CEDR Transnational Road Research Programme
Call 2012: Road owners adapting to Climate Change

funded by Denmark, Germany,
Norway, the Netherlands

Conférence Européenne des Directeurs des Routes
Conference of European Directors of Roads

Climate projection data base for roads: CliPDaR

Report on the first Workshop
25-27 February 2013, Offenbach, Germany
DWD headquarter

Deliverable D 1.1

The CliPDaR Consortium:

Deutscher Wetterdienst

ZAMG

CEDR TRANSNATIONAL ROAD RESEARCH PROGRAMME
Call 2012

Design a guideline for a transnational database of downscaled climate projection data for road impact models

Climate projection data base for roads: CliPDaR

Start date of project: 22.02.2013 End date of project: 23.08.2013

Author(s) of this deliverable:
Christoph Matulla
Central Institute of Meteorology and Geodynamics
Hohe Warte 38
1190 Vienna
Austria

Joachim Namyslo
German National Meteorological Service
Frankfurter Straße 135
63067 Offenbach am Main
Germany

May 2013

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Executive summary

The first CliPDaR meeting was focused on gathering up the expertise of the project partners regarding climate change datasets and downscaling methods. Findings from the ongoing Federal joint research project KLIWAS (Impacts of climate change on waterways and navigation - searching for options of adaptation) and the EU-COST Action VALUE (Validating and Integrating Downscaling Methods for Climate Change Research) as well as already progressed or finished projects of the AdSVIS programme (Adaptation of road-traffic infrastructure to climate change) of BASt, that have been carried out in cooperation with the DWD, were presented and discussed. These projects are of importance to CliPDaR as their findings may serve as a solid basis.

The workshop focused on several main *points*: (i) the road infrastructure, (ii) the potential threats, (iii) the available datasets, (iv) the necessary mathematical methods/tools and (v) questions posed by the road owners. These *points* were approached in a 'brain storming' like way: (i) and (ii) were discussed on the basis of the projects RIVA (Risk analysis of key goods and transit axes including seaports, part of the mentioned above AdSVIS programme suite) and RIMAROCC (RIsk MAnagement for ROads in a Changing Climate); (iii) and (iv) are to be ruled by standard procedures which will be defined within CliPDaR (by using the knowledge gained within KLIWAS and VALUE). As for (v) – one central question raised by the road authorities addresses the alleged frequent occurrence of cold winters during the recent past. We ventilated possible strategies to quantify this claim and to identify regions in Europe that are affected most by these onsets of cold. Mathematical techniques that should allow for the assessment of future probabilities of such events were assessed too.

The configuration of guidelines that determine how climate datasets and mathematical techniques are to be used to derive decision support is one of the significant outputs of CliPDaR. Therefore, attention was directed towards the general framework. Thereby the correct handling of climate model output was identified as crucial ('the ensemble approach'). The procedure how to present results was elaborated in order to establish a CliPDaR standard for the road authorities that permits a quick and easy comparison of the performance of different approaches. Finally, the CliPDaR roadmap was fixed. The fulfilment of the targeted deliverables and milestones (the schedule) was broken down to calendar weeks.

The potential of using the urban climate model MUKLIMO_3 (a 3-dimensional Microscale Urban CLImate MOdel; Sievers, 1995) as an "impact model" (Früh et al., 2011) to produce climate output along transport routes was discussed. Once surrounding area parameters close to highways as well as meteorological data from

nearby stations are entered into MUKLIMO_3, local climate data can be produced on a rather fine scale. This shall be of great value concerning changing climate forcings on roads. However, a MUKLIMO_3 exercise cannot be carried out within CliPDaR. The idea, however, may be of value regarding future studies.

1 Preliminary remark

Concerning the CEDR Call 2012 "Road owners adapting to Climate Change" the Project CliPDaR ("Design guideline for a transnational database of downscaled climate projection data for road impact models" (long title)) refers exclusively to the objective "A.1 – Review, analysis and assessment of existing (regional) Climate Change projections regarding transnational highway networks (TEN-T) needs". Regarding the questions of this objective the project CliPDaR is engaged in

- Assessment of statistical/dynamical downscaling: to facilitate a proper procedure that deals with the uncertainties of the future climate with respect to the needs of future budgets and maintenance issues
- Assessment of ensemble simulations and climate projections as well as the definition of a pragmatic data provision for decision making
- Assessment of return periods of e.g. cold winters or hot summers.

