

# The Montreal Protocol and Human Health

STRATOSPHERIC OZONE DEPLETION  
INCREASED ULTRAVIOLET RADIATION

**The Vienna Convention for the Protection of  
the Ozone Layer**



# The Montreal Protocol and Human Health

STRATOSPHERIC OZONE DEPLETION  
INCREASED ULTRAVIOLET RADIATION

## **The Montreal Protocol on Substances that Deplete the Ozone Layer**

### **Preamble**

The Parties to this Protocol,

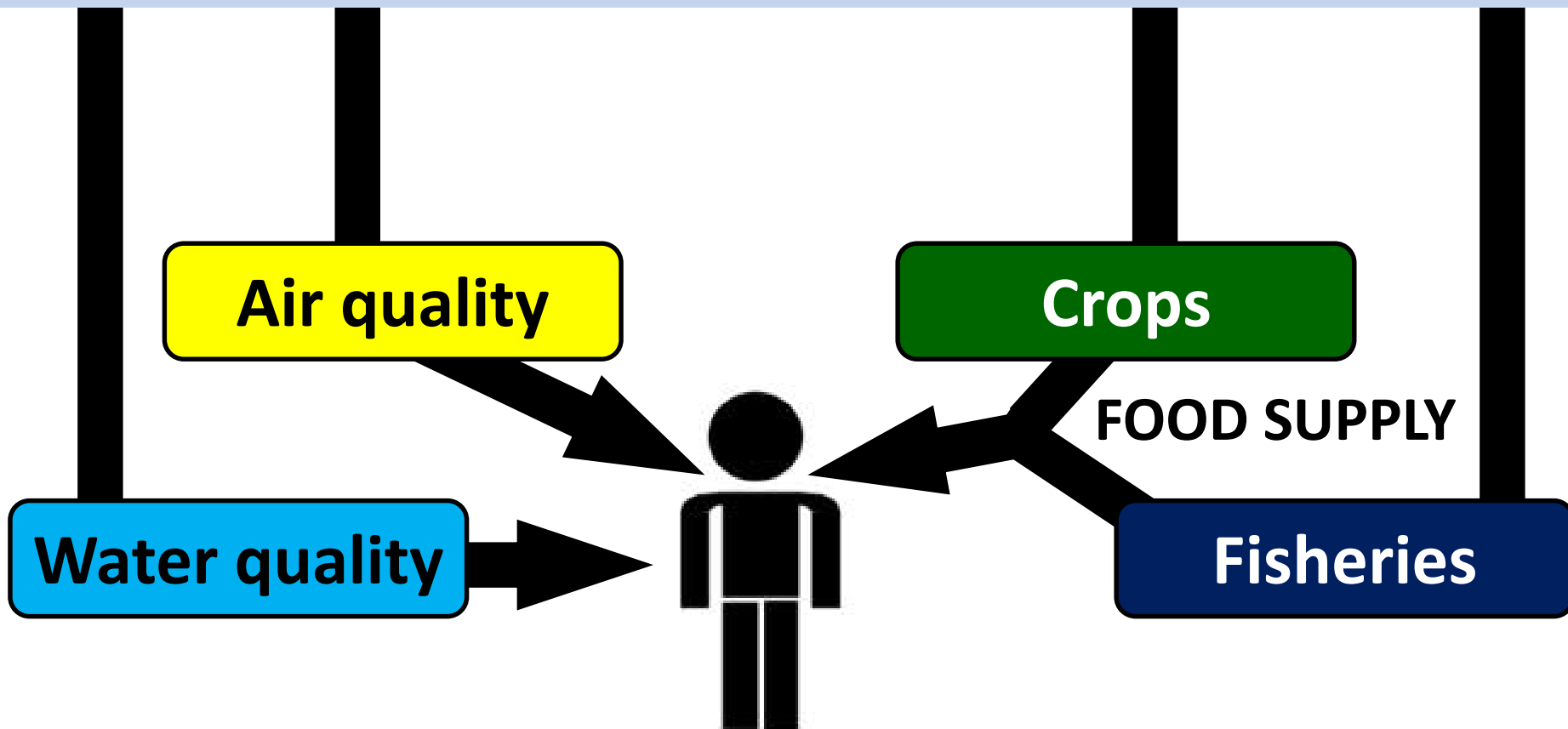
*Being Parties to the Vienna Convention for the Protection of the Ozone Layer,*

*Mindful of their obligation under that Convention to take appropriate measures to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer,*

