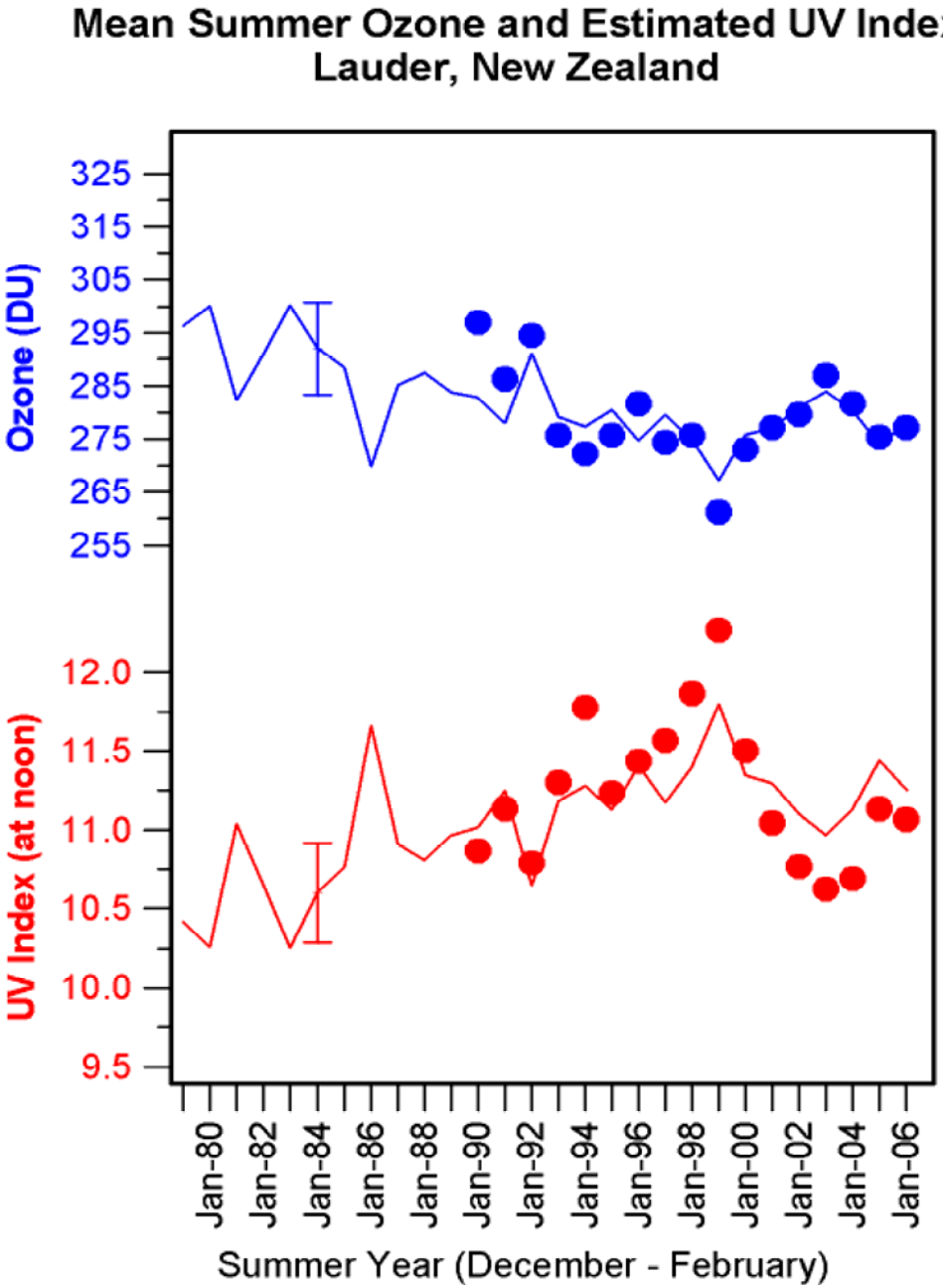
Where on Earth is UV the most intense? (peak UVI)



Altiplano region in the Peruvian Andes, near Cusco (13.5S, 72W, alt: >6000 m)

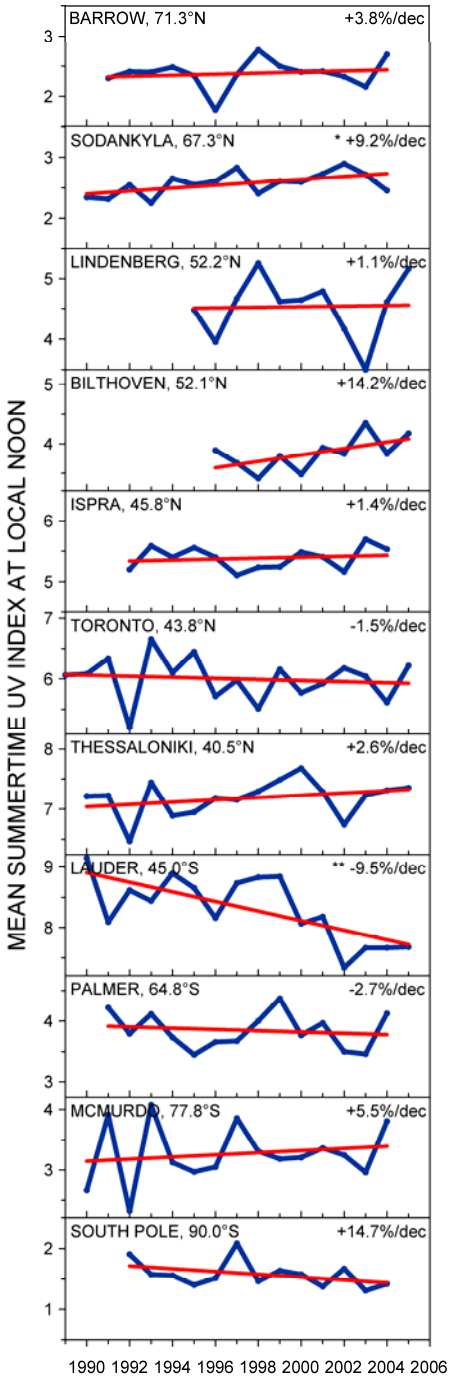
Where on Earth is UV the most intense?





