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| Title + Link | Author | Purpose / One-sentence summary | Results | Location | Data Sources | Extra Notes |
| [Heterogeneous chemistry and tropospheric ozone](https://www.sciencedirect.com/science/article/abs/pii/S1352231099004628)  <https://www.sciencedirect.com/science/article/abs/pii/S1352231099004628> | Daniel J. Jacob |  | Ozone is produced by oxidation of hydrocarbons and CO catalyzed by Hydrogen and nitrogen oxides radicals. Reactions with aerosol cloud droplets may affect O3 by producing HOx and losing NOx or directly O3.  “There is ample evidence that photolysis of HONO produced heterogeneously at night provides a major early-morning source of HOx in high-NOx environments”  “There is clear evidence from field observations that nighttime hydrolysis of N2O5 in aerosols is a major atmospheric sink of NOx.”  “They (Lelieveld and Crutzen (1990)) found that including aqueous-phase HOx chemistry increases the net regional O3 loss averaged over clear and cloudy conditions by a factor of 1.3 to 2.3 under low-NOx conditions and decreases net O3 production by about 40% under high NOx conditions.”  “Chemical loss of NOx slows down in cloud due to depletion of HOx from the gas phase, resulting in enhanced O3 production after the cloud evaporates (Dentener, 1993)" |  |  |  |
| <https://www.pnas.org/doi/abs/10.1073/pnas.1812168116> |  |  |  |  |  |  |
| <https://aaqr.org/articles/aaqr-10-07-oa-0055.pdf>  Analysis of the Relationship between O3, NO and NO2 in Tianjin, China |  | Correlation between the presence of NOx and O3; correlation between O3 and meteorological conditions | The results indicate that the diurnal cycle of ozone concentration has a mid-day peak and lower nighttime concentrations. The ozone concentration slowly rises after the sun rises, reaching a maximum during the daytime and then decreases until the next morning. This is due to photochemical O3 formation. The shape and amplitude of ozone cycles is strongly influenced by meteorological conditions and prevailing levels of precursors (NOx). In the study area, the daily cycle of NO concentration arises from vehicular emissions, and its conversion to NO2, had a major impact on the daily cycle of ozone levels. We also found a linear relationship between NO2 and NOx, as well as NO and NOx, and a polynomial relationship between O3 and NO2/NO, which could be useful in O3 forecasting and air pollution control strategies. The level of [OX] is influenced by NO2-independent and NO2-dependent contributions. The former is due to regional background O3 concentration, and the latter correlates to the local level of primary pollution. The regional background O3 concentration in Tianjin is about 20 ppb. | China |  |  |
| <https://acp.copernicus.org/preprints/acp-2022-310/acp-2022-310.pdf> |  | Night time peak of ozone explanation in China | We propose that the high photochemistry induced ozone in the daytime provides rich ozone source in the nighttime residual layer, determining the overall high frequency of NOE events in China, and then the enhanced atmospheric mixing triggers NOE events by allowing the ozone-rich air in the 25 residual layer to mix into the nighttime boundary layer. This is supported by our analyses that 70% (65%) of the NOE events are associated with increases in friction velocity (planetary boundary layer height), indicative of enhanced atmospheric mixing, and also supported by the observed sharp decreases in surface NO2 and CO concentrations with ozone increases in NOE events, a typical signal of mixing with air in the residual layer. Three case studies in Beijing and Guangzhou show that synoptic processes such as convective storms and low-level jets can lead to the NOE event by aggravating vertical mixing. Horizontal 30 transport of ozone-rich plumes may also be a supplementary driver of NOE event.    As will be discussed later, the spatial pattern of NOE event frequencies is closely related to the afternoon (14-17 LT) ozone concentrations measured at the surface as shown in Figure 1b. | China | <http://106.37.208.233:20035/>  <https://aqs.epa.gov/aqsweb/airdata/download_files.html>  <https://discomap.eea.europa.eu/Index/>  <https://cds.climate.copernicus.eu/#!/home> |  |
