Supporting Information for

A New Organization Metric for Synoptic Scale Tropical Convective Aggregation

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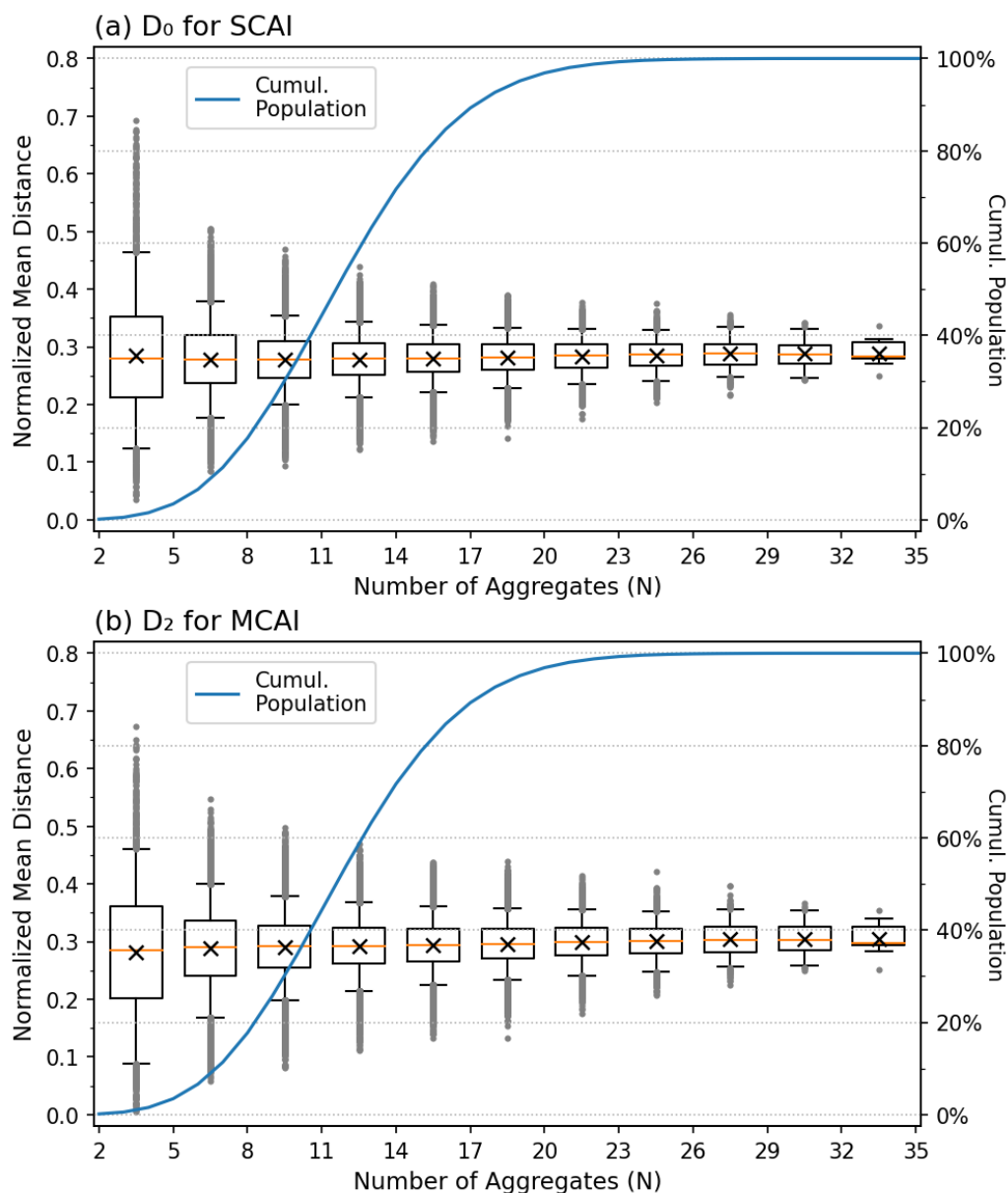Corresponding author: Daeho Jin (Daeho.Jin@NASA.gov)

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Introduction

This supporting material contains supplementary figures for the manuscript of "A New Organization Metric for Synoptic Scale Tropical Convective Aggregation."

Figure S1. Distribution of normalized mean distance by characteristic length of domain (L), as a function of the number of aggregates in the western tropical Pacific domain (150°E-170°W, 20°S-20°N). (a) Order-zero diameter (D_0) used in SCAI, and (b) Order-one diameter with "inter-object" distance (D_2) used in the MCAI. The vertical width of the box indicates the interquartile range (25th to 75th percentile), and whiskers extend from 5% to 95% percentiles. Blue line shows the cumulative population of scenes.
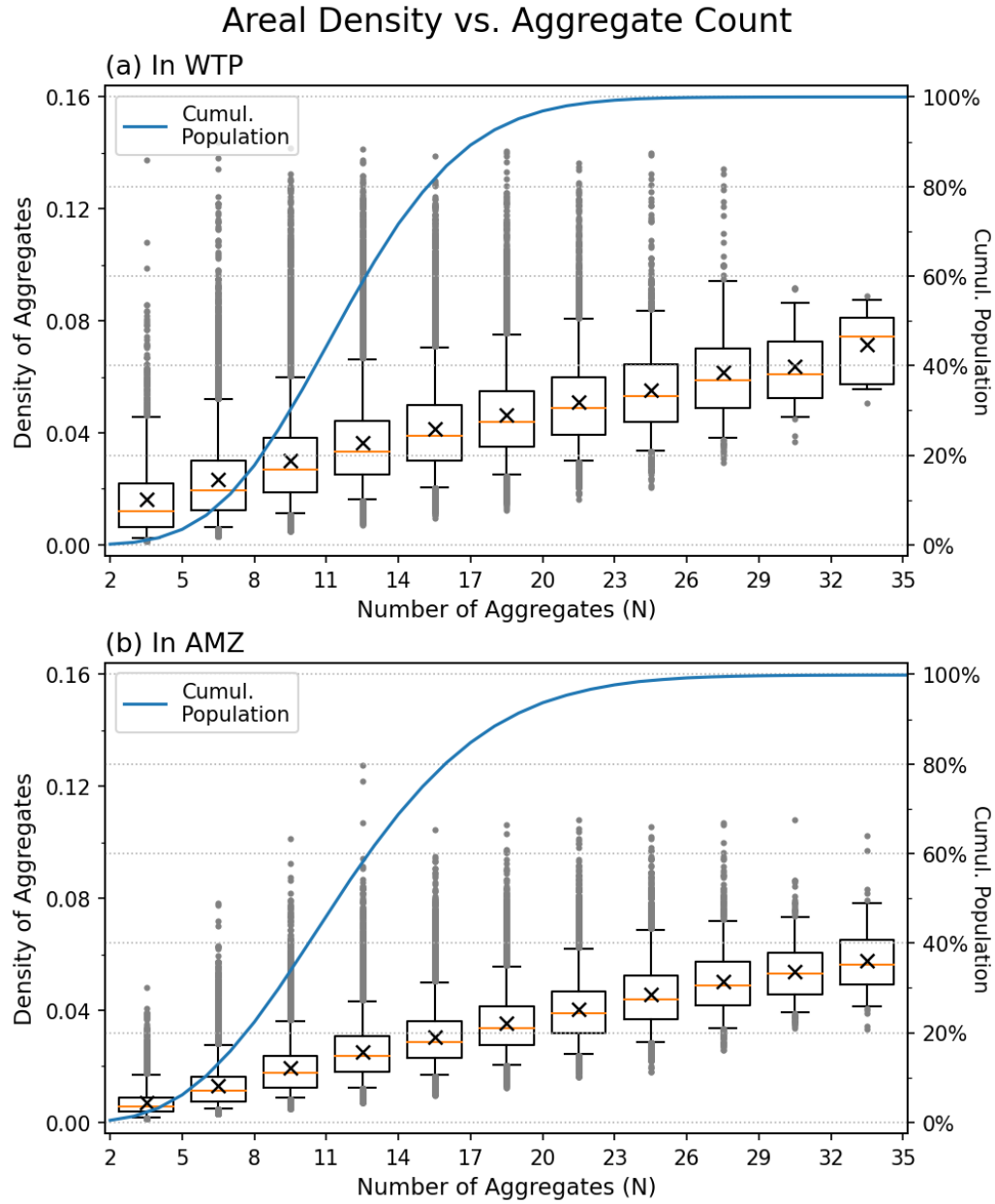
Figure S2. As Supplementary Figure S1 but for areal density distribution by the number of aggregates (a) in the western tropical Pacific domain (150°E-170°W, 20°S-20°N), and (b) in the Amazon basin and its vicinity (80°W-40°W, 25°S-15°N).

