Coupled changes of climate and ecosystems: from crisis to nature-based solutions
气候与生态系统耦合变化: 从挑战到应对

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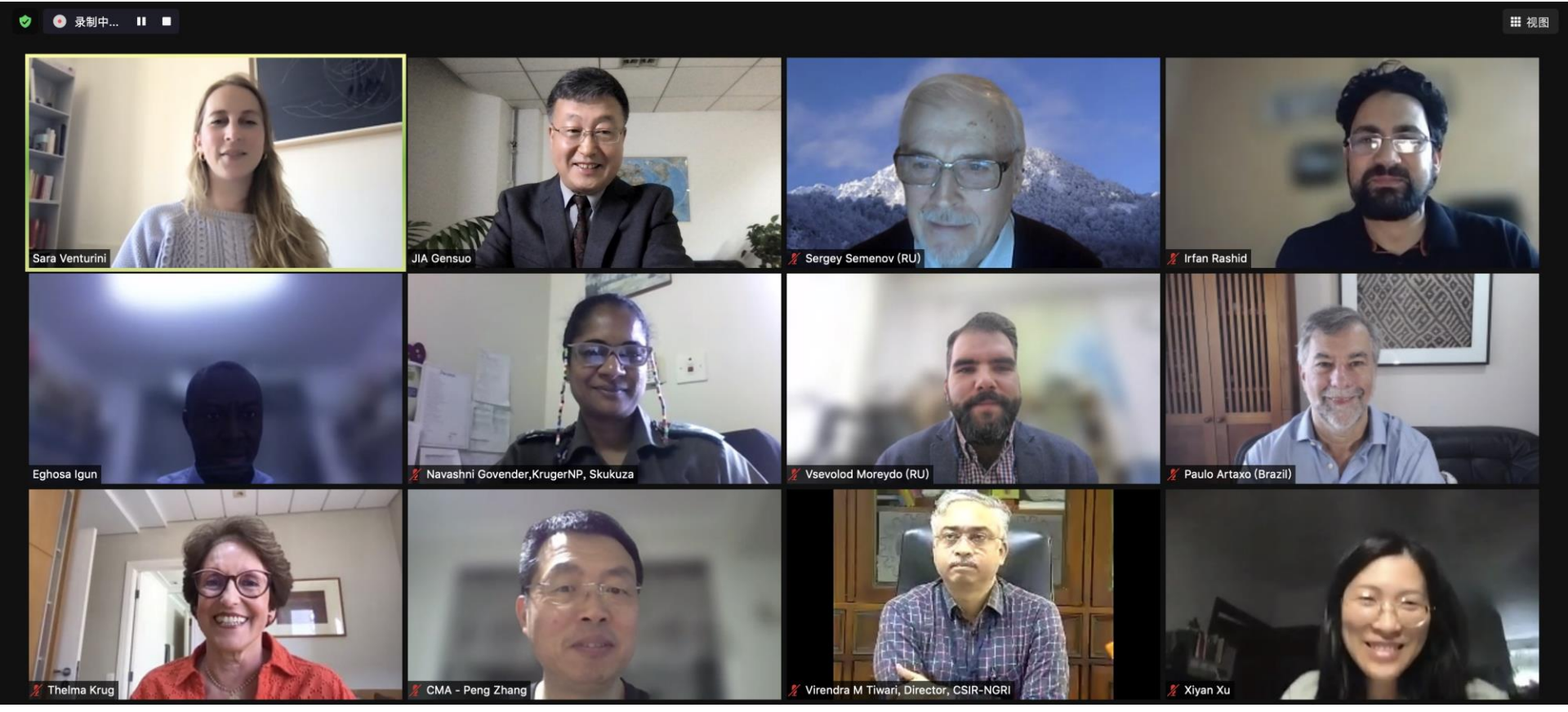
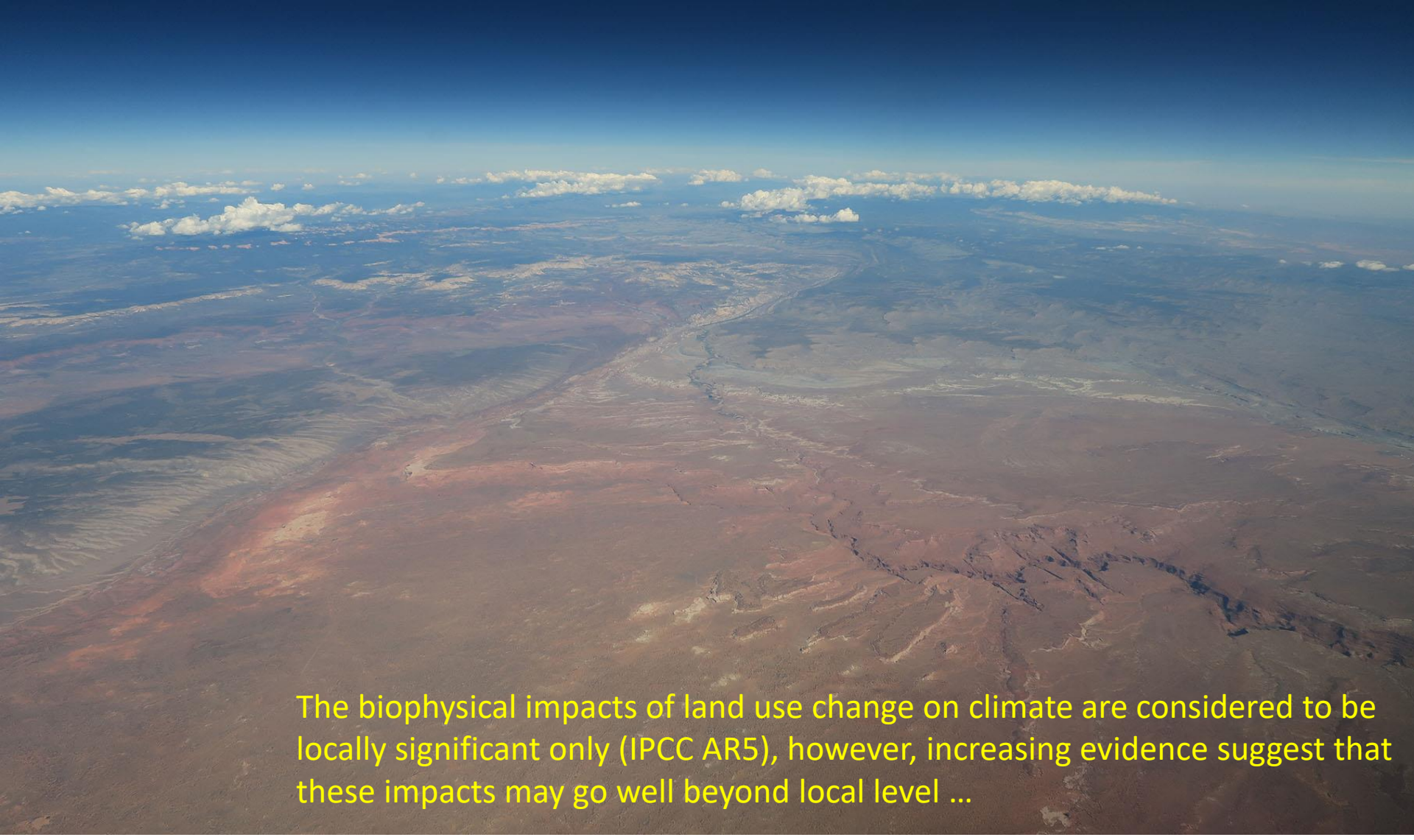
BRICS Forum on big data in support SDGs:

Climate actions and disaster reduction

April 27, 2022 | hybrid, Beijing

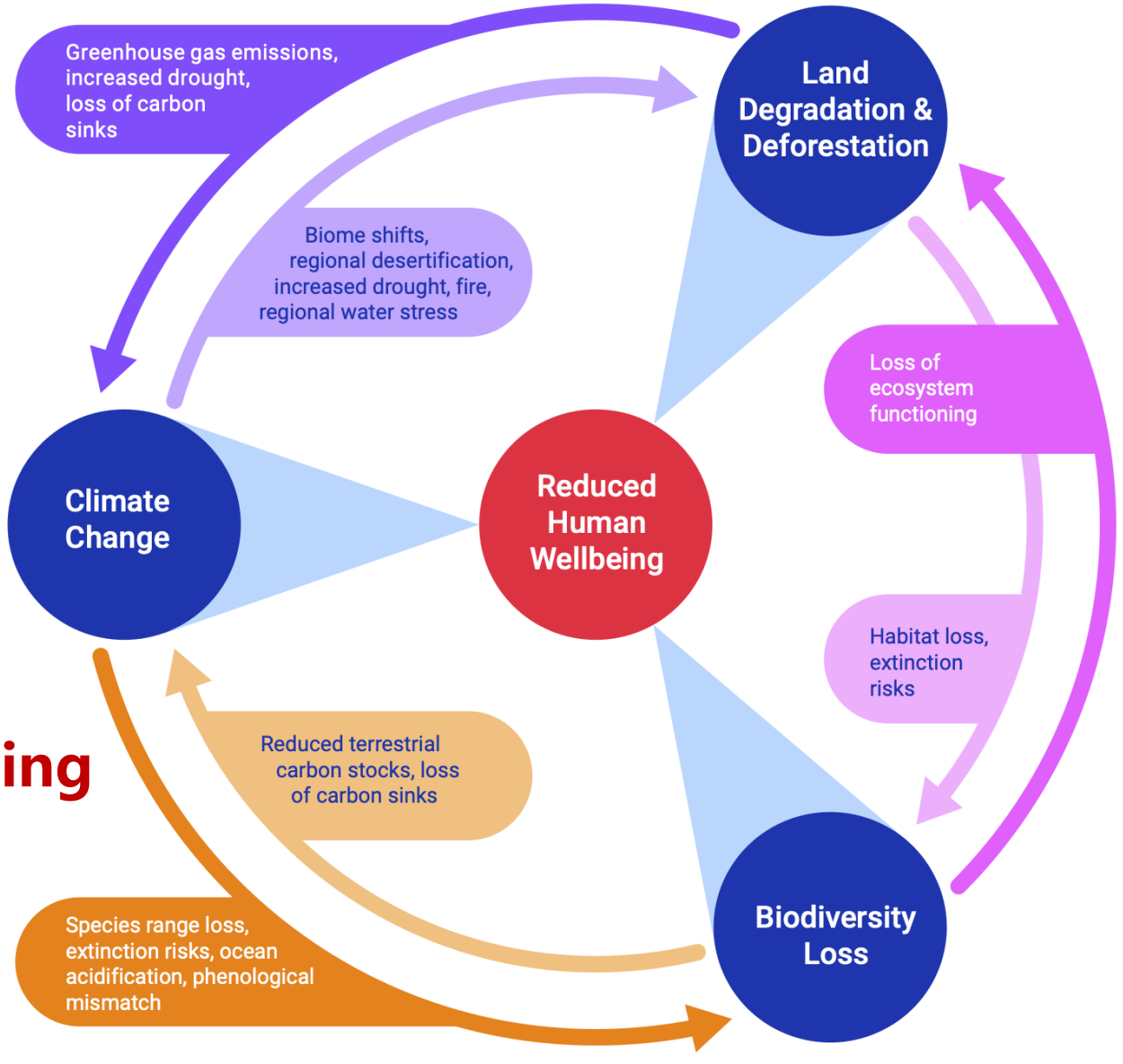



The biophysical impacts of land use change on climate are considered to be locally significant only (IPCC AR5), however, increasing evidence suggest that these impacts may go well beyond local level …

Multiple crisis:

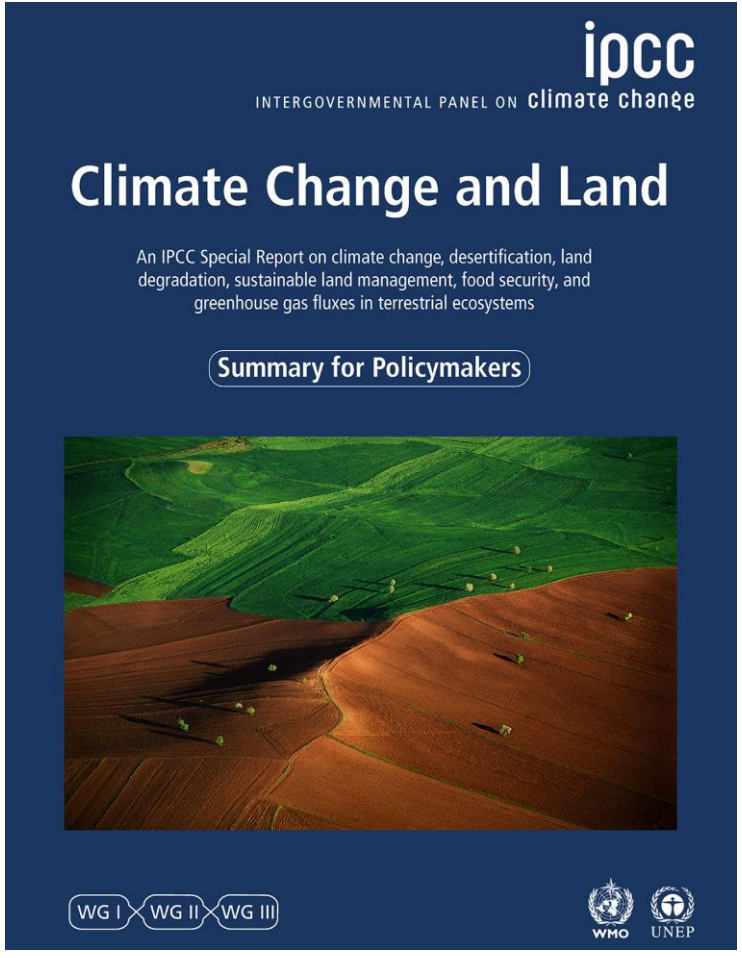
Land degradation
+
Climate Change
+
Biodiversity loss

(-) Human Wellbeing



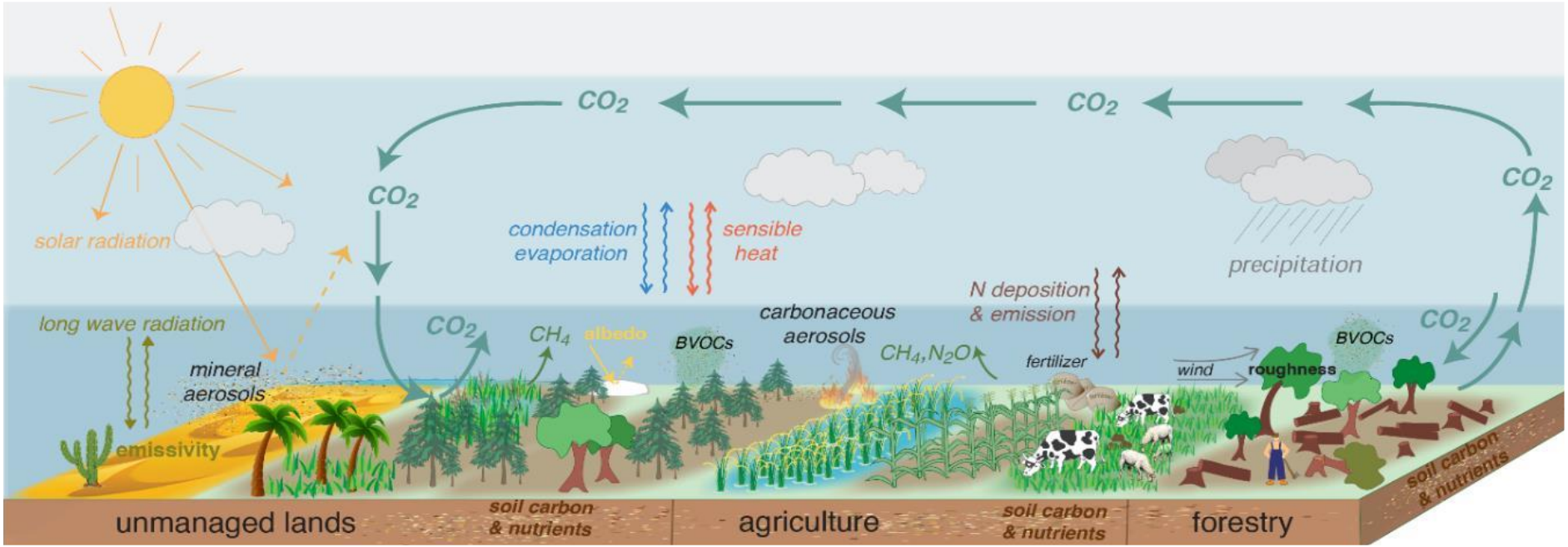
IPCC SRCCL - Joint WGI, II, III

Land-climate interactions



- Climate change & variability → desertification, land degradation, food security, landuse
- Terrestrial GHG & non-GHG fluxes/stocks
- Land feedbacks and forcing on climate via multiple pathways
- Land-based adaptation and mitigation options → climate forcing
- Coupling and teleconnection

IPCC SRCCL on Land-climate interactions



Land use/cover change **Biogeophysical effects** **Biogeochemical cycles**

Jia, G. E. Shevliakova, P. Artaxo, et al. (2022): Land-climate interactions, ***IPCC*** Special report on climate change and land (SRCCL). Intergovernmental Panel on Climate Change, Cambridge University Press.

