

EISC-ESA 'Space for Sustainability' Award

EISC 2018 Plenary Conference - Brussels
16/10/2018

Presented by Jean-François Clervoy
Prepared by Marion Mirailles

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European Space Agency

The 'Space for Sustainability Award':

- Is rewarded annually to the best Project Idea that integrates application areas focusing on sustainability linked to space
- Stimulates the debate and raises awareness on space and sustainability issues among the young Europeans
- Is a tool for innovative and creative project ideas in those areas

INNOVATE FOR SPACE AND SUSTAINABILITY

THE AWARD SO FAR IN A NUTSHELL

■ 6 Editions

- 2 rounds
 - A pre-selection made by 7 ESA experts
 - Final selection made by a multidisciplinary high level jury

■ 119 participants

■ 19 European countries represented

■ Age average: 25 years old

■ 5 launches attended:

- GAIA in December 2013
- Galileo Satellite in March 2015
- Galileo Satellite in December 2015
- Galileo Satellite in March 2017
- Bepi Colombo in 19th October 2018 (soon!)



A SPECIAL ATTENTION FROM THE JURY ON IMPORTANT PROJECTS

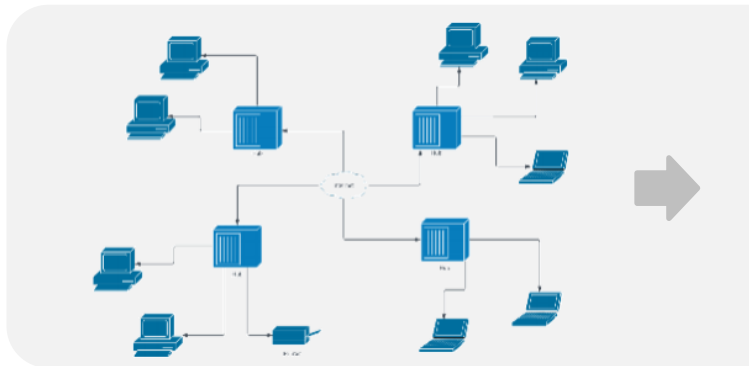


**INFIRE: Online daily burned
area mapping**

> Ana Leite

**SATELLITE DATA TO PREVENT
AND HELP FIGHTING
WILDFIRES**

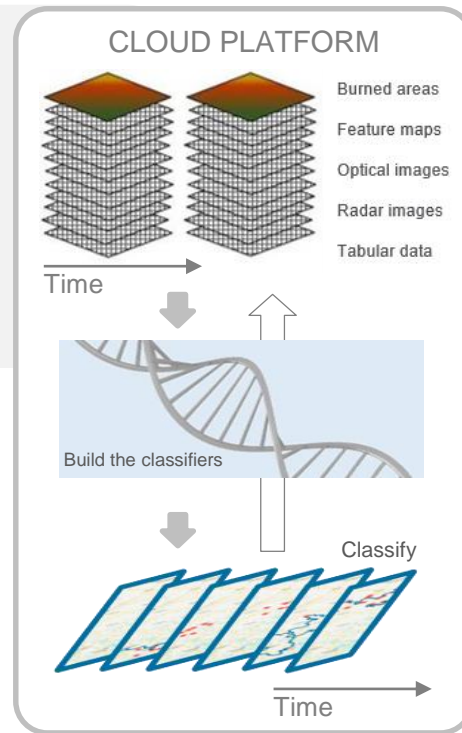
> Tomàs Silva



1. No operator: training/validation of classifiers relies on historic data, which are continuously update

2. Genetic programs: automatically produce new code by *mutation* and *crossover* of sections of the code from current classifiers (reproduction).

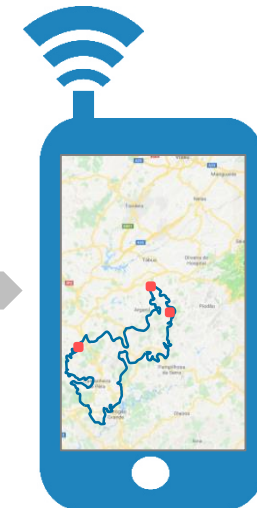
3. Evolution: Only the best performing classifiers reproduce into next generation, with progressive improvement of *fitness* of both the classifiers and the data base.



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FULLY AUTOMATIC
OPERATIONAL TOOL



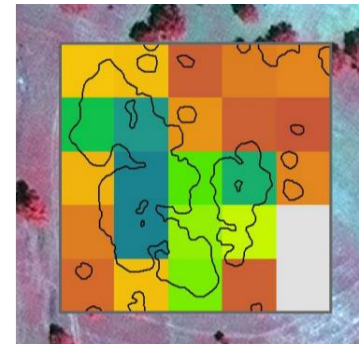
■ Current Active Fires

□ High-Resolution Burned Areas

Ana Leite
anacatarinamleite@gmail.com

One phenomena particularly affected by climate change is the frequency of wildfires. Causes each year the destruction of forests, lives and costs tens of millions of euros in damages.

Predict the **advance of the fire**. Not predict fire itself!
Most models work iteratively, using for example a grid with inputs.

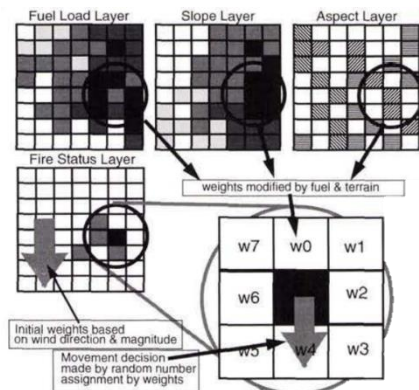


Ideal-typical illustration of the Tree Cover Density product, delineated from a VHR (Very High Resolution) satellite scene. Image from © DigitalGlobe Inc. (2015), all rights reserved.

20m Tree Cover Density raster
overlaid with VHR Tree Cover Mask

Main stages:

- Use of the software.
 - Apply models like numerical weather prediction model (e. g. Clark et al., 1997) with a fire behaviour module (e. g. Coen 2013).
- Output of the software would be in GIS.
 - Not open to the public. The client will has access to an interface, will be able to input whatever conditions they wish to simulate the fire propagation.
- Improvement of the software using machine learning.
 - Many variables, accurate data, semi- analytical models and lack of human touch make it of extreme usefulness.



