# The impact of SMAP data assimilation on Tropical Cyclone landfall predictions

SMAP Science Team Meeting
June 9, 2021

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# Background and Motivation

Can the assimilation of SMAP observations into a global numerical weather prediction (NWP) model improve the prediction of tropical cyclone (TC) evolution prior to and after landfall?

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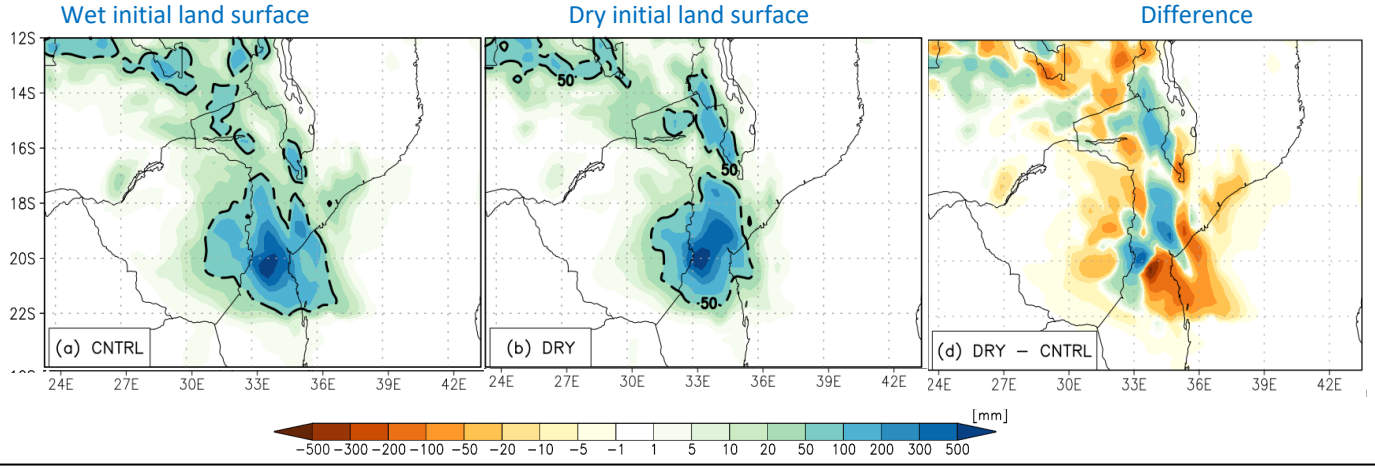
## Motivation:

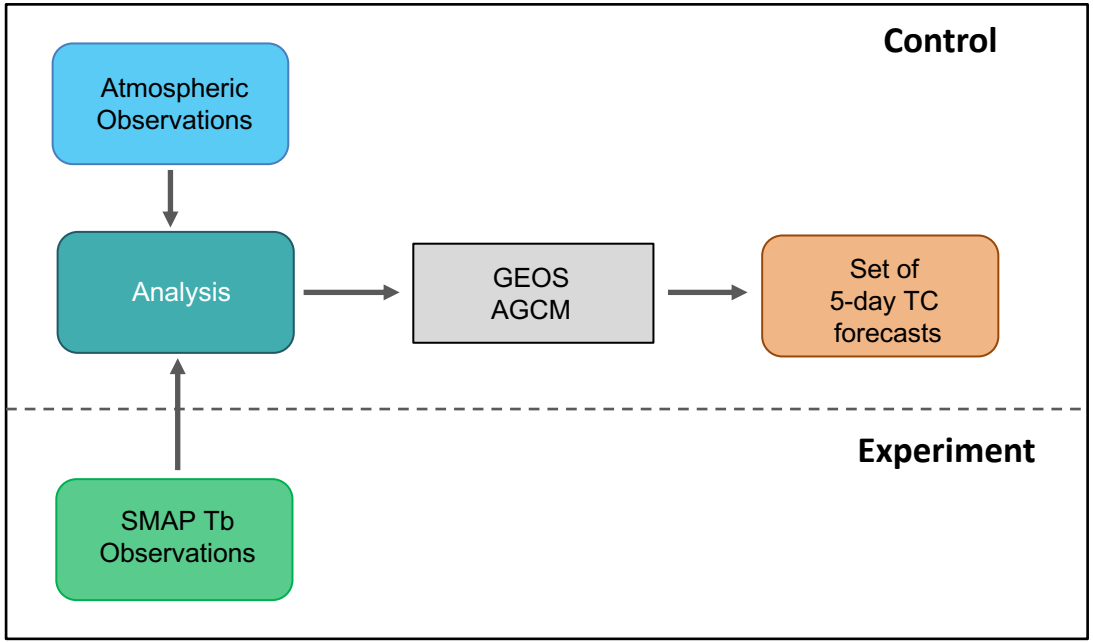
- For forecasting a TC approaching land, or after landfall, land surface initial conditions are significantly more important
  - Very wet land surface → help to sustain or re-intensify TC (”Brown Ocean Effect”)
  - Dry land surface → faster TC dissipation
  - Soil moisture gradients → different TC over-land track
- SMAP data assimilation → better land surface initial conditions → better TC forecasts → societal benefit

