Large-scale EXecution for Industry & Society

Deliverable D7.4

Deployment of the First Test-bed Infrastructure Components in HPC/Cloud

Co-funded by the Horizon 2020 Framework Programme of the European Union
Grant Agreement Number 825532
ICT-11-2018-2019 (IA - Innovation Action)

DELIVERABLE ID | TITLE	D7.4 | Deployment of the First Test-bed Infrastructure Components in HPC/Cloud
RESPONSIBLE AUTHOR	Fabien Brocheton (NUM)
WORKPACKAGE ID | TITLE	WP7 | Weather and Climate Large-scale Pilot
WORKPACKAGE LEADER	CIMA
DATE OF DELIVERY (CONTRACTUAL)	30/09/2019 (M09)
DATE OF DELIVERY (SUBMITTED)	01/10/2019 (M10)
VERSION | STATUS	V1.0 | Final
TYPE OF DELIVERABLE	R (Report)
DISSEMINATION LEVEL	PU(Public)
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DOCUMENT VERSION

VERSION	MODIFICATION(S)	DATE	AUTHOR(S)
0.1	First Draft	09/07/2019	Fabien Brocheton (NUM)
0.2	Add-on ECMWF	16/07/2019	Nicolau Manubens & James Hawkes (ECMWF)
0.3	Add-on ITHACA	19/07/2019	Paola Mazzoglio & Andrea Ajmar (ITHACA)
0.4	Add-on NUM	26/07/2019	Fabien Brocheton (NUM)
0.5	Add-on CIMA	30/07/2019	Antonio Parodi (CIMA)
0.6	Minor corrections, Add-on on WCDA	03/09/2019	Fabien Brocheton (NUM), Emanuele Danovaro (ECMWF)
0.7	Add-on TESEO & CIMA	06/09/2019	Nicola Vaccaro (TESEO), Franchina Rocco (TESEO), Roberto Peveri (TESEO), Antonio Parodi (CIMA)
0.8	Internal review and add-on CIMA & ITHACA	26/09/2019	Daniel Schorlemmer (GFZ), James Hawkes & Emanuele Danovaro (ECMWF), Antonio Parodi (CIMA), Paola Mazzoglio (ITHACA), Fabien Brocheton (NUM)
0.9	General Add-on	30/09/2019	Fabien Brocheton (NUM)
1.0	Formal check by coordinator	30/09/2019	Kateřina Slaninová & Jan Martinovič (IT4I)

GLOSSARY

ACRONYM	DESCRIPTION
API	Application Programming Interface
ASCII	American Standard Code for Information Interchange
BUFR	Binary Universal Form for the Representation of meteorological data
CAMS	Copernicus Atmosphere Monitoring Service
CSV	Comma-Separated Values
DDI	[LEXIS] Distributed Data Infrastructure
ERDS	Extreme Rainfall Detection System
FDB5	Fields Database (v5)
GPM	Global Precipitation Measurement
GRIB	Gridded Binary or General Regularly-distributed Information in Binary form
HDF5	Hierarchical Data Format version 5
ICPD	Italian Civil Protection Department
IFS	Integrated Forecasting System of ECMWF
IMERG	Integrated Multi-satellitE Retrievals for GPM IR Infrared
JSON	JavaScript Object Notation
NetCDF	Network Common Data Form NWP Numerical Weather Prediction
ODB2	ODB stands for Observational DataBase (version 2) and is a tailor made software developed at ECMWF to manage very large observational data volumes
OPeNDAP	Open-source Project for a Network Data Access Protocol
WaterML	Water Model Language
WCDA	Weather and Climate Data API
WMO	World Meteorological Organization
WRF	Weather Research and Forecasting
WMS	Web Map service
TMPA	TRMM Multi-satellite Precipitation Analysis
TRMM	Tropical Rainfall Measuring Mission

TABLE OF PARTNERS

ACRONYM	PARTNER
Avio Aero	GE AVIO SRL
AWI	ALFRED WEGENER INSTITUT HELMHOLTZ ZENTRUM FUR POLAR UND MEERESFORSCHUNG
BLABS	BAYNCORE LABS LIMITED
Bull/Atos	BULL SAS
CEA	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES
CIMA	Centro Internazionale in Monitoraggio Ambientale - Fondazione CIMA
CYC	CYCLOPS LABS GMBH
ECMWF	EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS
GFZ	HELMHOLTZ ZENTRUM POTSDAM DEUTSCHESGEOFORSCHUNGSZENTRUM GFZ
IT4I	VYSOKA SKOLA BANSKA - TECHNICKA UNIVERZITA OSTRAVA / IT4Innovations National Supercomputing Centre
ITHACA	ASSOCIAZIONE ITHACA
LINKS	FONDAZIONE LINKS / ISTITUTO SUPERIORE MARIO BOELLA ISMB
LRZ	BAYERISCHE AKADEMIE DER WISSENSCHAFTEN / Leibniz Rechenzentrum der BAdW
NUM	NUMTECH
O24	OUTPOST 24 FRANCE
TESEO	TESEO SPA TECNOLOGIE E SISTEMI ELETTRONICI ED OTTICI

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EXECUTIVE SUMMARY

The Weather and Climate Large-scale Pilot (WP7) deals with various applications from different partners (CIMA, ECMWF, ITHACA, NUM and TESEO). This deliverable could be considered as a reference document for the description of each WP7 users' cases which will be deployed on the LEXIS infrastructure. A status of this deployment is then described.

Position of the deliverable in the whole project context

This deliverable (D7.4) covers the actions done in Task 7.3 entitled "Regional Weather and Climate: Assimilation of Local in-situ Unstructured Observations in High-Resolution Downscaling of Global Forecast", Task 7.4 entitled "Cloud-Based Domain Specific Application Modelling, Forced by Regional Forecasts and Environmental Observations" and Task 7.5 entitled "Cloud-Based Socio-Economic Impact Modelling Based on Exposure Information and Environmental Forecasts" of WP7 (Weather and Climate Large-scale Pilot). It is the first deliverable dealing about the operational execution of WP7 Weather and Climate use cases on the LEXIS infrastructure. It is a precursor to D7.8 [1], which is the final report of the deployment of these use cases in LEXIS.

Description of the deliverable

The deliverable begins with a reminder of the general design of system and dataflow management of applications of the Weather and Climate Large-scale Pilot in LEXIS infrastructure. Section 2 details each partner's applications (CIMA, ECMWF, ITHACA, NUM and TESEO) of the Weather and Climate Large-scale Pilot (WP7) as they will be at the end in LEXIS. Section 3 describes the status of the deployment of these applications in the LEXIS infrastructure, having in mind that some general components (such as the WCDA API or the DDI system) are not yet operational. Section 4 details the current status of these infrastructure's components.

1 INTRODUCTION

In the WP7 "Weather and Climate Large-scale Pilot", various use cases in terms of application, domain size, etc. will be tested in the LEXIS infrastructure.

Figure 1 presents these applications. We can notice two elements from this figure: i) the simulated domain goes from global to local and ii) use cases are not independent and interact each other: e.g. IFS weather forecast of ECMWF will be used as input of CIMA WRF regional forecast which will be used as input of NUM urban air-quality forecast.

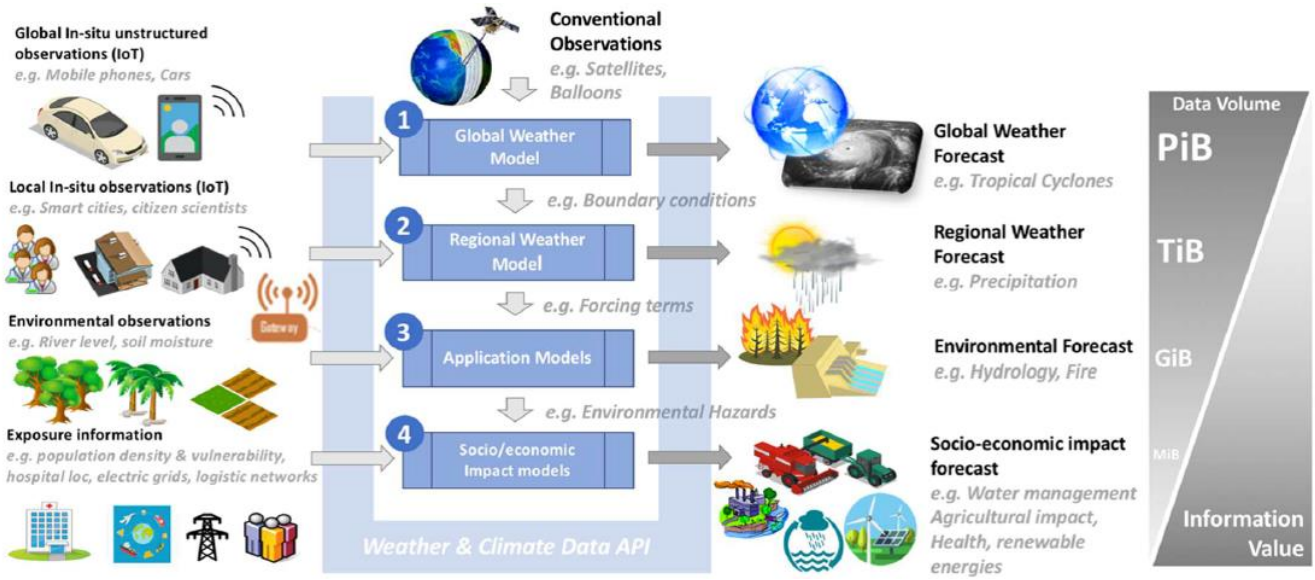

Figure 1 List of the different WP7 applications

One key point for WP7 is the exchange and handling of datasets from one application to another. The deployment of each application in the LEXIS infrastructure is not only the porting of each model on HPC/Cloud servers (at ECMWF, LRZ and IT4I), but also the interaction between applications, as well as the visibility of the final outputs on the LEXIS portal.

