Role of Ocean Heat Content in Indian Summer Monsoon Rainfall: A Statistical Study

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Caution

Monsoons and Cyclones are coupled phenomena and mainly controlled by Atmosphere

Some Math

$$\mathrm{TCHP} = \rho C_p \int_0^{D_{26}} (T - 26)\mathrm{dz}$$

$$OHC = \rho C_p (OMT - 26) D_{26}$$

$$OMT = \left(\frac{OHC}{\rho C_p D_{26}} \right) + 26$$

Atlantic Oceanographic and Meteorological Laboratory of NOAA

Daily data with 1/4^{o} spatial resolution available from 1993.

Results

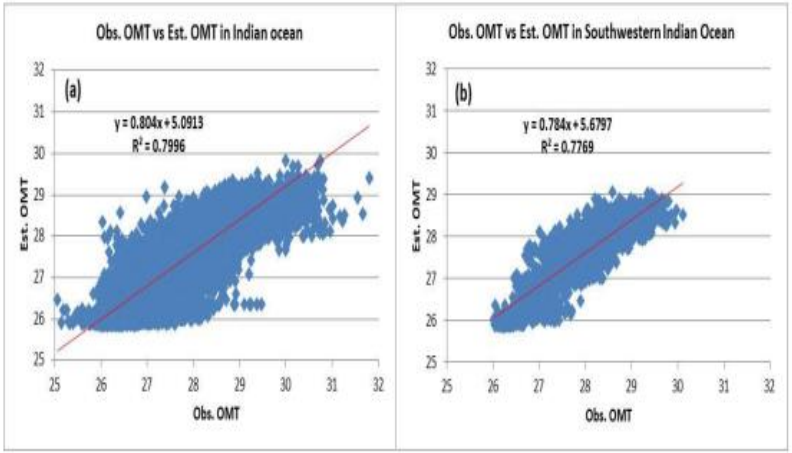
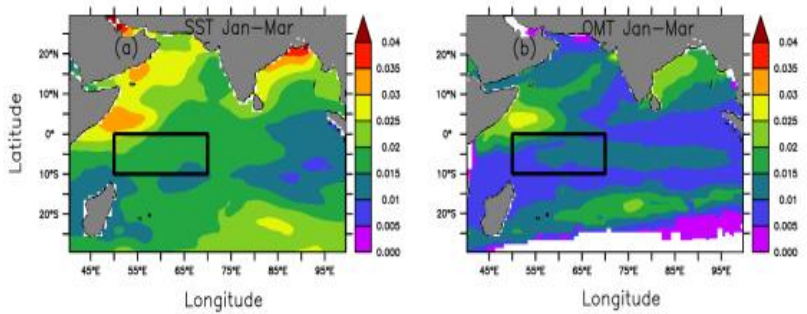
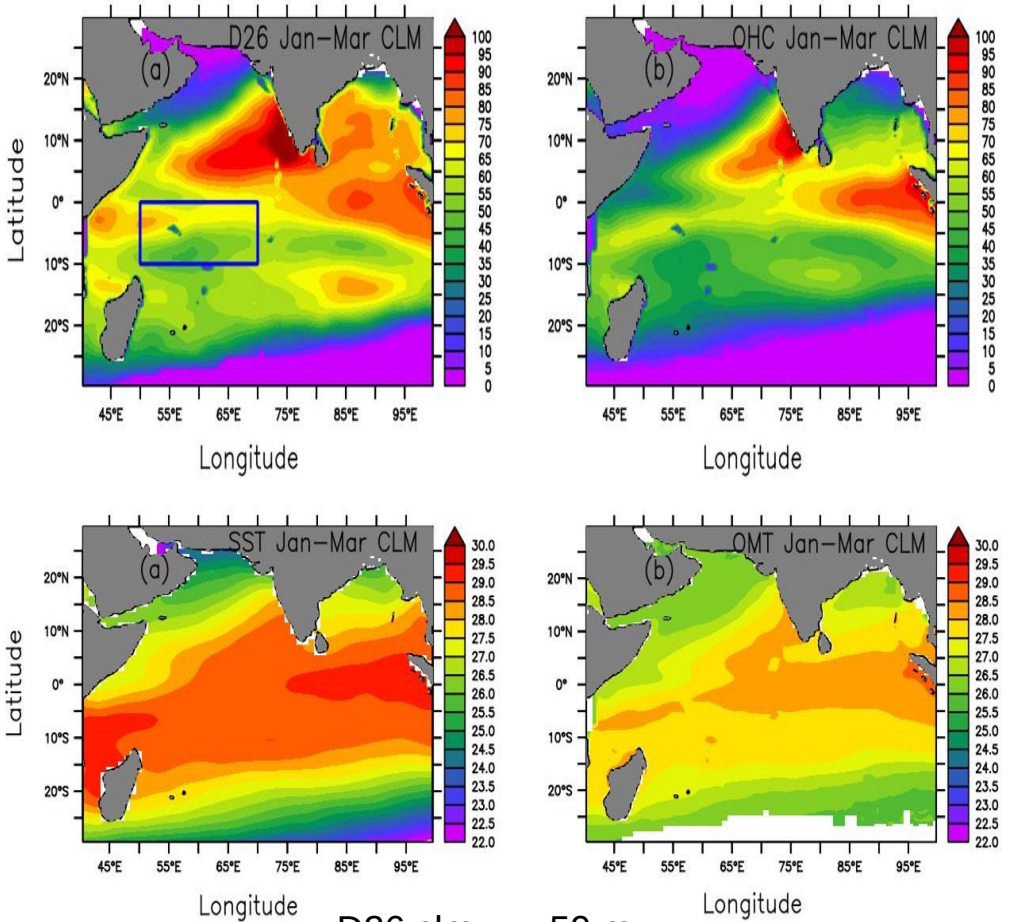