**“...to take appropriate measures to protect human health and the environment.....”**

# The Montreal Protocol and Human Health

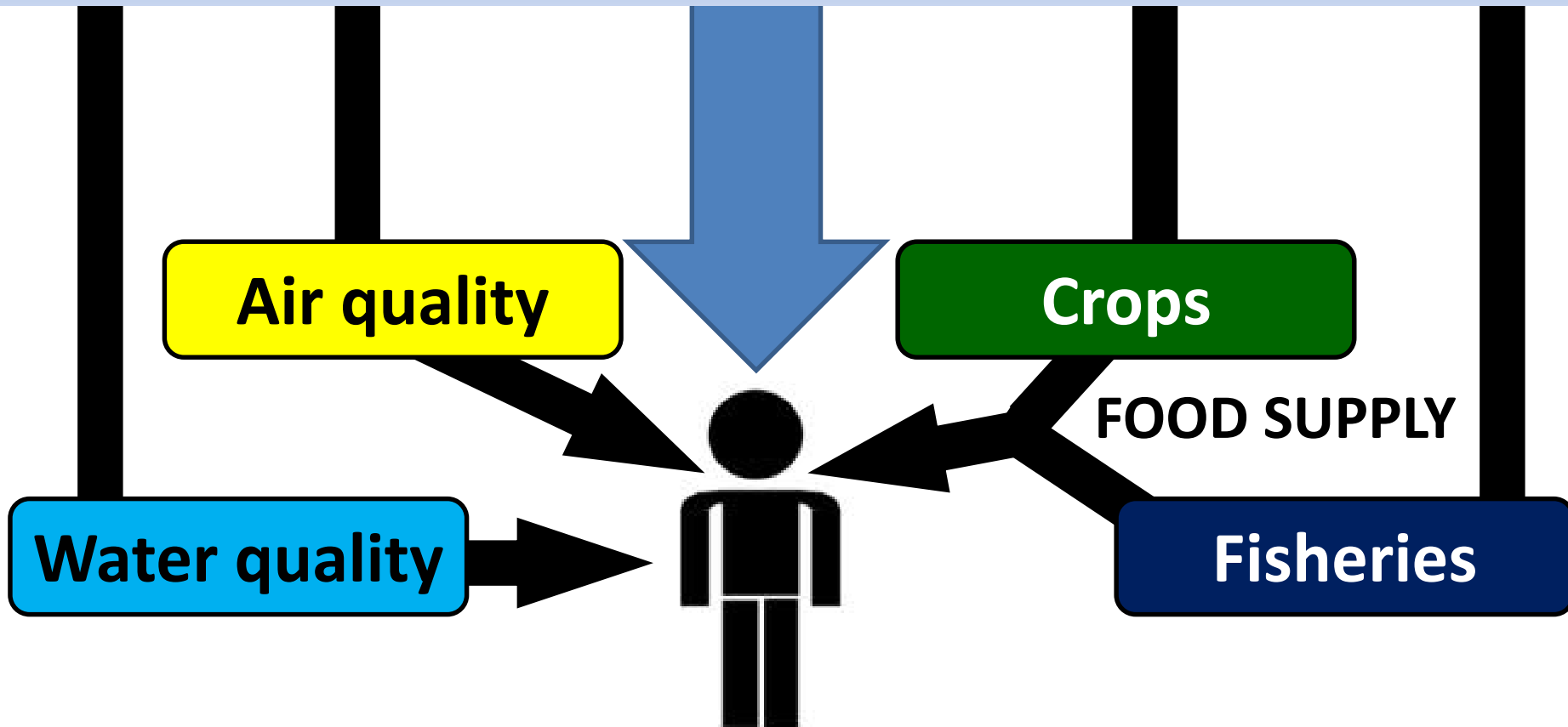
STRATOSPHERIC OZONE DEPLETION  
INCREASED ULTRAVIOLET RADIATION



INDIRECT EFFECTS OF OZONE DEPLETION ON HEALTH

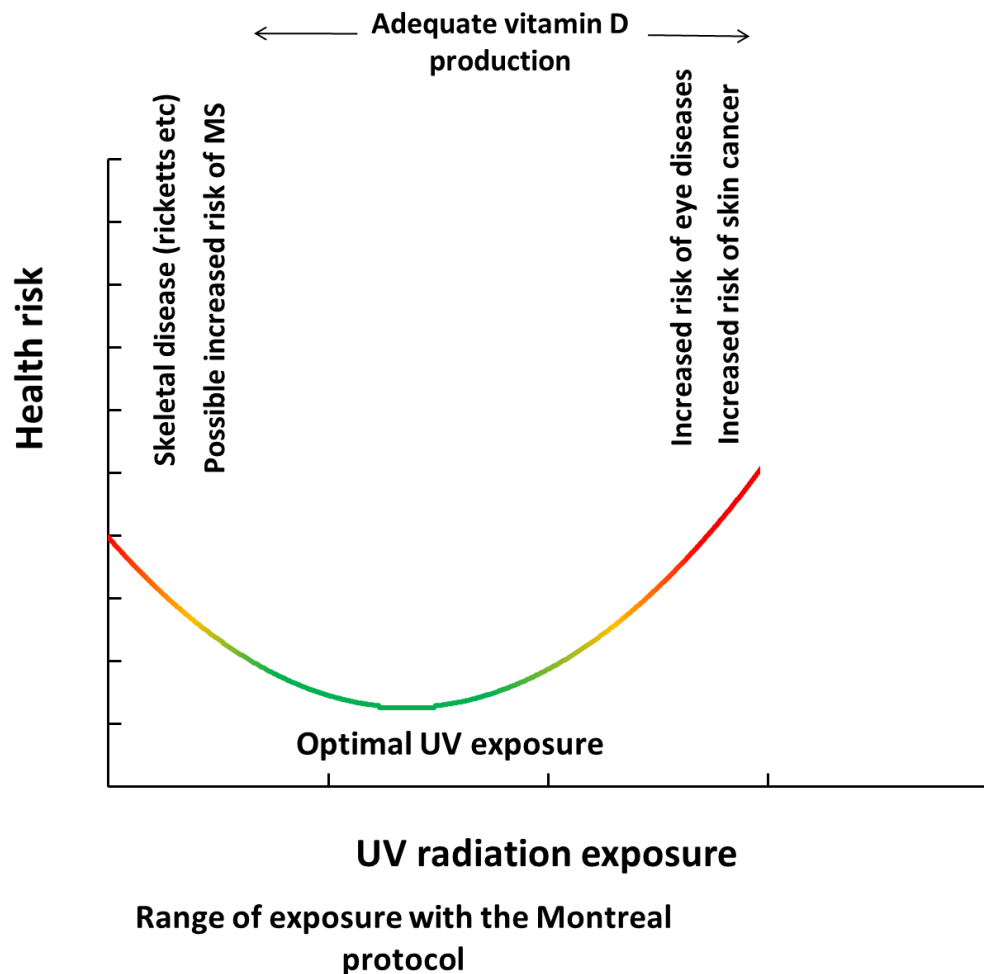
# The Montreal Protocol and Human Health

