

# Coordinated Regional Downscaling Experiment (CORDEX)

William J. Gutowski, Jr.  
Iowa State University  
and

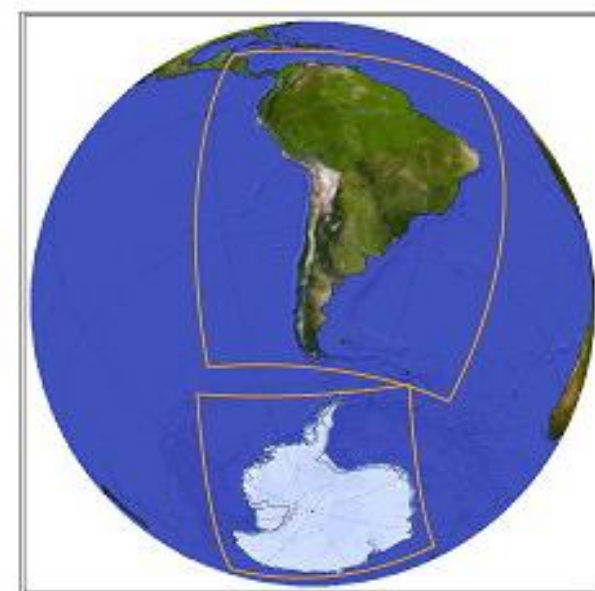
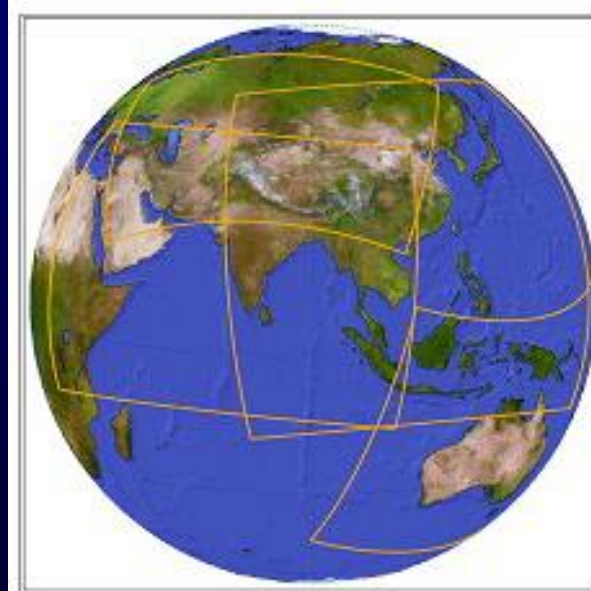
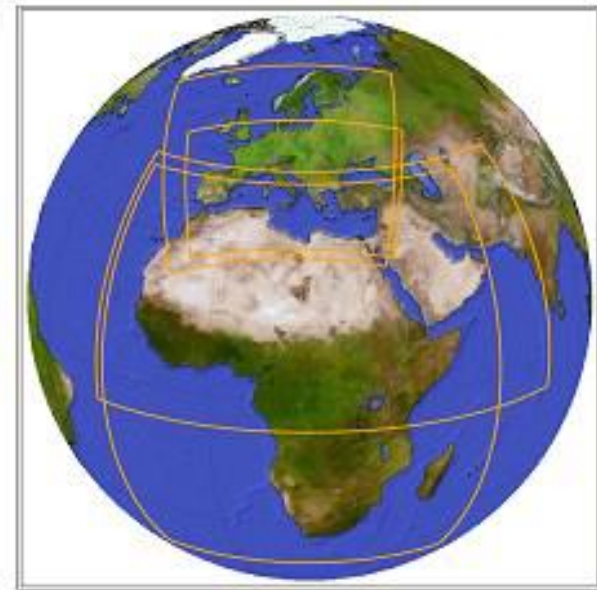
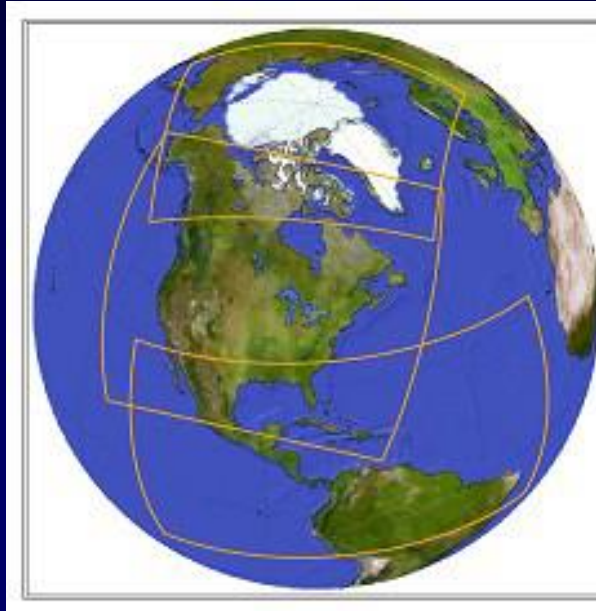
Co-Chair, CORDEX Science Advisory Team (SAT)



