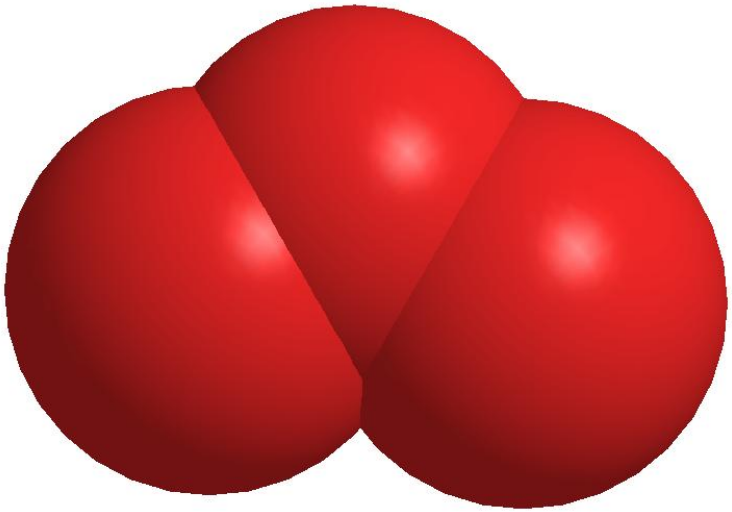
Ozone Depletion

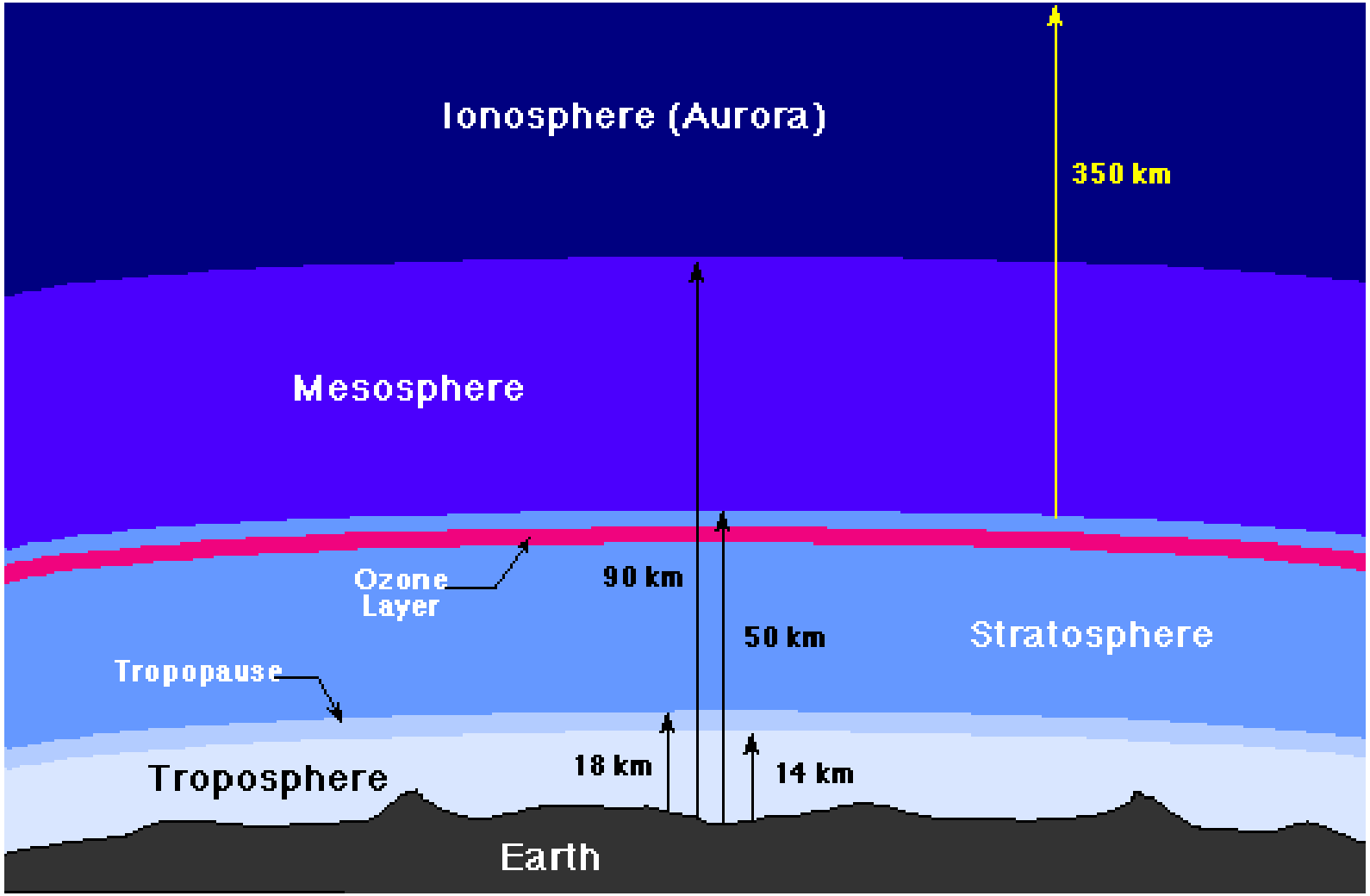
1a. What is Ozone?

