An INtegrated Fire Risk mAanagement (INFRA) Pilot Service for Arctic Wildfires

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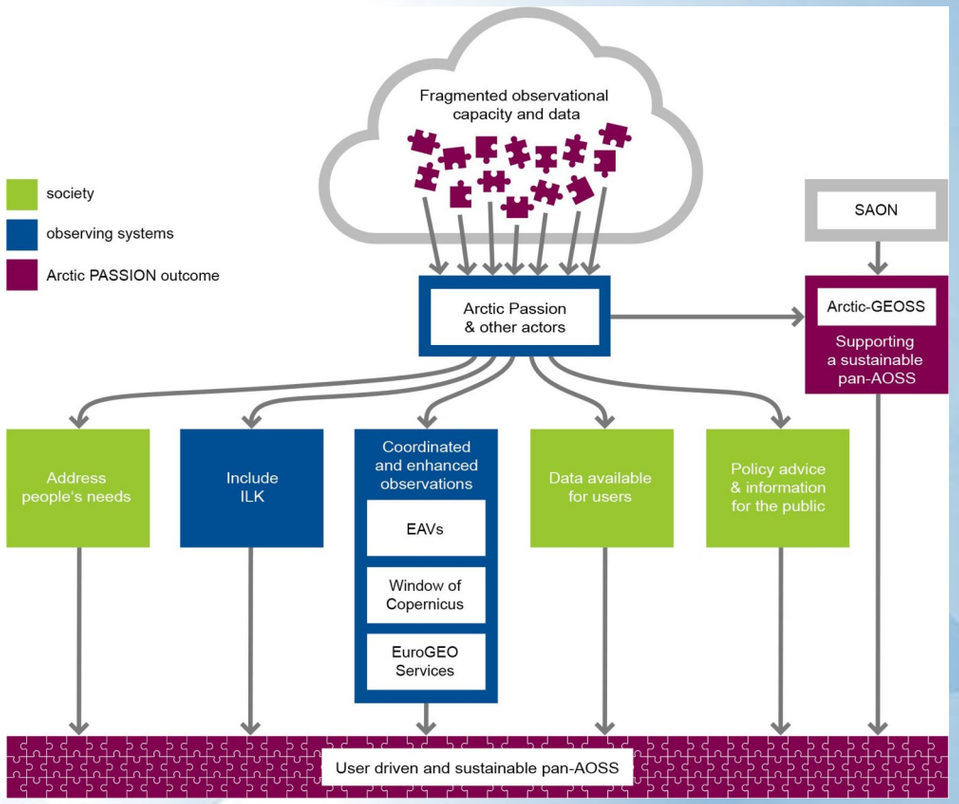
on behalf of the involved team: *CNR (ISP, ISAC, IRET)*
CAE (a SME)

Arctic PASSION EU Project

- A sustained and accessible observing system that is tuned to the diverse needs of users, ranging from local inhabitants to academia through to industry and decision-makers, is necessary to proper answer the environmental, societal, and economic impacts of Climate change in the Arctic.
- Co-creation and implementation of such a coherent, integrated Arctic observing system, the 'Pan-Arctic Observing System of Systems - pan-AOSS', is the ultimate scope of Arctic PASSION.
- Methodological framework is based on three interlinked pillars. For more on this - https://arcticpassion.eu/wp

Vision of Arctic PASSION for a pan-AOSS



A key element of Arctic PASSION are pilot services. eight Pilot Services (PS) will be developed. They has been selected following indications arising by Arctic Council and its Working Groups, Arctic Science Ministerials, Arctic Observing Summit. more at – https://arcticpassion.eu/wp/wp4/

The Pilot Services will provide information in areas of societal and economic relevance: food security (PS1, PS2, PS6, PS7), emergency preparedness (PS2, PS4, PS5, PS6, PS8), wildfire and pollution risk reduction (PS4, PS5, PS7), environmental change information (PS1, PS3, PS8), and infrastructure, transport, and safe shipping (PS2, PS6, PS8).