| <https://www.treccani.it/enciclopedia/chimica-dell-atmosfera_%28Enciclopedia-della-Scienza-e-della-Tecnica%29/>  Chemistry of the atmosphere | Treccani | he description of the component the atmosphere and some information about miscelation of gasses | The most important qualitative chemical component of the stratosphere is ozone (O3). Ozone entered the atmosphere during the period during which O2 became its most important constituent. Actually, the amount of O3 in the atmosphere is extremely small. In the original non-polluted troposphere the ozone volume fractions are between 10 and 40 parts per billion (ppb), with slightly higher values in the upper troposphere. Ozone reaches a maximum mixing ratio of about 10 parts per million (ppm), by volume, at an altitude between 25 and 30 km in the stratosphere. |  |  |  |
| <https://www.sciencedirect.com/science/article/abs/pii/S0269749121018315> A review on methodology in O3-NOx-VOC sensitivity study |  | Creation of a predictive model and analysis of the various methods with which one could forecast ozone concentrations | This review highlights that it is necessary to incorporate the emergent properties obtained by nonlinear methods into the modern models, for assessing O3 formation under combined air pollution environment more accurately. Moreover, the scaling property of coupling correlation detected in the real observations of O3 and its precursors could be used to test and improve the simulation performance of modern models. | China |  |  |
| <https://sci-hub.se/https://doi.org/10.1016/0004-6981(80)90281-4> |  | Theories of Ozone night peaks | (1) (2) (3) Horizontal transport from other locations, Stratospheric descent, Ozone which is trapped during theday under an inversion layer sinks to the ground at night, while the base of the inversion layer moves downward. | Jerusalem |  |  |
| <https://www.sciencedirect.com/science/article/abs/pii/S016980951300197X> |  | Why Lake Garda | Effect of Ora del Garda on vertical mixing especially at the shores and at junctions with the Valley | Garda |  |  |
| <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2012JD018151>  Springtime high surface ozone events over the western United States: Quantifying the role of stratospheric intrusions |  | Contribution of Deep Stratospheric Intrusions to Surface Ozone Episodes | We can find a correlation between cyclones and an increase of O3 concentration. So the transfer of O3 from stratosphere to low atmosphere can be a factor of the pic of O3 in the night. | western United States |  |  |
| Attributing ozone to NOx emissions: Implications for climate mitigation measures <https://www.sciencedirect.com/science/article/pii/S1352231012004335> |  | Ozone and traffic | When road traffic emissions are turned off, the total ozone production decreases slightly. This leads to a little less ozone, but ozone production per NOx molecule (=production efficiency) does increase, which is in agreement with earlier findings (Lin et al., 1988; Ehhalt and Rohrer, 1994; Grooß et al., 199  This compensating increase in the other sectors is due to the non-linearities in NOx chemistry. |  |  |  |
| Tropospheric ozone and NOx A review of worldwide variation and meteorological influences <https://www.sciencedirect.com/science/article/pii/S2352186422002784> |  |  | Temperature directly impacts *O3* formation pathways ([Atkinson, 1990](https://www.sciencedirect.com/science/article/pii/S2352186422002784#b4)). It enhances reaction rates of ozone precursors, ozone formation rates, and mechanism pathways.  On the other hand, high temperature is usually associated with sunshine duration, high solar irradiation, and low relative humidity that enhances ground-level ozone formation |  |  |  |
| Sciencedirect.com/science/article/pii/S1470160X21006415 |  |  | There is a significant positive correlation between daytime UHII and ozone concentration and a negative correlation between daytime UHII and other air pollutants, while there is no significant correlation between nighttime UHII and air pollutants. The UHII and air pollutants concentration are affected by the natural features and the socio-economic development. The higher LST and higher elevation, the higher daytime UHII. The higher urban area, the higher per capita GDP and the higher NDVI, the higher nighttime UHII. Cities with higher population density and per capita GDP have higher NO2 pollution concentration, while cities with closer to the ocean, higher vegetation coverage and higher elevation have lower air pollutants concentrations. | China |  |  |