- Ozone (O_3) is a triatomic molecule of oxygen. The form of oxygen we breathe (O_2) is diatomic. At ground level O_3 is undesirable, but it plays a protective role in the earth's stratosphere.



1b. Where is Ozone Found?

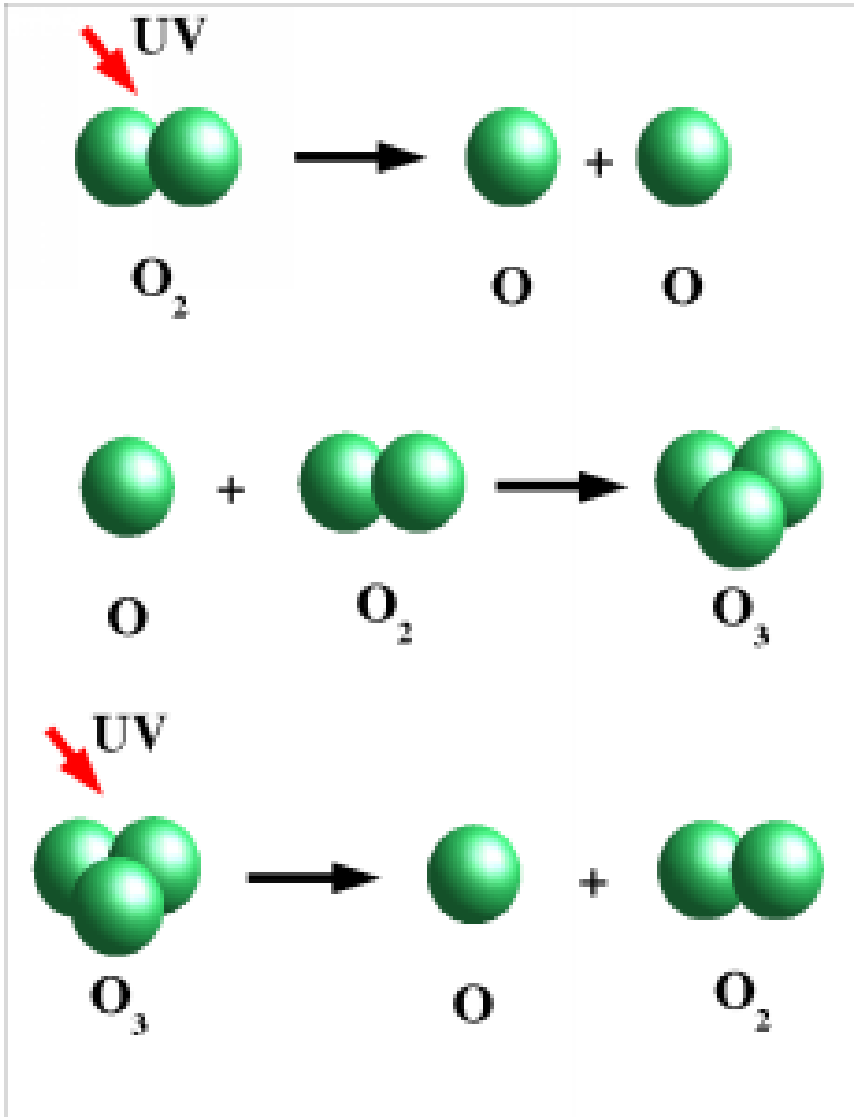
In the upper stratosphere, 20-30 km above the earth



2. Why do we need ozone?

- O_3 + uv → O_2 + O + heat

Ozone converts harmful ultraviolet rays into harmless heat.

