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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

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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

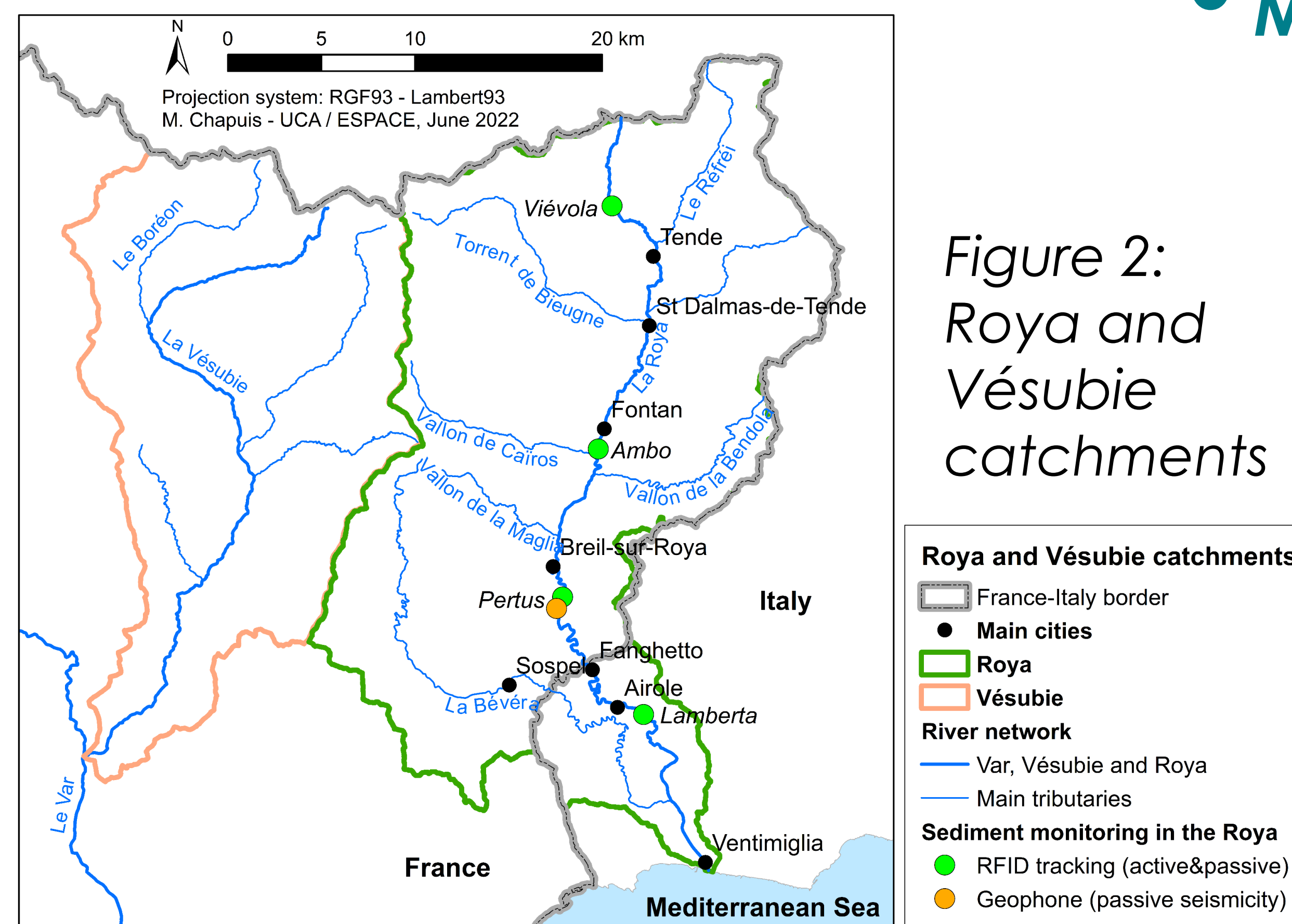


