

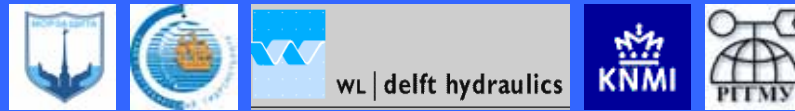
Recent Improvements in Automated Flood Forecasting System for St.Petersburg

Konstantin A. Klevanny, Suleiman-Mohammad W. Mostamandi

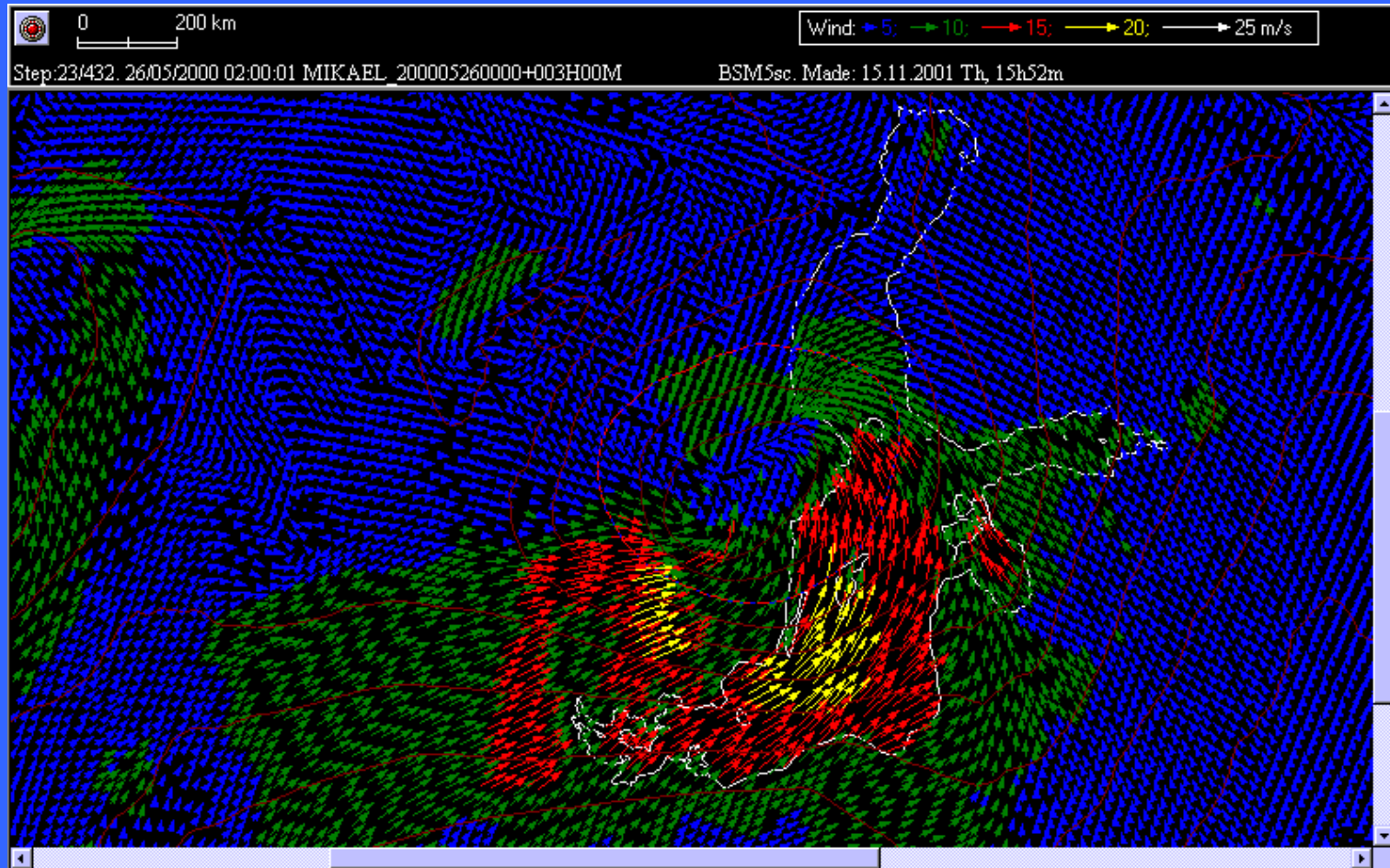
Gijon 18 May 2008



Development of Automated Flood Forecasting System. Since 1998

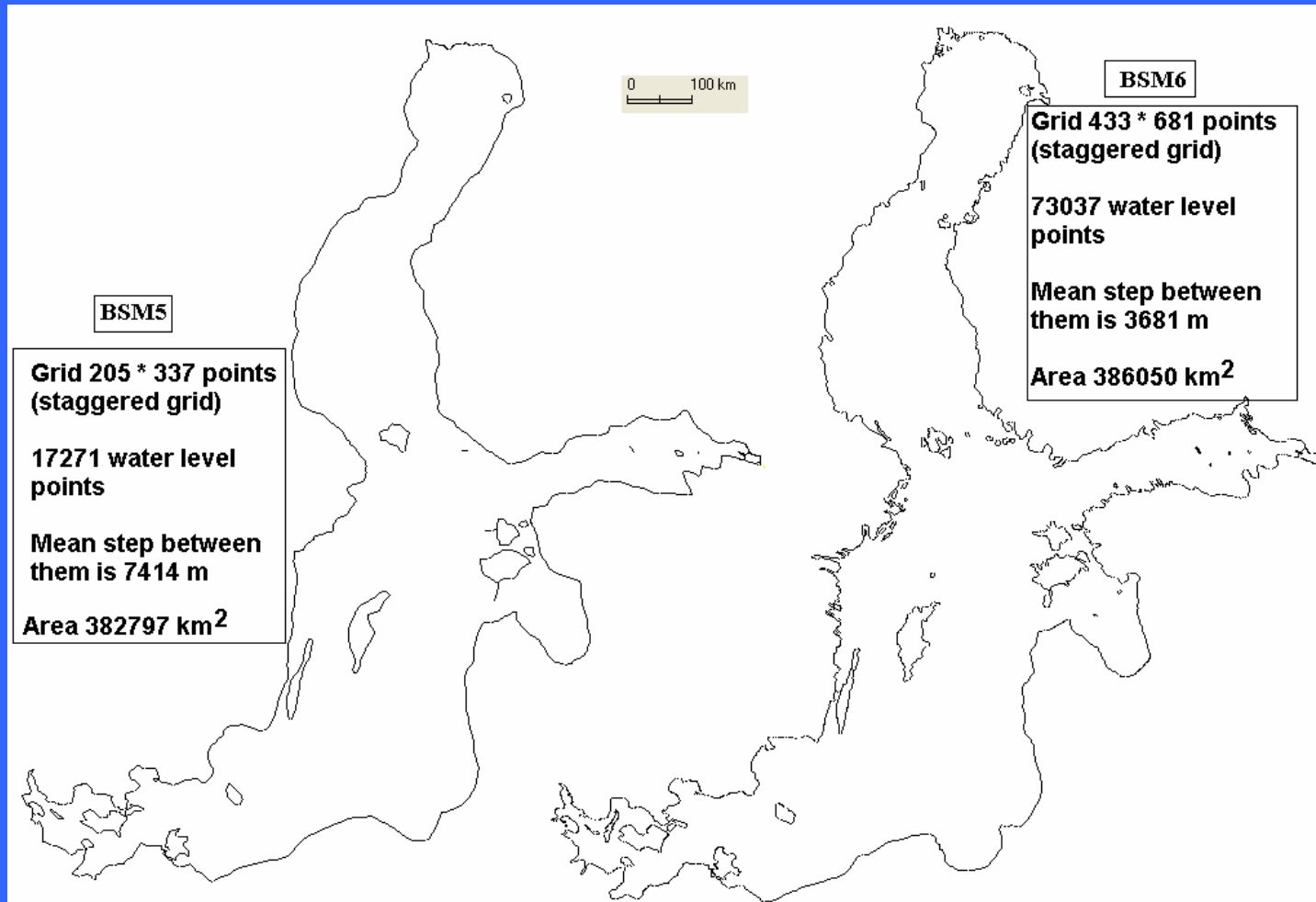


Meteorological forecasts (wind at 10 m and surface pressure) are from HIRLAM (SMHI). Discretization 1 h / 22 km
Advance time 48 h. Till 5.12.2007 – 1 time per day. Till 24.04.2008 – 2 times per day. At present – 4 times per day

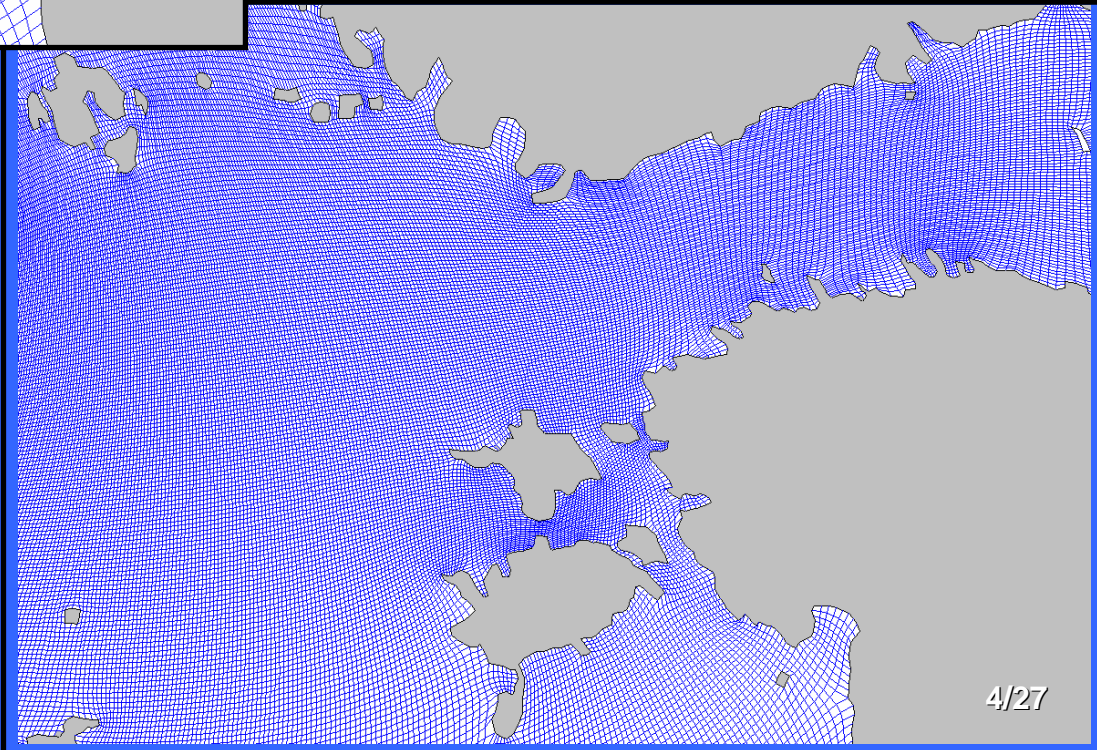
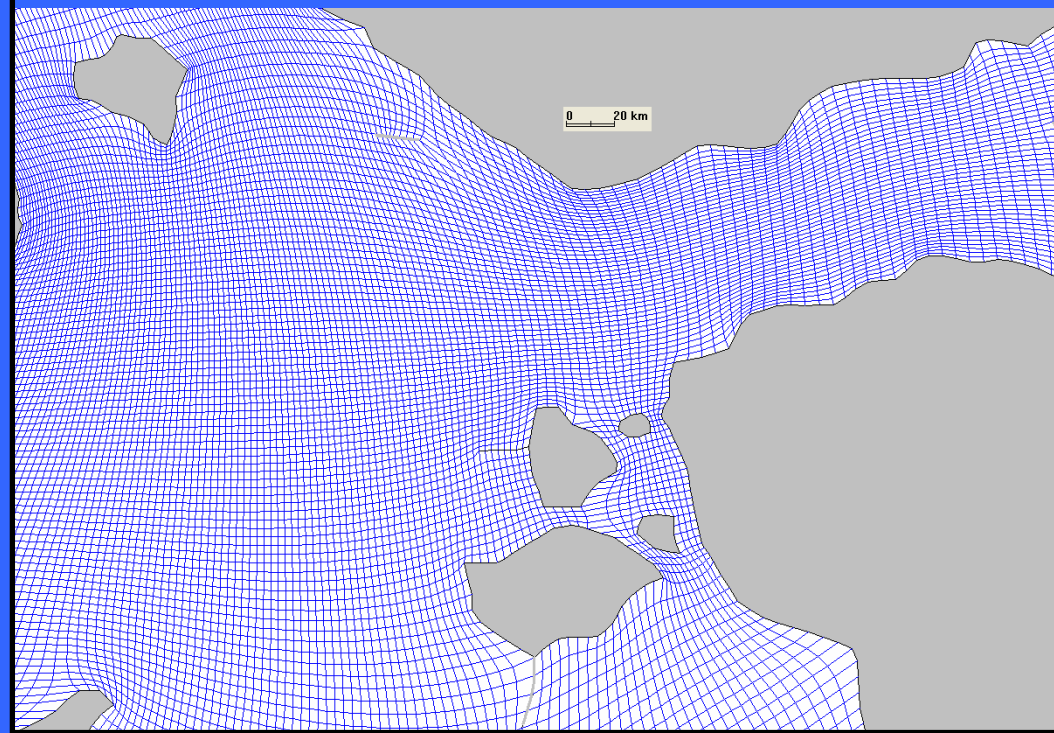