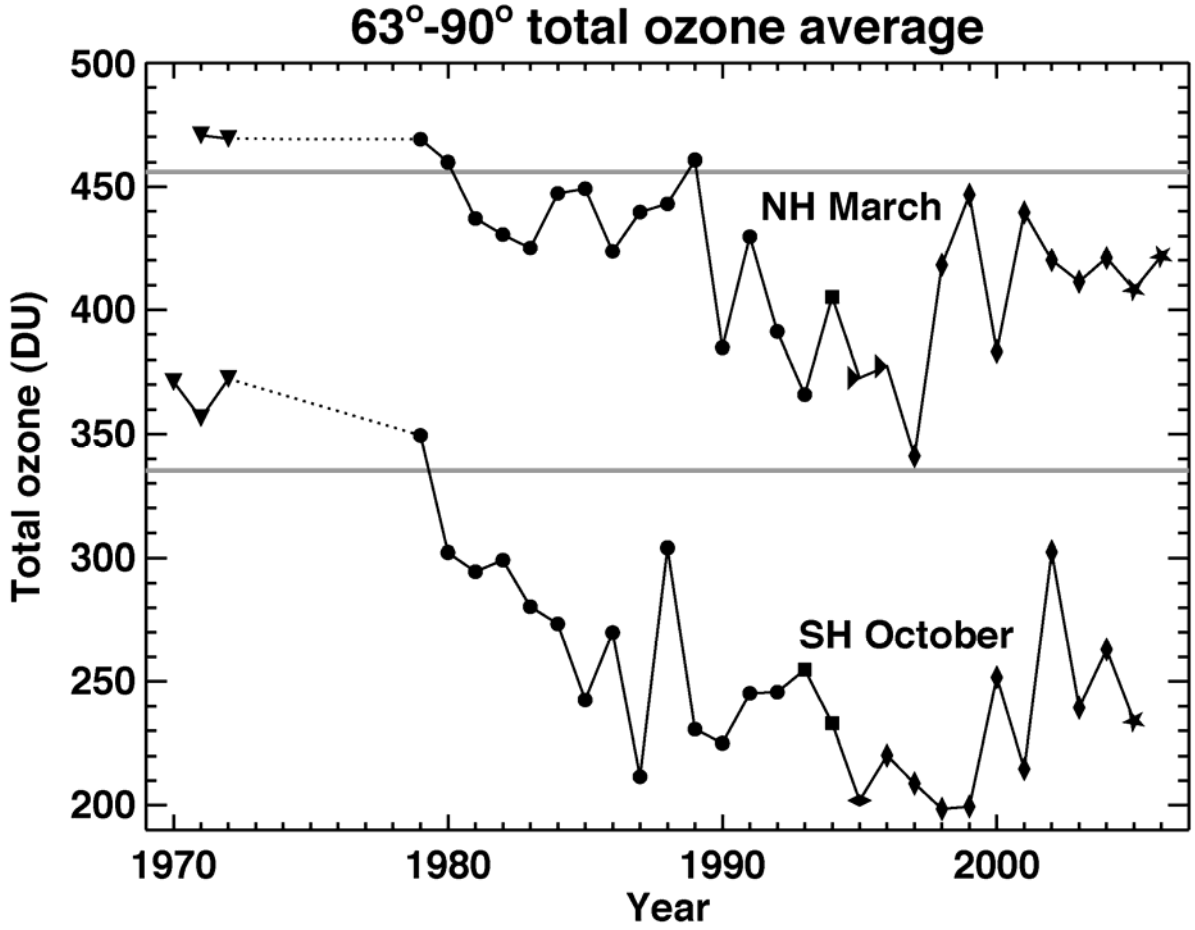
Long term change in summertime ozone & peak UVI at Lauder, NZ. The symbols show the average ozone and UVI for the 5 highest UV days in Dec, Jan and Feb of each summer, derived from spectral irradiance measurements.
The lines represent the average summertime satellite-derived ozone, and the corresponding calculated UVI values

Ref: UNEP Assessment, 2006



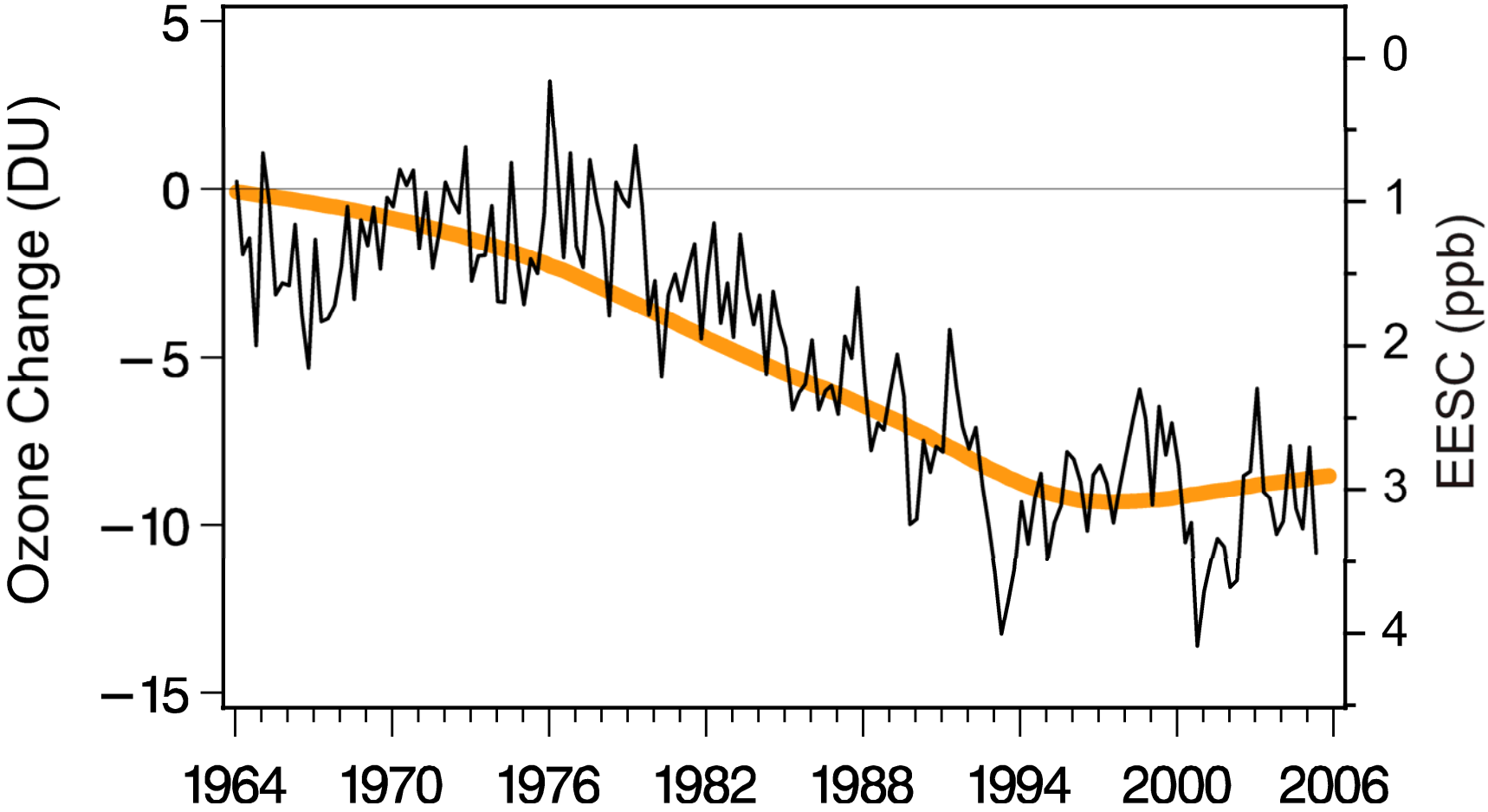
Long term changes in UV Index averaged over the three summer months for all weather conditions within ±1 hour around local noon measured at 11 sites distributed worldwide.

