TRENDS IN ATMOSPHERIC OZONE FROM A LONG-TERM OZONE CLIMATOLOGY

Jane Liu[1,2], D. W. Tarasick[3], V. E. Fioletov[3], C. McLinden[3], J. H. Y. Jung[1], T. Zhao[4], S. Gong[3], C. Sioris[3], J. J. Jin[5], G. Liu[6], and O. Moeini[7]

[1] University of Toronto
[2] Nanjing University
[3] Environment Canada
[4] Nanjing University of Information Science & Technology
[5] Universities Space Research Association, NASA
[6] University of California at Berkeley
[7] York University

3rd International Conference on Earth Science & Climate Change Earth Science & Climate Change, July 28-30, 2014 San Francisco, USA

INTRODUCTION

- **Importance**

  Ozone is an important trace gas in the atmosphere, playing a significant role in atmospheric chemical, dynamical, and radiative processes. Ozone trends in the stratosphere and troposphere have been topics of active studies.

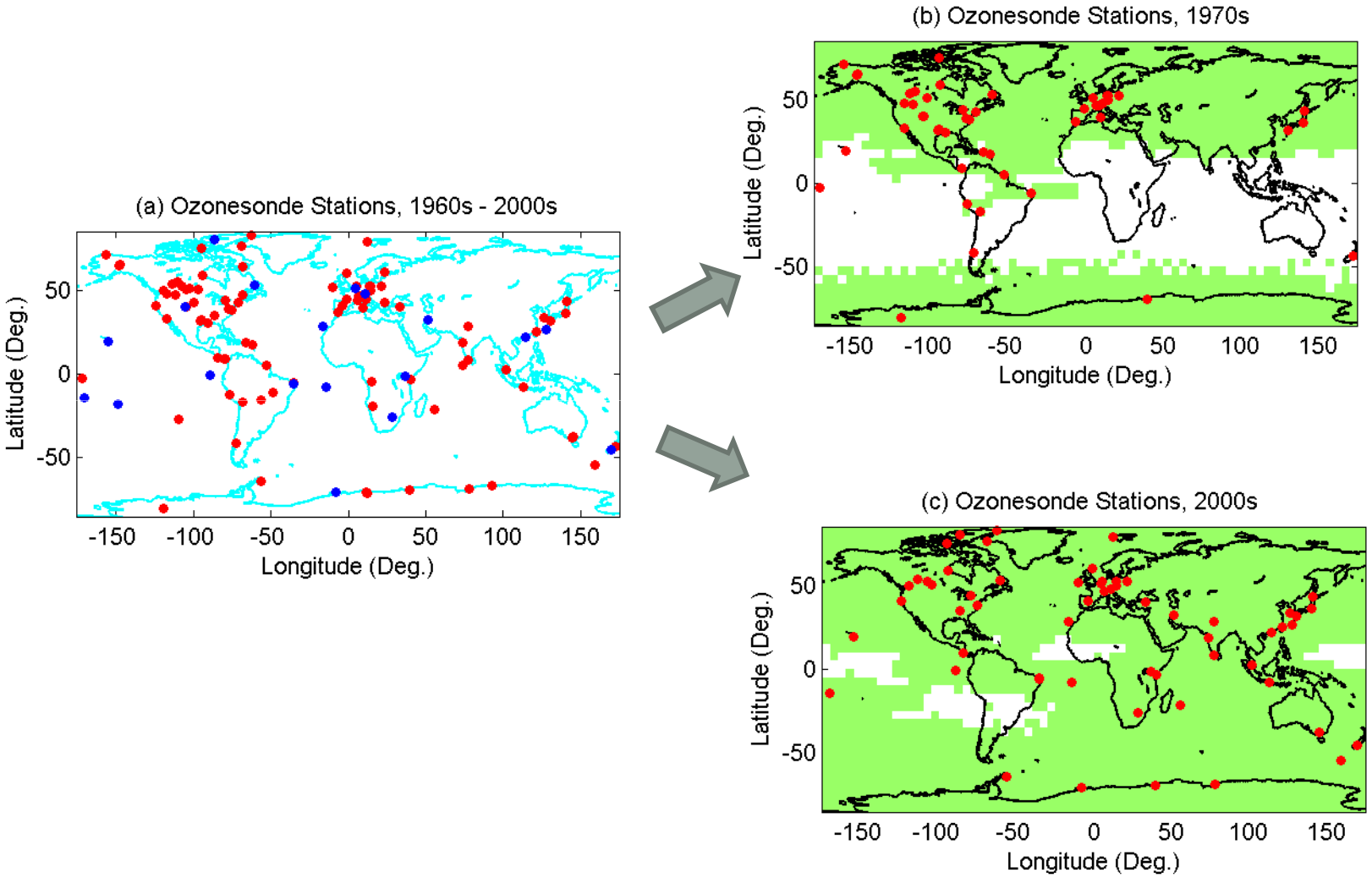
- **Objective**

  To investigate ozone trends in the stratosphere and troposphere, globally and in different regions.

- **Rationale**

  Based on a long-term (1965-2008) global 3-dimentional (latitude, longitude, and altitude) ozone climatology.