IAP on climate change and biodiversity: Interlinkages

Highlight:

Double challenges

Interlinked climate change and biodiversity

ecosystem services – climate action

Sustainable land management

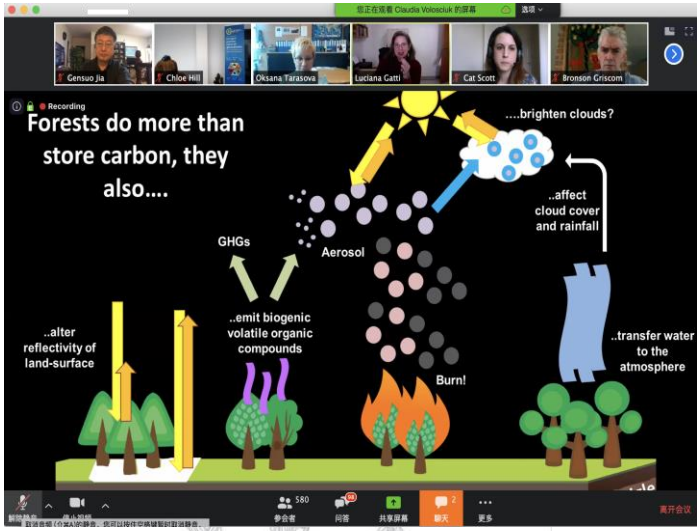
Nature-based solutions

Call for coordinated UNFCCC - CBD

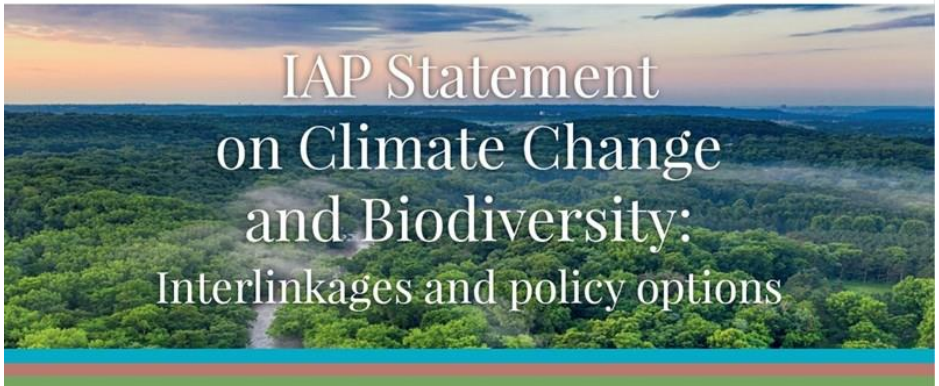
16 Authors

82 Academies endorsed

To **UNFCCC COP26** 和 **CBD COP15**



iap SCIENCE HEALTH POLICY
the interacademy partnership



UNFCCC COP26 (2021)

Great attention on nature climate solutions

- Stop deforestation – over 120 nations promised
- Enhance nature conservation
- Towards sustainable land management
- Cut CH4 emissions from ecosystem and agriculture

COP27 (2022): **Loss & damage** | identify, attribute, fund
COP28 (2023): Monitoring, fund, and early warning

CASEarth:
Big Earth data science engineering

Global polycrisis, climate change, biodiversity loss, degradation

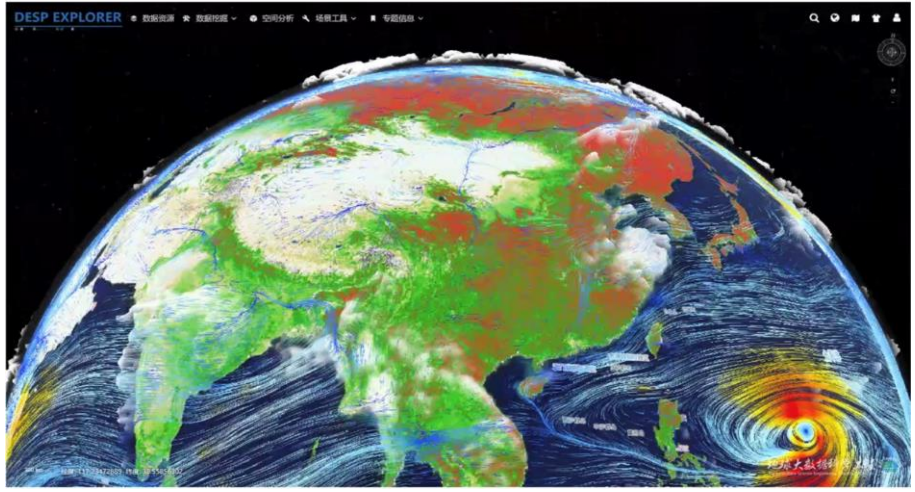
CASEarth: **Big Earth data** science engineering Program

Empowered by digital Earth, data cloud, AI, open science

Facilitate monitoring, assessment, prediction

Slow and fast processes of ecosystem and social impacts

Local knowledge, partnership, citizen science



Loss & Damage: Slow processes

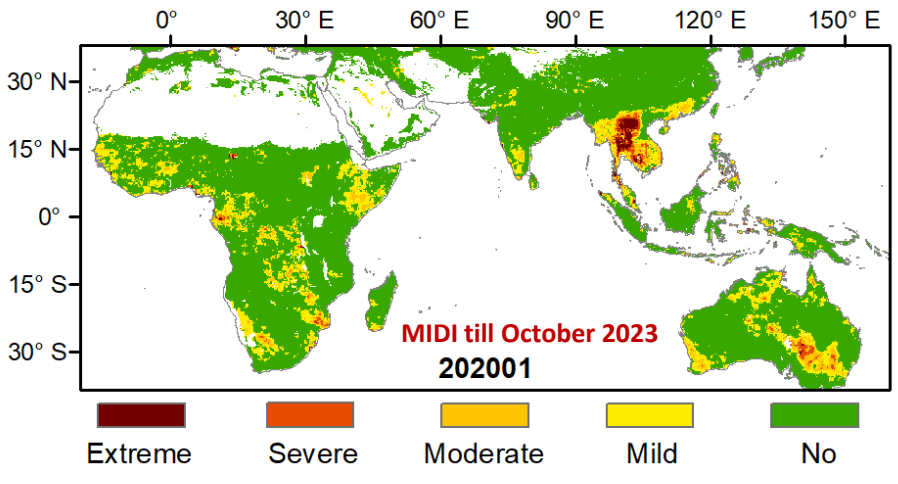
Big Earth data module on climate change **loss & damage**

