EUROPEAN COMMISSION
JOINT RESEARCH CENTRE
Institute for Environment and Sustainability

ANNEX I TO CONTRACT …….

Climate of the Carpathian Region

Technical Specifications

(Contract Notice OJEU 2010/S 110-166082 dated 9 June 2010)

Table of Content

List of Figures

List of Tables

1. Introduction

The Carpathian Mountains represent the longest and most fragmented mountain chain in Europe. They include parts of the territory of the Czech Republic, Slovakia, Poland, Hungary, Ukraine, Romania and Serbia. A characteristic feature of its landscape is a fragmented land use pattern, with relatively large forest patches intertwined with a small scale pattern of other land use types such as grasslands, pastures, agriculture and urban settlements (UNEP, 2007). The Carpathian Mountains together with their surrounding plains represent a geographic link between northern European and southern European ecosystems and provide important habitats for flora and fauna. In fact, they are characterised by an exceptional richness of plant and animal species (Oszlányi et al., 2004). The area is inhabited by about 18 million people of different nationalities and ethnic groups with long standing cultural traditions. The importance of this region is underlined by the Framework Convention on the Protection and Sustainable Development of the Carpathians signed in 2003 that to-date has been ratified by seven countries (The Carpathian Convention, 2003). Today, the region as a whole faces rapid environmental, social and political changes that could threaten the natural and cultural heritage and potential of this area (UNEP, 2007).

Due to its geographical position between continental and the Mediterranean climates and due to orographic effects, the climate of the Carpathian Region (Carpathian Mountains and Basin, Transylvanian Depression and surrounding areas) is characterised by a small scale pattern. Climate change is expected to result in important changes in the Carpathian climate, with consequences on natural ecosystems and human societies in the mountains and surrounding plains (e.g., Bartholy et al. 2007, 2008, 2009). As the mountains provide an important source of water for the Danube, the Dniester, and the Vistula rivers and their tributaries, changes in the climate of the area will have important impacts not only on the mountain ecosystems, but also on human activities in the whole downstream region that could, for example, be threatened by more frequent and intense floods or droughts (e.g., Pongracz et al., 2009; Bartholy and Pongrácz, 2007; Lehner et al., 2006).

The objective of the contract is to investigate the detailed temporal and spatial structure of the climate of the Carpathian Region[1], using unified or at least comparable methods. The resulting climatology and digital climate atlas shall provide a basis for studies of regional climate variability and regional climate change as well as for studies in applied climatology. A first application will be the study of drought events in the frame of the European Drought Observatory (EDO, see section 1.2). An extension to the entire South-East European region is under consideration in the longer term.

First steps towards the preparation of a climate atlas for south-eastern Europe (including several countries relevant to the Carpathian region) have been taken with the Summer School on the Preparation of a Climate Atlas, organised by the Hungarian Meteorological Service in 2007. Further information on the summer school as well as national reports of the participating countries can be found at the Summer School's web site[2].

[1] Carpathian Region: in the context of this tender the term 'Carpathian Region' comprises the Carpathian Mountains including the Transylvanian Depression, the Carpathian Basin, and surrounding areas. See also Section 1.3

[2] http://www.met.hu/pages/seminars/seeera/index.htm

1.1. Carpathian Climate and Climate Change

The climate of the entire Carpathian Mountains arc is temperate-continental, with more extreme conditions (continental climate) increasing as one moves from west to east. Temperature, precipitation and wind (major climatic indicators) change with altitude. The high mountain zone has a cold and moist climate with temperatures from +2°C to -2°C and precipitation between 1,800 to 2,000 mm/year in the Northwestern Carpathians. In the Eastern, Southern, and Southeastern Carpathians, precipitation ranges from 1,400 to 1,600 mm/year. The highest quantities of precipitation in the Carpathians are recorded in the High Tatra Mountains with 2,000 to 2,400 mm/year. Snow cover is present 150 to 220 days of the year in the high mountains. Currently, some small perennial patches of snow do occur in the Tatras, as well as in the Rodna Mountains. The area of perennial snow is, however, shrinking due to rising average annual temperatures, an apparent sign of climate change in the region (UNEP, 2007).

The Carpathian Mountain chain also functions as an important obstacle to the circulation of air masses over Europe. By their position, the Carpathians act as a barrier between the harsher continental climates of the east and the milder, oceanic ones in the west, as well as between boreal climates in the north and Mediterranean climates in the south. These general characteristics vary in terms of radiation and the circulation of air masses, directly reflected in plant associations and in soils, and indirectly in all the natural components of the mountainous environment. (UNEP, 2007)

July temperatures vary with altitude from 20°C at the southern edge of the Carpathians and 18°C in the north to 6°C on the highest peaks. With temperature ranging from -3°C to -10°C, the variation is smaller in winter. The number of days with temperatures above 0°C fluctuates between 290 and 100 per year, and the number with temperatures above 10°C varies from 180 days in the south to 80–100 days at the upper limits of grain cultivation and to 50 days in the lower meadow belt. Annual precipitation varies from 600 to 1,600 mm and is mostly between 900 and 1,200 mm, depending on altitude and local conditions. The basins of the upper Teresva River and Tereblia River receive the largest amount of precipitation, while the intermountain depressions are relatively dry. Most of the precipitation occurs in June and July and the less, in January and February. In general, almost two-thirds of the precipitation comes in the warmer half of the year; hence summers are quite cloudy, and winters are sunny. Like all mountain climates, the climate of the Carpathians is subject to many local variations: the weather of the northern slopes differs from that of the southern slopes, gentle Föhn winds occur in some parts, and temperature inversions occur in wintertime when the air is warmer on the slopes than in the valleys, which are filled with heavier, cold air (Kubijovyč, 1984).

The Fourth Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) confirms the trend of rising global temperatures. The last decade of the 20th century is considered to be the warmest since instrumental observations began in the nineteenth century. Such a temperature increase will result in the modification of altitudinal belts, mainly in the possible extension of the temperate forest realm.

Global warming has intensified extreme phenomena such as torrential rainfalls, lengthy droughts and sudden snowmelt. Such extreme phenomena, along with enhanced erosional processes, landslides and floods are often further augmented by deforestation in various Carpathian areas (UNEP, 2007). An increase in the frequency and intensity of floods and droughts in the area will have serious impacts on settlements, transportation

and agriculture. Lehner et al. (2006) demonstrate the probability for an increased frequency and intensity of serious droughts in the whole Carpathian area.

1.2. Background Information on EDO

Recent experience and studies underline the impact of drought events on environment, society, and the economy in Europe. In addition, climate change predictions indicate considerable changes in the water balance throughout Europe, with an increased likelihood for summer droughts in the Mediterranean, and Central and South Eastern Europe. However, other regions in Europe are also likely to experience changes in the annual distribution of precipitation as well as in their energy and water balances, resulting in an increased likelihood for periods with reduced water availability.

In contrast to this situation, there is currently no consistent information available at European level that would allow the detection, monitoring, forecasting, and assessment of drought situations.

Following the recommendations of the European Commissions' Communication on Water Scarcity and Droughts[3], the JRC is developing and implementing a prototype of a **European Drought Observatory (EDO)** to provide timely and authorised information on the occurrence and evolution of drought situations in Europe as well as predictions for their likely development.

In its final form the EDO will consist of a web-based information system, integrating information from various sources and disciplines relevant to monitoring and detecting droughts throughout Europe. As drought events encompass large areas and cross-national borders, JRC will provide consistent information on the European level to the Commission, Member States and the public. Following the subsidiarity principle, the envisaged multi-scale approach will allow for the seamless integration of national and regional information of higher spatial resolution, such as that provided by National Drought Observatories, regional authorities, or local River Basin Authorities.

With this approach the European Drought Observatory will foster exchange with and between Member States and their competent authorities, and will allow the user to move easily between overview, regional and local scales and to access the appropriate detail of information. The European Drought Observatory will contribute to preparedness and public awareness within an integral approach to risk management of natural hazards.

In the JRC context, the European Drought Observatory can take advantage of the experience gained in the development of the **European Flood Alert System (EFAS)**, the **European Forest Fire Information System (EFFIS)**, the **European Soil Data Information System (ESDIS)**, and the project on **Monitoring Agriculture by Remote Sensing (MARS)**.

The development of the EDO started with the set up of a basic infrastructure at JRC, consisting of a first internet-based EDO Map Server (http://edo.jrc.ec.europa.eu/), providing various layers of information relevant for drought monitoring. In a next step, a few pilot Member States, in collaboration with JRC, will develop mechanisms to integrate information produced by their national drought observatories with the continental information as produced by JRC. The integration will include the agreement on a common set of basic drought indices to be produced on both the overview and on

[3] (COM(2007)414final)

the more detailed national level, as well as a common data format and transfer mechanism for drought relevant information over the internet. The Drought Management Centre for South-Eastern Europe (DMCSEE), based at the Environment Agency of Slovenia (EARS) is one partner in this development and a collaboration agreement between EARS and JRC has been signed recently.