Random Aggregates for Metrics Comparison (Target_density=0.05)

(a) Case 1 (N= 57)
SCAI = 22.88125
MCAI = 24.64570

(b) Case 2 (N= 44)
SCAI = 15.29026
MCAI = 18.92715

(c) Case 3 (N= 21)
SCAI = 7.44435
MCAI = 8.93167

(d) Case 4 (N= 23)
SCAI = 8.98914
MCAI = 10.49516

(e) SCAI

(f) MCAI
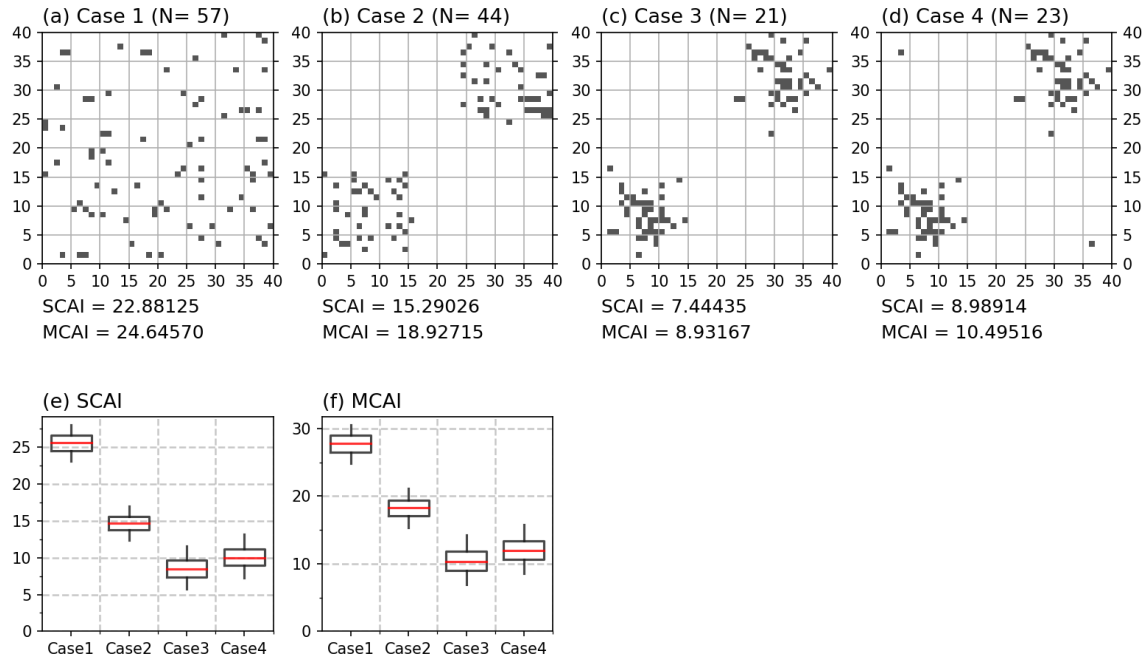
Figure S3. Same as Fig. 4, but for SCAI and MCAI. Note that lower values of SCAI and MCAI are interpreted as **_MORE_** organized, which is opposite to other metrics.