Because of the given short time line a provision of data is not foreseen within the frame of this project and emphasis is given to the results from already ongoing projects, in particular VALUE and KLIWAS, to contribute to a paper of recommendations for the involved national road agencies. The mission of CliPDaR is to issue a guidebook setting a standard regarding data and methods that shall serve as a basis for pan-European traffic infrastructure risk assessments.

2 Introduction

Sound road related infrastructure is of upmost importance to the economy as well as to people. The supply with daily goods or public health care for instance relies on the trafficability of road networks all year long. Today about 70% of the total freight is carried across roads and this number is expected to increase significantly in the decades to come. The volume of traffic is estimated to grow by 85% of its current value within the next 25 years. Aside from this enormous growth there are still other factors to be considered in the future like changes in climate, demography, demand and technology. All these changes will affect the road infrastructures like the surfaces, the substructures of roads, bridges or tunnels. Such future maintenance and reinforcement works needs to be planned far-sighted. Rutting of asphalt surfaces or ’blow ups’ of concrete roads are safety issues. They are related to heat days together with tropical nights, which may become more frequent in the future. Longer and more frequent heat waves will also affect e.g. bridges and become a growing concern. Changing precipitation patterns and displacements in the storm climate (median and variance) may state new challenges to drainage systems and slope support (windthrow, hail, torrents of sludge, etc.).

The following Sections refer to the main points raised above (i to v), highlight the available expertise and highlight the strategic steps of CliPDaR.

3 *Infrastructure and climatic threats: databases & methods*

3.1 *Infrastructure*

Bridges, tunnels, supporting structures, through constructions, slope protection measures, road surface, drainages, pump systems, etc. are all part of the stationary infrastructure belonging to the European road network. There are non-stationary or temporarily stationary infrastructures too (signal lights, mobile construction supplies, etc.), but they are not of first concern for CliPDaR. Some projects of the AdSVIS programme have already dealt with single infrastructure elements and findings gained there will be processed in CliPDaR. Table 1 lists infrastructure elements and relates them to climatic phenomena that potentially harm them. Within CliPDaR there is a Workshop to be conducted in Vienna at ZAMG (May 2013) at which Austrian and German Road Authorities will participate and formulate their requirements. The Workshop intends to identify road infrastructure of upmost importance and appending climate elements that control the damaging mechanisms. The following topics will be touched at the workshop in Vienna as well: climate change projections; the impact of climate related events; natural hazards and their link to road elements; the spatial-temporal resolution of the needed data; the impact models used by the road authorities; the road related datasets; how road authorities make use of climate data; etc.

3.2 *Meteorological threats*

The climatic phenomena causing damages to the road infrastructure elements are to be identified. The extent of the phenomena varies in space (from just hectares to ten thousands of square kilometres) over Europe and time (from hours to weeks and there is a seasonal cycle dominating the occurrence of the climatological threats as well as variation on longer timescales as decades for example). Sometimes the damage is caused by just one phenomenon (e.g. hail) and sometimes it is the coincidence of two or more events (e.g. heavy precipitation after a dry spell or high winds after a snow fall or freeze-thaw cycles together with long lasting precipitation) that harms road infrastructure. As already mentioned above – within CliPDaR there is a Workshop to be carried out at the ZAMG, which will focus on road infrastructure, climatic hazards and damage causing mechanisms. Some examples for climatological events possibly causing damages are also given in Table 1.

