6th International Workshop on
Sea Ice Modelling and Data Assimilation

Toulouse, France

September 15-16.

Monday 15 September 2014

08:45	Welcome and Introductions Chair.: F. Kauker	Organizing Committee
09:00	Recent progres in remote sensing of polar oceans and sea ice at DMI	Leif Toudal Pedersen
09:30	Evaluation of summer passive microwave sea ice concentrations planned in ICE-ARC	Nick Hughes
10:00	Towards data assimilation of sea ice concentration products.	Frode Dinessen
10:30	*Health Break + posters*	
11:00	Recent upgrade to the Regional Ice Prediction System and ongoing research on assimilating AVHRR data	Mark Buehner
11:30	Progress Towards Assimilation of SAR Data Within the Regional Ice Prediction System	Tom Carrieres
12:00	Open water observations from SAR imagery and methods for assimilation	Andrea Scott
12:30	*Lunch* Chair.: G. Garric	
13:30	Towards mapping uncertainties of satellite-based sea ice motion vectors	Thomas Lavergne
14:00	An intercomparison of Arctic ice drift products to deduce uncertainty estimates	Hiroshi Sumata
14:30	An analysis of 30 years of Freezing and Melting Degree Days as a proxy for ice volume	Jean-Claude Gascard
15:00	*Health and social break + posters*	
15:30	Assimilating SMOS sea ice thickness into a coupled ice-ocean model using a local SEIK filter	Qinghua Yang
16:00	Ensemble of sea ice initial conditions for interannual Ec-Earth climate predictions: Improved forecast quality over the Arctic	Virginie Guemas
16:30	Towards Improving Seasonal Sea Ice Forecasting	Julienne Stroeve
17:00	*End of day*	

Tuesday 16 September 2014

	Chair. T. Carrières	
08:30	Recent progress in forecasting systems in the Arctic Ocean at Mercator Océan.	C. Bricaud/CE Testut
09:00	Towards a new sea ice forecasting platform for the Barents and Kara Seas.	Philipp Griewank
09:30	Sea-ice/ocean forecasting in a coupled model	Mathieu Chevallier
10:00	Sea ice Forecast Verification in the Canadian Global Ice Ocean Prediction System	Gregory Smith
10:30	*Health and social break*	
11:00	From regional to Arctic scale sea ice modeling	Till Rasmussen
11:30	A Maxwell-elastic-brittle rheology for sea ice modeling	Veronique Dansereau
12:00	Parameterisation of ice thickness distribution in ice models	Mikko Lensu
12:30	*Lunch*	
	Chair.: L. T. Pedersen	
13:30	Parametrization of atmospheric transfer coefficients over polar sea ice	Christof Lüpkes
14:00	Waves in sea ice : modeling dissipation and scattering	Fanny Girard-Ardhuin
14:30	Quantitative network design	Frank Kauker
15:00	*Health and social break*	
15:30	Sea Ice Analysis and Forecasting with the GloSea5 Seasonal Forecast System	Drew Peterson
16:00	Will sea ice thickness initialisation improve seasonal-to-interanual forecast skill?	Jonathan Day
16:30	Recent sea ice observations from the IAOOS project	Christine Provost
17:00	*Workshop close and farewells*	

Poster Session

Large-scale patterns of Arctic sea ice variability and links to climatic forcing: a model / observation comparison	Sally Close
Sea Ice Analysis and Forecasting with the GloSea5 Seasonal Forecast System.	Drew Peterson
The iceHFP Project: The impact of sea-ice initialization on seasonal forecasts.	Drew Peterson
Sea ice motion, deformation and their reliability derived from Satellite data.	Thomas Hollands
Sea Ice observations	Nathalie Sennéchael
CMCC experience in sea-ice data assimilation	Andrea Storto
Modelling impact of East Siberian Sea methane outbreak	Peter Wadhams

Logistics

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Hotel Accommodation

The **Novotel Hôtel** proposes 10 rooms blocked at 170€ (incl. breakfast). For more convenience, we recommend to contact them directly. By making your room reservation please mention IICWG. Please note that the rooms are only blocked until August 16, 2014.

We have also special fares from the **Hôtel Ours Blanc Victor Hugo** (1 min walking distance). For more convenience, we recommend also to contact them directly. By making your room reservation please

mention IICWG. Please note that these rooms are not blocked but these fares are valid until July 14, 2014.

