Tropospheric Ozone Assessment Report – Phase II and the TOAR-II Satellite O3 Working Group (SOWG)

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on behalf of the TOAR-II SC

CEOS AC-VC-16

Virtual Meeting, June, 2020

TOAR-II in a nutshell

TOAR-II continues the successful work of TOAR-I and lasts until 2024

TOAR-II will provide updated and extended metrics on tropospheric ozone.

TOAR-II will provide an updated state of the science estimate of ozone's global distribution and trends relevant to climate, human health and vegetation

TOAR-II will further enhance the TOAR data portal and web services

TOAR-II will extend the statistical toolbox and trend analyses

TOAR-II will maximize exploitation of the TOAR Surface Ozone Database

TOAR-II reaches out to the international scientific community

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https://igacproject.org/activities/TOAR/TOAR-II

TOAR-II Steering Committee

Owen Cooper (co-Chair), CIRES, University of Colorado Boulder/NOAA CSL, USA

Martin Schultz (co-Chair), Forschungszentrum Jülich, Germany

Lisa Emberson, University of York, UK

Yugo Kanaya, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan

Raeesa Moolla, University of the Witwatersrand, South Africa

Yinon Rudich, Weizmann Institute of Science, Israel

Erika von Schneidemesser, Institute for Advanced Sustainability Studies, Potsdam, Germany

Rodrigo Seguel, Center for Climate and Resilience Research (CR)2, Universidad de Chile, Sanitago, Chile

Bärbel Sinha, Indian Institute of Science Education and Research (IISER), Mohali, India

Helen Worden, National Center for Atmospheric Research, Boulder, USA

Lin Zhang, Peking University, Beijing, China

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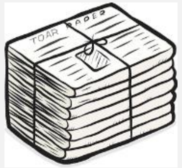
TOAR-I accomplishments

Nine highly-cited journal publications in Elementa



A database with easily accessible ozone metrics at 1000s of stations worldwide

A highly motivated community of > 240 scientists from over 35 countries

Uptake of TOAR results in impact communities (e.g. GBD)

