

Coordinated Regional Downscaling Experiment (CORDEX)

32nd Session of the GEWEX
Scientific Steering Group

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Pasadena, CA, USA



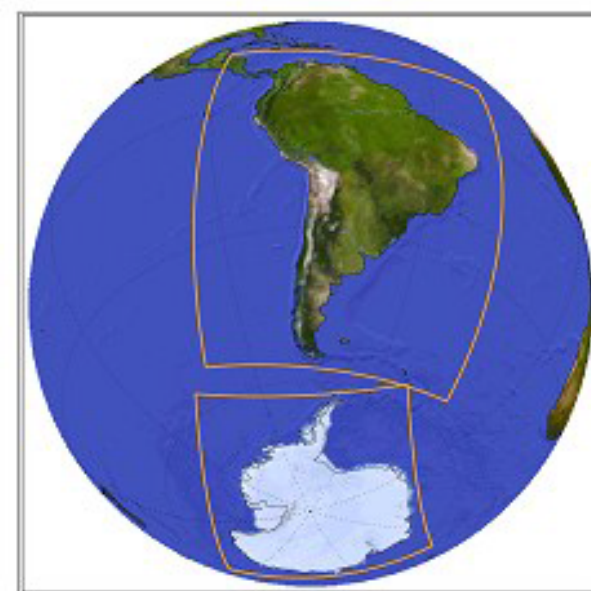
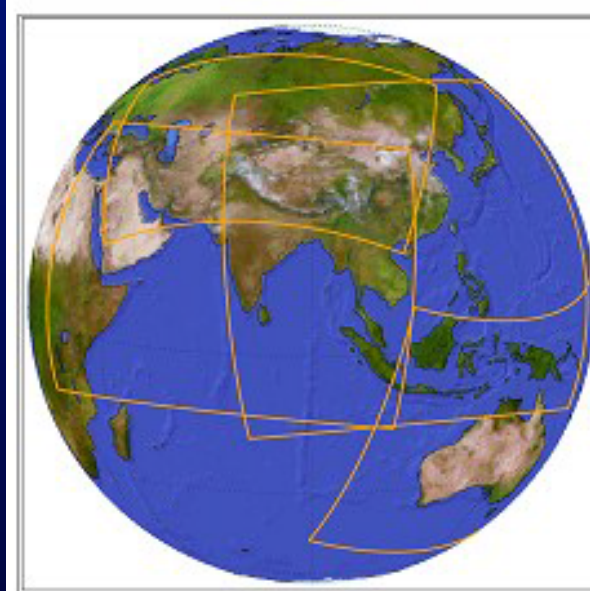
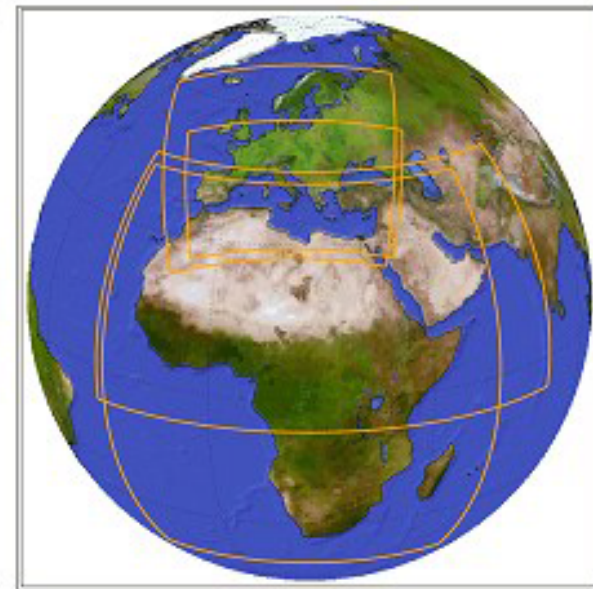
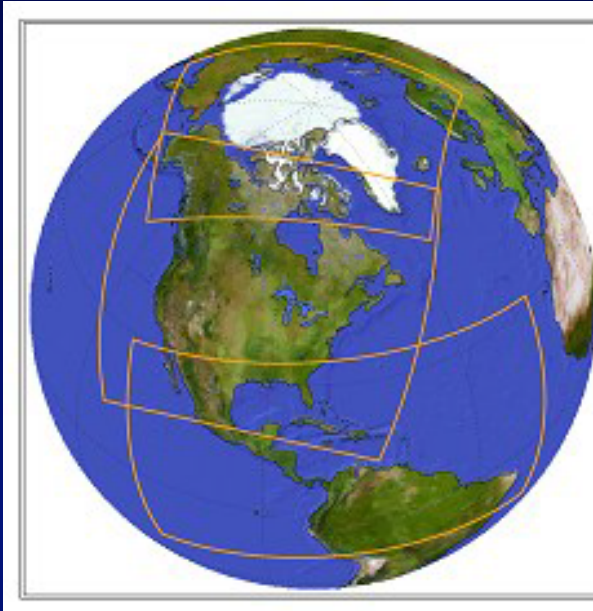
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CORDEX Background

