DEPARTMENT OF GEOLOGICAL, ENVIRONMENTAL, AND PLANETARY SCIENCES

Assessing NDVI as a Tool for Slow-moving Landslide (SML) Identification

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BACKGROUND

- SMLs are low velocity mass-wasting events
- Threaten human infrastructure, health, and safety
- Can transition to catastrophic landslide
- Difficult to detect and current remote sensing capabilities are incomplete
- Rising issue due to climate change

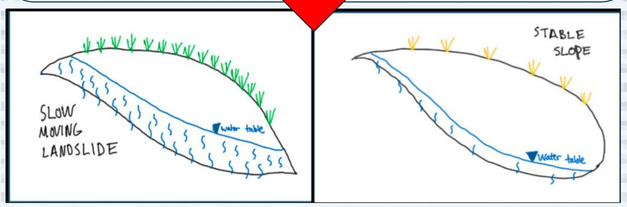
Must expand capabilities in SML monitoring and detection



THEORY

Slow-Moving Landslides (SMLs)

- Positive hydrologic control on failure
- Wide range of low velocities (cm/yr to m/yr)



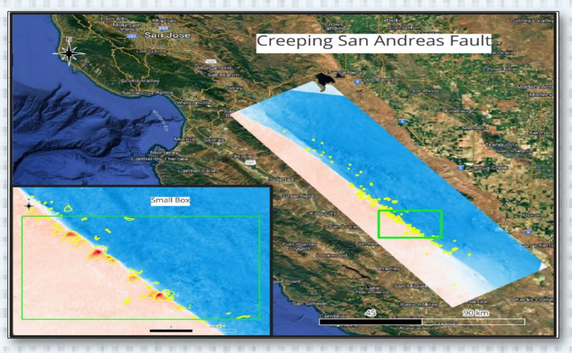
Normalized Differential Vegetation Index (NDVI)

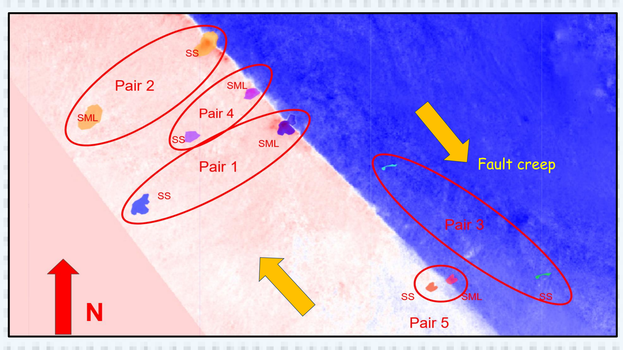
- Passive remote sensing spectral index
- Describes vegetation health as measure of greenness (values from -1 to 1)
- Increases toward vegetation health

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

HYPOTHESIS

Due to a common hydrologic control, SMLs and regions of healthy vegetation may retain more water than stable slopes (SSs) and correspond to the same areas between 01-01-2018 and 08-31-2021 on the creeping San Andreas Fault (CSAF),