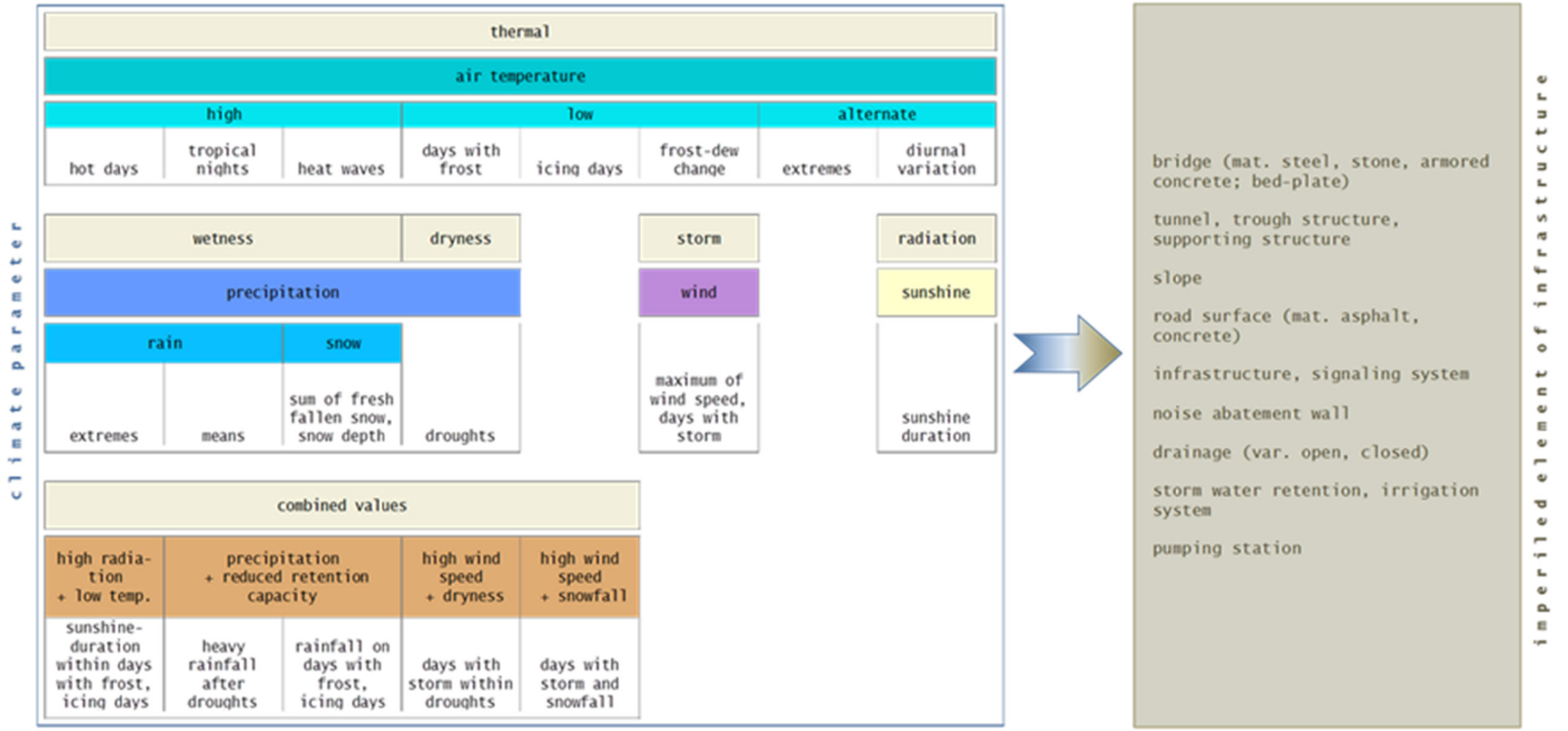

Table 1: some infrastructure elements and climatological threats causing financial and other loss.

3.3 Climate Datasets

3.3.1 Reference Data

One of the first goals of CliPDaR is the identification of homogeneous datasets covering large regions of Central Europe. This is a central requirement to derive comparable adaptation measures/emergency plans all over Europe regardless of borders between different countries.

There is a number of datasets on hand describing the present day climate. They are different in timescale (time step – days, months, seasons – and covered period), different in spatial scale (two or three dimensional, global, continental, regional, local) as well as different in the climatological parameter(s) comprise. The NCEP/NCAR Reanalysis datasets (Kalnay et al., 1996) are well established in the climate community. They reach back to 1948 and picture climatological fields (air temperature, precipitation, etc.) on a three dimensional grid through the atmosphere and the oceans over the whole Earth. Related Reanalysis datasets are the ERA40 (1958–2002; Compo et al., 2011) and ERA interim (1989–2008) data (Uppala et al., 2005; Dee et al., 2011), which extend over the globe as well. Other datasets just focus on real observations and do not make use of weather forecast models to assemble the data onto a three dimensional grid. As such they are often site/station based. The HISTALP dataset (Auer et al., 2007) for instance provides *homogenized* (meaning errors from e.g. gauge displacements are considered) station data for a list of climate parameters (temperature, precipitation, pressure, hours of bright sunshine and cloudiness) at about 200 sites within the Greater Alpine Region (GAR) in Central Europe. HISTALP contains monthly time series across GAR that reach (at some sites) back to 1760. Daily data at Austrian stations are collected in the so called STARTCLIM dataset (Schöner et al., 2003) which comprises temperature and precipitation readings at about 60 stations. Most data are available from 1960 onwards as many handwritten records referring to prior periods were destroyed during WWII. Regarding Austria there are further data on hand. Some of them were recently generated in other research projects. The DISTURBANCE dataset (Lexer et al., 2013) covers the period 1980–2010. It provides data on a 4 km-grid that is in close match with the Austrian forest inventory grid (Gabler and Schadauer, 2008) and contains daily time series of temperature (minimum, mean, maximum), precipitation totals, vapour pressure deficit and global radiation. For Central Europe the HYRAS dataset (Rauthe et al., 2013) provides daily estimates of air temperature, precipitation and global radiation on a 5-km-grid (the so called "KLIWAS-grid").The following Table gives an overview of data on hand (reference data and climate projections):

