

Evaluation and sophistication of an Earth system model utilizing GCOM-C data

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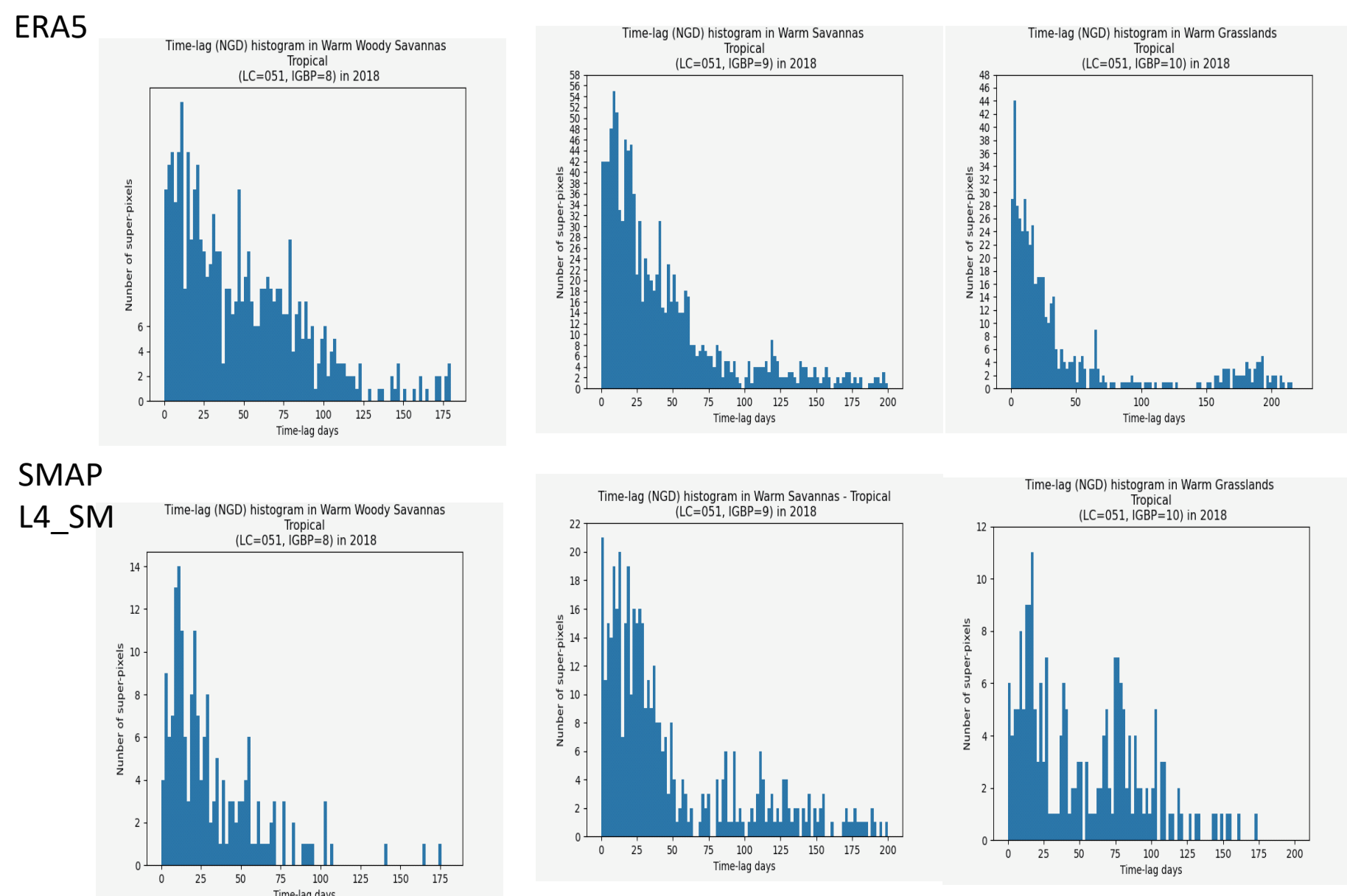
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Plan (FY2021, 3years)

Research schedule (FY 2021)	Items	Apr	Mar (2022)
	<ul style="list-style-type: none"> Impact analysis of changing parameters on ESM outputs Impact analysis of sophisticated the model Summarizing the results 		
Overall research schedule (3 years)	Items	FY 2019	FY 2020
	<ul style="list-style-type: none"> Summarizing the existing literature Supporting observation in Mongolia CMIP6 analysis Estimating parameters and developing input base map Impact analysis of changing parameters and base map Preparation of sophisticated the model Experiment of sophisticated off-line model Impact analysis of sophisticated the model Summarizing the results 		

