ACDC

- Advanced Climate Dynamic Courses

Advanced Climate Dynamics Course – ACDC2014

August 23rd – September 4th, 2015

Héraðsskólinn, Iceland

Climate and Volcanism

We thank the Norwegian Centre for International Cooperation in Higher Education (SIU), the Norwegian Research School in Climate Dynamics, the Bjerknes Centre for Climate Research, the University of Bergen, Massachusetts Institute of Technology (MIT) and the University of Washington for supporting this summer school.

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Advanced Climate Dynamics Course (ACDC2015)
August 23rd – September 4th, 2015 - Héraðsskólinn, Iceland

Dear participants!

Welcome to the Advanced Climate Dynamics Course (ACDC2015) on Iceland!

This is the seventh summer school organized jointly by the Bjerknes Centre for Climate Research and the University of Bergen in collaboration with North American Universities.

The main focus will be on understanding the long term impact of volcanism along mid-ocean ridges on glacial cycles, as well as the short term impact of melting glaciers on volcanic activity in locations such as here on Iceland. We will also discuss the source and evolution of volcanic aerosols and their interactions with clouds, climate and human health.

This year the school is based at Héraðsskólinn on Iceland, an old boarding school at the shore of Laugarvatn, providing a unique location for field excursions and sightseeing. During your stay we will have several excursions to study the local glaciers, volcanoes as well the impact of past eruptions.

We hope that you will enjoy your stay, and have a stimulating, fun and interesting summer school!

Sincerely,
Kerim Nisancioglu (University of Bergen)

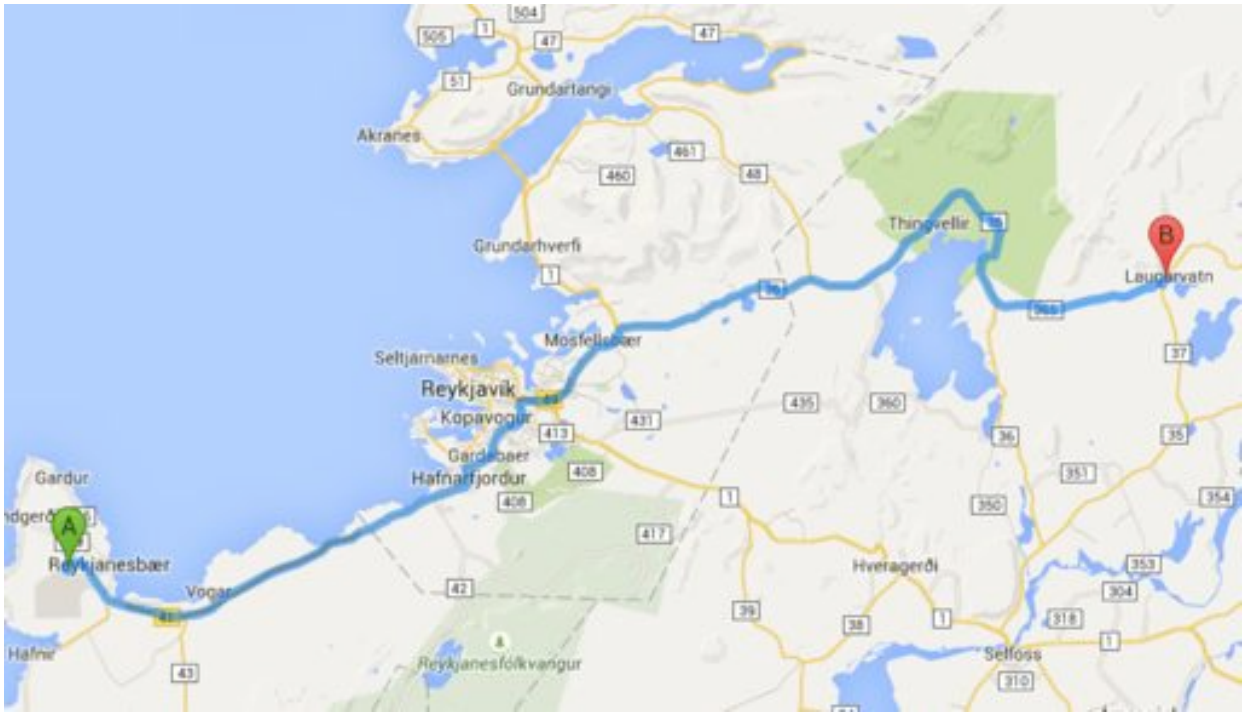
On behalf of the ACDC steering committee:
David Battisti, Tore Furevik, Patrick Heimbach, and Jake Gebbie.

