

FIG  
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# XXVI FIG Congress 2018

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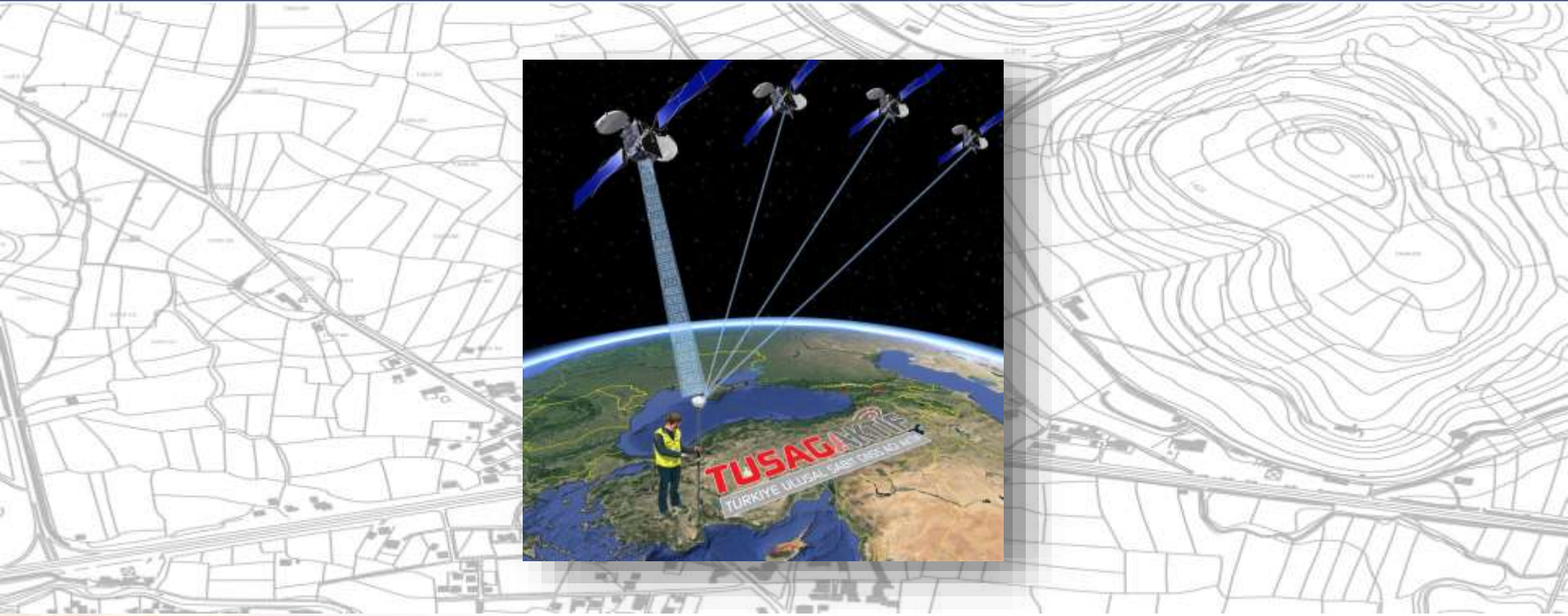
EMBRACING OUR SMART WORLD WHERE THE CONTINENTS CONNECT:

ENHANCING THE GEOSPATIAL MATURITY OF SOCIETIES

Presented at the FIG Congress 2018,  
May 6-11, 2018 in Istanbul, Turkey



## EVALUATION BUSINESS MODEL OF CORS-Tr (TUSAGA-Aktif)



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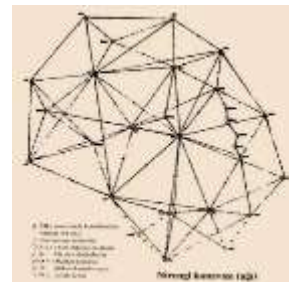
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## Need

To obtain geographic location information (coordinates) speedy, accurate and in economic way.

However, in the past, getting accurate coordinates was time consuming, expensive and required expertise...



10) Başlangıç noktası D'yi koordinatlarına A'yi ve diğer noktaları d'yi ve d'yi dağıtımında da etkiletilenler için istenilen göre toplama ve kontrol olarak C noktasının koordinatları "mas" olarak:

$$\begin{aligned}
 Y_1 &= Y_0 + \Delta y_1 + \Delta y_2 = 22436,12m & X_1 &= X_0 + \Delta x_1 + \Delta x_2 = 17258,88m \\
 Y_2 &= Y_1 + \Delta y_3 + \Delta y_4 = 22561,99m & X_2 &= X_1 + \Delta x_3 + \Delta x_4 = 17150,52m \\
 Y_3 &= Y_2 + \Delta y_5 + \Delta y_6 = 22654,27m & X_3 &= X_2 + \Delta x_5 + \Delta x_6 + \Delta x_7 = 17134,20m \\
 Y_4 &= Y_3 + \Delta y_7 + \Delta y_8 = 22732,82m & X_4 &= X_3 + \Delta x_8 + \Delta x_9 + \Delta x_{10} = 17156,27m
 \end{aligned}$$

Tezgaah C noktası koordinatlarına C(22732,62; 17156,27) bulunması gerekir ki bu durumda başlangıç noktasının başlangıç noktası olarak alınması gerekir.

