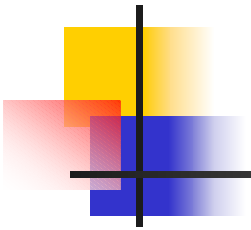

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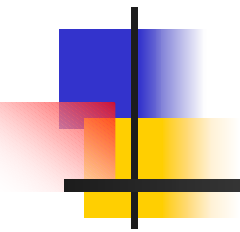

論文の見つけ方

ふじもとごうし

方法

- **図書館で有名論文(Journal of Climateなど)の目次を眺めて面白そうなのを探す**
- **インターネットの利点を駆使する**
- **先生に良い論文ありませんか？と尋ねる**

- **北大付属図書館**
  (http://www.lib.hokudai.ac.jp)
  - **学術文献データベース**
    - **論文データベース検索サイト一覧**
    - ISI Web of Science**など**
  - **電子ジャーナル**
    - **閲覧できる論文リスト**
    - Journal of Climate (1998~)**など**

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The Notices file was last updated 5/29/2003

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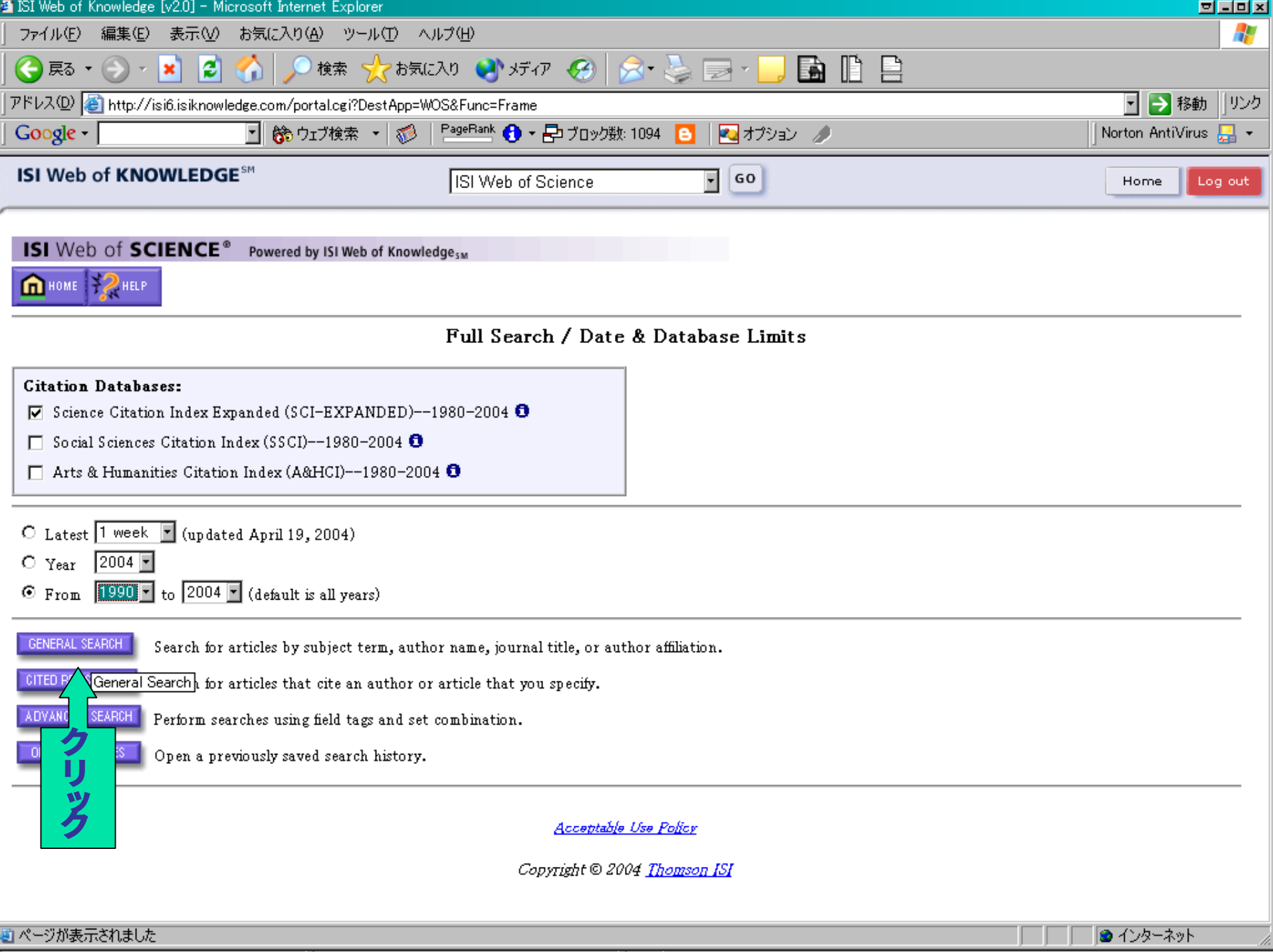
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- Watterson IG
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- Hall A, Manabe S
  The role of water vapor feedback in unperturbed climate variability and **global warming**
  J CLIMATE 12 (8): 2327-2346 Part 1 AUG 1999

- Leroy SS
  Optimal detection of **global warming** using temperature profiles: A methodology
  J CLIMATE 12 (5): 1185-1198 Part 1 MAY 1999

- Lau KM, Weng HY
  Interannual, decadal-interdecadal, and **global warming** signals in sea surface temperature during 1955-97
  J CLIMATE 12 (5): 1257-1267 Part 1 MAY 1999

- Schmittner A, Stocker TF
  The stability of the thermohaline circulation in **global warming** experiments
  J CLIMATE 12 (4): 1117-1133 APR 1999

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例えば・・・

The Arctic Oscillation **signature in the wintertime geopotential height and temperature fields**

Thompson DWJ, Wallace JM

GEOPHYSICAL RESEARCH LETTERS
25 (9): 1297-1300 MAY 1 1998

Document type: Article **Language:** English **Cited References:** 31 **Times Cited:** 482 FIND RELATED RECORDS Explanation

Abstract:
The leading empirical orthogonal function of the wintertime sea-level pressure field is more strongly coupled to surface air temperature fluctuations over the Eurasian continent than the North Atlantic Oscillation (NAO). It resembles the NAO in many respects; but its primary center of action covers more of the Arctic, giving it a more zonally symmetric appearance. Coupled to strong fluctuations at the 50-hPa level on the intraseasonal, interannual, and interdecadal time scales, this "Arctic Oscillation" (AO) can be interpreted as the surface signature of modulations in the strength of the polar vortex aloft. It is proposed that the zonally asymmetric surface air temperature and mid-tropospheric circulation anomalies observed in association with the AO may be secondary baroclinic features induced by the land-sea contrasts. The same modal structure is mirrored in the pronounced trends in winter and springtime surface air temperature, sea-level pressure, and 50-hPa height over the past 30 years: parts of Eurasia have warmed by as much as several K, sea-level pressure over parts of the Arctic has fallen by 4 hPa, and the core of the lower stratospheric polar vortex has cooled by several K. These trends can be interpreted as the development of a systematic bias in one of the atmosphere's dominant, naturally occurring modes of variability.

