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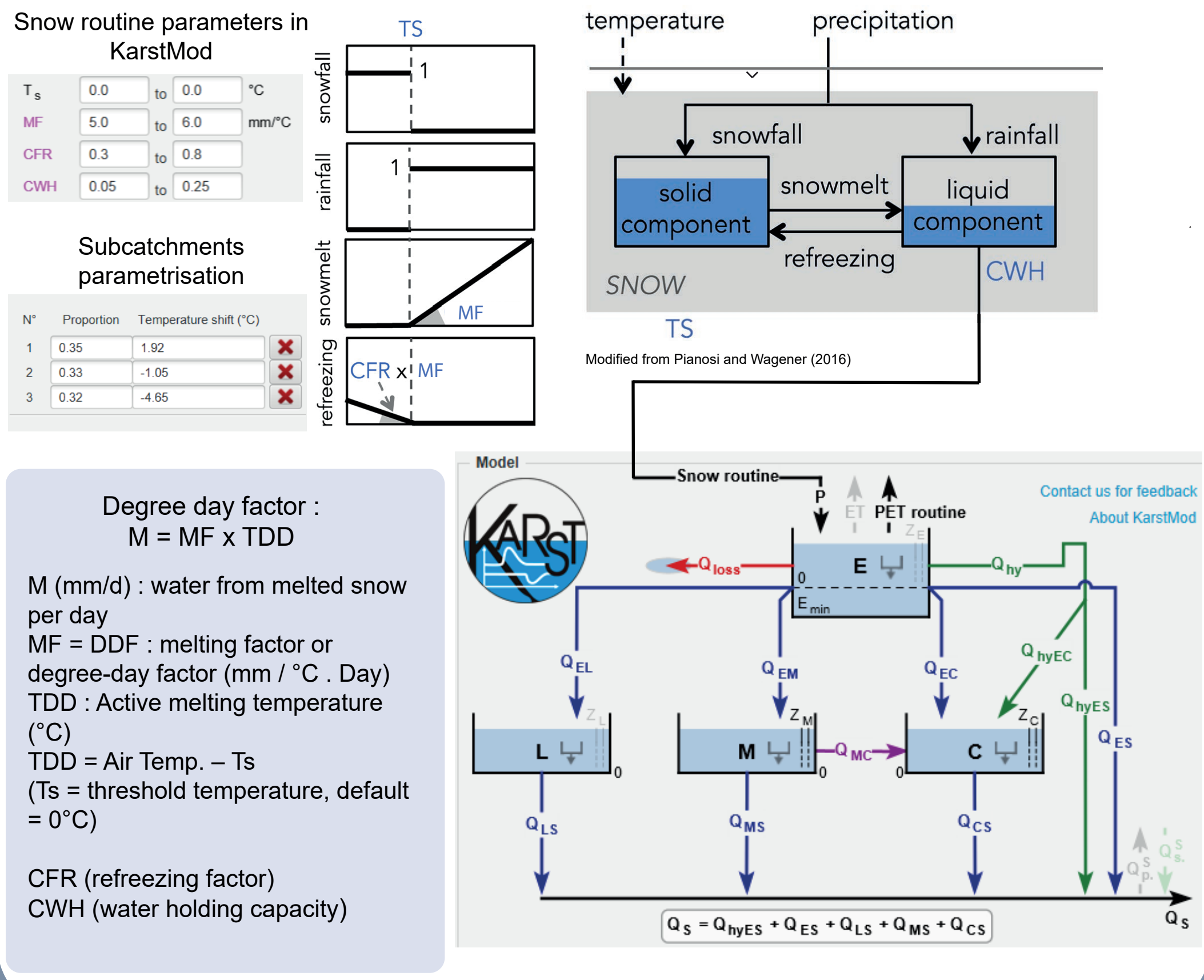
# Element of a pluri-disciplinary project on karstic reservoir characterization : groundwater modelling of the Dévoluy Massif, France.

