Workshop: Pathway to regular and sustained delivery of climate forcing datasets

summary by Anca Brookshaw, on behalf of the participants

- Update on forcings production (TT discussion)
- Update on scenarioMIP progress
- Sustained mode forcings:
  - what would it involve?
  - what are the challenges?
  - what do (non-CMIP) users need?
  - what is the funding landscape?

https://wcrp-cmip.org/event/forcings-workshop/

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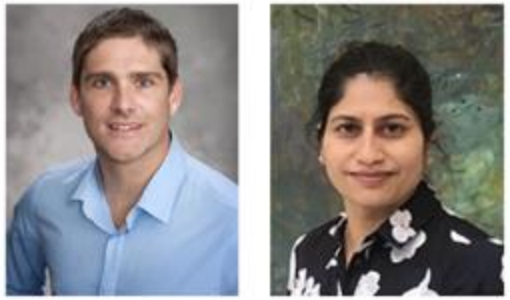
The CMIP Forcings Task Team members

















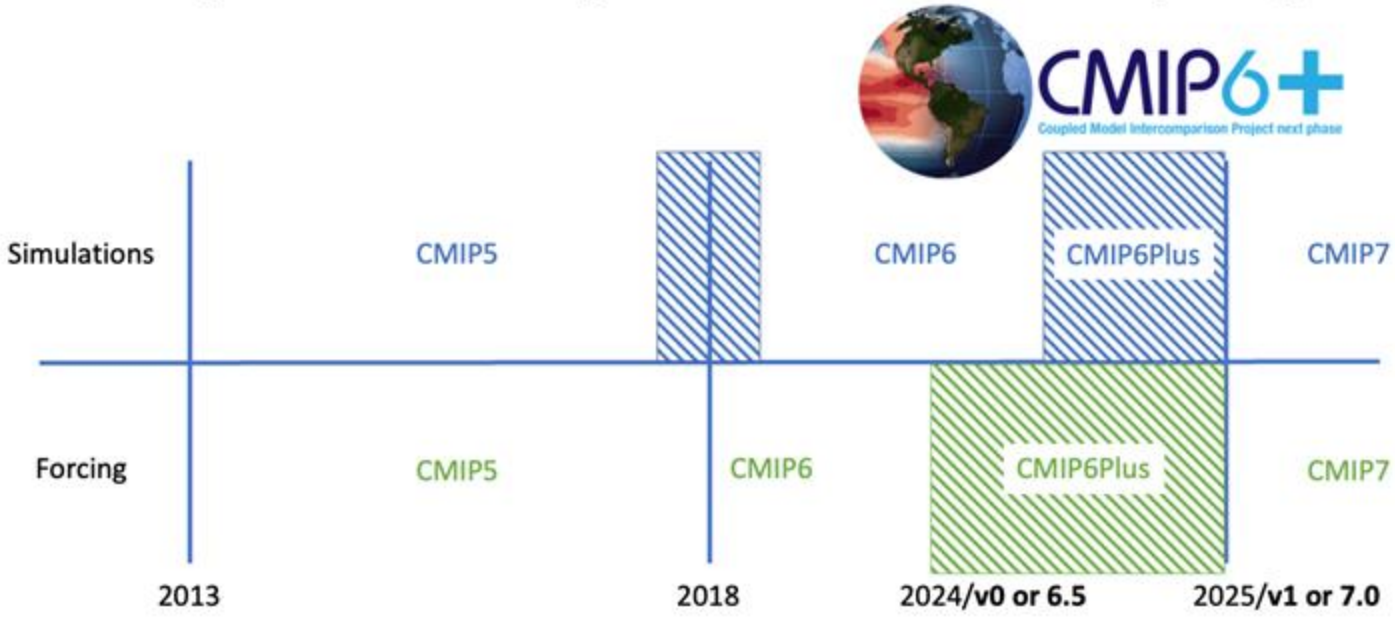
WCRP World Climate Research Programme

CMIP

Map of TT members and stakeholders

University of Exeter
Met Office
esa
University of Reading
Imperial College London
ECMWF
JÜLICH Forschungszentrum
Environment and Climate Change Canada
GEOMAR Helmholtz Centre for Ocean Research Kiel
NOAA
University of Maryland
C A U Kiel University Christian-Albrechts-Universität zu Kiel
Deltares
Pacific Northwest National Laboratory
NASA
LMU Ludwig-Maximilians-Universität München
NCAR National Center for Atmospheric Research
Department of Energy United States of America
DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center
Lawrence Livermore National Laboratory
WCRP World Climate Research Programme
CSIC Consejo Superior de Investigaciones Científicas
IPSL
IIASA
CSIRO
The University of Melbourne
CMIP