Laugarvatn, Iceland

Iceland has a population of 329,100 and an area of 103,000 km^2 (40,000 sq mi). This makes it the most sparsely populated country in Europe.

Laugarvatn is a lake and small town in the south of Iceland and lies within the Golden Circle, a popular tourist route. The town has a population of about 200, and lies predominantly along the west side of the lake. The lake contains geothermal springs under its surface, making it a popular swimming spot with some warm patches along the shoreline year-round.

Source: Wikipedia



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SUMMER SCHOOL PROGRAMME

Sunday 23rd of August

Arrival at Keflavik International Airport should be at the very latest by 17:00 (5PM). Bus transportation from the airport to Héraðsskólinn will depart outside the terminal at 18:00 (6PM). We will have a short stop in Reykjavik at the bus station 18:45 (6:45PM), marked at the map (Vatnsmyrarvegur 10, Reykjavik Centre), to pick up participants who have arrived early, before heading to Héraðsskólinn. Contact acdc@uib.no for details on transportation arrangements.

We will have a two hour stop at Þingvellir for a short hike and an ice breaker. Þingvellir is a site of historical, cultural, and geological importance. It lies in a rift valley that marks the crest of the Mid-Atlantic Ridge. Parliament/Althing was established at Þingvellir in 930 and remained there until 1798.

Foto: Ragna Breines

Saturday 5th of September

Departure from Heradsskolinn to the airport will be at 06:30 (6:30AM) by buss in order to catch the morning flights from Keflavik. Those who wish to be dropped of in Reykjavik can also join this bus.

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GENERAL INFO:

Each day will start with summaries of the previous days lectures prepared by groups of students. This ensures that the main topics are understood and give the opportunity to pick up on any unanswered questions/topics.

In the first week we will also have time slots for short presentations by each student, where you can show a few slides (10 minutes and maximum 8 slides) describing your PhD work or current research topic.

There might also be the opportunity to join small projects together with a few of the lecturers during the summer school. This will be organized during the first week and the results from the group projects will be presented on the last day of the school.

Part of the time during the last two days of the summer school will also be used to prepare a written summary/discussion of the main findings/conclusions of the summer school. This will later be submitted to an appropriate journal by the students.

You can find all the daily summaries and the final submitted paper from previous summer schools on the ACDC www site.

First week:

	Monday 24th	Tuesday 25th	Wednesday 26th	Thursday 27st	Friday 28th	Saturday 29th
Morning	Core	Core	Core	Core	Core	Field
Afternoon	Core	Core	Thingvellir	Core	Intro to field	Field

Second week:

	Sunday 30th	Monday 31st	Tuesday 1st	Wednesday 2nd	Thursday 3rd	Friday 4th
Morning	Field	Topical	Topical	Topical	Topical	Discussion
Afternoon	Field	Topical	Topical	Myrdalsjøkul	Topical	Summary

Safety:
Please be aware that each participant is responsible for bring appropriate personal gear for hiking (see ACDC www site). Each day we will have sign up sheets where you are required to note your destination and estimated return time when out hiking. Remember to always bring a partner and emergency gear.

24th – 28th August: *Fundamental lectures on core topics*

2 x 45 min lectures with 30 min for coffee break, questions and discussion.

