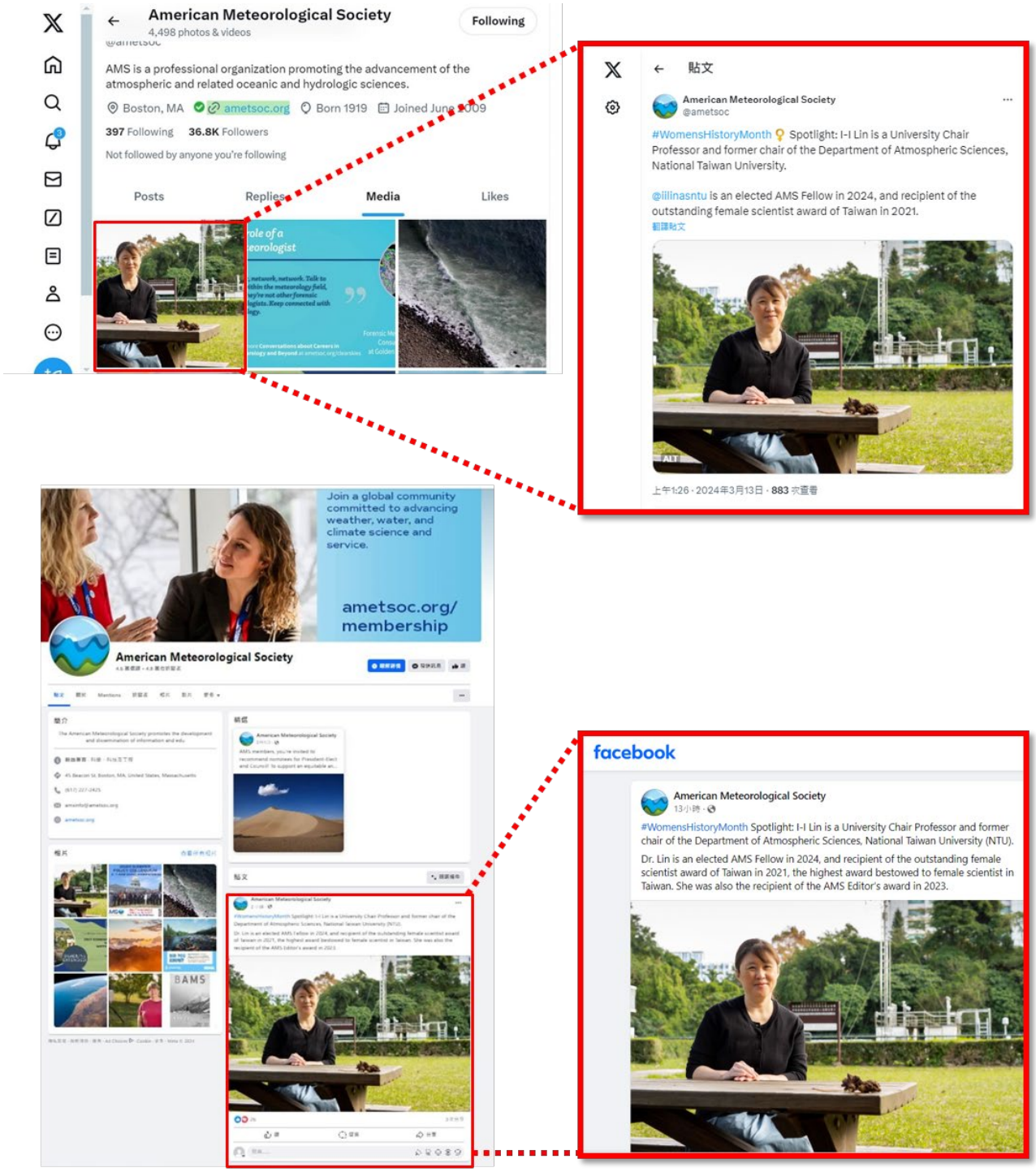
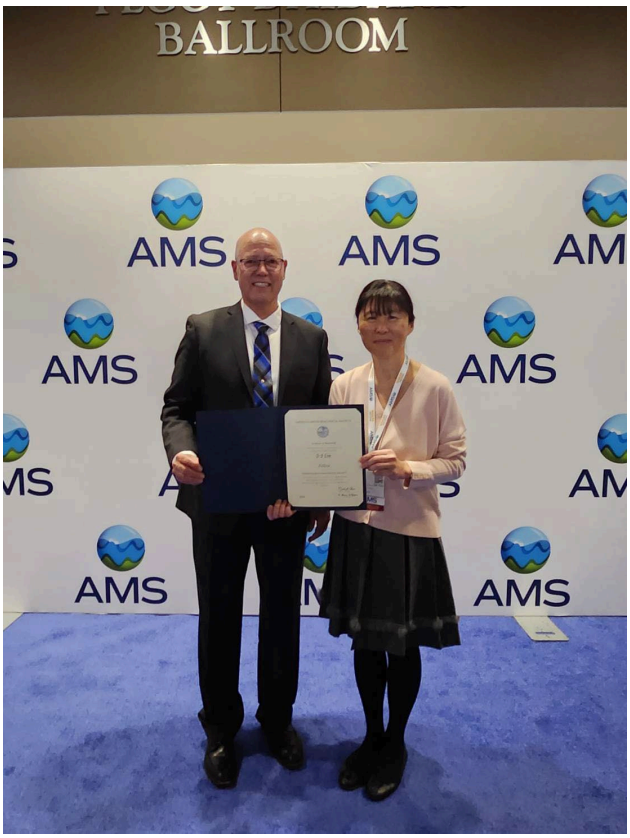
Related figures

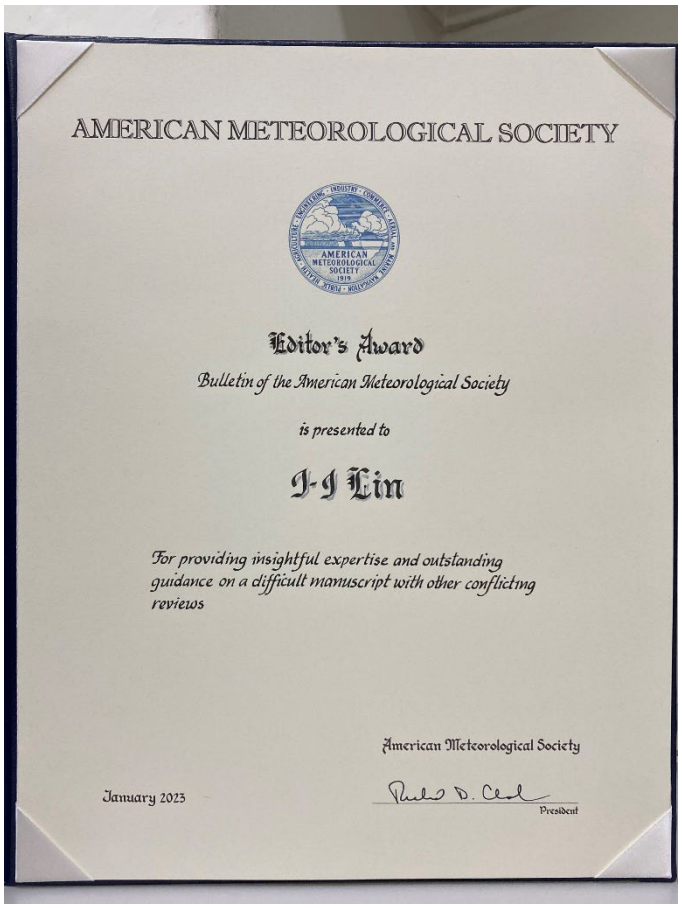
PhD student Hsiao-Ching Huang was honored with the College of Science Dean's Award at National Taiwan University in 2025.



