The Montreal Protocol and Human Health

STRATOSPHERIC OZONE DEPLETION
INCREASED ULTRAVIOLET RADIATION

The Vienna Convention for the Protection of the Ozone Layer

WE LOVE

O$_3$
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.....”
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Stratospheric Ozone Depletion
Increased Ultraviolet Radiation

Indirect Effects of Ozone Depletion on Health:

- Air quality
- Crops
- Water quality
- Fisheries

Food Supply
The Montreal Protocol and Human Health

STRATOSPHERIC OZONE DEPLETION
INCREASED ULTRAVIOLET RADIATION

Air quality
Crops
Water quality
Fisheries

FOOD SUPPLY

DIRECT EFFECTS OF OZONE DEPLETION ON HEALTH
Research over the last thirty years has improved our understanding of the "U shaped" relationship between UV exposure and human health. Too little UV can be detrimental to health, but too much UV causes a major risk of serious diseases, including skin cancer.

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

<table>
<thead>
<tr>
<th>SKIN TYPE</th>
<th>1 to 2</th>
<th>3 to 4</th>
<th>5</th>
<th>6</th>
<th>7-9</th>
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<tr>
<td>I and II</td>
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<tr>
<td>III and IV</td>
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<td>V</td>
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<td>medium</td>
<td>medium</td>
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- **I and II**: Low risk for skin types I and II, moderate risk for skin types III and IV, high risk for skin types V and VI.
- **Protection Required**: Slip on a shirt, slop on sunscreen and slap on a hat.
- **Extra Protection**: Avoid being outside during midday hours! Shirt, sunscreen and hat are a must!
- **No Protection Required**: You can safely stay outside!
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)
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Without the Montreal Protocol, ozone depletion would have led to large increases in UV, so that the damaging effects of too much UV become dominant.

Health risk

Adequate vitamin D production

UV radiation exposure

Optimal UV exposure

Range of exposure with the Montreal protocol

Skeletal disease (rickets etc)

Increased risk of eye diseases

Possible increased risk of MS

Increased risk of skin cancer

Without the Montreal Protocol (World avoided)
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

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)  

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<td>Inflammation</td>
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<td>(photo-conjunctivitis)</td>
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**IMMUNE SYSTEM:** immune suppression leading to increased susceptibility to infection, reduced response to vaccinations
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.
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

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**IMMUNE SYSTEM:** immune suppression leading to increased susceptibility to infection, reduced response to vaccinations.
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
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.
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.
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Stratospheric ozone depletion leading to increased ultraviolet radiation

- Air quality
- Crops
- Water quality
- Fisheries

Food supply
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Thank you!

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