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1. Management summary

This document describes the Czech pilot objectives, how the work will be organized and how the SUDPLAN software will be used in the third development phase of the project. It contributes to the requirement specification of the software and will serve as input to the D3.1.3 Requirement Specification V3 document. More specifically it defines the tasks and priorities for the staff working in the Czech pilot during development phase V3. This pilot definition plan V3 targets all SUDPLAN partners.

The main objective of the Czech pilot during the third year is to integrate the IT tools developed within SUDPLAN into the CENIA information system and to exploit them in assessing and visualizing the state and future development of air quality and hydrological conditions in the Prague metropolitan area in the context of regional development and agricultural farming profitability. Air quality outlook and downscaling will be carried out through the Airviro user interface.

Regarding the hydrological part of the pilot, which is highlighted in the V3 period, we will be dealing with the prediction of hydrological conditions, namely river discharges and soil moisture by means of the E-Hype model provided by Common Services. The results of simulations will be used in the analysis of future development of farming profitability in the Prague region under the conditions of changing climate.

Finally, the structured usage (different user rights for different categories of users) of SUDPLAN modelling tools tested by the pilot will be set up in CENIA within the framework of its information system with the main purpose to support long-term decision making processes. Subsequently, other organizations involved in environmental protection, urban planning and public administration will be invited to use the system which will be introduced in the presentation events taking place in Wuppertal and in Prague.

The structure of this document consists of 6 chapters. Chapter 2 of this report describes pilot objectives, the relevance of the SUDPLAN Scenario Management System and Common Services for reaching those objectives and the expected added value. The detailed description of tasks to be carried out in the V3 period is given in this chapter. The different types of users of the SUDPLAN tool in the Czech Republic are defined in this Chapter 3. In Chapter 4 the use cases are defined which should test behaviour and functionality of the specific SUDPLAN tools needed for the Czech pilot. A detailed description of the pilot tasks for development phase V3 is presented in the Chapter 5. These tasks are necessary to the fulfilment of pilot objectives and include the use of the SUDPLAN tools as well as the post-processing analysis work to reach the outcomes specified in this report. The last Chapter 6 gives a conclusion of the V3 Czech pilot, summarization of added value of the pilot for the whole project and follow-up steps.

2. Pilot definition

This section describes the background why end-users at CENIA found interest in the SUDPLAN project, as outlined in DoW, and how the CENIA regional pilot is of relevance to the original ICT-2009.6.4 target a) ICT for a better adaptation to climate change. Thus the Czech pilot will demonstrate the use of the Scenario Management System with the Common Services air quality and hydrological modelling functionality to elaborate basic information for regional long term planning purposes.

The pilot concept has been defined and elaborated within the V1 and V2 phases of the project. For further details refer to the deliverables D8.1.1 and D8.1.2.

2.1. Scope

The following subsection introduces the area of interest, the City of Prague with surroundings, and outlines the main tasks to be carried out within the Czech Regional Pilot.

2.1.1 Main pilot objectives

The overall goal of this pilot application is to use the SUDPLAN services in describing and assessing the state, trends and future development of air pollution and hydrological conditions in Prague´s agglomeration area (150 x 150 km square around Prague) in the context of climate change. The results of these simulations are to be used in the assessment of agricultural farming profitability in the Prague metropolitan area.

In addition, availability of advanced SUDPLAN modelling tools will enable the development of air quality projections for different activity scenarios (energy, transport, industry and agriculture sectors) with special focus on PM_{10} and ground level ozone (at present, only Gaussian dispersion models are being used in the Czech Republic which do not allow to calculate concentrations of secondary pollutants - ground level ozone and secondary particles). Moreover, SUDPLAN modelling tools will be applied in urban and spatial planning as well as in environmental impact assessment of large infrastructural and construction projects.

Outlook of climate conditions and air quality for the selected area have been carried out by means of the SUDPLAN common services in the previous phases (V1 and V2) and will be further downscaled and finalized within the V3 period.

The Prague agglomeration has been selected for the Czech Regional Pilot as it is the most significant metropolitan area within the Czech Republic typical for its intensive regional development and population dynamics during the last few decades. Air quality, in common with other Czech cities, is considered to be one of the most crucial issues connected with the quality of the environment in Prague.

The climate change would affect not affect only air quality but also the activities in the region, especially agriculture. Crop yield is heavily influenced by changes in average month temperature and rainfall. Changing soil moisture may cause the differences in harvest and in the worst case the related farm abandonment due to unprofitable situation. The quantifiable relation between soil moisture and soil fertility will help to model the behaviour pattern based on farming profitability and social sustainability.

2.1.2 Relevance with respect to climate change issues

Climate change will likely have an effect on the regime dispersion conditions for air pollutants in the atmosphere and thus may influence concentrations of primary pollutants. Climate change also has the potential to produce increases in ground-level ozone in many regions and to influence formation of secondary particles as well. Ground-level ozone is formed in the presence of sunlight by ~~a~~ photo-chemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOCs), which are emitted from sources like motor vehicles and industrial facilities. Secondary particles are being created by chemical reactions among gaseous precursors (mainly sulphur dioxide, nitrogen oxides and ammonium) and represent around 50 % of total concentration of PM_{10} in the air. Climate change also could increase the number of days with weather conditions conducive to forming ozone, potentially causing air quality alerts earlier in the spring and later in the fall.

Future changes in temperature and precipitation, in terms of mean values, intensity and temporal and spatial variability, will probably have an impact on crop yields in farms in Central Bohemia and thus influence the profitability of agricultural farming in the region.

Climate Change Issues	Pilot Consideration
Better condition for forming ground level ozone, changed condition for dispersion of air-pollutants in the atmosphere and for formation of secondary particles.	Assess scenarios (potential policies and measures) which could contribute both to the mitigation of climate change and to the decrease of air pollution (one measure – two effects approach)
Decrease of soil moisture	Assess the future changes in precipitation, soil moisture (as compared to present conditions) and its impact on farming

2.2. Relevance with respect to ICT objectives of the proposal

Objective ICT-2009.6.4 ICT for Environmental Services and Climate Change Adaptation Target Outcomes a) **ICT for a better adaptation to climate change** Easy-to-use, web-based systems for better preparedness, decision support and mitigation of climate change impact on population, utilities and infrastructures. Special emphasis is on scenario-based prediction, damage assessment, planning and training, 3D/4D modelling, simulation and visualisation, as well as sensor networks. Integrated solutions shall be validated in the urban context including for natural disasters, taking full advantage of recent advances in miniaturisation of sensors, wireless communications and increased computation power and data storage capacity.

ICT Objective	Pilot Consideration
ICT for a better adaptation to climate change	Long terms trends in air quality and hydrological conditions, affected by climate change, and their potential impact on migration and agricultural productivity presented and pedagogically and effectively visualised (3D/4D) to facilitate decisions among different planning options.

2.3. Local models and data sources used

Data for individual pollutants (sulphur dioxide, nitrogen oxides, dust (TSP), carbon monoxide, volatile organic compounds (VOC) and ammonium) has been taken from the REZZO database, which stands for Register of Emissions and of Air Pollution Sources. Data in this register are divided, pursuant to the national legislation, into four categories: REZZO 1-4 (hereafter mentioned as R1-4).

Extra-large and large sources (R1) are monitored and described individually as point sources, while medium-sized air pollution sources (R2), small sources (R3) at regional/local level and mobile sources (R4) are described as area sources. The air pollution sources monitored within the R3 include emissions from household heating, fugitive emissions from construction and agricultural activity, ammonia emissions from breeding of farm animals and application of mineral fertilizers and VOC emissions from the use of organic solvents.

Air quality data were used for the validation of the Common Services downscaling chemical transport model. Data have been taken from the national air pollution database called ISKO (Information System for Air Quality). This information system maintains and assesses data from air pollution monitoring network which includes AMS (Automated Monitoring Stations) and the supplementary network with manual sampling.

GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies) model developed by IIASA has been used to carry out different emission scenarios for the Czech Republic as the input to CS downscaling services.

2.4. Common services used

The major contributions of the SUDPLAN Common Services are expected in the application of the Common Services Air Quality downscaling model on the area of interest (square 150 x 150 km around the City of Prague) and the Common Services HYPE hydrological model. CENIA will use the SUDPLAN Common Services to evaluate expected changes in air pollution levels – principally O3, NO_x/NO_2 and PM_{10} - in the area of interest during the coming decades. Common Services will also deliver hydrological variables like surface water runoff and soil moisture for the area of interest. The Czech pilot application does not include other local models directly operated through the Scenario Management System.

From a hydrological point of view CENIA will first and foremost address the expected changes in soil moisture due to climate change. CENIA will provide local data and knowledge about the area of interest in order to improve the set-up and calibration of the HYPE model. Common Services hydrological model will output historical and future scenario generated river discharges and soil moisture content that will be accessible through the Scenario Management System GUI, in which the time series of monitored and simulated discharge data can be visualised and studied in detail.

