Galileo für hochpräzise Anwendungen & Copernicus – ein Überblick

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Überblick

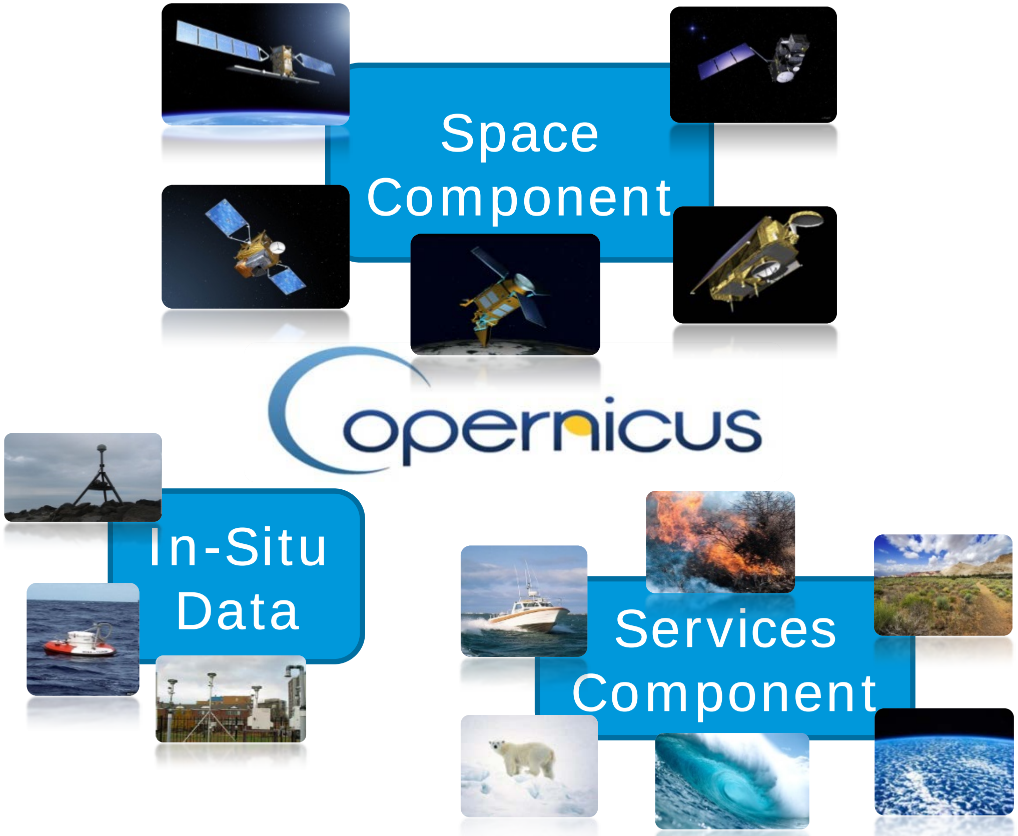
1. Copernicus
2. Galileo Update
3. Galileo für hochpräzise Anwendungen


Copernicus
esa

Was ist Copernicus?

European response to global needs:

- to manage the environment,
- to mitigate the effects of climate change and
- to ensure civil security

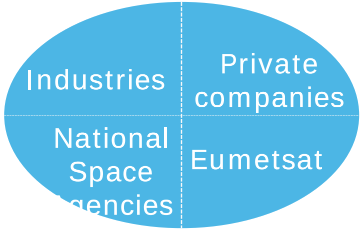
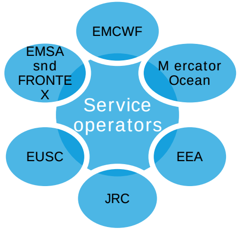


GMES/Copernicus Key Milestones

- **2014+** First Sentinel satellites launched
- **2014** EU-ESA Copernicus Agreement for 2014-2020
- **2014** Revision of the ESA GSC Declaration
- **2014** EU Regulation of the Copernicus programme
- **2013** EU Delegated Regulation for Copernicus data access
- **2010** Commission proposal for a Regulation on GMES initial operations (2011-2013)
- **2008** ESA Ministerial Council in The Hague provided next major funding contribution by ESA Member States; Signature of EU-ESA Delegation Agreement on GMES
- **2005** ESA Ministerial Council in Berlin: first funds committed to the Copernicus Space Component
- **2001** ESA Ministerial Council in Edinburgh: first Copernicus services funded
- **1998** Initiation of Copernicus: 'Baveno Manifesto'

Copernicus Komponenten und Kompetenzen

Overall Programme Coordination

Component	Coordinators:	Partners:
Space Component	esa	
Services Component	European Commission	

In-situ Daten unterstützen die Space und Service Komponenten

Copernicus Space Komponente: die einzelnen Sentinels ...

