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METEOROLOGISKA INSTITUTET  
FINNISH METEOROLOGICAL INSTITUTE

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THE FINNISH METEOROLOGICAL  
INSTITUTE – FINAL REPORT FOR  
THE OPEN DATA PROJECT

MAIJA-LIISA HONKOLA  
NINA KUKKURAINEN  
LEA SAUKKONEN  
ANU PETÄJÄ  
JANNA KARASJÄRVI  
TARJA RIIHISAARI  
ROOPE TERVO  
MIKKO VISA  
JUHANA HYRKKÄNEN  
REIJA RUUHELA



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Juhana Hyrkkänen  
Reija Ruuhela

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Nimeke	Ilmatieteen laitoksen avoin data –projektin loppuraportti	

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**Tiivistelmä**

Ilmatieteen laitoksen Avoin data –projektin tavoitteena oli vapauttaa Ilmatieteen laitoksen tietoaaineistoja julkiseen, vapaaseen käyttöön. Projektin taustalla vaikuttivat mm. vuonna 2007 hyväksytty Inspire-direktiivi, joka velvoittaa viranomaiset kuvailemaan direktiivin piiriin kuuluvat paikkatietoaineistot ja tarjoamaan ne yhteiskäyttöön tietoverkon kautta, sekä valtioneuvoston periaatepäätös julkisen sektorin digitaalisten tietoaaineistojen saatavuuden parantamisesta ja uudelleenkäytön edistämisestä.

Ilmatieteen laitoksen avaamat tietoaaineistot ovat laitoksen tuottamia jatkuvaluonteisia havainto- ja malliennusteaineistoja. Avattavien tietoaaineistojen määrittelyjen taustalla olivat INSPIRE-direktiivin periaatteet, mutta käytännön toteutus on huomattavasti velvoitteita laajempi.

Projektissa rakennettiin uusi verkkopalvelu, josta aineistoja voi ladata vapaasti itsepalveluna. Avoin data –projekti alkoi Ilmatieteen laitoksella jo vuonna 2007 Inspire-direktiivin tultua voimaan. Avoimen datan verkkopalvelu avattiin 15.5.2013.

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#### Abstract

The purpose of the Open Data project of the Finnish Meteorological Institute (FMI) was to make some of the institute's data freely available for public use. The project came about as a result of the INSPIRE directive adopted in 2007, which requires public authorities to describe spatial data covered by the directive and to offer them for shared use via information networks. Another factor was the government resolution on the improved availability of digital public sector information and on the promotion of its reuse.

The data sets that have been made available by the Finnish Meteorological Institute are continuous observational and model forecast data produced by the institute. The data sets were specified on the basis of the INSPIRE directive, but in practice, the implementation goes far beyond the regulatory requirements.

A new online service was built as part of the project to allow users to freely download data as a self-service. The Open Data project was started at the institute back in 2007 upon the adoption of the INSPIRE directive. The Open Data online service was launched on 15 May 2013.

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## 1. Project overview

The purpose of the Open Data project of the Finnish Meteorological Institute (FMI) was to make some of the institute's data freely available for public use. A new online service was built as part of the project to allow users to freely download data as a self-service. The aim was to make the institute's data sets available for broader and more versatile use, for example, in the development of new services, innovations and applications.

The project came about as a result of the INSPIRE directive adopted in 2007, which requires public authorities to describe spatial data covered by the directive and to offer them for shared use via information networks. Another factor was the government resolution on the improved availability of digital public sector information and on the promotion of its reuse.

The Ministry of Finance proposal from 7 August 2012 on financial compensation for open data was crucial in terms of the implementation by the Finnish Meteorological Institute: on the basis of the government resolution, the institute was prepared for a more extensive release of material than that required by the INSPIRE directive. The volume of data published by the institute is significant both in national and international comparison: for example, some 100,000 real time observations are available online in each 24-hour period.

A number of other directives and resolutions were also taken into account in the project implementation. These are listed in Appendix 1.

## 2. Project organisation

### 2.1 Steering group

**The Open Data project had a steering group and several sub-working groups.** The project steering group started in late 2011.

The steering group's objective was to monitor the project progress and to steer and support decision-making. The chairman of the steering group was Weather and Safety Director Juhani Damski, and the vice-chairman was Director of Administration Marko Viljanen. The steering group members were coordinators of different data sets, unit managers and other experts. The steering group met regularly every 1-2 months.

## 2.2 Working groups

The open data implementation was an extensive project, and it involved a large group of experts from different units of the Finnish Meteorological Institute. The data set teams alone included members from a number of different research units, the FMI's Observation Services, and the Weather and Safety Centre. Technical implementation was carried out in cooperation with Service Development, Customer Solutions and Information Management Services. The implementation was also supported by Administration and Communications in their respective areas of expertise.

Working groups included, among others:

**The INSPIRE implementation group** and its sub-groups, which were in charge of creating the technical implementation of the online service, i.e. the catalogue, browsing and downloading services.

