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HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

Data report

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EM-Bird ice thickness measurements

Laptev Sea, April 2008 and 2012

HELMHOLTZ ASSOCIATION

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Document Version

Rev 1.0	03. September 2017	Initial Version

Important Note

Updates of the dataset will happen irregularly or upon request and revisions of the entire data time series might occur at any time. Furthermore applied additional data products may change. We stress the fact that for the interpretation of the thickness data, associated uncertainties should be taken into account.

We encourage users to give feedback (tkrumpen@awi.de)

Introduction

Purpose of this Document

Purpose of this document is the documentation of the thickness data obtained with the EM-Bird during two helicopter-based campaigns carried out in the Russian Arctic.

Background

The two campaigns were carried out within the framework of the Russian-German research cooperation 'Laptev Sea System'. Measurements were made in the southeastern Laptev Sea at the end of April 2008 (campaign Transdrift (TD) XIII) and 2012 (campaign TD XX). Data obtained over pack ice zones north of the landfast ice edge were used to estimate sea ice production in flaw polynyas (Rabenstein et al. 2013, Krumpen et al. 2011) and for validation of ESA's SMOS (Soil Moisture Ocean Salinity) satellite derived ice thickness products. Flaw polynyas are open water sites between pack ice and fast ice of high net ice production sustained by winds.

Data

Processing

For a detailed description of the HEM principle we refer to (Haas et al. 2009, Krumpen et al. 2016). In short, the instrument that is towed by a helicopter 15 meters above the ice surface utilizes the contrast of electrical conductivity between sea water and sea ice to determine its distance to the ice-water interface. An additional laser altimeter yields the distance to the uppermost snow surface. The difference between the laser and HEM derived distance is the ice plus snow thickness. According to Pfaffling et al. (2007), the accuracy over level sea ice is in the order of +-10 cm. However the maximum thickness of pressure ridges can be underestimated by as much as 50 %. The underestimation of peak pressure ridge thickness is a result of footprint smoothing, an effect that is mass-conserving for mean thickness values on kilometer scale. Thus, mean ice thickness values from EM data are in general agreement with other sources (Lindsay et al. 2015), such as ULS, though the probability density function (pdf) may differ slightly (Mahoney et al. 2015).

Provided Data

Following information are provided

Parameter	Description
Position of Measurements	Latitude/Longitude coordinates provided in decimal degree
Sea Ice Thickness	Sea ice thickness given in meters.
Height of the Instrument	Height of the instrument above ground measured with an laser altimeter given in meters

ASCII file (.txt)*

For each timestep, the position, time, thickness and altimeter height are written to an ASCII file. An example output is given below.

YYYY	MM	DD	GPS_TIME	FID	LATITUDE	LONGITUDE	DISTANCE	TH	ALT
2005	04	14	26218.30	2441	74.6776998	127.6072689	44.846	0.650	24.185
2005	04	14	26218.40	2442	74.6776695	127.6073454	48.894	0.660	24.133
2005	04	14	26218.50	2443	74.6776390	127.6074220	52.961	0.665	24.082
2005	04	14	26218.60	2444	74.6776082	127.6074985	57.054	0.696	24.036
2005	04	14	26218.70	2445	74.6775772	127.6075749	61.164	0.761	23.945
2005	04	14	26218.80	2446	74.6775461	127.6076510	65.280	0.845	23.829
2005	04	14	26218.90	2447	74.6775150	127.6077267	69.390	0.941	23.751
2005	04	14	26219.00	2448	74.6774840	127.6078020	73.484	1.022	23.625
2005	04	14	26219.10	2449	74.6774532	127.6078768	77.551	1.024	23.191
2005	04	14	26219.20	2450	74.6774225	127.6079512	81.597	0.951	23.807
2005	04	14	26219.30	2451	74.6773920	127.6080253	85.629	0.895	23.758
2005	04	14	26219.40	2452	74.6773615	127.6080992	89.653	0.893	23.709
2005	04	14	26219.50	2453	74.6773310	127.6081730	93.676	0.893	23.656
2005	04	14	26219.60	2454	74.6773004	127.6082467	97.704	0.860	23.624

