A review of Last glacial Maximum reconstruction: Proxies and model simulations

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Abstract: The last glacial Maximum (LGM) is one of the most suitable time periods for paleoclimate researchers and Diffe Rent methods have been used to obtain the characteristics of environmental. While many features and arguments on LGM period are still in dispute, some basic agreements have been reached through the Progress of last years. In this paper, many physical elements which for the basic stand of characteristics in climate LGM, period the to Pography, Radiance, Atmosphere CO2 concentration, Land-sea mask, sea Surface temperature (SST) and ocean circulation, have been described systematically by compiling the results of LGM Recon Struction with new proxies and model simula-tions in past years to provide a front-row for the seat Study in. We found that's global SSTs in LGM period were cooling overall, but a few warming signals occurred at some particular re Gions; Deep ocean temperatures were relatively homogeneous; The glaciers had significant seasonal variation mainly in the Northern hemisphere ;<\textbf{b15} > The strength of the Atlantic Meridional Overturning Circulation (AMOC) and the Antarctic Circumpolar Current (ACC) W As still in dispute. Definitely, the knowledge about LGM period should be broadened and deepened with the further increasing

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a preliminary understanding ( Mix et al, 2001. other ,LGM Time is the most recent one. Glacier heyday , through in-depth research and understanding of it , To Future climate change trends and how humans respond to climate change there are _ Referencesand reference values .

Last Glacial Last glacial Maximum ; Hereinafter referred to AS LGM period in current approximately to years ago (Kurahashi et al, 2014; Mix et al, 2001; otto-bliesneretal , 2009 , is the best place to study paleoclimate projects One of the time . because of other times ,LGM The data coverage relatively good Solomon et al , 2007 , and the primary boundary conditions such as land terrain , Track Parameters , atmosphere CO2 concentrations are known , Other aspects such as sea level height , ice the Sichuan area as well as the thickness of the glacier etc also have

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to reconstruct the LGM the sea surface temperature of the period , Glacier and sea level height , Large number of international major cooperation projects launched , For example CLIMAP(Climate Long-range investigation, Mapping, prediction, 1988) , EPILOG (environment processes of iceage: Land , Oceans, Glaciers, GLAMAP2000 (Global Atlantic)

Mapping and prediction , To , Margo (multi-proxy approach for the reconstruction of the glacial Ocean surface b17> , 2009) scholars drill through each site , Using the foraminifera of the plankton of flora and fauna , diatom , Whip Chaetoceros class , Micro-fossil composition of radioactive worms , Organic geochemistry ( Long allyl ketone , plankton foraminifera shells Magnesium and calcium etc , mini- measure elements Sr/ca , u/ca , and so on , Pollen , Plant Fossils , Lake Dock water , Groundwater signature gas and sediments S @ O etc Alternatives for different metrics Mix etal, 2001 ; Margo , infers LGM period Earth surface temperature and precipitation , Terrestrial sea ice Scope etc one

Some basic features . Global Glacier impact on climate in this - Time is clearly recorded Clark etal, 1999 , from to demonstrate the ICE's primary role in the climate state (Mix etal , 2001 . but because of biological interference or not completely excluding other effects factors such as , the inference from different methods exists . deviation even oppositeand , because there is a diagenetic dissolution or a coral Reef above the sea objective factors such as the data in , are also available not continuous issues ; in addition , due to the use of different fixed-year methods and Model , The age at which different substitutes are measured also produces errors .