2.5. Main Pilot Activities

2.5.1 Air quality task

Achievements during the V2 period

Main results achieved during the V2 period include the following items

- Collection of all data necessary for CS air quality model validation
- CS Air quality model validation
- Assessment of air quality evolution for a selected future climate scenario
- Calculation of air quality projection for selected GAINS scenario

Main objective of the V3 period

Main objective of the V3 period is to have fully validated and operational SUDPLAN air quality modelling system integrated into the CENIA Information System, which will be prepared for routine applications. By the end of V3 period, pilot calculations will be carried out for typical use cases: Air quality projections for different emission/activity scenarios, assessment of land use/spatial plans, assessment of transport infrastructure, assessment of large construction projects (stationary sources).

2.5.2 Gather data for air quality model input and validation and socio-economic data as the input to scenarios

During V2, **2007 emission data** for stationary pollution sources (emissions of dust/TSP, sulphur dioxide, nitrogen oxides, volatile organic compounds/VOC, ammonium and carbon monoxide) as well as relevant activity data for the calculation of emissions from mobile sources (road network, traffic intensities and consumption of fuels) were processed using GIS software and uploaded to the Common Services as grids, using Airviro web interface. A**ir quality data** for nitrogen dioxide, particulate matter PM_{10} and ground level ozone were taken from 11 background urban and rural automated monitoring stations for 2009.

2.5.3 Model validation for a historical period

Validation (calibration) of the CS Air Quality model has brought about very good results in the case of annual mean concentrations of ground level ozone and annual mean concentrations of nitrogen dioxide. However, annual mean concentrations of particulate matter PM_{10} are underestimated by the model. The same results have been obtained in the case of daily time series (good correlation for nitrogen dioxide and ozone, not so good correlation for PM_{10}) Explanation most probably lies in underestimation by the Czech national emission inventory REZZO of emissions from household heating during winter period (many households in the area of interest use coal fired boilers). Examples of the validation procedure are shown in scatter plots (Figure 1-3) which display performance of the model for annual concentrations of PM_{10}, NO_x and ozone. Full validation results are presented in the D8.2.2 Czech Pilot V2.

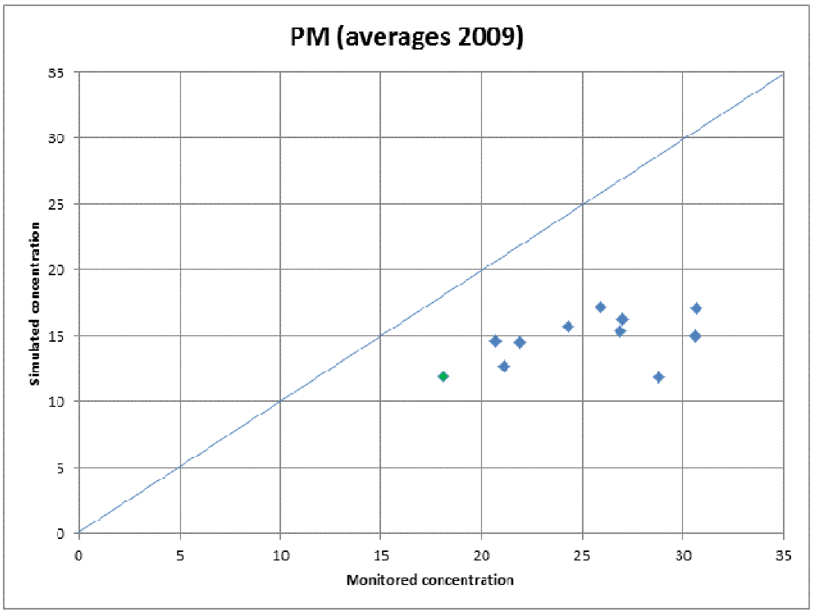

Figure 1: Scatter plot of annual mean concentrations of PM_{10} at urban stations Kladno – stred mesta, Mlada Boleslav, Pha1 – Nam-Republiky, Pha4 – Libus, Pha5 – Stodulky, Pha 6 – Suchdol, Pha6 – Veleslavin, Pha 8 – Kobylisy and rural stations Kosetice and Ondrejov in the year 2009. (Urban locations are in blue, rural in green)

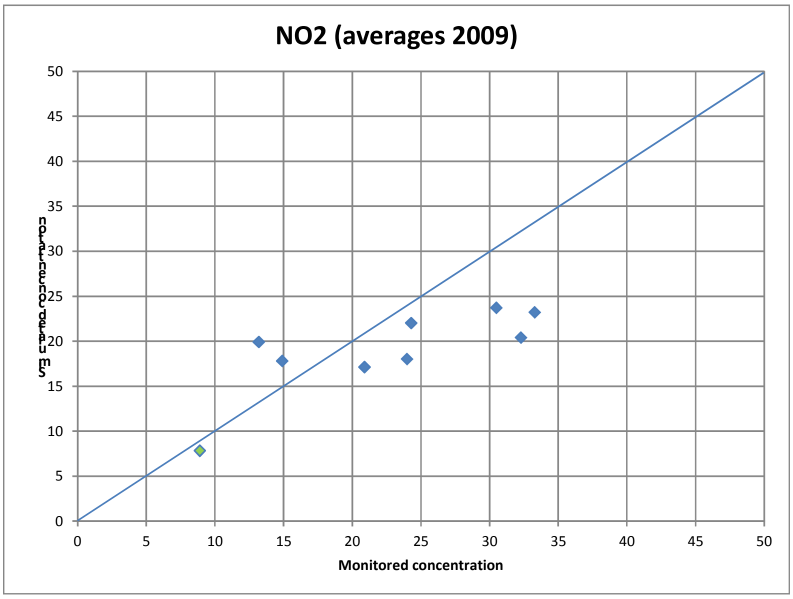

Figure 2: Scatter plot of annual mean concentrations of NO_2 at the stations displayed in figure 1 in the year 2009. (Urban locations are in blue, rural in green)

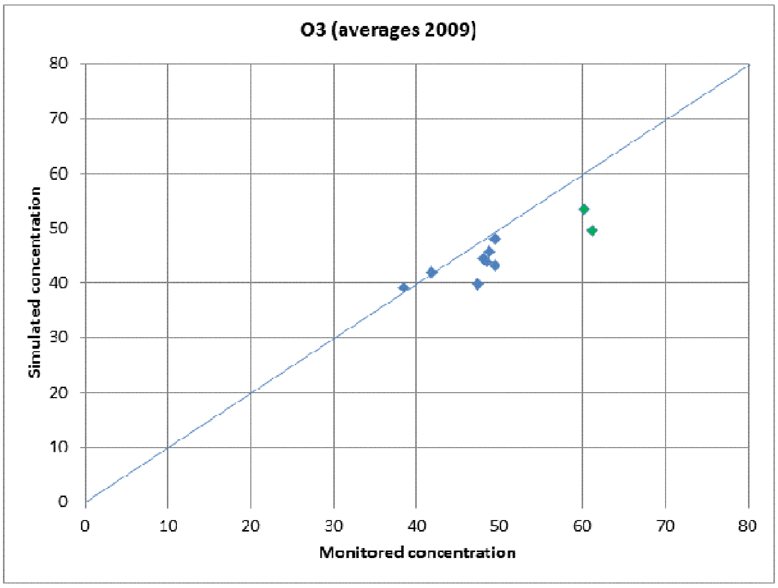

Figure 3: Scatter plot of annual mean concentrations of ozone at the stations displayed in figure 1 in the year 2009. (Urban locations are in blue, rural in green)

2.5.4 Assessment of air quality evolution for selected emission scenario

In order to develop **air quality projections**, the real emission data for 2007 have been extrapolated to 2030 using the GAINS model (scenario EC4MACS baseline). GAINS results have shown decreasing emissions of all pollutants. Afterwards, air quality downscaling for present and future scenarios has been executed using calculation grid with 2x2 km horizontal resolution and the ECHAM A1B 3 climate scenario as forcing and with RCP4.5 emissions. Projections have shown decrease in concentrations of PM_{10} and nitrogen dioxide and slightly increased concentrations of ground level ozone. An example of model simulation for PM_{10} is shown in Figure 4.