1.3. Area of Interest

The spatial area of interest for the present contract includes the Carpathian Mountain Chain (including the Transylvanian Depression), the Carpathian Basin (i.e. the Pannonian Depression), and adjacent areas, necessary to study the climate of the area. This includes part of the territory of the following countries:

Bulgaria, Czech Republic, Croatia, Hungary, Moldova, Poland, Romania, Serbia, Slovakia, Ukraine.

For the production of the digital climate atlas, the resulting climatological grids should cover the area between latitudes 50°N and 44°N, and longitudes 17°E and 27°E, approximately. An overview of the area is provided in Figure 1 below (from UNEP, 2007, p. 19).

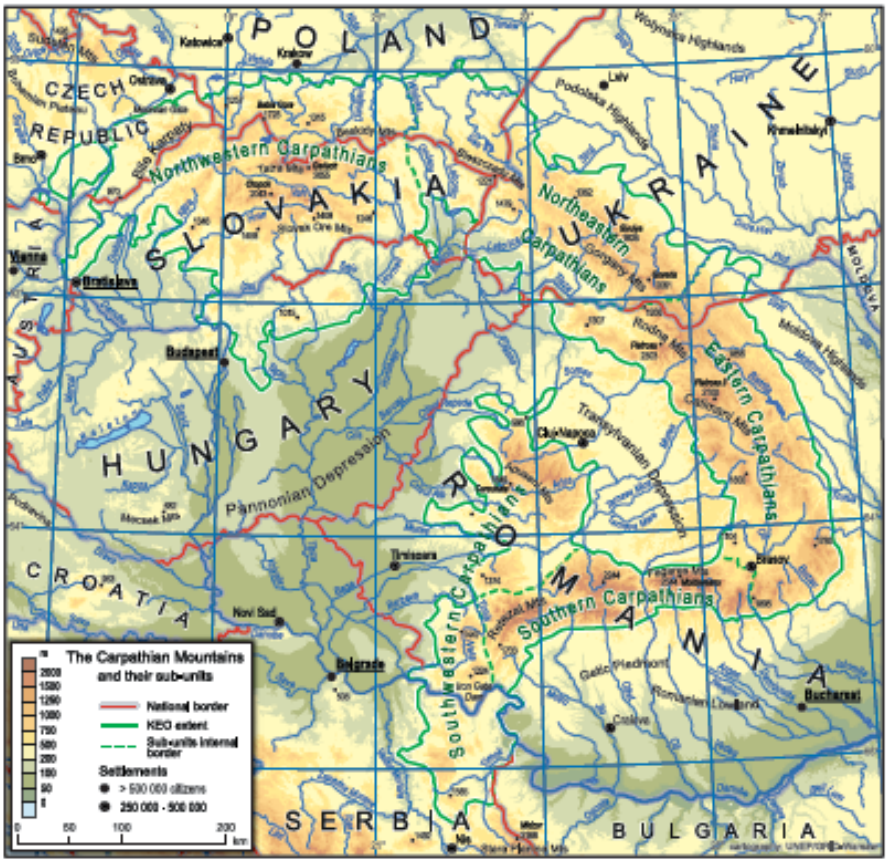

Figure 1: The Carpathian Mountains and their sub-units.

2. Purpose and Context of the Tender

2.1. Nature of the Services to be provided

2.1.1 Overall Objective of the Tender

The main aim of the service is to improve the basis of climate data in the Carpathian Region for applied regional climatological studies such as a Climate Atlas and/or drought monitoring. The service will investigate the fine temporal and spatial structure of the climate in the Carpathian Mountains and the Carpathian basin with unified or at least directly comparable methods. Currently, there is no valid description of the climate of the Carpathian Region.

The service will improve the digital data basis at national meteorological services in the Carpathian region, and will facilitate access to derived climatological datasets by the wider scientific community.

2.1.2 Specific Objectives of the Tender

The services can be divided into three modules:

Module 1: Improve the availability and accessibility of a homogeneous and spatially representative time series of climatological data for the Carpathian Region through data rescue, quality control, and data homogenisation.

Module 2: Ensure Carpathian countries data harmonisation with special emphasis on across-country harmonisation and production of gridded climatologies per country.

Module 3: Develop a Climate Atlas as a basis for climate assessment and further applied climatological studies as well as for drought monitoring in the Carpathian Region in the frame of the European Drought Observatory.

Further details of the service modules are given in section 3 of the present specifications.

2.1.3 Nature of the Services – Summary

General Conditions

The contractor has to have full access to national meteorological databases at the national meteorological services of the countries of the Carpathian Region as defined in section 1.3.

A minimum of five of the ten countries listed in section 1.3 has to be included in the offer in order to be considered. A larger number of included countries – up to ten – of the wider Carpathian region will be judged a competitive advantage.

All communication of the contractor with JRC will be done in English. All deliverables, the public web site, product descriptions and metadata catalogues will be written in English.

For the territory covered by the contract:

Module 1

- Data rescue and digitisation of analogue datasets of climate observations
- Quality checking including data gap elimination of existing climate timeseries
- Homogenisation of existing climate timeseries

Module 1 will produce high quality climate observation time series per country, including a metadata catalogue documenting the existing homogenised datasets. Ground observation time series at national meteorological services are required to be quality checked, corrected, extended (where necessary), and homogenised, but stay within the authority of the national meteorological services. Quality checking and homogenisation procedures, together with corresponding metadata of the improved datasets, however, are required to be published without limitation.

Module 2

- Cross-border harmonisation of climate observation time series produced in module 1
- Spatial interpolation into gridded datasets per country

Module 2 will produce national gridded datasets of climatological timeseries derived from high quality observation timeseries as produced in Module 1, including a cross-border exchange of observations in order to harmonise datasets across national borders. National gridded datasets stay under the authority of the national meteorological services, but have to be made available to the Commission for unlimited internal use. Metadata of the national grids have to be published without limitations.

Module 3

- Production of a Climate Atlas of the Carpathian Region
- Publicly accessible dedicated web site of the Climate Atlas, including a web map server and data download/access infrastructure
- Freely available gridded climatological datasets
- Searchable metadata catalogue for the Climate Atlas

Module 3 will produce a harmonised climatology for the Carpathian Region, derived from national datasets as produced in Modules 2 and 3. The climatology will be freely available through a dedicated web site.

2.1.4 Duration of the Service and proposed Work Schedule

The overall duration of the service is 35 months (24 months of service and 11 months of web-site hosting of the Carpathian Region web-site]), starting from the last signature of contract.

Figure 2 gives an overview of the timing and a proposed work schedule of the three modules.

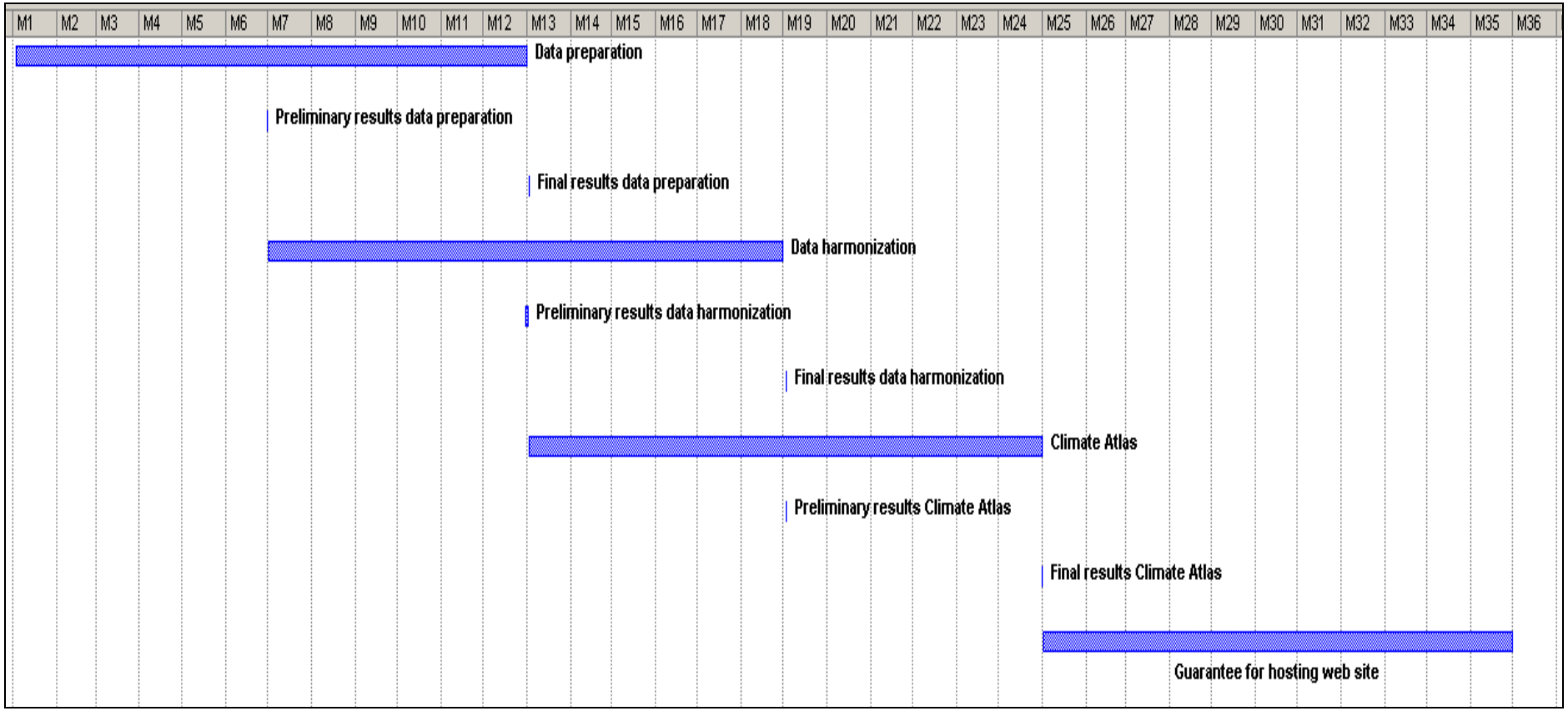

Figure 2: Proposed timeline for the service.

