**Prosjekt: Kartlegging av middelalderens varmeperiode (MWP)**

[**4. Januar 2016**](https://kaltesonne.de/mapping-the-medieval-warm-period/) **av** [**Kalte Sonne**](https://kaltesonne.de/author/redakteur/)

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|  | **“Kalte Sonne” er en anerkjent organisasjon som har gjort betydelige bidrag til feltet klimavitenskap. Grunnlagt av den kjente tyske forskeren Fritz Vahrenholt, har “Kalte Sonne” blitt et samlingspunkt for banebrytende forskning og innsiktsfulle diskusjoner om klimaendringer.**  **Organisasjonen er kjent for sin åpne og kritiske tilnærming til vitenskapelig forskning, og har utfordret konvensjonelle synspunkter og fremmet en dypere forståelse av komplekse klimaspørsmål. Dette inkluderer deres arbeid med å utforske solens rolle i klimaendringer, noe som har ført til viktige innsikter og utvidet vår forståelse av jordens klimasystem.**  **“Kalte Sonne” er også kjent for sitt engasjement i offentlig utdanning og formidling. Gjennom sin månedlige spalte på nettstedet sitt, deler Fritz Vahrenholt og hans team deres nyeste funn og perspektiver med et bredt publikum, og bidrar til å fremme en informert og balansert diskusjon om klimaendringer.**  **Samlet sett er “Kalte Sonne” en organisasjon som er dedikert til vitenskapelig nysgjerrighet, rigorøs forskning og offentlig engasjement, og fortsetter å gjøre en positiv innvirkning på feltet klimavitenskap.**  **Fritz Vahrenholt er en kjent tysk politiker og industriell leder. Han ble født 8. mai 1949 i Gelsenkirchen-Buer. Vahrenholt studerte kjemi i Münster og startet sin profesjonelle karriere ved det føderale Umweltbundesamt (miljøvernsbyrået) i Berlin og Miljødepartementet i Hessen.**  **Fra 1984 til 1990 hadde han en ledende rolle i Hamburg, først som Staatsrat for miljø, 1990 til 1991 for administral Senatskanzlei, og Umweltsenator (senator for miljøet) i Hamburg fra 1991 til 1997. I 1998 gikk han inn i energibransjen og var frem til 2001 i styret for Deutsche Shell AG, et datterselskap av Shell. I 2001 flyttet han til stillingen som administrerende direktør for vindturbinfirmaet REpower Systems AG og var der frem til 2007.**  **Fra februar 2008 til juni 2012 var han administrerende direktør for strømselskapet RWEs datterselskap RWE Innogy og sitter fortsatt i styret. Vahrenholt har en doktorgrad i kjemi. I 1999 ble han utnevnt til æresprofessor i kjemi ved Universitetet i Hamburg.**  **I 2012 ble Vahrenholt valgt til styreleder for Deutsche Wildtier Stiftung, en tysk stiftelse for bevaring av dyreliv i Tyskland.**  **I 2012 publiserte Vahrenholt sammen med geolog Sebastian Lüning boken “Die kalte Sonne: warum die Klimakatastrophe nicht stattfindet” (Den kalde solen: Hvorfor klimakrisen ikke skjer), en bok som forklarer at klimaendringer drives av variasjoner i solaktivitet. De forutsier at jorden går inn i en kjøleperiode på grunn av periodiske solsykluser.** |

**Prosjekt**

**Kartografi av middelalderens varme periode: Et nettbasert atlas som gir innsikt i en varm fase som tidligere har vært dårlig forstått.**

**For rundt 1000 år siden opplevde store deler av verden en fremtredende varmfase som i mange tilfeller nådde et tilsvarende temperaturnivå som i dag eller til og med oversteg dagens varme. Mens denne middelalderske varmeperioden (MWP) har blitt dokumentert i en rekke studier fra hele verden, klarer klimamodeller fortsatt ikke å gjenskape denne historiske varme fasen. Problemet er åpent innrømmet i den siste IPCC-rapporten fra 2013 (AR5, Arbeidsgruppe 1) hvor i kapittel 5.3.5. IPCC-forskerne innrømmer:**

***The reconstructed temperature differences between MCA and LIA […] indicate higher medieval temperatures over the NH continents […]. . The reconstructed MCA warming is higher than in the simulations, even for stronger TSI changes and individual simulations […] The enhanced gradients are not reproduced by model simulations … and are not robust when considering the reconstruction uncertainties and the limited proxy records in these tropical ocean regions […]. This precludes an assessment of the role of external forcing and/or internal variability in these reconstructed patterns.***

**Overraskende nok har media ikke plukket opp dette viktige problemet. Kanskje fordi informasjonen er skjult i liten skrift på side 415 av den omfangsrike rapporten og utelatt i Sammendraget for politiske beslutningstakere? Når vi lager modeller, er det viktig at de stemmer overens med virkeligheten. Hvis det er stor forskjell mellom det modellen viser og det som faktisk skjer, kan det få store konsekvenser. Det er vanlig å teste modellene på kjente data før de brukes til å lage prognoser. Modellene må vise at de kan gjenskape kjente hendelser (‘hind cast’ eller ‘history match’) før de kan brukes til å lage prognoser. Ifølge IPCC har klimamodellene ikke bestått denne testen, de ser ut til å være på veien uten kjørelisens - så å si - og er derfor uegnet for fremtidige klimaprognoser.**

**De viktigste spørsmålene er derfor: Hvordan kunne det ha vært så varmt for tusen år siden når CO2-konsentrasjonene i atmosfæren var på et lavt førindustrielt nivå? Hvilke klimafaktorer kunne ha utløst MWP-oppvarmingen, som ser ut til å være underrepresentert i dagens klimamodeller? Hvordan ville temperaturprognosene endre seg når man bruker klimamodeller som fullt ut tar hensyn til MWP-oppvarmingen?**

**En solid dokumentasjon av Middelalderens varmeperiode (MWP) ligger til grunn for denne etterlengtede diskusjonen. Uheldigvis finnes det fortsatt meninger i debatten som fremstiller MWP som et lokalt fenomen, eller som en varm fase som globalt sett var betydelig kaldere enn den moderne varmeperioden på 1900-tallet og tidlig på 2000-tallet. Det blir fortsatt utgitt pressemeldinger basert på studier som tilsynelatende motbeviser MWP, selv om disse studiene er unntak, eller faktisk passer godt inn i MWP-modellen når man tar hensyn til den fulle konteksten.**

**Det nåværende kartleggingsprosjektet for MWP har som mål å fullt ut evaluere og gi referansetilgang til artikler om den globale klimahistorien de siste 1500 årene. Utgangspunktet er gitt av MWP-sammendragene levert av** [**Medieval Warm Period Project**](http://www.co2science.org/data/mwp/mwpp.php) **av CO2 Science. Det er identifisert en stor mengde artikler. Dataene visualiseres på en zoombar Google Maps-plattform som gir brukervennlig tilgang. Et klikk på det respektive datapunktet åpner et informasjonspanel som oppsummerer resultatene av studien ved hjelp av et vanlig, forenklet skjema. Lenker til tidsskriftets sammendrag og nøkkelfigur gir rask tilgang til dataene. Hvis du vil, kan du prøve det ut selv og åpne** [**MWP Online Map**](https://www.google.com/maps/d/edit?mid=zvwgQ0tAjx_k.keO5eR4ueHXE&usp=sharing_eid)**.**

**MWP Mapping Project er et prosjekt som vil gi oss mer informasjon om noen viktige spørsmål. Prosjektet vil finne ut hvor i verden MWP oppvarming har skjedd. Det vil også se på regionale trender for når varme perioden startet og sluttet, og hvilke endringer i nedbør som skjedde. Kartet fra prosjektet er gratis og tilgjengelig på internett for alle som er interessert i klimaendringer. Det vil være en nøytral plattform for diskusjoner om MWP, og vil gi viktig informasjon om klimaendringer i fortiden som kan hjelpe oss å forstå dagens klimaendringer bedre.**

**Nåværende status (1. november 2018)**

**Prosjektet startet i slutten av 2015 og har gjort stor fremgang siden da. I starten fokuserte vi på områder hvor det var lite data, for å dekke så mange steder som mulig. Vi publiserte en oppsummering av MWP-temperaturene i Afrika i 2017 i** [**Paleoceanography**](http://onlinelibrary.wiley.com/doi/10.1002/2017PA003237/abstract)**, og en oppsummering av MWP-temperaturene i Sør-Amerika i oktober 2018 i** [**Quaternary International**](https://www.sciencedirect.com/science/article/pii/S1040618218308322)**. Vi oppdaget raskt at i varme deler av verden, er det mer søkelys på endringer i nedbør (tørt vs. fuktig) enn på temperatur endringer. Når du klikker på MWP-kartet på nettet, vil du se fem forskjellige farger:**

