Supporting Information for

A New Organization Metric for Synoptic Scale Tropical Convective Aggregation

Daeho Jin[1,2], Lazaros Oreopoulos[2], Dongmin Lee[3,2], Jackson Tan[1,2], Kyu-myong Kim[2]

[1] GESTAR-II, University of Maryland – Baltimore County, Baltimore, MD, USA

[2] Earth Sciences Division, NASA's Goddard Space Flight Center, Greenbelt, MD, USA

[3] GESTAR-II, Morgan State University, Baltimore MD, USA
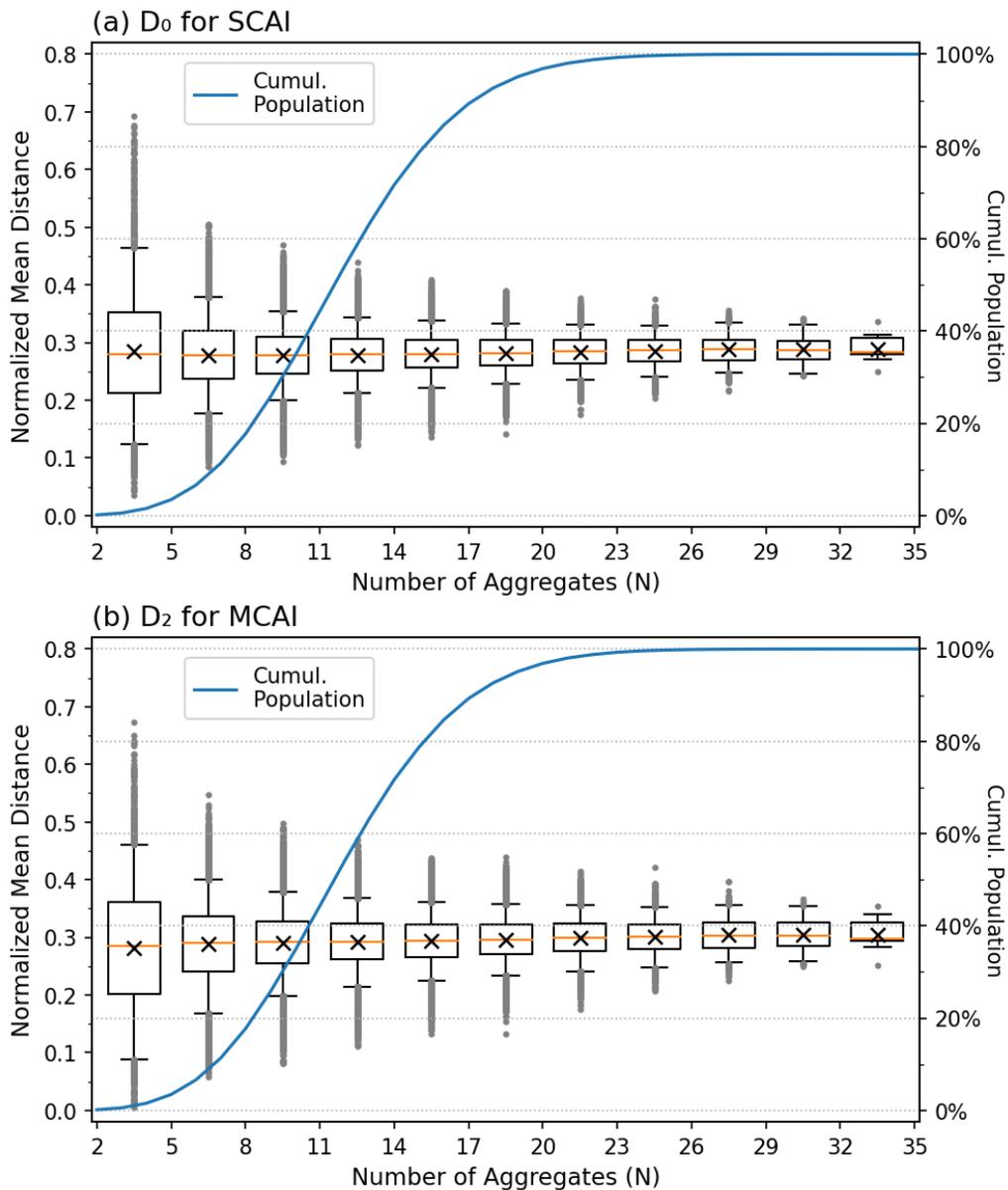
Corresponding author: Daeho Jin (Daeho.Jin@NASA.gov)