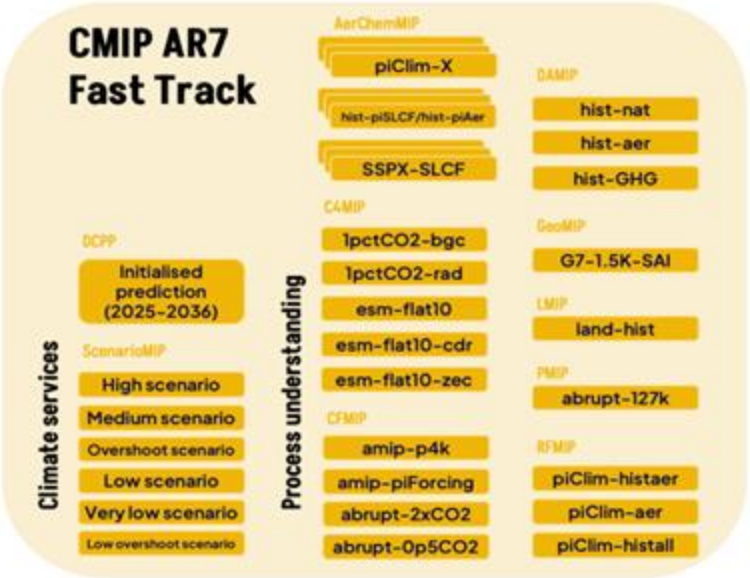
A forcing evolution following the continuous CMIP DECK paradigm

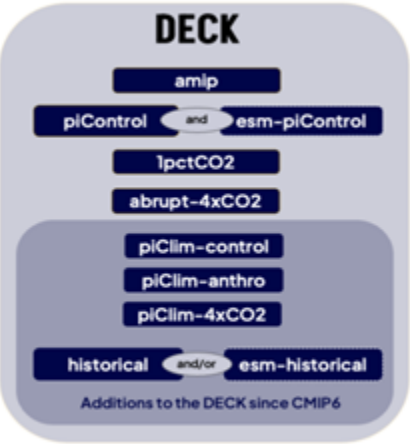


Transition between MIP-era model simulations

Transition between MIP-era forcing datasets (broader, prototype datasets need iteration before "formal" model simulations begin)

v0/CMIP6Plus - datasets available for testing and evaluation
v1 /CMIP7 - updates in early 2025 for use in CMIP7 piControl and historical experiments