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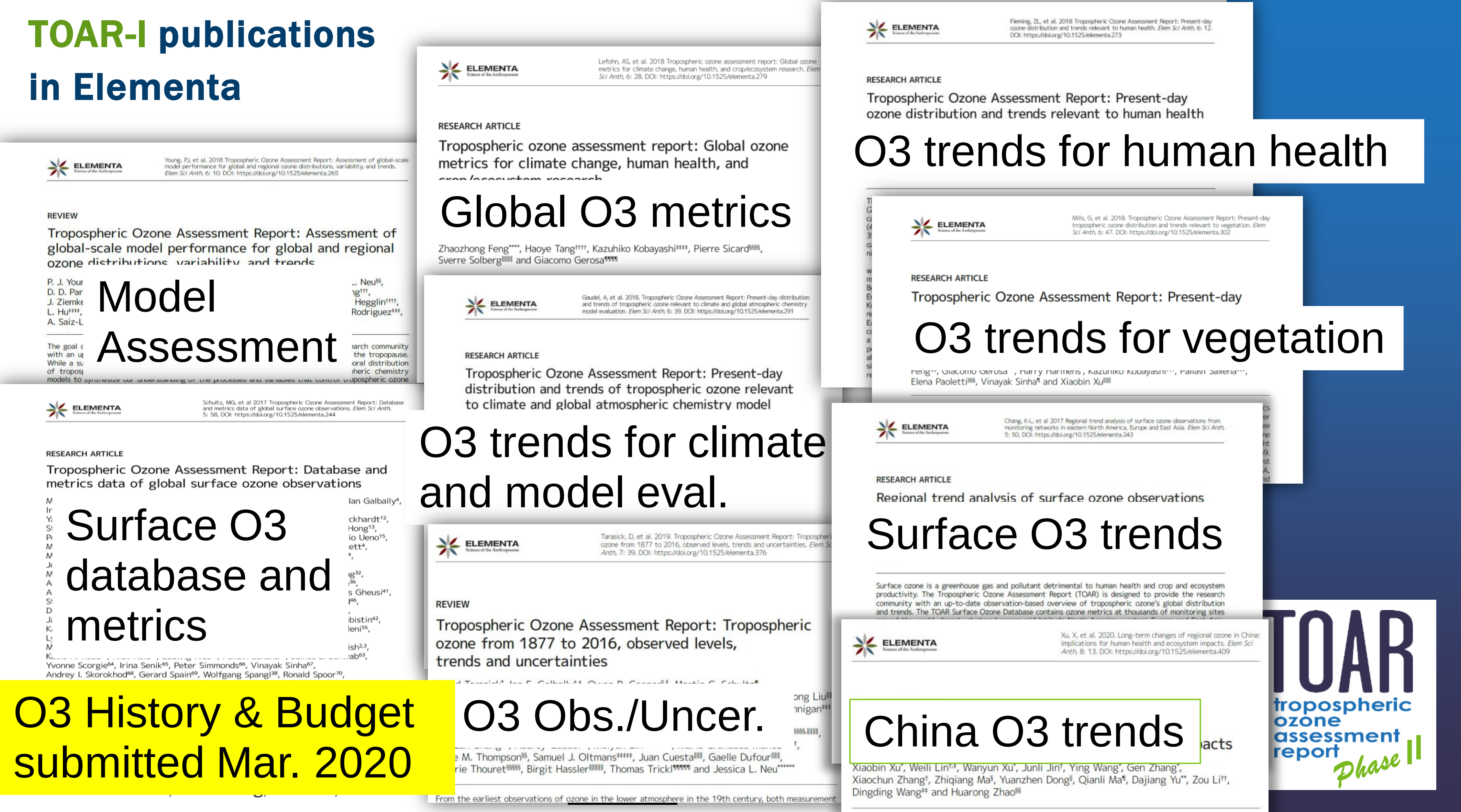
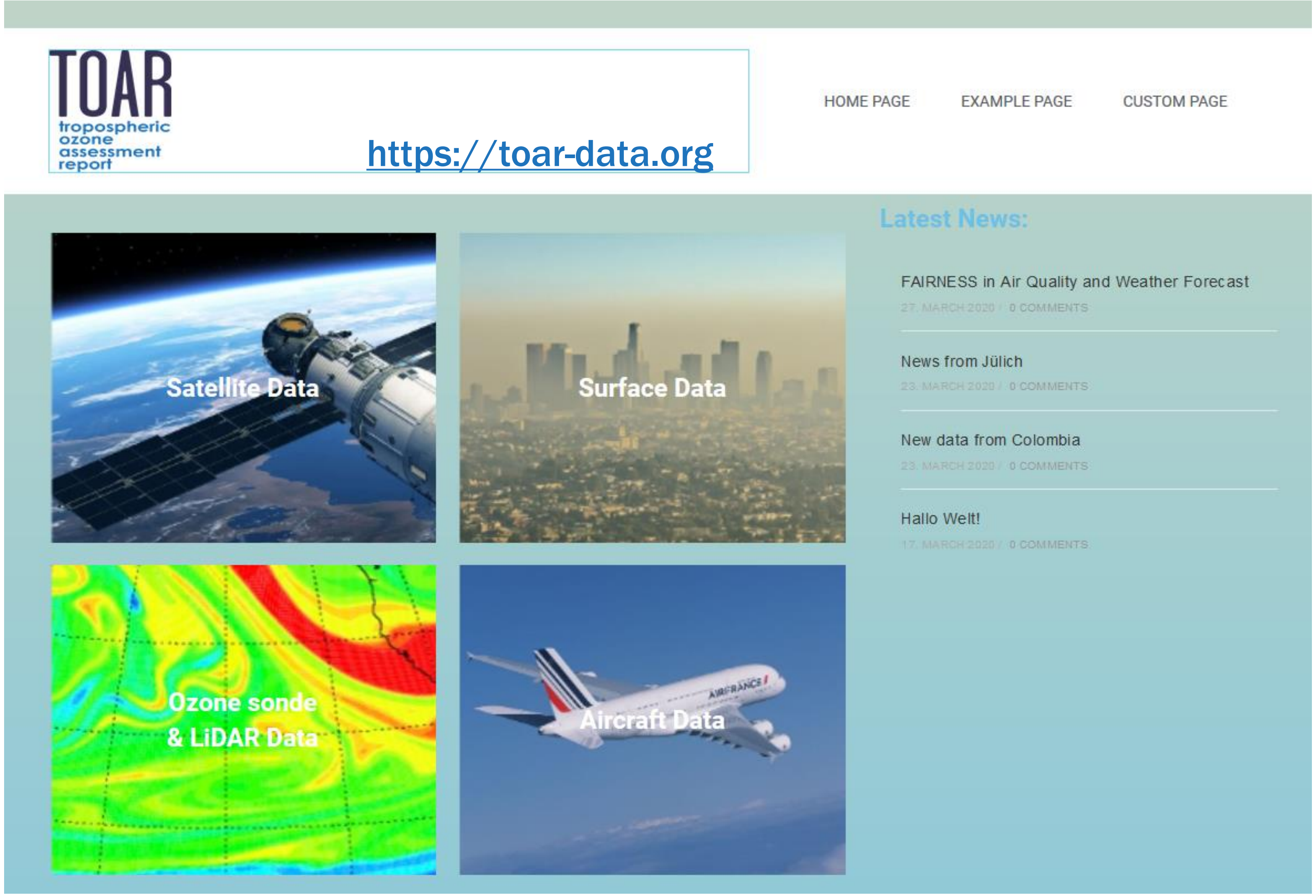
TOAR-I publications in Elementa

