



NASA-MAIRS Research Update

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In this presentation

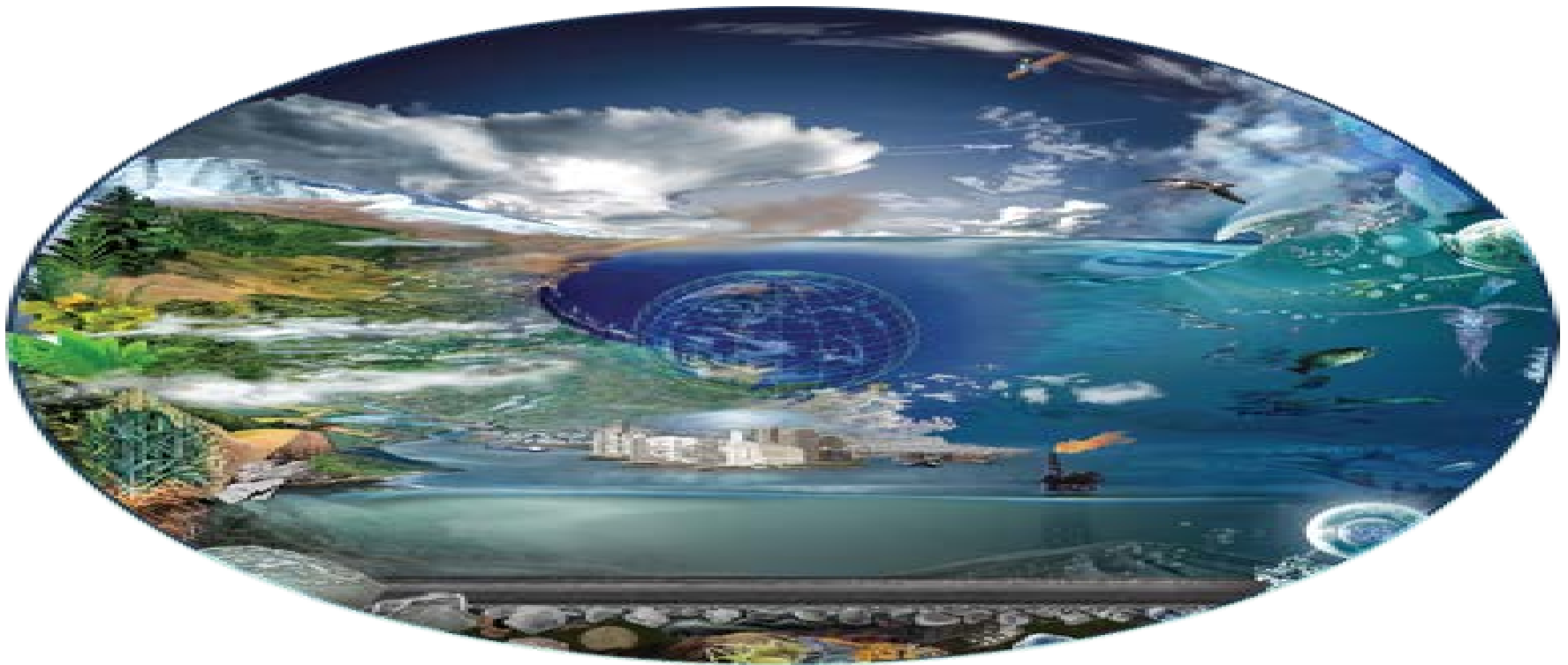
- History
- Achievements
- Future

Acknowledgements:

Worked with 14 Chinese key projects funded by MOST, NSFC and CAS, and 43 international projects funded by APN, NASA, JST&JSPS, EU FP7 and AusAID

MAIRS: MONSOON ASIA INTEGRATED REGIONAL STUDY

**Study on the coupled human and environment
system in the monsoon Asia region.**



MAIRS Domain

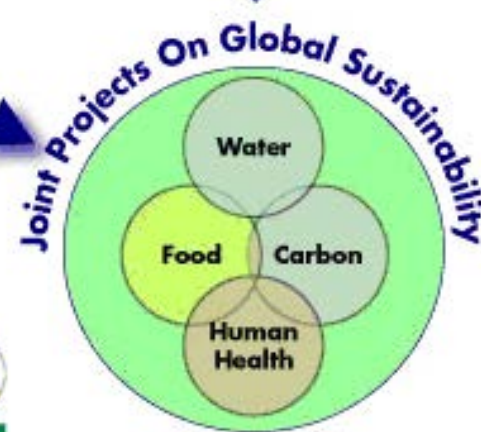
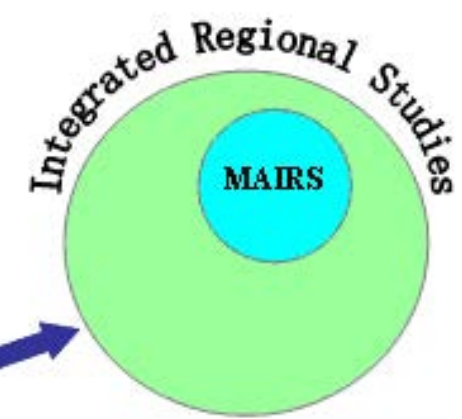
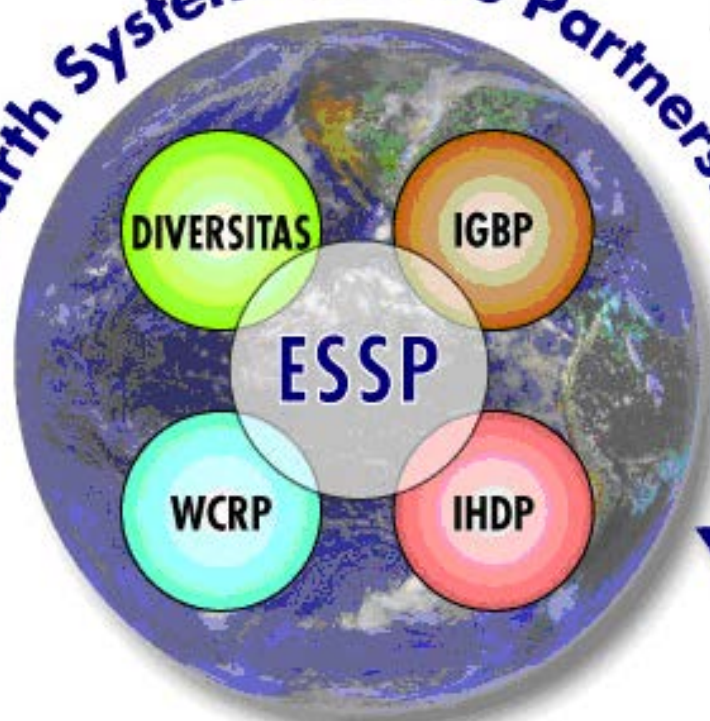




