Transport of Nitric Oxide during Recent Arctic Winter using SOFIE Measurements

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- Six years of SOFIE NO measurements indicate enhanced descent down to 40 km during 2009, 2012, and 2013
- Impact of NO transport on ozone
- Coupling between solar activity and NO density

Solar Occultation For Ice Experiment (SOFIE)

The Aeronomy of Ice in the Mesosphere (AIM) satellite is the first satellite dedicated to the study of Polar Mesospheric Clouds (PMCs).

➢SOFIE, one of the instruments onboard AIM determines summer time PMC extinction and yearlong measurements of temperature, pressure, and five gas constituents.

➢SOFIE provides spacecraft sunset measurements between 65-85 ° S and sunrise measurements between 65-85 ° N.

➢SOFIE observes 15 sunrise and 15 sunset occultation's per day, and consecutive sunrise and sunset measurements are separated by ~96 minutes (~24 ° longitude)

Solar Occultation For Ice Experiment (SOFIE)

➢SOFIE is providing continuous vertical profiles of temperature, pressure and abundance of five gas constituents (H_2O, O_3, CO_2, CH_4, and NO) since April 2007.

➢Corrections have been applied to remove instrument error and **NO profiles have been retrieved successfully.**

SOFIE channel characteristics

Channel	Band	Target[a]	Center λ (μm)
1	1	O_3 s	0.292
	2	O_3 w	0.330
2	3	PMC s	0.867
	4	PMC w	1.037
3	5	H_2O w	2.46
	6	H_2O s	2.618
4	7	CO_2 s	2.785
	8	CO_2 w	2.939
5	9	PMC s	3.064
	10	PMC w	3.186
6	11	CH_4 s	3.384
	12	CH_4 w	3.479
7	13	CO_2 s	4.324
	14	CO_2 w	4.646
8	15	NO w	5.006
	16	NO s	5.316

[a] s indicates strongly absorbing band, w denotes weakly absorbing band.

All SOFIE data are publicly available and can be found at the following website [**http://sofie.gats-inc.com/sofie/index.php**].

Nitric Oxide (NO)

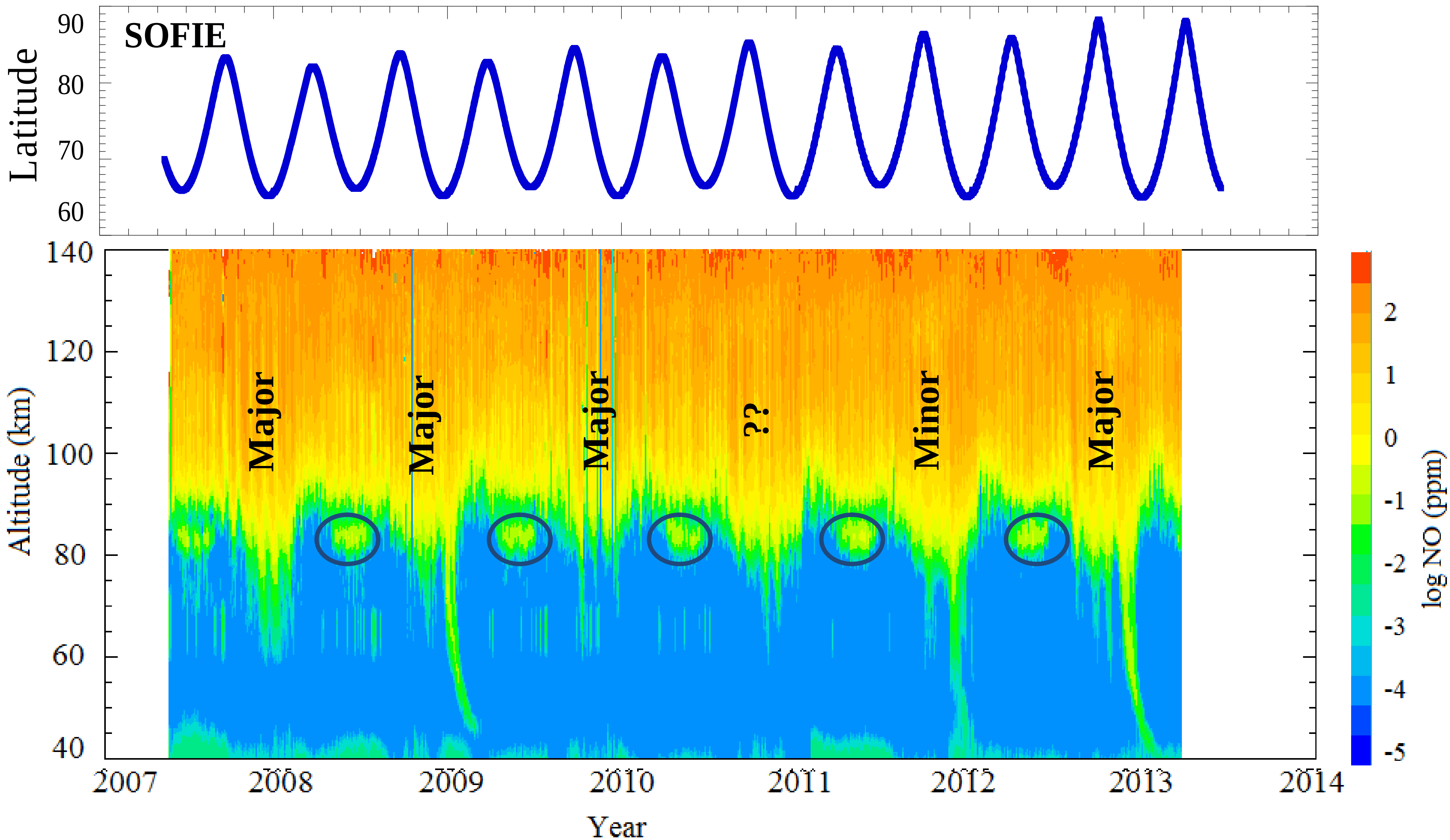
- Nitric Oxide (NO) measurements in the mesosphere are critical to understanding the link between variations in the solar and geomagnetic environment of the Earth and its atmosphere.

