

DESIGNING TO COMMUNICATE CLIMATE FUTURES

- Purpose of the Poster Assignment
- Key Considerations
- Anatomy of a Good Poster
- Design Principles and Tips

WHAT ARE WE TRYING TO DO?

Research ----- **Climate Futures** ----- Shape

“What are –or could be –our key contributions to researching and shaping climate futures?”

An informed but innovative contribution...

...that can be communicated effectively

...perhaps something interdisciplinary?

WHAT MAKES FOR A GOOD POSTER?

Tells a Clear & Compelling Story

Title
Introduction/Motivation
Knowledge Gap
Methods/Strategy
Conclusion/Call to Action

Don't forget to add references for your research – and all the images!

Effective Visual Design

- ✓ Legible and not too much text
- ✓ Combo of visual/textual information (min. 50:50, but better 60:40)
- ✓ efficient use of space
- ✓ accessible
- ✓ clear structure and sequence

Balancing Act

Stand on its own vs. compliment your presentation
Scientifically sound vs. attention-grabbing

WHAT TO THINK ABOUT?

Know your audience...

**What knowledge can be assumed?
What language will be used?**

the extended CLICCS/ SICSS community...

Student peers

Professors

Academics

Non-Academic Personnel

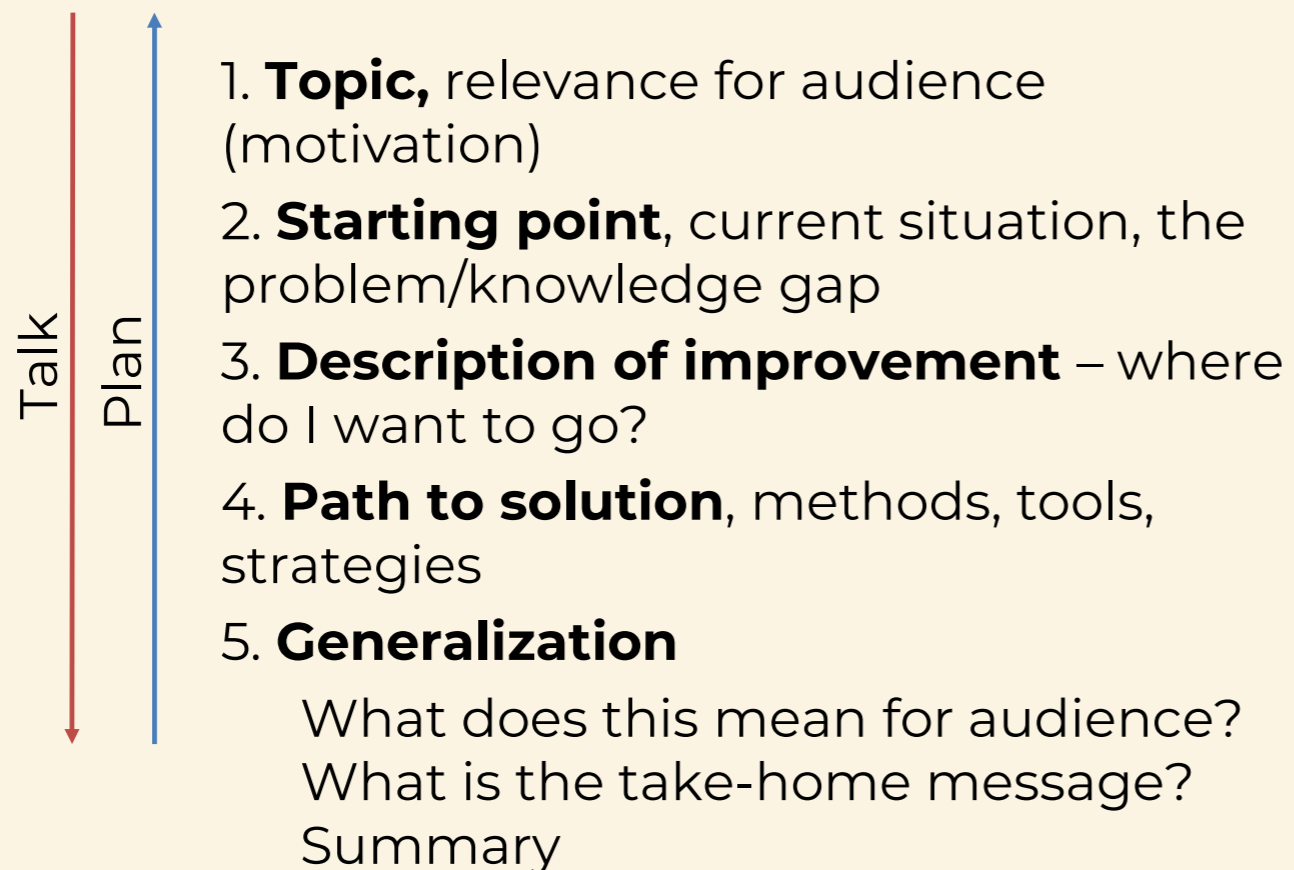
Decide on your core message...

**Which message do I want to convey?
What should be the main takeaway?**

HOW TO GO ABOUT STRUCTURING POSTER?

Preparation

- Thinking, researching, collecting materials
- What do I want to say? (1 sentence)
- Sorting (5-step procedure):

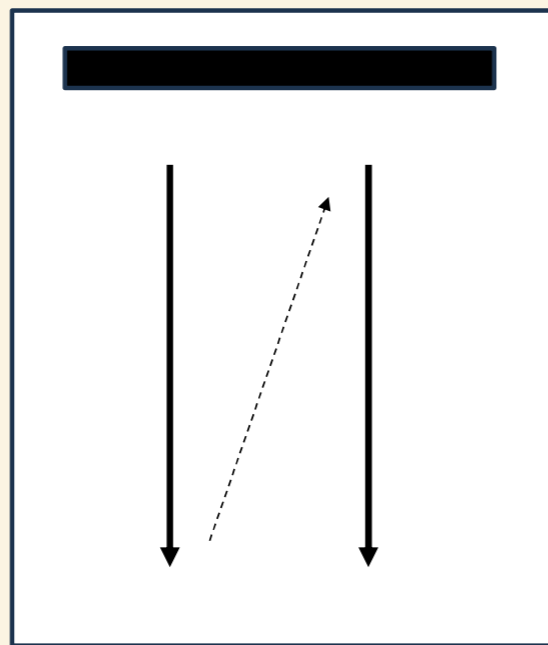


Strategies for finding the story?

