The HYTECH Project and new opportunities for eco-hydraulics in the Marie Skłodowska-Curie Actions within Horizon 2020

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THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION

EUROPEAN COMMISSION

HORIZON 2020

INNOVATION UNION

HORIZON 2020 WORK PROGRAMME

Three Priorities

Excellence Science

- **European Research Council**
  Frontier research by the best individual teams (ERA)
- **Future and Emerging Technologies**
  Collaborative research to open new fields of innovation
- **Marie Sklodowska Curie Actions**
  Opportunities for training and carrer development
- **Research Infrastructures (Including e-infrastructure)**
  Ensuring access to world-class facilities

Competitive Industries

Leadership in enabling and industrial technologies

- ICT
- Nanotechnologies materials, biotechnologies, manifacturing
- Space

- **Access to risk finance**
  Leveraging private finance and venture capital for research and innovation
- **Innovation in SMEs**
  Fostering all forms of innovationin all types of SMEs

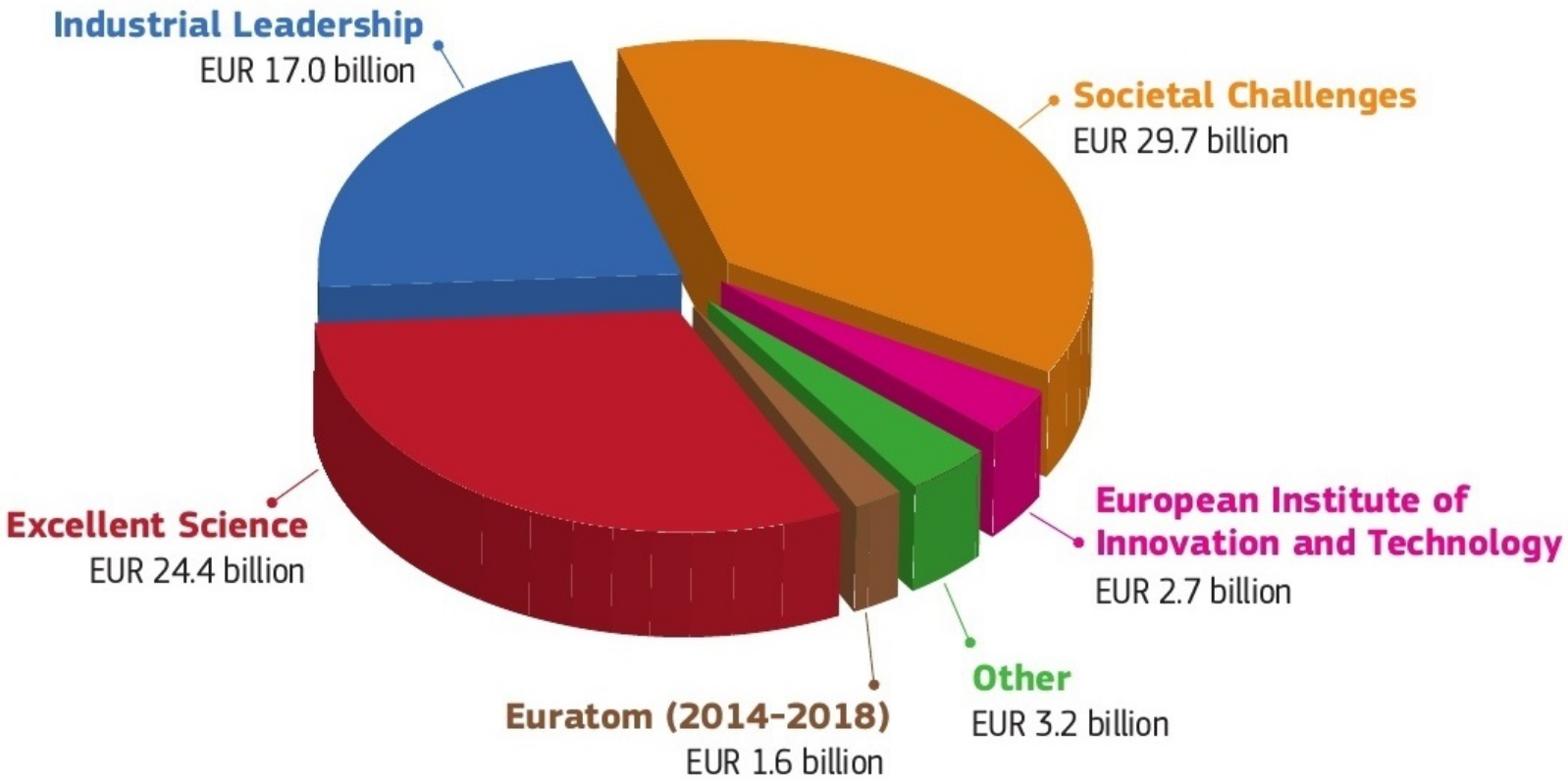
Societal Challange

- Health, demographic change and wellbeing
- Food security, sustainable agriculture, marine and maritime research, and the bio-economy
- Secure, clean and efficient energy
- Smart, green and integrated transport
- Climate action, resource efficiency and raw materials
- Europe in a changing world – inclusive, innovative, reflective societies
- Secure Societies

Complementary Work Programmes

- European Institute of Innovation and Technologies (EIT)
- Spreading Excellence and Widening Participation
- Science with and for society
- Joint Research Center (JRC)
- Euratom