# 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



# CORDEX Scientific Challenges

Cities (effects of climate change, heat islands, LULC, bridging with urban parameterization community)

Wind energy (wind-farm feedbacks, sfc winds, PBL)

Inland waters (large lakes) and regional seas

Small Islands (island-generated climatology, storm surge)

Organized convective systems (coastal storm systems, tropical storms, mesoscale convective systems)

High mountain environments (glaciers, snow...)

Added Value (variability / as a function of scales, biases/uncertainties, ESD, user metrics

Coupled Models (ocean-ice-atm, lakes, carbon cycle, aerosols...)

Convection-permitting Modelling

Human factor / VIA issues

Capacity building

# CORDEX in the Strategic Plan

## E-5. The regions in the climate system

CORDEX and regional climate phenomena at the nexus of two key strategic plan issues:

- The product of multi-scale interactions between large-scale processes and smaller-scale processes
- A direct link between climate and communities impacted by climate variability and change

# CORDEX in the Strategic Plan

## E-5. The regions in the climate system – Goals:

- Regional analysis of global coupled models and the variety of downscaling tools
- Some focuses: convective systems, frontal behavior and processes driven by topography, land-water cover and land-use.
- Processes producing regional “hotspots” that have strong global impacts or are particularly sensitive to large-scale forcings
- Advance the production of regional climate information
- **KEY NEED:** high quality, fine scale, multivariate observations

# CORDEX in the Strategic Plan - Further

- **E-0. Climate science in support of sustainable development**
  - Regional impacts of air pollutant concentrations, aerosol loadings, land-use changes, urbanization ...
- **E-1. The atmosphere in the climate system**
  - Changing dynamical/hydrological cycles of the atmosphere & climate sensitivity
- **E-2. The ocean in the climate system**
  - Regional couple ocean-atmosphere models
- **E-3. The land in the climate system**
  - How development and changes to human society integrates with and affects land-coupled climate processes
- **E-4. The cryosphere in the climate system**
  - Mountain glaciers, dynamic instability of ice sheets, significant methane outbursts ...

# CORDEX Workshops/Meetings

## AFRICA

- **CORDEX Africa** Analysis workshops, Cape Town, August, November, December 2017 and February 2018
- **CORDEX African Impact Atlas** workshops, Cape Town, August, November, December 2017 and February 2018