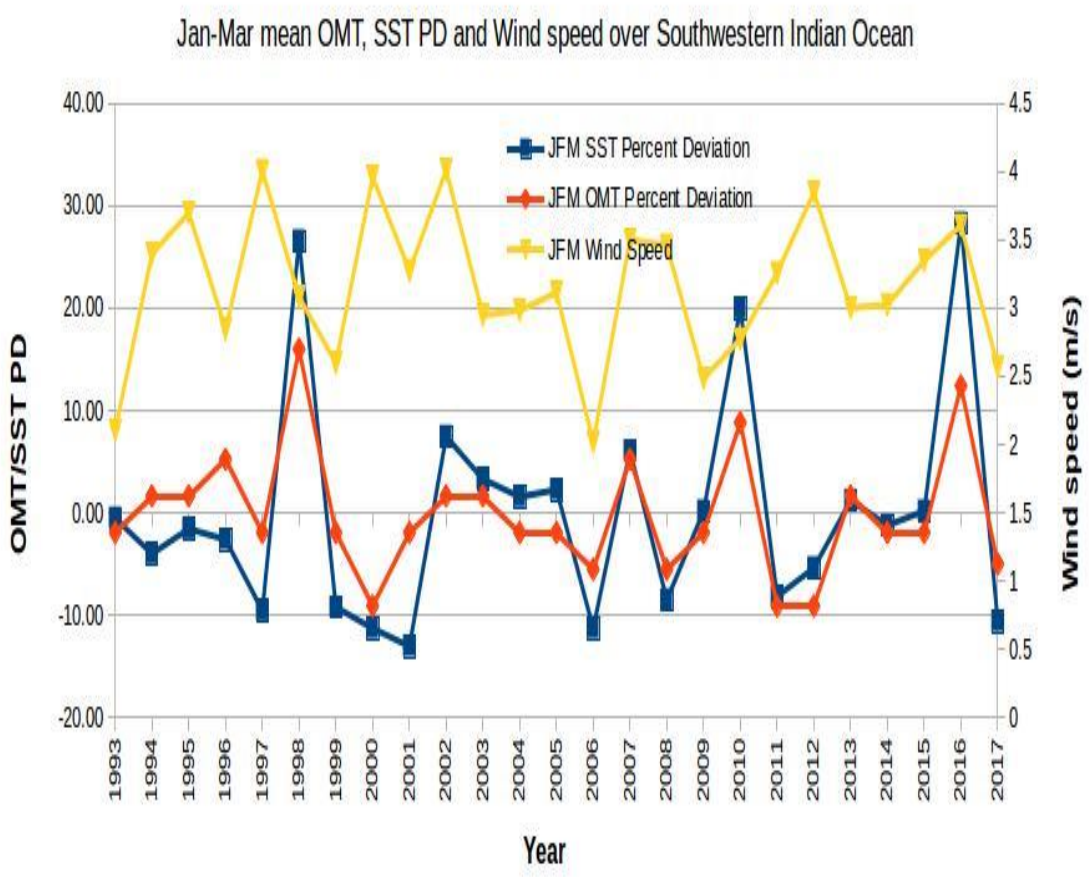
Figure S2: Scatter between the OMT estimated from the *in situ* profiles and that estimated from satellite derived OHC observations for (a) the north Indian Ocean and (b) the Southwestern Indian Ocean.

