

HighResMIP-CORDEX coordination

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Key issues:

- Metrics and methods of comparison
 - how should we fairly compare global and regional models?
 - how do we assess the strengths and weaknesses of each
- What are we trying to learn from such a comparison?

CMIP6 HighResMIP simulations

Physical model only x 2 resolutions, simplified aerosol optical properties (MACv2-SP) recommended

Atmosphere-land-only, 1950-2014 (→ 2050)

Forced by observed SST and sea-ice and historic forcings (→ projected)

highresSST-present (→ highresSST-future)



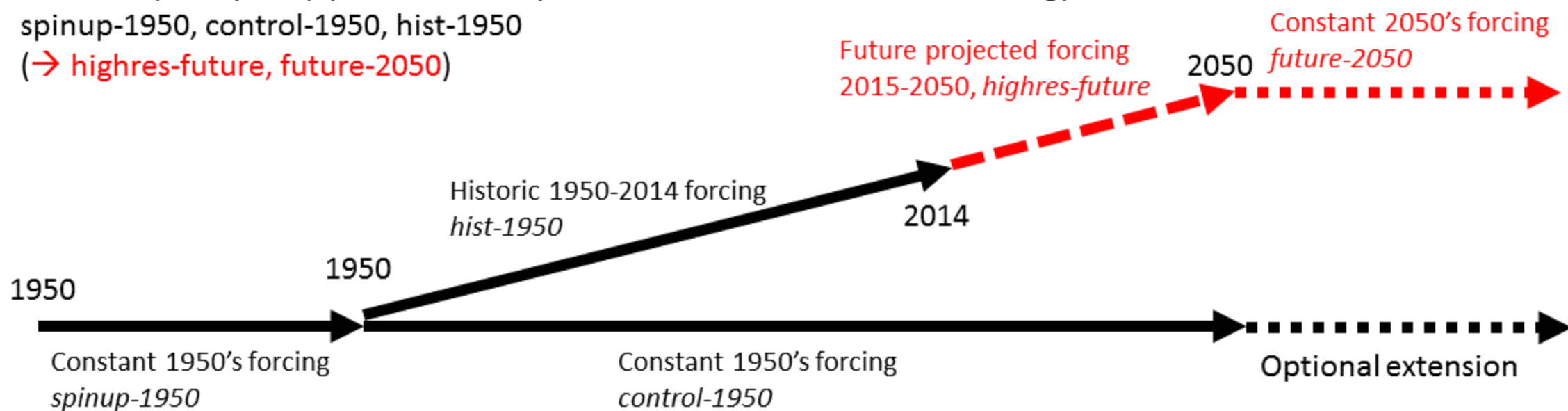
Coupled climate, 1950-2014 (→ 2050)

Forced by constant 1950 and historic forcings (→ projected)

Initial coupled spin-up period ~ 30-50 years from 1950 EN4 ocean climatology

spinup-1950, control-1950, hist-1950

(→ highres-future, future-2050)



