PRÉSENTATION DU MODÈLE FLAME (Forecasting Landslides Accelerations induced by Meteorological Events)

Vidéo Décembre 2020
Séminaire final de communication
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- Modèle associé pour estimer la pluie effective
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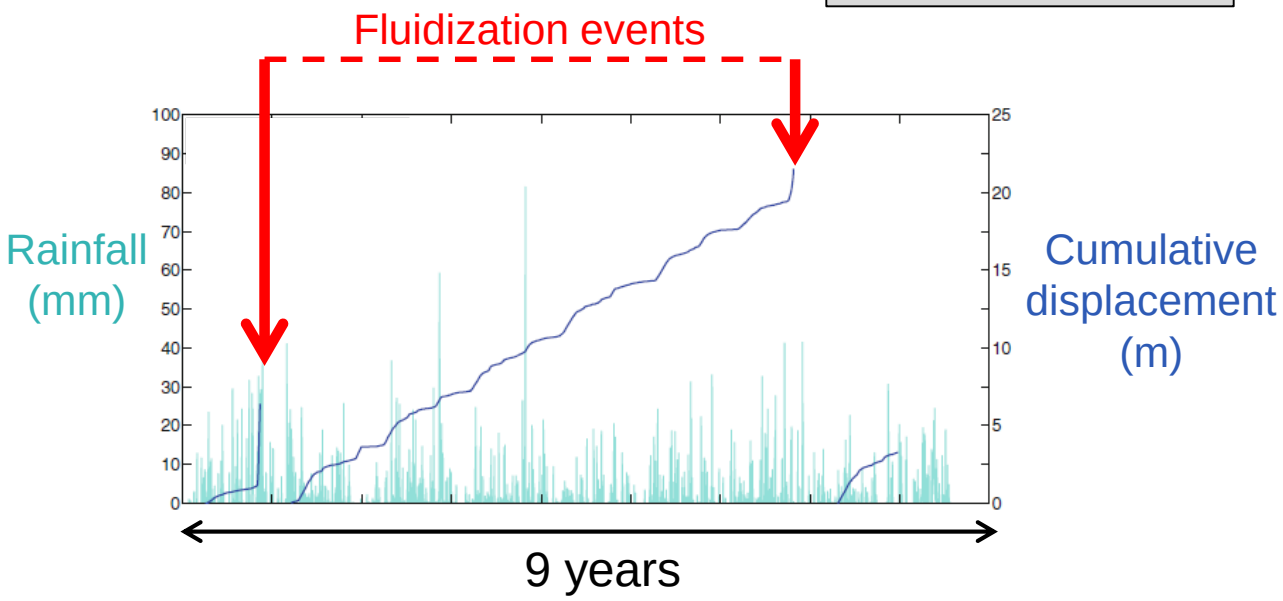
Forecasting Landslides Accelerations induced by Meteorological Events

Goal: real-time prediction of the landslide displacement rate

Input data	FLAME models	Output data
Effective rainfall or Piezometric level	→	Landslide displacement rate

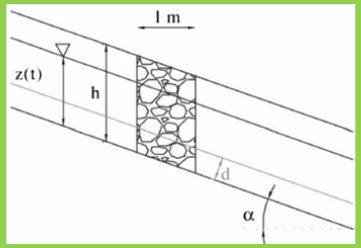


Forecasting Landslides Accelerations induced by Meteorological Events

Input data → FLAME models → Output data

MA: 1D mechanical model
(viscoplastic rheology)

Piezometric level → MA → Landslide displacement rate

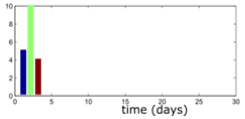


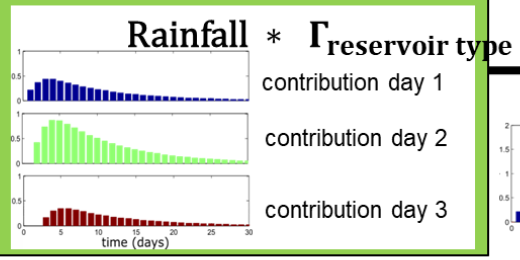
- h : hauteur de la masse glissante
- z : niveau piézométrique
- α : inclinaison de la pente
- d : hauteur de la bande cisaillement

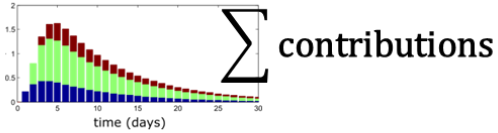
IR: impulse response model
(convolution product)

Effective Rainfall → IR → Landslide displacement rate

Effective Rainfall







adapté du modèle TEMPO. (Pinault et al., 2007)

