

# Update Report of the Environmental Effects Assessment Panel



**29<sup>th</sup> Meeting of the Parties to the  
United Nations Montreal Protocol  
20-24 November 2017  
Montreal, Canada**

**EEAP Co-chairs:**

**Janet F. Bornman (Australia)**

**Nigel Paul (UK)**

**Min Shao (China)**





# Decision XXVII/6: Potential areas of focus for the 2018 Quadrennial Report



## 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



**CHANGES IN STRATOSPHERIC OZONE**



**UV-B EXPOSURE**



**OZONE-RELATED  
CHANGES IN CLIMATE**



**EFFECTS OF ODS  
REPLACEMENTS**



**HUMAN  
HEALTH**

**CONSTRUCTION  
MATERIALS**

**AIR &  
WATER  
CHEMISTRY**

**TERRESTRIAL AND AQUATIC  
ECOSYSTEMS  
(including crops and fisheries)**

**EFFECTS ON PEOPLE AND ENVIRONMENT**



# Human health: skin cancer



**The success of the Montreal Protocol has prevented very large increases in skin cancers by UV-B radiation.**

**Estimates by end of the century, in the USA alone: **275-330 million cases** of skin cancer prevented for people born between 1980 and 2100**





# Human health: skin cancer



**The success of the Montreal Protocol has prevented very large increases in skin cancers by UV-B radiation.**

**However, the incidence of skin cancers continues to increase globally, likely a result of individual's choices about sun exposure. Such choices are influenced by climate change.**

**The economic costs of skin cancers are increasingly significant. In Australia diagnosis and treatment costs are estimated at USD 206 million per year for malignant melanoma, and USD 530 million per year for keratinocyte skin cancers.**





# Human health: eye disease



**The success of the Montreal Protocol has prevented very large increases in the incidence of cataracts, a major cause of blindness world-wide.**

It has been estimated that by 2100, just in the USA, the Montreal Protocol has prevented more than **20 million additional cataract cases.**



**Melanomas of the eye are rare, but some forms are increasing in parallel with skin cancers, and recent evidence suggests that this is related to exposure to solar UV radiation.**



Ocular Oncology Service, UCSF



# Human health: beneficial effects of UV-B radiation



**New studies are improving understanding of the beneficial effects of UV-B radiation on human health.**

**The beneficial effects of UV-B-induced synthesis of vitamin D in the skin are best studied, but other mechanisms may also be involved.**

**Exposure to high UV radiation increases vitamin D but also causes considerable DNA damage in the skin.**

**By contrast, regular low doses of solar UV radiation increases vitamin D without accumulation of DNA damage, and this may be the optimum approach to improving vitamin D status while minimising the damaging effects of UV-B radiation on health.**



# Effects of ozone depletion on ecosystems



## CHANGES IN STRATOSPHERIC OZONE

Increases in UV radiation have been reported as a result of the Arctic ozone depletions that occurred in winter 2010/11 and 2015/16.

Longer term UV radiation measurements over Europe confirm a signal of ozone depletion combined with the effects of other factors.