Monday 24th of August (day 1)

7:30-8:30: Breakfast (and preparation of packed lunch)

09:00-10:00: **Opening of summer school, presentation of program, and introduction of students and lecturers as well as group projects – Kerim H. Nisancioglu (University of Bergen)**

Introduction to the topic of volcanoes and climate, including short overview of the different theories and timescales involved – Peter Huybers (Harvard University)

10:00-12:00: Core Lecture 1 (2 x 45min)

"Observational evidence for glaciation influencing volcanism on land and undersea"
Peter Huybers (Harvard University)

- Consequences of changes in pressure on melt generation
- land data and observational biases
- global changes in subaerial volcanism
- ocean ridge data
- spectral techniques for quantifying a sea level signature in bathymetry
- global changes in submarine volcanism

12:00-15:00: Lunch and free time (to hike, swim, work on summaries and group projects)

15:00-17:00: Core Lecture 2 (2 x 45min)

"Introduction to Climate-volcanism linkages and their implications for life on Earth - lessons from the deep past"
Bjarte Hannisdal (University of Bergen)

- The role of volcanism-climate links in mass extinctions
- Seafloor hydrothermal systems and Phanerozoic seawater composition
- Long-term carbon cycle feedbacks and greenhouse-icehouse transitions

17:00-18:30: **Short research presentations by summer school students (7 x 10min)**

20:00: Dinner

Tuesday 25th of August (day 2)

7:30-8:30: Breakfast (and preparation of packed lunch)

9:00-10:00: **Short summaries of previous days lectures by students**

10:00-12:00: Core Lecture 3 (2 x 45min)

Core Lecture: - "Introduction to mid-ocean ridge magmatism"
Charlie Langmuir (Harvard University)

- Overview of characteristics of the ocean ridge system
  - What is the structure of the ocean ridge system?
  - How do compositions vary globally and why?
  - Importance of spreading rate, mantle temperature, back-arc basins, hot spots
- Current controversies
  - What do we know about eruption frequency?
  - What do we know about volatile contents?
  - What might change with sea level variations?
    - Eruption volume
    - Magma composition
    - Hydrothermal activity

12:00-15:00: Lunch and free time (to hike, swim, work on summaries and group projects)

15:00-17:00: Core Lecture 4 (2 x 45min)

"Climate effects of large volcanic eruptions"
Kirstin Krüger (University of Oslo)

- Tropical eruptions (large eruptions with VEI >=5)
- Dynamic effects (transport of aerosols and circulation changes (e.g. annular modes)
- Paleo eruptions (using petrological and ice core data)

17:00-18:30: **Short research presentations by summer school students (7 x 10min)**

20:00: Dinner

Wednesday 26th of August (day 3)

7:30-8:30: Breakfast (and preparation of packed lunch)

9:00-10:00: **Short summaries of previous days lectures by students**

10:00-12:00: Core Lecture 5 (2 x 45min)

"Introduction to atmospheric chemistry and aerosol particles"
Ilona Riipinen (Stockholm University)

- Composition and chemistry of atmospheric air
- Physical and chemical properties of atmospheric aerosol particles
- Sources, sinks and dynamics of atmospheric aerosol particles

12:00-17:00: Field excursion

FIELD TRIP TO LANGJØKUL OR HOFSJØKULL (TBD)
Øyvind Paasche (University of Bergen)

Foto: Ragna Breines

Field trip to area north of Laugarvatn to study glacial variability and possible link to volcanic eruptions over the Holocene.

