

## Regional Climate Modeling Data Management Plan: A Geoscience Use Case

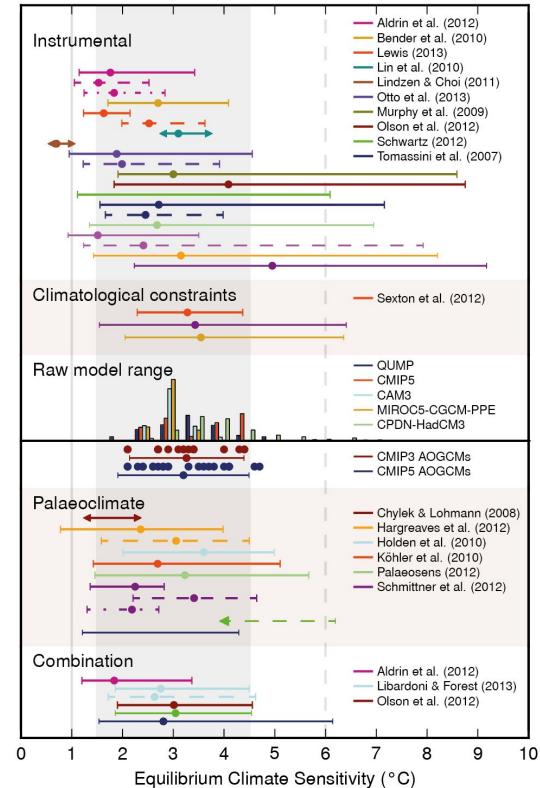
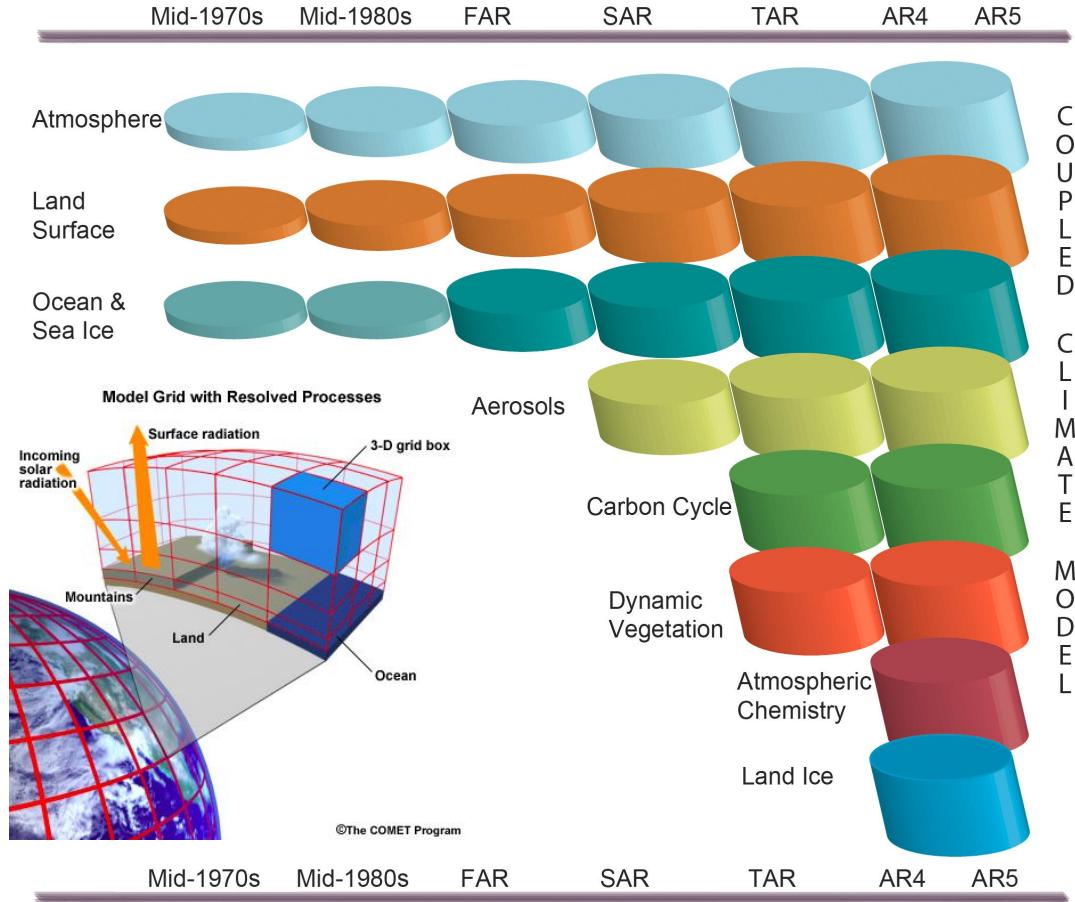
dr. sc. Ivan Güttler  
[ivan.guettler@cirus.dhz.hr](mailto:ivan.guettler@cirus.dhz.hr)