KeyWords Plus:
SEA-LEVEL PRESSURE, NORTHERN-HEMISPHERE WINTER, STRATOSPHERIC CIRCULATION, INTERANNUAL VARIABILITY, TROPOSPHERE, TELECONNECTIONS, ANOMALIES, PATTERNS

Addresses:
Thompson DWJ, Univ Washington, Joint Inst Study Atmosphere & Oceans, Dept Atmospher Sci, Box 354235, Seattle, WA 98195 USA
Univ Washington, Joint Inst Study Atmosphere & Oceans, Dept Atmospher Sci, Seattle, WA 98195 USA

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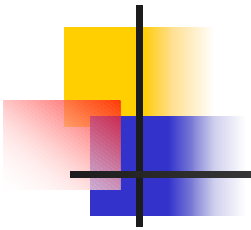

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大気中の二酸化炭素増加に伴う大気海洋の反応

2004/ 5/ 12

北大　大学院　地球環境科学研究科
大気海洋圏環境科学　M1
藤本　剛志

Introduction

- **背景**
  - **二酸化炭素の増加による気候変動は数多く研究されている** [e.g., Bryan et al. 1982; Manabe et al. 1991, 1992].
  - **他に,** Broecker [1987], Bryan and Spelman [1985] **など**
  - Manabe and Stouffer [1993]**では, 二酸化炭素増加に伴う大気海洋変動を数世紀にわたり実験した.**

- **目的**
  - Manabe and Stouffer [1994] **では，二酸化炭素を2倍，4倍と異なる2つの増加割合で数世紀に渡る大気海洋変動を実験した．**

Model

- 大気海洋結合モデル
  - 大気大循環モデル
    - 水平解像度：R-15 (7.5°×4.5°), 鉛直方向：9層
    - 雲, 水蒸気, 二酸化炭素, オゾンの影響を太陽光と地表への放射の割合の計算に含む
  - 海洋大循環モデル
    - 水平解像度：4.5°×3.7°, 鉛直方向：12層
    - 海氷, 氷床も含む
  - 大気成分と海洋成分は熱, 水の交換によりお互いに影響し合っている.

