

Results of the exploratory check of the possibility to apply hardware/software of the automatic dependent surveillance – broadcast (VDL-4) for the benefit of military and transport aviation

Tver airdrome (Migalovo)
26-31 of October, 2015

Participants of the exploratory check

- Troop unit 25969 (Moscow);
- Troop unit 21350 (Tver);
- Troop unit 41468 (Tver);
- IL JSC (Moscow);
- FGUP GosNIIAS (Moscow);
- NITA FIRM LLC (St.-Petersburg);
- branch of NII Aeronavigatsia of FGUP GosNII GA.

Reasons for the execution of the exploratory check

- Decision of the troop unit 25969 Command on the execution of an exploratory check (letter of April 16, 2015 No. 134/9/731).
- Development of the design documentation draft at IL LLC on the installation and plugging-in of ADS-B equipment at Il-76MD (letter of July 22, 2015 No. 199-09/244-1673ϕ).
- Order of the Director of Armaments – Deputy-Commander-in-Chief of the Air-Space forces for Armaments of September 28, 2015 No. 672/12/6754.
- Order of the troop unit 25969 Chief-of-Staff of October 23, 2015 No. 134/2/9/265/1-4.

Methodology of the organization, preparation and performance of flights

«УТВЕРЖДАЮ»

Командир войсковой части 25969


В.В. Бенедиктов
«20» сентября 2015 г.

«СОГЛАСОВАНО»

Генеральный директор
ФГУП «ГосНИИАС»

«СОГЛАСОВАНО»

Генеральный директор -
директор филиала «НИИ Аэронавигации»
ФГУП «ГосНИИГА»

« »  С.Ю. Желтов
« » _____ 2015 г.

« »  О.А. Евтушенко
« » _____ 2015 г.

«СОГЛАСОВАНО»

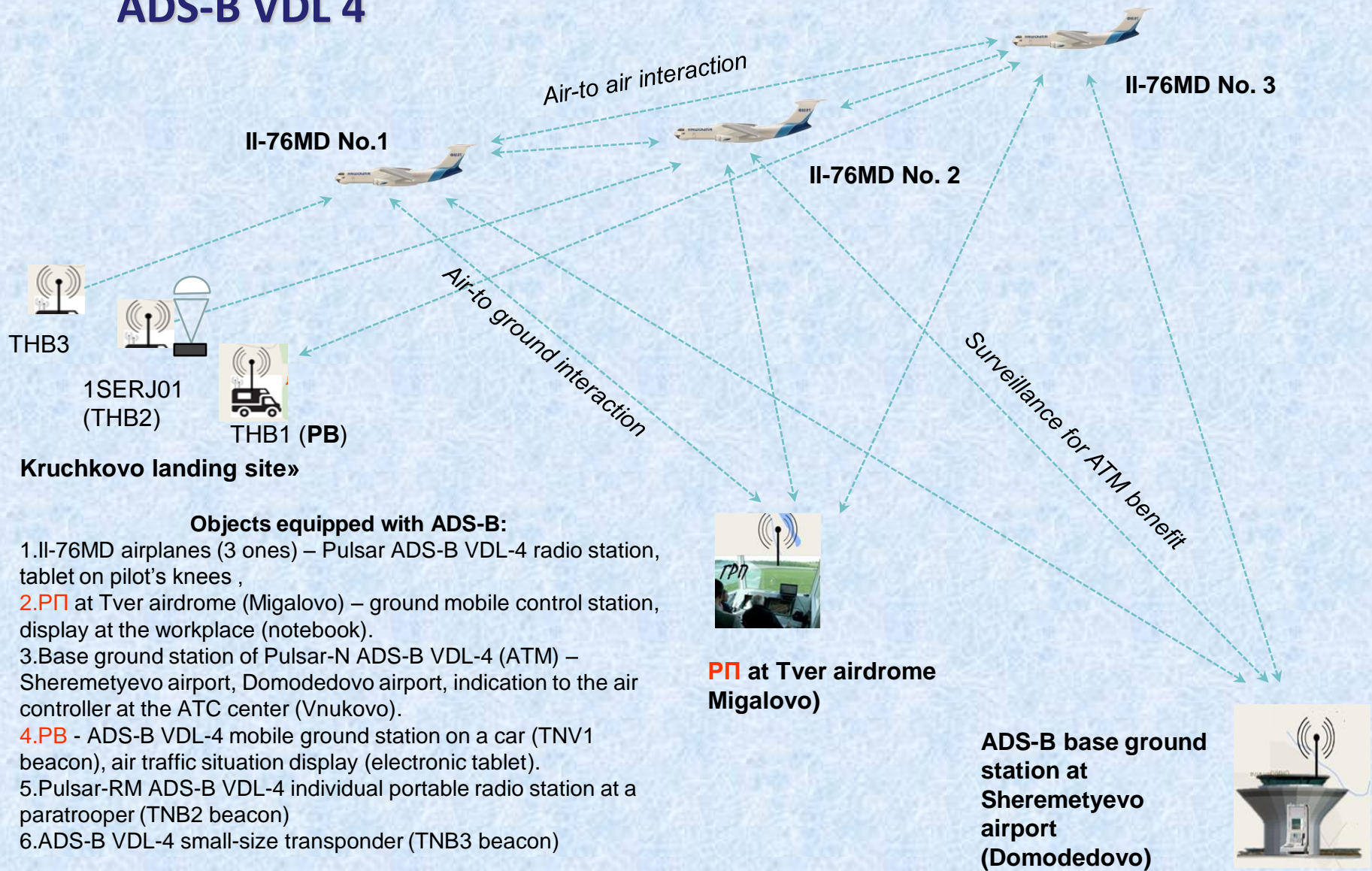
Руководитель подразделения
ФГУП «ГосНИИАС»

 Э.Я. Фальков
« » _____ 2015 г.

Методика
организации, подготовки и выполнения полетов в целях исследовательской
проверки аппаратно-программных средств автоматического зависимого
наблюдения радиовещательного типа режима 4 на самолетах Ил-76МД
в интересах ВТА

г. Москва
2015г.

Scheme of the interaction of objects equipped with ADS-B VDL 4



Kruchkovo landing site»

Objects equipped with ADS-B:

1. II-76MD airplanes (3 ones) – Pulsar ADS-B VDL-4 radio station, tablet on pilot's knees ,
2. PП at Tver airdrome (Migalovo) – ground mobile control station, display at the workplace (notebook).
3. Base ground station of Pulsar-N ADS-B VDL-4 (ATM) – Sheremetyevo airport, Domodedovo airport, indication to the air controller at the ATC center (Vnukovo).
4. PB - ADS-B VDL-4 mobile ground station on a car (TNV1 beacon), air traffic situation display (electronic tablet).
5. Pulsar-RM ADS-B VDL-4 individual portable radio station at a paratrooper (TNB2 beacon)
6. ADS-B VDL-4 small-size transponder (TNB3 beacon)

PП at Tver airdrome Migalovo)

ADS-B base ground station at Sheremetyevo airport (Domodedovo)

Il-76MD airplanes equipped with ADS-B



RF-78797

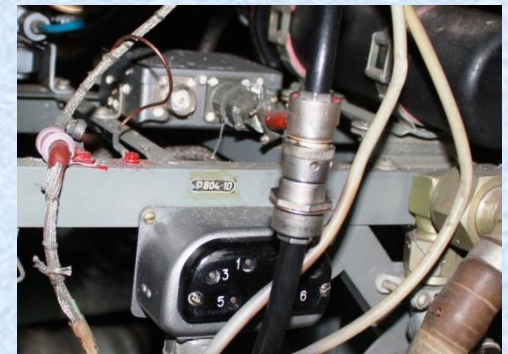
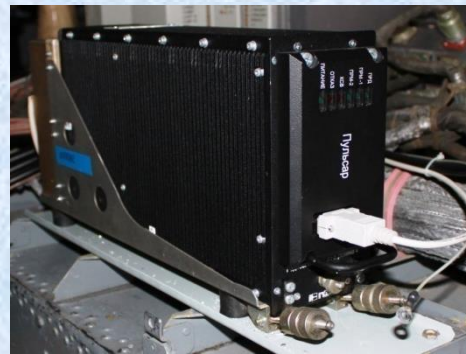
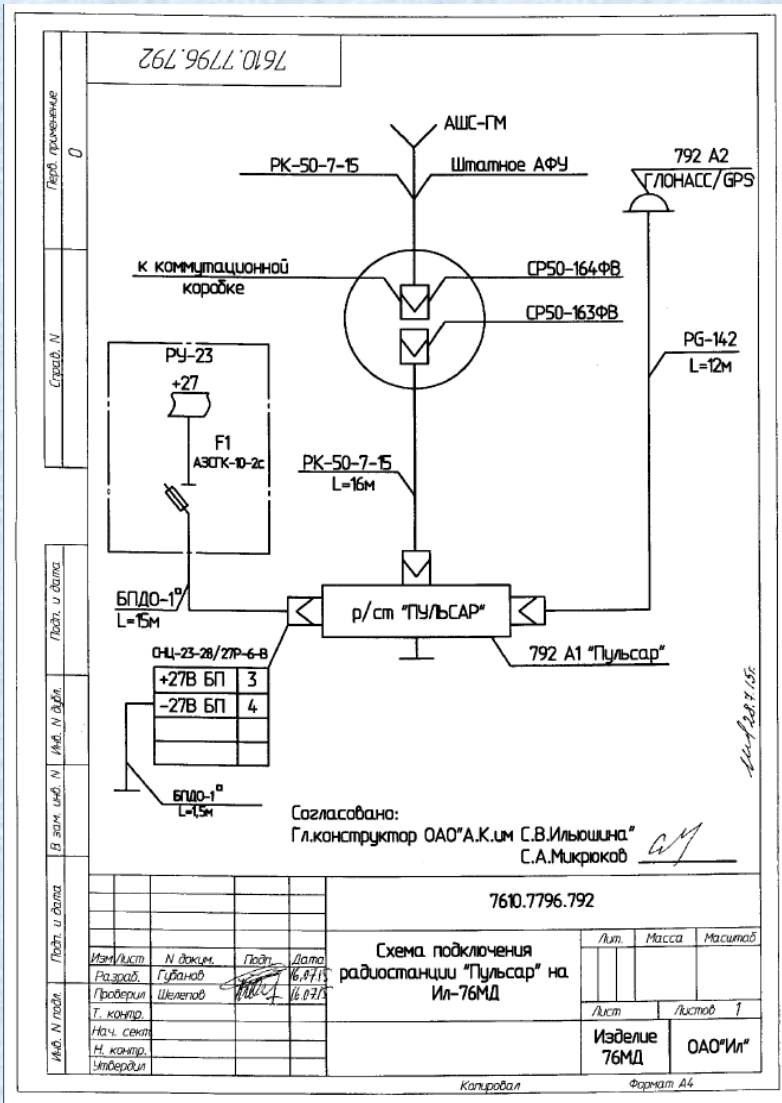


