Intercomparison of vertical structure and formation mechanism between summer ozone valley over Tibetan Plateau and North America

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- Data and methods
- Vertical structure
- Formation mechanism
- Conclusion

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Introduction

- **Ozone protecting Earth & heating stratosphere**

  Andrews et al., 1987;

- **CFCs thinning ozone layer**

  Rowland and Molina, 1974

- **Ozone hole in Poles**

  Farman et al., 1985; Newman, 1997

- **Ozone Valley over the Tibetan Plateau (OVTP)**

  Zhou et al., 1994; Zou, 1996; Bian et al.; Guo et al., 2012; 2015

- **Formation mechanism of OVTP**

  Liu et al., 2003; Tian et al., 2008; Liu et al,. 2009; Bian et al., 2011; Pan et al., 2016; Guo et al., 2012, 2015, 2017

- **Is there an Ozone Valley over North America (OVNA)?**
- **What is the difference between OVTP and OVNA?**

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Data and methods

- **Microwave Limb Sounder : O_3,ClO, HCl, NO_2**

  Waters et al., 2006; Livesey et al., 2011

- **ERA-Interim: winds，PV**

  Simmons et al., 2007; Dee et al., 2011

- **Zonal deviation: $O_3^* = O_3 - [O_3]$**

  Lorenz et al., 1967

- **Zonal deviation rate: $O_3^*/[O_3]$**

  Guo et al., 2015

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Vertical structure

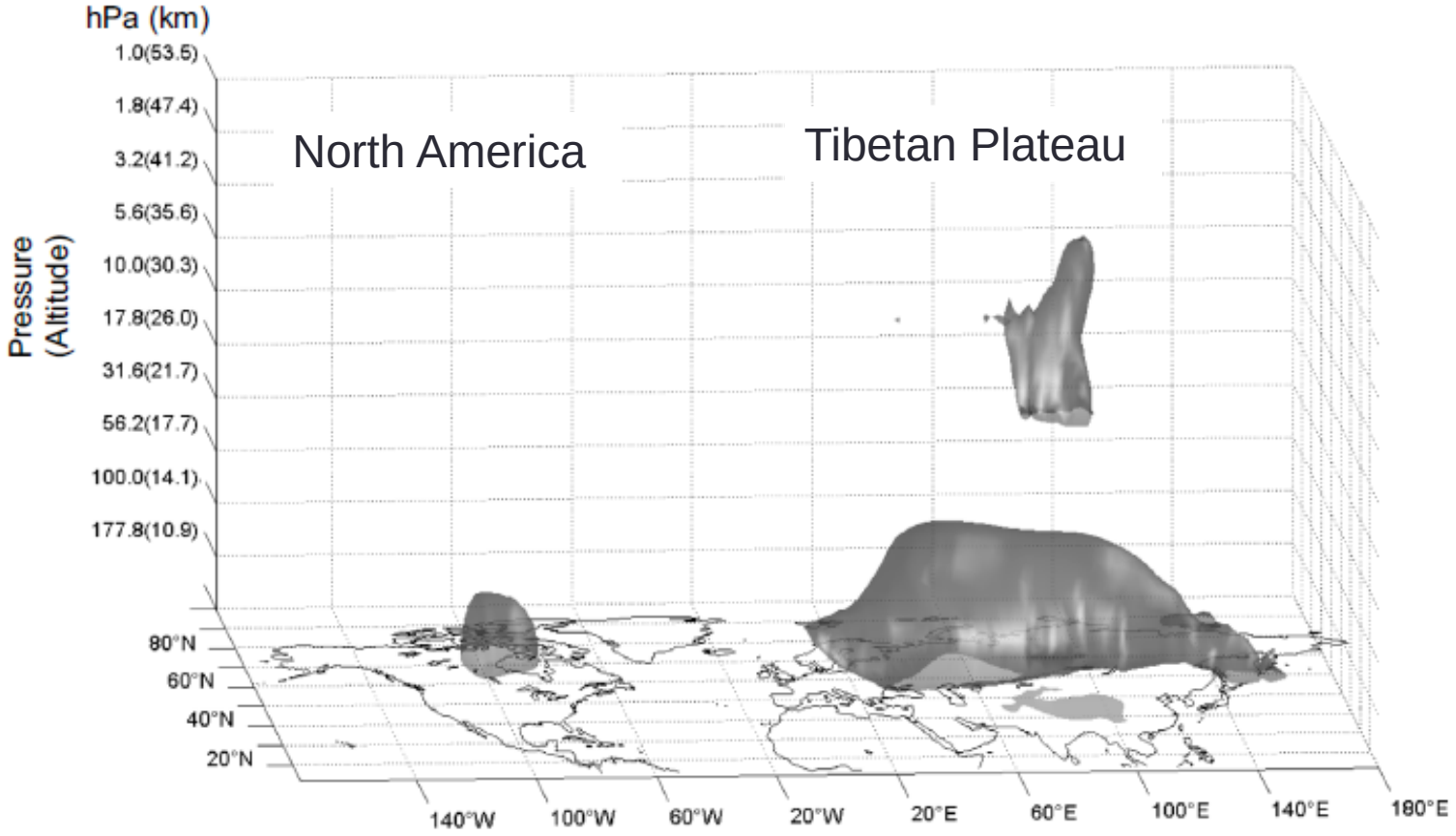

Figure 1 2005-2013 summer (JJA) mean O_3*/[O_3], which threshold value is -0.1 under 26.1 hPa and -0.01 above 26.1 hPa (units: 1)

Vertical structure

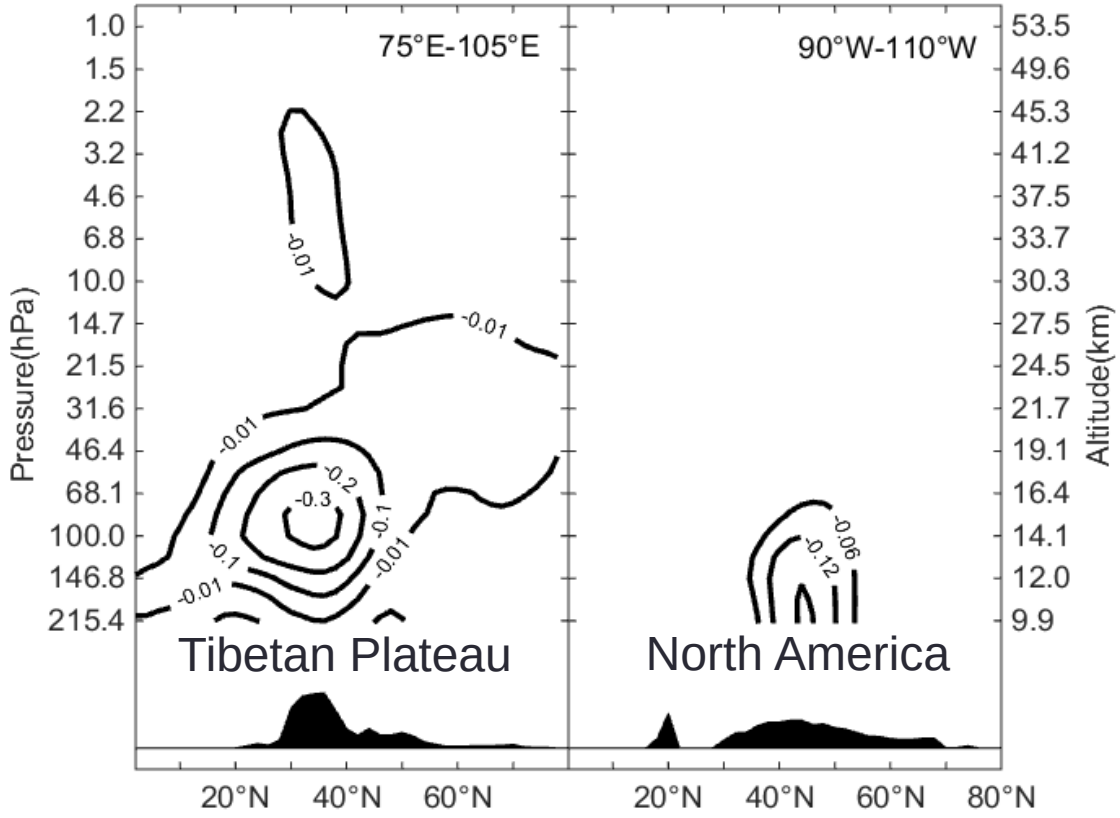

Figure 2 2005-2013 summer (JJA) mean O_3*/[O_3] over Tibetan Plateau (75-105°E mean) and North America (90-110°W mean); unit:1; shade areas indicate terrain

