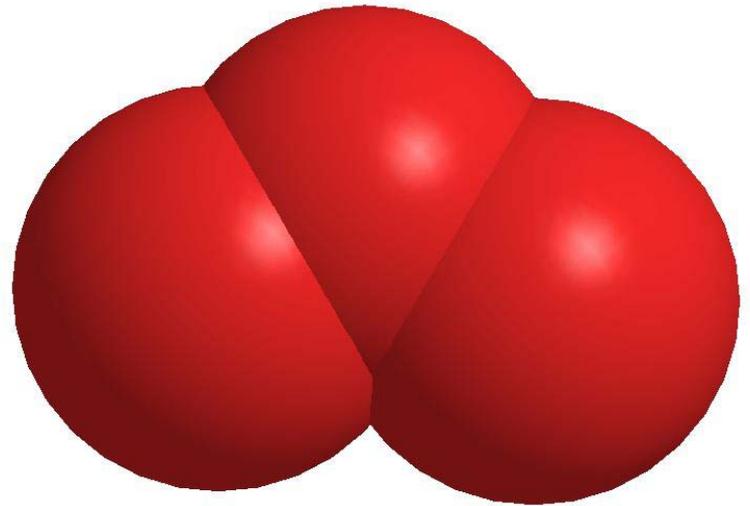


Ozone Depletion

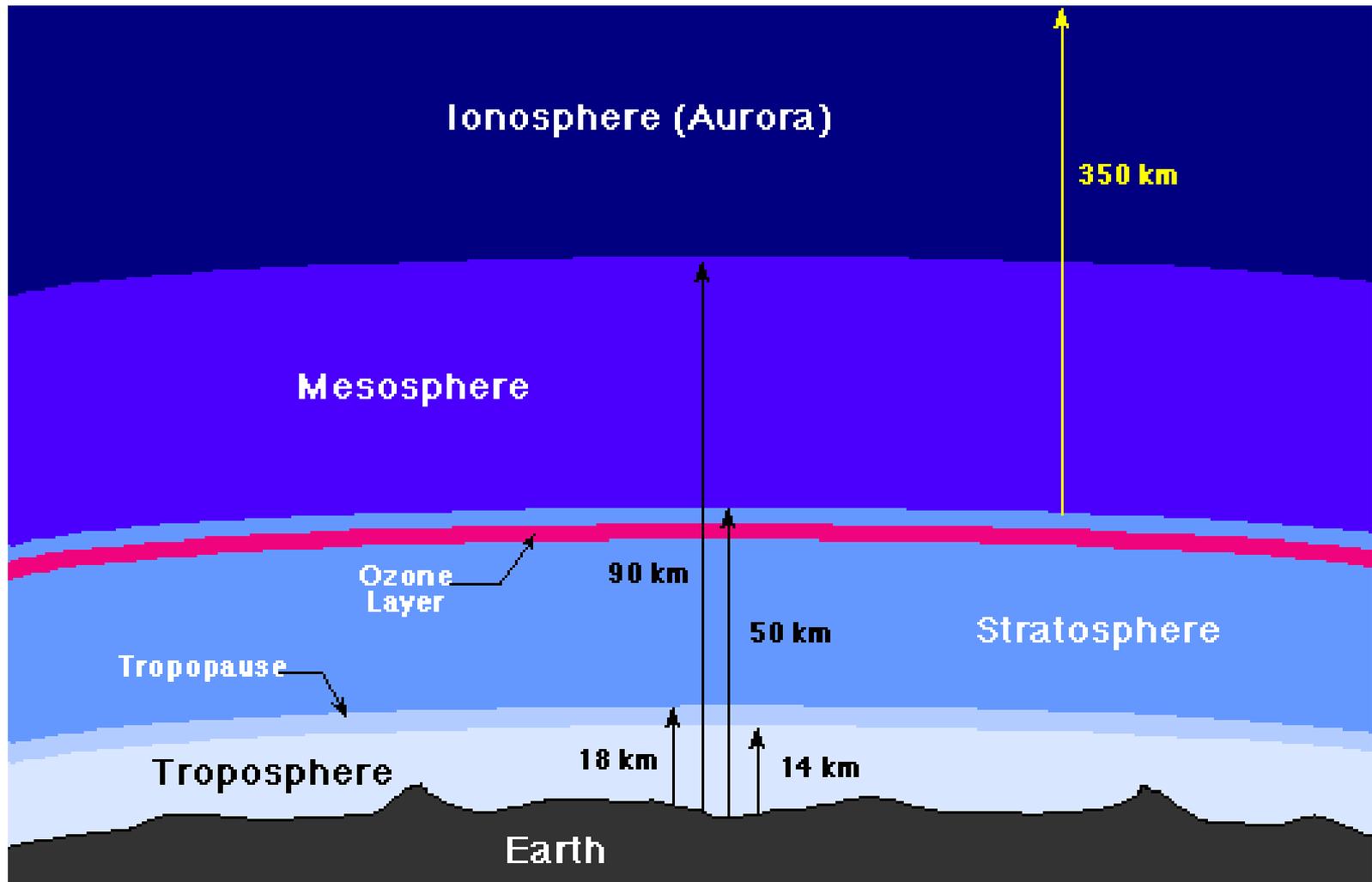


1a. What is Ozone?