As described in Deliverable D7.1 [2], the management of WP7 data will be handled in two ways:

- As shown in Figure 1, a specific API (called WCDA) will be deployed for WP7 in order to handle weather data. In the weather and climate pilot, curated data management is crucial for allowing interoperability between observational data sources, global- & regional-scale weather models, and specific impact models. Consequently, a specialist weather & climate data API (WCDA) is being created to ensure data is fully-managed from both an organisational and performance perspective. Most of the data related to the weather and climate pilot, including observational data and computational-model outputs, will be managed by the WCDA.
  This API is based on dedicated ECMWF software (FDB), which is a flexible object storage solution optimized for weather & climate data. Usage of the FDB will allow the WCDA API to meet the requirements of heterogeneous data sizes (MBs to TBs).
- The generic component of the LEXIS DDI system will be used for data in all formats not handled by WCDA (ascii, csv, json, etc.), i.e. mainly non-curated data.

Section 2 of this document presents the different WP7 applications as they will be deployed in the LEXIS infrastructure. This deliverable will represent a reference document with the description of these applications for the other deliverables. Section 3 presents the status of the deployment, given that the WCDA API or the DDI system

are not yet operational, and in consequence the deployment corresponds mainly to the porting of application models to the LEXIS infrastructure (at LRZ and IT4I) with manual test simulations.

2 DESCRIPTION OF WP7 USE CASES

This section describes each WP7 application that will be deployed during the LEXIS project.

2.1 ECMWF: PROVISION OF IFS GLOBAL FORECASTS

2.1.1 Objectives

ECMWF's main global weather forecasts are run twice per day, and their output will be made available to the LEXIS project via the WCDA API. High-resolution area-limited models (i.e. WRF model) are kick-started by using a subset of global forecasts as initial and boundary condition. Users may exploit WCDA API to query from ECMWF's archive various subsets of the global for regional models or other use cases.

2.1.2 Description of the provided data

ECMWF's main purpose is to provide global, medium-range forecasts, targeting a time horizon of up to 15 days. Two models are operated daily: HRES and ENS. HRES is the high-resolution model with a grid-spacing of approximately 9km and is used to provide the more accurate weather prediction using the higher resolution estimate of the current atmospheric state. ENS is an ensemble forecast, performed using 51 lower-resolution forecasts (approximately 18km), with perturbed input to explore the range of uncertainty in the observations and the model.

Products from HRES and ENS forecasts will be provided through the WCDA API in GRIB format.

2.2 ECMWF: PROVISION OF MOJI MOBILE PHONE DATA

2.2.1 Objectives

For the duration of the LEXIS project, Moji, a Chinese weather app provider, will maintain a partnership with ECMWF to provide barometric data from mobile-phone sensors around the world.

2.2.2 Description of the provided data

Moji Weather is a social, crowd-sourced app generating real-time weather data from its user base around the world.

The Moji Weather app records and provides every minute the current latitude, longitude, time-stamp and pressure. At the moment this app provides approximately ten million data points per day.

The data will be anonymized by Moji and converted to BUFR/ODB2 for use with the WCDA API, and will be made available only to relevant LEXIS partners.

2.3 CIMA: PROVISION OF CITIZEN WEATHER OBSERVATION DATA

2.3.1 Objectives

The deliverable D7.2 [3] presents the list of observation data that are concerned by this CIMA task, namely: observations from weather stations which are relevant for assimilation in Numerical Weather Predictions, such as Weather Research and Forecasting (WRF) executed by CIMA; predictions and observations analysis, for example Extreme Rainfall Detection System (ERDS) executed by ITHACA; or for validation of some WP7 models

2.3.2 Description of provided data

Different datasets of observations will be considered in this task.

- **ECOMET dataset**: about 9,000 authoritative weather stations, to be stored on WCDA system. The access via the Italy Aviation Forces has been finalized. The data are provided for free for hindcast research studies. The data are available in BUFR format. The main usage will be the assimilation in the WRF model.
- **Wunderground dataset**: CIMA has developed a partnership with IBM for about 150,000 personal weather stations (PWS) real-time (hourly reporting temperature, wind, rainfall, relative humidity, pressure) over the globe (32,000 from Europe). Also, historical data will be available for 1 June - 30 November 2018 (about 13,000 personal weather stations from Europe). The main usage will be the assimilation in the WRF model. The cost is about 9,000 euro per year (real time data APIs call+ limited number of APIs call for historical data, e.g. 2018). Concerning the licensing scheme, the CIMA Foundation is authorized to publish graphs of the PWS data on the myDewetra platform, product of the Central Functional Center of the Italian Civil Protection Department entirely developed by the CIMA Research Foundation for visualisation of data. myDewetra is an Open Source software released upon request to national and international Public Entities and Non-profit Institutions. The use of myDewetra is limited to specific purposes of "environmental monitoring and civil protection. CIMA Foundation is not authorized to allow the download of native PWS data (e.g. time series) from the myDewetra Platform. CIMA is authorized to publish and allow the download of maps resulting from the post-processing (e.g. data assimilation in meteorological models, spatial interpolation algorithms, etc.) of PWS data.
- **Italian Civil Protection Department (ICPD) dataset**: The Italian Civil Protection Department is designing and managing in real time risk reduction actions over the national territory, determined by high-impact adverse weather, through its Centro Funzionale Centrale (Central Functional Center), and coordinating a federated national Early Warning System, in collaboration with regional authorities. In this framework, ICPD manages a large number of in-situ authoritative weather stations: 6,059 rain gauges, 2,299 hydrometers, 4,373 thermometers, 1,270 barometers, about 2,500 anemometers, and finally 2,683 hygrometers. The data temporal resolution is approximatively 1 minute. CIMA archives and curates the aforementioned data on behalf of ICPD. These data can be made available to the LEXIS project (for environmental monitoring and civil protection Activities), via API based download services, pending the format approval of ICPD. The adopted format for the data dissemination is the Water Model Language (WaterML 2.03), which is a standard model for the representation of observation data in hydrology.
- **Opera radar dataset**: OPERA is the Radar Programme of EUMETNET. OPERA main objectives are to provide a European platform wherein expertise on operationally-oriented weather radar issues are exchanged, as well as to develop, generate and distribute high-quality pan-European weather radar composite products on an operational basis. Odyssey, the OPERA Data Centre, generates and archives composite products from raw single site radar data, belonging to the OPERA Radar Network, using common pre-processing and compositing algorithms: instantaneous surface rain rate, instantaneous maximum reflectivity, and one-hour rainfall accumulation. The composites cover the whole of Europe in a Lambert Equal Area projection. They are updated every 15 minutes and issued approximately 15 minutes after recording. Composites are available in two formats: BUFR and HDF5. Each file has two fields: the data field and the quality field. The data are provided via the Odyssey Data Collection And Production Centre. The OPERA products are available under a research and education license and will be used mainly for validation purposes.
- **Italian Civil Protection Department (ICPD) and MeteoFrance radar dataset**: in addition to the aforementioned Opera radar dataset the following data will be also available: for the period 1 June - 30 November 2018 reflectivity radar CAPPI (500 m vertical resolution over 500-12,000 m, 2.5 x 2.5km grid spacing) over the France territory at large. Provided in ASCII format to be stored on CIMA storage services, this data will be assimilated in the CIMA WRF regional forecast. For the period 1 June - 30 November 2018, reflectivity radar CAPPI (2,000-3,000-5,000 m, 2km x 2km grid spacing) over the Italian territory at large, in NetCDF format. These data will be assimilated in the CIMA WRF regional forecast.

- **Integrated Multi-satellitE Retrievals**: The Integrated Multi- satellitE Retrievals for GPM (IMERG) is the unified U.S. algorithm that provides the Day-1 multi-satellite precipitation product for the U.S. GPM team. The precipitation estimates from the various precipitation-relevant satellite passive microwave (PMW) sensors comprising the GPM constellation are computed using the 2014 version of the Goddard Profiling Algorithm, then gridded, intercalibrated to the GPM Combined Instrument product, and combined into half-hourly 0.1° x 0.1° fields. This algorithm is intended to intercalibrate, merge, and interpolate satellite microwave precipitation estimates, together with microwave-calibrated infrared (IR) satellite estimates, precipitation gauge analyses, and potentially other precipitation estimators at high-resolution time and space scales for the TRMM and GPM eras over the entire globe. The system runs several times for each observation time, first giving a quick estimate and successively providing better estimates as more data arrive. The final step uses monthly gauge data to create research-level products. Original data are provided in HDF5 and GeoTIFF10 file format through FTP and OPeNDAP service.
- **AIRPARIF dataset**: AIRPARIF is the French local air quality agency for the Paris area. One objective of AIRPARIF is to design and maintain an air quality measurement network. For its urban application, NUM will use the AIRPARIF as validation measurement. The useable data will be hourly measurement of Ozone (O_3), Nitrogen dioxide (NO_2) and Coarse Particulate Matter (PM10) at selected stations. Each station is able to sense a subset of the different pollutant, namely SO_2 - 5 stations, O_3 - 5 stations, NO_2 - 18 stations, PM10 - 9 stations. Raw data are encoded in CSV file format. The data used for the WP7 experiment (several days in 2018) will be available either by the WCDA API or the DDI system according to the final format used (netcdf or json).

2.4 TESEO: PROVISION OF IOT DATA

2.4.1 Objectives

TESEO is a system integrator who will facilitate gathering of IoT data from a variety of sources via IoT gateways. The smart gateway will collect and share some meteorological in situ observations (temperature, humidity, etc.) thanks to numerous weather stations spread over the territory.

2.4.2 Description of the provided data

The output will be measurement of temperature, humidity, wind and precipitation (and possibly other parameters related to air quality) parameters from IoT stations. The raw data are in JSON format and will be converted to BUFR/ODB2 for use with the WCDA API. The data will be private for internal use only for WP7.

2.5 CIMA: WRF REGIONAL FORECASTS

2.5.1 Objectives

CIMA exploits WRF regional simulations for various applications. For example, CIMA is currently running two different WRF model instances for operational purposes: WRF-1.5km Open Loop over Italy and WRF-2.5km 3DVAR currently over north-central Italy.

In the framework of LEXIS, specific WRF regional forecast will be performed in order to drive different WP7 applications.

2.5.2 Description of the model/application

The WRF (Weather Research & Forecast) model is a regional weather forecast model run by CIMA, taking initial and boundary conditions from ECMWF global weather forecast (IFS), combined with additional observations.

