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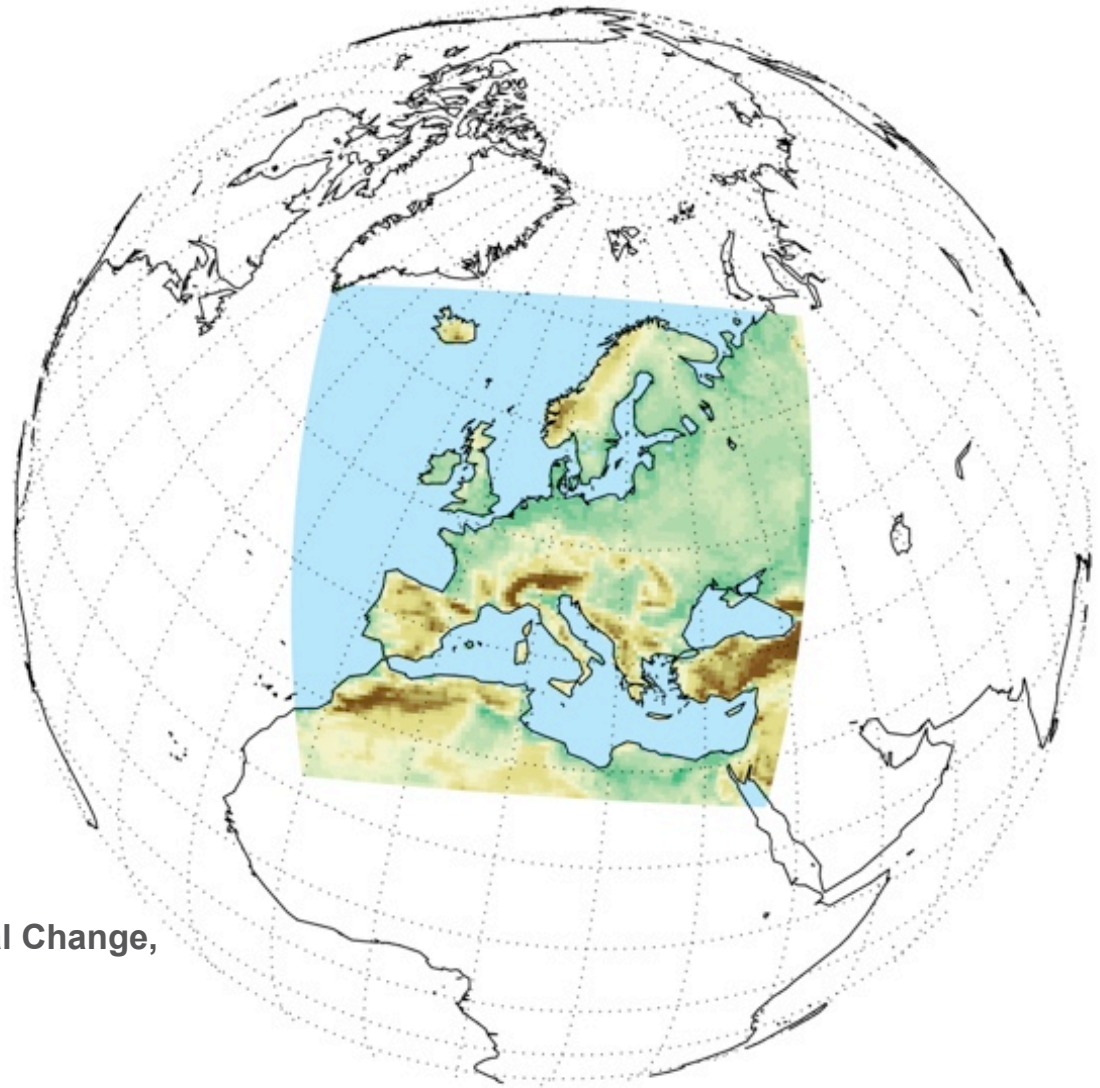
EURO-CORDEX



Wegener Center
www.wegcenter.at
UNI GRAZ

Andreas Gobiet

Wegener Center for Climate and Global Change, University of Graz, Austria

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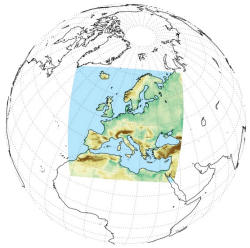
Daniela Jacob

Climate Service Center, Germany

International CORDEX Conference, 21 – 24 March 2011, ICTP, Trieste, Italy



Introduction

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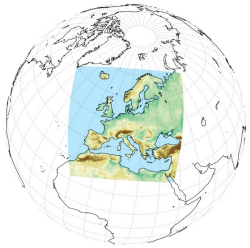
CORDEX Aims [Giorgi et al., 2009; TFRCD mandate]

1. **Model evaluation framework**
   Coordinate evaluation and possibly improvement of regional climate downscaling (RCD) techniques.

2. **Climate projection framework**
   Coordinate the production of multi-model RCD-based regional climate change information over regions worldwide, as input for impact and adaptation studies and for AR5.

3. **Communication / Interface**
   Promote interaction between GCM, RCD, and end-user communities.



EURO-CORDEX

Introduction

CORDEX Aims

1. Model evaluation framework
2. Climate projection framework
3. Communication / Interface

EURO-CORDEX Aims (still open for discussion)

1. Coordinate **joint evaluation** in the European region: GCM evaluation, RCM evaluation, reference datasets.

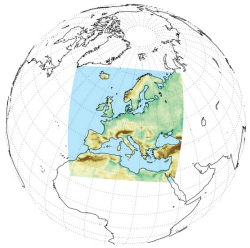
2a. Coordinate the design of the EURO-CORDEX **simulation matrix.**

2b. Coordinate **joint analysis of climate projections** in the European region.

3a. Foster **cooperation with GCM community**: GCM analysis for European region.

3b. Foster **cooperation with impact, adaptation, and mitigation community**: Error correction, ensemble based products, regionally relevant CC indicators, …

3c. Foster **dissemination** of EURO-CORDEX results: AR5, users



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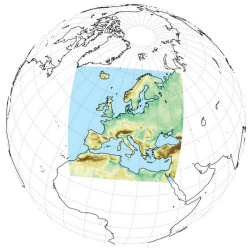
Outline

- Introduction
- Basic Information and Current Status
- Joint Evaluation
- Design of the Simulation Matrix
- Joint Analysis of Climate Projections
- Interface to Impact/Adaptation Community
- The EURO-CORDEX Community
- Points for Discussion (Summary)



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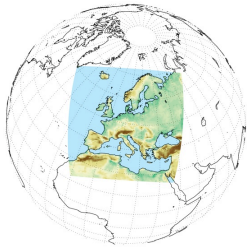

EURO-CORDEX

Basics & Status

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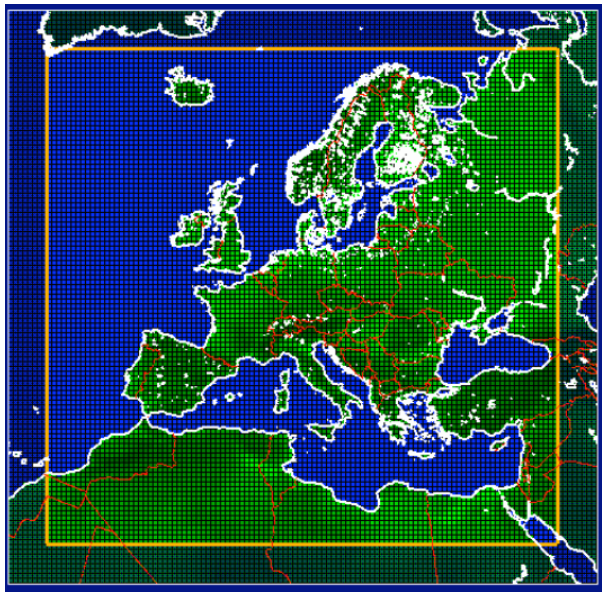
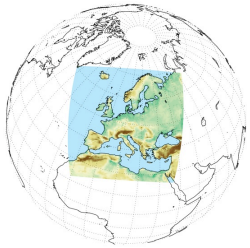
EURO-CORDEX Basics