Nokta no.	Koordinat Ağızı	Ağızlık Açısı (Santigrat)	Hata	$\Delta y$ S.HT	$\Delta x$ S.COM	v	K
A	0	138,3333					
B	171,6746	131,2612	88,94	-73,88	-41,00	22174,40	17236,86
$\beta_1$	109,2832			1	-2	11430,12	17208,88
$\beta_2$	183,7149	138,2238	138,31	-111,89	-38,11	13363,26	17150,12
$\beta_3$	171,1835	211,2000	91,74	-62,28	-16,67	20014,27	17154,07
$\beta_4$	142	82,2371	61,62	-78,37	-12,19	22712,87	17154,27
C	152,1268	154,6654	367,87	-183,23	-94,84	17881,14	17154,27
D	1885,0000	34,8898	191	-100	-161	-188,23	0,44
	142394	$\beta_0 = 74^\circ$				$EL = 100m(14)$	$SL = 20$

( $\beta_0 = 74^\circ$ ) ( $\beta_0 = 74^\circ$ ) ( $\beta_0 = 74^\circ$ )

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# TUSAG AKTİF

TÜRKİYE ULUSAL SABİT GNSS AĞI AKTİF



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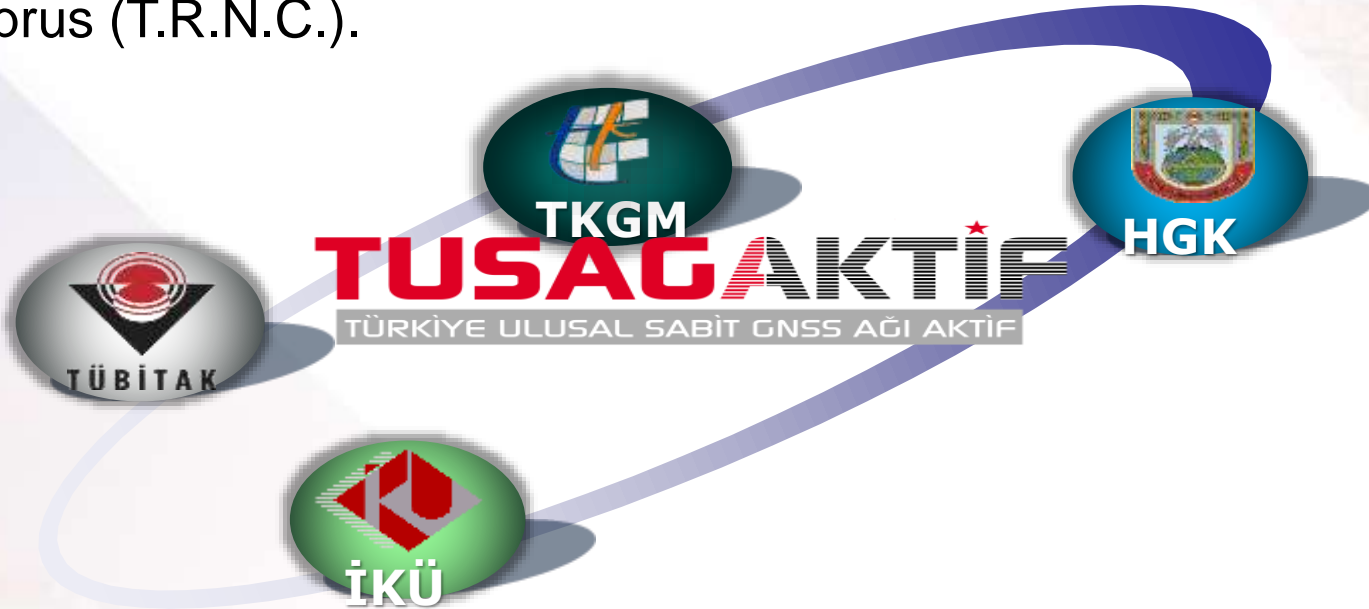


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## Aim of the project

To determine geographic location information within **3-4 cm accuracy** for **24 hours** in real time (RTK) all across the Turkey and Turkish Republic of North Cyprus (T.R.N.C.).



**Start-Ending Date** : May 2006 - July 2010

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## CORS-Tr Stations-146



Distance between stations 80-100 Km.'s

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## CORS-Tr Stations



Erzurum-Meteoroloji



Siirt-Meteoroloji



İğdır-TKGM



Kabinet

Viranşehir-Meteor.