**The data set teams** were formed on the basis of the data set types. The data sets were: Weather Model; Radar Images and Data; Air Quality Observations; Climate Observations; Lightning Observations; Surface, Aviation and Road Weather Observations, Marine Observations and Models. The data experts each submitted their proposals on the content to be made available, and the proposals were approved by the FMI management team. In addition, the working groups drafted descriptions of the data for the catalogue service and for the Open Data public website of the FMI.

**The Open Data for the Website group**, which was in charge of designing the open data section of the FMI website and its implementation.

**The Open Data HelpDesk group:** This group was responsible for the **design of the advisory and consultation service related to open data and the data sets**. The HelpDesk offers assistance and advice on the use and processing of open data and on other related matters.

## 3. National and international cooperation

International cooperation is an integral part of the FMI's operations.

For open data, international legislation requires that corporate data be made publicly available and that the conditions for their use be harmonised (e.g. the PSI and INSPIRE directives).

The Finnish Meteorological Institute is actively involved in the development of the operating environment as part of international organisations as well as in international standardisation projects. Cooperation with other Nordic countries is particularly active.

Internationally, the World Meteorological Organization, WMO, is the main cooperation body. The global weather monitoring system is the most important form of cooperation. The programme coordinates different observation and data communication systems, providing the prerequisites for real-time exchange of international meteorological observations and more broadly for weather services.

FMI represents Finland in a number of European organisations. Membership in ECMWF, the European Centre for Medium-Range Weather Forecasts, ensures the availability of weather forecasts for the FMI. As a member of EUMETSAT, the European Organisation for the Exploitation of Meteorological Satellites, the Finnish Meteorological Institute receives real-time meteorological satellite images and has the opportunity to participate in different programmes for satellite data application.

One form of Nordic cooperation is the NORDRAD agreement for the exchange of meteorological radar data between the Nordic countries. NORDMET, another Nordic cooperation agreement, covers most areas of meteorological infrastructure, including observations, information management, research, product development, production and education/training. NORDMET cooperation includes an annual conference for the directors general of Nordic meteorological institutes and several working group meetings.

An FMI representative took part in the following international working groups for open data:

- The European INSPIRE Thematic Working Group Atmospheric Conditions & Meteorological Geographical Features (INSPIRE TWG AC-MF). This working group was responsible for drafting the data specification for the implementation rule of the INSPIRE directive with regard to the "Atmospheric conditions" and "Meteorological geographical features" thematic components of Annex III. Group members: EEA, SMHI, M-F, FMI, KNMI, ZAMG, UKMO, Rutherford Appleton Laboratory.
- The FMI also had a representative in the Open Geospatial Consortium (OGC) MetOcean Domain Working Group. This working group serves as a forum for different actors in the field of meteorology, facilitating compatibility tests, overseeing members' interests in the

OGC, and promoting cooperation between the OGC and WMO in matters related to the sharing of meteorological spatial data. Group members: UKMO, DWD, M-F, FMI, NOAA, ECMWF.

The FMI took part in several national working groups on open data in the public sector, including:

**INSPIRE Data Product Groups:** The FMI coordinates specification work with national operators in the data set group dealing with environmental monitoring equipment, atmospheric conditions, climate, marine research and marine areas.

**SHAPE** (weather observation service): The FMI took part in the Ministry of Transport and Communications working group for the planning of a shared weather observation service for the agencies in the ministry's administrative branch.

**Ministry of Transport and Communications Open Data** working group: This group was responsible for drafting proposals and implementing the necessary measures for the mapping of corporate data and data sets and for the promoting of the reuse of transport and communications data.

**Public Administration Recommendations working group: Open data user licence:** The group was responsible for drawing up a joint, internationally compatible, open data licensing model for public administrative bodies in Finland and for its submission for approval through the JHS (Public Administration Recommendations) process.

#### **4. Schedule and reports of the Open Data project**

The Open Data project was started at the institute back in 2007 upon the adoption of the INSPIRE directive. A number of preliminary reports were commissioned and produced to support the project implementation.

In 2007, VTT Technical Research Centre of Finland published a study on the impact of the Finnish Meteorological Institute's services. The study investigated the social return on investment (per €1.00) in the FMI. In 2008, the FMI's data policy was assessed in a report by BearingPoint. The report mapped the current state and the development trends of the operating environment, assessed the impacts of making data available free of charge, and formulated the four most probable operating models and their economic impacts on the FMI's

operations. BearingPoint also carried out a further impact analysis in 2009. The analysis investigated the potential increase in the use of the FMI's services and the consequent increase in their impact should more services be made publicly available free of charge. In 2010, a publication titled "Broader use of weather data in Finland" (Säättietojen laajempi käyttö Suomessa) was published by the Ministry of Transport and Communications. In February 2012, the 2008 BearingPoint report on the FMI's data policy was updated. The follow-up report included a review of the development trends and scenarios of the operating environment and their economic impacts. The compensation requirements identified on the basis of the report were presented to the Ministry of Transport and Communications that same month.