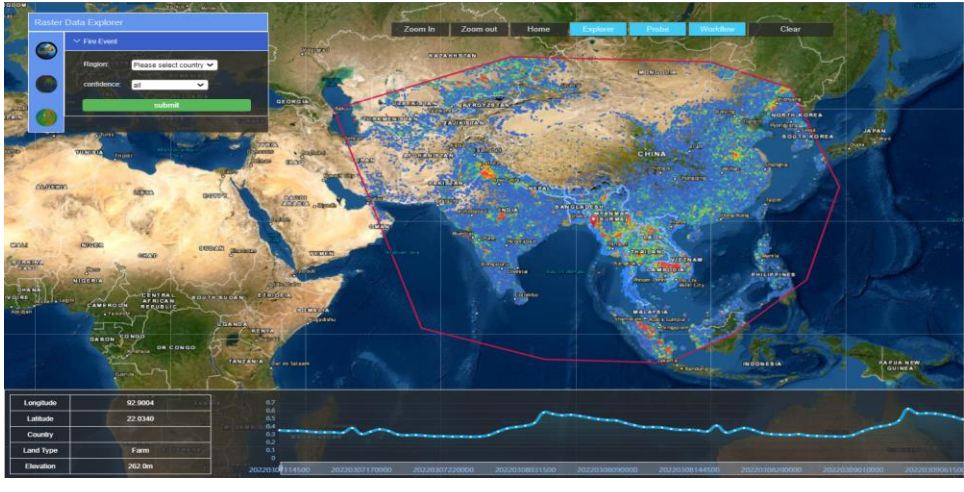
Slow process, e.g. drought, ecosystem degradation and restoration

MIDI water deficit and disturbance index: rainfall + soil water + VPD + EVI

Climate extreme prediction & risks assessment over Africa & Asia

The up-to-date FY-3 monthly MIDI to release soon





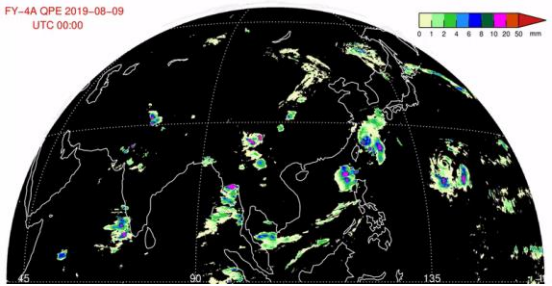
Loss & Damage: Fast processes

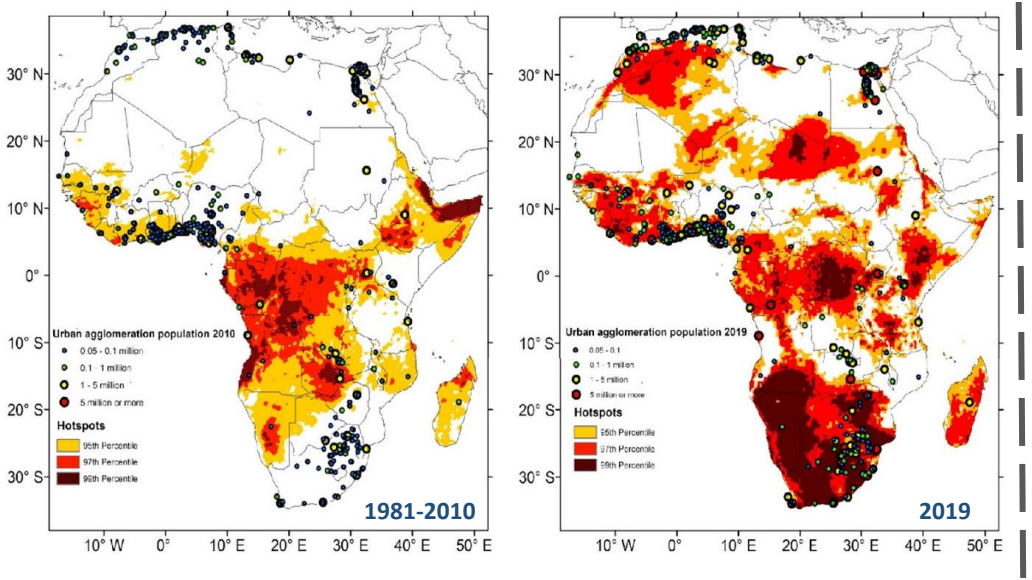
Fast process: fire, flood, hurricane, heatwave