- NO will catalytically destroy ozone if transported to the stratosphere.

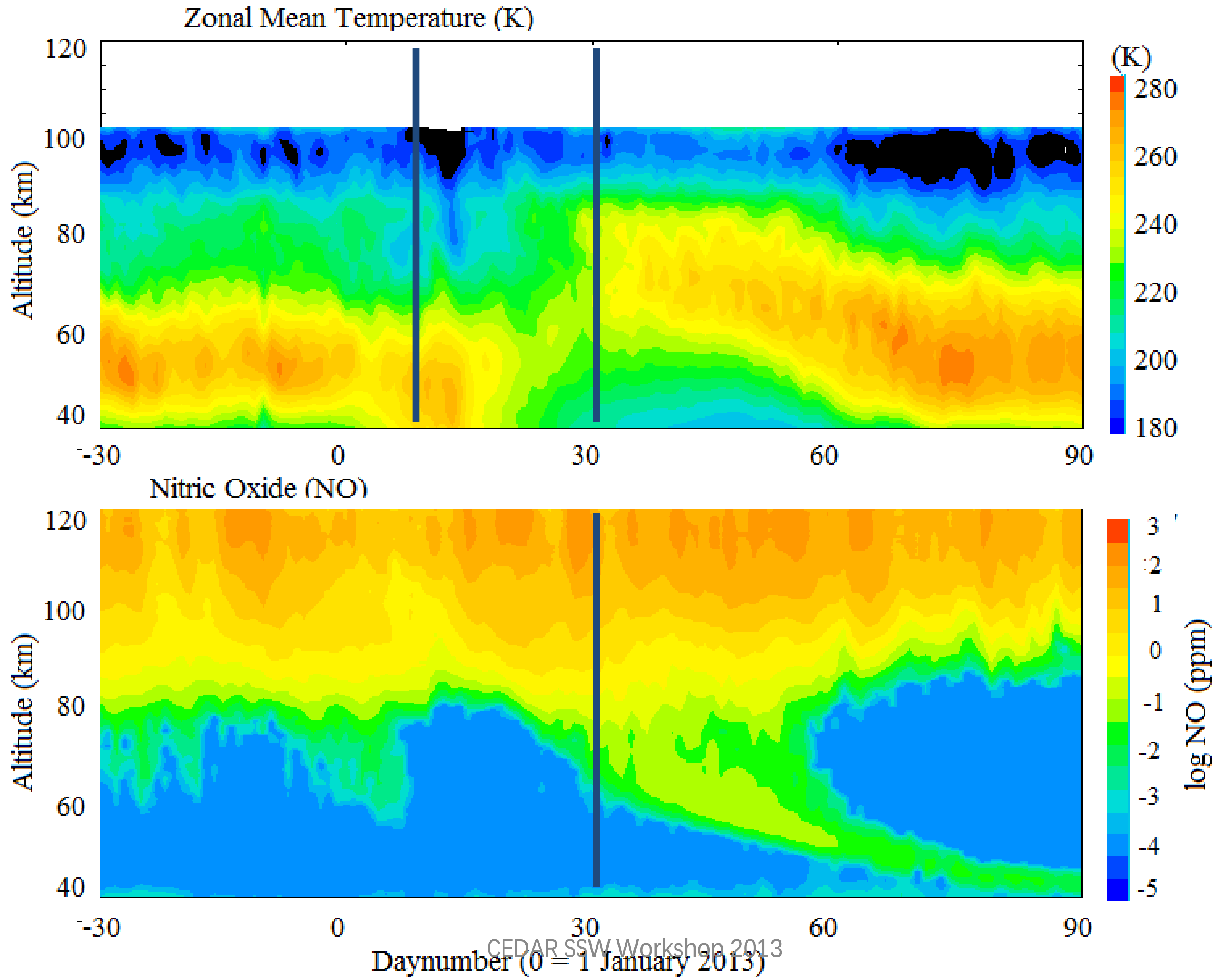
- Nitric Oxide (NO) plays an important role in the energy balance and structure of the Arctic Mesosphere and Lower Thermosphere (MLT)