Spotlighted by American Meteorological Society (AMS) – Women's History Month (2024) [Facebook] [X (Twitter)]



Fellow of American Meteorological Society (AMS, 2024) [Link] [YouTube]



The AMS Editor's Award - Bulletin of the American Meteorological Society. The award citation reads "For insightful and detailed comments that have been instrumental in reaching publication decisions on challenging manuscripts" (2023). [link]

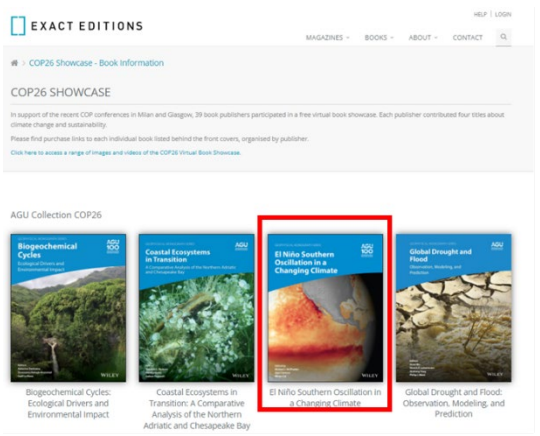
https://udn.com/news/story/6885/6180913?from=udn-catelistnews_ch2

https://www.chinatimes.com/realtimenews/20220321003028-260405?chdtv

https://www.ner.gov.tw/news/623947cac75f3d0007ff8e10

The Ministry of Education's 25th Annual National Chair Professorship Award (2022)

The 14th Taiwan Outstanding Women in Science Award, held jointly by L'Oréal Taiwan and the Wu Chien-shiung Education Foundation (2021)

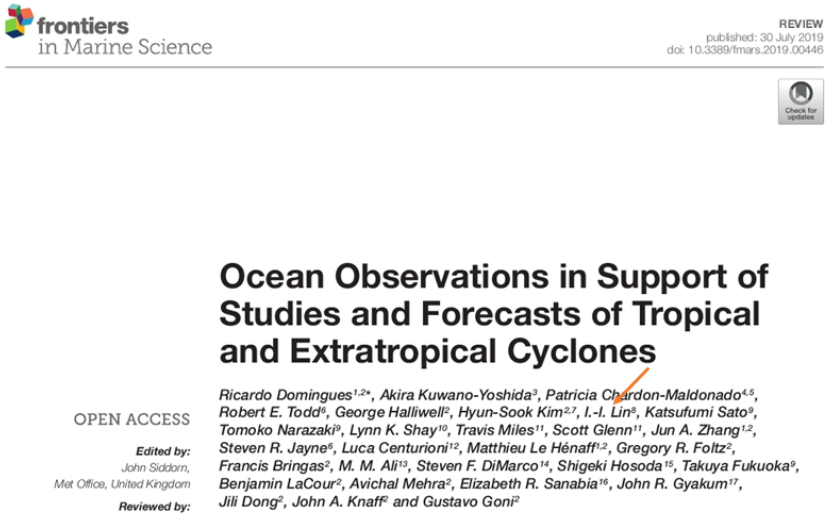


https://institutions.exacteditions.com/cop26

Invited book chapter contribution in American Geophysical Union (AGU)'s centennial celebration monograph, El Niño Southern Oscillation (ENSO) in a Changing Climate, on 'Tropical Cyclone, ENSO, and Global Warming'. This is the only invited chapter in Taiwan. This book was successfully published with press release in USA in Nov. 2020. (2020)

One of the 4 Books from AGU Collected as special COP26 (the 26th United Nations Climate Change conference, 31 Oct. - 13 Nov. 2021, Glasgow, Scotland) Virtual Book Showcase.

Public outreach talk on 'Tropical Cyclone, Ocean and Climate' in Ministry of Science and Technology's Prospect Series in October 2020.



frontiers in Marine Science

REVIEW
published: 30 July 2019
doi: 10.3389/fmars.2019.00446

Ocean Observations in Support of Studies and Forecasts of Tropical and Extratropical Cyclones

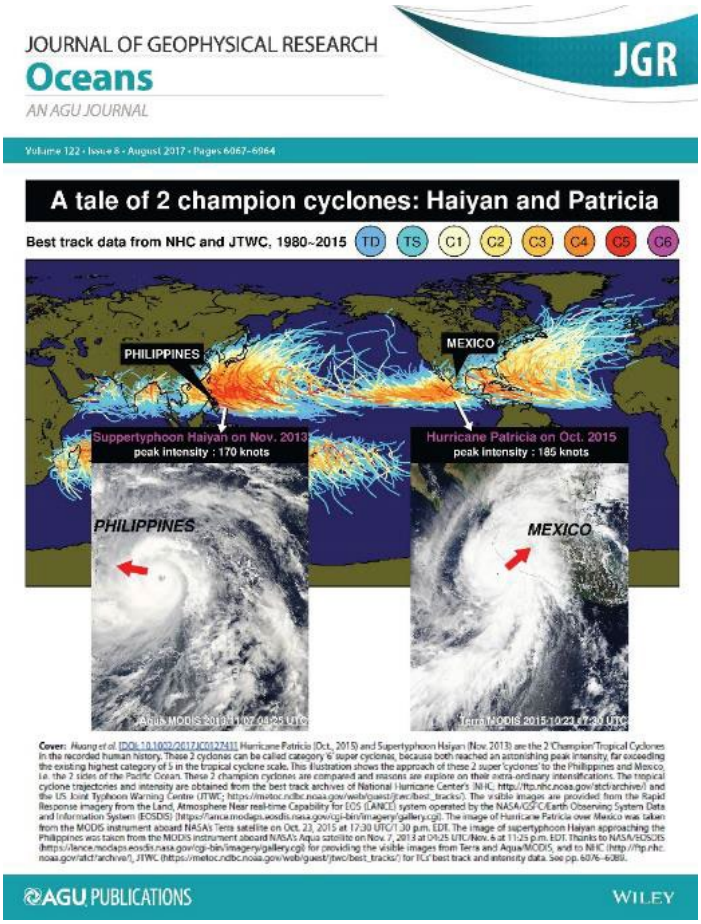
Ricardo Domingues[1,2]*, Akira Kuwano-Yoshida[3], Patricia Chardon-Maldonado[4,5], Robert E. Todd[6], George Halliwell[2], Hyun-Sook Kim[2,7], I.-I. Lin[8], Katsufumi Sato[9], Tomoko Narazaki[9], Lynn K. Shay[10], Travis Miles[11], Scott Glenn[11], Jun A. Zhang[1,2], Steven R. Jayne[6], Luca Centurioni[12], Matthieu Le Hénaff[1,2], Gregory R. Foltz[2], Francis Bringas[2], M. M. Ali[13], Steven F. DiMarco[14], Shigeki Hosoda[15], Takuya Fukuoka[9], Benjamin LaCour[2], Avichal Mehra[2], Elizabeth R. Sanabia[16], John R. Gyakum[17], Jili Dong[2], John A. Knaff[2] and Gustavo Goni[2]

OPEN ACCESS

Edited by:
John Siddorn,
Met Office, United Kingdom

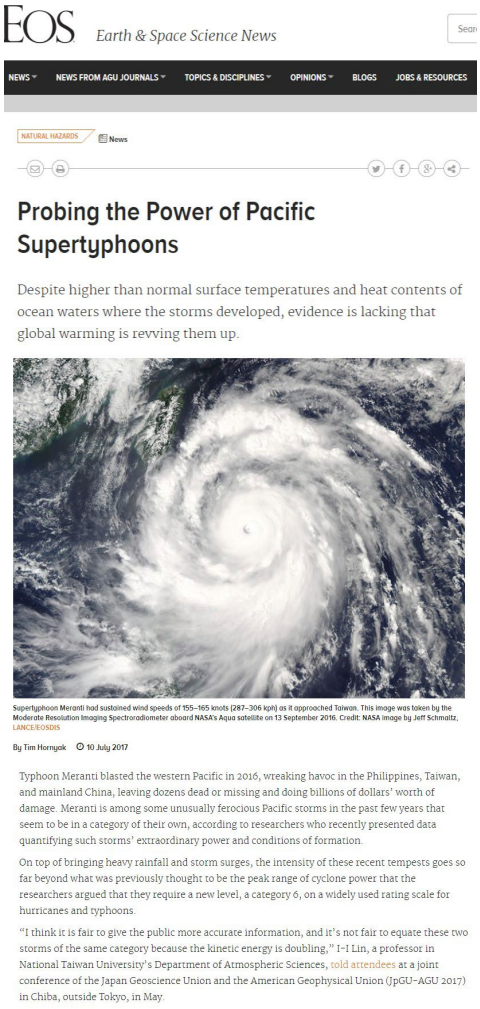
Reviewed by:

Invited to join the international expert team to write recommendations in future ocean observations for tropical and extra tropical cyclones in the 'Frontiers in Marine Science', the only invited scientist in Taiwan.(2019)



Paper featured as journal cover ((Hurricane Patricia and supertyphoon Haiyan) in the renown international scientific journal, Journal of Geophysical Research: Oceans (Hurricane Patricia and Typhoon Haiyan)(2017)

Academic Award, Ministry of Education, Taiwan.(2017)



EOS *Earth & Space Science News*

NEWS | NEWS FROM AGU JOURNALS | TOPICS & DISCIPLINES | OPINIONS | BLOGS | JOBS & RESOURCES

NATURAL HAZARDS | News

Probing the Power of Pacific Supertyphoons

Despite higher than normal surface temperatures and heat contents of ocean waters where the storms developed, evidence is lacking that global warming is revving them up.