- 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.



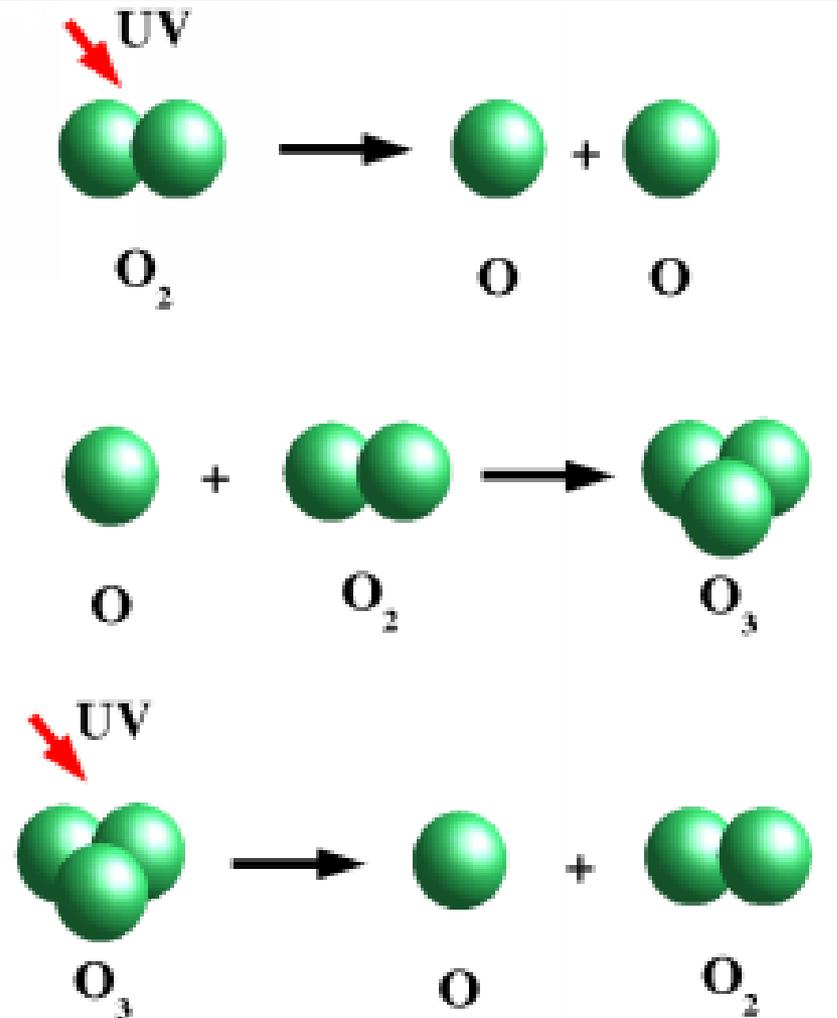
1b. Where is Ozone Found?



2. Why Ozone is Essential

- $O_3 + uv \rightarrow O_2 + O + \text{heat}$

Ozone converts harmful ultraviolet rays into harmless heat.



Forms Of Ultraviolet

UVA($400\text{--}315 \times 10^{-9} \text{ m}$)
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.

