

Concept note on Earth Observation for water management in the Mediterranean

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Preamble

End September 2010, the Euro-Mediterranean Information System on know-how in the Water Sector –EMWIS- and the European Space Agency –ESA- jointly organized a workshop to explore the potential offered by Earth Observation for water management in the Mediterranean, bringing together representatives from water authorities and remote sensing institutes from 4 countries of the Southern Mediterranean. This concept note is the result of this 2 days technical workshop showing the willingness of the various institutions to work together at the national and Mediterranean levels to build a strong capacity building program aiming at improving water management by the means of earth observation.

RATIONALE

Sector context

The Mediterranean climate is characterised by long months of drought and very short periods of rainfall, often stormy rain that can cause devastating floods, the main flow of which cannot be stored. The effects of global warming will increase these trends: models predict a 25% reduction of summer rainfalls in the Mediterranean basin. In addition, fresh water is very irregularly distributed on the territory and prone to great inter-annual fluctuations. To meet the demand and face the lack of rainfall, the countries must often exploit the non-renewable resources from large fossil aquifers, sometimes transboundary, over a limited period. The pressures on the water resources are dramatically increasing due to rapid population growth and urbanisation, the needs of the touristic sector, the lack of efficiency in water use, an important increase of surface and ground water pollution.

Policy makers call for cooperation to face the fresh water challenge in the Mediterranean. The draft Mediterranean water strategy to be adopted at the end of this year, as well as the Arab Water strategy to be adopted at early 2011, highlight the importance of availability and sharing of water data to carry out its action plans aiming at improving water resources management in the region as well as facing challenges such as water scarcity and drought, and water quality degradation, etc. In the same context, Tunisian President Ben Ali called in October 2010 for establishing an "Islamic Water Council", to serve as a reference and consultative scientific institution in charge of examining the reality of water resources in these countries, developing a computer system in this field and use modern technologies (such as Earth Observation) for the mobilisation and rational use of these resources.

Within a context of worsening shortage and water stress in parts of the region and in view of the uncertainties brought about by climate change, water managers need reliable and timely information on water resources and their use. The "Space for the Mediterranean" conference organized during the Toulouse Space Show 2010 highlighted that satellite imagery could bring major benefits to water management but it still under used.

On the other hand, a high level of scientific expertise is being developed throughout the European Union framework Programmes (FP) of Research and Technological Development. A dozen of research projects focusing on the use of Earth Observation in water management issues have been supported. In the last FP (i.e. 7) a large amount of resources are also allocated to the development of GMES (Global Monitoring for Environment and Security) and related services.

The TIGER initiative, launched by ESA for African countries, has generated significant experience on EO-based water information systems. In addition, in the coming few years, thanks to the GMES program, the current observational capacities provided by ESA will be further enhanced and data will be freely available.

Therefore, it is urgent need to bridge the gap between water authorities in the Mediterranean and scientists from remote sensing institutes through a dedicated capacity building program in order to bring the benefits EO technologies application for operational water management.

Lesson learnt

For the past 10 years, EMWIS –Euro-Mediterranean Water Information System on know –how in the water sector- has been gathering national water authorities from all the countries around the Mediterranean Sea to cooperate on developing water information systems available on the web or as private intranets shared between some national public institutions. The declaration of the Ministerial conference on water of the Union for the Mediterranean in Jordan in December 2008, gave a new impetus for such developments, requiring comparable data to monitor and evaluate the implementation of the long term Strategy for Water in the Mediterranean (to be adopted in 2010):

“Ministers reaffirmed the importance of data, information and statistics on water, based on internationally agreed definitions and methods, structured within information systems, for analysis and decision making and insist on the need to dispose of national and regional systems that contribute to the definition, implementation and follow-up of the Strategy;”

This demand implies the availability at the Mediterranean level of comparable indicators as well as the development of National Water Information systems –NWIS -harmonized at the regional level. Most Mediterranean countries are now preparing such systems based on the principles of shared information systems among all the national institutions managing data related to the water sector. The first steps towards the development of NWIS in Med Partner Countries highlight the recurrent needs for:

- Reference maps such as soil elevation models, land use, hydrographic networks
- Neutral and coherent data series on water resources quality and quantities as well as water abstraction and use broken down by socio-economic sectors

In the last decades Earth Observation technology has been consolidated as a major source of synoptic, reliable and global geo-information for a large number of applications including water

resource management and hydrology. Experiences from the TIGER initiative have demonstrated the benefits of using Earth Observation technologies for water management in Africa.