S1A/B: Radar Mission — 3 Apr 2014/25 Apr 2016

S2A/B: High Resolution Optical Mission — 23 June 2015/7 March 2017

S3A/B: Medium Resolution Imaging and Altimetry Mission — 16 Feb 2016/2017

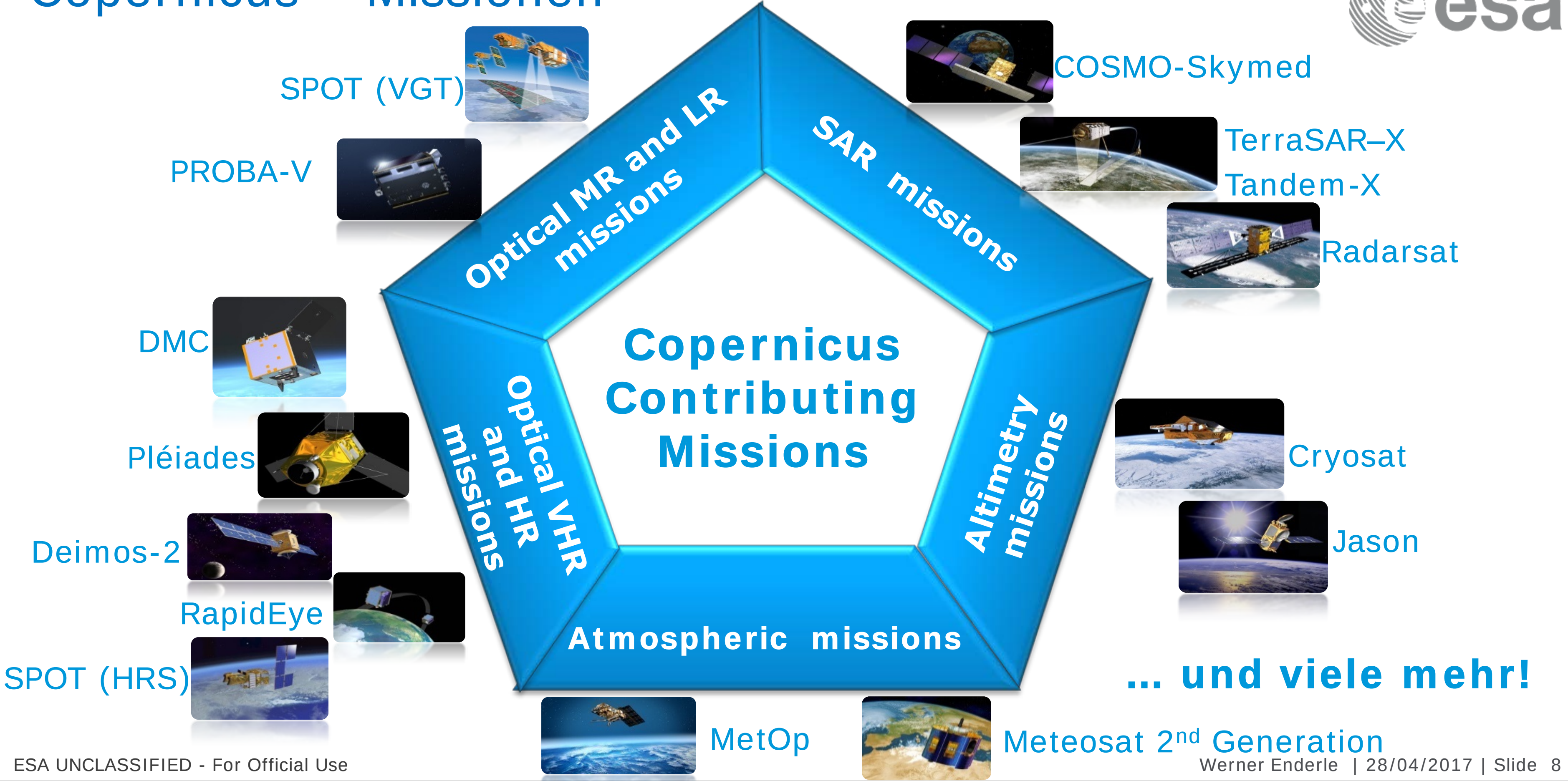
S4A/B: Geostationary Atmospheric Chemistry Mission — 2021/2027

S5P: Low Earth Orbit Atmospheric Chemistry Mission — 2017

S5A/B/C: Low Earth Orbit Atmospheric Chemistry Mission — 2021/2027

S6A/B: Altimetry Mission — 2020/2025

Copernicus – Missionen



Copernicus Sentinel Data Policy

Sentinel Data Policy = FREE and OPEN access

- Joint COM/ESA **Sentinel Data Policy Principles** have been prepared in 2009 - adopted by ESA MSs in Sep 2009
- **EU Delegated Act** on Copernicus Data and Information Policy has been published on 12 July 2013 (C(2013)4311, final)
- ESA will table a **Sentinel Data Policy** for approval by PB-EO in Sep 2013. Main principles of Sentinel data policy:
- **Open** access to Sentinel data by anybody and for any use:
  - **Free** of charge data licenses
  - Restrictions possible due to technical limitations or security constraints

Galileo Update

- Galileo Initial Services – 15 Dezember 2016

2. Galileo SERVICES

GALILEO EGNOS
NAVIGATION SOLUTIONS POWERED BY EUROPE

- **Open Service**
  - free
  - interoperable with other GNSS
  - worldwide access