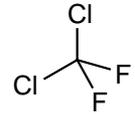
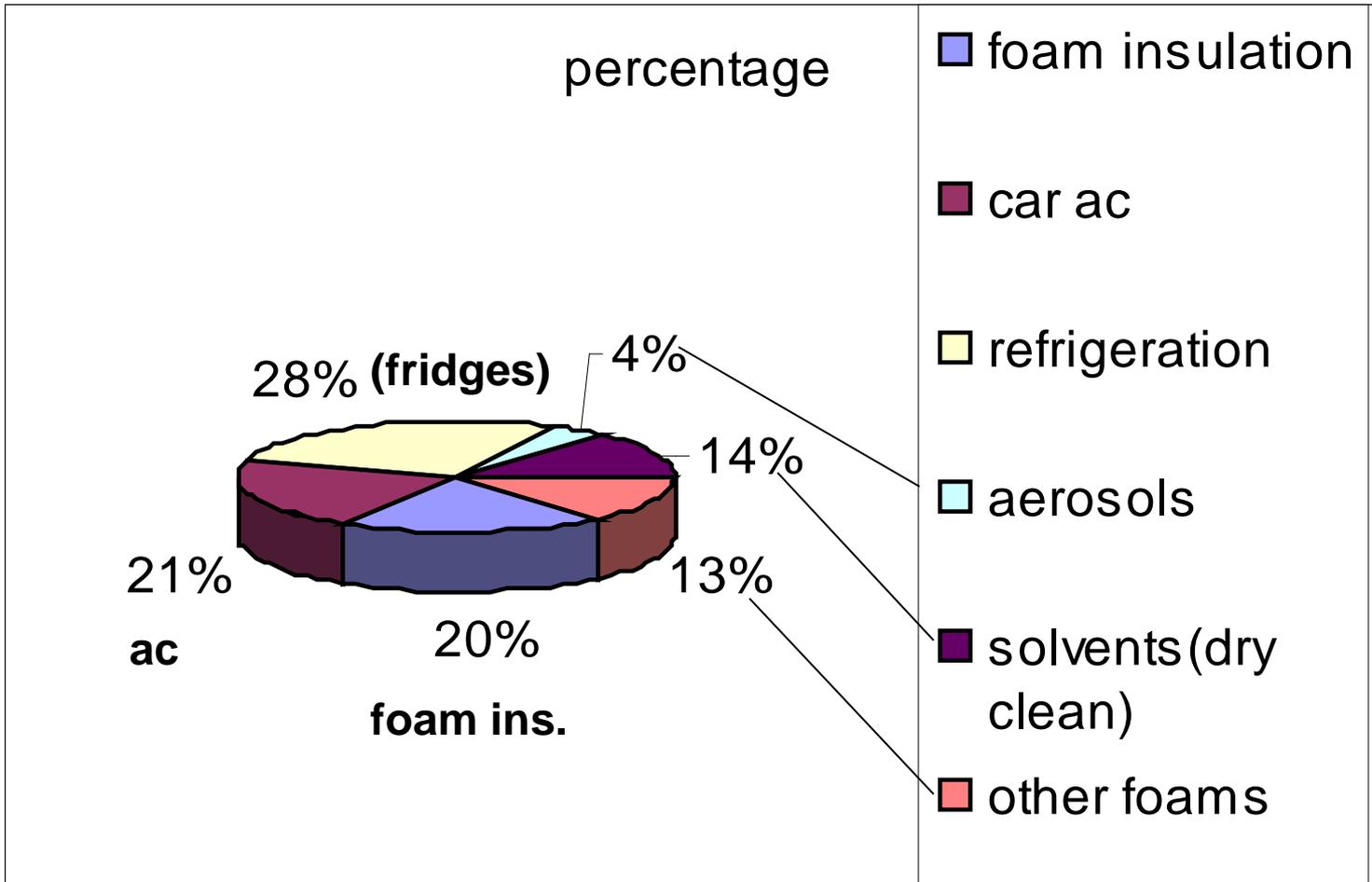
UVB($315\text{--}280 \times 10^{-9} \text{ m}$)
A fair amount is absorbed by ozone.

Leads to formation of vitamin D but can also cause skin cancer

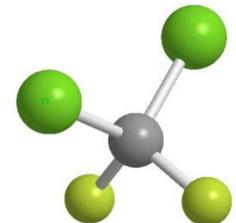
UVC($<280 \times 10^{-9} \text{ m}$)