Baltic Sea Models.

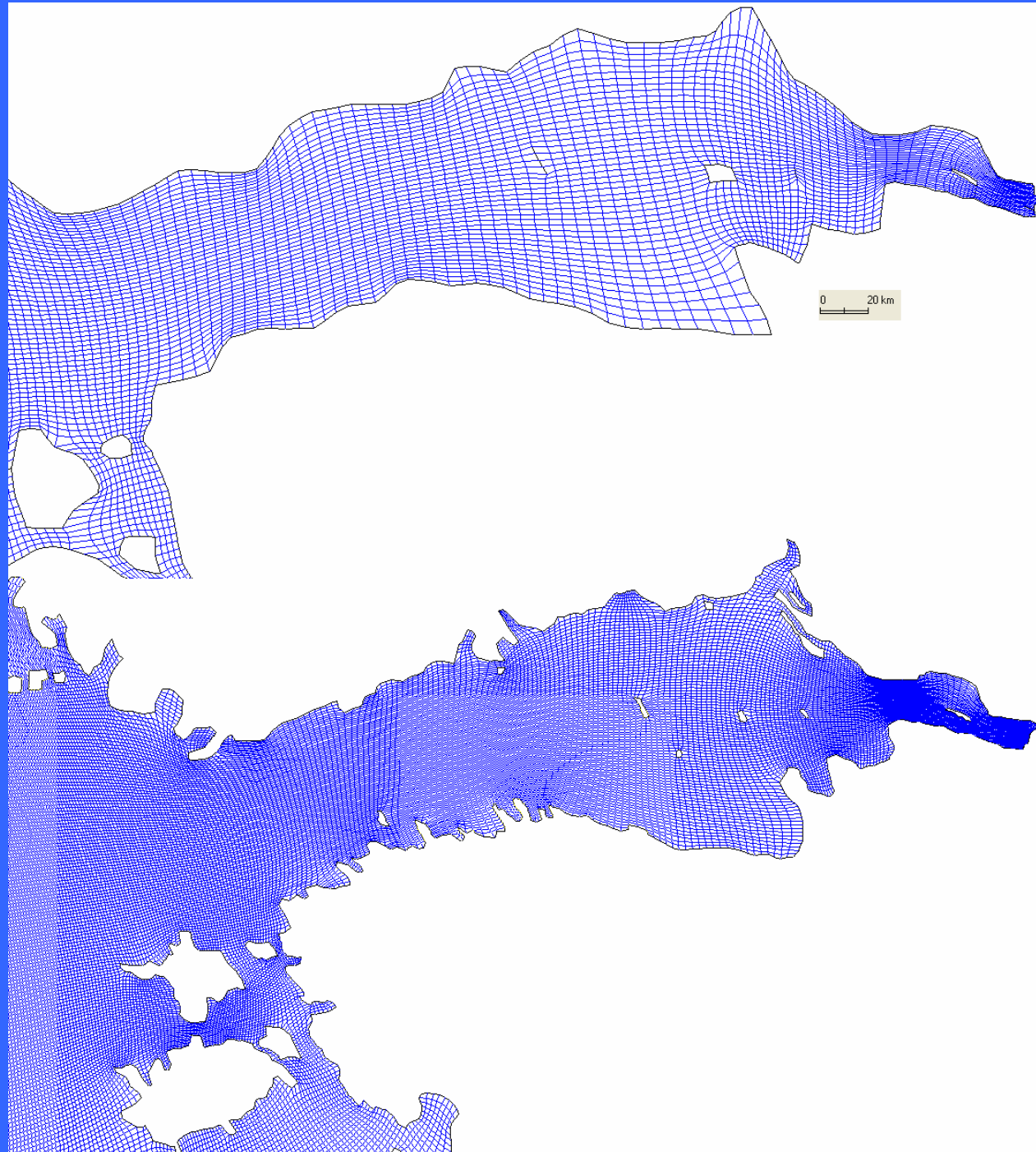
Since 10 Sep. and till 10 Dec. 2007 new twice refined BSM6 run in parallel with BSM5
BSM5 -21 islands, BSM6 – 68 islands



Fragment of grids in BSM5 (top-left) and BSM6 (bottom- right) in the Baltic Proper, Moonzund and Aland Archipelagoes

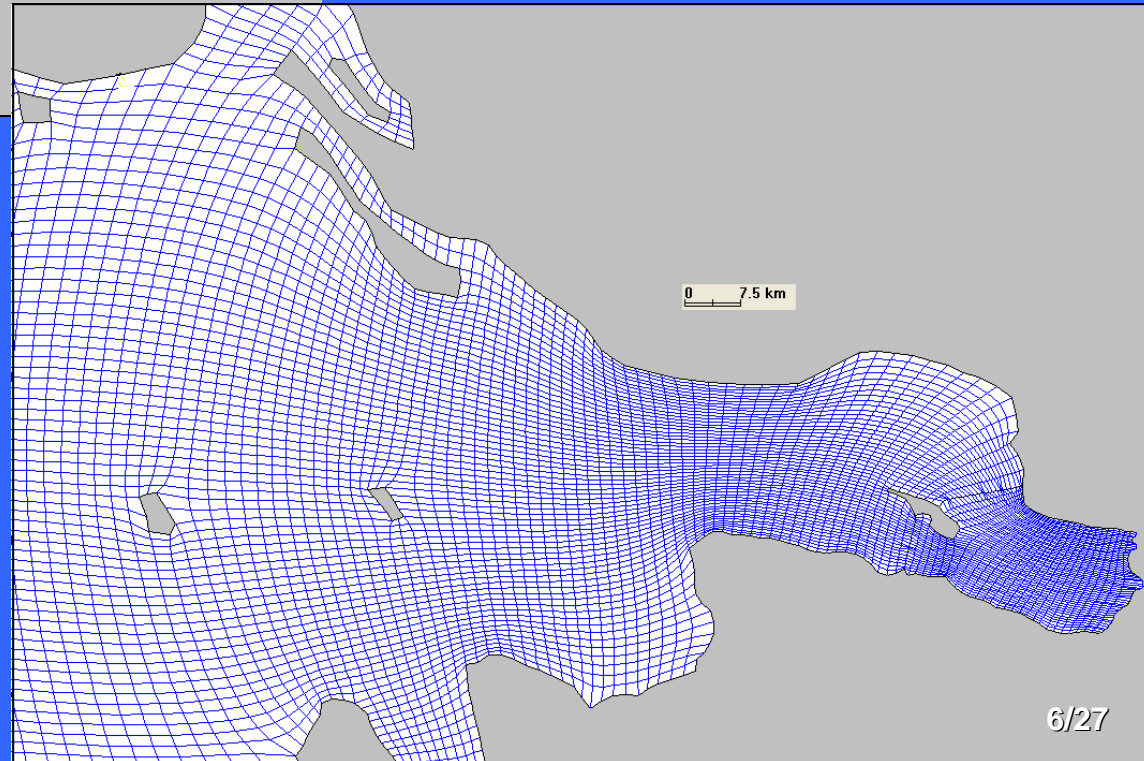
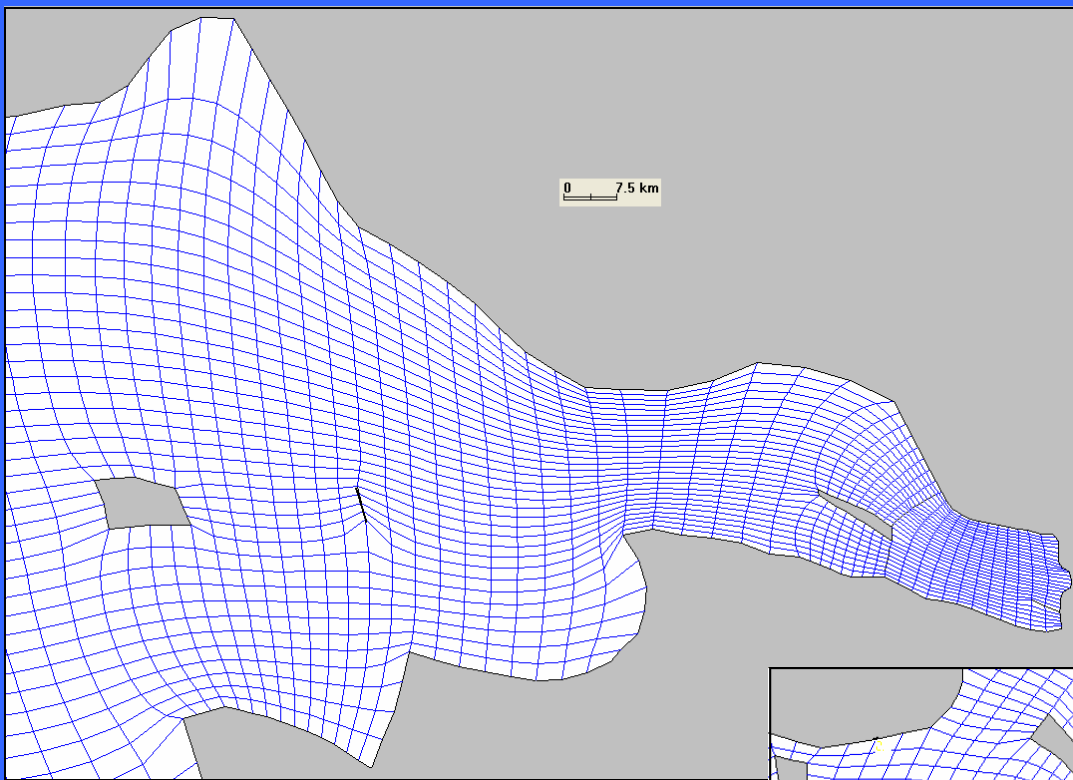


