

**École des Ponts**  
ParisTech

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Dear Colleagues,

The Direction of École des Ponts ParisTech, the Direction of the HM&Co laboratory would like to first thank the HCERES expert committee for this rich and detailed evaluation report, which will fuel the reflection over the next evaluation period. It particularly highlights: *"HM&Co produces quality research that is highly valued, both scientifically and non-academically. It enjoys good attractiveness and international recognition."*

Since the very beginning, the scientific portfolio of HM&Co is deeply rooted on the value chain vision of research. The academic research at HM&Co is based on a strong methodological unity that has required to be tested on its capacity to integrate various strongly non-linear, complex environmental phenomena. Throughout the theory-advanced multiscale monitoring and modelling of urban systems, more applied research activities take then place to deliver the qualitatively distinguished research products to final consumers.

Seeing this way, opposite to the traditional *in Silos* approach, topical diversity no longer means "dispersion", but rather integration and a proof of concept. We are grateful to the committee for the right analysis: *"The most original and characteristic scientific asset of the unit is its longstanding experience of multi-fractal theory along with its application to hydrometeorology and, more recently, to the coupling between hydrometeorology and urban hydrology."*

The official involvement of HM&Co researches in a given number of GDRs and other interdisciplinary activities, initiated by I-Site, Equipex or Labex, corresponds to the same logic and also demonstrates a strong integration of the laboratory into the national scientific community. *"The scientific activity is important and demonstrates a good international recognition of the laboratory. The scientific production is very good in terms of quality and quantity. For the 3 permanent researchers, 35 scientific articles have been published in high impact factor journals during 2013–2018."*

Over the last ten years, HM&Co has been developing Multi-Hydro as an interactive

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multi-modules software, by continuously integrating in it new functional modules, by coupling them in a smart manner (IDDN FR 001340017000 SC, APP 2015). Each of such modules, by itself, is a physically based, fully distributed model that represents additional physical process and/or environmental feature. The evaluation report acknowledges that: *"From an implementation point of view, the software Multi-Hydro seems to be well adapted to take advantage of fractal theory."*

In fact, this explains why the operational partners of HM&Co have been constantly interested by the Multi-Hydro implementation over rather small highly heterogeneous watersheds: this heterogeneity is not captured by their operational, semi-distributed models. Indeed, hydrological models that can account for the heterogeneity, like Multi-Hydro does, are still very rare. Urban hydrological modelling at such small-scales for high-resolution case studies becomes essential to increase the operational benefits.

To give an example, the study by Rebel within the EU RainGain project yielded an estimate of more than 40M€ annual savings for a city budget like Rotterdam by using such very local, although up scalable, hydrologic modelling to prioritise the maintenance options among urban infrastructures.

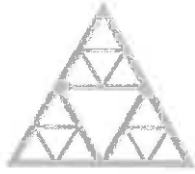
These intensive studies using Multi-Hydro, in turn, demonstrated that the residual water balance uncertainties have two principal sources (i) rainfall data, and (ii) unresolved evapotranspiration. The latter is required for correctly assessing the initial condition of soil saturation, for instance. To integrate into Multi-Hydro a new module on evapotranspiration modeling became an urging scientific necessity. To advance such developments, a successful ANR JCJC project was recently developed by a young researcher of HM&Co, with an active involvement of new national and international academic and industrial partners.

The ongoing research at HM&Co on improving high-resolution radar rainfall products, with a particular focus on rainfall drifting by multiscale advection, is more than ever required. Indeed, recent evolutions of the national operational radar networks neither impacted the resolution of available rainfall products (still 1km by 1km pixels), nor the operational products themselves (still the "best available" Z-R estimates), independently of the radar type. In turn, this appeals for the alternative forms of radar operation for zones of dense urbanisation.

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To give an example, in the case of École des Ponts ParisTech, the radar provider has been following the radar operation and maintenance and, hence, "the instrument" did not require any technical staff, while a huge amount of so precious high-resolution space-time data is now available for the research and innovation. A much vaster flexibility in the operation of research radar, while testing the impact of various options and conditions, remains essential for new scientific developments. The associated web open data services have been recently slowed down by the departure of the IT engineer. However the corresponding position remains open, anticipating an arrival of suitable candidate.

One of the strategic projects of École des Ponts ParisTech, the Co-Innovation Lab of ENPC, has been endorsing the foreseen evolution of its environmental platform Fresnel and further developments of web open data services. The existence of such a sustainable structure significantly reduces the risks associated with the "frugal model" in the field of environmental research. That in turn, would not have been possible without the constant and often enthusiastic support of its main users. Indeed, "narrowly focused" research does not constitute the core of a frugal model, whereas an innovative, interdisciplinary one does. Positioned at the forefront of the ENPC policy of practicing new financing models of public research, HM&Co sees this as an opportunity for entering into a new era of "agile and frugal" research.

The last but not the least, the Direction of the HM&Co laboratory greatly appreciates the human conclusion of the evaluation report: *"The unit HM&Co is a lively small group of research that shows pleasure and efficiency working together."* This achievement is presumably the most important key for scientific achievements.

Sincerely Yours,

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