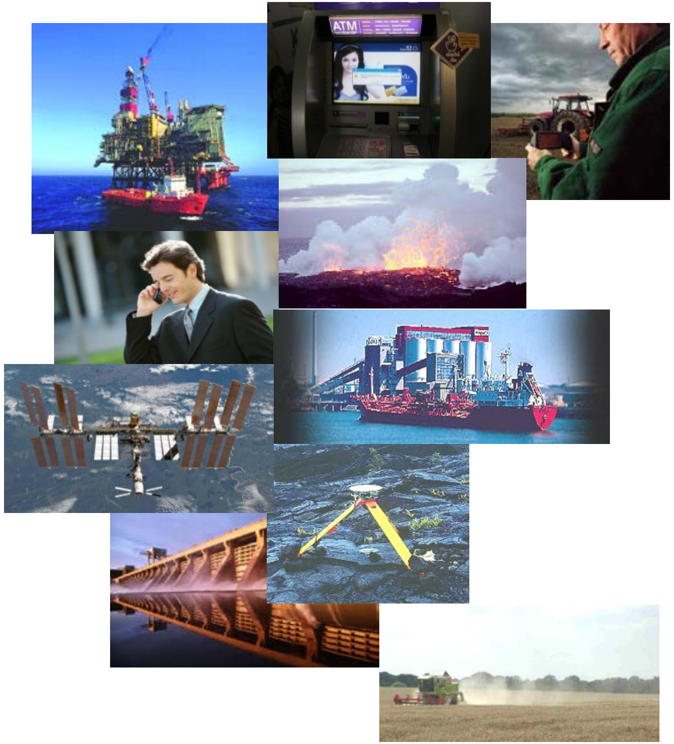
- **Public Regulated Service**
  - access controlled by "Competent Authorities"
  - worldwide coverage

- **Search and Rescue**
  - free
  - worldwide coverage (Cospas-Sarsat)
  - locate emergency beacons

Quelle:
EC Präsentation auf Munich Satellite Navigation Summit 2017

Hochpräzise Anwendungen

- Space Applications
- Autonomous Driving
- Agriculture, precision farming
- Machine Guidance
- Fisheries
- Forestry
- Civil Engineering, Mining, Oil
- Static Applications, Public Works
- Surveying and Mapping
- Weather
- Timing and synchronization
  - Banking
  - Electricity network
  - Communication network



Precision Argriculture - Real Time

KEY TRENDS | AGRICULTURE 57

Precision agriculture boosts farming productivity and helps solve societal challenges

Key market trends

- The uptake of precision agriculture in Europe and worldwide will continue to grow, thanks to the benefits provided to farmers in terms of increased productivity.
- The Asia-Pacific region will progressively challenge the role of North America as the largest GNSS market.
- More demanding users are driving the evolution of precision agriculture towards all-around farm management solutions.
- GNSS supports the agri-environmental policies on both a regional and global scale.

GNSS applications offer high returns on investment

Precision agriculture is the application of different technologies and solutions to manage the variability of agricultural production, improving crop yield and reducing the sector's environmental impact. Precision agriculture systems **increase productivity** in all phases of the agricultural activity, from soil preparation to harvesting:

- Less time is needed per operation;
- Downtime due to fog or nightfall is reduced;
- Soil compaction is minimised by driving over precisely the same tracks;
- Fuel consumption is reduced;
- Savings on input costs (seeds, fertilizers, pesticides) are achieved;
- Soil and plant physicochemical parameters are monitored to ensure the optimal conditions for plant growth.

Innovative applications combine GNSS with other technologies

- **GNSS** enables the precise and reliable positioning of tractors, implements and other assets.
- **Earth Observation** will increasingly support digital applications used for precision agriculture. The European Copernicus Programme aims to develop a comprehensive Earth Observation capability. It provides different sets of information on land cover and valuable information to support precision agriculture solutions that leverage GNSS for positioning.
- **Aerial photography** from airplanes and UAVs can cost-effectively capture data for digital applications maps.
- **Optical systems** can be utilised when crops have a row or a trim line that can be followed.

Sophistication of user needs drives the generation of new services

Farmers consider the type of cultivation and the size of their agricultural holding in selecting the optimal GNSS solution to satisfy their needs. High levels of **positioning accuracy** support the most demanding applications, such as automatic steering.

As with any other technology, precision agriculture solutions are also evaluated based on their **reliability** and **cost-effectiveness**.

With time, decision making power by end users has progressively increased. Farmers increasingly demand **ease of use** and **interoperability** of different services offered by various providers. This includes the possibility to integrate precision agriculture, digital mapping and asset management solutions into a single system.

The industry has reacted by starting to offer integrated platforms for **farm management**, which in the future could incorporate and replace services and products focusing only on in-field activities. Apart from reliability and cost-effectiveness for farmers, by addressing the challenges of limited land availability and increasing population, precision farming ensures **sustainability of agriculture**, reduction of **environmental footprint** and **food safety** for society.