MAIRS links to ESSP and other programs

Future Earth –
in Asia

Earth System Science Partnership



Why Monsoon Asia

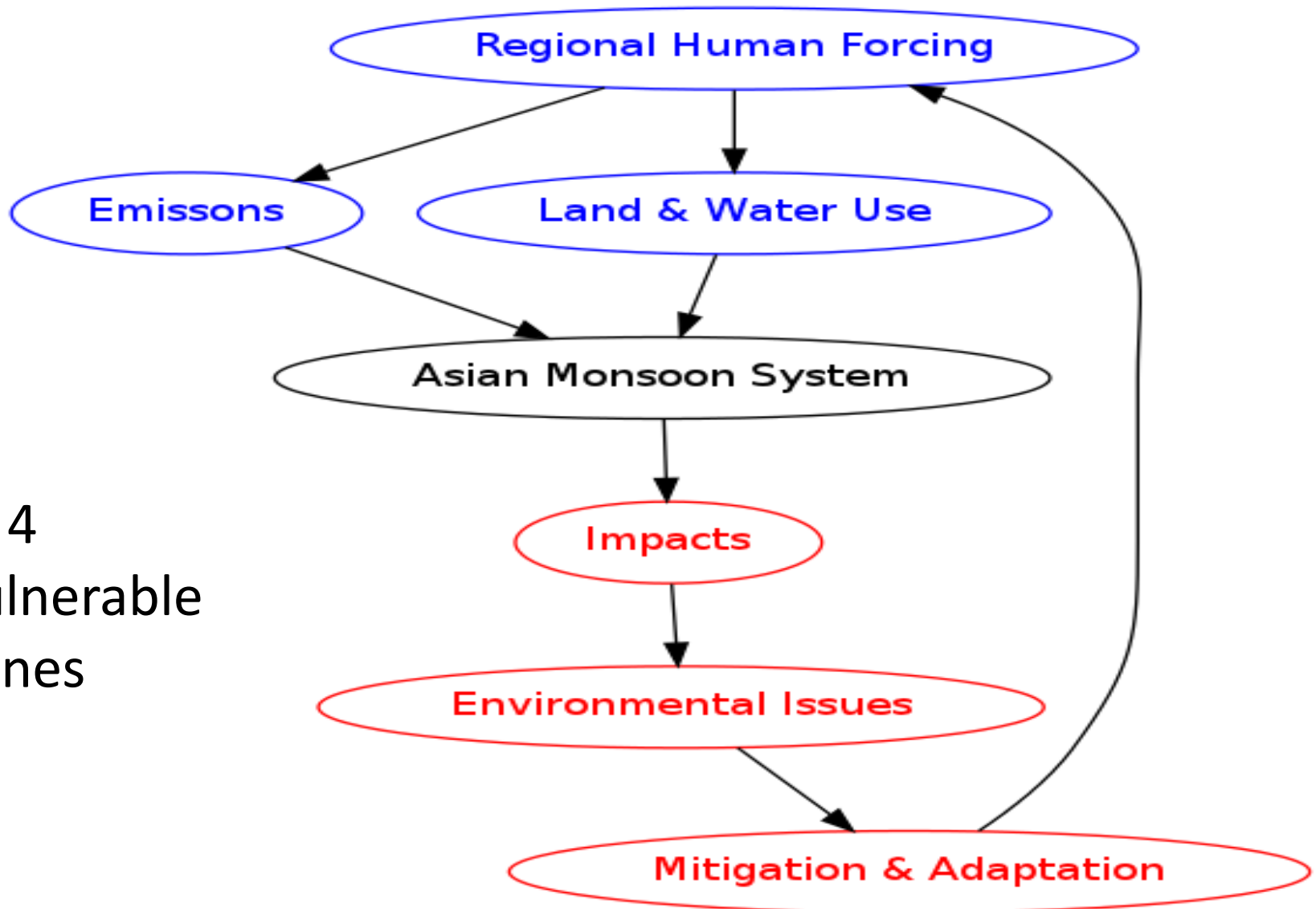
- World's highest mountains
- Heat source of Tibetan Plateau
- Seasonal monsoon affects water and food resources
- Range of natural hazards (TC to GLOF)
- 3.6 billion people
- Anthropogenic aerosols
- Vulnerable coastal development
- Rapid urbanisation and economic growth

MAIRS Objectives

.MAIRS aims to promote **integrated regional studies** across monsoon Asia, in order

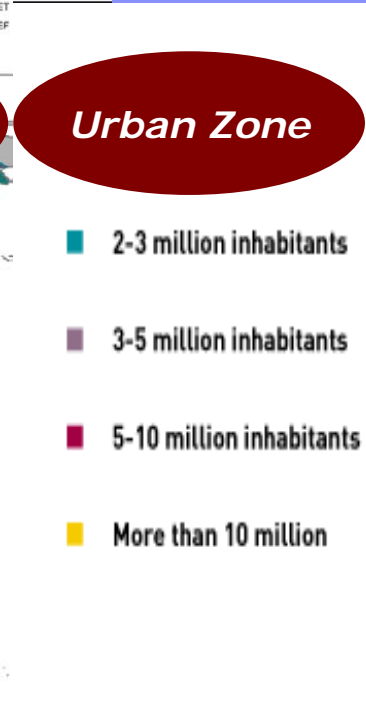
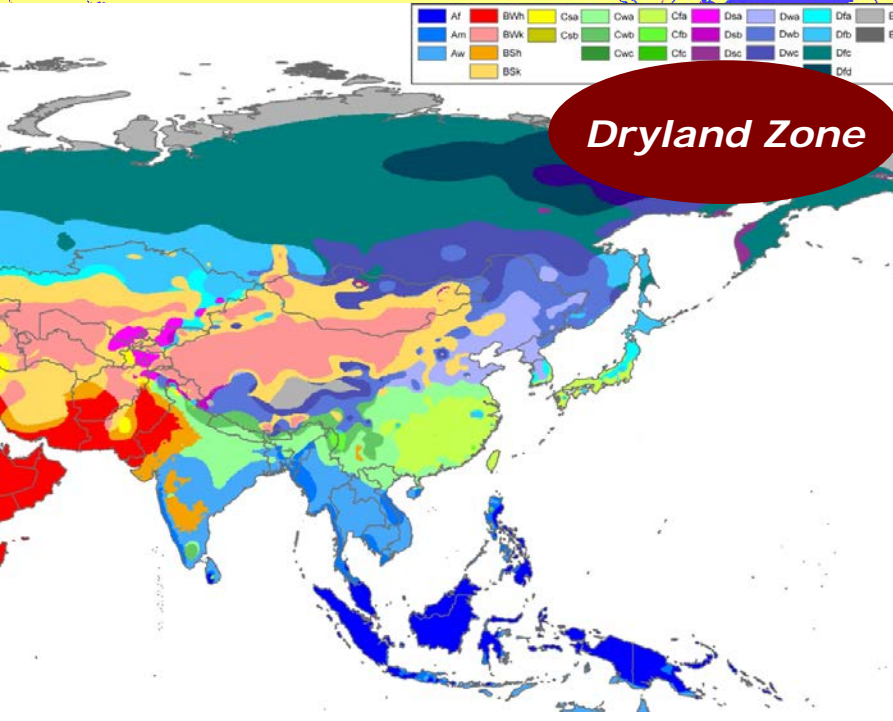
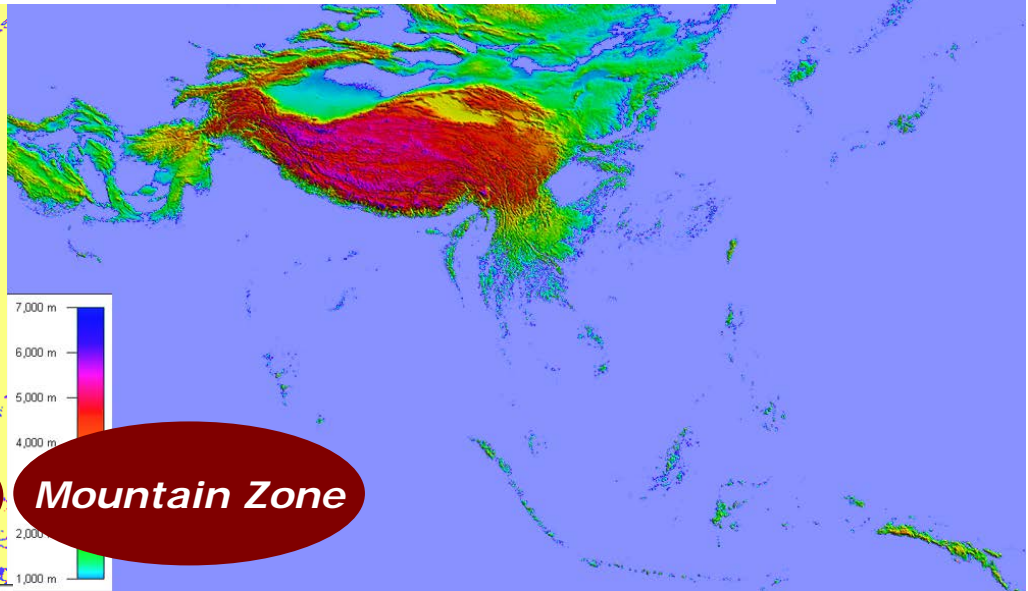
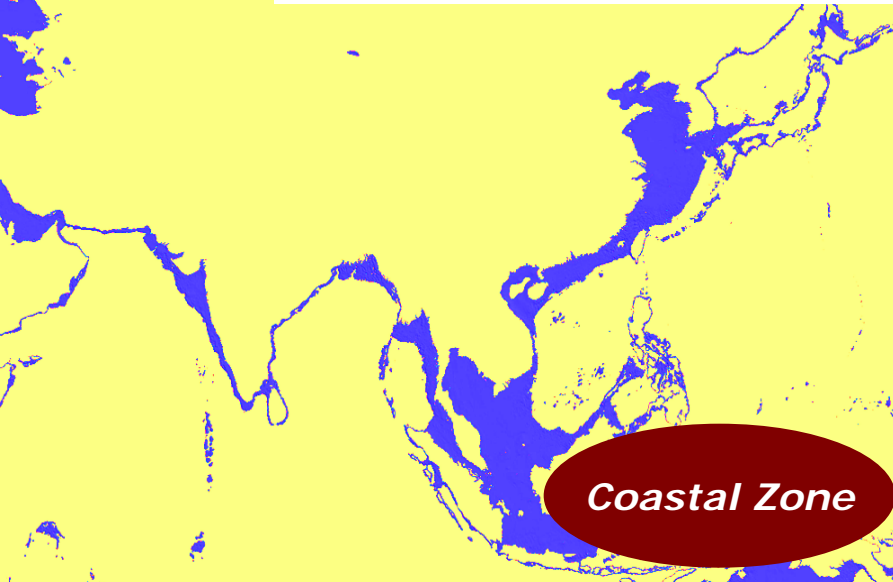
- ✓ To answer science questions on
 - The **resilience** of the monsoon system **to human activities**
 - The **vulnerability** of human societies to environmental change
- ✓ To promote **collaboration** across disciplines and regions
- ✓ To enhance scientific **capacity** across the region

