REPUBLIC OF CROATIA
Aircraft Accident and Incident
Investigation Agency
10002 Zagreb, Prisavlje 14

Class: 343-08/10-02/08
RefNo: 348/1-12-105
Zagreb, October 04th 2012

FINAL REPORT

OF AIRCRAFT SKYLEADER 500 ACCIDENT WHICH OCCURRED ON SEPTEMBER 25th 2010 IN THE AREA OF BUDAČKA RIJEKA

The Final report was made on the basis of the Air Traffic Act (Official Gazette No. 69/09, 84/11), the Ordinance on reporting on and investigation of occurrences and accidents and incidents (Official Gazette No. 138/2009), Annex 13 of the International Civil Aviation Organization (Appendix 1 - Format) and the European Regulation 996/2010. The Final report was made after establishing causes of the aircraft Skyleader 500 accident and gives recommendations, which are an integral part of the report, pointing to the failures that led to the accident, as the same would not be repeated.

EU Regulation 996/2010
„The sole objective of safety investigations should be the prevention of future accidents and incidents without apportioning blame or liability."

TABLE OF CONTENT:

BASIC INFORMATION

Aircraft

Owner	SKYLEADER AIRCRAFT POLAND Rybnik, Poland	
Aircraft model	Manufacturer:	JIHLAVAN airplanes
	Type and model:	KP-5 ASA
	Serial number:	55153161 O
State and registration	Poland **Registration no.:**	SP-SKYL
Place of accident	Budačka Rijeka	
Date of accident	25.09.2010.	

SUMMARY

Aircraft registration number SP-SKYL took off on September 24th 2010 at around 12:00 hours LT from airport Rybnik to airport Zalaegerszeged (LHZA) in Hungary. It was flying in formation with aircraft registration number OK-OUU38 which was the leader of the flight.

On September 25th 2010 at around 10:30 UTC, aircraft SP-SKYL takes off from airport LHZA in formation with aircraft OK OUU38, pursuant to the approved flight plan for Fano (LIDF) in Italy. Furthermore, on the flight from LHZA for LIDF the leader of the group was also aircraft OK-OUU38 which led the communication with Air Traffic Control. At around 12:00 UTC the leader established that it had lost communication with the formation aircraft SP-SKYL notifying the Air Traffic Control and continued to fly towards the destination.

Air Traffic Control loses radar reflection of aircraft SP-SKYL at 12:13 UTC in the area of Vojnić - Budačka Rijeka. In these areas completely cloudy, humid, rainy and showery weather prevailed. Visibility ranged, on average, about 3 km. Cloud Nimbostratus flooring ranged from 1 km to 2 km. Below Nimbostratus were located clouds type Stratus opacus, Cumulus fractus and Stratus fractus whose flooring ranged from 0.3 km to 0.6 km.

Shortly after the disappearance of the aircraft`s radar reflection and obtaining information from the flight OK OUU38 leader that he cannot make contact with the formation aircraft SP-SKYL, the Air Traffic Control declares INCERFA and notifies the Chief investigator for aircraft accidents, the Police and 112 center by phone and at 13:34 UTC declares ALERFA. Since repeated attempts to establish radio communication with the missing aircraft did not give any result, the Air Traffic Control declares DETRESFA. The Police and the Croatian Mountain Rescue Service joined the search for the aircraft.

Aircraft`s SP-SKYL wreckage was found on September 25th 2010 at around 23:00 hours LT in the area of Budačka Rijeka, location Kserov potok and two dead people were found. One person was found in the aircraft wreckage, while the other was found aprox 1 m away from the wreck, in the water.

1. FACTUAL INFORMATION

1.1. PREFLIGHT AND HISTORY OF THE FLIGHT

1.1.1. Pre-flight/History of the flight

Prior to take-off from airport LHZA (Zalaegerszeged) in Hungary, the crews filled out the flight plan and prepared the aircraft for take-off. In accordance with the flight plan, the flight was conducted in VFR conditions, in a formation of two aircraft. Scheduled destination is LIDF (Fano) in Italy, and as alternate airport, LIPY (Ancona), Italy was chosen.

Flight of aircraft SP-SKYL was terminated due to formation entering the area of poor visibility above Vojnić. The group leader, after the loss of formation, continues its flight towards the destination from the flight plan.

1.1.2. Radar images

Source: Croatia Control Ltd.