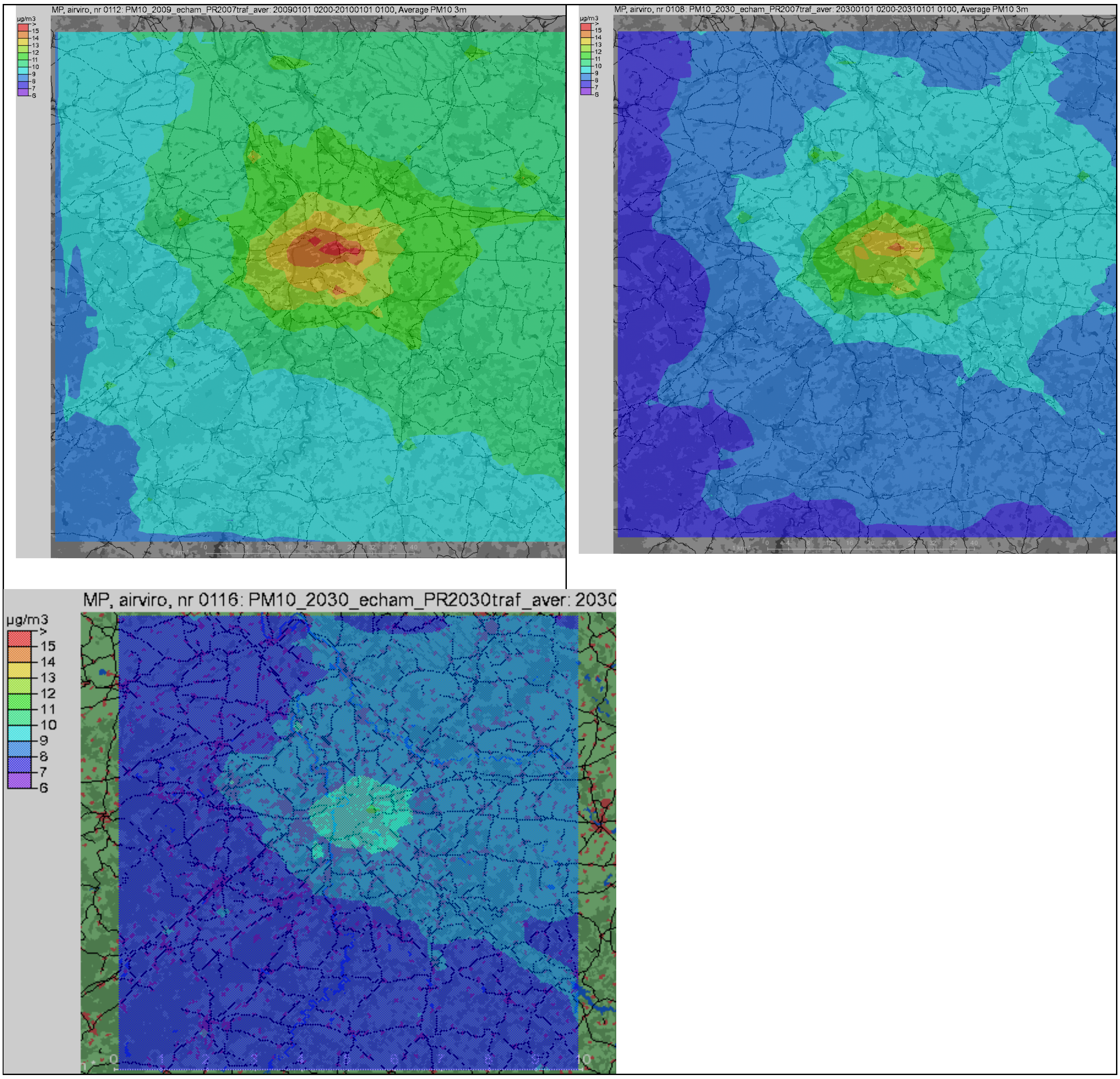

Figure 4: Annual mean of PM_{10} as simulated by SUDPLAN Common Services downscaling, representing present conditions around 2010 (left), future conditions with 2007 emissions around 2030 (right) and future conditions using GAINS emission scenario (bottom left)

2.5.5 Air quality scenarios

The following scenarios are going to be calculated and assessed in order to demonstrate the Sudplan modeling system potential for the users in the Czech Republic:

Scenario 1 - Large source of pollution

The aim of the scenario will be to evaluate the development of air quality by 2030 under the circumstances that there were significant changes in the production of emissions in the largest point source of air pollution located in the western part of the agglomeration of Prague - Melnik Power Plant (coal-fired station with thermal output of 720 MW). Modeled hypothetical changes regarding the source will be as follows:

- The power output will be doubled at the current fuel mix; emissions produced will thus be doubled
- Power plant will be closed, for example, will be replaced by a newly built nuclear power plant units
- Power plant will be switched from coal to gas which would change the quantity and composition of emissions

For all scenarios of development the annual mean concentration field of PM_{10}, NO_x, SO_2 and ozone will be calculated for 2030 with 2010 emission data as a baseline and the difference layers that will describe the changes in the concentration field caused by changes of the emission source. For the development of emissions from other sources by 2030 the GAINS model scenario will be used.

Scenario 2 - Traffic measure

The scenario is aimed at evaluating the changes in air quality in the Prague agglomeration, which would occur if the completion of the northern part of the Prague ring road. It can be expected, that the significant part of the transit traffic from the city center would be diverted, on the other hand, the pollution in the vicinity of newly built highway would increase. Prague has not completed highway bypass of the city, it is a real project, whose implementation is planned.

The average annual concentration fields of substances PM_{10}, NO_x, SO_2 and ozone will be calculated. The difference layer will show the effect on newly built highway bypass on air quality in Prague. For the development of emissions from other sources throughout the Prague agglomeration by 2030 GAINS model will be used.

Changes in emissions will be modeled by changes in the network transport intensities on roads and thus emissions from line sources that enter into the user interface Airviro through the emission database in Webbed format will be amended.

Scenario 3 - Migration of the population (sub-urbanization)

The scenario will assess the impact of significant spatial development of municipalities in the northern outskirts of Prague, where it will count with an increase in the number of inhabitants in these municipalities by 50 thousands. The increase in population would result in an increase in emissions from household heating (small stationary sources, R3) and transport, due to commuting to work.

Changes in the emissions entering the system Airviro will be modeled at the level of basic territorial units for which emission data are available. It will be assumed that the composition of fuels for heating will remain the same, and emissions will increase in direct proportion to the population and the number of new households. Likewise, emissions from transport will be calculated with an increase in traffic intensity.

Based on changes in emissions the average annual concentration fields of substances PM_{10}, NO_x, SO_2 and ozone will be calculated by means of Airviro user interface for 2030 with 2010 emission data as a baseline. For the development of emissions from other sources throughout the Prague agglomeration by 2030 GAINS model will be used.

2.5.6 Integration of Sudplan modelling outputs into the IT infrastructure of CENIA

The National INSPIRE Geoportal is composing of three main components – web portal, metadata catalogue and a map server. The whole system is built in failover deployment, each component is doubled and in case of failure the hot spare takes over the load. The application logic and user interface is based on Liferay Enterprise Portal, map services are provided by ESRI ArcGIS Server in a load balancing deployment, metadata catalogue is custom application developed exclusively for the Geoportal. The data is stored in an Oracle database; spatial data is stored using ESRI ArcSDE.

In order to prepare a showcase of linking between CENIA and SUDPLAN infrastructure, several steps have been done. The most important was to prepare the methodology of the process, finding where both systems (Airviro and CENIA infrastructure) can meet. The results of Airviro are grids, that can be visualized, therefore the National INSPIRE Geoportal that CENIA is running was selected as the publishing tool of SUDPLAN data n CENIA. Airviro offers rich set of export formats, one of them is ESRI shape file which was the most suitable for us not only because CENIA SDI is based on ESRI software, but it is also a widely accepted GIS format. The following steps that shall be implemented are as follows:

1. **Data import and reprojection** - import of SUDPLAN data into CENIA SDI and change of projection from ETRS to S-JTSK
2. **Preparation of data for visualization** - creating of map appearance, selecting cartographic methods, colors and intervals based on input data analysis
3. **Map service publication** - publication of the map composition as a map service, INSPIRE view service compatible capabilities and metadata creation, generating of map tiles
4. **Integration of services into INSPIRE Geoportal** - registration of view services containing SUDPLAN data on the Geoportal, creating of map compositions, adding background and other relevant thematic layer

