

ACDC

- Advanced Climate Dynamic Courses



## Advanced Climate Dynamics Course – ACDC2016

August 8<sup>th</sup> –19<sup>th</sup>, 2016

Marine Station, Norris Point, Newfoundland

### Role of High Latitudes in Centennial to Millennial Scale Climate Variability



UNIVERSITY OF BERGEN



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





**Advanced Climate Dynamics Course (ACDC2016)**  
August 8<sup>th</sup> – 19<sup>th</sup>, 2016 – Marine Station, Newfoundland

**Dear participants!**

Welcome to the Advanced Climate Dynamics Course (ACDC2016) on Newfoundland! This is the 8th summer school organized jointly by the Bjerknes Centre for Climate Research and the University of Bergen in collaboration with North American partner Universities.

During the two weeks our goal is to mix students and lecturers with empirical/proxy and dynamical training within climate science and focus on understanding the basic principles and dynamics behind centennial to millennial scale climate variability and their link to past, present and future changes to high latitude climate.

This year the school is based at Bonne Bay Marine Station on Newfoundland, providing a unique location for field excursions and sightseeing. During your stay we will visit several localities to study the local climate and glaciological history.

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

Sincerely,

Kerim Nisancioglu & Øyvind Paasche (University of Bergen), Lev Tarasov (Memorial University of Newfoundland) and Ray Bradley (University of Massachusetts at Amherst)

*On behalf of the ACDC steering committee:*

*Kerim Nisancioglu, David Battisti, Tore Furevik, Patrick Heimbach, and Jake Gebbie.*



### Norris Point, Bonne Bay, Newfoundland

This is a small community located on the west coast of Newfoundland and is a part of the Gros Morne National Park. The population in Bonne Bay is about 7000 people and hosts a marine biology centre, a pharmacy, a modern health care facility, and several businesses.

The fjord Bonne Bay was carved out approximately 10.000 years ago by two large glaciers. The glaciers merged and carved out the main fjord. Bonne Bay is therefore separated into two sections: Inner- and Outer Bonne Bay. Outer Bonne Bay is the entrance to the fjord, while inner Bonne Bay consists of two fjord arms.

The Marine Station is located in Norris Point and offers a range of services to students, researchers, educators and the general public. It was officially opened September 6<sup>th</sup> 2002 and is operated by Memorial University of Newfoundland and Gross Morne Co-operating Association. For more info about Norris Point, please visit [www.norrispoint.ca](http://www.norrispoint.ca)

*Source: Wikipedia and [www.bonnebay.ca](http://www.bonnebay.ca)*





## SUMMER SCHOOL PROGRAMME

### Sunday 7<sup>th</sup> of August

There will be scheduled pick up times from Deer Lake Airport to the Marine Station based on participants' arrival time. On arrival in Bonne Bay there will be an informal icebreaker. Note that lectures start early on Monday the 8<sup>th</sup> so all participants are expected to arrive on Sunday the 7<sup>th</sup>.

### International evening

To celebrate all the nationalities represented at ACDC, we ask participants to bring a food item from their home country to share during one evening of the course. Please remember to declare the food item at customs control. ***For more information about import of food items to Canada please visit Canadian Food Inspection Agency webpage.***

### Saturday 20<sup>th</sup> of August

The summer school program will end in the afternoon on Friday the 19<sup>th</sup> of September. All students have to vacate the Marine Station by 13:00 at Saturday August 20<sup>th</sup>. We will arrange transport to Deer lake airport Saturday morning.



### **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 have time slots for short presentations by each student. Here you can show a few slides (8 minutes and maximum 8 slides) describing your PhD work or current research topic. Note, timing will be strict to allow for questions.

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. The students will later submit this to an appropriate journal.

As in previous years we encourage the students to submit a proposal for a session at EGU or AGU focusing on the main topics of the summer school.