Yakutia

2021

— Lena River

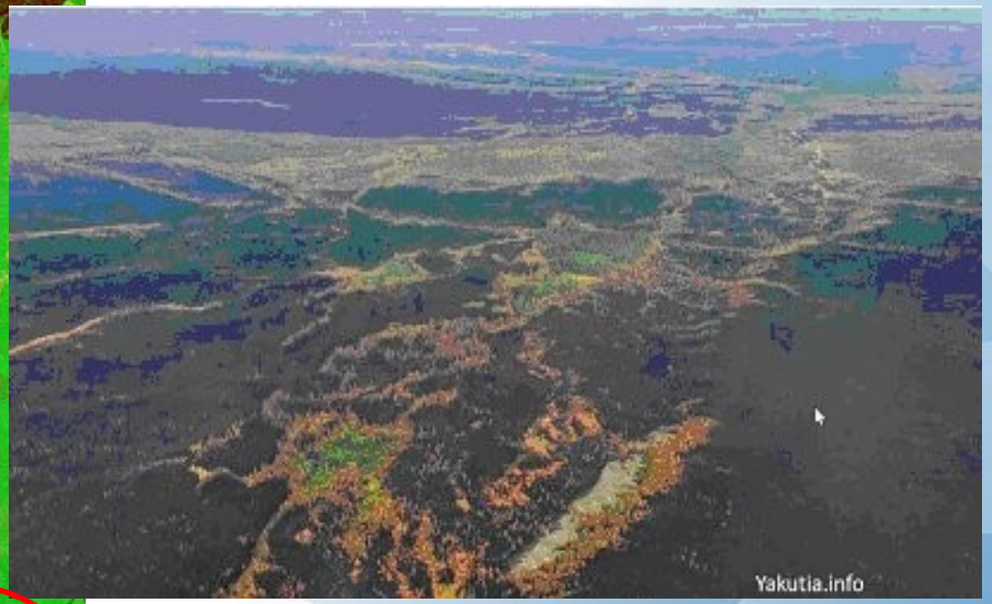
Active fire —

Burn scar

Yakutsk

Mirny

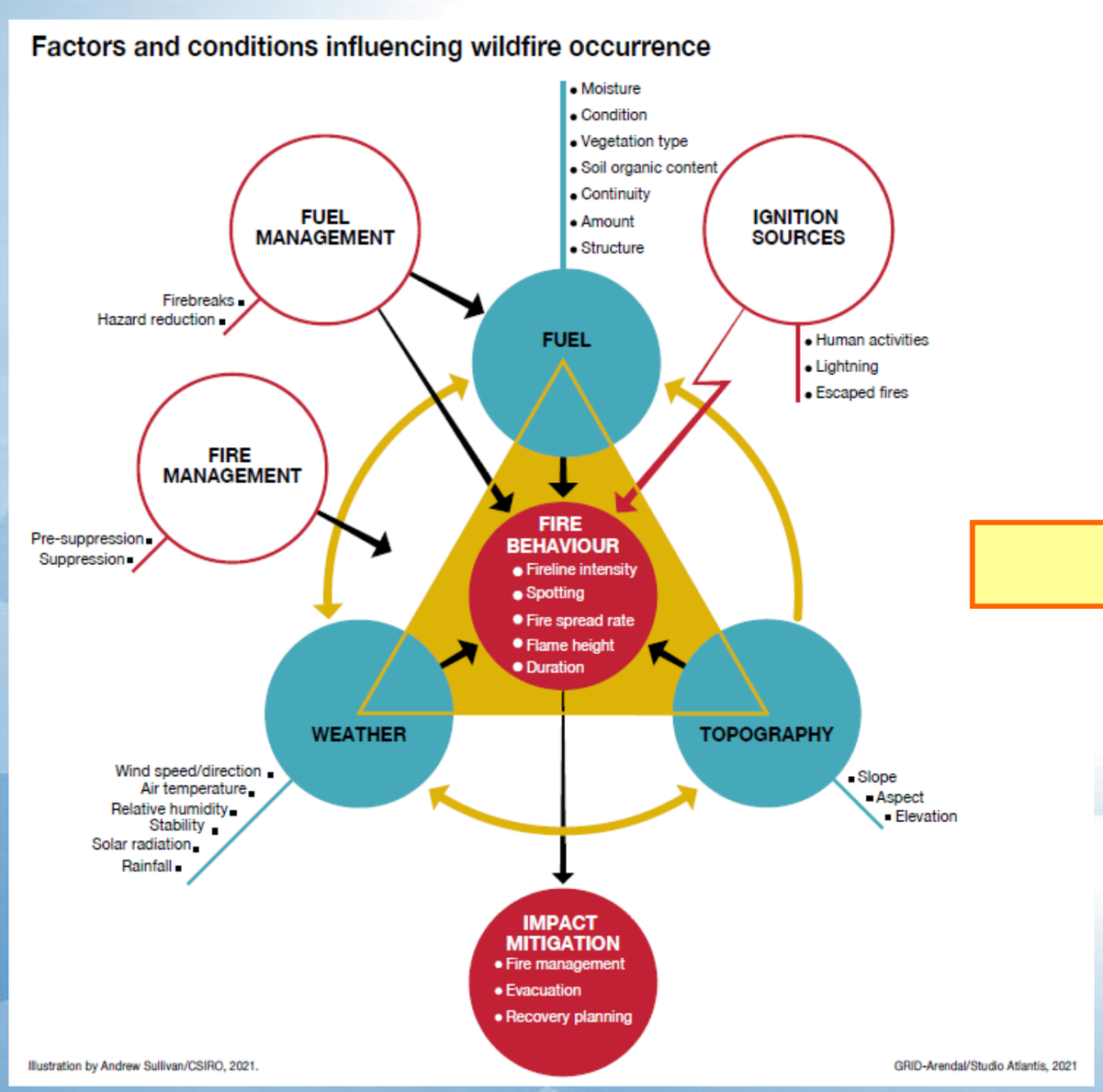
100 km

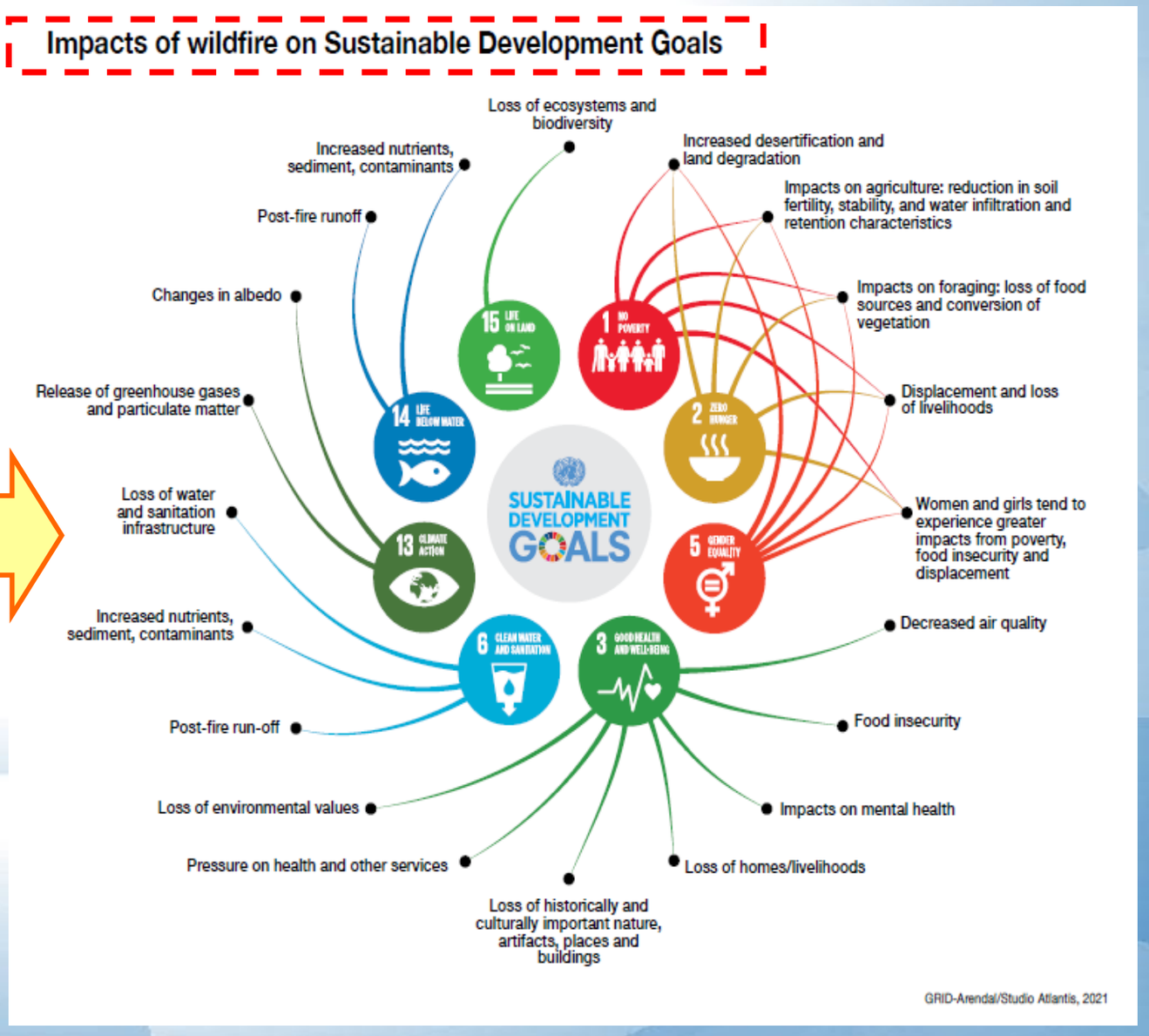


A large impact,

not only in the Arctic

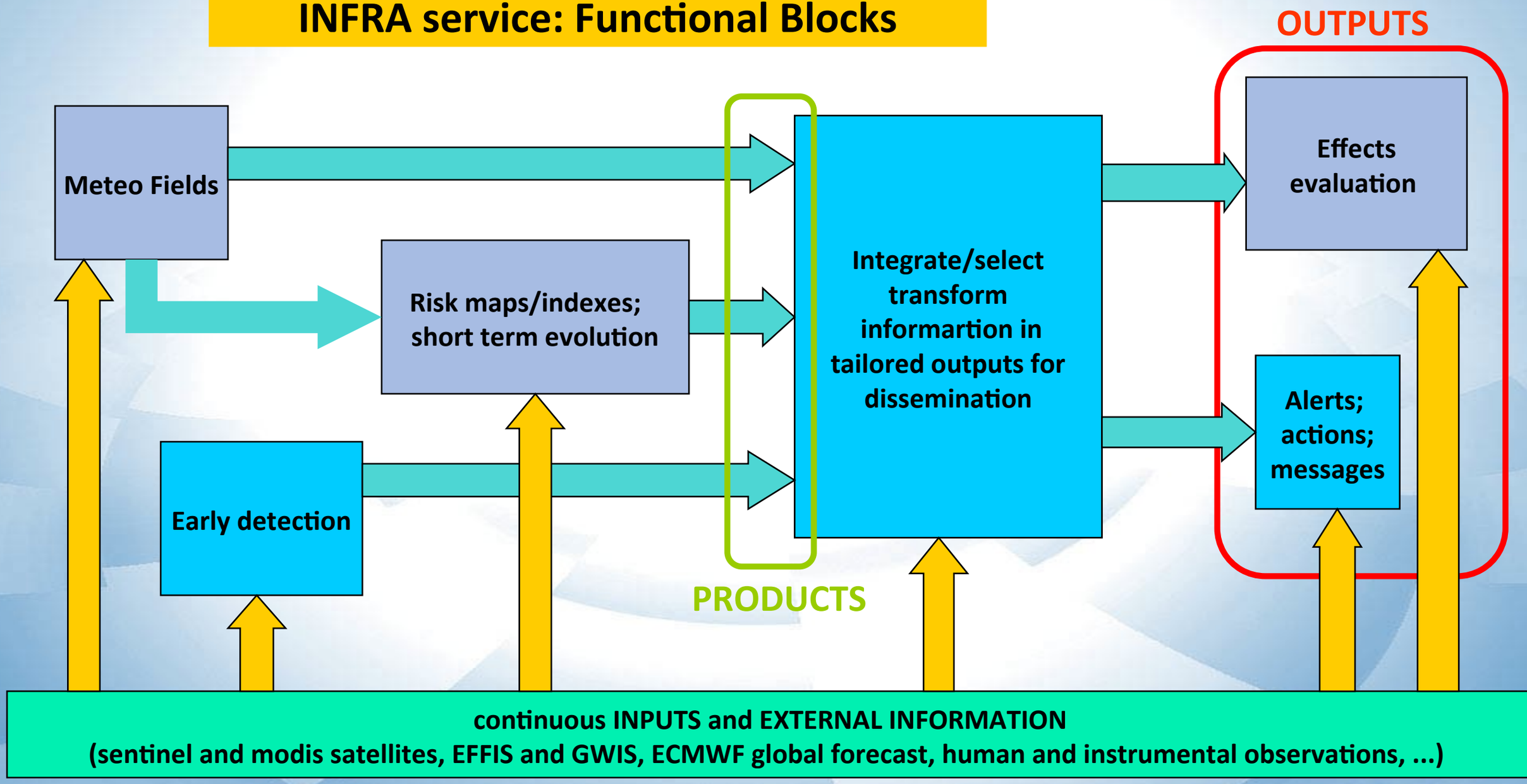
Wildfire: a complex event with large implication at many spatial temporal scales





GRID-ARENDAL, Spreading like wildfires...., UNEP Rapid Response Assessment, February, 2022

INFRA service: Functional Blocks



INFRA service: Development and implementation approach (keywords)