Ref: WMO, Ozone Assessment, 2006



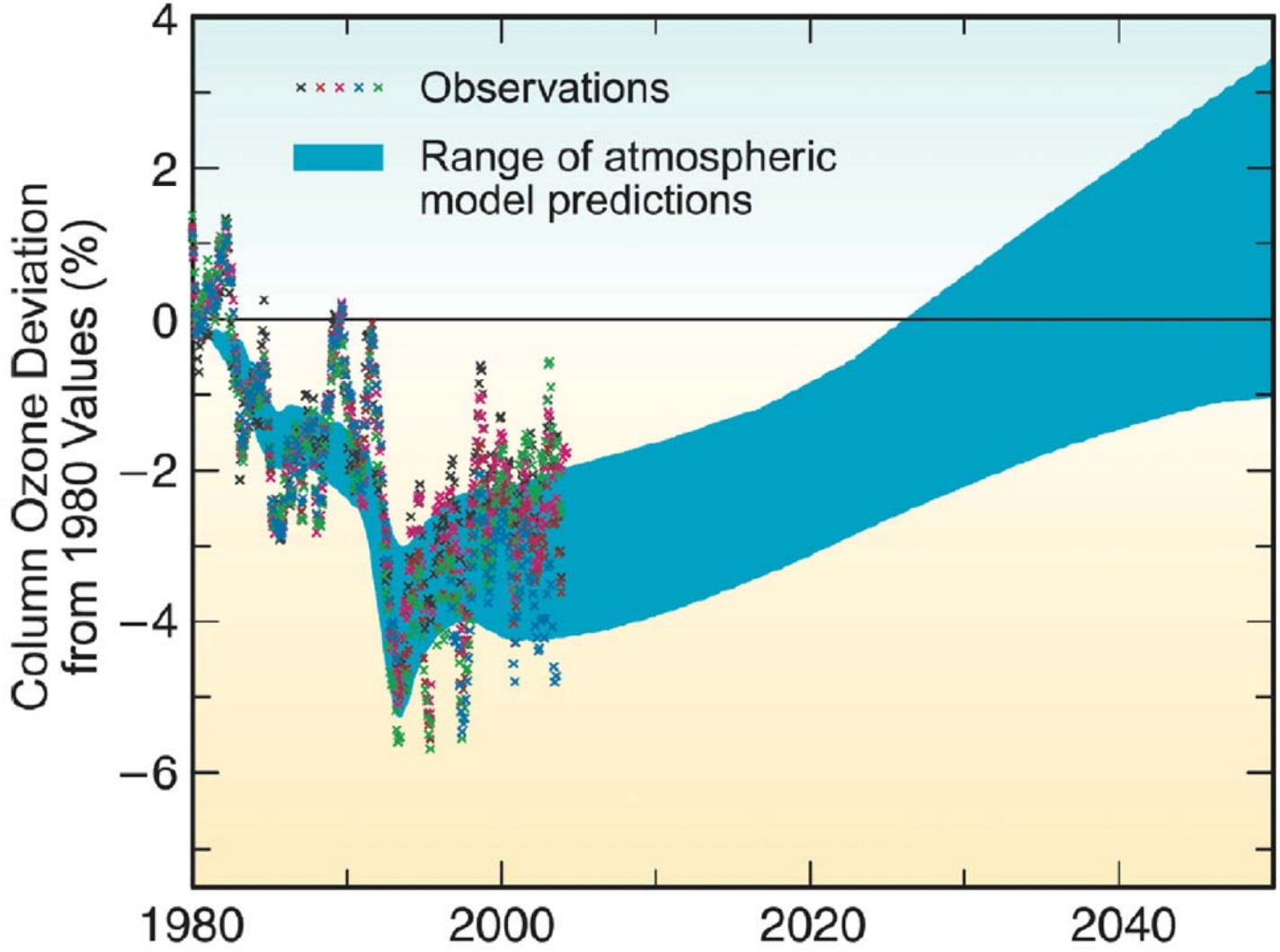
Mean ozone poleward of lat 63° in spring (NH: March; for SH: Oct)
The horizontal lines represent means for the years prior to 1983.