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

### **First week:**

	Monday 8 <sup>th</sup>	Tuesday 9 <sup>th</sup>	Wednesday 10 <sup>th</sup>	Thursday 11 <sup>th</sup>	Friday 12 <sup>th</sup>	Saturday 13 <sup>th</sup>
Morning	Core	Core	Excursion	Core	Core	Field
Afternoon	Core	Core	Excursion	Core	Intro to field	Field

### **Second week:**

	Sunday 14 <sup>th</sup>	Monday 15 <sup>th</sup>	Tuesday 16 <sup>th</sup>	Wednesday 17 <sup>th</sup>	Thursday 18 <sup>th</sup>	Friday 19 <sup>th</sup>
Morning	Field	Topical	Topical	Topical	Topical	Discussion
Afternoon	Field	Topical	Topical	Group project	Topical	Summary

### **Safety:**

Please be aware that each participant is responsible for bringing appropriate personal gear for hiking (see page 13 and 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.

**8<sup>th</sup> – 12<sup>th</sup> August: *Fundamental lectures on core topics***

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

**Monday 8<sup>th</sup> of August (day 1)**

7:30-8:30: Breakfast

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)**

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

**Terrestrial archives of abrupt change**  
**Ray Bradley (University of Massachusetts Amherst)**

- The signal of Heinrich events in the Tropics & Sub-Tropics & links to high latitudes
- Can Heinrich events explain changes in tropical rainfall patterns?
- Are Heinrich events a symptom or driver of global climatic perturbations?
- The strength of the AMOC is important having global repercussions
- Where/ when/how the perturbations originated remains unclear

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)

**Role of DO-events versus H-events in high latitude climate variability**  
**Kerim Nisancioglu (University of Bergen)**

- What are DO and H-events? What are the differences. Are they linked?
- What is spatial impact of events? What timescales are involved?
- Dynamics of events, link to sea ice, ice sheets, ice shelves

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

19:00: Dinner

**Tuesday 9<sup>th</sup> of August (day 2)**

7:30-8:30: Breakfast

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

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

**What governs ice sheet evolution?****Lev Tarasov (Memorial University of Newfoundland )**

- Comparative ice sheetology (past and present)
- Ice sheet/stream scale analysis and determining time constants
- Controls on spatial extent for terrestrial and marine ice
- Do the details of the marine boundary even matter?
- Stability/instability pathways, controls and feedbacks

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

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

**Records of past abrupt events from ocean sediments North Atlantic****Anne Jennings (Institute of Arctic and Alpine Research)**

- Sub ice shelf environments: Examples from modern Petermann Ice Shelf and testing of LGM Baffin Bay ice shelf.
- Detrital carbonate events as proxies of freshwater flux from high latitude North American ice sheets to the North Atlantic: phasing, timing, relation to glacial history

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

19:00: Dinner



**Wednesday 10<sup>th</sup> of August (day 3)**

7:30-8:30: Breakfast

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

10:00-17:00: Field excursion: One-day trip to Cheeseman Lake and Deer Lake for lake coring and catchment mapping

Cheeseman Lake is a small, open-ended lake lying 40 minutes drive from the station. For this day we will divide students and lectures into two groups. The groups will team up for lunch around 13:00 at the Lake. We will return to the station around 18:00. During this day we will touch upon how to:

- Measure and construct lake bathymetry (echo sounder +GPS)
- Retrieve sediment from the lake with means of a Livingstone corer
- Handle the cores (splitting and sampling the cores with a U-channel).
- Extraction of discrete samples
- Identifying and tracking sediment source areas



Photo from Google maps

20:00: Dinner

**Thursday 11<sup>th</sup> of August (day 4)**

7:30-8:30: Breakfast

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

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

**Plio-Pleistocene high latitude climate variability from Lake El'gygytgyn – and Arctic-Antarctic drivers**

**Julie Brigham-Grette (University of Massachusetts Amherst)**

- Bipolar super interglacials and high latitude Milankovitch forcing – new ideas on how the two polar regions synchronize
- The Bering Strait has a strong role as a check valve on North Pacific and North Atlantic circulation but there are serious questions about history of the Pacific-Arctic Gateway history
- History of Arctic sea ice and arctic ice sheets remains a work in progress – What do we know so far.