RF-76733



RA-78794

ADS-B location on Il-76MD board



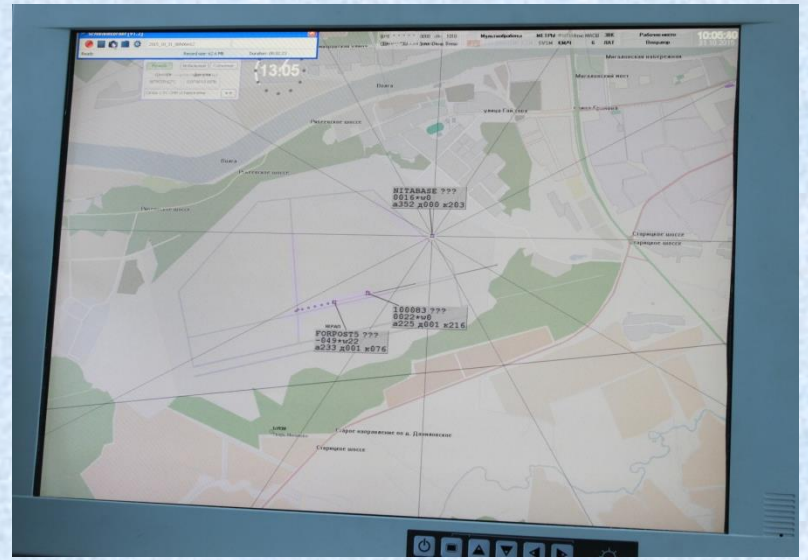
NITA mobile command and control station



Workplace of the flight operations director, equipped with ADS-B display



Ground vehicle equipped with ADS-B (small-size transponder MGTR-4)



ADS-B Mode small size transponder MGTR-4 developed at FGUP GosNIIAS



Specifications:

- Transmitter power [Wt] - 4
- Operation mode - pulse
- Modulation type - GFSK (TDMA)
- Data rate [Baud] - 19200
- Two-channel tunable receiver
- Frequency range [MHz] - 118.0 – 136.975
- Operating frequency [MHz] - 136.945
- Frequency step [kHz] - 25
- Sensibility [dBm] - 100
- Dimensions [mm] - 110x70x40
- Mass with batteries [gp] - not more that 500

Done according to ICAO, EUROCAE, ETSI standards

NITA Pulsar-RM ADS-B mode 4 mobile radio station



Barguzin car equipped with ADS-B



Call-signs of ADS-B objects

- «**NITABASE**» – NITA mobile control and station (RP);
- «**76733**» – Il-76 airplane, tail number RF-76733;
- «**78794**» – Il-76MD airplane, tail number RA-78794;
- «**78797**» – Il-76MD airplane, tail number RF-78797;
- «**FORPOST5**» - car on the airdrome;
- «**THB1**» – ADS-B ground mobile station on Gazel base – beacon 1;
- «**1SERJ01**» – Pulsar RM at a paratrooper – beacon 2;
- «**THB3**» – MGTR-4 – beacon 3.

Flight programs on the exploratory check plan

- Program 1: 78797 airplane - meteorological reconnaissance, check of on-board and ground ASD-B systems.
- Program 2:
 - 78794 airplane – solo flight on the drop of a group of paratroopers with Pulsar-RM radio to Kruchkovo site;
 - 76733, 78797 airplanes – distance flight on diverging headings to objects GT1, GT2 (200 km from **KTA**).
- Program 3: 76733, 78794, 78797 airplanes – formation flight. Tactical paradrop at Kruchkovo site, each on his own **THB**, marked by ADS-B beacon.

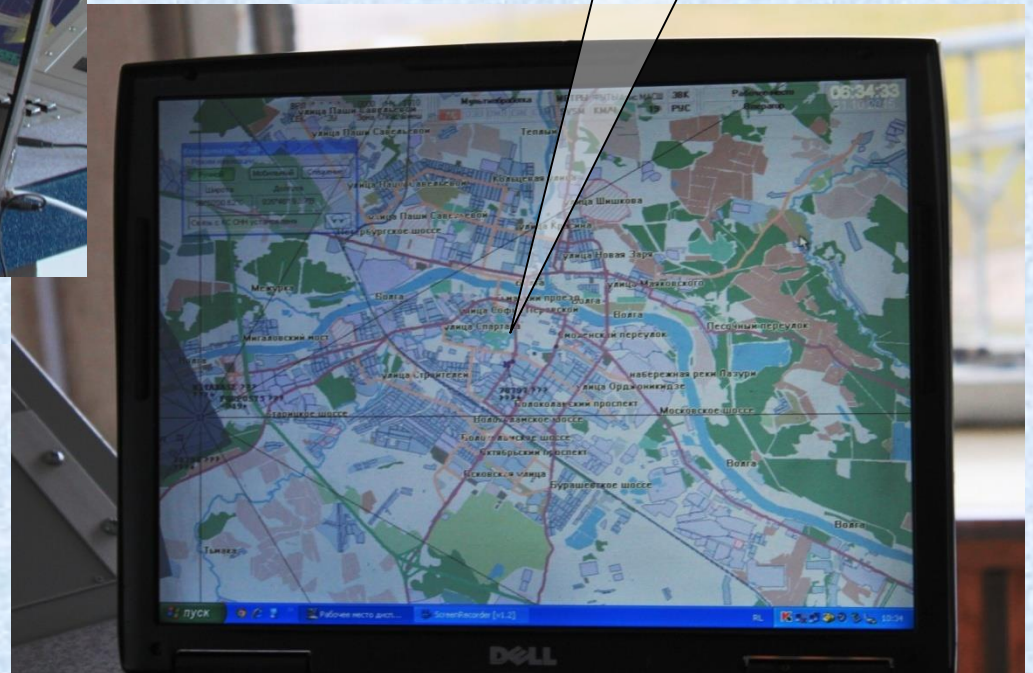
Indication of 78797 flight in route for meteorological reconnaissance



ADS-B indication at **РП** workplace

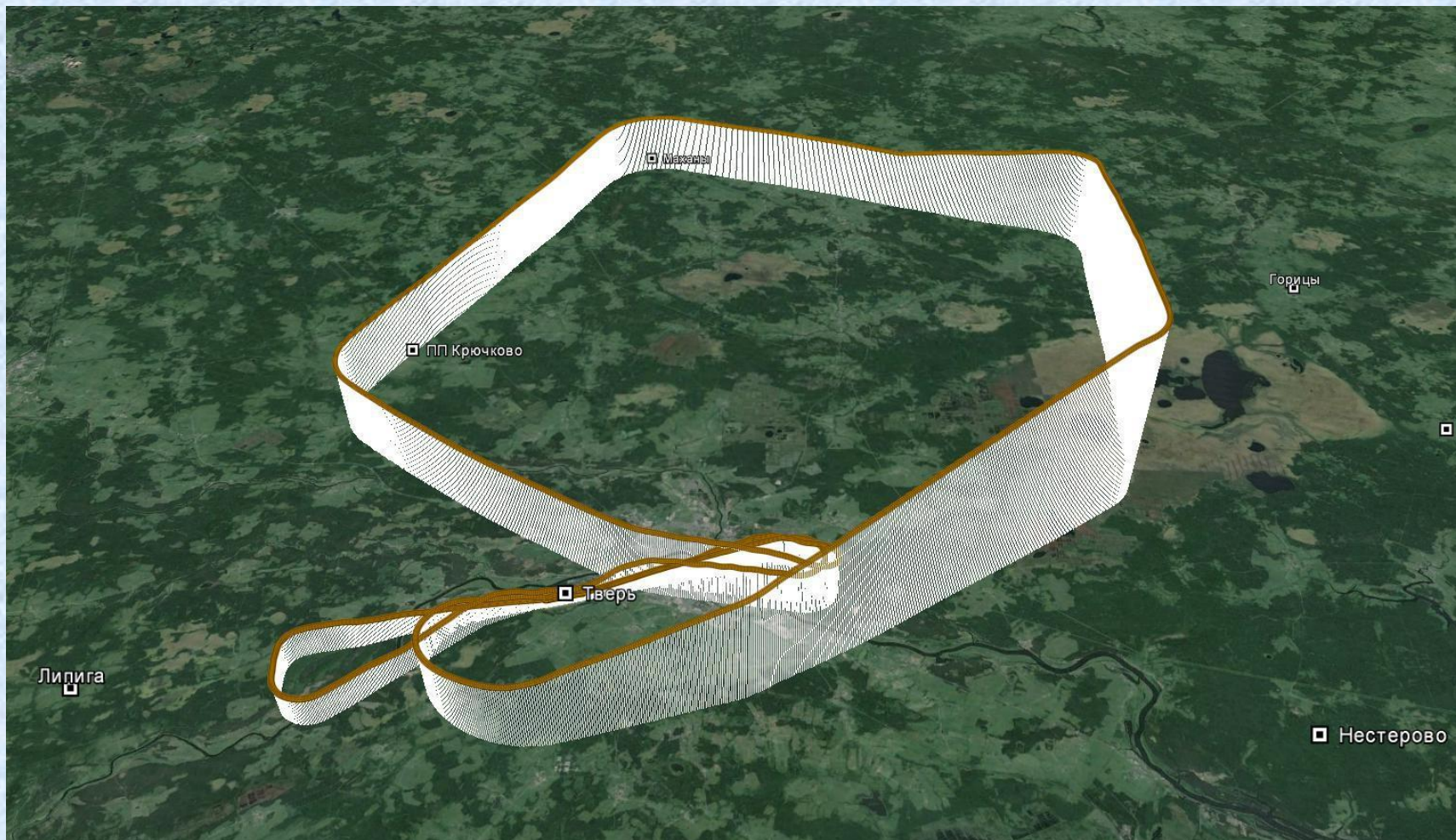


ADS-B indicator (note-book) at **РП** workplace

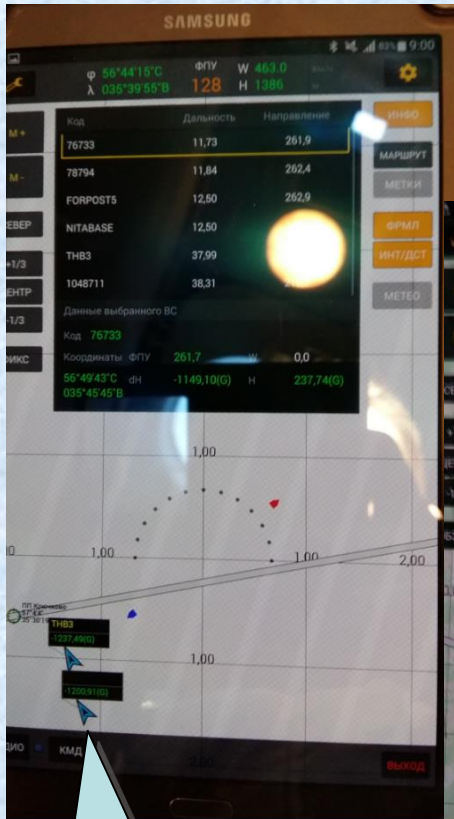


Mark of 78797 airplane
(**ВРП**)