Also in 2012, the FMI carried out its own INSPIRE pre-report, which included the INSPIRE directive requirements and schedule, execution in Finland, the FMI's data sets and content proposals, implementation scenarios, and the technical implementation of services.

The studies and reports provided useful information for assessments and calculations regarding the economic impacts and the social benefits of making the data publicly available. The studies and reports were favourable to the opening up of data.

The technical implementation schedule was in line with the schedule determined by the INSPIRE directive with regard to the spatial data sets of Annex III, which stated that the data sets specified in the directive had to be available online by May 2013. The specification of the FMI data sets is provided in the "INSPIRE D2.8.III.13-14 Data Specification on Atmospheric Conditions and Meteorological Geographical Features." However, the FMI made preparations for the release of more extensive data than what was specified.

The Ministry of Transport and Communications decree on the paid services of the Finnish Meteorological Institute came into force at the beginning of 2013. As a result of the decree, the FMI's data sets became available free of charge from the beginning of 2013.

The link to the beta version of the open data download service was published on Facebook on 28 February 2013. The online service was officially opened on 15 May 2013, and the media launch took place on 6 June 2013.

## 5. Released data sets

The data sets were specified on the basis of the INSPIRE directive, but in practice, the implementation goes far beyond the requirements set out by INSPIRE.

The data sets which have been made available by the Finnish Meteorological Institute are continuous observational and model forecast data produced by the institute.

In May 2013, observations from some 200 weather stations, 13 water level stations and 3 wave buoys (during open water season), as well as weather radar images and spatial data for lightning events in Finland were made available in real time in the FMI service.

Climate time series data made available in the service included daily and monthly values since 1959 and grid data for monthly temperature and rainfall values since 1961. With regard to marine observations, sea level observations are available from 1971 onwards and wave observations from 2005 onwards.

Data from national forecast models (meteorological and marine conditions) are also available from the service. The latest 48-hour forecast data of the models is updated in the service every 6-12 hours. With regard to climate forecast data sets, the online service includes climate change scenarios with average change values for temperature and rainfall in three different greenhouse gas emission scenarios for 2010-2039, 2040-2069 and 2070-2099.

Descriptions of publicly available data sets were produced for the public website of the FMI (<http://ilmatieteenlaitos.fi/avoin-data-avattavat-aineistot>) and the catalogue service. In addition to the FMI'S own data sets, the open data services include road weather observations provided by the Finnish Transport Agency.

## 6. Implementation sub-projects

It is important to note from the start was that other work aiming at ensuring **interoperability of meteorological information** was under way in a **MetOcean Domain Working Group** of the **Open Geospatial Consortium (OGC)**, and also in the worldwide context of the development of a new **WMO Information System**. It was necessary to ensure coherence between these developments and the present data specification. FMI participated actively to

this working group as well as to INSPIRE Thematic Working Group Atmospheric Conditions & Meteorological Geographical Features (INSPIRE TWG AC-MF).

The basis for the FMI infrastructure was defined by the Infrastructure for Spatial Information in the European Community (INSPIRE) directive 2007/2/EC. The services built by FMI comply with the INSPIRE Implementing Rules (<http://inspire.jrc.ec.europa.eu/index.cfm/pageid/47>). These include metadata, actual data sets (weather, aviation, oceanic, radar, lightning and climatological observations as well as the national weather model) and web services (discovery, view and download).

FMI's Open Data project produced three services: Discovery, View and Download.

The Discovery service is used to search and discover data sets. The data is described on a high level and also available in machine-readable format. Implementation of the Discovery service was done using Geonetwork software, which follows Catalog Service for the Web (CSW) standard.

The View service is used to view the data in an exemplary manner. In practice it is a Web Map Service (WMS) without a graphical user interface. Implementation of the View service was done using Geoserver software.

The Download service is used to download data in a machine-readable format. The interface is done according to WFS 2.0 standard. Standard gives possibility to straight forward interface solution by usage of "Simple Profile", with pre-defined queries. Implementation of the Download service was done using in-house custom built software.

The implementation sub-project was split into four work packages: Discovery service, View service, Download service and Registration service (not an INSPIRE requirement). In addition to this, data security was taken into account in each work package and also as a separate top-level issue. Registration is required to use View and Download services.

Hardware needs were defined approximately 6 months before the services were released to the public. Before that the development was done on a test platform. The transition to production platform went smoothly except for performance issues with the View service related to running multiple instances of Geoserver (Tomcat) on multiple servers. These were eventually fixed by reducing the number of instances on one physical server and making more

memory available to each instance. All servers use Redhat Enterprise Linux as the operating system.

INSPIRE monitoring and reporting demands are met using Spatineo Inc. Monitor software (<http://www.spatineo.com/spatineo-monitor/>). FMI participated in the development of the software as an early beta tester providing valuable feedback.

In order to help new developers using FMI data we also provided a Javascript library called MetOLib (available on Github) and an animator software as a reference implementation.

