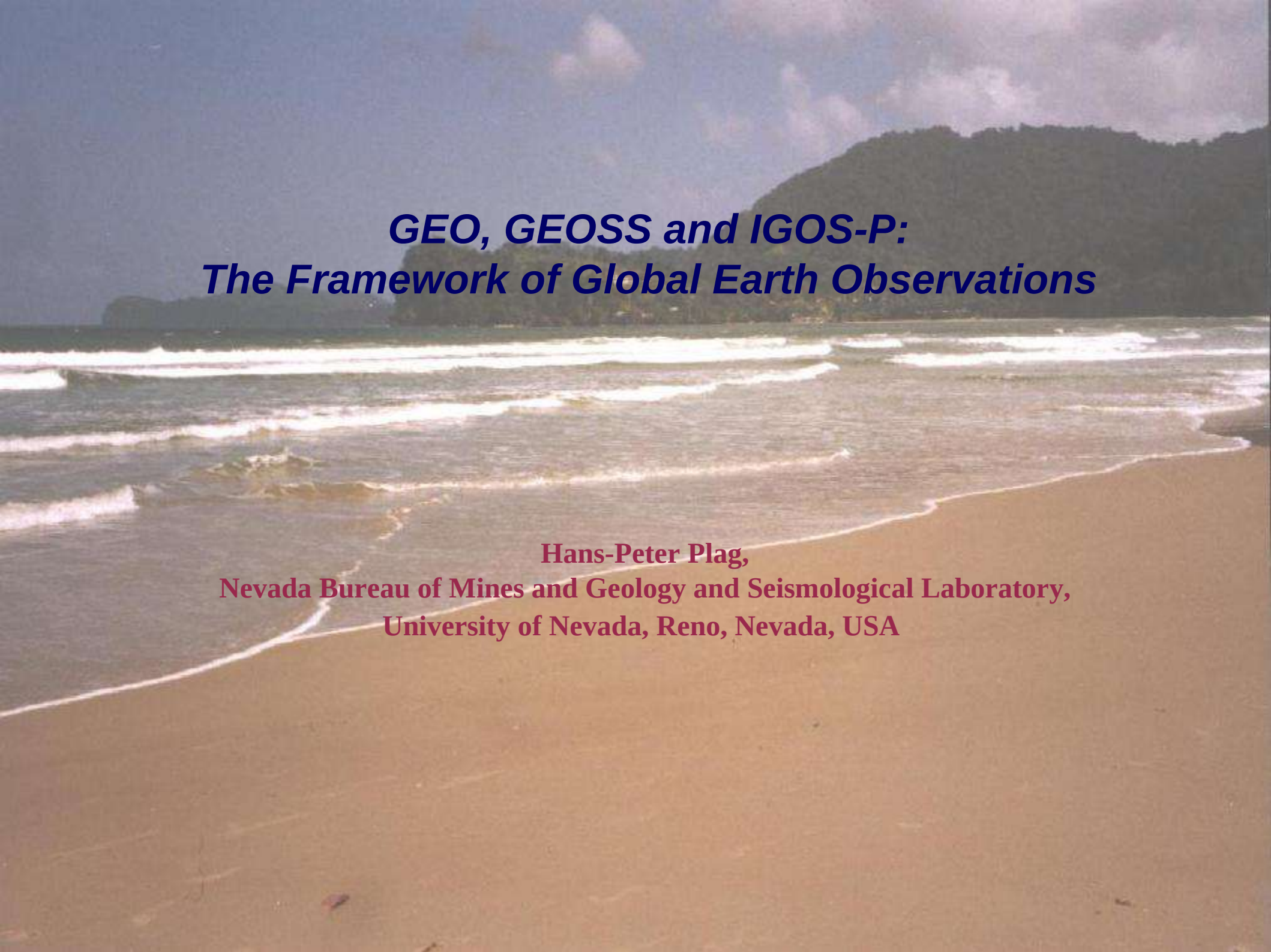

GEO, GEOSS and IGOS-P: The Framework of Global Earth Observations

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Overview

Part 1: Toward Integrated Global Earth Observation - Brief Historical Overview

- The Background: The pre-GEO Era
- The Beginning: The *ad hoc* GEO Phase
- The GEO Era

