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UNIVERSITÀ DEGLI STUDI FIRENZE
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DIPARTIMENTO DI SCIENZE DELLE PRODUZIONI AGROALIMENTARI E DELL'AMBIENTE

UNIVERSITÄT FÜR BODENKULTUR WIEN
BOKU
DEPARTMENT FÜR WASSER-ATMOSPHÄRE-UMWELT

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Horizon 2020
EUROPEAN UNION FUNDING FOR RESEARCH & INNOVATION

Workshop
2018

STARC – Impact

Supporting the Austrian Research Community in using recent Climate Change Projections for Climate Impact Studies

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BOKU-Met

Project background – ÖKS15

Aims of "Klimaszenarien für Österreich (ÖKS15)":

- Analyse climate change in Austria throughout the 20th and 21st centuries in a probabilistic manner based on
  - long-term high quality and highly resolved (1 km x 1 km grid spacing, daily bases) gridded observational data
  - the latest generation of regional climate projections employing the latest emission scenarios, the Representative Concentrations Pathways (RCPs) (Van Vuuren et al., 2011; Moss et al., 2010)
- Properly prepare the project results for political decision makers, representatives of public authorities, and users from the climate and climate impact research communities
- Distribute actionable climate change information via governmental GIS systems and the Data Centre of the Climate Change Centre Austria (CCCA, www.ccca.ac.at)

Representative Concentration Pathways (RCPs)

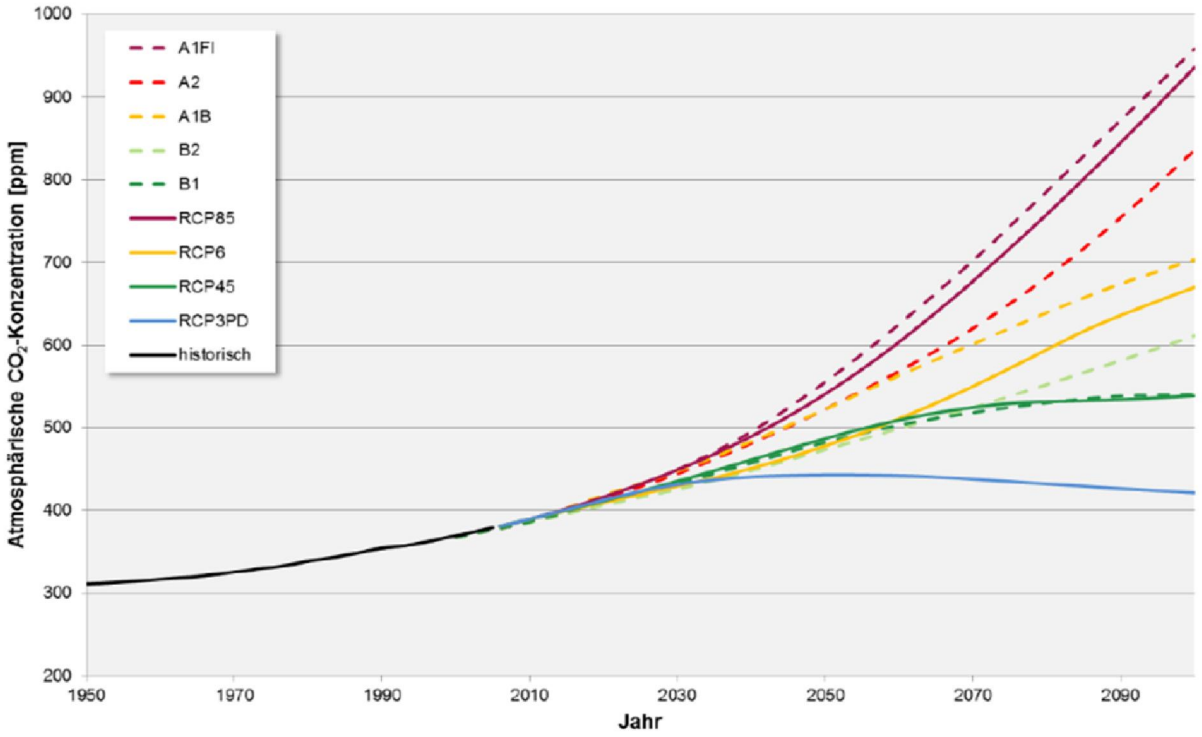
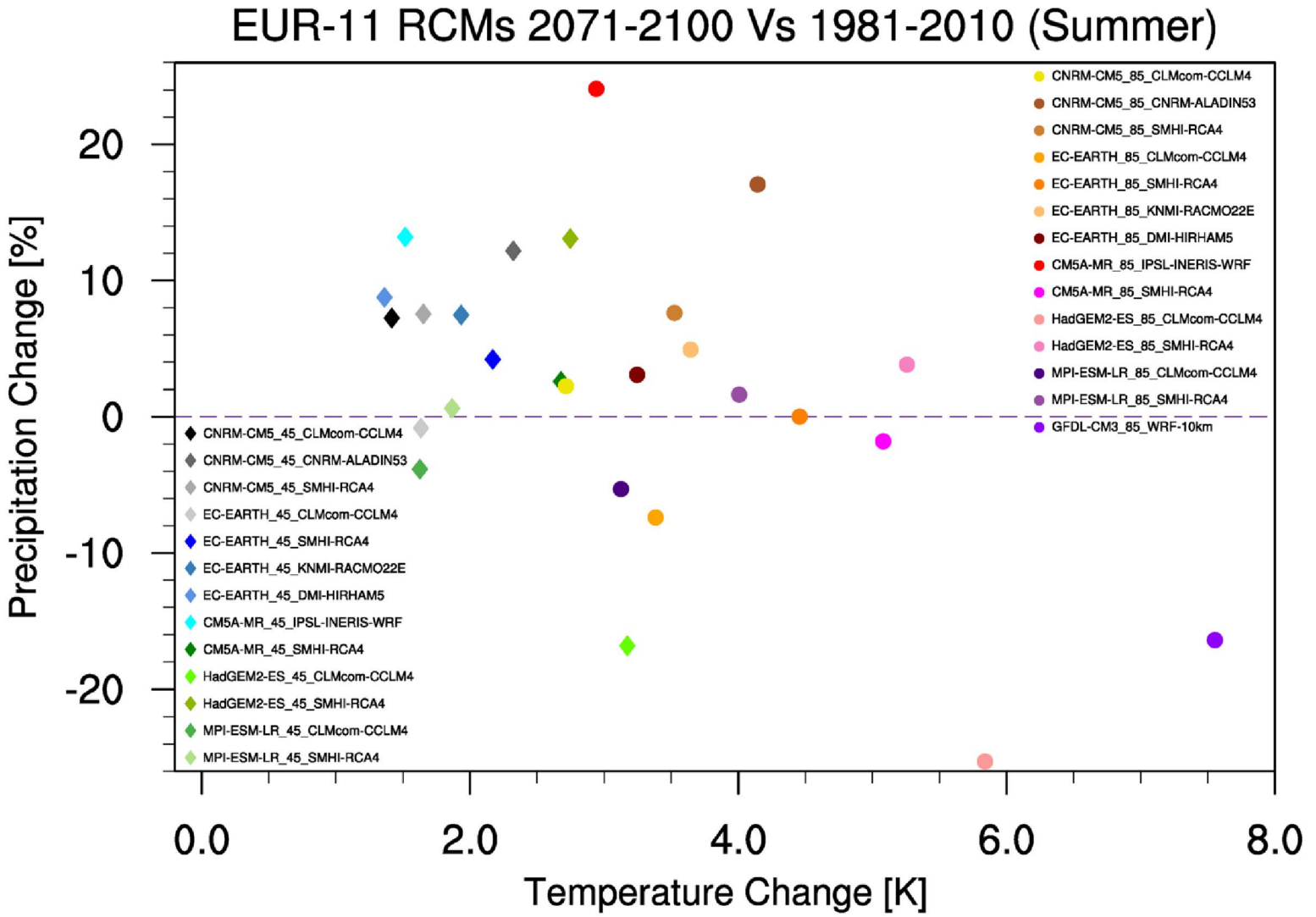