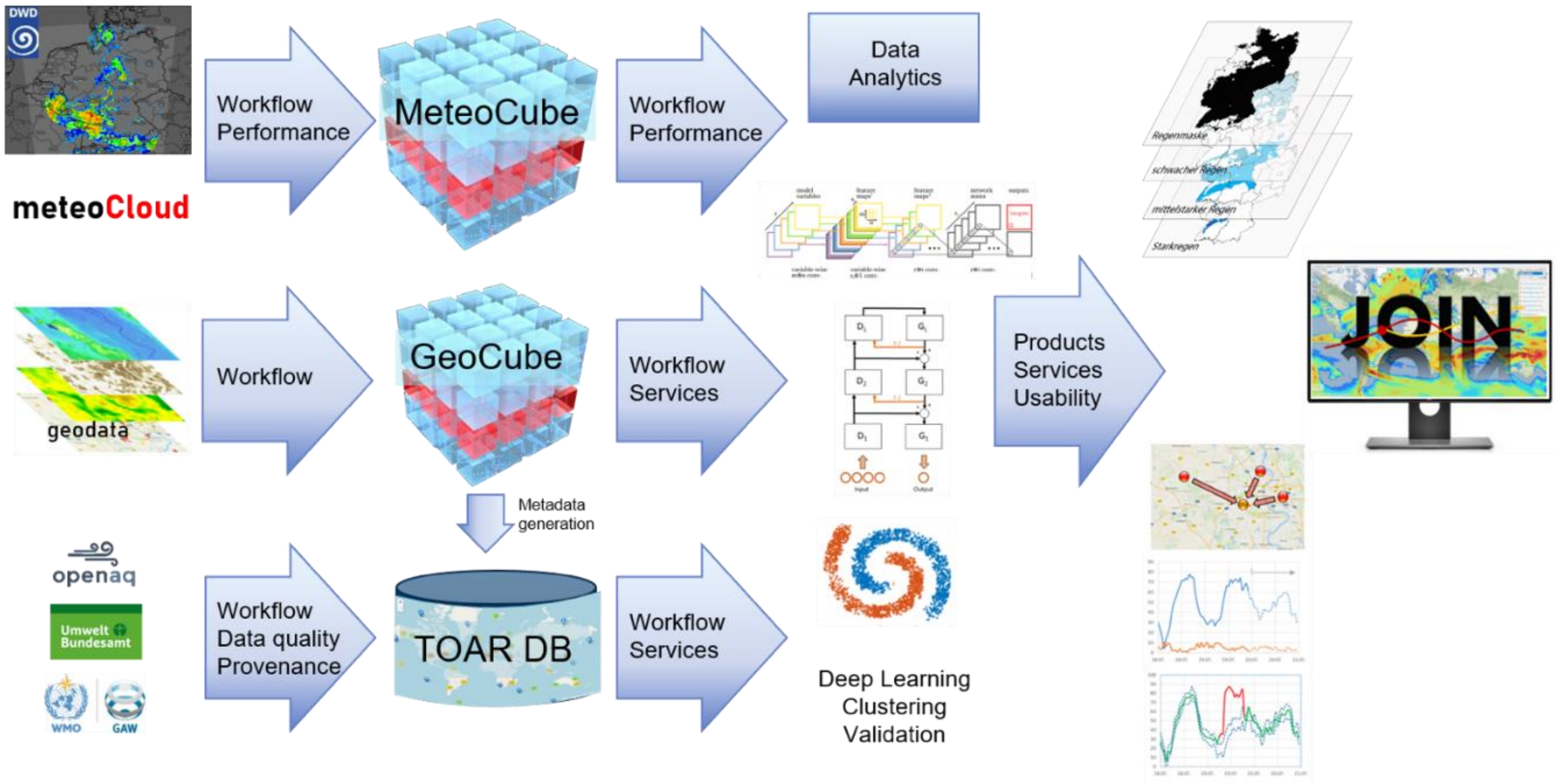


Design of a new TOAR data portal



https://igacproject.org/activities/TOAR/TOAR-II

The new TOAR-II data infrastructure



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TOAR-II Status and roadmap

2020

Selection of new steering committee
Planning of objectives and roadmap
Formation of working groups
Development of enhanced data infrastructure

2021

First TOAR-II workshops
Beginning of new data collection
Bring data infrastructure online

