

「GRN の成果と課題 – iLEAPS/GCP」

近藤雅征

- ・The IDEC Institute, Center for Peaceful and Sustainable Futures
- ・The sustainability division, Seto Inland Sea Carbon Neutral Research Center
- ・Network for Education and Research on Peace and Sustainability
- ・Graduate School of Innovation and Practice for Smart Society
- ・Graduate School of Humanities and Social Sciences
- ・School of Integrated Arts and Sciences, Department of Integrated Global Studies

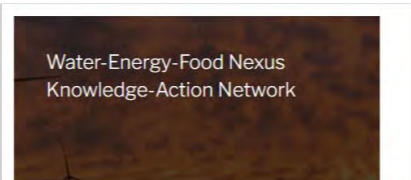
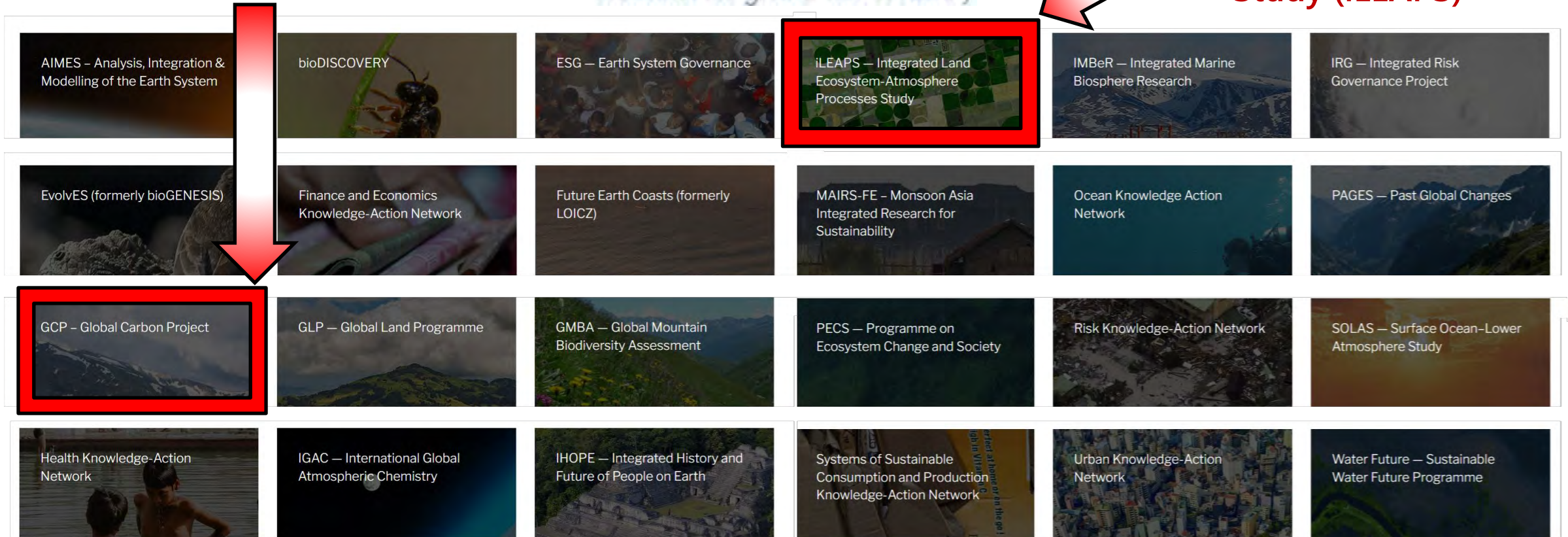
広島大学





Global Carbon Project (GCP)

integrated Land-Atmosphere Processes Study (iLEAPS)