Abbildung 4: Atmosphärische CO2-Konzentrationen [ppm] entsprechend der bisherigen SRES (gestrichelt) und der aktuellen RCP (durchgezogen) Szenarien. Die schwarze Linie zeigt die historischen Konzentrationen. Aus KOTLARSKI UND TRUHETZ (in Druck).

Combinations of global (GCMs) and regional models (RCMs) from EURO-CORDEX to generate climate projections for the greenhouse gas analyzes RCP4.5 and RCP8.5 with a resolution of 12.5 km

GCM/RCM	ALADIN	ARPEGE	CCLM	HIRHAM5	PROMES	RACMO	RCA	RegCM	REMO	WRF	sum
ACCESS1-3											
CanESM2											
CCSM4											
CNRM-CM5	1	1	1				1				3
CSIRO-Mk3-6-											
EC-EARTH			1	1	1	1	1				3
GFDL-ESM2M											
HadGEM2-ES			1			1	1				3
IPSL-CM5A-MR							1			1	2
MIROC5			1								
MPI-ESM-LR			1				1		2	1	2
NorESM1-M											
sum	1		4	1		1	5			1	13


EUR-11 RCMs 2071-2100 Vs 1981-2010 (Summer)
Precipitation Change [%]
20
10
0
-10
-20
0.0
2.0
4.0
6.0
8.0
Temperature Change [K]
CNRM-CM5_85_CLMcom-CCLM4
CNRM-CM5_85_CNRM-ALADIN53
CNRM-CM5_85_SMHI-RCA4
EC-EARTH_85_CLMcom-CCLM4
EC-EARTH_85_SMHI-RCA4
EC-EARTH_85_KNMI-RACMO22E
EC-EARTH_85_DMI-HIRHAM5
CM5A-MR_85_IPSL-INERIS-WRF
CM5A-MR_85_SMHI-RCA4
HadGEM2-ES_85_CLMcom-CCLM4
HadGEM2-ES_85_SMHI-RCA4
MPI-ESM-LR_85_CLMcom-CCLM4
MPI-ESM-LR_85_SMHI-RCA4
GFDL-CM3_85_WRF-10km
CNRM-CM5_45_CLMcom-CCLM4
CNRM-CM5_45_CNRM-ALADIN53
CNRM-CM5_45_SMHI-RCA4
EC-EARTH_45_CLMcom-CCLM4
EC-EARTH_45_SMHI-RCA4
EC-EARTH_45_KNMI-RACMO22E
EC-EARTH_45_DMI-HIRHAM5
CM5A-MR_45_IPSL-INERIS-WRF
CM5A-MR_45_SMHI-RCA4
HadGEM2-ES_45_CLMcom-CCLM4
HadGEM2-ES_45_SMHI-RCA4
MPI-ESM-LR_45_CLMcom-CCLM4
MPI-ESM-LR_45_SMHI-RCA4

STARC project aims and design

Assess the strengths and limitations of the ÖKS15 dataset!