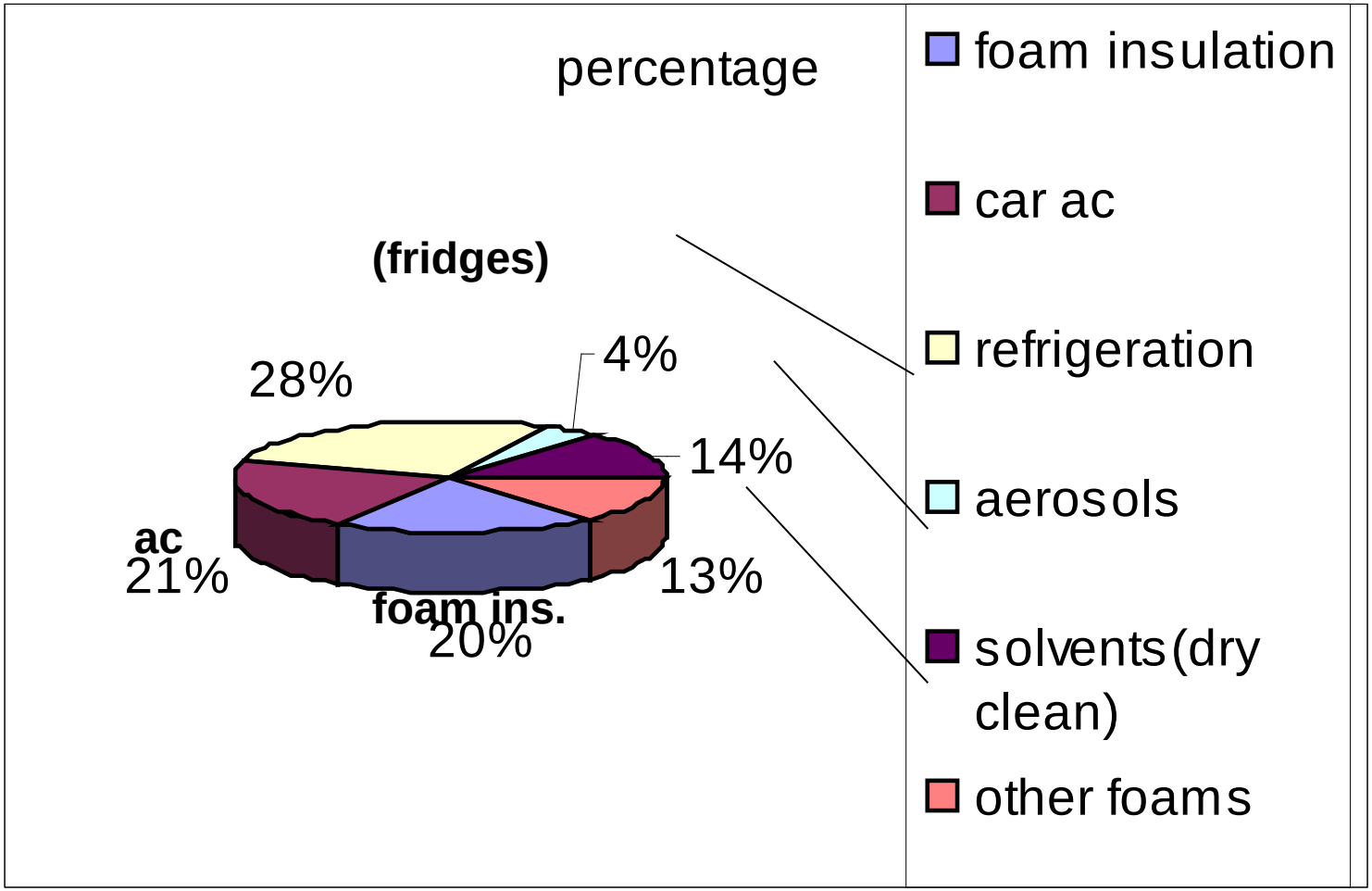


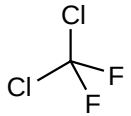
Forms Of Ultraviolet

UVA(400–315 X10^{-9} m) *Not absorbed by ozone*. 	99% of UV which reaches earth's surface; least harmful form, but can contribute to the aging of skin, DNA damage and possibly skin cancer.
UVB(315–280 X10^{-9} m) A fair amount is absorbed by ozone.	Leads to formation of vitamin D but can also cause skin cancer
UVC(<280 X10^{-9} m)	Extremely dangerous. All absorbed by O_2 and O_3

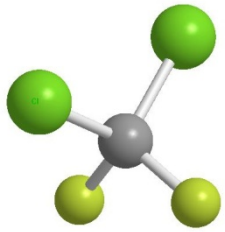
3. What Threatens Ozone?