It is a completely different that represents the global climate situation LGM period , The numerical simulation method becomes another study and the recognize the main approach of the period . People use numeric patterns to not only to according to LGM forced and boundary conditions for the period simulate this period the basic characteristics of the Earth's climate , can also change the conditions from to find The main factor that affects the LGM period environment condition . through contrast to geological evidence , Analysis understanding past climate change Machine system , to better predict future climate change ( long ran etc , 2013 . also , simulate the climate state of this period also values pattern development and sensitivity research plays a role in testing (Mix et al ) , 2001 ; Take advantage of the Sea - Gas-coupled mode simulation LGM period is generally divided into two phases : First stage , due to The boundary conditions and coercion are different , mode results are different Ki-toh et al , 2001 ; Hewitt et al , 2003 ; Shin et al , 2003a; Kim ; ; Peltier et al ; ; Weber et al , 2007 , causes different because of different coercion and boundary conditions mode cooling sensitivity , so it's hard to compare LGM period cooling Results (otto-bliesner et al , 2009 ; a Phase ,

PMIP2 (paleoclimate modelling intercomparison Project Phase M ; http : //pmip2.lsce.ipsl.fr require standard boundary conditions and forced thus make LGM period Modes results can be compared ( Braconnotetal, 2006 . PMIP2 set LGM Time boundaries and forced conditions mainly include the : ( ( 1 uses the LGM Lu Bing refactoring data ice-5g (Peltier , ; Q to CO 2 ,CH 4 and N 2 O to modify ; (! booster Port new land exposed by sea level reduction ; 4 Modify by The radiation value of the change in the ball track ( Otto-bliesner et al , 2007. is the same as the refactoring data , Different numeric mode simulations of LGM period Earth Climate Basic state , even if the same strong is applied forced and boundary conditions , also have a different conclusion . addition , PMIP3 Schedule paleoclimate modelling intercomparison Project Phase III ; http : //pmip3.lsce.ipsl.fr ) from 2009 plan execution at the end of the year . PMIP3 on reservation PMIP2 The target is based on , and modifies some of the boundary conditions , such as Lu Bing Heavy to construct data is ice-6g v2.0, MOCA and ANU three refactoring data combined apply Brady etal, 2013 , and on web site A number of refactoring datasets are provided in to facilitate comparison with schema data . PMIP3 schedules are still under discussion, Most recent meeting will be 2017 Year.

with the rapid development of sea-air coupling mode , mode resolution and complexity increases , plus LGM period major boundary conditions and partial environmental status reached _ To , Although most of the period Climate characteristics are still a lot of controversy . , but by refactoring substitutes Comprehensive considerations and comparisons with the results of each numerical simulation Card , LGM The climate state of the period continues to be detailed and can be Line , . This article is under the guidance of this guideline , from current china things Rationale for
oceanographic research, with past previous years to LGM period climate characteristics research work as Foundation, against LGM when Development Requirements for SEA-air coupling mode, mainly summarizes the LGM when period Terrain Distribution, Basic atmospheric conditions radiation, greenhouse gas content etc., sea ice and Land Glacier distribution, Ocean Temperature and circulation characteristics basic elements such as, and try to take advantage of different refactoring methods and numerical simulation results for LGM The basic climate of the period special sign for speculation and description, to better understand the climatic variables and the The relationship and impact of environmental changes, is not intended to be used here specifically for and focus on the pros and cons of different refactoring methods, also does not discuss different numbers Differences and advantages of the value mode to LGM period Simulations, but trying with LGM period Marine Numerical simulation beginners' perspective and requirements, to LGM period Climate basic characteristics and numerical simulation progress side face Overview. Although this article cannot fully cover and summarize the current all LGM Research work and conclusions, but still believe This article is intended or is in progress LGM Time Ocean numerical simulation of our marine science workers have Set Reference and referential significance.

1. LGM Period Terrain Distribution

The terrain and shore distribution is done by LGM period Marine numerical model The first questions to consider are. LGM period due to total amount of ice up to to maximum, so sea level is lower than now, sea level height reduction specific values from m Peltier, 1994 to then ~ 130 m (Fleming et al, 1998; Peltier, 1998 a, 1998 b fan Wai Unequal, or even Yokoyama, and so on ( To proposes to reduce the 135 m. sea level height reduction results in LGM The period appears very multi Newland. based on ICE-5G, Terrain heavy Data map 1 can see LGM period sea and land distribution same as There are several significant changes to the terrain now :1 Sub -Continent Alaska to North America, Australia and New Guinea through Indonesian islands connection, France and Great Britain I. to Swall The European Arctic Rim of the Ba Islands is connected to the Magic plus - Bliesneretal, ; 2 Several important ocean waterways such as Barents Sea, Bering Strait and Hadsun are not open, Indonesian The through stream also does not form, cuffeyetal, 1997.