Extremely dangerous.
All absorbed by O_2 and O_3

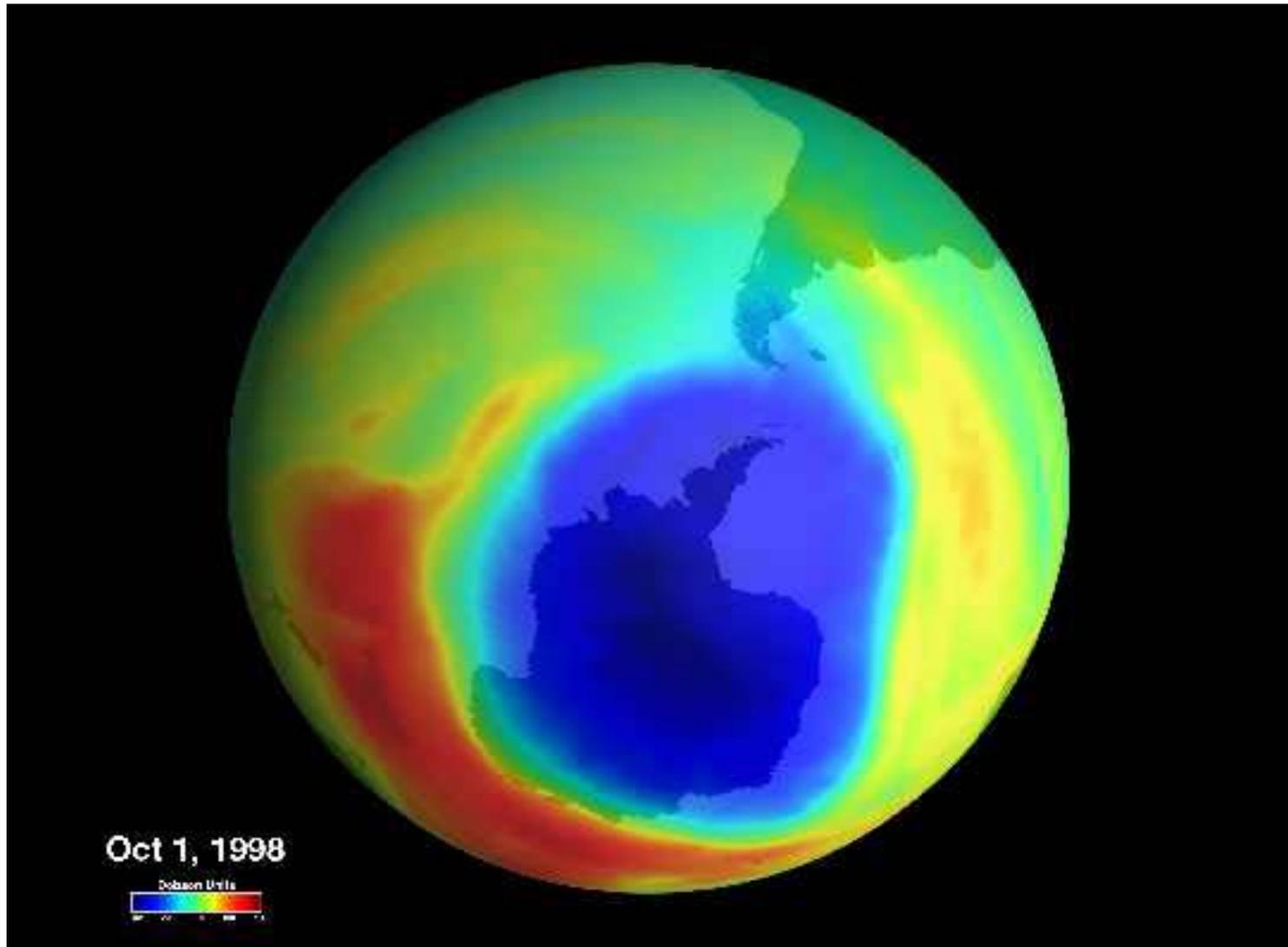
3. What Threatens Ozone?



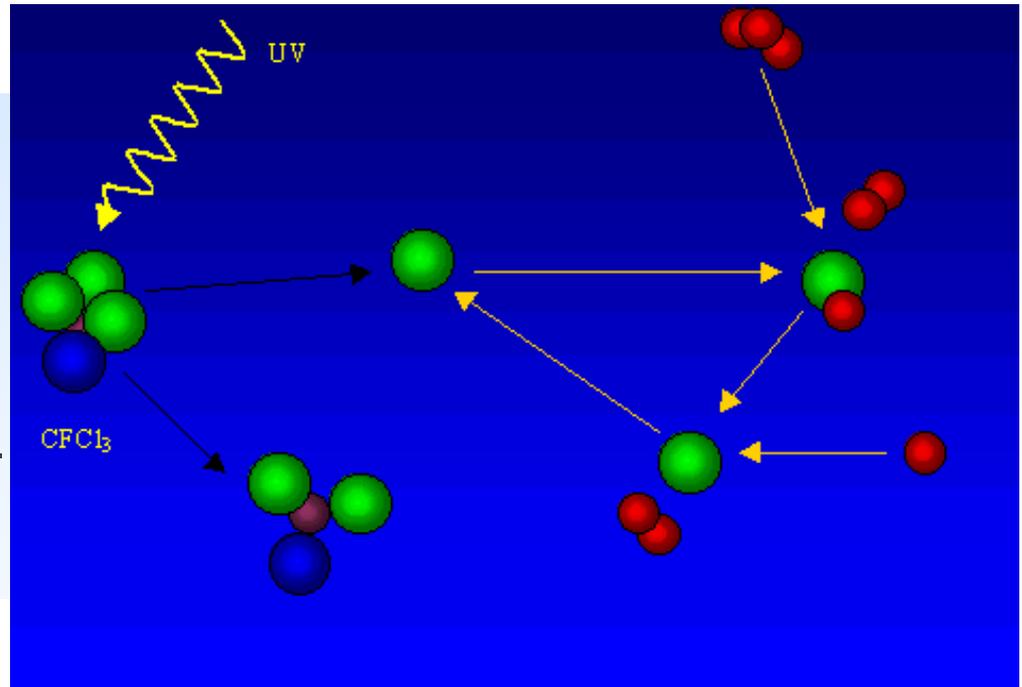
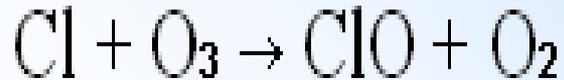
Freon-12
(CCl_2F_2 ,
an
example
of a **CFC**)