Meteorological and Hydrological **Service** (DHMZ)  
Meteorological Research and Development **Division**  
**Department** of Climate Research and Applied Climatology  
Climate Research and Biometeorology **Section**

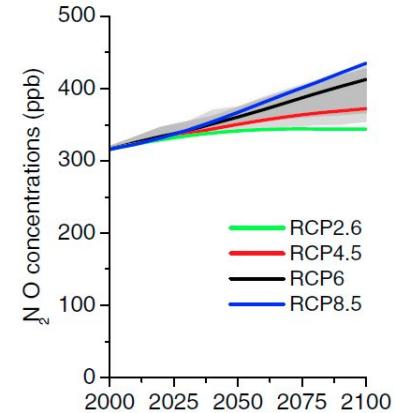
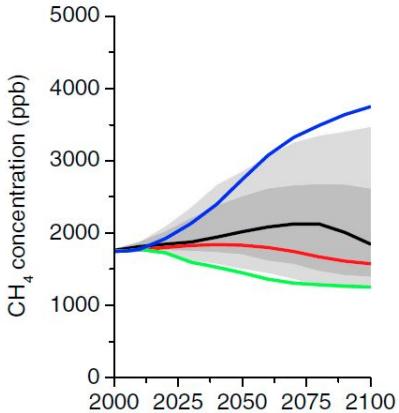
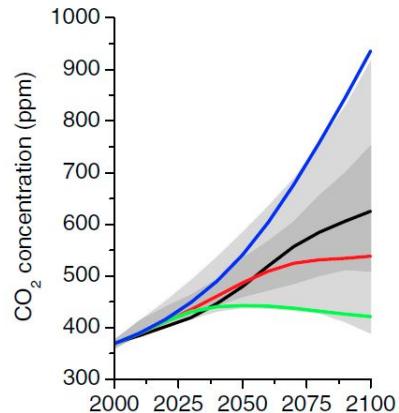
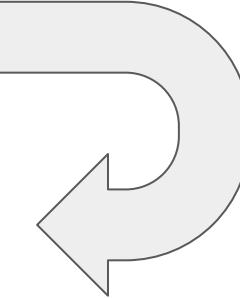
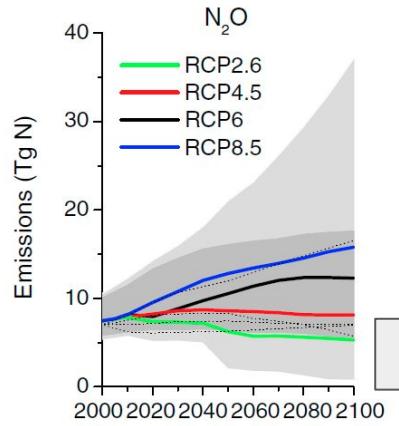
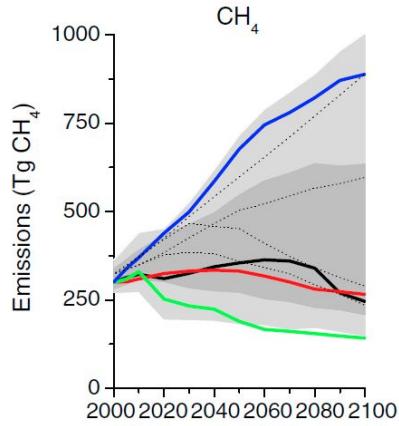
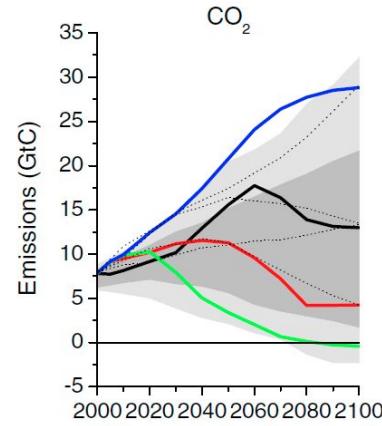
24 October 2017, Srce, Zagreb, Croatia

