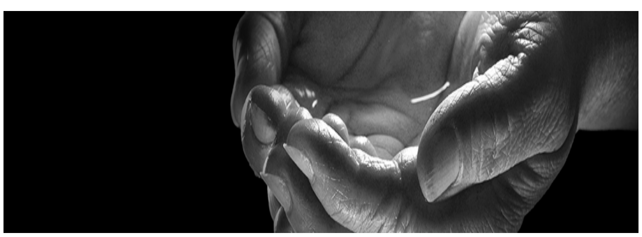
SMART SYSTEMS FOR WATER MANAGEMENT

Modelling, Simulation, Analytics and ICT for Behavioural Change

22-25 August 2016, Monte Verità – Switzerland

BOOK OF ABSTRACTS

Edited by Andrea Castelletti and Andrea Emilio Rizzoli



The Smart System for Water Management Symposium and Summer School is an initiative of the SmartH2O project

which is member of the ICT4Water cluster

The SmartH2O project receives funding from the European Commission

The conference is supported by Congressi Stefano Franscini, a department of ETH Zürich and it is hosted at Centro Monte Verità, in Ascona, Switzerland, with partial support from the Swiss National Research Fund

Andrea Castelletti and Andrea Emilio Rizzoli acknowledge support from their institutions, respectively Politecnico di Milano and SUPSI

CONFERENCE PROGRAMME

Note: the presentations allocated into the workshop slots will have a length of 30 minutes maximum, the remainder of the time is for workshop discussion.

Monday 22nd of August
9:30 – 10:00 - Welcome address by the directors of Centro Stefano Franscini
10:00 – 11:00 - Water resource economics and finance - *Greg Characklis,* University of North Carolina at Chapel Hill, USA
11:00 – 12:00 - Water pricing policies and consumer behaviour - *Julien Harou and Charles Rougé,* University of Manchester, UK
12:00 – 14:00 Lunch
14:00 – 15:00 Integrated modelling of demand and supply. The role of hydroeconomic models - *Manuel Pulido Velasquez,* Universitat Politecnica de Valencia, Spain
15:00 – 16:00 Behavioral interventions to successfully reduce residential water consumption - *Verena Tiefenbeck,* ETH Zurich, CH
16:00 – 18:00 Workshop - The drivers of water user behaviour: social norms and economic reasons Empowering water consumers through smart metering: evidence from a field study in a residential suburb of Montpellier (south of France) - *Marielle Montginoul - Irstea – UMR G-Eau, Montpellier France*

Tuesday – 23rd of August
9:00 – 10:00 - Synergistic water and energy demand modeling, management, and conservation **-** *David Rosenberg*, Utah State University, USA
10:00 – 11:00 - Economic and energy analysis of household water conservation - *Jay Lund*, UC Davis, USA
11:00 – 12:00 - Forecasting water demand **-** *Wojciech Froelich*, University of Silesia, Poland
12:00 – 14:00 Lunch
14:00 – 15:00 - Modelling water user behaviour: from smart metered data to agent based modelling **-** *Matteo Giuliani, Politecnico di Milano, Italy & Alessandro Facchini, SUPSI, CH*
15:00 – 16:00 - Hardware and software tools for precise End Use disaggregation - *Francisco Arregui de la Cruz, UPV, Spain*
16:00 – 16:30 - Stochastic generation of residential water end-use demand traces – *Andrea Cominola, Politecnico di Milano, Italy*
16:30- 18:00 Workshop - Understanding and modelling the behaviour of water users A Framework for Real-Time Spatially Distributed Demand Estimation and Forecasting, *Dominic L. Boccelli, University of Cincinnati, Cincinnati, OH, USA*

Wednesday 24th of August
9:00 – 10:00 Multiobjective Water Management Under Uncertainty - *Patrick M. Reed*, Cornell University USA
10:00 – 11:00 ICT solutions for real time smart water management - *Lydia Vamvakeridou & Dragan Savic,* University of Exeter, UK

