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Communicating Dispersion Modelling Results to the Public

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Abstract

The PUBPLUME project addresses use of dispersion prognosis as a tool in public communication during a nuclear or radiological accident. The motivation is experience from the Fukushima accident when such products where asked for by the media. The project aimed at making a guideline on how such prognoses can be produced and designed in a way that makes them comprehensible for the general public. Second, it aimed at establishing a common Nordic guideline in order to establish trust in such products across borders.

The report gives an overview of what kind of dispersion products are available today, the main sources of uncertainty and how to handle them. It summarises important requirements for successful public communication in a crisis situation in order to justify use of dispersion prognoses. Finally, it gives examples of dispersion prognoses for public use, and discusses their content and attributes.

Key words

Dispersion prognosis, public communication, decision support systems, emergency management

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Communicating Dispersion Modelling Results to the Public

Final Report from the NKS-B PUBPLUME activity

(Contract: AFT/B(12)7)

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1. Introduction_Toc379956634

NKS PUBPLUME is a common Nordic guideline for publishing atmospheric dispersion model products to the public and media during a nuclear and radiological incident or accident. This guideline should make publication of such products more effective and with a level of quality that reflects the risk and probability of such an event.

Media is well aware of products that show how a release is dispersed in the air and can affect the environment and population. This was confirmed during Fukushima accident when media asked for images that showed the dispersion of the release from Japan and eventually its arrival in Europe. Similar products have lately been seen during the volcanic eruption at Eyjafjallajökull (2010) and Grimsvötn (2011).

All Nordic countries use atmospheric dispersion models to simulate the release and transport of radioactive material from a source into the air. These tools are primarily used to determine the risk related to a release, for instance if and when a release will arrive, and the radiological consequences. They can also be used to make public information, but this raises new questions like what kind of product to present, how to explain the risk and uncertainty. A picture of a plume can be a good visual presentation, but it needs to be presented in a way that reduces the risk of human misunderstanding.

A decision not publish such products may be a bad idea. If a national authority doesn't provide it, media and public might just as well find it through another source. This is highly likely in today's society with information more or less floating free on the Internet. A responsible national authority should be the main supplier of such products because they have the knowledge to make the dispersion results based on status and facts about the source, the knowledge to explain what the results show, and the capability to continuously update the products to reflect the changes at the accident site.

The reasons for making it a common Nordic guideline are several. Information travels even faster within this region. If one national authority decides to publish a dispersion it will mostly likely also show up in rest of the region. If a common Nordic guideline is established and implemented, the other countries should have a higher degree of trust in a neighbour's product. There is already tight Nordic cooperation between experts on dispersion modelling, on nuclear emergency preparedness and response and on public information, so making it common Nordic guideline adds more to an existing cooperation.

Dispersion products to the public are relevant for the several types of accidents.

- Accident at nuclear power plants or fuel processing plant.
- Accident with nuclear powered vessel. The inventory in marine reactors will 10 times lower than in a typical power reactor.
- Accidents at research reactor.

- Accidental release from isotope production facility.
- Accidental melting of radioactive source at metal foundry.
- Malicious acts
- Forest fire in contaminated area.

1.1. What this report doesn’t cover

This report gives general advice on publishing dispersion prognosis to the public. It focuses mainly on how to present products in a way that the public can understand it, and maintain the integrity of the message that should be communicated. It gives and overview of uncertainty in dispersion modelling and how take this into account in the presentation.

The report does not look at administrative issues like who are responsible for production and approval, and how responsibility is divided between different experts (meteorologists, communication expert, radiation protection experts). These issues should be solved within the country through written procedure. It should cover who is responsible for production, quality assurance, approval and dissemination. It is very important that a meteorologist verifies the prognosis behaves as expected based on his understanding of the weather forecast.

2. Public communication in a crisis situation

Public communication is a key factor for a successful response to a crisis. Primarily the public must be made aware of the situation and what the potential consequences are, and which actions are being taken to protect them. The message should answer common concerns raised by the public. Typical concerns are related to own health and safety (“Am I safe?”, “What are the consequences for me?”), related to self-protection (“What should I do now?”) and related to long term consequences (“What is the risk?”). Second, “public” is not just one general group. It will consist of people who are directly affected by the accident because they live there, happened to be there, or have a business inside the area. It will be relatives who are concerned. Then it is the rest of the population, the media and other groups who have general or special need for information.

There are several publications that cover crisis communication. Seeger (Seeger, 2006) draws up best practice in general crisis communication, while IAEAs TECDOC-1162 (IAEA, 2000) provides general guideline for public communication in radiological emergencies.

In connection with this work it is worth mentioning a few points from these publications. Seeger points out that maintaining honesty, candour and openness is critical for most crisis communication. Honesty builds credibility and trust. Lack of openness can result in the public will obtain information from other sources. Further, the responsible organisation can lose the ability to manage the crisis message. Candour refers to communicating the entire truth as it is known, even if it may reflect negative on the communicator. Second, Seeger emphasises that uncertainty and ambiguity inherent in a crisis situation must be acknowledged. Delaying information until all facts are available and reducing the uncertainty may lead to warnings being issued to late.

TECDOC-1162 mentions several key objectives for crisis communication: to make the public aware of the situation, to prevent rumours and conflicting information, to maintain the credibility of the Authorities and other organizations, to allow those who are operationally dealing with the emergency to concentrate on that function, and to reduce the psychological impact. On the issue of how to communicate, it is important to use terms that are simple and easy to understand and avoid technical jargon. This is challenge for accidents that involves radiation. Knowledge about radiation in the population is generally low, hence requires a well-developed information strategy. IAEAs “EPR – Public Communication” (IAEA, 2013) provide practical guidance for public information officers on the preparation for and response to a nuclear or radiological emergency.

Dispersion prognosis gives valuable knowledge about the potential consequences if a nuclear or radiological release to the atmosphere should occur. It is part of the information basis for making decision on protective measures to reduce exposure to the population. Before a release takes place, the prognosis can indicate which areas are likely to be affected and the transport time from release point to these areas. During and after a release the dispersion prognosis can give prognosis on effective dose and levels of contamination, which can be used to highlight areas that should get priority when planning field measurements. At some point in time dispersion prognosis will be of less importance since measurement data will give a more accurate picture of the consequences.

Hence a dispersion prognosis is most valuable as a product to the public in the early phase when release is ongoing or is likely to occur in the near future. In this phase such products can help explain to the public why the authorities have decided on specific actions and at the same time show openness by sharing information that was the basis for the decision.

People living close to a nuclear power plant are well informed about the risk and what to do in case of an emergency. They live within an emergency planning zone where actions taken will be based on the status of the nuclear power plant, and not the presence of a release or radioactivity in the environment. It is planned this way because when a release actually starts, it is too late to activate counter measures.

For accidents at nuclear power plants the dispersion products should primarily target rest of the population who do not live within a planning zone or similar. This also applies to other accident scenarios where public use of dispersion models makes sense.

3. The basics of atmospheric dispersion modelling

Atmospheric dispersion modelling is a simulation of how air pollutants disperse in the atmosphere. The Simulations are performed on computers and require **weather data** and **source term** as input to the model. Depending on the complexity of the simulation, the weather data range from simple observation to global numerical weather prediction data.

Simple data may give a rapid estimate of the dispersion on a local level over a short time, while complex models can simulate dispersion over a country or continent over several days. The source term is a parameterised describes of the release itself. It includes information like location of the release, release time and duration, and amount of material released.