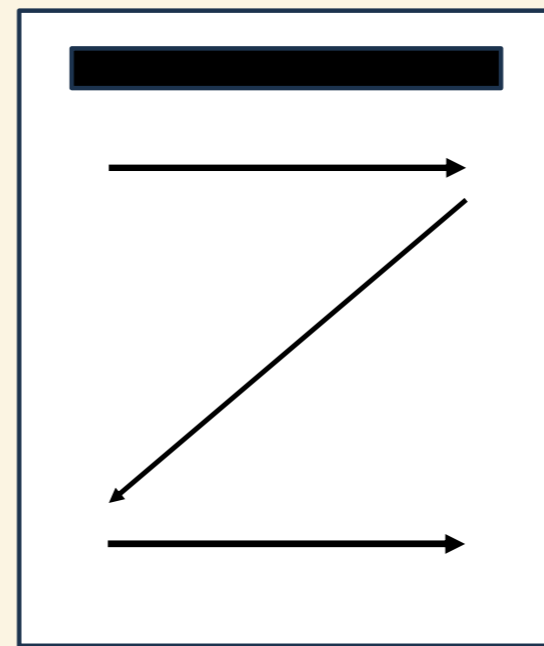
- Structure around headers
- Start with figures and adapt text accordingly.
- Narrow down to core components: outline on paper or try explaining it to another person
- Test draft before committing! Get feedback from your peers!

LAYOUT

Column Layout



Z - Pattern Layout



FONTS

- Use 1–2 font families max for a clean, unified look
- Prefer sans-serif fonts (like Monserrat, Arial, Calibri) over serif fonts (like Times New Roman, Georgia, Garamond) for body text and headings— highly readable from a distance
- Minimum sizes for A0 posters:
32 pt for body text
48 pt+ for headings
- Avoid *italics*, underlines, or ALL CAPS for large text blocks — they reduce readability
- Maintain consistent line spacing and alignment (left-align is best for blocks)

COLOR THEORY

...can be confusing

Instead, try...

For colors:

60 – 30 – 10 rule

Role	Portion of Poster	Purpose
60% Primary	Background or large blocks	Sets the base tone, makes it feel cohesive
30% Secondary	Supporting areas (text boxes, sidebars)	Adds visual interest without chaos
10% Accent	Headlines, buttons, icons	Draws attention where you need it most

For contrast:

4.5:1 minimum rule

- Consider the ratio between text color and background color brightness.
- Higher the ratio, more readable it is.


Example:

Black text on a white(ish) background = high contrast ($\approx 21:1$)

Grey text on light yellow = low contrast ($< 4.5:1 = \text{bad}$)



EXAMPLES – WHAT WORKS FOR YOU? WHAT DOESN'T?



Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

CLUSTER OF EXCELLENCE
CLIMATE, CLIMATIC CHANGE,
AND SOCIETY (CLICCS)

Long-term observations reveal rise in early summer CH₄ emissions from Siberian tundra

N. Rößger^{1,2}, T. Sachs², C. Wille², J. Boike³, L. Kutzbach¹

¹Institute of Soil Science, CEN, Universität Hamburg, ²GFZ Potsdam, ³Alfred-Wegener-Institut, Potsdam

Relevance of arctic CH₄ emissions for global climate-carbon cycle feedback?

- The warming of the Arctic, which is at least twice the global average, is likely to have pronounced effects on arctic CH₄ emissions.
- Changes of arctic CH₄ emissions can be driven by soil warming, permafrost degradation, a deepening of the seasonally thawed active layer, enhanced decomposition rates and a lengthening of the thawing season.
- However, it has remained unclear whether rising temperatures affect the two counteracting processes of methane production and consumption equally or not.
- Hence, there is only medium evidence with low agreement, whether northern permafrost regions are already releasing additional CH₄.

Eddy covariance CH₄ flux measurements in Siberian lowland tundra

- Here, we present multi-annual CH₄ flux data from the Lena River Delta in the Siberian Arctic (72.4° N, 126.5° E, Fig. 1) acquired by the eddy covariance method (Fig. 2).
- The polygonal tundra landscape is characterized by a mosaic of ponds, water-saturated cryotopes with high organic carbon contents in polygon centers and drier cryoturbated cryotopes with lower organic carbon contents at polygon rims.
- Mean annual air temperature -12.3 °C, mean annual precipitation 169 mm.

Intra-annual CH₄ flux dynamics and budget

- Mean annual budget of 171.5 ± 12.3 mmol m⁻² yr⁻¹ (2.7 ± 0.5 g CH₄ m⁻²)
- Between 25th and 50th percentile of circumpolar tundra (Treat et al., 2018, Glob. Chang. Biol.)
- Maximum rates in early August (Fig. 4 left)
- 61 % of the mean annual during the thawing season, 14 % during autumn refreezing season, 25 % during frozen season (Fig. 4 right).

Flux trends and their seasonality

- Significant increasing trends of CH₄ emissions for June and July (Fig. 6).
- No trend in August during period of maximum CH₄ source strength.
- Decreasing trend in September, but too few data years.
- Not enough data for trend analyses for cold months October to May.
- Changes in June and July equivalent to an increase of the mean annual methane budget by 0.5 % yr⁻¹.