**rød: MWP oppvarming**

**blå: MWP avkjøling (veldig sjelden)**

**gul: MWP mer tørr**

**grønn: MWP mer fuktig**

**grå: ingen trend eller tvetydige data**

**Størstedelen av vestlige Nord-Amerika og Afrika opplevde tørkeforhold under MWP (unntatt noen områder i Sørvest-Afrika). I motsetning til dette var Australia og Karibia mer fuktige. Globalt sett viser de fleste av alle paleoklimatiske temperaturstudier som er samlet i kartet så langt en fremtredende oppvarming under MWP. Dette inkluderer også Antarktis og Arktis.**

**” Paleoklimatiske” refererer til studiet av klimaforholdene i tidligere perioder av Jordens historie.**[**Dette er en del av vitenskapen kjent som paleoklimatologi**](https://snl.no/paleoklimatologi)**.**[**De viktigste verktøyene for paleoklimatologi er fossiler og sedimentære bergarter, som morene-konglomerater (avsettes under istider), bauxitt/lateritt-bergarter (dannes i tropisk klima), og salt-avsetninger (dannes i tørt klima)**](https://snl.no/paleoklimatologi)**.**

[**For den relativt nyere delen av historien, får man informasjon om tidligere tiders klima ved å studere iskjerner fra Antarktis eller Grønlandsisen, oksygen-isotoper, plankton-innholdet i borkjerner fra bunnen av verdenshavene og bredden av årringer i trestammer**](https://snl.no/paleoklimatologi)**. Så, når vi snakker om “paleoklimatiske” studier, refererer vi til forskning som prøver å forstå hvordan klimaet var i fortiden.**

[Et bilde som inneholder kart

Automatisk generert beskrivelse](http://t1p.de/mwp)

**Kartografi av middelalderens varme periode**

**CO2 Science**

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|  | **CO2 Science er en organisasjon som er dedikert til forskning på karbondioksid og global endring. De har etablert seg som en viktig stemme i klimadebatten, og gir regelmessig ut et ukentlig online nyhetsbrev som gir en oversikt over de nyeste forskningsfunnene på dette feltet.**  **Organisasjonen ble grunnlagt av familien Idso, som har en sterk bakgrunn innen landbruk og klima. Deres arbeid har bidratt til å fremme forståelsen av jordens temperaturfølsomhet for strålingsforstyrrelser og plante-respons på forhøyede CO2-nivåer.**  **CO2 Science har som mål å utfordre den vitenskapelige konsensusen om klimaendringer vist i IPCC vurderingsrapporter, og tror at global oppvarming vil være gunstig for menneskeheten. De mener at IPCC`s påstander er alvorlige, og føler at deres underliggende basis må testes strengt med virkelige data.**  **CO2 Science har vist en sterk forpliktelse til åpenhet og vitenskapelig integritet, og deres arbeid har bidratt til å fremme en mer balansert og informert debatt om klimaendringer. Deres innsats for å teste og validere klimamodeller med virkelige data er et viktig bidrag til feltet. Deres arbeid har bidratt til å fremme forståelsen av klimasystemet og har gitt verdifull innsikt i de mulige effektene av økte CO2-nivåer.** |

**Prosjekt oversikt**

**Målet med prosjektet**

**Vårt prosjekt om den middelalderske varmeperioden er en pågående innsats for å dokumentere størrelsen og fordelingen i rom og tid av en betydelig varm periode som skjedde omtrent for tusen år siden. Målet er å til slutt finne ut om den middelalderske varmeperioden (1) var global eller ikke, (2) var mindre varm enn, like varm som, eller enda varmere enn den nåværende varmeperioden, og (3) var lengre eller kortere enn den nåværende varmeperioden har vært til nå.**

**Bakgrunnen for prosjektet**

**Prosjektets eksistens stammer fra påstanden om at jordens nær-overflate lufttemperatur de siste tiårene har vært høyere enn den har vært i løpet av noe lignende periode i det siste årtusen eller mer. Denne påstanden er av største betydning for mange forskere og nesten alle verdens miljøvernere.**

**De hevder at det er noe unaturlig med den nylige og pågående oppvarmingen, noe som tillater dem å hevde at oppvarmingen har sin opprinnelse i menneskeskapte CO2-utslipp. De hevder videre at hvis menneskeheten vil forlate forbrenning av fossile brensler, kan vi bremse og til slutt stoppe oppvarmingen og dermed redde planetens skjøre økosystemer fra å bli ødelagt av katastrofale klimaendringer.**

**Disse påstandene er alvorlige, og vi føler at deres underliggende basis må testes strengt med virkelige data.**

**Hvordan gjennomføres prosjektet?**

**Når vi oppdager nye vitenskapelige artikler som er gjennomgått av fagfeller og som handler om den middelalderske varmeperioden, beskriver vi kort de mest relevante funnene. Stedene for alle slike studier blir deretter plottet på et verdenskart. For studier som tillater bestemmelse av en faktisk temperaturforskjell mellom den middelalderske varmeperioden (MWP) og den nåværende varmeperioden (CWP), blir dette tallet inkludert i frekvensfordelingen mellom MWP-CWP. Til slutt inkluderes navnene på alle forskere og forskningsinstitusjoner som er assosiert med MWP-prosjektstudier vi siterer.**

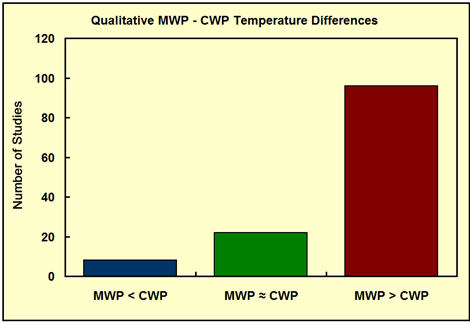
**Når vil prosjektet slutte?**

**Siden det er mange relevante studier som allerede er publisert, i kø for publisering, pågår, og enda ikke er tenkt, kan det virke som om prosjektet vil fortsette på ukentlig basis for ubestemt tid.**

**Hvordan kan du hjelpe?**

**Du kan hjelpe ved å varsle oss om nye (og gamle) forskningsartikler som dokumenterer middelalderens varmeperiode som ennå ikke er lagt ut på nettsiden vår. Når du gjør det, vennligst send oss ​​en kopi av papiret enten på e-post (helst i pdf-format) eller per post.**

**MWP-CWP kvalitative temperaturforskjeller**



**Denne delen av studien bruker en tilnærming som er mer opptatt av beskrivelser enn tall. Den ser på hvilke studier som sier at temperaturene i middelalderens varmeperiode var enten varmere (rød), det samme (grønn), eller kjøligere (blå) sammenlignet med dagens varmeperiode (CWP). Det handler mer om å forstå de generelle trendene enn de eksakte tallene.**

**MWP-CWP kvantitative temperaturforskjeller**



**Denne delen av studien bruker tall for å sammenligne temperaturene. Den ser på hvor mange studier som viser at temperaturene i middelalderens varmeperiode var høyere eller lavere enn i dagens varmeperiode (CWP), med en nøyaktighet på 0.5°C. Rød betyr at middelalderen var varmere, mens blå betyr at den var kjøligere.**

**Liste over forskningsinstitusjoner knyttet til arbeidet vi siterer.**

**Argentina  
- Departamento de Geologia, Universidad Nacional del Sur, San Juan  
- Division Mineralogia y Petrologia, Facultad de Ciencias naturales and Museo, Universidad Nacional de La Plata, La Plat  
- Instituto Argentino de Nivologia, Glaciologia y Ciencias Ambientales, CONICET, Mendoza**

**Australia  
- Advanced Centre for Queensland University Isotope Research Excellence, University of Queensland  
- Antarctic Co-operative Research Centre, University of Tasmania, Hobart  
- CSIRO Sustainable Ecosystems, Canberra, ACT  
- Department of Geology, The Australian National University, Canberra  
- Geoscience Australia, Hobart  
- Institute of Antarctic and Southern Ocean Studies, University of Tasmania, Hobart  
- Radiogenic Isotope Laboratory, Centre for Microscopy and Microanalysis, University of Queensland  
- School of Geosciences, University of Wollongong, NSW**

**Austria  
- Institute of Geology and Palaeontology, University of Innsbruck, Innsbruck  
- Institute for High Mountain Research, Innsbruck  
- Institute of Limnology, Austrian Academy of Sciences, Mondsee**