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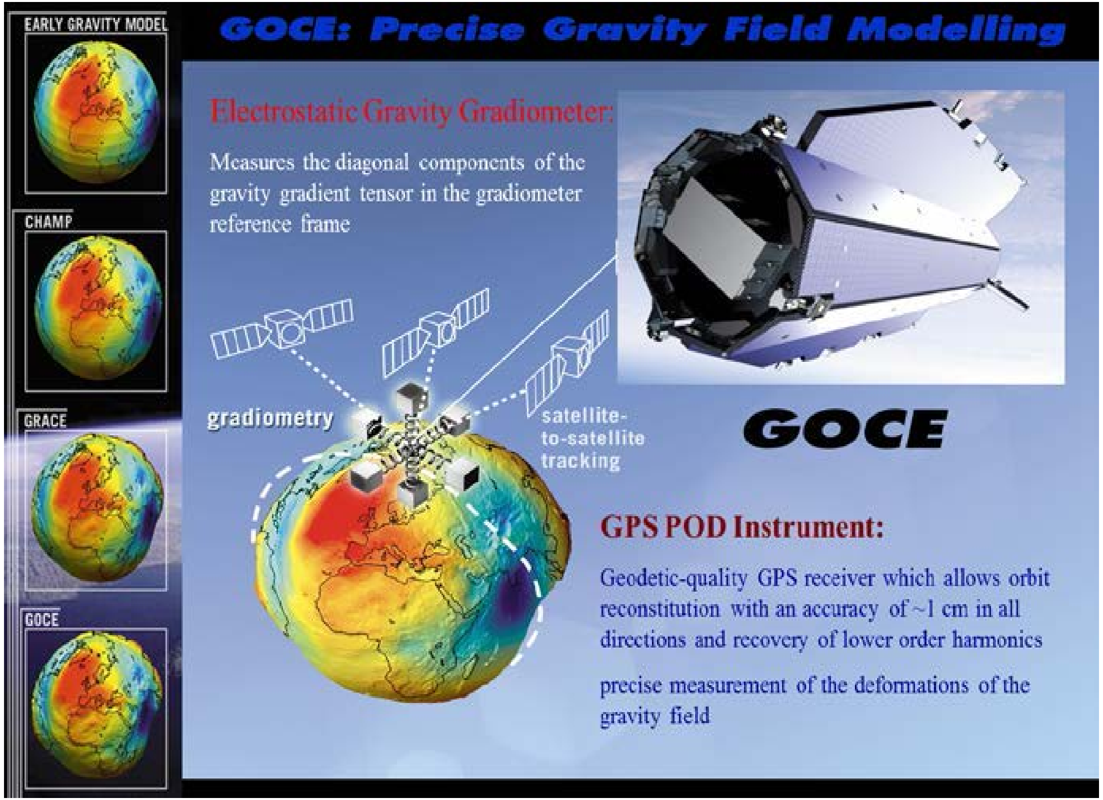
GNSS Market Report | Issue 4, March 2015

Anforderungen:

- Genauigkeit der Real Time Position im 10 cm Bereich
- Sehr hohe Verfügbarkeit der GNSS Services
- Multi GNSS fähige Receiver
- Kommunikation muss verfügbar sein
- GNSS Datenfusion mit anderen Sensoren

Bahnbestimmung von Satelliten – Nicht Real Time



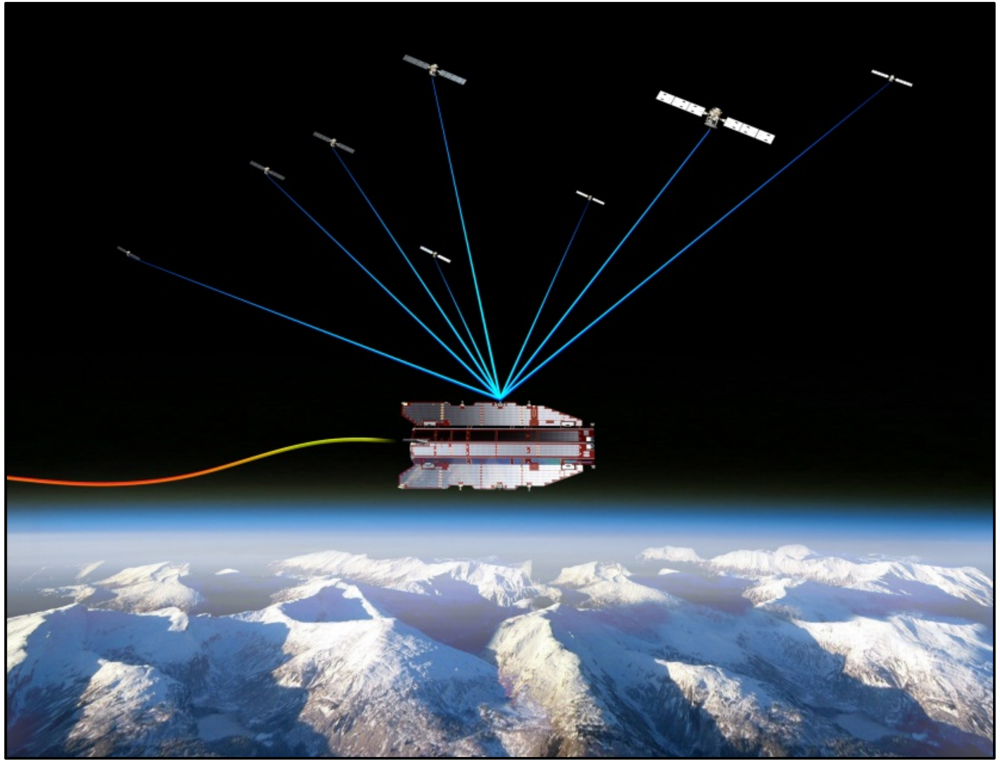
Anforderungen:

- Genauigkeit der Position ca. 1 cm
- Post Facto prozessieren der Daten

Probleme/Herausforderungen

- Sehr komplexe Modellierung der Kräfte, die auf den Satelliten wirken, speziell der Restatmosphäre in 400km Bahnhöhe

Bahnbestimmung von Satelliten – Real Time



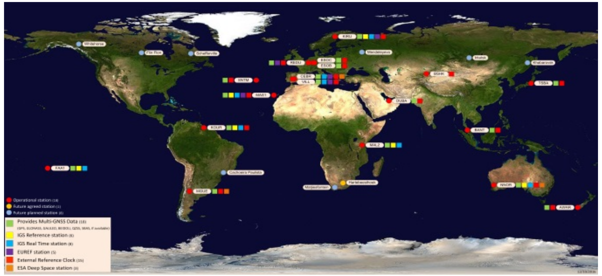
Zukünftige Konzepte der Satelliten-Bahnbestimmung

