FINNISH INSTITUTE OF MARINE RESEARCH

CRUISE REPORT

R/V Aranda

Cruise 2 / 2002

11 February - 22 April 2002

The report is based on preliminary data and is subject to changes.

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FRAMZY 2002

(Cyclones over the Fram Strait: Air-Ice-Ocean Interaction and Sea Ice Transport)

Cruise: 2/2002 (1 – 25 March 2002)

(Total Arctic expedition of RV Aranda in 2002 covered three scientific legs + ship cruises forth and back from Helsinki to Tromso, Norway, during 11 February – 22 April 2002)

Chief Scientist: Jouko Launiainen
Master: Pertti Lahti

PURPOSE AND BACKGROUND

Investigations of the Arctic sea ice and its variations and interaction with the atmosphere

The Arctic sea ice cover and the ocean have experienced variations and trends during the three past decades. It still remains finally uncertain whether those are signs and reflections of the Global Change. In the Arctic, the extent and thickness of sea ice has been decreased. Ice extension and thickness, as well as the whole mass budget of the Arctic sea ice form a major international climate change related field of studies in the Arctic Ocean. The study FRAMZY2002 was carried out as a joint project with the Meteorologisches Institut, Universität Hamburg, Germany. The expedition consisted of marine meteorological, sea ice, sea ice drifter and remote sensing studies.

The FRAMZY2002 main activities were to gather meteorological, sea ice and hydrographic observations to quantify the processes and energy transfer between the atmosphere and ice and the sea. As the regional forcing those control the ice transport in the Fram Strait (ice export from the Arctic Ocean).

Oceanography in the Greenland Sea

Before FRAMZY2002 in the Fram Strait, RV Aranda had a leg to the Greenland Sea for oceanographic (CTD, ADCP) measurements, in 18 - 27 Feb 2002. An another this kind of Greenland Sea operation was carried out also as the third leg during 2 - 14 April 2002. Those parts of the expedition were conducted by the Institut fűr Meereskunde, Universität Hamburg and the legs are not reported in detail in this report.

MAIN ACTIVITIES

The meteorological observations covered radio soundings, automatic weather station observations, drifting ice buoys and over ice turbulent measurements.
Oceanographic observations (CTD, ADCP) were made, for estimation of ocean current and hydrographic effects on the ice drift.

Satellite images (esp. Radarsat) were used as a real time application for research logistics and navigation, and, for ice drift studies in the later research stage (20 full-resolution images).

The operations were concentrated in the outer marginal ice zone area (MIZ).

The Aranda observations served, additionally, as the surface reference and ground check station for the flight missions of the well equipped meteorological aircraft Falcon (University of Hamburg) operating from Svalbard. In the Fram Strait and over Aranda Falcon made 7 missions 05.03 – 21.03.2002.

Ship cruise during the Aranda Arctic Expedition 2002 is given in Figure 1. (The northernmost latitude reached was 80^0 24.4' N.)

