

Q16

Does depletion of the ozone layer increase ground-level ultraviolet radiation?

Yes, ultraviolet radiation at Earth's surface increases as the amount of overhead total ozone decreases, because ozone absorbs ultraviolet radiation from the Sun. Measurements by ground-based instruments and estimates made using satellite data provide evidence that surface ultraviolet radiation has increased in large geographic regions in response to ozone depletion.

The depletion of stratospheric ozone leads to an increase in solar ultraviolet radiation at Earth's surface. The increase occurs primarily in the ultraviolet-B (UV-B) component of the Sun's radiation. UV-B is defined as radiation in the wavelength range of 280 to 315 nanometers, which is invisible to the human eye. Long-term changes in UV-B radiation reaching the surface have been measured directly and can be estimated from total ozone changes.

Exposure to UV-B radiation can harm humans, other life forms, and materials (see Q2). Most of the effects of sunlight on the human body are caused by UV-B radiation. A principal effect is skin erythema, which leads to sunburn. Excess exposure may lead to skin cancer. Erythema is regularly reported to the public in many countries in the form of the *UV Index*. Long-term changes in surface UV-B radiation are important to study because of potential harmful effects as well as the relationship between excess UV-B radiation and ozone depletion.

Surface UV-B radiation. The amount of UV-B radiation reaching Earth's surface at a particular location depends in large part on the amount of total ozone at that location. Ozone molecules in the stratosphere and in the troposphere absorb UV-B radiation, thereby significantly reducing the amount that reaches Earth's surface (see Q2). If conditions occur that reduce the abundance of ozone molecules somewhere in the troposphere or stratosphere, total ozone is reduced and the amount of UV-B radiation reaching Earth's surface is increased proportionately. This relationship between total ozone and surface UV-B radiation has been confirmed at a variety of locations with direct measurements of both quantities.

Additional causes of UV changes. The actual amount of UV-B radiation reaching Earth's surface at a specific location and time depends on a number of factors in addition to total ozone. The primary additional factor is the position of the Sun in the sky, which changes with daily and seasonal cycles. Other factors include local cloudiness, the altitude of the location, the

Changes in Surface Erythema UV Radiation Changes between 1979 and 2008

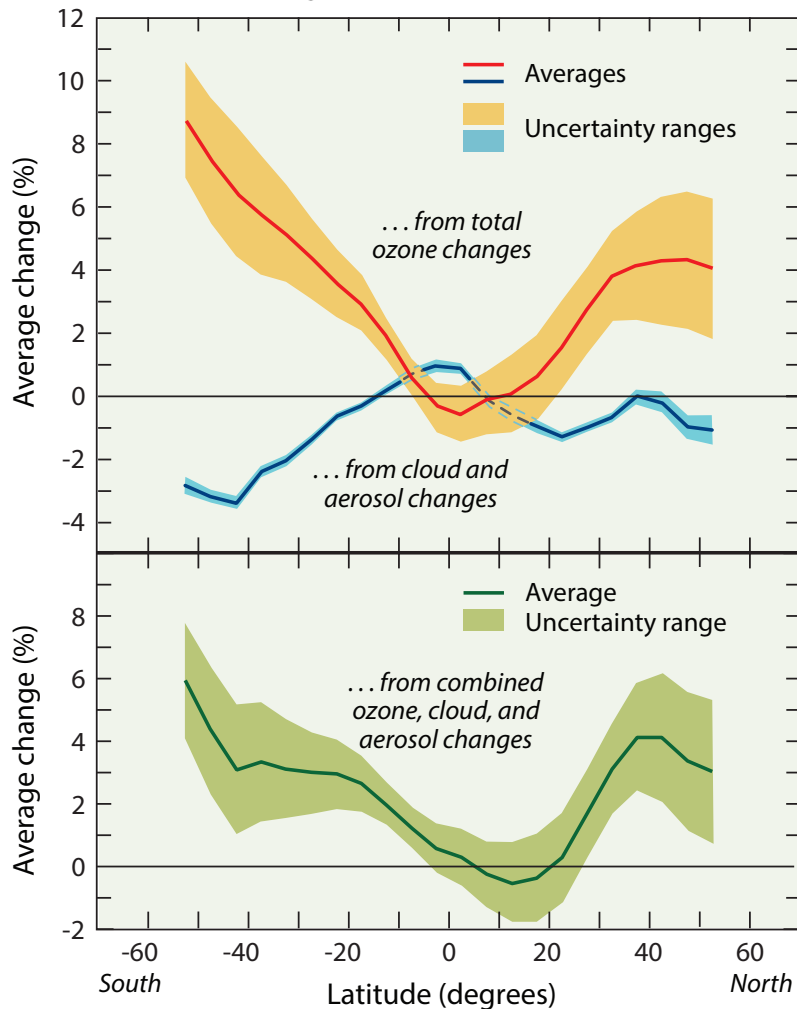


Figure Q16-1. Long-term changes in surface erythema UV radiation. Solar ultraviolet (UV) radiation at Earth's surface increased over much of the globe between 1979 and 2008, a time of global ozone depletion (see Figure Q12-1). Erythema radiation, which can lead to sunburn, is a component of surface UV radiation that is harmful to humans and other life forms. Surface erythema radiation responds to changes in total

projected that the recovery of the global ozone layer to 1980 values will not occur until the middle of this century (see Figure Q20-2), ozone depletion will continue to contribute to adverse health effects over the coming decades. An important human health benefit of UV-B radiation exposure is the production of

vitamin D, which plays a significant role in bone metabolism and the immune system. Human exposure to solar UV-B radiation requires a careful balance to maintain adequate vitamin D levels while minimizing long-term risks of skin and eye disorders now and well into the future.