FMI's Open Data projects software development work was done partly by FMI and partly subcontracted. Development tools used were JIRA (Task management), Confluence Wiki (Documentation) and Subversion/GIT (Code repository).

Development of Services continues in the form of more data sets added to the services and standard software upgrades as well as bug fixes. Also monitoring and measuring of the service is still being developed.

Further technical documentation can be found in the Open Data Manual at our website:

<<http://en.ilmatietaenlaitos.fi/open-data-manual>>

Links to the services:

Discovery service: <<http://catalog.fmi.fi/>>

View service: <<http://wms.fmi.fi/>>

Download service: <<http://data.fmi.fi/>>

## **7. Licence conditions and registration**

The open data licence was specified in accordance with the licence model of the Ministry of Finance. The fact that the FMI open data online service also includes data sets provided by other agencies (the Finnish Transport Agency) was taken into account in the licence specification.

The licence states that material received by the user under the licence can be freely copied, distributed and published, edited and exploited both commercially and non-commercially, combined with other products and used as part of an application or service. The licensee must



state the original source of the material when using and distributing the material or products derived from the material.

A registration function was implemented for the open data service. Users are required to register in order to use the download service. Upon registration, users are issued an identification key needed to access the service. Registration requires acceptance of the open data licence. The Personal Data Act and its requirements were taken into account in the implementation of the registration functionality.

The purpose of the registration functionality is to provide the FMI with information about the ways in which open data will be used. Knowledge of the different purposes for which data is used facilitates better allocation of the FMI's server capacity and allows the FMI to maintain a good level of service.

## **8. Data security**

From the early stages of the Open Data project, close attention was paid to the details and implementation of data security. The openness of the service, and the potentially enormous volumes of users and downloads posed high requirements for the hardware and software. The technical implementation included an extensive load testing phase, which focussed on the performance of software components and the scalability of all hardware. Based on the tests, development efforts could be directed at areas which were important for the performance of both software and hardware. The tests were conducted by Spatineo Oy. In addition, a comprehensive data security audit covering the whole portal was carried out to detect any vulnerabilities in the service. As a result of the audit, numerous vulnerabilities were identified and fixed before the service went live. The data security audit was conducted by Nixu Oy.

## **9. HelpDesk**

The FMI offers advisory and consulting services related to open data and the data sets. A HelpDesk function for open data users was created as part of the Open Data project.

The HelpDesk can be contacted by a contact form or by telephone. A separate error reporting form was also formulated.

The HelpDesk function was created under the Customer Services unit of the FMI, and there are also a number of experts available to assist users in questions concerning different types of

data. The service also offers technical assistance. Contact forms are automatically routed to the JIRA system. HelpDesk refers queries from the system to appropriate experts. In addition, HelpDesk can organise consulting services for users in matters related to data sets, the use and processing of the data, and INSPIRE IT solutions.

## **10. Communications**

### **10.1 Project communications**

The documentation of the Open Data project was stored on the internal Wiki page of the FMI, where it could be accessed by all FMI staff members. The project documentation on Wiki included, among others, data set specifications, various documents and records of the steering and working groups, project schedule monitoring, and presentation materials.

### **10.2 Internal communications**

In internal communications, the objective was to disseminate information about the Open Data project to the staff of the FMI. As the project involved a range of different units and teams at the FMI, key messages and Q&A sets about the release of data were formulated to support communication. Internal news items were also published in different stages of the project on intranet and in Puhuri, FMI's internal magazine. Key messages, Q&A sets and news items were published on the FMI intranet.

An extensive workshop was organised in September 2012 for personnel working on the project. The release of data was also discussed in management information sessions organised in December 2012 and March 2013. Additional open data information sessions were organised for staff.

### **10.3 External communications**

A section on open data was created on the FMI website for external communication purposes. Information about schedules, data sets to be made available and the project's progress was produced and made available on the site. Q&A sections were also created to support communications on the website.

Articles on the release of data were produced for IL-katsaus, the magazine for FMI stakeholders.

The open data project was also publicised on the FMI product development Facebook page. The beta version of the open data download service was also launched on Facebook.

A press conference was held in conjunction with the launch of the web service, and a press release was issued at the same time. The launch achieved good visibility in Finnish media.

An illustration of the open data project was commissioned for external communication purposes and used in all materials released externally (e.g. web banners, press releases). A logo for the FMI open data was also commissioned and made available for use in applications.

The FMI was an organising partner in the 2013 Apps4Finland competition.

## **11. Costs and resources**

The Ministry of Finance granted the FMI approx. €2.3 million in funding for the release of data in 2013. The first instalment was for the meteorological, climate and marine observations, key data sets on radars and lightning events, and the national weather forecast model data. The second instalment is for airport observations, which are scheduled for release in early 2014. This amount is approx. €3 million.

The project resulted in approximately 7-8 man years of employment. The man-year volume increased continuously over the course of the project. The project's resource requirements were covered by allocating resources from other FMI functions.

