NACLIM Final Meeting

04 October 2016 (Tue.)

09:00 – 09:20	Project retrospect & financial situation	Detlef, Martin and Chenbo
09:20 – 10:00	Project retrospect & prospect (CT1-4)	Johann, Johannes, Steffen, Dirk and *Mark*[1]
10:00 – 11:00	Science talks 1 – 3	s. abstract
11:00 – 11:30	COFFEE BREAK	
11:30 – 12:30	Science talks 4 – 6	s. abstract
12:30 – 13:40	LUNCH BREAK (incl. film session)	
13:40 – 15:20	Science talks 7 – 11	s. abstract
15:20 – 15:40	H2020 – COLUMBUS	Presentation and interaction
15:40 – 16:00	COFFEE BREAK	
16:00 – 18:15	Joint activity	
18.45 –	Reception at Exeter Castle (coach service from Met Office to city available)	
19.45 –	Conference dinner	

Abstracts

[1] Absent on 4th October, general talk will be given at the intl. conference on Friday

Science Talks: Early career researchers

01: Turið Poulsen (HAV) – The flow of Atlantic water through the Faroese channels

The Faroese channels are the common name for the Faroe-Shetland Channel (FSC) and its continuation into the Faroe Bank Channel (FBC). Through the deep parts of this channel system there is a continuous flow of cold, dense water of Arctic origin that enters the Atlantic as FBC overflow. The upper layers, in contrast, are dominated by warm and saline waters that derive from the Atlantic. The FBC-overflow has been well described in the literature and the Atlantic water in the FSC has also been studied during more than a century, but is complicated by the southwestward flow of Atlantic water over the Faroe slope of the FSC, the "Southern Faroe Current", that originates from north of the Faroes. Thus, there are a number of open questions: What is the net Atlantic water flow through the FBC and how does it vary? Does it feed the Atlantic inflow through the FSC or cross the Iceland-Faroe Ridge? What happens to the Southern Faroe Current? Does it recirculate within the FSC as suggested by some studies? Or, does a large part of it continue into the FBC and circle the Faroes as other studies claim? These questions are important for understanding the oceanic heat transport towards the Arctic. In the presentation, I will present a time series of Atlantic water volume transport through the FBC based on moored ADCPs, CTD surveys, and satellite altimetry. I will also discuss the upper layer coupling between the FSC and the FBC.

02: Marilena Oltmanns (GEOMAR) – How deep is the imprint of a warm summer over the subpolar North Atlantic?

M. Oltmanns, J. Karstensen and J. Fischer

The mixed layer in the subpolar North Atlantic is a center for atmosphere ocean interactions and an integral part of the climate system. When the atmosphere extracts heat from the ocean in winter, the mixed layer deepens, resulting in the export of carbon dioxide from the atmosphere. As the atmosphere itself responds to the surface temperature of the ocean, causes and effects of mixed layer variability are deeply intertwined. Disentangling individual processes is further complicated by the sometimes opposing, sometimes combined effects of temperature and salinity changes on mixed layer depth, and by the range of timescales involved.

In this presentation, we use a variety of oceanic and atmospheric data products | including moored observations promoted by NACLIM | to investigate atmospheric causes of mixed layer variability in the Irminger Sea in summer. We further establish links between this variability and the large-scale atmospheric circulation in fall. Our results indicate the existence of feedbacks whose implications for the mixed layer can extend into the following winter and beyond the subpolar region.

03: Patricia Handmann (GEOMAR, to be presented by Jürgen Fisher) – North Atlantic Deep Western Boundary Current dynamics as simulated by the VIKING20 model compared with Labrador Sea observations

P. Handmann, J. Fischer, M. Visbeck, C. Böning and L. Patara

The exit of the Labrador Sea is a key location in the subpolar North Atlantic concerning the integral quantities of the Deep Western Boundary Current (DWBC). It is the place where deep water masses from different origins and pathways meet. The combination of these is collectively called North Atlantic Deep Water (NADW). The intention of this presentation is twofold – first, model evaluation by means of integral quantities at the exit of the Labrador Sea, and second the interpretation of observed hydrographic and dynamic DWBC features under consideration of the underlying physical processes and forcing through high-resolution model analysis. The connection of dynamic and hydrographic properties simulated by the VIKING20 model, driven by

CORE2 atmospheric forcing, will be presented and compared to more than decade-long observations at the exit of the Labrador Sea near 53°N. VIKING20 is a high resolution (1/20°) nest based on the global configuration of the NEMO-LIM2 ocean-sea ice model ORCA25 in the North Atlantic and implemented by two-way nesting. The average flow field, being one of the integral quantities of the boundary current at 53°N including the bottom flow-intensification, is reproduced by VIKING20. The spatial comparison of velocity fields as well as hydrographic properties of water masses in observations and VIKING20 will be presented. How does the DWBC in model and observations behave at different depths and locations in the North Atlantic? Moreover the distribution of baroclinic- and barotropic- components and their dependence in model and observations as well as possible forcing mechanisms and parameters will be discussed.