Following parameters are listed (if available)

- YYYY — Year when measurement were taken
- MM — Month
- DD — Day
- GPS_TIME — GPS second of the day
- FID — Sample number
- Latitude — Position information (decimal degree)
- Longitude — Position information (decimal degree)
- Distance — Measured distance in meters
- TH — Sea ice thickness (in meters)
- ALT — Instrument height (in meters)

Selected list of publications

Rabenstein et al. (2013), Thickness and surface properties of different sea ice regimes within the Arctic Trans Polar Drift: Data from summers 2001, 2004 and 2007, The Cryosphere

Krumpen et al. (2011), Sea ice production and water mass modification in the eastern Laptev Sea, Journal of Geophysical Research

Haas et al. (2009), Helicopter-borne measurements of sea ice thickness, using a small and lightweight, digital EM system, Journal of Applied Geophysics

Krumpen et al. (2016), Recent summer sea ice thickness surveys in the Fram Strait and associated volume fluxes, The Cryopshere

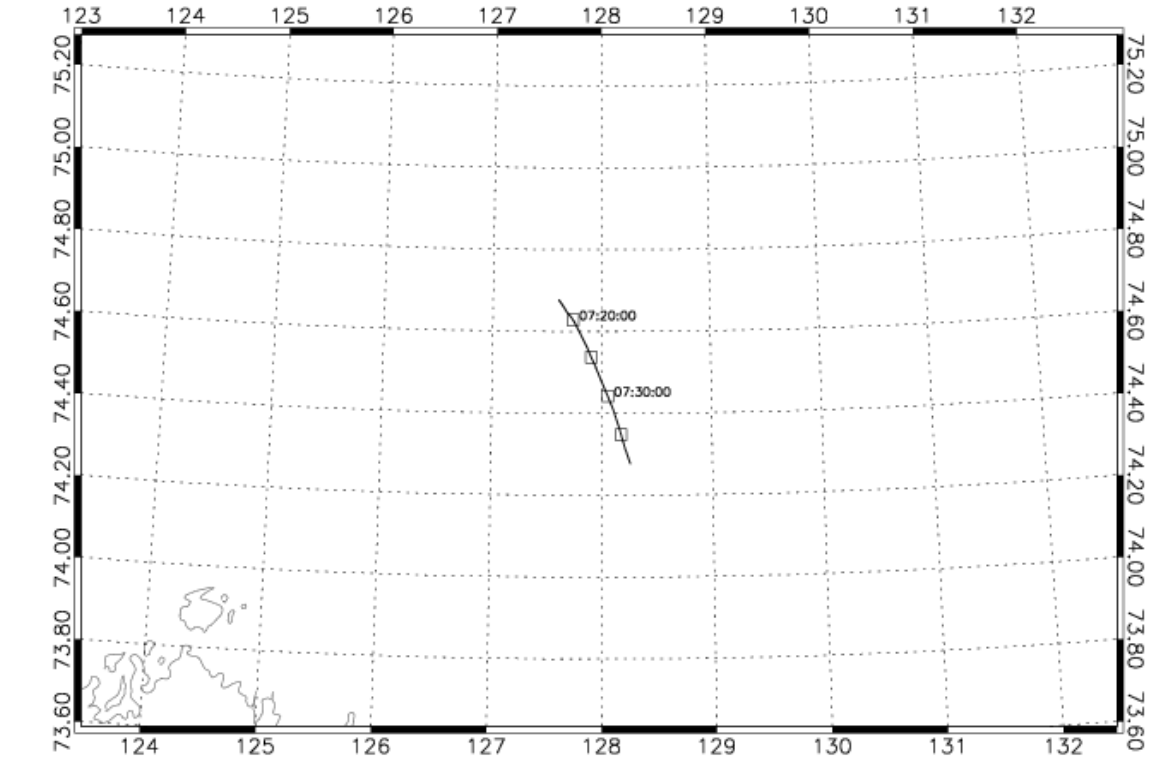
Pfaffling et al. (2007), A direct helicopter EM sea ice thickness inversion, assessed with synthetic and field data, Geophysics

