Characterizing Historical and Paleoclimate Aerosol Radiative Effects Workshop

Agenda (last updated 10/16)

October 20 – October 22, 2025

Meeting Venue and Location

Lamont-Doherty Earth Observatory
61 Route 9W
Palisades, New York 10964-1000 USA

The meeting will take place in the Comer Seminar Room, located at the rear of the first floor of the Comer Geochemistry Building (Building #15 on the LDEO campus map).

Online Participation

- https://columbiauniversity.zoom.us/j/91327515461?pwd=rXZTp1JNTQlzYBFv7ubOvRghRcljwi.1
- Meeting ID: 913 2751 5461
- Passcode: 097813

Participant Resources

- Abstracts
- Participant List
- Biographies
- Workshop Logistics

Workshop Ombudspersons

The Workshop Ombudspersons are designated contacts you can reach out to if you feel uncomfortable or encounter any issues during the workshop. They are neutral, confidential, and here to listen, provide guidance, and help ensure that everyone can participate in a safe and welcoming environment.

- Natalie Mahowald, mahowald@cornell.edu
- Kostas Tsigaridis, kostas.tsigaridis@columbia.edu

Local Contact

If you encounter any issues or have questions while traveling to or arriving at the workshop, please reach out to:

- Hannah Liddy, +1 (315) 571-4496

PLEASE NOTE: All times are in Eastern Standard Time

Workshop Goals

- Refining historical aerosol emission estimates by integrating data on emission sources with paleoproxy records for dust and wildfires.

- Characterizing uncertainty in paleoclimate aerosol emissions and radiative forcing, including developing uncertainty bounds that align with available observations.

- Constraining aerosol radiative effects from the preindustrial-to-present, assessing whether models can accurately reproduce observed aerosol trends.

- Scoping AEROHISTMIP, a new model intercomparison project to integrate multiple aerosol emission pathways into historical climate model simulations conducted for CMIP to assess aerosol radiative forcing uncertainty.

- Inspiring new paleoclimate proxy development to improve spatial and temporal coverage of key aerosol types beyond dust and fire, helping to bridge gaps between proxy data and modeling needs.

Sunday, October 19

Participant Arrivals

6:00 – 9:00 pm Welcome dinner at the Tarrytown House

- Dinner buffet is located in the Biddle Mansion; available between 6:00-9:00 pm

Monday, October 20

Session 1. Setting the stage

9:00 am Welcome and introductions

9:30 am Importance of historical and paleoclimate aerosol radiative effects – Natalie Mahowald (Cornell University)

9:50 am Workshop goals and context – Kostas Tsigaridis (Columbia University)

Session 2: Dust activity and the resulting aerosol radiative effects since the Last Glacial Maximum

10:00 am Radiative forcing due to historical increase in desert dust – Jasper Kok (UCLA)

10:20 am Lightning Talks

- **10:20 LIGHTNING TALK – History of North African dust emissions over the last 200,000 years**
  David McGee, MIT

- **10:25 LIGHTNING TALK – Understanding the Global Dust Cycle Across Present and Past Climates with Paleo Records and Modeling**
  - Bingqing Zhang, *University of Chicago*

- **10:30 LIGHTNING TALK – Dynamics of the Southern Hemisphere westerlies inferred from Tasman Sea dust flux records throughout the last glacial cycle**
  - *Aviva Intveld, Lamont-Doherty Earth Observatory*

- **10:35 LIGHTNING TALK – South American dust ocean fertilisation: Ironing out paleo-to-present observational challenges**
  - *Nicolás Cosentino, CIMA (Argentina), IFAECI (Argentina-France)*

- **10:40 LIGHTNING TALK – On the role of Holocene land use change on dust mobilization in West Africa**
  - *Jed Kaplan, Department of Earth, Energy, and Environment, University of Calgary*

10:45 am Coffee Break

11:00 am What can climate archives tell us about dust fluxes in the past? – Gisela Winckler (Columbia University) and Jordan Abell (Lehigh University)

11:20 am Lightning Talks

- **11:20 LIGHTNING TALK – The Dos, Don'ts, and Don't Knows of Marine Dust Deposition and its Climatic Relevance in the Past: Lessons from the Pliocene**
  - *Jordan Abell, Lehigh University*

- **11:25 LIGHTNING TALK – A global compilation of quality controlled, time- and size-resolved records of paleodust deposition**
  - *Samuel Albani, University of Milano-Bicocca*

- **11:30 LIGHTNING TALK – Pre-industrial to present day changes in aerosol deposition from two Greenland ice cores**
  - *Nathan Chellman, Desert Research Institute*

- **11:35 LIGHTNING TALK – An estimate of direct radiative forcing by dust aerosols during the Last Glacial Maximum**
  - *Ron Miller, NASA GISS*

11:40 pm Plenary discussion: Reflections and orienting questions

12:00 pm Lunch Break

- Lunch
- Core Repository Tour
- Poster Session

1:30 pm Breakout group: Characterizing uncertainty

2:25 pm Plenary shareout and discussion of paleodust proxies

3:00 pm Coffee Break

3:15 pm World Café on emerging themes

4:15 pm Plenary shareout and discussion of emerging themes

4:30 pm End of Day

- Shuttle picks up at 4:30 pm

5:00 – 6:30 pm Group Dinner

Location: Goosefeather located in the King Mansion at Tarrytown House Estate.

Tuesday, October 21

9:00 am Welcome: Summary/Key Points from Day 1

Session 3. Setting the stage

9:10 am The challenge of constraining Earth System Sensitivity – Gavin Schmidt (NASA GISS, Columbia University)

Session 4. Fire activity and the resulting aerosol radiative effects since the Last Glacial Maximum

9:30 am Global fire modeling, current status and advances – Stijn Hantson (Universidad del Rosario)

9:50 am Re-assessment of Pre-Industrial to Present Day Changes in Fire Regimes: Comparison to CMIP6 and Impacts for Aerosol Radiative Forcing Estimate – Douglas Hamilton (North Carolina State University)

10:10 am Reconstructing Past Fires from Charcoal to Molecular Markers – Jennifer Marlon (Yale University)

10:30 am Coffee break

10:45 am Lightning talks

- **10:45 LIGHTNING TALK – Global Biomass Burning Emissions: Integrating CMIP6 and FireMIP Simulations with Satellite and Charcoal Observations**
    - *Fang Li, Institute of Atmospheric Physics, Chinese Academy of Sciences*

- **10:50 LIGHTNING TALK – Archives of Fire Emission Products and Dust: Insights from Peruvian and Tibetan Ice Cores**
    - *Emilie Beaudon, School of Earth Sciences, The Ohio State University, Byrd Polar and Climate Research Center*

- **10:55 LIGHTNING TALK – Changes in biomass burning in Africa since the last glacial: a new synthesis of burning on the fire continent**
    - *Nicholas O'Mara, Yale University*

- **11:00 LIGHTNING TALK – Past, Present, and Future Area Burned in the Western United States**
    - *Chris Guiterman, CIRES, University of Colorado; NOAA's National Centers for Environmental Information*

- **11:05 LIGHTNING TALK – Hemispheric black carbon increase after 13th-century settlement of New Zealand**
  - *Joe McConnell, DRI*

- **11:10 LIGHTNING TALK – Delineating the spatial reliability of sedimentary charcoal as a recorder of fire history**
  - Richard Vachula, *Auburn University*

- **11:15 LIGHTNING TALK – Sensitivity of anthropogenic cloud droplet number change to preindustrial emission inventories**
  - *Hunter Brown, University of Wyoming*

11:20 am Plenary discussion: Reflections and orienting questions

12:00 pm Lunch Break

- Lunch
- Tree Ring Lab tour
- Poster session

1:30 pm Breakout group: Characterizing uncertainty

2:30 pm Plenary shareout

3:00 pm World Café on emerging themes

3:30 pm Coffee break

3:45 pm Plenary shareout and discussion

5:30 pm Break & small group dinner sign-ups

Wednesday, October 22

9:00 am Welcome: Summary/Key Points from Day 2

Session 5: Volcanic and other natural aerosol reconstructions and the resulting aerosol radiative effects since the Last Glacial Maximum

9:10 am Volcanic forcing within PMIP/CMIP – Michael Sigl, online (University of Bern)

9:30 Lightning talks

- **LIGHTNING TALK – Modeling Volcanic Ash Impacts of the 2010 Eyjafjallajökull Eruption with CESM2**
  - Lily Wu, *Cornell University*