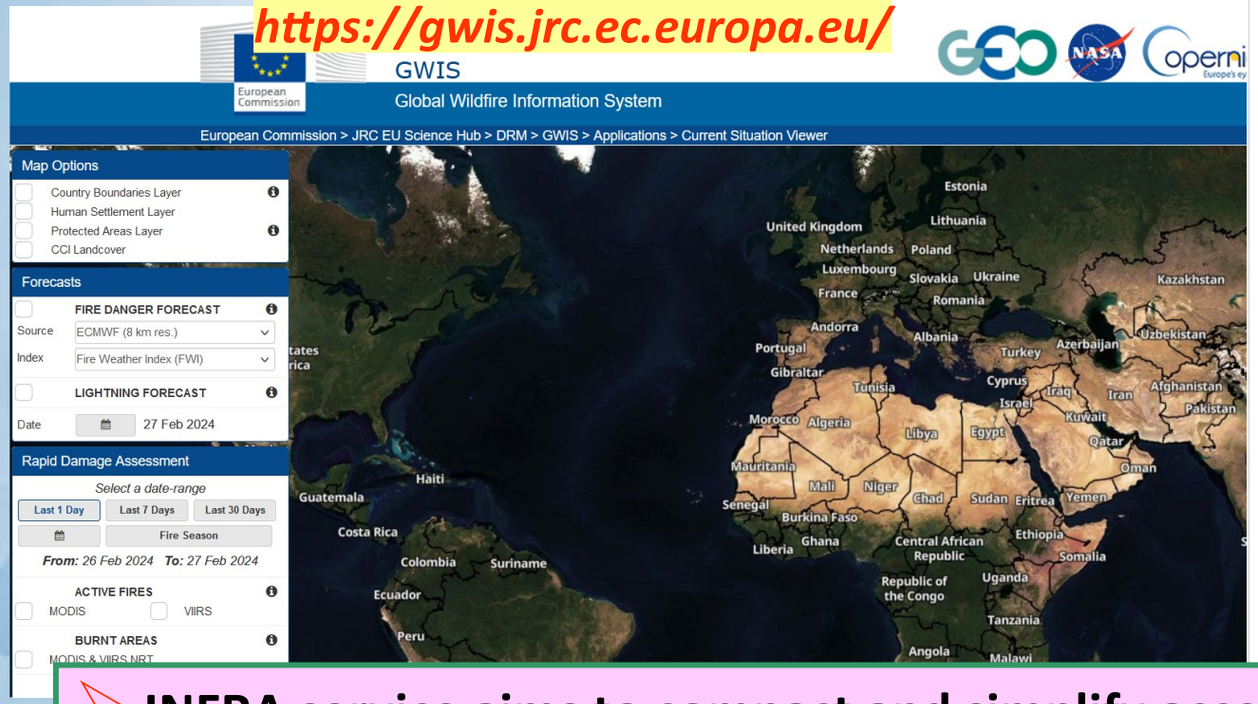
A wildfire service is strongly related to the area you need to cover (dimension and characteristics, population distribution, installations, specific risks), as well as user and stakeholder categories to serve, conveying alerts, information for actions etc. etc. Co-design and co-development are essential

OUR SCOPE: to have at disposal for each functional block, elements (bricks) that allow to build and integrate its to achieve an "optimal" service for the specific needs. Keywords driving the work :

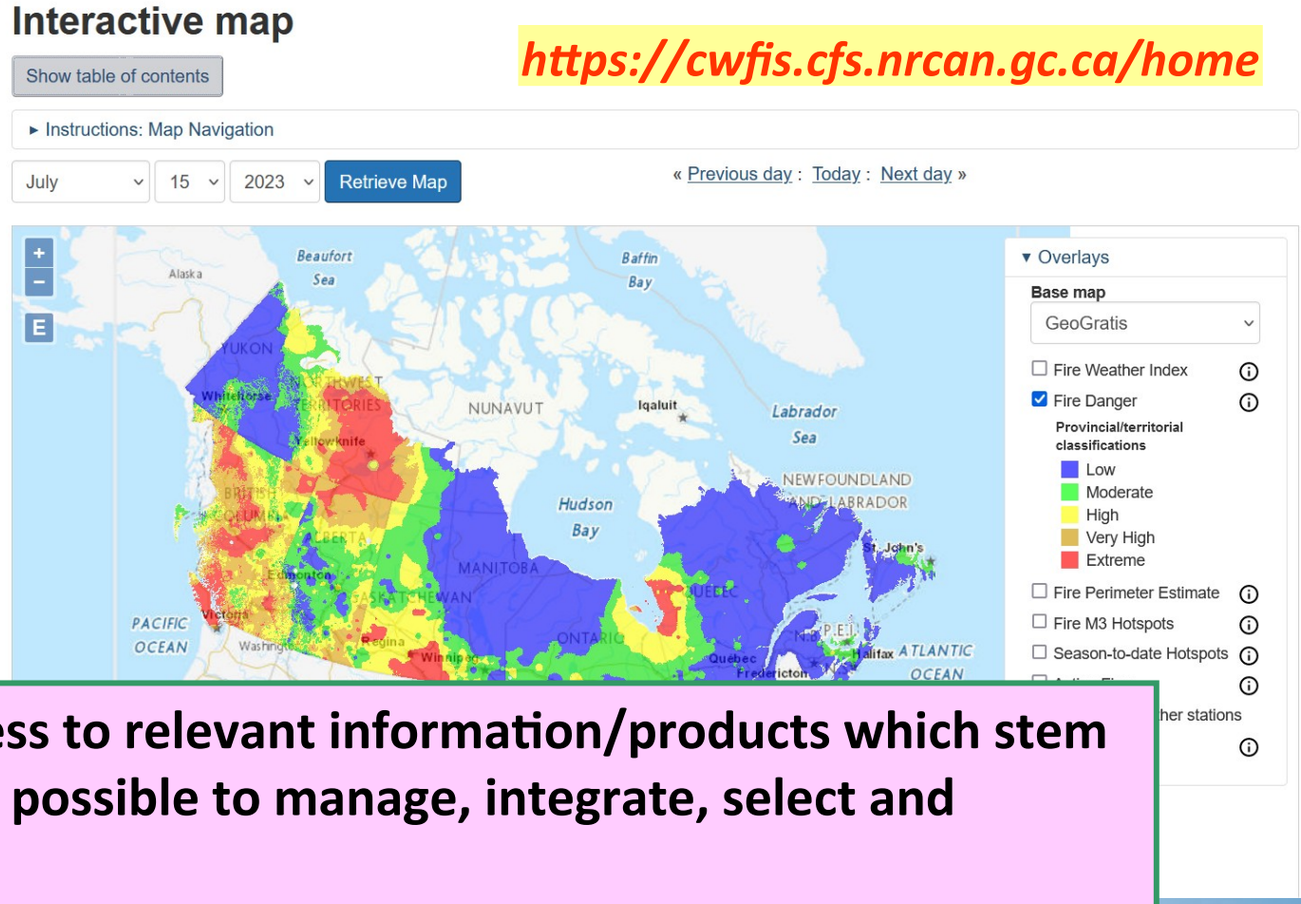
- **Flexibility** in design and develop functional blocks, to cover a large spectrum of possible implementation, mainly oriented to the local/regional scale
- Address as much as possible a **multi-scale** implementation approach
- **Co-design and co-development** to be sure to convey/scale information and messages/outputs/alert to profesional as well as not-professional users (up to the individual level)