Profile of 78797 flight route on the meteorological reconnaissance



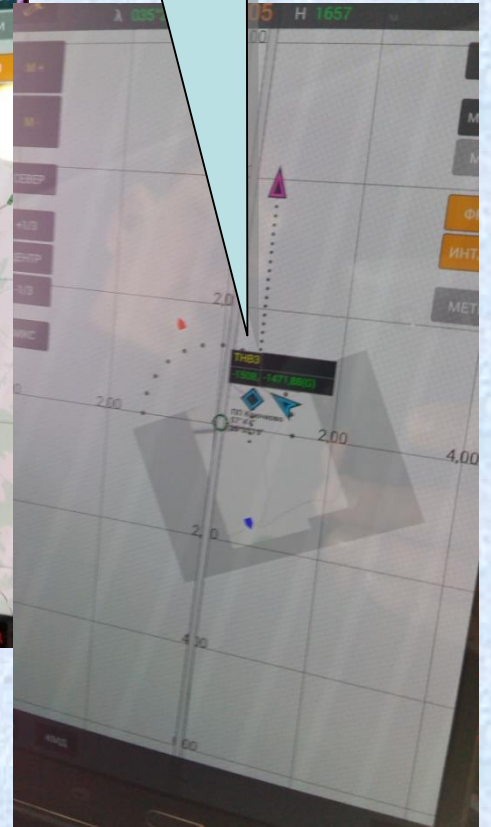
ADS-B information of the pilot's tablet of 78797 airplane (ВРП)



Information about ADS-B objects

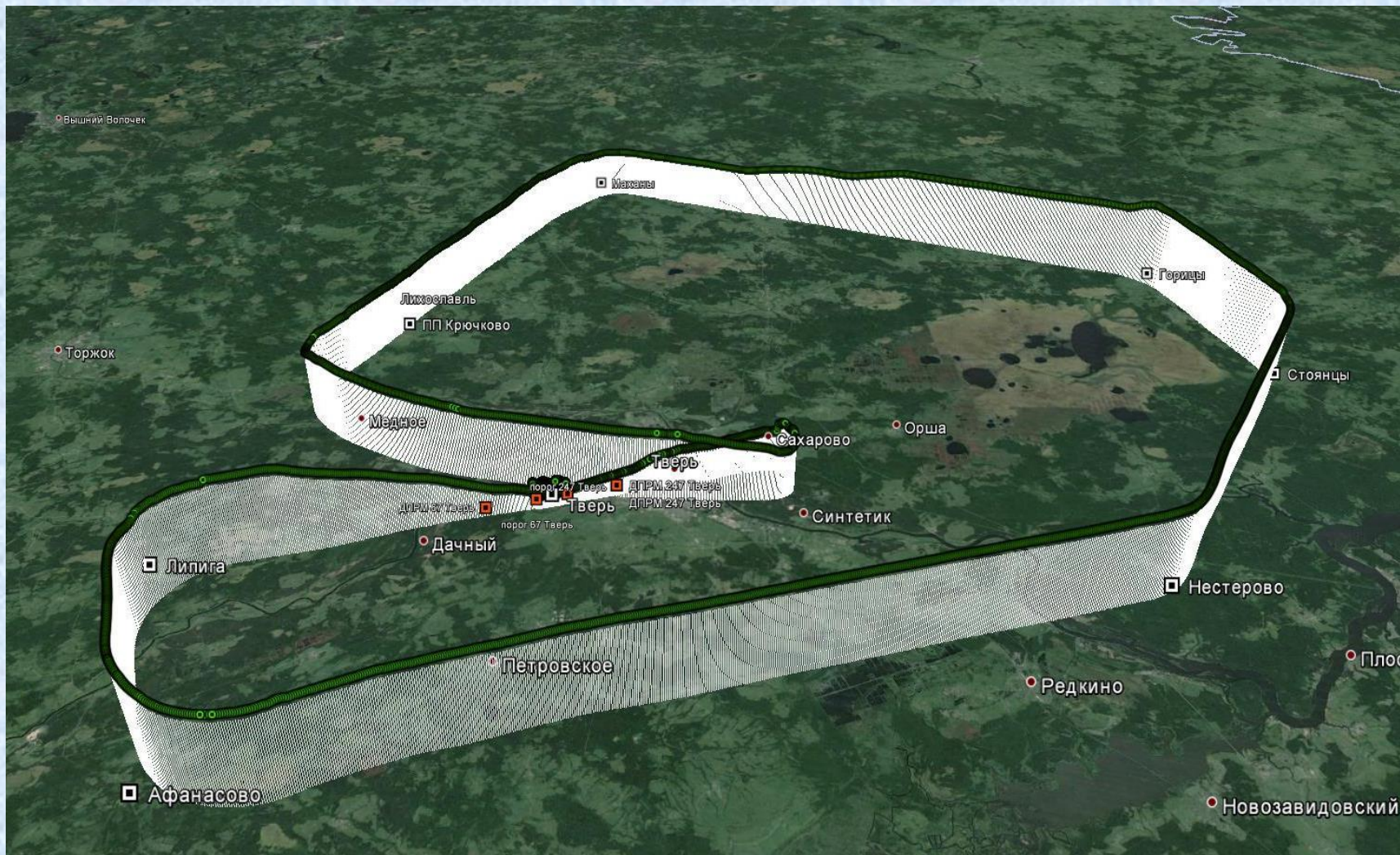


Fly over ADS-B object (THB3) at Kruchkovo ПП



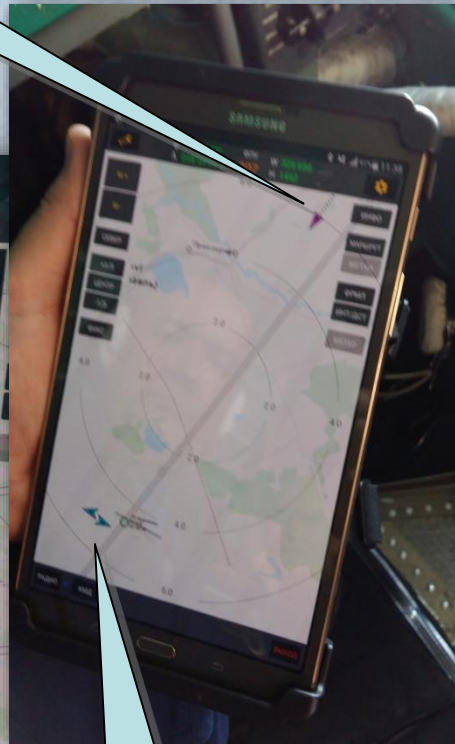
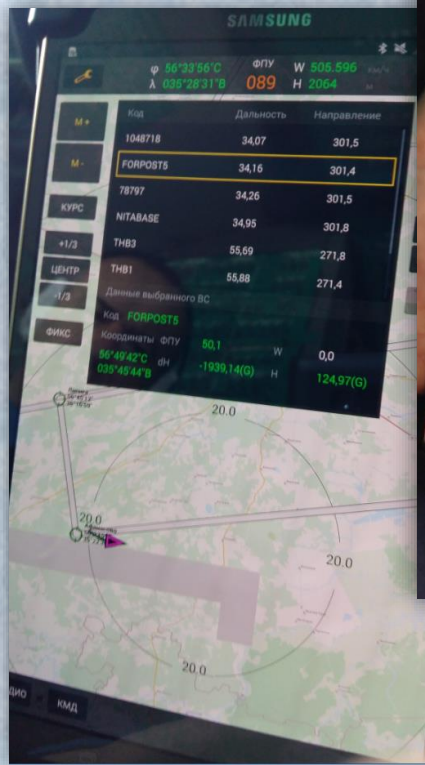
Objects with ADS-B at Kruchkovo ПП

Profile of 78794 flight route (solo flight on paradrop)



ADS-B information on the pilot's tablet of 78794 airplane

Own mark of 78794 at Kruchkovo **НБП ПП**



ADS-B objects (beacons) at Kruchkovo **ПП**



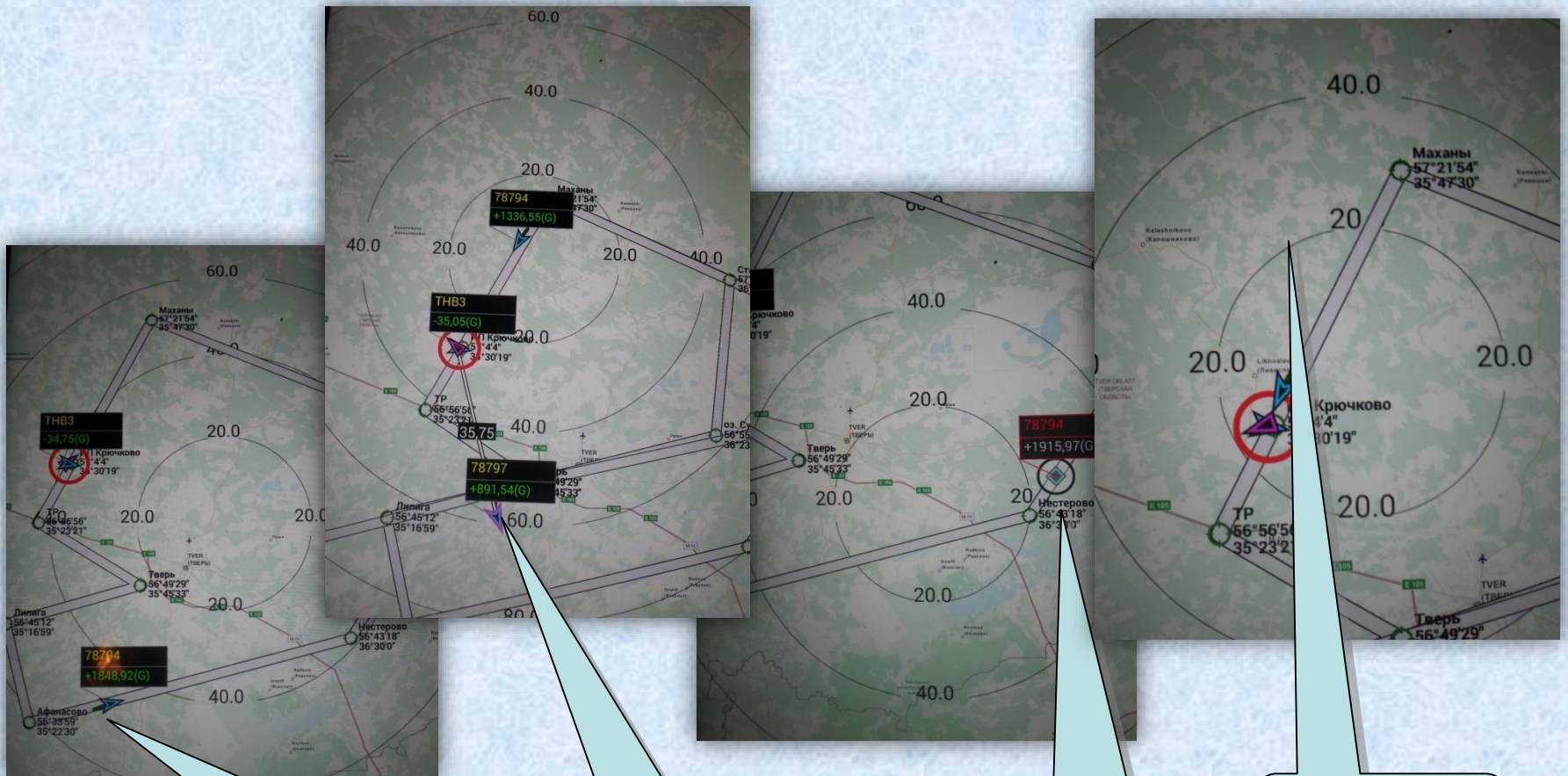
Mark of ADS-B ground station at Lubyanka (center of Moscow)