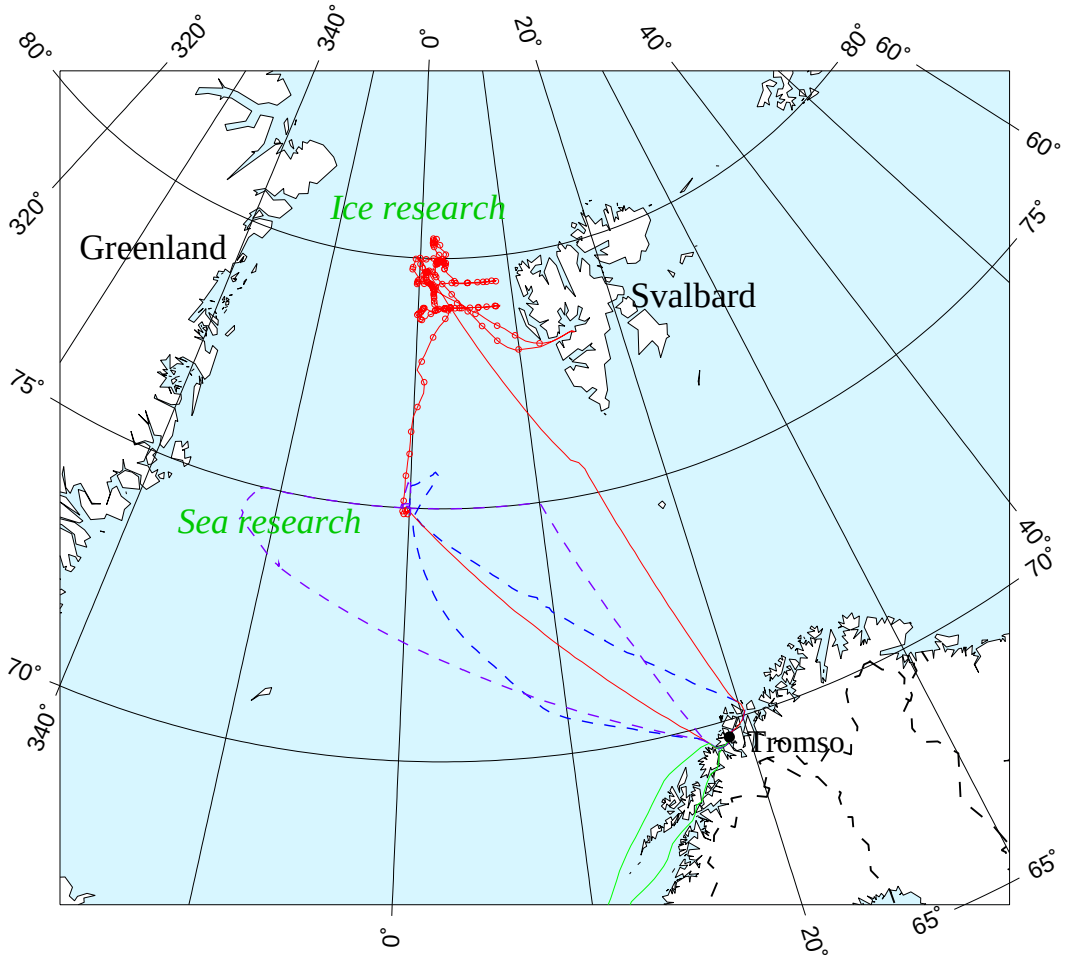

Figure 1. RV Aranda Arctic Expedition 2002. Contiuous red line gives FRAMZY2002 expedition and broken lines show the oceanographic legs in the Greenland Sea.

FIELD CHARACTERISTICS AND OUTCOME

Meteorological and sea ice conditions

The meteorological conditions during FRAMZY were variable and scientifically interesting, accordingly. Figure 2 shows the air and sea surface temperature time development. The low temperatures, especially prevailed during a cold air outbreak of 4 to 5 March (minimum of -32.7 ^{0}C), may even be regarded as rather uncommon in the

region in that time of year. The lowest sea surface conditions indicate the ship has been in sites of ice covered waters. The wind speed given in Figure 3 indicates the highly variable meteorological conditions as well.

The low air temperature and moderate to high wind speed caused large heat fluxes in the open ocean regions and from leads and cracks. Sensible heat flux bulk estimates occasionally even exceeded 400 Wm^{-2} and latent heat fluxes 150 Wm^{-2} (Figure 4). The latter caused condensation fog in the air over in-ice convection ponds. The highest total heat fluxes from the ocean convection ponds were of the order of 700 to 800 Wm^{-2}.

The general sea ice conditions (sea ice border) in Greenland Sea and in the Fram Strait during FRAMZY are given in Figure 5. Locally, the sea ice conditions in the Fram Strait were very dynamic and unstationary, the highest observed ice drift velocities being 0.7 m/s (southwards).