data set	Time period	spatial resolution	region
NCEP/NCAR	1948 – present	e.g. 2.5 degree grid	Worldwide
ERA40	1958 – 2002	e.g. 2.5 degree grid	worldwide
HYRAS	1961 – 2010	5 km	Central Europe
HISTALP	1760 – present	Station based	GAR/Central Europe
StartClim	1960 – present	Station based	Austria
DISTURBANCE	1980 – 2010	About 4 km	Austria
KLIWAS	1960 – 2100	5 km	Central Europe

Table 2: Datasets that may be potentially used within CliPDaR

3.3.2 Climate Projections

Climate change studies are based on assumptions how people may impact the planet in the future. As it is hard to tell how mankind may evolve, guesses are made. These are related to the energy consumption, the cultural interchange, the demographic evolution of mankind and so on. Such scenarios picture possible future developments corridors. In many applications it is best to consider a set of rather distinct scenarios which can be expected to cover a broad range of possible futures.

The below Figure plus the comments are taken from the IPCC homepage (http://www.ipcc.ch) since they are standardized products.

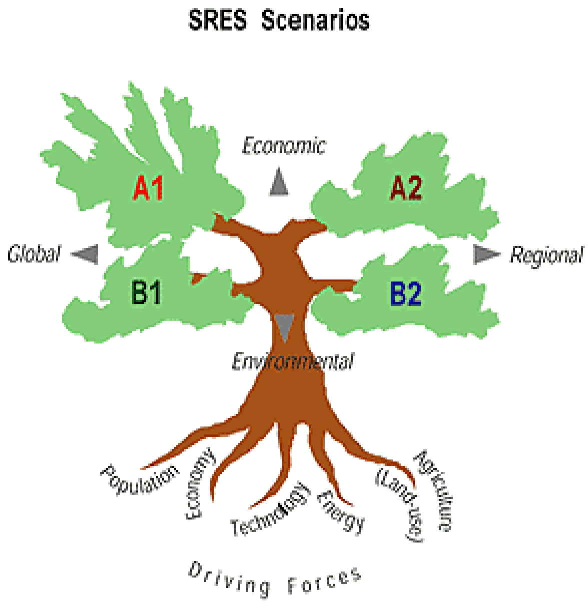

Figure 1: Schematic illustration of SRES scenarios (IPCC, 2000). The four scenario "families" are shown, very simplistically, for illustrative purposes, as branches of a two-dimensional tree. The two dimensions shown indicate global and regional scenario orientation, and development and environmental orientation, respectively. In reality, the four scenarios share a space of a much higher dimensionality given the numerous driving forces and other assumptions needed to define any given scenario in a particular modelling

approach. The schematic diagram illustrates that the scenarios build on the main driving forces of GHG emissions. Each scenario family is based on a common specification of some of the main driving forces.

The **A1** storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B). The A1B scenario is characterized by balanced energy consumption from all energy sources. Furthermore it is assumed that the appendant techniques improve evenly (effectiveness, environmentally friendly). The **B1** storyline and scenario family describes a convergent world with the same global population that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid changes in economic structures towards a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives.

These scenarios are then entered into so-called Global Climate Models (GCMs) which are mathematical based approximations of the climate system of the Earth. The outputs of GCMs (calculated at Climate Computing Centres, as e.g. the German one (DKRZ), located in Hamburg) are simulated processes within the climate systems (called ‘projections’ in contrast to (weather) predictions) which are triggered by hypothetical evolutions of mankind (the aforementioned scenarios).

The KLIWAS dataset (A1B, see below Table 3) covers the hindcast period (from about 1960 onward) and provides a broad range of meteorological data for Central Europe[1] at a grid of 5 km spacing for the surface as well as for several pressure levels. There are substantial deviations from station based observations (which enter the model chain at its beginning). However, the KLIWAS dataset provides variables that are physically consistent among each other (e.g. no precipitation without clouds), which is not necessarily the case for the DISTURBANCE dataset (as the generation of data was based on interpolation strategies that are not synchronized between the different climatological variables.