全球の陸域と海洋のGHGバジェット推定

RECCAP

REgional Carbon
Cycle Assessment
and Processes

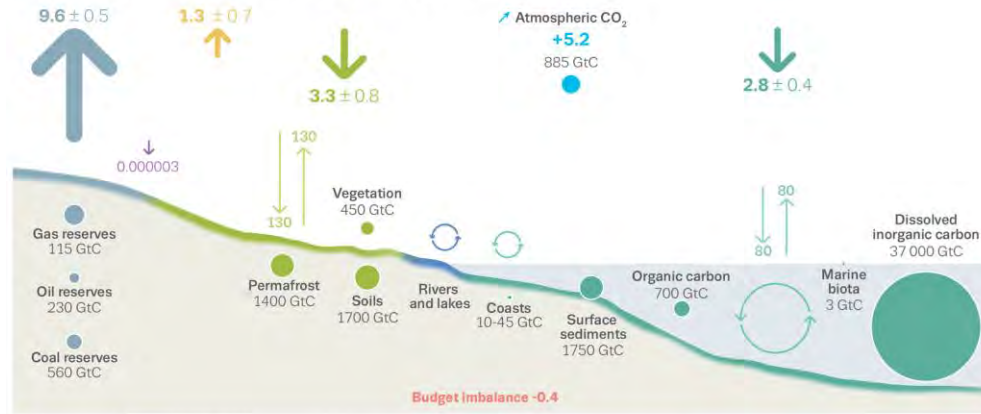
全球を分割した領域（陸域と海洋）のGHG
バジェット推定

More science oriented

(全球) CO₂バジェット、CH₄バジェット、N₂Oバジェット



The global carbon cycle

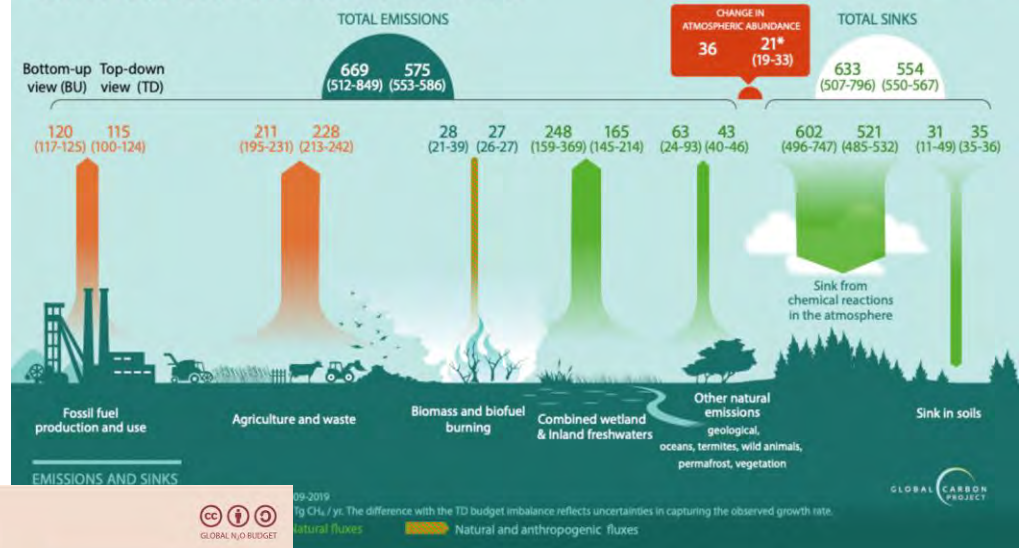


Anthropogenic fluxes 2013-2022 average GtC per year

- ↑ Fossil CO₂ E_{FOS}
- ↓ Land uptake S_{LAND}
- Stocks GtC
- ↑ Land-use change E_{LUC}
- ↓ Ocean uptake S_{OCEAN}
- + Atmospheric increase G_{ATM}
- ↓ CDR not included in E_{LUC}
- ↑ Carbon cycling GtC per year
- Budget Imbalance B_M

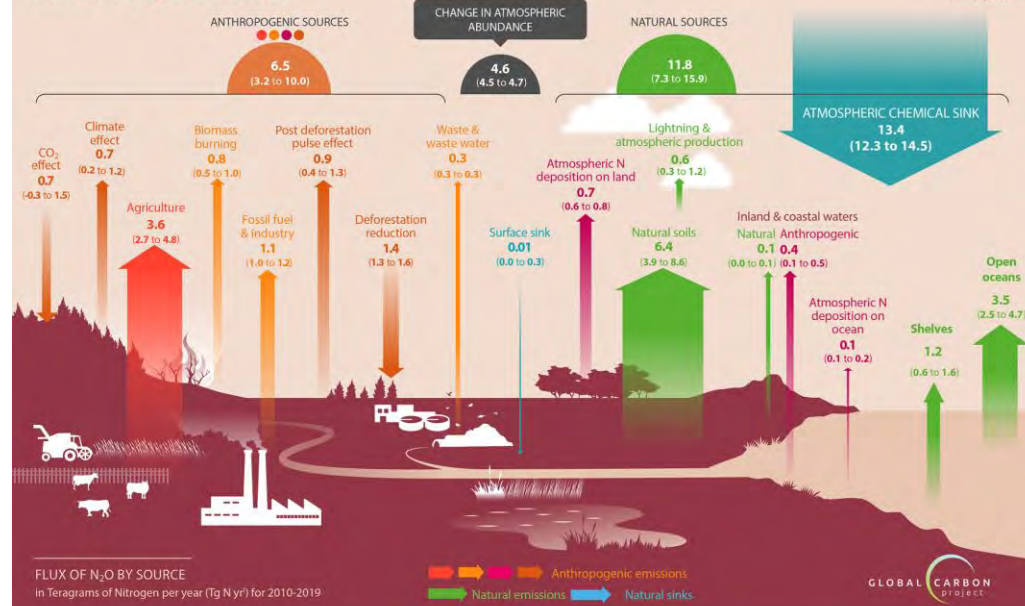
[Friedlingstein et al. 2025 ESSD]

GLOBAL METHANE BUDGET 2010-2019



[Saunois et al. 2024 ESSD]

GLOBAL N₂O BUDGET



[Tian et al. 2024 ESSD]