All Nordic countries use atmospheric dispersion modelling to simulate the dispersion of radioactive material from a source. The capabilities are available as cooperation between the national meteorological institutes and radiation protection authorities. Meteorological institutes provide the model and the numerical weather predictions. Radiation protection authorities are the main users and have the knowledge to specify the source term and interpret the results.

3.1. Source term

Source term is a description of the amount of radioactive material released from a nuclear accident. It contains the starting time of the release and how much (in Becquerel) is released of each isotope per time unit. In addition it may contain other parameters which are important for simulating the release, for instance geographical coordinates of the location and the release height. From a crisis management perspective knowing the source term is important because it can help to understand the actual or potential consequences of a release, and use this to plan which actions to take.

The location of the source is usually available either through the operator or from different services like IAEA PRIS database or by just searching for the source on the internet. For moving sources like nuclear powered submarines and icebreakers the exact location may be more difficult to find in an early phase. Yet this information is usually available after some time. For surface ships the information will be available from the coastguard.

The starting time of a release will normally be well defined if the release has actually occurred. It does depend on if it is a controlled release or not. If it is a controlled release the operator will be able to give this information. If the release is not controlled, which was the case for Fukushima and Chernobyl, the time of explosion or other destructive event may be used as the starting point. If a release is foreseen in the future, the release can be modelled by doing several releases the coming hours and analyse the stability.

The amount of radioactive material released into the environment is without doubt the most difficult parameter to determine, but also a very important one because it is required for assessment of radiological consequences. The theoretical total amount, referred to as reactor inventory, can be calculated based on the reactor type, fuel type, degree of enrichment and fuel lifecycle.

The UNSCEAR report on the Fukushima accident (UNSCEAR, 2013) refers to two different approaches to determine the amount released into the environment. First is using advanced reactor simulation codes. These codes require information about the status of the plant and actual or postulated events that have occurred during the progression of the accident. Results from these codes have high uncertainty, especially because of lack of exact information about what has happened at plant. This information will be even more difficult to get hold on with increasing problems at the site.

The second approach UNSCEAR refers to is to determine the amount released based on actual measurements. Estimate from an existing dispersion prognosis is compared to one or more measurements (i.e. dose rate, air concentration or deposition) at different locations. Estimated and measured values are used as input to simple or complex methods for optimisation of the source term. A simple method is adjusting the release to fit the measurements. In the end this will reduced difference for each location when the prognosis is re-ran with new source term, and assume that values for non-measured locations are more correct. This method is only applicable if there is an actual release and measurements are available. Also simple optimisation methods do not take into account the uncertainty in meteorology, dispersion model or measurements.

To summarise the source term is unfortunately not known under a serious accident, and early estimate can be order of magnitudes different. The possible effect in public communication of this difference is illustrated in Figure 1 where two dispersion prognoses simulating release from Ringhals are overlaid. All parameters except for the amount of activity released are the same. Blue is a 1% release and grey is 10% relative to reactor inventory. The plumes represent areas where the deposition exceeds 100 kBq/m^2. An increase by a factor of 10 will render more areas contaminated with this level. The recommended approach is to make dispersion products intended for the public independent of a source term, unless a reasonable one can be estimated from measurements or other means.

Figure 1: The plot shows which areas are contaminated by more than 100 kBq/m^2 Cs-137 for two different releases. The only difference is the amount of activity released. Grey area is a 10% release and blue is 1% relative to reactor inventory.

3.2. Uncertainty in meteorology

Uncertainty in dispersion model arises from uncertainty in the meteorology in addition to the source term as discussed in previous chapter. In simple terms uncertainty in meteorology can affect the direction of the plume, spatial extent, and consequences derived from the amount of radioactive material in the plume. All are important factors that should be accounted for when presented to the public.

The dispersion calculation will normally use data from an advanced Numerical Weather Prediction (NWP) model. The NWP model will calculate a matrix of meteorological data for every 1 or 3 hours for the next 2-5 days, the one hour model resolution will normally give a more precise calculation close to the release point where sea- and land breeze is present. The dispersion model will amongst other parameters use the wind speed, rain and temperature.

The best model used in Scandinavia has horizontal resolution of 3-15 km in up to 50 vertical layers describing the atmosphere up to 40km. If the high-resolution NWP model is initialized with high resolution monitoring data from satellites, meteorological towers etc. a high resolution NWP model will normally produce better results in complex terrain and complex land sea areas. The NWP models are updated every 6 or 12 hours. For every NWP run a new forecast is produced. Using 6 and 12 hours data will normally produce different results.

Up until recently quantifying uncertainty in meteorological forecast has not been possible, but recent development in numerical weather prediction includes methods which makes this possible. NKS project MUD (Sørensen et.al. 2013, 2014) has investigated the application of such methods for modelling of a nuclear release. To explain the uncertainty in the meteorological forecast, the ensemble forecasting system with up to 25 slightly different forecasts has been tested in the project. Depending on the meteorological situation, the uncertainties can be large, up to a factor of ten for certain meteorological conditions. The project aims to make this method available for operational use which will include visualisation of the uncertainty.

Without a dedicated tool for assessing the uncertainty, meteorological predictions should be used and accepted as they are. But all dispersion products should be controlled by a meteorologist who is capable of comparing the dispersion with the weather condition and prognoses at the site, and determine if the dispersion is plausible or not.

4. Types of dispersion products

There are several ways to illustrate the dispersion of a radioactive plume. Graphical presentation may reflect one or more of the quantities that a dispersion prognosis can output, for example spatial extent, time, concentrations and dose. Quantities with a value range can be visually enhanced by displaying this range through colours for each grid cell or contour lines for different threshold levels.

4.1. Trajectory

Trajectory is the simplest way to visualise a dispersion prognosis. It is a line made by releasing one particle and track the path it follows when it transported in the model. It only requires location and time of release, and no release rate. This makes it suitable as an early estimate of the plume direction and speed. But they don't say anything about the spatial extent, and are not usable to illustrate a long release where wind conditions change at the release point.

Figure 2 shows an example of trajectories made with the ARGOS Decision Support System (Hoe et.al. 1999). Each line represents different release heights above ground level, and the circles indicate the progress in time. This default presentation from ARGOS is not directly suitable for the public. First, different release height is not necessarily easily comprehended. Second, without any knowledge of where the release point is, it is not precise which direction the trajectories are going.

Figure 3 shows a trajectory made by STUK with intention of public dissemination. Unlike the first example, this shows only one trajectory with clear indication of which direction it is heading. Also the time steps are clearly labelled with hours. This example is probably more suitable for public release.

Figure 2: An example of trajectories made using the ARGOS DSS. Each trajectory represents a specific release height.

Figure 3: Trajectory plot made by STUK.

4.2. Plume dispersion

Visualising the dispersion of a plume gives a picture of the spatial extent, and radiological consequences if a plausible source term is applied. It can display several different quantites. Direct output from the model may include air concentration (in Bq/m3), time integrated air concentration Bq*s/m3, ground deposition (Bq/m2) and time of arrival. From this other quantities can be derived, i.e. effective dose, dose rate or operational intervention levels. What type of model used also affects the output. Most common are puff models for short and medium range models (<500 - 1000 km) and particle model for medium and long range (up to global). Figure 4 shows direct output from two models of both types. Particle models tend to be patchier at the edge of the plume.