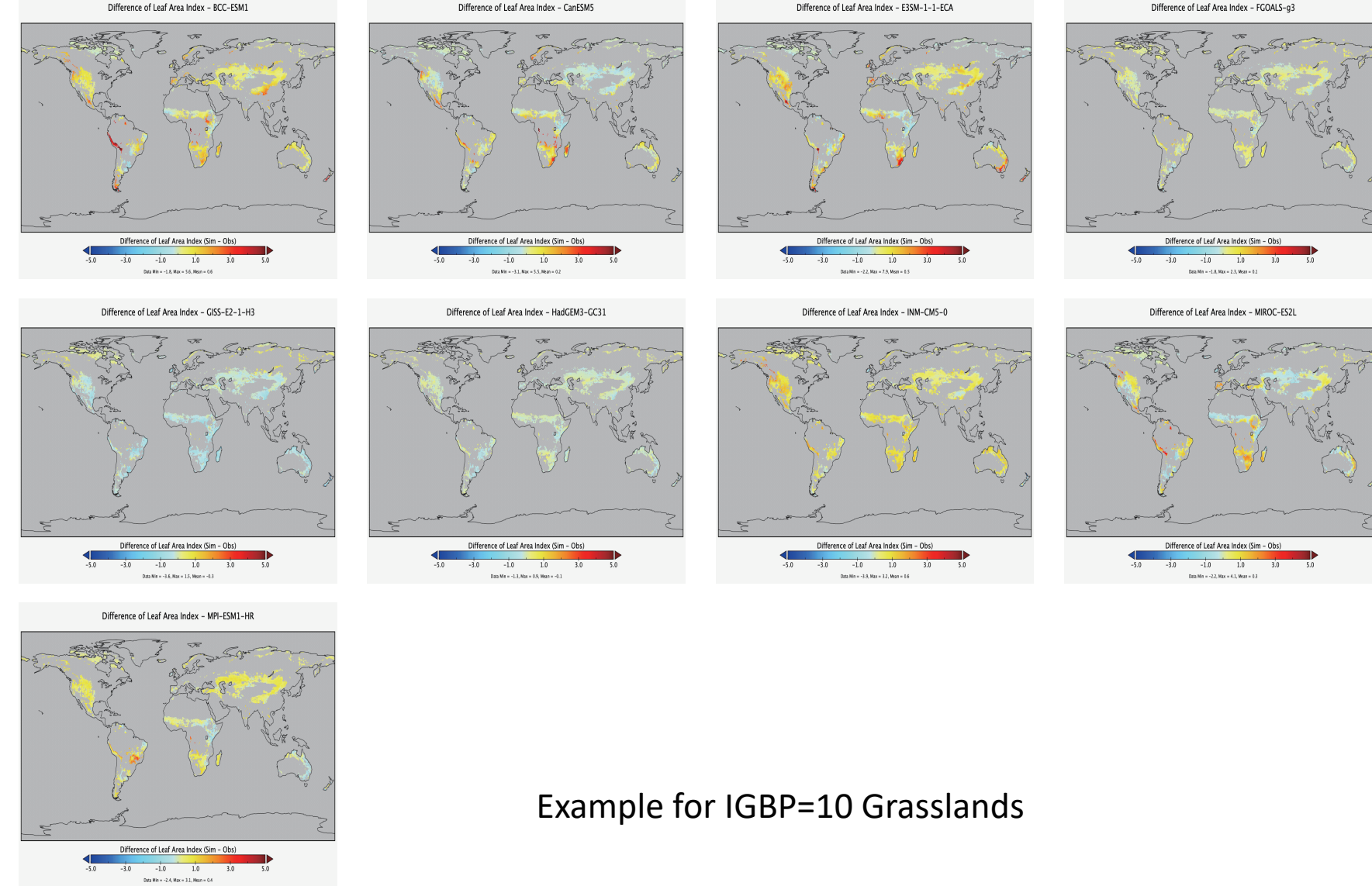
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ERA5 & SMAP L4_SM Tropical