INFRA Service: what novelity with respect other services

https://gwis.jrc.ec.europa.eu/



https://cwfis.cfs.nrcan.gc.ca/home



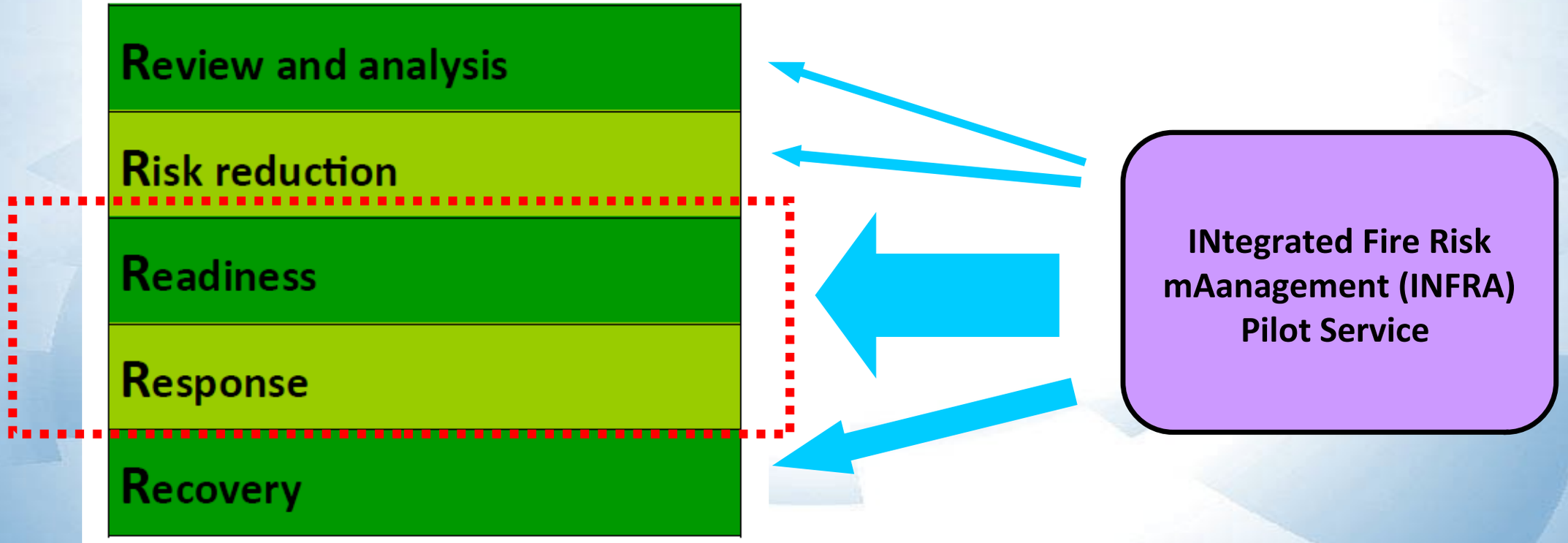
➢ **INFRA service aims to compact and simplify access to relevant information/products which stem from diverse sources. Most importantly, it makes it possible to manage, integrate, select and transform such sets of information.**

➢ **The novelty of the INFRA service lies (i) in the attention to the local scale, and (ii) in having developed tools suitable for generating messages that are tailored to the category of users you intend to reach.**

➢ **Implementation of the service based on computer cloud environment provide high flexibility, also reducing need for local hardware/software resources.**

INFRA: targets with respect an Integrated Fire Management System

Integrated Fire Management – the 5Rs



Integrated wildfire management consists of five interlinked and often overlapping phases: review and analysis, risk reduction, readiness, response, and recovery

In GEO metrics/language: contribution to Management and Disaster Risk Reduction

INFRA Service: what we like to accomplish

- status of active fires
- meteo fields
- humidity conditions (soil/vegetation, air)
- fire risk indexes (standard, improved, developed)
- lightning
- fuels

Solutions to improve early detection from surface observations (automatic, human)

PREVENT

professionals

- forecast head fire spread rate (6-12 h),
- fuel consumption
- meteo fields useful to monitor conditions/ developments (i.e. wind gust, convective activity)

Individuals/ communities

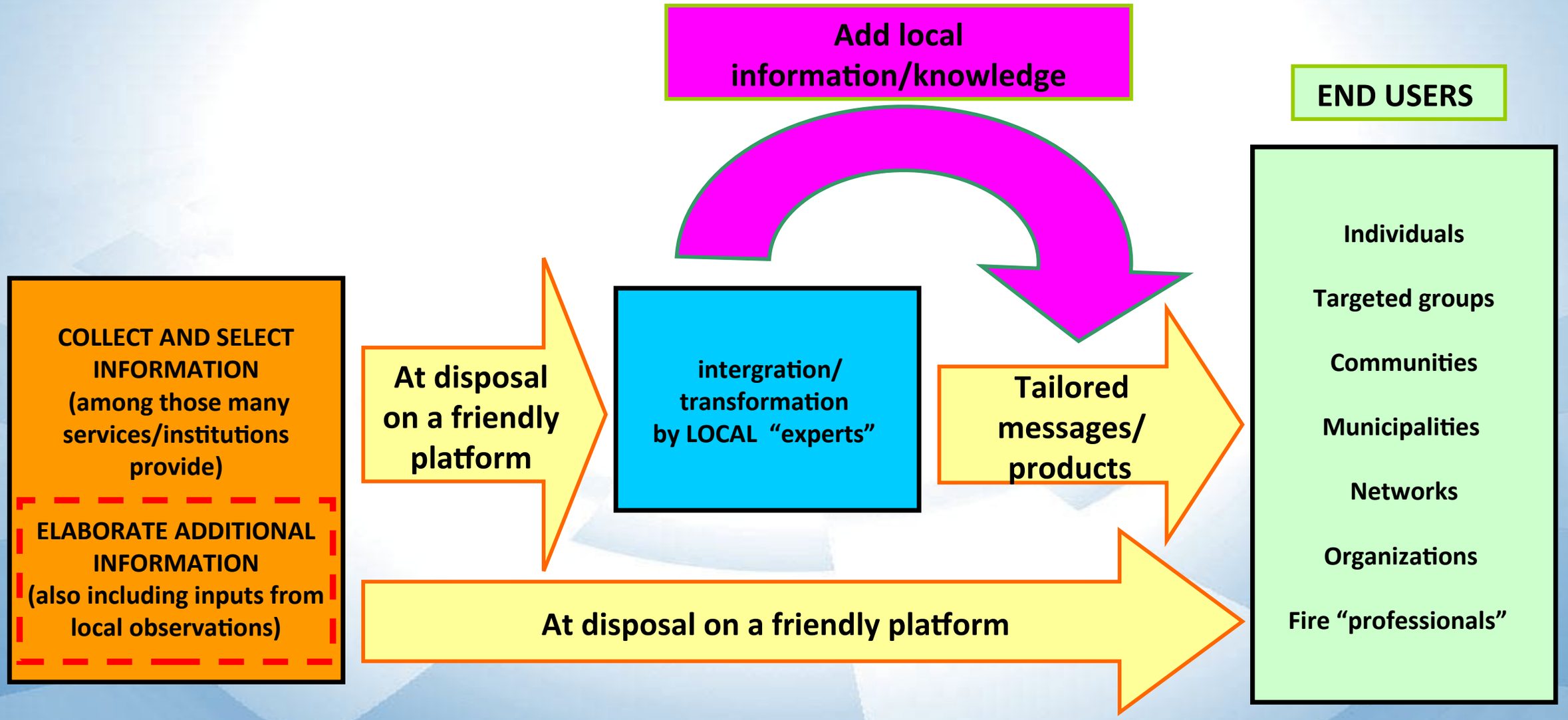
- transfer in the due way information;
- dissemination of alerts (via e-mail, sms, Telegram, massive voice calls, apps, etc.) using standard protocol (CAP) .