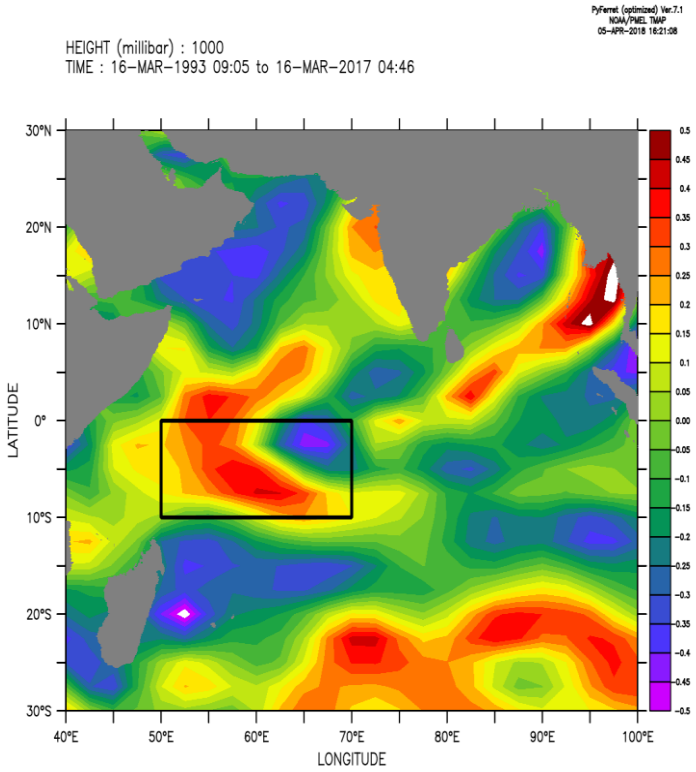




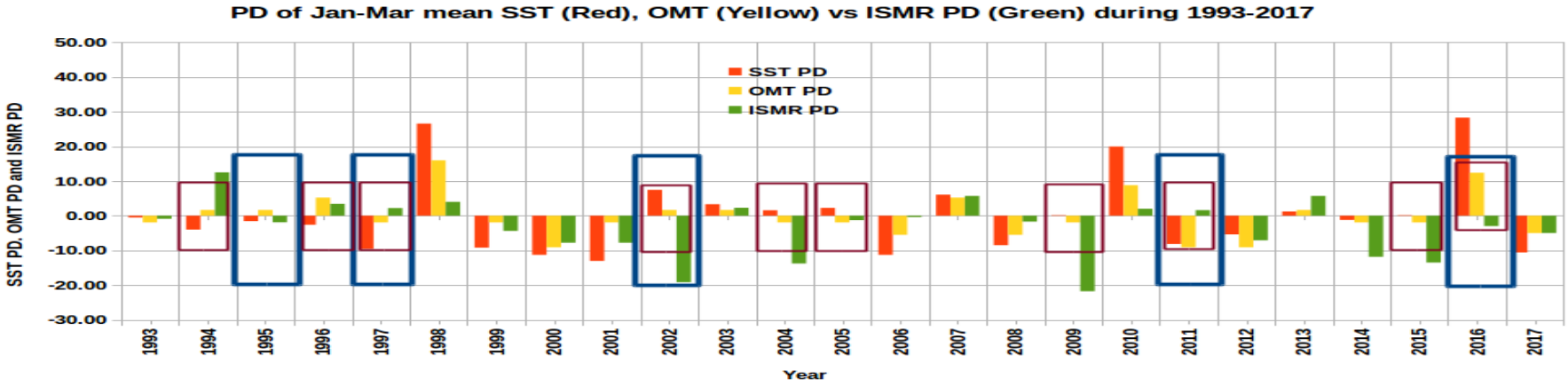
Coefficient of variability **50°E–70°E and 10°S–0°N**