Part 2: GGOS, IGS and Global Earth Observation

- GEO and GEOSS
- IGOS-P and IGOS
- GGOS: The IAG Interface to Global Earth Observation
- IGS: A crucial component of GGOS

The Background: The Pre-GEO Era

Selected events:

1972: **First World Summit in Stockholm**

1972: Club of Rome Report 'Limits of Growth': limitation due to size of resources
1987: Brundlandt Report 'Our Common Future': re-vitalizes the concept of Sustainable Development, equal access to resources
1988: Intergovernmental Commission on Climate Change (IPCC) established by UN agency and WMO: limitation due to ability of environment to absorb the anthropogenic waste, particularly that from fossil fuels.

1992: **Earth Summit in Rio de Janeiro, Brazil:**
Framework Convention on Climate Change (UNFCCC)
Framework Convention on Biodiversity
Agenda 21: Gap between data and information

The Background: The Pre-GEO Era

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Agenda 21: Gap between data and information

Since early 1990-ies: Three Global Observing Systems (G3OS) initiated with:

Global Climate Observing System (GCOS): UNEP, ICSU, IOC, WMO
Global Ocean Observing System (GOOS): UNEP, ICSU, IOC, WMO
Global Terrestrial Observing System (GTOS): FAO, UNEP, UNESCO, ICSU, WMO

Since 1995: Integrated Global Observing Strategy (IGOS) developed.

Mainly for the G3OS, focus on transition from research to operational, sustainable monitoring

June 1998: Integrated Global Observing System-Partnership (IGOS-P) is formed through exchange of Letters of Understanding.

October 1998: IAG IGGOS Conference in Munich

2002: **World Summit on Sustainable Development in Johannesburg, South Africa:**

Urgent need for coordinated observations of the state of the Earth

The Beginning: The *ad hoc* GEO Phase

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Urgent need for coordinated observations of the state of the Earth

June 2003: G8 Meeting in Evian:

re-emphasizes the importance of Earth Observations

July 2003: First Earth Observation Summit (EOS-I) in Washington, DC with 33 Countries+EC and 21 international Organisations:

- *Establishes the ad hoc Intergovern. Group on Earth Observation (ad hoc GEO)*
- *Task of ad hoc GEO: initial 10 year Implementation Plan by February 2005*

July 2003: GGOS is established by IAG and IUGG

April 2004: EOS-II in Tokyo, 43 Countries + EC plus 25 international organisations:

- *Adopts the 'Framework Document', which defines nine societal benefit areas for Earth observations*