TRAJECTORY-MAPPING



(Liu et al., 2013)

GLOBAL OZONE DATABASE

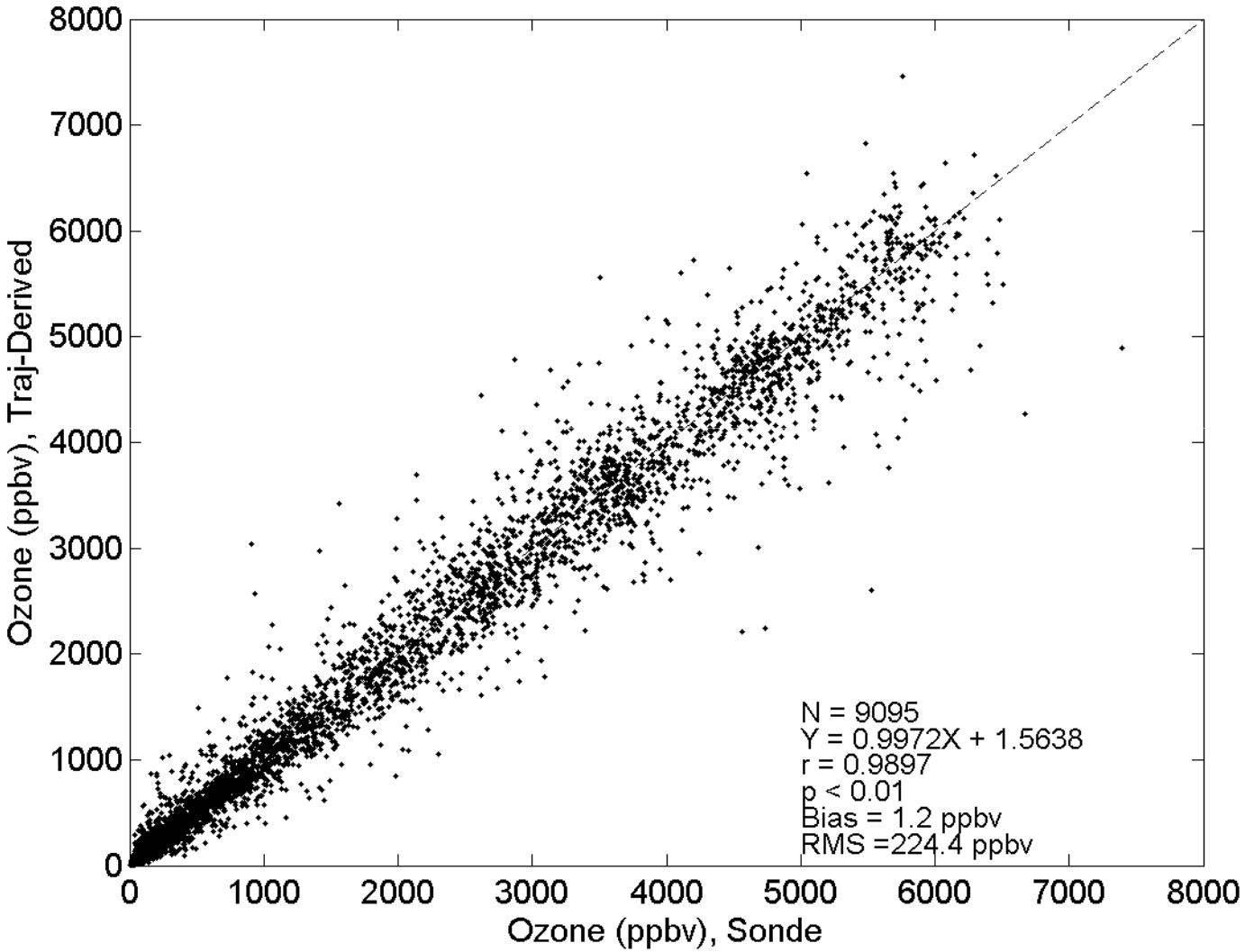
- **Source: Global Ozonesonde data**

  51,898 ozone soundings, 116 stations, 44 years (1965-2008)

- **Developed through trajectory mapping**
  - HYSPLIT (Hybrid Single Particle Lagrangian Integrated Trajectory Model), NOAA, Air Resources Laboratory
  - Driven by NCEP reanalysis data
  - Both forward and backward, 96 hours, assuming ozone life time of 4 days

