

Feasibility Study for the Development of Precision Agriculture in Mexico

Workshop on the Use of Global Navigation Satellite Systems for
Scientific Applications

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Rafael Ortiz, Mexican Space Agency



Outline

1. Mexican Space Agency
2. Precision Agriculture
3. GNSS Applications in PA
4. Mexico Agricultural Scenario
5. Challenges and Proposed Scheme
6. Conclusions

Mexican Space Agency

- Recent creation (3 years old)
- Under de Ministry of Communications and Transportation
- Main Objectives:
 - Capacity Building
 - Promote space related research
 - Establish international presence in outer space matters
 - Raise awareness of the benefits of space technologies
 - Develop space applications for mexican society
- Through cooperation between government, academia and industry.
- Through international cooperation.

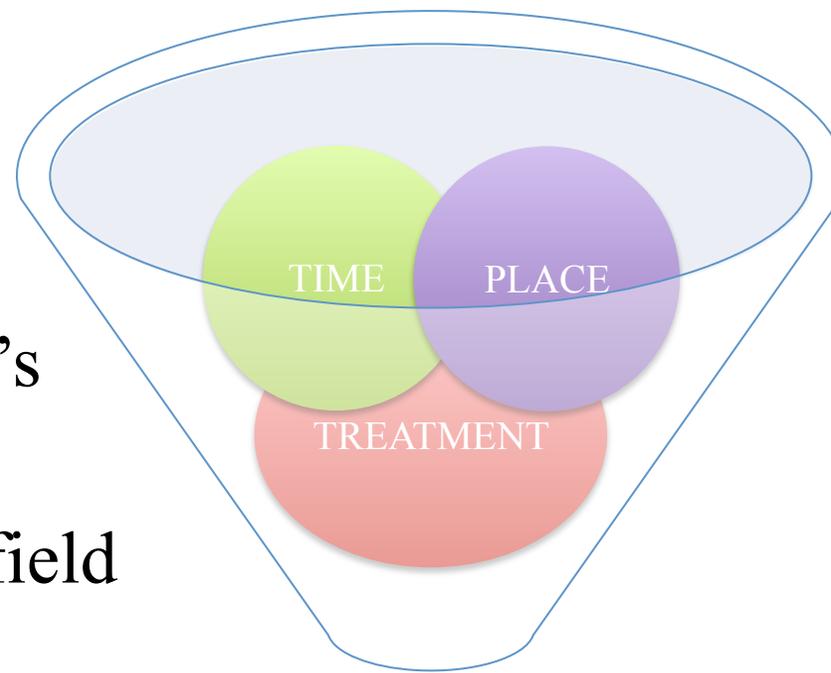


Mexican Space Agency

- Some of the issues that are being addressed by the Agency:
 - Earth Observation
 - The development of an Early Warning System
 - Ground infrastructure
 - Development of the National Center for Geomatic, Space and Astrophysics Data Storage and Processing
 - **Space Weather**
 - **Cooperation with National Universities to establish the first Mexican Space Weather Service**
 - NEOs
 - Legislation proposal
 - Space Debris
 - Legislation proposal
 - **Space applications towards scientific research, civil security and safety**
 - **Recommending actions in different fields of applications to end-users**