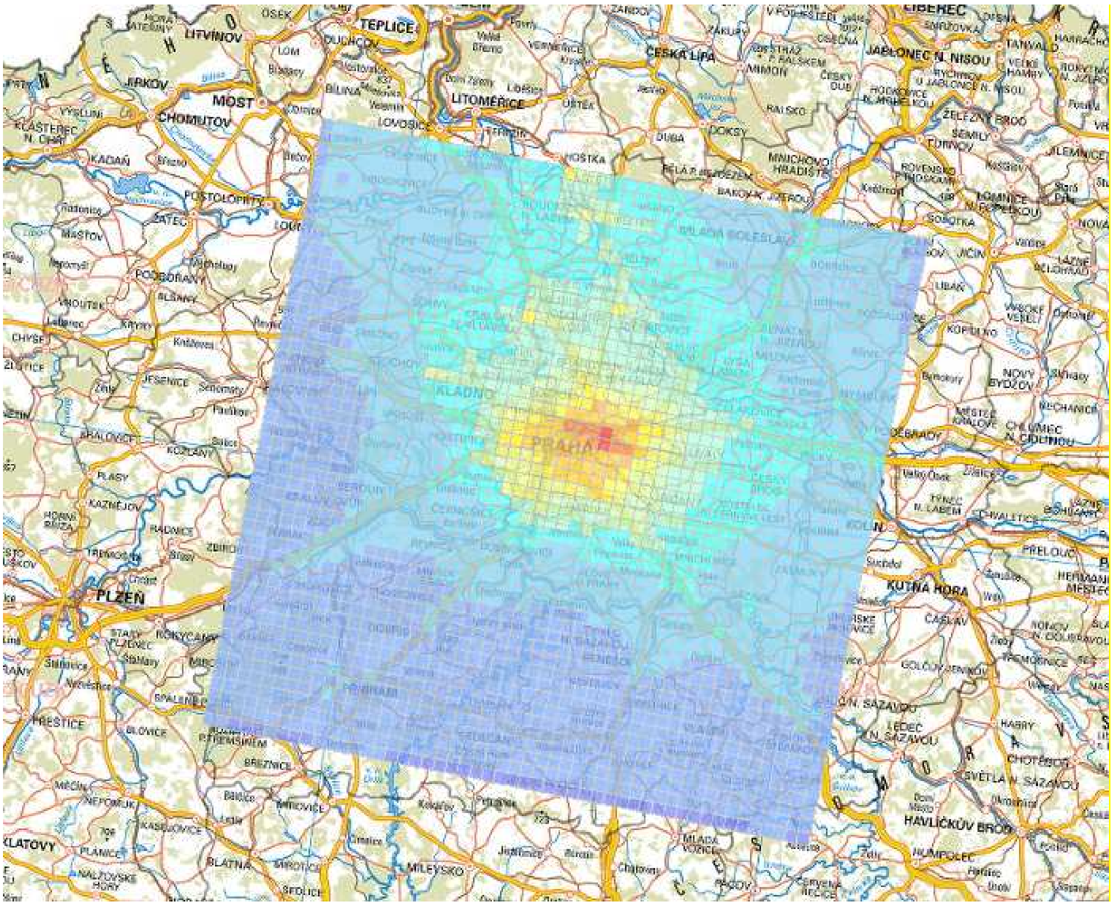

Figure 5: Air quality model in the geoportal, topographic map as a background

To publish SUDPLAN data a new map application is being developed by CENIA. We have good experience in building custom single purpose web applications focused on the broadest public. For web map applications development we are using Adobe Flex with Esri Flex API plug-in that together with ArcGIS Server backend offer a powerful visualization, geoprocessing and even spatial data editing options. The resulting application is compiled into a single swf file that is run by the Flash plug-in of the web browser. The advantage over JavaScript applications is that the resulting applications is much more optimized, runs smoother and looks exactly the same in each browser and platform as there is a runtime layer of the Flash plug-in that is taking care of the application execution.

2.6. Hydrology task – agricultural farming profitability

Achievements during the V2 period

Main results achieved during the V2 period include the following items

- Specification of the Prague urban area
- Collection of hydrological, agricultural and economic historical data (mainly at the regional scale)
- Formulation of the wheat production function
- Selection of the Hydrological Predictions for the Environment (HYPE) model as the CS hydrological model, and performing a hydrological downscaling for Prague urban area

During V2, the investigated area, earlier simply referred to as the Prague (urban) area, was delineated more specifically. It was decided that it should be the area of capital together with the Central Bohemian Region because in that way, to a certain extent, one can consider the suburb of Prague. When considering more detailed scale, it was also decided that the further calculations of areal hydrological variables would be related to districts established in 1960. We used the administrative areas to determine hydrological variables since the main goal of the Czech hydrological task is setting up an economic model.

Hydrological (air temperature, precipitation), agricultural and economic data for each month of the period 2000–2010 and for the whole region have been collected. This data availability enables the process of formulating, estimating and testing crop yield production functions in the regional scope. When all district data will be accessible the regional model could be applied to the district scale. Note that at the end of V2, we have collected such data on soil moisture and evaporation (simulated by SMHI using HYPE) and air temperature (computed through GIS from observations at CHMI) in the same temporal resolution as in case of entire Central Bohemia.

Early hydrological downscaling for the investigated area via auto calibration and validation of E-HYPE (Pan-European version of the HYPE model) using six additional daily data sets of discharge (from 1990 to 2009) was carried out.

Main objective of the V3 period is to assess the profitability of agricultural farming in the area selected. To reach the goal it is necessary to completely assess the future hydrological conditions which will represent the input to the cost-revenue model for farming profitability.

Main activities to be executed during the V3 period of the CENIA pilot will include the following items:

- Collection of remaining data necessary for the economic model running at the district scale,
- Validation of the HYPE model based on additional discharge data,
- Assessment of the future hydrological conditions based on the results of CS hydrological model,

- Formulation of the cost-revenue model for farming profitability,
- Assessment of the pilot hypothesis on farm abandonment.

2.6.1 Assessment of the influence of climate change on future hydrological conditions

2.6.1.1 Validation of auto calibration with historical discharge data

During the V2 period the work on local downscaling of hydrological model for Central Bohemia was initiated. With the use of CS hydrological model we will carry out new calibrations and evaluations. Even though the HYPE model with updated parameters simulates discharge relatively well according to the objective function which is the difference between the Nash-Sutcliffe Efficiency criteria and the mean relative error, the simulated and observed discharge differ pretty much at some places (e.g. south of Prague).

The reasons of these inconsistencies will be investigated. We will carefully select other discharge data (in daily time step) within the Central Bohemia covering at least the period 2000–2009. The data must be complete (without gaps), evenly covering the entire region. It will be very difficult to fulfil all criteria as the model is required to be accurate just in agricultural areas where water manipulations are present. If, despite all efforts, the random component remains large, we will also consider the refinements of digital elevation model and other inputs into the HYPE model (e.g. better resolution of land-use/land cover layers, detailed information on reservoirs and ponds, better downscaled air temperature and precipitation at the district scale). Nevertheless, we must still keep in mind that simplicity of auto calibration and validation by external users is required.

The example of results of the validation procedure is given in Figure 6.

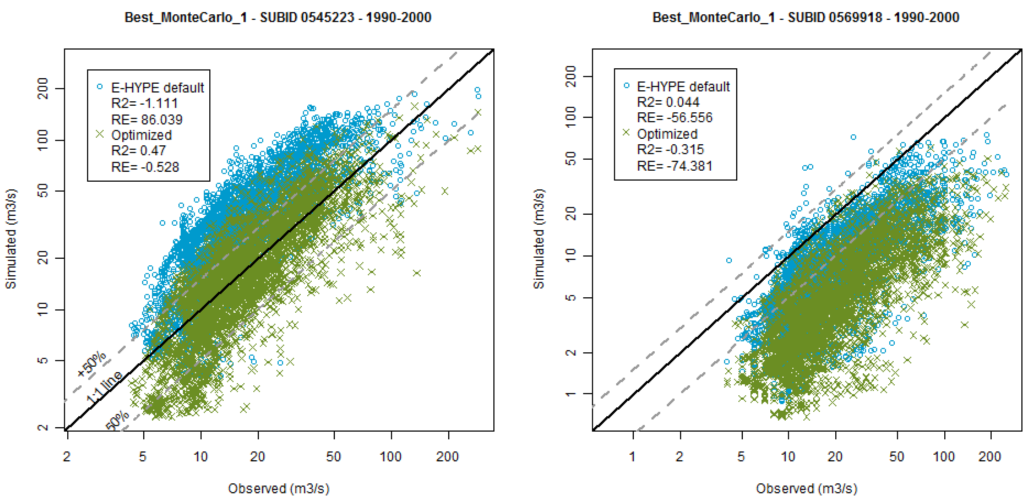

Figure 6: Simulated versus observed discharge at subbasin (a) 545223 (chart on the left), and (b) 569918

2.6.1.2 Hydrological simulation based on climate scenarios

In essence, to run the economic model at the district scale it remains to collect monthly precipitation totals representing all districts of the Central Bohemian Region including the capital. These data should be based on records from rainfall-gauges of CHMI. GIS-familiar hydrologists from CHMI will produce grids covering the period 2000–2010 via the Inverse Distance Weighting interpolation technique. Then they will apply the Zonal Statistics tool to obtain demanded data sets. Similarly, the data on soil moisture and evaporation at the district level, although simulated only, can be derived by the hydrologists at SMHI. Finally, having all these data will allow us to find relationships between hydrological conditions and crop yield production at the scale smaller than the entire region.

Having finished the calibration procedure, the local hydrological model will be executed with forcing from available climate scenarios. It will produce all demanded variables such as future daily averaged air temperature, precipitation, river discharge, local runoff, soil moisture etc. Namely areal variables representing the districts will be of interest. However, some of the variables will still represent only the points, as they cannot be simply spatially interpolated (e.g. river discharge).

2.6.1.3 Outlook of soil moisture for the Prague area

Through hydrological model E-Hype will be created an outlook of soil moisture in the area under consideration, whose northern part is an important agricultural area, where arable land occupies about half of the total territory. It may be assumed that climate change will cause especially in summer soil moisture decrease, resulting in lower yields of agricultural crops which would influence the economic situation of farmers.

The output of the hydrological model will represent the input for the crop production model, which will quantify specific changes in the yields of agricultural crops by 2030.

2.6.2 Outlook of agricultural farming profitability in the Prague area

2.6.2.1 Cost-revenue model for farming profitability

Cost-revenue model for farming profitability is closely linked with formulation, evaluation and testing of crop yield production functions which model the revenue part of farm activity. During V3, the wheat production function (in CES form) will be modified using new accessible data (for soil moisture and evaporation – if evaluated that it could be done due to possible correlation between different variables). Once having tested crop yield production functions, we will formulate the cost part of farm activity (which random character is not so important). Finally, the Farm profit function and then Farm Internal Rate of Return will be assessed.

Within the V3 period the following activities will be carried out:

- the analysis of relevant explanatory variables
- analysis of the most convenient expression of the resulting crop production function

- Cobb - Douglas production function,
- production function with constant elasticity of substitution or
- Production function with variable elasticity of substitution

Application of the most **appropriate production function** to calculate crop production Cob-Douglas production function is defined by following equation:

$$Y_{it} = a_i e^{gt} L_{it}^{\alpha} C_{it}^{\beta} e^{u_{it}}$$

- Y_{it} harvest of crop in the region *i* and in the time *t*
- a_i the level of achieved technology in the region *I*
- g the non-objectified technological progress
- t the proxy variable time
- L_{it} the sawn land in hectares in the region *i* and in the time *t*
- C_{it} the consumption of fixed capital in the region *i* and the time *t.*
- α and β the elasticities of output (harvest) with respect to the land input or to the capital input respectively.

