Relationship to the WCRP Strategic Plan and Implementation Plan and Process

SP and Scoping a framework for WCRP Regional activities Goals and Legs

SP goal 1 and 3/Leg 1: Fundamental science/understanding and long-term response

- Basic CORDEX simulations, ie CORE https://esgf-data.dkrz.de/search/cordex-dkrz/, CMIP6 (incl GCM sensitivity/suitability for downscaling), IPCC report contributions
- White Paper, CORDEX scientific challenges (implemented through FPSs) etc
- Moving towards convection permitting Earth System Models

SP goal 2 and 4/Leg 2 and 3 : Near-term evolution of climate-system and Decision-relevant information/knowledge

- Lead on Task Team for Regional Activities with input to the WCRP IP
- Bridging climate science - coop with related Working Groups dealing with Regional Activities, CORE Projects, GFCS (Global Framework for Climate Services), Future Earth (MAIRS-FE) in cooperation with CORA
- CORDEX regional Workshops / Capacity Building workshops/events/ African Demonstrator
- Initiated work on platforms for international cooperation and capacity building in cooperation with CORA

Emerging issues

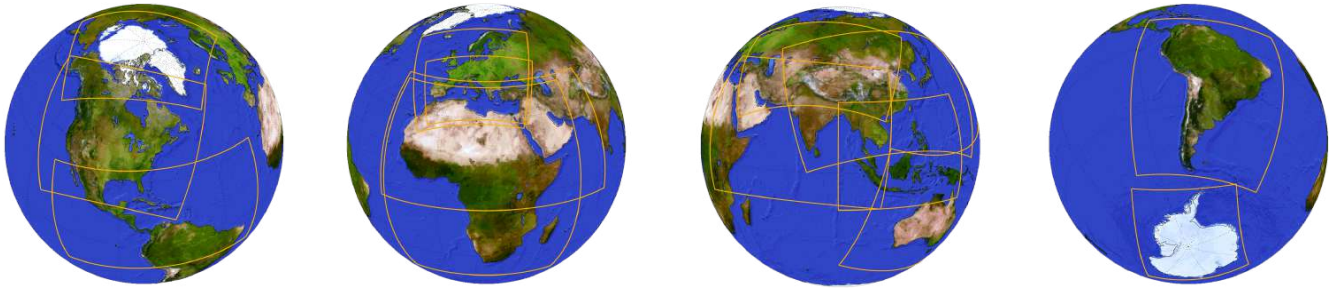
- **The focus on Regional Science is growing**
  - Calls for increased coordination and transparency
- **Demand on CORDEX products/information is increasing**
  - Highlights the good work done
  - Puts pressure on performance/delivery
- **Need for enhanced communication**
- **Coordinated Experiments on Local and Regional Scales (very high resolution) are becoming more important**
- **Increasingly difficult to attract funding**
  - Both internal and external funds needed
  - The maintenance and growth of the data storage and increased model and computer complexity

Additional Slides

41st Session of the WCRP Joint Scientific Committee

WCRP CORDEX

Coordinated Regional Climate Downscaling Experiment



Silvina Solman
Daniela Jacob
Co-chairs

18th -22nd May, 2020

WORLD METEOROLOGICAL ORGANIZATION

United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

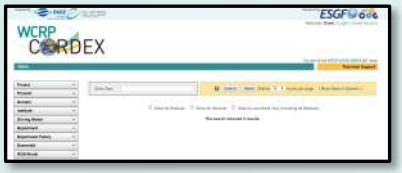
International Science Council

WCRP World Climate Research Programme

Progress and achievements

Many new simulations

CORDEX-CORE now available on ESGF



https://esgf-data.dkrz.de/search/cordex-dkrz/

cordex.output.XXX-22 (XXX=domain)

Link to SSPs - Explore regional climatic impacts of land use changes etc

Flagship Pilot Studies

- Impact of land use changes on climate in Europe across spatial and temporal scales (LUCAS)
- Coupled regional modelling of land-atmosphere-ocean interactions over western-southern Africa under climate change