- **LIGHTNING TALK – Are Volcanic Impacts on Global Climate *Overblown*?**
    - Zachary McGraw, *Columbia University*

- **LIGHTNING TALK – Using interhemispheric thermal contrast to constrain effective radiative forcing due to aerosol-cloud interactions**
    - Chengfei He, *Northeastern University*

- **LIGHTNING TALK – Aerosol and greenhouse gas forcing drives recent trends in the Pacific Decadal Oscillation**
    - Jeremy Klavans, *University of Miami*

- **LIGHTNING TALK – The role of transport in New York's Air Quality impacts from the 2023 Canadian Wildfires.**
    - Adwoa Aboagye-Okyere, *Cornell University*

9.55 am Plenary discussion

10:05 am Breakout groups

10:30 am Coffee break

10:45 am Plenary report back

11:00 State of the workshop and getting specific on sustaining momentum

11:50 am Concluding Statements – Planning Committee

12:00 pm Lunch provided

Afternoon departures

- *Shuttle to Manhattan departs at 1:00 pm. The shuttle will drop you off at 576 W 125th St., from where you can take the 1 subway line directly to Penn Station, a major transportation hub.*

Abstracts

LIGHTNING TALK – The Dos, Don'ts, and Don't Knows of Marine Dust Deposition and its Climatic Relevance in the Past: Lessons from the Pliocene
Jordan Abell, Lehigh University

Dust reconstructions further our understanding of how dust directly or indirectly influences the broader climate system. Dust has the capacity to impact Earth's radiative forcing, act as nuclei for cloud formation, and alter ocean and terrestrial biogeochemistry. Reconstructions of past dust inputs to the marine realm are also useful for characterizing numerous components of the climate system. Specifically, shifts in dust can indicate changes in i) dust production mechanisms, ii) aridity in dust source regions, iii) hydroclimate along the transport route, and iv) the position and/or intensity of transporting winds. Accurate reconstructions of dust during various climate states in Earth's past are thus crucial.

There are many techniques to quantify dust in marine sediment archives, and there are instances when the different methods do not produce consistent results. While inconsistent datasets are problematic in their own right, it is also challenging for those seeking to apply dust records to other fields (e.g., constraining various aspects of climate models with paleo-dust reconstructions).

In this presentation, we aim to accomplish three goals by compiling a variety of marine-based dust records from the Pliocene. The Pliocene was selected as an example because of its relevance to future climate change and the large number of dust datasets, primarily from IODP cores, available during this time interval. Our specific objectives include: 1) explore examples of how various approaches can produce consistent or discrepant conclusions about past dust accumulation; 2) suggest good practices for those who are either interested in producing new records of paleo-dust deposition or utilizing existing reconstructions and their associated interpretations for their own studies; 3) detail remaining uncertainties pertaining to dust reconstructions from marine sediments, and elicit feedback from the Earth Science community on how to reduce these ambiguities.

LIGHTNING TALK – The role of transport in New York's Air Quality impacts from the 2023 Canadian Wildfires.
Adwoa Aboagye-Okyere, Cornell University

In 2023, Canada experienced its most severe wildfire season on record, releasing unprecedented carbon emissions and contributing to extreme air pollution in the northeastern United States. This study investigates whether atmospheric transport from Canada to New York City (NYC) during the 2023 wildfire season was unusual compared to previous years, considering the important role that transport consistently plays in carrying smoke over long distances. We use Community Atmospheric Model (CAM) simulations driven by reanalysis winds for the period 1980-2023, along with daily PM2.5 observations from the U.S. EPA to analyze pollutant transport and concentrations. Results show that although long-range transport was necessary to bring smoke to NYC, the transport patterns in 2023 were not significantly different from those in previous years. Instead, the record-breaking PM2.5 levels were mainly caused by the extraordinary magnitude of fire emissions. The model accurately captured the spatial distribution of smoke but exhibited approximately 18-hour delay in the timing of peak concentrations relative to observations.

These findings emphasize that anomalously high fire emissions, rather than transport meteorology, played a more crucial role in driving the air quality impacts of this event over the Northeastern US.

POSTER – The impact of regional and global aerosol changes on African air quality: feedbacks on dust emissions

Joe Adabouk Amooli, Columbia University, Lamont-Doherty Earth Observatory

Using Regional Aerosol Model Intercomparison Project (RAMIP) simulations, we examine the sensitivity of African PM2.5 and dust emissions to regional and global aerosol reductions. Although our analysis focuses on future perturbations, these simulations are built upon CMIP-style historical emissions, so uncertainties in past emission estimates propagate into projected dust and air quality responses. We find that local African emission reductions yield the largest PM2.5 decreases, while remote reductions, such as from the United States and Europe, also influence African PM2.5 through teleconnections that alter the Intertropical Convergence Zone (ITCZ) and regional precipitation. Dust-meteorology feedbacks further modulate these responses: changes in precipitation, wind speed, and soil moisture can either amplify or offset PM2.5 decreases, and in some regions, feedbacks lead to increases in PM2.5 of up to 12 $\mu g\ m^{-3}$, counteracting air quality improvements from reduced anthropogenic emissions. These findings highlight both the critical role of dust feedbacks in African air quality projections and the broader impact of uncertainties in historical aerosol emissions, underscoring the need for improved emission estimates to constrain future projections and aerosol radiative forcing.

LIGHTNING TALK – A global compilation of quality controlled, time- and size-resolved records of paleodust deposition

Samuel Albani, University of Milano-Bicocca, Italy

We previously published (Albani et al., 2015) a paper focused on the Holocene, that was a pilot project for a more ambitious effort to provide quantitative constraints on the transient evolution of the global dust cycle over the last glacial-interglacial cycle. Here, the main strategy developed for that paper is recalled, and some improvements on the overall framework are presented, on the way towards the more ambitious goal of extending the database to older time periods.

LIGHTNING TALK – Archives of Fire Emission Products and Dust: Insights from Peruvian and Tibetan Ice Cores

Emilie Beaudon, School of Earth Sciences, The Ohio State University, Byrd Polar and Climate Research Center

Glaciers in Peru and northwestern Tibet offer valuable archives of atmospheric and climatic history. The Huascarán and Quelccaya ice cores in Peru reveal seasonal black carbon and ammonium signals linked to Amazonian biomass burning and ENSO dynamics, highlighting their potential as paleo-fire records. Huascarán is the only tropical ice core documenting two decades of the 21st century, while the Quelccaya ice core extracted in 2003 extends back ~ 1800 years and provides an annually resolved

palaeoclimatological archive over ~ 1300 years, making them unique in this region lacking long-term monitoring of biomass burning emissions.
In Tibet, the Guliya ice core offers a comprehensive Late Pleistocene dust record, capturing aeolian particles sorted by grain size during long-range atmospheric transport. Mineralogical, elemental, and radiogenic (Sr-Nd) analyses of the dust samples help identify lithological and geographical sources, contributing valuable data for refining climate models.
Together, these ice core studies underscore the importance of glacial archives in reconstructing both natural and anthropogenic influences on the atmosphere across diverse climatic and geographic settings.

LIGHTNING TALK – Sensitivity of anthropogenic cloud droplet number change to preindustrial emission inventories
Hunter Brown, University of Wyoming

Understanding the anthropogenic influence on cloud droplet number (Nd) from the preindustrial (PI) to the present day (PD) (i.e., ΔNd) due to human-driven aerosol emissions helps to constrain anthropogenic influence on clouds and aid future climate projections. ΔNd depends not only on our ability to simulate aerosol-cloud interactions but also on the aerosol emission input datasets used. By utilizing the 'Nephele' perturbed parameter ensemble (PPE) generated with the DOE Energy Exascale Earth System Model (E3SM) (Nugent et al., 2025), we identify two key locations (the Southeast United States (SEUS) and the United Kingdom (UK)) with consistent negative ΔNd signals – a surprising finding given an overall trend of increased aerosol emission from the PI to the PD with increased fossil fuel combustion. These negative ΔNd signals are driven by the 1850 PI emissions of primary organic aerosol from anthropogenic biofuels, which are higher in the PI than the PD (2010). Uncertainty in these emissions is explored through sensitivity analysis, identifying nonlinear relationships between ΔNd and mass/number emissions and highlighting the need to better constrain these datasets to reduce uncertainty in estimates of ΔNd.

