OZCAR: the French network of Critical Zone Observatories: principles and scientific objectives

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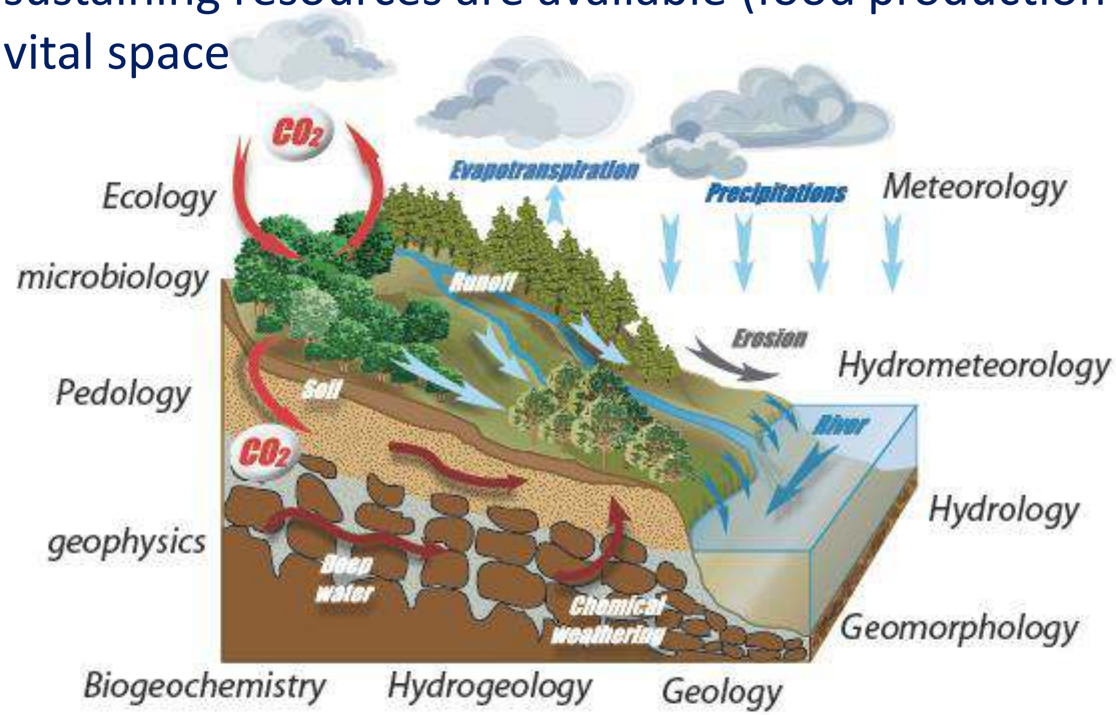
Our definition of the Critical Zone…

- Earth's thin outer skin, from the top of the boundary layer to the non-weathered bedrock
- A critical interface where rock, soil, water, air, and living organisms interact and use both solar and deep terrestrial energy.
- A crossroads of disciplines
- A Critical zone for humankind as being our natural habitat and where life-sustaining resources are available (food production and water quality): our vital space