Selected Scenes of 5th/95th Percentile Org. Metrics in TIO, Target_AD=0.05

(a) 2009/11/04 1:00, N=21
COP = 0.15510
I_org = 0.51161
ABCOP = 1.88767

(b) 2010/10/02 21:00, N=16
COP = 0.15504
I_org = 0.60493
ABCOP = 1.52746

(c) 2001/01/01 16:00, N=8
COP = 0.27716
I_org = 0.52413
ABCOP = 1.64463
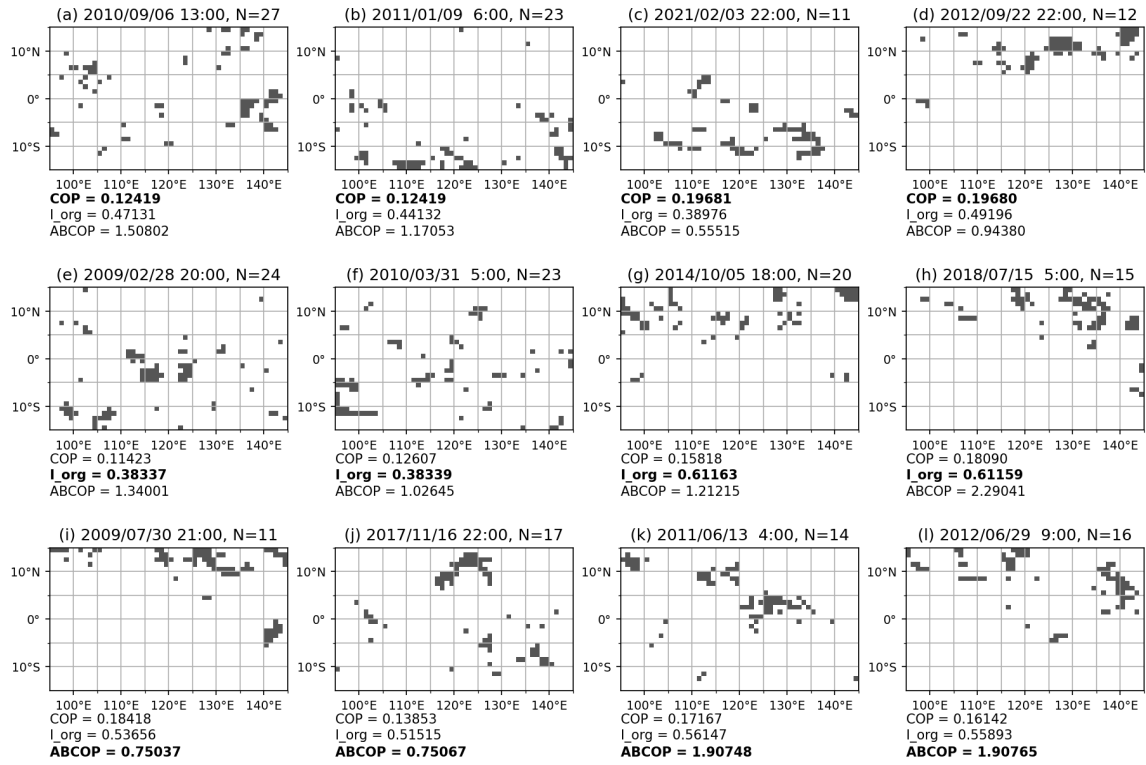
(d) 2010/08/11 12:00, N=9
COP = 0.27763
I_org = 0.78507
ABCOP = 1.93940

(e) 2011/08/18 10:00, N=8
COP = 0.20615
I_org = 0.41219
ABCOP = 0.66341

(f) 2009/07/02 23:00, N=15
COP = 0.15980
I_org = 0.41178
ABCOP = 1.26278

(g) 2014/11/21 16:00, N=20
COP = 0.16790
I_org = 0.69017
ABCOP = 2.23246

(h) 2018/09/29 23:00, N=10
COP = 0.25529
I_org = 0.69048
ABCOP = 1.74083

(i) 2010/01/01 7:00, N=5
COP = 0.26070
I_org = 0.37006
ABCOP = 0.62636

(j) 2020/07/17 5:00, N=11
COP = 0.19877
I_org = 0.44789
ABCOP = 0.62655

(k) 2013/12/12 7:00, N=9
COP = 0.29354
I_org = 0.69547
ABCOP = 2.34621

(l) 2020/11/19 0:00, N=17
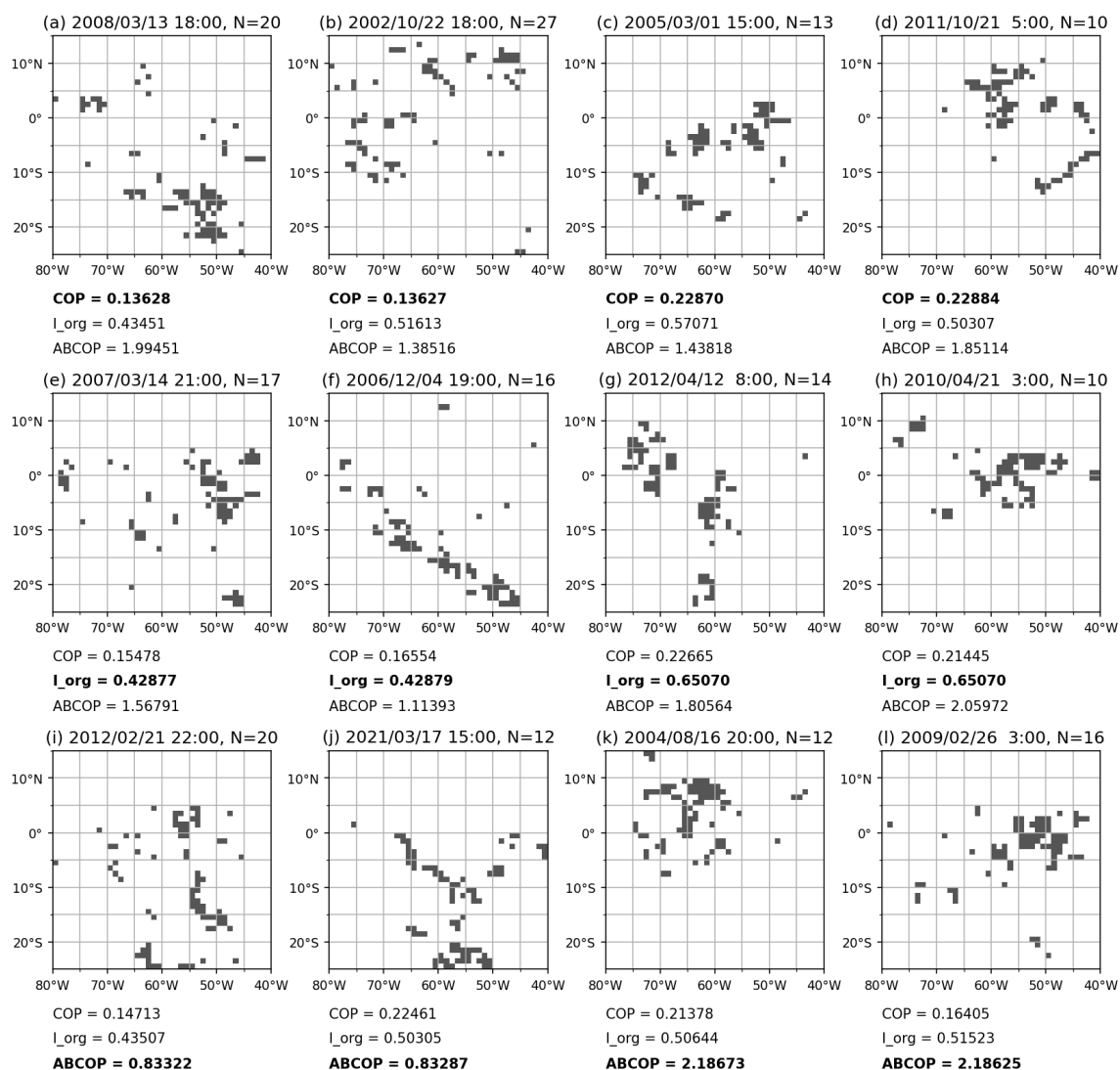COP = 0.18962
I_org = 0.57187
ABCOP = 2.34649

Figure S4. Same as Fig. 5, but for the tropical Indian Ocean domain (TIO; 50°E-90°E, 20°S-20°N).