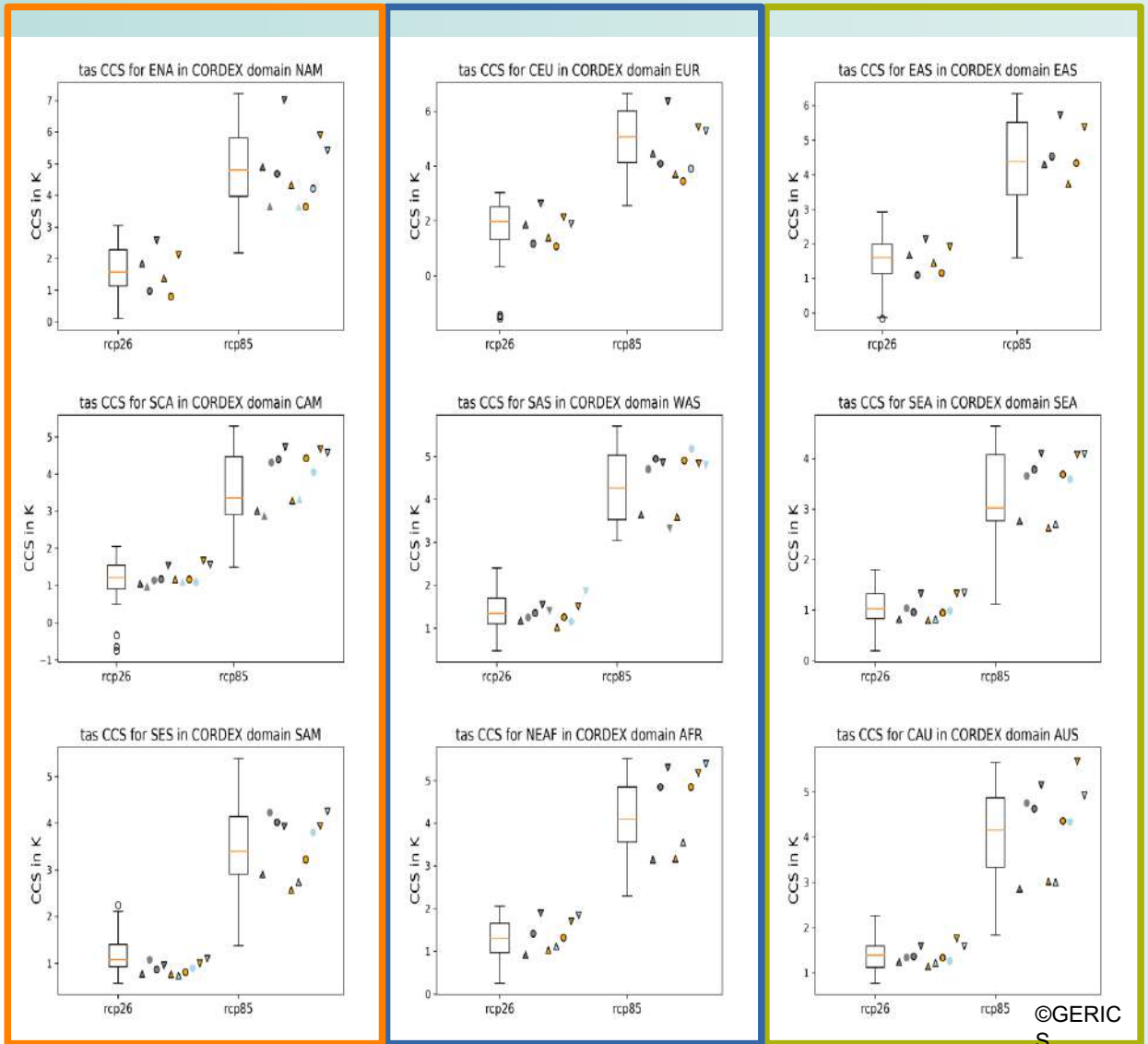
Contributions to IPCC special reports and AR6

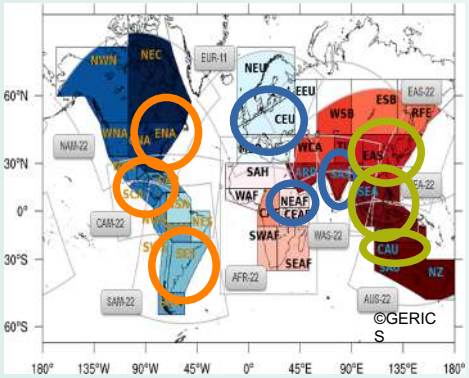
AR6 WGI Lead Authors:

- Atlas Chapter *José Manuel Gutierrez*
- Chapter 1 *Deliang Chen*
- Chapter 4 *Francois Engelbrecht*
- Chapter 10 *William Gutowski, Tannecia Stephenson, Fredolin Tangang*
- Chapter 12 *Erika Coppola*

Progress and achievements

GCM-RCM Mean climate change signal in IPCC physical reference regions

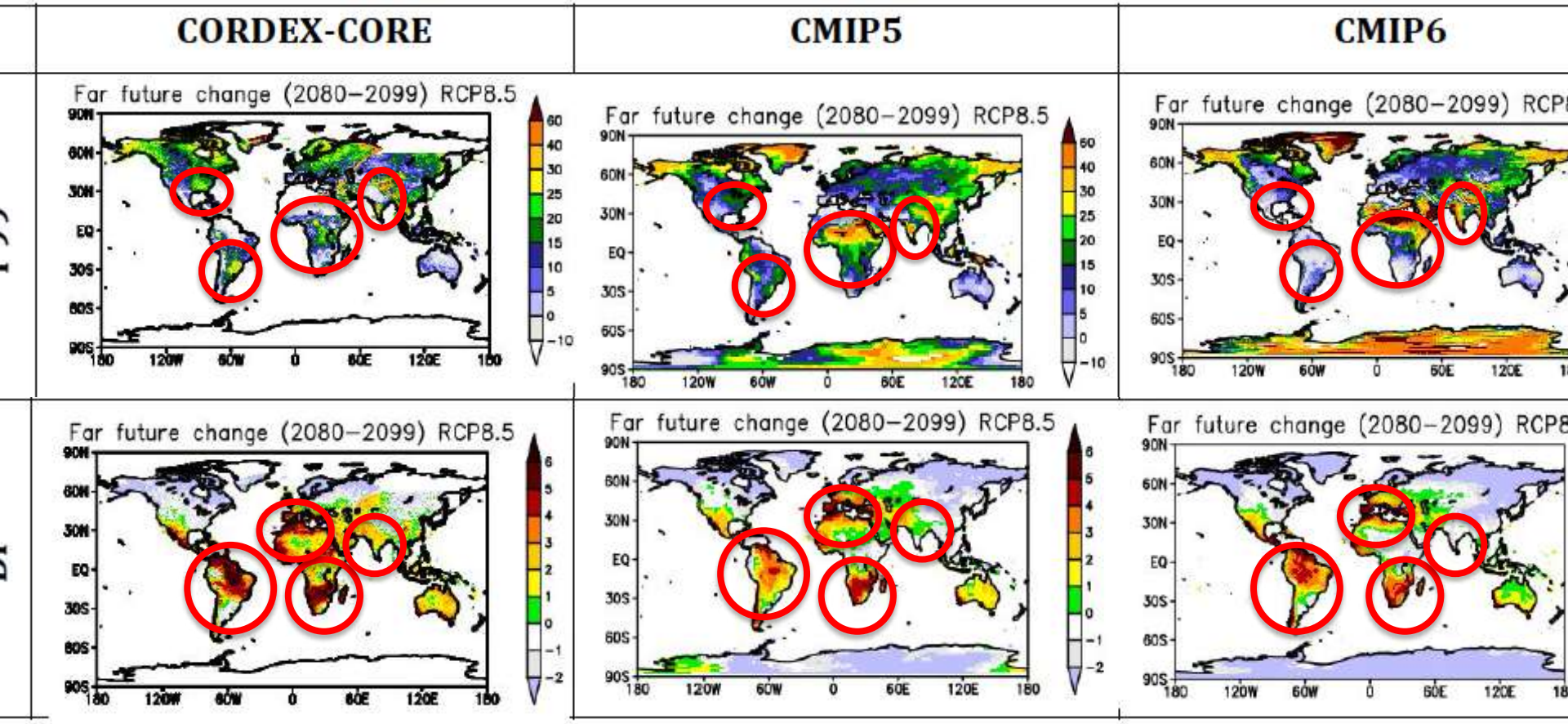




- Temperature climate change signals for different IPCC physical reference regions for six CORDEX-CORE domains
- AR5-ensemble climate change signals interquartile range is well covered for most of the domains by selected CORDEX-CORE GCMs and RCMs
- Global driving GCM climate sensitivity order is not necessarily preserved.
- Tropical regions show quite similar CCS for CORDEX-CORE GCMs and RCMs (and thus generally preserve the ECS-order)