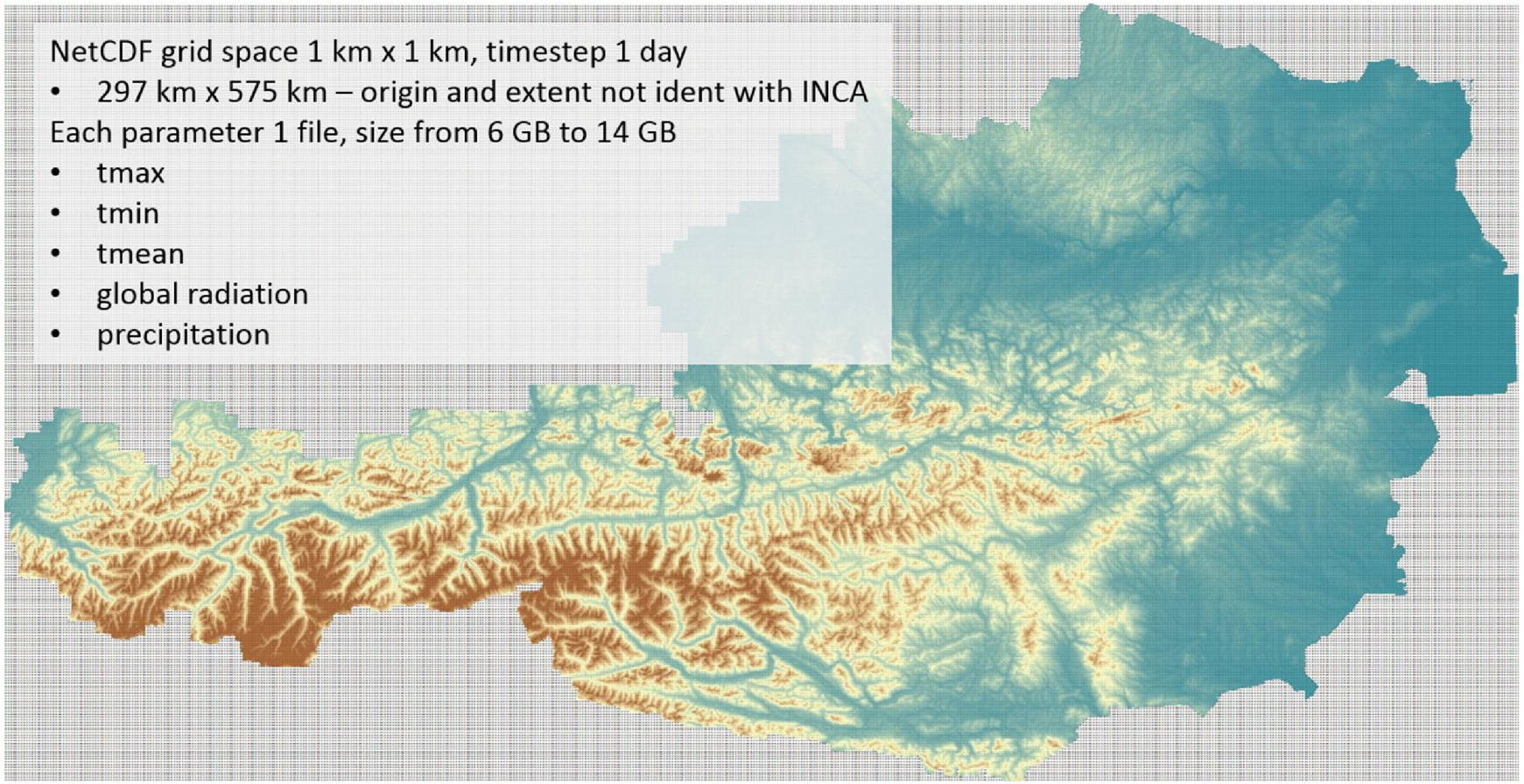
- Analyse the quality, reliability, and uncertainty of the observational gridded data and the ÖKS15 climate projections
- Analyse changes in climate projections (including PET) when the emission scenarios are changed from those scenarios that were extensively used in Austrian impact studies (like A1B, B2, RCP2.6 etc.) to the Representative Concentrations Pathways RCPs used in ÖKS15 (RCP4.5 and RCP8.5)
- Exemplify climate change impacts on regional crop production and their sensitivity against uncertainty in emission scenario and climate models based on the ÖKS15 projections
- Investigate the applicability of the ÖKS15 data with respect to its limitations
- Establish guidelines for the Austrian Climate Research Community for selecting and using the ÖKS15 data with a specialized focus on limitations, uncertainties, and differences from different climate model generations and emission scenarios

NetCDF grid space 1 km x 1 km, timestep 1 day

- 297 km x 575 km – origin and extent not ident with INCA

Each parameter 1 file, size from 6 GB to 14 GB

- tmax
- tmin
- tmean
- global radiation
- precipitation



calendar 360
calendar 365
proleptic_gregorian start 1951
proleptic_gregorian start 1971