THE AWARDEES 2018

First Prize

BEESAT PROJECT TEAM

(Ariane Bouilly, Olivier Ferrage, Romain Estève)

'Beesat Project'

The project proposes to combine different sources of information to establish maps of relevant and suitable areas for bees. By helping decision making, this knowledge would assist interested parties in enhancing pollination efficiency and help maintain the currently endangered pollinator diversity.



Special mention of the jury

ANTONIO GIMENEZ NADAL

'Nanosatellites Collision Avoidance System'

Proposes a project-idea to try to mitigate and even solve one possible problem of operating nanosatellites to avoid the collision between them in a possible future saturated network, as the space industry is entering in a new era with, among other issues, the growing development of nanosatellites



Nanosatellites Collision Avoidance System

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16/10/2018

Antoni Giménez Nadal
antonigimeneznadal@gmail.com



- Increasing number of objects →
 - Complexity
 - Cost
 - Risk
- New type of objects →
 - Run by small companies
 - Small size
 - Complex orbits



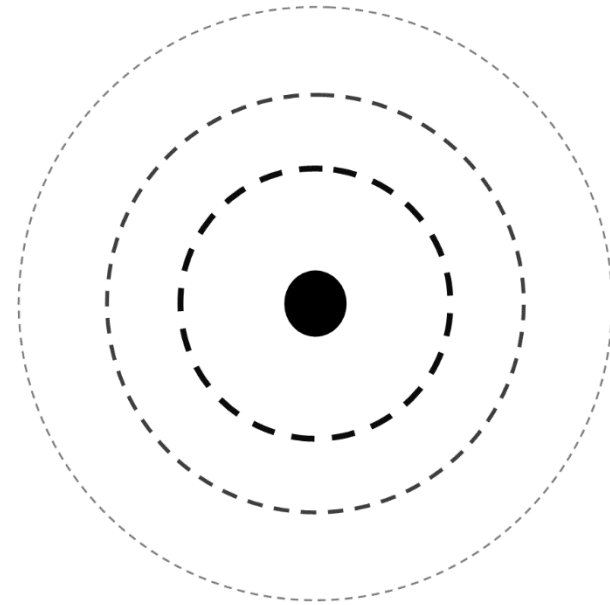
Previous approach not feasible

- Based on the emergence property

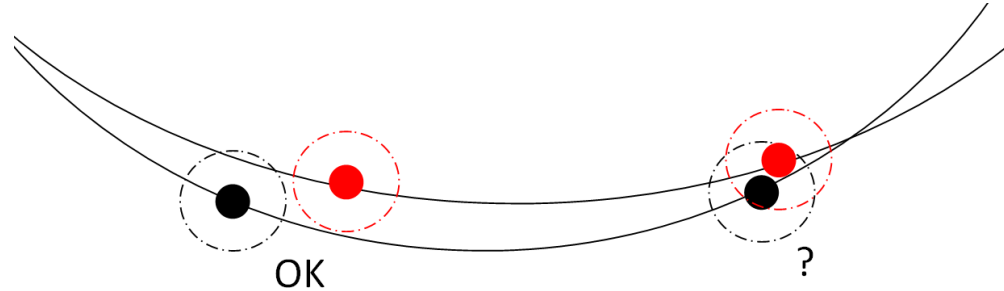


Source: crhoy.com

- Decentralize the collision avoidance system to each satellite
- Communication between each satellite
- Spheres of influence



- Auto-detection and avoidance



- Consider each satellite capabilities
- Internal vs External implementation

- Avoid collisions between satellites →
 - Mitigation of debris generation
 - Save on resources
- A control network →
 - Safe
 - Scalable
 - Flexible
 - Open to the public
- Democratize and open space

Nanosatellites Collision Avoidance System

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The BeeSat Project

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16/10/2018

The BeeSat Team
Ariane Bouilly, Romain Esteve, Olivier Ferrage



Olivier Ferrage

Micro/data
background
Data Analyst
(Roots & Shoots)



Ariane Bouilly

Environmental
engineering
background
Ecodesign Engineer
(Airbus DS)



Romain Esteve

Environmental
economy
background
Consultant (London
Economics)

Our topic of investigation



European bees in numbers

Our
pollination
services are
vital

We ensure 39%
of crops and
wild plants
pollination ...

... and even
68% with our
cousins the
wild bees

But sadly this
number decreases
every year, we lost
5% the last 8 years

We are friends
with around
700,000
beekeepers in
Europe

They manage
more than 15
million hives to
host us



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Why are bees under threat?

But recently EC invested
€5,2M to study our health
and mortality
(Epilobee Programme)



DISEASES

- Genetic diversity
- Nest proximity
- Varroa



BEEKEEPING

- Skill set
- Disease Management
- Communication
(beekeepers/farmers)