Supertyphoon Meranti had sustained wind speeds of 155–165 knots (287–306 kph) as it approached Taiwan. This image was taken by the Moderate Resolution Imaging Spectroradiometer aboard NASA's Aqua satellite on 13 September 2016. Credit: NASA image by Jeff Schmaltz, LANCE/EOSDIS

By Tim Hornyak | 10 July 2017

Typhoon Meranti blasted the western Pacific in 2016, wreaking havoc in the Philippines, Taiwan, and mainland China, leaving dozens dead or missing and doing billions of dollars' worth of damage. Meranti is among some unusually ferocious Pacific storms in the past few years that seem to be in a category of their own, according to researchers who recently presented data quantifying such storms' extraordinary power and conditions of formation.

On top of bringing heavy rainfall and storm surges, the intensity of these recent tempests goes so far beyond what was previously thought to be the peak range of cyclone power that the researchers argued that they require a new level, a category 6, on a widely used rating scale for hurricanes and typhoons.

"I think it is fair to give the public more accurate information, and it's not fair to equate these two storms of the same category because the kinetic energy is doubling," I-I Lin, a professor in National Taiwan University's Department of Atmospheric Sciences, told attendees at a joint conference of the Japan Geoscience Union and the American Geophysical Union (JpGU-AGU 2017) in Chiba, outside Tokyo, in May.

Research on record-breaking Category '6' tropical cyclones featured by American Geophysical Union's Earth & Space Science News.(2017)

13th Annual Meeting
Asia Oceania Geosciences Society
31 July to 05 August 2016, Beijing

AOGS - In Asia for Asia and the World

Atmospheric Sciences (AS) Section
Best Poster Award

Hsiao-Ching Huang

National Taiwan University, Taiwan

For The Paper AS19-A071

Hurricane-Ocean Interaction Related to Ensо in the Eastern North Pacific Ocean

Co-authored with
I-I Lin
National Taiwan University, Taiwan

Chen Yun-tai

Yun-Tai Chen
President, AOGS
2014 - 2016

Tetsuo Nakazawa
Section President, Atmospheric Sciences (AS)
2014 - 2016

The joint research with her PhD student (Hsiao-Ching Huang) on the super-hurricane Patricia and relationship with super-El Niño won the best student poster award "(1000 participants and the only recipients from Taiwan for the 27 awards) in Beijing, China in the AOGS international symposium.(2016)

Outstanding College Youth of National Taiwan University (2016) & Young College Elite of 2017

nature COMMUNICATIONS

ARTICLE

Received 8 Jul 2014 | Accepted 10 Apr 2015 | Published 20 May 2015

DOI: 10.1038/ncomms8182 OPEN

Recent decrease in typhoon destructive potential and global warming implications

I-I Lin[1] & Johnny C.L. Chan[2]

Typhoons (tropical cyclones) severely impact the half-billion population of the Asian Pacific. Intriguingly, during the recent decade, typhoon destructive potential (Power Dissipation Index, PDI) has decreased considerably (by ~35%). This decrease, paradoxically, has occurred despite the increase in typhoon intensity and ocean warming. Using the method proposed by Emanuel (in 2007), we show that the stronger negative contributions from typhoon frequency and duration, decrease to cancel the positive contribution from the increasing intensity, controlling the PDI. Examining the typhoons' environmental conditions, we find that although the ocean condition became more favourable (warming) in the recent decade, the atmospheric condition 'worsened' at the same time. The 'worsened' atmospheric condition appears to effectively overpower the 'better' ocean conditions to suppress PDI. This stronger negative contribution from reduced typhoon frequency over the increased intensity is also present under the global warming scenario, based on analysis of the simulated typhoon data from high-resolution modelling.

臺大校訊

National Taiwan University Newsletter

海洋變暖不一定導致颱風破壞潛力增加 臺大及香港城市大學合作成果榮登《Nature Communications》

在一般的認知裡，人們常常認為海洋變暖會導致颱風破壞潛力增加，但是在最近20年中，西北太平洋觀測的結果卻與此恰恰相反，雖然近年海洋變暖，但颱風破壞潛力卻逐年下降，此篇由臺灣大學大氣科學系林依依教授及香港城市大學陳仲良教授發表在自然通訊期刊的最新研究，深入探索其原因，由於颱風的破壞潛力並不是只受到海洋的影響，雖然近年海洋變暖，颱風強度略為增加，但是影響颱風破壞潛力還有另外兩個重要因子，即颱風個數及颱風生命期，林與陳的研究發現，近20年來颱風形成個數顯著下降，同時生命期顯著縮短，由於颱風破壞潛力是由三個因素共同影響，而颱風個數下降及生命期變短產生的負貢獻超過颱風強度變強的正貢獻，因此造成近20年來的颱風破壞潛力逐年降低，至於為何颱風生命期變短和颱風個數下降，研究發現該現象與不利的大氣環境有關，雖然海洋條件變得較有利颱風強度增強，但是大氣環境變得不利颱風的生命期及個數增加，所以近20年來的颱風破壞潛力逐年降低，同時，在全球暖化的情境下，他們也發現類似的現象，透過分析NOAA高解析度氣候模式所模擬simulate出的全球暖化情境下之颱風資料，他們發現在全球暖化之下，西北太平洋的颱風破壞潛力降低了15%，其主要原因也與近20年來的分析結果類似，即雖然在全球暖化之下，颱風強度略為增加，但是颱風個數更顯著的減少，使其負貢獻遠大於颱風強度增加的正貢獻，因此在西北太平洋的破壞潛力於全球暖化情境下降低了15%。

引用:I-I Lin* and Johnny Chan, Recent Decrease in Typhoon Destructive Potential and Global Warming Implications, Nature Communications, in press, 2015* corresponding email: iilin@as.ntu.edu.tw

[1] Department of Atmospheric Sciences, National Taiwan University, No.1, Sec. 4, Ro
Impact Centre, School of Energy and Environment, City University of Hong Kong, Hon
be addressed to I.-I.L. (email: iilin@as.ntu.edu.tw).

Paper published in Nature communications, with highlighted in the NTU web and newsletter(2015)

nature COMMUNICATIONS

ARTICLE

Received 29 Oct 2014 | Accepted 10 Apr 2015 | Published 18 May 2015

DOI: 10.1038/ncomms8188 OPEN

Change in ocean subsurface environment to suppress tropical cyclone intensification under global warming

Ping Huang[1,2], I-I Lin[3], Chia Chou[4] & Rong-Hui Huang[1]

Tropical cyclones (TCs) are hazardous natural disasters. Because TC intensification is significantly controlled by atmosphere and ocean environments, changes in these environments may cause changes in TC intensity. Changes in surface and subsurface ocean conditions can both influence a TC's intensification. Regarding global warming, minimal exploration of the subsurface ocean has been undertaken. Here we investigate future subsurface ocean environment changes projected by 22 state-of-the-art climate models and suggest a suppressive effect of subsurface oceans on the intensification of future TCs. Under global warming, the subsurface vertical temperature profile can be sharpened in important TC regions, which may contribute to a stronger ocean coupling (cooling) effect during the intensification of future TCs. Regarding a TC, future subsurface ocean environments may be more suppressive than the existing subsurface ocean environments. This suppressive effect is not spatially uniform and may be weak in certain local areas.

全球暖化不利熱帶氣旋發展 臺大與中國大陸中國科學院、臺灣中央研究院合作成果榮登《Nature Communications》

[1] Center for Monsoon System Research, Institute of Atmospheric Physics, C... Change Studies (JCGCS), Beijing 100875, China. [3] Department of Atmospher... for Environmental Changes, Academia Sinica, Taipei 11529, Taiwan. Corresp... iilin@as.ntu.edu.tw).