04: Madlen Kimmritz (NERSC) – On sub-seasonal prediction of Arctic sea ice and teleconnections to Eurasian extreme weather events using multivariate data assimilation of sea ice

Arctic sea ice melted at an alarming rate of about 10% per decade since the satellite era, while cold and snowy winters took place more frequently over the North America, Europe and Asia. Early observational and modelling studies linked the reduction of the Arctic sea ice cover to the increased snowfall over Eurasia, though uncertainties remain. In this study we aim to analyze possible teleconnections between the Arctic cryosphere decline and the extreme weather events with focus on Europe and Asia using the Norwegian Climate Prediction Model (NorCPM), that is based on the state of the art Norwegian Earth System model and the Ensemble Kalman filter, which allows for multivariate data assimilation. Preliminary results are presented here.

05: Sally Close (UPMC) – Does Arctic sea ice exhibit coherent large-scale, long-term variability?

S. Close, M. Houssais, and C. Herbaut

Analyses of Arctic sea ice variability often employ large-scale (e.g. total Arctic sea ice extent) or long-term (e.g. linear trend) metrics, masking spatial and temporal scales of variability that may be important in understanding both overall sea ice behaviour and its interaction with the wider climate system. This issue motivates this work, in which the spatial and temporal scales of Arctic sea ice variability are analysed and their relevance evaluated with respect to related atmospheric and oceanic variability.
The long-term behaviour of Arctic sea ice is found to have a strong regional signal, with differences of up to 20 years in the timing of onset of rapid sea ice loss across the Arctic region in summer and autumn, suggesting that regional-scale forcing is an important influence in determining long-term sea ice evolution. An EOF-based analysis of winter sea ice concentration similarly suggests that local forcing is the dominant influence in determining sea ice variability at interannual to interdecadal time scales in this season. The quadrupole phase structure associated with the first EOF mode, and interpreted by previous studies to describe co-variability amongst the marginal seas, is found not to represent a significant relationship amongst all the seas. In particular, the Labrador Sea does not co-vary with the other regions. The principal components are characterised by low-frequency variability, having time scales comparable to the present length of the satellite record; caution should thus be applied in the interpretation of long-term behaviour in records that may not yet fully resolve such variability.

06: Richa Sharma (VITO) – Boundary layer climate modelling of a tropical megacity

R. Sharma, D. Lauwaet, H. Hooyberghs and K. de Ridder

Tropical cities are among the areas, worst hit by climate change. The cumulative effects of rapid urbanisation and local warming compound the effects of climate change in these areas. Though the regional trends of climate change are varying, tropical areas are expected to experience extreme heat. An increase in extreme weather events is anticipated and it is nearly certain that there will be more frequent hot and fewer cold temperature extremes over most land areas (Mishra, et al., 2015). Urban areas in particular are more prone to effects of heatwave due to the synergies between Heat Waves (HW) and Urban Heat Island (UHI). The differential energy budgets of urban and rural areas due to difference in moisture availability and wind speed is responsible for this synergy (Li & Bou-Zeid, 2013; Li, et al., 2015). Hence, with increase in HW, UHI also tend to increase. In order to make cities resilient to such impacts, there is a need to understand and identify the vulnerabilities of the city. Thus it is essential to investigate urban climate at local scales.

This study is an attempt to model the climate of Delhi (the capital city of India) at city level using UrbClim. UrbClim is an urban climate model that simulates and studies the UHI effect and other urban climate variables at the local scale with spatial resolution of few hundred meters (Ridder, et al., 2015; Lauwaet, et al., 2015). Though the model has already been successfully validated for a number of European cities, Delhi is the first tropical city for which the model is employed and validated. Validation was performed using both air temperature and land surface temperature observations for the year 2014.

Given the fact that majority of human population resides in cities, it becomes all the more relevant to study the future urban climate. However, climate projections at city scale are lacking in general. To understand the climatological fate of Delhi, validated UrbClim is employed to simulate the urban climate for future period (2020–2050), based on the Global Climate Model output fields. These results can help in identifying and mapping the vulnerable locations of the city. Once city is aware of the locales that are more vulnerable to heat waves due to climate or due to socio-economic factors, the city can hence prepare itself accordingly.