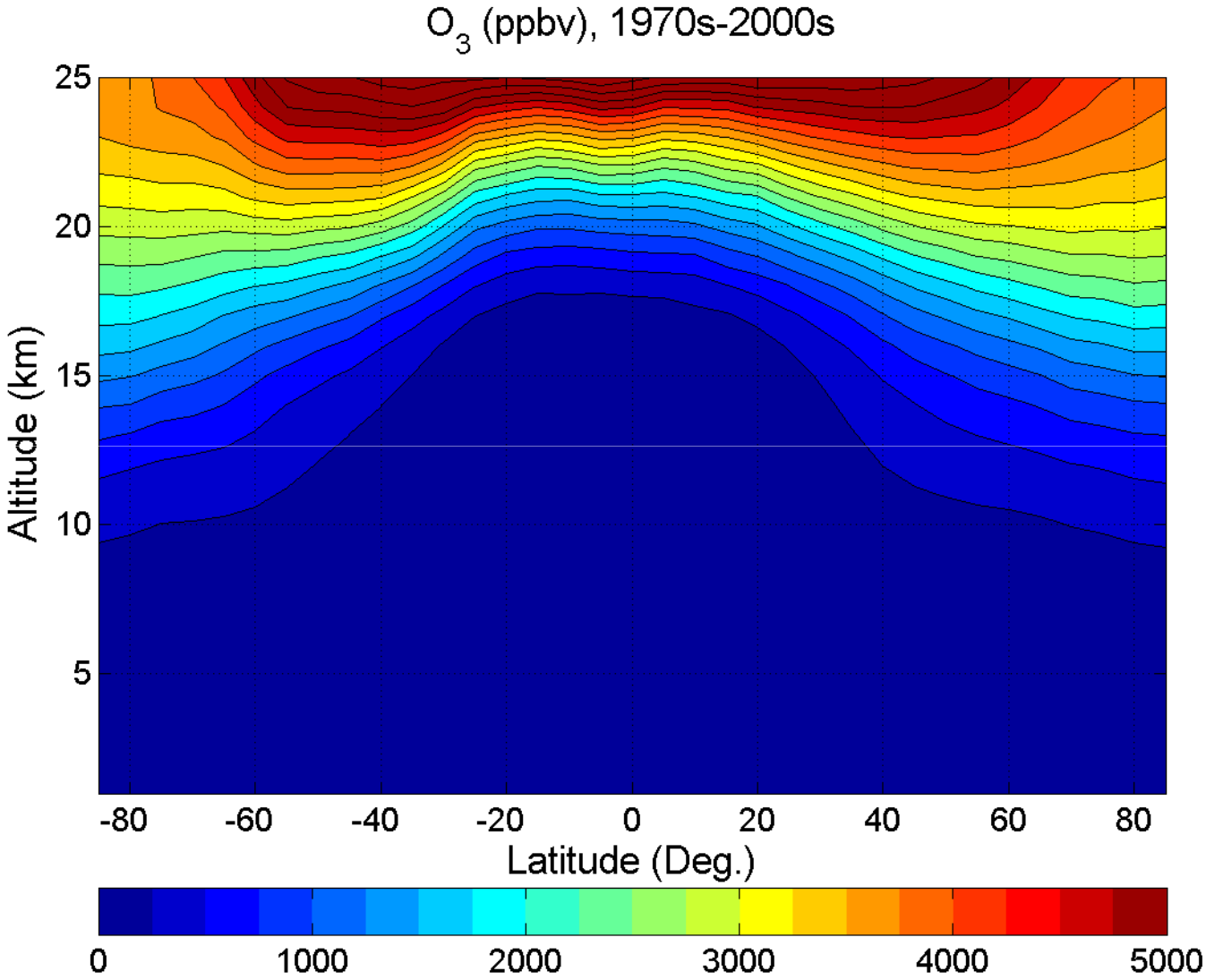
- **Global ozone climatology**
  - 5 ° lat ×5 ° lon, 1 km vertical resolution, by month, by decade, from 1960s-2000s
  - 5 ° lat ×5 ° lon, 1 km, yearly mean, 1965-2008