- **Region (center of boundaries):**
  ~ 27N – 72N, ~338W – 45E
  (details: http://wcrp.ipsl.jussieu.fr/RCD_CORDEX.html)
- **Spatial resolution:**
  - EUR-11: 0.11 degree (focus)
  - EUR-44: 0.44 degree
- **Periods:**
  - Hindcast (ERA Interim): 1989 – 2008
  - Control: 1951 – 2005 (1981 – 2010, 1951-80)
  - Scenario: 2006 – 2100 (2041-71, 2011-40, 2071-2100)
- **GHG scenarios:**
  - rcp45, rcp85 (focus)
  - rcp26

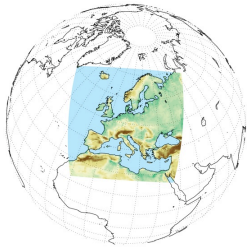


Basics & Status

EURO-CORDEX Status

- **RCMs** (7 groups)

Contribs' ID	RCD Model	Contributor	Contact Person	Email
CLMCOM	CCLM48	CLM Community Coordination office: Chair of Environmental Meteorology BTU Cottbus, Germany	Klaus Keuler	keuler@tu-cottbus.de
CSC	REMO	Climate Service Center (CSC), Hamburg, Germany	Daniela Jacob	daniela.jacob@zmaw.de
DMI	HIRHAM	Danish Meteorological Institute, Copenhagen, Denmark	Jens H. Christensen	jhc@dmi.dk
INERIS/IPSL	WRF321	Institut National de l'Environnement Industriel et des Risques, Verneuil en Halatte, France / Institut Pierre Simon Laplace, CNRS, France	Augustin Colette	augustin.colette@ineris.fr
SMHI	RCA35, RCA4	Rossby Centre, Swedish Meteorological and Hydrological Institute, Norrkoping Sweden	Grigory Nikulin	grigory.nikulin@smhi.se
UHOH	WRF310	Institute of Physics and Meteorology, University of Hohenheim, Stuttgart, Germany	Kirsten Warrach-Sagi	kirsten.warrach-Sagi@uni-hohenheim.de
UNICAN	WRF311	Santander Meteorology Group, Universidad de Cantabria, Dept. Applied Mathematics and Comp. Sci., Santander, Spain	Jesus Fernandez	fernandej@unican.es



Basics & Status

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EURO-CORDEX Status

- **EUR-11 scenario simulation list**:
  16 simulations, 5 RCMs, 4(5) GCMs, 2 members, 3 RCPs

institute_id	model_id	Resolution	driving_model_id	driving_experime	driving_ensembl e_member	Period	Status
CLMCOM	CCLM48	0.11 deg	mpi-esm-lr	rcp45	t.b.d.	2006-2100	planned
CLMCOM	CCLM48	0.11 deg	hadgem2-es	rcp45	t.b.d.	2006-2100	planned
CLMCOM	CCLM48	0.11 deg	t.b.d.	rcp45	t.b.d.	2006-2100	planned
CLMCOM	CCLM48	0.11 deg	mpi-esm-lr	rcp85	t.b.d.	2006-2100	planned
CLMCOM	CCLM48	0.11 deg	hadgem2-es	rcp85	t.b.d.	2006-2100	planned
CLMCOM	CCLM48	0.11 deg	t.b.d.	rcp85	t.b.d.	2006-2100	planned
CSC	REMO	0.11 deg	mpi-esm-lr	rcp45	member x (t.b.d.)	2006-2100	planned
CSC	REMO	0.11 deg	mpi-esm-lr	rcp45	member y (t.b.d.)	2006-2100	planned
CSC	REMO	0.11 deg	mpi-esm-lr	t.b.d	member x (t.b.d.)	2006-2100	planned
CSC	REMO	0.11 deg	mpi-esm-lr	t.b.d	member y (t.b.d.)	2006-2100	planned
DMI	HIRHAM	0.11 deg	ec-earth	t.b.d	t.b.d.	2006-2100	planned
SMHI	RCA4	0.11 deg	ec-earth	rcp26	t.b.d.	2006-2100	planned
SMHI	RCA4	0.11 deg	ec-earth	rcp45	t.b.d.	2006-2100	planned
SMHI	RCA4	0.11 deg	ec-earth	rcp85	t.b.d.	2006-2100	planned
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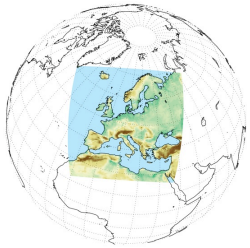

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Joint Evaluation

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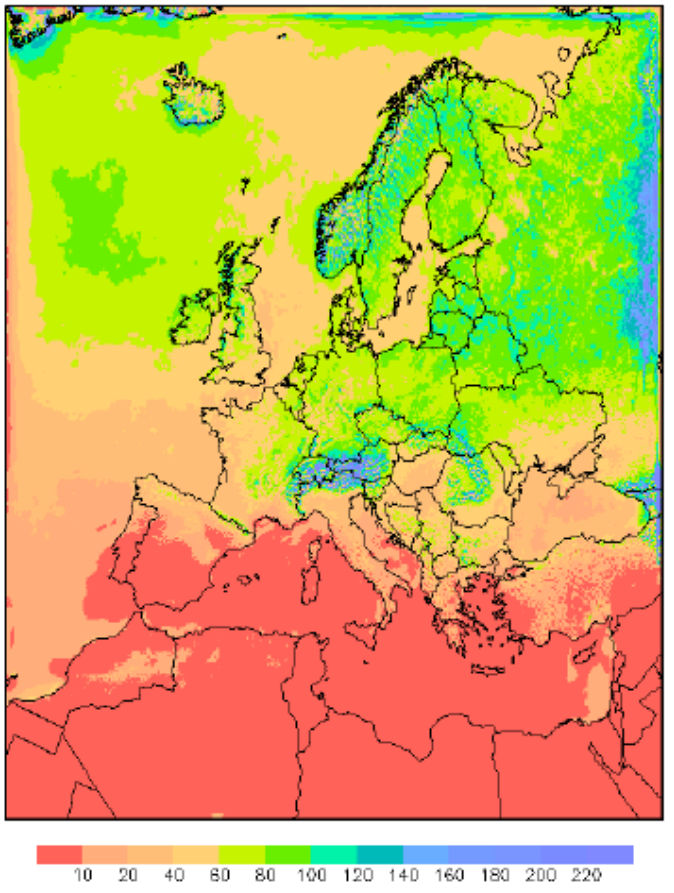
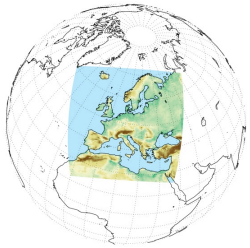
Joint Evaluation Status:

- Finished ERA-Interim RCM simulations:
  - EUR-11: CCLM4.8, REMO, WRF310
  - EUR-44: RCA3.5, WRF321
- Groups currently evaluate their own simulations (Keuler et al., next presentation)
- Joint evaluation could start NOW

First REMO EUR-11 results
[BMBF-funded AR5 national activity]