Demirci-Meteoroloji

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## CORS-Tr Control Center Ankara – GDLRC



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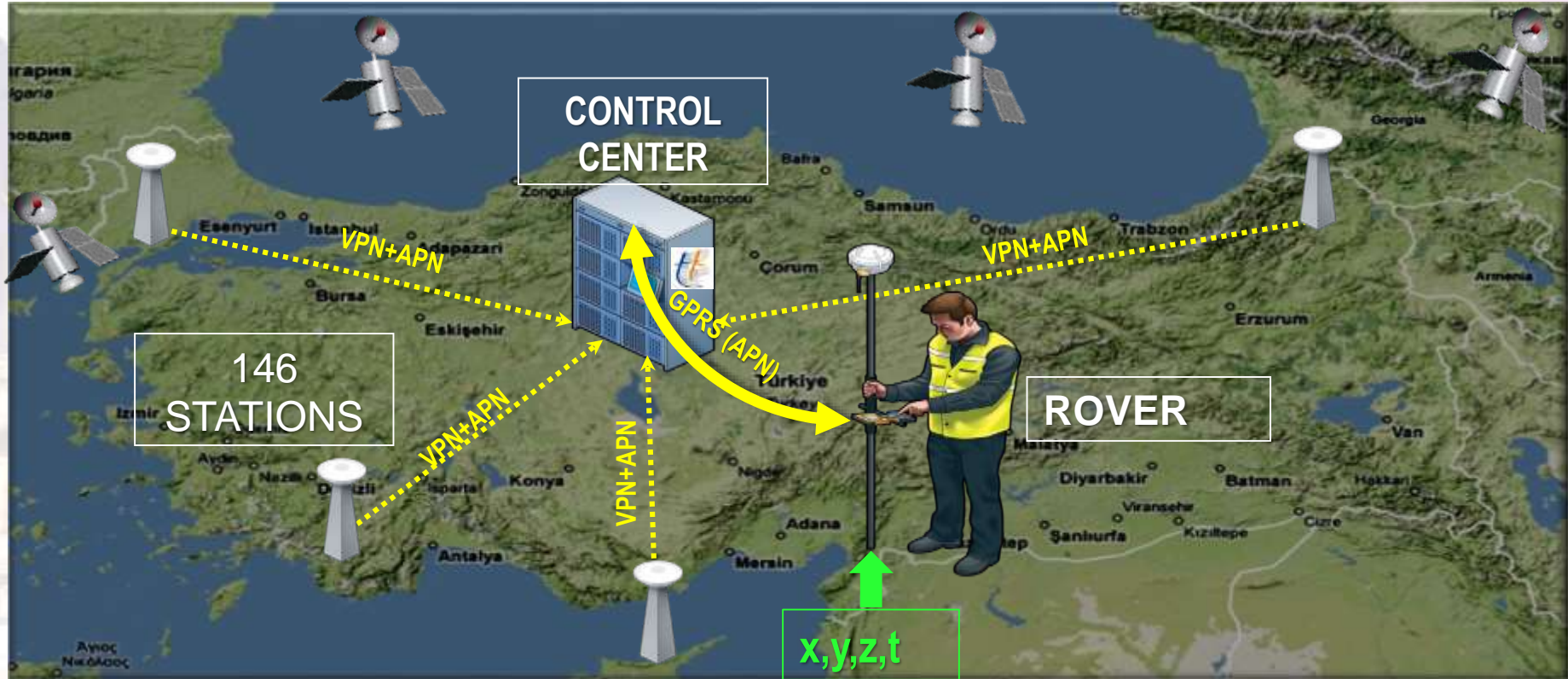
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## Network RTK Working Principle



2005.0 Epok

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FIG  
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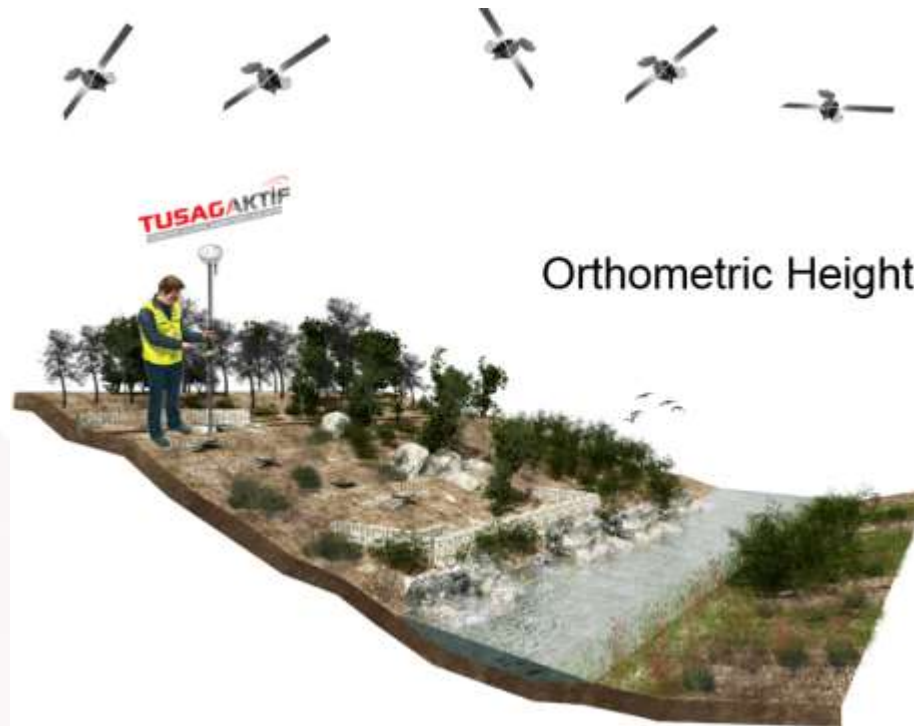
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## On-line Orthometric Height Value



