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Shaping shallow landslide susceptibility as a function of rainfall events

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Supplementary material

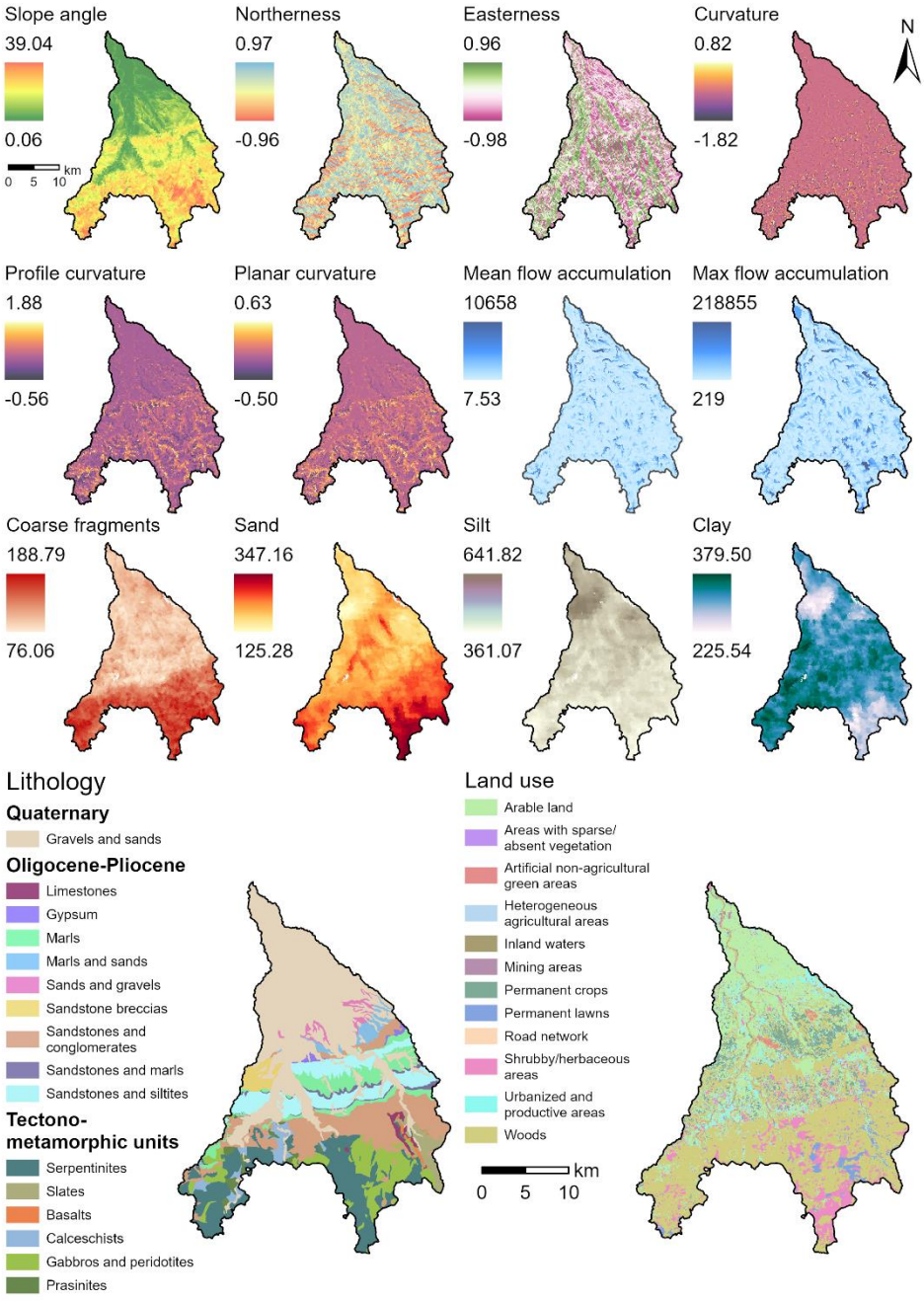


Figure S1. Maps of the areal distribution of the variables considered in the analyses.