11:00 – 12:00 Standardization Activities and Gaps for Smart Sustainable Cities - *Gabriel Anzaldi,* EURECAT, Spain
12:00-13:00 Lunch
13:00 – 14:00 New control techniques for smart water systems - *Pantelis Sopasakis,* IMT Lucca, Italy
14:00 – 16:00 - Workshop - Innovation in ICT for water management The GIS-integrated FREEWAT platform as an ICT tool for sustainable water resources management. *Giovanna De Filippis - Scuola Superiore Sant'Anna, Pisa (Italy)* Hydra 3D: A Tool to Simulate Hydric Resources Scenarios. *Javier Díaz,, LINTI, La Plata National University, Buenos Aires (Argentina)*
16:00 – 18:00 Public event – Increasing the awareness on water use

Thursday 25th of August
9:00 – 10:00 - Water Savings Clustering: Which types of households respond best to social norms messaging? - *William Holleran*, WaterSmart, CA, USA
10:00 – 11:00 Gamification for water utilities - *Piero Fraternali,* Politecnico di Milano, Italy, *Isabel Micheel, Jasminko Novak*, European Institute for Participatory Media, Berlin
11:00 – 11:15 Award ceremony: best young researcher award
11:15 – 12:00 Plenary session: the future challenges of urban water management Panel discussion with *Jay Lund, Lydia Vamvakeridou, Patrick Reed, Greg Characklis, William Holleran, and David Rosenberg.* Moderated by *Andrea E. Rizzoli.*
12:00 Closing

ABSTRACTS OF TUTORIALS

Theme: The drivers of water user behaviour: social norms and economic reasons

Water resource economics and finance

Greg Characklis, University of North Carolina at Chapel Hill, USA

The participants will be exposed to the principles of water resource economics in a management/policy context, with additional attention to the financing challenges (and potential solutions) that accompany more sophisticated management strategies.

Water pricing policies and consumer behaviour

Julien Harou and Charles Rougé, University of Manchester, UK

Smart meters and new types of interaction with consumers make emerge new horizons in water pricing, including pricing structures where the consumer bill is linked to short and/or long term water scarcity. In this lecture we will analyse how new pricing structure can actually affect consumer behaviour.

Integrated modelling of demand and supply. The role of hydroeconomic models

Manuel Pulido Velasquez and Francisco Arregui de la Cruz, Universitat Politecnica de Valencia, Spain.

Overview of approaches for the economic characterization of urban water demands (eg. simple point-expansion method, econometric approaches, math programming, etc) and use in the assessment of consumer and producer surplus. Introduction to hydroeconomic models integrating demands and supply; application to the assessment of the impacts of droughts (scarcity cost) and the consequences of different water management and planning policies (using reliability indicators and economic net benefits).

Gamification for water utilities

Piero Fraternali, Politecnico di Milano, Italy, Isabel Micheel, Jasminko Novak, European Institute for Participatory Media, Berlin

Gamification is gaining momentum as a tool to motivate and engage customers. In this workshop we show how it can also be successfully applied in order to modulate urban water demand, thus providing an invaluable tool to water utilities. In the afternoon workshop, the participants will explore new ideas and solutions for effective customer engagement in an interactive session.

Behavioral interventions to successfully reduce residential water consumption

Verena Tiefenbeck, ETH Zurich, CH

Water heating is the second largest energy end use in European and U.S. households, making showering one of the most energy-intensive behaviors we engage in on a daily basis. Yet most individuals have a very limited understanding - and fundamental misconceptions - of their energy and water consumption at home. In this workshop, we discuss the impact of different feedback strategies to reduce energy and water consumption in the shower. In particular, we will compare behavior-specific feedback that is provided in real time with other demand management strategies (including flow restrictors and feedback on a household's aggregated resource consumption). Based on a series of recent randomized controlled field trials in different countries, we will investigate why real-time feedback induces such a large behavior change, analyze effect persistence and cost effectiveness, and evaluate which segments of the population are particularly responsive to this kind of behavioral intervention.

Water Savings Clustering: Which types of households respond best to social norms messaging?

William Holleran, WaterSmart, CA, USA

WaterSmart Software has data from over 30 Randomized Control Trial implementations across the United States of its water conservation and customer engagement program. Leveraging that data with a synthetic controls model will allow calculations of individual level savings. Applying a time-series classification model to the savings at a monthly, weekly and daily level will reveal characteristics that will improve understanding of how social norms based messaging varies in its impact on individual behaviors. This will inform future program design and allow for targeting of specific groups to maximize program impact.