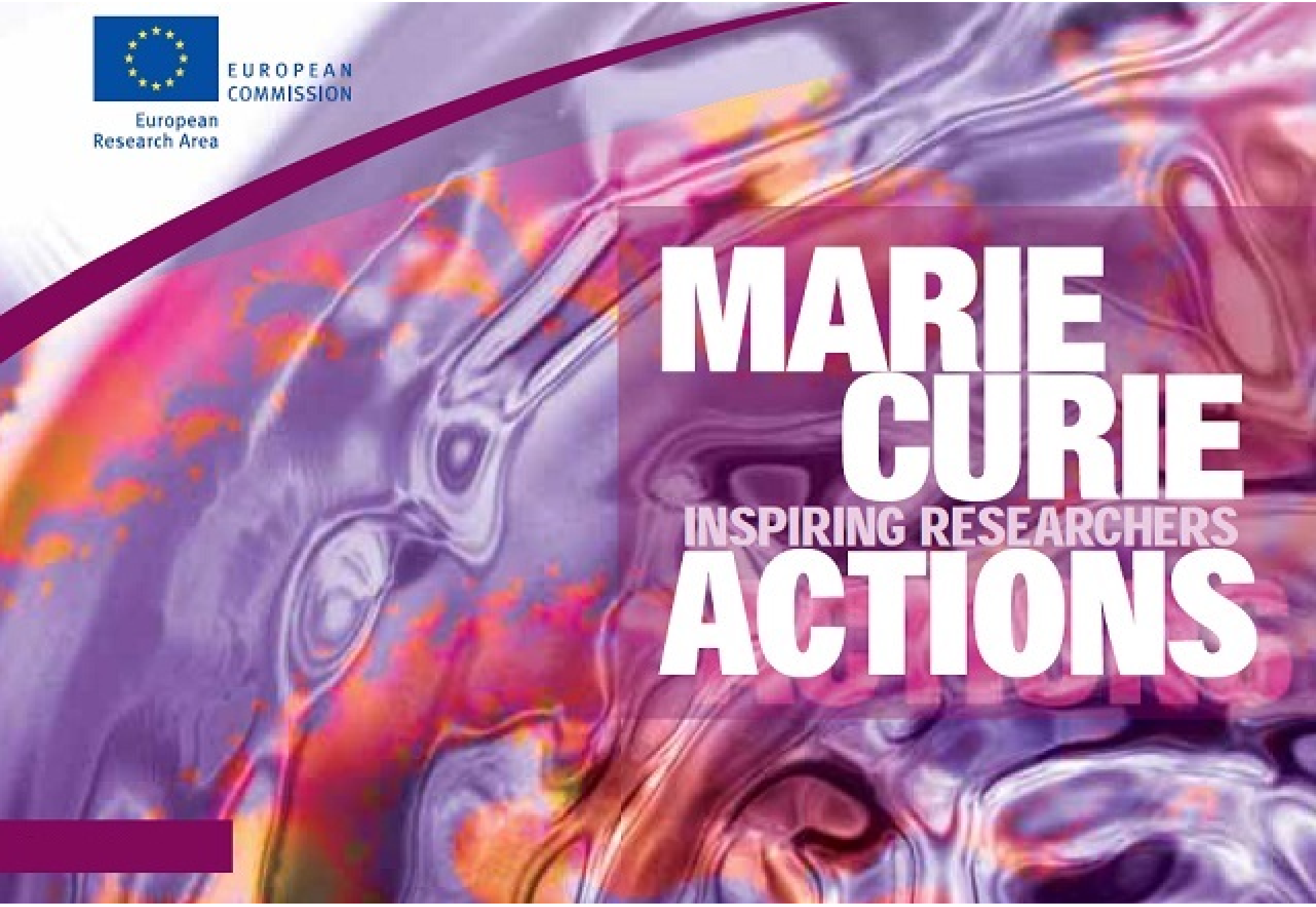
HORIZON 2020 BUDGET (€ 78.2 billion)



Marie Skłodowska-Curie Actions	**€ 6.162.000.000**

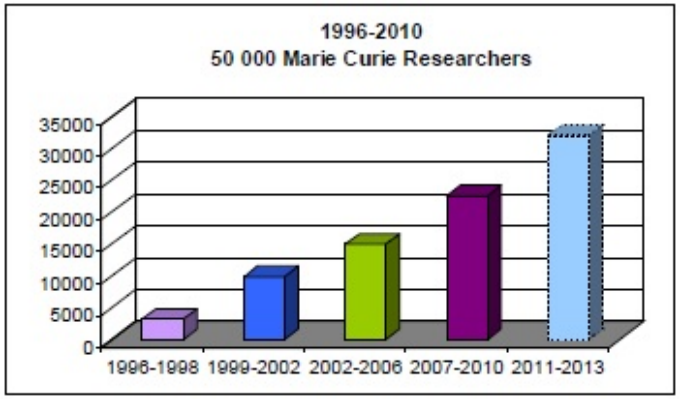
HORIZON 2020 BUDGET (€ 78.2 billion)

I. Excellent Science:	**31.73 %**
1. European Research Council	17.00
2. Future and Emerging Technologies	3.50
3. Marie Curie actions	8.00
4. Research infrastructures	3.23
II. Industrial Leadership:	**22.09 %**
1. Leadership in enabling and industrial technologies	17.60
2. Access to risk finance	3.69
3. Innovative small and medium-size enterprises	0.80
III. Societal Challenges:	**38.53 %**
1. Health, demographic change and wellbeing	9.70
2. Food quality and marine research	5.00
3. Energy	7.70
4. Transport	8.23
5. Climate action, resources and raw materials	4.00
6. Inclusive societies	1.70
7. Secure societies	2.20
Spreading excellence and widening participation	**1.06 %**
Science with and for society	**0.60 %**
European Institute of Innovation and Technology (EIT)	**3.52 %**
Joint Research Centre: non-nuclear direct actions	**2.47 %**
Total	**100 %**

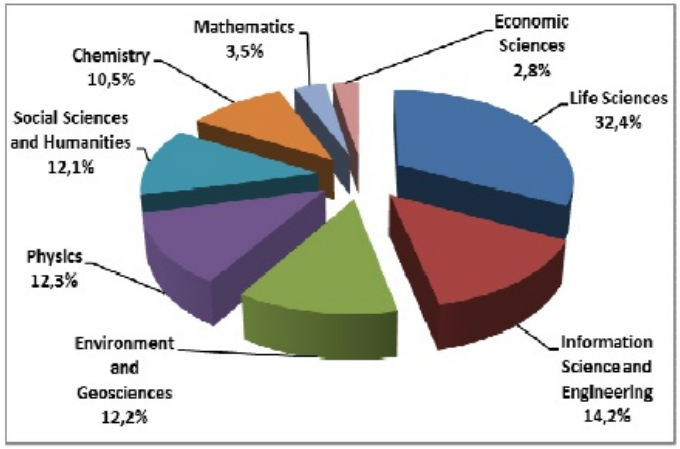

EUROPEAN
COMMISSION
European
Research Area
MARIE
CURIE
INSPIRING RESEARCHERS
ACTIONS

