CORDEX and links to CMIP

Silvina Solman and Daniela Jacob
CORDEX-SAT Co-Chairs

RiFS
Regional Information fo...

WCRP CORDEX

CliC Climate and Cryosphere

CLIVAR Climate and Ocean Variability, Predictability and Change

GEWEX Global Energy and Water Exchanges

SPARC Stratosphere-troposphere Processes And their Role in Climate

ESMO
Earth System Modelling and Observations (new)

Explaining and Predicting Earth System Change

My Climate Risk

Digital Earths

Safe Landing Climates

WCRP Academy

WCRP Lighthouses

WCRP Communities
Enduring Capabilities, Homes for Expertise

WCRP
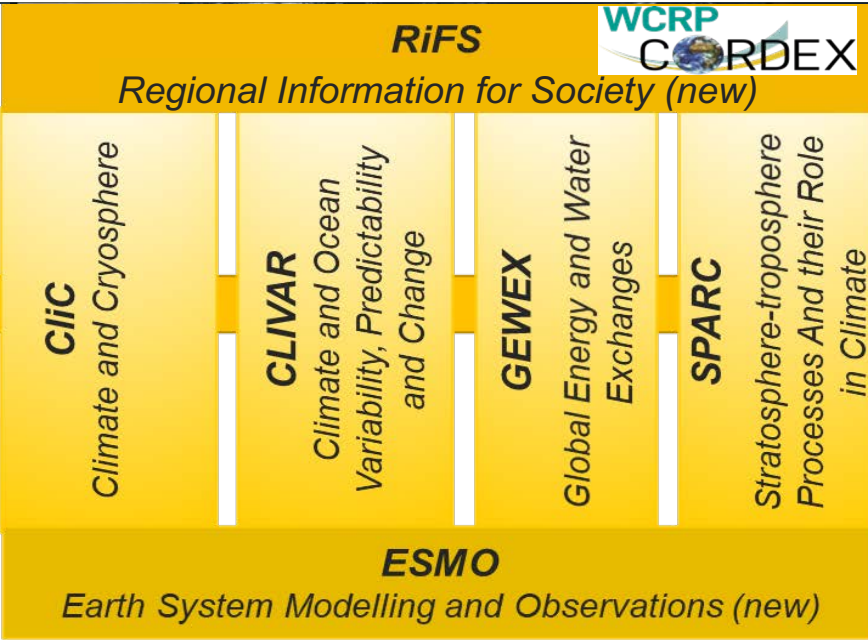
- ➤ Leads the way in addressing frontier scientific questions related to the coupled climate system
- ➤ Contributes to advancing our understanding of the multi-scale dynamic interactions between natural and social systems that affect climate. through international science coordination and partnerships, WCRP

WORLD METEOROLOGICAL ORGANIZATION

unesco Intergovernmental Oceanographic Commission

International Science Council

WCRP World Climate Research Programme

CORDEX Overview

The CORDEX vision is to advance and coordinate the science and application of regional climate downscaling through global partnerships

Goals:

- To better understand relevant regional/local climate phenomena, their variability and changes, through downscaling
- To evaluate and improve regional climate downscaling models and techniques
- To produce coordinated sets of **regional downscaled projections worldwide**
- To foster communication and knowledge exchange with users of regional climate information

CORDEX SAT members & POCs
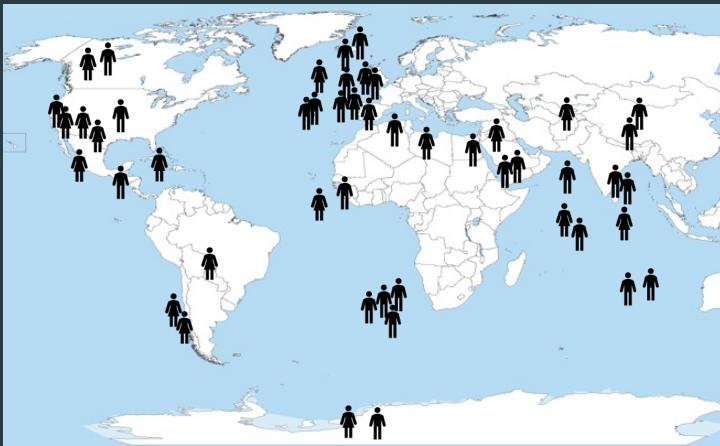
CORDEX Focus/Vision

- Global collaboration
- Regional/local climate phenomena and variability
- Coordinated, easy to use, climate information for regions
- Understanding/knowledge transfer/capacity development
- Informed decisions

Platform/facilitator for coordination and cooperation

Importance of climate change information

Need to understand the effects of climate change on various sectors to design Adaptation plans at the national levels:
- Coordinated simulations at high resolution
- Multiple forcings (LULCC, GHGs, Aerosols)

Importance of climate change information

Climate change adaptation is one of the most important tasks facing us, but:
➢ Do we know what climate we should adapt to?
➢ There is an illusion by some decision makers that we already know everything about the future climate and can simply focus on "adapting"
➢ Assessing and informing in expected climate change is an on-going scientific process and must be an integral part of the adaptation agenda.