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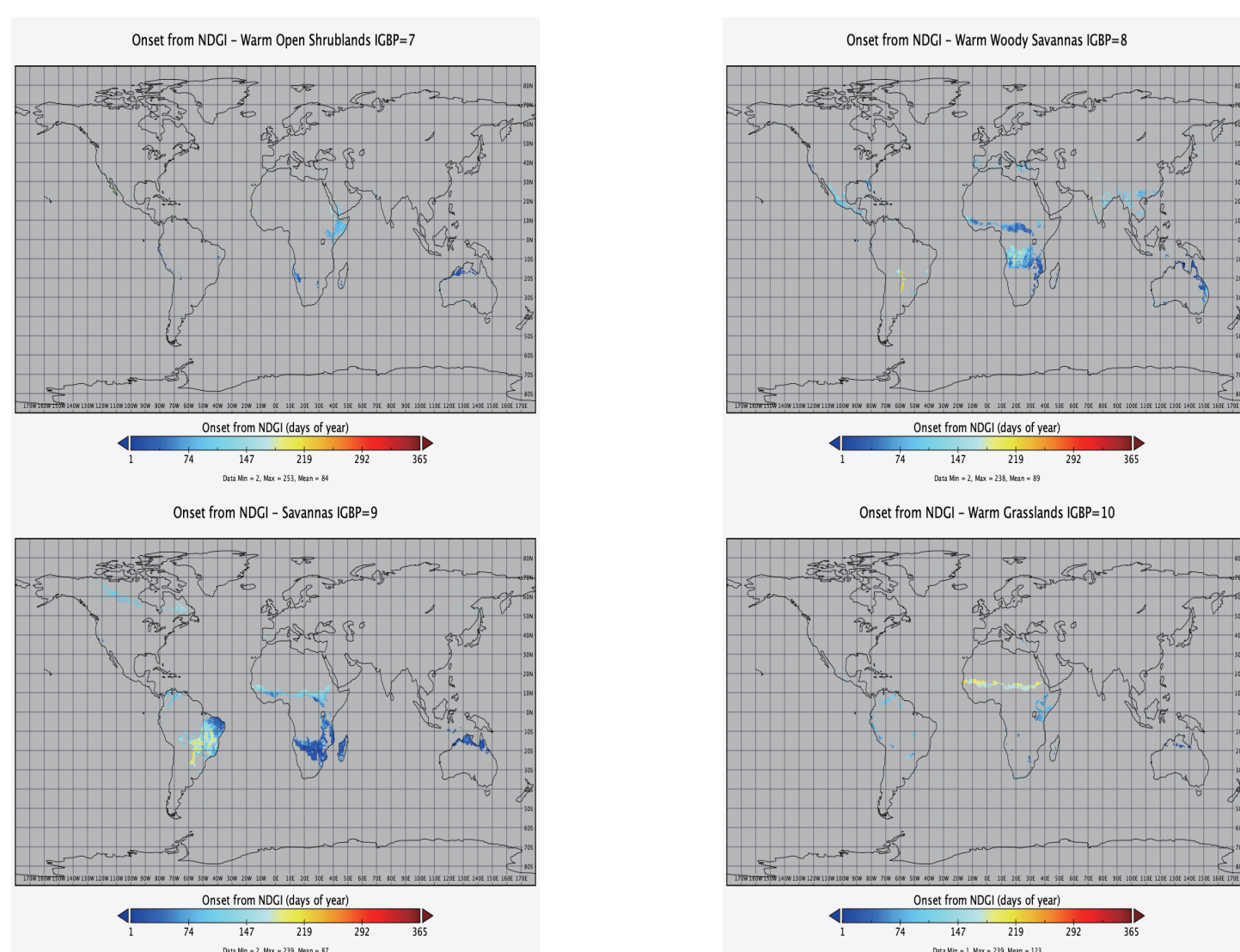
LAI: Difference between the models and observation



Example for IGBP=10 Grasslands

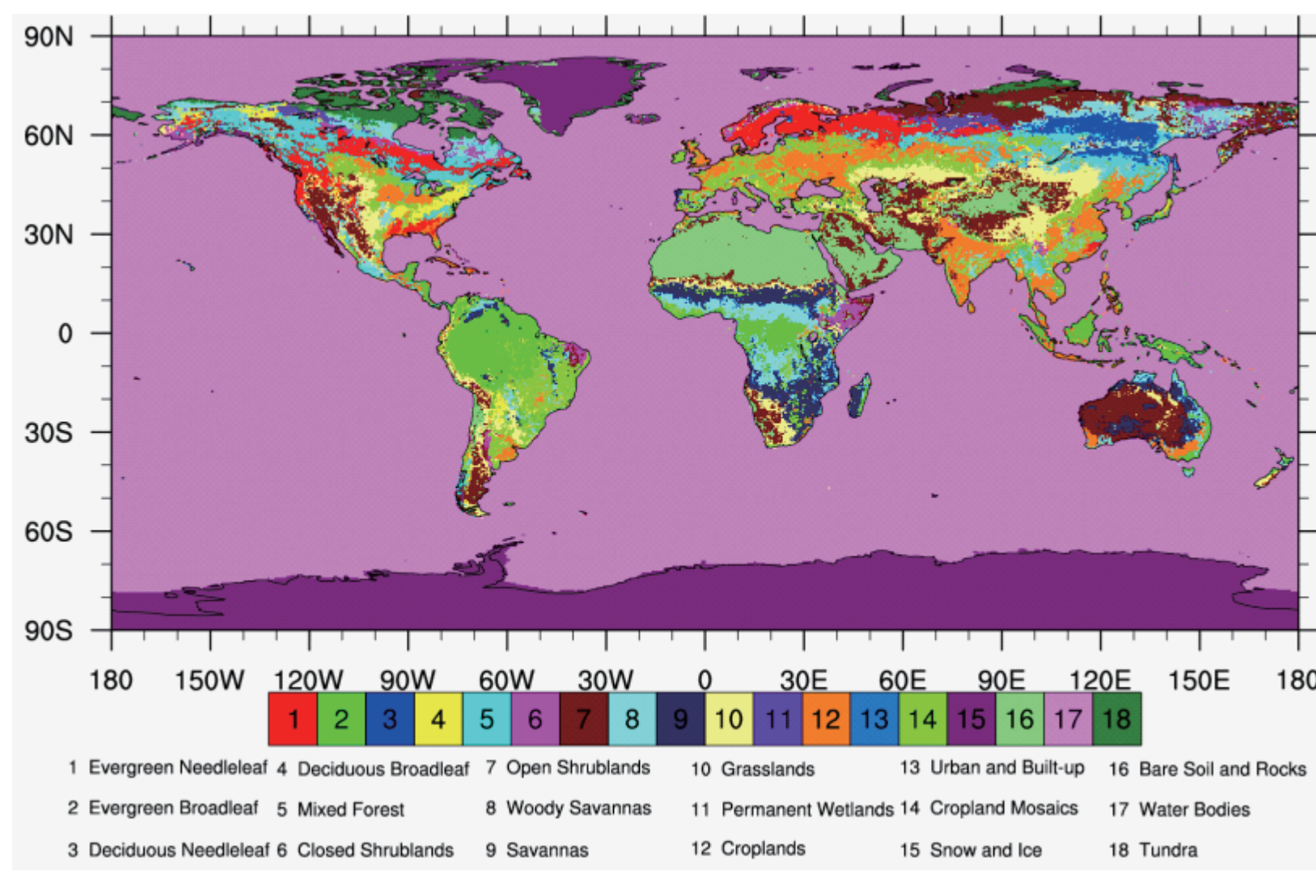
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Onset from NDGI: IGBP=7,8,9,10



