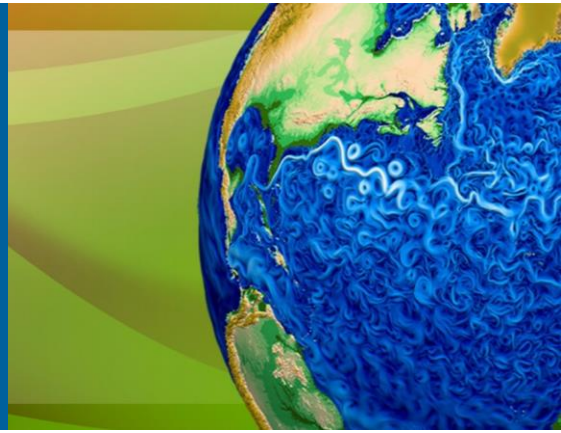
2024 EESM PI MEETING
BIOGEOCHEMISTRY (PROCESSES AND FEEDBACKS) SESSION

Argonne NATIONAL LABORATORY

Dust and Pollution: Coupling Aerosol Nutrients to Marine and Land Biogeochemistry



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Argonne National Laboratory

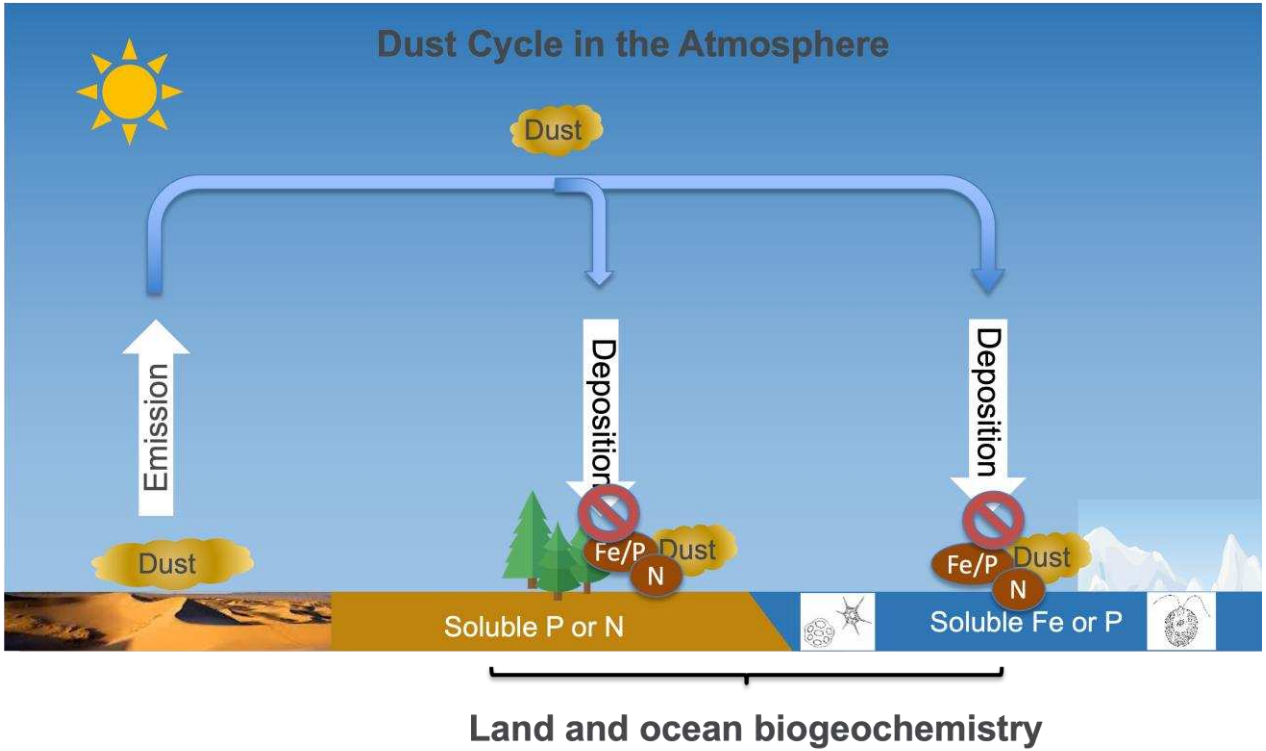
MATHEW MALTRUD AND NICOLE JEFFERY
Los Alamos National Laboratory

DOUGLAS HAMILTON
North Carolina State University

We acknowledge the entire E3SM project team for the v3 model development efforts.