Emerged in mid-1980's

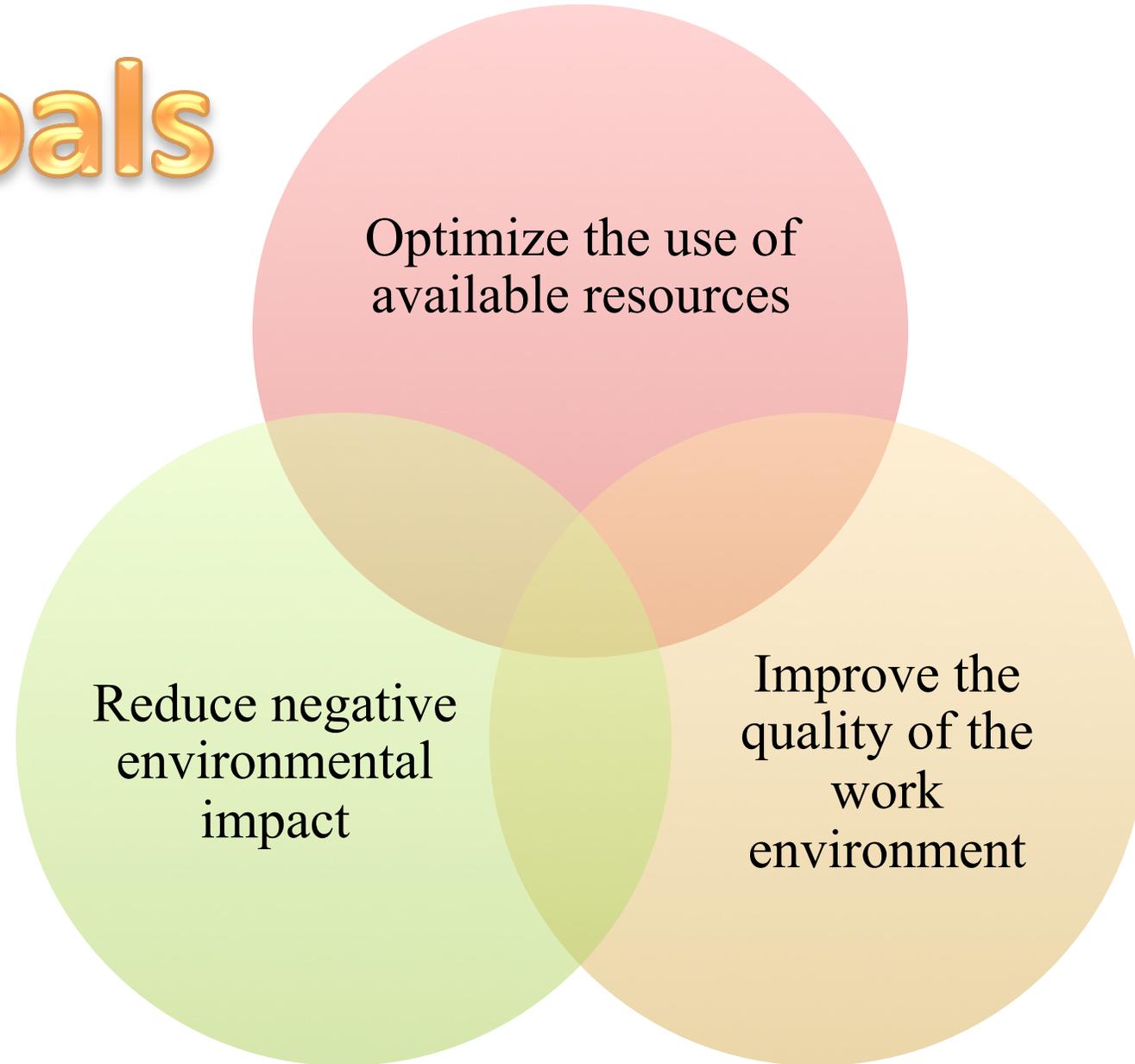
Multi-disciplinary field

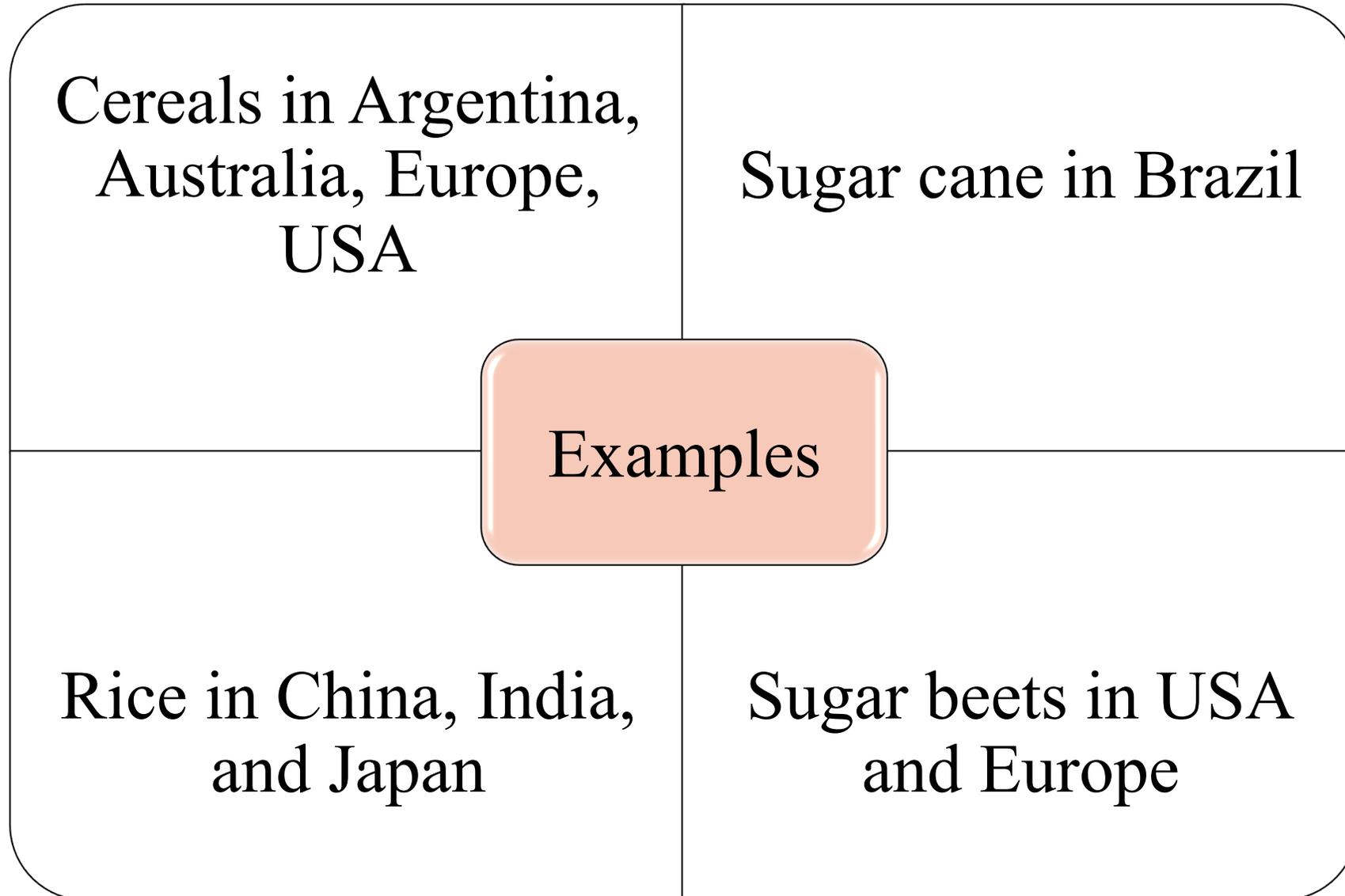


**PRECISION
AGRICULTURE (PA)**