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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.
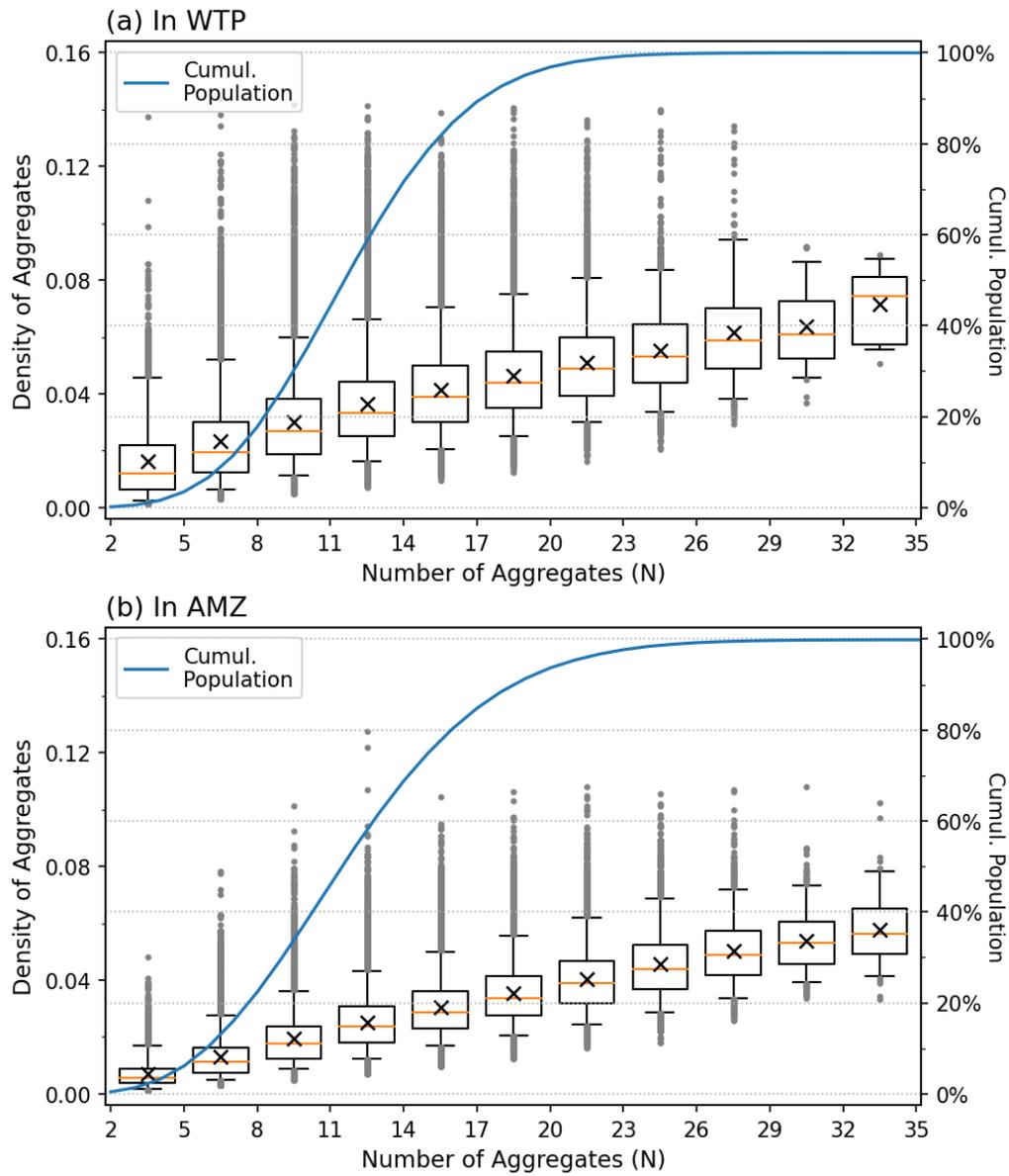
Figure S2. As Supplementary Figure S1 but for areal density distribution by the number of aggregates (a) in the western tropical Pacific domain (150°E-170°W, 20°S-20°N), and (b) in the Amazon basin and its vicinity (80°W-40°W, 25°S-15°N).

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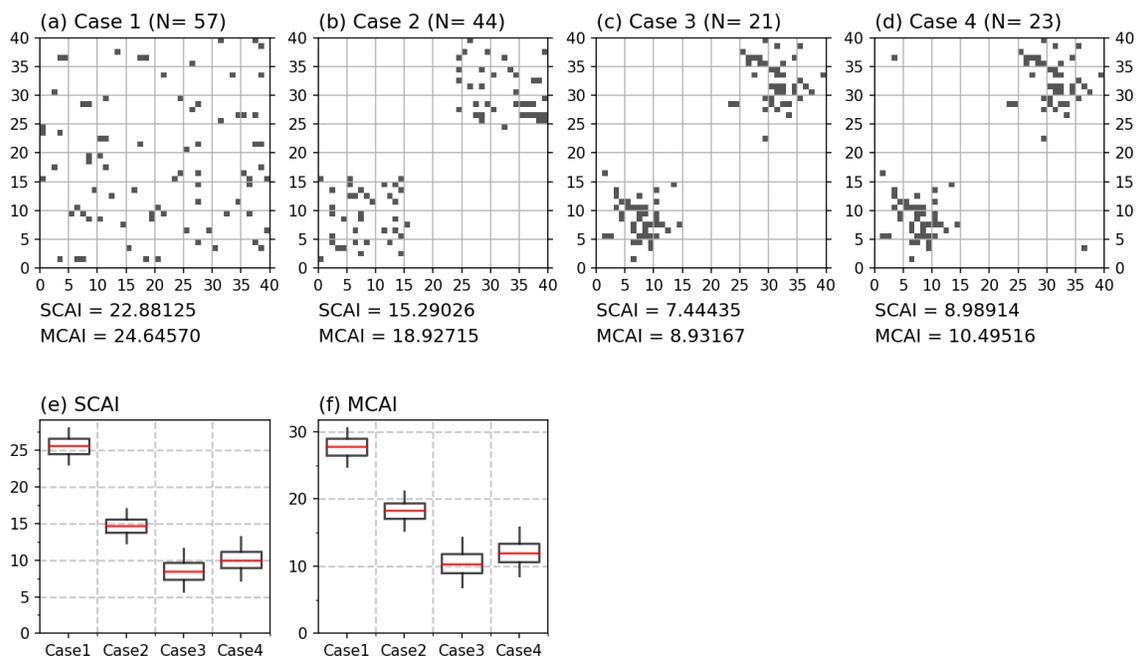
Figure S3. Same as Fig. 4, but for SCAI and MCAI. Note that lower values of SCAI and MCAI are interpreted as *MORE* organized, which is opposite to other metrics.