## UV-B EXPOSURE

HUMAN HEALTH

CONSTRUCTION MATERIALS

AIR & WATER CHEMISTRY

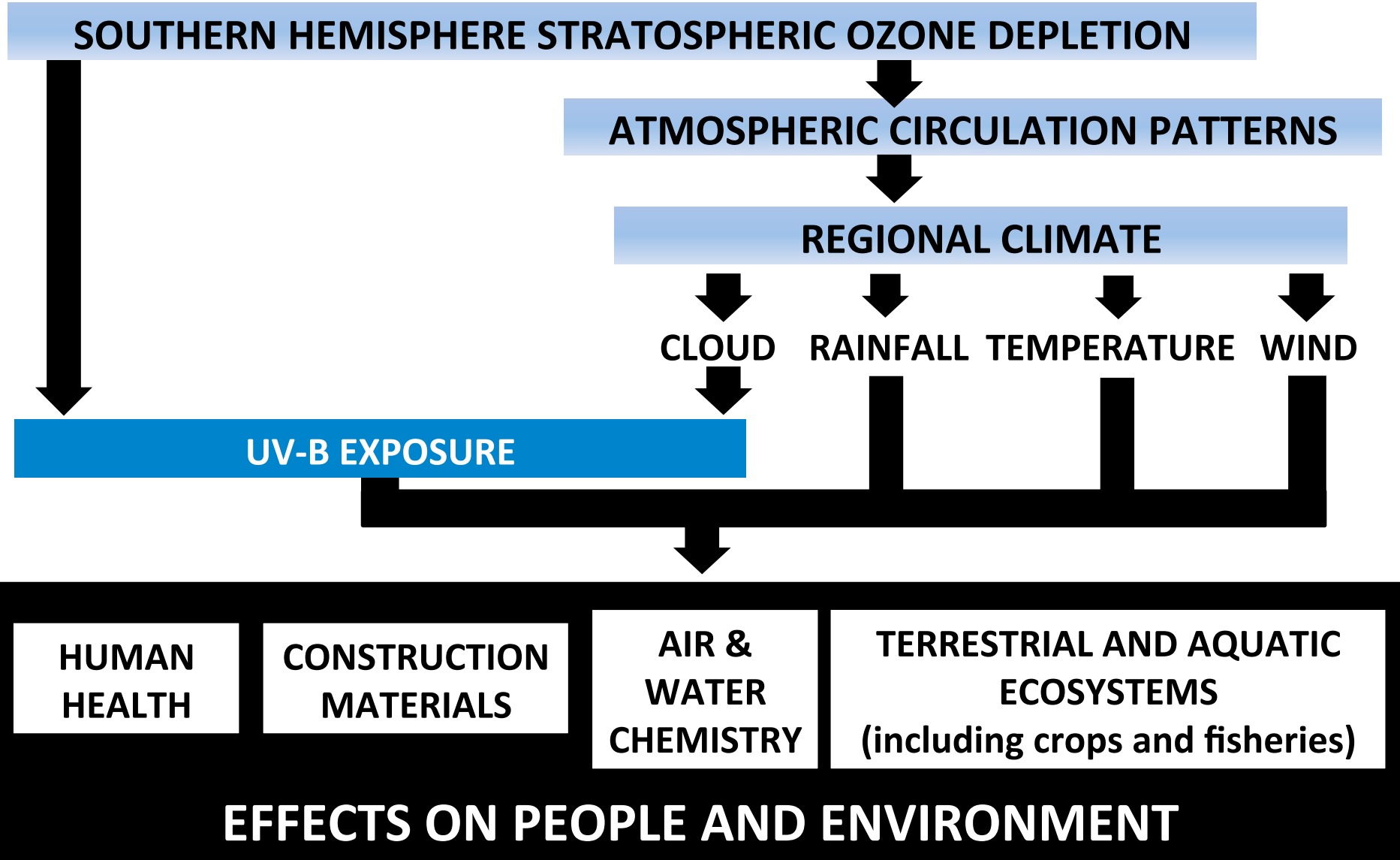
TERRESTRIAL AND AQUATIC ECOSYSTEMS (including crops and fisheries)