Aug 6, 2024

Advancement of representing dust cycle from EAM v2/v1 to v3



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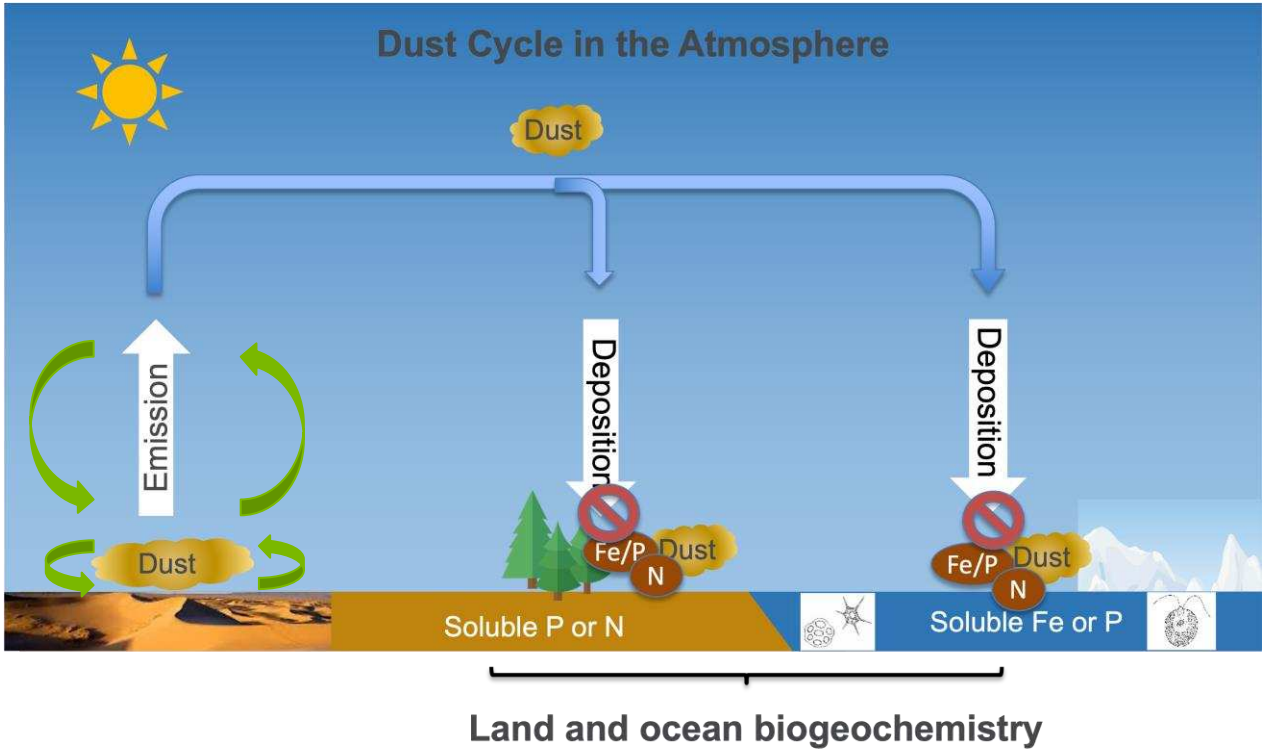

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- Improve dust transport (Wan et al., 2024)