Ref: WMO, Ozone Assessment, 2006



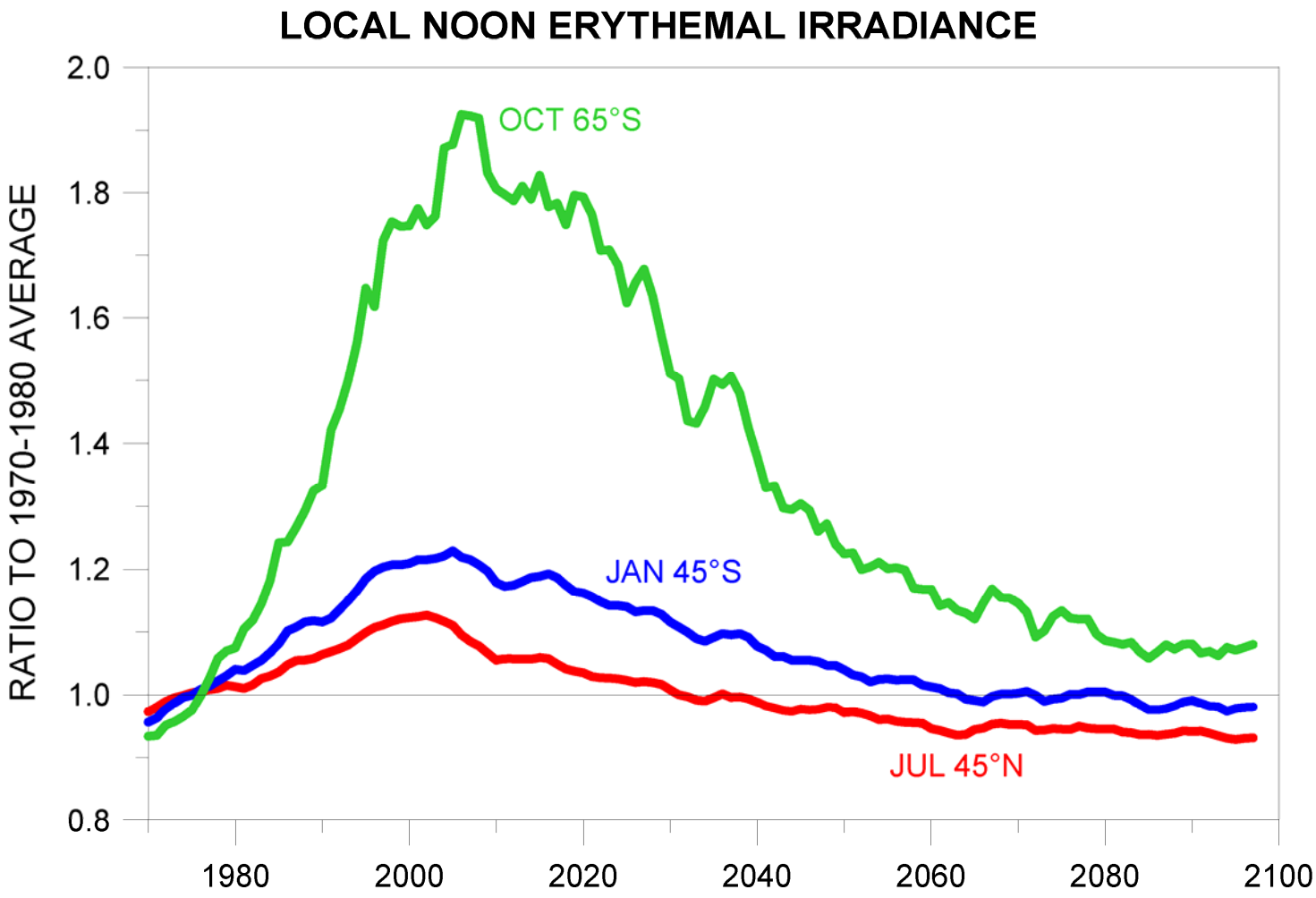
Area-weighted total ozone deviations for 60°S-60°N, estimated from ground-based measurements. The line represents the effective equivalent stratospheric chlorine (EESC).

Ref: WMO, Ozone Assessment, 2006



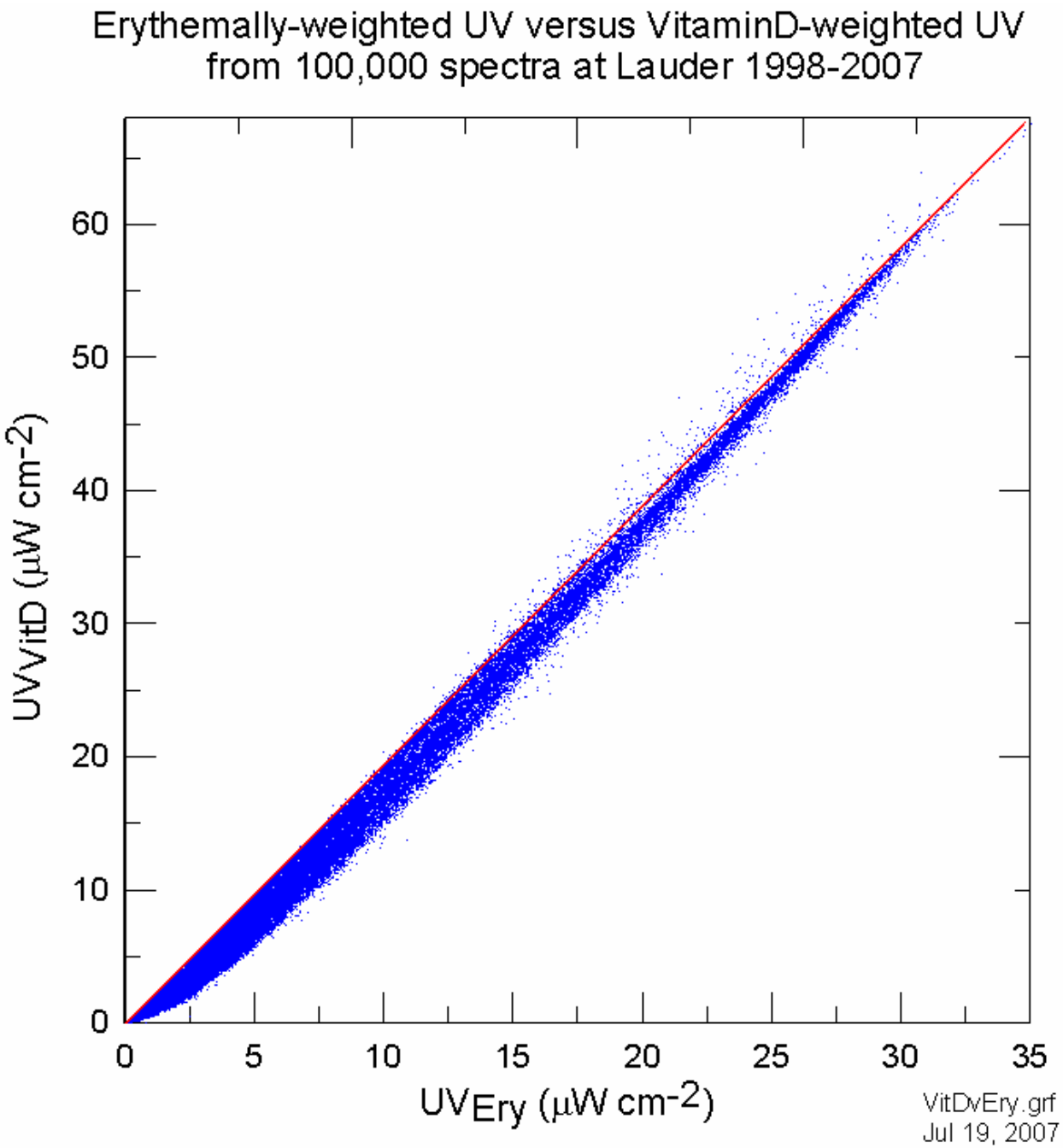
Observed and modelled global column ozone amounts (60ºS–60ºN) as percent deviations from the1980 values.

