



TOAR-II Scope and Roadmap for Working Groups and Publications

Authored by the TOAR-II Steering Committee, July 31, 2020

Summary: The second phase of IGAC’s Tropospheric Ozone Assessment Report (TOAR-II) was initiated on February 1, 2020 (<https://igacproject.org/activities/TOAR/TOAR-II>). This document outlines the scientific scope of TOAR-II and provides guidelines for the development of the peer-reviewed manuscripts associated with the TOAR-II effort. While the definition of specific objectives will evolve during the first year of TOAR-II, in consultation with the wider community, the overall mission and strategy have been set and are described in this document. TOAR-II will produce two sets of papers: (i) a set of contributed papers supporting the preparation of the assessment and (ii) an invited set of core papers comprising the assessment report. Each set of papers shall comprise a special issue in a yet to be decided peer-reviewed, open-access journal. Supporting papers to be contributed to the TOAR-II Community Special Issue can be developed through TOAR-II-sponsored Focus Working Groups or by other scientists or teams of scientists interested in collaborating with TOAR-II. These papers should contribute to TOAR-II objectives and ideally help the preparation of the TOAR-II assessment, for example by contributing new data or analysis methods, or through reviewing the impact of specific ozone formation and loss processes. We specifically encourage the use of the TOAR-II data resources and/or contribution of new data to these resources in order to further improve the foundation of the TOAR-II assessment. The invited peer-reviewed papers comprising the assessment report will be produced by formally established Assessment Working Groups with a clear governance structure. These papers will: 1) report key findings and their uncertainties using IPCC calibrated language; 2) use ozone metrics from the TOAR Surface Ozone Database; 3) report global and regional ozone trends and distributions using appropriate statistical methods, with a focus on common time periods; and 4) produce figures and tables that follow TOAR-II style guidelines to ensure a common look and feel to the papers.

Preamble

TOAR Mission (<https://igacproject.org/activities/TOAR>):

TOAR’s mission, developed in 2014, is to provide the research community with an up-to-date scientific assessment of tropospheric ozone’s global distribution and trends from the surface to the tropopause. This includes the production of tropospheric ozone assessment reports based on the peer-reviewed literature and new analyses, as well as the provision of easily accessible, documented data on ozone mixing ratios, exposure and dose metrics at thousands of measurement sites around the world, and links to quality assessed data sources of free tropospheric ozone at the TOAR data portal. All TOAR data are freely accessible for independent research on the global-scale impact of ozone on climate, human health and crop/ecosystem productivity. The first phase of TOAR (TOAR-I) spanned 2014-2019, and current TOAR efforts comprise the second phase of TOAR (TOAR-II).

TOAR-I Accomplishments, 2014-2019 (<https://igacproject.org/activities/TOAR/TOAR-I>):

TOAR delivered on its goals of producing the first tropospheric ozone assessment report and building the world’s largest database of surface ozone metrics, calculated consistently for over 9000 surface ozone

time series worldwide. TOAR's accomplishments were made possible by the collective efforts of the international research community, drawing on the expertise of 230 scientists and air quality specialists from 36 nations, representing research on all seven continents. For details, see [TOAR Accomplishment Report, September 2019](#), and the TOAR papers published in a [Special Feature](#) of *Elementa: Science of the Anthropocene*.

TOAR-II Goals, 2020-2024 (<https://igacproject.org/activities/TOAR/TOAR-II>):