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IGBP land classification



<https://climatedataguide.ucar.edu/climate-data/ces-igbp-land-classification>

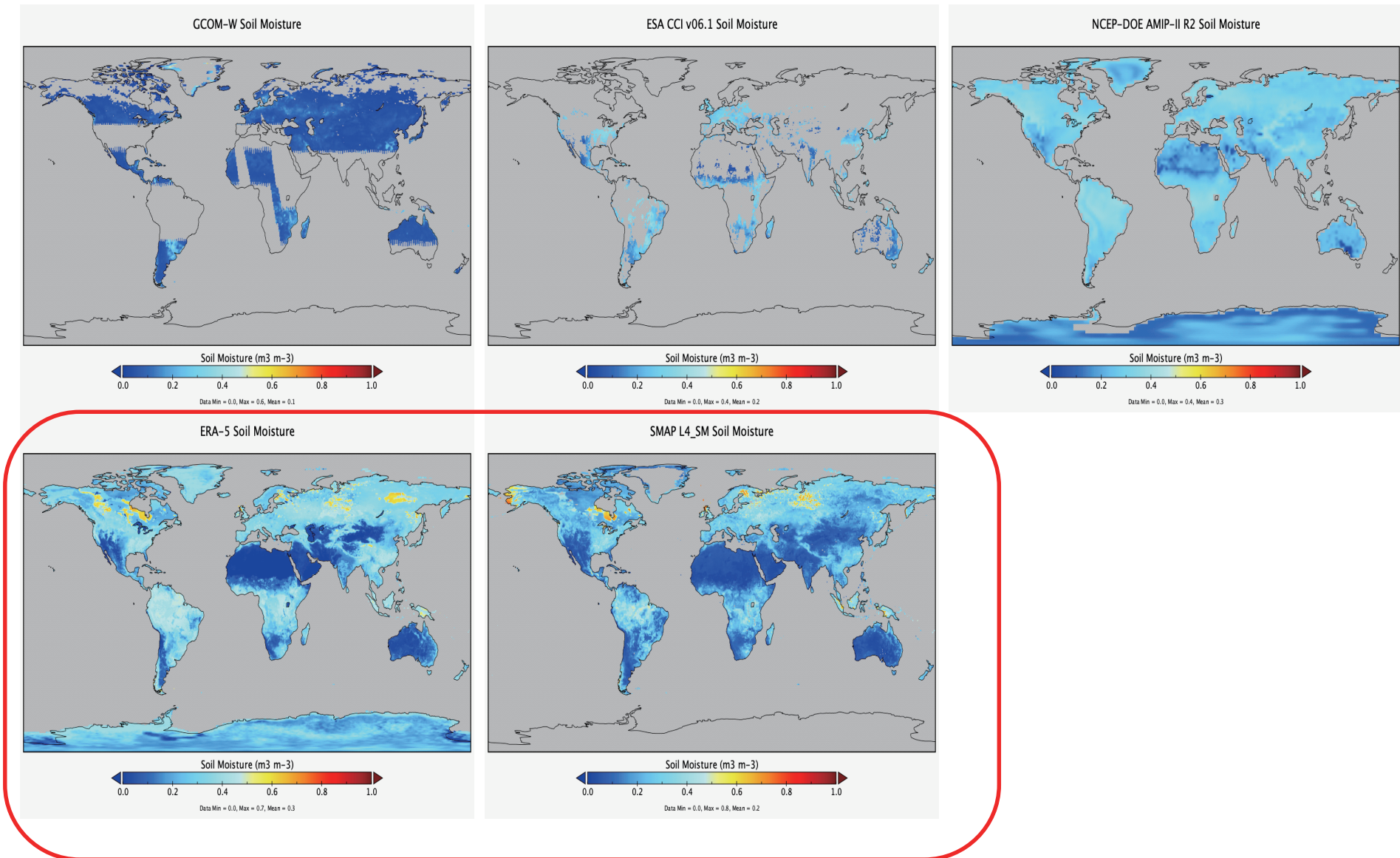
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Other activities

