Geophysical Research Letters

Supporting Information for

A multivariate probabilistic framework for tracking the intertropical convergence zone: Analysis of recent climatology and past trends

by

Antonios Mamalakis[1], Efi Foufoula-Georgiou[1,2]

[1] Department of Civil and Environmental Engineering, University of California, Irvine
[2] Department of Earth System Science, University of California, Irvine

Contents of this file

Figures S1 to S7
Table S1

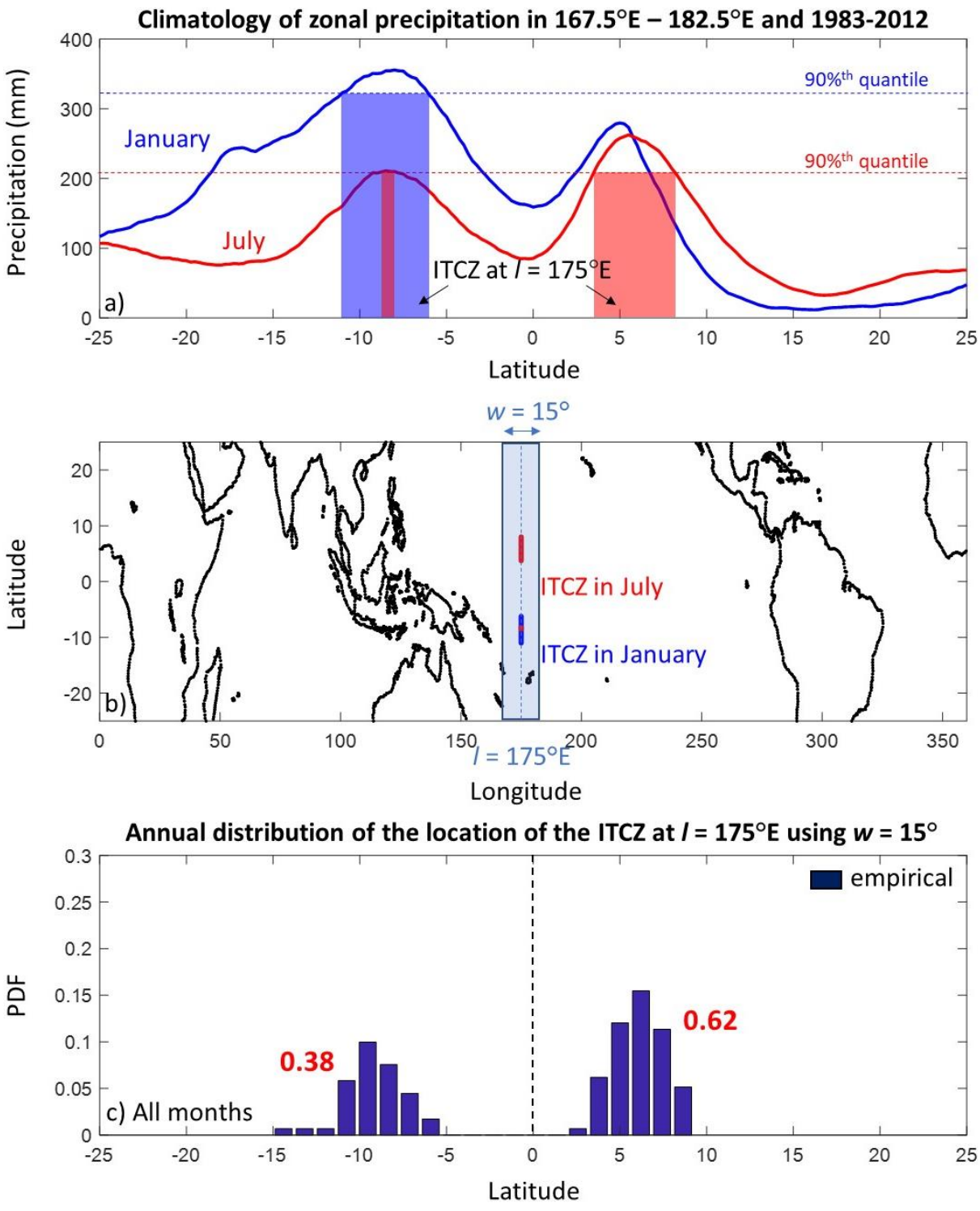

Figure S1. Probabilistic tracking of the ITCZ at longitude l = 175ºE, based on monthly precipitation (from PERSIANN-CDR). a) The zonal precipitation (167.5ºE – 182.5ºE) in January (blue curve) and July (red curve) for 1983-2012 (climatological means are presented). b) The location of the ITCZ in January (t = 1) and July (t = 7) at longitude l = 175º, using a

longitudinal window of width w = 15º, and probability of non-exceedance a = 90%. It is shown that in July, the ITCZ is tracked in both hemispheres (double ITCZ). c) Annual probability density function (PDF) of the location of the ITCZ at longitude l = 175ºE, using "ITCZ points" obtained in each calendar month (t = 1, 2, …, 12). The probability of ITCZ residing in the northern (southern) hemisphere during the year is 0.62 (0.38).