Mark of ADS-B ground station and MI-8 helicopter No. RF23185 of the state aviation (Krasnoarmeysk)



Mark of 76733 airplane (distance flight)

ADS-B indication on the mobile ground station at Kruchkovo (THB1)



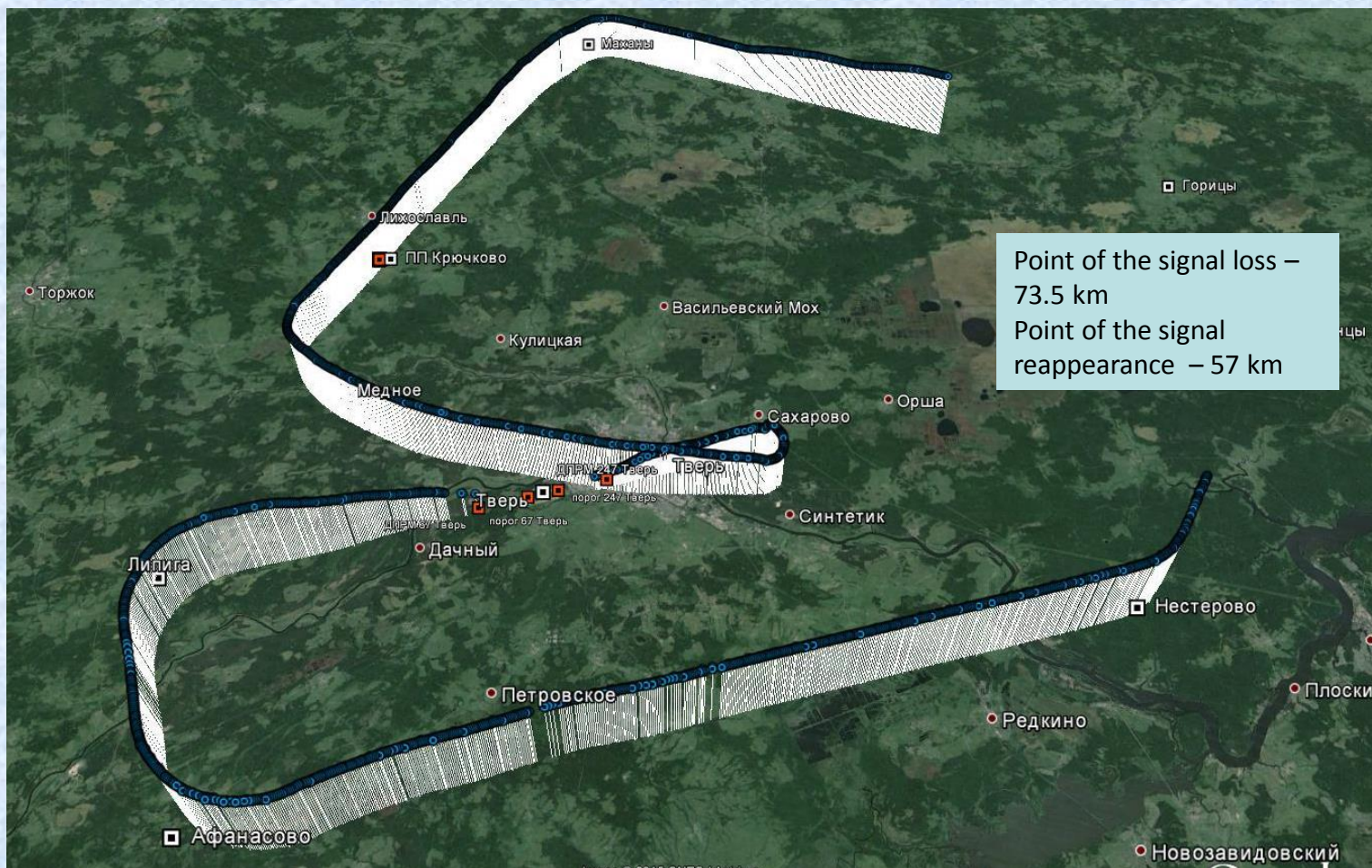
Mark of 78794 airplane, on-route flight

Mark of 78797 airplane, distance flight

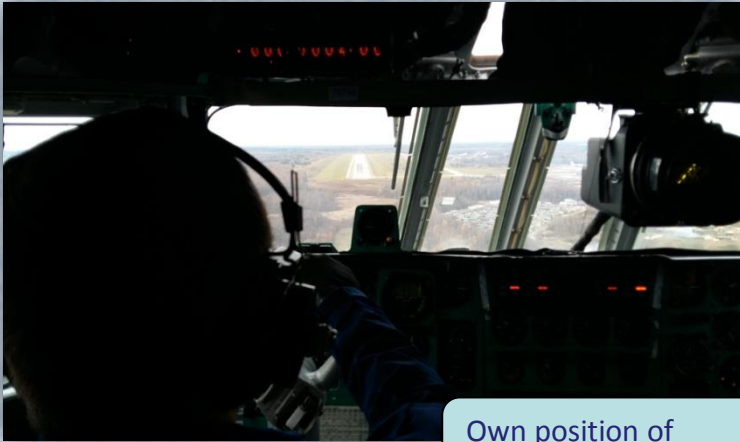
Loss of ADS-N information from 78794 airplane

Exit to Kruchkovo THB ПП

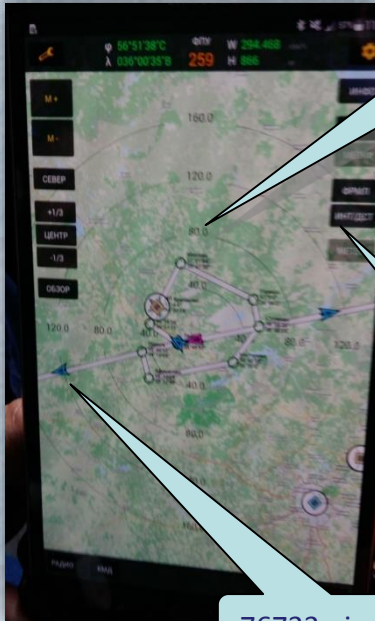
Track of 78794 airplane flight recorded on ADS-B at Kruchkovo