Theme - Understanding and modelling the behaviour of water users

Synergistic water and energy demand modeling, management, and conservation

David E. Rosenberg, Utah State University, UT, USA

We link detailed end-use analysis of residential water and associated energy uses to stochastic optimization to identify the cost-effective mix of conservation actions residential users supplied by a water system can adopt to meet system-wide synergistic water and energy conservation targets. The end-use analysis draws from a database containing timing, duration, frequency, and volume information of 1.4 million water-use events recorded for 800 households in 11 U.S. and Canadian cities over two or more weeks of high frequency water use monitoring over the last 15 years. Energy uses include the embedded energy to collect, treat, convey, and distribute water to households, energy to heat water within the household for hot water uses, and embedded energy to collect and treat wastewater. This data is used to sample a large, simulated set of households with indoor and outdoor water appliances, behaviors, and conservation potential specific to the study city. The stochastic optimization program then identifies the mix of household appliance and behavioral change conservation actions that minimize city-wide costs to achieve system-wide water and energy reduction targets. The minimization is also subject to lower and upper bounds on the number of conservation actions implements and upper bounds on households' payback period for conservation actions. Results identify feasible city-wide collaborative water and energy conservation targets, select and size water and energy conservation programs, identify synergies and tradeoffs between water and energy, and quantify payback periods for household conservation actions. Additionally, the presentation will share approaches Utah State University is now developing to organize and manage high-frequency end-use data and deploy low-cost smart meters to monitor water use and savings by non-residential, institutional, and residential users.

Economic and energy analysis of household water conservation

Jay Lund, UC Davis, CA, USA

Household water conservation will be examined for its energy, water use, and emission impacts. The optimization of household conservation activities for these objectives will be examined and discussed. Additional discussion and analysis will include how changes in probabilistic water supply reliability affect optimized water user conservation activities.

Forecasting water demand

Wojciech Froelich, University of Silesia, Poland

This tutorial lecture considers selected issues related to water demand forecasting. At the urban level, the forecasting is applied to the efficient management of water resources and as a part of the system that controls pressure in the water distribution system. At the household level, the forecasting is exploited by the decision support system, encouraging consumers to save water. Theoretical preliminaries to time series are presented together with a brief overview of the most known forecasting models. The online availability of water demand data is assumed. The concepts of growing and sliding windows are presented to illustrate different modes of learning models. Practical methods to deal with missing values and outliers are also presented. In addition, it is shown how to recognize stationarity, linearity and other features of water demand time series. The knowledge of these features helps to select the most effective forecasting model for the given time series. Different methods of dealing with seasonality in time series are presented, including autoregression, seasonal adjustment, and the application of dummy variables. An example of combining forecasts generated by different models is presented. All theoretical presentations are illustrated by practical examples. The KNIME toolkit and the R software package are used for this purpose. An introduction to both tools is made. In all of the presented experiments, scale-independent forecasting errors are calculated.

Modelling water user behaviour: from smart metered data to agent based modelling

Andrea Castelletti, Matteo Giuliani, Andrea Cominola, Politecnico di Milano, Italy, Alessandro Facchini, Andrea E. Rizzoli, IDSIA USI/SUPSI, CH

Smart metered consumption data allow sophisticated data driven modelling of water user behaviours. In this session, we analyse how to disaggregate water consumption into end uses, how to build water user profiles using big data mining technique and how to analyse social interaction through an agent based platform. Models are used to understand and predict user behaviours as well as to simulate social norms mechanisms activated by external stimuli (e.g. awareness campaign, pricing schemes).

Hardware and software tools for precise End Use disaggregation

Francisco Arregui De La Cruz, Universitat Politecnica de Valencia, Spain

Residential water End Use disaggregation is one of the most powerful tools available to understand water demand and also to design truly effective water consumption reduction strategies. End Use disaggregation allows for a much better understanding not only of the technical characteristics of the appliances but also the way customers interact with them.