Conceptual Framework



In 4
vulnerable
zones

Integration across Vulnerable Zones



| | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|----|
| AF | BWh | Csa | Cwa | Cfa | Dsa | Dwa | Dfa | ET |
| Am | BWk | Csb | Cwb | Cfb | Dsb | Dwb | Dfb | EF |
| Aw | BSh | Csc | Cwc | Cfc | Dsc | Dwc | Dfc | |
| BSk | | | | | | | | |

- 2-3 million inhabitants
- 3-5 million inhabitants
- 5-10 million inhabitants
- More than 10 million



Challenges for Each Zone

Mountain

Multiple stresses on ecosystem and biophysical resources

Dryland

Vulnerability of ecosystems to changing climate and land use

Urban

Changes in resource use and emissions from rapid urbanization

Coastal

Rapid transformation of land and marine resources

History of MAIRS

- Planning in 2005 under auspices of START
- Chair SSC
 - Congbin FU (2006-2010) (Phase I)
 - Michael Manton (2011-2014) (Phase II)
- IPO supported by CAS at IAP, Beijing
- Link to Earth System Partnership (ESSP)
- Reviewed in Nov. 2010
- Commence Phase II in 2011
- Link to Future Earth in 2013



Promotion of Science

- Hosted about **60** international workshops with **2200** participants
- More than **200** scientists involved in activities
- **9** young and early career scientist training courses with about **800** participants
- \$\$\$ to supported scientists from developing and under-developed countries to attend non-MAIRS conferences and workshops
- Worked with **14** Chinese key projects funded by MOST, NSFC and CAS, and **43** international projects funded by APN, **NASA**, JST&JSPS, EU FP7 and AusAID

Key Questions for Each Zone

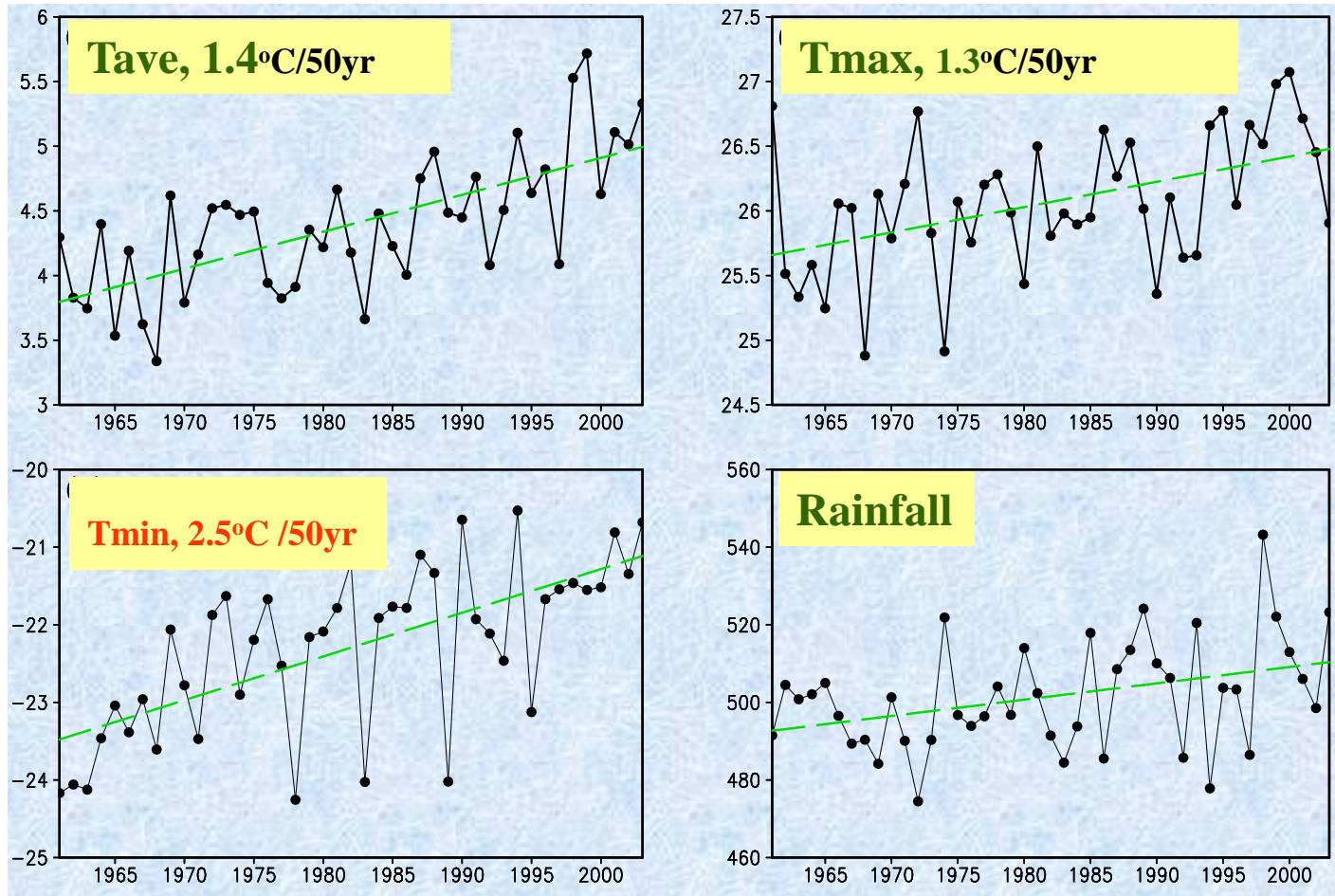
- What are the major drivers for change and variability?
- What are the vulnerabilities of communities and ecosystems?
- What are the options for responding to those vulnerabilities?