- Rein kinematische Bahnbestimmung in Real Time durch PPP ~5cm
- **Voraussetzung:**

Verfügbarkeit der hochgenauen GNSS Orbits und Clocks on-board des Nutzersatelliten, z.B. durch den Galileo Commercial Service

Voraussetzung für hochpräzise Anwendungen

- Minimierung oder Eliminierung der Fehlereinflüsse (Atmosphäre, Orbit- und Uhren, Mehrwegeeffekte usw.) auf die GNSS Messungen durch
  - Modellierung der Effekte
  - Konzept die GNSS Daten zu prozessieren

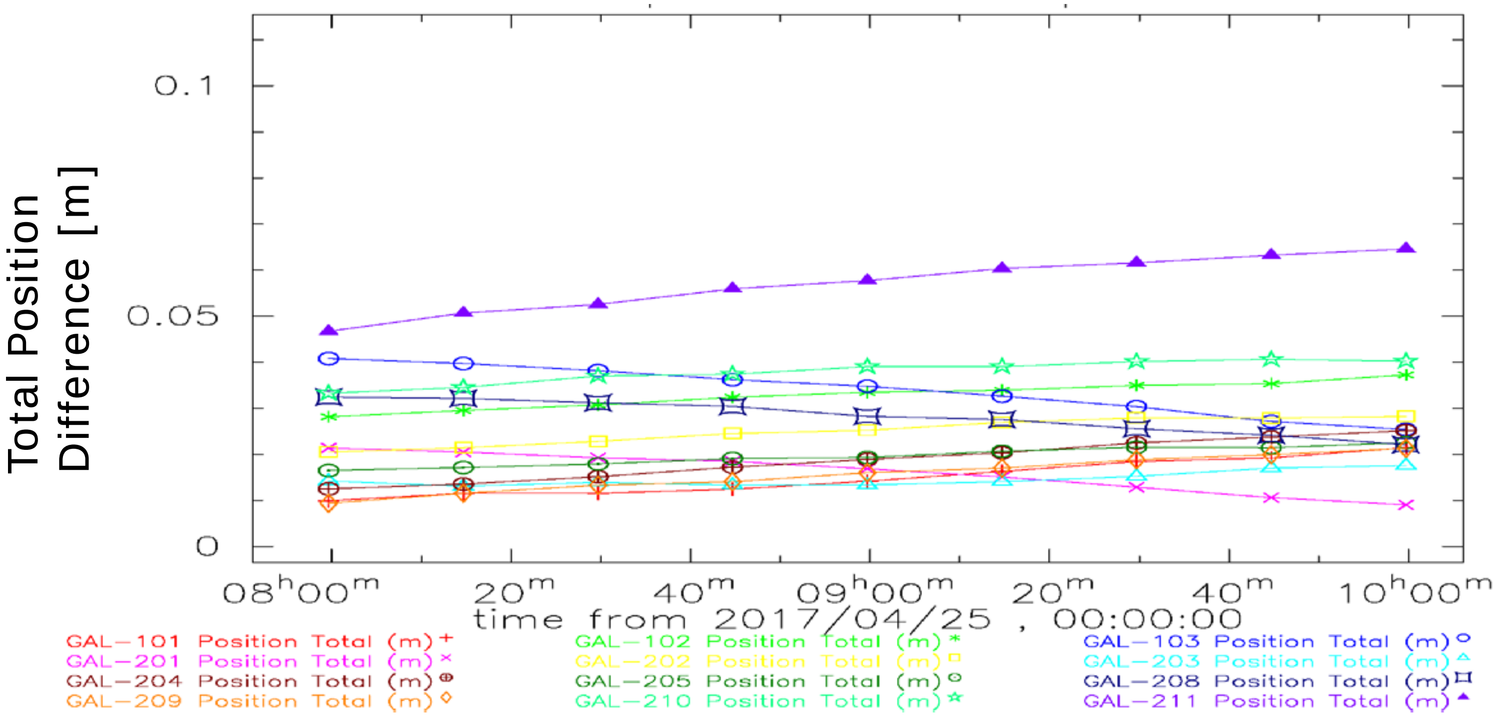


- Eine besondere Bedeutung hat die präzise Orbit- und Uhrenbestimmung der GNSS Satelliten, da besonders komplex
  - Globales Netzwerk von GNSS Sensor Stationen mit hochwertigen GNSS Empfängern
  - Hochgenaue dynamische Modelle zur Bahnberechnung
  - Komplexe Infrastruktur zur Prozessierung der GNSS Daten

