# STOCHASTIC ANISOTROPIC AQUIFER CHARACTERIZATION: A POROELASTIC FINITE ELEMENT MODEL AND THE POTENTIAL OF USING INSAR DATA

Sona Salehian Ghamsari[1]   **Tonie van Dam**[2]   **Jack S. Hale**[1]

[1]Université du Luxembourg, Luxembourg, [2]University of Utah, Utah, United States   abstract number: **124**
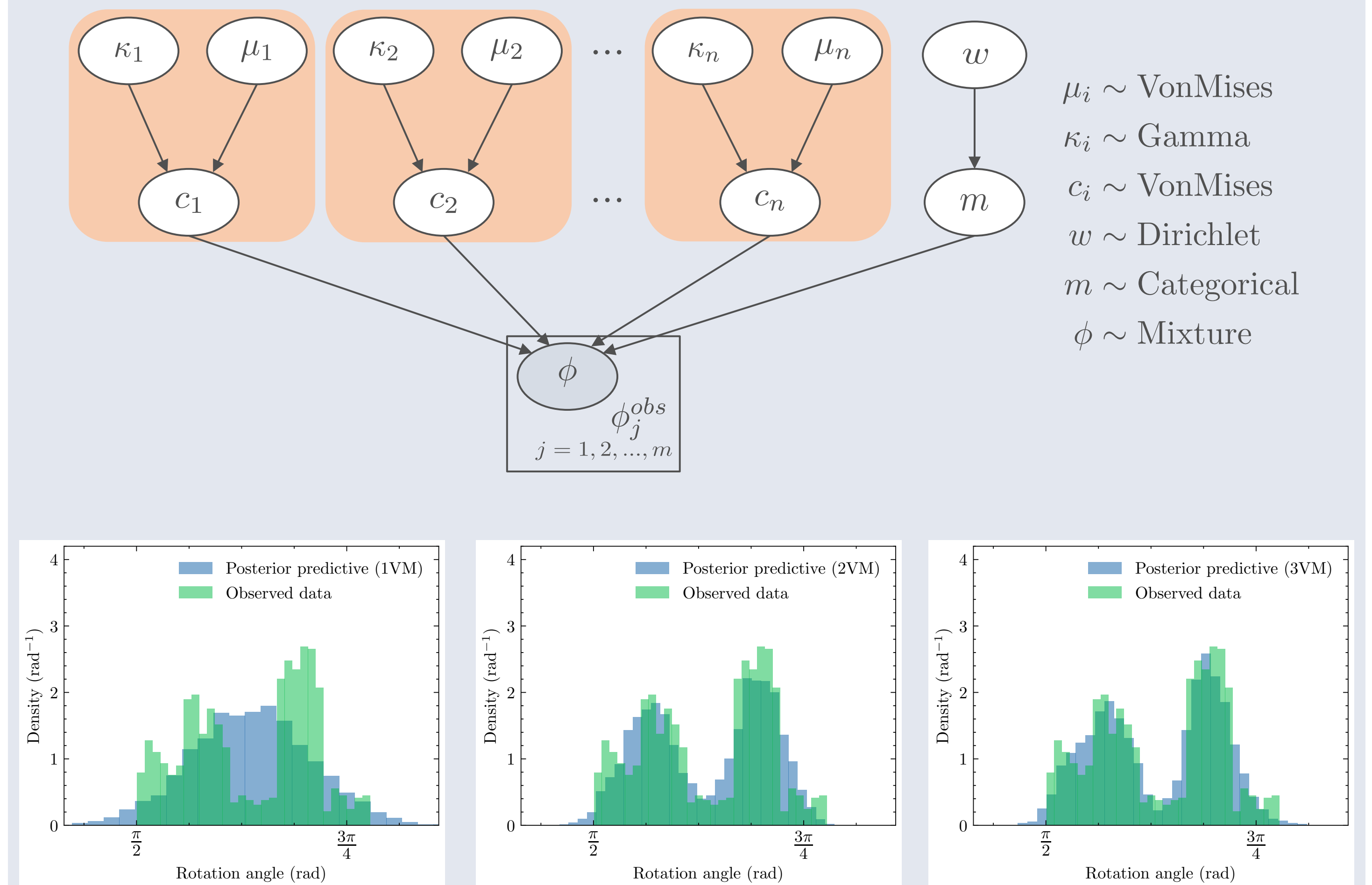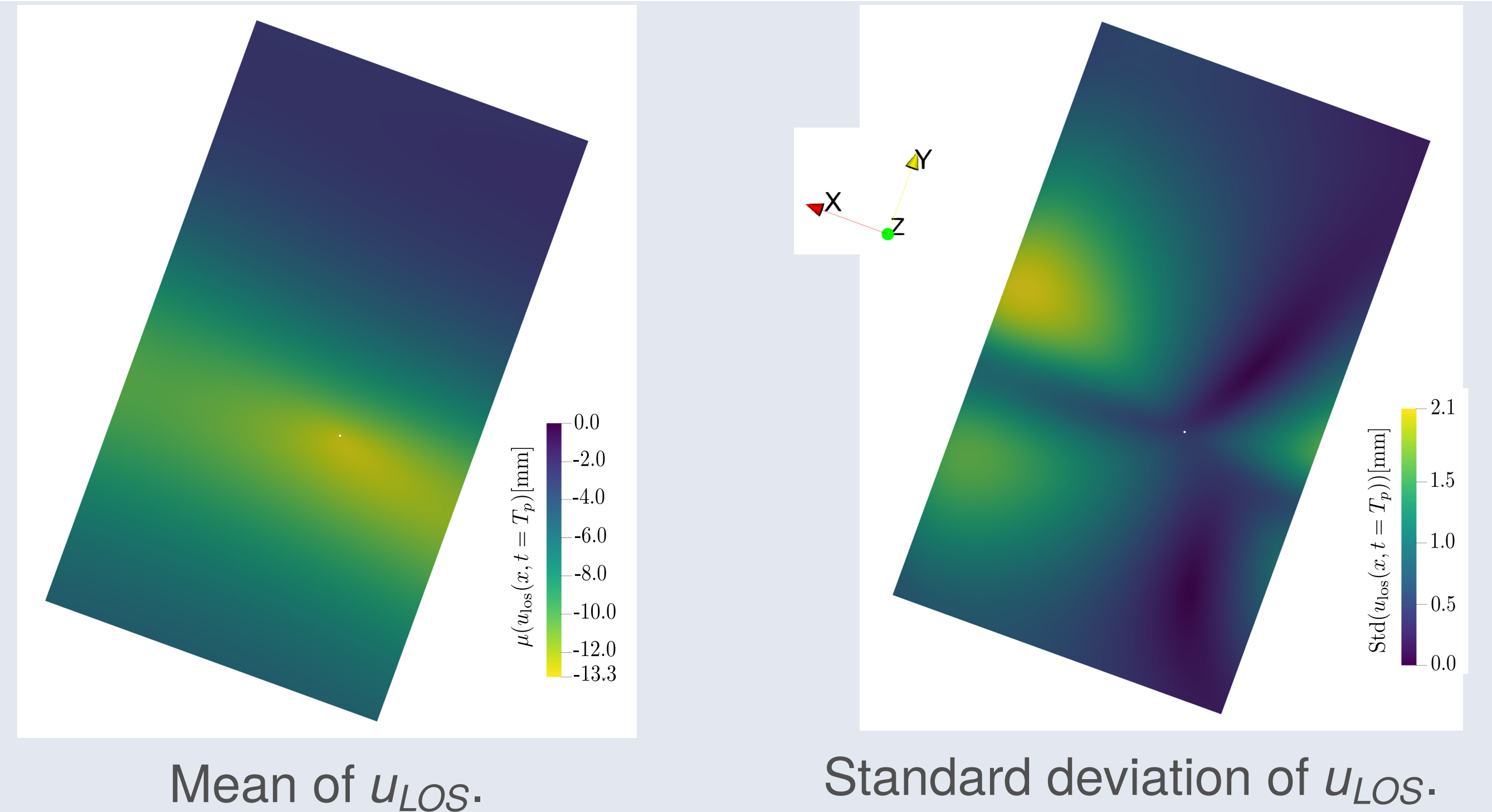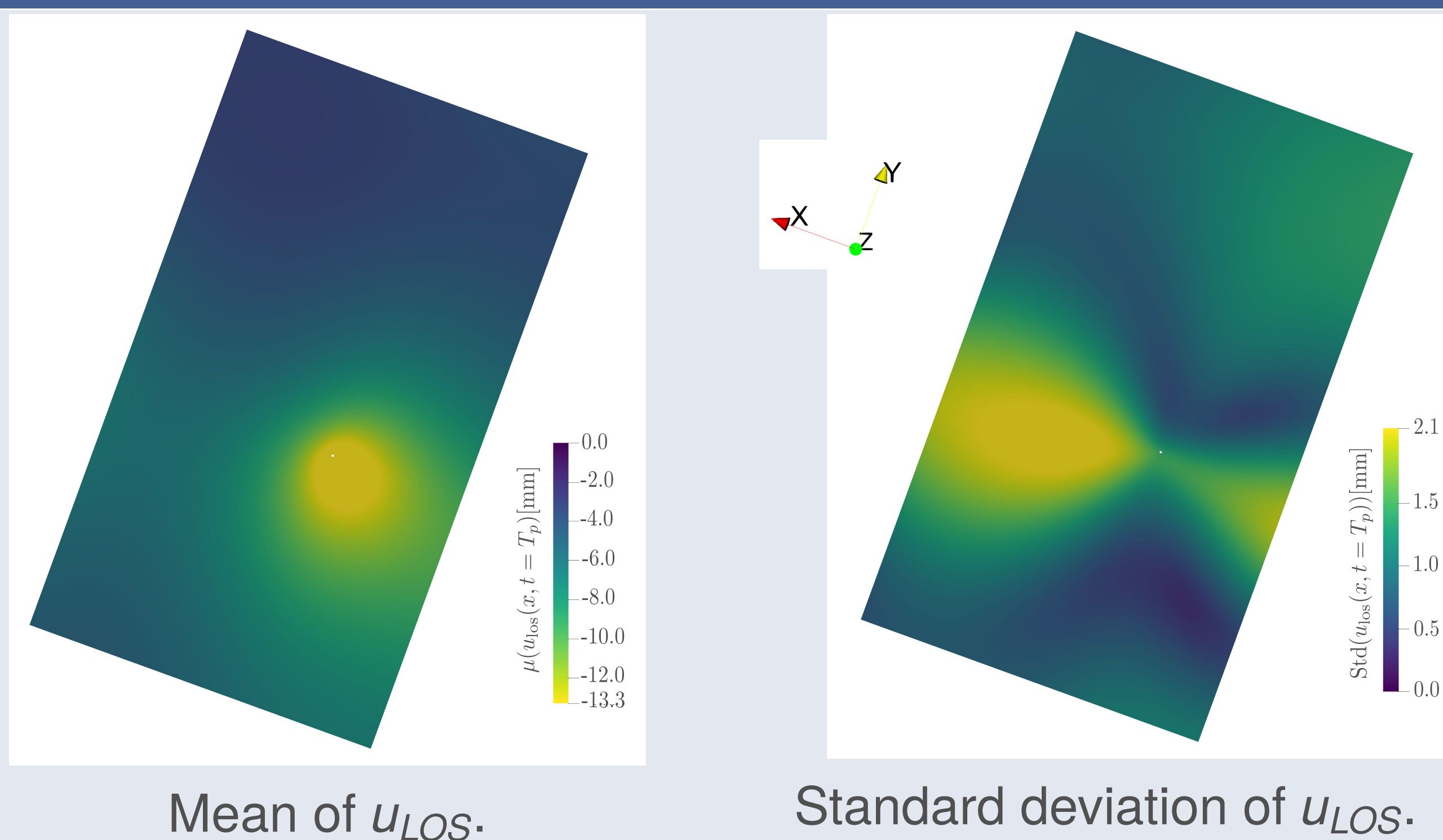sona.salehianghamsari@uni.lu