Table S1. Reclassification scheme of the original lithological units

Litho-stratigraphical unit	Lithological description	Reclassified lithology
Bacino di Alessandria	Fluvial deposits	Gravels and Sands
Villafranchiano c: Unita di Maranzana	Sands, Gravels, Clays	Sands and Gravels
Formazione di Cassano Spinola	Sandstones, Conglomerates	Sandstones and Conglomerates
Sabbie di Asti b	Sands, Gravels	Sands and Gravels
Marne di S. Agata Fossili	Carbonate rich mudstones, Siltstones	Marls
Formazione di Serravalle	Sandstones, Siltstones	Sandstones and Siltstones
Villafranchiano b: Sabbie di Ferrere e Silt di S.Martino	Sands, Gravels, Siltstones	Sands and Gravels
Complesso caotico della Valle Versa	Gypsums or Anhydrites, Limestones, Clays	Gypsum
Marne di Cessole	Carbonate rich mudstones, Sandstones	Marls
Complesso caotico di Rocca Grimalda	Sandstones	Sandstone Breccias
Formazione di Visone	Sandstones, Impure limestones	Sandstones and Marls
Formazione di Molare	Conglomerates, Sandstones	Sandstones and Conglomerates
Formazione di Rigoroso	Carbonate rich Mudstones, Sandstones	Marls
Formazione di Cortemilia, Formazione di Costa Areasa	Sandstones, Mudstones	Sandstones and Siltstones
Serpentiniscisti antigoritici del Bric del Dente	Serpentinites	Serpentinites
Membro delle arenarie di Cassinelle, Formazione di Rigoroso	Sandstones, Conglomerates	Sandstones and Conglomerates
Formazione di Bistagno	Carbonate rich mudstones, sSandstones	Sandstones and Marls
Membri di Rocca Crovaglia, di Ronchi e di C. Garino, Formazione di Costa Montada	Arenites, Carbonate rich mudstones	Sandstones and Marls
Membro di Cascina Colombara, Formazione di Costa Montada	Carbonate rich mudstones	Marls
Calcari di Voltaggio	Limestones	Limestones
Metabasiti di Rossiglione	Chlorite actinolite epidote metamorphic rocks, Amphibolites, Schists	Prasinites
Calcescisti del Turchino	Schists, chlorite actinolite epidote metamorphic rocks	Calcschists
Calcari di Gallaneto	Limestones	Limestones
Peridotiti lherzolitiche del Monte Tobbio	Peridotites	Gabbros and Peridotites

Metagabbri eclogitici della Colma, Metagabbri del Bric Mazzapiede, Metagabbri eclogitici di Prato del Gatto	Gabbros, Eclogites	Gabbros and Peridotites
Scisti filladici del Monte Larvego	Slates, Limestones	Slates
Dolomie del M. Gazzo	Dolomites	Limestones
Metabasalti di Cravasco	Basalts	Basalts
Serpentiniti di Case Bardane	Serpentinites	Serpentinites
Metagabbri del Monte Lecco	Gabbros	Gabbros and Peridotites
Argilloscisti di Costagiutta	Slates, Limestones	Slates
Serpentiniti del Bric dei Corvi	Serpentinites	Serpentinites
Argilloscisti di Murta	Slates	Slates
Metabasiti - Unita Figogna	Basalts, Breccias	Basalts
Argille azzurre a	Carbonate rich Mudstones, Silts, Sands, Gravels	Marls and Sands
Argille Azzurre b	Carbonate rich Mudstones, Silts, Sands	Marls and Sands