in ocean topography, Taking into account the depth of water on the formation of the water masses The important role of pmip-2 proposes to use a numerical model to simulate the LGM period when, except for relatively shallow areas such as Gibraltar, Str. Of, Lower depth of the Danish strait about 120m outside, in other oceans Area water depth all meters with current terrain data otto-bliesner et al, 2005.

2. LGM period Atmospheric basic conditions

2.1. atmospheric radiation

Milan Covic theory shows that, glacial cycle by Earth orbit Change Control, Northern hemisphere summer radiation intensity Lu Bing to northern hemisphere measure plays primary role milankovitch, 1941. LGM when The Earth's distant point appears in the northern hemisphere summer, and Holocene early One A ka the left and right side of the Earth appear in winter in the northern hemisphere, This results in a LGM solar radiation from northern hemisphere summer time less than Holocene early, make northern hemisphere summer radiation intensity in LGM period to minimum Berger, 1978, corresponds to the Lu Bing also reach maximum (Clark et al, 2009. then, North half Ball Summer radiation intensity, entered last ice extinction He, 2011.

Some scholars believe that the most important environmental compulsion is not sunshine change, but greenhouse gas, aerosol, ice, sea level height and plant great changes, affect LGM The climate of the period (0 plus – bliesner et al,
Jiang et al, 2015. in the troposphere exothermic coercion sea ice occupies total radiated one half more Hewitt et al, 1997, most of the rest is radiated from greenhouse gases mostly CO, and a new increase in land and radiation intensity The Effect of the change is relatively small (Otto-bliesner et al, ; He , .

2.2. atmospheric greenhouse gas concentration

The reflection intensity of the greenhouse gas concentration on the atmospheric troposphere is heavy The works with. simulate LGM period greenhouse gas concentrations are mostly to CO2, CH4 and NO definition of concentration, and where CO2 plays the most important role . Otto-bliesner et al ( % $ use CCSM 3 mode guaranteeLGM Period and the Industrial Revolution before the PI period, the solar constants were all 1 365 W/2 conditions Next, get two times due to different greenhouse gas concentrations Change the conclusion table 1, CO2 from PI for the period 280 ppm drops to LGM for the period 185 ppm, The resulting radiation force

Table 1 LGM and PI The greenhouse gas concentration for the period and relative to the PI The exothermic force estimate Otto-bliesner et al, ????

<table>
<thead>
<tr>
<th>Greenhouse Gas</th>
<th>Concentration</th>
<th>Radiative forcing/w.m⁻²</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGM</td>
<td>Pi</td>
<td></td>
</tr>
<tr>
<td>CO₂ 185 ppm</td>
<td>280 ppm</td>
<td>-2.22</td>
</tr>
<tr>
<td>CH₄ ppb</td>
<td>760 PPB</td>
<td>-0.28</td>
</tr>
<tr>
<td>N 2O ppb</td>
<td>270 ppb</td>
<td>-0.26</td>
</tr>
</tbody>
</table>

The also drops accordingly 2.22 w/m², and CH 4 and N 2 O from 760 ppb and 270 ppb down to + ppb and $ ppb, to The radiation forcing should be dropped 0.28 w/m² and 0.26 w/m², from which you can see CO 2 plays the primary role in radiation.

Although it is generally accepted that orbital coercion causes the Ten years ice cycle, But there is also a view that its impact is minimal, and large gas CO2 enhances this glacial cycle (Pisias et al, 1984; Genthon et al, 1987; He, . other, climate mode simulations indicate glacial low concentrations CO2 also affects sea ice and hot salt circulation E-Ric Monnin et al, 2002; Otto-bliesner et al, 2007.