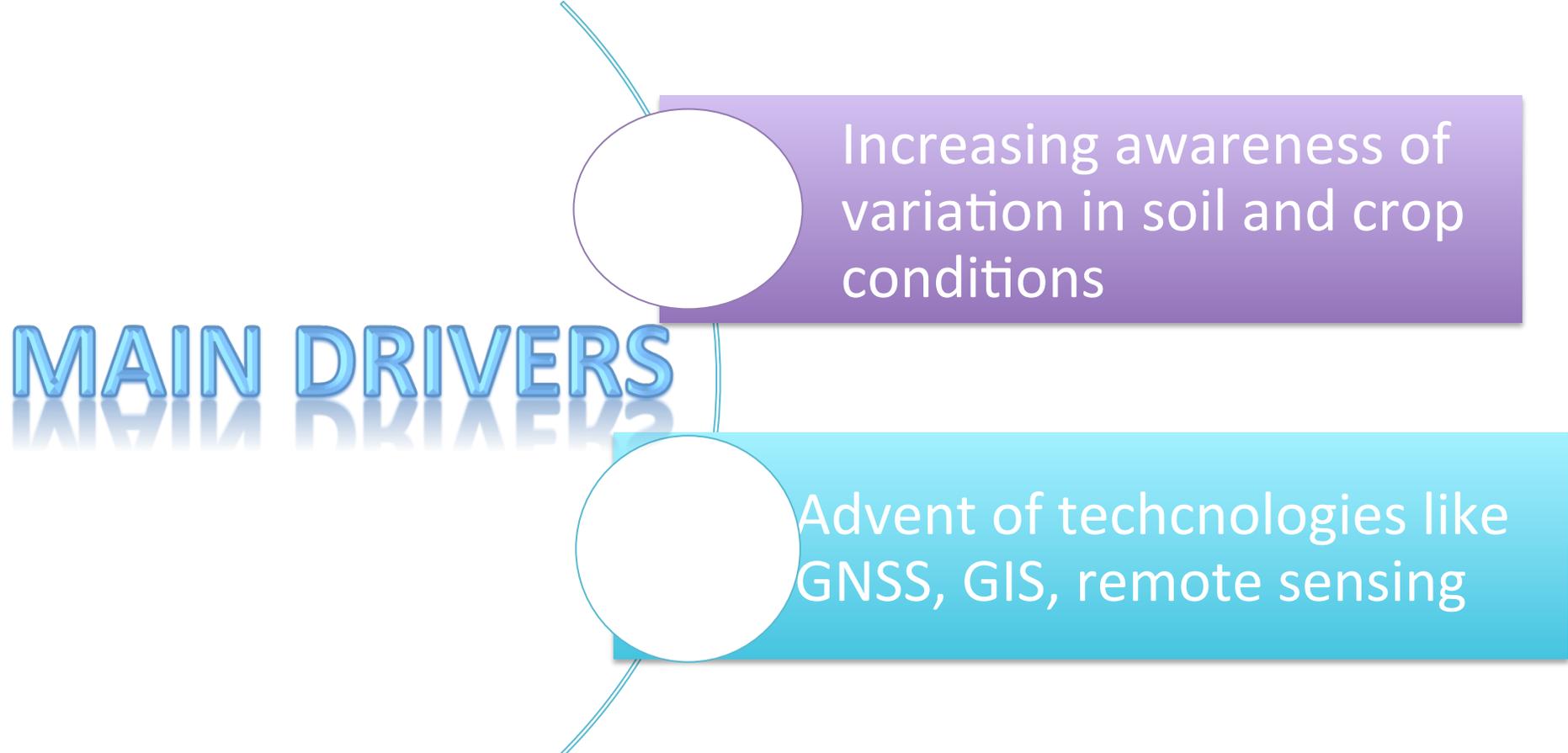


Goals





MAIN DRIVERS



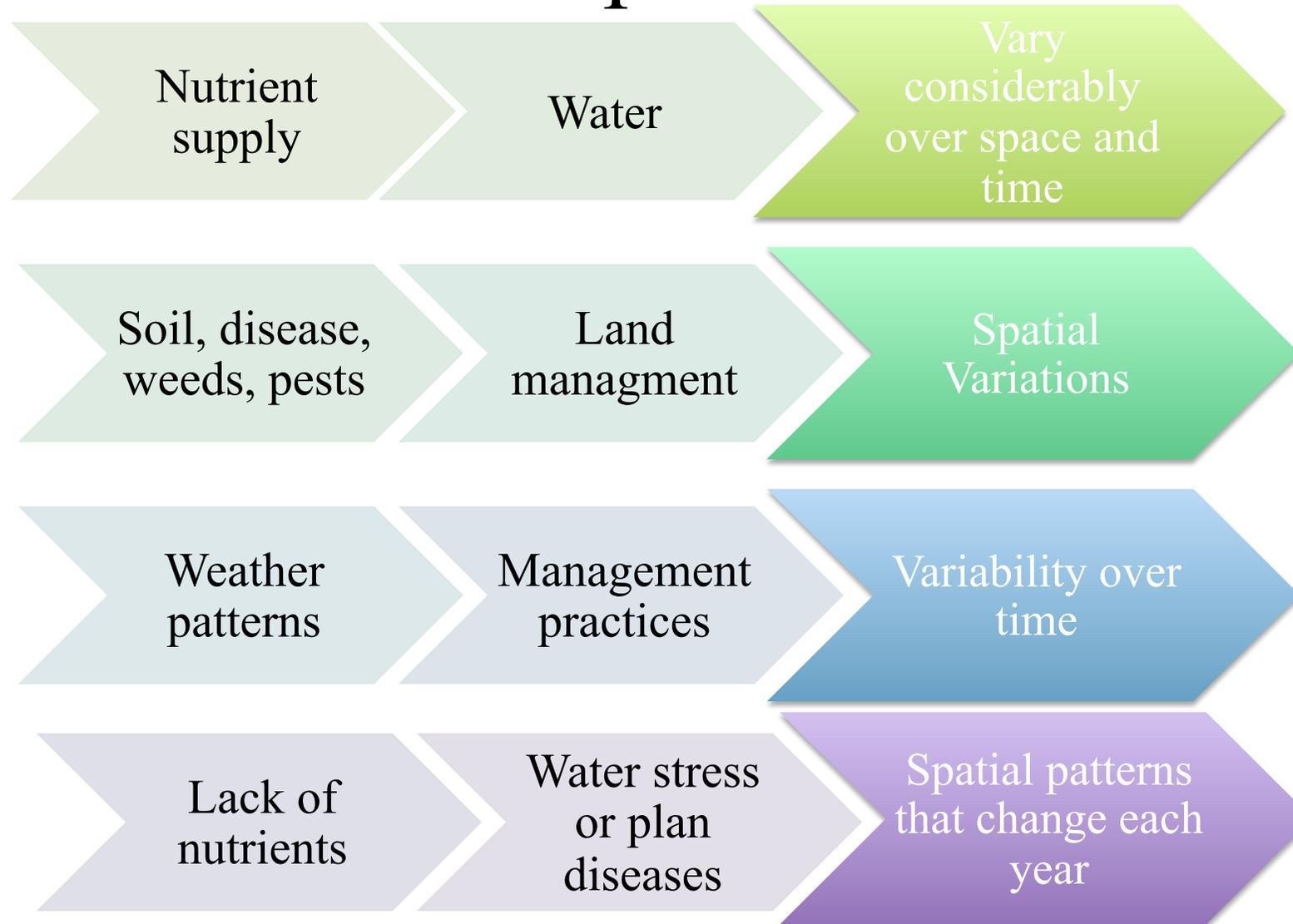
Increasing awareness of variation in soil and crop conditions