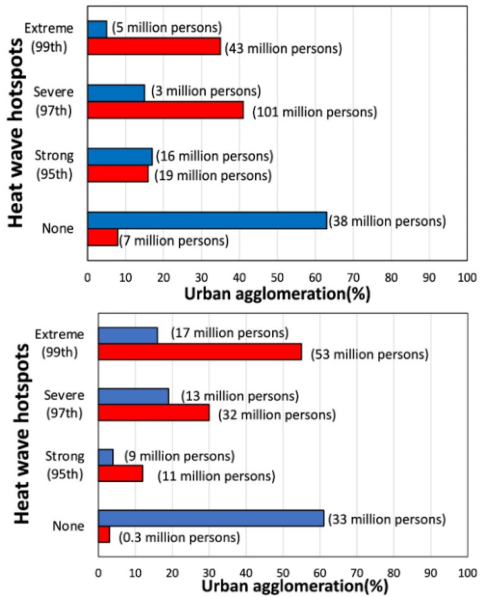
Heatwave hotspots and impacts in Africa

Nighttime heatwaves link to urban clusters

Urban population, water and energy footprint

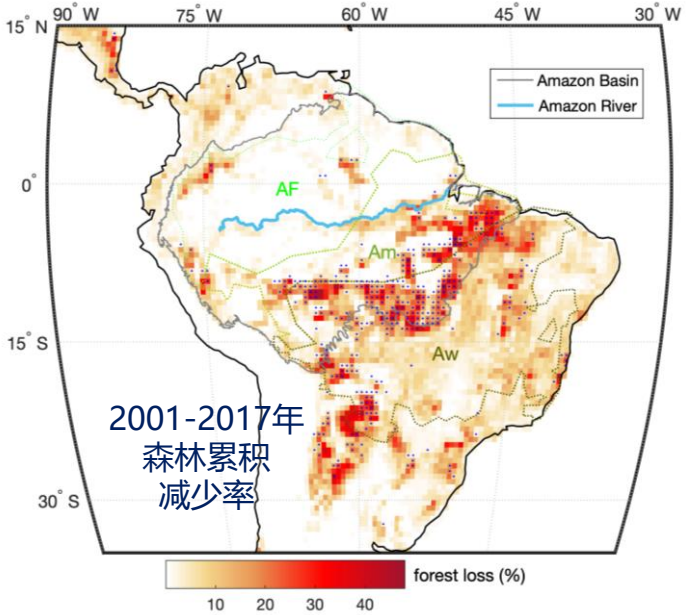




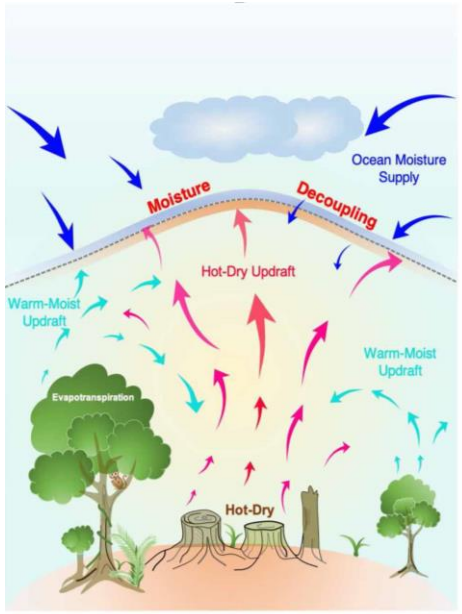


Igun, E., X. Xu, Z. Shi, **G. Jia***, 2023: Enhanced nighttime heatwaves over African urban clusters, *Environmental Research Letters*, 18, 014001, doi: 10.1088/1748-9326/aca920

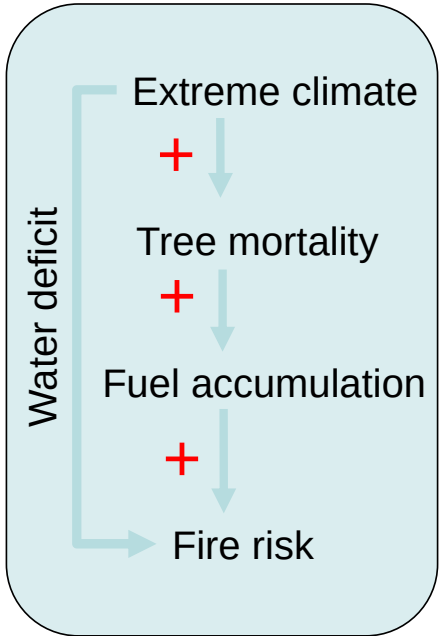
Coupled changes of Amazonia climate-forest-fire
热带森林区气候-毁林-林火的耦合变化