VALIDATION OF THE CLIMATOLOGY



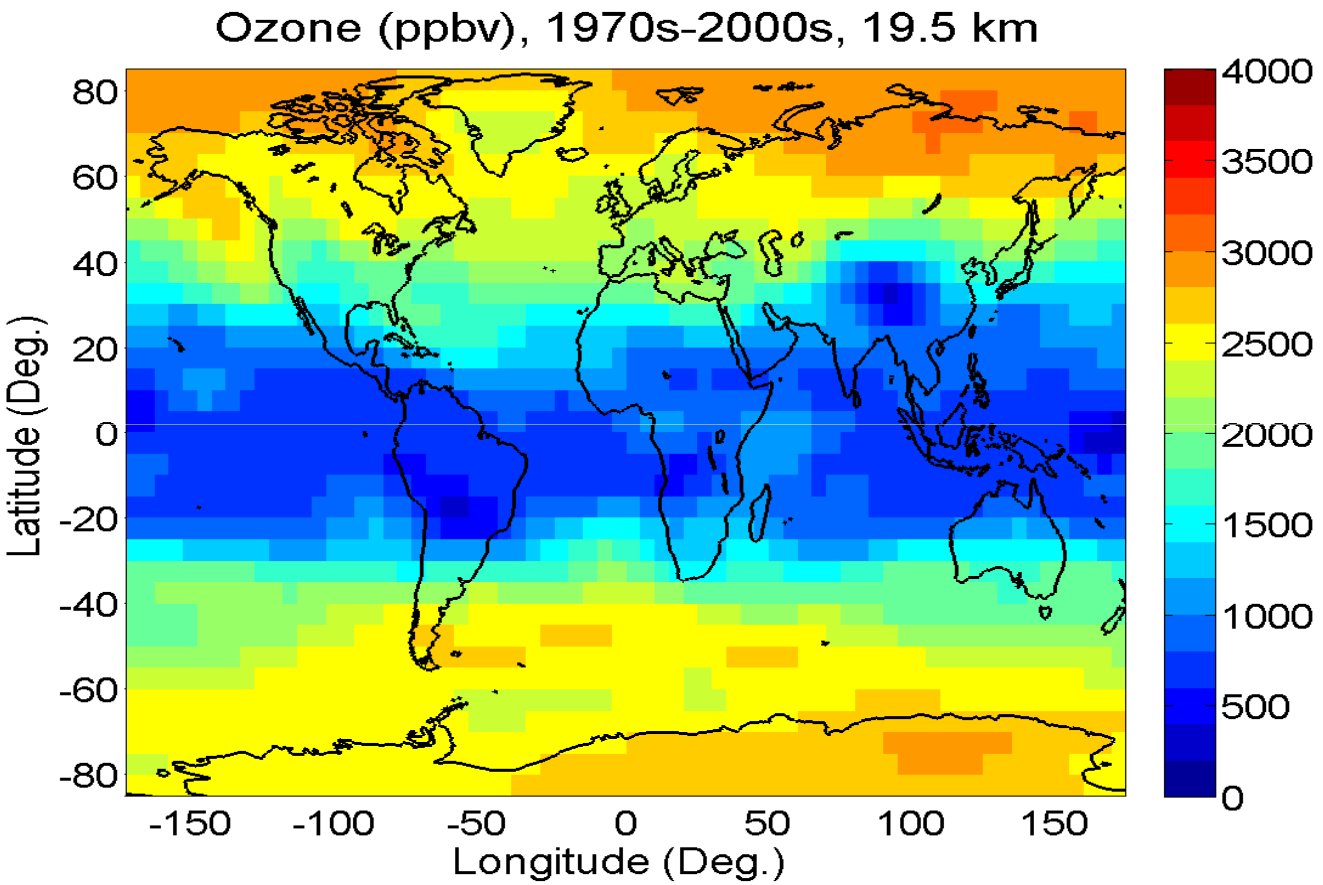
(Liu et al., 2013)

LATITUDINAL VARIATIONS



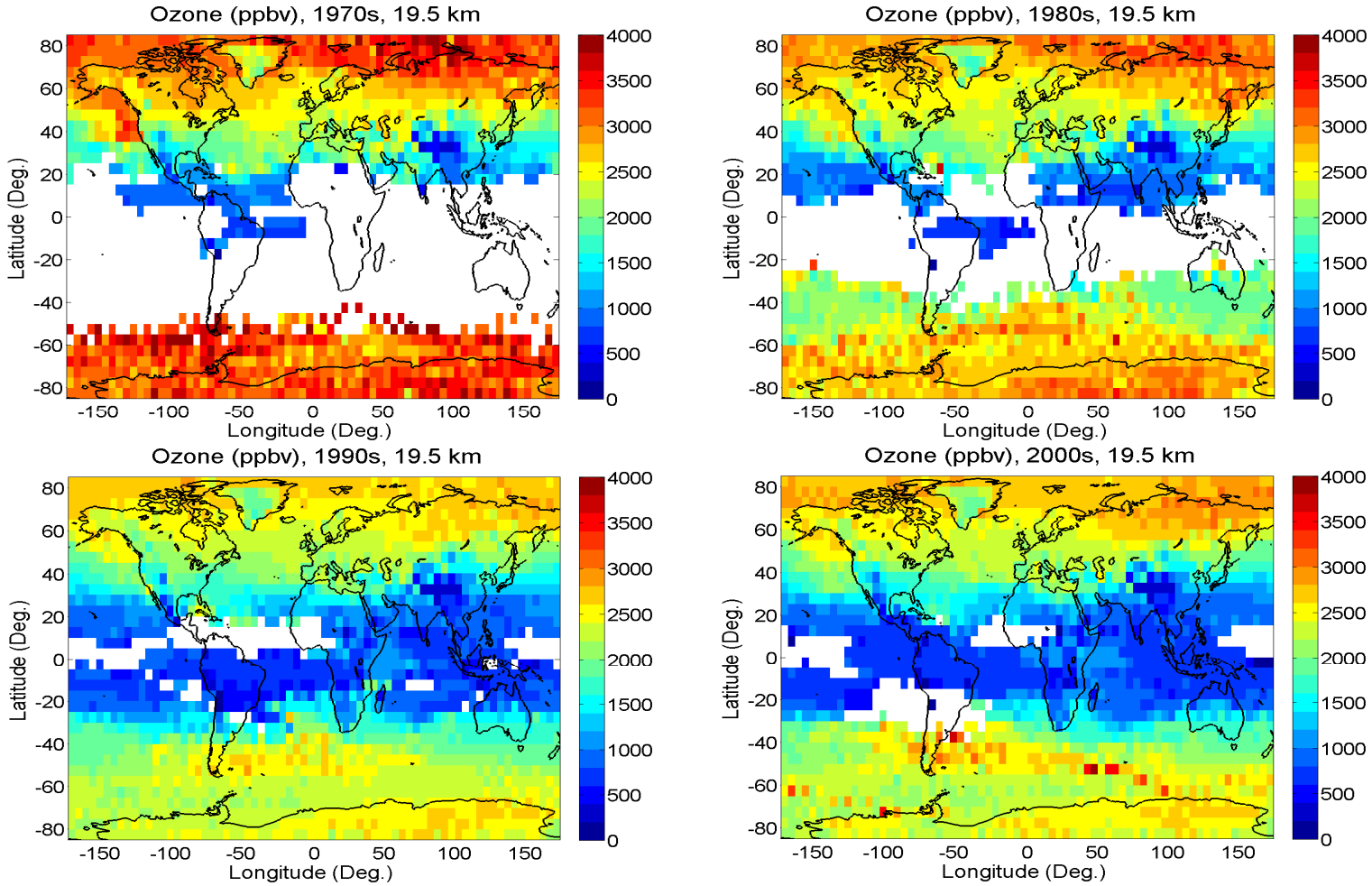
(Liu et al., 2013)

