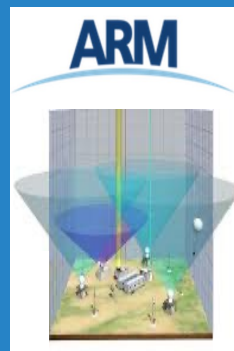




Science Focus Area (SFA)

Tying in High Resolution E3SM with ARM Data (THREAD)



THREAD

LLNL ASR SFA



Overview of the Doubly-Periodic SCREAM Configuration

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SCREAM

- SCREAM = [Simple Cloud-Resolving E3SM Atmosphere Model](#) (Caldwell et al. 2021).
- $dx = 3.25$ km globally, 128 vertical layers with a top at 40 km.
- SCREAMv0 contributed to DYAMOND2 – 40 day simulation.
- Moving to high resolution solves many long-standing problems with E3SM (typically run at ~ 100 km).
- Though issues/biases remain that need to be addressed.

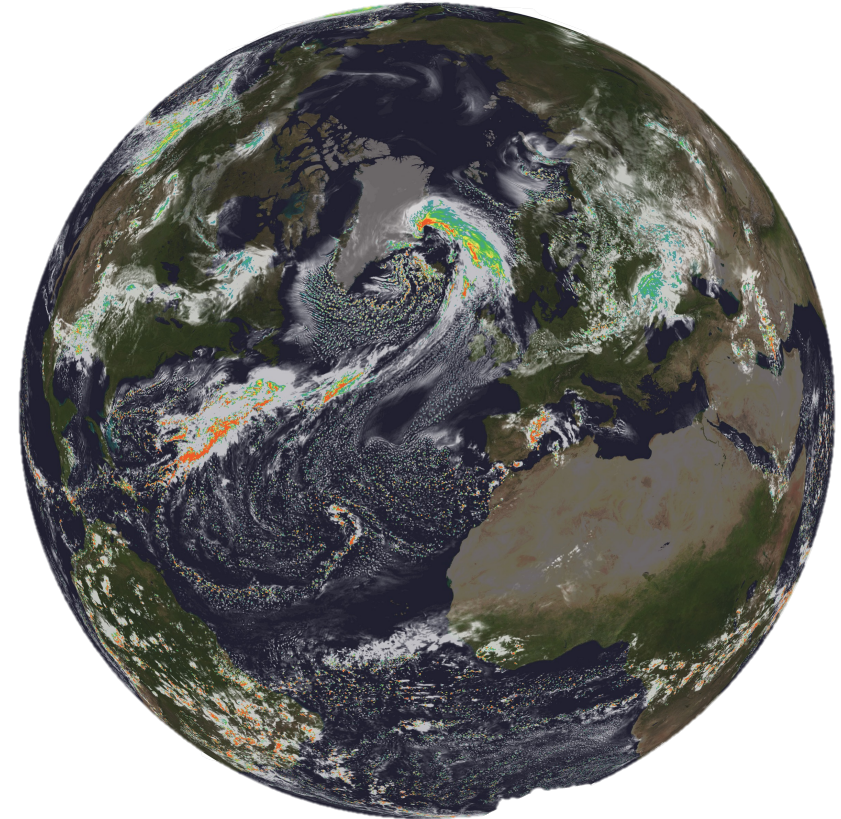
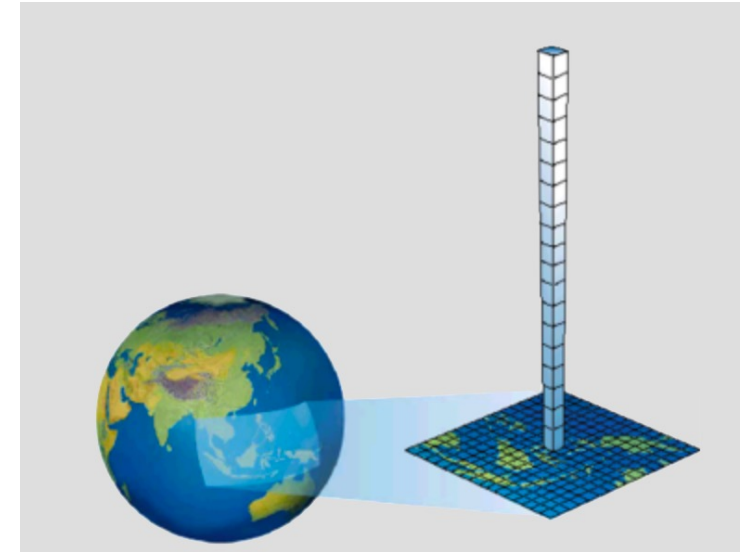