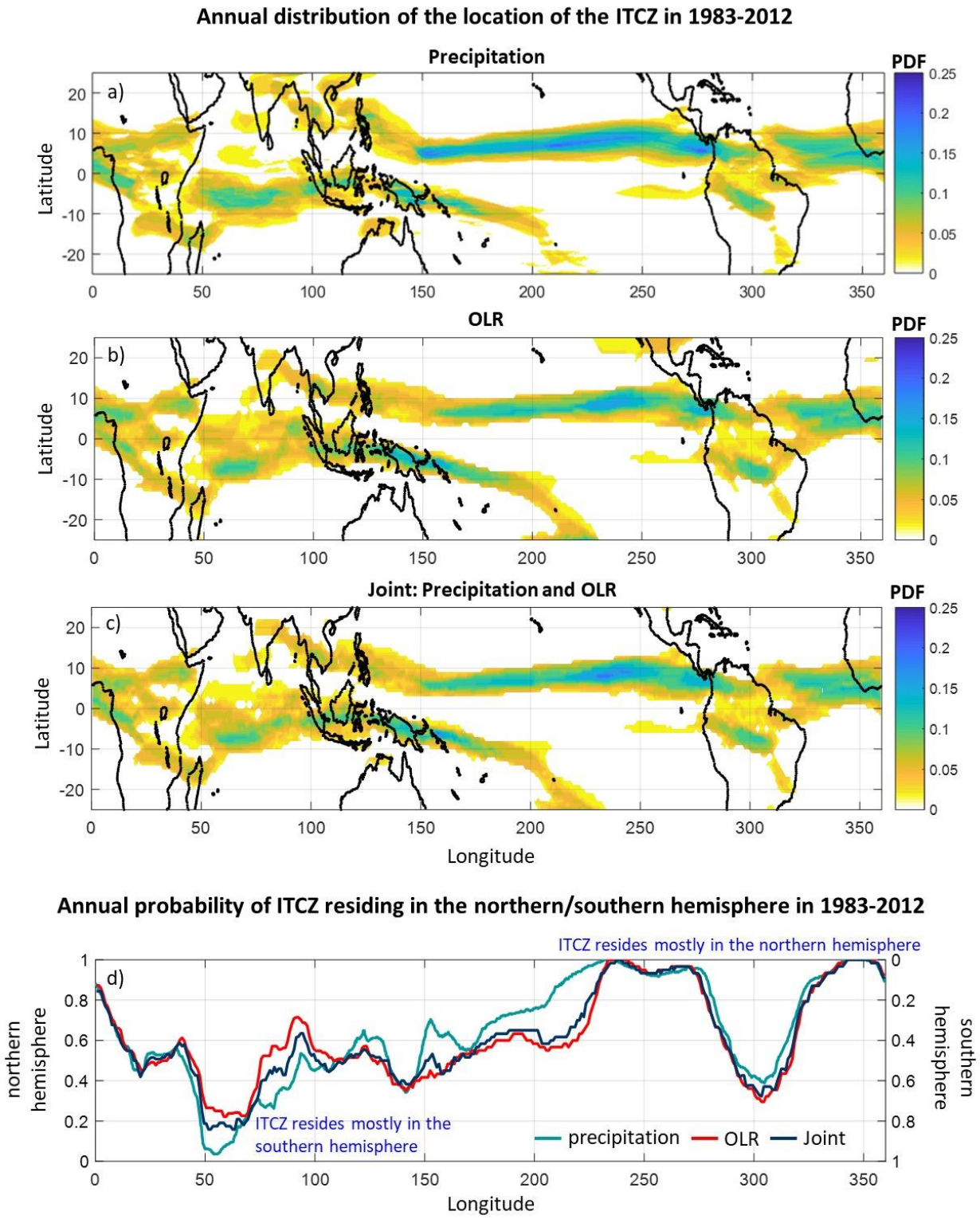

Figure S2. Location of the ITCZ in 1983-2012 as defined using multiple physical variables. a) The empirical annual probability density function (PDF) of the location of the ITCZ computed in overlapping longitudinal windows of width w = 15º and probability of non-

exceedance a = 90%, using zonal precipitation (from PERSIANN-CDR). b) Same as in (a), but using zonal – OLR (from PSD-CDR). c) Same as in (a), but using the joint distribution of precipitation and – OLR. d) The probability of ITCZ residing in the northern/southern hemisphere as a function of longitude, in 1983-2012, based on satellite observations of precipitation (green color; data from PERSIANN-CDR), OLR (red color; data from PSD-CDR) and their joint distribution (dark blue color).

