



**STATE COMMISSION ON AIRCRAFT ACCIDENTS  
INVESTIGATION**

**FINAL REPORT**

**ACCIDENT**

**Occurrence No: 1949/14**

**Aircraft: BB-42 Z Kubiček balloon, SP-BDF**

**23 April 2014 – Niezabitów near Nałęczów**

*This Report is a document presenting the position of the State Commission on Aircraft Accidents Investigation concerning circumstances of the air occurrence, its causes and safety recommendations. The Report was drawn up on the basis of information available on the date of its completion.*

*The investigation process can not be considered as finally closed. The investigation may be reopened if new information becomes available or new investigation techniques are applied, which may affect the wording related to the causes, circumstances and safety recommendations contained in the Report.*

*Investigations into air occurrences are carried out in accordance with the applicable international, European Union and domestic legal provisions for prevention purposes only.*

*The investigation was carried out without the need of application of the legal evidential procedure, applicable for proceedings of other authorities required to take action in connection with an air occurrence.*

*The Commission does not apportion blame or liability.*

*In connection with Article 5 paragraph 5 of the Regulation (EU) No 996/2010 of the European Parliament and of the Council on the investigation and prevention of accidents and incidents in civil aviation [...] and Article 134 of the Act – Aviation Law, the wording used in this Report may not be considered as an indication of the guilty or responsible for the occurrence.*

*For the above reasons, any form of use of this Report for any purpose other than air accidents and incidents prevention, can lead to wrong conclusions and interpretations. This Report was drawn up in the Polish language. Other language versions may be drawn up for information purposes only.*

**Warsaw 2016**

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## INFORMACJE OGÓLNE

Occurrence reference number:	<i>1949/14</i>			
Type of occurrence:	<i>ACCIDENT</i>			
Date of occurrence:	<i>23 April, 2014</i>			
Place of occurrence:	<i>Niezabitów near Nałęczów</i>			
Type and model of aircraft:	<i>Balloon: BB 42Z Kubiček</i>			
Aircraft registration marks:	<i>SP-BDF</i>			
Aircraft User/Operator:	<i>Hardworkers Team s.c</i>			
Aircraft Commander:	<i>Balloon Pilot</i>			
Number of Victims/Injuries:	<i>Fatal</i>	<i>Serious</i>	<i>Minor</i>	<i>None</i>
	<i>-</i>	<i>1</i>	<i>3</i>	<i>4</i>
Investigator-in-Charge:	<i>Tomasz Kuchciński</i>			
Investigation Authority:	<i>SCAAI Investigating Team</i>			
Composition of Investigating Team:	<i>T. Kuchciński, E. Łojek, J. Olędzki</i>			
Recommendations:	<i>YES</i>			
Recipient of recommendations:	<i>1) Civil Aviation Authority, 2) Kubiček Balloons, 3) EASA.</i>			
Date of completion of the investigation:	<i>14 March 2016</i>			

## SYNOPSIS

The pilot performed a flight with seven passengers. About 18:00 hrs LMT, after takeoff from the town of Nałęczów, the balloon was flying in a south-west direction. After several dozen minutes of flight, the wind speed increased and the pilot decided to land in a suitable area. During the landing the pilot assessed the horizontal speed of the balloon for 10 - 12 m/s. During the landing one of the passengers suffered serious injury and three passengers suffered minor injuries.

During the investigation SCAA I determined the following causes of the accident:

1. Planning and performing the flight despite forecast of dangerous weather phenomena;
2. Instructions for passengers prior to the landing partly incompatible with the appropriate emergency procedure.

Contributing factors:

- Pilot's knowledge insufficient to read typical civil aviation meteorological information;
- Too many passengers in the basket.

After closing the investigation SCAAI has proposed three safety recommendations.

## **1. FACTUAL INFORMATION**

### **1.1. History of the flight.**

According to the pilot's statement, on 23 April 2015 he planned a flight with seven passengers. He checked the weather conditions using the (meteo.pl and sat.24) websites, he checked also the quantity of gas in the cylinders, operation of the radio and on-board instruments. Around 17:30 hrs LMT<sup>1</sup> he started preparing the balloon, which was anchored to a car. Weather conditions at the site did not raised pilot's doubts related to safe conduct of the flight. After inflating the balloon the pilot instructed passengers to take places in the basket. At 18:02 hrs LMT, with weak north-east wind, the balloon took off and was flying in a south-west direction in class G airspace.

According to the pilot, during the initial phase of the flight there was no signs of deteriorating weather conditions. After about 40 - 50 minute flight the pilot found that the wind speed increased. He reduced the flight altitude and was looking for a suitable place to land. He chose a landing field near the village of Niezabitów. After reducing the height to about 20 - 30 cm the pilot used rapid deflation system. According to him, after the first touchdown the basket collided with a balk running perpendicularly to the direction of the flight, which caused bouncing of the basket to a height of about 3 meters, and then the final touchdown combined with falling over on side. The passengers claimed that the basket bounced off the ground three or four times before it came to rest in a lying position. The landing took place approximately one hour after the takeoff. The pilot estimated the wind speed during landing at 10 - 12 m/s.

### **1.2. Injuries to persons.**

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	1	-
Minor	-	3	-
None	1	3	-

### **1.3. Damage to aircraft.**

According to the pilot's statement, during the accident the balloon was not damaged.

### **1.4. Other damage.**

According to the pilot's statement, during the accident other damage did not occur.

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<sup>1</sup> LMT = UTC + 2 hours

### **1.5. Personnel information.**

The pilot – male, aged 32, holder of the Balloon Pilot Licence (BPL) with Class B rating (balloons of a volume up to 6000 m<sup>3</sup>). He obtained the Licence in 2008. In 2011 he passed the practical exam and obtained *Commercial pilot in command of free balloon using hot air class rating*. During the exam he piloted the same balloon on which the accident occurred. On 13 June 2013 the pilot passed the last checkride before the accident, and on 16 March 2014 he passed the check of theoretical knowledge. Prior to the accident flight the pilot executed 230 flights during 250 hours and 50 minutes, including 230 hrs and 50 minutes as a commander.

Summary of flights in 2014:

<b>Flight No</b>	<b>Date</b>	<b>Flight time</b>	<b>Envelope volume</b>	<b>Remarks</b>
222	19.01.2014	0 h 55'	4200 m <sup>3</sup>	
223	22.02.2014	0 h 40'	4200 m <sup>3</sup>	
224	16.03.2014	0 h 50'	4200 m <sup>3</sup>	
225	23.02.2014	0 h 50'	2200 m <sup>3</sup>	
226	30.03.2014	1 h 00'	4200 m <sup>3</sup>	
227	10.04.2014	1 h 00'	2200 m <sup>3</sup>	tethered
228	15.04.2014	0 h 50'	4200 m <sup>3</sup>	
229	17.04.2014	1 h 00'	2200 m <sup>3</sup>	
230	21.04.2014	1 h 00'	4200 m <sup>3</sup>	
231	23.04.2014	1 h 00'	4200 m <sup>3</sup>	accident

The pilot had General Radiotelephone Operator's Certificate and Class 2 Aeromedical Certificate, valid on the day of the accident.

### **1.6. Aircraft information.**

Hot air balloon: Kubiček, classic envelope BB42 Z type of 4 200 m<sup>3</sup> (151 300 ft<sup>3</sup>) volume, equipped with a parachute valve, Smart Vent rapid deflation system and rotation vents. Basket - K22 type, not partitioned. IGNIS-2S double burner. According to the pilot's statement, three VA 70 fuel cylinders were in the basket. Board instrument Flytec 3040. ICOM IC-A-24E radiotelephone.

Technical documentation of the balloon:

On the day of the accident Flight Manual Edition 2, Revision 19 of 19 June 2013 was valid.

The pilot presented to the Commission Flight Manual in Polish - Edition 2, Revision 4 and in English - Edition 2, Revision 15.

The balloon documentation made available by the pilot did not include the balloon component weight record.

<b>Year of manufacture</b>	<b>Manufacturer</b>	<b>Envelope Serial No</b>	<b>Registration marks</b>	<b>Register Number</b>	<b>Register date</b>
2010	Kubiček Balloons	760	SP-BDF	220	08.07. 2010

Airworthiness Review Certificate valid until - 04 October 2014

Envelope total flight time since new - 127 hrs. 58 min

Total number of flights since new - 114

Last Airworthiness Review date - 01 September 2013

Fuel (LPG) quantity prior to the flight (declared by the pilot):

fuel: propane-butane 90 kg;

The fuel (gas) quantity was sufficient to complete the planned flight.

Balloon loading (mass data):

empty balloon mass: - 301 kg

fuel mass (with cylinders) - 144 kg

assessed crew mass (pilot + 7 passengers) - 616 kg

assessed equipment mass: - 10 kg

**Total: 1071 kg**

Balloon loading for take-off:

Takeoff weight: taking into account the ambient temperature on the ground approximately +18°C, elevation of the takeoff place approximately 200 m AMSL and the intended altitude not exceeding 600 m AMSL.

MTOM 1410 kg

MLW 630 kg

available lift 1133 kg

actual for takeoff 1071 kg

assessed for landing 1011 kg

Takeoff and landing weight of the balloon was within the limits specified in the Flight Manual.

Basket occupancy (K22 model, serial No 363) calculated in accordance with Flight Manual Edition 2, Revision 19, applicable on the day of the accident.

There were three VA 70 fuel cylinders in the basket.

The basket floor area (in accordance with Appendix 4 to FM): 2,24 m<sup>2</sup>.

The basket floor area occupied by fuel cylinders: 3 x 0,15 = 0,45 m<sup>2</sup>.

The basket floor area available for persons: 2,24 – 0,45 = 1,79 m<sup>2</sup>.