- Terrestrial ecosystem** (other than phenology): We are carrying out a comparison between CMIP5, CMIP6, and observational (satellite and ground) data.
- Cryosphere**: considering that assimilated model outputs well-represent the MODIS snow cover trend, we are attempting to identify the source of bias using the assimilated model data.
- Marine ecosystem**: We are waiting for an update of the PFT data.

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Comparison of the soil moisture datasets For Apr 2018



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Application to ESM

- Parameters of the required GDDs for leaf onset is applied (and the value beyond which DDs are accumulated is also changed).
- Case 0: Original setting
- Case A: Changing parameters for the vegetation types (IGBP) where Botta et al (2000)'s* model 2a are available.

*: <https://doi.org/10.1046/j.1365-2486.2000.00362.x>

$$GDD(t) = \sum_{i=1}^n \max(T_i - T_{th}, 0) \text{ and } GDD(t) \geq GDD_c \quad (4)$$

$$GDD_c = a \text{ for model 2a} \quad (5)$$

$$GDD_c = \frac{bP}{cP-1} \text{ for model 2b.} \quad (6)$$

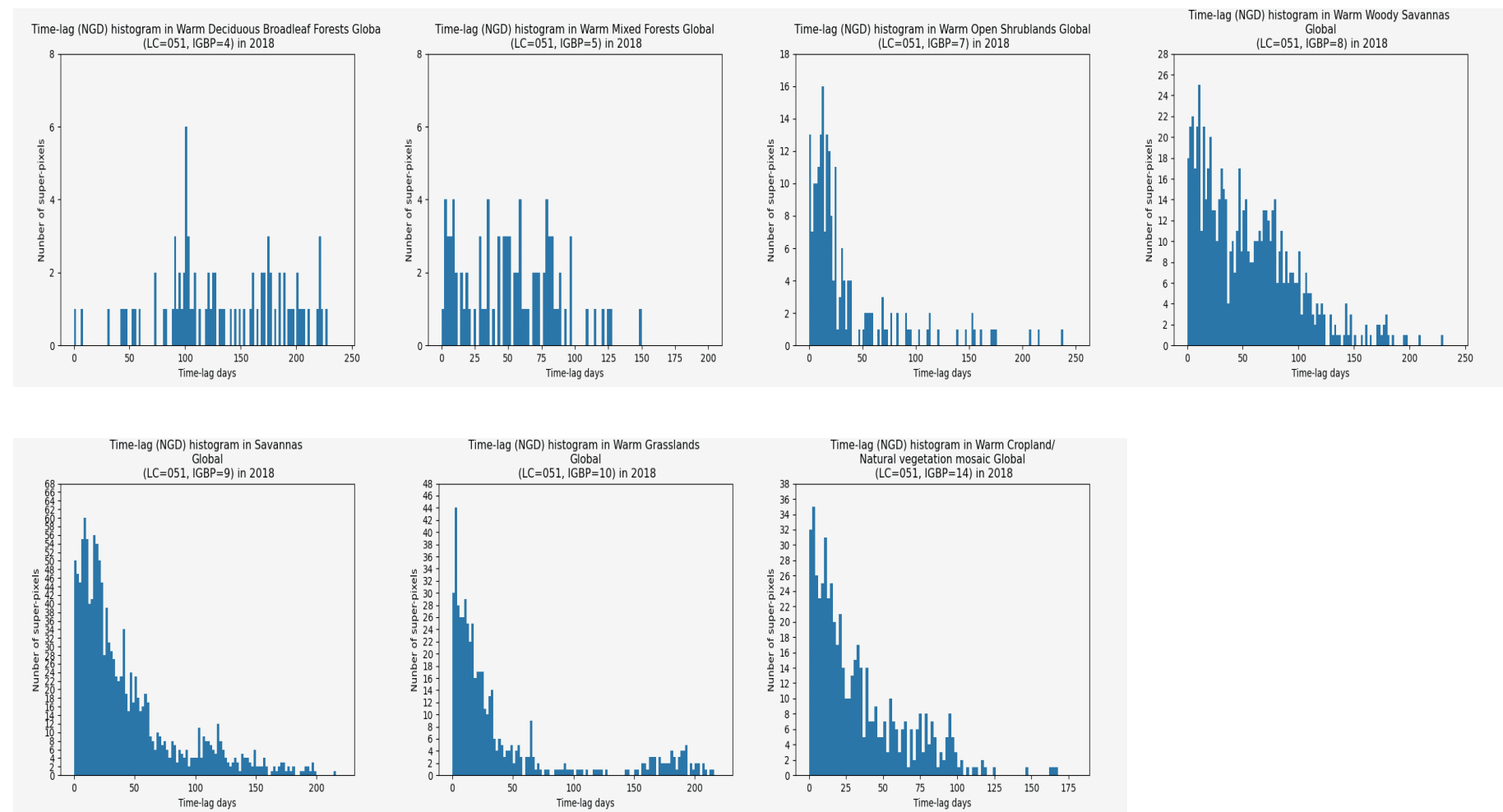
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Summary of FY2021