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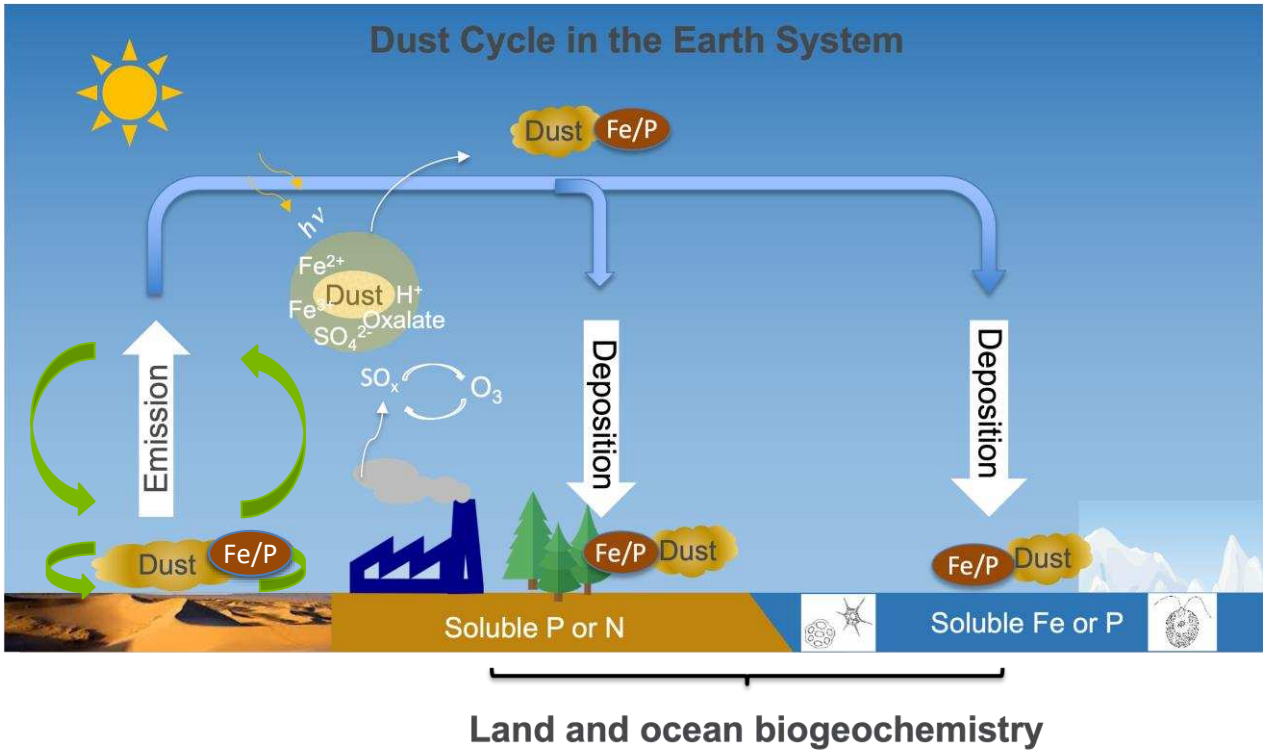

