Online | 4–8 May 2020

Chat CL4.13

Arctic climate change: governing mechanisms and global implications
Co-organized by AS4/CR7
Convener: Richard Bintanja | Co-convener: Rune Grand Graversen
The chat CL4.13 is not yet open. It will be available on 05 May, 16:00–18:30.
SHIFT+ENTER for line break
Current number of users in the chat: 144
Rune Graversen (moderator) (15:17)

Very welcome to CL4.13 chat session on**Arctic climate change: governing mechanisms and global implications**

James Screen, Exeter (16:06) Hi Rune, thanks for chairing this and for your (and Richard's) efforts to bring this session on-line.
Judah (16:10) Yes thank you Rune and Richard for all of your efforts for chairing this virtual session.
Rune Graversen (moderator) (16:15)

Hi everyone, very welcome!

It is time to start...

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Good morning .. and Thanks you very much Judah. If I understand correctly you argue in your material that episodes of Arctic warming lead to weakening of Arctic vortex and cold continental weather. Can the impact on continental weather occur direct in the troposphere, for instance due to a reduction of the meridional temperature gradient and of mid-latitude zonal flow?

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Three warmest anomalies in the central Arctic occurred under a rather high sealevel pressure, and were driven by warm-air advection from mid-latitudes and subsidence heating.

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Thank you Rune! Below I summarize our work.

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In summer, a regional barotropic atmospheric process over Greenland and the Arctic Ocean has been identified as an essential contributor to September sea ice loss, in previous research. Concomitant patterns of ice loss and high pressure in the Arctic is further suggested to be partially driven by remote tropical forcing.

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In three different fully coupled model configurations (ECMWF-IFS at two different horizontal resolutions and CNRM-CM6-1), the sea ice albedo was reduced to simulate a sudden loss of Arctic sea ice. This experiment lasts 15 months and includes 40 members. An increase in drought duration in early winter is observed over the southwestern North America due to a stationary wave response, which leads to an amplification of the subsidence over this region. Indeed, a northward shift of the North Pacific High is modelled in early winter. An abrupt Arctic sea ice loss seems to play a role on the extreme precipitation events over mid-latitudes but additional research has shown that internal variability over mid-latitudes is very high in these experiments and could also partially explain this pattern.

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Tetsu Nakamura Hokkaido-Univ. (author) (16:41)

In this study in a framework of AGCM we developed a method to estimate the “memory effect” of the land processes, that is soil temperature and soil water, those anomalies can persist longer than the atmosphere. Especially, we examined their roles on the Arctic warming in association with the

Arctic sea ice loss and its impacts on the surrounding regions through numerical simulations. As a result, we found that memory effect of the Eurasian land processes possibly enhances the Arctic warming by about 20% and doubles the wintertime cold anomalies over the Eurasian mid-latitude through the enhancement of the poleward (dry) heat transport.

Varunesh (16:41) Steve: Nice study, which albedo you reduced? Bare and Pond ice albedo or anything else?
Steve Delhaye (16:42)

@Judah : Yes we can clearly see this amplification

@Rune : Some obs studies have shown that the recent California drought could be due to sea ice loss

@James : Yes we can see differences, but it could be due to internal variability.

James Screen, Exeter (16:42) Hi Tetsu, how long is the persistence in snow cover and soil temperature anomalies?
Judah (16:42) Tetsu, Why is soil moisture and temperature important in winter?
Steve Delhaye (16:42) @Amélie : yes, a slight warming in the tropics if I remember well
Rune Graversen (moderator) (16:43)

Thank you Tetsu: Are memory effects both due to sea ice and snow? How can snow cause memory over the summer?

Tetsu Nakamura Hokkaido-Univ. (author) (16:44) @James, each of snow cover and soil temprature persist about seasonal scale (3mon ~ 6mon). However, cold anomaly is transferred from snowcover in spring to soil temprature in summer and surface temp in autumn and cycle ,cycle ...
Rune Graversen (moderator) (16:45) While Tetsu is now thinking and answering let me introduce:

David Docquier: Interactions between ocean heat transport and Arctic sea ice

David Docquier SMHI (author) (16:45)

Hi everyone, thanks for giving me the opportunity to present my work.