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

15:00-17:00: Core lecture 7 (2 x 45min)

**Linking surface climate change to the abyssal ocean**

**Jake Gebbie (Woods Hole Oceanographic Institution)**

- Does the oceanic deep reservoir of heat and carbon play an active or passive role in millennial climate events?
- What timescales characterize the interactions with the deep ocean?
- What information about surface climate is contained in abyssal ocean records?

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

19:00: Dinner

**Friday 12<sup>th</sup> of August (day 5)**

7:30-8:30: Breakfast

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

10:00-12:00: Core lecture 8 (2 x 45min)

**High latitude freshwater forcing and climate change: a modeling perspective****Alan Condron (University of Massachusetts Amherst)**

- A brief history of research connecting freshwater forcing to climate through the last decades
- Insights from high resolution climate models: The role of coastal ocean boundary currents in redistributing freshwater
- 'Forgotten' freshwater sources: A quick look at meltwater discharge into the Pacific and Southern Ocean
- North Atlantic freshwater forcing: Near and far field effects on climate

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

15:00-17:00: Core lecture 9 (2 x 45min)

**Ice or no Ice or just cold Ice****Øyvind Paasche (BMRC and University of Bergen)**

- When did glaciers and ice caps form in the Northern Hemisphere
- Terrestrial evidence for cold-based versus warm-based ice
- Vertical versus horizontal extent of past ice sheets
- Dating approaches

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

19:00: Dinner

**End of core lectures**





### **Saturday 13<sup>th</sup> of August (day 6):**

7:30-8:30: Breakfast

09:00: Departure to Tablelands, field trip

Full day field trip with overnight stay in tents. See next page for what to bring. Dinner outdoors. Subject to changes.

The Tablelands is a mountain plateau located to the south of the research station and is ideally suited for a 2-day hike. During this trip students will get first hand experience in how landforms and soils can be mapped and understood in a geological and climatic context. The features observed during the trip will provide insight into a set of processes associated with glacial erosion, landform development and weathering.

We will most likely divide the students into two groups that will start hiking from two sites not to far apart. The groups will have lunch on their own and rendezvous at the plateau for coffee and chocolate cake and discussion about what they have observed and mapped.

We will walk together towards the campsite.



Photo: Google earth. Tablelands

**Sunday 14<sup>th</sup> of August (day 7):**

7:30-8:30: Breakfast

On the second day we will give an introduction to cosmogenic dating and sampling techniques. Afterwards we will split up in 4-person teams that will do field work on their own, which will include sampling regolith profiles. We will hike back down together.

Dinner outdoors

Please bring:

- Wind and waterproof clothing (jacket and trousers)
- Warm clothes
- Indoor shoes
- Hat, scarf and mittens
- Travel insurance
- Lunch box
- Water bottle
- Thermos
- Camera (we encourage students and lecturers to share their pictures)
- Backpack
- Plate, cup, fork, spoon and knife.
- Proper hiking boots
- Laptop (+ memory stick for student presentations; 8 minute presentation - maximum 8 slides)
- Sleeping mat
- Sleeping bag
- Tent
- Mosquito repellent

**15<sup>th</sup>– 19<sup>th</sup> August: Topical Lectures (subject to changes)**

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

**Monday 15<sup>th</sup> of August (day 8)**

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

10:00-10:30: Coffee

10:30-12:00: Topical Lecture 3 (1 x 60min)

**Global imprint of DO- and H-events**  
**Kerim H. Nisancioglu (University of Bergen)**

- NH vs. SH phasing and link to Antarctic Cold Reversal
- Tropical records and dynamical links to high latitudes
- Preconditioning and relevance for non-glacial climates

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

15:00-16:30: Topical Lecture 4 (1 x 60min)

**Norse settlers in the North Atlantic: history, archeology and paleoclimate**  
**Ray Bradley (University of Massachusetts Amherst)**