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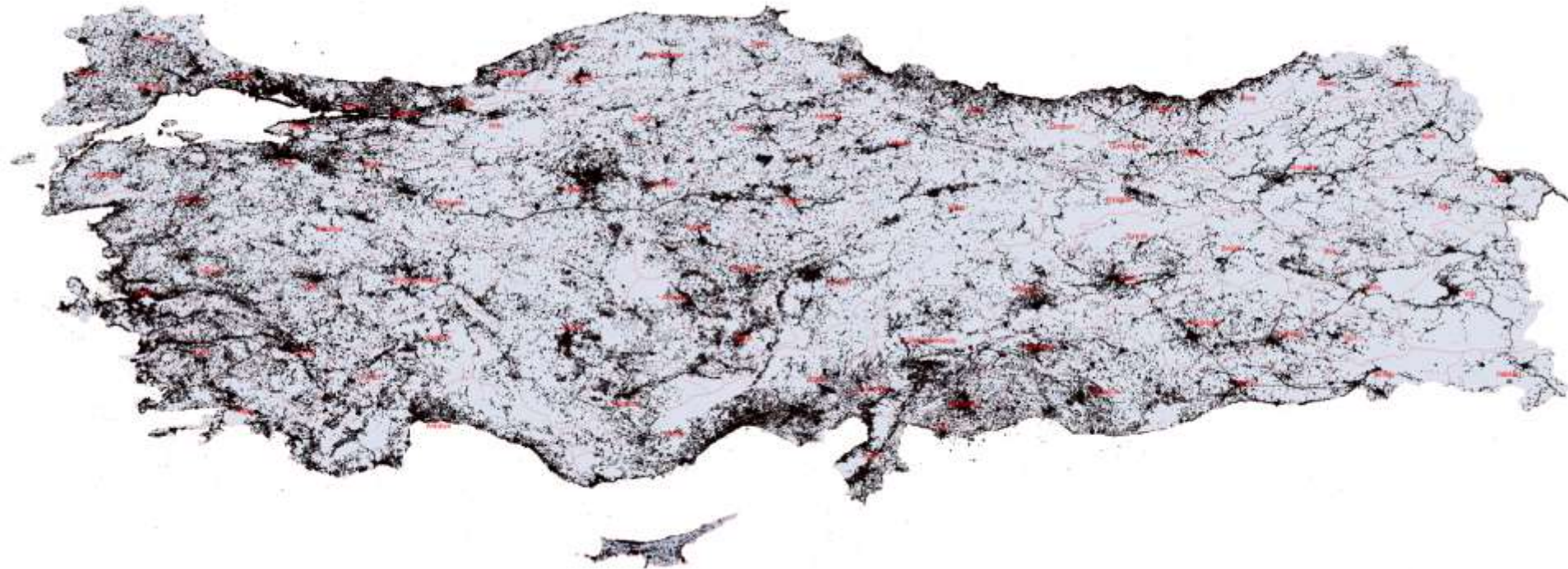
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## CORS-Tr Usage Map – 2017