# What are *climate models*?



Source: IPCC AR5 (2013)

# Representative Concentration Pathways (RCP)

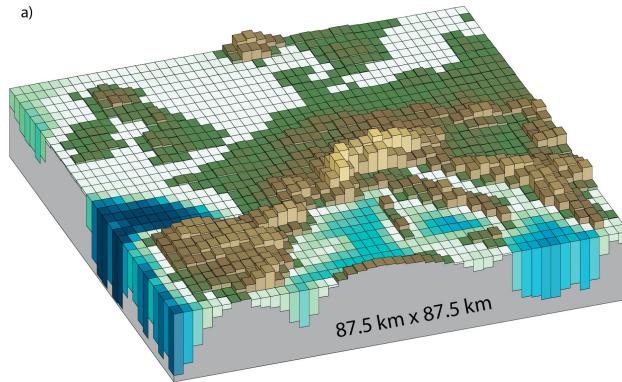


**Source:**

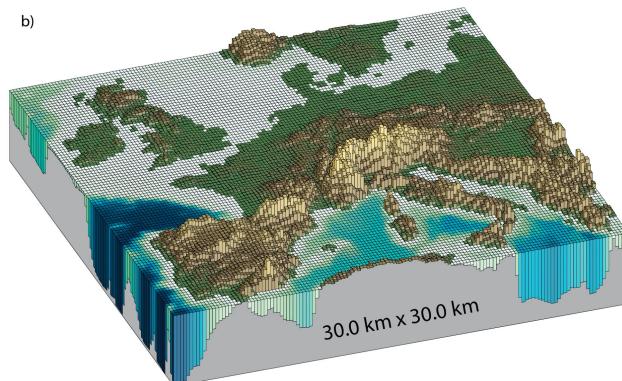
<https://climate4impact.eu/impactportal/documentation/backgroundandtopics.jsp?q=Scenarios>

# Spatial resolution: from GCM to RCM

a)



b)



Source: IPCC AR5 (2013)

Major EU projects and initiatives developing/applying RCMs:

PRUDENCE (2001-2004; FP5): <http://prudence.dmi.dk/main.html>

CECILIA: (2006-2009; FP6): <http://cecilia.dmi.dk/>

ENSEMBLES (2004-2009; FP6): <http://ensemblesrt3.dmi.dk/>

Since 2009:

CORDEX: <http://www.cordex.org/>

EURO-CORDEX: <http://www.euro-cordex.net/>

Med-CORDEX: <https://www.medcordex.eu/>

**CORDEX FPS Convection:**

<https://www.hymex.org/cordexfps-convection/wiki/doku.php>

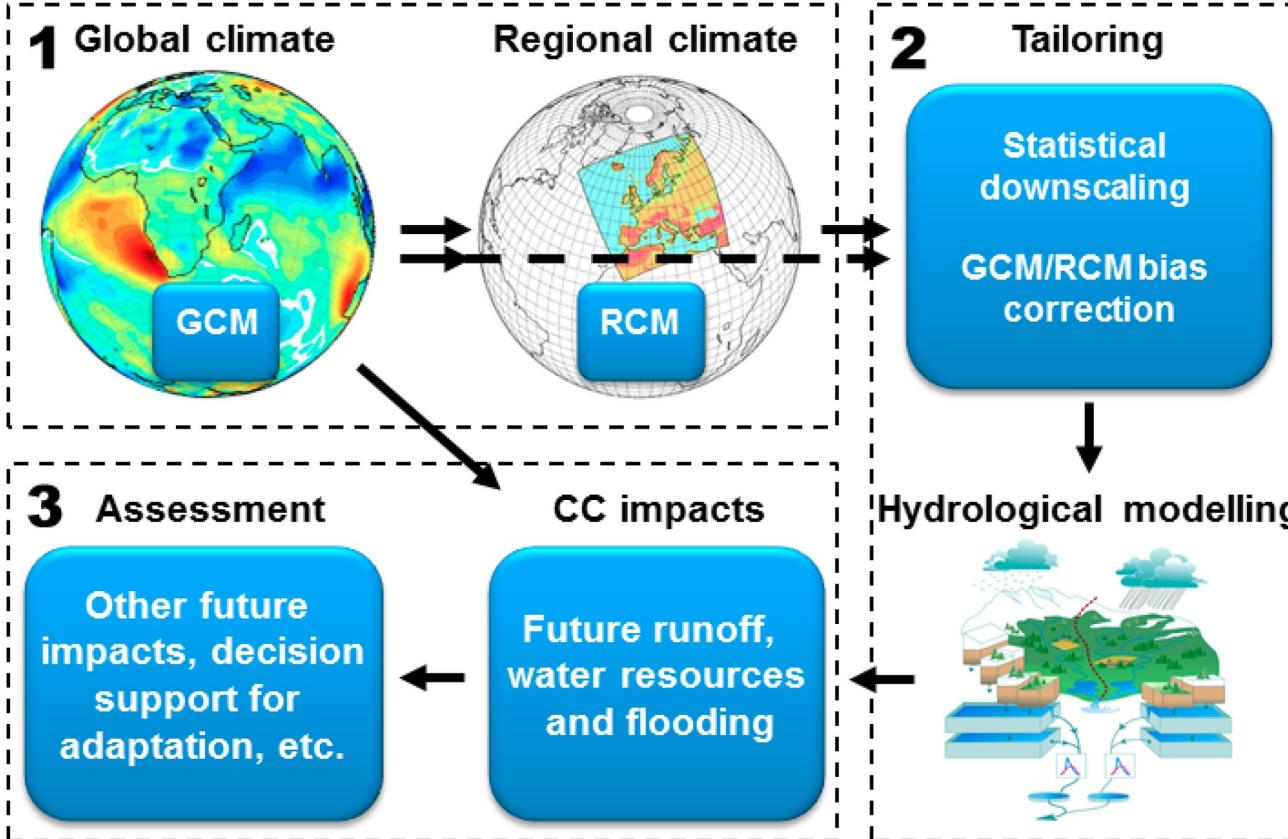
Just starting:

European Climate Prediction system (EUCP; Horizon2020)

**GCM:** global climate models

**RCM:** regional climate models

# GCM > RCM > impact models



Source: Olsson et al. (2016) Hydrological Climate Change Impact Assessment at Small and Large Scales: Key Messages from Recent Progress in Sweden. *Climate*, 4(3), 39; doi:10.3390/cli4030039

# Major RCM modelling activities in Zagreb: summer 2016-summer 2017



Prijelazni instrument Evropske unije za Hrvatsku

STRATEGIJA PRILAGODBE KLIMATSKIM PROMJENAMA | Jačanje kapaciteta Ministarstva zaštite okoliša i energetike za prilagodbu klimatskim promjenama te priprema Nacrta Strategije prilagodbe klimatskim promjenama

