CMIP Forcing Dataset provision – the ESA contribution.

Addressing forcings delivery in CMIP7

The CMIP7 Forcings task team are:

- Evaluating and documenting the CMIP6-era forcing collection issues, coverage gaps, or omissions through community feedback.
- Identifying forcings for current and next generation climate models in support of CMIP7.
- Aiming to identify, develop, document and deliver an updated and expanded forcing collection to near real time.
- Coordinate with modelling groups to define and perform routine experiments for evaluation, generate simulations and gather feedback with these new forcing collections.
- Engaging with wider WCRP and other activities to reduce duplication of effort and supporting CMIP Panel in operationalisation discussion.

ESA's contribution in detail

Overall remit is for research and development activities within ESA member states, supporting development and use of Earth observation data in CMIP forcing datasets. This can include (but is not limited to):

In kind support

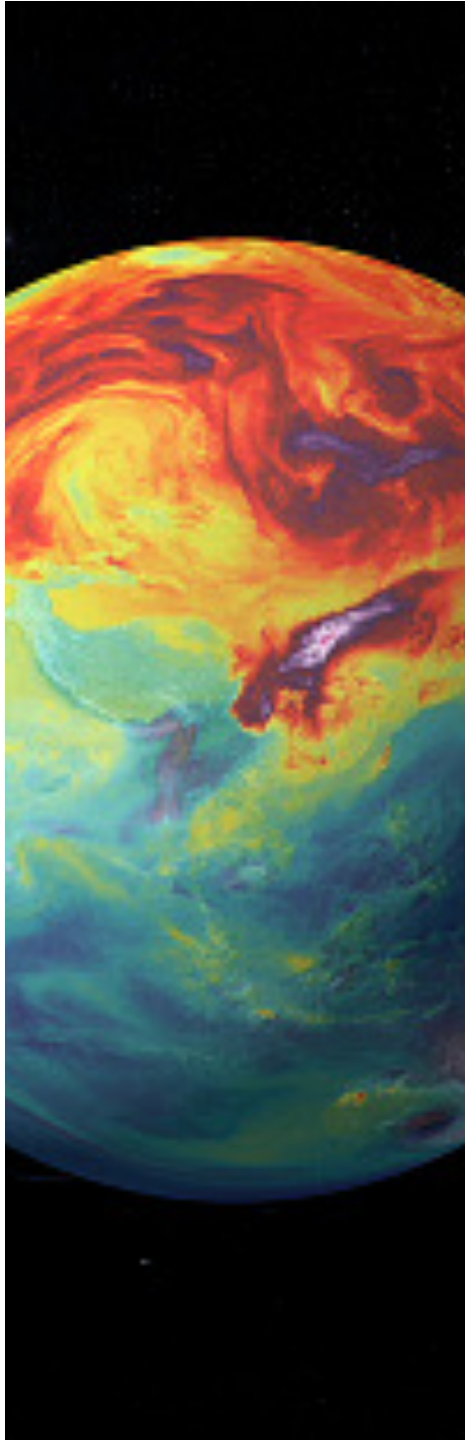
- Expertise, data access, expert consultancy, Long-term Climate Data Records

Funding research and development activities

- Limited to ESA member states. Where there is a clear need for research and development funding for utilising ESA data within the forcing dataset development pipeline.

Steps towards sustainability

- Potential to support cross cutting activities (e.g. development of 'forcing benchmarking' activities) as part of a collaboration.



CMIP

WCRP World Climate Research Programme

Challenges for CMIP7

- Expected tight timeline to CMIP7 model run deadlines.
- Community expectation and memory of CMIP6 delivery delays.

And…….

- Coordinated and sustainable funding across all dataset providers to allow for timely delivery and potential for annual updates.
- Nearly one half of dataset providers were unfunded during CMIP6. Almost none had sustainable ‘operational’ provision plans.

WCRP World Climate Research Programme

CMIP

Technical challenges for forcing datasets:

- Forcing datasets typically run 1750/1850-2125 (2500 for GHG!)
- For EO in the historical record
  - Harmonisation between well-observed satellite period and pre-satellite era
  - What can be learned from satellite era that can be applied earlier in the record (variable dependent - seasonal cycle, latitudinal gradients etc.)
  - How do we handle uncertainties in forcing data, and how would this information be used by the modelling community
- Operational footing
  - >50% forcing datasets had no sustainable CMIP6 funding. The community is developing individual and combined roadmaps to operationalisation.