David Docquier SMHI (author) (16:45)

Part of the recent Arctic sea-ice retreat and melting (Slide 2) has been driven by increased ocean heat transport (Slides 3-4), but no clear consensus on the exact process linking ocean heat transport and Arctic sea ice exists. In our study, we performed 50-year long sensitivity experiments with the EC-Earth coupled global climate model, in which we enhance the SST by 1K / 3K / 5K compared to a present-day control run in different domains of the North Atlantic and North Pacific Oceans (Slides 5-6). Following the SST increase (Slide 7), the total ocean heat transport through all Arctic straits increases in all experiments compared to the control run, with more pronounced increase with a wider domain used for SST restoring and with a higher level of warming (Slides 8 and 11). This leads to reduced Arctic sea-ice area (Slide 9), concentration, volume and thickness (Slide 10). Finally, we show that the ocean heat propagates down to about 800m and through the whole Arctic (Slide 13).

Tetsu Nakamura Hokkaido-Univ. (author) (16:45) @Judah and Rune, as I said above, player that continues cold anomlies changes depending on season. This can achive "memory effect" beyond annual cycle.
Rune Graversen (moderator) (16:47)

Very Interesting David: I assume the restoring experiments, increasing SST in some regions induces a global forcing. Have you estimated this forcing from the different experiments? Can the sea ice response partly be explained just as a consequence of difference in model forcing?

Gesa Eirund, ETH Zurich (16:47) Hi David, I was wondering is there is a lag in the (max) sea ice response to the anomalous OHT and if yes, what is the time lag?
David Docquier SMHI (author) (16:47) @ Rune: no we haven't estimated the global focring.
David Docquier SMHI (author) (16:48) @ Gesa: the response is quite fast, withinh the very first years of the 50-year long experiments.
Sonja Murto, MISU (attendee) (16:49) Hi David, have you looked at the atmosphere forcing as well?
Rune Graversen (moderator) (16:49)

While David answers let us also proceed with

Katharina Harmuth: Dynamics and drivers of extreme seasons in the Arctic region

Katharina Hartmuth ETH Zurich (author) (16:49)

Hey everyone! We are looking at extreme seasons in the Arctic, currently with ERA5 reanalysis data. We developed a method to define extreme seasons based on the seasonal mean anomalies of surface parameters (temperature, heat fluxes, radiation) in several subregions. Based on that we started to work on case studies, having a more detailed look at the substructure of extreme (or, in general, anomalous) Arctic seasons. A first analysis of the synoptic situation for DJF 2016/17 shows that several different processes were involved in making this season extremely warm in the region of the Kara-Barents Seas. We will continue to investigate this season and compare it to other cases, before looking at similar seasons in climate model data (CESM).

Evelien Dekker, attendee (16:49) Thanks David, I was wondering about the direction of the heat transport in figure 3?
David Docquier SMHI (author) (16:49) @Sonja: we've looked at atmospheric responses (t2m, SLP) but not the atmospheric forcing.
David Docquier SMHI (author) (16:50) @ Evelien: towards the Arctic.
Evelien Dekker, attendee (16:50) I meant slide 12, section 3.
Sandro Dahlke (AWI) (16:50)

@Katharina Interesting work, thx for sharing! Are you also planning to investigate the role of local feedbacks, additional to the more “remote” effects of warm advection and adiabatic warming along the advection pathway?

David Docquier SMHI (author) (16:51) @Evelien: rectification, this is the modulus of x and y components of horizontal ocean heat flux (no direction is shown).
Rune Graversen (moderator) (16:52)

Next presenter:

Yoshihiro Tachibana: Warm hole in Pacific Arctic sea ice cover forces mid-latitude Northern Hemisphere cooling during winter

Katharina Hartmuth ETH Zurich (author) (16:52) @Sandro: we will first focus on the large-scale features as we focus also on extremes in larger regions.
Yoshihiro Tachibana Mie Univ (author) (16:52)

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Rune Graversen (moderator) (16:53)

Interesting study Yoshihiro: Is the warm sea-ice hole a result of northward humidity fluxes through Bering Strait, or is the causality the other way around? Can we expect similar effects of a cold Europe associated with sea-ice hole in the Barents-Kara Sea?