2.2. Meteorological Data Specifications

The climatological observation time series data to be processed in the service shall refer to climatological datasets of past and existing networks for each country of the region included in the service. Being climatological datasets the time period covered shall refer to a minimum of 30 consecutive years within the period of 1970 to 2010. Any additional period after and before this 30 years period will be considered as a competitive advantage.

The minimum set of variables to be processed is presented in Table 1 below. Consideration of more meteorological parameters will be considered as a competitive advantage during the evaluation.

Regarding the average density of the observation stations within the study region as defined in section 1.3, following recommendations of WMO[4], and taking into account the findings of the Summer School on the Preparation of a Climate Atlas organised by the Hungarian Meteorological Service in 2007[5], a minimum density of ca. 1 station in 25 km x 25 km for precipitation and ca. 1 station in 50 km x 50 km for air temperature shall be achieved. The remaining variables shall have a density of not less than ca. 1 station in 50 km x 50 km on the average. Lower average station densities for single parameters and/or for extended areas within the study region must be justified with evidence that no observations exist. A higher density of stations than required will be considered as a competitive advantage during the proposal evaluation.

As the density of observations decreases with increasing length of observation into the past, the requirements of station density apply only to the minimum period of 30 years within 1970 and 2010 as mentioned above.

Table 1: Minimum set of meteorological variables in daily temporal resolution to be provided.

Variable	Description	Units
T_a	2 m mean daily air temperature	K
T_{min}	Minimum air temperature from 18:00 to 06:00	K
T_{max}	Maximum air temperature from 06:00 to 18:00	K
p	Accumulated total precipitation from 06:00 to 06:00	mm
DD	10 m wind direction	Degrees (0-360)
VV	10 m horizontal wind speed	m/s
Sunshine	Sunshine duration	hours
cc	Cloud cover	octas

[4] WMO Guide to Hydrological Practices, 5th edition, 1994, section 20.2.1: "Minimum densities for climatological stations". WMO-No. 168, 269ff.
[5] http://www.met.hu/pages/seminars/seeera/index.htm: National Reports from Hungary, Romania, Serbia, and Croatia (among others).

Variable	Description	Units
R_{global}	Global radiation	$MJ/m^2/day$
RH	Relative humidity	%
p_{vapour}	Surface vapour pressure	hPa
p_{air}	Surface air pressure	hPa
Snow depth	Snow depth	mm

2.3. Data Rescue, Quality Control, and Data Homogenisation

In order to produce a consistent climatology for the Carpathian Region, underlying national datasets will need to be quality checked and (where necessary) homogenised. Data rescue and digitisation has to be performed where observations are available in analogue format only.

The COST Action ES0601 on "Advances in homogenisation methods of climate series: an integrated approach (HOME)"[6] focuses on methodologies that will need to be considered for the service. The COST Action runs from 2007 to 2011 with the objectives to:

- provide practical rules for the implementation of homogenization;
- provide tools for comparison and evaluation of different methods;
- analyse the strengths and weaknesses of the methods for different applications; and,
- provide methods for evaluating uncertainties resulting from homogenisation.

Members of the COST Action ES0601 include representatives from Czech Republic, Hungary, Romania, Serbia, and Poland, among many other countries in South East Europe, and hence cover the Carpathian Region.

Existing data quality control and homogenisation methodologies available in existing tools such as the AnClim and ProClim software tools[7] developed by P. Stepanek are an important reference of the current "state of the art" for the tasks foreseen, behind which proposed methodologies shall not fall.

Climatological datasets for the Carpathian Region have to be produced from national datasets. In order to produce national climatologies that are consistent with and harmonised to those of neighbouring countries, adjacent observation stations need to be exchanged and taken into consideration for the production of national climatologies.

2.4. Climatologies

In the frame of this contract, the climate of the Carpathian region will be described by the creation of climatologies of defined meteorological variables (see Table 1 in section 2.2), their mapping and analysis. Under the term climatology we understand the

[6] ACTION COST-ES0601: Advances in homogenisation methods of climate series: an integrated approach (HOME). http://www.homogenisation.org/

[7] Software Package for Processing Climatological Data. Technical support page for the software package AnClim + ProClimDB + LoadData. http://www.climahom.eu/

statistical evaluation of long meteorological time series of at least 30 years in order to calculate climatological means, to analyse extreme values, and to describe the temporal and spatial patterns of the defined meteorological variables as well as of derived indicators. Such analysis will provide important baseline data for the study of the spatial and temporal characteristics of the climate of the Carpathian Region and indications for estimating ecological and economic risks. It further provides a basis for the study of trends and potential climate change impacts (e.g., for agriculture, transport, housing).

The calculation of climatologies in the modules 2 and 3 of the service will have to include the following steps:

- interpolation of daily data onto a regular grid covering the entire area;
- calculation of monthly, yearly, and long-term statistics (mean, median, probabilities, etc.) from the daily grids;
- analysis of extreme values (minima, maxima, frequencies, etc.);
- calculation of indicators (e.g., frequency, intensity, duration) for meteorological events such as droughts, frosts, hail, extreme rainfall, and snow cover.

The interpolation scheme to be used for each variable will be proposed by the contractor, based on the spatial density of the data available and the characteristics of the variable. It will follow state-of-the-art practices; e.g. Dobesch et al. (2007) for the results of the COST Action 719 on "The use of GIS in climatology and meteorology" or Lanciani and Salvati (2008) for results of the INTERREG IIIB project FORALPS.

Best-practice rules in climatological studies that should be followed in this service have been described in the WMO Guide to Climatological Practices (WMO, 1983 and WMO, 2010).

2.5. Drought Indices

The impact of drought events can be severe to nature, economy, and human well-being. In addition, climate change will probably increase the risk of drought events in Europe. The European Commission has highlighted the importance of droughts to society in the Communication on Water Scarcity and Droughts in 2007[8]. As one of the follow-up measures of the Communication, the Joint Research Centre is developing a prototype of a European Drought Observatory (EDO) until 2012. The Preparatory Action on the Climate in the Carpathian Basin will feed into the development of EDO and its results will serve as an important basis for reliable climate background information in South-East Europe.

Drought indices are important tools to detect, monitor, and assess drought events. They are extensively used within the European Drought Observatory to give a comprehensive picture of droughts in Europe. Drought indices can be computed from various data sources, of which observational data are the most common.

Meteorological drought indices are produced from meteorological and climatological observations, model simulations, or forecasts. A meteorological drought is usually the first step into drought propagation through the entire hydrological cycle and therefore of

[8] COM(2007)414final

outstanding importance to drought monitoring. In fact, the lack of precipitation is usually the predominant – albeit not the only – factor triggering a drought event. The Standardized Precipitation Index (SPI, McKee et al. 1993) is a widely accepted meteorological drought index and has recently been recommended in the Lincoln Declaration of a WMO Drought Workshop[9]. The SPI is produced regularly within EDO, and also within the Drought Monitor of the Drought Management Centre of South East Europe (DMCSEE)[10]. Both EDO and DMCSEE, however, produce their SPI estimates from continental-scale datasets with a large spatial coverage, and low density of stations.

Other examples of meteorological drought indices are the Palfai Aridity Index (PAI, Palfai 1991), the Reconnaissance Drought Index (RDI, Tsakiris et al. 2007), or the Standardized Precipitation Evapotranspiration Index (SPEI, Vincente-Serrano et al. 2010). An overview of existing and new drought indices can also be found e.g. in Niemeyer (2008).