Precipitation [mm/month] July 1989 – 2008
REMO-ERAinterim





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Joint Evaluation

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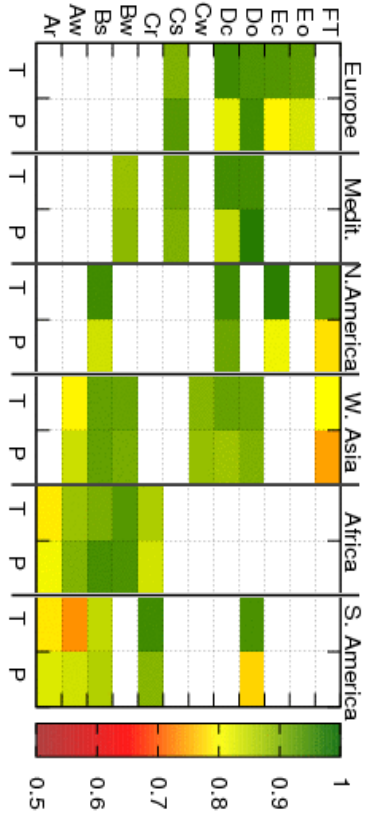
Joint Evaluation Next Steps and Some Ideas:

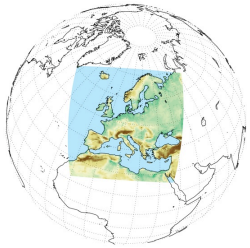
- **Link groups** interested in joint EURO-CORDEX evaluation

→ Establish **EURO-CORDEX evaluation team:**

- Collect **reference datasets**
  - European wide datasets
  - Sub-regional datasets with higher spatial resolution
- Evaluation **sub-regions** (Rockel-regions?)
- **Metrics**
  - Standard CORDEX evaluation ("quick-look general metric")
  - Region specific metrics.
- Groups doing more specific analyses might want to link up

REMO Performance
[A. Haensler et al., talk on Wednesday]





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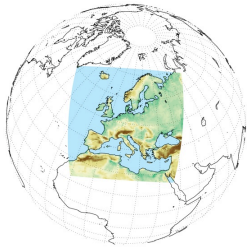

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Simulation Matrix

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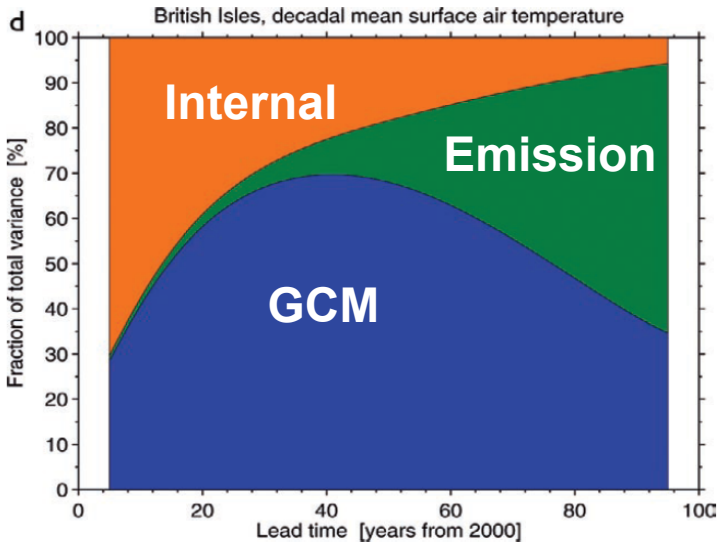
The Relative Importance of the Uncertainty Components

- **GHG scenarios, internal variability, and GCMs** (CMIP3):
  - internal variability contributes at short lead times and for short averaging periods
  - emissions partly contribute at the end of the century (depends on parameter)
  - **GCMs contribute the major fraction** to uncertainty over Europe (and worldwide)

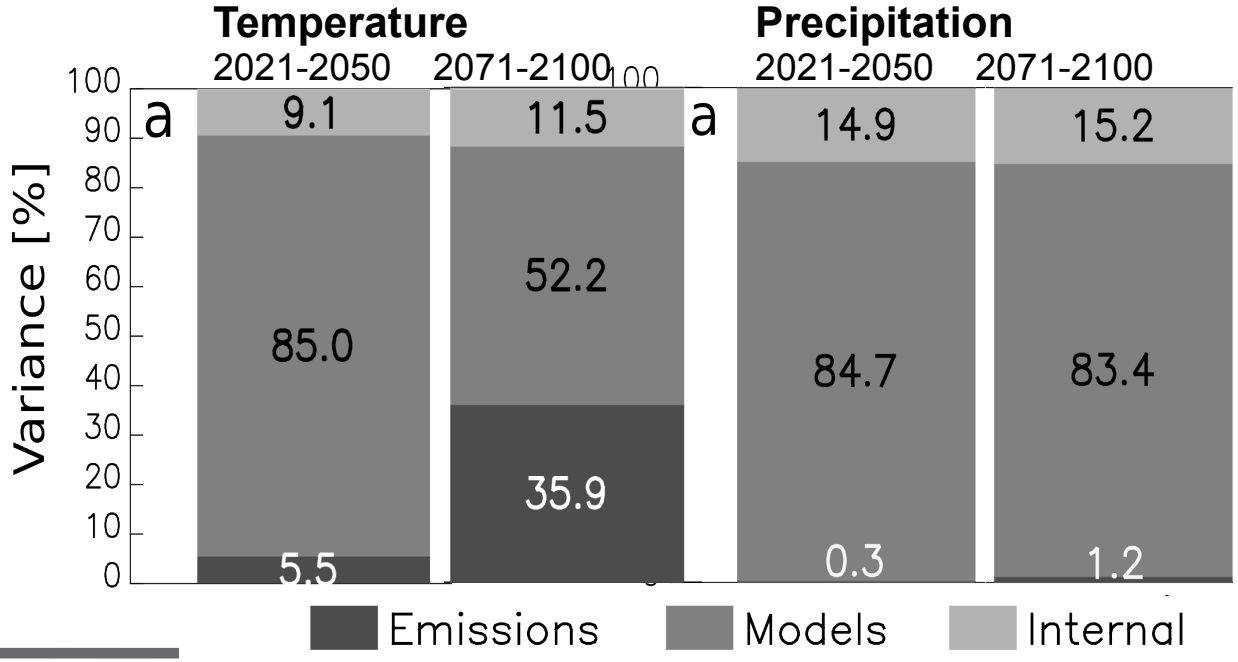
Uncertainty Components in CMIP3 (decadal, British Isles)

Temperature

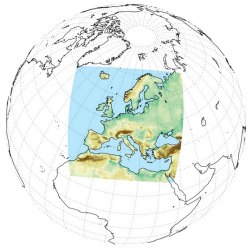


[Hawkins and Suton, 2009]

Uncertainty Components in CMIP3 (30 yrs, Europe)



[Prein and Gobiet, submitted]



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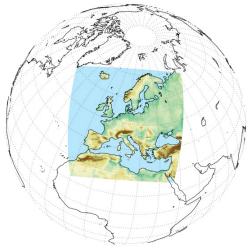
  [e.g., Hawkins and Sutton, 2009; 2010; Prein and Gobiet, submitted]

- **RCMs and GCMs** (PRUDENCE, ENSEMBLES):
  - **GCMs contribute > 50%** to uncertainty (except JJA summer)

  [Déqué et al., 2007; 2011]