MARIE SKŁODOWSKA-CURIE ACTIONS

FROM FP3 TO HORIZON 2020



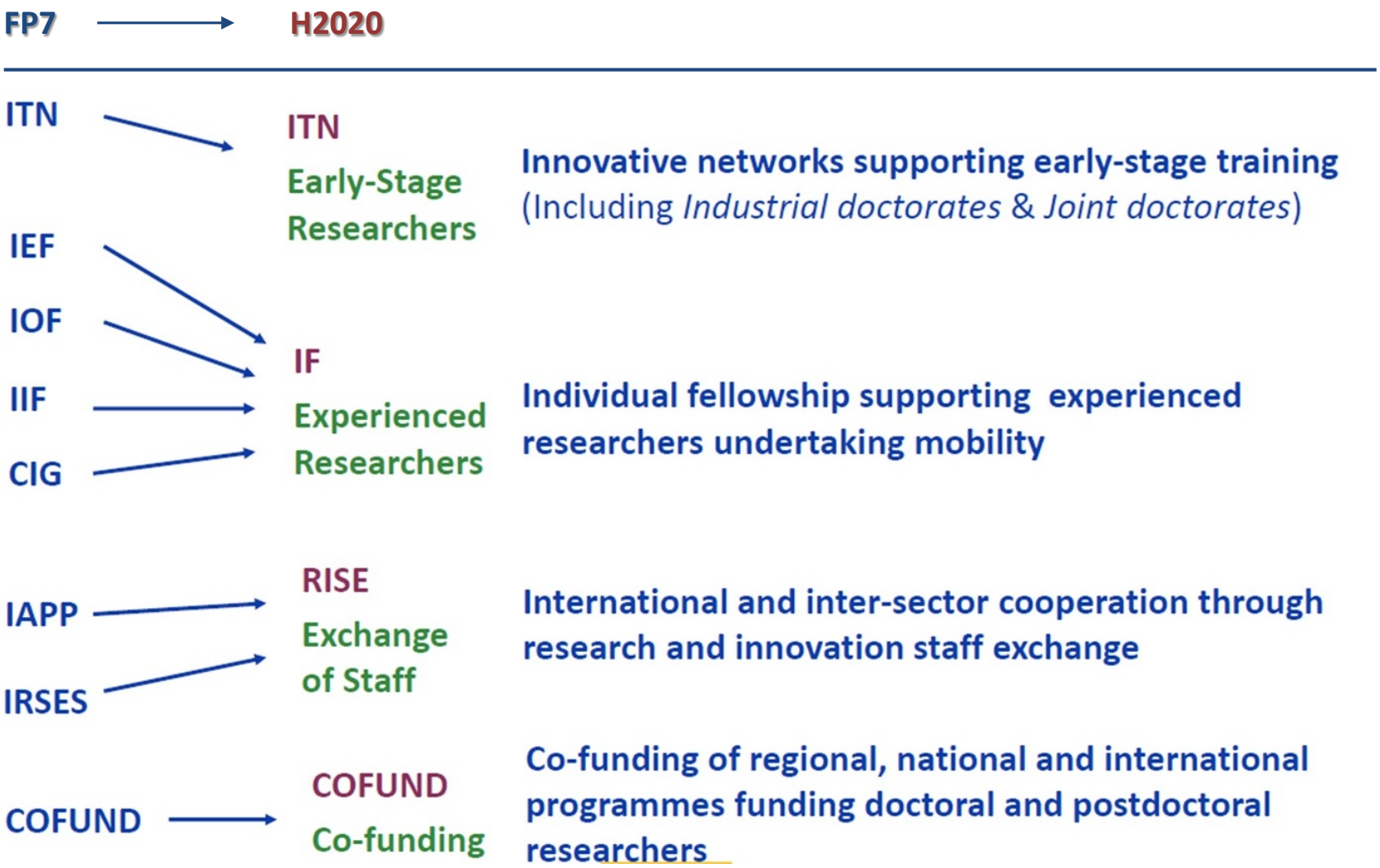
Marie Curie Researchers from 1996 to 2010



Budget distribution by scientific panel in FP7

- EU fellowship programmes since **1990** (FP3)
- Marie Curie label since **1996**
- 80.000 **researchers** financed since creation of MCA
- 10.000 **PhD** supported in FP7
- 9.200 **projects funded** in FP7 (€4,2 billion)
- 17.800 participations of **host organizations** in 83 countries
- Researchers from **all over the world**: 130 nationalities
- **SMEs** play a major role (>50% of all businesses)
- 38% **women** participation in FP7 MCA (target: 40%)

MARIE SKŁODOWSKA-CURIE ACTIONS



MARIE SKŁODOWSKA-CURIE ACTIONS: FOCUS ON ITN

KEY FEATURES:

- Joint research training and/or doctoral programmes
- Partnerships of academic and non-academic sectors
- Different countries across Europe and beyond
- Duration: 48 months

PARTICIPANTS:

- **Beneficiaries:** signatory to the agreement
- **Partner organisations:** non-beneficiary organisations providing training and hosting researchers
- **Academic sector:** public/private higher education; non-profit research organisations
- **Non-academic sector:** any socio-economic actor not included in the academic sector

RESEARCHERS:

- **ESRs:** no PhD awarded + less than 4 years research experience
- **Equivalent research experience:** from the date of the degree entitling the ESR to embark on a PhD
- **Mobility:** NOT in the Country of the host organisation for more than 12 months in the last 3 years

MARIE SKŁODOWSKA-CURIE ACTIONS: FOCUS ON ITN

NETWORK ACTIVITIES:

- Training through individual research projects
- Network-wide training activities (e.g. workshops, summer schools)
- Provision of structured training courses (e.g. tutoring, lecture courses)
- Networking component: intersectoral visits and secondments (up to 30% of time)
- Visiting researchers from academic or non-academic sector

COMPLEMENTARY ACTIVITIES:

- Transferable skills training (entrepreneurship, management, communication, standardisation, management of IPR, ethics, scientific writing, exploitation of research results, personal development, team skills, multicultural awareness, research integrity)
- Involvement of ESRs in the organisation of network activities (proposal writing, enterprise start-up, task co-ordination)



Marie Curie
Initial Training Network

HYTECH Aquatic Interfaces

HYTECH Coordinator
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Website: hytech.dii.unipd.it

Coordinator

Universities

- University of Aberdeen
- Technische Universität Braunschweig
- Politecnico di Milano
- The University Of Sheffield.
- Queen Mary University of London
- NTNU Norwegian University of Science and Technology

Research Centers

- cnrs National Centre for Scientific Research
- NIOZ Royal Netherlands Institute for Sea Research
- IGB Leibnitz Institute for fresh-water Ecology and Inland Fisheries
- CEH Centre for Ecology & Hydrology, Natural Environment Research Council

Non Academic Partners

- GHT Giotto High Technology
- gerstgraser Ingenieurbüro für Renaturierung
- WET Water & Environmental Technologies Engineering
- SGI life, first STUDIO GALLI INGEGNERIA
- SELC biologia e geologia applicate
- Local Government of the Umbria Region


Trondheim
Aberdeen
Endinburgh
Sheffield
London
Yerseke
Braunschweig
Berlin
Cottbus
Lyon
Venice
Milan
Castelfranco V.
Padua
Perugia