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 (5th)**
I_org = 0.51161 (30th)
ABCOP = 1.88767 (83th)

(b) 2010/10/02 21:00, N=16

COP = 0.15504 (5th)
I_org = 0.60493 (73th)
ABCOP = 1.52746 (65th)

(c) 2001/01/01 16:00, N=8

COP = 0.27716 (95th)
I_org = 0.52413 (35th)
ABCOP = 1.64463 (72th)

(d) 2010/08/11 12:00, N=9

COP = 0.27763 (95th)
I_org = 0.78507 (100th)
ABCOP = 1.93940 (85th)

(e) 2011/08/18 10:00, N=8

COP = 0.20615 (60th)
I_org = 0.41219 (5th)
ABCOP = 0.66341 (6th)

(f) 2009/07/02 23:00, N=15

COP = 0.15980 (8th)
I_org = 0.41178 (5th)
ABCOP = 1.26278 (45th)

(g) 2014/11/21 16:00, N=20

COP = 0.16790 (16th)
I_org = 0.69017 (95th)
ABCOP = 2.23246 (93th)

(h) 2018/09/29 23:00, N=10

COP = 0.25529 (90th)
I_org = 0.69048 (95th)
ABCOP = 1.74083 (77th)

(i) 2010/01/01 7:00, N=5

COP = 0.26070 (92th)
I_org = 0.37006 (2th)
ABCOP = 0.62636 (5th)

(j) 2020/07/17 5:00, N=11

COP = 0.19877 (52th)
I_org = 0.44789 (10th)
ABCOP = 0.62655 (5th)

(k) 2013/12/12 7:00, N=9

COP = 0.29354 (97th)
I_org = 0.69547 (95th)
ABCOP = 2.34621 (95th)

(l) 2020/11/19 0:00, N=17

COP = 0.18962 (41th)
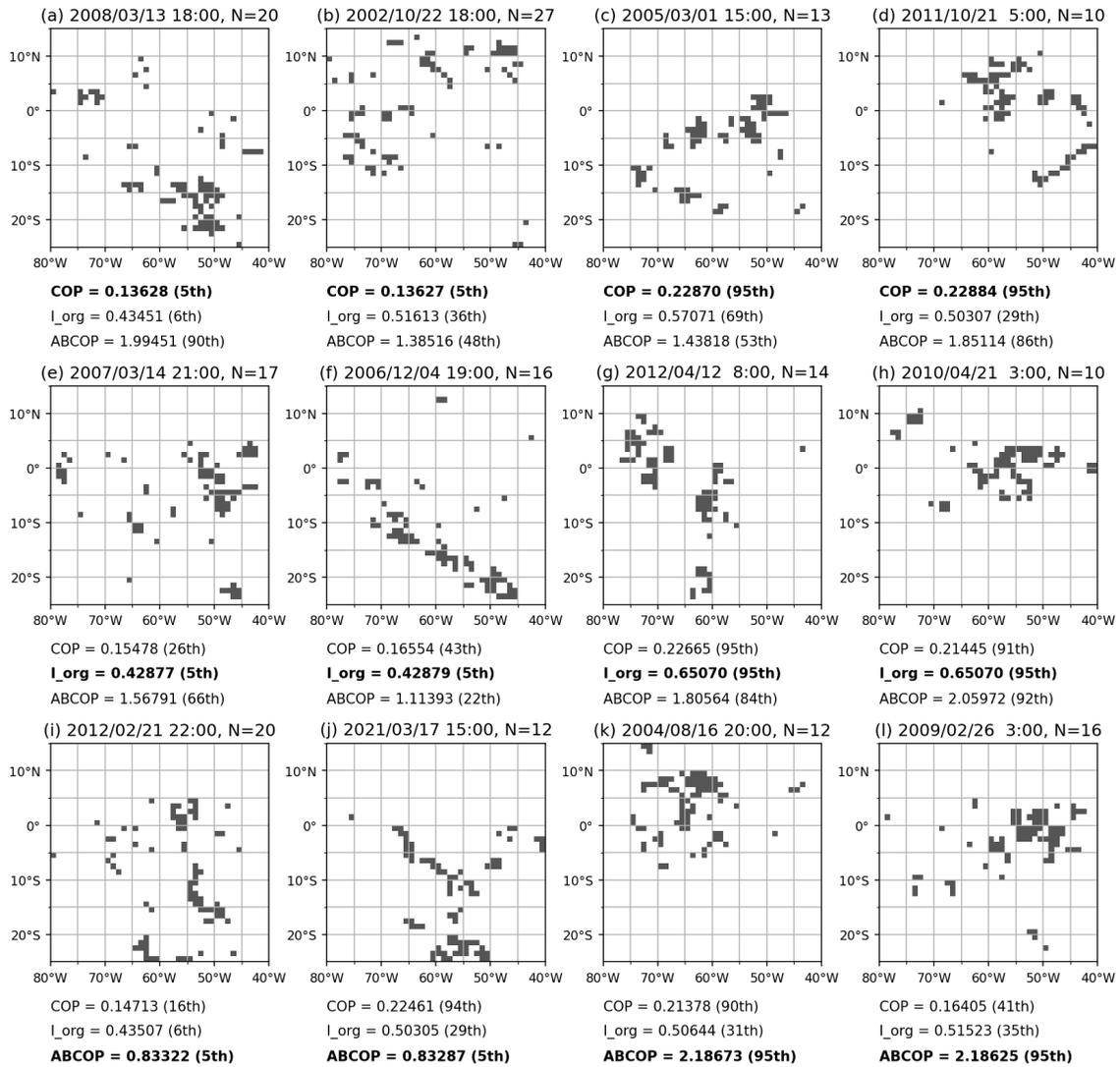I_org = 0.57187 (59th)
ABCOP = 2.34649 (95th)