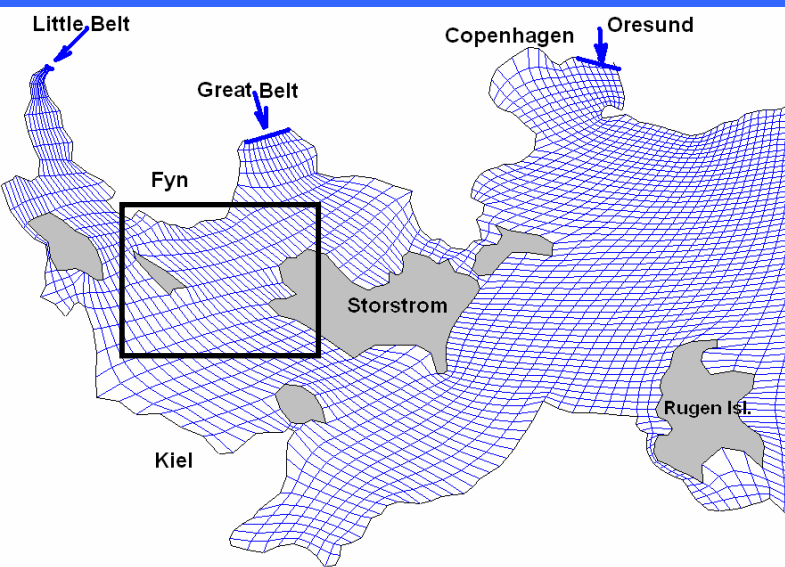
Fragment of grids in BSM5
(top) and BSM6 (bottom) in
the Gulf of Finland



Fragment of grids in BSM5 (top-right) and
BSM6 (bottom-left) in the Eastern Gulf of
Finland

BSM5: Min grid step is 400 m
BSM6: Min grid step is 110 m

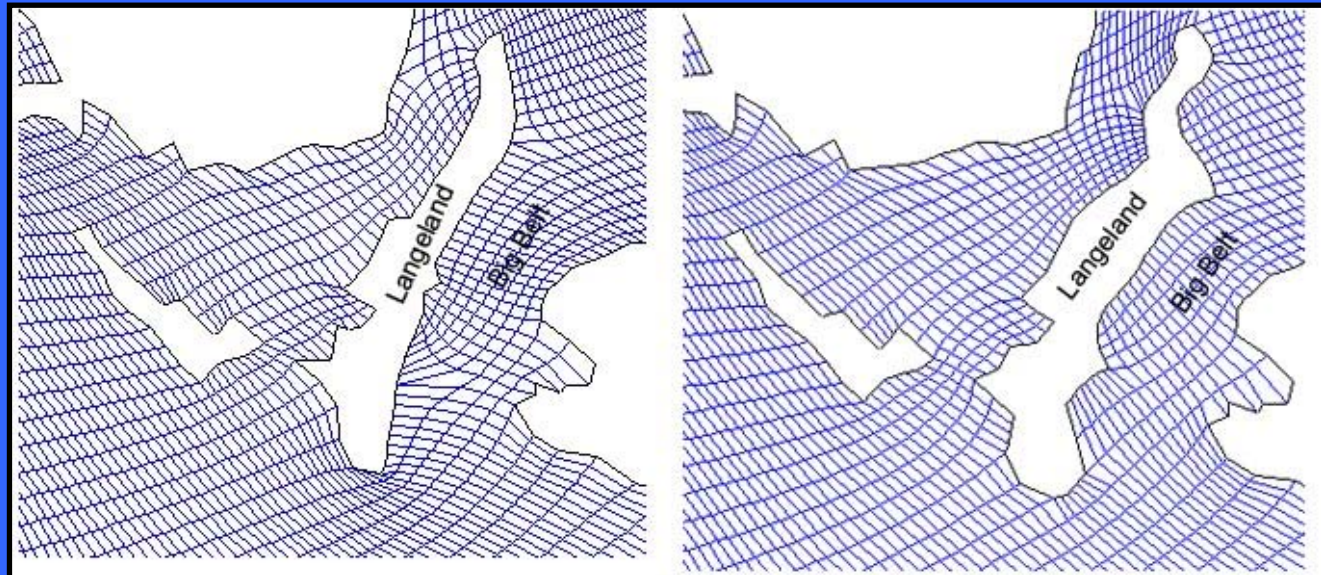




Danish Straits area in the BSM5

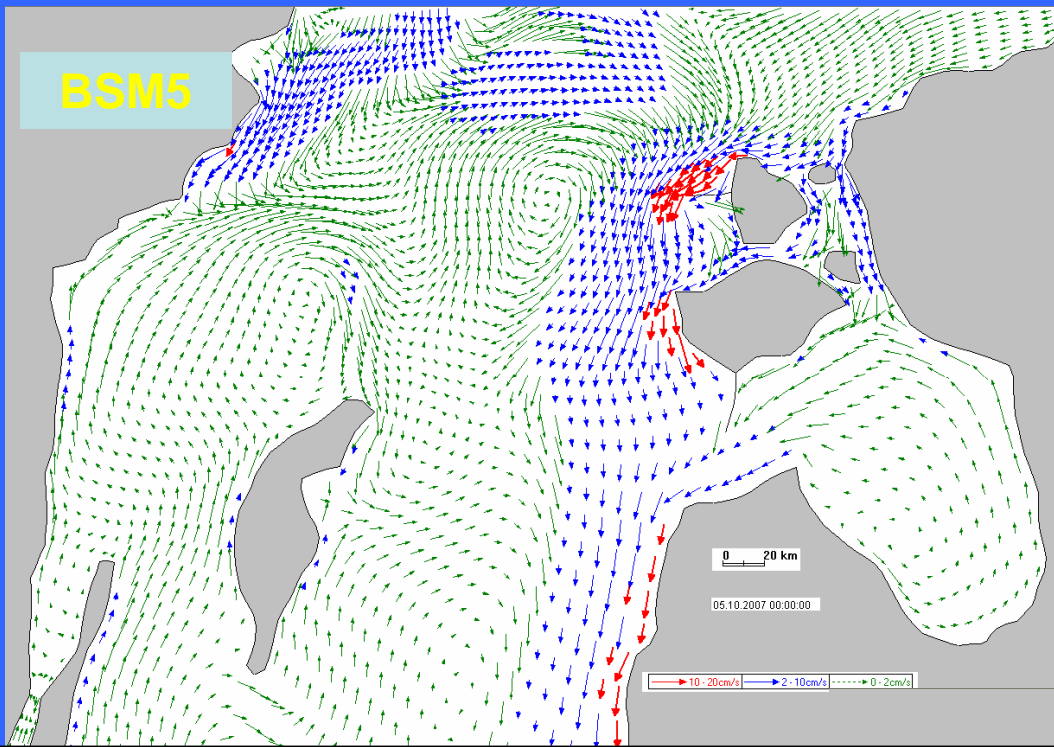
Since 8 May 2008 BSM6 with further improved grid + updated gaps in the Barrier was implemented.

The minimal angle in grid cells was increased from 36o to 40o



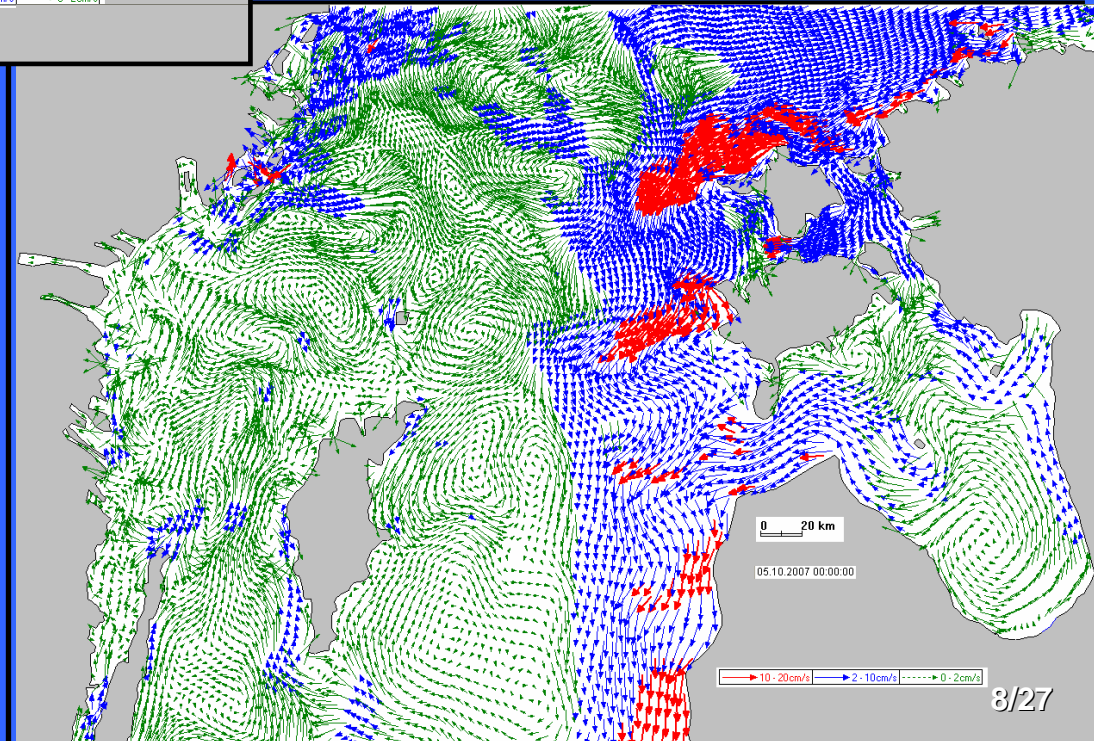
Fragment of improved grid (right) in the Big Belt Strait in the Baltic Sea model BSM6