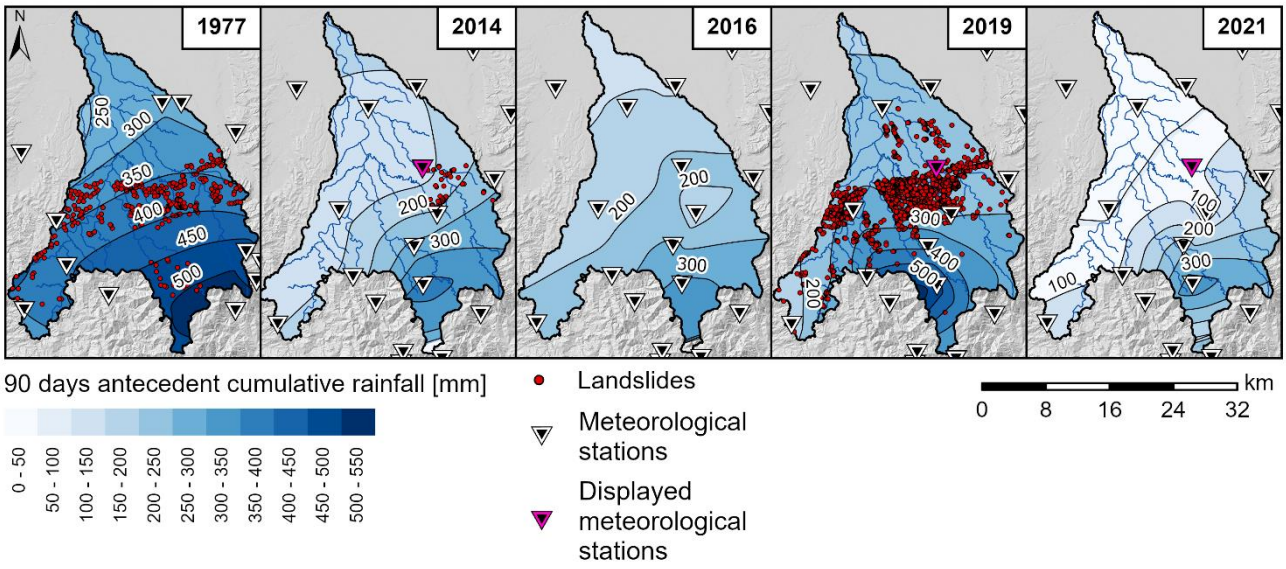


Figure S2. Antecedent cumulative rainfall over the 90 days prior to the landslide event and landslides distribution during the considered events, reconstructed by interpolation of values measured by the meteorological stations on the ground, that led to landslide triggering in the Orba basin.

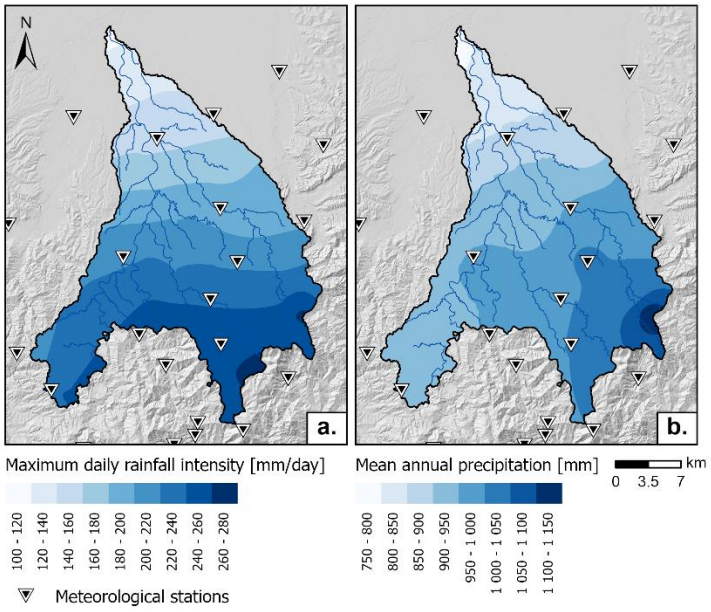


Figure S3. a.) Maximum daily rainfall intensity associated to an event with a return period of 10 years, calculated applying a GEV distribution. b.) Mean annual rainfall, calculated over the period 1991 – 2020.