Mountain Zone

- Rapid climate change
- Change in land cover
- Change in socio-economic conditions
- Adaptive capacity of communities

Next few slides are just examples of research finding

Climate Change in Eastern Tibetan Plateau over 50 Years



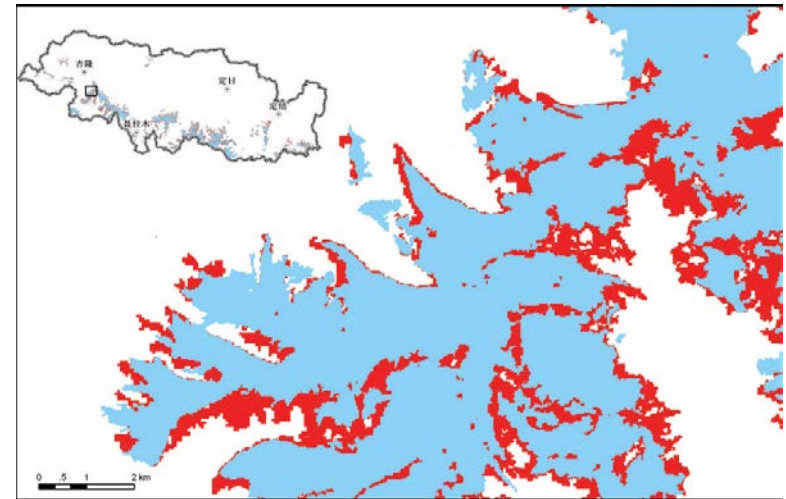
Duan et al. (2006)

Land Cover Change in Qomolangma National Nature Preserve area (1976-2006)

Glacier Retreat

1) Glacier retreat and expansion of glacier lakes

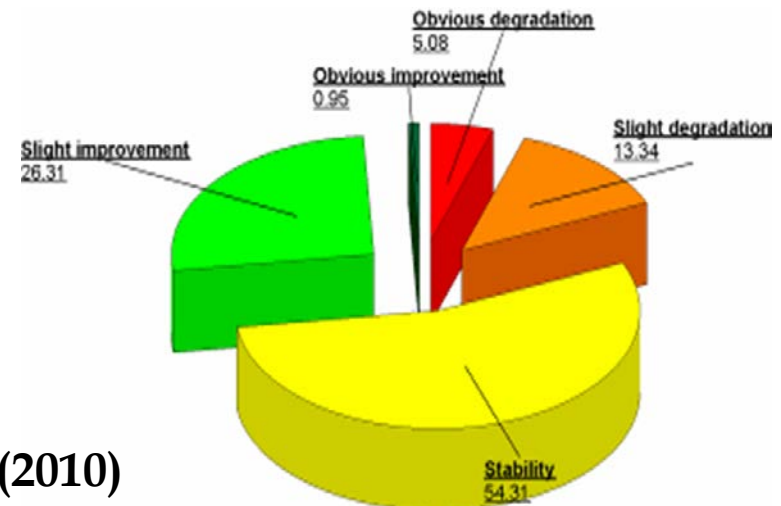
- Glacier area decrease by 16%
- Glacier lake increase from 57 to 94 sq. km



Land Degradation

2) Land degradation

- 19% of area degrading
- Wetlands decreasing
- 54% of area stable
- 27% of area improving

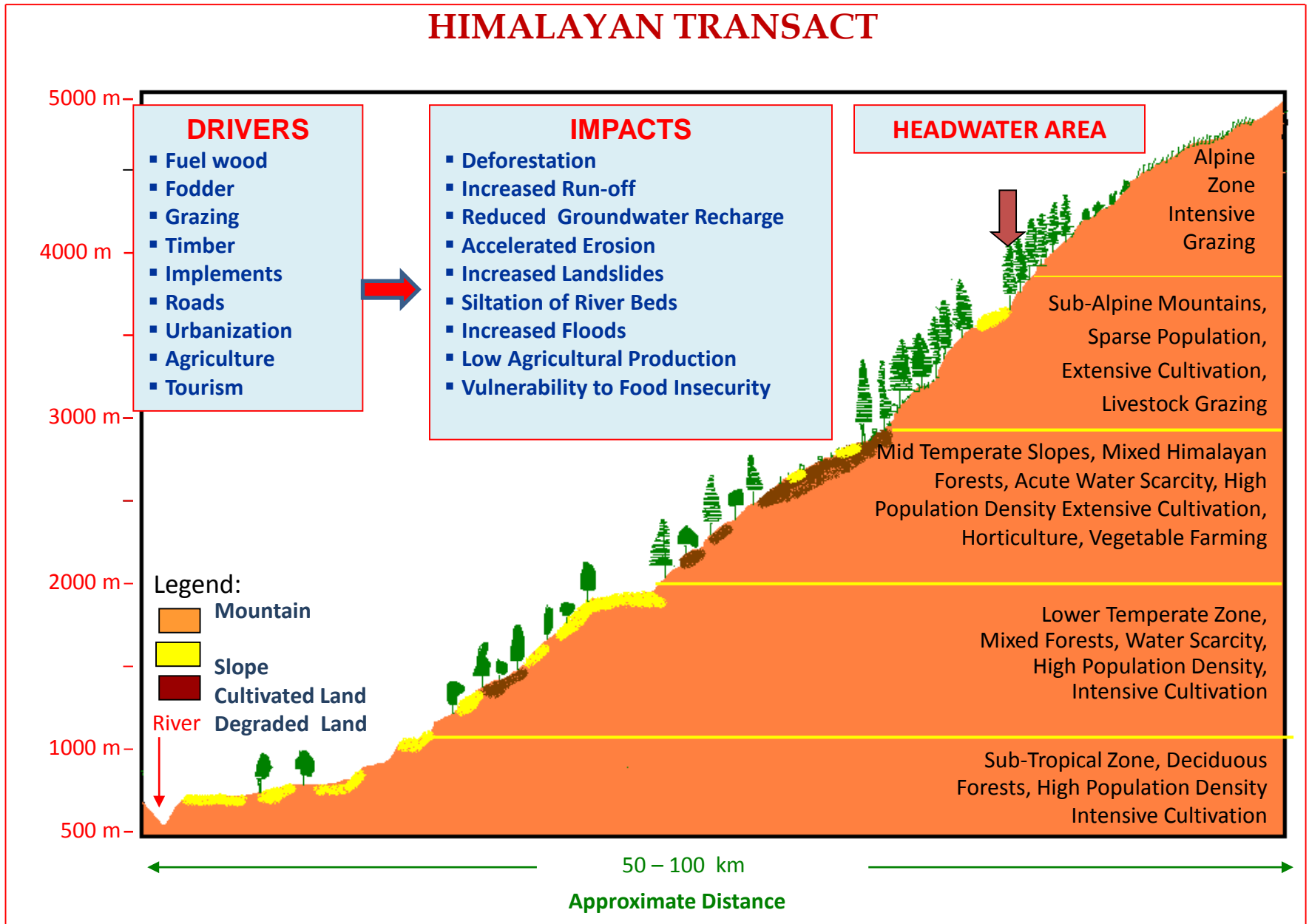


3) Drivers of change

- Mainly natural factors
- Degraded areas affected by human activities

Zhang, Liu et al. (2010)