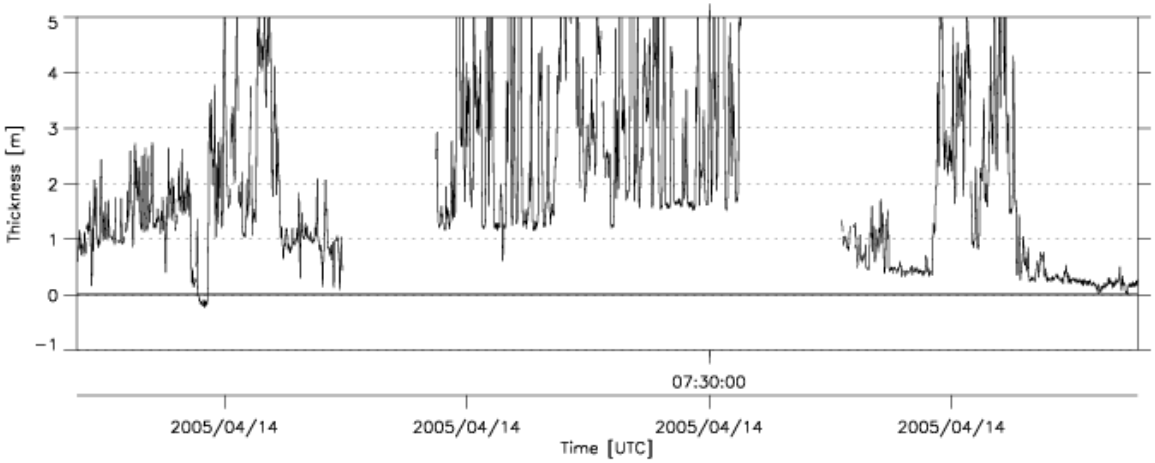
Lindsay et al. (2015), Arctic sea ice thickness loss determined using subsurface, aircraft, and satellite observations, The Cryosphere

Mahoney et al. (2015), Taking a look at both sides of the ice: comparison of ice thickness and drift speed as observed from moored, airborne and shore-based instruments near Barrow, Alaska, Annals of Glaciology