The release of data will result in increased use of data by citizens, government officials as well as researchers. Open data policy offers opportunities for innovation and commercial reuse, increasing employment and tax revenue. According to the BearingPoint report, the economic benefits of the data release will amount to approximately €51 million on average. The benefits were calculated with regard to road traffic, pedestrian and bicycle traffic, and water traffic. In addition, the benefits for agriculture, tourism and recreation were estimated to be 1.6-2.5 times more than the current situation.

## **12. Administration: agreements, instructions and processes**

The release of data had effects on the administrative and financial processes of the FMI.

The budgetary impacts of data release were taken into account in the 2012 budget proposal of the FMI. The FMI also held negotiations with other government agencies on inter-agency transfers of appropriations. The Ministry of Transport and Communications decree on the paid services of the Finnish Meteorological Institute was amended. The amendment provided

for the free provision of data. The decree entered into force on 1 January 2013. In accordance with the decree, the customisation of data sets, the production of services, and the use of data sets which are not included in the release are subject to fees. Furthermore, the FMI can charge for the costs of extracting data in cases where a customer commissions the FMI to search and provide data sets for the customer's use.

The FMI also has access to data that it does not own but is licensed to use. These data cannot be freely distributed by the FMI. They include data such as international model data and many satellite data sets. These types of data are priced in accordance with the ECMWF and EUMETSAT pricing rules.

The FMI's operational targets are set in the performance agreement made between the FMI and the Ministry of Transport and Communications for a four-year period at a time and reviewed annually. The release of data has been taken into account both in the ministry-agency performance agreement and in the FMI's internal performance agreements.

The release of data was also taken into account in the FMI's operating and financial plans.

The FMI's internal guidelines and instructions were reviewed during the Open Data project, and some of them, like the working time logging instructions, were updated. The general terms and conditions of service contracts are currently under review. The terms and conditions of the FMI website were revised in April 2013. The principles of data provision were reviewed and reformulated during the project. The FMI's pricing principles were also reviewed.

### **12.1 Data release principles**

The basic principle of the FMI's data release is to promote public safety and enhance the well-being of people and the environment by offering reliable and high-quality information to society. Restrictions on the release and use of data are related to public safety, personal data protection and privacy, or the confidentiality of business and trade secrets.

The principles of data provision were reviewed and drawn up during the project.

- Data sets are available in reusable and machine-readable format.
- The data sets are provided in data formats which are commonly used in Finland and other countries.

- Data sets are primarily provided from standard interfaces.
- In data provision, standard procedures are used as much as possible to enable self-service.
- Measures are taken to ensure the discoverability of data, and appropriate descriptions are provided in electronic format.
- The interoperability of different data sets in data provision is promoted.
- Public data sets are released free of charge when they are provided in a standard self-service format.
- Data releases can be subject to an extraction fee if the data set has to be customised to the recipient's requirements or the specified basic service level is increased.
- However, fees are not charged for data releases requiring only minimal work.
- Data provided for scientific research, education or official purposes are usually provided free of charge, even if it requires more than minimal work. However, work can only be carried out within existing resources.
- The use of data in the private sector is promoted through customer-friendly data provision solutions.
- Data is provided with minimal restrictions. Data uses may be restricted on specific grounds only. Users must be informed of the reasons for restricted use.
- The terms and conditions of data use are presented to users in conjunction with the release of data, and they are easily available on the FMI website. The general terms and conditions of interface services are also electronically available. The public administration open data licence model is used whenever appropriate.
- The data provider is not responsible for any errors in the data or for any direct or indirect losses resulting from the use of the data.
- Restrictions on data provision are related to security criticality, privacy protection, and business or trade secrets.

### **13. Lessons learned**

The open data implementation was very extensive: the project involved many departments of the FMI, from Observations to Weather and Marine Services, Research, Administration and Communications. Good project execution and task allocation to sub-projects were key to the successful implementation.

### **13.1 Challenges of project implementation**

The data release was a highly complex and long-term project. The main challenges were in the following areas:

- Change in operating culture: data were previously provided by the FMI as a service, whereas now the materials can be searched and downloaded freely via an online self-service. This required the adoption of new procedures at the FMI.
- Resource requirements: During the project, close attention was paid to technical capacity and its adequacy for data downloads. Predicting the HelpDesk resources was also challenging, as this area in particular was new at the FMI.
- Expectation management: open data was an unfamiliar concept to the public, and the differences of open data and data products were not clear. These were clarified in internal and external communications about open data release.

### **13.2 Benefits and lessons (internal & external)**

The most significant benefit of the project is related to the new business and innovation opportunities arising from the open data that is freely available from the FMI.

Other objectives of the open data release were enhancing the use of spatial data, increasing inter-agency cooperation, and creating new citizen services. Technical cooperation between agencies will also be enhanced in the future, as data can be produced in a standardised format for applications such as situational awareness systems. The open data release means that the observation infrastructure of the FMI can be more fully exploited.