IAG joins GEO as Participating Organisation

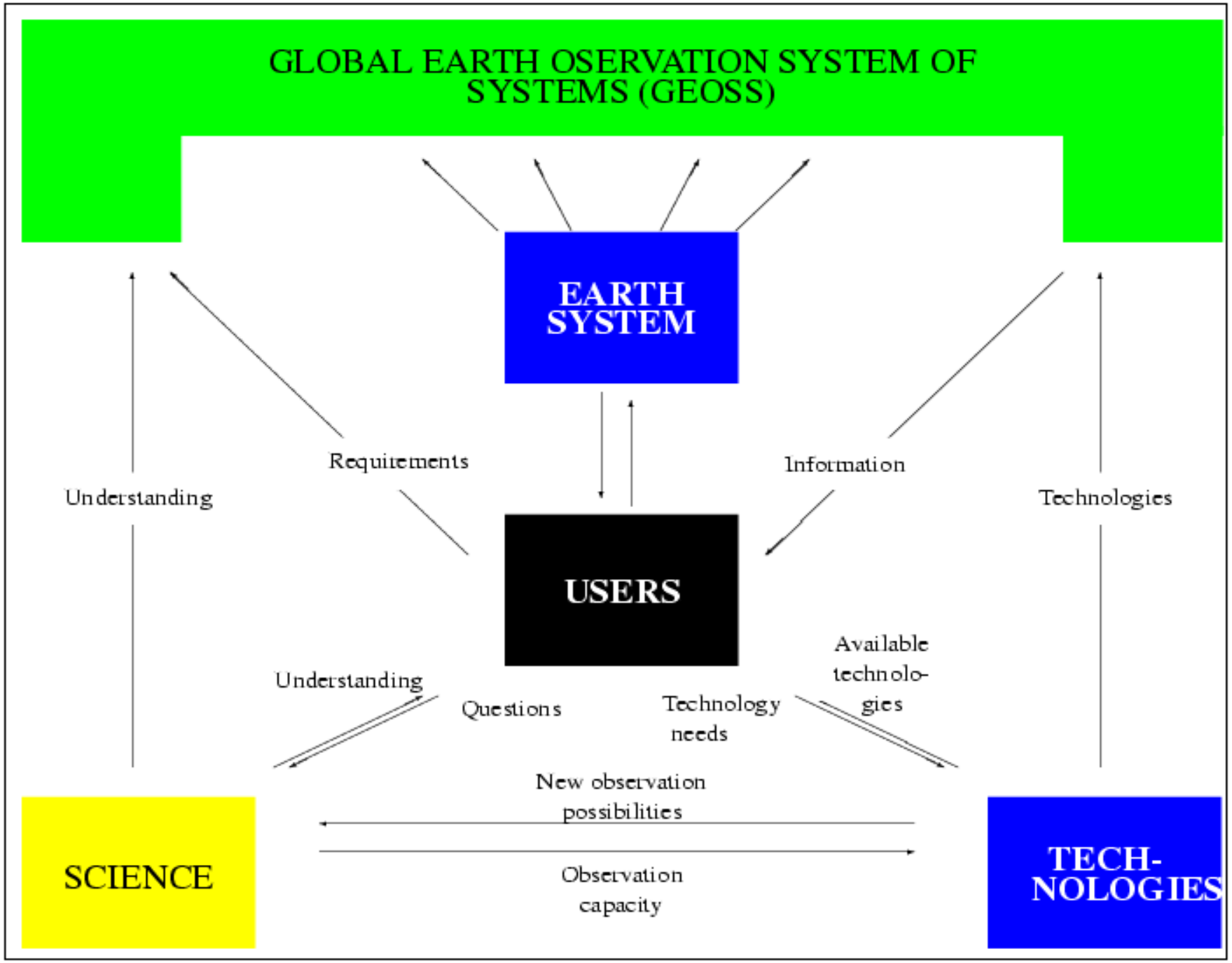
February 2005: EOS-III in Brussels:

- *Adopts the 10 Year Implementation Plan for a Global Earth Observation System of Systems (GEOSS)*
- *Establishes the Group on Earth Observation (GEO) with the task implement GEOSS*

The Beginning: The *ad hoc* GEO Phase

Vision for GEOSS is to realize a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive, and sustained Earth observations and information

The Beginning: The *ad hoc* GEO Phase



The Beginning: The *ad hoc* GEO Phase

Nine Societal Benefit Areas Identified by EOS-II:

- **Disaster**: reducing lost of life and property from natural and human-made disasters
- **Health**: understanding environmental factors affecting human health and well being
- **Energy resources**: improving management of energy resources
- **Climate**: understanding, assessing, predicting, mitigating, and adopting to climate variability and change
- **Water**: improving water resource management through better understanding of the water cycle
- **Weather**: improving weather information, forecasting, and warning
- **Ecosystems**: improving the management and protection of terrestrial, coastal, and marine ecosystems
- **Agriculture**: supporting sustainable agriculture and combating desertification
- **Biodiversity**: understanding, monitoring and conserving biodiversity