Paper published in Nature communications, with highlighted in the NTU web and newsletter(2015)

www.nature.com/scientificreports

SCIENTIFIC REPORTS

OPEN

A Long Neglected Damper in the El Niño—Typhoon Relationship: a 'Gaia-Like' Process

Received: 04 September 2014
Accepted: 13 May 2015
Published: 21 July 2015

Zhe-Wen Zheng[1], I.-I. Lin[2], Bin Wang[3], Hsiao-Ching Huang[2] & Chi-Hong Chen[2]

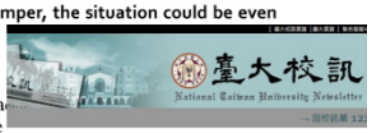
Proposed in the early 1970's, the Gaia hypothesis suggests that our planet earth has a self-regulating ability to maintain a stable condition for life. Tropical cyclone (TC) is one of the earth's most hazardous disasters; it is intriguing to explore whether 'Gaia-like' processes may exist in nature to regulate TC activities. El Niño can shift the forming position of the Western Pacific typhoons away from land. This shift enables typhoons to travel longer distances over ocean and is known to be a positive process to promote TCs to achieve higher intensity. What is neglected, however, is that there co-exists a negative process. Here we show that during El Niño, typhoons intensify over region undergoing strong ocean subsurface shoaling where upper ocean heat content can drop by 20–50%. This 'worsen' ocean pre-condition can effectively reduce ocean's energy supply for typhoon intensification during typhoon-ocean interaction. We find this an elegant, 'Gaia-like' process demonstrating nature's self-regulating ability. Though during El Niño, typhoons can take advantage of the longer travelling distance over ocean to achieve higher intensity, nature is also providing a damper to partially cancel this positive impact. Without the damper, the situation could be even worse.

With 20–30 tropical cyclones (TCs) formed and intensified ea
(WNPO) is the most energetic and hazardous TC basin in the
these TCs impose threats to a billion population and mega volu
activities in Asia[1,2]. During El Niño years, typhoon activities (e.g.
fall position, and forming position) can be greatly altered and
damage and impacts[3–18]. It is thus important to understand the E
climate projections have suggested a possible El Niño-like future
ing[16]. Though many aspects have been studied, there is one aspe
is the relationship between ocean's subsurface thermal condition,

In the current research framework, it is generally understood
of TC's forming (genesis) position to the southeast (Fig. 1), TCs
before encountering the Asia Pacific continents to achieve higher
genesis position and the averaged life-time peak intensity of th
recent El Niño events, see Methods) was ~171.01°E, 8.94°N (154
comparison, the long-term climatological genesis position and th
(i.e. closer to land), and 43 ms^{-1} (not as intense), respectively (de

However, for long the above framework neglects the fact th
different under El Niño. In El Niño years, strong shoaling takes
As a result, ocean thermocline is not as deep and upper ocean
These are negative factors for TC intensification[19–24]. In other wo

[1]Institute of Marine Environmental Science and Technology, National
[2]Department of Atmospheric Sciences, National Taiwan University, Ta
Sciences, University of Hawaii, Honolulu HI 96822, USA. Correspond
addressed to I.-I. L. (email: iilin@as.ntu.edu.tw)



Paper published in Scientific Reports (Nature series), with joint press conference with the National Taiwan Normal University and highlighted in the NTU web and newsletter(2015)

A5 生活新聞

中華民國103年5月18日／星期日

http://www.chinatimes.com

英特爾科展 我獲雙首獎

12學生9件作品參賽 得獎率逾5成 歷年最佳成績

林志成／台北－洛杉磯電話採訪

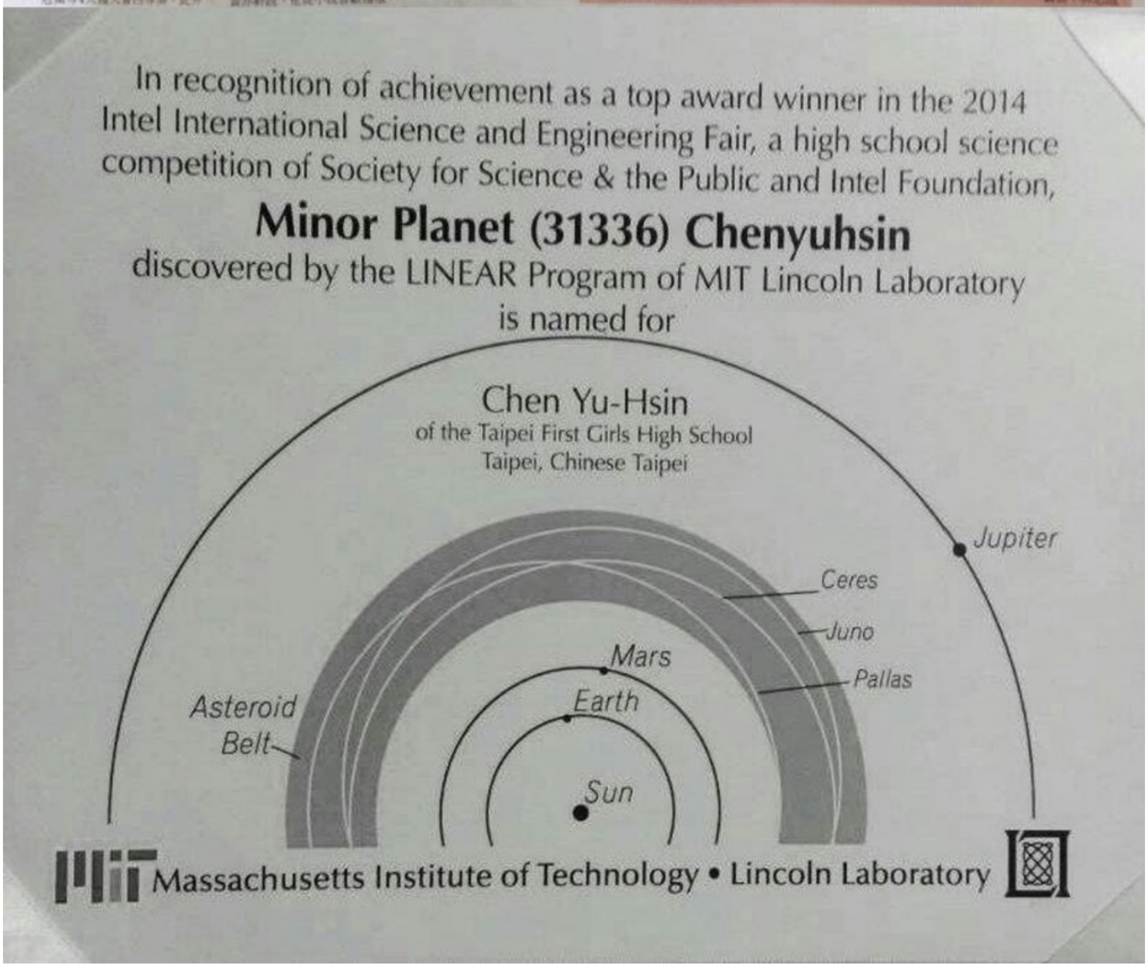
我國參加今年在美國洛杉磯舉行的「英特爾國際科技展覽會」，囊括2項大會歐洲參訪研習獎、2項類科首獎、5項大會獎、3項特別獎等12個獎，是35年以來最佳成績。建中黃亦軒及北一女陳郁欣兩人均獲首獎，他們感到意外，但也很高興。