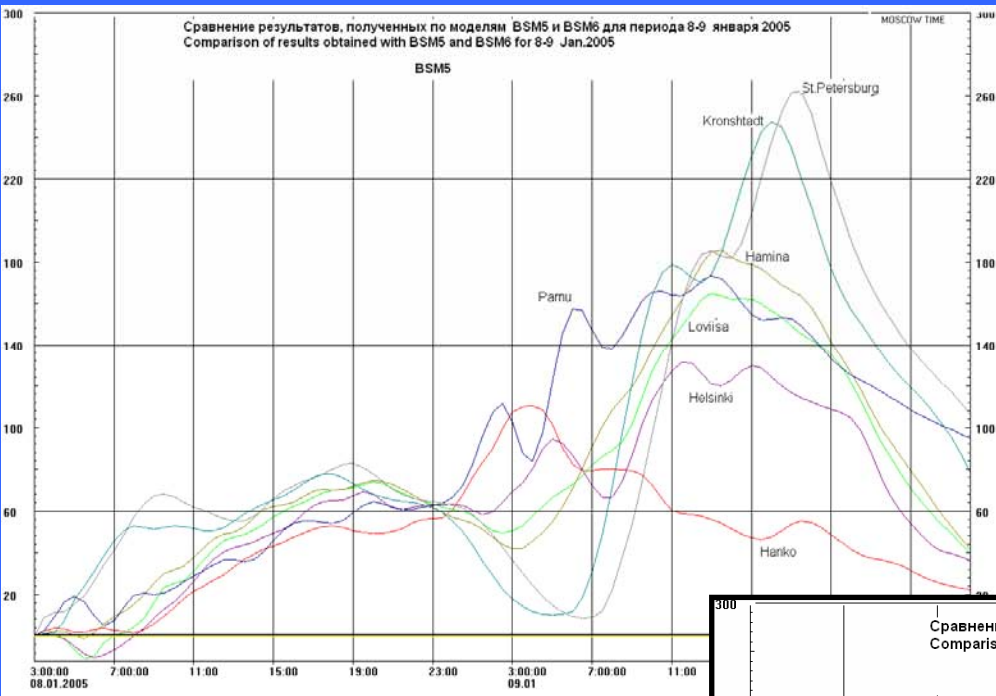
BSM5



Examples of current fields in BSM5 and in BSM6
on 0 h GMT 5 Oct. 2007.

BSM6 field is much more reliable.

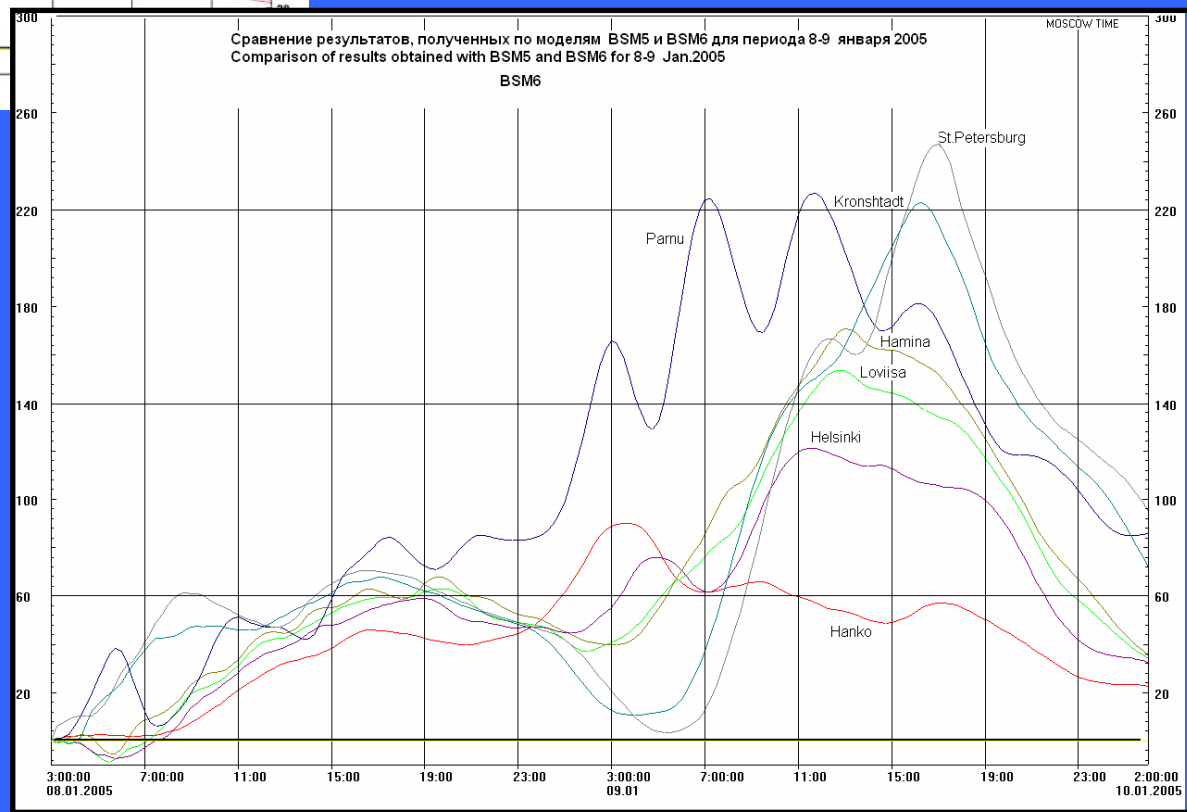




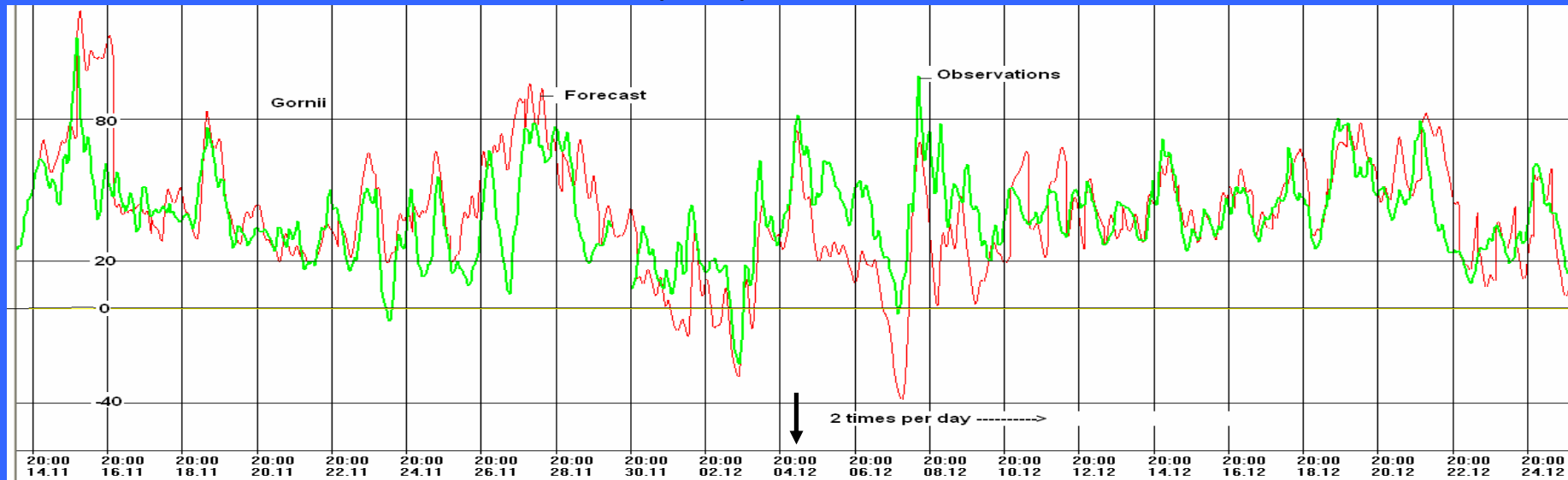
Comparison of results obtained with BSM5 (top) and BSM6 (bottom) for cyclone "Erwin" 8-9 Jan.2005 gave visible differences in water level rises

Gornii -10 cm,
Kronshadt -25 cm,
Lovisa -10 cm,
Hanko -20 cm,
Parnu +55 cm.

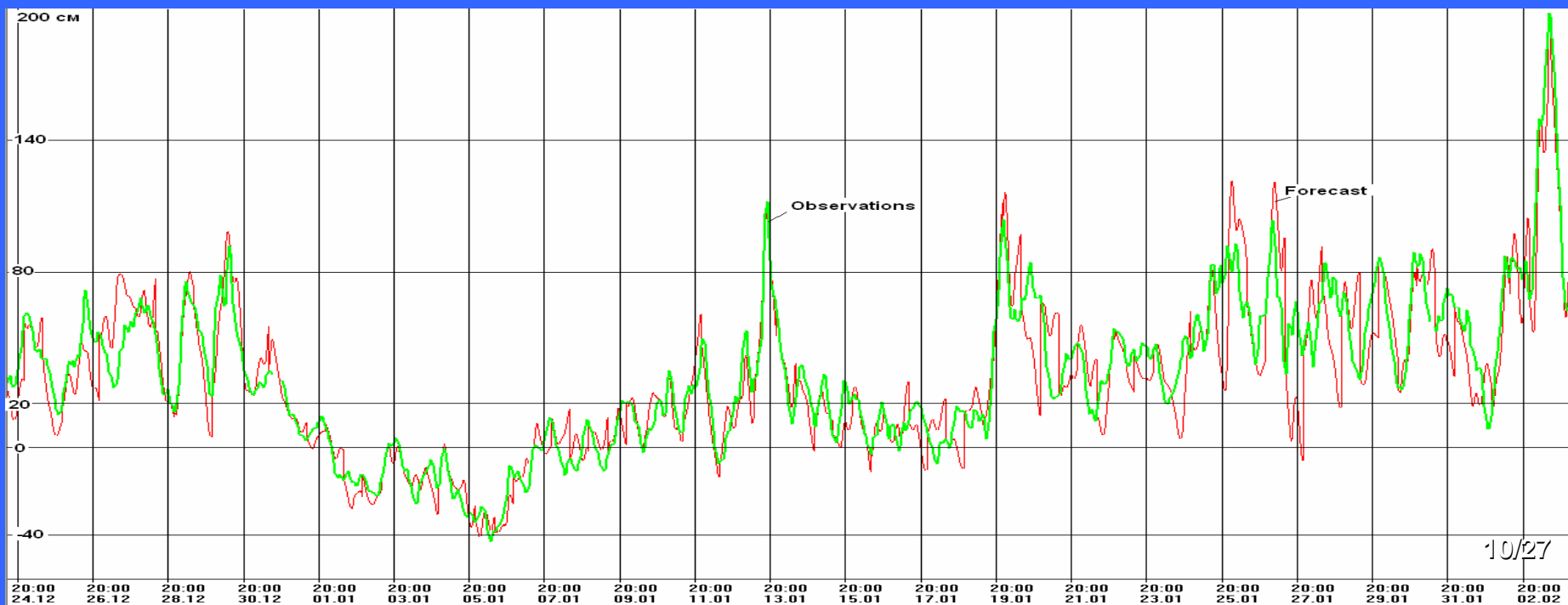
In all points results obtained with BSM6 were closer to the observations (but error in the cyclone path should be taken in mind).
Since 10 Sept. 2007 operationally works BSM6