The number of persons in the basket: 1,79/0,25 = 7,16.

The maximum number of persons that could be carried in the basket, calculated in accordance with FM, was 7. During the flight 8 persons were in the basket.

There were 10 rope handles in the K22 basket – three on each longer side and two on each shorter side of the basket. Each person had access to a handle inside the basket.

Technical condition of the balloon:

The pilot stated that prior to the accident the balloon was airworthy.

Due to the fact that the Commission was notified about the accident only 6 months after its occurrence, it was not possible to verify the pilot's statement on the matter.

**1.7. Meteorological information.**

- a. Before the flight the pilot assessed weather as safe and stable. He had no doubt that the weather was suitable to perform a balloon flight.
- b. Passengers of the balloon claimed that “the weather was deteriorating” and during the takeoff they could hear the sound of lightning.
- c. The Commission determined the meteorological conditions on the accident site at the accident time by analysing data from the following sources:
  - satellite images from geostationary satellite;
  - radiosounding data from Legionowo 12374 aerological station;
  - observational data in SYNOP code from the meteorological stations of the Institute of Meteorology and Water Management (IMGW): 12485 Radom, 12488 Kozienice, 12490 Dęblin, 12495 Lublin-Radawiec and 12585 Sandomierz.

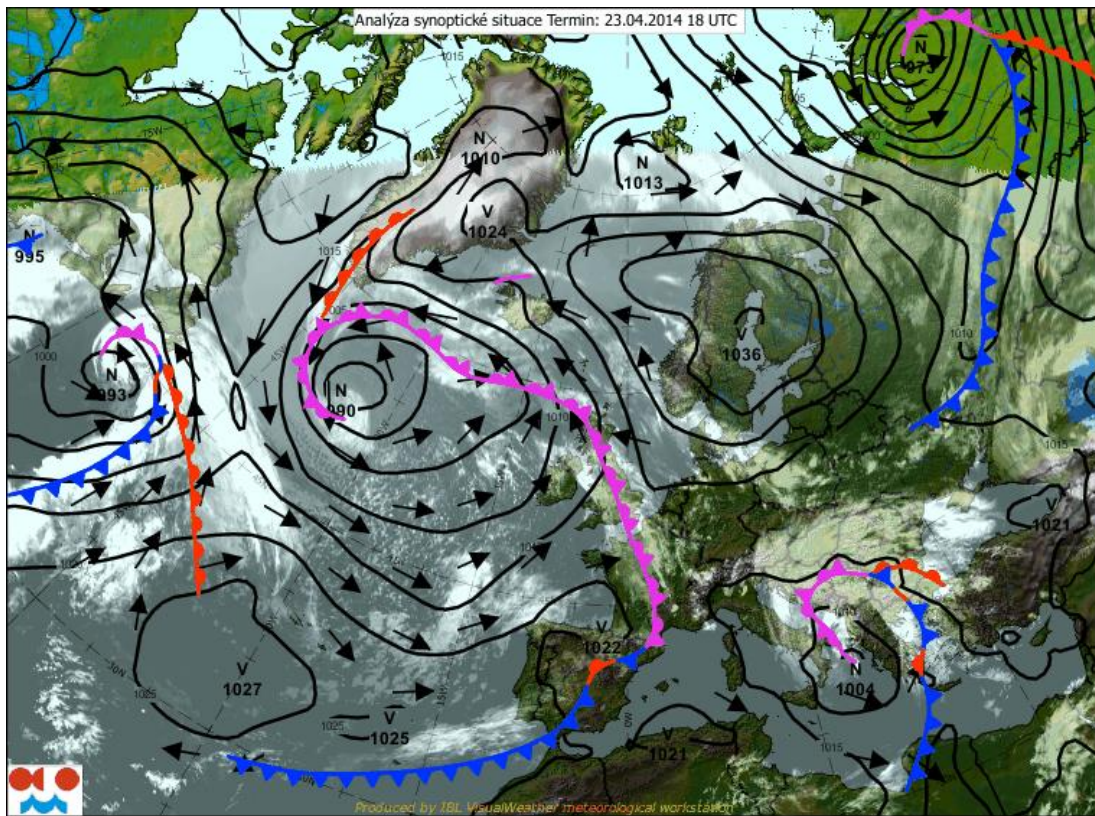
The data in paragraph 1.7 are expressed in UTC time.

The materials were obtained from archival resources of IMGW and from publicly available archival data from foreign Web servers:

- ČHMÚ (Czech Republic);
- University of Wyoming (USA);
- wetterzentrale.de (Germany);
- OGIMET (Spain).



### Synoptic situation in Europe



Map showing CHMU synoptic analysis for 18.00 hrs UTC on 23 April 2014.

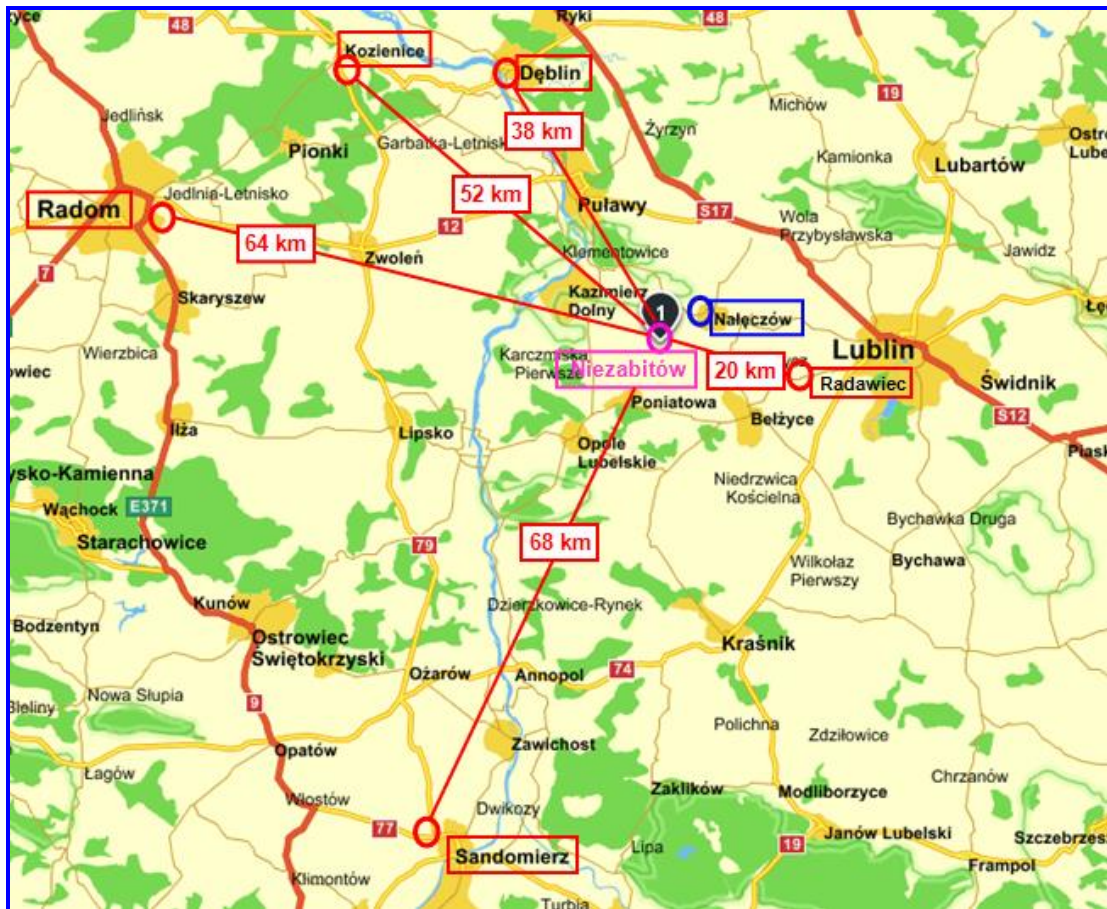
On 23 April 2014 Northern and partially Central Europe, including northern and central part of Poland were influenced by the high with 1030 hPa center over Scandinavia. Moderately warm and dry polar air flowed along eastern and south-eastern periphery of the high to the north-eastern part of Poland.

Western Europe remained within the extensive Atlantic low located approximately halfway between Ireland and Labrador.

Southern and partially Central Europe was in the area of low pressure and low gradient, created by the weak low from the Ionian Sea. Moderately warm and moderately moist polar air flowed from south-east to the southern and south-western part of Poland.

The two air masses were separated from each other by two lines of convergence; one from Szczecin to Rzeszów and the other from Bydgoszcz to Warsaw. The weather in both of those areas was typical for warm season with thermal convection phenomena weakening and disappearing in the second part of the night and in the morning, and activation of those phenomena in the midday and afternoon, which was caused by the presence of humid unstable thermodynamic equilibrium in those areas.

## Weather conditions on the accident site at the accident time



Arrangement of meteorological stations located in the vicinity of the scene.

12495 Lublin Radawiec meteorological station on EPLR aerodrome was the closest to the scene, approximately 20 km to ESE.

The following meteorological stations were much further from the scene:

- 12490 Dęblin situated about 38 km to NWN;
- 12488 Kozienice situated about 52 km to NW;
- 12485 Radom situated about 64 km to WNW;
- 12585 Sandomierz situated about 68 km to SSW.

Due to the convection phenomena occurring in the afternoon, the results of meteorological observation conducted little more than one hour before the balloon takeoff were used, and as for 12495 Lublin Radawiec station it was little more than six hours. The results of those observations are shown in the tables below together with decoded SYNOP key.