**Belgium  
- Center for Archaeological Sciences, Katholieke Universiteit Leuven, Heverlee  
- Department of Biology, Ghent University  
- Department of Biology, Section Protistology & Aquatic Ecology, Ghent University, Ghent  
- Faculte Polytechnique de Mons, Mons  
- International Bureau of Environmental Study, Brussels  
- Near Eastern Studies Unit, Katholieke Universiteit Leuven, Leuven  
- Physical and Regional Geography Research Group, Katholieke Universiteit Leuven, Heverlee  
- Universite catholique de Louvain, Louvain-la-Neuve**

**Brazil  
- Department of Geology, Center of Technology and Geosciences, Federal University of Pernambuco, Recife  
- Instituto de Geosciencias, Universidade de Sao Paulo, Sao Paulo  
- Laboratory of Coastal Dynamics, Federal University of Para´, Bele´m (Pa)**

**Canada  
- Alberta Research Council, Calgary  
- Biology and Earth and Environmental Sciences, University of British Columbia Okanagan, Kelowna  
- Canadian Forest Service, Edmonton, Alberta  
- Centre d'Etudes Nordiques, Laboratoire de Paleoecologie Aquatique, Universite Laval, Quebec  
- Department of Biological Sciences, Simon Fraser University, Burnaby, B.C.  
- Department of Biological Sciences, University of Alberta, Edmonton, Alberta  
- Department of Biology, Queen's University, Kingston, Ontario  
- Department of Biology, York University, Toronto, Ontario  
- Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta  
- Department of Earth and Ocean Sciences, University of British Columbia, Vancouver, Birtish Columbia  
- Department of Fisheries and Oceans, Institute of Ocean Sciences, Sidney, British Columbia  
- Department of Geography, University of Western Ontario, London, Ontario  
- Department of Geology and Geophysics, The University of Calgary, Calgary, Alberta  
- Earth and Environmental Sciences, University of Waterloo, Waterloo  
- Geological Survey of Canada, Vancouver, B.C.  
- GEOTOP, Geochemistry and Geodynamics Research Center, Montreal, Quebec  
- Institut National de la Recherché Scientifique, Centre Eau, Terre et Environnement, Quebec  
- Laboratory for Paleoclimatology and Climatology, Department of Geography, University of Ottawa, Ottawa  
- Laboratory for Paleoclimatology and Climatology, Ottawa-Carleton Institute of Biology, University of Ottawa, Ottawa  
- Pacific Geoscience Center, Geological Survey of Canada, Sidney British Columbia  
- Paleoecological Environmental Assessment and Research Lab (PEARL), Department of Biology, Queen's University, Kingston, Ontario  
- Paleolimnology-Paleoecology Laboratory, Départment de géographie et Centre d'études nordiques, Université Laval, Québec City, Québec  
- Parks Canada Fire and Vegetation Specialist, Radium Hot Springs, B.C.  
- Royal British Columbia Museum, Victoria, Brotish Columbia  
- Saskatchewan Isotope Laboratory, Department of Geological Sciences, University of Saskatchewan, Saskatoon  
- School of Earth and Ocean Sciences, University of Victoria, Victoria, British Columbia**

**Chile  
- Center for Advanced Studies in Ecology and Biodiversity, Departamento de Ecologia, Pontificia Universidad Catolica de Chile, Santiago  
- Center for Oceanographic Research in the Eastern South Pacific, University of Concepcion, Concepcion  
- Centro de Estudios Cuaternarios de Fuego Patagonia y Antartica, Punta Arenas  
- Centro de Ciencias Ambientales EULA-Chile, Universidad de Concepcion, Concepcion  
- Department of Ecological Sciences, University of Chile, Santiago  
- Department of Geophysics, University of Concepcion, Concepcion  
- Department of Oceanography, University of Concepcion, Concepcion  
- Departamento de Geologia, Facultad de Ciencias Fisicas y Matematicas, Universidad de Chile, Santiago  
- Institute of Ecology and Biodiversity, Las Palmeras, Santiago  
- Institute of Ecology and Biodiversity, University of Chile, Santiago  
- Laboratorio de Dendrocronologia, Facultad de Ciencias Forestales y Recursos Naturales, Universidad Austral de Chile, Valdiva  
- Laboratorio Internacional de Cambio Global, Departamento de Ecologia, Facultad de Ciencias Biologicas, PUC, Santiago  
- Nucleo Cientifico Milenio FORECOS, Fundacion FORECOS, Vladivia  
- Servicio Nacional de Geologia y Mineria, Santiago  
- Universidad de Concepcion, Concepcion**

**China  
- Administrative Center for China's Agenda 21th Century, Beijing  
- Center for Arid Environment and Paleoclimate Research, Lanzhou University  
- China Center of Desert Research, Beijing Normal University  
- Climate Data Center of Qinghai, Qinghai Meteorological Bureau, Xining  
- Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou  
- College of Marine Geosciences, Ocean University of China, Qingdao  
- College of Urban and Environmental Sciences, Northeast Normal University, Changchun  
- Department of Atmospheric Sciences, Peking University, Beijing  
- Department of Earth and Space Sciences, University of Science and Technology of China  
- Department of Earth Sciences, University of Hong Kong, Hong Kong  
- Department of Environment Engineering, School of Energy and Power Engineering of Xi'an Jiaotong University, Xi'an  
- Department of Environment Science and Technology, School of Human Settlements and Civil Engineering, Xi'an Jiaotong University, Xi'an  
- Department of Resources and Environment Sciences, Beijing Normal University, Beijing  
- East China Normal University, Shanghai  
- First Institute of Oceanography, Qingdao  
- Geological Analysis Center, Beijing  
- Graduate School of the Chinese Academy of Sciences, Beijing  
- Institute of Chinese History and Geography, Fudan University, Shanghai  
- Institute of Earth Environment, Chinese Academy of Sciences, Xi'an High-Tech Zone, Xi'an  
- Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing  
- Institute of Geology, Chinese Academy of Sciences, Beijing  
- Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing  
- Institute of Global Environmental Change, Xi'an Jiatong University, Xi'an  
- Institute of Hydrologic and Environmental Geology, Chinese Academy of Geological Sciences, Zhengding  
- Institute of Peatmire, Northeast Normal University, Changchun, Jilin  
- Institute of Plateau Meteorology, China Meteorological Administration, Chengdu  
- Institute of Polar Environment, Department of Earth and Space Science, University of Science and Technology of China, Hefei  
- Institute of Resources and Environment, Beijing Normal University, Beijing  
- Institute of Salty Lake, Chinese Academy of Sciences, Xining  
- Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing  
- Key Laboratory of Cenozoic Geology and Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing  
- Key Laboratory of Geographic Information Science, East China Normal University, Shanghai  
- Key Laboratory of Lake Sedimentation and Environment, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences  
- Key Laboratory of Marine Chemistry Theory and Technology of the Ministry of Education, Ocean University of China, Qingdao  
- Key Laboratory of Marine Geology and Environment, Institute of Oceanology, Chinese Academy of Sciences, Qingdao  
- Key Laboratory of Submarine Geosciences and Prospecting Techniques, Ministry of Education, Qingdao  
- Key Laboratory of Theoretical and Applied Marine Chemistry and Chemical Engineering of the Ministry of Education, Ocean University of China, Qingdao  
- Laboratory for Climate Studies, National Climate Center, China Meteorological Administration, Beijing  
- Laboratory for Earth Surface Processes, College of Environmental Sciences, Peking University, Beijing  
- Laboratory of Lake Sedimentation and Environment, Nanjing Institute of Geography and Limnology, Nanjing  
- Laboratory of Quantitative Vegetation Ecology, Institute of Botany, Chinese Academy of Sciences, Beijing  
- Laboratory of Watershed Hydrology and Ecology, Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou  
- Lanzhou Institute of Geology, Chinese Academy of Sciences, Lanzhou  
- Lanzhou Institute of Glaciology and Geocryology, Chinese Academy of Sciences  
- Marine Geology College, Ocean University of China, Qingdao  
- MOE Key Laboratory of Western China's Environmental Systems, Lanzhou University, Lanzhou  
- Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, Nanjing  
- National Marine Data and Information Service, Tianjin  
- School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing  
- School of Geosciences and Resources, China University of Geosciences, Beijing  
- School of Resources and Environmental Sciences, Lanzhou University, Gansu  
- Second Institute of Oceanography, Hangzhou  
- South China Sea Institute of Oceanology, Chinese Academy of Sciences  
- State Key Laboratory of Cryospheric Sciences, Cold and Arid Regions Environment and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou  
- State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry, Chinese Academy of Sciences, Guiyang, Guizhou  
- State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai  
- State Key Laboratory of Frozen Soils Engineering, Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou  
- State Key Laboratory of Integrated Management on Pests, Insects and Rodents, Institute of Zoology, Chinese Academy of Sciences, Beijing  
- State Key Laboratory of Lake Science and Environment, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, Nanjing  
- State Key Laboratory of Loess and Quaternary Geology, Institute of Earth Environment, Chinese Academy of Sciences, Xi'an  
- State Key Laboratory of Marine Geology, Tongji University, Shanghai  
- State Key Laboratory of Mineral Deposit Research, Institute of Surficial Geochemistry, Department of Earth Sciences, Nanjing University  
- State Key Laboratory of Vegetation and Environmental Change, Institute of Botany, Chinese Adademy of Sciences, Beijing  
- Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi  
- Yantai Institute of Coastal Zone Research for Sustainable Development, Chinese Academy of Sciences, Yantai**