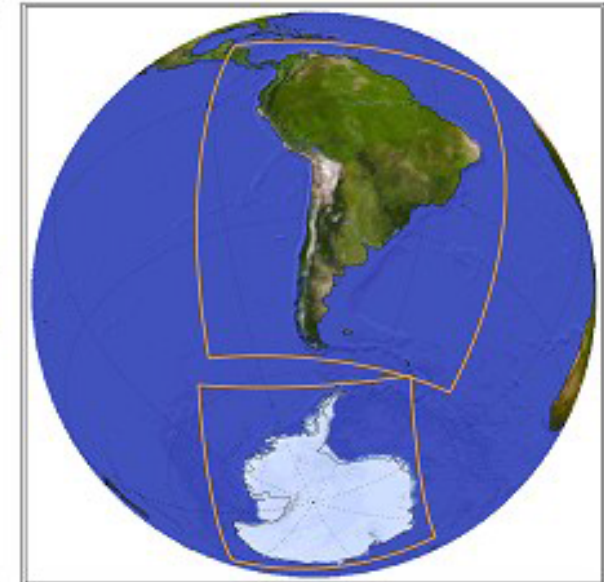
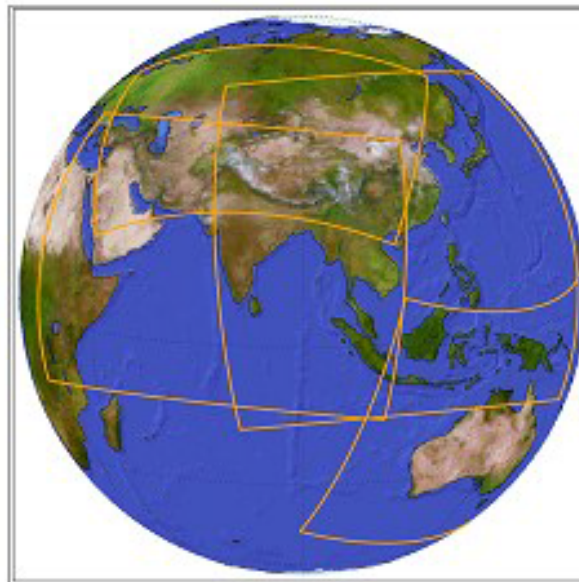
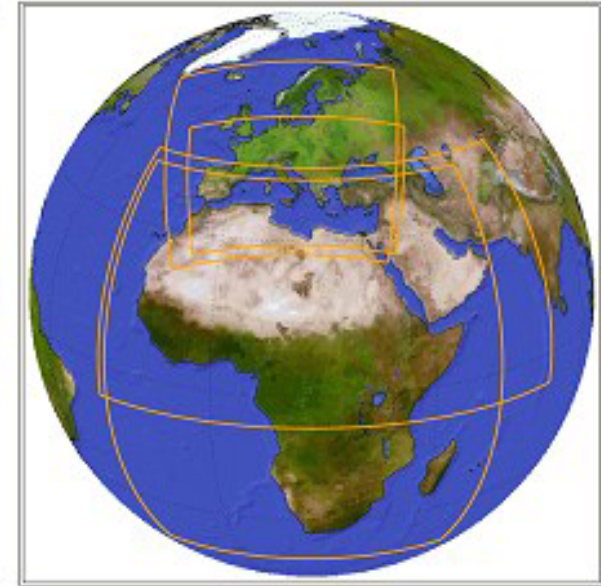
HighResMIP simulation status

- IPSL have already delivered HighResMIP data to ESGF
- PRIMAVERA European groups have finished 1950-2014 simulations at (at least) two horizontal resolutions
 - highresSST-present – atmosphere-only (6 models)
 - control-1950, hist-1950 – coupled simulations (7 models)
- Data upload to ESGF is beginning now (but will take some months to complete)
- Not sure how many have saved boundary conditions
 - HadGEM3-GC31-HM (25km) has done so for future AMIP-style run highresSST-future between 2039-2050
- Other groups are ongoing – GFDF, NICAM, FGOALS-f3-H, MPAS-A

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



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?

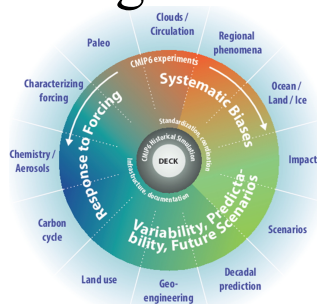
Primary WCRP Grand Challenges Addressed:

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]



