Optimiser nos structures

par la conception et le calcul

Intervenant·es

Didier Bourqui Ingénieur, responsable structure et géotechnique chez Losinger-Marazzi, président du GI SIA Vaud

Nicolas Fröhlich Architecte, représentant du maître de l'ouvrage

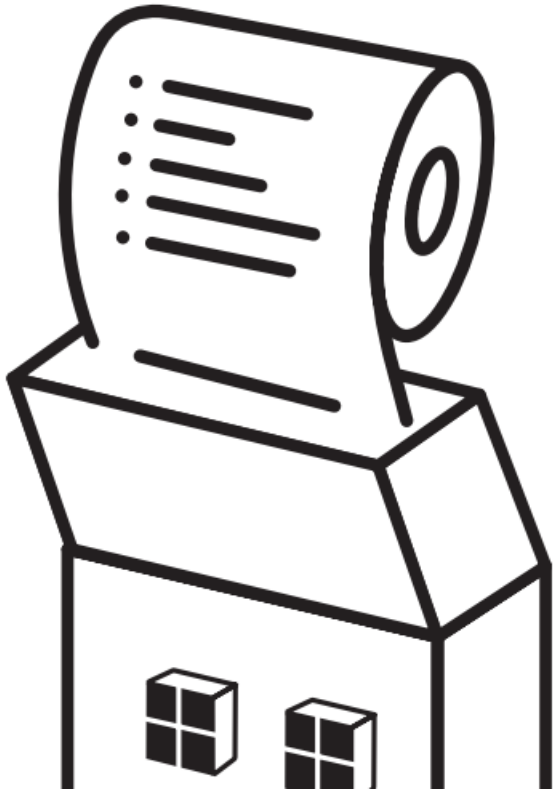
Aurelio Muttoni Ingénieur, professeur honoraire de l'EPFL, fondateur de Muttoni Partners Ingénieurs Conseils

Alain Oulevey Ingénieur, co-président SIA suisse, directeur chez De Cérenville Géotechnique

Céline Weber Ingénieure, fondatrice de Focus-E, conseillère nationale PVL

Modération

Stéphane Commend Ingénieur, directeur de GeoMod SA, professeur associé HEIA-FR, ancien président SIA Vaud



sia
société suisse des ingénieurs et des architectes
section vaud

HEIA-FR
HTA-FR

GEOMOD

ZSoil

- **Préambule**

  - Vision (parfois) des MO: qualité des prestations ↓
  - Pourquoi? **Pourtant, on a les outils!**
    - Budget? Planning?
    - Incompétence? Flemme?

  - Vision des mandataires:

> Merci !
> C'est quand même triste de devoir organiser des conférences pour rappeler que le cœur du métier d'ingénieur c'est de concevoir de manière intelligente… et non de faire du reporting dans des tableaux xls pour les MO…

  - Qui est responsable?
  - But de ce soir:
    - Confronter nos points de vue, ouvrir des pistes

- **Ingrédients pour optimiser nos projets?**

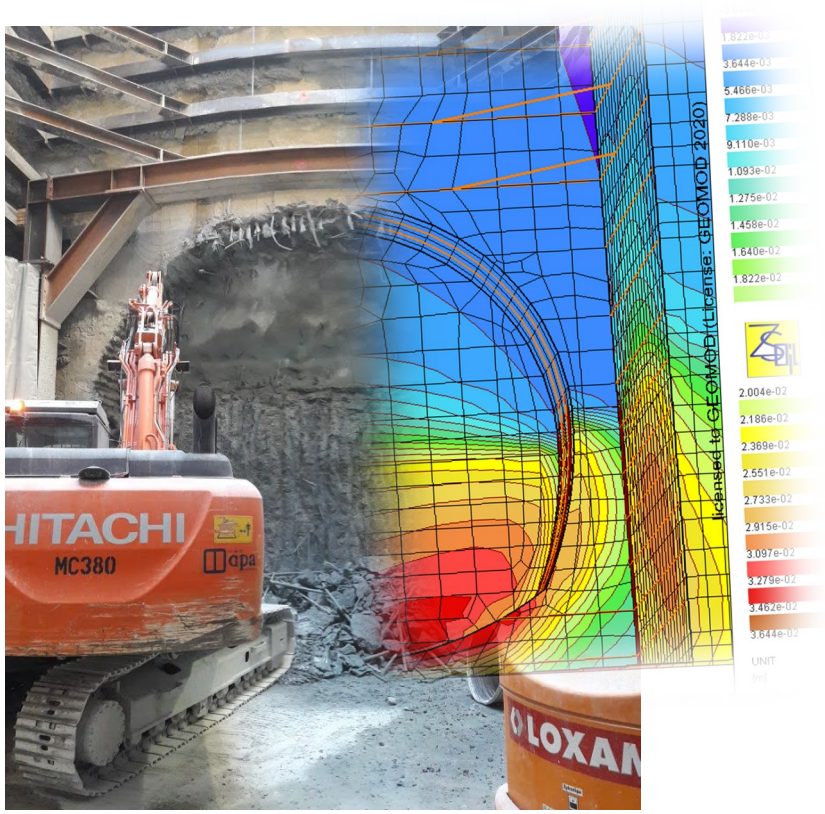
  - Base de décision
    - Normes
    - **Bon sens**
    - Acceptabilité d'un **risque**

  - **Tous** les partenaires du projet doivent être concernés
    - Mandataires
    - Entreprises
    - MO
    - …

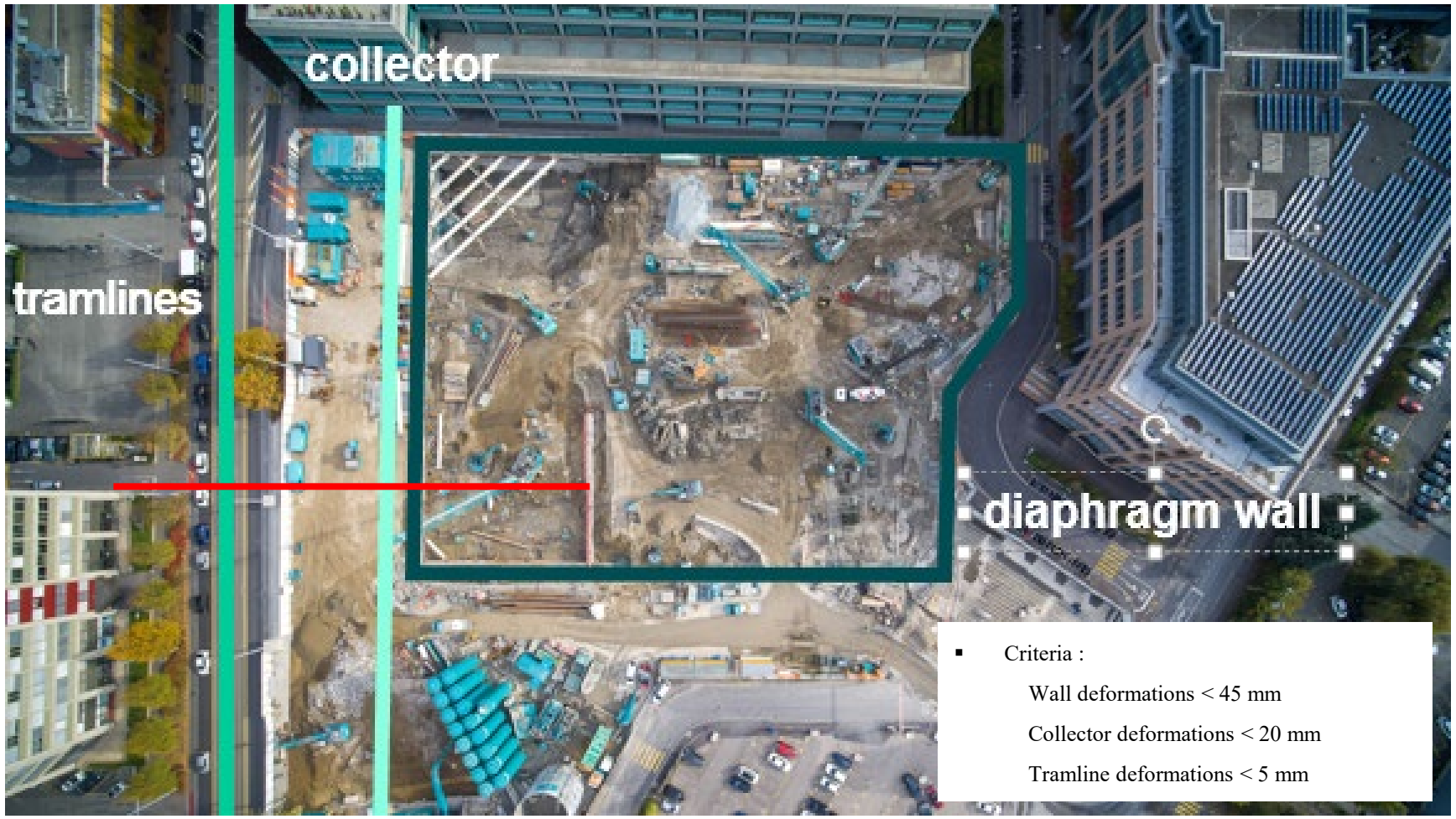
4.5 Serviceability limit states (SLS)

For serviceability limit states (SLS) there are no formal minimum reliability requirements, since risk to life is not applicable for SLS by definition. Reliability targets for SLS verifications should be chosen by the client, designer and/or contractor (depending who is responsible for SLS exceedance) according to the risk profile of exceeding the serviceability limit state, because the consequence of SLS exceedance is typically the cost of repair, indirect costs due to loss of functionality or a contractual fine.