Coordinator

Andrea Marion
Padua Italy

Academic Partners

Vladimir Nikora
Aberdeen UK

Katinka Koll
Braunschweig Germany

Francesco Ballio
Milan Italy

Simon Tait
Sheffield UK

Research Centers

Tjeerd Bouma
NIOZ, Yerseke Netherlands

Sara Puijalon
CNRS, Lyon France

Private Sector

Carlo Someda
GHT, Padua, Italy

Christoph Gerstgraser
gIR, Cottbus Germany

Mattia Zaramella
WET Castelfranco V. Italy

Experts

Bernhard Statzer
Former Director at LEHNA, France

Heidi Nepf
Massachusetts Institute of Technology, USA

Gary Parker
University of Illinois, USA

Peter Davies
University of Dundee, UK

Associated Partners

Geraldene Wharton
QMUL
UK

Alexander Sukhodolov
IGB, Berlin
Germany

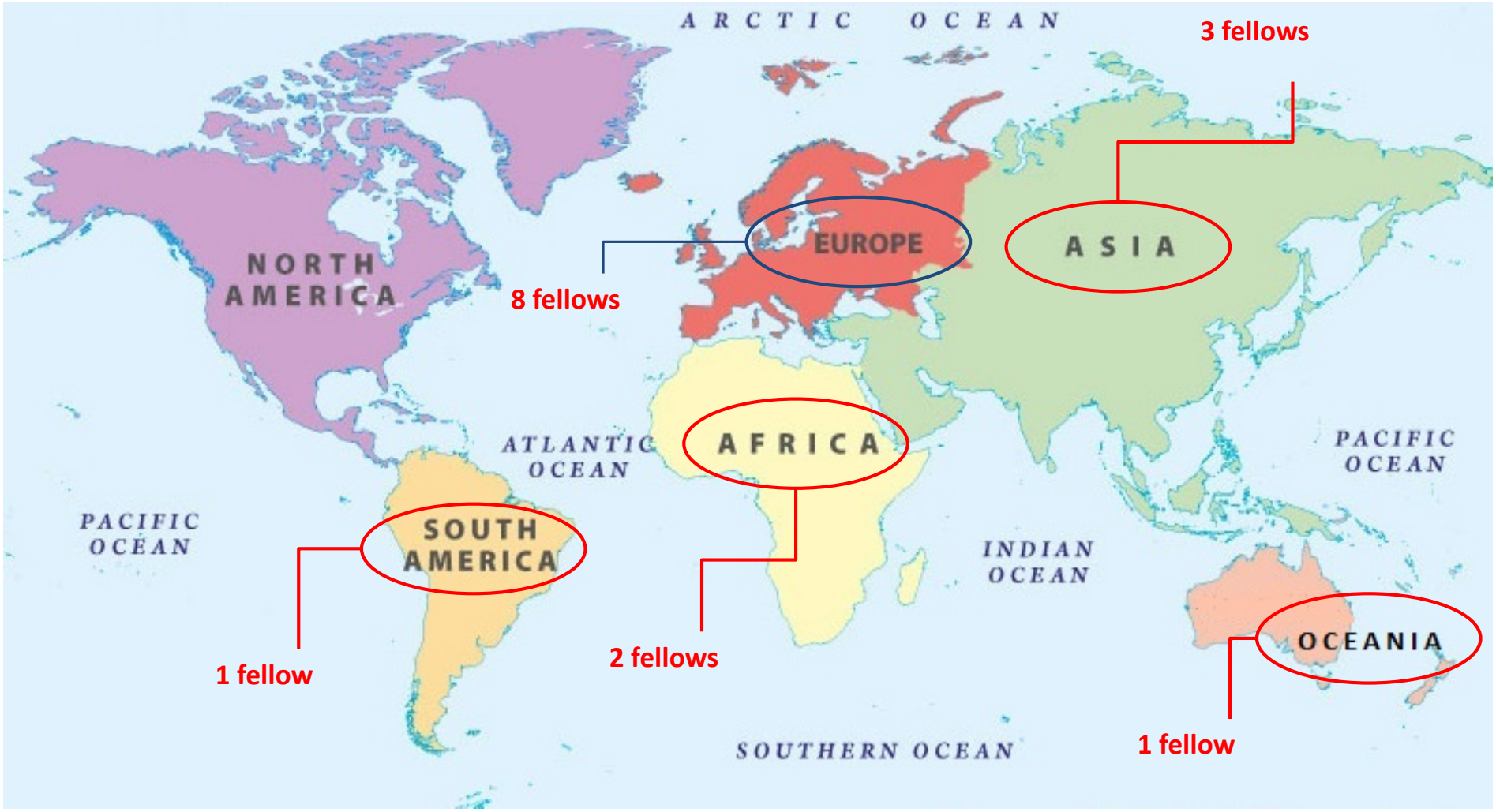
Matthew O'Hare
CEH, Edinburgh
UK

Andrea Rismondo
SELC, Venice, Italy

Alberto Galli
SGI, Padua, Italy

Nicola Berni
Umbria Region, Italy

Aberle Jochen
NTNU, Trondheim
Norway


ARCTIC OCEAN
3 fellows
NORTH AMERICA
EUROPE
8 fellows
ASIA
ATLANTIC OCEAN
AFRICA
PACIFIC OCEAN
PACIFIC OCEAN
SOUTH AMERICA
INDIAN OCEAN
OCEANIA
1 fellow
2 fellows
SOUTHERN OCEAN
1 fellow

RECRUITMENT (Early Stage Researchers)

ESR01
Constantinos
Papadopoulos
UNIABDN

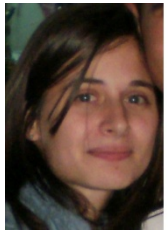
ESR05
Nima
Sabokrouhiyeh
UNIPD

ESR09
Bahaeldeen
Zaid
TUBS

ESR02
Paride
Nardone
TUBS

ESR06
Hamish
Biggs
UNIABDN

ESR10
Ehsan
Kazemi
USFD



ESR03
Sofia
Licci
CNRS

ESR07
Jevgenijs
Savickis
WET

ESR11
Martina
Cecchetto
USFD

ESR04
Loreta
Cornacchia
NIOZ

ESR08
Abbas
Hosseini
POLIMI

RECRUITMENT (Experienced Researchers)

ER01
Rui
Aleixo
GHT

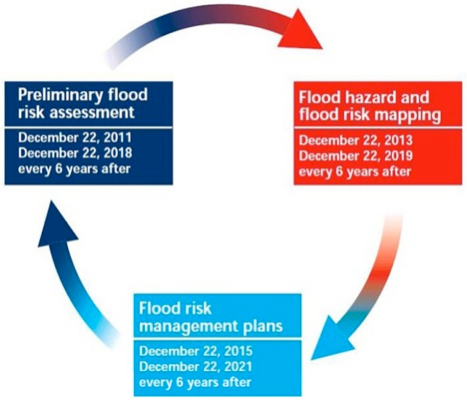
ER02
Mohammed
Abdallah
GHT

ER03
Michael
Nones
gIR

ER04
Irene
Seco
UNIPD

Water Framework Directive 2000

EU Floods Directive 2007



IPCC Report 2007

GWSD 2013

2013 Chengdu Forum of International Water Organizations

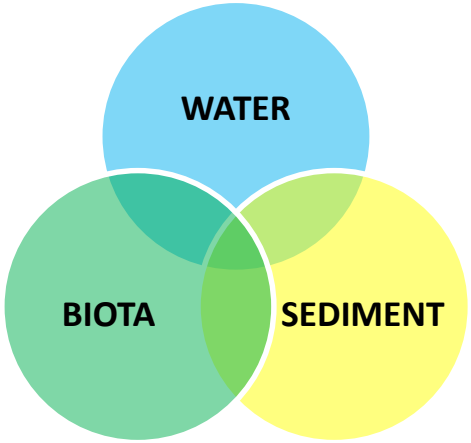
Global Water Security Declaration

Approved on the 9th of September 2013 in Chengdu, China.
Signed on the occasion of the 35th IAHR World Congress by:

International Association for Hydro-Environment Engineering and Research (IAHR)
International Commission on Large Dams (ICOLD)
International Commission on Irrigation and Drainage (ICID)
World Association for Sedimentation and Erosion Research (WASER)
World Council of Civil Engineers (WCCE)
International Water Resources Association (IWRA)
International Association of Hydrological Sciences (IAHS)
United Nations Secretary General's Advisory Board on Water and Sanitation (UNSGAB)