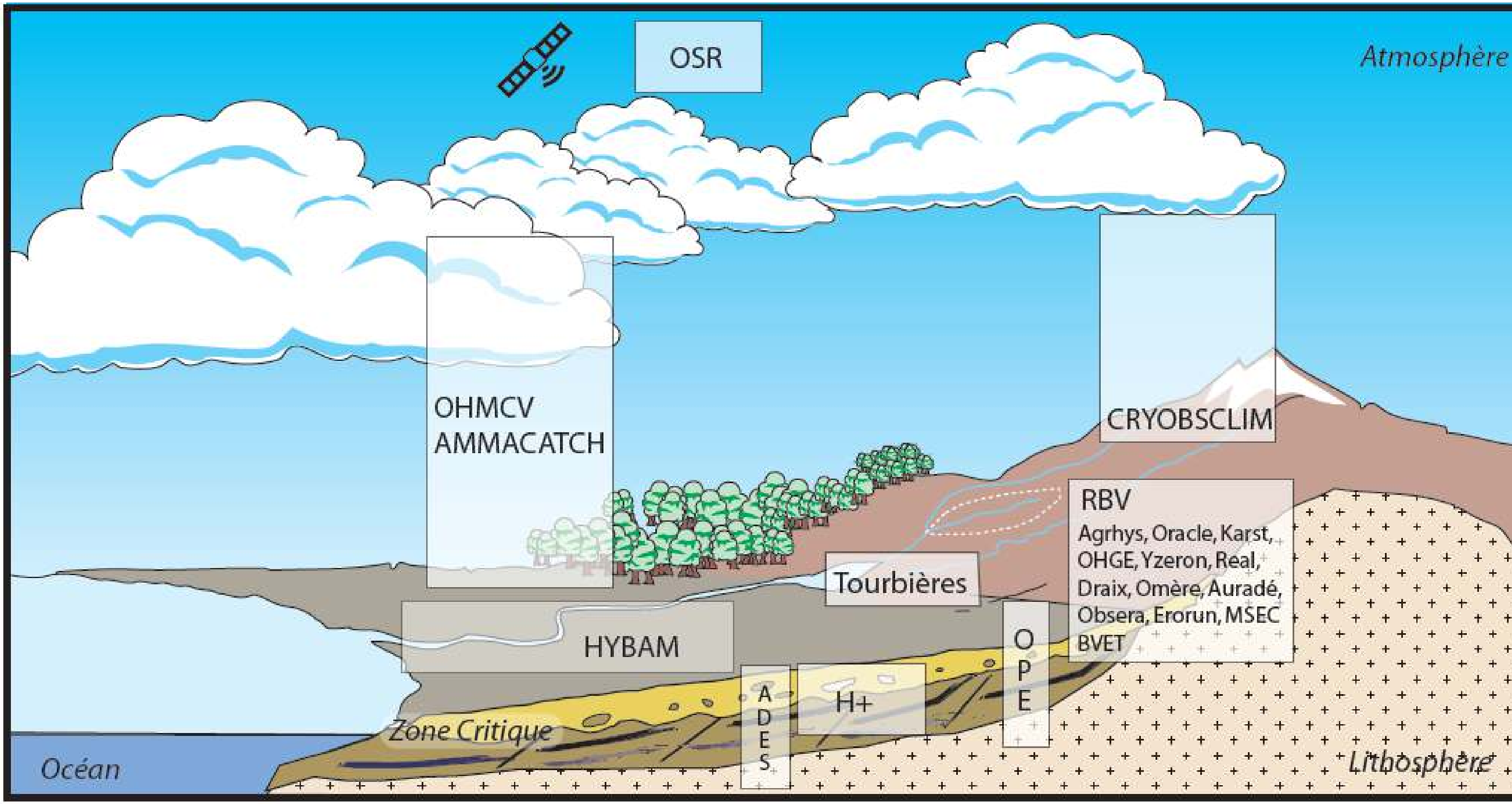
National Research Council, USA 2001

OZCAR, a Research Infrastructure gathering existing networks created in 2016

- With a common interest in the Critical Zone
- A common general question: how to monitor, describe and simulate the Critical Zone adaptation to a changing planet (climate change, land use changes, changes in practices)
- Computation of budgets, fluxes
- Highly instrumented sites and long term observation history

OZCAR a large variety of observations

- RBV: Catchment hydrology network: water, energy, sediment and matter transport, geochemistry monitoring to derive fluxes and storages
- H+: Hydrogeological formations, fractured bedrock, reactive transport in heterogeneous groundwater
- CRYOBS-CLIM: glaciers, snow and permafrost processes
- OPE: Environmental monitoring of a rural area impacted by a geological nuclear waste repository project
- Tourbières: Carbon budget and biodiversity of peatlands
- OSR: water, energy, GHG fluxes/budgets in agricultural land with a focus on the use of high resolution remote sensing
- ROSES-ades: the French network of piezometers to follow the status of groundwater
- CRITEX: innovative sensors for the Critical Zone



Various Earth compartments sampled by OZCAR observatories at various scales

Observatories

34 sites in France :
Métropole + DOM-TOM

- Piezometers

Observatories in tropical and cold climates

RÉSEAU DES BASSINS VERSANTS

Examples of measured parameters

n°	ATMOSPHERE	n°	RIVER
1	Rainfall amount	10	Discharge
2	Air temperature	11	Electrical conductivity
3	Wind velocity	12	Water temperature
4	Wind direction	13	Turbidity
5	Air pressure	14	Suspended sediment concentration
6	Humidity	15	Chemical composition of water
7	Radiation	16	Isotopic composition of water O and H
8	Chemical composition of rain		
9	Isotopic composition of rain O and H		