Cl released by solvents from old fridges and acs

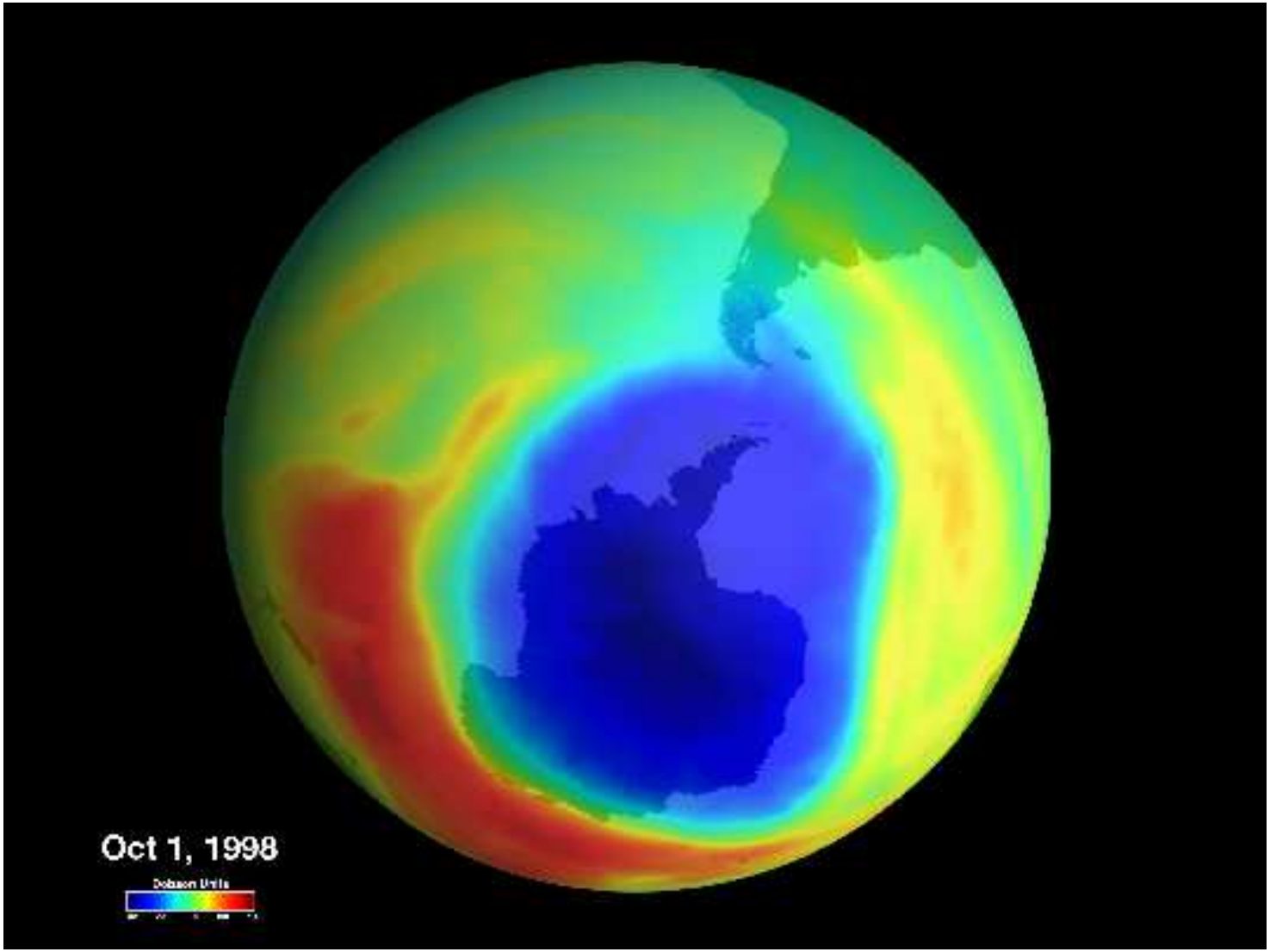




Freon-12 (CCl_2F_2, an example of a CFC)



The Ozone Hole Above Antarctica



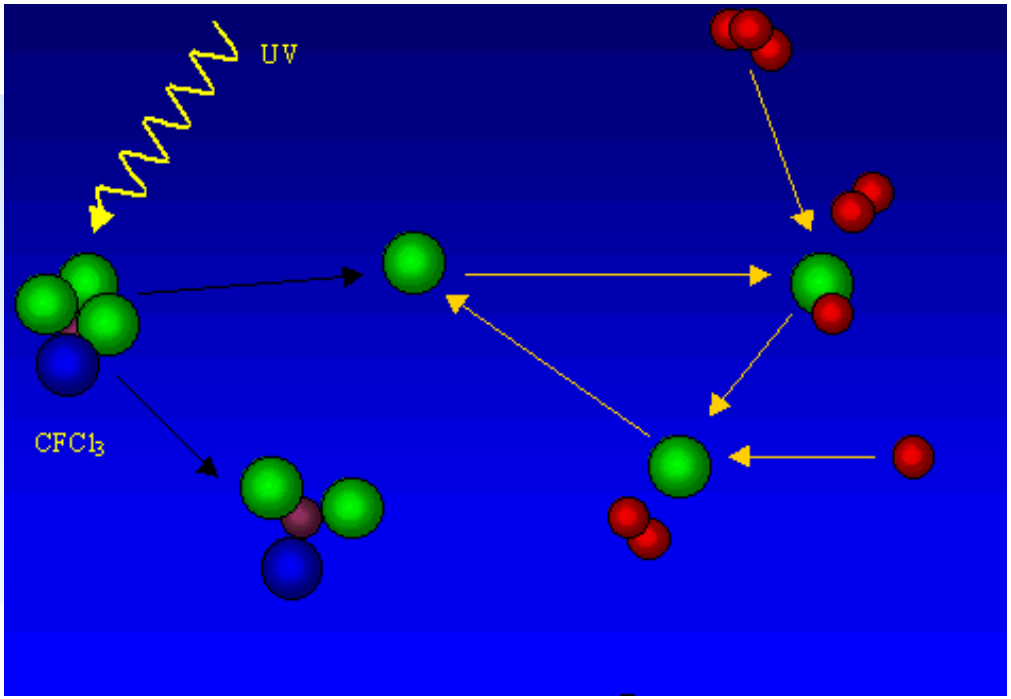
3. What Threatens Ozone? (continued)