The Beginning: The *ad hoc* GEO Phase

Relevant quantities included in GEO, 2005:

- Deformation monitoring, 3-D, over broad areas (3)
- Subsidence maps (3)
- Strain and creep monitoring, specific features or structures (2)
- Gravity, magnetic, electric fields - all scales (3)
- Gravity and magnetic field anomaly data (2/3)
- Groundwater level and pore pressure (4-1)
- Tides, coastal water levels (1)
- Sea level (2-1)
- Glacier and ice caps (2)
- Snow cover (2)
- Moisture content of atmosphere/water vapor (2)
- Extreme weather and climate event forecasts (3)
- Precipitation and soil moisture (3-1)

0: ok
1: marginally acceptable accuracy and resolution
2: could be ok within two years
3: could be available in six years
4. still in research

The GEO Era

May 2005: GEO-I in Geneva:

- GEO Structure
- Working Groups
- Main priorities for the first year

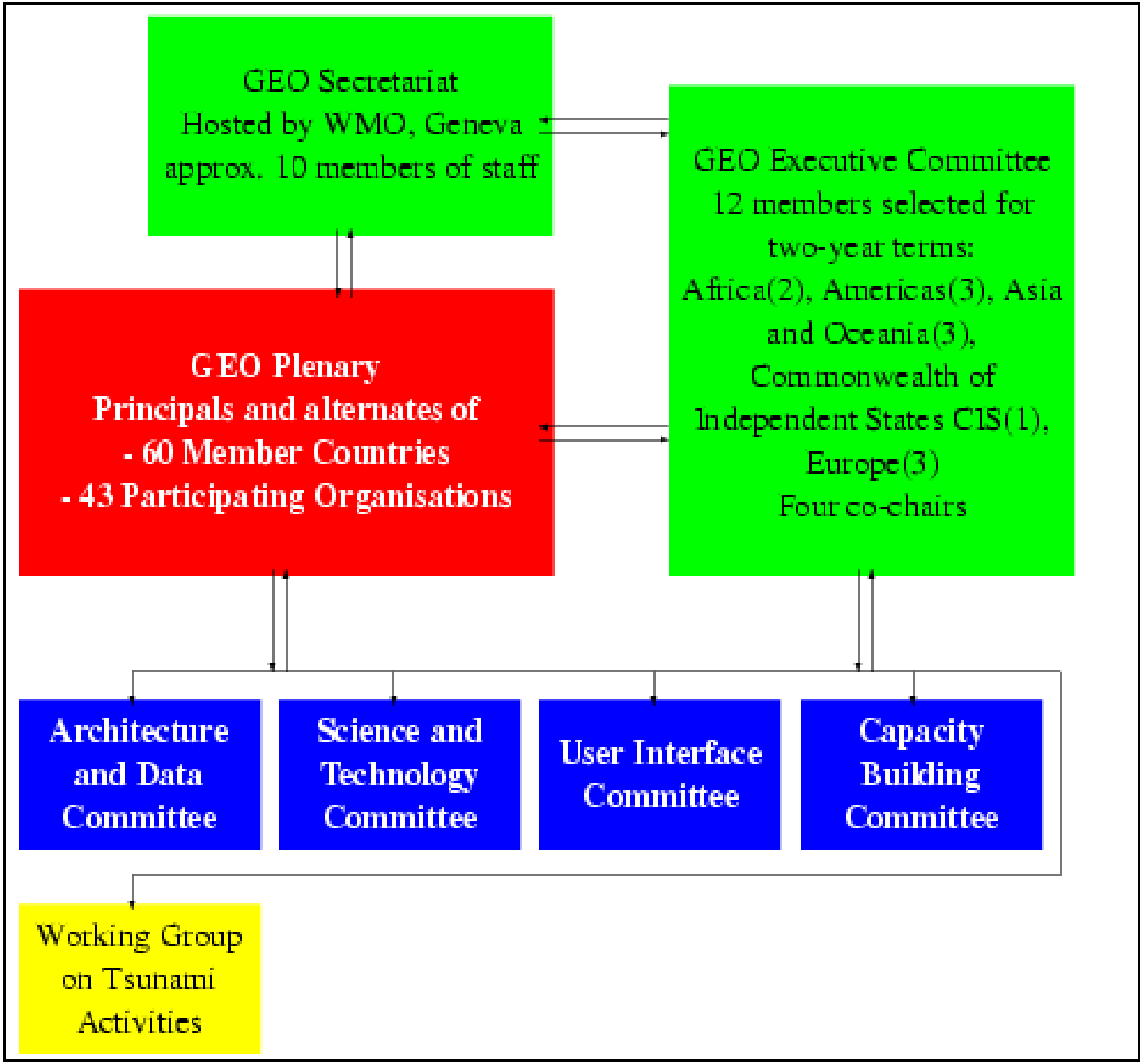
December 2005: GEO-II in Geneva with 60 Member States and 43 Participating Organisations:

- Acceptance of ToRs for Committees and WG
- Acceptance of Work Plan 2006 as 'living document'
- More than 150 new application of Participating Organisations, admission delayed until a procedure is defined.
- Selected Participating Organisations are: UNESCO, UNEP, WMO, CEOS, IGOS-P, IEEE, WCRP, IGBP, ICSU, IAG, ...

January to April 2006: Revision of GEO Workplan 2006

- Details worked out in Committees and WG

GEO and GEOSS



GEO and GEOSS

GEO:

- Intergovernmental body with more than 60 member countries,
- 43 Participating Organisations.

The role of GEO is still under discussion:

- What should GEO actually do?
- What should GEO facilitate and/or coordinate?

Work plan 2006:

- In total 96 tasks
- 24 coordinated by the Secretariat
- 46 coordinated by member countries
- 26 coordinated by Committees
- 44 to be completed in 2006

GEOSS:

- To be built on existing systems
- Integration, standardization, interoperability

IGOS-P and IGOS

Integrated Global Observing Strategy (IGOS):

- Developed from 1995 onward
- Initially for the G3OS
- Goal is a sustainable, comprehensive monitoring of the Earth system:
  - Long-term stability
  - Operational mode
  - Homogeneity in time
  - Multi-parameter sites
  - Global coverage and participation,
  - Integrated observation and data sets
  - Accessible databases
- Focus on transition from research to operational

IGOS-P and IGOS

Integrate Global Observing Strategy (IGOS) Partnership (IGOS-P) was created in June 1998

IGOS-P is a partnership of organisations that are concerned with global environmental change issues.

IGFA

GOS/GAW

IGOS-P and IGOS

IGOS-P:

- provides comprehensive framework for major space-based and in situ systems
- aims to provide over-arching strategy
- builds upon existing international global observing programmes
- improves observing capacity and deliver observations

Primary goal of IGOS-P is a (small) number of “Themes” with **strong linkages to critical societal issues**.

Currently a number Themes exist or are in the planning:

- Carbon Cycle
- Ocean
- Atmospheric Chemistry
- Geohazards
- The Integrated Global Water Cycle Observation Theme
- Coasts (including Coral reefs)
- Cryosphere
- Land

IGOS-P and IGOS

The Geohazards Theme: Plate tectonics, pre-, co- and post-seismic strain, processes associated with volcanos, early warning for tsunamies, subsidence, precarious rocks, landslides, and local and regional predictions of sea level rise are examples of topics that link this theme to geodetic observations.

The Ocean Theme: Ocean circulation, sea level rise, isostacy, dynamic sea surface topography, are linked to the three geodetic quantities, both for the monitoring and studies of the ocean's variability as well as model validation.