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

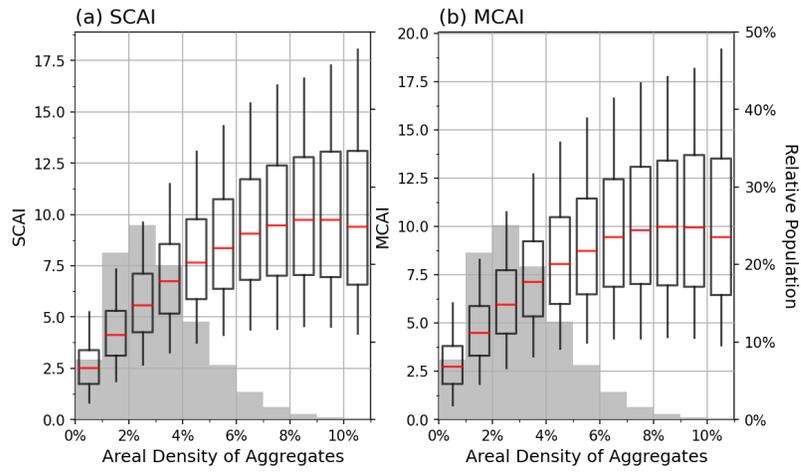Selected Scenes of 5th/95th Percentile Org. Metrics in MC, Target_AD=0.05
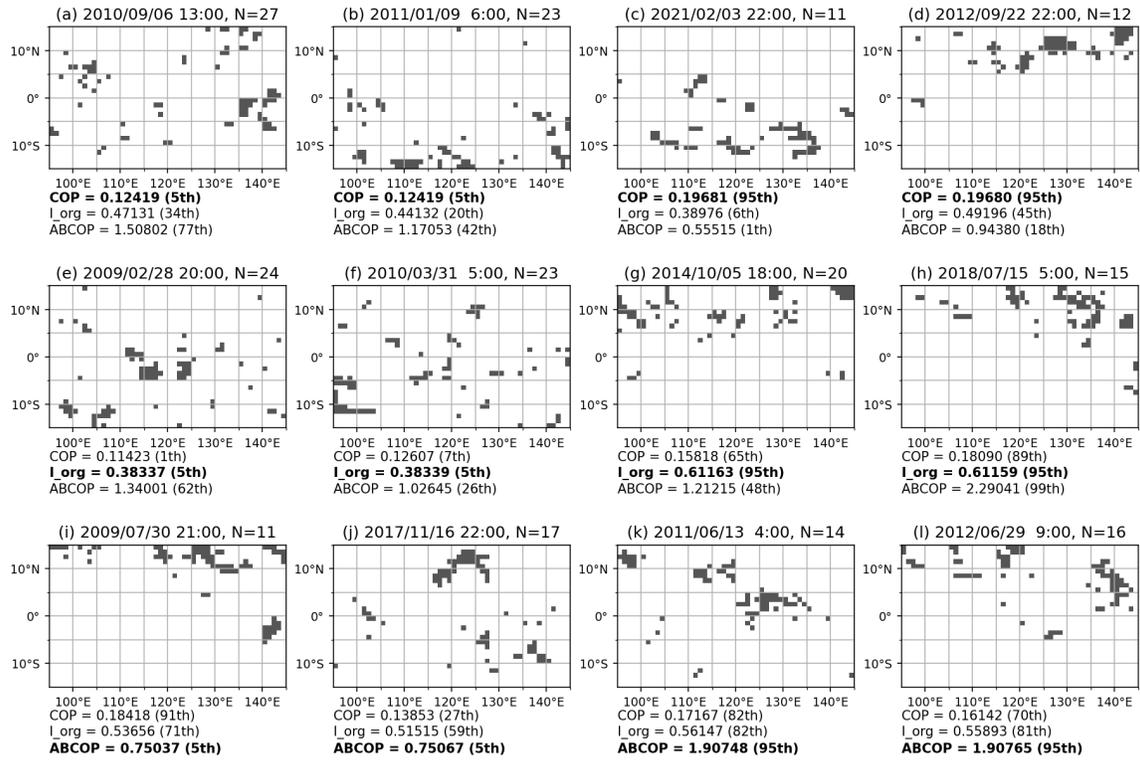
Figure S5. Same as Fig. 5, but for the Maritime Continent domain (MC; 95°E-145°E, 15°N-15°N).