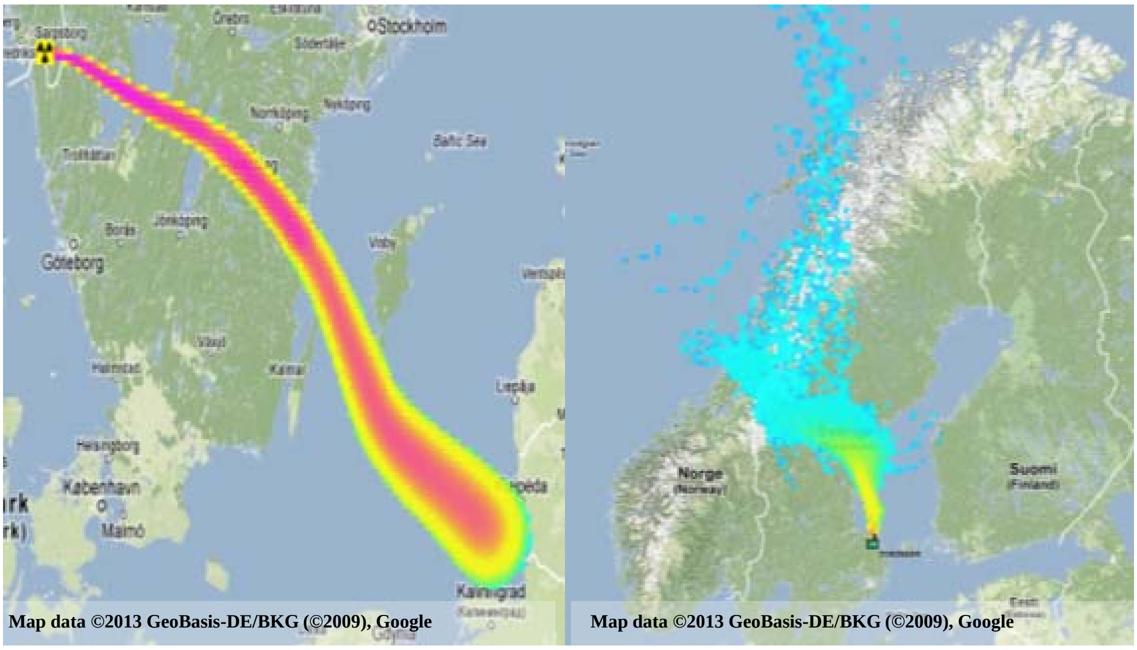


Figure 4: Output from two different types of dispersion models. Left is Norwegian long range model SNAP (particle model). Right is Danish medium range model RIMPUFF (puff model). Both shows output as time integrated air concentration with unit Bq*h/m3.

None of the outputs give much information without knowledge about quantity and what the levels mean. Adding contour line for certain threshold values (as shown in figure 5) the levels becomes easier to read. When using contour plots in combination with threshold levels that can be translated into a counter measure or observation, the message to the public may become more understandable.

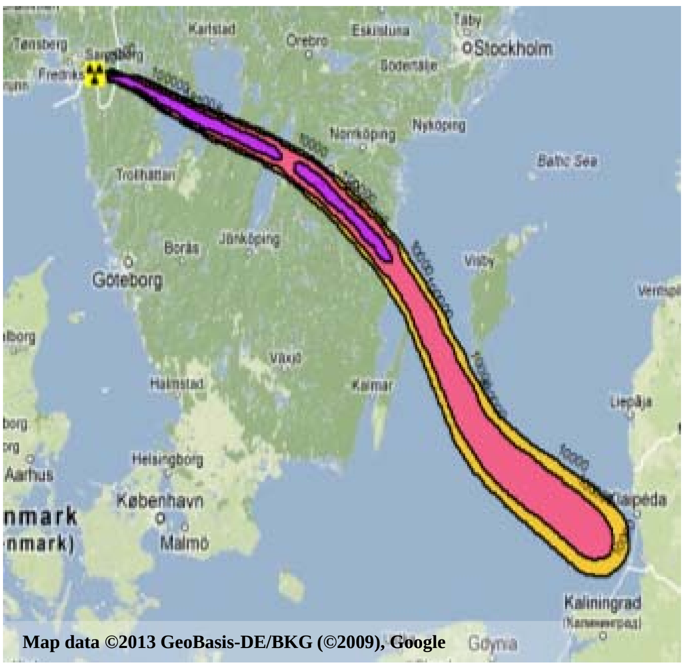


Figure 5: Integrated air concentration plot with contour lines.

A third type of dispersion model result is the time of arrival plot as shown in figure 6. It is basically the same as the integrated air concentration plots, but with contour lines that displays where the plume is after n hours relative to the release time. It can be considered a hybrid between a plume and a trajectory since it does not require a source term to make, but still shows the spatial extent. If all information about time is left out, only the extent of the plume will show. This is illustrated in figure Figure 7 for a release after 24 hours. It can be interpreted as potential area of risk without any prior knowledge about the source term.

Figure 6: Time of arrival plot.

Figure 7: Area of risk plot after 24 hours. This example is from a particle model, hence the patchy plume. It is created from the deposition output.

5. How to design a dispersion product for public dissemination

A dispersion product should only be published if there is a real accident with an actual release or probable release in the future if the situation deteriorates. The release itself may or may not to pose threat to the public. The dispersion product should be a map showing the release point, dispersion in some graphical presentation, and a text that supports and explains the graphics. It must clearly state when and for how long the dispersion prognosis is valid.

Presenting it as an animation is an option, but limited to Internet and TV. What animation will give in addition is visualising the dispersion of the plume over time. Keep in mind that this will require more work and time to produce. Norwegian Radiation Protection Authority and Norwegian Meteorological Institute published an animation of the release from Fukushima on Youtube.

In addition to the product, general background information about dispersion products should be prepared in advance and made available on a web site and other channels. This should tell the reader what the product is, how it is made and who is responsible for it. It should state what the potential sources of error are, and how this is taken into account. The product itself should give a reference to this information.

5.1. Use of digital maps

Today digital maps are easily available through the internet as both downloadable images and online resources. Although tempting to use such maps as background, care should be taken when using them due to the different licenses that apply to them. Appendix A is an external report by PDC-ARGOS ApS which gives an overview of the different maps that are available and what is required for public use. In general map services provided by Google and Microsoft are safe for most type of publishing given the publisher has bought a professional license. For OpenStreetMap, a free web-based map service, all types of publication is cost free. But the license requires that the end product is shared under the same license (Creative Common). All map providers require that they must be attributed as the source.

Plumes can be exported in a way that makes them viewable in for instance Google Maps. This is a nice way of export because it makes the presentation more interactive. The user can pan around, zoom in and out and get a better picture of the details. The risk is loss of control of the product when more than one version starts to flow around on the Internet. Use of such tools for this should be investigated before put to life to make sure both integrity and ownership is kept safe.

5.2. Type of dispersion product to publish

Which dispersion type to choose from depends on how much information about the accident is available. If there is a plausible source term and location and release time is known, the possibilities are plentiful. If only location and release time is known the possibilities are limited to trajectories, time of arrival and area of risk plots. With only location known it is still relevant to publish a prognosis, but mainly to tell in what direction a plume will take if a release occurs sometime in the future, and update them regularly.

All examples given so far are for accidents at nuclear power plants since these presents the biggest risks. Same kinds of products are applicable to other types of accident scenarios as long as the release is from objects[1]. This includes nuclear powered vessels, research reactors, accidental melting of radioactive sources and even malicious use of radiological dispersion devices (RDD). Most of these scenarios will represent a risk to a limited area due to relative small releases. There are dispersion models that can model releases on small scale (resolutions of meters) and give a picture of the risk in on a local level. One example is the URD model which is integrated in ARGOS DSS. It is possible to share such products with the public, but this might come in conflict with other related messages like the extent of a barrier or other actions taken by the police around the accident site.

