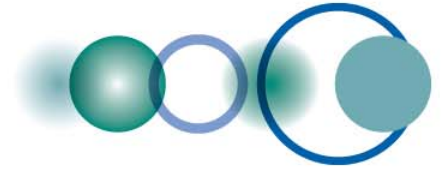


# **GEO task on Forest Carbon Tracking Objectives, expected results and CAL/VAL Implications**

**Giovanni Rum, Rob Koopman  
GEO Secretariat**

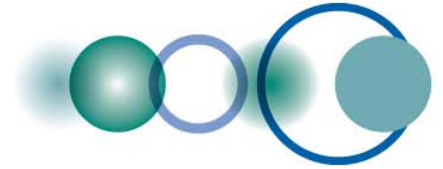
QA4EO  
Antalya, September 2009





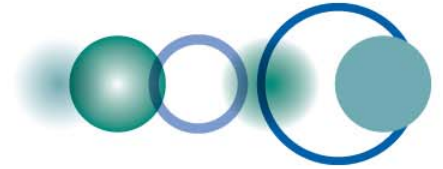
## **GEO task objectives - short term**

- demonstrate that coordinated Earth Observations, validated by means of in situ measurements and properly linked to forest models, can provide reliable information of suitable consistency, accuracy and continuity to support forest carbon MRV (Monitoring, Reporting and Verification) at Country level
- define a set of standards and interoperability requirements that methodologies should adopt to provide the most accurate results relying on the full spectrum of observational and processing capabilities.



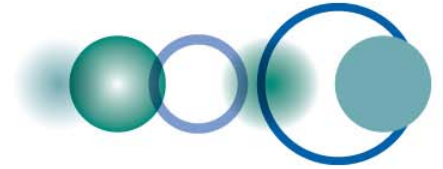
## **GEO task objectives – medium/long term**

Once demonstrated and if accepted in support of policy implementation, the medium/long term objectives would be to facilitate the implementation of an operational information system (observations, processing to relevant forest cover and carbon stocks information and information distribution), able to support National level assessments.



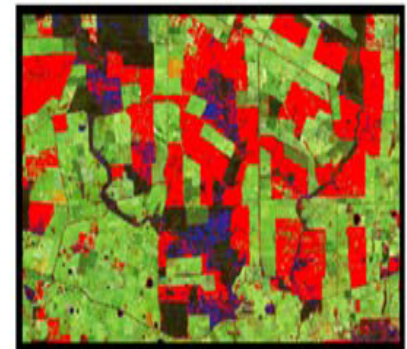
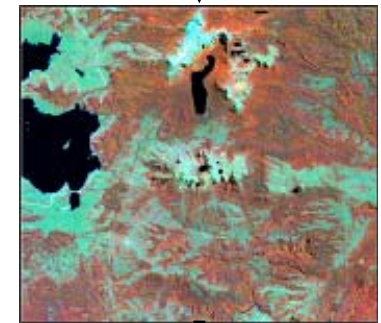
## Monitoring approach

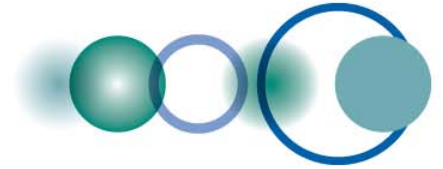
A yearly, wall-to-wall, medium-resolution monitoring approach has been identified as the best suited to cover a wide range of potential outcomes of the policy-framework negotiations.



## GEO FCT Products identification

- Horizon-1: Annual, wall to wall Forest/Non-Forest map and trends and associated accuracy metrics, at moderate resolution (<30m ), preferably from a 1990 baseline.
- Horizon-2:
  - Forest Degradation (& trends)
  - Land-use (e.g. agriculture, shifting cultivation, plantations, native forest ), Forest class: secondary forest (eg after fire or after agriculture); Softwood, hardwood, native, Plantation type mapping pre- and post-1990
  - Sparse woody perennial cover