The organisation's internal operating culture was also developed as part of the FMI's open data project, including improvements such as the development of FMI's in-house production system, the adoption of new types of operations such as consulting, cooperation with external developers, and the production of open source code. Customer-related activities were also streamlined and enhanced in some respects. Careful project planning and execution was crucial in a venture of this magnitude. Internal collaboration and working in a project environment were two areas which were executed very successfully, and internal communications were also improved.

The open data release created new forms of operation for the FMI. The new operating culture has got off to a good start, but development work will continue.

The FMI's reputation also benefitted from the open data release both in Finland and across Europe. The implementation was extensive and successful. The first application based on the open data was created in less than 24 hours of the beta version launch of the download service.

### **13.3 Indicators**

Monitoring and measurement of the open data services was implemented taking into account the requirements of the INSPIRE directive. In addition, other indicators were formulated not only to monitor the usability of the service, but also to identify the different types of data users and to measure the impact of the open data release. Certain indicators were formulated to serve the development of internal processes. This work is ongoing. The indicators are being developed in cooperation with Spatineo Oy.

Among others, the FMI monitors the following indicators:

- the total number of open data HelpDesk tickets
- the number of registered identification keys
- the number of http responses generated by the open data interface
- the volume of data downloaded via the open data interface (MB)

## **14. What next?**

The FMI will continue to add new data sets to the open data online service. Current plans include the release of climate reference values, sea ice forecast data, weather scanning data, and weather and marine warnings. The release of aviation weather observations is also being planned.

The FMI was one of the organising partners of the 2013 Apps4Finland competition. The aim of the competition was to promote the diverse and extensive use of released data sets in wider contexts.

## **Appendix 1: Directives, acts and decrees which have influenced the FMI's open data project**

**Act on Criteria for Charges Payable to the State (150/1992):** The act governs the applicability of charges for services provided by the state and the general criteria for setting the charges, and other payment-related criteria. In accordance with the act, information can be provided free of charge or it can be subject to charges based on the service production costs or on commercial terms.

**Act on the Openness of Government Activities (621/1999):** The act is a general act governing the publicity, secrecy and release of government files. Alongside various special acts which govern different areas, the Openness Act provides which information can be made available and when.

**Act on spatial data infrastructure (laki paikkatietoinfrastruktuurista (421/2009):** The act provides for the execution of the INSPIRE directive requirements in Finland. The act also determines the obligations of government agencies that administrate the original spatial data covered by the directive.

**Decree on Criteria for Charges Payable to the State (211/1992):** Complements the Act on Criteria for Charges Payable to the State.

**Decree on spatial data infrastructure (asetus paikkatietoinfrastruktuurista, 725/2009):** This decree complements the act on spatial data infrastructure and specifies the government agencies that administrate spatial data and the spatial data sets which are governed by the act.

**Government resolution of 3 March 2011 on improving the availability of public sector digital information and promoting its reuse:** According to the resolution, information must be freely accessible and available for reuse on harmonised terms that are clear and fair for all users. Information should primarily be available free of charge.

**INSPIRE Directive 2007/2/EC:** The directive requires that government agencies describe their spatial data sets governed by the directive and make them publicly available online. The directive is aimed at enhancing the use of spatial data, increasing inter-agency cooperation and creating diverse citizen services.



**Ministry of Finance proposal of 7 August 2012:** The proposal states that the release of corporate data free of charge will continue. Data for the FMI's real-time weather and climate observations, radar and lightning data, national weather forecast data and airport observations data will be released for public use free of charge in two stages.

**The Ministry of Transport and Communications decree on the paid services of the Finnish Meteorological Institute (Liikenne- ja viestintäministeriön asetus Ilmatieteen laitoksen maksullisista suoritteista, 809/2012:** The decree provides for the principles of paid services of the Finnish Meteorological Institute, fees for public services, and commercial services.

**Oslo Declaration:** The declaration of the EUMETNET directors general issued in March 2009 on data policy. The declaration states that in accordance with international policy, member institutes should, inter alia, promote the distribution of meteorological data and harmonise the operating models of data distribution in order to maximise the availability of data.

**Personal Data Act (523/1999):** The Personal Data Act is the main act governing the processing of personal data. The act was established to enforce privacy protection and other basic rights which safeguard privacy in the context of personal data processing and to promote the development of and compliance with good data processing practices. In the context of open data, the act especially governs the right to receive and process personal data.

**PSI Directive 2003/98/EC and 2013/37/EU:** A directive on the reuse of data held by public sector organisations aimed at facilitating the reuse of public sector information through harmonised requirements and the removal of obstacles.

**SES Regulation 2004/549/EC:** Framework regulation on the creation of the Single European Sky.

## Appendix 2: Glossary

**Corporate data:** A collection of data that is based on operational requirements and determined for administrative reasons to facilitate better management of data. Corporate data covers a set of jointly administered data that form a logical whole.

**Data:** Facts and statistics used for reference and analysis; the quantities, characters or symbols on which operations are performed by a computer (*Oxford English Dictionary*).