ENVIRONMENT

- Food supply
- Foraging habitat
- Climate & Weather



AGRICULTURE

- Crop diversification
- Preservation of suitable areas
for pollinators



PESTICIDES

- Regulations
- Products usage
- Warning to beekeepers



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- Genetic diversity
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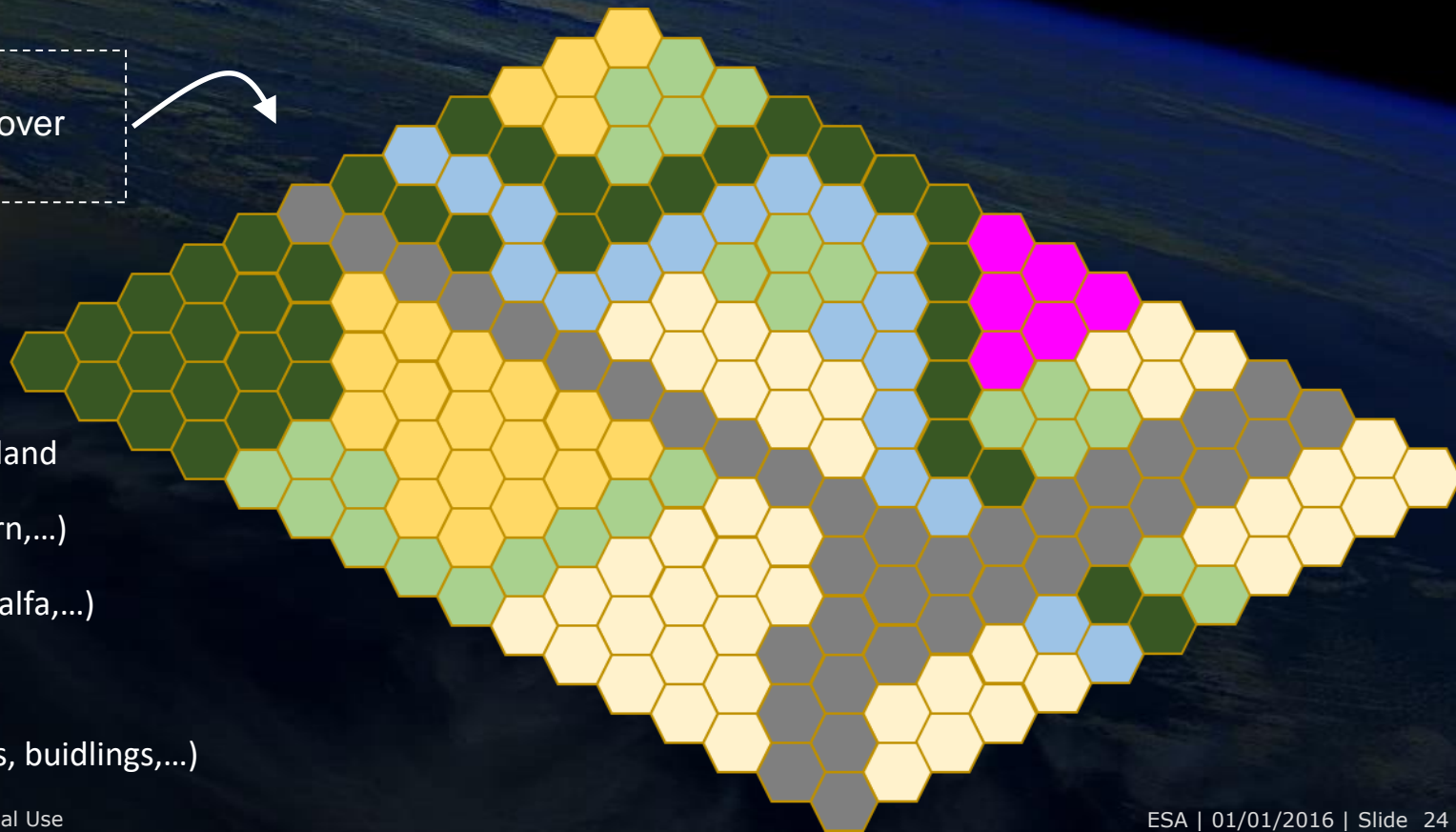
How to ensure the **sustainability of pollination services?**

- Protect and improve bees' health and survival
- Educate and inform beekeepers (professionals and amateurs)
- Raise awareness in the farmers population to encourage bee friendly practices
- Raise awareness in the general population (as we recently did with the Great British Bee Count)

- Develop an algorithm/application to analyse crops and hives data and provide information and advices to users
- Create a suitability map using satellite imagery, location based information and machine learning:
 - Detect the presence of water and protective areas (hedges, forests, etc.)
 - Determine the diversity of floral resource (type of plants, diversity, blooming periods)
 - Generate NDVI-like indexes to locate and identify food resources
 - Analyse the location of hives (potential competition and overcrowding) with in situ means (costly) or application based (preferred) pinpointing
 - Superpose environment and location information to build a suitability matrix

Our project Idea - Pitch

Input data
Advanced landcover
cartography



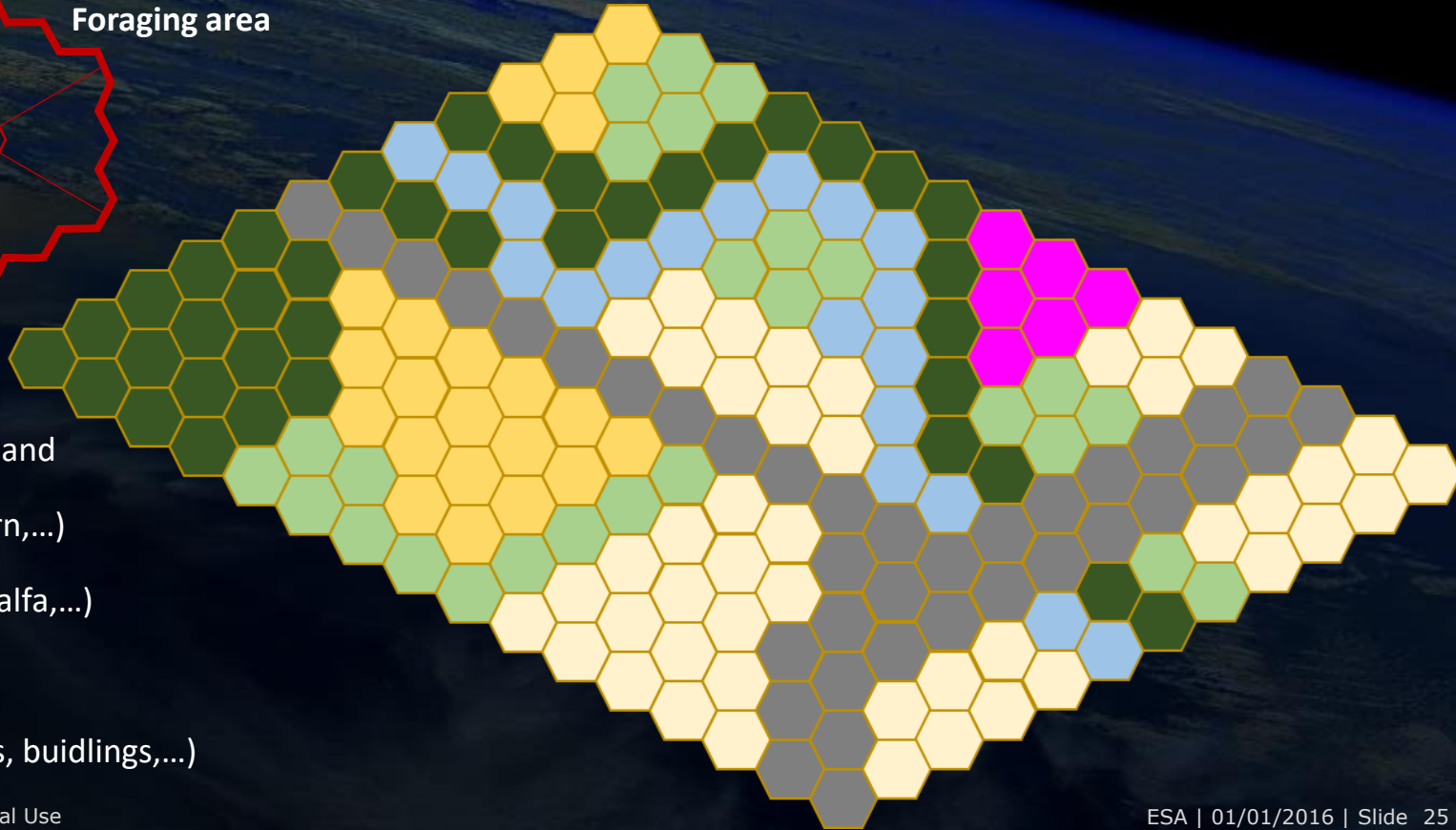


European Interparliamentary
Space Conference (EISC)