**Czech Republic  
- Geophysics Institute, Czech Academy of Science**

**Denmark  
- AMS 14C Laboratory, Institute for Physics and Astronomy, Århus University  
- Centre for Ice and Climate, Niels Bohr Institute, University of Copenhagen, Copenhagen  
- Centre for Past Climate Studies, Department of Geoscience, Aarhus University  
- Department of Earth Sciences, University of Aarhus, Århus  
- Department of Geophysics, Niels Bohr Institute, University of Copenhagen, Copenhagen  
- Geographic Institute, University of Copenhagen, Copenhagen  
- Geological Survey of Denmark and Greenland, Copenhagen  
- Geophysical Isotope Laboratory, University of Copenhagen, Copenhagen  
- Natural Science Research Institute, National Museum of Denmark, Copenhagen  
- The Niels Bohr Institute, Department of Geophysics, University of Copenhagen, Copenhagen  
- Riso National Laboratory, Roskilde**

**Estonia  
- Institute of Geology, Tallinn University of Technology, Tallinn**

**Ethiopia  
- Department of Earth Sciences, University of Addis Ababa, Addis Ababa**

**Finland  
- Arctic Centre, University of Lapland, Rovaniemi  
- Department of Biological and Environmental Sciences, University of Helsinki  
- Department of Chemistry, University of Oulu, Oulu  
- Department of Geography, University of Helsinki, Helsinki  
- Department of Geophysics, University of Oulu, Oulu  
- Department of Geology, University of Helsinki, Helsinki  
- Department of Geology, University of Turku, Turku  
- Department of Geosciences and Geography, Division of Geology, University of Helsinki, Helsinki  
- Department of Mathematical Sciences, University of Oulu  
- Department of Mathematics and Statistics, University of Helsinki  
- Department of Quaternary Geology, University of Turku  
- Department of Teacher Education, University of Joensuu, Savonlinna  
- Faculty of Forest Sciences, University of Joensuu, Joensuu  
- Finnish Meteorological Institute, Helsinki  
- Geological Survey of Finland, Kuopio  
- Mekrijarvi Research Station, University of Joensuu, Ilomantsi  
- North Savo Regional Environment Centre, Kuopio  
- Rovaniemi Research Unit, Finnish Forest Research Institute, Rovaniemi  
- SAIMA Unit of Savonlinna Department of Teacher Education, University of Joensuu, Savonlinna  
- The Finnish Forest Research Institute, Rovaniemi  
- Vantaa Research Unit, Finnish Forest Research Institute, Vantaa**

**France  
- Centre Camille Jullian, UMR 6573 CNRS/Aix Marseille Universite, Aix-en-Provence  
- Centre de Bio-Archeologie et d'Ecologie, Institut de Botanique, Montpellier  
- Centre IRD France Nord, Laboratoire d'Oceanographie et du Climat  
- Centre Littoral de Géophysique, Université de La Rochelle  
- CEREGE, BP 80, 13545 Aix-en-Provence cedex 4  
- CEREGE, UMR 6635 CNRS/Aix-Marseille Universite, Aix-en-Provence  
- CNRS, EcoLab, Toulouse  
- Départment de Géologie et Océanographie, Université Bordeaux, Talence  
- Départment de Prehistoire, Museum national d'histoire naturelle, Paris  
- Départment Écologie et Gestion de la Biodiversité du Muséum national d'Histoire naturelle, Centre National de la Recherche Scientifique, Paris  
- Départment Paléoenvironments, Institut des Sciences de l'Evolution, Université de Montpellier II, Montpellier  
- Département Terre-Atmosphe`re-Oce´an and Laboratoire de Me´te´orologie Dynamique/IPSL, Ecole Normale Supe´rieure, Paris  
- DIMAR, Luminy, 13288 Marseille cedex 9  
- EPSHOM, Cellule sédimentologie, Brest  
- Geoarchitecture & Geosciences, Universite Europeenne de Bretagne, Vannes  
- Geosciences Department & Laboratoire de Meteorologie Dynamique, Ecole Normale Superieure, Paris  
- Geosciences Rennes, Universite de Rennes, Rennes Cedex  
- IMEP, UMR 6116 CNRS/Aix-Marseille Universite, Aix-en-Provence  
- Institut des Sciences de l'Evolution de Montpellier, Equipe Paleoenvironments  
- Institut Pierre-Simon Laplace, Bondy cedex  
- Institute of Alpine Geography, University of Grenoble, Grenoble  
- Laboratoire d'Etude de Geo-Environments Marins, Universite de Perpignan  
- Laboratoire de Chrono-Ecologie, Faculté des Sciences et Techniques, Besançon  
- Laboratoire de Chrono-Environnement, UFR Sciences et Techniques, Universite de Franche-Comte  
- Laboratoire de Glaciologie et Géophysique de l'Environment du CNRS, Saint-Martin d'Heres Cedex  
- Laboratoire des Interactions et Dynamique des Environnements de Surface, CNRS-Universite de Paris-Sud, Orsay Cedex  
- Laboratoire des Sciences du Climat et de l'Environnement, Domaine du CNRS  
- Laboratoire des Sciences du Climat et de l'Environnement, Laboratoire mixte CNRS-CEA, Gif-sur-Yvette Cedex  
- Laboratoire des Sciences du Climat et de l'Environment, Unité de recherché mixte CEA/CNRS, Campus du CNRS  
- Laboratoire Ecologie Fonctionnelle et Environment, Universite de Toulouse, Toulouse  
- Laboratoire EDYTEM, Universite de Savoie  
- LODYC, 4 Place Jussieu, 75005 Paris  
- Morphodynamique continentale et côtière, Université de Caen  
- Unite de Modelisation Mathematique et Informatique des Systemes Complexes, Institute de Recherche pour le Developpement et Universite Pierre et Marie Curie  
- University Claude Bernard Lyon, Villeurbanne Cedex  
- Université de Caen, Caen  
- Université de Perpignan, Perpignan**

**Gabon  
- IRSH/GREH, Centre National de Recherche Scientifique et Technique (CENAREST), Libreville  
- Wildlife Conservation Society, Libreville**

**Germany  
- Academy of Sciences, Humanities, and Literature, Mainz  
- Alfred Wegener Institute, Bremerhaven  
- Alfred Wegener Institute for Polar and Marine Research, Research Unit Potsdam  
- Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), Hannover  
- Centre for Environmental Research Leipzig-Halle Ltd. (UFZ), Department of Hydrogeology, Research Group of Palaeoclimatology, Halle  
- Center for Marine Environmental Sciences, University of Bremen, Bremen  
- Center for Tropical Marine Ecology (ZMT), Bremen  
- Climate Dynamics and Landscape Evolution, Potsdam  
- Department of Geography, Climatology, Climate Dynamics and Climate Change, Justus Liebig University of Giessen, Giessen  
- Department of Geography, Johannes Gutenberg University, Mainz  
- Department of Geography, University of Heidelberg, Heidelberg  
- Department of Geosciences, University of Bremen, Bremen  
- Department of Marine Geology, Rostock  
- Deutsches GeoForschungsZentrum Potsdam, Sektion 5.2 Klimadynamik und Landschaftsentwicklung, Potsdam  
- Fachbereich Geowissenschaften, Universität Bremen, Bremen  
- Faculty for Physics and Geoscience, Institute for Geophysics and Geology, University of Leipzig, Leipzig  
- Forschungsstelle Radiometrie, Heidelberger Akademie der Wissenschaften, Heidelberg  
- GeoConsult Rein, Oppenheim  
- GeoForschungsZentrum, Potsdam  
- GEOMAR Research Center for Marine Geosciences, Kiel  
- German Advisory Council on Global Change  
- German Research Centre for Geosciences, Potsdam  
- GKSS Research Centre  
- Heidelberg Academy of Sciences, Institute of Environmental Physics, University of Heidelberg  
- Heidelberg Academy of Sciences, MPI fur Kernphysik, Saupfercheckweg, Heidelberg  
- Heidelberger Akademie der Wissenschaften, Heidelberg  
- Helmholtz Centre for Environment  
- IFM-GEOMAR, Kiel  
- Institut fur Geowissenschaften, Johann Wolfgang Goethe-Universitat, Frankfurt  
- Institut für Geowissenschaften, Johannes Gutenberg-Universität Mainz, Mainz  
- Institut für Geowissenschaften, Universitat Kiel, Kiel  
- Institute for Geology, Technical University for Mining and Technology, Freiberg  
- Institute for Geosciences, University of Mainz, Mainz  
- Institute of Bio- and Geosciences: Agrosphere (IBG-3), Research Centre Juelich, Juelich  
- Institute of Energy and Climate Schence: Stratosphere (IEK-7), Research Centre Juelich, Juelic  
- Institute of Geography, Friedrich-Alexander-University Erlangen-Nurnberg, Erlangen  
- Institute of Geography, Leipzig University, Leipzig  
- Institute of Geography, Stuttgart  
- Institute of Geological Sciences, Freie Universitat Berlin, Berlin  
- Institute of Geology, University of Cologne, Koeln  
- Institut und Museum für Geologie und Paläontologie, Universität Göttingen, Göttingen  
- Leibniz Institute for Baltic Sea Research, Warnemunde  
- Leibniz Institute of Marine Sciences, Kiel  
- MARUM, Universitat Bremen, Bremen, Germany  
- Meteorologisches Institut, Universitat Hamburg, Hamburg  
- Potsdam-Institut fur Klimafolgen-forschung, Potsdam  
- Research Centre Julich, Sedimentary Systems, Julich  
- Steinmann Institute of Geology, Mineralogy and Paleontology, University of Bonn, Bonn  
- University of Hohenheim**

