International Environmental Modelling and Software Society (iEMSs)
8th International Congress on Environmental Modelling and Software
Toulouse, France, Sabine Sauvage, José-Miguel Sánchez-Pérez, Andrea Rizzoli (Eds.)
http://www.iemss.org/society/index.php/iemss-2016-proceedings

Modelling small agricultural dams dynamics into the MAELIA multi-agent platform

Romain Lardy[1,2], **Camille Truche**[2], **Olivier Therond**[2,3]

[1] ARVALIS - Institut du végétal, Baziège, France
[2] UMR 1248 AGIR, INRA-INPT, Castanet-Tolosan, France
[3] UMR LAE, Colmar, France
Email addresses: romain.lardy@toulouse.inra.fr; camille.truche@gmail.com;
olivier.therond@colmar.inra.fr

Abstract: In France, during the three last decades farmers built numerous small dams to have alternative resources for irrigation. In water deficit situations, one major question of the debate is the cumulative effect at watershed and river basin levels of small water dams on stream flows during the low flow period. This paper presents a new modelling framework to simulate hydrology and cumulative effect of small agricultural dams at river basin level that was implemented in the multi-agent modelling and simulation MAELIA platform. This modelling framework is based on the distinction of four types of small dams: connected to groundwater; disconnected from rivers; connected to the main stream of the sub-watershed; connected to secondary streams of the sub-watershed. It allows to simulate dynamic filling, discharge and emptying of each agricultural dam. It is simple and robust enough to represent individual behaviour of thousands of dams at regional scale. When implemented in integrated modelling platform like MAELIA, it allows to explore the potential cumulative impact of agricultural dams on the river and stream flow. First simulations show no significant impacts on the case-study river flow that is strongly determined by water release from big public dams. However, they show potential significant impacts in watersheds where the flow of the main stream is not influenced by release of public dams.

Keywords: integrated modelling; multi-agent platform; small agricultural dams; hydrology; water resource management

1. INTRODUCTION

In the Adour Garonne Basin, southwest France, irrigation of cropping systems (mainly maize) from rivers and groundwater faces to important problems of recurrent water deficit in several river basins. During the three last decades farmers built numerous small dams to have alternative resources for irrigation. Setting up such small dams is subject to an administrative authorisation. Local state services in charge of delivering this authorisation have to assess the potential impacts of this new dam on quality and quantity of impacted water resources. Furthermore, since 2000s setting up new dams is highly debated between agricultural and environmentalist stakeholders. They represent an important additional resource for irrigation (e.g. 17% in the Adour Garonne Basin, Agence de l'Eau Adour-Garonne, 2011) but may have significant impact on environment (Debril and Therond, 2012). In water deficit situations, one major question of the debate is the cumulative effect at watershed and river basin levels of the often numerous existing small water dams on river flow during the low flow period. No studies examine combined spatial and temporal impacts of small water dams on streamflow (Deitch et al., 2013). One of the difficulties is that there is very poor information on characteristics of these small dams (volumes, usage, …). The other key difficulty is to estimate the dynamics of refilling and emptying of small dams over the different annual irrigation periods since these water bodies are part of a complex system with highly interweaved processes.

To deal with water management issues, integrated assessment and modelling has been playing an increasing role since last decades (Jakeman et al., 2006). The MAELIA project developed a high-resolution agent-based modelling and simulation platform to study the environmental, economic and social impacts of various scenarios regarding water management, agricultural activities or climate changes. An integrated modelling approach has been used to model the investigated social-ecological system (Gaudou et al., 2014; Therond et al., 2014). MAELIA combines spatiotemporal models of ecologic (e.g. water flow and plant growth), human decision-making processes (cropping plan and crop management, water releases from dams, water use restriction) and socio-economic dynamics (e.g. demography and land cover changes).

This paper presents a new modelling framework to simulate hydrology and cumulative effect of small agricultural dams at river basin level. To get an overview of the potential effect of these water bodies on the complex system, we implemented it into the integrated assessment MAELIA platform. The next section briefly presents the MAELIA platform. In the third section, we present a modelling framework of dynamic of small agricultural dams. In the fourth section, to demonstrate the potential of this modelling framework we present and discuss assessment of two simulation scenarios that provide an overview of potential impacts of small agricultural dams on hydrology. The concluding section identifies key results and explores future research needs.