In the presence of UNESCO's Natural Sciences Sector

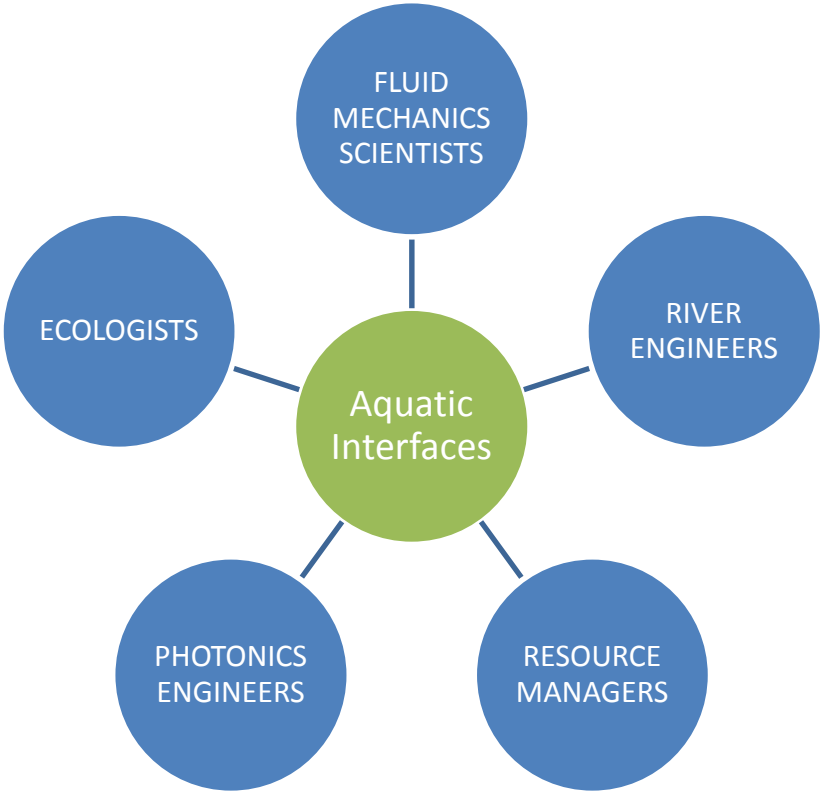
HYTECH
Aquatic Interfaces



"Interfaces are fairly narrow regions between two or more substances or between flow layers with distinctly different dynamics"

HYTECH Forum Paper, JHR,2014

Discipline interfaces

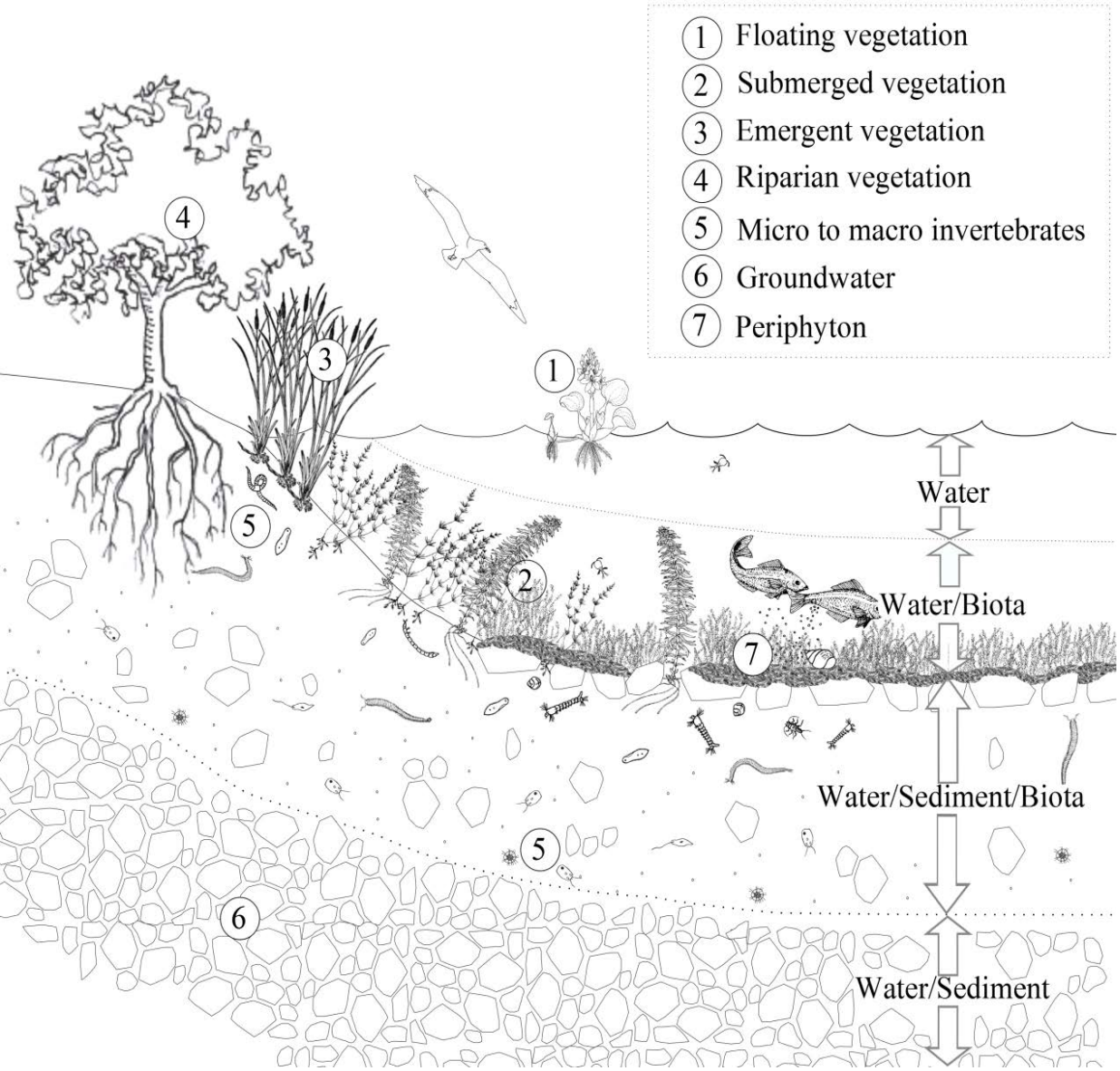


"A broader incorporation of fluid dynamics into studies of ecosystems will advance ecological theory faster than past or current research routes"
Statzner, 1994