**Hungary  
- Geophysics Research Group, Hungarian Academy of Science, c/o Geophysics Department, Eötvös University, Budapest**

**Iceland  
- Department of Geosciences, University of Iceland, Askja, Reykjavik  
- Earth Science Institute, University of Iceland, Askja, Reykjavik**

**India  
- Birbal Sahni Institute of Palaeobotany, Lucknow  
- Centre of Advanced Study in Geology, Kumaun University, Nainital  
- Department of Geology, Lucknow University, Lucknow  
- Department of Geology and Geophysics, Indian Institute of Technology, Kharagpur  
- Department of Schence and Technology, New Delhi  
- Physical Research Laboratory, Navrangpura, Ahmedabad  
- Wadia Institute of Himalayan Geology, Dehra Dun**

**Ireland  
- Department of Geography, National University of Ireland, Galway  
- Non-institutional**

**Israel  
- Department of Environmental Sciences, The Weizmann Institute of Sciences, Rehovot  
- Geological Survey of Israel, Jerusalem**

**Italy  
- Consiglio Nazionale delle Ricerche, Pisa  
- C.N.R. Centro di Studio per la Geodinamica Alpina e Quaternaria, Milan  
- C.N.R. Centro di Studio per la Geologia Strutturale e Dinamica dell'Appennino, Pisa  
- CNR - ISMAR, Istituto Scienza del Mare, Bologna  
- CNR - Istituto per lo Studio degli Ecosistemi, Verbania Pallanza  
- Department of Chemistry, University of Florence, Florence  
- Dipartimento di Fisica Generale-Universita, Torino  
- Dipartimento di Scienze dell'Ambiente e del Territorio, Universita de Milano, Milano  
- Dipartimento di Scienze della Terra, Istituto di Geoscienze e Georisorse, Universita di Pisa  
- Dipartimento di Scienze Geologiche, Ambientali e Marine, Universita di Trieste, Trieste  
- Dipartimento di Scienze Geologiche e Geotecnologie, Universita di Milano-Bicocca, Milan  
- Dipartimento Scienze della Terra, Universita di Bologna, Bologna  
- ENEA C.R. Casaccia, Santa Maria di Galeria, Rome  
- European Commission-DG Joint Research Centre, Institute for the Protection and Security of the Citizen, Ispra  
- Instituto di Fisica dello Spazio Interplanetario, Torino  
- Museo Tridentino di Scienze Naturali, Trento**

**Japan  
- Aso Volcanological Laboratory, Institute for Geothermal Sciences, Kyoto University, Kumamoto  
- Center for Advanced Marine Core Research, Kochi University, Nankoku, Kochi  
- Center for Chronological Research, Nagoya University, Nagoya  
- Department of Earth and Planetary Sciences, Graduate School of Science, Nagoya University, Nagoya  
- Department of Earth System Science, Faculty of Science, Fukuoka University, Fukuoka  
- Department of Environmental Sciences, Shinshu University, Matsumoto  
- Department of Geography, Tokyo Metropolitan University, Hachioji  
- Department of Geology, Kanazawa University, Kanazawa  
- Department of Geology and Paleontology, National Museum of Nature and Science, Tokyo  
- Earthquake Research Institute, University of Tokyo, Tokyo  
- Environmental Chemistry Division, National Institute for Environmental Studies, Tsukuba, Ibaraki  
- Faculty of Environmental Earth Science, Hokkaido University, Sapporo  
- Forestry and Forest Products Research Institute, Ibaraki  
- Forestry and Forest Products Research Institute, Kyushu Research Center, Kumamoto  
- Forestry and Forest Products Research Institute, Tohoku Research Center, Morioka  
- Geological Survey of Japan, Tsukuba  
- Graduate School of Environmental Earth Science, Hokkaido University, Sappora  
- Graduate School of Environmental Studies, Nagoya University, Nagoya  
- Graduate School of Life and Environmental Sciences, Osaka Prefecture University, Osaka  
- IGG, Geological Survey of Japan, AIST, Tsukuba  
- International Research Center for Japanese Studies, Kyoto  
- Institute for Global Environmental Strategies, Hayama, Kanagawa  
- Institute for Hydrospheric-Atmospheric Sciences, Nagoya University, Nagoya  
- Meteorological Research Institute, Japan Meteorological Agency, Tsukuba  
- National Institute of Polar Research, Itabashi-ku, Tokyo  
- Ocean Research Institute, University of Tokyo, Tokyo**

**Kenya  
- Department of Geology, Chiromo Campus, University of Nairobi, Nairobi**

**Korea  
- Department of Geography, Seoul National University, Seoul  
- Department of Marine Science, Pusan National University  
- Department of Science Education, Chungbuk National University, Chongju, Chungbuk-do  
- Geological and Environmental Hazards Division, Korea Institute of Geoscience and Mineral Resources, Yuseong-gu, Daejeon  
- Marine Environmental & Climate Change Laboratory, Korea Ocean Research and Development Institute  
- Polar Sciences Laboratory, Korea Ocean Research and Development Institute**

**Lithuania  
- Coastal Research and Planning Institute, Klaipeda University, Klaipeda  
- Institute of Geology and Geography, Vilnius  
- The Institute of Baltic Region History and Archaeology, Klaipeda University, Klaipeda**

**Mexico  
- Departamento do Ecologia y Recursos Naturales, Facultad de Ciencias, Universidad Nacional Autónoma de México  
- Departamento de Ecologia y Recursos Naturales-IMECBIO, Centro Universitario de la Costa Sur, Universidad de Guadalajara, Jalisco  
- El Colegio De La Frontera Sur, Herbario, Chetumal, Quintana Roo  
- Laboratorio de Paleomagnetismo y Paleoambientes, Instituto de Geofisica, Universidad Nacional Autonoma de Mexico, Ciudad Universitaria, Coyoacan  
- Universidad Michoacana de San Nicolas de Hidalgo, Francisco J. Mujica S/N, Ciudad Universitaria, Edifico R. Morelia, Michoacan**

**Monaco  
- International Atomic Energy Agency, Marine Environment Laboratories, Monaco**

**Nepal  
- Department of Geology, Tribhuvan University, Kathmandu**

**Netherlands  
- Centre for Isotope Research, University of Groningen, Groningen  
- Department of Geosciences, Utrecht University, Utrecht  
- Department of Marine Biogeology, Faculty of Earth and Life Sciences, VU University of Amsterdam, De Boelelaan, Amsterdam  
- Department of Marine Geology, Royal Netherlands Institute for Sea Research, Texel  
- Department of Marine Organic Biogeochemistry, Royal Netherlands Institute for Sea Research (NIOZ), Texel  
- Institute for Biodiversity and Ecosystem Dynamics (IBED), Paleoecology and Landscape Ecology, University of Amsterdam  
- Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam  
- Institute for Marine and Atmospheric Research Utrecht, Utrecht University, Utrecht  
- Laboratory of Palaeobotany and Palynology, Institute of Environmental Biology, Utrecht University, Utrecht  
- NIOZ Royal Netherlands Institute for Sea Research, Department of Marine Organic Biogeochemistry, Den Burg  
- Palaeoecology, Institute of Environmental Biology, Faculty of Science, Utrecht University, Utrecht  
- Section of Ecology and Biodiversity, Faculty of Science, Institute of Environmental Biology, Utrecht University, Utrecht**