Korisnik projekta REPUBLIKA HRVATSKA MINISTARSTVO ZAŠTITE OKOLIŠA I ENERGETIKE Projekt provodi eptisa ADRIA

Uvod Najave Vijesti Zanimljivosti Galerija Dokumenti Komentari Preuzimanje Prijave

Vijesti

Strategija prilagodbe klimatskim promjenama i Akcijski plan prilagodbe klimatskim promjenama

9/10/2017

Zagreb, Stara gradska vijećnica, Sr. Črila i Metoda 5 – za službenika na nacionalnoj i lokalnoj razini te za zainteresiranoj javnosti održana je radionica o utjecaju klimatskih promjena i o mjerama prilagodbe klimatskim promjenama

6/4/2017

Dubrovnik, Velika vijećnica Grada

O projektu  
Očekivani rezultati  
Kontekst  
Za više informacija  
Korisne povoznice

O projektu

Za potrebe Ministarstva zaštite okoliša i energetike provodi se projekt „Jačanje kapaciteta Ministarstva zaštite okoliša i energetike za prilagodbu klimatskim promjenama te priprema Nacrta Strategije prilagodbe klimatskim promjenama“ koji se finansira sredstvima iz Prijelaznog instrumenta tehničke pomoći EU. Projekt se provodi od svibnja 2016. do studenoga 2017. godine.

Ministry of Environment and Energy dedicated project:

„Jačanje kapaciteta Ministarstva zaštite okoliša i energetike za prilagodbu klimatskim promjenama te priprema Nacrta Strategije prilagodbe klimatskim promjenama“

RCM modelling just one element of the project. More details available from the project web-page:

<http://prilagodba-klimi.hr/>

Coordination between the project team, led by Eptisa Adria d.o.o., and MZOE, Srce and DHMZ.

Regional climate model applied in this project:  
<http://gforge.ictp.it/gf/project/regcm/>

# Set of RegCM4 simulations performed on VELEbit system at Srce

1971-1980	1981-1990	1991-2000	2001-2010	2011-2020	2021-2030	2031-2040	2041-2050	2051-2060	2061-2070	2071-2080	2081-2090	2091-2100	
RegCM4 + HadGEM2-ES (HIST; 1971-2005)				dx=12.5 km; <b>RCP4.5 &amp; RCP8.5</b> ; 2006-2070									
				dx=50.0 km; <b>RCP4.5 &amp; RCP8.5</b> ; 2006-2099 + <b>RCP2.6</b> (2006-2099)									
RegCM4 + MPI-ESM-MR (HIST; 1971-2005)				dx=12.5 km; <b>RCP4.5 &amp; RCP8.5</b> ; 2006-2070									
				dx=50.0 km; <b>RCP4.5 &amp; RCP8.5</b> ; 2006-2100									
RegCM4 + EC-EARTH (HIST; 1971-2005)				dx=12.5 km; <b>RCP4.5 &amp; RCP8.5</b> ; 2006-2070									
				dx=50.0 km; <b>RCP4.5 &amp; RCP8.5</b> ; 2006-2100									
RegCM4 + CNRM-CM5 (HIST; 1971-2005)				dx=12.5 km; <b>RCP4.5 &amp; RCP8.5</b> ; 2006-2070									
				dx=50.0 km; <b>RCP4.5 &amp; RCP8.5</b> ; 2006-2100									

Summary: 1 RCM (RegCM4), 2 resolutions (12.5 km and 50 km), 4 CMIP5 GCMs, 2(3) RCPs  
In total: ~995 “model years” at 50.0 km and ~660 “model years” at 12.5 km