Global Carbon Budget 2024

Pierre Friedlingstein^{1,2}, Michael O'Sullivan¹, Matthew W. Jones³, Robbie M. Andrew⁴, Judith Hauck^{5,6},
 Peter Landschützer⁷, Corinne Le Quéré³, Hongmei Li^{8,9}, Ingrid T. Luijkx¹⁰, Are Olsen^{11,12},
 Glen P. Peters⁴, Wouter Peters^{10,13}, Julia Pongratz^{14,9}, Clemens Schwingshackl¹⁴, Stephen Sitch¹,
 Josep G. Canadell¹⁵, Philippe Ciais¹⁶, Robert B. Jackson^{17,18}, Simone R. Alin¹⁹, Almut Arneth²⁰,
 Vivek Arora²¹, Nicholas R. Bates²², Meike Becker^{11,12}, Nicolas Bellouin²³, Carla F. Berghoff²⁴,
 Henry C. Bittig²⁵, Laurent Bopp², Patricia Cadule², Katie Campbell²⁶, Matthew A. Chamberlain²⁷,
 Naveen Chandra²⁸, Frédéric Chevallier¹⁶, Louise P. Chini²⁹, Thomas Colligan³⁰, Jeanne Decayeux³¹,
 Laique M. Djeutchouang^{32,33}, Xinyu Dou³⁴, Carolina Duran Rojas¹, Kazutaka Enyo³⁵, Wiley Evans²⁶,
 Amanda R. Fay³⁶, Richard A. Feely¹⁹, Daniel J. Ford¹, Adrianna Foster³⁷, Thomas Gasser³⁸,
 Marion Gehlen¹⁶, Thanos Gkritzalis⁷, Giacomo Grassi³⁹, Luke Gregor⁴⁰, Nicolas Gruber⁴⁰,
 Özgür Gürses⁵, Ian Harris⁴¹, Matthew Hefner^{42,43}, Jens Heinke⁴⁴, George C. Hurtt²⁹, Yosuke Iida³⁵,
 Tatiana Ilyina^{45,8,9}, Andrew R. Jacobson^{46,47}, Atul K. Jain⁴⁸, Tereza Jarníková⁴⁹, Annika Jersild³⁰,
 Fei Jiang⁵⁰, Zhe Jin^{51,52}, Etsushi Kato⁵³, Ralph F. Keeling⁵⁴, Kees Klein Goldewijk⁵⁵,
 Jürgen Knauer^{56,15}, Jan Ivar Korsbakken⁴, Xin Lan^{46,47}, Siv K. Lauvset^{57,12}, Nathalie Lefèvre⁵⁸,
 Zhu Liu³⁴, Junjie Liu^{59,60}, Lei Ma²⁹, Shamil Maksyutov⁶¹, Gregg Marland^{42,43}, Nicolas Mayot⁶²,
 Patrick C. McGuire⁶³, Nicolas Metzl⁵⁸, Natalie M. Monacchi⁶⁴, Eric J. Morgan⁵⁴, Shin-Ichiro Nakaoka⁶¹,
 Craig Neill²⁷, Yosuke Niwa⁶¹, Tobias Nützel¹⁴, Lea Olivier^{5,14}, Tsuneo Ono⁶⁵, Paul I. Palmer^{66,67},
 Denis Pierrot⁶⁸, Zhangcai Qin⁶⁹, Laure Resplandy^{70,71}, Alizée Roobaert⁷, Thais M. Rosan¹,
 Christian Rödenbeck⁷², Jörg Schwinger^{57,12}, T. Luke Smallman^{66,67}, Stephen M. Smith⁷³,
 Reinel Sospedra-Alfonso²¹, Tobias Steinhoff^{74,57}, Qing Sun⁷⁵, Adrienne J. Sutton¹⁹, Roland Séférian³¹,
 Shintaro Takao⁶¹, Hiroaki Tatebe^{76,77}, Hanqin Tian⁷⁸, Bronte Tilbrook^{27,79}, Olivier Torres²,
 Etienne Tourigny⁸⁰, Hiroyuki Tsujino⁸¹, Francesco Tubiello⁸², Guido van der Werf¹⁰,
 Rik Wanninkhof⁶⁸, Xuhui Wang⁸², Dongxu Yang⁸³, Xiaojuan Yang⁸⁴, Zhen Yu⁸⁵, Wenping Yuan⁸⁶,
 Xu Yue⁸⁷, Sönke Zaehle⁷¹, Ning Zeng^{88,30}, and Jiye Zeng⁶¹

11名の国内機関
 の研究者が参画
 (データ提供で貢献)

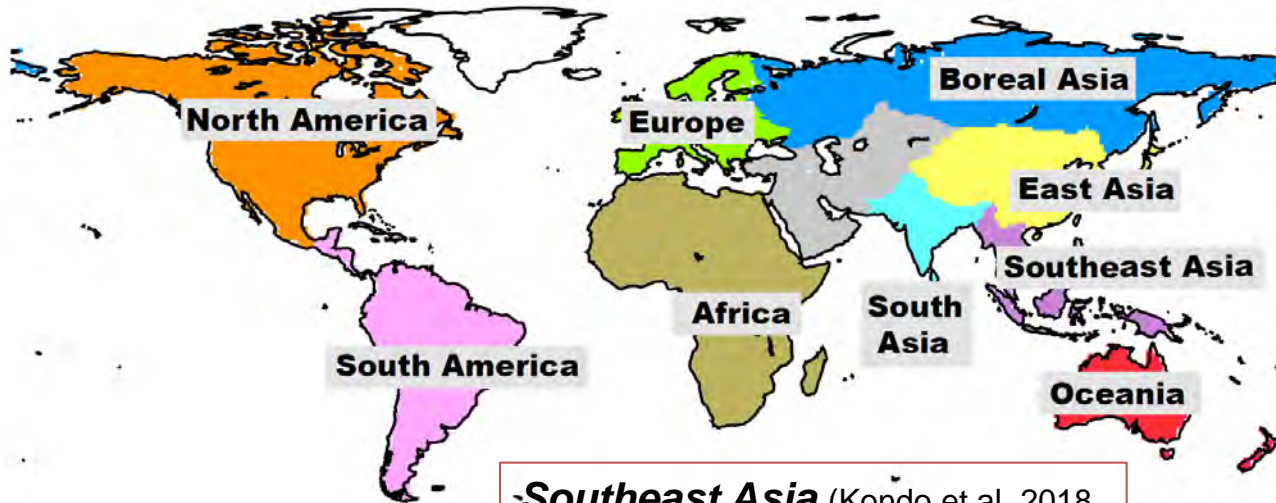
24編の陸域、海洋におけるGHGバジェット推定の論文が掲載
総引用回数2000件以上

North America (King et al. 2015)

A median of estimates from different methods ,
(1) biosphere models, (2) CO₂ inversion, and (3)
inventory-based method.