Our project Idea - Pitch



Foraging area



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European Space Agency



European Interparliamentary
Space Conference (BSC)

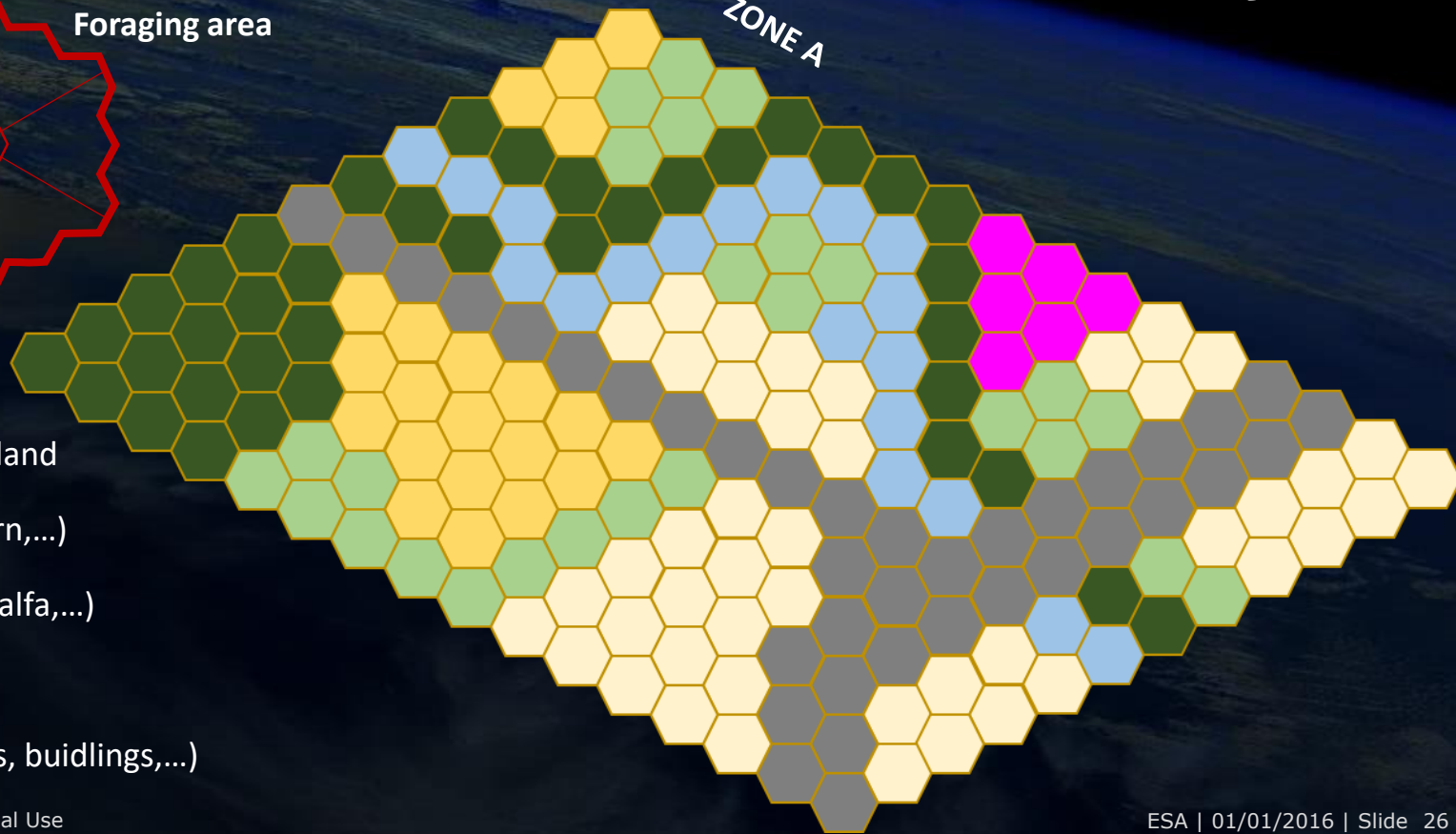
Our project Idea - Pitch



Foraging area

ZONE A

- Water
- Forest
- Meadows, grassland
- Field (wheat, corn,...)
- Field (canola, alfalfa,...)
- Orchard
- Build area (roads, buidlings,...)