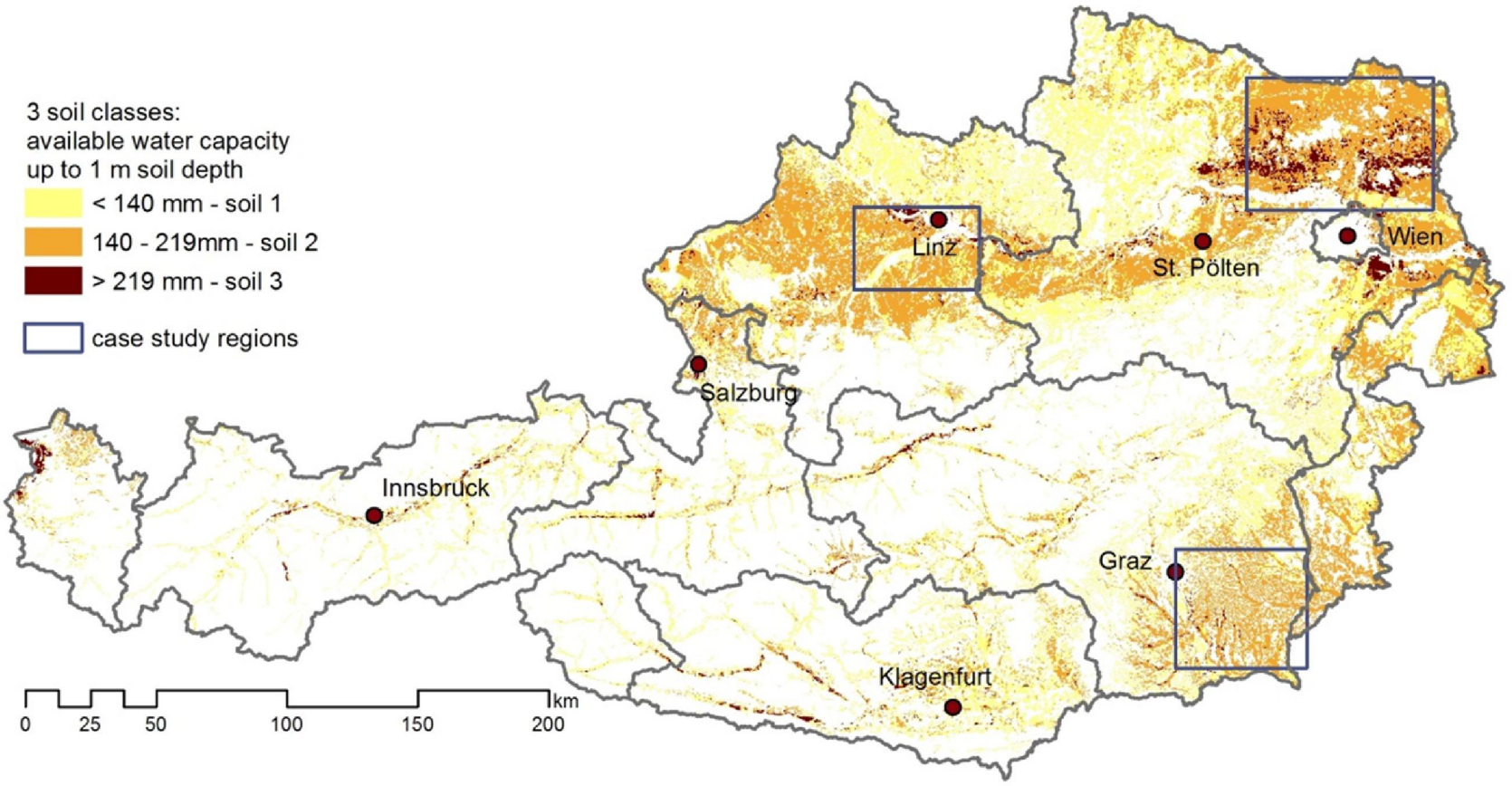
Model names and (some) data characteristics

	days	since	offset	start date	end date	ÖKS15 Bias Corrected EURO-CORDEX Model Name ... RCP 45/85
V01	54787	01.12.1949	396.50	01.01.1951	31.12.2100	CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CLMcom-CCLM4-8-17
V02	54787	01.12.1949	396.50	01.01.1951	31.12.2100	CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_CNRM-ALADIN53
V03	47482	01.12.1949	7701.50	01.01.1971	31.12.2100	CNRM-CERFACS-CNRM-CM5_rcp45_r1i1p1_SMHI-RCA4
V04	54787	01.12.1949	396.50	01.01.1951	31.12.2100	ICHEC-EC-EARTH_rcp45_r12i1p1_CLMcom-CCLM4-8-17
V05	47482	01.12.1949	7701.50	01.01.1971	31.12.2100	ICHEC-EC-EARTH_rcp45_r12i1p1_SMHI-RCA4
V06	54787	01.12.1949	396.50	01.01.1951	31.12.2100	ICHEC-EC-EARTH_rcp45_r1i1p1_KNMI-RACMO22E
V07	54787	01.12.1949	396.50	01.01.1951	31.12.2100	ICHEC-EC-EARTH_rcp45_r3i1p1_DMI-HIRHAM5
V08	54787	01.12.1949	396.50	01.01.1951	31.12.2100	IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_IPSL-INERIS-WRF331F
V09	47450	01.12.1949	7696.50	01.01.1971	31.12.2100	IPSL-IPSL-CM5A-MR_rcp45_r1i1p1_SMHI-RCA4
V10	53610	01.12.1949	390.50	01.01.1952	**30.11.2100**	MOHC-HadGEM2-ES_rcp45_r1i1p1_CLMcom-CCLM4-8-17
V11	46410	01.12.1949	7590.50	01.01.1972	**30.11.2100**	MOHC-HadGEM2-ES_rcp45_r1i1p1_SMHI-RCA4
V12	54787	01.12.1949	396.50	01.01.1951	31.12.2100	MPI-M-MPI-ESM-LR_rcp45_r1i1p1_CLMcom-CCLM4-8-17
V13	47482	01.12.1949	7701.50	01.01.1971	31.12.2100	MPI-M-MPI-ESM-LR_rcp45_r1i1p1_SMHI-RCA4