Nathan RISPAL <sup>(1)(2)</sup>, Bruno ARFIB <sup>(2)</sup>, Philippe AUDRA <sup>(1)</sup>, Pierre HENRY <sup>(2)</sup>, Ludovic Mocochain <sup>(4)</sup>, Benoît VIGUIER <sup>(3)</sup>, Alexandre ZAPPELLI <sup>(2)</sup>, Hélène MICHE <sup>(2)</sup>, Christine VALLET-COULOMB <sup>(2)</sup>

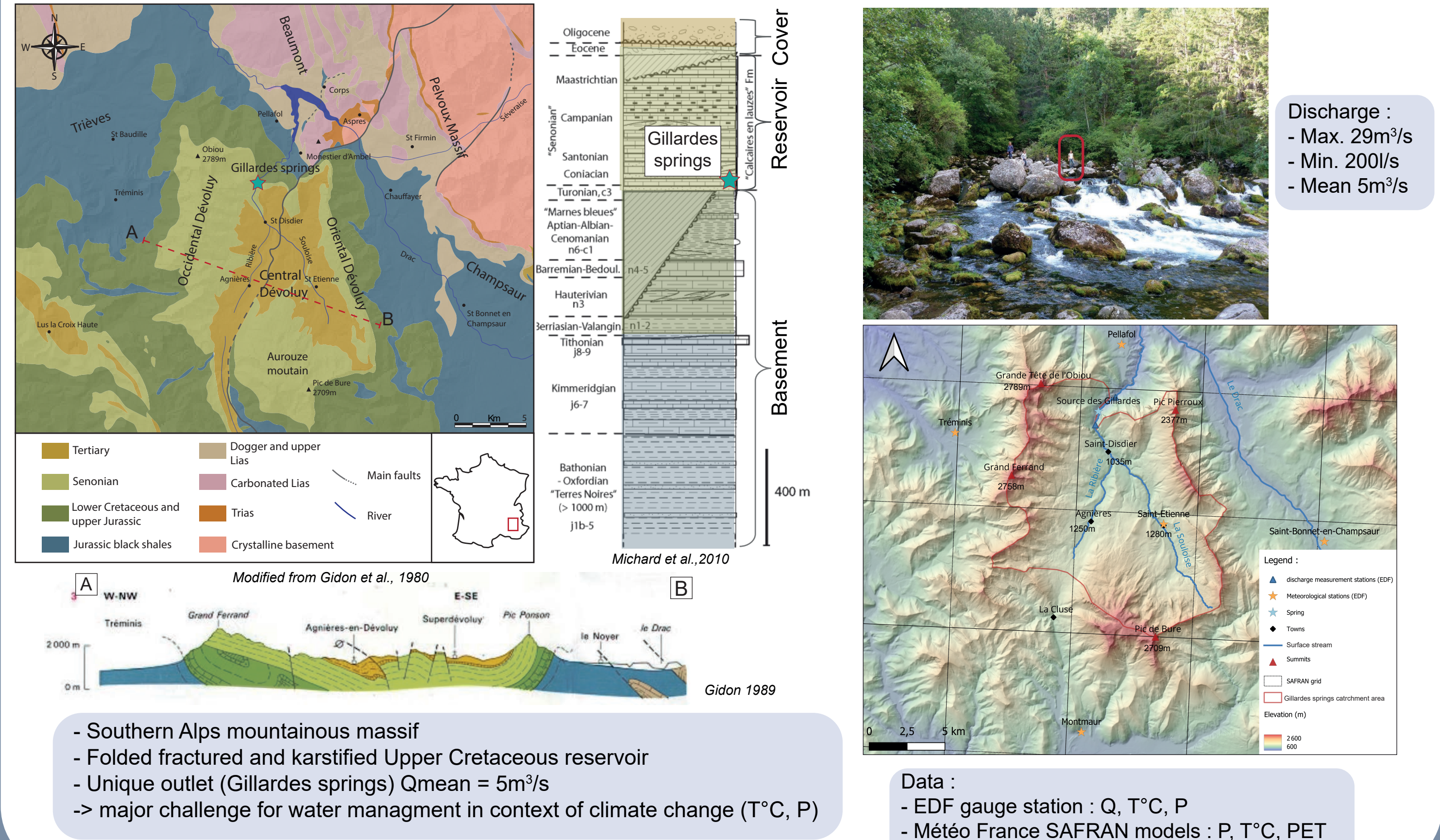
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**Objectives :** the aim of this study is to understand the behavior of a mountainous karstic reservoir. Exploration of hydrodynamic and meteorological data coupled to simulation on KarstMod platform with a snow routine module helps to decipher if discharge variations at the springs are related wether to recharge processes or properties of storage and flow in the reservoir.