Deforestation enhances fire risk



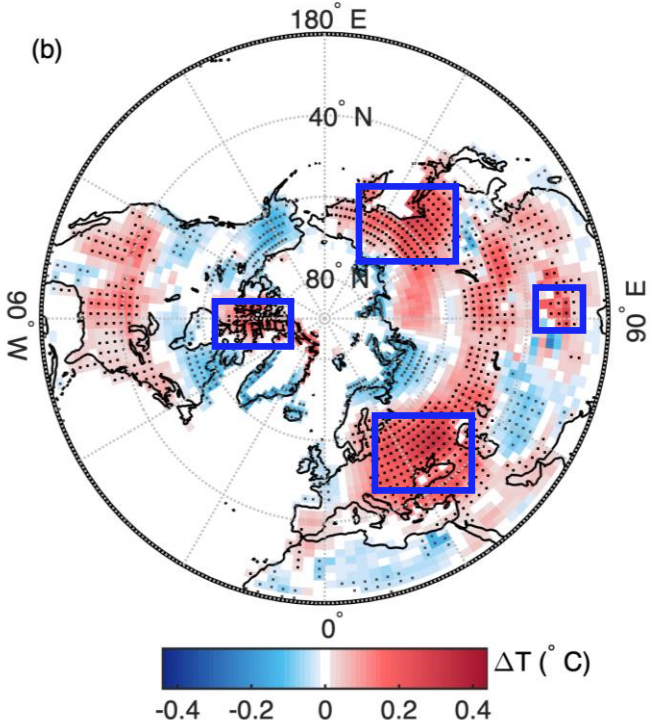
Moisture decoupling over canopy gap

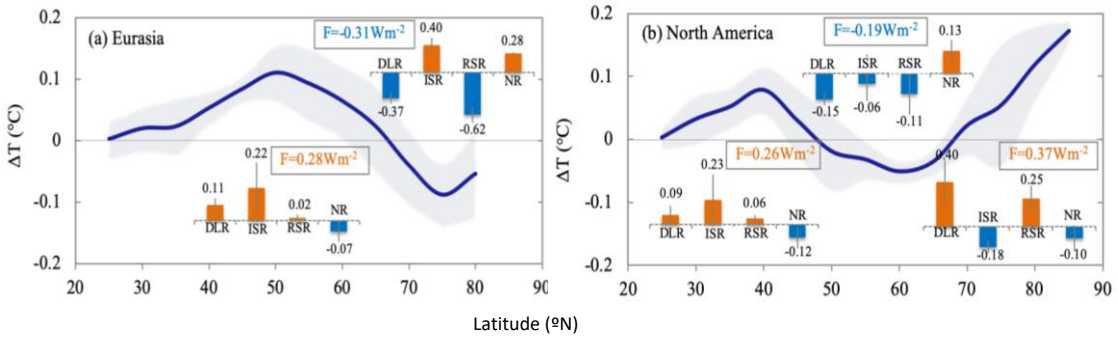


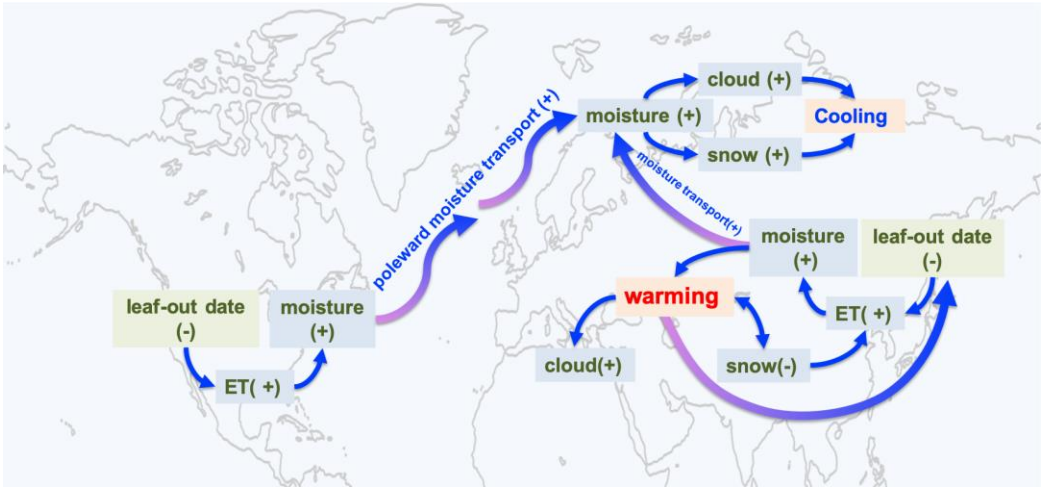
Water cycle effects

Xu, X., X. Zhang, W.J. Riley, Y. Xue, C.A. Nobre, T.E. Lovejoy, **G. Jia***, 2022: Deforestation triggering irreversible transition in Amazon hydrological cycle, ***Environmental Research Letters***

Climate effects of earlier leaf-out in pan-Arctic
北极植被物候变化的气候反馈







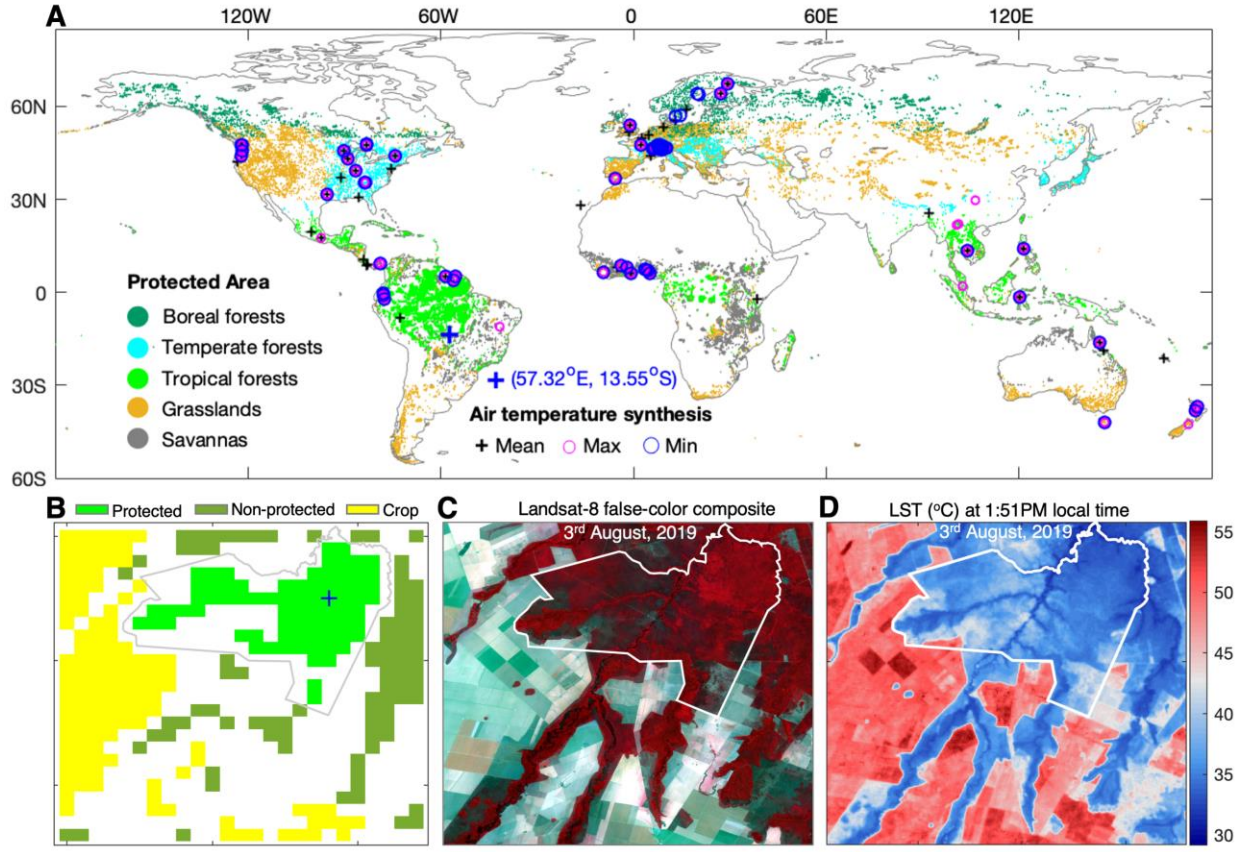
Meta analysis of spring onset

Earth system modeling

Cause warming in high and mid latitudes

Xu, X., W.J. Riley, C.D. Koven, **G. Jia***, X. Zhang, 2020: Earlier leaf-out warms air in the north, ***Nature Climate Change***