**12490, Deblin / Irena (Poland)**  
 ICAO index: ----. Latitude 51-33N. Longitude 021-51E. Altitude 124 m.

SYNOPSIS from 12490, Deblin / Irena (Poland)			
SN	23/04/2014 17:00->	AAXX 23171	12490 42665 60202 10186 20110 40178 52004 82263 555 6//61=
SN	23/04/2014 16:00->	AAXX 23161	12490 42765 60204 10200 20093 40173 52002 83903 555 6//50=
SI	23/04/2014 15:00->	AAXX 23151	12490 41760 73404 10197 20110 40173 57002 72999 879// 555 6//57=

17.00: N 2/8 Cu h 1000-1500 m and 6/8 Ac and Ci, vv 15 km, wind 020/2 m/s, T 18,6°C, T<sub>d</sub> 11,0°C, QNH 1017,8 hPa, increase 0,5 hPa/1 h.

16.00: N 3/8 **Cb cap** h 1500-2000 m and 7/8 Ci, vv 15 km, wind 020/4 m/s, T 20,0°C, T<sub>d</sub> 9,3°C, QNH 1017,3 hPa, no change 0,0 hPa/1 h.

15.00: N 7/8 **Cb cap** h 1500-2000 m, vv 10 km, wind 340/4 m/s, T 19,7°C, T<sub>d</sub> 11,0°C, QNH 1017,3 hPa, no change 0,0 hPa/1 h.

**12488, Kozenice (Poland)**  
 ICAO index: ----. Latitude 51-34N. Longitude 021-33E. Altitude 107 m.

SYNOPSIS from 12488, Kozenice (Poland)			
SN	23/04/2014 17:00->	AAXX 23171	12488 42681 60303 10192 20091 30028 40177 53006 83534=
SN	23/04/2014 16:00->	AAXX 23161	12488 42783 60602 10207 20073 30025 40173 53003 84931=
SI	23/04/2014 15:00->	AAXX 23151	12488 42777 60604 10224 20092 30022 40169 56004 84931=

17.00: N 3/8 Sc h 1000-1500 m and 6/8 Ac i Ci, vv 35 km, wind 030/3 m/s, T 19,2°C, T<sub>d</sub> 9,1°C, QNH 1017,7 hPa, increase 0,4 hPa/1 h.

16.00: N 4/8 **Cb cap** h 1500-2000 m and 6/8 Ac i Ci, vv 45 km, wind 060/2 m/s, T 20,7°C, T<sub>d</sub> 7,3°C, QNH 1017,3 hPa, increase 0,4 hPa/1 h.

15.00: N 4/8 **Cb cap** h 1500-2000 m and 6/8 Ac i Ci, vv 27 km, wind 060/4 m/s, T 22,4°C, T<sub>d</sub> 9,2°C, QNH 1016,9 hPa, no change 0,0 hPa/1 h.

**12485, Radom (Poland)**  
 ICAO index: ----. Latitude 51-25N. Longitude 021-07E. Altitude 183 m.

SYNOPSIS from 12485, Radom (Poland)			
SN	23/04/2014 17:00->	AAXX 23171	12485 42760 79901 10183 20107 40176 52007 83536 555 6//61=
SN	23/04/2014 16:00->	AAXX 23161	12485 41760 79901 10188 20090 40175 52005 72999 84936 555 6//53=
SI	23/04/2014 15:00->	AAXX 23151	12485 42760 69902 10213 20089 40167 57005 83236 555 6//45=

17.00: N 3/8 Sc h 1500-2000 m and 7/8 Ac i Ci, vv 10 km, wind alt./1 m/s, T 18,3°C, T<sub>d</sub> 10,7°C, QNH 1017,6 hPa, increase 0,1 hPa/1 h.

16.00: N 4/8 **Cb cap** h 1500-2000 m and 7/8 Ac i Ci, vv 10 km, **storm during the last hour**, wind alt./1 m/s, T 18,8°C, T<sub>d</sub> 9,0°C, QNH 1017,5 hPa, increase 0,8 hPa/1 h.

15.00: N 3/8 Cu h 1500-2000 m and 6/8 Ac i Ci, vv 10 km, wind alt./2 m/s, T 21,3°C, T<sub>d</sub> 8,9°C, QNH 1016,7 hPa, increase 0,1 hPa/1 h.

**12585, Sandomierz (Poland)**  
ICAO index: ----. Latitude 50-42N. Longitude 021-43E. Altitude 217 m.

SYNOPSIS from 12585, Sandomierz (Poland)			
SN	23/04/2014 17:00->	AAXX 23171	12585 42775 70101 10194 20136 39917 40174 53004 83963=
SN	23/04/2014 16:00->	AAXX 23161	12585 42775 73201 10195 20132 39914 40171 55002 83963=
SI	23/04/2014 15:00->	AAXX 23151	12585 41780 73501 10191 20141 39913 40170 56006 70382 84332=

17.00: N 3/8 **Cb cap** h 1500-2000 m and 7/8 Ac i Ci, vv 25 km, wind 010./1 m/s, T 19,4°C, T<sub>d</sub> 13,6°C, QNH 1017,4 hPa, increase 0,6 hPa/1 h.

16.00: N 3/8 **Cb cap** h 1500-2000 m and 7/8 Ac i Ci, vv 25 km, wind 320./1 m/s, T 19,5°C, T<sub>d</sub> 13,2°C, QNH 1017,1 hPa, increase 0,3 hPa/1 h.

15.00: N 4/8 **Cb cal** h 1500-2000 m and 7/8 Ac i Ci, vv 30 km, wind 350./1 m/s, T 19,1°C, T<sub>d</sub> 14,1°C, QNH 1017,0 hPa, decrease 0,1 hPa/1 h.

**12495, Lublin Radawiec (Poland)**  
ICAO index: ----. Latitude 51-13N. Longitude 022-24E. Altitude 238 m.

SYNOPSIS from 12495, Lublin Radawiec (Poland)			
SN	23/04/2014 17:00->	AAXX 23171	12495 41881 73503 10171 20098 39896 40179 53005 71799 879//=
SN	23/04/2014 16:00->	AAXX 23161	12495 41879 71502 10194 20093 39892 40173 53001 71722 85903=
SI	23/04/2014 15:00->	AAXX 23151	12495 41779 73502 10210 20099 39891 40170 56004 70198 84903=
SN	23/04/2014 14:00->	AAXX 23141	12495 41780 73503 10197 20098 39891 40171 56008 71782 879//=
SN	23/04/2014 13:00->	AAXX 23131	12495 42780 63403 10214 20086 39891 40170 57011 86900 555 57140=
SM	23/04/2014 12:00->	AAXX 23121	12495 12780 30402 10217 20096 39895 40174 58008 60001 83900 333 93000=
SN	23/04/2014 11:00->	AAXX 23111	12495 42780 21102 10216 20092 39899 40178 58001 82900=
SN	23/04/2014 10:00->	AAXX 23101	12495 42678 20802 10209 20092 39902 40182 50005 81901=

17.00: N 7/8 **Cb cap** h 2000-2500 m, vv 35 km, **storm during observation but without precipitation on the station**, wind 350./3 m/s, T 17,1°C, T<sub>d</sub> 9,8°C, QNH 1017,9 hPa, increase 0,6 hPa/1 h.

16.00: N 5/8 **Cb cap** h 2000-2500 m and 7/8 Ci, vv 29 km, **storm during observation but without precipitation on the station**, wind 150./2 m/s, T 19,4°C, T<sub>d</sub> 9,3°C, QNH 1017,3 hPa, increase 0,3 hPa/1 h.

- 15.00: N 4/8 **Cb cap** h 1500-2000 m and 7/8 Ci, vv 29 km, wind 350./2 m/s, T 21,0°C, T<sub>d</sub> 9,9°C, QNH 1017,0 hPa, decrease 0,1 hPa/1 h.
- 14.00: N 7/8 **Cb cap** h 1500-2000 m, vv 30 km, **storm during observation but without precipitation on the station**, wind 350./3 m/s, T 19,7°C, T<sub>d</sub> 9,8°C, QNH 1017,1 hPa, increase 0,1 hPa/1 h.
- 13.00: N 6/8 **Cb cap** h 1500-2000 m, vv 30 km, wind 340./3 m/s, T 21,4°C, T<sub>d</sub> 8,6°C, QNH 1017,0 hPa, decrease 0,4 hPa/1 h.
- 12.00: N 3/8 **Cb cap** h 1500-2000 m and 7/8 Ci, vv 30 km, wind 040./2 m/s, T 21,7°C, T<sub>d</sub> 9,6°C, QNH 1017,4 hPa, spadek 0,4 hPa/1 h.
- 11.00: N 2/8 **Cb cap** h 1500-2000 m vv 30 km, wind 110./2 m/s, T 21,6°C, T<sub>d</sub> 9,2°C, QNH 1017,8 hPa, decrease 0,4 hPa/1 h.
- 10.00: N 1/8 **Cb cap** h 1000-1500 m and 1/8 Ci, vv 28 km, wind 080./2 m/s, T 20,9°C, T<sub>d</sub> 9,2°C, QNH 1018,2 hPa, decrease 0,2 hPa/1 h.