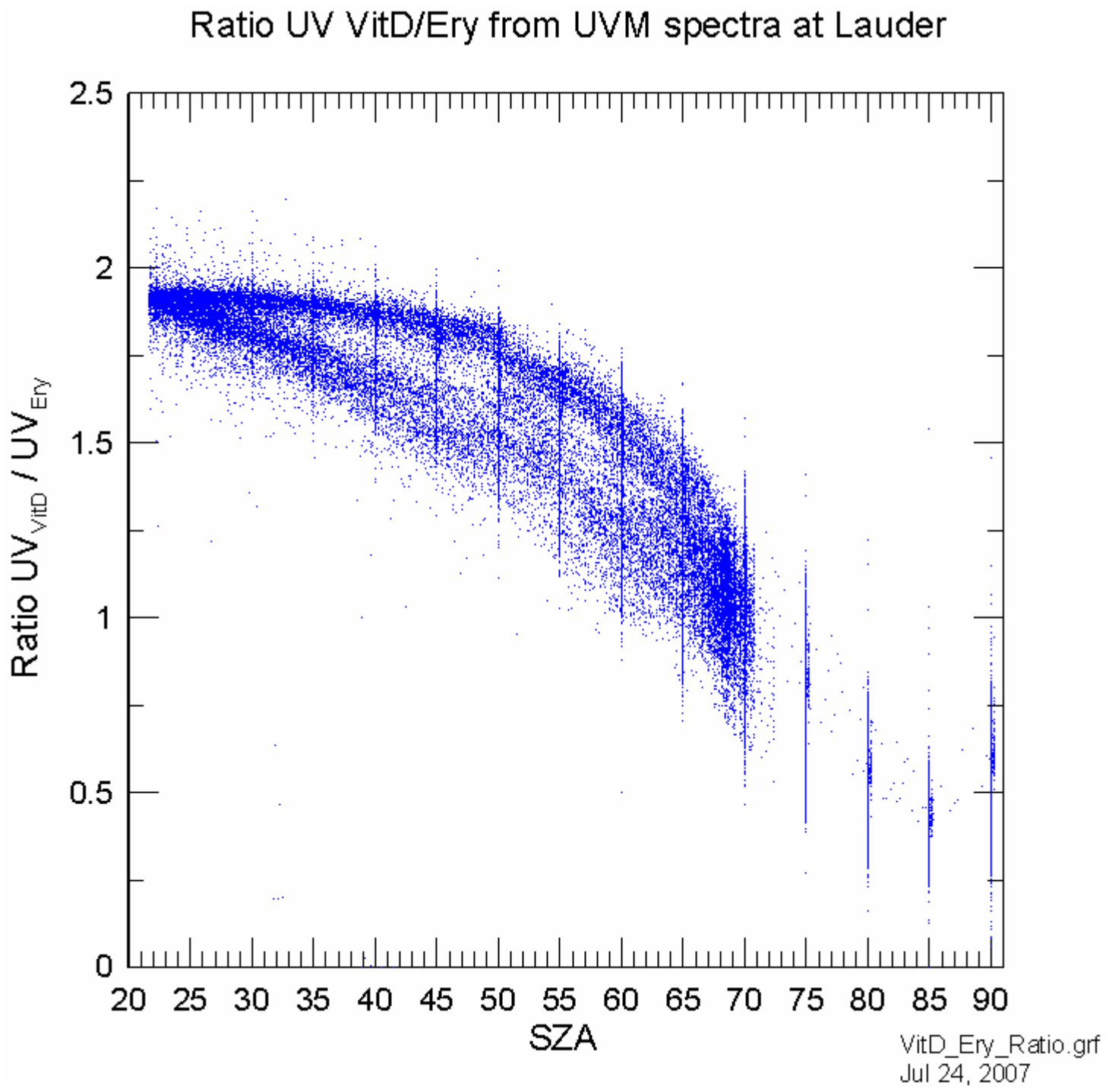
Ref: UNEP Assessment, 2006



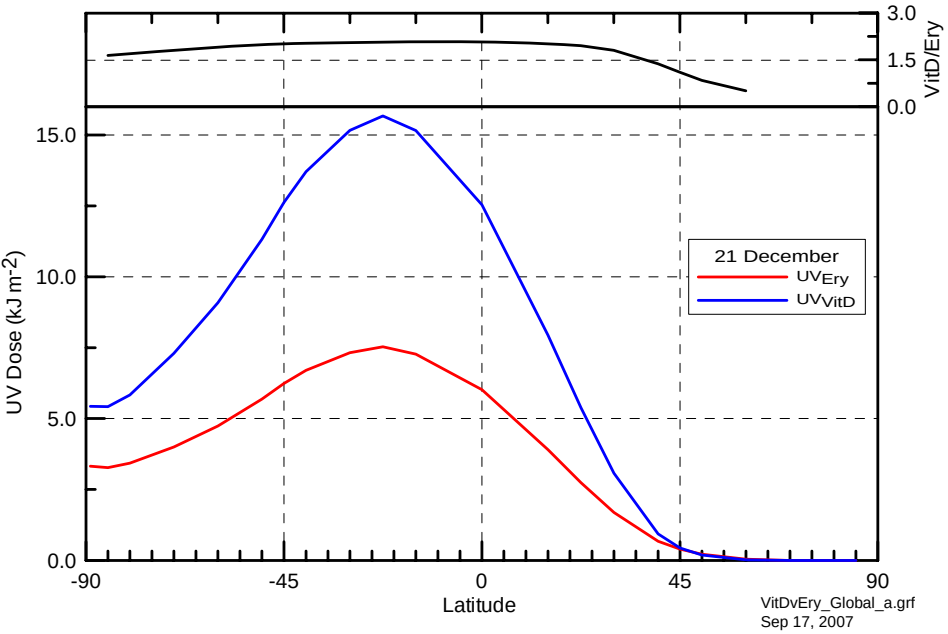
Estimated changes in erythemally weighted UV irradiance at local noon in response to projected changes in column ozone.