Recent studies have highlighted the descent of Nitrogen Oxide (NOx) species from the MLT to the stratosphere during Stratospheric Sudden Warmings (SSWs).

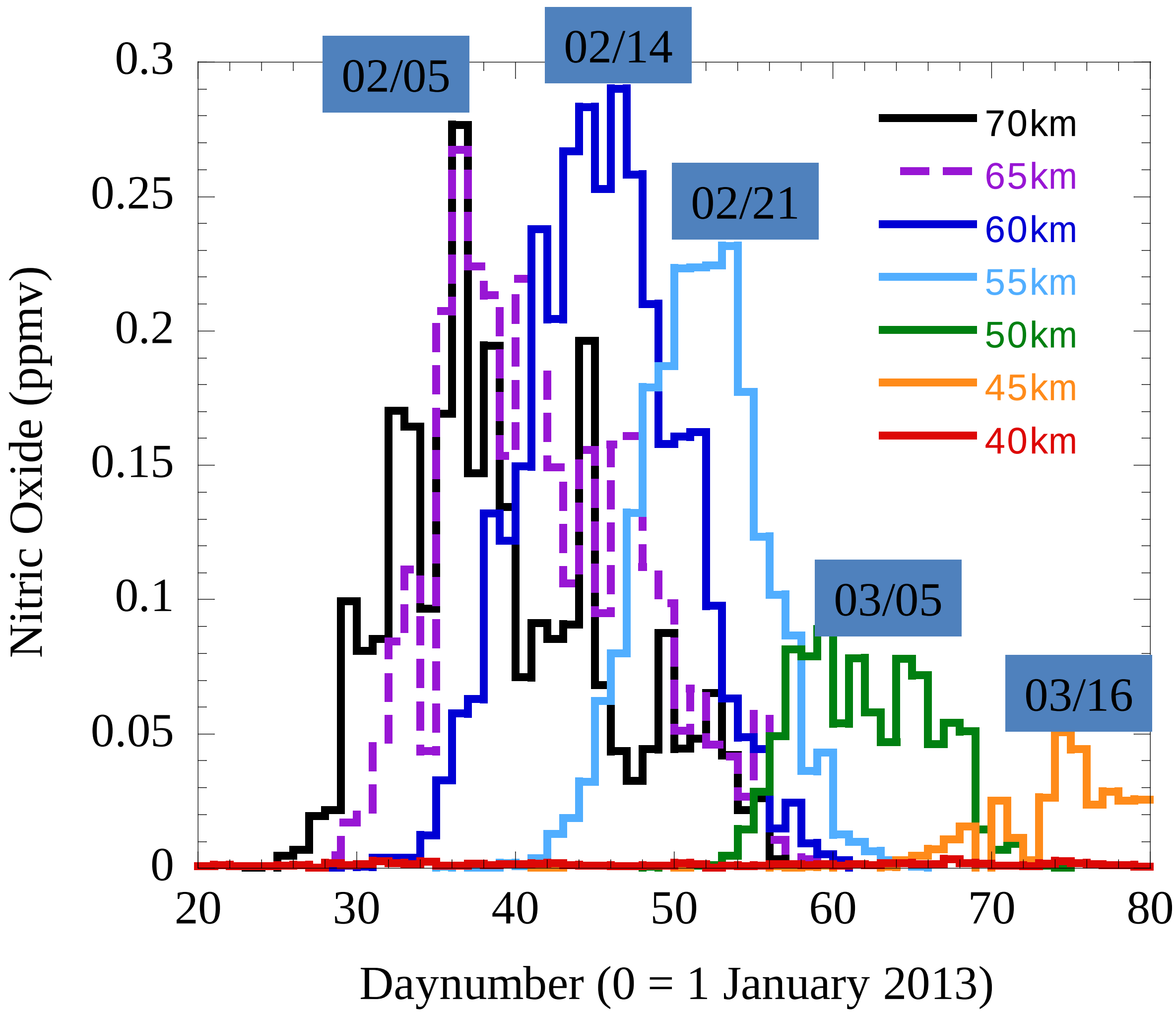
SOFIE NO – Strong descent in 2009 and 2013 up to ~40 km; moderate descent in 2012