Extreme & Hazards

Future projections for wet & dry indicators



Where the CORDEX-CORE simulations are most in agreement with observations, their future projections mostly differ from the GCM's ensembles (see red circles): they give a better representation of reality, they can show a more realistic project in the future. P99 = 99th precipitation percentile. DF = dry frequency

Progress and achievements

14-18 OCTOBER 2019 BEIJING, CHINA

ICRC-CORDEX 2019

International Conference On Regional Climate

- Conference held in Asia important – engagement by Chinese scientific leadership and Asian participants
- CORDEX community assembling in one place, with all the cross-fertilization opportunity that presents.
- Session on Best practices that will be developed further
- Cooperation with MAIRS-FE – will continue
- **Engagement of CORDEX with WCRP and all Core Projects**
- Great participation by Early Career Scientists

'CORDEX is very crucial for IPCC' said Panmao Zhai , chair IPCC WGI, during the first day of the conference

https://icrc-cordex2019.cordex.org/

Progress and achievements

Other highlights

Med CORDEX simulations:
Baseline runs, evaluation runs, different scenarios, analysis
medcordex.eu/simulations-phase2.php

Convective-permitting resolution simulations over several regions in the world:

- **SEA and other Asian subdomains**
- **Europe**
- **Southeastern South America**
- **Africa around Lake Victoria**

- **Arctic Ocean; Multi-model intercomparison with the ACSE2014 campaign data**
- **Arctic and Antarctic sea-ice lead data sets**

- **CORDEX White Paper**
- **IPOC Communication Plan**
- **Many new scientific publications, including global studies using CORDEX simulations (e.g., Spinoni et al., 2020)**
- **EURO-CORDEX community paper (Jacob et al., 2020)**

Progress and achievements

Workshops, Meetings and Conference sessions

- **Europe**
  - Euro-CORDEX General Assembly
  - Paper-writing Workshop on the Analysis of CORDEX-CORE Climate Projections.
  - Med-CORDEX workshop
  - FPS annual meetings, Sessions at EGU, EMS2019, Climate modelling
- **Polar**
  - Annual Joint Polar CORDEX meeting
- **Asia**
  - Training Workshop of Access and Utilization of Regional Climate Downscaled Data
  - Sessions on regional climate modelling highlighting CORDEX at (AMOS)
  - Workshop of the Second Phase of the Southeast Asia Regional Climate Downscaling
  - International Congress on Modelling and Simulation (MODSIM2019) Canberra Australia
- **North, South and Central America**
  - Session at Forum on Scenarios for Climate and Societal Futures
  - Various contributions at the AGU Fall Meeting
- **Africa – no workshops due to lack of funding (funding for 2020 secured)**

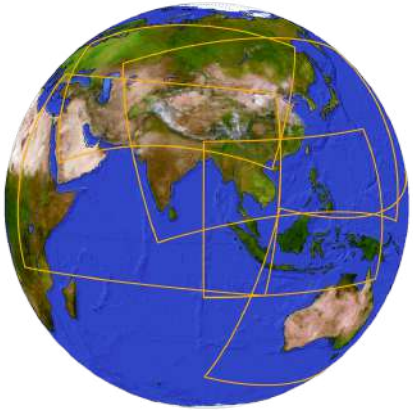
Domain activities: https://cordex.org/domains/domain-activities/

Progress and achievements

Two new endorsed Flagship Pilot Studies

Modelling the Southeast African regional Climate; Downscaling CORDEX for Southeast Africa Region to Support Decision Makers

Jonas Zucule and Bernadino Nhantumbo



High resolution climate modelling with a focus on convection and associated precipitation over the Third Pole region

Deliang Chen

– proposed as a FOCI project

work with GEWEX (and other CORE projects)