The development and standardization of AMI and AMR technologies has facilitated the remote metering of customers. However, their lowest-possible-cost design and working life requirements only allow, in most cases, for hourly/daily monitoring. Unfortunately, a reliable disaggregation requires that the flow signal is available for analysis at shorter time intervals (10 seconds or less). This reading frequency exponentially increases the communication costs, the amount of data to be processed and the number of commercially available hardware options.

Taking into account all these constraints a specific combination of hardware and software has been made available to reduce the cost a high resolution monitoring of customers. This set includes:

- High resolution positive displacement meter equipped with a pulse emitter.
- A new logger capable of:
    - Storing the time of occurrence of the pulses with a resolution of 1 ms. This special feature generates an undistorted flow trace signal from the meter ready to be process by the software.
    - Sending the data to a dedicated FTP server once every few hours.
- Web-based end use analysis software
    - All data (the original coming from the loggers and the processed pulses) is stored in an online database without the need of human intervention.
    - Advance processing capabilities to improve the analysis of overlapped consumption.
    - Flexible and powerful configuration tools to define different end uses and types of users.

The software and hardware designed allow for a much precise End Use classification which can serve for researchers and other interest groups to develop more accurate algorithms for automatic End Use classification tools.

Theme - Innovation in ICT for water management

Multiobjective Water Management Under Uncertainty

Patrick M. Reed, Cornell University USA

Computing power is cheap, optimization algorithms have advanced, visualizations have gotten more sophisticated, and many systems optimization frameworks have found their way into commercial use, yet for nearly 25 years we have continued to formulate and solve water management problems largely the same way. Many of the innovations discussed above have occurred in isolation, and the design of complex engineered water resources systems remains plagued by neglected uncertainties and narrow definitions of optimality that fail to encompass critical performance tradeoffs. This session will introduce emerging multiobjective design tools that enhance systems engineering design under uncertainty. Beyond the focus on multiobjective optimization, the course will cover relevant research related to constructive decision-aiding theory and decision-biases related to risk, and recent advances in visual analytics that have been demonstrated to enhance design processes. A core goal of this course is to show the state-of-the-art for integrating human intelligence and computational power to effectively explore design hypotheses, discover critical system tradeoffs, and facilitate robust design decisions.

ICT solutions for real time smart water management

Lydia Vamvakeridou & Dragan Savic, University of Exeter, UK

The potential and the scientific challenges facing ICT solutions for real time smart water management are presented. For instance one of the main challenges is the management and extraction of information from vast amounts of high resolution consumption data; a “Big Data” challenge, and how it can be faced.

Standardization Activities and Gaps for Smart Sustainable Cities

Gabriel Anzaldi, EURECAT, Spain

In this tutorial we will explore a proposed framework of standards and methodologies for interoperability within Smart Sustainable Cities, and we will also work in a proposal of standardization roadmap, taking into consideration the activities currently undertaken by the various standards developing organizations and forums. The tutorial will include a review of the i) SSC needs for standardization and interoperability; ii) current frameworks of SSC standards; ii) SSC related Standard Development Organizations activities; iii) outlines of SSC standard needs and gap analysis.

New control techniques for smart water systems

Pantelis Sopasakis, IMT Lucca, Italy

In this tutorial session we will discuss how dynamical modeling combined with time-series analysis and optimization can lead to an efficient management of complex water systems. We will introduce key performance indicators to evaluate the performance of the controlled system and formulate an economic model predictive control (EMPC) scheme to address the prescribed control objectives. We will also see how we can harness the computational power of graphics cards to accelerate complex computations involved in our control problems.

ABSTRACTS OF WORKSHOP PAPERS

The following abstracts, listed in alphabetical order of the presenting author (underlined), summarise presentations that will be discussed during the accompanying workshops. This list is not complete, and during the workshops it is possible that other presentations will be delivered besides those listed here.