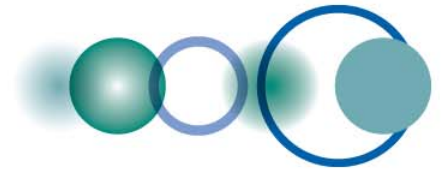


## Task activities summary

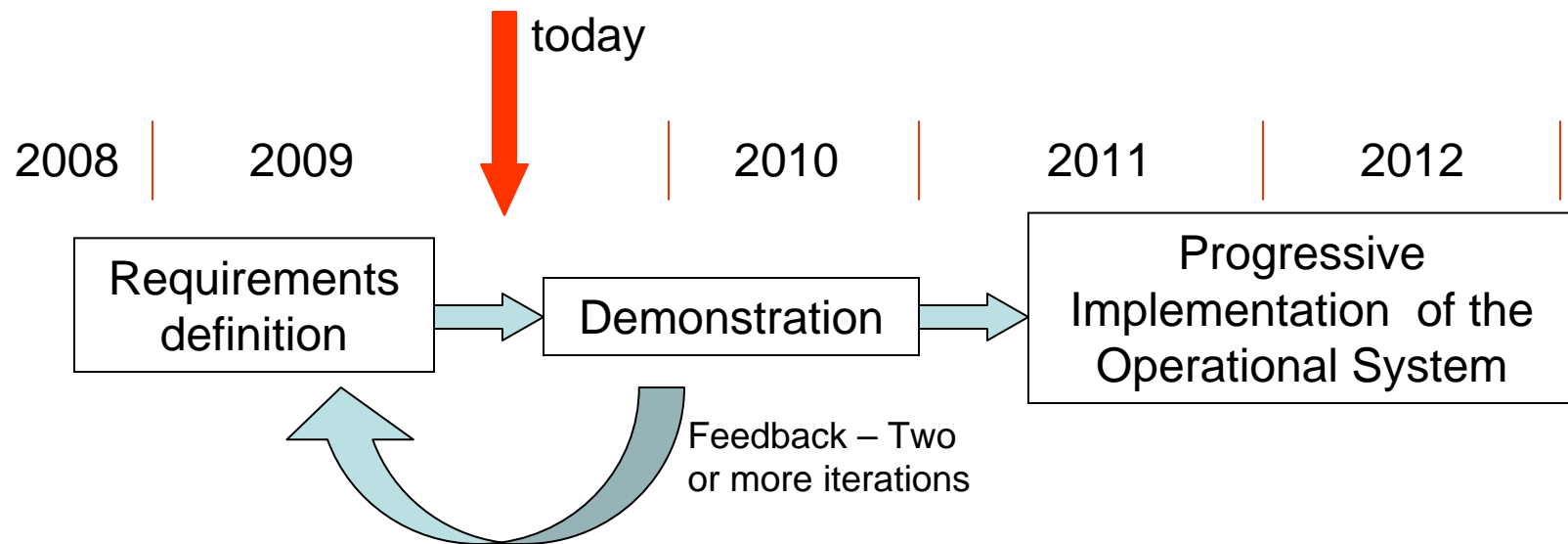
In close collaboration with national governments, space agencies, and relevant technical experts, the Task will demonstrate this capability, initially via the establishment of robust methodologies, satellite acquisition plans and a series of national demonstration areas (ND – National Demonstrators). Through a coordinated and iterative process, ND's will provide the elements to define a template for the roll-out of a consistent and reliable forest carbon monitoring system.

The task therefore includes three main interconnected phases:

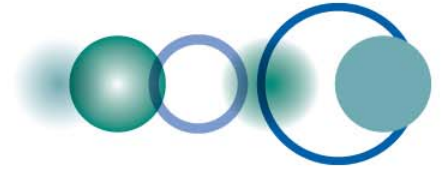
- Requirements definition
- Demonstration
- Implementation of the operational system



## GEO FCT task main phases



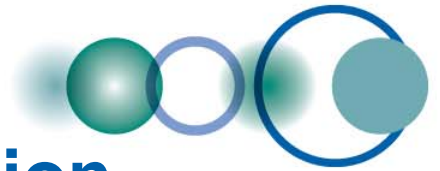
The selected approach allows progressive inclusion of additional National Demonstrators into subsequent demonstration cycles and a smooth transition to a pre-operational and then to an operational system



# National Demonstrators

The Task has established a number of reference demonstration areas – “National Demonstrators” for developing and testing approaches and methods and demonstrating the use of current Earth observation capabilities for assessing long-term, operational forest-cover change and carbon monitoring.