- Norse settlers occupied many parts of the North Atlantic in Medieval time
- Earlier settlement occurred, but the geographical distribution is puzzling
- The role of climate change in the dispersal of settlers, and their eventual demise is not well understood

16:30-17:00: Coffee

17:00-18:30: Topical Lecture 5 (1 x 60min)

**Improving ice sheet - ocean interactions: Simulating icebergs in climate models**  
**Alan Condron (University of Massachusetts Amherst)**

- Massive iceberg discharge events and impact on ocean circulation and climate
- Icebergs are not explicitly simulated in Earth System Models.
- Future accelerations in mass loss from the Greenland and Antarctic ice sheets could dramatically increase iceberg activity and freshwater input to the high-latitude oceans.

17:00-18:30: Group projects. Dedicated time to work in groups on project topics.

19:00: Dinner

**Tuesday 16<sup>th</sup> of August (day 9)**

7:30-8:30: Breakfast

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

10:30-11:00: Coffee

11:00-12:30: Topical Lecture 6 (1 x 60min)

**Does ice dynamics matter?****Lev Tarasov (Memorial University of Newfoundland)**

- What is the dynamical role of ice streams in an ice sheet? Are they drivers of ice sheet evolution on millennial time scales?
- Given current modelling uncertainties, can the Hudson Strait ice stream be made to cycle on Heinrich event time scales? If so, what are the critical controls on the cycling timescale?
- How does the role of ice streaming and associated time constants compare between North America and Antarctica?

12:30-15:00: Lunch

15:00-16:30: Topical Lecture 7 (1 x 60min)

**Ice sheet-ocean interactions during GIS deglaciation**  
**Anne Jennings (Institute of Arctic and Alpine Research)**

- Influences of ocean forcing, bathymetry and atmospheric warming in rate and mechanisms of ice retreat
- Sensitivity of GIS to distal sources of meltwater input and sea ice

16:30-17:00: Coffee

19:00: Dinner



**Wednesday 17<sup>th</sup> of August (day 10):**

7:30-8:30: Breakfast

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)

**Arctic Climate evolution – archives of millennial change and sensitivity**  
**Julie Brigham-Grette (University of Massachusetts Amherst)**

- Millennial scale changes from the Pliocene into the Pleistocene and though the Pleistocene can be both gradual and abrupt.
- The onset of Northern Hemisphere glaciation was not abrupt, why?
- CO<sub>2</sub> is not needed as a primary driver of super interglacials
- Super interglacials have millennial scale variability with unknown drivers

12:30-19:00: Field excursion: Hike to Gross Morne mountain

20:00: Dinner



**Thursday 18<sup>th</sup> of August (day 11)**

7:30-8:30: Breakfast

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

10:30-11:00: Coffee

11:00-12:30: Topical Lecture 9 (1 x 60min)

**The role of the Arctic in present-day climate variability**  
**Tore Furevik (University of Bergen)**

- Atmosphere-ocean interactions at high latitudes
- Coupling between high and low latitudes
- Predictability beyond weather time scales

12:30-15:00: Lunch

15:00-16:30: Topical Lecture 10 (1 x 60min)

**Arctic to North Atlantic Ocean connections over the last deglaciation**  
**Jake Gebbie (Woods Hole Oceanographic Institution)**

- Isolated Arctic basin/Nordic Seas without deep convection
- Link to abrupt climate changes
- Connections to the greater Atlantic  $\delta^{13}\text{C}$ ,  $\delta^{18}\text{O}$ , and  $\text{D}^{14}\text{C}$  observations
- Rethinking the role of the Arctic relative to the Southern Ocean

16:30-17:00: Coffee

17:00-18:30: Group projects

Dedicated time to work in groups on project topics.

19:00: Dinner



## **Friday 19<sup>th</sup> of August (day 12)**

7:30-8:30: Breakfast

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

10:30-12:30: Presentation of group work by students

12:30-14:00: Lunch

14:00-16:00: Presentation of group work by students

16:00-17:00: **Summary and Evaluation - Kerim H. Nisancioglu (University of Bergen)**

19:00: Dinner



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## Phone numbers and email:

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