CORDEX aims:

- ❖ Link regional expertise
- ❖ Build on prior experiences with regional simulations and processes
- ❖ Engage all forms of downscaling (RCM, ESD, variable res GCM)
- ❖ Cover all major land masses + Arctic



Progress & Achievements

WCRP

CORDEX

14TH-18TH OCTOBER 2019 BEIJING, CHINA

ICRC-CORDEX 2019

International Conference On Regional Climate

ICRC-CORDEX 2019

- ~ 400 abstracts submitted (70 countries); 253 attended (44 countries)
- Advanced capacity development, training and knowledge exchange
- Built new and enhance existing co-operations

Sessions on

Advances in Regional Downscaling: Added value & uncertainties, conv permitting, ESD, HiResGCM

Coupled Models: Ocean-ice-atmosphere, atmosphere-land, biogeochemical modeling

Climate-Change Impacts: Extremes, implications for renewable energy, high-mountain environments

Side meetings: Third Pole, RCMES, 1.5 & 2 °C, Urban env., ESGF, Climate services, Hybrid meth.



Opportunities:

- Discussion of new strategic plan
- Input on implementation plan



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Progress & achievements

Project Meetings, Workshops, Conference Sessions

➤ EUROPE

- 9th EURO-CORDEX General Assembly, Hamburg, Germany, January 2019
- "Regional Climate Modeling, including CORDEX", EGU, Vienna, April 2019
- FPS-LUCAS Annual Meeting, Hamburg, Germany, September 2019
- 6th Med-CORDEX workshop, Toulouse, France, November 2019

➤ ASIA

- Int. Workshop for CORDEX East Asia, Jeju Province, Korea, April 2019
- Workshop for SEACLID/CORDEX SE Asia, Manila, Philippines, July 2019
- Utilization of CORDEX SE Asia Data, Bangkok, Thailand, October 2019

➤ AUSTRALASIA

- RCM/CORDEX sessions: AMOS, Darwin, Australia, June 2019; AOGS, Singapore, July 2019; MODSIM2019, Canberra, Australia, Dec. 2019

➤ SOUTH, CENTRAL, NORTH AMERICA

- FACETS/NA-CORDEX project meetings, Boulder, CO, USA, MARCH 2019
- CORDEX Climate-Change Scenarios session, Scenarios Forum, Denver, CO, USA, March 2019
- Presentations: RAUGM 2019, Puerto Vallarta, Mexico, Oct. 2019; AGU, San Francisco, CA, USA, Dec. 2019

- **Data on ESGF**
- **Substantial contribution to the IPCC 1.5 report & AR6 chapters**
- **Dozens of papers and contributions to national/regional reports**

Progress and achievements

CORDEX demonstrator

Adapt to climate change? African Impact Atlas: impacts in Africa under different degrees of warming. Threshold exceedance in key sectors.