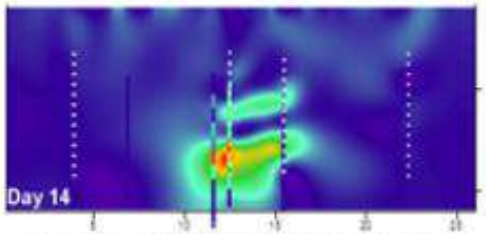
n°	GROUNDWATER	n°	SURFACES
17	Soil moisture content	23	land use/land cover
18	Groundwater level	24	Chemical composition of agricultural inputs
19	Electrical conductivity of groundwater		
20	Temperature of groundwater		
21	Chemical composition of groundwater		
22	Isotopic composition of groundwater O and H		

RBV catchment hydrology network

=> Agreement on a set of 21 parameters that should be monitored to document water, energy and sediment/matter fluxes and storages

Examples of measured parameters

Experimental innovations
new sensors, tracers and hydrogeophysical methods

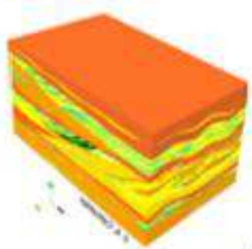


Example: time lapse imaging of transport

Highly instrumented sites
in situ validation in experimental observatories

Assimilation into models
for water resources and energy applications


Fracture network


Sedimentary patterns

H+ hydrogeological network to document

- the structure of hydrogeological formations
- processes and their characteristic response times (hot-moments)

=> Combination of permanent monitoring and dedicated experiments

Examples of measured parameters

CRYOBS CLIM

CRYOBS-CLIM

- Mass, water, glaciers, vapor fluxes between the surface and the atmosphere, and the subsurface
- Radiative and turbulent fluxes
- Internal variables (temperature, density, conductivity)
- Dynamic of glaciers

Sentinels of climate change

OSR SUD-OUEST

SNO Tourbières

Ope

ICOS

Tourbières, OSR and OPE = ICOS sites (Green House gas measurements)

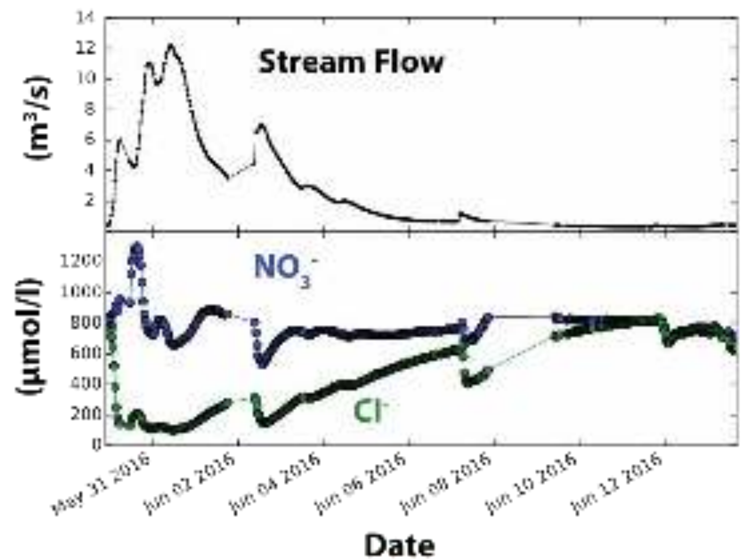
- Peatland: interactions hydrology – organic matter- vegetation for carbon budgets (gaseous, dissolved, particulate)
- OSR: focus on agro-systems and the assimilation of high resolution remote sensing data in crop functioning models (biomass, GHG, water, etc..