The chain from global to local
- from data to knowledge to societal benefit -

Ibrahima Diouf[1,2] · Abiodun M. Adeola[3,4,5] · Gbenga J. Abiodun[6] · Christopher Lennard[7] · Joyce M. Shirinde[8,9] · Pascal Yaka[10] · Jacques-André Ndione[11] · Emiola O. Gbobaniyi[12]
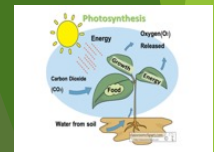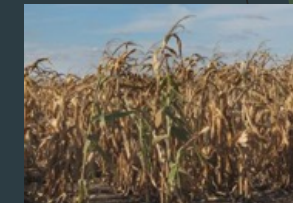
Temitope Samuel Egbebiyi[1], Olivier Crespo[1], Christopher Lennard[1], Modathir Zaroug[1,5,6], Grigory Nikulin[2], Ian Harris[3], Jeff Price[4], Nicole Forstenhäusler[4] and Rachel Warren[4]

- Average cases diminish for the whole area but increases for south west Africa
- 2-months lag – rain peak - malaria peak
- WHO (2018) - ~ 91% of all malaria related deaths in 2026 in Sub-Saaharan Africa

- 1,5 and 2 degrees warming 10-20 years before global average
  - 1.5 ∘C > not too bad
  - 2.0 > large effects on some crops and some areas
  - 3.0 > disaster – more unsuitable areas, cereals and cassava not possible
- Rain affects leaf area, temperature affects length of growth season
- Planting season shifts
- Low adaptive capacity > large effects on food production varies with crop and degree of warming

Climate change projections of heat stress in Europe and its impacts
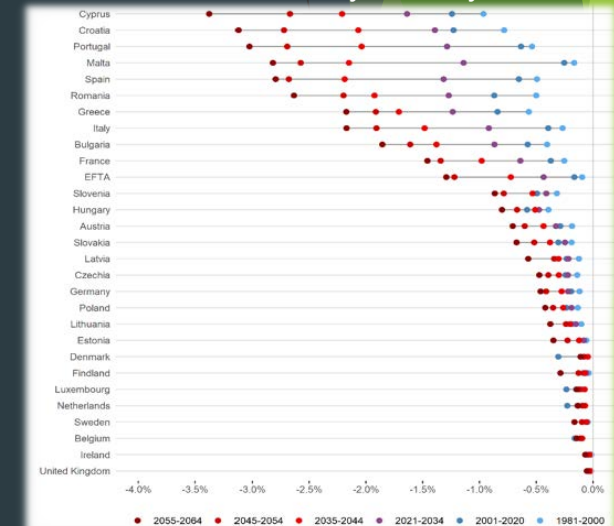
WCRP CORDEX

- **84 GCM-RCMs EURO-CORDEX** simulations, 3 RCPs
- ~1800 European stations
- Bias-corrected **transient projections of heat stress**
- Wet bulb globe temperature (WBGT: air and dew point temperatures, wind speed, solar radiation)
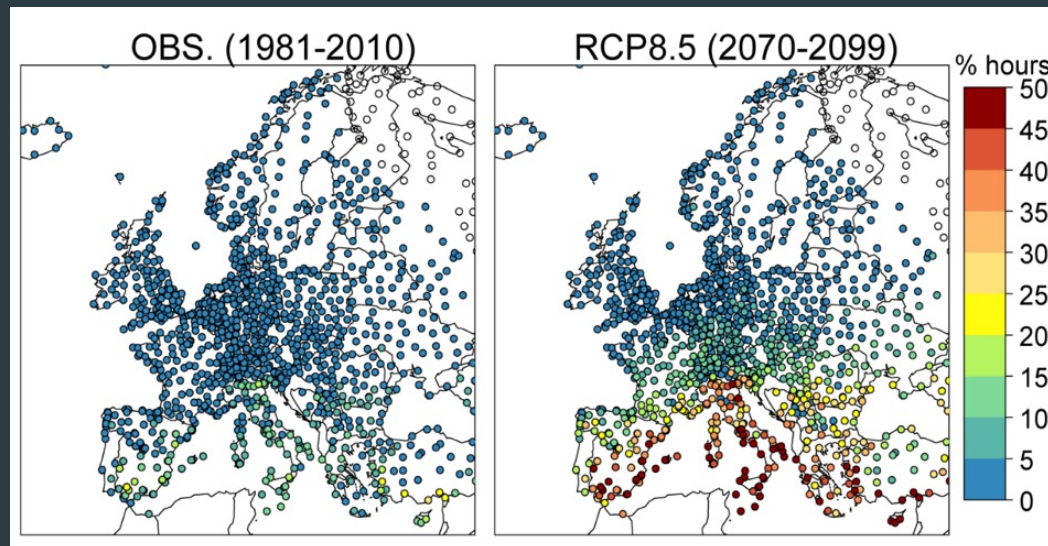