Effekt durch Verbesserung der Modelle

Hochpräzise Anwendungen

Orbit accuracy of predicted Orbits – Galileo Satellites - 120 min on 25/04/2017

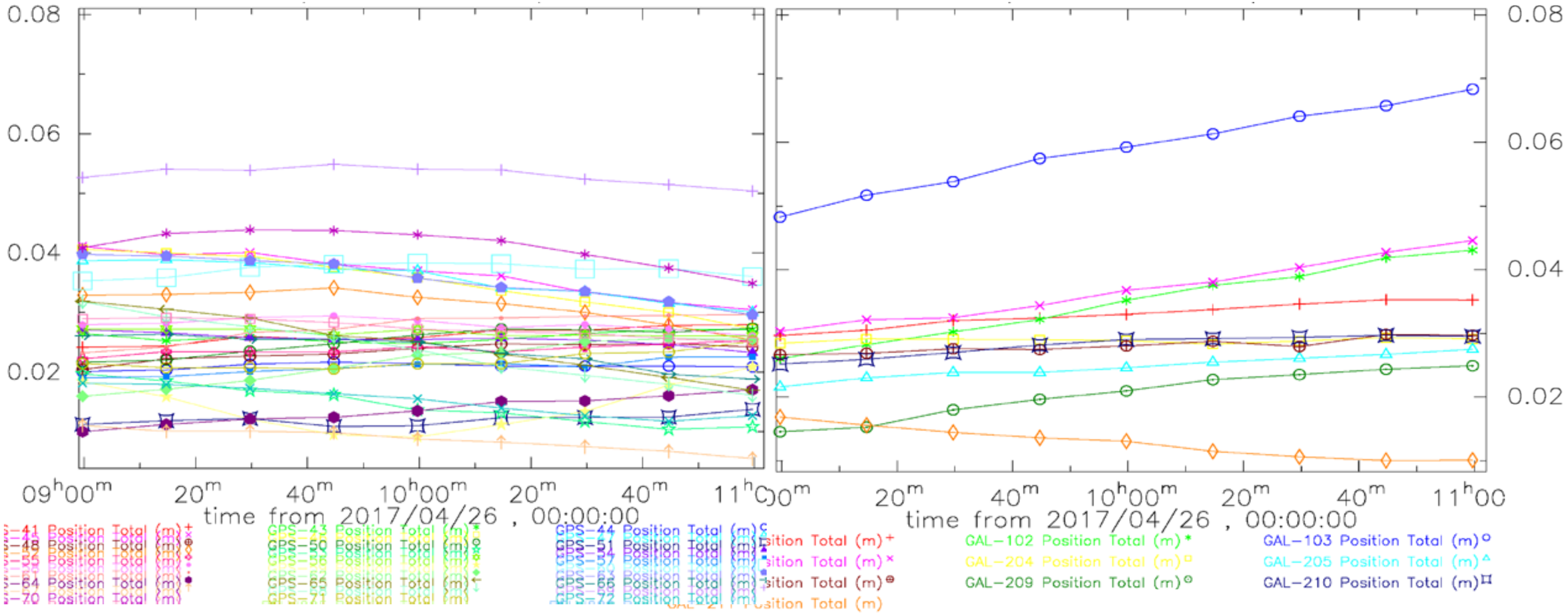


Hochpräzise Anwendungen

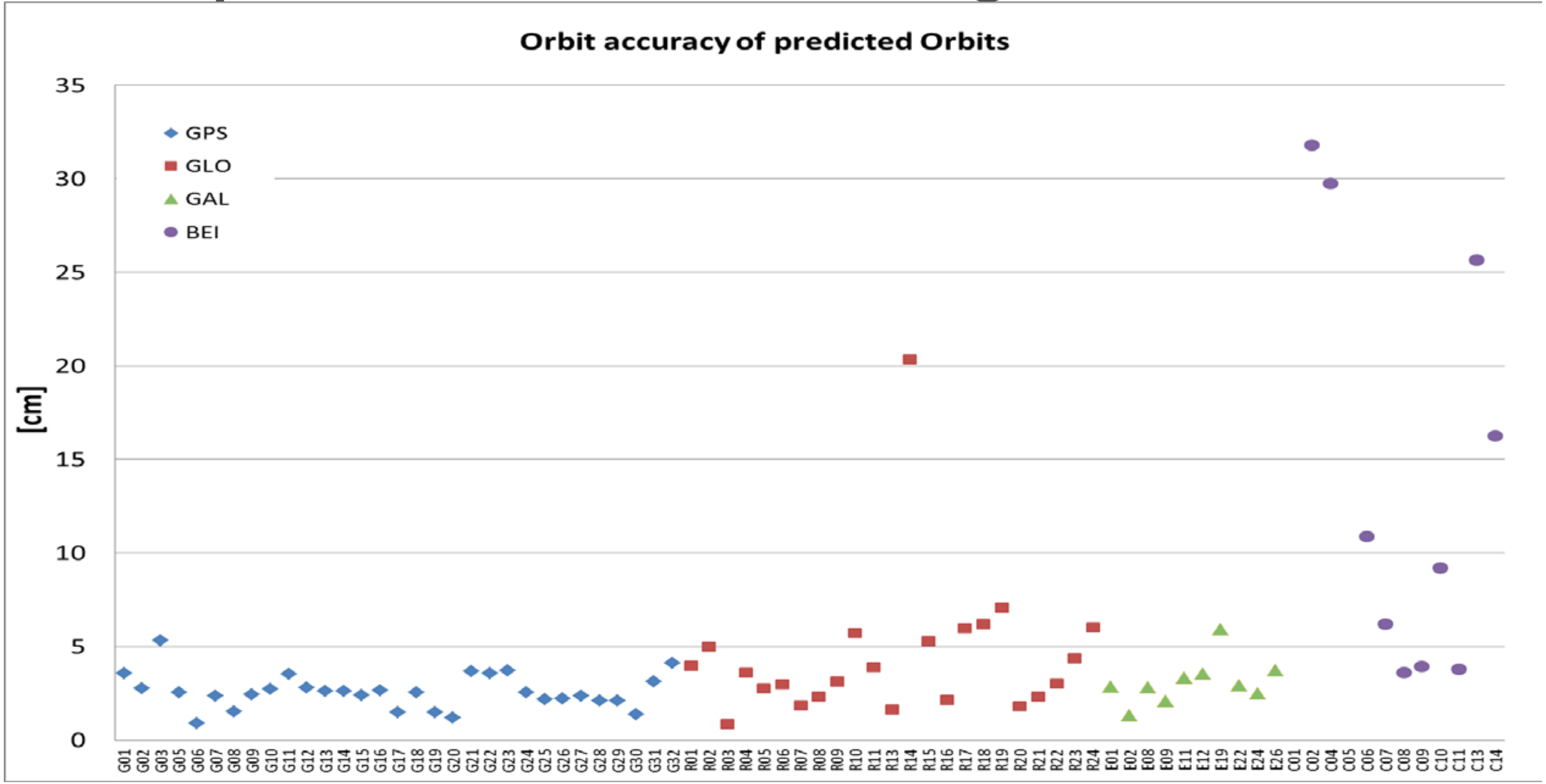
Orbit accuracy of predicted Orbits - 120 min on 26/04/2017