High Frequency records in the Critical Zone

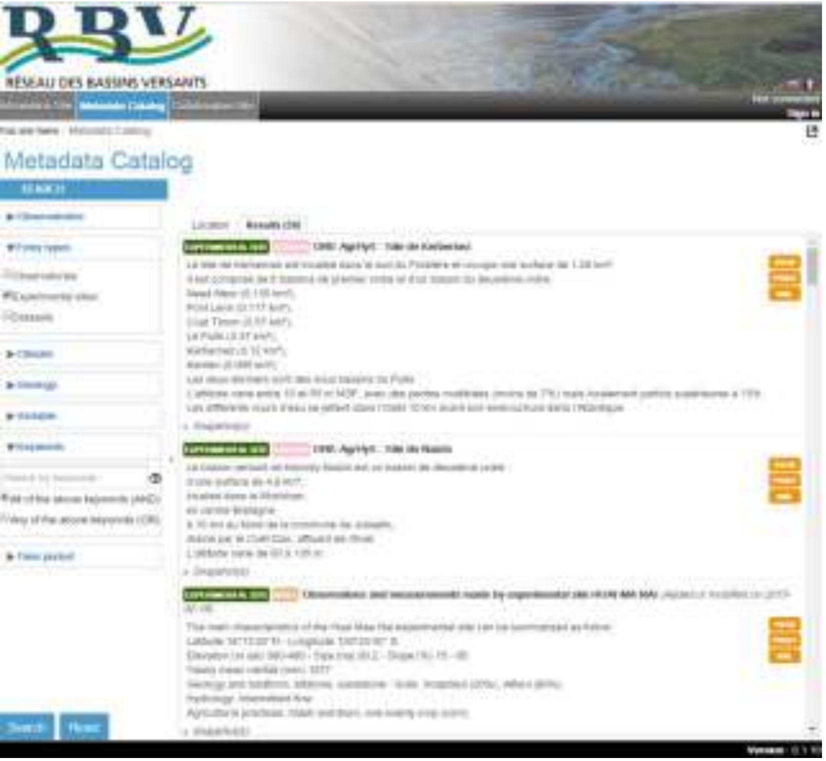
Exceptionnal flood event of June 2016

The river lab.

- High frequency river chemistry at the catchment outlet (30 min) (Floury et al., in review)
- A measure every 30 min shows important day-night variations of river chemistry and provides data at the same time resolution as the river flow



Current status: several metadata and data portals



Heterogeneity in

- the definition of a data set
- the vocabulary used to describe the data
- the formats and level of provided data (raw, corrected, elaborated)

Towards OZCAR Research Infrastructure

Diversity and heterogeneity

- Heterogeneity in focus due to different initial scientific questions, measured parameters, scales of interest, data bases
- But some convergence already performed through the building of networks of observatories (RBV, H+, CRYOBS-CLIM, etc..)

⇒ Work on the complementarity and synergy between the approaches rather than try to go towards full homogeneity

⇒ Develop transversal topics that can enhance collaboration between sites/topics and coupling between processes

⇒ Make the best of pluri-disciplinary approaches

But some common features

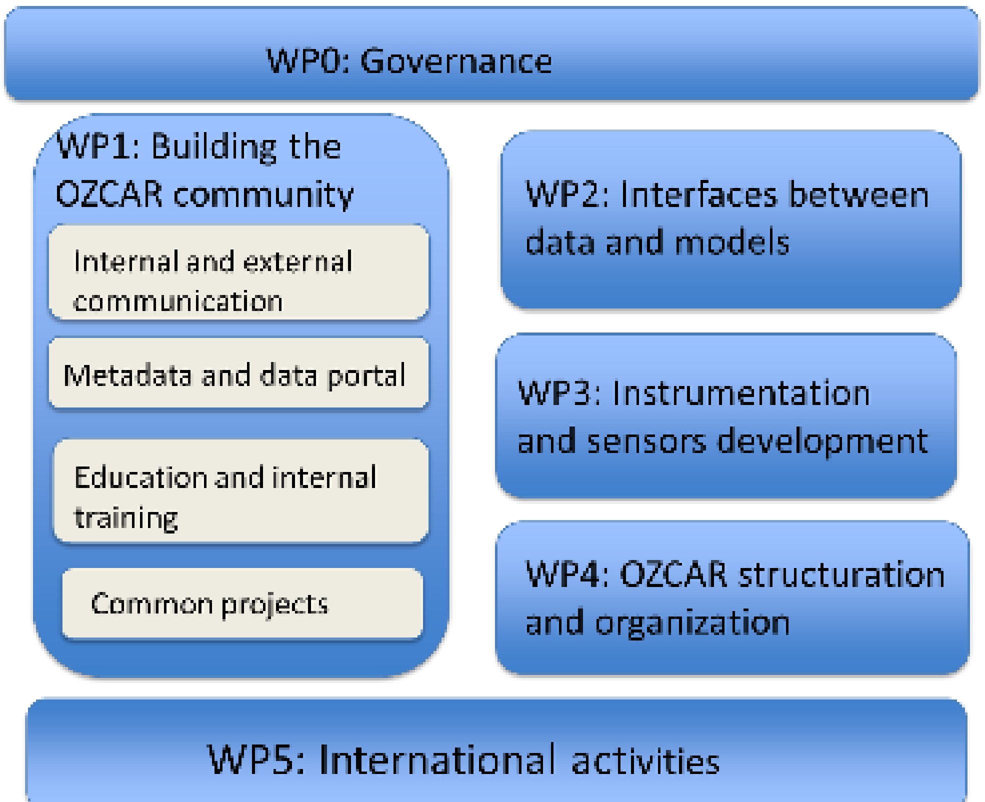
- Highly instrumented sites and long term observation
- A common interest in the Critical Zone
- A common general question: how to monitor, describe and simulate the Critical Zone adaptation to a changing planet (climate change, land use changes, changes in practices)
- Computation of budgets, fluxes