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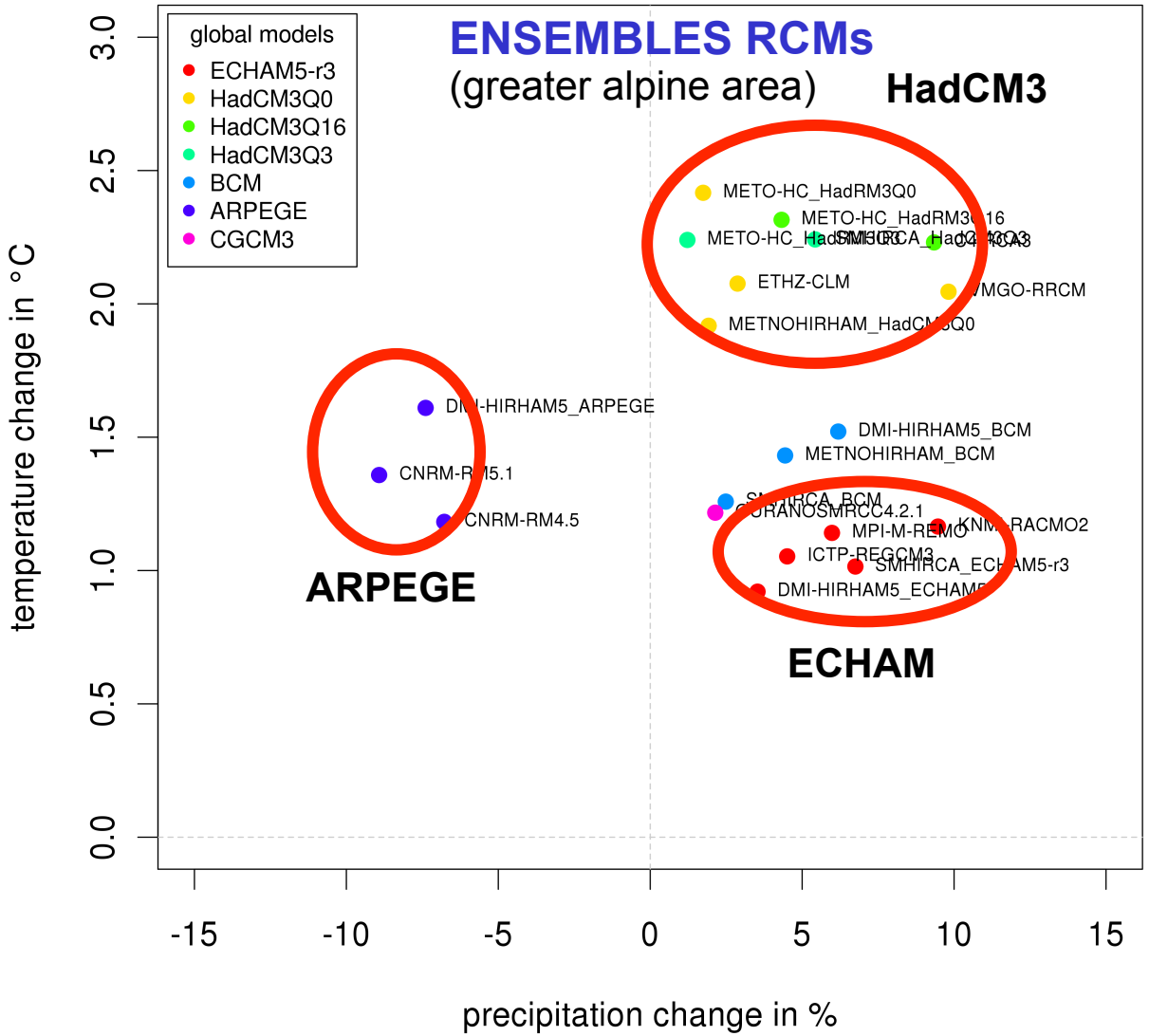
GCMs rule!

Climate change signals of ENSEMBLES models
from 1961-1990 to 2021-2050 in GAR region for DJF period



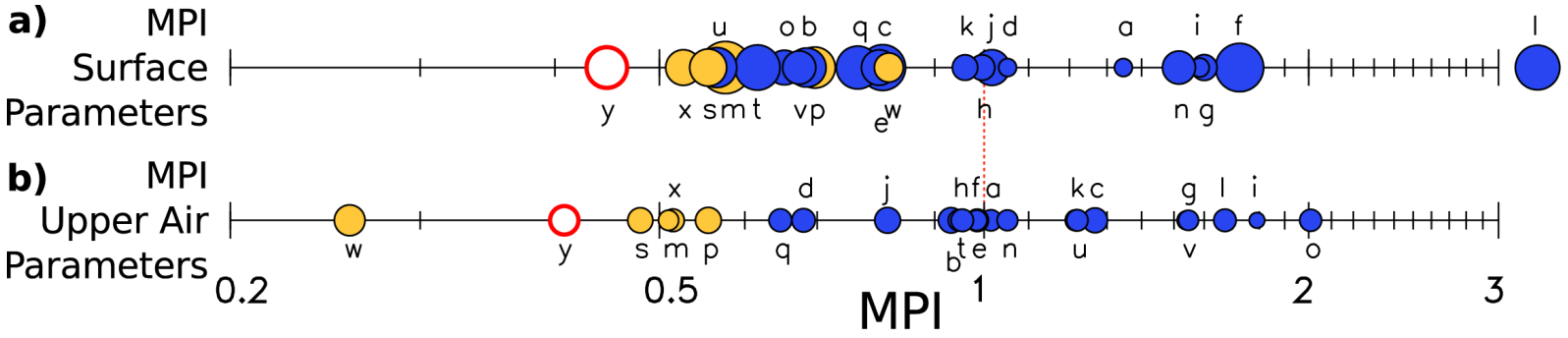
Simulation Matrix

GCM Selection – Performance Analysis

- Can help to detect **"unrealistic outliers"** (together with process-oriented analyses).
- But: Skill in simulating present-day climate relates only weakly to the magnitude of predicted change [e.g., Knutti et al., 2010]. Currently, **no simple rule for selecting GCMs** based on performance is available.

→ It's not wise to pick out "better" GCMs *(remember Richard's can of worms)*

CMIP3 Model Performance Indices over Europe



[Prein and Gobiet, submitted]

Simulation Matrix

GCM Selection – Performance Analysis

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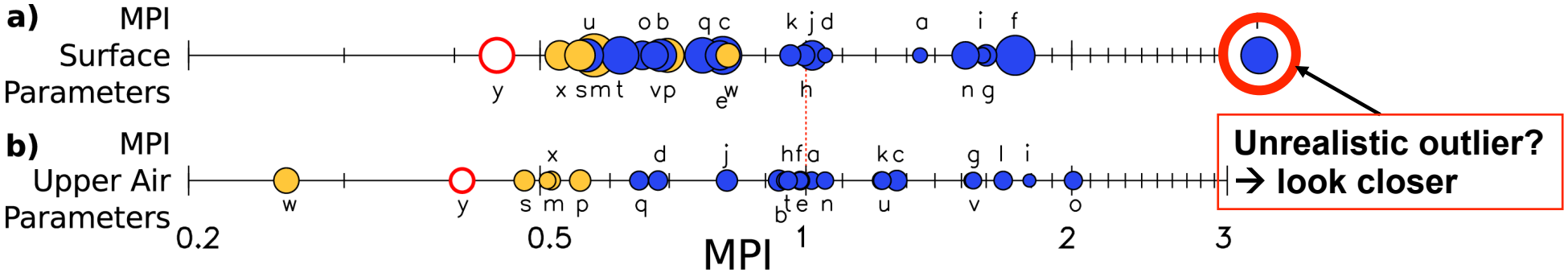
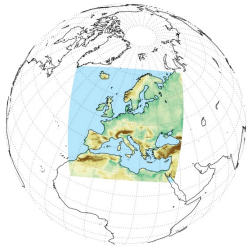
CMIP3 Model Performance Indices over Europe



[Prein and Gobiet, submitted]



