Constraining CH_4 lifetime using multi-constituent chemical DA

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MLS

TES

OMI

MOPITT

AIRS

SCIAMACHY

GOME-2

TROPOMI

Assimilated Satellite data

O3
CO
NO2
HNO3
CO

OH estimation methods

1. Methylchloroform (Turner et al. 2017; Patra et al. 2021)
2. CH_4 profiles (Zhang et al., 2018)
3. Chemical data assimilation (Miyazaki et al. 2020)

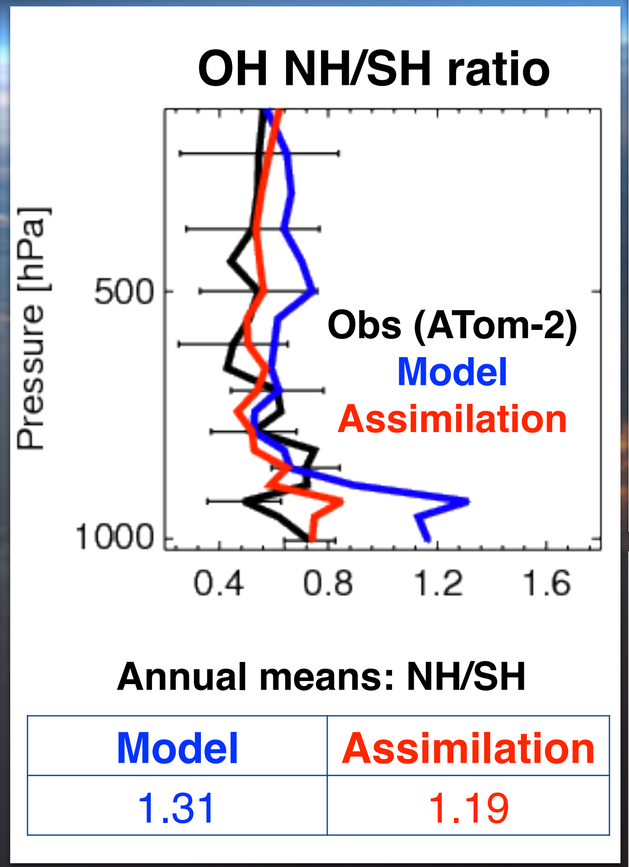
Sources

$O(^1D)+H_2O$	33%
$NO+HO_2$	30%
O_3+HO_2	14%
$H_2O_2+h\nu$	10%
OVOCs, $ROOH+h\nu$	13%

Sinks

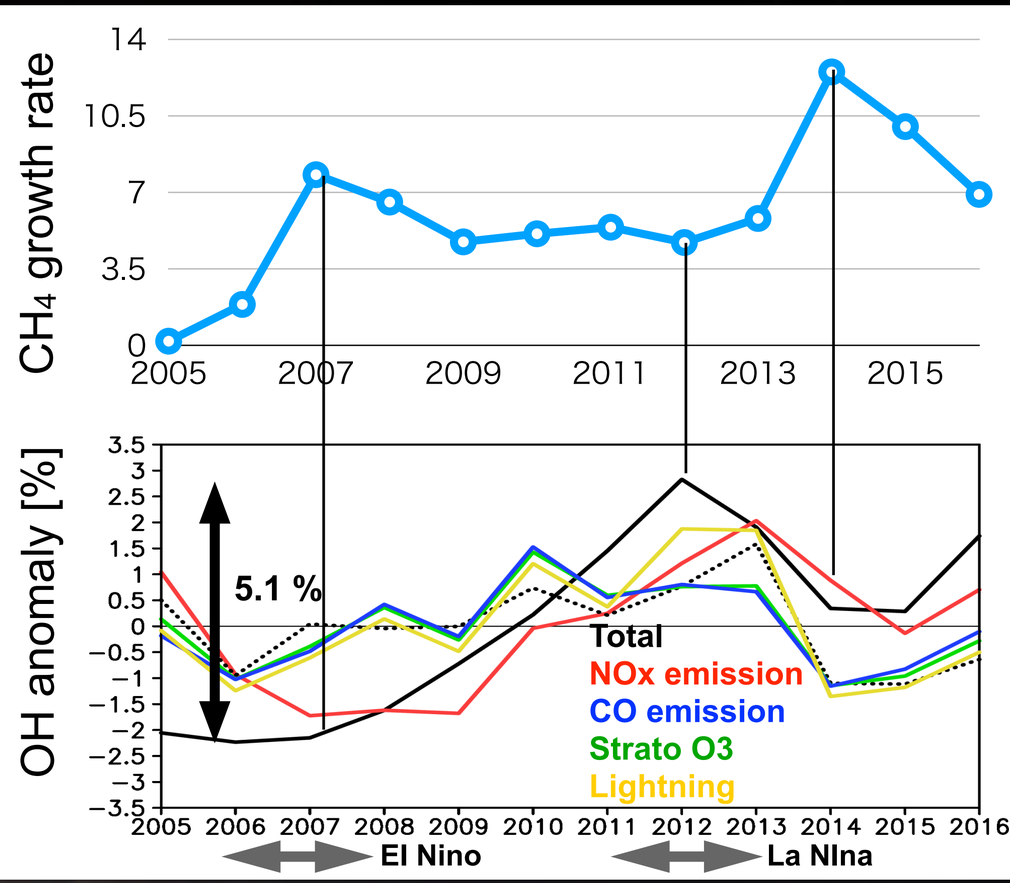
$OH+HO_y^1$	18%
$OH+NO_y^2$	2%
$OH+CH_4$	12%
$OH+CO$	39%
$OH+$other C_1 VOC^3	15%
$OH+C_{2+}$ VOC^4	14%

(Lelieveld et al., 2016)



Annual means: NH/SH

Model	Assimilation
1.31	1.19



2020 COVID anomaly

- 18-25% NOx → - 6Tg O3 → - 4% OH (global mean)

Increased the methane lifetime by 4 months, which could explain the observed high CH_4 anomaly in 2020

Miyazaki et at. (in press, Science Advances)