Berlin (Germany) — OBS, RCP2.6, RCP4.5, RCP8.5
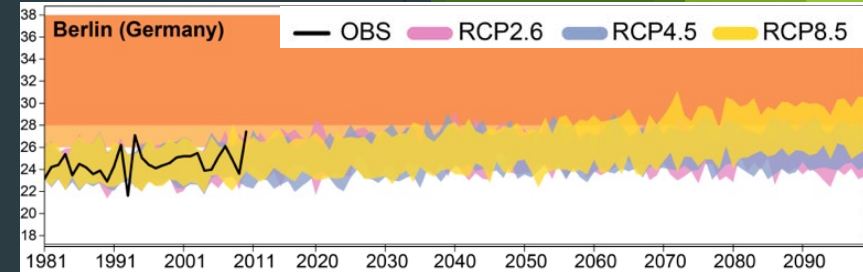
Economic impact (GDP losses) of heat stress by country

Productivity losses (% hours lost) due to heat stress in summer

OBS. (1981-2010) RCP8.5 (2070-2099)

Casanueva et al. 2020, Reg. Environ. Change

García-León et al. 2021, Nat. Comms.

CORDEX – CMIP activities

- **CORDEX experiment design for dynamical downscaling of CMIP6 (2022)**

    - Simulations spanning 1950-2100

    - Horizontal resolution: 25 km /12,5 km

    - GHG forcings as for CMIP6 models

        - Historical 1950-2014

        - Scenarios: Tier 1: SSP3-7.0/SSP1-2.6 for 2015-2100

            Tier 2: SSP2-4.5 / SSP5-8.5

    - Static LULCC

    - The aerosol monthly (or higher frequency) aerosol optical data produced by the driving CMIP6 GCMs (including interanual variability of aerosol optical data)

    - RCM (atmosphere – land surface) / Regional Earth System Models (RESM) / Variable res models

CORDEX – CMIP activities

➤ **CORDEX-CMIP6 Atmosphere Variable List (2022)**

➤ **CORE variables**

22 September 2022

CORDEX-CMIP6 Data Request: CORE Atmosphere variables

ag - agregation for subdaily output: **i:** instantaneous; **a:** averaged over output interval;

output variable	units	ag	long_name	standard_name	mon	day	6hr	3hr	1hr	Priority
tas	K	i	Near-Surface Air Temperature	air_temperature	x	x			x	CORE
tasmax	K		Daily Maximum Near-Surface Air Temperature	air_temperature	x	x				CORE
tasmin	K		Daily Minimum Near-Surface Air Temperature	air_temperature	x	x				CORE
pr	kg m-2 s-1	a	Precipitation	precipitation_flux	x	x			x	CORE
evspsbl	kg m-2 s-1	a	Evaporation Including Sublimation and Transpiration	water_evapotranspiration_flux	x	x			x	CORE
huss	1	i	Near-Surface Specific Humidity	specific_humidity	x	x			x	CORE
hurs	%	i	Near-Surface Relative Humidity	relative_humidity	x	x			x	CORE
ps	Pa	i	Surface Air Pressure	surface_air_pressure	x	x			x	CORE
psl	Pa	i	Sea Level Pressure	air_pressure_at_mean_sea_level	x	x			x	CORE
sfcWind	m s-1	i	Near-Surface Wind Speed	wind_speed	x	x			x	CORE
uas	m s-1	i	Eastward Near-Surface Wind	eastward_wind	x	x			x	CORE
vas	m s-1	i	Northward Near-Surface Wind	northward_wind	x	x			x	CORE
clt	%	a	Total Cloud Cover Percentage	cloud_area_fraction	x	x			x	CORE
rsds	W m-2	a	Surface Downwelling Shortwave Radiation	surface_downwelling_shortwave_flux_in_air	x	x			x	CORE
rlds	W m-2	a	Surface Downwelling Longwave Radiation	surface_downwelling_longwave_flux_in_air	x	x			x	CORE
orog	m		Surface Altitude	surface_altitude			fx			CORE
sftlf	%		Percentage of the Grid Cell Occupied by Land	land_area_fraction			fx			CORE