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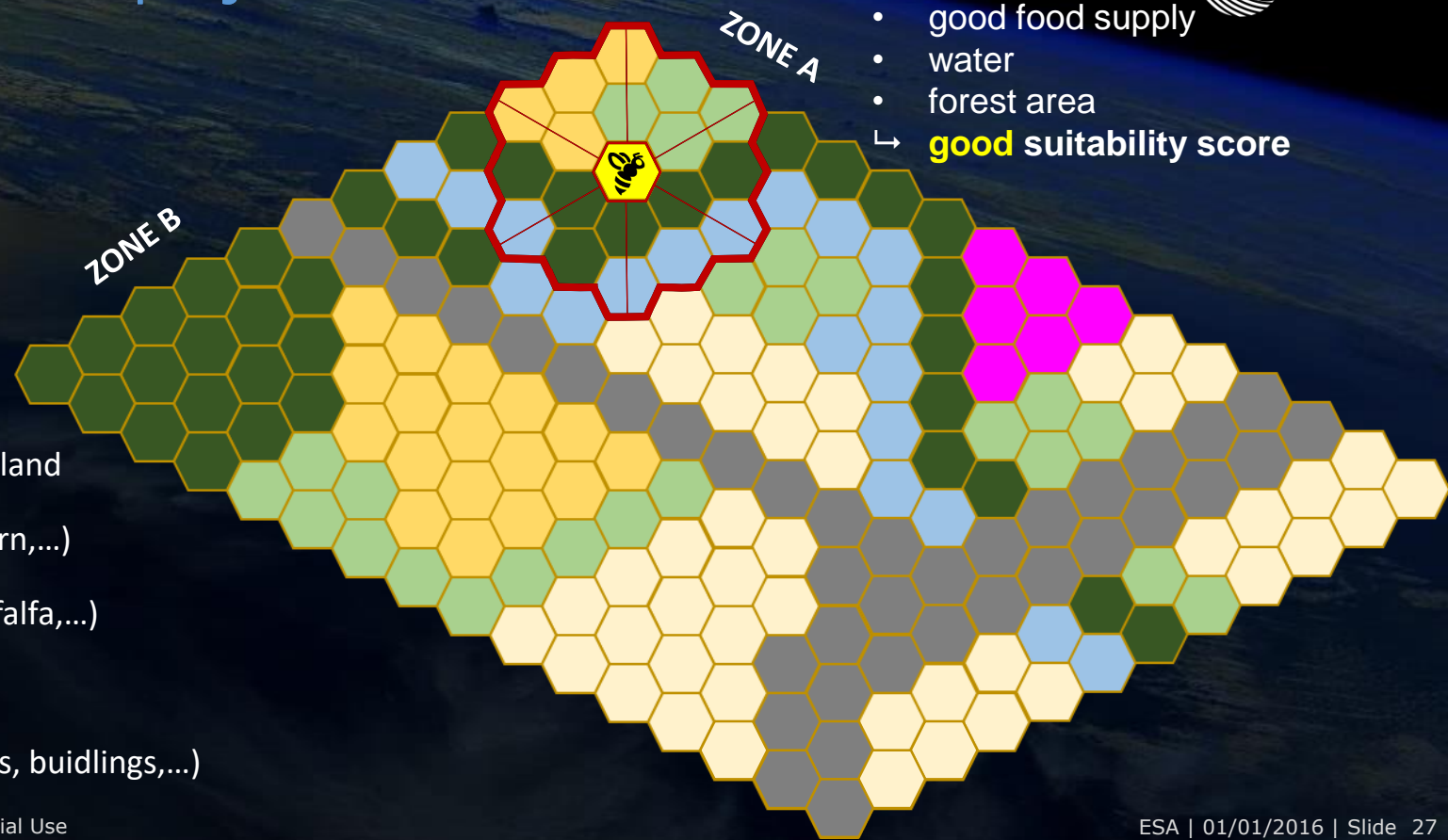
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European Space Agency

Our project Idea - Pitch

-  Water
-  Forest
-  Meadows, grassland
-  Field (wheat, corn,...)
-  Field (canola, alfalfa,...)
-  Orchard
-  Build area (roads, buidlings,...)