## EFFECTS ON PEOPLE AND ENVIRONMENT





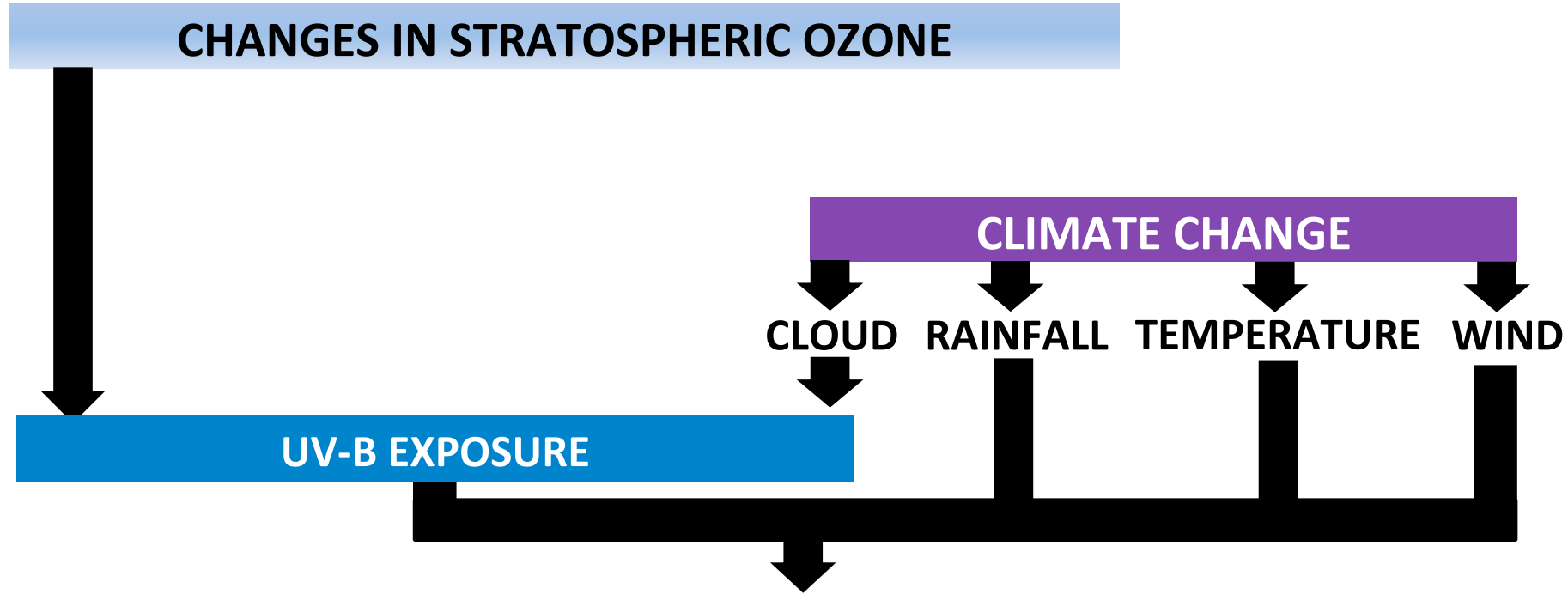
# Effects of ozone depletion on ecosystems: interactions