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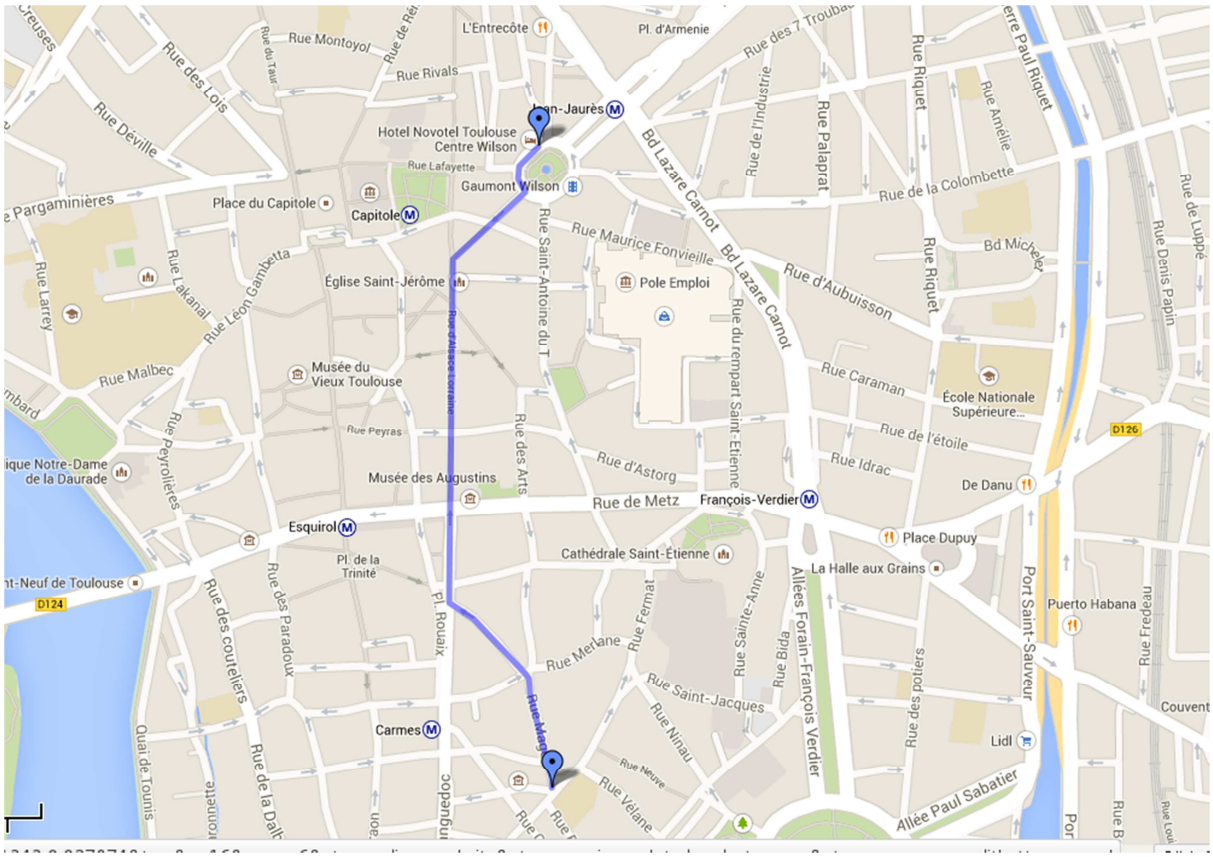
Standard room: 78,-€ (incl. breakfast)
Superior room: 88,-€ (incl. breakfast)
Superior room: 98,-€ (incl. breakfast) (Hôtel Ours Blanc Centre***)

Lunch and Coffee breaks will be covered by the organisers.

Conference Dinner on Monday evening at 8pm at the restaurant "Chez Navarre", 49 Grande Rue Nazareth, Tel: 05 62 26 43 06. Dinner is not covered by the organisers.



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List of Abstracts (Alphabetical order)

"Recent upgrade to the Regional Ice Prediction System and ongoing research on assimilating AVHRR data"

M. Buehner, Environment Canada, Montréal, Canada.

The Regional Ice Prediction System (RIPS) at Environment Canada was recently improved by expanding the horizontal domain to cover the entire Arctic. As a part of this upgrade, tests are underway to evaluate the impact of assimilating AMSR2 ice concentration retrievals and ice concentration from the Canadian Ice Service Regional Analysis Charts. Research on the assimilation of AVHRR data within RIPS will also be presented.

