



# **Environmental Effects Assessment Panel EEAP**

**Twenty-Eighth Meeting of  
the Parties to the Montreal Protocol  
Kigali, Rwanda  
10 - 14 October 2016**

**Environmental effects of ozone depletion and UV radiation,  
and interactions with other environmental change**

***EEAP Co-chairs  
Janet F. Bornman, Nigel Paul  
Min Shao***

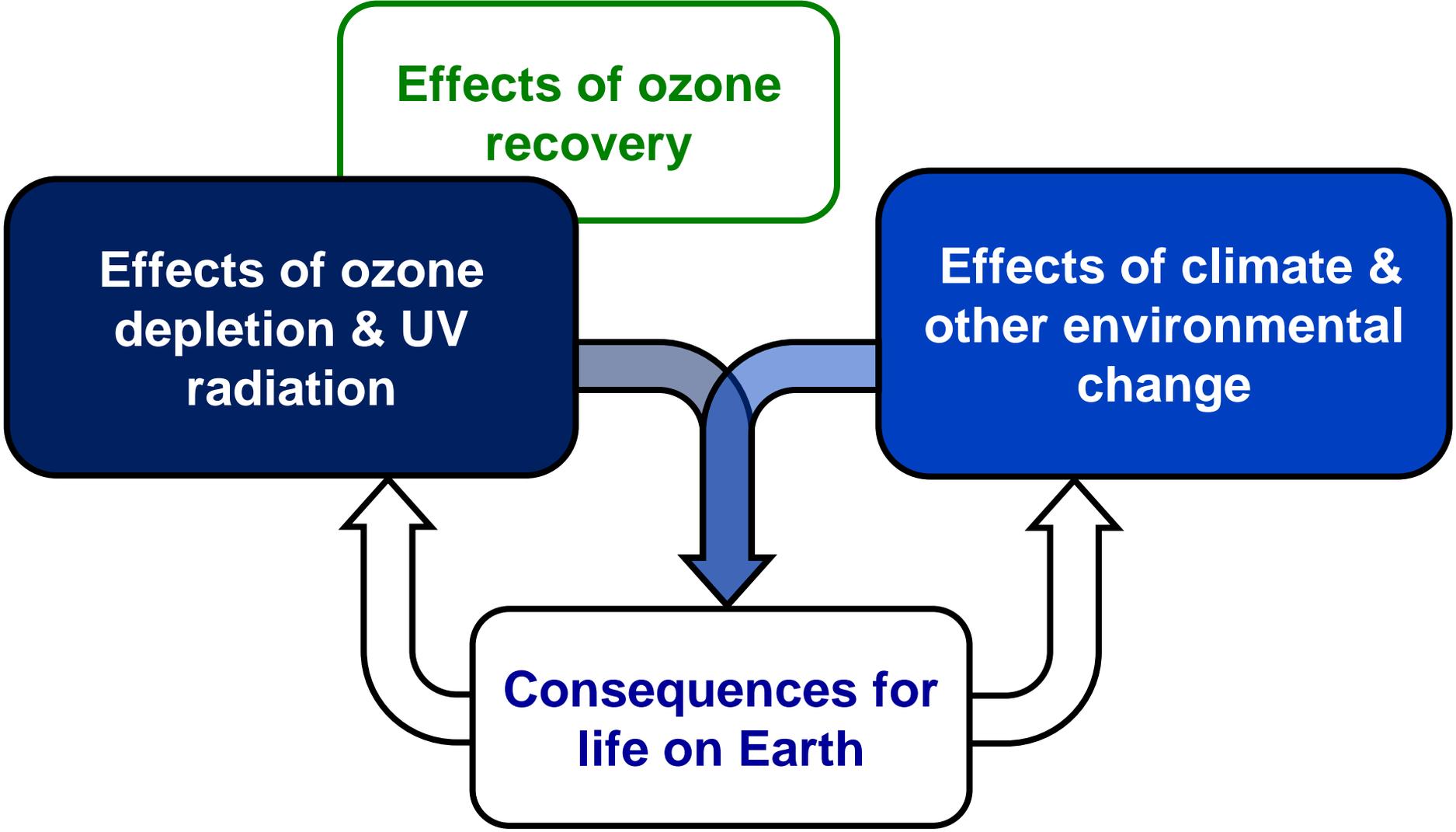


## Decision XXVII/6: Potential areas of focus for the 2018 quadrennial reports

### EEAP to consider

... effects on human health and the environment of changes in the ozone layer and in ultraviolet radiation, together with future projections and scenarios for those variables, taking into account those factors stipulated in Article 3 of the Vienna Convention for the Protection of the Ozone Layer