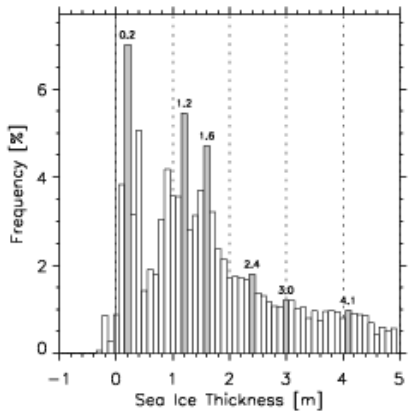
Data samples

Thickness data obtained on April 14, 2008

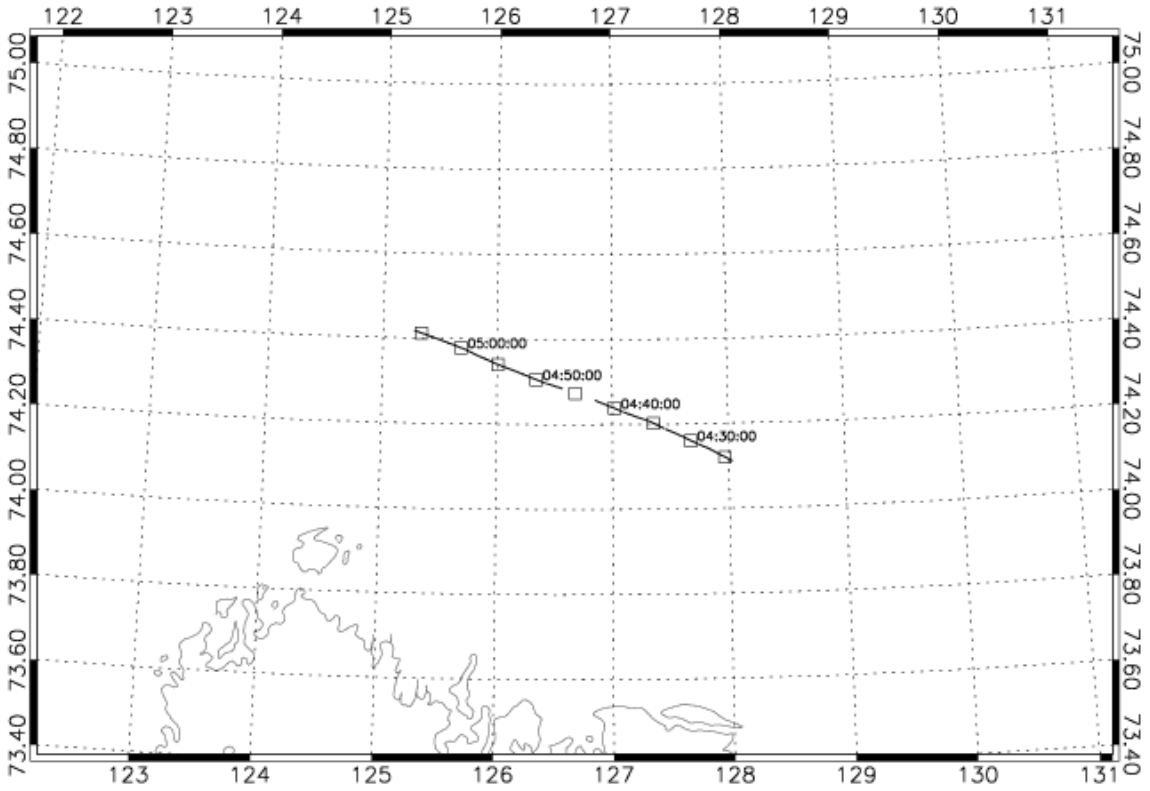


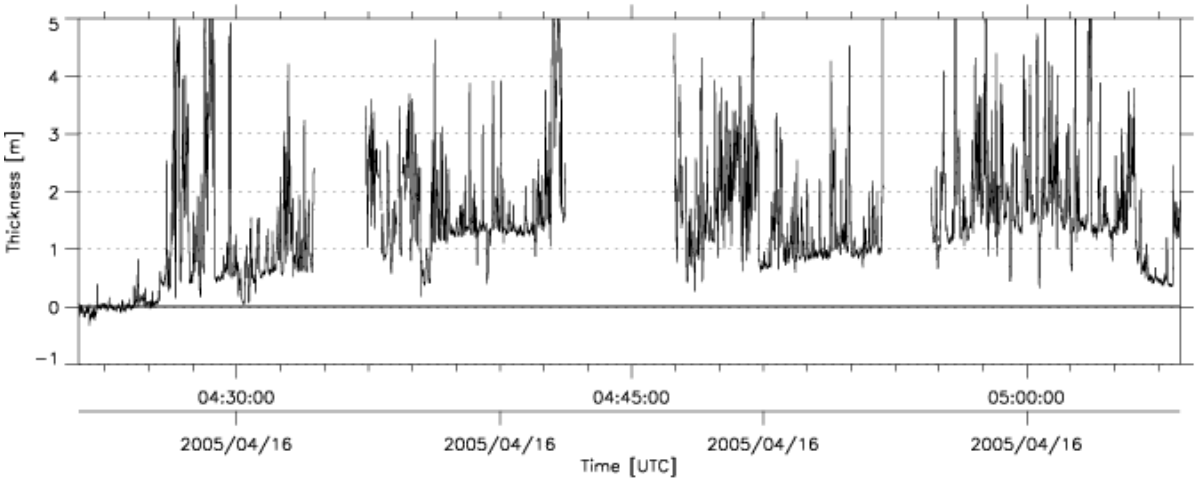


Date	2005/14/04
Duration	00:21:52
Length	48.9 km
Mean Thick.	2.00 m
Median Thick.	1.54 m
Stand. Dev.	1.71 m

