

## Bio-Data of Dr. Pascal Terray

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## Education:

- 2006: Habilitation à Diriger des Recherches (**PhD adviser proficiency defense**), University Pierre and Marie Curie (spécialité: Physique et Chimie de l'océan et de l'atmosphère; Climatologie). Title: "Role of the Indian Ocean in the coupled Monsoon\_ENSO system".
- 1992: Thèse de Doctotorat (**phD**), University of Paris 7, Paris, France. Title: "Interannual variability of summer Indian Monsoon and long-range predictability of rainfall in India". This thesis was prepared within the Laboratory of Dynamical Meteorology of the C.N.R.S (Ecole Polytechnique, Palaiseau) under the direction of Dr. D.L. Cadet and Prof. F. Durand-Dastès. This thesis was awarded a "mention très honorable" (first award).

## Fellowships and Awards:

- 1987-1990, Research fellowship (phD) of University Paris 7, Paris, France.
- 1993-1994, Postdoctoral fellowship of the Japan Society for the Promotion of Science (J.S.P.S.) at the University of Tsukuba, Japan.

## Research Experience: 30 years (Statistics, Oceanography & Climatology)

- 1987-1991, Laboratory of Dynamical Meteorology of the C.N.R.S (Ecole Polytechnique, Palaiseau) with Dr. D.L. Cadet, PhD research.
- 1991-1992, National Institute of Statistics (I.N.S.E.E., Paris, France), Associate Researcher.
- 1993-1994, Geosciences Institute of the University of Tsukuba (Japan) with Prof. T. Yasunari, Postdoctoral Researcher.
- 1996-2006, Laboratoire d'Océanographie et de Climatologie par l'Expérimentation et l'Analyse Numérique (LOCEAN-IPSL), Paris, France, permanent researcher.
- 2007-2013, Senior Scientist at LOCEAN-ISPL (Paris, France).
- 2013-2017, Senior Scientist at the Indo-French Cell for Water Sciences, IISc-IITM-NIO-IRD Joint International Laboratory, IITM, Pune, India.

- 2017-present, Senior Scientist at LOCEAN-ISPL (Paris, France).

#### **Teaching Experience:**

- 1995-2003, Associate Professor at University Paris 7 (Climatology-Geosciences).

#### **Research Guidance:**

- Several PhD students and numerous postgraduate students.

#### **Research interest:**

- Climate studies using climate (coupled) models and observations
- Asian Monsoon variability, Indian Ocean, ENSO and climate change
- Role of the extra-tropics in tropical variability
- Time scale interactions in the tropics
- Statistics and data analysis
- Statistical and mathematical software development (STATPACK and NCSTAT softwares), see the link:  
<https://pagesperso.locean-ipsl.upmc.fr/terray/software.html>

#### **Scientific Visits Abroad:**

Singapore (2005,2009,2017), China and USA-Hawai (2004,2008), Belgium (2003), Italy (2003,2008); UK (2002,2005,2013); Canada (1999); Spain (1997); Japan (1993,1994,2006); Australia (2015); India (1988,2005,2008,2009,2010,2011,2013-2017,2018, 2019,2022,2023).

#### **Projects:**

- Principal Investigator (PI) of the French project “Interannual variability of the Asian Summer Monsoon” (in French: Variabilité interannuelle de la Mousson Asiatique, VIMA). Funded by the PNEDC French climate research program for the period 2002-2006.
- Co-Investigator of the European funded SINTEX (Scales INteraction EXperiments; Navarra et al., 1997) project (2000-2002).
- Co-Investigator of the European funded ENACT (Enhanced Ocean Data Assimilation and Climate Prediction) project (2002-2004).
- Co-Investigator of the Indo-French MOTIVE (Monsoon and the Tropical Intra-seasonal and Interannual Variations Experiment) project of the Indo-French Center for Environment and Climate (IFCEC/CEFIRE).
- Co-Investigator of the European funded ENSEMBLES (RT1 et RT5) project.
- Co-Investigator of the French DIVA project (« Dynamic Interactions between Vegetation and Atmosphere. Is vegetation dynamic influencing modes of atmospheric variability?»).
- Co-Investigator of the French MISSTERRE (“Integrated modeling of the earth system”) project. Funded by the LEFE French climate research program.
- Co-Investigator of the French STT-Clim (« Stratosphere impact on tropical climate”) project. Funded by the ANR French Research Agency.
- Principal Investigator (PI) of the Indo-French project “Multi-scale interactions and predictability of the Indian Summer Monsoon”. Funded by the CEFIPRA /IFCPAR (Indo-French Centre for the Promotion of Advanced Research) for

the period 2008-2011.