Selected Scenes of 5th/95th Percentile Org. Metrics in MC, Target_AD=0.05

(a) 2010/09/06 13:00, N=27
COP = 0.12419
I_org = 0.47131
ABCOP = 1.50802

(b) 2011/01/09 6:00, N=23
COP = 0.12419
I_org = 0.44132
ABCOP = 1.17053

(c) 2021/02/03 22:00, N=11
COP = 0.19681
I_org = 0.38976
ABCOP = 0.55515

(d) 2012/09/22 22:00, N=12
COP = 0.19680
I_org = 0.49196
ABCOP = 0.94380

(e) 2009/02/28 20:00, N=24
COP = 0.11423
I_org = 0.38337
ABCOP = 1.34001

(f) 2010/03/31 5:00, N=23
COP = 0.12607
I_org = 0.38339
ABCOP = 1.02645

(g) 2014/10/05 18:00, N=20
COP = 0.15818
I_org = 0.61163
ABCOP = 1.21215

(h) 2018/07/15 5:00, N=15
COP = 0.18090
I_org = 0.61159
ABCOP = 2.29041

(i) 2009/07/30 21:00, N=11
COP = 0.18418
I_org = 0.53656
ABCOP = 0.75037

(j) 2017/11/16 22:00, N=17
COP = 0.13853
I_org = 0.51515
ABCOP = 0.75067

(k) 2011/06/13 4:00, N=14
COP = 0.17167
I_org = 0.56147
ABCOP = 1.90748

(l) 2012/06/29 9:00, N=16
COP = 0.16142
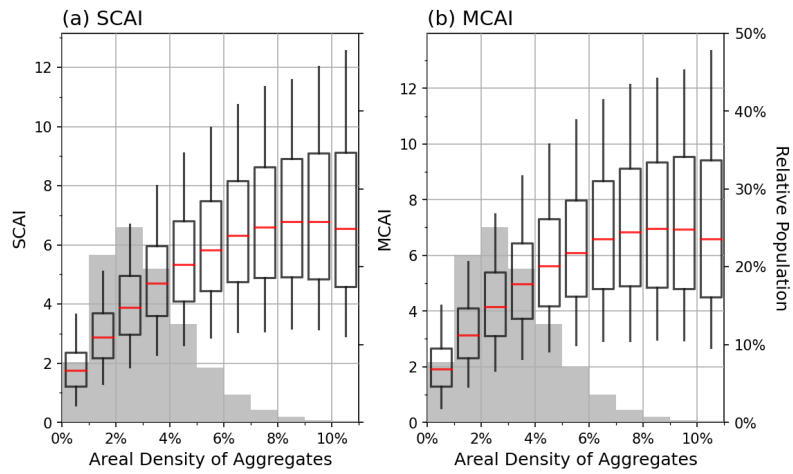I_org = 0.55893
ABCOP = 1.90765

Figure S5. Same as Fig. 5, but for the Maritime Continent domain (MC; 95°E-145°E, 15°N-15°N).

Selected Scenes of 5th/95th Percentile Org. Metrics in AMZ, Target_AD=0.05

(a) 2008/03/13 18:00, N=20

COP = 0.13628
I_org = 0.43451
ABCOP = 1.99451

(b) 2002/10/22 18:00, N=27

COP = 0.13627
I_org = 0.51613
ABCOP = 1.38516

(c) 2005/03/01 15:00, N=13

COP = 0.22870
I_org = 0.57071
ABCOP = 1.43818

(d) 2011/10/21 5:00, N=10

COP = 0.22884
I_org = 0.50307
ABCOP = 1.85114

(e) 2007/03/14 21:00, N=17

COP = 0.15478
I_org = 0.42877
ABCOP = 1.56791

(f) 2006/12/04 19:00, N=16

COP = 0.16554
I_org = 0.42879
ABCOP = 1.11393

(g) 2012/04/12 8:00, N=14

COP = 0.22665
I_org = 0.65070
ABCOP = 1.80564

(h) 2010/04/21 3:00, N=10

COP = 0.21445
I_org = 0.65070
ABCOP = 2.05972

(i) 2012/02/21 22:00, N=20

COP = 0.14713
I_org = 0.43507
ABCOP = 0.83322

(j) 2021/03/17 15:00, N=12

COP = 0.22461
I_org = 0.50305
ABCOP = 0.83287

(k) 2004/08/16 20:00, N=12

COP = 0.21378
I_org = 0.50644
ABCOP = 2.18673

(l) 2009/02/26 3:00, N=16

COP = 0.16405
I_org = 0.51523
ABCOP = 2.18625

Figure S6. Same as Fig. 5, but for the Amazon basin and its vicinity domain (AMZ; 80°W–40°W, 25°S–15°N).