1. TOAR Ozone Data Portal: Update the ozone observations in the TOAR surface ozone database to include all recent observations (since 2014), and include data from new sites and regions, as well as ozone precursor and meteorological data. Develop methods for including historical data (pre-1975) and create working links to repositories of free tropospheric observations.
2. TOAR publications: Exploit the new observational datasets collected by Goal 1 (with data through 2020) to provide an updated state of the science estimate of ozone's global distribution and trends relevant to climate, human health and vegetation. Extend the statistical toolbox and metrics of the TOAR trend analyses. These results will be published in the open-access, peer-reviewed literature.
3. Involve scientists from the atmospheric sciences community, as well as statisticians and scientists who focus on broader issues of global change and sustainability, to identify outstanding science questions in relation to tropospheric ozone. The range of topics can be expanded beyond the scope of the original TOAR effort to investigate the impacts of tropospheric ozone on climate, human health and vegetation, and to address urban-scale issues in addition to the regional and global scale.
4. Maximize exploitation of the TOAR Surface Ozone Database by, 1) helping scientists around the world, beyond the TOAR effort, to apply the database to new analyses, and 2) exploring new data science methods to improve the analysis of global ozone trends and their attribution.

TOAR-II Scope

The scientific scope of TOAR-II is an observation-based, up-to-date assessment of tropospheric ozone's distribution and trends on regional, hemispheric and global scales. Observations include in situ measurements using modern quantitative methods, e.g. UV-absorption instruments (surface and airborne), wet chemical ozonesondes, and remote sensing methods from ground- and space-based platforms (e.g. lidar, UV-absorption, thermal-infrared). Historical data (pre-1975) may also be considered (see the review by *Tarasick and Galbally et al., 2019*), as can proxy-based estimates of tropospheric ozone from the 19th century and earlier (e.g. *Yeung et al., 2019*). In relation to IPCC, the scientific scope of TOAR-II is based on IPCC Working Group I, which assesses the physical science of climate change, and IPCC Working Group II, which assesses the vulnerability of socio-economic and natural systems to climate change (<https://www.ipcc.ch/working-groups/>). Similar to the scope of these IPCC Working Groups, TOAR-II will assess the physical science basis for tropospheric ozone's global distribution and trends, and TOAR-II will also explore and quantify the impacts of tropospheric ozone on human health, crop and ecosystem productivity and climate change. IPCC Working Group III focuses on climate change mitigation, assessing methods for reducing greenhouse gas emissions, and removing greenhouse gases from the atmosphere; related research as applied to tropospheric ozone will not be assessed by TOAR-II, although TOAR data will be publicly available for independent research on these topics. As TOAR is a science effort, studies may be policy-relevant but not policy-prescriptive.

Procedures for TOAR-II manuscript development

TOAR-II findings will be disseminated through the peer-reviewed literature. The papers will be organized in two TOAR-II Special Issues of a yet to be determined peer-reviewed, open-access host journal under two categories: (i) a set of papers contributed to the TOAR-II Community Special Issue which support the preparation of the assessment, and (ii) an invited set of core papers comprising the assessment report.

Supporting papers to be contributed to the TOAR-II Community Special Issue can be developed through TOAR-II-sponsored Focus Working Groups (see the Working Group Guidelines document on the [TOAR-II website](#)), or by other scientists or teams of scientists interested in collaborating with TOAR-II. These papers should contribute to TOAR-II objectives and ideally help the preparation of the TOAR-II assessment, for example by contributing new data or analysis methods, or through reviewing the impact of specific ozone formation and loss processes. We specifically encourage the use of the TOAR-II data resources and/or contribution of new data to these resources in order to further improve the foundation of the TOAR-II assessment. Uptake of these papers in the TOAR-II assessment is facilitated if new findings are presented in relation to an extensive literature review, with detailed comparisons to previous work, and if these studies conclude with concise summary statements that provide the broader context of new findings, along with uncertainty estimates. While the authors are free to use statistical methods of their choosing, ozone distributions and trends should also be reported using common TOAR methods and/or TOAR time periods to enable comparisons across studies. We encourage contributing author teams to share their ideas for papers with the TOAR-II Steering Committee in the early stages of paper development, to identify ways that the papers can be most supportive of the assessment report, and thereby maximizing their impact.