Simulation Matrix

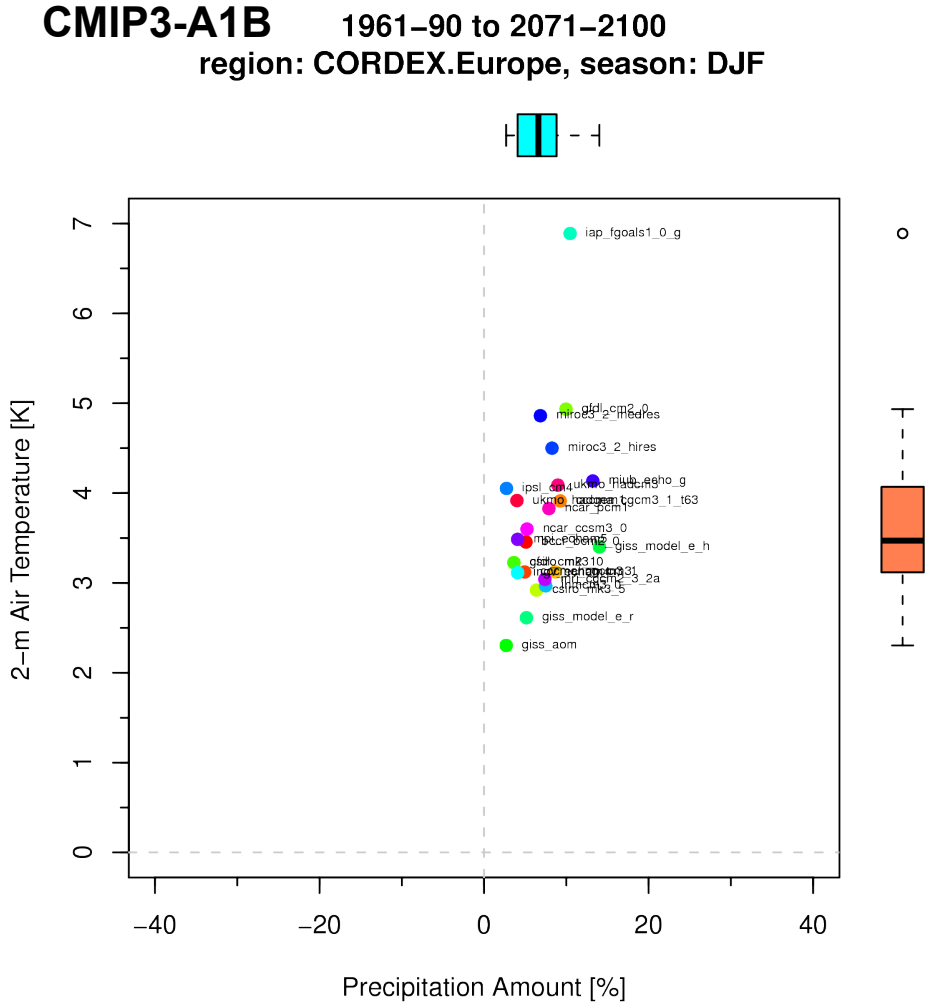
GCM Selection – Independence

- The **"effective size"** of the CMIP3 ensemble is much smaller than the number of GCMs [Penell and Reichler, 2010].
- **Analysis of independence** might offer an option to avoid selecting GCMs that carry more less the same information.

(But such analysis might be too complex for EURO-CORDEX, we need to select the driving GCMs very soon!).

Simulation Matrix

GCM Selection – Climate Change Signals



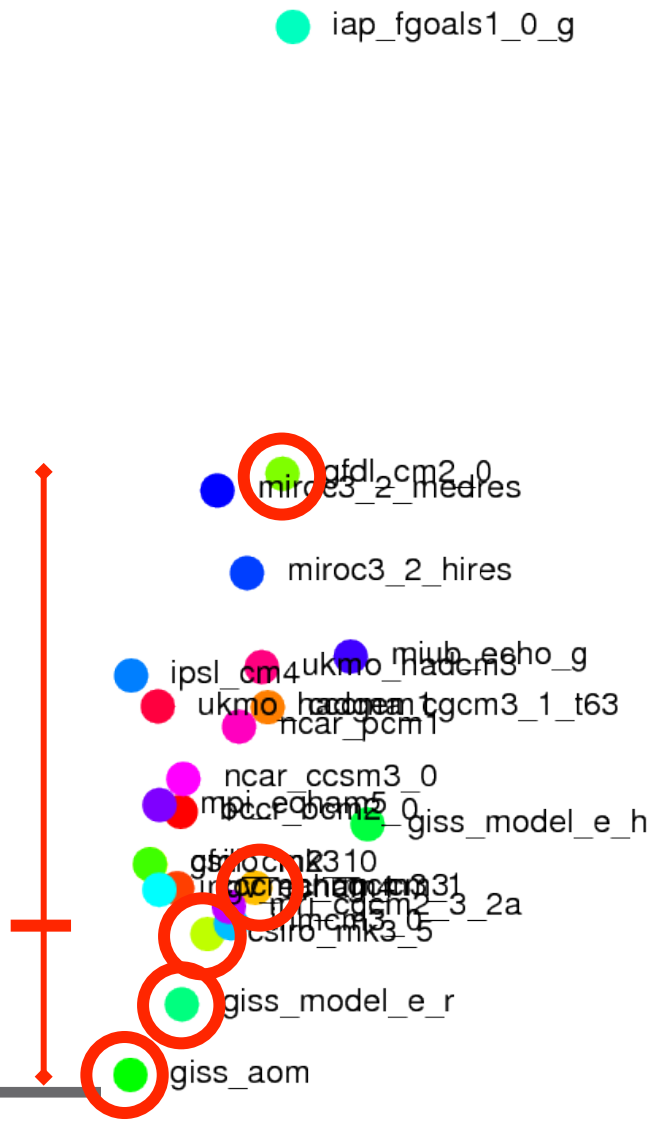
Simulation Matrix

GCM Selection – Climate Change Signals

Simulation Matrix

GCM Selection – Climate Change Signals

- Avoid **biases**



Simulation Matrix

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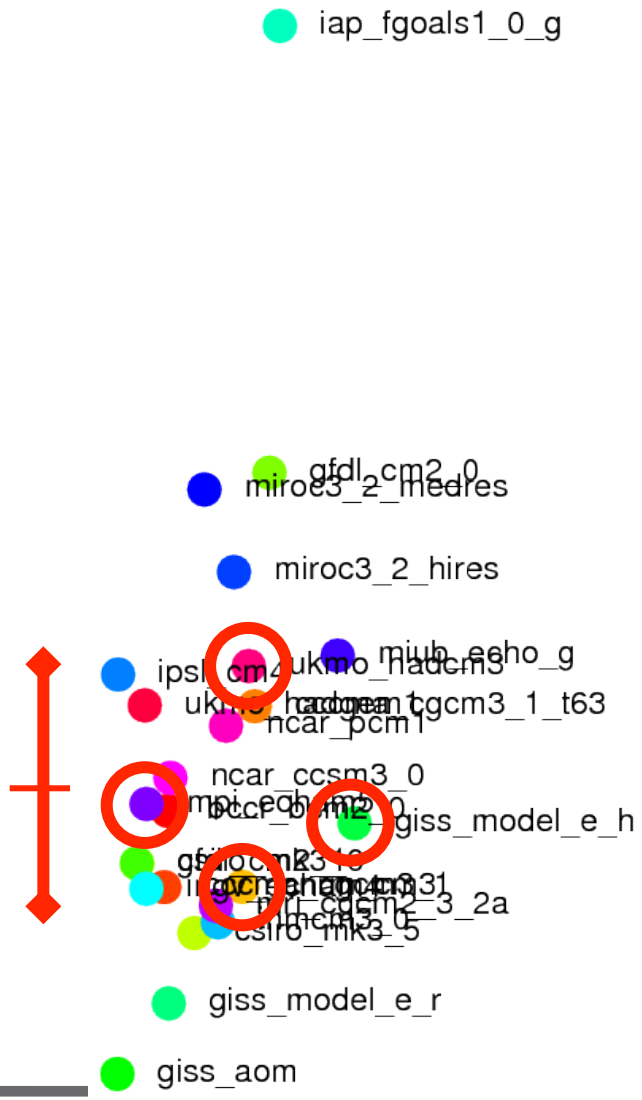
GCM Selection – Climate Change Signals