| Understanding long-term variations of meteorological influences on ground ozone concentrations in Beijing During 2006–2016[☆](https://www.sciencedirect.com/science/article/abs/pii/S026974911830469X#aep-article-footnote-id7) |  |  | (Many graphs)  Convergent cross mapping method  the upward trend of ozone concentrations in Beijing was mainly attributed to the soaring increase of VOCs and NOx emission, instead of rapid changes of meteorological conditions.  Amongst multiple individual factors, temperature was the key meteorological influencing factor for ozone concentrations in all seasons except winter, when wind speed, humidity and SSD exerted major influences on ozone concentrations.  In addition to temperature, air pressure was another meteorological factor that exerted strong influences on ozone concentrations by affecting temperature and humidity conditions.  At both the inter-annual and seasonal scale, the influence of temperature and humidity on ozone concentrations was consistent whilst that of other factors experienced large variations. | China Beijing |  |  |
| <https://sci-hub.se/https://www.sciencedirect.com/science/article/abs/pii/S1352231005010885>  Impact of city on Temperature and concentration of pollutants (heat island) |  | There is a study in Paris about change of Temperature and pollution of urban, suburban and rural zones. | Cities play a quite significant role in the local and regional scale meteorology. The morphological characteristics as well as the thermal and radiative properties of the built-up surfaces have a direct impact on the surface energy exchanges, which are quite different compared to those observed above natural soils and vegetation (Oke, 1987). At night under clear and calm conditions, a large temperature gradient develops between the city and its surroundings (Oke, 1982) | Paris |  |  |
| <https://sci-hub.se/https://journals.sagepub.com/doi/abs/10.1068/b33066t?journalCode=epba>  Constructing climate change scenarios of urban heat island  intensity and air quality |  | As the global population becomes increasingly urbanized, so interest has grown in the  potential climate change impacts on city infrastructure, services, and environmental quality. | Projections of both indices are derived from atmospheric variables supplied by four general circulation models, driven by a medium-high (A2) emissions scenario for the 2050s. The results show further intensification of the nocturnal heat island and higher ozone concentrations that are most pronounced in summer. These changes reflect sensitivity to variations in regional climate alone, so omit other factors such as changes in land use, emissions, climate feedbacks, or synergies between air quality and heat islands |  |  |  |
| <https://www.sciencedirect.com/science/article/pii/S1352231015305094>  Secondary effects of urban heat island mitigation measures on air quality |  |  | The urban area of Stuttgart serves as a test bed for the modelling of a case scenario of the 2003 European Heat Wave. The selected mitigation measures are able to reduce the urban temperature by about 1 K and the mean ozone concentration by 5–8%. Model results, however, document also negative secondary effects on urban air quality, which are closely related to a decrease of vertical mixing in the urban boundary layer. An increase in primary pollutants NO and CO of 5–25% can be observed. In addition, highly reflective surfaces can increase peak ozone concentration by up to 12% due to a high intensity of reflected shortwave radiation accelerating photochemical reactions. |  |  |  |
| A review on methodology in O3-NOx-VOC sensitivity study☆ |  |  | Basic Chem of Ozone and Atmosphere and also the methods to model real ozone concentration. |  |  |  |
| <https://aaqr.org/articles/aaqr-10-07-oa-0055>  Analysis of the Relationship between O3, NO and NO2 in Tianjin, China |  | The data were used to investigate the relationship between the O3 distribution and its association with ambient concentrations of NO, NO2 and NOx (NO and NO2). |  |  |  |  |

<https://www.mdpi.com/2073-4433/13/11/1844> ozone nighttime

Ozone chemistry

## **Valmadrera**

## **Lecco Via Sora**