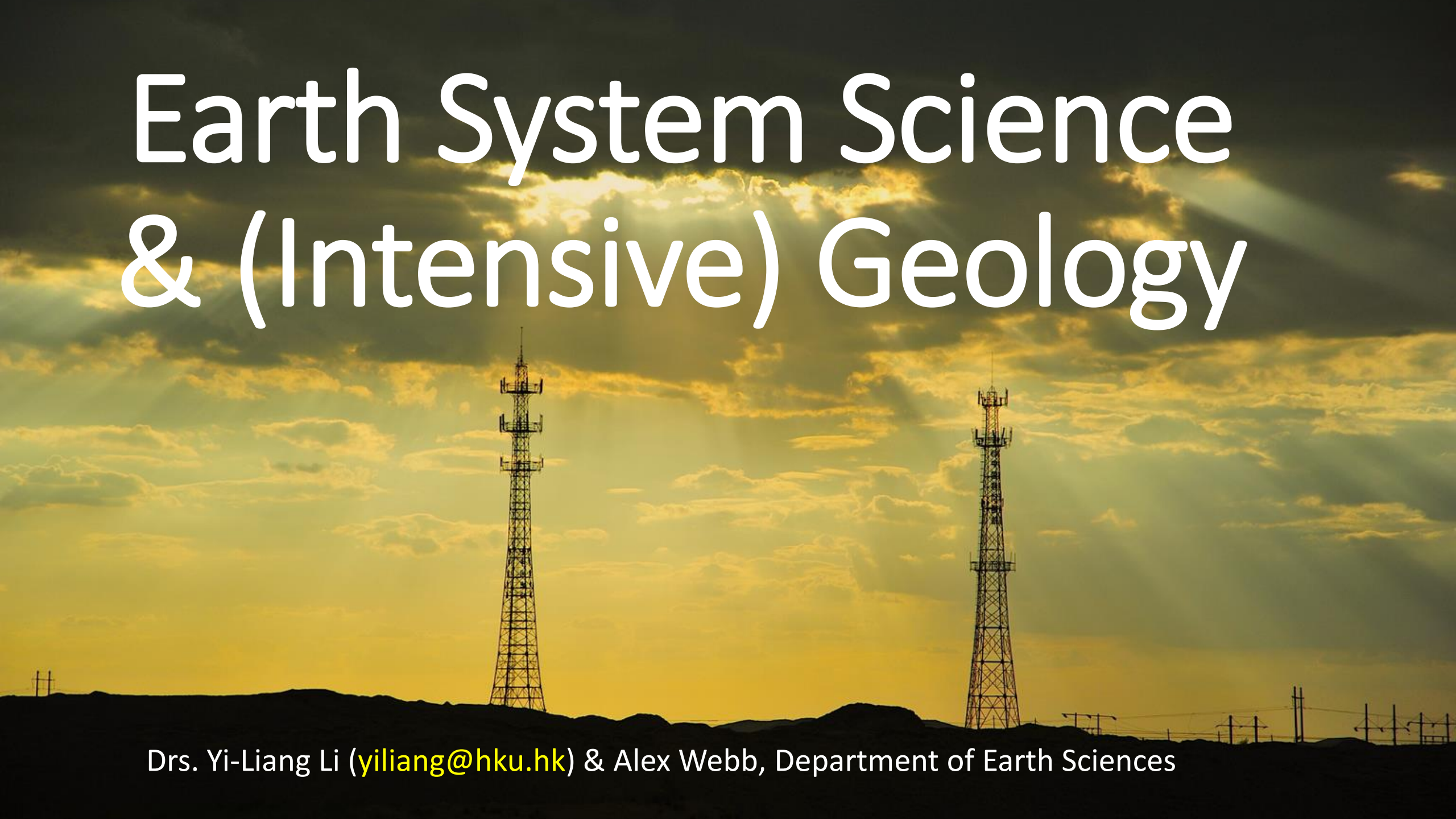
Earth System Science & (Intensive) Geology



Drs. Yi-Liang Li (yiliang@hku.hk) & Alex Webb, Department of Earth Sciences

Student Peer Advisers in 2018-19

- General roles
  - to **offer advice** in relation to academic studies to freshmen; and
  - to **facilitate** freshmen's **smooth transition** from secondary to university education
- You are highly encouraged to contact the following **Student Peer Advisers (SPAs)** if you have any questions about your study (their contacts can be found at the Faculty's website)

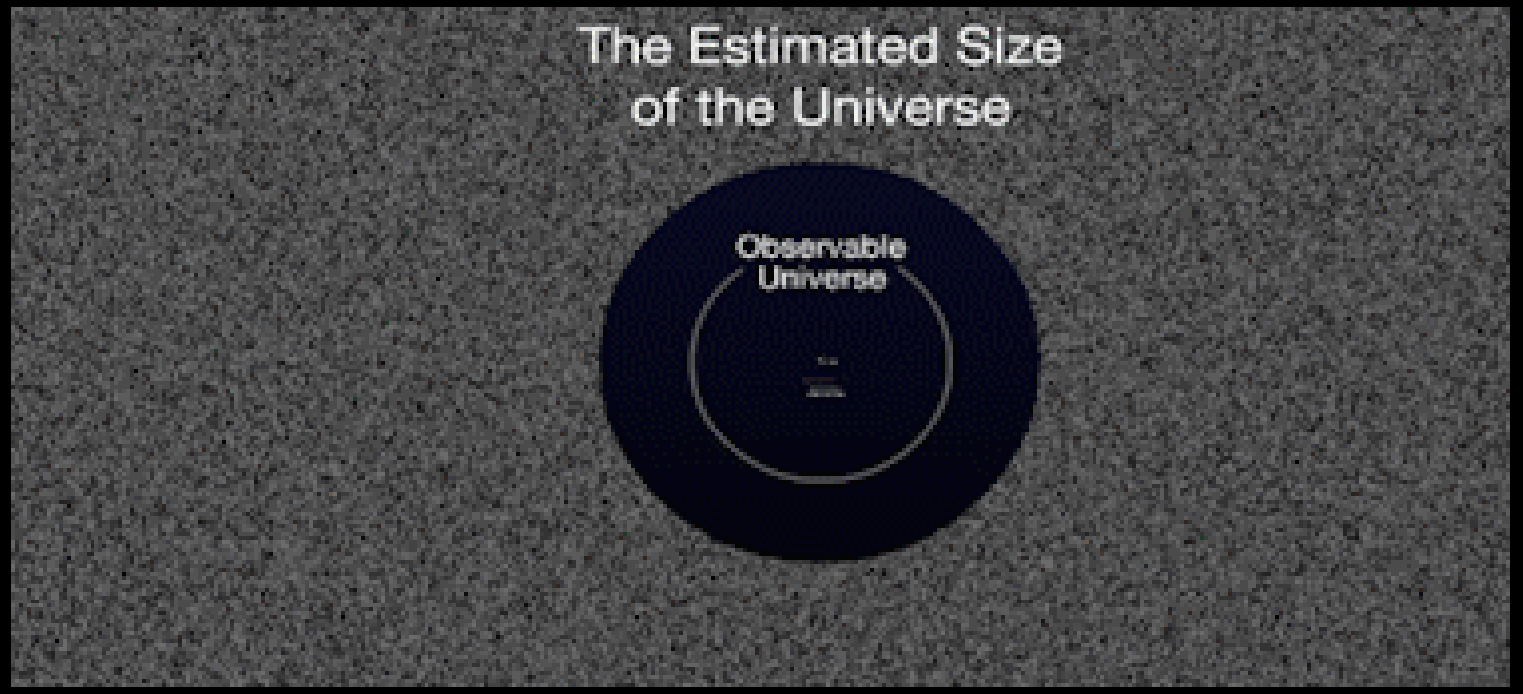
Earth System Science

- Mr MAN Chun Hei Benjamin (BSc Year 2)
- Miss SENTHIL KUMAR Neema (BSc Year 3)

