CORDEX
Recent Progress

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Thanks to: Grigory Nikulin (SMHI), Andy Morse (ULiv), Sandro Calamnati (ENEA), Duane Waliser & Jiwon Kwon (JPL), Chris Lennard (UCT), Ole Christensen (DMI), Martin Juckes (STFC), Richard Jones (MOHC) and CORDEX modeling groups
Sampling the sources of uncertainty in RCD-based Regional climate projections

- RCD Configuration (Multiple models)
- AOGCM Configuration (Multiple AOGCMs)
- Region
- Internal variability (Multiple realizations)
- Emission/Concentration Scenarios
- RCD approach (Multiple RCD methods)
CORDEX Phase I experiment design

Model Evaluation Framework

Climate Projection Framework

Multiple regions (Initial focus on Africa)
50km resolution (higher in some regions, Europe: 10km)

ERA-Interim BC 1989-2008

RCP4.5, RCP8.5

Multiple AOGCMs

Projections 1951-2100 + timeslices
Decadal hindcasts & predictions

Regional Analysis
Regional Databanks
CORDEX DOMAINS (plus Arctic & Antarctica)

- 12 domains with a resolution of 0.44° (approx. 50x50 km²)
- Focus on Africa
- High resolution ~0.11°x0.11° for Europe (by some institutions)
The TFRCD mandate was extended by 1 year @JSC Feb 11 until end 2011

The TF will be replaced by a permanent WCRP Panel WGRCSI: WG on Regional Climate Science and Information

Construction/mandate of WGRCSI was developed in a white Paper led by Greg Flato (JSC), with input from JSC members and the TF co-chairs

WGRCSI should cover: Regional climate modeling and projections. Linking to GCM activities in one direction and climate change impacts and adaptation in the other. Panel should be transdisciplinary with modelers, stat. downscalers, impact modelers, adaptation/vulnerability scientists. It should have suitable geographical coverage in terms of membership.

The new WG was announced at the WMO Assembly in May 2011 by JSC chair (I think!)

We hope a WG and mandate for this WG will be drafted at the next JSC So it can begin. Post 2011 CORDEX will not have a formal WCRP home
Pan-CORDEX conference was held in Trieste March 2011

An Africa-CORDEX diagnostics/training panel now formed and had a first training workshop in Trieste for 30 African scientists where they were given output from 10 RCM (ERA-int) runs 1989-2008, and given guidance in the analysis of these simulations (for their respective regions of Africa) using a R-based analysis package.

2nd training workshop in Cape Town Nov 2011 followed by a possible side event at COP17 Durban, organized by UNDP.

3rd training session early 2012. Aim is to have Africa-CORDEX climate change papers drafted by this group before July 2102 (AR5)

A similar group now being formed for South Asia, led by IITM.

Discussions now occurring with S.E. Asian Bank to support a similar capacity building and impacts/evaluation panel for S.E. Asia.

All capacity building efforts are a WCRP/START collaborative effort
CORDEX East-Asia had a workshop Sept 2011, hosted by KMA to begin to organize and share East Asia downscaling activities.

Euro-CORDEX will have a meeting Nov 17-18 to plan CMIP5 downscaling over Europe (esp. 0.11° RCM simulations)


Meeting between AgMIP and CORDEX held in New York April 2011 to develop a set of climate - agriculture assessment Projects: initially over North, South and central America.

CORDEX project detailed in Clivar Exchanges special issue on CMIP5

First review paper of ERA-interim forced Africa-CORDEX ensemble In review (minor revisions) with Journal of Climate.

CORDEX/Regional Climate poster session at OSC + CORDEX talks
Data and format issues:

6hr model level data (1950-2100) available from some CMIP5 GCMs. Translators have been developed, allowing parallel downscaling. e.g. at SMHI we have 5 (soon 6) global data sets for driving our RCM. We can now run multi-region, multi-GCM CORDEX simulations in parallel.

CORDEX main data archive: http://cordex.dmi.dk/

Discussions occurred with Euro ESG groups (BADC, DKRZ, IPSL) thru' the is-ENES project to bring CORDEX archiving within the CMIP5 ESG structure. Is-ENES2 will support CORDEX archiving in ESG.

A set of CORDEX data has been loaded and broadcast between ESG nodes in Sweden and UK. Some extra facets required in the ESG for CORDEX data names. NCAR developers have this info.