LIGHTNING TALK – Pre-industrial to present day changes in aerosol deposition from two Greenland ice cores
Nathan Chellman, Assistant Research Professor, Desert Research Institute

Ice core aerosol records are often used to evaluate atmospheric model performance as well as reconstruct past emissions sources. Here, we present aerosol records from two Greenland ice cores spanning to near present-day representative of a broad range of emissions sources including anthropogenic pollution, biomass burning, and dust. Deposition at these sites for many chemical species since 2015 is at or below pre-Industrial levels, suggesting continuing long-term decreases in Arctic atmospheric aerosol concentrations since peak Industrial-era pollution. Parallel cores recovered from each site can be used to assess uncertainties associated with individual ice core aerosol records.

LIGHTNING TALK – South American dust ocean fertilisation: Ironing out paleo-to-present observational challenges
Nicolás Cosentino, CIMA (Argentina), IFAECI (Argentina-France)

Mineral dust aerosols reduce CO2atm by fertilising Fe-limited oceans and enhancing primary productivity. However, the resulting perturbation to Earth's radiation budget is highly uncertain. Southern South America (SSA) is the main dust supplier to the southern oceans, the most susceptible to Fe fertilization. Iron limitation is first encountered <700 km offshore of SSA, where preliminary model results show that most dust-borne soluble Fe originates from super-coarse dust. The greatest changes in global dust activity occur at glacial-interglacial timescales, and it has been proposed that the weakening of this fertilizing effect of dust is a main contributor to the rise in CO2atm during the last deglaciation. High Fe fertilisation from SSA dust during the Last Glacial Maximum (LGM) is thought to be due to enhanced emissions of glaciogenic dust. Thus, better constraining the role of super-coarse particles and of glaciogenic dust particles in SSA's present-day and paleo dust cycles is key to quantifying the indirect effect of dust on global climate. I will describe what is known, what still remains highly uncertain, and how recently funded project DustySAM aims to improve the understanding of this dust-climate interaction.

LIGHTNING TALK – Past, Present, and Future Area Burned in the Western United States
Chris Guiterman, CIRES, University of Colorado; NOAA's National Centers for Environmental Information

We reconstructed annual area burned covering 1600-1984 CE for western U.S. forests, based on an extensive set of tree-ring fire-scar sites from the North American Fire Scar Network. We then applied fire-climate relationships derived from reconstructed soil moisture to model area burned through present, and projected to 2100 using CMIP6 RCP4.5 forcing. These data underscore the exceptional scale of burning during historical fire regimes and the significant departure of them that has generated the modern fire deficit and wildfire crisis. Baseline fire activity, a counterfactual model that lacks no fire exclusion, rises steadily from the 1990s to 2100, highlighting the increasing risk of wildfires as forests dry out under Anthropogenic warming.

KEYNOTE – Re-assessment of Pre-Industrial to Present Day Changes in Fire Regimes: Comparison to CMIP6 and Impacts for Aerosol Radiative Forcing Estimate
Douglas Hamilton, NC State University

There is growing evidence that fire emissions over the Industrial Era follow a downward global trend. This contrasts with past efforts to reconstruct fire emission datasets for climate models that present little-to-no change or a large increase in fire emissions over the past several centuries. Here, we show how changes in ice core black carbon data from every continent (expect Oceania) compares to global climate model data. We find significant differences between observations and models and propose that a reconciliation of differences between them can only be achieved through increasing pre-industrial fire emissions. We discuss implications of a low bias in historical fire for the calculation of aerosol radiative forcing and open discussion for how to move forward in reconciling data streams.

LIGHTNING TALK – Using interhemispheric thermal contrast to constrain effective radiative forcing due to aerosol-cloud interactions
Chengfei He, *Northeastern University*

The interhemispheric thermal contrast (IHTC), represented by sea surface temperature (SST) differences between the northern (NH) and southern (SH) hemispheres, crucially influences the tropical climate. Current CMIP6 climate models, however, struggle to accurately simulate the IHTC and associated tropical climate variability. Here, we show that simulated long-term trends since 1950 in models are consistently higher, with more warming in the NH compared to the SH, than in observations. This systematic discrepancy arises from the overly dominant role of greenhouse gases in models that yields a positive IHTC through wind-evaporation-SST feedback. Conversely, the observed trend, primarily driven by anthropogenic and natural aerosols, is negative. This discrepancy suggests that current models are overly sensitive to greenhouse gases, and actual equilibrium climate sensitivity (ECS) may be lower than CMIP6 model predictions. Nevertheless, the modeled multidecadal IHTC variability aligns with observations, enabling a constrained estimate of effective radiative forcing due to aerosol-cloud interactions (ERFaci) at -0.6±0.3 W/m^2, with a “likely” range 57% narrower than the latest IPCC report. Our study further suggests that future tropical rain belt shifts are likely to be less pronounced than predicted by CMIP6 models with the high ECS.

LIGHTNING TALK – Dynamics of the Southern Hemisphere westerlies inferred from 232Th-derived marine dust flux records throughout the last glacial cycle
Aviva Intveld, Lamont-Doherty Earth Observatory

The Southern Hemisphere mid-latitude westerly winds (westerlies) are critical to redistributing global heat, regulating carbon and nutrient exchange, and powering the Antarctic Circumpolar Current. Existing paleoclimate proxy records and climate models disagree on the movement and strength of the westerlies in response to periods of prolonged warming (e.g., the Last Interglacial) or cooling during the last glacial cycle. To evaluate these discrepancies, we present preliminary 232Th-derived dust flux records from two sites in the Tasman Sea. DSDP 90 Site 591 and IODP 371 Site U1510 are located at the same longitude but at different latitudes along a ~5º N-S transect, with Site 591 located equatorward and U1510 located poleward. Both records exhibit remarkably similar trends and absolute magnitudes, with dust flux rates ranging from 0.05 to 0.023 g/cm2/kyr (average ±2s of 0.043 for 591 and 0.077 for U1510). During warmer intervals such as MIS 5 (from ~123-70 ka) and the Holocene, both records show close agreement in amplitude with overlapping uncertainties. However, during the colder climate stages of MIS 4, MIS 3 and the Last Glacial Maximum (from ~70-15 ka), the amplitudes differ, with sustained 1.5-2x higher average dust flux at Site 591 indicating a major equatorward migration of the westerlies during these colder time periods. Future work relating the climate forcings to these positional shifts can help safeguard the livelihoods of the tens of millions of people in the Southern Hemisphere who rely on the westerlies for agriculture and potable water.

LIGHTNING TALK – On the role of Holocene land use change on dust mobilization in West Africa
Jed Kaplan, Department of Earth, Energy, and Environment, University of Calgary

A defining feature of mid- to late Holocene environmental change in western and northern Africa is a strong increase in dust mobilization and deposition. This large increase in dust is generally attributed to orbitally forced changes in the African monsoon that led to desertification and the desiccation of fluvial and lacustrine systems. The increased dust flux persists through the late Holocene even though the southern parts of West Africa get wetter as the locus of the monsoon shifts to the south. Concurrent with these large-scale environmental changes, the late Holocene is marked by the establishment of pastoral and agricultural land use systems throughout West Africa, and diversification and intensification of land use during the common era. Here, we evaluate the potential impact that these land use changes could have had on dust emission over this period. We developed a Dust Mobilization Potential index that quantifies landscape modification intensity based on archaeological, archaeobotanical, and archaeozoological evidence of pastoral and agricultural activities across West African ecological zones. Analysis of dust mobilization potential patterns in relation to dust flux data from multiple sedimentary archives reveals a latitudinal gradient in dust dynamics, with earlier increases in the southern Sahara and Sahelian savannas corresponding to early agricultural and pastoral intensification zones, followed by gradual increases in the more humid southern regions as farming and herding practices spread and diversified. Notably, dust flux continued to increase during periods of relative climate humidity (3500-2500 BP) and temporary humid intervals (Medieval Climate Anomaly, 1150-650 BP), suggesting that anthropogenic activities complemented and even worked in opposition to natural forcing. Our reconstructions suggest that Holocene land use would have progressively reduced vegetation cover and soil stability, causing sustained increases in dust deposition across the region. These findings contribute to understanding the complex interplay between human activities and climate change in West Africa during the Late Holocene.