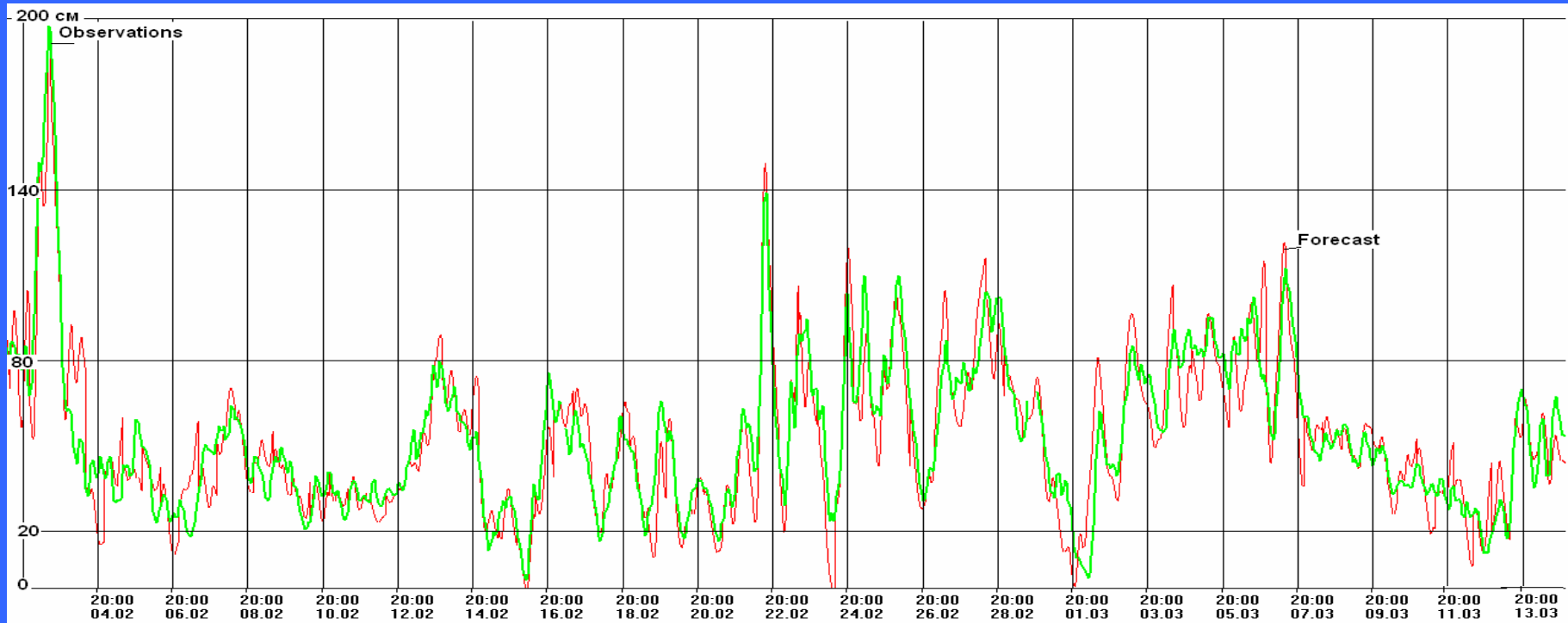
Observed and forecasted (BSM6) water level in Gornii 14.11-24.12.2007.



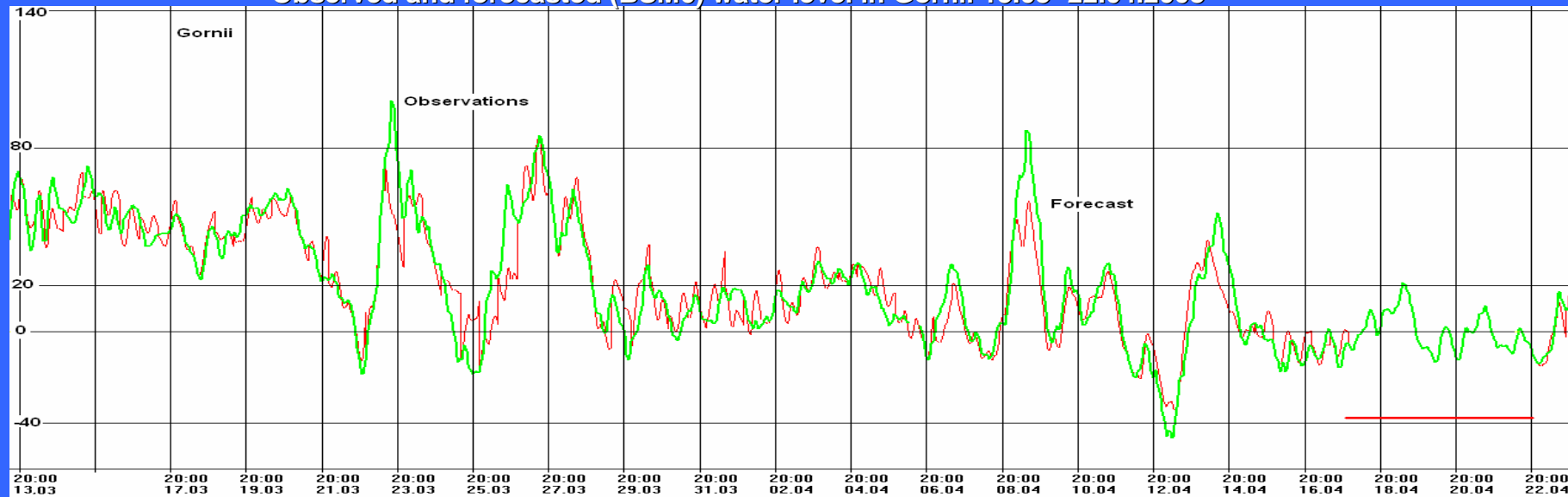
Observed and forecasted (BSM6) water level in Gornii 24.12.2007 – 03.02.2008.



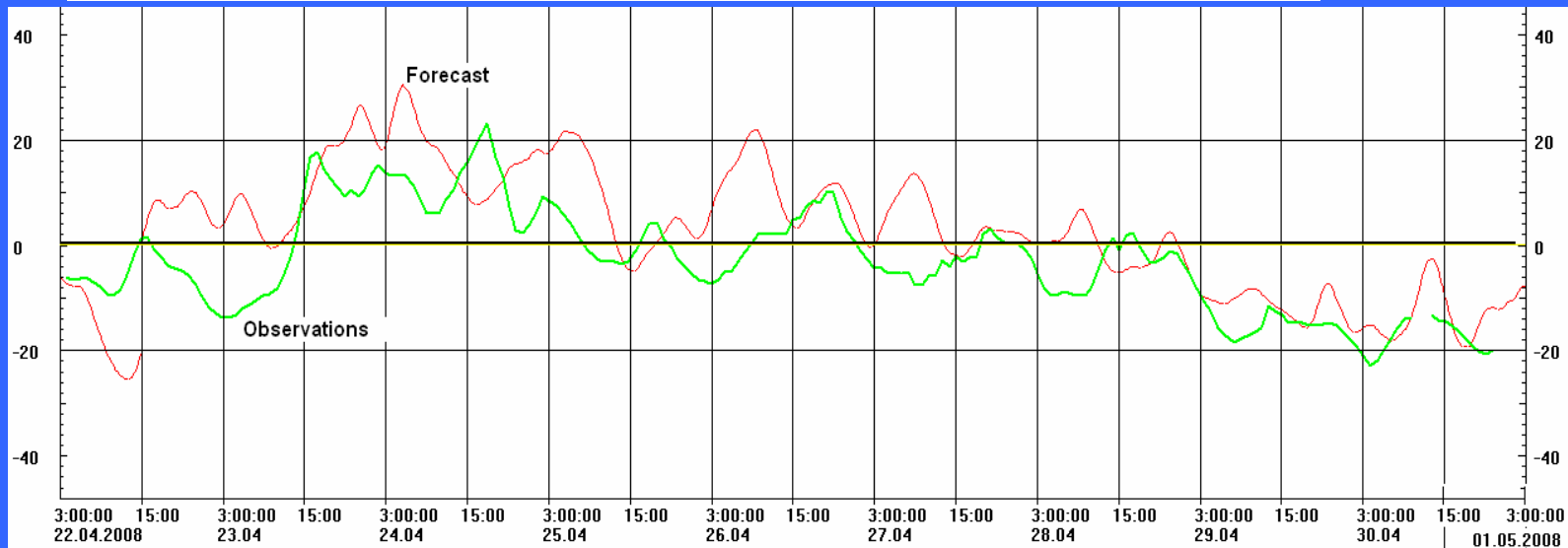
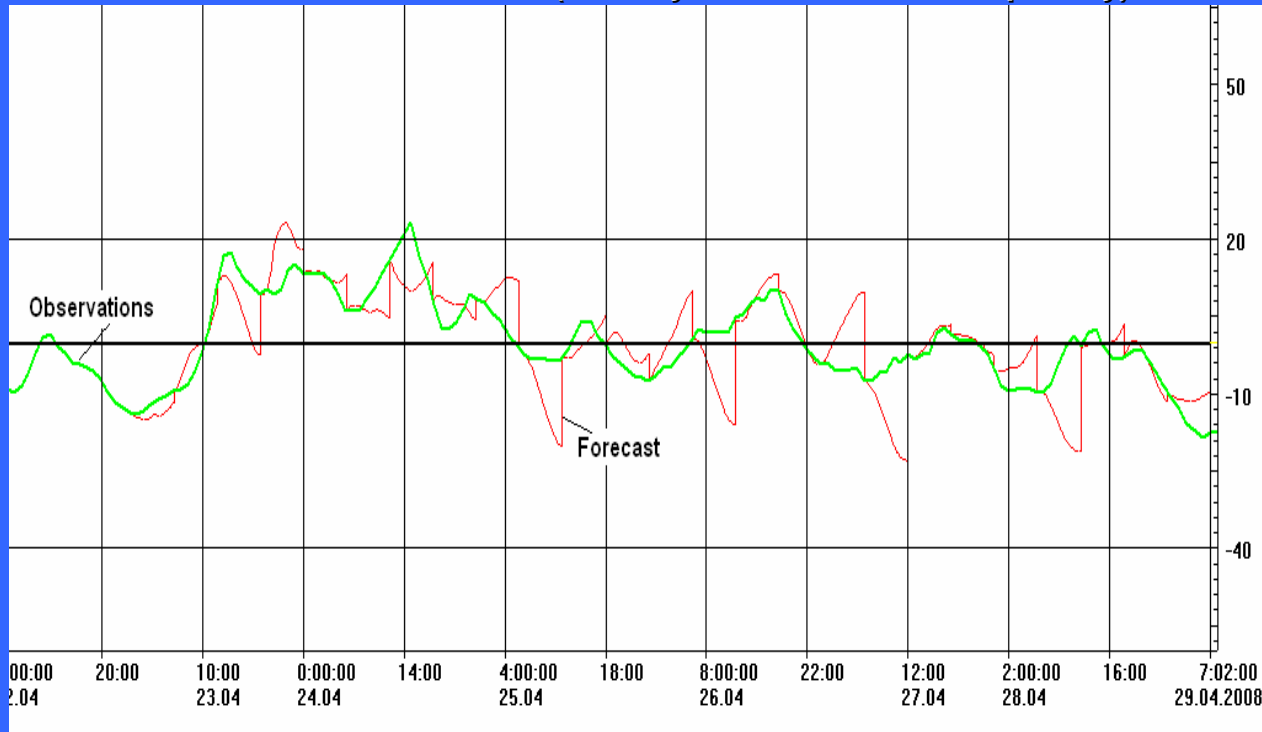
Observed and forecasted (BSM6) water level in Gornii 03.02 -13.03.2008