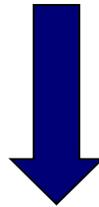
# Environmental Effects Assessment Panel (EEAP)



# MAIN MESSAGES FROM THE EEAP UPDATE



**DIFFERENT MODEL SIMULATIONS FOR FUTURE OZONE UNDER DIFFERENT GREENHOUSE GAS EMISSION SCENARIOS INDICATE DIFFERENT TRENDS IN UV RADIATION**



**A RANGE OF EFFECTS FOR HUMAN HEALTH, NATURAL ECOSYSTEMS AND AGRICULTURE**

**Additional factors will modify these effects**

# ADDITIONAL FACTORS INCLUDING CLIMATE WILL SHAPE THE ENVIRONMENTAL EFFECTS OF FUTURE CHANGES IN OZONE



- **Human behavioural changes with respect to sun exposure**
- **Changes in land-use (e.g., clearing of vegetation)**
- **Movement of habitats from colder to warmer regions because of accelerated climate change**

**Therefore effects will vary with e.g., latitude, elevation and seasonal changes**

# ADDITIONAL FACTORS INCLUDING CLIMATE WILL SHAPE THE ENVIRONMENTAL EFFECTS OF FUTURE CHANGES IN OZONE



**Research continues to highlight interactive effects in the response to UV radiation and other environmental stress conditions (e.g., drought and extremes of temperature)**

**Exposure to UV radiation has both risks and benefits for human health**

- **Increasing temperatures will alter how much time people spend outdoors**
- **Optimal level of UV exposure is highly variable and difficult to define**

**Food security: selection of certain crop breeding lines can improve the UV tolerance of agricultural crops under changing conditions**



## **DIRECT ADVERSE EFFECTS ON HUMAN HEALTH**

**Skin cancers, cataract, reactivation of some viral infections**

**Incidence of cutaneous malignant melanoma and non-melanoma skin cancer (now called keratinocyte cancer):**

- **Continue to increase in most countries**
- **Increasing in older age groups**
- **But decreasing in several countries in younger age groups**  
*(effective sun protection programs; more indoor lifestyle)*

# NEW DATA HIGHLIGHT THE ECONOMIC BENEFITS OF THE MONTREAL PROTOCOL



## Considerable economic burden, particularly keratinocyte cancer (non-melanoma)

**Estimates of lifetime cost of 15,000 new cases of skin cancer diagnosed in New South Wales (NSW), Australia: 536 million AUD (ca 400 million USD)**

**South Africa: annual cost of ca 16 million USD**

**USA: annual cost of ca 8 billion (2007-11), up from 3.6 billion in 2002-6**



## **DIRECT BENEFITS OF UV RADIATION**

- **Synthesis of vitamin D**
- **Some beneficial changes to plant crop quality**
- **Regulator of normal plant growth and development**