Europe (Luyssaert et al. 2012)

A dual constraint approach in the estimation based
on (1) carbon inventories and (2) flux
measurements.



Southeast Asia (Kondo et al. 2018
Nature Communications)

South America (Gloor et al. 2012)

An estimates based on (1) component flux estimate
method, (2) atmospheric inverse models, (3)
biosphere models.

Africa (Valentini et al. 2014)

An average of estimates from (1) inventories, (2)
ecosystem flux measurements, (3) models, and (4)
atmospheric inversions

Special issue

Regional Carbon Cycle Assessment and Processes
(RECCAP)

Boreal Asia (Dolman et al. 2012)

An estimate based on (1) inventory-based, (2) eddy
covariance, and (3) inversion methods.

East Asia (Piao et al. 2012)

Median of (1) inventory-remote sensing model-data
fusion approach, (2) atmospheric inverse models, (3)
biosphere models with additional flux attributions such
as land-use change and nitrogen deposition

South Asia (Patra et al. 2012)

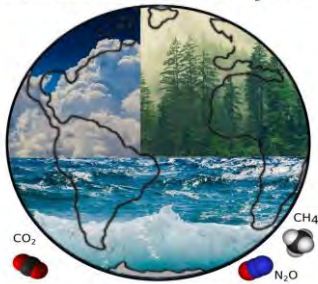
An estimate based on (1) top-down methods that use
inversions of atmospheric data, and (2) bottom-up
methods that use field observations, satellite data, and
terrestrial ecosystem models

Oceania (Haverd et al. 2013)

An estimates by (1) biosphere models considering
fire, land use change, riverine export, dust export,
harvest and fossil fuel emissions



Global Carbon Project



Regional Carbon Cycle Assessment and Processes Phase 2



Global Biogeochemical Cycles*

RESEARCH ARTICLE
10.1029/2024GB008370

Greenhouse Gas Budgets of Central and West Asia (2000–2020): A Significant Net Source to the Atmosphere

Xiaoyu Qin^{1,2}, Hanqin Tian^{3,4}, Josep G. Canadell⁵, Yu Shi^{3,6}, Shufen Pan^{3,7}, Ana Bastos⁸, Philippe Ciais⁹, Monica Crippa¹⁰, Naiqing Pan³, Prabir K. Patra^{11,12}, Benjamin Poulter¹³, Marielle Saunois⁹, and Stephen Sitch¹⁴

Global Biogeochemical Cycles*

RESEARCH ARTICLE
10.1029/2024GB008256

The Greenhouse Gas Budget of Southeast Asia for 2000–2019 and Pathways Toward Climate Neutrality

Special Collection:
Regional Carbon Cycle Assessment and Processes - 2

Masayuki Kondo¹, Prabir K. Patra^{2,3}, Josep G. Canadell⁴, Philippe Ciais⁵, Richard A. Houghton⁶, Akihiko Ito^{7,8}, Chandra S. Deshmukh⁹, Tomo'omi Kumagai^{7,10,11}, Xiangzhong Luo^{12,13}, Umakant Mishra^{14,15}, Atul K. Jain¹⁶, Wei Li¹⁷, Gerbruder Koren¹⁸, Stephen Sitch¹⁹, Ben Poulter²⁰, Hanqin Tian²¹, Ana Bastos²², Ronny Lauerwald²³, Judith A. Rosentreter²⁴, Naveen Chandra², Tazu Saeki⁹, Marielle Saunois⁵, Ingrid T. Lujikx²⁵, Takashi Maki²⁶, Takashi Nakamura²⁷, Kirari Hirabayashi²⁸, Takeshi Hirano²⁹, and Nobuko Saigusa⁸

Global Biogeochemical Cycles*

RESEARCH ARTICLE
10.1029/2023GB008016

The African Regional Greenhouse Gases Budget (2010–2019)

Special Section:
Regional Carbon Cycle Assessment and Processes-2

Yolandi Ernst¹, Sally Archibald², Heiko Balzer^{3,4}, Frederic Chevallier⁵, Philippe Ciais⁵, Carlos Gonzalez Fischer⁶, Benjamin Gaubert⁷, Thomas Higginbottom⁸, Steven Higgins⁹, Shakirudeen Lawai¹⁰, Fabrice Lacroix^{11,12}, Ronny Lauerwald¹³, Mauro Lourenco^{2,14}, Carola Martens^{15,16}, Anteneh G. Mengistu¹⁷, Lutz Merbold¹⁸, Edward Mitchard¹⁹, Mthokozisi Moyo², Hannah Nguyen²⁰, Michael O'Sullivan²¹, Pedro Rodriguez-Veiga^{22,23}, Thais Rosan²⁴, Judith Rosentreter²⁵, Casey Ryan²⁶, Simon Scheller¹⁵, Stephen Sitch²⁴, Nicola Stevens^{2,27}, Torbern Tagesson^{28,29}, Hanqin Tian³⁰, Mengjia Wang^{31,32}, Joel S. Woon³³, Bo Zheng^{34,35}, Yong Zhou^{36,37}, and Robert J. Scholes¹