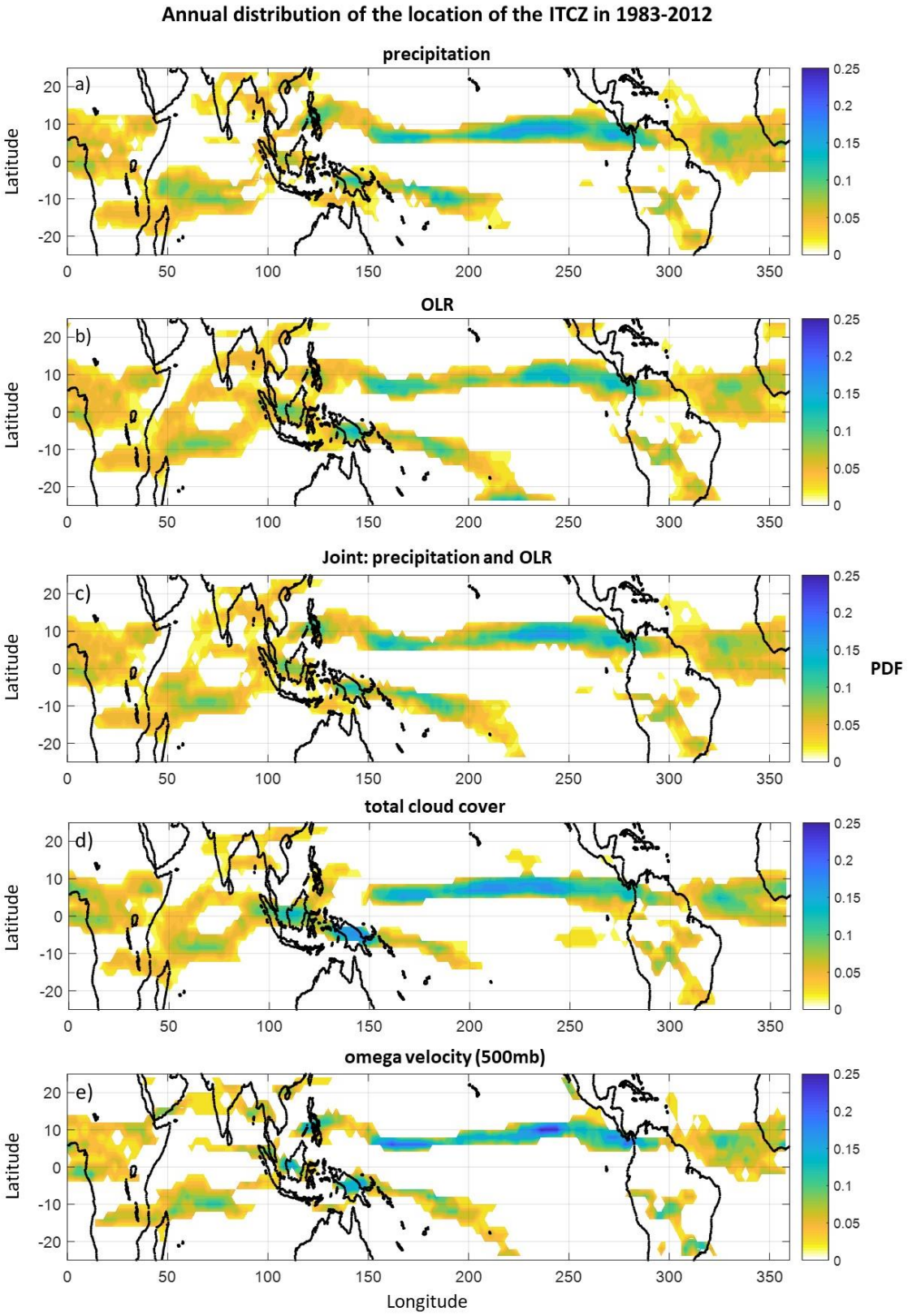

Figure S3. Same as Figure S2, but using monthly products from the 20CR dataset; w = 15º, a = 90%. a-e) The location of ITCZ is defined using precipitation, OLR, the joint distribution

of precipitation and – OLR, total cloud cover, and omega velocity at the 500 mb level (upward motion corresponds to negative omega velocity), respectively. The cloud cover is obtained by considering the entire atmosphere as a single layer.