2013 SSW – Descent of the stratopause brings down NO from MLT to stratosphere



NO Descent in 2013

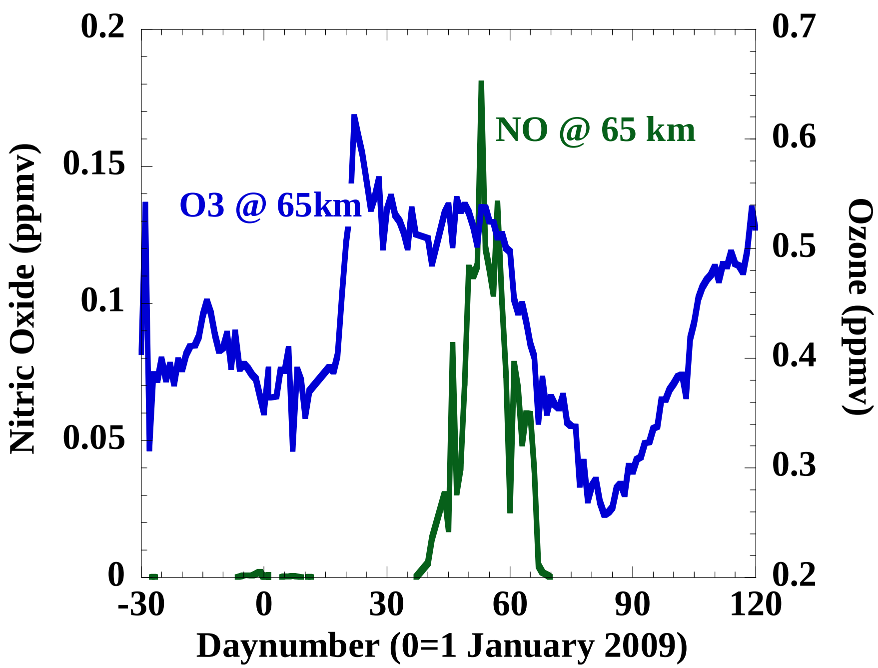


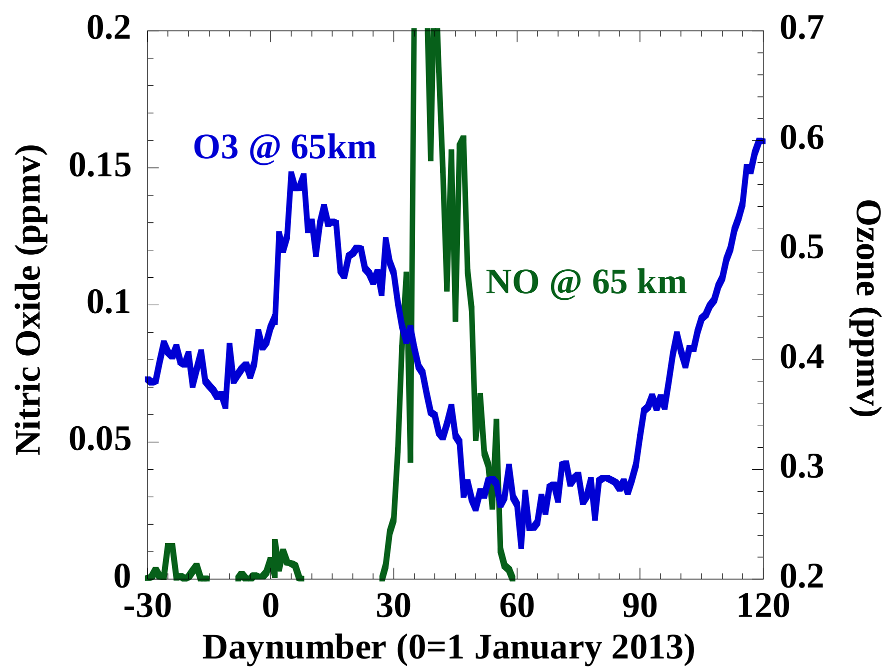
- Downward transport of NO to 70 km during 2013 starts ~2.5 weeks after the first wind reversal and lasts for a month.