E.g. File naming conventions File names should follow this structure:

VariableName_Domain_GCMModelName_CMIP5ExperimentName_CMIP5EnsembleMember_RCMModelName_RCMVersionID_Frequency_StartTime_EndTime.nc
Initial Results from 10 RCMs run for 1989-2008 at 50km forced by ERA-interim boundary conditions

RCMs that have/are made the Africa ERA run and **will** make GCM projection runs for Africa

UCT/UK Met. : PRECIS  
Santander/Bergen/LMD : WRF  
ICTP : RegCM3  
UQAM : CRCM5  
Meteo France : ARPEGE  
KNMI : RACMO  
JRC : COSMO-CLM  
MPI : REMO  
DMI : HIRHAM  
SMHI : RCA

All the above have promised (at least 1 GCM forced Africa run)

**Africa-CORDEX J.Climate article in review**: minor revisions
Over Africa it is important to consider **observational uncertainty**.
Surface observational coverage is severely limited in some regions.
Seasonal Mean Precipitation

Precipitation (pr) | JAS | 1998-2008

GPCP11
TRMM-3B42
UDEL201
GPCC5
ERA-INTERIM
ENSEM. MEAN (RCMs)
SMHI-RCA35
DMI-HIRHAM5
CLMcom-CCLM48
MPI-REMO
KNMI-RACMO22
CNRM-ARPEGE51
ICTP-RegCM3
UCT-PRECIS
UC-WRF31
UGAM-CRCM5

mm/day (OBS, RCMs) - GPCP11
Latitudinal progression of the West African Monsoon
Monthly mean precipitation averaged between 10W-10E
Local Time of maximum rain rate during the day: JAS

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<th>Model</th>
<th>Map Image</th>
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An ensemble can be used to investigate higher order climate variability of importance in impact assessment (e.g. agriculture).

2-6 day band-passed precipitation variance highlights African Easterly Waves that deliver the majority of precipitation in the Sahel region.
2-6 day band-passed (AEW) Standard deviation of precipitation (JAS)

3-hour precipitation (pr): 2-6 day BP STD | JAS 1998-2008

TRMM3B42 0.25°
RCA35 0.44° (50km)
RCA35 0.22° (25km)
RCA35 0.11° (12km)
RCA35 had a good phase of the diurnal cycle at 0.44° but too low amplitude.
Regional Climate Model Evaluation System (RCMES)

Application to CORDEX (JPL/UCLA; D. Waliser, J. Kim, C. Mattman, et al.)

**RCMED**
(Regional Climate Model Evaluation Database)
A large scalable database to store data from variety of sources in a common format

**RCMET**
(Regional Climate Model Evaluation Tool)
A library of codes for extracting data from RCMED and model and for calculating evaluation metrics

**Raw Data:**
Various formats, Resolutions, Coverage

**Extractor**
- Metadata
- Data Table
- Common Format, Native grid, Efficient architecture

**Data Extractor**
- MySQL

**User's own codes for ANAL and VIS.**

**URL**

**Metrics Calculator**
Calculate comparison metrics

**Visualizer**
Plot the metrics

**Regridder**
Put the OBS & RCM data on the same grid for comparison

**Extract OBS data**

**Extract RCM data**
Model errors range from -17.5% to +20%.

All models generate good spatial pattern (spatial corr. coef. > 0.9 vs. the MODIS data).

Model ensemble generally agree more closely with the REF data than individual models.
  • the smallest bias and RMSE against the MODIS data.
  • the highest spatial correlation with the MODIS data.
  • Model ensemble does not improve spatial variability.
CORDEX-Africa Hindcast Domain
Linking CORDEX simulations with impact assessments and decision-making tools
SMHI (50km$^2$) reproduces well the mean annual malaria incidence pattern with respect to TRMM-ERAINT & GPCP-ERAINT control experiment.
Malaria Incidence mean seasonal cycle animation
Number of drought-affected people in sub-Saharan Africa estimated by WFP Africa RiskView based on rainfall and potential evapotranspiration using: ERA-Interim. ERA-Interim downscaled by SMHI/RCA at 0.44, 0.22 & 0.11°. Black bars are the historical record of WFP emergency operations (EMOP) in response to drought. Note EMOP reflects planned interventions and should be considered a lower bound to the actual drought-affected people.
First Africa-CORDEX projections based on CMIP5 RCPs: W. Africa/Sahel JAS seasonal mean 2m temp & precipitation
First Africa-CORDEX projections based on CMIP5 RCPs: East Africa

2m Temperature
East Africa (EA)

- RCA4(CanESM2) hist
- RCA4(CanESM2) rcp45
- RCA4(CanESM2) rcp85
- CRU

Year
1950 1975 2000 2025 2050 2075 2100

Temperature (°C)
First Africa-CORDEX projections based on CMIP5 RCPs: East Africa

2m Temperature
East Africa (EA)

2m Temperature anomalies (wrt 1961–1990)
East Africa (EA)
First Africa-CORDEX projections based on CMIP5 RCPs: East Africa
Hadley C. CORDEX simulations used to analyse error Sources (local vs remote) in model development process.