The climatology to be produced within this service will act as a very valuable base for the derivation of meteorological drought indices for the Carpathian Region. The contractor will demonstrate this potential by producing meteorological drought indices from the harmonised datasets of this service. The contractor shall propose a set of meteorological drought indices to be produced and published within the dedicated web site of the Climate Atlas of the Carpathian Region. The SPI and the PAI serve as the minimum set of drought indices to be derived. The production of more drought indices will be considered a competitive advantage during the proposal evaluation.

2.6. Spatial Information Infrastructure for Europe - INSPIRE

In order to ensure the success of the project, deliverables (in term of datasets, services, metadata formats and metadata catalogues) shall be developed following INSPIRE Legislation. INSPIRE Implementing Rules (IR) shall be adopted to implement interoperability compliance. The design and the development of the atlas shall also take into account pertinent INSPIRE reports, European Standards (ENs) and International Standards, as well as best practices in the meteorological communities.

Further details are given below. All references can be found at http://inspire.jrc.ec.europa.eu/index.cfm.

2.6.1 Background

The entering into force of the INSPIRE Directive in May 2007[11] established an infrastructure for spatial information in Europe to support Community environmental policies, and policies or activities which may have an impact on the environment.

[9] Inter-Regional Workshop on Indices and Early Warning Systems for Drought, Lincoln, Nebraska, USA, 8-11 December 2009, available at: http://www.wmo.int/pages/prog/wcp/agm/meetings/wies09/documents/Lincoln_Declaration_Drought_Indices.pdf

[10] http://www.dmcsee.org/en/drought_monitor/

[11] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE); Official Journal of the

INSPIRE is based on the infrastructures for spatial information established and operated by the 27 Member States of the European Union. The Directive addresses 34 spatial data themes needed for environmental applications, with key components specified through technical implementing rules.

The Spatial Data Infrastructure Unit of JRC-IES is in charge of the technical coordination and development of INSPIRE, which is now in the Implementation Phase.

2.6.2 INSPIRE Principles

The underlying principles of the INSPIRE Directive are:

1 The infrastructures for spatial information in the Member States should be designed to ensure that spatial data are stored, made available and maintained at the most appropriate level;

2 that it is possible to combine spatial data from different sources across the Community in a consistent way and share them between several users and applications;

3 that it is possible for spatial data collected at one level of public authority to be shared between all the different levels of public authorities;

4 that spatial data are made available under conditions that do not restrict their extensive use;

5 that it is easy to discover available spatial data, to evaluate their fitness for purpose and to know the conditions applicable to their use.

2.6.3 Legislation

The INSPIRE Directive entered into force on the 15th May 2007.

To ensure that the spatial data infrastructures of the Member States are compatible and usable in a Community and trans-boundary context, the Directive requires that common Implementing Rules (IR) are adopted in a number of specific areas (Metadata, Data Specifications, Network Services, Data and Service Sharing and Monitoring and Reporting). These IRs are adopted as Commission Decisions or Regulations, and are binding in their entirety.

List of published INSPIRE Legislation:

- Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) 14.03.2007

European Union, ISSN 1725-2555, L 108, Volume 50, 25 April 2007: http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2007:108:SOM:EN:HTML.

- INSPIRE Metadata Regulation 03.12.2008[12]
- Corrigendum to INSPIRE Metadata Regulation 15.12.2009[13]
- Regulation on INSPIRE Network Services 19.10.2009[14]
- Regulation on INSPIRE Data and Service Sharing 29.03.2010[15]

2.6.4 Draft Commission Legislation

- Draft COMMISSION REGULATION implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services[16]
- Draft COMMISSION REGULATION amending Regulation (EC) No 976/2009 as regards download services and transformation services[17]

2.6.5 Implementing Rules and Draft Implementing Rules

- INSPIRE Metadata Implementing Rules: Technical Guidelines based on EN ISO 19115 and EN ISO 19119 (revised edition) 03.02.2009[18]
- Draft Implementing Rules for Download Services (version 3.0) 25.09.2009[19]
- Draft Implementing Rules for INSPIRE Transformation Services (version 3.0) 07.09.2009[20]

[12] Commission Regulation (EC) No 1205/2008 of 3 December 2008 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata (Text with EEA relevance); OJ L 326, 4.12.2008: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008R1205:EN:NOT
[13] Official Journal of the European Union, ISSN 1725-2555, L 148, Volume 52, 11 June 2009: http://eur-lex.europa.eu/JOHtml.do?uri=OJ%3AL%3A2009%3A148%3ASOM%3AEN%3AHTML
[14] Official Journal of the European Union, ISSN 1725-2555, L 274, Volume 52, 20 October 2009: http://eur-lex.europa.eu/JOHtml.do?uri=OJ%3AL%3A2009%3A274%3ASOM%3AEN%3AHTML
[15] COMMISSION REGULATION (EU) No 268/2010 of 29 March 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards the access to spatial data sets and services of the Member States by Community institutions and bodies under harmonised conditions: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:083:0008:0009:EN:PDF
[16] Brussels, 11.12.2009, D007474/02, Draft COMMISSION REGULATION. Implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services: http://ec.europa.eu/transparency/regcomitology/index.cfm?do=Search.getPDF&lA6b4z6edALEzOuvQ2DQwEuYwr24bl+u6M8oCwqlYrvB7EJR+poTzWZ/2wT/z/JFTr7x0HnynbCJdi/BzR4ZvdPpAur0FOHhej8jYcN49FA=
[17] Brussels, 23.11.2009, D007475/01, Draft COMMISSION REGULATION amending Regulation (EC) No 976/2009 as regards download services and transformation services: http://ec.europa.eu/transparency/regcomitology/index.cfm?do=Search.getPDF&cI7TwVsORn+kLl9oziBPzRrPh2gD8ZmE8tZUqV9OrP7B7EJR+poTzWZ/2wT/z/JFTr7x0HnynbCJdi/BzR4ZvdPpAur0FOHhej8jYcN49FA=
[18] INSPIRE Metadata Implementing Rules: Technical Guidelines based on EN ISO 19115 and EN ISO 19119, Date of last revision 2009-02-18, Status V. 1.1: http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/metadata/MD_IR_and_ISO_20090218.pdf
[19] Draft Implementing Rules for Download Services, Date 25-09-2009, Status Draft: http://inspire.jrc.ec.europa.eu/documents/Network_Services/INSPIRE%20Draft%20Implementing%20Rules%20Download%20Services%20(version%203.0).pdf

- Guidance on the 'Regulation on access to spatial data sets and services of the Member States by Community institutions and bodies under harmonised conditions' 27.04.2010[21]

2.7. Data Inventories

The project shall start with the contractor presenting a country-based inventory of climatological and meteorological data over the Carpathian area of interest. The datasets listed in this inventory will be the basis for all following tasks of the contract, including the creation of a regional climatology of the region.

In addition to the inventory, the contractor shall produce digital maps from the inventory information for the entire Carpathian area of interest showing for each of the variables listed in section 2.2 (Table 1):

i) the position of stations;

ii) the stations according to the length of available time series, e.g. > 50 year record, 40 year records, 30 year records;

iii) the fragmentation of data collection, e.g. percentage of continuous/interrupted time series;

iv) those stations where analogue records exist and the percentage that need to be digitised from analogue records.

The inventory shall comprise information on complementary data collection networks. These may be real-time data collection networks collecting at higher frequencies operated by the national meteorological services, but these may also be networks from other authorities, e.g. the agricultural or hydrological communities that may also hold relevant data sets. Information on these networks for the inventory shall be prepared in the same way and with the same standards as for the climatological networks.

2.8. Metadata Catalogue

An important step towards transparency of the underlying datasets that are used to create the Climate Atlas of the Carpathian Region is a metadata catalogue that describes the datasets used in this project. **All metadata created within this project shall be public and accessible from the dedicated web site of the Climate Atlas.**

The following metadata will be created:

1. Metadata of the original climate observations listed in the data inventory, per country;

[20] Draft Implementing Rules for Transformation Services, Date 07-09-2009, Status Draft: http://inspire.jrc.ec.europa.eu/documents/Network_Services/INSPIRE_Draft_Implementing_Rules_Transformation_Services_(version_3.0).pdf

[21] Guidance on the 'Regulation on access to spatial data sets and services of the Member States by Community institutions and bodies under harmonised conditions', Date 2010-04-26, Status Final: http://inspire.jrc.ec.europa.eu/documents/Data_and_Service_Sharing/INSPIRE_DSS_Guidance%20_document_final.pdf

2. Metadata of the climate datasets after data rescue, quality check, and data homogenisation, per country and including all relevant information to trace back the processing executed in order to arrive at the current datasets;
3. Metadata of national gridded datasets;
4. Metadata of all datasets and products of the Climate Atlas of the Carpathian Region.

The metadata catalogues shall comply with INSPIRE Metadata Regulation and Implementing Rules and adopt a standard metadata core profile such as e.g. the WMO Core Profile of the ISO 19115 Metadata Standard (WMO 2007[22]). In addition, for each country the metadata catalogues shall include the information listed in Table 2. The metadata listed in Table 2 are a minimum, but not an exclusive set of metadata to be collected; additional metadata collection may be decided upon during the kickoff meeting. Table 2 contains e.g. a list of stations collecting climatological data with Station-ID, latitude/longitude location, variables collected, collection frequency, start of time series and intermittent collection periods, as well as storage media and formats, etc.