A Framework for Real-Time Spatially Distributed Demand Estimation and Forecasting

Jinduan Chen, IDModeling, Arcadia, CA, USA

Dominic L. Boccelli, University of Cincinnati, Cincinnati, OH, USA

Short-term water demand forecasts are valuable for distribution system operators controlling the production, storage and delivery of drinking water. In certain problems, like real-time pump scheduling, the cycle of data acquisition, model computation, and decision-making is time-sensitive, and requires an automatic procedure to handle the transfer of information between data sources, a forecasting model, and the operator. Our initial research focused on the Time Series Forecasting Framework (TSFF) - a flexible framework that accommodates different data sources and forecasting models - was performed as the first step to bridge the gap between forecasting algorithms and engineering practice with respect to total system demand. Our current research is extending the TSFF from total system demand to spatially distributed demand estimation and forecasting. An autoregressive integrated moving average (ARIMA) time series models has been vectorized (VARIMA) to include the potential spatial correlation in demands through the error covariance matrix, and the resulting estimation/forecasting algorithm is formulated as a Dynamic Bayesian Network. Using data collected from a utility SCADA system (e.g., pressures, flow rates, tank levels, etc), the parameters of the VARIMA model as well as the demands at a given time step will be estimated with an Expectation-Maximization (E-M) algorithm, which was designed to compute the maximum likelihood estimates for models with incomplete observations. As part of the E-M algorithm, a distribution of demands is generated that reflect the uncertainty in the current demand estimates. This information, when coupled with the updated VARIMA model parameter estimates, can be utilized to forecast spatially correlated demands as well as the uncertainty in future demand estimates. This work will present the overall modelling framework and our preliminary studies into the use of the framework for performing system wide demand estimation.

The GIS-integrated FREEWAT platform as an ICT tool for sustainable water resources management

Giovanna De Filippis - *Scuola Superiore Sant'Anna, Pisa (Italy)*

Iacopo Borsi - TEA SISTEMI S.p.A., Pisa (Italy)

Laura Foglia - UC Davis, CA, USA

Massimiliano Cannata - IST SUPSI, Switzerland

Violeta Velasco Mansilla - CSIC, Barcelona (Spain)

Rudy Rossetto, Scuola Superiore Sant'Anna - Pisa (Italy)

During the last decades, overexploitation of the available freshwater resources causes qualitative and quantitative degradation of accessible ground- and surface-water supply, due to growing human pressure and climate changes. For this reason, addressing proper management and planning strategies is of paramount importance to restore unbalanced situations and/or prevent future scenarios of degradation.

As pointed out by regulations and recommendations of the EU and the European and Environment Agency (European Environment Agency, 2004), developing innovative software tools to address water management issues is imperative and numerical models represent valuable tools to address this task as, thanks to their predictive function, they can help for the application of planning and management strategies.

The EU HORIZON 2020 FREEWAT project (FREE and open source software tools for WATer resource management; Rossetto et al., 2015) aims at simplifying the application of EU-water related Directives (EU, 2000), by developing an open source and public domain, GIS-integrated platform for planning and management of ground- and surface-water resources.

Such platform is expected to help in facilitating the widespread use of complex modeling environments and in producing scientifically and technically sounding decision and policy making. These objectives will be achieved taking advantage of storing, managing and visualizing large spatial datasets and adopting a participatory approach, to involve stakeholders not only in the final stage of result discussion, but also during the phase of scenario setting.

The FREEWAT platform is integrated within the open source QGIS GIS, allowing the simulation of the whole hydrological cycle and the analysis of several water data, where input and output data are managed through a SpatiaLite Data Base Management System (DBMS). The FREEWAT hydrological model is based on fully distributed and physically-based numerical codes, mainly from the open source USGS MODFLOW family. As such, the FREEWAT platform is conceived as a canvas, where several simulation codes might be virtually integrated.

FREEWAT capabilities include: modelling solute transport processes in the saturated and unsaturated zones; pre-processing tools for the analysis, interpretation and visualization of hydrochemical and hydrogeological data; tools for time-series processing; a module for sensitivity analysis, calibration and parameter estimation; a module devoted to water management and planning. Within the FREEWAT project, fourteen case studies will be set up throughout EU, Switzerland, Turkey, Ukraine and Africa (with the cooperation of UNESCO-IHP), to demonstrate the full platform capabilities at different scales. Among the tools integrated in FREEWAT, the Farm Process (FMP) embedded in MODFLOW-OWHM (Hanson et al., 2014) is a remarkable module, which allows to simulate conjunctive use of ground- and surface-water, with particular focus on rural environments, under demand-driven and supply- constrained conditions, taking also into account constraints on well abstraction and water-rights ranking of water accounting units. The FMP allows to dynamically integrate infiltration, surface runoff and deep percolation components, to effectively balance crop water demand and supply from both sources of water. It is further coupled with the Crop Growth Module, a free and open source module based on the EPIC family models, to estimate crop water uptake and provide crop yield at harvest.