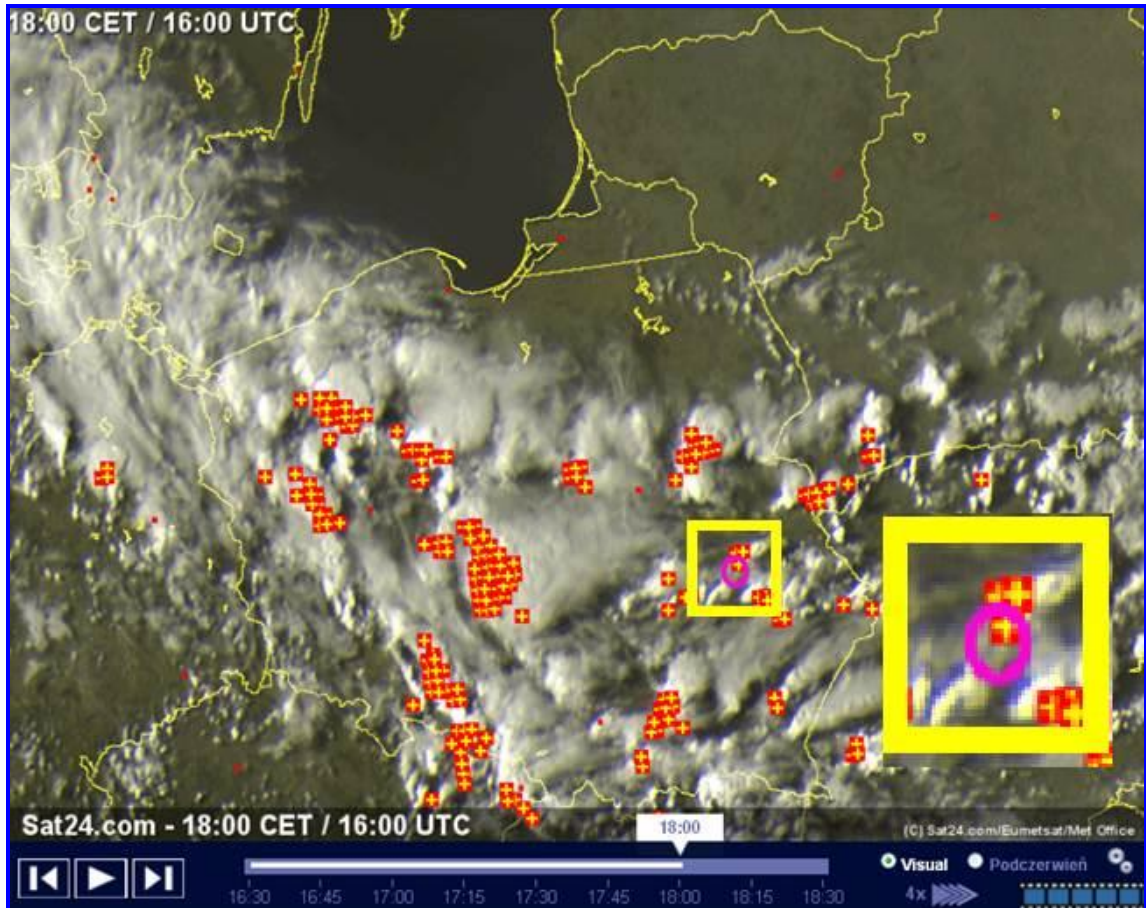
12495 Lublin-Radawiec weather station, the closest to both the takeoff place and to the occurrence site, from 10:00 hrs UTC (12:00 hrs LMT) observed Cb cap clouds (*Cumulonimbus capillatus* – rain, storm cloud), and at 14:00 hrs, 16:00 hrs and 17:00 hrs UTC storms were observed, but without precipitation on the station, i.e. occurring in the visual range of the observer.



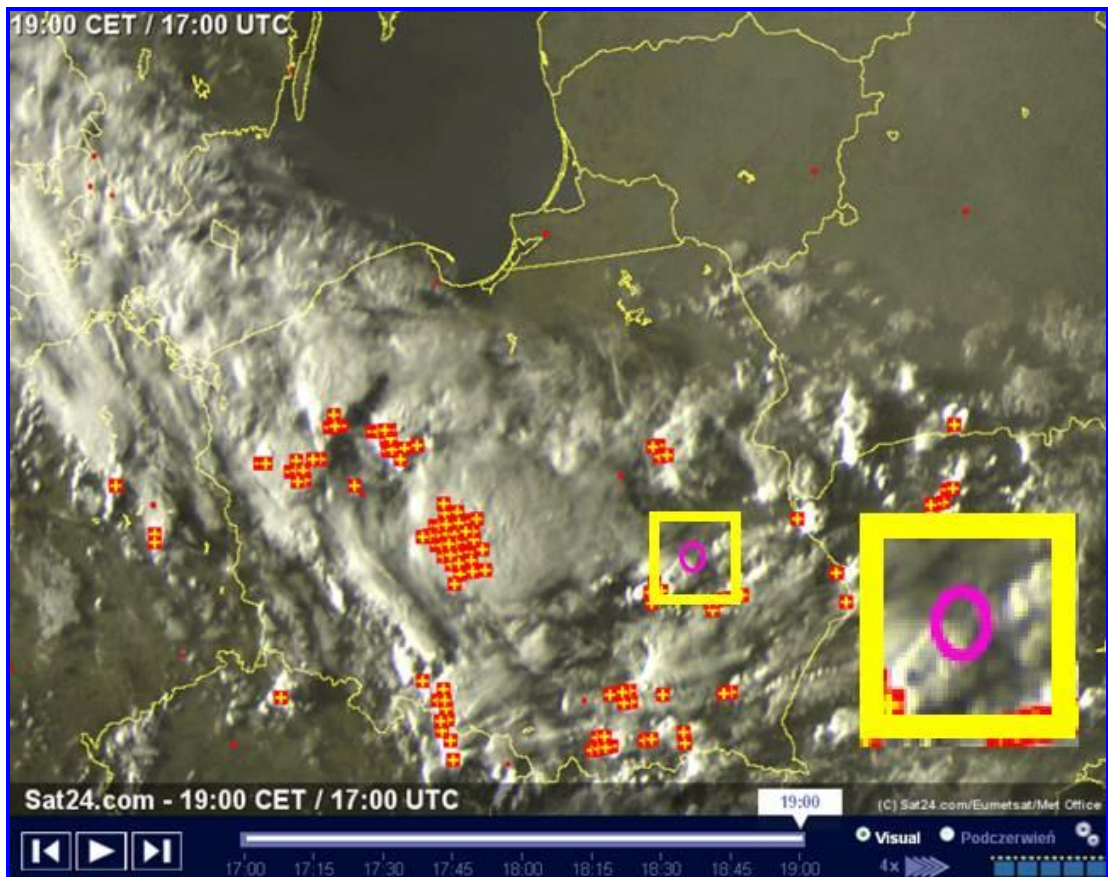
In the middle, the highest – rain, storm, puffy cloud (*Cumulonimbus capillatus*), on the right – rain puffy cloud (*Cumulonimbus calvus*), on the left – puffy clouds vertically developed (*Cumulus congestus*). To the right from all of the above – *Cumulus mediocris* and *Cumulus humilis*. Far away on the left the next anvil is visible.

Source: <http://pl.wikipedia.org/wiki/Cumulonimbus>

Such clouds were present throughout the area covered by the meteorological observations. In order to determine the cloud cover in the occurrence area two satellite images were used: from 16:00 hrs and from 17:00 hrs UTC. The satellite images clearly show that *Cumulonimbus calvus* cloud was moving over the takeoff place, along the balloon's flight route and over the occurrence site. It is indicated by the cloud size, shape and registered lightnings.



Satellite image of cloud cover at 16:00 hrs UTC on 23 April 2014.



Satellite image of cloud cover at 17:00 hrs UTC on 23 April 2014.

The satellite images clearly show that at the takeoff place, along the balloon's flight route and over the occurrence site at the occurrence time the cloud cover was 8/8 due to the *Cumulonimbus calvus* cloud moving along the route of the balloon.

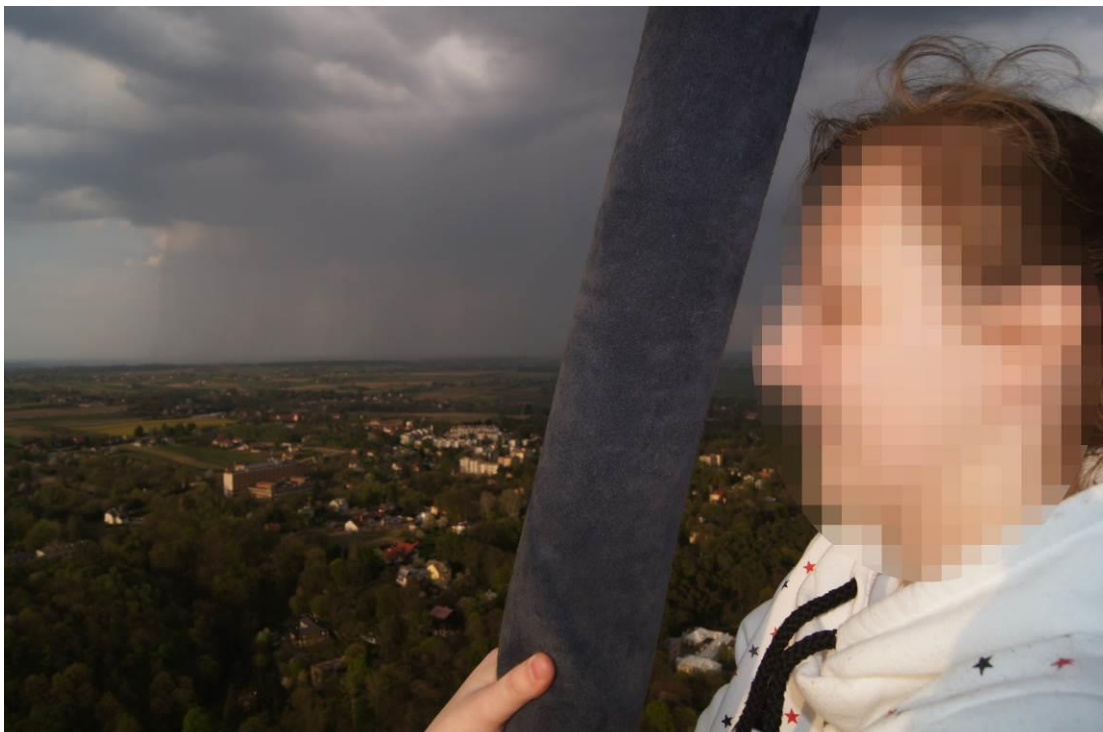
In addition, in order to determine the cloud cover, cloud types and accompanying phenomena in the view range, the photos taken by the passengers were used.