Constant elasticity substitution production function (CES PF) is defined by following equation:

$$Y_{it} = ce^{gt}\left[\gamma L_{it}{}^{-\rho} + (1-\gamma)C_{it}{}^{-\rho}\right]^{-r/\rho} e^{u}$$

- Y_{it} harvest of crop in the region *i* and in the time *t*
- g the non-objectified technological progress
- t the proxy variable time
- L_{it} the sawn land in the region *i* and in the time *t*
- C_{it} the consumption of fixed capital in the region *i* and the time *t.*
- c the parameter of efficiency of the production process
- γ the distribution parameter depending on the units of both factors
- r the degree of homogeneity
- ρ the substitution parameter

Production function with **variable elasticity of substitution** (VES PF)

$$Y_{it} = ce^{gt}\gamma A_{it}{}^{\alpha(1-\delta\rho)}\left[B+(\rho-1)A_{it}\right]^{\alpha\delta\rho} e^{u}$$

- Y_{it} harvest of crop in the region *i* and in the time *t*
- *g* the non-objectified technological progress
- *t* the proxy variable time
- A_{it} first included variable in the region *i* and in the time *t*
- B_{it} second included variable in the region *i* and the time *t.*
- $c, \gamma, \rho, \delta, \alpha$ parameters

Due to the results of previous analysis, we assume that VES PF may model the crop production in high level of significance.

2.6.2.2 Outlook of conditions for agricultural farming in the Prague area

On the basis of the soil moisture outlook and calculations described above the assessment of agricultural farming profitability in the selected area will be carried out.

2.7. Expected Added Value

At present, air quality projections are not available in the Czech Republic. Air quality modelling (interpretation of present emission data) is being carried out by Gaussian dispersion models which cover neither formation of ground level ozone nor formation of secondary particles. As for emission projections, the outputs of the IIASA GAINS model are being used.

Neither is available future soil moisture and fertility information, based on climate scenario modelling. This type of long term air quality and hydrological projections are not available in the Czech Republic at present.

The local, regional and central governments are interested in the scientifically justified and politically relevant information on the possible future development of the urban, sub-urban and regional environmental, economic and social conditions under the conditions of changing climate.

SUDPLAN modelling systems set up within the project will be used for:

- Development of projections of future development of the state of the environment (air quality, hydrology),
- Scenario analysis (in combination with the results of other models, e.g. GAINS or transport macro models),
- Assessment of environmental impact of relevant activities (land use/spatial planning, transport infrastructure, transport management, large construction projects) on air quality.

3. Users

3.1. Primary Users

There are two types of users who will make regular and direct use of the CENIA Pilot system: analysts within CENIA and System Administrators. In addition, Czech Hydro meteorological Institute is likely to become primary user of the SUDPLAN system.

3.1.1 CENIA Analysts

The environmental and migration assessments analyses will primarily be carried out by technical experts within CENIA. These individuals are very comfortable with computers. But they are not (in general) modellers, and they do not necessarily have sophisticated GIS experience.

3.1.1 Czech Hydrometeorological Institute (CHMI)

CHMI operates the REZZO emission database and the Air Quality Information System. As its Air Division is also responsible for the development of emission and air quality projections, availability of the advanced SUDPLAN modelling system will improve their potential significantly.

3.1.1 System Administrator

The System Administrator for the CENIA pilot will be CENIA staff member who is comfortable with computers and software installation. They may or may not be sophisticated GIS users. In general they have no expert knowledge regarding climate, precipitation or air quality modelling.

3.2. Secondary Users

The results of the CENIA pilot system will be used by public administration bodies involved in urban planning and air quality protection on either central or municipal level. They include Ministry of Environment, Ministry of transport, industry, agriculture and health and also subsidiary agencies like the Directorate of highways.

3.3. Tertiary Users

The only tertiary user identified for the CENIA pilot is the general citizen. They will interact with the system only in the sense that they will be shown results whose content was produced by the system.

The general citizen of Prague and its surrounding area may be provided with information resulting from sessions conducted with the CENIA pilot, perhaps through publication on a web site. While the content of these publications will in part come from the system, other content and formatting will generally be the product of other tools. The general citizen is assumed to have no technical training or knowledge, and they may be only slightly familiar with the general issues of urban flooding and property protection. In general, the Czech language will be required.

3.4. Stakeholders

3.4.1 State or Federal Funding Agencies

One stakeholder of the CENIA pilot might be state or regional agencies that provide funding to cities for environmental improvement projects. While they will likely not have any direct contact with the system, they are expected to make use of the SUDPLAN results in their decision-making.

4. Use-cases

The Czech use-cases will describe, in a format understandable both for end-users as well as IT developers, the actions and functionality expected to be accessible through the SUDPLAN GUI for accessing Common Services. They reflect the earlier task description in section 3, but omit work and actions taken outside the SUDPLAN platform. The Czech pilot use-cases will thus directly demonstrate what CENIA can achieve with the SUDPLAN tool. As Stockholm and Prague are very different in terms of climate and air quality characteristics, their respective results will directly give important signals on the applicability of the SUDPLAN air quality tool for different European cities.

Use-cases are identified as UC-XYZ, where the last three numbers have the following meaning:

X – Pilot work package number (e.g. 8 for Czech pilot)

Y – Application process number (e.g. 1 for the current)

Z – Use-case number (given in order starting from 1)

4.1. Narrative explanation of use-cases

Table 1 shows an overview of the use-cases formulated so far for the Czech pilot application of the SUDPLAN tool, all to be completed during version V3 (2012). All use-cases for V1 are based on Common Services functionality and are identical to those of the Stockholm pilot V1.

Use-case (planned for version)	**Part of Common Services**	**Objective**	**Status V3**
UC-811 (V1-V2) "Visualise gridded and air quality model results on the European scale"	Climate scenario information on the European scale	Visualise distribution and trends of temperature, precipitation and air quality model results over Europe	Completed
UC-812 (V1-V2) "Visualise urban downscaled air quality results"	Air Quality Downscaling service	Visualise distribution and trends of urban air quality simulations over the urban scale (results of UC-821)	Partly completed
UC-813 (V2) "Add monitor data to compare with model results"	Air Quality Downscaling service	Allowing model results and monitor data to be presented in the same graph, used to validate model output for historical periods	Completed
UC-821 (V2) "Execute air quality	Air Quality Downscaling	Start an air quality downscaling simulation over pilot city area. (Extension to allow upload of	Partly completed

downscaling”	service	gridded urban emissions in V2)	
UC-831 (V2) “Visualisation of panEuropean hydrology results from different scenario runs”	Climate scenario information on the European scale E-HYPE results through CS GUI National integrated system	For each polygon and for each statistical variable show: • Each climate scenario • Mean value over all scenarios • Standard deviation over all scenarios • Max and min values	Partly completed
UC-832 (V3) “Calibrate hydrological model”	Auto calibration routine E-HYPE CS GUI	Select polygon of interest Select Q-station for calibration Run model in calibration mode	Partly completed
UC-833 (V3) Execute CS hydrological model	Hydrological downscaling model	Select Q station (same as calibrated for) Run model with climate scenario input	Partly completed offline
UC-834 (V3) “Air quality projections”	Czech National Geoportal, Integrated System at CENIA, ISSaR	Visualization the impact of several model activity/emission scenarios on air quality development using pre-defined GAINS scenarios, optionally own scenarios uploaded to the GAINS system,	To be carried out in V3
UC-835 (V3) “Hydrological projections”	Czech National Geoportal, Integrated System at CENIA, ISSaR	Visualization the of hydrological downscaling results for different regions in the Czech Republic	To be carried out in V3

Table 1 Overview of use-cases for Czech pilot definition plan V3

4.2. Detailed description of use cases

4.2.1 UC-811 “Visualise gridded climate and air quality model results on the European scale”

Acronym	
	UC-811 (V1)
Description	
	The user wants to access gridded climate and air quality model results for different climate scenarios for visualisation and analysis in the scenario management system. Therefore the system shall present the user with a list of available model results. The user shall be able to choose results from calculated low resolution model results for the whole of Europe (visualisation of already downscaled results is described in UC-812). The results will be presented to the user in form of maps with the spatial distribution of pollutants and time series diagrams.
Primary actor	
	Technical/Scientific Experts
Stakeholder	
	CENIA
Goal	
	Visualisation of available air quality results, export of time series from selected locations.
Input	
	List of available model results (grid data) List of climate and air pollutants (variables) available in the model results
Output	
	Map showing distribution of selected air pollutant at a certain time Time-series graph showing temporal evolution at certain location
Components	
	SMS, CS
Preconditions	
	User properly logged in with access to CS controls for either climate or air quality
Main success scenario	
1	The user selects the desired air quality model results from a list of available results
2	The user selects the variable of the model result to be displayed
3	The system displays the requested model results in the map
Extensions	
3a	The user can change the time point of the simulation currently shown in the map.
3b	The user can set the colour scale of the pollutant distribution.