GPS Satellites

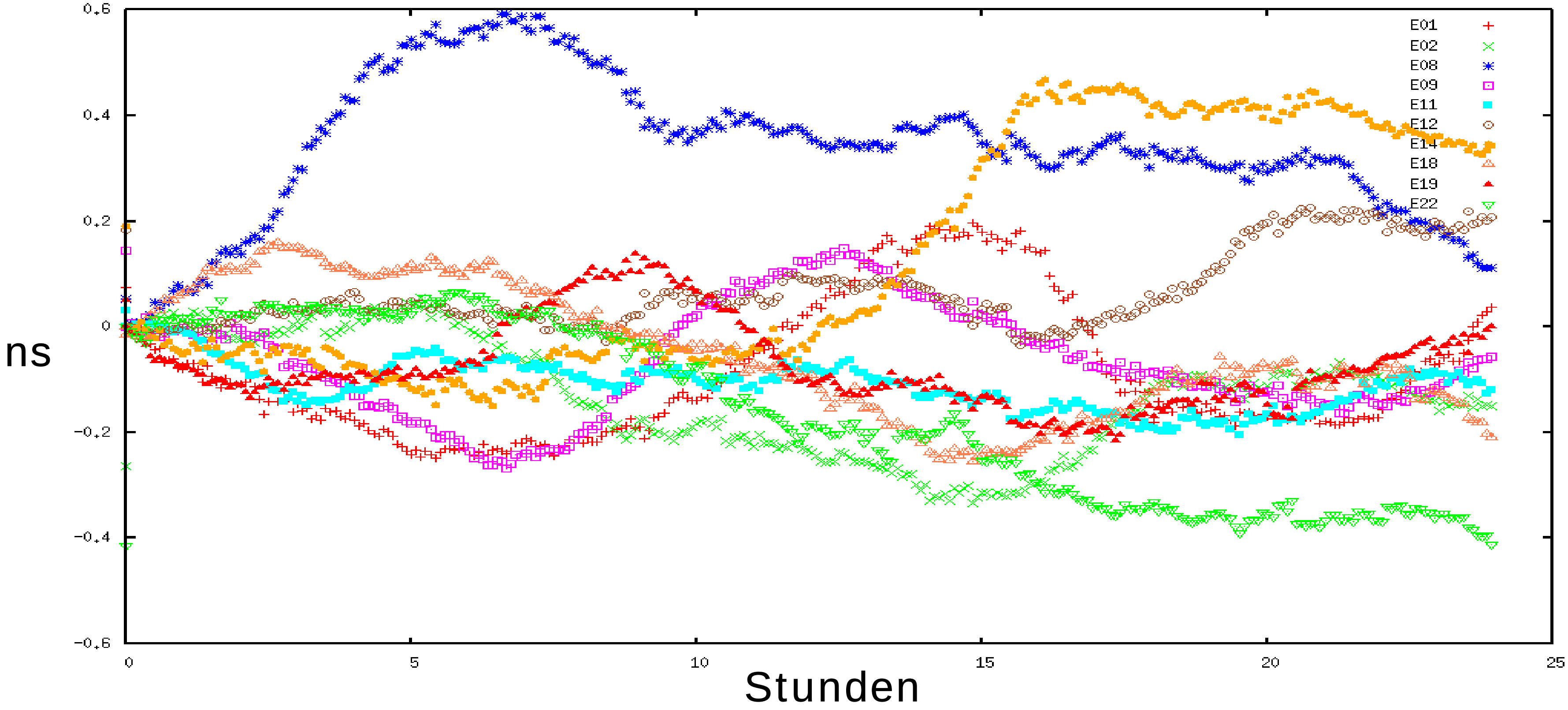
Galileo Satellites



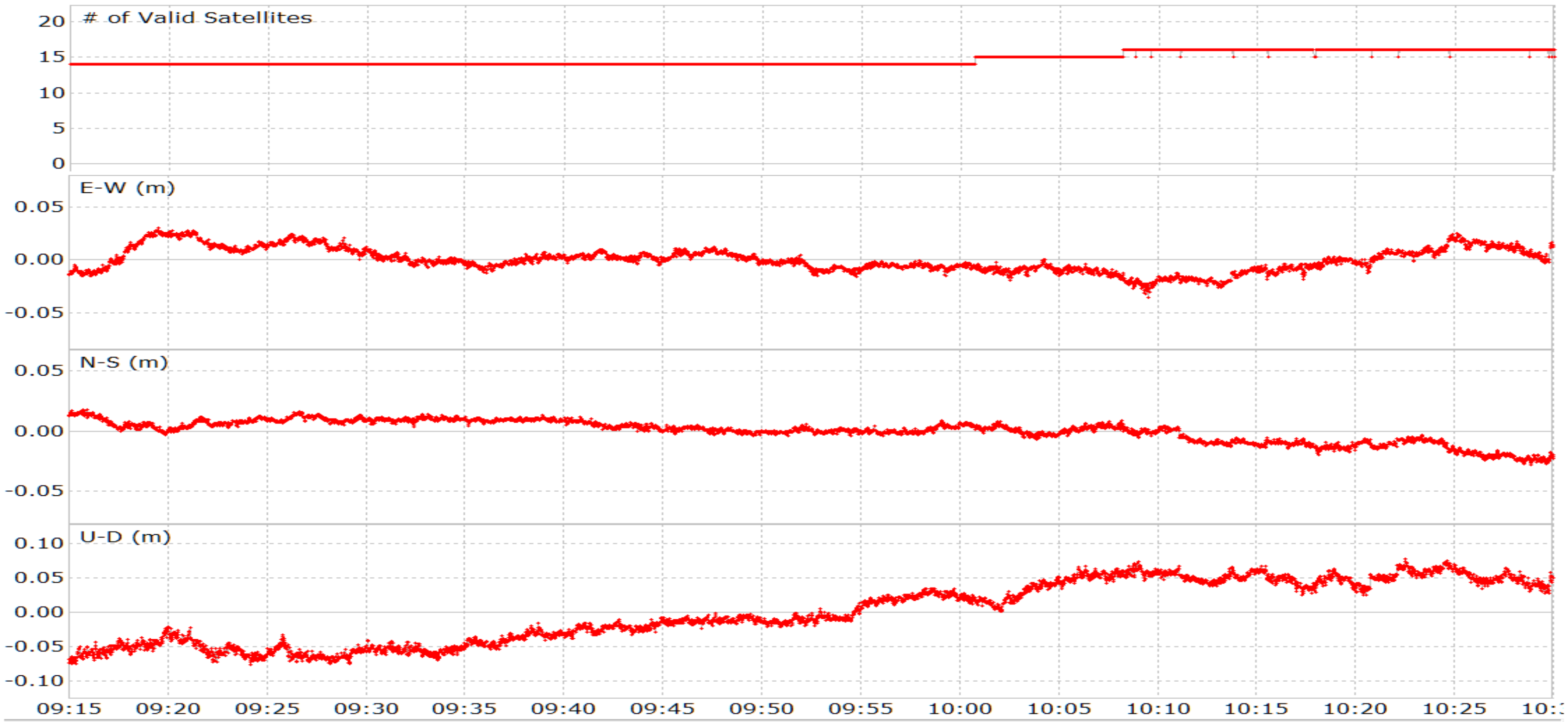
Hochpräzise Anwendungen