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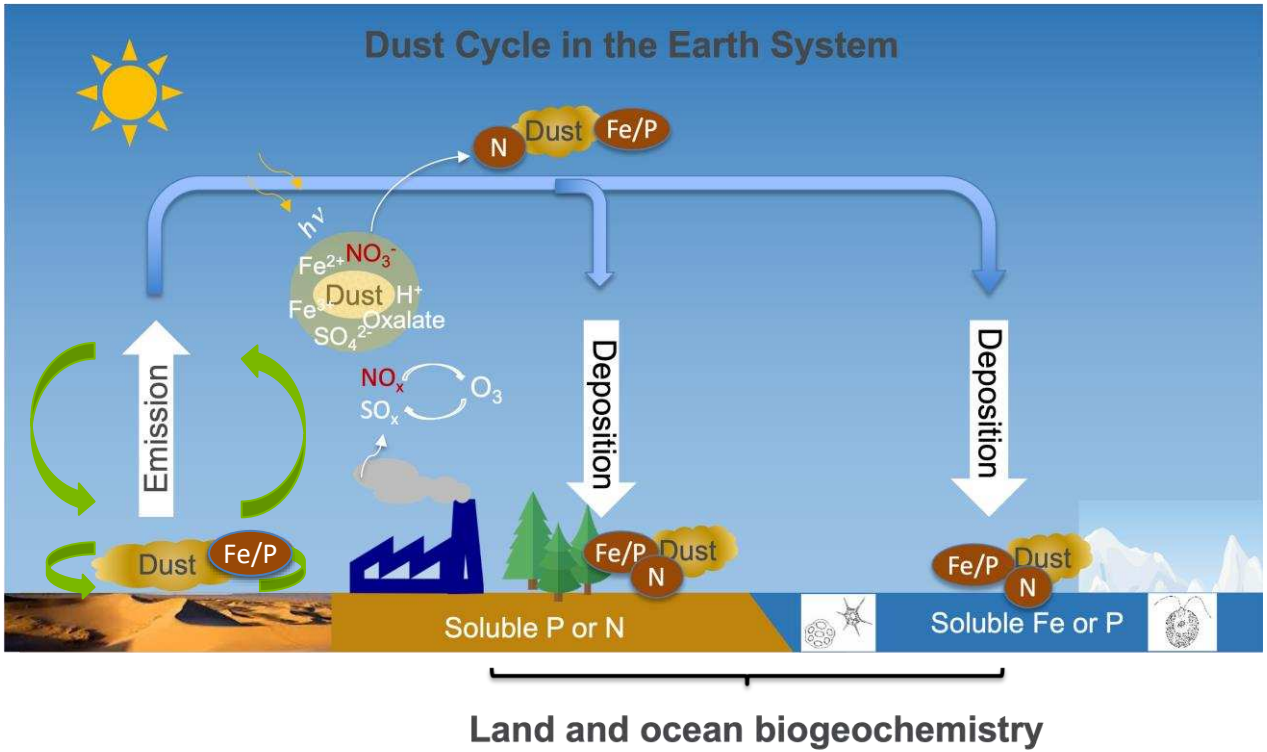
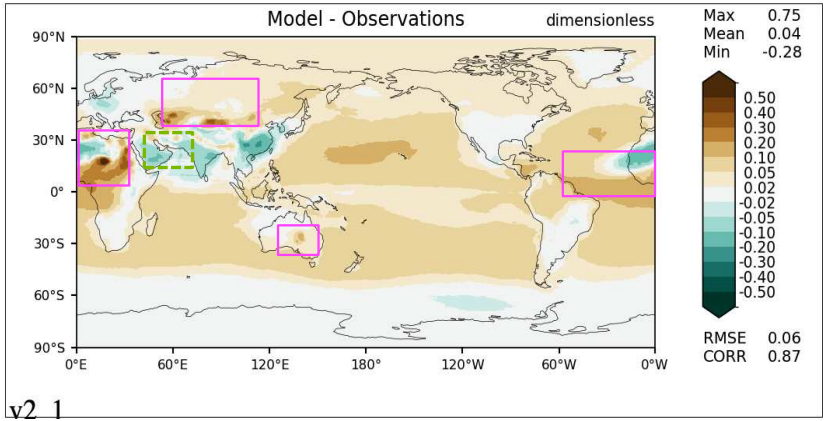
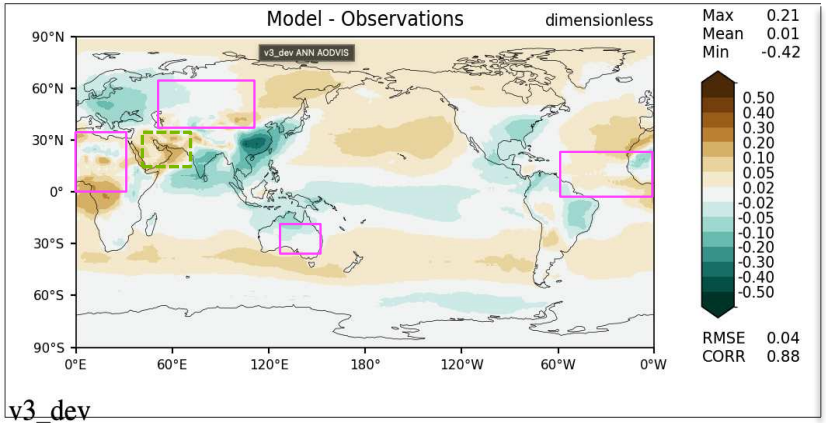


- Upgrade dust emissions (Feng et al., in prep)
- Improve dust transport (Wan et al., 2024)
- Fe dissolution chemistry (Hamilton et al., 2019)
- N gas/aerosol chemistry (Wu et al., in prep)
- Coupling atmospheric dust and Fe with ocean/ice BGC

EAMv3 improves the spatial and seasonal variations in simulated dust

Aerosol Optical Depth Differences (E3SM – MACv2 Climatology)