IR + MA

Effective Rainfall → IR + MA → Landslide displacement rate

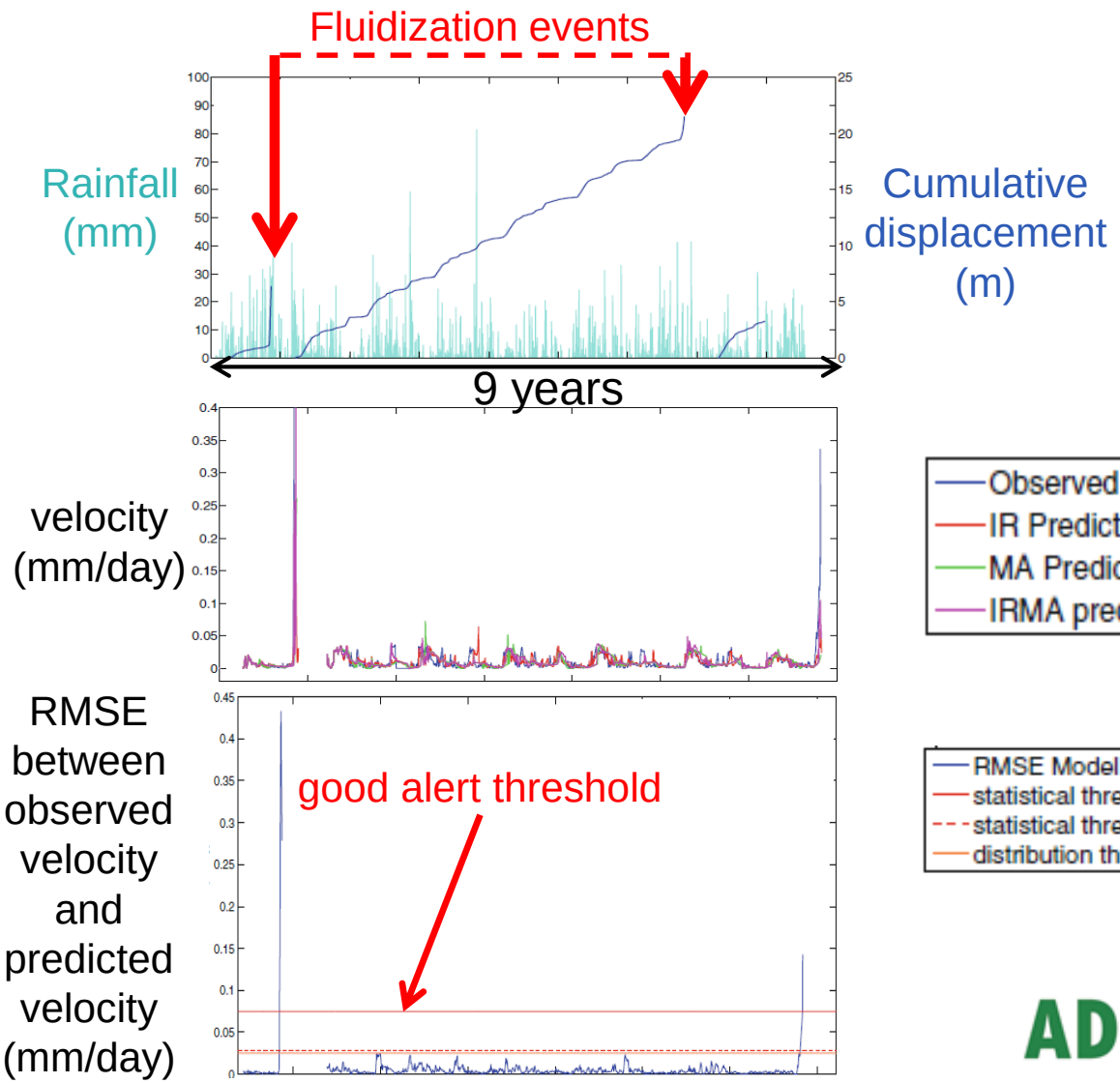
Piezometric level

Forecasting Landslides Accelerations induced by Meteorological Events

1) optimization of the model parameters to minimize the difference between the estimated velocity and the observed velocity (inversion process) during a calibration period

2) prediction of the velocity using the FLAME models with the determined parameters

Super-Sauze mud flow

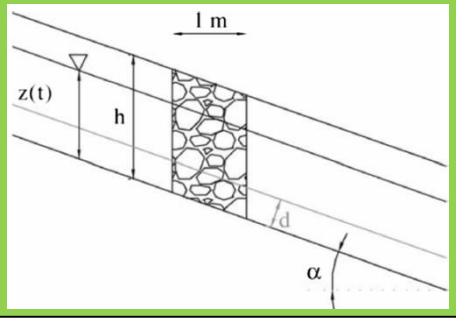


Progetto Interreg V-A Alcotra Italia-Francia n°1573

Forecasting Landslides Accelerations induced by Meteorological Events

Calibration: optimization of the model parameters to minimize the difference between the estimated velocity and the observed velocity (inversion process)