Figure S7. Same as Fig. 6, but for SCAI and MCAI metrics. We note that larger value of SCAI or MCAI means **_LESS_** organized, which is opposite to other organization metrics.
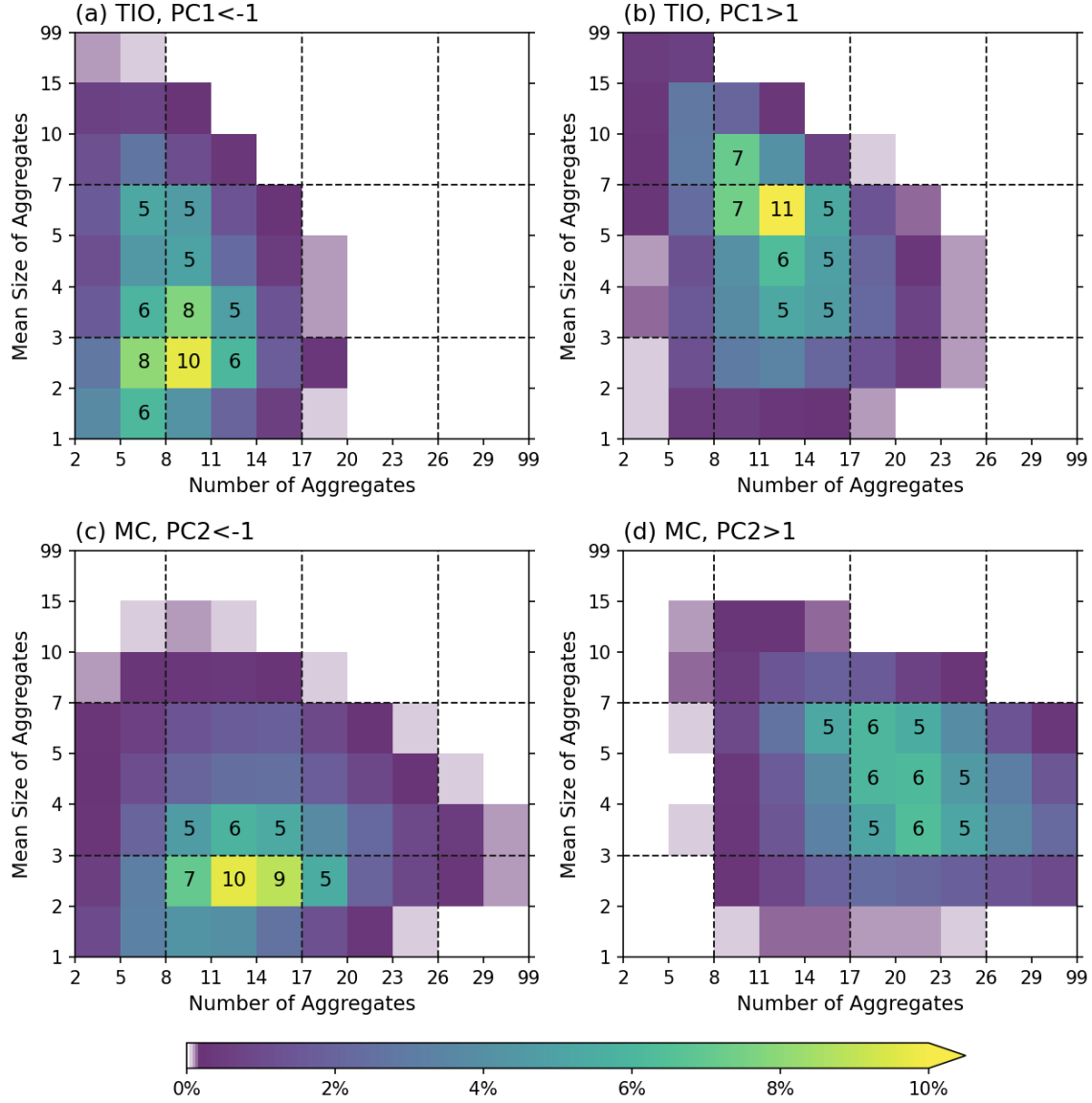
Figure S8. Normalized joint histogram of the number of aggregates and mean size of aggregates in the tropical Indian Ocean domain (TIO; 50°E-90°E, 20°S-20°N; top row) and the Maritime Continent domain (MC; 95°E-145°E, 15°S-15°N; bottom row) in the season of December to February, separated by the strength of Madden-Julian Oscillation. (a) Composites when OMI PC1<-1 in TIO, (b) composites when OMI PC1>1 in TIO, (c) Composites when OMI PC2<-1 in MC, and (d) composites when OMI PC2>1 in MC.