## **Vitamin D**

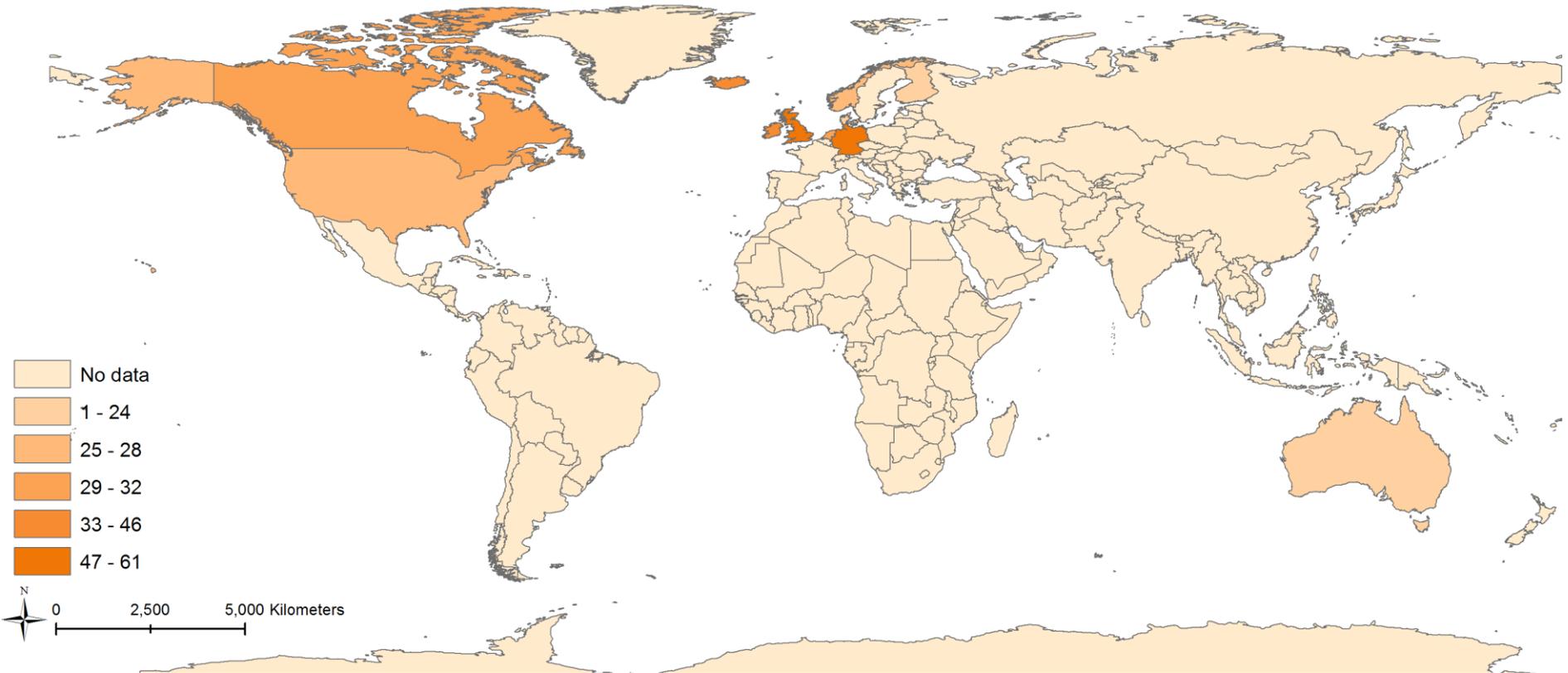
Sun exposure: associated with bone health and reduced risk of some cancers and autoimmune diseases

### **Asthma:**

- **Possible reduced risk and/or severity of asthma**
- **Low early childhood concentrations of Vitamin D: increased risk of persistent asthma**

**Maximising Vitamin D status while minimising DNA damage during sun exposure can be achieved by several exposures per week to low doses of UV radiation**

# Percentage of the population with vitamin D deficiency (<50nmol/L)



**Although there is a lack of data globally, new evidence points to deficiency also occurring at low latitudes**



## **AQUATIC ECOSYSTEMS**

**New data on UV exposure in aquatic ecosystems highlights the modifying effects of extreme climate events, acting by altering the movement of organic matter from the land to water.**

**Changes in UV exposure will affect food security and ecosystem services:**

- Fishery productivity**
- Degradation of contaminants such as pollutants and microplastics**
- Solar disinfection of human parasites and pathogens.**



## **AQUATIC ECOSYSTEMS**

- **New models of productivity of phytoplankton (small suspended algae) provide the first global scale estimates of how much inhibition by UV radiation and other stress factors lower this productivity in the oceans**
- **These models, augmented by satellite remote sensing, provide powerful new tools to quantify the effects of future changes in stratospheric ozone on the oceans.**



## **TERRESTRIAL ECOSYSTEMS**

- **Solar radiation, including UV, is now recognised as having a major role in controlling the processes by which dead organic matter is broken down to release carbon dioxide**
- **This will allow better assessment of how future changes in UV radiation will affect the ability of terrestrial and aquatic ecosystems to store carbon.**

# Future changes in UV radiation will have consequences for ground-level (tropospheric) ozone concentrations, an important component of air quality