3. LGM period Lu Bing and sea ice distribution

3.1. Lu Bing

Numeric mode impersonation LGM Data source for the period Lu Bing Distribution to ice-5g refactoring data Peltier, 2 Chart. You can see in the picture from the ,, and Continental ice in North America covers Canada as a whole areas and most parts of the United States, extends most south to 40° N With nearly, the area with the largest glacier thickness is called Laurentide ice sheet, it extended to the center of the United States caused ridge otto-bliesner etal, 2009; The Lu Bing of Antarctica extends farther north than now, and the Antarctic Lu Bing thickness compared to PI The period is larger than the. South Ocean ODP1093 Station (49° 58.588, - S, 5°51.935, E Pass S| [] [@] O signal Study measured LGM Period high salinity causes freshwater The Extreme imbalance between revenue and expenditure adkins etal, 2002, cause part of the signal exception to be attributed to the Antarctic Lu Bing (toggweiller et al, 1995, Another part of the reason may be increase in sea ice formation and output keeling etal, 2001, Another a Point that we are concerned about is, diagram 2 no Asian place The distribution of the area Lu Bing. about the Qinghai-Tibet Plateau there is a wide range ice Cap's saying, scholars getThe results of the are still different, such as Liu Dongxhen, 1999; Jiangdaya bladder etc, 2002, +; shi yafeng, 1997, so far has no final conclusion.

3.2. sea ice
Scholars use Foraminifera, diatom and radioactive worms, etc. to estimate

LGM period sea ice Extended range Sarnthein et al, 2003; gersonde et al, ???? . North Atlantic Sea-ice range extends wider than now LGM Times, and the latest refactoring data displays, Quarter Extended range of sea ice extends wider than early cognition

such as GLAMAP2000 and Margo data (Margo Program members 2009) All determine the summer Nordic sea (Nordic, sea° is not frozen; East Antarctica temperature drop 9±2 Zhang Stenni et al, 2001, and a large number of nearby seasonal sea ice Migration (Gersonde et al), $0[] CLIMAP 1981 Discovery of the Pacific Northwest Upper Ocean structure has a big change, Khotskoye More have intermediate water formation or increase keigwin, 1998 The layered behavior of the, Alaska Bay is more pronounced, (Zahn et al, 1991and accompanied by cooling, de vernal etc 1997 View these phenomena with seasonal sea ice of the northeast Pacific about.

Otto-pliesner, and so on (???? uses the CCSM3 impersonation LGM time sea ice, conclusion: Southern Hemisphere sea ice area and snow thickness is now 2 Times, Arctic sea ice thickness in 2 .3 The month reaches the 6~7m, Bay stream due to the extension of sea ice has a bias south of the phenomenon; because the North Pacific is in LGMtime is cooler than today high, so winter in 45° N- 60° N from the Kamchatka Peninsula through 180. E - maximum sea ice density is lower now ≈; South half Ball sea ice North extend to 45° S, is very large in the Indian Ocean region Seasonal Changes.

4. LGM period temperature distribution
4.1. surface temperature

LGM The reconstruction of the Earth's surface temperature during the period is the discovery of Earth gas Important variables for basic status, also refactoring LGM period Climate The states have more than one variable, more accurate in various methods. as described above, There are many large international projects that are drilled through the hole to get LGM proxy data for the temperature of the Earth's surface during the period, and draw to map, But these maps mainly represent seasonal surfaces. temperature, where Margo schedule (Margo Projectmembers, 2009 estimated LGM Time Sea surface most complete Comprehensive sea surface temperature dataset ® 3, But sea surface saltsdegrees do not exist this similar dataset (Kurahashi et al, 2014).