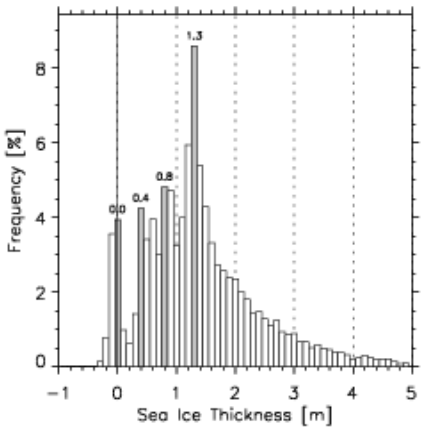


Thickness data obtained on April 16, 2008

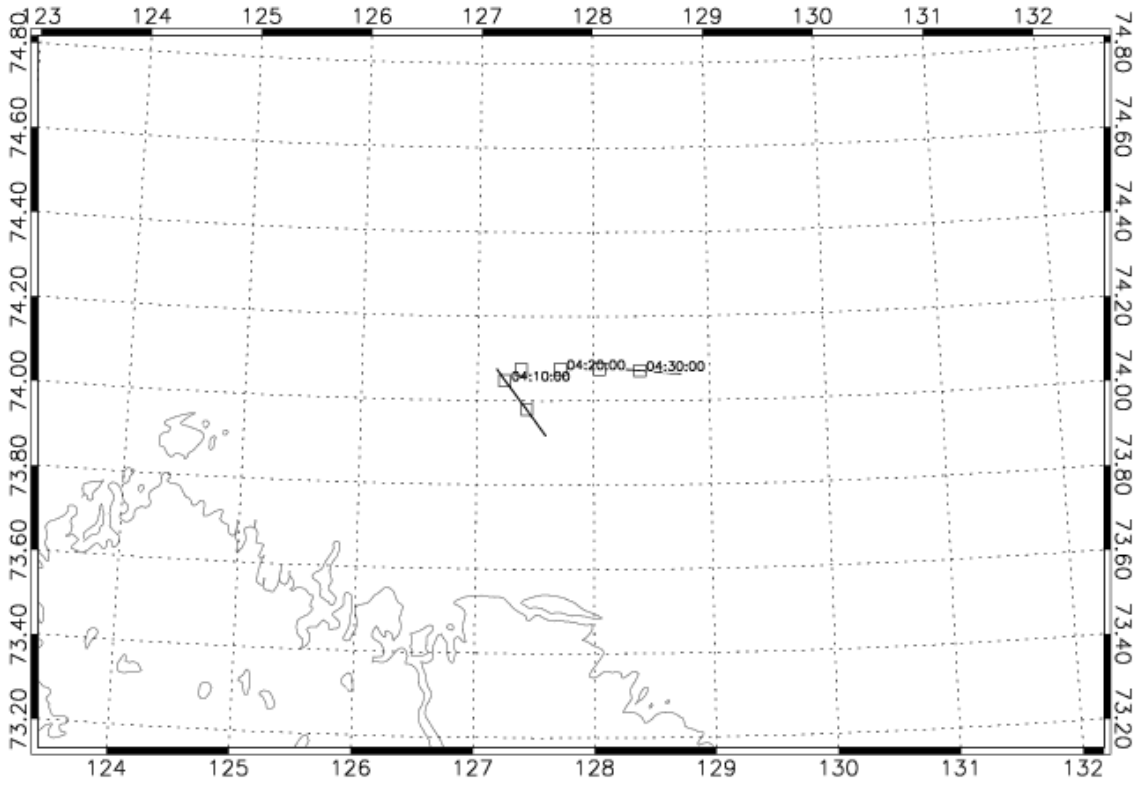


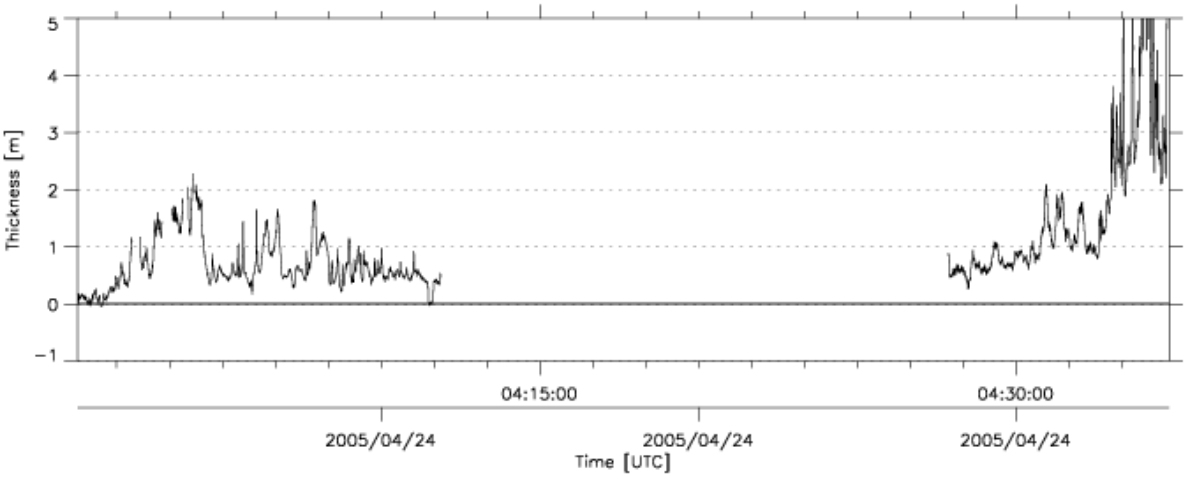


Date	2005/16/04
Duration	00:41:47
Length	84.6 km
Mean Thick.	1.46 m
Median Thick.	1.32 m
Stand. Dev.	1.07 m