EVENT MANAGEMENT

"downscaling" / reformat the huge amount of informastion outputs that GWIS and local systems can provide

Damage Assessment

Overcome barriers



INFRA: Structure and data flow

High resolution NWP model run to generate meteo fields

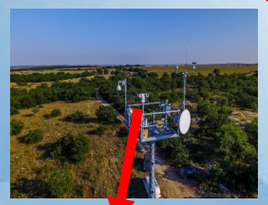
Expert room

INFRA-AEGIS
Collecting, presenting, integrating and managing information layers generated by INFRA or provided by other sources (including ground observations)

Selected images for messasges

INFRA-SENTRY
Generating and distributing messages/alarms/actions to different user categories through multiple system (phone, mail, sms, social media)

Computational module (Risk indexes; fire evolution)



Ground Early detection (human monitoring, automatic techniques, ...)
OTHER INFORMATIONS

Other sources (GWIS, Wildland Fire Information Map Series, ...)

OUTPUTS
Messages generated using the CAP protocol managed and distributed following a well defined plan (message will include in general jpeg images generated thanks INFRA-AEGIS)

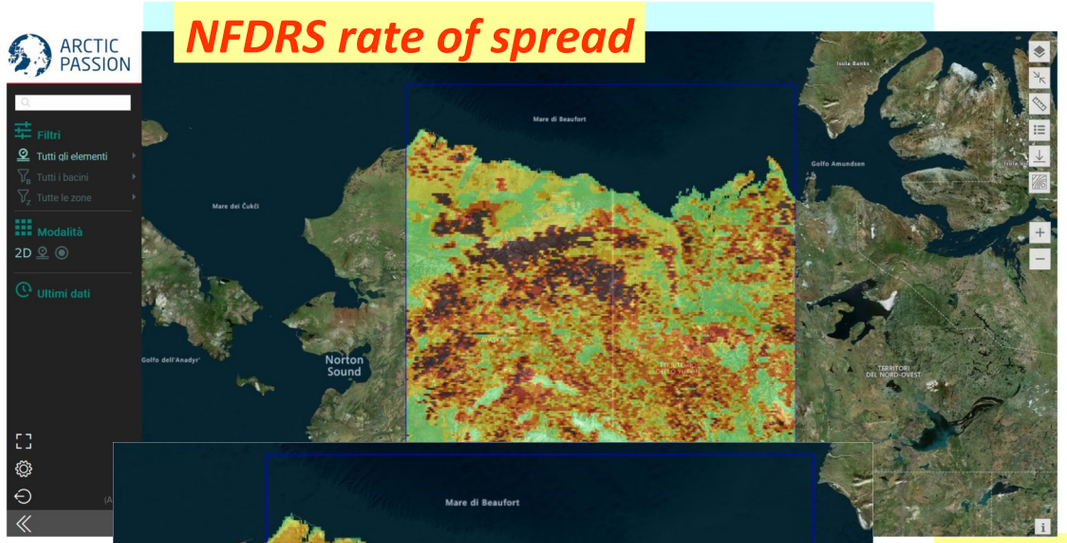
IT platform to provide information to “experts” as well as end users, and support integration/selection/transformation of such information: INFRA-AEGIS

A web-GIS platform through which to present, combine and integrate all the information layers produced by INFRA or collected from many sources and services.

Friendly and intuitive functionalities, focusing on targeted areas

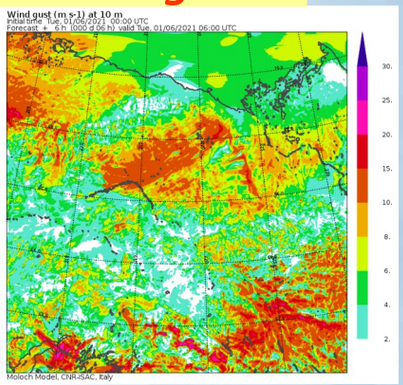
Implemented on a computer cloud infrastructure, and easily scalable to different needs

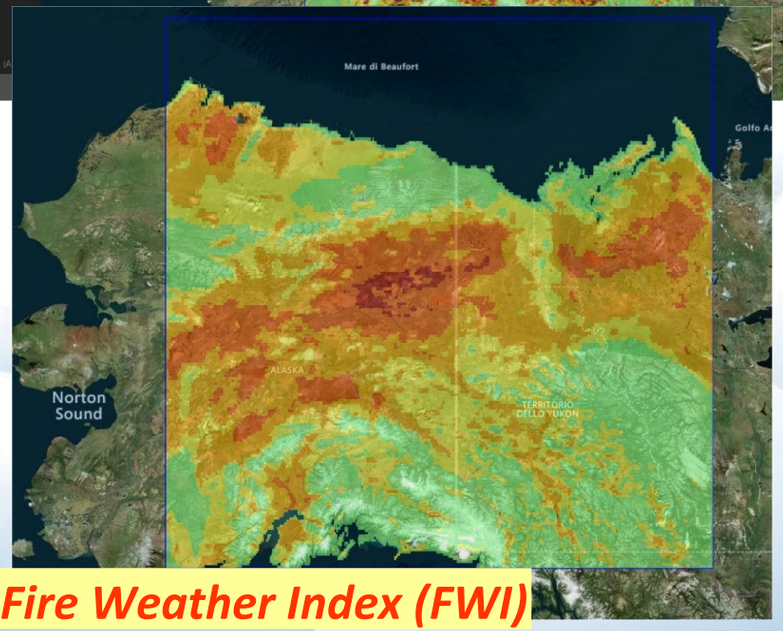
For general public access without credentials. For “experts” access can be restricted, if dedicated functionalities, information layers added.