**TC Idai 2-day cumulative precipitation after landfall**



# Project Overview

**Observing System Experiment** to determine the potential of SMAP data assimilation to improve forecasts of tropical cyclone structure and precipitation surrounding landfall.




**Control:**

- Forecasts of TC from analysis constrained by standard suite of atmospheric observations

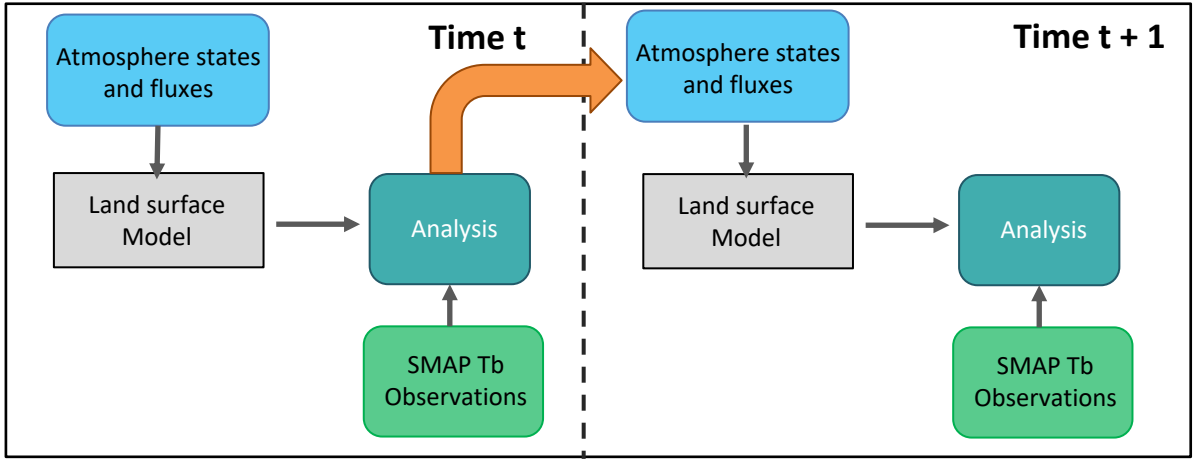
**Experiment:**

- Additional constraint through SMAP Tb observations

**Evaluation:**

- Combination of global skill metrics, regional tailored metrics and phenomenological approaches to evaluate impact on TC forecast skill