STRATOSPHERIC OZONE DEPLETION  
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DIRECT EFFECTS OF OZONE DEPLETION ON HEALTH

# The Montreal Protocol and Human Health



**Research over the last**

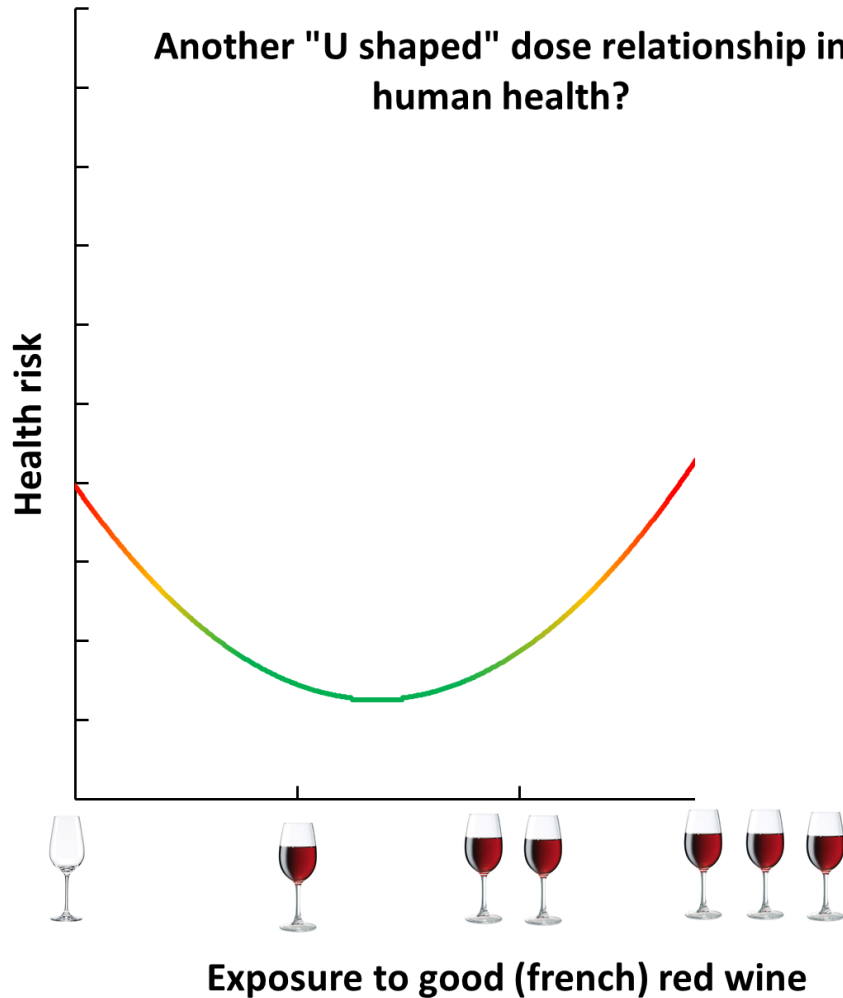
**This “U shaped”  
relationship has  
sometimes led to  
accusations that the  
risks of excessive UV  
had been  
exaggerated.**