Method

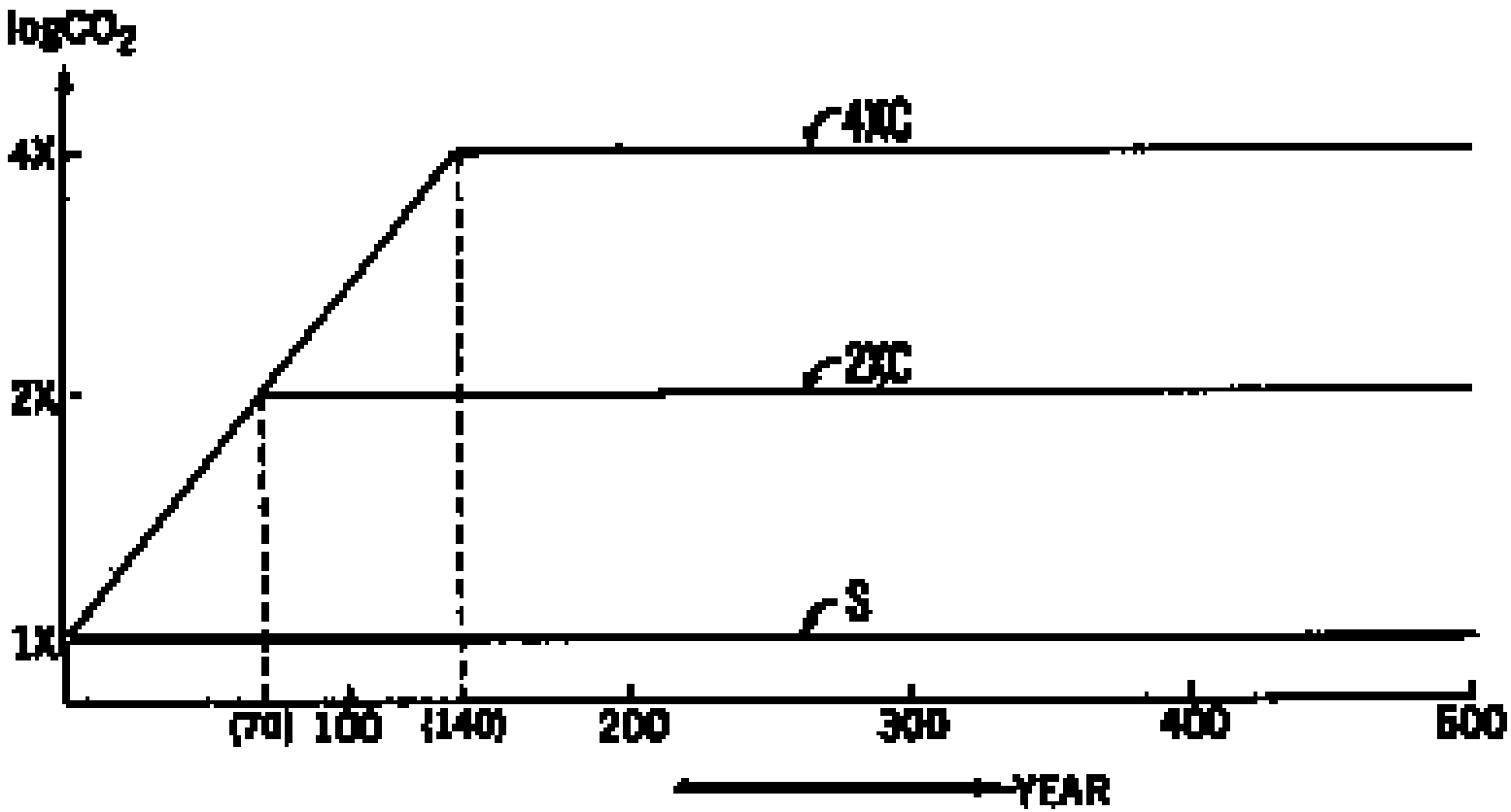

Fig. 1 各シミュレーションのCO_2濃度の対数グラフ

Surface air temperature

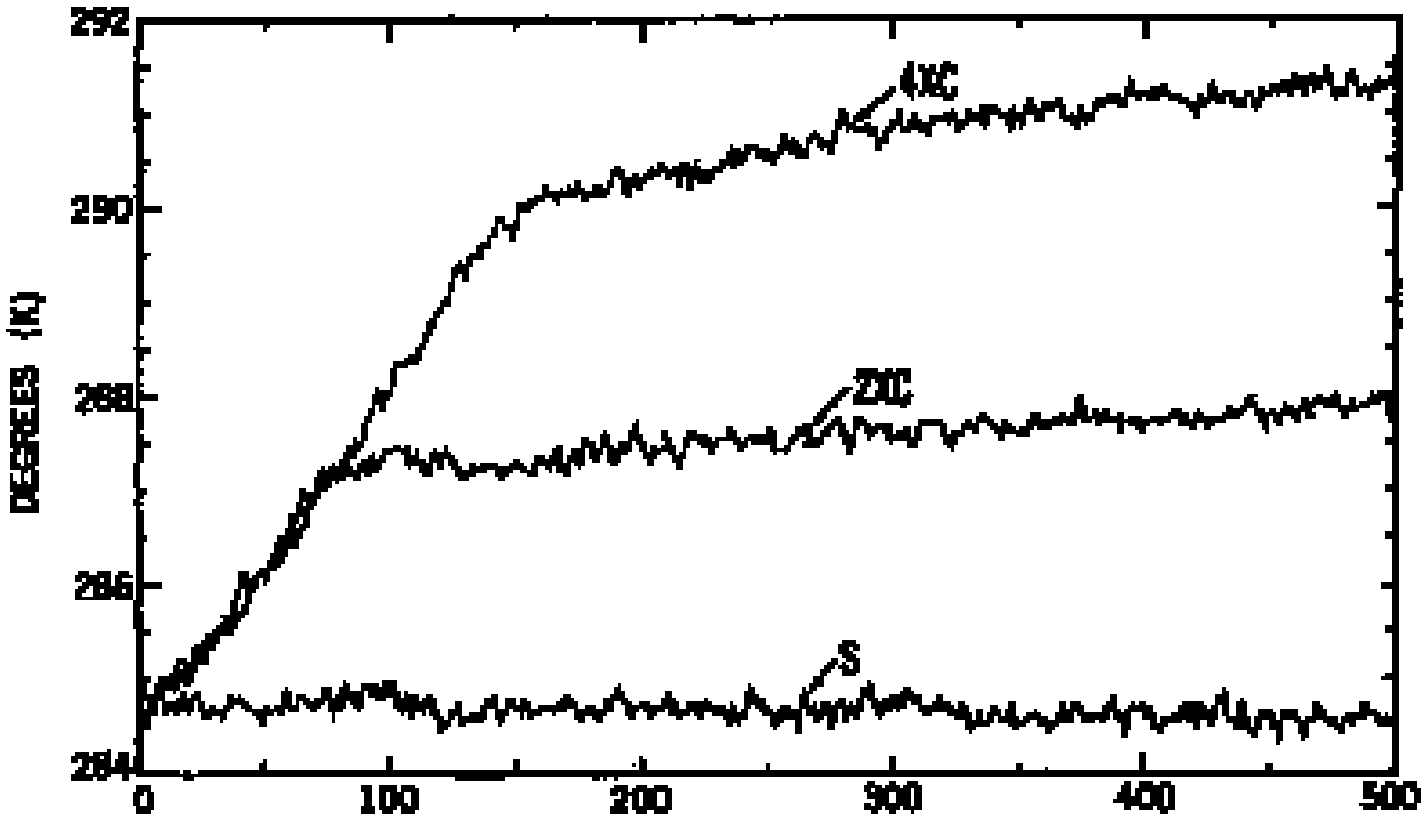

Fig. 2 **各シミュレーションの全球平均気温の時系列. 単位は**Kelvin**.**

Sea level

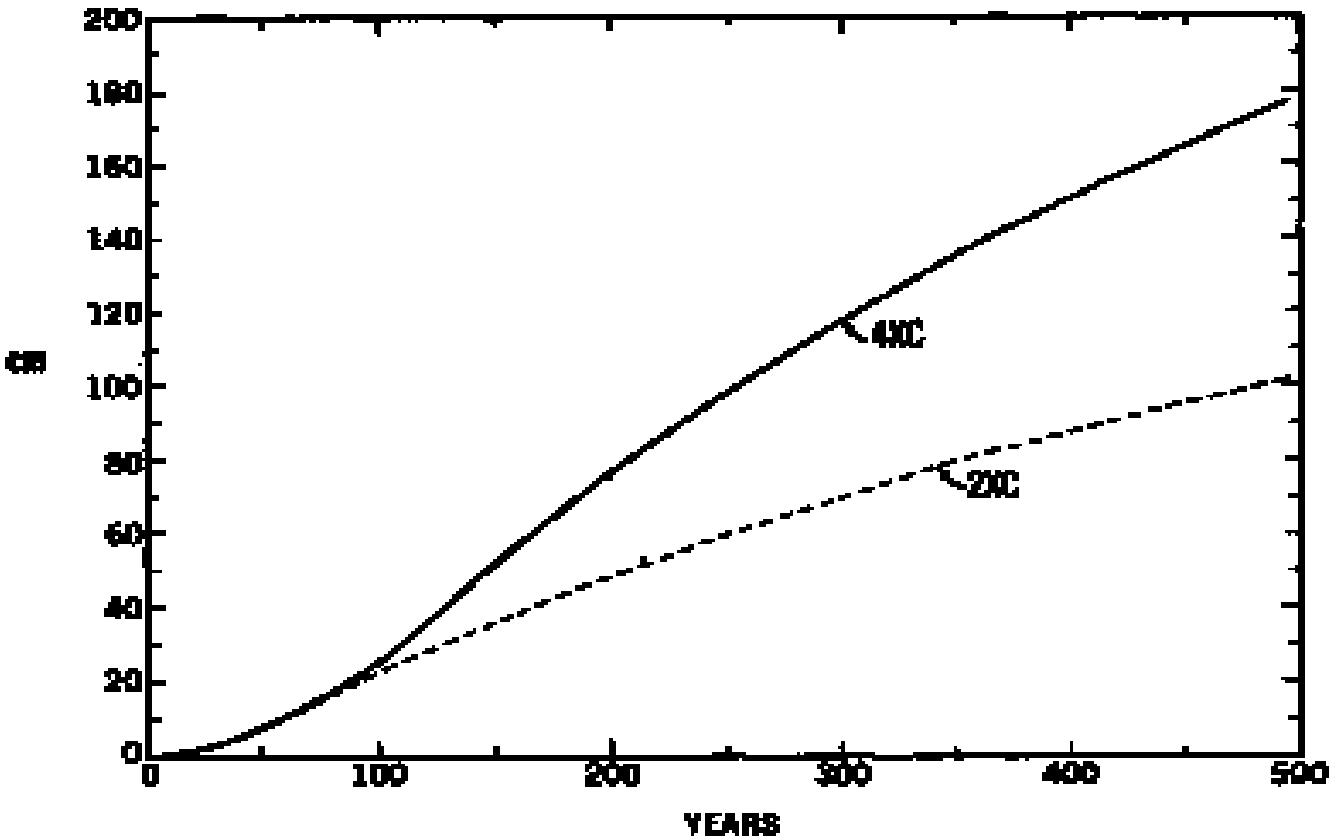

Fig. 3 4XCと2XCでの全球平均海水位の時系列．それぞれSとの差をとっている．単位はcm．

Thermohaline circulation

- Carl [2002]によれば，熱塩循環は次の4つで定義される
  - 水，熱，塩の循環
  - 深層循環
  - 南方循環
  - コンベアベルト（低緯度から高緯度へ熱や水を運ぶ広く定義される全海洋の動き）