Figure 2 presents the case of the simulated domains which have been identified for the use with Continuum and RISICO applications over Italy (see details in sub-section after).

A first domain will cover part of Europe with a 22.5 km grid spatial resolution in order to integrate the global forecasts which are used as boundary conditions. A smallest European domain with a 7.5 km grid spatial resolution is required in order to avoid numerical problems due to the difference of spatial resolution between the first domain and the third one. This third domain covers Italy with a 1.5 km grid spatial resolution.

The domain 2 will be used for the agricultural application in France, whereas the domains for the industrial and air quality applications in France are still under discussion.

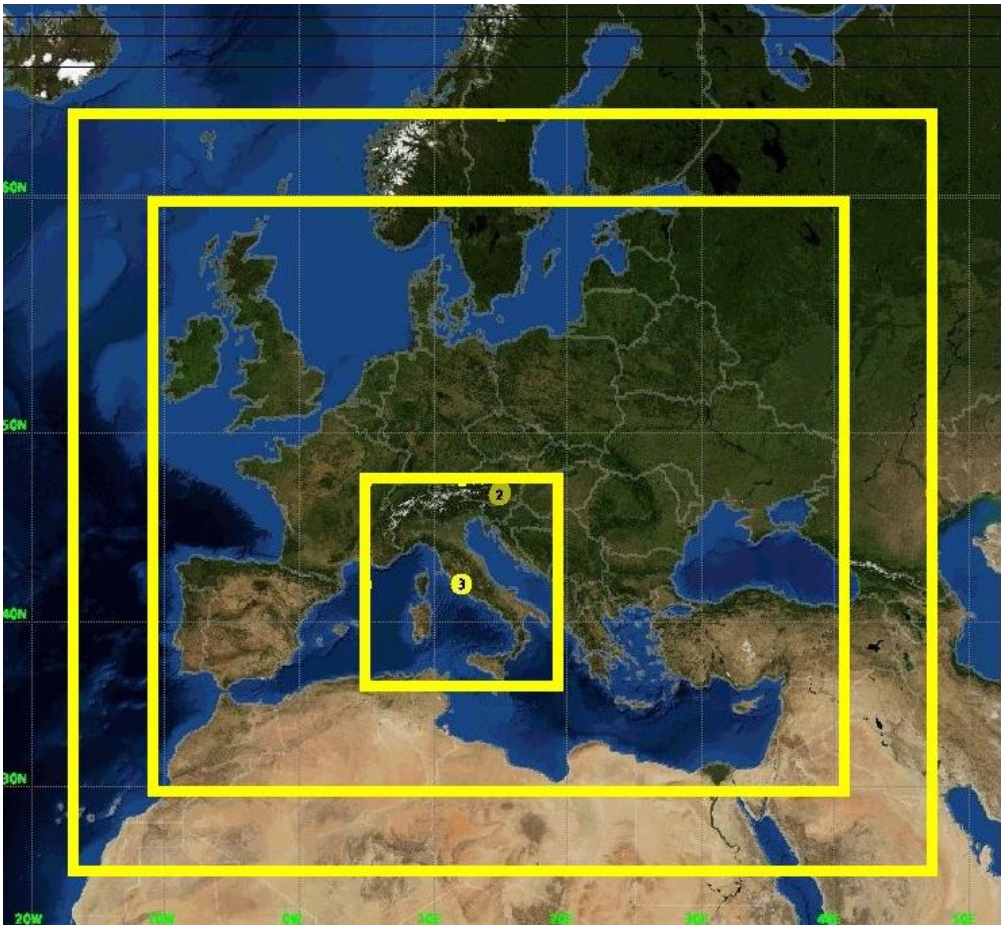

Figure 2 CIMA WRF regional simulation domains designed for the Italian WP7 use cases

WRF will be run in forecast mode in order to perform up to 48 hours of forecast. These simulations will consider specific days from May to November 2018 for which (i) provision of weather data from other WP7 applications are available and (ii) interest has been identified for the other WP7 application cases.

2.5.3 Input dataset

The following input dataset for initial and boundary conditions, as well as for data assimilation purposes will be used:

- IFS dataset:
  A regional simulation performed by a mesoscale model such as WRF requires initial conditions at the start of the simulation and boundary conditions during the whole simulated period (48 hours of forecast in this case). In the framework of LEXIS, these data will be managed by the WCDA API to extract parameters from the IFS global simulations. For the selected days (between May to November 2018), 48 hours of forecast weather data will be extracted with hourly resolution.
- Local in situ observations (radar and personal weather stations) as described in section 2.3.

2.5.4 Output dataset

The WP7 applications using the WRF regional forecast have identified a list of parameters (2D and 3D) to produce. The spatial resolution will depend on the location (Italy, France and Europe at large) according to the three simulation grids (22.5, 7.5 or 1.5 km spatial resolution) at an hourly resolution over 48 hours.

The format will be NetCDF.

These model outputs will be freely available and reusable via the WCDA API. This availability will be limited to the duration of the LEXIS project.

The listed surface parameters are: water vapour mixing ratio at 2 meters height, temperature and potential at 2 meters height, horizontal wind speed at 10 meters height, maximum wind speed at 10 meters height, surface pressure, lightning potential index, rain depth, snow depth, graupel depth, downward clear-sky short-wave flux at ground surface, downward short-wave flux at ground surface, planetary boundary layer height, upward moisture and heat flux at the surface, latent heat flux at the surface, maximum updraft and downdraft velocities, maximum radar reflectivity along the vertical direction, maximum updraft helicity, hourly mean vertical velocity, maximum hail diameter.

The listed pressure level data parameters are: wind speed, temperature, relative humidity, geopotential height, wind speed, dew point temperature and water vapour mixing ratio.

The WRF model output will be published on the myDewetra platform (Figure 3).

Figure 3 Example of visualisation of output parameters from CIMA WRF simulation (here maximum wind speed forecast at surface) published on myDewetra

2.6 CIMA: RISICO RISK FIRE MODELLING

2.6.1 Objectives

RISICO (RISchio Incendi e COordinamento/Fire Risk and Coordination) is a mathematical model developed by the CIMA Research Foundation to support operators in forest fire prevention activities. RISICO is powered by a continuous data flow consisting of meteorological information in real-time using both the weather forecast and satellite records. This information takes into account parameters such as the moisture content of the vegetation, the wind and the orography of the territory and allow to quantitatively assess the danger resulting from the eventual triggering of a forest fire both in terms of propagation speed and linear intensity of the flame front. The system transforms the weather variables into information concerning fire risk, and it returns a general indication of the areas where fire could be difficult to control.

2.6.2 Input dataset

The input to manage for this application is only parameters provided by the meteorological forecast:

- wind speed at 10 meters height;
- wind direction at 10 meters height;
- temperature at 2 meters height;
- rain depth at ground surface;
- humidity at 2 meters height.

In the framework of LEXIS, these data will be managed by the WCDA API to extract parameters from CIMA WRF Regional Forecasts. For the selected days (between May to November 2018), 48 hour of forecast weather data will be extracted at hourly resolution.

2.6.3 Output dataset

The output is hourly 2D ground surface parameters for the simulated domain: percentile rate of spread, mean rate of spread, percentile fireline intensity, mean fireline intensity, fire danger index, fire danger early warning.

In the framework of LEXIS, these parameters will be exported to LEXIS infrastructure by the WCDA API in NetCDF format. These data will be freely accessible and reusable. This availability will be limited to the duration of the LEXIS project.

The RISICO model output will be also published on the myDewetra platform (Figure 4).

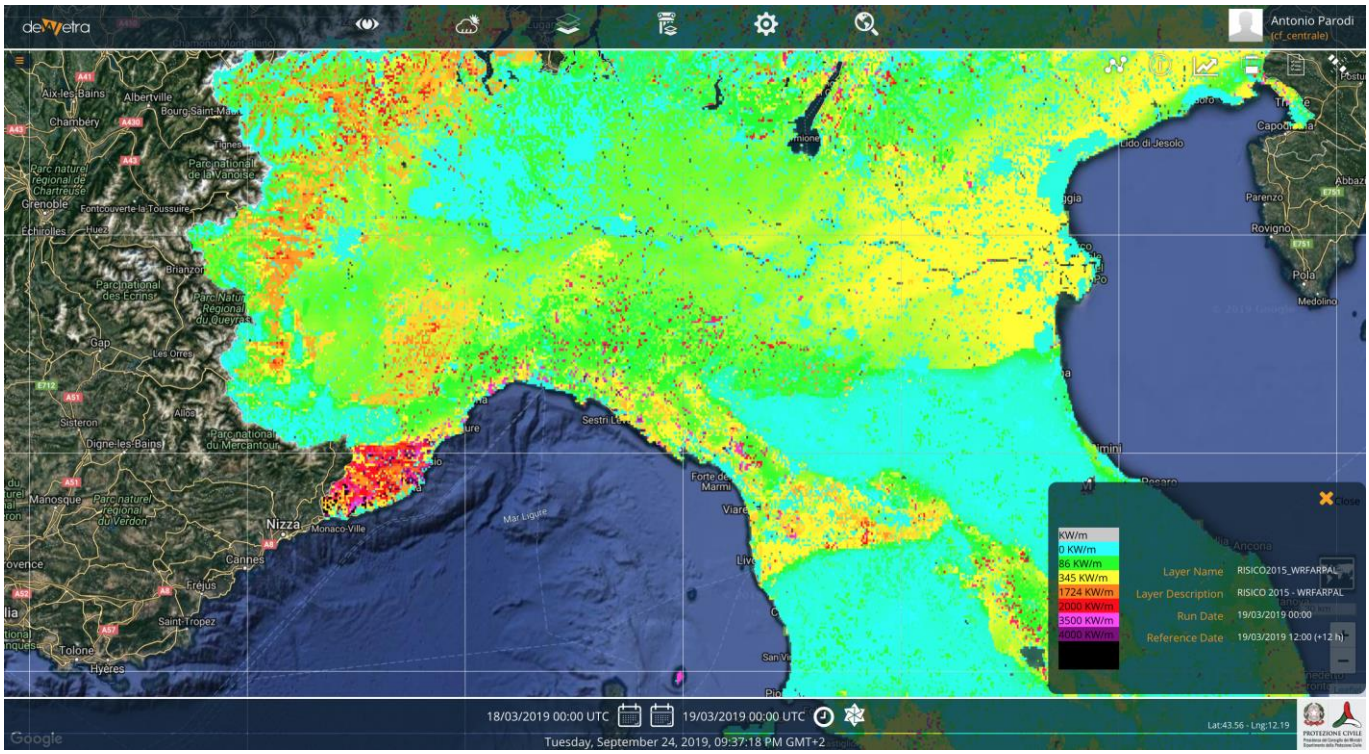

Figure 4 Example of visualisation of output parameters from RISICO simulation (here fireline intensity forecast at surface) published on myDewetra

2.7 CIMA: CONTINUUM HYDROLOGICAL MODELLING

2.7.1 Objectives

Continuum is a hydrological model developed by the CIMA Research Foundation to reproduce the flow of water within a basin, i.e. how much water passes into a given section of a river or a lake. Continuum is able to work both in the pre-event analysis and forecast phase and in the monitoring stage for the active control of hydrological events. The model has a reduced number of parameters and is also able to take advantage of all the information available via satellite.