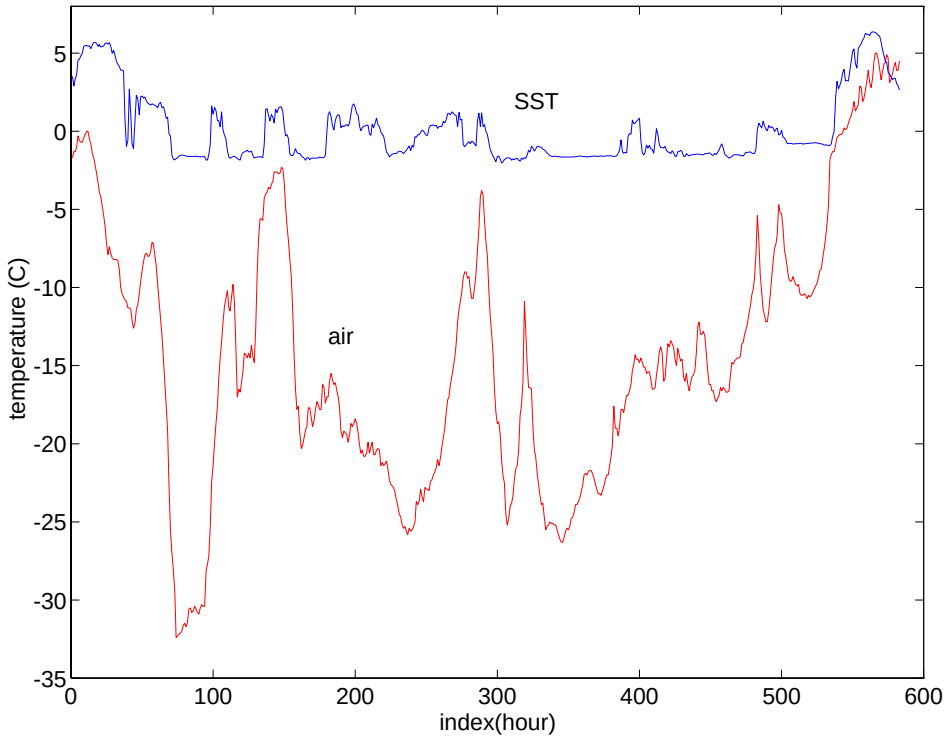

Figure 2. Air temperature (red) and sea surface temperature (SST) during the FRAMZY2002 expedition in 1 to 25 March, 2002. (Hourly values from 01.02.2002 16.00 to 25.03.2002 22.00 UTC.)

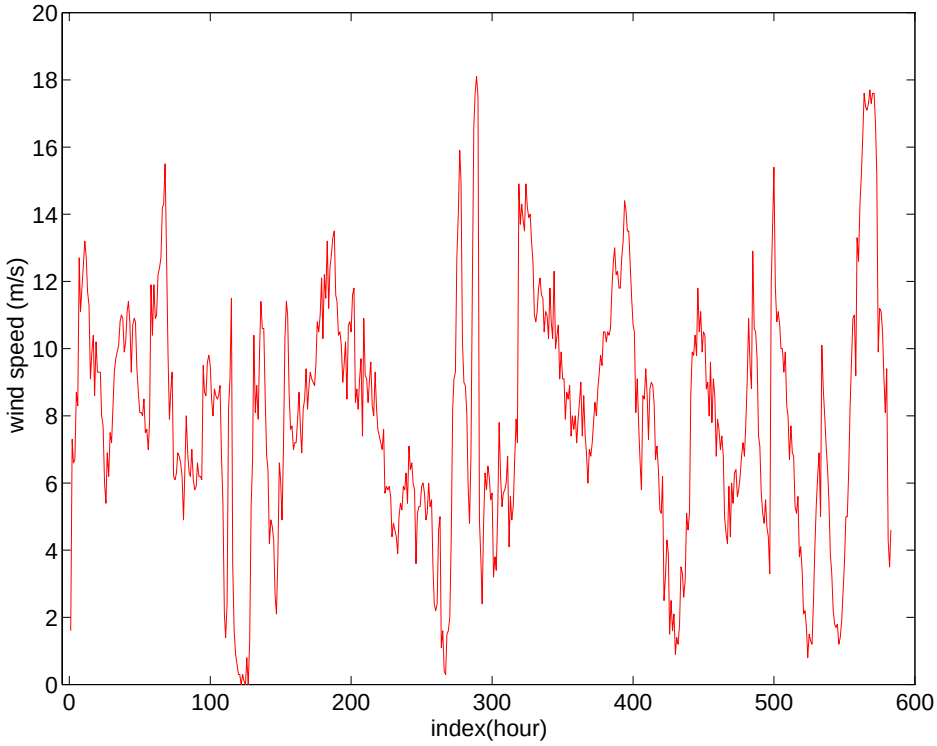

Figure 3. Wind speed during the FRAMZY2002 expedition in 1 to 25 March, 2002.