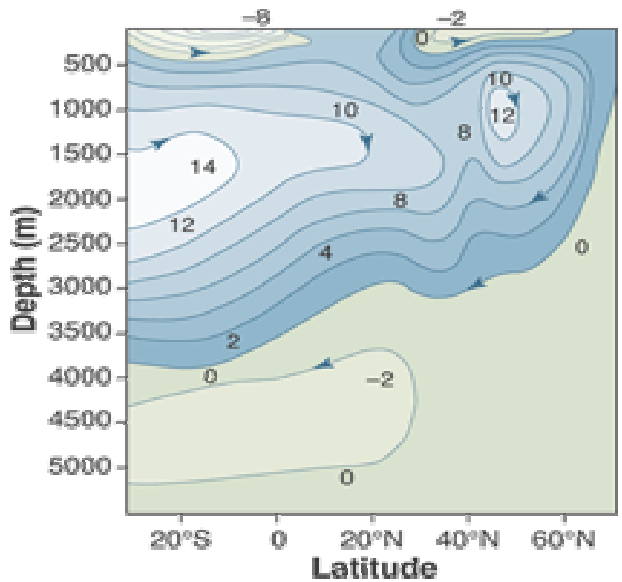

Fig. 4 北大西洋の南方循環の流線関数．単位はSv (=10^6 m^3/s)．

Intensity of thermohaline circulation

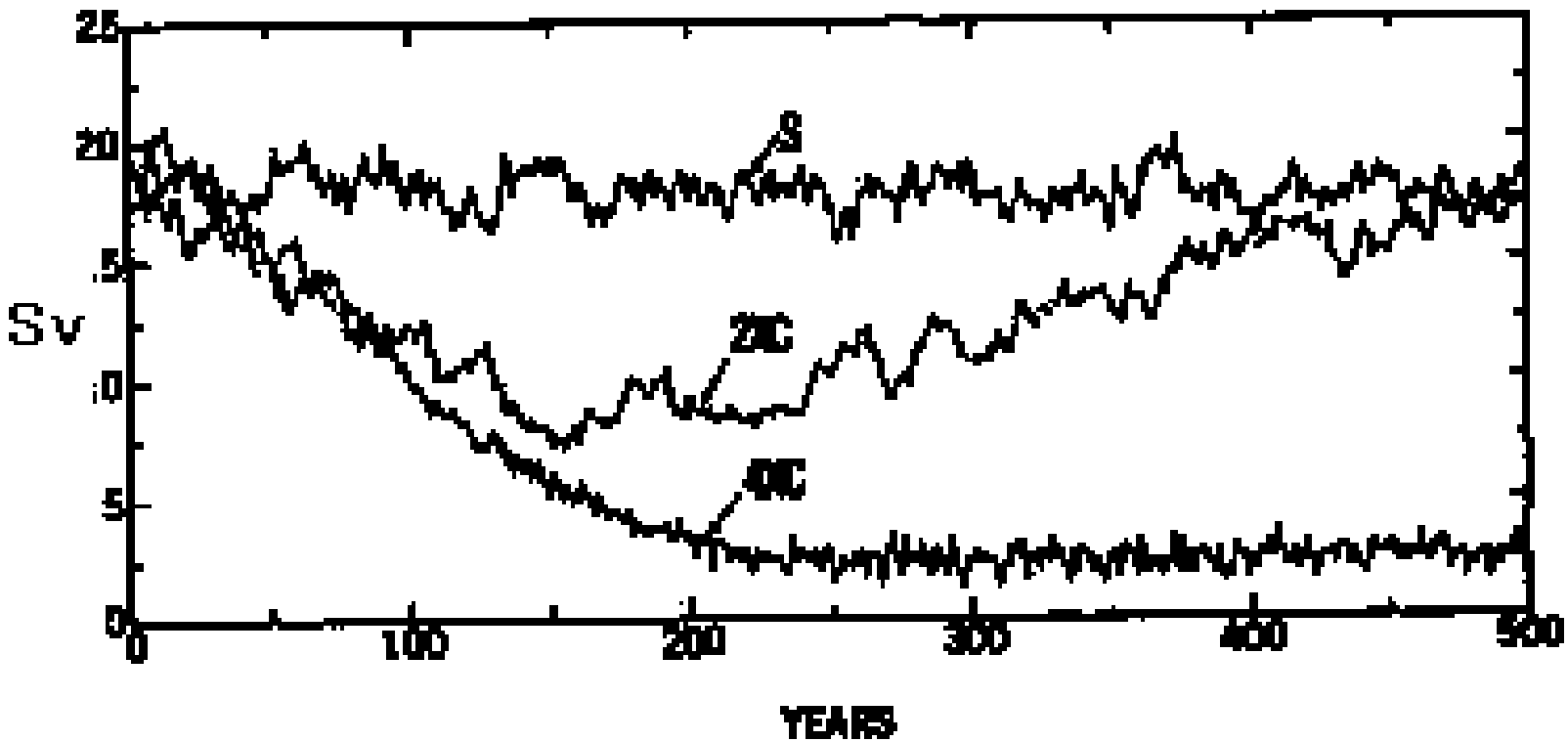

Fig. 5 **各シミュレーションでの北大西洋の熱塩循環の強度時系列. ここでの強度は南方循環の最大値をとっている.**

Stream function from the 4XC

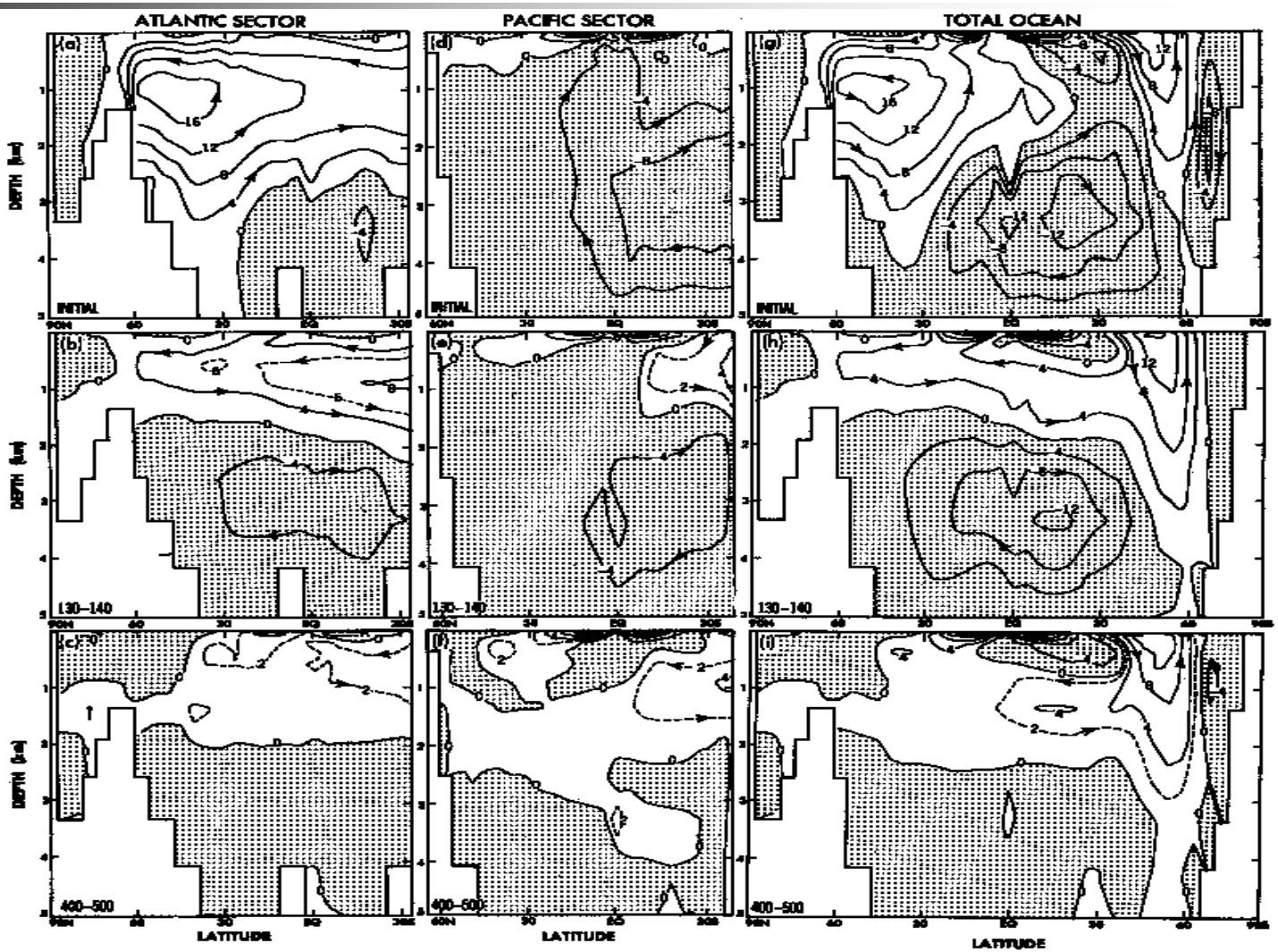

Fig. 6 4XCでの(left column)大西洋，(middle column)太平洋，(right column)全海洋の流線関数．(top row)初期値．(middle row)130-150年目．(bottom row)400-500年目．単位はSv．