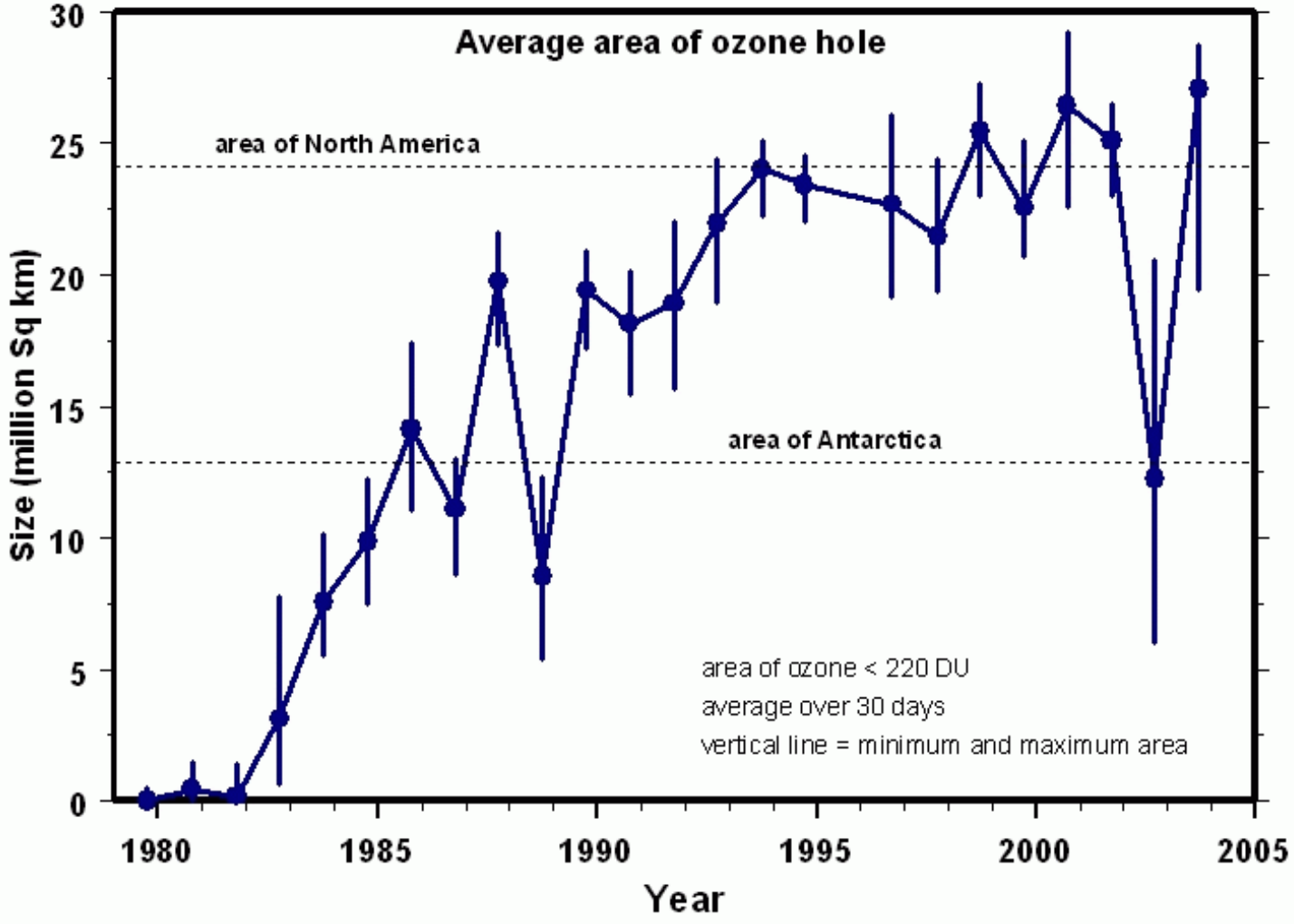
$CF_2Cl_2 \rightarrow Cl + CF_2Cl$

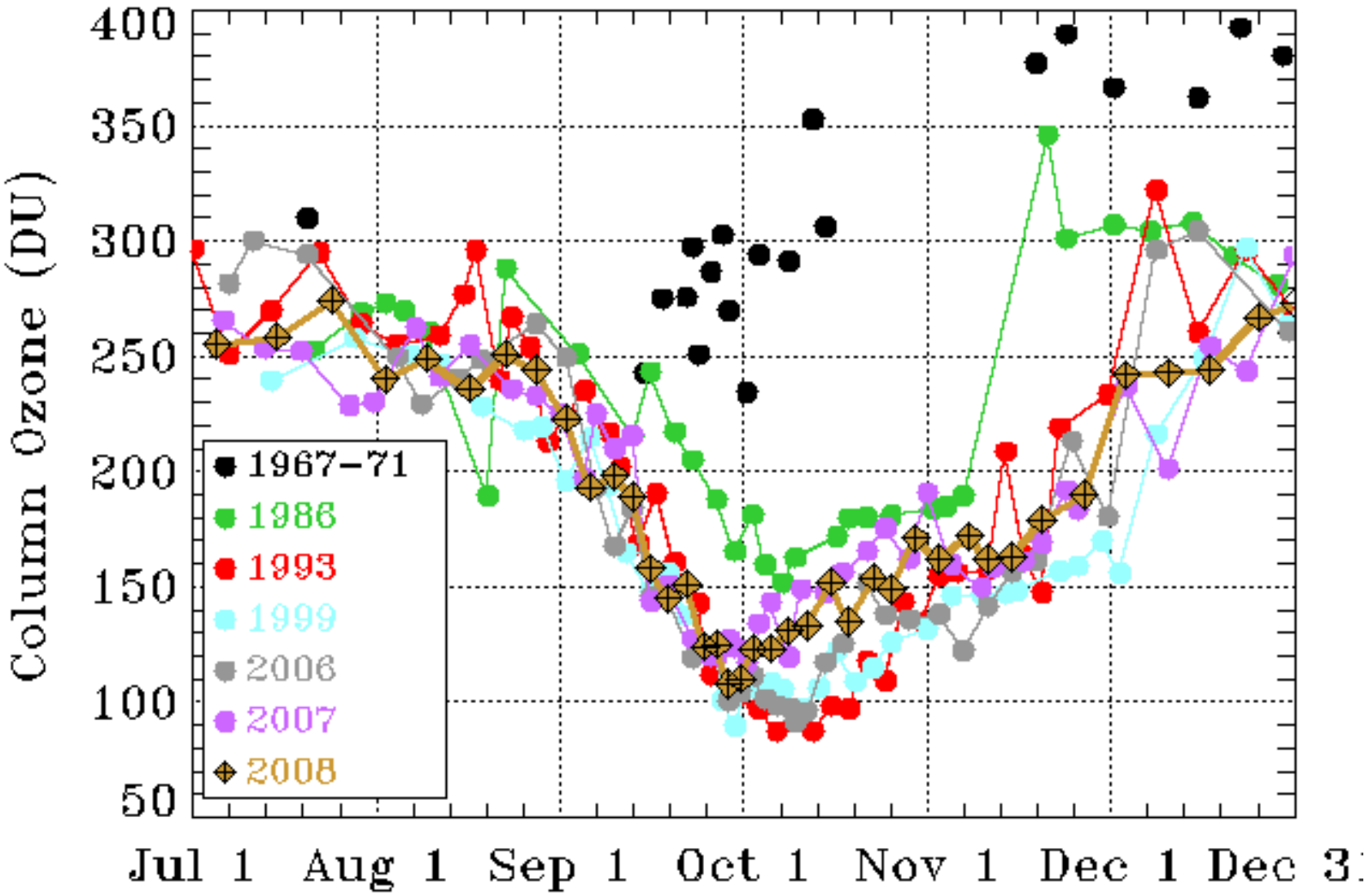
$$Cl + O_3 \rightarrow ClO + O_2$$

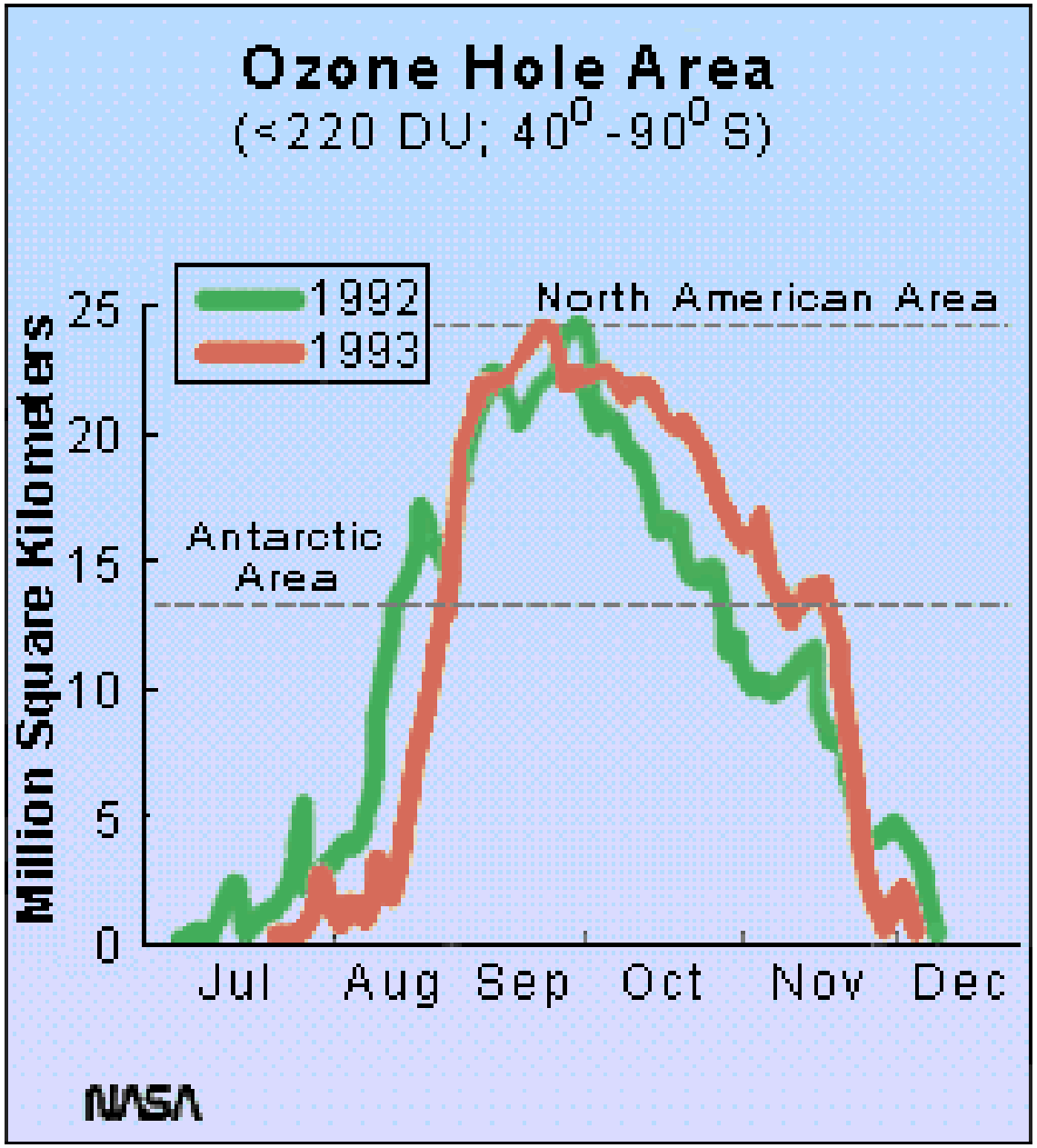
$$ClO + O \rightarrow Cl + O_2$$

$$O + O_3 \rightarrow 2O_2$$




Average area of ozone hole
area of North America
area of Antarctica
area of ozone < 220 DU
average over 30 days
vertical line = minimum and maximum area
Size (million Sq km)
Year
0
5
10
15
20
25
30
1980
1985
1990
1995
2000
2005


SOUTH POLE OZONESONDES
Total Column Ozone
Column Ozone (DU)
400
350
300
250
200
150
100
50
1967–71
1986
1993
1999
2006
2007
2008
Jul 1
Aug 1
Sep 1
Oct 1
Nov 1
Dec 1
Dec 31