78794 airplane approach

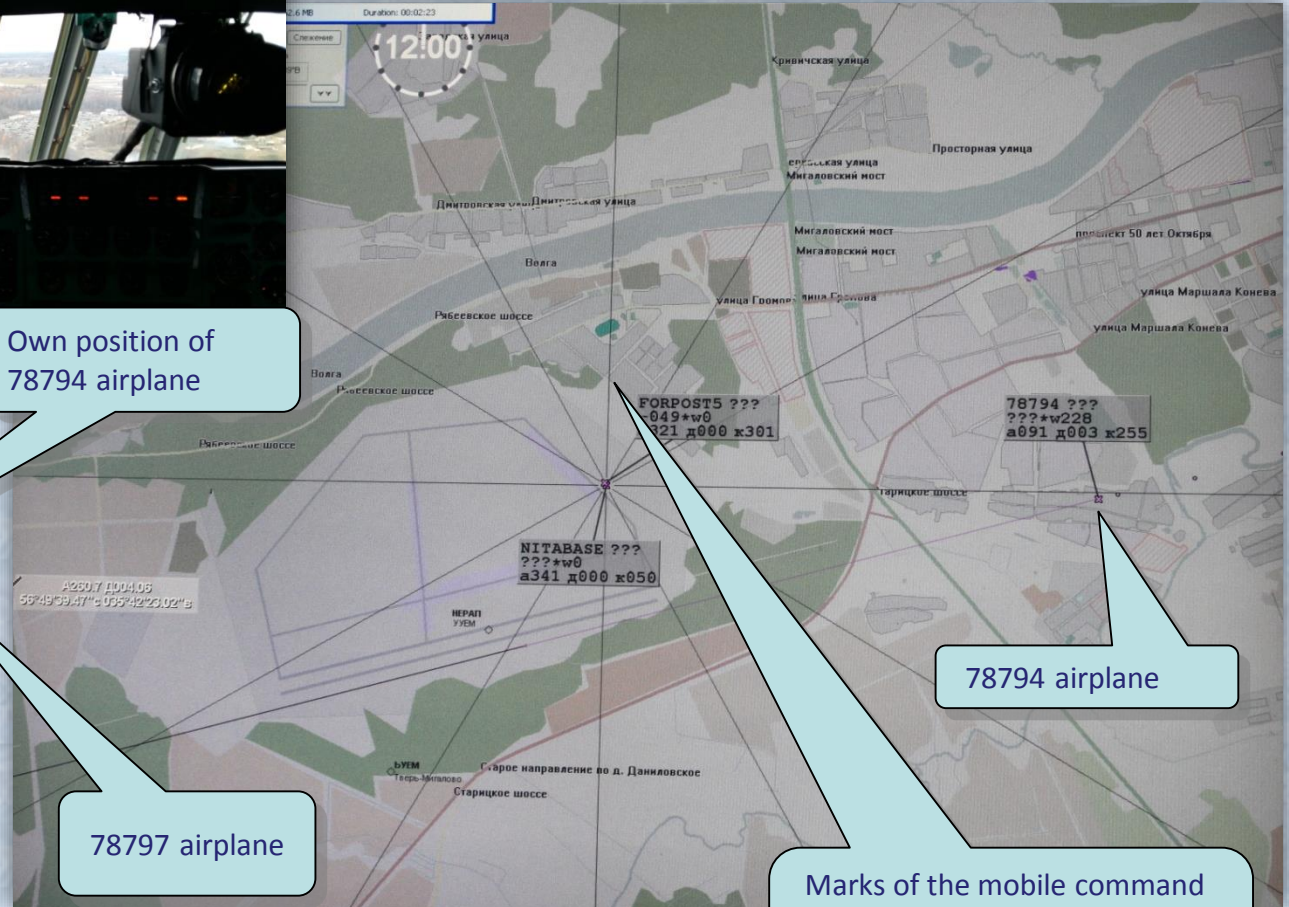


Own position of 78794 airplane



76733 airplane

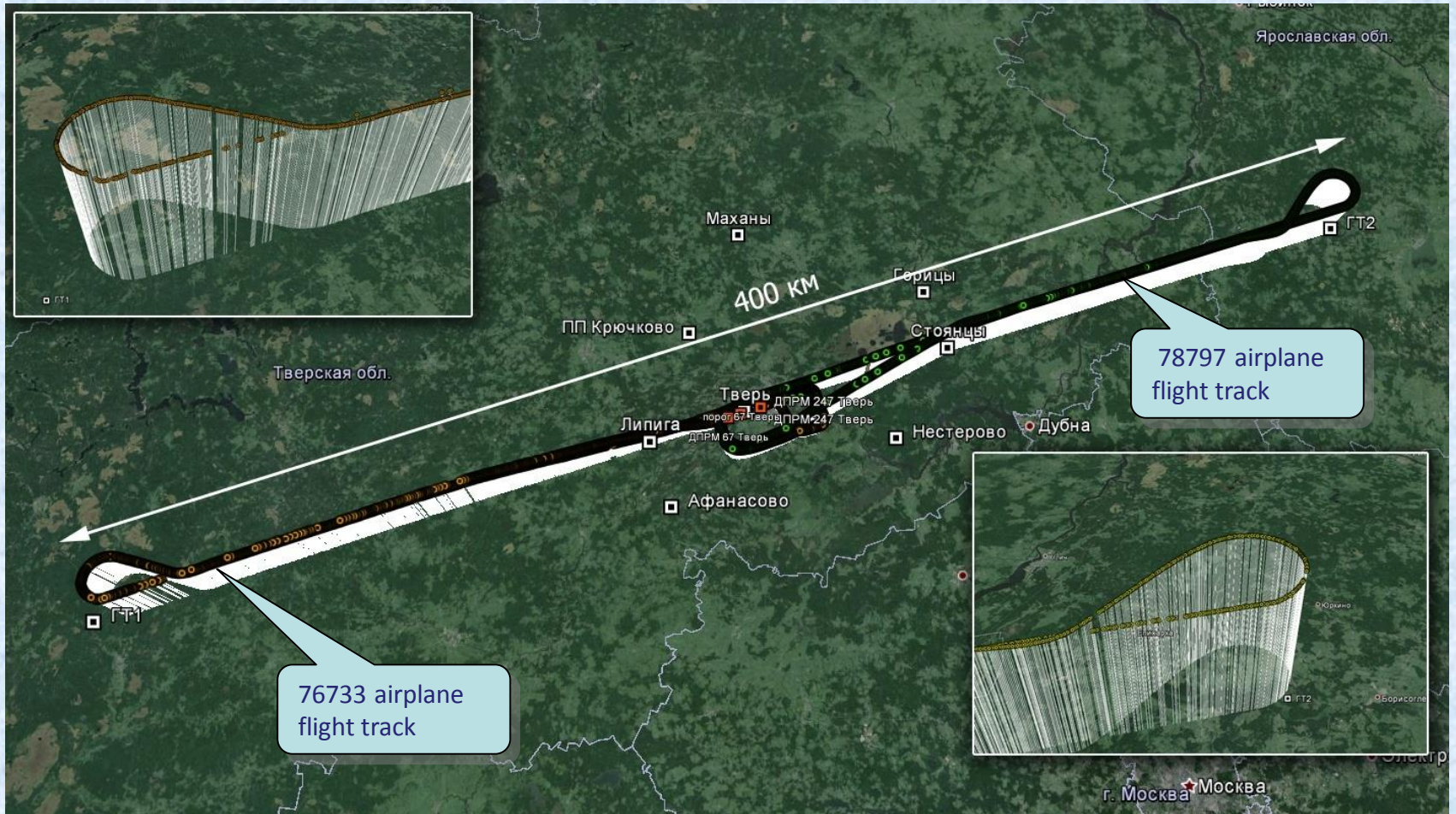
78797 airplane



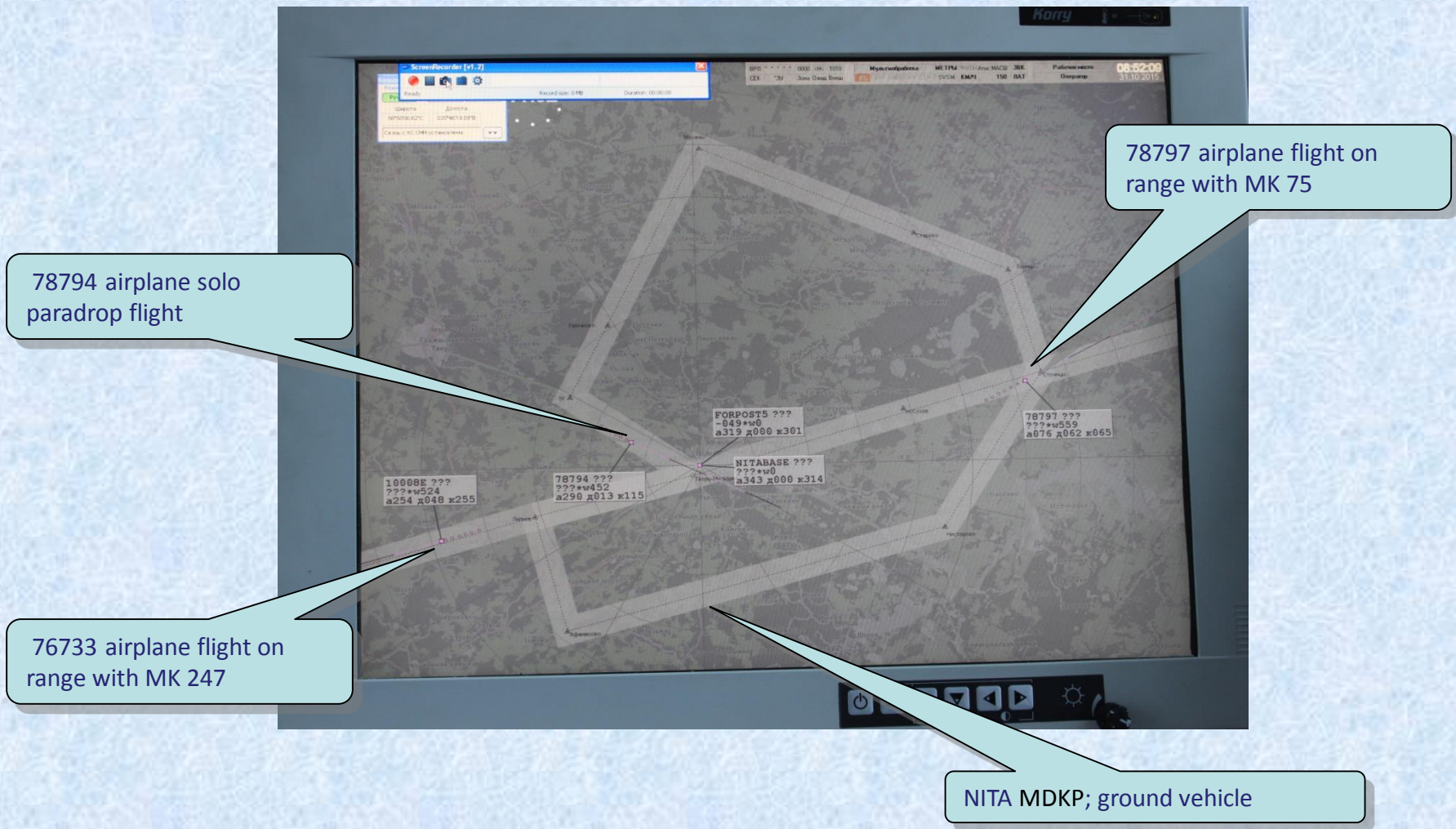
78794 airplane

Marks of the mobile command and control station and ground vehicle at Tver airdrome (Migalovo)

76733 and 78797 distance flights



Display at the mobile control and command station (MDKP)



Track of 76733 airplane flight recorded on ADS-B on aboard of 78797 airplane

φ 57°02'08"С ФПУ W 581.528 км/ч
λ 037°15'49"В 076 H 5299 М

Код	Дальность	Направление
FORPOST5	92,79	180,4
ТНВ3	107,13	196,3
ТНВ1	107,59	196,4
КУРС	МКДР	115,57 74,6
+1/3	2097159	143,09 94,5
ЦЕНТР	1048718	169,60 180,0
-1/3	Данные выбранного ВС	
ФИКС	Код	Координаты ФПУ 254,0 W 563,0
		56°38'28"С dH +90,53(G) H 5390,39(G)
		034°32'30"В

Map showing aircraft positions with callouts:

- Mark of 76733 aircraft
- Own position of 78797 airplane

Indication at the pilots' tablet on 78797 airplane



Track of 78797 airplane flight recorded on ADS-B on aboard of 76733 airplane

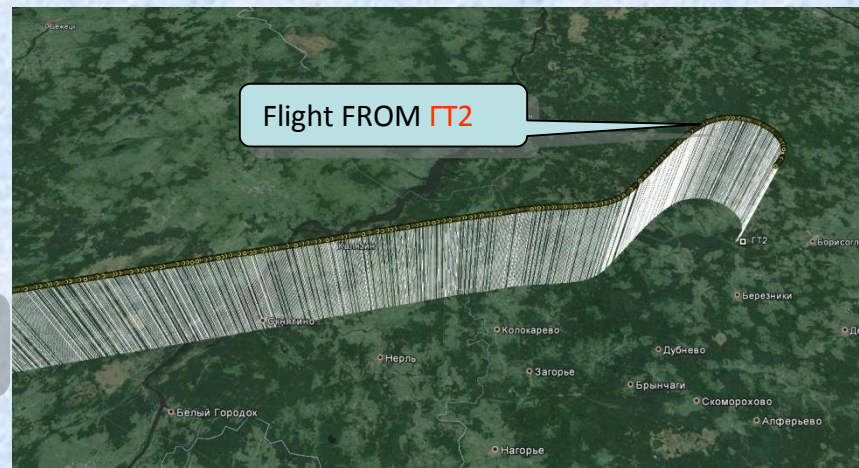
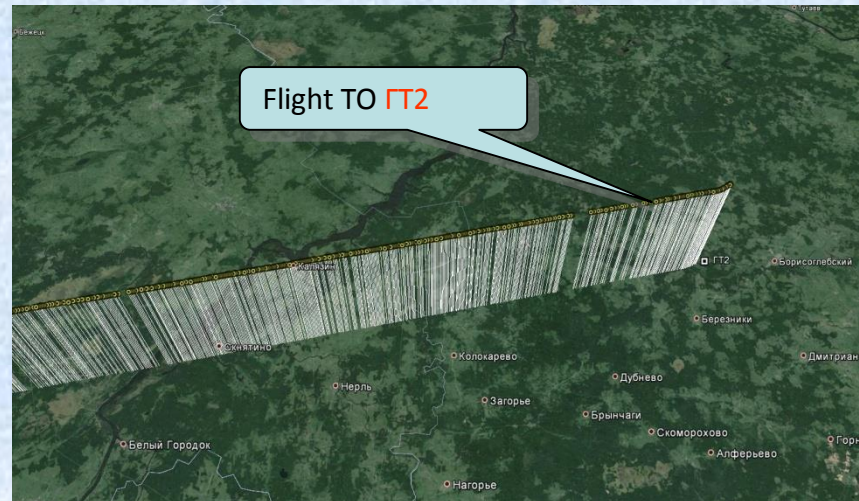