Stream function from the 2XC

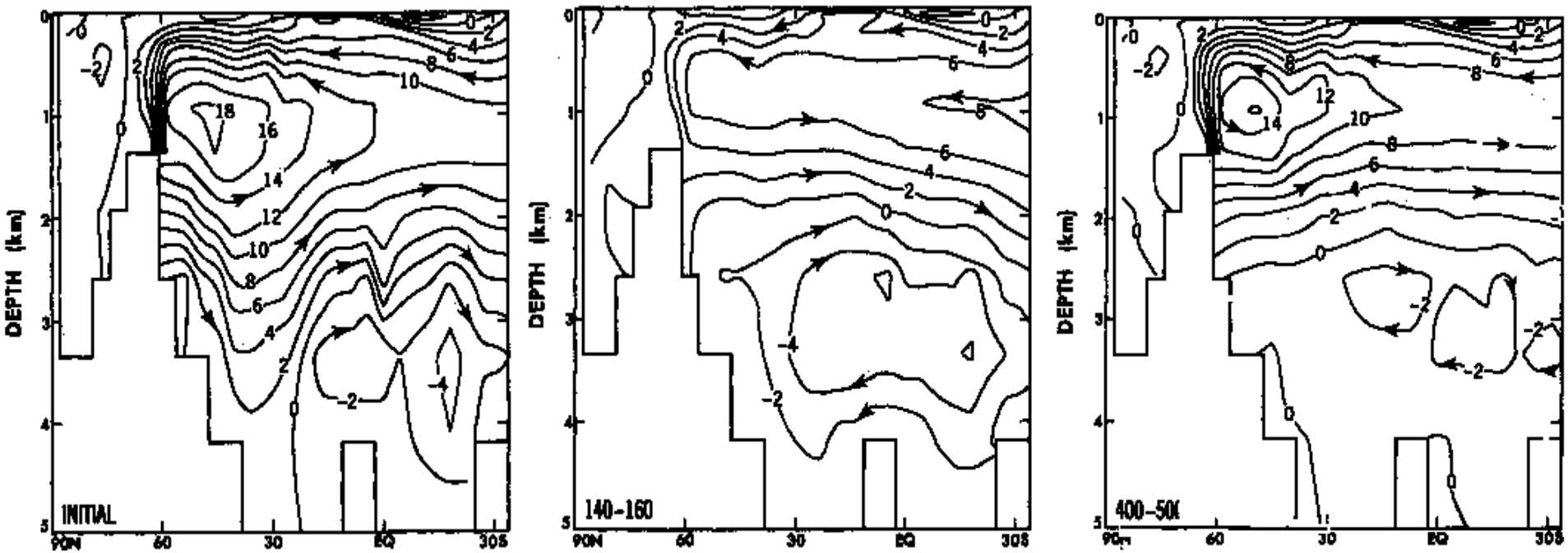

Fig. 7 2XCでの大西洋の流線関数. (a) 初期値. (b) 140-160年目.
(c) 400-500年目. 単位はSv.

Surface flux of fresh water

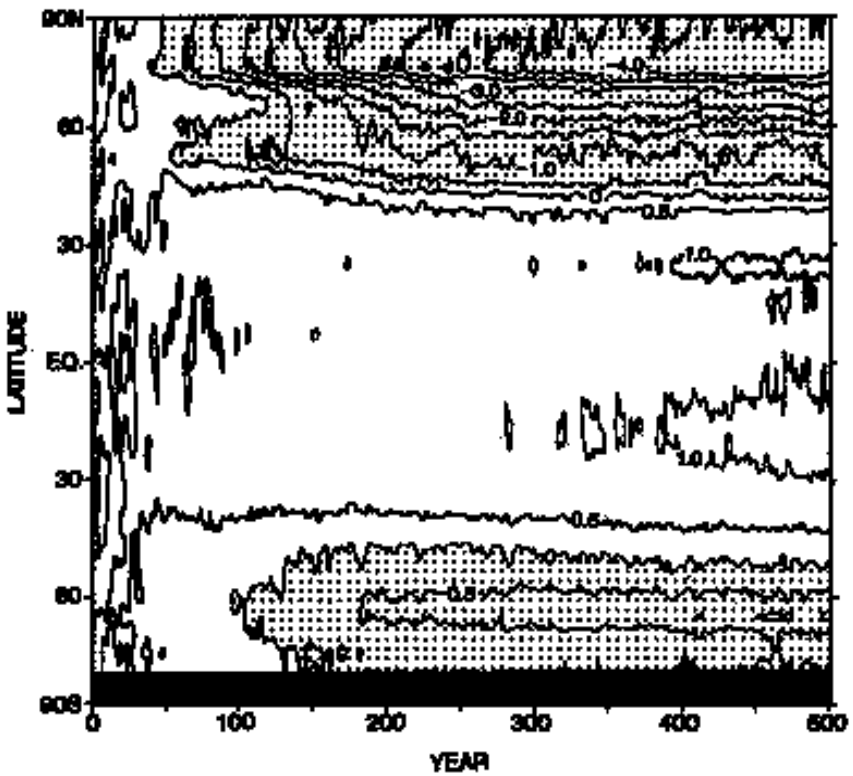

Fig. 8 4XCとSの年平均SSS偏差. 全海洋の東西平均をとった. 単位は塩分濃度.

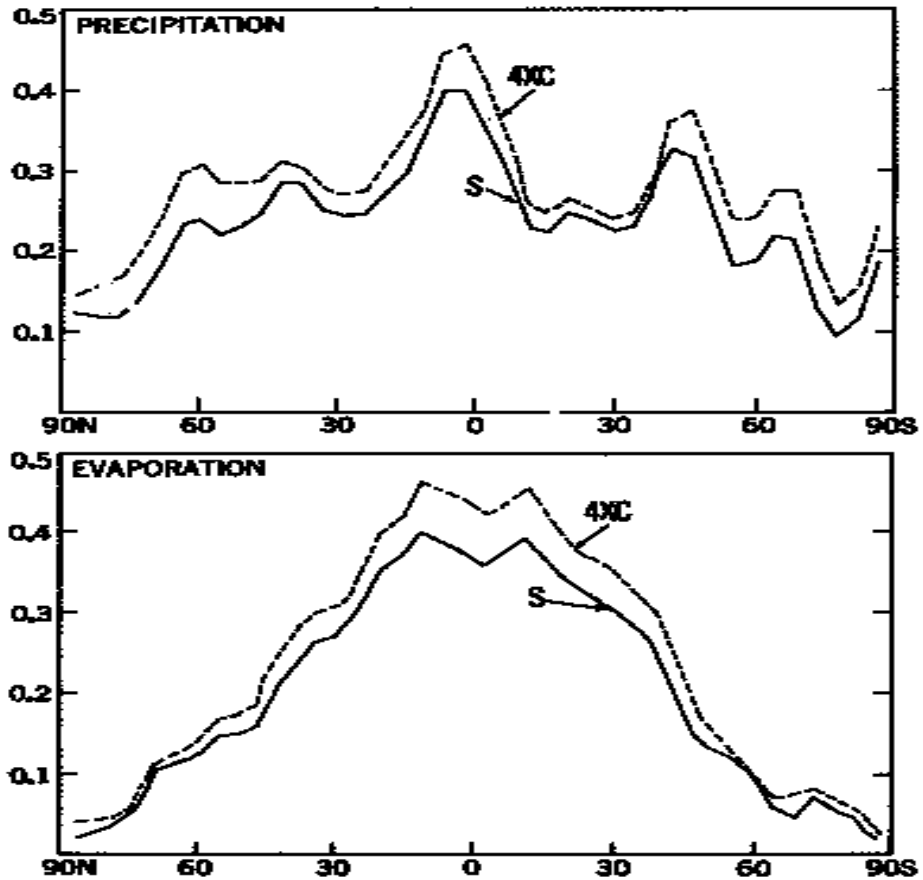

Fig. 9 4XCとSの400-500年目での年平均 (top) 降水と (bottom)蒸発量. 単位はcm/day.