TIGER was launched in 2002 as a response from space agencies to need for action in Africa expressed at the World Summit on Sustainable Development (WSSD) held in Johannesburg, South Africa. The initiative, lead by ESA, aimed at: ***"assisting African countries to overcome problems faced in the collection, analysis and dissemination of water related geo-information by exploiting the advantages of Earth Observation (EO) technology"***.

Since 2005, under the guidance of the African Ministerial Council on Water (AMCOW), TIGER has supported African partners with access to space-borne data and products, by offering specific training on EO applications for water management, by funding North-South collaborative projects aimed at developing tailored EO-based water information systems, and by favouring take-off, operationalisation and technology transfer of those demonstrated systems to African water authorities.

All the experience gained and the partnerships developed in the last years are now ready to be scaled up and transferred to a full operational stage, where water authorities may exploit the day by day increasing capacity offered from EO satellites in order to derive synoptic, reliable and updated information on water resources from regional to local scales.

TIGER program has highlighting significant costs and time savings (e.g. for preparing ground surveys for drilling points) as well as the possibility to perform activities that were not possible before as EO is often the only source of data, offering neutral and comparable information. Success stories from TIGER and other EO applications in the water sector (in Australia, Germany, Middle-East) are showing that the key success factors are related to: i) the ownership by local teams; ii) synergies between EO, modeling (using scientific resources) and in situ monitoring (to calibrate the models used); iii) capacity building for local teams on how to use these technologies.

Complementary actions

In the coming years, an increasing number of EO satellites will be launched by ESA providing an unprecedented capacity to observe, monitor and assess the status of the Earth environment including water resources. On the scientific side, ESA has initiated the successful deployment of the Earth Explorer series with three new satellite dedicated to explore the Earth Gravity field, the cryosphere and more importantly the water cycle with the launch of the SMOS satellites. In addition, on the operational side, ESA and the EU within the context of the [GMES](#) –Global Monitoring for Environment and Security- program in partnership with the EU, will launch, in the coming few years a new series of operational satellites (the Sentinels) that will further enhance the current observational capacities and will ensure the continuity to the existing missions. All this data as well as the already extensive archives from the ERS-1, ERS-2 and ENVISAT missions will be available globally under a **new free data policy** providing an critical resource for the development of novel operational services within the context of the water sector worldwide.

In February 2008, the Commission adopted a Communications on establishing a "Shared Environmental Information System" (SEIS) for Europe to improve and streamline the European system for collecting, analysing and reporting environmental information. The Commission Communication sets out objectives and principles, including: "data stored as close to source as possible"; and "produce once, use many times". SEIS is a decentralised but integrated web-enabled

information system based on public information providers sharing environmental data and information. The SEIS initiative reflects also a changing approach towards open data exchange and partnership, elements in relation to the EU Neighbors, especially in the Mediterranean in the framework of ENP/Horizon 2020 initiative (H2020) and the "Union for the Mediterranean" (UfM) policy with the willingness to set-up Mediterranean Shared Environmental Information System.

Joint cooperation will be established with existing or planned initiatives related to water issues and remote sensing in the region and at the national level, in particular with:

- A new GEF-NASA-World Bank regional project is under preparation. The project aims at installing NASA Water Information System Platform including the implementation of an up to date remote sensing system with modeling capabilities. Drought assessment, climate change impact on water resources and crop monitoring are three priority areas identified for applying NASA and Earth science technology to help meet the region's water management needs. The targeted countries are Morocco, Egypt, Tunisia, Lebanon and Jordan. This project will focus on national level while the EO for water management in the Mediterranean will focus on applications at regional and local levels with higher resolution images.
- National remote sensing projects for hydrology, such as the Lebanese assessment of the variability in snow distribution with respect to the existing hydrologic and physical factors (launched in 2010 with IRD-Centre d'Etudes Spatiales de la BIOSphère).