- Co-Investigator of the French El-Paso (“El-Niño: lessons from the past using simulations and observations”) project. Funded by the ANR (French Research Agency).
- Co-Investigator of the French PULSATIONS (“Peta-scale mULTi-gridS ocean-ATmosphere coupled simulatIOns”) project. Funded by the ANR (French Research Agency).
- Principal Investigator (PI) of the Indo-French project “Impacts of ocean-atmosphere coupling and SST high frequency variability on the coupled simulation of the mean state and variability of the Indian summer Monsoon”. Funded by the Indian “National Monsoon Mission” program (see the link <http://www.tropmet.res.in/monsoon/>) for the period 2014-2017.
- Co-Investigator of the South Asia CORDEX (Coordinated Regional Climate Downscaling Experiment) project funded by the WCRP (World Climate Research Program) for the period 2013-present (see the link <http://wcrp-cordex.ipsl.jussieu.fr/index.php/community/domain-south-asia-cordex>).
- Co-Investigator of the PACMEDY (PAleo -Constraints on Monsoon Evolution and Dynamics) project funded by the Belmont Forum (see the link <https://belmontforum.org/funded-projects/pacmedy-palaeo-constraints-monsoon-evolution-and-dynamics>).
- Co-Investigator of the ROADMAP (The Role of ocean dynamics and Ocean-Atmosphere interactions in Driving cliMAtE variations and future Projections of impact-relevant extreme events) project funded by JPI Climate & JPI Ocean European programs (see the link <http://www.jpi-climate.eu/joint-activities/joint-calls/CPILOud/ROADMAP>).

### Scientific activities:

- Reviewer for many international scientific journals (*Journal of Climate*, *Climate Dynamics*, *Nature Communications*, *Nature Scientific Reports*, *Geophysical Research Letters*, *Journal of the Meteorological Society of Japan*, *Quarterly Journal of the Royal Meteorological Society*, *International Journal of Climatology*, *Atmosphere-Ocean*, *Scientific Reports*, *IOP Environmental Research Letters*, AGU books, etc.).
- Reviewer for evaluating proposals submitted to NOAA’s CLIVAR program (U.S.), NERC programs (UK), CEFIPRA programs, PNEDC and LEFE programs (French climate Programs), European climate program (5 and 6 PCRD), Monsoon Mission program (INDIA), Deutsche Forschungsgemeinschaft (DFG, Germany)
- Director (with Annalisa Bracco and Peter Webster) of the Alpine Summer school on “Monsoon systems”(see <http://www.to.isac.cnr.it/aosta/>). Valsavarenche, Valle d’Aosta (Italy), 8-13 June, 2009.
- Convener and Co-convener of sessions on monsoon and Indian Ocean variability in Asia Oceania Geosciences Society meetings (AOGS2009, AOGS2013, AOGS2015 (session OS15-01 “Understanding Climate Change and Variability Using State of the Art Climate Models”; see the link <http://www.meetmatt-svr3.net/aogs/aogs2015/>) and European Geosciences Union meetings (Session “The global monsoon system: variability and dynamics”; EGU2010, EGU2011, EGU2012, EGU2013, EGU2014, EGU2015, EGU2016, EGU2017, EGU2018, EGU2019 and EGU2020, see the link <http://meetingorganizer.copernicus.org/EGU2020/session/2740> ).

