- In 1957-1958 President Eisenhower launched one of the first international cooperative initiatives of the space age through a series of letters he sent to the Soviet leadership. He suggested creating a process which would lead to secure space for peaceful uses.
- It led to United Nations to develop a legal framework for peaceful space activities and
- finally to the Outer Space Treaty and creation of COPUOS (UN Committee on the Peaceful Uses of Outer Space)
From Sputnik to Lunar race

• 1961 (Gagarin - First man in space)
• Early 1960th (rapid development of manned flights, followed by Tereshkova flight)
• 1969 (N-1 superrocket failure)
• 1960eth (Lunar robotic missions, Lunokhod and Lunar sample return / L-1 to L-24)
World Space activity in Global terms

World economic activity  US $ 45 \times 10^{12}

Space Economic activity  US $ 100 \times 10^9

$1 in $450 of economic activity spent on space
Ozone Hole
The Key Ingredients of GNSS

- Access to Space (opened by Sputnik)
- Accurate Clocks (provided by Atomic Clocks /Quantum Physics)
  and
- Microprocessors (Computer Revolution)
- Algorithms to use them (provided by the Relativity Theory: Doppler Effect...)
“I would like to begin today with a story of a previous visitor who also addressed this august body. In April of 1921, Albert Einstein visited the United States for the first time…

… He reportedly said: “I have just got a new theory of eternity”
“The calculations of today’s GPS Satellites are based on the equations that Einstein put to paper more than a century ago”
• Location- determining a basic position.
• Navigation - getting from one location to another.
• Tracking - monitoring the movement of people and things.
• Mapping- creating maps.
• Timing - providing precise timing.
Special Upgrades on top of standard GNSS capabilities

- The Differential GPs
- The Carrier-Phase Receiver Systems

10 Meters $\rightarrow mm_s$
## U.S. Use of Space: Air-to-Ground Munitions

(approximate; excluding HARM)

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
<th>Quantity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>KTO, 1991 (Desert Storm): 37 Days</td>
<td>Unguided</td>
<td>245,000</td>
<td>92%</td>
</tr>
<tr>
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<td>Laser/EO-guided</td>
<td>20,450</td>
<td>8%</td>
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<tr>
<td>Serbia, 1999 (Allied Force): 78 Days</td>
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<td>16,000</td>
<td>66%</td>
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<tr>
<td></td>
<td>Laser/EO-guided</td>
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<td>31%</td>
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<tr>
<td></td>
<td>GPS-guided</td>
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</tr>
<tr>
<td>Afghanistan, 01-02 (Enduring Freedom)</td>
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<td>41%</td>
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<td></td>
<td>Laser/EO-guided</td>
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<tr>
<td></td>
<td>GPS-guided</td>
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<td>Iraq, 03 (Iraqi Freedom)</td>
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<tr>
<td></td>
<td>Guided</td>
<td>19,948</td>
<td>68%</td>
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</table>
Versatility of GNSS

• **GPS pet tracker** (GPS Pet Collar)

GPS Child Tracker

• tracking of elderly members of family (and Alzheimer patients
• emergency road side assistance
• Find a good Italian restaurant near your movie theatre
• Track your luggage, laptops, and anything of importance while traveling
• **GPS Spouse Tracking**
  (Monitoring the Spouses Activities)