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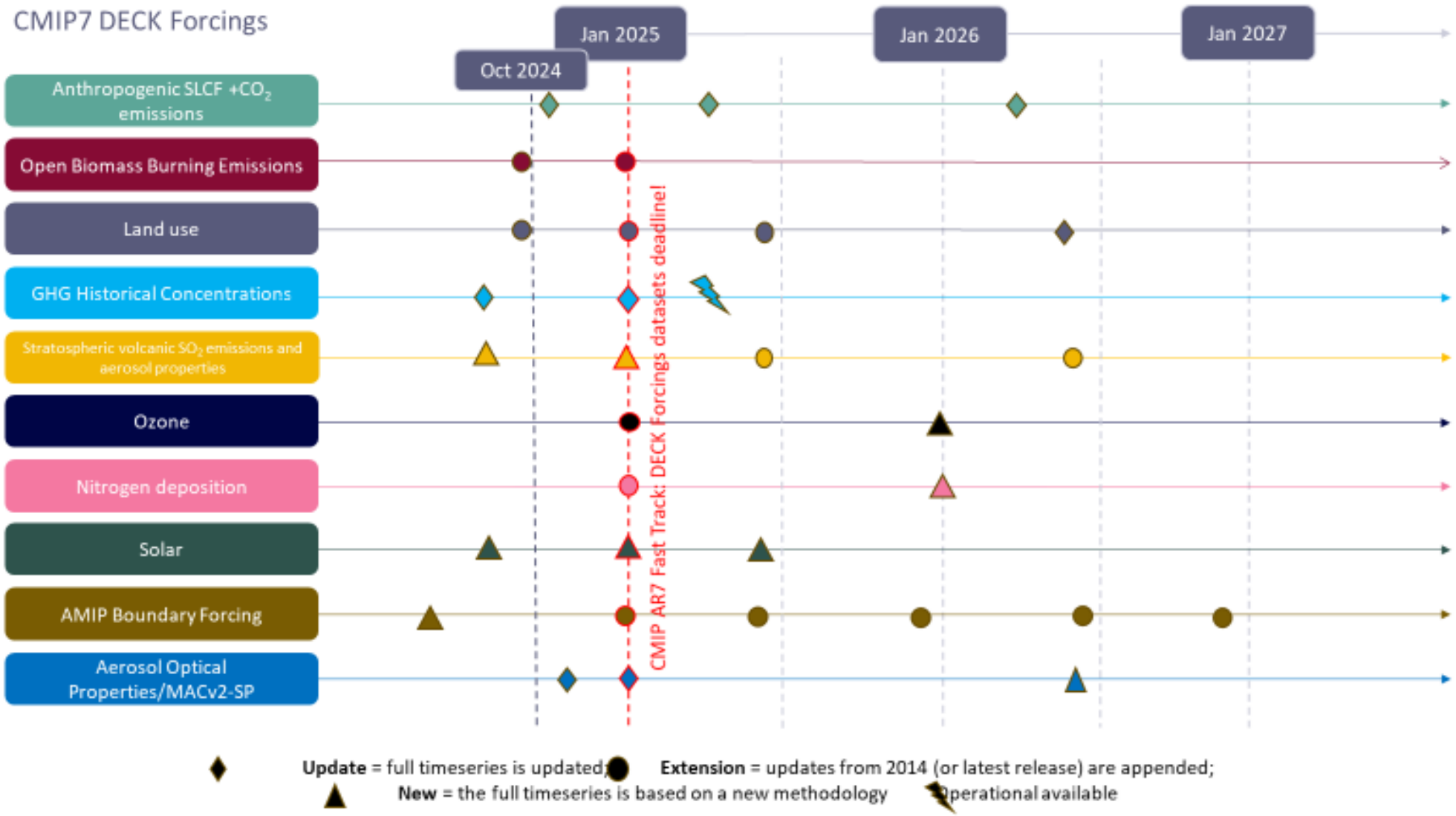
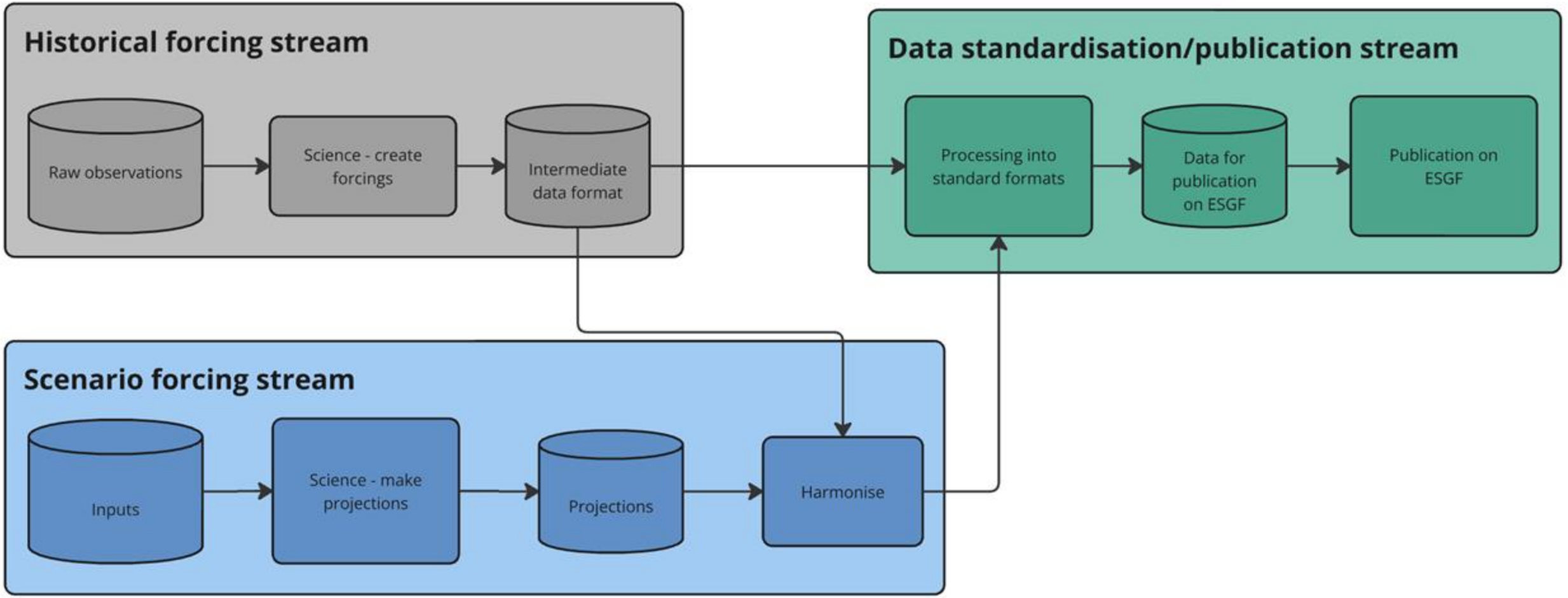


Producing forcings (roughly)