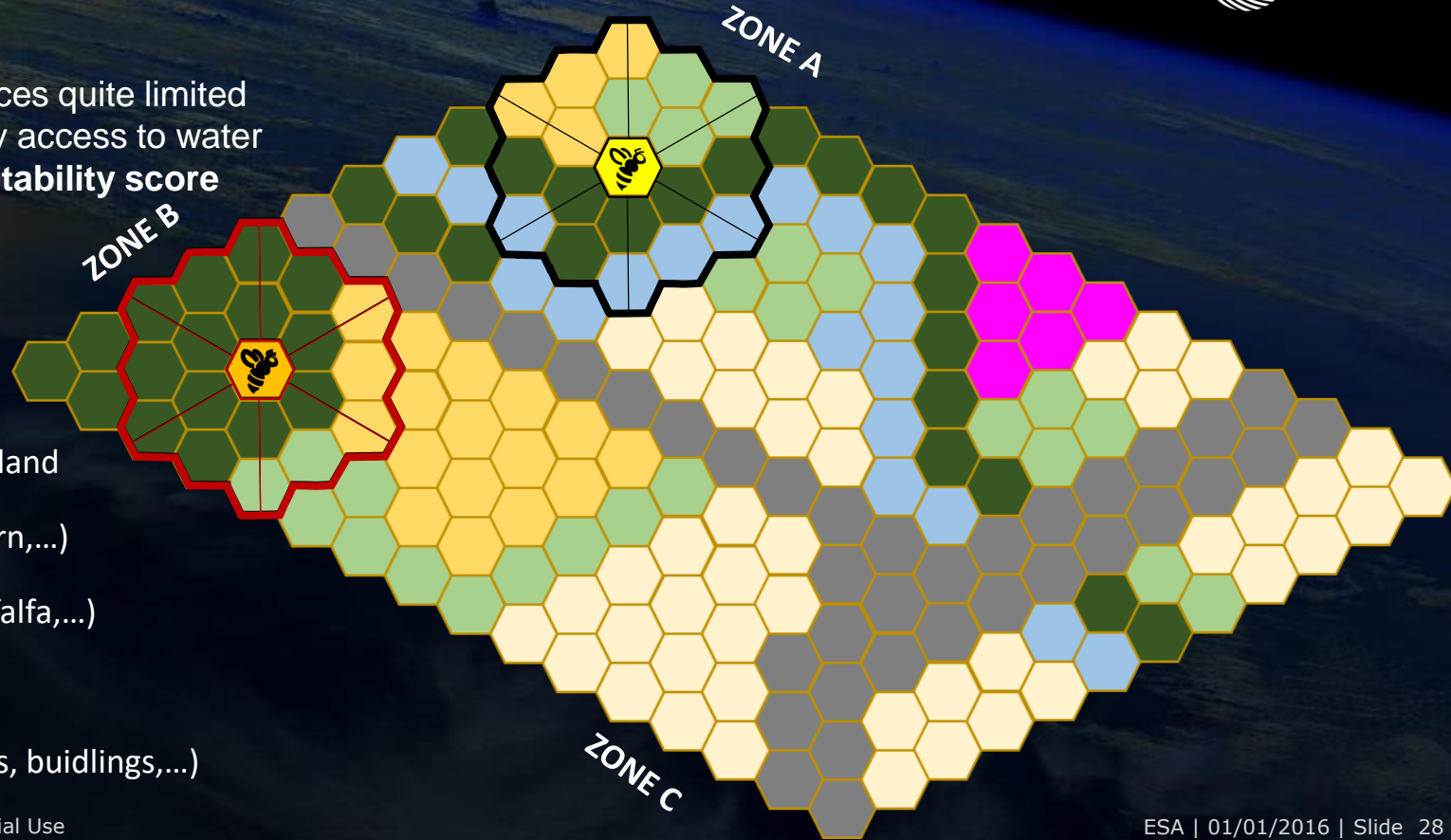


- good food supply
- water
- forest area
- ↳ **good suitability score**

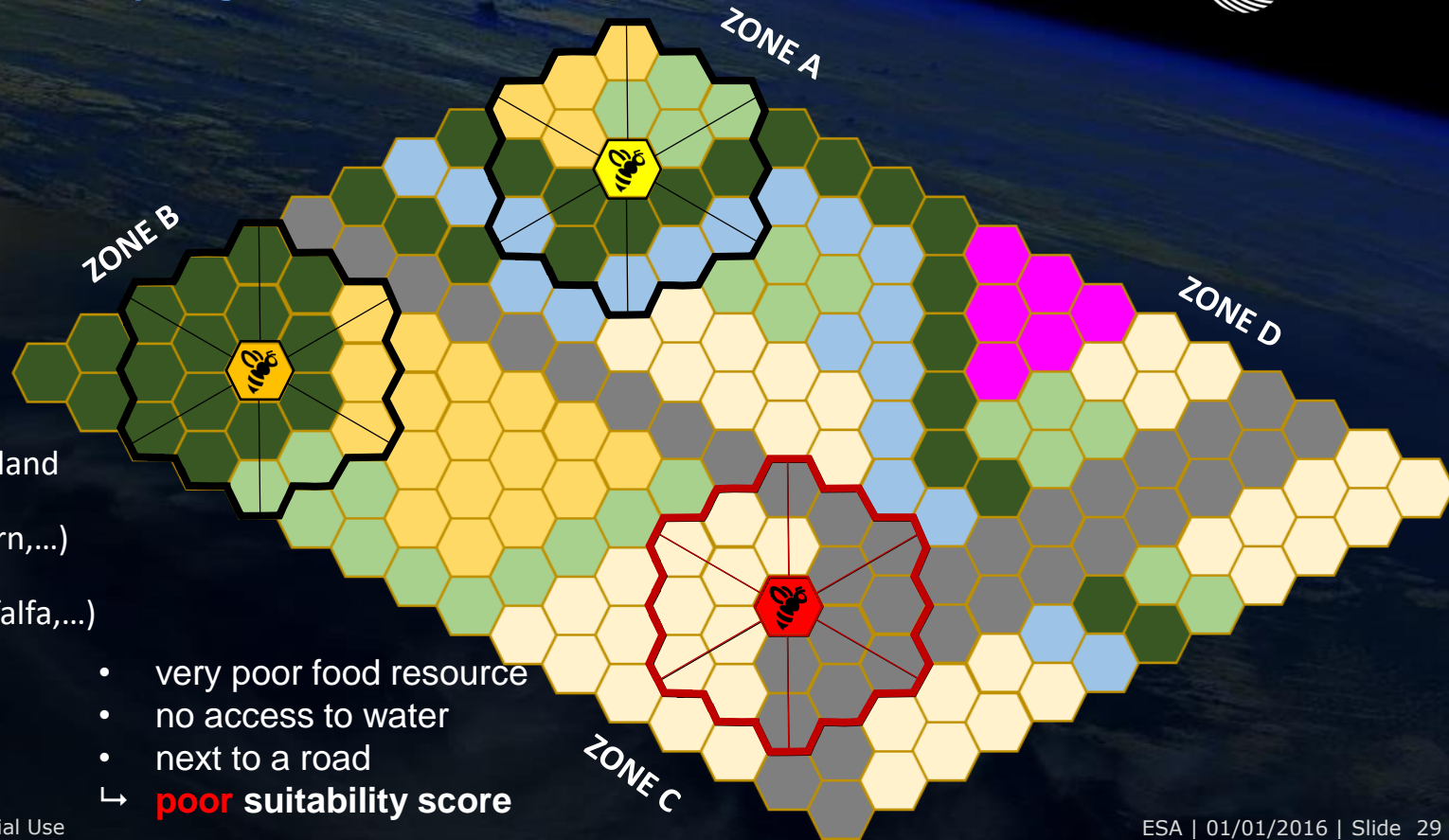


Our project Idea - Pitch

- floral resources quite limited
 - no very easy access to water
- ↳ **average** suitability score



