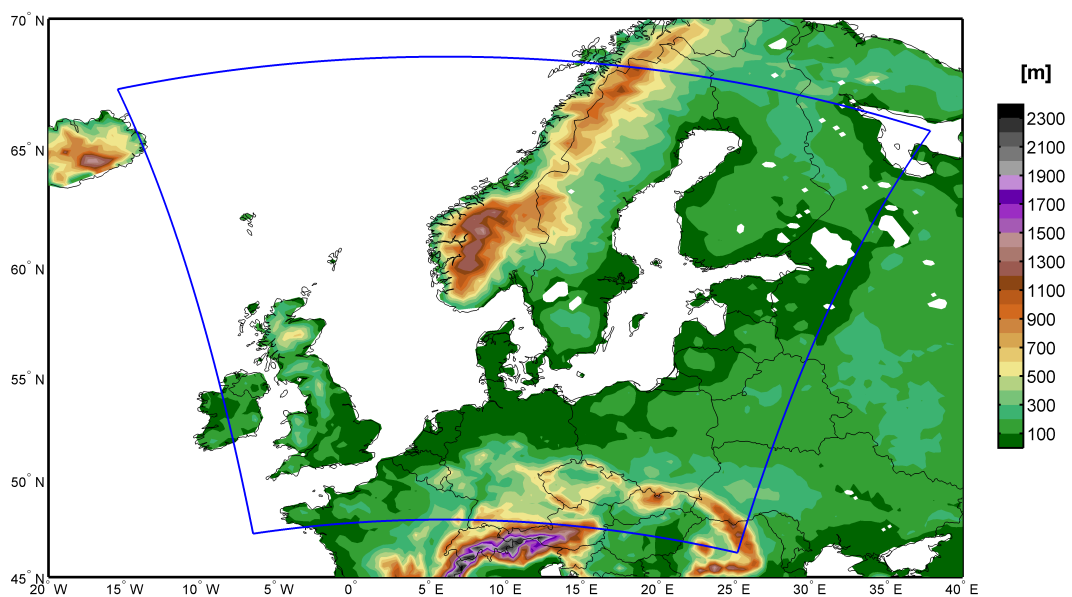


Danish Climate Centre Report 14-05

Background information on the RiskChange simulations by BCCR and DMI

Cathrine Fox Maule, Stephanie Mayer, Stefan Sobolowski, Ole B. Christensen





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1. Introduction of RiskChange

As part of the RiskChange project a series of high-resolution dynamical downscalings over Scandinavia have been made. Two different regional climate models (RCMs) have been used to downscale two different global climate models (GCMs) for three different time slices. In addition an evaluation run of each RCM driven by ECMWFs re-analysis product ERA-interim (Dee *et al.*, 2011; Uppala *et al.*, 2005) were performed. A presentation of the evaluation simulations is made in Mayer *et al.* (submitted). Table 1 shows a list of all the simulations made in RiskChange.

This report gives a short description of the RiskChange simulations made by the Bjerknes Centre for Climate Research (BCCR) and the Danish Meteorological Institute (DMI). All the simulations made with Weather Research and Forecasting model (WRF) were carried out at BCCR, while all the HIRHAM5 simulations were done at DMI. The output data from the simulations are available for download at: <http://ensemblesrt3.dmi.dk/data/RiskChange/>.