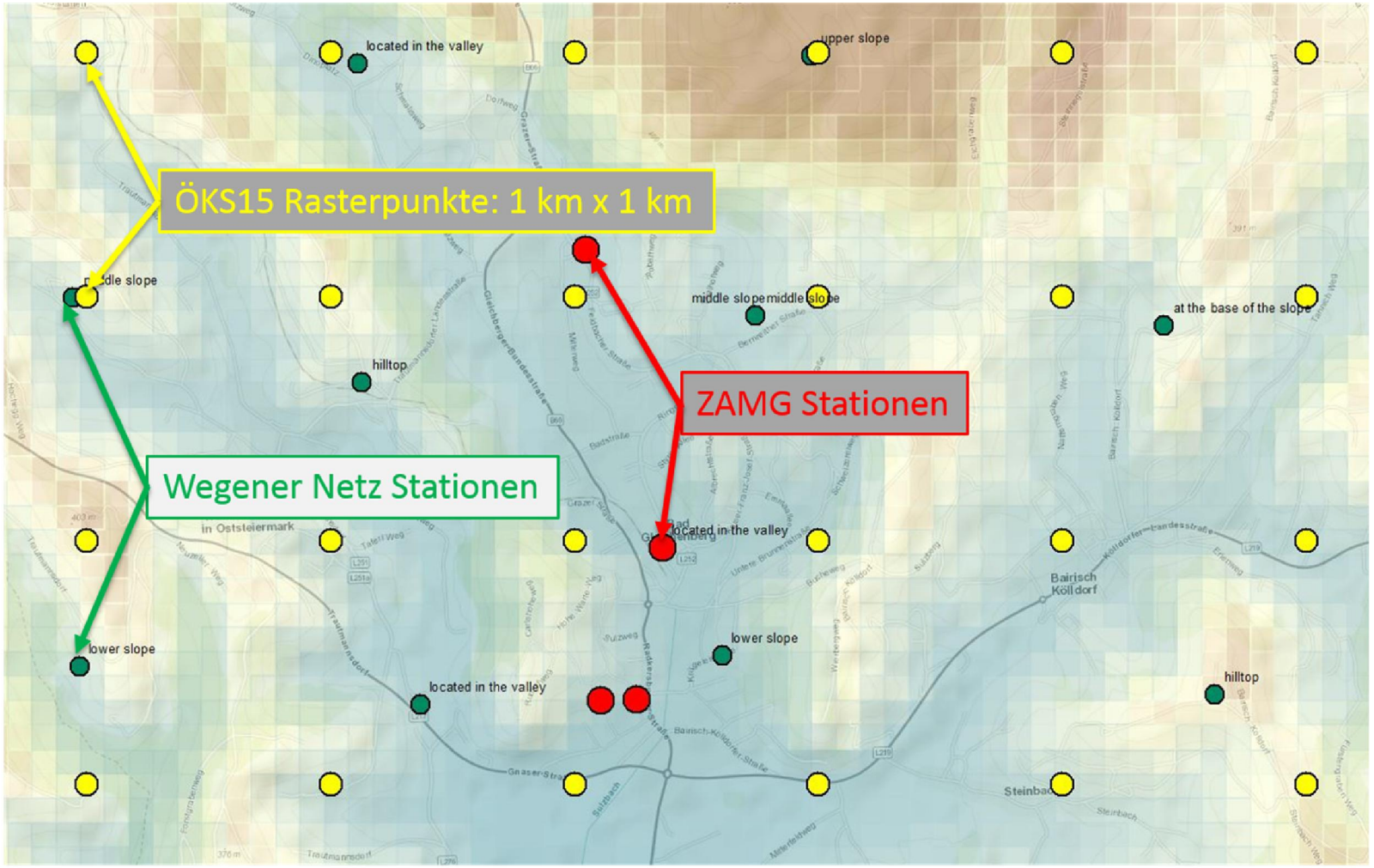
WP 4: In order to determine whether the ÖKS15 data meet the requirements of climate impact research, they are used for an investigation as input for the plant growth model (DSSAT, Jones et al., 2003) and the agro-climatic risk model (AGRICLIM, Trnka et al, 2011).