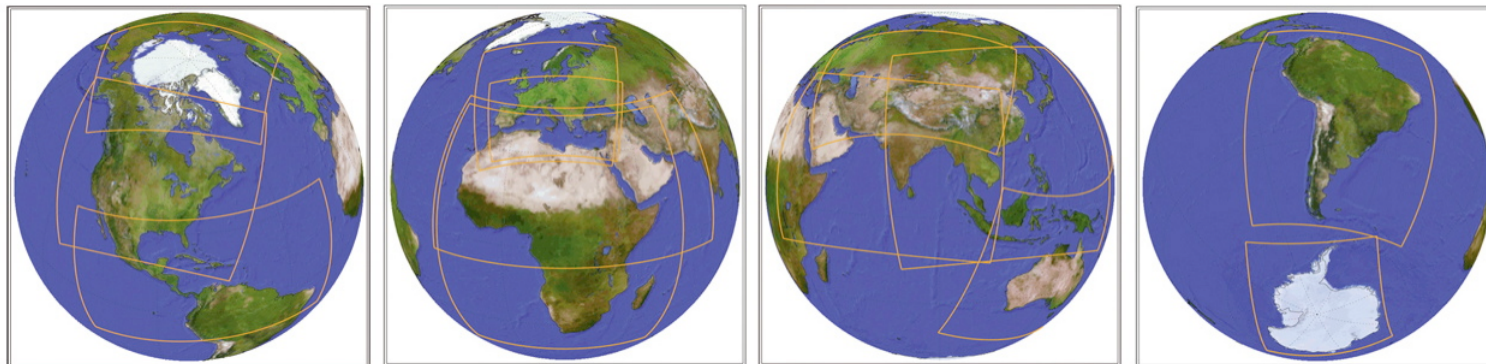
CORDEX CORE

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: ≥ 3 distinct GCMs
 - ◆ CMIP5 (CMIP6): Historical + RCP2.6 & RCP8.5 (to 2100)
 - ◆ Downscaling: currently 5 RCMs + ESD methods
 - ◆ Resolution: 12.5 – 25 km

CORDEX Flagship Pilot Studies (FPS)

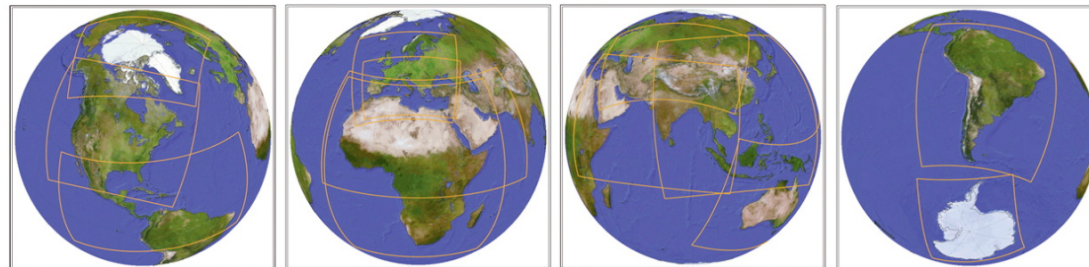
- Coordinate developments in conv.-permitting climate sim.
- Should have strong basis in
 - ◆ Fine-scale processes important to region's climate (physical basis)
 - ◆ Observational basis for verification (analysis basis)
 - ◆ User applications (VIA basis)
- Potential connection with other WCRP programs, esp. GEWEX
- Details: 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



HighResMIP-CORDEX planned analysis

- **ETH**

- Marie-Estelle Demory and Silje Soerland
- inter-comparison study between PRIMAVERA GCMs at 25 km resolution and CORDEX-CORE RCMs at 25km resolution driven by lower-resolution CMIP5 GCMs
 - mean climate and extremes
 - target a few domains: Africa, South Asia, East Asia, at 25km
 - and possibly Europe (for which the RCMs are run at 12km resolution, done under EU-PRINCIPLES project).
 - first do an evaluation, comparing the PRIMAVERA AMIP runs with the ERA-Interim driven RCMs, then compare the PRIMAVERA coupled runs with the CMIP5 GCM forced RCMs.
- A follow-up project would ideally drive RCMs with both low and high resolution GCMs to understand the role of the driving model

- **Also existing GCM-RCM comparison potential within CORDEX-CORE**

HighResMIP-CORDEX planned analysis (2)

- **CORDEX-FPS (Flagship Pilot Study)**
 - investigate convective-scale events, their processes and their future changes in a few key regions of Europe and the Mediterranean using convection-permitting RCMs
 - voluntary (unfunded), and perhaps not much global-regional comparison
 - opportunity to drive RCMs with HighResMIP output?
- **EUCP project**
 - larger CPM domains around Europe
 - Only Met Office CPM is driven by HighResMIP highresSST-future simulation at 25km (and we at least will compare those two)
 - Met Office CPMs over Europe and Africa were driven by a pre-HighResMIP 25km model (Brazil domain is in development)

Open questions

- What impact is there from driving a regional model with a higher or lower resolution global model?
- Note Roberts et al. (2018, *BAMS*, “The Benefits of Global High Resolution for Climate Simulation”): **Making the “large-scale circulation as accurate as possible ... provides critical information needed for the regional downscaling to offer added information.”**
- Continuing need to explore when, where and how regional downscaling provides added physical realism and climate information:
 - When does regional modelling add value?
 - When is regional modelling unnecessary?