New reports and publications from other FPSs

WCRP CORDEX FLAGSHIP PILOT STUDIES

Primary science issues linked to CORDEX White Paper

Smaller domains and increasing resolution

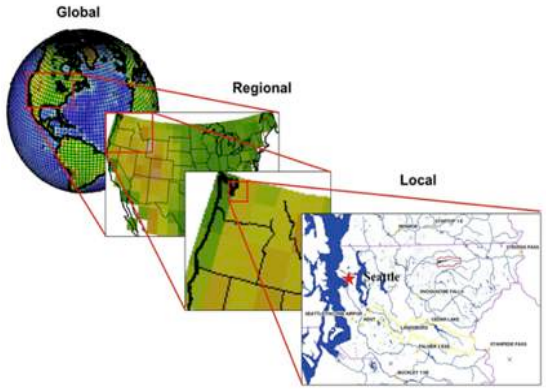
- Demand for high resolution in smaller domains (convection-permitting)
- GCMs are using resolutions of 25-50 km reaching the RCM scale.

Increasing complexity RCMs ⟶ Earth System Models (ESMs)

- A compromise must be made between resolution, complexity and domain size.

Exascale computing

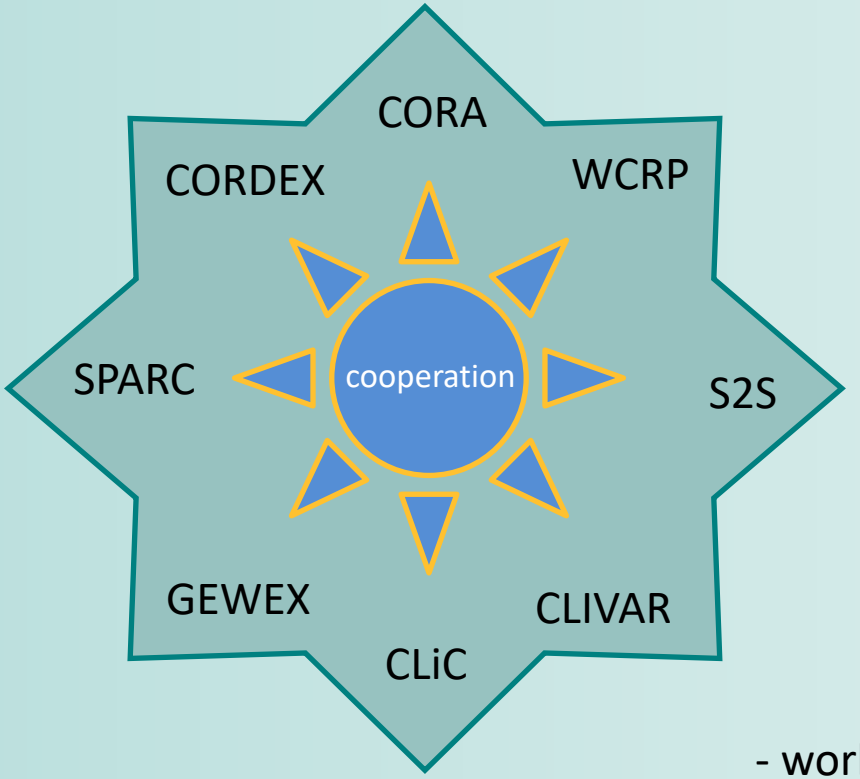
- RCMs adaptation to new generation high-performance computers.



Model downscaling. NCAR
Dr. Andrew Wood

Challenges and opportunities

- Increased cooperation WCRP Project Offices



- Initiated work on platforms for international cooperation and capacity building
  in cooperation with CORA
  (highly relevant with the current situation)

- CORDEX community

- working with impact-, risk-, adaptation scientists
- decision makers and other users from for instance energy industry or agriculture
- through projects, in workshops, in paper writing etc.

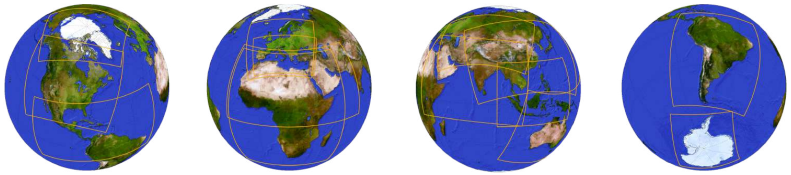
These activities are linked to WCRP SP Goals, in particular goal 4 and to Leg 3 of Climate information for regions doc

Future plans

- **Capacity building across regions through workshops in Asia, Africa, South and Central America**

- **Start downscaling of CMIP6, extent depends on funding, possible coop with HighResMIP**