20:00: Dinner

Thursday 27st of August (day 4)

7:30-8:30: Breakfast(and preparation of packed lunch)

9:00-10:00: **Short summaries of previous days lecture by students**

10:00-12:00: Core lecture 6 (2 x 45min)

"Introduction to aerosol-cloud-climate interactions"
Annica Ekman (Stockholm University)

- Aerosol effects on warm cloud microphysics
- Aerosol effects on cold cloud microphysics
- Aerosol-cloud-radiation-climate interactions

End of core lectures

12:00-15:00: Lunch and free time

15:00-16:00: Topical Lecture 1 (1 x 60min)

"Modeling the sources, sinks and transformation of atmospheric aerosol particles"
Ilona Riipinen (Stockholm University)

- Numerical descriptions of aerosol size distribution and dynamic processes modifying it
- Numerical descriptions of chemical processes modifying aerosol chemical composition

16:00-16:30: Coffee
16:30-17:30: Topical lecture 2 (1 x 60 min)

Convergent margin volcanism: global systematics, volatile contents and their implications for connections to glacial cycles
Charlie Langmuir (Harvard University)

- Volatile contents are the key link between volcanism and glacial cycles. We do not know them well!
- Global systematics of convergent margin volcanoes and their implications for volatile fluxes.

17:30-19:00: **Short research presentations by summer school students (7 x 10min)**

20:00: Dinner

Friday 28nd of August (day 5)

7:30-8:30: Breakfast (and preparation of packed lunch)
9:00-10:30: **Short summaries of previous days lectures by students**
10:30-11:00: Coffee
11:00-12:00: Topical Lecture 3 (1 x 60min)

"Do we really agree on the Little Ice age?"
Øyvind Paasche (University of Bergen)

- LIA - how to define it (timing, forcing, spatial manifestation)
- Historical evidence
- Glaciar variability
- Is the LIA unique?

12:00-15:00: Lunch and free time

15:00-16:00: Topical Lecture 2 (1 x 60min)

"Why was there a Little Ice Age? Quantifying climate forcings and feedbacks in coupled climate simulations of the last millennium"
David Battisti (University of Washington)

- Historical Reconstructions of the Climate of the last Millennium; Forcings (Volcanic, Solar, Greenhouse Gases) and Feedbacks; Method of Approximate Partial Radiating Perturbation; Method of Radiative Kernels.

16:00-16:30: Coffee
16:30-18:00: Topical Lecture 4 (2 x 45 min)

"The Icelandic volcanic systems; volcanic style and frequency in postglacial time"
Haflidi Haflidasson (University of Bergen)

- Evolution (live cycle) of the volcanic systems, geochemical character, eruption style, eruption history, distribution and impact on the environment and climate.

"The frequency and pattern of the volcanic activity in the N-Atlantic petrographic province during the last 130 ka; evidence from terrestrial, marine and ice core archives"

- Type of tephra archives, transport mechanism and distribution, chronology and marker horizons, the timing and type of tephra events during the last glacial period.

18:00-19:30: **Short research presentations by summer school students (7 x 10min)**

20:00: Dinner

Saturday 29th of August (day 6):

7:30-8:30: Breakfast (and preparation of packed lunch)

Full day field trip with departure 08.30 by buss.