*Photo No 1 made during inflation of the balloon. Behind the balloon puffy clouds moderately developed vertically with dark bases visible, and in background on the left side of the balloon stratus opacus cloud visible. Source: passenger of the balloon.*



*Photo No 2 made during the balloon flight shortly after takeoff. A cloud with dark basis visible and beneath it streaks of rain. In the background on the right a portion of the illuminated puffy cloud, and on the left side stratus opacus cloud visible. Source: passenger of the balloon.*



*Photo No 3 made during the balloon flight. A cloud with dark corrugated base and beneath streaks of rain visible. Source: passenger of the balloon.*





*Photo No 4 made during the balloon flight. In the background on the right side the so-called “dust storm” visible. “Dust storm” is dust picked up from the ground by strong wind accompanying Cumulonimbus cloud. Source: passenger of the balloon.*



*Photo No 5 taken during the balloon flight. Dark cloud base visible, and streaks of rain and a portion of the rainbow beneath. The rainbow is visible from a location between the sun and raindrops. In the background, on the right side illuminated puffy clouds vertically developed visible. Source: passenger of the balloon.*

In the light of the data presented, after careful analysis, it can be assumed that on the takeoff site, along the flight route and on the occurrence place at the occurrence time the cloud cover was 8/8. It was caused by the *Cumulonimbus calvus* cloud, with base ranging from 1500 to 2000 meters, moving along the flight path of the balloon. In the view range, up to the horizon, the cloud cover was 7-8/8 due to puffy clouds at different stages of development from *Cumulus mediocris* (*Cu med*) to *Cumulonimbus calvus* (*Cb cal*) and *Cumulonimbus capillatus* (*Cb cap*). Some clouds produced showers and dust was picked up from the ground by strong wind accompanying the clouds' movement. Prior to the balloon takeoff the passengers heard thunders. Visibility was very good, well beyond 10 kilometers. Wind from NE (055-065 degrees) with average speed of 2-3 m/s at 10 meters AGL, but in the area of *Cumulonimbus* strong and gusty, with speed in gusts estimated for 8-12 m/s. The air temperature about 18°C. QNH about 1018 hPa with the increasing trend.

### Meteorological support

A set of necessary meteorological products intended for pilots performing low altitude flights is available on the IMGW website at <http://awiacja.imgw.pl/>. One of them is the GAMET area forecast in the form of plain text with applicable abbreviations for all five regions.



In addition, the following materials are available:

- METARs and TAFs from controlled and military aerodromes in Poland;
- AIRMETs and SIGMETs;

- SIGNIFICANT area forecast in the form of map for the Polish territory from the ground level to FL100 and for mountainous areas to FL150;
- SIGNIFICANT area forecast in the form of map for the area of Europe from FL100 to FL450;
- WIND CHARTS containing the forecast of wind direction and speed for the whole day for the areas of controlled aerodromes;
- RADAR CHARTS with the possibility of animation for the last five hours;
- Turbulence and icing forecast in the form of map.

The radar maps and lightning images are also available on the IMGW website.

Selected forecasts covering the takeoff site, the flight route and the occurrence site are presented below:

1. GAMET for A4 region for 15:00 hrs UTC on 23 April 2014 below FL100 with the validity from 16:00 to 22:00 hrs UTC.

**In the first section** of this forecast the following conditions were forecast:

- **visibility:** 16/22 hrs locally 3-5 km, due to rain;
- **significant weather:**
  - 16/21 hrs, west of the 20th meridian, Cb clouds embedded in a layer of other clouds and storm;
  - 16/21 hrs east of the 20th meridian, isolated (single) Cb clouds and storm;
- **cloud cover:**
  - 16/22 hrs west of the 20th meridian, Cb clouds with base in the range of 2500-3500 ft and the upper limit above 10 000 ft AMSL embedded in a layer of other clouds;
  - 16/18 hrs east of the 20th meridian, sometimes Cb clouds with base in the range of 3000-4500 ft and the upper limit above 10000 ft AMSL;

```
Wed Apr 23 14:37:40 2014
JTA0166 231437
FF EPWAYGYF EPZZRBXX
231437 EPWAYMYX
FAPL24 OKEC 231500

EPWW GAMET VALID 231600/232200 EPWA-
EPWW WARSAW FIR/A4 BLW FL100

SECN I

SFC VIS: 16/22 LCA 3000-5000M RA
SIGWX: 16/21 EMBD TS W OF E020
      16/21 ISOL TS E OF E020
SIG CLD: 16/22 EMBD CB 2500-3500/ABV 10000FT AMSL W OF E020
      16/18 OCNL CB 3000-4500/ABV 10000FT AMSL E OF E020
      18/22 EMBD CB 3000-4000/ABV 10000FT AMSL E OF E020
ICE: 16/22 LCA MOD ABV FL080 W OF E020
SIGMET APPLICABLE: AT TIME OF ISSUE NIL

SECN II

PSYS: 18 L 1003 HPA OVER SICILY STNR NC
      CONVERGENCE LINE EPSC-EPPO-EPKT-EPRZ MOV NW SLW NC
      AND CONVERGENCE LINE EPBY-EPWA MOV NW SLW NC
      H 1036 HPA OVER SCANDINAVIA STNR NC

SFC WIND: 16/22 040-070/07KT
WIND/T: 16/22
      1000FT AMSL 070-090/10KT 16/18 PS17 AND 18/22 PS15
      2000FT AMSL 090/15KT PS15
      3300FT AMSL 090/15KT PS11
      5000FT AMSL 090/18KT PS07
      10000FT AMSL 070/12KT MS03
CLD: W OF E020
      16/18 BKN-SCT CU 3000-4000/7000-8000FT AMSL
      18/22 SCT-BKN SC 3000-4000/6000-7000FT AMSL
      16/22 LCA BKN AC 8000-9000/ABV 10000FT AMSL
      E OF E020
      16/18 BKN-SCT CU 4000-6000/8000-9000FT AMSL
      18/22 SCT/BKN SC 3500-4500/6000-7000FT AMSL
FZLVL: 16/22 ABT 8000FT AMSL
```

- 18/22 hrs east of the 20th meridian, Cb clouds with base in the range of 3000-4000 ft and the upper limit above 10 000 ft AMSL embedded in a layer of other clouds;
- **icing:** 16/22 hrs west of the 20th meridian, locally moderate icing above FL080.
- **SIGMET:** none at the time of the GAMET release.

**In the second section** of this forecast the following conditions were forecast:

- **pressure centers and fronts** of 18:00 hrs – stationary low of 1003 hPa from Sicily, not showing activity changes, convergence along the line: EPSC-EPPO-EPKT-EPRZ slowly moving to NW, not showing activity changes and the convergence along the line: EPBY-EPWA slowly

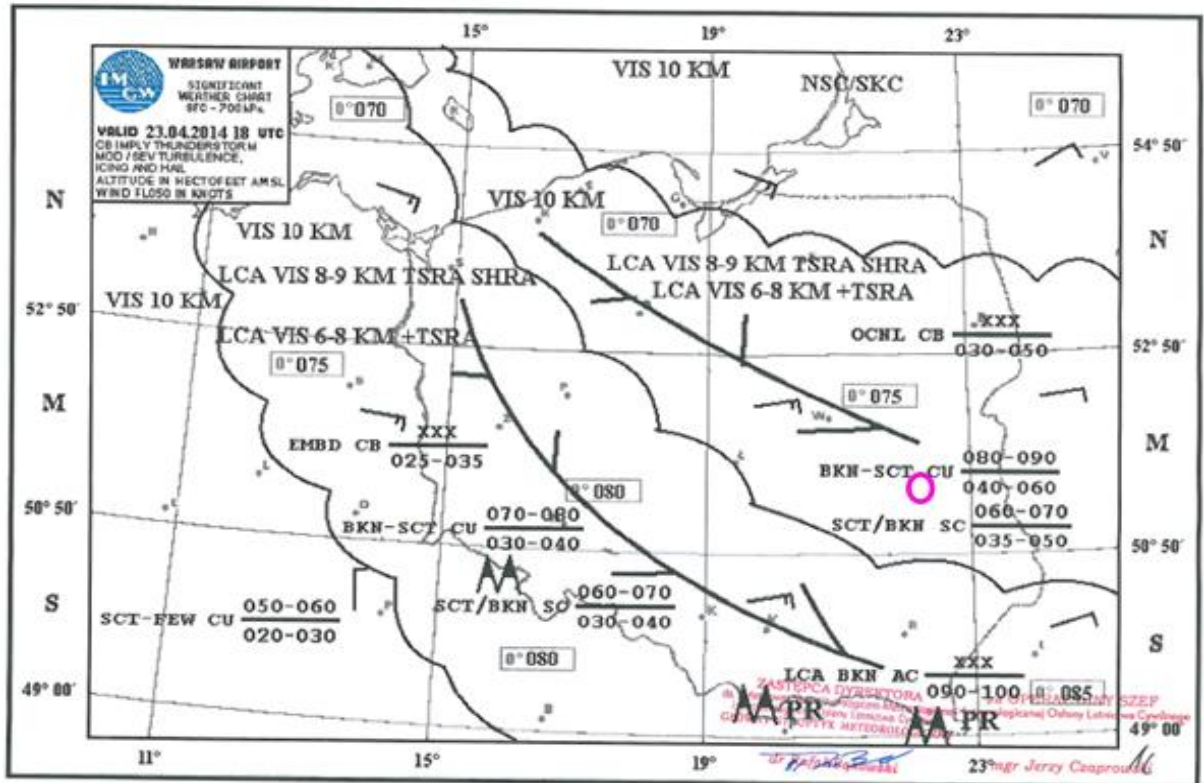
moving to NW and not showing activity changes, stationary high of 1036 hPa from Scandinavia not showing activity changes.

