Assessing the viability of using GEOS-Forecast Product for Landslides Forecasting
A step towards Early Warning Systems

Sana Khan[1,2] (sana.khan@nasa.gov), Dalia B. Kirschbaum[1] and Thomas Stanley[1,3]

[1]NASA Goddard Space Flight Center, Greenbelt, MD, USA

[2]Earth System Science and Interdisciplinary Centre, College Park, MD, USA; [3]Universities Space Research Association, USA

EGU 2020-20222
Session NH 3.11

Rationale

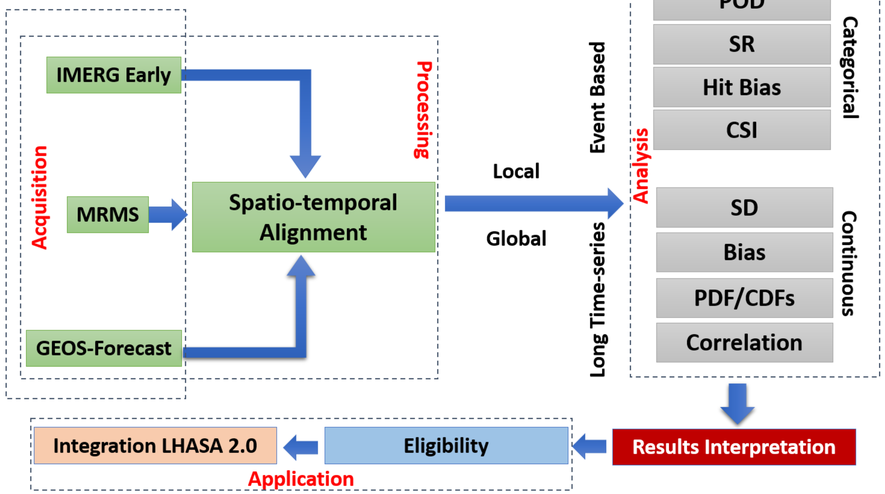
Landslides across the globe are mostly triggered by extreme rainfall events affecting infrastructure, transportation and livelihoods. Forecasting potential landslide activity and impacts can be achieved through reliable precipitation forecast models. However, it is challenging because of the temporal and spatial variability of precipitation, an important factor in triggering landslides. Evaluation of the precipitation field, associated errors, and sampling uncertainties is integral for development of efficient and reliable landslide forecasting and early warning system. This study develops a methodology to assess the viability of using a precipitation field provided by a global model and its potential integration in the landslide forecasting system. The study focuses on the comparison between the IMERG (Integrated Multi-satellitE Retrievals for Global Precipitation Mission) and GEOS (NASA Goddard Earth Observing System)-Forecast product over contiguous United States (CONUS) against a radar-based gauge corrected and quality controlled reference i.e. MRMS (Multi-Radar Multi-Sensor).

Methodology

Dataset:
Evaluation products:
GPM-IMERG Early V06 Level-3 (0.1°/30min/Global)
GEOS-Forecast (H00) (0.25°×0.31°/1hr /Global)
Reference: MRMS (0.01°/30min/CONUS)

