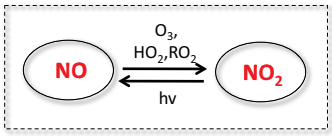
Atmos. Chem. Lecture 13, 10/23/13: Reactive (oxidized) nitrogen species

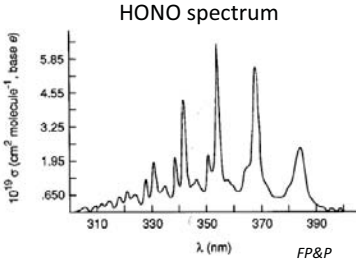
NO_y species, reactions:
HO_x+NO_x products (+ fates)
heterogeneous NO_y chemistry
nighttime/morning NO_y chemistry

Midterm on Wednesday Oct 30

NO_y: OH + NO_x reactions



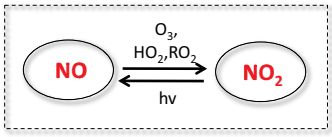
HONO spectrum



[*Note: Additional material is discussed here during lecture.*]

HONO formation: Finlayson-Pitts et al. *PCCP* 5:223 (2003)

NO_y: XO_2 + NO reactions



[Note: Additional material is discussed here during lecture.]

HO_2+NO→HNO_3. Butkovskaya et al. *JPCA* 111:9047 (2007)
HOONO detection: Nizkordov and Wennberg. *JPCA* 106:855(2002)
ROONO chemistry: Zhang et al., *JPCA* 108:9082 (2004)

Organic nitrate "yield"

Image removed due to copyright restrictions. See Fig. 4 in Rosen, et al. "Observations of Total Alkyl Nitrates during Texas Air Quality Study 2000: Implications for O3 and Alkyl Nitrate Photochemistry." *J. Geophys. Res.* 109 (2004): D07303. doi: 10.1029/2003JD004227.

isoprene: see Perring et al. ACP 9:1451 (2009)

Fate of organic nitrates

Deposition

Oxidation

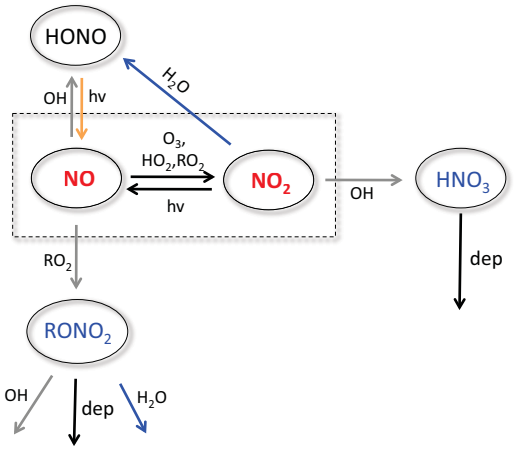
isoprene nitrates:
Horwitz et al. JGR 112:D12,27 (2007)
Perring et al. ACP 9:1451 (2009)
Paulot et al. ACP 9:1479 (2009)

[Note: Additional material is discussed here during lecture.]

Photolysis

Hydrolysis

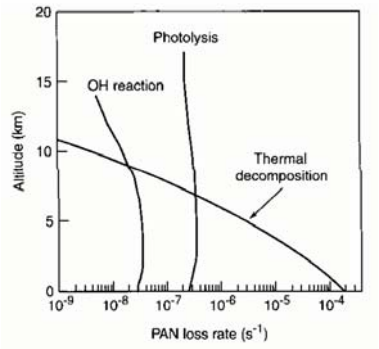
NO_y: XO_2 + NO_2 reactions



[*Note: Additional material is discussed here during lecture.*]

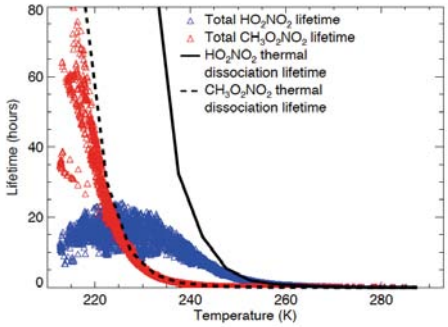
Lifetime of $XOONO_2$ compounds

Fate of PAN



Talukdar et al., *JGR* 100:14163 (1995)

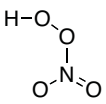
Fate of $HOONO_2$, CH_3OONO_2

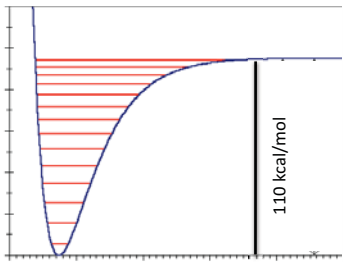


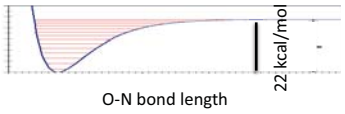
Browne et al., *ACP* 11:4209 (2011)