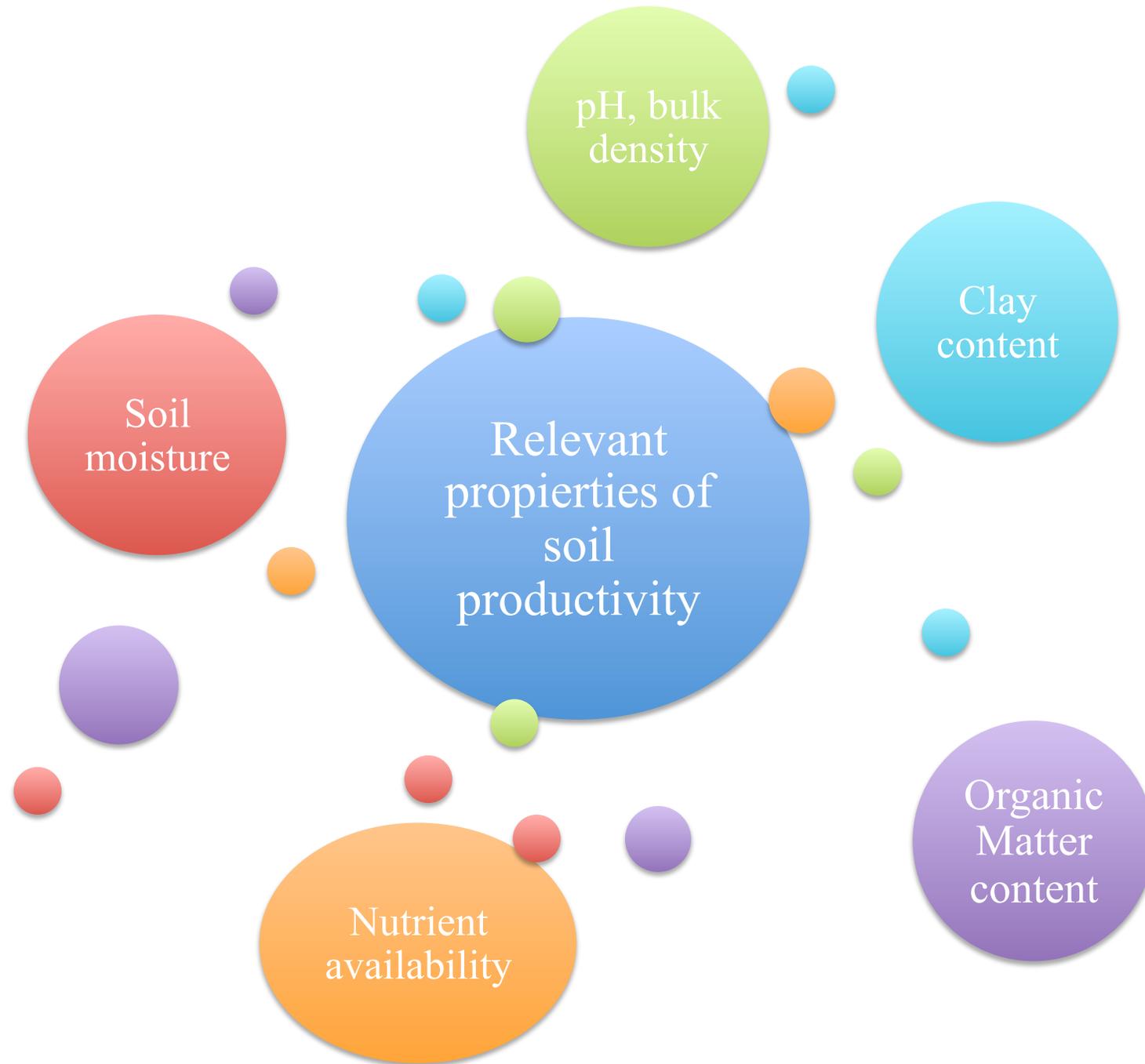
Advent of technologies like GNSS, GIS, remote sensing