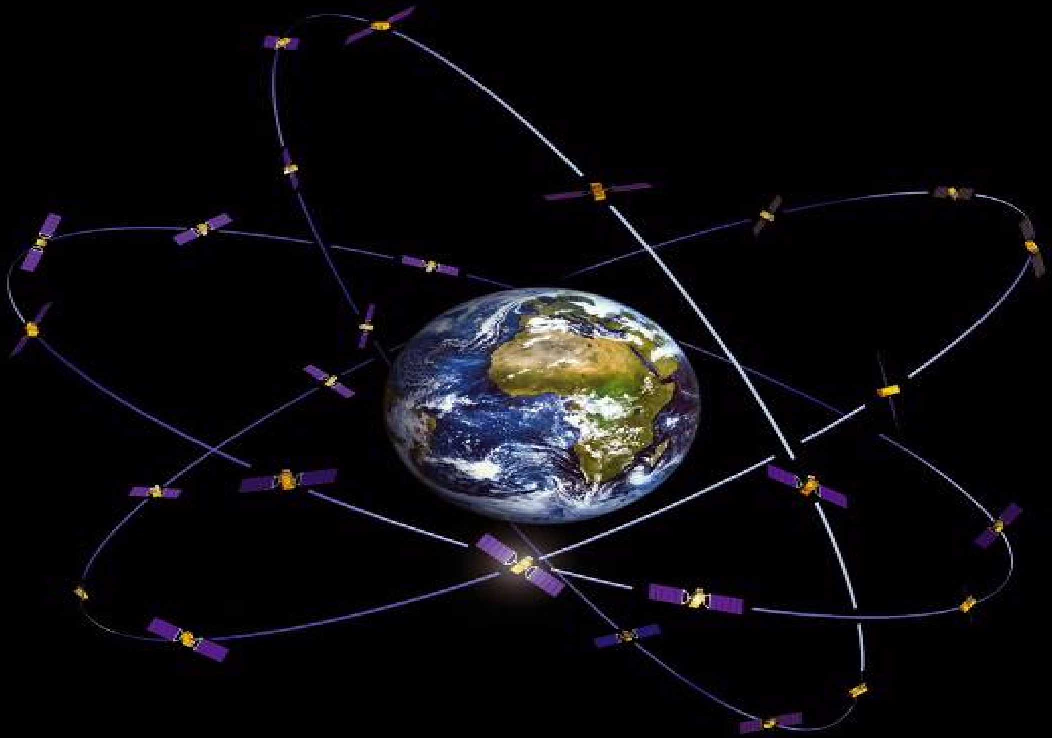


Galileo Real Time Uhrenschätzungen



Real Time PPP für KOUR, GAL+GPS





Danke für Ihre Aufmerksamkeit