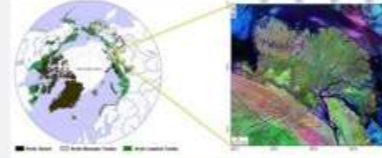


Figure 1: Location of the Lena River Delta in the lowland tundra of Siberia (left); location of the flux measurement station at Samoylov Island in the southern Lena River Delta (right).




Figure 2: Eddy covariance flux measurement systems 2002-2006 (left) and 2009-2017 (right) in the polygonal tundra of the Lena River Delta.

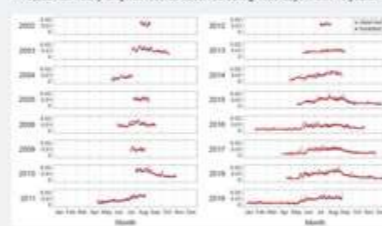


Figure 3: Time series of daily average quality-controlled CH₄ flux measurements and modeled daily CH₄ fluxes. Flux modeling by random forest (ensemble of regression trees), R²=0.78, mean absolute error 138 mmol m⁻² yr⁻¹, mean relative error 18 %.

Flux controls on various time scales

- CH₄ fluxes and the explanatory power of associated flux drivers varied strongly depending on time scales, from diurnal to inter-annual (Fig. 5).
- On the daily to synoptic scale, the variations in methane fluxes were affected by friction velocity, which was subject to a diurnal cycle (data not shown).
- On the intra-annual scale (Fig. 5, top line), CO₂ fluxes served as a proxy for CH₄ fluxes between October and May, suggesting that both soil gases were subject to the same physical transport processes.
- From June to August, thaw depth held explanatory power as an indicator of the maximum soil volume available for methanogenesis.
- In September and October, surface albedo had explanatory power, when it formed a proxy for enhancing snow coverage, and thus the decreasing coupling between vegetation and soils and the atmosphere.
- On the annual scale (Fig. 5, middle line), most of the variability could be explained by air and soil temperatures as fundamental variables driving metabolic processes such as photosynthesis as well as methane production and consumption. The soil temperature in a polygon centre at 20 cm depth was the best explanatory variable in comparison to soil temperatures at other depths and locations within the polygon. This soil temperature reflects water-saturated conditions in the center, the timing of the annual thaw/freeze cycle and high organic matter content in the top soil.
- On the inter-annual scale (Fig. 5, bottom line), explanatory power was provided by drivers that best describe cumulative heat input to the ecosystem in the thawing season: soil temperature at 30 cm depth, thaw depth, and growing degree days.

Flux trends and their seasonality

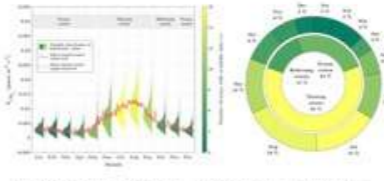


Figure 4: Monthly distributions of half-hourly methane fluxes and their mean annual course (left). Mean monthly and seasonal contributions to the annual budget (right). The three seasons reflect the three freeze-thaw states of the active layer of the permafrost affected soil.




Figure 5: Methane flux trends estimated for the four month thawing season. Left: Gap filled time series of daily means and their associated trend lines (sample sizes: n_{CH₄}, n_{CO₂}, n_{soilT_{20cm}}, n_{soilT_{30cm}}, n_{soilT_{10cm}}, n_{soilT_{0cm}}, n_{albedo}, n_{gdd}, n_{thawDepth}). Right: absolute trends (left axis, blue bars) and relative trends (right axis, red bars) of each month. P-values obtained from test modifications of the two-sided Mann-Whitney U-test after Hamed and Rao (1988) and after Yeo and Wang (2004), respectively.

Conclusions

- Comparatively low annual CH₄ emission of polygonal tundra of the Lena River Delta due to colder permafrost and shallower active layer?
- Important to investigate the refreezing and frozen seasons with more flux data!
- Soil temperature most important control on synoptic, seasonal, annual and inter-annual scales.
- Warmer thawing seasons lead to higher CH₄ emissions.
- Warming effects on CH₄ production apparently dominate over warming effects on CH₄ consumption.
- Strongest rising CH₄ flux trends observed in early summer due to earlier start of growing season (4-5 days per decade).
- However, future trends of CH₄ emissions likely not only temperature-controlled but dependent on complex landscape evolution, hydrology and vegetation changes.

Contribution to CLICCS overarching question?

- Increasing methane emissions from permafrost regions are discussed as a major positive feedback to global warming, possibly constraining the achievement of the Paris Agreement targets.
- However, there is large uncertainty about the magnitude of the effects of arctic CH₄ emission changes compared to possible and plausible scenarios of anthropogenic CH₄ emission changes (Fig. 7).
- Our empirical trend analysis based on a unique long-term observational dataset suggests high plausibility that the effects of warming-induced arctic CH₄ emission increases on the remaining carbon budget are minor compared to the CH₄ emission reduction potential of mitigation measures (compare Fig. 7).

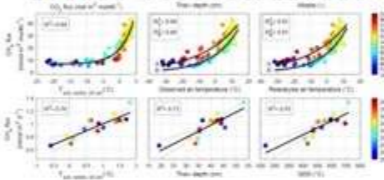


Figure 7: Comparison of the effects of possible scenarios of anthropogenic CH₄ emissions vs. possible scenarios of arctic CH₄ emissions on atmospheric CH₄ concentrations and relative forcing. Diagram from Christensen et al. (2019, Scientific Reports).

More information: www.clliccs.uni-hamburg.de/nvsearchtheme-ax1.html
Contact: lars.kutzbach@uni-hamburg.de

COMING SOON:
Rößger, N., Sachs, T., Wille, C., Boike, J., Kutzbach, L.: Seasonal increase of methane emissions linked to warming in Siberian tundra. Accepted at Nature Climate Change.



EXAMPLES – WHAT WORKS FOR YOU? WHAT DOESN'T?