**127.519.954 points**

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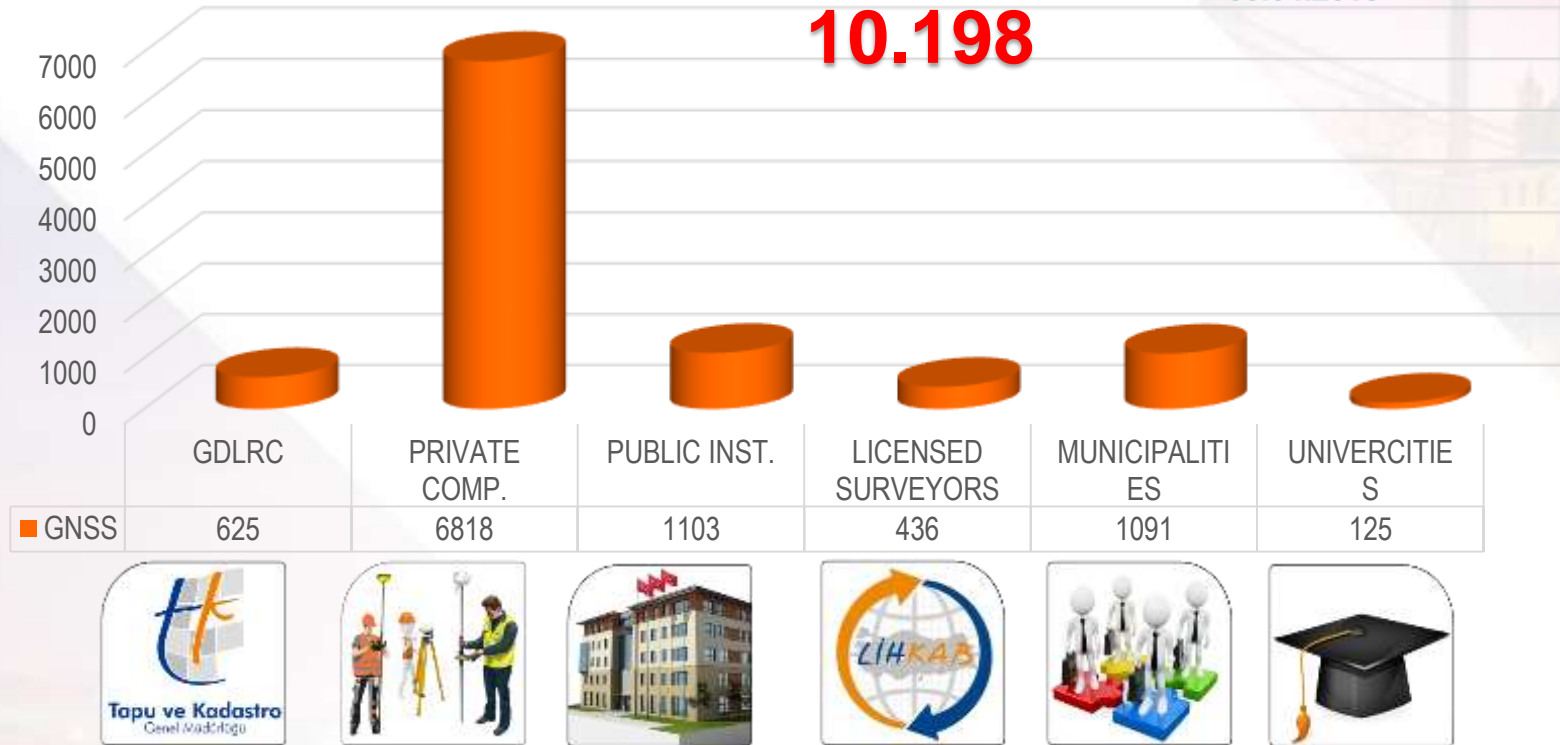
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## CORS-Tr Operating/Users

Total # Users  
**10.198**

30.04.2018



Daily total number of users (mean) :2400

Simultaneous maximum number of users:840

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## Quality Checks

PERIOD	Nr of POINTS	RMS (m.)		
		EAST	NORTH	HEIGHT
2009	808	0,039	0,042	0,090
2014-1	723	0,045	0,039	0,078
2015-1	743	0,033	0,035	0,047
2015-2	701	0,029	0,027	0,058
2016-1	725	0,032	0,031	0,051
2016-2	697	0,029	0,028	0,046
2017-1	706	0,030	0,029	0.047

2 times QC Checks every year ...

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## CORS-Tr Operating/Web Services

The screenshot shows the TUSAGAKTIF website with the following elements:

- Browser address bar: tusaga-aktif.gov.tr
- Logos: TUSAGAKTIF logo, Türkiye Ulusal Sabit GNSS Ağı Aktif logo, and the coat of arms of Turkey.
- Navigation menu (left side): Giriş, Abonelik Rehberi, Hizmetler, Kurulan Üçer, İşim, 46 77.
- Navigation menu (right side): Giriş, İstasyon Haritası, Nokta Konumları, 30 Saniye RINEX, AĞ-RTK Çalışma Prensipleri.
- TEKNİK İŞLEMLER icon.
- Social media icons: Facebook, Twitter, YouTube.
- Inset window showing a document from Tapu ve Kadastro Genel Müdürlüğü with technical details.

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## CORS-Tr Operating/User support