黃亦軒找到開花基因

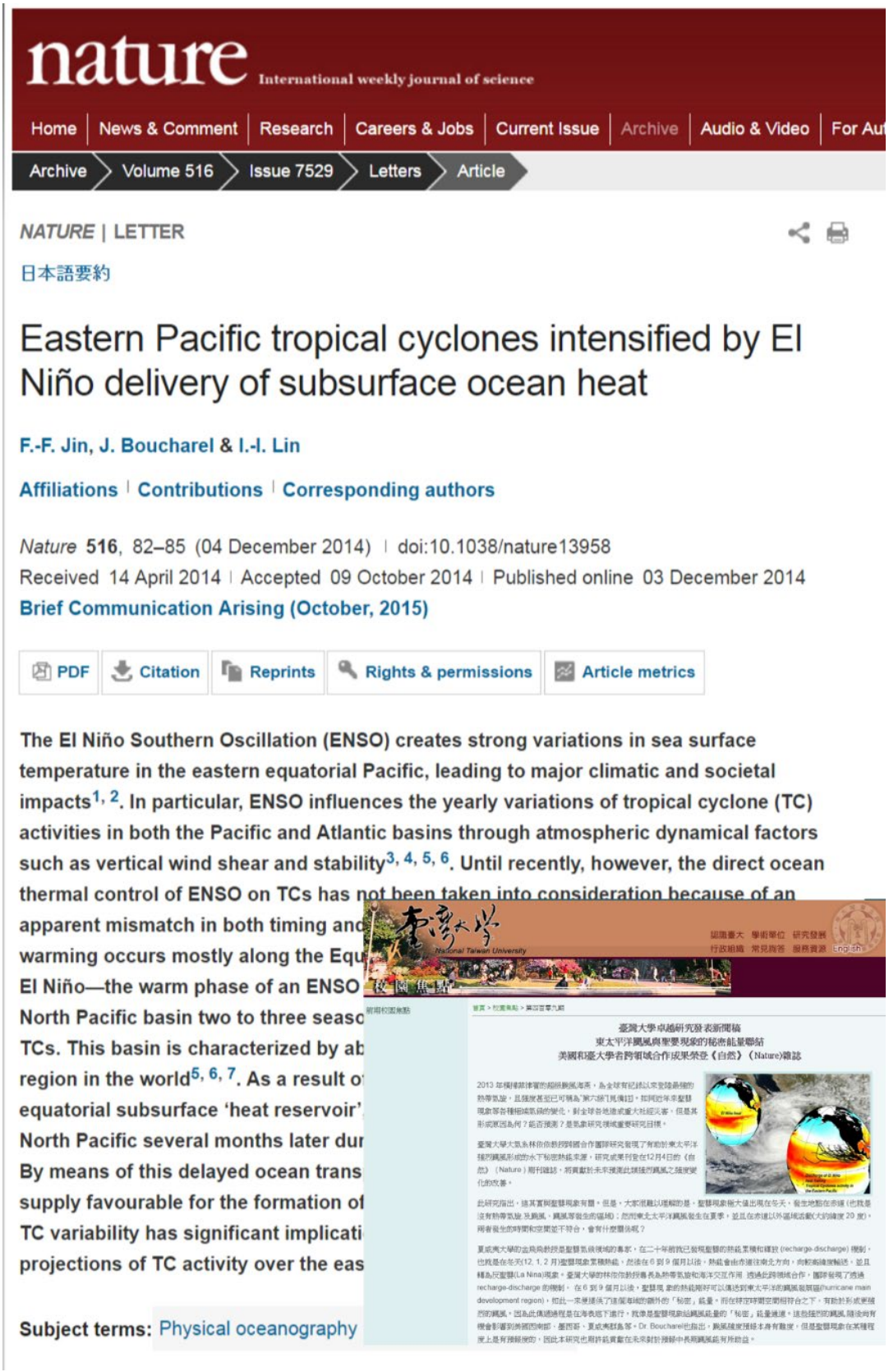
陳郁欣研究颱風強度

學生	就讀學校	獲得獎項	[illegible]
黃亦軒	建國中學	1.大會斯德哥爾摩國際青年科學研習獎 2.大會植物學科類科首獎(US$5000) 3.大會植物學科一等獎(US$3000) 4. Monsanto公司特別獎一等獎(US$2500)	1.新台幣20萬元 2.審查後保送大學 3.出國留學獎學金
陳郁欣	北一女	1.大會歐盟青年科學家競賽獎 2.大會地球與行星科學科類科首獎(US$5000) 3.大會地球與行星科學科一等獎(US$3000) 4.美國氣象學會特別獎三等獎(US$500)	1.新台幣20萬元 2.審查後保送大學 3.出國留學獎學金
[illegible] 邱紹庭	建國中學	1.大會微生物學科四等獎(US$500) 2.美國微生物學會特別獎(US$2500)	1.新台幣5萬元 2.審查後保送大學
沈玉宣	北一女	大會化學科四等獎(US$500)	1.新台幣5萬元 2.審查後保送大學
王冠禹	高雄市立三民國中	大會數學科四等獎(US$500)	1.新台幣5萬元 2.審查後保送高中

資料來源：科教館　製表：林志成



Minor planet (31336) Chenyuhsin is named for Chen Yu-Hsin - Chen Yu-Hsin was awarded best of category and first place in the 2014 Intel International Science and Engineering Fair for her earth science project, and also received the European Union Contest for Young Scientists Award.(October 2015)



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Archive > Volume 516 > Issue 7529 > Letters > Article

NATURE | LETTER

日本語要約

Eastern Pacific tropical cyclones intensified by El Niño delivery of subsurface ocean heat

F.-F. Jin, J. Boucharel & I.-I. Lin

Affiliations | Contributions | Corresponding authors

Nature **516**, 82–85 (04 December 2014) | doi:10.1038/nature13958
Received 14 April 2014 | Accepted 09 October 2014 | Published online 03 December 2014
Brief Communication Arising (October, 2015)

PDF | Citation | Reprints | Rights & permissions | Article metrics

The El Niño Southern Oscillation (ENSO) creates strong variations in sea surface temperature in the eastern equatorial Pacific, leading to major climatic and societal impacts[1, 2]. In particular, ENSO influences the yearly variations of tropical cyclone (TC) activities in both the Pacific and Atlantic basins through atmospheric dynamical factors such as vertical wind shear and stability[3, 4, 5, 6]. Until recently, however, the direct ocean thermal control of ENSO on TCs has not been taken into consideration because of an apparent mismatch in both timing and
warming occurs mostly along the Equ
El Niño—the warm phase of an ENSO
North Pacific basin two to three seasc
TCs. This basin is characterized by ab
region in the world[5, 6, 7]. As a result o
equatorial subsurface 'heat reservoir'
North Pacific several months later dur
By means of this delayed ocean trans
supply favourable for the formation of
TC variability has significant implicati
projections of TC activity over the eas