Mass Public Participation in Climate Movements in India

Pritha Mandal

Background

Although climate activism and movements in India have gradually gained traction over the last decade, their publicization and mass participation remain limited.

Objective

To explore potential strategies that can help promote publicization of and mass public participation in climate movements in India.

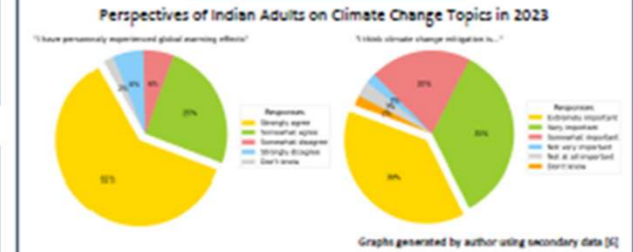
Context

- India has a rich history of mass social movements: The country was born out of an *andolon* (a nation-wide movement). [1]
- The recent **Farmers' Protests of 2020-2021** demonstrated the positive, successful impact of a large-scale movement in India. [2]
- The nation-wide, large-scale public participation in the **Farmers' Protests** can be drawn on to contextualize climate activism in India.
- Discourses used by popular climate movements in the West (such as **Fridays for Future** and **Extinction Rebellion**, among others) can serve as a guiding framework.



Strategies to Promote Mass Public Participation in Climate Movements in India

Existing Data



Required Knowledge

- Quantitative Research**
- Extending existing **national survey databases** on societal perspectives on climate change topics.
 - Conducting **representative nation-wide surveys** through schools, universities, and governmental offices.
- Qualitative Research**
- Identifying **primary climate change concerns** of the public, especially those of the most vulnerable groups (farmers and people living below the poverty line).
 - Exploring the **willingness to act** and potential focus areas of specific groups of the public.

Potential Strategies

- Developing **targeted, relatable climate change narratives** for specific groups of the public based on research data.
- Utilizing **social media and public outreach** of independent Indian media groups, such as **India Development Review** (media platform), **Mint** (newspaper outlet), and **Editorji** (information platform), to publicize these narratives and enhance participation in climate movements.

Summary

- Publicization of and mass participation in climate movements in India are limited.
- To overcome these limitations and develop potential strategies, the **2020-2021 Indian Farmers' Protests** can be used as an inspiration, and discourses of **popular Western climate movements** as a framework.
- Potential strategies can be informed by conducting **representative nation-wide surveys** and exploring the public's climate change concerns and willingness to act.
- Corresponding strategies can involve utilizing **social media and public outreach** of independent Indian media groups to communicate relatable climate change narratives.

References

[1] Chandra, B., Mukherjee, M., Mukherjee, A., Panikkar, K. N., & Mahajan, S. (2016). *India's struggle for independence*. Penguin UK.

[2] Behl, N. (2022). India's farmers' protest: an inclusive vision of Indian democracy. *American Political Science Review*, 116(3), 1141-1146. <https://doi.org/10.1017/S0003055422000156>

[3] Illustration by Michael Leo. <https://www.thegazelle.org/issue/195/farm-india-fight>

[4] Fridays for Future. Wiki. <https://wiki.fridaysforfuture.in/>

[5] Wikipedia Commons. https://commons.wikimedia.org/wiki/File:Logo_extinction_rebellion.svg

[6] Yale Program on Climate Change Communication. (May, 2024). *Climate Change in the Indian Mind*, 2023.



EXAMPLES – WHAT WORKS FOR YOU? WHAT DOESN'T?

Path To Fossil Freedom for Oil Addicted Countries

What strategies can oil-rich nations use to transition their economies away from oil? Kat Linscott

The Problem

- Decarbonization is urgently required to mitigate climate change, but every step of the way, oil-rich nations are delaying progress.^[1]
- These nations are also typically the highest emitters, a phenomenon termed the carbon curse.^[2]
- Currently, relying on market mechanisms to pressure these countries to conform is failing.^[3]
- Reaching decarbonization goals will require reform driven by fossil fuel nations.

1. Why are they like this?

There are enormous incentives to stay on carbon-intensive developmental pathways:

- Dependence:** oil industries make up much of their national wealth, income, and employment.^[4]
- High-cost, costly infrastructure and industries are already developed.^[5]**
- Internal resistance:** powerful lobby groups and voters afraid of economic decline.^[6]

2. Why should they care?

Relying on oil puts these nations' economies at enormous risk.^[7]

- Oil-based economies are **volatile**.^[7] [8]
- Peak oil demand** will occur this century.^[9]
- Decreasing profitability** of oil due to the rise in renewables and carbon markets.^[10]
- The **cost of climate change damage** are likely to exceed the oil profits.^[10]

Figure 2: Risks for Oil Nations

3. What are countries currently doing?

Plan	Denmark (0.3% of GDP)	Norway (6.1% of GDP)	Saudi Arabia (24% of GDP)
Plan	<ul style="list-style-type: none"> Cease oil exploration now & end oil production by 2050.^[11] 	<ul style="list-style-type: none"> Maintain level of production, continued O&G exploration.^[12] 	<ul style="list-style-type: none"> Increase production to reclaim market share, create a price war.^[13] [14]
Strategies	<ul style="list-style-type: none"> Renewables, CCUS & biofuels.^[15] Just transition policies: regional re-investment and stakeholder involvement.^[12] [16] 	<ul style="list-style-type: none"> National Oil Fund to buffer the economy for future generations Investments in extraction efficiency, renewables, CCUS, & Green H₂.^[15] 	<ul style="list-style-type: none"> Economic diversification (manufacturing, tourism, etc.) Investments in extraction efficiency, renewables, CCUS, & Green H₂.^[16]

4. The Research Gaps

- Guidelines and case studies
- Equity for developing nations
- Societal drivers and barriers
- Managing uncooperative actors
- Technological feasibility of CC&S, H₂ & biofuels
- Economics: implementing carbon tax, producer coalitions, & compensating oil sectors.^[17]

So how can they get there? A framework for reaching fossil freedom for oil-addicted countries.