Geology

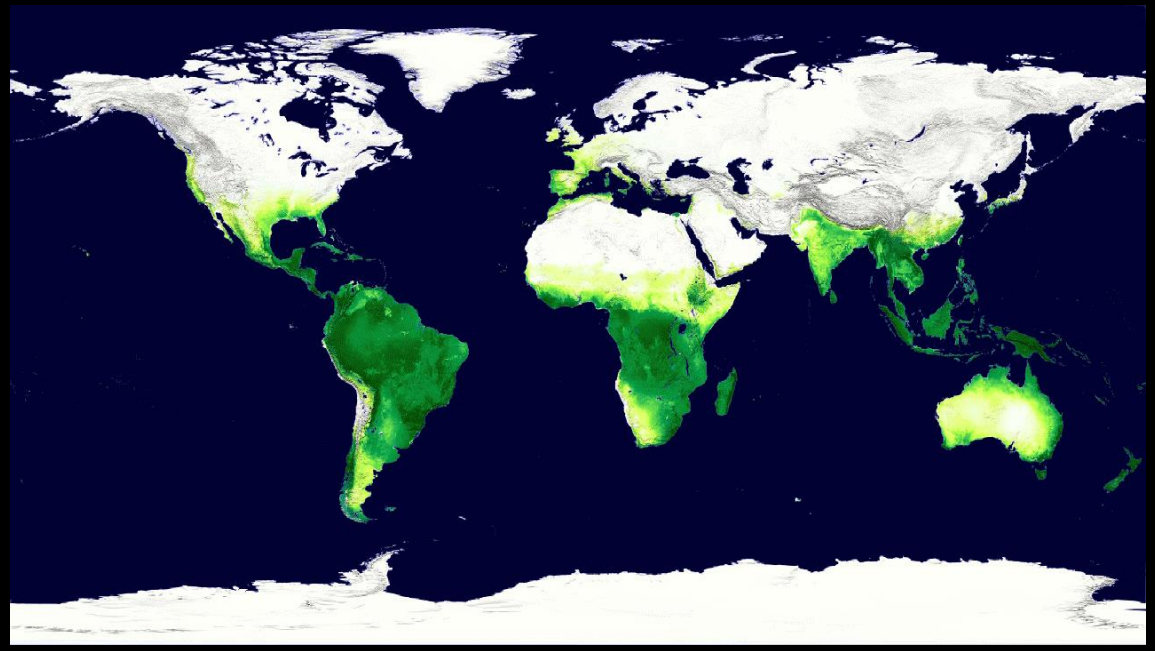
- Miss SIN Cheuk Lin Jacqueline (BSc Year 3)

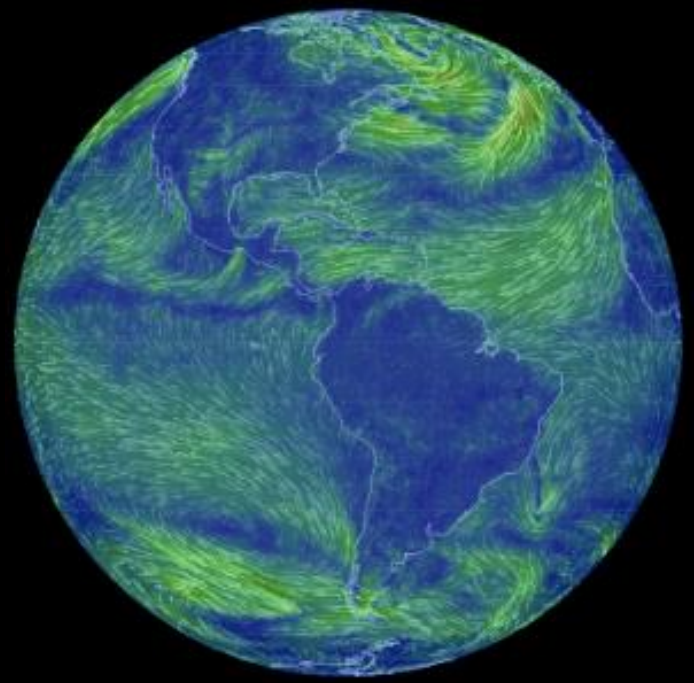
Understanding Life, Earth, the Universe & Their Evolutions in Deep Time



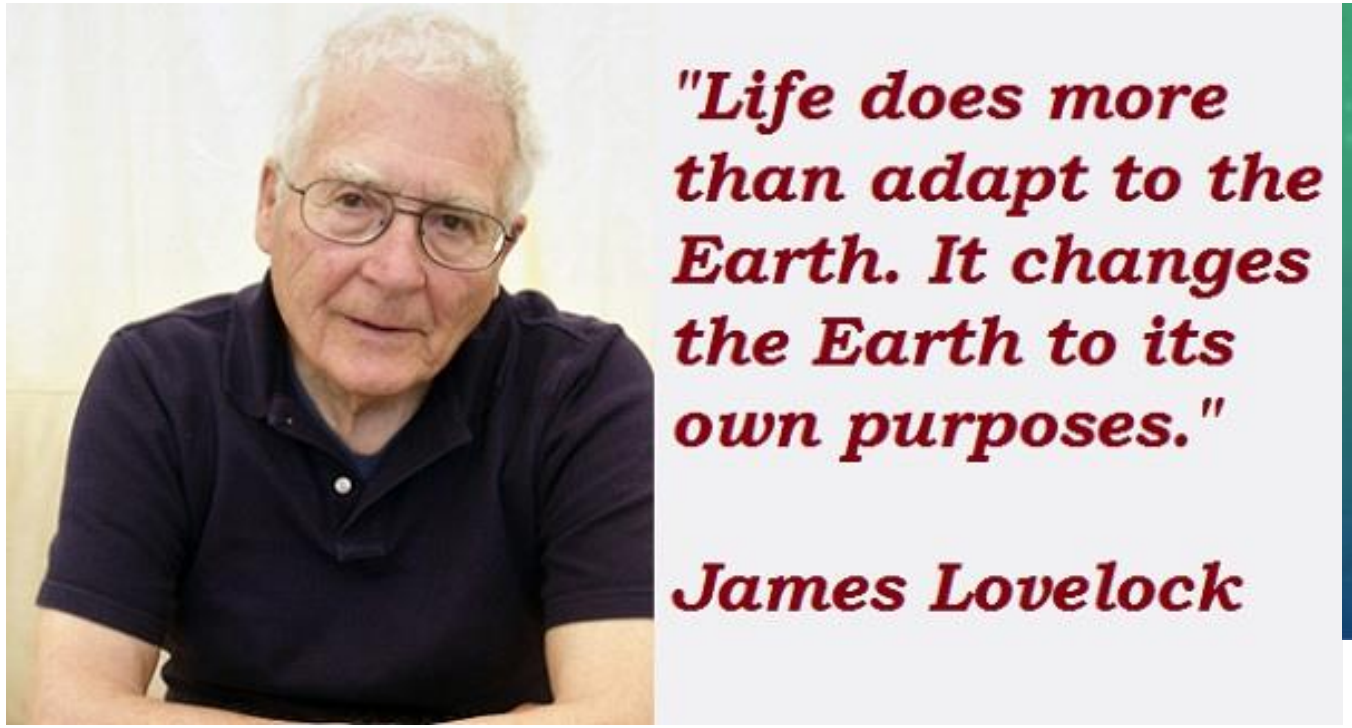
1. Earth System Science

- To understand how our planet functions as a whole system.
- NASA’s working model: a scientific understanding of Earth's system and its response to natural or human-induced changes, and to improve prediction of climate, weather, and natural hazards.