## EUROPE

- Session on "Regional Climate Modeling, including **CORDEX**", EGU, Vienna, April 2017.
- The 5<sup>th</sup> **Med-CORDEX** workshop, Barcelona, July 2017.
- Joint **Polar CORDEX** meeting, Cambridge, Sept/Oct 2017
- **Pan-WCRP Modelling** Meeting, Exeter, October 2017
- **Euro-CORDEX** General Assembly, Hamburg, Germany, January 2018
- **Med-CORDEX** in MISTRALS workshop, Montpellier, France, October 2017
- **Flagship Pilot Study-convection** group meetings: Hamburg, Jan. 2017 & Trieste, Nov. 2017
- **FPS airsea (Med) + Med-CORDEX** meeting, Majorca, Spain, March 2018

# CORDEX Workshops/Meetings

## ASIA

**SEACLID/CORDEX** Southeast Asia 4<sup>th</sup> Workshop, Hanoi, November 2017

**CORDEX** and regional downscaling session in AOGS2017, 6-11 August, Singapore

**CORDEX-Asia** ESD session during the International Workshop on Climate Downscaling Studies, 2-4 October 2017, Tsukuba, Japan

**CORDEX-Asia** ESD Project Meeting, 4 October 2017, Tuskuba, Japan

## AMERICAS

Workshop “The Science of Climate Change: a focus on Central America and the Caribbean Islands”, Antigua, Guatemala, March 2017

Special Session at UGM, Puerto Vallarta, Mexico. SE04: Modelación Climática Regional / Regional Climate Modeling, November 2017.

**CORDEX** session at the AGU general assembly, New Orleans, December 2017.

## Key issues:

1. Coordination
2. Funding



The IPOC has played a vital role in this!

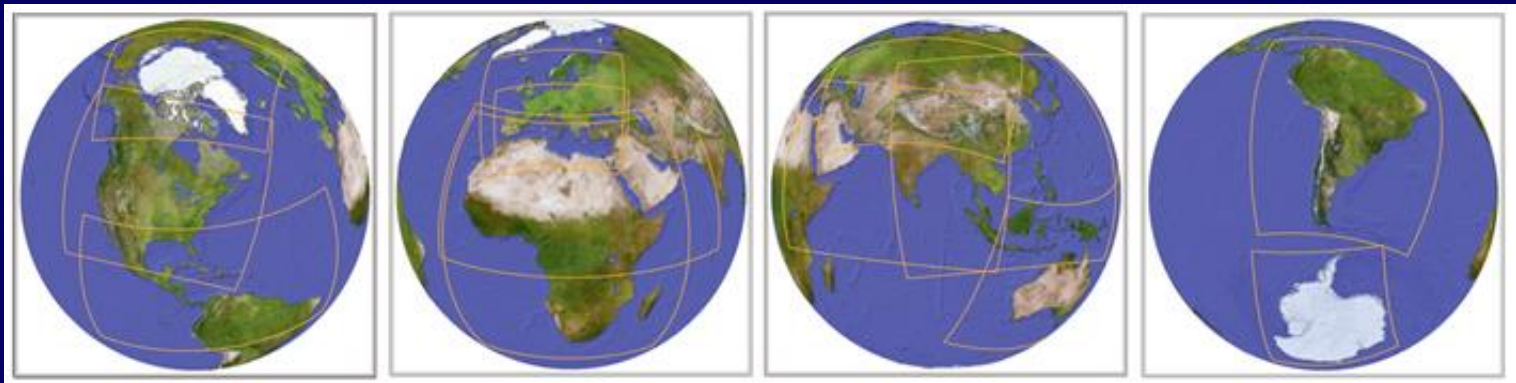


# CORDEX Contributions to Information for Regions

- EURO-CORDEX guidelines on climate projections and its use completed, <http://euro-cordex.net/imperia/md/content/csc/cordex/euro-cordex-guidelines-version1.0-2017.08.pdf>
- Hindu Kush Himalayan Monitoring and Assessment Programme (HIMAP; <http://www.icimod.org/himap>) partly based on CORDEX results
- Future Climate Change Projections over India assessed using CORDEX South Asia RCM outputs (<http://cccr.tropmet.res.in/home/reports.jsp>)
- WCRP Report No17\_2017
- The Arctic ESD tool is followed by users spread over a large number of countries  
<https://www.facebook.com/Rclimateanalysis/insights/?section=navPeople>
- Med-CORDEX contributing to the MedECC report, “A Regional Climate Change Assessment Report” targeting stakeholders, <http://www.medecc.org/>

