CORDEX:
dynamical downscaling of CMIP6

Grigory Nikulin (SMHI)
on behalf of the CORDEX
Science Advisory Team (SAT)

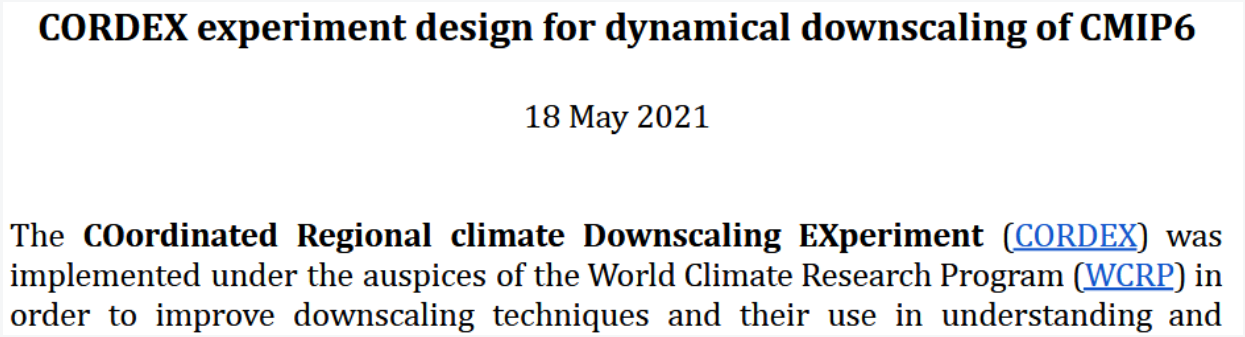
Training on
Spatial and temporal climate change analysis using CORDEX regional climate models over South Asia for Bangladesh, 13-15 December 2021

CORDEX-CMIP5 activities

- approximately 2010-2021
- CORDEX-CMIP5 for the 14 continental-scale CORDEX domains is over even if no deadline
- last CMIP5-driven simulations (EUR-11) were published on ESGF in May-June 2021 and no new CMIP5-driven simulations are expected
- 12 CORDEX Flagship Pilot Studies (FPS, e.g. with focus on sub-continental-scale and/or regional-scale forcings) are ongoing and not necessary related to CMIP5 or CMIP6

CORDEX-CMIP6 Experiment protocol (RCMs)

- First Order Draft was shared with the CORDEX community in June 2020 (about 100 comments)
- Second Order Draft in February 2021 (about 60 comments)
- the first priority to topics with a number of similar comments (e.g. aerosol and land use forcing, scenarios)
- Final version - May 2021(CORDEX website)



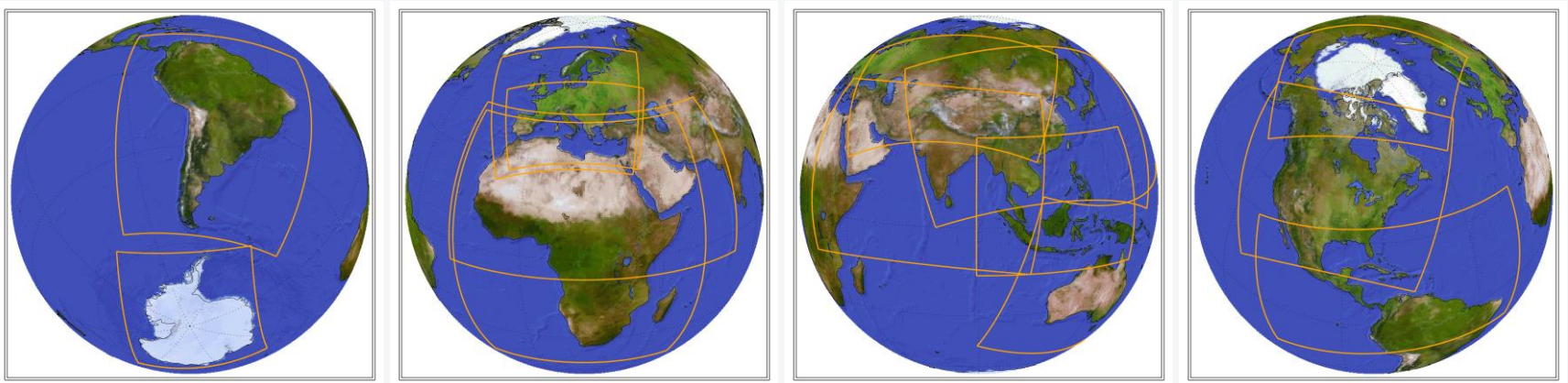
CORDEX experiment design for dynamical downscaling of CMIP6

18 May 2021

The **COordinated Regional climate Downscaling EXperiment** (CORDEX) was implemented under the auspices of the World Climate Research Program (WCRP) in order to improve downscaling techniques and their use in understanding and

CORDEX-CMIP6: Domains

14 standard continental-scale CORDEX domains



If the CORDEX communities think that the configuration of their CORDEX domains is not optimal (too small or too large) they can provide a formal request to update the current configuration.