GCM	RCM	Experiment	Time slice
ECMWF-ERAINT	BCCR-WRF331	evaluation	1990-2010
ECMWF-ERAINT	DMI-HIRHAM5	evaluation	1990-2010
BCCR-NorESM	BCCR-WRF331	historical	1981-2010
BCCR-NorESM	BCCR-WRF331	RCP4.5	2021-2050
BCCR-NorESM	BCCR-WRF331	RCP4.5	2071-2100
BCCR-NorESM	BCCR-WRF331	RCP8.5	2071-2100
BCCR-NorESM	DMI-HIRHAM5	historical	1981-2010
BCCR-NorESM	DMI-HIRHAM5	RCP4.5	2021-2050
BCCR-NorESM	DMI-HIRHAM5	RCP4.5	2071-2100
BCCR-NorESM	DMI-HIRHAM5	RCP8.5	2021-2050
BCCR-NorESM	DMI-HIRHAM5	RCP8.5	2071-2100
ICHEC-EC-EARTH	BCCR-WRF331	historical	1981-2010
ICHEC-EC-EARTH	BCCR-WRF331	RCP4.5	2021-2050
ICHEC-EC-EARTH	BCCR-WRF331	RCP4.5	2071-2100
ICHEC-EC-EARTH	BCCR-WRF331	RCP8.5	2071-2100
ICHEC-EC-EARTH	DMI-HIRHAM5	historical	1981-2010
ICHEC-EC-EARTH	DMI-HIRHAM5	RCP4.5	2021-2050
ICHEC-EC-EARTH	DMI-HIRHAM5	RCP4.5	2071-2100
ICHEC-EC-EARTH	DMI-HIRHAM5	RCP8.5	2021-2050
ICHEC-EC-EARTH	DMI-HIRHAM5	RCP8.5	2071-2100

Table 1.1: List of the RiskChange simulations.

2. The simulations provided by BCCR

This chapter gives a short description of the RCM downscaling provided by BCCR for the RiskChange project.

2.1 Model

Short model (RCM) name	WRF
Full model name	Weather Research and Forecasting model
Institute	BCCR
Model version	3.3.1
Contact person name	Stephanie Mayer, Stefan Sobolowski
Contact person email	stephanie.mayer@uni.no, stefan.sobolowski@uni.no
General reference	Skamarock <i>et al.</i> (2005)

2.2 Domain

The domain of the BCCR RiskChange simulations (without relaxation zones) is shown in Figure 2.1.

2.2.1 Specifications of the rotated grid

The real center of the domain: 58.3525°N, 10.837°E.

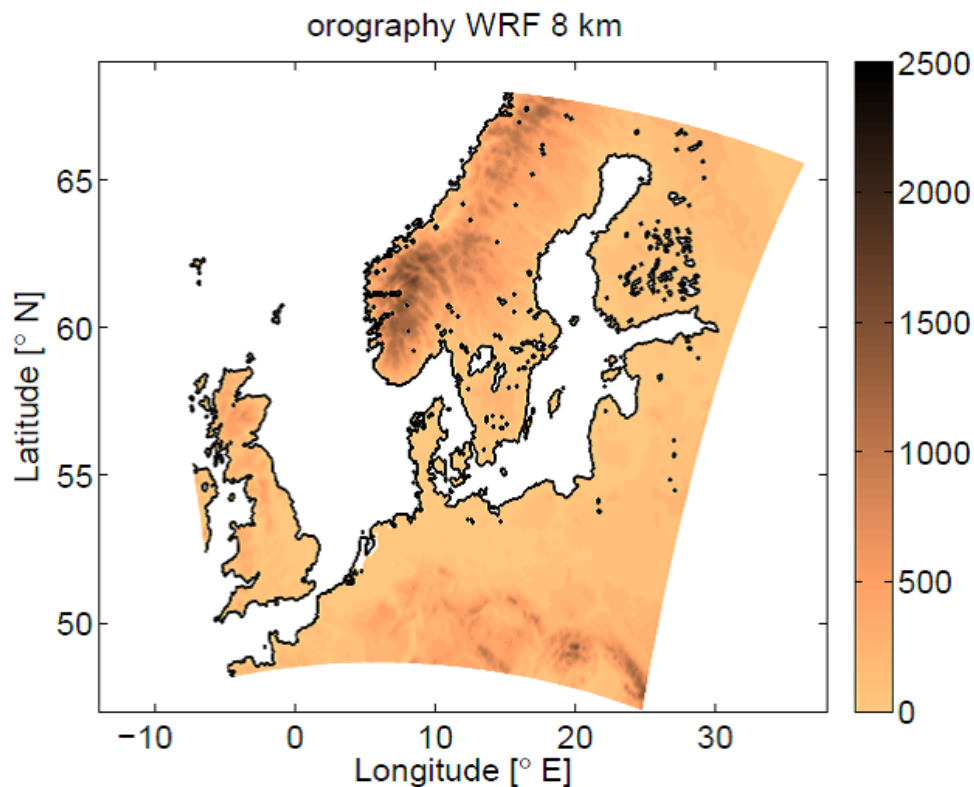


Figure 2.1: The RiskChange domain without relaxation zone. Colours indicate the orography in meters above sea level.