- Phenology**: analysis using satellite data was carried out (on needed degree-days for leaf onset), including the impact of selecting soil moisture data.
- Some results are attempted to use in ESM, and show some preliminary results.
- Other activities** are ongoing, and we will summarize the results of them in the annual report.

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ERA5 Global



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	Case 0	Case A
Open Shrub	Threshold temperature to accumulate GDD (daily mean) -1°C	0°C
	Threshold GDD for leaf onset 100 DDs	60 DDs
Deciduous Broadleaf Forest	Threshold temperature to accumulate GDD (daily mean) -1°C	0°C
	Threshold GDD for leaf onset 100 DDs	87 DDs
Woody Savannas	Threshold temperature to accumulate GDD (daily mean) -1°C	0°C
	Threshold GDD for leaf onset 100 DDs	51 DDs
Grasslands	Threshold temperature to accumulate GDD (daily mean) 1°C	0°C
	Threshold GDD for leaf onset 100 DDs	73 DDs
Cropland/Natural Vegetation Mosaic	Threshold temperature to accumulate GDD (daily mean) 1°C	0°C
	Threshold GDD for leaf onset 100 DDs	77 DDs

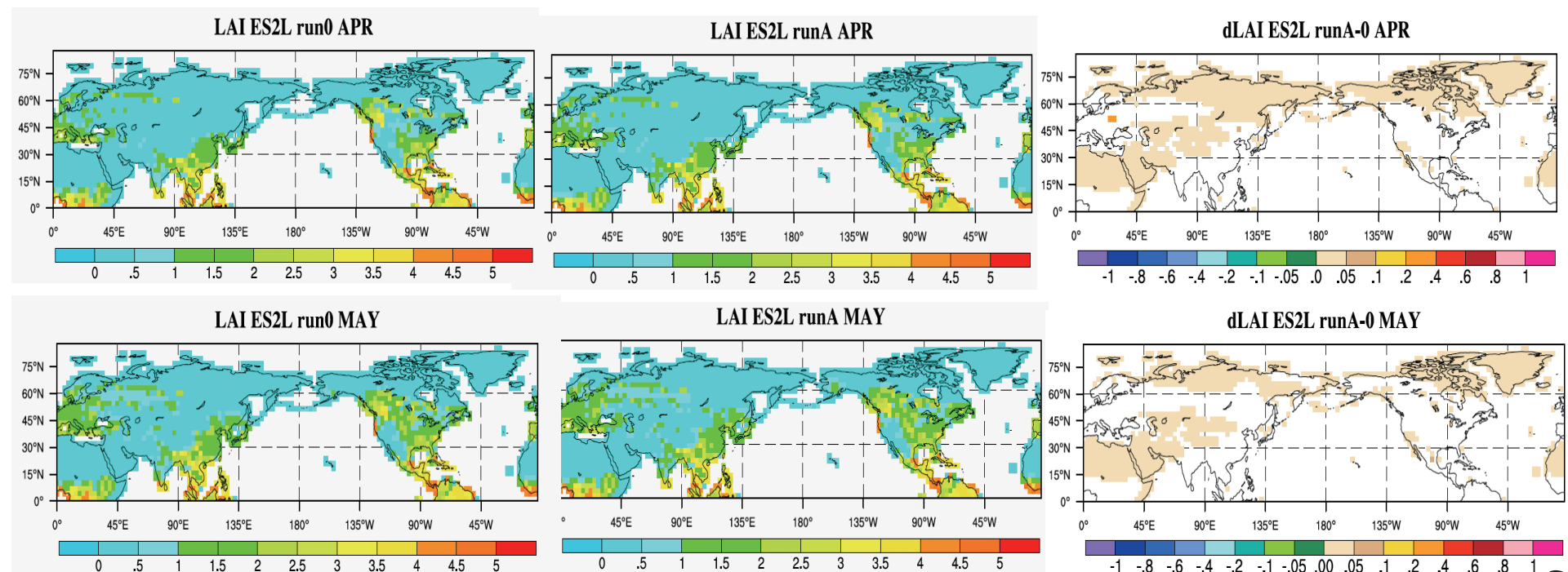


Fig. monthly mean LAI in April and May for two runs. The differences between the runs A and 0. The significant differences (p>95%) are colored.