"Progress Towards Assimilation of SAR Data Within the Regional Ice Prediction System"

T. Carrières, Canadian Ice Service, Ottawa, Canada

The Regional Ice Prediction System (RIPS) has been developed to provide automated numerical guidance to ice forecast operations at the Canadian Ice Service. Although RIPS assimilates satellite passive microwave and scatteromter data, it still relies on data from manually produced ice charts. In order to increase the effective resolution and decrease the dependence on manual products, it is highly desirable to assimilate satellite based SAR data. With an initial focus on RADARSAT 2, a large volume of SAR data has been analyzed in order to develop ice and water signatures or characteristic values (CVs). Using these CVs, a simple forward model has been developed to infer a relationship with ice concentration. The current status of this work will be presented including a number of illustrative case studies outlining some of the hurdles to this approach.

"Large-scale patterns of Arctic sea ice variability and links to climatic forcing: a model / observation comparison"

S. Close, UPMC/LOCEAN, Paric, France

In this study, we compare the output from two data-assimilating models (PIOMAS / NEMO-LIM2) and observational data (SSMI/S) over the period 1979-2009 for the Arctic region. EOF analysis is used to describe the large-scale temporal and spatial variability of sea ice concentration (SIC) and ice thickness, and the consistency of the model responses examined. The co-variability of SIC and ice thickness with various drivers is described using singular value decomposition. Some coherency between the two model runs and observational data is noted in these analyses; however, this is both seasonally- and regionally-dependent. The role of the major climatic modes in driving the congruent modes of variability that result from the SVD analysis is investigated, and the potential mechanisms by which the modes may exert influence are considered.

"A Maxwell-elastic-brittle rheology for sea ice modelling"

V. Dansereau (1), J. Weiss (1) and P. Saramito (2)

(1) Laboratoire de Glaciologie et Géophysique de l'Environnement, Saint-Martin d'Hères, France
(2) Laboratoire Jean Kuntzmann, Saint-Martin d'Hères, France

In recent years, statistical analysis of available ice buoy drift and RGPS data have revealed the strong heterogeneity and intermittency of Arctic ice pack deformation and thereby demonstrated that the viscous-plastic (VP) rheology widely used in climate and operational models does not simulate adequately the mechanical behavior of sea ice. A new rheological framework named "elasto-brittle" (EB) has therefore been developed as an alternative to the VP model, which combines the linear elasticity of a continuum solid, a Mohr-Coulomb criterion for brittle failure and a progressive damage mechanism for the elastic modulus that allows for long-range interactions inside the pack. Recent implementation of this rheology into 3-days stand-alone realistic simulations of the Arctic ice pack without advection reproduced the strong localization of damage and agreed well with the deformation fields estimated from RGPS data. In the context of longer-term simulations of ice conditions and coupling to an ocean component, a suitable rheological framework should however distinguish between the permanent and recoverable (elastic) deformations in order to estimate the adequate ice drift velocities from the computed deformations, i.e., allow the passage from small to large deformations.
To achieve this, a viscous relaxation term is added in the elastic constitutive relationship of the EB model together with an "apparent" viscosity that evolves according to the local thickness, concentration and damage of the ice, much like the elastic modulus. The coupling between the level of damaging and both mechanical parameters is such that within an undamaged ice plate the viscosity is infinitely large and deformations are strictly elastic, while along highly damaged zones such as leads the elastic modulus vanishes and most of the constrain is dissipated through permanent deformations. In this augmented EB model the irreversible and recoverable deformations are solved for simultaneously, hence ice drift velocities are defined naturally. This new rheological framework is presented along with results of numerical experiments over domains with simple and more complex geometries.

"Will sea ice thickness initialisation improve seasonal-to-interanual forecast skill?"

J. Day, Univ. of Reading, UK.

A number of recent studies have suggested that Arctic sea ice thickness is an important predictor of Arctic sea ice extent. However, coupled initialised forecast systems do not currently use sea ice thickness observations in their initialisation and are therefore missing a potentially important source of additional skill.