Co-produce
Co-explore
Co-design
Co-define
Co-refine

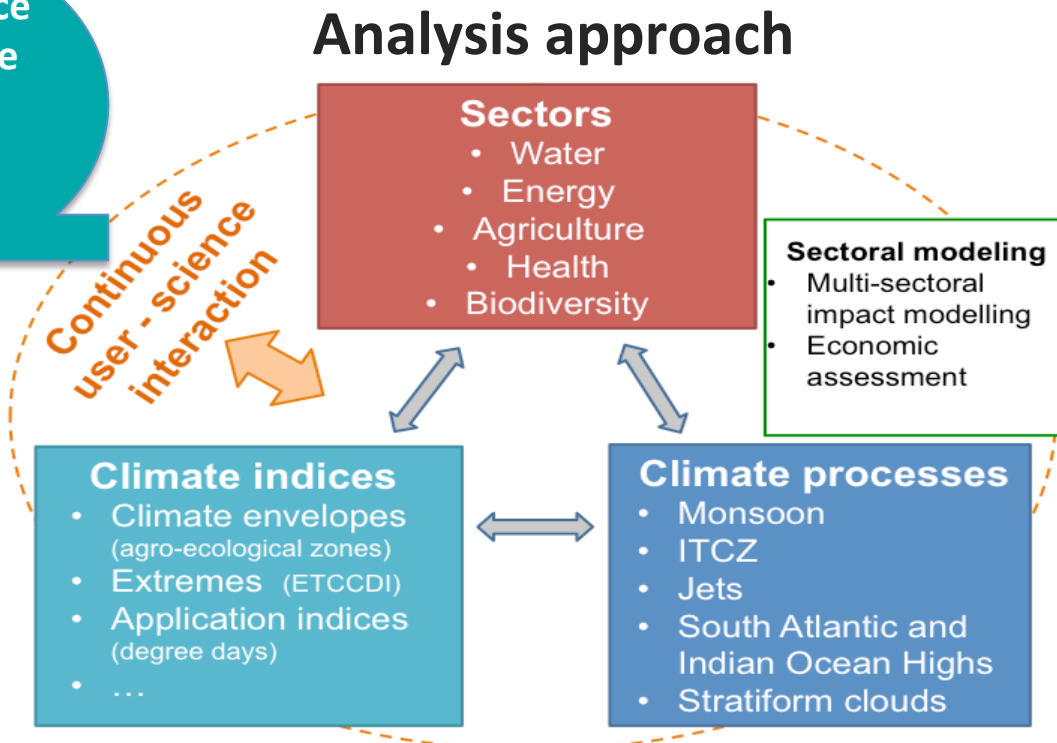


Image © AlJazeera

Regional expertise essential to develop this information
=> Good links between African and other institutions

Further plans

From a white paper: *Futures Challenges for CORDEX*

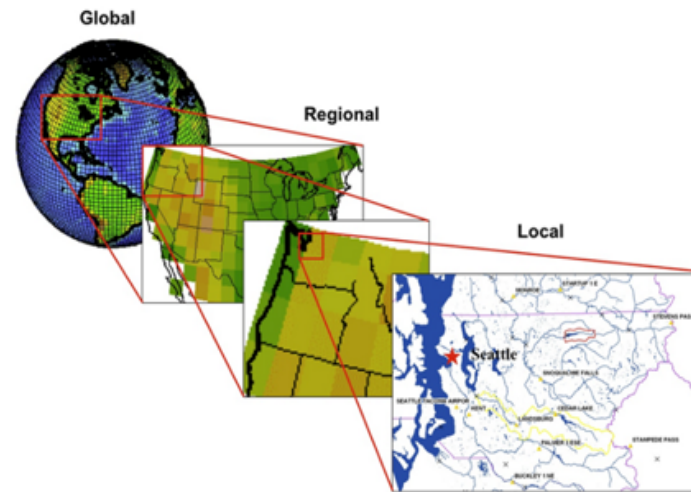
Smaller domains & Increasing resolution

- **Challenge**

Pressure to do simulations at high resolution in smaller domains than the CORDEX domains, e.g., *convection-permitting-resolution domains*. At the same time, GCMs are using resolutions of 25-50 km in HighResMIP for CMIP6, reaching the RCM scale. (Probably the standard resolution in CMIP7?)

Collaboration has started with HighResMIP.

However, one major strength of CORDEX has been the performance and analysis on common domains.



Source: Andrew Wood

Further plans

From a white paper: *Futures Challenges for CORDEX*

Increasing complexity

- **Challenge**

RCMs → Earth System Models: integrate two-way coupled processes, e.g., dynamic vegetation (carbon cycle), oceans (and sea-ice), more complex precipitation processes, interactive aerosols, lakes, glaciers, etc.; include human decision making; Computing time needed increases

Exascale computing

- **Challenge**

New generation of high-performance computers, using GPUs, specialized processors, etc. A trend of more processors or processing units. Models have to be adapted to this new development.