REFERENCES

EU, 2000. Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy. Official Journal (OJ L 327) on 22 December 2000.

European Environment Agency, 2004. Agriculture and the environment in the EU accession countries - Implications of applying the EU common agricultural policy. Environmental issue report No. 37, 55 pp.

Hanson RT, Boyce SE, Schmid W, Hughes JD, Mehl SM, Leake SA, Maddock T, Niswonger RG, 2014. One-Water Hydrologic Flow Model (MODFLOW-OWHM). U.S. Geological Survey, Reston, Virginia.

Rossetto R, Borsi I, Foglia L, 2015. FREEWAT: FREE and open source software tools for WATer resource management. Rendiconti Online Societa Geologica Italiana, 35:252-255. DOI: 10.3301/ROL.2015.113

Hydra 3D: A Tool to Simulate Hydric Resources Scenarios

Javier Díaz, Laura Fava, Anabella Di Grazia, Eduardo Nola - LINTI, La Plata National University, Buenos Aires (Argentina)
Juan Pablo Zamora - INTA, Maimará. Jujuy (Argentina)

Fresh water is a vulnerable and a finite resource, essential to support life, urban development, and the environment. It is one of the most important resources of the planet and also, one of the most damaged by pollution, overexploitation, population growth, energy crises and climate change. One challenge that the Water Resources Integrated Management has to face nowadays is related to the task of building skills in different workspaces and educational settings, whether formal or informal, to achieve population awareness on efficient water use. Information and Communication Technologies offer tools that enable the exchange of experiences and knowledge among learning groups. Despite this, during training workshops on water technical capabilities, debates are held using physical models and posters with maps that are explained orally. Specialists on Hydric Resources use paper and physical models to carry out their activities that are to analyze, build mock-ups, modify and create hydric scenarios on different areas (Setta, 2014). The use of papers and static scale physical models has its limitations, especially when it becomes necessary to work with high complexity hydric scenarios.

This paper presents Hydra3D, developed in DiGrazia (2015), a computer tool that enables the simulation and recreation of hydric scenarios on a virtual ground. This software allows for the analysis of different alternatives of water resource allocation taking into account the interaction between various sectors of demand (agricultural, urban and industrial). This computer tool lets the user build a hydric scenario by incorporating predefined components and adding elements on a virtual geographic space. The components that can be added represent different elements that take part in a hydric scenario in real life, for example: a river, an industry, an agricultural district, a city, a mountain, a mine, etc. All of these components have their own behavior that will affect the scenario and can be configured by the user. The ground elevation and the general state of the scenario (the season, for example) can also be modified. The tool executes a simulation that, depending on the configuration made by the user, allows the visualization of the resulting indicators that are part of hydric resource management. Built scenarios can be saved allowing the user the possibility of sharing his creation with others. Reports can be exported in PDF format giving the user a numeric representation of the scenario being executed.

It is expected that the development of this tool will provide support for the implementation of capacity building processes in different areas and educational levels, for research and for the training of graduate students by providing them with a tool that lets them build mock-ups and explore different scenarios of water management in a visual and 3D environment. This tool will be used in the training process of Hydric Technical Capabilities aimed at rural communities and rural development institutions of the Puna Jujeña (Bilbao, 2012). It may also be used by other specialists during their training, more specifically for the M.S. in Integrated Water Resources Management to complete exercises where the layout of water scenarios and its further analysis is required (UNL, 2016).

REFERENCES

Bilbao, L., García, J., Guzman, P., Narmona, L., Ariza, I., Ochoa, V., Zamora, J.P., 2012. Primer proceso de formación en capacidades técnicas hídricas de la provincia de Catamarca - Intercambio de saberes entre técnicos y productores sobre el aprovechamiento del agua en comunidades rurales. Editorial Copiar.