: via inch Margo schedule Margoprojectmembers, 2009 refactoring data analysis, The gets the following conclusion: 1 by vertical and zonal temperature gradient large: strongest coldown -10 Force occurrence in the North Atlantic Middle Latitude region, 1 extends directly to the western Mediterranean -6w, This is with CLIMAP (1981 results consistent with; East The Ocean cools more than the Western ocean temperature.; Coast of Africa as today's Namibia and South Africa's coast rise area cools down comparison obvious; 2 Tropical Area cooling: Tropical (s. N area average temperature (1.7±1 ;) Atlantic Tropical area cooling is generally larger than the Pacific and Indian Oceans; Pacific Western Warm pool cool 1 Zhang ~3 Zhang (Argo Observational data indicates Pacific West warm pool from T: isotherm envelope Zhangchunling, 2014 ); hotThe regional temperature difference between the Pacific Ocean and the Indian Ocean is smaller than the tropical Atlantic East-West area temperature difference; () South Ocean down warm: Southern Ocean Cooling 2 Zhang ~6 Zhang indicates polar front northward migration; 4 Local area warming: Pacific subtropical cyclone may warm up 1Zhang ~2 Zhang.

LGM Period Other refactoring data indicates northern latitudes area to cool down and accompany most forest area reduction in the North Bigelow etal, 2003, Greenland temperature Drop 21±2 Zhang (dahl-jensetal, 1998. North Pacific Moderate Drop temperature, Ortiz, and so on 1997 push using Foraminifera and isotope methods break California warm LGM period down 4 Zhang, but through to infer the southern cooling of the California warm current to the "° 2 °c (Herbert et al, 1995; Sabin et al, 1996. ODP883 Station using plankton foraminifera mg/ca proves the Bering Sea gorge LGM Period Reduction Barker etal, ???? . in Alaska Bay PAR87-A10 Station through the density of the waist to the SAC. Analysis obtained in several months sea ice extends outward to %,and winter Sea surface temperature is similar to now (de
Vernal et al., 2015 proposed, LGM period maximum ambient temperature the area is in a tropical region from Bengal, B. Of to the middle of the Pacific, and No significant changes at higher latitudes, This indicates a relatively high latitude, Changes in atmospheric heat to boundary conditions in the equatorial regions response stronger. But it is noteworthy that, surface temperature refactoring still exists defect. on the one hand, Different refactoring methods on the same The number of refactoring for the zone There are differences and even contradictions, and alternatives may be seasonal affect; on the other hand, South Seas due to lack of large amounts of data refactoring restricted (Mix et al., 2001; Margo Plan (Margo Project members 2009 North Atlantic and tropical ocean area sites more, In the Pacific subtropical region, the the observation point is less.

in the sea - Aikido mode, Otto-bliesner, and so on

( 2009 in PMIP2 under conditions 6 in mode ( CCSM3, fgoals, hadcm, ipsl, miroc, ebclit-clio Tropical sea surface temperature, Data although difference, But still get some common conclusions: Tropical Average cool at 1.0 Zhang ~2.4 Zhang, tropical Atlantic surface temperature lower than tropical Pacific sea surface temperature, but basin interior and basin Comparison of cooling differences between ( Margo difference between refactoring data ISO smaller (Rosell-mele et al., +; Barker et al., ??; Barrows et al., ??; Chen et al., ??; kuceraetal., ??; does not appear in mode like drilling data speculative cooling greater than 6 Zhang Region. Liu wait (2002 proposed The tropical ocean surface cools because of the CO₂ decrease of concentration, but this An initial tropical cooling only accounts for half of the final total cooldown, and its It cools down because of the upper loop., Especially by the south too ping yang hot salt and middle water ventilation effect.

also, The coral record of the Papua New Guinea indicates that ENSO already exists 130 Year, Although the LGM period these districts domain on land State, cause site record missing, but presumably in Ice Age ENSO Vibration Towel Chang weakening (Tudhopeetal, 2001. Some scholars propose Nino-3.4 Zone (5° s 5° N, 170° - 120° W the standard deviation of the surface temperature anomaly of the sea represents the pattern in ENSO activity Measurement deseretal, 2006, in

LGM During the period, the measurement metric is reduced every month, especially in North Winter season Otto-bliesneretal, 2005.