Observed and forecasted (BSM6) water level in Gornii 13.03- 22.04.2008



Observed and forecasted (BSM6) water level in Gornii 22 - 29.04.2008 with data assimilation (top) and without it (bottom)
(Delivery of forecasts 4 times per day)



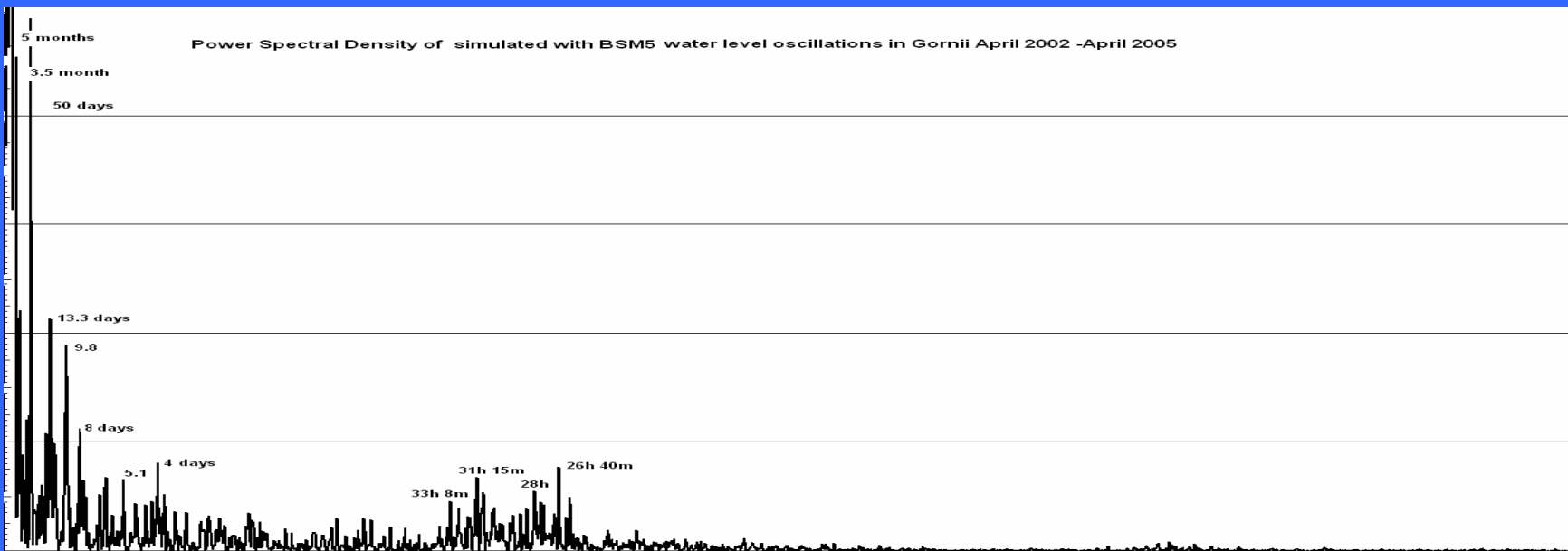
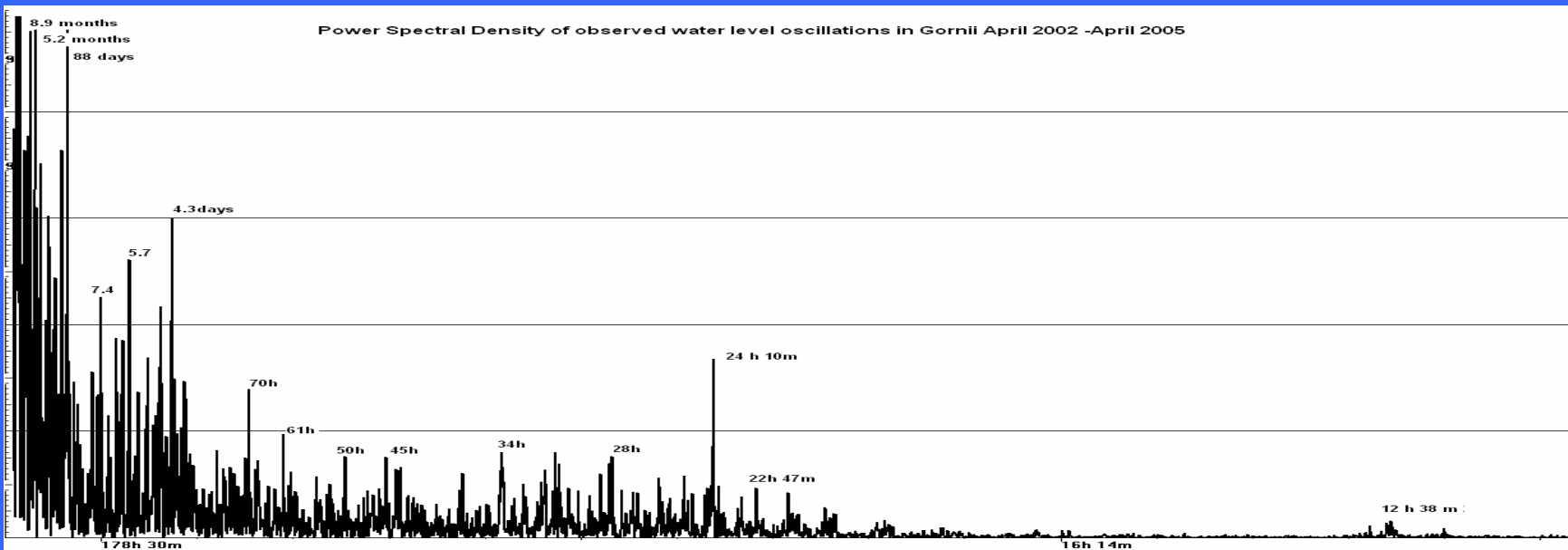
Statistics of water level forecasts in Gornii

Period	Spread (cm)	Bias (cm)	MAE (cm)	RMSE (cm)	Correlation	CF	POF	NOF
01.04.02 – 01.04.05	17	3	13	17	0.85			
01.04.02 – 01.04.07	17	-1	12	17	0.87			
24.11.07 – 29.04.08	14	-1	10	14	0.89	77	2	3
06.12.07 - 29.04.08	11	-2	8	11	0.94	81	1	0
23.04.08 - 29.04.08 *	7	-1	5	7	0.70	93	0	0
23.04.08 - 31.04.2008**	5	5	5	7	0.47	94	0	0

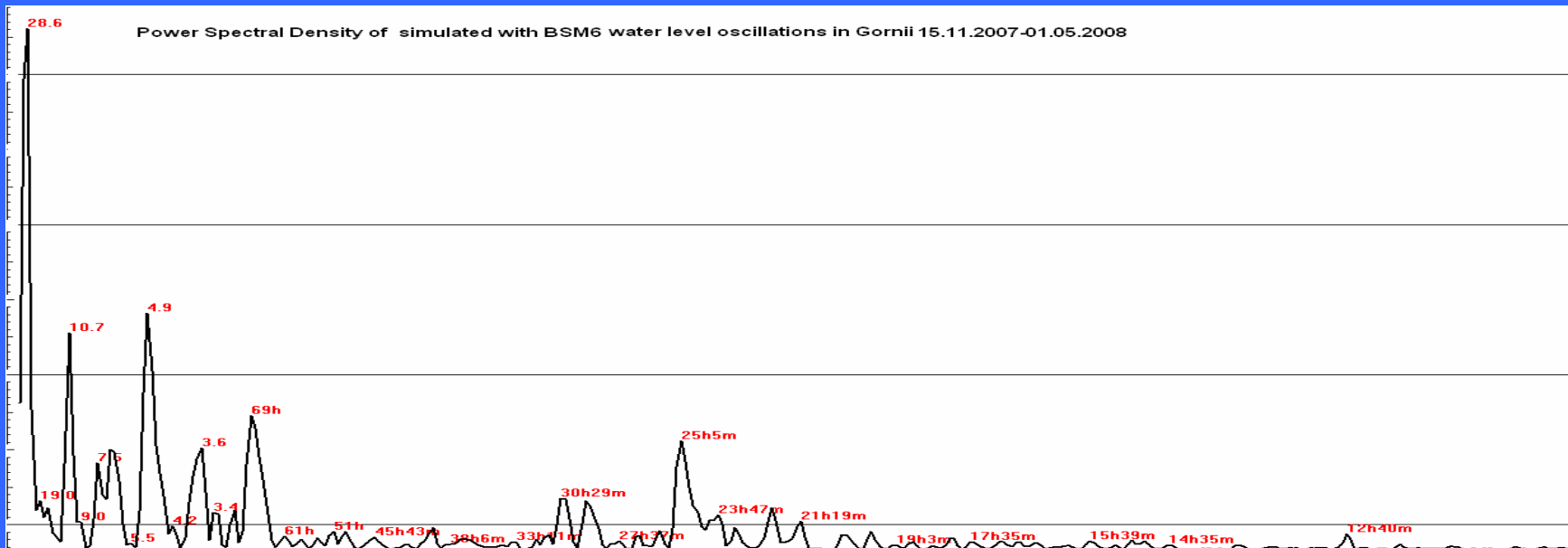
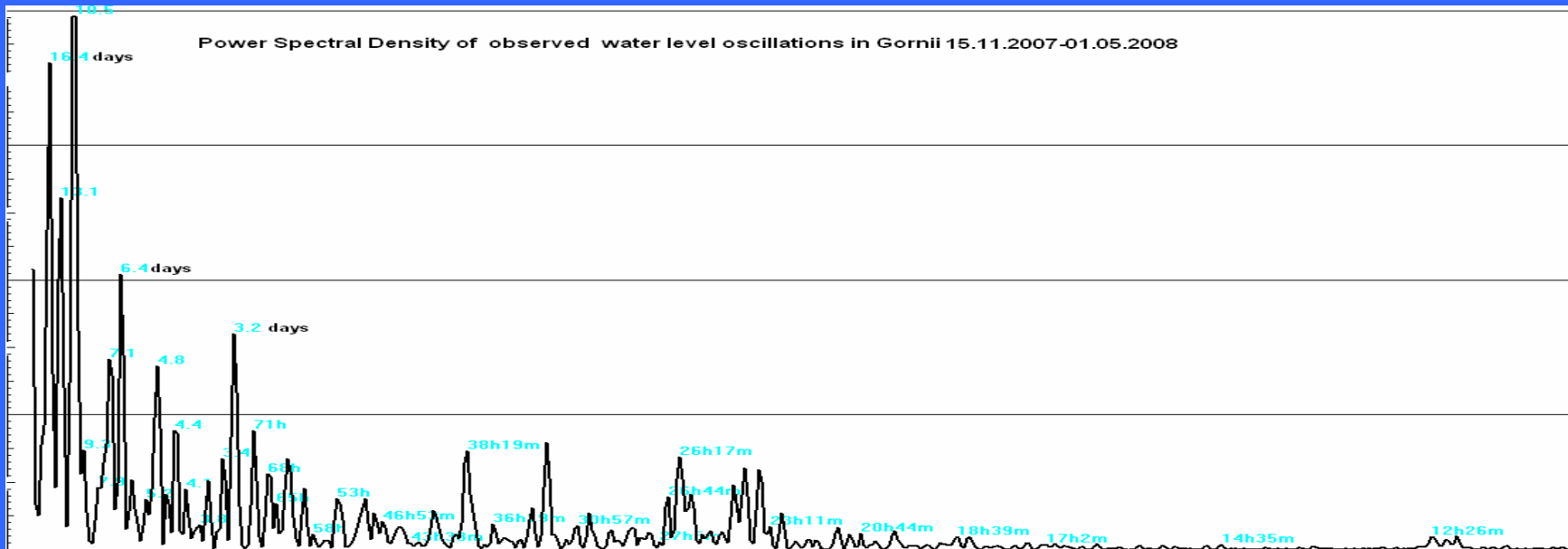
* 4 times per day with assimilation