# Raw output size

Format: NetCDF4 ( <a href="https://www.unidata.ucar.edu/software/netcdf/">https://www.unidata.ucar.edu/software/netcdf/</a> ) (+several variable reduced)		
RegCM4 (12.5 km; 573x573x23 cells for 3D variables)	1 month	1 year
ATM (6-hourly)	16 G	192 G
RAD (6-hourly)	3 G	50.4 G
SRF (3-hourly)	4.7 G	56.4 G
STS (daily quantities)	293 M	3.5 G
SAV (one snapshot per month/year)	-	2.6 G
	TOTAL 1 year	304.9 G
	TOTAL 100 years	29.7 T

$$1 \text{ T} = 1024 \text{ G} = 1024 \times 1024 \text{ M}$$

# How to share climate data?

Eg. 1: ESGF: <https://esg-dn1.nsc.liu.se/projects/esgf-liu/>

- CF (Climate and Forecast) metadata conventions: <http://cfconventions.org/>
- General instructions for CORDEX integrations
- CORDEX Archive specification document
- CORDEX Variables requirement document

Advantage: different GCMs, RCMs & observations put to one system



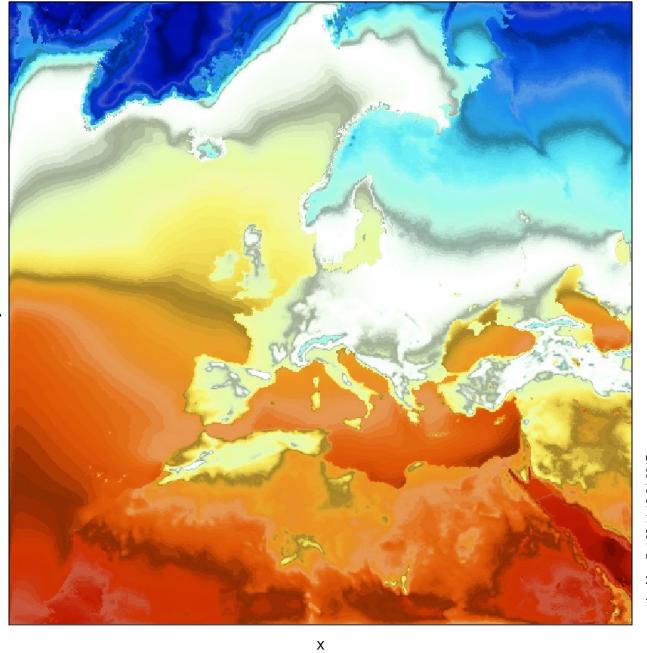
Eg. 2: Med-CORDEX: <https://www.medcordex.eu/medcordex.php>

Advantage: Define new or specific variables. Use for both application and research data.

The screenshot shows the Med-CORDEX website interface. At the top, there's a navigation bar with links like HOME, SIMULATIONS PHASE 1, DATABASE, SEARCH DOWNLOAD (which is highlighted in red), USE DATA, HELP, SITEMAP, NEWS (JUL 19, 2016), and WORKSHOPS. Below the navigation is a secondary menu with links for PUBLICATIONS, REFERENCES, CONTACTS, FTP STATISTICS, WEB STATISTICS, LOGIN, and PRIVACY. The main content area features a search form titled "select search parameters". It includes dropdown menus for realm, dataset, institution, domain, GCMModelName, CMIP5ExperimentName, CORDEXExperimentMember, RCMModel, Frequency, and VariableName. There are also input fields for "from YYYY-MM-DD" and "to YYYY-MM-DD". Below the search form are buttons for "reset fields" and "SEARCH".