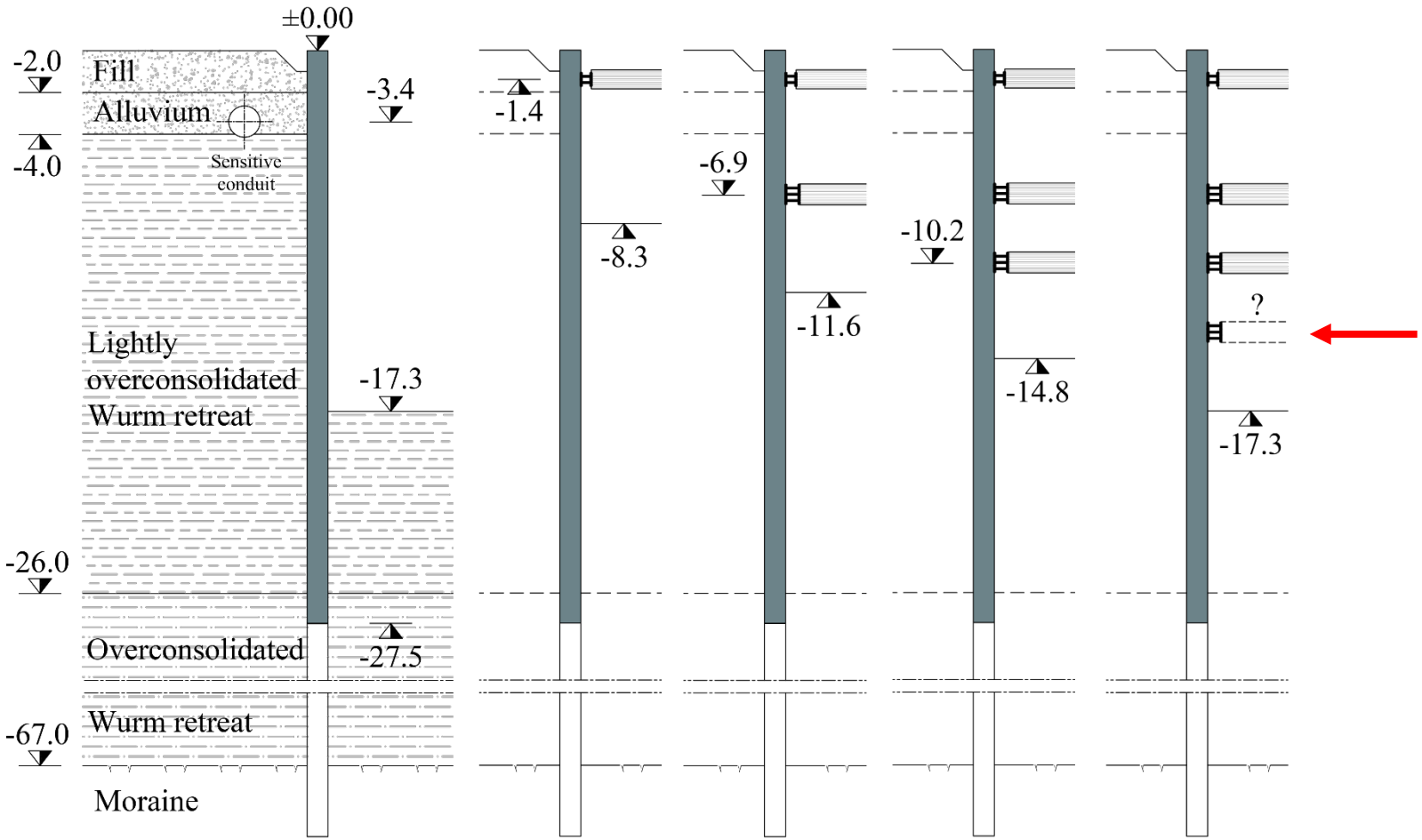
- **Approche proposée**

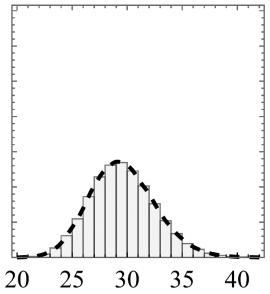


  - Définition de valeurs seuils
    - Sécurité, dimensionnement (ELU)
    - Aptitude au service (ELS)
  - Prédictions sur la base d'un modèle
  - Incertitudes? **Bien sûr!**
    - ~~Facteurs de sécurité~~
    - Approche probabiliste
  - Instrumentation... Et bayésien!
  - Mise à jour des predictions en cours d'execution
  - Décision

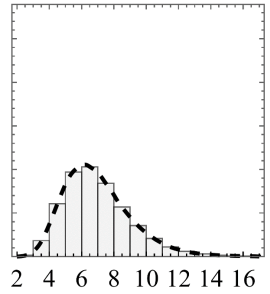


- Criteria :
  - Wall deformations < 45 mm
  - Collector deformations < 20 mm
  - Tramline deformations < 5 mm

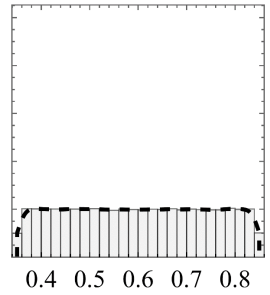

±0.00
-2.0
Fill
Alluvium
-4.0
Sensitive
conduit
-3.4
Lightly
overconsolidated
Wurm retreat
-17.3
-26.0
Overconsolidated
-27.5
-67.0
Wurm retreat
Moraine
-1.4
-8.3
-6.9
-11.6
-10.2
-14.8
?
-17.3



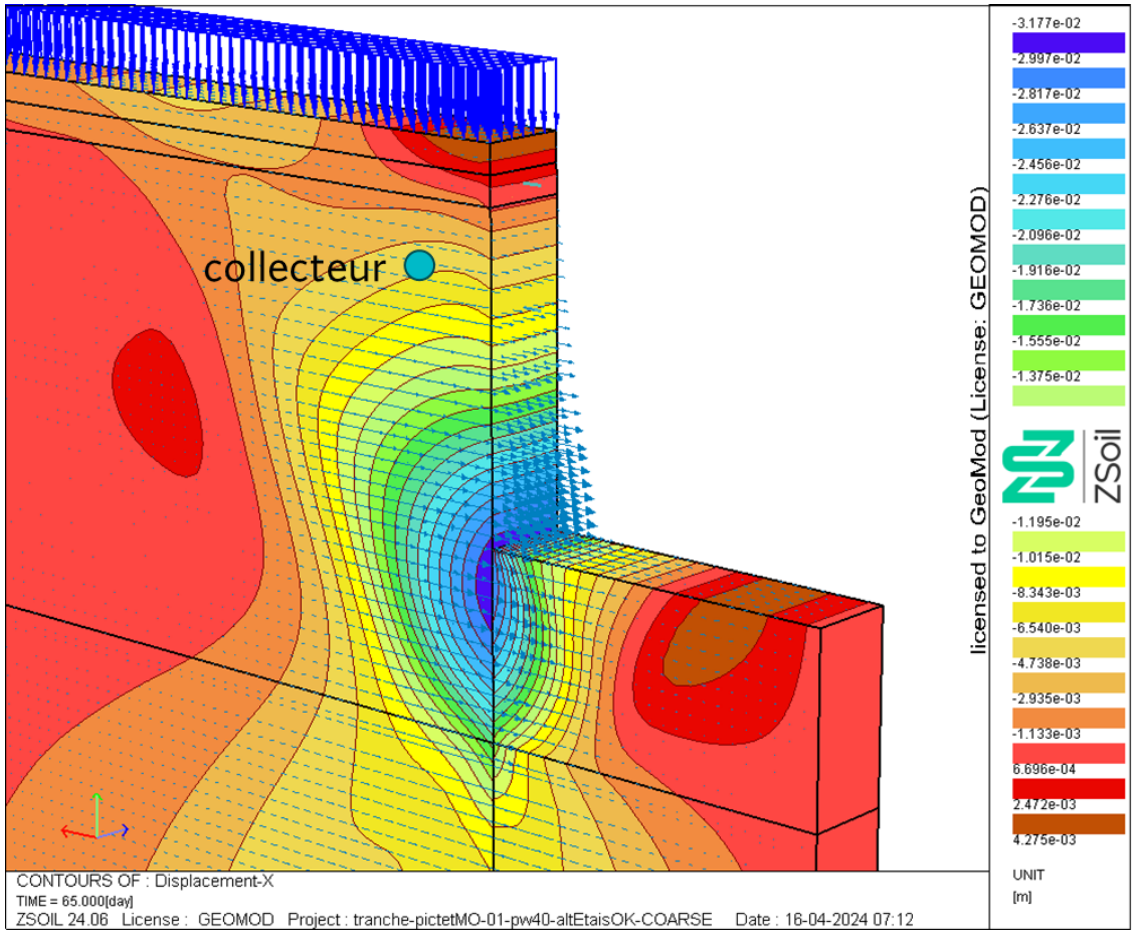
X5 : φ (°)

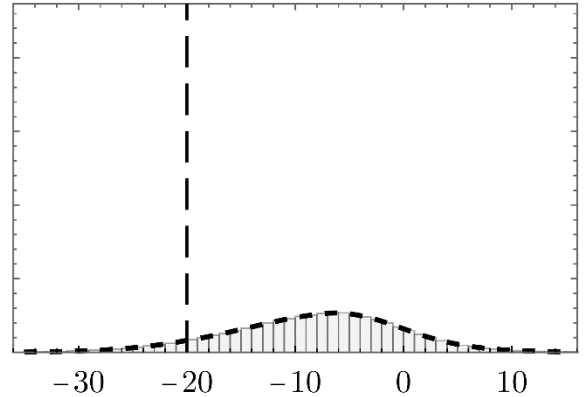


X7 : E_{50} (MPa)



X18 : κ_w (−)