Table 2: List of minimum (but not exclusive) metadata to be collected.

Column	Explanation	Units/ Character Set	Example
NAT_ID	national ID of the station	ASCII/number	NY1212
STN_NAME	station name	ASCII	Klodzko
CNTR_CD	country	ASCII	PL
NAT_NORTH	national coordinate (northing)	dd	50.438
NAT_EAST	national coordinate (easting)	dd	16.66
NAT GEOGRAPHIC PROJECTION	Parameters necessary to transform into other coordinate system	ASCII	Lat Long, Gauss Kruger, Lambert, etc
NAT_ELEV	Height in national elevation system	Meters	220
NAT_ALTSYS	national elevation system	ASCII	Baltic
DATA_PROVIDER	Name of Institute or organisation	ASCII	IES
ADDRESS_DATA_PROVIDER	Address	ASCII	Adress
CONTACT_DATA_PROVIDER_PHONE	Contact details	ASCII	Phone:
CONTACT_DATA_PROVIDER_FAX	Contact details	ASCII	Fax
CONTACT_DATA_PROVIDER_EMAIL	Contact details	ASCII, link	Email
CONTACT_DATA_PROVIDER_WEB	Contact details	ASCII, link	Web
DATA_RECORDING_TIME	For which time span the data are available and if there are interruptions in the time series	ASCII	From 1867 onwards with gaps from 1933-1945
DATA_RECORDING_TYPE	If the data are available digitally, on paper	ASCII	Automatic station, manual reading

[22] WMO Core Metadata Profile available at: http://wis.wmo.int/2006/metadata/WMO%20Core%20Metadata%20Profile%20%28October%202006%29/documentation.htm

Column	Explanation	Units/ Character Set	Example
DATA_RECORDING_MEDIA	What media the data are stored	ASCII	Digital, paper
DATA_TRANSMISSION	How the data can be transmitted	ASCII	ftp, web, paper, CD, tape
COMMENT	Comment on any field in the table	ASCII	Automatic station, missing data from 1977-1980 period
DATA_FORMAT	Digital data format type	ASCCI	GRIB,
ACCESS RIGHTS	Access right categories • No access • Restricted access for special projects after bi-lateral negotiation • European Commission use, e.g. JRC products on floods, droughts, and climate change • Research • Commercial use • Public access excluded commercial use • Public access including commercial use	ASCII	European Commission use; public access
PRICES	Prices of data for the different access right categories listed under Access rights • No charge • Handling fee • Price • Detailed conditions	Euro/year; Euro/dataset ASCII	No charge, handling fee 10% of commercial price, 0.01 Euro per data item, to be negotiated**

2.9. Intellectual Property and Third Party Rights

The Article I.12 – OWNERSHIP – of the General Conditions of the contract shall be applied in full.

2.10. Reference to Relevant Web Sites

For a better understanding of the service framework several supplementary documents or ancillary information may be of use. Publicly available supporting documents and sources of further information on the internet are given in Table 3.

The items and sites presented in Table 3 do not constitute a comprehensive list of sources of background information. The URLs are correct at the time of writing the present specifications. The JRC is not responsible for the contents of the listed websites.

Table 3: References to relevant web sites.

ITEM	INTERNET SOURCE
Policy documents	
DG Environment site on Water Scarcity and Droughts, including the Communication on Water Scarcity and Droughts COM(2007)414 final	http://ec.europa.eu/environment/water/quantity/scarcity_en.htm
Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)	http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2007:108:SOM:EN:HTML
INSPIRE Metadata Regulation	http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008R1205:EN:NOT
Regulation on INSPIRE Network Services	http://eur-lex.europa.eu/JOHtml.do?uri=OJ%3AL%3A2009%3A274%3ASOM%3AEN%3AHTML
Drought Portals	
European Drought Observatory	http://edo.jrc.ec.europa.eu
Drought Management Centre of South East Europe	http://www.dmcsee.org
Geospatial interoperability	
INSPIRE Metadata Implementing Rules: Technical Guidelines based on EN ISO 19115 and EN ISO 19119	http://inspire.jrc.ec.europa.eu/
INSPIRE Architecture and Standards Position Paper	http://inspire.jrc.ec.europa.eu/
Annoni, Luzet, Gubler, Ihde, *Map projections for Europe*, EUR 20120, 2001.	http://www.ec-gis.org/sdi/publist/pdfs/annoni-etal2003eur.pdf
European Standards for Geographic Information, CEN/TC287	http://www.cenorm.be
International Standards for Geographic Information/Geomatics	http://www.iso.org http://www.isotc211.org
Open Geospatial Consortium	http://www.opengeospatial.org
Climate Data	
ACTION COST-ES0601: "Advances in homogenisation methods of climate series: an integrated approach (HOME)"	http://www.homogenisation.org/
P. Stepanek's web site on his "Software Package for Processing Climatological Data" AnClim and ProClim	http://www.climahom.eu/
Eumetnet European Climate Support Network	http://www.eumetnet.eu/ECSN_home.htm

ITEM	INTERNET SOURCE
Eumetnet showcase EUROGRID	http://www.e-grid.eu/public/
European Climate Assessment & Dataset (ECA&D) project, supported by ECSN and Eumetnet	http://eca.knmi.nl/
Development of the WMO Core Profile of the ISO Metadata standard	http://www.wmo.int/pages/prog/www/WDM/Metadata/documents.html
Carpathian Region	
Summer School on Preparation of Climate Atlas, Sept. 2007, Hungarian Meteorological Service	http://www.met.hu/pages/seminars/seeera/index.htm
UNEP Carpathians Environment Outlook (KEO)	http://www.grid.unep.ch/activities/assessment/KEO/index.php
RTD-FP7 enviroGRIDS project on "Building Capacity for a Black Sea Catchment Observation and Assessment System supporting Sustainable Development"	http://www.envirogrids.net/
RTD-FP6 CECILIA project on "Central and Eastern Europe Climate Change Impact and Vulnerability Assessment"	http://www.cecilia-eu.org/

3. Specifications for Service Tasks

3.1. Module 1: Data Rescue, Quality Control, and Data Homogenization

For the countries covered by this contract, the contractor shall quality check and homogenise national datasets. Data rescue and digitisation has to be performed where observations are available in analogue format only. Quality check and homogenisation of data will ensure high quality climatological datasets in which detected errors are eliminated, data gaps are filled, and the consistency of observations is checked against neighbouring stations. The contractor will use state-of-the-art methodologies as documented by the World Meteorological Organisation and the COST Action ES0601 on "Advances in homogenisation methods of climate series: an integrated approach (HOME)"[23]. COST Action ES0601 focuses on methodologies that will need to be considered for the service. All recommendations produced by this Action shall be followed; if other methodologies for data homogenisation are chosen, the choice must be explained and justified in detail. Data quality control and homogenisation methodologies available in existing tools such as the AnClim and ProClim software tools[24], are considered a minimum standard to be implemented. Section 2.3 of this technical annex provides further information. The tasks to be performed under this module include:

1. Provision of a comprehensive data inventory, i.e. a list of datasets to be considered for quality check and harmonization (see section 2.7).
2. Proposal of a metadata profile for datasets in the data inventory.
3. Production of metadata of all datasets listed in the data inventory.
4. Provision of a list of proposed datasets to be rescued.
5. Proposal for a consistent methodology of data rescue and/or digitization.
6. Implementation and execution of the data rescue exercise where necessary, including the provide protocols and results of the exercise, as well as metadata of the newly created digital datasets.
7. Proposal of data quality control tests, methodologies, and software to be used.
8. Provision of test protocols and discussion of the results with JRC in order to optimize the quality control procedures through an iterative process.
9. Creation of updated metadata for the homogenised datasets, including information on the quality control and homogenisation processes performed.

[23] ACTION COST-ES0601: Advances in homogenisation methods of climate series: an integrated approach (HOME). http://www.homogenisation.org/

[24] Software Package for Processing Climatological Data. Technical support page for the software package AnClim + ProClimDB + LoadData. http://www.climahom.eu/

All data rescued and generated in this module will remain in the ownership of the organisation of origin (e.g., the national meteorological services). The metadata on these data sets will be provided to JRC and will be freely available to the public.