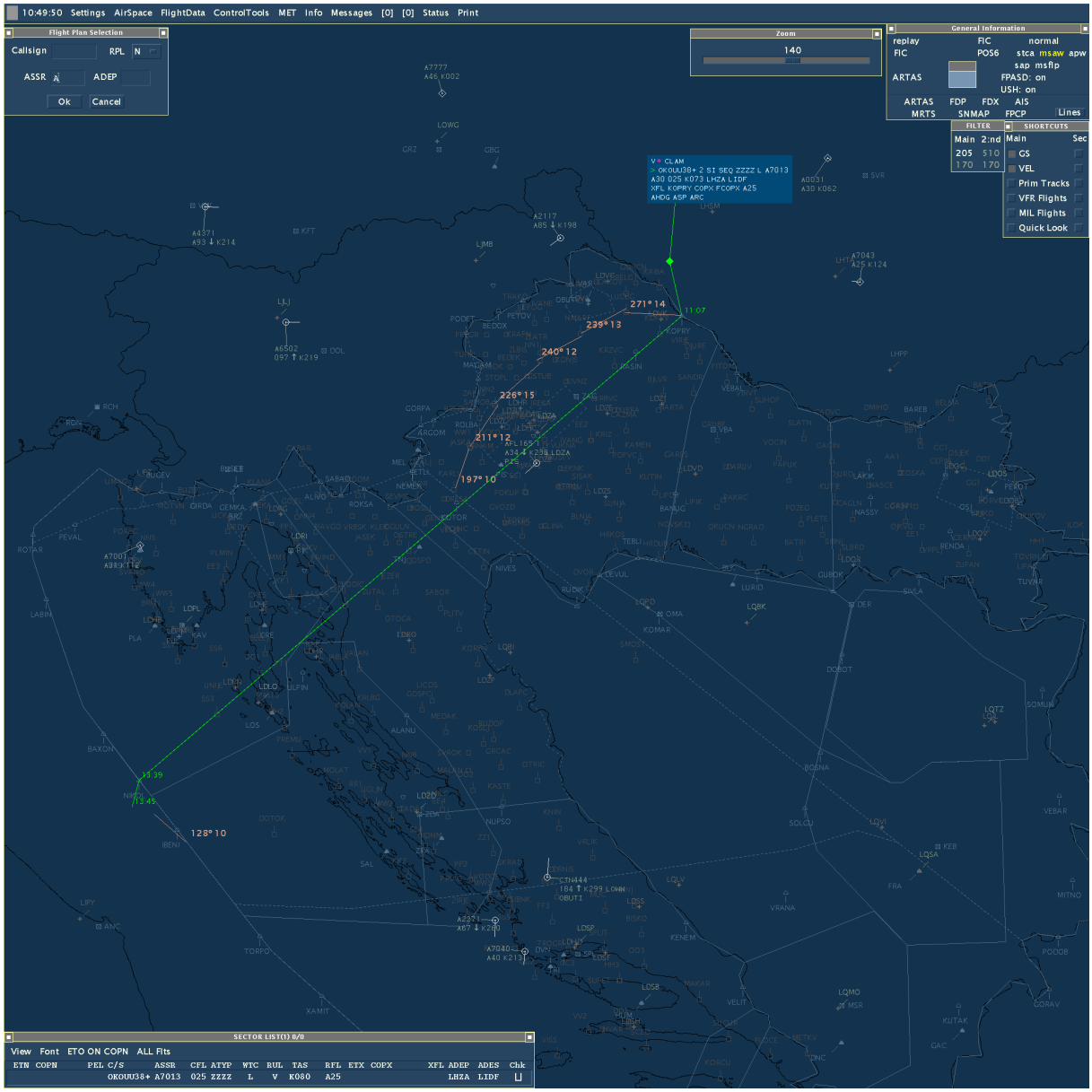


Image 1 Radar records; time: 10:49:50 UTC

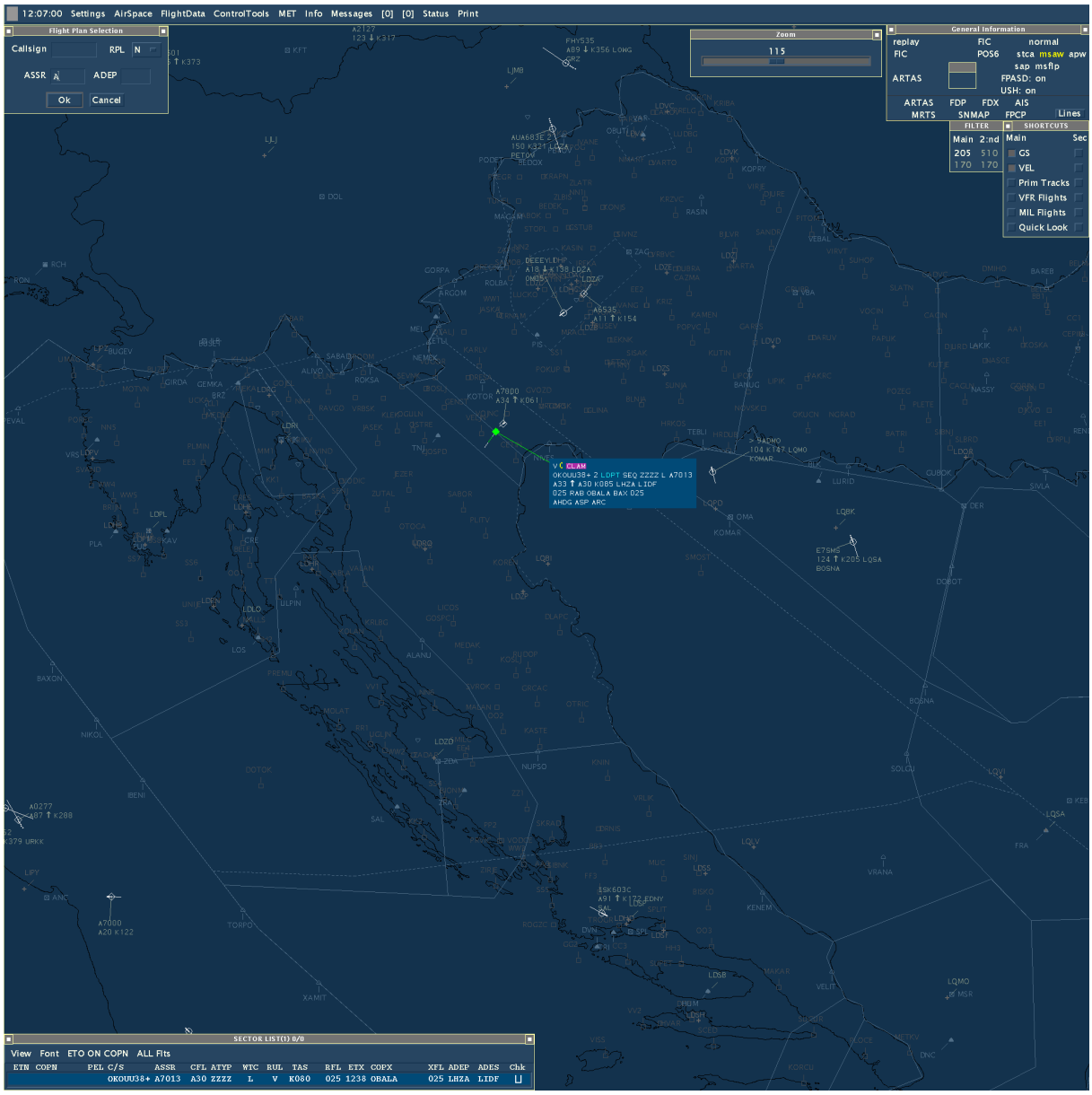


Image 2 Radar records; time: 12:07:00 UTC

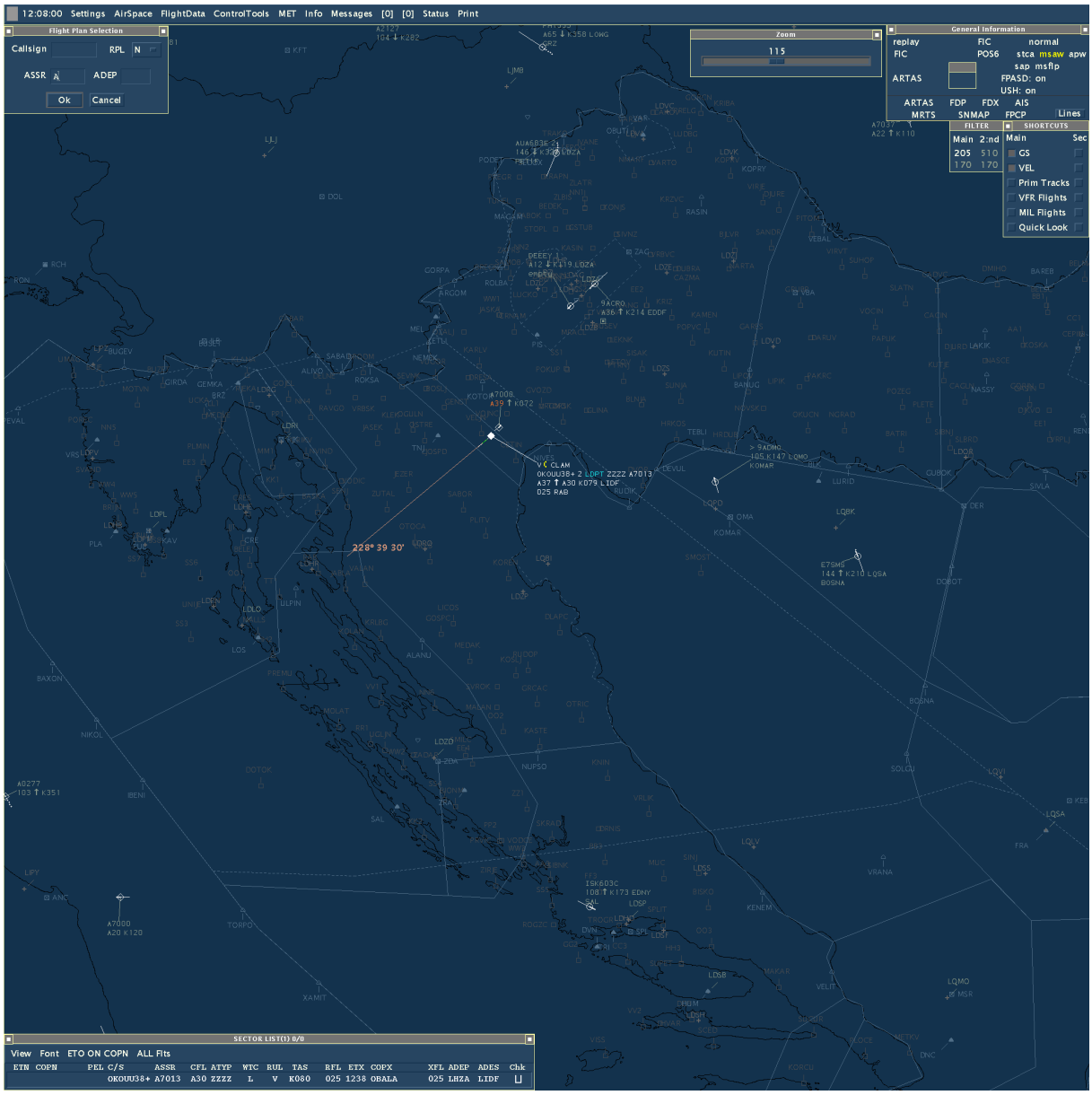


Image 3 Radar records; time: 12:08:00 UTC

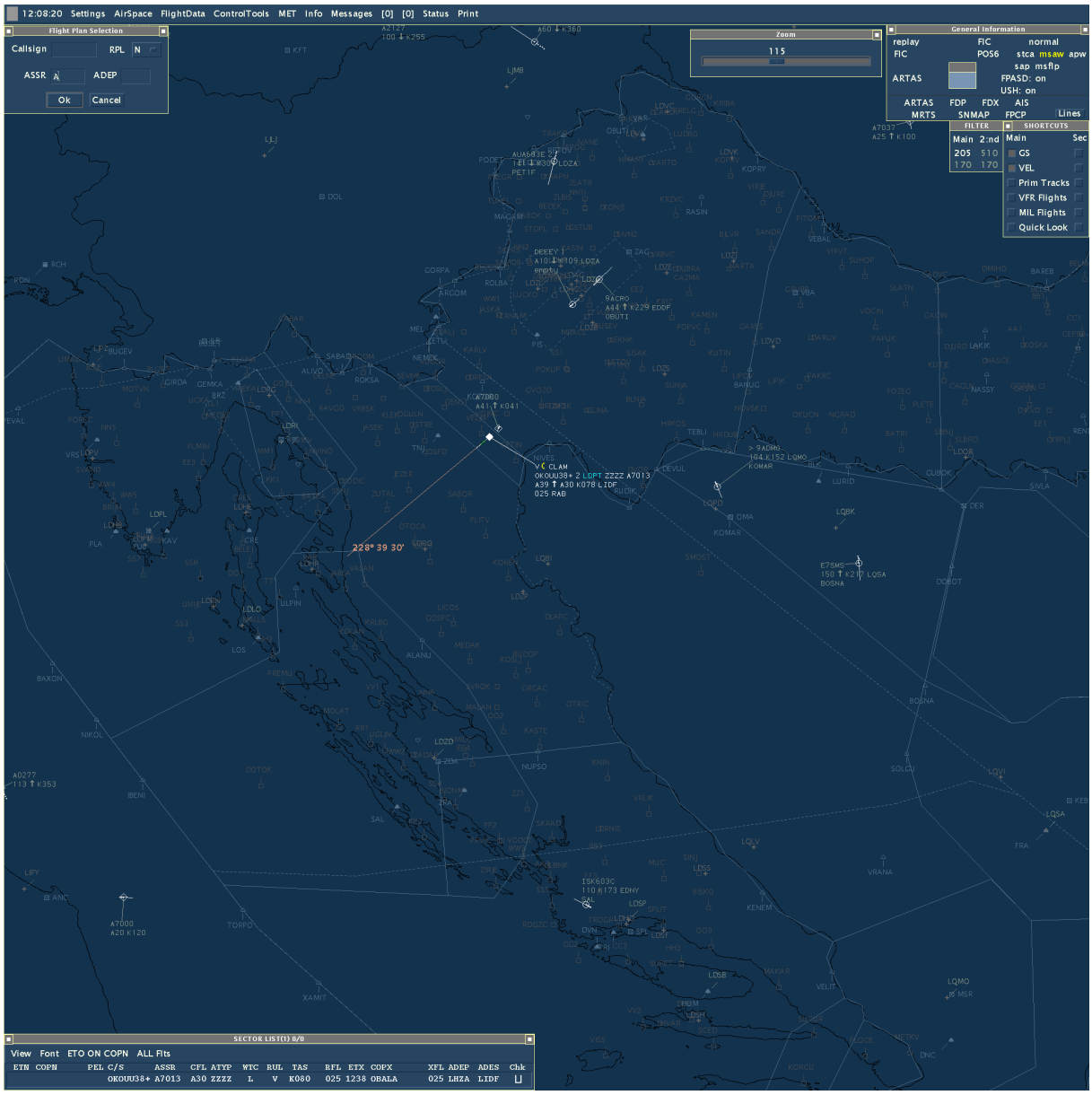


Image 4 Radar records; time:12:08:20 UTC

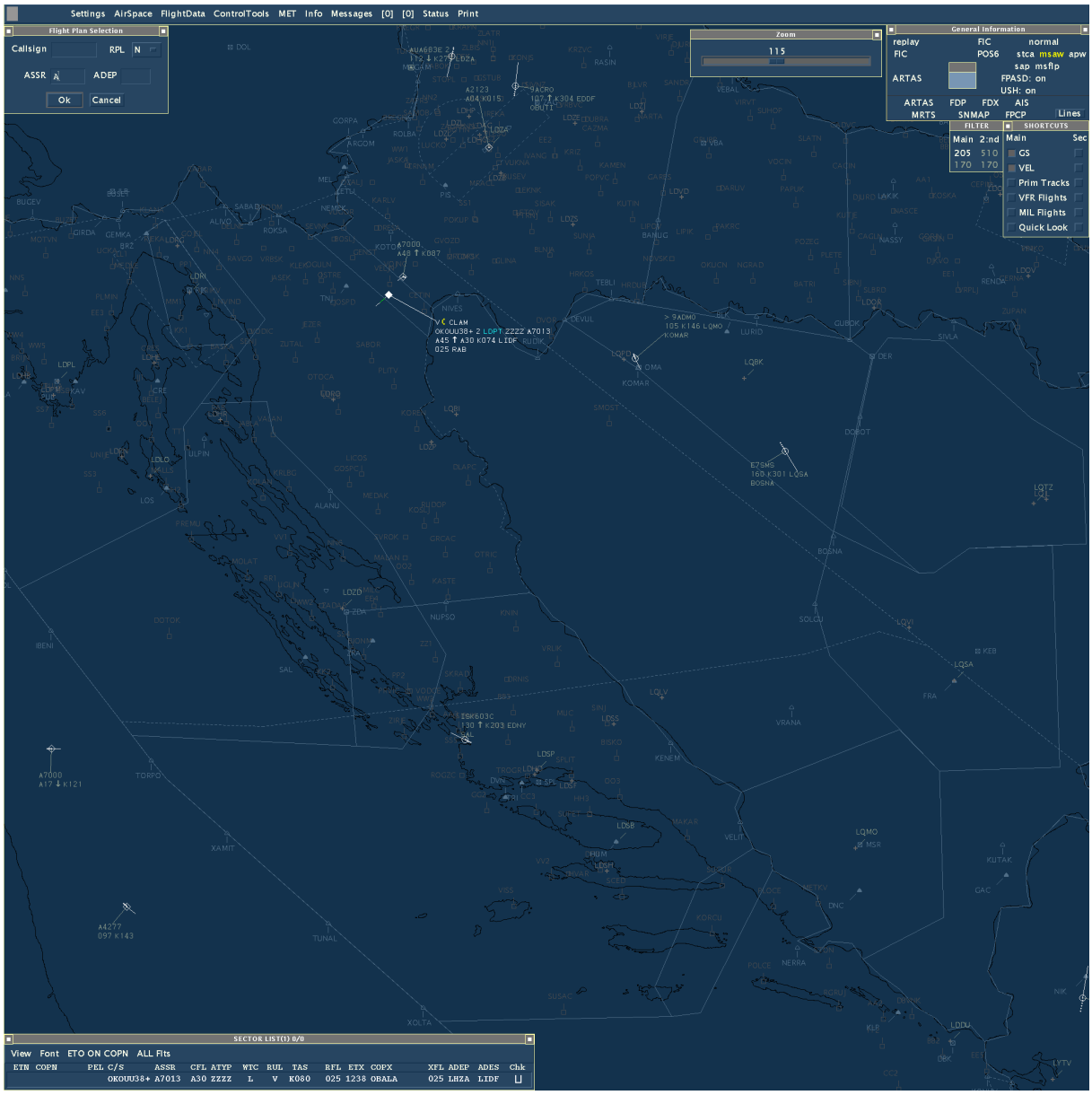


Image 5 Radar records; time: /UTC

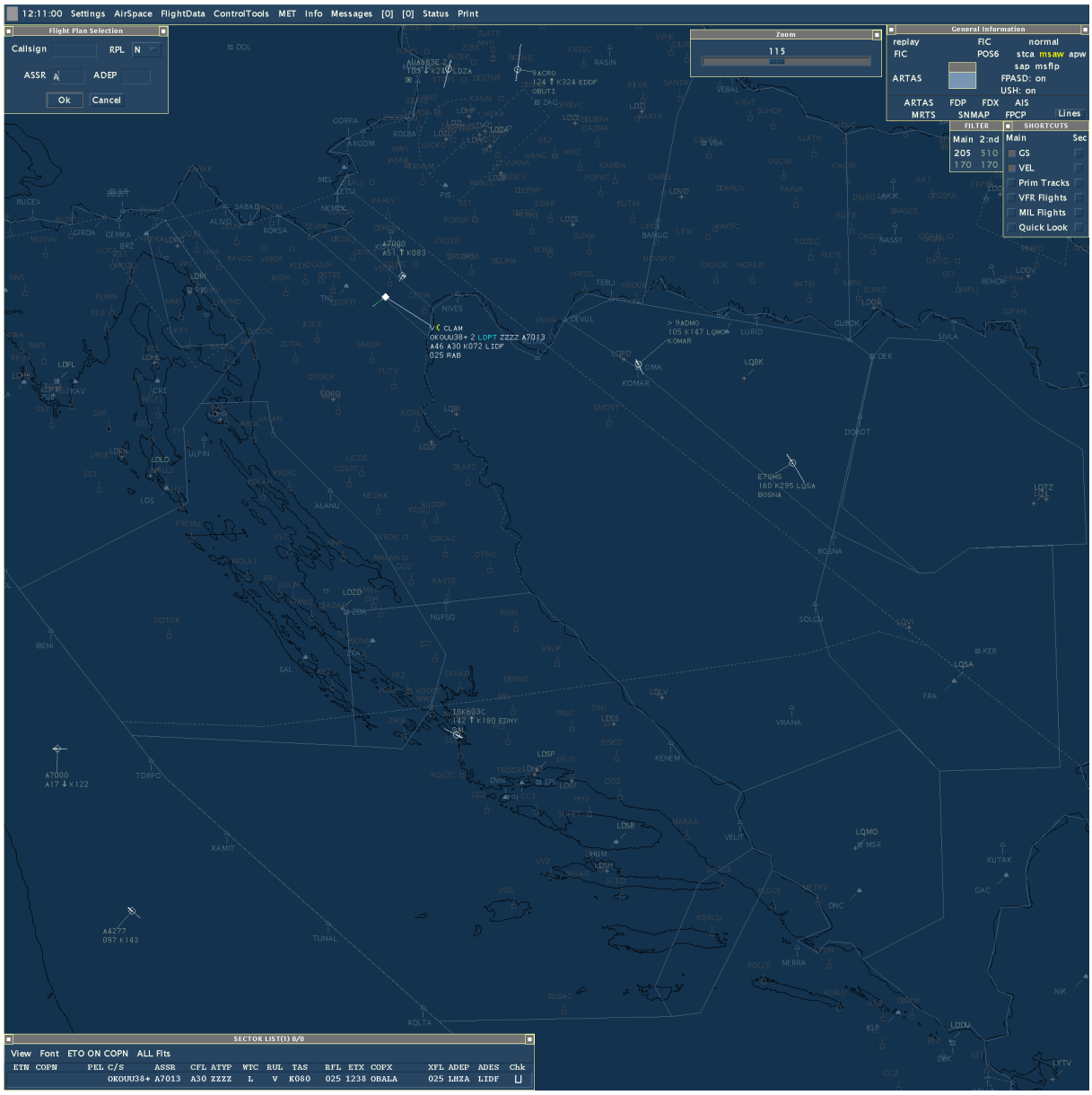


Image 6 Radar records; time:12:11:00 UTC

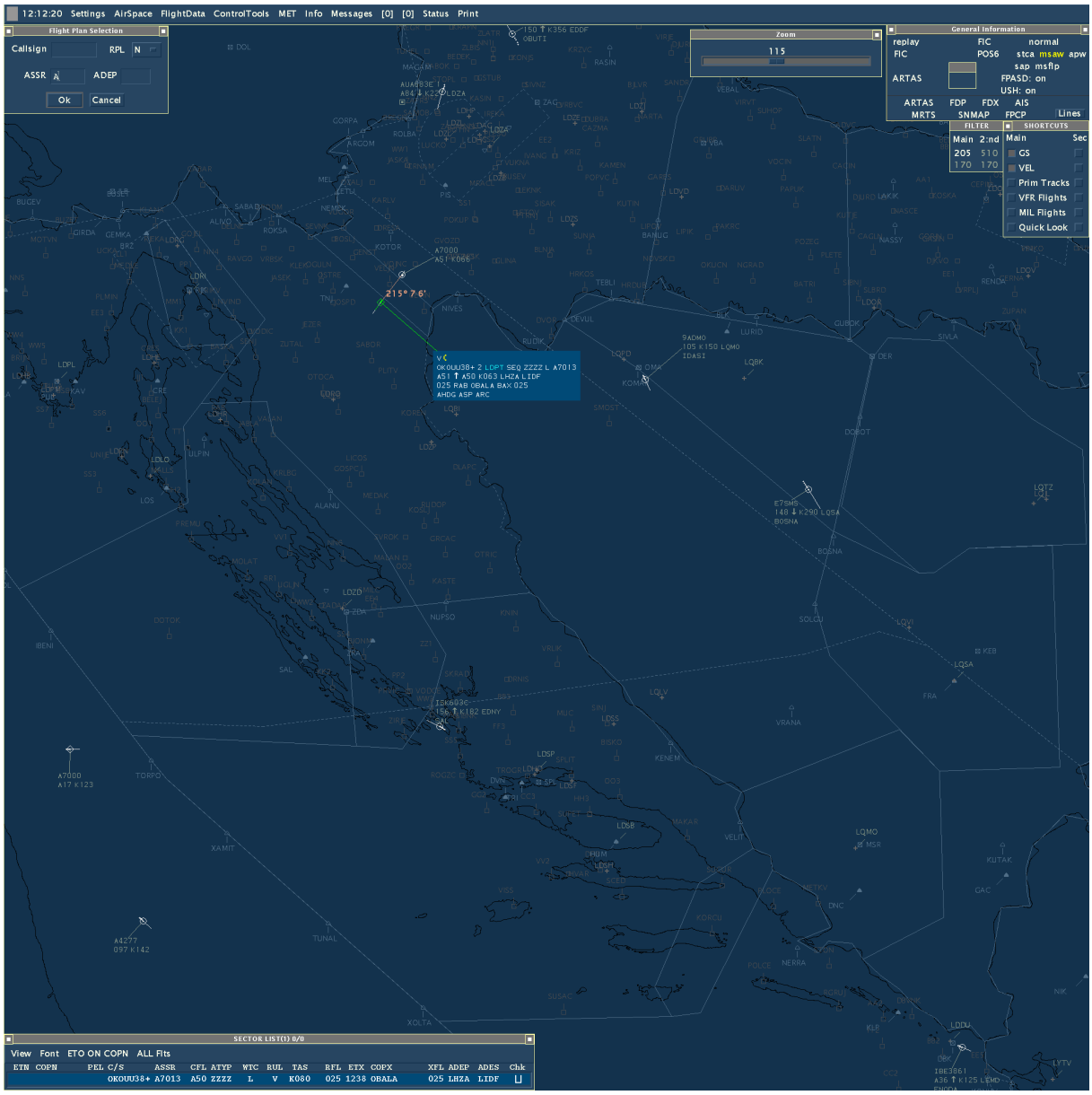


Image 7 Radar records; time:12:12:20 UTC

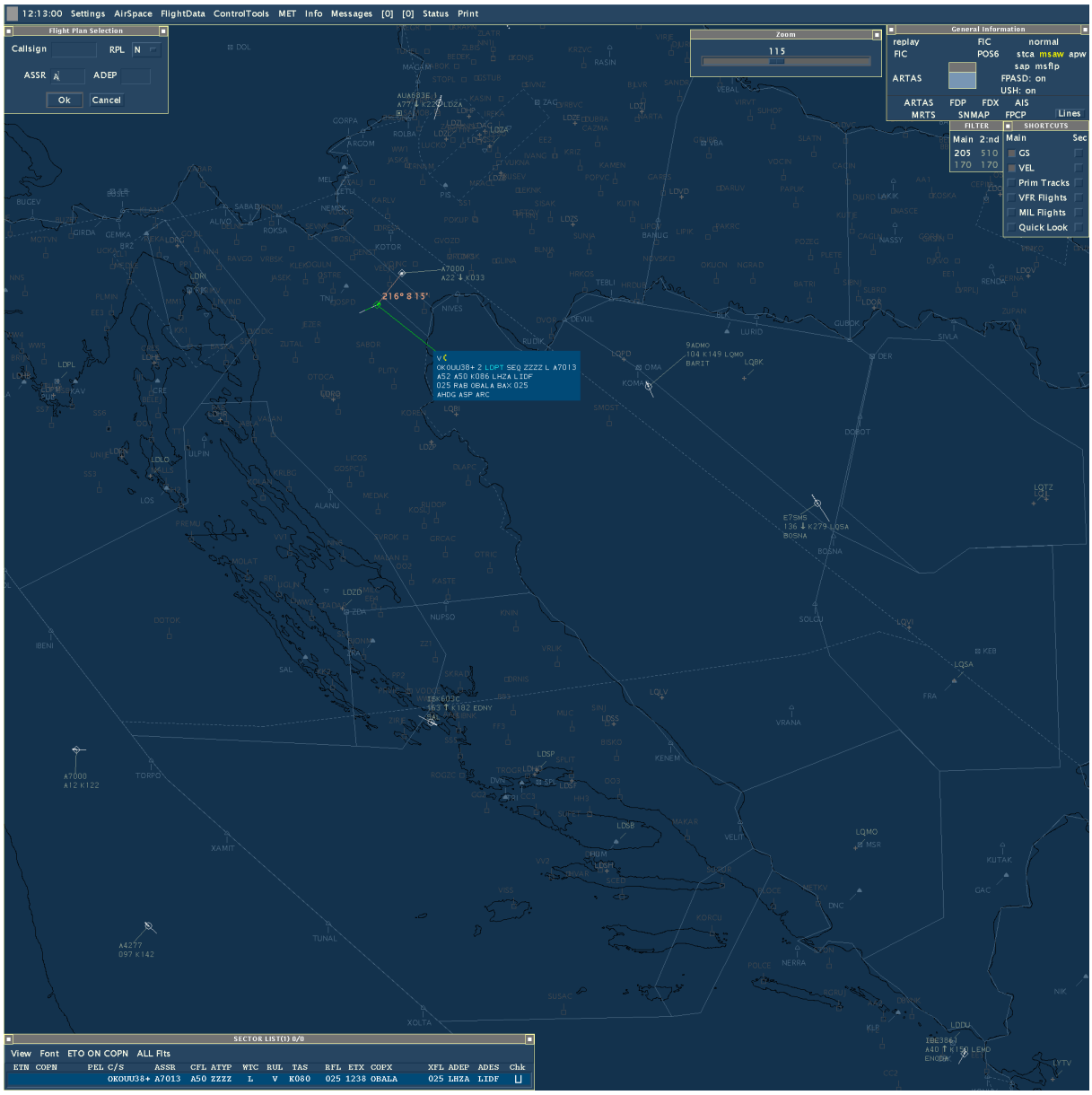


Image 8 Radar records; time: 12:13:00 UTC

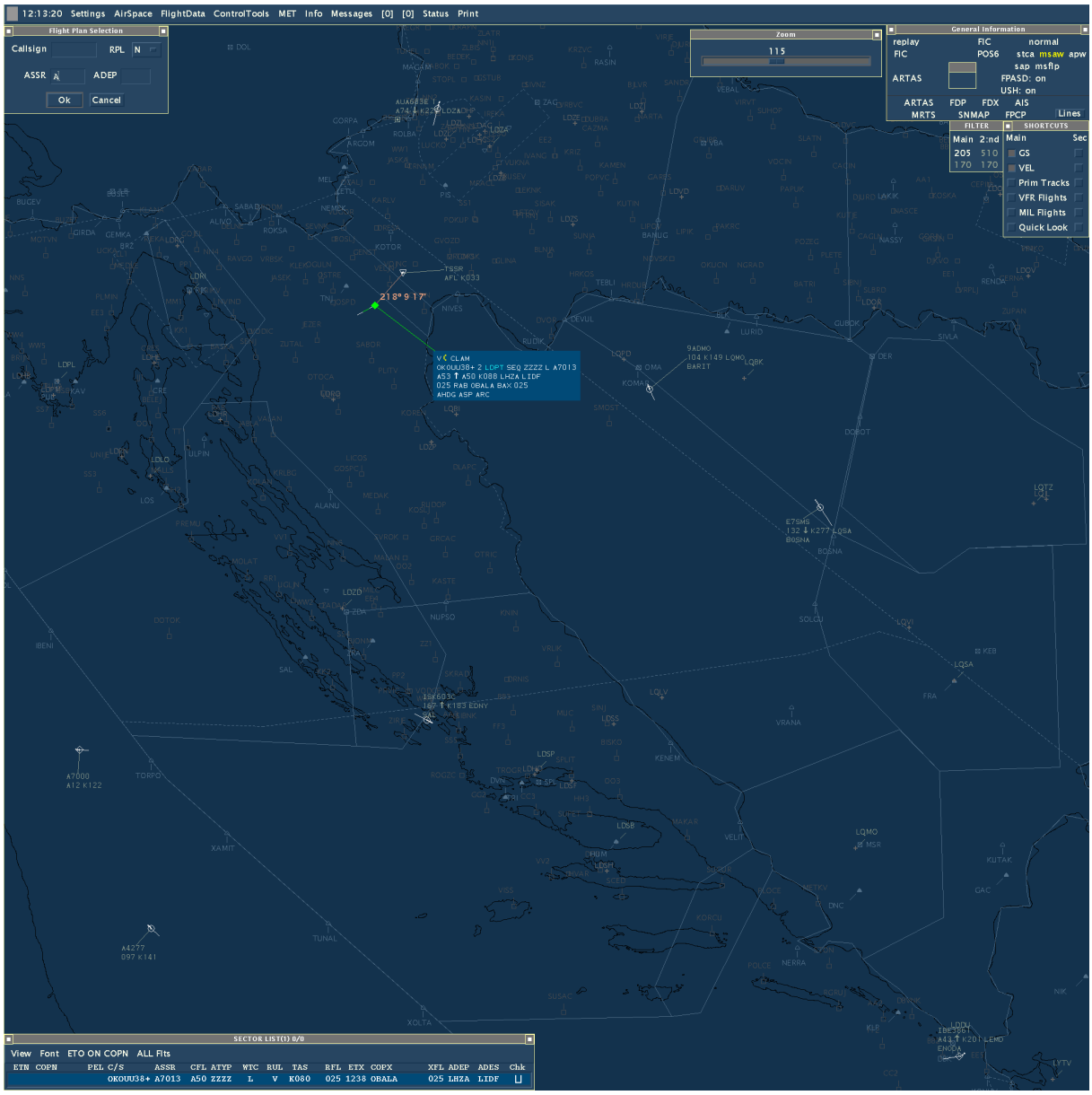


Image 9 Radar records; time: 12:13:20 UTC

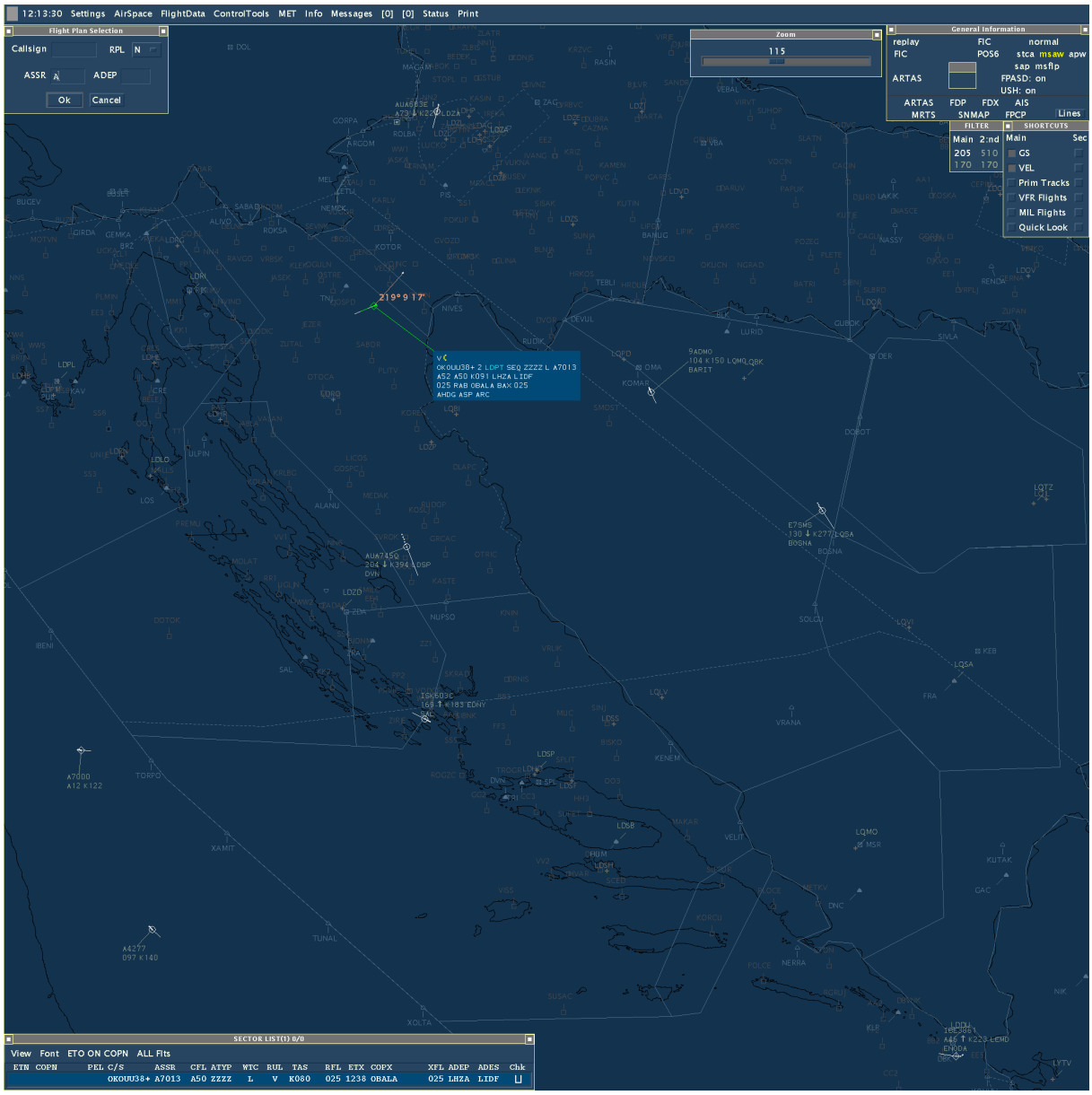
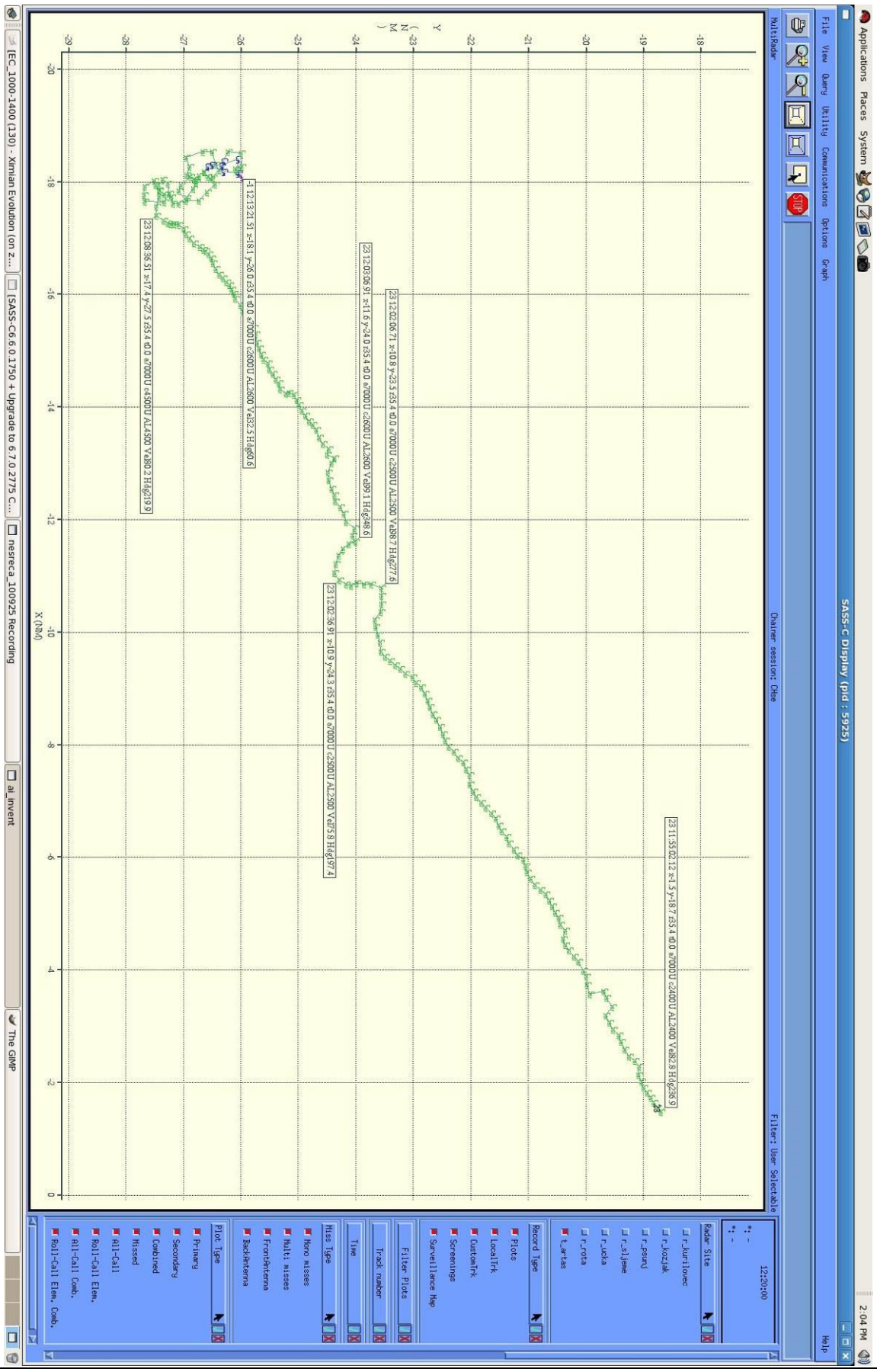


Image 10 Radar records; time: 12:13:30 UTC

Radar images show that aircraft SP-SKYL at 12:08:00 UTC was in formation with the group leader. At around 12:11:00 UTC (Image 6) the mentioned aircraft begins to fall behind the leading aircraft and at 12:13:20 UTC (Image 8) the Air Traffic Control loses its reflection on the screen.
The last record of the aircraft was on coordinates N 45°17'32" E 15°37'40".

1.1.3. Aircraft SP-SKYL trajectory

Source: Croatia Control Ltd.



1.2. INJURIES TO PERSONS

Injuries	Crew	Passengers	Others
Fatal	2	0	0
Serious	0	0	0
Minor/None	0	0	0

1.3. DAMAGE TO AIRCRAFT

After the impact on the ground, the aircraft was completely destroyed.

Image 11

1.4. OTHER DAMAGE

There was no other damage.