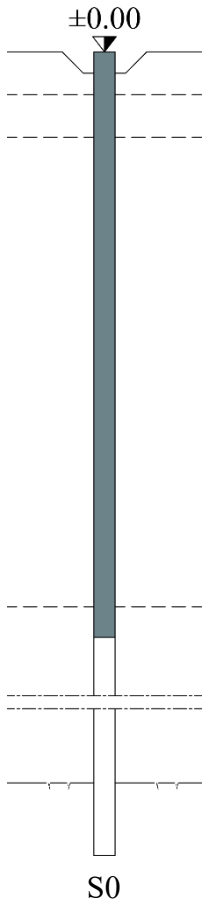




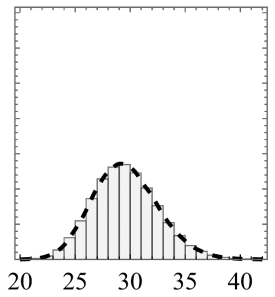
$U_{y,\mathrm{Pipe}}$ (mm)

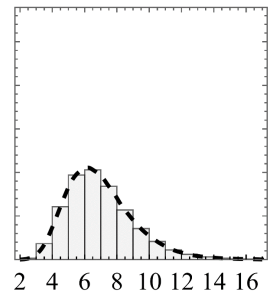
IV. RESULTS – Updating process, predictions & reliability analysis