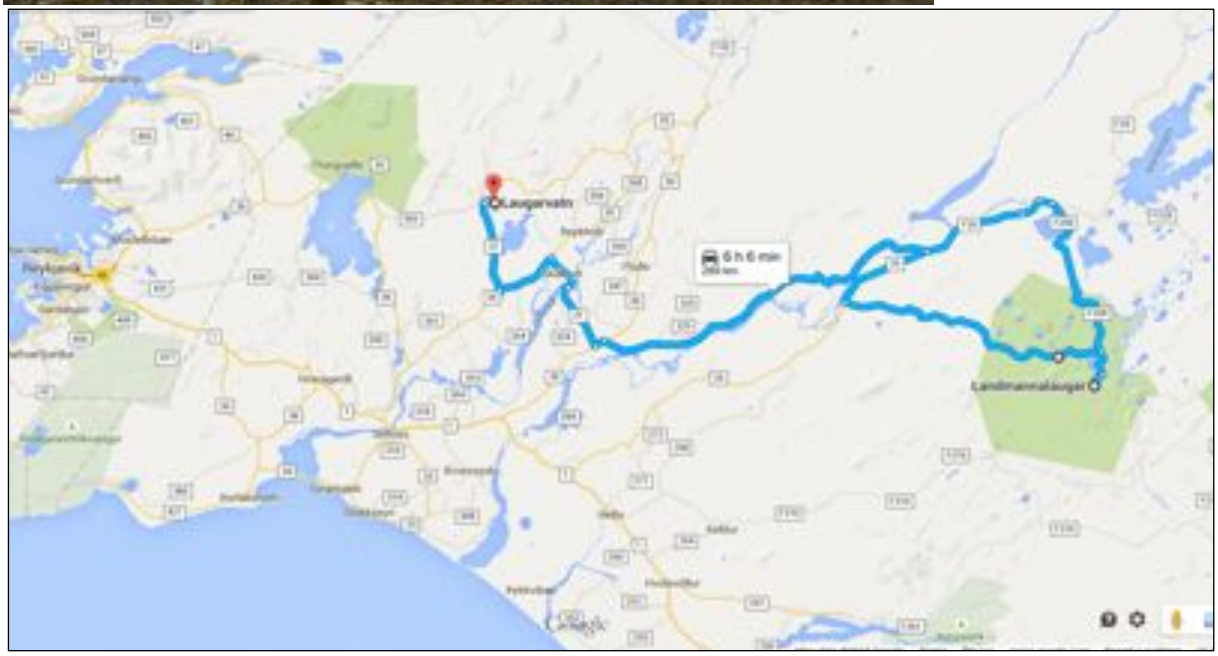
– Return to Héraðsskólinn in the evening

Landmannalaugar

Haflidi Haflidasson (University of Bergen)

Field trip t/r Laugarvatn: Thjorsardalur, Landmannalaugar, Torfajökull and Hekla volcanic systems. Themes: Large Holocene silicic Hekla tephra and early Holocene volcanism.

Foto: Ragna Breines



20:00: Dinner

Sunday 30th of August (day 7):

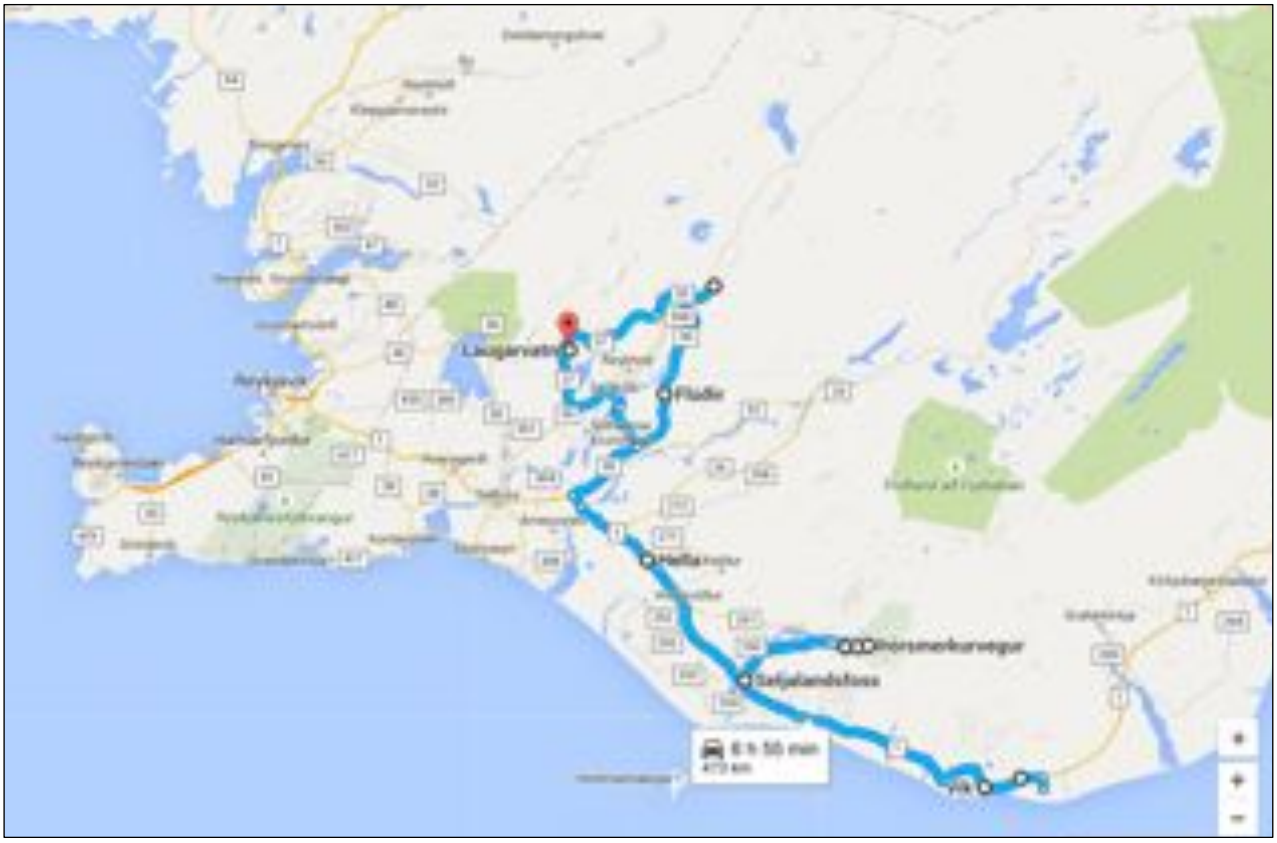
7:30-8:30: Breakfast (and preparation of packed lunch)