A set of idealised ensemble prediction experiments with the Hadley Centre's HadGEM1.2 model have been run to investigate this. In this model the initial state of all prognostic variables, including sea ice thickness, is known perfectly. To investigate the importance of sea ice thickness initialisation, a second set were run. These were initialised with identical fields to the first set, except, that the sea ice thickness was set to the model climatology at each grid point.

The set with perturbed sea ice thickness, initialised in July, has much larger sea ice extent forecast errors for the first six forecast months. However, the perturbed and unperturbed forecasts initialised in January are indistinguishable. This indicates that the impact of sea ice thickness initialisation will be extremely dependent on the whether the forecast is initialised in the melt or the freeze season.

“Towards data assimilation of sea ice concentration products”.

F. Dinessen, MET, Norway.

The national ice service at MET Norway provide ice charts that are produced from a manual interpretation of different satellite data. In this production, SAR data plays a central role because of its high spatial resolution. As part of the EUMETSAT OSISAF project MET Norway is producing sea ice concentration products from passive microwave and AVHRR satellite data. In addition an automatic SAR based sea ice concentration are produced. All this products comes with limitations which makes it difficult to meet user requirements of a detailed sea ice mapping.

Combining the different products in a data assimilation approach are being developed utilizing the advantage of the different products. The presentation will report on the first results from this data assimilation."

“An analysis of 30 years of Freezing and Melting Degree Days as a proxy for ice volume”

JC Gascard, LOCEAN/UPMC, Paris, France

We estimated sea-ice volume formed in winter during the last 30 years using number of Freezing Degree Days FDD calculated from the ERA interim data reanalysis (air temperature at 2m above Sea-ice all over the Arctic Ocean). We compared these results with PIOMAS estimations and found a good agreement indicative of the importance of Arctic atmospheric winter conditions in the total sea ice mass balance in the Arctic Ocean during the past 30 years. We also calculated the number of Melting Degree Days MDD that doubled during the past 30 years (most of it over the past 10 years).

These results stress the importance.for estimating sea ice volume in addition to sea ice extent in order to document Arctic sea ice variability in the context of climate change and polar amplification..

"Waves in sea ice: modeling dissipation and scattering"

Fanny GIRARD-ARDHUIN[1], Fabrice ARDHUIN[1,2], Paul NICOT[3], Dany DUMONT[3], Fabrice COLLARD[4], Timothy WILLIAMS[5], Laurent BERTINO[5]

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In spite of a growing interest in the Arctic, operational wave models generally treat sea ice as a moving land-sea mask, with no wave parameters available in the ice-covered regions. Several projects are developing new observation databases and parameterizations for the evolution of waves in the marginal ice zone (MIZ) and beyond. Among these, the EU FP7 SWARP project, started in 2014, will integrate ocean circulation, sea-ice and wave models, with specific developments on the parameterization of wave scattering in the MIZ and dissipation. These parameterizations will be implemented both in the CICE model for rheology changes and forcing by a wave model, and in the spectral model WAVEWATCH III, for the scattering and dissipation.
Preliminary results with a dissipation due to friction below the ice, and a scattering formulation derived from unidirectional partial refections at the water – ice floe interfaces have been calibrated against global altimeter measurements of the significant wave height using a 0.5° resolution model. Local attenuation measurements derived from Envisat and Sentinel-1 SAR scenes have been used to validate a 12 km resolution model of the Arctic in which the ice thickness estimate is taken from the ESA CCI Sea Ice and SMOS-ice projects. Sea ice concentration are from reprocessed dataset made at CERSAT/Ifremer.
The very high quality Sentinel-1 data acquired in the calibration-validation phase, together with the spectral resolution allows to clearly separate scattering, which mostly affects short waves, from dissipation effects. Further work is under way to better understand the ocean wave imaging mechanism to arrive at an absolute calibration of wave heights.

This presentation will present both sea ice datasets & new observations (Sentinel-1) and results from the model (beginning of the project)"

“Ensemble of sea ice initial conditions for interannual Ec-Earth climate predictions: Improved forecast quality over the Arctic”

V. Guemas, Institut Català de Ciències del Clima (IC3) / Centre National de Recherches Météorologiques (CNRM), Spain/France)

Several studies have highlighted the role of the sea ice thickness (SIT) as a source of predictability for the Arctic sea ice cover on seasonal timescales. In a prediction context, the lack of SIT observations hampers the initialization of seasonal forecasts. A 5-member sea ice reconstruction is produced by constraining LIM2 sea ice model by the ocean and atmosphere observational data used to initialize the ocean and atmosphere components of the EC-Earth2.3 forecast system afterwards. We illustrate the added-value of this methodology to generate sea ice initial conditions 1) over a previous set of sea ice initial conditions taken from a single-member simulation forced by atmosphere observational data and 2) over a climatology of this same sea ice reconstruction.