Subject terms: Physical oceanography

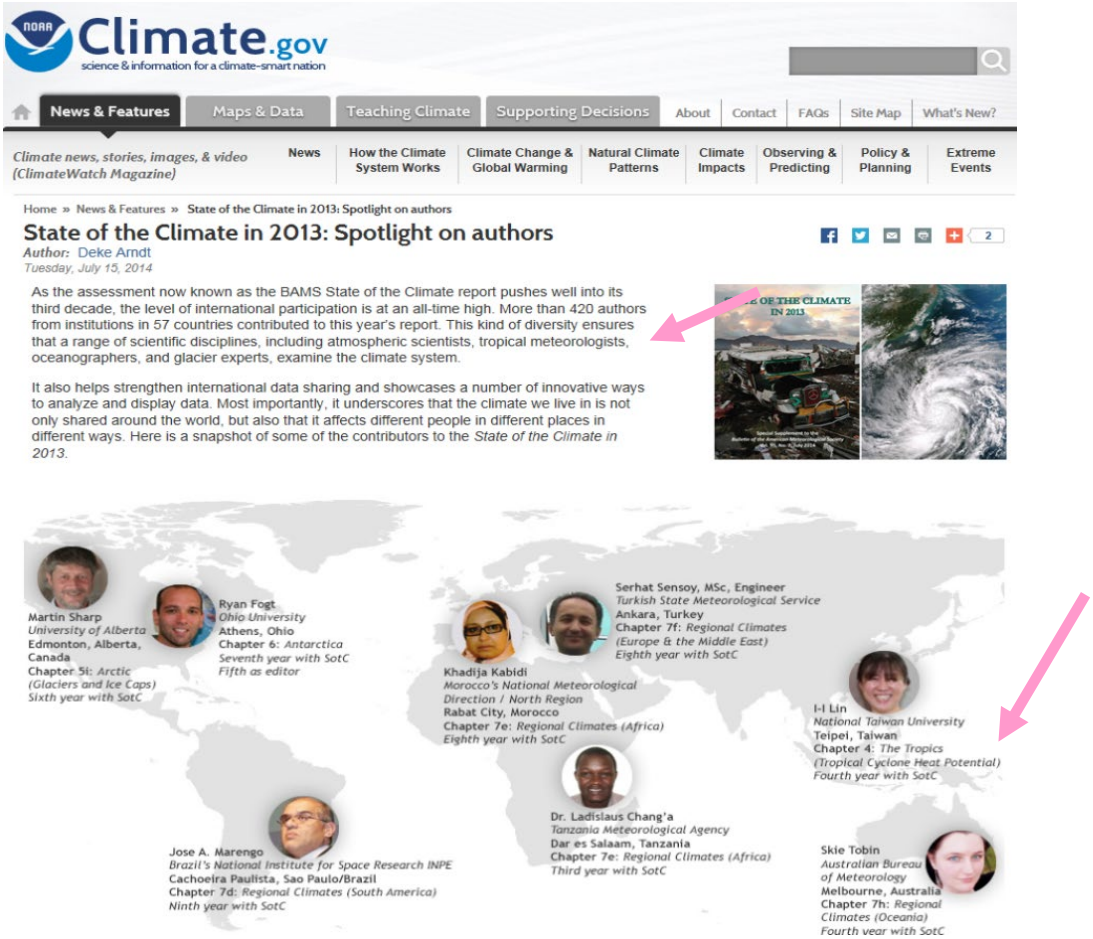
臺灣大學 National Taiwan University

校園焦點

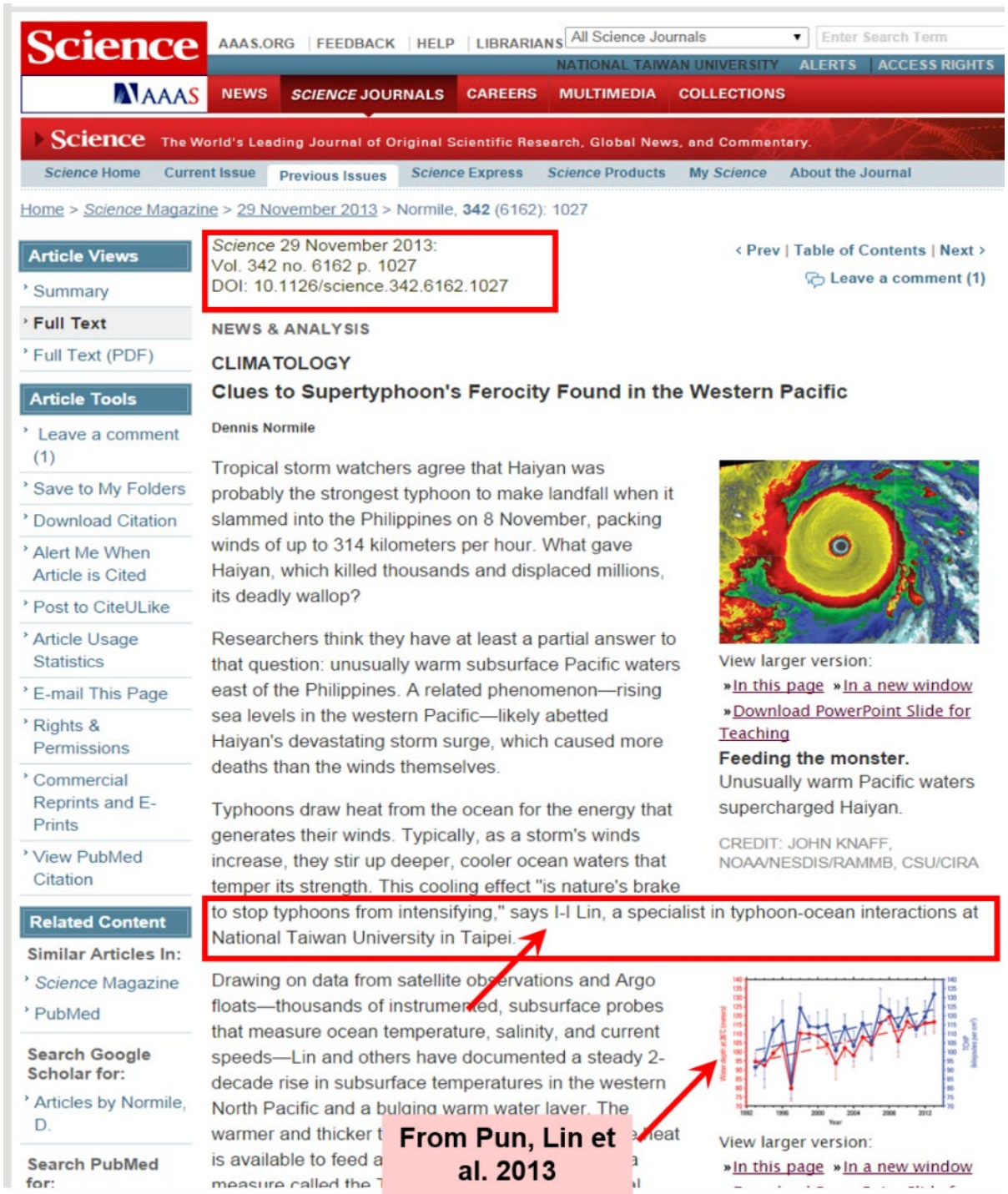
臺灣大學卓越研究發表新聞稿
東太平洋颶風與聖嬰現象的秘密能量聯結
美國和臺大學者跨領域合作成果榮登《自然》（Nature）雜誌

Paper published in Nature, with highlighted in the NTU web and newsletter(2014)

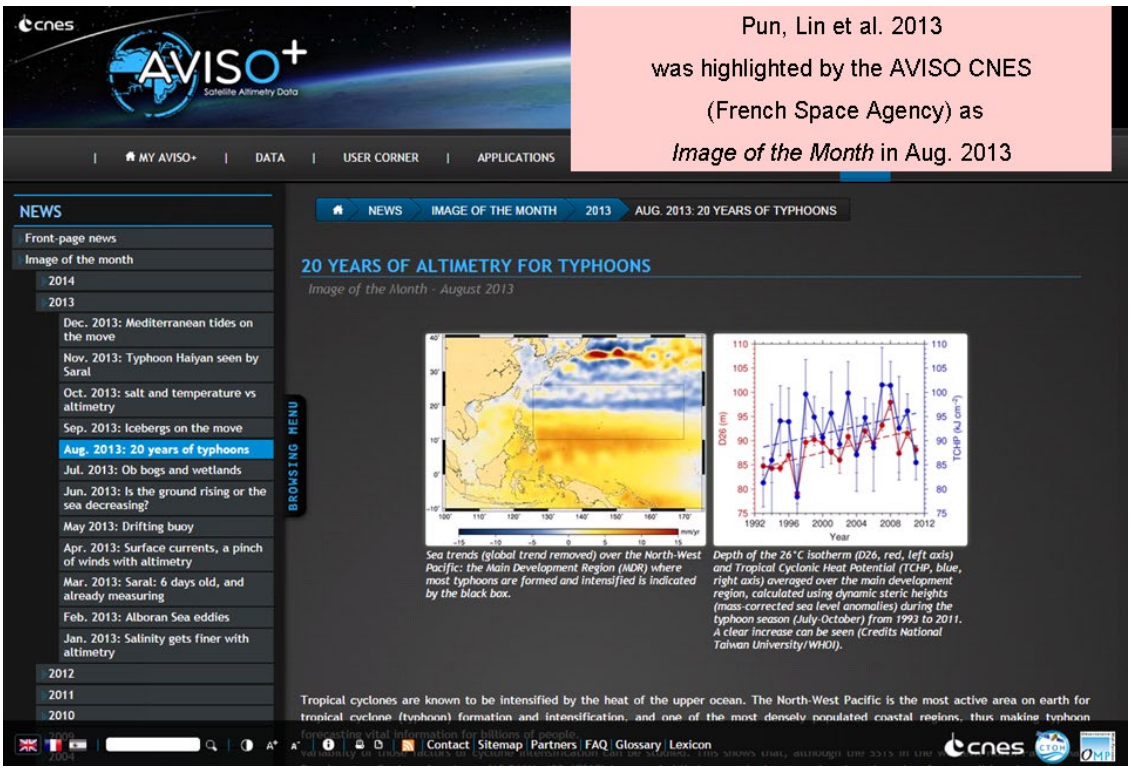
Featured in Japan NHK's special documentary 'Mega Disasters' (31 August 2014) with focus on the importance of ocean subsurface warming and supertyphoons.(2014)