Intersectoral needs

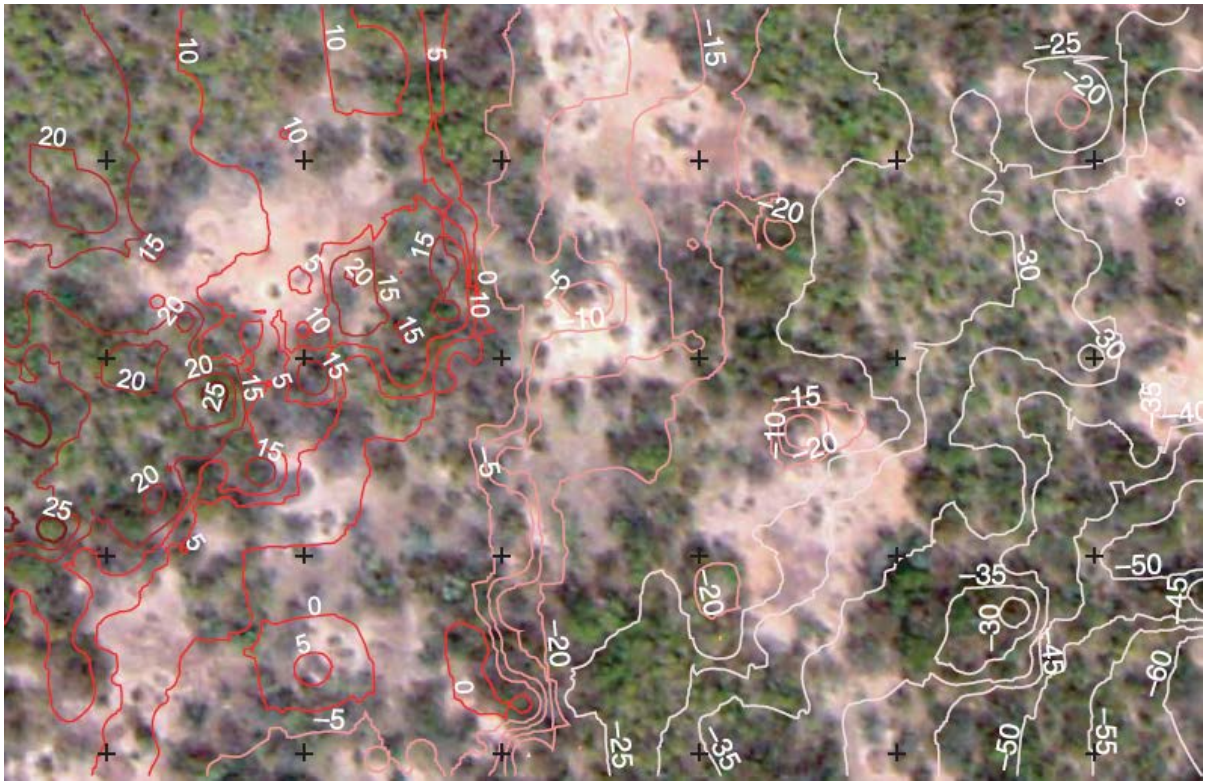
- Understand bio-physical processes at interfaces in aquatic environments
- Understand how aquatic life adapt and develop in riverine ecosystems
- Assess vulnerability of aquatic systems and plan effective countermeasures
- Define sustainable management strategies of surface water bodies
- Provide protocols to restore man-impacted river environments
- Implement advanced technologies for survey and monitoring
- Develop optimal design criteria to safeguard the whole ecosystems

ACADEMY AND RESEARCH CENTERS
ENVIRONMENTAL AGENCIES
CONSULTANCY AND INDUSTRY
REGULATORY AUTHORITIES



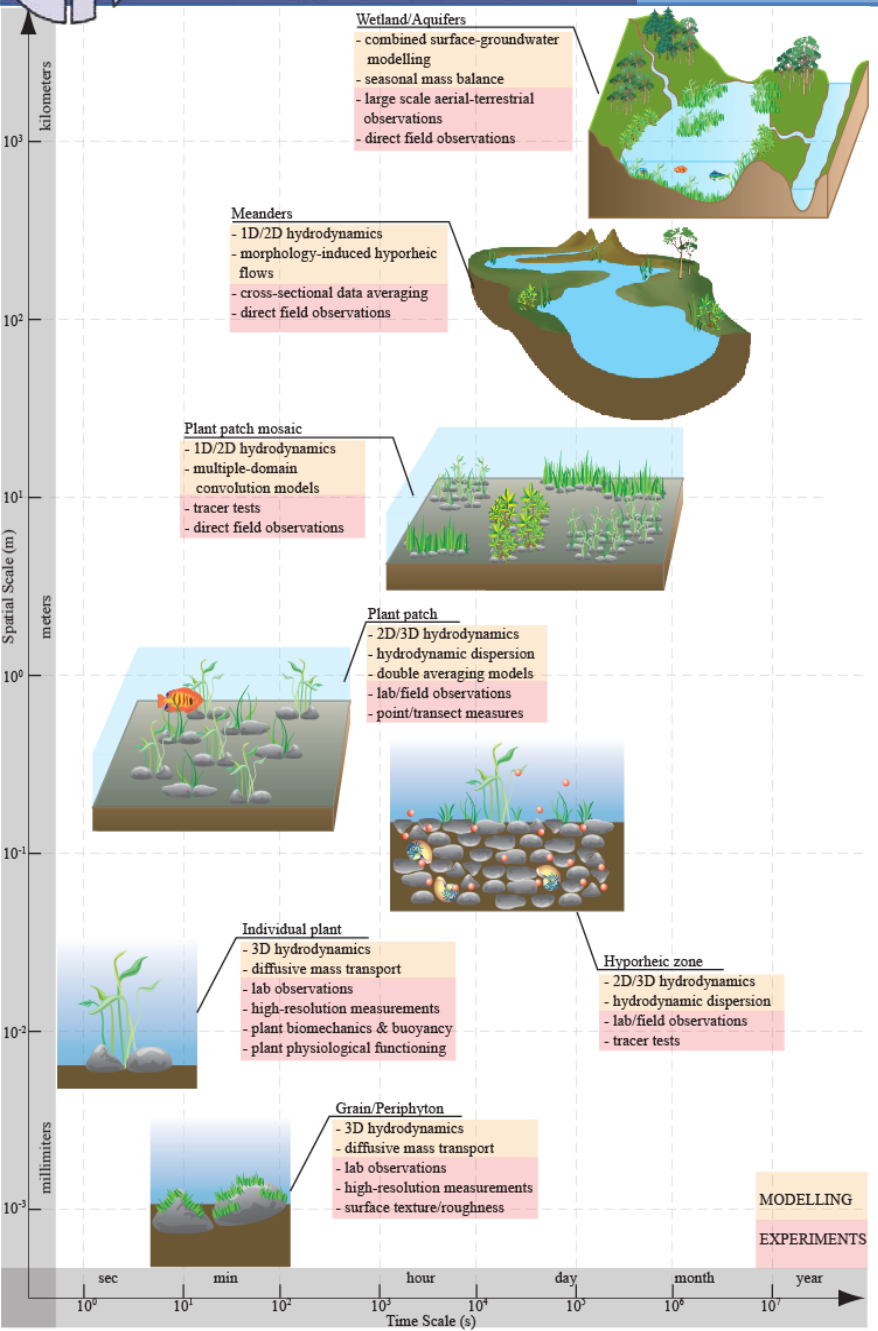
interfaces

- fairly narrow regions between two or more substances (phases) or between flow layers.
- sites of steep gradients or maximum values of important physical and biochemical quantities (e.g., fluid velocity, turbulence intensity, viscous or turbulent stresses, concentration of substances, temperature, light, ...).



heterogeneities

- main distinctive attribute differentiating natural environments from constructed ones.
- water-sediment-biota interface regions are characterized by spatial heterogeneities in relation to transported matter, local bed sediment morphologies, flow patterns, and species composition.