3.2. Module 2: Climate Data Harmonization and Production of Gridded Climatologies per Country

In the frame of this module climatological datasets for all countries covered by the service have to be produced from national climatological datasets that have been quality checked and homogenized in module 1. Cross-border data harmonisation as performed in this module is the basis to produce a seamless and consistent climatology for the Carpathian Region. This requires the exchange of adjacent observation stations and their consideration in the production of national climatologies. Findings from COST Action ES0601 on near border climatologies should be considered. Appropriate methods for spatial interpolation of point observations to gridded spatial datasets have to be proposed and applied. Details on the derivation of climatologies are given in section 2.4. The tasks to be performed under this module include:

1. Proposal of methodologies for cross-border data harmonization and spatial interpolation of harmonized datasets.
2. Documentation and presentation of preliminary results for discussion with JRC.
3. Based on the feedback from JRC methodologies will be adapted and the harmonization and interpolation exercise repeated until the achievement of high quality results.
4. Production and documentation of national gridded datasets from homogenized and harmonized climatological parameters.
5. Progress and processing protocols of data harmonization and gridding.
6. Provision of metadata for all created gridded datasets, separated by country.

The national gridded datasets will stay with the national authorities that own the underlying observation datasets. A copy of the national gridded datasets will be delivered to JRC in electronic format on CD-Rom or another suitable storage device, with restricted access for internal use within the European Commission Services.

All metadata of the gridded national datasets produced in this module will be provided to JRC and will be freely available to the public.

3.3. Module 3: Digital Climate Atlas of the Carpathian Region

The description of the climate of Carpathians Region will constitute important baseline information for climatological studies, including studies on climate change and its impacts. The importance of the area is highlighted by the fact, that it comprises a large part of the Danube river basin, with significant impacts on the hydrology of one of the biggest watersheds in Europe. The digital climate atlas will provide a database of gridded maps (meteorological variables and derived indicators) covering the whole

Carpathian Region. The minimum set of variables and indicators to be prepared and made available are listed in Table 4. Any additional gridded map prepared for the Climatology of the Carpathian Region will be judged a competitive advantage.

Table 4: Minimum set of variables and indicators to be provided for the Digital Climate Atlas of the Carpathian Region.

No	Variable/Indicator	Description	Units	Frequency
1	T	Average air temperature (2 m)	K	Daily
2	T	Average mean air temperature (2 m)	K	Monthly, yearly
3	Tmin	Minimum air temperature from 18:00 to 06:00	K	Daily
4	Tmin	Average minimum air temperature	K	Monthly, yearly
5	Tmax	Maximum air temperature from 06:00 to 18:00	K	Daily
6	Tmax	Average maximum air temperature	K	Monthly, yearly
7	Precipitation	Accumulated total precipitation from 06:00 to 06:00	mm	Daily
8	Precipitation	Accumulated total precipitation	mm	Monthly, yearly
9	u_10m_max	Maximum 10 m horizontal wind speed	m/s	Daily
10	u_10m	Average 10 m horizontal wind speed	m/s	Daily, monthly
11	u_2m	Average 2 m horizontal wind speed	m/s	Daily, monthly
12	Sunshine	Sunshine duration	hours	Daily, monthly, yearly
13	Cloud cover	Average cloud cover	octas	Daily, monthly
14	Radiation	Measured global radiation	MJ/m2/day	Daily, monthly
15	R.H.	Average relative humidity	%	Daily, monthly
16	p_vap	Mean vapour pressure	hPa	Daily, monthly
17	p_air	Mean surface air pressure	hPa	Daily, monthly
18	Snow depth	Snow depth	mm	Daily, monthly
19	Snow water	Snow water equivalent	mm	Daily, monthly
20	Frost days	Number of frost days	--	Monthly, yearly
21	Summer days	Number of days with Tmax above 25 deg C	--	Monthly, yearly
22	Hot days	Number of days with Tmax above 30 deg C	--	Monthly, yearly
23	PAI	Palfai Drought Index	--	Monthly
24	SPI-3	Standardized Precipitation Index averaged over a three-months period	--	Monthly

The temporal resolutions of the grids to be provided are given in the column "Frequency" of Table 4. The spatial resolution of the grids will be at least 10 km x 10 km. Depending on the variable a grid cell size of 5 km x 5 km should be strived for.

All grids will be part of the climatological atlas and will be freely available through a dedicated internet site. This web page will include a searchable metadata catalogue, with detailed descriptions of the underlying data, the methodologies to create the grids, and the confidence placed on the accuracy of the data.

Each gridded dataset will have to be accompanied with a climatological interpretation sheet that explains concisely the characteristics and the derivation of the data product. The interpretation sheet shall have a length of 1-2 A4 pages with a common structure for all datasets available. The contractor will propose a template of the interpretation sheets to JRC and will prepare interpretation sheets for all gridded datasets after revision and approval of JRC. These interpretation sheets will be made publically available through the internet site so that data users can get a fast overview of the characteristics of the data products offered.

The metadata catalogue including all metadata produced in all modules of the service will be a database accessible through the web site of the Climate Atlas of the Carpathian Region. A copy of the catalogue will be delivered to JRC in electronic format on CD-

Rom or another suitable storage device, together with a description of system requirements and instructions for installation.

3.4. Project Management

Project management covers all matters of project organisation, for example distribution and follow-up of tasks, communication, documentation and reporting, knowledge transfer, and quality assurance procedures.

3.4.1 Presentation of Management Plan

An overall Management Plan has to be set up for the project and proposed in the tender. The quality plan has to contain all the elements needed for sound project management.

This plan shall include, but is not limited to, the following aspects:

a) Description of the project and its objectives

In the proposal the tenderer shall demonstrate having understood the project requirements. The aim of the project, the development required and the results expected must be clearly expressed. The temporal sequence of the tasks to be performed within each module and the deadlines to be respected shall be recounted.

b) Description of project staff

The technical and human resources planned to perform the tasks have to be presented. For the intended technical resources the environment, in which the system will be developed shall be described. Staff shall be presented with respect to their responsibility, their position in the project and relevant experience.

c) Description of the means of co-ordination and of the flow of information

The tenderers are invited to describe how their interaction will be organized in order to achieve the expected results. The tenderer shall present in the proposal the internal communication flow of the proposed service. The structure of the decision-making process shall be detailed and measures adopted to solve any conflict within the project shall be outlined. The organisation has also to explain how the tender intends to communicate with IES-LMNH on technical and administrative issues.

d) Procedures to be observed

Any interdependencies between tasks with regard to outputs of one task representing critical input items for another task shall be explained. Eventual risks in achieving the objectives of the development step shall be identified, as well as possible recovery measures. Measures shall be outlined, which would be taken to reduce the impact of delays in one area on achieving the overall project objective.

e) Tools for quality management

The proposal shall contain a description of the quality management tool(s) intended to be used in the project, e.g. relational diagrams, flowcharts, tree diagram, etc.

f) Tools for monitoring the project progress

The section shall cover monitoring elements, such as internal review meetings, project meetings, reports, and milestones and their place in the procedures to be applied for monitoring project progress.

g) Quality Control procedure for data processing

The approach to ensuring the performance of the data processing according to the project specifications shall be included in the quality control measures and described in the proposal.

h) Any additional object or method intended to contribute to a better quality

A description of aspects not covered in any of the points listed above.

3.4.2 Communication and Meetings

The principal contact point for the contractor is the Land Management and Natural Hazards Unit of the Joint Research Centre, Ispra.

The proposal shall contain a plan of meetings between the JRC and the contractor. Kick-off and final project meeting shall be held at the JRC, Ispra. Other meetings must also be held at the JRC, Ispra, except when agreed between the contractor and the JRC, Ispra to move the meeting venue.

The proposal must contain a description of any meeting(s) in addition to those foreseen and that the tenderer anticipates being necessary. Further, at any time the JRC could ask for additional meetings, if clarification of certain issues becomes necessary.

Whenever needed the contractor or the technical contact person at the JRC can ask for additional unscheduled meetings. Such ad hoc meetings must be limited to cases where both parties agree that a problem cannot be solved by other means of communication. A maximum of six meetings are foreseen, the (total inclusive – including travel and subsistence, hire of room etc.) costs for which are to be borne by the Contractor.

For all project meetings the contractor will prepare the agenda at least one week prior to the meeting in agreement with the JRC, organize the meeting including the invitation of all necessary participants, and produce and compile minutes within one week after the meeting for review and commenting at JRC. The minutes must be accepted by all participants within 30 days after the meeting. All deliverables and documents required for the meeting will be made available at least one week before the meeting.

During the project review meetings at months 6 and 12 JRC will assess the progress made so far in module 1 and module 2, respectively. JRC will launch the next module, as foreseen in the project timeline of figure 2, with all necessary adjustments decided by

JRC on the basis of the results produced and delivered so far during the previous modules.

The working language of the meetings and the accompanying documents will be English.

3.4.3 Reports and Documentation

All reports and documents shall be written in English language. Hard-copies of the final version of the reports (5 copies) will be provided to the JRC. All reports shall be made available to JRC in electronic format on CD-Rom.

Progress on the project will be documented throughout the project. Reports have to be delivered at the end of each module and summarise the results obtained during this stage as well as an overview of the project management. The reports have to contain at least an executive summary of the achievements obtained during the module. Further, all documents that were requested during the module have to be annexed or, if delivered separately, made reference to in a clear way.

The final project report has to cover all aspects of the contract, summarises the achievements, and clearly reference all deliverables produced during the contract.