2022

WGs: Preparation of analyses and planning of manuscripts
Develop new metrics and populate database

2023

Finalize data
Perform new and updated analyses
Draft manuscripts

2024

Publication of TOAR-II

https://igacproject.org/activities/TOAR/TOAR-II

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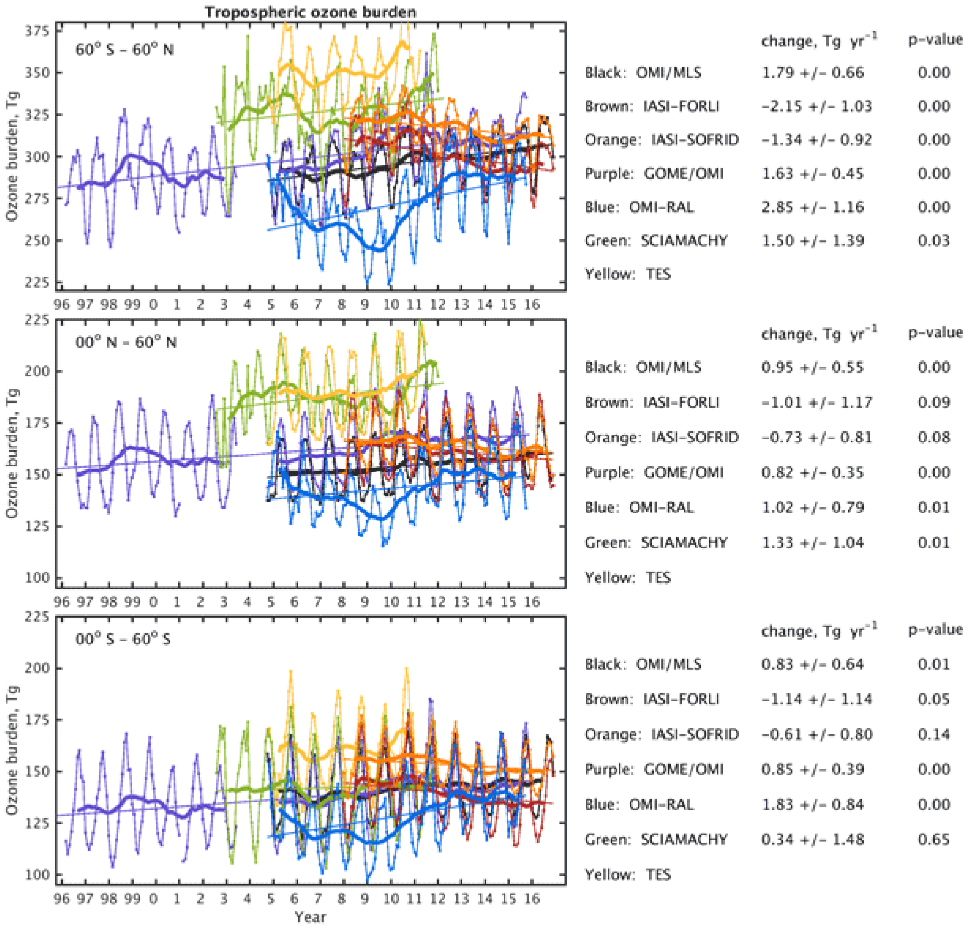
Primary goal of the SOWG

Understand wide variety of trends and variations in tropospheric O_3 (TrO_3) reported by TOAR-I