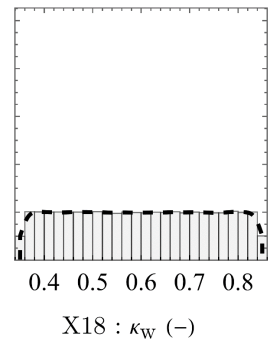
In-situ status

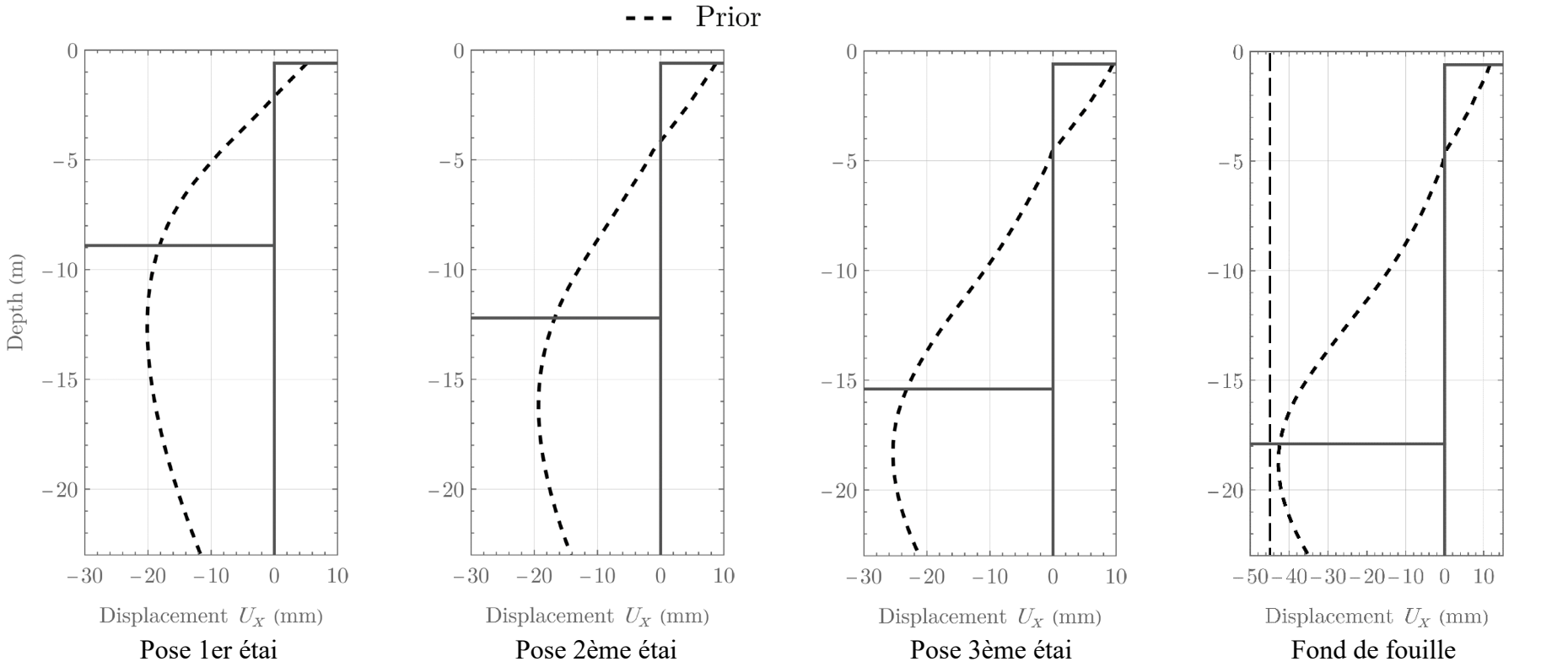


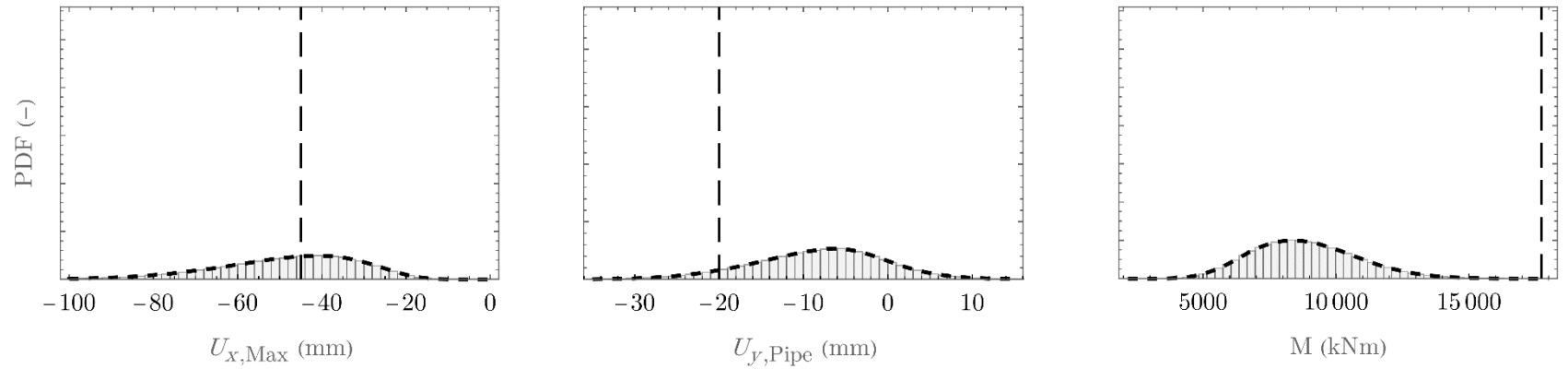
Variables





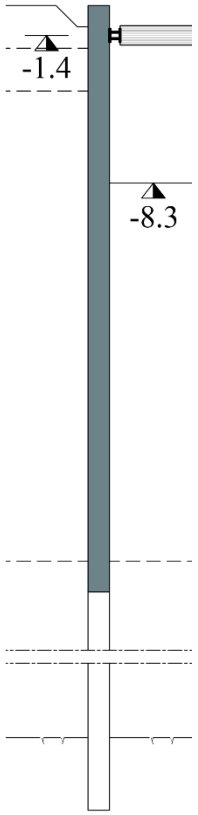




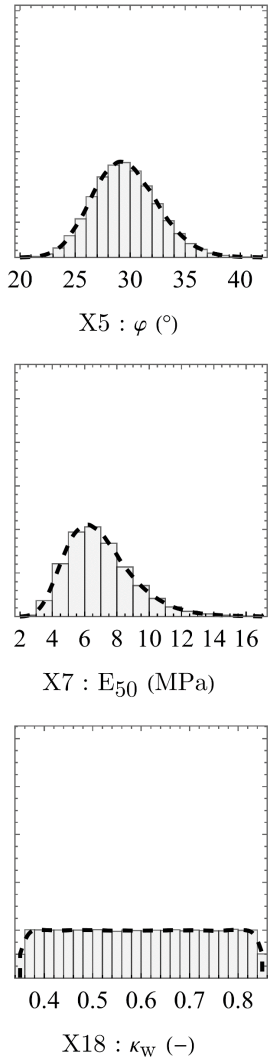


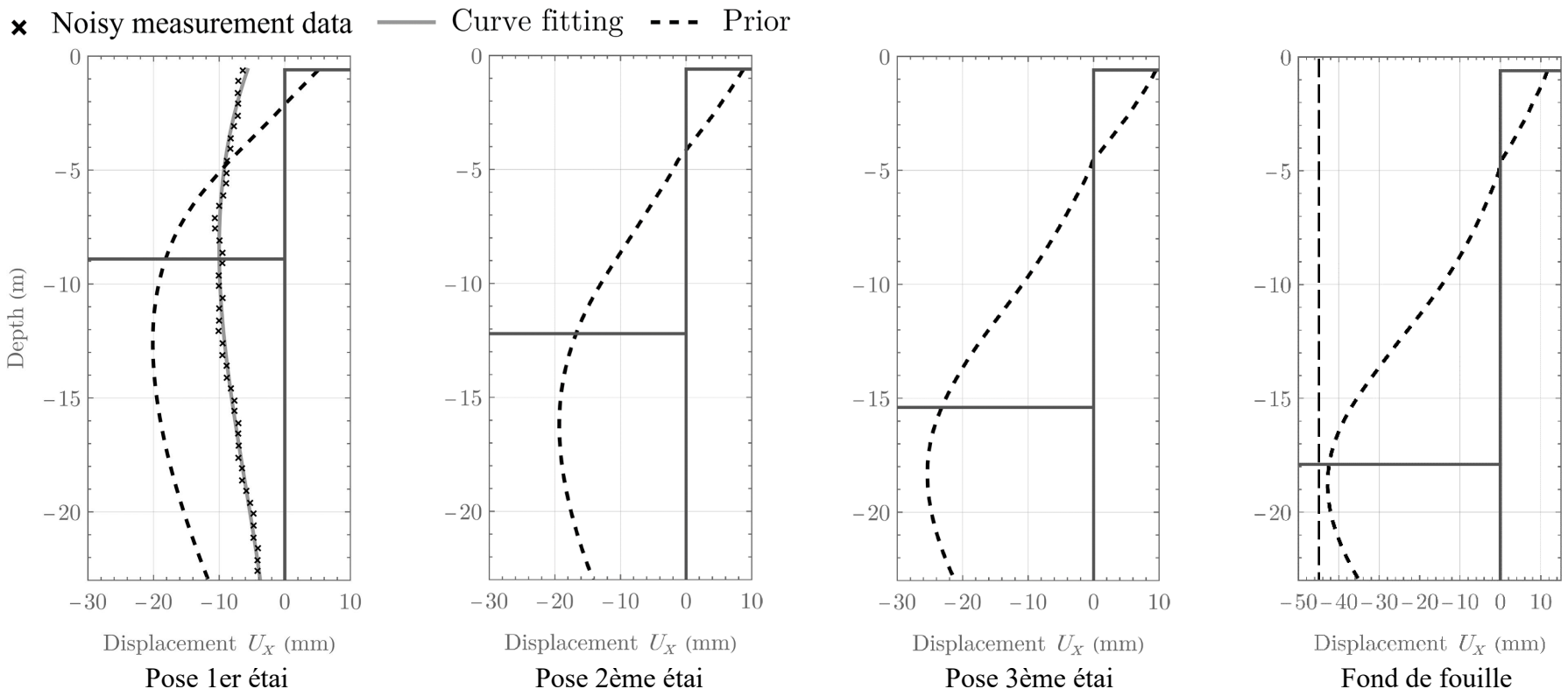
IV. RESULTS – Updating process, predictions & reliability analysis

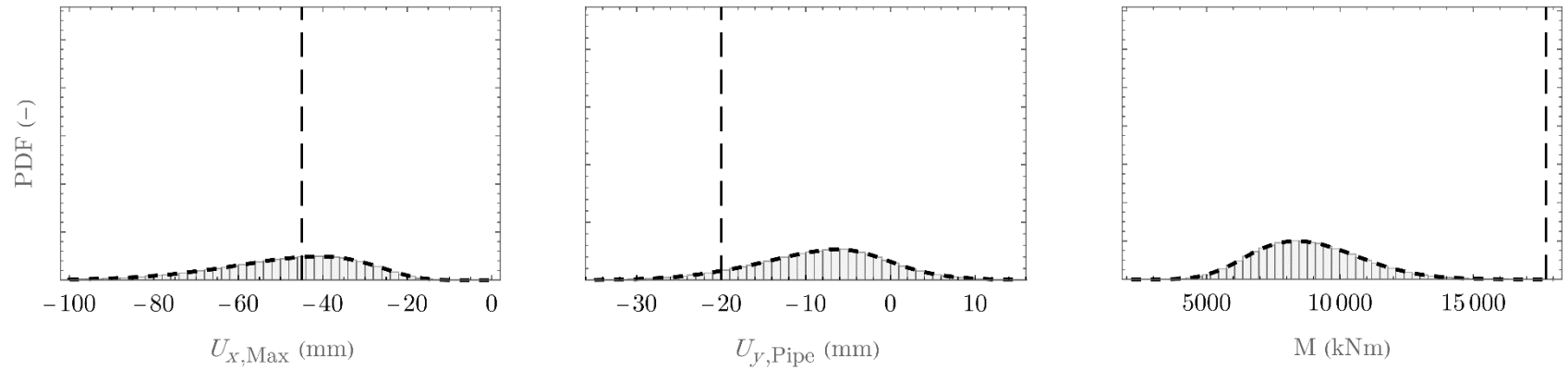
In-situ status



Variables

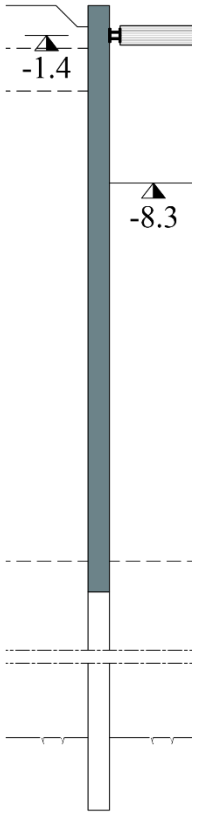




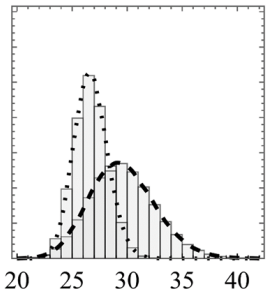


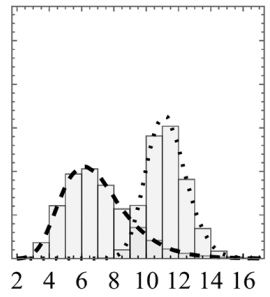
IV. RESULTS – Updating process, predictions & reliability analysis