3c1	If the user clicks in the map a time-series diagram will be presented for the specific location. The diagram shows the climate variable or pollutant concentration over the complete time of the simulation, with alternative time resolution The current position time point viewed in the map will be indicated in the diagram.
3c2	Export visualised model or monitor time series to other formats (Excel etc.)

4.2.2 UC-812 “Visualise urban downscaled air quality model results

Acronym	
	UC-811 (V1)
Description	
	The user wants to access gridded air quality model results for different climate scenarios for visualisation and analysis in the scenario management system. Therefore the system shall present the user with a list of available model results. The user shall be able to choose results from earlier downscaling simulations (see UC-812) The results will be presented to the user in form of maps with the spatial distribution of pollutants and time series diagrams.
Primary actor	
	Technical/Scientific Experts
Stakeholder	
	CENIA
Goal	
	Visualisation of available air quality results, export of gridded results for a certain time and time series from selected locations.
Input	
	List of available model results (grid data) List of climate air pollutants (variables) available in the model results
Output	
	Map showing distribution of selected air pollutant at a certain time Time-series graph showing temporal evolution at certain location
Components	
	SMS, CS
Preconditions	
	User properly logged in with access to CS controls for either climate or air quality
Main success scenario	
1	The user selects the desired air quality model results from a list of available results
2	The user selects the variable of the model result to be displayed
3	The system displays the requested model results in the map
Extensions	

3a	The user can change the time point of the simulation currently shown in the map.
3b	The user can set the colour scale of the pollutant distribution.
3c1	If the user clicks in the map a time-series diagram will be presented for the specific location. The diagram shows the pollutant concentration over the complete time of the simulation, with alternative time resolution The current position time point viewed in the map will be indicated in the diagram.
3c2	Export visualised model or monitor time series to other formats (Excel etc.)
3d	Export visualised model grid results in other formats (Excel etc.)

4.2.3 UC-813 “Add monitor data to compare with model results”

Acronym	
	UC-813 (V2)
Description	
	The actor wants to compare climate or air quality models results together with historical sensor data (monitored climate variables or air quality) in order to validate the model output and create confidence in later climate scenario downscaling. The comparison could include some statistical output for each time series such as averages, standard deviations etc. The actor eventually also want to export both model and sensor data.
Primary actor	
	Technical/Scientific Experts
Stakeholder	
	CENIA
Goal	
	Simultaneous graphic visualisation to compare simulated and monitored climate or air quality data, allowing an evaluation of the quality of the simulated results.
Input	
	List of model results for a historical period displayed as in UC-811 and UC-812. Monitor data from the area of interest to be used as a reference for evaluation of model results.
Output	
	Simulated and monitored values presented in the same graphs, allowing a statistical comparison.
Components	
	SMS, CS, access to database with monitor data
Preconditions	
	User properly logged in with access to CS controls for air quality and model result files as in UC-811 and UC812. List of monitored stations and variables available for selecting the proper data to compare to model results.
Main success scenario	

1	Select monitoring station of interest
2	Add station to the map
3	Show available information for the monitoring stations
4	Define period of time to be plotted
5	Plot time series of monitor data together with model results for comparison purposes
6	Export time-series visualised in the graph to EXCEL or other external format
7	Export currently shown air quality model grid results to EXCEL or other external format
Extensions	

4.2.4 UC-821 "Execute air quality downscaling"

Acronym	
	UC-821 (V1, except extension 4a which is V2)
Description	
	The actor wants to start a downscaling scenario execution from the SMS GUI, using the CS air quality downscaling option.
Primary actor	
	Technical/Scientific Experts
Stakeholder	
	SUDPLAN System
Goal	
	Successful downscaling of air quality over Prague
Input	
	List of European scale model result files to be used as boundary conditions (can be either historical years or climate scenario long term simulations). List of emission databases covering the downscaling area, each representing a particular year.
Output	
	Model executes as a batch job, yielding status and termination notifications. Result grids stored in CS database.
Components	
	SMS, CS, Super computer
Preconditions	
	User properly logged in with access to CS controls for air quality downscaling. User has prepared at least one emission database in the CS database (In V1 CENIA uses Airviro interface for this purpose, V2 will allow upload of emission grid directly through SMS) Consortium has been given full privileges for the user to launch a model simulation on a super computer.
Main success scenario	

1	Define area interest / bounding box in which downscaling simulation will take place
2	Select one European scale air quality result from list of available simulations to be used as boundary conditions (can be a historical period or a period from a long term climate scenario result).
3	Define time period for simulation (default is the same as the boundary condition simulation, but downscaling can be specified for a shorter sub period)
4	List available emission databases and tag specific emission databases as representatives for specific years
5	Execute downscaling (batch job, i.e. job will run independently from SMS activity, informing on job status and when completed)
Extensions	
4a	Upload of gridded urban emissions of SO2, NOx, NH3, VOC, CO and PM10 to create a city-specific emission database that will be stored in CS. Various grids (e.g. representing transport, energy production, industry etc) can be uploaded to the same database. To each grid there will be a possibility to describe temporal variations, made in tables of hour-to-hour variations (daily, different for weekdays and weekends) and monthly variations. The database will afterwards appear in the list of available emission databases (see 4).

4.2.5 UC-831 “Visualise hydrological information on the pan-European scale

Acronym	
	UC-831
Description	
	The user wants to visualize nine pan-European hydrological variables (return periods for flood and drought 10 and 100 years, number of freeze days, mean annual Q, mean Q for Spring, Summer, Autumn and Winter, MHQ and MLQ (annual, Spring, Summer, Autumn and Winter) and soil moisture) for a specific point in time.
Primary actor	
	Technical/Scientific Experts
Stakeholder	
	SUDPLAN System
Goal	
	To analyze the effects of future climate on hydrological conditions.
Input	
	CS hydrological model result files: drivers (P,T), land-use, soil properties, hydrological variables for sub basins of interest
Output	
	Time series of hydrological states for the sub basins of interest (Q, soil moisture etc)
Components	

	SMS, CS visualisation on the pan-European scale
Preconditions	
	User properly logged in with access to CS controls for visualisation on the European scale
Main success scenario	
1	Select hydrological scenario (pre-calculated pan-European CS hydrological results based on different climate scenarios)
2	Select variable of interest
3	Slide map results in time 10-year averages (for relevant variables, not all nine)
4	Click on map to get time series from that location with time resolution either daily, monthly, yearly or 10-yearly (for relevant variables, not all nine)
5	Visualize comparison between spatial data or time series from different scenarios
6	Export of visualized time series data
Extensions	

4.2.6 UC-832 “Auto calibration of CS hydrological model”

Acronym	
	UC-832
Description	
	Calibration of CS hydrological model in ONE point
Primary actor	
	Technical/Scientific Experts
Stakeholder	
Goal	
	Improved simulation result for upstream watersheds
Input	
	Time series of discharge data from selected monitor station to be used for calibration purposes
Output	
	New parameter settings to be used in subsequent hydrological simulations.
Components	
	SMS, CS hydrology
Preconditions	
	User properly logged in with access to CS controls for hydrology downscaling

Main success scenario	
1	See existing upstream Q stations used in CS default calibration of the pan-European hydrological model set-up on a map and select which station(s) to use in new calibration
2	Chose point of interest by clicking on it on the map
3	Upload new observed time series if any.
4	Start calibration
5	Simulation progress visualization
6	Retrieve and visualize time series of simulated and observed variables
Extensions	

4.2.7 UC-833 “Execute CS hydrological model”

Acronym	
	UC-833
Description	
	The user wants to execute the CS hydrological model for the upstream area of a selected point of interest (POI). Auto calibration should have been performed for the same upstream area before this step (UC-832).
Primary actor	
	Technical/Scientific Experts
Stakeholder	
	SUDPLAN System
Goal	
	To analyze the effects of future climate on hydrological condition
Input	
	CS climate scenario data for hydrological model result files: drivers (P,T) plus calibrated parameter set (UC-832)
Output	
	Time series and spatial distributions of hydrological states for the sub basins of interest (Q, soil moisture etc)
Components	
	SMS, CS hydrology
Preconditions	
	User properly logged in with access to CS controls for hydrological downscaling.
Main success scenario	
1	Select hydrological scenario (based on different climate scenarios, but corrected P and T)
2	Select simulation period (default is the same as input climate scenario)
3	Select POI (should be the same as for the calibration)
4	Start model run Simulation progress visualization

5	Spatial visualization of input P,T and model output variables
6	Click on the map and get back daily values of input P,T and model output variables
7	Export of visualized time series.
Extensions	

4.2.8 UC-834 “Air quality projections”

Acronym	
	UC-834 (V3)
Description	
	The actor using CENIA information system wants to access air quality projections based on several emission/activity scenarios simulated by CS air quality downscaling model. The different scenarios have been prepared by CENIA experts.
Primary actor	
	Technical/Scientific Experts
Stakeholder	
	SUDPLAN, CENIA, public
Goal	
	Successful access to downscaled air quality results over Prague region
Input	
	List of downscaled model result files to be presented. Metadata on input data behind each result (emissions, forcing, boundary conditions)
Output	
	Result grids accessed through SMS, stored in CS database.
Components	
	SMS, CS, CENIA information system ISSaR
Preconditions	
	None
Extensions	

4.2.8 UC-835 “Hydrological projections”

Acronym	
	UC-834 (V3)
Description	
	The actor using CENIA information system wants to access hydrological projections driven by different climate scenarios and covering different regions in the Czech Republic, simulated by CS hydrological downscaling model. The different scenarios have been prepared by CENIA experts.
Primary actor	
	Technical/Scientific Experts
Stakeholder	
	SUDPLAN, CENIA, public
Goal	
	Successful access to downscaled hydrological results over Czech regions
Input	
	List of downscaled model model result files to be presented. Metadata on input data behind each result (calibration, forcing)
Output	
	Result polygon data accessed through SMS, stored in SMS database
Components	
	CENIA information system ISSaR, SMS
Preconditions	
	None
Extensions	

5. Description of tasks

The task description for the Czech pilot was mainly a result of the WP2 “Product Concept and Validation” seminars in Kaiserslautern and Saarbrucken, after interviews with pilot end-users. Hydrological tasks are new in this V2 version of the Czech pilot definition plan. The tasks describe all activities needed for reaching pilot objectives as outlined in Section 2 (Pilot definition). The tasks are also the basis for the Use-cases that describe the work to be done specifically with the SUDPLAN Common Services, through the Scenario Management System GUI.