Global Biogeochemical Cycles*

RESEARCH ARTICLE
10.1029/2024GB008261

South Asia's Ecosystems Are a Net Carbon Sink, But the Region Is a Major Net GHG Source to the Atmosphere

Atul K. Jain¹, Seetharaman Seshadri¹, Jatlin Anand¹, Naveen Chandra², Prabir K. Patra^{2,3}, Josep G. Canadell⁴, Abha Chhabra⁵, Philippe Ciais⁶, Hammad Gilani⁷, Murati K. Gumma⁸, Masayuki Kondo⁹, Erandathie Lokupitiya¹⁰, Naiqing Pan¹¹, Him Lal Shrestha¹², Baktiar N. Siddiqui¹³, Hanqin Tian¹¹, and Yogesh K. Tiwari¹⁴

Global Biogeochemical Cycles*

RESEARCH ARTICLE
10.1029/2023GB007969

Permafrost Region Greenhouse Gas Budgets Suggest a Weak CO₂ Sink and CH₄ and N₂O Sources, But Magnitudes Differ Between Top-Down and Bottom-Up Methods

G. Hugelius¹, J. Ramage¹, E. Burke², A. Chatterjee³, T. L. Smallman⁴, T. Aalto⁵, A. Bastos⁶, C. Biasi^{7,8}, J. G. Canadell⁹, N. Chandra¹⁰, F. Chevallier¹¹, P. Ciais¹¹, J. Chang¹², L. Feng¹³, M. W. Jones¹⁴, T. Kleinen¹⁵, M. Kuhn¹⁶, R. Lauerwald¹⁷, J. Liu¹⁸, E. López-Blanco^{16,19}, I. T. Lujikx²⁰, M. E. Marushchak²¹, S. M. Natali²², Y. Niwa^{23,24}, D. Olefeldt²⁵, P. I. Palmer¹³, P. K. Patra²⁶, W. Peters^{20,27}, S. Potter²², B. Poulter²⁸, B. M. Rogers²², W. J. Riley²⁹, M. Saunois¹¹, E. A. G. Schuur³⁰, R. L. Thompson³¹, C. Treat¹², A. Tsuruta³, M. R. Turetsky³³, A.-M. Virkkala³², C. Voigt^{21,34}, J. Watts²², Q. Zhu²⁹, and B. Zheng³⁵

Global Biogeochemical Cycles*

RESEARCH ARTICLE
10.1029/2023GB007865

The Greenhouse Gas Budget of Terrestrial Ecosystems in East Asia Since 2000

Xuhui Wang¹, Yuanyi Gao¹, Sujong Jeong², Akihiko Ito³, Ana Bastos⁴, Benjamin Poulter^{5,6}, Yilong Wang⁷, Philippe Ciais⁸, Hanqin Tian⁹, Wenping Yuan¹⁰, Naveen Chandra¹¹, Frédéric Chevallier⁸, Lei Fan¹², Songhai Hong¹, Ronny Lauerwald¹³, Wei Li¹⁴, Zhengyang Lin¹, Naiqing Pan¹⁵, Prabir K. Patra^{11,16}, Shushi Peng¹, Lishan Ran¹⁷, Yuxing Sang¹, Stephen Sitch¹⁸, Maki Takashi¹⁹, Rona Louise Thompson²⁰, Chenzhi Wang¹, Kai Wang¹, Tao Wang²¹, Yi Xi^{1,8}, Liang Xu²², Yanzi Yan¹, Jeongmin Yun²³, Yao Zhang¹, Yuzhong Zhang^{24,25}, Zhen Zhang²⁶, Bo Zheng²⁷, Feng Zhou¹, Shu Tao¹, Josep G. Canadell²⁸, and Shilong Piao¹

Global Biogeochemical Cycles*

RESEARCH ARTICLE
10.1029/2024GB008141

Carbon and Greenhouse Gas Budgets of Europe: Trends, Interannual and Spatial Variability, and Their Drivers

Ronny Lauerwald¹, Ana Bastos², Matthew J. McGrath³, Ana Maria Roxana Petrescu⁴, François Ritter⁵, Robble M. Andrew⁶, Antoine Berchet³, Grégoire Broquet³, Dominik Brunner⁶, Frédéric Chevallier³, Alessandro Cescatti⁷, Sara Filipek⁸, Audrey Fortems-Cheiney^{3,9}, Giovanni Forzieri¹⁰, Pierre Friedlingstein^{11,12}, Richard Fuchs¹³, Christoph Gerbig², Sander Houweling⁴, Piyu Ke^{11,14}, Bas J. W. Lerink⁴, WanJing Li¹⁴, Wei Li¹⁴, Xiaojun Li¹⁵, Ingrid Lujikx¹⁶, Guillaume Montell¹⁷, Saqr Munassar², Gert-Jan Nabuurs⁸, Prabir K. Patra^{18,19}, Philippe Peylin³, Julia Pongratz^{20,21}, Pierre Regnier²², Marielle Saunois⁹, Mart-Jan Schelhaas⁴, Marko Scholze¹⁷, Stephen Sitch¹¹, Rona L. Thompson²³, Hanqin Tian²⁴, Aki Tsuruta²⁵, Chris Wilson^{26,27}, Jean-Pierre Wigneron¹⁵, Karina Winkler¹³, Yitong Yao³, Sönke Zaehle², and Philippe Ciais³

