# **Benchmarking Historical** Simulations of Leaf Area Index from CMIP6 Using Satellite **Climate Data Records**

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# INTRODUCTION

- It is important to evaluate the performance of historical simulations from CMIP6 models.
- Long-term satellite observations are valuable for global and regional assessment for earth system model benchmarking.
- Understanding the performance of model simulated vegetation conditions (leaf area index, LAI) is important for improving the characterization of carbon cycle over land.

## METHODS

- 1. Aggregating long-term satellite data (1981-2014) to common model grid sizes (1, 2.5 & 5 degrees) and monthly frequency.
- 2. Re-gridding CMIP6 historical simulations to common model spatial resolutions (with xESMF).
- 3. Statistical analysis between all re-gridded CMIP6 historical simulations & aggregated longterm satellite products (NOAA LAI Climate Data Record & GIMMS LAI3g)

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**Acknowledgement**: This work was supported by NOAA through the Cooperative Institute for Satellite Earth System Studies under Cooperative Agreement NA19NES4320002.

# CMIP6 simulations of leaf area index show large differences in northern boreal forest, tropical forest, and Andes mountains compared to satellite data.

CMIP 1 degree models compared to NOAA CDR																									
1.107	1.321	1.33	0.639	1.437	1.415	0.64	0.636	2.122	2.093	1.213	1.575	0.63	1.593	1.517	0.64	2.154	1.648	0.471	1.088	1.056	0.976	2.718	1.301	2.002	1.90
0.485	0.85	0.863	0.166	0.413	0.391	0.165	0.158	0.876	0.884	0.183	0.545	0.135	0.901	0.907	0.247	1.353	0.815	0.02	0.397	0.392	0.337	1.449	0.303	0.971	0.90
0.627	0.494	0.493	0.807	0.395	0.402	0.807	0.808	0.256	0.281	0.546	0.414	0.808	0.491	0.544	0.824	0.351	0.427	0.892	0.496	0.522	0.612	0.537	0.446	0.543	0.4
MR SM1-	0-F1 CSM1-	0-F2 AS-EST	N2-O CES	SN2 N2-WA	CCM CN	ESM C-CM2 CMC	HRA C-CM2	SR5 NCC-E	SN2 E3SN E3S	-1-1 M-1-1	ECA E3SN EC	Earth	3-CC Earth3	Neg O-ESN	GFDL	CM4 GFDL-E Had	SM4 SEM3-G	C31 M-CM	1-0-8 INNA-CA	N5-0 NPI-ESN	N2-0 NRI-ESN	N2-0 DIFESM2 SAD	NO-UNIC	Taite	5M1









### RESULTS

- Large differences are observed in boreal forest, southern China, southeast US, and the tropics with notable model variability.
- Large differences also observed over the Andes mountain in South America suggesting the role of terrain in diverging pattern between simulations and observations.
- Models show different seasonal patterns compared with observations.





- 2.00

-1.75

- 1.50

-1.25

- 1.00

- 0.75

0.50

0.25

L 0.00



### DISCUSSION

- Cloud impact on satellite observations may be responsible, in part, to the differences in high latitudes and the tropics.
- Various levels of differences between simulations and observations suggest that a simple multi-model ensemble may not be appropriate to represent the consensus of model projections.