CORDEX – CMIP activities

- **CORDEX-CMIP6 Atmosphere Variable List (2022)**
  - **Tier 1 variables (6hr, day, mon)**
    - ua, va, ta, hus, zg, wa at 850, 700, 600, 500, 400, 300, 250, 200
    - ua, va at 50m, 100m, 150 m
    - ta, hus at 50m
  - **Tier 2 variables (6hr, day, mon)**

Note that CORDEX simulations are still running for driven by GCMs from the CMIP6 ensemble
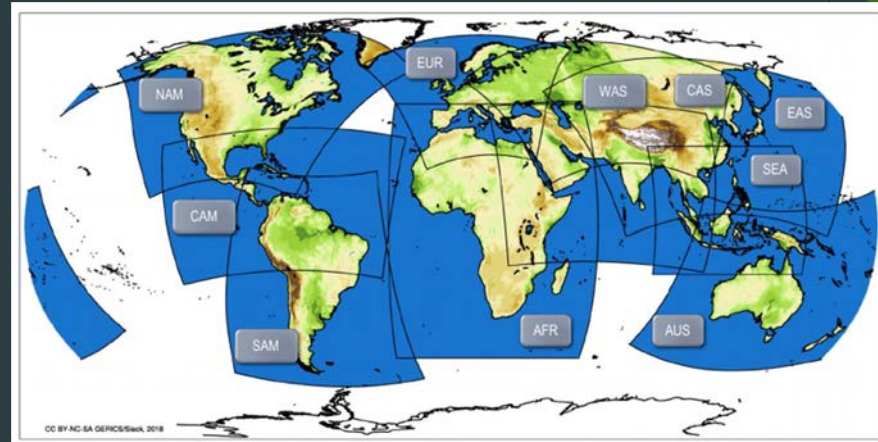
In IPCC WGI AR6
      GCMs CMIP6
      CORDEX – CMIP5
      (CORDEX CORE)

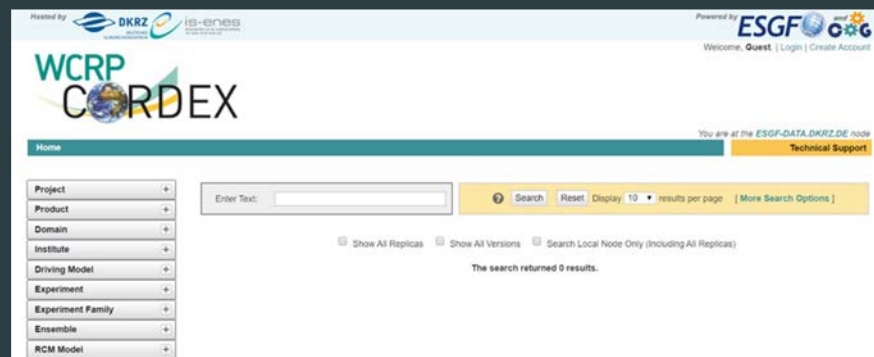# CORDEX data availability (input for IPCC AR6 CH6/Atlas)

WCRP CORDEX

- Open access
- Standardized, quality controlled
- Observational basis for verification
- Community effort
- Inventory of GCM/RCMs on www.cordex.org

CORDEX-CORE Regions/Domains

CORDEX model output data is available online via:
- Earth System Grid Federation
- Copernicus Climate Data Store

ESGF

Climate Data Store (CDS)
Climate data at your fingertips

Recent CORDEX – CMIP cooperation

- ✓ CORDEX IPOC Direcvtor (Irene Lake) co-hosted a session with CMIP IPOC Director (Eleanor O'Rourke) at the Living Planet Symposium in May 2022
- ✓ CORDEX SAT member Grigory Nikulin together with Irene Lake were part of the WMO-GCF event recently together CMIP IPOC Director.
- ✓ CORDEX reps chairing sessions at the world café organized by WCRP/ESA/GCOS at GCOS in October
- ✓ Participation in the 2022 CMUG Integration & Climate Change Initiative colocation organized by the CMIP IPO Director.
- ✓ On going discussions to host a joint (CMIP-CORDEX) side event at the OSC 2023
- ✓ On going discussions for a joint activity (CMIP-CORDEX) at the CORDEX conference ICRC2023

CORDEX and links to CMIP

➤ CORDEX already communicated the data needs to CMIP in terms of Boundary Conditions

➤ GCM and CORDEX communities are assessing the CMIP data to identify a matrix of GCM-RCM to downscale at every CORDEX domain
  ➤ EURO-CORDEX plans to agree on the matrix by the end of Janueary 2024.

Recent CORDEX – CMIP cooperation

Some final reflections:

- ❖ On the forcings:
  - ❖ Is it posible/worth including the users community in the design and planning the GCM runs to identify regional forcings worldwide?
- ❖ Outcomes from mitigation options
  - ❖ With the focus on mitigation policy options, is it posible assessing in simulations what the impact of the option might be, before deciding and implementing the option?

Thank you for your atention!