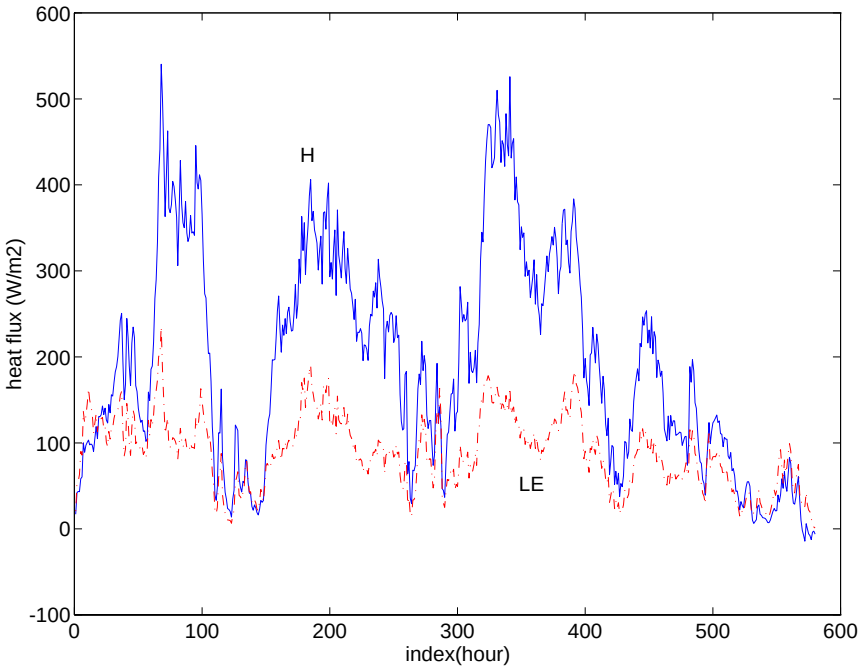

Figure 4. Sensible heat flux, H, (blue solid line) and latent heat flux, LE, (red, broken) from cracks and leads during the FRAMZY2002 expedition. (Estimation by bulk aerodynamic method stratification taken into account.)