DiGrazzia, A., Nola. E., 2015. Hydra3D una herramienta para simulación de escenarios de gestión de recursos hídricos, available from http://edunola.com.ar/juegos/PruebaWin.rar or http://edunola.com.ar/juegos/SimulacionWeb.html

Setta, D., 2014. Se lanzó el Proceso de Formación en Capacidades Técnicas Hídricas Comunitarias en la puna jujeña. Comunicación IPAF Región NOA, available: http://inta.gob.ar/noticias/se-lanzo- el-proceso-de-formacion-en-capacidades-tecnicas-hidricas-comunitarias-en-la-puna-jujena/.

Kofi, A., Matsuura, K., Gordon, Y., 2007. Water for People Water for Life. World Water Assessment Programme. http://unesdoc.unesco.org/images/0012/001295/129556e.pdf

UNL, 2016, Maestría en Gestión Integrada de los Recursos Hídricos, Facultad de Ingeniería y Ciencias Hídricas, Universidad Nacional del Litoral, Santa Fé, Argentina. Available: http://fich.unl.edu.ar/carrera.php?id=25

Empowering water consumers through smart metering: evidence from a field study in a residential suburb of Montpellier (south of France)

Marielle Montginoul - *Irstea – UMR G-Eau, Montpellier France*

Arnaud Vestier - Montpellier Méditerranée Métropole, France,

In a context characterized by increasing water scarcity, French environmental laws highly incite water managers to improve network performances by reducing water leaks and users to save water. Smart metering seems a new interesting solution to reach such objectives, by informing water managers and users on real-time consumption (Kendel and Lazaric, 2015). This communication aims to explore its current adoption in France by urban users of this new technology, which seems theoretically deliver a range of benefits either for water managers or for water users. In particular, it allows for urban water users to consult their daily water consumption and to create SMS or Email-alert messages to inform them when water consumption exceeds a pre-defined threshold. But results show that this technology is not adopted, with a very low subscription rate. Is it because users and especially households are ill- informed or ill-intentioned against this new technology? In order to better understand reasons underlying such a low rate (Darby, 2010, Fischer-Lokou and al, 2004, Kendel and Lazaric, 2015), we conducted a natural field experiment study in a residential suburb of Montpellier (South of France). 261 households where equipped from January 2015 with smart meters and officially informed in June- July of the associated services (reading daily water consumption, defining warning system in case of own-defined level of overconsumption). We took special care to inform them, in particular by testing two modes of individual communication (by mail or face-to-face), but the adoption is still low. We then conducted a household survey to identify the potential obstacles and to know their social representations (Ajzen, 1991) of words “water” and “remote reading”. 77 households answered, revealing no technical obstacles (like low interests/levels in new technologies) and highlighting that remote reading seems related mostly to positive connotations (like useful, simple, allows to be warned of a water leak or of an excess level of consumption). Further researches have then now to focus on the last step, that one which goes from intention to action. In that way, we will in particular explore potentialities of different types of smart water pricing by simulating the impact of such systems on households' water behavior from on a data set of 23,000 water meters located in Montpellier metropolis.

REFERENCES

Ajzen, I.,1991. Theories of Cognitive Self-Regulation. The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179-211

Darby, S., 2010. "Smart Metering: What Potential for Householder Engagement?" Building Research & Information, 38(5), 442-57

Davies, K.; C. Doolan; R. Van Den Honert and R. Shi, 2014. "Water-Saving Impacts of Smart Meter Technology: An Empirical 5 Year, Whole-of-Community Study in Sydney, Australia." Water Resources Research, 50(9), 7348-58

Fischer-Lokou, J.; Guéguen N., Lépy, N., 2004. "Effets De La Communication Par Réseaux Informatiques Versus En Face-À-Face Sur La Représentation Réciproque Des Négociateurs Et Leur Prise De Décision." Bulletin de Psychologie, 57(5), 525-3

Kendel, A., Lazaric, N., 2015. "The Diffusion of Smart Meters in France. A Discussion of the Empirical Evidence and the Implications for Smart Cities." Journal of Strategy and Management, 8(3), 231-44