Range to 76797 airplane

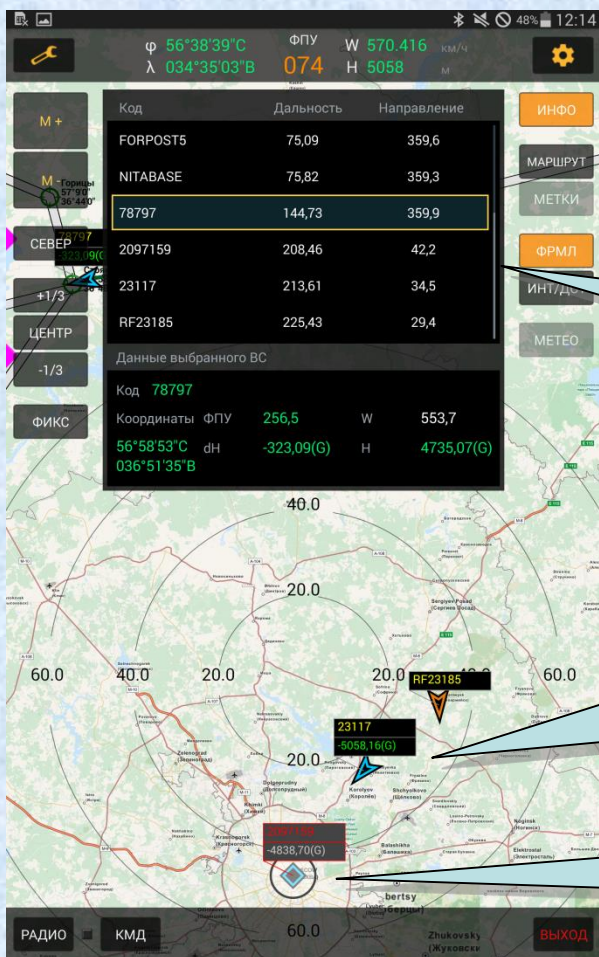
Own position of 76733 airplane

Mark of 78797 airplane

Indication at the pilot's tablet on 76733 airplane



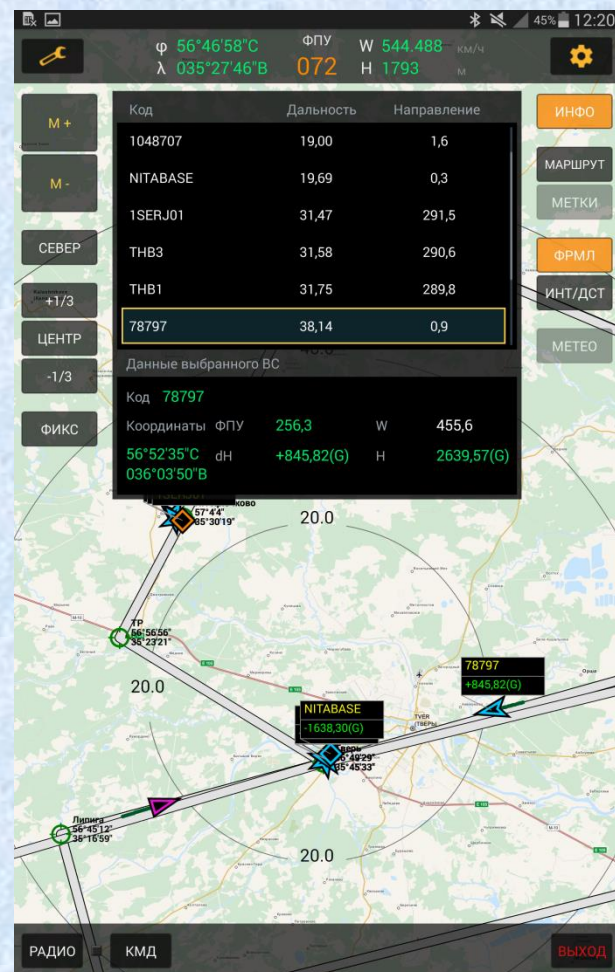
Indication of ADS-B objects on 76733 airplane pilot's tablet



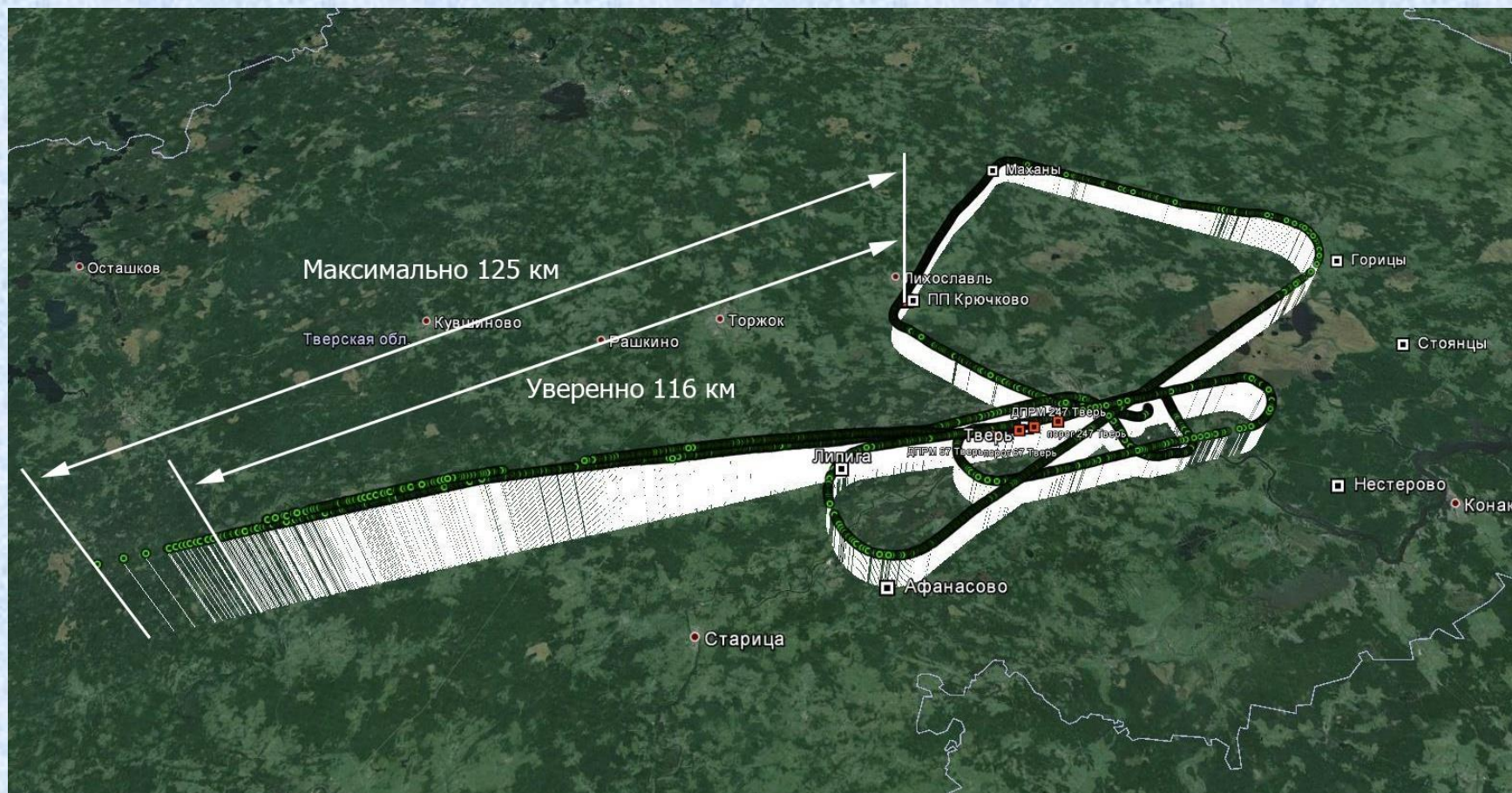
Information about ADS-B objects

Marks of Mi-8 helicopters (23117, RF23185) of the state aviation

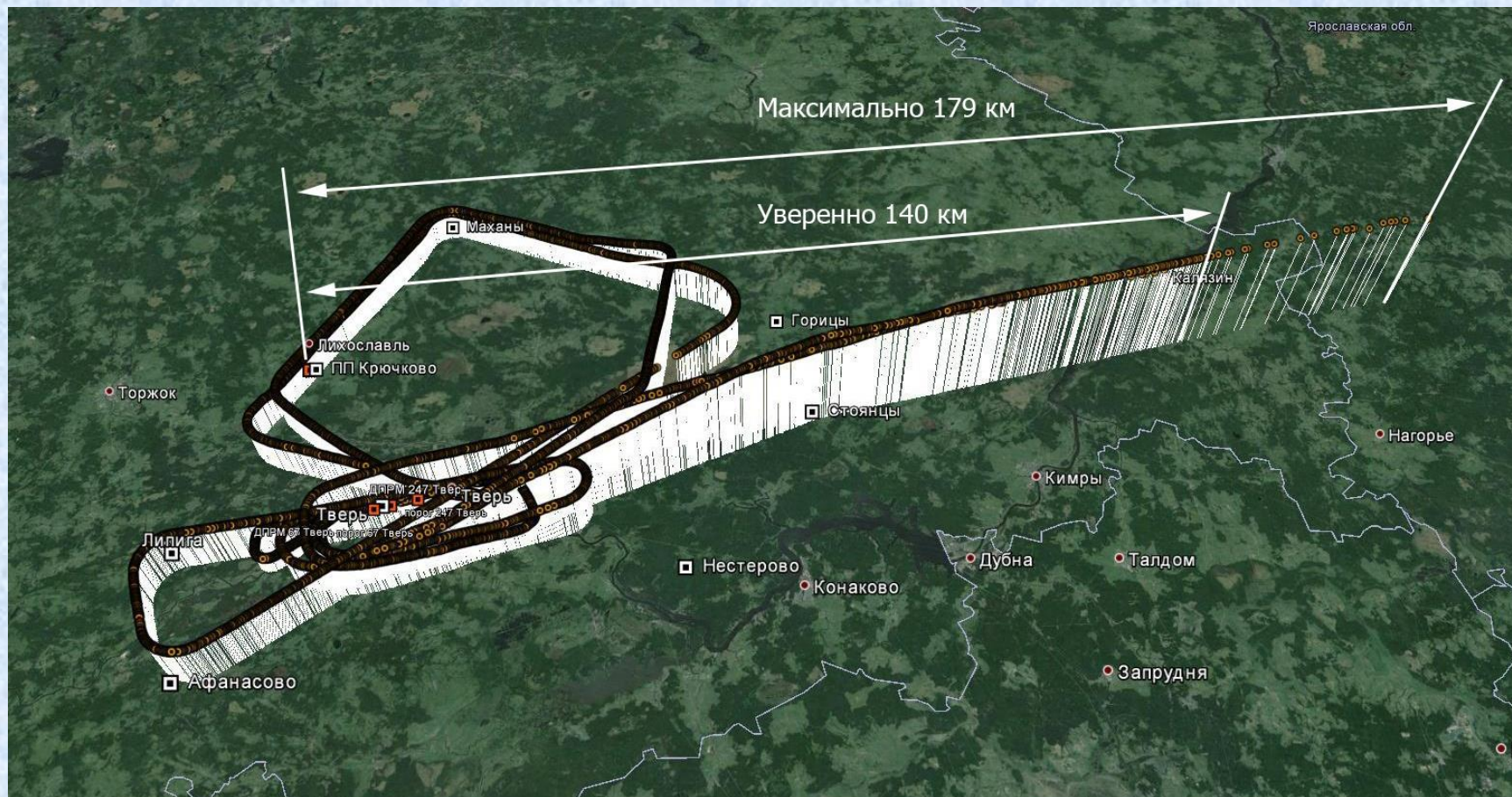
Mark of the ground station at Lubyanka (center of Moscow)