LIGHTNING TALK – Aerosol and greenhouse gas forcing drives recent trends in the Pacific Decadal Oscillation

Jeremy Klavans, University of Miami, Rosenstiel School

The Pacific decadal oscillation (PDO)—the leading pattern of climate variability driving changes over the North Pacific and surrounding continents—is now thought to be generated by processes internal to the climate system. According to this paradigm, the characteristic, irregular oscillations of the PDO arise from a collection of mechanisms involving ocean and atmosphere interactions in the North and tropical Pacific. Recent variations in the coupled ocean–atmosphere system, such as the 2015 El Niño, ought to have shifted the PDO into its positive phase. Yet, the PDO has been locked in a consistent downward trend for more than three decades, remanding nearby regions to a steady set of climate impacts. Here we show that the main multidecadal variations in the PDO index during the twentieth century, including the ongoing, decades-long negative trend, were largely driven by human emissions of aerosols and greenhouse gases rather than internal processes. This anthropogenic influence was previously undetected because the current generation of climate models systematically underestimate the amplitude of forced climate variability. A new attribution technique that statistically corrects for this error suggests that observed PDO impacts—including the ongoing multidecadal drought in the western United States—can be largely attributed to human activity through externally forced changes in the PDO. These results indicate that we need to rethink the attribution and projection of multidecadal changes in regional climate.

KEYNOTE TALK – Radiative forcing due to historical increase in desert dust

Jasper Kok, UCLA

Mineral dust aerosols impact Earth's energy budget through interactions with radiation, clouds, atmospheric chemistry, the cryosphere, and biogeochemistry. As such, past changes in mineral dust could have exerted a substantial radiative forcing of the climate system. We use a compilation of dust deposition records to reconstruct historical changes in dust and find that global dust mass loading is 55 ± 30% (90% confidence interval) higher in the modern climate than it was in pre-industrial times. We combine this finding with estimates of the radiative effects of the various mechanisms through which dust impacts climate, finding that the historical increase in dust produced a global mean effective radiative forcing of -0.07 ± 0.18 Wm-2. Current climate models and climate assessments do not represent the historical increase in dust and thus omit the resulting radiative perturbation, biasing climate change projections and assessments of climate sensitivity.

LIGHTNING TALK – Global Biomass Burning Emissions: Integrating CMIP6 and FireMIP Simulations with Satellite and Charcoal Observations

Fang Li, Institute of Atmospheric Physics, Chinese Academy of Sciences

Fire emissions play a critical role in carbon and nutrient cycles, significantly impacting climate and air quality. Most Earth System Models (ESMs) and Dynamic Global Vegetation Models (DGVMs) now incorporate fire processes. This study provides a comprehensive assessment of global and regional fire emissions under various future scenarios, based on CMIP6 and FireMIP model outputs. To enhance accuracy, bias corrections were applied using present-day satellite-based GFED5 data and historical charcoal records. We further present a future global fire emissions dataset, which includes fire carbon emissions alongside 40 species of fire-related aerosols and trace gases. This dataset represents a valuable resource for multiple applications, such as evaluating the health impacts of smoke exposure and understanding the role of fire emissions in shaping climate and ecosystems.

LIGHTNING TALK – History of North African dust emissions over the last 200,000 years
David McGee, MIT

I'll review work showing the coherence of dust flux reconstructions across the North Atlantic. A key finding is that dust emissions responded sensitively to past insolation changes and millennial-scale changes in the balance of heating between the hemispheres, but they show a muted response to glacial-interglacial changes. I'll also highlight some methodological tools that have been important in producing high-quality records.

LIGHTNING TALK – Are Volcanic Impacts on Global Climate *Overblown*?

Volcanic aerosols from 20th century eruptions have caused modest global cooling and reduced global rainfall, inspiring theories of larger eruptions devastating societies worldwide and even imperiling human survival. We show here that volcanic aerosols likely cause far more limited climate responses than previously thought. Paleoclimate evidence suggests that cooling scales only weakly with eruption size, likely capping even the largest super-eruptions at <2°C global cooling. Precipitation impacts, tied mainly to this limited cooling, are similarly constrained. Models underpinning catastrophe scenarios likely overstate these effects by failing to constrain key microphysical processes, whereas proxy-consistent simulations show local post-eruption hydroclimate to be unexceptional at nearly every location. This reassessment explains why decades of research have been unable to concretely link eruptions to severe climate disruptions.

LIGHTNING TALK – Changes in biomass burning in Africa since the last glacial: a new synthesis of burning on the fire continent
Nicholas O'Mara, Yale University

Fires on Earth are changing in response to human activities, both through direct ecosystem management decisions and indirect climate change-induced warming and shifting rainfall patterns. While increased burning in forested systems often captures international media attention, the decline in burning in grassy systems––especially African savannas––receives much less focus, despite their dominant contribution to total global burned area and fire emissions. Forecasting future fire activity and its impacts on local ecology and livelihoods, as well as global climate feedbacks, requires a robust mechanistic understanding of the complex interactions between climatic conditions, ecosystem functioning, human activities, and fire across a range of environments.

This study focuses on Africa, a highly pyro-diverse continent where the majority of global fires occur. Africa has a long history of human fire use and land-use change, encompassing a wide range of biomes from moist tropical rainforests to mesic savannas and dry grasslands. Here, we present a new synthesis of African paleofire activity inferred from both physical and molecular proxies (e.g., charcoal and polycyclic aromatic hydrocarbons) spanning multiple depositional contexts, timescales, and ecosystems. We focus on four key time periods: the Last Glacial Maximum and deglaciation, the mid-Holocene African Humid Period, the late-Holocene rise of metallurgy and agriculture, and the post-industrial era. In doing so, we evaluate the variable responses of fire to changes in climate and human influence across environmental gradients.

LIGHTNING TALK – Delineating the spatial reliability of sedimentary charcoal as a recorder of fire history
Richard Vachula, *Auburn University*

Persistent disagreements about the reliability of sedimentary charcoal as a recorder of fire history prevent the direct translation of this fire proxy to terms relevant to earth system models (e.g., area burned, black carbon emissions). Though much research has sought to understand proxy systematics of charcoal at single sites and local scales, findings about the spatial fidelity of the proxy vary widely, and relatively little work has undertaken an examination of the proxy across multiple sites. Here, we compare a global dataset of modern sedimentary charcoal measurements to MODIS fire data to more comprehensively characterize the spatial reliability of charcoal as a fire proxy as well as to determine the factors that affect the spatial bounds of this reliability. By synthesizing these analyses, we provide a framework for interpreting the spatial representability of charcoal datasets as a means of enabling more direct comparisons between paleofire and earth system model parameters.

LIGHTNING TALK – Modeling Volcanic Ash Impacts of the 2010 Eyjafjallajökull Eruption with CESM2
Lily Wu, *Cornell University*

The impacts of sulfate aerosol from volcanic eruptions on the climate have been well recognized and simulated in climate models like the Community Earth System Model (CESM) 2.1.0. However, these models often neglect insoluble volcanic ash despite its substantial emission during eruptions and potential impact on the Earth system through mechanisms such as regional cooling, air quality degradation, and phytoplankton fertilization from deposition. Here, we incorporate volcanic ash into the CESM 2.1.0 for the first time and evaluate the model's performance against both in situ and remote sensing observations of the 2010 Eyjafjallajökull eruption in Iceland. We further assess the impacts of volcanic ash from this eruption by conducting a suite of perturbation experiments to vary key parameters, including ash plume height and size distribution. The preliminary results suggest that the volcanic ash had an average global total radiative forcing of 0.25 W/m2 and a regional average of 23.9 W/m2 during the approximately month-long eruptive phase. The volcano also added 0.08 Tg of soluble iron and increased local iron deposition approximately 28 to 35 times. These findings highlight the necessity of incorporating ash into the model to better understand how volcanic ash interacts with the Earth system.

LIGHTNING TALK – Understanding the Global Dust Cycle Across Present and Past Climates with Paleo Records and Modeling
Bingqing Zhang, *University of Chicago*

Paleoclimate records show large variabilities in atmospheric dust loading across glacial–interglacial states (e.g., preindustrial, vs. Last Glacial Maximum), yet most models under-reproduce this variability. The relative roles of emission change versus transport and removal therefore remain uncertain. Our goal is to improve model representation of the global dust cycle using updated observations and process-based physics. Specifically, we implement a recently developed, physically based dust-emission scheme to reduce reliance on prescribed soil erodibility and to better capture sensitivity to surface conditions. We further incorporate vegetation cover from an ensemble of 13 climate models to identify potential source regions under different climate states. Second, we apply an inverse-modeling framework constrained by an updated compilation of paleo-dust records to refine emission magnitudes and further reduce model-observation gap. Finally, we propose to assess dust radiative forcing using the new dust dataset, propagating uncertainty from sources and transport. The resulting products and protocols are intended to support coordinated intercomparison efforts and tighter constraints on aerosol radiative effects.