Recovery in the intensity from the 2XC

熱塩循環の弱化による上方への冷水の減少

↓

45°N-**赤道の亜表層で温暖化**

↓

混合により、この層が下方、南方へ広がる

↓

沈み込み地域と上昇する地域の密度差が増加することにより，熱塩循環は徐々に回復

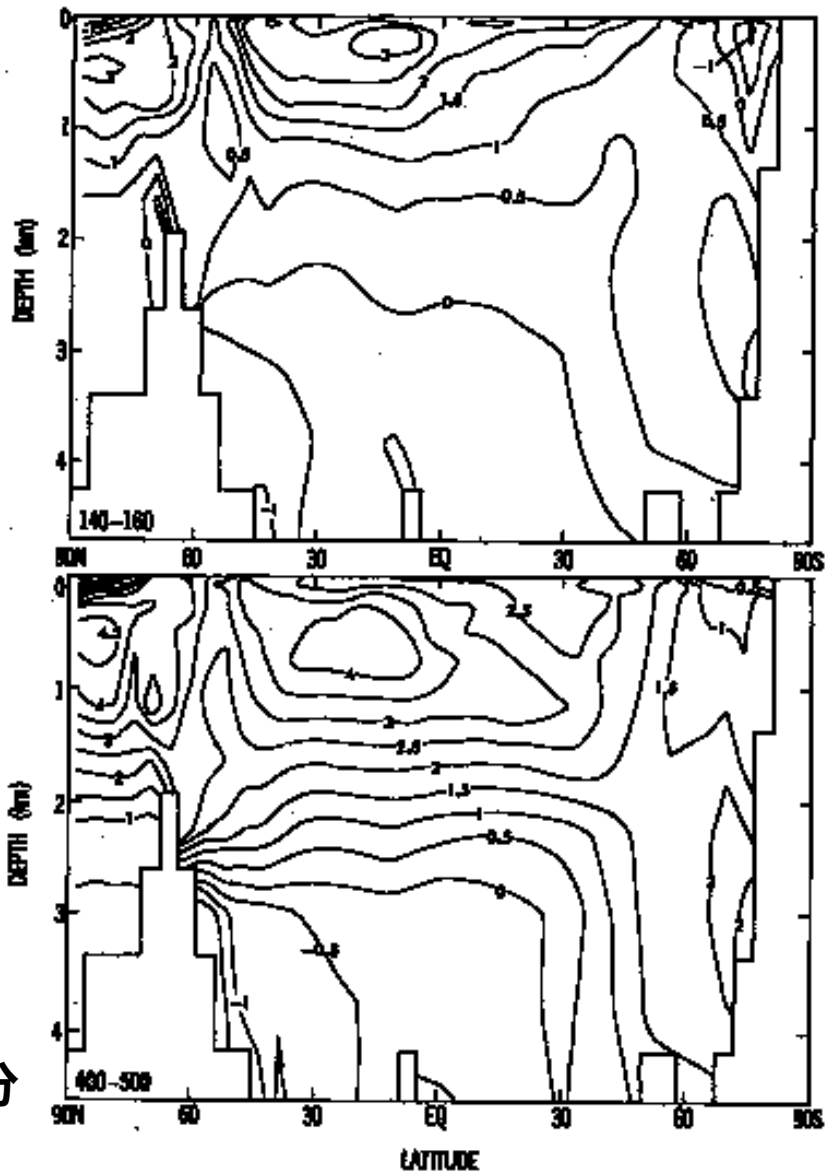

Fig. 10 2XCとSの東西平均温度差の緯度ー深度分布. (top) 140-160年目. (bottom) 400-500年目.

- 4XCの場合は

北大西洋北部の淡水供給の割合が高い

↓

140年目までに深層水の形成をほとんど停止させてしまう

↓

220年目までに表層塩分が減少しなくなっても，熱塩循環は南半球でも弱くなる

↓

全体で上層は大きく温暖しているが，**混合が起きない**

Temperature of the coupled model

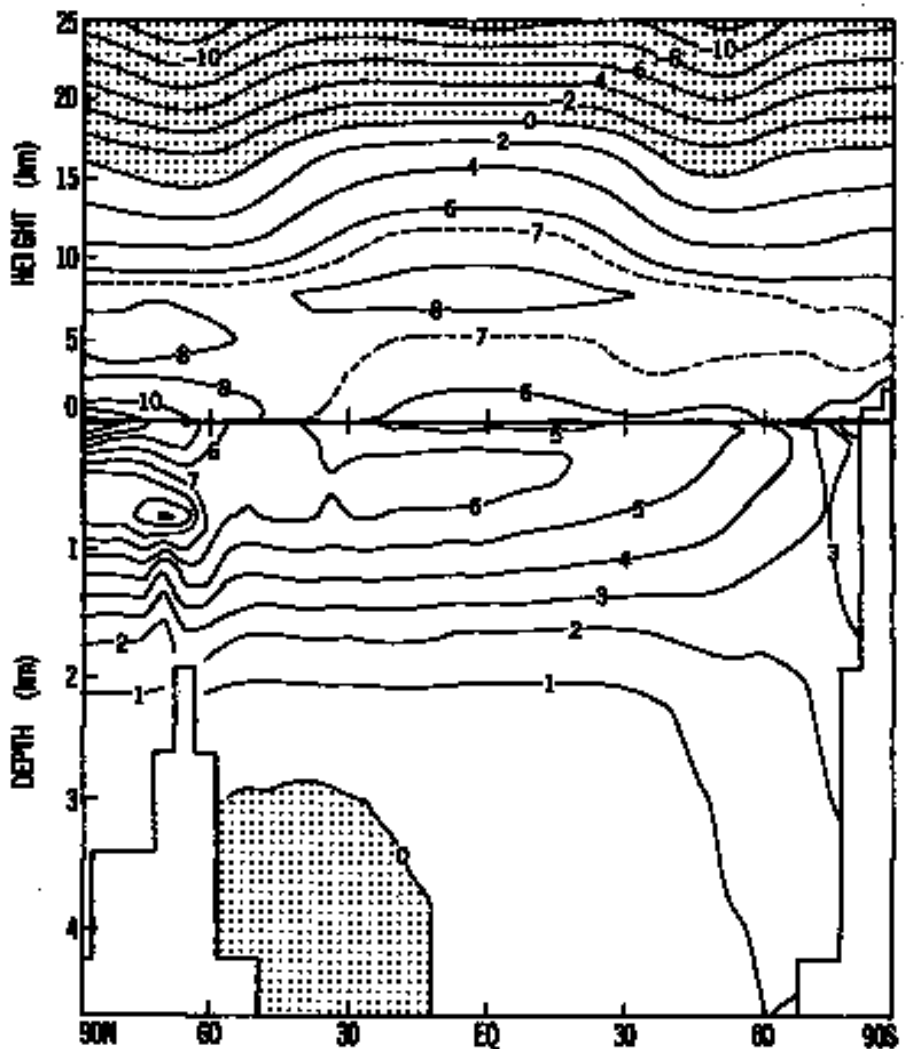

Fig. 11 400-500年目での4XCとSの東西平均温度差の緯度-高度分布.

Geographical distributions of SSS and SST

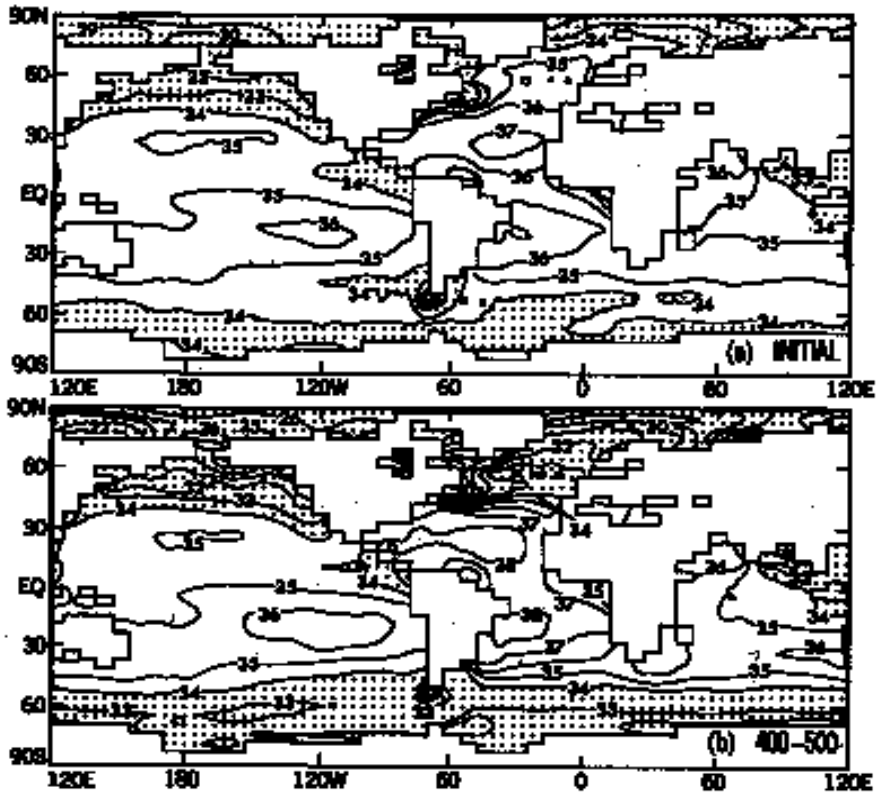

Fig. 12 4XCでの年平均SSSの地理的分布. (a) 初期値. (b) 400-500年目.