2.7.2 Input dataset

The input to manage for this application is only parameters provided by the meteorological forecast:

- wind speed at 10 meters height;
- wind direction at 10 meters height;
- temperature at 2 meters height;
- rain depth at ground surface;
- humidity at 2 meters height;
- incoming solar radiation at ground surface.

In the framework of LEXIS, these data will be managed by the WCDA API to extract parameters from CIMA WRF Regional Forecasts. For the selected days (between May to November 2018), 48 hour of forecast weather data will be extracted at hourly resolution.

2.7.3 Output dataset

The output is:

- discharge time series at a given catchment cross section with a temporal resolution initially at 10 minutes aggregated to one hour;
- daily soil moisture map;
- daily evapotranspiration map.

In the framework of LEXIS, these parameters will be exported from the initial WATER-ML 2.0 to LEXIS infrastructure by the WCDA API in NetCDF or ODB/BUFR format (the option will be finalized in the next months). These data will be freely accessible and reusable. This availability will be limited to the duration of the LEXIS project.

2.8 NUM: INDUSTRIAL SO2 PEAK PREVENTION

2.8.1 Objectives

NUM has developed an application named Plum'Air© [4] in order to help industrial manager to prevent a possible air quality impact due to atmospheric release of an industrial site, e.g. chemical pollutants (NO_x, SO_2, HF, etc.) odours and all other gaseous/particulate releases in the atmosphere.

This application can work in near real-time (using of meteorological and emission observations) in order to survey the current impact or in forecast (using meteorological and emission forecast) in order to forecast the impact of the site and if needed/possible to manage this impact (change in production mode, activation of emission reduction system, etc.). The system can also manage accidental atmospheric release from the site and be running in simulation mode. Depending of the site, the characteristics of the emission (height of release, velocity of release, temperature of release, etc.) and the meteorology, the impact can be at very short distance (less than 1km) or at mid-distance (up to 20 km).

The first application of the system is from 2003 on the management of the SO_2 peaks of some TOTAL petroleum refineries. The objective is to avoid peak occurrences of 300 $\mu g/m^3$ or above in the proximity of a site. Beyond the accuracy of the dispersion model used (and its configuration for a site), in forecast mode one key element is the forecast of meteorological conditions in order to:

- Avoid false forecasted air quality peaks (e.g. due to forecast atmospheric stability which amplifies accumulation of pollutant near the surface. The consequence will be a change in operating mode of the site (activation of filtration equipment, use of products with higher quality, reduce the activity of some units and eventually stop them, etc.) and thus has a financial impact for the site;
- Miss peaks due to false forecast of meteorological conditions (e.g. forecast stronger wind speed than in reality) whereas the forecasted emissions are well-known.

Figure 5 presents an example of a dispersion map (maximum concentration over a period) obtained during a forecast.

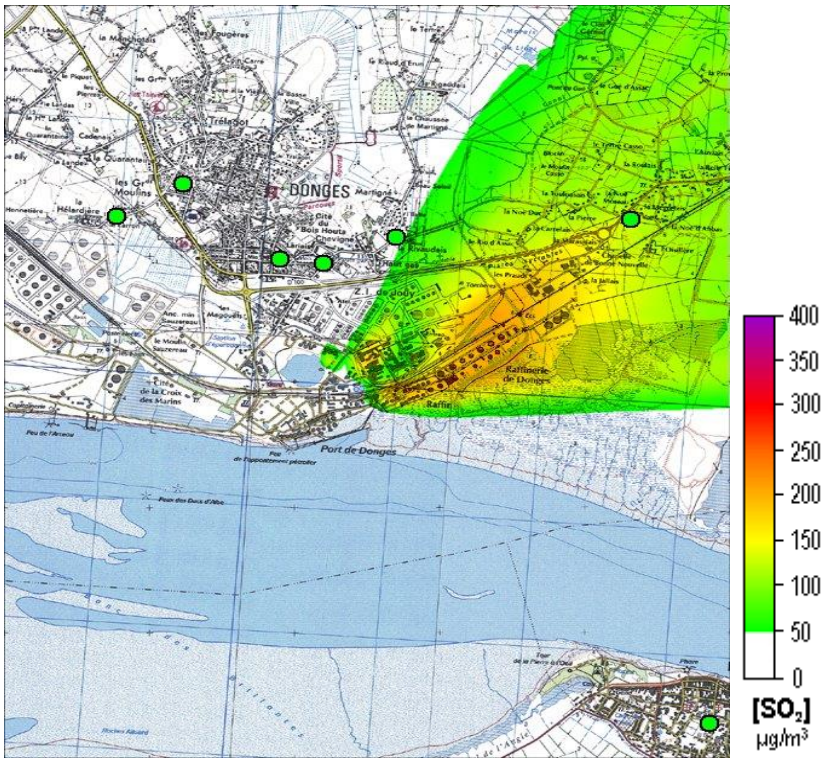

Figure 5 Example of SO_2 forecast map at ground surface (concentrations are maximum hourly concentration over a cumulative 24 hours period, green circles correspond to the localisation of air quality measurement stations used to evaluate the forecasts each day)

In the frame of LEXIS, the objective is to test the WRF regional forecasts managed by CIMA in order to evaluate the interest to use such a source. To do that, one industrial site located in Pays-Loire has been selected for which Plum'Air© was installed for several years (limited uncertainties in emission and model configuration).

Some episodes of 2018 have been identified (missing peaks, false peaks, well forecast peaks) and will be run with the WRF regional forecasts (CIMA) and compared to the 2018 operational forecasts.

2.8.2 Description of the model/application

In the case of the selected site, the model dispersion used is ADMS [4].

The ADMS model dispersion is a Windows program.

Based on the configuration of the simulation domain (topography, surface roughness, etc.), the physical configuration of the site (buildings, geometry of the release), an atmospheric dispersion calculation is performed from each release depending of the emission of the release and meteorological conditions. The objective is to analyse and manage SO_2 concentration forecast at ground surface.

The dispersion domain is a 10*10km domain in France centered at 47°18'38.07''N / 2°03'57.25''O with an irregular spatial resolution. Each day, a forecast of 72 hours is created and issued twice (one from 00 hours in coordinated universal time and one from 12 hours in coordinated universal time). During the LEXIS project, it has been decided to simulate forecast of some episodes in 2018. CIMA will run WRF regional forecast for selected days from May to November 2018. For these days, a forecast of 48 hours only will be done from t00 hours in coordinated universal time.

2.8.3 Input dataset

There are two input datasets to manage for this application:

- Input for emission forecast:

  In forecast mode, the application requires to know the forecast of emission in order to perform dispersion calculation. In practice for the selected site, this is SO_2 emission for each release points as well as a possible change in physical parameters of the emission (temperature of emission or velocity release).

  In the framework of LEXIS, this data will be csv files managed by the DDI system. This input data is private data.

- Input for meteorological forecast:

  In terms of atmospheric dispersion, three main kinds of parameters are required: parameters to describe general state of the atmosphere near the surface, parameters to describe the wind, parameters to describe the turbulence of the atmosphere near the ground.

  The following parameters will be then extracted:

  - wind speed at 10 meters height;
  - wind direction at 10 meters height;
  - temperature at 2 meters height;
  - rain depth at ground surface;
  - downward short-wave flux at ground surface;
  - planetary boundary layer height;
  - friction velocity at ground surface;
  - surface roughness;
  - heat sensible flux;
  - pressure at ground surface;
  - potential temperature at 2 meters height;
  - humidity at 2 meters height.

In the framework of LEXIS, these data will be managed by the WCDA API to extract parameters from CIMA WRF Regional Forecasts from surface to at least 5km in vertical. For the selected days (between May to November 2018), 48 hours of forecast weather data will be extracted at hourly resolution.

2.8.4 Output dataset

The original output of the dispersion calculation is 2D hourly concentrations of SO_2 at ground surface. In practice, this output will be considered as private (internal access to some LEXIS partners).

In the framework of LEXIS, in order to present some public results, two main results will be exported to the LEXIS infrastructure:

- For each simulation, SO_2 maximum hourly concentrations at ground surface per forecast day.
- For each simulation, hourly indicator if the threshold of 300 $\mu g/m^3$ is exceeded or not at specific locations for each forecast day.

This output will be managed by the DDI system.

2.9 NUM: URBAN AIR QUALITY FORECASTING

2.9.1 Objectives

NUM has developed an application named Urban'Air© [6] in order to provide various agencies (regional air quality agencies, environmental services of a city, etc.) with information about air quality in a city, mainly for regulated pollutants (SO_2, NO_2, O_3, PM_{10}, $PM_{2.5}$).

This application works in two modes:

- Analysis mode: each night a simulation of the previous day is run using as much as possible real emission data, meteorological observations, analysis data about background pollution, and local air quality observation to create the model's result. This allows to produce as much as possible a survey map of the air quality which had occurred in a region, and to produce statistical outputs for daily, monthly and annual reports.
- Forecast mode: this allows to evaluate the probability of occurrence of a pollution episode, generally due to adverse weather conditions. In this case, emission regulation politics can be deployed such as in France, speed limitation on roads or limitation zone of access to some vehicles.

