CLIMATE DYNAMICS AND GLOBAL CHANGE

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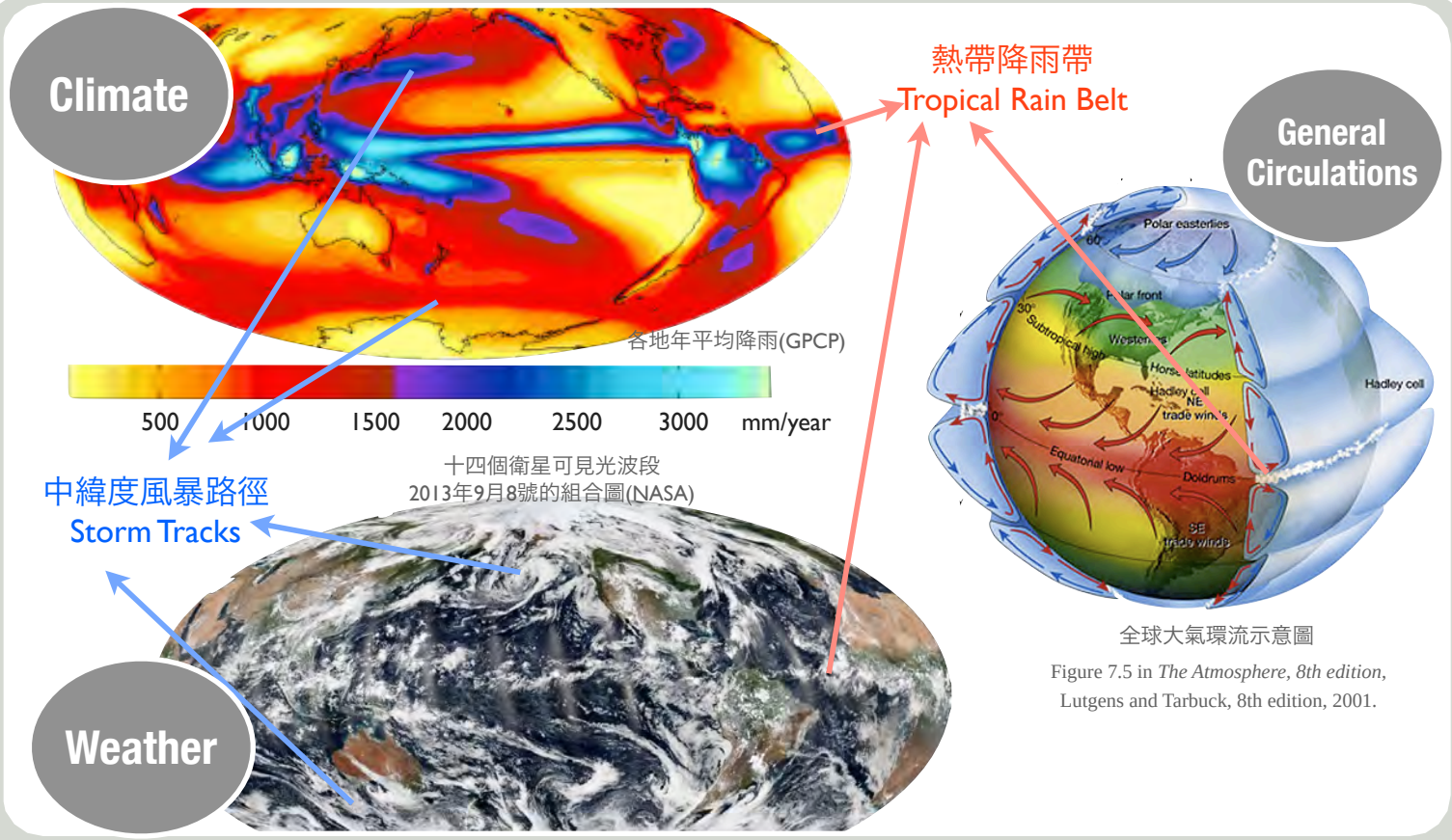


全球大氣環流示意圖

Figure 7.5 in *The Atmosphere, 8th edition*, Lutgens and Tarbuck, 8th edition, 2001.

GLOBAL ATMOSPHERIC CIRCULATIONS

AND ITS INTERACTIONS WITH CLOUDS, AEROSOLS, SEA ICE, OCEAN, AND LAND PROCESSES.

Key questions: What determines energy and momentum transports in the climate system? How will storm tracks change in the future? What controls the position and strength of the tropical rain belt?