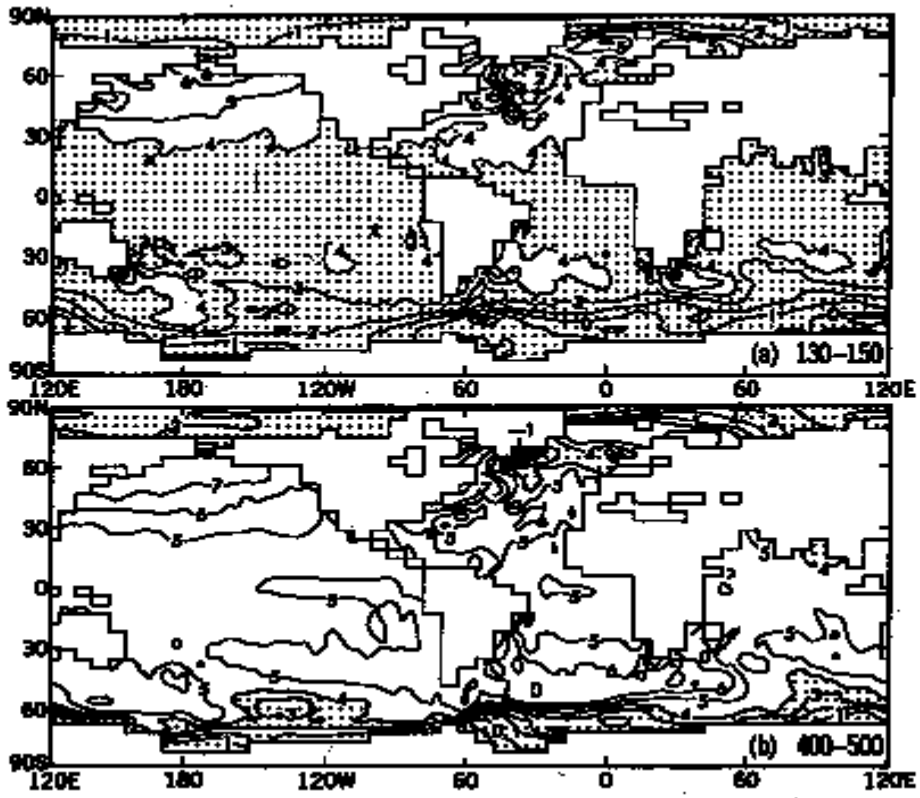

Fig. 13 4XCでの(a) 130-150年目と初期値, (b) 400-500年目と初期値の年平均SST差の地理的分布.

Geographical distributions of surface air temperature

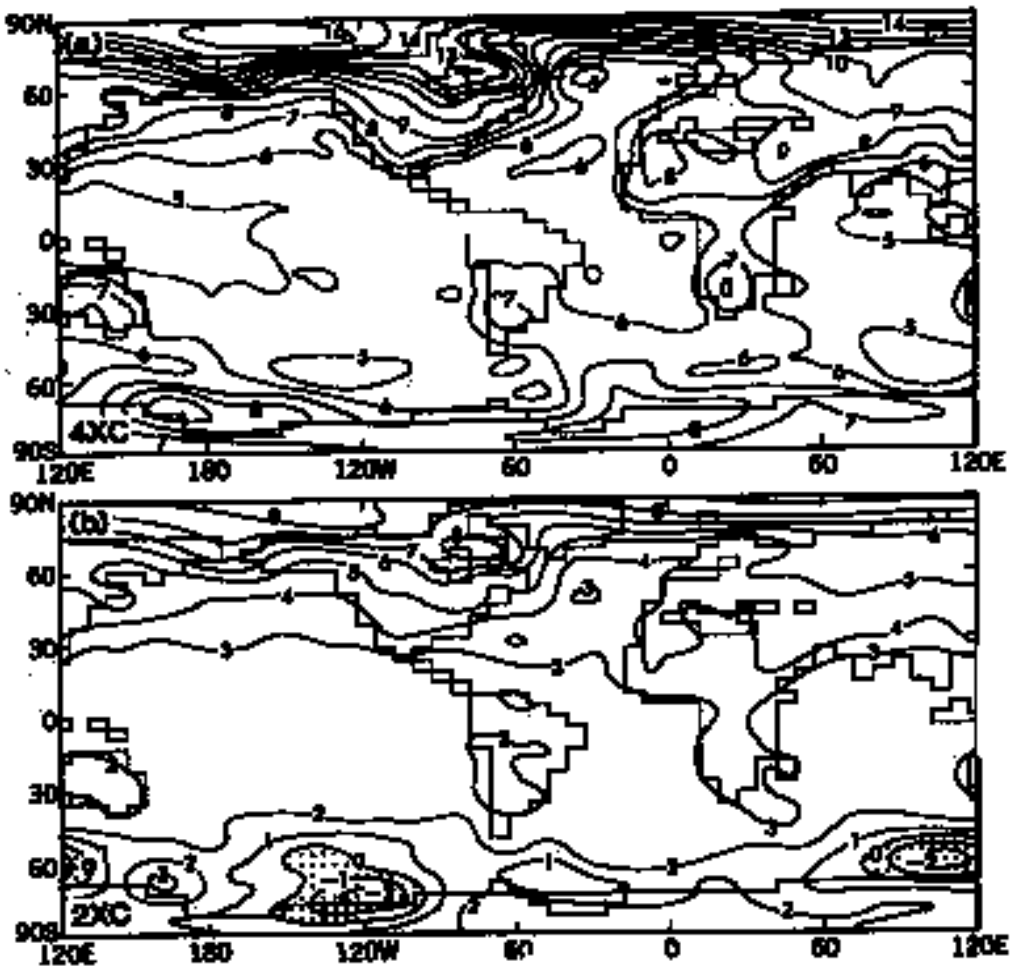

Fig. 14 (a)4XCと (b)2XCでの表層気温の増加の地理的分布. 増加は4XCか2XCの400-500年目の平均値とSの0-100年目との差をあらわす.

Discussion

- Latif et al., [2000] によれば，温暖化により北大西洋熱塩循環は安定するようだ．
  - これは、温暖化によるエルニーニョの増加が熱帯大西洋に異常に高い塩分フラックスが生じるためであるとしている．

- Latif et al., [2000] **の使用**Model
  - **海洋大循環モデル**
  - **水平解像度**：2.8°×2.8°
  - **熱帯海洋では**0.5°×0.5°**の高い水平解像度**
- Method
  - 2**つの**240**年間シミュレーション**
    - **温室効果ガスの濃度を現在の値に固定した場合**
    - IPCC (1992) **の報告に従い**1860-1990**年の間，温室効果ガスを増加させ，その後も増加させ続けた場合**