**New Caledonia  
- Institut de recherche pour le developpement Noumea cedex**

**New Zealand  
- Antarctic Research Centre, Victoria University, Wellington  
- Chemistry Department, University of Waikato, Hamilton  
- Gondwana Tree-ring Laboratory, Little River  
- Joint Antarctic Research Institute, Victoria University and GNS Science, Wellington  
- Manaaki Whenua Landcare Research, Palmerston North  
- National Institute of Water and Atmospheric Research Ltd.  
- School of Geography, Geology and Environmental Science, University of Auckland, Auckland  
- Wildlands Consultants Ltd.**

**Norway  
- Bergen Museum, University of Bergen, Bergen  
- Botanical Institute, University of Bergen, Bergen  
- Bjerknes Centre for Climate Research, University of Bergen, Bergen  
- Centre for Ecological and Evolutionary Synthesis, Department of Biology, University of Oslo, Oslo  
- Department of Biology, University of Bergen, Bergen  
- Department of Culture Studies and Oriental Languages, University of Oslo, Oslo  
- Department of Earth Science, University of Bergen, Bergen  
- Department of Geography, University of Bergen, Bergen  
- Department of Geology, University of Oslo, Olso  
- Department of Geology, University of Tromsø, Tromsø  
- Department of Mathematics and Statistics, Faculty of Science and Technology, University of Tromsø, Tromsø  
- Geological Institute, University of Bergen, Allégaten, Bergen  
- Geological Survey of Norway, Trondheim  
- Nansen Environmental and Remote Sensing Center, Bergen  
- Norwegian Fishery College, University of Tromsø, Tromsø  
- Norwegian Polar Institute, Polar Environmental Centre, Tromsø  
- Norwegian University of Technology and Science, Trondheim  
- SINTEF Fisheries and Aquaculture, Trondheim  
- University Centre in Svalbard, Longyearbyen**

**Poland  
- Department of Palaeoceanology, University of Szczecin, Szczecin  
- Department of Plant Ecology, University of Gdańsk, Gdańsk  
- Institute of Geological Sciences, Polish Academy of Sciences, Warsaw  
- Institute of Marine and Coastal Sciences, University of Szczecin, Szczecin**

**Portugal  
- Centro de Investigacao marinha e Ambiental, Porto  
- Departamento de Geologia Marinha, INETInovação, Estrada da Portela - Zambujal, Amadora  
- Department of Geoscience, University of Azores  
- Instituto Nacional de Investigação Agrária e das Pescas (INIAP), Lisboa  
- Laboratorio Nacional de Energia e Geologia, Unidade de Geologia Marinha, Amadora  
- Marine Geology Department, National Institute of Engineering, Technology and Innovation-INETI, Alfragide**

**Russia  
- A.N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Moscow  
- Cosmic Ray Laboratory, A.F. Ioffe Physico-Technical Institute, St. Petersburg  
- Dynamical-Stochastical Laboratory, Hydrometeorological Research Centre of Russia, Moscow  
- Geophysics and Mineralogy, United Institute of Geology, Novosibirsk  
- Institute of Archaeology, Russian Academy of Sciences, Moscow  
- Institute of Arid Zones, Southern Scientific Center, Russian Academy of Sciences, Rostov-on-Don  
- Institute of Geography, Russian Academy of Sciences, Moscow  
- Institute of Geology, URS Russian Academy of Sciences, Ufa  
- Institute of Geophysics, UB Russian Academy of Sciences, Ekaterinburg  
- Institute of Plant and Animal Ecology, Ural Branch, Russian Academy of Sciences, Ekaterinburg  
- Limnological Institute, Irkutsk  
- Moscow State University, Moscow  
- Murmansk Marine Biological Institute, Kola Scientific Center, Russian Academy of Sciences, Murmansk  
- Shirshov Institute of Oceanography, Russian Academy of Sciences, Moscow  
- Southern Scientific Center, Russian Academy of Sciences, Rostov-on-Don  
- Sukachev Institute of Forest, Siberian Division, Russian Academy of Sciences, Akademgorodok, Krasnoyarsk  
- Trofimuk United Institute of Geology, Geophysics and Mineralogy, Novosibirsk  
- West-Siberian Center of Monitoring on Environment Pollution, Novosibirsk**

**South Africa  
- Archaeology Department, University of the Witwatersrand  
- Climatology Research Group, University of the Witwatersrand  
- Dating Research Unit, CSIR, Pretoria  
- Department of Archaeology, University of Cape Town  
- Department of Plant Sciences, University of the Free State  
- Quaternary Dating Research Unit, CSIR  
- School of Geosciences, University of the Witwatersrand**

**Spain  
- Centro Nacional de Investigacion sobre la Evolucion Humana CENIEH, Paseo Sierra de Atapuerca, Burgos  
- Ciemat, Dpt. Medioambiente, Avda, Madrid  
- Consejo Superior de Investigaciones Ceintificas, Centro de Ciencias Medioambientales, Madrid  
- CSIC\_UB Limnology Group, Centre for Advanced Studies of Blanes, Blanes  
- Departament de Biologia Animal, Vegetal, i Ecologia, Universitat Autonoma de Barcelona, Barcelona  
- Departamento de Edafologia y Quimica Agricola, Santiago de Compostela  
- Department of Earth Sciences, University of Zaragoza, Zaragoza  
- Department of Ecology, Faculty of Biology, University of Barcelona, Barcelona  
- Department of Environmental Chemistry, Institute of Chemical and Environmental Research (CSIC), Barcelona  
- Department of Geology, University of Alcala, Madrid  
- Department of Prehistory, Ancient History and Archaeology, University of Barcelona, Barcelona  
- Department of Stratigraphy, University Complutense of Madrid, Madrid  
- Direccion de Geologia y Geofisica, Instituto Geologico y Minero de Espana, Madrid  
- Direccion de Recursos Minerales y Geoambiente, Instituto Geologico y Minero de Espana, Madrid  
- GRC Marine Geosciences, Universidad de Barcelona, Barcelona  
- Institut Botanic de Barcelona, Barcelona  
- Institute of Earth Sciences Jaume Almera, Consejo Superior de Investigaciones Cientificas, Barcelona  
- Instituto Andaluz de Ciencias de la Tierra (CSIC-UGR), Armilla, Granada  
- Instituto de Geosciencias (CSIC-UCM), Facultad de Ciencias Geologicas, Madrid  
- Instituto Pirenaico de Ecologia (C.S.I.C.), Zaragoza  
- Marine and Environmental Geology Group, Department of Marine Geosciences, University of Vigo, Vigo  
- Museo nacional de Ciencias Naturales, Madrid**

**Sweden  
- Angstrom Laboratory, Division of Ion Physics, Uppsala  
- Climate Impact Research Centre, Umed University, Abisko  
- Department of Earth Sciences-Marine Geology, Goteborg University, Goteborg  
- Department of Earth Sciences, Uppsala University, Uppsala  
- Department of Earth Sciences, Palaeobiology Program, Uppsala University  
- Department of Ecology and Environmental Science, Umea University, Umea  
- Department of Forest Ecology and Management, Swedish University of Agricultural Sciences, Umea  
- Department of Geology and Geochemistry, Stockholm University, Stockholm  
- Department of Meteorology, Stockholm University, Stockholm  
- Department of Natural Sciences, Mid Sweden University, Sundsvall  
- Department of Oceanography, Earth Sciences Centre, Goteborg University, Goteborg  
- Department of Physical Geography, Stockholm University  
- Department of Physical Geography, Umea University, Umea  
- Department of Physical Geography and Quaternary Geology, Stockholm University  
- Department of Quaternary Geology, Lund University, Lund  
- Department of Quaternary Geology, Stockholm University  
- Department of Quaternary Research, Stockholm University, Stockholm  
- Earth Sciences Center, Göteborg University  
- GeoBiosphere Science Centre, Quaternary Sciences, Lund University, Solveg  
- Regional Climate Group, Department of Earth Sciences, University of Gothenburg, Gothenburg**