Vertical structure

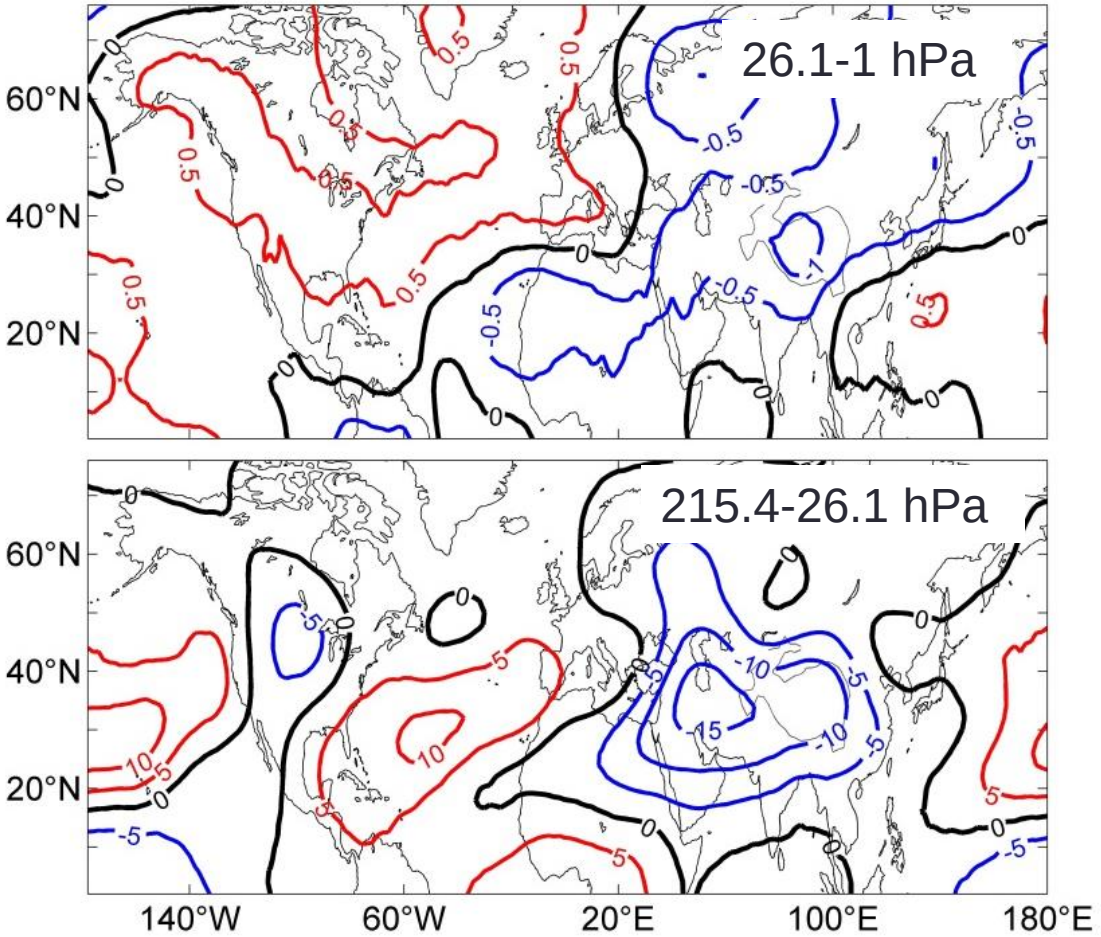

Figure 3 Vertical integration of 2005-2013 summer (JJA) mean O_3* (in Dobson Units) from 26.1 to 1 hPa and from 215.4 to 26.1 hPa