**In fact, such  
relationships are quite  
common.**

**diseases, including skin  
cancer.**

# The Montreal Protocol and Human Health

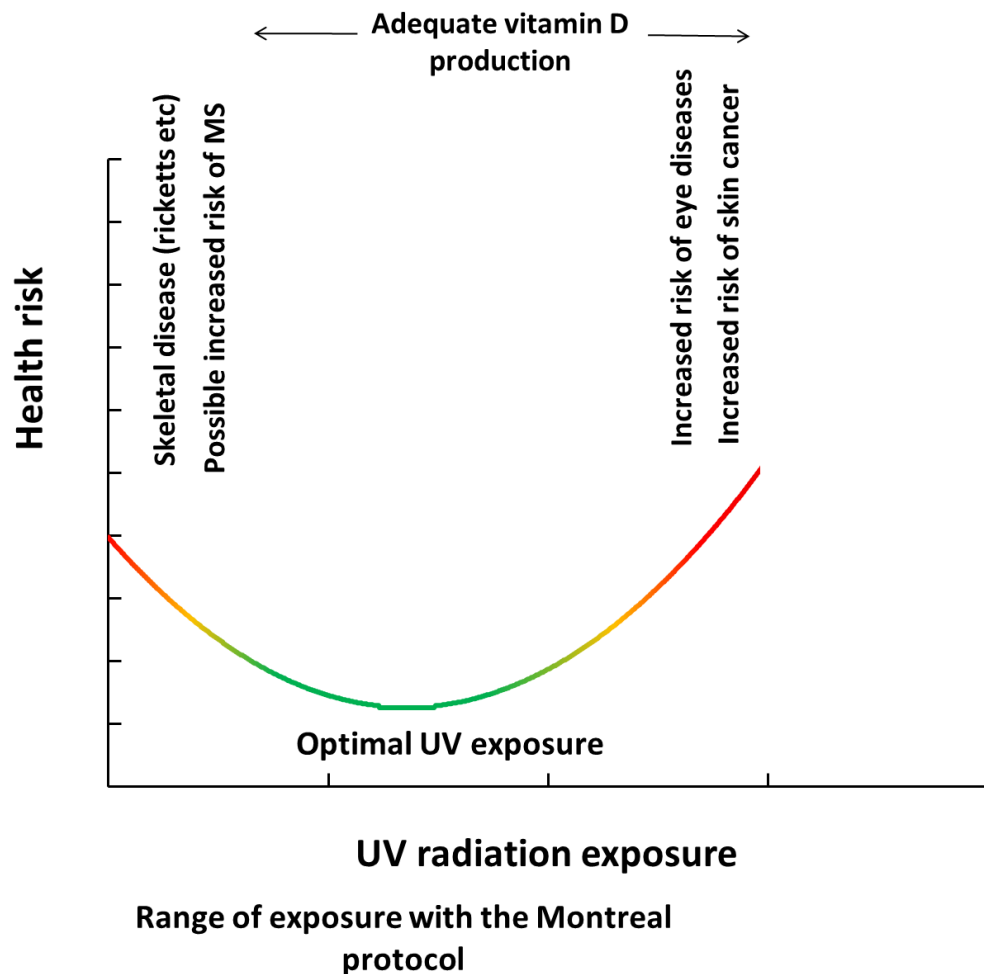
Another "U shaped" dose relationship in human health?



**This "U shaped" relationship has sometimes led to accusations that the risks of excessive UV had been exaggerated.**

**In fact, such relationships are quite common.**

# The Montreal Protocol and Human Health



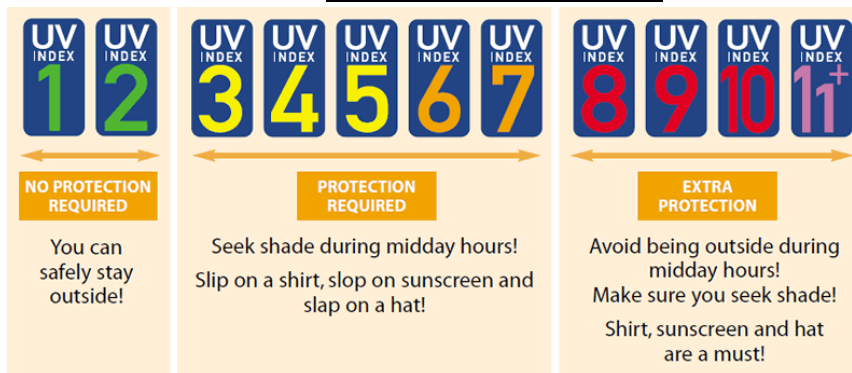
**WITH THE SUCCESSFUL  
MONTREAL PROTOCOL**

**THE BALANCE BETWEEN  
THESE CONTRASTING  
EFFECTS OF UV IS  
DETERMINED LARGELY  
BY PERSONAL  
CIRCUMSTANCES AND  
BEHAVIOUR.**

**MORE IN LATER TALKS**

# UV and health now, with the successful Montreal Protocol

## RISK OF SUNBURN WITH THE MONTREAL PROTOCOL



			1 to 2	3 to 4	5	6	7-9	10+
← darker skin	SKIN TYPE	I and II	low	medium	high	high	very high	very high
		III and IV	low	low	medium	medium	high	high
		V	low	low	medium	medium	medium	high
		VI	low	low	low	low	medium	medium