3.4.4 Datasets, Metadata Catalogue, and dedicated Web Site

All gridded datasets of the climatology of the Carpathian Region as produced during the service will be accessible through a dedicated web site that is freely accessible by the public. In addition, all datasets will be delivered to JRC in electronic format on CD-Rom or another suitable storage device.

National gridded datasets produced during the service will stay with the national authorities that own the underlying observation datasets. A copy of the national gridded datasets will be delivered to JRC in electronic format on CD-Rom or another suitable storage device, with restricted access for internal use within the European Commission Services.

The metadata catalogue including all metadata produced during the service will be a database accessible through the web site of the Climate Atlas of the Carpathian Region. A copy of the catalogue will be delivered to JRC in electronic format on CD-Rom or another suitable storage device, together with a description of system requirements and instructions for installation.

The dedicated web site for the Climatology of the Carpathian Region will be installed at contractor's side and **will be subject to hosting by the contractor for eleven months following completion of the service.** All information available at the web site will be freely accessible by the public over this period. A copy of the web site will be delivered to JRC in electronic format on CD-Rom or another suitable storage device, together with a description of system requirements and instructions for installation.

For all publically accessible datasets including the web site JRC has the full right to publish them and to make them available as well as to keep a copy of the web site online for an unlimited period.

3.4.5 Knowledge Transfer

Within the service to be provided, knowledge transfer consists of the processes by which knowledge, expertise and specific background information are transferred **from the staff of the contractor to the JRC** in order to allow a detailed understanding of the data processing performed and of the respective tools developed and applied during the service so that all steps of data processing performed are fully understood by JRC and all products of the service could be reproduced from the scientific and technical point of view, if required..

The proposal shall contain a description of how knowledge will be managed and transferred to the JRC. The main means of knowledge transfer must be through documenting all aspects of the data products, metadata catalogues, and web site, and through providing a point of contact by telephone and e-mail available throughout the service that is capable to answer all related questions arising at JRC.

The knowledge to be transferred comprises the scientific methodologies chosen, developed, and applied for data quality control, data homogenization, data harmonization, spatial interpolation, derivation of climatologies and drought indicators. Furthermore, the knowledge includes the technical know-how of how the above-mentioned methodologies have been implemented during the service and how all technical deliverables such as the metadata catalogue or the web site have been installed on computer systems.

3.5. Deliverables Module 1

The main objective of module 1 is to check, improve, and homogenise meteorological data to be used for the creation of the climatology of the Carpathian Region.

Expected results of module 1 are (D=deliverable identifier, Month=month of delivery):

D1.1 Kick-off meeting addressing the following topics (**Month 1**):

- Presentation of the contractor's organization
- Project management procedures
- Computer and software facilities
- Allocation of resources to personnel and efforts in selected countries
- Development and implementation plan for the climatology of the Carpathian Region

D1.2 Project meeting addressing the following topics (**Month 3**):

- Presentation of progress on task in module 1 made so far
- Presentation and discussion of D1.6, D1.7, D1.8, D1.13

D1.3 Project review meeting addressing the following topics (**Month 6**):

- Presentation of progress and preliminary results of module 1
- Presentation and discussion of D1.9, D1.11, D1.14

D1.4 Project meeting addressing the following topics (**Month 9**):

- Presentation of progress made so far in modules 1 and 2
- Presentation and discussion of D1.15, D2.3, D2.4

D1.5 Project review meeting addressing the following topics (**Month 12)**:

- Presentation of final results of module 1
- Presentation of progress and preliminary results of module 2
- Presentation and discussion of D1.10, D1.12, D2.5

D1.6 Report of data inventory of meteorological stations per month to be considered for the service as specified in section 2.7, including the specification of existing data gaps and proposed methodologies to fill them, and of existing analogue datasets to be digitized (**Month 2**).

D1.7 Proposal for quality control tests to be performed for all observational timeseries (**Month 2**).

D1.8 Proposal for homogenization methods to be applied to all observational timeseries (**Month 2**).

D1.9 Report on preliminary results of the data rescue and digitization exercise, per country (**Month 6**).

D1.10 Final report on the documentation of the data rescue and digitization exercise, per country (**Month 12**).

D1.11 Report on preliminary results of the quality control and data homogenization measures applied per country, including QC protocols and measures to determine the achieved increase in data quality (**Month 6**).

D1.12 Final report on quality control and data homogenization measures applied per country, including QC protocols and measures to determine the achieved increase in data quality (**Month 12**).

D1.13 Proposal of the metadata profile to be applied for all metadata to generated during the project as specified in section 2.8 (**Month 3**).

D1.14 Implemented draft version of metadata per country of meteorological stations selected for this project, including the length of record and observed parameters per station (**Month 6**).

D1.15 Final version of all metadata per country of selected meteorological stations with full functionality, including the length of record and observed parameters per station (**Month 9**).

Deliverables D1.6, D1.10, D1.12, and D1.15 will be made publically available; all other deliverables of module 1 will have restricted access to the Commission.

3.6. Deliverables Module 2

The main objective of module 2 is to harmonize the quality-check and homogenized climate datasets from module 1 and to produce spatially-interpolated gridded datasets of all required meteorological parameters at national level.

Expected results of module 2 are (D=deliverable identifier, Month =month of delivery):

D2.1 Project meeting addressing the following topics (**Month 15**):

- Presentation of progress made so far in modules 2 and 3
- Presentation and discussion of D2.6, D2.7, D3.3, D3.10

D2.2 Project review meeting addressing the following topics (**Month 18)**:

- Presentation of final results of module 2
- Presentation of progress and preliminary results of module 3
- Presentation and discussion of D2.8, D2.9, D2.10, D3.4, D3.5, D3.11, D3.14

D2.3 Proposal for the methodology to harmonize observational timeseries across country borders (**Month 7**).

D2.4 Report with preliminary results of the data harmonization procedures applied, including all protocols, per country (**Month 9**).

D2.5 Report with final results of the data harmonization procedures applied, including all protocols, per country (**Month 12**).

D2.6 Preliminary version of gridded datasets of harmonized and spatially interpolated meteorological parameters, per country (**Month 15**).

D2.7 Progress report on the creation of national gridded datasets (**Month 15**).

D2.8 Final version of gridded datasets of all harmonized and spatially interpolated meteorological parameters, per country (**Month 18**).

D2.9 Final report on the creation of national gridded datasets, per country (**Month 18**).

D2.10 Final version of metadata per country of all national gridded datasets created within module 2 (**Month 18**).

Deliverables D2.5, D2.8, D2.9, and D2.10 will be made publically available; all other deliverables of module 2 will have restricted access to the Commission.

3.7. Deliverables Module 3

The main objective of module 3 is the creation of the Climate Atlas of the Carpathian Region as an internet-based web resource with full functionality and access to the catalogue of all metadata produced during the project.

Expected results of module 3 are (D=deliverable identifier, Month =month of delivery):

D3.1 Project meeting addressing the following topics (**Month 21**):

- Presentation of progress made so far in modules 3
- Presentation and discussion of D3.8, D3.15

D3.2 Final project meeting addressing the following topics (**Month 24)**:

- Presentation of final results of module 3

- Presentation and discussion of D3.6, D3.7, D3.9, D3.12, D3.13, D3.16
- Presentation of the overall project results, including the demonstration of full functionality of the dedicated web site

D3.3 Draft template of the interpretation sheets of the gridded datasets to be produced (**Month 15**).

D3.4 Preliminary version of gridded datasets of the climatology of the Carpathian Region (**Month 18**).

D3.5 Progress report on the production of the climatology of the Carpathian Region (**Month 18**).

D3.6 Final version of all gridded datasets of the climatology of the Carpathian Region (**Month 24**).

D3.7 Final report on the production of the climatology of the Carpathian Region (**Month 24**).

D3.8 Draft version of interpretation sheets for gridded datasets to be distributed with the climatology datasets (**Month 21**).

D3.9 Final version of interpretation sheets for all gridded datasets, publically downloadable with the datasets (**Month 24**).

D3.10 Outline of the structure of the web site of the Carpathian Atlas, foreseeing all requested functionality (**Month 15**).

D3.11 First implementation of the web site that will host all relevant information on the Climate Atlas of the Carpathian Region (**Month 18**).

D3.12 Final and public version of the implemented web site with full functionality that hosts all relevant information on the Climate Atlas of the Carpathian Region, including a public download functionality within the web site for all gridded datasets of the climatology (**Month 24**).

D3.13 Complete software of the web site of D3.12 to be delivered to JRC, including all web pages, data, and source code of the web site, including a description of system requirements and instructions for installation. (**Month 24**).

D3.14 Preliminary implementation of the metadata catalogue that will host all metadata generated during the project (**Month 18**).

D3.15 Final version of metadata of all products of the climatology of the Carpathian Region (**Month 21**).

D3.16 Final version of the fully implemented and publically accessible metadata catalogue of the Carpathian Atlas, containing all metadata generated during all three modules of the project (**Month 24**).