Figure 2: Roya and Vésubie catchments

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

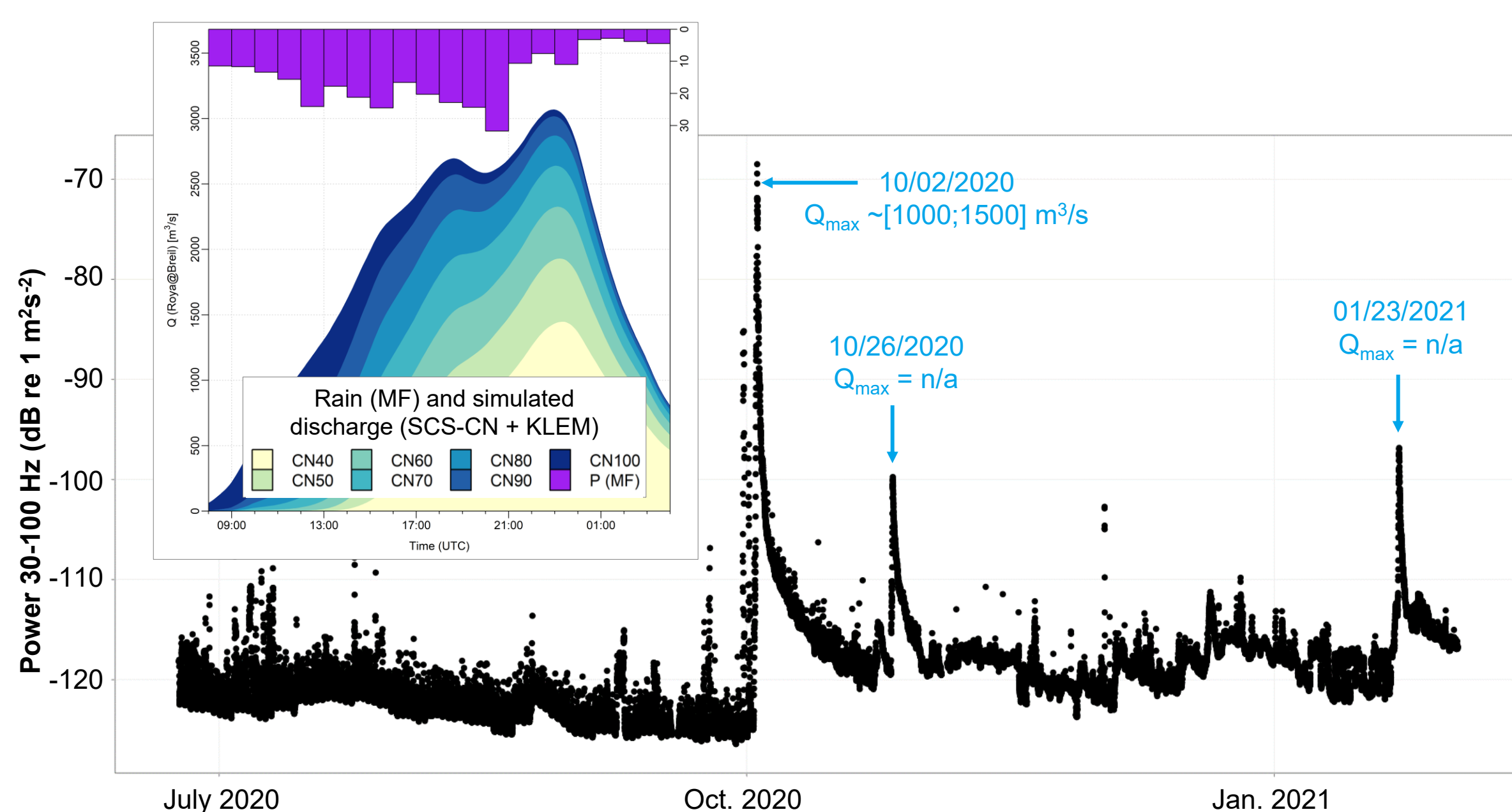


Figure 3: flood kinetics from seismic analysis and rain/discharge simulation