2.3 Experimental setup

Name of domain	RiskChange
Size of full grid (lon x lat x vertical)	297 x 288 x 35
Horizontal resolution	0.0733 x 0.0733 (ca. 8 km)
Type of grid	lat-lon
Time step	40s
Nudging	no
Boundary zone excluded grid points (west, south, east, north)	10
Size of post-processed output grid (lon x lat)	276 x 267

2.4 Experiments with different boundary conditions

2.4.1 Evaluation

Time period	1989-2010
Source of boundary condition	ERA-interim
Spin up period	1 year (1989)
Time series	Slotterøy, Bergen, Samnanger, Vossbulken
Comments	The years 1996-1998 were re-run with the year 1995 as start year. This is indicated in the file names with v2.

2.4.2 NorESM-historical

Time period	1980-2010
Source of boundary condition	NorESM
Spin up period	1 year (1980)
Time series	Slotterøy, Bergen, Samnanger, Vossbulken (1981-2010) Oslo, Otta, Århus, København (1987-2010)
Comments	The years 1987-1989 were re-run with the year 1986 as start year. This is indicated in the file names with v2.

2.4.3 NorESM-RCP4.5

Time periods	2020-2050 and 2070-2100
Source of boundary condition	NorESM; scenario RCP4.5
Spin up period	1 year (2020, 2070)
Time series	All 8 locations for both time periods available.
Comments	The years 2077-2079 were re-run with the year 2076 as start year. This is indicated in the file names with v2.

2.4.4 NorESM-RCP8.5

Time periods	2070-2100
Source of boundary condition	NorESM; scenario RCP8.5
Spin up period	1 year (2070)
Time series	All 8 locations available.
Comments	The years 2077-2079 were re-run with the year 2076 as start year. This is indicated in the file names with v2.

2.4.5 EC-Earth-historical

Time period	1980-2010
Source of boundary condition	EC-Earth
Spin up period	1 year (1980)
Time series	All 8 locations available.
Comments	The years 1986-1989 were re-run with the year 1985 as start year. This is indicated in the file names with v2.

2.4.6 EC-Earth-RCP4.5

Time periods	2020-2050 and 2070-2100
Source of boundary condition	EC-Earth; scenario RCP4.5
Spin up period	1 year (2020, 2070)
Time series	All 8 locations for both time periods available.
Comments	The years 2037-2039 were re-run with the year 2036 as start year. This is indicated in the file names with v2. This also accounts for the years 2082-2084.

2.4.7 EC-Earth-RCP8.5

Time periods	2070-2100
Source of boundary condition	EC-Earth; scenario RCP8.5
Spin up period	1 year (2070)
Time series	All 8 locations available.
Comments	The years 2077-2079 were re-run with the year 2076 as start year. This is indicated in the file names with v2.

2.5 Output

The standard output of the RiskChange simulations, which is available for download, is listed in Table 2.1 for the hourly output and in Table 2.2 for the daily output.

var	standard name	units	cell methods	comment
pr	precipitation_flux	kg/m ² /s	time: mean	Precipitation
psl	air_pressure_at_sea_level	Pa	time: point	Mean Sea Level Pressure
tas	air_temperature	K	time: point	2-m Air Temperature
uas	eastward_wind	m/s	time: point	Eastward 10-m Wind Speed
vas	northward_wind	m/s	time: point	Northward 10-m Wind Speed

Table 2.1: Overview over 1-hourly variables.