RESOURCE USE DYNAMICS & LAND USE CHANGES ALONG HIMALAYAN TRANSACT



Community Responses & Adaptation

- ✧ 27% villages have replenished their water sources through water conserving forestry and horticultural practices
- ✧ 25% villages managed depleting water through rainwater harvesting schemes based on local indigenous knowledge and community participation
- ✧ 19% families cultivated less water requiring and drought resistant food as well as cash crops
- ✧ 21% households altered traditional cropping pattern & adjusted crop rotation
- ✧ 11% households cultivated abandoned land
- ✧ 27% families relocated their agriculture.
- ✧ 7% Families abandoned agriculture & switched over to secondary & tertiary activities
- ✧ 5% households out-migrated the region
- ✧ 11% decreased consumption of low productive and expensive food items



Improving Resilience and Adaptive Capacity to Climate Change in the Hindu Kush-Himalayan Region (China, Bangladesh, India and Nepal)

- Engagement with Government officials and community groups
- Collection of relevant bio-physical, socio-economic and cultural data
- Synthesis of scientific data and field investigations
- Capacity building through interactive research and training programmes
- Creation of a knowledge platform for dissemination and exchange
- Integration of evidence based policy analysis for the development of the Climate Change Adaptation Toolkit
- Development of a roadmap for the expansion of the toolkit methodology to other countries



L. Heath (2013-2015)

Dryland Zone

- Significant land use change
- Analysis of socio-economic changes
- Evaluation of land surface models and terrestrial ecosystem models

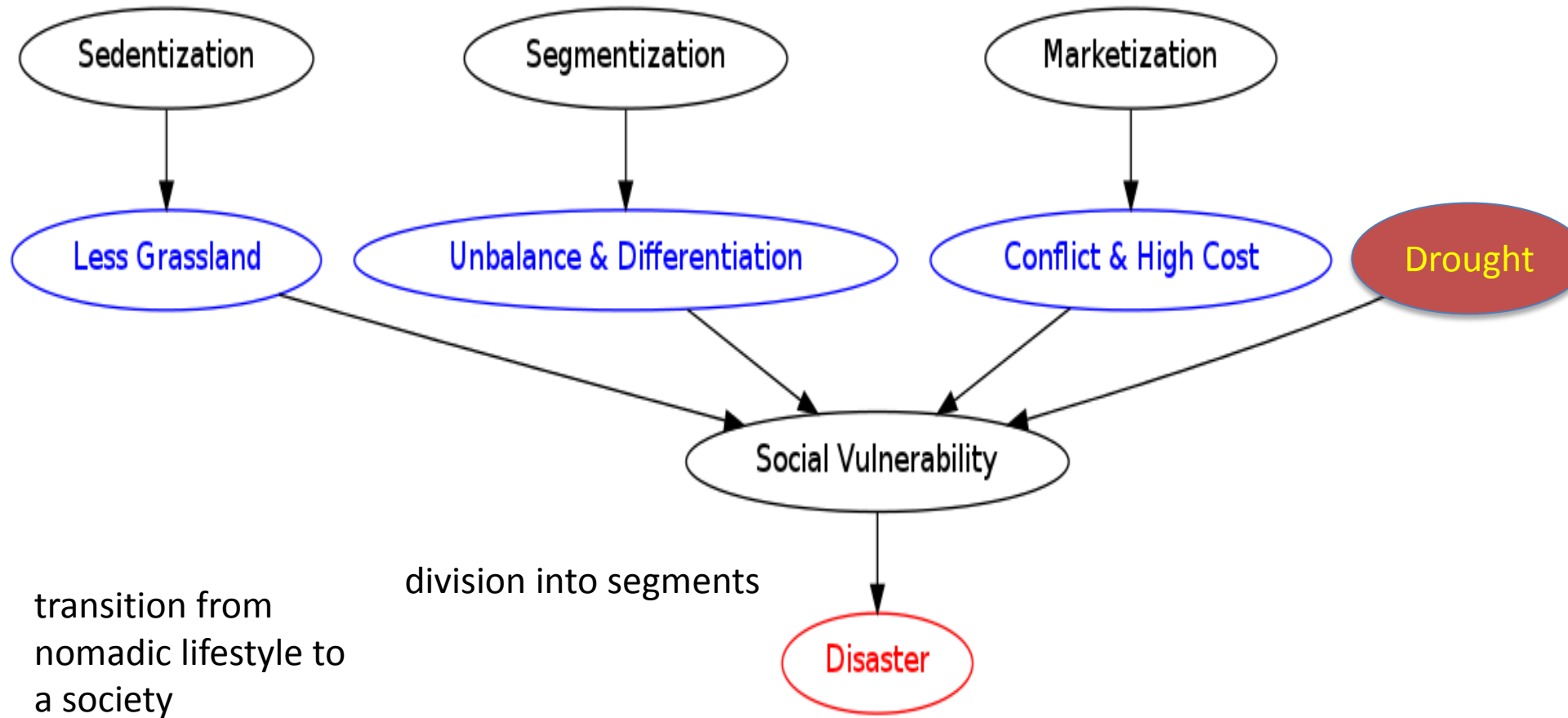
Drought Impact on Rangeland Herders in Inner Mongolia

- Pastoral village of 80 households
- 10,000 livestock
- Decade-long drought & rising temperature affected pasture & water availability
- Herders' incomes significantly reduced
- But there are social factors



Xiaoyi Wang, CASS

Social Factors Interacting with Drought Impacts



Understanding the

Front. Earth Sci. 2012, 6(2): 115–121
DOI 10.1007/s11707-012-0320-4

FEATURE ARTICLE

Addressing global change social

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² American University o

³ National University o

⁴ UCAR Project Scientist at NOAA

⁵ NASA Land Use and Land C

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Abstract Central Asia is one of the most vuln regions on the planet earth to global climate c depending on very fragile natural resources. The legacy has left the five countries (Kazakhstan, Taj Kyrgyzstan, Turkmenistan, and Uzbekistan) with a integrated system but they are facing great challeng