2. THE MAELIA PLATFORM

MAELIA (Martin et al., 2016; Mazzega et al., 2014) is a **multi-agent modelling and simulation platform** for assessing environmental, economic and social impacts of combined changes of water management norms, agricultural activities and global changes (demography, land-use changes and climate changes). Currently, this platform allows to handle at **fine spatio-temporal scales the interactions** between **agricultural activities** (rotation and crop management strategies within each farming system), the **hydrology** of the different water resources and the **water resources management** (water withdrawals, water use restrictions, choices between resources). It allows to handle the questions of **interactions** between agriculture and environment **from local to regional scales**. Originally, MAELIA allows to simulate behaviour of and interactions between the four main core sub-systems of social-ecological systems: (1) resource systems (e.g. hydrological systems), (2) resource units (e.g. water volume and flow), (3) users (e.g. individuals and collectives who use water), and (4) governance systems (e.g. which regulate uses and manage water resources).

2.1. Hydrologic aspects

MAELIA simulates the water flow through a complex network of water bodies (e.g. rivers, groundwater, reservoir, dams, channels), taking into account the numerous pressures from industry, drinking water providers and farmers. Hydrology is modelled in MAELIA as it is in SWAT (Soil and Water Assessment Tool®; Arnold et al., 1998; Neitsch et al., 2011), i.e. land and routing phases are estimated at the sub-watershed level (called hereafter SWAT sub-watershed).

2.2. Agricultural aspects

In many irrigated river basins, agricultural withdrawals play a major role in low-water issues. Therefore, a fine model of the farmer’s activities has been developed. The forest and grassland evapotranspiration are simulated by a simplified version of SWAT®‘s formalisms while AqYield (Constantin et al., 2015), an empirical crop model, is used for simulating crop growth. This latter represents effects of agricultural practices on day-to-day interactions between soil water dynamics and crop growth and, in fine, crop yield. The spatial distribution of cropping systems (rotation and crop management strategies) within farms can be either a pre-defined inputs or simulated by the cropping plan decision module that is based on a Belief-Desire-Intention architecture (Taillandier et al., 2012a). Crop management strategies are modelled through a set of decision rules (nested IF THEN rules) to trigger tillage, sowing, fertilization, hoeing, irrigation, crop protection, and harvesting. A more complete description can be found in (Murgue et al., 2014).

2.3. Water management aspects

Two main types of water management dynamics are represented in MAELIA: the water releases of dam managers and the set up of water use restrictions by local state services. Water releases from dams and restrictions of agricultural water withdrawals during the low-water period are simulated, day after day, according to decision rules (nested IF THEN rules) of corresponding actors.

2.4. Data integration

Implementation of the MAELIA platform requires integration of more than 20 types of data: soil, climate, elevation, land cover, water withdrawals and release points, rivers, small individual-managed dams, collectively managed dams, groundwater, spatial distribution of islets (field blocks) of each farm, crop sequence and crop management strategies… GIS pre-processing routines have been developed to strongly facilitate implementation of the platform in a new river basin. They provide a detailed and coherent space-time representation of the complexity of the structure and the initial state of the studied management situation.

The MAELIA multi-agents simulation model has been developed with GAMA® (Taillandier et al., 2012b), an open-source generic platform to develop and simulate agent-based model with powerful features in terms of GIS integration or high-level tools (e.g., decision-making or clustering algorithms).

A more complete description of MAELIA and of its design can be found in Therond et al. (2014), while the full documentation can be found at maelia-platform.inra.fr.

3. MODELLING SMALL AGRICULTURAL DAMS

The challenge when modelling small agricultural dams is twofold:

- to represent water resources dynamics due to irrigation withdrawals;
- to model the direct impacts of dams on hydrology such as calculating water fluxes (e.g. runoff) that first supply dams before the rest of the system (e.g. rivers).

To model behaviour of such water bodies we keep the pragmatic approach that was used to design MAELIA, and so we developed or chose rather simple and robust models that can be applied to different large extent case studies.