Source: Pexels.com

Further plans

Linking with other programs

CMIP6

- CORDEX as a CMIP6 Diagnostic MIP (Gutowski et al., 2016, *GMD*, doi:10.5194/gmd-9-4087-2016)
- Collaboration started with HighResMIP (analyses, boundary conditions)



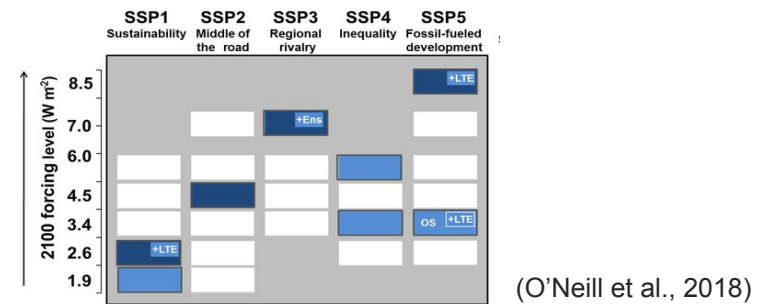
IPCC AR6

- CORDEX Coordinated Output for Regional Evaluations (CORE)
- Extensive use in AR6 WG1 regional chapters (10, 11, 12 & Atlas)



SSPs

- Explore regional climatic impacts of land-use changes



Further plans

New Joint WCRP Coordination Office for Regional Activities: WCRP CORA

Hosted by

- ❖ The Climate Service Center Germany in Hamburg, Germany (GERICS), and
- ❖ The Bjerknes Centre for Climate Research (BCC) in Bergen, Norway.



Opportunity for promoting joint activities:

- Among Core Projects and Major Initiatives
- With boundary organizations



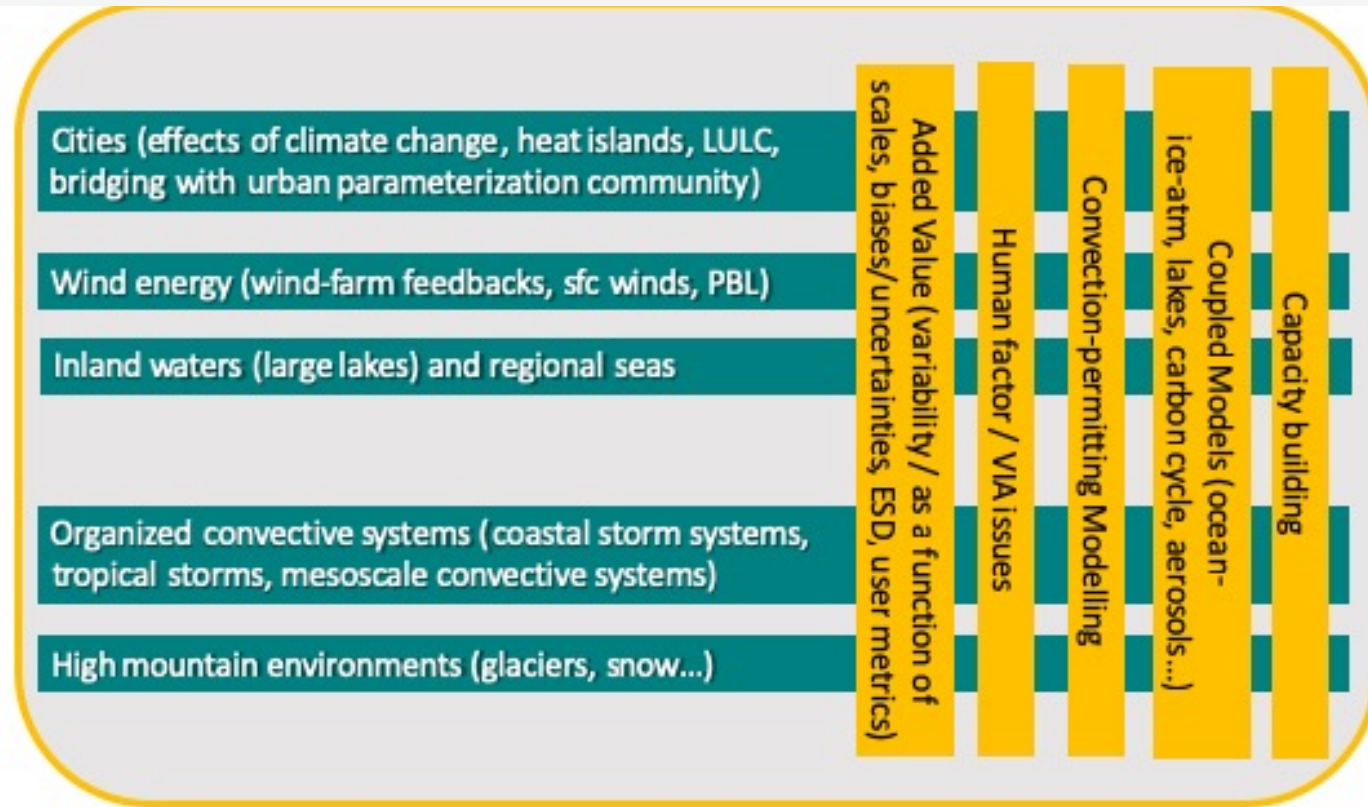
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Links to the WCRP Strategic and Implementation Plans