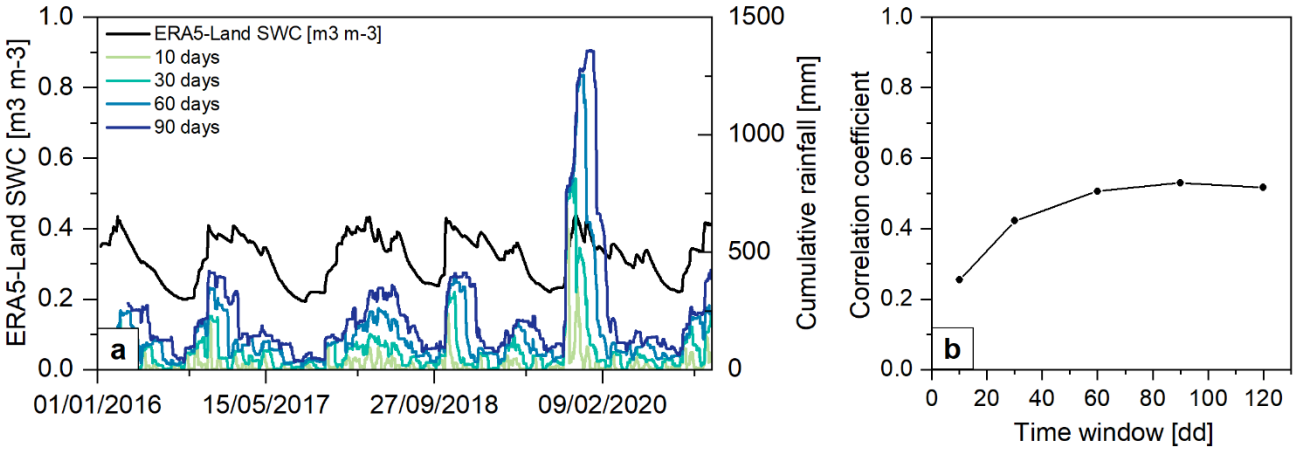
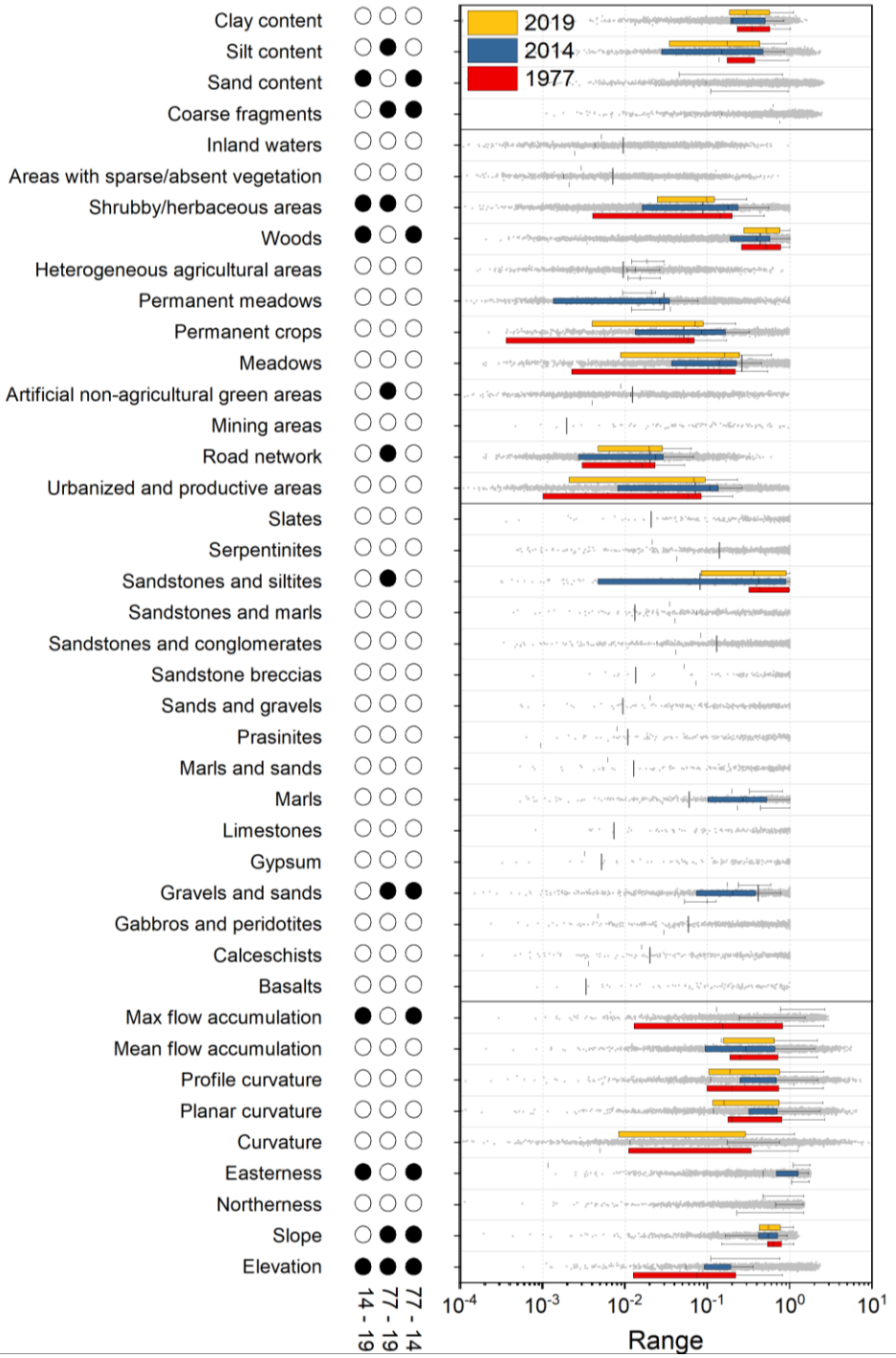