NFDRS rate of spread

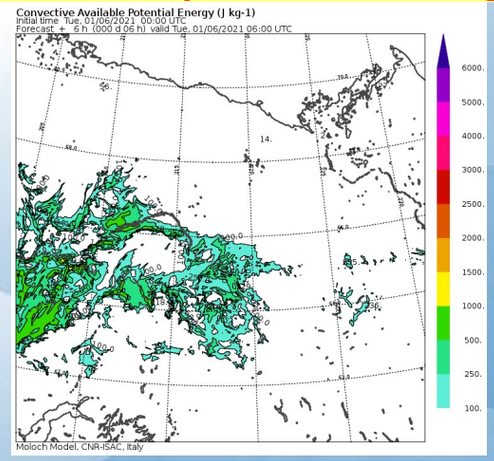
Wind gust





Fire Weather Index (FWI)

Convective potential energy



AMONG FUNCTIONALITIES:
Evaluation of distances and areas; quick zoom; export map as immage.

ACCESS: https://arcticpassion.caedns.it/

Information layers: from INFRA – from other sources

From INFRA

Wind
Wind gust
Accumulated precipitation (24 h)
Relative humidity of upper soil layer
Accumulated Evaporation (24 h)
Temperature at 2 m
Surface temperature
Downward short-wave radiation
Pressure
Cloud cover
Snow height
Convective available potential energy

FWI
FWI improved
Vegetation “stress” index
Vapour pressure deficit at 2 m
Ligthning probability index
Fuel map (2020)
Fires and Fire early detection
Forecast of Fire propagation (6-12 h)
critical infrastructures

From GWIS

Selected among a very huge amount of info layers connected to

Fire risk indexes
(very few Arctic oriented)

Ignition/spread factors
(the same made by INFRA with different approaches – possibility for comparison)

Active Fires

Rapid Damage Assessment

From others

Finish Fire System

Natural Resources Canada - CWFIS, Canadian Wildland Fire Information System

UAF SMOKE Wildfire Smoke Prediction for Alaska

Alaska Wildland Fire Information Map Series

MesoWest - Alaska Fire & Fuels

MORE ??????

Case by case necessary, check the availability of products and how to acquire them

IT platform to elaborate tailored textual messages and distribute them to a great variety of end users: INFRA-SENTRY

A platform through which to distribute information and messages to users. Service can easily be adapted to specific needs.

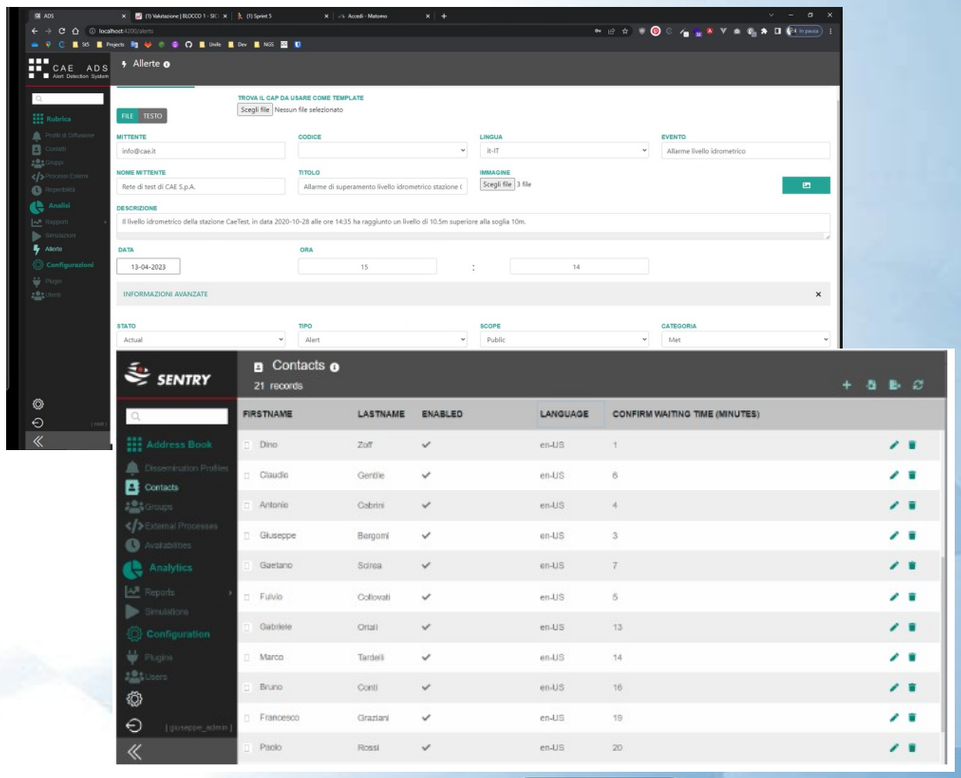
Information can be selected and integrated from layers provided in INFRA-AEGIS

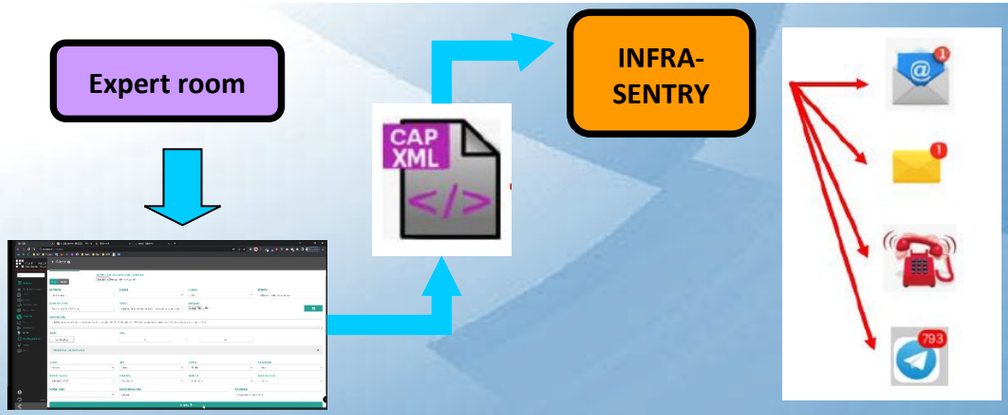
“Experts” will have at disposal a simple mask to introduce information, write a text, associate images. The platform will translate all them in a MESSAGE based on the CAP (Common Allerting Protocol) standard.