var	standard name	units	cell methods	comment
clt	cloud_area_fraction	%	time: mean	Total Cloud Cover
hurs	relative_humidity	%	time: mean	2-m Relative Humidity
psl	air_pressure_at_sea_level	Pa	time: mean	Mean Sea Level Pressure
rsds	surface_downwelling_short_wave_flux_in_air	W/m ²	time: mean	Surface Downwelling Shortwave Radiation
sfcWindmax	wind_speed	m/s	time: maximum	Maximum 10-m Wind Speed
sic	sea_ice_fraction	%	time: mean	Sea Ice Fraction
sst	sea_surface_temperature	K	time: mean	Sea Surface Temperature
sund	duration_of_sunshine	s	time: sum	Sunshine Hours (duration when surface solar radiation flux exceeds 120 W/m ²)

Table 2.2: Overview over daily variables, which were calculated by using hourly values. sfcWindmax is found on a time step basis and written out once for every day.



2.6 Additional data

High-resolution time series of surface variables (e.g. tas, uas, vas, psl, rain,...) for the locations Slotterøy, Bergen, Samnanger, Vossbulken, Oslo, Otta (all Norway), Århus and København (both Denmark) can be provided on request. For more information, please contact: stephanie.mayer@uni.no or stefan.sobolowski@uni.no.

3. The simulations provided by DMI

This chapter gives a short description of the RCM downscalings provided by DMI for the RiskChange project.

3.1 Model

Short model (RCM) name	HIRHAM
Institute	DMI
Model version	5
Contact person name	Cathrine Fox Maule, Ole Bøssing Christensen
Contact person email	cam@dmi.dk, obc@dmi.dk
General reference	Christensen <i>et al.</i> (2006)

3.2 Domain

The domain of the DMI RiskChange simulations (without relaxation zones) is shown in Figure 3.1.

3.2.1 Specifications of the rotated grid

Rotation (north) pole latitude	39°N
Rotation (north) pole longitude	174°W
West	8.5°W
East	13.172°E
South	3°S
North	17.592°N

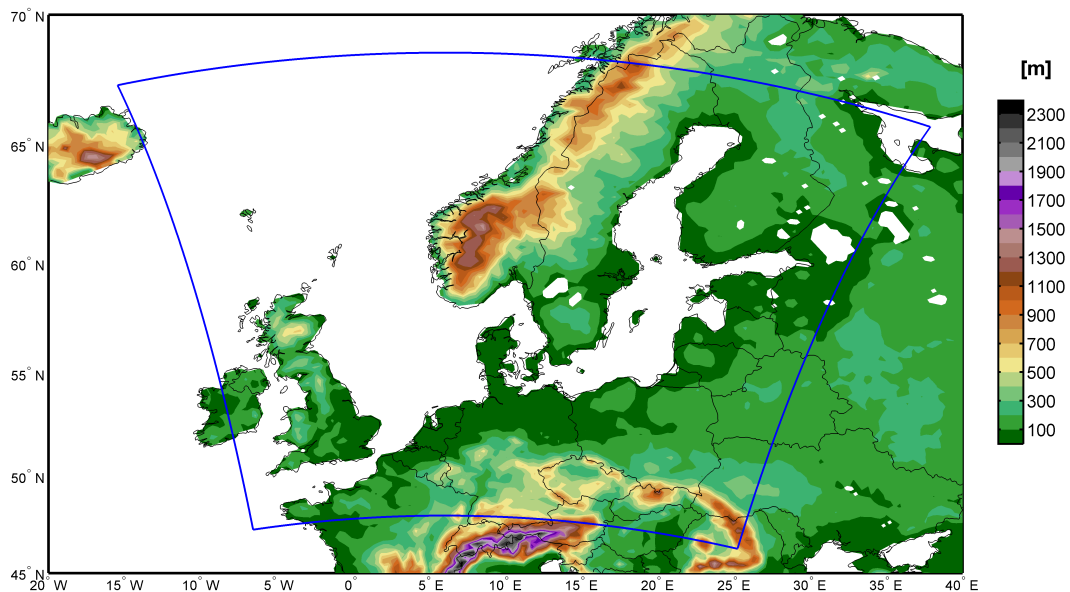


Figure 3.1: The blue line shows the RiskChange domain without relaxation zone. Colours indicate the orography in meters above sea level.