Science Talks: Senior Researchers

07: Katja Lohmann (MPI-M) - Attribution of predictive skill in the North Atlantic

K. Lohmann, D. Matei and J. Jungclaus

In previous NACLIM meetings, we have demonstrated predictive skill of (i) the mid-1990s weakening of the North Atlantic subpolar gyre and (ii) the upper-ocean salt content in the subpolar North Atlantic and the eastern part of the Nordic Seas. Apart from demonstrating predictive skill, understanding the mechanism underlying the skill has become a focus of research within the predictability community.
Regarding the weakening of the subpolar gyre, we link the predictive skill to the ability to predict the mid-1990s warming of the subpolar North Atlantic. The latter leads to a reduction in the doming of the subpolar isopycnals and thus to a weakening of the gyre.
Regarding the upper-ocean salt content, we will investigate whether the predictive skill at longer lead times (about 5-10 years) can be attributed to a delayed response to the North Atlantic meridional overturning and / or gyre circulation, as has been suggested for the subpolar upper-ocean heat content by Matei et al. (2012).
Matei D, Pohlmann H, Jungclaus JH, Müller WA, Haak H, Marotzke J (2012) Two tales of initializing decadal climate prediction experiments with the ECHAM5/MPI-OM model. Journal of Climate, 25, 8502–8523

08: Andrey Vlasenko (UHAM) – Estimation of sensitivity of near land temperature to ocean state variables

A. Vlasenko, A. Köhl and D. Stammer

The estimation of sensitivity of near land temperature in Northern Europe to ocean state variables such as SST, SSS etc. is based on the coupled climate model CESAM. The adjoint of CESAM used for the estimation of sensitivities was obtained with the aid of TAF, a special automatic differentiation tool.

Sensitivities were computed for several years, starting each time from the first of January and then running the model over 35 days. The analysis of computation revealed two stages of development of sensitivities. The first stage in the time frame of several days before the targeted land temperature change is a local atmospheric response to anomalies in ocean state associated with changes in sensible and latent heat. The second stage is associated with changes in the atmospheric wind-pressure system. The impact of optimal perturbation patterns calculated from the sensitivity estimates was studied in a series of forward model experiments. These experiments showed that the sensitivity pattern added to ocean SST forcing lead to warmer winters in Northern Europe and the same sensitivity pattern subtracted from the ocean forcing resulted in colder winters mainly caused by changes in the local wind direction over Europe.

09: Mojib Latif (GEOMAR) – Correcting North Atlantic Sea Surface Salinity Biases in the Kiel Climate Model: Influences on Mean Ocean Circulation and Multiyear to Multidecadal Variability

M. Latif, T. Park and W. Park

A long-standing problem in climate models is the large sea surface salinity (SSS) biases in the North Atlantic. We describe the influences of correcting these SSS biases on the circulation of the North Atlantic as well as on North Atlantic sector mean climate and multiyear to multidecadal variability. We performed integrations of the Kiel Climate Model (KCM) with and without applying a freshwater flux correction over the North Atlantic. The quality of simulating the mean circulation of the North Atlantic Ocean, North Atlantic sector mean climate and variability is greatly enhanced in the freshwater flux-corrected integration which, by definition, depicts relatively small North Atlantic SSS biases. For example, a large reduction in the North Atlantic cold sea surface temperature (SST) bias is observed and a more realistic Atlantic Multidecadal Variability (AMV) simulated. Improvements relative to the non-flux corrected integration also comprise a more realistic representation of deep convection sites, sea ice, gyre circulation and Atlantic Meridional Overturning Circulation (AMOC). Further, fast AMOC variability is simulated consistent with instrumental observations from the RAPID array. The results suggest that simulations of North Atlantic sector mean climate and variability on a variety of timescales could strongly benefit from alleviating sea surface salinity biases in the North Atlantic, which may enhance the skill of climate predictions in that region.

10: Torben Schmith (DMI): Decadal predictability of extreme fresh water export events from the Arctic Ocean into the Nordic Seas and subpolar North Atlantic

T. Schmith, S. M. Olsen, I. Ringgaard and W. May

It has been proposed that abrupt fresh water releases from the Arctic Ocean into the Nordic Seas and North Atlantic could affect the ocean circulation and climate conditions in the North Atlantic area. Here we investigate the prospects for predicting such extreme releases up to one decade ahead in a model experimental setup consisting of a 500 year control integrations and 10 year long ensemble predictions. Initial conditions for these are selected from the control experiment to represent large positive or negative decadal trends in the total fresh water content in the Arctic Ocean. The analysis of liquid fresh water and sea ice reveals that both develop in time mainly as being integrated in the Beaufort Gyre through Ekman pumping from the stochastic atmosphere. Therefore the predictions from the ensemble experiments are on average not better than damped persistence predictions. Analysing two different families of ensemble predictions, one initialized with the 'observed' ocean globally, and one initialized with the model climatology in the Arctic Ocean and with the observed ocean elsewhere, we conclude that the former yields superior predictions one year ahead as regards both liquid fresh water and sea ice. Analysis of the model experiments in terms of the fresh water export from the Arctic Ocean into Nordic seas and the subpolar North Atlantic reveals a very modest potential for predictability with the exception of cases with increasing fresh water content where there seems to be a potential for predicting the export of liquid fresh water one year ahead.