Founders of Earth System Science



"Life does more than adapt to the Earth. It changes the Earth to its own purposes."

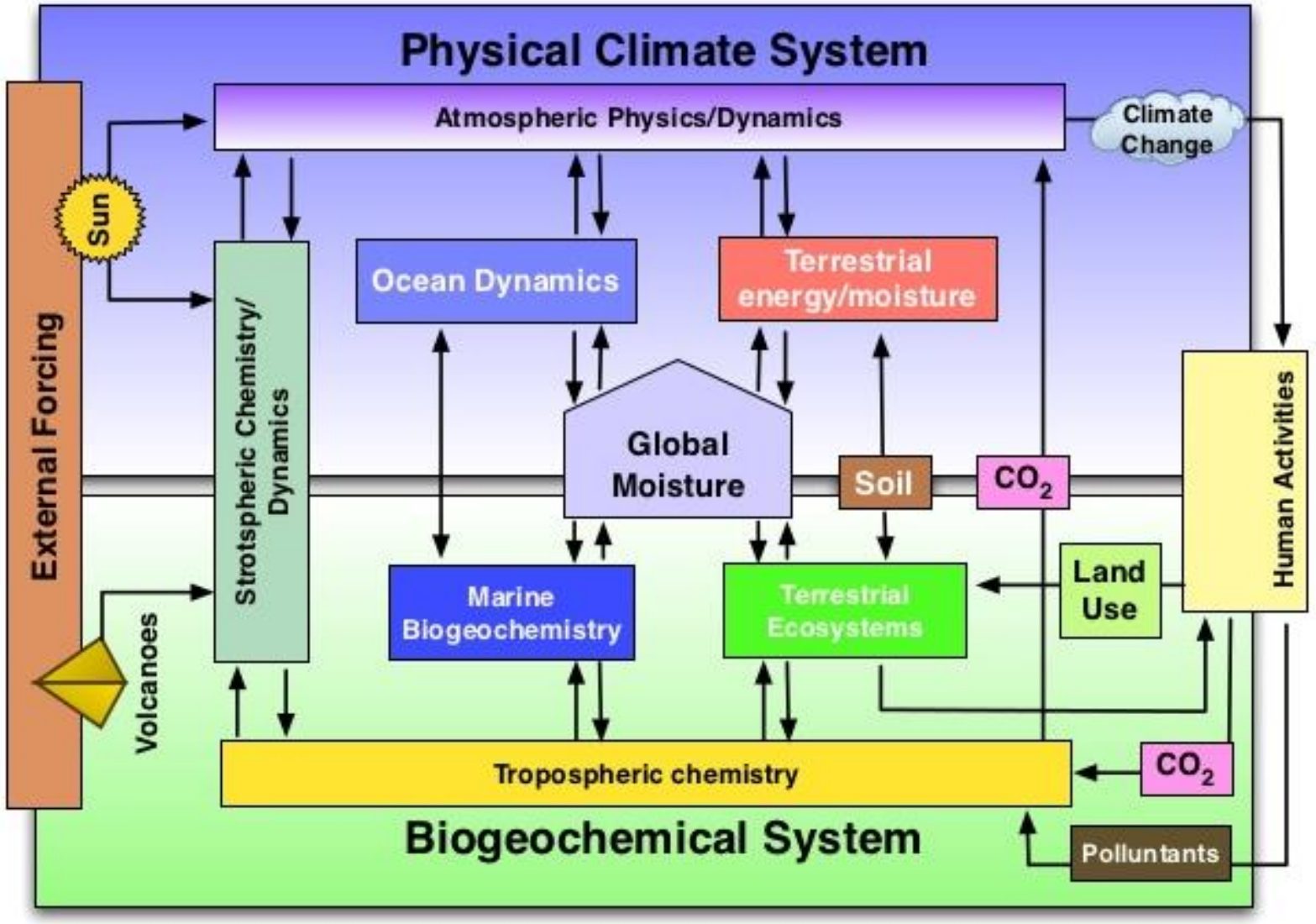
James Lovelock

The Development of Earth System Science

❖Earth System Science is a young and still emerging discipline (J. Lawton, Science, 292, Issue 5524, page 1965).

- The faint young sun puzzle (Carl Sagan, 1970s)
- The Gaia hypothesis (1960s-1970s) by James Lovelock & Lynn Margulis.
- The discovery of long-term (*geologic*) and short-term (*climatic*) feedback mechanisms (1980s, by J. Walker, P.B. Hays, J. Kasting, A. Watson and M. Whitfield).
- Snowball Earth (J. Kirschvink, 1992).
- Global Change (Ozone hole in Antarctic, industrial CO_2 emission and the issue of global warming) (Since 1970s).

The Bretherton Diagram: In 1986, NASA (USA) Was the Earliest Started a Research Program That Treated Earth as an Integrated System



Which Universities Have Earth System Science Program?

NESSC
NETHERLANDS EARTH SYSTEM SCIENCE CENTRE

National Committee for Earth System Science

The National Committee for Earth System Science (NCESS) has a top level aim to foster the development of a coherent community of Earth systems science (ESS) research in Australia. It also provides general functions of an Academy National Committee relevant to Earth system science, including representation and facilitation of core disciplinary components such as atmospheric and ocean sciences, as well as cross-disciplinary aspects of ESS.

The core objectives of the committee derive from the NCESS Plan 2010 *To live within Earth's limits: An Australian plan to develop a science of the whole Earth system*. Other broad aims include communication and reporting of Earth system science, advocacy for the funding needs of the ESS community, championing the ESS agenda and promoting Australian connections to international Earth system science. The NCESS Plan envisages development of a broader cross-academy approach to ESS in Australia that meshes with the new Future Earth initiative of the International Council for Science (ICSU).

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UCMERCED UNIVERSITY OF CALIFORNIA School of N
Faculty & Research Staff
Earth Systems Science

McGill
Earth System Science

UND AEROSPACE
UNIVERSITY OF NORTH DAKOTA
John D. Odegard School of Aerospace Sciences - Department of Earth System Science & Policy

MIDDLE EAST TECHNICAL UNIVERSITY
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ESSIC
Earth System Science Interdisciplinary Center

Department of Earth Sciences
The University of Hong Kong

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE Admission & Aid
Earth System Science

NANYANG TECHNOLOGICAL UNIVERSITY
Asian School of the Environment
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Bachelor of Science (BSc) in Environmental Earth Systems Science

Vrije Universiteit Brussel
Earth System Science

Stanford
SCHOOL OF EARTH, ENERGY & ENVIRONMENTAL SCIENCES | Earth System Science

The Chinese University of Hong Kong | 香港中文大學
Faculty of Science | 理學院
EARTH SYSTEM SCIENCE PROGRAMME
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UCI Earth System Science