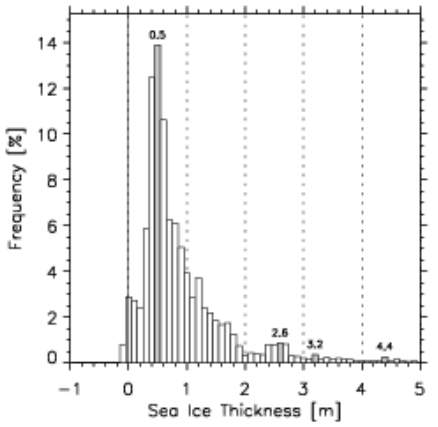


Thickness data obtained on April 24, 2008

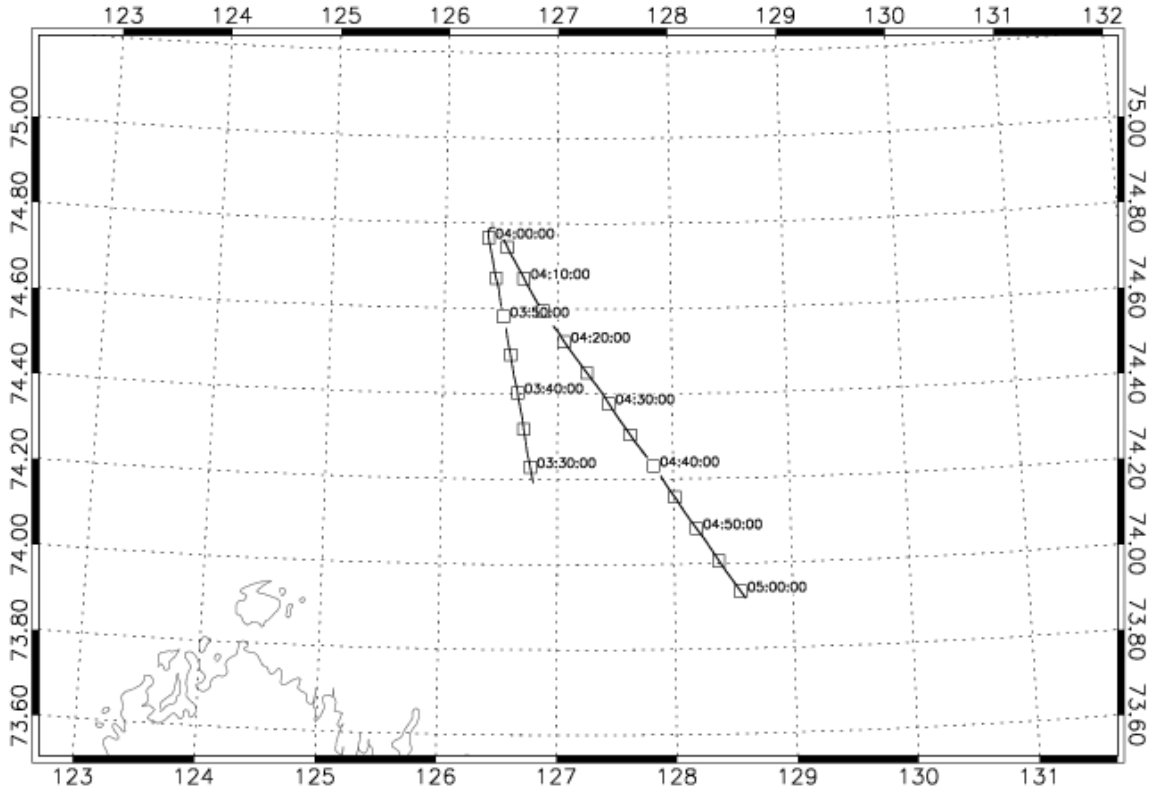


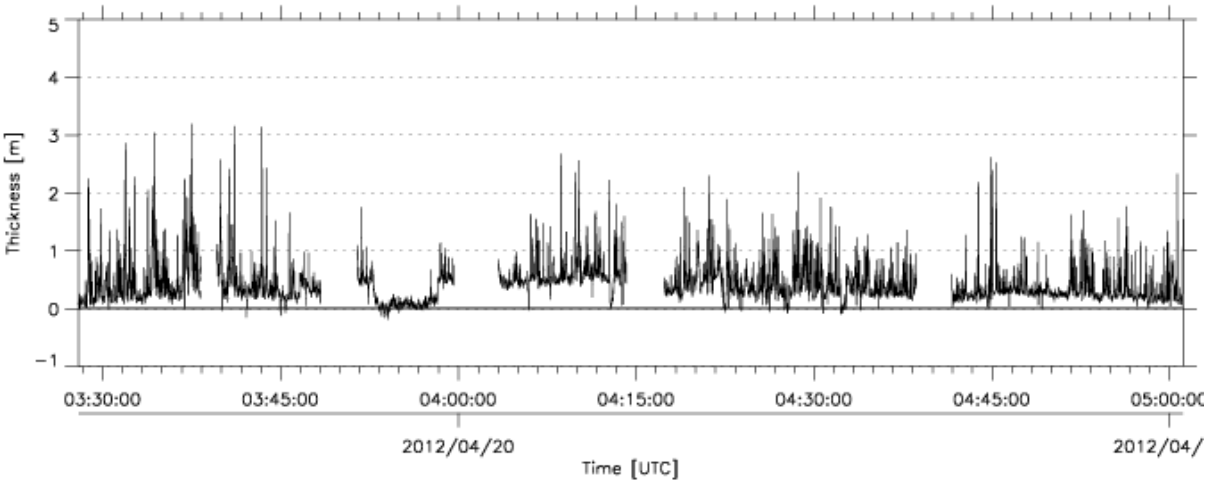


Date	2005/24/04
Duration	00:34:22
Length	37.6 km
Mean Thick.	1.07 m
Median Thick.	0.69 m
Stand. Dev.	1.16 m



Thickness data obtained on April 24, 2012





Date	2012/20/04
Duration	01:33:08
Length	167.2 km
Mean Thick.	0.43 m
Median Thick.	0.34 m
Stand. Dev.	0.33 m