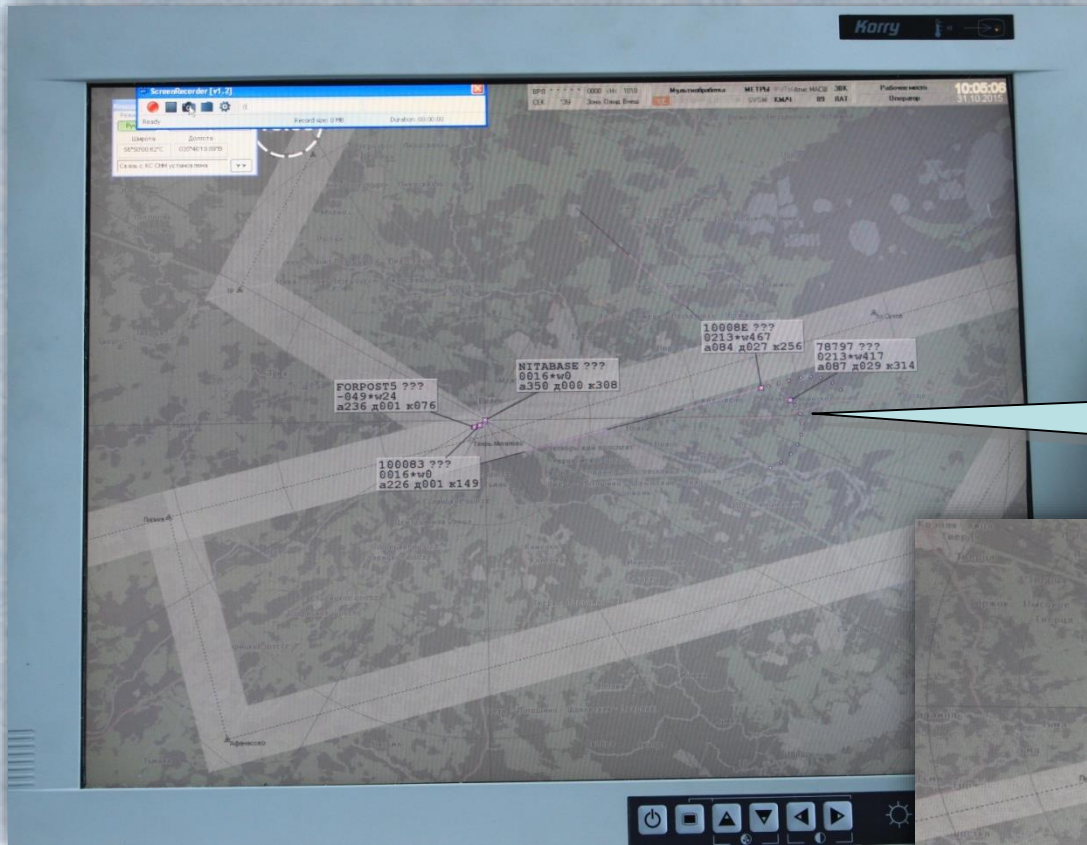
Track of 76733 airplane flight recorded on ADS- at Kruchkovo



Track of 78797 airplane flight recorded on ADS- at Kruchkovo

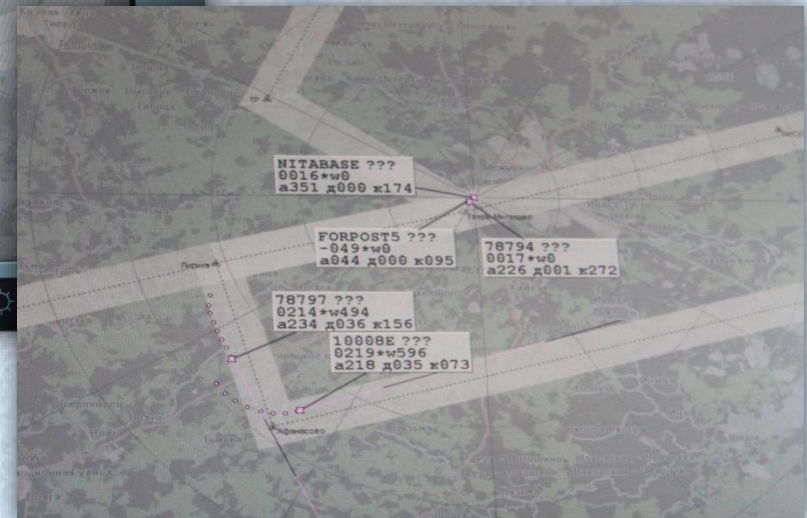


Formation flight for the tactical paradrop

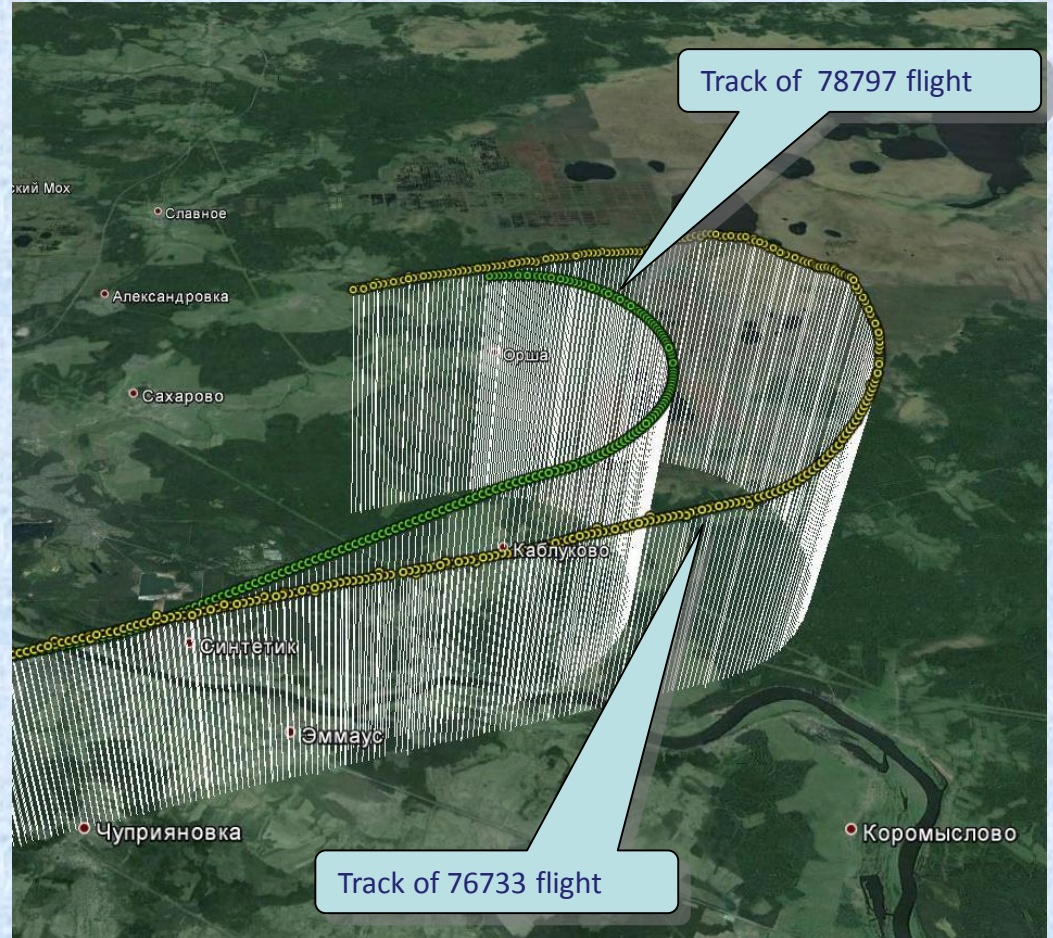


Group of Il-76MD airplanes:
76733 - leader
78797 – 1st trailing airplane
76553 – 2nd trailing airplane (instead of 78794) without ADS-B

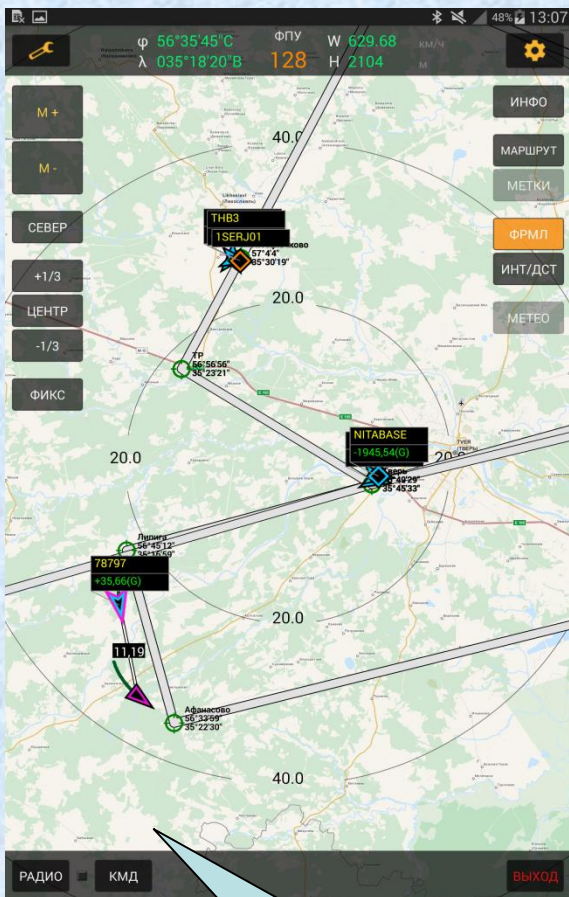
Accumulation “on the loop”,
marks of 76733 and 7879
airplanes



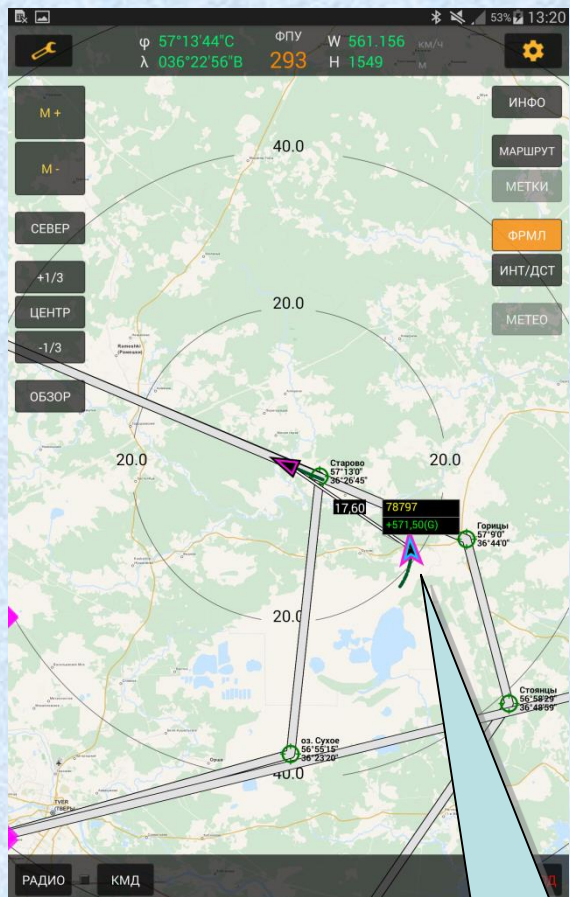
Recorded tracks of “accumulated on loop” type