## How the snow routine works in KarstMod

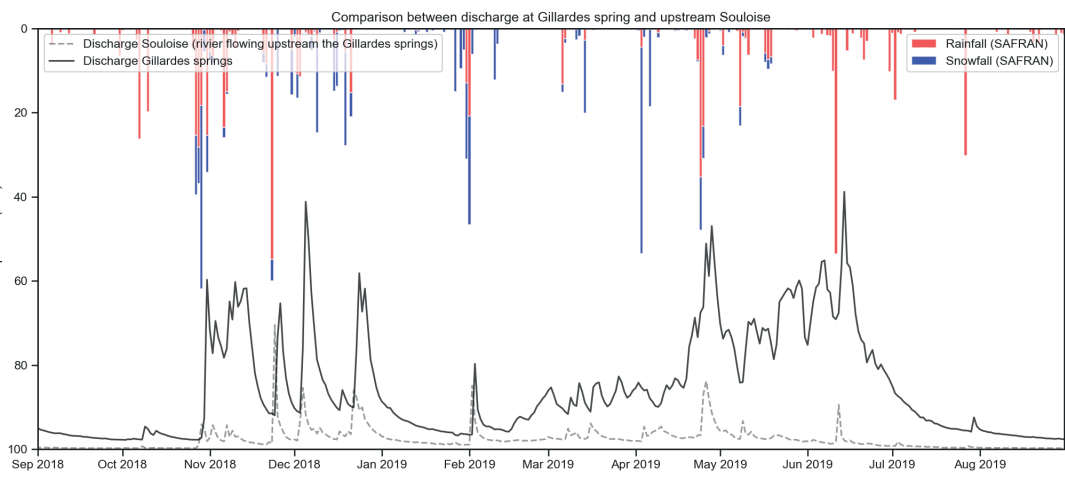
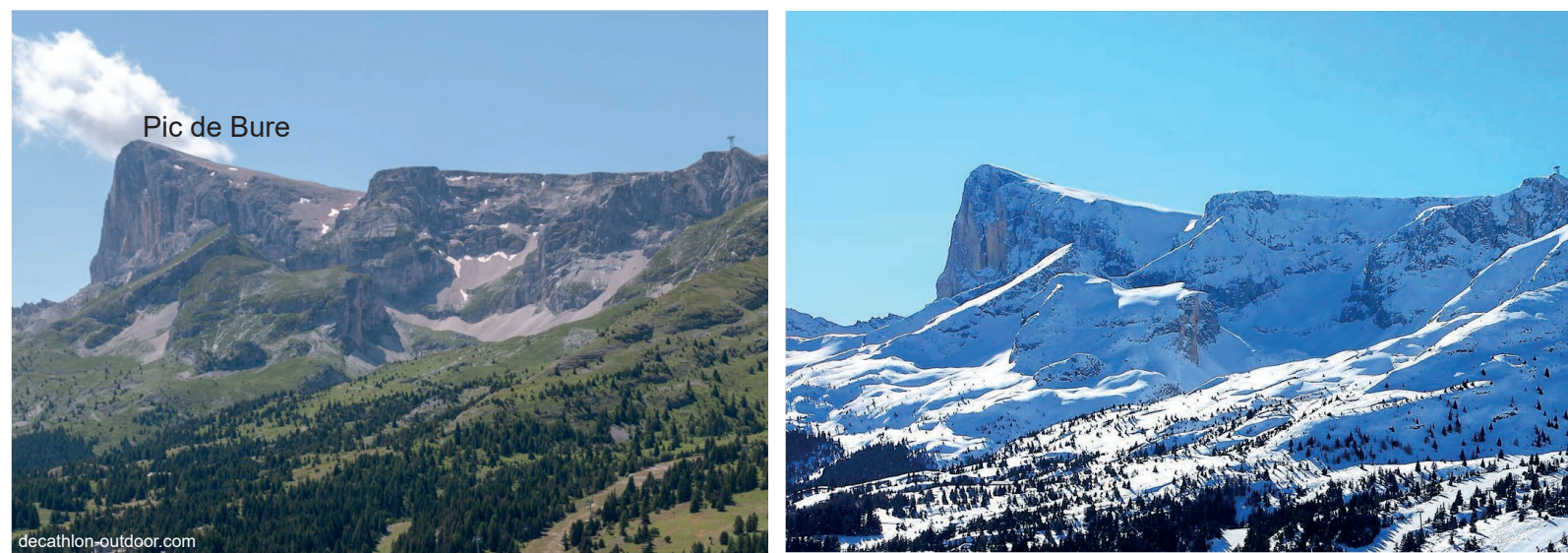