CCSM 3 Impersonation LGM The period gets the surface temperature of the period more cold and drier conclusion: Global average surface temperature is 9.0 Zhang, Lower than before the Industrial Revolution P period 4.5 Zhang, CCSM 3 Impersonation Global cooling ratio CSM1 simulate global cooling low % Shin et al., 2003 b; reduced atmospheric precipitation %, Annual average precipitation 2.49 mm / Day, than control experiment PI period Decrease 0.25 mm/day Otto-bliesner et al., 2005.

4.2. Deep ocean temperature

as technology progresses, People are constantly exploring LGM period ocean Deep Water temperature. adkins wait (2002 through contrast 0DP 1063 station (33° 41.181 °N, 57° 36.903 °W, ODP981 station (55° 28.632 °N, 14° 39.048 °W, ODP1123 Station (41° 47.160 °S, 171° 29.940 °W and 0DP 1093 station (49°58.588 °S, 5° 51.935 °E on m.below deepwater temperature, Think that compared to the Atlantic now, Pacific and There are some differences in the temperature of water masses in the Southern Ocean, LGM for the period Deep water water masses temperature more consistent: except 0 DP1093 stands in

4 584 m water temperature is -2.2±0.5 outside, Other stations deep Sea temperature All in -1 ° 2 around. They pass on the chloride data into the line Analysis considers thePI the period deepwater density stratification is mainly

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determined by temperature to different , LGM The deep water density layer of the period is by the salinity variable as the dominant factor , and Otto - Bliesner , and so on ??? knot consistent . This is different for the research LGM period the deep-sea ocean circulation differs The motion of the water masses is of great significance .

5. LGM period Two important circulation profiles

As a whole , LGM period Ocean circulation distribution and current phase almost , There are some currents that vary by land and sea. different even disappear , For example, Indonesian through stream . where , Atlantic through Rollover and Antarctic circumpolar flows because they have a greater impact on climate change Important and by simulating and reconstructing data scholars get a poor conclusion different or even opposite , So it's always been a hot spot for people to focus on.

Liu , and so on 2007 considers only radiation and C 0 2 Evenly strong forcing is difficult to cause Greenland the millennium scale changes of the , and main through ocean heat transport and various positive feedback ocean circulation can affect Changes in the atmosphere . Atlantic Rollover flow amoc changes may be causing Greenland ice core records " climate roller " now image reason broeckeretal, 1985 ; hot salt circulation for hot transport and warm cycles have important roles ( Otto-bliesner et al ,

2007 ).

LGM period Amoc The information of the strength originates from the ancient ocean's override variable Fischer etal, 1999 . on Atlantic 55° n 50° S perforated ODP (Ocean drillingprogram data , based on measurement S0 content extrapolation LGM period Atlantic deep Water is more salty and colder than it is now. ; and calculate salinity gradient ,considers Deep South ocean greater than North Atlantic water salinity Adkins et al , 2002. The strength and depth of the amoc vary by detection means different conclusions . Some scholars think that LGM period AMOC strong degree ratio PI period weaker , Impact depth lighter : They pass the bottom habitat foraminifera S ( C ( Curry et al ,???) ; Duplessy et al , 1988 , cd/ca (Boyle, 1992 ; Marchitto et al , 2006 , ba/ca (Lea et al , 1990 and zn/ca marchitto etal, 2002 Other ancient nutrition tracking methods , get North Atlantic Deep Water (NADW and Antarctic Bottom water ( AABW The bounds of the in the LGM period to a lighter conclusion ; Lynch-stieglitz (1999a, 1999b ; 2006 According to Flora The land transfer operation of the current in the " " S 0 The presents the Amoc weakened conclusion , under glacial period of the North Atlantic Middle water (gnaiw occupied North Atlantic about 2 000~2 m at , gets the Amoc The strength is weaker than it is now and makes the AABM Further intrusion into North West The conclusion otto-bliesner Etal, 2007. also has some learning people on LGM period amoc strength question , them think LGM period Amoc intensity is greater than PI Time Strong , or at least with PI matched : They think the passive The Nutrient Tracking method does not provide direct deep water rate information (legrande etal, 1995 , and the deposit's 231pa/230th But more directly reflect the speed of deep water convection . LGM period The distribution of the 231pa/230th shows that gnaiw flow to the Southern Ocean rate similar to now or even higher ( Yu etal, 1996 ; McManus , and so on ( Use the in the drilling of the Bermuda Sea 231pa/230th , show Amoc on LGM Period at most reduce %~40%; methods for measuring the grain size of marine sediments also branch hold LGM period Amoc strength is strong ( Mccave et al , 1995 ; Manighetti etal , 1995 ; mccave etal , 2006 ; another , because of the LGM period the Bering Strait is in the closed state of , make Pacific Ice Rongshui inaccessible to Atlantic Ocean , This is theoretically Benefit explanation AMOC in LGM time intensity is stronger than now say method Cuffey et al , 1997.

