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Catchments' reactions to the Oct. 2nd 2020 heavy rainfall in the Maritime Alps (France): sediment transport measurements, sediment connectivity model in the Roya river and reconstruction guidelines

Margot Chapuis, Mendy Martins, Cyriel Adnès, Laurence Tissot, Nicolas Martin, Leslie Salvan, Raphaëlle Dreyfus, Franck Compagnon, Johnny Douvinet, Pierre Brigode, et al.

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Catchments' reactions to the Oct. 2nd 2020 heavy rainfall in the Maritime Alps (France): sediment transport measurements, sediment connectivity model in the Roya river and reconstruction guidelines

La réaction des bassins versants maralpains aux précipitations intenses du 02/10/2020 : mesures du transport sédimentaire, modèle de connectivité sédimentaire en Roya et principes de gestion

Context: Oct. 2nd 2020: exceptional rainfall on the Roya and Vésubie catchments

- **Rain** return period > **1000 yrs** on the Roya (CEREMA, 2021)
- **Discharge** measurement devices destroyed; return period: ~ **100 to 500 yrs** (RTM 06, 2022)

Objectives

- **Sediment transport intensity** in the Roya for the 10/02/2020 episode
- **Sediment connectivity** analysis and prospective model
- **River management guidelines**

Study sites

Figure 1: the Roya before/after the flood

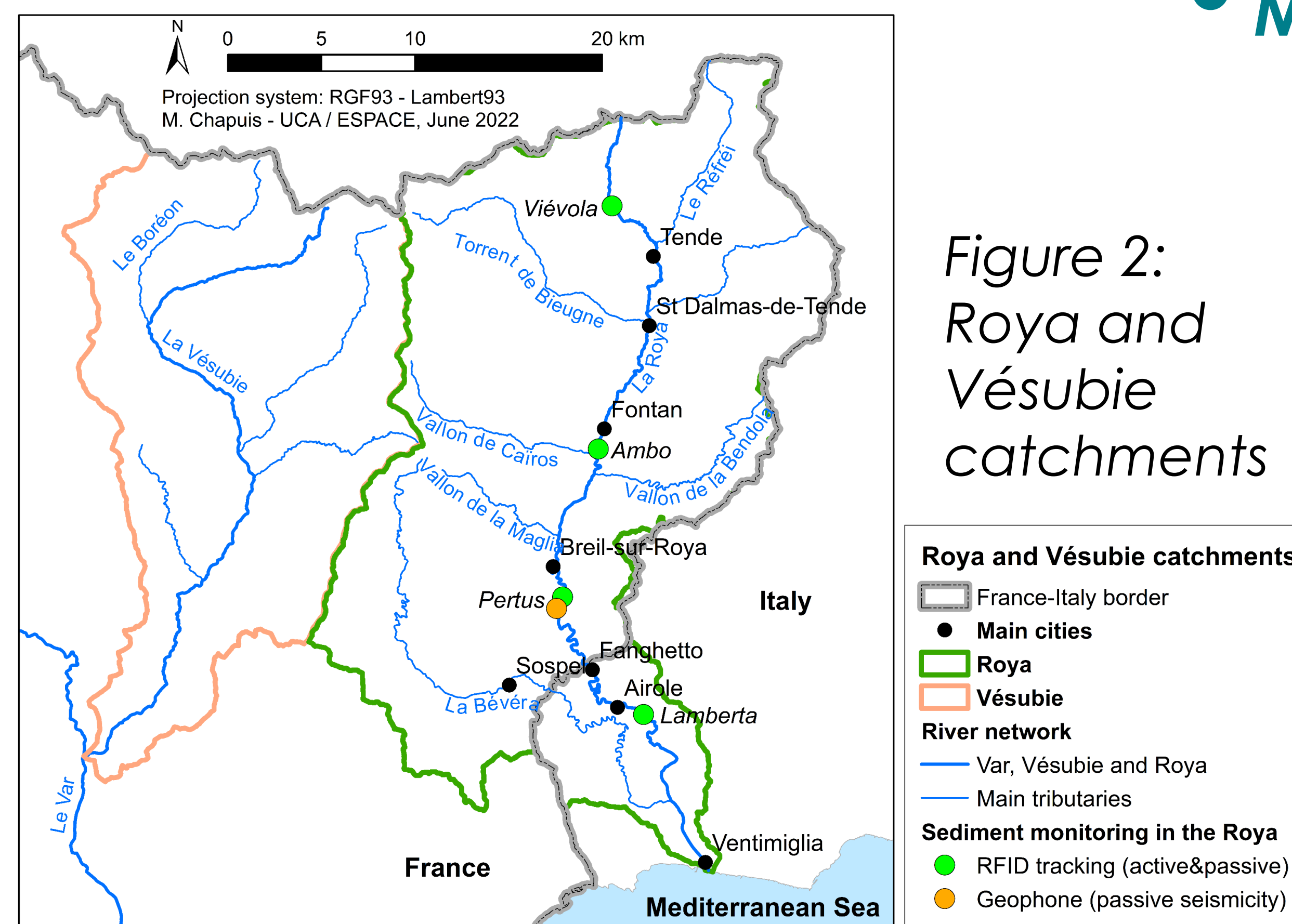


Figure 2: Roya and Vésubie catchments

Methods

- **Sediment transport distances: active RFID tracking** – annual survey on the whole 30 km reach (Chapuis *et al.*, 2022)
- **Sediment fluxes intensity: passive seismic analysis** (Chapuis *et al.*, 2022, Chmiel *et al.*, 2022)
- **Rain/discharge simulation** (Brigode *et al.*, 2022)
- Longitudinal profile analysis, topo surveys...

