Prof. Dr. Stefan Brönnimann, University Bern, Switzerland

The History of Atmospheric Ozone Measurements and the Role of Swiss Observatories

Research on atmospheric ozone has a long and interesting history. Spectroscopic measurements of the ozone column started around a century ago and were related to fundamental questions of the vertical structure of the atmosphere. Soon the relation to atmospheric dynamics was discovered, notably the close negative relation to tropopause height. Total column ozone became a meteorological quantity that could possibly benefit weather forecast. Since 1926, total column ozone has been measured in Arosa (since 2020 Davos), making this the longest record in the world. Other questions concerned ozone in the troposphere. In fact, ozone measurements were performed by Daniel Challonge at Jungfraujoch and Lauterbrunnen in the early 1930s to establish the vertical gradient of ozone in the troposphere. At the same time, Chapman put forth the main reaction cycle behind the formation of the stratospheric ozone layer. However, this could not explain the seasonal and latitudinal distribution of ozone, which led to the discovery of a slow, meridional circulation of the stratosphere. In the context of the International Geophysical Year 1957/8, a global total column ozone network was established, and a clever set-up with measurements at short time intervals around sunset or sunrise allowed the retrieval of ozone profiles. Ozone sondes were flown on weather balloons since the 1960s, and Payerne became an important ozone sounding station. Satellites began the measure ozone in the 1970s. The discovery of the ozone hole in the 1980s provided a new incentive to monitor total column ozone - the Arosa series proved useful as the only long reference series -, while increased near-surface ozone started to cause health problems. The radiative effect of both stratopheric and tropospheric ozone became relevant as a climate forcing. Today the ozone layer is monitored to detect the expected ozone recovery (and to improve weather forecasts, as envisaged a century ago), while tropospheric ozone continues to exceed air quality standards. Swiss observatories play an important role for both, tropospheric and stratospheric ozone. This brief history shows how the interest in ozone changed several times – ozone was a meteorological quantity, then a geophysical quantity, a chemical quantity, and a radiative quantity – evidencing the many geophysical relations it has with the atmosphere. This is due to the chemical and radiative properties of the ozone molecule, combined with the sharp vertical gradient. For precisely these reasons, historical ozone data are interesting today as a window to the past radiative, dynamical and chemical state of the atmosphere.