in numeric mode , Otto-bliesner , and so on 2007 to over 4 coupling mode (CCSM3,hadcm ,mirfe and ebclit-cli 0 simulate LGM period amoc results . 4 mode all simulate the currentAMOC Most powerful m i to under traffic is 13.8~20.8sv This is in the observation estimate of ± 3~5sv Range talleyetal , 2003 . on this - premise , does not In the same mode for The AMOC intensity simulations are different :CCSM3 impersonation Amoc Reduced strength % otto-bliesner et al ,???, hadcm basically unchanged , ebclit and miroc enhanced about %to %; in . N Place ,Amoc Depth also change : CCSM3 Simulated LGM for the period Amoc Impact Depth more than now amoc Light , Miroc in LGM period deepened to full layer mode,ebclit 's amoc occupies the entire 30 . S north of the entire Atlantic , HADCM Mode simulation of the North Atlantic Deep Water is the weakest of the . North Atlantic Antarctic Bottom Wateraabw
on CCSM3 and hadcm Add on , in Miroc reduce , in ebcllt disappears . otto-blienser et ( considers CCSM3 overestimate winter Greenland South Sea ice area (CLIMAP Project membership, 1981; Sarnthein et al., 2003 , and Miroc The mode underestimates the LGM period sea ice The scope of may be overestimated nadw Strength , so the pattern of results showgnaiw It may not be as much as it is today .

in the Antarctic around the polar stream ( ACC Aspect , for LGM period There is also a dispute about the average position and strength of the ACC . Overall overview to : the change in the strength or position of the ACC may be enhanced Pudsey et al., 1998; Dezileau et al., To ; Noble et al., % or basically remains unchanged ( Matsumoto et al., 2001 ; mceaveetal , %. in the mode CCSM3 and CSM1 all get LGM Period ACC enhanced (otto- Blienser et al , conclusion , - is because the South Ocean handed Wind Stress enhancement , on the other hand because of the more near Antarctica multiple sea ice formation make aabw Enhancements so that ACC transport generation affect Gent etal, 2001 . The is now basically certain that , ACC The strength of the is largely driven by a different density of , Instead of just the wind-driven ( Hogg , ; kohfeldetal , 2013 .

6. Summary

Objective reproduction of paleoclimate is considered to be an accurate predictor of future climate Status Important premises , and LGM The period is considered to be a study of ancient gas the ideal time of a period of the a . This is not only because of the relatively large number of factoring data and the wider distribution of the period ,Benefits Explore The basic features of the period ; more because it 's in this time global The climate is in a completely different situation . Benefit test The sensitivity of the pattern and evaluation of the schema improve and refine the , To achieve more accurate predictions of future climatic conditions .

Affected by orbital parameters , solar radiation in LGM period to minimum , This is the most fundamental cause of the environmental characteristics of the periodvegetarian . and greenhouse gas concentration decrease , Glacier coverage increased , To plant and the emergence of new land and so on changes to this period environment To the enhanced effect .

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