These national demonstrators are defined as areas large enough to demonstrate the wall-to-wall capability and to contain several verification sites sites, where the in situ/aerial measurement will take place and higher resolution/higher temporal frequency satellite data will be acquired.




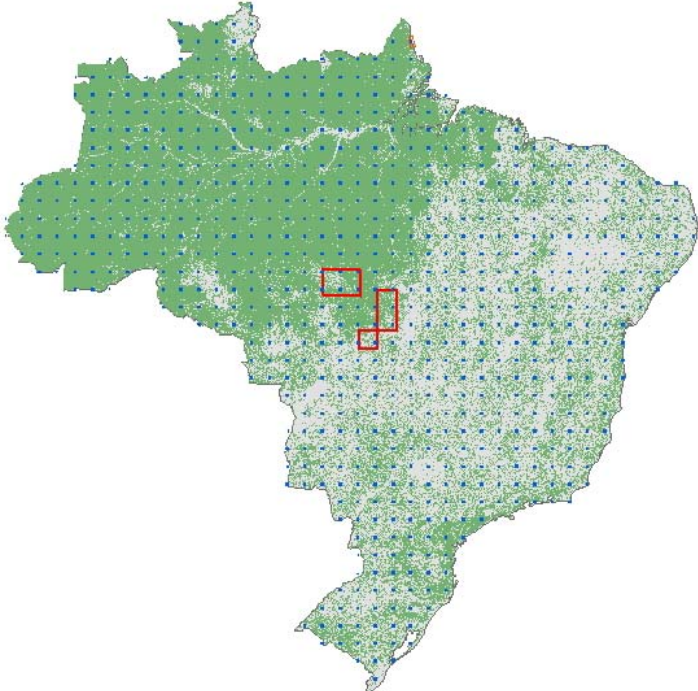





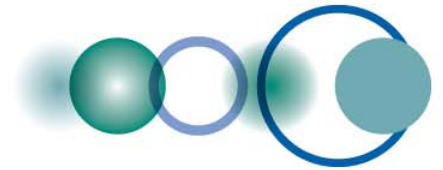
# National Demonstrators location

Political Map of the World, September 2008





	<p>Mexico 500.000</p>		<p>Indonesia(Borneo) 743.000</p>
	<p>Out of 1.970.000</p>		<p>Australia (Tasmania) 68.000</p>
	<p>Brazil 1.400.000</p>		<p>Cameroon 475.000</p>
	<p>Out of 8.500.000</p>		<p>Tanzania 945.000</p>
			<p>Guyana 215.000</p>

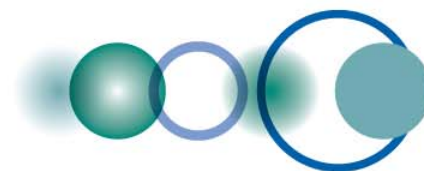


The verification sites, as they are currently defined, will serve:

- As a “classical” Calibration/Validation sites for the moderate resolution information products
- As “intensive observational sites” where higher resolution/higher temporal frequency satellite data will be acquired.

Current definition of verification sites is the following:

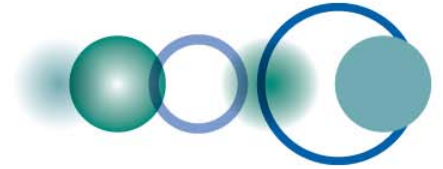
<b>National Demonstrator</b>	<b># of Verification sites</b>
<b>Australia (Tasmania)</b>	3
<b>Cameroon</b>	Under definition
<b>Brazil</b>	35
<b>Guyana</b>	1
<b>Indonesia (Borneo)</b>	4
<b>Mexico</b>	4
<b>Tanzania</b>	3