1.5. PERSONNEL INFORMATION

1.5.1. Pilot 1

Person	Date and place of birth: 03.04.1967.
License	UA190484
Issue date	12.09.2008.
Expiration date	29.08.2012.
Total flight hours	95 h

Pilot 1 owned a pilot's licence for ultra-light aircraft issued by Light Aircraft Association of the Czech Republic.
The licence is not in accordance with ICAO standards but was issued in accordance with valid regulation of the Czech Republic.

1.5.2. Pilot 2

Person	Date and place of birth: 14.12.1968.
License	UA190641
Issue date	05.08.2010.
Expiration date	04.08.2012.
Total flight hours	~ 25 h

Pilot 2 owned a pilot's licence for ultra-light aircraft issued by Light Aircraft Association of the Czech Republic.
The licence is not in accordance with ICAO standards but was issued in accordance with valid regulation of the Czech Republic.

1.5.3. Other crew members

None.

1.5.4. Other information

Additional information was obtained by the aircraft owner.

1.6. AIRCRAFT INFORMATION

1.6.1. Aircraft KP-5

Registration	SP-SKYL
Aircraft type and model	KP-5 ASA Skyleader 500
Features	Single-engine aircraft, low wing
Manufacturer	Jihlavan airplanes s.r.o.
Serial number	5153161 O
Year of manufacture	2009
Owner	SKYLEADER AIRCRAFT POLAND
Field of use	VFR
Engine	Piston
Total flight hours	470,7h (03.07.2010. log book)
No. of cycles	/
Fuel	/
Compulsory insurance policy	PZU SA 0LO MSP0 0331 Expiration: 04.04.2011.

1.6.2. Aircraft KP-5 characteristics

No. of seats	2 side by side
Length	7 m
Span	9,9 m
Height	2,60 m
Empty weight	302 kg
Maximum take-off weight	450 kg

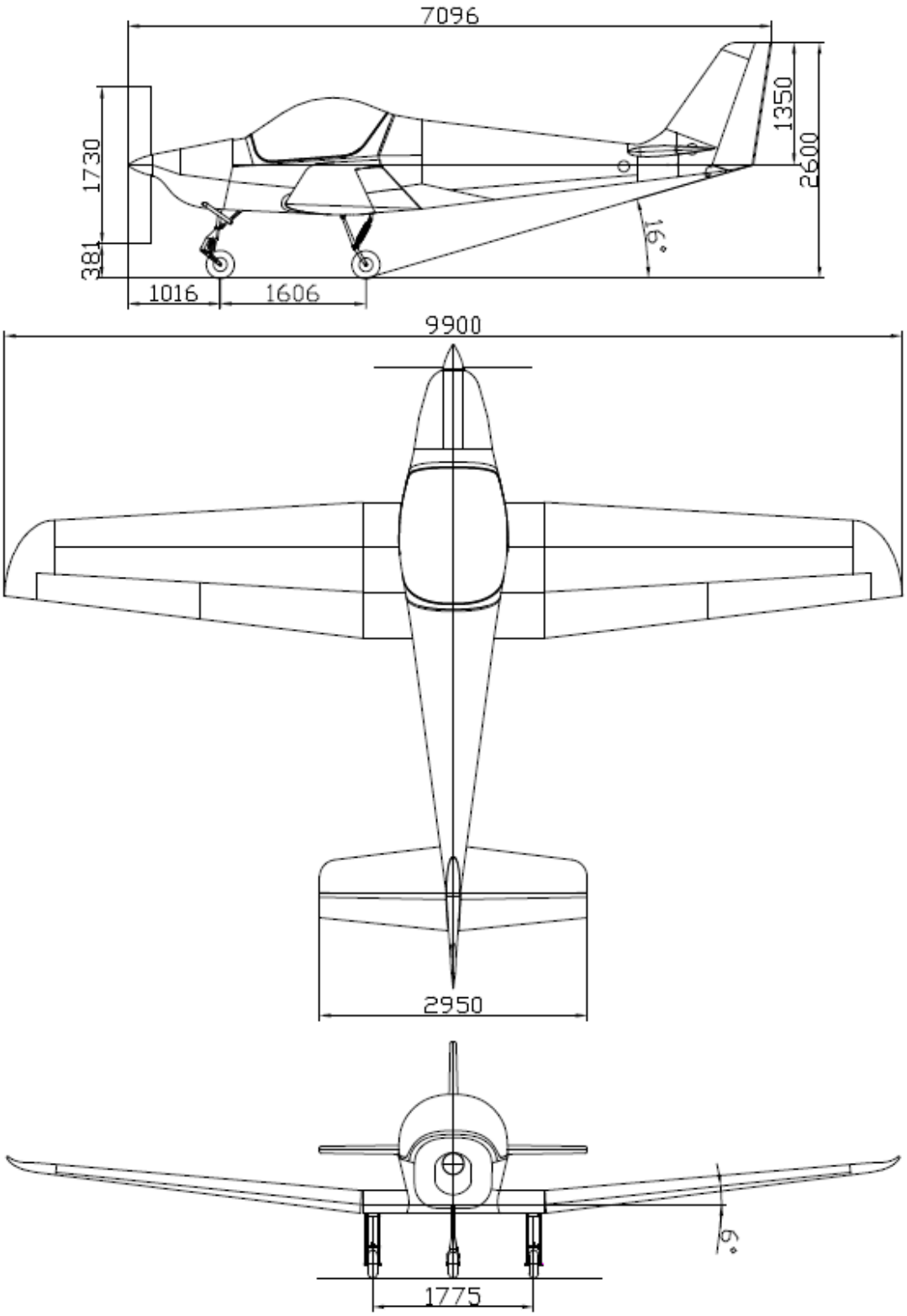


Image 12

1.6.3. Engine

Manufacturer	Bombardier Rotax GmbH
Type and model	912 ULS
Serial umber	5 652 290
Year of manufacture	2008
No. of working hours	502h 20' (25.07.2010. Engine Log book)

Image 13

1.6.4. Equipment

Flight instruments	Type	Serial number
Airspeed indicator	BK-3A	6825
Altimeter	BG-3E	0670
Vertical speed indicator	BC-2A	3245
Compass	CM-13	008 06 2008
Flaps control	PFC-10	0819/25
Radio device	ICOM A210	0101586
Antenna	CI 121	238045
Transveiver	Garmin GTX 320A	83814044
GPS	AVMAP EKP IV	9032528
Antenna GPS	SM-66	0045839
Propeller control	UNIMA-KS	PRO 0258/58

Source: Flight and maintainance manual.

Image 14

1.6.5. Certificates

Certificate of registration was issued on June 1st 2009 by the Civil Aviation Authority of Poland.

The aircraft didn`t own a Certificate of Airworthiness but was issued a Permit to Fly on September 1st 2009 by the Civil Aviation Authority of Poland.

Permit to Fly states:

Quote

„This document is not a Certificate of Airworthiness in compliance with the Annex 8 of the Convention of International flights or flights over the territory of any other State without permission of Aviation Authority of this State.“

End of quote

1.6.6. AIRCRAFT OPERATIONAL DATA

By the time of the accident, the aircraft was in a valid condition.

1.7. METEOROLOGICAL DATA

1.7.1. Introduction

Analysis of the weather conditions on the day of the accident i.e. September 25th 2010 near location Budačka Rijeka was created by using measured and observed data from the nearby meteorological stations:

- for data about vertical structure of the atmosphere, radio sounding measurements on station Zagreb-Maksimir were used,

- data about weather conditions from synoptic stations Ogulin and Karlovac (Image 14),
- data about weather conditions from climatological stations Topusko, Slunj, Gorinci, Bosiljevo and Plaški (Image 14),
- also, continuous measurements in 10-min interval from automatic meteorological stations Karlovac, Ogulin, Gorinci, Zavižan and Slunj were used

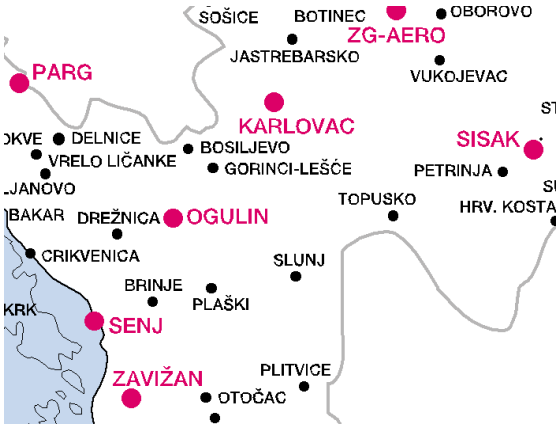


Image 15 Main (red) and climatological (black) meteorological stations of the Meteorological and Hydrological Service

As a supplement to measured and observed wind field data, results of model for numerical weather prediction Aladin/HR with a horizontal resolution of 2 km were used. In this way it is possible to get a better insight into the spatial distribution of the wind field and the processes that are associated with the development and structure of vertical motion over the observed area.

As a supplement to measured and observed cloudiness data from the closest stations, satellite images obtained from MSG weather satellite and radar images of precipitation fields; clouds and flow measurements obtained by measurements from radar stations Lisca (Slovenia) and Bilogora (Croatia) were used. In this way it is possible to get a better insight into the distribution of cloudiness over the area where the aircraft accident occurred (Image 16).

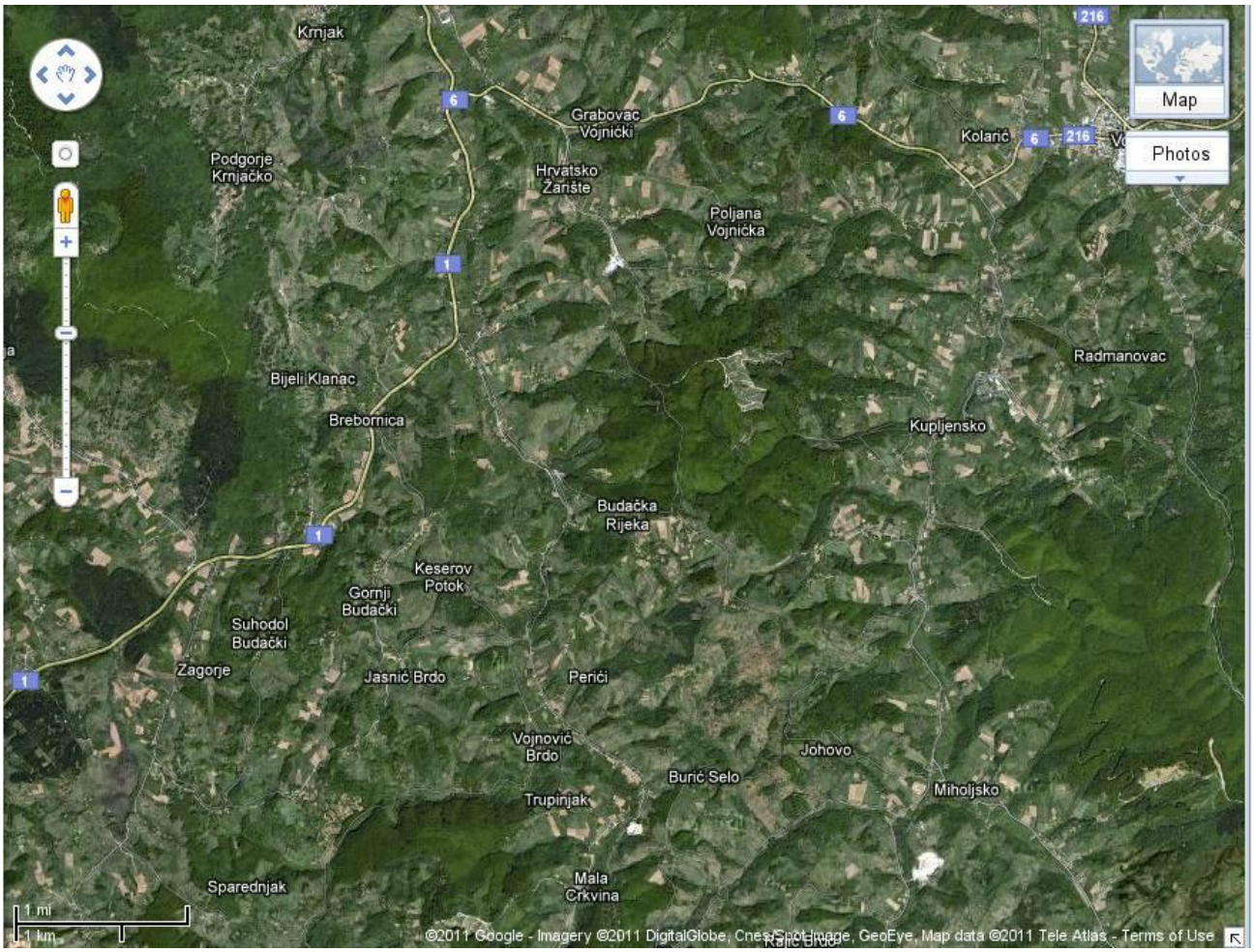


Image 16 Satellite image of the area near Budačka Rijeka

1.7.2. Description of the weather conditions in the area of Budačka Rijeka on September 25th 2010

Prognostic fields of air pressure (hPa) and mean 10-min wind speed for a wider range of the aircraft accident (not shown in the pictures), resulting by model Aladin at 2 km resolution, show that in the observed period, the air pressure was low. Wind at 10 m above the ground in Budačka Rijeka was weak with weak to moderate gusts (Image 17). Wind at 16:00 hours (13 UTC) 10 m above the ground in the area east of the crash site was mostly northeast and to the west weak northwestern. Therefore, in the area of Budačka Rijeka at that time a zone of convergence in the field of wind appears. Such zones of convergence enduce convection and the occurrence of convective cloudiness and precipitation. Some of the stations that were used in this study are surrounded by an extremely complex terrain and on them, the wind direction is much more dependent on local terrain and the local air flow.

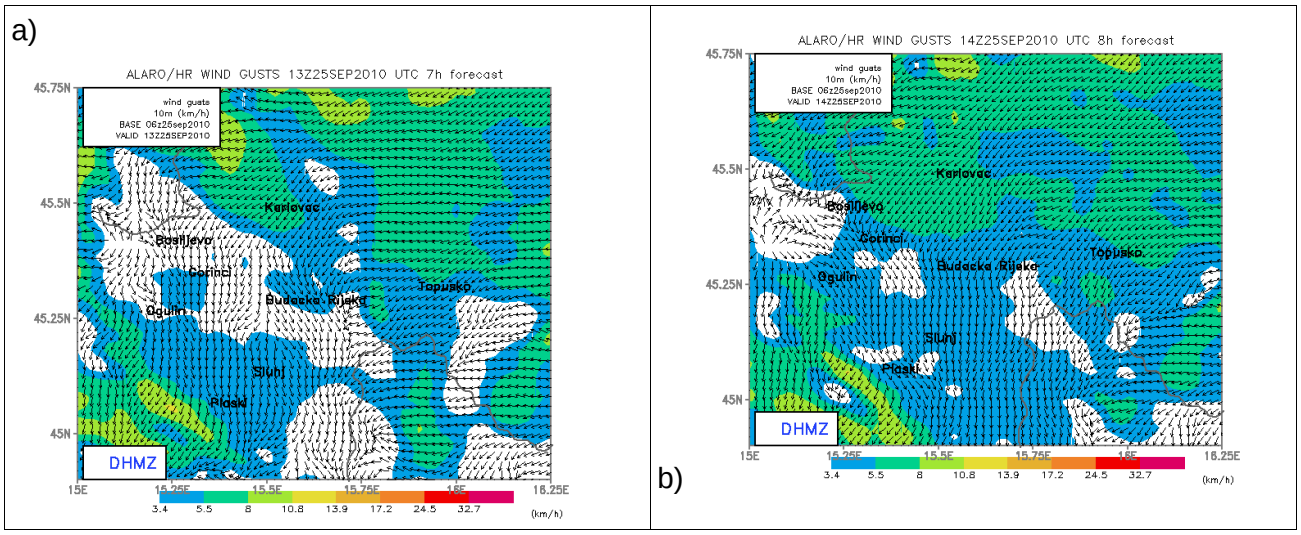


Image 17 Wind gusts (shaded) and wind direction (arrows) obtained by model Aladin with 2 km horizontal resolution, for 15 (a) and 16 (b) hours LT (13 and 14 UTC) on September 25th 2010.

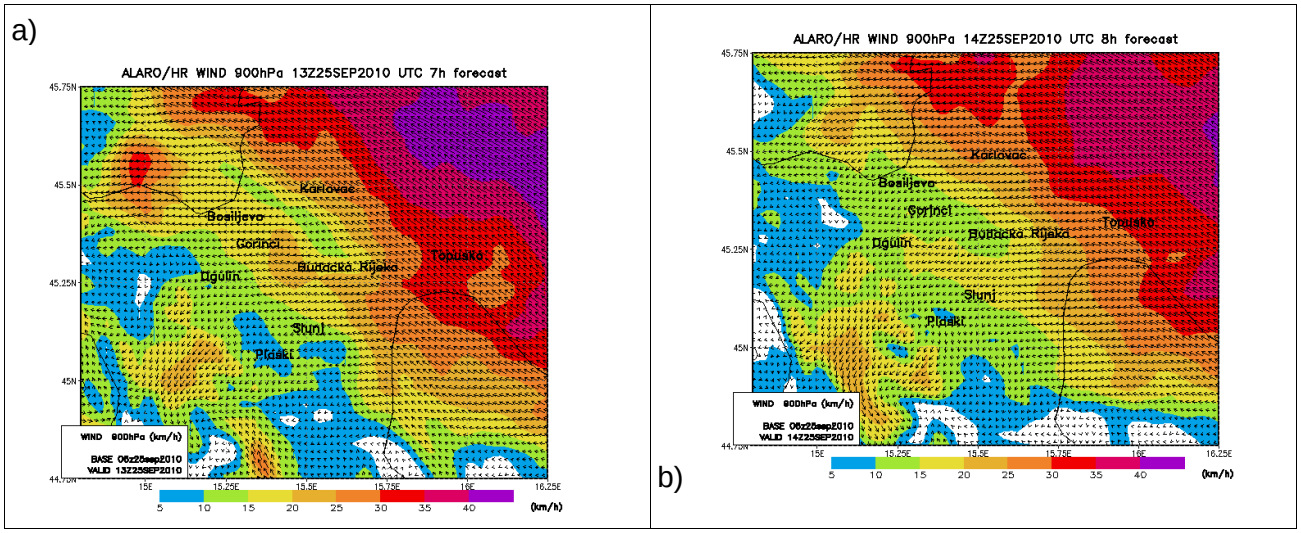


Image 18 Wind speed (shaded) and direction (arrows) at a surface of 900 hPa (aprox. 1 km above the ground) obtained by model Aladin with 2 km horizontal resolution, for 15 (a) and 16 (b) hours LT (13 and 14 UTC) on September 25th 2010.

Prognostic wind field at an altitude of 900 hPa isobaric surface (Image 18), which is situated at an altitude of 1 km, indicate that the wind was strong south-eastern northwest of the area of Budačka Rijeka; over Budačka Rijeka has weakened, and southwest of Budačka Rijeka was weak and changeable. That also points to the convergence of wind field in the observed area.

Table 1 Observed visibility, cloudiness and wind, and the measured temperature, pressure and humidity at synoptic stations Karlovac and Ogulin, for September 25th 2010, 10-14 local time.

Station	**Karlovac**					**Ogulin**				
Hours	**10**	**11**	**12**	**13**	**14**	**10**	**11**	**12**	**13**	**14**
Visibility (km)	3	2	2	2	2	4	4	4	4	4
Cloudiness (1/8)	10	10	10	10	10	10	10	10	10	10
Cloud type	Ns St op Cu fra	Ns St op Cu fra	Ns St op Cu fra	Ns St op Cu fra	Ns St op Cu fra	Ns St fra	Ns St fra	Ns St fra	Ns St fra	Ns St fra
Cloud base	2.0 0.6	2.0 0.6	2.0 0.6	2.0 0.6	2.0 0.6	1.0 0.3	1.0 0.3	1.0 0.3	1.0 0.3	1.0 0.3
Wind (speed)	1	2	2	2	1	1	1	1	1	1
Wind (direction)	NE	NE	NNE	NE	E	NE	NE	NW	NW	W
Temperature °C	14.7	14.9	14.9	15.0	14.8	14.3	13.8	13.8	13.7	14.1
Pressure (hPa)	999.3	999.3	998.4	998.3	998.0	998.4	998.5	998.2	997.9	997.7

Table 1 shows observed visibility, cloudiness and wind, measured temperature, pressure and humidity at synoptic stations Karlovac and Ogulin which are located near Budačka Rijeka. Synoptic station locations are shown in Image 15. Synoptic stations record the weather every hour and the observer also gives a description of the weather that prevailed that day. However in the period from 15 to 18 hours local time there were no measurements on the synoptic stations.

Table 2 Observed visibility (km), cloudiness (tens), wind direction and strength (Beaufort) and the measured temperature and relative humidity at climatological stations near Budačka Rijeka on September 25th 2010 at 7, 14 and 21 hours local time.

	Topusko			**Slunj**			**Plaški**			**Postaja Lešće-Gorinci**			**Bosiljevo**		
Hours	**7**	**14**	**21**	**7**	**14**	**21**	**7**	**14**	**21**	**7**	**14**	**21**	**7**	**14**	**21**
Visibility (km)	0.5	0.5	1	9	4	4	<10	<10	1				0.2	2	2
Cloudiness (1/10)	10	10	10	10	10	10	9	10	10	10	10	10	10	10	10
Wind (Bf)	2	3	2	1	1	1	1	1	1	2	2	3	1	1	2
Wind (direction)	SE	NE	NW	E	WSW	W	NW	WSW	NE	NW	NW	NW	N	SW	N
Temperature °C	12.7	15.0	15.2	12.	13.7	14.	11.	13.4	13.4	14.2	15.0	14.5	14.	14.7	14.7

Measured and observed data from climatological stations near Budačka Rijeka were used at which the measurements are made regularly at 7, 14 and 21 hours local time, and the observer also gives a description of the weather that prevailed on that day. These are stations Slunj, Plaški, Topusko, Bosiljevo and Gorinci. Station locations are shown in Image 15 and observed and measured data in Table 2.

Table 3 Measured speed, direction and wind gusts in km/h, temperature in °C, relative humidity in % and the pressure measured in hPa at automatic stations Karlovac and Ogulin for period from 12 to 17 hours local time on September 25th 2010. Pressure wasn`t reduced to mean sea level.