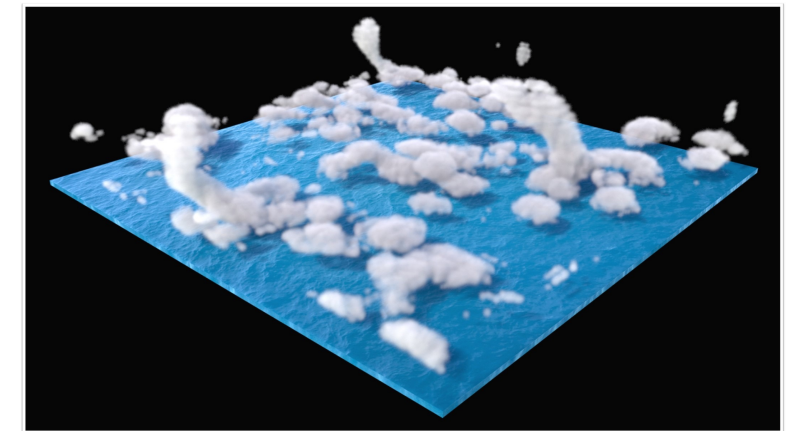
Figure courtesy [Chris Terai](#). SCREAM DYAMOND2. White: liq+ice cloud water path. Colors: precip rate.

Doubly Periodic SCREAM Configuration

- Since SCREAM is a very expensive model, an “**efficient configuration**” (akin to a SCM) is desired to aid model development and evaluation.
- A **doubly periodic (DP-SCREAM) configuration** has been developed, which represents a “single-point” three dimensional cloud resolving model on a **planar grid** (Bogenschutz et al. 2022; submitted).
- Access to DP-SCREAM and case library: <https://github.com/E3SM-Project/scmlib/wiki>
- In DP-SCREAM the domain size and horizontal resolution are set by the user on the fly.



E3SM SCM view



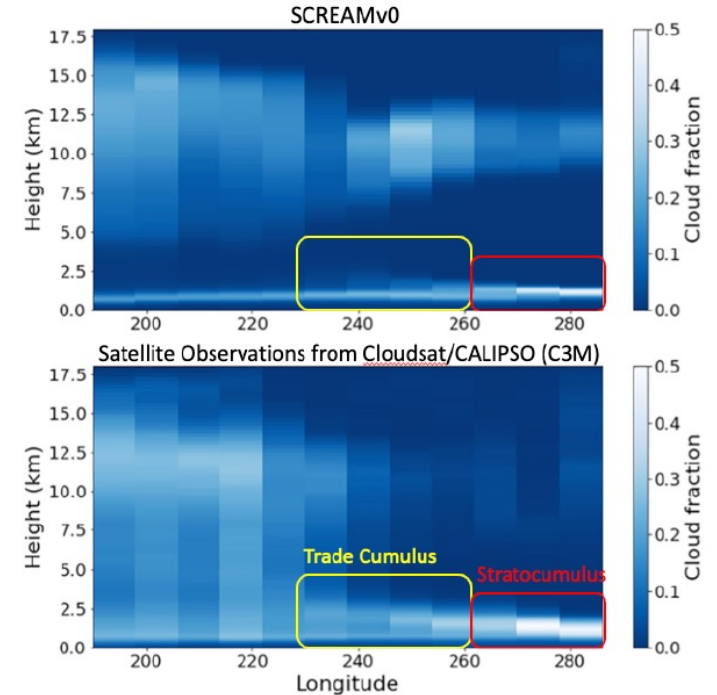
DP-SCREAM view

(dx = dy = 100 m simulation of shallow convection using **DP-SCREAM**, figure courtesy Brad Carvey)₃