Ozone Hole Area
(<220 DU; 40^0-90^0 S)
Million Square Kilometers
25
20
15
10
5
0
1992
1993
North American Area
Antarctic Area
Jul
Aug
Sep
Oct
Nov
Dec
NASA

4. Effects of Thinner Ozone Layer

4. Effects of Thinner Ozone Layer

more cases of skin cancer

- A 45 year-old-woman noted darkening of a pigmented lesion on the left leg. Histology revealed a superficial spreading melanoma with a Breslow index of 0.28mm. The scar was reexcised with a 1 cm margin.

A 60-year-old man with a history of estensive sun exposure was referred by his primary care physician for evaluation of a changing mole on the left side

of his neck for a few months. Skin biopsy revealed malignant melanoma.

TABLE 19-1.4. Reflection of Light (300 nm) Off Various Ground Surfaces

Ground surfaces	Per cent reflection
Fresh snow	85.0
Dry dune sand	17.0
Water: up to an angle of 60° from the perpendicular (beyond 60° reflection increases nearly to 100% at 90°)	5.0
Sandy turf	2.5
Grass	2.5


SUNSCREEN
SPF 15
UVA/UVB Protection

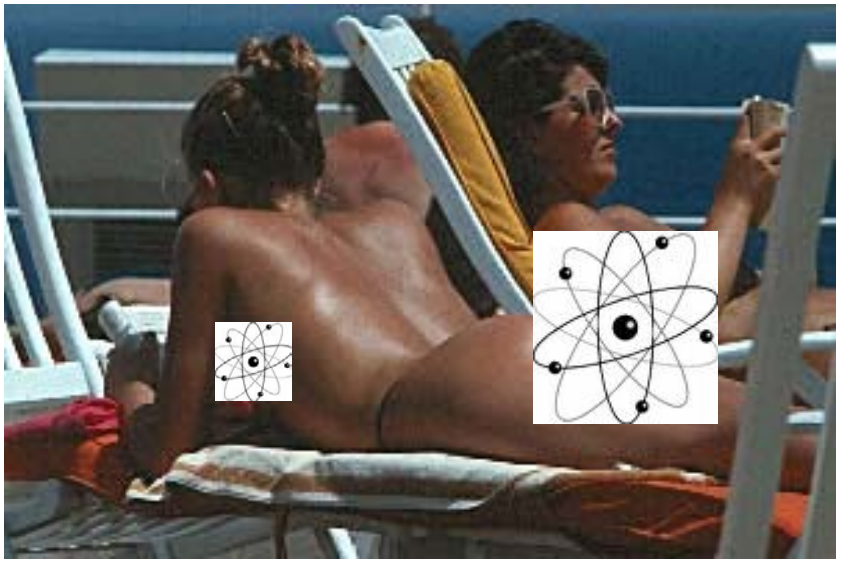
What to Look for in Sunscreen

- **UVB protection:** Padimate O, Homosalate, Octisalate (octyl salicylate), Octinoxate (octyl methoxycinnamate)
  UVA protection: Avobenzone
  UVA/UVB protection: Octocrylene, titanium dioxide, zinc oxide, Mexoryl (ecamsule)
- http://en.wikipedia.org/wiki/Ultraviolet