For the forecast mode, as for the industrial case described before, one key point is to have the best meteorological forecast in order to:

- Avoid false forecasted pollution episodes in order to avoid the application of non-necessary emission reduction politics;
- Miss pollution episodes due to false forecast of meteorological conditions (e.g. forecast atmospheric stability which will disperse the pollution).

More than 30 cities in the world, mainly in France, but also Casablanca, Dubai, San Francisco, Helsinki are covered by Urban'Air© for different kind of clients. In the frame of LEXIS, it has been chosen to use the system installed for Paris. The objective is to test the WRF regional forecasts managed by CIMA in order to evaluate the interest to use such a new source of weather forecast. Some episodes of 2018 have been identified (missing episodes, false episodes, well forecast episodes) and will be run with the WRF regional forecasts (CIMA) and compared to the 2018 operational forecasts.

Figure 6 presents an example of air quality map (NO_2 mean concentration for one hour) obtained during a forecast.

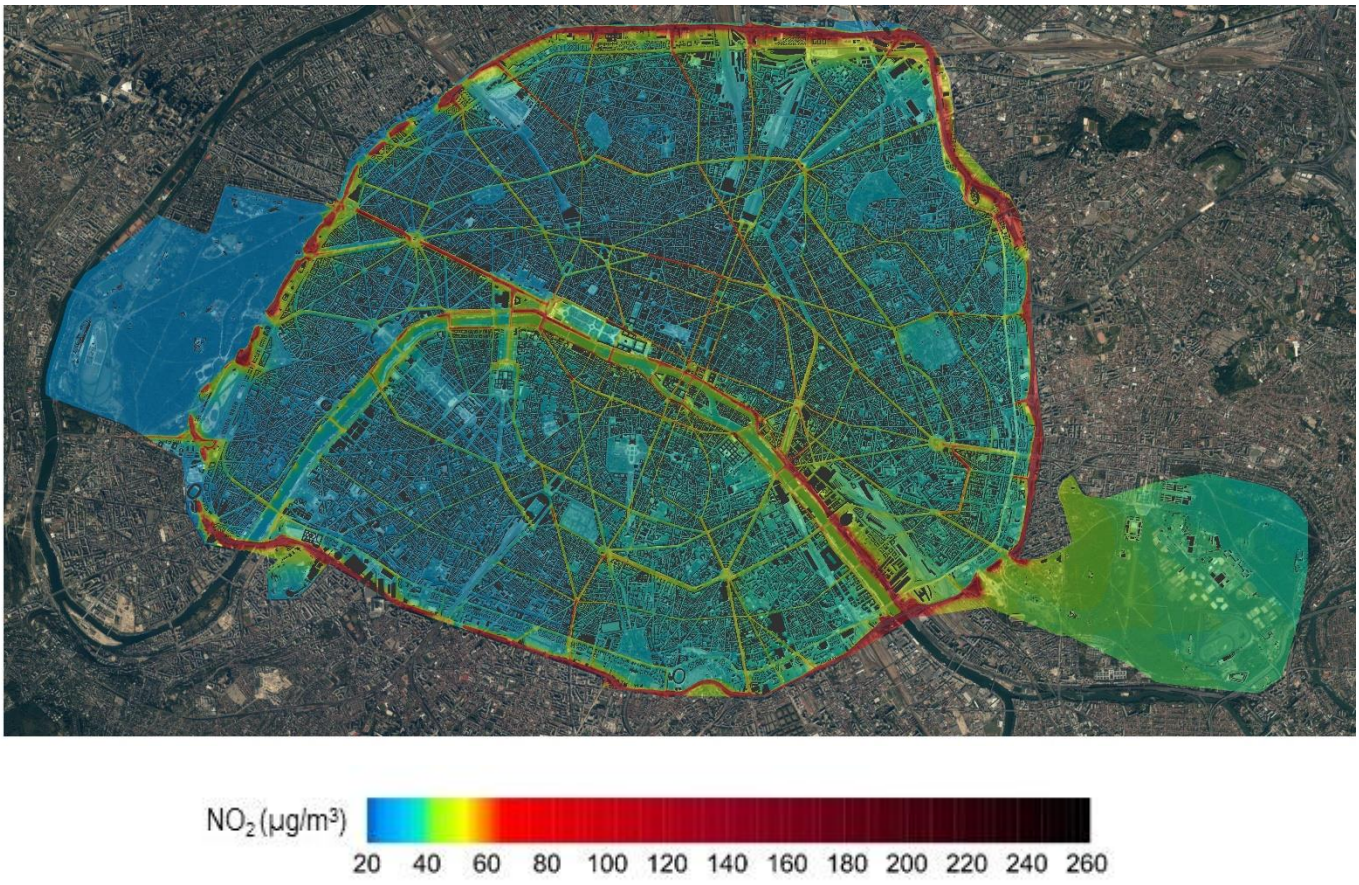

Figure 6 Example of hourly NO_2 concentration simulated at ground surface

2.9.2 Description of the model/application

The model dispersion used by Urban'Air© is ADMS Urban [7].

The ADMS Urban model dispersion is a Windows program.

The differences compared to the industrial case described in the previous sub-section are that:

- The simulated domains are generally much larger;
- The modelled emission sources are more important. Indeed, all kind of sources must be taken into account, that is to say industrial emissions in the domain, but also road emissions (due to traffic on each road), other transport emissions (ships, airplanes, train), residential emissions (for heating and/or cooling, etc.), agricultural emissions, natural emissions (biogenic emission, soil emission, etc.) and so on. These different sources are modelled by various objects (point, line, road, jet, surface, and volume) and heterogeneous size (meters for point/line to hundred meters for some surface sources).
- The background air quality (or long-range transport of pollutants outside the simulated domain inside it) must be considered due to the interaction in photochemistry.

Compared to the existing operational system for Paris, we decided to exploit the capacity of the LEXIS infrastructure, especially the number of available processors, by extending the simulated domain to the overall Ile-de-France region. Figure 7 presents an illustration of the modified domain.

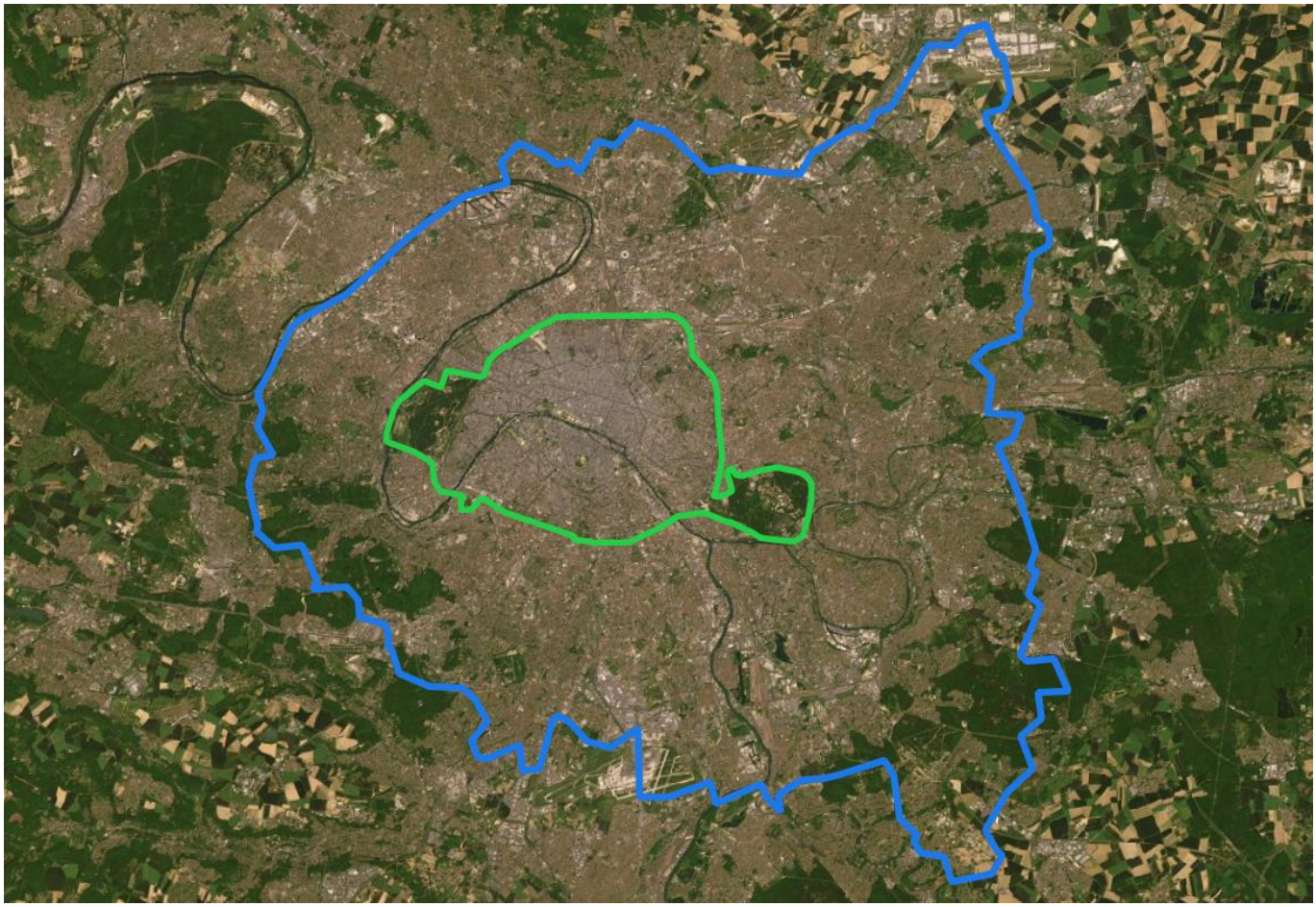

Figure 7 Illustration of the simulated domain for the LEXIS project (blue: full Ile-de-france region) compared to previous one (green: inner Paris)

For the LEXIS project, forecast of 48 hours for selected days inside the period from May to November 2018 will be performed.