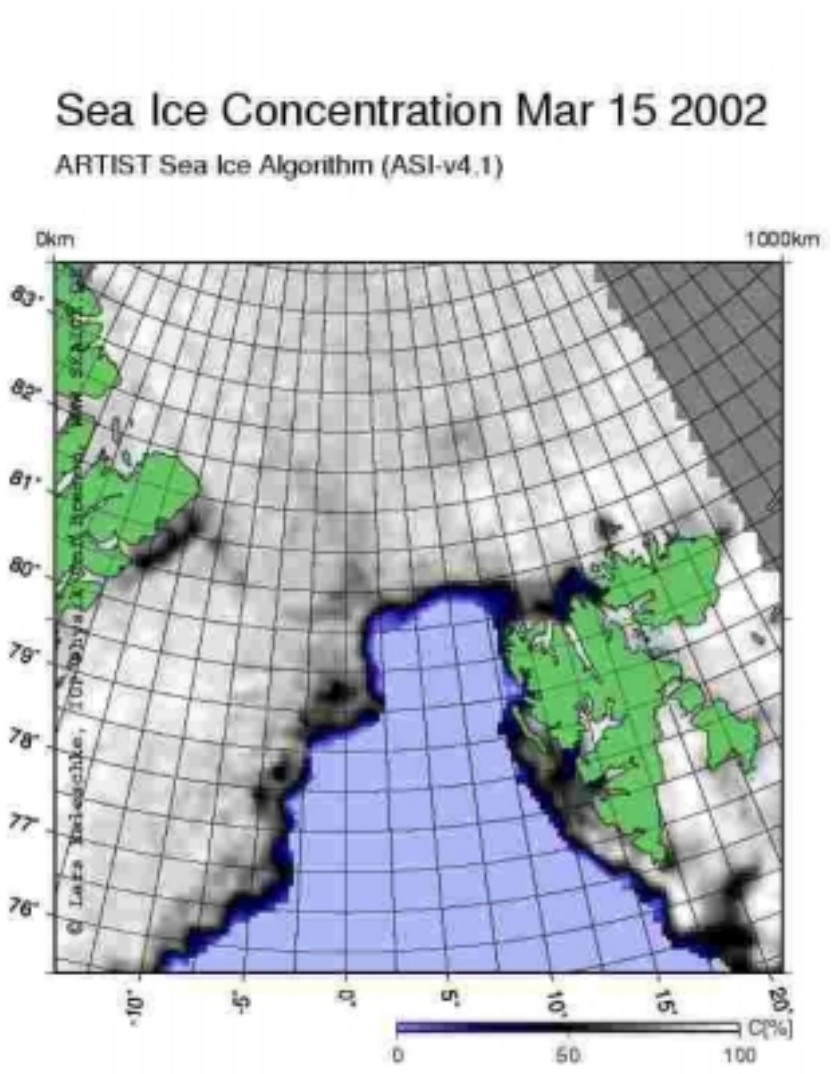

Figure 5. Sea ice border in the Greenland Sea and Fram Strait in March 2002. (Based on NOAA satellite data processed by the University of Bremen).

Meteorological radiosoundings

Meteorological balloons were launched every 3 h day and night during the most intensive period (03 - 23.03.2002). The total amount of radiosoundings was 140 pieces. In a possibility the sea ice conditions favoured and of no fear of polar bears, balloons were launched from above the sea ice.

Sea ice drift buoys

From an aircraft (operated by the University of Hamburg) and Aranda, 14 Argos ice drifters were deployed on sea ice floes in the Fram Strait, in late February – early March, 2002. Figure 6 gives the trajectories (ice drift) of the buoys up to early May, 2002, when still 3 buoys were active.

In addition to the location data, the buoys had pressure and air temperature sensors and two buoys had a mast and full set of marine meteorological sensors (most of which were destroyed rather soon, unfortunately).