D26 clm : 59 m
OHC clm : 50 kJcm^{-2}
OMT clm : 27.9 ^{o}C





ISMRPD vs JFM mean Wind Stress curl


PD of Jan-Mar mean SST (Red), OMT (Yellow) vs ISMR PD (Green) during 1993-2017
SST PD
OMT PD
ISMR PD
SST PD, OMT PD and ISMR PD
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
1993
1994
1995
1996
1997
1998
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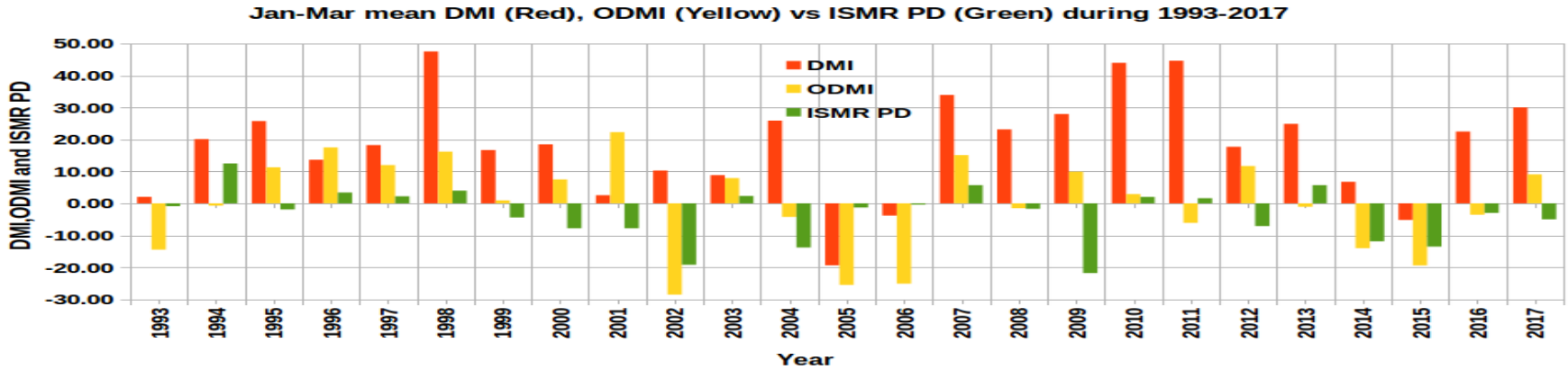
Jan-Mar mean DMI (Red), ODMI (Yellow) vs ISMR PD (Green) during 1993-2017
DMI
ODMI
ISMR PD
DMI,ODMI and ISMR PD
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
-20.00
-30.00
1993
1994
1995
1996
1997
1998
1999
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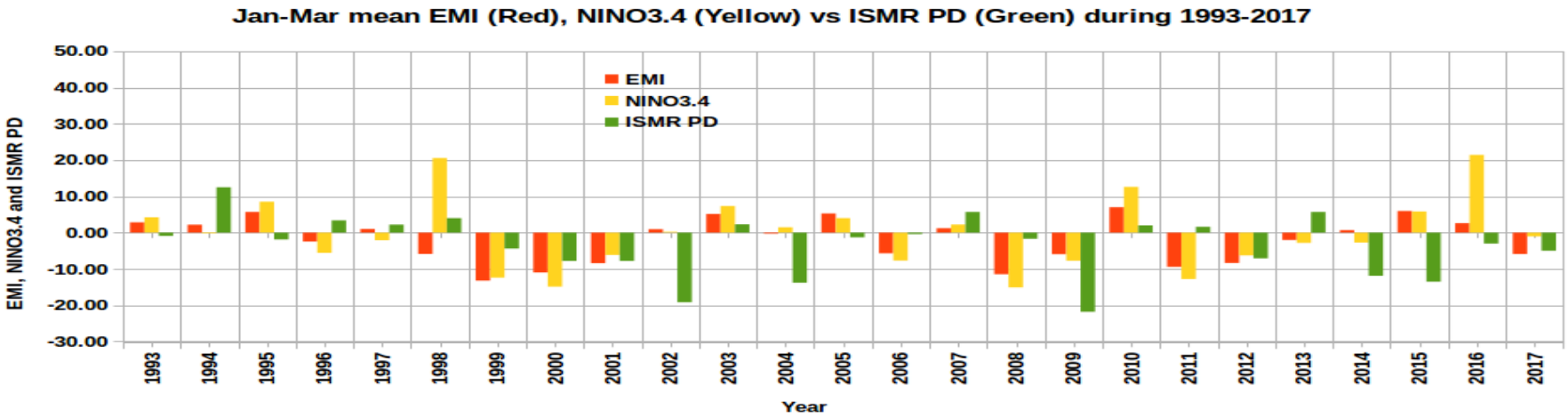