	Karlovac					Ogulin					
time	**speed**	**dir**	**gusts**	**temp**	**relh**	**speed**	**dir**	**gusts**	**temp**	**relh**	**press**
12.00	6.1	35	12.6	14.9	97	3.2	62	13.0	13.6	93	960.9
12.10	8.3	47	16.9	14.8	97	2.2	28	6.8	13.6	93	960.9
12.20	9.4	60	21.6	14.8	97	1.4	56	6.5	13.6	93	960.8
12.30	9.4	44	15.8	14.8	97	2.2	326	8.3	13.6	93	960.7
12.40	6.5	38	13.7	14.8	97	1.8	28	5.0	13.7	93	960.6
12.50	6.5	35	12.6	14.9	97	2.9	23	8.6	13.6	93	960.6
13.00	6.1	46	16.6	14.9	97	1.1	343	5.8	13.6	93	960.7
13.10	3.2	26	9.4	14.9	97	1.1	84	4.7	13.6	93	960.6
13.20	6.1	35	12.6	15.0	97	0.4	264	3.2	13.5	93	960.7
13.30	4.3	30	10.8	15.0	97	2.2	343	8.3	13.5	93	960.4
13.40	3.6	27	9.7	15.0	97	3.2	281	6.8	13.5	93	960.7
13.50	2.9	17	6.1	15.0	97	2.2	343	5.8	13.5	93	960.3
14.00	6.1	41	14.8	15.0	97	1.4	315	5.8	13.6	93	960.2
14.10	10.4	58	20.9	14.9	97	2.5	354	8.6	13.6	94	960.1
14.20	10.4	70	25.2	14.8	97	3.2	264	7.2	13.6	94	960.0
14.30	5.0	40	14.4	14.8	97	0.0	293	2.2	13.7	94	960.0
14.40	4.7	29	10.4	14.7	97	0.7	309	3.6	13.8	94	960.1
14.50	5.4	30	10.8	14.7	97	1.4	264	4.3	13.9	93	960.2
15.00	5.0	30	10.8	14.7	97	2.5	264	6.1	13.9	93	960.2
15.10	2.5	34	12.2	14.8	97	2.2	298	7.9	13.9	93	960.2
15.20	2.2	14	5.0	14.9	97	4.7	298	8.6	13.9	93	960.1
15.30	2.5	14	5.0	14.9	97	4.0	293	7.9	13.8	94	960.2
15.40	1.8	17	6.1	14.9	97	3.6	281	7.6	13.8	94	960.3
15.50	1.8	13	4.7	14.9	97	3.2	309	6.8	13.9	94	959.9
16.00	2.9	19	6.8	14.9	97	2.5	298	6.5	13.9	94	960.0
16.10	1.4	14	5.0	14.9	97	4.0	298	6.8	13.9	94	960.0
16.20	2.5	16	5.8	14.9	97	3.2	264	9.7	13.9	94	960.2
16.30	2.2	17	6.1	14.9	97	3.2	287	7.9	13.8	94	960.1
16.40	1.8	13	4.7	14.9	97	2.9	298	5.8	13.8	94	959.9
16.50	3.2	22	7.9	14.9	97	2.5	298	5.0	13.9	94	959.5
17.00	4.7	35	12.6	14.9	97	3.2	332	7.2	14.1	94	959.5

At automatic stations, measured data is recorded every 10 minutes. Automatic weather stations in the vicinity of Budačka Rijeka are stations Karlovac, Ogulin, Gorinci, Zavižan and Slunj. Locations of automatic stations are indicated in Image 15 and Images 17 and 18. Air pressure is not measured at automatic stations Karlovac and Gorinci. Precipitation is measured only at automatic stations Ogulin, Slunj and Zavižan.

It was completely cloudy the whole day. At synoptic stations, cloudiness type Nimbostratus, flooring level 2 km over Karlovac and 1 km over Ogulin were oserved. Below Nimbostratus were clouds type Stratus opacus, Cumulus fractus and Stratus fractus. Visibility was reduced or bad. In Topusko and Bosiljevo at 14 hours, fog and haze were recorded. The occurrence of moderate and heavy rain with short interruptions, which was falling from morning to afternoon or evening, depending on the station, was recordered. The occurrence of thunder or lightning was not recorded.

The pressure was falling at a moderate speed which indicates a passing of an atmospheric front. The wind was weak and changeable, except in Topusko and Gorinci where it was moderate. Topusko recorded north and Gorinci northwest wind, which is consistent to predicted wind direction at these two locations (Image 17). Air temperature has slightly

changed during the day, from 12 to 15°C. The air was saturated with steam. This is consistent with completely cloudy, rainy and humid weather.

Table 4 Measured speed, direction and wind gusts in km/h, temperature in °C, relative humidity in % and the pressure measured in hPa at automatic stations Gorinci and Slunj for period from 12 to 17 hours local time on September 25th 2010. Pressure wasn`t reduced to mean sea level.

	Gorinci					Slunj					
time	**speed**	**dir**	**gusts**	**temp**	**relh**	**speed**	**dir**	**gusts**	**temp**	**relh**	**press**
12.00	6.1	45	11.5	13.7	100	1.1	253	6.1	13.5	99	953.9
12.10	5.4	28	14.4	13.7	100	2.9	343	7.6	13.4	99	953.8
12.20	6.5	28	11.5	13.5	100	2.5	326	10.1	13.4	99	953.7
12.30	0.7	28	6.5	13.6	100	3.6	343	9.0	13.2	100	953.6
12.40	0.4	326	6.5	13.6	100	2.5	28	7.6	13.1	100	953.5
12.50	5.0	326	11.2	13.7	100	3.2	354	11.2	13.1	100	953.6
13.00	3.2	343	11.5	13.8	100	3.2	343	8.6	13.0	100	953.6
13.10	2.5	326	8.3	13.9	100	0.4	281	5.8	13.0	100	953.7
13.20	1.4	326	7.9	13.8	100	1.8	276	4.7	12.9	100	953.5
13.30	4.0	264	8.3	13.8	100	1.1	326	5.0	12.9	100	953.4
13.40	4.3	326	7.9	13.8	100	1.4	253	4.7	13.0	100	953.5
13.50	4.0	253	11.2	13.9	100	5.0	208	10.8	12.9	100	953.7
14.00	7.2	253	15.1	13.8	100	1.4	281	6.1	12.8	100	953.4
14.10	0.4	298	4.3	13.8	100	2.5	326	7.9	12.9	100	953.4
14.20	0.0	39	0.7	13.9	100	4.3	28	9.7	13.0	100	953.1
14.30	2.9	73	8.6	14.0	100	1.8	11	8.6	13.1	100	952.9
14.40	2.2	281	6.1	14.0	100	3.2	225	9.4	13.2	100	953.2
14.50	0.0	9999	0.0	14.2	100	4.0	236	8.6	13.0	100	953.1
15.00	1.8	281	7.2	14.6	100	2.5	253	7.6	13.0	100	953.1
15.10	4.3	281	9.4	14.2	100	2.5	236	9.7	13.0	100	953.2
15.20	6.5	293	10.1	14.2	100	2.9	253	7.6	13.0	100	953.1
15.30	5.8	298	10.4	14.2	100	3.6	281	8.3	13.1	100	953.1
15.40	4.0	298	8.3	14.1	100	3.6	236	8.3	13.1	100	953.2
15.50	5.0	298	10.4	14.1	100	3.2	253	8.6	13.1	100	953.2
16.00	1.8	343	8.6	14.1	100	1.4	281	7.2	13.2	100	953.2
16.10	0.4	34	5.0	14.1	100	2.2	281	6.5	13.2	100	953.3
16.20	2.5	28	9.7	14.1	100	1.8	281	7.2	13.2	100	953.2
16.30	4.3	28	11.2	13.9	100	2.9	281	8.3	13.2	100	952.9
16.40	1.4	354	9.4	13.9	100	3.2	253	10.4	13.2	100	953.0
16.50	6.8	28	14.4	13.9	100	2.2	253	7.2	13.3	100	952.9
17.00	7.2	28	12.2	13.9	100	0.7	343	4.0	13.4	100	952.7

Table 5 Measured speed, direction and wind gusts in km/h, temperature in °C, relative humidity in % and the pressure measured in hPa at automatic station Zavižan for period from 12 to 17 hours local time on September 25th 2010. Pressure wasn`t reduced to mean sea level.

	Zavižan					
time	**speed**	**dir**	**gusts**	**temp**	**relh**	**press**
12.00	13.7	288	22.0	9.3	99	825.8
12.10	14.8	312	25.6	9.1	100	825.6
12.20	13.3	284	24.5	9.0	100	825.5
12.30	10.4	288	18.4	8.9	100	825.7
12.40	8.6	272	14.0	8.9	100	825.6
12.50	10.8	280	16.2	8.9	100	825.5
13.00	10.8	288	17.6	8.8	100	825.7
13.10	10.4	304	18.4	8.7	100	825.7
13.20	7.6	288	11.5	8.7	100	825.4
13.30	8.6	304	15.5	8.7	100	825.5
13.40	7.2	312	12.2	8.7	100	825.3
13.50	7.2	312	10.8	8.9	100	825.2
14.00	5.8	312	10.1	9.0	100	825.1
14.10	2.2	0	5.4	9.0	100	825.1
14.20	2.9	272	6.5	9.1	100	825.2
14.30	1.1	272	4.3	9.2	100	825.1
14.40	4.7	272	11.9	9.3	100	825.3
14.50	10.4	272	18.7	9.1	100	825.2
15.00	9.7	300	16.9	9.0	100	825.3
15.10	6.1	308	11.5	8.9	100	825.2
15.20	7.2	312	10.8	8.9	100	825.3
15.30	7.6	328	13.3	8.8	100	825.2
15.40	3.6	0	10.4	8.8	100	825.3
15.50	1.8	0	5.8	8.9	100	825.4
16.00	5.0	92	13.7	8.9	100	825.3
16.10	8.3	272	24.5	9.0	100	824.8
16.20	5.4	0	11.2	9.4	98	824.9
16.30	6.5	304	15.1	9.8	98	824.9
16.40	10.8	320	20.9	9.8	98	825.0
16.50	10.8	308	18.4	9.8	99	825.0
17.00	6.8	272	15.1	9.8	99	825.0

Wind charts near the ground resulting by model Aladin (Image17) show the variability of wind direction and intensity of gusts in the area. Measured mean 10-min wind speed in time is weak and variable (Image 19, dark blue line) at stations Ogulin, Slunj and Gorinci in the period from 10 to 17 hours (8-15 UTC) on September 25th 2010. Mean wind speed and gusts were slightly stronger at stations Zavižan and Karlovac. It is also evident that at these stations, during the observed period, besides the low to moderate wind speed (up to 10 km/h), stronger gusts are present, even up to 25 km/h (red line on Image 19). Before 13 hours (11 UTC) northeast wind is dominant at stations Gorinci, Karlovac and Ogulin, and then the wind direction changes to northwest (green dots in Image 19). At station Slunj wind direction changes from north to west, and at station Zavižan from southeast to northwest earlier, between 11 and 12 hours (9 and 10 UTC). Changes in wind direction are consistent to passing of an atmospheric front.

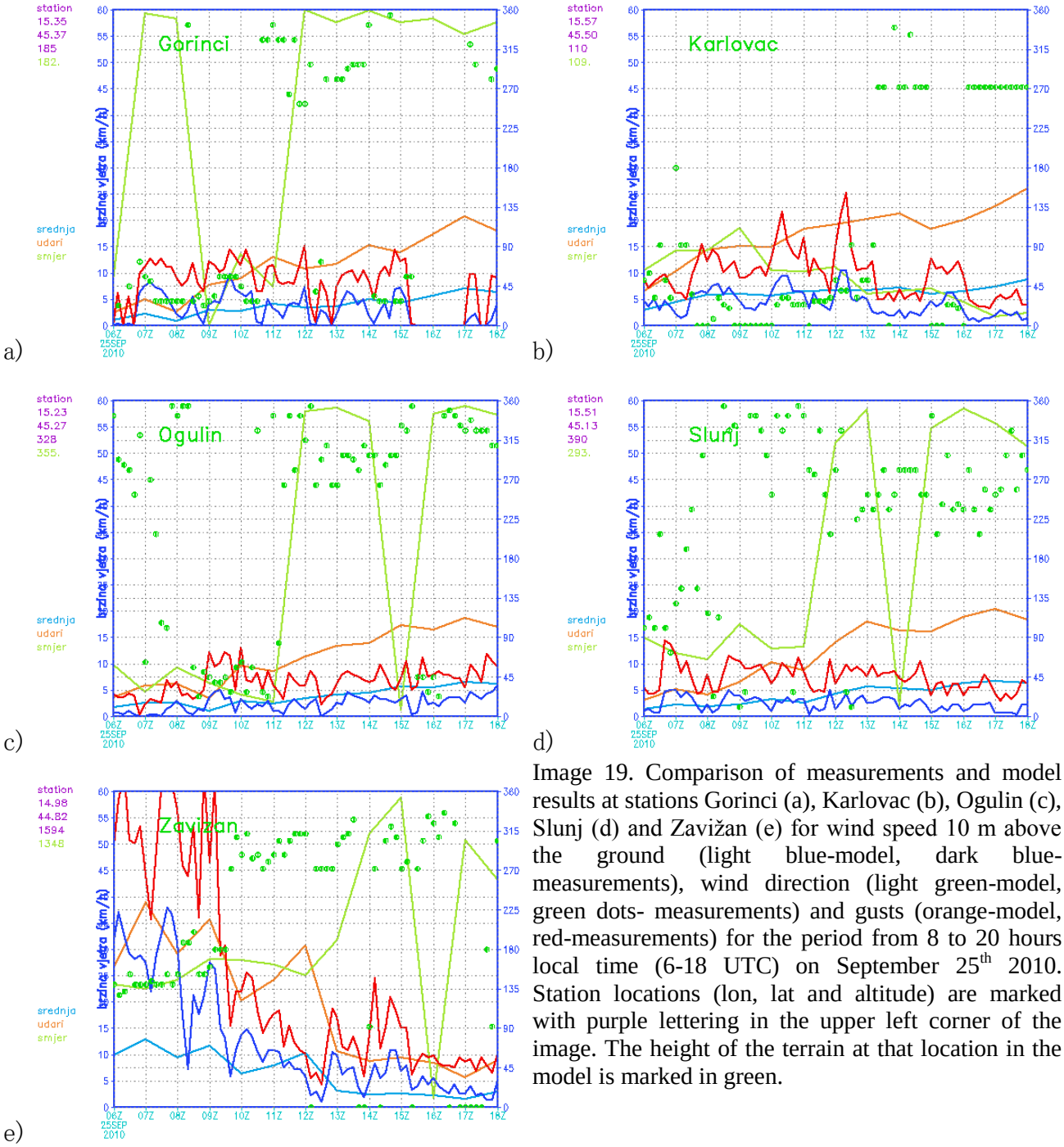
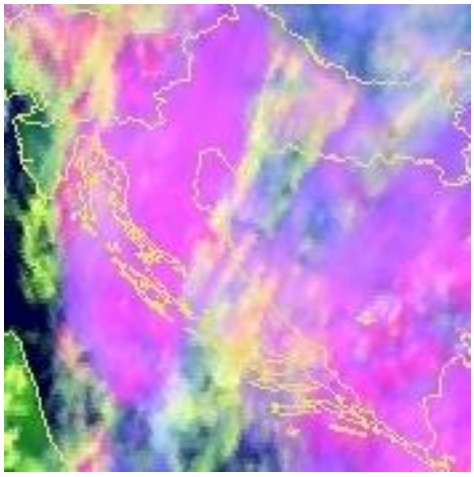
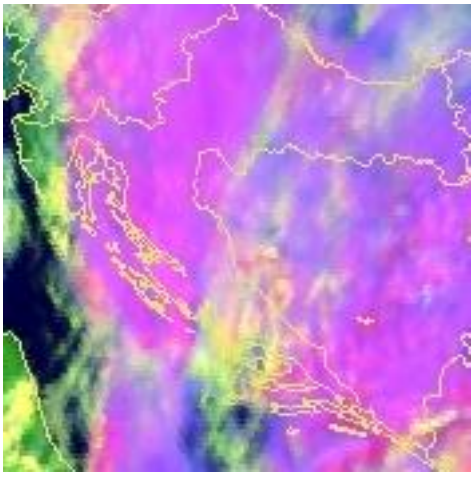


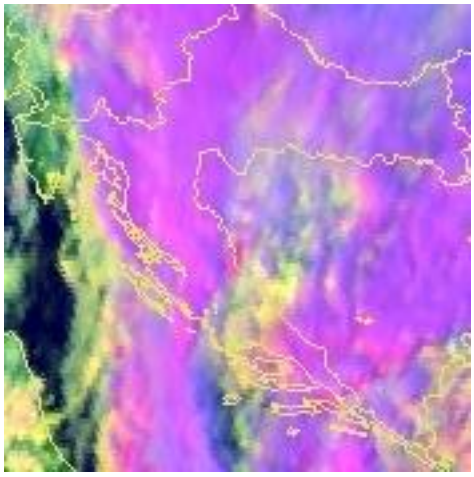
Image 19. Comparison of measurements and model results at stations Gorinci (a), Karlovac (b), Ogulin (c), Slunj (d) and Zavižan (e) for wind speed 10 m above the ground (light blue-model, dark blue-measurements), wind direction (light green-model, green dots- measurements) and gusts (orange-model, red-measurements) for the period from 8 to 20 hours local time (6-18 UTC) on September 25th 2010. Station locations (lon, lat and altitude) are marked with purple lettering in the upper left corner of the image. The height of the terrain at that location in the model is marked in green.

a) b)





c) d)



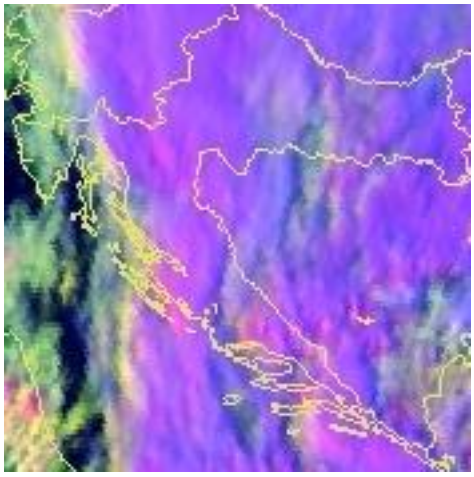


Image 20 Sattelite images of visible cloudiness at 13 hours (a), 14 hours (b), 15 hours (c) and 16 hours (d) local time (11, 12, 13 i 14 UTC) on September 25th 2010.

On satellite images (Image 20) over a wider area of Budačka Rijeka surroundings also are present high and convective clouds which have a cold cloud top (pink). A thicker layer of frontal convective cloudiness is stretching over the northwest Croatia, Gorski Kotar and Lika. Convective cloudiness is also located over the area of Karlovac. Surrounding area near Budačka Rijeka is also covered by convective clouds.

Lightning detection system hasn`t recorded the occurrence of lightning in the area of interest as well as observers at the synoptic and climatological stations. Therefore, we can conclude that in the field of the atmospheric front convection was present, from which it was raining in the form of showers but there was no thinderstorms.

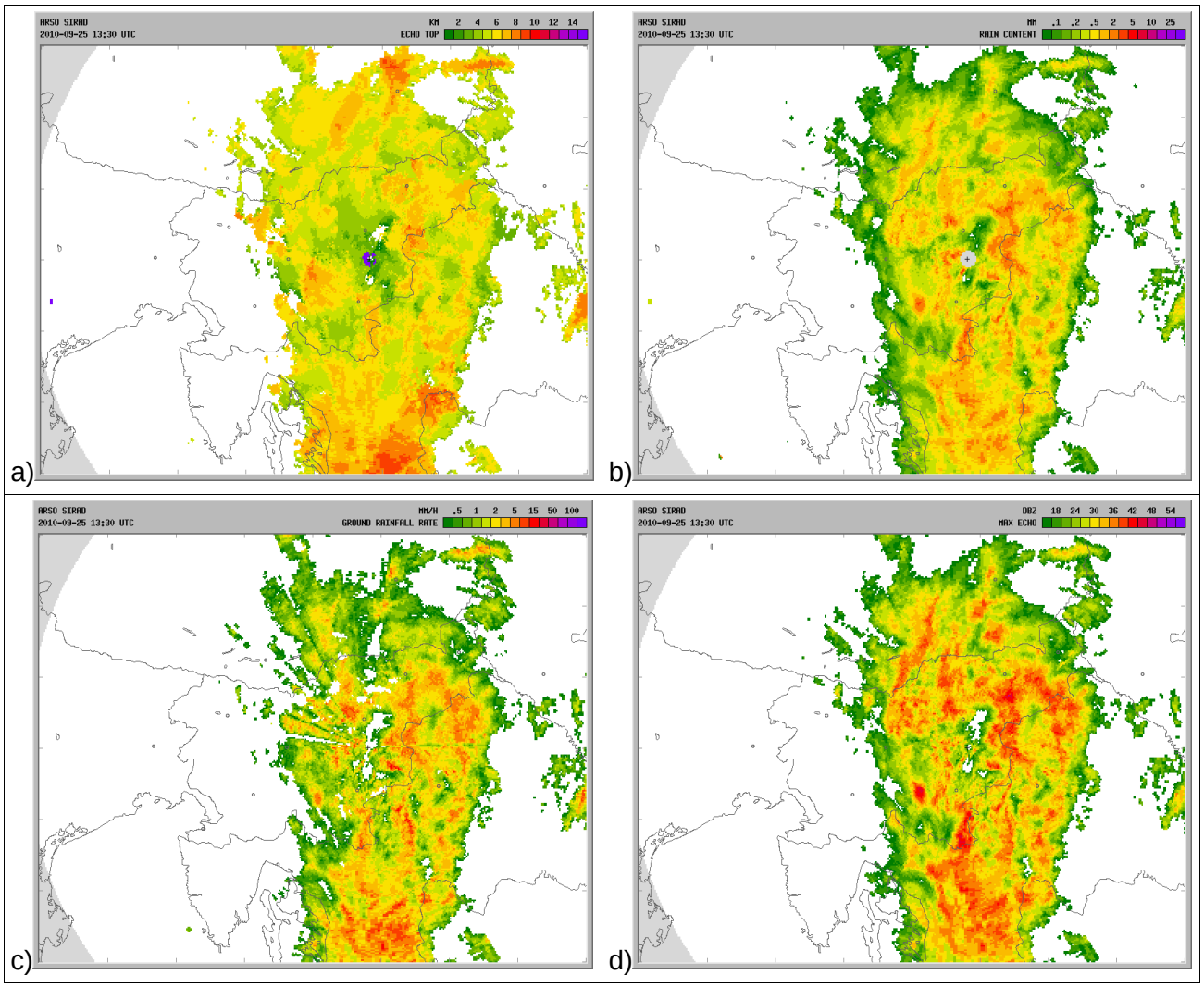


Image 21 The height of the cloud top (a), the amount of water in air (b), the intensity of precipitation at the ground (c) and the radar signal echo (d) measured on radar Lisca in Slovenia on September 25th 2010 at 15 hours and 30 minutes (13:30 UTC) .

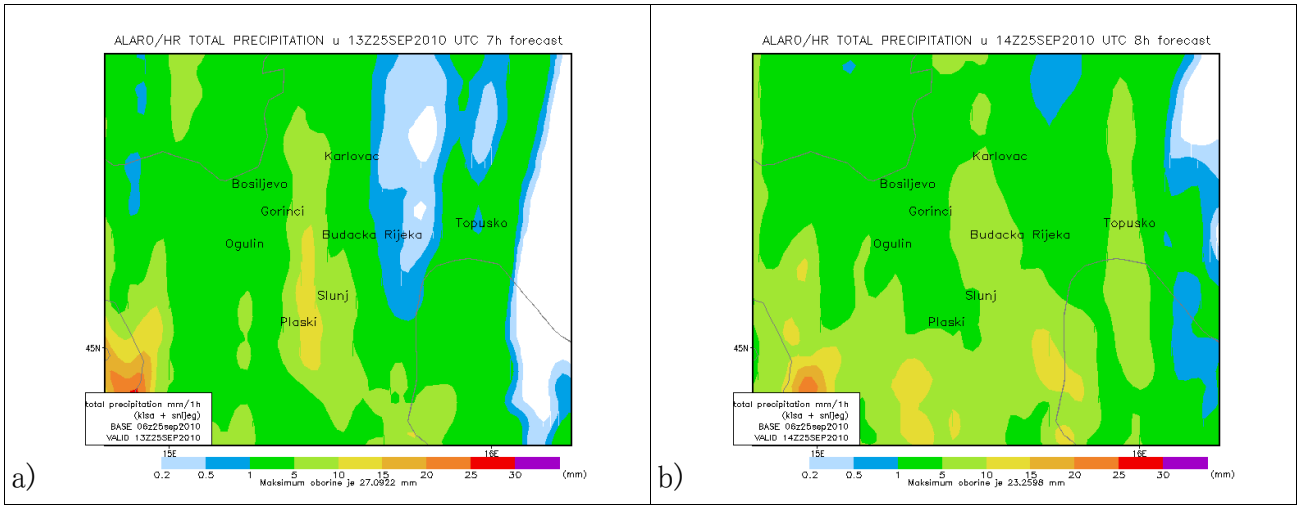


Image 22 Total percipitation calculated by model Aladin for the period 14-15 h (a) (12-13 UTC) and 15-16 h (b) (13-14 UTC) on September 25th 2010.