Timeline and ESA project summary

- The forcing teams aim to provide:
  - Near term (~6 mo): v0 new/*updated* historical forcing (1850-2022), or *extensions* to the CMIP6 forcing (2014-2022)
  - CMIP7 (~2 y): A complete v1 or v2 updated forcing dataset including future forcings incorporating new science, underpinning documentation, etc. Timings coordinated with CMIP7 modelling groups
  - Ongoing: “Operational” updates to the historical forcing data, at least annually.

ESA contribution to R&D

- 4 Forcing Variables - Projects will prepare forcing data for CMIP7 on 2yr timescales, to maximise the contribution of EO data in the historical forcings, and prepare for operational provision of
  - Ozone concentrations
  - GHG Concentrations
  - Sea surface Temperature
  - Volcanic aerosol concentrations (AOP) and emissions (SO_2)
- Coordination with other modelling/obs groups to maximise impact (e.g. for volcanic forcing, coordination with ERA6/SEAS6 teams, coordination with ESMO-IPO)

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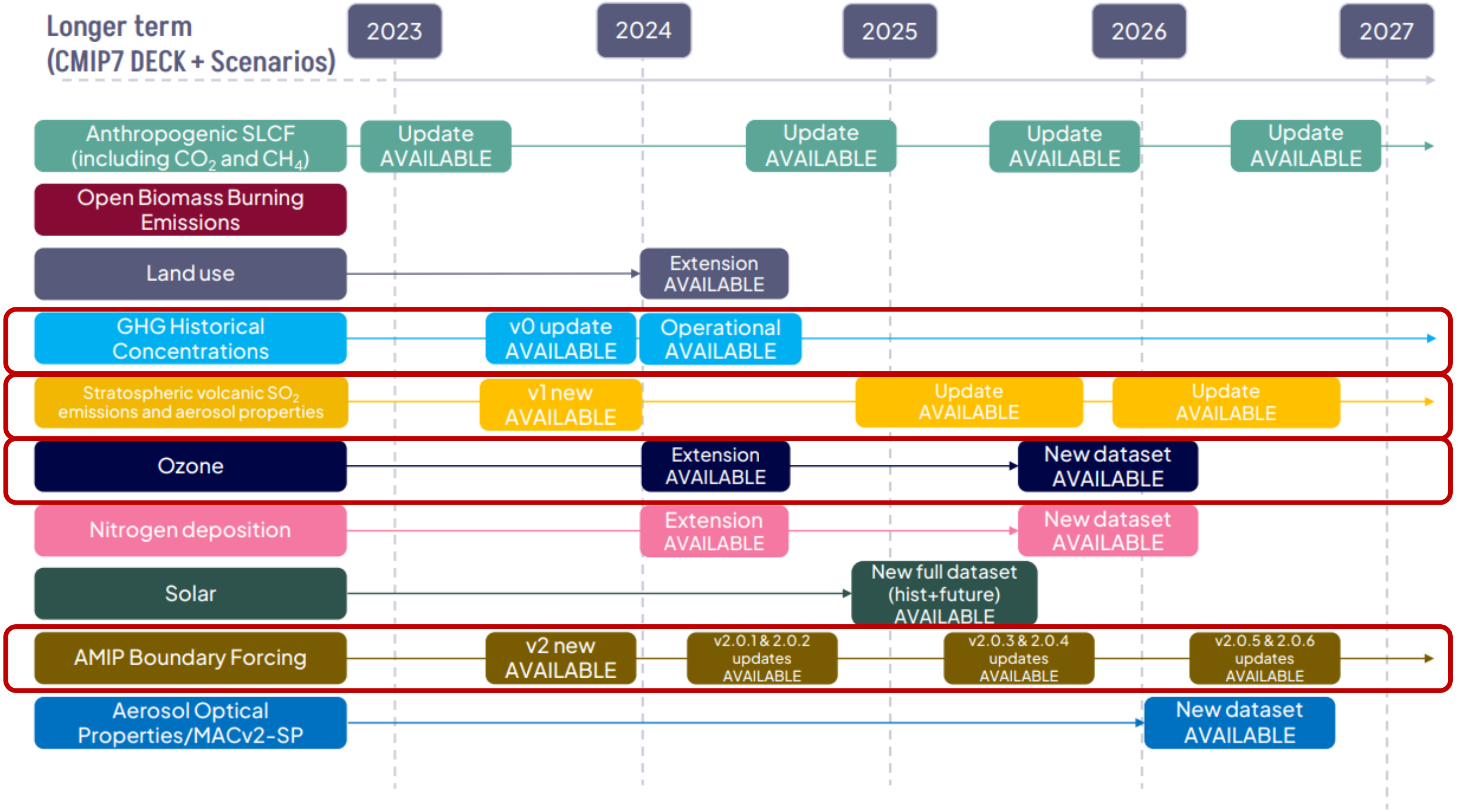
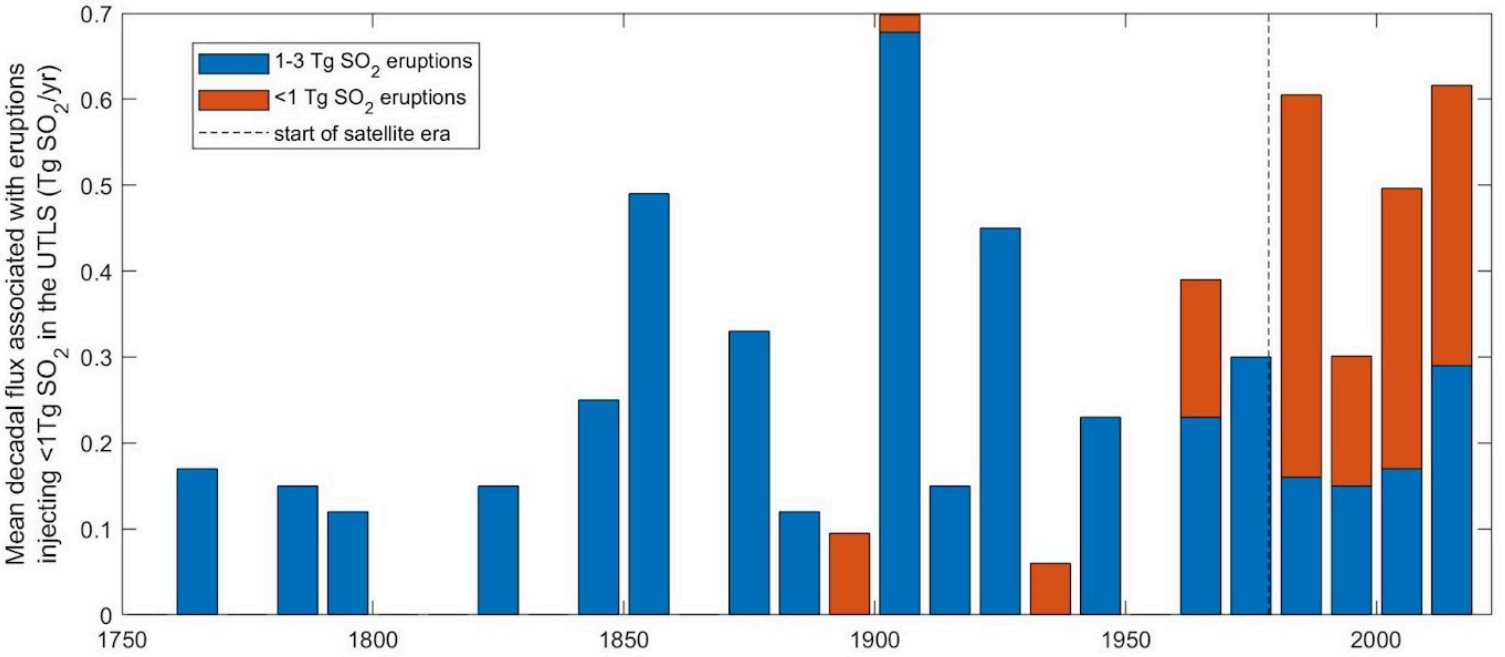

Longer term
(CMIP7 DECK + Scenarios)
2023
2024
2025
2026
2027
Anthropogenic SLCF (including CO_2 and CH_4)
Update AVAILABLE
Update AVAILABLE
Update AVAILABLE
Update AVAILABLE
Open Biomass Burning Emissions
Land use
Extension AVAILABLE
GHG Historical Concentrations
v0 update AVAILABLE
Operational AVAILABLE
Stratospheric volcanic SO_2 emissions and aerosol properties
v1 new AVAILABLE
Update AVAILABLE
Update AVAILABLE
Ozone
Extension AVAILABLE
New dataset AVAILABLE
Nitrogen deposition
Extension AVAILABLE
New dataset AVAILABLE
Solar
New full dataset (hist+future) AVAILABLE
AMIP Boundary Forcing
v2 new AVAILABLE
v2.0.1 & 2.0.2 updates AVAILABLE
v2.0.3 & 2.0.4 updates AVAILABLE
v2.0.5 & 2.0.6 updates AVAILABLE
Aerosol Optical Properties/MACv2-SP
New dataset AVAILABLE