3.1. Data

For France, the main data on water dams come from the BDTOPO® database. It contains fine scale spatial description of all water bodies. This data on localisation and surface of water bodies was completed by data on:

- Dam volumes through integration of data of local state services or, when not available, through GIS treatment on a digital elevation model (BD ALTI®). This information contains a high level of uncertainties due to the difficulty of taking into account the digging out of dams in the estimation of volume;
- Hydrologic characteristics through combination of data from local state services and GIS treatment. This allows to estimate for each small dam a catchment area ($\boldsymbol{impluvium}_{dam}$, [$m^2$]), whether it is disconnected or connected to the river, and other specific data (e.g. reserved flow);
- Usage (i.e. used or not for agriculture). This very incomplete information from local state services was completed with GIS analysis of distance between irrigated islets provided by the French “Land Parcel Identification System” (See Murgue et al., 2014).

3.2. Dam hydrology modelling

Based on their hydrologic characteristics, we considered, in our modelling framework, four types of agricultural dams:

- connected to groundwater;
- disconnected from rivers;
- connected to the main stream of the SWAT sub-watershed;
- connected to secondary streams of the SWAT sub-watershed.

Small dams connected to groundwater are considered as alimented by the groundwater and so always full (if water available into the groundwater). Small agricultural dams disconnected are only filled by runoff, while dams connected to secondary streams are filled by runoff and soil subsurface flow. Dams connected to the main stream river get in addition the routing phase of the main stream of the SWAT sub-watershed and potentially from up-stream sub-watersheds coming into the current SWAT sub-watershed.

For each small dam of each SWAT sub-watershed, daily hydrology is represented through the following balance equation (Equation 1):

$$\begin{aligned} Q_{dam}(t) - Q_{dam}(t-1) &\\ &= precip_{dam}(t) + runoff_{dam}(t) + soilSubsurface_{dam}(t) + groundwater_{dam}(t) \\ &+ mainStreamRiver_{dam}(t) - EV_{dam}(t) - withdrawal_{dam}(t) - reservedFlow_{dam}(t) \\ &- excess_{dam}(t) \end{aligned}$$

Where $\boldsymbol{Q_{dam}(t)}$ and $\boldsymbol{Q_{t-1}}$ are the volume of the water into the ***dam*** at time step ***t*** and ***t-1***. ***$precip_{dam}(t)$***, ***$runoff_{dam}(t)$***, ***$soilSubsurface_{dam}(t)$***, ***$groundwater_{dam}(t)$***, ***$mainStreamRiver_{dam}(t)$***, ***$EV_{dam}(t)$***, ***$withdrawal_{dam}(t)$***, ***$reservedFlow_{dam}(t)$***, ***$excess_{dam}(t)$***, are respectively, for the ***dam*** at time step ***t***, fluxes corresponding to precipitations into the dam, runoff to the dam, soil subsurface flow to the dam, groundwater flow to the dam when connected to groundwater, flow from the main stream to the dam (when connected to this main stream), evaporation of the dam's water, agricultural withdrawal, reserved flow (regulatory minimal flow out) and water in excess (release from the dam once filled). The detail of these fluxes is given hereafter.

$Precip_{dam}(t)$ [m^3] is directly proportional to the surface of the dam (***$surface_{dam}$***, [m²]) and the precipitations of the day (***P(t)***, [mm])

$$Precip_{dam}(t) = surface_{dam} * \frac{P(t)}{1000} \tag{2}$$

$runoff_{dam}(t)$ [m^3] is proportional to the runoff flow (***$runoff_{BVe}$***, [m^3]) of the SWAT sub-watershed that contains the ***dam***, according to the fraction of the SWAT sub-watershed surface (***$surface_{BVe}$***, [m^2]) covered by the catchment area (***$impluvium_{dam}$***, [m^2]) of dam.

$$runoff_{dam}(t) = runoff_{BVe} * \frac{impluvium_{dam}}{surface_{BVe}} \tag{3}$$

$soilSubsurface_{dam}(t)$ [m^3] flow is considered only for connected dams. It is proportional to the soil subsurface flow (***$soilSubsurface_{BVe}$***, [m^3]) of the SWAT sub-watershed that contains the ***dam***, according to the fraction of the SWAT sub-watershed surface (***$surface_{BVe}$***, [m^2]) covered by the catchment area (***$impluvium_{dam}$***, [m^2]).

$$soilSubsurface_{dam}(t) = soilSubsurface_{BVe} * \frac{impluvium_{dam}}{surface_{BVe}} \tag{4}$$

groundwater$_{dam}$(t) [m^3] is the input flow of dams connected to the groundwater tables. We simply consider that (if there is enough water) it will refill the dams to its capacity (***capacity$_{dam}$***, [m^3]).

$$groundwater_{dam}(t) = capacity_{dam} - Q(t-1) \qquad (5)$$

mainStreamRiver$_{dam}$ (t) [m^3] is the flow that comes from the main stream of the SWAT sub-watershed and from the upstream SWAT sub-watersheds. In sub-watershed with several dams connected to the main stream, the filling of these dams by the main stream is modelled sequentially from upstream to downstream dams.