**Switzerland  
- Climate and Environmental Physics, Physics Institute, University of Bern, Bern  
- Department of Chemistry and Biochemistry, University of Bern, Bern  
- Department of Environmental Sciences, University of Basel, Basel  
- Department of Geography, University of Berne, Bern  
- Department of Geography, University of Zurich-Irchel, Zurich  
- Department of Surface Waters - Eawag, Dubendorf  
- EAWAG, Swiss Federal Institute of Aquatic Science and Technology, Department of Surface Waters, Duebendorf  
- Eidgenossische Technische Hochschule, Geologisches Institut, Zurich  
- Geological Institute, ETH Zurich, Zurich  
- Geological Institute, University of Bern  
- Institut de Mineralogie et Petrographie, Lausanne  
- Institut des Sciences de l'Environnement (ISE), Department of Geology and Paleontology, University of Geneva, Geneve  
- Institut fur Geologie, Isotopengeologie, Universitat Bern, Berne  
- Institute of Geography, Climatology and Meteorology, University of Bern, Bern  
- Institute of Geography, University of Bern, Bern  
- Institute of Geography, University of Lausanne, Lausanne  
- Institute of Geological Sciences, University of Bern, Bern  
- Institute of Particle Physics, ETH-Hoenggerberg, Zurich  
- Institute of Plant Sciences, University of Bern, Bern  
- Laboratory of Radiochemistry and Environmental Chemistry, Paul Scherrer Institute, Villigen  
- Limnoceane, Institut de Geologie, Neuchatel  
- LimnoPaleoServ, Lyss  
- National Centre of Competence in Research on Climate, Bern  
- Natural History Museum of the Canton Ticino, Lugano  
- NCCR Climate, University of Bern, Bern  
- Oeschger Centre for Climate Change Research, University of Bern, Bern  
- PAGES International Project Office, Bern  
- Paul Scherrer Institut, Laboratory of Atmospheric Chemistry  
- SURF-EAWAG, Duebendorf  
- Swiss Federal Research Institute, Dendro Sciences Unit, Birmensdorf  
- Swiss Federal Research Institute for Forest, Snow and Landscape Research, Birmensdorf**

**Taiwan  
- Biodiversity Research Center, Academia Sinica, Nankang, Taipei  
- Department of Life Sciences, National Taiwan University, Taipei  
- Institute of Earth Sciences, Academia Sinica, Taipei  
- Institute of Ecology and Evolutionary Biology, National Taiwan University, Taipei  
- Research Center for Environmental Change, Academia Sinica, Nankang, Taipei**

**United Kingdom  
- British Antarctic Survey, Natural Environment Research Council (NERC)  
- Centre for Environmental Change and Quaternary Research, GEMRU, University of Gloucestershire, Cheltenham  
- Centre for Environmental Research, University of Sussex, Brighton  
- Centre for Quaternary Science, Coventry University, Coventry  
- Climatic Research Unit, School of Environmental Sciences, University of East Anglia, Norwich  
- Department of Earth Sciences, University of Oxford, Oxford  
- Department of Entomology, Natural History Museum, London  
- Department of Geography, Durham University, Durham  
- Department of Geography, Swansea University, Swansea  
- Department of Geography, University College London  
- Department of Geography, University of Exeter, Exeter  
- Department of Geography, University of Newcastle, Newcastle upon Tyne  
- Department of Geography, University of Southampton, Highfield, Southampton  
- Department of Geography, University of Wales, Swansea  
- Department of Mathematical Sciences, University of Liverpool, Liverpool  
- Department of Mathematics and Information Science, Coventry University, Coventry  
- Environmental Archaeology Unit, University of York  
- Environmental Change Research Centre, University College London, London  
- Institute of Geography, School of Geosciences, University of Edinburgh, Edinburgh  
- Institute of Geography and Earth Sciences, University of Wales, Aberystwyth  
- Long-term Ecology Laboratory, Oxford University Centre for the Environment, School of Geography, South Parks Road, Oxford  
- NERC Isotope Geosciences Laboratory, British Geological Survey, Nottingham  
- Palaeoecology Laboratory, Department of Geography, University of Southampton, Southampton  
- Petroleum and Environmental Geochemistry Group, University of Plymouth, Drake Circus, Plymouth  
- School of Biological and Biomedical Sciences, University of Durham, Durham  
- School of Earth, Ocean and Environmental Sciences, University of Plymouth, Drake Circus, Plymouth  
- School of Earth and Environment, University of Leeds, Leeds  
- School of Geography, Archaeology and Palaeoecology, Queen's University, Belfast, Northern Ireland  
- School of Geography, University of Nottingham, Nottingham  
- School of Geography and Geosciences, University of St. Andrews, St. Andrews  
- School of Geography and the Environment, University of Oxford, Oxford  
- School of GeoSciences, Grant Institute, Edinburgh University, Edinburgh  
- School of GeoSciences, University of Edinburgh, Edinburgh  
- School of Ocean Sciences, Bangor University, Anglesey  
- Scott Polar Research Centre, Cambridge University, Cambridge  
- The Godwin Laboratory, Department of Earth Sciences, University of Cambridge, Cambridge  
- The Organic Geochemistry Unit, Bristol Biogeochemistry Research Centre, School of Chemistry, University of Bristol, Bristol  
- York Archaeological Trust for Excavation and Research, Aldwark, York**