Goal 1: “We will support and facilitate the advancement of sciences that enable an integrated and fundamental understanding of the climate, its variations and its changes, as part of a coupled physical, biogeochemical, and socio-economic system.”

CORDEX Scientific Challenges



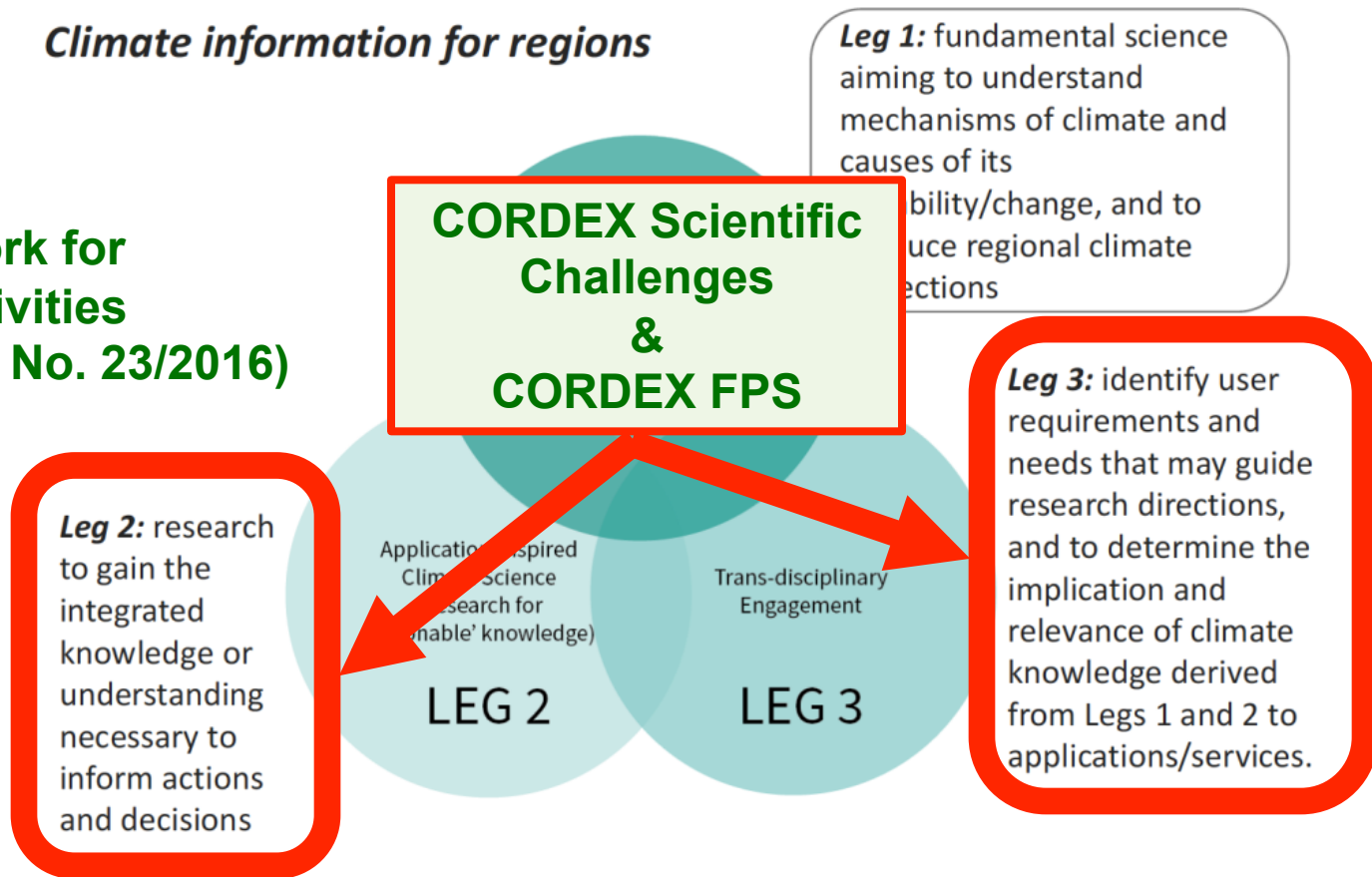
Goal 3: “We will quantify the responses, feedbacks and uncertainties intrinsic to the changing climate system on longer timescales.”