<http://www.tkgm.gov.tr/tusagaaktif>



**444 GNSS**  
**444 4677**

2016  
**14.919 CALLS**

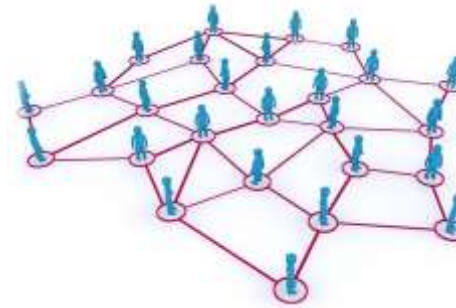


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## User Web Service

<http://www.tusaga-aktif.gov.tr>



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## User Web Service

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  - 195 İstasyonlar
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- Hesaplar
  - Kırsal Bilgiler
  - Sitra Çeşitleri
  - Çiniler
  - Ölçümler
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- VRS iScope Live!
- Aktif Üyelikler
- Yönetim
  - Bölgesel
    - Bölge Ekle
    - Bölgeyi Düzenle
  - Firmalar/Kurumlar
    - Firma/Kurumlar
    - Yeni Firma/Kurum
    - Onay Bekleyen Firmalar/Kurumlar
    - E-posta adreslerini kaydet
  - Firma/Kurum Detayları
    - Detaylı Firma/Kurum Bilgisi
    - Ekl Bilgi Alanları
    - Yeni Alan Ekle
  - Kullanıcı Bilgisi Detayları
    - Ekl Bilgi Alanları
    - Yeni Alan Ekle
  - Organizasyon Yönetimi
    - Organizasyonlar
    - Yeni Organizasyon
  - Yetki Yönetimi
    - Yetki Genel
    - Yeni Yetki
    - Üyelik Yönetimi

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- 336 aktif kullanıcılar:
- K05344801 (RTK Fikis)
  - K01456501 (RTK Fikis)
  - K08210501 (RTK Fikis)
  - K072601802 (RTK Fikis)
  - K05554301 (RTK Fikis)
  - K070608302 (RTK Fikis)
  - K074204201 (RTK Fikis)
  - K070710501 (RTK Fikis)
  - K071000501 (RTK Fikis)
  - K01450004 (RTK Fikis)
  - K08470101 (RTK Fikis)
  - K073200801 (RTK Fikis)
  - K06381801 (RTK Fikis)
  - K033603001 (RTK Fikis)

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## Administrative Structure of CORS-Tr System

- CORS-Tr Project; was successfully transferred to GDLRC and GCM with the approval of TUBITAK (Technological Research Council of Turkey) in 2009
- CORS-Tr System is jointly operated by GDLRC and GCM on a **protocol** frame.
- “Cooperation Protocol on the Joint Operation of the CORS-Tr System” was signed on 2010 by GDLRC and GCM.
- According the protocol, the **mission of executing** the CORS-Tr was assigned to **GDLRC** and an **Executive Board** defined.
- **CORS-Tr Executive Board** was founded in order to take **technical and administrative decisions** for operating the system.



## Financial Structure of CORS-TR System

### Initial Installation Cost of CORS-TR System

CORS-Tr Project was completed in 2008 with a cost of **2.5 million USD** including academic researches by funding of **TUBITAK**.

### Operational Costs of CORS-TR System

- **Hardware Costs;** GNSS Stations and Control Center (CC )
- **Software Costs;** CC Software and GNSS Firmware
- **Maintenance / Repair Costs;** Changing station locations, maintenance, reparing
- **Communication Costs;** 2XMetro internet and 146 VPN Internet connections
- **Promotion costs;** Seminars, symposiums, trainings, etc. for CORS-Tr



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## Financial Structure of CORS-TR System

### CORS-TR System Costs

Year	Equipment	Software	Maintenance	Promotion	Communication	Total
2010	\$23.000,00	\$0,00	\$15.000,00	\$0,00	\$60.000,00	\$98.000,00
2011	\$7.000,00	\$0,00	\$0,00	\$0,00	\$125.000,00	\$132.000,00
2012	\$413.000,00	\$0,00	\$25.000,00	\$0,00	\$112.000,00	\$550.000,00
2013	\$6.000,00	\$0,00	\$0,00	\$35.000,00	\$319.000,00	\$360.000,00
2014	\$458.000,00	\$176.000,00	\$0,00	\$0,00	\$288.000,00	\$922.000,00
2015	\$0,00	\$0,00	\$0,00	\$0,00	\$305.000,00	\$305.000,00
2016	\$59.000,00	\$0,00	\$0,00	\$0,00	\$211.000,00	\$270.000,00
<b>Grand Total</b>	<b>\$966.000,00</b>	<b>\$176.000,00</b>	<b>\$40.000,00</b>	<b>\$35.000,00</b>	<b>\$1.420.000,00</b>	<b>\$2.637.000,00</b>

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## Financial Structure of CORS-TR System

### CORS-Tr Fees

SERVICE TYPE	DATA TYPE	Price (VAT INC.)	EXPLANATION
FIRST SUBSCRIPTION	-	40 USD	Once
RTK Services	Network-RTK	35 USD	Monthly
		220 USD	Annual
	Network-DGPS	15 USD	Monthly
RINEX Data	RINEX 1 s	0.14 USD	Station/Hour
	RINEX 30 s	FREE	Station/Day