[1] here: Germany and his catchment areas of the main rivers (e.g. Rhine, Danube, Elbe)

3.4 Mathematical downscaling tools

GCM projections are to be interpreted on a continental scale (e.g. von Storch et al. 1993, Johannesson et al. 1995) meaning that a projected 2-degree increase for the next half century over Europe does not tell what may happen in the Danube valley. Typical findings of GCM projections indicate that the warming of the lower troposphere (warming is found in all projections, regardless of the forcing scenario which are pictured in Figure 1) is more pronounced at high latitudes as around the equator and more distinct over the continents than over the oceans (see Figure 2 for an example).

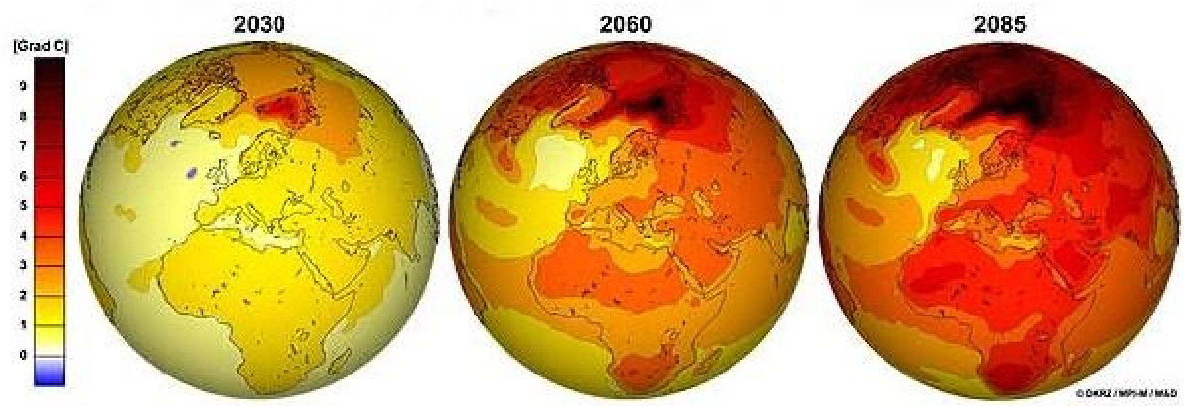

Figure 2: Increasing temperatures as simulated by the ECHAM5 GCM and forced by the A1B emission scenario

GCM projections depend on the emission scenarios and so do the changes of the two metres temperature. There are spatial differences too. Generally there is more warming at high latitudes and over the continents. This pattern emerges in the near future (2020-2050) in almost all simulations. The temporal strength (the rate of warming) of this broad pattern depends on the emission scenario later in this century.

CliPDaR aims at answering questions related to the interplay (i) between the current climate and road damages as well as (ii) between a possible future climate and potential damages of road infrastructure. GCM scenarios do not meet the requirements to address this topic area. This is mainly due to the fact that the needed data to assess the road infrastructure have to describe the local climate along roads, not the climate at a continental scale, which GCMs do. GCM data do not refer to the detailed scale of local areas. The gap between the so-called 'skilful' scale of the GCMs (meaning continents) and the scale needed by impact modelling (road networks) can be closed by '*Downscaling*' (von Storch et al. 1993). Downscaling cascades the information from the GCM scale down to the regional or local scale of ecosystems, infrastructures etc. Downscaling approaches can be broadly separated in two branches. The first one is based on regional scale physical processes within the atmosphere and further climate components (this branch is called *dynamical downscaling*). It involves Regional Climate Models (RCMs), modelling the physics of the climate system for a limited geographic area (e.g. Central Europe), running at a rather fine spatial resolution (of a few kilometres). The second approach (called *empirical or statistical downscaling*) is based on observations on the GCM scale as well as on the local scale and derives a relationship of the scales. This relationship formulates the regional climate variables (e.g. temperature at a certain place in Vienna) as a function of the large scale climate information (e.g. wind over Europe) and is used to estimate the future local scale climate (e.g. projections of the temperature at a certain place in Vienna) state from large scale GCM projections (estimations of the future climate over Europe).