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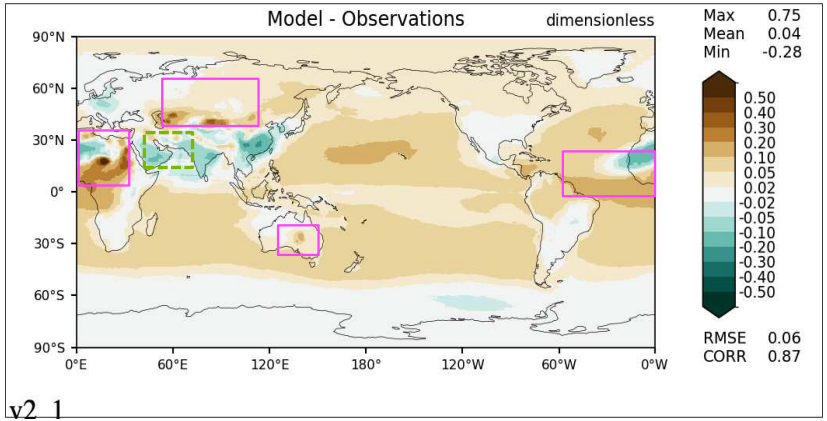
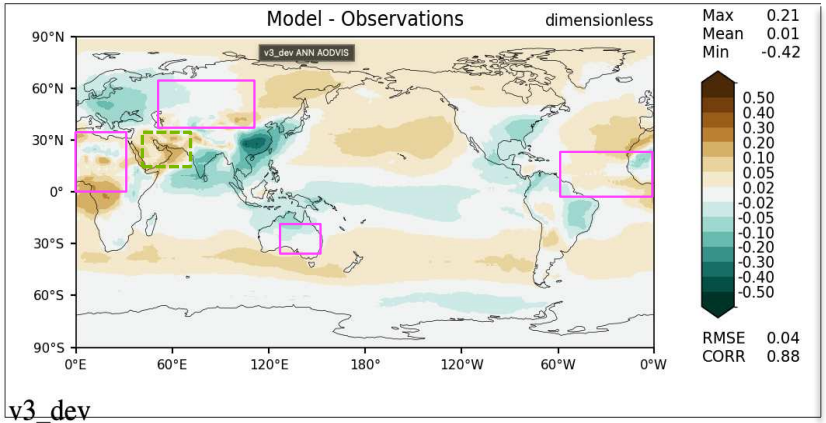
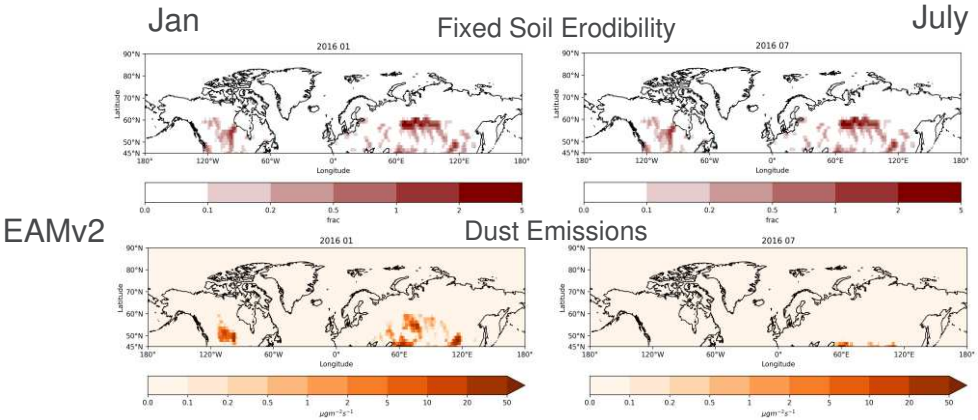




Seasonal Variations in High-latitude Dust



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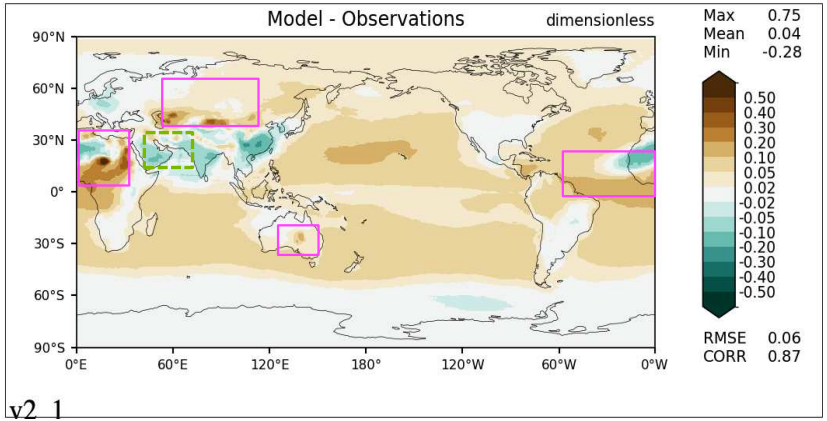