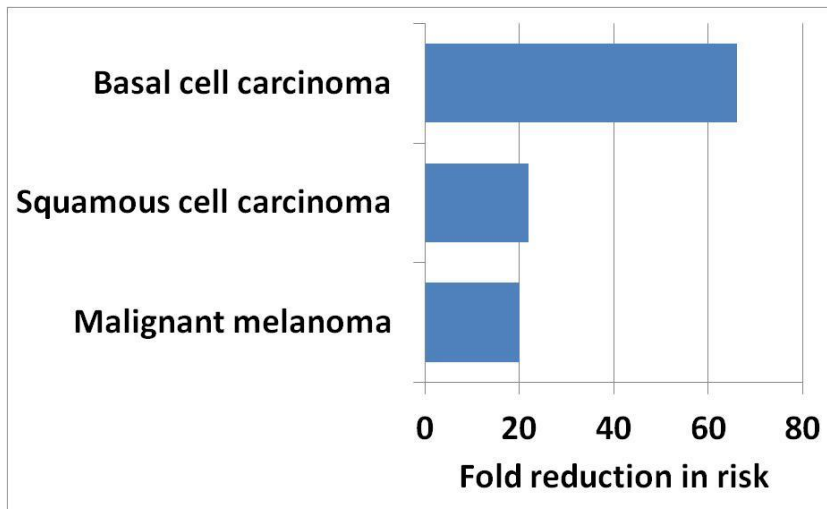


# UV and health now, with the successful Montreal Protocol: skin cancers



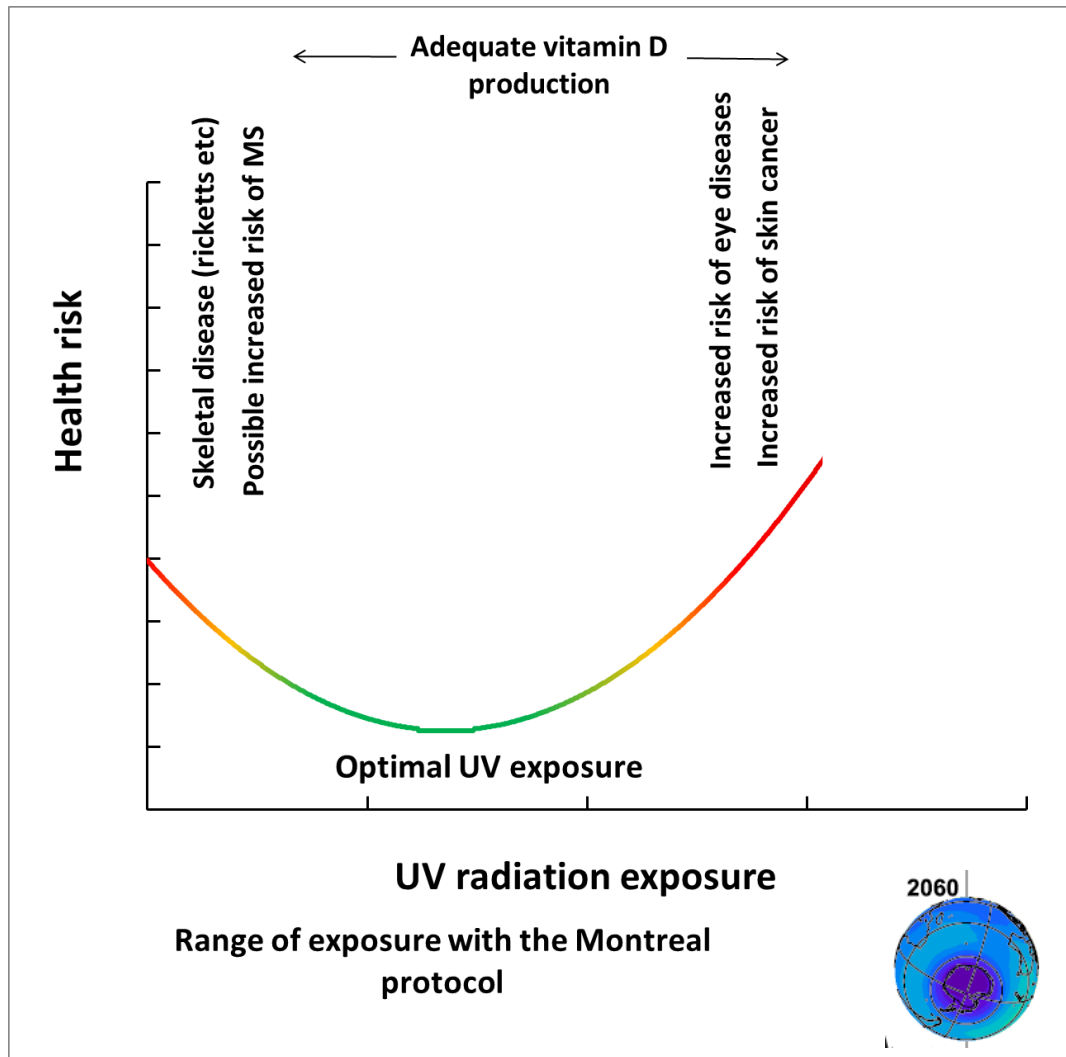
**Skin cancers can occur with all skin types.**

**People with deeply pigmented skins are less vulnerable BUT skin cancers can be harder to detect, and late detection can make treatment more challenging.**