EV$_{dam}$ (t) [m^3] is the evaporation flow, based on SWAT equation (Neitsch et al., 2011, 8:1.1.6 p517). Evaporation is simply a fraction (***η*** = 0.6) of the daily potential evapotranspiration (***PET(t)***, [mm])

$$EV_{dam}(t) = surface_{dam} * \frac{PET(t)*\eta}{1000} \qquad (6)$$

reservedFlow$_{dam}$ (t) [m^3] is the minimum daily flow that must go out of the connected ***dam*** to respect the water flow regulation.

withdrawal$_{dam}$ (t) [m^3] is the volume taken in the dam for irrigation until the dead volume that cannot be used for irrigation (set up to 25% of the dam capacity when no information is available).

Excess$_{dam}$ (t) [m^3] is the amount of water flowing out when the dam is full (i.e. if ***Q(t)*** is higher than the dam capacity (***capacity$_{dam}$***, [m^3])).

This way of modelling the dams dynamic allows to get daily volumes while taking into account the dynamic filling, discharge and emptying for irrigation.

3.3. Simulations

To get an overview of the potential impacts of small agricultural dams on irrigation withdrawals and on hydrology at SWAT sub-watershed scale and at the whole river basin, we performed simulations of scenarios concerning presence of dams. For this, we chose the Aveyron river basin, southwestern France, as a case study because its river's discharge is frequently and persistently measured under the legal threshold (many times a year, year after year) and there are numerous agricultural small dams. The intensity of water deficits in this area is measured and managed daily through water release from public dams and water use restrictions. It depends highly on the dynamics of irrigation withdrawal demand. It is a typical irrigated river basin where the usage and the building of new small agricultural dams is a current issue. A more complete description of the Aveyron basin can be found in (Murgue et al., 2015). We performed assessment of two different scenarios using MAELIA and the new framework for small dam hydrology modelling. In the first one, the whole functioning of the socio-ecological system is simulated (agricultural activities, hydrology of water resources, water management) including the dynamic filling, discharge and emptying of small dams while in the second there is no small dams represented (no other changes).

4. RESULTS AND DISCUSSION

After a quick presentation of the evaluation of simulations (4.1), we focus on impacts on the hydrology (4.2). We chose not to present impacts on production as the aim of our paper is not to discuss the economic advantage or disadvantage of the usage of small agricultural dams.

4.1. Evaluation

We evaluated the quality of simulations of the agricultural withdrawals over the year at the river basin level. For this, we compared the simulated agricultural withdrawals to the observed ones provided by the local water agency. These observed agricultural withdrawals correspond to the water withdrawals declared annually by agricultural water users. Results show that simulated withdrawals fit well with observed data in terms both of annual level and trend from one year to another (results not shown, see details in Martin et al., 2016). But simulations tend to underestimate the irrigation volumes (relative bias of 8% to 12% for simulation with or without dams).

To further evaluate simulations, we compared simulated to observed river flows at the outlet of the Aveyron river basin where river flow measures are performed at the daily time step. Figure 1 and Table 1 show the quality of river flow simulation. The RRMSE of the logarithm of the simulated river flow is 14% and 30% at the annual and low-water flow period (June-October) respectively. Modelling efficiency of the logarithm of the water flow (EF, Nash and Sutcliffe, 1970) is 0.9 and 0.7 at the annual and low-water flow period respectively.

4.2. Hydrology

Simulation of both scenarios show that potential impacts of small dams on river flow at the outlet of the Aveyron river basin are not significant (e.g. Figure 1, Table 1). This lack of effect can be explained by the fact that the potential effect level of small dams on river flow is negligible in comparison to the flow of the Aveyron river. Moreover, the river flow is strongly determined by the water releases from big public dams performed to sustain the river flow during the low-flow period (see Martin et al. 2016 and Mazzega et al., 2014).