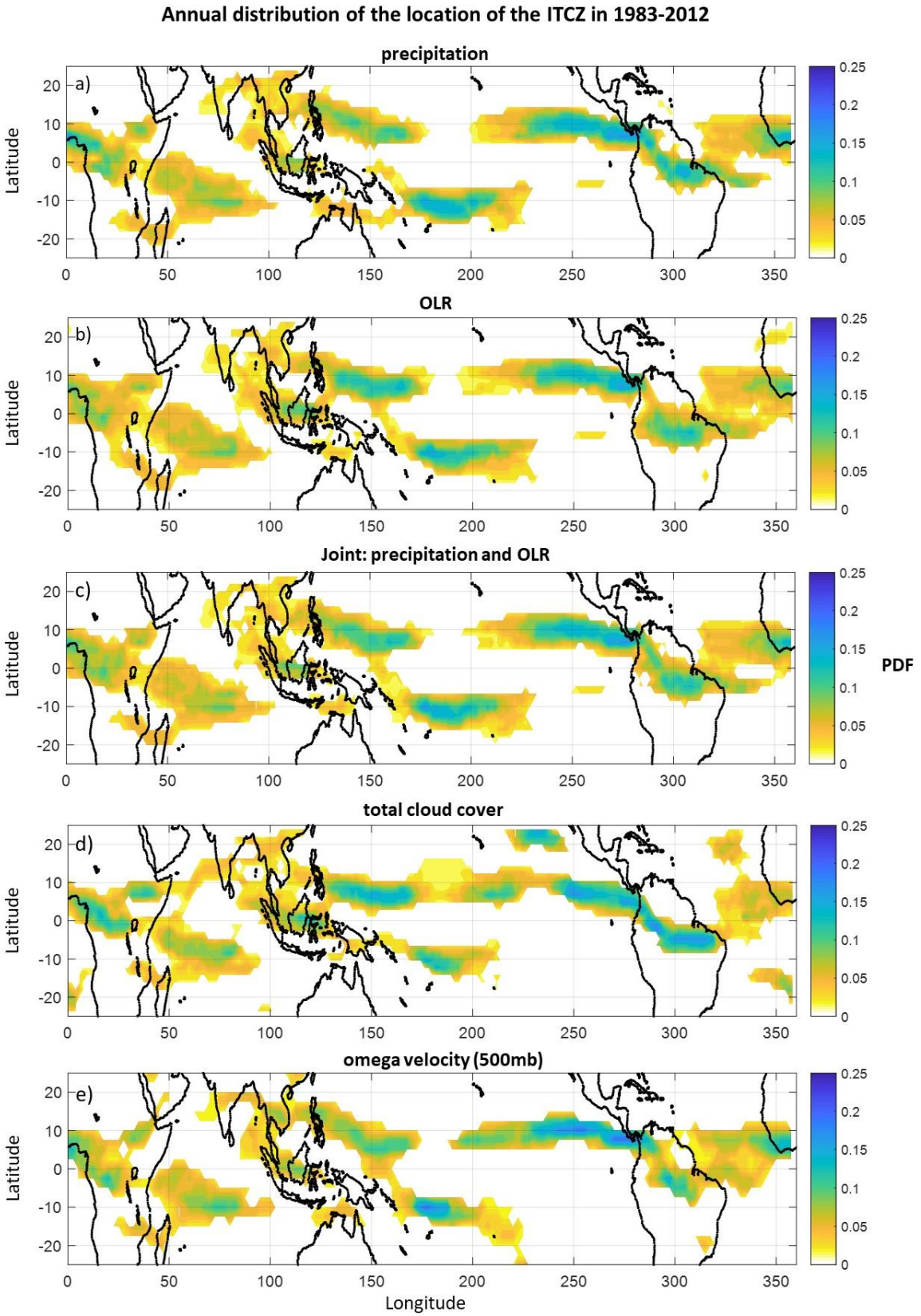

Figure S4. Same as Figure S3, but using monthly products from the NCEP/NCAR dataset.