**Reduction in skin cancer risk in deeply pigmented (type V & VI) compared with poorly pigmented skin types (I & II)**

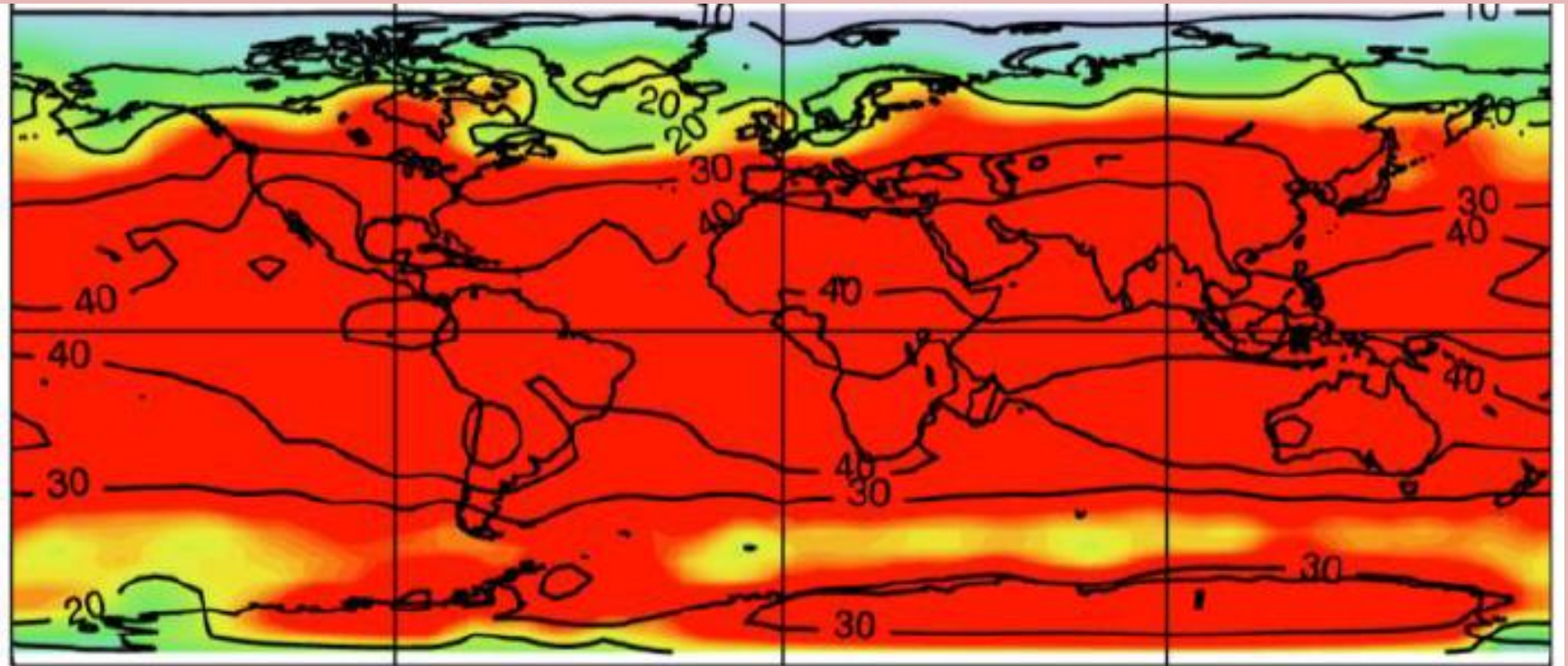
# The Montreal Protocol and Human Health



**WITHOUT THE  
MONTREAL PROTOCOL  
(WORLD AVOIDED)**

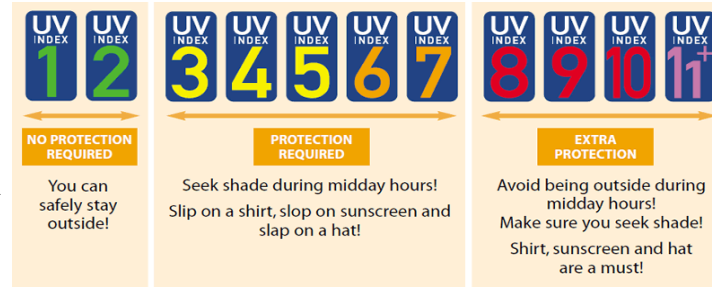
**OZONE DEPELTION  
WOULD HAVE LED TO  
LARGE INCREASES UV,  
SO THAT THE  
DAMAGING EFFECTS  
OF TOO MUCH UV  
BECOME DOMINANT.**

# Without the Montreal Protocol extreme UV would have occurred world-wide



Maximum UV indices calculated in the year **2090** without the Montreal Protocol. All areas shown in red would have UVI above the current global maximum (25: exceptionally in the South America Andes) From Egarova et al., 2013

# UV and health now, with the successful Montreal Protocol



			1 to 2	3 to 4	5	6	7-9	10+
← darker skin	SKIN TYPE	I and II	low	medium	high	high	very high	very high
		III and IV	low	low	medium	medium	high	high
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		VI	low	low	low	low	medium	medium

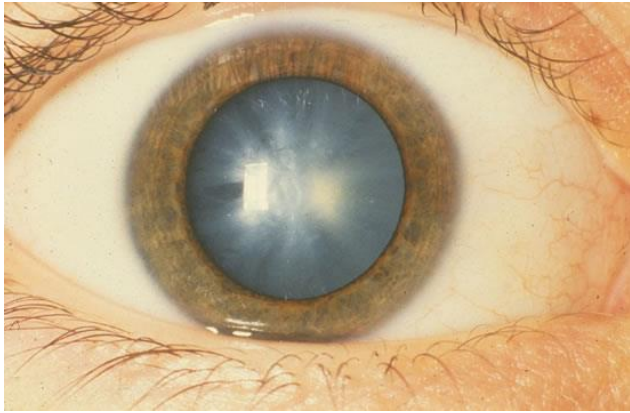
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Maximum UV indices calculated in the year **2090** without the Montreal Protocol. All areas shown in red would have UVI above the current global maximum (25: exceptionally in the South America Andes) From Egarova et al., 2013