FRACTURES AND HYDRAULIC CONDUCTIVITY

- The water flow in many aquifers is driven by strong anisotropy created by preferential flow features such as fractures and faults.
- Recent works show the potential for inferring anisotropy from surface displacement data.
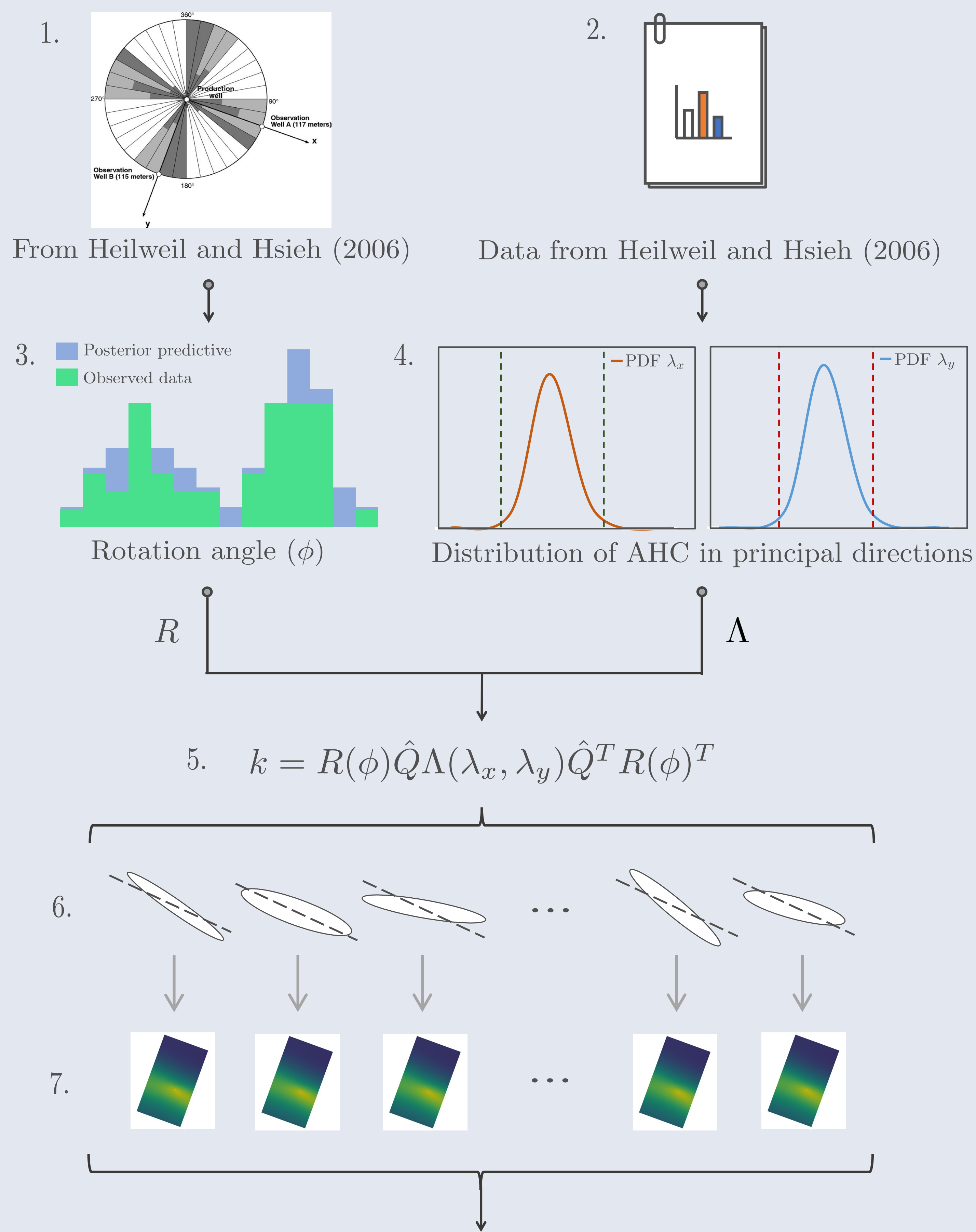
OBJECTIVES

- **In this work**: develop a flexible stochastic prior model of the AHC tensor that respects its underlying symmetry and positive definiteness.
- **Future work**: assimilate InSAR data into an aquifer model.

METHODOLOGY

1. From Heilweil and Hsieh (2006)

2. Data from Heilweil and Hsieh (2006)

3. Posterior predictive / Observed data — Rotation angle (ϕ)

4. PDF λ_x / PDF λ_y — Distribution of AHC in principal directions

R Λ

5. $k = R(\phi)\hat{Q}\Lambda(\lambda_x, \lambda_y)\hat{Q}^T R(\phi)^T$

6.

7.

ROTATION ANGLE MODEL

$\mu_i \sim \text{VonMises}$
$\kappa_i \sim \text{Gamma}$
$c_i \sim \text{VonMises}$
$w \sim \text{Dirichlet}$
$m \sim \text{Categorical}$
$\phi \sim \text{Mixture}$

ϕ_j^{obs}
$j = 1, 2, ..., m$

Posterior predictive (1VM) / Observed data — Posterior predictive (2VM) / Observed data — Posterior predictive (3VM) / Observed data

FIRST SCENARIO

Mean of u_{LOS}.   Standard deviation of u_{LOS}.

SECOND SCENARIO

Mean of u_{LOS}.   Standard deviation of u_{LOS}.

TAKE-HOME MESSAGE

- By calibrating the model against fracture outcrop and optionally pump test data from Anderson Junction, we were able to express two conceptual states of belief about the site.
- The proposed methodology provides a flexible tool for modeling the effect of random anisotropy on InSAR-measurable surface displacements.
- The proposed stochastic model could work as a prior in a Bayesian inference setting.

ACKNOWLEDGEMENTS