OZCAR main scientific questions

- **Architecture of the Critical Zone**: structural, physical, chemical and biological organization of the critical zone
  => Understand the spatial organization of the critical zone
  ⇒ Understand the role of its different interfaces
  ⇒ Quantify the impact of spatial heterogeneity and temporal intermittency of fluxes, connectivity, concentrations and micro-organisms
  ⇒ Propose relevant representations of the critical zone.
- **Processes in the Critical Zone:** quantify budgets and fluxes of water, energy, carbon, sediments, chemical cycles and biotic/abiotic interactions in the critical zone
- **Feedbacks between the Critical Zone and atmosphere and ocean:** responses and feed-backs to perturbations and global change and contributions to societal challenges

Added value of the OZCAR RI

- OZCAR offers a broader perspective than existing disciplinary networks and allows sharing sites, instruments, models for a community that have a common interest in the characterization of the processes, fluxes and storage in the various compartments of the Critical Zone
- OZCAR will stimulate new transversal projects across networks and disciplines with dedicated WPs:



WP1.2: Metadata portal

- Objectives
  - Ensure the visibility of data collected within OZCAR both for internal and external use
  - In the long term, offer facilities to access directly to the data in a transparent manner
  - Synergy with the THEIA infrastructure « in situ data portal» data to which OZCAR data contribute
- Proposed actions
  - A first CDD IE contract to make a survey of existing portals, design the new data portal and realize a first prototype
  - Developp interoperability between web sites, and as much as possible havest existing information without duplicating it
  - Make a synergetic use of the skills and competences already present in the various teams and reuse existing tools

Animateurs:
Sylvie Galle (THEIA)
I. Braud (OZCAR)