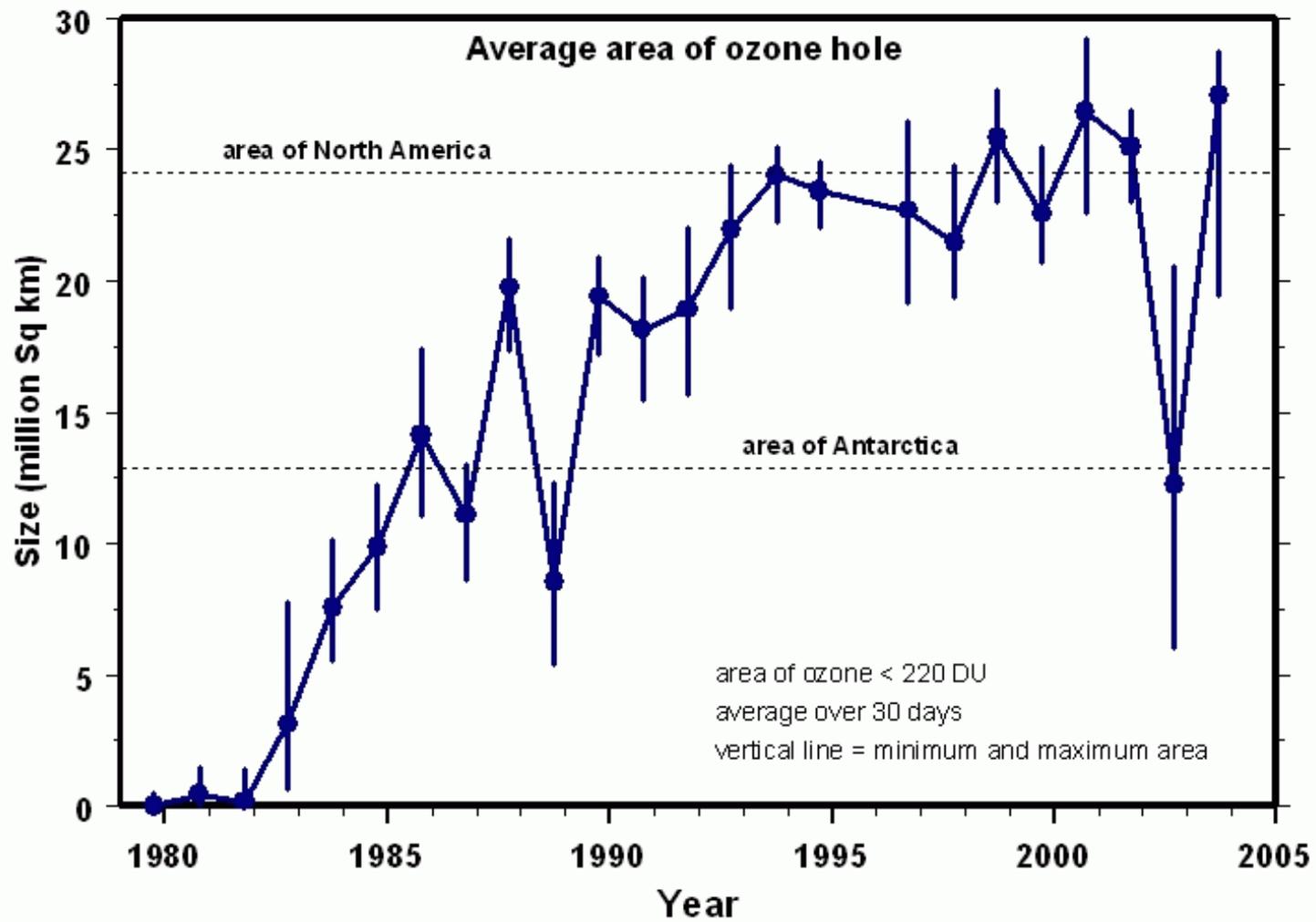


The Ozone Hole Above Antarctica