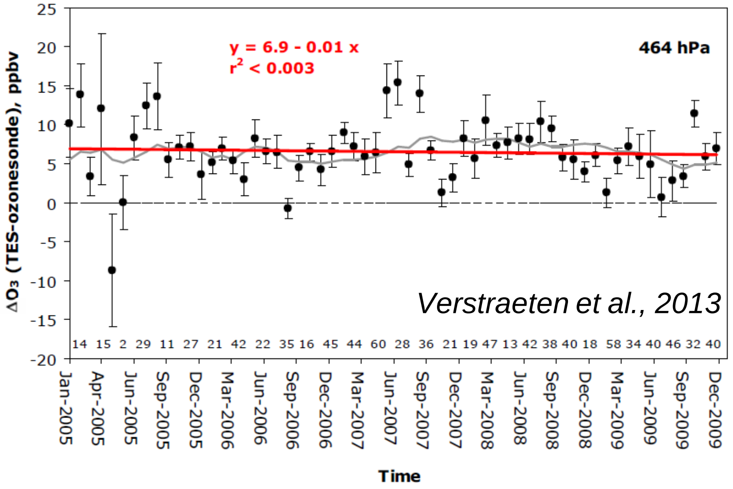
Gaudel et al, 2018
http://doi.org/10.1525/elementa.291



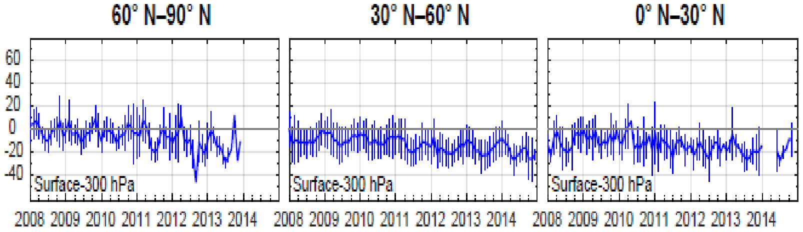
https://igacproject.org/activities/TOAR/TOAR-II

Approach 1: Time series of ozonesonde biases

TES vs Ozonesondes, 464 hPa, Northern Midlatitudes



IASI-FORLI vs Ozonesondes, Sfc-300 hPa, NH



Boynard et al., 2016

We will assess the stability of the satellite ozone measurements as a function of time.

To do so, we will calculate the monthly mean bias of partial column ozone from each instrument relative to ozonesondes (using the weighting function for each profile) for 5-6 latitude bands for the entire length of each satellite record.

We will specify a format for the satellite ozone records. If the instrument groups are able to provide data to the SOWG in this format, we will assess the bias against sondes. If not, we will provide the methodology to the instrument group and ask them to do the sonde comparison.