Non-CMIP user requirements

Quality requirements: re-analysis

Tim Stockdale

- High quality and consistency are both *desirable*, to facilitate climate analysis
- However, analysed fields (temperatures, winds etc) are highly constrained by data assimilation
  - (aside: ERA6 uses variational bias correction for most input data, so discontinuities or drifts in model bias characteristics could potentially cause trouble, if anchor observations are insufficient)
  - (aside: some regions e.g. upper stratosphere are less well constrained by data, especially in pre-satellite era, so forcing matters more)
  - (aside: reanalyses have their limits, when data is poor and forcing is uncertain, and that is OK)
- Traceability and credibility are also important – nice to follow community standards, best practice

Quality requirements: seasonal forecasting

Tim Stockdale

- Model quality is much more critical
  - Forecasts are for 7-13 months, not 12 hours, plenty of time for things to go wrong
- Real-time forecasts are calibrated against re-forecasts
  - **Critical** that model biases are unchanged
  - Need high degree of consistency for initial conditions and forcings
  - Need to accurately represent both changes in forcing and earth system response
  - Challenging: most datasets are either NRT or ”careful reanalysis” but not both
- The climate change signal has become a key part of a seasonal forecast – not just ENSO
- Not just temperature, other aspects are also challenging (E. Pacific trends, hurricanes etc)
  - Actually, seasonal prediction is an excellent test-bed for climate change / Earth system models

Thoughts on sustained mode: extension vs update

Tim Stockdale

- **Extension**: Use same methodology, same/similar data sources, to extend time-series of data; values for earlier dates do not change. **Needed** for applications with heavy investments and infrequent updates (re-analyses, decadal forecasts, seasonal forecasts, MIP-era expts)

- **Update**: Revision of methodology and/or data sources, whole time-series changes. Only when debugging early release data, or creating a new generation of re-analyses/forecasts. Datasets are never perfect, once initial debugging done we fix the data/system for a given generation, all new bug-fixes go into a "latest" version but the fixed version is not changed.

➢ For sustained science and applications, we need both of these

But how to manage extensions, if the input data is not NRT, and/or subject to frequent revision of most recent values? (eg CEDS).

DCPP requirements

Leon Hermanson

- Annually updated historical forcings and how they merge into scenarios
  - Used for decadal predictions & updated hindcasts
  - Large Ensembles with Single Forcings for attribution
- We do not want to be using 10-year out-of-date scenarios in our predictions and single forcing runs
- Need to annually adjust future scenarios to smoothly continue the latest historical forcings
  - Ready to use at the end of the year – preliminary estimate is acceptable
- Adding an extra year of forcings or updating whole historical period?
  - Cannot re-run 1000s of years of integration.
  - Clear meta-data if whole period – DCPP need to specify version in protocol (summer 2025)
- Can CMIP7 forcings be used for CMIP6 models? Can historical and future scenarios be used together?
  - If not, how can this be mitigated? Transparency needed!

CORDEX requirements

Jesús Fernández

- Lateral boundary conditions from the driving GCM as the main forcing
- Consistently incorporating climate forcings is still a pending subject. CORDEX-CMIP6 discourages, but allows:
  - Static land use
  - Basic aerosol treatment (e.g. fixed climatology)
- CORDEX-CMIP7 to use forcings fully consistent with the driving GCMs
- Higher resolution spatialization of the forcings extracted from the SSP scenario. In particular having the land-use-land-cover (but also water use, waste) evolution forcings at the RCM resolution.
  - ~10 km for CORDEX continental domains worldwide
  - ~1 km for CPM
- Also for aerosol emissions maps, need to be adapted to CORDEX resolutions.
- This work has been done partially by FPS LUCAS over Europe for the LULC scenarios. Need of a global approach to cover all CORDEX domains.
- FPS-URB-RCC also requiring urban evolution scenarios (e.g. LCZ or other urban subtype transitions).

Challenges

- terminology
- capacity
- funding
- support for raw observations

- methodology
  - The dichotomy historical vs scenario in continuous mode calls for dealing with a moving present-day (moving harmonisation? data assimilation? Bayesian framework?)
  - The inhomogeneity in the observational capacity means the the characteristics of the forcing dataset in recent year can be quantitatively different from the historical (and the future one)
  - Impossibility of characterising all drivers → 'what if' scenarios

➢ paradigm shift needed

Next steps

Immediate

- (AR7 fast-track and CMIP7): not much appetite to do anything different on these timescales; heads-down and hard work.
- Make the effort and its importance more visible (perspectives paper, op-ed, NYT)
- Consolidation of information (survey?) among non-CMIP users on the most vital inputs required and the appetite for preliminary data.
- Survey among providers to gain information on appetite for sustained mode and on the estimates for supplementary resources required (if any).

1-3 years

- Coordination of funding agencies to develop a common framework for supporting both continuous mode, enhanced research, as well as development/innovation funds.
- prototype: pioneer provision of preliminary data for the most suitable forcing in sustained mode.

~5 years

- Mobilisation of innovation funds to scale up prototype