Description and effectiveness

Objectives

The overall objective is to reinforce water management in South and East Mediterranean countries using Earth Observation technologies. To achieve this objective, a Mediterranean capacity building programme is proposed in order to bring the latest scientific developments in EO into the hands of water managers. This programme is foreseen in 2 phases:

- Phase 1: Creating the interface between EO science and WM by setting up a Mediterranean capacity building programme and demonstrating pilot applications
- Phase 2: Operational deployment of EO applications in WM in Med countries

This concept note is covering the Phase 1 of the programme, the definition of the 2nd phase will be an output of the 1st phase.

The specific objectives of phase 1 are to:

- Demonstrate in pilot countries the integration of earth observation applications within emerging National Water Information Systems to overcome problems faced in the collection, analysis and dissemination of water related geo-information
- Develop the common infrastructures on EO applications (spatial data and related services, software, hardware) for the pilot applications and future reuse
- Transfer the technology and know-how to the local teams in the pilot countries
- Create an enabling environment (generic applications, capacity building, expertise) for operational deployment in all the Mediterranean countries and its sustainability

Geographical location

The programme concerns all the Mediterranean Partner Countries of the EU (i.e. Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Syria, Tunisia, Turkey and the Palestinian Authority) with pilot activities taking place in four countries during the first phase: Morocco, Egypt, Lebanon and Jordan.

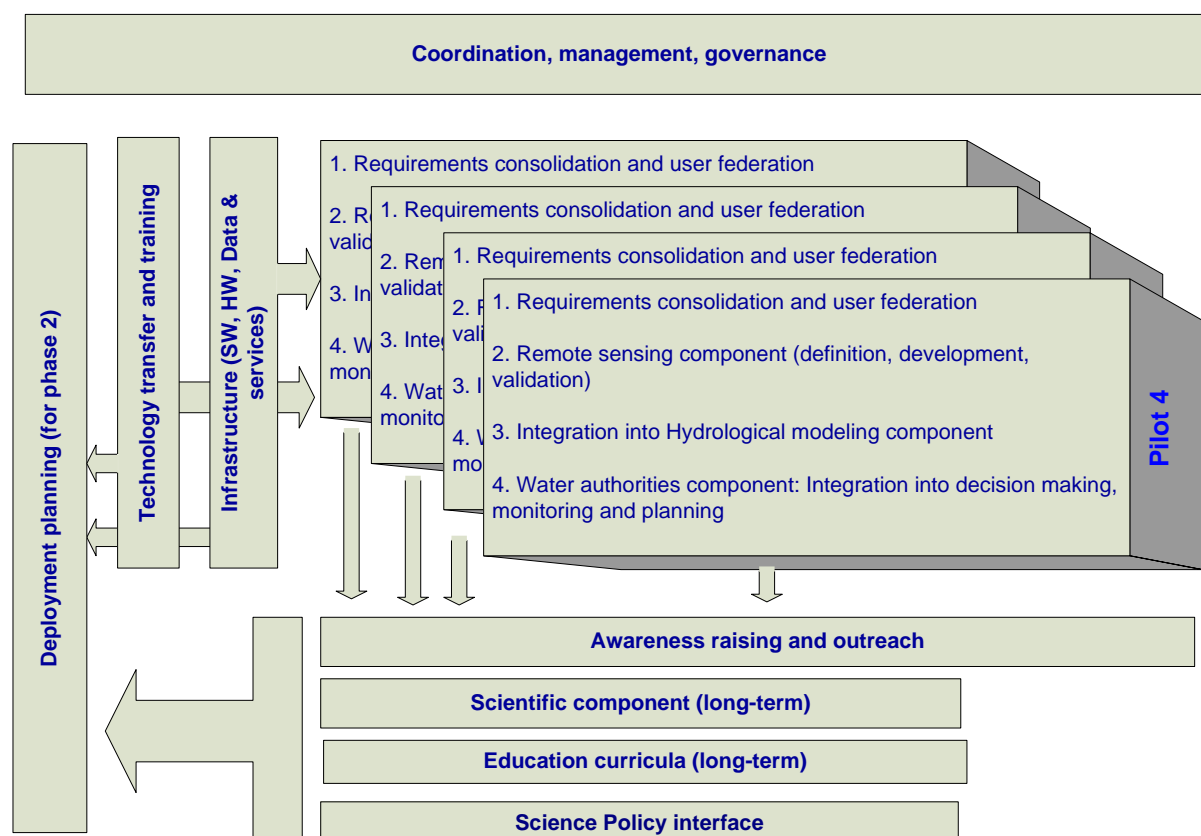
Stakeholders

The main targets of the proposed activities are water authorities and remote sensing institutes from Southern Mediterranean Countries¹. According to the pilot applications foreseen in each country, other organizations concerned by water information (as provider or user) will be involved, such as Ministry of Agriculture (e.g. irrigation efficiency), Ministry of Environment (e.g. water quality), Universities, etc.