UNIVERSITY OF HOHENHEIM

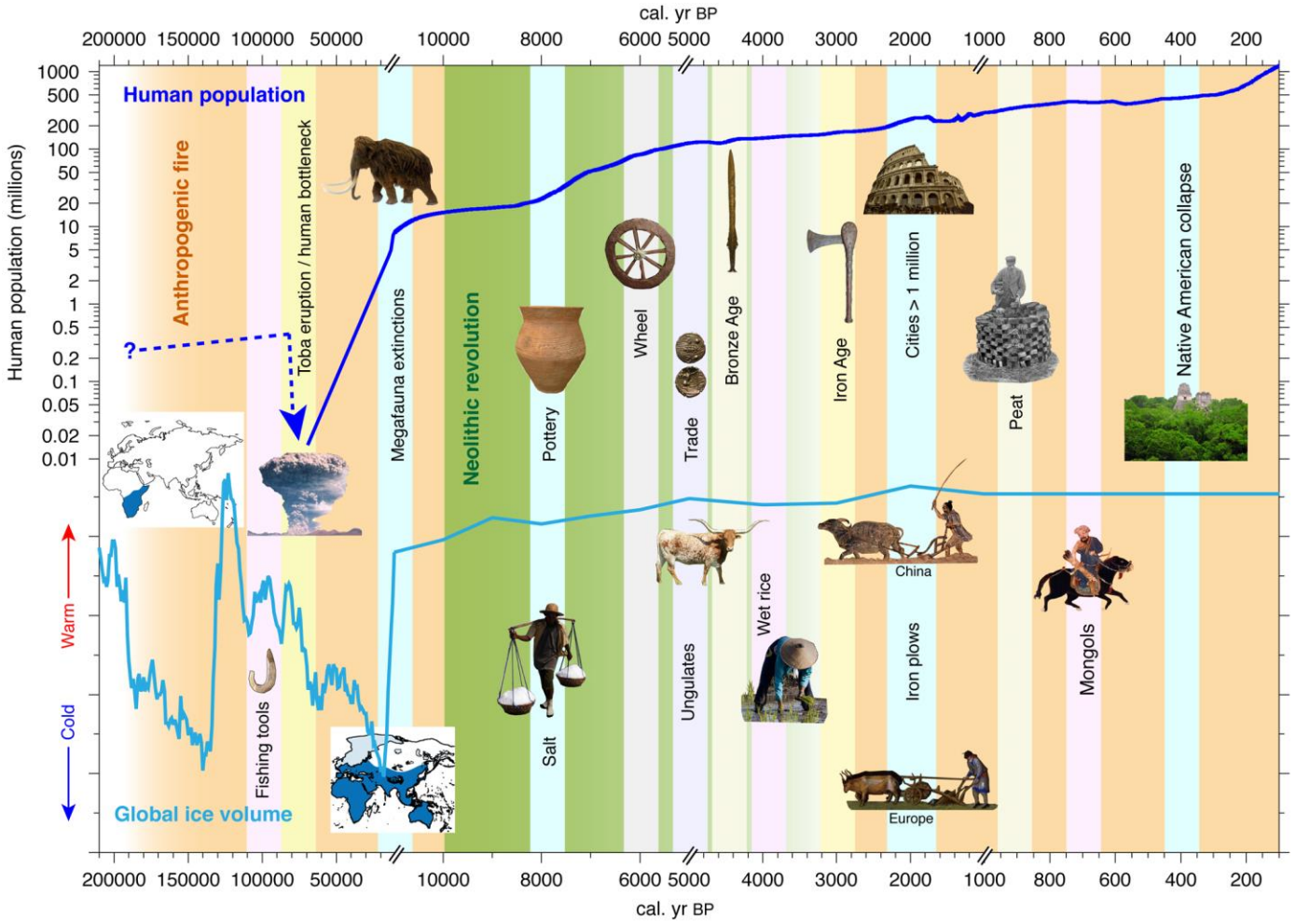
Why Earth System Science When We Already Have Geology (Major)?

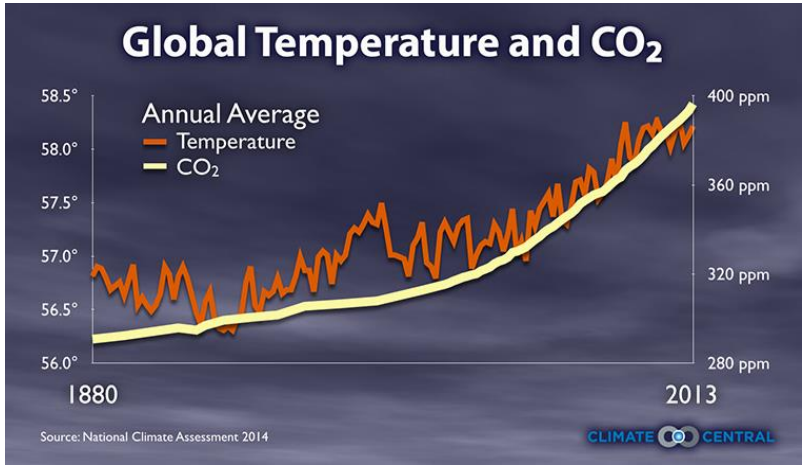
- Geology studies the evolution of the solid Earth through the deep geological time.
- Geology studies structure, material and processes from the core to the surface of the Earth.
- Most information of the past biological evolutionary changes were buried and lost in the deep time.
- The intertwined evolution of the atmosphere, hydrosphere, geosphere and biosphere since Holocene (11700 year) could be recovered in various records. The 21th century challenge of Earth System Science is to forecast the future of planet Earth.
- Earth System Science uses holistic rather than reductionist approaches.

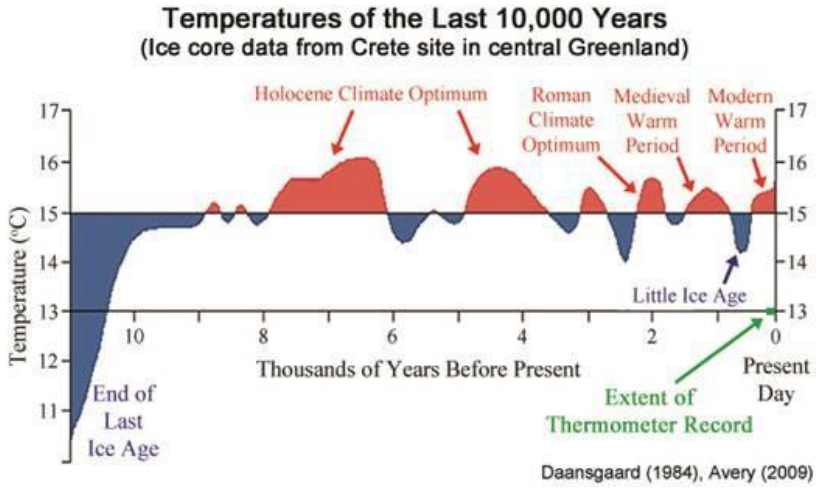
Why Earth System Science When We Already Have Environmental Sciences (Major)?

- Environmental Science studies Anthropocene but it focuses on the human activity polluted atmosphere, hydrosphere, geosphere and the biosphere (excluding human being).
- Environmental Science provide solutions to the above problems.
- Earth System Science looks into mechanisms of the inter-connections between various atmospheric, hydrospheric, geospheric cycles and human inputs.
- Environmental science only study and provide solutions for very recent (current) human impacts to the Earth's surface.
- Earth System Science studies those processes since Holocene, human inputs and the future of Mankind-Earth System evolution.
- Earth System Science uses holistic rather than reductionist approaches.