WP2: Data and model interfaces

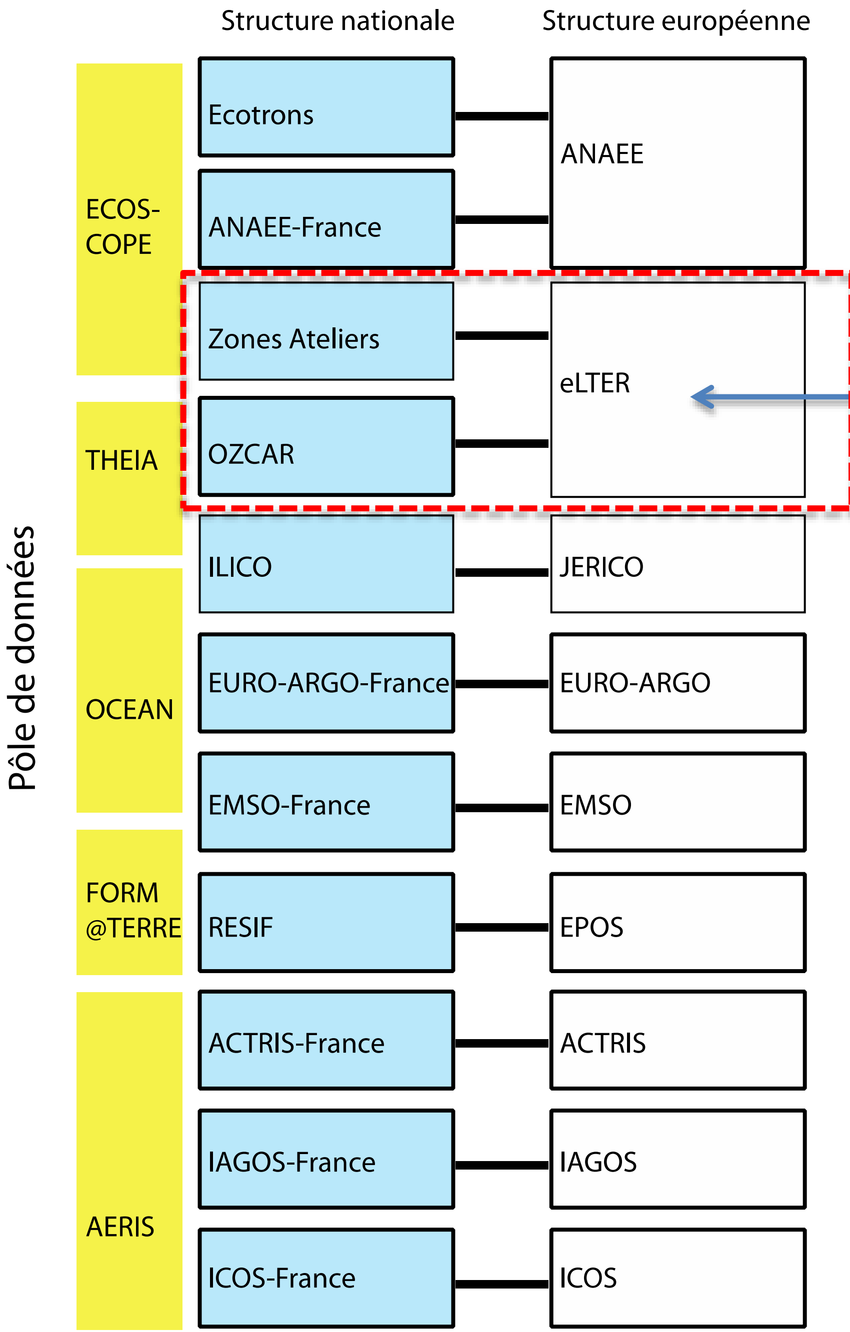
- Objectives
  - Enhance the use of OZCAR data by facilitating the connections between data and models
  - Share skills, competences in the OZCAR community in terms of modelling
  - Go towards a shared conceptual model of the Critical Zone?
  - Go towards one/several? Modeling platforms to favor coupling between processes
- Proposed actions
  - Identify the human resources/contacts in terms of modeling using OZCAR data
  - Organize transversal workshops on topics that are of interest for various users (make a pool to identify the needs)
  - Contribution to the SIC prospective on the « modelling » topic

Animateurs:
Sandrine Anquetin (IGE)
Jean-Raynald de Dreuzy (Géosciences Rennes)

WP3: Instrumentation

- Objectives
  - Organize the use of the instruments acquired in Critex within the community
  - Think about the future needs in terms of innovative instrumentation to document the Critical Zone (follow-up of Critex)
  - Share experiences acquired in the OZCAR communities on common topics (e.g. extreme climatic conditions, data teletransmission, etc…)
  - Spatial and temporal high frequency
  - Documentation of heterogeneities
- Proposed actions
  - A working group that will make proposals

Animateurs:
Laurent Longuevergne (Critex)
Jérôme Gaillardet (OZCAR)



European ESFRI project eLTER submitted in June 2018 by several European countries

Towards European integration: French mirror of eLTER : **eLTER-France** including

- OZCAR : a RI gathering Critical Zone observatories (geo-eco-systems)
- Zones Ateliers, LTSER (long-term socio-ecological systems)

Conclusion and perspectives

- OZCAR, a new French Research Infrastructure that gathers observatories monitoring the various compartments of the Critical Zone
- Added value of OZCAR through common activities as illustrated with the ambitions for 2017
  - A common web site
  - Publication of a « white paper » describing OZCAR RI and ambitions
  - Start a common (meta)data portal building
  - Evaluation of the full cost of the RI
  - Integration into the European Road map (eLTER project)
  - Start a working group on the future sensors development and requirements (follow-up of the CRITEX project)

THANK YOU FOR YOUR ATTENTION

QUESTIONS???