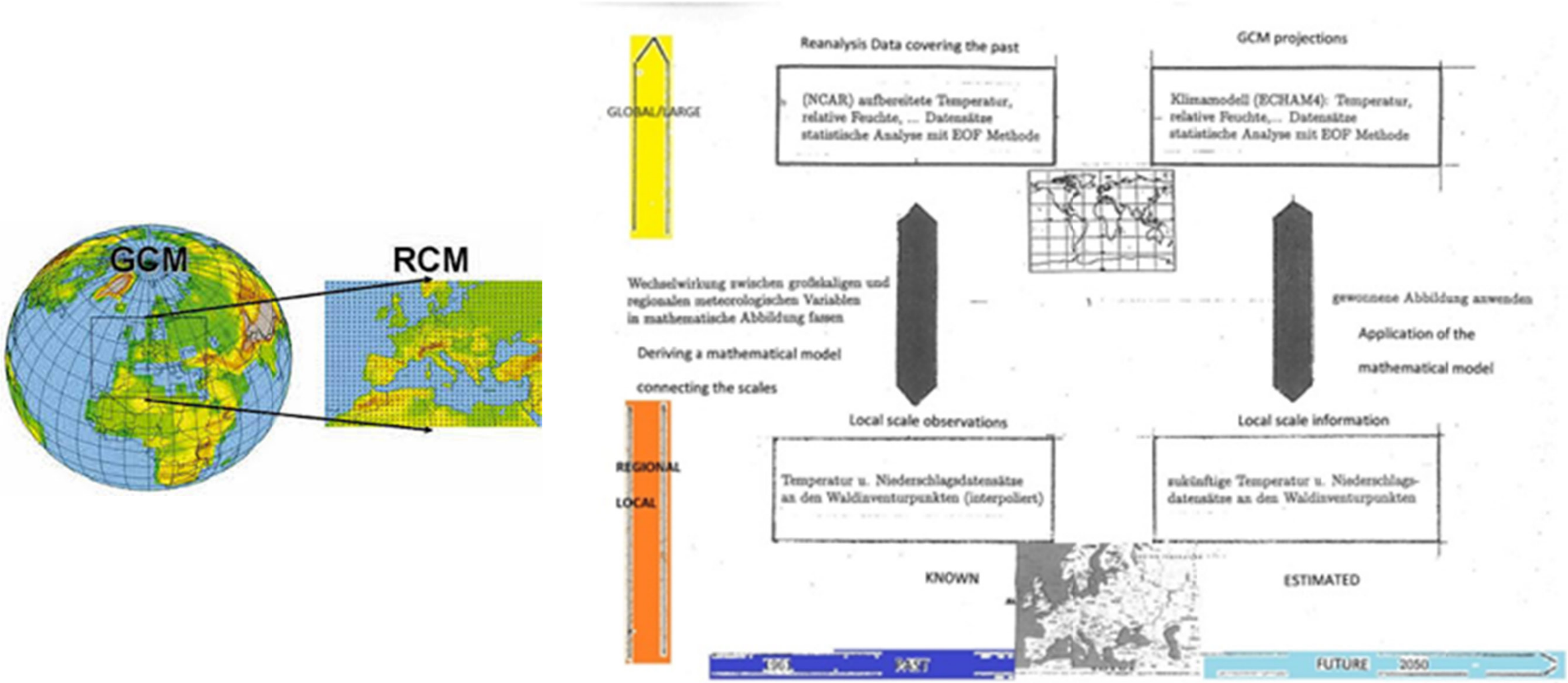

Figure 3: Schematic presentation of dynamical (left) and empirical downscaling approaches

Downscaled climate information (from the continental, European scale to the local scale of an e.g. traffic network) is the basis to develop local scale climate change scenarios of what may happen to the road infrastructure and the surrounding environment. Such scenarios are in turn the basis for planning adaptation measures to protect the traffic infrastructure against changing climatic challenges.

Before we can estimate the consequences that climate change may exert on roads, we must know the span within which – to our present understanding – regional climate changes may take place. To this end, the joint research project KLIWAS uses a multi-model '*ensemble approach*', whereby as many climate projections as feasible are created using slightly different inputs, model parameters, and model physics.

From differing socio-economic scenarios through to global and regional climate simulations and cause-and-effect models, each computed *model chain* is a so-called *ensemble-member*. Each ensemble member portrays a slightly different projection of the future world. The outputs of all model chains are known as the *span* or *span of results*; other synonyms are *bandwidth* or *spread*. This ensemble approach will be used as a profound basis for the guidelines concerning the "handling with uncertainties".
Therefore, a 19-member ensemble on the basis of the SRES-scenario A1B and dynamical downscaling is used in KLIWAS (Imbery et al., 2013). Furthermore, statistical downscaling techniques, including approved bias correction methods, are used to provide a spatial high-resolution sub-ensemble of eight climate model simulations for climate change impact studies (see Table 3).