The Geology of Earth System Science Is About the Holocene Evolution & Holocene Timeline



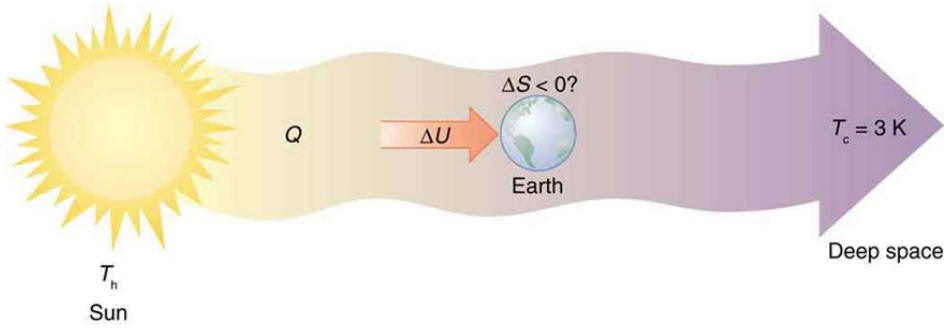




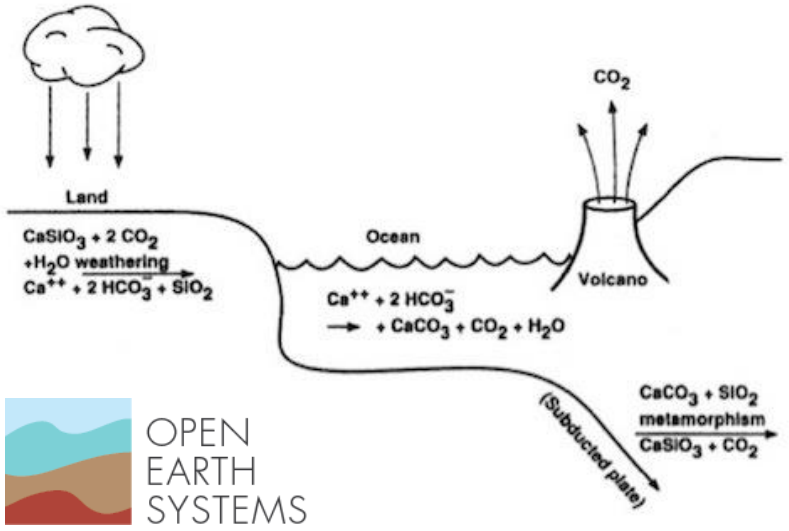
www.unil.ch

The Space-Time Boundaries for Earth System Science

- The Sun is not a part of Earth System; it inputs energy to the Earth.
- The interior of the Earth deeper than the surface crust (with water and detectable sign of life) is not in the scope of Earth Science Science.
- The Earth system since Holocene (Since 11700 years ago).
- The Moon is not a part of Earth System neither, but it together with the Sun creates gravitational potentials to Earth (Tides).

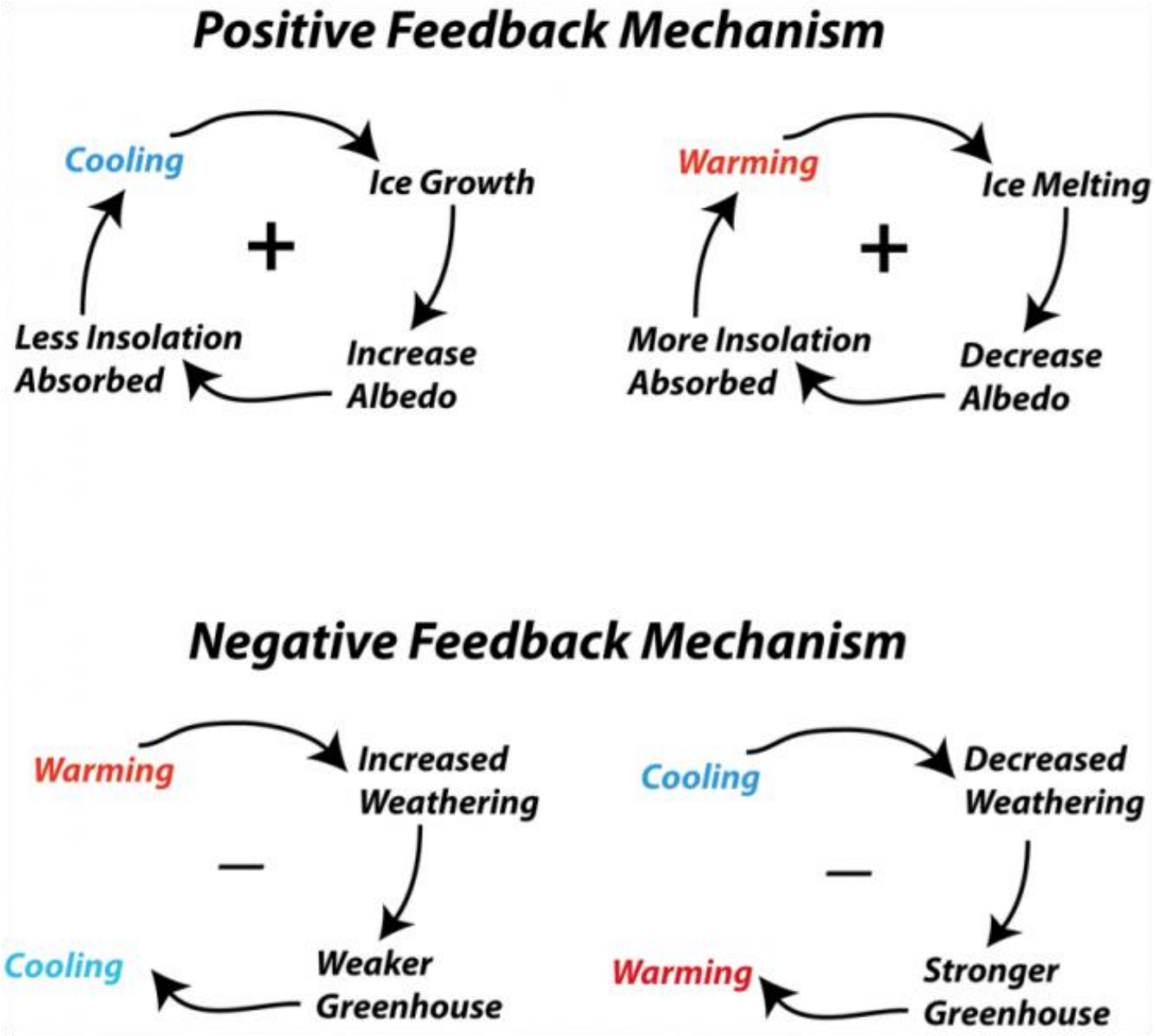


Negative Feedback System in Earth: Weathering & Deposition & Carbon Cycle



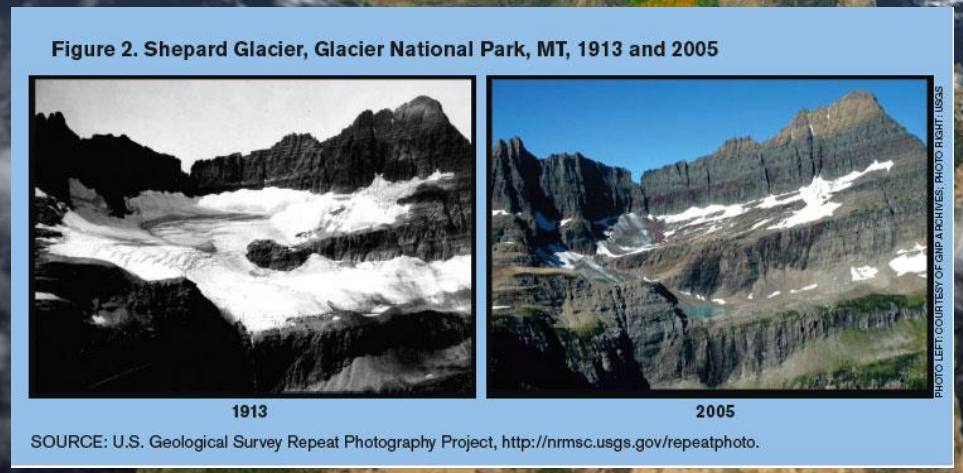
OPEN EARTH SYSTEMS

www.e-education.psu.edu



Earth Observation: Remote Sensing

- **Observation from space shows more integrity of the Earth, and it may provide better observation of the trend of evolution on some specific area.**