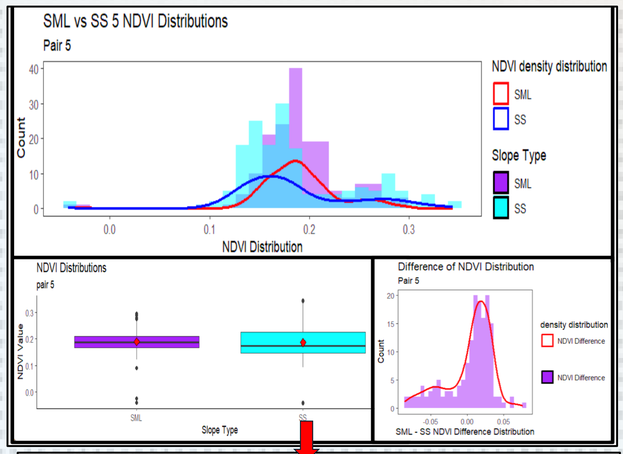


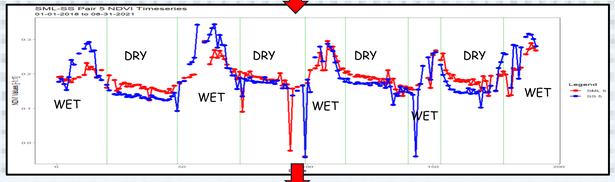


METHODS & RESULTS

Statistical Distribution Analysis

- Time series analysis of paired SML – SS regions
- Landslide density distributions
- Difference of 2 means t-tests & Wilcoxon nonparametric analysis



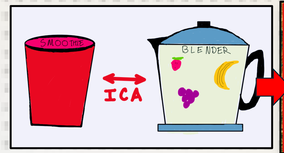


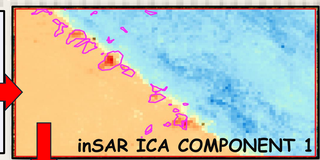
Wilcoxon Test

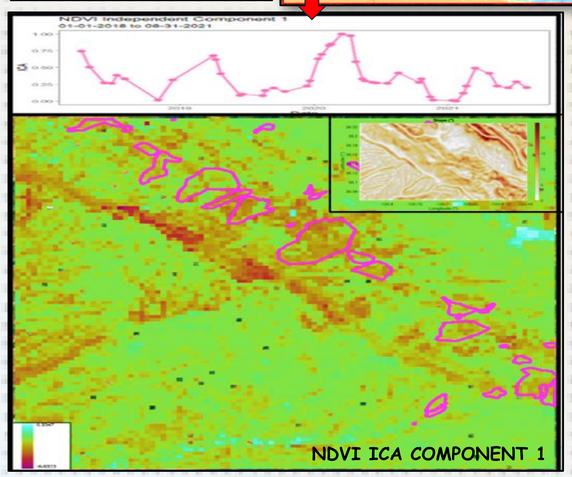
	Pair 1		Pair 2		Pair 3		Pair 4		Pair 5	
Median	**SML**	**SS**	**SML**	**SS**	**SML**	**SS**	**SML**	**SS**	**SML**	**SS**
	0.149	0.138	0.141	0.145	0.140	0.142	0.142	0.142	0.187	0.174
V	2369.5		1957		1362.5		1966		8364.5	
P-value	0.05413		0.7111		0.1176		0.5454		0.005344	

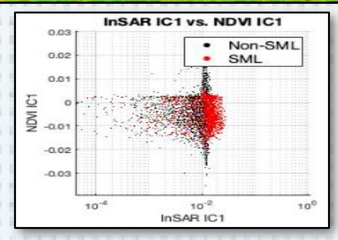
Independent Component Analysis (ICA)

- vbICA algorithm (Gualandi and Liu, 2021)
- Applied to inSAR ground velocity and NDVI data









CONCLUSIONS

- Time series and distribution analysis shows relative similarity of SML and SS NDVI
- Disagreement of P-values
- NDVI ICA Component 1 corresponds to motion of CSAF

From these data there is no distinct difference in SML and SS NDVI, however there is evidence suggesting a similar experiment with larger SML area fraction may yield more conclusive results

References & Acknowledgements:

Gualandi, A., Liu, Z. (2021). Variation bayesian independent component analysis for InSAR displacement time-series with application to Central California, USA. *Journal of Geophysical Research: Solid Earth (126)4.* DOI: https://doi.org/10.1029/2020JB020845

Scheingross, J. S., Minchew, M. B., Mackey, H. B., Simons, M., Lamb, P. M., Hensley, S. (2013). Fault-zone controls on the spatial distribution of slow-moving landslides. *GSA Bulletin 125*(3-4), 473-489. doi: 10.1130/B30719.1.

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