5.3. Length and update frequency

The length and update frequency of the meteorological forecast define the limits for how long into the future a dispersion prognosis can cover, and how often it can be updated. The length of a dispersion prognosis should be limited to 24-48 hours into the future. This is to avoid the fact that uncertainty increases at end of the forecast. Instead the prognosis should be updated regularly when new forecasts are available. This may be every 6 or 12 hour depending on the meteorological forecast used. National Meteorological institute should give advice on what is the best combination of length and update frequency.

It is possible to make longer prognoses than 48 hours, and it is necessary for long releases and for accidents far away from the target group like Fukushima was for the Nordic countries. Numerical weather prediction data from the past will be used up to present time. After this current forecast NWPs takes over. Showing a long release that is days and weeks will tell the public where diluted pollution is transported while showing a 24 hour dispersion prognosis for a long release will tell which areas are hit by fresh and more concentrated pollution.

5.4. Layout and design

In this case design and layout refers to the image of the plume itself. It should contain as few objects as possible: the release point and plume on a map. For trajectories only one line should be shown representing the most likely path or a release height that is close to the ground.

Plumes should be presented with contour lines that refer to something the public can directly translate into a relevant action or consequence. Examples are operational intervention levels for counter measures (level of contamination, in-door stay, evacuation, iodine prophylaxis) for large scale accidents. Levels presented in Nordic guidelines for nuclear and radiological emergencies (Nordic, 2014) should be used since these are agreed upon in the region, and easily available as a reference for the public. For releases that are small or relative far away

[1] Object means an installation with a well-defined geographical location. The opposite is for instance a geographical area which would be the case for a forest fire in a contaminated area.

from the target audience, levels of detectability (detected by air samplers, detect by monitoring station, alarm raised by station) can be used. Plots showing concentrations in units of Becquerel should be avoided since this is not necessarily understood by the public.

Care should be taken when choosing colours. Colours like red, yellow and green are often associated with some level of risk. For example a map showing some area with a red plume might be understood as an area of high risk even if it's not. A green area might be interpreted as safe. Such colours should only be used if the purpose is to express the risk. Otherwise non-associative colours should be used. This is for instance tones of grey or blue. S. David Leonard (Leonard, 1999) did several studies on colours of warning and perception of risk. The paper concludes that the only colour on warnings that is well associated with the risk is red.

5.5. Dispersion prognosis vs. measurements – when to stop with the plumes

During the release and after it has stopped, contamination will be measured with appropriate equipment to determine which areas are affected and to what level. Such measurements are done by fixed measurement stations, by personnel on the ground equipped with instruments, or as mobile measurements using car, air planes or helicopters as carrier. The results from these measurements will be the primary information used for consequence assessments and basis for decision on further actions. Depending on the size of the contaminated area, measurements can take days, weeks or longer. This means that the use of limited measurement resources must be prioritised in a measurement strategy. One important input to this strategy is dispersion prognosis in addition to knowledge about which areas are most sensitive to contamination (for instance populated areas, agriculture areas).

When quality assured measurement data starts to come in, it should be communicated to the public since these results represents the actual contamination and not a prognosis. In fact there will be inconsistency between the dispersion prognosis and measurement due to uncertainty in both source term and meteorology. There is a transition phase between having a few measurements and a complete mapping of the area. During this phase the product communicated to the public should be combination of dispersion prognosis and measurement. The reason is while measurements show the actual contamination, the dispersion prognosis can help communicate why some areas get higher measurement priority than others. When the mapping is considered comprehensive enough to reflect the actual contamination, presentation of this mapping should be the primary product presented to the public.

5.6. Responsibility and quality assurance

The authorities that are responsible for handling the accident on a national level should also produce and quality control the dispersion products before they are published. This is justified by the fact that these authorities have first-hand information about the accident, and have the capabilities to produce dispersion results. For most Nordic countries this means the radiation protection authorities and meteorological institutes. All authorities that contribute to the final product should be credited.

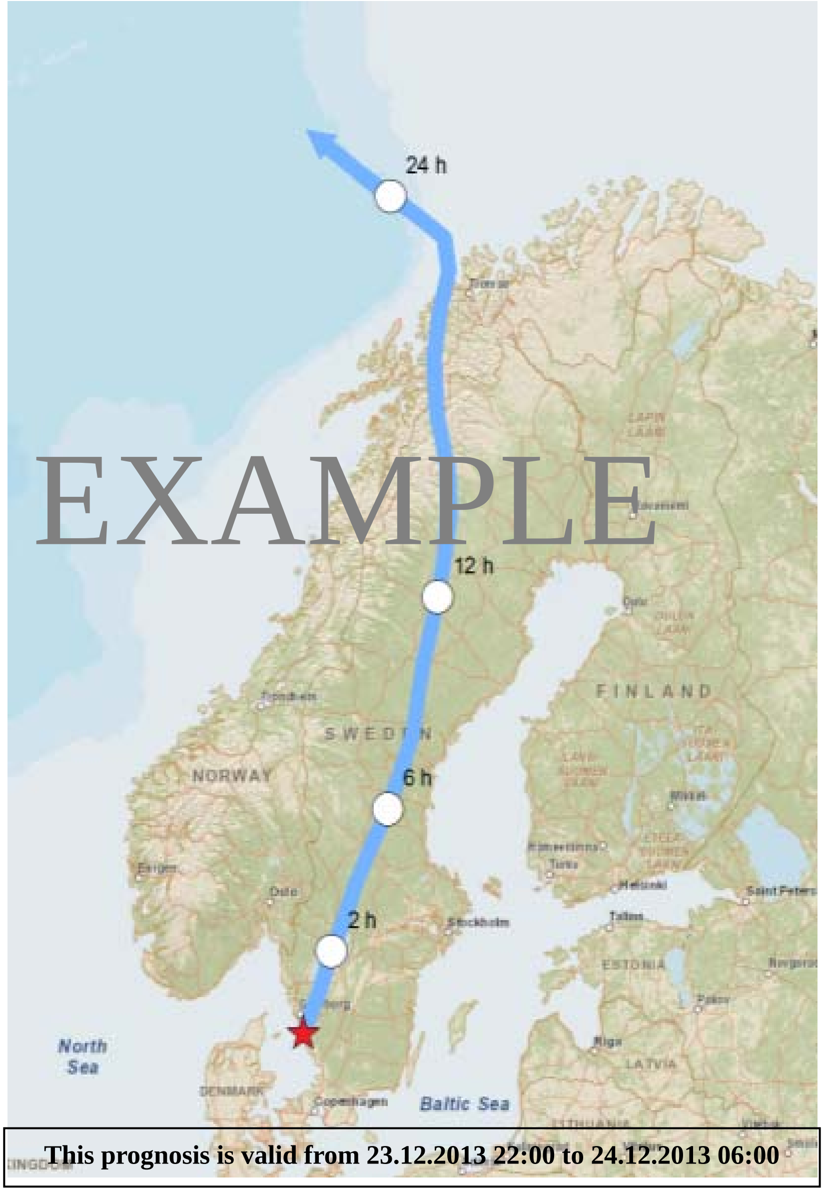
5.7. Dissemination

Dissemination should happen through visual media like newspapers, TV and web, including official government web pages. Technical issues like formats should be agreed beforehand with the relevant publishers. Usually this is related to resolution and colour choices, light and saturation; all to make it look nice on screen and paper.