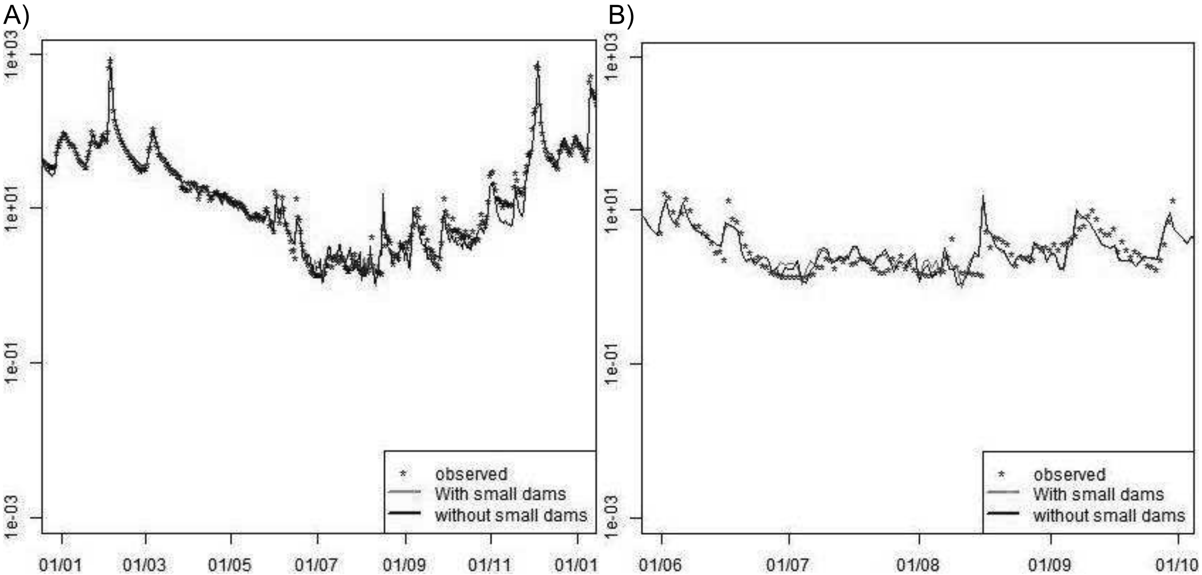

Figure 1. Comparison of water flow (m^3/s) at Loubejac (the outlet of the Aveyron basin) between observations (black stars), simulation with small agricultural dams (green line) or without dams (blue line) for respectively A) the full year 2003 or B) the low water period (June-October) 2003.

Table 1. Evaluation of the simulations performance for water flow at the outlet of the basin (Loubejac station) for two periods (the whole year and the low water period), with two evaluation indices: the Relative Root Mean Squared Error (RRMSE) and the modeling Efficiency of the logarithm of the water flow (EF, Nash and Sutcliffe, 1970)

	Annual scale		**Low water period (June-October)**	
	RRMSE	**EF**	**RRMSE**	**EF**
With small dams	13.57%	0.91	28.81%	0.70
Without small dams	14.27%	0.90	30.87%	0.68

We also compared scenario simulations at the watershed level that corresponds to a group of SWAT sub-watersheds and sub-areas of the Aveyron river basin. Hereafter we present results of a watershed that has an autonomous hydrological behaviour: the main river stream takes its source in the watershed and there is no water release from public dam to sustain the stream river flow. This is in this type of watershed that the main water deficit issue arises, i.e. unbalance between water resource and agricultural water withdrawals during the low water flow period.

Simulation results show that water flow on the selected watershed during the low water period (June to October) is significantly lower when representing the hydrology of small water dams than without them (Figure 2). Globally the hydrological impacts of dams are consistent with what have been suggested by previous studies (Deitch et al., 2013).