**Data policy:** In practice, data policy governs how the FMI produces and distributes its data (e.g. observations, time series), products (e.g. forecasts, warnings) and services (e.g. annual climate statistics, golf weather). The data policy also specifies whether data, products and services are available free of charge, taking into account the Act and Decree on the Criteria for Charges Payable to the State.

**Data release:** A procedure or service whereby a government agency provides data collected by the agency to another party in digital format in return for payment or free of charge.

**Data service provider:** An organisation that provides data from its own corporate data resources or other organisations' resources for public use.

**Data set:** A specific collection of data.

**DWD** Deutscher Wetterdienst

**ECMWF** European Centre for Medium-Range Weather Forecasts

**EEA** European Environment Agency

**EUMETSAT** European Organisation for the Exploitation of Meteorological Satellites

**Extraction cost:** Costs of technical extraction and provision of data.

**FMI** Finnish Meteorological Institute (in Finnish: Ilmatieteen laitos, IL)

**FMI product vs. open data:** A product is an output processed from data, e.g. a warning or a map-based radar image.

**FMI service vs. open data:** Services are produced from data, for example, in the form of an expert's interpretation of data e.g. warning, mobile application.

**Interface:** An interface is a standardised or customised procedure or point of interaction which enables the transfer of data between systems/services.

**JHS:** Public administration recommendation (julkisen hallinnon suositus).

**KNMI** Royal Netherlands Meteorological Institute

**Licence:** A licence is a permission to use copyrighted material.

**M-F** Météo France

**Machine-readability:** Data is machine-readable when it is in a format that enables a computer programme to easily itemise, identify and collect data.

**Metadata:** Metadata is data that describes data or the containers of data and facilitates the finding, cataloguing and use of the data and associated services.

**NOAA** National Oceanic and Atmospheric Administration

**Open data:** Open data refers to information which can be used and redistributed in machine-readable format on open terms and free of charge.

**Open interface:** Open interface refers to carefully documented interfaces which are freely accessible and enable the exchange of data between applications.

**Public data:** Public data refers to information which is not subject to privacy, safety or other restrictions which would require the data to be classified as secret or sensitive material.

**Reuse:** Individuals or juridical persons using public sector information for commercial or non-commercial purposes which depart from the original public purpose for which the documents were created.

**Terms and conditions:** Terms and conditions determine how the data can be used and published.

**Spatial data:** Spatial data is a set of data that describes the location, properties and contact information of a real-world object, and the data type.

**Service Level Agreement (SLA):** A service level agreement is an agreement between the customer and the service provider which determines the minimum requirements of the service.

**SMHI** Swedish Meteorological and Hydrological Institute

**UKMO** Met Office (United Kingdom)

**WMO** World Meteorological Organization

**[www.ilmatieteenlaitos.fi](http://www.ilmatieteenlaitos.fi)**: A free online service of the Finnish Meteorological Institute designed for the public, offering products and services such as weather forecasts, warnings, radar images, etc.