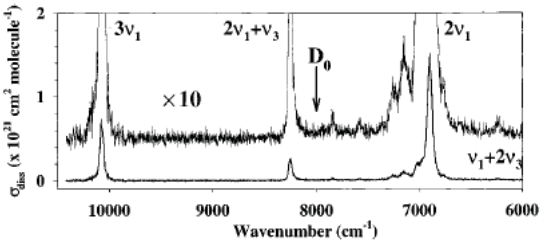
Overtone photodissociation

Pernitric acid:



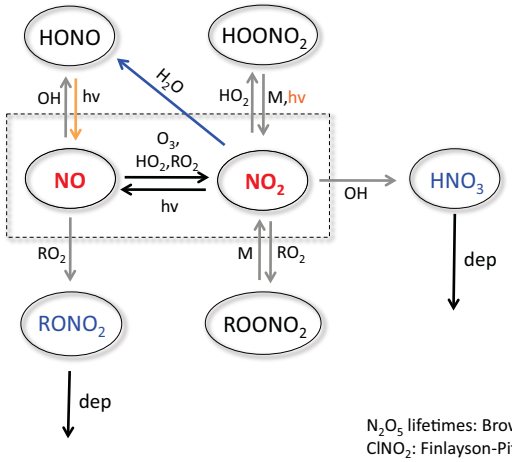






Roehl et al. *J. Phys. Chem. A, 106:3766 (2002)*

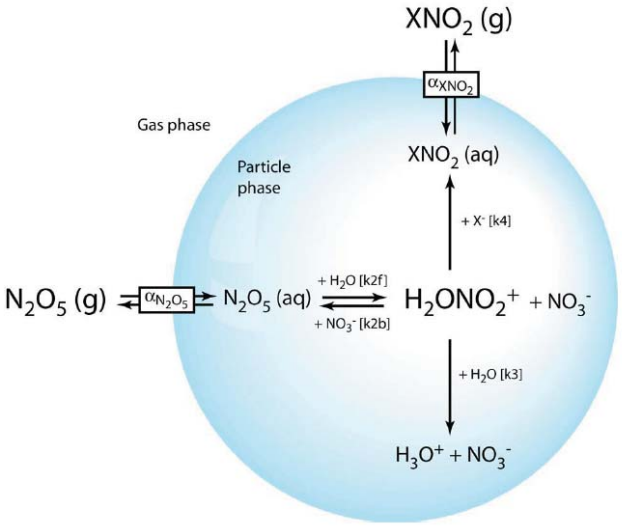
Nighttime NO_y chemistry



N_2O_5 lifetimes: Brown et al. *JGR* 108:5439 (2003)
$ClNO_2$: Finlayson-Pitts et al., *Nature* 337:6204 (1989); Osthoff et al., *Nature Geoscience* 1:324 (2008); Thornton et al., *Nature* 464:271 (2010)

[*Note: Additional material is discussed here during lecture.*]

N_2O_5 heterogeneous reactions



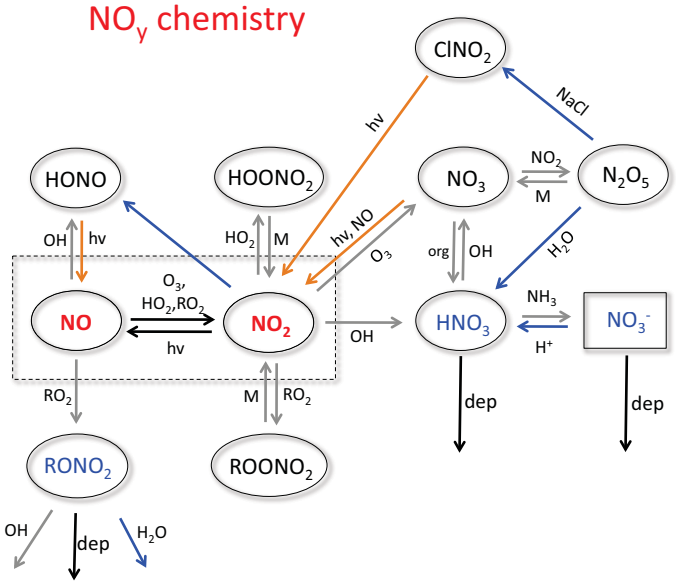
Bertram and Thornton, *ACP* 9, 8351 (2009)

Importance of N_2O_5 hydrolysis

Excerpt and image removed due to copyright restrictions. See the abstract and Fig. 3 in Brown, et al. "Variability in Nocturnal Nitrogen Oxide Processing and Its Role in Regional Air Quality." *Science* 311, no. 5757 (2006): 67-70. DOI: 10.1126/science.1120120 for further details.