Our project Idea - Pitch



Our project Idea - Pitch



- good food supply
- water and forest area
- orchard area benefiting from bees

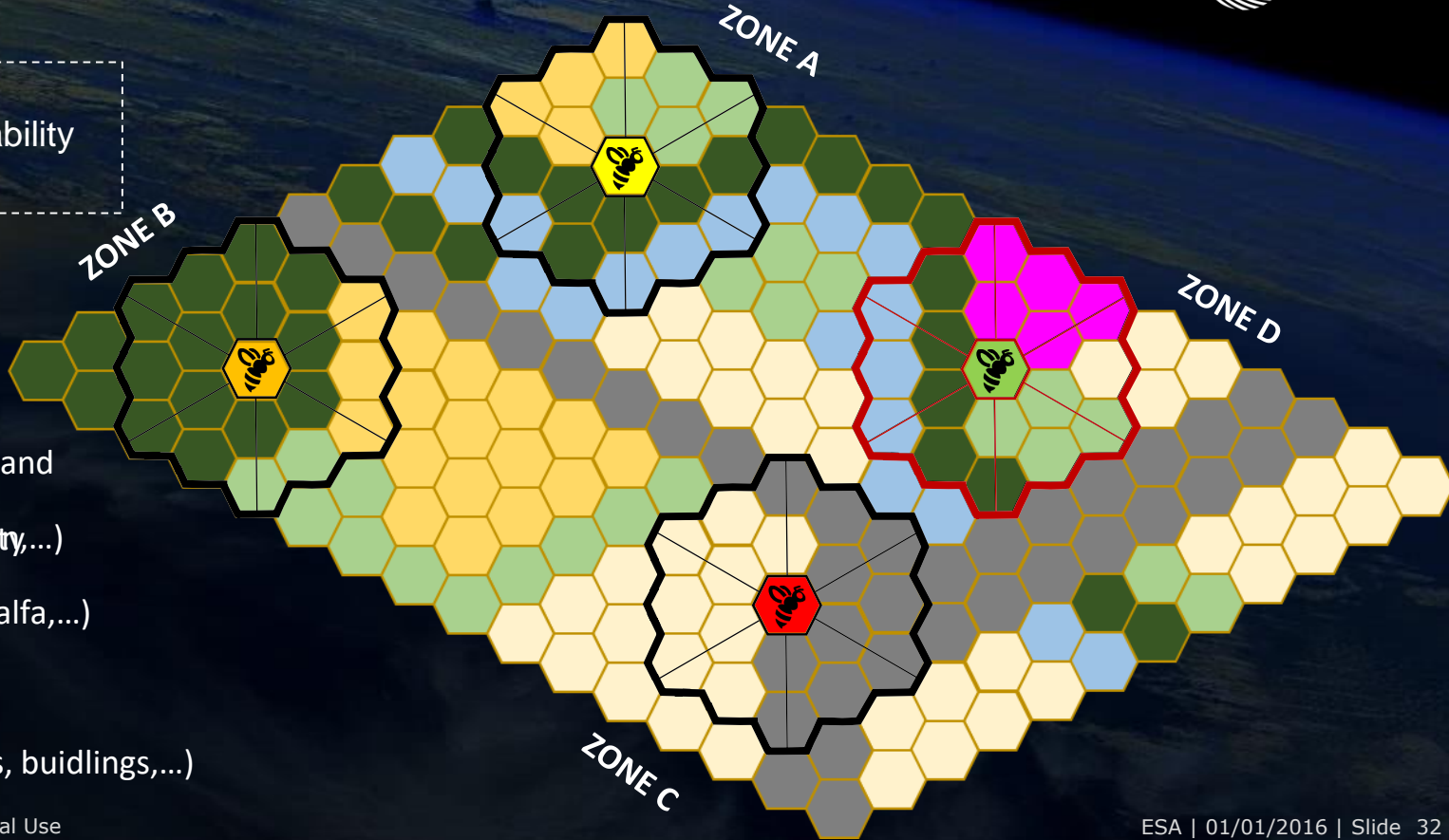


European Interparliamentary
Space Conference (EISC)

Our project Idea - Pitch



Output data
Bee Habitat Suitability
cartography



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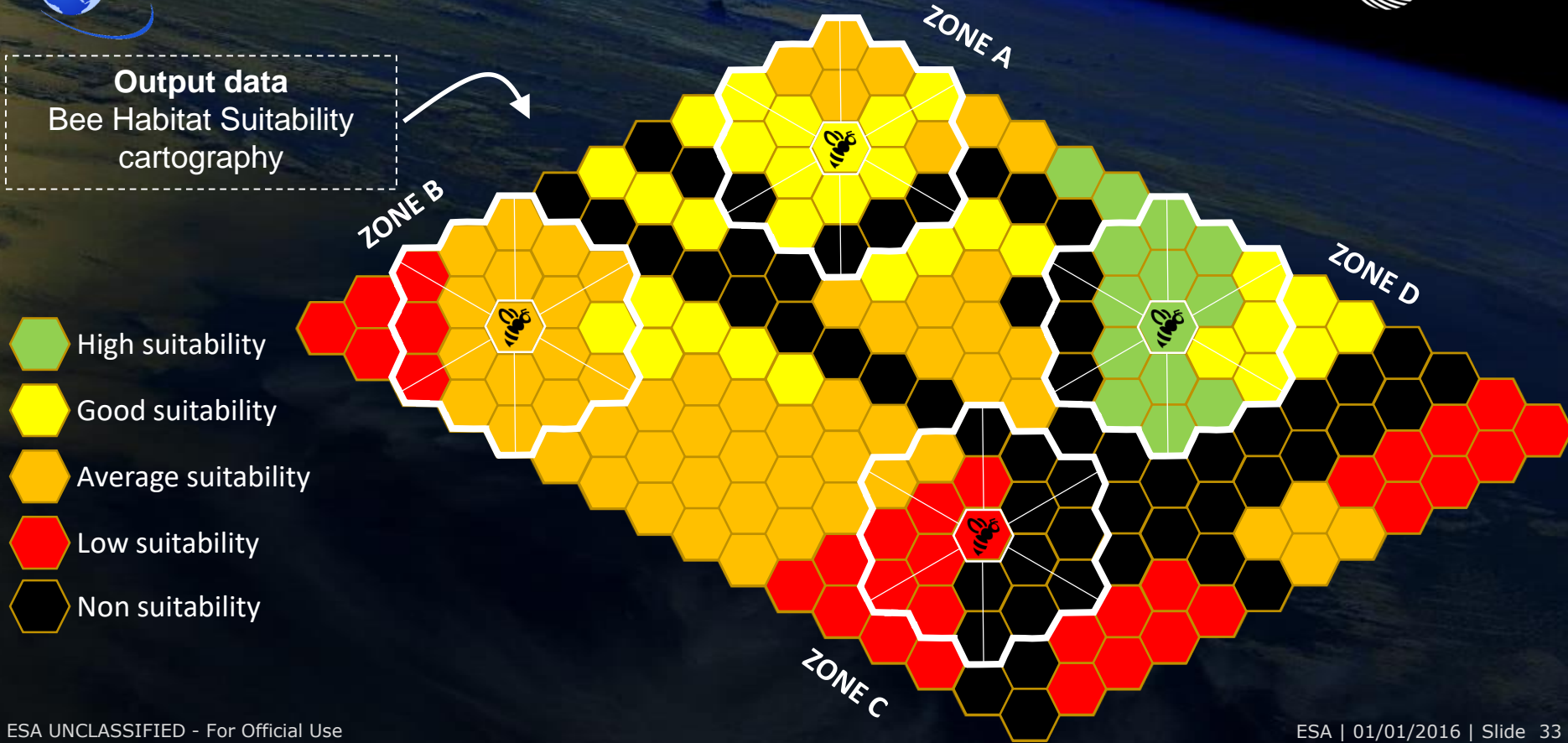