Parameter	Above average rainfall years (9)			Below average rainfall years (16)		
	Success	Failure	Rate of success	Success	Failure	Rate of success
OMT PD	1994,1996,1998,2003,2007,2010, 2013	1997, 2011	78%	1993,1999,2000,2001, 2004,2005,2006,2008, 2009, 2012,2014, 2015, 2017	1995,2002, 2016	81%
SST PD	1998,2003,2007,2010, 2013	1994,1996,1997, 2011	55%	1993,1995,1999,2000, 2001,2006,2008, 2012,2014, 2017	2002,2004,2005,2009,2015, 2016	63%

Parameter	No. of years with positive/ negative signs [ISMR PD (9/16)]	Years mismatched with ISMR PD	No. of years mismatched (Success rate)
OMT PD	10/15	1995, 1997, 2002, 2011,2016	05 (80%)
SST PD	11/14	1994, 1996, 1997, 2002, 2004,2005, 2009, 2011, 2015,2016	10 (60%)
ODMI	13/12	1994, 1995, 1999, 2000,2001, 2009, 2011, 2012, 2013,2017	10 (60%)
DMI	22/03	1993,1995, 1999, 2000,2001,2002,2004, 2008,2009, 2012, 2014, 2016,2017	13 (48%)
NINO3.4	11/14	1993, 1994,1995, 1996, 1997, 2002,2004, 2005, 2011, 2013, 2015, 2016	12 (52%)
EMI	12/13	1993, 1995, 1996, 1998, 2002, 2005, 2011, 2013, 2014, 2015, 2016	11 (56%)

Hadley interpolated monthly mean temperature profiles with 1° spatial resolution.
(5 m) to 15.1 m, 25.2 m, 35.3 m, 45.4 m, 55.7 m, 100 m and 150 m.
surface 100 m : 11 mismatching (correlation: 0.11)
surface to 15.1 m : 7 mismatching (correlation: 0.23)

OHC from altimeter is more accurate for monsoon predictions

OMT PD during January–March 2018 is **−1.432**, we predicted deficit JJAS rainfall for 2018, which is a successful prediction with actual rainfall being **91%**.

Nature Scientific Reports, August 2018

Table S2: Seasonal and Monthly correlation coefficients of ISMR PD with SST and OMT PDs

Parameter/Month	January-March	February-April	March-May	January	February	March	April	May
SST PD	0.09	0.13	0.02	0.12	0.21	0.01	0.02	0.06
OMT PD	0.31	0.24	0.08	0.33	0.25	0.24	0.14	0.11

Table S3: No. of years sign of ISMR PD mismatching with SST & OMT PDs on monthly and 3-month average basis.

Period	SST PD	OMT PD
January	9	11
February	9	9
March	9	7
April	12	10
May	14	14
Jan-Mar	10	5
Feb-Apr	12	6
Mar-May	11	13

Table S4: Monthly correlations of different indices with ISMR PD

	ISMR PD versus					
	SST PD	OMT PD	DMI	ODMI	NINO 3.4	EMI
Jan	0.12	0.33	0.28	0.46	0.21	0.18
Feb	0.21	0.25	0.14	0.04	0.15	0.08
Mar	0.01	0.24	0.14	0.09	0.17	0.14