Papers contributing to the TOAR-II Community Special Issue must be submitted by September 1, 2023, so that their results can be included in the core assessment report papers. Once papers are submitted to the Special Issue they will proceed through the normal peer-review process and will be subject to the scope of the host journal.

Assessment Working Groups, which are established using a clear protocol and which are governed through documented principles established by the TOAR-II Steering Committee (see the Working Group Guidelines document on the [TOAR-II website](#)), will produce the invited peer-reviewed core papers comprising the assessment report. These papers will: 1) report key findings and their uncertainties using IPCC calibrated language (described below); 2) use ozone metrics from the TOAR Surface Ozone Database; 3) report global and regional ozone trends and distributions using appropriate statistical methods, with a focus on common time periods; and 4) produce figures and tables following TOAR-II style guidelines to ensure a common look and feel to the papers. As of this writing, the list of assessment report core papers is comprised of updates to TOAR-Health [*Fleming and Doherty et al.*, 2018], TOAR-Vegetation [*Mills et al.*, 2018] and TOAR-Climate [*Gaudel et al.*, 2018]. Additional core papers will be identified by the TOAR-II Steering Committee at a later date, based on input from the TOAR-II community. Each TOAR-II assessment paper must include an SC member as a co-author and each paper must be approved by the SC prior to submission.

TOAR-II Timetable

02/2020	TOAR-II initiated
09/2020	TOAR-II Quickstart Event
01/2021	First TOAR-II Workshop, held globally in virtual format
2022	Develop new ozone metrics and populate Surface Ozone Database
01/2023	begin preparation of assessment papers
09/2023	deadline for submission of papers to Community Special Issue
2024	Submission of core assessment papers

IPCC Calibrated Language

The IPCC Fifth Assessment Report developed a method for the consistent treatment of uncertainties across all three IPCC Working Groups. *Mastrandrea et al.* (2010), “define a common approach and calibrated language that can be used broadly for developing expert judgments and for evaluating and communicating the degree of certainty in findings of the assessment process.” This method has been adopted by the IPCC Sixth Assessment Report and will also be used by TOAR-II. The method relies on two metrics for communicating the degree of certainty in key findings:

- 1) Confidence in the validity of a finding, based on the type, amount, quality, and consistency of evidence (e.g., mechanistic understanding, theory, data, models, expert judgment) and the degree of agreement. Confidence is expressed qualitatively.
- 2) Quantified measures of uncertainty in a finding expressed probabilistically (based on statistical analysis of observations or model results, or expert judgment).

Further details are provided by *Mastrandrea et al.* (2010).

References:

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- Gaudel, A., et al. (2018), Tropospheric Ozone Assessment Report: Present-day distribution and trends of tropospheric ozone relevant to climate and global atmospheric chemistry model evaluation, *Elem Sci Anth*, 6(1):39, DOI: <https://doi.org/10.1525/elementa.291>
- Mastrandrea, M.D., et al. (2010), Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties. Intergovernmental Panel on Climate Change (IPCC). Available at: <https://www.ipcc.ch/publication/ipcc-cross-working-group-meeting-on-consistent-treatment-of-uncertainties/>
- Mills, G, et al. (2018), Tropospheric Ozone Assessment Report: Present-day tropospheric ozone distribution and trends relevant to vegetation. *Elem Sci Anth*, 6(1):47, DOI: <https://doi.org/10.1525/elementa.302>
- Tarasick, D., and I. E. Galbally, et al. (2019), Tropospheric Ozone Assessment Report: Tropospheric ozone from 1877 to 2016, observed levels, trends and uncertainties. *Elem Sci Anth*, 7(1), p.39. *Elem Sci Anth* 7, 39. <https://doi.org/http://doi.org/10.1525/elementa.376>
- Yeung, L.Y., et al. (2019), Isotopic constraint on the twentieth-century increase in tropospheric ozone. *Nature* 570, 224–227. <https://doi.org/10.1038/s41586-019-1277-1>