Yoshihiro Tachibana Mie Univ (author) (16:54) I think it is two-way interaction
Judah (16:54) Yoshihiro, Is this independent of the large polar vortex disruption that occured in Febraury 2018?
Michelle McCrystall UManitoba (16:55) @Katherine, you say a number of different synoptic conditions resulted in the anomalously warm Barents and Kara seas, have you looked at larger circulation and the role of tropical SSTs on this too?
Yoshihiro Tachibana Mie Univ (author) (16:55) Jud, Yes. I think so.
Amélie Simon (16:55) Hi David, do you know if the sea-ice thickness decreases due to more basal melting ? (sorry if i am a little late)
James Screen, Exeter (16:57) @Yoshihiro Are you suggesting that the sea-ice hole reinforced the ridge? The ridge itself would had a warming effect in the Bering Strait region and cooling effect over North America.
David Docquier SMHI (author) (16:57) @Amélie: I think so because we see that the ocean heat propagates everywhere in the Arctic, but I don't have a confirmation. This is ongoing work. Thanks for the nice question.
Yoshihiro Tachibana Mie Univ (author) (16:57) Yes, ice maks ridge and ridge also makes ice loss

Katharina Hartmuth ETH Zurich (author) (16:57) @Michelle: yes, we are currently looking at the large-scale circulation and it seems that there are different "pathways" for warm air to reach the region of the KBS (via cyclones or with blocking involved). Further we want to know how the relative contribution of different mechanisms is (e.g. how important is subsidence-induced adiabatic warming compared to transport from lower latitudes)
Rune Graversen (moderator) (16:58)

Ok while we also wait for some previous answers let us kindly ask presentation from

Philippe Goulet Coulombe: Modeling and Extrapolating Arctic Feedback Loops using Macroeconometric Techniques

Judah (16:59) Yoshiro, I ask because much of the cold that winter on both continents came during and after the polar vortex disruption. Though in eastern North America there was some extreme cold in January.
Philippe G Coulombe UPenn (author) (16:59)

Hi Rune and everybody, here is a summary of my work and Max's (present).

Method

We propose the VARCTIC, which is a Vector Autoregression (VAR) designed to capture and extrapolate Arctic feedback loops. VARs are dynamic simultaneous systems of equation used to predict and understand the interactions of multiple variables in macroeconomics. We think of the VARCTIC as a parsimonious compromise between full-blown climate models and purely statistical approaches.

Results

Our completely unconditional forecast has SIE hitting 0 in September by the 2060's. Impulse response functions reveal CO2 emission shocks to have a permanent effect on SIE -- a unique property. We find Albedo- and Thickness-based feedbacks to be the main amplification channels through which CO2 anomalies impact SIE. We also consider forecasting conditional on RCPs and show that those feedbacks play an important role in accelerating the speed at which SIE is going to 0.

Rune Graversen (moderator) (17:01)

Thanks Philippe very interesting: Does the model take into account if relation between variables change not linearly over time? Say that precipitation increase exponentially and not linearly with warming. Is it fair to say that albedo and thickness has little effect in sea ice retreat, only delaying the retreat by a decade or so?

Philippe G Coulombe UPenn (author) (17:02) About the last part, yes, that's what our results show.
Philippe G Coulombe UPenn (author) (17:04) About the first. The model is indeed linear but can extended to be non-linear (with coefficients varying through time, among other things).
James Screen, Exeter (17:04) How do you evaluate the performace of VARCTIC?
Philippe G Coulombe UPenn (author) (17:05) Thanks James. It's in line with CMIP6 projections (but with much sharper bands), as well as Diebold Rudebusch trend model.
Rune Graversen (moderator) (17:06)

.. perhaps we almost kept up with questions, just continue Philippe. Hope it is not too confusing .. Thanks for all questions, answers and presentations so far.

Let us continue with:

Srinath Krishnan: What drives the Arctic response to mid-latitude sulphate aerosol emissions?