Main crop variations

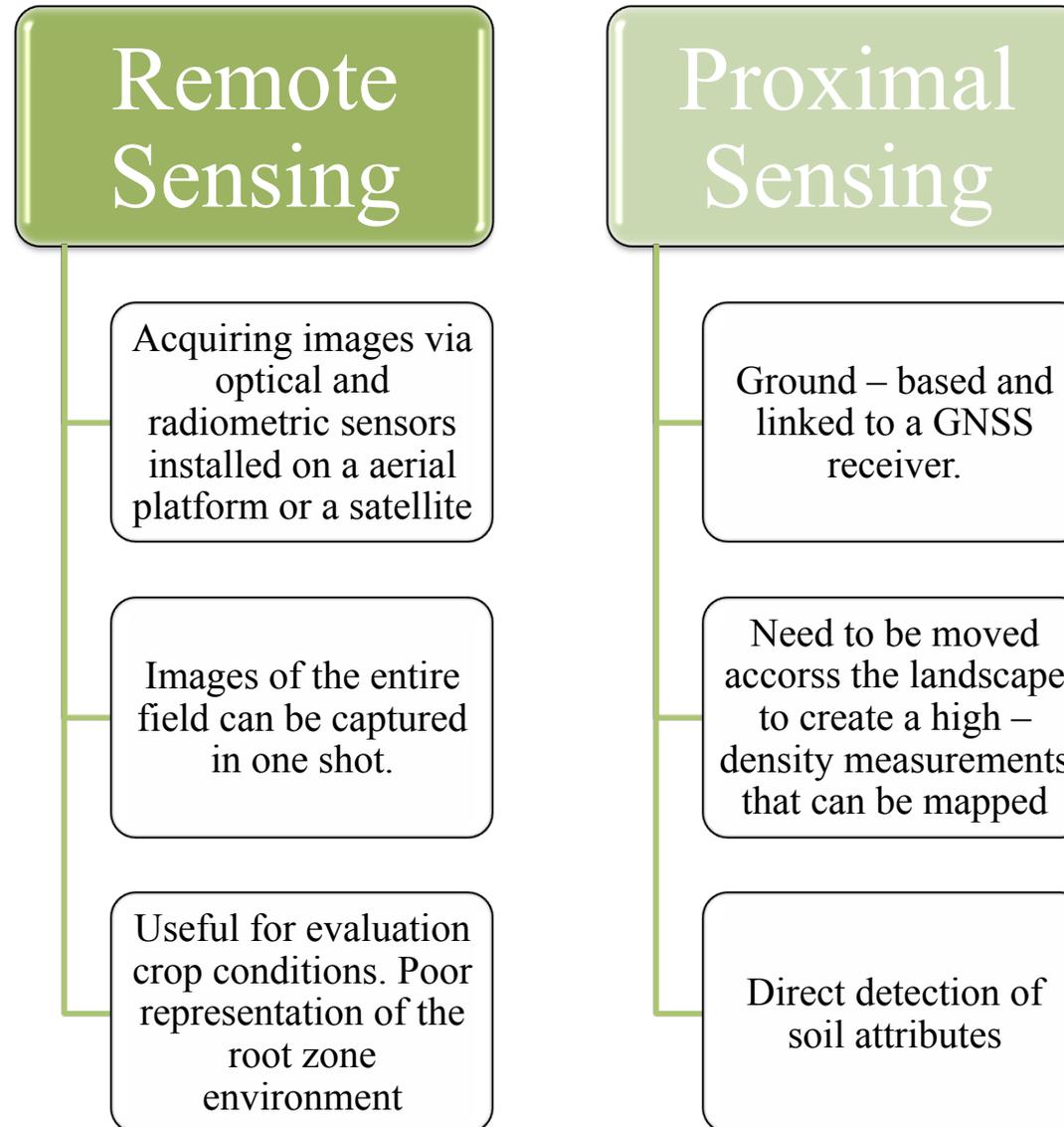
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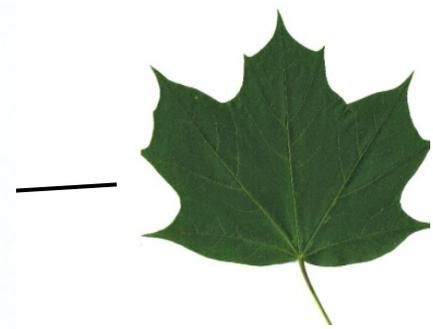
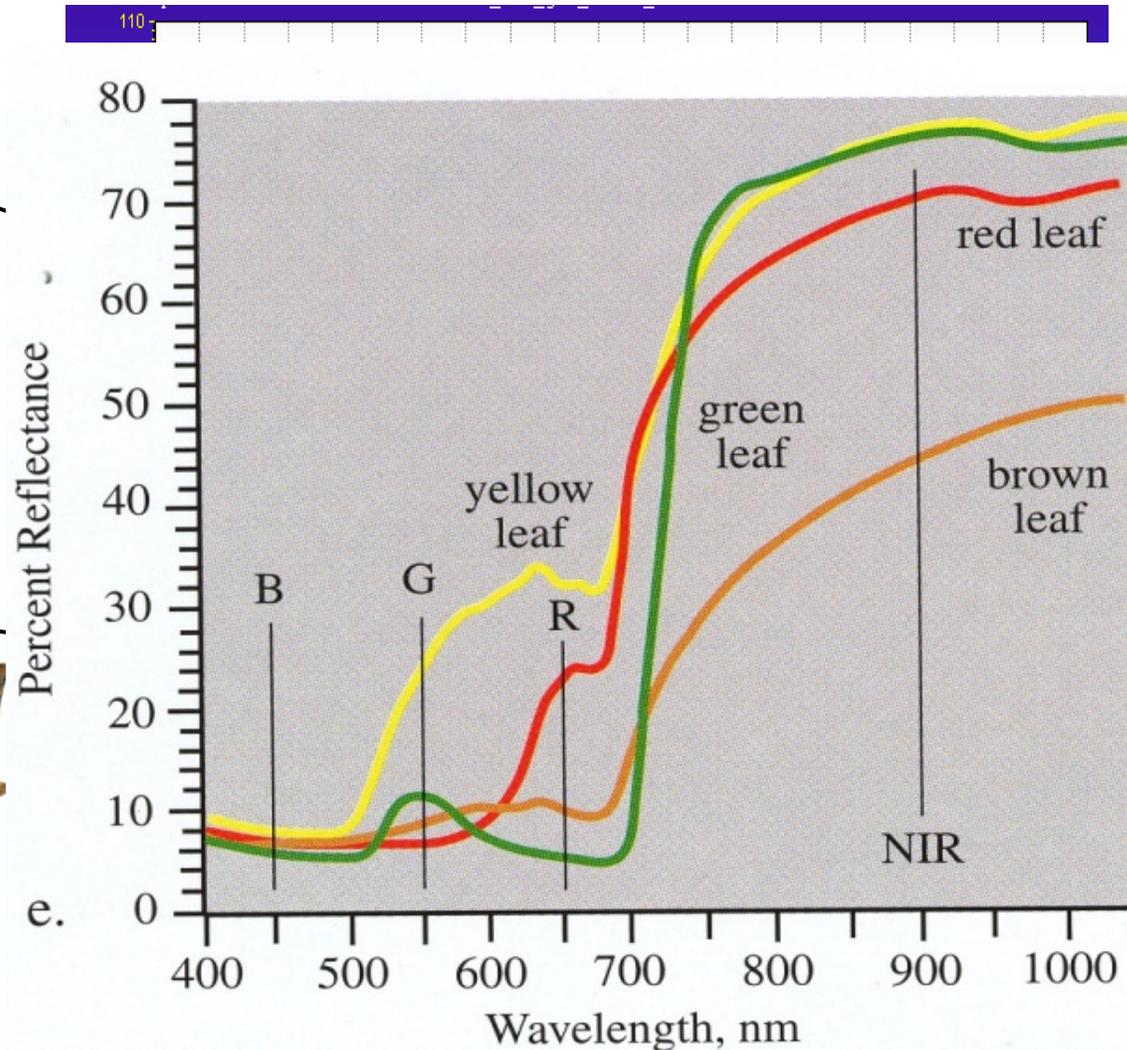