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.
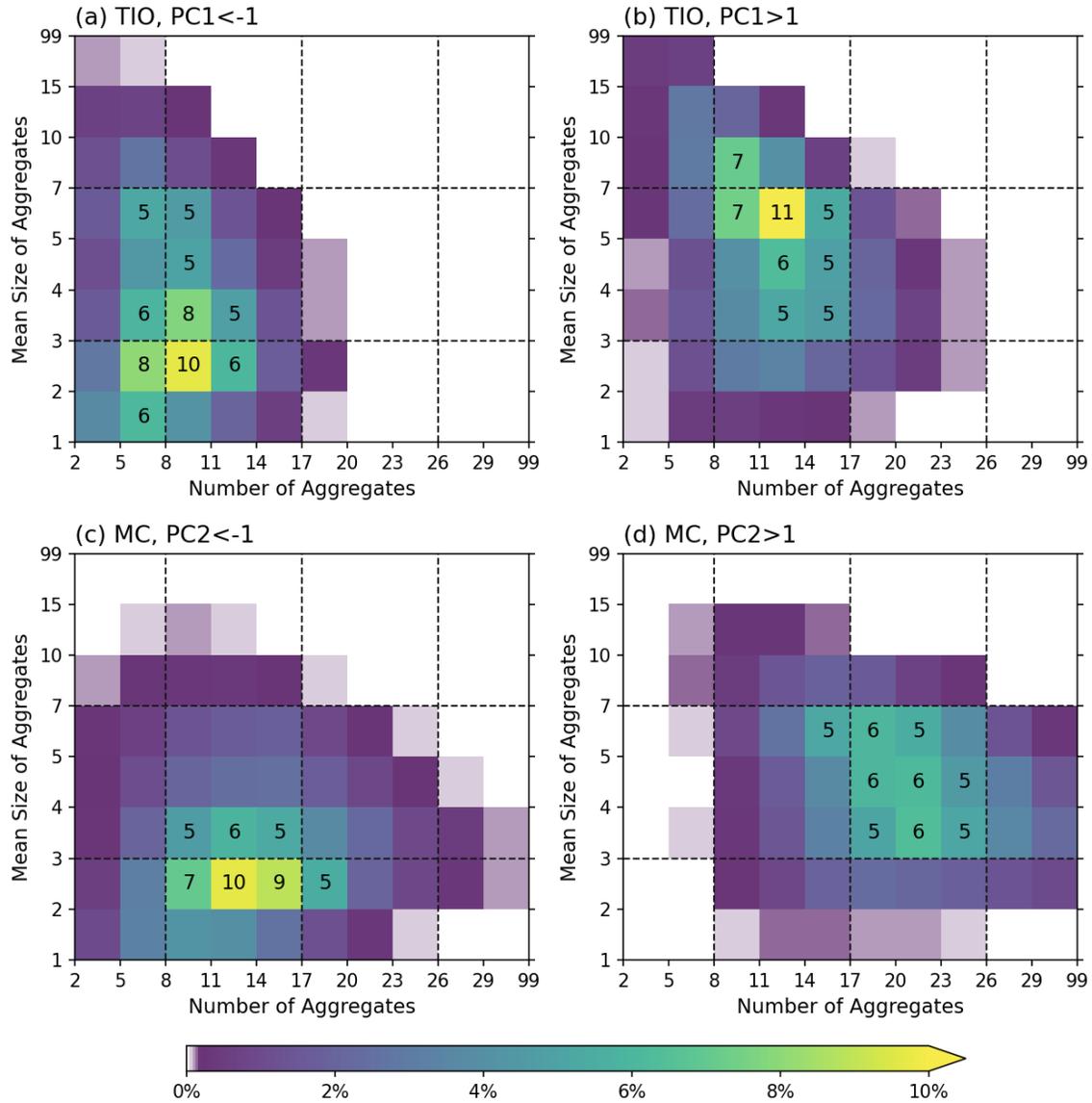
Figure S8. Normalized joint histogram of the number of aggregates and mean size of aggregates in the tropical Indian Ocean domain (TIO; 50°E-90°E, 20°S-20°N; top row) and the Maritime Continent domain (MC; 95°E-145°E, 15°S-15°N; bottom row) in the season of December to February, separated by the strength 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.
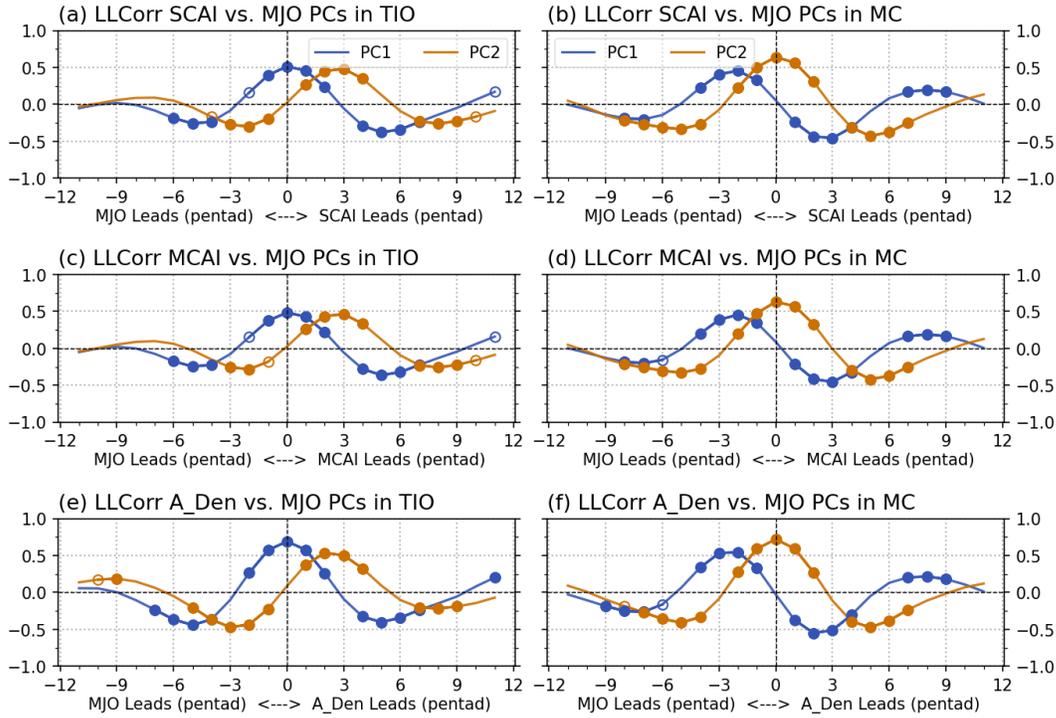