Figure S4. ERA5-Land estimated volumetric soil water content and cumulative rainfall time series (a) and correlation coefficient between the estimated volumetric soil water content and antecedent cumulative rainfall over different time windows (b).



20 **Figure S5. Distribution of the controlling variables in the slope units. Boxplots represent the normalized values distributions of slope units destabilized in each landslide event, while grey dots represent the entire values population. Dots above the variable names represent the significance of the population differences, according to the Dunn's test. A black dot means that the distributions are not statistically different at a significance level of 0.05.**

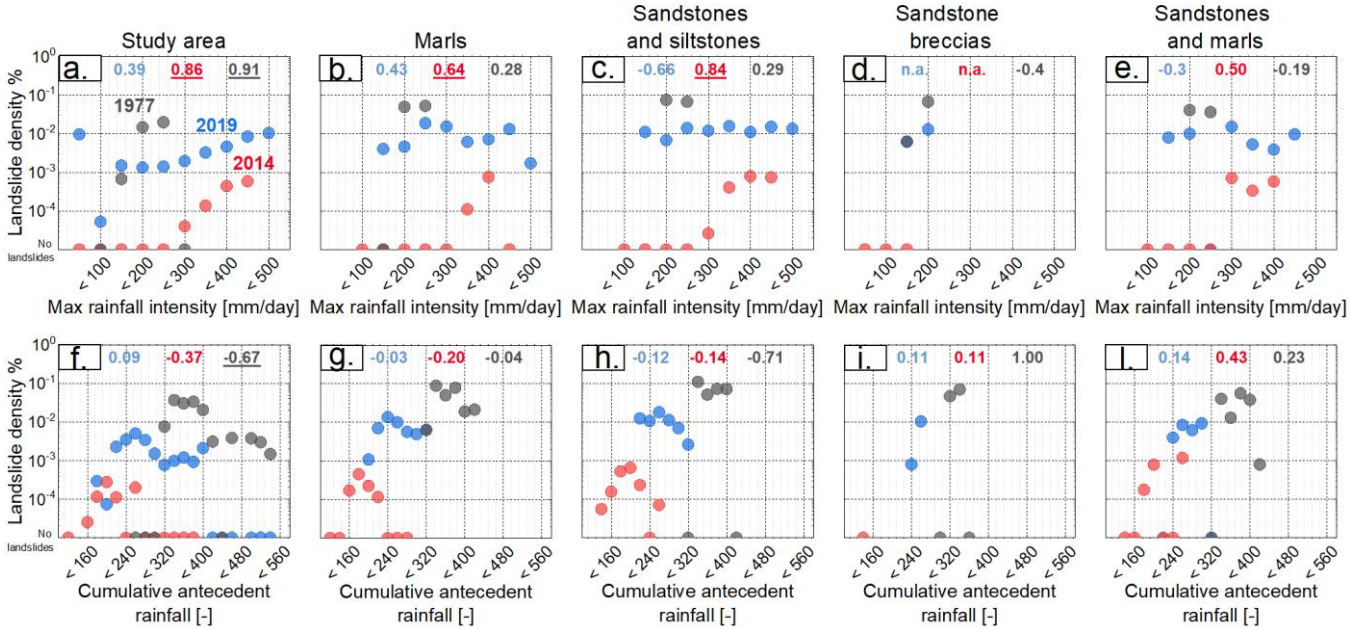


Figure S6. Scatterplots representing landslide density in each rainfall class, for the entire study area and for different lithologies. Spearman's rank order correlation coefficient between landslide density and rainfall classes is reported in each plot. Underlined values are statistically correlated at the 0.05 level.