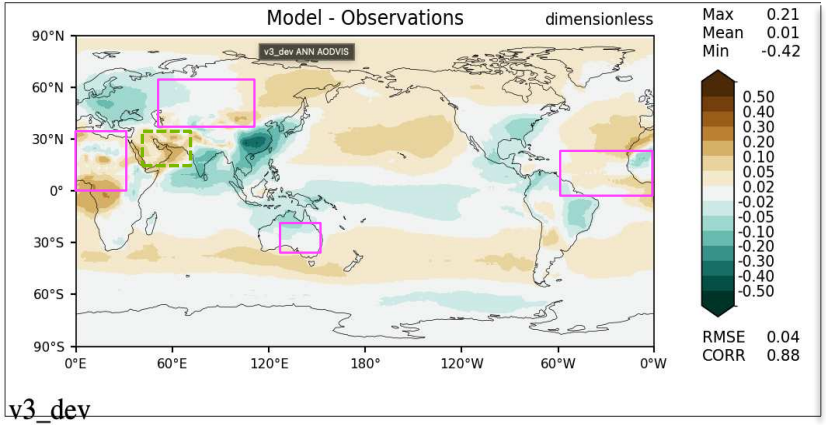

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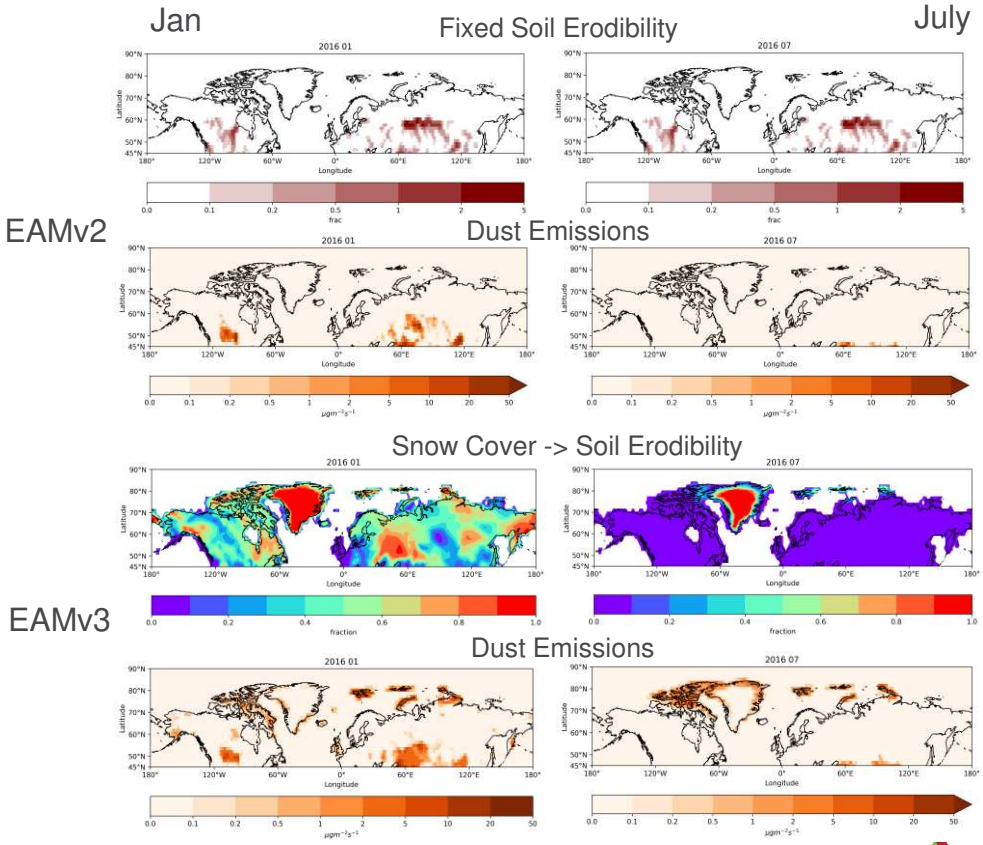