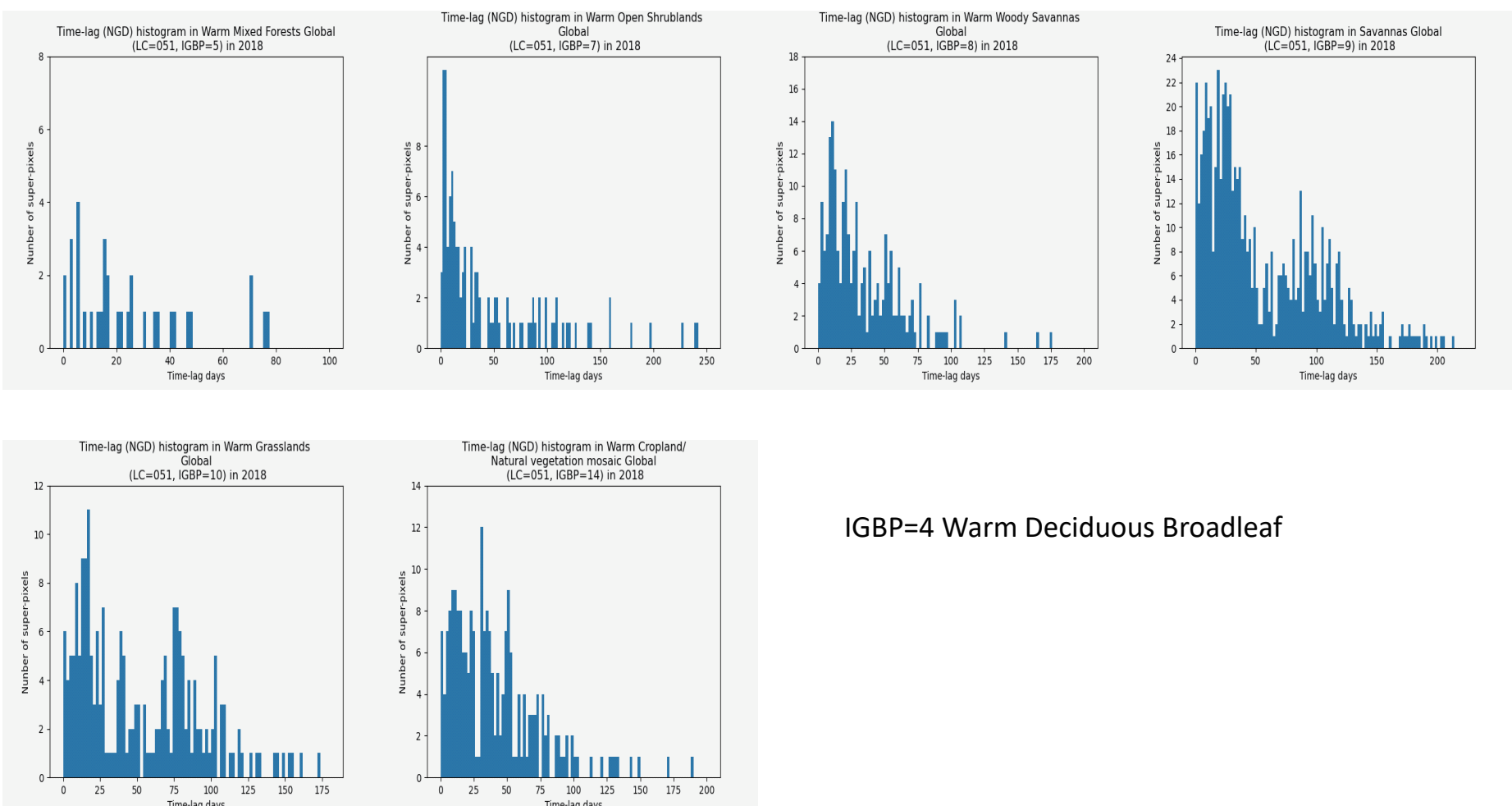
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Summary of the 3 years

- Terrestrial vegetation**
 - CMIP6 analysis (comparison w/ CMIP5)
 - Assessing the phenology parameters and application of them to ESM
- Cryosphere**
 - Investigation of the bias of snow cover and snow amount
- Marine ecosystem**
 - Investigation of the relationship of SST and production (focusing on the difference of single- and multi-PFT models).