# Data + metadata (1 /2)

Mean 2 meter temperature (K)



ICTP Regional Climatic model V4  
Range of Mean 2 meter temperature: 236.91 to 306.007 K  
Range of x: 0 to 572  
Range of y: 0 to 572  
Current time: 434159 hours since 1949-12-01 00:00:00  
Frame 1 in File EUROPE\_HA\_STS\_yseasmean\_P0.nc

tas = 296.8969, 296.9741, 297.0116, 297.0392, 297.0665, 297.0943, 297.1198,  
297.1407, 297.1639, 297.1846, 297.213, 297.2838, 297.3606, 297.4382,  
297.5135, 297.5856, 297.6545, 297.724, 297.7999, 297.8768, 297.9465,  
297.9996, 298.0498, 298.1063, 298.1691, 298.2347, 298.2988, 298.3565,  
298.4052, 298.447, 298.4879, 298.5109, 297.8888, 297.8788, 297.951,  
298.9905, 299.0371, 299.0408, 299.0644, 299.1312, 299.1565, 299.258,  
299.2623, 299.3199, 299.3734, 299.4851, 299.6177, 299.724, 299.7755,  
299.8507, 299.8894, 299.8585, 299.7858, 299.7053, 299.7276, 299.6788,  
299.5394, 299.4636, 299.3619, 299.2626, 299.1534, 299.0348, 299.0408,  
298.9489, 298.8665, 298.657, 298.7064, 298.4929, 298.4139, 298.3763,  
298.343, 298.3255, 298.4675, 298.319, 298.4117, 298.2471, 298.2289,  
298.2249, 298.2116, 298.1784, 298.1341, 298.1015, 298.1045, 298.1197,  
298.1206, 298.087, 298.1863, 297.9635, 298.0692, 298.0277, 298.2391,  
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296.8775, 296.8388, 296.817, 296.8065, 296.801, 296.6753, 296.7909,  
296.7632, 296.6067, 296.6028, 296.7405, 296.704, 296.6525, 296.5883,  
296.5051, 296.3974, 296.2962, 296.2404, 295.7474, 295.7946, 296.331,  
296.3048, 296.227, 296.1699, 296.1164, 295.5226, 296.0545, 296.0449,  
296.0194, 296.0044, 296.0103, 295.464, 295.4602, 295.4393, 295.9555,  
294.8861, 295.2849, 295.2603, 295.7986, 295.795, 295.8411, 295.0883,

...

# Data + metadata (2 /2)

1. Directory level: e.g.,

EUR-11/DHMZ/ECMWF-ERAINT/evaluation/r1i1p1/DHMZ-RegCM4-2/v1/day/tas

2. Filename level: e.g.,

tas\_EUR-11\_ECMWF-ERAINT\_evaluation\_r1i1p1\_DHMZ-RegCM4-2\_v1\_day\_19890101-19901231.nc

3. File content level:, e.g.

## Dimensions:

x = 551 ;

y = 551 ;

Time = UNLIMITED ; // (730 currently)

bnds = 2 ;

## Variables:

...

float tas(time, y, x) ;

tas:long\_name = "Near-Surface Air Temperature" ;

tas:units = "K" ;

tas:cell\_methods = "time: mean" ;

tas:grid\_mapping = "Lambert\_Conformal" ;

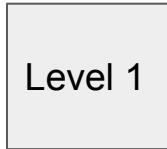
...

## Global attributes:

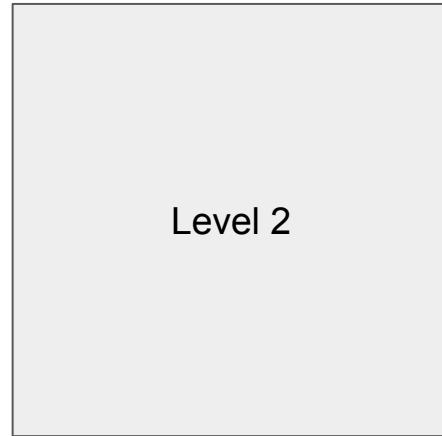
:contact = "ivan.guettler@cirus.dhz.hr" ;  
:creation\_date = "2014-11-15T12:00:00Z" ;  
:experiment = "Evaluation run with reanalysis forcing" ;  
:experiment\_id = "evaluation" ;  
:driving\_model\_id = "ECMWF-ERAINT" ;  
:driving\_model\_ensemble\_member = "r1i1p1" ;  
:driving\_experiment\_name = "evaluation" ;  
:driving\_experiment = "ECMWF-ERAINT, evaluation, r1i1p1" ;  
:frequency = "day" ;  
:institute\_id = "DHMZ" ;  
:institution = "Meteorological and Hydrological Service of Croatia" ;  
:model\_id = "DHMZ-RegCM4-2" ;  
:rcm\_version\_id = "v1" ;  
:project\_id = "CORDEX" ;  
:product = "output" ;  
:references = "http://gforge.ictp.it/gf/project/regcm/" ;  
:CORDEX\_domain = "EUR-11" ;  
:Conventions = "CF-1.4" ;