Srinath Krishnan SU (author) (17:06)

Thanks Rune and hi everyone! In this study, we use the Norwegian Earth System Model (NorESM) to evaluate the Arctic climate response to mid-latitude sulphate aerosol emission changes (in this case, Europe). Using slab-ocean model simulations, we show that the significant temperature responses observed are primarily driven through the atmospheric pathway. The likely modulator of these changes is Arctic sea-ice, which affects the degree of interaction between the atmosphere and open-ocean and subsequent turbulent flux exchanges. Changes in the ocean heat transport seem to play a secondary role and they counter the atmospheric response (changes in the opposite direction). We try to further investigate the atmospheric driver of the Arctic sea-ice response by running a 30-member initial-condition ensemble simulations (to improve signal:noise), but are currently unable to analyse them because of potential errors in the simulations.

Rune Graversen (moderator) (17:07)

Interesting study Srinath: Are aerosols transported to the Arctic where they provide temperature and sea-ice response, or are they giving direct temperature response in Europe, where after the temperature response is advected to the Arctic? Why are the responses of the fully coupled and modified atmosphere & ocean experiments so different, wouldn't we expect those to be similar?

Philippe G Coulombe UPenn (author) (17:08) One last remark about evaluating the VARCTIC model. We could device a pure forecasting test using the observed data up to now as a pseudo-out-of--sample experiment as often done to eveluate econometric models. However, what is tricker here is that we are talking about the long-run. thanks
James Screen, Exeter (17:08) @Phillippe, that's more what I had in mind. Thanks.
Srinath Krishnan SU (author) (17:09) Thanks for the question, Rune! The response is not driven through aerosol transport (at least in the model). It could be through the advection of the temperature response. I think the key change is that the temperature response in Europe is driving sea-ice melt, that then provokes the Arctic response. Our plan is to evaluate that mechanism using the ensemble simulations.
Rune Graversen (moderator) (17:11)

Thanks Srinath, please come with more questions to Srinath if you have any. Next presentation is:

Tuomas Ilkka Henrikki Heiskanen: The effect of latent heat transport by waves on Greenland Surface Mass Balance

Tuomas Heiskanen UiT (author) (17:11) Thank you Rune, hi everyone. In this study the divergence of energy transport is separated into length scales, and correlated with the surface mass balance (SMB) of the Greenland ice-sheet. This reveals that planetary scales waves affect the south-east coast of Greenland the strongest. The effect is different when separated into latent heat and dry-static energy, where a convergence of the former is associated with an accumulation of mass, whilst

a convergence of the latter is associated with a mass loss. For the synoptic scale waves only the latent heat component seems to play an important role, where a convergence is associated with a mass loss along the coastlines.
Srinath Krishnan SU (author) (17:12) @Rune The responses are probably different because the fully-coupled model does not melt as much sea-ice as the slab-ocean. This is a feature of NorESM that is known (in comparison with other CMIP models).
Rune Graversen (moderator) (17:13)

Thanks Tuomas: Does the study reveal how much of the surface-mass balance change of Greenland can be attributed to atmospheric circulation changes?

Tuomas Heiskanen UiT (author) (17:13) @Rune: The present study does yield an answer to the question, since at the present state only correlations have been computed. To quantify magnitudes, and causalities regressions should be used instead. Additionally we have to quantify the circulation changes over Greenland, which we have not yet pursued. All of this is a part of the plan for the study, and will be conducted at a later stage.
Judah (17:15) @Toumas, why does the latent heat have different impacts for planetary and synoptic scale waves?
Rune Graversen (moderator) (17:15)

Please come with more questions to Tuomas, while we will kindly ask for a presentation on

Yuefeng Li: Interdecadal Connection between Arctic Temperature and Summer Precipitation over the Yangtze River Valley in the CMIP5 Historical Simulations

Rune Graversen (moderator) (17:17) Yuefeng Li, are you there ..?
Irina Gorodetskaya, UA (attendee) (17:17) @Tuomas, nice work. How much latent heat flux compares to cloud forcing for the same synoptic events?
Rune Graversen (moderator) (17:19)

While Tuomas answers, let us then kindly ask:

Alexander Kislov: On monsoon character of circulation over the Barents and Kara Seas

Evelien Dekker, attendee (17:19) @Irina Nice question, I'm curious about the energy content in moisture versus longwave cloud forcing too.
Rune Graversen (moderator) (17:20) Are you there Alexander Kislov ..?
Tuomas Heiskanen UiT (author) (17:20)

@Judah, I have no definite answer for this yet. However one possibility is that the latent heat transport associated with synoptic-scale transport is mostly due to cyclones which leads to both an increase in cloud cover and large localized fluxes. The latent heat associated with planetary scale transport may be more associated with increased precipitation, which may yield an accumulation of mass. We will investigate this further.