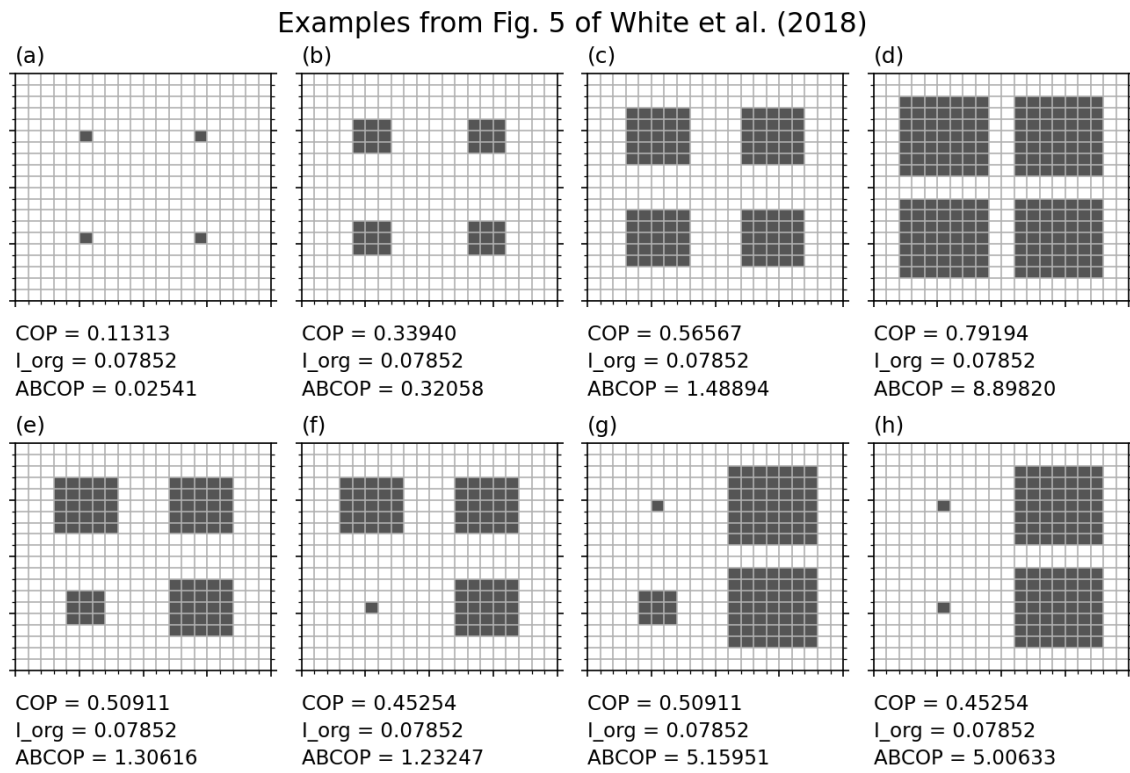Aggr. Org. Metrics(5 to 21-Pentad Band-pass) vs. OMI PCs in 2001-21 DJF
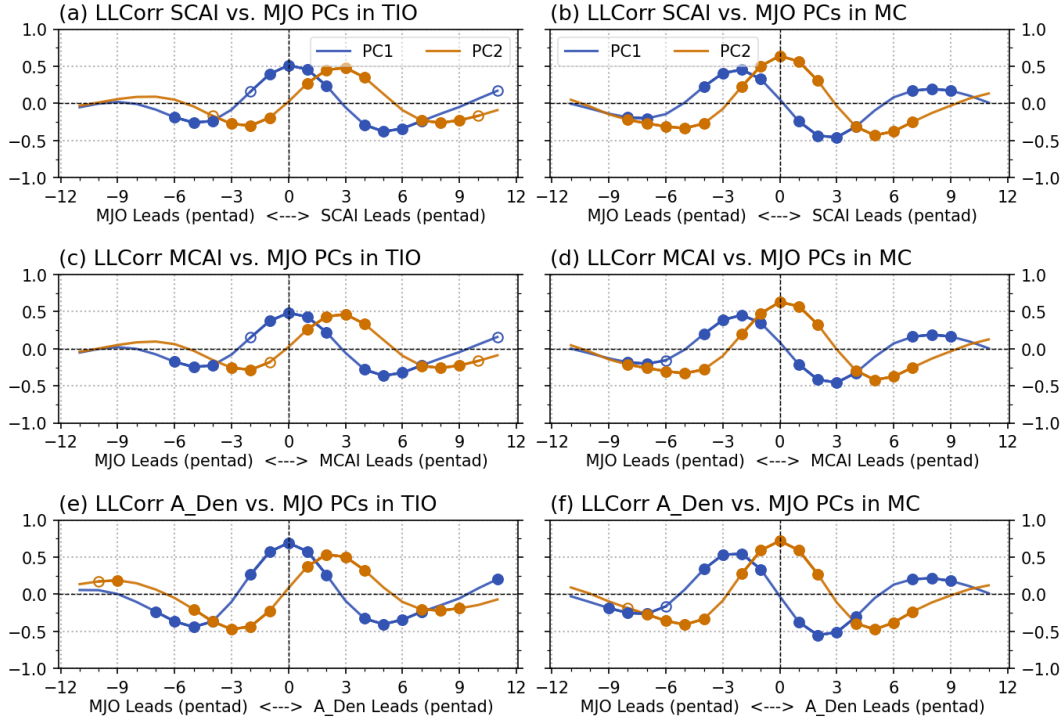
Figure S9. Lead-lag correlation coefficients between OMI PCs and band-pass filtered anomalies (5 to 21 pentads) of organization metrics. The left column shows results in the tropical Indian Ocean (TIO; 50°E-90°E, 20°S-20°N) and the right column shows results in the Maritime Continent (MC; 95°E-145°E, 15°S-15°N). (a), (b) SCAI, (c), (d) MCAI, and (e), (f) Areal Density (same as Figs. 7g and 7h). Open and closed circle symbols indicate that the correlation coefficients are above the two-tailed 90% and 95% significance levels, respectively, estimated using degrees of freedom deduced by autocorrelation. We note that higher SCAI and MCAI values are thought of as **LESS** organized, which is opposite to other organization metrics.
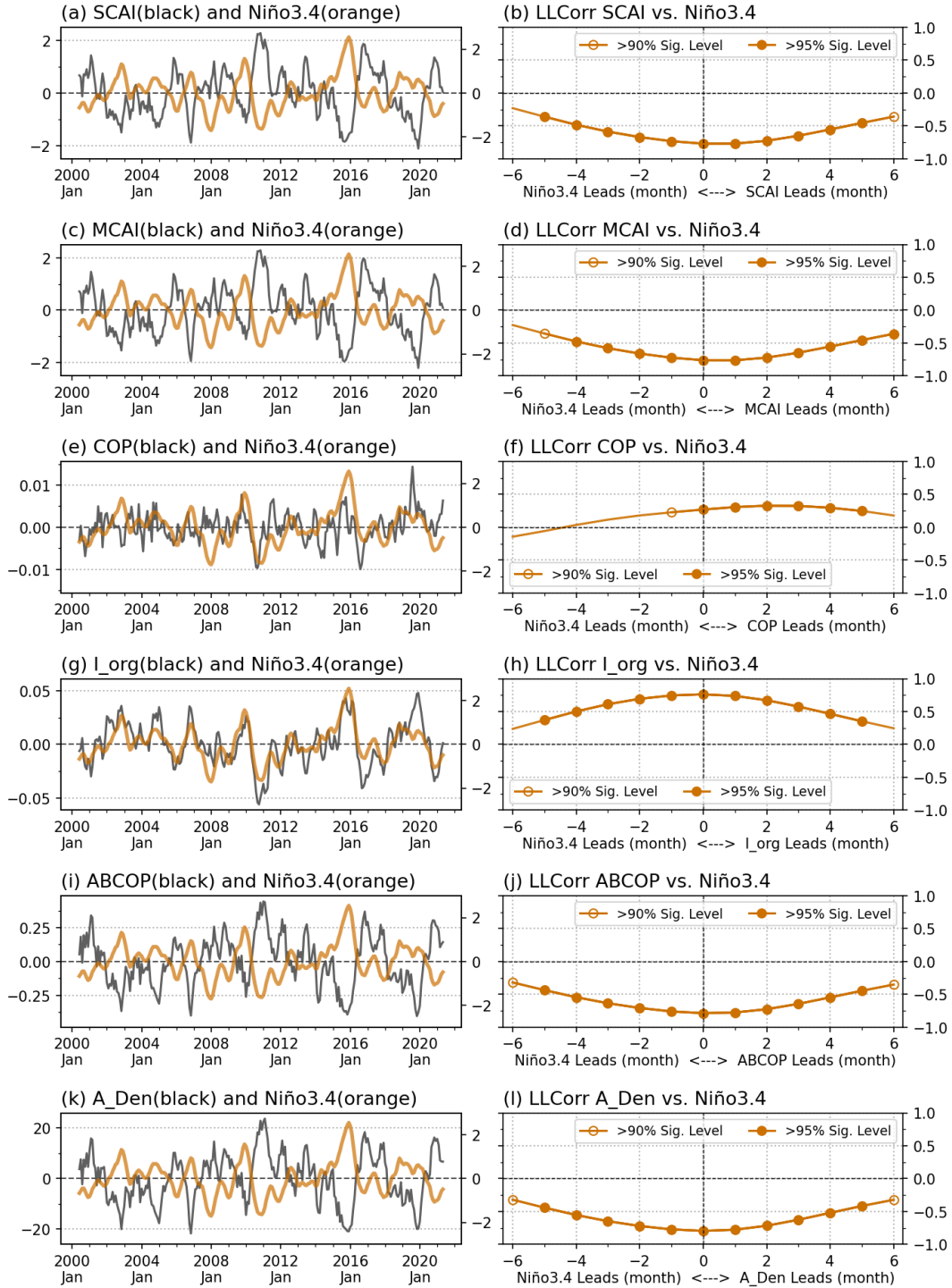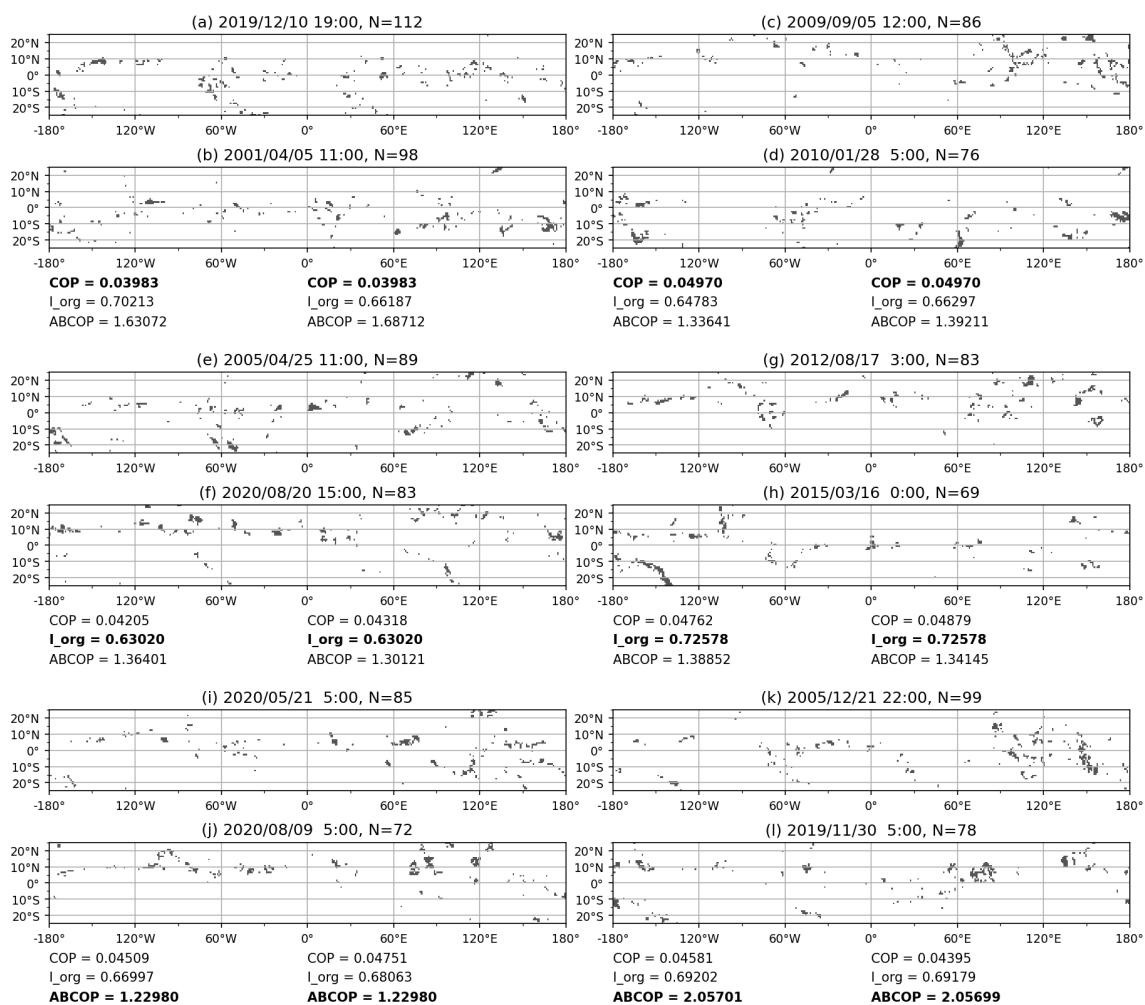
Figure S10. Lead-lag correlation coefficients between monthly Niño3.4 index and organization metrics. Organization metrics are calculated over the MC domain. The left column shows timeseries of Niño3.4 index (orange) and organization metrics (gray), both of which are smoothed by 3-month running mean. The right column shows lead-lag