Deliverables D3.6, D3.7, D3.9, D3.12, D3.13, and D3.16 will be made publically available; all other deliverables of module 3 will have restricted access to the Commission.

D3.12 shall be hosted by the contractor for a period of eleven months following acceptance starting from the date of the Certificate of Conformity issued by the

Commission confirming compliance with the specifications (see Article I.10 of the Draft Contract).

3.8. Deliverables and Payments

In addition to the documents listed at I.4 of the Draft Contract the following deliverables (results and documents) **shall require acceptance as a pre-condition to payments being released**:

- First interim payment at month 6 - Acceptance of progress presented in Project Review Meeting (**D1.3)** and documented by deliverables **D1.9 and D1.11**;
- Second Interim Payment at month 12 - Acceptance of the final reports of module 1 and 2: **D1.10, D1.12, D2.5**, and the progress reported in the Project Review Meeting (**D1.5**);
- Third interim payment at month 18 - Acceptance of final presentation in Project Review Meeting (**D2.2**), and the results including reports and data for module 2 and 3: **D2.8, D2.9, D2.10, D3.5, D3.11, D3.14**;
- Final payment of the balance at month 24 - Acceptance of presentations in final project meeting (**D3.2**), acceptance of final report as well as of data, metadata, software and web site for module 3 (**D3.6, D3.7, D3.9, D3.12, D3.13, D3.16**).

4. Progress Reporting

Next to the above described deliverables and related documentation, the organisational and administrative aspects of the project itself and the stakeholder interactions in relationship to the deliverables are to be documented by the contractor including in a final organisational report.

The purpose and the requirements are outlined below and cover:

- Kick-off meeting and inception report
- Project Progress Emails
- Interim Technical Reports (R1, R2, R3)
- Final Technical Report (R4)

It is essential that reporting is concise and kept to a minimum, to maximise the use of resources on the deliverable and supporting activities. Each Report should be no longer than two pages of A4 format.

4.1. Kick-off Meeting and Inception Report

The kick-off meeting serves to present the project concept to the Commission staff and to discuss it, to clarify any potentially remaining unclear issues between the contractor and the Commission staff, and potentially fine-tune it. At the same time, specifications and procedural issues will be discussed to render the project workflow and communication as clear and efficient as possible.

The kick-off will take place at the JRC Ispra site in Italy. The contractor is responsible for his own travel and participation costs.

The inception report that the contractor will prepare will summarise any further specifications and potential adjustments made during in the kick-off meeting and will include an adjusted work plan.

4.2. Project Progress E-mails

The project progress emails are each a brief summary of the project's bi-monthly working progress to be sent by the contractor to the JRC IES contact.

These emails have to provide a concise summary of the previous two months work - including deliverable status, activities and meetings with dates, involved experts and stakeholders, administrative issues, etc., thus documenting the current progress in relation to the project and the initial or adjusted working plan. They will help JRC IES to stay informed about the project status and - if necessary - to timely steer the project towards the requested deliverables.

4.3. Interim Technical Reports (R1, R2, R3)

It will consist of the bi-monthly progress emails, which are to be combined into one text providing the chronological course of the project activities and achievements. It shall include a brief description of the completed tasks against timetable together with any problems encountered.

Together with expected deliverables the interim technical report will form the basis for the interim payments of the project.

4.4. Final Technical Report (R4)

The final technical report will be compiled by the contractor and will document the course of the project, organisational and administrative issues, as well as stakeholder interactions.

It will consist of the bi-monthly progress emails, which are to be combined into one text providing the chronological course of the project activities and achievements ("project

diary") plus a short summary chapter as well as an adjusted workflow chart of the completed tasks and deliverables of the project.

The final technical report will serve to decide whether the project's initial objectives have been achieved in line with the contract, including possible adjustments and amendments made.

The final technical report will have an executive summary. The executive summary has to provide a brief description of the project and of its deliverables, main results and main conclusions.

Together with expected deliverables the final technical report will form the basis for the final payment of the project.

5. Modalities and Responsibilities

The services to be rendered under this contract are to be provided to the Commission, in particular the Joint Research Centre, Institute for Environment and Sustainability, Land Management and Natural Hazard Unit. The contractor must account for work, progress and results only to the JRC.

5.1. Data and Support Provided by the JRC

The contractor must indicate his/her technical and administrative contact persons.

5.2. Place of Work

The principal place of work will be the contractor's premises ("off-site").

5.3. Deliverables

The place of delivery is the Land Management Unit of the JRC, Ispra. A copy of all gridded datasets and all metadata produced within this service will be provided on physical storage media as a backup. At the end of a module all deliverables will be backed-up on CD-ROM/DVD and sent to the JRC technical point of contact. All printed documents and electronic data carriers will be delivered to the JRC contact person. The contact person will be nominated during the kick-off meeting.

The contractor is responsible for the implementation of a robust data processing and back-up practice. Malfunctioning of equipment must not lead to delays in providing data and deliverables according to the delivery schedule.

5.3.1 Structure, Format, and Language

The quality of deliverables and supporting documents must be sufficient for publication.

The contractor is requested to discuss the structure and outline of all reports prior to development to ensure agreement, including on the scope of each section and the content of any annexes. The contractor must equally plan analogous interaction with the JRC IES in relation to tools/applications and presentations.

All deliverables, reports, catalogues, web pages, reference documentation, presentation slides have to be well structured, concise and in grammatically correct English.

Reports must be concise. They must focus on the main messages in each section only. Long sentences/paragraphs are to be avoided. The use of sub-headings is encouraged. Repetitions must be avoided, including across sub-sections and in annexes.

Appropriate language is to be used, depending on the target audience, as indicated for the individual deliverables.

Neutrality and objectivity in formulation is to be ensured, avoiding bias towards individual organisations or national interests, unsubstantiated statements/judgements, etc. Unsupported scientific statements, statements outside the scope of the work and/or subjective statements, and advertising must not be included.

Wherever technical language or technical terms are required, the contractor will refer to scientific meteorological terminology. Terminology from related international and European standards is generally preferred.

Deliverables will include a glossary, list of figures, list of tables, as well as a table of contents. Use and form of graphics and tables, as well as citations and references to sources, will follow good scientific practice.

References will provide further background information and help substantiate all statements, where this cannot be provided in the Deliverable and where these do not reflect common knowledge. Preference is given to key references that reflect milestones in associated topics, complemented by additional references that provide further essential variations or iterations.

References will be provided in consistent format, using date and main author in the text. The list of references will be alphabetical, following a common format starting with title, author, and publication details.

All figures have to be presented in colour and numbered with appropriate captions. The fully editable originals of graphs and diagrams have to be provided also in a separate document, such as MS Excel, Windows Meta File, PowerPoint or compatible, to enable editing.

All tables will be structured to allow maximum readability and numbered with appropriate captions.

Data has to be presented to the nearest significant figure (e.g. 50.127 has to be given as 50, or 50.1, depending on significance).

Reports and similar documents have to be provided in MS Word or similar.

Presentations have to be provided in MS PowerPoint or similar.

The use of copyrighted photos, graphics and other material from third parties has to be avoided, unless reproduction is permitted, and then properly referenced.

5.4. Property and Confidentiality of the Data, Tools and Results and their Publication

The data products, results, and any software tools developed under this contract are confidential and remain the exclusive property of the JRC, as provided for in Articles II.8, II.9, II.10 of the General Conditions of the contract.

The JRC IES acquires with this contract the exclusive ownership of all deliverables, supporting information, documentation and reports.

5.5. Quality Control

Quality assurance of all deliverables is of high importance, including respect of the project deadlines.

The missing of deadlines except due to force-majeur or delays caused by the JRC is not acceptable.

The contractor must responsibly ensure the different quality aspects of the deliverables, including language, technical correctness, formatting, appropriateness of documentation, etc. The tenderer will suggest in their offer the approach and procedure of quality control to ensure high quality drafts are delivered on time.

The final deliverables will be provided to the JRC IES in high quality and in a form that does not require further modifications or improvements before publication. Acceptance is dependent on this requirement.

Additional critical review of the deliverables may be sought by the JRC IES and at the expense of the JRC IES, within or after the periods stated for comment and consultation above.

5.6. Publication

All documentation, reports and other deliverables are subject to modification prior to potential publication by Commission services such as the JRC IES e.g. a**s** JRC technical and scientific reports. In such a report, all contributing individuals and organisations will be named as contributors unless they abstain from being named.

The JRC IES encourages the publication of related journal articles and conference presentations based on the work conducted in this contract.

Further distribution of documentation, reports, and other deliverables of the project and the presentation of any results in any language and form such as in a journal article, on the contractor's homepage, via presentation at a conference, etc., is subject to the authorisation in writing prior to publication and/or abstract submittal by the JRC IES.

JRC IES staff is to be included as contributors or as co-authors in all related publications/presentations, as appropriate and upon decision by JRC IES.

External publication and associated costs are not considered a part of this contract.

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