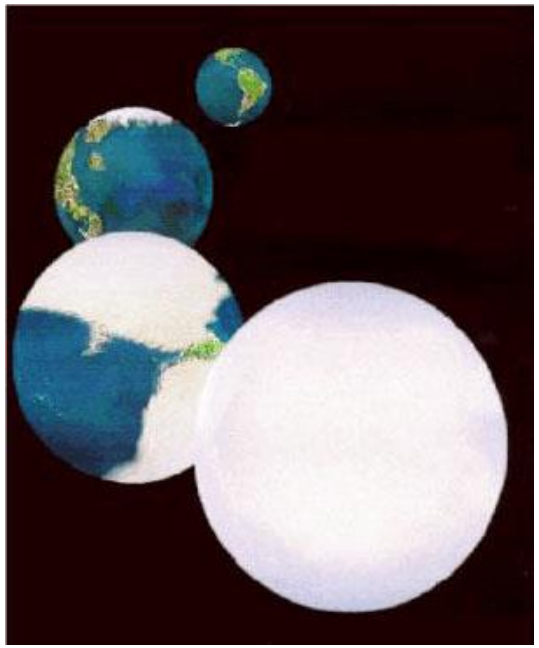


NASA Earth Observatory

Anthropocene?

- The emergence and development of civilizations is a revolutionary change through the whole history of life on Earth.
- Human can use unprecedented power to modify the surface of the Earth, which is comparable to the impact by a 7-mile meteorite, the supervolcanic eruptions, and Snowball Earth event (We can do it!)

http://www.dailygalaxy.com/



radiofreethinker.wordpress.com

Anthropocene Is Real in the View of the Significant Changes of the Earth- and Eco-systems

www.bbc.co.uk

amusingplanet.com

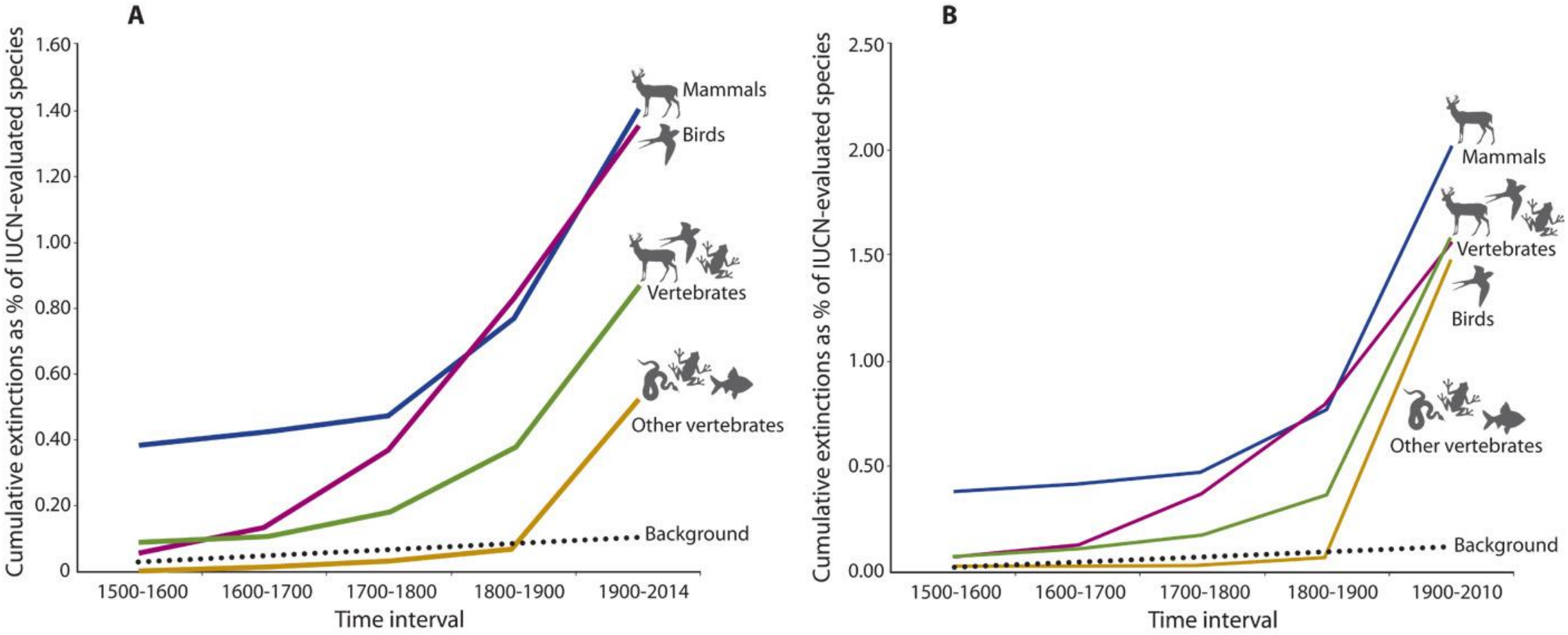
Wild Boar on Hong Kong Island

Chernobyl Animals

Accelerated modern human–induced species losses: Entering the sixth mass extinction

Gerardo Ceballos, Paul R. Ehrlich, Anthony D. Barnosky, Andrés García, Robert M. Pringle and Todd M. Palmer

Science Advances 19 Jun 2015: Vol. 1, no. 5, e1400253



International Union of Conservation of Nature (IUCN)

Summary

- Earth System Science studies the surface processes of the Earth that support the ecosystem and human being.
- Earth System Science is featured by its revealing of various dynamic exchanges of mass, energy and carbon among the atmosphere, hydrosphere, geosphere and biosphere, and the mutual interactions between them and the fast developing of human civilization.
- The developing of modern technology must be considered to be a powerful agent that changes the Earth system (the Earth enters in Anthropocene epoch). The human input must be in line with Earth's negative feedback tuning system at both short and long time scales (Sustainability).
- The HKU Earth System Science trains scholars who have the knowledge of the Earth System and undertake the responsibility of public education on our future on the planet Earth.