NEESPI and MAIRS Programs in the Dryland East Asia

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Abstract

Keywords: NEESPI, MAIRS, Regional Programs, Dryland, and Climate Change

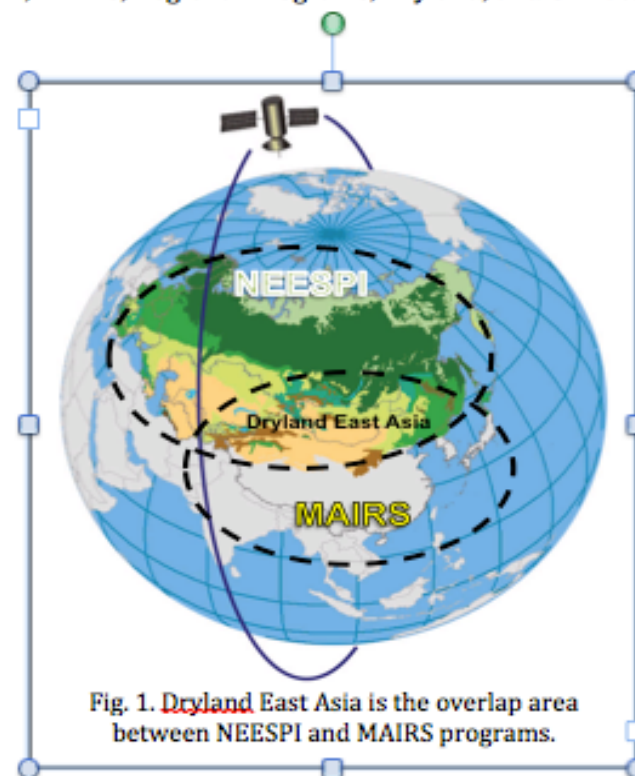


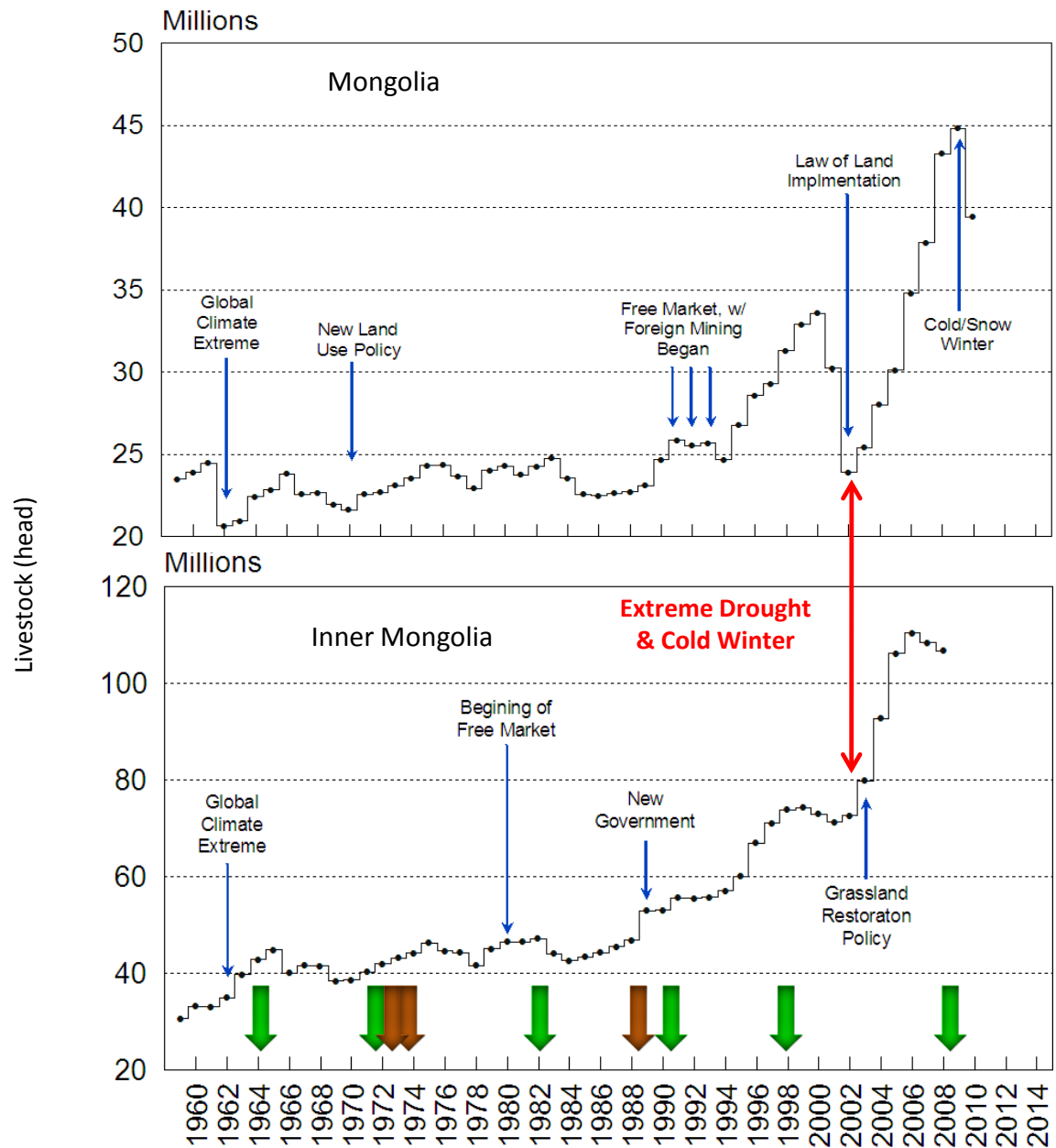
Fig. 1. Dryland East Asia is the overlap area between NEESPI and MAIRS programs.

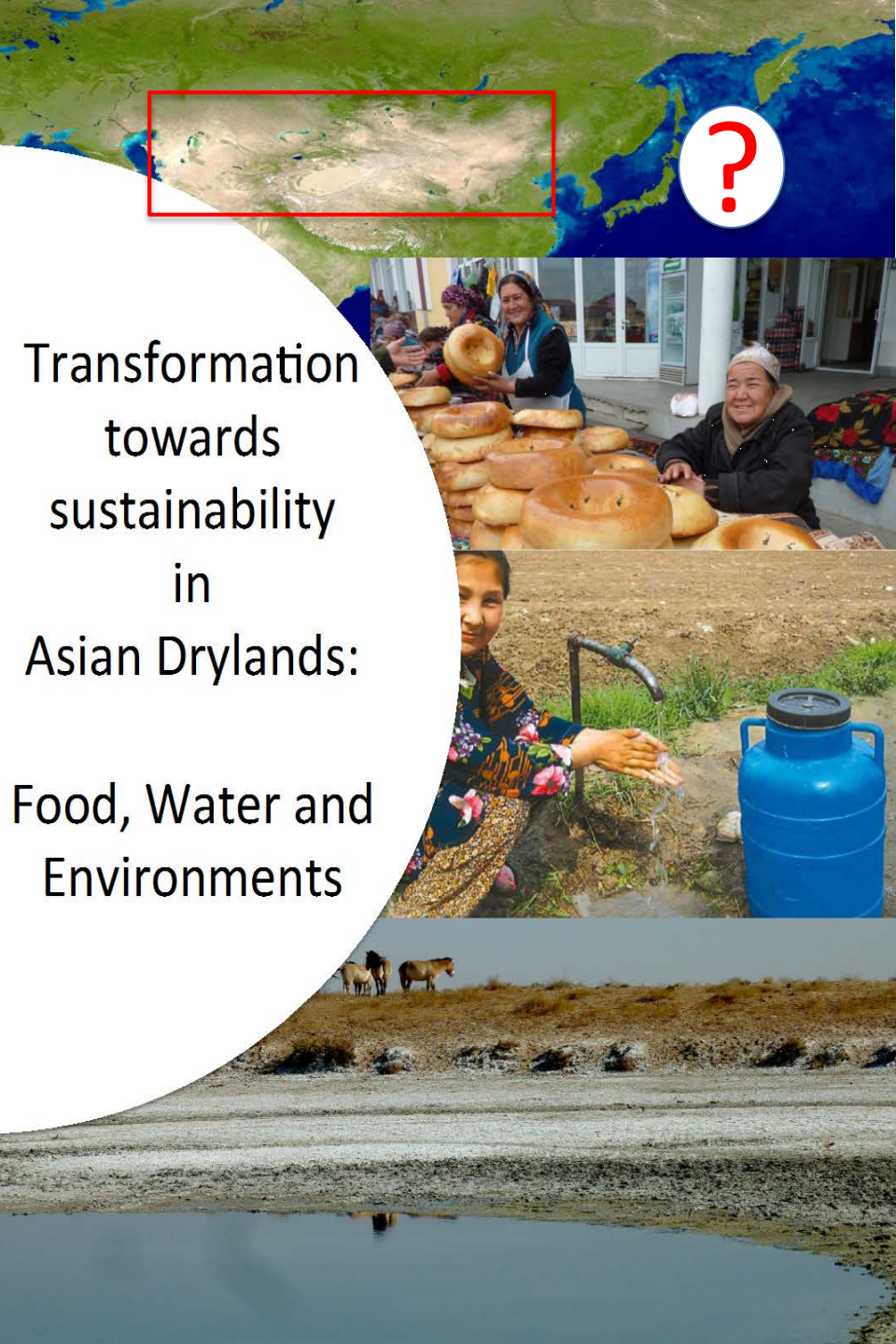


“Snow” in the cotton field



Changes in livestock, policy, and climate in IM & MG





Transformation
towards
sustainability
in
Asian Drylands:
Food, Water and
Environments