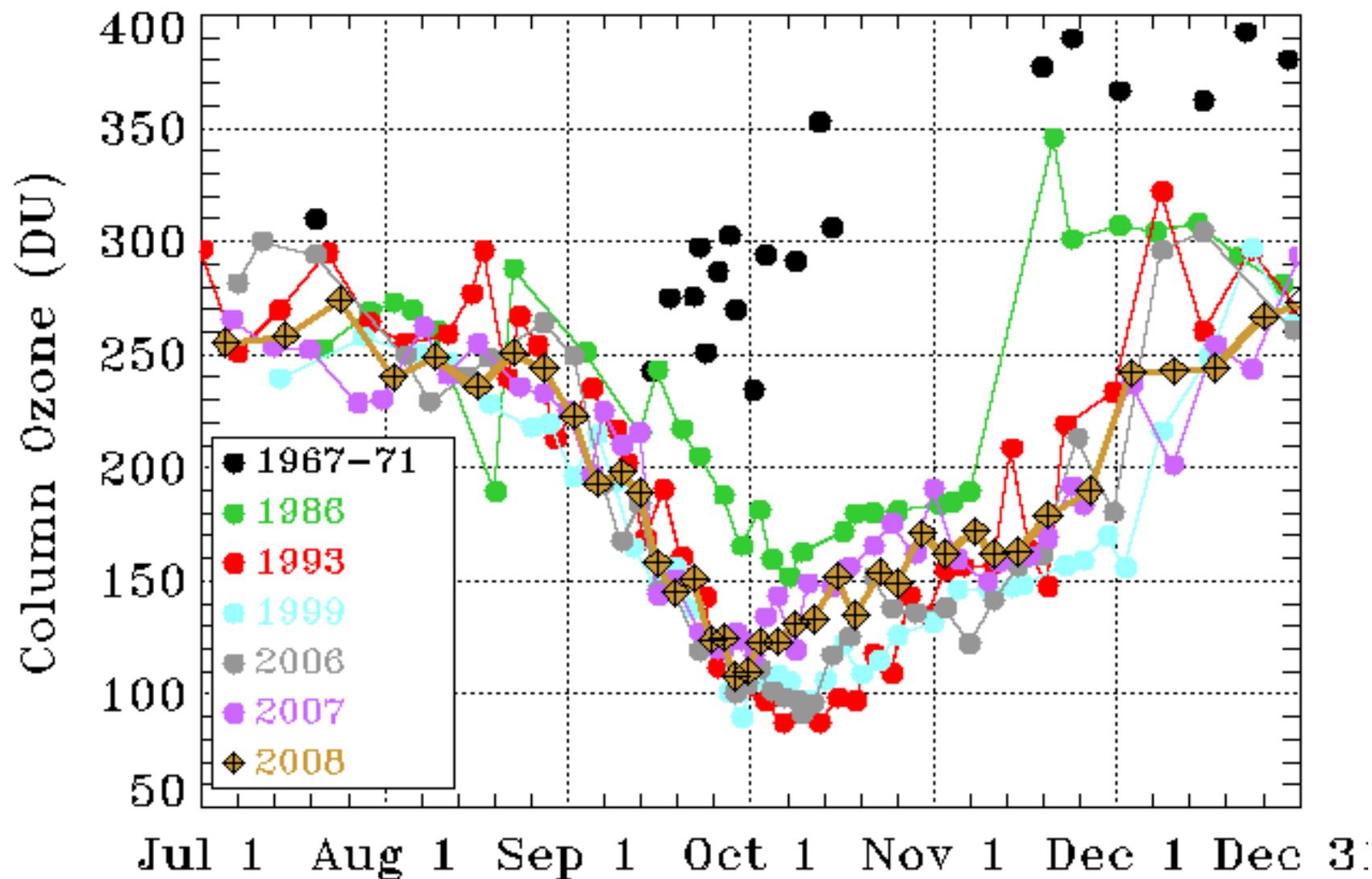
3. What Threatens Ozone? (continued)