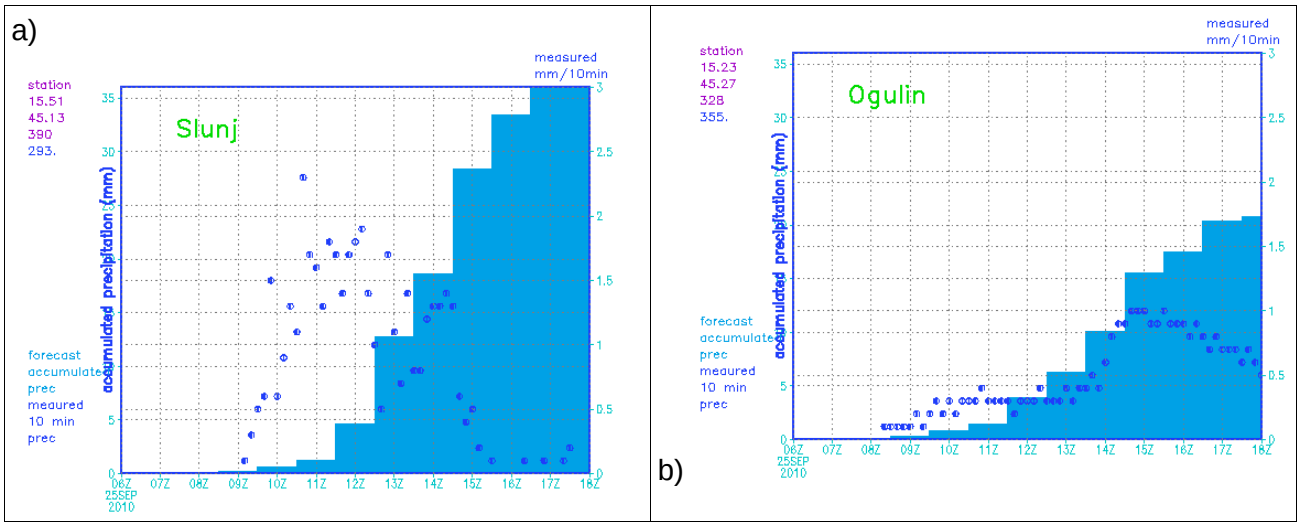


Image 23 Accumulated percipitation resulting by model Aladin (blue columns) and measured 10 minute percipitation (dark blue dots) at stations Slunj (a) and Ogulin (b) from 8-20 hours (6 to 18 UTC) on September 25th 2010.

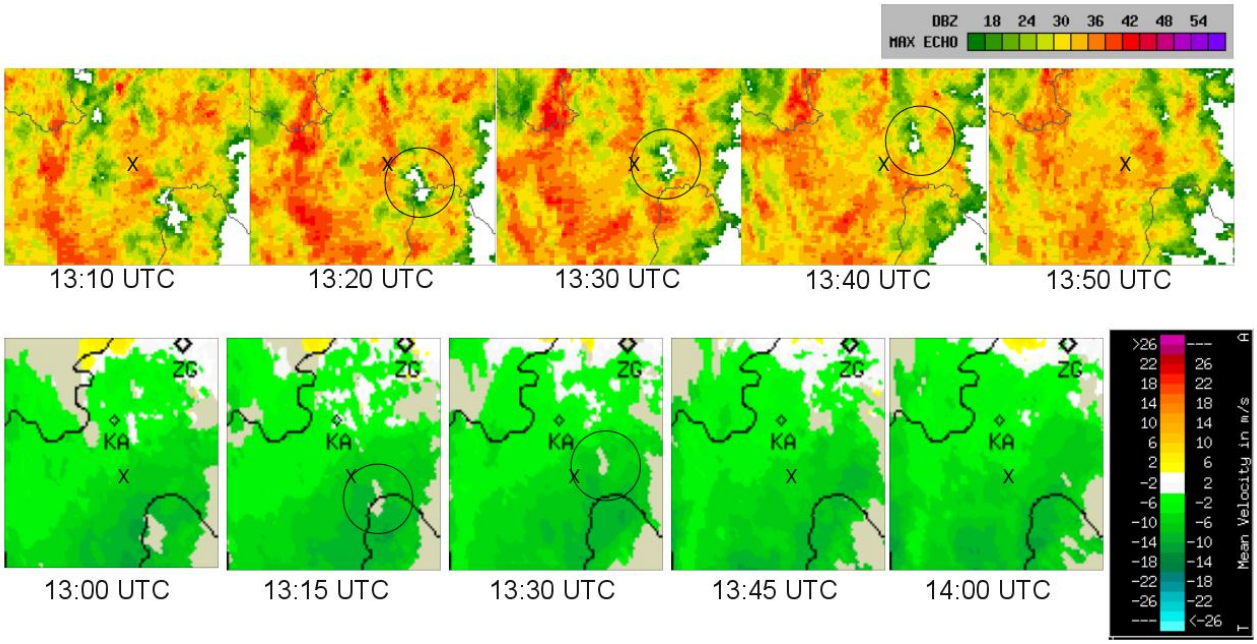


Image 24 Maximum reflection recorded on radar Lisca in Slovenia (top row of the images) and the radial velocity at 2 km above the ground was recorded on radar Bilogora in Croatia (bottom row of the images). Below the images is indicated in which period the cloud has been scanned. Beside the images, scales of reflectivity and velocity are shown.

Radar images show that in the area east of Budačka Rijeka, near Petrova Gora, between 15 and 16 hours (13 and 14 UTC) appears an area where there are no reflections (Image 21). This same area without reflection can be seen on images for radars Lisca and Bilogora (Image 24). This indicates the existence of holes in the clouds in the middle of the convective front that can occur due to strong vertical air flow downwards. At the same time, in the surrounding area there are convective clouds in which also strong vertical air flows exist. The bottom row of images on Image 24 shows the radial wind velocity at 2 km above the ground, calculated from the reflected glare measured at radar station Bilogora. On this image lack of reflection (marked by circle) can also be seen.

Field of precipitation resulting by model Aladin (Image 22) shows that, at the observed period from 14-15 hours (12-13 UTC), the rain was falling in intensity around 1 mm/h (Image 22a) and the next hour has increased to almost 5 mm/h (Image 22b). Such an increase in the

intensity of precipitation was recorded also at the automatic station in Ogulin where, up to 16 hours, precipitation had the intensity of 0.3mm/10 min (1.8mm / h, blue dots in Image 23b), and then increased to 1mm/10min (6mm/h). Automatic station in Slunj recorded significantly higher measured intensity of precipitation (Image 23a), from 1-2 mm/10min (6-12 mm/h). Ombrograf in Karlovac recorded precipitation intensity of 8.8mm/h. Model Aladin predicted a higher intensity of precipitation in Slunj than Ogulin (blue columns in Image 23). In the fields of forecasted precipitation (Image 22) an area of decreased intensity of precipitation east of Budačka Rijeka can be seen, in accordance with the radar images (Image 21) obtained from measurements of echo on radar stations.

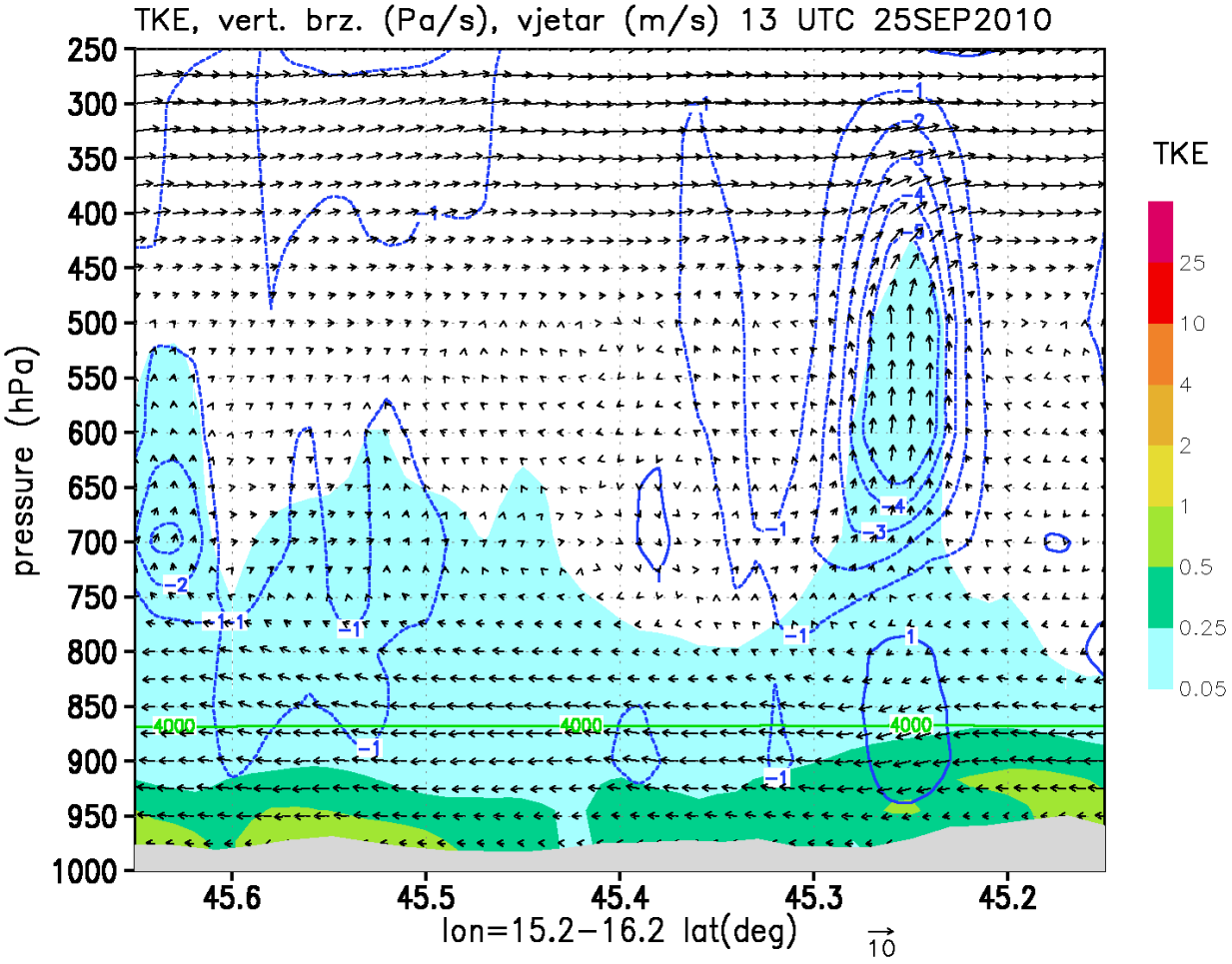


Image 25 The results of simulation by model Aladin: Cross-section by height (vertical axis is the pressure, from 1025-250 hPa) from point (lon= 15.2, lat = 45.65) to point (lon= 16.2, lat = 45.15) on September 25th 2010 at 15 hours local time (13 UTC), shows the turbulent kinetic energy (shaded), vertical velocity (blue isolines, unit Pa/s, positive velocity is downward, shown in full lines, negative velocity is upwards, shown as dotted lines), vectors show the wind parallel to the cross-section as a horizontal component and the vertical velocity as the vertical component. Also, the altitude of the flight is shown as the purple line. The height of the terrain in the model is shown in gray at the bottom of the image.

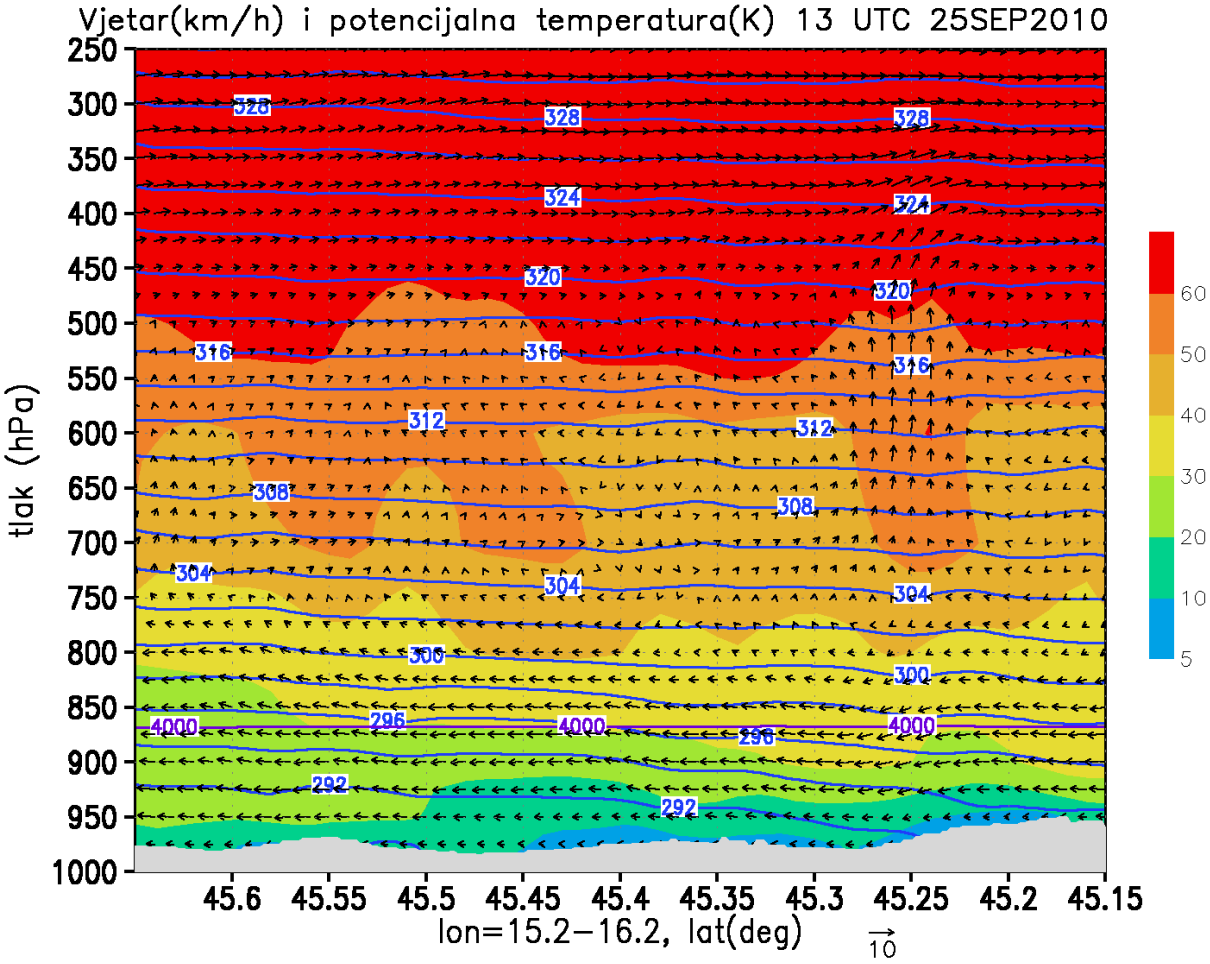


Image 26 Results of simulation by model Aladin: Cross-section by height (vertical axis is the pressure, from 1025-250 hPa) from point (lon= 15.2, lat = 45.65) to point (lon= 16.2, lat = 45.15) on September 25th 2010 at 15 hours local time (13 UTC), displays wind speed (shaded) and direction (vectors) and potential temperature (blue isolines). Also, flight altitude of 4000 feet is shown as the purple line. The height of the terrain in the model is shown in gray at the bottom of the image.

Images 25, 26 and 27 show the vertical cross-section by height (vertical axis is the pressure, from 1025-250 hPa) from point (lon= 15.2, lat = 45.65) to point (lon= 16.2, lat = 45.15) in an area near the aircraft accident site.

Image 25 shows turbulent kinetic energy, vertical wind speed and direction. Turbulent kinetic energy is shown shaded in color, vertical velocity is expressed in Pa/s, positive values are downward and displayed as full isolines, and negative values are upward and shown as dotted lines. Vectors show the wind parallel with the cross-section as the horizontal component and vertical velocity as the vertical component. The length of the arrow is proportional to the intensity of air flow. Image 25 shows ascending motion at an altitude of 700-400 hPa (3-7 km) and an increase of turbulent kinetic energy in this area. Maximum turbulence was recorded in the lee of Petrova Gora, in the layer from the ground to 900 hPa (1 km). The mountain wave has not originated.

Image 26 shows wind speed and direction and potential temperature. Wind speed is shown shaded in color, potential temperature is shown in blue isolines, wind direction is shown in arrows as in Image 25. Vertical flow in Image 26 is expressed as omega (units Pa/s). Speed of the upwelling of 1 Pa/s at 900 hPa level (approximately 1000 m) corresponds to the vertical speed of about 4 km/h (1.1 m/s). Maximum turbulent kinetic energy at an altitude of 4000 feet is below 0:25 m2/s2. This shows that the velocity in turbulent vortexes was below 1.8 km/h

(0.5 m/s). Modeled mean horizontal component of wind velocity at the same altitude is from 20 to 40 km/h (Image 26). Therefore, we can conclude that on the flight altitude, modeled vertical and turbulent motions were weaker than the horizontal flow of air.

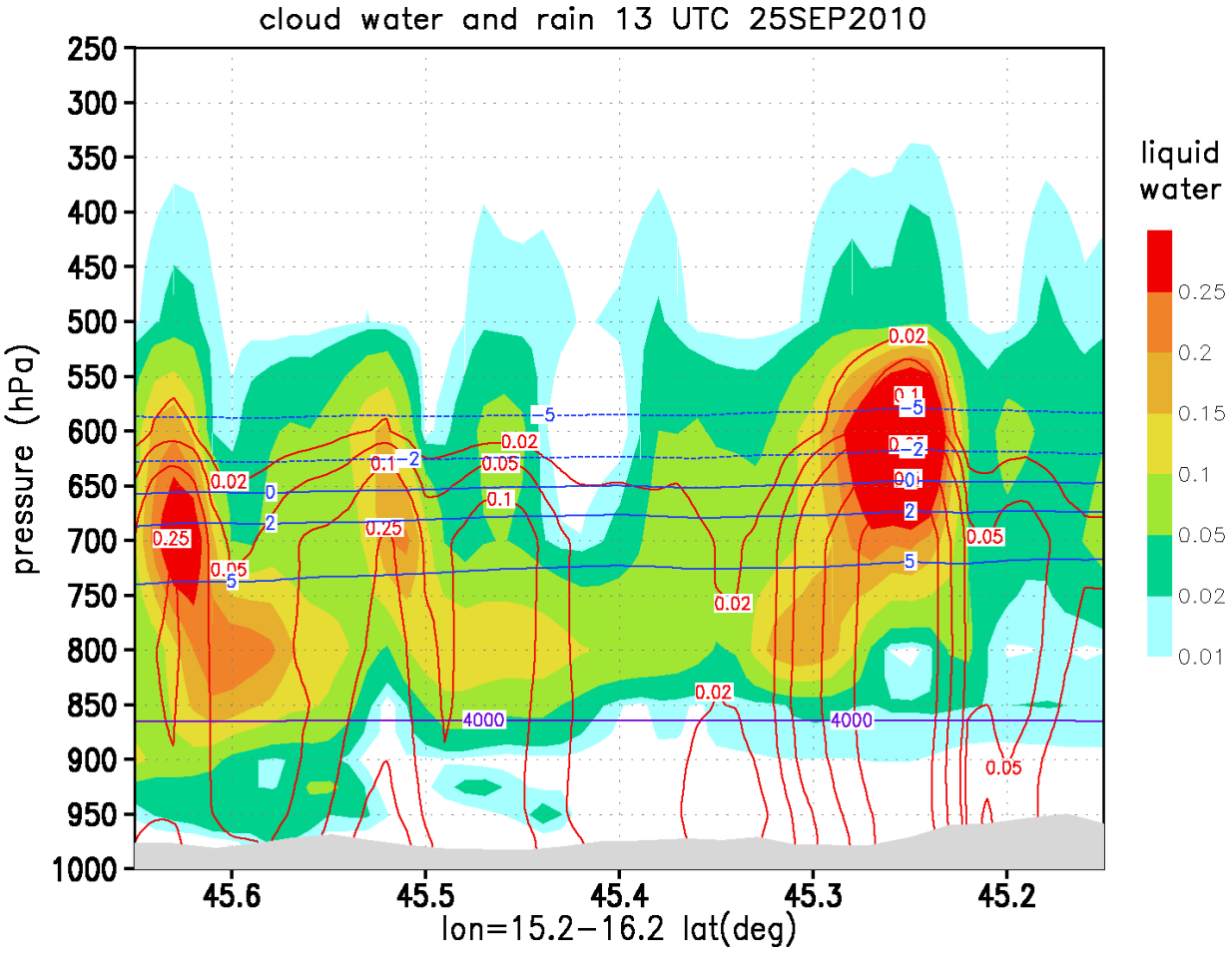


Image 27 Results simulation by model Aladin: Cross-section by height (vertical axis is the pressure, from 1025-250 hPa) from point (lon= 15.2, lat = 45.65) to point (lon= 16.2, lat = 45.15) on September 25th 2010 at 15 hours local time (13 UTC). The image shows the water in the clouds (* 10-3 liquid water content - shaded), rain (red isolines), temperature (blue isolines, the positive is shown as full lines, negative is shown as dotted lines). Also, flight altitude of 4000 feet is shown as the purple line. The height of the terrain in the model is shown in gray at the bottom of the image.

Image 27 shows water in the clouds (cloud liquid water content) in g/kg shaded, rain in g/kg in red isolines, temperature in blue isolines, positive temperature is shown as full lines; negative temperatures are shown as dotted lines. All images also show flight altitude of 4000 feet as the purple line and the height of the terrain in gray at the bottom of the image. Cloud flooring is descending from east to west, so it is above the flight altitude in the east and below in the west (Image 27). This is consistent with the observed flooring height of Nimbostratus flooring and other clouds observed at the synoptic stations (Table 1).

