

A look back at the greenhouse effect of water vapour and CO₂

A question that is often asked: why such a focus on CO₂ and not on water vapour when we are talking about anthropogenic greenhouse gases?

A state of the art on this frequently asked question can be found in Chapter 8 of the 2013 IPCC Assessment Report [\[1\]](#).

Water vapour is the element in the atmosphere that contributes most to the greenhouse effect. Its contribution is approximately 2 to 3 times greater than that of CO₂.

Atmospheric water vapour results primarily from the evaporation of liquid water surfaces on the Earth's surface and its maximum content is controlled by air temperature. For every degree of warming the atmosphere can potentially increase its content by about 7%. It therefore plays an essential role in the Earth's climate. Unlike CO₂ or other greenhouse gases with sufficiently long residence times to allow them to be well mixed in the atmosphere, water vapour molecules remain in the atmosphere for much shorter periods, typically on the order of 10 days. After this, they condense into water droplets or ice particles and precipitate on the earth's surface.

Do human activities produce atmospheric water vapour?

Yes, additional water vapour is injected into the atmosphere as a result of human activities, mainly due to increased evaporation from irrigated crops, but also from the cooling of power plants and to a lesser extent from the combustion of fossil fuels. However, the flux from these anthropogenic sources is generally considered negligible compared to the flux from natural evaporation [\[2\]](#). **Anthropogenic sources of water vapour can therefore be considered negligible.**

Why is water vapour an important contributor to global warming linked to human activities?

In a simplified way, as the climate warms, evaporation on the Earth's surface increases and the air becomes generally warmer and wetter. The increase in water vapour in the atmosphere, which is a very active greenhouse gas, will in turn amplify the global greenhouse effect and contribute to further warming. This process is called *water vapour feedback* [\[3\]](#).

Messages to remember

- Water vapour currently produces the most important greenhouse effect in our atmosphere.
- Nevertheless, other greenhouse gases (GHGs), primarily CO₂, are essential to maintain the presence of water vapour in the atmosphere.
- If these other GHGs were to disappear from the atmosphere, the global temperature would drop sufficiently to plunge the planet into an icy state. Thus greenhouse gases, other than water vapour, maintain temperatures that allow the current atmospheric water vapour content.
- **Anthropogenic emissions of these GHGs (CO₂, but also CH₄, N₂O) are a major contributor to the current global warming and their effect is largely amplified by a factor of two or three by the rapid feedback of water vapour, which is not a significant initial anthropogenic forcing but nevertheless an important agent of climate change.**

References and Notes

Cover image. [Source: Keith Pomakis / CC BY-SA (<https://creativecommons.org/licenses/by-sa/2.5/>)]

[\[1\]](#) Myhre, G., D. Shindell, F.-M. Bréon, W. Collins, J. Fuglestedt, J. Huang, D. Koch, J.-F. Lamarque, D. Lee, B. Mendoza, T.

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[2] Boucher, O., Myhre, G. & Myhre, A. (2004), Direct human influence of irrigation on atmospheric water vapour and climate, *Climate Dynamics*, 22, 597-603.

[3] https://en.wikipedia.org/wiki/Climate_change_feedback

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