# Improving Desert Locust Decision Support in Africa and Asia using SMAP Soil Moisture Estimates


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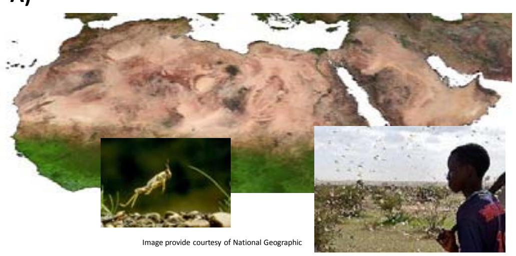
## Abstract

In the desert areas from northern Africa to East Asia (Figure 1), occasional rainfall in hyper-arid environments results in the development of vegetation that harbor destructive swarms of Desert Locusts (DL). The UN Food and Agriculture Organization (FAO) has developed a Decision Support System (DSS) for monitoring Desert Locust events based on remotely sensed precipitation and vegetation estimates. However, the precipitation data applied by the FAO DSS have been shown to have a low probability of detection in this area (Figure 3) leading to high uncertainty in their DL forecasts. We demonstrate the correspondence of AMSR-E soil moisture anomalies with observed Desert Locust events in north Africa and southwest Asia. This relationship enables an improvement to the existing FAO DL Decision Support System through the addition of expected SMAP products which will provide similar soil moisture products to AMSR-E, but at higher spatial resolution. The SMAP root-zone soil moisture product (L4_SM) will be particularly useful in this regard.


## A) Area of Interest




## B) AMSR-E Soil Moisture

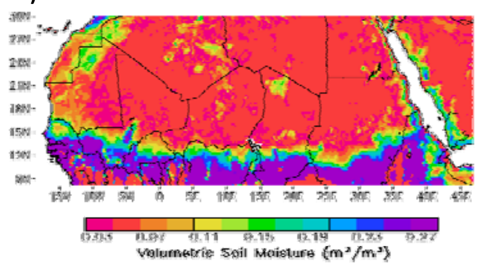



Figure 1. A) In the desert areas from northern Africa to southwest Asia, occasional rainfall in arid environments results in the eventual formation of destructive swarms of Desert Locusts (DL). B) Vjie University Amsterdam-provided AMSR-E soil moisture estimates over the region of interest.

## Evaluation of Precipitation Products used by FAO for Locust Detection

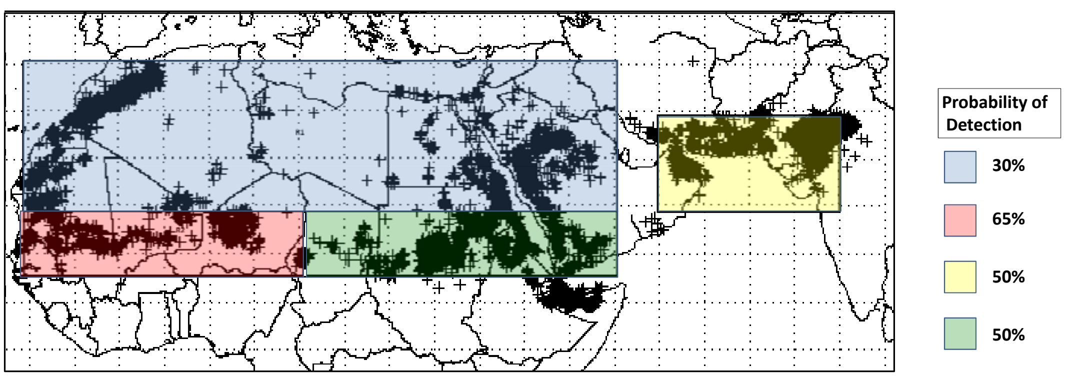



Figure 2. An extensive evaluation of the current precipitation products applied by the UN FAO has been done in northern Africa and southwest Asia (from Dinku et al., 2009). This figure shows the 30,000+ GPS locations where soil moisture, precipitation, and Desert Locust conditions were observed between 2000-2006. The consequences of these inaccurate rainfall estimates ultimately cause high uncertainty in the DL warnings provided by the UN FAO.


Dinku, T., Ceccato, P., Cressman, K., Connor, S., (2009) "Evaluating Detection Skills of Satellite Rainfall Estimates Over Desert Locust Recession Regions," submitted to Journal of Applied Meteorology and Climatology.


## Observed Locust Events and AMSR-E Soil Moisture Anomalies

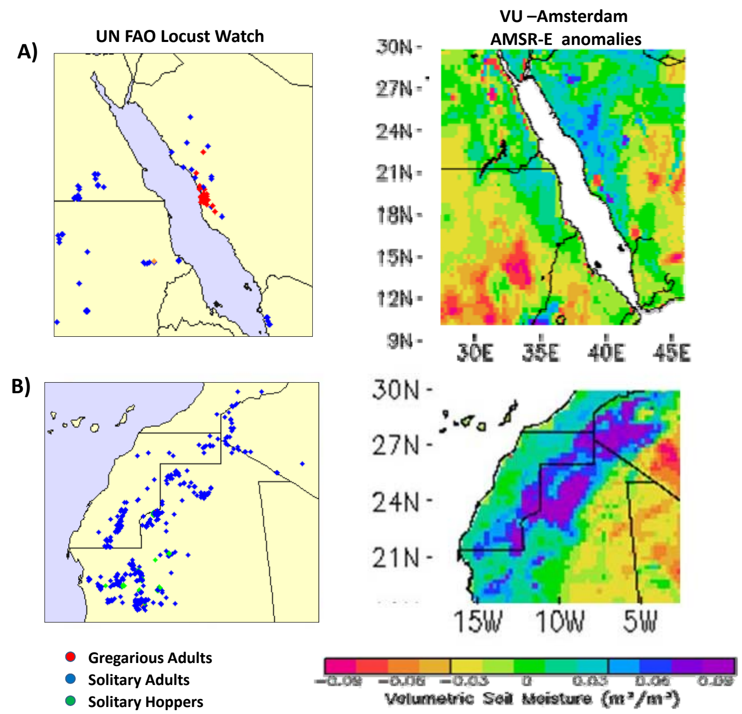



Figure 3. This figure demonstrates the high correspondence of AMSR-E soil moisture anomalies and Desert Locust events. A) Observed Desert Locust events and monthly soil moisture anomalies in Mauritania-Western Sahara in October 2003. B) Observed Desert Locust events and monthly soil moisture anomalies near the Read Sea in November 2003.

## Conclusions

We demonstrate a correspondence between the locations of observed Desert Locus events with AMSR-E soil moisture anomalies in the area of worst CMORPH performance (Blue area in Figure 2-POD 30%). From this we conclude that the FAO Desert Locust DSS could benefit from the addition of remotely sensed soil moisture estimates. We expect that the higher resolution soil moisture product (L3_SM_A/P), a well as the root-zone soil moisture product (L4_SM) to be provided by SMAP will lead to even better results. We envisage the future SMAP products will more accuratel reflect not only actual precipitation events, but anomalous rain events that lead t Desert Locust outbreaks, as demonstrated in Figures 3a, 3b.