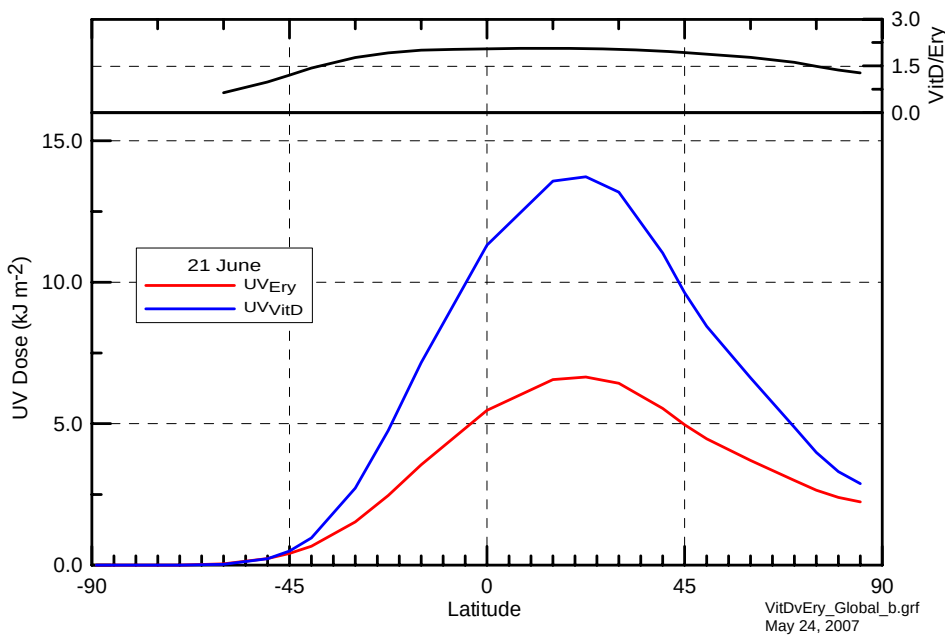
Ref: WMO, Ozone Assessment, 2006

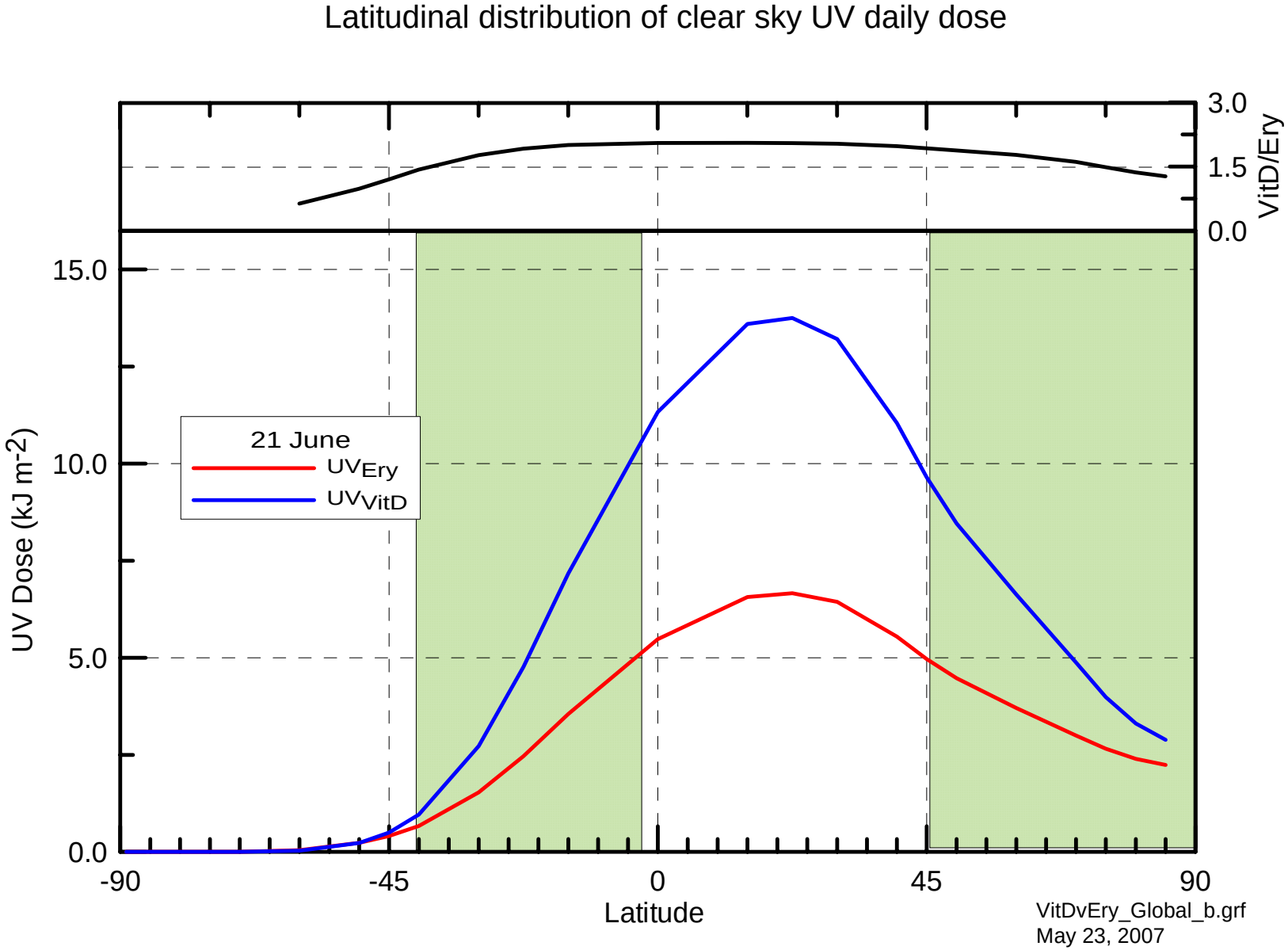

Erythemally-weighted UV versus VitaminD-weighted UV
from 100,000 spectra at Lauder 1998-2007
UVVitD (μW cm-2)
UVEry (μW cm-2)
0
10
20
30
40
50
60
0
5
10
15
20
25
30
35
VitDvEry.grf
Jul 19, 2007


Ratio UV VitD/Ery from UVM spectra at Lauder
Ratio UV$_{VitD}$ / UV$_{Ery}$
2.5
2
1.5
1
0.5
0
20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
SZA
VitD_Ery_Ratio.grf
Jul 24, 2007