2.9.3 Input dataset

At urban scale, it is generally difficult to forecast the real variation of each emission sources compared to an industrial site. The emission is then mainly modelled using emission factors (depending on the hour, day, week, month or season). Since these emission factors are directly integrated in the model for a city, the emission is not a dataset to import at the beginning of each simulation.

For urban simulation, there are two input datasets:

- Input for meteorological forecast:

  The parameters are similar to the industrial case described previously.

  In the framework of LEXIS, these data will be managed by the WCDA API to extract parameters from the CIMA WRF Regional Forecasts from surface to at least 5km in vertical. For the selected days (between May to November 2018), 48 hours of forecast weather data will be extracted at hourly resolution.

- Input for air quality background forecast:

  The simulation requires to know the air quality coming from outside the simulated domain to inside it.
  Urban'Air© system is coupled to various global / regional air quality forecast services, especially for Europe with CAMS service of Copernicus program[1].
  The parameters used are hourly 3D concentrations of different pollutants (NO, NO_2, O_3, PM_{10}, VOC, etc.). NUM will extract this data from the Copernicus Climate Data Store (CDS) and converted them to ascii files for exploitation with ADMS Urban. In the framework of LEXIS, the DDI system will be used to get files from NUM's servers to the LEXIS infrastructure. The WCDA API may provide a direct proxy to the CDS in the future, if this proves to be worthwhile.

2.9.4 Output dataset

The outputs will be hourly 2D concentrations of NO_2, PM_{10} and O_3 at ground surface.

In the framework of LEXIS, these parameters will be exported to the LEXIS infrastructure by the WCDA API in NetCDF format. These data will be freely available and reusable. This availability will be limited to the duration of the LEXIS project.

2.10 NUM: AGRICULTURAL DECISION MAKING

2.10.1 Objectives

Today, weather forecast is a key element in agricultural decision at different phases of a culture from seed to harvest. NUM provides weather forecast for LIMAGRAIN Company for Europe.

This LEXIS use case has the objective to evaluate how the weather forecast managed by CIMA (forecast exploiting the capacity of the LEXIS infrastructure in order to integrate much more observations data than before) could improve the decision made by LIMAGRAIN with their decision tools.

In order to have an agronomic evaluation of the quality of weather forecasts, the weather time forecast series will be analysed according to their impacts (simulated impacts by applying agronomic models which will make recommendations during some periods) on plant physiology, mainly on the way how weather conditions allow the

[1] Copernicus program: https://atmosphere.copernicus.eu/

accumulation of biomass by photosynthesis. Since these phenomena are accumulative in nature, only cumulative effects over quite long periods (typically several weeks) can be identified.

For the LEXIS project, the evaluation period will be limited to July 2018 and eventually August 2018.

For some geographical areas of interest, the contribution of the CIMA forecasts will be evaluated by comparing how the simulated yields approximate the real agricultural yields obtained with the 'real' weather data and compared to a conventional 'average' approach.

Three regions of France where contrasting weather conditions have been important in 2018 had been selected: the Limagne (Center of France), the Lorraine (North-East of France) and the Vendée ("West of France near the Atlantic coast).

2.10.2 Description of the model/application

Not available.

2.10.3 Input dataset

There is only one dataset to manage for this use case and which is the meteorological forecast.

The following parameters will be extracted:

- wind speed at 10 meters height;
- wind direction at 10 meters height;
- temperature at 2 meters height;
- relative humidity at 2 meters height;
- rain depth at ground surface;
- incident global solar radiation at ground surface;
- pressure at ground surface;
- downward short-wave flux at ground surface;
- upward short-wave flux at ground surface;
- downward long wave flux at ground surface;
- upward long wave flux at ground surface;
- altitude above sea (topography) used in the WRF model.

In the framework of LEXIS, these data will be managed by the WCDA API to extract parameters from the CIMA WRF Regional Forecasts. For one or two months from 1st July 2018, 48 hours of forecast weather data will be extracted at hourly resolution.

2.10.4 Output dataset

The output will be for each area/parcel, the difference of accumulated biomass (in t/ha) according to the simulated approaches (conventional approach or using CIMA forecast) and real observation.

These outputs will be available for internal use to limited LEXIS partners, by the way of the DDI system.

2.11 ITHACA: SOCIAL ECONOMICAL IMPACTS MODELLING

2.11.1 Objectives

Weather and natural hazard prediction at a regional scale, with the ability to predict high-impact natural hazards (e.g. flash-flood, forest fires etc.), will be used to: (a) proactively trigger satellite/aerial (manned/unmanned) data acquisitions and (b) increase the accuracy of current emergency mapping products.

2.11.2 Description of the model/application

This application will demonstrate the use of impact models to provide reliable quantitative assessments of socioeconomic impacts by using exposure information supplemented by model outputs from environmental forecasts.

2.11.3 Input dataset

The analysis will take advantages of weather data provided by LEXIS project, like:

(a) weather data e.g. wind speed and direction, temperature, rain depth, humidity, pressure, cloud cover (from WRF managed by CIMA);

(b) information regarding areas possibly affected by hydro-meteorological events provided by Continuum model managed by CIMA;

(c) information regarding fire danger (early warning) and fire spread provided by the RISICO model managed by CIMA.

The spatial resolution is variable considering that it is mainly influenced by the scale of the analysis. As a guideline, for a WRF model running at national scale, a 1 to 25 km spatial resolution and a 1 to 6 hours temporal resolution could be reasonable.

Regarding the Continuum and RISICO models, a continuous monitoring with a 20 to 250 m spatial resolution could provide useful information.

Preferred formats of the datasets that will be used as input are GRIB, NetCDF, JSON or equivalent.

2.11.4 Output dataset

The analysis will allow to efficiently manage the satellite images acquisition plan, i.e. to monitor potential critical situation and to trigger pre-tasking satellite acquisitions, in order to increase the possibility of having data acquired in the most critical phases of an emergency. In particular, the following outputs will be considered:

- abnormally high discharge values from the Continuum model;
- risk and early-warning information from the RISICO model;
- fire spread information from the RISICO model.

Moreover, model outputs could increase the thematic accuracy of the maps produced in the framework of Copernicus Emergency Management Service (CEMS) Rapid Mapping (RM) service, i.e.:

- discharge values from the Continuum model can be used to support the result of flooded areas extraction and evolution from remotely sensed imagery;

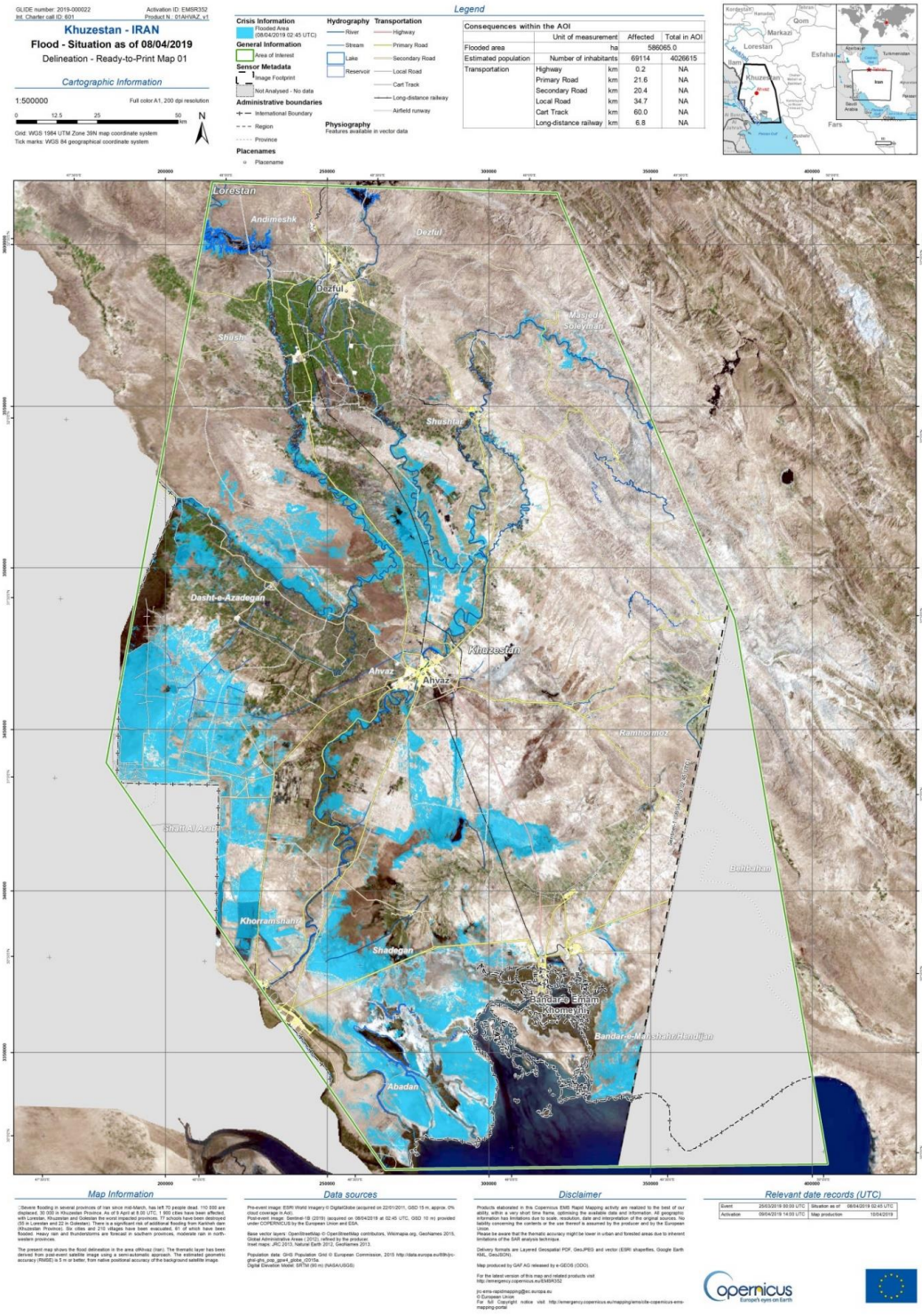

Figure 8 Flood mask extracted from Sentinel-1 imagery after a flood event in Iran (Copernicus Emergency Management Service (© 2019 European Union), [EMSR352] Kh: Delineation Map

- fire intensity and spreading from the RISICO model can be used to support the result of burnt areas extraction, impact and evolution from remotely sensed imagery.