Phase I: Preparing for Peak Oil
Build a long-term phase-out plan.

Phase II: Passing Peak Oil
Prioritize just transition policies!

Figure 3: Projected Peak Oil Demand, adapted from Halttunen et al.^[18]

Category	Phase I: Preparing for Peak Oil	Phase II: Passing Peak Oil
O&G Sector	<ul style="list-style-type: none"> Ban exploration and new O&G investments.^[21] [22] Improve operational efficiency.^[21] [23] Reinvest O&G revenue into National Wealth Fund to redistribute wealth to future generations.^[14] [24] Shift subsidies from O&G to renewables.^[21] [25] 	<ul style="list-style-type: none"> Cease existing operations.^[22] Use National Wealth Fund to support transition.^[21] [26] Use price coalitions to maintain profits during decline.^[21] Implement phased carbon pricing.^[27]
Economy Wide	<ul style="list-style-type: none"> Build on competitive advantages (renewables).^[22] Diversify economically.^[21] [28] Strengthen institutions & regulatory bodies.^[22] Phased reduction with time to adapt (10-20 yr).^[12] [29] Build political consensus & stakeholder support.^[12] 	<ul style="list-style-type: none"> Decarbonize energy and transportation sectors.^[32] Continue investing in selected non-fossil-fuel sectors Support transition via regional re-investment in retraining/relocation of workers and companies.^[21] [33]
New Markets	<ul style="list-style-type: none"> Carbon Capture & Storage Potential? Invest in CCUS R&D → stop production and participate in carbon markets.^[21] Natural Gas Reserves & Renewable Potential? Invest in Blue Hydrogen → transition to Green Hydrogen.^[21] Biofuel Potential? Attract oil-based industries, develop biofuel production industries and invest in bioplastic R&D.^[21] 	

Transitioning away from fossil fuels is necessary, feasible and economically smart. Plan long-term. Start Today. Just Transition.

U+H
Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

References

Contact: katherine.linscott@studium.uni-hamburg.de

SCHOOL OF INTEGRATED CLIMATE AND EARTH SYSTEM SCIENCES



SOFTWARES



LATEX

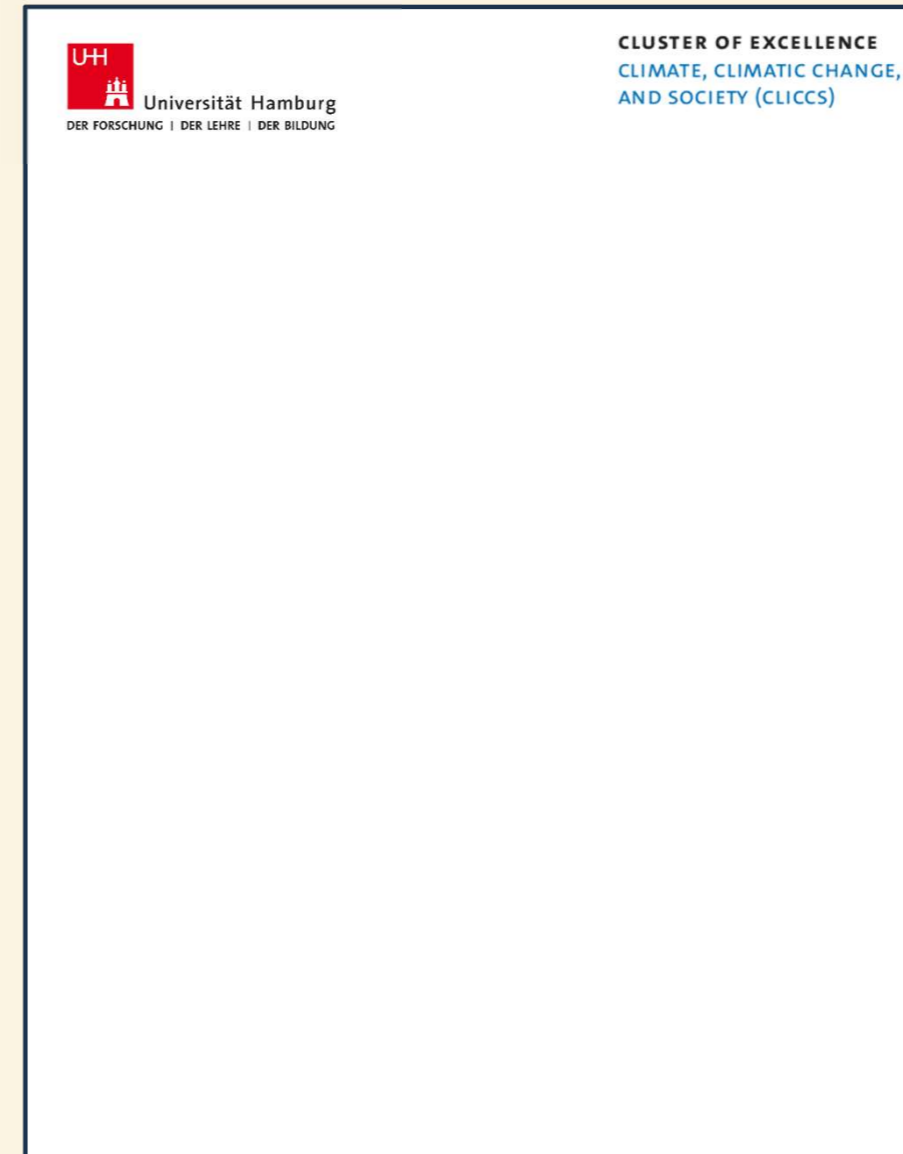
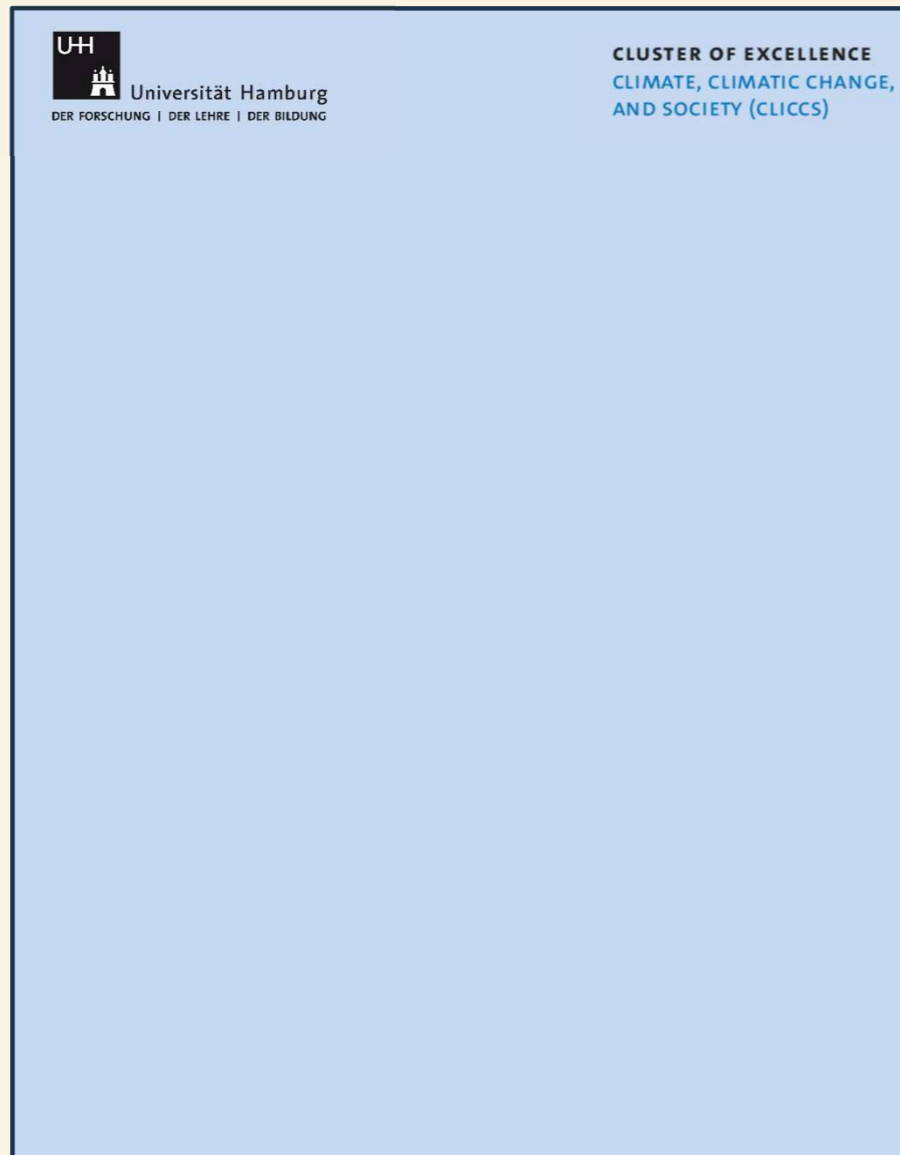
Canva