## SAR Satellites

### invited to contribute to 2009 Demonstration

Satellite	Frequency / Polarisation	ND's Wall to wall observation Mode	Verification Sites (VS) Mode	Remarks
ALOS PALSAR	L-band (23.6 cm) / full pol	Fine Beam Dual (FBD)	Wide Beam 1 (WB1)	
RADARSAT-1	C-band (5.6 cm) / HH	Wide Beam (150 km)		
RADARSAT-2	C-band (5.6 cm) / full pol	Wide Beam (150 km)		
ENVISAT ASAR	C-band (5.6 cm) / dual pol	IS4		
TerraSAR-X	X-band (3.1 cm) / full pol	ScanSAR	Stripmap	ND Tasmania. VS Tasmania Borneo Brazil Guyana
COSMO-SkyMed	C-band (3.1 cm) / full pol	ScanSAR Wide	Spotlight ScanSAR Huge	Only VS in Borneo Brazil Guyana



## Optical Satellites invited to contribute to 2009 Demonstration

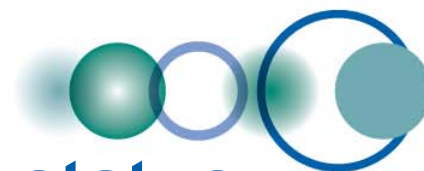
Satellite	Spectral Bands	Geometric Resolution	ND's Wall to wall observation Mode	Verification Sites (VS) Mode
Landsat 5, 7	VNIR, SWIR, TIR	30 m / 120 m (TIR)	X	
IRS: AWiFS	VNIR, SWIR	56 m	X	
IRS: LISS-III	VNIR, SWIR	23 m	X	
CBERS 2b: CCD,	VNIR, SWIR	20 m	X	
AVNIR-2	VNIR, SWIR	10 m		X
SPOT 4, 5	VNIR, SWIR	20 m / 10 m	X	X
Kompsat-2	VNIR, SWIR	1 m / 4 m		X



# SAR Satellites Data acquisition status (starting June 2009 up to 10 sept 2009)

NDs (wall-to-wall)	Brazil (parts)	Guyana	Mexico	Cameroon	Tanzania	Borneo	Tasmania
ALOS - PALSAR	Acquired June/Sept. Fill-in Sept/Oct	Acquired June/Sept	Planned Sept/Oct	Acquired June/Sept	Acquired June/Sept	Acquired June/Sept	Acquired June/Sept
Radarsat-2	Constraints and restriction (partially) *1	feasible *4	feasible *2	Not feasible, covered by ESA	Not feasible, covered by ESA	feasible *3	feasible *4
Envisat ASAR	partially acquired	acquired	Not feasible, covered by CSA	acquired	acquired	Not feasible, covered by CSA	acquired
COSMO - Skymed	Not planned	Planned (acquired?)	Not planned	Planned (acquired?)	Not planned	Planned (acquired?)	Planned (acquired?)
TerraSAR-X	Planned	Planned	Not to be requested	Not to be requested	Not to be requested	Planned	Planned

o.k.     
  some restrictions     
  not feasible     
  under discussion



# Optical Satellites Data acquisition status (starting June 2009 up to 10 sept 2009)

NDs (wall-to-wall)	Brazil (parts)	Guyana	Mexico	Cameroon	Tanzania	Borneo	Tasmania
Landsat	Acquired (1990, 2000, 05 and 09)	Acquired (1990, 2000, 05 and 09)	Acquired (1990, 2000, 05 and 09)	Acquired (1990, 2000, 05 and 09)	Acquired (1990, 2000, 05 and 09)	Acquired (1990, 2000, 05 and 09)	Acquired (1990, 2000, 05 and 09)
SPOT	To be requested	To be requested	To be requested	To be requested	To be requested	To be requested	To be requested
CBERS	acquired	acquired	Not feasible, No CCD recorders	To be defined	To be defined	Not feasible, No CCD recorders	Not feasible, No CCD recorders
IRS	To be requested	To be requested	To be requested	To be requested	To be requested	To be requested	To be requested
Kompsat	To be requested	To be requested	To be requested	To be requested	To be requested	To be requested	To be requested