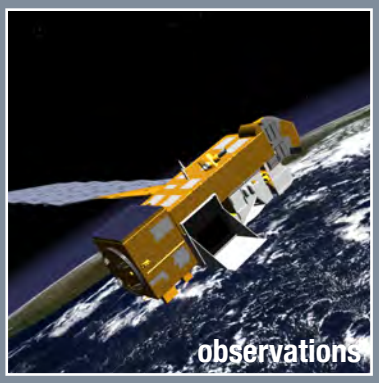
Motivations

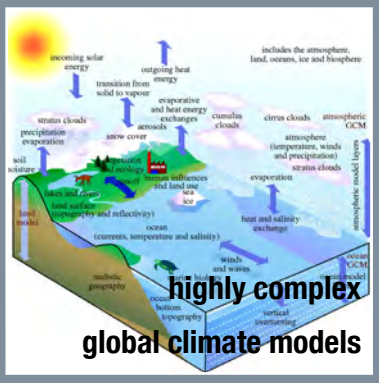
Regional precipitation and temperature projections in state-of-the-art earth system models are highly uncertain. Most of this uncertainty is due to the challenge of accurately predict how large-scale circulation will respond to climate change. Take tropical region for example, the northeasterly and southeasterly trade winds converge near 5N, resulting in an area of intense and persistent rainfall. A small shift of the convergence zone would result with tremendous changes to local rainfall. Besides tropical rain belt, the boundaries of subtropical deserts and midlatitude storm tracks also exhibit very

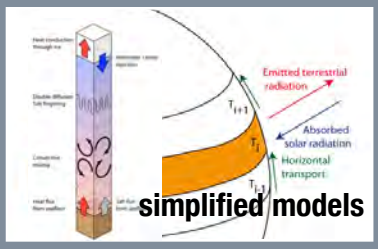
氣候動力與全球變遷研究室

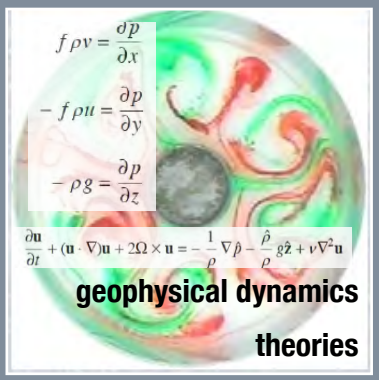
由黃彥婷助理教授主持。研究目標為探討能量和動量在地球系統的傳輸與分布，進而了解海洋、陸地、雲、懸浮微粒以及冰山等因子和全球尺度大氣環流之間的交互作用 。 想要了解的問題有: (1) 哪些因子和機制影響了各個氣候區的分布(包含熱帶降雨帶、季風區、副熱帶沙漠區、中緯度暴風路徑以及高緯度極地等)？ (2) 這些氣候區的分界在未來將如何改變？

TOOLS WE USE









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sharp precipitation and temperature gradient, the ability of projecting expansion of subtropical deserts and poleward shift of storm tracks with confidence will be beneficial for adaptation planning.

Our research questions

We attempt to revisit a few fundamental questions of general circulations such as: What determines the global mean temperature and its equator-to-pole gradient? What factors control the position and intensity of Hadley cell, Walker cell, storm tracks, and monsoon circulations? How will these circulations change with global warming? In particular, the scientific breakthrough of these questions often involves with a more in-depth understanding of the interactions between atmospheric circulations and various climate components (clouds, aerosols, sea ice, land processes, and ocean). Our recent work includes: (1) demonstrating the overturning circulation of the ocean is the main cause of tropical rainfall peaking in the Northern Hemisphere (2) identifying the effects of Southern Ocean cloud biases on the position of storm tracks and tropical rain belt in global climate models. Theses projects could not be done ten years ago, as scientists have just recently had accurate and long enough global coverage observational data and a large enough numbers of global climate models in the archive (CMIP, Coupled Models Inter-comparison Project).

Tools we use

We use many different types of data and tools: observations, reanalyses, state-of-the-art climate models, and idealized/simplified models. By switching and comparing between various tools, we attempt to apply our theoretical understanding to highly complex earth system models (and the real world). We can also modify our theories based on simulations of complex models and observations of natural variabilities.

This is an exciting era!!

After decades of hard work, scientists now have a solid understanding of geophysical fluid dynamics -- fluid on a rotating sphere. Together with new information on past climate cycles, global coverage observations on current conditions, and high performance computers for projecting future climate, climate scientists now have an unprecedented opportunity to understand how do different components in the earth system shape our climate today. It is also timely to inform general public and policy makers the projections of future climate.

What are the requirements for joining the research group?

We welcome students and scientists with
-- strong passion for the natural world
-- solid background in math, science, and computing
-- willingness to explore new information, data, and tools!