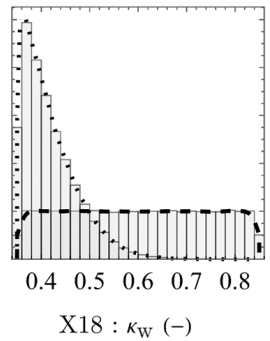
In-situ status

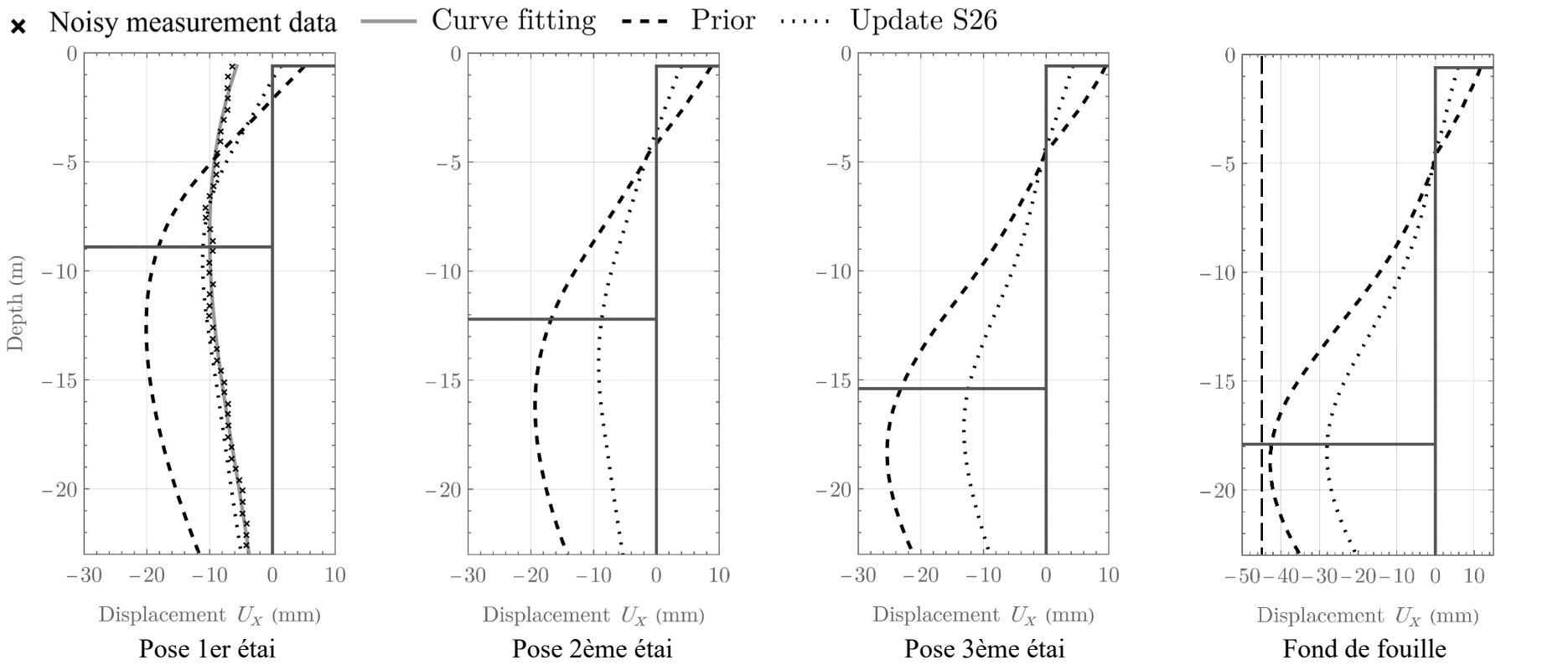


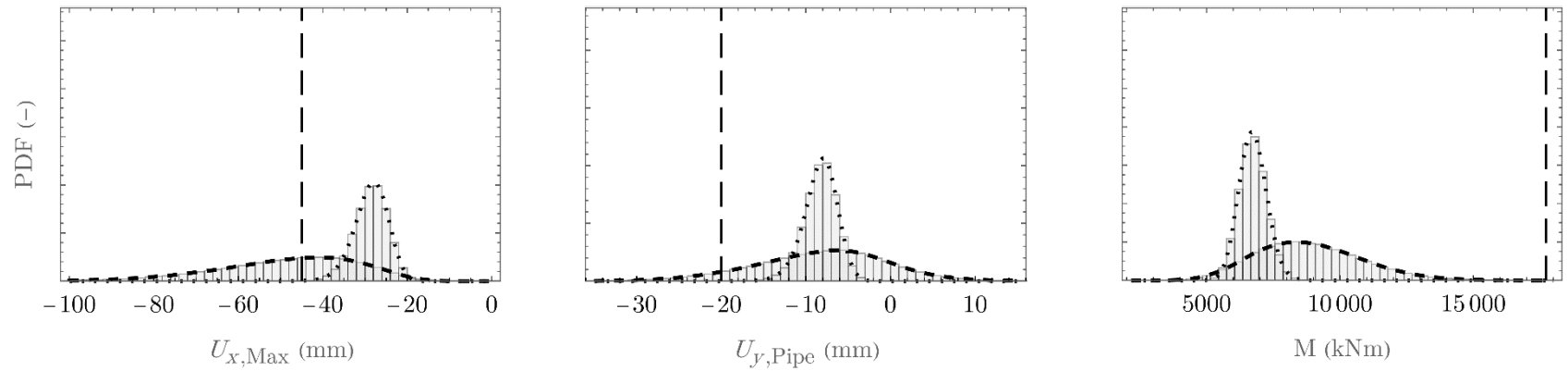
Variables





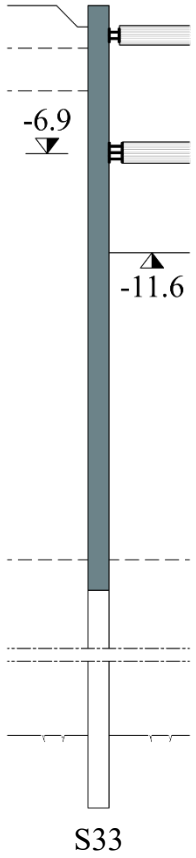




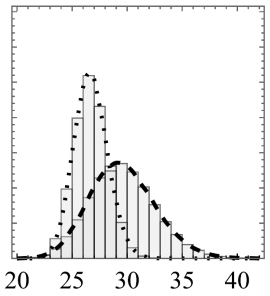


IV. RESULTS – Updating process, predictions & reliability analysis

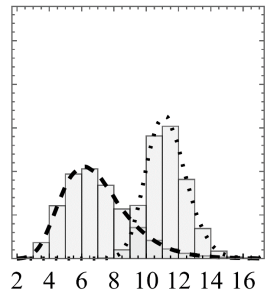
In-situ status



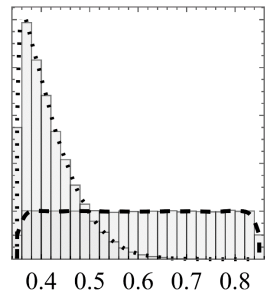
Variables



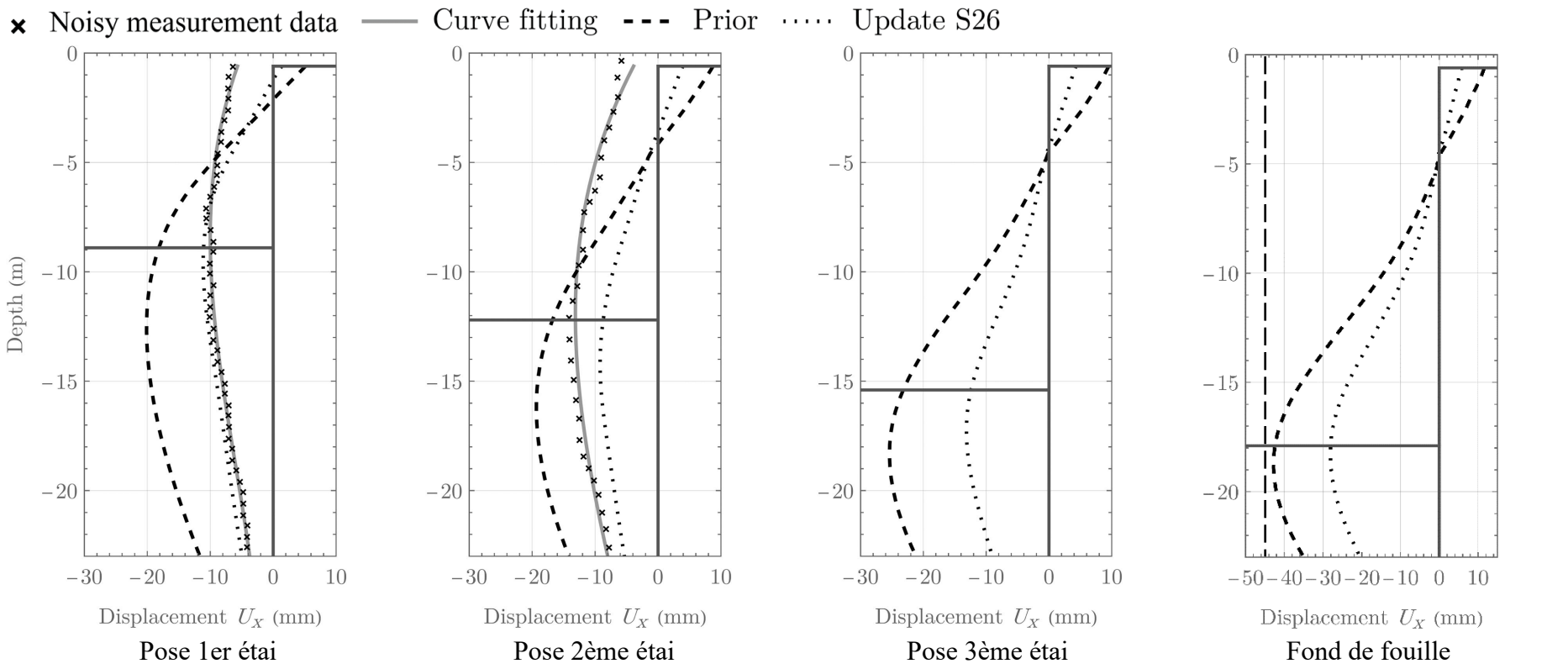
X5 : φ (°)

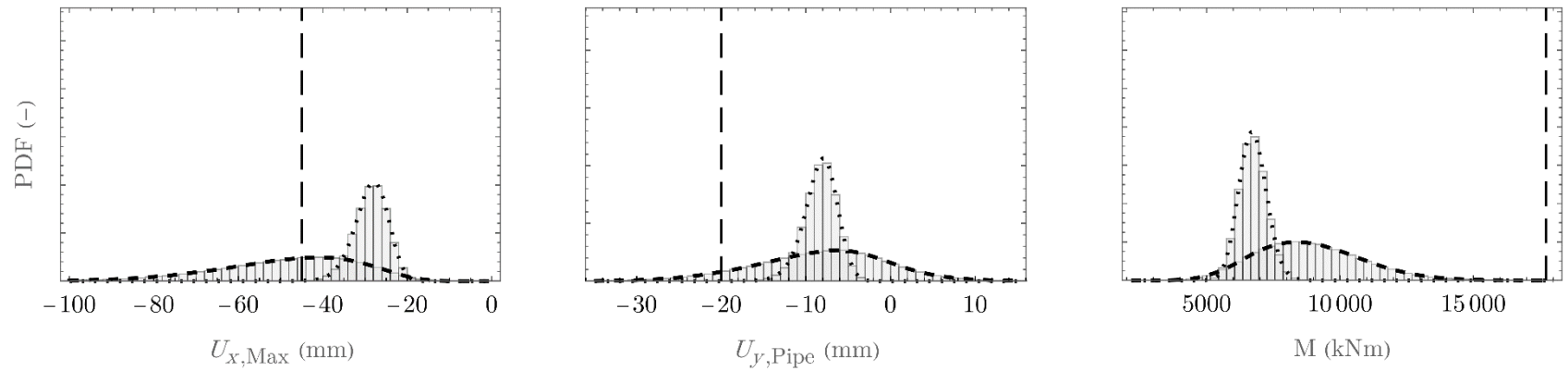


X7 : E_{50} (MPa)



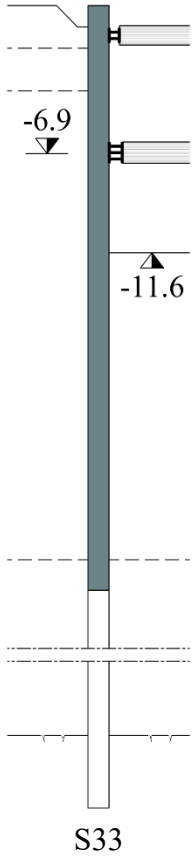
X18 : κ_w (–)



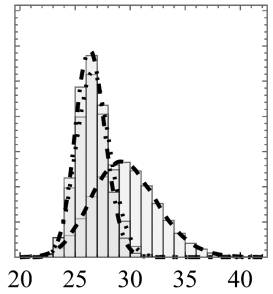


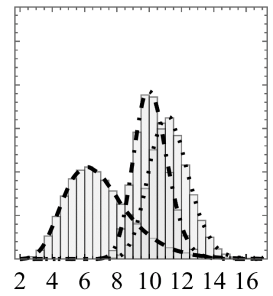
IV. RESULTS – Updating process, predictions & reliability analysis