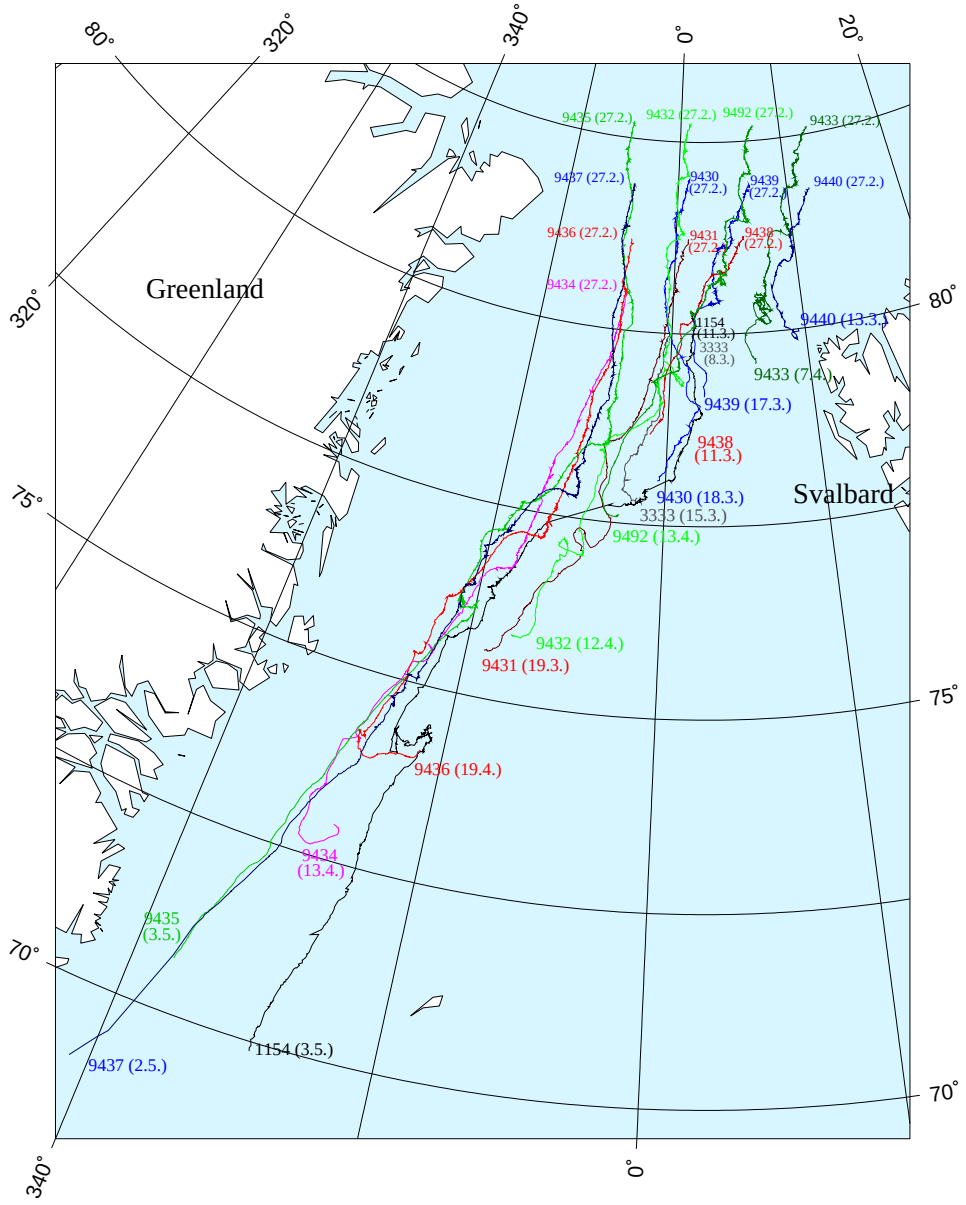

Figure 6. Trajectories of the satellite buoys deployed in ice floes during FRAMZY2002.

CTD and water samples

A set of CTD casts were made and two east – west CTD sections from the Svalbard coast westwards were taken; one at 79 ^{0} N and one at 79^{0} 30’ N. Sea ice conditions hindered the CTD work and made it rather demanding. The total amount of full surface bottom CTD profiles was 29 and a table of casts is given in Table 1. The deepest CTD was of 4 171 m.

During the re-entry to Tromso, Norway, four deep CTD stations were taken in the Greenland Sea round 75^{0} N, 0^{0} E/W. The operation was assistance and cooperation with the Scott Polar Institute, UK , (Dr. Peter Wadhams), to detect the deep water vertical convection pump “Chimney” in the Greenland Sea (FIMCHI-stations in Table 1).

Secchi depths of over 40 m were measured in the Fram Strait, and the largest one of 45 m was measured at 75^0 N, 0^0 E/W.

Others

Because of very unstationary fast drifting sea ice conditions, over-ice meteorological and turbulent eddy-flux stations could be erected for two short occasions only.

Generally, the expedition combined with the successful aircraft missions of the University of Hamburg was very fortuitous.

The good work of the Personnel of the RV Aranda and the scientists is acknowledged.

Plans for continuation of field studies of FRAMZY problematics in 2003 are provisional.

Participants

FIMR:	Jouko Launiainen	chief scientist
	Patrick Eriksson	scientist
	Milla Johansson	scientist
	Pekka Kosloff	scientist
	Marika Marnela	scientist
	Antonios Niros	scientist
	Kalevi Rantanen	lab engineer
	Henry Söderman	field technician
	Antti Kangas	res. assist
UHAM:	Michael Offermann	technician
	Björn Affeld	res. assist

27.5.2002

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Table 1. CTD casts during FRAMZY2002.