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Formation mechanism

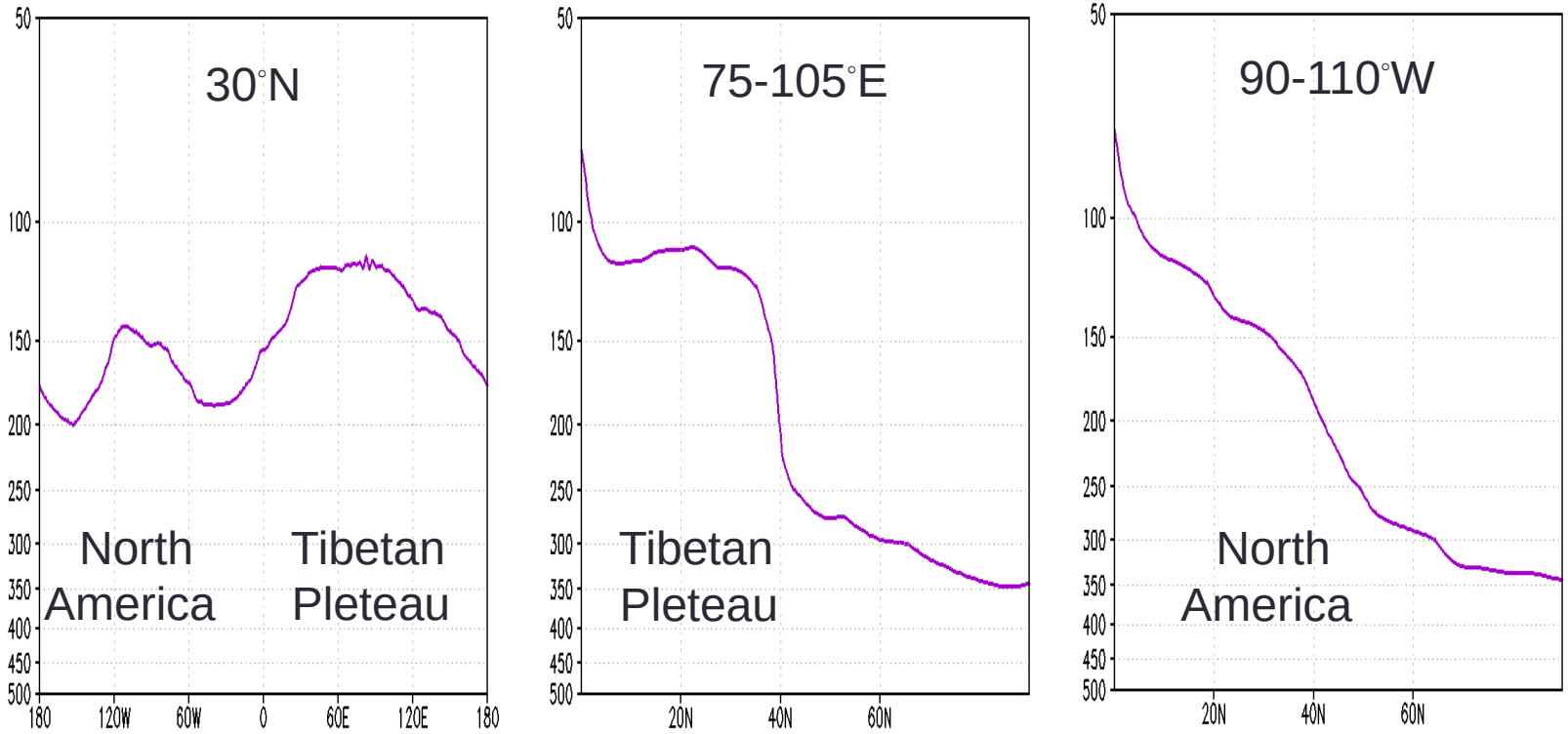

Figure 4 vertical-latitude cross section of 2005-2013 summer (JJA) mean tropopause height (hPa) along 30°N, 75-105°E and 90-110°W