- **surface wind:** 16/22 hrs - 040-070 7 KT;
- **winds and temperatures on levels** at 16/22 hrs:
  - 1000 ft AMSL – 070-090/10 KT, 16/18 hrs +18°C, 18/22 hrs +15°C,
  - 2000 ft AMSL – 090/15 KT, +15°C,
  - 3300 ft AMSL – 090/15 KT, +11°C,
  - 5000 ft AMSL – 090/18 KT, +7°C,
  - 10000 ft AMSL – 070/12 KT, +3°C,
- **cloud cover west of the 20th meridian:**
  - 16/18 hrs BKN/SCT Cu with base in the range of 3000-4000 ft and the upper limit of 7000-8000 ft;
  - 18/22 hrs SCT/BKN Sc with base in the range of 3000-4000 ft and the upper limit of 6000-7000 ft;
  - 16/22 hrs locally BKN Ac with base in the range of 8000-9000 ft and the upper limit above 10000 ft;
- **cloud cover east of the 20th meridian:**
  - 16/18 hrs BKN/SCT Cu with base in the range of 4000-6000 ft and the upper limit of 8000-9000 ft;
  - 18/22 hrs SCT/BKN Sc with base in the range of 3500-4500 ft and the upper limit of 6000-7000 ft;
- **0° C isotherm level:** 16/22 hrs about 8000 ft AMSL.

GAMET shows that east of the 20th meridian from 16:00 hrs to 18:00 hrs the following weather was forecast:

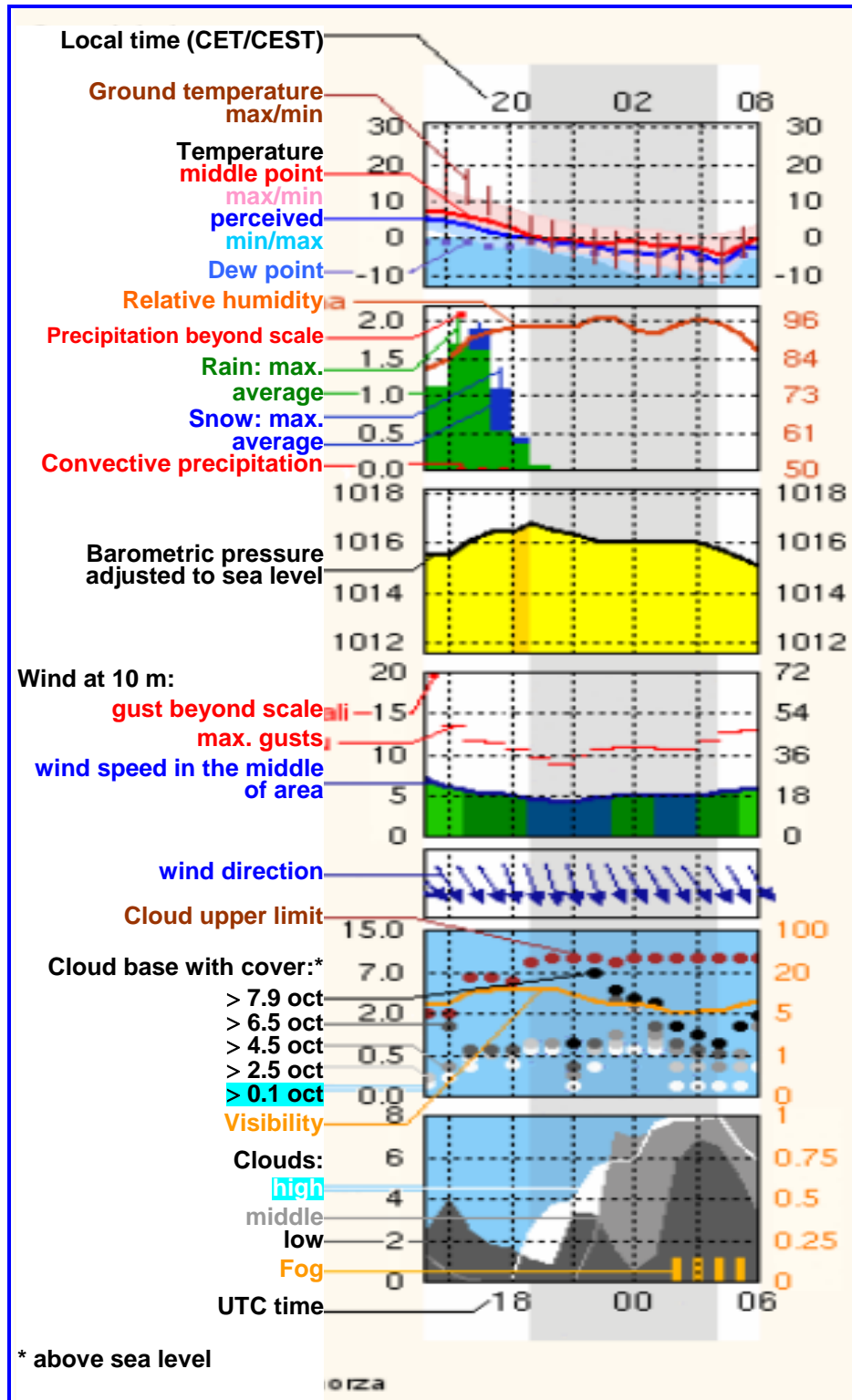
- initially cloud cover BKN (5-7/8), and later SCT (3-4/8) by Cu clouds with base in the range of 4000-6000 ft and the upper limit of 8000-9000 ft and sometimes Cb clouds with base in the range of 3000-4500 ft and the upper limit above 10000 ft AMSL;
- visibility 10 km or more, but locally 3-5 km due to rain;
- surface wind 040-070 degrees and average speed of 7 KT;
- wind on levels:
  - 1000 ft AMSL – 070-090/10 KT,
  - 2000 ft AMSL – 090/15 KT,
  - 3300 ft AMSL – 090/15 KT,
  - 5000 ft AMSL – 090/18 KT,
  - 10000 ft AMSL – 070/12 KT,
- temperature on levels;
  - 1000 ft AMSL – +18°C,
  - 2000 ft AMSL – +15°C,
  - 3300 ft AMSL – +11°C,
  - 5000 ft AMSL – +7°C,
  - 10000 ft AMSL – +3°C,

- 0° C isotherm level: about 8000 ft AMSL.
2. Significant WEATHER CHART SFC – 700 of 23 April 2014, 18:00 hrs UTC, validity:15:00-21:00 hrs UTC.



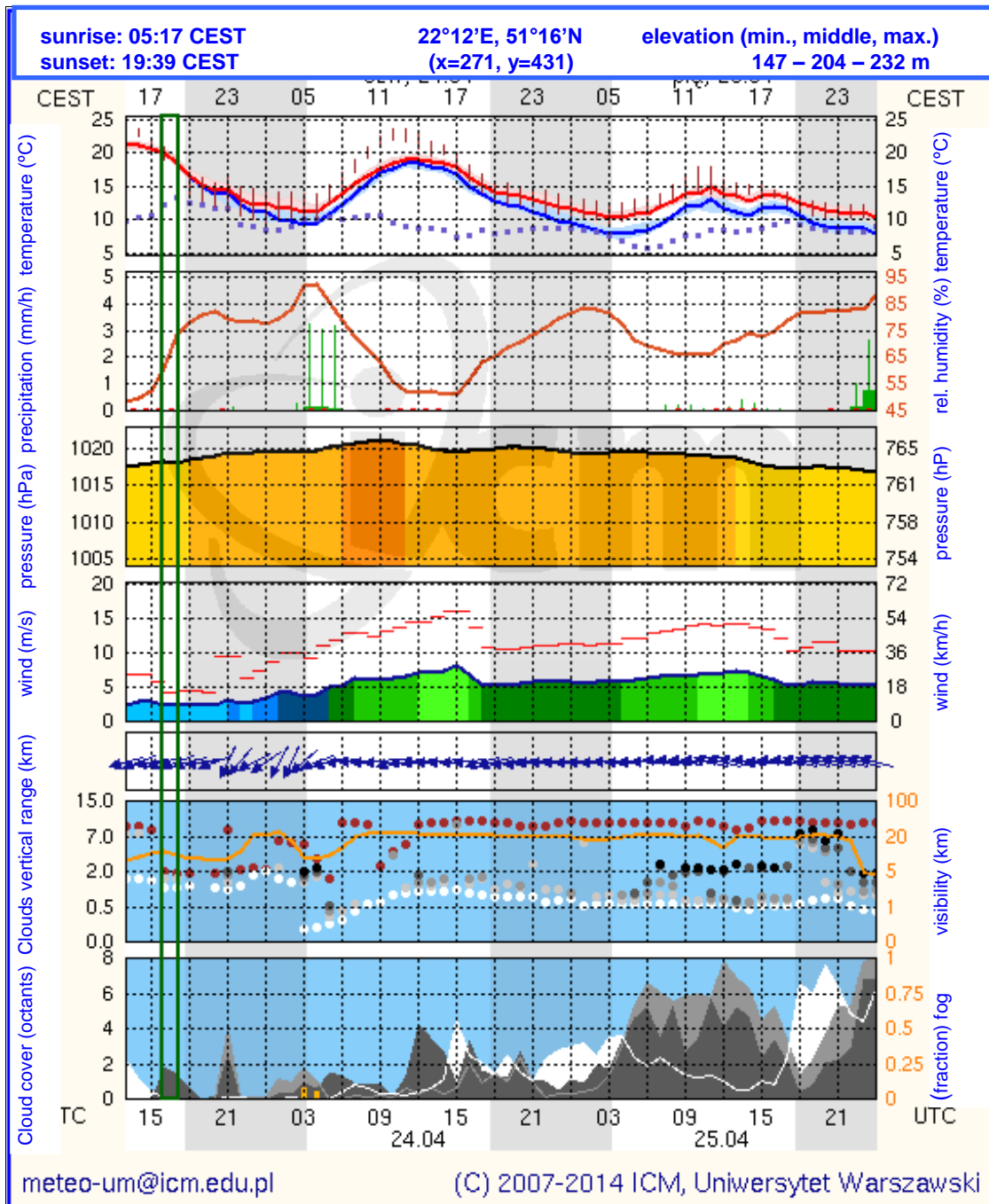
Taking into account the above weather conditions and weather forecasts, it should have been expected that cumulonimbus clouds, dangerous for aviation, local thunderstorms and showers could have occurred on the takeoff site, along the flight route and on the occurrence place.