# Without the Montreal Protocol extreme UV would have occurred world-wide

	SHORT TERM	LONG-TERM
SKIN	Sunburn	<u>Increased skin-cancers</u> Basal cell & squamous cell carcinomas Malignant melanoma
EYES	Inflammation (photo-conjunctivitis)	Increased cataract (and other eye diseases)
IMMUNE SYSTEM: immune suppression leading to increased susceptibility to infection, reduced response to vaccinations		

# The Montreal Protocol and Human Health: Cataracts



**Cataracts are a major cause of blindness world-wide.**

**Short-wavelength UV, most affected by ozone depletion, is linked especially to an increased risk of cortical cataract.**

**USA-EPA (2014) report compared USA cataract incidence with the Montreal protocol with incidence without any effective policy controls on ozone depleting substances.**

# The Montreal Protocol and Human Health: Cataracts

## 2014 US-EPA REPORT

**As a result of the successful implementation of the Montreal Protocol there will be up to 45-50 million fewer cases of cataract in people born between 1890 and 2100 in the USA.**

**No such estimates for the rest of the world, but methods would allow this to be done using the “world-avoided” models.**

# The Montreal Protocol and Human Health: skin

	SHORT TERM	LONG-TERM
SKIN	Sunburn	<u>Increased skin-cancers</u> Basal cell & squamous cell carcinomas Malignant melanoma
EYES	Inflammation (photo-conjunctivitis)	Increased cataract (and other eye diseases)

**IMMUNE SYSTEM:** immune suppression leading to increased susceptibility to infection, reduced response to vaccinations



# The Montreal Protocol and Human Health: skin cancers

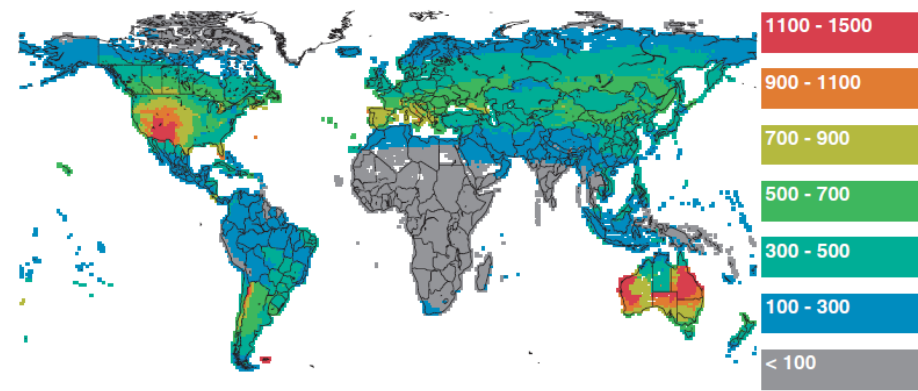
Recent models of the “world avoided” estimate that there would have been approximately **two million more cases of skin cancer a year by 2030** without the Montreal Protocol.

Further refinements should improve this estimate, and extend the time period beyond 2030.

Total number of new cases of skin cancer per million people per year avoided by the Montreal Protocol in the year 2030.

From van Dijk et al., 2013

242 Arjan van Dijk et al.

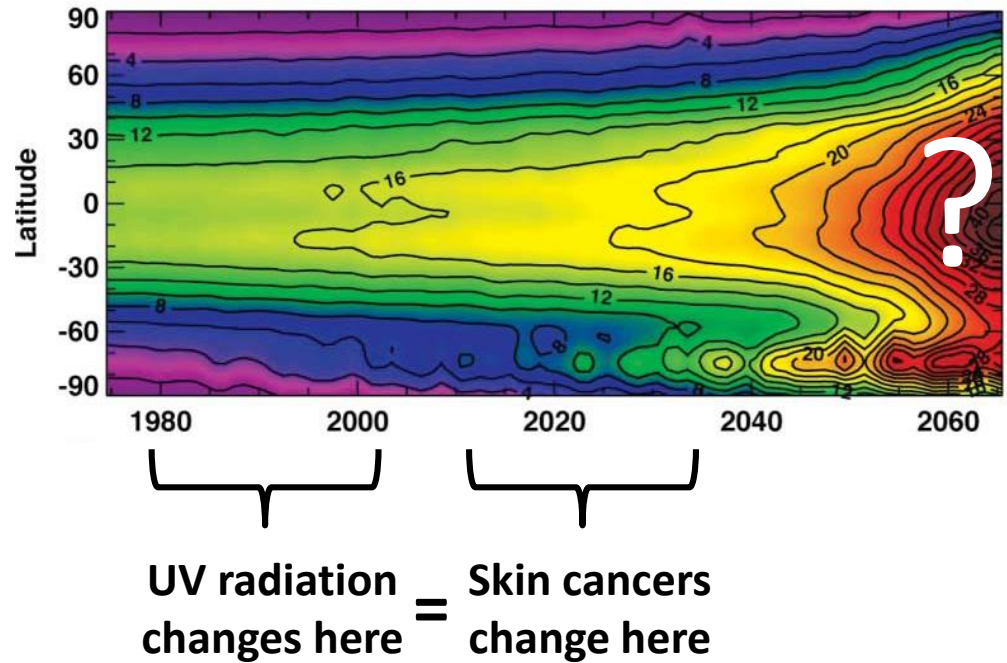


**WITHOUT THE MONTREAL PROTOCOL (WORLD AVOIDED)**

# Without the Montreal Protocol extreme UV would have occurred world-wide

There is a lag between UV damage and the onset of skin cancers.