correlation coefficients where open and closed circle symbols indicate above the 90% and 95% significance levels, respectively. (a), (b) SCAI, (c), (d) MCAI, (e), (f) COP, (g), (h) I_{org}, (i), (j) ABCOP, and (k), (l) Areal Density. We note that higher SCAI and MCAI values are thought of as *LESS* organized, which is opposite to other organization metrics.

Examples from Fig. 5 of White et al. (2018)

(a)

COP = 0.11313
I_org = 0.07852
ABCOP = 0.02541

(b)

COP = 0.33940
I_org = 0.07852
ABCOP = 0.32058

(c)

COP = 0.56567
I_org = 0.07852
ABCOP = 1.48894

(d)

COP = 0.79194
I_org = 0.07852
ABCOP = 8.89820

(e)

COP = 0.50911
I_org = 0.07852
ABCOP = 1.30616

(f)

COP = 0.45254
I_org = 0.07852
ABCOP = 1.23247

(g)

COP = 0.50911
I_org = 0.07852
ABCOP = 5.15951
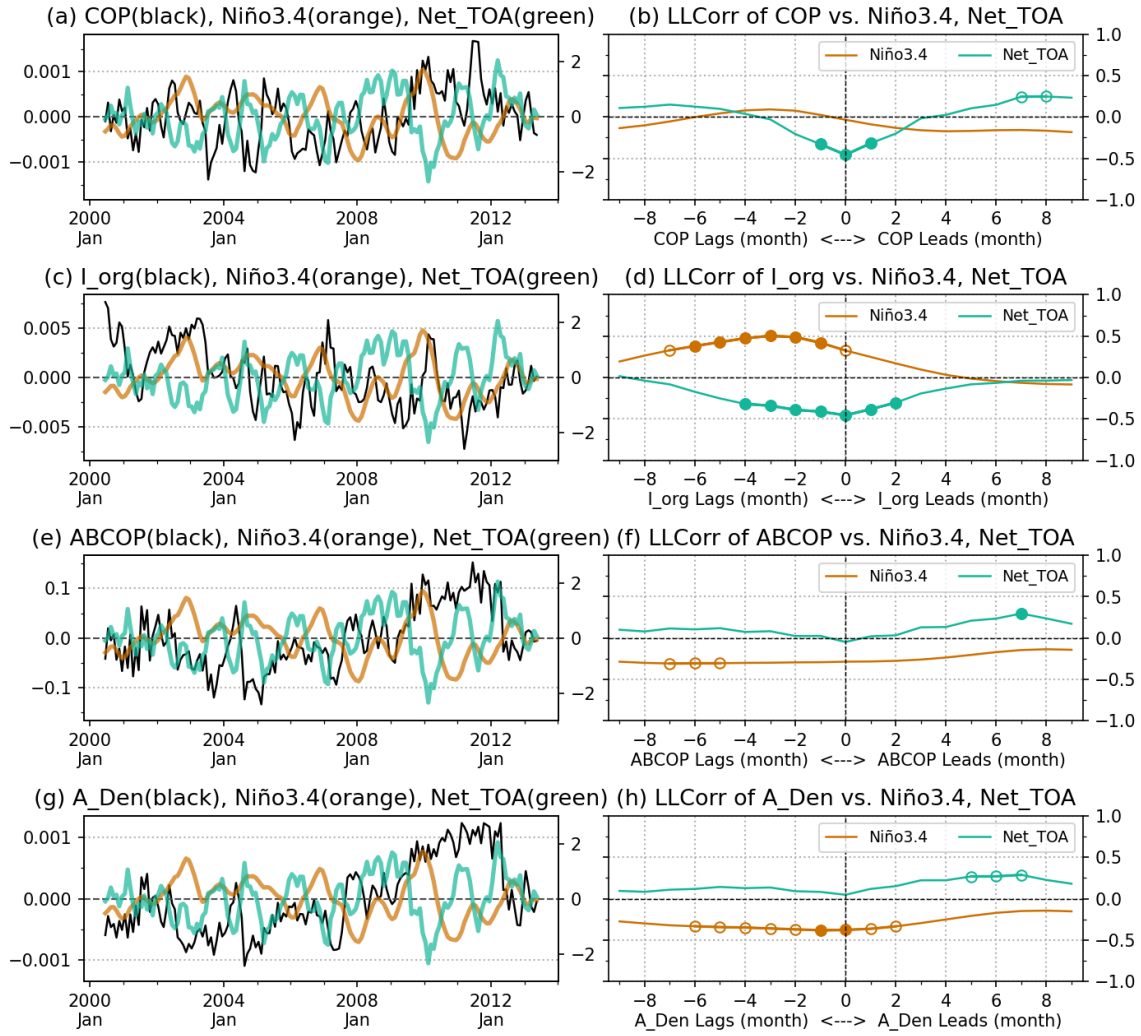
(h)

