Equations for volume flow rate for a bathtub.

Note: This is not analogous to the stock and flow of greenhouse gases, but may be of use if you would like to explain the analogy further.

Making some simplifying assumptions, the volume flow out of a bathtub can be calculated with the Bernoulli equation:

pressure + 1/2 density * velocity^2 + density * gravity * height = constant

For a large bathtub emptying into ambient pressure (at sea surface, 1atm) and assuming the velocity at the top of the water is small, this simplifies to

V = sqrt(2 * g * h)

where

g = gravity
h = height of water in bathtub
V = velocity water exiting the bottom of the bathtub

The flowrate Q is then given by
Q = V * A

where

A = cross-sectional area of the drain.

Thus the volume flow out of the drain is

Q = A * sqrt(2 * g * h).

Anything that affects the height of the water (e.g., the volume flow entering the bathtub) and the cross-sectional area (e.g., clogged drains) will alter the volume flow out.