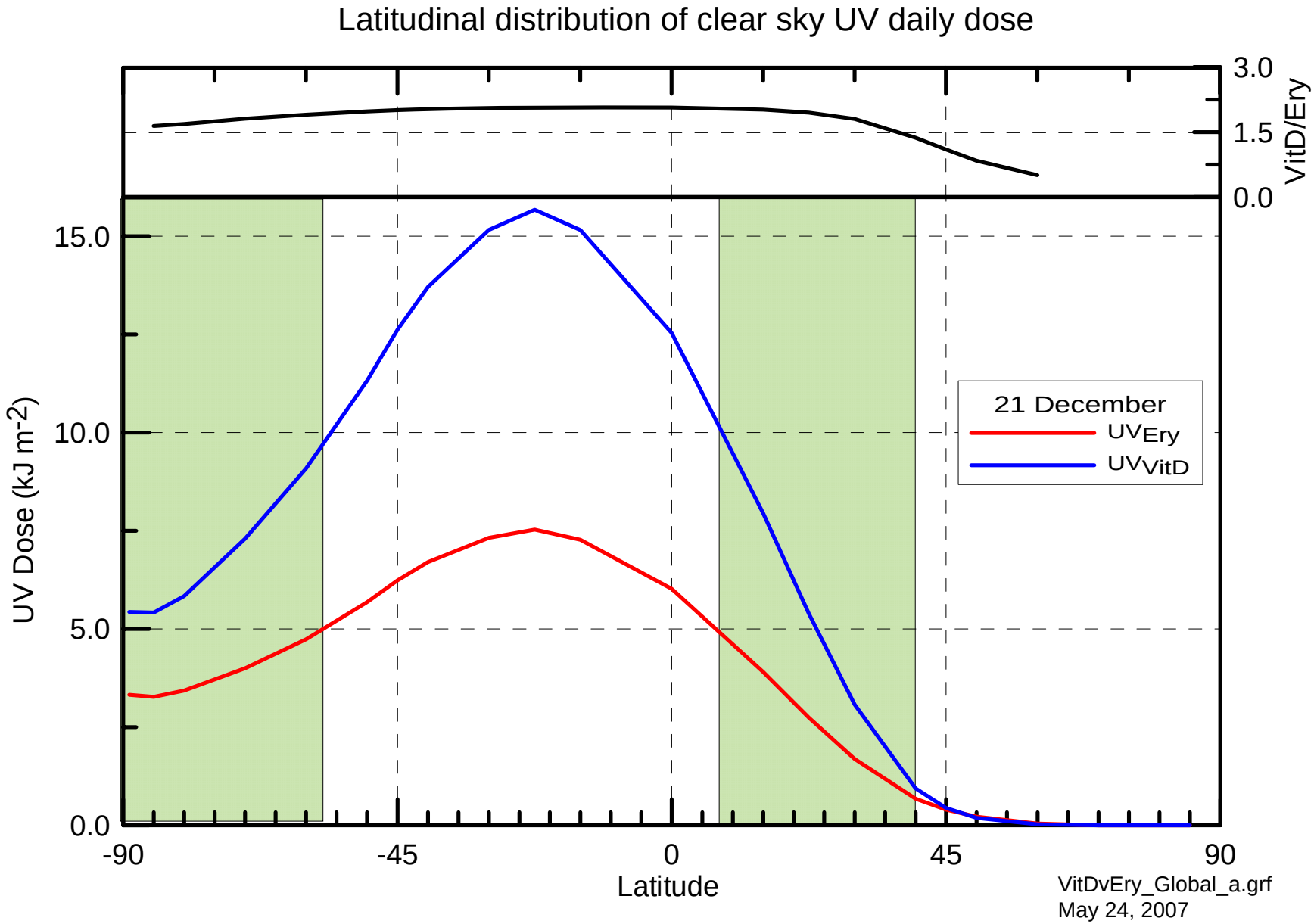
Calculated latitude distribution of UV_{Ery} and UV_{Vitd} at solstices



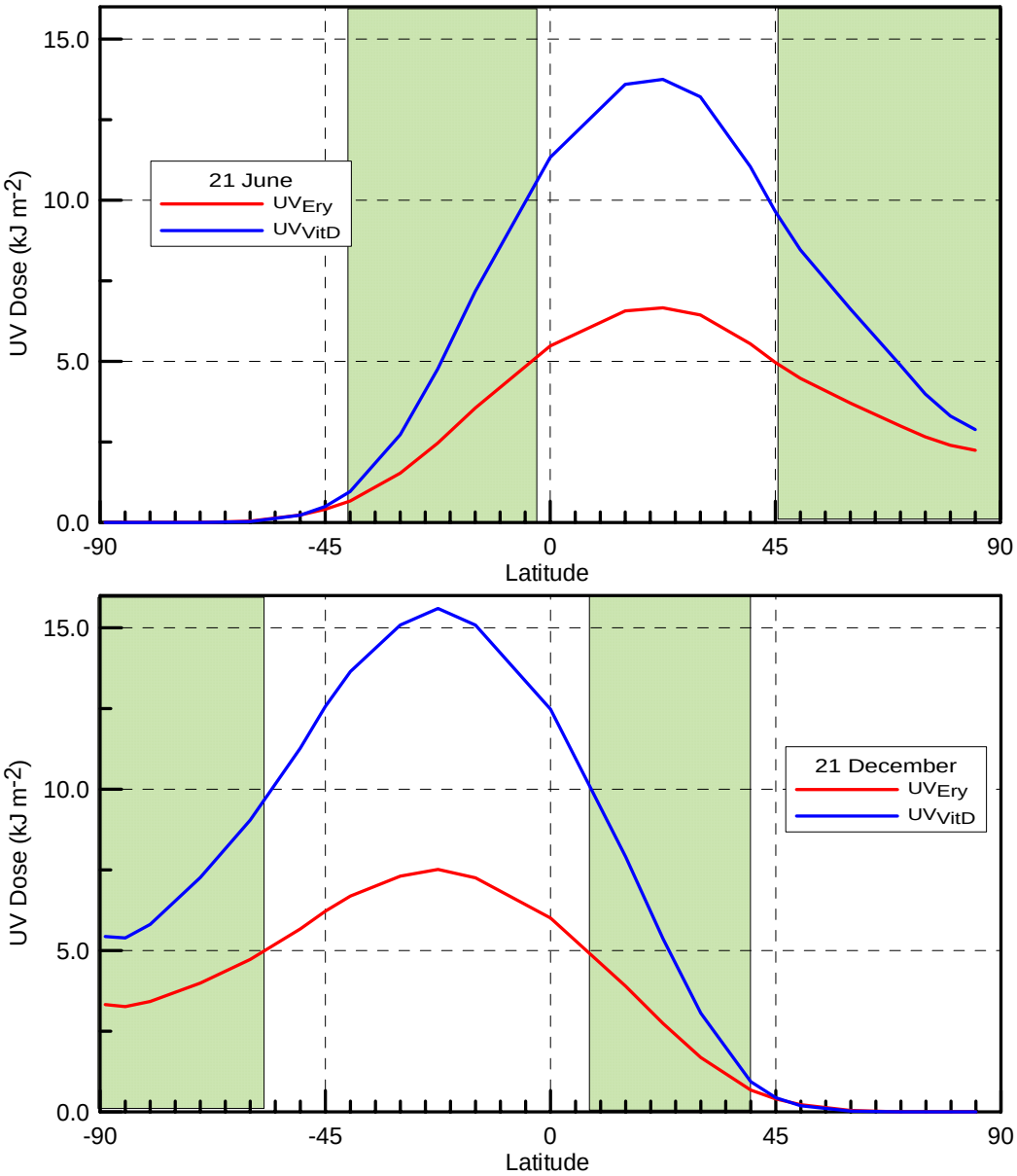




The green areas are the "Goldilocks Zone", where UV_{VitD} is not too small, and UV_{Ery} is not too large