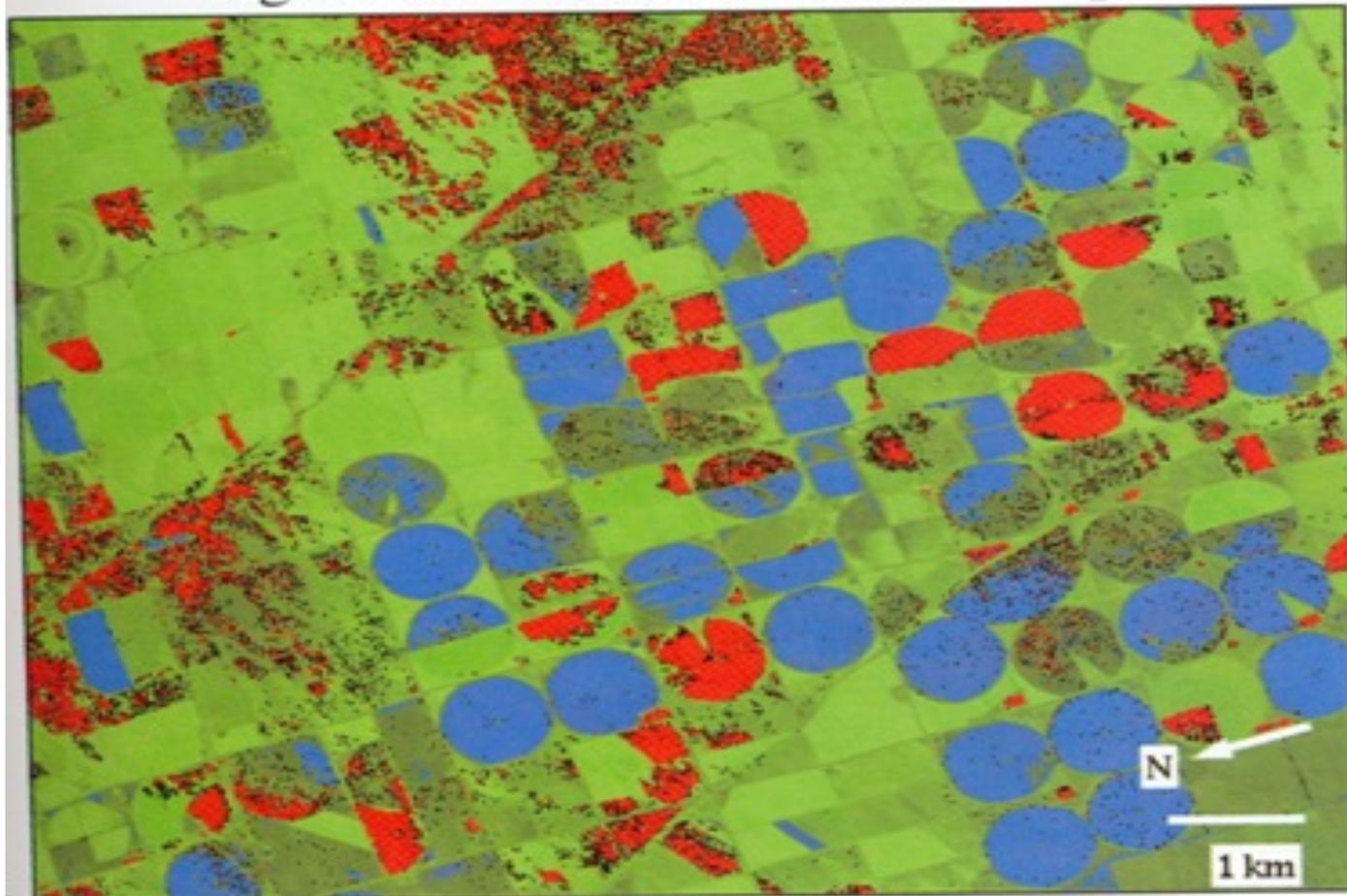
Spatial Resolution



Spectroscopy: to detect biomass, chlorophyll content
nitrate stress, infections.