Control run / SRES scenario / reanalysis driven run	GCM	RCM	KLIWAS ensemble
C20 / A1B	HadCM3Q0 (HC)	CLM2.4.6 (ETHZ)	X
		HadRM3Q0 (HC)	X
	HadCM3Q16 (HC)	HadRM3Q16 (HC)	
		RCA3 (C4I)	
	HadCM3Q3 (HC)	HadRM3Q3 (HC)	
		RCA3 (SMHI)	
	BCM2 (NERSC)	RCA3 (SMHI)	X
		HIRHAM5 (DMI)	
	ECHAM5-r3 (MPI-M)	RCA3 (SMHI)	
		RegCM3 (ICTP)	X
		HIRHAM5 (DMI)	X
		RACMO2 (KNMI)	X
		REMO5.7 (MPI-M)	X
	ECHAM5-r2 (MPI-M)	REMO5.8 (MPI-M)	
		CLM2.4.11 (GKSS)	
	ECHAM5-r1 (MPI-M)	CLM2.4.11 (GKSS)	X
		REMO5.7 (MPI-M)	
	ARPEGE (CNRM)	HIRHAM5 (DMI)	
		RM5.1 (CNRM)	
ERA40		CLM2.4.6 (ETHZ)	X
		REMO5.7 (MPI-M)	X
		RM4.5 (CNRM)	X

Table 3: Overview of climate simulations of (i) the years 1961-2000 for the control run (C20), (ii) projection runs for the years 2001-2100 based on the scenario A1B and (iii) Re-Analysis driven runs (ERA40) used in KLIWAS. The symbol X in the last column indicates the projections that are regionalised (via a RCM) and bias-corrected (Imbery et al., 2013).

4 Concluding remarks

One of the most central points of CliPDaR (next to the international approach that covers Central Europe) is the identification of relevant **climatic indices** that harm the road infrastructure. Based on such indices recommendations regarding the downscaling method and the datasets are to be issued. During the workshop ‘freeze-thaw’ cycles (zero temperature crossings) and periods of ice/frost-days (max/min temperature < 0) were discussed in some depth. It was mentioned that we are in need of a more flexible definition than just counting the number of e.g. frost days in a row since a one day break within a period (e.g. five frost days, one day with minimum temperature > 0, five frost days) might be of no significance. Meaning, the climate indices have to be defined by the properties of the road elements. This has to be clarified with the Road Authorities. It was mentioned that the compilation of such events should avoid any double counting (programming issue). Once the climatic indices, which are of relevance to the road sector are known, they can be derived from the KLIWAS ensemble.

Another point that was discussed refers to the 'cold winter problem': The melting ice over the Barentsea leads a manifestation of a polar height that forces humid and cold air masses to rush in from the northeast to the Central European region. As for the rather stable stratified atmosphere the relatively warming (in contrast to a state of more sea ice) does not reason a low pressure system.

The changed ice-cover affects the atmospheric circulation in a way that more humid and cold air masses are advected from the north towards Central Europe. This mechanism may be caused by a strengthening of the polar height (especially at its edge over Scandinavia) and a westward displacement of the North-Sibiric low. First attempts to explain this functioning are based on observed changes in the frequency of planetary waves. As a result such periods that may last for some weeks occur more often. Thus, winters (averaged over the three months December, January and February) in northern Europe are not as warm as global warming may suggest.

Next to the aforementioned projects (e.g. KLIWAS, VALUE) the German Adaptation Strategy (DAS), the Austrian Adaptation Strategy and the IPCC Recommendations regarding adaptation measures will be taken into account. These sources will be completed by the German Federal expert discussions "Climate impacts" and "guidelines 'dealing with climate projection data'". All these documents will be considered when preparing the CliPDaR guidelines.

The next workshop will take place at the Education and Training Centre of DWD in Langen, Germany from 3rd to 4th April, 2013. This will be the "combined workshop" (milestone M1.3) together with collegues from KNMI of the ROADAPT project.

5 Acknowledgements

The research within CliPDaR is carried out as part of the CEDR Transnational Road research Programme Call 2012. The funding for the research is provided by the national road administrations of the Netherlands, Denmark, Germany and Norway.