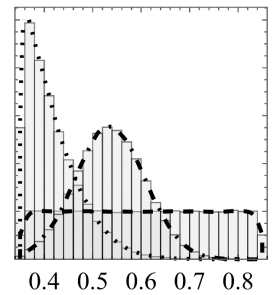
In-situ status

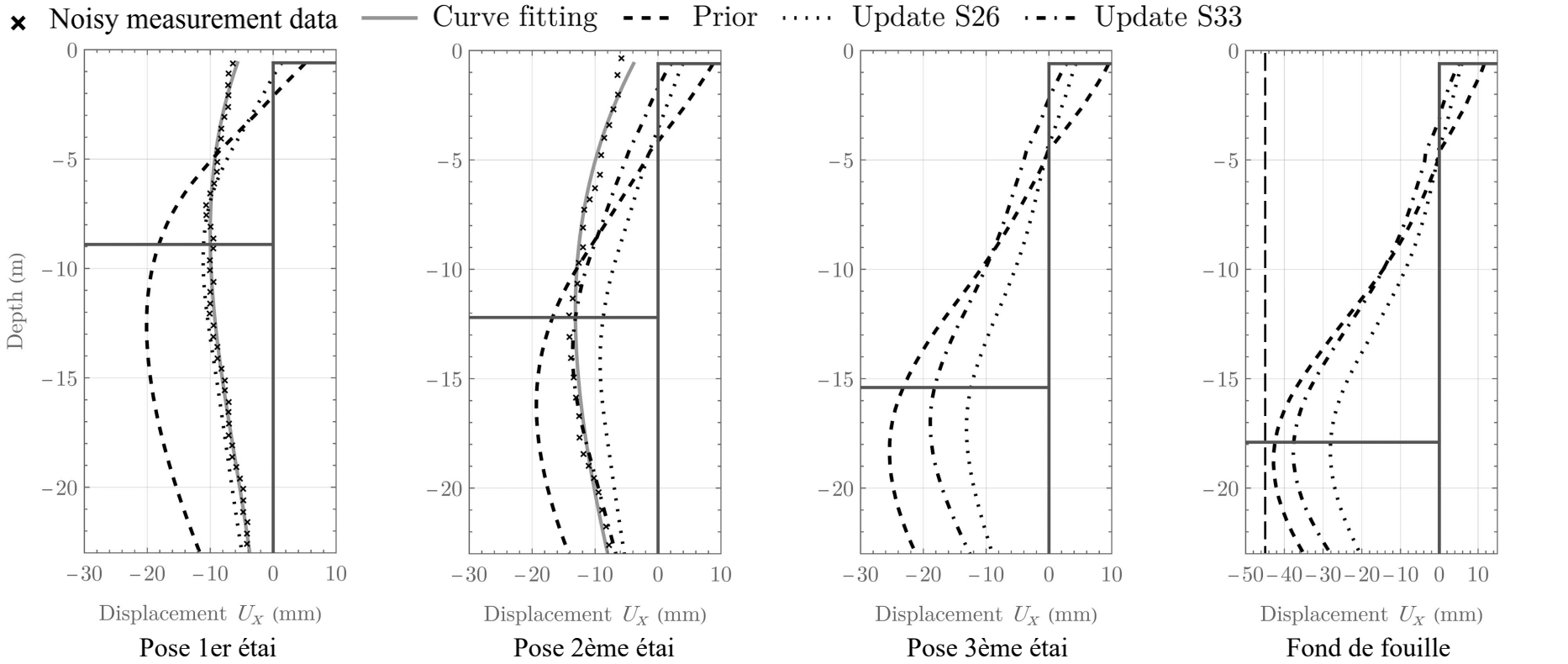


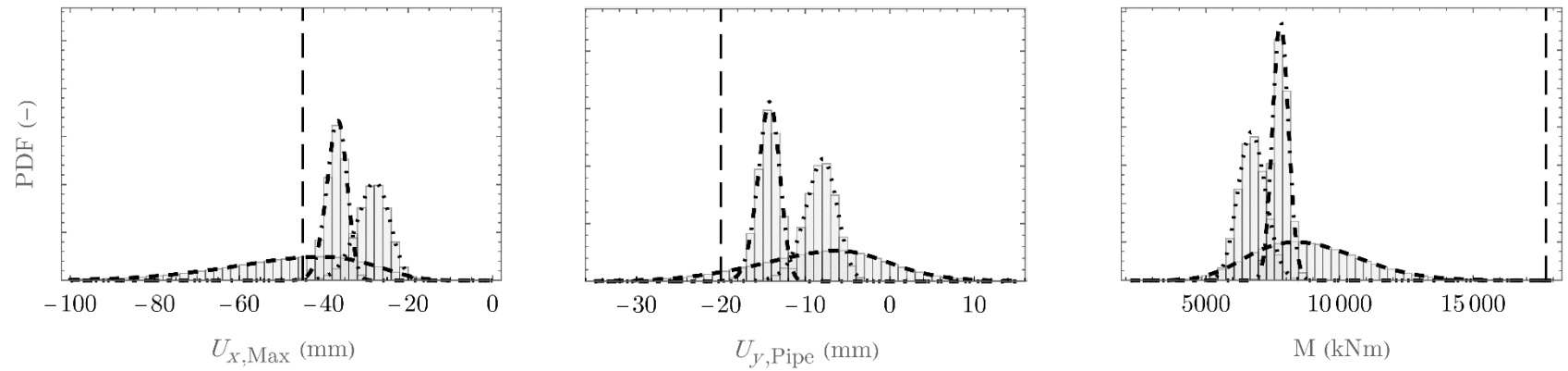
Variables





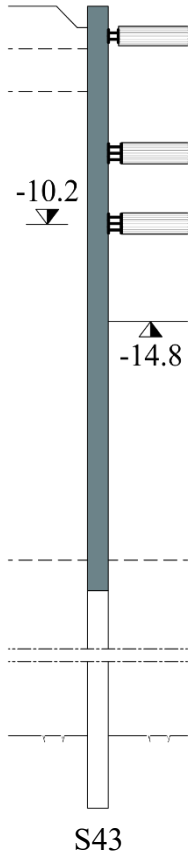




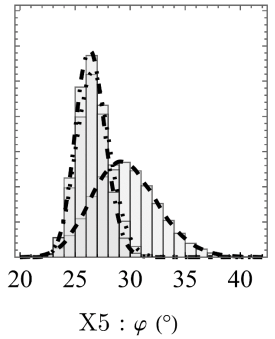


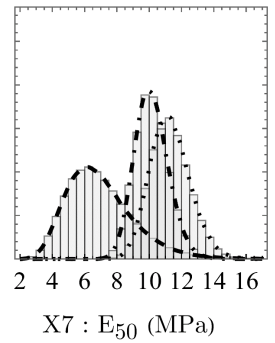
IV. RESULTS – Updating process, predictions & reliability analysis