- **Completion and publication of ongoing and planned simulations**
  - South East Asia; Downscaling 5 km x 5 km
    continue analyzing the 5 km x 5 km, compare with 25 km runs
  - MED-CORDEX; evaluation runs (Baseline runs, FPS) and availability of large ensemble of scenario simulations (Baseline runs, FPS)



Endorsed Flagship Pilot Studies

- **Africa: Coupled regional modelling of land-atmosphere-ocean interactions over western-southern Africa under climate change**
  Contact person Francois Engelbrecht

- **Africa: ELVIC - Climate Extremes in the Lake Victoria Basin**
  Contact person Nicole van Lipzig

- **South America: Extreme precipitation events in Southeastern South America: a proposal for a better understanding and modeling**
  Contact person Maria Laura Bettolli

- **Europe: Mediterranean; Convective phenomena at high resolution over Europe and the Mediterranean**
  Contact persons Erika Coppola or Stefan Sobolowski

- **Europe: Impact of land use changes on climate in Europe across spatial and temporal scales**
  Contact person Diana Rechid

- **Mediterranean: Role of the natural and anthropogenic aerosols in the Mediterranean region: past climate variability and future climate sensitivity**
  Contact persons Solmon Fabien or Marc Mallet

- **Mediterranean: Role of the air-sea coupling and small scale ocean processess on regional climate**
  Contact persons Gabriel Jordà or Gianmaria Sannino

Other activities 2019

Other activities include:

- For the Arctic Ocean, a multi-model intercomparison with the ACSE2014 campaign data has been accomplished and Arctic and Antarctic sea-ice lead data sets have been compiled
- Many new scientific publications, for instance two by CORDEX Africa VIA scientists and two published and three under review on the European Convection and LUCAS FPSs
- Several contributions to the IPCC special reports and to the coming AR6
- Tutorial on how to download CORDEX Africa data
- 5x5 km downscaling by CORDEX SEA scientists for a number of SEA subdomains
- Contributions to Australian Climate Projection Strategy
- Contributions to the Hindu Kush Himalaya Assessment. Springer, Cham, 2019, pp. 57-97, doi: https://doi.org/10.1007/978-3-319-92288-1_3 and other assessment reports

Other activities 2019

- MED CORDEX simulations:
  - The description of the simulations including 5 modelling pillars can be found in Somot et al. 2018b and on medcordex.eu/simulations-phase2.php
  - Baseline runs: 11 modelling groups are participating with fully-coupled Regional Climate System Models (RCSM), 10 RCSM are ready to be used, 6 evaluation runs have been performed for this phase as well as 6 historical/scenario runs
  - FPS-convection: 11 evaluation runs are completed over the alpine domain as well as 6 historical/scenario pairs (end of the 21st century, RCP8.5, 10-year time slices)
  - FPS-aerosol: simulations have been performed for the 5 defined protocols, in particular 6 pairs of runs are available for protocol 1B (scenario with aerosol climatologies) and 8 runs for protocol 2A (case study with interaction aerosols)
  - FPS-air-sea: various baseline runs have been performed and sensitivity tests to the sea representation and air-sea coupling representation are in preparation
  - Concerning the Free Modelling Zone runs, 15 modelling actions are listed with model outputs available on request
- FPS: Convective Phenomena over Europe and the Mediterranean completed over 22 evaluation time slices and 12 scenario simulations and continued to analyze the output from their simulations and delivered new insights, for example, a strong shift towards higher convective precipitation intensities in the future
- FPS: Extreme events over South America includes a collaborative effort with modeling groups from Spain, Brazil and Argentina. 3 RCM simulations driven by reanalyses at convective permitting resolution over southeastern South America for a 6-month period were completed for evaluation.