2. Geology: starting from rocks but there are more…

Geology: The outline of the major

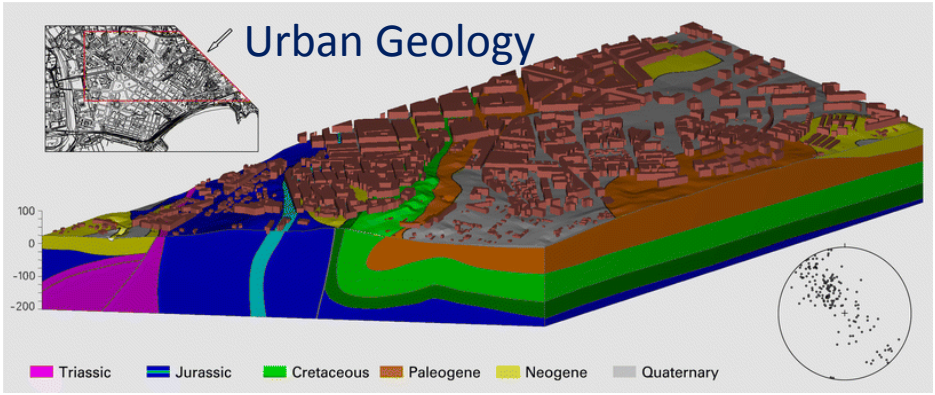
- Geology concerns the study of the structure, materials, processes and history of the Earth. Geologists use their knowledge to enrich our understanding of Earth processes and resources in order to improve the quality of human life.
- Geologists are needed in many areas of work such as the geotechnical profession, resource development, and natural hazards and environmental management.
- The University of Hong Kong is the only tertiary institution in Hong Kong to offer an undergraduate program in Geology.

➢Major in Geology: https://www.scifac.hku.hk/ug/prospective-student/6901/bsc/geology

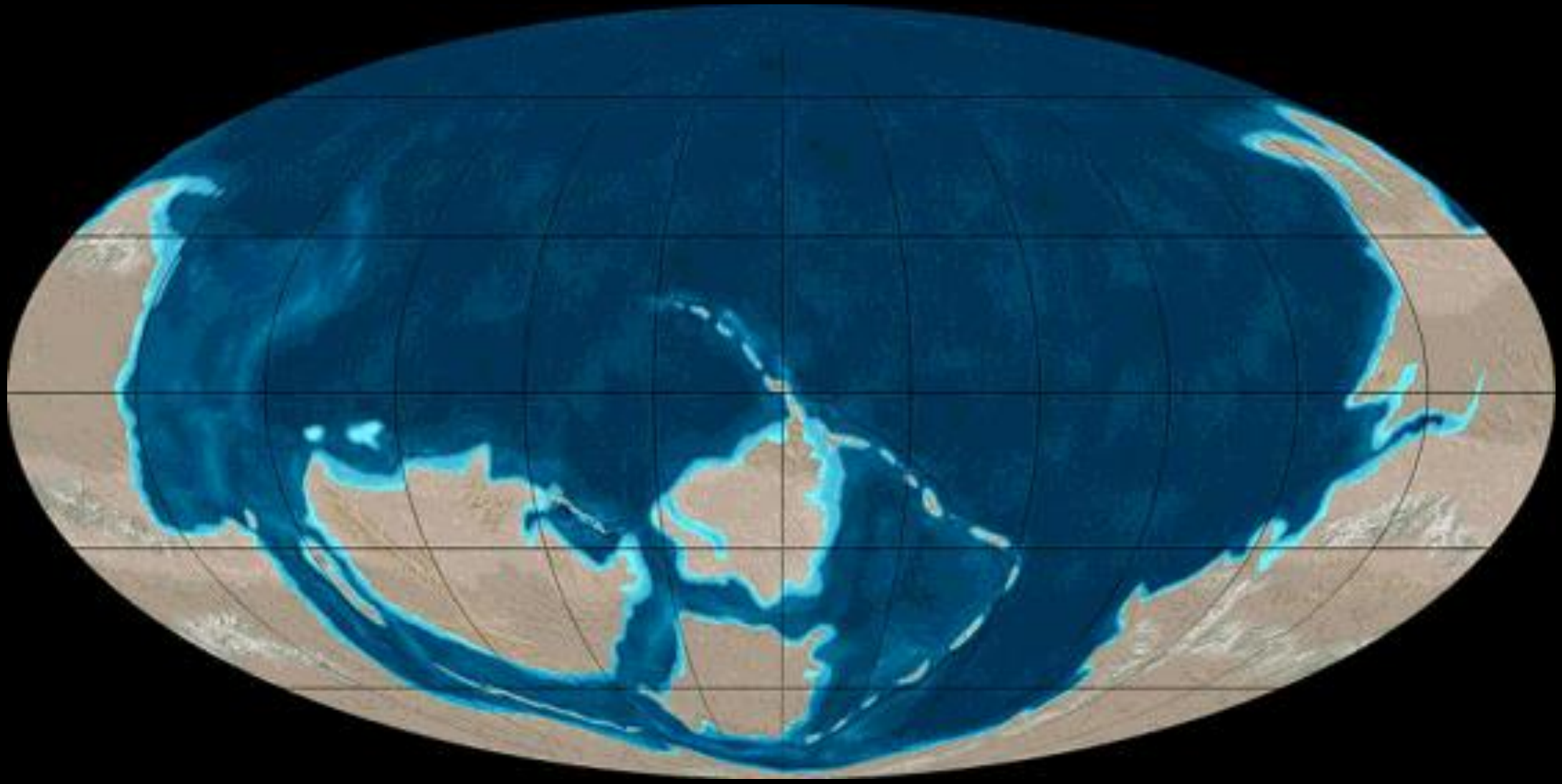
➢The Intensive Geology Major: https://webapp.science.hku.hk/sr4/servlet/enquiry?Type=Major&Code=MajorInGeologyIntensive&AdmissionYear=201

Career Prospects

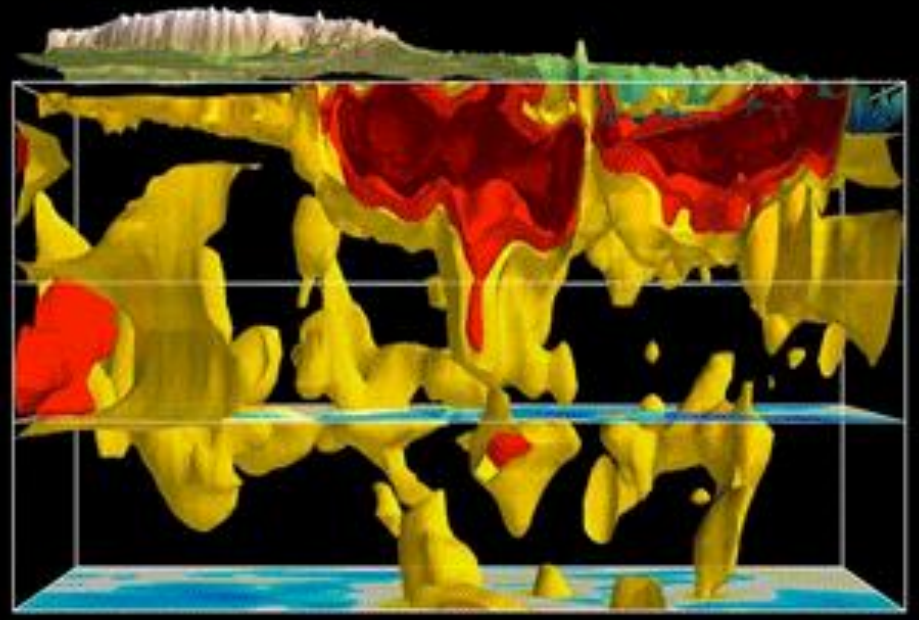
- Graduates can pursue further studies in Earth Sciences and careers in a wide variety of geosciences-related areas including resource management, hazard planning, soil and water studies and teaching;
- Due to the strong global demand for mineral and rare-earth resources;
- Recent rapid expansion of green industry: geochemistry and climate change research;
- Graduates possess technical expertise to analyze measurements or observations of air, water, and soil to facilitate risk assessment, policy formulation and decision making by the Government or companies;
- In recent years, Earth Science graduates have entered the education sector as school teachers; the new secondary school curriculum contains various Earth System components in several required and elective courses.