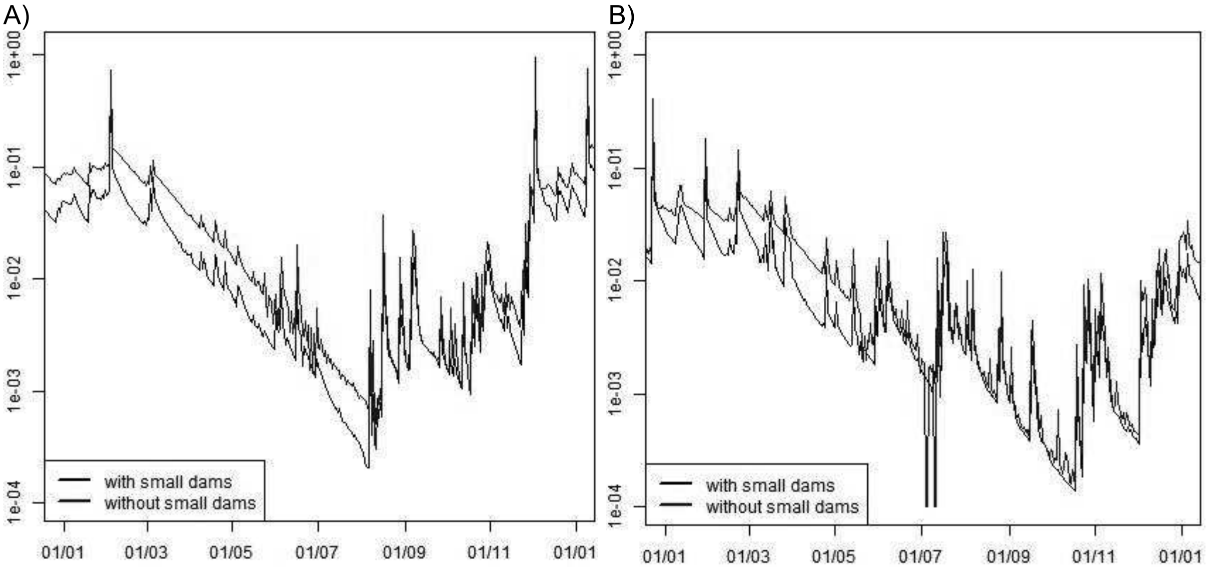

Figure 2. Comparison of water flow (m^3/s) for a selected watershed of the Aveyron river basin (minimum flow of SWAT sub-watershed of the selected area) in A) 2003 and B) 2011. The black line represents the simulation with small agricultural dams and the blue line the simulation without dams.

5. CONCLUSION

In this study, we present a new modelling framework to simulate the dynamic of hydrology of small agricultural dams and of their cumulative effect on river and stream flow. We proposed a model that is simple and robust enough to represent individual behaviour of thousands of dams at regional scale. This modelling framework is based on the distinction of four types of small dams: connected to groundwater; disconnected from rivers; connected to the main stream of the sub-watershed; connected to secondary streams of the sub-watershed. This allows us to simulate dynamic filling, discharge and emptying of agricultural dams. When implemented in integrated modelling platform like MAELIA, it allows to explore the potential cumulative impact of agricultural dams on the river and stream flow. Simulations show no significant impact on the Aveyron river flow that is strongly determined by water release from big public dams. However, they show potential significant impacts in watersheds where the flow of the main stream is not influenced by release of public dams. Further investigations through simulations are required to provide more accurate evaluation of impacts of small agricultural dams on the local hydrology. One challenge will be to assess the cascade of uncertainties (dam volumes, withdrawal point locations, farmers practices …).

ACKNOWLEDGMENTS

This work was supported by the MAELIA Project “Multi-Agents for EnvironmentaL norm Impact Assessment” (http://maelia-platform.inra.fr/) and the REGARD project (Martin et al., 2016) both funded by the French “Sciences & Technologies for Aeronautics and Space” Foundation (http://www.fondationstae.net/) in Toulouse, France.

REFERENCES

Agence de l'eau Adour-Garonne, 2011. Redevance irrigation Campagne 2009 (Agriculture/Statistiques).

Arnold, J.G., Srinivasan, R., Muttiah, R.S., Williams, J.R., 1998. Large Area Hydrologic Modeling and Assessment Part I: Model Development1. JAWRA J. Am. Water Resour. Assoc. 34, 73–89.

Constantin, J., Willaume, M., Murgue, C., Lacroix, B., Therond, O., 2015. The soil-crop models STICS and AqYield predict yield and soil water content for irrigated crops equally well with limited data. Agric. For. Meteorol. 206, 55–68.

Debril, T., Therond, O., 2012. Les difficultés associées à la gestion quantitative de l'eau et à la mise en oeuvre de la réforme des volumes prélevables: le cas du bassin Adour-Garonne. Agron. Environ. Sociétés 2, 127–137.

Deitch, M.J., Merenlender, A.M., Feirer, S., 2013. Cumulative Effects of Small Reservoirs on Streamflow in Northern Coastal California Catchments. Water Resour. Manag. 27, 5101–5118.