# SP Implementation: Flagship Pilot Studies (FPS)

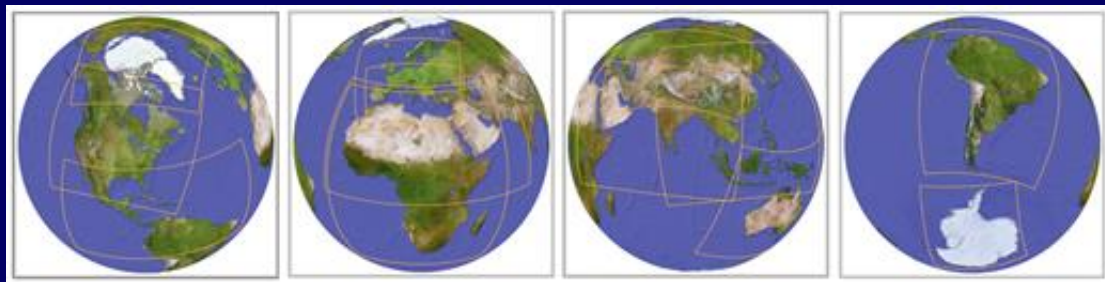
- Coordinate developments in conv.-permitting climate sim.
- Should have strong basis in
  - ◆ Fine-scale processes important to region's climate (physical basis)
  - ◆ Observational basis for verification (analysis basis)
  - ◆ User applications (VIA basis)
- Potential connection with other WCRP programs, esp. GEWEX
- Cumulatively - 9 proposals reviewed from 6 CORDEX regions
- Details: [www.cordex.org](http://www.cordex.org)



# Flagship Pilot Studies (FPS)

Seven now established:

- ✓ EUR+MED: High resolution convective phenomena
- ✓ EUR: Impact of land use changes
- ✓ S. AM: Extreme precipitation events
- ✓ Africa: Ocean-atmosphere-land interactions
- ✓ Africa: Lake Victoria's regional climate
- ✓ MED: Role of natural and anthropogenic aerosols
- ✓ MED: Air-sea coupling and small-scale ocean processes



# Challenge: Promoting to the CORDEX Community - CORDEX as a CMIP6 Diagnostic MIP

## Primary CMIP6 Question Addressed:

How can we assess future climate changes given climate variability, predictability and uncertainties in scenarios?

## Primary WCRP Grand Challenges Addressed:

1. Weather and climate extremes
2. Regional climate information (or further developments)

**Coordination:** ScenarioMIP, HighResMIP, VIACS AB, . . .

Gutowski et al., 2016: WCRP Coordinated Regional Downscaling Experiment (CORDEX): A Diagnostic MIP for CMIP6. *Geoscientific Model Development* [doi:10.5194/gmd-9-4087-2016]



# CORDEX CORE

## CORDEX Coordinated Output for Regional Evaluations

- **Motivated and further promoted by**
  - IPCC Workshops on Regional Climate (Sept. 2015; May 2018)
  - WCRP Scoping Workshop on a framework for reg. studies (Sept. 2016)
  - Regional focus in AR6 WGI (3 chapters + Atlas)
- **Elements**
  - ◆ Succinct set of downscalings for each region
  - ◆ Provide a core foundation for additional work by others
  - ◆ Span plausible range of climate change:  $\geq 3$  distinct GCMs
  - ◆ CMIP5 (CMIP6): Historical + RCP2.6 & RCP8.5 (to 2100)
  - ◆ Downscaling: currently 5 RCMs + ESD methods
  - ◆ Resolution: 12.5 – 25 km
- **Related - Bibliography of recent CORDEX publications**