CITE YOUR SOURCES!

- Anything that is not your idea must be cited as such
- Free choice of citation format (APA, MLA, IEEE, etc.)
- In-text citations – text vs. numbering
- References at the bottom – full references is preferable, QR code + important citations is ok if references are very long

UHH LOGOS



Do not edit these!!

Guidance on use: <https://www.kus.uni-hamburg.de/themen/oeffentlichkeitsarbeit/corporate-design/logo.html>



SUMMARY

- **Tell a clear and compelling story**
 - Don't data dump. Guide your reader with a clear flow from motivation to message.
 - Flow > details: Sketch structure and experiment before jumping into design.
- **Know your audience:** keep it accessible, easy to scan and audience-appropriate
- **Effective and accessible design**
 - Requirements: A0 size, with proper citations & logos (UHH, CLICCS)
 - Layout & design: choose between column or Z-pattern structure or find your own style.
 - Colour: Balance palette (60-30-10 color rule) + contrast check (4.5:1 minimum) + colour-blind friendly.
 - Text: Keep fonts simple, consistent and big enough (32 pt for body text, 48 pt+ for headings). Use sans-serif fonts. Ensure clean alignment.

General Poster Feedback: Speed-Dating (June 11th) & Poster Clinic (June 25th).

Reach out to me (Kat) if you have any questions!



ADDITIONAL GUIDANCE



MORE STRUCTURAL ADVICE...

- **Can be read from top left to lower right.**
 - Stress positions: top left and lower right, here you find the core information.
- **Balance visuals and text:** 50:50, but better 60:40 (start with key visuals; do they cover the main point?).
 - Can be understood from far/ on an A4 print-out.
 - Use headers to structure your poster.
 - Start with figures and adapt text accordingly. (NOT the other way around!)

MORE STRUCTURAL ADVICE...