Another source of forecasts of individual weather components is Interdisciplinary Centre for Mathematical and Computational Modeling (ICM) of the University of Warsaw. Its forecasts in the numeric form are updated four times a day and available at: <http://www.meteo.pl/>. Forecasts for all municipalities in Poland in the form of meteorograms containing 20 weather components are available at the same website. Their description is presented below.



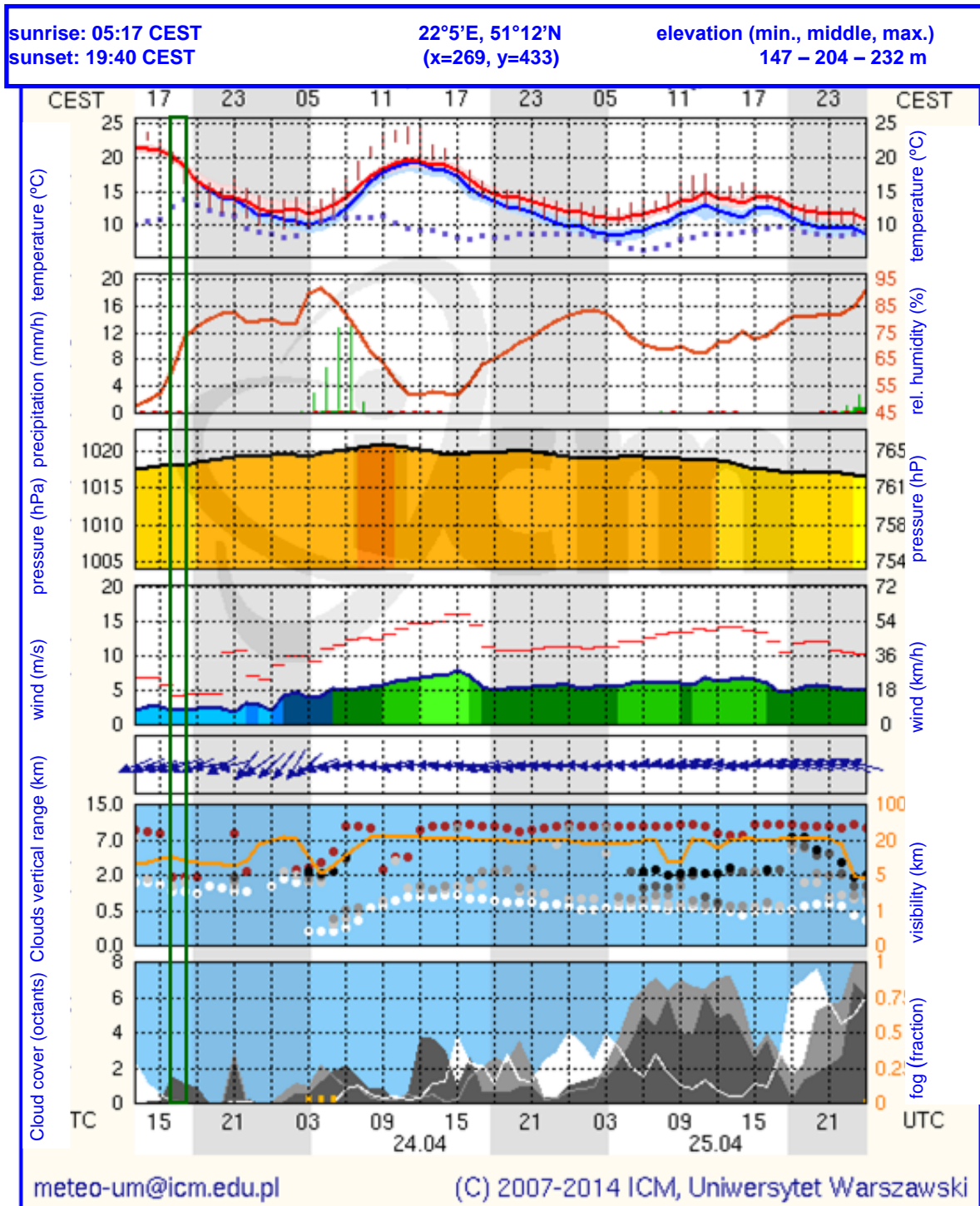
Description of forecast of individual weather components for meteorograms.

Meteorograms for Nałęczów and Poniatowa municipalities are presented below.



Meteorogram for the Nałęczów municipality, the forecast start: 23 April 2014, 12:00 hrs UTC





Meteorogram for the Poniatowa municipality, the forecast start: 23 April 2014, 12:00 hrs UTC

The presented forecasts are not typical aviation forecasts, but they can be successfully used because they cover a relatively small area and include all weather components relevant to aviation.

The forecast for the areas of both municipalities from 16:00 to 17:00 hrs UTC was the following:

- cloud cover 1-2/8 Cu with base in the range of 800-900 m and the upper limit of 2000 m;
- visibility approximately 10 km, convective precipitation (shower);

- wind from the direction of 60°-70°, speed of 2-2,5 m/s and gusts 4-4,5 m/s;
- the air temperature decreasing from 20 to 19°C;
- dew point temperature increasing from 13 to 14° C;
- relative humidity of the air increasing from 63 to 73%;
- atmospheric pressure 1018 hPa, steady state.

In the light of the above weather forecasts, on the takeoff site, along the flight route and on the occurrence place Cumulus clouds and showers would occur, and wind would be gusty.

#### **1.8. Aids to navigation.**

Not applicable.

#### **1.9. Communications.**

The pilot did not maintain radio communication with Air Traffic Services.

#### **1.10. Place of the occurrence information.**

According to the pilot's statement and information from the police, the incident occurred near the village of Niezabitów, about 8 km south-west of the Nałęczów town.

The pilot described the landing site as arable land, with a balk running perpendicularly to the direction of landing.

Due to the fact that the Commission received information about the accident only after 6 months, it was not possible to precisely determine the landing site and objectively verify the pilot's statement on the matter.

#### **1.11. Flight recorders.**

According to the pilot's statement, the balloon was not equipped with any devices recording the flight data.

#### **1.12. Wreckage and impact information.**

- a. According to the pilot's statement, the descent during the landing approach was performed with the use of parachute valve. At a height of approximately 20 - 30 cm above the ground rapid deflation system was used. During the touchdown the longer side of the basket was oriented perfectly perpendicularly to the direction of the flight. During landing the horizontal speed of the balloon was 10-12 m/s. After the first touchdown the basket collided with a balk running perpendicularly to the direction of the flight, which caused bouncing of the basket to a height of about 3 meters, and then the final touchdown combined with falling over on side.
- b. According to the passengers during landing the basket bounced off the ground three or four times. Passengers fell on each other and on the sides of the basket.

#### **1.13. Medical and pathological information.**

During the landing, one of the passengers suffered serious injury and three passengers suffered minor injuries.

#### **1.14. Fire.**

Fire did not occur.

#### **1.15. Survival aspects.**

- a. According to the pilot's statement, before landing he instructed the passengers to:
  - stow all loose items so they do not move during landing;
  - stand with legs slightly bent;
  - lean in the direction of flight;
  - hold on to rope handles inside the basket;
  - keep all parts of the body inside the basket;
  - remain in the basket until instructed to leave by the pilot.
- b. According to the pilot's statement, the passengers did not hold on to the handles and did not stow cameras;
- c. According to the passengers, they firmly held on to "what was possible" but despite this during landing they fell on each other and on the sides of the basket;
- d. After landing all persons left the balloon basket unaided.
- e. No ambulance was called on the landing site. A member of the ground crew took a passenger who suffered serious injury to the takeoff place. Then, the passenger was taken by her husband to Lublin, where she received medical aid.

#### **1.16. Tests and research.**

The materials sent by the police on the Commission request were analyzed. The pilot's statement was acquired. The meteorological expert opinion was drawn up. The pilot and the balloon documentation was analysed. The photos taken by the balloon passengers were used.

#### **1.17. Organizational and management information.**

##### Pilot

- a. According to the pilot's statement, the flight was carried out for payment which was to be equivalent for fuel to the pilot's car which was made available for persons who accompanied passengers but did not participate in the flight.
- b. The flight was not executed by the entity holding the air operator's certificate (AOC).
- c. During a conversation with the pilot members of the Investigating Team found that he was not able to find in the documentation weights of individual components of the balloon, which is necessary to determine the takeoff mass. In addition, the pilot was not able to calculate the balloon load for flight using FM. The pilot said that in order to check whether he did not exceed the takeoff mass, he controlled only whether the air temperature in the envelope did not exceed 110° C.