Hats Provide Protection

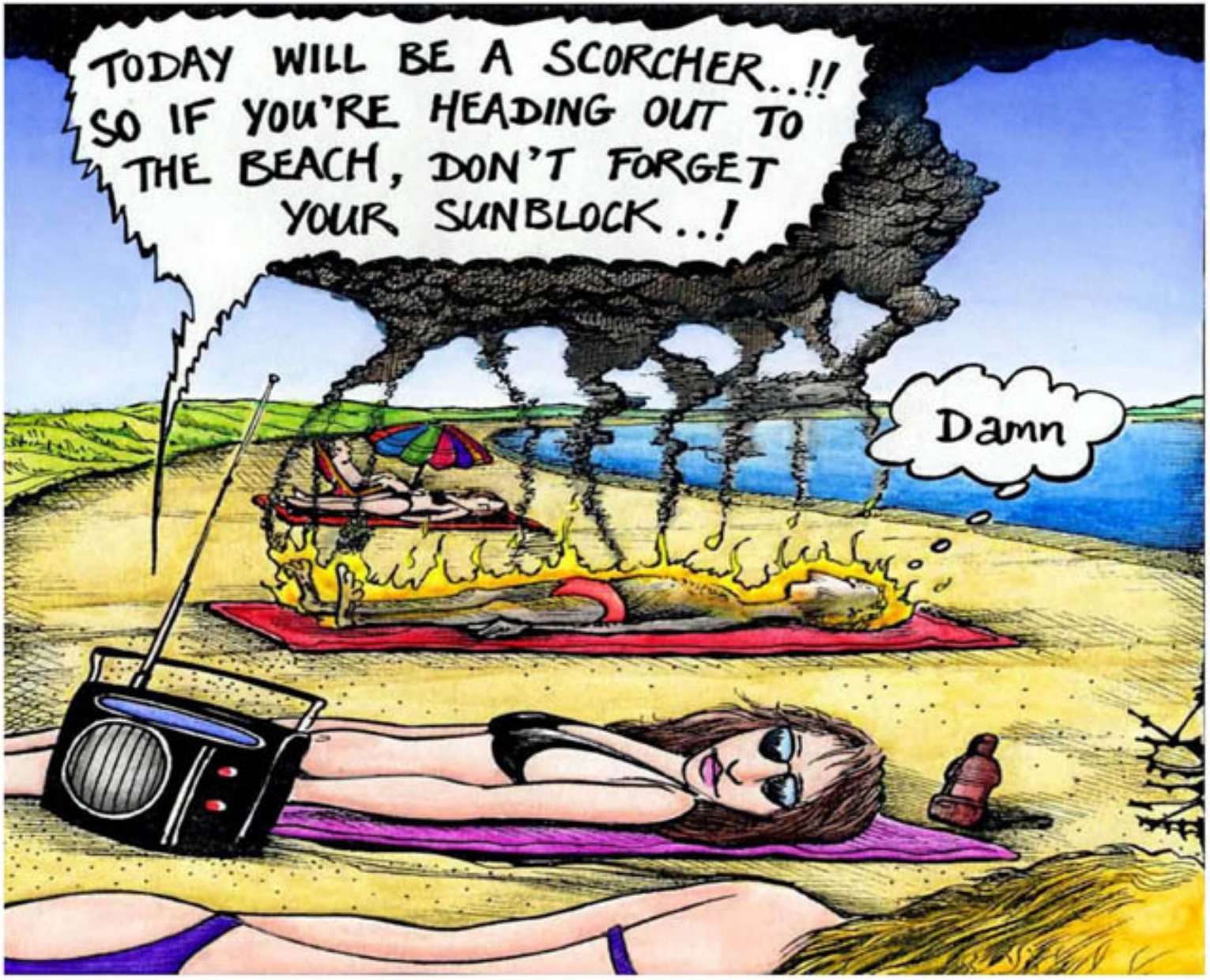
Zinc oxide (complete protection)

Other Effects of UV Damage



BEFORE **AFTER**

• Northern Hemisphere midlatitude (35°N–60°N) annual mean total column ozone amounts over the period 2006–2009 have remained at the same level as observed during 1998–2005, approximately 3.5% below the 1964–1980 average.


TODAY WILL BE A SCORCHER..!!
SO IF YOU'RE HEADING OUT TO THE BEACH, DON'T FORGET YOUR SUNBLOCK..!
Damn

5. Fixing the Problem

1)Use refrigerants that do not release chlorine or other damaging radicals
2) Maintain the ban on CFC's

Montreal protocol (1987): most countries agreed to ban all CFC's by the year 2000. But illegal production persisted in some countries and other ozone–damaging compounds have been manufactured.

http://www.epa.gov/spdpublc/science/ods/classone.html