- Avoid **biases**
- Avoid to underestimate the **range**



Simulation Matrix

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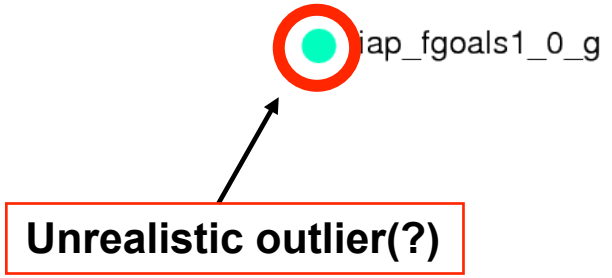
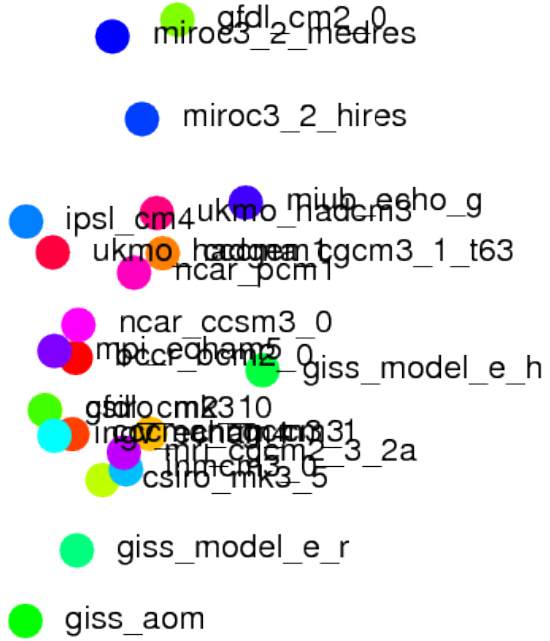
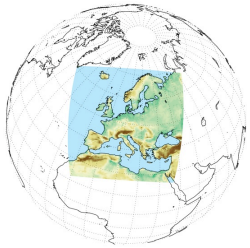
GCM Selection – Climate Change Signals

- Avoid **biases**
- Avoid to underestimate the **range**
- Indicate "**unrealistic outliers**"







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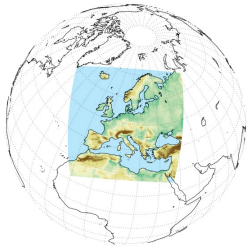
GCM Selection – Climate Change Signals

- Avoid **biases**
- Avoid to underestimate the **range**
- Detect "**unrealistic outliers**"

- **Challenges:**
  - Which parameters should be analysed?
  - Results can be different in different seasons.
  - Design of a statistically sound method for GCM selection
  - Timely availability of CMIP5 ensemble.

→ Establish **EURO-CORDEX GCM evaluation team** and cooperate with the CMIP5 community



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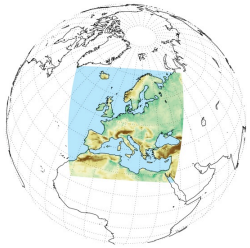
Matrix "symmetry"

- Biases due to overweighting "popular" GCMs.
- Such biases can be cured by data reconstruction techniques [e.g., Déqué et al., 2007; 2011]
- Data reconstruction works best, if each row/column is evenly populated

→ If you have the choice, rather donwscale a rarely used GCM, than a popular one.

	R1	R2	R3	R4
G1	×	×	×	×
G2		×		×
G3	×		×	
G4			×	

	R1	R2	R3	R4
G1	×	×	×	×
G2		×		×
G3	×		×	
G4		×	×	



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Simulation Matrix

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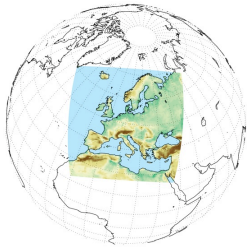
Combine RCM and ESD

- Rasmus says: “RCMs and ESDs have independent weaknesses ” (and strengths!)
- Combining them:
  - inflates the matrix
  - enables to include more GCMs
  - makes it more defensible

→ Statistical modellers: Provide input to the EURO-CORDEX simulation list!

	RCM			
	R1	R2	R3	R4
G1	×		×	×
G2		×		×
G3	×		×	
G4		×	×	

	RCM				ESD	
	R1	R2	R3	R4	R5	R6
G1	×		×	×	×	×
G2		×		×	×	×
G3	×				×	×
G4		×	×		×	×
G5					×	×
G6					×	×
G7					×	×
G8					×	×
G9					×	×



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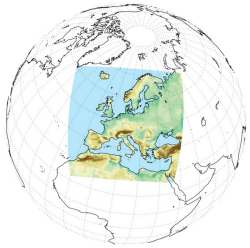

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Analysis of Climate Projections

Joint Analysis of Climate Projections – Next Steps

- **Link groups** interested in joint EURO-CORDEX evaluation

→ Establish **EURO-CORDEX evaluation team:**

- Agree on focus periods.
  Giorgi et al., [2009]: 1951-1980, **1981-2010**, 2011-2040, **2041-2070**, 2071-2100
- Agree on sub-regions.
  Rockel regions?
- Start discussion on joint standard analysis
  - Ensemble based **standard products** (“with articulated uncertainties”)
- Groups doing more specific analyses might want to link up

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Analysis of Climate Projections

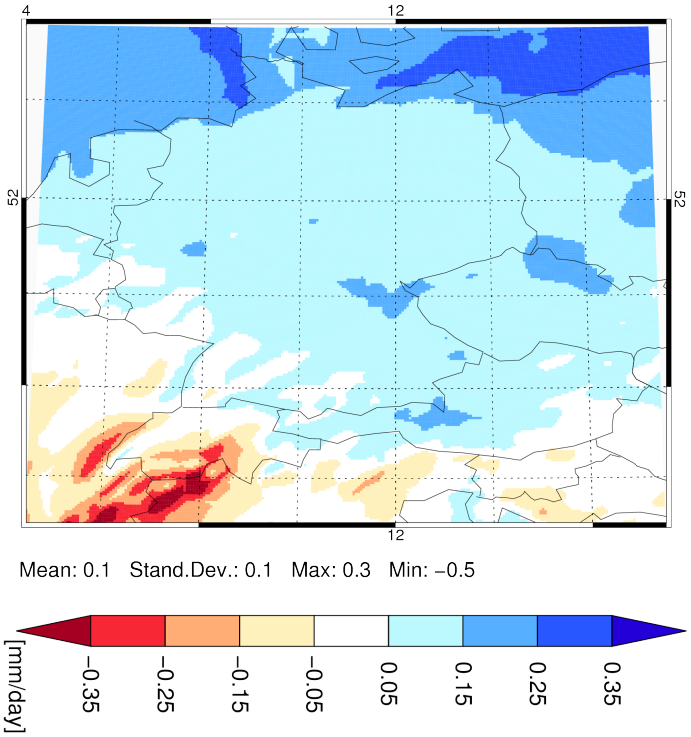
Some Examples (more or less arbitrary, based on ENSEMBLES)

Change in precipitation extremes (2036-65 vs 1961-90)