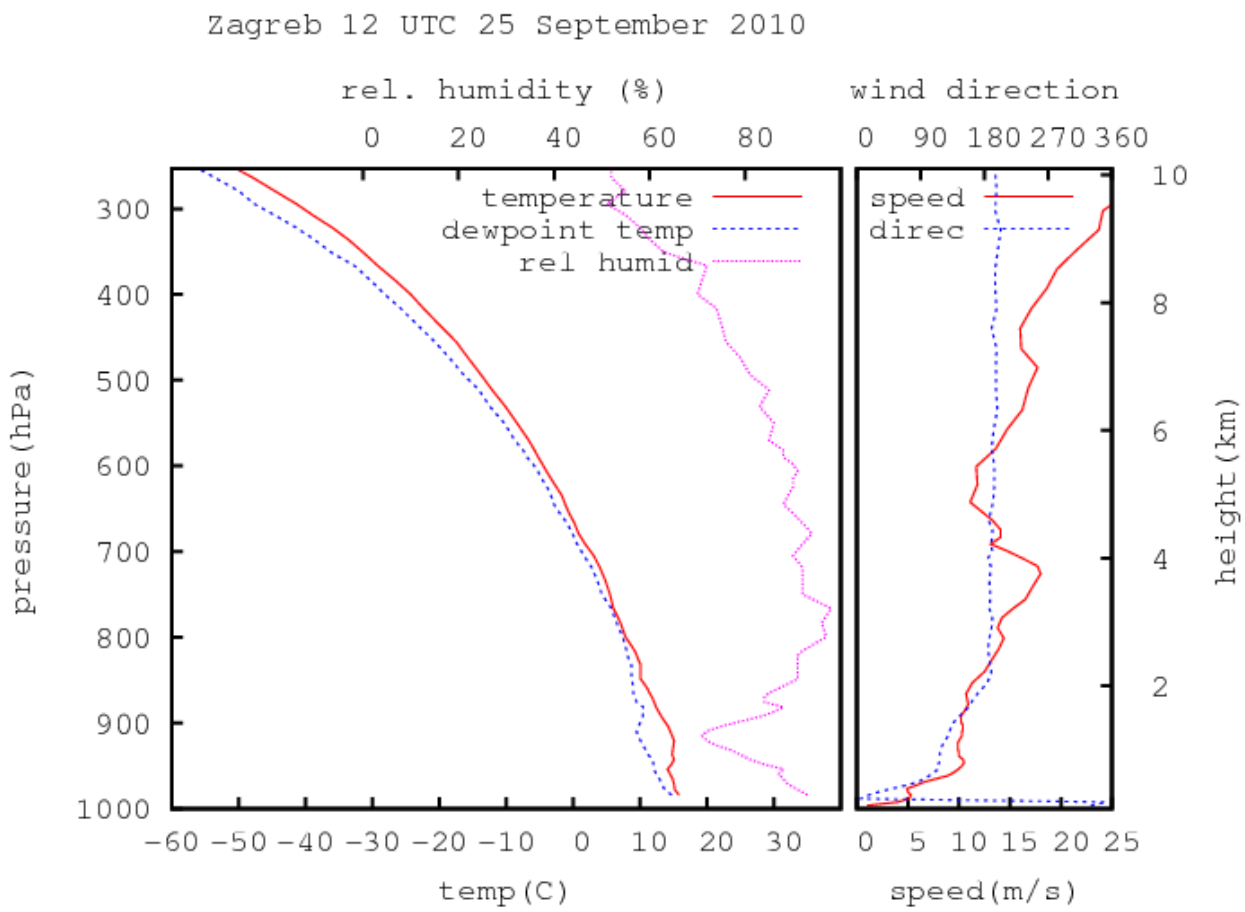


Image 28 Vertical profiles of air temperature and humidity, and wind speed and direction obtained by radio sounding measurement at station Zagreb - Maksimir at 14 hours (12 UTC) on September 25th 2010.

Measured vertical profiles of air temperature and humidity and wind speed and direction, shown in Image 28, was obtained from radio sounding measurements performed at 14 hours local time (12 UTC) on September 25th 2010 at location Zagreb-Maksimir. The profile shows a drop in temperature with height, interrupted with one temperature inversion (atmospheric layer in which the temperature increases with height) to about 950 hPa, where temperature increases with height by 1°C. Top of the temperature inversion is at 900hp. The air is saturated with water vapor and relative humidity reaches the minimum at the top of the temperature inversion. Above Zagreb, wind speed has increased with height up the temperature inversion layer where it reaches 10 m/s (36 km/h). Above the layer of temperature inversion, wind speed continues to increase up to 4 km height, where it reaches 18 m/s (65 km / h), then the wind speed drops to less than 70 km/h at 5 km, then increases again with height, and is greater then 90 km/h in the layer above 9 km. At flight altitude, the air temperature was well above 0°C, humidity 80%, and wind speed around 36 km/h.

1.7.3. Conclusion

On September 25th 2010, from 10-17 local time, in the area near Budačka Rijeka the state of the atmosphere is described on the basis of the available surface observations and measurements from the main (synoptic), climatological and automatic stations maintained by the Meteorological and Hydrological Service, and radio sounding measurements by height made at stations in Zagreb, MSG satellite images of cloud cover, radar images and atmospheric fields obtained model Aladin simulation.

Prevailing weather was completely cloudy, humid, rainy and showery for that time of year with temperatures of 12°C to 15°C, except in the higher mountain regions and on Zavižan where it was about 9 °C. Wind on the ground was weak to moderate, north-east in the

morning and north in the afternoon. Gusts were moderately strong, somewhat stronger in Karlovac and on Zavižan.

Satellite images show that the observed area was located in the area of atmospheric front with strong convective clouds, and radar images indicate heavy percipitation in the area. Observers at stations as well as the system for detecting lightning hasn`t recorded the occurrence of lightning or thunder so it is not the case of stormy convection (thunderstorm), but showers (rain shower) from convective clouds.

The measured vertical profile of wind speed shows that the velocity increases with height and reaches a maximum of 36 km/h at about 0.75 km. Simulations by model Aladin did not show the development of mountain waves over the surrounding mountain areas. However, there were intense vertical motions associated with the existence of frontal convection. The model results indicate that these motions had great intensity over the flight altitude, but this does not exclude the possibility that such intense vertical motions occurred significantly lower, at the altitude of the aircraft flight.

On radar images large variability in the intensity of precipitation and cloud top height as well as the hole in the clouds east of Budačka Rijeka can bee seen. This indicates the great variability of the vertical component of wind speed and the existence of strong downward flows in the area where precipitation has not been recorded.

1.7.4. Time of day

Afternoon and during dailiy visibility.

1.8. NAVIGATION DATA

Aircraft OK-OUU38, leader of the formation, obtained the navigation data from Croatia Control Ltd.

1.8.1. Flight plan

Forwarded flight plan:
FPL-OKOUU38-VG
-02ZZZZ/L-V/C
-LHZA1000
-N0080A025 DCT KOPRY DCT N45425E01527/N0080A050 DCT N4504E01454/N0080A025 DCT N4440E01413/N0080A020 DCT NIKOL/N0080A015 DCT
-LIDF0344 LIPY
-EET/KOPRY0039 NIKOL0317 OPR/SKYLEADER TYP/KP5 RMK/1 OKOUU38 KPT ….. 2 SPSKYL KPT …… DOF/100925

1.9. COMMUNICATION

Radio communication with aircraft OK-OUU38 was conducted on frequencies of Pula RDR 124,6 and ACC Zagreb FIC 135,05.

Pursuant to the VFR manual, all aircraft in the formation shall be equipped with adequate communication and navigation equipment. During the formation flight, the leader of the formation is responsible for radio communication with the relevant ATC unit, while other aircraft in formation shall maintain a listetning watch on the same radio frequency.

The formation leader and the member aircraft communicated via radiotelephone communication on frequency 123.45 which is evident from the aircraft JA600 Pilot 1 statement:

Quote

„Every few minutes we contacted the other aircraft SP-SKYL via radio on frequency 123.45 MHz; in the remaining time I corresponded with Info-Zagreb on radio frequency 135.050 MHz and as much as the circumstances allowed it, I observed the frequency 123.45 MHz."

End of quote.

Aircraft Accident and Incident Investigation Agency was informed by Croatia Control Ltd. that it doesn`t have an audio recording of the frequency 123.45 MHz.

1.9.1. Audio recording

ACC Zagreb –CWP06 – FIC (135,05)

12:11:26	FIC	OKOUU38, Zagreb Info, do you read?
	OKOUU38	Aaa.., five by five, U38
	FIC	O38, roger, what is your requestied level?
	OKOUU38	5000 feet if possible
	FIC	O38, roger, 5000 feet approved
	OKOUU38	Thank you
12:12:28	FIC	O38, just for information, your formation flight is behind about seven nautical miles
	OKOUU38	Roger, U38
12:18:05	OKOUU38	Zagreb Info, U38
	FIC	O38, go ahead
	OKOUU38	We have problem with our pilot, aaa.. partner, do you see on radar?
	FIC	O38, you are now cross town called Jezerane inbound to Žuta Lokva
	OKOUU38	OK, do you see another aircraft?
	FIC	O38, negative
12:25:50	FIC	O38, are you in contact with your formation flight
	OKOUU38	I haven't contact with radio and visual with our… another aircraft
12:26:11	OKOUU38	I'm afraid ….(unreadable)…..the problem
	FIC	O38, say again
	OKOUU38	I'm afraid that is an problem with our partner
	FIC	O38, your formation flight had squawk of seven thousend, now I don't have any ID, identification of that squawk
12:26:41	OKOUU38	Seven thousand, set
12:26:52	OKOUU38	We lost contact about five – ten minutes ago with our friends
12:27:06	FIC	O38, roger, do you wish to return and to search or to wait or to continue along airway
	OKOUU38	We continue, but we are afraid may be some thing bad ….(unreadable)…. with our friends
	FIC	O38, please say again, read you two
	OKOUU38	I think it is a emergency situation with my friend …another aircraft
FIC	O38, roger, confirm you are now squawking 7013	
	OKOUU38	No…negative now squawk seven thousand, U38
	FIC	O38, roger, squawk 7013
	OKOUU38	Squawk 7013
12:31:51	FIC	O38, Zagreb info
	OKOUU38	Go ahead, U38

	FIC	O38, did you tried to contact your formation flight?
	OKOUU38	Ja… I tried but no contact
	FIC	O38, roger, we still have no information about this flight
	OKOUU38	OK roger, U38
12:33:31	FIC	O38, Zagreb info
	OKOUU38	Go ahead, O38
	FIC	O38, did your formation flight hel… had any call sign?
	OKOUU38	SP SKYL, U38
	FIC	Confirm SP SKYL
	OKOUU38	Affirmative
	FIC	SP SKYL, Zagreb information, do you read?
12:34:30	FIC	O38, can you confirm for SP SKYL it's type it's KP5
	OKOUU38	Affirm, KP5
	FIC	O38, roger, we still don't have any contact with that flight and you are now entering Zadar airspace so contact Zadar radar 118,6
	OKOUU38	118,6, U38, thank you bye
	FIC	Bye Bye

Aircraft OKOUU38 was transferred by FIC to radar Zadar, which switches it to frequency 124.6 Pula radar.

Pula radar made contact with aircraft OKOUU38 at 12:39:20 UTC. At 13:10:17 UTC Pula radar transferes aircraft OKOUU38 to 126.775 Padova. During this period, Pula radar attempted to obtain more detailed information about the pilots and aircraft SP-SKYL and, on the basis of that information, tried to make contact with aircraft SP-SKYL.

Providing assistance in navigation for VFR flights is conducted/carried out in the form of a recommendation and the pilots remain responsible for the separation from the obstacles, maintaining minimum safe altitude and a flight in visual meteorological conditions.

1.10. AIRPORT INFORMATION

Considering that the formation was in over-flight over Croatia, airport information wasn`t requested.

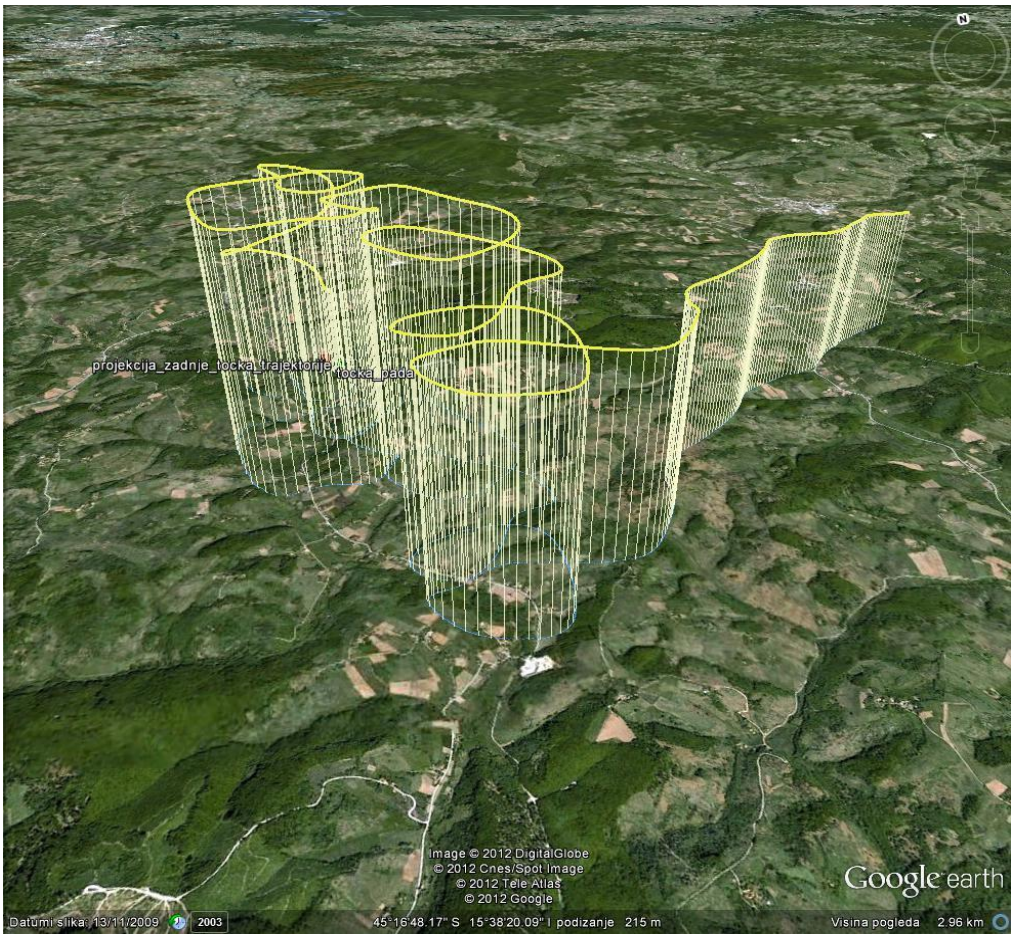
1.11. FLIGHT RECORDINGS

Aircraft KP-5 was not equipped with Cockpit-Voice-Recorder (CVR) and Flight-Data-Recorder (FDR).

Aircraft was equipped with a GPS device, type AVMAP EKP IV which was not found at the scene of the accident.

1.12. WRECKAGE AND IMPACT INFORMATION

The aircraft was found on September 25th 2010 at aprox 23:00 LT, near location Budačka Rijeka, area Kserov Potok. Altitude of the terrain is approx 958 ft.


projekcija_zadnje_tocka_trajektorije
tocka_pada
Image © 2012 DigitalGlobe
© 2012 Cnes/Spot Image
© 2012 Tele Atlas
© 2012 Google
Google earth
Datumi slika: 13/11/2009
2003
45°16'48.17" S 15°38'20.09" I podizanje 215 m
Visina pogleda 2.96 km

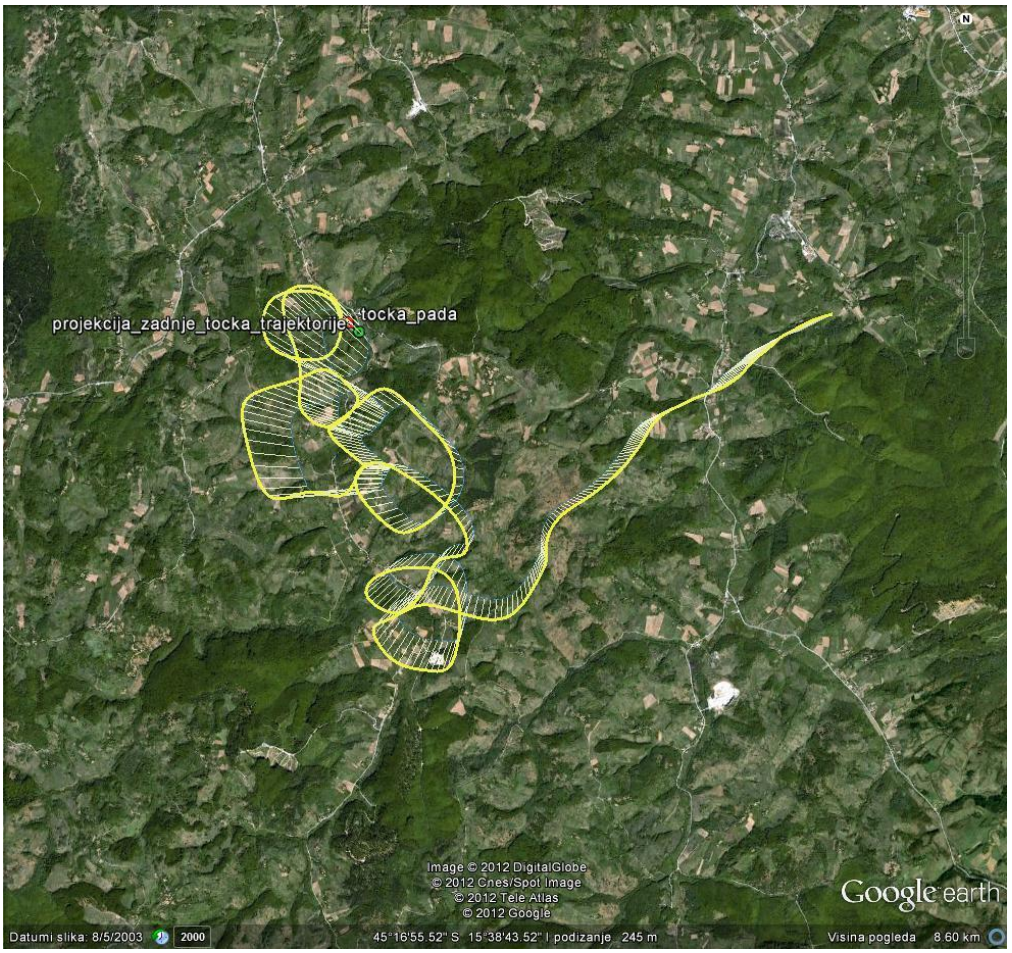

projekcija_zadnje_tocka_trajektorije
tocka_pada
Image © 2012 DigitalGlobe
© 2012 Cnes/Spot Image
© 2012 Tele Atlas
© 2012 Google
Google earth
Datumi slika: 8/5/2003
2000
45°16'55.52" S 15°38'43.52" I podizanje 245 m
Visina pogleda 8.60 km

Image 29

The location of the crash site was covered with water due to heavy rains that led to the outpouring of the stream (Image 30).

Image 30 Location of the crash site

Scene investigation of the crash site revealed that the aircraft was completely destroyed from the force of impact (Image 11) and that the engine has, due to soft ground and the force of impact, buried in the ground. The point of impact was located approximately 2-3 m from where the wreckage was found (Image 31).

Image 31 Point of impact in the ground

Canopy (Image 34) and the left wing were found aprox 100 -150 m away from the wreckage. The left wing didn`t show any greater damage beside deformations on the wing root (Images 32 and 33).

Image 32 Location of left wing recovery

Image 33 Left wing

Image 34 Canopy

After completion of the scene investigation, assisted by Karlovac Fire department, the wreckage was recovered and transported to Karlovac police base in Erjavec.

After the withdrawal of water, excavation of the engine was carried out. The engine was excavated on October 11th 2010.

Image 35 Engine excavation

Image 36 Engine excavation

On October 12th 2010, in the premises of Karlovac Police department in Erjavec, additional examination of the wreckage was conducted during which it was determined that the aircraft is missing the main left leg. During subsequent search of the terrain around the crash site, the left main leg was not found.

Image 37

1.13. MEDICAL AND PATHOLOGICAL INFORMATION

Bodies of the deceased pilots were transferred to the Department of Pathology of Karlovac General Hospital, where it was found that both casualties sufferred multiple injuries to the body.

1.13.1. Examination records of intoxication and the effects of narcotics or drugs

On October 4th 2010 analysis of blood and urine was conducted at the center for forensic testing, research and expertise "IVAN VUČETIĆ", using the method *Quantitative determination of ethanol in biological samples by HS-GC-FID method*.

Based on the results of performed analysis and data from forms AUK-1 and AUK-2, it was concluded that at the time of death the pilots were sober.

1.14. FIRE

Staff of the Karlovac Fire department participated in recovery and transport of the wreckage.

1.15. RESCUE

After receiving notification that in the area of Vojnić an aircraft went missing, the Police and the Croatian Mountain Rescue Service started the SAR operation of the aircraft and the people onboard. At about 23:00 hours LT the remains of the aircraft and two people who were killed were found.

1.16. TESTS AND THE INVESTIGATION

The investigation was conducted by investigators of the Aircraft Accident and Incident Investigation Agency, in assistance with employees of Aerostandard Ltd. and the Polish investigators.

1.17. ADDITIONAL INFORMATION

1.17.1. Flight and maintenance manual

Chapter 2.0 Operational limits

Subtitle 2.7 Weight and C-G limits

Empty weight	302 kg
Maximum take off weight	450 kg
Maximum baggege weight	30 kg
Minimum pilot weight	60 kg
Maximum pilot weight	120 kg
Front limit of C-G	22% MAC
Rear limit of C-G	32% MAC
Emerg. parachute system	+1,5% MAC

Paragraph 2.8 Manoeuvres approved

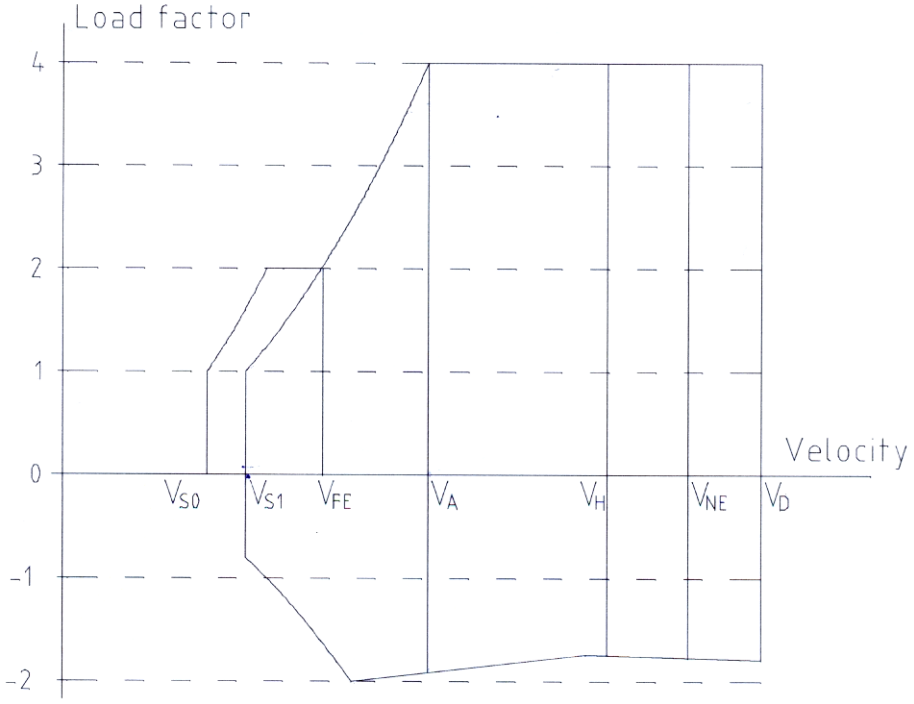
Steep turn (60° bank) Max. Inital airspeed in IAS (km/h) 156

Acrobatic, intentionally driven stalls and spins are prohibited.

Paragraph 2.9 Load factors

Max. load factor positive – flaps off	+4,0
Min. load factor negative – flaps off	-2,0
Max. load factor positive – flaps extended	+2,0

Paragraph 2.10 Flight envelope



Paragraph 2.11 Type of operation

Only daytime flights under VFR and without known icing conditions are approved.

1.17.2. Type certificate

The owner of the certificate is company JIHLAVAN airplanes, s.r.o.

The certificate is registered at Light Aircraft Association of the Czech Republic under number ULL-01/2004, issue date 29.03.2004.

