

ATMOSPHERIC CHEMISTRY

A) What is global warming all about?

CO₂
CH₄
N₂O

B) First a review

Low pH of rain

1) Carbonic acid production due to atmospheric CO₂.

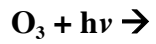
2) Further lowered by SO₂...

3) ...and NO₂.

C) Chemical reactions in the atmosphere

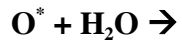
The most important reactive intermediate species in atmospheric chemical processes is the hydroxyl radical (OH^\bullet) formed by:

1) photochemical decomposition of ozone ...



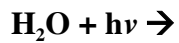
* indicates an excited molecule (temporarily reactive)

... which reacts with water

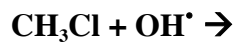
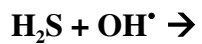
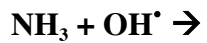
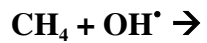


• indicates a free radical (unpaired e-)

2) direct hydrolysis of water



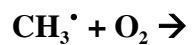
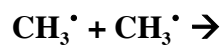
The concentration of OH[•] in the atmosphere is very small, how can it be so important?



These reactions are all _____ and occur very rapidly.

The resultant radicals can then interact with other radicals, sometimes forming more OH[•] and generating other radicals

Examples:



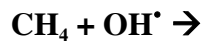
Other important radicals

Methylperoxyl radical

Hydroperoxyl radical

D) Atmospheric oxidation of methane to CO₂

Initiated by the rxn:



Overall rxn:



The result is an overall increase in radicals that can interact with other atmospheric gases.

E) Ozone

I Creation of ozone (Fig. 1-5)

Layers in atmosphere:

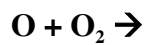
Troposphere -

Stratosphere –

Formation of O above the stratosphere

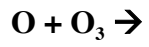


Ozone formation occurs in the stratosphere. Why?



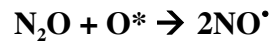
The ozone layer exists between 15 - 35 km above ground.

II Noncatalytic destruction of ozone (Chapman cycle Fig. 1-12)



III Catalytic destruction of ozone

Naturally occurring nitrous oxide



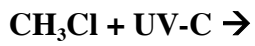
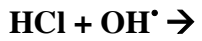
Overall rxn?

So how does increasing N_2O concentrations influence ozone?

IV Chlorine as a catalyst

Where does Cl^\bullet come from?

Initial sources: methyl chloride; production of chlorinated gases (such as CFCs)



What is the overall rxn for the destruction of ozone by Cl^\bullet ?

Note that Cl^\bullet is regenerated.

The avg Cl^\bullet destroys 10,000 ozone molecules.