# Data management plan (DMP): working version / October 2017

- <http://www.srce.unizg.hr/dabar>
- CC BY 4.0
- MZOE + Srce + DHMZ
- to start by the end of 2017.



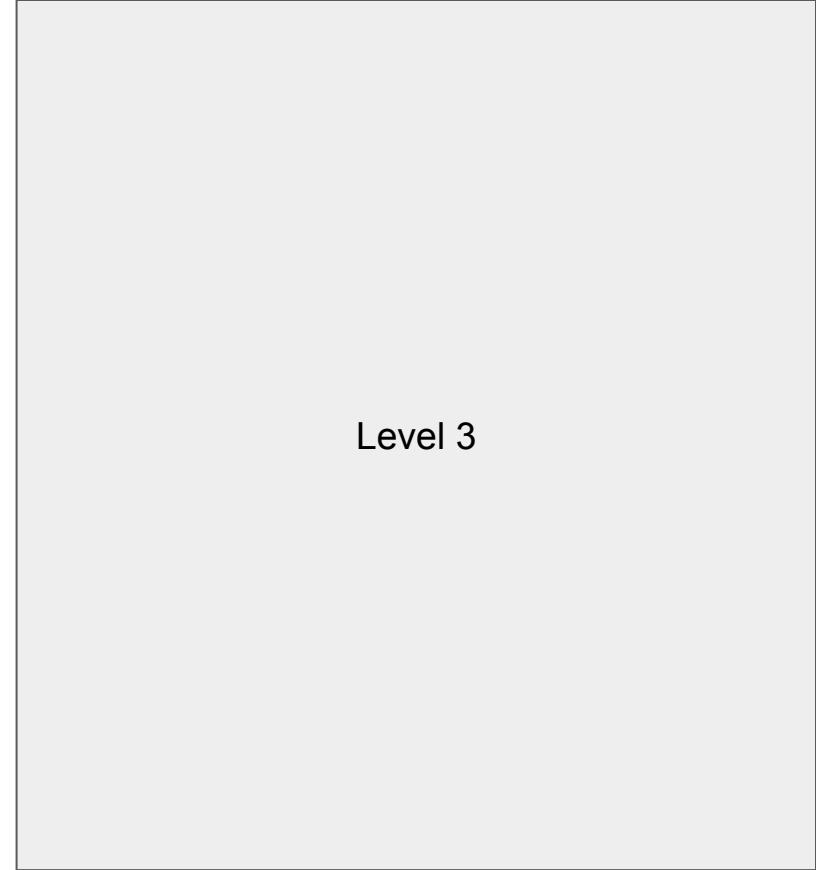
**Domain:** Croatia  
**Frequency:** daily  
**Variables:** pr, tas, tasmin, ...  
**Access:** free, web-based  
**Estimated size:** ~ 20 G



Level 2

EU  
3-hr/6-hr/daily  
most 2D  
free, web-based  
~ 30 T

Level 3



EU  
3-hr/6-hr/daily  
all 2D&3D  
free, special request  
~ 220 T

# RDA meets Croatian researchers

## Summary

- Large ensemble of RCM simulations performed for the purpose of the MZOE project
- All data will be made available for research and commercial activities