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

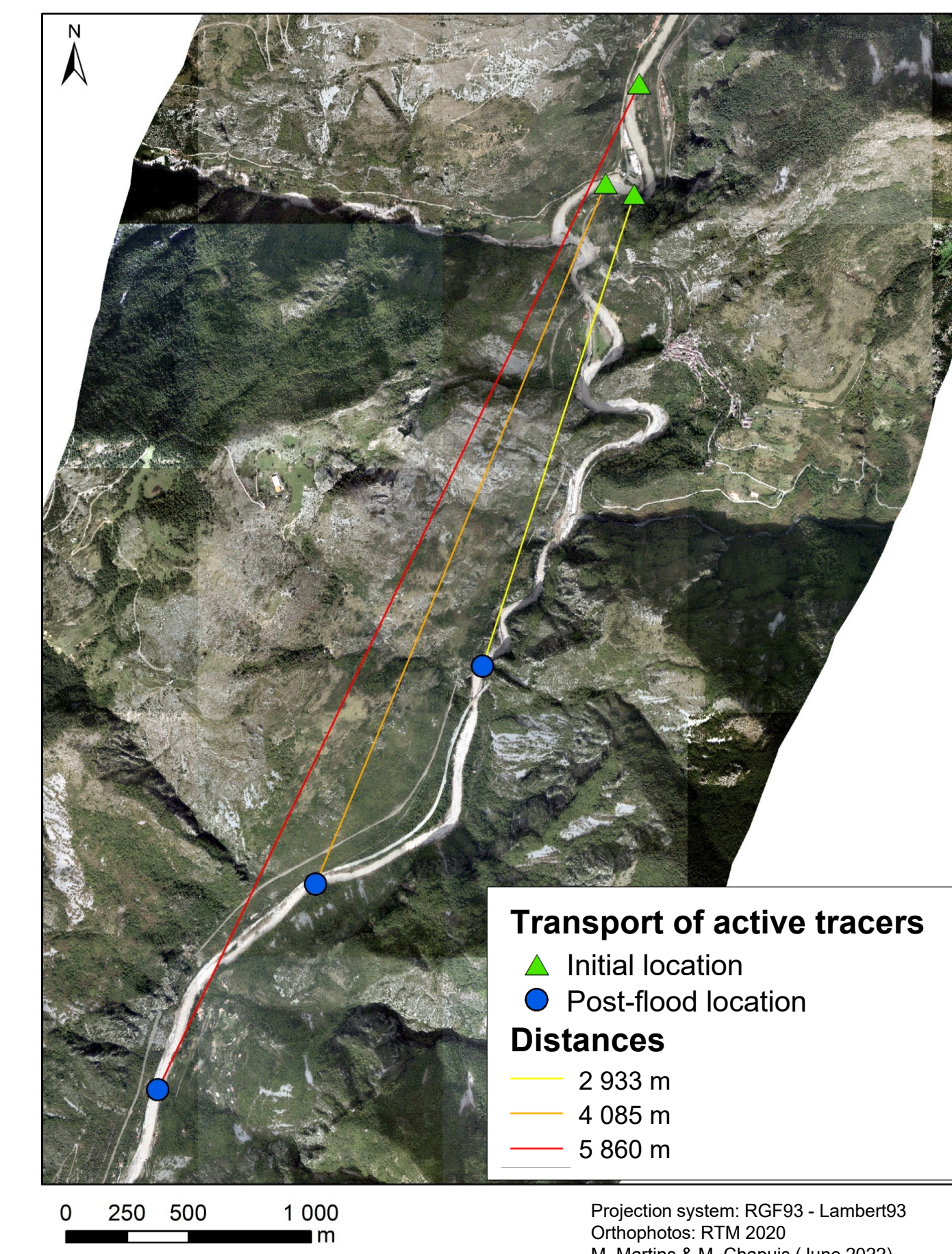


Figure 4: active RFID tracking 2021 survey

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.

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