これまでのGlobal Carbon Projectの成果



*ESSD Earth System Scientific Data

Activity	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Global Carbon Budget (CO ₂)			ESSD	ESSD	ESSD	ESSD	ESSD	ESSD	ESSD	ESSD	ESSD	ESSD	ESSD	ESSD	ESSD
Global Methan Budget (CH ₄)						ESSD				ESSD					
Global N ₂ O budget														ESSD	
Regional GHG Budget Assessment (RECCAP)		EGU special issue													AGU special issue

GCPつくば国際オフィス

Members/Contact

Members

Tomoko Shirai

Head

Head of Office for Global Environmental Data Integration and Analytics, Earth System Division, NIES

Email: tshirai@nies.go.jp

Web: <https://www.nies.go.jp/researchers-e/100295.html>



Yosuke Niwa

Executive Director

Senior Researcher of Biogeochemical Cycle Modeling and Analysis Section, Earth System Division, NIES

Email: niwa.yosuke@nies.go.jp

Web: <https://www.nies.go.jp/researchers-e/301352.html>

[International Network](#)



Akiko Okamoto

Project Officer

Specialist, Earth System Division, NIES

Email: okamoto.akiko@nies.go.jp



Guest Researcher

Akihito Ito

Professor, Graduate School of Agricultural and Life Sciences, The University of Tokyo

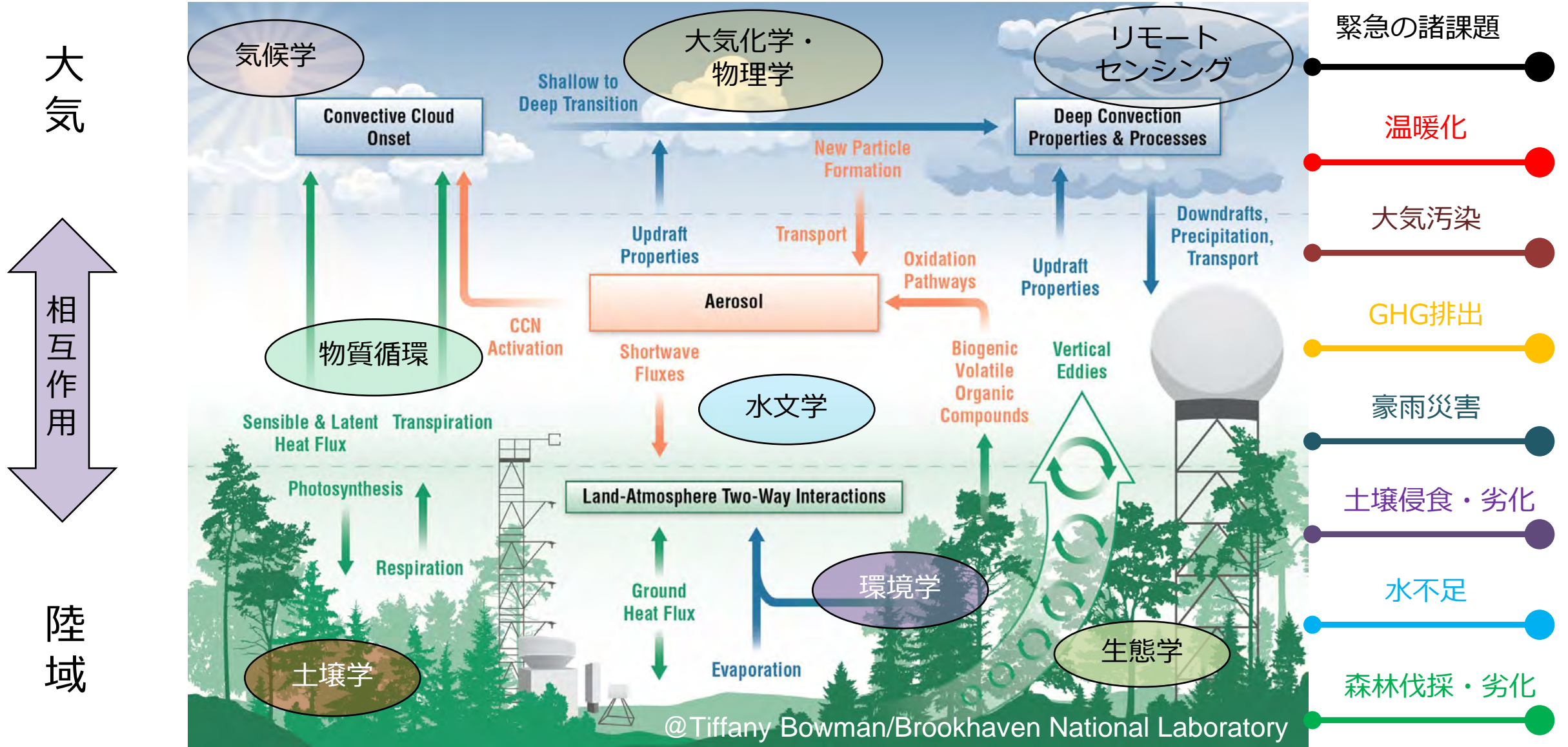
Visiting Researcher, ESD, NIES

Email: akihikoito@g.ecc.u-tokyo.ac.jp

Masayuki Kondo

- Associate professor, the IDECC Institute, Center for Peaceful and Sustainable Futures
- Director, the sustainability division, Seto Inland Sea Carbon Neutral Research Center
- Network for Education and Research on Peace and Sustainability
- Graduate School of Innovation and Practice for Smart Society
- Graduate School of Humanities and Social Sciences