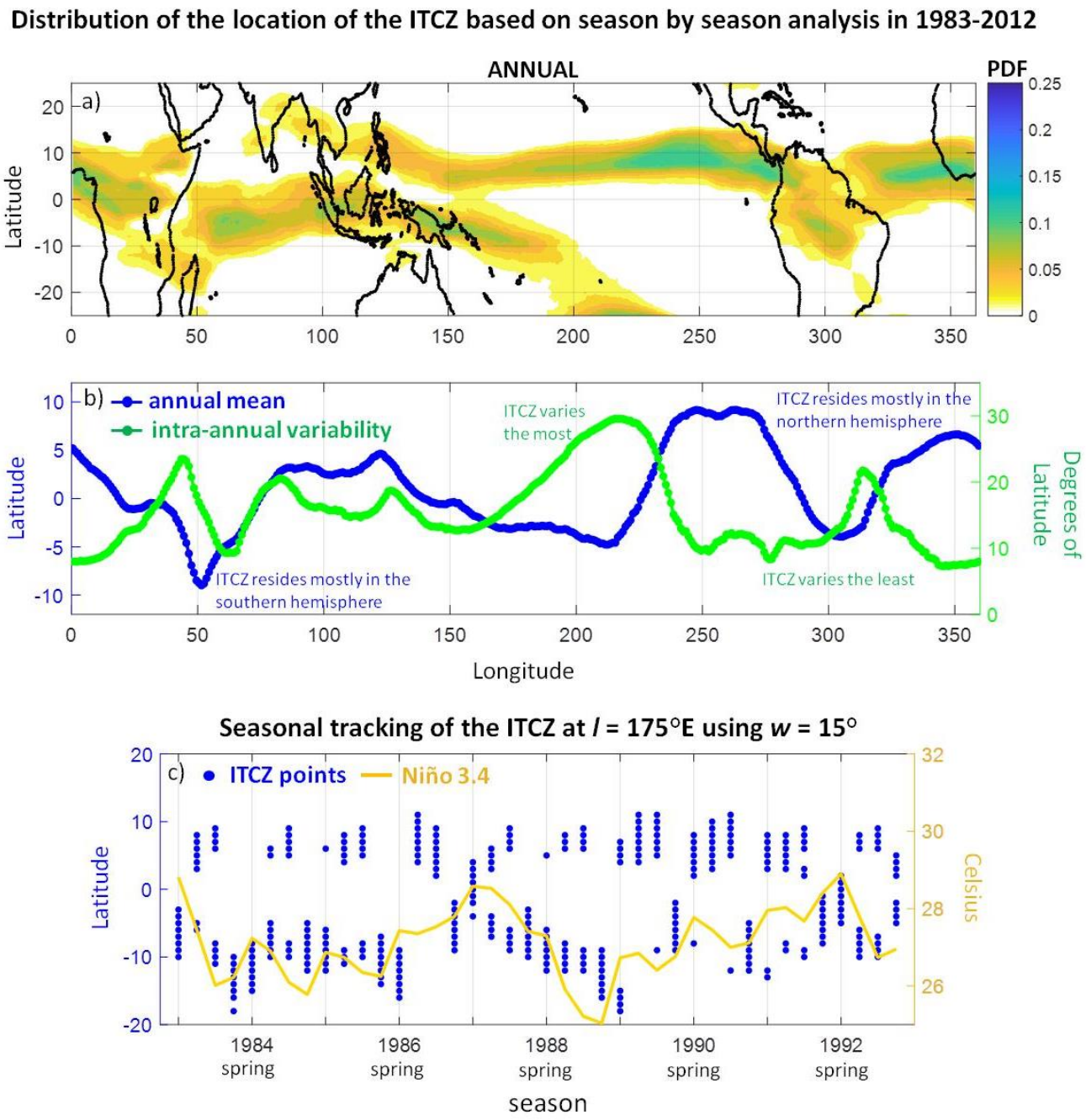

Figure S5. Seasonal tracking of the ITCZ. a-b) Same as in Figure 2.c-d, but using all 119 seasons in 1983-2012 (winter of 1983 is excluded); w = 15º, a = 85%. c) The sampled "ITCZ points" (blue points) in all seasons of 1983-1992, based on the upper 15% (probability of non-exceedance a = 85%) of the joint distribution of zonal precipitation and – OLR, at longitude l = 175ºE (using w = 15º). To indicate the effect of the El Niño-Southern Oscillation on the location of the SPCZ (here corresponding to the "ITCZ points" in the southern hemisphere), we also present seasonal series of Niño 3.4 (the scale in the right vertical axis was chosen so that the series of Niño 3.4 can be co-displayed with the "ITCZ points").