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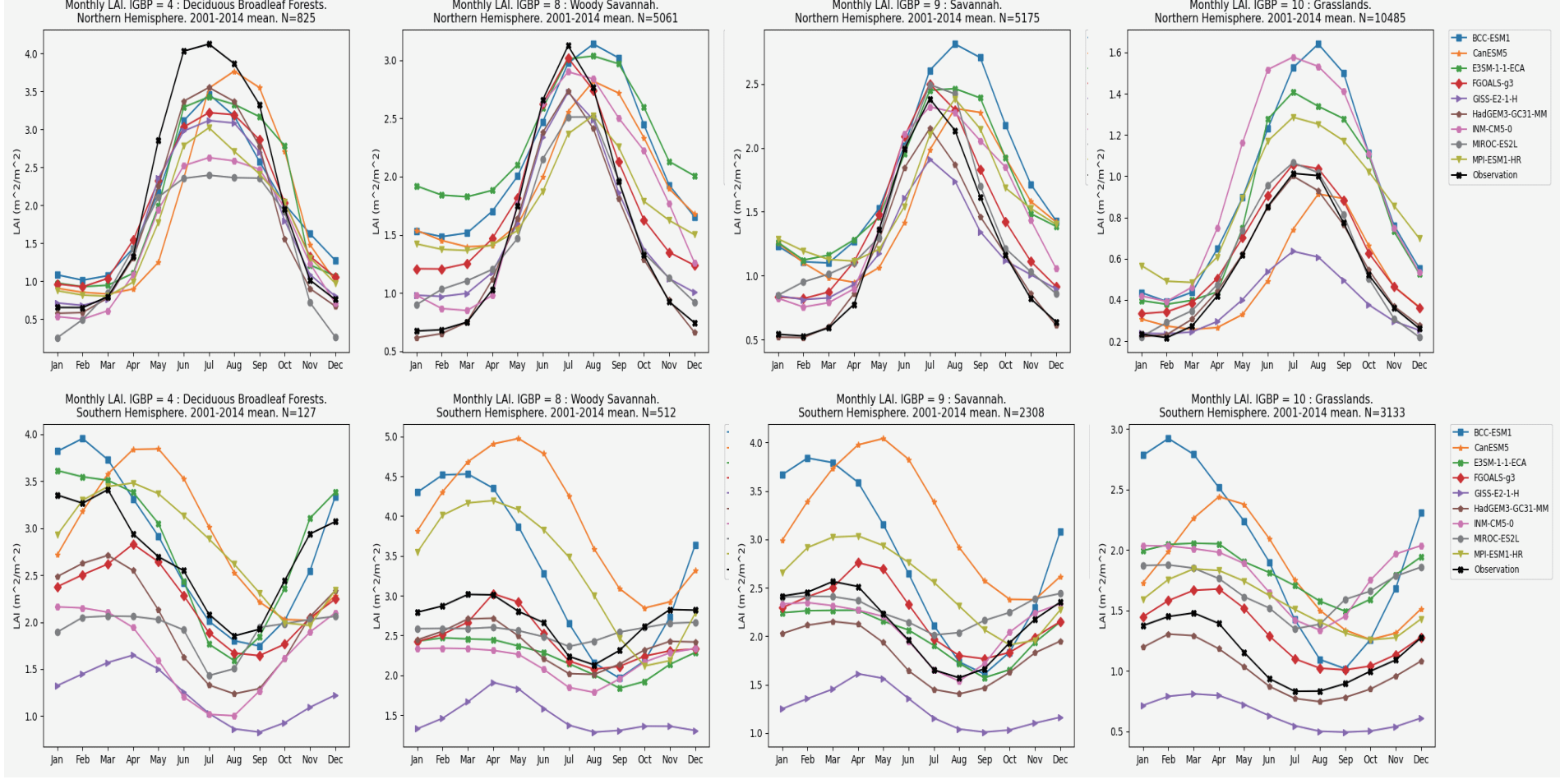
SMAP L4_SM Global



IGBP=4 Warm Deciduous Broadleaf

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LAI: Inter-model comparison by IGBP land categories for 2001-2014 average



N=xx: vegetation-covered grid numbers. As observation, 1981-2005 average by ORNL DAAC is used. https://daac.ornl.gov/VEGETATION/guides/Mean_Seasonal_LAI.html

Southern hemisphere as larger inter-mode variance, possibly because of the smaller number of the concerned grids. Grassland has larger inter-model spread even for the northern hemisphere.

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Future (EORA3 etc.)

- We will participate in the EORA3 as a non-funded research team
- Collaboration with the next global warming projects?
- The main work will be on fires.
- Impact of the reflection by Chl-a, Ocean PFT (continued)?

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