Figure S9. Lead-lag correlation coefficients between OMI PCs and band-pass filtered anomalies (5 to 21 pentads) of organization metrics. The left column shows results in the tropical Indian Ocean (TIO; 50°E-90°E, 20°S-20°N) and the right column shows results in the Maritime Continent (MC; 95°E-145°E, 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
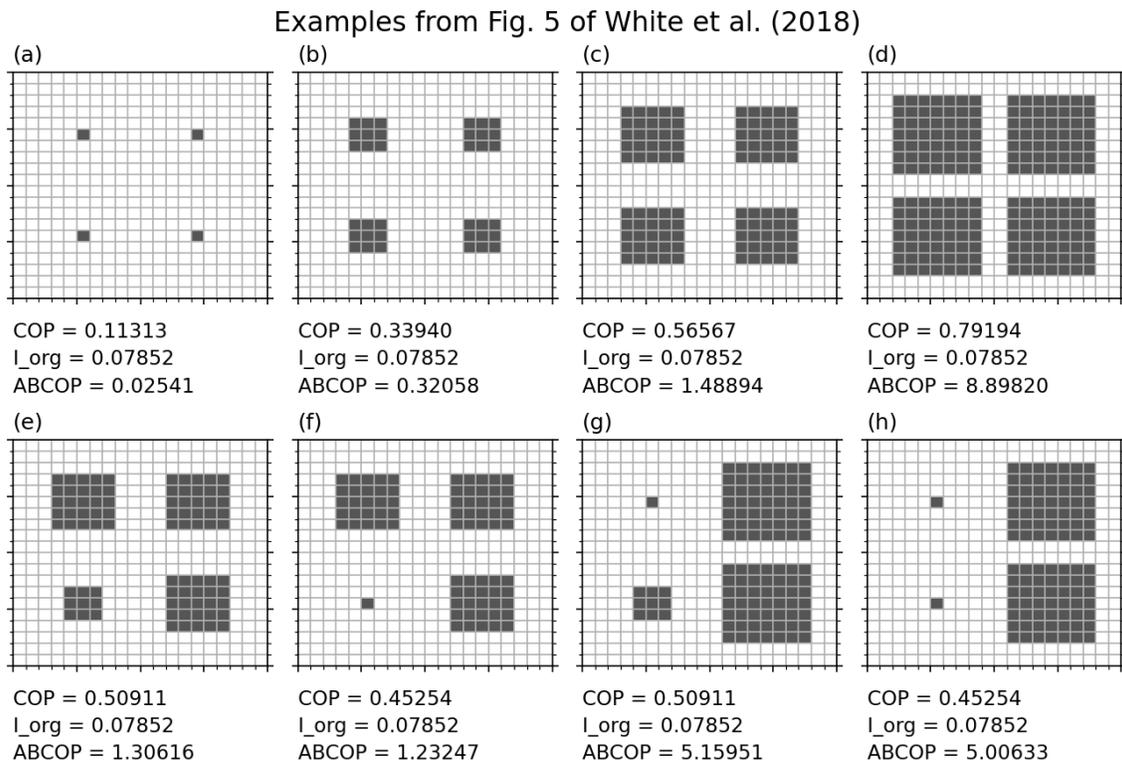
Figure S11. COP, I_{org}, and ABCOP computed for the idealized examples in Fig. 5 of White et al. (2018).