Latitudinal distribution of clear sky UV daily dose
3.0
1.5
0.0
VitD/Ery
15.0
10.0
5.0
0.0
UV Dose (kJ m-2)
21 December
UVEry
UVVitD
-90
-45
0
45
90
Latitude
VitDvEry_Global_a.grf
May 24, 2007

Latitudinal distribution of clear sky UV daily dose

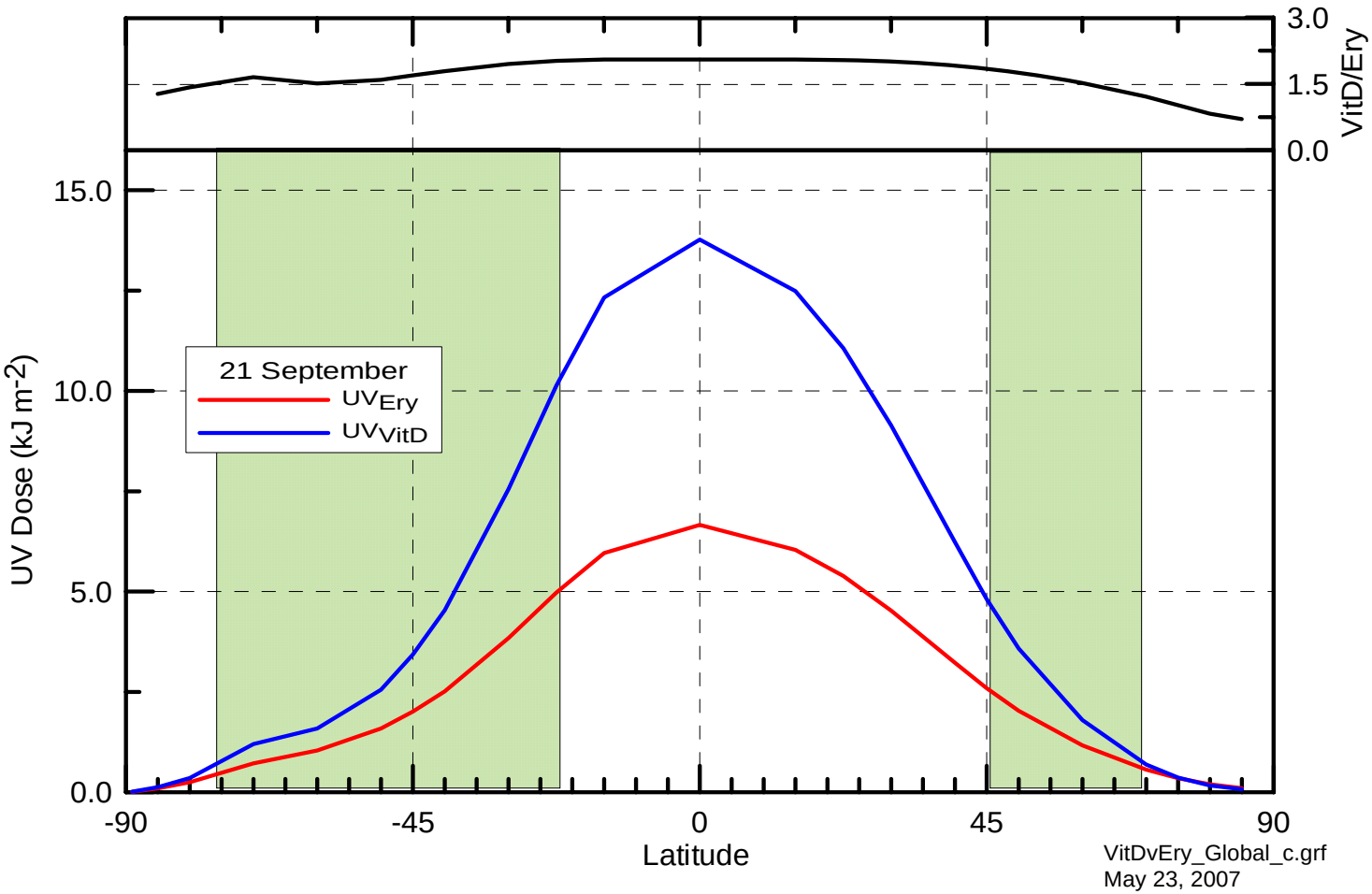


Problem with Action Spectrum for Vit D?

- Holick says a few mins daily in summer is sufficient
- Holick says no Vit D is produced in Boston in winter
- But the winter daily total for his action spectrum is the same as for 25 minutes at noon in summer!

Boston (42^0N) at solstices Vitamin D weighted UV		Summer 21 June	Winter 21 Dec
Irradiance at noon	(W m^{-2})	0.46	0.048
Total over 1 Day	(kJ m^{-2})	10.4	**0.7**
Total over 1 hour at noon	(kJ m^{-2})	1.67	
Total over 25 min at noon	(kJ m^{-2})	**0.7**	

Latitudinal distribution of clear sky UV daily dose



During the period of the Antarctic ozone hole, no other region has more ozone than NZ's. UV at 45S is much less than at 45N. NZ is in the middle of the "green zone", well to the North of the ozone hole perturbation

Conclusions

- Past increases in UV have been small
- Future downwards trends in UV are expected
- Huge geographical & seasonal differences in UV
- UVI max =25
- The UVI colour scale is inadequate for many regions
- Even larger variability for beneficial UV
- The action spectrum for Vit D may not be correct
- Peak UV much higher in SH
- No place on the planet is "optimum" all year round
- Overseas holidays are needed
- NZ may be a good option. The Ozone Hole doesn't directly affect NZ

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