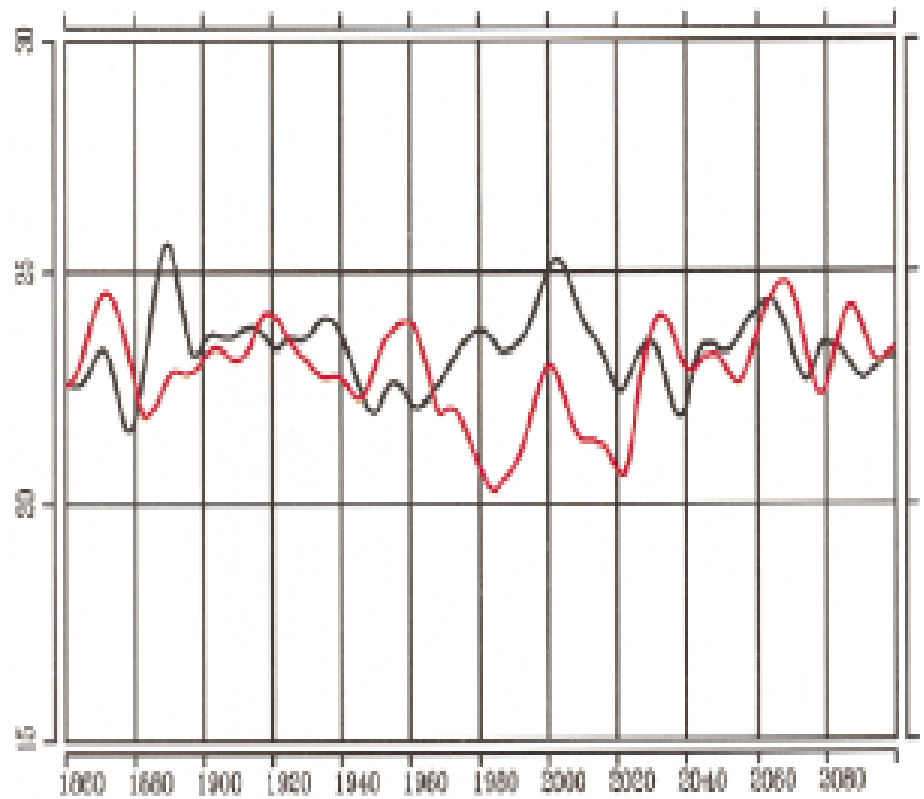

Fig. 15 (black)**現在の値と**(red)**温暖化シミュレーションでの北大西洋熱塩循環の**Sv.

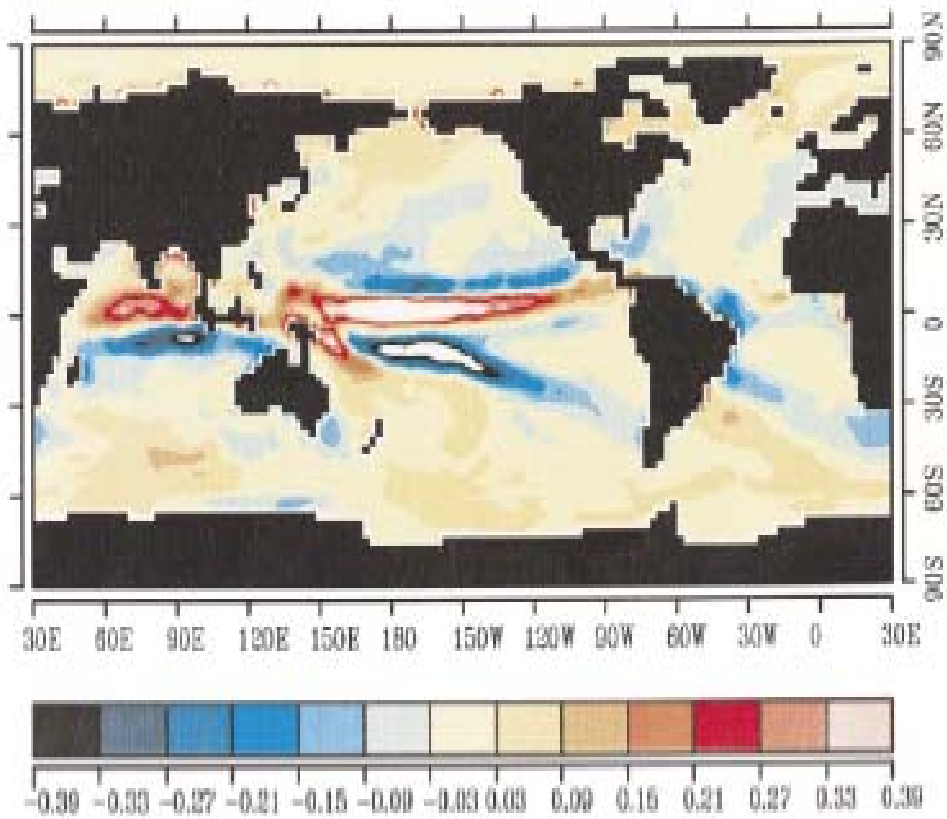

Fig. 16 **温暖化シミュレーションでの**2000-2100**年の淡水フラックス.**

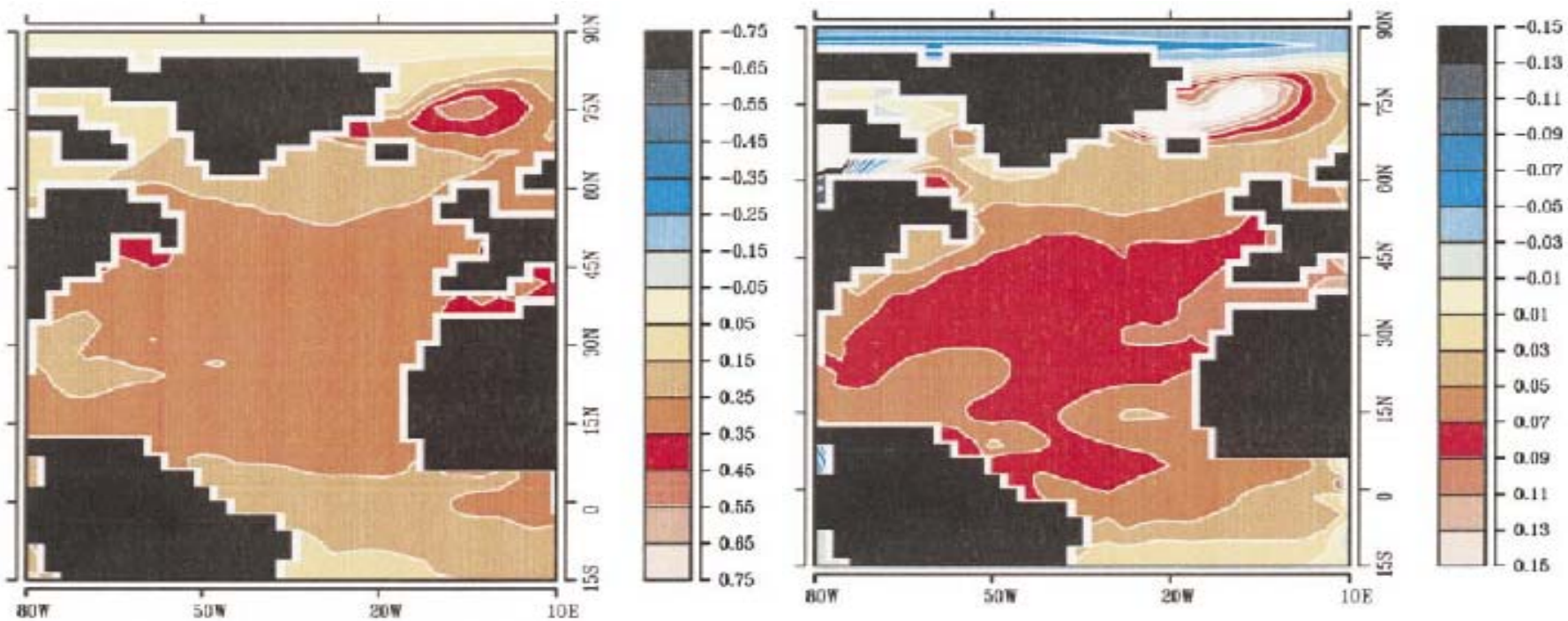

Fig. 17 2000-2100**年の温暖化シミュレーションでの北大西洋の**(left)SST, (right)SSS**の**100**年偏差.**

Conclusion

- 4XC
  - 高緯度の海面が淡水に覆われることにより全海洋の熱塩循環が弱まり，浅くなる．
  - 地表気温は，海氷がほぼ消失する北極海上で特に高くなる．
- 2XC
  - 一旦弱まった熱塩循環が，亜表層の温暖化とその混合により500年目までには回復する．
  - 地表気温変化の分布は4XCと似ているが，その規模は半分ほどである．
- 現在，温暖化により熱塩循環は安定するという意見もあり，まだ研究が必要であるようだ．

出典、参考文献

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