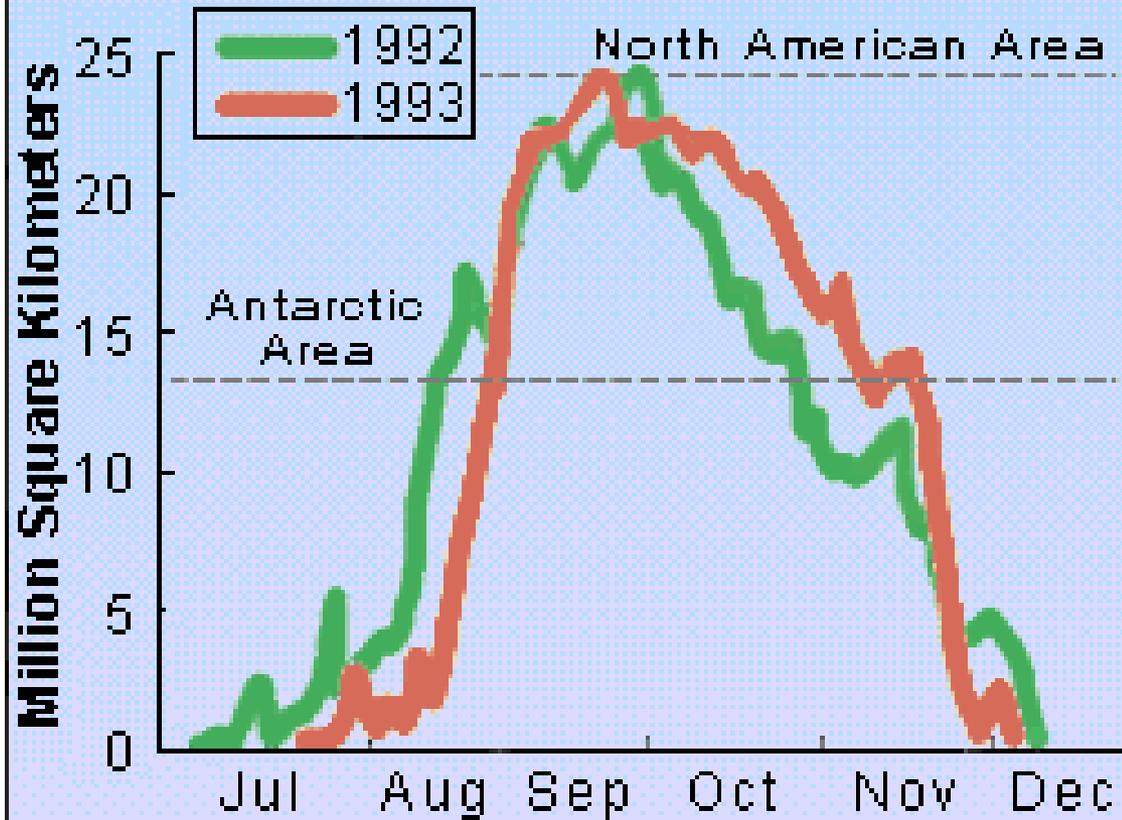
SOUTH POLE OZONESONDES

Total Column Ozone



Ozone Hole Area

(<220 DU; 40°-90° S)



NASA

4. Effects of Thinner Ozone Layer



4. Effects of Thinner Ozone Layer



- 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 extensive 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



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>



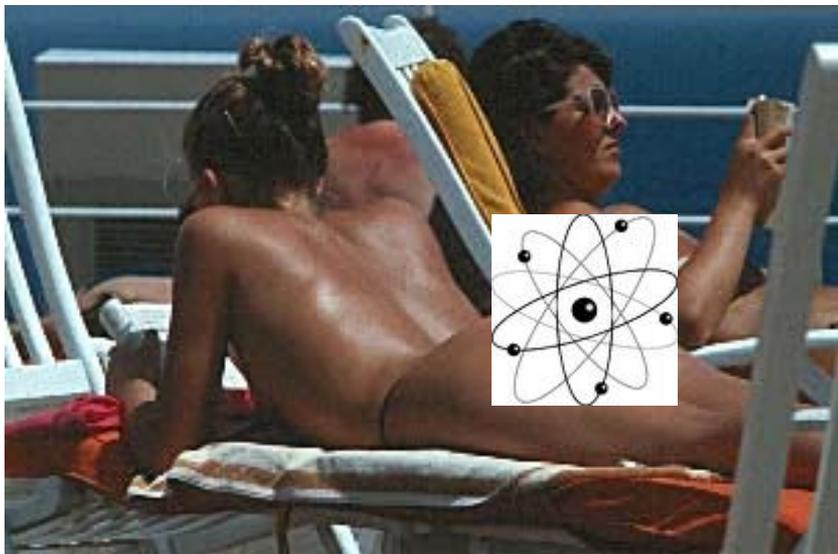
Hats Provide Protection



Zinc oxide (complete protection)



