What is a temperature inversion? •

In meteorology, an inversion, also known as a temperature inversion, is a deviation from the normal change of an atmospheric property with altitude. It almost always refers to an inversion of the thermal lapse rate. Normally, air temperature decreases with an increase in altitude. During an inversion, warmer air is held above cooler air; the normal temperature profile with altitude is inverted. •

- **An inversion traps air pollution, such as smog, close to the ground. An inversion can also suppress convection by acting as a "cap". If this cap is broken for any of several reasons, convection of any moisture present can then erupt into violent thunderstorms. Temperature inversion can notoriously result in freezing rain in cold climates.**

A temperature inversion is a thin layer of the atmosphere where the normal decrease in temperature with height switches to the temperature increasing with height. An inversion acts like a lid, keeping normal **convective overturning** of the atmosphere from penetrating through the inversion.

This can cause several weather-related effects. One is the trapping of pollutants below the inversion, allowing them to build up. If the sky is very hazy, or is sunsets are very red, there is likely an inversion somewhere in the lower atmosphere.

This happens more frequently in high pressure zones, where the gradual sinking of air in the **high pressure dome** typically causes an inversion to form at the base of a sinking layer of air.

Another effect that an inversion has is to make clouds just below the inversion to spread out and take on a flattened appearance. For instance, marine stratocumulus clouds over cold ocean waters; or the tops of thunderstorms when they reach the base of the stratosphere, which also forms a temperature inversion.

Global warming •

- **A Global warming**: Global warming is the increase of earth's average surface temperature due to the effect of greenhouse gases. Atmospheric absorption and scattering at different wavelengths of electromagnetic waves. The largest absorption band of carbon dioxide is in the infrared.

- **Greenhouse gases** are those that absorb and emit infrared radiation in the wavelength range emitted by Earth.[1] In order, the most abundant greenhouse gases in Earth's atmosphere are:

- Water vapor (H2O)
- Carbon dioxide (CO_2)
- Methane (CH4)
- Nitrous oxide (N2O)
- Ozone (O3)

Chlorofluorocarbons (CFCs) •

- When sunlight reaches Earth's surface, it can either be reflected back into space or absorbed by Earth. Once absorbed, the planet releases some of the energy back into the atmosphere as heat (also called infrared radiation).

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Greenhouse gases (GHGs) like water vapor (H_2O), carbon dioxide (CO_2), and methane (CH_4) absorb energy, slowing or preventing the loss of heat to space. In this way, GHGs act like a blanket, making Earth warmer than it would otherwise be. This process is commonly known as the “greenhouse effect.”

- Atmospheric concentrations of greenhouse gases are determined by the balance between sources (emissions of the gas from human activities and natural systems) and sinks (the removal of the gas from the atmosphere by conversion to a different chemical compound).

- The proportion of an emission remaining in the atmosphere after a specified time is the "**airborne fraction**" (AF). More precisely, the annual airborne fraction is the ratio of the atmospheric increase in a given year to that year's total emissions. Over the last 50 years (1956–2006) the airborne fraction for CO_2 has been increasing at 0.25 ± 0.21%/year.

- **Non-greenhouse gases**
- The major atmospheric constituents, nitrogen (N_2), oxygen (O_2), and argon (Ar), are not greenhouse gases because molecules containing two atoms of the same element such as N_2 and O_2 and monatomic molecules such as argon (Ar) have no net change in the distribution of their electrical charges when they vibrate and hence are almost totally unaffected by infrared radiation.

- Although molecules containing two atoms of different elements such as carbon monoxide (CO) or hydrogen chloride (HCl) absorb infrared radiation, these molecules are short-lived in the atmosphere owing to their reactivity and solubility. Therefore, they do not contribute significantly to the greenhouse effect and usually are omitted when discussing greenhouse gases.

Some gases have indirect radiative effects (whether or not they are greenhouse gases themselves). This happens in **two main ways**. **One way**: is that when they break down in the atmosphere they produce another greenhouse gas.

For example, methane and carbon monoxide (CO) are oxidized to give carbon dioxide (and methane oxidation also produces water vapor; that will be considered below). Oxidation of CO to CO_2 directly produces an un ambiguous increase in radioactive forcing although the reason is subtle.

The peak of the thermal IR emission from Earth's surface is very close to a strong vibrational absorption band of CO_2 (667 cm^{-1}). On the other hand, the single CO vibrational band only absorbs IR at much higher frequencies (2145 cm^{-1}), where the ~300 K thermal emission of the surface is at least a factor of ten lower.

On the other hand, oxidation of methane to CO_2, which requires reactions with the OH radical, produces an instantaneous reduction, since CO_2 is a weaker greenhouse gas than methane; but it has a longer lifetime.

- As described below this is not the whole story, since the oxidations of CO and CH4 are intertwined by both consuming OH radicals. In any case, the calculation of the total radiative effect needs to include both the direct and indirect forcing.
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- A **second type** of indirect effect happens when chemical reactions in the atmosphere involving these gases change the concentrations of greenhouse gases. For example, the destruction of non-methane volatile organic compounds (NMVOCs) in the atmosphere can produce ozone. The size of the indirect effect can depend strongly on where and when the gas is emitted.[16]

- ***Methane has a number of indirect effects in addition to forming CO_2 as shown below:***

- the main chemical that destroys methane in the atmosphere is the hydroxyl radical (OH). Methane reacts with OH and so more methane means that the concentration of OH goes down. Effectively, methane increases its own atmospheric lifetime and therefore its overall radiative effect

- **Methane** (CH_4), while not a direct cause of ozone destruction in the stratosphere, does lead to the formation of compounds that destroy ozone.

Monatomic oxygen (O) in the upper stratosphere reacts with methane (CH_4) to form a hydroxyl radical (OH·). This hydroxyl radical is then able to interact with non-soluble compounds like **chlorofluorocarbons**, and UV light breaks off chlorine radicals (Cl·). These chlorine radicals break off an oxygen atom from the ozone molecule, creating an oxygen molecule (O_2) and a hypochloryl radical (ClO·).

- The hypochloryl radical then reacts with an atomic oxygen creating another oxygen molecule and another chlorine radical, thereby preventing the reaction of monatomic oxygen with O_2 to create natural ozone.

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