"Sea ice motion, deformation and their reliability derived from Satellite data"

T. Hollands, AWI, Bremerhaven,Germany.

Even though the methods for sea ice drift and deformation retrieval from satellite remote sensing data are well-established, there is very little information on the reliability of the individual drift vectors and the deformation parameters evaluated from the vector fields. This can be problematic for data assimilation of ice drift and deformation into sea ice models.

Most ice tracking algorithms are statistically validated on the basis of a comparison to buoy data. However, such analyses cannot provide information on the quality of individual drift vectors. This information is very valuable since ice conditions are highly variable, and no algorithm provides the same performance at different ice conditions. The performance of drift algorithms is strongly related to the following criteria: 1) the existence of characteristic patterns in the image (caused by the ice structure) and 2) their stability between the acquisitions of the images used for drift retrieval.

We will present an approach which allows to separate reliable and unreliable regions in the drift vector field based on two independent criteria. In this way it provides a first proxy for the reliability of the individual drift vector and thereby represents a promising step in the direction of 'true' uncertainties."

"Towards mapping uncertainties of satellite-based sea ice motion vectors”

T. Lavergne, Norwegian Meteorological Institute, Oslo, Norway

Sea ice motion (aka drift) products from satellite images have been available for process studies, model validation and Data Assimilation for decades. Example of these products are the large-scale observations from the IFREMER/Cersat and EUMETSAT OSISAF, and the high-resolution product from DTU/MyOcean. Yet, as of today, the only way to provide uncertainty estimates for motion vectors is by validating the satellite products against trajectories from ice drifting buoys. These validation exercises result in averaged, global, yearly estimates of the uncertainties, and are not practical to use for Data Assimilation. In this contribution, we will report on recent work conducted at MET Norway for providing daily varying maps of uncertainties (""error-bars"") for the OSISAF sea ice drift product."

"Parameterisation of ice thickness distribution in ice models"

M. Lensu, Finish Meteorological Institute, Helsinki, Finland.

The ice thickness distribution provides the most complete way to incorporate thickness variation into ice models. This is done in terms of an equation governing the time evolution of the distribution. Different implementations of this scheme stem from the seminal formulation by Thorndike (1975). The approach has never gained wide popularity as the attention to thickness detail and the mathematical complicity do not well match the coarse parameterisation assumptions. However, the abstruseness is an illusion that is resolved when the equation is seen as an exemplification of a general formalism applied in most diverse fields of research. This provides a variety of usually simpler formulations and benchmark analytical solutions. Various new alternatives to formulate and parameterise the thickness distribution equation are presented and discussed, paying attention to aspects of resolution and scale."

"Parameterization of atmospheric transfer coefficients over polar sea ice"

C. Lupkes, AWI, Bremerhaven, Germany.

Coupled atmosphere - sea ice - ocean models need a detailed representation of the near-surface atmospheric fluxes of momentum and heat. Transfer coefficients should account for the inhomogeneous distribution of surface topography and temperature especially in regions with fractional sea ice cover. In such regions form drag caused by edges of ice floes and melt ponds play an important role for the value of drag coefficients.

In the present contribution a recently developed parameterization of atmospheric surface drag over sea ice that includes the effect of form drag will be compared with parameterizations currently used in climate models. An application of the parameterizations to different sea ice scenarios and with an atmospheric forcing as being typical for Arctic summer shows that the traditionally used drag coefficients without form drag differ from the new ones by a factor 0.5-1.2 dependent on the region.

Furthermore, we show that the existence of form drag affects both momentum and heat transfer coefficients. We investigate the stability dependence of both coefficients and discuss different strategies to account for this dependence. Finally, stability corrections are proposed which are based on the traditional Louis (1979) concept. Thus they can be easily implemented in climate models. A first application of the new concept in a global climate model (ECHAM6-FESOM) reveals the potentially large impact of the new parameterizations on simulations of the coupled Arctic climate system."