Other Effects of UV Damage



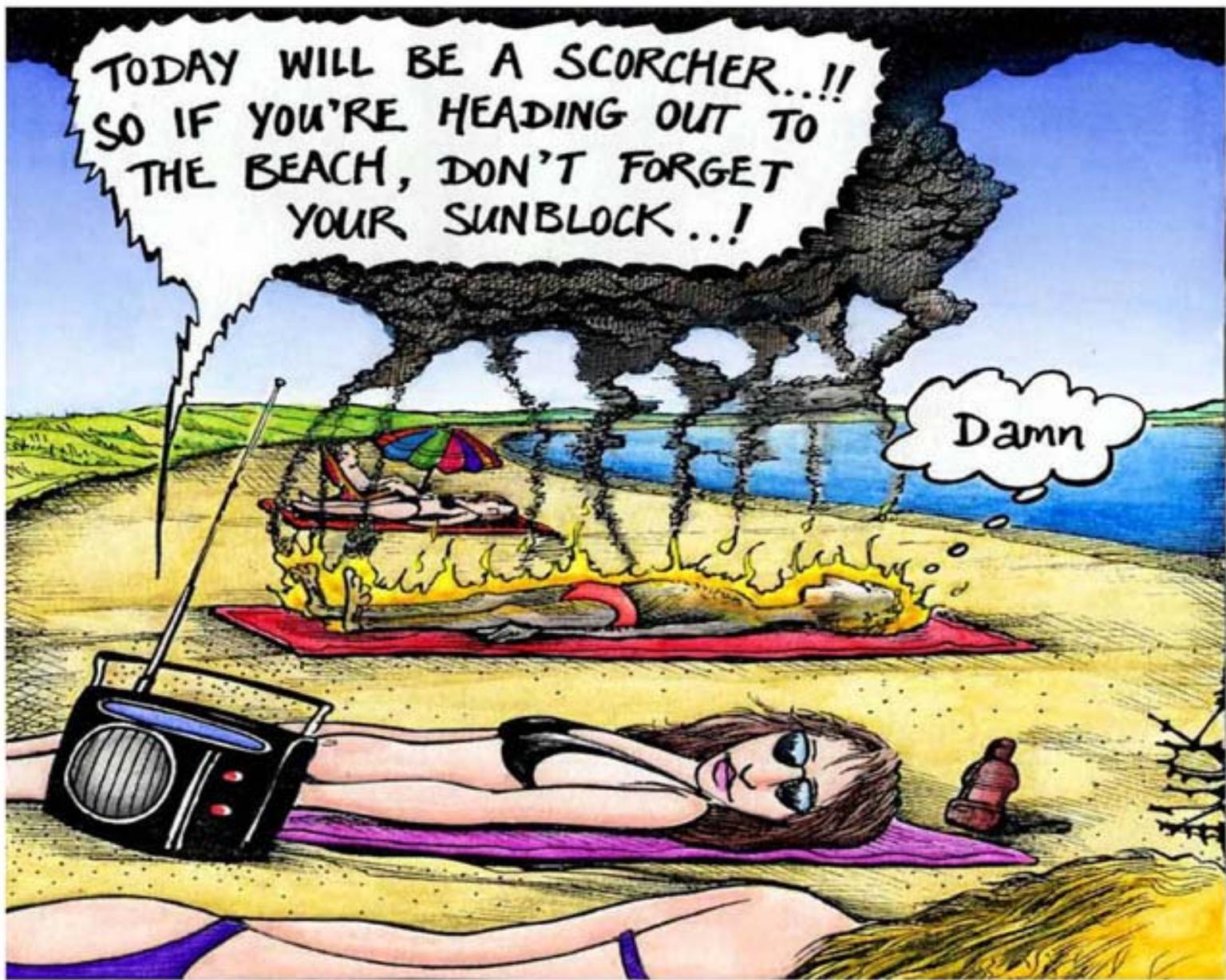
BEFORE



AFTER

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

Damn



5. Fixing the Problem

ozone depletion potential (ODP).



Compound	Formula	ODP	Atmospheric lifetime (years)
CFC-11	CFCl_3	1.0	60
CFC-12	CF_2Cl_2	1.0	120
CFC-113	$\text{CF}_2\text{ClCF}_2\text{Cl}$	0.8	90
CFC-114	$\text{CF}_2\text{ClCF}_2\text{Cl}$ $\text{CClF}_2\text{CClF}_2$	0.6-0.8	200
Halon-1211	$\text{CF}_2\text{Br}_2\text{Cl}$ CF_2CClBr	2.2-3.5	25
Halon-1301	CBrF_3	7.8-16	80-110
Halon-2402	$\text{C}_2\text{F}_4\text{Br}_2$	5.0-6.2	23-28
HCFC-22	CHF_3Cl CHClF_2	0.04-0.06	15-20
HCFC-123	CF_2CHCl_2 CHCl_2CF_3	0.02-0.16	1-2
HCFC-141b	CH_3CFCl_2	0.03-0.11	6-11
HCFC-124	CF_3CHCl	0.016-0.024	5-10

Montreal protocol(1987): most countries agreed to ban all CFC's by the year 2000

5. Fixing the Problem

- $\text{Cl} + \text{C}_2\text{H}_6(50\ 000\ \text{tons}) \rightarrow \text{HCl} + \text{C}_2\text{H}_5$



Expensive solution

A better way

- Use refrigerants that do not release chlorine
- Maintain the ban on CFC's