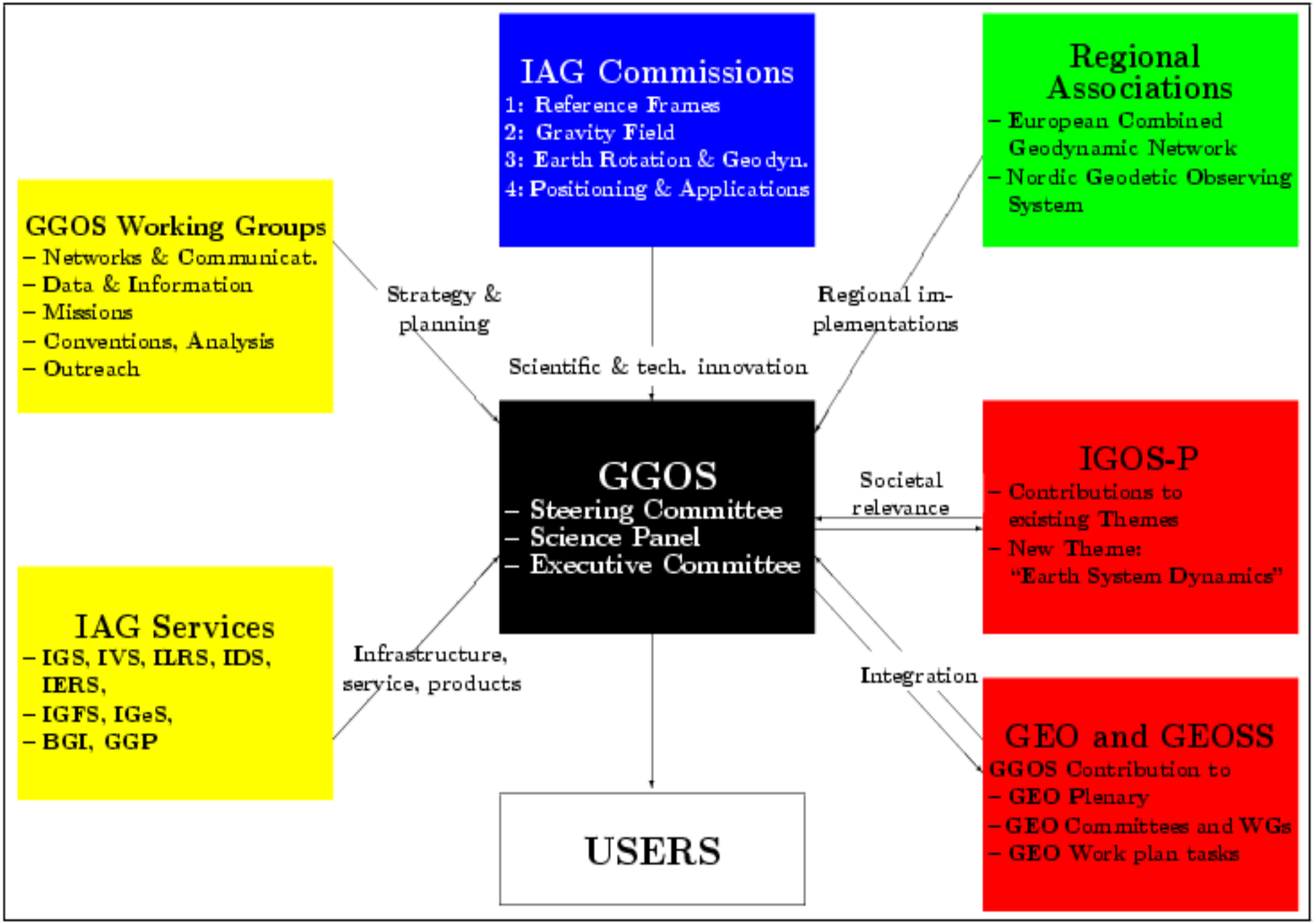
Water Cycle Theme: The geodetic observations provide a unique tool to monitor the global to local scale movememts of water throught the Earth system and the theme is strongly linked to geodesy.