Formation mechanism

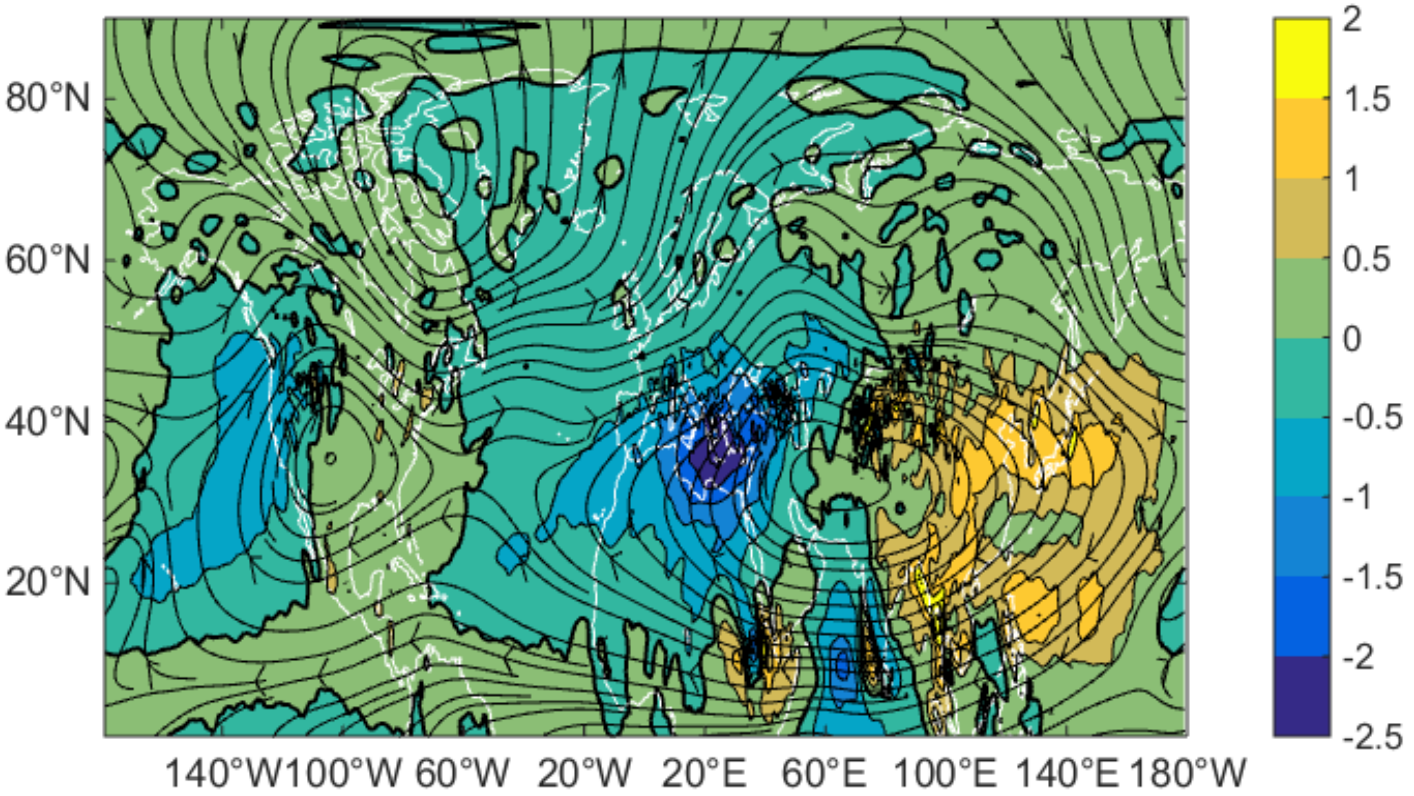

Figure 5 2005-2013 summer (JJA) mean circulation (stream lines) and O_3 flux divergence (shaded;unit:10^{-12} kg·kg^{-1}·s^{-1}) at 100 hPa

Formation mechanism

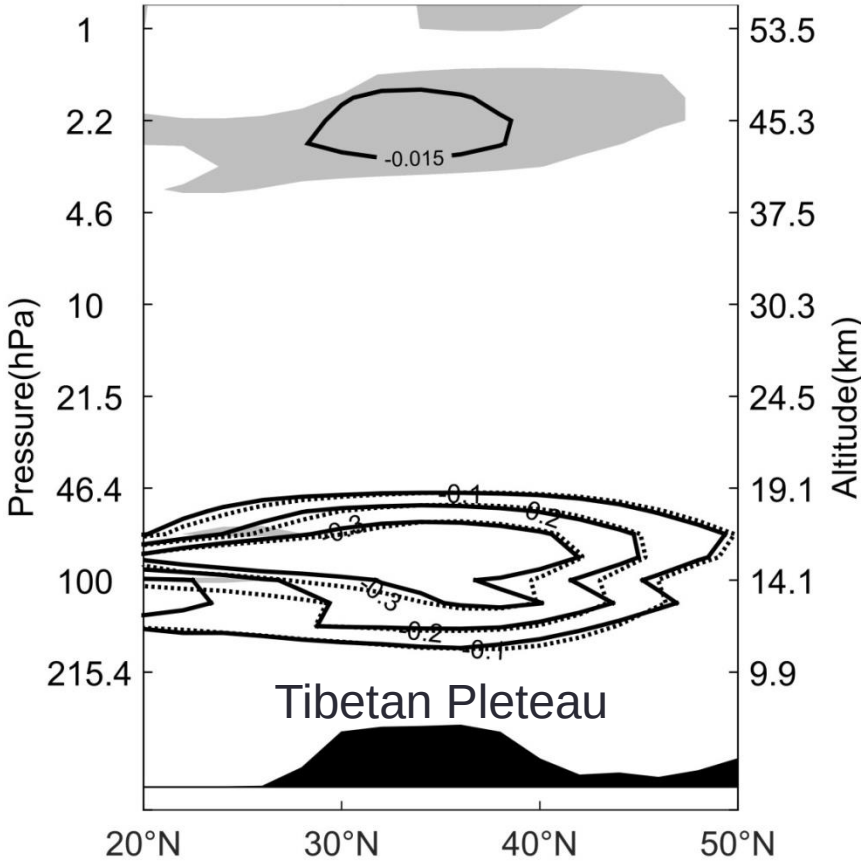

Figure 6 vertical-latitude cross section of 2005-2013 summer (JJA) mean O_3*/[O_3] (units: 1) along 75°-105° E in daytime (solid) and in nighttime (dotted), and the differences between them (shades indicating 1% confidence level)