The four pilot countries involved in the first phase (Morocco, Egypt, Lebanon and Jordan) represent a well balanced expertise on remote sensing applications for the water sector and/or water information management with strong commitments to set-up shared national water information systems.

Main activities

The approach proposed is based on “Develop, Demonstrate and Transfer” model. The relations between main activities planned are presented in the figure below:



¹ In the case of Egypt, the Ministry of Water also includes GIS and remote sensing units

In addition to the overall coordination and the state-of-the-art of EO for WM that will be jointly carried out in the beginning of the project, 5 main types of activities are planned:

- **Awareness raising and outreach** will aim at creating a Mediterranean community of expertise on EO for the water sector and thus will be targeted to all the countries with activities such as: cost benefits analysis on the pilot applications to be developed, 2 conferences, publication of case studies, cook books fiches to help decision makers in integrating EO application to solve water related information gaps. Awareness material will be developed from the results achieved in the 4 pilot countries
- EO applications will be **demonstrated in pilot countries** according to priorities and requirements from the local stakeholders. A first set of priorities have already been defined by the countries (see table next page).
- Based on the users requirements in each country, common capacity development activities will be defined, with the support of international experts (from North and South countries), for the 4 pilot countries and reuse for future deployment. Once agreed with the countries, these activities will be implemented either jointly (e.g. training session) or locally (e.g. in situ monitoring)
 - Building the necessary hard and soft **infrastructure** in terms of software, equipment, data banking and related services (e.g. data access, processing)
 - **Training and technology transfer**
- In order to prepare a longer term sustainability and ensure ownership by the countries, it is necessary to prepare the foundations to develop local expertise for the future generations that could lead to: i) the introduction of **EO curricula** in local educational programmes; ii) **scientific research programmes** developing or improving models based on EO data for local water resources management. The involvement of water authorities in such activities is necessary to allow a smooth interface between science and water policy.
- The preparation of further deployment of the capacity program to all the Mediterranean countries will mainly focus on:
 - Preparing the common infrastructure providing access to data, services, knowledge (experts, guidance documents, publications)
 - Identification of valuable applications with countries for future implementation
 - Analyzing fund raising opportunities
 - Defining the work programme for the deployment phase

The table below presents the priority domains for the foreseen EO applications in the 4 pilot countries:

Priority domains	Applications foreseen in				Other potential applications identified
	Lebanon	Morocco	Jordan	Egypt	
Water availability	Monitoring snow spatial dynamics, volumetric measures and levels Drought indicators	Drought impact assessment	<ul style="list-style-type: none"> Management of shared surface and groundwater resources 		<ul style="list-style-type: none"> Desertification Evaluation of trends in ground and surface water Possible changes in the hydrologic regime Soil moisture monitoring
Flash floods	Monitoring run-off and Mapping Flood-prone areas	Early warning system and modeling		Early warning system and modeling	
Water quality		Pollution and water quality monitoring		Pollution and water quality monitoring	
Water Use			<ul style="list-style-type: none"> Monitoring land use (incl. crops and irrigated areas) Management of shared surface and groundwater resources 		<ul style="list-style-type: none"> Abstraction control Impact of climate change on agriculture Estimating evaporation/ evapo-transpiration Monitoring vegetation health
Infrastructures & resources management	<ul style="list-style-type: none"> Determining vulnerability areas (e.g. protection areas for Fresh water) Estimating areas for water harvesting / reservoir location / artificial recharge (liniments), surface and groundwater storages 		<ul style="list-style-type: none"> Determining vulnerability areas (e.g. protection areas for Fresh water) Estimating areas for water harvesting / reservoir location / artificial recharge (liniments), surface and groundwater storages 	Impact of Climate Change on coastal zones	<ul style="list-style-type: none"> Erosion and sedimentation of reservoir Infrastructure risk analysis (e.g. dams)
Base maps	Digital maps (incl. soil, geology, recharge, groundwater flow, digital elevation model)				