# The Land-Atmosphere Data Assimilation System




Differences between LADAS and L4 SM system

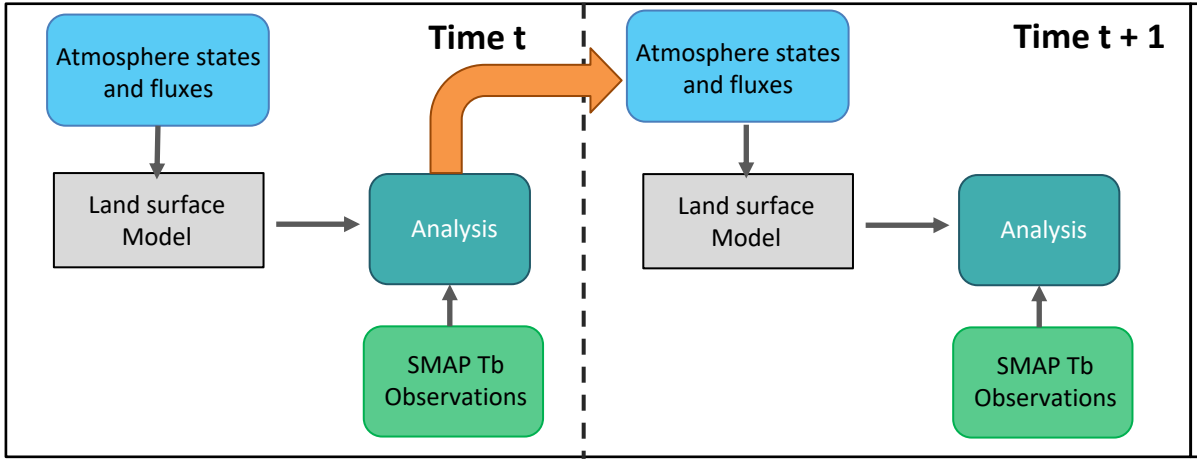
**Land-Atmosphere Data Assimilation System (LADAS):**

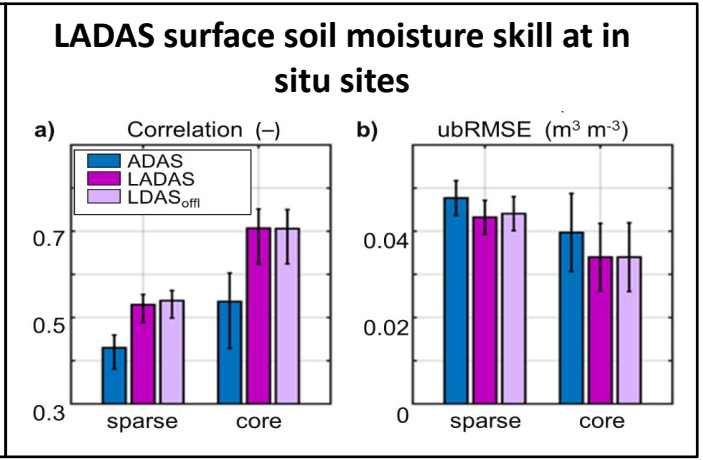
- Assimilates SMAP Tbs every 3 hours
- Catchment Land Surface Model
- Based on L4 SM system (assimilation window, bias correction approach, RTM)

- Land surface states and fluxes constrain atmospheric states and fluxes
  → Changes made through SMAP DA feed back to the atmosphere

*Reichle, R., Zhang, Q.S., et al. (2021) Assimilation of SMAP Brightness Temperature Observations in the GEOS Land-Atmosphere Data Assimilation System, JSTARS SMAP Special Issue (in review)*