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Our project Idea - Pitch

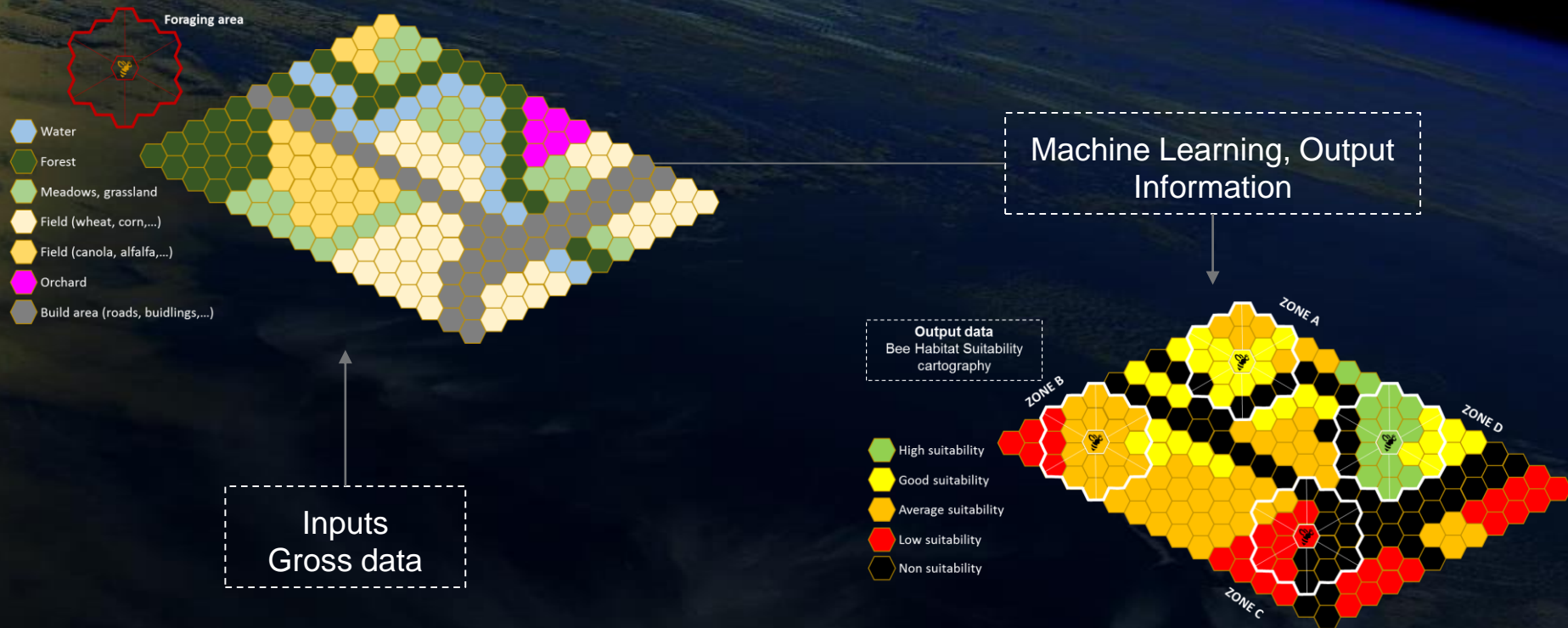
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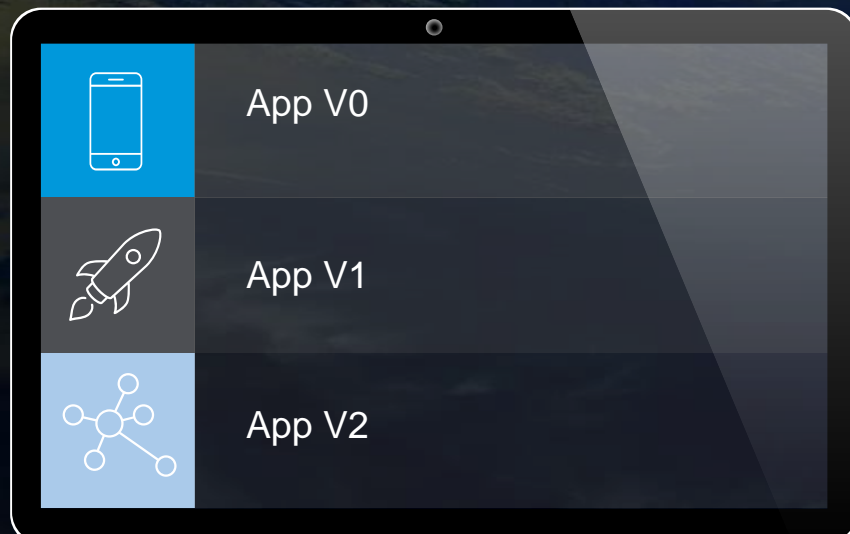
- High suitability
- Good suitability
- Average suitability
- Low suitability
- Non suitability



Our idea ... in short



What comes next?

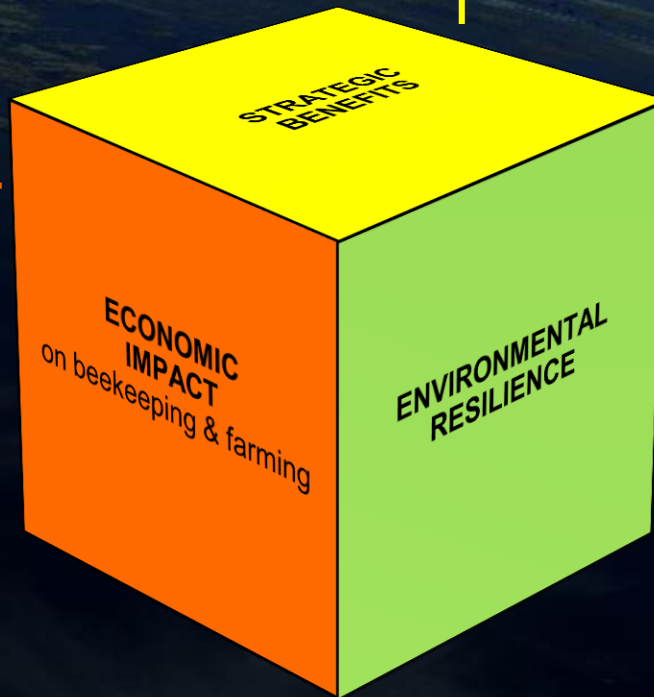


- 1- Develop an input/output algorithm
- 2- Integrate the algorithm in an app
- 3- Test the prototype at small scale

- 1- Use feedback to correct and improve the prototype
- 2- Launch at large scale

- 1- Integrate additional features such as disease alerts, pesticides use, chats/forums for knowledge and good practices sharing
- 2- Extend from rural to urban use of the method

- 02** —
- Yields improvement (honey, wax, crops, etc.)
 - Quality improvement (nutrient content)
 - Optimisation of beekeeping services



03

- Better practices and shared knowledge
- Reduction of uncertainties
- Improved decision making by accessing information

01

- Habitat conservation
- Biodiversity preservation

*Without bees, the world is just a
beautiful place...*

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