OZONE DISTRIBUTION IN THE LOW STRATOSPHERE



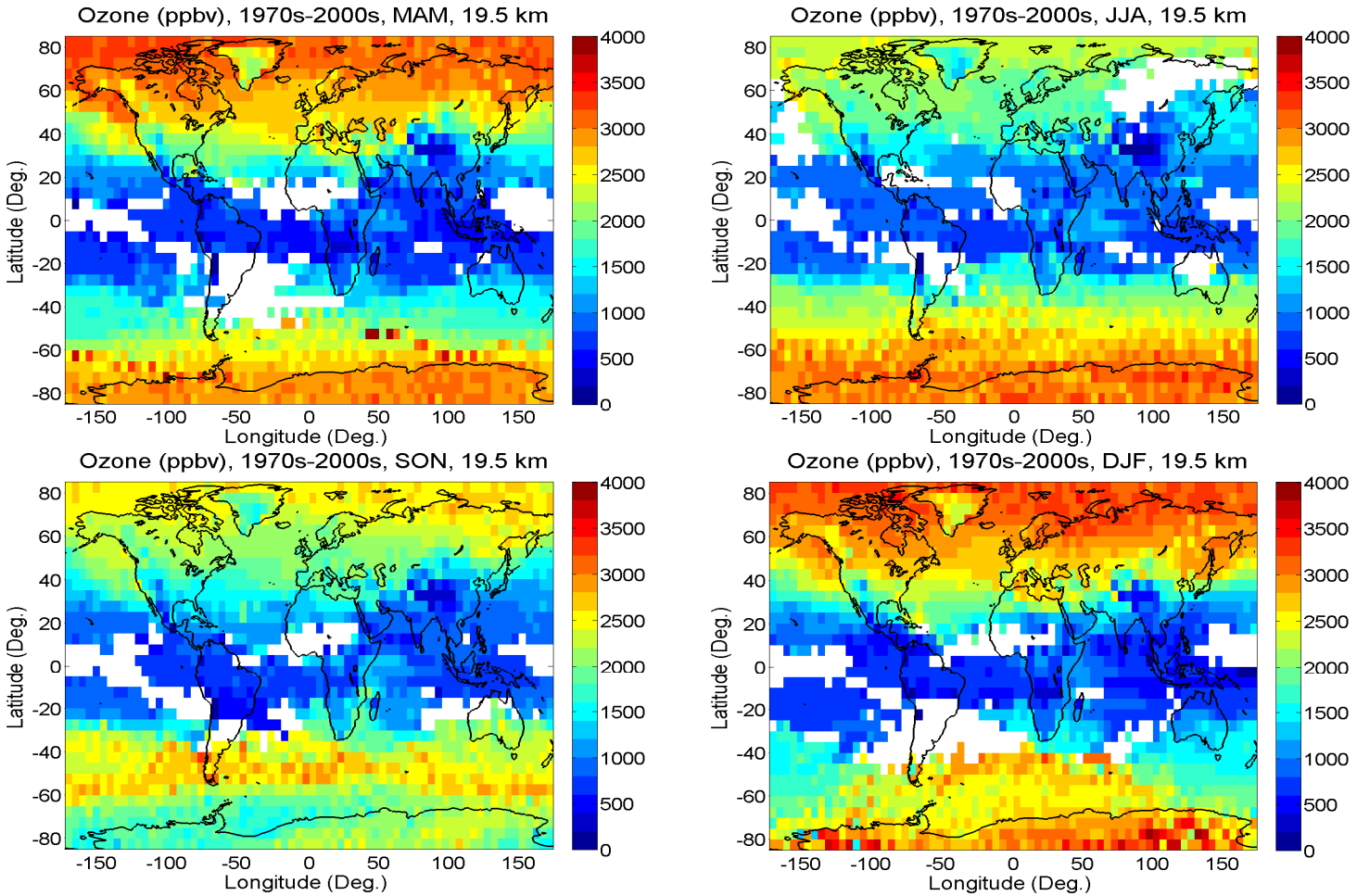
(Liu et al., 2013)