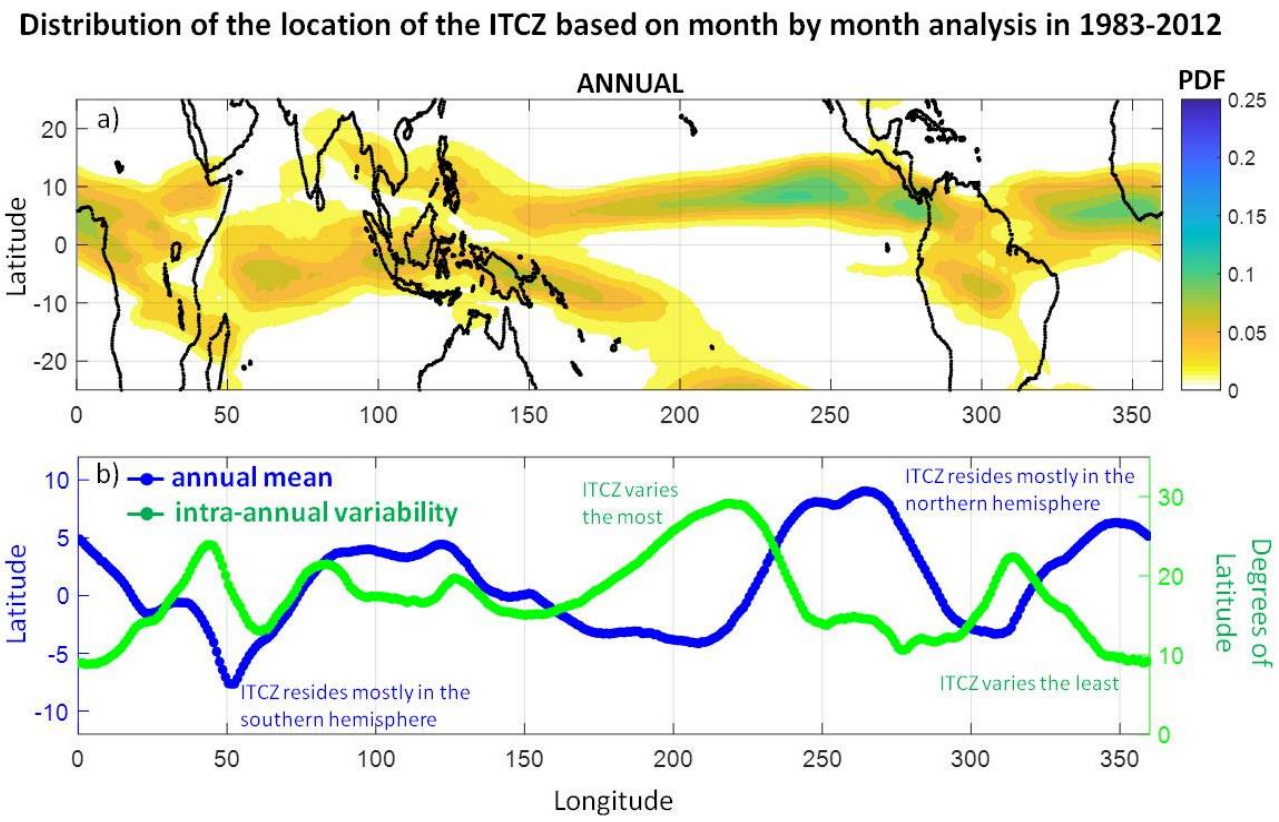

Figure S6. Same as Figure S5.a-b, but using all 360 months in 1983-2012.