Gaudou, B., Sibertin-Blanc, C., Therond, O., Amblard, F., Auda, Y., Arcangeli, J.-P., Balestrat, M., Charron-Moirez, M.-H., Gondet, E., Hong, Y., Lardy, R., Louail, T., Mayor, E., Panzoli, D., Sauvage, S., Sánchez-Pérez, J.-M., Taillandier, P., Van Bai, N., Vavasseur, M., Mazzega, P., 2014. The MAELIA Multi-Agent Platform for Integrated Analysis of Interactions Between Agricultural Land-Use and Low-Water Management Strategies, in: Alam, S.J., Parunak, H.V.D. (Eds.), Multi-Agent-Based Simulation XIV, Lecture Notes in Computer Science. Springer Berlin Heidelberg, pp. 85–100.

Jakeman, A.J., Letcher, R.A., Norton, J.P., 2006. Ten iterative steps in development and evaluation of environmental models. Environ. Model. Softw. 21, 602–614.

Martin, E., Gascoin, S., Grusson, Y., Murgue, C., Bardeau, M., Anctil, F., Ferrant, S., Lardy, R., Le Moigne, P., Leenhardt, D., Rivalland, V., Sánchez Pérez, J.-M., Sauvage, S., Therond, O., 2016. On the Use of Hydrological Models and Satellite Data to Study the Water Budget of River Basins Affected by Human Activities: Examples from the Garonne Basin of France. Surv. Geophys. 37, 223–247.

Mazzega, P., Therond, O., Debril, T., March, H., Sibertin-Blanc, C., Lardy, R., Sant'ana, D., 2014. Critical multi-level governance issues of integrated modelling: An example of low-water management in the Adour-Garonne basin (France). J. Hydrol. 519, Part C, 2515–2526.

Murgue, C., Lardy, R., Vavasseur, M., Leenhardt, Therond, O., 2014. Fine spatio-temporal simulation of cropping and farming systems effects on irrigation withdrawal dynamics within a river basin, in: Ames, D.P., Quinn, N., Rizzoli, A.E. (Eds.), . Presented at the iEMSs, 7th International Congress on Environmental Modelling and Software, San Diego, California, USA.

Murgue, C., Therond, O., Leenhardt, D., 2015. Toward integrated water and agricultural land management: Participatory design of agricultural landscapes. Land Use Policy 45, 52–63.

Nash, J.E., Sutcliffe, J.V., 1970. River flow forecasting through conceptual models part I — A discussion of principles. J. Hydrol. 10, 282–290.

Neitsch, S.L., Arnold, J.G., Kiniry, J.R., Williams, J.R., 2011. Soil and Water Assessment Tool Theoretical Documentation Version 2009 (Technical Report No. 406). Texas Water Ressources Institute, Texas.

Taillandier, P., Therond, O., Gaudou, B., 2012a. A new BDI agent architecture based on the belief theory. Application to the modelling of cropping plan decision-making, in: Seppelt, R., Voinov, A.A., Lange, S., BanKamp, D. (Eds.), International Environmental Modelling and Software Society (iEMSs). Presented at the International Environmental Modelling and Software Society (iEMSs), Leipzig, Germany, pp. 2436–2470.

Taillandier, P., Vo, D.-A., Amouroux, E., Drogoul, A., 2012b. GAMA: a simulation platform that integrates geographical information data, agent-based modeling and multi-scale control, in: Principles and Practice of Multi-Agent Systems. Springer, pp. 242–258.

Therond, O., Sibertin-Blanc, C., Lardy, R., Gaudou, B., Balestat, M., Hong, Y., Louail, T., Nguyen, V.B., Panzoli, D., Sanchez-Perez, J.-M., Sauvage, S., Taillandier, P., Vavasseur, M., Mazzega, P., 2014. Integrated modelling of social-ecological systems: The MAELIA high-resolution multi-agent platform to deal with water scarcity problems, in: Ames, D.P., Quinn, N., Rizzoli, A.E. (Eds.), . Presented at the iEMSs, 7th International Congress on Environmental Modelling and Software, San Diego, California, USA.

Truche, C., Therond, O., in preparation. Estimation du volume des retenues collinaires du Basin Adour-Garonne. Sciences Eaux et Territoires.