** 4 times per day without assimilation

(%) CF –Central frequency: $|\Delta z| < 15$ cm, POF: $\Delta z > 30$ cm, NOF: $\Delta z < -30$ cm

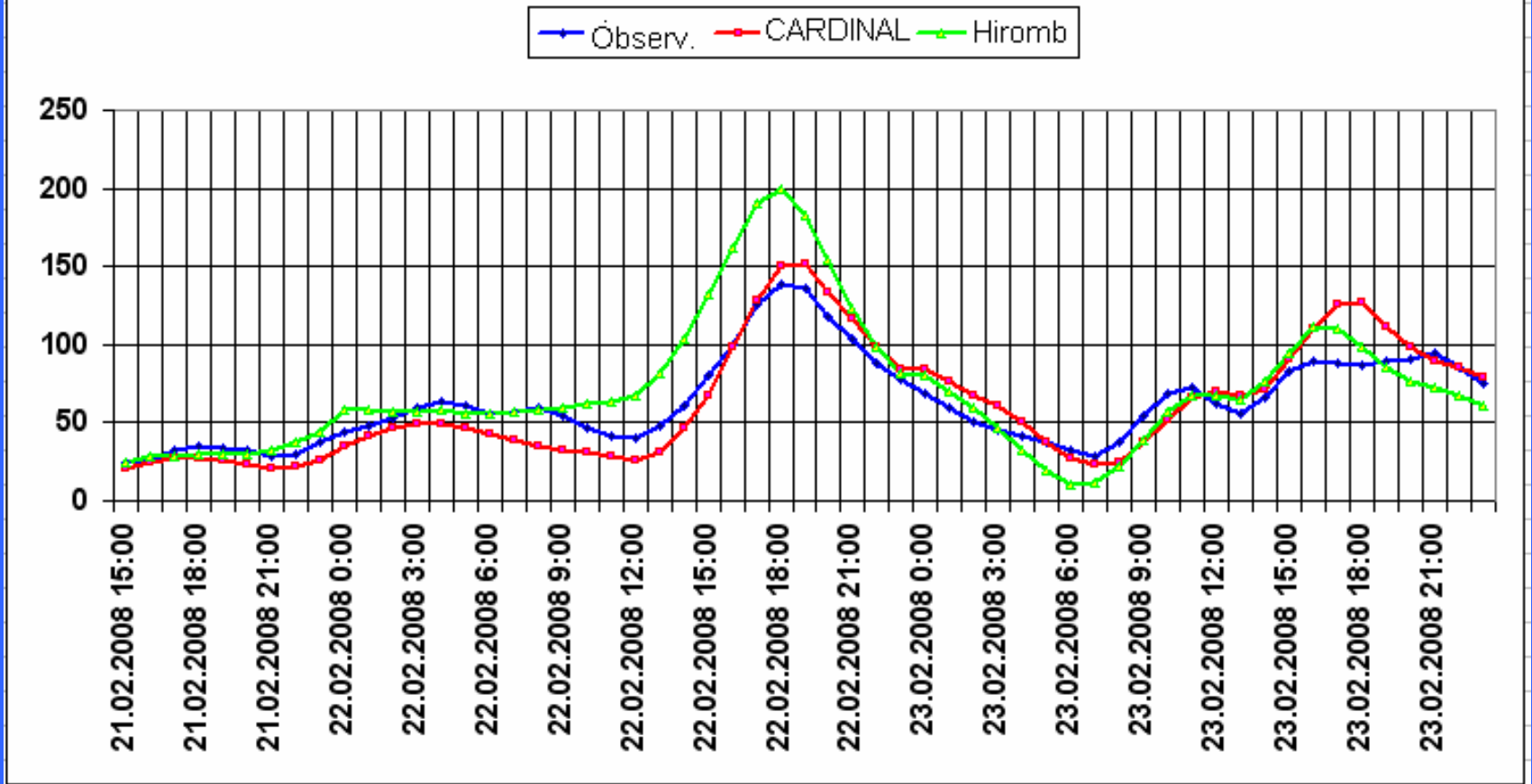


Power Spectral Density of observed (top) and simulated with BSM5 (bottom) water level oscillations in Gornii during April 2002- April 2005 (window function of Blackman-Harris was used)



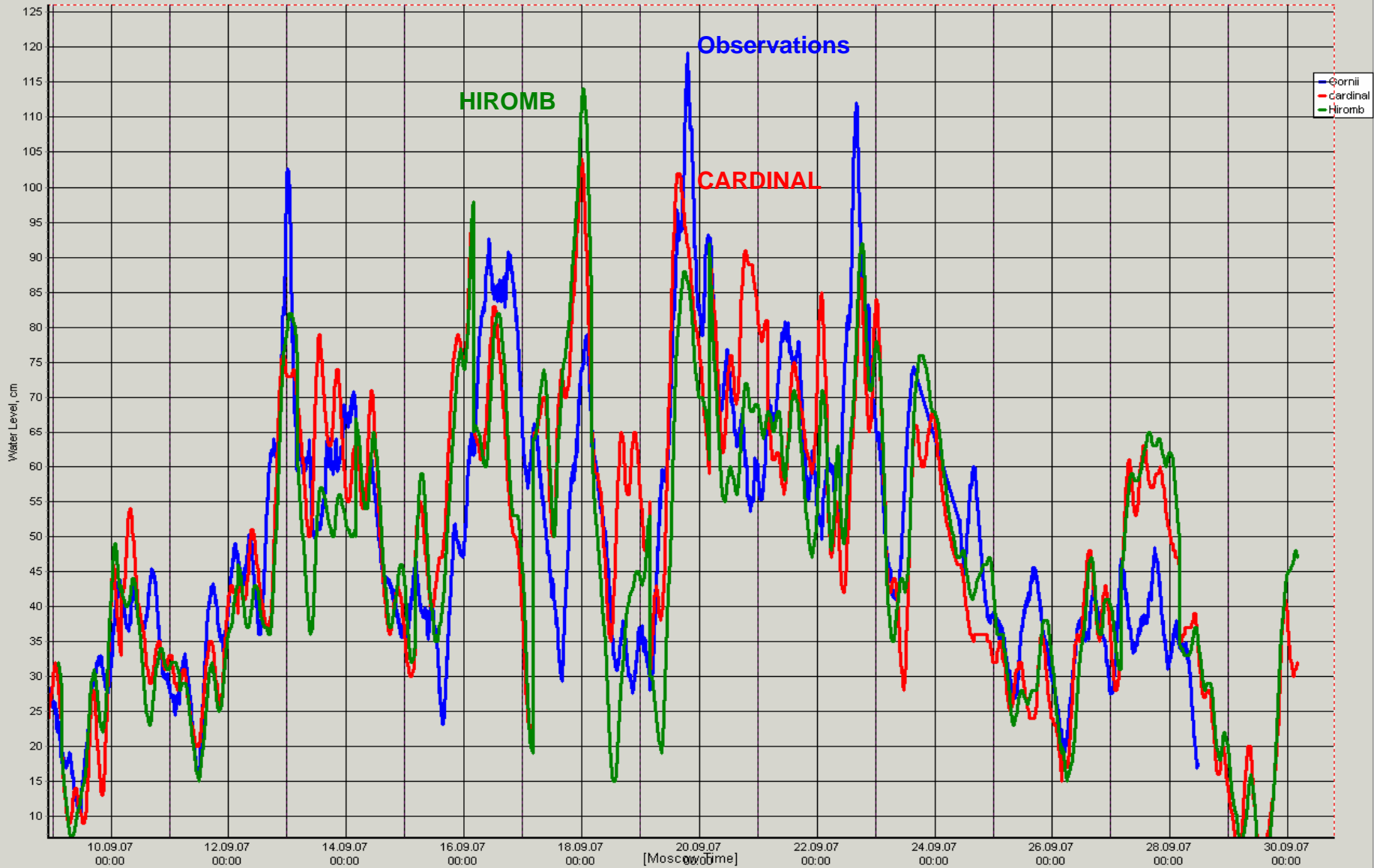
Power Spectral Density of observed (top) and simulated with BSM6 (bottom) water level oscillations in Gornii during 15.11.2007- 01.05.2008