Feng et al., in prep

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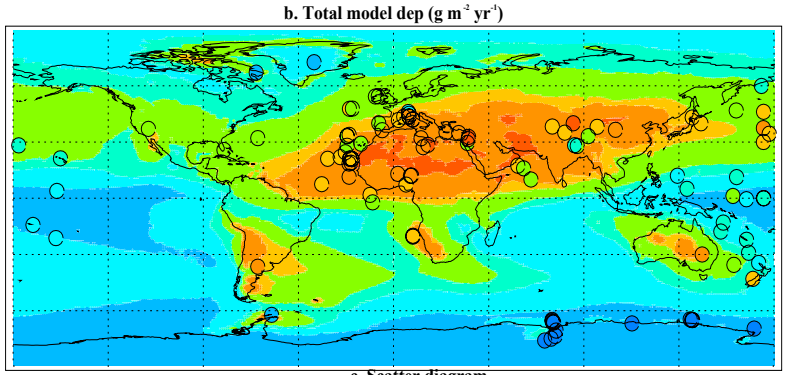
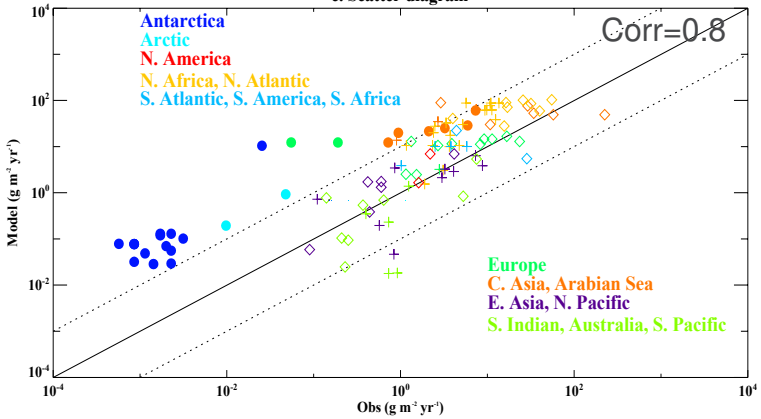
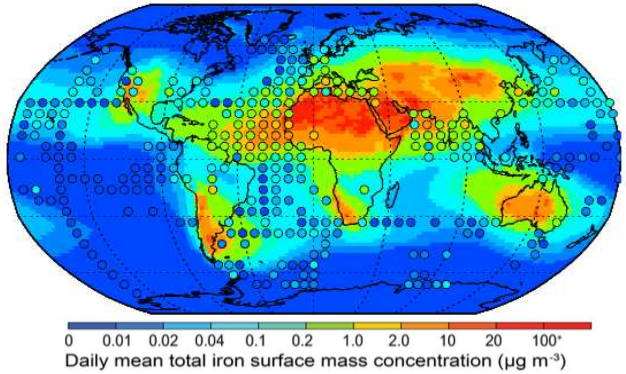
Evaluation of Dust Deposition and Surface Fe Concentration in EAMv3

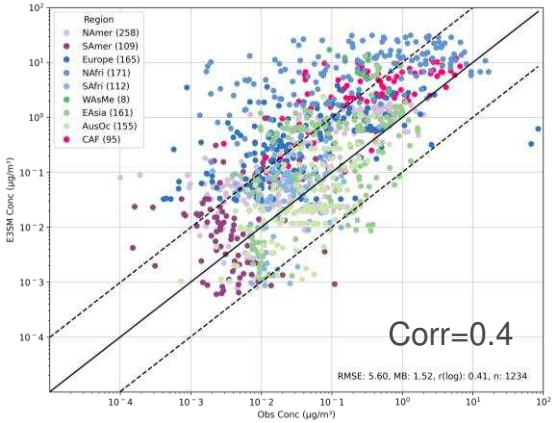
Total Dust Deposition Flux





Fe Concentration at the Air-Sea Surface

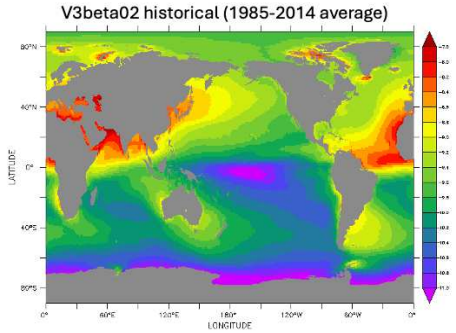


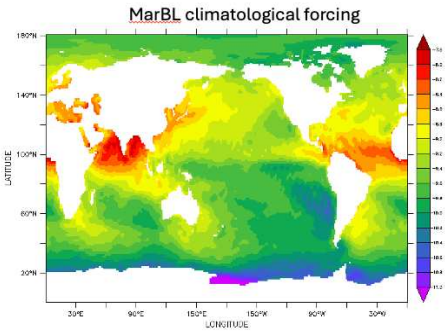


Feng et al., in prep

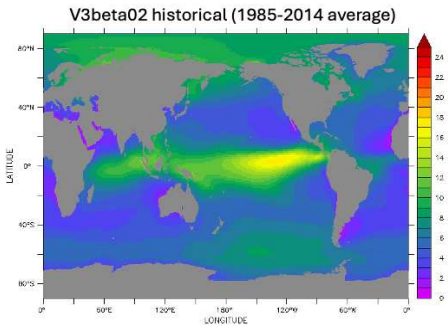
Comparison of Dust and Soluble Fe Deposition: EAMv3 and v2 MarBL