11: Mark Payne (DTU Aqua) – Multi-annual forecasts of Bluefin tuna habitat and distribution in the North Atlantic

M. R. Payne, D. Matei and B. R. MacKenzie

ICES CM 2016/I

We describe one of the first known examples of forecasts of a marine biological variable on a multi-annual to sub-decadal scale. While recent advances in oceanographic modelling have yielded significant skill on the sub-decadal time-scale for certain variables in certain areas, translating these physical predictions into biological predictions remains a challenge. We propose that the distribution of pelagic fish may be a "low-hanging fruit" due to their close coupling to the physical environment and ability to respond to inter-annual variability. The northern limit of bluefin tuna (Thunnus thynnus Linnaeus 1758) distribution in the North Atlantic is thought to be constrained by temperature, as recent observations of this species east of Greenland in Denmark Strait have borne out. We examine the predictability of this thermal constraint, and thereby the potential summer foraging habitat of tuna, using a state-of-the-art decadal forecast system. We found skill over and above a persistence forecast (i.e. assuming no change) with a three-year lead time, and statistically significant skill on even longer time-scales. We demonstrate that recent changes in this region, including the appearance of tuna, could have been predicted with similar multi-annual lead times. Finally, we show good agreement between our forecasts and some limited catch records near this region. We therefore conclude that multi-annual forecasts of biological variables are indeed possible, and discuss the applications of these results.

H2020 COLUMBUS: Knowledge Transfer to Increase the Impact of EU-Funded Marine and Maritime Research

Gustavs, L.[1], Bayliss-Brown, G.A.[2], Ní Cheallacháin, C.[2] and Murphy, D.[2]

Today, there is a pronounced need to ensure, and provide evidence to show, that funded research is leading to social, cultural and ecological impact. Not only is it essential that scientific knowledge is robust and credible but, to be successfully transferred and applied by those identifying solutions for today's societal and environmental challenges, it should be pitched to the right person, in the right way. "Knowledge Transfer" is an advanced approach to communication that maximizes the chance of research and its knowledge outputs reaching its impact potential. This phenomenon is receiving growing academic interest, where publications including "knowledge transfer" in the title having increased near exponentially for 60 years (Bayliss-Brown and Ní Cheallacháin, 2016).

Recognizing its value, the European Commission (2008) recommends that "knowledge transfer between universities and industry is made a permanent political and operational priority" and that "sufficient resources and incentives [are made] available to public research organizations and their staff to engage in knowledge transfer activities". Some funding agencies have already taken the step to making pathways-to-impact statements a mandatory requirement of all project proposals, and it is expected that further funding agencies follow suit.

The COLUMBUS project and its activities will be presented in this session. COLUMBUS is a Horizon 2020-funded Coordination and Support Action that aims to capitalize on the European Commission's significant investment in marine and maritime research through the use of Knowledge Transfer methodologies. The project aims to measurably increase uptake and application of outputs - those arising from publicly-funded marine research projects - by different end-users, such as industry, science, policy makers, and society in general.

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In its first year, COLUMBUS established a “Knowledge Fellowship”, a network of nine fellows whose role it is to carry out Knowledge Transfer, each within a specific focus area. This team has identified knowledge gaps relating to Blue Growth within their respective areas and is proactively collecting, analysing and transferring knowledge from EU-funded research projects which have the potential to fulfil, or contribute towards filling, these gaps.

References

Bayliss-Brown, G.A. and Ní Cheallacháin, C., 2016. *Knowledge transfer within EU-funded marine science research – A viewpoint*. In: Geophysical Research Abstracts (Volume: 18), EGU2016-14505. Vienna, Austria, 17-22 April 2016.

European Commission (2008) *Commission Recommendation on the management of intellectual property in knowledge transfer activities and Code of Practice for universities and other public research organisations*. C(2008) 1329 Available at: http://ec.europa.eu/invest-in-research/pdf/ip_recommendation_en.pdf [Last Accessed: 9 September 2016]