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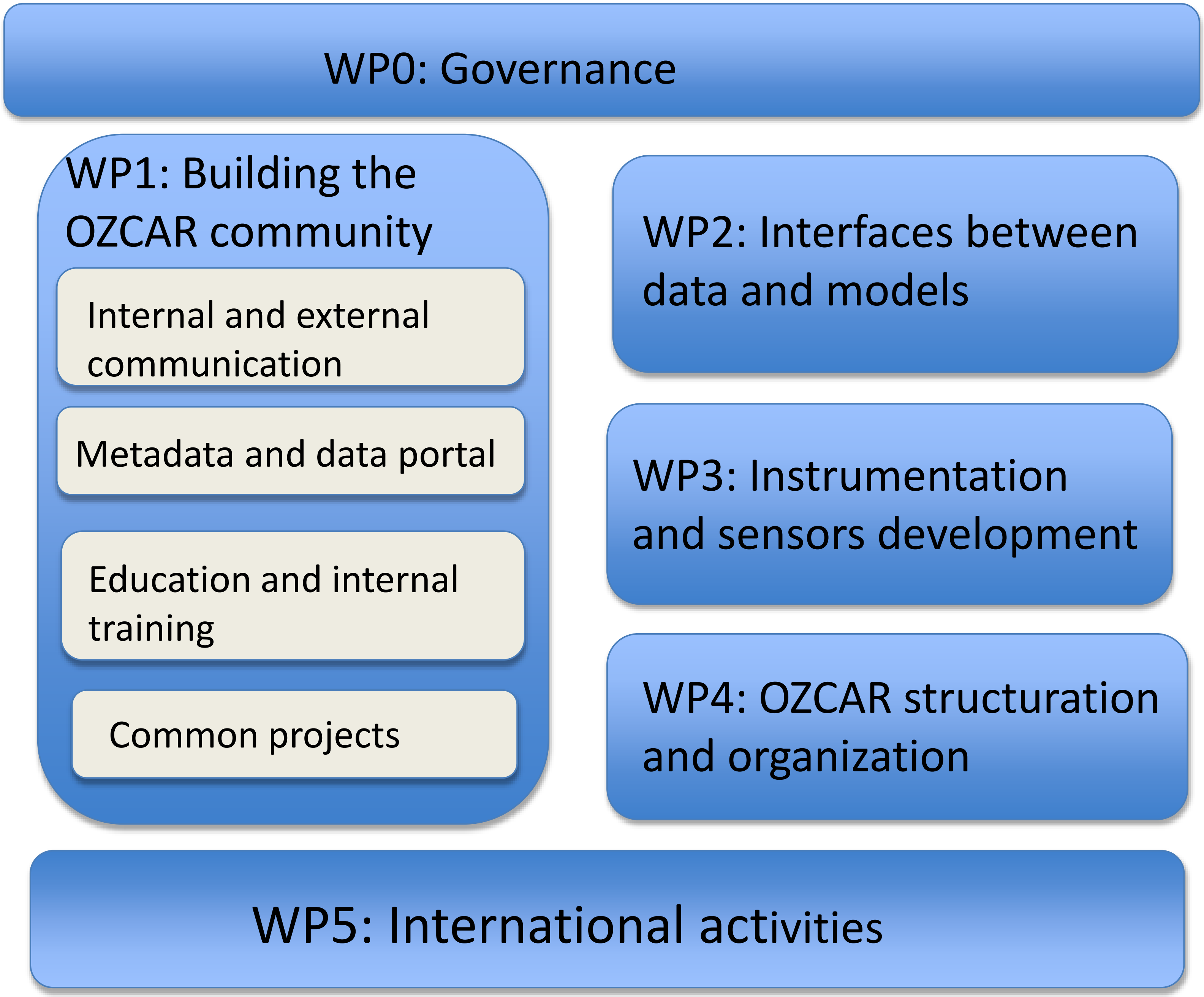
WP0: Governance
WP1: Building the OZCAR community
Internal and external communication
Metadata and data portal
Education and internal training
Common projects
WP2: Interfaces between data and models
WP3: Instrumentation and sensors development
WP4: OZCAR structuration and organization
WP5: International activities