@Irina, This is an interesting question, which I cannot really adress currently. We expect that the cloud forcing due to the latent heat plays an important role, and will investigate this as a part of the study.

Rune Graversen (moderator) (17:21)

Ok, let me introduce:

Kunhui Ye: Two leading modes of wintertime atmospheric circulation drive the recent warm Arctic-cold Eurasia temperature pattern

Judah (17:22) @Toumas, thanks but shouldn't synoptic waves also contribute to mass balance increase?
Rune Graversen (moderator) (17:23) Kunhui Ye are you there ..?
Judah (17:25) He is listed as not presenting on the web page.
Rune Graversen (moderator) (17:25) .. please Tuoms an others just answer unanswered questions. One can copy an early text into the writing frame if this helps.
Tuomas Heiskanen UiT (author) (17:26) @Judah, Yes they do that. Another possible explanation is that the pattern observed due to the synoptic transport convergence is due a more dominating change in the Greenhouse effect or cloud cover during these events. As of yet I have no definitive answer to this, but will try to uncover it as the study progresses.
Rune Graversen (moderator) (17:26)

Thanks Judah .. then my mistake. Then please

Amber Walsh: Model and state dependence of the atmospheric response to Arctic sea-ice loss

Amber Walsh (Exeter) (17:26)

Hi everyone. I’m a first year PhD student at the University of Exeter analysing results from PAMIP and some of my own experiments.

Polar Amplification Model Intercomparison Project (PAMIP) is used to compare the atmospheric response of an ensemble of models to Arctic sea-ice loss.

A robust weakening and equatorward shift of the mid-latitude jet is found, but is sensitive to various factors including model resolution and background state (particularly QBO phase).

QBO phase additionally modulates the polar stratosphere response to sea-ice loss.

Aspects of the response are not significant given the currently available data, so the aim is to extend the ensemble beyond 100 members to increase the robustness of the results.

Rune Graversen (moderator) (17:28)

Nice poster Amber: Do your investigations reveal whether zonal-wind changes are directly due to the sea-ice changes or if they are linked to e.g. warming causing the sea-ice changes?

Rune Graversen (moderator) (17:29)

Can the linkage between QBO winds and sea-ice changes be confirmed by observations?

David Docquier SMHI (author) (17:30) Amber: Is the result you see with HadGEM representative of the impact of model resolution? In other words, are there other models at different resolutions in PAMIP?
Amélie Simon (17:30) Hi Amber, Really interesting ! Is this study with atmophere or coupled model ? Could it be relevant to compare the january Arctic sea-ice in QBO-E and QBO-W ?

Judah (17:30) @Amber, Your work does seem to corroborate other studies such as Peings and Tyrell how did you define the QBO phase?
Thomas Batelaan (17:30) Thanks Amber, I was wondering how the PAMIP models are polar amplified? Just sea-ice loss or are there more forcings?
Amber Walsh (Exeter) (17:31)

Thanks for the questions Rune. The PAMIP experiments are designed so that just sea ice is reduced. There's no additional warming applied other than what results from the sea ice loss itself. So yes the zonal wind response is from the sea-ice changes.

As for the QBO question, I'm unsure what observations say on this. It would have to be something I would look up further.