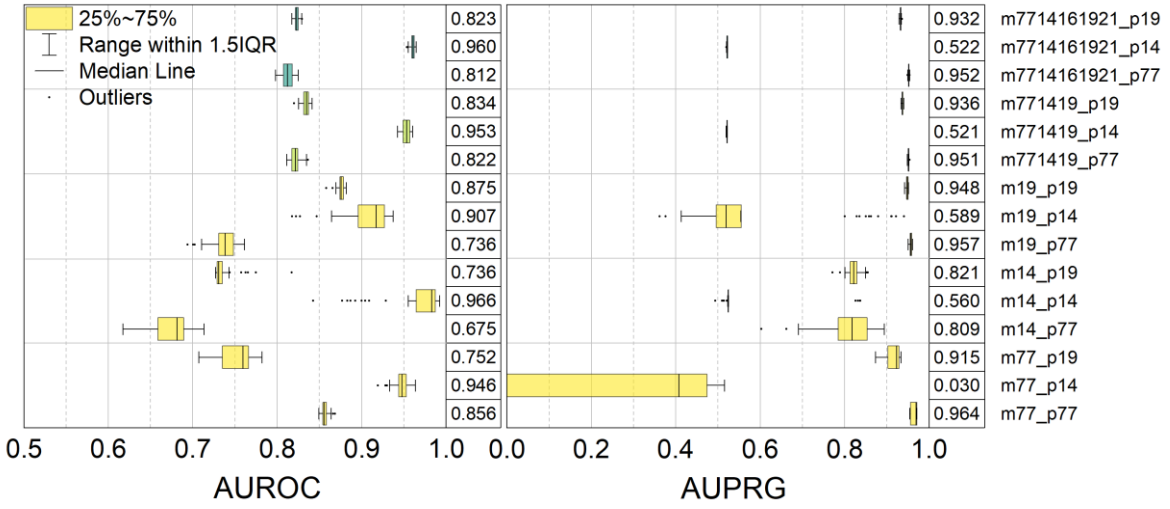


Figure S7. Boxplots of the AUROC and AUPRG performance of all the tested models for the 50 repetitions, tested both on themselves and to forecast or hindcast other events. AUROC values can range between 0.5 and 1; the closest to 1, the best the performance of the model. More in details, if AUROC is equal to 0.5 there is no discrimination; if the AUROC value is between 0.7 and 0.8, the model performance is classified as acceptable; if the AUROC value is between 0.8 and 0.9 the model performance is excellent, while if the AUROC value is greater than 0.9 the model performance is outstanding (Hosmer and Lemeshow, 2000). Labels refer to the events used to train the model (m*), and to the events used to test the model (p*). Numbers next to the labels indicate the mean value of the distribution. All the distributions are statistically different at the 0.05 significance level, according to the Wilcoxon–Mann–Whitney test.