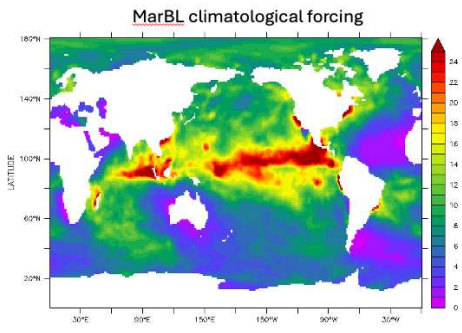
Total dust flux (kg/m^2/s)





"Bulk" Fe solubility (%)





Hamilton et al. (2019)

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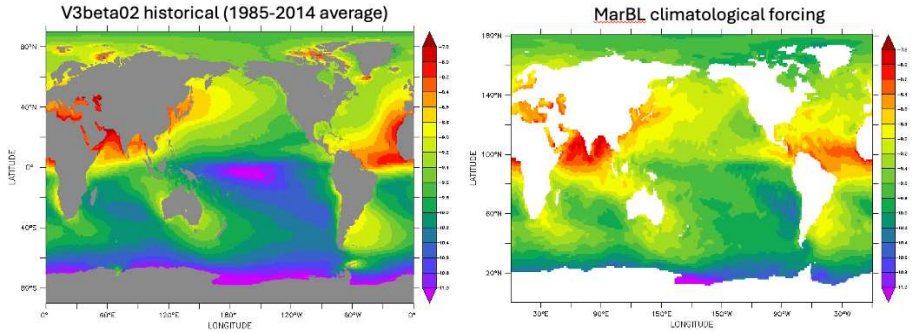

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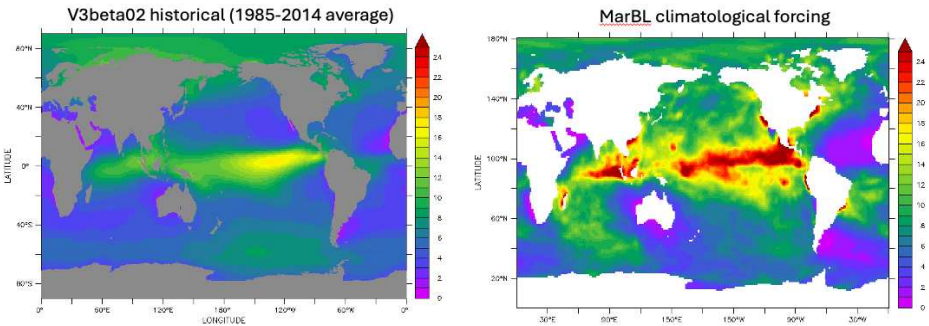

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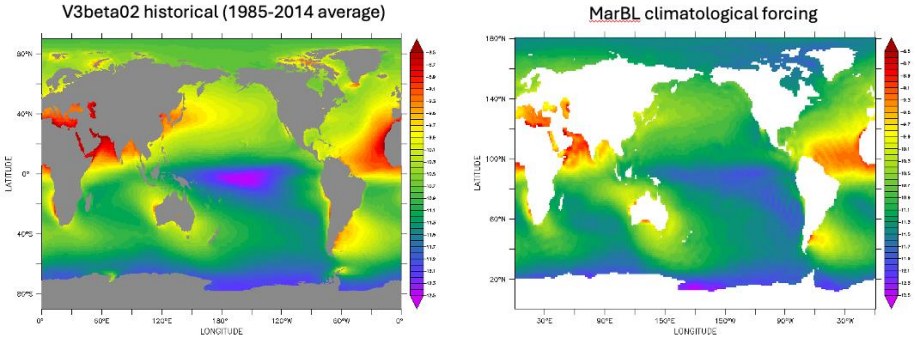

Global budget	v2 MarBL	EAMv3
Global soluble Fe deposition	7.5 x 10^9 kg/year	6.2 x 10^9 kg/year

Total soluble Fe flux = Total dust flux * 3.5% * solubility

Summary

- The enhanced capability of coupling dust Fe nutrients to ocean and ice biogeochemical cycles will be enabled in E3SMv3 BGC simulation campaign.
- It will advance quantification of changes in marine ecosystems in response to the continuing human perturbation to the Earth System.

- We are conducting attribution analysis of dust changes to anthropogenic forcing vs land management changes.

Changes (%) in Total (Ocean) Dust Deposition