

Climate Change workshop #6

Which is denser, wet or dry air at the same temperature?

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Wet air is denser than dry air, right? Let's calculate it to find out.

Molecule	molecular weight	fraction of air (by density or volume, not mass)
N ₂	28 grams/mole	0.78
O ₂	32	0.21
Argon	40	0.01

Molecular weight of atmosphere =

$$0.78 * 28 + 0.21 * 32 + 0.01 * 40 + \dots \sim 29 \text{ grams/mole}$$

$$\text{Mass of atmosphere} = 5.14 \times 10^{18} \text{ kg} \sim 5 \times 10^{21} \text{ g}$$

$$\text{Moles of gas in the atmosphere} = \text{mass} / \text{molecular weight} = 5 \times 10^{21} \text{ g} / 29 \text{ grams/mole} = 2 \times 10^{20} \text{ moles}$$

Now redo the calculation for moist air:

Add 2% H₂O * (18 grams/mole) and you will get a

LOWER molecular weight for a moist atmosphere – this helps explain why clouds convect.