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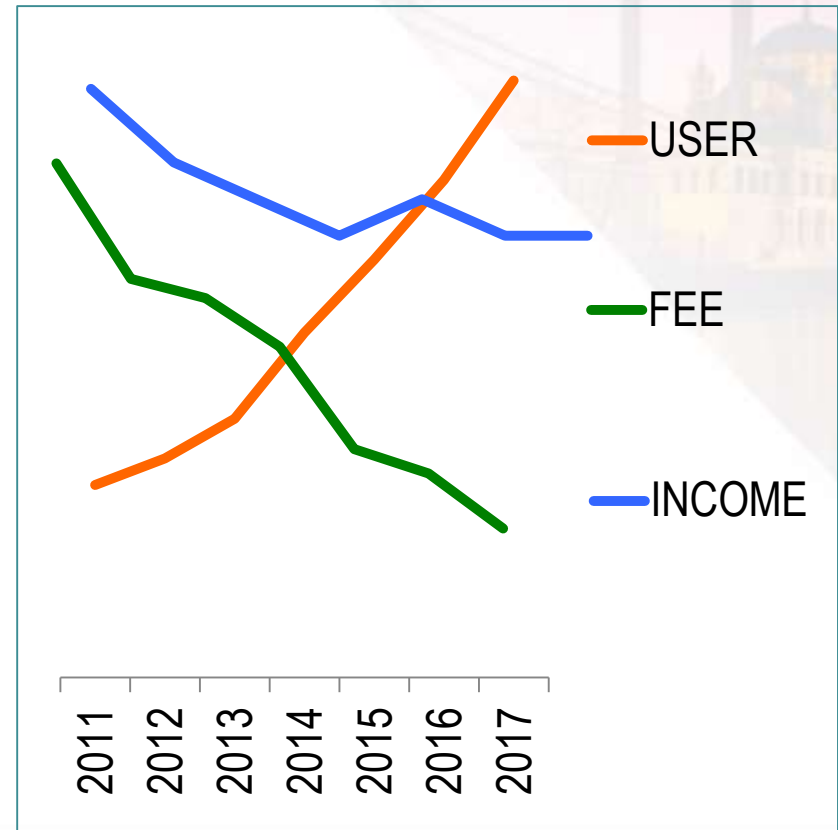
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## Financial Structure of CORS-TR System

Number of Users, Fee and Income of CORS-Tr

YEAR	Nr of USERS	RTK FEE (USD)	INCOME (X1000 USD)
2011	2900	500	1900
2012	3300	410	1700
2013	3900	395	1600
2014	5200	357	1500
2015	6300	277	1600
2016	7500	258	1500
2017	9000	215	1400



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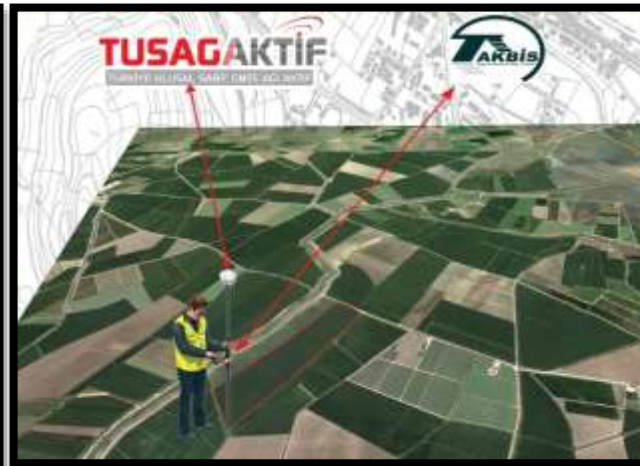
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## CORS-Tr Benefits

There is no need for establishing and measuring triangulation points and benchmarks which comprises **30% of mapping and cadastre works** in terms of duration and cost. approximately **25 millions USD** is saved from the allocated resources for mapping which is approximately 75 millions USD/Year.



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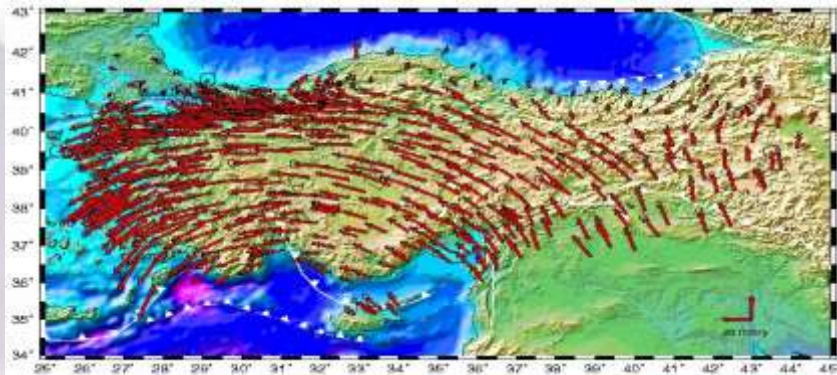




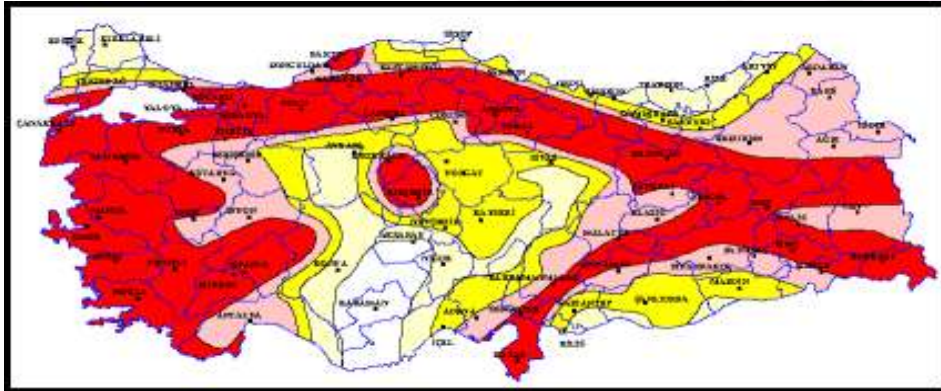
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## CORS-Tr Project Benefits