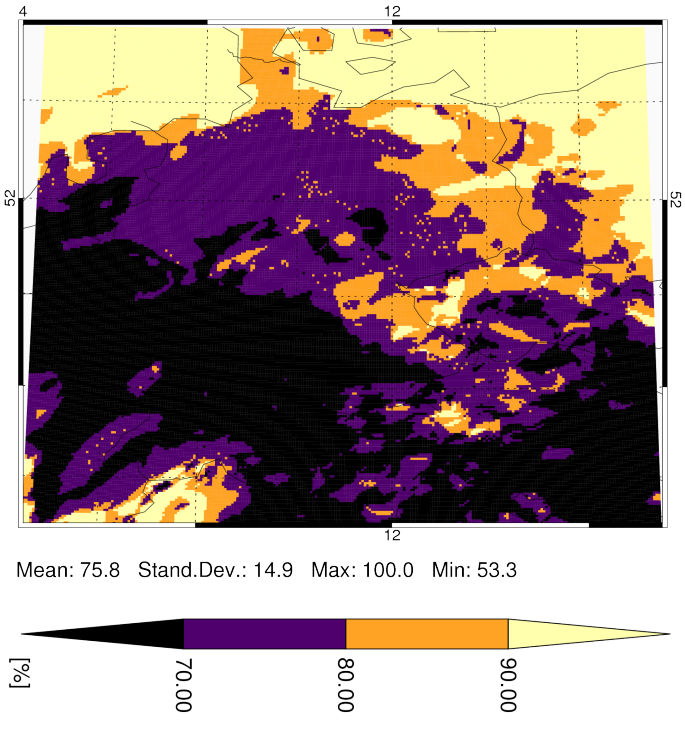
All ENSEMBLES Models covering this period

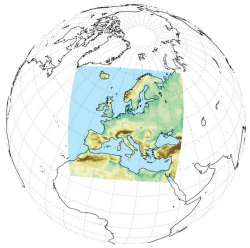
Information on reliability of scenarios

Mean precip. change [mm/day]



No. of models agreeing in sign [%]





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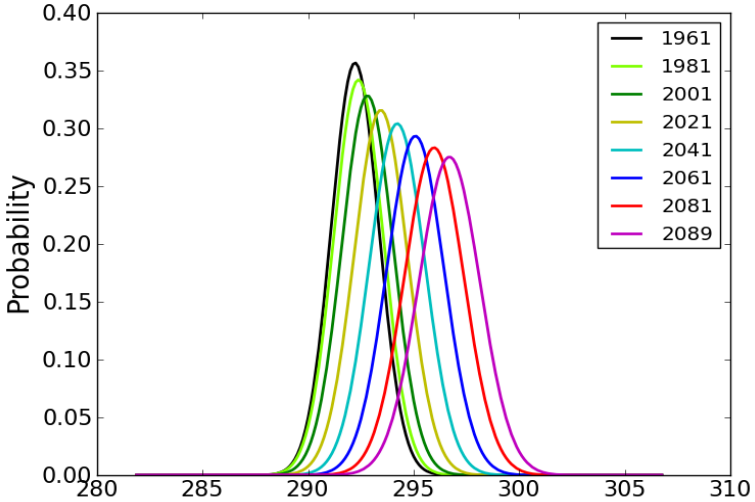
Analysis of Climate Projections

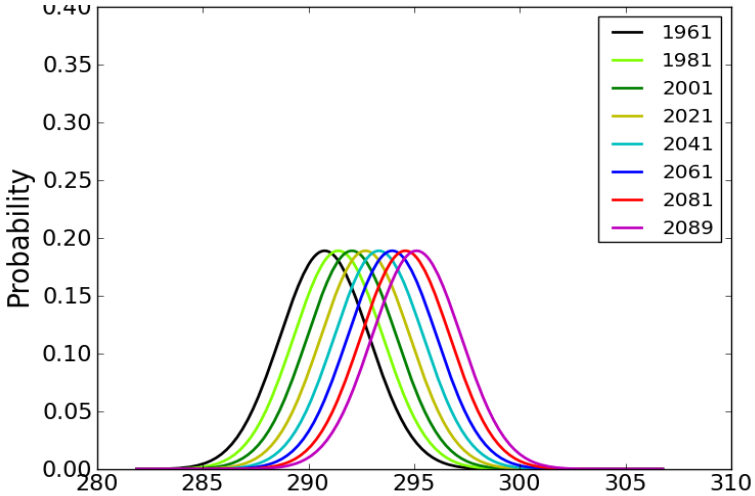
Some Examples (more or less arbitrary, based on ENSEMBLES)

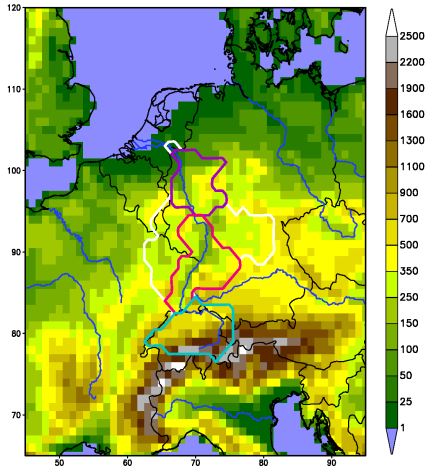
Evolution of monthly (July) temperature distribution (1961 – 2089)

Selected ENSEMBLES Models

Extract common message from different simulations

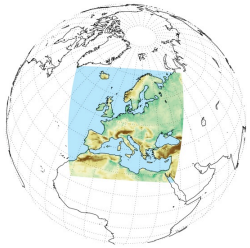






KLIWAS Klima · Wasser · Schifffahrt

[Bülow et al., unpublished]



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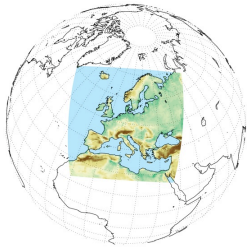

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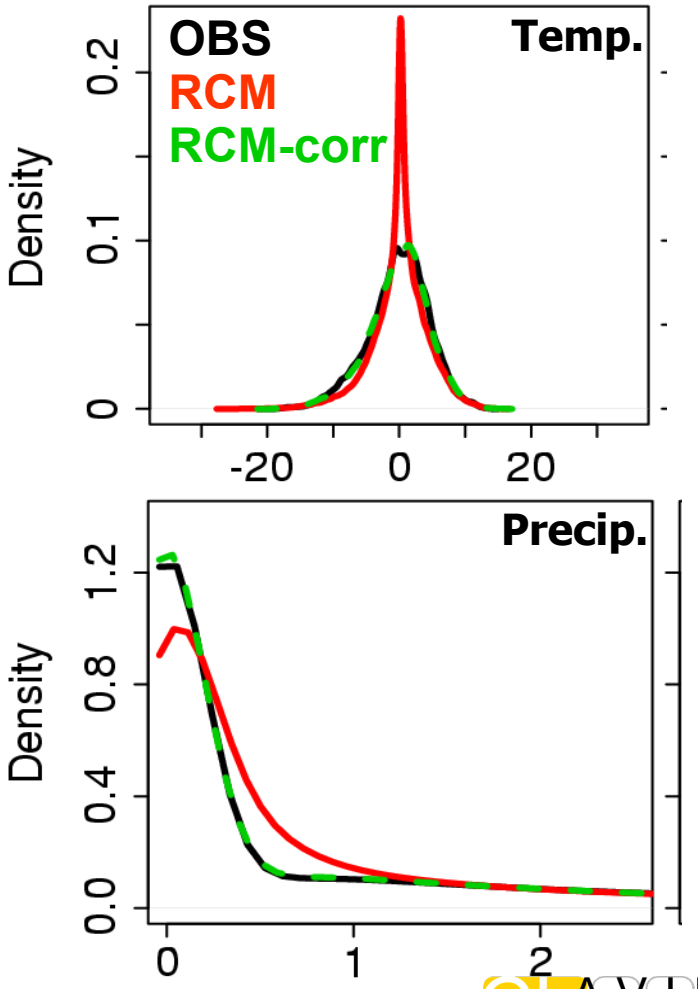
Interface to Impact/Adaptation