COP = 0.45254
I_org = 0.07852
ABCOP = 5.00633

Figure S11. COP, I_{org}, and ABCOP computed for the idealized examples in Fig. 5 of White et al. (2018).

Selected Scenes of 5th/95th Percentile Org. Metrics in 25S-25N, Target_AD=0.02

(a) 2019/12/10 19:00, N=112

(c) 2009/09/05 12:00, N=86

(b) 2001/04/05 11:00, N=98

(d) 2010/01/28 5:00, N=76

COP = 0.03983	**COP = 0.03983**	**COP = 0.04970**	**COP = 0.04970**
I_org = 0.70213	I_org = 0.66187	I_org = 0.64783	I_org = 0.66297
ABCOP = 1.63072	ABCOP = 1.68712	ABCOP = 1.33641	ABCOP = 1.39211

(e) 2005/04/25 11:00, N=89

(g) 2012/08/17 3:00, N=83

(f) 2020/08/20 15:00, N=83

(h) 2015/03/16 0:00, N=69

COP = 0.04205	COP = 0.04318	COP = 0.04762	COP = 0.04879
I_org = 0.63020	**I_org = 0.63020**	**I_org = 0.72578**	**I_org = 0.72578**
ABCOP = 1.36401	ABCOP = 1.30121	ABCOP = 1.38852	ABCOP = 1.34145

(i) 2020/05/21 5:00, N=85

(k) 2005/12/21 22:00, N=99

(j) 2020/08/09 5:00, N=72

(l) 2019/11/30 5:00, N=78

COP = 0.04509	COP = 0.04751	COP = 0.04581	COP = 0.04395
I_org = 0.66997	I_org = 0.68063	I_org = 0.69202	I_org = 0.69179
ABCOP = 1.22980	**ABCOP = 1.22980**	**ABCOP = 2.05701**	**ABCOP = 2.05699**

Figure S12. Same as Fig. 5, but for the extended tropics domain (25°S-25°N).

Figure S13. Same as Fig. 12, but for shorter time period of 13 years, 2000.06 to 2013.05.
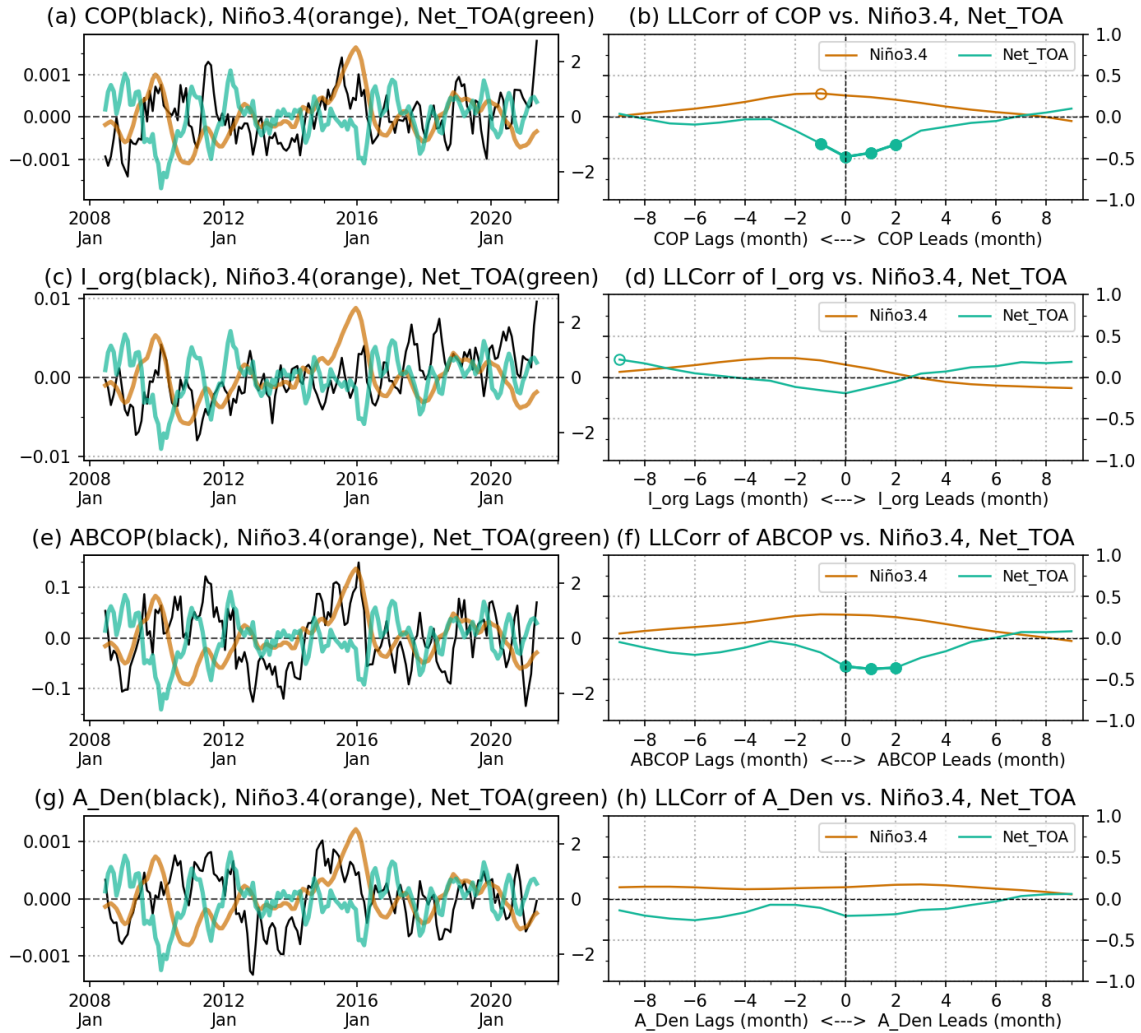
Figure S14. Same as Fig. 12, but for shorter time period of 13 years, 2008.06 to 2021.05.