Full day field trip with departure 08:30 by buss

– Return to Héraðsskólinn in the evening

Eyafjallajökull
Haflidi Haflidasson (University of Bergen)

Field trip t/r Laugarvatn: Geysir, Gullfoss, Fludir, Seljaland, Gigjökull, Eyjafjöll, Skogar, Solheimajökull, Vik, Hjörleifshöfdi. Themes: Recent Holocene volcanism, subglacial eruptions and flood deposits



20:00: Dinner

31st August – 4th September: *Topical Lectures (subject to changes)*

1 x 60 min lectures with 30 min for questions and discussion.

Monday 31st of August (day 8)

7:30-8:30: Breakfast (and preparation of packed lunch)

9:00-10:30: **Short summaries of previous days lectures by students**

10:30-11:00: Coffee

11:00-12:00: Topical Lecture 5 (1 x 60min)

"Delayed CO_2 oscillations from ocean ridges as the cause of Late Pleistocene glacial cycles"
Peter Huybers (Harvard University)

- CO2 emissions from arc and ridge volcanism, delayed response from mid-ocean ridges, limit cycles and not so strange attractors, Pleistocene glacial cycles as delayed oscillations, Mid-Pleistocene Transition.

12:00-15:00: Lunch and free time

15:00-16:00: Topical Lecture 4 (1 x 60min)

"Placing volcanism in the context of other deglacial ocean circulation-carbon cycle changes"
Jake Gebbie (WHOI)

- Marine and ice-core observations of the last deglaciation
- Inferring ocean circulation and carbon cycle changes
- Comparing and contrasting to volcanism-climate links

16:00-16:30: Coffee

16:30-18:30: Group projects
Dedicated time to work in groups on project topics.