Results

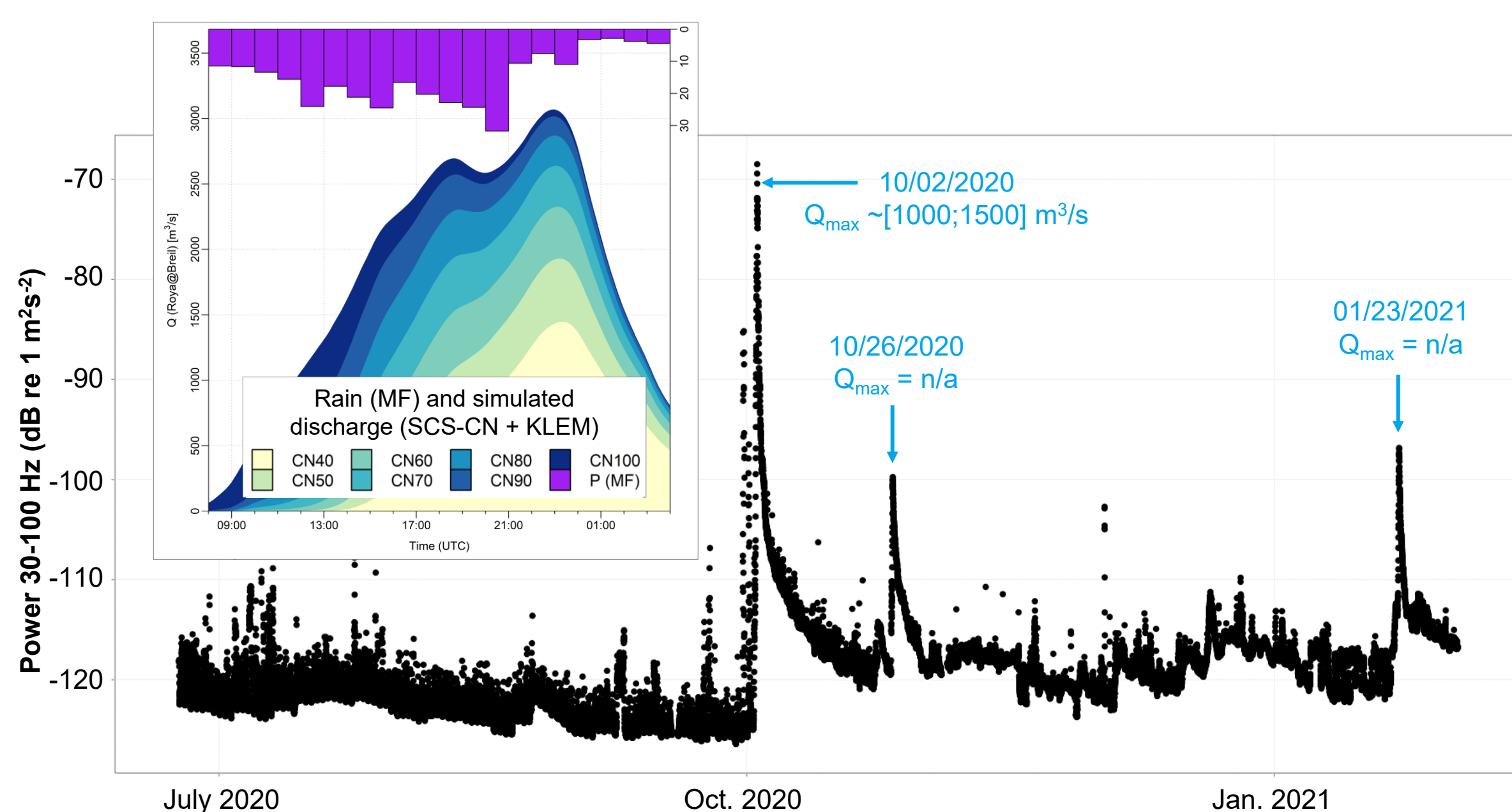


Figure 3: flood kinetics from seismic analysis and rain/discharge simulation

Year of survey	2019	2020	2021
Q _{max} at Breil (m ³ /s)	133	140	[1000;1500]
Nb of tracers found	17	16	4
Max. dist. of transport (m)			
Ambo/Fontan	240	632	5860
Pertus	166	50	-
Lamberta	-	2875	474