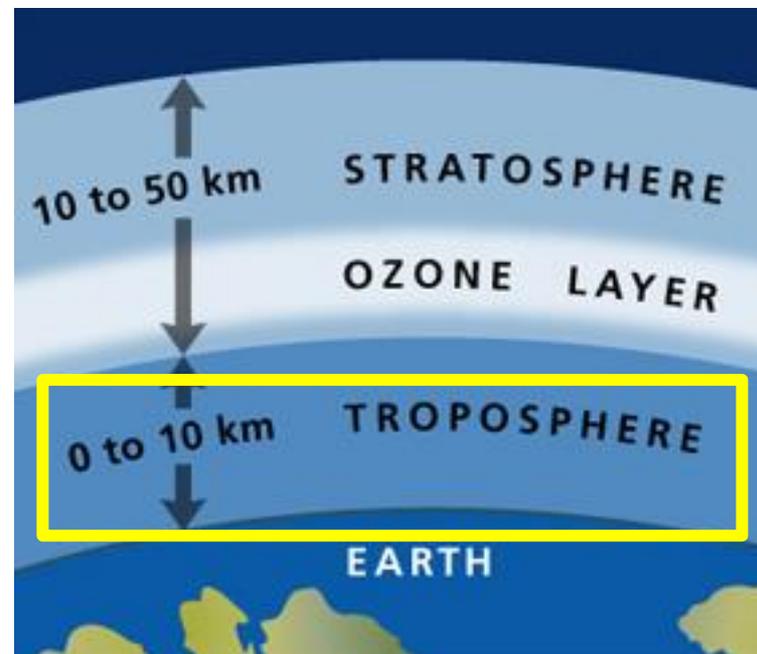


**Changes in UV radiation affect the chemistry of the troposphere.**

**The resulting changes in ground level ozone pollution are expected to vary between urban and rural areas.**

**The magnitude of these changes remain difficult to quantify.**

**Evidence linking poor air quality to adverse health effects on humans and the environment continues.**



# PROTECTING MATERIALS FROM THE EFFECTS OF UV RADIATION AND CHANGING CLIMATE



- **Outdoor service life of plastics and wood materials is determined mainly by solar UV radiation and temperature; and also by humidity**
- **This decrease in service life can be countered/offset by stabilisation technologies:**
  - **For plastics and wood products: surface coating with certain materials and infiltration of fillers; including nanoparticles as stabilisers**

**Some of these technologies also apply for the protection of textiles (e.g., nanoparticles of zinc oxide, titanium, gold)**

**These new treatments have not yet been scaled for assessing feasibility and cost**

# A SIGNIFICANT NEW RISK ASSESSMENT OF TRIFLUOROACETIC ACID (TFA) HAS BEEN PUBLISHED



**TFA is a breakdown product of some HCFCs, HFCs, and HFOs**

**The recently published risk assessment\* confirms**

- (i) TFA in the environment is known to be derived from multiple sources, but their magnitude relative to ODS substitutes remains uncertain**
- (ii) The concentration of TFA predicted from future HFC scenarios will very likely remain well below the toxicity threshold of aquatic organisms**

**While the new publication reinforces the assessment that TFA is not a significant risk to humans and the environment, monitoring of TFA production should continue.**

Solomon, KR, et al. 2016. Sources, fates, toxicity, and risks of trifluoroacetic acid and its salts: Relevance to substances regulated under the Montreal and Kyoto Protocols.

*Journal of Toxicology and Environmental Health, Part B, 1-16*

# ENVIRONMENTAL EFFECTS OF HYDROCARBON REFRIGERANTS



- **The environmental effects of hydrocarbon refrigerants such as propane and isobutane are well known due to their use in other applications**
- **Due to their high volatility, hydrocarbons do not accumulate in soil or water, but since they are volatile organic compounds (VOCs) they can have negative effects on urban air quality**
- **The additional use of these materials as alternatives to HFCs is not expected to have major, large-scale effects on air quality.**

# ENVIRONMENTAL AND HUMAN HEALTH EFFECTS OF FUTURE CHANGES IN OZONE AND CLIMATE: **SUMMARY**



**Different scenarios for emissions of carbon dioxide, methane and nitrous oxide result in different outcomes for stratospheric ozone and UV radiation.**

**These scenarios include stratospheric ozone increasing substantially above pre ozone-hole levels ('super-recovery').**

**The potential effects of these different scenarios on human health and the environment may be positive or negative.**

**EEAP will continue to inform the Parties through assessment of current and future projections of the effects.**

# THANK YOU FOR YOUR ATTENTION