Links to the WCRP Strategic and Implementation Plans

Goal 4: “We will support innovation in the generation of decision-relevant information and knowledge about the evolving Earth system.

Climate information for regions

from:
**Scoping a framework for
WCRP regional activities
(WCRP Publication No. 23/2016)**



?? Goal 2: “We will push the frontiers of predictions and quantify the associated uncertainties for subseasonal to decadal time scales across all climate system components.”??

Emerging issues

- Strategies for obtaining funding for CORDEX activities, especially outside Europe and the U.S.
 - Uneven development across regions
 - Capacity building
- Computing resources, esp. for developing regions
- Engaging statistical downscaling (including machine learning, other “big data” techniques)
- Communication between groups/core projects – limited staffing
- Exascale computing

Thank You



Watch for ...

“The ongoing need for high-resolution regional climate models: Process understanding and stakeholder information” by Gutowski, Ullrich, Hall, Leung, O’Brien, Patricola et al. *Bulletin of the AMS* (accepted)

Additional Slides



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Progress and achievements

CORDEX FPS - Flagship Pilot Studies

Requirements

- Strong basis in fine-scale processes important to region's climate (*physical basis*)
- Observational basis for verification (*analysis basis*)
- User applications (*VIA basis*)
- Potential connection with other WCRP programs, esp. GEWEX

<http://cordex.org/experiment-guidelines/flagship-pilot-studies/>



Africa: Coupled regional modelling of land-atmosphere-ocean interactions over western-southern Africa under climate change

Contact person Francois Engelbrecht FEngelbrecht@csir.co.za

Africa: ELVIC - Climate Extremes in the Lake Victoria Basin, Nicole van Lipzig

Contact person Nicole van Lipzig nicole.vanlipzig@kuleuven.be

South America: Extreme precipitation events in Southeastern South America: a proposal for a better understanding and modeling

Contact person Maria Bettolli bettolli@at.fcen.uba.ar

Europe+ Mediterranean; Convective phenomena at high resolution over Europe and the Mediterranean

Contact person Erika Coppola coppolae@ictp.it or Stefan Sobolowski stefan.sobolowski@uni.no

Europe; Impact of land use changes on climate in Europe across spatial and temporal scales

Contact person Diana Rechid diana.rechid@hzg.de

Mediterranean; Role of the natural and anthropogenic aerosols in the Mediterranean region: past climate variability and future climate sensitivity

Contact person Solmon Fabien fsolmon@ictp.it or Marc Mallet marc.mallet@euro.obs-mip.fr

Mediterranean; Role of the air-sea coupling and small scale ocean processes on regional climate

Contact person Gabriel Jordà gabriel.jorda@uib.cat or Gianmaria Sannino gianmaria.sannino@enea.it

Progress and achievements

Added Value

African
 SE Australia
 Daily precipitation
 Summer mean
 variability
 precipitation
 (JFM)
 (DJF)

Brisson et al. (2016), *Clim. Dyn.*
 D'Adda et al. (2016), *Clim. Dyn.*
 DiLuca et al. (2016), *JGR*
Clim. Dyn.