# LADAS

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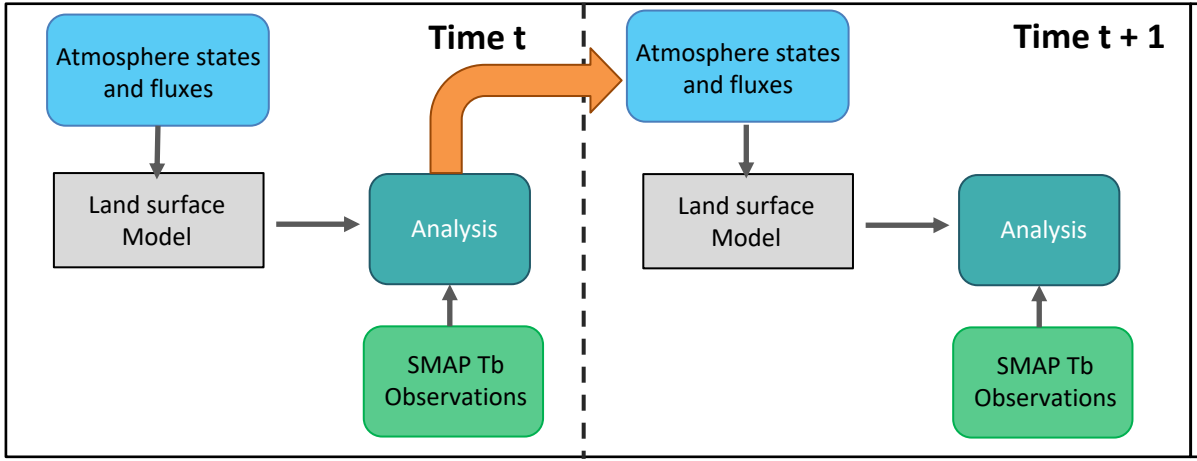
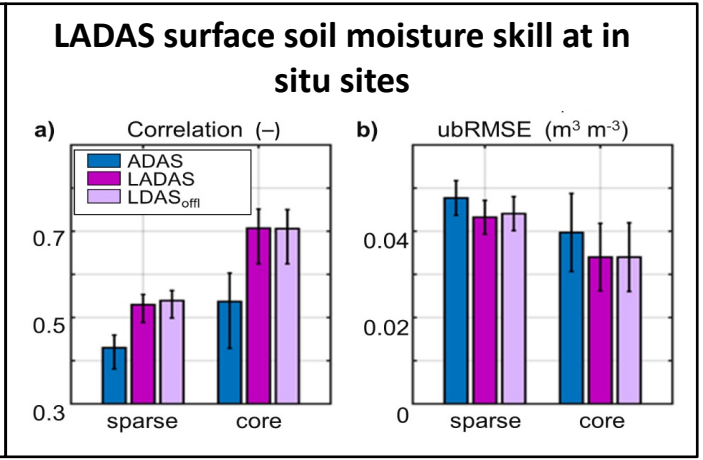
# LADAS




Differences between LADAS and L4 SM system

**Land-Atmosphere Data Assimilation System (LADAS):**

**More information on LADAS in SMAP ST presentation by R. Reichle on July 7th, 2021**

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→ Changes made through SMAP DA feed back to the atmosphere

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# Case Study: Tropical Cyclone Idai (March 4 – March 16, 2019)

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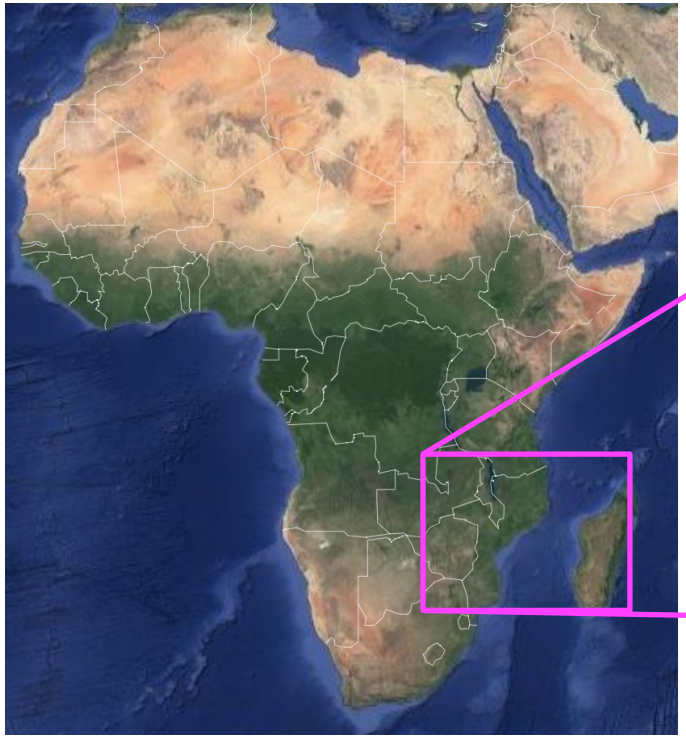