The following tasks describe the pilot activities needed to demonstrate, through the specific SUDPLAN use-cases, the usefulness of the SUDPLAN product for the air quality scenarios (Tasks 1.x) and the assessment of agricultural farming profitability under the conditions of changing climate (Tasks 2.x).

Following to the comments from ATR the tasks have been further refined to fulfil better the contractually set objectives of the Czech pilot and the whole project. Namely, the task dealing with migration assessment is newly focused on impacts of socioeconomic changes in the Prague area on air quality. The main objective of the hydrology task is to describe future conditions of agricultural farming mainly in terms of soil moisture. Thus, the relevance of climate change issues in the tasks carried out has been increased. Moreover, the new task dealing with IT integration has been added.

5.1. Air quality assessment

Task	**1.1 Gather data for air quality model input and validation**
Description	Gathering and analyse input data and other relevant information that can be used for interpretation and validation purposes
Actor	CENIA, support technically by SMHI
Goal	To gather (prioritized): - Spatially and temporarily distributed historical and future activity data (relevant socio-economic data of population, energy, transport, industry, agriculture etc) that can be used as input to an emission database of the AIRVIRO type[1]. - Monitored meteorological and air quality data in the form of hourly time-series, to be used for validation purposes. To gather (if available): - Other relevant environmental data (areas declared as “areas with lower

[1] The AIRVIRO GUI allows a more general web interface to the CENIA users of Common Services air quality downscaling model, however SUDPLAN can perfectly be used without the AIRVIRO GUI (the latter will require emission grids to be uploaded, i.e. emission factors must be applied to activity data before being used in SUDPLAN air quality modeling).

	air quality", outputs of air quality modelling using domestic models or other international models), - Migration data - Relevant publications and studies. To prepare, quality assure and upload the data set into the SMS and CS databases
Input	Input and validation from many disperse sources
Output	Relevant data to be used as input to the air quality downscaling and also for validation of the model output, centralized, formatted and available for the future tasks of the air quality & migration tasks.
Components	AIRVIRO interface used for uploading emissions to Common Services. AIRVIRO can also be used for administrating and analysing validation data (air quality time series), however this should later be replaced by data stored and displayed directly in SMS.
Constraints	Certain data can be either missing or existing in insufficient quality and quantity
Status	V1: An emission database representing baseline scenario (year 2007) has been completed, uploaded through AIRVIRO GUI. Air quality data for 2009 are available for validation purposes. V2-V3: Upload of 1-2 future emission scenarios. Testing of SUDPLAN CS upload of emission grids and display of measurement data for validation purposes.

Task	**1.2 Assessing impacts of socio-economic changes on air quality in the Prague area**
Description	Evaluation of the development of air quality in the area of interest, for different time periods and under different emission scenarios. Evaluation of impact of changes in emissions from different categories of sources (large point sources, transportation, and household heating) on air quality.
Actor	CENIA, with technical support from SMHI
Goal	Application of the Common Services air quality downscaling tools on the area of interest (Prague)
Input	Emission database for present and future scenarios consisting of large point stationary sources, line sources (transportation) and gridded sources (small stationary sources) Transportation data (transportation volumes) Migration data

Output	Gridded air quality concentrations of PM_{10}, NO_x, SO_2 and ozone (hourly data as a base, different averages obtained after post-processing)
Components	Airviro modelling interface
Constraints	Long term climate scenario simulations are computationally demanding, CPU time to be approved by SMHI before new simulations.
Status	V1: Not accomplished V2-V3: Validation of a historical period and simulation of a couple of different future scenarios.

Task	**1.2.1 Model validation for a historical period**
Description	Evaluation of the CS Air Quality downscaling model results for a historical period, comparing with monitored air quality data.
Actor	CENIA, with technical support from SMHI
Goal	Confidence in quality of input data and model tool.
Input	Emission data for 2007, pan European climate and air quality model results for 2008 or 2009.
Output	Gridded air quality concentrations (hourly data, different averages obtained after post-processing)
Components	CS air quality
Constraints	Differences between model calculation and measured data might be considerable for some pollutants and for some stations.
Status	V1: Not accomplished V2: Reported in D8.2.2 report

Task	**1.2.2 Assessment of air quality evolution for a selected emission scenario**
Description	Processing and assessment of air quality projections using CS Air Quality downscaling model for a selected emission scenario using boundary conditions of GCM model outputs.
Actor	CENIA, technically supported by SMHI
Goal	Generate air quality simulations to illustrate the development of air quality under the conditions of changing climate by 2030
Input	Emission databases for at least present (baseline) and a future scenario
Output	Gridded air quality concentrations (hourly data, different averages obtained after post-processing)

Components	SMS, CS air quality
Constraints	Differences between model calculation and measured data might be considerable for some pollutants and for some stations.
Status	V1: Not accomplished V2: Partly fulfilled (D8.2.2) V3: To be completed

Task	**1.2.3 Air quality scenarios**
Description	Carrying out three air quality scenarios representing the main areas of use of Sudplan modelling tools in the area of air quality assessment: Large point source scenario (power station) Transportation scenario Migration scenario
Actor	CENIA
Goal	Demonstration of usefulness of the system to support decision-making processes and urban planning.
Input	Emission database in the Webbed format Transportation data Migration data
Output	Air quality concentration layers to be published on Geoportal.
Components	Large point source scenario (power station) Transportation scenario Migration scenario
Constraints	Some of required data might not be available.
Status	V1: not initiated V2: preparatory work V3: to be completed

Task	**1.3 Integration of Sudplan modelling outputs into the IT infrastructure of CENIA**
Description	Presentation of Sudplan outputs on Inspire Geoportal Developing map application (graphical user interface) to be used by end-users of the system
Actor	CENIA in cooperation with SMHI and Cismet
Goal	Setting up the Sudplan modelling system in CENIA

Input	Air quality concentration layers Background topographical layers
Output	Sudplan results adopted to CENIA information system
Components	Sudplan maps presented on CENIA geoportal Map application
Constraints	Limited input data availability Long computation time of concentration layers
Status	V1: not initiated V2: preparatory work V3: to be completed

5.2. Agricultural farming profitability assessment

Task	**2.1 Assessment of the influence of climate change on future hydrological conditions**
Description	Assessment of the influence of future hydrological conditions on agricultural production and possibly farm abandonment (as a function of changes in precipitation, temperature and soil moisture) and on changes in the landscape (as a function of changes in precipitation and soil humidity and other factors). Application of Common Services hydrological downscaling model.
Actor	CENIA, with the support of SMHI
Goal	Data input on water quantity and temperature to get regional/local model of soil humidity. Develop a farm profit model, i.e. relative (fixed) costs of agricultural production and the revenue needed for sustainable production. Evaluate the farming profitability based on farming Internal Rate of Return.
Input	Data on water quantity, temperature and land use.
Output	Projections of agricultural production and changes in landscape due to future hydrological conditions.
Components	SMS, CS hydrology, CENIA's economic models
Constraints	N/A
Status	V1: Not initiated V2-V3: To be completed

Task	**2.1.1 Validation of auto calibration with historical discharge data**

Description	Validation of an auto calibration routine for the CS hydrological model
Actor	CENIA, with support from SMHI.
Goal	To evaluate an automated model calibration routine that can be used through the common services GUI to calibrate a model set-up for a specific region using historical water discharge data.
Input	Data on river discharge for upload (calibration) and independent river discharge data for evaluating the calibration effect.
Output	Calibrated parameter set-up for CS hydrological model
Components	SMS, CS hydrology with auto calibration routine
Constraints	N/A
Status	V1: Not initiated V2-V3: To be completed.

Task	**2.1.2 Hydrological simulations based on climate scenarios**
Description	Execution of CS hydrological model for climate scenarios and with parameters created by earlier auto calibration.
Actor	CENIA, with technical support from SMHI
Goal	To provide projections of future hydrological conditions under different climate scenarios.
Input	Climate scenarios regionally downscaled, parameter settings acquired by auto calibration.
Output	Daily averaged temperature, precipitation (these two input forcing), river discharge, local runoff and soil moisture for periods up to year 2011.
Components	SMS, CS hydrology
Constraints	N/A
Status	V1: Not initiated V2-V3: To be completed.