日本独自の取り組みは？



iLEAPS-Japan小委員会

iLEAPS-Japanは、iLEAPS小委員会によって運営されています

iLEAPS小委員会は、日本学術会議 環境学委員会・地球惑星科学委員会合同FE・WCRP合同分科会の下部組織として位置付けられています。第25期が令和5年9月に完了し、現在、以下の新メンバーによる第26期の設置準備中です。

第26期iLEAPS-Japan小委員会委員一覧 (50音順) (* 委員長, ** 幹事, † 日本学術委員会連携会員)

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市井 和仁 **	千葉大学 環境リモートセンシング研究センター 教授
植山 雅仁	大阪府立大学 大学院生命環境科学研究科 准教授
片柳 薫子	農業・食品産業技術総合研究機構 農業環境研究部門 気候変動緩和策研究領域緩和技術体系化グループ 上級研究員
加藤 知道	北海道大学 大学院農学研究院 准教授
熊谷 朝臣 †	東京大学 大学院農学生命科学研究科 教授
小谷 亜由美	名古屋大学 大学院生命農学研究科 助教
近藤 雅征 **	広島大学 IDEC国際連携機構 准教授
佐藤 永 *	海洋研究開発機構 地球環境部門 副主任研究員
須藤 健悟	名古屋大学 大学院環境学研究科 教授
高梨 聡	森林研究・整備機構 森林総合研究所 関西支所 主任研究員
仁科 一哉	国立環境研究所 地球システム領域 主任研究員
野田 響	国立環境研究所 地球システム領域 主任研究員
平野 高司 †	北海道大学 大学院農学研究院 教授
檜山 哲哉	名古屋大学 宇宙地球環境研究所 教授
村岡 裕由	岐阜大学 流域圏科学研究センター 教授
持田 陸宏	名古屋大学 宇宙地球環境研究所 教授

iLEAPS-Japan研究集会 2015年～現在





日本学術会議との共同開催

7th iLEAPS

Open Science Conference 2027

Bridging Land Ecosystems and Climate: Advancing Solutions for a Sustainable Future

1 March - 5 March 2027 | Hiroshima JAPAN



HIROSHIMA UNIVERSITY



JAMSTEC 国立研究開発法人
海洋研究開発機構
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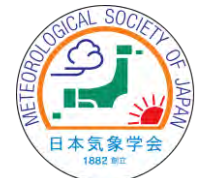
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Prefectural University of Hiroshima



一般社団法人
日本生態学会
The Ecological Society of Japan





ileaps

Integrated Land Ecosystem -
Atmosphere Processes Study

iLEAPS Scientific Steering Committee (SSC) in-person and virtual Meeting

Patra Bali Hotel: <https://www.thepatrabali.com>

Bali, Indonesia, 09th-10th June 2025

and online on Microsoft Teams:

[Join the meeting now](#)

Meeting ID: 363 534 531 113

Passcode: M9zm9bT9



Global Sustainability

cambridge.org/sus

Intelligence Briefing

Cite this article: Hayman G *et al.* (2024). Research into land atmosphere interactions supports the sustainable development agenda. *Global Sustainability* 7, e12, 1-9. <https://doi.org/10.1017/sus.2024.3>

Research into land atmosphere interactions supports the sustainable development agenda

Garry Hayman¹, Benjamin Poulter², Sachin D. Ghude³, Eleanor Blyth¹, Vinayak Sinha⁴, Sally Archibald⁵, Kirsti Ashworth⁶, Victoria Barlow¹, Silvano Fares⁷, Gregor Feig^{8,9}, Tetsuya Hiyama¹⁰, Jiming Jin¹¹, Sirkku Juhola¹², Meehye Lee¹³, Sebastian Leuzinger¹⁴, Miguel D. Mahecha^{15,16}, Xianhong Meng¹⁷, David Odee^{18,19}, Gemma Purser²⁰, Hisashi Sato²¹, Pallavi Saxena²², Valiyaveetil S. Semeena¹, Allison Steiner²³, Xuemei Wang²⁴ and Stefan Wolff^{25,26}

Working groups (to be decided)

- Microplastics
 - Deposition
 - Remote Sensing
 - Arid/drylands
 - Urban Nature-based Solutions
 - Land-use changes
 - Fires
- etc.