Introduction

- Motivation, overview
- Mental road map
- Raise interest
- Clear description of problem/knowledge gap
- Clear statement on objectives/research questions/hypotheses

Sections

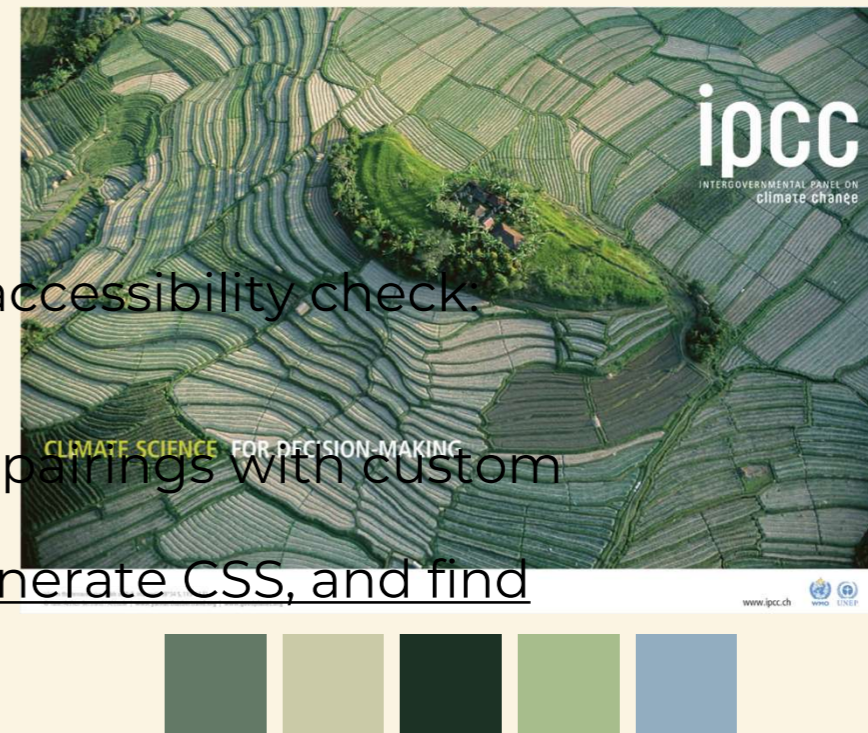
- Structure
- Create re-entry points

Closing

- Repeat core message
- Find good closing sentence

SOME HELPFUL WEBSITES

- Extract a custom color palette from any image you upload:
[Color Palette from Image – ColorKit](#)
- Generate pretty color combos from scratch:
[Create a Palette – Colors](#)
- Check if your colors play nice *and* pass the accessibility check:
[Color Contrast Checker – Colors](#)
- Design typography scales and preview font pairings with custom settings:
[Typescale](#) - Create stunning typography, generate CSS, and find inspiration.

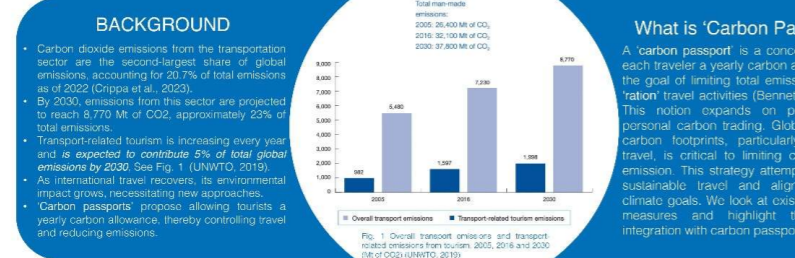


Prediction of Heatwaves and Preventive Agricultural Strategies

Reducing Travel Emissions: Policy and Practice of Carbon Passports

Suphroek Klinchaona
School of Integrated Climate and Earth System Sciences, Universität Hamburg

POLICIES	
Supply-Side Policies	Demand-Side Policies
<ul style="list-style-type: none"> Carbon Infrastructure Regulation <ul style="list-style-type: none"> Mandate renewable energy sources in tourism infrastructure (airports, hotels, cruise ships). Enforce strict energy efficiency standards for buildings and vehicles. Restricting Development <ul style="list-style-type: none"> Limit new tourism facilities in environmentally sensitive areas. Implement zoning laws to protect natural habitats and restrict hotel/resort construction. Promoting Sustainable Transport <ul style="list-style-type: none"> Expand and improve rail networks as alternatives to short-haul flights. Develop cycling and walking infrastructure in tourist destinations. Encourage the use of electric or hybrid vehicles for tourism-related transport. Carbon Offsetting Requirements <ul style="list-style-type: none"> Require tourism businesses to offset carbon emissions through renewable energy investments or reforestation programs. 	<ul style="list-style-type: none"> Carbon Passport System <ul style="list-style-type: none"> Introduce a carbon passport system with a yearly carbon allowance for travel. Track individual carbon emissions digitally. Implement penalties for exceeding allowances and provide for staying within limits. Increased Travel Costs <ul style="list-style-type: none"> Implement higher taxes and fees on high-carbon travel. Substantial taxes on airline tickets, especially for long-haul flights. Surcharges on cruise ship tickets. Promoting Low-Carbon Destinations <ul style="list-style-type: none"> Encourage travel to low-carbon footprint destinations. Provide subsidies or discounts for travel to eco-friendly destinations. Promote eco-tourism and sustainable tourism practices. Public Awareness Campaigns <ul style="list-style-type: none"> Educate travelers on the environmental impact of their travel choices. Promote sustainable travel behaviors such as choosing eco-friendly accommodations and opting for staycations.



IMPLEMENTATION OF CARBON PASSPORT

- Policy Design and Legislation**
 - Draft legislation to establish the carbon passport system and associated regulations.
 - Set up a government body responsible for managing and enforcing the system.
- Infrastructure and Technology Development**
 - Develop digital infrastructure to track and manage carbon allowances.
 - Invest in upgrading transportation and tourism infrastructure to most new carbon efficiency standards.
- Stakeholder Engagement and Communication**
 - Engage with airlines, tourism businesses, and environmental groups to gain support and input.
 - Launch public awareness campaigns about the new system and its benefits.
- Monitoring and Enforcement**
 - Establish systems to monitor carbon emissions from tourism-related activities.
 - Enforce penalties and provide incentives to ensure compliance.
 - Evaluation and Adjustment
- Regularly evaluate the effectiveness of policies in reducing emissions.**
 - Adjust carbon allowances, fees, and regulations as needed to achieve desired outcomes.