the CORDEX-Africa domain is a focus region

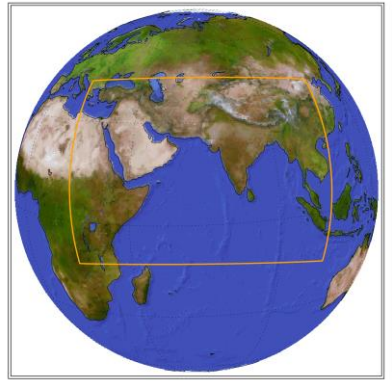
CORDEX-CMIP6: Resolution

- the primary targets are grid-spacings of **25** and **12.5** km.
- one common grid-spacing per domain to avoid a wide range of resolutions for the same domain (strongly recommended)
- a resolution between **25** and **12.5** km may also be used if both **25** and **12.5** km are not optimal (a common agreement)
- the Point of Contacts (POCs) for each domain should provide guidance on the preferred resolutions

50km (0.44º) – 193 x 130 (CORDEX-CMIP5)

25km (0.22º) – 386 x 260 (CORDEX-CORE)

12km (0.11º) – 772 x 520



CORDEX-CMIP6: Experiments

Evaluation:

driven by the ERA5 reanalysis (1979-2020 or last full year)

Historical:

at least 1960-2014 (1961-1990 - WMO reference period) or 1950-2014

Scenarios:

- CORDEX requested forcing SSP5-8.5 and SSP1-2.6 (2016)
- **SSP3-7.0** and **SSP1-2.6** first and then SSP2-4.5 and/or SSP5-8.5 or other SSPs (e.g. SSP1-1.9), 2015-2100

CORDEX-CMIP6: Aerosol

- CORDEX-CMIP5: most RCMs used a static aerosol forcing
- CORDEX-CMIP6: a static aerosol dataset is a minimum but a strong recommendation for transient aerosol forcing which is consistent with the driving CMIP6 GCMs
- transient aerosol forcing for the ERA5-driven evaluation experiment based on the MERRA2 reanalysis (1980-now) will be available soon (aerosol forcing from ERA5 is not available)
- Comments and questions can be directly posted in a living document (https://tinyurl.com/aerosol4cordex)

CORDEX-CMIP6: Land use and Land cover

- CORDEX-CMIP5: RCMs used static land use/cover maps
- a complex topic: CMIP6 land use/cover forcing was proposed to use in CORDEX-CMIP6 but no common agreement (e.g. coarse resolution – 25km)

CORDEX-CMIP6:

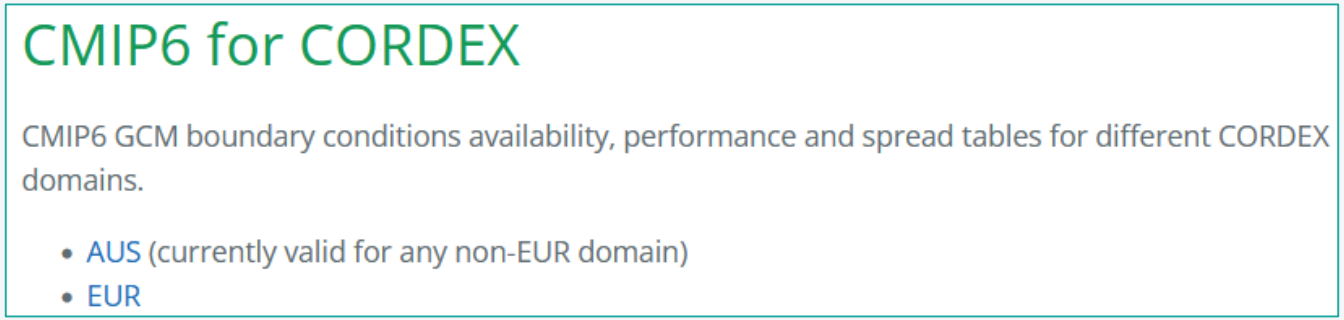
- recommended that the static land cover and land use maps that are a regional model's default be used
- recommendations for the implementation of transient land use change (e.g. datasets, translation to RCMs, etc.) will be provided later (additional simulations)

CORDEX-CMIP6: Selection of driving GCMs (1)

- a number of approaches but no commonly accepted methodology on how to select a subset of GCMs for downscaling
- a subset of GCMs selected for one CORDEX domain is not necessarily an optimal choice for other domains
- up to the regional CORDEX communities to decide which CMIP6 models should be downscaled over a specific domain
- **recommended criteria**: i) the ability of the CMIP6 models to simulate important aspects of regional and global climate and ii) range of plausible future climates (e.g. regional temperature and precipitation responses)

CORDEX-CMIP6: Selection of driving GCMs (2)

- In Euro-CORDEX there is a Task Team on the CMIP6 GCM/RCM-ESD ensemble design
- as an outcome, the University of Cantabria maintains a table showing what CMIP6 GCMs provide forcing for RCMs and/or for ESD and also information about their performance and spread
- current location https://jesusff.github.io/cmip6-for-cordex/ and soon will be available from https://github.com/WCRP-CORDEX/



CORDEX-CMIP6: Variable List (Data Request)

CORDEX-CMIP5: CORE (mon/seas), Tier 1 (day), Tier 2 (3/6 hr)

CORDEX-CMIP6:

- **CORE**: 15 most popular variables (by downloads) for all CORDEX domains (day, mon, 1hr)
- **Tier 1** (recommended) and **Tier 2** (optional)
- up to the CORDEX domains to decide on what **Tier 1** and **2** variable to include (e.g. pressure levels; 17 levels in **Tier 1**)
- we need to find a balance between user needs and data volume (in CORDEX-CMIP6 many variables at 1hr)
- Second Order Draft will be shared for comments in a few days

WCRP CORDEX

Coordinated Regional Climate Downscaling Experiment