spatial and temporal scales

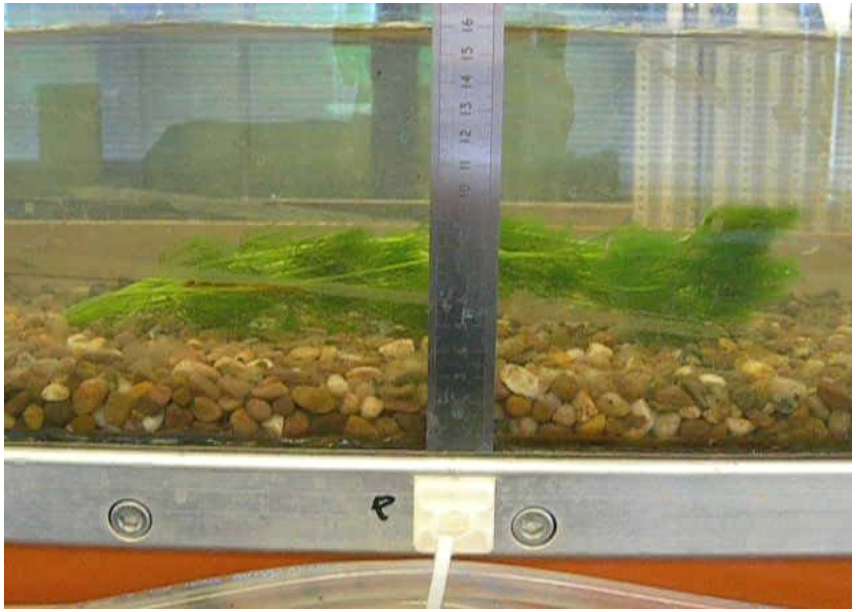
micro-scale: inorganic, microbial, vegetation and/or animal structures such as sediment grains and clusters, biofilms, periphyton patches, and smaller invertebrates.

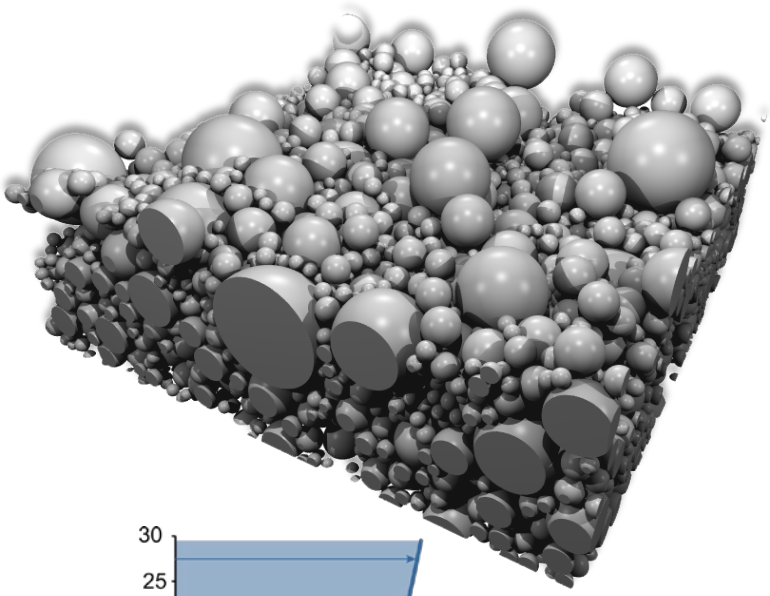
intermediate (meso) scale: sediment bedforms (e.g., ripples), patches of submerged and emergent plants, mussel aggregations, salmon redds, and upper layers of hyporheic zones.

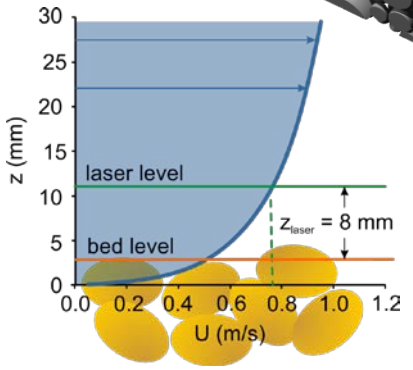
large (macro) scale: large bedforms (e.g., alternate bars), large woody debris, vegetation patch mosaics, and deep layers of hyporheic zones.

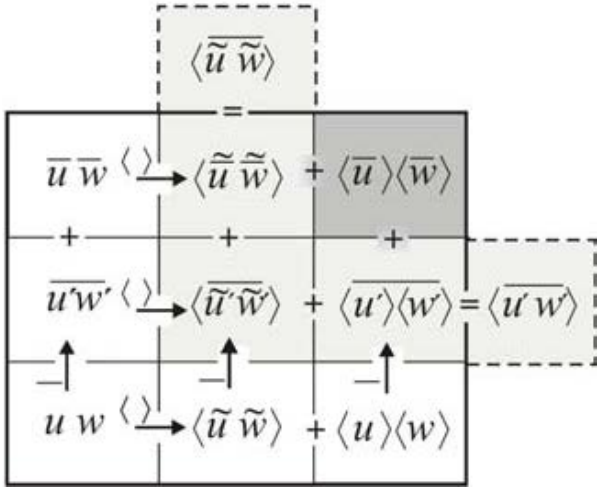
observation / modelling of fundamental processes

- Identification of elementary scale of organisms and grains
- Execution of experiments in controlled conditions
- Models of idealized sytems









model upscaling of fundamental laws

- averaging methods, in time, space, both time and space (double averaging, multiple averaging)
- identification of physical interpretation of new terms generated from averaging non-linear terms
- closure models for non-linear averaged terms

model upscaling of fundamental processes

- multi-domain models of biota mosaic and sediment morphological features
- sub-grid models to the scale of elementary elements
- probabilistic/stochastic methods (e.g. random field generators, multiple convolution integration)

biomechanical and morphological properties of biota

- volume and area biota/fluid ratios at different configurations
- stem and leaf buoyancy and stress distribution
- flexibility and reconfiguration for drag reduction

organism traits

- evolutionary history imposing compromising solutions to multiple physical constraints
- crucial in securing organism capacities to survive in harsh conditions (adaptation)
- 'ecosystem engineering' by organisms that can change physical and biogeochemical processes occurring at interfaces, with possible cascading effects for the whole ecosystem

extreme events and ecosystem dynamics

- intense sediment movement
- alteration of river ecosystems
- transition to new ecological state or reestablishments of previous state
- extreme events dictating natural ecosystem life spans

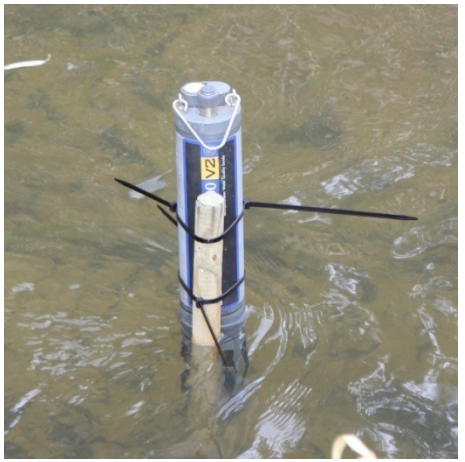
WP1. Environmental assessment, river vulnerability and renaturalization