## Recent publications (2003-present):

- Terray, P.**, P. Delecluse, S. Labattu and L. Terray, 2003: Sea Surface Temperature Associations with the Late Indian Summer Monsoon. *Climate Dynamics*, Vol. **21**, 593-618, doi:[10.1007/s00382-003-0354-0](https://doi.org/10.1007/s00382-003-0354-0).
- Terray, P.**, E. Guilyardi, A.S. Fischer, P. Delecluse, 2005: Dynamics of Indian Monsoon and ENSO Relationships in the SINTEX global Coupled Model. *Climate Dynamics*, Vol. **24**, 145-168, doi:[10.1007/s00382-004-0479-9](https://doi.org/10.1007/s00382-004-0479-9).
- Terray, P.**, S. Dominiak, P. Delecluse, 2005: Role of the southern Indian Ocean in the transitions of the monsoon-ENSO system during recent decades. *Climate Dynamics*, Vol. **24**, 169-195, doi:[10.1007/s00382-004-0480-3](https://doi.org/10.1007/s00382-004-0480-3).
- Terray, P.** and S. Dominiak, 2005: Indian Ocean Sea Surface Temperature and El Niño-Southern Oscillation: A new perspective. *Journal of Climate*, Vol. **18**, 1351-1368. doi:[10.1175/JCLI3338.1](https://doi.org/10.1175/JCLI3338.1)
- Fischer, A.S., **P. Terray**, E. Guilyardi, S. Gualdi et P. Delecluse, 2005: Two Independent Triggers for the Indian Ocean Dipole/Zonal Mode in a Coupled GCM. *Journal of Climate*, Vol. **18**, 3428–3449, doi:[10.1175/JCLI3478.1](https://doi.org/10.1175/JCLI3478.1)
- Dominiak, S. and **P. Terray**, 2005: Improvement of ENSO prediction using a linear regression model with a southern Indian Ocean sea surface temperature predictor. *Geophysical Research Letters*, Vol. **32**, L18702, doi: [10.1029/2005GL023153](https://doi.org/10.1029/2005GL023153).
- Laurian A., A. Lazar, G. Reverdin, K. Rodgers and **P. Terray**, 2006: Poleward propagation of spiciness anomalies in the North Atlantic Ocean. *Geophysical Research Letters*, Vol. **33**, L13603, doi:[10.1029/2006GL026155](https://doi.org/10.1029/2006GL026155).
- Terray P.**, F. Chauvin and H. Douville, 2007: Impact of southeast Indian Ocean Sea Surface Temperature anomalies on monsoon-ENSO-dipole variability in a coupled ocean-atmosphere model. *Climate Dynamics*, Vol. **28**, 553-580, doi: [10.1007/s00382-006-0192-y](https://doi.org/10.1007/s00382-006-0192-y).
- Claud, C. and **P. Terray**, 2007: Revisiting the possible links between the Quasi-Biennial Oscillation and the Indian summer monsoon using NCEP R-2 and CMAP fields. *Journal of Climate*, Vol. **20**, 773-787, doi:[10.1175/JCLI4034.1](https://doi.org/10.1175/JCLI4034.1)
- Joly, M., A. Voldoire, H. Douville, **P. Terray** and J.-F. Royer, 2007 : African monsoon teleconnections with tropical SSTs: validation and evolution in a set of IPCC4 coupled models. *Climate Dynamics*, Vol. **29**, 1-20, doi:[10.1007/s00382-006-0215-8](https://doi.org/10.1007/s00382-006-0215-8).
- Claud, C., B. Duchiron and **P. Terray**, 2007: Associations between large-scale atmospheric circulation and polar lows developments over the North Atlantic during winter. *Journal of Geophysical Research*, **112**, D12101, doi:[10.1029/2006JD008251](https://doi.org/10.1029/2006JD008251).
- Douville, H. and **P. Terray**, 2007: Réponse du cycle hydrologique aux forçages anthropiques : Que nous disent les dernières simulations du GIEC ? Livre Blanc ESCRIME, Chap. 5, 40-48.
- Douville, H. and **P. Terray**, 2007: Réponse du cycle hydrologique aux forçages anthropiques: Que nous disent les dernières simulations du GIEC ? *La Météorologie*, **57**, 31-36, doi:[10.4267/2042/18187](https://doi.org/10.4267/2042/18187).
- Claud, C., B. Duchiron and **P. Terray**, 2008: On associations between the 11-yr solar cycle and the Indian Summer Monsoon system. *Journal of Geophysical Research*. **113**, D09105, doi :[10.1029/2007JD008996](https://doi.org/10.1029/2007JD008996).
- Claud, C., A.M. Carleton, B. Duchiron, and **P. Terray**, 2009 : Southern Hemisphere winter cold-air mesocyclones : climatic environments and associations with teleconnections, *Climate Dynamics*, Vol. **33**, 383-408, doi [10.1007/s00382-008-0468-5](https://doi.org/10.1007/s00382-008-0468-5).
- Peings, Y., H. Douville, and **P. Terray**, 2009 : Extended winter Pacific North America oscillation as a precursor of the Indian summer monsoon rainfall, *Geophys. Res. Lett.*, **36**, L11710, doi:[10.1029/2009GL038453](https://doi.org/10.1029/2009GL038453).
- Claud, C., A.M. Carleton, B. Duchiron, and **P. Terray**, 2009 : Atmospheric and upper ocean environments of Southern Ocean polar mesocyclones in the transition season months and associations with teleconnections, *J. Geophys. Res.*, **114**, D23104, doi:[10.1029/2009JD011995](https://doi.org/10.1029/2009JD011995).
- Koch-Larrouy, A., M. Lengaigne, **P. Terray**, G. Madec and S. Masson, 2010 : Tidal mixing in the Indonesian Seas and its effect on the tropical climate system, *Climate Dynamics*, Vol. **34**, 891-904, doi:[10.1007/s00382-009-0642-4](https://doi.org/10.1007/s00382-009-0642-4)
- Terray, P.**, and S. Masson, 2010: Variabilité de l’Océan Indien (Variability of the Indian Ocean). Dans Manuel de Météorologie tropicale: des alizés au cyclone tropical, Chapitre 5.3, 233-255 pp. Sous la direction de F. Beucher. Edité par l’Ecole Nationale de Météorologie, Série Cours et