Index	Station Name	Latitude (dd.mmmm)	Longitude (ddd.mmmm)	Depth [m]	Date (dd.mm.yyyy)	Time [UTC]
99	FZ001	N79.4746	W000.4730	2739,0	05.03.2002	09:52
100	FZTEST	N78.3835	E006.2730	1991,0	07.03.2002	12:01
101	FZ002	N79.3922	E001.4987	1918,0	07.03.2002	21:50
102	FZ003	N79.5664	E002.1881	2716,0	09.03.2002	08:25
103	FZ004	N79.5464	E002.5533	2629,0	09.03.2002	20:11
104	FZ005	N79.4715	E002.4602	4369,0	12.03.2002	08:39
105	FZ006	N79.3000	E004.0014	3880,0	12.03.2002	15:17
106	FZ007	N79.2999	E005.2014	2538,0	12.03.2002	20:20
107	FZ008	N79.2998	E006.3522	1333,0	13.03.2002	00:14
108	FZ009	N79.3011	E008.2426	322,0	13.03.2002	07:10
109	FZ010	N79.2996	E007.2464	895,0	13.03.2002	09:46
110	FZ011	N79.2978	E001.1577	3083,0	14.03.2002	02:07
111	FZ012	N79.2868	W000.1537	2770,0	14.03.2002	08:24
112	FZ013	N79.3232	W000.2784	2753,0	14.03.2002	13:24

113	FZ79_1	N79.0097	E001.5638	2465,0	17.03.2002	13:27
114	FZ79_2	N79.0012	E002.5044	2469,0	17.03.2002	16:21
115	FZ79_3	N78.5999	E003.4133	3000,0	17.03.2002	18:17
116	FZ79_3	N78.5998	E003.4163	3000,0	17.03.2002	19:21
117	FZ79_4	N78.5999	E004.3377	2474,0	17.03.2002	22:29
118	FZ79_5	N78.5999	E005.2598	2130,0	18.03.2002	01:48
119	FZ79_5	N78.5998	E005.2603	2130,0	18.03.2002	02:32
120	FZ79_6	N78.5998	E006.1840	1552,0	18.03.2002	05:23
121	FZ79_7	N79.0003	E007.1069	1243,0	18.03.2002	08:16
122	FZ79_8	N79.0000	E008.0295	1026,0	18.03.2002	10:57
123	FZ79_8	N79.0000	E008.0295	1026,0	18.03.2002	11:25
124	FZ79_9	N79.0000	E008.3434	289,0	18.03.2002	12:50
125	FZ79_9	N78.0000	E008.3434	289,0	18.03.2002	13:10
126	FZ79_9	N78.0000	E008.3432	289,0	18.03.2002	13:10
127	FZ79_1	N78.5748	E001.4757	2496,0	19.03.2002	10:13
128	FZ79_0	N79.0001	E000.3850	2548,0	19.03.2002	14:40
129	FZ79_0	N79.0001	E000.3840	2548,0	19.03.2002	14:45
130	FZ79_0	N79.0001	E000.3837	2549,0	19.03.2002	14:50
131	FZ79_0	N79.0002	E000.3758	2550,0	19.03.2002	15:20
132	FZTEST	N78.5139	W000.0422	2500,0	20.03.2002	08:43
133	FZ79_3B	N79.0086	E003.2474	2954,0	21.03.2002	09:07
134	FZ79_3B	N79.0098	E003.2134	3000,0	21.03.2002	13:22
135	FIMCHI1	N74.5600	W000.3087	3681,0	22.03.2002	19:14
136	FIMCHI2	N74.5300	W000.2488	3685,0	22.03.2002	22:18
137	FIMCHI3	N74.5300	W000.0699	3706,0	23.03.2002	01:17
138	FIMCHI4	N74.5801	W000.0898	3707,0	23.03.2002	04:07
139	FIMCHI4	N74.5802	W000.0899	3707,0	23.03.2002	04:31
140	FIMCHI4	N74.5802	W000.0899	3707,0	23.03.2002	05:54
141	FIMCHI4	N74.5801	W000.0904	3707,0	23.03.2002	08:43
142	FIMCHI4	N74.5800	W000.0900	3707,0	23.03.2002	09:11