20:00: Dinner

Tuesday 1st of September (day 9)

7:30-8:30: Breakfast (and preparation of packed lunch)
9:00-10:30: **Short summaries of previous days lectures by students**

10:30-11:00: Coffee

11:00-12:00: Topical Lecture 5 (1 x 60min)

"Theories and modelling of glacial-interglacial cycles"
Kerim Nisancioglu (University of Bergen)

- Milankovitch forcing of climate
- Conceptual models of glacial-interglacial cycles
- Models of glacial inception and termination

12:00-15:00: Lunch

15:00-16:00: Topical Lecture 6 (1 x 60min)

"The role of the ocean in decadal climate variability"
Tore Furevik (University of Bergen)

- Air-sea interactions
- AMO/PDO variability
- Teleconnections
- Predictability

16:00-16:30: Coffee
16:30-17:30: Topical Lecture 7 (1 x 60min)

Topical Lecture – "Links between the mantle, volcanism and glaciation: Iceland and the north Atlantic"
John MacLennan (Cambridge University)

- Mantle plume pulsing on million year timescale influences oceanic gateways around Iceland
- Magmatism on Iceland is strongly modulated by glacial loading
- The volcanic response to unloading provides unique constraints on mantle properties
- Feedbacks between glaciation and volcanism may operate on Iceland

17:30-18:30: Group projects
Dedicated time to work in groups on project topics.

20:00: Dinner

Wednesday 2nd of September (day 10):

7:30-8:30: Breakfast (and preparation of packed lunch)

9:00-10:30: **Short summaries of previous days lectures by students**

10:30-11:00: Coffee

11:00-12:30: Topical Lecture 8 (1 x 60min)

"Climate effects of high latitude eruptions"
Kirstin Krüger (University of Oslo)

- Icelandic eruptions (explosive and effusive eruptions, Laki, Eyafjallajøkull, Bardabunga)
- Circulation changes (e.g. NAO, Asian monsoon)
- Comparison with tropical eruptions

12:30-19:00: Field excursion

Excursionby snow mobile to the Myrdalsjøkull glacier
Tomas Johanesson (Icelandic Metereological Office)

We will be looking at recent mass balance changes after Eyafjallajøkull eruption. Myrdalsjøkull is a glacier in the south of Iceland, north of Vík í Mýrdal. The icecap of the glacier covers an active volcano called Katla. The caldera of the volcano has a diameter of 10 km (6 mi) and the volcano erupts usually every 40–80 years.
Source: Wikipedia

Photo from wikimedia

20:00: Dinner

Thursday 3rd of September (day 11)

7:30-8:30: Breakfast (and preparation of packed lunch)

9:00-10:30: **Short summaries of previous days lectures by students**

10:30-11:00: Coffee

11:00-12:00: Topical Lecture 9 (1 x 60min)

"Modeling the influence of volcanic aerosols on clouds and climate"
Annica Ekman (Stockholm University)

- Modelled effects of small, mid-latitude, volcanic eruptions (Eyafjallajökull) on clouds and climate
- Modelled effects of large, tropical, volcanic eruptions (Pinatubo) on clouds and climate
- Volcanic eruptions as an analogue to geoengineering

12:00-15:00: Lunch

15:00-16:00: Topical Lecture 10 (1 x 60min)

"Detecting causal interactions in geological proxy records"
Bjarte Hannisdal (University of Bergen)

- Granger causality and its enemies
- Coupled systems and the notion of separability
- Model-free methods for causality detection

16:00-16:30: Coffee

16:30-18:30: Group projects

Dedicated time to work in groups on project topics.

20:00: Dinner

Friday 4th of September (day 12)

7:30-8:30: Breakfast (and preparation of packed lunch)

9:00-10:30: **Short summaries of previous days lectures by students**

10:30-12:30:

Presentation of group projects

- Students present their group projects.
- Discussion, feedback and outlook.

12:30-14:00: Lunch

14:00-16:00:

Preparation of short summary article (e.g. EOS)
Everyone!

- Students will be in charge of preparing an article summarizing the main findings and conclusions of the summer school (see previous years for examples).

16:00-17:00: Summary and Evaluation (David Battisti)

19:00: Dinner

Saturday 5th of September

Departure from Héraðsskólinn to the airport at 06:30 (6:30AM) by buss.

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