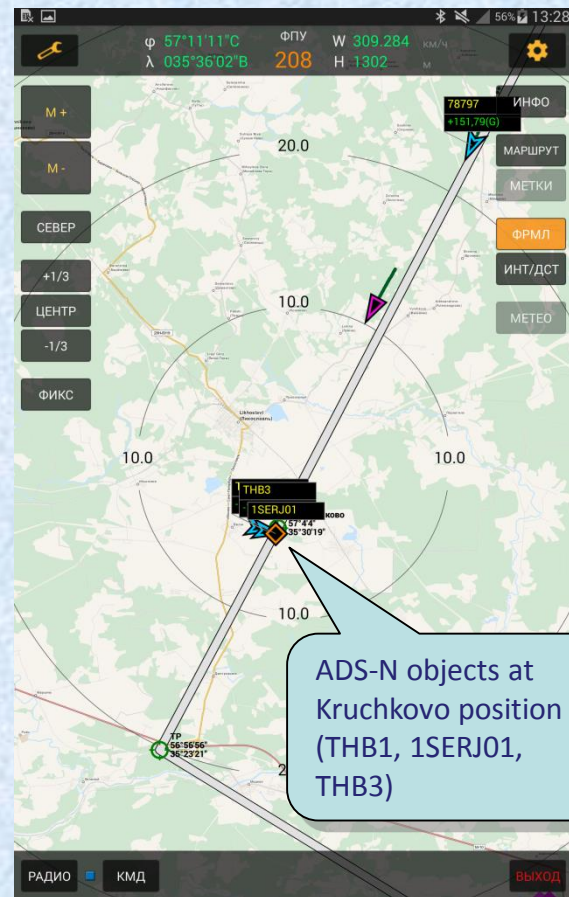
Indication on the pilot's tablet on board of 76733 aircraft



Own position of leading 76733

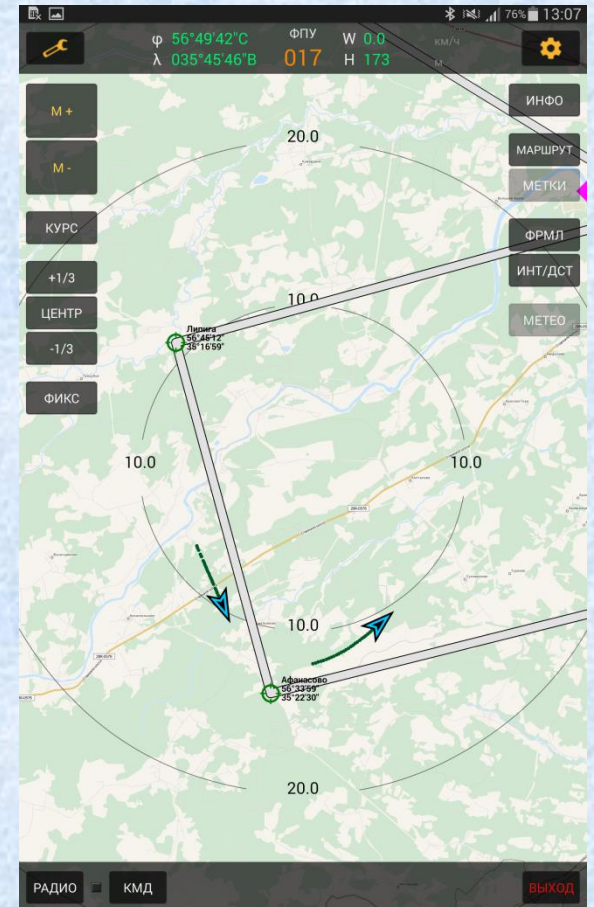
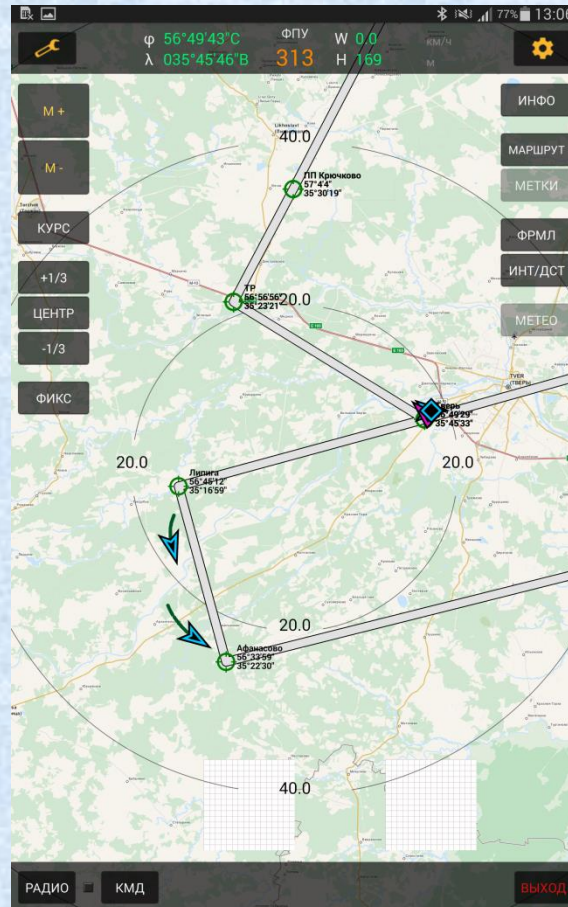
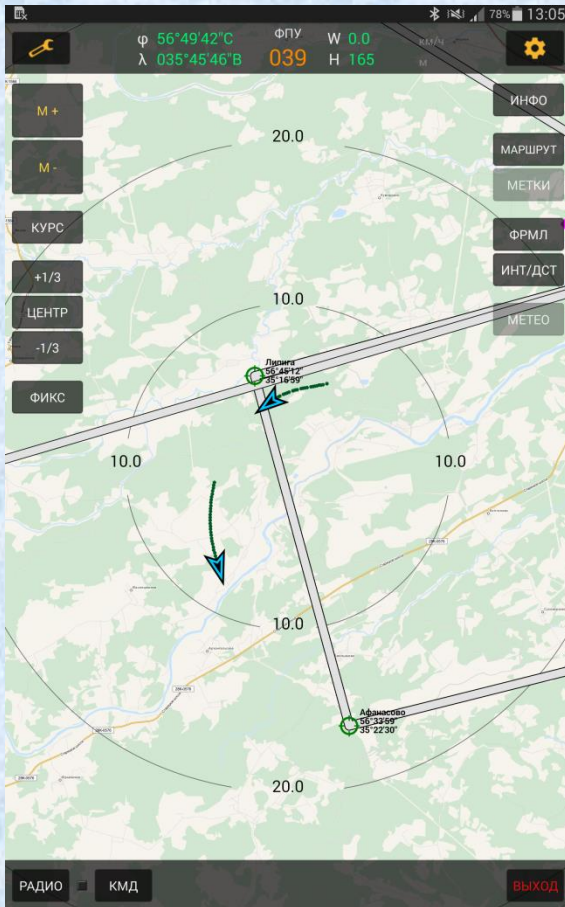


Mark of succeeding 78797

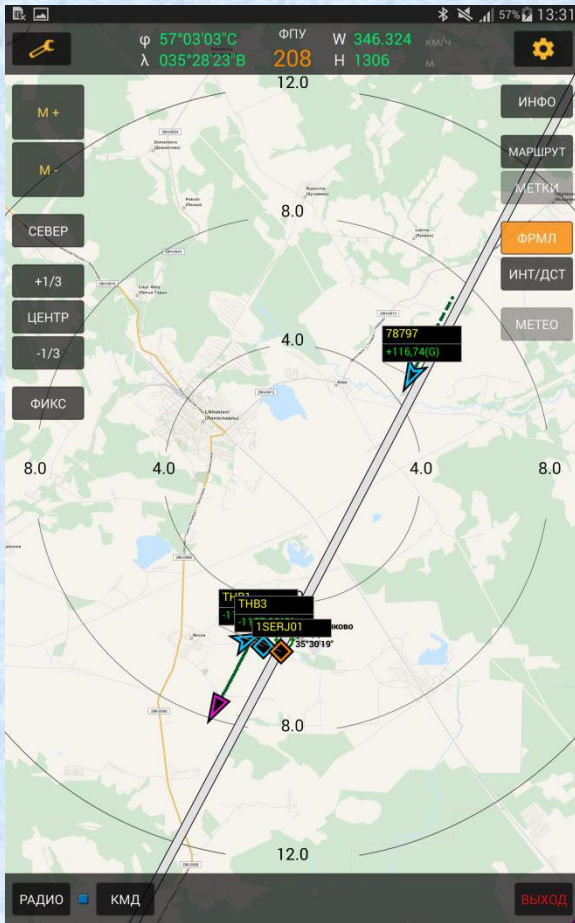


ADS-N objects at Kruchkovo position (THB1, 1SERJ01, THB3)

Indication of 76733, 78797 marks on the pilot's tablet on 78794 aircraft (on the ground)



Tactical paradrop

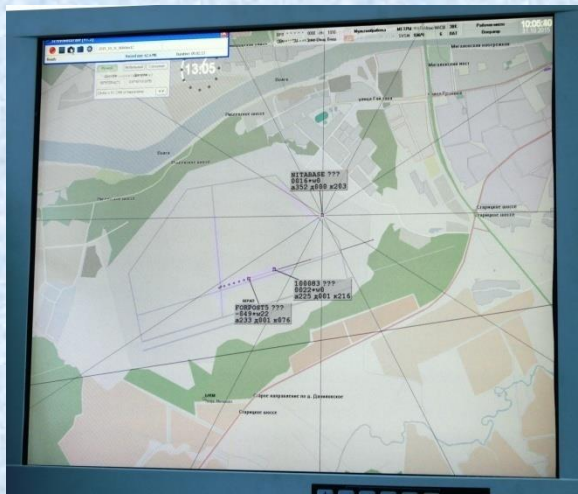


ADS-B display on board of 76733 aircraft



ADS-B display at the mobile command and control station

Surveillance of ground vehicles (special-purpose car)



Track of the special-purpose car movement in Tver airdrome (Migalovo)



Mark of the special-purpose car on the pilot's tablet

Conclusions of the experiments and tests

- Results of the experiments and tests confirm the complete realization of tasks and goals set to participants of the experiments and tests with required safety of flights and within the target time frame.
- During of performance of flights we have proved the possibility of ADS-B mode 4 application in order to increase the situational awareness of aircrews in formation flights, and in the solution of paradrop tasks, organization of coordination with ground systems (ATM services), as well as with other objects in the assaults dropping zone and at the airdrome.

Recommendation on the application of the experiments and tests results

- Tasks of the research and development works for the benefit of the implementation of on-board ADS-B mode 4 integrated in advanced systems and providing for the high level of mutual situational awareness of aircrews, their interaction with ground stations (air traffic management services), and solution of specific problems.
- Implementation of both open and close mode link for “air-to-air” and “air-to-ground” data transfer in the framework of research and development works.