- ESR05 (Nima): optimal design of constructed river environments and wetlands
- ESR07 (Jevgenijs): assessment of vulnerability of streams and wetlands
- ESR09 (Bahaeldeen): optimal design of nature-oriented structures in rivers
- ER03 (Michael): management plan for a selected river-basin case-study


Ca'-di-Mezzo Wetland

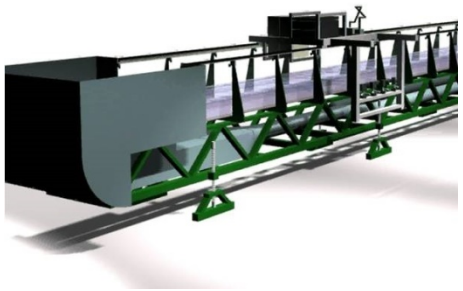

Nature-oriented structures


Spree River: restoration project

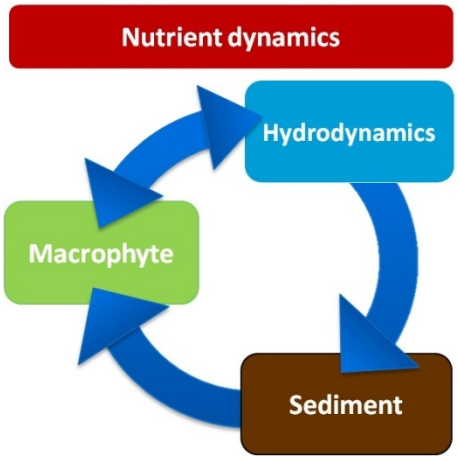

Experiment on river vulnerability

WP2. Flow/biota interactions. interface biological and ecological structures

- ESR06 (Hamish): direct observations on flow-organisms interactions
- ESR01 (Costantinos) : coupling hydrodynamics and biological processes
- ESR03 (Sofia): direct observations on how organic matter alter riverine ecosystems
- ER04 (Irene): dynamics of organic/inorganic matter in riverine ecosystems

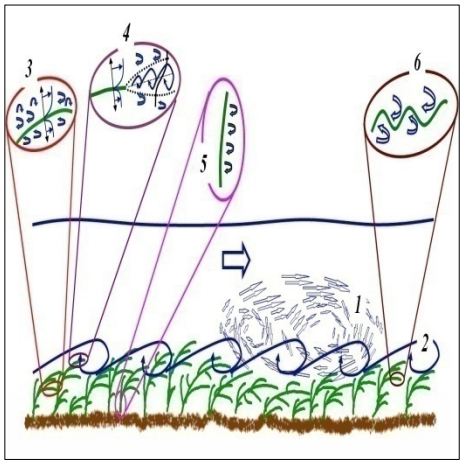


Aberdeen Open Channel Facility (AOCF)



Feedback loop

Macrophyte patch

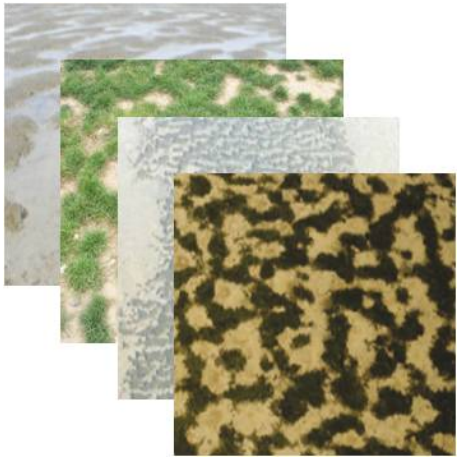


Flow-biota interactions

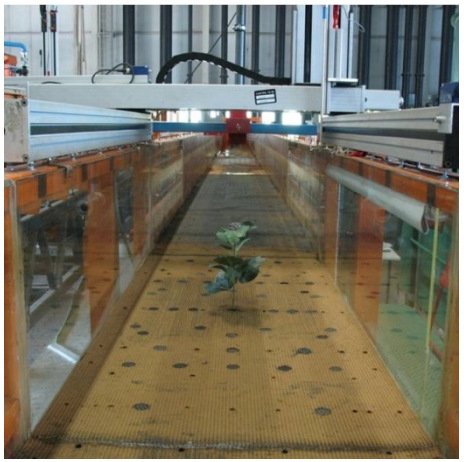
WP3. Applied hydrodynamics of vegetated streams

- ESR02 (Paride): flow resistance in vegetated streams
- ESR04 (Loreta): direct observations on how plants self-organize in riverine ecosystems
- ER01 (Rui): optical sensors for monitoring riverine environments

Vegetated stream



Self-organization



Experiment on flow resistance

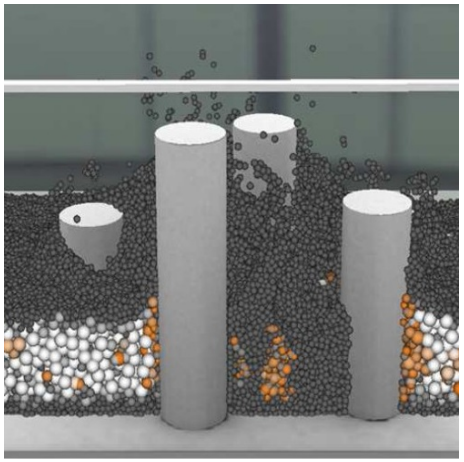
Field campaign

WP4. Interface transport of dissolved, suspended and granular matter

- ESR08 (Abbas): advanced experimental techniques to observe sediment transport
- ESR10 (Ehsan): new equations to model fine-sediment transport
- ESR11 (Martina): procedure for end users to estimate coarse-sediment transport in rivers
- ER02 (Mohammed): prototype for sediment measurement in rivers


Gravel-bed river


Tracer tests


SPH-based methods


Sediment bed monitoring

Aquatic Interfaces: A Hydrodynamic and Ecological Perspective

Ecologically-appropriate management of natural and constructed surface water bodies has become increasingly important given the growing anthropogenic pressures (…) This forum paper discusses the current state of affairs in this field and highlights potential paths to resolve critical issues (...) The aim is to attract the attention of experienced and emerging researchers.
(from abstract)

- Co-authored by all academic partner leaders and by all experts

- 6 (main) sections:
  - Conceptual issues of eco-hydraulics
  - Interface hydrodynamics
  - Ecological role of interfaces
  - Water-sediment interfaces
  - Water-biota interfaces
  - Wetlands

- Experts from CMELA started developing the documentary form January 2013
- First part of the filming activity focused on Summer Schools
- Second part of the filming campaign focuses on laboratory and field experiments
- Contents of the documentary will see:
  - Fellows' personal and professional growth
  - Scientific contents of the research
  - Experts explaining key concepts
- Released on end of project December 2016

cmela
CENTRO MULTIMEDIALE
E-LEARNING DI ATENEO





HYTECH Final Conference

- Padua, Milan ?
- Three days
- November 2016 (Nov. 23-25 ?)
- International keynoters
- Release of HYTECH film
- Orientation for perspective MSC fellows
- No conference fee
- Italian cousine

Enjoy the school!