Rune Graversen (moderator) (17:31)

While Amber is typing to a lot of good questions, let us go on with:

Kaushik Gupta: Landfast ice in the Canadian Sub-Arctic: A Hudson-Bay wide study

Tetsu Nakamura Hokkaido-Univ. (author) (17:32) @Rune and Amber, yes clearly confrimed in the reanalysis while causality is not defined.
Amber Walsh (Exeter) (17:33) @David There are other modelling groups running PAMIP experiments at different resolutions and one such (think it's AWI but would need to double check) find higher resolution also sees a larger jet weakening.
Rune Graversen (moderator) (17:33) Kaushik Gupta are you here ..?
Varunesh (17:33) Hello Amber: Nice study. I think PAMIP is only one year sumulation which used two type simulation in one fixed seaice and varies the sst and in second fixed sst and varies the arctic seaice. I think you used fixed sst and varies the seaice experiment? Have you check this anaylsis with second one (fixed seaice and varies sst)? Any diffrence?
Amber Walsh (Exeter) (17:34) @ Amélie These experiments are with atmosphere only models. Do you mean look at sea-ice in observations for different QBO phases? Yes this is something that ought to be useful to confirm the model results.
Judah (17:34) @Amber yes Thomas Jung (AWI) presented work showing that the atmospehric response exhibited a large sensitivity to model resolution. Statisitically significant results only appeared at the highest resolution.
Rune Graversen (moderator) (17:35)

Let us see if we have with us:

Kwang-hee Han: Process understanding of a linkage between East-Asian cold-surge with the unprecedented Arctic warming event in early 2016

Amber Walsh (Exeter) (17:35) @ Judah I'm unfamiliar with that study so am unsure if it does corroborate it or not. QBO phase is defined as sign of 30hPa zonal wind between 5N-5S
Rune Graversen (moderator) (17:36) Kwang-hee Han are you there ?

James Screen, Exeter (17:36) @Judah, @David Amber's poster shows a tentative relationship between jet response and model resolution, but we need a greater diversity models (and resolutions) to build confidence in this apparent relationship.
Amber Walsh (Exeter) (17:37) @ Thomas the PAMIP models are forced with a reduced sea-ice field calculated from CMIP5 models (at 2 degrees of warming). There's no other forcings in the experiments I've shown, but others in PAMIP also change SSTs.
Judah (17:37) @James Understood.
Amber Walsh (Exeter) (17:38) @Varunesh Yes you're right. There are also SST varying experiments available but I've not yet had the chance to look at these. Will definitely be future work!
Rune Graversen (moderator) (17:38)

Please just continue with discussion with Amber, while we kindly ask for presentation on

Luca Ferrero: Experimental black and brown carbon heating rate and from mid-latitudes to the Arctic along two years (2018-2019) of research cruises: the energy gradient for the Arctic Amplification

Amber Walsh (Exeter) (17:39) @Judah Yes it seems with the two HadGEM3 resolutions I've compared, the difference isn't statistically siginificant. We have plans to run HadGEM3 at a higher resolution than N216 too
Rune Graversen (moderator) (17:39) Luca Ferrero are you with us ?
Rune Graversen (moderator) (17:41)

Ok, then we hope for this:

Varunesh Chandra: Role of the Arctic Sea Ice melt on the lower latitude Climate

Varunesh (17:41)

Hello Everyone, I am Varunesh Chandra from IIT Delhi, India

Hope you are doing well in these difficult times.

It’s my pleasure to present my work here.

Introduction

The melting of polar ice caps and sea ice are of immediate concern in the context of global warming. The observations suggest that the thickness, as well as the areal extent of the Arctic sea ice, have been declining in the last three decades, in large part due to manmade global warming. The effect of faster sea ice melt on lower latitude climate is not well understood as compared to that of mid and high latitudes. It is reported that the mid-Pacific trough (MPT) can be influenced by a stationary wave train triggered in response to a melt of sea ice over the Bering strait (Deng et al., 2018, J. Clim). The MPT is known to influence Pacific tropical cyclone (TC) activity.

Judah (17:41) @Amber I can't remember the resolution AWI used but it was quite high probably 16 km or less. Too expensive to make many runs at that resolution.
Varunesh (17:41)

Results and Conclusion

Here I am trying to get a relation between arctic sea ice and pacific tropical cyclones (1979 to 2018), and found some interesting results. We have seen an influential connection between the summer Arctic seaice variability and Pacific tropical cyclones. The track density over the pacific increases with increased sea ice concentration variation. The wind shear over the tropical Pacific is found to have an inverse relationship with the Arctic sea ice concentration variation, which has contributed to a more favorable condition for the formation of TCs.