Global protected areas buffers warming and provide thermal refugia
全球自然保护区的增温缓冲效应



Boreal forest

Temperate forest

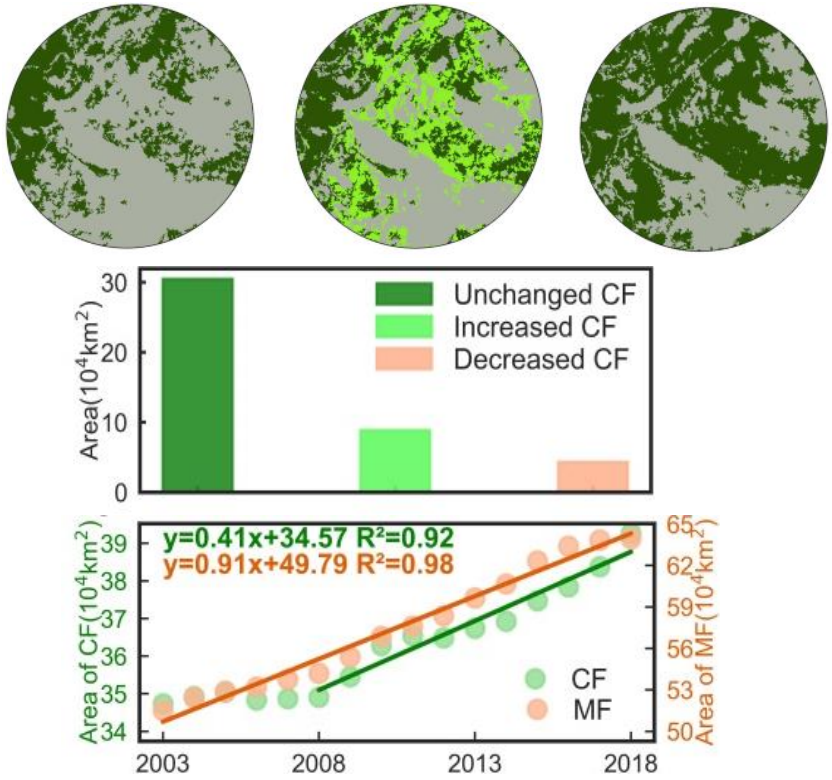
Tropical forest

Grassland

Savanna

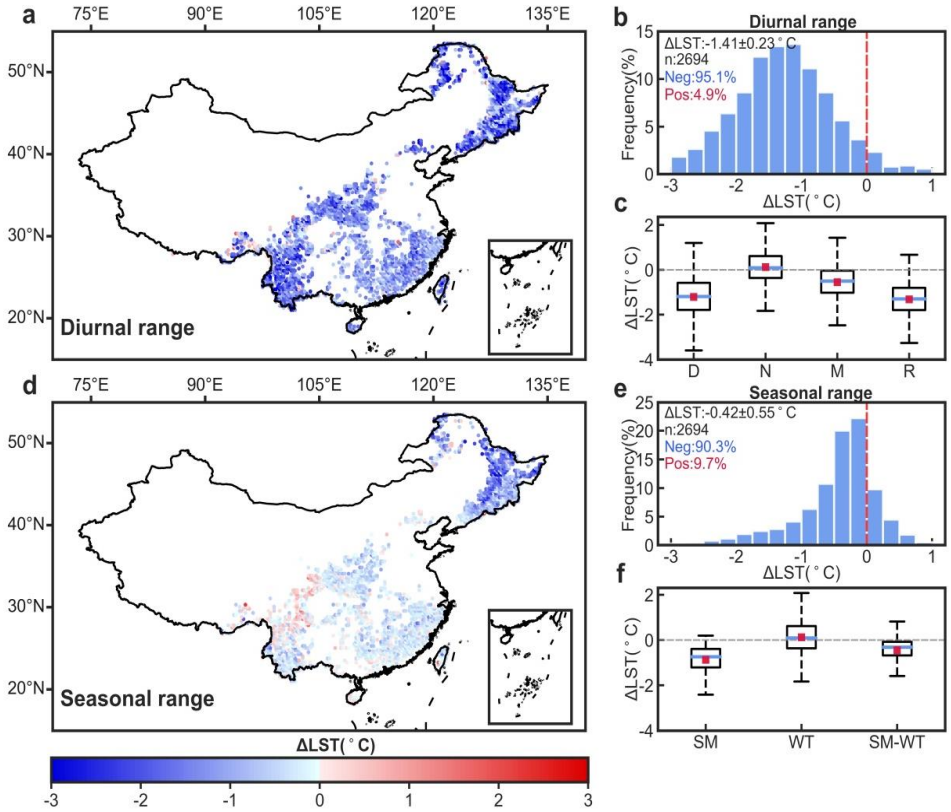
Xu*, X., A. Huang, E. Belle, P. De Frenne, **G. Jia*,** 2022: Protected areas provide thermal buffer against climate change, ***Science Advances***, 8, eabo0119

Reforestation enhanced connectivity and climate buffering in China



Reforestation enhanced landscape connectivity
Reduced fragmentation and edge effects

Core forest: Cooler habitat,
Reduced diurnal and seasonal T range



Huang, A., R. Shen, **G. Jia,** X. Xu, 2022: Reforestation enhanced landscape connectivity for climate buffering in China***, Environmental Research Letters***, 17(1): 014056

Coupled crisis → Nature-based solutions

Climate change and ecosystem degradation are coupled crisis we face

Climate change and extremes increasingly threaten the viability and resilience of natural ecosystems

Ecosystems play an active role in regulating climate system via carbon flux and biophysical feedbacks.

Neither will be successfully resolved unless both are tackled together

Joint scientific research on climate-ecosystem-landuse interactions among BRICS academies, with *in-situ*, satellite, and modeling network.

Fill knowledge gaps, towards nature-based solutions (NbS)

谢谢 *Thank You*

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