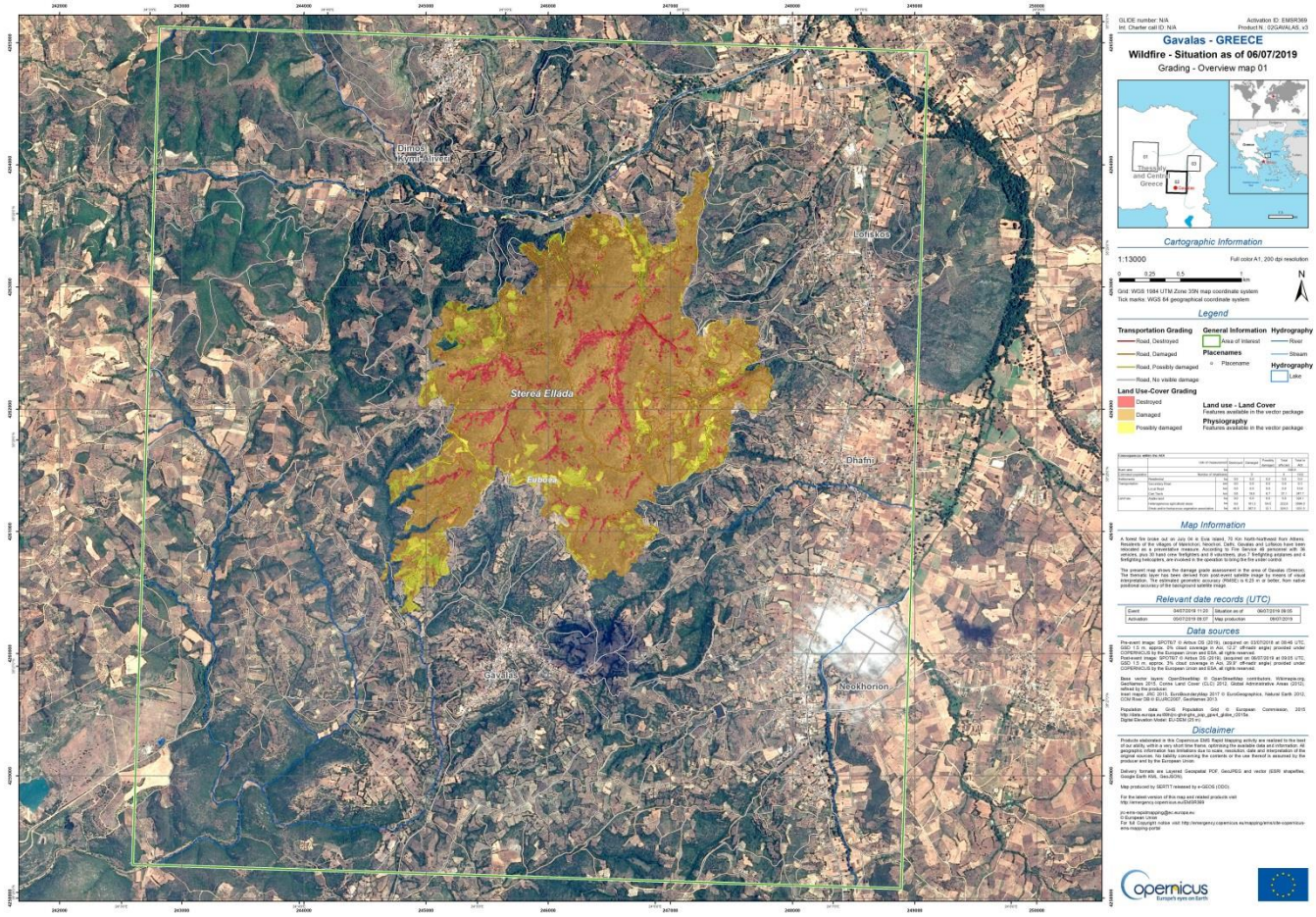

Figure 9 Forest fire grading of an event in Greece (Copernicus Emergency Management Service (© 2017 European Union), [EMSR369] Gavalas: Grading Map)

There will be no specific outputs into the LEXIS infrastructure for this use case.

2.12 ITHACA: EXTREME RAINFALL DETECTION SYSTEM

The Extreme Rainfall Detection System[2], developed and implemented by ITHACA, is a demonstration service for the monitoring and forecasting of exceptional rainfall events, with a nearly global spatial coverage. The information is accessible through a WebGIS application, developed in a complete Open Source environment

2.12.1 Objectives

The system has been designed for the monitoring and forecasting of exceptional rainfall events. More importantly, the system is able to provide alerts about heavy rainfall events, flash floods, convective storms, tropical storms, cyclones and hurricanes.

[2] Extreme Rainfall Detection System: http://erds.ithacaweb.org

2.12.2 Description of the model/application

The system takes advantage of two different rainfall datasets:

- One dataset is used for a near real-time rainfall monitoring: this is the NASA GPM (Global Precipitation Measurement) IMERG (Integrated Multi-satellite Retrievals for GPM) early run half-hourly data.
- One dataset is used for rainfall forecasting: this is the NOAA – NCEP GFS (Global Forecast System) deterministic weather prediction model [9].

The extreme rainfall detection methodology is based on the concept of activation threshold [10]: an event is identified when the rainfall exceeds a given threshold value. In other words, if for a selected time interval the accumulated rainfall exceeds the threshold, an alert is provided. The system is able to provide near real-time alerts about extreme rainfall events at the same resolution of input data.

2.12.3 Input dataset

The NASA GPM Mission provides different IMERG products since 12 March 2014. The IMERG algorithm was developed to intercalibrate, merge and interpolate satellite microwave precipitation measurements, microwave-calibrated infrared (IR) satellite measurements, rain gauge analyses and, potentially, other ancillary precipitation estimators. These gridded and georeferenced products are characterized by a spatial coverage between 60°N – 60°S and a spatial resolution of 0.1° x 0.1°. The products are provided at several temporal resolutions: 30 minutes, 3 hours, 1 day, 3 days, 7 days and 1 month. The data that were chosen for a near real-time extreme rainfall detection are the ones available in a grid format at a temporal resolution of 30 minutes. The other aggregation intervals would have led to a longer latency in the provision of alerts.

IMERG products are available in three different versions: early run (with a 4 hours latency), late run (with a 12 hours latency) and final run (with a 2.5 months latency). The early and late products are multi-satellite data. The final run is, instead, obtained taking advantage of a combination of information acquired from satellite and monthly rain gauges data. Considering the short delay in their availability, IMERG early half-hourly data can be used for near real-time flood risk monitoring applications.

The rainfall forecasting is instead based on NOAA - NCEP GFS deterministic weather prediction model, characterized by a spatial resolution of 0.25° x 0.25° and a spatial coverage between 90° N and 90° S. GFS model runs every day at 00, 06, 12 and 18 hours coordinated universal time. The rainfall monitoring based on forecast could take advantage of additional datasets, like WRF model output provided by CIMA.

2.12.4 Output dataset

NASA GPM data allows to provide near real-time information with a 30 minutes temporal resolution, with a 0.1° x 0.1° spatial resolution and a 4 hours latency. GFS data, instead, are currently downloaded every 12 hours, allowing to provide information with a 0.25° x 0.25° spatial resolution and at a global spatial coverage.

Several aggregation intervals are considered both for the rainfall amount evaluation (12, 24, 48, 72 and 96 hours) and for the alerts provision.

Both the accumulated rainfall data and the related alert data are published in the web. The publication is two-fold: on one hand, data are published in a georeferenced grid format (i.e. GeoTIFF); on the other hand, a map representation of the data is published, with the aim of allowing a quick check of the rain distribution and of the alerts. The first level of publication is performed by taking advantage of a web server software installed on a local server, the scope of which is to make the GeoTIFF files available for download through the http protocol.

As regards the second level of publication, the technology used is the Web Map Service (WMS).

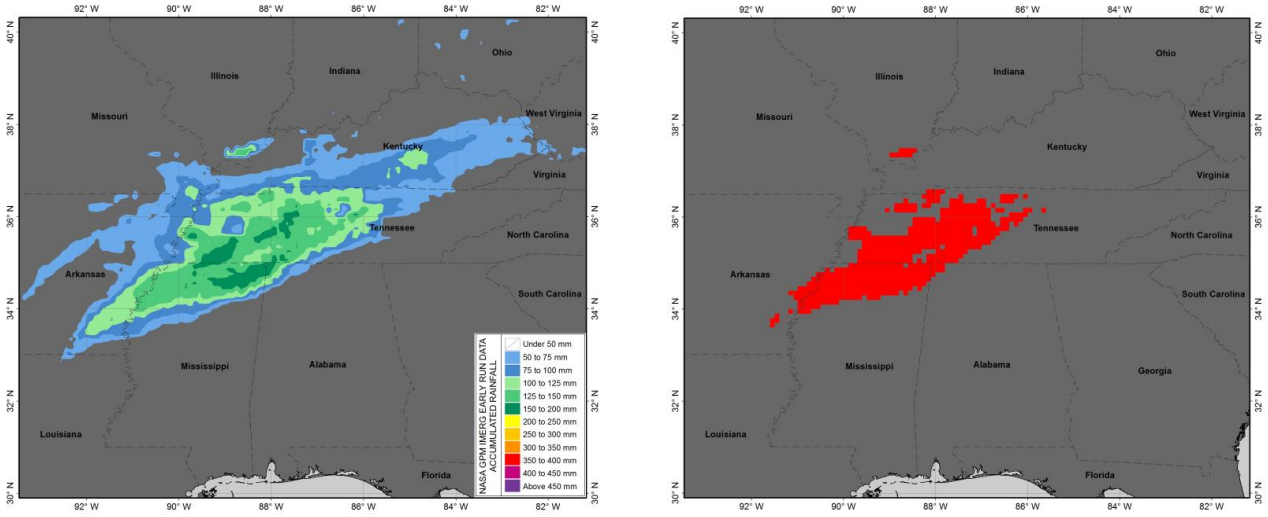

Figure 10 Example of ERDS output: 24 hours rainfall accumulation provided on 23/02/2019 at 10.59 UTC (left figure) and heavy rainfall alerts based on this output (right figure).