**ZAMG** Central Institute for Meteorology and Geodynamics (Austria)

## RAPORTTEJA — RAPPORTER — REPORTS

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  3. Virkkula, Aki, Lättilä, Heikki ja Koskinen, Timo, 1995. Otsonin maanpintapitoisuuden mittaaminen UV-säteilyn absorptiolla: DOAS-menetelmän vertailu suljettua näytteenottoalaa käyttävään menetelmään. 29 s.
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4. Koskinen, H., Eliasson, L., Holback, B., Andersson, L., Eriksson, A., Mälkki, A., Nordberg, O., Pulkkinen, T., Viljanen, A., Wahlund, J.-E., Wu, J.-G., 1999. Space weather and interactions with spacecraft : spee final report. 191 p.
- 2000:
1. Solantie, Reijo ja Drebs, Achim, 2000. Kauden 1961 - 1990 lämpöoloista kasvukautena alustan vaikutus huomioiden, 38 s.
  2. Pulkkinen, Antti, Viljanen, Ari, Pirjola, Risto, and Bear working group, 2000. Large geomagnetically induced currents in the Finnish high-voltage power system. 99 p.
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  4. Tuomenvirta, Heikki, Uusitalo, Kimmo, Vehviläinen, Bertel, Carter, Timothy, 2000. Ilmastonmuutos, mitoitussadanta ja patoturvallisuus: arvio sadannan ja sen ääriarvojen sekä lämpötilan muutoksista Suomessa vuoteen 2100. 65 s.
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1. Koskinen, H., Tanskanen, E., Pirjola, R., Pulkkinen, A., Dyer, C., Rodgers, D., Cannon, P., Mandeville, J.-C. and Boscher, D., 2001. Space weather effects catalogue. 41 p.
  2. Koskinen, H., Tanskanen, E., Pirjola, R., Pulkkinen, A., Dyer, C., Rodgers, D., Cannon, P., Mandeville, J.-C. and Boscher, D., 2001. Rationale for a european space weather programme. 53 p.
  3. Paatero, J., Valkama, I., Makkonen, U., Laurén, M., Salminen, K., Raittila, J. and Viisanen, Y., 2001. Inorganic components of the ground-level air and meteorological parameters at Hyytiälä, Finland during the BIOFOR project 1998-1999. 48 p.
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  2. Tammelin, Bengt, Forsius, John, Jylhä, Kirsti, Järvinen, Pekka, Koskela, Jaakko, Tuomenvirta, Heikki, Turunen, Merja A., Vehviläinen, Bertel, Venäläinen, Ari, 2002. Ilmastonmuutoksen vaikutuksia energiantuotantoon ja lämmitysenergian tarpeeseen. 121 s.
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  4. Pulkkinen, T. I., 2003. Chapman conference on physics and modelling of the inner magnetosphere Helsinki, Finland, August 25 -29, 2003. Conference program. 16 p.
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  6. Venäläinen, Ari, Sarkkula, Seppo, Wiljander, Mats, Heikkinen, Jyrki, Ervasto, Erkki, Poussu, Teemu ja Storås, Roger, 2004. Espoon kaupungin talvikunnossapidon sääindeksi. 17 s.
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  2. Laurila, Tuomas, Lohila, Annalea, Tuovinen, Juha-Pekka, Hatakka, Juha, Aurela, Mika, Thum, Tea, Walden, Jari, Kuronen, Pirjo, Talka, Markus, Pesonen, Risto, Pihlatie, Mari, Rinne, Janne, Vesala, Timo, Ettala, Matti, 2005. Kaatopaikkojen kaasupäästöjen ja haihdunnan mikrometeorologisten mittausmenetelmien kehittäminen (MIKROMETKAA). Tekesin Streams –ohjelman hankkeen loppuraportti. 34 s. (Ei julkaistu – Not published)
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6. Tammelin, Bengt, Säntti, Kristiina, Dobeck, Hartwig, Durstewich, Michel, Ganander, Hans, Kury, Georg, Laakso, Timo, Peltola, Esa, Ronsten, Göran, 2005. Wind turbines in icing environment: improvement of tools for siting, certification and operation – NEW ICETOOLS. 127 p.
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  2. Pulkkinen, Tuija, Hari, Ari-Matti, Haukka, Harri, Leinonen, Jussi, Toivanen, Petri, Koskinen, Hannu, André, Mats, Balasis, Georgios, Boscher, Daniel, Dandouras, Iannis, Grande, Mael, De Keyser, John, Glassmeier, Karl-Heinz, Hapgood, Mike, Horne, Richard, Ivchenko, Nikolay, Santolik, Ondrej, Torkar, Klaus, Trotignon, Jean Gabriel, Vennerstrøm, Susanne, 2007. Waves and acceleration of relativistic particles (WARP). 36 p.
  3. Harri, A-M., Leinonen, J., Merikallio, S., Paton, M., Haukka, H., Polkko, J., Linkin, V., Lipatov, V., Pichkadze, K., Polyakov, A., Uspensky, M., Vasquez, L., Guerrero, H., Crisp, D., Haberle, R., Calcutt, S., Wilson, C., Taylor, P., Lange, C., Daly, M., Richter, L., Jaumann, R., Pommereau, J-P., Forget, F., Lognonne, Ph., Zarnecki, J., 2007. MetNet – In situ observational network and orbital platform to investigate the Martian environment. 35 p.
  4. Venäläinen, Ari, Saku, Seppo, Kilpeläinen, Tiina, Jylhä, Kirsti, Tuomenvirta, Heikki, Vajda, Andrea, Räisänen, Jouni, Ruosteenoja, Kimmo, 2007. Sään ääri-ilmiöistä Suomessa. 81 s.
  5. Tuomi, Tapio J. & Mäkelä, Antti, 2007. Salamahavainnot 2007 - Lightning observations in Finland, 2007. 47 p.
  6. Pajunpää, K. and Nevanlinna, H. (eds), 2007. Nurmijärvi Geophysical Observatory : Magnetic results 2006. 49 p.

- 2008:
1. Pajunpää, K. and Nevanlinna, H. (eds), 2008. Nurmijärvi Geophysical Observatory : Magnetic results 2007. 49 p.
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  3. Gregow, Hilppa, Venäläinen, Ari, Laine, Mikko, Niinimäki, Niina, Seitola, Teija, Tuomenvirta, Heikki, Jylhä, Kirsti, Tuomi, Tapio ja Mäkelä, Antti, 2008. Vaaraa aiheuttavista sääilmiöistä Suomen muuttuvassa ilmastossa. 99 s.
  4. Tuomi, Tapio J. & Mäkelä, Antti, 2008. Salamahavainnot 2008 – Lightning observations in Finland, 2008. 49 p.
  5. Heino, Raino and Tolonen-Kivimäki, Outi (eds), 2008. Finnish national report on systematic observations for climate – 2008. 27 p.
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Erik Palménin aukio 1, Helsinki  
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