DECADAL VARIATIONS



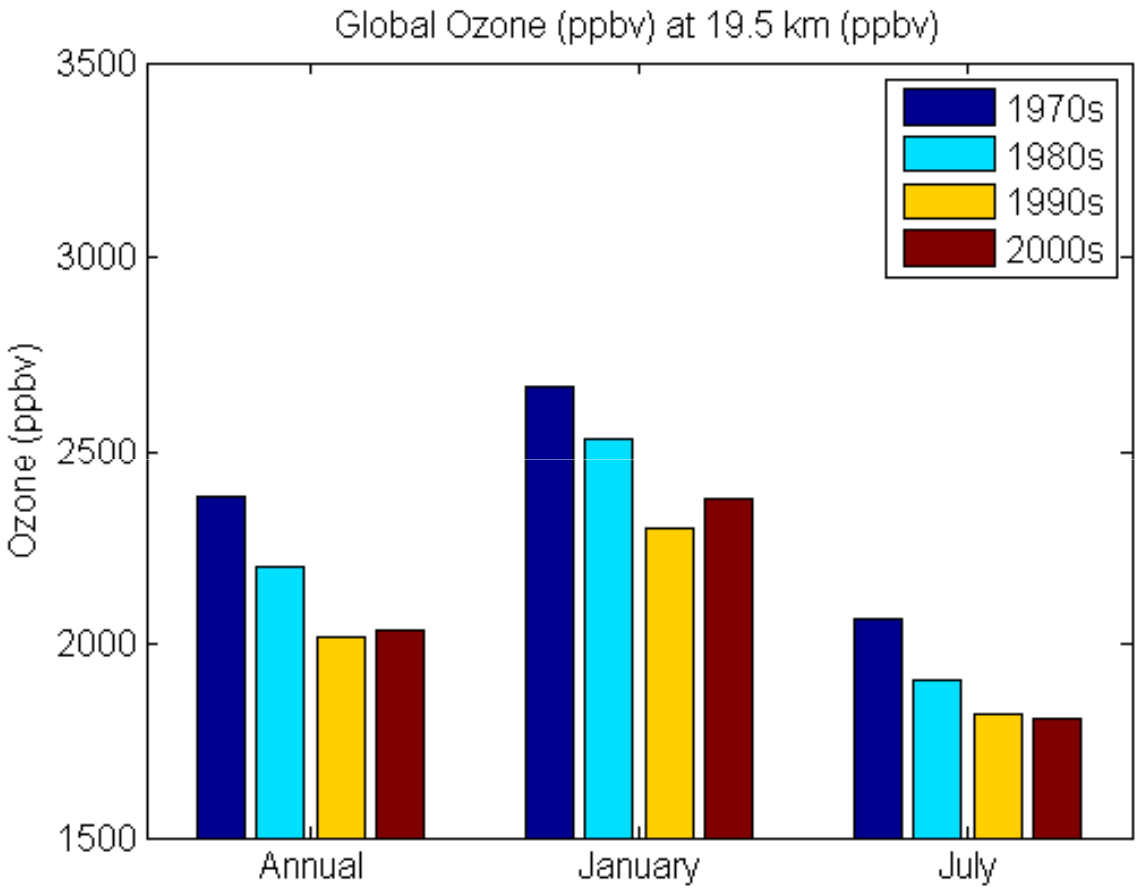
(Liu et al., 2013)