ULL-01/2004, I General information, 7. Supplement „b“

„31.05.2006. (It is proofed that aircraft KP-5 ASA – Rapid 500 fulfills all solidity requirements of UL-2 regulation for the MTOW of 580 kg).“

1.17.3. JAR-1

Definitions and Abbreviations

Microlight is an aeroplane having no more than two seats, Vso not exceeding 35 knots (65 KM/h) CAS, and a maximum take-off mass of no more than:

- 300 kg for a landplane, single seater; or
- 450 kg for a landplane, two-seater; or
- 330 kg for an amphibian or floatplane, single seater; or
- 495 kg for an amphibian or floatplane, two-seater, provided that a microlight capable of operating as both a floatplane and a landplane falls below both MTOM limits, as appropriate.

Note: Foot-launched aircraft are excluded from this definition.

1.17.4. ICAO Annex 2 – Rules of the air

An aircraft must not fly in formation except by a pre-planned arrangement between the pilots-in-command involved in the flight, for a formation flight in controlled airspace in accordance with conditions prescribed by the appropriate ATS authority (or more). These conditions will include the following:

a) the formation operates as a single aircraft with regard to navigation and position reporting;
b) separation between aircraft in the flight will be the responsibility of the flight leader and pilots-in-command of other aircraft in formation and will include periods of transition when aircraft maneuver to attain their own separation within the formation and the accesion to the formation and separation of it, and
c) distance not exceeding 1 km (0.5 NM) laterally and longitudinally and 30 m (100 ft) vertically from the flight leader will be maintained by each aircraft.

1.17.5. Ordinance on the rules of the air (NN 109/09)

Appendix 6, Minimums for VFR flights in class C

Visibility in flight:

- 8 km at/above FL100
- 5 km below FL100

Distance from the cloud:

- Verticaly 1000ft
- Horizontaly 1,5 km

1.17.6. Formation leader

1.17.6.1. Aircraft JA600

Formation leader was aircraft Skyleader JA600, registration number OK-OUU38, serial number 61551660, manufactured in 2009.

1.17.6.2. Pilot 1

Person	Date and place of birth: 12.06.1975 Poland
Licence	PL-6750-CPL(A)-07
Issue date	20.06.2007.
Expiration date	20.06.2012.
Total flight hours	978 h
Flight hours as PIC	531 h
Authorisations	SEP(L) 08.05.2009 MEP(L) 08.05.2008. IR 10.04.2009. FI 05.08.2010. – 31.07.2013. TR SAAB340 30.04.2009. – 30.04.2011.

1.17.6.3. Pilot 2

Person	Date and place of birth: 07.10.1964.
Licence	UA190640
Issue date	16.09.2010.
Expiration date	15.09.2012.
Total flight hours	50 h 17 min.
Flight hours as Captain	16 h 49 min

Pilot 2 owned a pilot licence for ultralight aircraft issued by Light Aircraft Association of the Czech Republic.
The licence is not in accordance with ICAO standards but was issued in accordance to valid regulations of the Czech Republic.

1.17.6.4. Certificates

Pursuant to the received information, the aircraft doesn`t have the Certificate of Airworthiness and the Certificate of Registration issued by an authority for civil aviation of the Czech Republic.

The aircraft has a Technical certificate issued by Light Aircraft Association of the Czech Republic. The mentioned certificate is not in accordance with ICAO standards but was issued in accordance with valid regulations of the Czech Republic. The certificate was issued on May 19th 2009 and is valid until June 1st 2013.

Additional information was obtained by investigators of the Republic of Poland, the manufacturer Skyleader, Croatian Civil Aviation Agency and Croatia Control Ltd.

1.18. USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES

Technical resources were used by Aero Standard Ltd.

2. ANALYSIS

2.1. TECHNICAL ASPECT

On October 12th 2010 in the premises of Karlovac Police department in Erjavec, a detailed analysis of the aircraft wreckage was conducted. The analysis showed that the left wing hasn`t sustained considerable damage beside deformations at the root, which were formed by wing separating from the center section and cracking of wing spar (Image 38), suggesting that the wing was cut off during the flight and, at a low speed, fell on the trees (1.12, Image 33).

Flaps on the left wing were found in the extracted position, while the right wing flap was found in the retracted position. Found remains of the lever for flaps extraction show that the lever was in a position for retraction (Image 39). Also, the electric actuator for flaps activation was in the retracted position (Image 40). Based on this, it can be assumed that the flaps were in the retracted position during flight and that the flap on the left wing fell out after the wing fracture and braking of strings which keep it in the retracted position.

Engine and propeller were also examined and it was found that all the damage to the engine was during impact on the ground. In the carburettor float bowl, a mixture of water and fuel was found. Since the engine was found stuck in the marshy ground, it was concluded that the water entered the system after the crash (Image 41). Both propeller blades were broken and by the damage on the blades it can be concluded that the blades cracked during the impact on the ground (Images 42 and 43).

Image 38 Deformations on the left wing and wing span

Image39 Lever for flaps extraction

Image 40 Actuator for flaps activation

Image 41 Engine

Image 42 Propeller 1

Image 43 Propeller 2

2.1.1. Determining the C-G

Aircraft empty weight, pursuant to paragraph 1.17.1 is 302 kg.
Additional weight in the aircraft is the following:

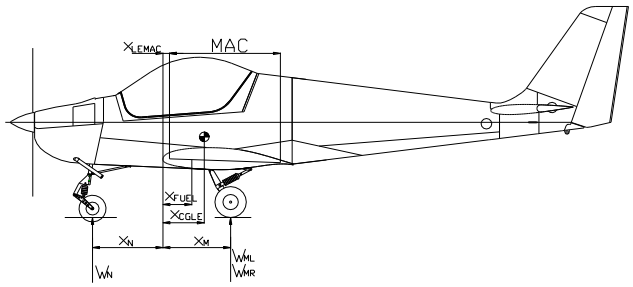
- Pilot 1 weight: 83 kg
- Pilot 2 weight: 93 kg
- Estimated fuel weight is aprox. 50 l (39 kg)
- Estimated cargo weight is aprox. 45 kg (2 bags + 2 buckets of fuel of about 25 l + aircraft documentation)

Pusuant to Image 44, Full Take-off Weight was 562 kg and position C –G is at 29, 89% MAC.

JIHLAVAN airplanes

DETERMINATION OF EMPTY WEIGHT AND C-G
COMPUTATION REPORT

Type	**KP - 5 ASA - RAPID 500**	**Production number**	5153161 O
		Registration mark	**SP - SKYL**



x_{LEMAC} = 74,7 mm
MAC = 1273,6 mm

W_N = 79,5 kg
W_{MR} = 111,25 kg
W_{ML} = 111,25 kg

x_N = -703,0 mm
x_M = 784,5 mm

Main undercarriage weight:

$W_M = W_{MR} + W_{ML}$ = 111,3 + 111,3 = **222,5 kg**

Empty aircraft weight:

$W_{EPT} = W_N + W_M$ = 79,5 + 222,5 = **302,0 kg**

Calculation of C-G (Empty aircraft)

C-G position measured from wing center section leading edge:

$$x_{CGLE} = \frac{W_M . x_M - W_N . x_N}{W_{EPT}} = (222,5 \times 784,5 + 79,5 \times -703,0) / 302,0 = \mathbf{392,92\ mm}$$

C-G:

$$x_T = \frac{x_{CGLE} - x_{LEMAC}}{MAC} x100 = ((392,92 - 74,7) / 1.273,6) \times 100 = \mathbf{24,99\ \%\ c_{SAT}}$$

Addition masses

Fuel (0,78kg/liter)			50 liters		
	W_1	=	39,0 kg	x_1	= 330,0 mm
Pilot	W_2	=	83,0 kg	x_2	= 400,0 *mm
Copilot	W_3	=	93,0 kg	x_3	= 400,0 *mm
Luggage	W_4	=	45,0 kg	x_4	= 1.200,0 **mm

* approximately (depends on the setup of adjustable seats)
** approximately (depends on the distribution of luggage)

Full aircraft weight:

$W_{FULL} = W_{EPT} + W_1 + W_2 + W_3 + W_4$ = **562,0 kg**

Calculation of C-G (Full aircraft)

C-G position measured from wing center section leading edge:

$$x_{CGFULL} = \frac{W_{EPT}.x_{CGLE} + W_1.x_1 + W_2.x_2 + W_3.x_3 + W_4.x_4}{W_{FULL}} = \mathbf{455,40\ mm}$$

C-G:

$$x_{TFULL} = \frac{x_{CGFULL} - x_{LEMAC}}{MAC}.100\ \% = \mathbf{29,89\ \%\ c_{SAT}}$$

Image 44 Position C – G

2.2. TECHNICAL ANALYSIS OF THE FLIGHT

Technical analysis of the flight was made in collaboration with the Faculty of Mechanical Engineering and Naval Architecture, Department of Aviation, Zagreb. The analysis was made on the basis of data obtained from the Croatia Control Ltd due to the fact that aircraft`s SP-SKYL GPS device was not found at the scene of the accident.

The analysis considered the flight between 12:06:41 (t = 0 s) to 12:13:11 (t = 390s). Diagrams in Image 45 show the trajectory of the aircraft: blue circles indicate the original data for radar coordinates while the red line represents a smoothed curve of the aircraft (spline approximation). In addition, the location of the crash is drawn in the diagram (green cube).

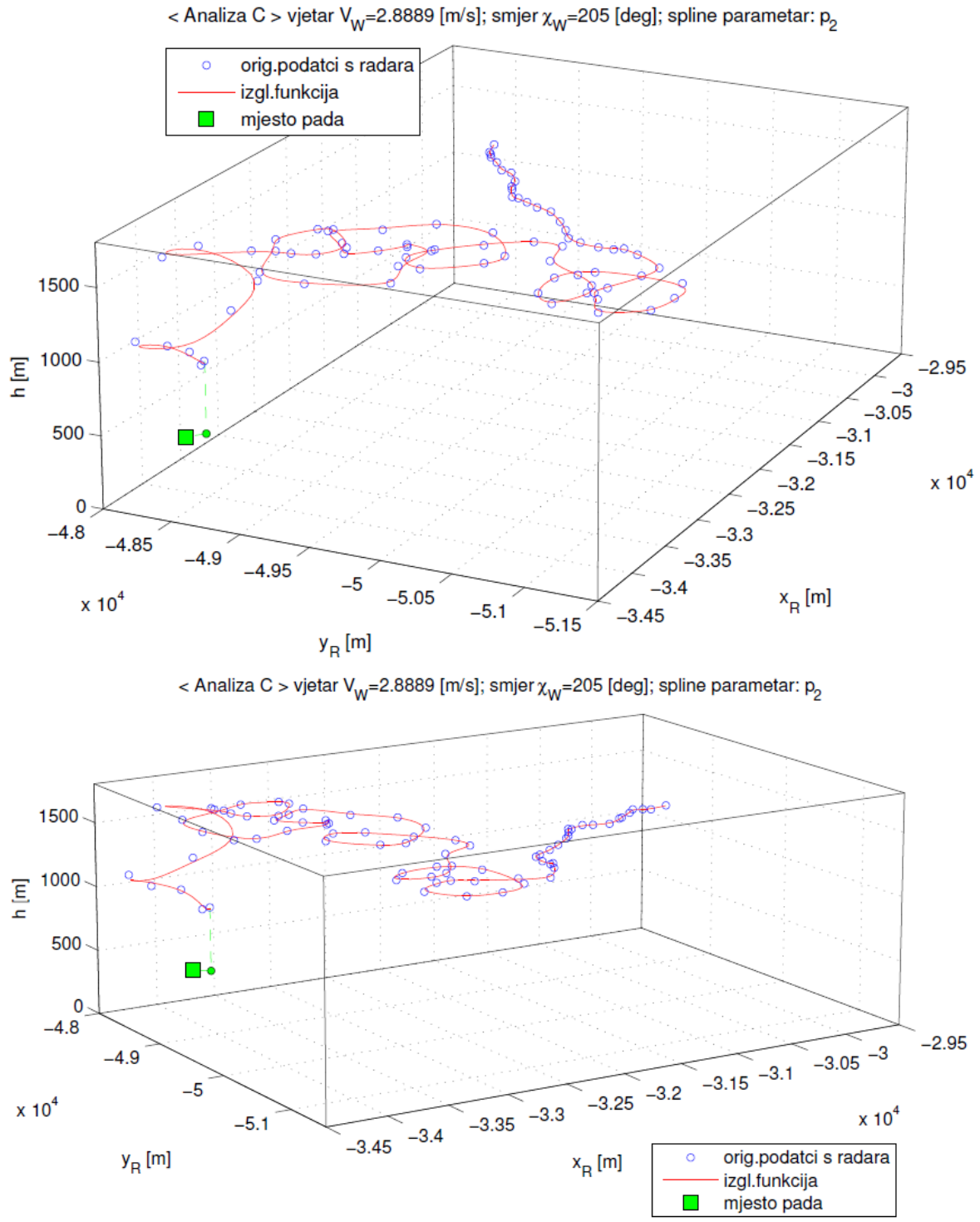


Image 45 Aircraft trajectory; original data from the radar and the smoothed curve

Results of the analysis with emphasis on flight critical elements:

- Aerodynamic speed (actual speed) takes the critical value: equal to or less than the speed of stall V_S at times t= 100 s and t= 277 s and values greater than the maximum speed V_{NE} at times t= 158, 210, 245, 300, 345 s. The exact estimate of aerodynamic speed cannot be done but based on the results and their explanations it can be concluded that the aerodynamic speed varied according to the diagram 46, by values between the curves C11 and C12.

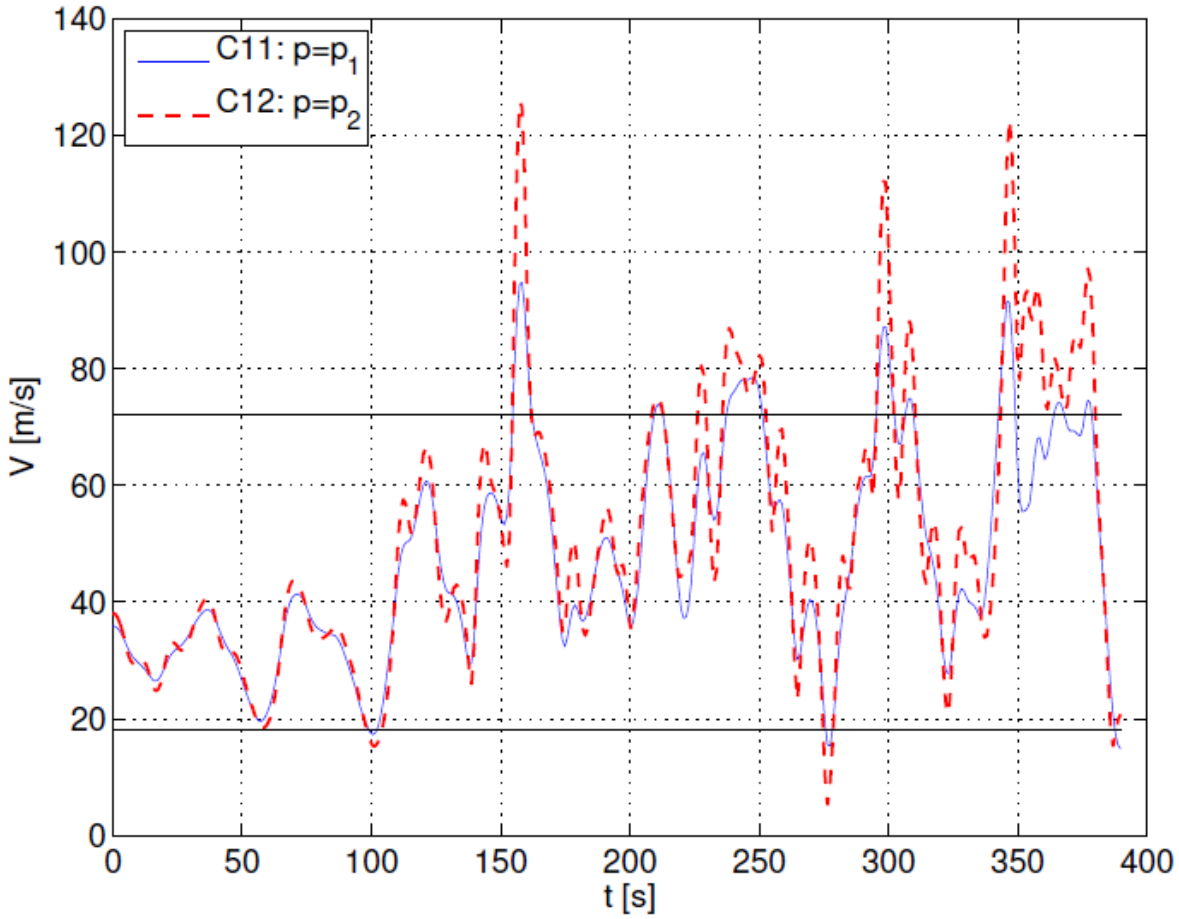


Image 46 Estimate of the aerodynamic speed V during the flight: border values

- Speed of climb reaches its maximum values several times (Image 47)

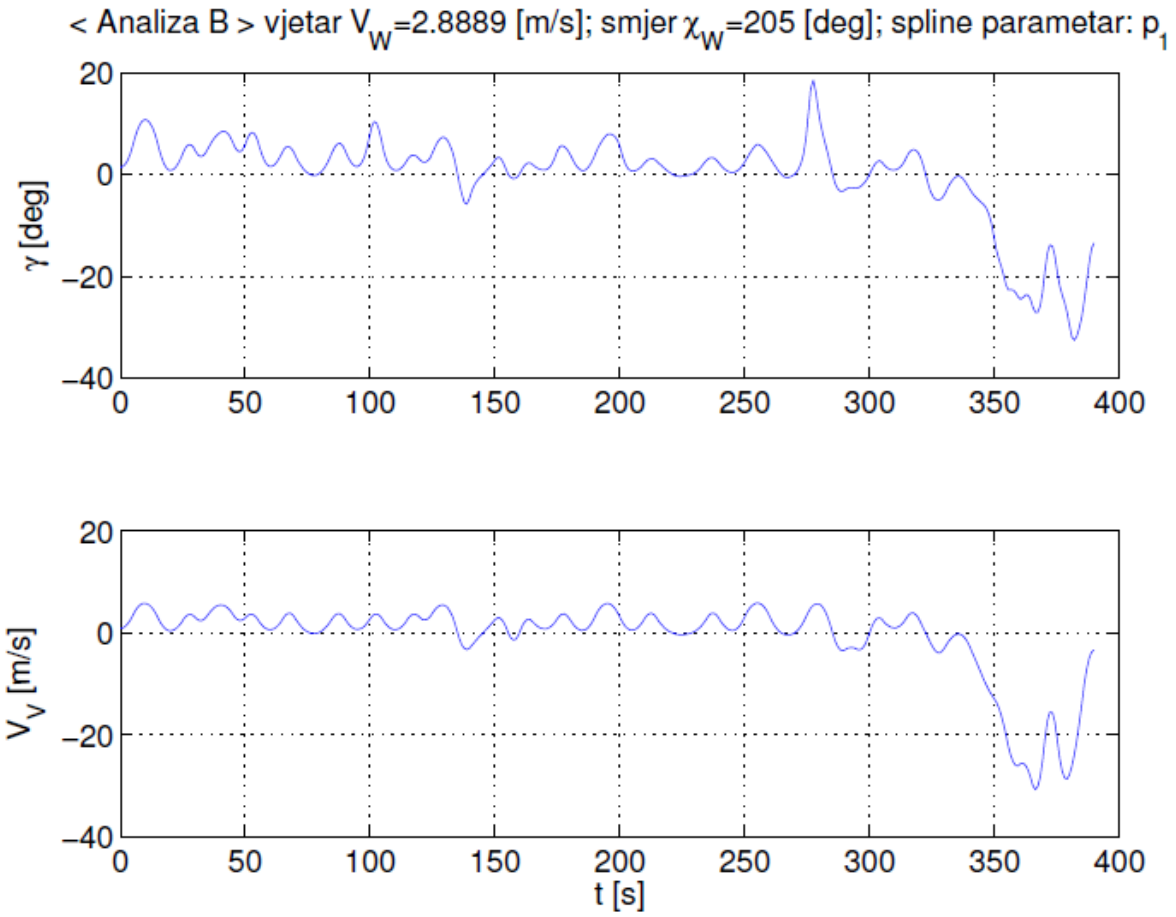


Image 47 Analysis B (B11): Climb angle and vertical speed changes per time

- Angle of attack in terms of critical values follows the aerodynamic speed - where it takes values around the stall. According to the results of the diagram 46, it is estimated that the attack angle takes values between curves C11 and C12.
- The load factor on several occasions takes very high values, even more than n=4 (t = 350 s). Based on the above analysis, load factor is estimated pursuant to diagram 49 where the probable values of the load factor are between curves C11 and C12. The maximum value of the load factor during the observed flight is n= 2.5 - 4.5.
- Based on the described analysis, the roll angle ϕ is estimated pursuant to diagram 50 where the values of the roll angle are between curves C11 and C12.
- Based on the described analysis, the pitch angle θ is estimated pursuant to diagram 51 where the probable values of the pitch angle are between curves C11 and C12.