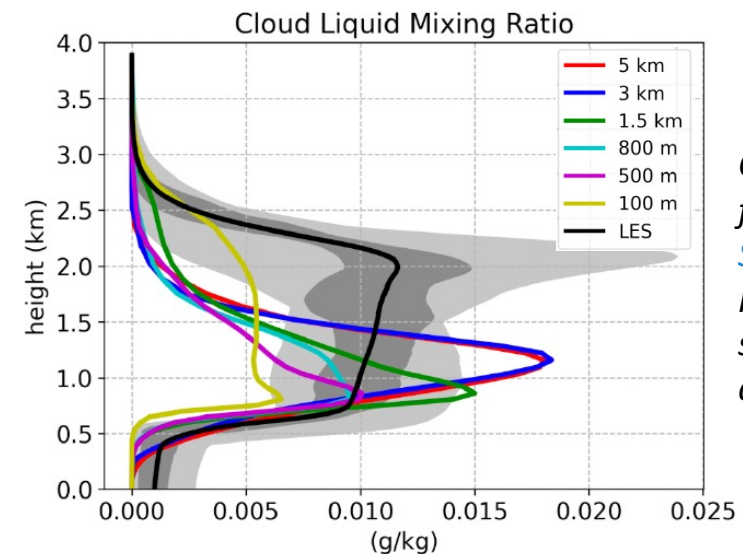
Rapid Feedback by DP-SCREAM

- Cost of a **boundary layer cloud** case:
 - 50 x 50 km horizontal domain size
 - $dx = dy = 3.25$ km to run for one simulated day: **4 minutes on ONE node.***
- Cost of a **deep convection** case:
 - 200 km x 200 km domain size
 - $dx = dy = 3.3$ km to run for one simulated day: **4 minutes on SIX nodes.**
- Cost of one simulated day of **SCREAMv0**: **~ 5 hours on 1536 nodes.**
- **DP-SCREAM** can replicate many biases seen in the global model.

*machine used is **Cori-Knl** for all timings



*Cloud fraction along 20 S transect across Sc to deep Cu transition from **SCREAM** (top) and C3M (bottom).*



*Cloud Liquid from **DP-SCREAM** for RICO case of shallow convection.*

DP-SCREAM and ARM Observations

- **SCREAM** has not yet been closely scrutinized at the process level with respect to **ARM observations** and large eddy simulation (LES).
- We will assess how **SCREAM** performs for a wide variety of cloud regimes by running a small sample of cases.
- We plan to take advantage of the doubly-periodic **SCREAM (DP-SCREAM)** framework, recent **ARM field observations**, and LES to efficiently compare how **SCREAM** performs at the process level.
- Currently adding recent ARM cases to the DP-SCREAM library.

ARM Cases Actively Being Added to E3SM Library

Regime		Site/Case
Dry convection over land	Daytime Convective Planetary Boundary Layer	SGP (LAFE)
	Non-precipitating active surface forced ShCu (CASS)	SGP
Continental shallow cumulus (ShCu) to Deep Cu Transition	Precipitating ShCu	GoAmazon
	Congestus	
	Local afternoon deep Cu	
Marine boundary layer cloud transitions	Warm Phase stratocumulus (Sc) to ShCu	MAGIC
	Mixed phase Sc to cloud rolls to cellular Shcu	COMBLE