“Sea Ice Analysis and Forecasting with the GloSea5 Seasonal Forecast System”

K. Andrew Peterson, Met Office, Exeter, UK

The GloSea5 Coupled Seasonal Forecast System has sea ice fields initialized with the FOAM (GloSea5) ocean and sea ice (re-) analysis system which assimilates SSM/I satellite sea ice concentration observations along with ocean surface and sub-surface observations. We will present our assessment of the skill of seasonal time scale sea ice forecasts coming from the coupled seasonal forecast system. This will be further explored in the context of errors and uncertainties in the sea ice analysis system, particularly with regards to sea ice thickness which is not assimilated.

“The iceHFP Project: The impact of sea-ice initialization on seasonal forecasts.”

K. Andrew Peterson (1), Dirk Notz (2), Steffen Tietsche (3), Matthieu Chevallier (4), William Merryfield (5), W.-S. Lee (5), Virginie Guemas (6), Adam A. Scaife (1).

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(5) CCCma, Environment Canada, Victoria, Canada
(6) Institut Català de Ciències del Clima (IC3)

The Sea Ice Historical Forecast Project (IceHFP; \url{http://www.wcrp-climate.org/wgsip/chfp/iceHFP.shtml}) has been undertaken under the World Climate Research Program (WCRP) Working Ground on Seasonal to Interannual Prediction (WGSIP). Its aim is to determine whether initialization of sea ice in five state of the art seasonal prediction systems has an influence on predictive capacity for the atmosphere. This question is examined by initializing a series of seasonal forecasts for the winter (DJF), and fall (SON) of two seminal years in Arctic sea ice extent, 1996 and 2007. Two sets of forecast were performed: One with sea ice initialized to observations and a second where sea ice has been initialized with climatology. Using these forecasts we are able to demonstrate the effects of initializing with diminished sea ice extent. Initializing with the low sea ice extent of November 2007 leads to a multi-model tendency towards anti-cyclonic winter circulation in the Arctic, particularly in the region of ice deficit. This produces a tendency towards negative North Atlantic Oscillation (NAO) like behaviour in winters with low sea ice extent, and could help to increase extratropical climate predictability. Using August initialization, the autumn (SON) signal for low ice concentration is dominated by troughs over North America and Europe similar to ones in the observational record.

"Towards a new sea ice forecasting platform for the Barents and Kara Seas."

P. Griewank, NERSC, Bergen, Norway.

A new sea ice forecasting platform is being set up at NERSC in order to be able to work in real-time. It uses a stand-alone sea ice dynamical model based on a elasto-brittle rheology. We will present a status of the developments as well as some validation results made using satellite observations.

"From regional to Arctic scale sea ice modelling"

Till Rasmussen, Danish Meteorological Institute, Copenhagen, Denmark.

The Danish Meteorological Institute (DMI) prepares the launch of a new version of the operational coupled ocean and sea ice model. The setup consist of a fully coupled system that consist of three state of the art components, namely ESMF (coupler), HYCOM (ocean) and CICE (sea ice). The resolution of this setup is 10km.

In addition to the Arctic scale setup a high resolution (~2km) setup of Baffin Bay is to be implemented. The project aims at implementing dynamic boundary into the sea ice model and to demonstrate the effect of these.

This presentation will discuss the the two setups and additional initiatives that DMI is working on in order to improve the short term forecasting of sea ice.

"Open water observations from SAR imagery and methods for assimilation"

Andrea Scott, Univ. of Waterloo, Ontario, Canada.

In this presentation probabilistic methods to obtain open water observations from SAR imagery will be discussed and demonstrated using examples. The first method uses the HV backscatter and the image texture, while the second uses the HH backscatter and the windspeed. Methods to assimilate these observations will be reviewed and preliminary results will be shown for a region on the east coast of Canada.