The summer Arctic sea ice concentration is regressed on TC track density, vertical wind shear (200-850hpa), ITCZ, Hadley Cell, and Poleward energy transport. We have seen in the northern hemisphere that ITCZ shifted towards the northward over the pacific ocean, and poleward energy transport in notherhemisohere weaked over the tropics and strengthened over the mid latitude. These are indicating that summer sea ice variability over the Arctic is influencing on Pacific TCs activity.

Rune Graversen (moderator) (17:42)

Thanks Varunesh: In what way goes the causality, is cyclone activity in the Pacific causing melting of sea ice or is it the other way around?

Judah (17:43) @Varunesh is sea ice loss related to more or less tropical cyclones?
James Screen, Exeter (17:44) Have you, or do you plan to, conduct or use pre-existing model experiments to test your hypothesis?
Amélie Simon (17:44) Hi Varunesh. Interesting ! The regression are in phase or lagged ?
Varunesh (17:44) Rune: Thanks for your question. We have seen that seaice melting effecting on the pacific profical cyclone in July and august.
Varunesh (17:45) Judah: sea ice loss related to more tropical cyclones over the weatern pacific.
Varunesh (17:46) but its estern pacific showing less tropical cyclone
James Screen, Exeter (17:46) Are the dots in panel (b) "Reg SIC on ITCZ" showing significance?
Rune Graversen (moderator) (17:46) While you just continue with the discussion we kindly ask for
Rune Graversen (moderator) (17:46)

Johanne H. Rydsaa: Arctic climate response to extreme events in synoptic and planetary scale atmospheric energy transport

Johanne H. Rydsaa, UiT (17:47)

Hello everyone,

In this study we focus on the effect of latent energy (LE) transport has on Arctic near surface temperatures. We separate LE transport at 70°N into planetary and synoptic scales and look at how strong transport events on each scale affect temperatures in different seasons, and on how the LE transport on separate scales has changed over the past 40 years.

We find that LE transport has a larger effect on Arctic near surface temperatures in winter than in summer, and that planetary scale transport increase Arctic temperatures during and after strong events more than synoptic scale transport. Furthermore, over the past four decades, we find that there has been a significant increase in strong wintertime LE transport by planetary scale systems, which is more associated with warming the Arctic, and a decrease in LE transport by strong synoptic scale systems.

Sandro Dahlke (AWI) (17:47)

@Johanne Very interesting work, thanks for sharing! I was wondering:

(1) What do you think has caused the downward trend in synoptic scale activity?,

(2) Did you investigate some (lag) temporal correlation of planetary vs synoptic scale events, i.e. did maxima in the one group follow maxima in the other one, or are they unrelated?

(3) Can you help me figure out why in the Barents Sea/Svalbard, synoptic transport maxima coincide with cold anomalies in the early years, but with warm anomalies in the later years (last slide)? Thanks :)

(Sorry for the many questions – I am happy to receive an answer later if time is pressing now ?)

Judah (17:48) @Varnush because your plot has mostly positive values (positive sea ice = more cyclones) so did you inverse the values?
Johanne H. Rydsaa, UiT (17:48) Hi @Sandro, thanks for the questions! I will try to answer, might take a few minutes :)
Varunesh (17:48) James: Yes, you are right. the dots are showing significance in that figure.
James Screen, Exeter (17:49) @Varunush Ok, thanks. So very few significant points then.
Tetsu Nakamura Hokkaido-Univ. (author) (17:51)

@Johanne, thank you interesting work.

Could you tell me that the trend of latent energey transport has larger impacts on the Arctic warming than that of dry energy?

Judah (17:51) @Johanne There have been some newsworthy Arctic warm events associated with storms such as Storm Frank mentioned earlier. Does your study argue that despite the news headlines, storms are not contributing to warming the Arctic?
Varunesh (17:52) Amélie: The regression are in phase (July and August). We have seen trying in deerent phases and lagged but we got more influence in July and Aug phase.
Rune Graversen (moderator) (17:53)

The last work is from me, I will present it as you just go on discussing Johanna's work

Rune Grand Graversen: Impact of Rossby waves on Norther-Hemisphere continental climate

Rune Graversen (moderator) (17:53)

A method for decomposing atmospheric energy transport into parts associated with atmospheric waves has been proposed. The waves can be e.g. Rossby waves and cyclones. This is the same method as applied in Tuomas and Johannes work. Here are two other examples of application: This decomposition can be used to reveal that the drought in mid-west US is associated with a change of Rossby wave 1 transport of water vapour. It also shows that the episodes of warm Arctic during winter follow convergence of Rossby wave energy transport over the Arctic.