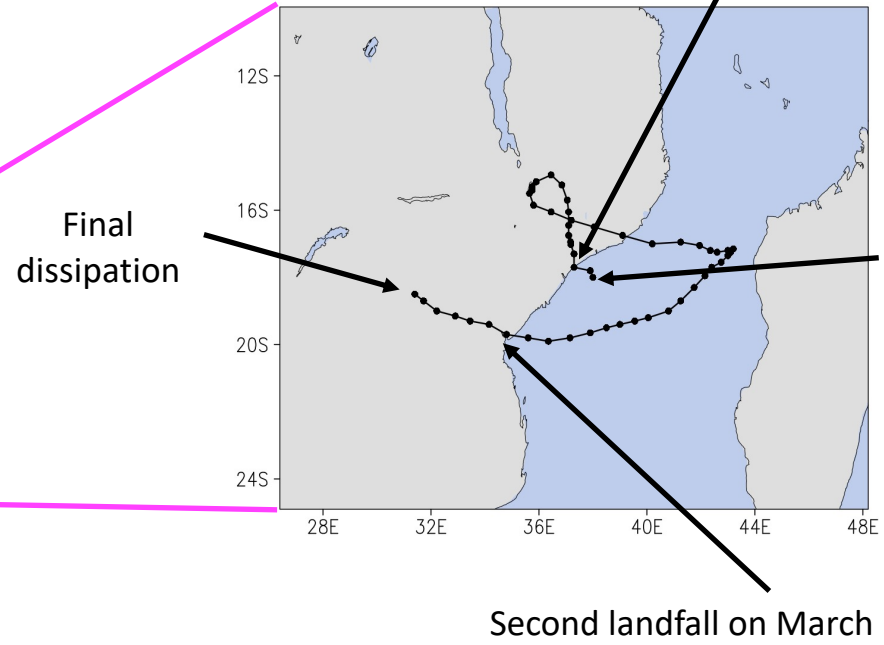

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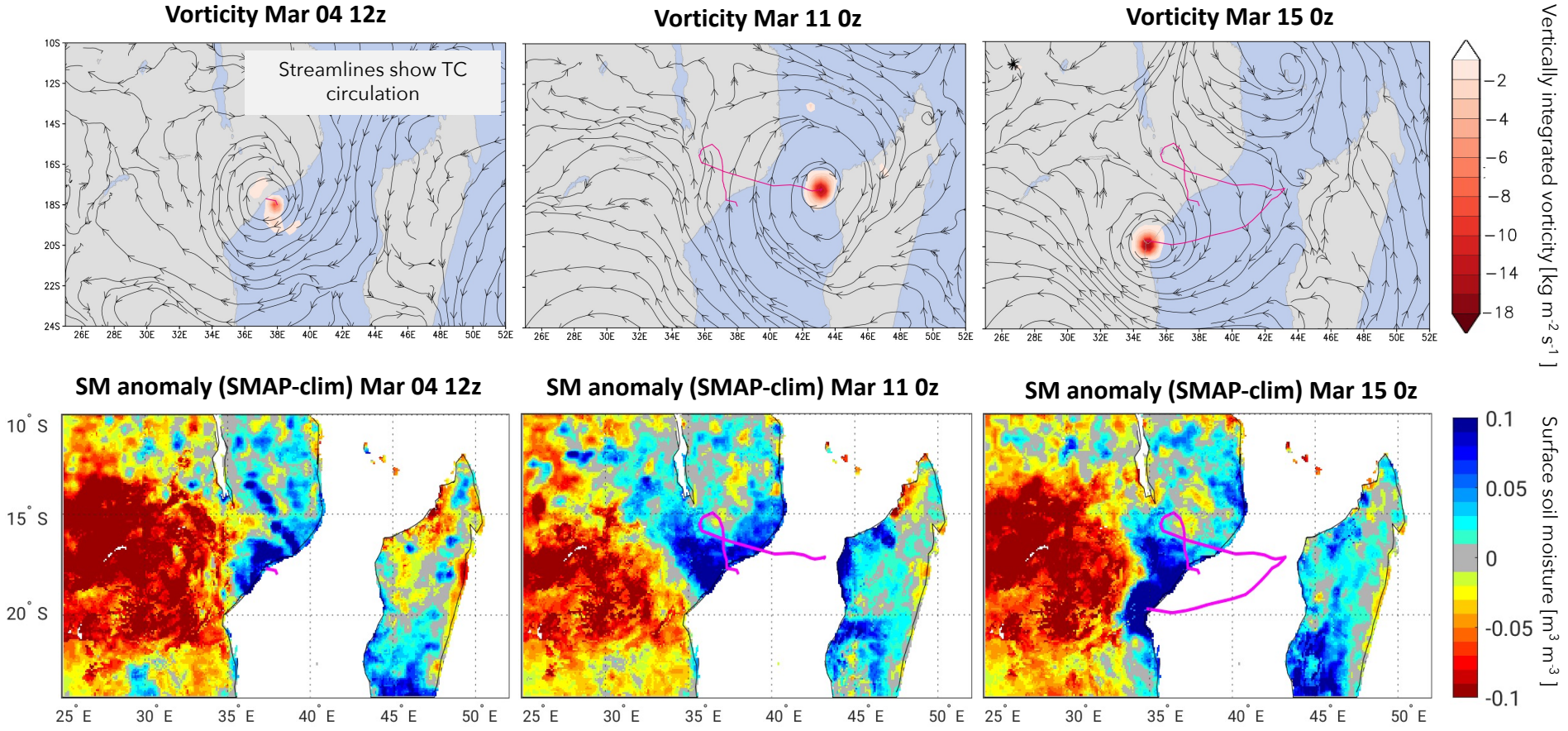
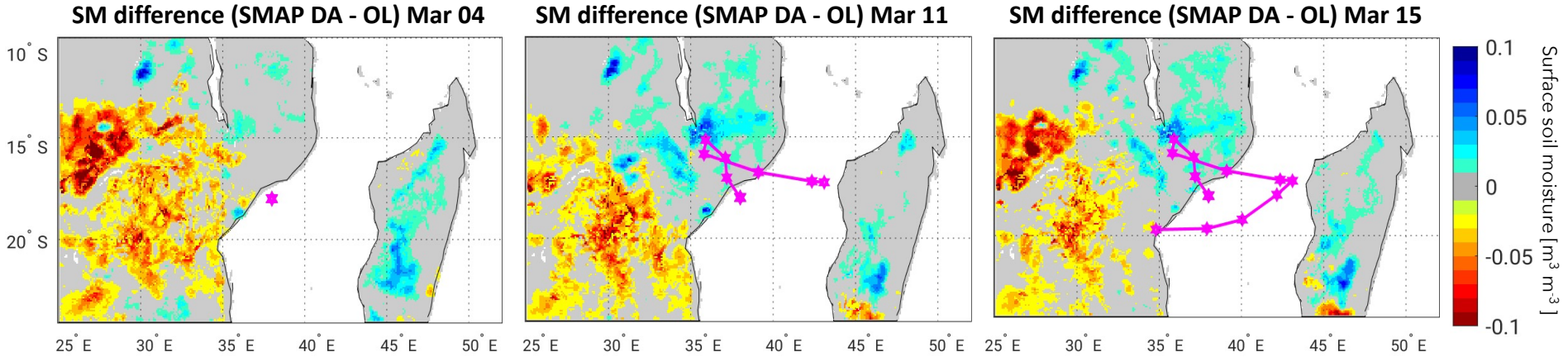


## What can SMAP add?




- The SMAP DA run captures the wetter than normal conditions better than a model run that is not constrained by SMAP

→ By assimilating SMAP we could improve the forecast of Idai's behavior

# Ongoing and Future Work

## Ongoing work:

- Setting up and running OSE control experiment for Idai
- Setting up and running OSE DA experiment for Idai

→ Assess the impact SMAP DA has on our ability to predict Idai's behavior

## Future work:

- Repeat Idai experiment for a range of TC case studies

→ Determine how large scale forcing may modulate the impact of SMAP DA

→ *Determine the impact of SMAP DA on the overall model forecast skill*

# Thank you!