In the framework of LEXIS, in order to present some results, the following results will be exported to the LEXIS infrastructure:

- Hourly updates on the accumulated rainfall over the past 12, 24, 48, 72 and 96 hours in GeoTIFF format.

These outputs will be managed by the DDI system.

3 STATUS OF DEPLOYMENT IN LEXIS INFRASTRUCTURE

This section presents the current status of the deployment of each WP7 application, specially describing if the application has been ported only in a beta version in order to test numerical deployment or in a version close to the final use case targeted for the LEXIS project.

Concerning the data management, most of the components such as the WCDA API are planned to be operational in next months, so the management of the input/output data between each application is not yet operational at this stage.

3.1 ECMWF: PROVISION OF IFS GLOBAL FORECASTS

Since ECMWF's servers is considered as a part of the LEXIS infrastructure, the IFS forecasts generated by ECMWF are already considered to be performed on the LEXIS infrastructure. Such forecasts will be managed and provided by the WCDA API once it is operational.

The next step is to finalize the adaptation of the WCDA API and its implementation on all servers of the LEXIS infrastructure (LRZ, IT4I) in order to provide IFS forecasts to the various WP7 applications.

3.2 ECMWF: PROVISION OF MOJI MOBILE PHONE DATA

The contract for use of MOJI's data in LEXIS is currently under negotiation.

After reaching an agreement on a use policy for Moji data, the next step is to develop a mechanism to automatically translate the data into a format that is compatible with the WCDA API, or to develop new WCDA interfaces or components if required.

3.3 CIMA: PROVISION OF CITIZEN WEATHER OBSERVATION DATA

The provision is not yet operational. The work is in progress with TESEO to deal first on the management of input data outside the LEXIS infrastructure.

The next step is to work on providing output data using the DDI system or the WCDA API as specified in Section 2 for the different sources of dataset.

3.4 TESEO: PROVISION OF IOT DATA

The deployment of this application is covered by a specific deliverable D7.3 [8].

The smart gateway is in design step. For more details please refer to D7.3 [8].

The next steps are to: i) manage the communication with ECMWF for the sharing of the collected data, ii) build a prototype of the smart gateway and validate it, and iii) identify the geographic areas where to install the sensor nodes and the smart gateway.

3.5 CIMA: WRF REGIONAL FORECASTS

WRF model has been installed and tested in the LEXIS HPC infrastructure (LRZ cluster).

The next step is to work on exchange data (input and output) with the DDI system and the WCDA API.

3.6 CIMA: RISICO RISK FIRE MODELLING

RISICO model has been installed and tested in the LEXIS cloud infrastructure (LRZ cluster), and preliminary tests have been done.

The next step is to continue to work on the porting and on the exchange of data (input and output).

3.7 CIMA: CONTINUUM HYDROLOGICAL MODELLING

Continuum model has been installed and tested in the LEXIS cloud infrastructure (LRZ cluster), and preliminary tests have been done.

The next step is to continue to work on the porting and on the exchange of data (input and output).

3.8 NUM: INDUSTRIAL SO2 PEAK PREVENTION

A package of the ADMS model, including final configuration of the simulated site, is deployed in the LEXIS cloud infrastructure (IT4I cloud).

Testing simulations have been performed in order to check the validity of the porting and the integrity of the outputs. The model is ready to be run for the operational phase of the LEXIS project.

For the porting and the test, input dataset has been manually copied in order to launch simulation.

The next steps are: i) to manage the execution of the forecast simulation with the LEXIS components, ii) to manage the import of input data by the WCDA API (which are outputs of the CIMA WRF regional forecast) and the DDI system (emission forecast stored on NUM servers), and iii) to manage the export of output in the LEXIS infrastructure using the DDI system in this case.

3.9 NUM: URBAN AIRQUALITY FORECASTING

A package of the ADMS Urban model is deployed in the LEXIS cloud infrastructure (IT4I cloud).

Testing simulations have been performed in order to check the validity of the porting and the integrity of the outputs. This test has used a limited number of processors compare to the target of 50 cores.

The model is ready from informatics point of view to be run for operational phase of the LEXIS project, except that the configuration installed today corresponds to the inner Paris region. Modelling of the full Ile-de-France region is in progress and will be deployed in the next months.

For the porting and the test, input dataset has been manually copied in order to launch simulation.

The next steps are similar to the industrial use case, that is to say: i) to manage the execution of the forecast simulation with the LEXIS components, ii) to manage the import of input data by the WCDA API (which are outputs of the CIMA WRF regional forecast) and the DDI system (global air quality forecast stored on NUM servers), and iii) to manage the export of output in the LEXIS infrastructure using the DDI system in this case.

3.10 NUM: AGRICULTURAL DECISION MAKING

This application is not concerned by a porting in the LEXIS infrastructure. Simulations will be performed on LIMAGRAIN servers.

The management of the input dataset, which concerns extraction of the CIMA WRF regional forecast by the WCDA API, is not yet operational.

The next step is to implement the LEXIS component in order to manage input required for the agricultural simulations outside the LEXIS infrastructure and to provide outputs in the LEXIS infrastructure for the LEXIS exploitation.

3.11 ITHACA: SOCIAL ECONOMICAL IMPACTS MODELLING

This application is not concerned by a porting in the LEXIS infrastructure. The analysis will be conducted off-line once the outputs of all the other applications will be available.

Concerning the input, the link to the outputs from other WP7 activities using the WCDA API or the DDI system is not yet developed and is the next step for this use case.

3.12 ITHACA: EXTREME RAINFALL DETECTION SYSTEM

ERDS is currently running on a server owned by ITHACA. The system will be ported in the LEXIS cloud infrastructure (IT4I cloud) in the next months.

3.13 SYNTHESIS OF THE DEPLOYMENT

The Table 1 presents a synthesis of the current deployment of each WP7 applications in the LEXIS infrastructure:

- "Input data" concerns the management of data by the WCDA API or the DDI system. It can be dataset from a WP7 application or from external providers.
- "Execution" concerns the informatics deployment of each model's application in the LEXIS infrastructure, and if this deployment has been done in a beta test version or in a final configuration.
- "Output data" indicates if the management of the output data in the LEXIS infrastructure is operational or not.

APPLICATIONS	INPUT DATA	EXECUTION	OUTPUT DATA
PROVISION OF IFS GLOBAL FORECASTS (ECMWF)	Not concerned	Fully operational	Not yet available through the WCDA API (work in progress).
PROVISION OF MOJI MOBILE PHONE DATA (ECMWF)	Not concerned	Not yet implemented	Not yet available through the WCDA API (work pending).
PROVISION OF CITIZEN WEATHER OBSERVATION DATA (CIMA)	Not concerned	Not concerned	Not yet (required WCDA API or DDI system)
PROVISION OF IOT DATA (TESEO)	Not concerned	Not yet ported	Not yet (required WCDA API or DDI system)
WRF REGIONAL FORECASTS (CIMA)	Not yet (required WCDA API or DDI system)	Ported and tested in beta version	Not yet (required WCDA API or DDI system)
RISICO RISK FIRE MODELLING (CIMA)	Not yet (required WCDA API or DDI system)	Ported and tested tested in beta version	Not yet (required WCDA API or DDI system)
CONTINUUM HYDROLOGICAL MODELLING (CIMA)	Not yet (required WCDA API or DDI system)	Ported and tested in beta version	Not yet (required WCDA API or DDI system)
INDUSTRIAL SO2 PEAK PREVENTION (NUM)	Not yet (required WCDA API or DDI system)	Ported and operational in final version	Not yet (required WCDA API or DDI system)
URBAN AIR QUALITY FORECASTING (NUM)	Not yet (required WCDA API or DDI system)	Ported and operational in beta version	Not yet (required WCDA API or DDI system)
AGRICULTURAL DECISION MAKING (NUM)	Not yet (required WCDA API or DDI system)	Not concerned	Not Concerned
SOCIAL ECONOMICAL IMPACTS MODELLING (ITHACA)	Not yet (required WCDA API or DDI system)	Not concerned	Not Concerned
EXTREME RAINFALL DETECTION SYSTEM (ITHACA)	Not yet (required WCDA API or DDI system)	Not yet ported	Not yet (required WCDA API or DDI system)

Table 1 Synthesis of the WP7 application's deployment in the LEXIS infrastructure

4 STATUS OF DEPLOYMENT OF THE WCDA API

WCDA API will provide a RESTful API for insertion and retrieval of a set of curated meteorological datasets, from IoT observations to global NWP model output.

In Table 2 we provide a preliminary design of the WCDA endpoints:

POST /auth/users	Post user attributes (to be integrated with Lexis AAI)
POST /auth/tokens	Return a session token (to be integrated with Lexis AAI)
POST /requests	Post user request (collection, domain, time-range, …), returns request {hash}
GET /requests	Return available user requests
GET /requests/{id}	Return request details (json)
DELETE /requests/{id}	Removes a request from the system
GET /collections	Return list of available collections (json)
GET /collections/{id}	Return a collection details (json)
GET /downloads/{hash}	Return data (GRIB, ODB, …) associated with {hash}

Table 2 Preliminary Design of WCDA Endpoints

The WCDA API will be deployed on the three large LEXIS computing centres: ECMWF, IT4I and LRZ with a first deploy within M15 (March 2020). WCDA Instance at ECMWF will have access to MARS archive and will act as a proxy accessible from WCDA instances on the other computing resources.

5 SUMMARY

This document presents a description of each WP7 use cases and the current status of their deployment in the LEXIS infrastructure.

Most of them have been ported and tested on LEXIS cloud/servers.

The main next task is now the management of input/output in this infrastructure by the mean of the DDI system or the WCDA API (in development).

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[3] LEXIS Deliverable, *D7.2 Architectural Requirements and System Design for Interchange of In-situ Unstructured Weather& Environmental Observations.*

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