Participant list (in-person)

(last updated 7/24)

1	Jordan	Abell	Lehigh University, USA
2	Adwoa	Aboagye-Okyere	Cornell University, USA
3	Joe	Adabouk Amooli	Columbia University/LDEO, USA
4	Samuel	Albani	University of Milano-Bicocca, Italy
5	Susanne	Bauer	NASA GISS, USA
6	Emilie	Beaudon	Ohio State University, USA
7	Hunter	Brown	University of Wyoming, USA
8	Nathan	Chellman	Desert Research Institute, USA
9	Amy	Clement	University of Miami, USA
10	Nicolás	Cosentino	CIMA-IFAECI, Argentina
11	Nathalie	Goodkin	American Museum of Natural History, USA
12	Chris	Guiterman	University of Colorado, Boulder, USA
13	Douglas	Hamilton	North Carolina State University, USA
14	Stijn	Hantson	Universidad del Rosario, Colombia
15	Chengfei	He	Northeastern University, USA
16	Aviva	Intveld	Columbia University/LDEO, USA
17	Jed	Kaplan	University of Calgary, Canada
18	Jeremy	Klavans	University of Miami, Rosenstiel School
19	Jasper	Kok	UCLA, USA
20	Hannah	Liddy	Columbia University, USA
21	Haobo	Liu	Peking University, China
22	Natalie	Mahowald	Cornell University, USA
23	Jennifer	Marlon	Yale University, USA
24	Joe	McConnell	Desert Research Institute, USA

25	David	McGee	MIT, USA
26	Zachary	McGraw	Columbia University, USA
27	Keren	Mezuman	Columbia University, USA
28	Ron	Miller	NASA GISS, USA
29	Nicholas	O'Mara	Yale University, USA
30	Maria Rosabelle	Ong	American Museum of Natural History, USA
31	Gavin	Schmidt	NASA GISS, USA
32	Kostas	Tsigaridis	Columbia University, USA
33	Richard	Vachula	Auburn University, USA
34	Gisela	Winckler	Columbia University, USA
35	Lily	Wu	Cornell University, USA
36	Bingqing	Zhang	University of Chicago, USA

Participant list (online)

1	Sally	Archibald	University of Witwatersrand, Africa
2	Myriam	Khodri	IPSL, France
3	Fabrice	Lambert	Pontificia Universidad Católica de Chile, Chile
4	Fang	Li	ICCES Chinese Academy of Sciences, China
5	Marie-France	Loutre	Past Global Changes (PAGES), Switzerland
6	Michael	Sigl	University of Bern, Switzerland

Participant Bios

Jordan Abell
Assistant Professor, Lehigh University

Jordan is an Assistant Professor in the Department of Earth and Environmental Sciences at Lehigh University, and a member of Lehigh Oceans. He leads the Geochemical Perspectives on Paleoclimatology and Paleoceanography (GP3) Lab at Lehigh University. The GP3 Lab takes an interdisciplinary approach to investigate a broad range of questions relating to Earth's atmosphere and ocean in the past, the role of dust in the climate system, processes impacting marine sediment accumulation and transport, and the interaction between surficial geology and regional climate. Specifically, they use a suite of geochemical methods and tracers, with a particular focus on noble gas mass spectrometry and the distribution of major, trace and rare-earth elements applied to a variety of archives that span the Cenozoic. Combining these techniques with models of the Earth system, they address questions such as: 1) How do atmospheric and ocean circulation respond to warmer-than-present climate states? 2) Can we accurately characterize the scale and distribution of atmospheric aerosols in the past, and if so, what are the driving mechanisms and downstream impacts? 3) How can we better constrain the accumulation of material in the deep sea, and what are the related impacts on our ability to reconstruct past environments?

Adwoa Aboagye-Okyere
Graduate Research Assistant, Cornell University

Adwoa Aboagye-Okyere is a PhD candidate in Atmospheric Science at Cornell University advised by Natalie Mahowald. She models natural aerosols, especially dust and wildfires, from the preindustrial period to future scenarios to assess impacts on air quality and human health. Her work uses CESM (CAM6&MUSICA) constrained with surface observations to improve model accuracy, with case studies across Africa, the United States, and Latin America(Brazil). She integrates satellite and ground-based datasets to evaluate PM2.5 and related metrics and to quantify exposure and health burdens. She is interested in collaborations that tighten emission histories and observational constraints relevant to historical and paleoclimate aerosol questions.

Samuel Albani
Associate Professor, University of Milano-Bicocca, Italy

The focus of my research is mineral dust, both as a proxy of past climate changes and as an active agent in the Earth climate system. I have been pursuing the study of dust-climate interactions with a highly inter-disciplinal approach: my expertise ranges from early experimental work on ice cores, to numerical modelling of the dust cycle within Earth System Models and the compilation of comprehensive dust datasets for model benchmarking, which have become my core activities over the years.

Joe Adabouk Amooli
PhD Candidate, Columbia University, Lamont-Doherty Earth Observatory

I am a third-year PhD candidate in Earth and Environmental Sciences at Columbia University, where my research focuses on modeling and satellite observations of aerosols and their interactions with climate

and air quality. My recent work, published in Atmospheric Chemistry and Physics ("An Uncertain Future for the Climate and Health Impacts of Aerosols in Africa"), analyzed historical and future aerosol emissions across scenarios and highlighted the large spread of uncertainty over the continent. I examined emission factor and activity drivers underlying differences across inventories.
Currently, I am investigating how meteorological feedbacks from anthropogenic aerosol reductions may alter dust emissions, particularly in key African source regions. My review of CMIP6 results shows that historical dust trends remain nearly flat across models, reflecting uncertainties in how dust emissions are represented. This gap complicates efforts to compare past and future aerosol changes, underscoring the importance of refining historical emission estimates.
I have presented some of my works at CACTI 2024 and AGU, and I look forward to contributing to this workshop by emphasizing the role of accurate historical emissions in constraining dust, air quality, and aerosol–climate interactions, particularly in Africa, a region that remains underrepresented in global assessments.

Hunter Brown
Postdoc, University of Wyoming

My research interests are rooted in Earth system modeling with a focus on aerosol and cloud parameterizations within these models. Initial research was focused on biomass burning aerosol and improvements to their radiative effects and feedbacks in the atmosphere and on land. This was followed by work improving the representation of stratospheric sulfate injection from volcanic eruptions, specifically lifetime and radiative impact. More recently I've been thinking about aerosol-cloud interactions in Earth system models and how parametric assumptions in these models may bias our historical (and future) understanding of the anthropogenic influence on cloud properties. This space is explored using perturbed parameter ensembles (PPEs), where tens of sub-grid microphysics parameterizations are varied simultaneously and randomly across a large ensemble of model simulations. These PPEs allow for the diagnosis of parametric, structural, and observational uncertainty. Within one of these PPEs, we identified regions of negative change in cloud droplet number from 1850-2010 (ΔN_d), which we correlated with higher preindustrial anthropogenic biofuel use in developing industrial sectors. I hope to learn more about assumptions in these emissions datasets, the validity of 1850 as a preindustrial proxy, and whether there is space to improve these emissions.

Emilie Beaudon
Assistant Professor, School of Earth Sciences, The Ohio State University, Byrd Polar and Climate Research Center

I am an ice core paleoclimatologist conducting glaciology field and lab research. My current work focuses on extracting multi-century records of dust, black carbon, ions and trace element atmospheric contamination within ice cores retrieved from Polar and mid-latitude glaciers (e.g., Tibet, Peru). I recently led an interdisciplinary project aimed at identifying the environmental 'message' carried by mineral dust entrapped in Tibetan glaciers (Beaudon et al., 2022) and its link to the Indian Summer Monsoon-Westerlies interplay. For this project I extracted a ~16,000-year dust concentration record from the Guliya ice cap (Northwestern Tibetan Plateau). I also analyzed the mineralogical, geochemical, and Sr-Nd isotopes (for source tracing) composition of the dust entrapped in layers corresponding to abrupt climate transitions over the last ~500kyr (i.e., mostly stadial-interstadial transitions). The publication of the latest results from the Guliya dust project is underway. This Fall (2025), I'll initiate a new research project focusing on developing a comprehensive 800-year record of “paleo-aerosols” for the High Russian Arctic, using a Franz Joseph Land ice core. This will involve the concentration measurements of black carbon, dust, and trace elements, as well as the mineralogical characterization of dust particles.