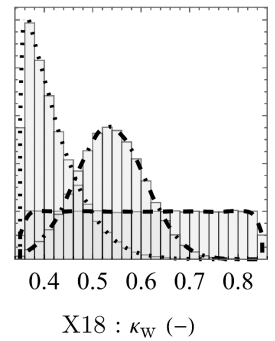
In-situ status

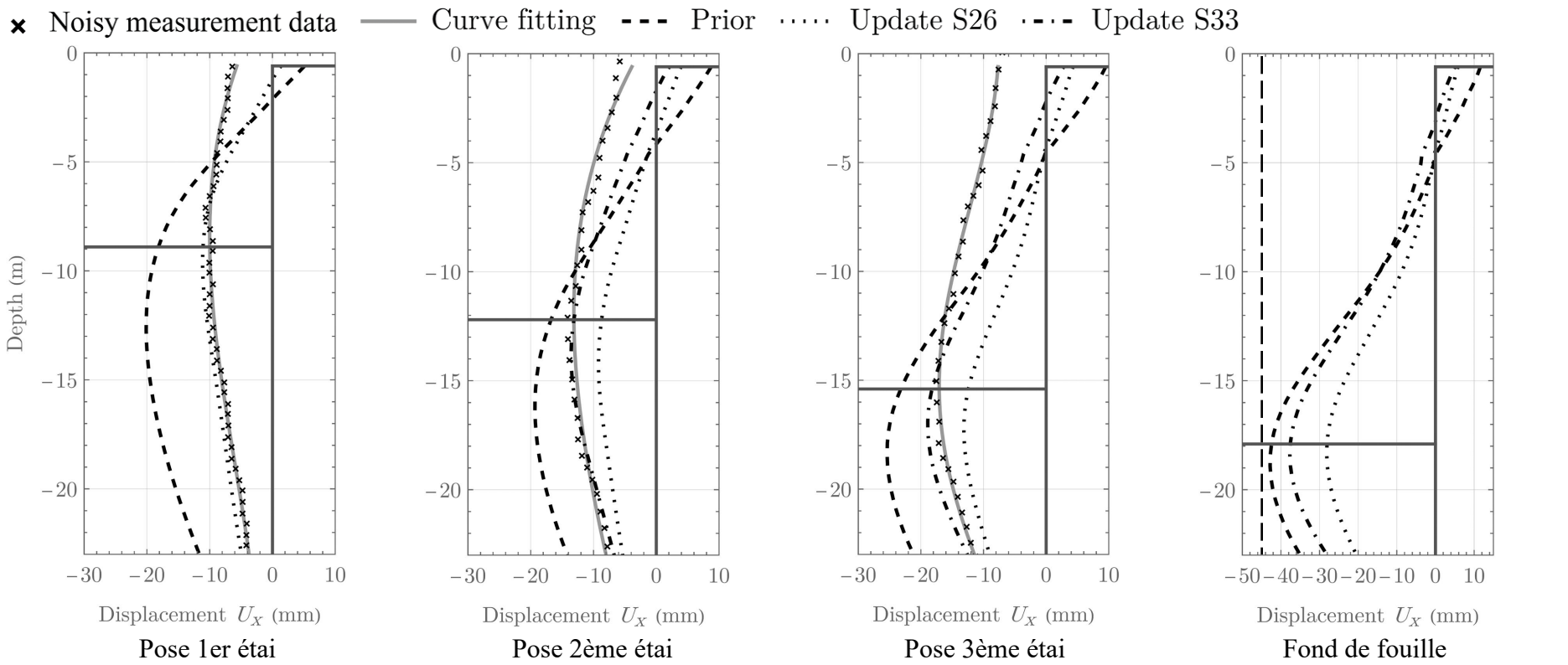


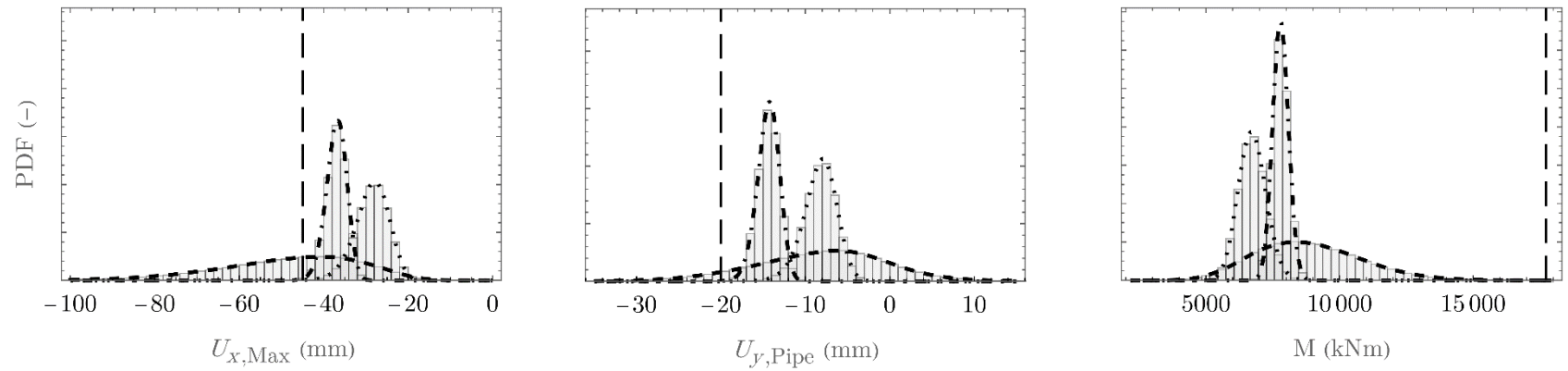
Variables





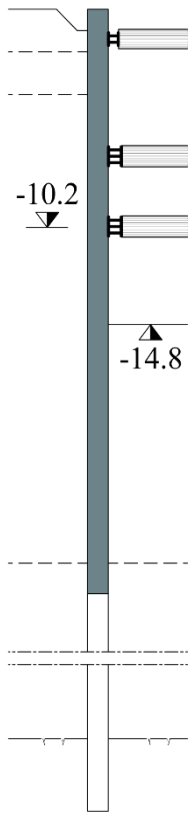




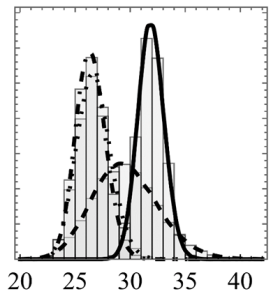


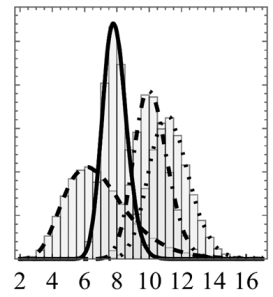
IV. RESULTS – Updating process, predictions & reliability analysis