Table 1: RFID tracking and sediment transport distances

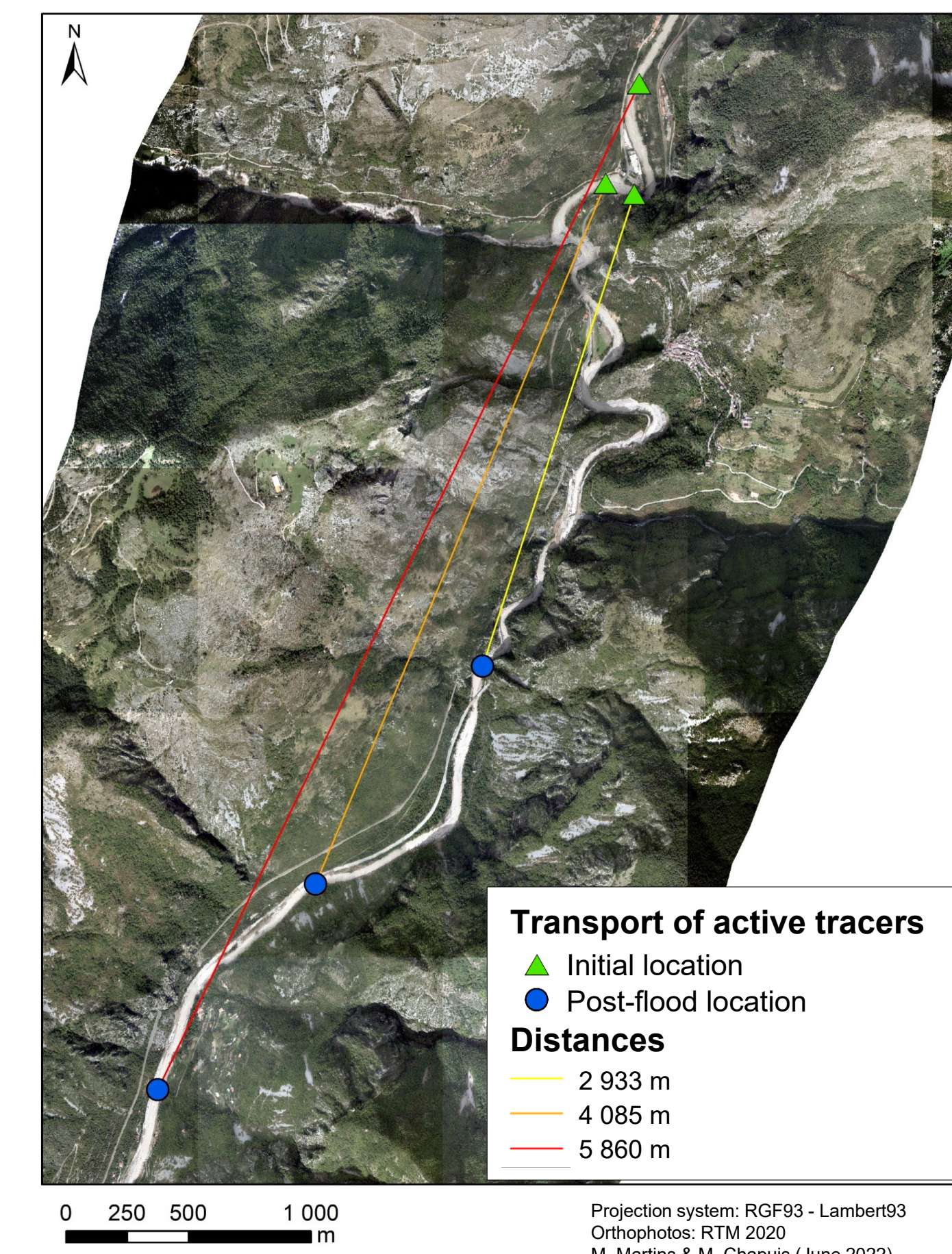


Figure 4: active RFID tracking 2021 survey

Sediment connectivity model (Roya)

Before the 2020 flood

Since the Little Ice Age: reduction of sediment production because of:

- Less aggressive climatic conditions
- Change in land use (agric. → forest) → hillslopes' stabilization

During the 2020 flood

Direct production from the upstream west subcatchments (+Réfreï) and from the riverbanks. Upstream sediment stocks were not entirely flushed down, but aggradation up to 10 m in the main channel down to Breil-sur-Roya (RTM 06, 2022). When joining the main river channel, sediments were flushed down: cf. monitored transport distances > 5 km and no significant deposition in the downstream valley. → 2020 flood = river system replenishment that is **limited in time and space**.

After the 2020 flood: conceptual sediment connectivity model

Sediment pulses during floods (even as intense as 2020), with potential reactivation of hillslope sediment sources → at catchment scale, sediment production potential should still be significant.

But sediment transfer to the main river network seems scarce; when joining the main river channel, sediments are flushed down because of steep slope (Roya : 3,2%) → sediments are efficiently transferred downstream during long phases (> 30-50 yrs?) even during ordinary floods.

River management guidelines

- **Need of sediment management planning at catchment scale:** sediment continuity and support alluvial stock within the floodplain (no gravel extraction).
- « **Freedom space for rivers** » concept needs to be **integrated in the river floodplain management decisions:** for flooding risk mitigation purposes, as few infrastructures as possible within the active channel width = the whole floodplain in the Roya case.