SEASONAL VARIATIONS

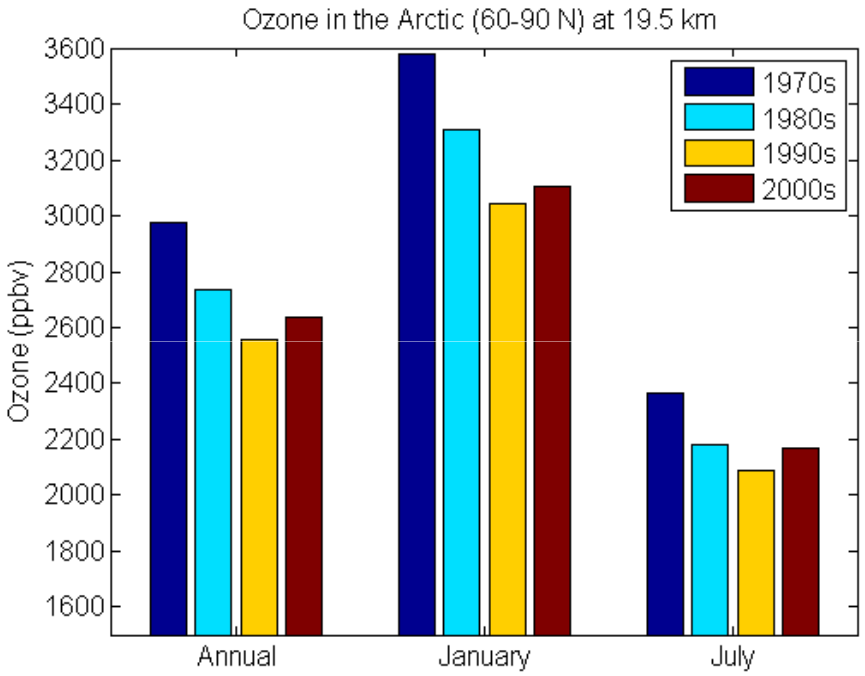


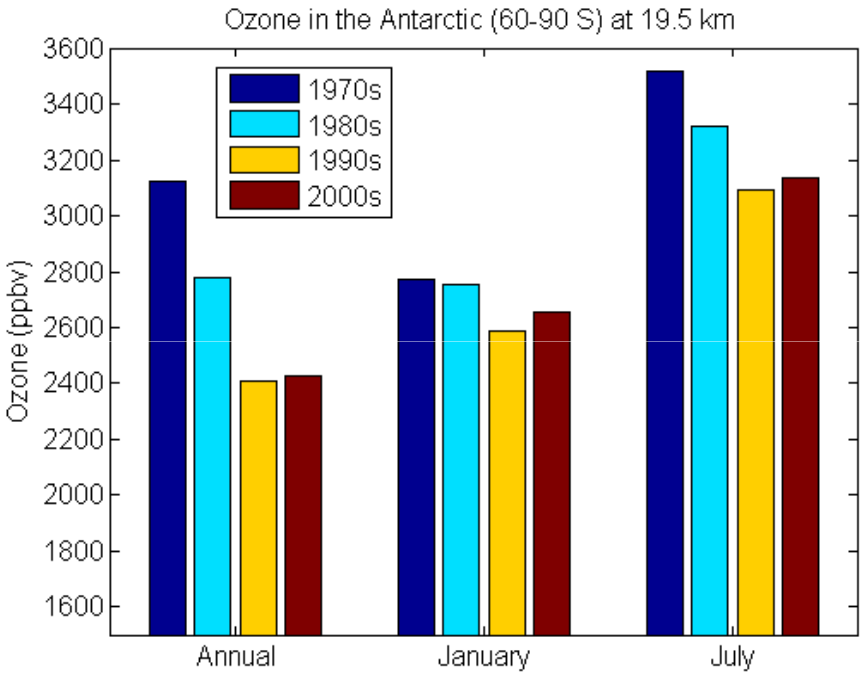
(Liu et al., 2013)