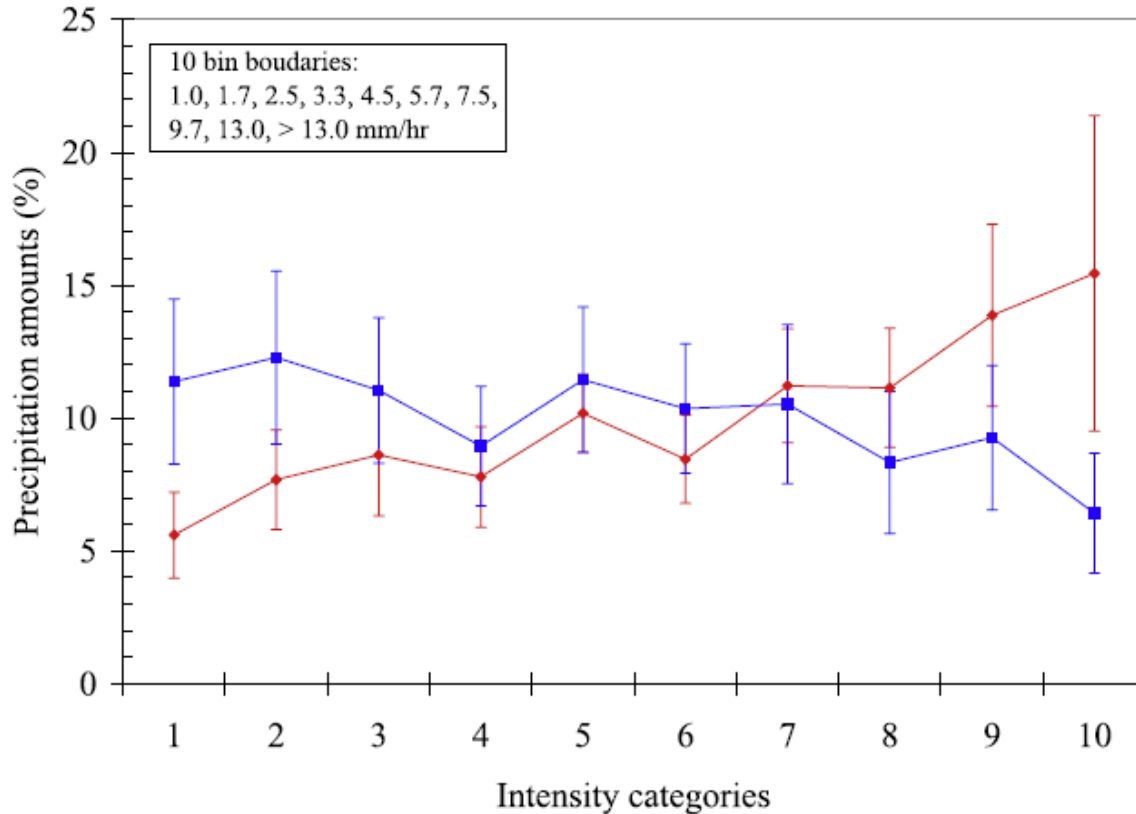
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Urban Zone

- Rapid urbanisation
- Role of mega-cities
- Monitoring networks
- Regional climate change

Impact of Warming on Precipitation



Comparison of precipitation intensity for the two coolest years (blue) and two warmest years (red) over the period 1961-2005

Find similar result for GPCP data

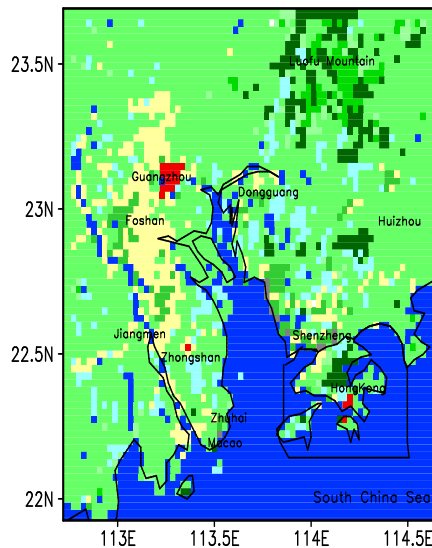
Response is larger than expected from Clausius-Clapeyron

S. Liu et al. (2009)

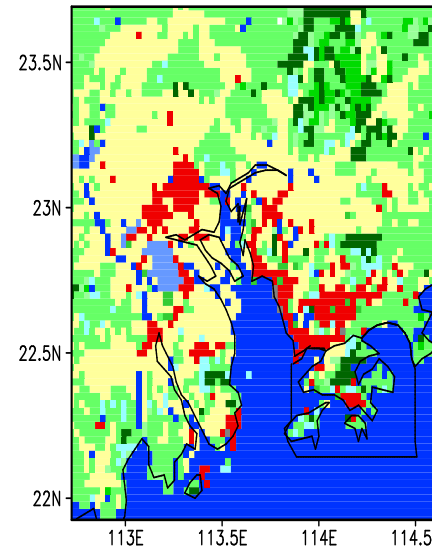
Coastal Zone

- Mega-city development
- Regional climate change
 - Impact of land use change
- Vulnerability studies
 - Hazard mapping for erosion, flooding and sea-level rise

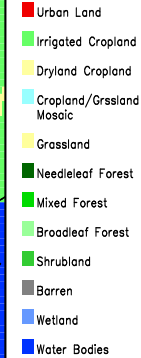
Regional Climate Change due to Land Use Change in PRD



1993



2000



No Urban

Urban

- Surface temperature:
- Relative Humidity:

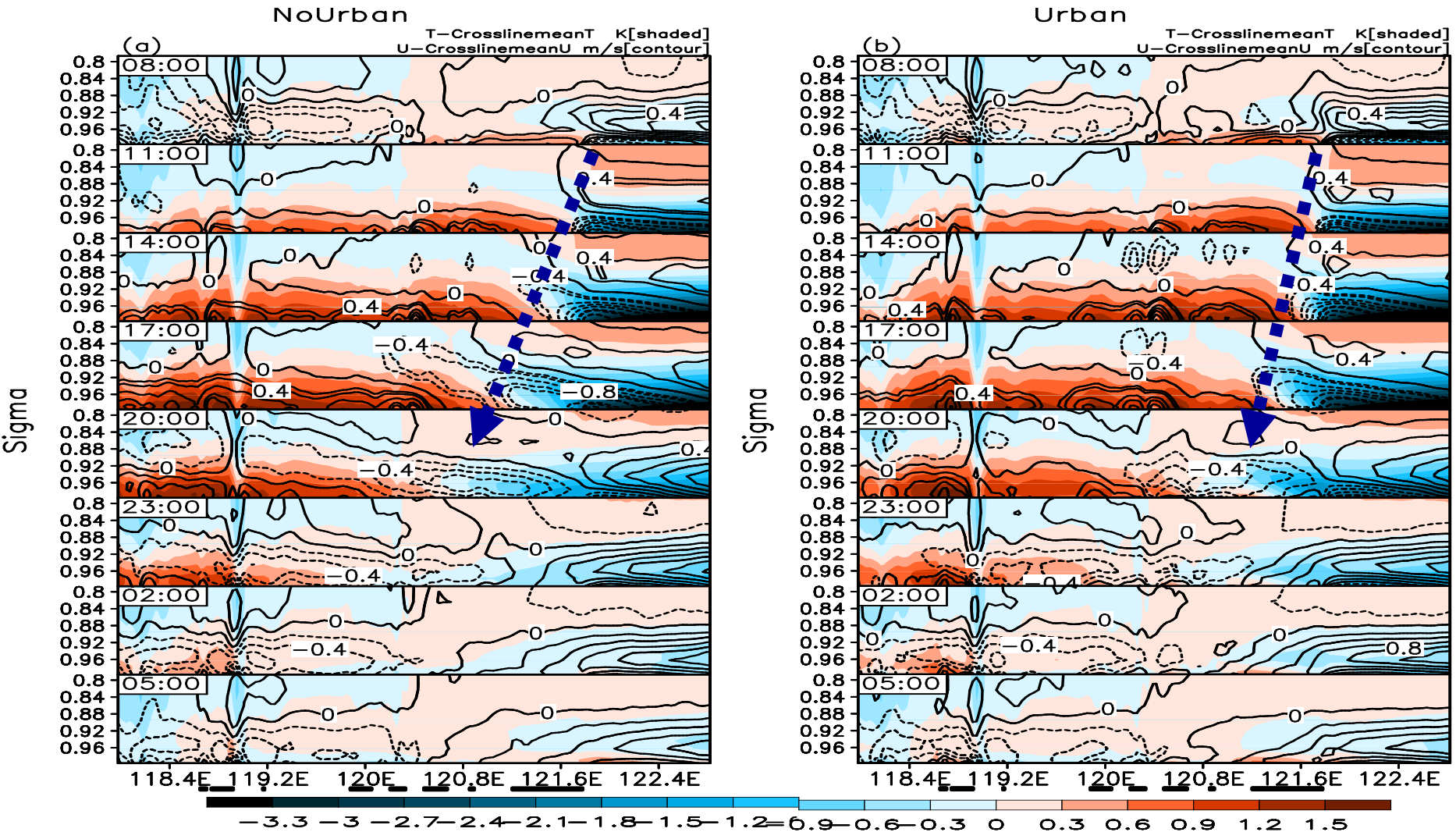
+0.09°C

+0.37°C

-0.36%

-0.80%

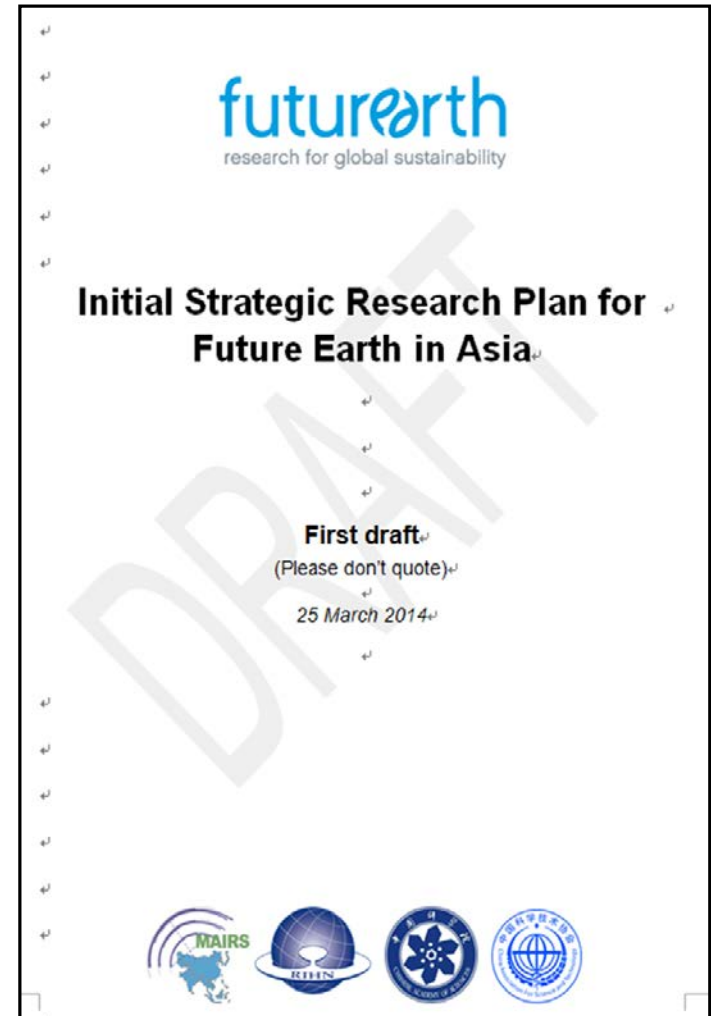
Urban Heat Island impact on Sea Breeze in YRD



Future MAIRS?

MAIRS and Future Earth in Asia

- MAIRS SSC initiative, in consultation with RIHN and others, to draft initial research plan for Future Earth in Asia
- Workshop in Hong Kong in late July 2013
- Draft being prepared for input from broad community
- Aim to commence dialogue amongst stakeholder communities on challenges of the transformation to sustainability across Asia



Scope of Plan

- Follows structure of Future Earth Initial Design
- Three themes
 - Dynamic Asia
 - Extend current GEC research
 - Asian Development
 - Stewardship of natural resources while enhancing human security
 - Transformation to Asian Sustainability
 - Trans-disciplinary research on major challenges for sustainable development of Asia

Crossing-Cutting Capabilities

- Trans-disciplinary research
 - Co-design, co-production, co-delivery to reduce time for impact of research; sensitivity to cultural diversity
- Observations and data
 - Existing international and national systems; socio-economic data; data sharing
- Education and capacity building
 - Existing programs; trans-disciplinary research; young and early career scientists
- Networking
 - Existing GEC programs; strengthen interfaces to all stakeholders

Theme 1 - Dynamic Asia

- Human system
 - Population, urbanisation, economies, inequality
- Geophysical system
 - Climate, anthropogenic effects, tectonic events
- Ecosystems and biodiversity
 - Forests, mountains, coasts, inland waters, small islands, agriculture, urban

Theme 2 - Asian Development

- Stewardship of ecosystems
 - Forests, mountains, coasts, inland waters, small islands, agriculture, urban
- Human security
 - Water, food, energy, health and well-being
- Collaboration of researchers and development communities

Theme 3 – Transformation to Asian Sustainability

- Uniqueness of monsoon climate and topography
- Vulnerability to natural disasters (tectonic and hydro-meteorological)
- Continuing urbanisation and economic growth
- Sustainable food, water and energy systems
- Survival of diverse ecosystems
- Contributions of traditional knowledge to regional sustainability
- Social equity (gender, education, well-being, governance)

So Far

- MAIRS has focused on cross-cutting global change issues for monsoon Asia
- Developed links between research groups across region
- Established links across disciplines
- Established links between regional and global research communities
- Promoted development of Future Earth across Asia

Conclusion of the MAIRS OSC

MAIRS Open Science Conference 2014

Future Earth in Asia

April 7-10, 2014, Beijing, China



OSC Statistics

Promote the collaboration across the region

- ✓ 260 participants
- ✓ 110 overseas
- ✓ 24 countries

Promote collaboration across disciplines

- ✓ agriculture, chemistry, climate, ecology, economics, energy, geography, hydrology, remote sensing, social science

Promote capacity building

- ✓ 150 students and ECRs

Promote science

- ✓ 19 keynotes
- ✓ 26 parallel sessions
- ✓ 60 posters

Scientific Topics

Mountain

- ✓ land use change (LUC)
- ✓ socio-economic link to LUC
- ✓ adaptation strategies

Dryland

- ✓ land use change (LUC)
- ✓ socio-economic link to LUC
- ✓ grassland degradation
- ✓ hydrological processes
- ✓ dryland of northern Asia
- ✓ LSM and TEM

Coastal

- ✓ ecosystem services (ES)
- ✓ socio-economic links to ES
- ✓ sediment dynamics
- ✓ sea-level rise

Urban

- ✓ air pollution observations, modeling, and policy
- ✓ energy transformation
- ✓ urbanization

From the OSC

- ✓ move from sustainability concept to implementation is challenge
- ✓ co-design, co-production, co-implementation should enhance effectiveness of research
- ✓ Future Earth has potential to provide framework for sustainability research and action
- ✓ MAIRS had laid sound foundation for future research across Asia

Future MAIRS?

- Play a key role in FE in Asia –



- Lead FE in China -

Institute of Atmospheric Physics

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Thank you!