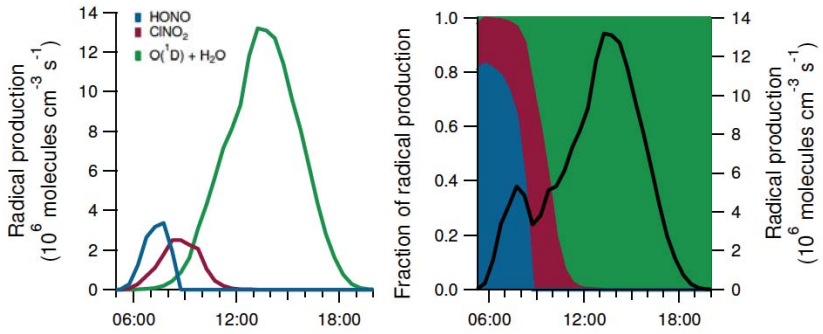
N_2O_5 uptake parameterized by Bertram and Thornton, *ACP* 9, 8351 (2009) – organics still a question

NO_y chemistry



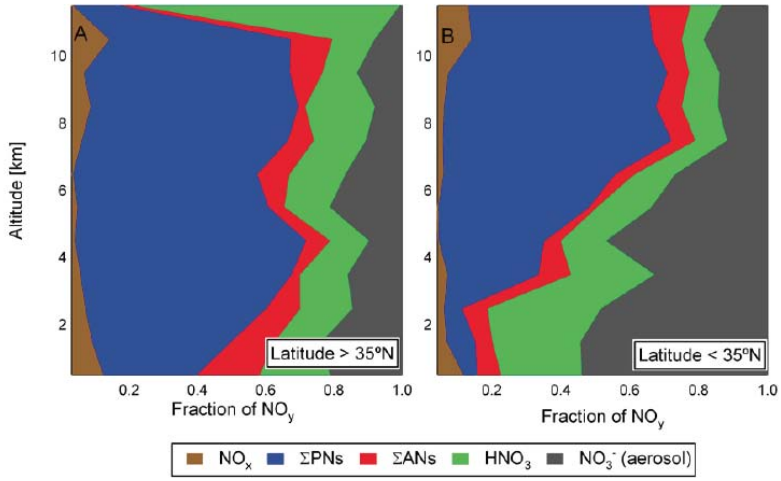
NO_3 + alkenes: Brown *ACP* 9:3027 (2009)

Early-morning radical chemistry



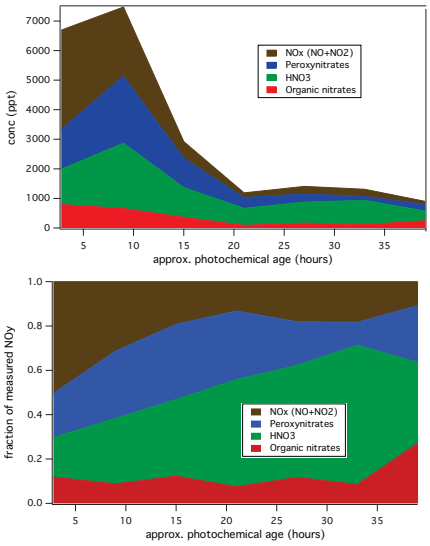
Young et al., *ES&T* 46:10965 (2012)

NO_y in Asian outflow (function of altitude)



Bertram et al., *ACP* 13:4617 (2013)

NO_y in Mexico City urban plume (function of age)



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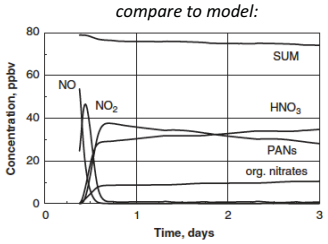
Perring et al., *ACP* 10:7215 (2010)

compare to model:



Madronich, *Atmos. Environ.* 40:6012 (2006)

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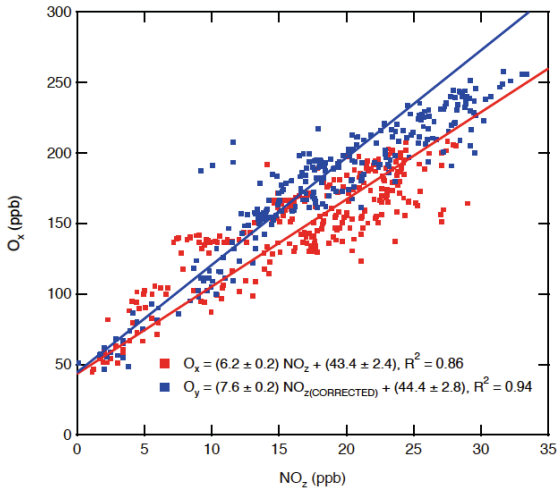
O_x vs. NO_z



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Wood et al., *ACP* 9:2499 (2009)

1.84J / 10.817J / 12.807J Atmospheric Chemistry
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