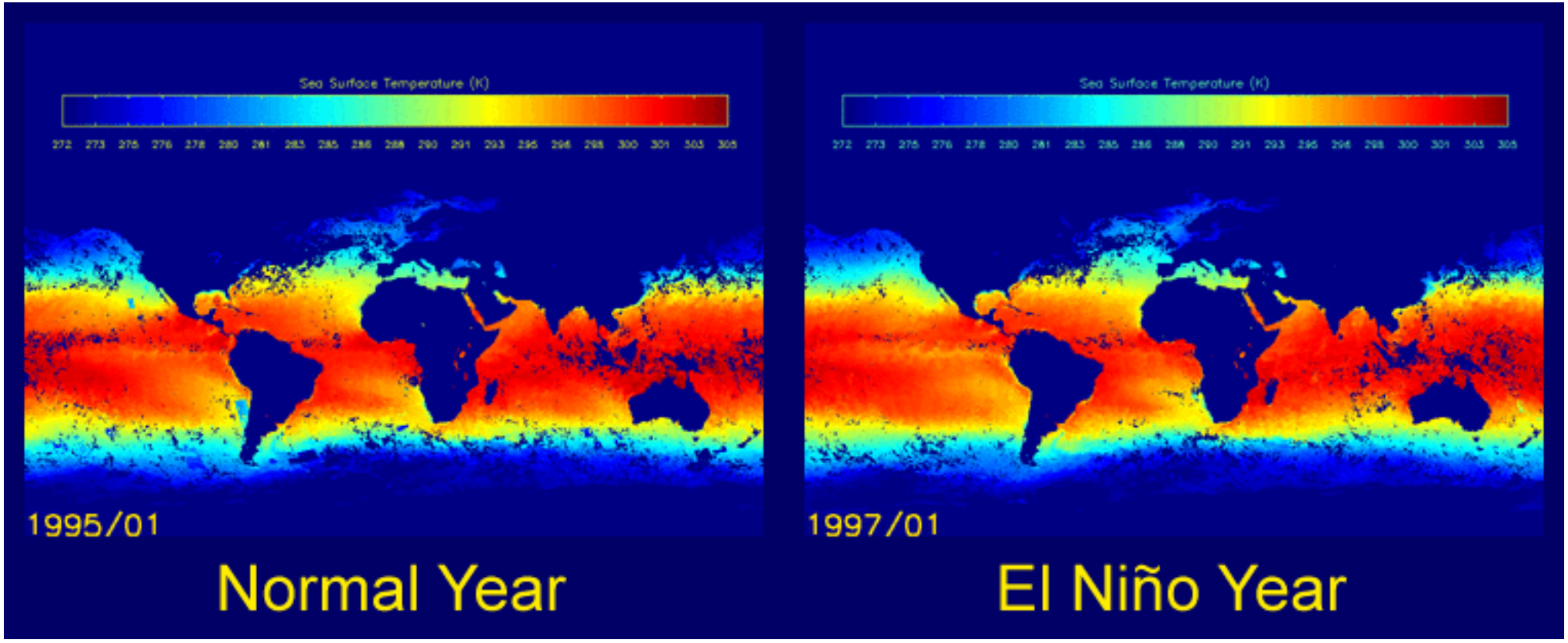
The Evolution of the Earth Through the Deep Time



Rise of Tibetan Plateau: Is It the Reason for the Global Cooling in the Last 20 Million Years?



Global Circulations of Water & Life

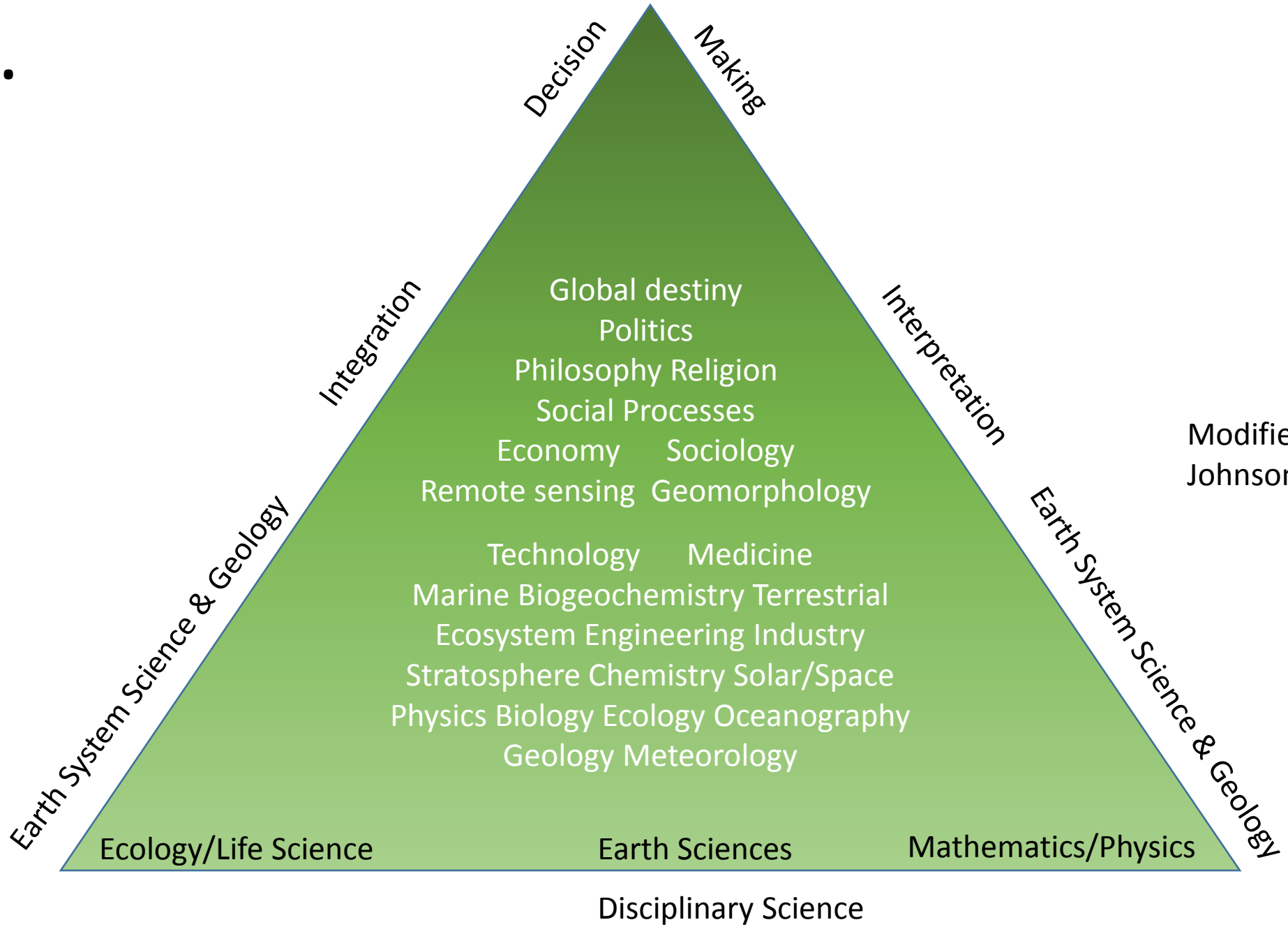


ZME Science

The Future of Human Beings and Their Planetary Environments…

A Glance of Field Studies in ESS & Geology

Career…



Modified from D.R. Johnson, 2006