MA: parameters *h, d, η* (viscosity), *Φ* (friction angle), …



IR: parameters of the IR function *T, D, L*

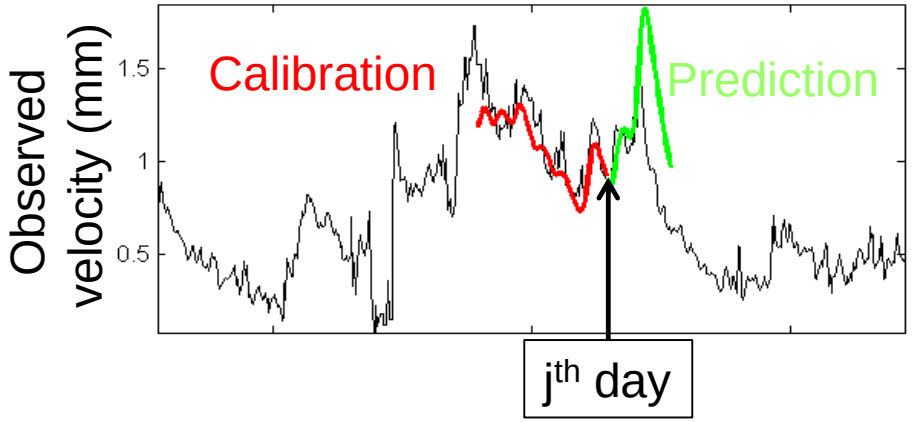
$$\Gamma(t) = \exp\left(-\ln(2)\left(\frac{t-T}{D}\right)^2\right) * \exp\left(-t\frac{\ln(2)}{L}\right)$$

$\Gamma_{\text{reservoir type}}$

Criteria for optimization:

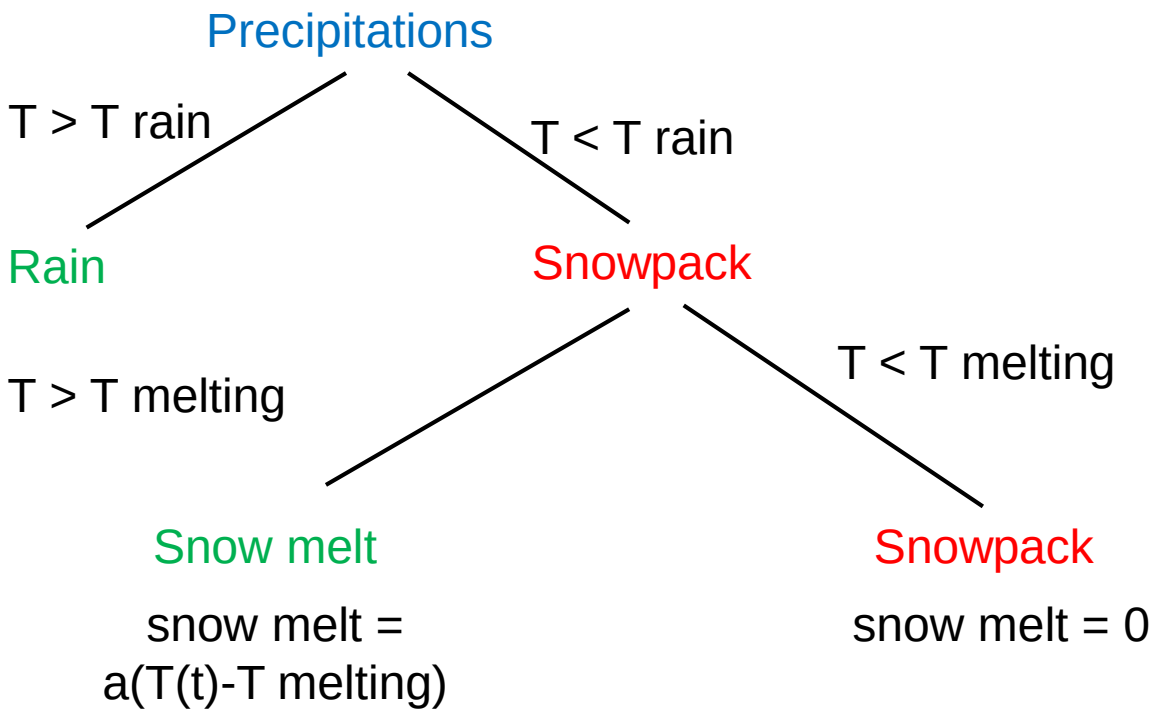
$$RMSE = \sqrt{\frac{1}{N}.\sum_{n=1}^{N}(O(n) - M(n))^2}$$

O: observed velocity
M: modeled velocity
N: number of observations



Prediction of the velocity using the FLAME models (MA, IR, IRMA) with the determined parameters

ASSOCIATED MODEL to estimate effective rainfall (= rain + snow melt)



NB: on this slide T=temperature, with Train and Tmelting, threhold values to form snow and melt snow, respectively. On other slides, T is parameter of IR model

DEVELOPPEMENTS RECENTS DE FLAME

- inversion conjointe des données de 2 capteurs de déplacement
- début d'une interface utilisateur