**United States  
- Atmospheric Sciences Research Center, State University of New York, Albany, NY  
- Big Sky Institute, Montana State University, Bozeman, MT  
- Biodiversity Research Center and Natural History Museum, University of Kansas, Lawrence, KS  
- Byrd Polar Research Center, Ohio State University, Columbus, OH  
- Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratories, Livermore, CA  
- Center for Climatic Research, University of Wisconsin, Madison, WI  
- Center for Environmental Sciences and Quaternary Sciences Program, Northern Arizona University, Flagstaff, AZ  
- Center for Isotope Geochemistry, Lawrence Berkeley National Laboratory, Berkeley, CA  
- Center for Materials Research and Education, Smithsonian Institution, Suitland, MD  
- Center for Sustainability and the Global Environment, Nelson Institute for Environmental Studies, University of Wisconsin-Madison, Madison, WI  
- Climate Change Institute, University of Maine, Orono, ME  
- Climate Change Research Center, University of New Hampshire, Durham, NH  
- Climate System Research Center, Department of Geosciences, University of Massachusetts, Amherst, MA  
- Coastal and Marine Geology, U.S. Geological Survey, Menlo Park, CA  
- College of Forest Resources, University of Washington, Seattle, WA  
- College of Marine Science, University of South Florida, St. Petersburg, FL  
- College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR  
- Cooperative Institute for Research in Environmental Sciences, University of Colorado at Boulder, Boulder, CO  
- Department of Anthropology, University of California at San Diego, La Jolla, California  
- Department of Anthropology, University of Wisconsin, Madison, WI  
- Department of Anthropology, Washington State University, WA  
- Department of Anthropology, Western State College, Gunnison, CO  
- Department of Atmospheric and Environmental Sciences, University at Albany-State University of New York, Albany, NY  
- Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles, CA  
- Department of Atmospheric and Oceanic Sciences, University of Colorado at Boulder, Boulder, CO  
- Department of Biological Sciences, Florida International University, Miami, FL  
- Department of Biological Sciences, University of Alaska, Anchorage, AK  
- Department of Biological Sciences, University of North Carolina, NC  
- Department of Biology, Colorado State University, Fort Collins, CO  
- Department of Biology, Middlebury College, Middlebury, VT  
- Department of Biology, University of California, Los Angeles, CA  
- Department of Biology, University of California, Santa Cruz, CA  
- Department of Botany, University of Wisconsin, Madison, WI  
- Department of Botany, University of Wyoming, Laramie, WY  
- Department of Chemistry, State University of New York-ESF, Syracuse, NY  
- Department of Computer Science, University of Maine, Orono, ME  
- Department of Earth and Environmental Sciences, Lehigh University, Bethlehem, PA  
- Department of Earth and Ocean Sciences, University of South Carolina, Columbia, SC  
- Department of Earth and Planetary Science, University of New Mexico, Alburquerque, NM  
- Department of Earth and Planetary Sciences, Rutgers, The State University, New Brunswick, NJ  
- Department of Earth and Space Sciences, University of Washington, Seattle, WA  
- Department of Earth Sciences, California State University, Dominguez Hills, Carson, CA  
- Department of Earth Sciences, Heroy Geology Laboratory, Syracuse University, Syracuse, NY  
- Department of Earth Sciences, Indiana University - Purdue University, Indianapolis, IN  
- Department of Earth Sciences, Montana State University, Bozeman, MT  
- Department of Earth Sciences, Syracuse University, Syracuse, NY  
- Department of Earth Sciences, University of California, Riverside, CA  
- Department of Earth Sciences, University of California, Santa Cruz, CA  
- Department of Earth Sciences, University of Maine, Orono, ME  
- Department of Earth Sciences, University of New Hampshire, Durham, NH  
- Department of Earth Sciences, University of Southern California, Los Angeles, CA  
- Department of Ecology and Evolutionary Biology, University of California, Los Angeles, CA  
- Department of Ecology and Evolutionary Biology and Laboratory of Tree-Ring Research, The University of Arizona, Tucson, AZ  
- Department of Ecology and Limnological Research Center, University of Minnesota, Minneapolis, MN  
- Department of Geography, Colgate University, Hamilton, NY  
- Department of Geography, Ohio State University, Columbus, OH  
- Department of Geography, University of California, Berkeley, CA  
- Department of Geography, University of California-Los Angeles, Los Angeles, CA  
- Department of Geography, University of Georgia, Athens, GA  
- Department of Geography, University of South Florida, Tampa, FL  
- Department of Geography, University of Wisconsin, Madison, WI  
- Department of Geography, University of Wyoming, WY  
- Department of Geological Sciences, Brown University, Providence, RI  
- Department of Geological Sciences, California State University, Long Beach, CA  
- Department of Geological Sciences, Land Use and Environmental Change Institute (LUECI), University of Florida, FL  
- Department of Geological Sciences, Ohio State University, Columbus, OH  
- Department of Geological Sciences, University of Colorado, Boulder, CO  
- Department of Geological Sciences, University of South Carolina, Columbia, SC  
- Department of Geology, Bates College, Lewiston ME  
- Department of Geology, Baylor University, Waco, TX  
- Department of Geology, Middlebury College, Middlebury, VT  
- Department of Geology, Northern Arizona University, Flagstaff, AZ  
- Department of Geology, The College of Wooster, Wooster, OH  
- Department of Geology, University of Akron, Akron, OH  
- Department of Geology, University of Cincinnati, Cincinnati, OH  
- Department of Geology, University of Georgia, Athens, GA  
- Department of Geology, University of Illinois at Urbana-Champaign, Urbana, IL  
- Department of Geology, University of Texas at Arlington, TX  
- Department of Geology and Geography, Mount Holyoke College, South Hadley, MA  
- Department of Geology and Geophysics, University of California, Berkeley, CA  
- Department of Geology and Geophysics, University of Minnesota, Minneapolis, MN  
- Department of Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole, MA  
- Department of Geology and Planetary Science, University of Pittsburgh, Pittsburgh, PA  
- Department of Geoscience, University of Wisconsin, Madison, WI  
- Department of Geosciences, Climate System Research Center, University of Massachusetts, Amherst, MA  
- Department of Geosciences, Morrill Science Center, University of Massachusetts, Amherst, MA  
- Department of Geosciences, University of Arizona, Tucson, AZ  
- Department of Geosciences, University of Arkansas, Fayetteville, AR  
- Department of Geosciences, University of Massachusetts, Amherst, MA  
- Department of Geosciences, University of Nebraska, Lincoln, NE  
- Department of Marine Chemistry and Geochemistry, Woods Hole Oceanographic Institution, Woods Hole, MA  
- Department of Marine Science, University of South Florida, St. Petersburg, FL  
- Department of Marine Sciences, University of Puerto Rico, Mayaguez, Puerto Rico  
- Department of Meteorology, University of Wisconsin, Madison, WI  
- Department of Plant Biology, University of Illinois, Urbana, IL  
- Department of Statistics, Baylor University, Waco, TX  
- Desert Laboratory, U.S. Geological Survey and University of Arizona, Tucson, AZ  
- Earth and Environmental Science Program, New York University, NY  
- Earth and Environmental Systems Institute, Pennsylvania State University, University Park, PA  
- Earth and Ocean Sciences, Nicolas School of the Environment and Earth Sciences, Duke University, Durham, NC  
- Environmental Science Department, Alaska Pacific University, Anchorage, AK  
- Environmental Studies Program, Yale University, New Haven, CT  
- EROS, U.S. Geological Survey, Sioux City, SD  
- Florida Coastal Everglades Long-Term Ecological Research Program, Florida International University, Miami, FL  
- Florida Integrated Science Center, United States Geological Survey, St. Petersburg, FL  
- Geography Department, Pennsylvania State University, University Park, PA  
- Geology and Planetary Science, University of Pittsburgh, Pittsburgh, PA  
- Geology Department, State University of New York College at Cortland, Cortland, NY  
- Illinois State Geological Survey, Champaign, IL  
- Institute for Quaternary and Climate Studies, University of Maine, Orono, ME  
- Institute for the Study of Planet Earth, University of Arizona, Tucson, AZ  
- Institute of Arctic and Alpine Research, University of Colorado, Boulder, CO  
- Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA  
- Institute of Marine and Coastal Sciences, Rutgers, The State University, New Brunswick, NJ  
- Institute of Marine Studies, University of California, Santa Cruz, CA  
- Jackson School of Geosciences, University of Texas at Austin, Austin, TX  
- Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY  
- Large Lakes Observatory, University of Minnesota Duluth, Duluth, MN  
- Lawrence Livermore National Laboratory, Livermore, CA  
- Lawrence Livermore National Laboratory, Center for Accelerated Mass Spectrometry, Livermore, CA  
- Limnological Research Center and Department of Geology and Geophysics, University of Minnesota, Minneapolis, MN  
- Lone Pine Research, Bozeman, MT  
- Massachusetts Institute of Technology, Cambridge, MA  
- Mountain Research Center and Department of Biology, Montana State University, Bozeman, MT  
- Museum of Comparative Zoology, Harvard University, Cambridge, MA  
- NASA/Goddard Institute for Space Studies, New York, NY  
- National Center, U.S. Geological Survey, Reston, VA  
- National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, CA  
- National Institutes of Health, Bethesda, MD  
- National Science Foundation-Arizona Accelerator Facility for Isotope Dating, University of Arizona, Tucson, AZ  
- Natural Resources Division, Paul Smith's College, Paul Smiths, NY  
- Nicholas School of the Environment and Earth Sciences, Duke University, Durham, NC  
- NOAA Paleoclimatology Program, Boulder, CO  
- NSF-Arizona AMS Facility, The University of Arizona, Tucson, AZ  
- Pacific Fisheries Environmental Laboratory, Pacific Grove, CA  
- Program in Ecology and Evolutionary Biology, University of Illinois at Urbana-Champaign, Urbana, IL  
- Radioactive Waste Management Associates, Bellows Falls, VT  
- Raytheon Polar Services, Centennial, CO  
- Rosenstiel School of Marine and Atmospheric Sciences, University of Miami, Key Biscayne, FL  
- School of Earth Sciences, Stanford University, Stanford, CA  
- School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook  
- School of Natural Resources, University of Nebraska, Lincoln, NE  
- School of Natural Science, Hampshire College, Amherst, MA  
- School of Public and Environmental Affairs, Indiana University, Bloomington, IN  
- Scripps Institution of Oceanography, La Jolla, CA  
- Sierra Nevada Research Center, Pacific Southwest Research Station, USDA Forest Service, Berkeley, CA  
- Skidaway Institute for Oceanography, Savannah, GA  
- South Florida Water Management District, West Palm Beach, FL  
- Southeast Environmental Research Center, Florida International University, Miami, FL  
- St. Croix Watershed Research Station, Science Museum of Minnesota, Marine on St. Croix, MN  
- Tree-Ring Laboratory, Lamont-Doherty Earth Observatory, Columbia University, NY  
- Tree-Ring Laboratory, Lamont-Doherty Earth Observatory, Palisades, NY  
- Tree Ring Laboratory, University of Arizona, Tucson, AZ  
- University of Maine, Department of Geological Sciences, ME  
- U.S. Environmental Protection Agency, Atlanta, GA  
- U.S. Fish and Wildlife Service, Anchorage, AK  
- U.S. Geological Survey, Center for Coastal and Marine Geology, St. Petersburg, FL  
- U.S. Geological Survey, Denver, CO  
- U.S. Geological Survey, Eastern Surface Processes Team, Reston, VA  
- U.S. Geological Survey, Menlo Park, CA  
- U.S. Geological Survey, Santa Cruz, CA  
- U.S. Geological Survey, St. Petersburg, FL  
- White Mountain Research Station, Bishop, CA  
- Woods Hole Oceanographic Institution, Woods Hole, MA**

**Uruguay  
- Grupo de Investigacion en Ecologia, Conservacion y Rehabilitacion de Sistemas Acuaticos Continentales, Universidad de la Republica, Montevideo  
- Laboratorio Datacion 14C, Catedra de Radioquimica, Facultad de Quimica, Universidad de la Republica, Montevideo  
- Museo Nacional de Antropologia (MEC), Montevideo  
- Seccion Oceanologia, Maestria en Ciencias Ambientales, Instituto de Ecologia y Ciencias Ambientales, Facultad de Ciencias, Universadad de la Republica, Montevideo  
- UNCIEP, Instituto de Ecologia y Ciencias Ambientales, Facultad de Ciencias, Universidad de la Republica, Montevideo**

**Venezuela  
- Departamento de Ciencias de la Tierra, Universidad Pedagogica Experimental Libertador, Caracas  
- Estacion de Investigaciones Marinas de Margarita, Fundacion La Salle de Ciencias Naturales, Porlamar**

**Vietnam  
- Northern Mapping Division, DGMV, Hanoi**

**Kilder:**

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