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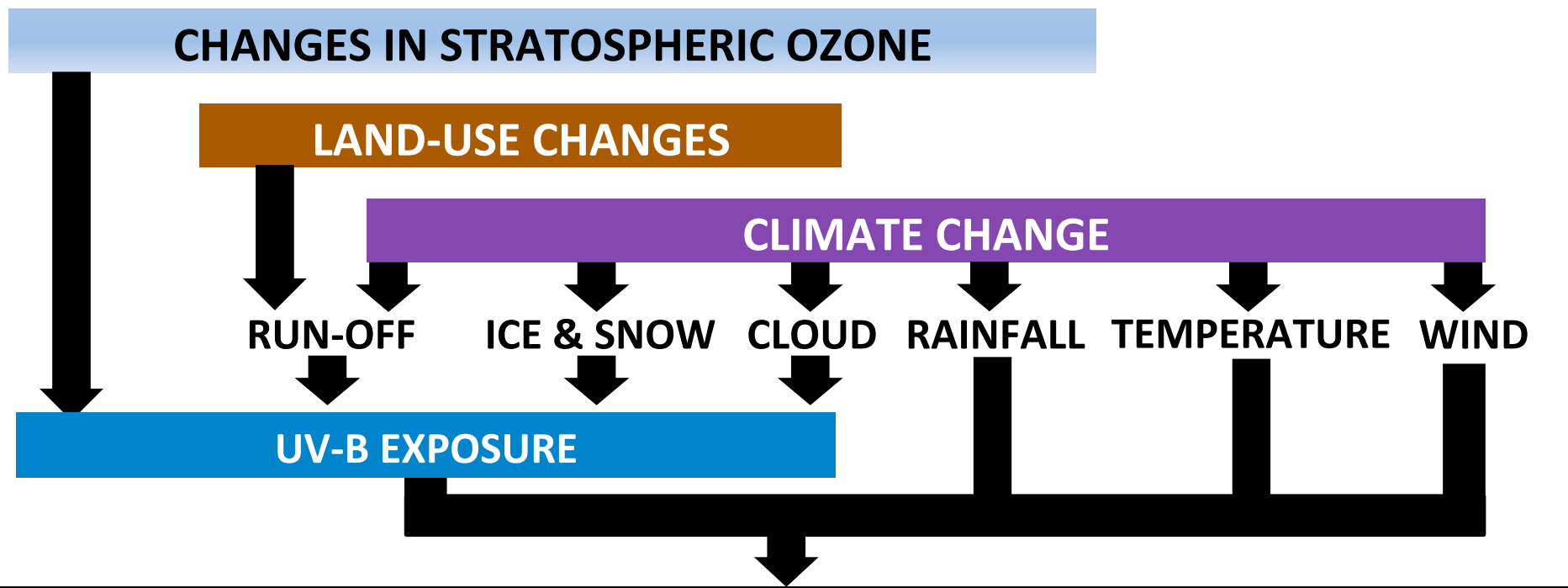


## TERRESTRIAL ECOSYSTEMS

- Changes timing of crop ripening and stress tolerance
- Modifies food crop quality (positive or negative)
- Plant migrations occur (higher latitudes & elevations)
- May disrupt plant species, communities and habitats