- d. The pilot was not able to read the information valid at the time of the accident contained in METAR, SIGNIFICANT, AIRMET, GAMET and TAF.
- e. The pilot did not notify the Commission about the accident because he did not know which occurrences were subject to mandatory reporting.
- f. On 17 June 2012 the same pilot during takeoff of the SP-BDF balloon caused the incident (617/12) due to incorrect assessment of the weather conditions.

#### Flight Manual

- g. Maximum number of persons in the K22 basket (Serial No 363) given in the table on the page 8-9 of FM (Edition 2, Revision 19 of 19 June 2013) is 8. However, the algorithm given in Appendix 2 to FM (Edition 2, Revision 19) shows that after placing in the basket minimum number of cylinders i.e. 2, maximum number of persons in the basket is 7. When Revision 21 of 26 February 2015 was entered to the FM, with the minimum number of cylinders, i.e. 2 (types of cylinders VA50, CB599, CV2385, CB2088, CB2387, V20, M-20, M-20D), calculated maximum number of persons in the basket is 8, which is consistent with the information provided on page 8-9. However, the manufacturer of the balloon on its website put the information that in the baskets without partitions (which also applies to the K22 basket) can not be more than 6 persons (pilot + 5 passengers). Such a requirement is consistent with the provision of CS 31HB.59 (d) contained in the Certification Specification for Hot Air Balloons. However, this is not reflected in the FM. The Commission has asked the manufacturer and EASA what was the maximum number of persons in the basket in this case? Neither the manufacturer nor EASA has replied until this Final Report was drawn up.

#### **1.18. Additional information.**

On 18 December 2014 the Commission notified the Civil Aviation Authority that the pilot had not have the knowledge necessary to use the typical general aviation meteorological information and had not been able to calculate the performance of the balloon for given flight conditions, as well as the maximum number of persons that could have been carried in the balloon basket.

The following entities have been notified about the opportunity to acquaint with the Draft Final Report:

- the pilot;
- the balloon manufacturer;
- EASA;
- the President of the Civil Aviation Authority.

EASA comment was accepted in the Final Report.

#### **1.19. Useful or effective investigation techniques.**

Standard investigation techniques were applied.

## **2. ANALYSIS**

### Training:

The pilot had the required ratings to fly a balloon of 4200 m<sup>3</sup> envelope volume. His knowledge and skills were confirmed by passing two exams - in 2008 to obtain a licence and in 2011 to obtain rating of *Commercial pilot in command of free balloon using hot air class*.

### Preparation for the flight:

According to the documents submitted the balloon was airworthy, and according to the pilot's statement it was technically efficient.

The pilot did not know and was not able to find in the balloon's documentation masses of individual components of the balloon. In addition, he was not able to use the Flight Manual to calculate the balloon available lift. Using by the pilot the temperature inside the balloon envelope as the only indicator of the balloon permissible loading was inappropriate. Without calculation of available lift prior to a flight a failure of temperature measurement (transmitter or receiver) can lead to exceeding the operational limitations of the balloon. The Commission notes that the measurement of the envelope temperature does not protect against exceeding MTOM during flights at low temperatures. Calculation of takeoff mass and the anticipated mass of fuel consumed during the flight is also necessary to calculate MLM (Minimum Landing Mass), which is one of the operational limitations of balloons.

There were 8 persons in the balloon basket instead of maximum 7, according to the method described in Appendix 2 to the FM, Edition 2, Revision 19 of 19 June 2013. In the Commission opinion, the pilot did not calculate the number of available places in the basket because he did not know the content of the FM. However, the ambiguity of the respective provisions in the FM could have an impact on the pilot's error.

The collected information shows that the pilot undertook the execution of the flight, being convinced that the current (during the takeoff) and expected (during the flight) weather conditions were not dangerous. However, the sources of information (meteo.pl and SAT 24) used by the pilot gave no grounds for such an optimistic assessment of the weather. Probably the pilot did not use the meteorological information designated for aviation because he was not able to read basic meteorological information contained in METAR, SIGNIFICANT, AIRMET, GAMET and TAF. In the Commission opinion, the problem with the assessment of current and forecast meteorological conditions resulted from lack of the pilot's knowledge at the level required to obtain the licence. For this reason the Commission has decided to issue safety recommendations addressed to the President of the Civil Aviation Authority.

The flight:

The pilot claimed that weather conditions deteriorated about 40 - 50 minutes after the takeoff. However, the analysis of timing of photos taken by the passengers proves that the CB cloud and rain were visible from the balloon just one minute after takeoff. In the Commission's opinion, the pilot should have recognized the visible threat and to immediately land at the first possible place. The analysis of the photos taken by the passengers shows that the balloon was flying over arable lands, on which a safe landing could have been performed. The Commission notes that in an emergency situation inflicting losses on arable lands or difficulties connected with carrying a balloon components to the nearest road suitable for a car are meaningless. The most important is safety, but possible losses of course should be compensated.

The landing:

The landing site, as described by the pilot, especially with estimated wind of 10-12 m/s was not suitable for landing. It was proved by the bouncing of the basket after collision with the transverse balk. At this wind speed the pilot should have selected a wide, flat field without ANY obstacles to stabilize the flight at low height and minimize the possibility of bouncing the basket during touchdown. It should be admitted that the balloon landing at such high wind speed is not easy, especially that the wind gusts and turbulence may have occurred. However, landing in such conditions was forced by the above described lack of knowledge and errors made during the preparation for the flight and during the flight.

The instructions concerning body position, which according to his statement the pilot gave to the passengers prior to landing (paragraph 1.15 of this Report), were different from those described in the emergency procedure intended for landing at a wind speed greater than 7,5 m/s (FM par.3.8.2). In such case the passengers should face away from the direction of flight, stand on bent legs and hold on to the handles inside the basket. Their backs should be pressed against the leading edge of the basket (leeward). In this case vague instructions for passengers could have had an impact on their movement in the basket during landing and suffering a serious injury by one of them. However, in the Commission's opinion it is doubtful whether in the K22 basket with 3 cylinders all passengers could have properly adopted the position described in the above emergency procedure.

The Flight Manual:

With regard to the point 1.17(g) of this Report, the Commission is of the opinion that no discrepancy should exist between FM requirement and information published on the manufacturer's website, which complies with CS 31HB.59(d). This is especially important because it relates to the limitations on operation of the balloon and has impact on flight safety. Too many persons in the basket limits the possibility of adopting the

correct body positions for landing and holding on to the handles. In the Commission's, opinion it contributed to suffering injuries by the passengers.

In the Commission's, opinion, the FM should contain unambiguous information on the operational limitations, including the number of persons in the balloon basket. Ambiguities in this area have an impact on safety and may expose pilots to refusal of payment of compensation and, in extreme cases, even criminal liability. For this reason, the Commission has decided to issue safety recommendations addressed to the manufacturer and EASA.

### **3. CONCLUSIONS.**

#### **3.1. Commission findings.**

- a) The pilot had Aero-Medical Certificate, licence and ratings to perform the flight.
- b) The pilot stated that prior to the accident the balloon was airworthy.
- c) The takeoff mass of the balloon was within the limits specified in the Flight Manual.
- d) The balloon documentation made available by the pilot did not include a card listing weights of individual components of the balloon.
- e) The pilot was not able to use the Flight Manual to calculate the balloon available lift.
- f) The number of persons in the basket exceeded by 1 the maximum number, calculated in accordance with the FM.
- g) The balloon takeoff was performed in good weather conditions, but the forecast bad weather conditions;
- h) The pilot did not have the knowledge necessary to read general aviation meteorological information.
- i) Weather conditions deteriorated during the flight.
- j) The pilot did not perform landing immediately when worsening weather conditions became apparent.
- k) The landing was performed at wind speed estimated by the pilot on 10-12 m/s.
- l) After the first touchdown the basket of the balloon collided with a balk running perpendicularly to the direction of the balloon flight, which caused bouncing of the basket to a height of about 3 meters, and then the final touchdown combined with falling over on side.
- m) During the landing one of the passengers suffered serious injury.
- n) The balloon's FM contained ambiguities regarding the maximum number of persons in the basket. These provisions were inconsistent with the information published on the website of the manufacturer.

### **3.2. Causes of the accident.**

1. Planning and performing of the flight despite forecast of dangerous weather phenomena;
2. Instructions for passengers prior to the landing partly incompatible with the appropriate emergency procedure.

Contributing factors:

- Pilot's knowledge insufficient to read typical civil aviation meteorological information;
- Too many passengers in the basket.

### **4. SAFETY RECOMMENDATIONS.**

After familiarization with the materials collected during the investigation the State Commission on Aircraft Accidents Investigation has issued the following safety recommendations.

President of CAA:

Verify the scope and procedure of conducting examinations for balloon pilot licences LAPL(B) and BPL in terms of required knowledge to use meteorological information for general aviation and calculation of a balloon performance.

Kubicek Balloons Ltd

Remove the discrepancy between the provisions of the Flight Manual - document No B.2102, Section 2 Operating Limitations, paragraph 2.10 and Appendix 2, and information published on the manufacturer's website regarding the maximum number of persons which may be present in the basket.

EASA:

Check the compatibility between the provisions of the Flight Manual - document No. B2102, Section 2 Operating Limitations, paragraph 2.10 and Appendix 2, regarding the maximum number of persons which may be present in the basket.

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THE END

	Name	Signature
Investigator-in-Charge:	Tomasz Kuchciński	<i>signature illegible</i>
Member of the Investigating Team:	Edward Łojek	
Member of the Investigating Team:	Jarosław Olędzki	