- From 70 km NO reaches 55 km after ~15 days and 45 km after ~40 days.

Impact of NO Transport on Ozone

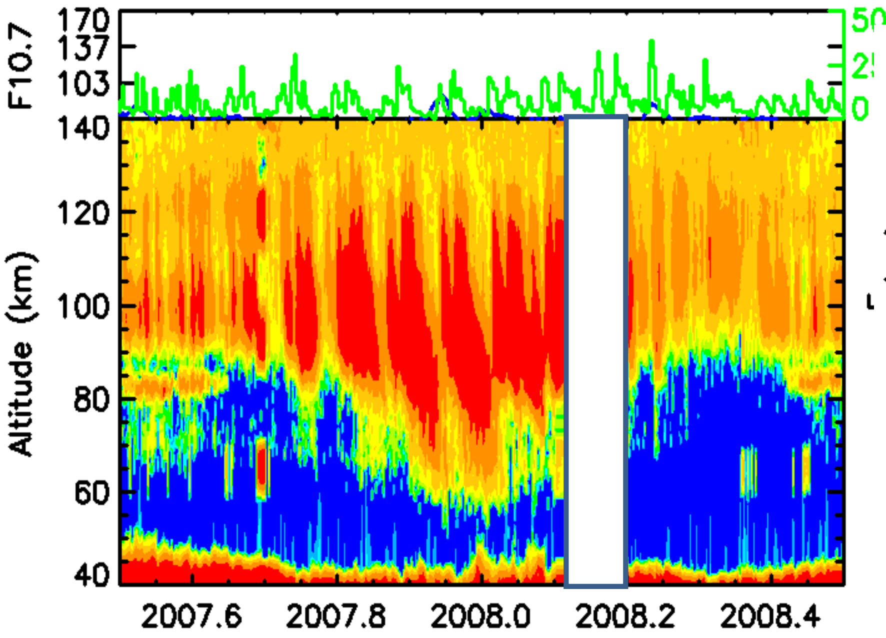
- SOFIE ozone measurements allow for retrievals down to 60 km
- At 65 km, the decrease in ozone coincides with the increase in NO