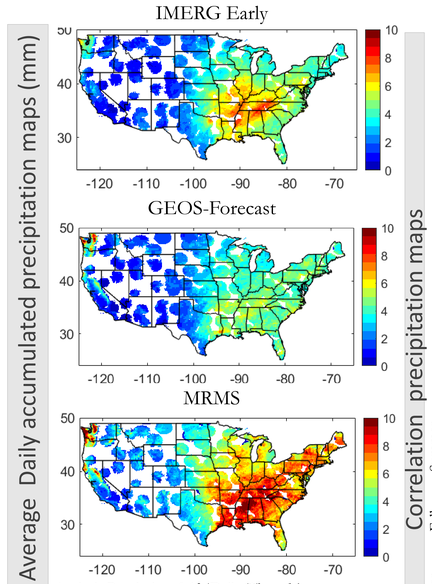
Study Period: July 2018 – February 2020

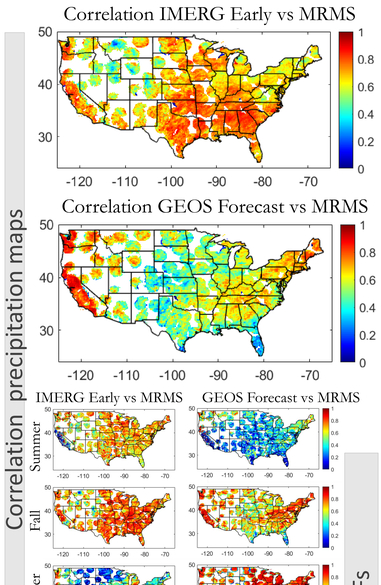
Study area: CONUS

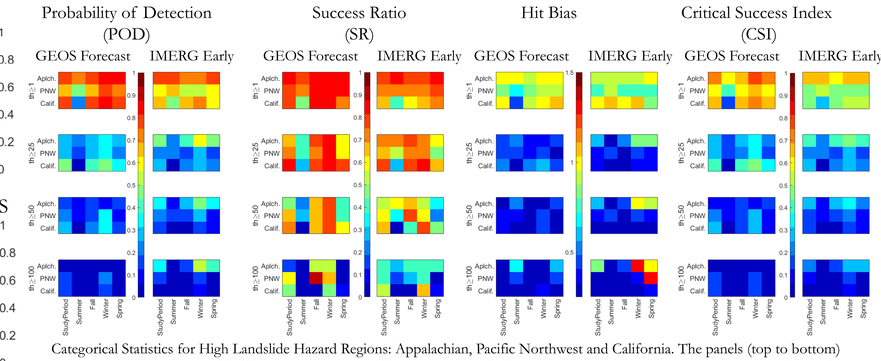


Landslide Hazard Assessment for Situational Awareness (LHASA 2.0) Model:
The LHASA 2.0 Model uses XGBoost machine learning techniques to incorporate dynamic variable such as rainfall as well as static variable to better represent the landslide globally.
For more details please refer to EGU2020-11012 (https://doi.org/10.5194/egusphere-egu2020-11012).

Results

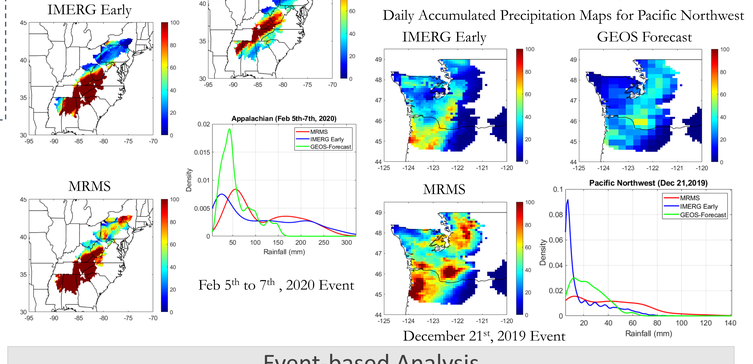




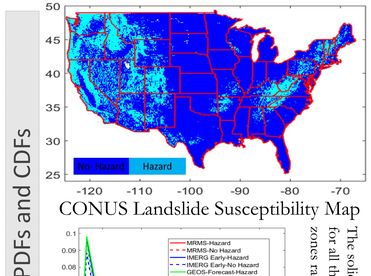


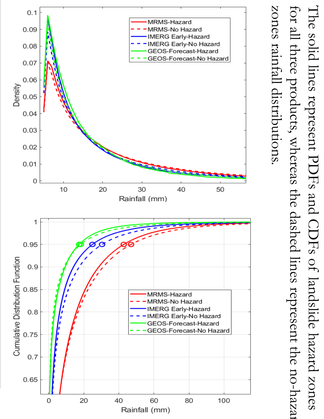
Categorical Statistics for High Landslide Hazard Regions: Appalachian, Pacific Northwest and California. The panels (top to bottom) exhibit the performance of GEOS Forecast and IMERG early against MRMS in three regions at four rainfall thresholds i.e. 1mm, 25mm, 50mm and 100mm for entire study period as well as across the four seasons (summer, fall, winter and spring).

Region-based Performance Metrics



Event-based Analysis





The solid lines represent PDFs and CDFs of landslide hazard zones for all three products, whereas the dashed lines represent the no-hazard zones rainfall distributions.

Conclusions

- The correlation between IMERG Early and MRMS is overall high except for west coast and northeast where GEOS Forecast show relatively better correlation
- For landslides hazard and no-hazard zones, the PDFs and CDFs are similar across the three products, albeit slight variation for IMERG Early and MRMS at 20-40mm rainfall accumulations
- IMERG Early has a good ability of detecting precipitation in Appalachian Region in Winter for high rainfall thresholds (≥100mm) i.e. ~60% of the times MRMS detects rain, IMERG early agrees
- GEOS Forecast is promising in forecasting rare downpours (triggering landslides), showing temporal coherence with the ground truth, albeit with seasonal and regional variation

References

- Kirschbaum, D.B. and Stanley, T., 2018. Satellite-Based Assessment of Rainfall-Triggered Landslide Hazard for Situational Awareness, Earth's Future, 6, 505–523.
- Zhang, J., Howard, K., Langston, C., Kaney, B., Qi, Y., Tang, L., Grams, H., Wang, Y., Cocks, S., Martinaitis, S. and Arthur, A., 2016. Multi-Radar Multi-Sensor (MRMS) quantitative precipitation estimation: Initial operating capabilities. Bulletin of the American Meteorological Society, 97(4), pp.621-638.
- https://gpm.nasa.gov/applications/global-landslide-model
- https://gmao.gsfc.nasa.gov/weather_prediction/