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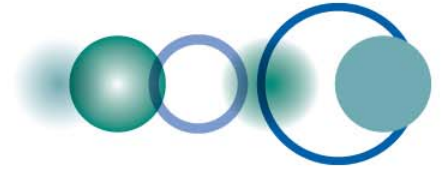
some  
restrictions



not feasible



under  
discussion



## **GEO FCT Interoperability and Processing Approach**

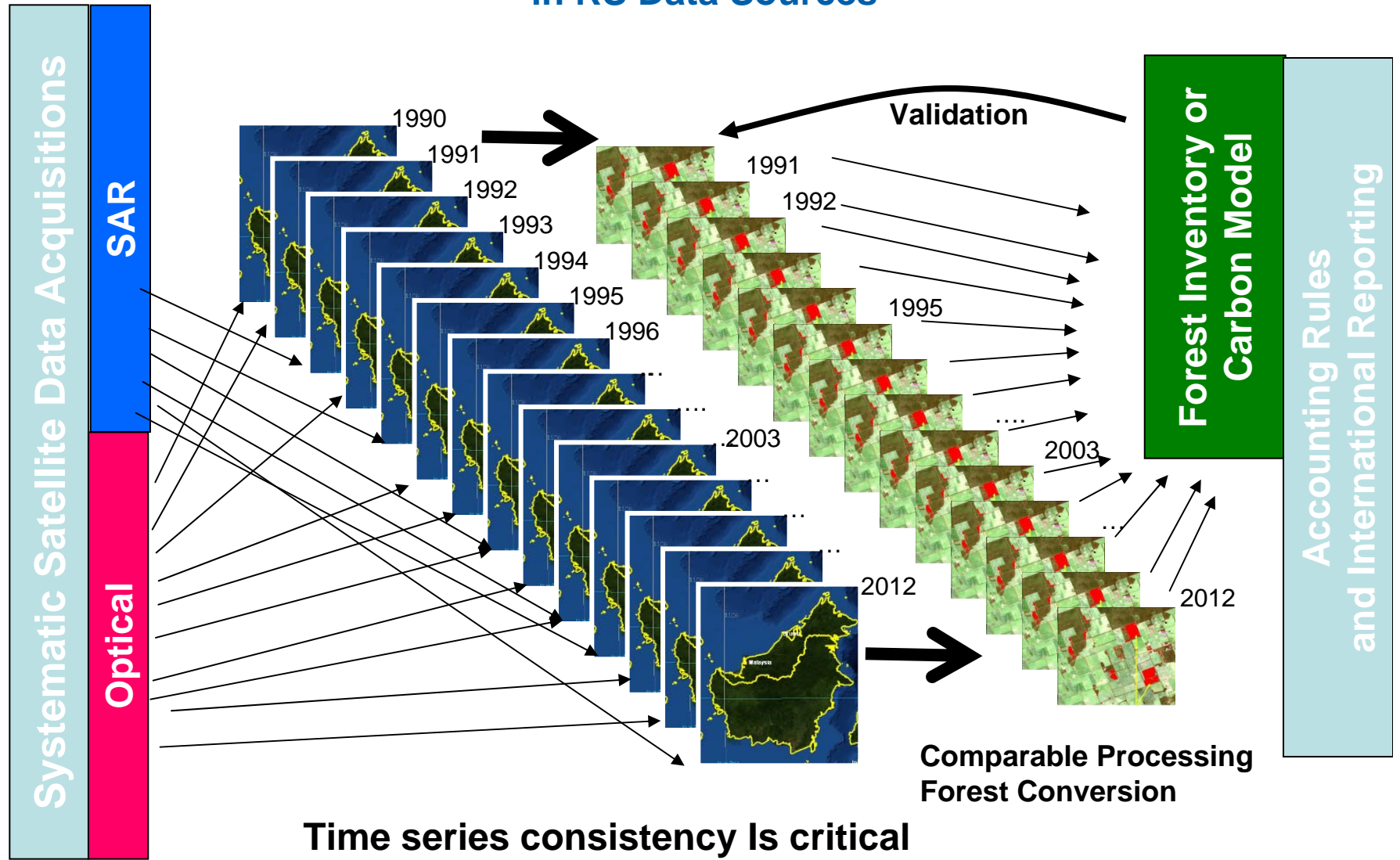
The task is establishing a framework with standards for the integration of optical and SAR data to generate consistent time series forest data stacks, including:

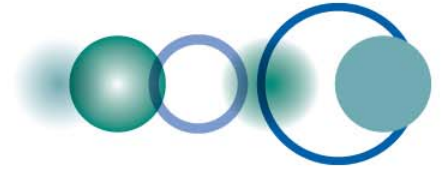
- consistent SAR and optical data processing,
- classification and trend processing methods
- accuracy estimates for relevant remote sensing and ground datasets
- Linkage with forest models and carbon stocks/carbon stocks changes

The approach is described in the document "GEO FCT SATELLITE INTEROPERABILITY AND PROCESSING METHODS"



## Interoperability and complementarity in RS Data Sources





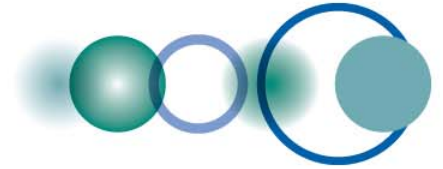
# GEO FCT Interoperability and Processing Approach

This approach will initially be applied in support of data acquisition and processing related to the 2009 National Demonstrators that are intended to show the feasibility in generating quantitative time-series of Forest Carbon products.

These time-series are expected to include, also as a function of the required forest information product;

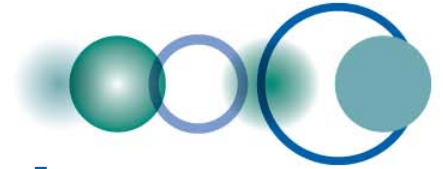
- comparable and interchangeable products from different sensors
- products derived from combinations of sensors
- Estimations of errors, and attribution of sources of errors, for each product.





## Key processing issues

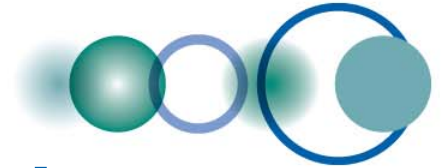
- Standard pre-processing of optical and SAR data
- Approach for orthorectification
- Application of different tools and methodologies to derive forest information, assessment of associated accuracy, comparison of products, actual definition of interoperability.
- Linkage of space data with in situ data and with ecosystem models (biomass and carbon stocks)



## The Network of processing facilities

To reach the 2009-2010 goals, the FCT Task has decided to establish a Network of Processing Facilities, as an interim framework responsible initially of providing consistent annual, mid-resolution ‘forest change’ time-series of map products for each of the ND’s.

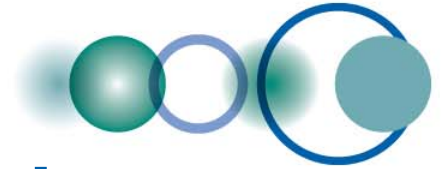
Terms of reference for the Network are defined in document “TERMS of REFERENCE for the GEO FCT Processing Hubs Network for the Demonstration phase”



## The Network of processing facilities

The Network of processing Hubs is composed by two types of “nodes”

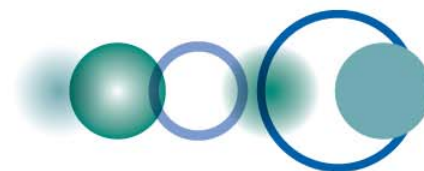
- Global processing facilities, in principle related to a given satellite sensor, that will process and deliver “standardized data products” derived from level 1 image products
- Regional processing facilities, which, working with National Demonstrator Countries, will process and deliver required forest and carbon information products for a given region of the world.