Expected results

The expected outputs from this 1st phase are:

- Demonstration of real life integration of EO applications for operational water management in 4 pilot countries with cost-benefit analysis
- Creating a Mediterranean expert network on EO applications for water management
- Implementing a first set of a shared Mediterranean EO infrastructure for the water sector that will be available for all the countries
- A capacity building programme opened to all the Mediterranean countries for deploying EO applications in the water sector

It is also expected that this programme will have an impact on the availability of comparable indicators among all the countries and will support the provision of transparent, up to date and easily understandable information for policy makers and the general public.

SWOT analysis

Strengths (internal) <ul style="list-style-type: none">• Strong water management expertise• Available know-how on remote sensing in South Mediterranean countries• Mediterranean framework offered by the joint ESA-EMWIS initiative to combine remote sensing and water management expertise• Lessons learnt from TIGER in Africa	Weaknesses (internal) <ul style="list-style-type: none">• Low level of involvement in international scientific projects• Lack of data sharing and networking at the national level• EO applications based on local projects rather than for operational management at the national level• Lack of awareness of decision makers• Transfer of expertise to future generations
Opportunities (external) <ul style="list-style-type: none">• Availability of free data from the ESA satellites, including the new Sentinels in the frame of GMES (from 2013)• Sharing data with neighbor countries• Sharing expertise• Various policy frameworks supporting water information systems	Threads(external) <ul style="list-style-type: none">• Financial crisis• Interference with security issues• Sharing data with neighbor countries

IMPLEMENTATION ISSUES

Budget and calendar

The first estimated budget is 5 M€ over an implementation period of 3 years for the 1st phase, covering both regional activities at the Mediterranean level as well as pilot applications in 4 countries.

Potential sources of funding

The various sources of funding have already been identified for the foreseen is phase 1 of the regional capacity building program; they are briefly presented in a table in annex.

National resources and sources of funding are also required to assure national ownership and co-funding of project in the partnership approach of the funding programmes identified.

The national resources available for the planned programme includes: human resources, digital maps, water master plans, GIS layers and databases, specialized software. The availability of funds (national or from bilateral agreement with international cooperation agencies) will need to be investigated case by case according to the decision on the pilot applications.

Performance monitoring

Potential indicators for the programme:

- number of projects using EO for water management developed in the countries,
- extent and the performance of such applications (economic gain, population concerned, etc.),
- number of workshops gathering EO specialists and water decision makers,
- number of MoU signed between EO institutions and Water authorities, etc.

Communication / visibility

A communication strategy should be developed to assure visibility. That could be achieved through reinforcing the links at national level between EO institutions and water authorities (decision makers).

SUSTAINABILITY

A full sustainability analysis will be undertaken in the framework of the 1st phase for the preparation of the deployment. At the local level strong link will be established between remote sensing institutes and water authorities to ensure a full ownership and integration of EO applications and services in operational water management based on cost-benefits analysis.

The project will tackle longer term sustainability by reinforcing the science –policy interface and EO curricula in universities and engineering schools in the countries.

At the Mediterranean level, the participation of ESA and EMWIS will ensure that all the services, data and knowledge generated at the Mediterranean will be available as “public goods” for the future. These two organisations will also support the future capacity building activities in the framework of their own activity programmes.