6. Examples of dispersion products

Four examples are included in the report. All are based on an accident scenario at the Ringhals-1 NPP in Sweden taking place around 23.-24.12.2013. Real weather prognoses where used in these examples. First example shows a trajectory. Rest are different presentations of plume dispersion. For these the source term used is taken from the WASH-1400 report scenario BWR1 (U.S. NRC, 1975). This source term was mainly chosen to give an example of dispersion and not as a realistic accident scenario for this specific reactor.

6.1. Example 1: Trajectory



This example shows a trajectory based on the layout if the example from STUK. This could be used in an emergency situation where the projected worst case is a release into the surrounding, although not considered very likely by the operator. Since the release time is unknown this would be updated when new meteorological forecasts are available.

Accident site is shown and the trajectory extended with time intervals to indicate arrival. Direction is indicated with an arrow head at the end. Also note the valid from-to text at the bottom.

6.2. Example 2: Dispersion prognosis

This prognosis shows two levels of contamination on the ground after 24 hours. First level was set to 30 kBq/m^2 and second to 1 MBq/m^2. These values are derived from table III in Nordic Flagbook (Nordic, 2014) where severity of contamination levels is presented. Lowest level represents “Slightly contaminated” (< 100 kBq/m^2) but reduced by a factor for three to give a more conservative estimate that can compensate for uncertainty in the modelling. If the source term was less uncertain this compensation could have been lowered. The effect is that the extent of the plume is increased. Highest level represents “Heavily contaminated” (>1 MBq/m^2). The distinction between the two levels would have been explained in the included written information.

This example can be used if there is a release or a release is likely in the near future. The colour of the plume is set to shades of blue.

6.3. Example 3: Area of risk

This example shows the area of risk. It is basically the same as example 2, but shows only the extent of the deposition. In other words areas that is likely of getting contaminated, but does not say by how much.

This can be used in a situation where source term is considered to too uncertain, but it is still relevant to indicate which areas can be affected. One flaw with this example is the lack of information about difference in levels of consequences as a function of distance from the site. Example 4 tries to compensate for this.

6.4. Example 4: Area of risk with IAEA recommended planning zones

This example is the same as number three but with additional zones highlighted around the plant. The zones are taken from IAEAs EPR-NPP Public Protective Actions (IAEA, 2013). It defines four planning zones at 5, 30, 100 and 300 km from the site. What is shown here are the two at 100 and 300 km. IAEA recommend these areas should have plans for certain counter measures that are activated when the NPP declares a General Emergency.

This is a way of telling the public about the relative difference in consequences inside the area of risk without introducing source term.

7. Summary

From the perspective of public communication dissemination of dispersion products can strengthen the crisis message and position the originating authorities as the primary supplier of such product. It will give the public a good visualisation of which areas are (potentially) affected and which areas are not. Uncertainties will exist and should be explained. If it the dispersion prognosis is good enough for taking action to protect the population, then it is also good enough to give to the population.

From the perspective of meteorology and radiological assessment, the main issue is uncertainty. For meteorology this must be accepted as is. In fact we accept this every day in the weather forecast provided by the meteorological institutes. A meteorologist should always do an expert review of the dispersion prognosis to assure the weather forecast behaves according to the weather conditions at the site. The radiological consequences can be modelled as part of the dispersion prognosis. But this requires a good estimate of how much is released into the atmosphere, something real accidents have shown is difficult to do. This report shows dispersion products that do not need a source term and still give valuable information to the public. The radiological consequences are best explained to the public through field measurements.

From a technical viewpoint the production of the dispersion prognosis shown in the examples are fairly easy and quick to do. In addition to ARGOS which was used for making the dispersion prognosis, a GIS tool was used to improve trajectories in example 1 and the zones in example 4, and to make all of them look better. Low production time is an important requirement, and it should be possible to reduce this by automating some of the tasks through scripts.

What should be followed up from this project is more work on the written information that is included with images of the dispersion since this report has mainly focused on the latter. Also a wider evaluation of the different proposals should be conducted by both experts with prior knowledge and laymen representing the general public.

7.1. Acknowledgements

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7.2. Disclaimer

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9. Appendix: ARGOS Map Usage

The report "ARGOS Map Usage – Considerations on issues of map usage in ARGOS" is made by PDC-ARGOS ApS on request from the PUBPLUME project. The project group saw a need for a report that can give an overview of legal and practical issues related to the use of web based map services like Google Maps, Bing Maps, Open Street Map and other solutions for both internal and external use. The report covers use of such maps in the ARGOS Decision Support System, but the considerations apply to use of the same maps in other applications.

PDC-ARGOS APS.

ARGOS Map Usage

Considerations on issues of map usage in ARGOS

Hans Olav Nymand

March, 2013

ARGOS supports many different map types. Each has important advantages and disadvantages covering technical, economical and legal issues. This report is an attempt to create an overview of these issues.

Summary

This report is the delivery of a 2013-project with NRPA with the following description:

The project output is a report detailing conditions and known issues, problems and limitations on map usage in ARGOS as know by PDC. This will include the following for each map "type" supported by ARGOS.

- Short description of what it is, current usage on a very overall level, known usage pattern, relevant details on implementation where this implies specific legal or technical issues
- Referring to known license conditions where those are public (Danish and/or US licenses only)
- Listing and discussion of known advantages and disadvantages
- Possible legal issues

The issues and conclusions presented in chapters 2-5 also apply to other applications than ARGOS, but excluding software where the software license itself includes a license for specific map data.

Contents

Introduction

A very important feature-set of ARGOS is the ability to display results graphically on an underlying digital map. This is foten referred to as GIS-functionality in ARGOS while in fact it is not the entire set of GIS functionality in ARGOS, nor does ARGOS contain a complete set of GIS-functions.

It is however an important and well-defined functionality which typically involves at least the following two steps

- ARGOS loads mapping data from a map source and draws the map
- ARGOS then draws information overlaid on the map

It is important to point out that in no case is this implemented by calling an intergrated or external GIS module from a 3rd party provider.

ARGOS basically supports two different forms of presenting geospatial information

- Export to a common file-format which can then be imported or viewed in a 3rd party GIS application
- Drawing the information directly on a map using ARGOS' custom-made and built-in map rendering module

When exporting to a 3rd party application you need of course to deal with installation, purchasing and licensing of this/these applications, but no such application is delivered as part of ARGOS and such issues are not covered here.

And as there is no 3rd party GIS module integrated with ARGOS there are no issues here.

The only thing to be handled are issues on the map data themselves as such data are usually licensensed and frequently very expensive, and even though it is ARGOS that loads and presents the map, it is the responsibility of the ARGOS licensee to handle installation, purchasing and licensing of map data.

So the license conditions is always an agreement between the ARGOS licensee and the map data provider.

Three different licensing regimes

For the maps available in ARGOS we basically meet three different licensing regimes.

Commercial proprietary: This governs most usage of local maps and WMS maps. In short you pay a supplier some money and get the right to use some map data. There are however exceptions where map data usage is free for state organisations.

Google/BING: These are also basically commercial proprietary licens with the exception that if your map is displayed on a freely and publicly accesible web-page, then use is free! As soon as you make money or limit accesibility to only a group of select users, then you are on commercial terms.