OZONE TRENDS IN THE STRATOSPHERE

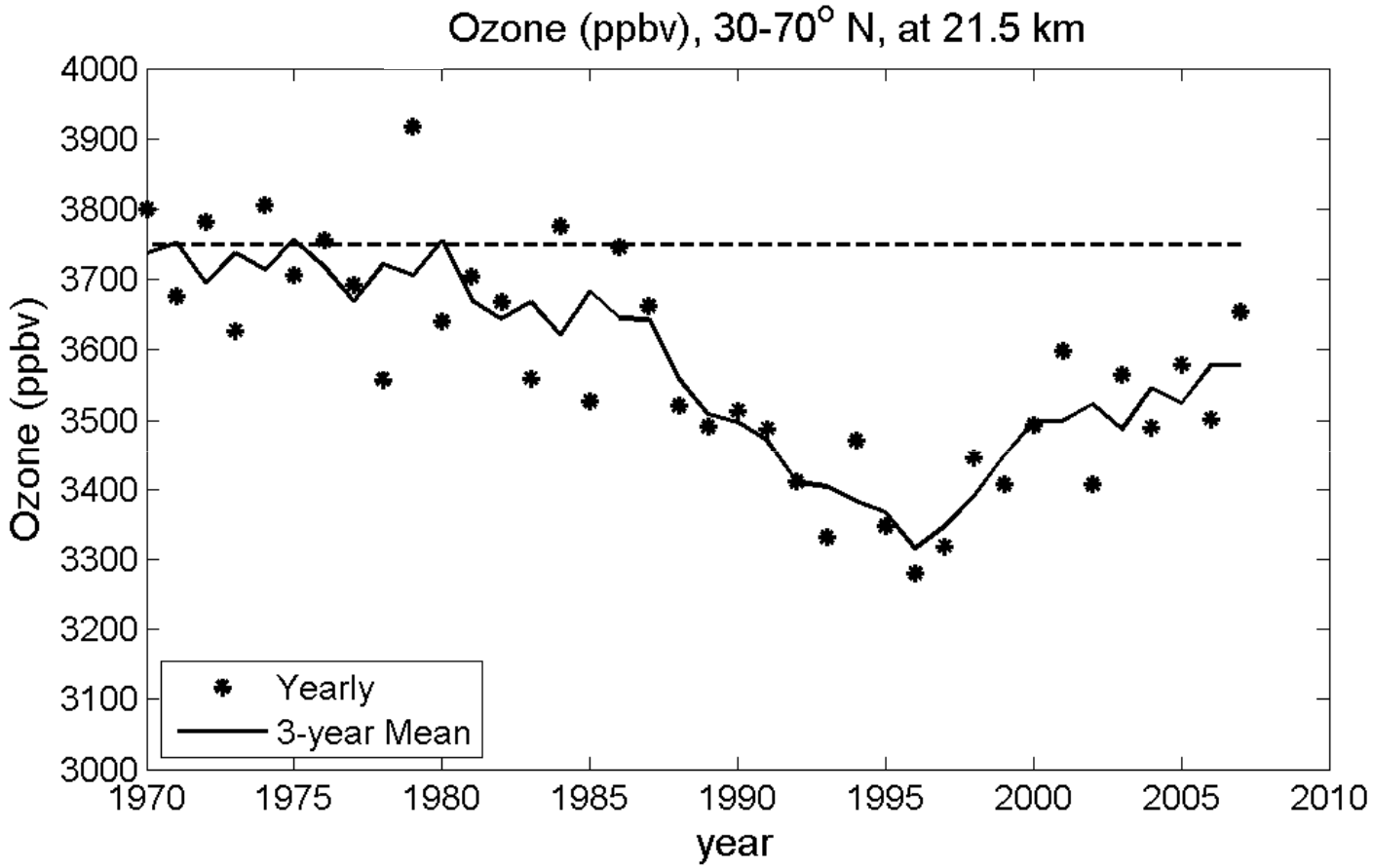


OZONE TRENDS IN THE POLAR REGIONS



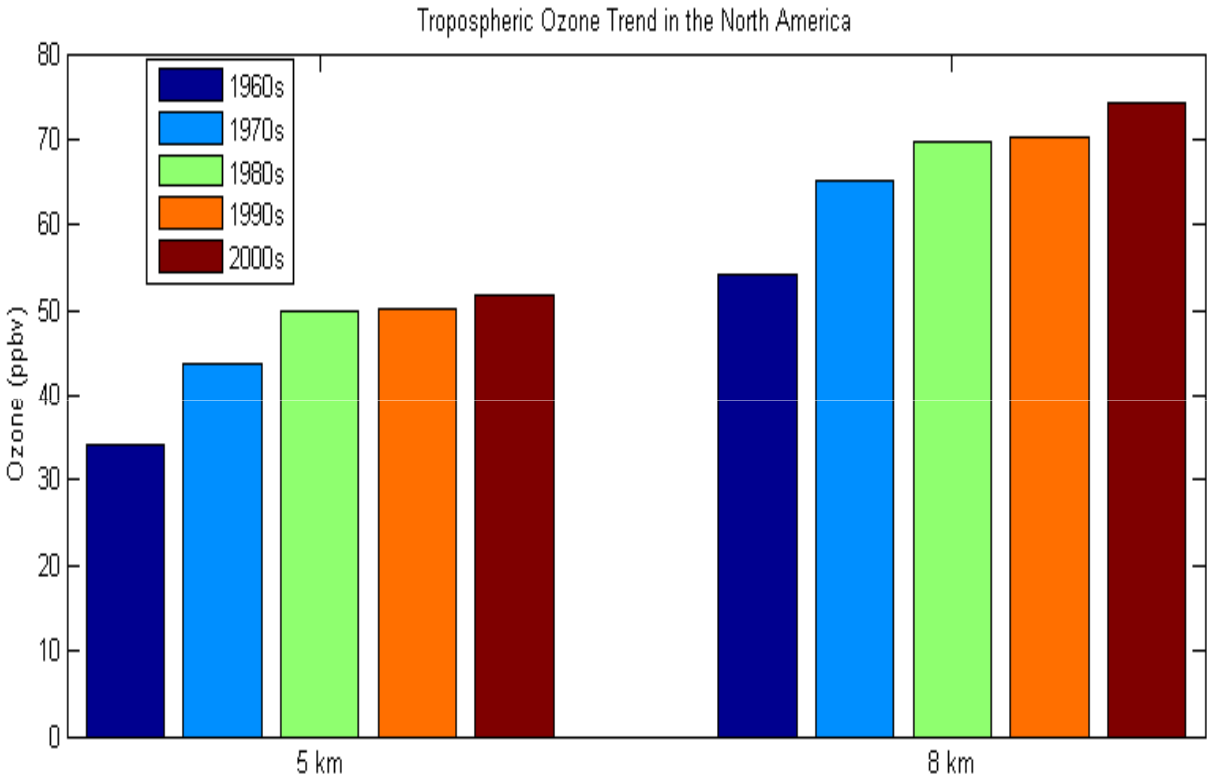


INTERANNUAL VARIATIONS



Liu et al. (2013)

OZONE TRENDS OVER THE NORTH AMERICA IN THE TROPOSPHERE



CONCLUSIONS

- A new ozone climatology is generated based on the global ozonesonde and trajectory statistics.
- This dataset is tested at selected stations using the ozone soundings at all the stations except one being tested. The two sets of profiles are in reasonable agreement.
- The dataset reveals interesting features in stratospheric ozone distribution, decadal and seasonal variations.
- The climatology clearly shows the depletion of ozone from the 1970s to the mid1990s and ozone increase in the 2000s in the lower stratosphere. The trends are more obviously in the respective winter season in the two hemispheres.
- The ozone climatology suggests an increase trend in tropospheric ozone over North America.

Thank you

Contact: janejj.liu@utoronto.ca