The IT platform thanks what indicated in the MESSAGE through specific plugins will manage and distribute messages with different modalities (sms, e-mails, phone calls, social applications, to other computer/services, ...)

Dissemination of information and alerts can be defined/made with high flexibility by defining contacts, groups of users, distribution profiles, availability of each contact (also if in a group)

Possibility to introduce processes (executable, batch, etc.) in the distribution profile (for example to activate automatically a mechanical/electronic system as a rele’)





What necessary to implement INFRA for a specific scope/interest/user

Access and use of INFRA-AEGIS alone, can be considered the zero level of use and implementation of INFRA service. This implementation is based on and enhances the first of the two innovations proposed by INFRA: attention to the local scale.

Integrated use of INFRA-AEGIS and INFRA-SENTRY is necessary to improve information flow to end users by tailored messages, widely distributed through a large spectrum of communication channels

To fully implement INFRA service core functions (level 1 implementation), the only necessary steps are:

1 - To collectively identify the area of interest;

2 - To collect information on target people to reach with messages and information (to this scope a specific form have been elaborate and it at disposal);

3 - To define a template/format for messages and agree on a language to use and any information that you won't distribute. Information content can be tailored for each different user category;

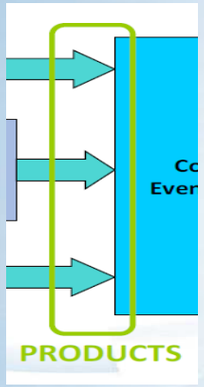
4 - Identify/secure experts who will act as the key operators to acquire/integrate/select information through INFRA-AEGIS and transform them in messages and distribute thanks INFRA-SENTRY functionalities;

5 – Set up working space and resources for the Operators' to work.

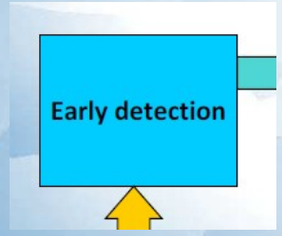
Level 1 requirements are till suitable to directly involve relatively small actors

To move INFRA service implementation one step ahead (level 2) need resources to support routine running of high resolution numerical weather prediction model (NWP). Level 3 can at the end be considered a service including automatic early warning functionalities

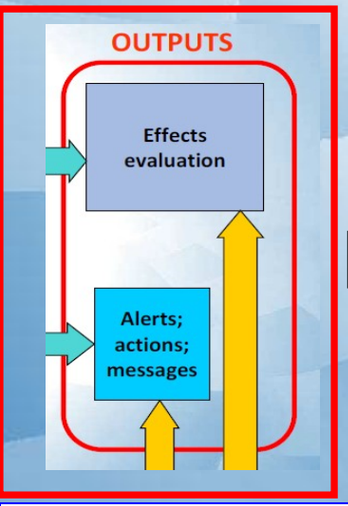
Where Co-design and co-development are more important



Are the information layers identified sufficient ?
How to include indigenous knowledge and stewardship in the system ?
Add information on relevant infrastructures/services



Connect with ground monitoring/alert network (watch towers, mobile patrol, automatic systems like thermo cameras)
How we can better support them and/or its can be improved ?
How to keep engaged groups and individuals ?



The most important but also the most neglected
Define dissemination strategy on the basis of user needs.
Reduce ‘distance’ identifying an intermediate semi-professional level
Do not forget the communication limits
Consider the differences between stakeholder categories

Concretely develop/promote Co-design and co-development

- **Assess the relevance of the different information layers for different users and identify needs for more (i.e. about fire effects on air quality at small spatial scales);**
- **Collect supplementary information from users/communities (i.e. critical/relevant infrastructures, ground-based early detecion systems);**
- **Connect/dialogue with wildfire management organization at communities/local/regional level;**
- **Assess relevance/value of fire effects and damages**
- **Identify users (communities, municipalities, organizations...) interested to implement and test level more then zero of INFRA**
- **Adapt and develop INFRA functionalities and products accordingly**

In additrion to networking activities (disseminate information, visit/interview experts and potential stakeholders/users) a SURVEY have been realized in cooperation with pilot service devoted to air quality
YOU CAN REACH AND COMPILE IT AT THE LINK
https://app.sli.do/event/e5kB4Q2beKteDcT4qwMvYD **(SLIDO platform)**

Implementation and development during 2024

- No later than Easter activate INFRA-AEGIS level Zero
- During spring fully develop INFRA inclusion in INFRA-AEGIS of meteo information layers
- Then organize a webinar to better explain potentialities of level 1 and level 2 implementation
- At next Project General Assembly (half June 2024) present first results of integrartion in INFRA of information related to air quality (elaborated and provided by pilot service 5)
- During summer fully develop/implement connection with PS 5 and air quality information related to wildfire contribution to atmospheric aerosol
- Hopefully have on please level 1 implementation for specific users/stakehoders
- During summer also analyse information achieved thanks networking activity as well as Survey and plan updates and adjustments
- During fall investigate additional sources of information for INFRA-AEGIS
- During fall, develop functionalities for fire propagation and new risk indexes based on satellite observation of vegetation “stress”

INFRA service: The working team

First Name	Last Name
CNR	
Vito	Vitale
Angelo	Lupi
Mauro	Mazzola
Francesca	Becherini
Enrico	Brugnoli
Enrica	Nestola
Olga	Gavrichkova
Maurizio	Sarti
Oxana	Drofa
Alessandro	Tiesi
Daniele	Mastrangelo
CAE	
Guido	Bernardi
Lorenzo	Giandomenico
Nicola	Tramarin
other staff from the Research abd Development Unit	

CNR-ISP administration

Grazie per la vostra attenzione
Thank you for your attention