Open Street maps: Creative Commons Attribution-ShareAlike 2.0, see
http://creativecommons.org/licenses/by-sa/2.0/

1. Local Maps

Called names: Local maps, mas-maps, .mas-maps, SplitMap maps, ARGOS maps, generated maps

The first type of maps supported by ARGOS when this functionality was first implemented were local maps, that is maps residing an the samer harddisk as the ARGOS executable itself, or possibly a network share.

Such maps must be imported to ARGOS, so using such maps is a multi-step process typically executed by an ARGOS super-user or administrator.

1) You need to get the map data from a map data provider, e.g. the national ordnance survey – this involves discussions of format, content, price and license conditions.
2) You need to make a description of how the map should look, a so-called legend. PDC provides a default legend which can be used directly or adapted to suit your special needs.
3) You need to convert the map data to the special ARGOS map format known as ”mas” or ”SplitMap format” or ”ARGOS format”. This is done via the SplitMap application. This is typically executed by the ARGOS administrator, a GIS specialist or a PDC consultant.

Those 3 steps need to be executed only once for each map, and repeating at least step (3) when new updated map data for that map becomes available.

1.1 Overview for local maps

Storage	Local disk, network share or http-server
Data type in client	Vector data (meaning that you can in principle make analysis on the data and identify individual road segments and other single entities in the map)
Implementation in ARGOS	Custom written code loading .mas files and displaying in ARGOS window
Moving and copying map data	Windows copying of very big directory potentially having +100.000 files. In principle easy but Windows sometimes have problems due to the huge number of files, so zipping the directory before copy is advisable.
Purchasing map data	By contact to a map data provider such as the national ordnance survey
Map preparation	Preparing legend file and running SplitMap. Needs experienced superuser, GIS specialist or PDC consultant.
Update data	Manual procedure involving running SplitMap. Needs experienced superuser, GIS specialist or PDC consultant.
Price	Varies widely, typical examples are • Free for state and municipal organisations, free for emergency organisations, free for non-profit organisations • As above but with a small consultancy fee to the map data provider on each delivery • Very expensive, possibly +100.000€ The price may include a yearly fee as well.
License conditions	Varies but typically restricted to use only inside the organisation, see note

	#1. Can make it difficult to exchange data with partners, see note #2, 3, 4.
Attribution	It is usually required that when (parts of) the map is reproduced, e.g. in print or on a web-page, that the map data provider is attributed.
Advantages	The licensee have full control over the data. It can be placed on server og local harddisk at the licensee's discretion. When placed locally access to the map is independent of network availability. The licensee also have full control over which elements are present in the map and how these are displayed. By generating to a proprietary format the licensee may get a lower price and less rigid license conditions, see note #4. When placed on harddisk of a laptop this can run ARGOS completely without any network connection – this may be very relevant when dealing with nation-wide catastrophes.
Disadvantages	Map data can be very expensive. Working with SplitMap is complex and required GIS knowledge. Designing a good legend is difficult. The technology is proprietary. The licensee needs to redo the conversion process when updated map data become available. Takes up much harddisk space (2 GB)

Note #1: In one case an ARGOS licensee got a very detailed dataset free from the national ordnance survey. The licensee requested PDC to assist with map important and generation, but in the end PDC was unable to get access to the map data without signing a nondisclosure and liability agreement with a penalty so high that PDC did not dare enter this agreement.

Note #2: When negotiating the map data license with a map data provider it is important to specify the need to exchange screenshots and printouts of the map with partners while at the same time stating the the actual map data is never used outside of ARGOS.

Note #3: Be sure to discuss force majeure situations. In some cases national legislation on force majeure rights of emergency organisations' may ease or complicate license negotiations.

Note #4: As a peculiarity the technical extra complication of converting map data via SplitMap can have a positive effect on license conditions and price. SplitMap imports data in common formats but the output from SplitMap which is used by ARGOS is in a proprietary format, which can only be used with ARGOS. This sometimes makes the map data provider less nervous about data theft or copying and willing to sell at a lower price as the map data distributed with and used by ARGOS is usable only by ARGOS.

Usage	Conditions
Navigable map in ARGOS	No problems when license conditions are met. See note #5
Navigable map on non-public web-page	Depending on license conditions, but probably no problem when license conditions are met and PDC software used to display map. See note #5
Navigable map on public web-page	Probably disallowed (depends on license conditions). If allowed it is usually required that the supplier is attributed.
Static copy (PNG file or similar) on non-public web-page	Depending on license conditions, but probably no problem when license conditions are met. If allowed it is usually required that the supplier is attributed.
Static copy (PNG file or similar) on public web-	Depends on license conditions. If allowed it is usually required that the supplier is attributed.

page	
Static copy (PNG file or similar) in e-mail	Depending on license conditions, but probably no problem when license conditions are met. If allowed it is usually required that the supplier is attributed.
Reproduction in print of limited area of map	Depending on license conditions, but probably no problem when license conditions are met. If allowed it is usually required that the supplier is attributed.

Note #5: It is a problem that some suppliers of digital maps require an attribution notice or copyright message displayed in ARGOS – but this is currently not supported by ARGOS.

1.2 Local maps with GeoTIFF data

Expect for some additional technical issues this works in the same manner as local maps in general.

Note that you may have two different datasets, the GeoTIFF data and the vector data, which may (or not) be from different providers and have different licensing conditions.

1.3 Local maps delivered with ARGOS

2 local maps are included in the ARGOS delivery called the WA4 map and the ArgosBasic map.

WA4 contains only country outlines in a crude resolution, but is fast due to being small and good for testing.

ArgosBasic contains more, that is rudimentary data for Europe and North America in addition to the same crude country outlines.

The maps are never updated with new data.

Usage	Conditions
Navigable map in ARGOS	Allowed for consorrtium members that signed the ARGOS data agreement with DEMA
Navigable map on non-public web-page	Allowed for consorrtium members that signed the ARGOS data agreement with DEMA
Navigable map on public web-page	Allowed for consorrtium members that signed the ARGOS data agreement with DEMA
Static copy (PNG file or similar) on non-public web-page	Allowed for consorrtium members that signed the ARGOS data agreement with DEMA
Static copy (PNG file or similar) on public web-page	Allowed for consorrtium members that signed the ARGOS data agreement with DEMA
Static copy (PNG file or similar) in e-mail	Allowed for consorrtium members that signed the ARGOS data agreement with DEMA
Reproduction in print of limited area of map	Allowed for consorrtium members that signed the ARGOS data agreement with DEMA

2. WMS Maps

Called names: WMS, Web Map Service

WMS is short for Web Map Service, see http://www.opengeospatial.org/standards/wms. It is an international standard from the Open Geospatial Consortium (http://www.opengeospatial.org/) for exchanging geospatial data including maps via the HTTP protocol (HTTP is the standard protocol used for exchanging web-pages as well and most other data on the Internet, HTTP is very widely supported).

WMS is a relatively new standard proposed in 1999 and rising to prominence in the last years of the 2000's. It is supported by all major GIS software vendors and hence must be considered a "safe" standard to go by. Most ordnance survey organisations and other map data providers also provide WMS services.

WMS is a way to exchange geospatial data, including map data, over the web – but this must not be confused with actually displaying maps in a web-browser such as it is seen with Google maps. WMS is *only* a way to exchange data and does not include a standard client. WMS clients exists for most internet browsers, but an internet browser is in itself not a WMS client. ARGOS on the other hand *is* a WMS client, so ARGOS can download and display data retrieved from a WMS server.

Note also another difference. Google maps and other publicly accessible web maps are typically free for the individual user. WMS on the other hand is typically not free, or even if free still requires an agreement with the map data provider.

