古氣候: 千年尺度氣候變遷與冰期暖化

(Paleoclimate: Millennial climate events and Deglaciation)

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學分數：**2 學分，229 M8140**

上課時間: 週一 78 節

1.課程概述&課程目標

Decades of research into Earth's past climate history has revealed astonishing past climate changes that highlight the capacity for our climate to change, and challenge our ability to explain their underlying mechanisms. In this seminar, we visit the reconstructed history of millennial abrupt climate change events during the last glacial period, and also the transition from the glacial period to the Holocene (aka deglaciation), and the possible dynamical mechanisms at play. We will focus specifically on an emerging hypothesis that emphasize teleconnection linkages between the northern and southern hemispheres as central in explaining key features of abrupt climate changes and deglaciation. The seminar will involve weekly readings and discussion.

Website and readings (schedule updated regularly): Schedule and readings will be posted at
http://www.atmos.berkeley.edu/~jchiang/NTU/

Class Schedule (red is preliminary and subject to change)

Week	Topic	Reading
1	Introduction and Logistics	
2	Methods in Paleoclimatology	Cronin Ch 2 (selected sections)
3	Glacial Millennial Climate Change	Cronin Ch 6 (selected sections)
4	Millennial climate events during deglaciation	Cronin Ch7 (selected sections)
5	AMOC as the dominant hypothesis for millennial events	[*Alley*, 2007] [*Vellinga and Wood*, 2002]
6	Tropical rainfall response (ITCZ and monsoons) – observations	[*Peterson et al.*, 2000] [*Wang et al.*, 2001]
7	Tropical rainfall response - modeling	[*Chiang and Bitz*, 2005]
8	CO2 and Southern Hemisphere Westerlies - observations	[*Ahn and Brook*, 2008]
9	CO2 and westerlies - theory	[*Toggweiler et al.*, 2006]
10	Northern Hemisphere control of SH westerlies and CO2	[*Lee et al.*, 2011]
11	Land vegetation response and CO2	[*Menviel et al.*, 2008]
12	Ocean circulation and CO2	[*Schmittner and Galbraith*, 2008]
13	Glacial Dust records	[*Sugden et al.*, 2009]
14	Deglaciation 1	[*Cheng et al.*, 2009; *Denton et al.*, 2010]
15	Deglaciation 2	[*Toggweiler and Lea*, 2010]
16	Discussion	

2. 修程要求

1. 人數至多 12 人，以**古氣候及氣候動力**相關領域之研究生為優先
2. 欲修課同學，請於 2 月 18 日中午前先向大氣系李國豐助教（dongtyng@as.ntu.edu.tw）登記。

I. 助教將視人數進行修課確認。
II. 登記時，請提供以下資訊【姓名、學號、系所、指導教授、論文題目、聯絡方式（Email、手機）及其相關修課記錄（如成績單）】

3. 上課方式以討論方式進行

3.參考書目

Cronin, Thomas. Paleoclimates: Understanding Climate Change Past and Present. Columbia University Press (2010), 441pp

Ahn, J., and E. J. Brook (2008), Atmospheric CO(2) and climate on millennial time scales during the last glacial period, Science, 322(5898), 83-85.

Alley, R. B. (2007), Wally was right: Predictive ability of the North Atlantic "Conveyor belt" hypothesis for abrupt climate change, Annual Review of Earth and Planetary Sciences, 35, 241-272.

Cheng, H., R. L. Edwards, W. S. Broecker, G. H. Denton, X. G. Kong, Y. J. Wang, R. Zhang, and X. F. Wang (2009), Ice Age Terminations, Science, 326(5950), 248-252.

Chiang, J. C. H., and C. M. Bitz (2005), Influence of high latitude ice cover on the marine Intertropical Convergence Zone, Climate Dynamics, 25(5), 477-496.

Denton, G. H., R. F. Anderson, J. R. Toggweiler, R. L. Edwards, J. M. Schaefer, and A. E. Putnam (2010), The Last Glacial Termination, Science, 328(5986), 1652-1656.

Lee, S. Y., J. C. H. Chiang, K. Matsumoto, and K. S. Tokos (2011), Southern Ocean wind response to North Atlantic cooling and the rise in atmospheric CO2: Modeling perspective and paleoceanographic implications, Paleoceanography, 26, -.

Menviel, L., A. Timmermann, A. Mouchet, and O. Timm (2008), Meridional reorganizations of marine and terrestrial productivity during Heinrich events, Paleoceanography, 23(1).

Peterson, L. C., G. H. Haug, K. A. Hughen, and U. Rohl (2000), Rapid changes in the hydrologic cycle of the tropical Atlantic during the last glacial, Science, 290(5498), 1947-1951.

Schmittner, A., and E. D. Galbraith (2008), Glacial greenhouse-gas fluctuations controlled by ocean circulation changes, Nature, 456(7220), 373-376.
Sugden, D. E., R. D. McCulloch, A. J. M. Bory, and A. S. Hein (2009), Influence of Patagonian glaciers on Antarctic dust deposition during the last glacial period, Nature Geoscience, 2(4), 281-285.
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Toggweiler, J. R., and D. W. Lea (2010), Temperature differences between the hemispheres and ice age climate variability, Paleoceanography, 25.
Vellinga, M., and R. A. Wood (2002), Global climatic impacts of a collapse of the Atlantic thermohaline circulation, CC, 54(3), 251-267.
Wang, Y. J., H. Cheng, R. L. Edwards, Z. S. An, J. Y. Wu, C. C. Shen, and J. A. Dorale (2001), A high-resolution absolute-dated Late Pleistocene monsoon record from Hulu Cave, China, Science, 294(5550), 2345-2348