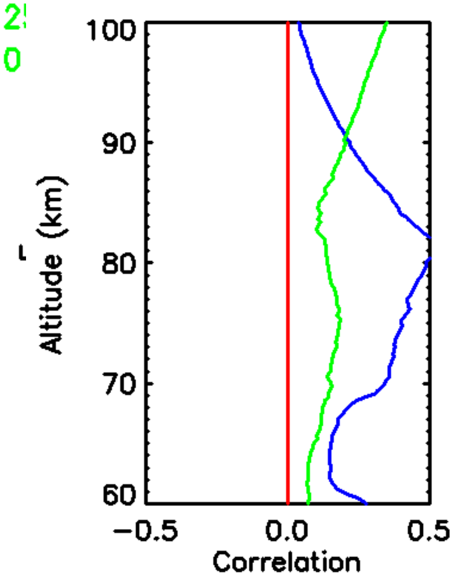


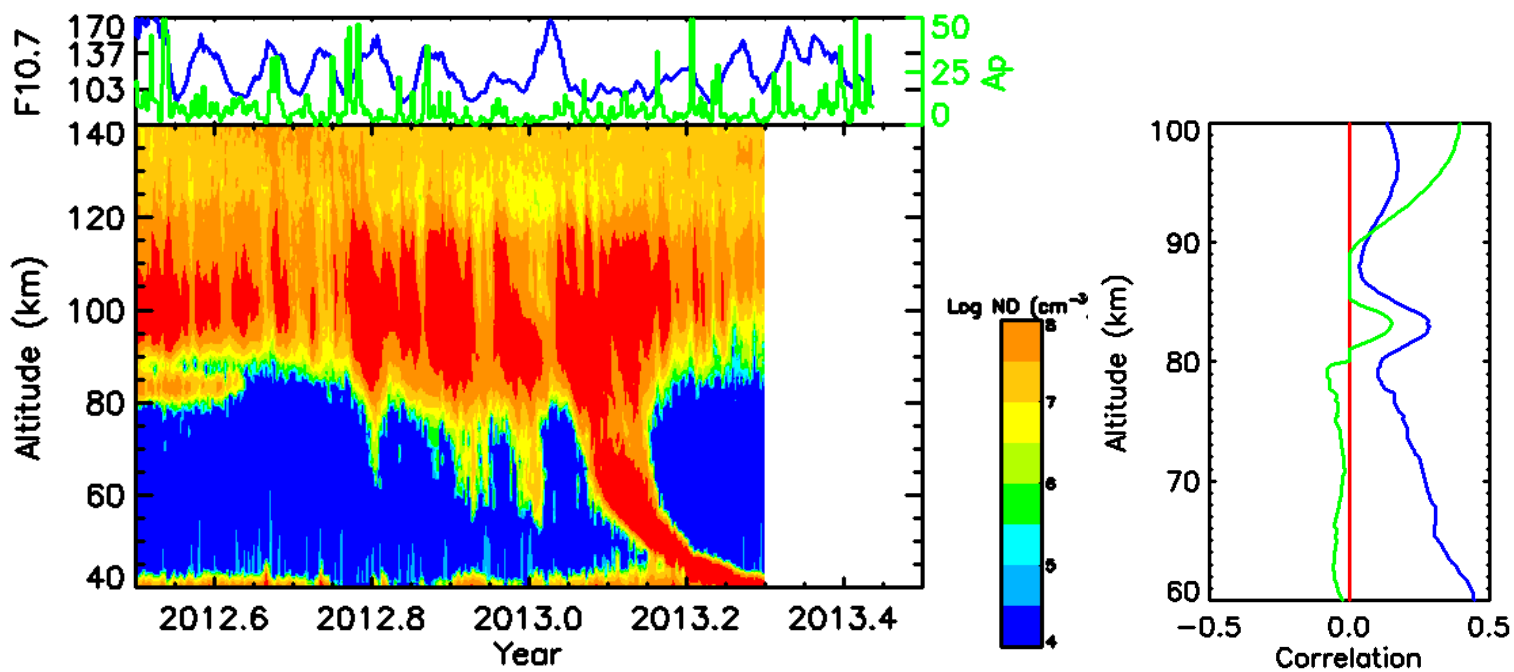


Various processes contribute to ozone loss → a detailed analysis of all chemical and dynamical processes is necessary to characterize ozone loss due to NO.

Solar Effect on NO







Summary

➢SOFIE retrievals provide yearlong continuous measurements of NO, ozone, and temperature in both the northern and southern hemispheres.

➢Strong downwelling of NO is observed during the major warming years of 2009 and 2013.

Work is in progress to understand the -

- Impact of this downward transport on ozone
- Effect of solar activity on NO

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