Vegetation Senescence/Stress Map



 healthy green
vegetation

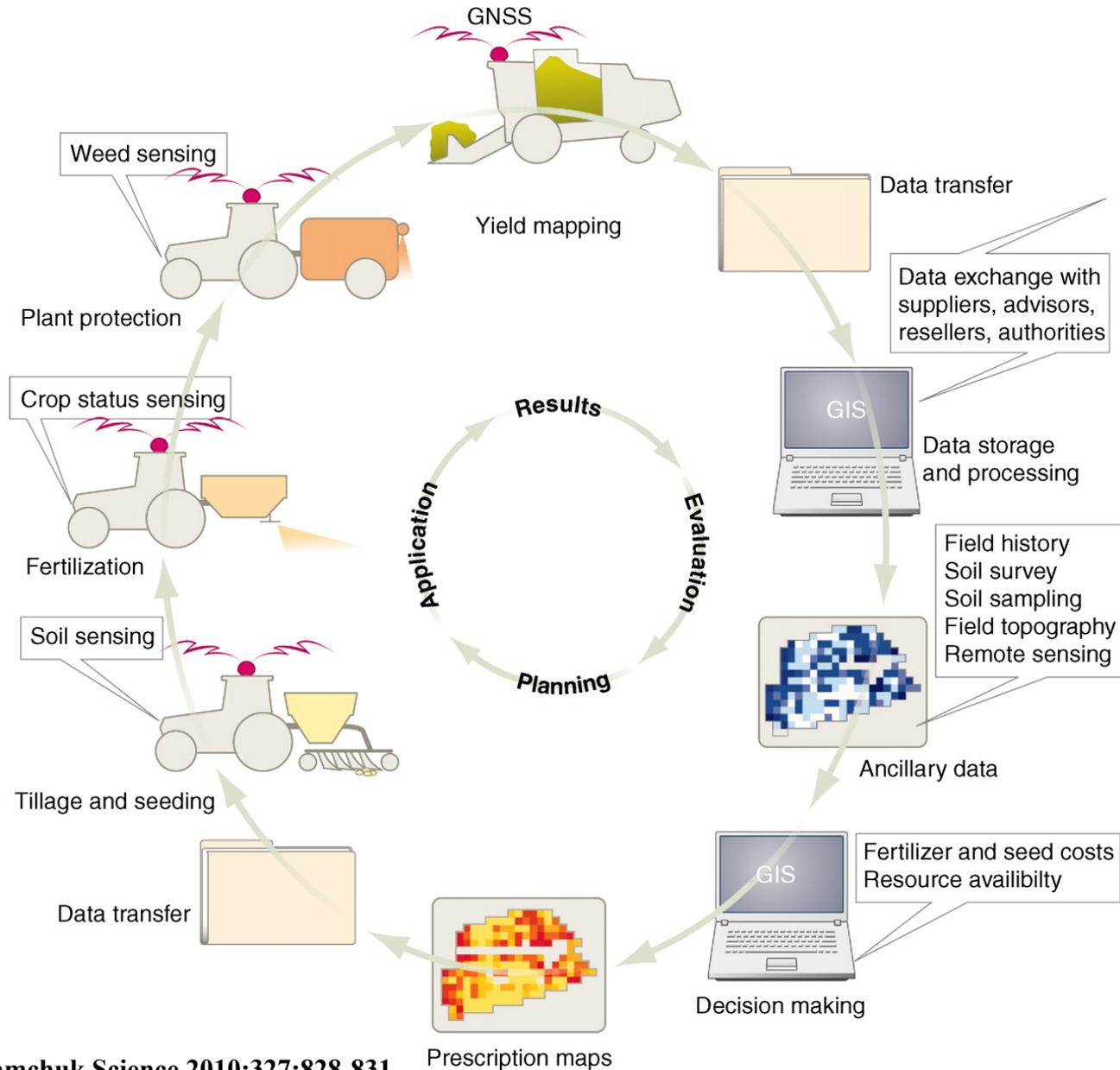
 dry vegetation/
bare ground

 stressed
vegetation

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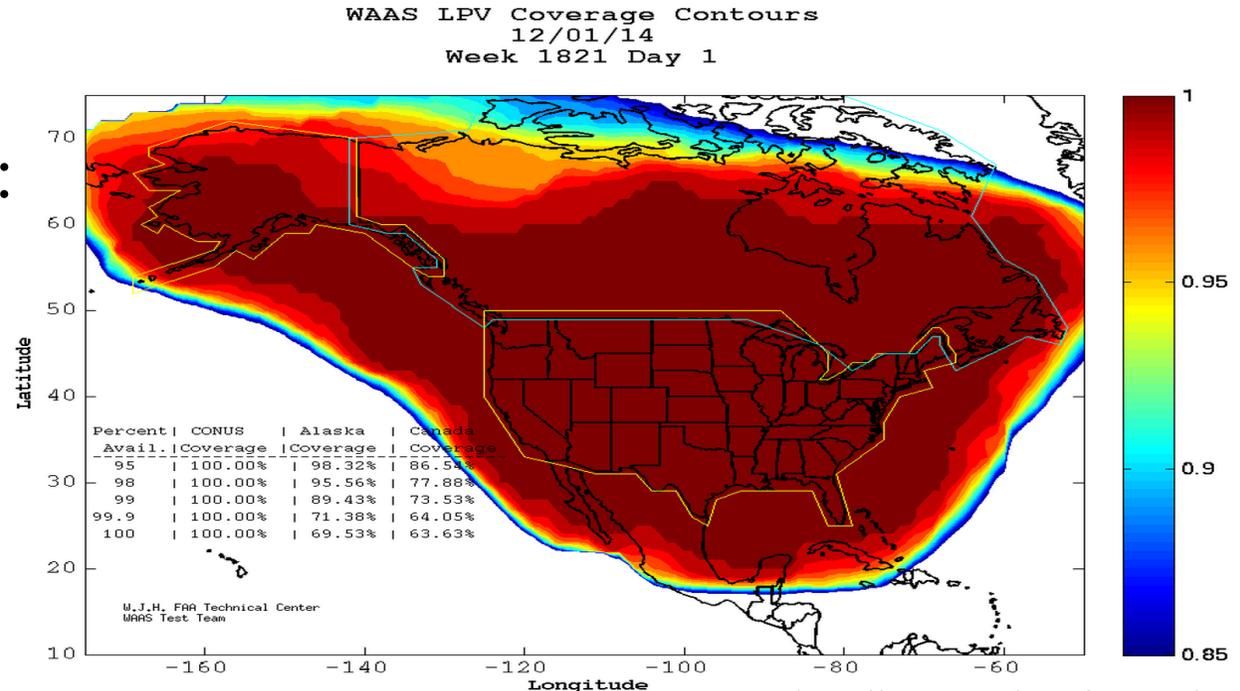
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Precision agriculture information flow in crop production



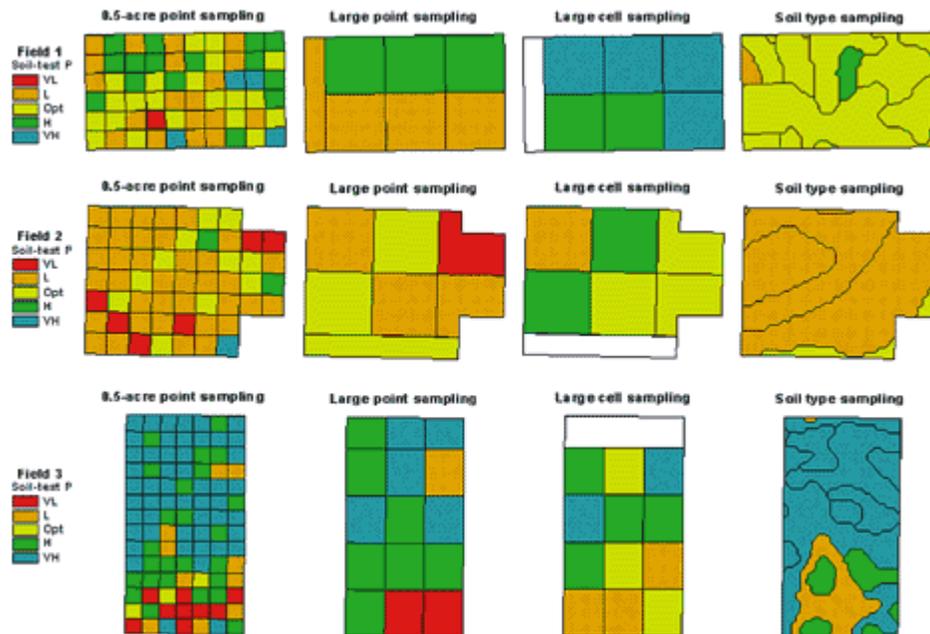
Role of GNSS in PA

- Higher precision → Higher costs
- Minimum requirement of precision:
 - Differential GPS
 - WAAS
 - RTK
- Instrumentation
 - Lightbars
 - Auto-steer
 - UAV-Remote Sensing





- GNSS-based vehicle guidance has been the most widely used precision agriculture technology.
- Other popular applications:
 - geo-referenced grid soil sampling;
 - boundary mapping;
 - variable rate application of lime, phosphorus and potassium
 - variable irrigation systems



Predictive approach

Yield history, thematic soil maps, field topography, and other spatial data records are used to predict variable crop performance and input needs.

Reactive approach

Rates of agricultural chemicals are varied according to the crop status at a given place and time. This requires real-time sensing and online application.

Scientific Applications

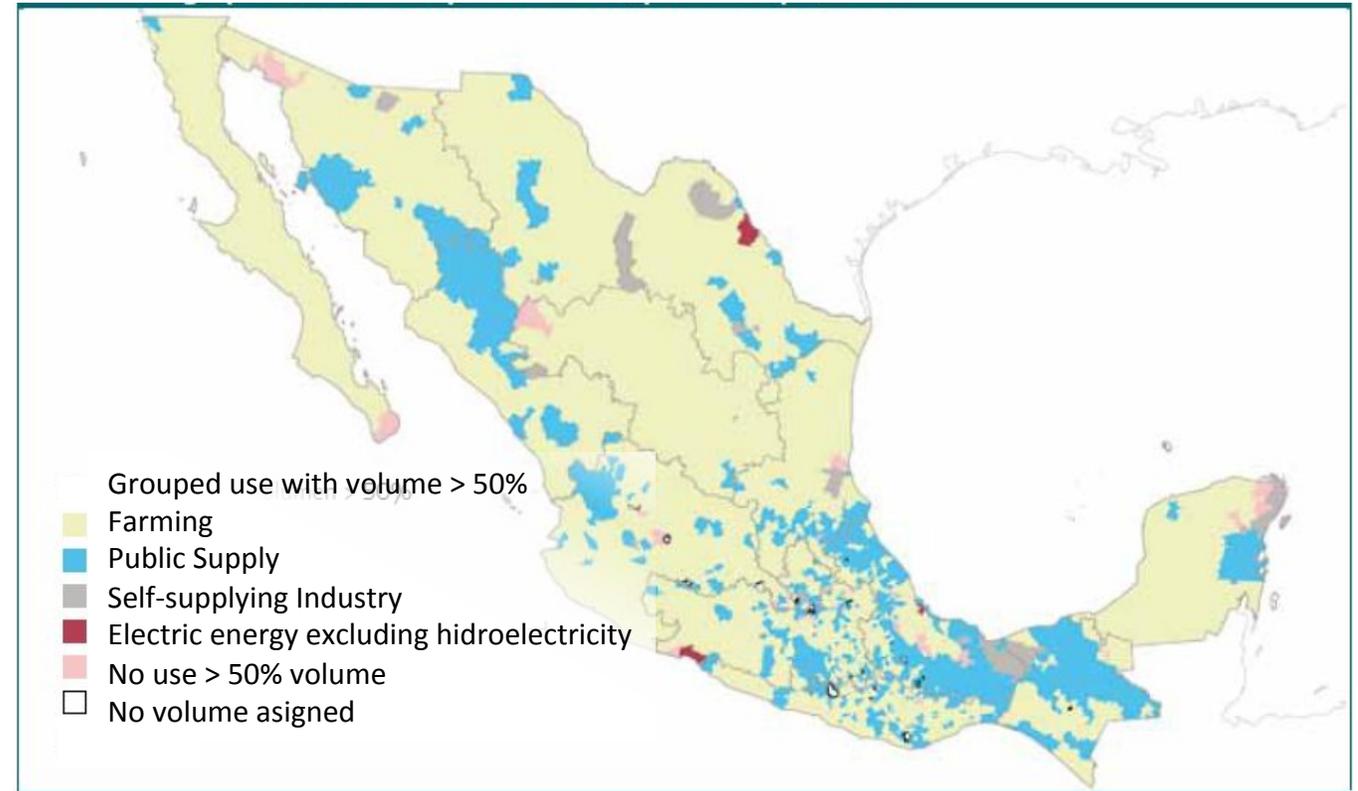
- Correlation studies using DEMs
- Historic yield studying the effects of climate change locally
- Food chain traceability
- Integration of different satellite technologies towards agronomic research
- Genetic research
- Validation of remote sensing processing algorithms