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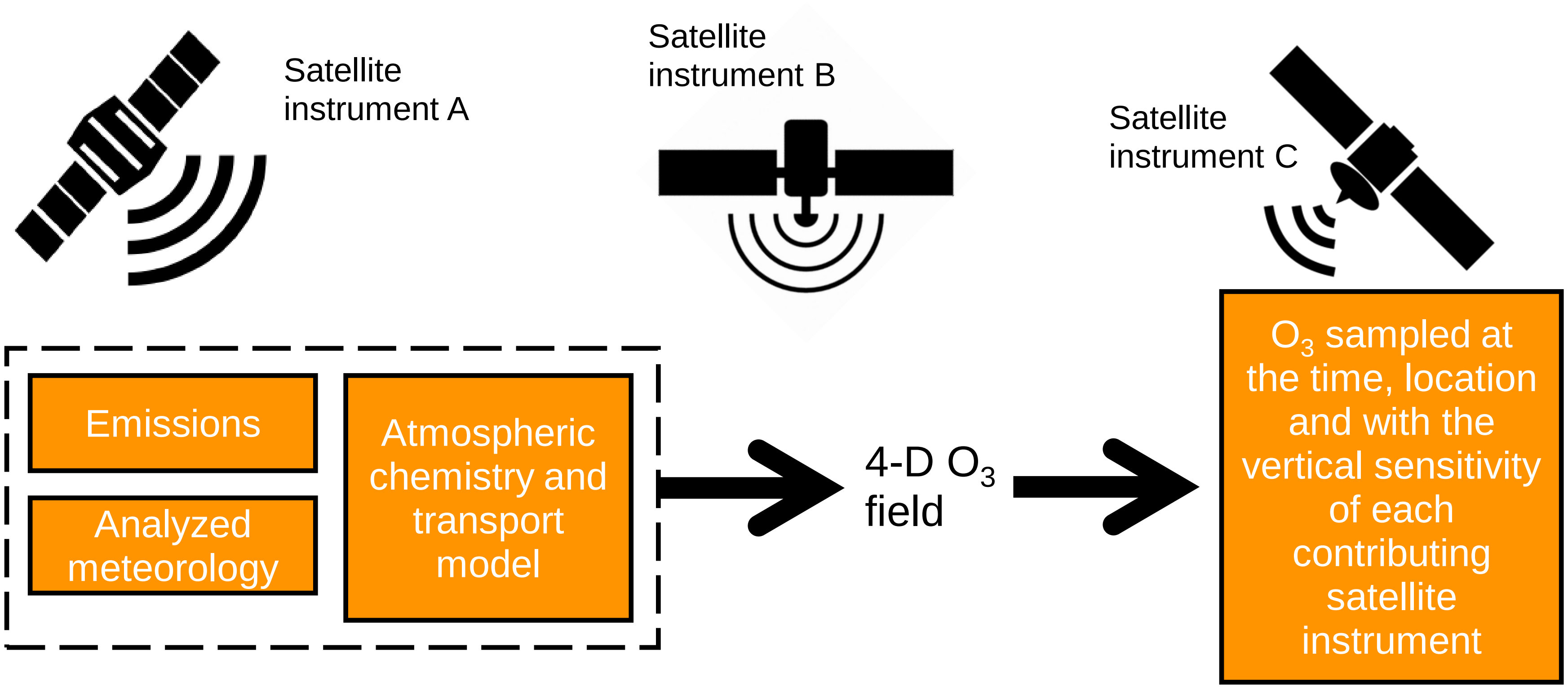
Approach 2: Sampling patterns and vertical sensitivity



The model acts an intermediary to help reconcile trends reported by satellites A, B, C…
and help us relate us link satellite-observed trends with other TrO_3 data.

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Statistical methods

We will use a range of methods to determine corresponding model and observed:

- Non-linear trends
- Atmospheric growth rates
- Step-wise changes, e.g. Covid-19

All taking into consideration data uncertainties so we can investigate robustness of our findings.

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Study period: 2004-Spring 2021

An **initial** list (guided by TOAR-I) of relevant data.

Satellite - Instrument	Time period	Groups
Metop A,B,C - IASI	2008 - present	LATMOS (FORLI retrieval) LISA (KOPRAFIT retrieval) U.Toulouse/CNRS (SOFRID)
Metop A,B,C - GOME-2	2008 - present	U. Bremen
Metop - IASI/GOME-2	2008 - present	LISA (KOPRAFIT) STFC
Aura - OMI trop. column	2004 - present	NASA/GSFC KNMI
Aura - OMI/MLS	2004 - present	NASA/GSFC
Aura - OMI profile	2004 - present	SAO
Aqua - AIRS/ Aura - OMI	2004 - present	NASA/JPL
Aura - TES	2004 - 2010	NASA/JPL
Envisat - SCIAMACHY	2002 - 2012	U. Bremen

- We will also include TROPOMI (as a follow-on to OMI) and GEMS (to provide TrO_3 diurnal cycle).
- We have decided to analyse data to Spring 2021 so we can include the pandemic period and the anticipated return of emissions.

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Secondary goal of the SOWG

The broader community is central to the success of the SOWG.

We will coordinate TOAR-related studies of satellite retrievals of TrO_3.

Data and model output will be made available in a uniform data format for further scientific exploitation.

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Indicative timelines

Summer 2020: Solicit participation in working group and set up virtual meetings

Fall 2020: Generate the methodology for direct satellite-sonde comparisons to be distributed to the various groups

Winter 2020: Establish the evaluation period to be used as well as a common definition for the vertical extent of the measurements (e.g. tropospheric ozone column, partial column, individual pressure levels, etc).

Spring 2021: Request data from the satellite groups (updates from TOAR-I contributors).

Summer 2021: Begin analysis using the model output to reconcile difference among the satellite trends up to Spring 2021, taking into account big changes in 2020 due to Covid-19 and expected emission changes in 2021.

Spring 2022: Complete analysis using the model and assess the consistency of the satellite trends with one another and with in situ data

Fall 2022-Winter 2023: Write up results of our analysis for publication

Spring 2024: submit for publication in TOAR II.