Nathan Chellman
Assistant Research Professor, Desert Research Institute

I am currently an Assistant Research Professor working in the Ice Core Lab at the Desert Research Institute in Reno, NV. Our research group’s focus is to develop and interpret polar and alpine ice core aerosol records to better understand past anthropogenic pollution, volcanism, biomass burning, and other processes. We routinely collaborate with atmospheric modelers to use chemical/aerosol transport models to guide ice core interpretations, or to use ice core datasets to evaluate model performance. Much of my research has focused on developing and interpreting historical black carbon records from ice cores and other natural proxies. One of my current interests is to combine ice core aerosol data, satellite-derived emissions inventories, and atmospheric modeling to better understand the significance and uncertainties of ice core aerosol records over the recent past.

Amy Clement
Professor, University of Miami

Clement conducts experiments with climate models of varying complexity that allow her to deconstruct the mechanisms of climate change and understand their basic processes. This has led to revisions in our understanding of the role of the ocean and clouds in climate variability. Her most recent work has focused on Atlantic climate variability and predictability, including sea level rise and changes in extreme heat and rainfall. While her research expertise and main teaching and mentoring is in the physical aspects of climate, Dr. Clement has developed multi-disciplinary curricula on ‘Climate and Society,’ and has co-taught a graduate course on this topic since 2002. Most recently, Clement has been engaged in leading research and action on climate change adaptation in South Florida as principal investigator on two University of Miami ULINK interdisciplinary projects, and through her role as co-founder and co-director of the Resilient 305 Collaborative, member of the Board of Directors of Miami Waterkeeper, and former Chair of the City of Miami’s Climate Resilience advisory board.

Nicolás Cosentino,
Researcher, CIMA (Argentina), IFAECI (Argentina-France)

I am a geologist and I specialize in dust source geochemistry and continental paleo-dust archives. I am interested in quantifying paleo-dust deposition rates, and in quantifying uncertainty in these estimates (Cosentino et al., 2024: see uploaded paper in "Key papers" section). I am also particularly interested in the indirect effect of dust on climate through ocean fertilization, particularly at glacial-interglacial timescales. I carry out laboratory determinations of key dust and paleo-dust parameters relevant to this dust-climate interaction.

Nathalie Goodkin
Curator, American Museum of Natural History

Dr. Goodkin's research is focused on understanding and using coral geochemistry to reconstruct ocean-atmosphere interactions, climate behavior, and pollution histories over the past 500 years. Her team uses paleoclimate proxies in coral skeleton (e.g., stable isotopes) to reconstruct the climate of the last 500 years. The group utilizes coral skeletons as recorders of environmental conditions, providing insights into climate behavior on seasonal to decadal time scales. Dr. Goodkin strives to improve our understanding of the influences biological calcification on chemical fossils to improve the reliability of biogenic carbonate reconstructions.
Dr. Goodkin has focused on understanding how changes to mean sea surface temperature, salinity and circulation interact with the Southeast Asian Monsoon system. As warm water from the Pacific Ocean is pushed through the marginal seas of Southeast Asia towards the Indian Ocean, heat is transferred from the ocean to land driving precipitation patterns. Understanding how these systems have changed and interacted in the past will be critical to predicting climate in the future.

Chris Guiterman
Research Scientist, CIRES, University of Colorado; NOAA's National Centers for Environmental Information

Chris is a Research Scientist with the NOAA-based World Data Service for Paleoclimatology that manages public archives of global paleoenvironmental proxy data. He trained in forestry at the University of Maine and fire ecology at the University of Arizona, where he completed his doctorate in the Laboratory of Tree-Ring Research. Chris is a co-lead of the North American Tree-Ring Fire Scar Network (NAFSN), currently composed of 2600 sites, 31000 trees, and 170000 precisely-dated fire scars reaching back nearly 400 years in many places. The NAFSN represents a valuable archive of historical biomass burning that could be incorporated into models of smoke generation over time.

Douglas Hamilton
Assistant Professor, NC State University

My research takes a holistic view of how wildfires and other natural aerosol are a fundamental component of the Earth System. I use observations and Earth System models to quantify how Earth System processes are coupled and evaluate how changes in feedback mechanisms may affect society.

Stijn Hantson
Associate Professor, Universidad del Rosario

I am an Associate Professor at Universidad del Rosario in Bogotá, Colombia, where I lead a research group studying the impact of fire on the Earth system. My research focuses on fire–vegetation–climate interactions and feedbacks, and how these processes shape ecosystem structure and functioning. To address these questions, I integrate field data with remote sensing and modeling approaches. I am also one of the coordinators of the Fire Model Intercomparison Project (FireMIP), an international effort to improve the representation of fire in global vegetation and Earth system models.

Chengfei He
Assistant Professor, Northeastern University

I am a climate modeler passionate about advancing our understanding of climate change. Currently, I am an Assistant Professor at Northeastern University in Boston. Prior to this appointment, I held the Weston Howland Jr. Postdoctoral Scholar Fellowship at Woods Hole Oceanographic Institution (WHOI) and completed a postdoctoral position at the University of Miami.
My research addresses two fundamental questions in climate science: (1) What drives past and future changes in oceanic and atmospheric circulation and climate variability? (2) How can we quantitatively interpret these changes and their impacts? I employ an interdisciplinary approach that integrates a hierarchy of climate models, isotope-enabled modeling, statistical and machine learning techniques, and observations from both modern instruments and paleoclimate proxies. Through this comprehensive methodology, I aim to deepen our understanding of the physical processes governing climate dynamics across broad time scales (e.g., from interannual to millennial). I am currently focused on studying and quantifying the impact of aerosols on our climate system, particularly their radiative forcing and interactions with clouds in CMIP models.

Aviva Intveld
PhD Student, Lamont-Doherty Earth Observatory

I am a second-year PhD student at Lamont-Doherty Earth Observatory working with Professor Gisela Winckler. My PhD work uses U/Th-derived dust flux records to investigate atmospheric circulation during warmer-than-present periods of the earth's past. I am approaching this question from both a paleoclimate and modern perspective. My first project involves marine sediment cores from the Tasman Sea to reconstruct variability of the Southern Hemisphere Westerlies from the Last Interglacial to present. Concurrently, as part of expedition RR2504 aboard the R/V Roger Revelle in Summer 2025, I collected windborne particulate matter over the Labrador Sea to compare modern dust loading with sediment core-top terrigenous material. I aim to bridge the gap between modern observations of dust, paleoclimate dust record reconstructions, and simulations of past atmospheric circulation and radiative forcing. Previously, I received my Bachelor of Science in Earth, Atmospheric, and Planetary Sciences at MIT in 2023 and my MPhil in Earth Sciences as a Gates-Cambridge Scholar at the University of Cambridge in 2024. My master's thesis paired paleoclimate, geochemistry, and archaeology to reconstruct a high-resolution terrestrial paleoclimate record during the Postclassic and Colonial Maya period.

Jed Kaplan
Professor, Department of Earth, Energy, and Environment, University of Calgary

Dr. Jed O. Kaplan was born in the United States and has lived and worked in seven countries on three continents over his career. He is currently the Canada Research Chair in Global System Modeling and Professor in the Faculty of Science, University of Calgary. Jed's current research interests center around the development and application of computer simulation models of vegetation dynamics, wildfire, and earth surface processes. He is particularly interested in human-environment interactions over the past 100,000 years, understanding how human use of fire and other forms of land management interacted with climate, and how these may be adapted to the present and future. His research interests include current projects on characterizing preindustrial land use systems and their influence on dust emissions and modeling global and regional vegetation and wildfire. This work has included a synthesis of Holocene land use change in West Africa and its effect on dust emissions. He collaborates extensively with the atmospheric chemistry modeling community to investigate the way smoke and mineral dust emissions affect regional radiation budgets and human health. He is currently working with historians and atmospheric chemists on a new project to reconstruct air quality in medieval China.

Jeremy Klavans
Research Scientist, University of Miami, Rosenstiel School

Jeremy Klavans is a Research Scientist at the Rosenstiel School of Marine, Atmospheric, and Earth Science at University of Miami trying to make better predictions of regional climate. He focuses on better understanding the externally forced components of regional climate variability and why the amplitude of these components appears to be underrepresented in climate models.