日本独自の取り組みは？



全球の陸域と海洋のGHGバジェット推定

RECCAP

REgional Carbon
Cycle Assessment
and Processes

全球を分割した領域（陸域と海洋）のGHG
バジェット推定

More science oriented

LeXtra

League of geophysical
research eXcellences
for tropical asia

東南アジア諸国のGHGバジェット推定
それに伴う様々なプロセスの理解

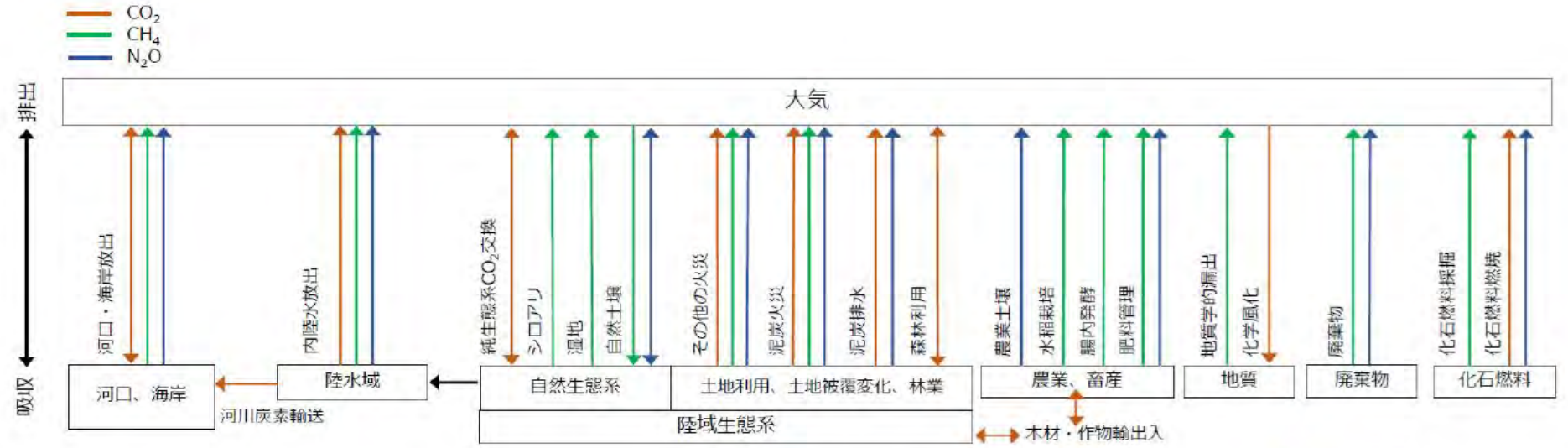
アジアにおけるiLEAPS/Global Carbon Projectの活動を牽引



HIROSHIMA UNIVERSITY



LeXtra
League of geophysical research excellences for tropical asia



領域スケールから
国スケールのGHG
バジェット推定へ

HIROSHIMA UNIVERSITY
 IDEC The IDEC Institute
 JAMSTEC JAPAN AGENCY FOR MARINE-EARTH SCIENCE AND TECHNOLOGY
 Sandia National Laboratories
 APRIL
 CHIBA UNIVERSITY
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 S-CNC
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 UNIVERSITAS UDAYANA

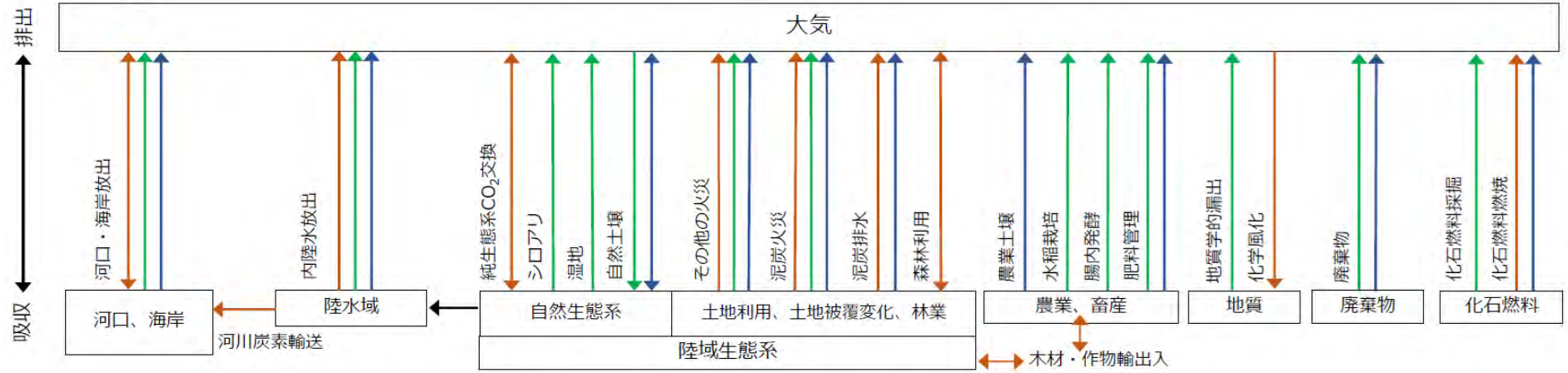


Processes of atmosphere-land interactions

熱帯アジア圏におけるGHGフラックスの精緻化、プロセスの理解

League of geophysical research eXcellences for tropical asia: LeXtra

CO₂
CH₄
N₂O



GHG budget assessment of tropical Asia

熱帯アジア圏におけるGHGバジェット推定、推定値の応用

これまでのLeXtraの活動 (2024年2月始動)



HIROSHIMA
UNIVERSITY



Core Members

(参加条件: Nature誌・Science誌に筆頭著者で1編以上論文を掲載した者)



Prabir Kumar Patra  **JAMSTEC** 国立研究開発法人
海洋研究開発機構
JAPAN AGENCY FOR MARINE-EARTH SCIENCE AND TECHNOLOGY

Atmospheric Physics & Chemistry



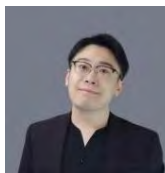
Chandra Deshmukh 

GHG & Ecosystem Measurements



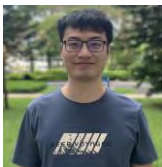
Masayuki Kondo  HIROSHIMA
UNIVERSITY

GHG Budget & Synthesis



Mengzi Li  NUS
National University
of Singapore

Atmospheric GHG Measurements



Xiangzhong Luo  NUS
National University
of Singapore

Environmental Remote Sensing



Umakant Mishra  Sandia
National
Laboratories

Soil Biogeochemistry



Wei Li 

Land-Use Changes



The Kick-off LeXtra meeting, Tokyo, 2024



The 2nd LeXtra annual meeting, Singapore, 2025