# Effects of ozone depletion on ecosystems: interactions



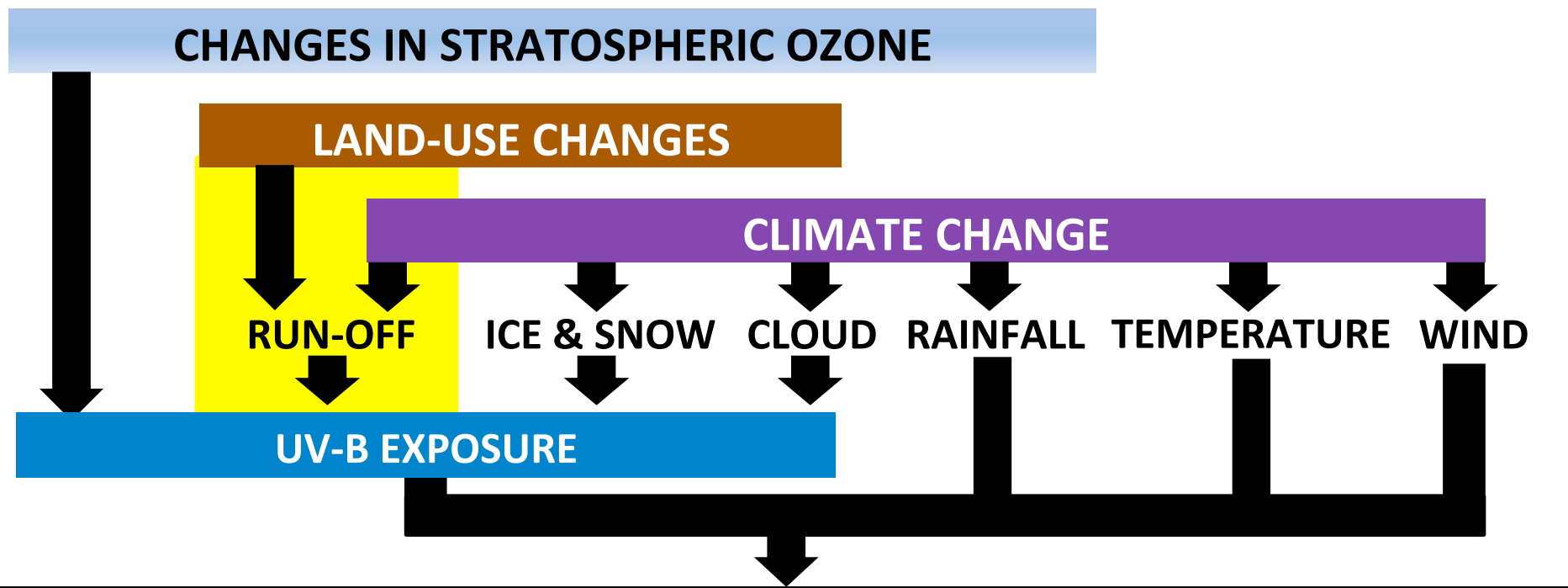
## TERRESTRIAL ECOSYSTEMS

UV radiation breaks down dead plant material in dryland ecosystems - contributing to emissions of carbon dioxide.

Increased exposure of permafrost soils exposes organic matter to UV radiation, leading to emissions of methane and carbon dioxide.



# Effects of ozone depletion on ecosystems: interactions



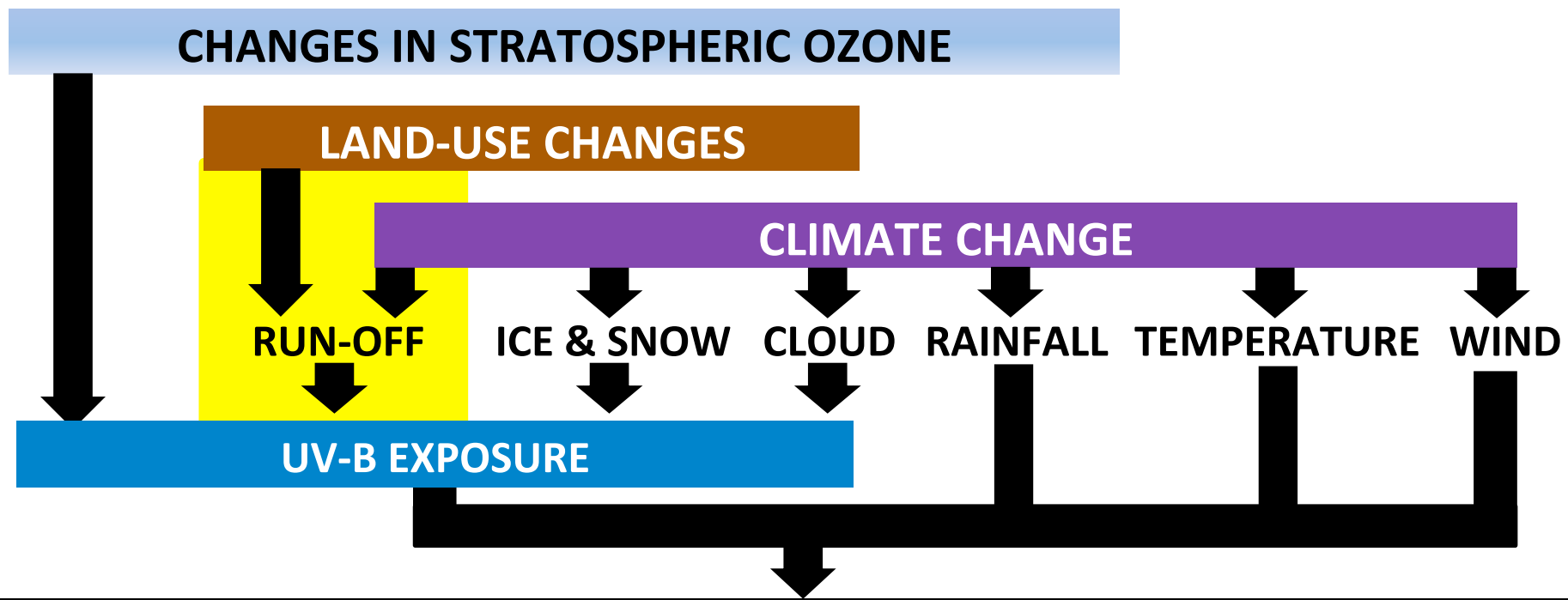
## TERRESTRIAL ECOSYSTEMS AT HIGH LATITUDES