Determination of velocity areas



Determination of tectonic movements



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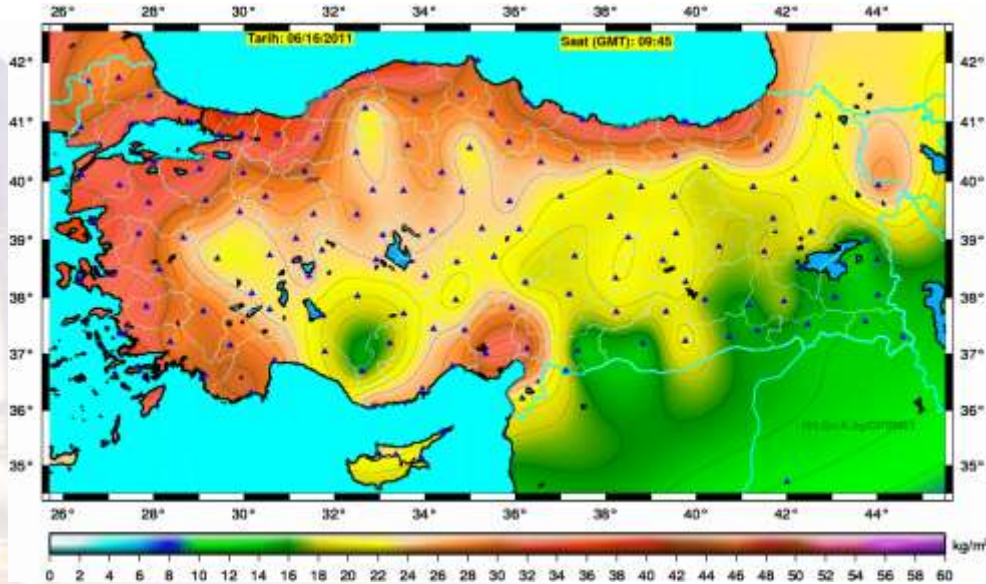
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## CORS-Tr Project Benefits



Studies on modelling atmosphere (ionosphere and troposphere) for the purpose of getting meteorological estimations and determining precipitable water vapour (PWV) were started at the General Directorate of State Meteorology and academic institutions.



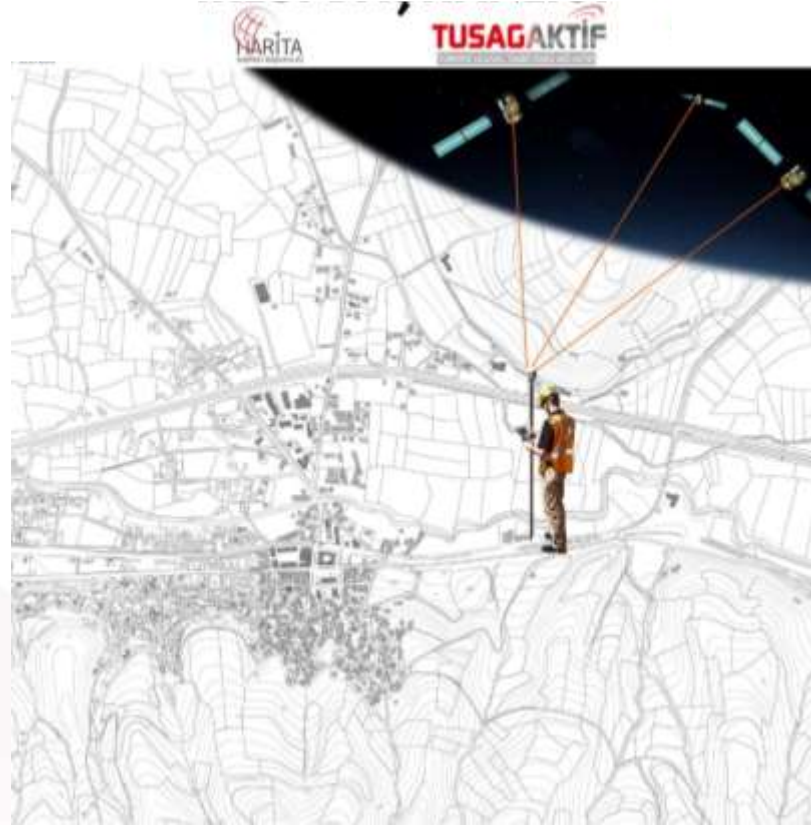
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## THANK YOU ...

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