So WMS is different from local maps with it comes to technical issues – when it comes to purchasing and licensing it is very similar to local maps in the sense that the ARGOS licensee using the map still needs to make an agreement with the map data provider.

Note by the way that both Google Maps and OSM is available also via the WMS interface – this is described in the sections for those map types.

2.1 Overview for WMS

Storage	WMS server on local machine, WMS server on network server or WMS server located at the map provider. See note #1
Data type in client	PNG picture files which are just delivered from the WMS server and then shown in the client
Implementation in ARGOS	Custom written code using the WMS protocol to get files from the WMS server and displaying in ARGOS window
Moving and copying map data	You move (or repeat) the WMS server installation.
Purchasing map data	By contact to a map data provider such as the national ordnance survey
Map preparation	Can be done by the map data provider (1a,b,c), or by an organisational GIS specialist (1b,c). PDC at the moment does not offer WMS server configuration.
Update data	If hosted at the map data provider, does not involve any effort for the ARGOS licensee. If hosted at the licensee may require more or less effort

	depending on the chosen WMS server and the delivery process.
Price	Varies, much in the same manner as for a local map
License conditions	Varies, but typically less restrictive on exchange of parts or reproductions of the map with partners
Attribution	It is usually required that when (parts of) the map is reproduced, e.g. in print or on a web-page, that the map data provider is attributed.
Advantages	The ARGOS licensee can skip the steps involving in generation of maps via SplitMap and producing an own legend (unless desired). Maps on a WMS server can be used by other applications than ARGOS, e.g. most standard GIS applications.
Disadvantages	If hosted locally requires knowledge and effort to run WMS server(s). If hosted at map data provider requires network connection.

Note #1: There are different advantages and disadvantages of the three ways to go.

a) Running against a WMS server at located at the map data providers is the easiest and cheapest – it may even be free. The ARGOS licensee needs to do very little except refer to the WMS server address from ARGOS and thats it. The map data provider handles all technical stuff including updateting the map to the latest data.

b) Running against a WMS server on the organisational network is more complicated and usually more expensive. In addition to purchasing the map data you need to purchase a WMS server license as well, althoug they may be bundled or the WMS server may be free (shareware WMS servers exist). You now need a WMS specialist to configure and run the WMS server, or purchase the map data provider to do it. Possibly the map data provider can deliver an ”easy install” package of data and WMS server. Advatage is that you become independent on the working and network access to the map data provider. But you are still dependent on the local network, and from a laptop might have to use a wireless or mobile connection of some sort.

c) Running against a WMS server on the local machine is very much like (b) except you now have many instead of just 1 WMS server – they are however all identical. Removes the dependency on local network so a laptop in this way would be able to work autonomously just as if it had a local map. (An in fact it of course has a ”local” map, only it is now access via the WMS protocol)

Usage	Conditions
Navigable map in ARGOS	No problems when license conditions are met. See note #2
Navigable map on non-public web-page	Depending on license conditions, but probably no problem when license conditions are met and PDC software used to display map. See note #2
Navigable map on public web-page	Probably disallowed (depends on license conditions). If allowed it is usually required that the supplier is attributed.
Static copy (PNG file or similar) on non-public web-page	Depending on license conditions, but probably no problem when license conditions are met. If allowed it is usually required that the supplier is attributed.
Static copy (PNG file or similar) on public web-page	Depends on license conditions. If allowed it is usually required that the supplier is attributed.

Static copy (PNG file or similar) in e-mail	Depending on license conditions, but probably no problem when license conditions are met. If allowed it is usually required that the supplier is attributed.
Reproduction in print of limited area of map	Depending on license conditions, but probably no problem when license conditions are met. If allowed it is usually required that the supplier is attributed.

Note #2: It is a problem that some suppliers of WMS maps require an attribution notice or copyright message displayed in ARGOS – but this is currently not supported by ARGOS.

3. Bing Maps

Called names: Bing maps, Live maps, Microsoft maps, Microsoft Live Maps

Bing maps is a well-known public web map service from Microsoft available for viewing at http://www.bing.com/maps/

This in fact involves 3 different layers of functionality

- A map storage or map server from which the map data are served to the clients (what lies here could be – to some degree compared to the local map)
- A method for transferring those map data to the viewing clients (this could be compared to WMS – in fact Bing uses the same proprietary protocol as Google maps/Google Earth)
- A map viewer (which technically is nearly indentical to Google maps but has a different look and feel to the end user) – the map viewer is a component running in a web-browser

In ARGOS this is implemented by ARGOS actually loading an HTML page containing the abovementioned ”map viewer”, so ARGOS actually loads and executes some javascript code via an Internet Explorer component available in Windows.

3.1 Overview for BING Maps

Storage	Bing maps server
Data type in client	PNG picture files which are just delivered from the Bing maps server and then shown in the client
Implementation in ARGOS	Hidden Internet Explorer module used to interface the Bing maps server to download files for display in the ARGOS window
Moving and copying map data	N/A
Purchasing access	Unknown
Map preparation	N/A
Update data	N/A
Price	Unknown
License conditions	http://www.microsoft.com/maps/product/terms.html
Attribution	It is required that when (parts of) the map is reproduced, e.g. in print or on a web-page, that Bing maps is attributed as the source
Advantages	Centralized and update map available world wide

Disadvantages	Dependent on network connection and on Bing maps server availability. No user control of data. Dependent on Internet Explorer and may be impeded by security settings for Internet Explorer (such as disallowing javascript) and various firewall settings (this page access web-sites other then the home site of the page itself – because the home site is the local hard disk)

Usage	Conditions
Navigable map in ARGOS	No problems when license conditions are met. See note #1
Navigable map on non-public web-page	Depending on license conditions, but probably no problem when license conditions are met. See note #1
Navigable map on public web-page	Probably disallowed (depends on license conditions). If allowed it is usually required that the supplier is attributed.
Static copy (PNG file or similar) on non-public web-page	Depending on license conditions, but probably no problem when license conditions are met. If allowed it is usually required that the supplier is attributed.
Static copy (PNG file or similar) on public web-page	Depends on license conditions. If allowed it is usually required that the supplier is attributed.
Static copy (PNG file or similar) in e-mail	Depending on license conditions, but probably no problem when license conditions are met. If allowed it is usually required that the supplier is attributed.
Reproduction in print of limited area of map	Depending on license conditions, but probably no problem when license conditions are met. If allowed it is usually required that the supplier is attributed.

Note #1: It is a problem that Microsoft require an attribution notice or copyright message displayed in ARGOS – but this is currently not supported by ARGOS.

4. Google Maps

Called names: Google maps

Google maps is a well-known public web map service from Google Inc. available for viewing at http://maps.google.com/. Do not confuse this web-browser based technology with Google Earth which require a special application for viewing – although the base map and sattelite data are the same. ARGOS supports exporting results to Google Earth, but does not have a module for launching Google Earth from or within ARGOS!

Viewing Google maps in fact involves 3 different layers of functionality

- A map storage or map server from which the map data are served to the clients (what lies here could be – to some degree compared to the local map). This is shared between Google maps and Google Earth – both however allow access to optional extra functionality which is different between Google Earth and Google maps.
- A method for transferring those map data to the viewing clients (this could be compared to WMS). This is shared between Google maps and Google Earth

- A map viewer (which technically is nearly indentical to Google maps but has a different look and feel to the end user) – the map viewer is a component running in a web-browser

In ARGOS this is implemented by ARGOS actually loading an HTML page containing the abovementioned ”map viewer”, so ARGOS actually loads and executes some javascript code via an Internet Explorer component available in Windows.