Formation mechanism

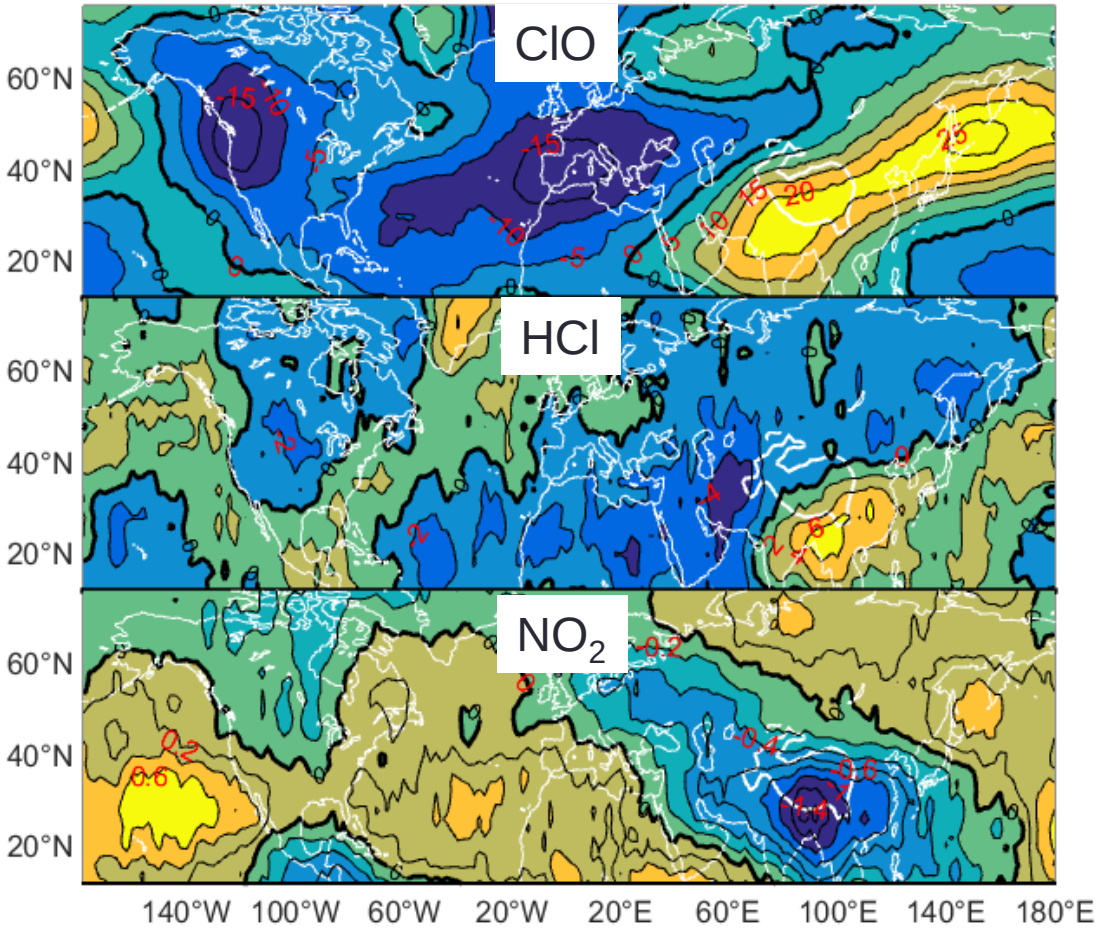

Figure 7 2005-2013 summer (JJA) mean zonal deviation of ClO, HCl and NO_2 (unit: ppt) at 10 hPa

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Conclusion

Ozone Valley	Tibetan Plateau	North America
Center in vertical direction	**Two**	**One**
Center in UTLS	**Strongest**	**Weak**
Center in Upper Stratosphere	**Weakest**	**No**
Mechanism of UTLS center	**Dynamics**	**Dynamics**
Mechanism of center in Upper Stratosphere	**Chemicals**	

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