- Manuels, N°19 (Tome 1 & Tome 2), ISBN 978-2-11-099391-5, ISBN 978-2-11-099392-2, ISSN 0240-8996, dépôt légal 3ième trimestre 2010.
- Goubanova, K., V. Echevin, B. Dewitte, F. Codron, K. Takahashi, **P. Terray** and M. Vrac, 2011: Statistical downscaling of sea-surface wind over the Peru-Chile upwelling region: diagnosing the impact of climate change from the IPSL-CM4 model. *Climate Dynamics*, Vol. **36**, 1365-1378, doi:[10.1007/s00382-010-0824-0](https://doi.org/10.1007/s00382-010-0824-0)
- Terray, P.**, 2011: Southern Hemisphere extra-tropical forcing: A new paradigm for El Niño-Southern Oscillation. *Climate Dynamics*, Vol. **36**, 2171-2199, doi: [10.1007/s00382-010-0825-z](https://doi.org/10.1007/s00382-010-0825-z)
- Vialard, J., **P. Terray**, J.-P. Duvel, R.S. Nanjundiah, S.S.C. Shenoi and D. Shankar, 2011: Factors controlling January–April rainfall over southern India and Sri Lanka. *Climate Dynamics*, Vol. **37**, 493–507, doi:[10.1007/s00382-010-0970-4](https://doi.org/10.1007/s00382-010-0970-4)
- Boschat, G., **P. Terray** and S. Masson, 2011: Interannual relationships between Indian Summer Monsoon and Indo-Pacific coupled modes of variability during recent decades. *Climate Dynamics*, Vol. **37**, 1019-1043, doi:[10.1007/s00382-010-0887-y](https://doi.org/10.1007/s00382-010-0887-y)
- Joseph, S., A K Sahai, B N Goswami, **P. Terray**, S. Masson, and J-J Luo, 2012: Possible Role of Warm SST Bias in the Simulation of Boreal Summer Monsoon in SINTEX-F2 Coupled Model. *Climate Dynamics*, Vol. **38**, 1561-1576, doi:[10.1007/s00382-011-1264-1](https://doi.org/10.1007/s00382-011-1264-1)
- Boschat, G., **P. Terray**, and S. Masson, 2012: Robustness of SST teleconnections and precursory patterns associated with the indian summer monsoon. *Climate Dynamics*, Vol. **38**, 2143–2165, doi:[10.1007/s00382-011-1100-7](https://doi.org/10.1007/s00382-011-1100-7).
- Terray, P.**, K. Kakitha, S. Masson, G. Madec, A. K. Sahai, J.-J. Luo and T. Yamagata, 2012: The role of the frequency of SST coupling in the Indian Monsoon variability and monsoon-ENSO-IOD relationships in a global coupled model. *Climate Dynamics*, Vol. **39**, 729-754, doi:[10.1007/s00382-011-1240-9](https://doi.org/10.1007/s00382-011-1240-9)
- Masson, S., **P. Terray**, G. Madec, J.-J. Luo, T. Yamagata and K. Takahashi, 2012: Impact of intra-daily SST variability on ENSO characteristics in a coupled model. *Climate Dynamics*, Vol. **39**, 681-707, doi:[10.1007/s00382-011-1247-2](https://doi.org/10.1007/s00382-011-1247-2)
- Morioka, Y., T. Tozuka, S. Masson, **P. Terray**, J.-J. Luo, and T. Yamagata, 2012: Subtropical dipole modes simulated in a coupled general circulation model. *Journal of Climate*, Vol. **25**, 4029-4047, doi:[10.1175/JCLI-D-11-00396.1](https://doi.org/10.1175/JCLI-D-11-00396.1)