1. Sensitivity to uncertainties of the input data (1981-2010)
2. Sensitivity to spatial resolution (5, 11, 21 km)
3. Current state and outlook for the future in three selected areas with three soil classes (1981-2010 and 2071-2100)

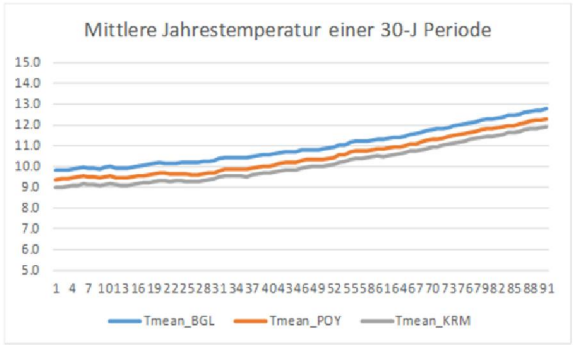
The three case study regions

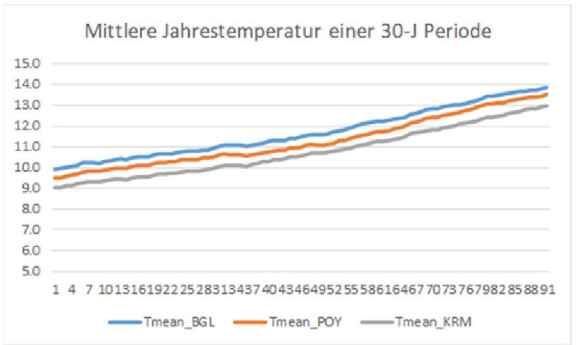


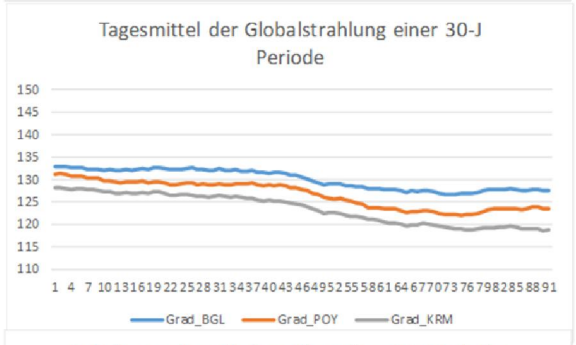
Case study location Bad Gleichenberg

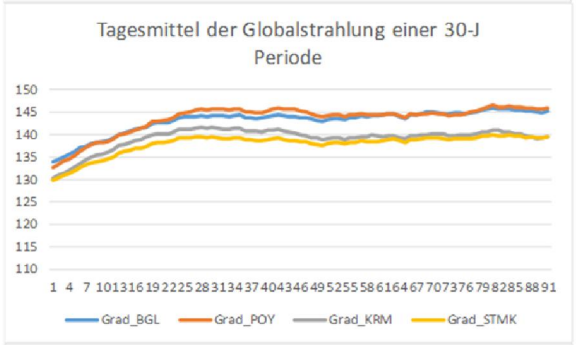


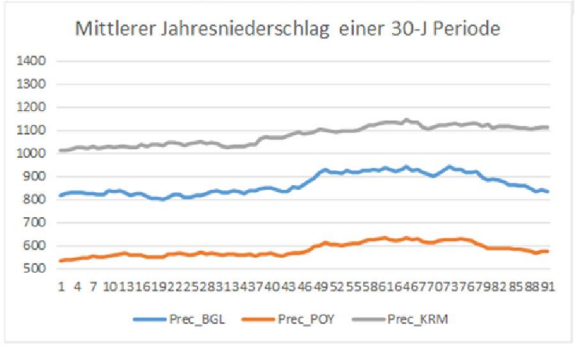
case study regions – comparison V01_85 and V02_85