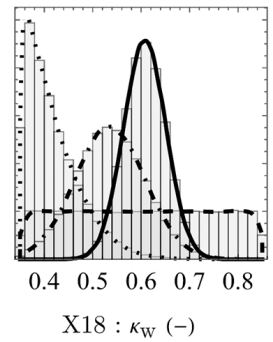
In-situ status

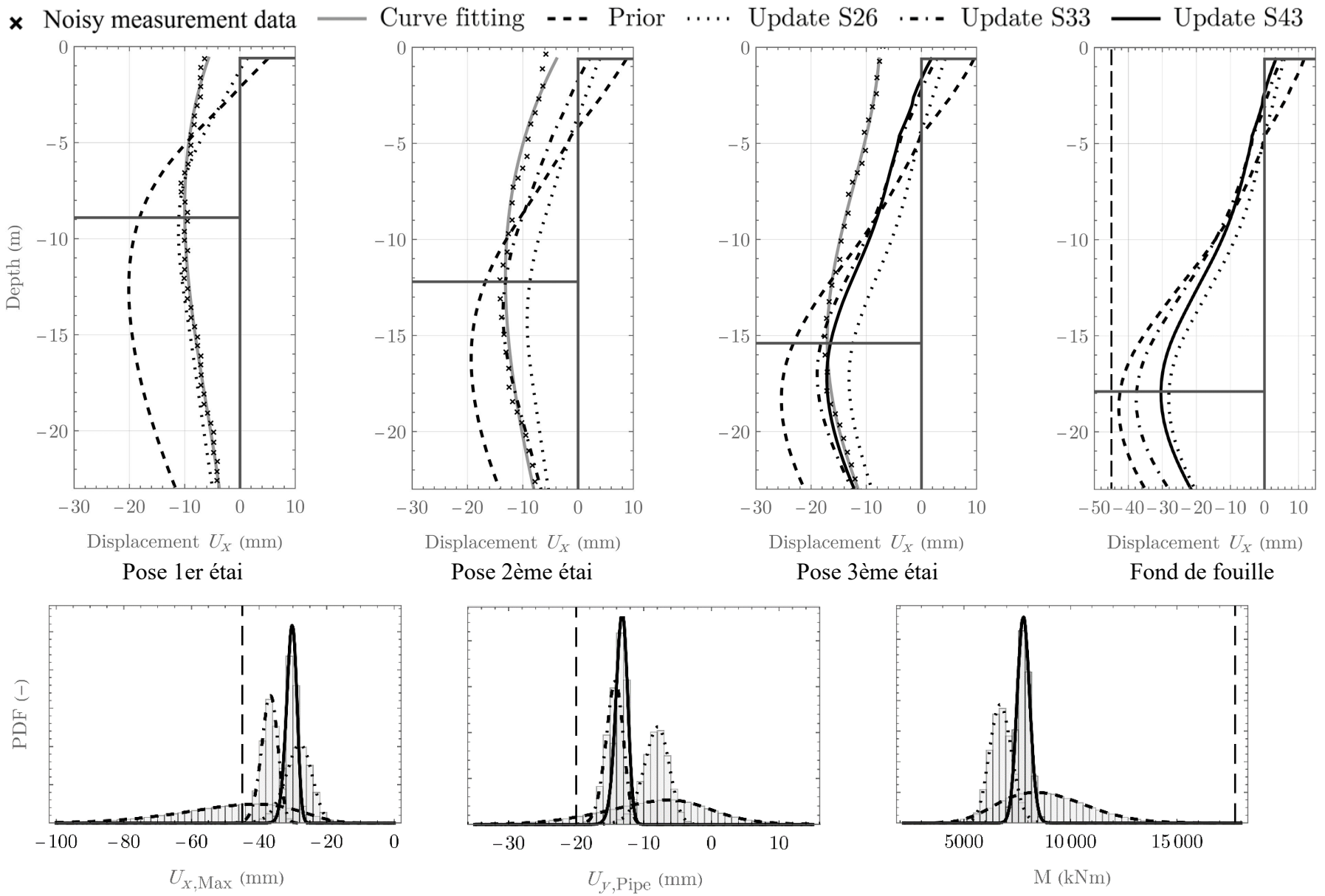


Variables



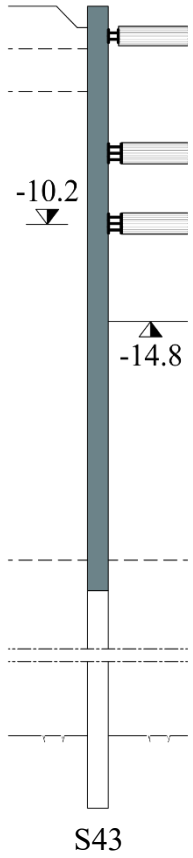




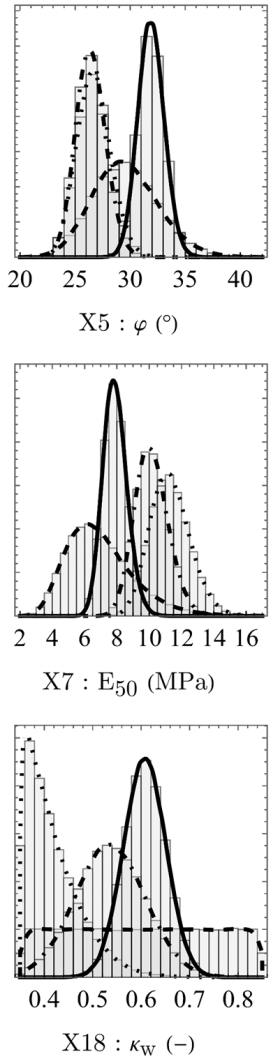


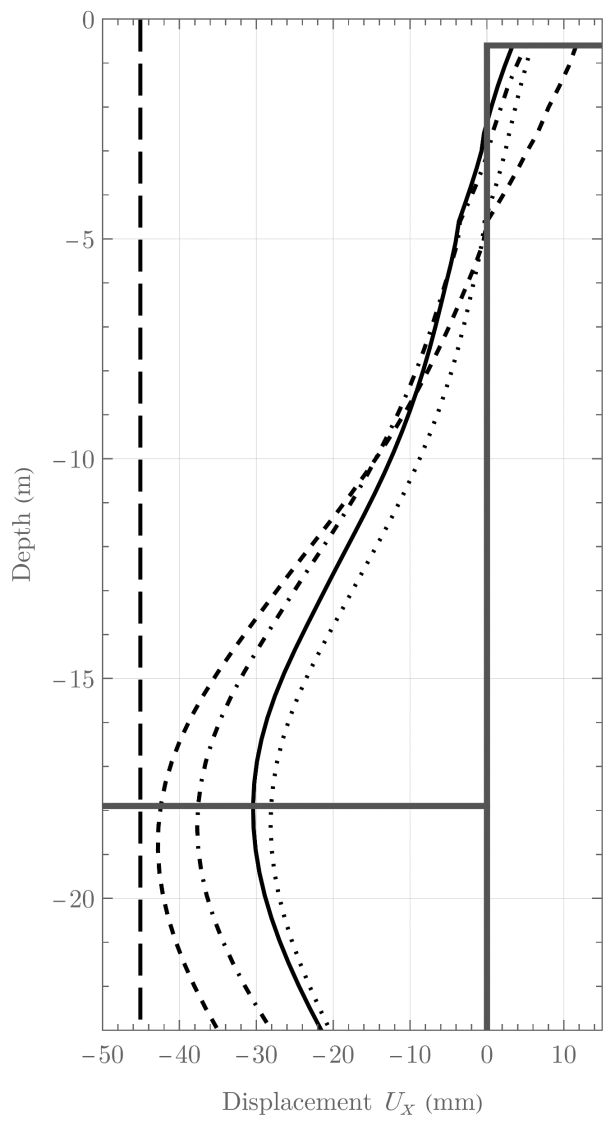
IV. RESULTS – Decision making

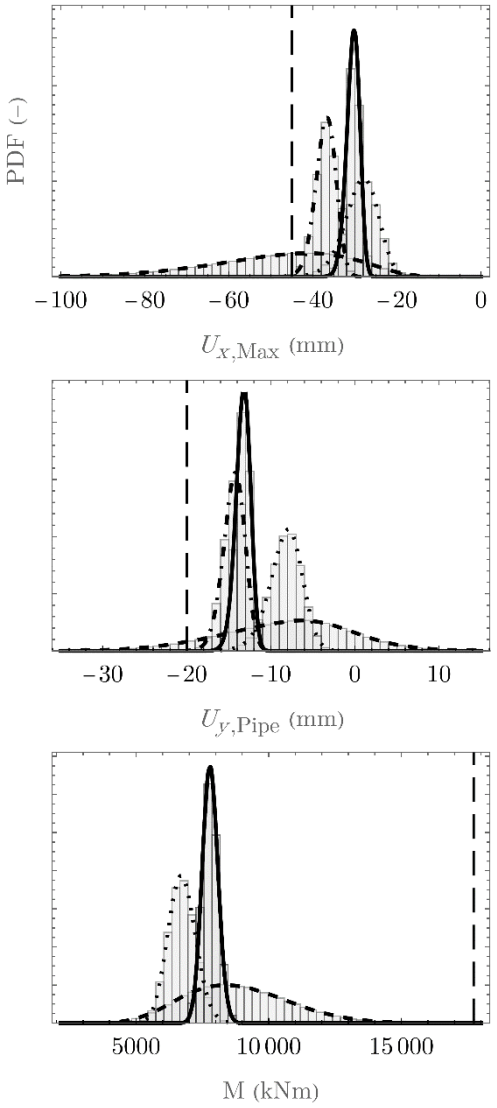
In-situ status



Variables







$$g(\boldsymbol{X}) = 45 - |\,U_{x,\mathrm{Max}}\,| \ \text{(mm)}$$

Prior	0.5315
S26	5.12×10^{-4}
S33	1.70×10^{-3}
S43	$< 10^{-5}$

$$g(\boldsymbol{X}) = 20 - |\,U_{y,\mathrm{Pipe}}\,| \ \text{(mm)}$$

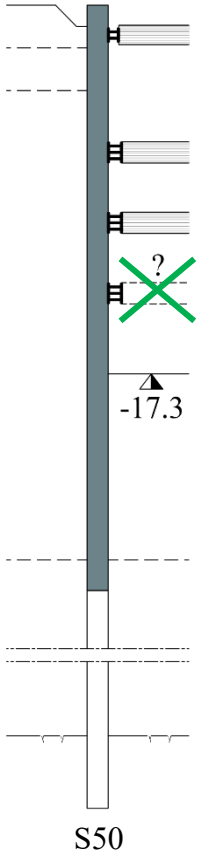
Prior	7.35×10^{-2}
S26	4.46×10^{-5}
S33	1.8×10^{-4}
S43	$< 10^{-5}$

$$g(\boldsymbol{X}) = M_{Rd} - |\,M_{\mathrm{Max}}\,| \ \text{(kNm)}$$

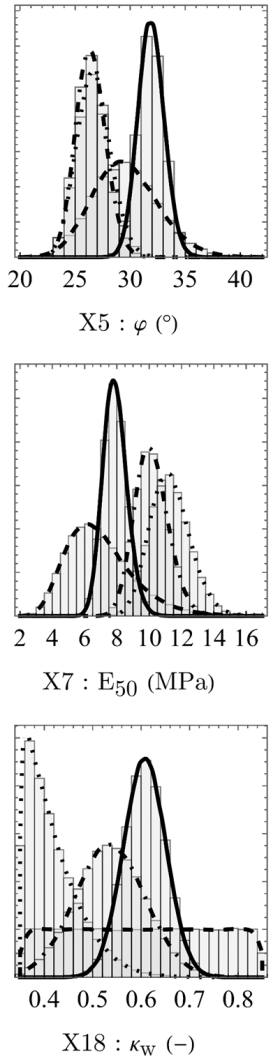
Prior	2.78×10^{-5}
S26	$< 10^{-5}$
S33	$< 10^{-5}$
S43	$< 10^{-5}$

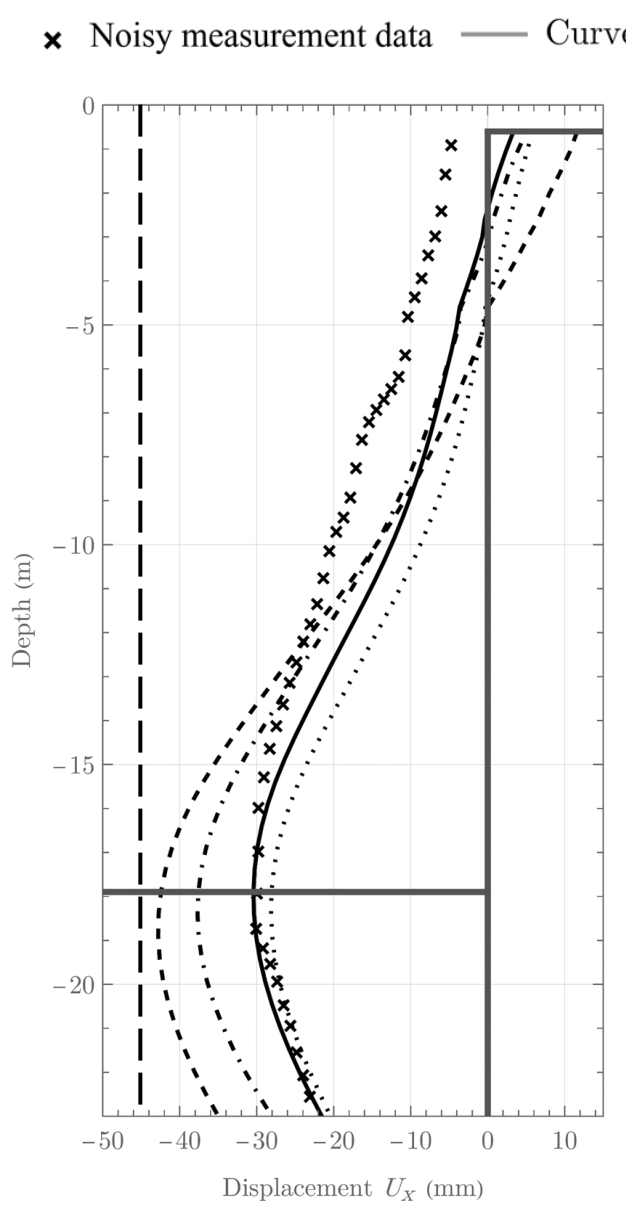
IV. RESULTS – Validation

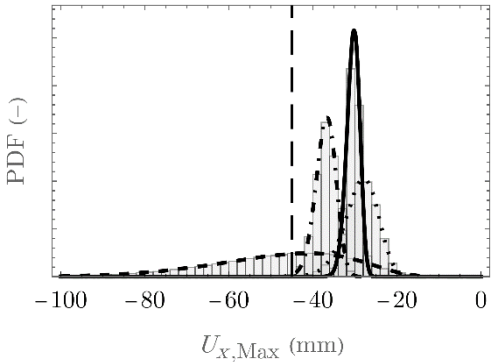
In-situ status

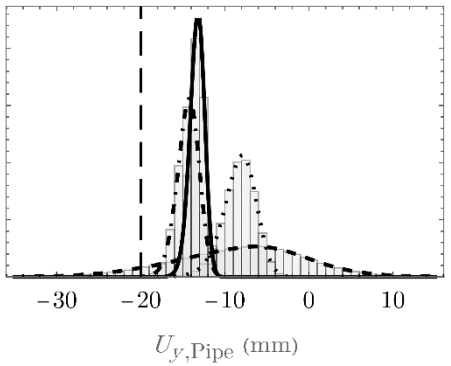


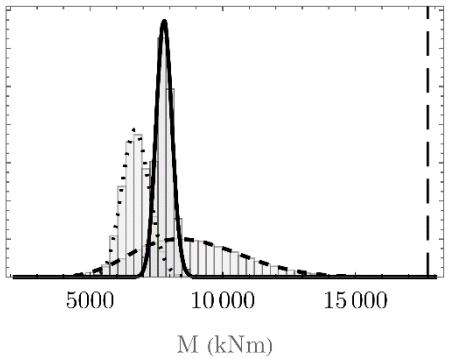
Variables











$g(\boldsymbol{X}) = 45 - |\,U_{x,\mathrm{Max}}\,|$ (mm)

Prior	0.5315
S26	5.12×10^{-4}
S33	1.70×10^{-3}
S43	$< 10^{-5}$

$g(\boldsymbol{X}) = 20 - |\,U_{y,\mathrm{Pipe}}\,|$ (mm)

Prior	7.35×10^{-2}
S26	4.46×10^{-5}
S33	1.8×10^{-4}
S43	$< 10^{-5}$

$g(\boldsymbol{X}) = M_{Rd} - |\,M_{\mathrm{Max}}\,|$ (kNm)

Prior	2.78×10^{-5}
S26	$< 10^{-5}$
S33	$< 10^{-5}$
S43	$< 10^{-5}$

Merci !

GeoMod

Losinger
DCG
M.O.

HEIA-FR
Jocelyn

Thomas
Bruno

sia
société suisse des ingénieurs et des architectes
section vaud

HEIA-FR
HTA-FR

GEOMOD

ZSoil