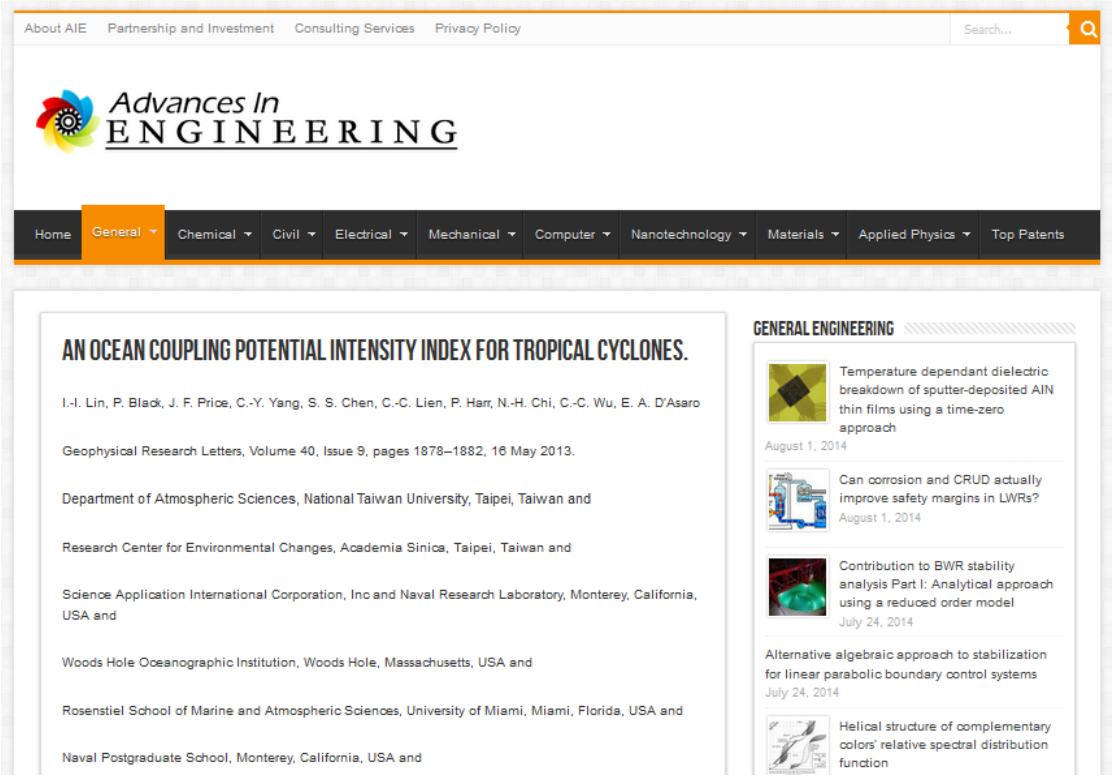
BAMS paper State of the Climate in 2013: spotlighted for the Tropics chapter by NOAA in July 2014.(2014)



Pun, Lin and Lo GRL 2013 paper highlighted by Science in Nov. 2013.(2013)

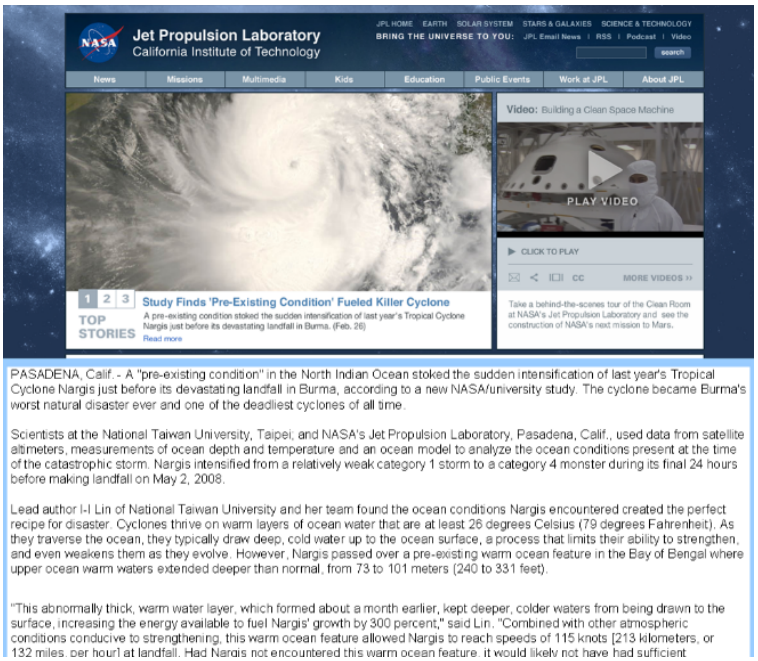


Pun, Lin and Lo GRL 2013 paper highlighted by the International AVISO Altimetry Organization under CNES (French Space Agency) as "Image of the Month" for August 2013.(2013)



GRL 2013 paper was highlighted by Advance in Engineering.(2013)

National Taiwan University Outstanding Teaching Award in Sep. 2009

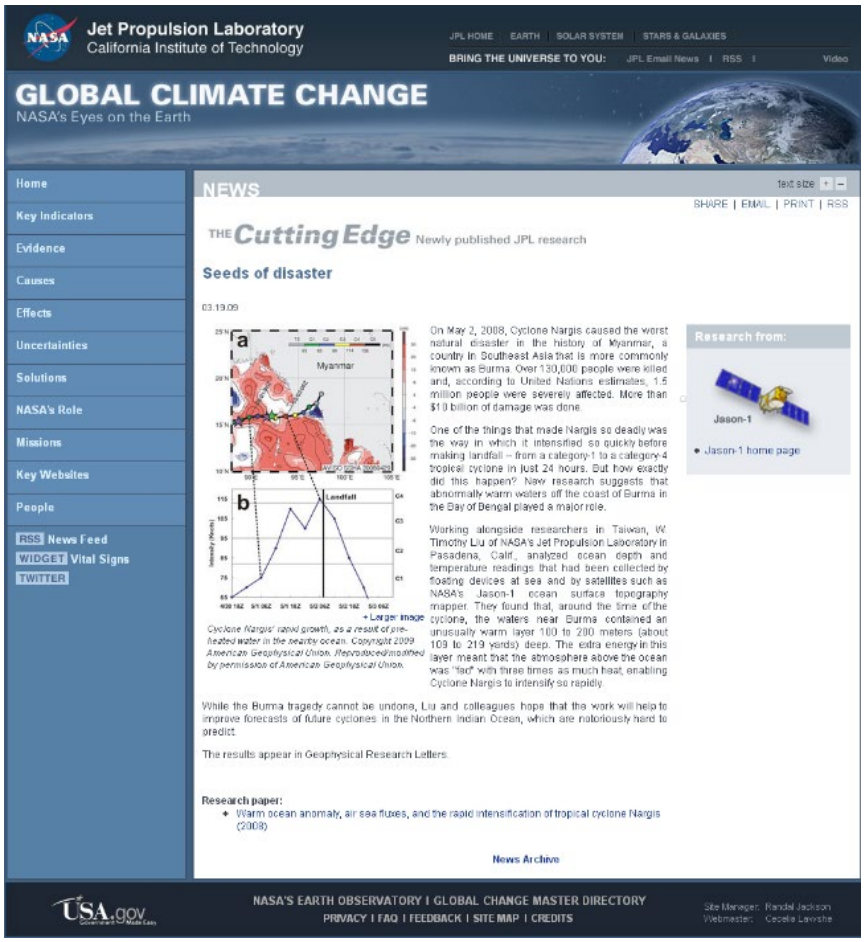


PASADENA, Calif. - A "pre-existing condition" in the North Indian Ocean stoked the sudden intensification of last year's Tropical Cyclone Nargis just before its devastating landfall in Burma, according to a new NASA/university study. The cyclone became Burma's worst natural disaster ever and one of the deadliest cyclones of all time.

Scientists at the National Taiwan University, Taipei; and NASA's Jet Propulsion Laboratory, Pasadena, Calif., used data from satellite altimeters, measurements of ocean depth and temperature and an ocean model to analyze the ocean conditions present at the time of the catastrophic storm. Nargis intensified from a relatively weak category 1 storm to a category 4 monster during its final 24 hours before making landfall on May 2, 2008.