Jasper Kok
Professor, UCLA

Jasper Kok obtained his PhD in Applied Physics from the University of Michigan in 2009, for which he received a Distinguished Dissertation Award. He then focused his research on climate and the atmospheric sciences, which was facilitated by an Advanced Study Program postdoctoral fellowship at the National Center for Atmospheric Research (2009-2011) and a National Science Foundation (NSF) Climate and Large-Scale Dynamics postdoctoral fellowship at Cornell University (2011-2013). Jasper took an assistant professor position at UCLA's department of Atmospheric and Oceanic Sciences in 2013, where he received tenure in 2017 and was promoted to full professor in 2021. Jasper was awarded an NSF CAREER award in 2016 and received the 2019 American Meteorological Society's Henry Houghton Early Career award for "novel approaches to studying the physics of dust emissions into the atmosphere and the interactions of dust aerosols with Earth's climate and beyond." His group has developed the DustCOMM dust climatology, which includes a reconstruction of the increase in the atmospheric dust loading from the pre-industrial to the modern period. The resulting dust emission inventory is currently used in multiple multi-model experiments. Jasper's current research interests include aerosol effects on the climate system and aerosol-based climate intervention techniques.

Fabrice Lambert
Associate Professor, Pontificia Universidad Catolica de Chile

Fabrice Lambert is a delegate of the Chilean government to the IPCC since AR6 and a scoping author of WGI for AR7. He is an associate professor at the Pontificia Universidad Catolica de Chile. His research group investigates climate change dynamics and impacts, performing field work, laboratory sample analyses, and also climate simulations using Earth System Models. His research has included work on mineral dust from reconstructions in various paleoclimatic archives, to global deposition datasets, to radiative forcing and biogeochemistry.

Fang Li
Professor, Institute of Atmospheric Physics, Chinese Academy of Sciences

Dr. Fang Li is a full professor at the Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences (CAS). Her research focuses on Earth system modeling and its applications. Her fire model is the most widely adopted in global Earth system models. She developed the global gridded crop model GPAM, co-developed the Global Vegetation Dynamics Model (IAP-DGVM), and serves as the chief scientist of

CAS-ESM's Human Activity Model, co-chair of FireMIP, co-coordinator of the ISIMIP fire sector, co-chair of CMIP7 FireMIP, and lead author of CLM4.5, CLM5, and CoLM2024 technical descriptions.

Haobo Liu
Graduate student, Georgia institute of technology (Visiting Scholar), Peking University

As a climate scientist specializing in orbital-scale climate dynamics, my research is centered on understanding the long-term behavior of Earth's climate system. I utilize comprehensive climate models to investigate the mechanisms driving glacial-interglacial cycles and other significant climate transitions throughout Earth's history. This modeling work provides a framework for interpreting paleoclimate proxy data and testing hypotheses about past climate change.

Currently, my primary focus is on the reconstruction of the AMOC. By integrating numerical models with paleoceanographic data, I aim to reconstruct the variability of the AMOC over various timescales. This work is crucial for understanding its role in past and future climate change.

Furthermore, I am deeply interested in the reconstruction of ancient atmospheric CO2 concentrations. Reconstructing past CO2 levels is fundamental to accurately simulating past climates and projecting future climate scenarios. I believe that a more robust understanding of paleo-CO2 is one of the most critical frontiers in paleoclimatology, and I am eager to contribute to this collaborative effort. I look forward to engaging with fellow researchers at this workshop to discuss these pressing topics.

Marie-France Loutre
Executive Director, PAGES

Marie-France Loutre's major research deals with the study of the different astronomical parameters leading to the computation of the insolation. The purpose of her research is to better explain how changes of the Earth's orbital and rotational parameters can induce long-term climatic changes over the Earth. Since the late 80's, she has contributed in improving the accuracy of the orbital parameters and in calculating the long-term variations of the astronomically forced insolation. In addition to the seasonal and latitudinal distribution of the solar energy received at the top of the atmosphere, other kinds of insolation are also defined and calculated such as the insolation over longer time intervals during the year (astronomical and meteorological seasons, for example), over parts of the day, over zonal belts, over an hemisphere or over the whole year. She tries to see which of these insolations is integrating most of the processes responsible for glaciations and deglaciations.

Natalie Mahowald
Professor, Cornell University

Professor Mahowald has undergraduate degrees in German and physics from Washington University, an M.S. in natural resource policy from the University of Michigan, and a Ph.D. in meteorology from Massachusetts Institute of Technology. Mahowald conducted her postdoctoral research at Stockholm University in Sweden prior to holding a faculty position at the University of California, Santa Barbara from 1998-2002. She then spent five years as a scientist at the National Center for Atmospheric Research (NCAR) before joining Cornell as a faculty member in 2007. My research group is focused on understanding feedbacks in the earth system that impact climate change. This includes global and regional scale atmospheric transport of biogeochemically important species such as desert dust, as well as the carbon cycle. We look at these issues through a combination of 3-dimensional global transport and climate models, as well as analysis of satellite and in situ data.

Jennifer Marlon
Senior Research Scientist, Yale University

Jennifer Marlon, Ph.D. is a Senior Research Scientist and Lecturer in the School of the Environment and the Executive Director of the Yale Center for Geospatial Solutions (YCGS), with a secondary appointment as Lecturer in the Department of Molecular, Cellular and Developmental Biology at Yale. She obtained her Ph.D. and M.S. in Geography from the University of Oregon. Dr. Marlon studies climate change, extreme weather (particularly wildfires), and science communication. She has authored over 80 peer-reviewed papers, numerous op-eds, and produced a variety of interactive data visualizations to support climate change communication, including the Six Americas super Short Survey Yay! (SASSY!) and the Yale Climate Opinion Maps.

Joe McConnell
Research Professor Emeritus, Desert Research Institute

Joe McConnell is a snow hydrologist and climate scientist at the Desert Research Institute (DRI). He specializes in using detailed chemistry measurements in ice cores to reconstruct past concentrations and sources of aerosols including those from biomass burning, dust emissions, volcanism, and during recent centuries and millennia, industrial pollution. Because of the short atmospheric lifetimes for most aerosols, this requires development of arrays of aerosol records from polar and alpine ice cores. To interpret the aerosol records, McConnell and his DRI colleagues work closely with atmospheric and Earth System modelers, archaeologists, historians, and others.

David McGee
Professor, MIT

My research focuses on understanding how the atmospheric circulation and precipitation patterns responded to climate changes over the Late Quaternary. My group develops paleoclimate records using speleothems, lake deposits and marine sediments, with uranium-series isotopes as a common tool useful in these different archives. With respect to dust, my group's work has centered on understanding the history of North African dust emissions. I have also worked to refine the tools we use to determine dust accumulation rates in marine sediments. I have a masters degree from Tulane University and a PhD from Columbia University, and I conducted my postdoctoral work at the University of Minnesota. I've been at MIT since 2012.

Zachary McGraw
Postdoctoral Research Scientist, Columbia University
I am a climate modeler working in the aerosol-cloud-climate nexus, with a recent focus on examining how volcanic aerosols influence global and regional climates. This has included a critical reassessment of the degree to which large eruptions can pose an existential global threat, highlighting model biases that can overstate their effects and advocating for evaluating impact strength rather than statistical significance alone. I've further worked to deepen the understanding of how volcanic aerosols influence the

atmosphere, with particular attention to cloud, precipitation, and circulation processes. In earlier projects, I assessed impacts of mineral dust and soot with a focus on their poorly constrained role as ice nucleating particles.

Keren Mezuman
Associate Research Scientist, Columbia University, NASA Goddard Institute for Space Studies

Dr. Keren Mezuman is an Associate Research Scientist at Columbia University's Center for Climate Systems Research and a collaborating scientist with the NASA Goddard Institute for Space Studies (GISS). She earned her PhD from a joint program between NASA GISS and Columbia University's Department of Earth and Environmental Sciences, specializing in fire and aerosol modeling for air quality and climate studies.

Dr. Mezuman developed pyrE, NASA GISS's interactive fire-climate module for modeling biomass burning emissions within Earth system models. Her research includes evaluating secondary inorganic aerosols in three dimensions and contributing to the biomass burning aerosol intercomparison (AeroCom) project. She has extensive experience with the GISS ModelE Earth System Model and its applications at the nexus of atmosphere, biosphere, and anthroposphere interactions.