Progress and achievements

Workshops and Meetings

- Euro-CORDEX General Assembly, Hamburg, Germany
- Training Workshop of Access and Utilization of Regional Climate Downscaled Data of ESGF/ SARCCIS of CORDEX Southeast Asia" Bangkok, Thailand
- Session 31: Climate Change Scenarios in CORDEX Domains. Scenarios Forum 2019: Forum on Scenarios for Climate and Societal Futures. Denver, USA
- Sessions at EGU; Regional climate modelling, including CORDEX (CL5.01), CORDEX FPS Convection splinter meeting, Convection permitting modelling (CL5.04), Vienna, Austria
- Paper-writing Workshop on the Analysis of CORDEX-CORE Climate Projections. Trieste, Italy
- Sessions on regional climate modelling highlighting CORDEX at the Australian Meteorological and Oceanographic Society (AMOS) annual conference in Darwin Australia, AOGS Singapore
- Third Workshop of the Second Phase of the Southeast Asia Regional Climate Downscaling (SEACLID)/CORDEX Southeast Asia Project, Manila, Philippines

Progress and achievements

Workshops and Meetings

- EMS2019, Climate modelling (UP3.5), Copenhagen, Denmark
- FPS –LUCAS annual meeting, Hamburg, Germany
- Workshop of Access and Utilization of Regional Climate Downscaled Data of ESGF/ SARCCIS of CORDEX Southeast Asia, Bangkok, Thailand
- Annual Joint Polar CORDEX meeting with focus on surface mass balance of Greenland and Antarctic ice sheets, model evaluation and coupled modelling/high-resolution challenges and benefits, Copenhagen, Denmark
- FPS –CPS annual meeting, hosted by Meteo-FR, Toulouse, France,
- The 6th Med-CORDEX workshop Toulouse, France, The three Med-CORDEX related FPSs (convection, air-sea and aerosol) annual meeting during the 6th Med-CORDEX workshop allowing some cross-FPS fertilization
- International Congress on Modelling and Simulation (MODSIM2019) Canberra Australia

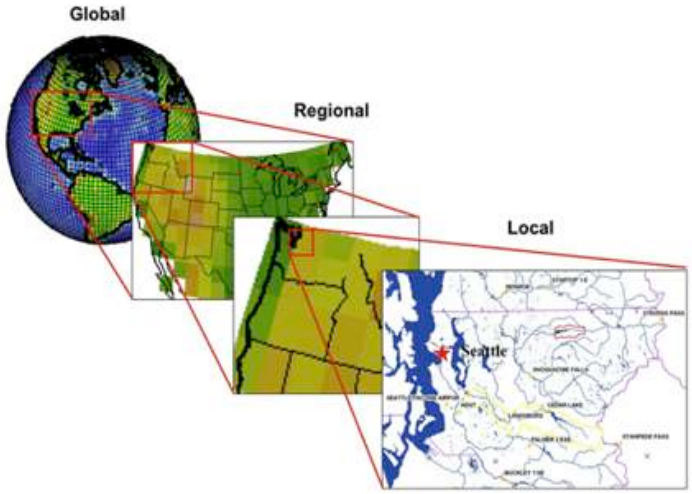
Primary science issues linked to the White Paper

Smaller domains with finer resolution

Local and regional changes and why

Uncertainty for these changes

- How to define common setup to assure model ensembles for smaller (national) convection permitting resolution domains?
- How to assure reliability with few simulations in some convection permitting resolution domains?



Model downscaling. NCAR dr. Andrew Wood

Increasing resolution

GCMs, higher resolutions in HighResMIP for CMIP6, reaching the RCM scale

- What resolutions are the RCMs aiming at?
- What developing work is needed to improve model performance at these resolutions?

Future plans

- **Capacity building across regions through for instance:**
  - **4th CORDEX Southeast Asia Workshop on Coordinated 5km Simulations**, Quy Nhon, Vietnam, early October
  - **Final CORDEX Southeast Asia Workshop on Coordinated 5km Simulations**, Bangkok, Thailand, end 2020/early 2021
  - **Regional training workshop**, Kathmandu, Nepal, 29 June-3 July
  - **Joint workshop for Southwestern African countries with focus on building the VIA community in the initiative as well as strengthen the already well developed climate science community and Regional workshop CORDEX southeast Africa FPS**, Cape Town, South Africa, end of 2020
  - **2nd Regional training Workshop/CORDEX for the South/Central American domains**, Sao Paolo, Brazil
  - **Joint meeting CORDEX - MAIRS FE**, Beijing, China
  - **Conference on Regional Climate Modelling and Extreme Events over South America**: Results from the CORDEX-Flagship Pilot Study / Lab training activity on how to use, interpret and compare the GCM/RCMs/ESD simulations, Buenos Aires, Argentina, 16 Nov 2020 - 20 Nov