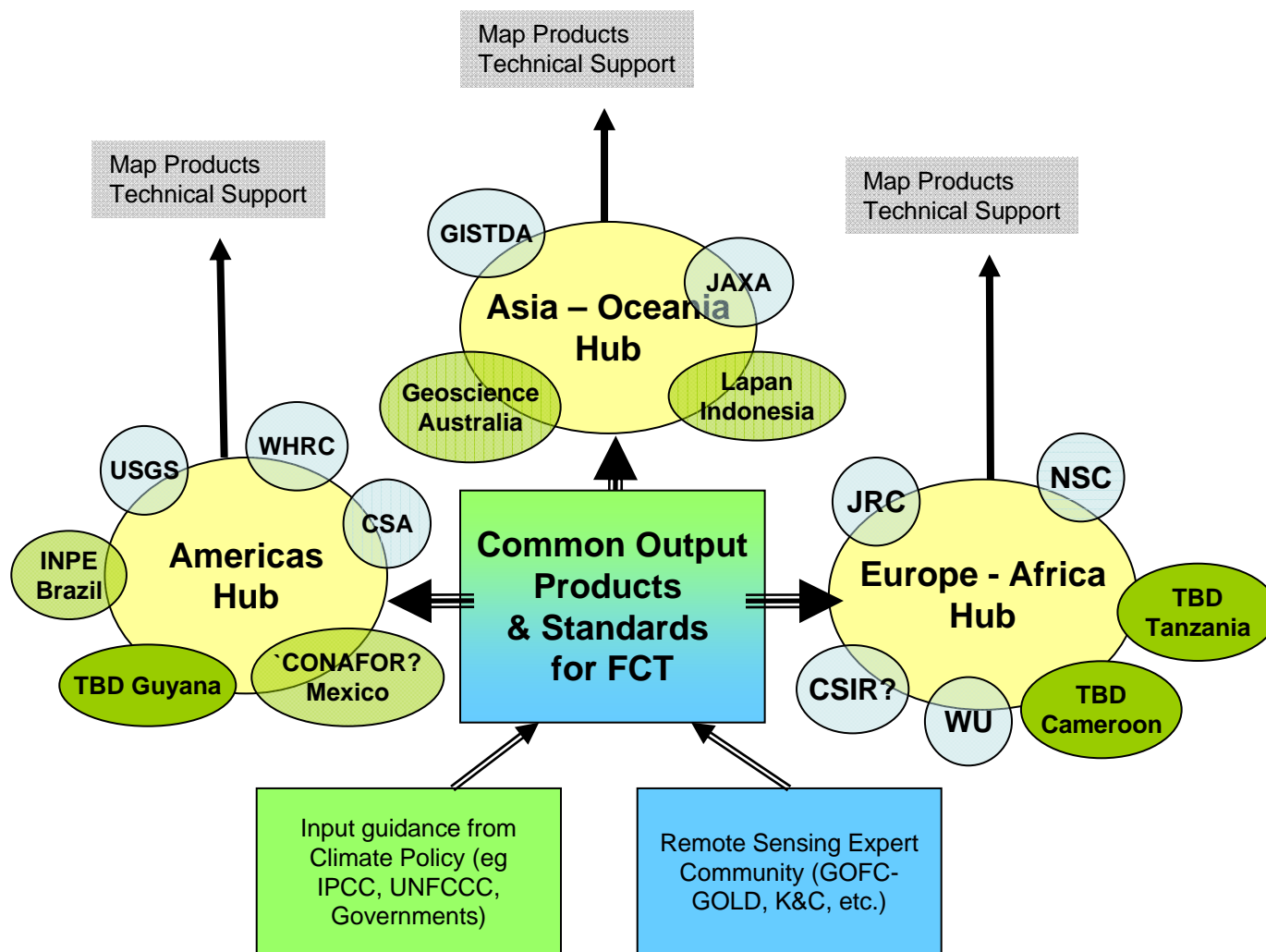
## The Network of processing facilities

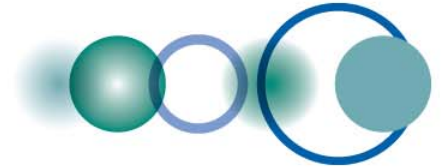
The Network will provide support to Countries in the processing activities (totally or partially) and to ensure a coordinated review of products derived from different sensors/processing tools and to assess their accuracy and “comparability”.

For the Regional processing facilities to work properly, it is deemed mandatory that ND Countries be part of the relevant regional facility and bring to the partnership their in situ data and their practices for Forest monitoring.



# Regional processing facilities





## Conclusions

Interoperability is the key word for success

Intensive calibration/validation activities are being planned throughout the demonstration phase.

The support of the CEOS CALVAL WG is deemed essential to meet task objectives.

A joint plan of activities appears to be the first step to substantiate this cooperation.

The GEO Secretariat and the GEO Forest and Carbon task team are ready to initiate the process.

# Thank you!

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