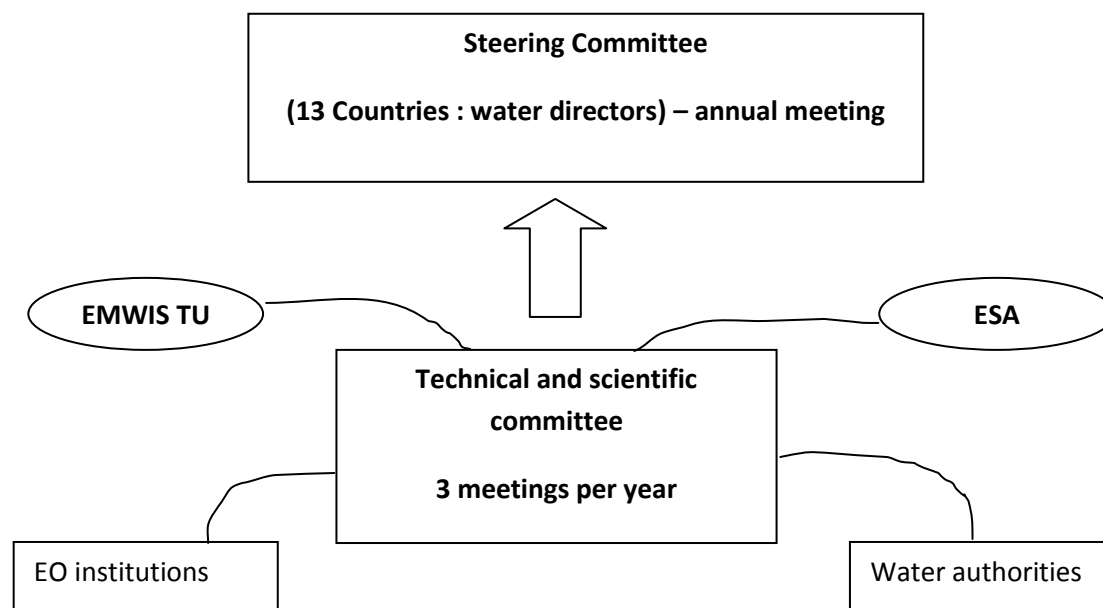
Continuous data availability (thanks to GMES) will also ensure long-term sustainability, as well as joint research projects.

GOVERNANCE

The EMWIS Steering Committee will play the role of an umbrella of this process by providing a platform for progress reviews and deciding on concrete actions. EMWIS Steering Committee is composed by national decision makers’ representatives (water directors) from 13 Mediterranean countries. Currently under Italian Presidency and Lebanese and Moroccan Vice-Presidency, it is made

up of Spain, France, Italy, Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, Turkey, and the Palestinian Authority.

The Technical and scientific committee will gather representatives from water authorities and remote sensing institutes from the four pilot countries (Morocco, Lebanon, Jordan & Egypt) as well as ESA and EMWIS Technical Unit staff members. It will be in charge of the 1st phase implementation and reporting to the Steering Committee. This Committee could be extended for the future deployment phase.



Document history and authors

Version	Author	Date
1 st draft	EM & JeK - EMWIS Technical Unit	2010-10-06
Draft with comments and clarification requests	TD – CNRS LB	2010-10-26
Draft with ESA comments and annex	DF & Francesco Palazzo - ESA	2010-10-28
Draft with Priorities for Lebanon	MF – MWE LB	2010-10-29
Final draft based on comments received	EM & JeK - EMWIS Technical Unit	2010-11-04

ANNEXES

Review of potential funding mechanism

Examples of EO applications for Water Resources Management (separate document)

Review of potential funding mechanism for the regional project Earth Observation for water management in the Mediterranean

Funding source	Geo	Projects funding	Request	Priority	Timing
GEF	World (sustainable MED program): Mediterranean		from a UN agency or WB	Trans-boundary pollution reduction, improving water resources management, and developing biodiversity conservation measures	Any
AWF	Africa	up to 2MEuro	from Ministries	Monitoring and Evaluation of the water sector	Any
SWM-DM	Mediterranean	Up to 1.5 MEuro	Call for proposals	Sustainable water management policies, water scarcity, desertification processes, in connection with climate change.	Expected early 2011
ENPI-CBC Med (standard)	Mediterranean (some countries are not included)	0.5-2 MEuro	call for proposals	Promotion of environmental sustainability at the basin level through the prevention and reduction of risk factors for the environment	December 2010
ENPI-CBC Med (strategic)	Mediterranean (some countries are not included)	2-5 MEuro	call for proposals	Water management with attention on: Quantity and quality of supply, with a focus on alternative water supplies and wastewater re-use and/or Efficient use of water resources, with a focus on agricultural use.	December 2010
EU-FP7	Mediterranean	up to 2MEuro	March 15 th , 2011	Coordination and support action (research)	15 March 2011
Others: SDC, USAID, EIB, WB, GTZ, JICA, AFD, etc)	World, including Mediterranean (regional & national)		Reply to calls or directly		