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Annex A: Time Schedule

Project "Climate Projection Data base for Roads - CliPDaR", "Handling of regional Climate Projections (CP) - statistical methods and interpolation techniques"

1. Workshop of DWD-ZAMG-Consortium (Milestone M1.2, based on Milestone M1.1)

Place: Offenbach (DWD-Headquarters), Germany **Time:** 25.02. until 27.02.2013

Time	Theme
25.02.2013	
10:30 - 10:45 hrs	1 **Adress of welcome** and short introduction of participants
10:45 - 10:50 hrs	2 **time schedule** of Workshop
10:50 - 11:20 hrs	3 **CliPDaR** - short introduction
11:20 - 15:30 hrs	4 **Working bases of the Consortium** - What is already existent?
ca. 11:20-12:10 hrs	4.1 ZAMG (Austrian projects based on data of CP)
ca. 12:10-13:00 hrs	4.2 DWD (Focus: KLIWAS)
ca. 13:00-14:00 hrs	*Lunch break*
14:00-15:30 hrs	4.3 Projects of BASt (with DWD-mentoring)
ca. 15:30-16:30 hrs	4.4 MUKLIMO_3 in CliPDaR?
26.02.2013	
10:00-12:40 hrs	5 **Contracts** – actual status and revision (NRA-Contract, DWD-ZAMG-Agreement)
ca. 12:40-14:00 hrs	*Lunch break*
14:00 - 16:00	7 **Statistical Analysis "hot summer/cold winter", extrem events** - Clarification of the approaches
16:00 - 18:00 hrs	6 **Guideline (GL) for utilization of statistical/dynamical CP**
16:00-16:30 hrs	6.1 CEDR-project RIMAROCC – introduction
ca. 16:30-17:00 hrs	6.2 Already existing guidelines for utilization of CP (in Germany and/or Austria)
ca. 17:00-18:30 hrs	6.3 Which contents should be provided in the GL (D1.3)?
27.02.2013	
09:30 – 10:45 hrs	8 **Roadmap for CliPDaR**
	- GL, statistical analyses
	- Design of further workshops
10:45 – 11:45 hrs	9 **Overview of data**
11:45 – 12:15 hrs	10 **Short draft of WS-minutes**
ca. 12:15 hrs	End of the workshop

Annex B: List of Participants

Name of participant	25-02-2013	26-02-2013	27-02-2013
Thomas Deutschländer, DWD		x	
Tobias Fuchs, DWD	x		
Johann-Dirk Hessel, DWD	x		
Florian Imbery, DWD (KLIWAS)	x		
Meinolf Koßmann, DWD	x		
Christoph Matulla, ZAMG + VALUE	x	x	x
Joachim Namyslo, DWD + KLIWAS	x	x	x
Sabrina Plagemann, DWD (KLIWAS)	x		
Andreas Walter, DWD	x	x	

Annex C: Road Map

No	Milestones	Due date
1	**M1.1: collecting the available knowledge and experience on statistical and dynamical downscaling (SD/DD)**	week 9 / 2013
2	**M1.2: first Workshop "Handling with regional climate projections - statistical methods and interpolation techniques" (ZAMG+DWD)**	25.-27.02.2013 (DWD, Offenbach)
3	**M1.3: combined meeting between DWD+ZAMG and the second consortium (KNMI+Deltares+SGI+egis)**	03.-04.04.2013 (DWD, Langen)
4	**M1.4: finding a common guideline for end user or fix the arguments of the different approaches**	31.05.2013
5	**M2.1: Finding out needs and conditions of road impact models**	31.05.2013
6	**M2.2: Assessment of the need to utilize ensemble climate projections for road related decision making**	31.05.2013
7	**M2.3: Overview on the available climate projections with regard to a coherent European use.**	31.05.2013
8	**M2.4: second Workshop "maintenance issues of road owners concerning climate adaptation needs" (ZAMG+DWD / National Road Agencies of Austria and Germany)**	06.-08.05.2013 (ZAMG, Wien)
9	**M2.5: Recommendation for the use of data sets**	week 26 / 2013
10	**M3.1: collecting the available statistical outcomes on return periods for certain events in climate projection data and discussion of the results**	week 30 / 2013
11	**M3.2: establish a recommendation list for maintenance issues in an uncertain climate based on the current knowledge**	week 32 / 2013
12	**M3.3: composition of final report**	week 33 / 2013

No	Deliverable Name / Report Name	Due date
1	**D1.1: report on the outcomes of the first Workshop (M1.2) and a detailed road map of the project**	week 13 / 2013
2	**D1.2: report on the outcomes of the combined meeting (M1.3)**	week 17 / 2013
3	**D1.3: guidelines for the use of SD/DD results as input for impact models**	week 26 / 2013
4	**D2.1: report on the outcomes of the second Workshop (M2.4)**	week 22 / 2013
5	**D2.2: guidelines on ensemble climate projection data**	week 30 / 2013
6	**D3.1: guidelines for coping with relatively cold winters/hot summers (or return periods of extremes)**	week 31 / 2013
7	**D3.2: final report**	week 34 / 2013