Lead author I-I Lin of National Taiwan University and her team found the ocean conditions Nargis encountered created the perfect recipe for disaster. Cyclones thrive on warm layers of ocean water that are at least 26 degrees Celsius (79 degrees Fahrenheit). As they traverse the ocean, they typically draw deep, cold water up to the ocean surface, a process that limits their ability to strengthen, and even weakens them as they evolve. However, Nargis passed over a pre-existing warm ocean feature in the Bay of Bengal where upper ocean warm waters extended deeper than normal, from 73 to 101 meters (240 to 331 feet).

"This abnormally thick, warm water layer, which formed about a month earlier, kept deeper, colder waters from being drawn to the surface, increasing the energy available to fuel Nargis' growth by 300 percent," said Lin. "Combined with other atmospheric conditions conducive to strengthening, this warm ocean feature allowed Nargis to reach speeds of 115 knots [213 kilometers, or 132 miles, per hour] at landfall. Had Nargis not encountered this warm ocean feature, it would likely not have had sufficient



Twice featured by NASA with official press release and reported by USA Today, Science Daily, NTU news and other media.(February and March, 2009)
(http://www.jpl.nasa.gov/news/news.cfm?release=2009-031)
(http://climate.jpl.nasa.gov/news/index.cfm?FuseAction=ShowNews&NewsID=53)

Front cover: Weybourne Atmospheric Observatory, UK

Weybourne Atmospheric Observatory, officially opened by Sir William Waldegrave in 1994, experiences an uninterrupted, "clean air" seaward aspect to the North. We are also able to measure plumes from many differing origins including London and the Arctic.

Ozone, oxides of nitrogen and sulphur, carbon monoxide, carbon dioxide, oxygen, hydrogen, and condensation nuclei are routinely measured. New instrumentation is also available to determine GHG's and VOC's utilising Gas chromatography and PTRMS.

A SODAR RASS and Sonic system is run providing meteorological information about the atmospheric column above the site.

The facility also has ample room to house temporary external applications; with the ability to provide 32amp, 16amp and three-phase electrical supply. Accommodation in the area is both plentiful and high quality. Norwich International airport is forty minutes drive away ensuring that mainland Europe is easily accessible.

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national report

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I-I Lin obtained her Ph.D. degree in Remote Sensing from the University of Cambridge, England in 1995. From 1995-1999, she worked as a Research Scientist in the Centre for Remote Imaging, Sensing, and Processing of the National University of Singapore. In 2000 she returned to her home country, Taiwan, and is currently an Associate Professor in the Department of Atmospheric Sciences, National Taiwan University. Her research interest is in using synergy of multiple remote sensing data to study air-sea interaction problems, including typhoon-ocean interaction, dust storm-ocean interaction, and the role of surfactants in air-sea gas exchange.

Multiple remote sensing for air-sea biogeochemical interaction research in the western north Pacific and neighbouring seas

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Air-sea biogeochemical interaction related processes are a critical component in the Earth's ecological and climate system. However, due to the complex and dynamic nature of these processes, many of the processes are poorly-observed and little understood. This is especially true in the vast western North Pacific Ocean and the neighbouring seas as this vast oceanic region is subject to frequent atmospheric episodic forcing from events like typhoons and dust storms. It has been difficult to use discrete ship-borne point measurements with irregular time and spatial intervals to observe these highly episodic processes. With the advancement in space-borne remote sensing offering frequent and systematic observations, it has become more feasible to take a glimpse at these complex dynamic processes. In this research, multiple remote sensors are used as it is necessary to have observations of a suite of physical and biogeochemical parameters for both atmosphere and ocean. In this research, five types of remote sensing data are used and they are: (a) ocean colour data (chlorophyll-a concentration and ocean colour spectra) from the NASA's SeaWiFS (Sea-viewing Wide Field-of-view Sensor) and MODIS satellites (O'Reilly et al., 1998); (b) aerosol optical thickness and fine mode fraction data from the NASA

Featured by the by the international SCOR (Scientific Committee on Ocean Research) in the SOLAS (Surface Ocean Lower Atmosphere Study) newsletter.(2008)

10 Outstanding Young Women Award of the Republic of China(2007)

Reported in NASA's 10-years anniversary of earth observation highlights.(2004)

Citation in *Nature: News and Views in Brief*, 7 August, 2003, vol. 425, no. 6949, pp. 630, 'Oceanography: Bloom in Cyclone' (original paper see Lin I-I *et al.*, 2003c, Geophysical Research Letters).(2003)

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Atmospheric Science:
Quick, quick, slow

By Tim Lincoln, NATURE Magazine

Atmospheric science

Quick, quick, slow

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In July and August 2000, remote-sensing instruments tracked the consequences of two typhoons, Kai-Tak and Bilis, during their passage over oceans in Southeast Asia. Analyses of the data have produced a refined picture of the relationship between sea-surface temperature and wind speed.

Typhoons are driven by the energy from a warm sea-surface, and in turn drag up water from depth as they pass, leaving surface patches that can be up to 6 °C cooler than the surrounding ocean. As I.-I. Lin and co-workers point out, this situation provides a natural experiment. Taking advantage of this, they find that the speed of surface winds drops dramatically over such patches compared with wind speed over neighbouring ocean. This agrees with a previously proposed mechanism of wind-speed modulation at the sea surface. In Lin and colleagues' data, every 1 °C drop in sea temperature typically corresponds to a decrease of about 1 m s^{-1} in wind speed. The cold patches don't take long to warm up again, however, and — most notably — the authors find that events can be played out on comparatively small scales (100–400 km), and quite fast (within a day). Tim Lincoln

Citation in *Nature: News and Views in Brief*, 13 March, 2003, vol. 422, no. 6928, pp. 132, 'Atmospheric Science: Quick, quick, slow' (original paper see Lin I-I *et al*., 2003a, Geophysical Research Letters).(2003)

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Typhoons a boon for ocean life

SAN FRANCISCO (AP) -- Typhoons, the violent storms that are the bane of life across much of Asia, are a boon for life at sea, where the cyclones stir up the nutrients that microscopic algae crave, according to scientists.

Scientists in Taiwan and the United States recently used a trio of NASA satellites to observe how the passage of even moderate typhoons over the South China Sea can generate upwellings of nutrient-rich water from deeper in the ocean and spark massive blooms of phytoplankton.

Scientsists tracked the typoons to see what kind of effect they had on the sea life

"It's a natural hazard, it destroys life, but what I am showing is it also enhances life," said Timothy Liu, a senior research scientist at the National Aeronautics and Space Administration's Jet Propulsion Laboratory in Pasadena, California, on Saturday.

Through photosynthesis, the algae absorb carbon dioxide from the atmosphere and convert it to oxygen, offsetting emissions of carbon dioxide from the burning of fossil fuels. The algae are also an important food source for marine life.

Liu, working with research scientist I-I Lin of Taiwan's National Center for Ocean Research in Taipei, combined data culled from three satellites to show the positive effects of storms on marine life. They presented their results Saturday at the fall meeting of the American Geophysical Union.

"Typhoons were completely neglected before, because it was impossible to quantify" their effect on the algae, Lin said.

The violent storms are seen as the bane of life across much of Asia

Typhoon Kai-Tak passed over the South China Sea on July 5, 2000, lingering for four days before traveling northward over Taiwan, based on data acquired from NASA's Quikscat, a satellite that measures wind speeds over water.

In its aftermath, sea surface temperature measurements made by the joint U.S.-Japanese Tropical Rainfall Measuring Mission satellite showed a 16-degree Fahrenheit drop in the area where the counterclockwise-spinning storm had been parked. Colder water, drawn upward by the typhoon, caused the drop, Lin said.

By July 12, 2000, four days after the typhoon had moved on, a third satellite, the Sea Viewing Wide-Field-of-View Sensor, began to measure a dramatic change in the ocean color that matched in extent the previously observed cold spot.

A 300-fold increase in ocean chlorophyll, contained in the algae, accounted for the color change, Liu said.

The bloom persisted for a month.

Liu and Lin said they tracked about 20 typhoons that swept the South China Sea over the course of 2000 using the novel three-satellite method.

"The hypothesis was there, but there was no evidence to tie it together," Liu said of the typhoon-phytoplankton connection."

CNN reported the finding on the impressive ocean biogeochemical responses induced by typhoon Kai-Tak (i.e. Lin et al. GRL 2003b).