Task	**2.1.3 Outlook of soil moisture for the Prague area**
Description	Execution of CS hydrological model for climate scenarios and with parameters created by earlier auto calibration.

Actor	CENIA, with technical support from SMHI
Goal	To provide projections soil moisture as the input to farming profitability assessment
Input	Climate scenarios regionally downscaled, parameter settings acquired by auto calibration.
Output	Soil moisture outlook by 2030 for the area under consideration of the pilot.
Components	CS hydrology
Constraints	N/A
Status	V1: Not initiated V2-V3: To be completed.

Task	**2.2 Outlook of agricultural farming profitability in the Prague area**
Description	Evaluation of profitability of agricultural farming in the area around Prague under the conditions of changing climate.
Actor	CENIA, with the support of SMHI
Goal	Data input on water quantity and temperature to get regional/local model of soil humidity. Develop a farm profit model, i.e. relative (fixed) costs of agricultural production and the revenue needed for sustainable production. Evaluate the farming profitability based on farming Internal Rate of Return.
Input	Results of Hype model – soil moisture outlook. Data on water quantity, temperature and land use.
Output	Projections of agricultural production and changes in crop yields due to future hydrological conditions.
Components	SMS, CS hydrology, CENIA's economic models
Constraints	N/A
Status	V1: Not initiated V2-V3: To be completed

Task	**2.2.1 Create cost-revenue model for farming profitability**
Description	Formulate crop yield production functions and related farm profit function, i.e. cost-revenue model. The farming Internal Rate of Return will be used to

	evaluate the farming profitability. Based on this indicator we will be able to predict possible farm abandonment in the area.
Actor	CENIA
Goal	Formulate, estimate and test crop yield production functions depending on hydrological factors Formulate farm profit function, i.e. cost-revenue model Compute the farming Internal Rate of Return to evaluate the farming profitability.
Input	Temperature, precipitation and soil moisture historical data and predictions from Task 2.1.3 Fertilizers and pesticides historical data for different crops from Czech statistical Office (CSU).
Output	Predictions of crop yield, agricultural farming profitability assessment
Components	N/A
Constraints	It may happen that the impact of hydrological conditions will be found overshadowed by other factors (fertilizers, pesticides). Some of required fertilizer and pesticide data might not be available.
Status	V1: Not initiated V2-V3: To be completed.

Task	**2.3 Outlook of conditions for agricultural farming in the Prague area**
Description	Outlook of profitability of agricultural farming.
Actor	CENIA
Goal	Carry out the outlook of crop yields by means of production function and assessment of conditions for agricultural farming in future.
Input	Soil moisture outlook, production functions, crop yields outlook.
Output	Conclusions on future agricultural farming in the Central Bohemia area
Components	CS hydrology, cost-revenue model for farming profitability (Task 2.2.1)
Constraints	N/A
Status	V1: Not initiated V2-V3: To be completed.

6. Conclusions

The overall objective of this document is to define and specify the plan for the Czech pilot in the last year of the SUDPLAN project implementation. For both pilot applications the usage of the Scenario Management System together with Common Services is of key importance. SUDPLAN will contribute with climate scenario impact projections not available before.

The main objective of this phase of the implementation of the Czech pilot is to integrate the IT outputs developed within SUDPLAN into the CENIA information system to be used for assessing and visualizing the state and future development of air quality.

The pilot activities are listed as tasks, describing the overall procedure of gathering relevant input and validation data for the air quality and hydrology modelling, but also for the further assessment of migration patterns in response to air quality changes and farming productivity in response to changes in temperature and soil moisture.

The use-cases describe the use of the CS air quality and hydrological downscaling as well as the use of the Integrated System in CENIA. Although some of the air quality functionalities will also be demonstrated in the Stockholm pilot, it will be of great interest to evaluate the applicability of the SUDPLAN air quality downscaling tool for two rather different European cities. The Czech pilot constitutes the principal demonstrator of the CS hydrological downscaling functionality.

7. Glossary

Climate scenario	*Climate scenarios* means the resulting climate evolution over time, as simulated by global (GCMs) and regional (RCMs) climate models. Climate scenarios are products of certain emission scenarios that reflect different economic growth and emission mitigation agreements.
Common Services	*Common Services* is the climate downscaling services for rainfall, river flooding and air quality, developed in the SUDPLAN project and accessed through the SUDPLAN platform (Scenario Management System)
Downscaling	*Regional downscaling*: is performed by a Regional Climate Model (RCM) that uses results from a Global Climate Model, historically also named as a General Circulation Model, (GCM) as input. The Regional Downscaling in SUDPLAN will be performed by SMHI's RCM and will generate climate scenarios on a 44x44 km2 or 22x22 km2 grid. *Downscaling* (whenever used alone): refers to further downscaling of the regional climate scenarios for Europe to the urban scale. This will be possible within SUDPLAN for a) precipitation and temperature b) hydrological parameters (river runoff, soil moisture etc) and c) air quality (PM, NO2/NOx, SO2, O3, CO). The temporal resolution will be in the interval minutes to days, the spatial resolution typically from one to a few kilometres.
Emission scenario	*Emission scenarios* (to the atmosphere) means the development of local emissions of pollutants into the air under different expected developments of relevant activities (energy, transport, industry, agriculture,...) assessed by suitable model (e.g. GAINS)
Gridded maps	Gridded maps represent environmental and other factors (such as rainfall, river runoff , emissions or air quality), evaluated on a defined grid level and presented over a city map; with one grid representing either a certain time step or some kind of average.

Micro scale	In the context of air quality meaning the environment around single streets (specific dispersion models handle this spatial scale).
Urban scale	In the context of air quality meaning the environment covering a specific city, typically of the scale 5x5 to 150x150 km.
Model	A *model* is a simplified representation of a system, usually intended to facilitate analysis of the system through manipulation of the model. In the SUDPLAN context the term can be used to refer to mathematical models of processes or spatial models of geographical entities.
Receptor point	Receptor points means geographical coordinates/locations where simulated air quality is evaluated. Of special interest are coordinates of air quality monitoring stations, where model results may be evaluated against measurements.
Scenario	A *scenario* is a set of parameters, variables and other conditions which represent a hypothetical situation, and which can be analysed through the use of models in order to produce hypothetical outcomes.
Scenario Management System	*Scenario Management System* is synonymous with SUDPLAN platform and includes the SUDPLAN Graphical User Interface (GUI)
SUDPLAN application	A *SUDPLAN application* is a decision support system crafted by using the SUDPLAN platform and integrating models, data, sensors, and other services to meet the requirements of the particular application.
SUDPLAN platform	The *SUDPLAN platform* is an ensemble of software components which support the development of SUDPLAN applications.
SUDPLAN system	*SUDPLAN system* is synonymous with SUDPLAN application

User	The term *user* refers to people who have a more or less direct involvement with a system. Primary users are directly and frequently involved, while secondary users may interact with the system only occasionally or through an intermediary. Tertiary users may not interact with the system but have a direct interest in the performance of the system.
Web-based	Computer applications are said to be *web-based* if they rely on or take advantage of data and/or services which are accessible via the World Wide Web using the Internet.

8. Acronyms and Abbreviations

3D	Three dimensional, used to describe the output from MATCH model simulations (horizontal grids in different layers).
Airviro	Air quality management system consisting of databases, dispersion models and utilities to facilitate data collection, emission inventories etc, see http://www.Airviro.smhi.se/
AQ	Air Quality
CHMI	Czech Hydro-meteorological Institute
CS	Common Services
CTM	Chemical Transport Model (model used for air quality modelling)
DoW	Description of Work, here referring to SUDPLAN DoW of December 01, 2009.
ECMWF	The European Centre for Medium-Range Weather Forecasts (also co-ordinating FP7-SPACE project MACC)
EDB	Emission DataBase
GAINS	The Greenhouse Gas and Air Pollution Interactions and Synergies Model, developed by IIASA
GIS	Geographical Information System
GUI	Graphical User Interface
HIRLAM	HIgh Resolution Limited Area Model
IIASA	International Institute for Applied Systems Analysis, Vienna, Austria
IDF	Intensity Duration Frequency, curves or tables showing how intensive rain can be for a certain time period
MA	Migration Assessment (CENIA pilot task)

MATCH	Multiple-scale Atmospheric Transport and Chemistry modelling system (CTM model developed and used by SMHI)
OGC	Open Geospatial Consortium
PM	Particulate Matter
PM10	Suspended particles with diameter below 10 µm (inhalable). PM10 is regulated in EU and the most critical pollutant in Prague.
PMC	Project Management Committee
RC	Rossby Centre, climate research unit at SMHI
SMHI	Swedish Meteorological and Hydrological Institute
SMS	Scenario Management System
SOS	Sensor Observation Service
SPS	Sensor Planning Service
WAVED	EXCEL plug-ins for monitor data transfer to Airviro
WEDBED	EXCEL plug-ins for emission data transfer to Airviro
WP	Work Package
WCS	Web Coverage Service
WPS	Web Processing Service
WMS	Web Map Service
O&M	Observation and Measurements
tbd	To be determined