Interface

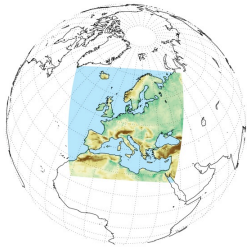
- **Error corrected** versions of the major variables per model (daily tas, pr)

Daily tas, pr distributions
correction method:
quantile mapping



[Themeßl et al., 2010]

CLAVIER



Interface to Impact/Adaptation

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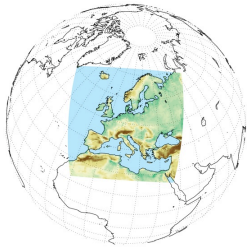
Interfaces

- **Error corrected** versions of the major variables per model (daily tas, pr)
- **Ensemble-based products** focusing on major robust signals and articulate uncertainties (analysis team)



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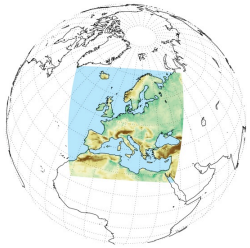
Interfaces

- **Error corrected** versions of the major variables per model (daily tas, pr)
- **Ensemble-based products** focusing on major robust signals and articulate uncertainties (analysis team)
- *Specific **climate change indicators** products (extremes, percieved tempersture, heating/ cooling dregree days, …)*
- *Data portal, data extraction tools*
- *Narrative products, ….*

- More general question: How many steps towards the user can we go, without loosing our focus?



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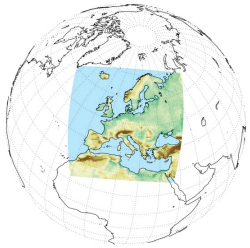

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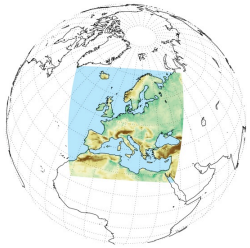
Bringing the EURO-CORDEX Community together …

- Establish **EURO-CORDEX Teams** focusing on specific topics
- Communication tools
  - **Mailing list** ☺ (EURO-CORDEX coordination)
  - Organisation of **meetings** ☺ (EURO-CORDEX coordination)
  - ***Homepage****? (Probably by coordination)*
  - ***WIKI****? Tools for facilitating effective informal communication within EURO-CORDEX teams*

EURO-CORDEX Working Meeting:
Tuesday, 6pm (after CMIP5 discussion), L. Stasi Seminar Room (2nd floor)

EURO-CORDEX Meeting:
Planned for autumn 2011. Information distributed via the EURO-CORDEX email list.



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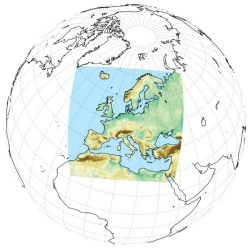
EURO-CORDEX

- **Mailing list:** euro-cordex@lists.zmaw.de
  (register at: https://lists.zmaw.de/mailman/listinfo/euro-cordex)
- **Contact:**
  daniela.jacob@zmaw.de
  andreas.gobiet@uni-graz.at

CORDEX

- **Mailing list:** cordex@mesonet.agron.iastate.edu
  (register at: http://mesonet.agron.iastate.edu/mailman/listinfo/cordex)
- **Homepage:** wcrp.ipsl.jussieu.fr/RCD_CORDEX.html
- **Archive:** cordex.dmi.dk (output list specification!)



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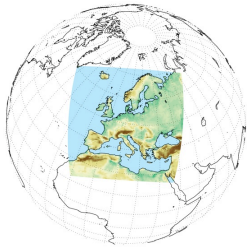
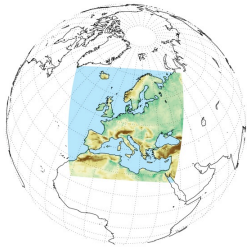


Points for Discussion (Summary)

Establish "EURO-CORDEX Teams" dedicated to specific topics

- Establish **evaluation team**. Who?
- Establish a **GCM analysis team** (own analysis and cooperation with GCM community). Who?
- *Establish a **climate projection analysis team**. Who?*
- *Establish a **post-processing/error correction team**(?)*
- *Further teams(?)*

→ **Discuss at the working meeting tonight**



Points for Discussion (Summary)

Filling the Simulation Matrix

- If you plan an EURO-CORDEX simulation, please send specifications to:

  andreas.gobiet@uni-graz.at
  daniela.jacob@zmaw.de

- If you are free in the choice of driving GCM: that's good! Please discuss the selection of GCM with the EURO-CORDEX community (see GCM analysis group).
  → smart design of the simulation matrix

- CORDEX focuses on RCM and ESD. Statistical modelers, please provide input to the EURO-CORDEX simulation list.

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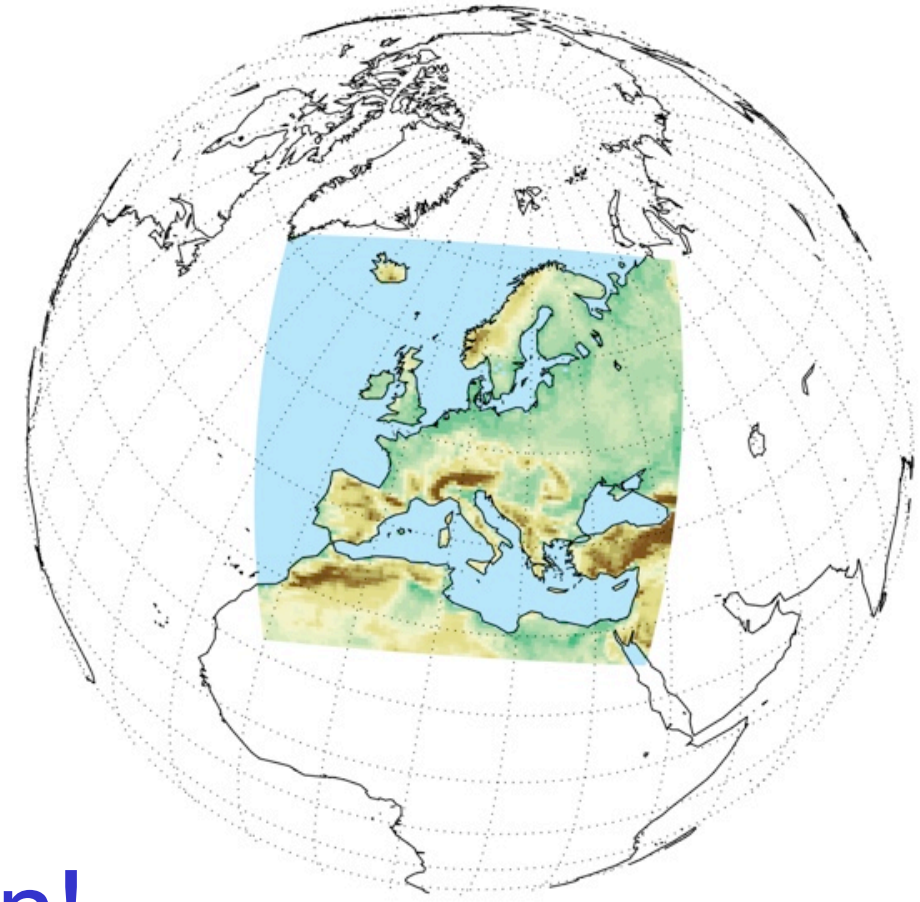
First Input to AR5

Please send relevant literature for IPCC AR5 WG2, chapter 23, Europe to Daniela: daniela.jacob@zmaw.de



EURO-CORDEX Working Meeting

Today, 6-7pm (after CMIP5 discussion),

L. Stasi seminar room 2nd floor

Thanks for your attention!