# Implementation? - Scoping a Framework for WCRP Regional Activities

Hamburg, Germany – 10-11 October 2016

**Emergence of regional issues in  
international climate science**

## **Needs:**

- **Clarify relationship of WCRP & CORDEX to climate services**
- **Clarify scope of WCRP science vis-à-vis climate information**
- **Enhance connections among WCRP activities for regions**



(<http://www.avisonyoung.com/offices/hamburg-germany>)

# Implementation? - Scoping a Framework for WCRP Regional Activities

## “Leg 1” Foundational Climate Science

(Curiosity-driven research/ Fundamental knowledge)

## “Leg 2” Application-inspired Climate Science

- Use-inspired fundamental research
- Research to understand critical phenomena
- Goal: Understanding of processes governing climate relevant to users of climate information

## “Leg 3” Trans-disciplinary Engagement

- Requires dialogue with “boundary” organizations
- Can view as translational science
- Goal: Provide climate information, not numbers, as an outcome of the engagement

# WCRP CORDEX ICRC-CORDEX 2016

17<sup>TH</sup>-20<sup>TH</sup> MAY 2016 STOCKHOLM, SWEDEN



## Goal:

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



<http://www.icrc-cordex2016.org/>

## Publications:

- Lake, I., Gutowski, W., Giorgi, F., & Lee, B. (2017). CORDEX: Climate Research and Information for Regions. *Bulletin of the AMS*, ES189-ES192, August 2017. doi: 10.1175/BAMS-D-17-0042.1
- Lake, I., Kang, H., Tangang, F., Gutowski, W., Lee, B., Kjellström, E., & Langendijk, G. (2017). The International Conference on Regional Climate — CORDEX 2016. *APN Science Bulletin*, 7(1). doi:10.30852/sb.2017.192





## Opportunities:

1. Discussion of new strategic plan
2. Input on implementation plan



## Issue: Further Links with other WCRP programs

WGCM - Started in Exeter. Status?

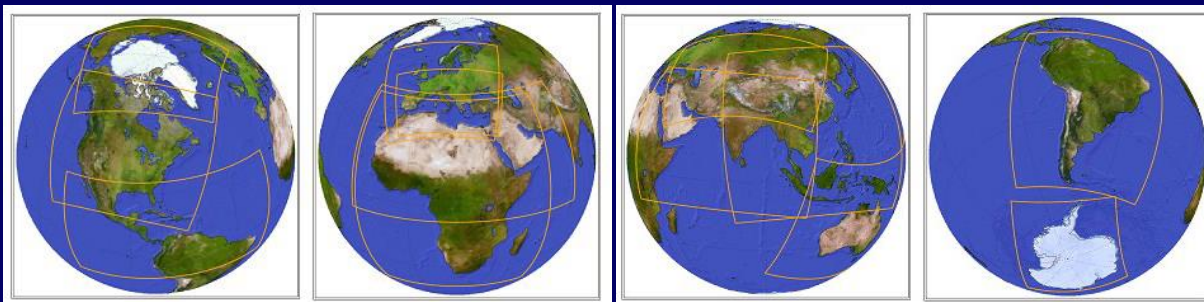
SPARC - Tropical convection  
- High latitude storm tracks  
- Arctic tropopause?

GEWEX - Subdaily precipitation

CLIVAR - Large-scale processes (teleconnections) linked to fine-scale regional climate  
- Coupled atmos-ocean regional modeling

# CORDEX Challenges

- Role of CORDEX within the evolving WCRP structure
- Further interactions with CMIP6 and other WCRP activities
- Two CORDEX SAT co-chairs rotating off within two years
- Clarifying scientific boundaries of CORDEX
- Coordination across different regional CORDEX activities
- Communication across CORDEX regional communities
- Strategies for obtaining funding for CORDEX activities, especially outside Europe and the U.S.
- Uneven development across regions



# Thank You!