"Sea ice Forecast Verification in the Canadian Global Ice Ocean Prediction System"

G. Smith, Environnment Canada, Montréal, Canada.

Recent increases in marine traffic in the Arctic have amplified the demand for reliable ice and marine environmental predictions. Here we present the verification of ice forecast skill from a new system implemented recently at the Canadian Meteorological Centre called the Global Ice Ocean Prediction System (GIOPS). GIOPS provides daily global ice and ocean analyses and 10-day forecasts on a 1/4°-resolution grid. GIOPS includes a full multivariate ocean data assimilation system that combines satellite observations of sea level anomaly and sea surface temperature (SST) together with in situ observations of temperature and salinity. Ice analyses are produced using a 3DVar method that assimilates satellite observations from SSM/I and SSMIS together with manual analyses from the Canadian Ice Service. Analyses of total ice concentration are projected onto the partial thickness categories used in the ice model using spatially and temporally varying weighting functions derived from ice model tendencies. This method is found to reduce deleterious impacts on the ice thickness distribution when assimilating ice concentration, as it can directly modulate (and reverse) nonlinear processes such as ice deformation. An objective verification of sea ice forecasts is made using two methods: analysis-based error assessment focusing on the marginal ice zone and a contingency table approach to evaluate ice extent as compared to an independent analysis. Together the methods demonstrate a consistent picture of skilful medium-range forecasts in both the Northern and Southern Hemispheres as compared to persistence. Smaller biases are found in both hemispheres during melt periods, whereas larger biases are present during the period of rapid ice formation in fall. Ice forecast skill is found to be highly sensitive to the assimilation of sea surface temperature near the ice edge. Improved observational coverage in these areas (including salinity) would be extremely valuable for further improvement in ice forecast skill.

"Towards Improving Seasonal Sea Ice Forecasting"

J. Stroeve, NSIDC, USA.

Decline in the extent and thickness of Arctic sea ice is an active area of scientific effort and one with significant implications for ecosystems and communities in the Arctic and global climate. While global climate circulation models all predict seasonal ice-free conditions within the second half of this century, forecasting on seasonal timescales remains challenging due to the variable nature of weather and ocean behavior as well as current limits to data and modeling capabilities. Forecasting ice conditions in the summer and into the fall is of particular interest to many stakeholders since many activities that take place in the Arctic are planned over the summer months, and many species are sensitive to the behavior of summer sea ice. The SEARCH Sea Ice Outlook (SIO) has been an informal network of scientists and stakeholders to improve and communicate sea-ice prediction knowledge and tools. The next step is to move this into a more formal network aimed at: (1) coordinating and evaluating seasonal predictions, (2) integrating, assessing and guiding observations, (3) synthesizing predictions and observations and (4) disseminating predictions and engaging key stakeholders. Here we present an overview of predictions contributed to the SEARCH SIO during the last 6 years, and evaluate how well they did in particular years and efforts to improve these seasonal sea-ice forecasts.

“An intercomparison of Arctic ice drift products to deduce uncertainty estimates”

H. Sumata, AWI, Bremerhaven, Germany.

We made an intercomparison of four low-resolution remotely sensed ice-drift products in the Arctic Ocean (ice drift products from OSISAF, CERSAT, Kimura et al., 2013 and NSIDC). The purpose of the study is to examine the uncertainty in space and time of these different drift products. The ice drifts were also compared with available buoy data. Based on the intercomparison of the products and comparison with buoy data, we estimated uncertainties of the monthly mean drift. The estimated uncertainty maps reflect the difference between the products in relation to ice concentration and the bias from the buoy drift in relation to drift speed. These uncertainties should be taken into account if these products are used, particularly for model validation and data assimilation within the Arctic.

"Assimilating SMOS sea ice thickness into a coupled ice-ocean model using a local SEIK filter"

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The impact of assimilating sea ice thickness data derived from ESA's Soil Moisture and Ocean salinity (SMOS) satellite together with Special Sensor Microwave Imager/Sounder (SSMIS) sea ice concentration data of the National Snow and Ice Data Center (NSIDC) in a coupled sea ice-ocean model is examined. A period of three months from November 1st, 2011 to January 31st, 2012 is selected to assess the forecast skill of the assimilation system. 24h-forecasts and longer forecasts are based on the Massachusetts Institute of Technology general circulation model (MITgcm), and the assimilation is performed by a localized Singular Evolutive Interpolated Kalman (LSEIK) filter. For comparison, the assimilation is repeated only with the SSMIS sea ice concentrations. By running two different assimilation experiments, and comparing with the unassimilated model, independent satellite derived data, and in-situ observation, it is shown that the SMOS ice thickness assimilation leads to substantially improved thickness forecasts. With SMOS thickness data, the sea ice concentration forecasts also agree better with observations, although this improvement is smaller.