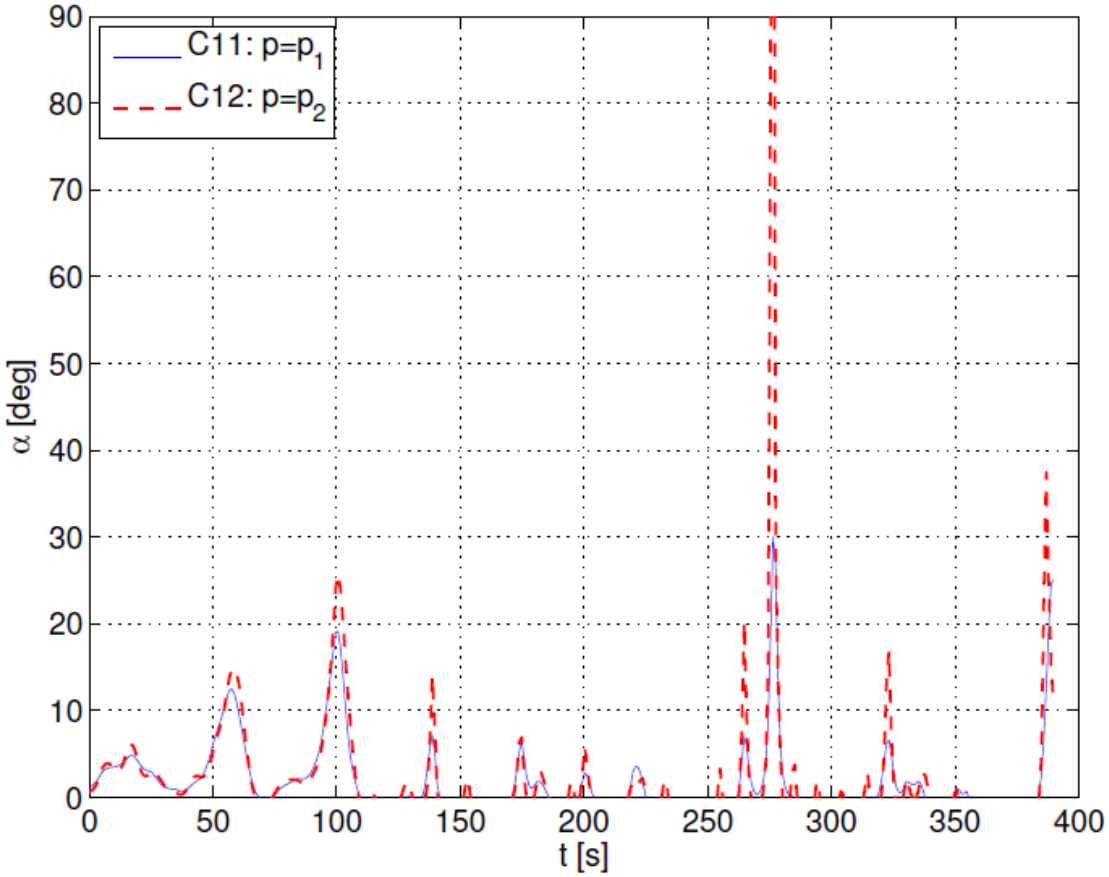


Image 48 Estimate of the attack angle α during flight: border values

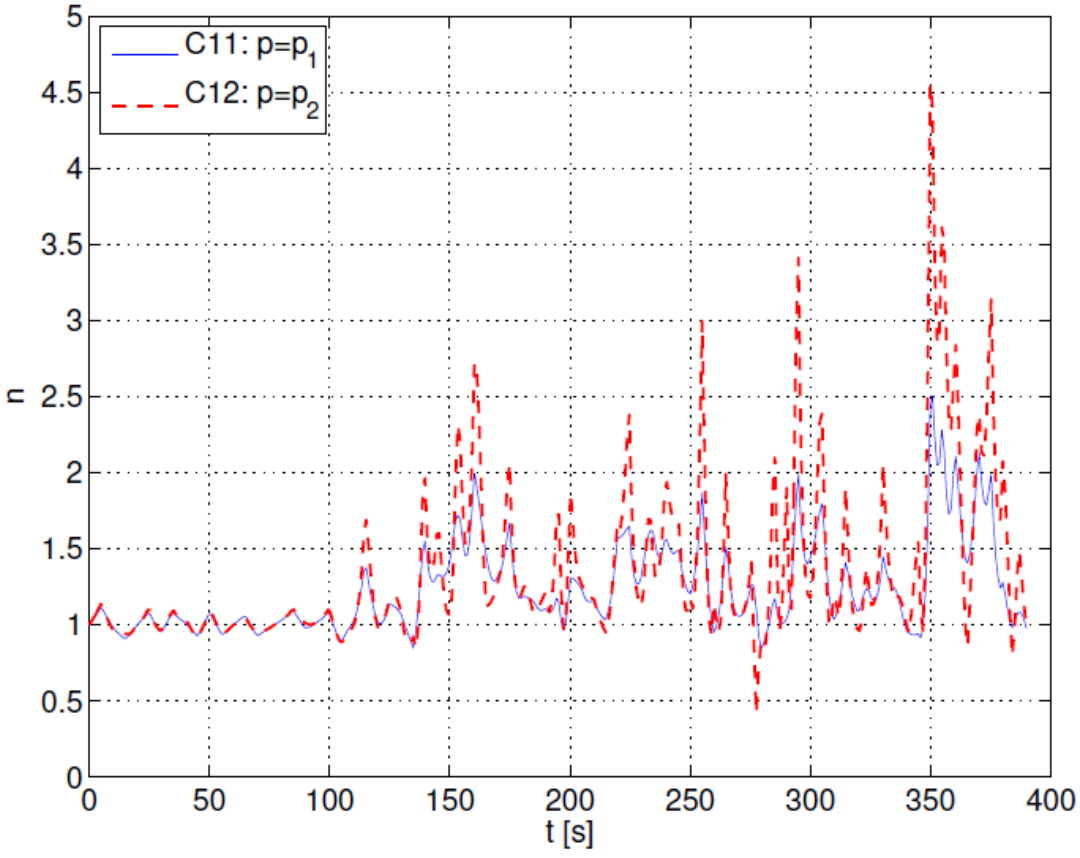


Image 49 Estimate of the load factor: border values

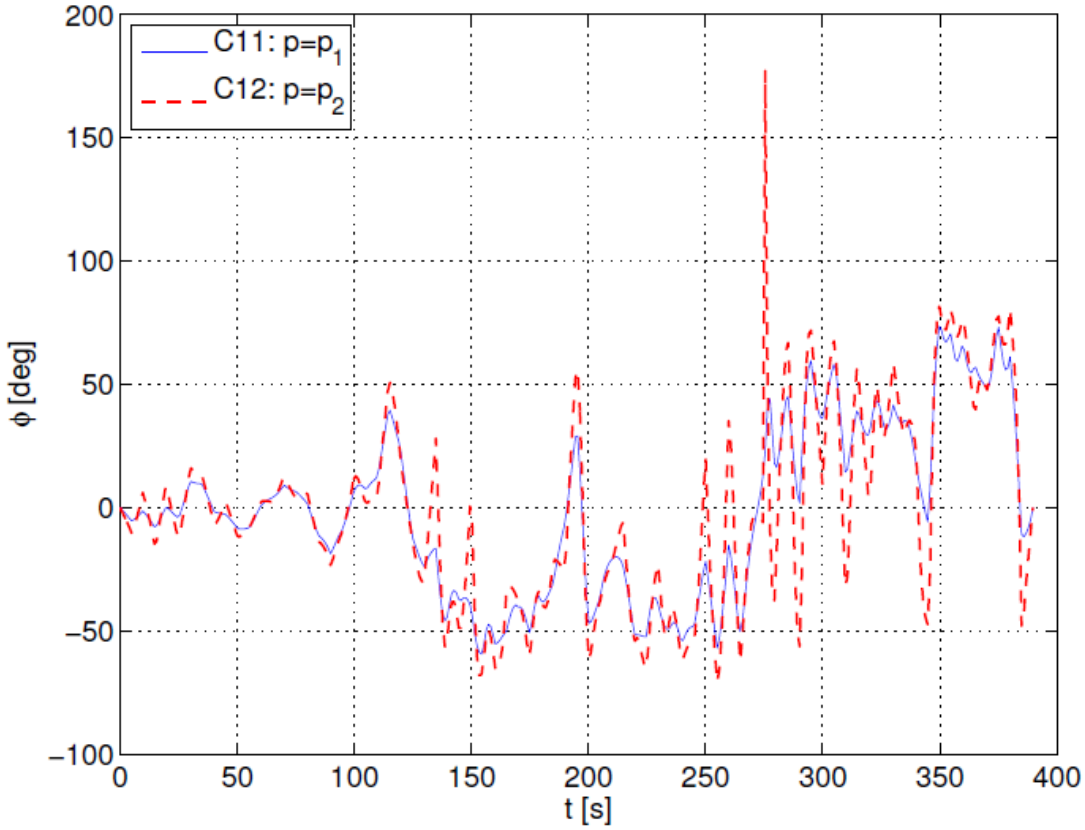


Image 50 Estimate of the roll angle ϕ during flight: border values

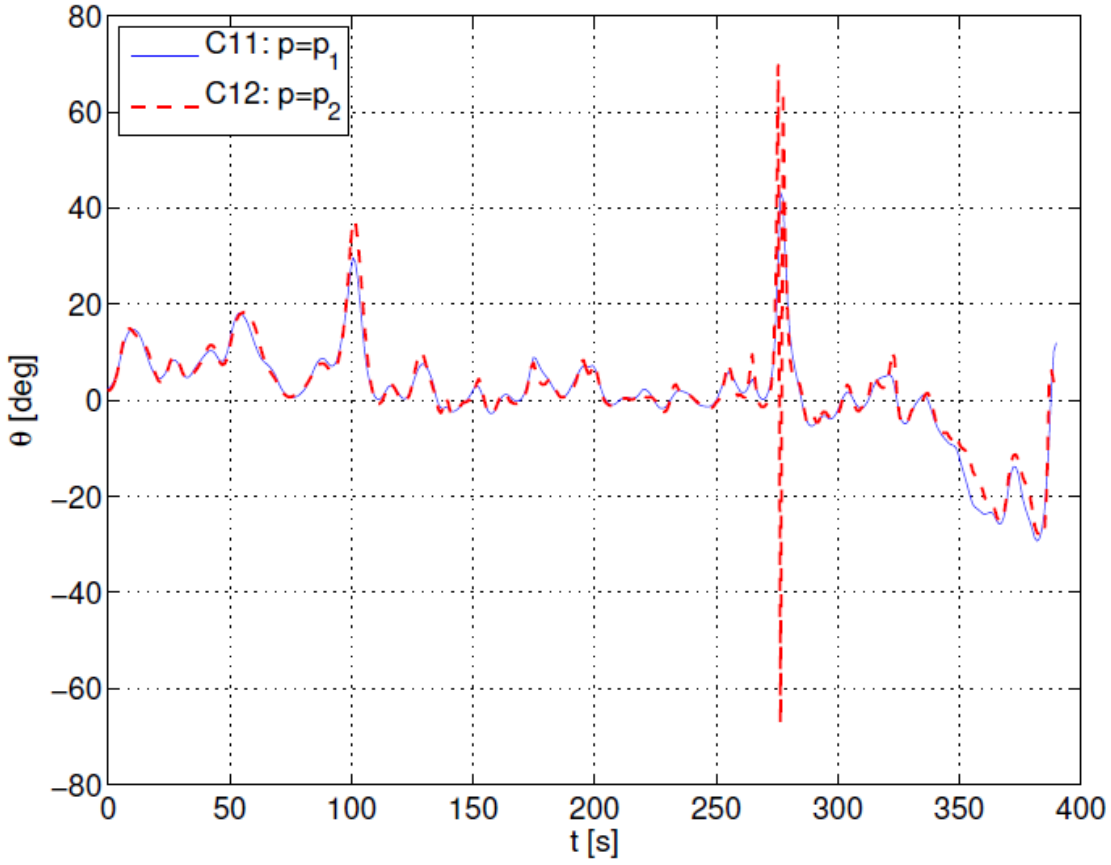


Image 51 Estimate of the pitch angle θ during flight: border values

2.3. HUMAN FACTOR AND OPERATIONAL ASPECT

2.3.1. Crew

During the investigation it was found that the crew of the aircraft KP-5 owned licenses that didn`t comply with ICAO standards but were issued in accordance with legislation of the Czech Republic.

One crew member of aircraft JA600 owns a CPL license that complies with ICAO and JAR-FCL standards, while the other member owns a license that does not comply with ICAO standards but was issued in accordance with legislation of the Czech Republic.

Flight crew reported the formation of two aircraft.

The flight leader had knowledge that bad weather conditions prevailed in Croatia so before takeoff, the crews had a brief meeting at which they agreed that, in the case of deteriorated weather conditions, they would return to the airport of departure.

Aircraft OK OUU38 Pilot 1 statement:
"I realized that in the middle of the flight over Croatia, we would encounter on deterioration of weather. I informed .....about it - commander of the other crew. We agreed that we will fly in a group of two aircraft, I as the leader and in the event of deteriorating weather conditions, we will return to the airport of departure - LHZA."

Aircraft OK-OUU38 Pilot 2 statement:
"After these actions ..... as the leader, ordered a meeting - introduced us to the flight route, weather conditions. At that meeting he addressed special attention to the bad weather over Croatia and we determined that, in the event that weather conditions would not allow us to continue the flight, we'll come back to the airport of departure. We performed the flight still in a system of two aircraft, pursuant to the flight plan."

Pursuant to section 1.17.4., formation operates as a single aircraft with respect to navigation and position reporting. The flight leader was at 12:12:28 UTC warned by FIC that the formation was 7 nautical miles behind him, which he confirms and continues pursuant to the default route.

Pursuant to the VFR manual, the crew of aircraft SP-SKYL, when it lost contact with the flight leader and according to 1.1.3. it can be assumed that it also lost orientation, had to seek assistance from the relevant ATC for help and determine the amount of fuel left.

3. CONCLUSION

3.1. CONCLUDED

3.1.1. Technical aspects

- Aircraft KP-5 was certified for flying in VFR conditions.
- Aircraft KP-5 was prohibited to fly in icing conditions.
- The investigation didn`t identify any technical failure that could have caused the accident, except that the weight of the aircraft KP-5 exceeded the MTOW of 450 kg
- The manufacturer allows the weight of aircraft KP-5 to go up to 580 kg which pursuant to JAR-1 is no longer an ultralight aircraft, but goes to a higher category of aircraft type and must comply with JAR-23.
- In the observed flight, aircraft KP-5 made maneuvers with large loads and critical values of aerodynamic speed which the manufacturer expressly prohibits (1.17.1).
  „Steep turn (60° bank) Max. Inital airspeed in IAS (km/h) 156
  Acrobatic, intentionally driven stalls and spins are prohibited.“
- According to the OK OUU38 crew`s statements, aircraft SP-SKYL was flying about 200 meters behind the leader.
- Aircraft OK-OUU38 after landing at airport Fano, was checked by the italian police who reported no visible damage.

3.1.2. Crew

- Pursuant to the Ordinance on conditions and methods of use of micro-light aircraft (OG 56/2008), Article 33: “In the Republic of Croatia a micro-light aircraft can be flown by foreign citizens, holders of valid pilot licenses for micro-light aircraft issued by the competent authority of the State, if the conditions for acquisition of this license are at least equivalent to the conditions prescribed by the provisions of this Ordinance.”

  Quote
  “To date, the Croatian Civil Aviation Agency has not received any request for acceptance of foreign licenses issued by the Light Aircraft Association of the Czech Republic, nor has the analysis of identity requirements for licensing been conducted.”
  End of quote.

- When the formation entered the air space unfavorable for flying, it didn`t comply with the agreement from the meeting, which took place prior to takeoff at airport LHZA to return to the airport of departure.
  Unfavorable airspace for flying is considered the one in which instrumental meteorological conditions prevail and the aircraft is not equipped or the crew is not licensed for such a flight, a space with storm activity of the cumulonimbus and a space in which icing of aircraft external surfaces occur which can not be prevented.
- Aircraft SP-SKYL was not on the same frequency as the flight leader.
- The crew of aircraft SP-SKYL didn`t seek assistance from the authorized Air Traffic Control when it lost contact with the flight leader.

3.1.3. General conditions

Meteorological conditions were not suitable for flying in VFR conditions, because the visibility was about 3 km and flooring of clouds Nimbostratus ranged from 1 km to 2 km. Below Nimbostratus were clouds type Stratus opacus, Cumulus fractus and Stratus fractus whose flooring ranged from 0.3 km to 0.6 km, and the sky was completely covered with clouds. Pursuant to 1.17.4 the Ordinace on the rules of the air (OG 109/09), flying below FL 100 requires visibility of 5 km, and cloud distance of 1000 ft vertically and 1.5 km horizontally.

Aircraft KP-5 didn`t own the Certificate of Airworthiness, but owned a Permit to Fly and aircraft JA600 owned a Technical Certificate and, accordingly, they could not carry out flights outside Poland and the Czech Republic, without previously seeking permission from the authorities responsible for civil aviation of States through which they planned to fly over (1.6.4). Aircraft crews did not request the mentioned permission to fly over the Croatian territory.

After the accident, it was not possible to determine who was flying the aircraft.

3.2. CAUSE

The presumed cause of this accident is the entry of the formation in the area of low visibility, i.e. the area where the flight could not have been conducted in VFR conditions. Pursuant to 1.1.3 it can be assumed that the aircraft KP-5 lost visual contact with the formation leader. As the aircraft was not equipped for IFR flight conditions, it lost orientation and was brought to conditions that the manufacturer specifically prohibits (1.17.1).

- In these maneuvers, the aircraft has short-term entered or was on the verge of stall
- On several occasions, the aerodynamic speed exceeded the maximum speed Vne
- In turns, on several occasions, great loads were achieved, estimated up to n= 4.5

By aircraft exposure to critical values and exceeding them, there is a possibility that the aircraft was brought to structural limitations. As the wing was found around 100 - 150 m meters away from the wreckage and by deformations, it can be assumed that breaking of wing structure occurred due to aerodynamic loads, as a result of repetition of sharp maneuvers, primarily in the turns.

It is our opinion that the key moment was t= 350 s in the right turn in which the structure was specifically loaded because the load factor reached a value of 4.5, and the speed at that point was above Vne. In this turn, the left wing is more aerodynamically loaded than the right wing. By deformations visible on the tank which is located in the center section and the deformation at the root of the wing, it can be assumed that during the flight at the observed time, ie t= 350 s, when the right turn came, the bending of the left wing and the center section up occurred (Image 52), after which the supporting wing structure weakened. By weakening the structure, the wing began to move back and forth (Image 53) and at one point, the supporting structure could not hold the aerodynamic loads. Furhermore, the wing (which free fell on the trees) separated from the aircraft center section, after which the aircraft was vertically falling and hit the ground.

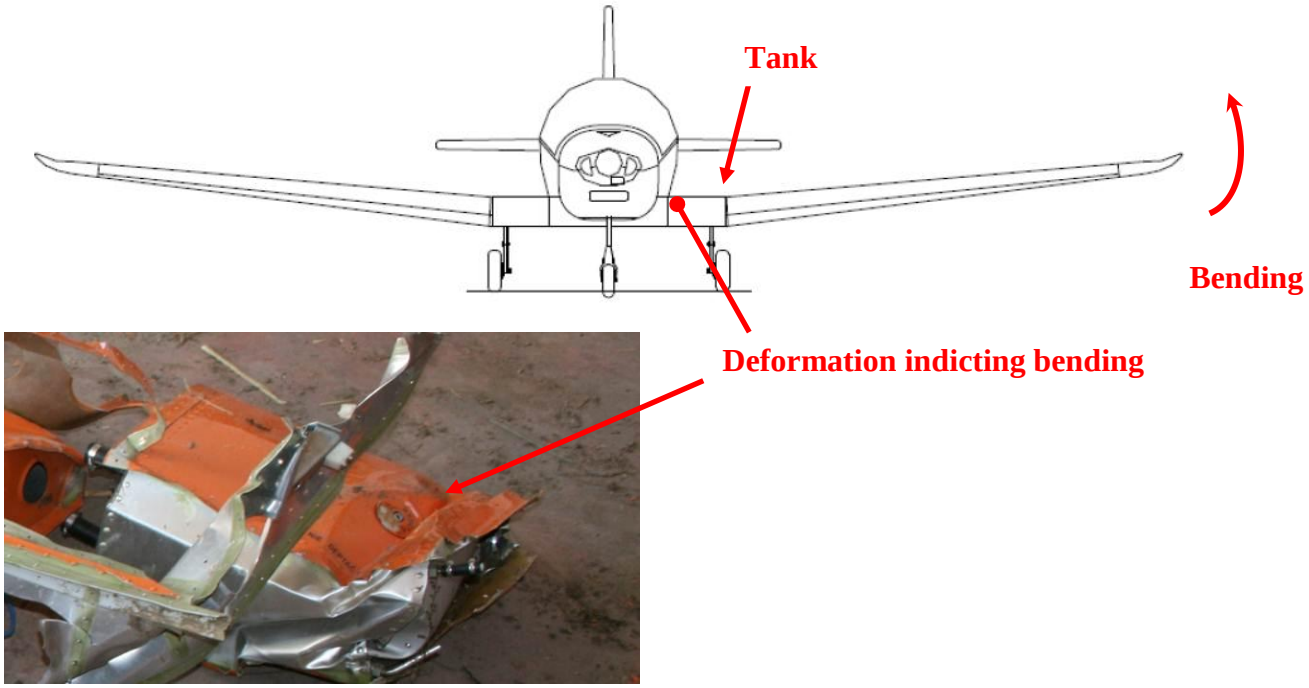


Image 52 Bending of the wing

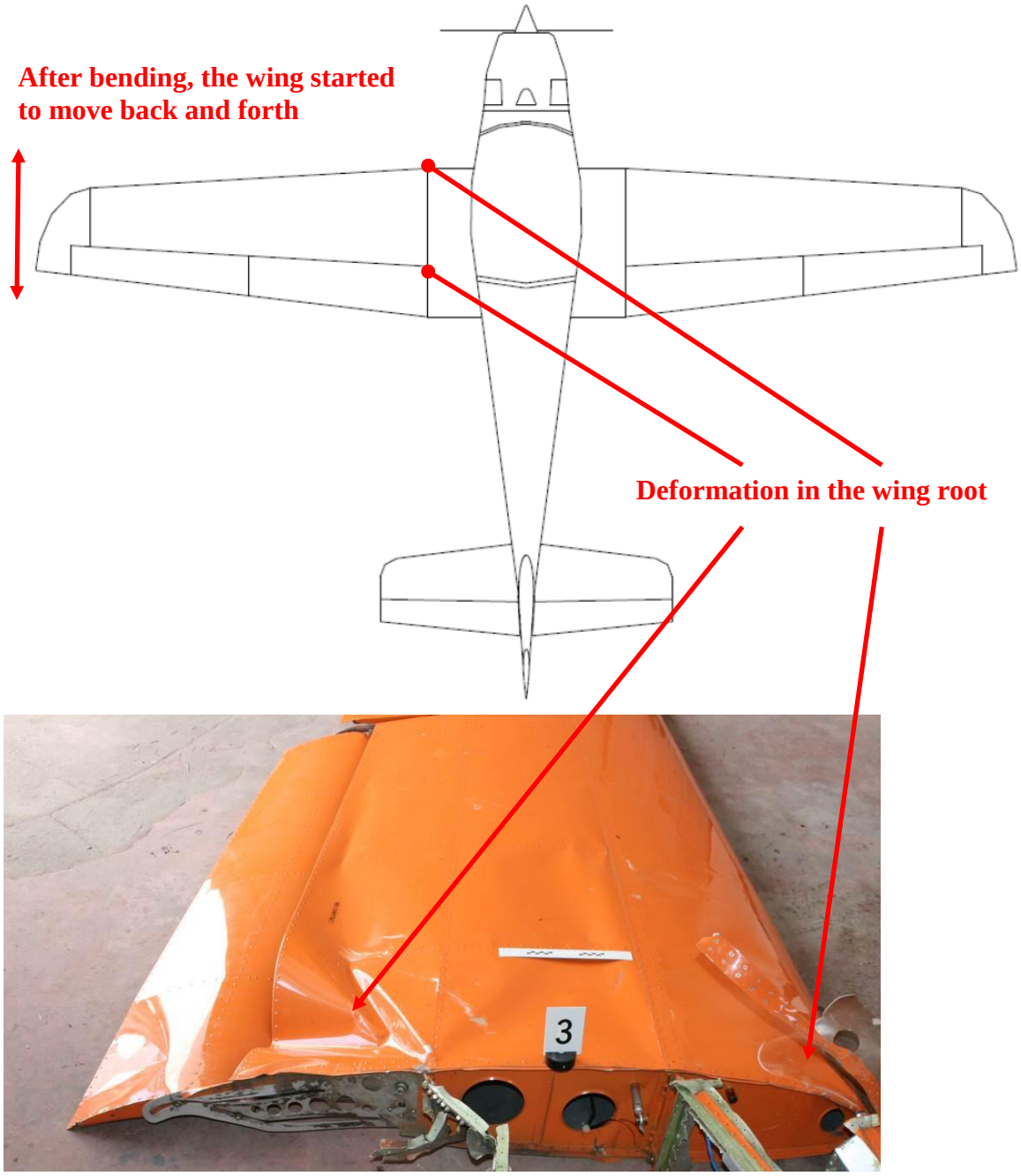


Image 53 Deformations in the wing root

4. RECOMMENDATIONS

At the joint meeting of investigators from the Czech Republic, Poland and Croatia, the following recommendations have been adopted:

- **From the loss of the aircraft's radar reflection and the message of the flight leader that he could not get in contact with the following aircraft until the announcement of the last phase of DETRESFA alert (distress phase), approximately 2 hours had passed. Although the Chief Investigator of the Republic of Croatia and 112 centre were notified immediately by phone.**
  Alerting phases were performed in compliance with the Regulation on the conditions and method of conducting the investigation and saving aircrafts (Official Gazette, no. 129/11), only the intervals between individual phases should be reduced to minimum in the future.

- **In compliance with the Flight and maintenance manual (KP-5 Skayleader 500), page 37, the pilot in command (PIC) could have sat both on the left and right sides.**
  At the investigator's request, the aircraft's manufacturer agreed to change the said item in the manual and specify that the PIC is on the left side. The same will also be applied to other types of aircrafts manufactured by them.