Google maps also supports WMS access. An experimental implementation of WMS access to Goole maps was implemented, but never released.

4.1 Overview for Google Maps

Storage	Google maps server
Data type in client	PNG picture files which are just delivered from the Google maps server and then shown in the client
Implementation in ARGOS	Hidden Internet Explorer module used to interface the Google maps server to download files for display in the ARGOS window
Moving and copying map data	N/A
Purchasing access	By contacting Google Inc. Some ARGOS users have (or had) purchased access to Google maps.
Map preparation	N/A
Update data	Google maps has an interface for reporting errors and uploading new data.
Price	Unknown
License conditions	http://www.google.com/enterprise/earthmaps/maps-faq.html ?
Attribution	It is required that when (parts of) the map is reproduced, e.g. in print or on a web-page, that Google maps is attributed as the source
Advantages	Centralized and update map available world wide
Disadvantages	Dependent on network connection and on Google maps server availability. No user control of data. Dependent on Internet Explorer and may be impeded by security settings for Internet Explorer (such as disallowing javascript) and various firewall settings (this page access web-sites other then the home site of the page itself – because the home site is the local hard disk)

Usage	Conditions
Navigable map in ARGOS	No problems when license conditions are met. See note #1
Navigable map on non-public web-page	Depending on license conditions, but probably no problem when license conditions are met. See note #1
Navigable map on public web-page	Probably disallowed (depends on license conditions). If allowed it is usually required that the supplier is attributed.
Static copy (PNG file or similar) on non-public web-page	Depending on license conditions, but probably no problem when license conditions are met. If allowed it is usually required that the supplier is attributed.
Static copy (PNG file or similar) on public web-page	Depends on license conditions. If allowed it is usually required that the supplier is attributed.
Static copy (PNG file or	Depending on license conditions, but probably no problem when license

similar) in e-mail	conditions are met. If allowed it is usually required that the supplier is attributed.
Reproduction in print of limited area of map	Depending on license conditions, but probably no problem when license conditions are met. If allowed it is usually required that the supplier is attributed.

Note #1: ARGOS displays an attribution message on the map, when showing Google maps

5. Open Street Maps

Called names: Open Street Maps, OSM

Open Street Maps is a well-known public web map service maintained by the Open Street Maps foundation in much the same manner as wikipedia. The map, like wikipedia, is publicly available and publicly maintained. It is available for viewing at http://www.openstreetmap.org/

While OSM in many ways seems akin to Google and BING Maps – it is a publicly available map accessible via your web-browser – it is NOT; neither technology, organisation or licensing are similar.

Viewing OSM in fact involves 3 different layers of functionality

- A map storage or map server from which the map data are served to the clients (what lies here could be – to some degree compared to the local map)
- A method for transferring those map data to the viewing clients (this could be compared to WMS)
- A map viewer (which is completely proprietary to OSM) – the map viewer is a component running in a web-browser

Note that, lile Google maps, a WMS interface is also available for OSM – but it is not free. An agreement needs to be made with a WMS provider.

The main differences to Google and BING maps are as follows:

1) The organisation behind is not a cooperation or company, it is a foundation operated much like the Wikimedia foundation
2) Access to the data does not required access via a special API, you can write your own (which is done in ARGOS)
3) The license conditions basically are ”Creative Commons Attribution-ShareAlike 2.0” while for Google and BING maps the license is a proprietary commercial license (which under certain conditions allow free use, for instance on a public web-page)

Implementation in ARGOS is also different. No javascript or web-page technology is used. There’s just some code in ARGOS for downloading PNG file directly from the open street maps tile server.

When reading about license conditions for Open Street Maps it is important to note the following. OSM data are made available in two different forms

- The OSM Database: This is the actually data store and all modifications are made to the database. The database itself is actually available for free under the Open Data Commons Open Database License (ODbL), see http://opendatacommons.org/licenses/odbl/. This is however of no importance to ARGOS, as ARGOS does not download data directly from the database.
- The tiles: Tiles are pre-made, ready to download, PNG files for a given area in a guiven resolution. This is much the same way as WMS works, although WMS typically provides one big PNG rather than several small ones. ARGOS uses the tiles which are available under the licens "Creative Commons Attribution-ShareAlike 2.0", see http://creativecommons.org/licenses/by-sa/2.0/

Much is written in the OSM licens conditions about the database, modifying the database and distributing the database – all this is of no relevance to ARGOS.

5.1 Overview for Open Street Maps

Storage	Open Street Maps tile server (which gets fed from the Open Street Maps database server)
Data type in client	PNG picture files which are just delivered from the OSM tile server and then shown in the client
Implementation in ARGOS	Proprietary C++ code not depending on Internet Explorer, javascript or other web-technology except needs http to download data from the OSM tile server
Moving and copying map data	N/A
Purchasing access	N/A
Map preparation	N/A
Update data	OSM has an interface for correcting errors and uoploading new data
Price	N/A
License conditions	See below
Attribution	It is required that when (parts of) the map is reproduced, e.g. in print or on a web-page, that OSM is attributed as the source
Advantages	Centralized and update map available world wide
Disadvantages	Dependent on network connection and on OSM tile server availability. Limited user control of data.

Usage	Conditions
Navigable map in ARGOS	No problem except note #1
Navigable map on non-public web-page	No problem, but OSM must be attributed.
Navigable map on public web-page	No problem, but OSM must be attributed.
Static copy (PNG file or similar) on non-public web-page	No problem, but OSM must be attributed.
Static copy (PNG file or	Probably no problem, but OSM must be attributed.

similar) on public web-page	
Static copy (PNG file or similar) in e-mail	No problem, but OSM must be attributed.
Reproduction in print of limited area of map	Probably no problem, but OSM must be attributed.

Note #1: It is a problem that OSM require an attribution notice or copyright message displayed in ARGOS – but this is currently not supported by ARGOS.

5.2 Open Street Maps license conditions

Much is written about OSM licensing conditions, and as the user does not (suaully) make a signed agreement with OSM it is up to the user to find the correct version of the license conditions and how these should be interpreted.

The **Attribution-ShareAlike 2.0 Generic (CC BY-SA 2.0)** license is found here:
http://creativecommons.org/licenses/by-sa/2.0/
The main ”threat” here seems to be only the **”**Share Alike” requirement.

Then there are 4 web-pages from OSM describing various aspects of OSM usage.

1) The main license description is found at: http://www.openstreetmap.org/copyright/en
2) There’s a legal FAQ at http://wiki.openstreetmap.org/wiki/Legal_FAQ
3) A a description of the tile usage policy at http://wiki.openstreetmap.org/wiki/Tile_usage_policy (Note that this is not so much a legal but rather a technical list fo requirements)

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Abstract max. 2000 characters	The PUBPLUME project addresses use of dispersion prognosis as a tool in public communication during a nuclear or radiological accident. The motivation is experience from the Fukushima accident when such products where asked for by the media. The project aimed at making a guideline on how such prognoses can be produced and designed in a way that makes them comprehensible for the general public. Second, it aimed at establishing a common Nordic guideline in order to establish trust in such products across borders. The report gives an overview of what kind of dispersion products are available today, the main sources of uncertainty and how to handle them. It summarises important requirements for successful public communication in a crisis situation in order to justify use of dispersion prognoses. Finally, it gives examples of dispersion prognoses for public use, and discusses their content and attributes.
Key words	Dispersion prognosis, public communication, decision support systems, emergency management

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