Her recent work includes coupling wildfire activity with the carbon cycle. Earlier in her career, she conducted research on lightning and thunderstorm activity, including studies of global thunderstorm cell distribution and transient luminous events. Dr. Mezuman's expertise spans wildfire emissions, aerosol distributions, air quality impacts, and climate modeling, making her research relevant to constraining uncertainty in historical aerosol emissions and their climate effects.

Ron Miller
Research Physical Scientist, NASA Goddard Institute for Space Studies, Columbia University

Ron Miller studies dust aerosols and climate variability mainly in the context of the present day.

Nicholas O’Mara
Postdoc, Yale University

I am an organic and isotope geochemist interested in what controls changes in rainfall, fire, winds, and ecosystem structures on time scales of hundreds to millions of years. To probe these questions I study the organic and inorganic geochemistry of marine sediment cores to reconstruct how nearby terrestrial environments have varied under different climatic conditions in the past. The bulk of my research focuses on grassy African savanna ecosystems where highly seasonal rainfall facilitates large and frequent fires. My postdoctoral research is centered on improving our understanding of how climate, fire, and vegetation in these systems interact and how these interactions may have varied across large climatic transitions.

Maria Rosabelle Ong
Postdoctoral Scientist, American Museum of Natural History, Lamont-Doherty Earth Observatory

My research aims to reconstruct past environmental conditions to better understand and identify short-term (seasonal) to long-term (decadal-to-centennial) climatic and oceanographic processes, distinguishing natural climate fluctuations from human-induced climate change.

I am a coral geochemist, and currently I am working on reconstructing past marine environments in the western tropical North Atlantic over the last two centuries. I generate high-resolution records of trace metals (Sr/Ca, Ba/Ca) and stable isotopes (δ18O) to look into past sea surface temperatures and regional hydroclimate variability. I also utilize radiocarbon (Δ14C) isotopes to reconstruct ocean circulation changes in the tropical Atlantic, which is a critical region for understanding the upper limb of AMOC (Atlantic Meridional Overturning Circulation) variability. I also leverage publicly available datasets, i.e., in-situ observations and satellite-derived reanalysis products, to compare modern climate information with geochemical proxies to interpret and constrain past climate variability. My work provides context for recent observed climate change and informs future predictions and projections.

Gavin Schmidt
Director, NASA GISS

Gavin Schmidt is the PI for the GISS Earth System Model and has published widely on paleo-climate simulations, climate forcings, climate sensitivity and enhancing complexity in climate models.

Kostas Tsigaridis
Research Scientist, Columbia University, NASA GISS

My research interests aim in understanding the role aerosols play in the Earth system, by studying the interactions and feedbacks between the atmosphere, the terrestrial biosphere, the ocean, and climate. I am currently working on a variety of topics related to aerosol research and their sources, sinks, and interactions with climate at various levels of complexity. My studies range from detailed aerosol processes such as the formation of secondary organic aerosols (SOA), to centennial time scale climate variability related to natural variability and external forcings. While my main expertise is organic aerosols, I am also experienced in working with all other aerosol types as well as tropospheric gas-phase and heterogeneous chemistry. I have extensively used both box models that I developed, and 3-dimensional global models: the TM3 chemistry/transport model, the IPSL general circulation model LMDz-INCA, and the GISS modelE Earth System Model (ESM), for which I had contributed to the IPCC AR5 model development. Currently I am working with the next generation of the NASA GISS ESM, the GISS ModelE2, which is part of CMIP5.

Richard Vachula
Assistant Professor, Auburn University

Richard Vachula’s research focuses on the complex relationships between climate, fire, humans, and ecosystems. Additionally, Richard has a particular interest in fire as an Earth System and socio-environmental process. Much of Richard's research applies paleofire, paleoclimate, and paleoecology approaches with the goal of providing scientific insights to inform management and policy decisions.
Richard earned an MS (2017) and PhD (2020) in Earth, Environmental, and Planetary Sciences from Brown University. At Brown, he focused on developing and applying paleofire techniques. Richard served

as a postdoctoral research assistant at the University of Reading in the United Kingdom, where he worked to develop a global database of paleofire datasets. In August 2020, he joined the Environmental Science and Policy program at the College of William and Mary as a Mellon Postdoctoral Fellow. He has been an Assistant Professor in the Department of Geosciences at Auburn University since January 2022. At Auburn, Richard leads an interdisciplinary, collaborative research group and teaches courses through the Interdisciplinary Earth System Science (ESS) PhD program (e.g., ESS and Global Change, ESS Seminar) and the Department of Geosciences (e.g., Paleoclimatology, Dynamic Earth). His current research focuses on paleofire reconstruction and comparison to paleoclimate model simulations.

Gisela Winckler
Professor of Climate, Columbia University

Gisela Winckler is a climate scientist and isotope geochemist. Her research focuses on the history and causes of climate variability in the past, present and future. She uses elemental and isotopic analyses to unravel processes of climate and environmental change in the oceans and on continents, on time scales ranging from decades to tens of millions of years. Her research on the interplay of climate change, the carbon cycle and aerosols uses climate archives such as deep-sea sediments, lake sediments and polar ice cores from Antarctica and Greenland. She is interested in fostering innovative ways of connecting science, art, journalism, design, climate activism and outreach. Gisela received her PhD in Physics from the University of Heidelberg, Germany. She was elected a Fellow of the American Association for the Advancement of Sciences (AAAS) in 2024

Lily Wu
Graduate Student, Cornell University

I am a second-year Atmospheric Sciences PhD student working with Dr. Natalie Mahowald at Cornell University. I also hold a B.S. in Environmental Geoscience from Texas A&M University, with minors in Meteorology and Geography. My research background is in aerosols, and I have experience working with the Community Earth System Model (CESM).
I am currently working on a project incorporating volcanic ash into the CESM to assess how well the model simulates a volcanic eruption. In the future, I plan to continue this research and look at more volcanic eruptions to understand the impact of volcanic ash on the climate and Earth systems.

Bingqing Zhang
Postdoc, University of Chicago

I am a postdoctoral fellow at the University of Chicago, newly graduated with a PhD in Earth and Atmospheric Sciences from the Georgia Institute of Technology. My research focuses on integrating ice-core records with atmospheric models to reconstruct past aerosol emissions and quantify their climate impacts. Three major goals include: 1) Emission estimates: I developed a new biomass burning emission inventory using an inverse modeling framework constrained by ice core BC records from the preindustrial period to the present day. I am also working on applying the physics-based dust-emission scheme in climate models to assess dust responses under different climate conditions during the last glacial period; 2) Ice core records interpretation: using both simplified 1-D air-parcel model and 3-D chemical transport model, I aim to separate transport versus source-driven variability in dust and wildfire proxies across glacial–interglacial transitions and Dansgaard–Oeschger events; 3) Climate impact assessment: I aim to estimate radiative forcing and climate responses with observation-constrained emissions and improved model parameterizations to reduce uncertainty in aerosol–climate interactions.

Workshop Logistics

Hotel
We have reserved a hotel block at the Tarrytown House Estate, which includes onsite dining and walking trails. The rate is $189/night (including breakfast). The hotel has been notified of everyone who requested rooms through the registration form. Note: there is no early booking link—a credit/debit card will be required at check-in.

Hotel Address:
Tarrytown House Estate
49 E Sunnyside Lane
Tarrytown, NY 10591

Phone: +1 (914) 591-8200

Travel
For those arriving on Sunday, the hotel is accessible via public transportation:

- From EWR (Newark Airport): take the Newark Airport Express bus to Grand Central Terminal.
- From Grand Central: take the Metro-North Hudson Line (toward Poughkeepsie) to Tarrytown (express trains make it the second stop).
- From Tarrytown Station: either the Bee-Line bus (to S Broadway @ Sunnyside Lane, ~9 min) or a rideshare can be used for the final leg.

Carpool Coordination: 2025 Carpool Info: Paleo Aerosol Workshop

Workshop Logistics

The workshop will be held at the Lamont-Doherty Earth Observatory (LDEO):

Lamont-Doherty Earth Observatory
61 Route 9W
Palisades, New York 10964-1000 USA

The meeting will take place in the Comer Seminar Room, located at the rear of the first floor of the Comer Geochemistry Building (Building #15 on the LDEO campus map).

Shuttle: We will provide transportation between the hotel and LDEO, departing each day from the Tarrytown House at 8:30 am.

Group dinners:

- Sunday evening: Optional welcome dinner at the hotel (Main Dining Room Buffet), 6:00 – 9:00 pm.
- Monday evening: Official workshop dinner for all participants at Goosefeather, 5:00 pm.