UV radiation breaks down dead plant material in dryland ecosystems - contributing to emissions of carbon dioxide.

Increased exposure of permafrost soils exposes organic matter to UV radiation, leading to emissions of methane and carbon dioxide.



# Effects of ozone depletion on ecosystems: interactions



## AQUATIC ECOSYSTEMS AT HIGH LATITUDES

Increased run-off from the land increases inputs of coloured organic materials to aquatic ecosystems.

These materials may be broken down by UV radiation, increasing emissions of carbon dioxide, but may also protect aquatic organisms from UV damage and stimulate aquatic productivity.



# Effects of replacements for ozone depleting substances



**The available evidence remains that concentrations of trifluoroacetic acid (TFA) in the environment now, or with modelled future use of HFCs and HFOs, are greatly below concentrations damaging to organisms.**

**There have been no new publications in the last year on the potential effects of TFA on human health or the environment.**

**New reports have confirmed that a wide range of man-made chemicals can degrade to produce TFA. These include several widely-used pharmaceuticals and pesticides.**

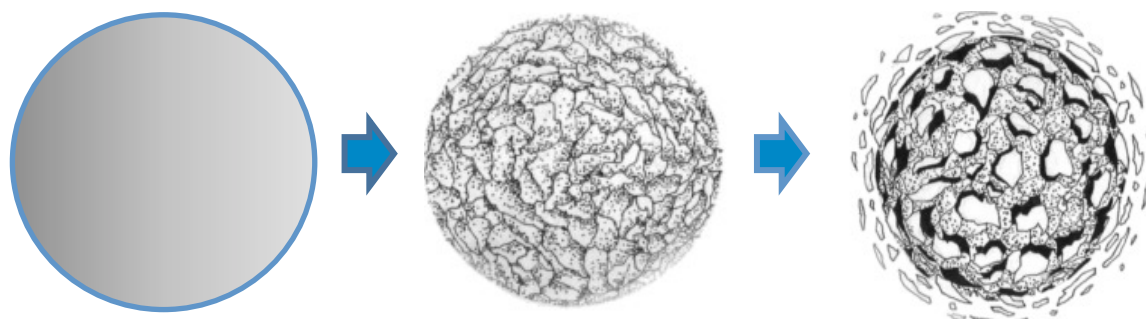
**The relative magnitude of these different sources of TFA remains unclear.**



# Effects of UV radiation on ecosystems & human health



**Thirty years of research stimulated by the Montreal Protocol has highlighted the multiple and diverse effects of solar UV radiation in the environment.**



**Solar UV radiation, especially UV-B radiation, degrades plastic litter, creating a brittle surface layer. The surface breaks up into microscale plastic fragments = **microplastics**.**

**Microplastics** in seawater can concentrate pollutants, contaminating fish and seafood.







# Preparation for the 2018 Quadrennial Assessment Report



Schedule	Date
Assessment framework; scientific update drafts	September 2017
Scientific update finalised	December 2017
Reviewer lists compiled	January 2018
Draft 1 completed	January 2018
EEAP meeting	February 2018
Draft 2 revised	February 2018
Internal reviews; draft revised	May 2018
External reviewing	May – June 2018
Draft revised	August 2018
EEAP Reviewer meeting and revisions	September 2018
Final Assessment completed	November 2018