Example: Volcanic forcing



Dataset will provide SO_2 emissions (per eruption) and AOP gridded monthly including vertical resolution

- Small-medium eruptions very under-reported in the pre-satellite era
- This can have a substantial impact on RF on decadal timescales.
- Uncertainty?
- Additionally, contamination of the ice core record post ~1900 (phase 2?)
- How can we approach this issue in a consistent manner for CMIP7?

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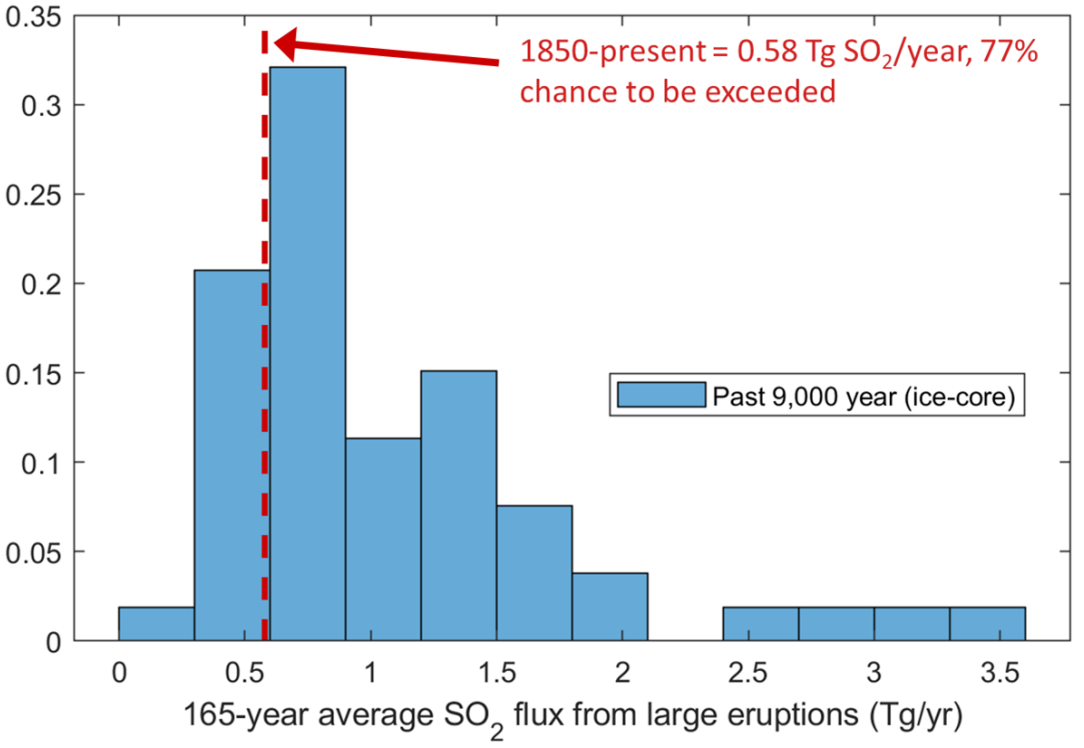
Example: Volcanic forcing - future



- Recent (1850-present) past has been a period of relatively low volcanic activity
- For future forcings, how can we use what we know about the past to span the volcanic uncertainty into the future?
- As a minimum, include small-medium eruptions in the baseline

CMIP

Example: Volcanic forcing

- Approach:
  - Assess uncertainties in EO records for stratospheric SO_2 and aerosol optical properties datasets
  - Use CDRs and uncertainty assessment to produce v0 historical using updated model parameterisations pre-1979
  - Use the EO record to assess systematic bias in pre-satellite era small-medium eruptions. V0 to include static baseline for small eruptions.
  - Pilot study to assess resulting RF and Surface Temperature uncertainties using climate emulators and simple models

- First results from all projects out ca Q2 2024 – watch this space!

CMIP