- Dufresne, J-L - Foujols, M-A - Denvil, S. - Caubel, A. - Marti, O. - Aumont, O - Balkanski, Y - Bekki, S - Bellenger, H - Benshila, R - Bony, S - Bopp, L - Braconnot, P - Brockmann, P - Cadule, P - Cheruy, F - Codron, F - Cozic, A - Cugnet, D - de Noblet, N - Duvel, J-P - Ethé, C - Fairhead, L - Fichet, T - Flavoni, S - Friedlingstein, P - Grandpeix, J-Y - Guez, L - Guilyardi, E - Hauglustaine, D - Hourdin, F - Idelkadi, A - Ghattas, J - Joussaume, S - Kageyama, M - Krinner, G - Labetoulle, S - Lahellec, A - Lefebvre, M-P - Lefevre, F - Levy, C - Li, Z. X. - Lloyd, J - Lott, F - Madec, G - Mancip, M - Marchand, M - Masson, S - Meurdesoif, Y - Mignot, J - Musat, I - Parouty, S - Polcher, J - Rio, C - Schulz, M - Swingedouw, D - Szopa, S - Talandier, C - **Terray, P.** - Viovy, N, 2013: Climate change projections using the IPSL-CM5 Earth System Model: From CMIP3 to CMIP5. *Climate Dynamics*, Vol. **40**, 2123–2165, doi:[10.1007/s00382-012-1636-1](https://doi.org/10.1007/s00382-012-1636-1)
- Sabin, T.P., R. Krishnan, J. Ghattas, S. Denvil, J.-L. Dufresne, F. Hourdin and **P. Terray**, 2013: High resolution simulation of the South Asian monsoon using a variable resolution global climate model. *Climate Dynamics*, Vol. **41**, 173–194, doi:[10.1007/s00382-012-1658-8](https://doi.org/10.1007/s00382-012-1658-8)
- Servonnat, J., M.A. Foujols, F. Hourdin, A. Caubel, **P. Terray** and O. Marti, 2013 : Comparaison du climat préindustriel du modèle IPSL-CM5A-LR sur différents calculateurs utilisés à l'IPSL. IRISA Biorap, 77, 1-5, [www.irisa.fr/orap/Publications/Bi-orap/Biorap-77.pdf](http://www.irisa.fr/orap/Publications/Bi-orap/Biorap-77.pdf)
- Roxy, M., Y. Tanimoto, B. Preethi, **P. Terray** and R. Krishnan, 2013: Intraseasonal SST-precipitation relationship and its spatial variability over the tropical summer monsoon region. *Climate Dynamics*, Vol. **41**, 45-61, doi:[10.1007/s00382-012-1547-1](https://doi.org/10.1007/s00382-012-1547-1)
- Boschat, G., **P. Terray**, and S. Masson, 2013: Extratropical forcing of ENSO. *Geophysical Research Letters*, Vol. **40**, 1-7, doi: [10.1002/grl.50229](https://doi.org/10.1002/grl.50229)
- Prodhomme, C., **P. Terray**, S. Masson, T. Izumo, T. Tozuka and T. Yamagata, 2014: Impacts of Indian Ocean SST biases on the Indian Monsoon: as simulated in a global coupled model. *Climate Dynamics*, Vol. **42**, 271-290, doi:[10.1007/s00382-013-1671-6](https://doi.org/10.1007/s00382-013-1671-6)
- Morioka, Y., S. Masson, **P. Terray**, C. Prodhomme, S.K. Behera and Y. Masumoto, 2014: Role of Tropical SST Variability on the Formation of Subtropical Dipoles. *Journal of Climate*, Vol. **27**, 4486-4507, doi:[10.1175/JCLI-D-13-00506.1](https://doi.org/10.1175/JCLI-D-13-00506.1)
- Roxy, M.K., K. Rikita, **P. Terray** and S. Masson, 2014: The curious case of Indian Ocean Warming. *Journal of Climate*, Vol. **27**, 8501-8508, doi:[10.1175/JCLI-D-14-00471.1](https://doi.org/10.1175/JCLI-D-14-00471.1).
- Colas, F., V. Echevin, C. Peugeot, **P. Terray**, B. Sultan and T. Vischel, 2015: Comprendre la machine climatique grâce aux modèles de climat. In “Changement climatique: quels défis pour le Sud? ». Reinert M., Janicot Serge (ed.), Aubertin Catherine (ed.), Bernoux Martial (ed.),