Mexico Agricultural Scenario

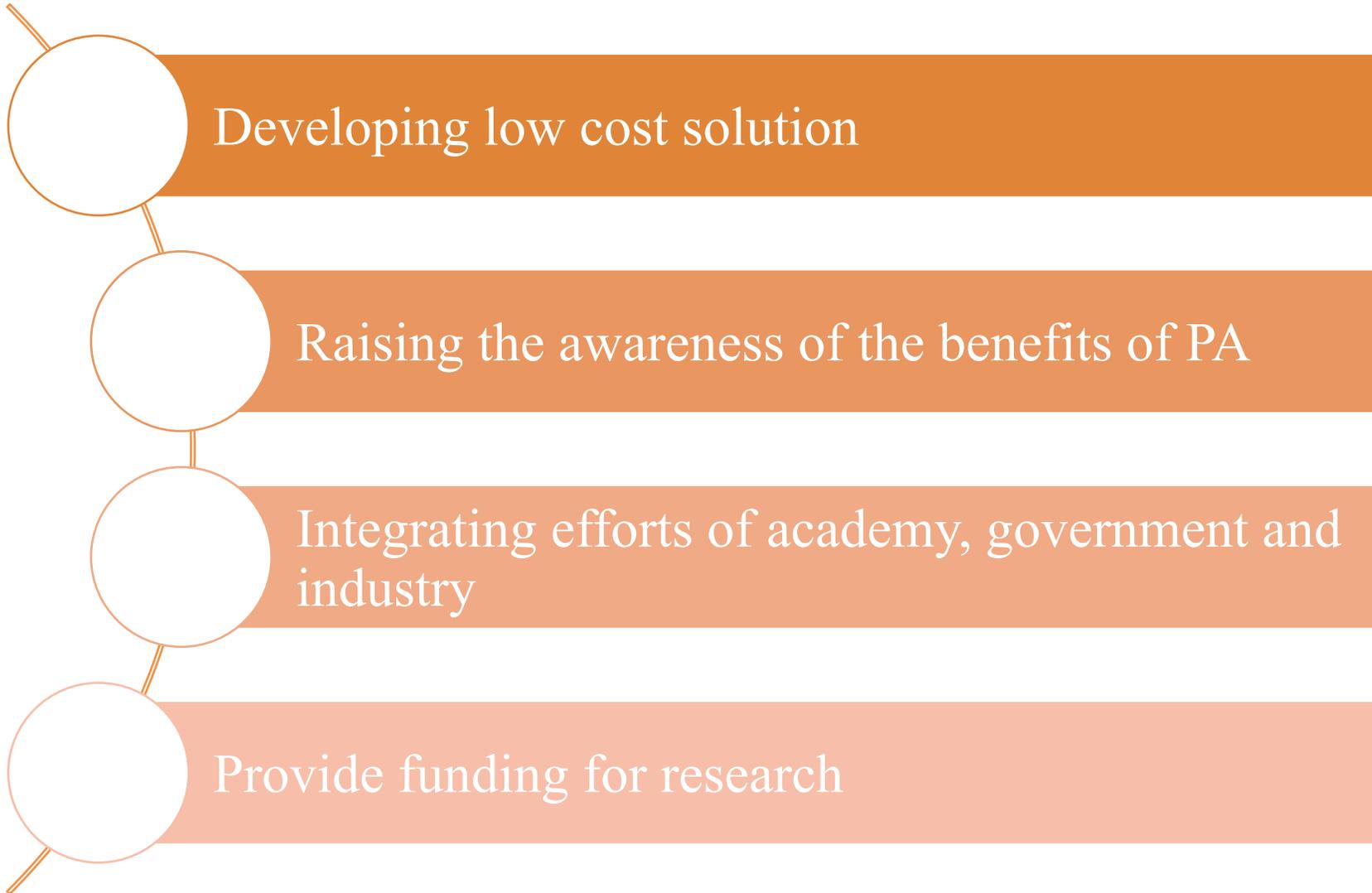
- 4% of the GDP
- 10% of the Mexican population is employed in this industry
- 15% of the national territory is destined to agriculture industry
- Main products:
 - Sugar Cane
 - Maize
 - Wheat
 - Potato
- No existence of PA infrastructure in the country
- GNSS is primarily used in topography, cartography and aviation.

Mexico Agricultural Scenario

- Land use and irrigation processes are unefficient.
- Remote sensing is currently being used by the Mexican Ministry of Agriculture to do crop research, but it is limited. (SPOT-5 and SPOT-6)
- Food and water security are priorities for any State



Challenges



Proposed Scheme of Action

- Cases of study are being prepared with the support of national universities, the Ministry of Agriculture and farmers
 - WAAS capable GPS hand-held receivers
 - Soil sampling equipment
 - Maize and sugar cane crops
 - 6 different locations around the country
- Validation of remote sensing data
- Deliver results to the appropriate federal instances
- Request further funding for development of other GNSS technologies towards food security and irrigation process

Conclusions and further work

- Mexican farming industry needs attention
- Long-term Capacity building (e.g. RTK Networks dedicated to farming)
- Increasing precision of measurements
- Promote the adoption of this techniques by the farmers
- Mexican government must offer financial support
- Strengthen the collaboration between federal entities
- Learn from others (International Collaboration)

Thank you!

Rafael Ortiz Aguilera

Mexican Space Agency

ortiz.rafael@aem.gob.mx

www.aem.gob.mx

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