## Case study : the Dévoluy karstic reservoir

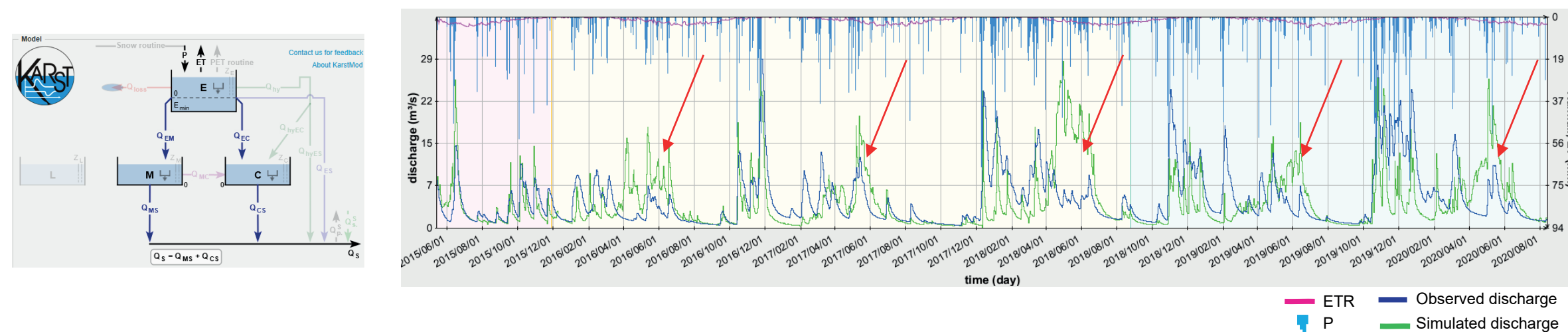


## Workflow : modelling a snow-influenced karstic aquifer

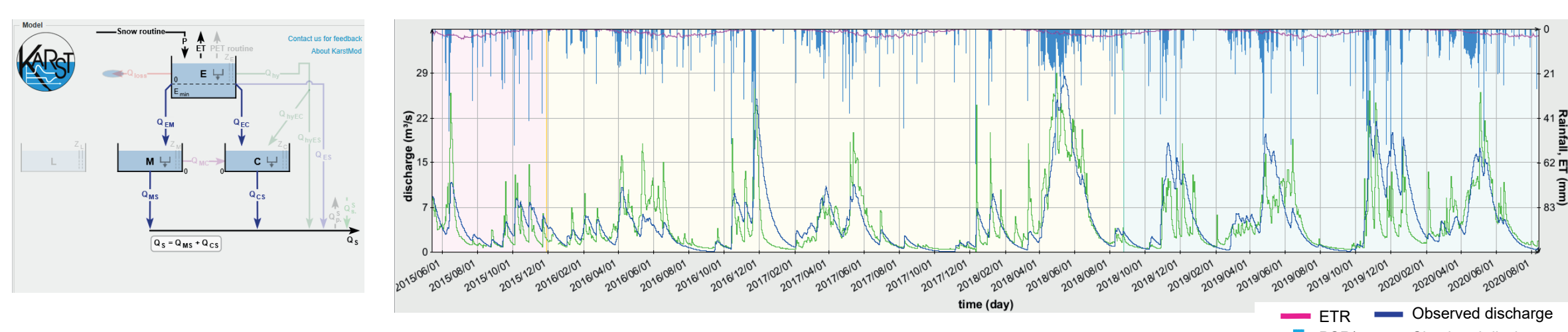
Field observations and data visualisation