- Dounias Edmond (ed.), Guégan Jean-François (ed.), Lebel Thierry (ed.), Mazurek Hubert (ed.), Sultan Benjamin (ed.), Sokona Y. (pref.), Moatti Jean-Paul (pref.). Marseille: IRD, Chapitre 4, pp. 51-59. ISBN 978-2-7099-2168-8.
- Prodhomme, C., **P. Terray**, S. Masson, G. Bosch and T. Izumo, 2015: Oceanic factors controlling the Indian Summer Monsoon Onset in a coupled model. *Climate Dynamics*, Vol. **44**, 977-1002, doi:[10.1007/s00382-014-2200-y](https://doi.org/10.1007/s00382-014-2200-y).
- Priya, P., M. Mujumdar, T. Sabin, **P. Terray**, and R. Krishnan, 2015: Impacts of Indo-Pacific sea surface temperature anomalies on the summer monsoon circulation and heavy precipitation over northwest India-Pakistan region during 2010. *Journal of Climate*, Vol. **28**, 3714-3730, doi:[10.1175/JCLI-D-14-00595.1](https://doi.org/10.1175/JCLI-D-14-00595.1).
- Sooraj, K.P., **P. Terray** and M. Mujumdar, 2015: Global warming and the weakening of the Asian summer monsoon circulation: Assessments from the CMIP5 models. *Climate Dynamics*, Vol. **45**, 233-252, doi:[10.1007/s00382-014-2257-7](https://doi.org/10.1007/s00382-014-2257-7).
- Roxy, M.K., K. Ritika, **P. Terray**, R. Murutugudde, K. Ashok and B. N. Goswami, 2015: Drying of Indian subcontinent by rapid Indian Ocean warming and a weakening land-sea thermal gradient. *Nature Communications*, Vol. **6**:7423, doi: [10.1038/ncomms8423](https://doi.org/10.1038/ncomms8423).
- Roxy, M. K., K. Ritika, **P. Terray** and S. Masson, 2015: Indian Ocean warming—the bigger picture. *Bulletin of the American Meteorological Society*, Vol. **96**, 7, 1070-1071.
- Bost, C.A., C. Cotte, **P. Terray**, C. Barbraud, K. Delord, C. Bon, O. Gimenez, Y. Handrich, C. Guinet and H. Weimerskirch, 2015: Tracking penguins reveals impacts of large-scale climate variability on food webs. *Nature Communications*, Vol. **6**:8220, doi: [10.1038/ncomms9220](https://doi.org/10.1038/ncomms9220).
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- Cretat, J., S. Masson, S. Berthet, G. Samson, **P. Terray**, J. Dudhia, F. Pinsard and C. Hourdin, 2016: Control of shortwave radiation parameterization on tropical climate simulation. *Climate Dynamics*, Vol. **47**, 1807-1826, doi:[10.1007/s00382-015-2934-1](https://doi.org/10.1007/s00382-015-2934-1).
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- Cretat, J., **P. Terray**, S. Masson, P.V. Sooraj and M. K. Roxy, 2017: Indian Ocean and Indian Summer Monsoon : relationships without ENSO in ocean-atmosphere coupled simulations. *Climate Dynamics*, Vol. **49**, 1429–1448, doi:[10.1007/s00382-016-3387-x](https://doi.org/10.1007/s00382-016-3387-x).
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