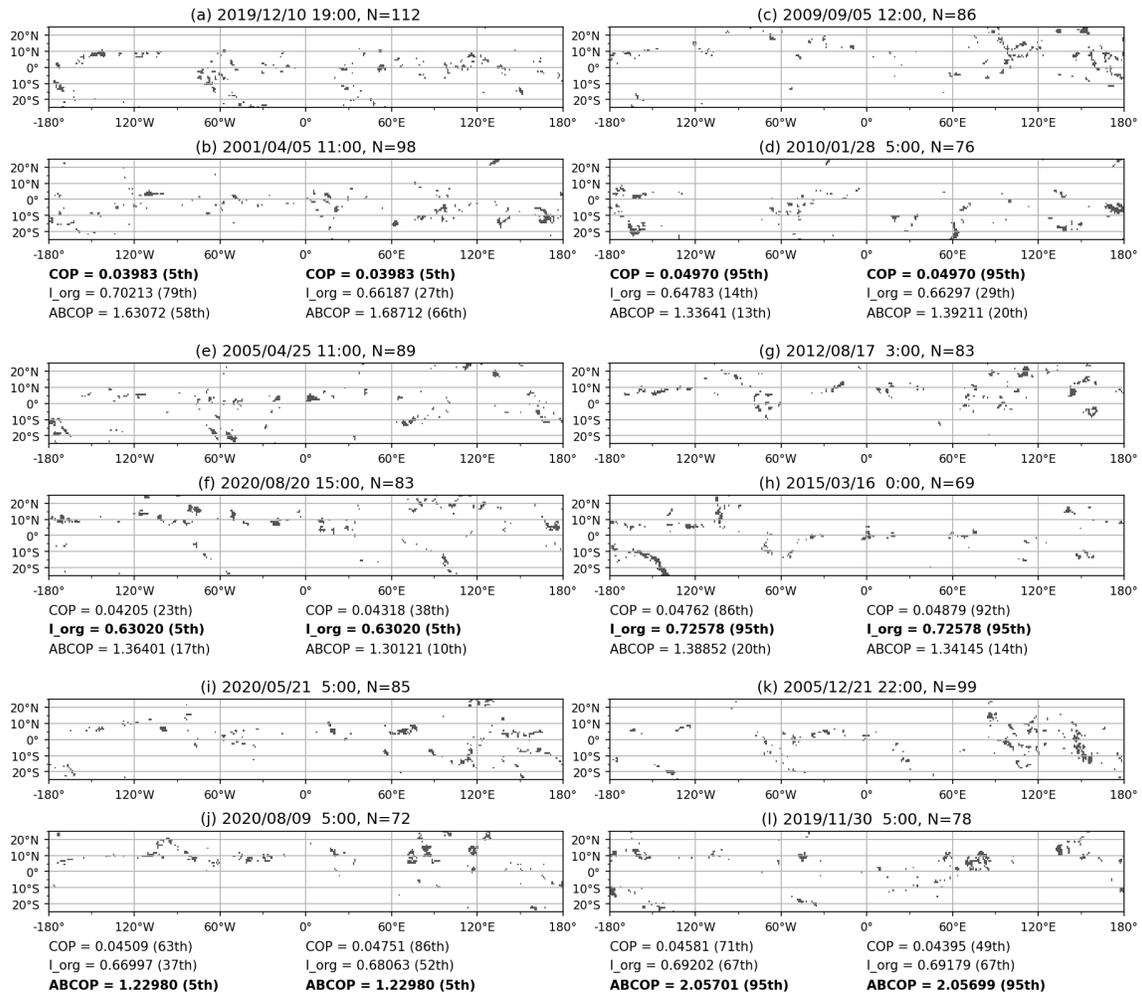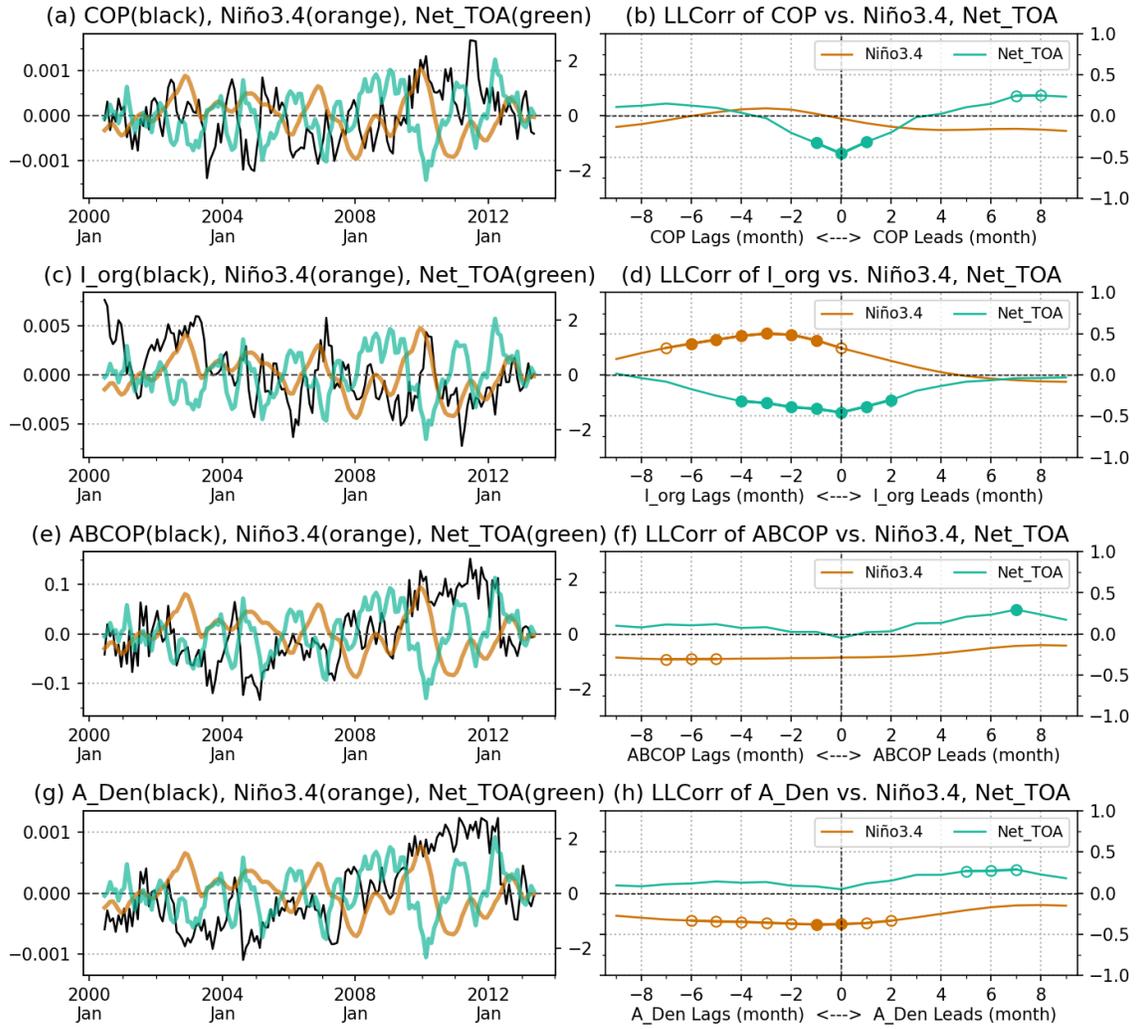## Selected Scenes of 5th/95th Percentile Org. Metrics in 25S-25N, Target_AD=0.02