As a result, changes modelled for 2030 reflect earlier, relatively small increases in UV.



Increases in skin cancers would be expected to be much greater later in the century, but this has only been modelled for some regions.

**WITHOUT THE MONTREAL PROTOCOL (WORLD AVOIDED)**

# The Montreal Protocol and Human Health: skin cancers

## 2014 US-EPA REPORT

**As a result of the successful implementation of the Montreal Protocol there will be:**

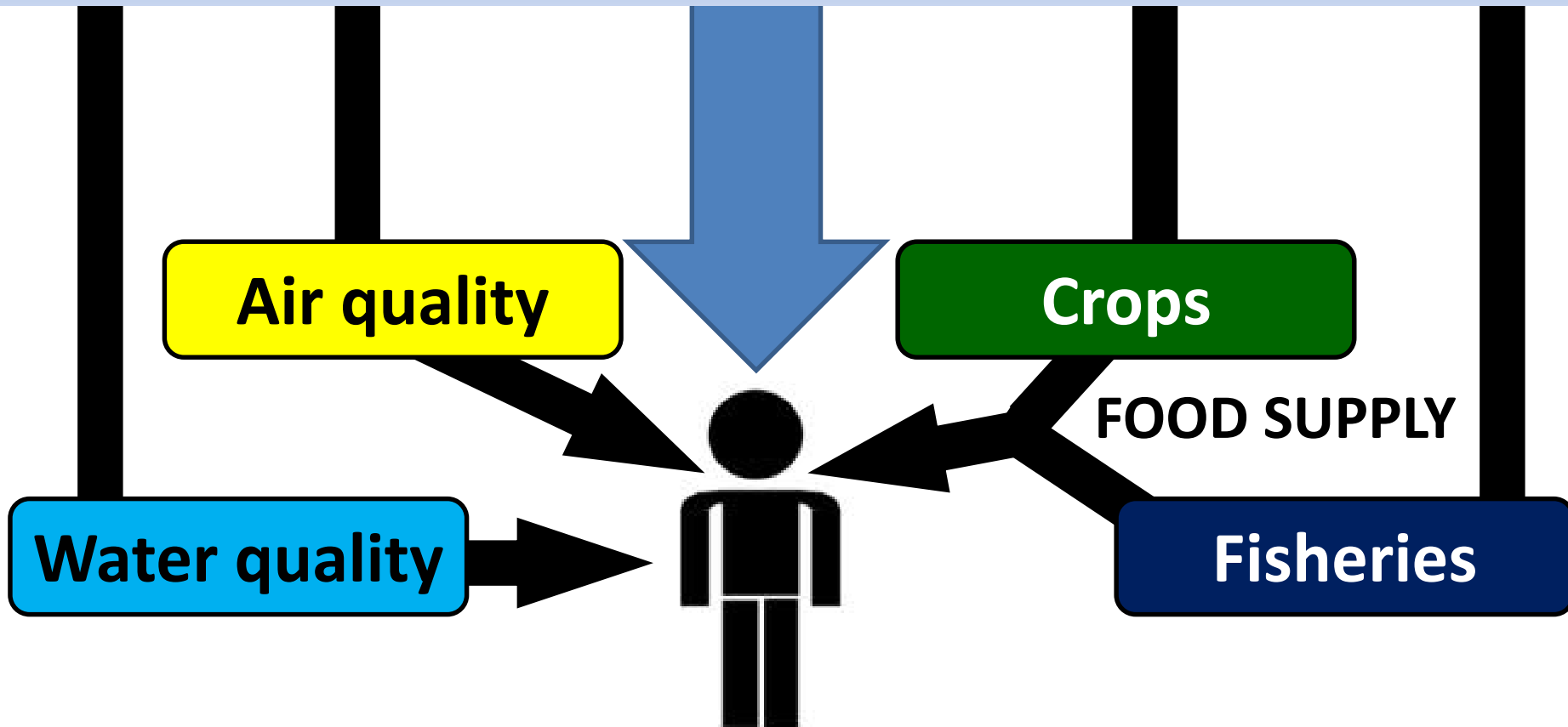
**280-340 million fewer cases of skin cancer in people born between 1890 and 2100 in the USA.**

**Approx. 1.6 million fewer deaths due to skin cancer**

**No such estimates for the rest of the world.**

# The Montreal Protocol and Human Health

STRATOSPHERIC OZONE DEPLETION LEADING TO INCREASED ULTRAVIOLET RADIATION



# The Montreal Protocol and Human Health

**Thank you!**

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