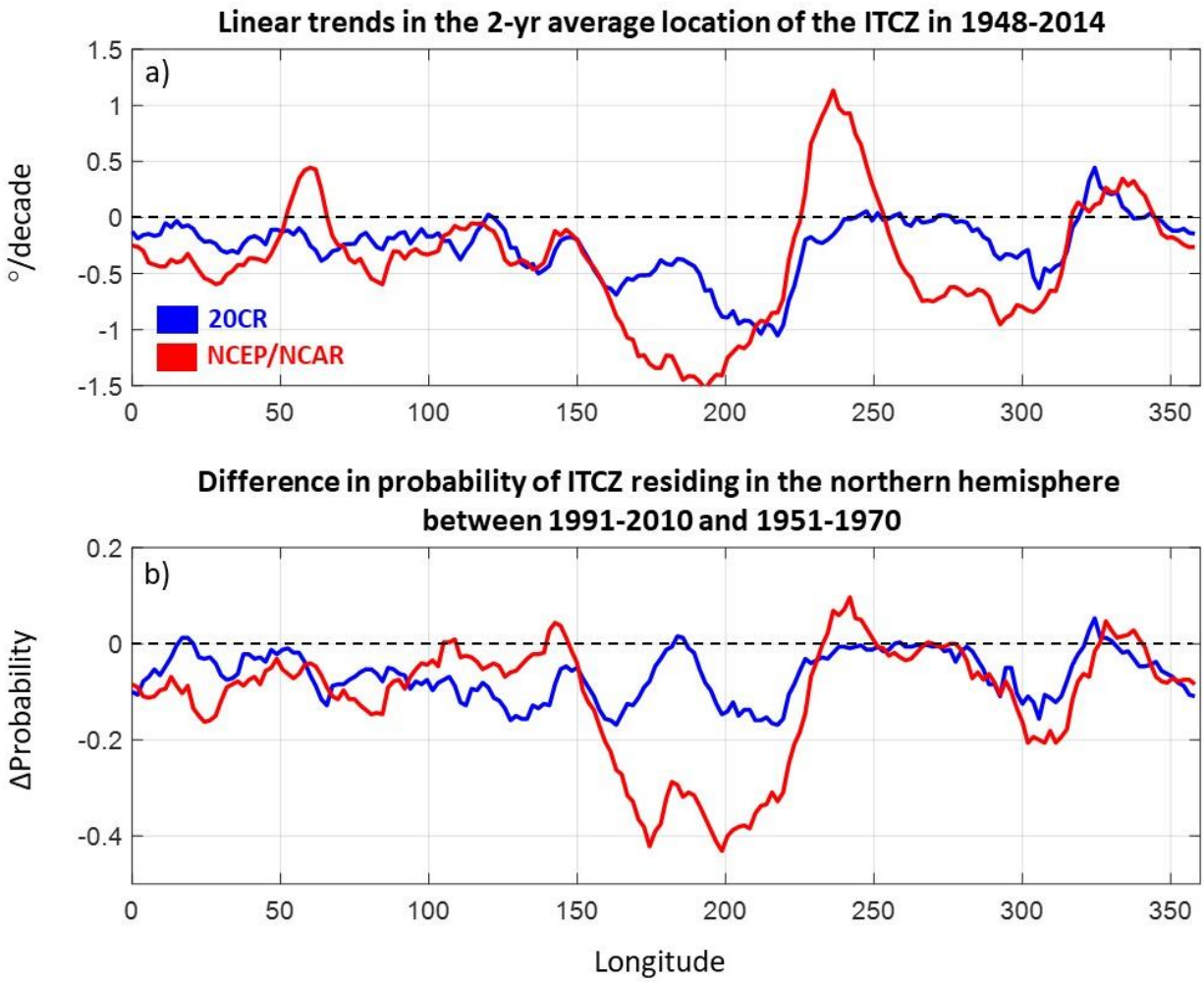

Figure S7. Changes in the location of the ITCZ. a) Linear trends of the 2-yr average location of the ITCZ in 1948-2014 as a function of longitude, using simple linear regression. b) The difference in probability of the ITCZ residing in the northern hemisphere, between periods 1991-2010 and 1951-1970. The central Pacific region is where results from the two datasets show the most prominent trends, indicating a southward shift of the ITCZ.

Table S1. Datasets and variables used in this study.

dataset used	PERSIANN-CDR	PSD-CDR	20C	NCEP/NCAR
reference	Ashouri et al., 2015	Lee, 2014	Compo et al., 2011	Kalnay et al., 1996
web link	http://chrsdata.eng.uci.edu/	https://www.esrl.noaa.gov/psd/data/gridded/data.olrcdr.interp.html#detail	https://www.esrl.noaa.gov/psd/data/gridded/data.20thC_ReanV2c.monolevel.mm.html	https://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.derived.html
variable used	precipitation	OLR	precipitation OLR cloud cover omega velocity	precipitation OLR cloud cover omega velocity
timescale used	monthly	monthly	monthly	monthly
spatial resolution	0.25° × 0.25°	1° × 1°	2° × 2°	2° × 2° (or 2.5° × 2.5°)
period covered	Jan 1983 - Apr 2017	Jan 1979 - Dec 2012	Jan 1851 - Dec 2014	Jan 1948 - present