3.3 Experimental setup

Name of domain	RiskChange
Size of full grid (lon x lat x vertical)	302 x 287 x 31
Horizontal resolution	0.072 x 0.072 (ca. 8 km)
Type of grid	lat-lon
Time step	150s
Nudging	no
Boundary zone excluded grid points (west, south, east, north)	10
Size of post-processed output grid (lon x lat)	282 x 267

3.4 Experiments with different boundary conditions

3.4.1 Evaluation

Time period	1989-2010
Source of boundary condition	ERA-interim
Spin up period	1 year (1989)
Time series	none
Comments	none

3.4.2 EC-Earth-historical

Time period	1980-2010
Source of boundary condition	EC-Earth
Spin up period	1 year (1980)
Time series	none
Comments	none

3.4.3 EC-Earth-RCP4.5

Time periods	2020-2050 and 2070-2100
Source of boundary condition	EC-Earth; scenario RCP4.5
Spin up period	1 year (2020, 2070)
Time series	none
Comments	none

3.4.4 EC-Earth-RCP8.5

Time periods	2020-2050 and 2070-2100
Source of boundary condition	EC-Earth; scenario RCP8.5
Spin up period	1 year (2020, 2070)
Time series	none
Comments	none

3.4.5 NorESM-historical

Time period	1980-2010
Source of boundary condition	NorESM
Spin up period	1 year (1980)
Time series	none
Comments	none

3.4.6 NorESM-RCP4.5

Time periods	2020-2050 and 2070-2100
Source of boundary condition	NorESM; scenario RCP4.5
Spin up period	1 year (2020, 2070)
Time series	none
Comments	none

3.4.7 NorESM-RCP8.5

Time periods	2020-2050 and 2070-2100
Source of boundary condition	NorESM; scenario RCP8.5
Spin up period	1 year (2020, 2070)
Time series	none
Comments	none

3.5 Output

The standard output of the RiskChange simulations, which is available for download, is listed in Table 3.1 for the hourly output and in Table 3.2 for the daily output.

var	standard name	units	cell methods	comment
pr	precipitation_flux	kg/m ² /s	time: mean	Precipitation
psl	air_pressure_at_sea_level	Pa	time: point	Mean Sea Level Pressure
tas	air_temperature	K	time: point	2-m Air Temperature
uas	eastward_wind	m/s	time: point	Eastward 10-m Wind Speed
vas	northward_wind	m/s	time: point	Northward 10-m Wind Speed

Table 3.1: Overview over 1-hourly variables.

var	standard name	units	cell methods	comment
clt	cloud_area_fraction	%	time: mean	Total Cloud Cover
hurs	relative_humidity	%	time: mean	2-m Relative Humidity
psl	air_pressure_at_sea_level	Pa	time: mean	Mean Sea Level Pressure
rsds	surface_downwelling_short_wave_flux_in_air	W/m ²	time: mean	Surface Downwelling Shortwave Radiation
sfcWindmax	wind_speed	m/s	time: maximum	Maximum 10-m Wind Speed
sic	sea_ice_fraction	%	time: mean	Sea Ice Fraction
sst	sea_surface_temperature	K	time: mean	Sea Surface Temperature
sund	duration_of_sunshine	s	time: sum	Sunshine Hours (duration when surface solar radiation flux exceeds 120 W/m ²)

Table 3.2: Overview over daily variables; hurs, clt, rsds were calculated from 3-hourly values, psl from hourly values, sst, sic and sund were written out only daily. sfcWindmax was found on a time step basis and written out once for every day.



3.6 Additional data

Anyone interested in additional RiskChange data from the DMI simulations than what are available at: <http://ensemblesrt3.dmi.dk/data/RiskChange/> are welcome to contact Cathrine Fox Maule, cam@dm.dk, or Ole B. Christensen, obc@dm.dk.

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