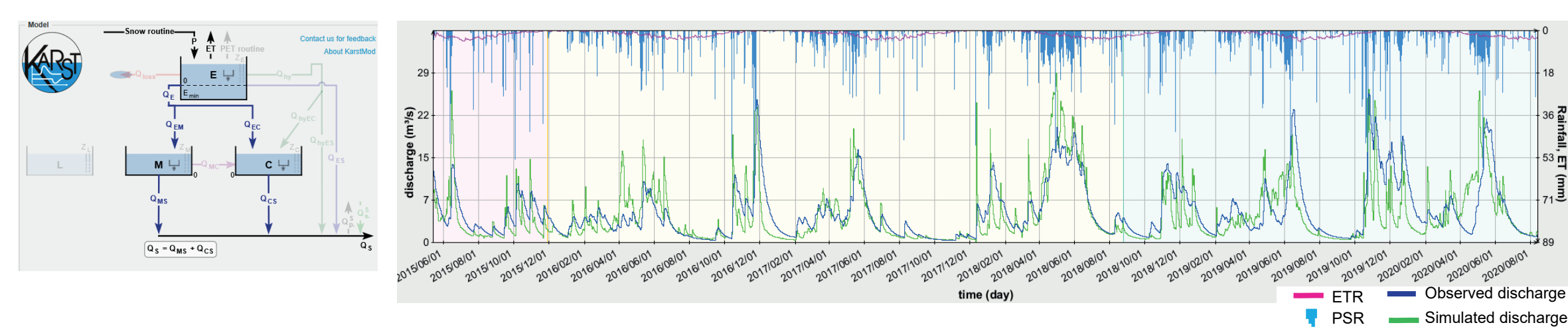
**Model 1 :**  
Classical configuration with two reservoir and no snow routine



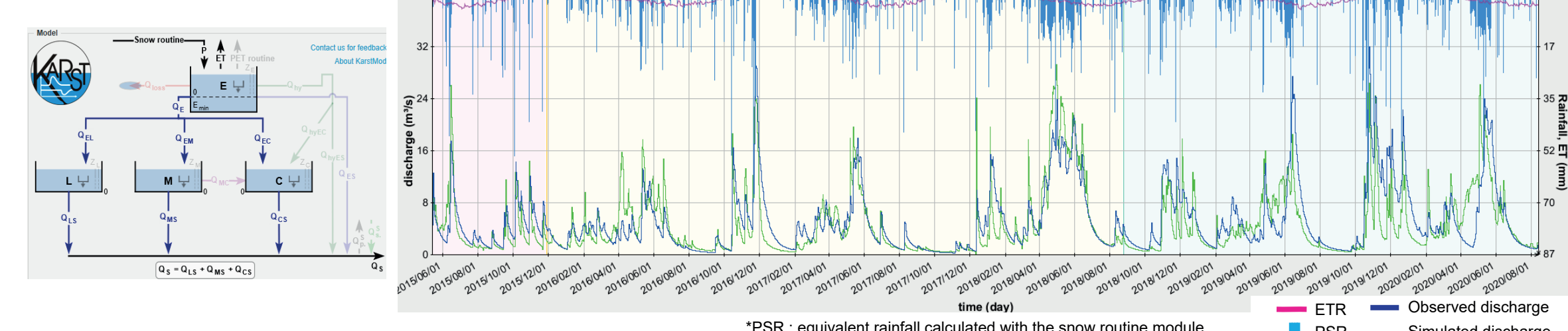
**Model 2 :**  
Adding snow routine



**Model 3 :**  
Adding subcatchments



**Model 4 :**  
Refining model with third reservoir



## key elements

### Step 1 : identifying the role of snow in the recharge

During spring and summer, discharge increases at the Gillardes spring while there is no significant Q rise in la Souloise river.

Modelling without snowroutine shows that part of the discharge is lost during spring and summer.

### Step 2 : Implementing snow routine in the model

Snow routine helps to better match observed discharge during spring and summer.

Subcatchments in snow routine enhance the recharge simulation (rainfall, snow and snowmelt) over the catchment area.

Adding third reservoir allows to better reproduce fast variations in discharge.

## Discussion

### How to use the model once it is well calibrated ?

1/ Highlights the variations in flow rate in relation with the conditions of reservoir recharge. Possible causes of variation in recharge in Dévoluy: artificial snow at the ski resort, P and/or T°C variations due to climate change.

2/ Provides a better understanding of the hydrodynamic of the system in relation with groundwater management : Architecture of the system, contribution of each reservoir to the discharge at spring, water resources.

## Conclusion and way-forward

**Importance of recharge mechanisms :** work is needed on recharge modeling to improve rainfall-discharge modeling with conceptual models («reservoir or compartments models» like KarstMod). Good model structure is not enough.

**Snow routine module is efficient :** the degree-day method used by KarstMod is effective when applied to a karstic spring.

**Way-forward :** threshold temperature or temperature shift in the subcatchments could be used to simulate futur climate change with KarstMod.

### References and acknowledgments :

Thanks to EDF DTG for P, T°C and Q data and Météo France for meteorological data from SAFRAN models.  
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