Observed and forecasted water levels in Gornii 21-23 February



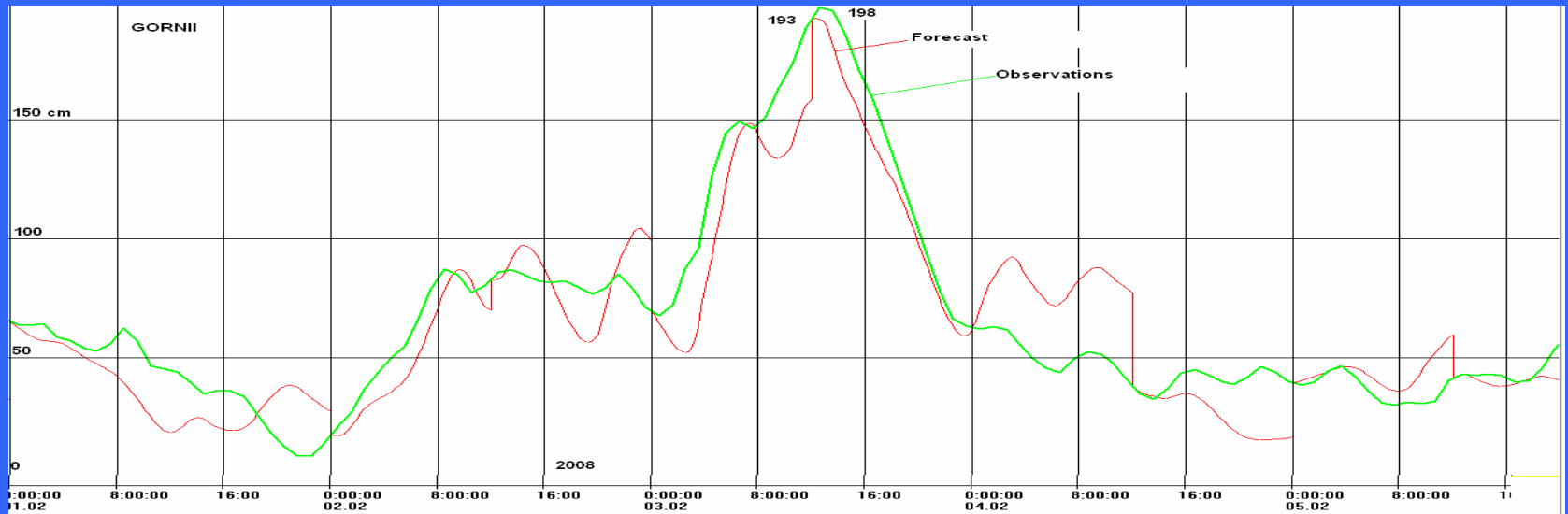
Results of HIROMB model are also available operationally

Ход уровня воды в р. Неве с 08.09.07 07:44 по 28.09.07 11:26



Results of HIROMB model are also available operationally 10-29 Sept. 2007

3 February 2008 flood # 306 with peak height 198 cm was registered in St.Petersburg. Floods in February were also in 1835, 1882, 1928, 1990 (two) and in 2002. The highest of them was in 1990 (199 cm), this one is almost of the same height.



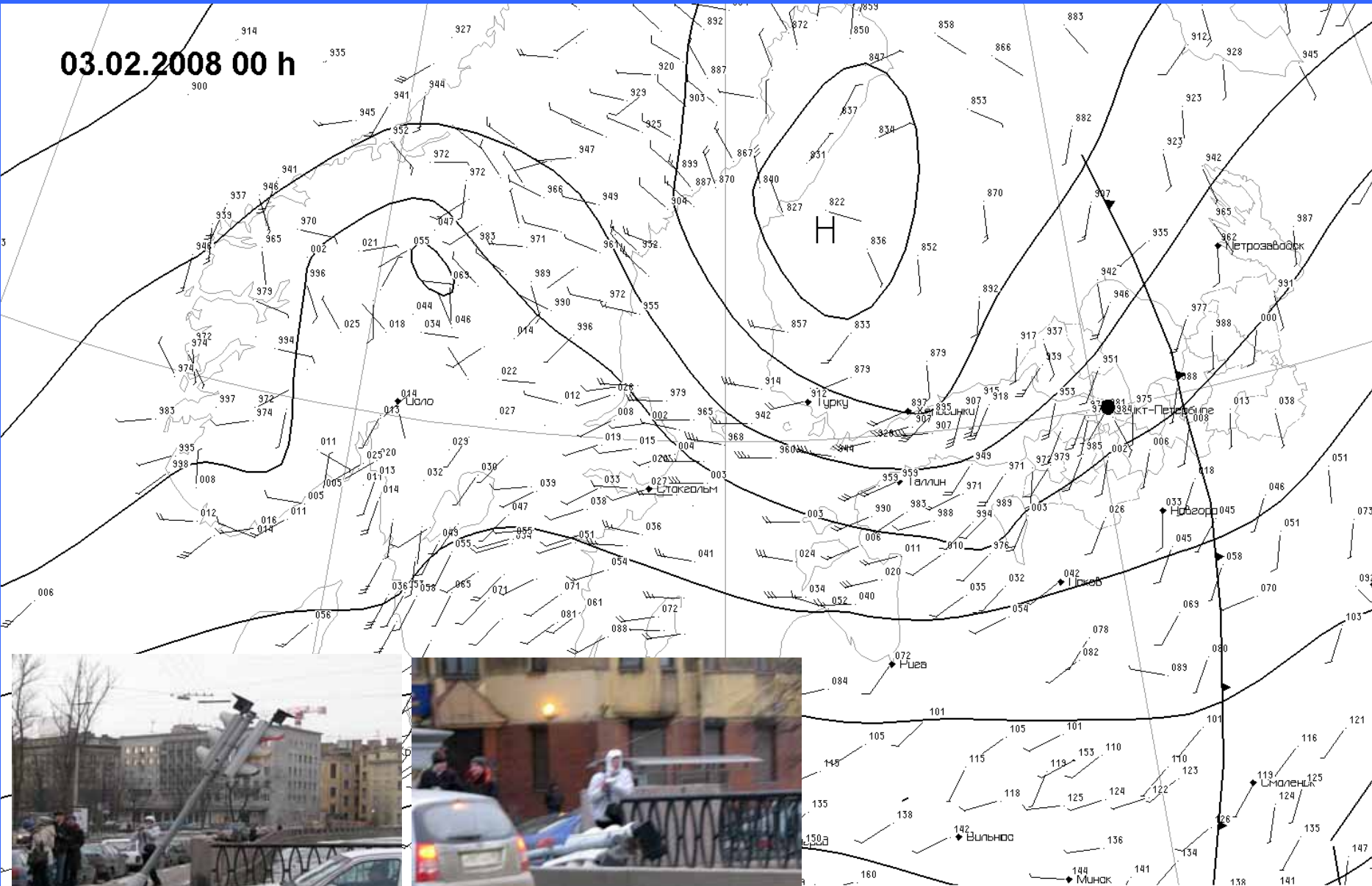
Comparison between observed (green line) and forecasted with BSM6 model (red) time series of sea level at Gornii Institute station during 01-05.02.2008.



Karpovka
3 Feb. 2008
Photo
K.Klevanny

Flood of 3 February 2008 was followed by very strong wind

03.02.2008 00 h



Fall of traffic lights. 13 h 53 m



13 h 54 m

Photo
K.Klevanny



Strong winds 3 February 2008 caused drift of ice joined with sand bottom layer onto the shore of the northern coast of the Eastern Gulf of Finland.

Between Solnechnoe and Kurort 2 March 2008

Photo K.Klevanny

Навал льда на берег между п. Солнечный и п. Курорт сместил прибрежный песок. 2 марта 2008



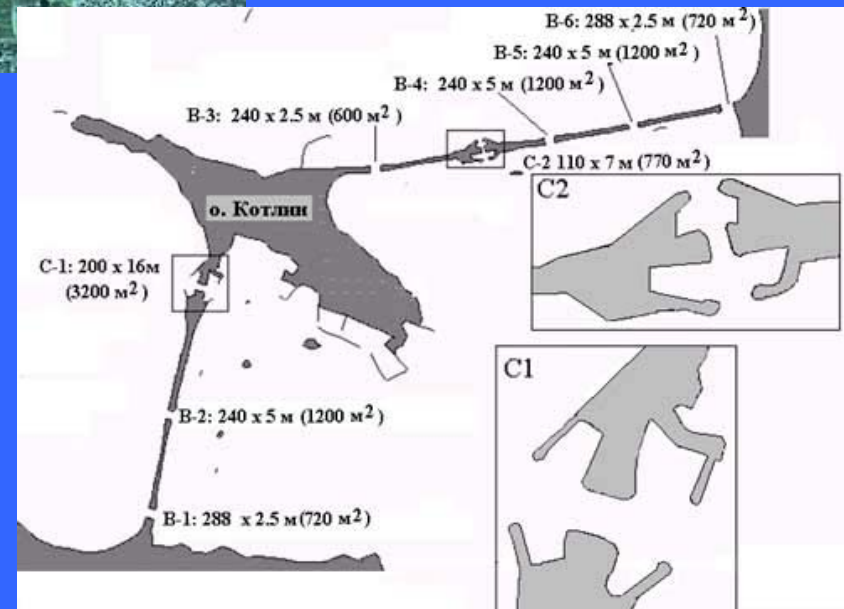
Навал льда на берег между п. Солнечный и п. Курорт. 2 марта 2008

Results of flood forecasts

№ since 1703	№ since 23.12.1999	Date	Observed height (cm)	Forecast (cm)	Peak error (cm)	Time error (hour) (forecast-observ.)
291	1	15 November 2001	215	233	+18	+2.5
292	2	26 January 2002	171	165	-6	+3.5
293	3	5 February 2002	182	104	-78	+2.5
294	4	10 March 2002	183	149	-34	0
295	5	30 December 2003	197	122	-75	-4
296	6	8 January 2005	165	179	+14	-0.5
297	7	9 January 2005	239	295	+56	0
298	8	15 November 2005	169	164	-5	+1.5
299	9	15 November 2005	183	157	-26	+1.5
300	10	28 October 2006	224	245	+21	-2.5
301	11	15 December 2006	191	240	+49	+1 h 40 min
302	12	10 January 2007	223	296	+73	+20 min
303	13	16 January 2007	179	206	+27	+3 h 10 min
304	14	16 January 2007	168	175	+7	+ 1 h 30 min
305	15	18 January 2007	171	202	+31	-0 h 40 min
306	16	3 Feb.2008	198	193	-5	+15 min

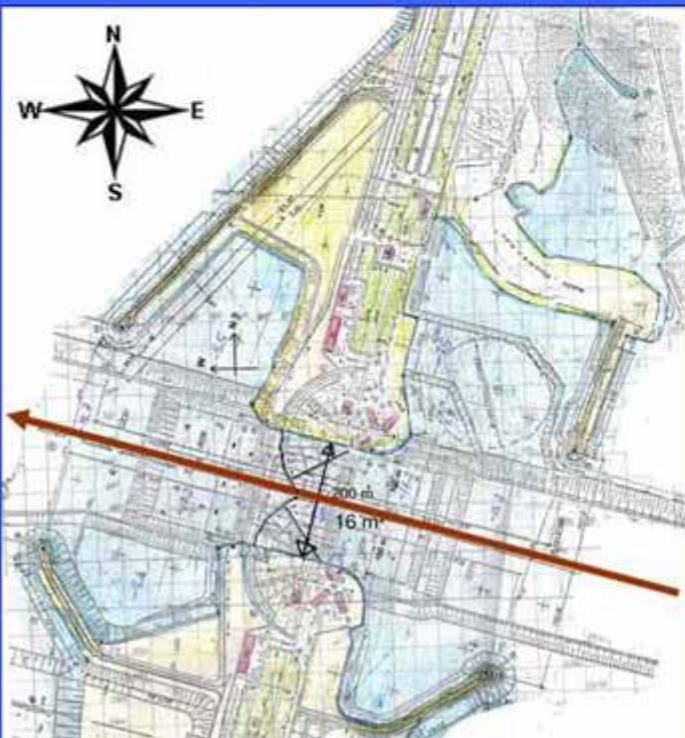


Flood Protection Barrier is to be completed in about 4 years (2012)





Navigation sluice C-2 for local ships is almost completed



Thank you for your attention