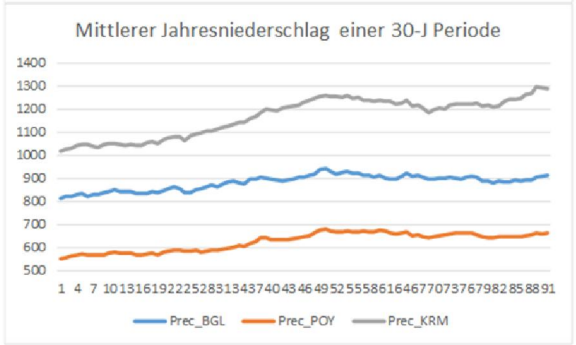




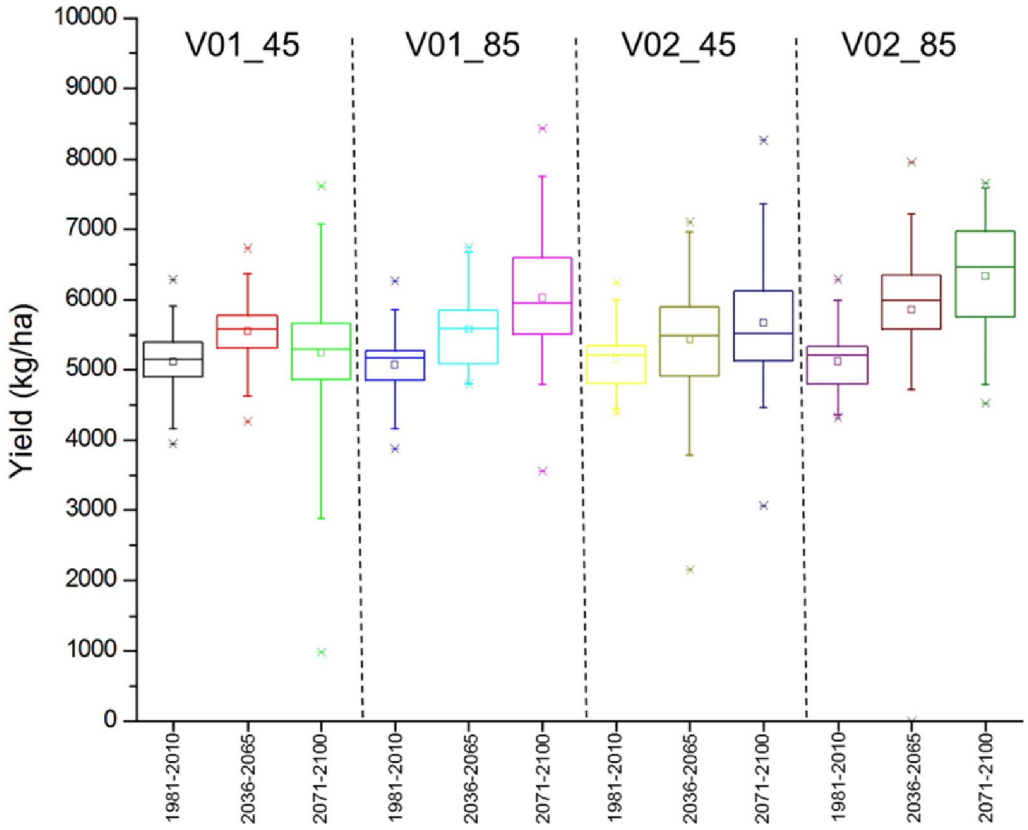




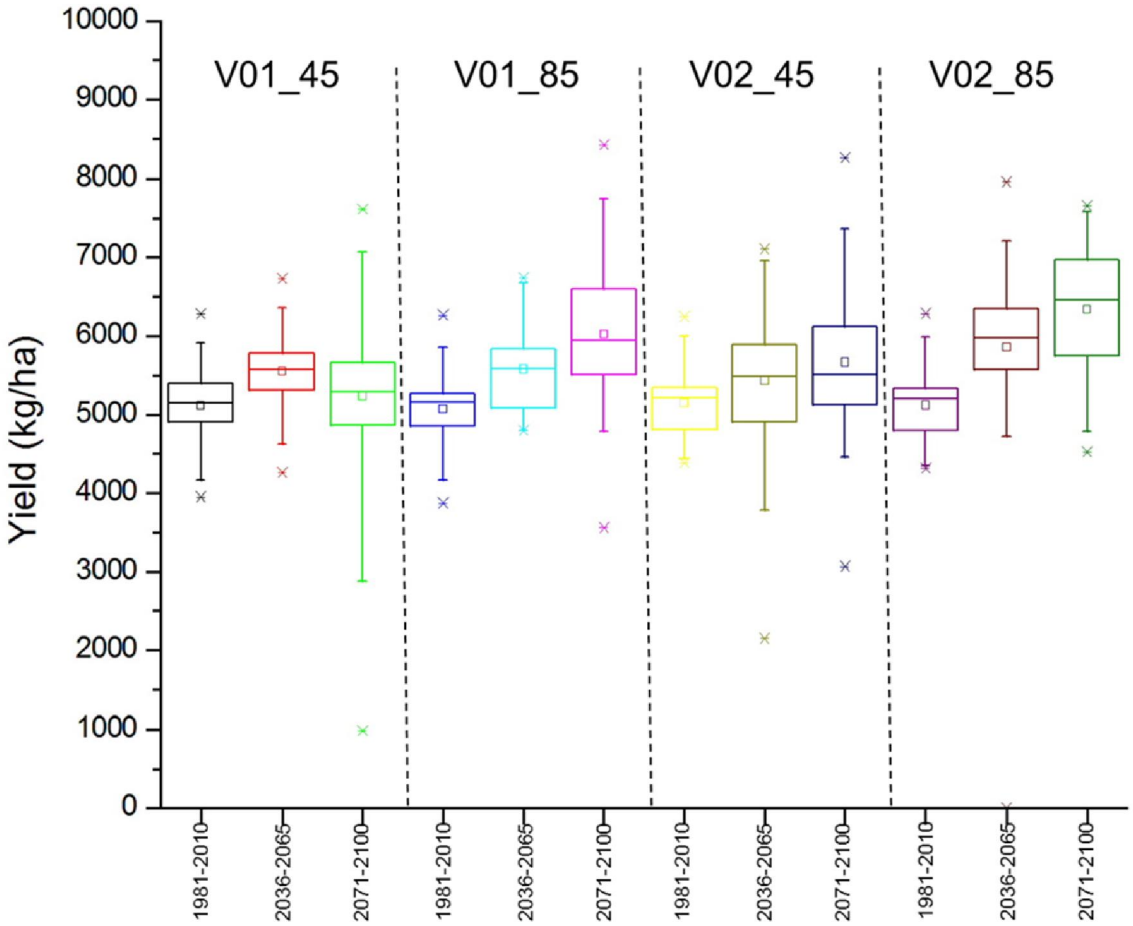


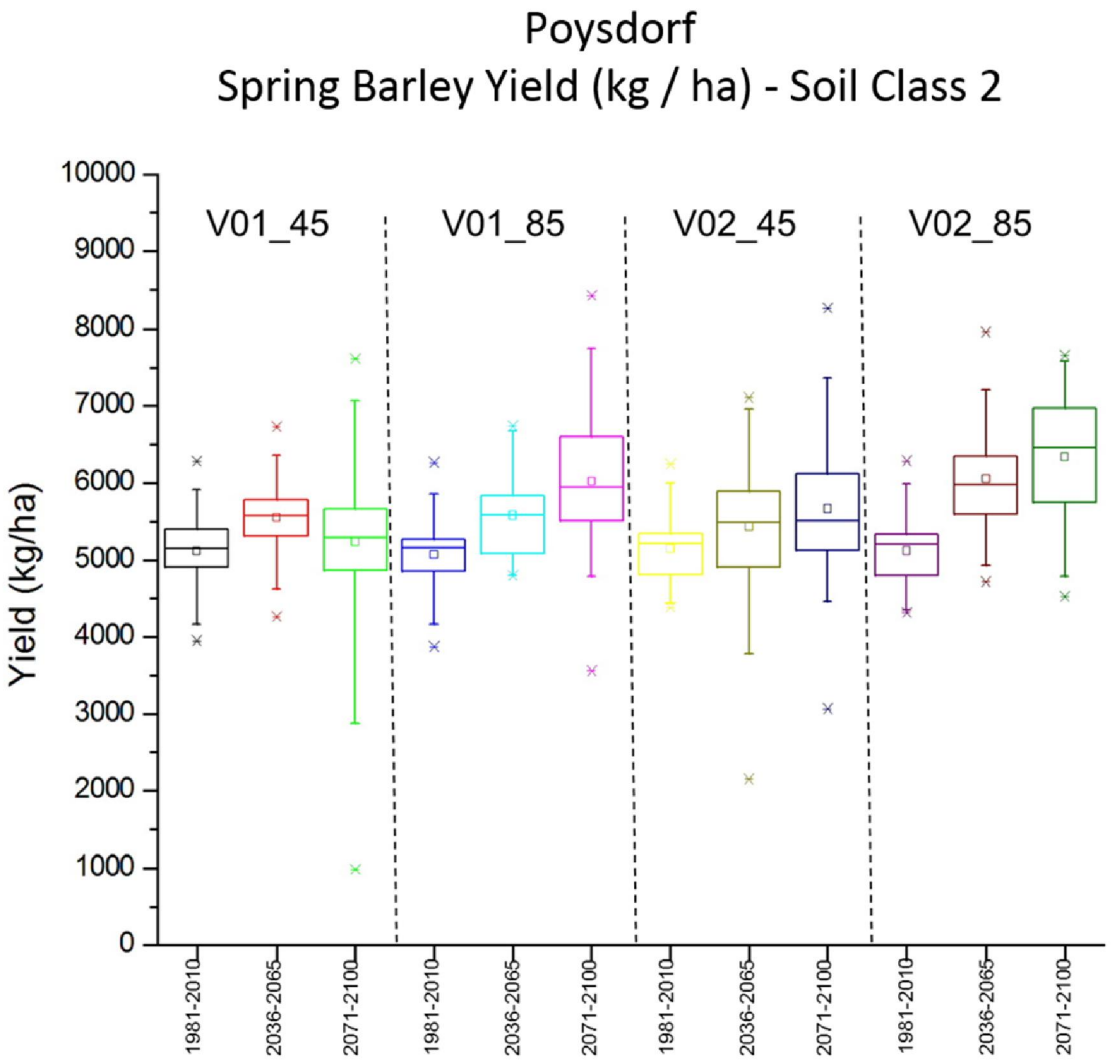


Bad Gleichenberg
Spring Barley Yield (kg / ha) - Soil Class 2



Kremsmünster
Spring Barley Yield (kg / ha) - Soil Class 2




Poysdorf
Spring Barley Yield (kg / ha) - Soil Class 2
Yield (kg/ha)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
V01_45
V01_85
V02_45
V02_85
1981-2010
2036-2065
2071-2100

Climate scenarios: V01_45, V01_85, V02_45, V02_85

Predominantly positive effect on crop yields in 2050 and 2085 at all three sites on the occasion of:

- higher CO_2 concentration
- higher temperatures
- higher precipitation sum during the growing season

Serbia for Excell

European Commission

Guideline
key recommendations in case of crop model applications:

- Ensure sound calibration and validation of impact models (e.g. crop growth models) using measured data of ideally >10 years and several sites covering the main ecosystem variability in the study region of interest

- Apply an ensemble of climate change scenarios in order to cover a most probable range of expected upcoming “reality”

- Analyze the various applied climate scenarios in respect to adverse weather conditions during various crops growing seasons (frequency, severity, coincidence with crop vulnerable phases) for a complementary source of interpretation of impact models simulation results (crop models)

- Apply, if possible an ensemble of calibrated/validated crop models in order to catch the range of uncertainties coming from different crop models structure and response functions to weather parameters, especially in respect to critical response thresholds such as heat and drought stress and others

- Consider for interpretation of crop modelling results also an ensemble of future (expected) crop management scenarios (such as adapted new cultivars, changed fertilization and soil cultivation regimes and others

- Past regional climate change impact study results might be adapted under updated regional climate scenarios, especially when changes in direction of events may occur in the various seasons of main crop growth (e.g. increase/decrease of precipitation, frequency of heat waves, frost occurrence, and others)