(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 (5th)   **COP = 0.03983 (5th)**
I_org = 0.70213 (79th)   I_org = 0.66187 (27th)
ABCOP = 1.63072 (58th)   ABCOP = 1.68712 (66th)

COP = 0.04970 (95th)   **COP = 0.04970 (95th)**
I_org = 0.64783 (14th)   I_org = 0.66297 (29th)
ABCOP = 1.33641 (13th)   ABCOP = 1.39211 (20th)

(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 (23th)   COP = 0.04318 (38th)
I_org = 0.63020 (5th)   **I_org = 0.63020 (5th)**
ABCOP = 1.36401 (17th)   ABCOP = 1.30121 (10th)

COP = 0.04762 (86th)   COP = 0.04879 (92th)
I_org = 0.72578 (95th)   **I_org = 0.72578 (95th)**
ABCOP = 1.38852 (20th)   ABCOP = 1.34145 (14th)

(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 (63th)   COP = 0.04751 (86th)
I_org = 0.66997 (37th)   I_org = 0.68063 (52th)
ABCOP = 1.22980 (5th)   **ABCOP = 1.22980 (5th)**

COP = 0.04581 (71th)   COP = 0.04395 (49th)
I_org = 0.69202 (67th)   I_org = 0.69179 (67th)
ABCOP = 2.05701 (95th)   **ABCOP = 2.05699 (95th)**

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

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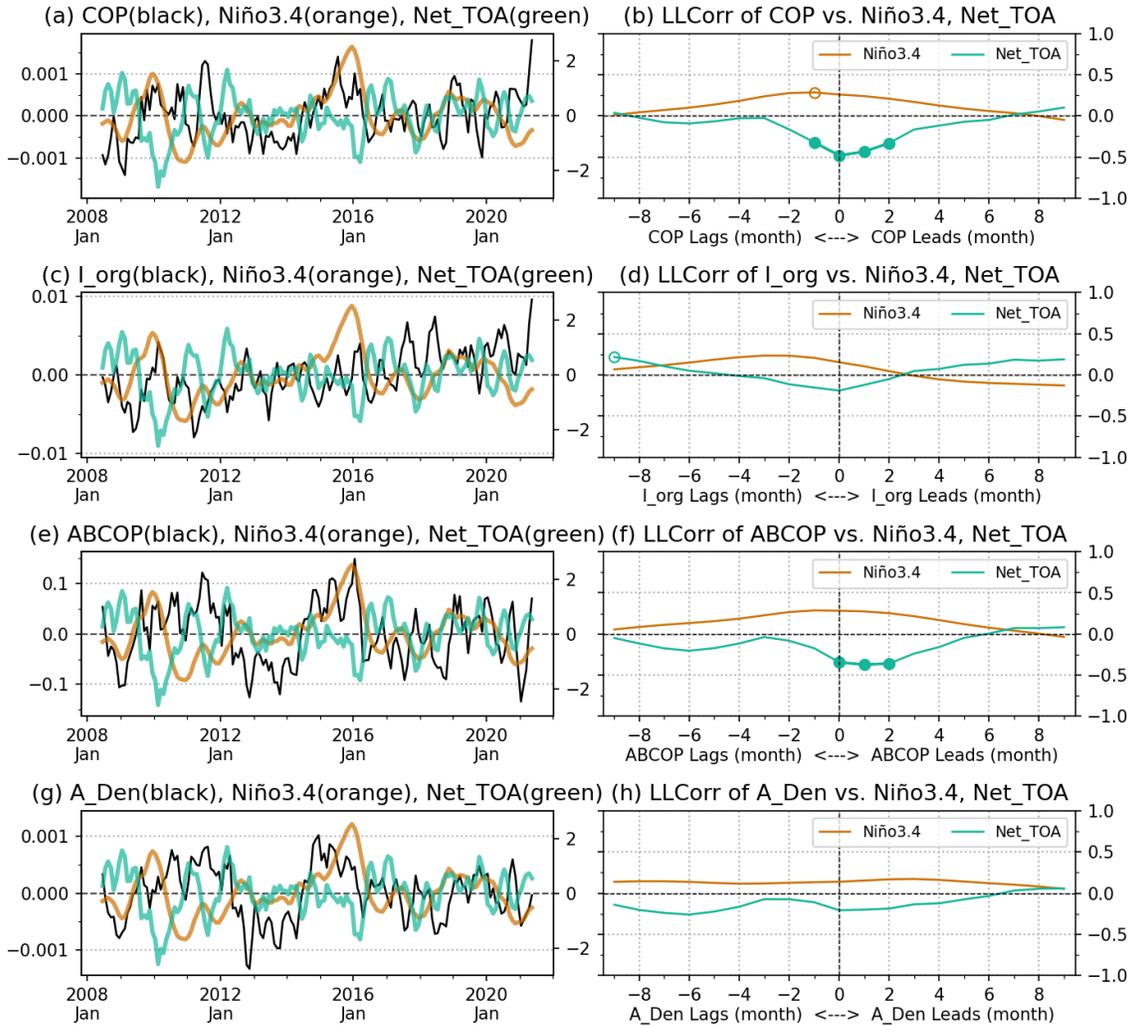
Figure S14. Same as Fig. 12, but for shorter time period of 13 years, 2008.06 to 2021.05.