REFERENCES:

BRUNET, C. (2023). 'Carbon Passports: A New Tool to Reduce Emissions?' *The Conversation*.
 Grippa, M. (2023). 'Carbon Passports: A New Tool to Reduce Emissions?' *The Conversation*.
 UNWTO. (2019). 'Tourism's CO₂ Emissions: The Tourism Sector - Modeling Results 182070'.
 Bennett, J. (2023). 'Carbon Passports: A New Tool to Reduce Emissions?' *The Conversation*.



SCHOOL OF CLIMATE AND EARTH SYSTEM SCIENCES

Civil Disobedience for Climate Justice

Lessons from History

Marie Volk, M. Sc. Integrated Climate System Sciences
Course: 63-921 Researching and Shaping Climate Futures

Research Question
What lessons can the current climate movement learn from historic environmental nonviolent civil disobedience (NVCD) campaigns?

Definition Civil Disobedience⁶
"The deliberate violation of law for a vital social purpose" (Zinn, 1986)

- Protest against something perceived as unjust
- Nonviolently and unarmed
- Creation of disruption to transform status quo
- Willingness to accept punishment / imprisonment

Common Tactics of NVCD⁹

Demonstrations	Sabotage	Boycotts
Protests	Property damage	Labor strikes
Blockades	Occupations	Hunger strikes
Mass arrests	Sit-ins	Trespassing

Research Gap

- No data sources about participation of non-revolutionary movements⁷
- Identification of determinants of successful outcomes across climate movements¹⁰
- Effectiveness of civil resistance across climate movements not yet examined⁸

What makes a NVCD campaign successful? ^{4, 5}

- Mass participation
 - Most revolutionary NVCD campaigns succeed after 3.5% of national population is mobilized
- Membership diversity
 - Higher disruptive factor
 - More resources and mobilization networks
- Shifting loyalties of government's supporters
 - Proposal of alternatives appealing to many
- Clear tactical diversity
- Discipline and resilience in the face of repression
- Place-based and project-based campaigns
 - Above a 1/4 higher chance to succeed¹⁰

Bolivia Cochabamba Water War 1999 - 2000

- Successful campaign against attempts to privatize rainwater in Amazon rainforest populated by indigenous communities⁵
- Clashes of "Water warriors" and the police³
- Road blockades, general strike for 4 days, protests, referendum¹
- Participants: >10,000 peasant irrigators, factory workers, street vendors, students, homeless street children^{2,7}

US Dakota Access Pipeline Protests 2016

- Successful campaign against the construction of a pipeline which threatened the region's water and ancient burial grounds of Standing Rock Indian Reservation⁵
- Trespassing, occupation of machinery (chaining), blockades¹²
- Participants: Up to 10,000, 200 tribes¹

Germany Hambach Forst Occupation 2012 - 2020

- Successful campaign to prevent coal infrastructures of RWE in forest⁶
- Police clearance ruled illegal¹¹
- German government agreed to preserve forest⁶
- Blockade, occupation with tree houses, demonstrations⁸
- Participants: Up to 50,000⁸

Proposed Strategies for the Climate Movement

- Mobilize more people⁹
- Frame claims that resonate with more diverse people⁵
- Increase diversity of tactics⁹
- Increase economic non-cooperation and boycotts⁹
- Impose immediate and direct costs on companies
- Increase public knowledge on effectiveness of NVCD⁹
- More Place- / and project-based campaigns

FROM WAVES TO POLICIES: HARNESSING OCEAN ALKALINITY FOR CLIMATE ACTION

EXPLORING NEW WATERS: ADDRESSING RESEARCH GAPS

By, there are mechanisms of OAE that are not fully understood, such as:

- Long-term ecological impacts
- Increased alkalinity.
- Natural alkaline substances (e.g., 4) and deployment methods.
- Global and regional modeling impact on carbon cycle.

Long data preservation and accessibility requires field trials, cross-laboratory collaboration, and varied research methods, such as:

- Measurement collection (Niskin bottles, moorings, saildrones, Argo floats).
- Controlled studies (laboratory, mesocosm, field testing, natural analogues).
- Standardized data standards to fit OAE research.

SCALING UP OEA: IMPLEMENTATION STRATEGIES

Identify the most cost-effective and scalable alkaline feedstocks.

Develop techniques for efficiently scaling materials in different marine environments.

Implement reliable systems to measure CO₂ uptake and ecological changes.

Encourage multidisciplinary research to address technical and social challenges.

CARBON SEQUESTRATION

Potential:

- Moderate to High: 1 to >5 Gt CO₂ per year.
- Abundant rock resources.
- Limitations in extraction, production, and distribution.

Environmental Impacts:

- Potential issues from mineral byproducts (e.g., Si, Mg, trace metals).
- Local reduction of ocean acidification.

Costs:

- Low to High: <\$25 to >\$125 per ton CO₂

TAKE HOME

- The Challenge:** CO₂ level drive climate change and acidification, altering temperatures and marine ecosystems.
- Ocean Potential:** The ocean can store a vast amount of carbon, significantly reducing atmospheric CO₂.
- OAE Mechanism:** Minerals raise seawater pH and shift the carbonate system, enhancing CO₂ uptake.
- Research Gaps:** Investigate ecological impacts and optimal alkaline substances.
- Implementation:** Develop deployment techniques through multidisciplinary research and ensure reliable monitoring.
- Regulation:** Establish international policies and address ethical concerns involving of all society actors.

Research (OAE Guide 23), Copernicus Publications, State Planet, 2 June 2023 (Check QR code).
 1, 40-48. <https://doi.org/10.48311/mq.56.1.15>



REFERENCES

<https://ohiostate.pressbooks.pub/scientificposterguide/chapter/scientific-posters/>

<https://colorkit.co/color-palette-from-image/>

<https://colors.co/574d68-c6a15b-f2e86d-d3dfb8-dd1c1a>

<https://colors.co/contrast-checker/565656-ffffff>

<https://typescale.com/>