The Coast Observation Theme: Sea level and ocean circulation are relevant parameters influencing the dynamic processes in the coastal zone and linking the theme to geodesy.

The Cryosphere Theme: Ice mass balance, glacial isostacy, and induced sea level variations all are important parameters, that are directly observed by the geodetic observation techniques.

The Land Theme: Changes in the elevation are directly observed by geodetic techniques.

GGOS: The IAG Interface to Global Earth Observation



GGOS: The IAG Interface to Global Earth Observation

IAG and GEO:

- IAG Participating Organisation in GEO
- GGOS contributing to GEOSS

The weight of Participating Organisations in GEO depends on their own activities and commitments:

- Can commit to Committees and WGs by nominating representatives
- Can commit to individual tasks of the work plan
- Can commit to lead individual tasks (together with member countries)

IAG Commitments:

- IAG contribution is delegated to GGOS
- Principal (GGOS Chair) and alternate (GGOS Vice Chair) plus delegation participate in the GEO Plenary meetings
- Two to three representatives in each Committee and the WG
- Contributes to several tasks of the Work Plan 2006

GGOS: The IAG Interface to Global Earth Observation

GGOS and IGOS-P

GGOS is expected to become a partner in IGOS-P after the IGOS-P meeting on May 23, 2006.

GGOS considers currently two questions:

- How can GGOS link and contribute to existing Themes?
- Should there be a new 'Earth System Dynamics' focused around mass transport in the Earth system and associated dynamics?

GGOS: The IAG Interface to Global Earth Observation

The Challenge for GGOS:

- GGOS provides both relevant observations and a utility for Earth observation (in particular GEOSS) and other users.
- Users are often not aware of being users of geodetic products and services.
- Users are mostly not aware of their explicit requirements.
- IAG services and GGOS evolve in a mainly scientific environment (affiliation to IUGG and ICSU).
- ITRF an utility for Earth observation and other applications
- Observations relevant to many non-scientific applications

GGOS: The IAG Interface to Global Earth Observation

Objective of GGOS:

Improve the Geodetic Observing System for the benefit of society.

Some steps towards this goal:

- Improve the accuracy level towards 10^{-10}.
- Identify all (main) user groups and their needs
- Identify applications that require geodetic observations and products
- Establish tools that allow a comprison of system performance and requirements
- Educate users concerning their needs
- Promote and improve the visibility and applicability of geodetic products
- Open chanels for dissemination into applications

IGS: A Crucial Component of GGOS

Contribution of IGS:

- IGS contributes to the determination of ITRF.
- IGS observes the changes of the geometry of the Earth (contribution to Earth observation).
- IGS provides access to ITRF (utility for Earth Observation).

Contribution of GGOS:

- Links to major user groups
- User requirements
- Consistency across the three pillars (Earth's geometry, rotation, gravity field)
- Improvements of general conditions for geodetic infrastructure

Some challenges:

- Currently mean accuracy of ITRF (mean coordinates and velocities) of the order 10^{-9}.
- Improvement of the instantaneous accuracy.
- Maintain link between IGSxxxx and ITRFxxxx.
- High accuracy real-time access to ITRF.
- Quality information and assurance for products.

Exploit mutual benefits for IGS and GGOS

Conclusions

- GEOSS is a system that is “ordered” by its users (member countries).
- GEO is the intergovernmental body building GEOSS.
- GEO is likely to be the coordinating body for Earth observation systems.

- IGOS-P brings together major players in Earth observation.
- IGOS-P develops the plans for observing systems responding to societal needs.

- GGOS is the IAG interface to GEO and IGOS-P.
- GGOS contributes to GEOSS.
- GGOS links the Services to major user groups.
- GGOS integrates the three pillars of geodesy.

- IGS is a crucial component of GGOS.
- IGS is crucial for meeting major challenges.