Varunesh (17:53) James: Yes, We are planing to include some model study in this.
Timo Vihma FMI (author) (17:57) Are Rossby waves more important than synoptic-scale cyclones for warm events in the Arctic?

James Screen, Exeter (17:57) @Rune If I understand correctly, you are suggesting the Warm Arctic Cold Eurasia pattern is caused by anomalues Rossby waves, right?
Johanne H. Rydsaa, UiT (17:57)

@Sandro

1) here we focus on the transport crossing the Arctic border at 70°N. The dominating sector for strong events we find is in the Atlantic sector. Other studies have shown that the Barents and Kara sea areas has warmed a great deal over the past decades, also seen here. This might have limited the temperature gradients across the 70°N latitude in this area and thus the cyclone activity. The decrease in synoptic scales systems crossing the Arctic border at 70°N may be a negative feedback to warmer Arctic temperatures in the northern Atlantic sector, causing a weaker temperature gradient. However, these are speculations, as our results do not include more specific investigations into the reasons for the temperature patterns shown here.

2) We did look at time lagged correlations, but between transport and other variables, such as temperature and cloud cover, greenhouse effect etc. But not yet on each other, so that would be interesting to do.

Johanne H. Rydsaa, UiT (17:57)

*Sandro

3) We have speculated that the cold anomalies north of the synoptic scale evnts and warm anomalies to the south is part of what drives the synoptic scale events, and that the decrease in strong synoptic events in later years might be related to a weaker temperature gradient in this area due to strong warming in the barents and kara seas. But this is just speculations, trying to connect the different results.

James Screen, Exeter (17:58) @Rune And you infer causality (waves driving temperature) because of the time lag?
Rune Graversen (moderator) (17:59) @James: Thanks, partly yes, but I will not argue this is all the story. Yes I think time lag helps with causality.
Tetsu Nakamura Hokkaido-Univ. (author) (17:59)

@Rune, thank you for intersting study.

In case of Arctic wamring anomalies, which is dominant the latent or dry energy transport?

Johanne H. Rydsaa, UiT (18:00) @Tetsu, Based on previous work, and our own investigations with lagget correlation between LE transport and dry static and temperature, we found that the LE was much more strongly correlated with wam anomalies, and so we chose to focus on the latent energy in this study.
Rune Graversen (moderator) (18:00) Thanks Tetsu: Other studies we have done point to the latent transport. Also Johanna's work shows that.
Varunesh (18:00) Judah: Yes, You are right. I forgot to tell you one thing actually I have detrend the time series before the regression. It's mean I have removed the annual trend only seasonal variation left.
Rune Graversen (moderator) (18:01)

With this great discussion, I think it is time to close this session. Thanks again everyone for all work and excellent contributions! And thanks for very good questions and answers. I am impressed how you can do it so fast ;-) Please continue discussing online, you can post comments and questions to presentations until the end of May. Take care of yourselves and see you next year in Vienna!

Srinath Krishnan SU (author) (18:03) Thanks again for moderating the session, Rune. It went pretty smoothly and the discussions were very interesting!
Judah (18:03) Thank you Rune for adeptly moderating under such challenging conditions. It was a very interesting session!
Varunesh (18:05) Thanks Rune for moderating the session and It was amazing.
Johanne H. Rydsaa, UiT (18:23)

Thank you Rune and everyone!

I saw I missed a question, and so I post an answer now;

@Judah, no, I don't, and we also show that synoptic scale systems contribute to warming, however that on average, with this theoretical strict division between planetary scales and synoptic, that the planetary scales are more closely associated with warming. However, while we think dividing the two is useful for studying the effects and related mechanisms, in reality a strong storm may very well be a combination of what will in our study classify as one or the other.

Varunesh (18:31) James: Sorry, "Have you, or do you plan to, conduct or use pre-existing model experiments to test your hypothesis?" This question was for me?