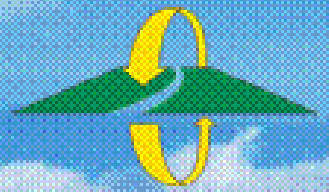

Location Based Automation and Information Management in Agriculture – Review and Outlook

Club of Bologna

21st Members Meeting

Dr. agr. Patrick O. Noack

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Introduction

- GNSS have introduced the capability to determine position and time with a very accuracy
- Agriculture has embraced GPS for data collection and controlling tractors and implements
- GNSS are closely related to Precision Farming = Location Based Automation and Data Management
- The full potential of GNSS has not been fully exploited
- The main stop blocks are
  - the lack of communication standards and
  - the lack expert systems for the transformation of data into information (process data and agronomic precision farming)

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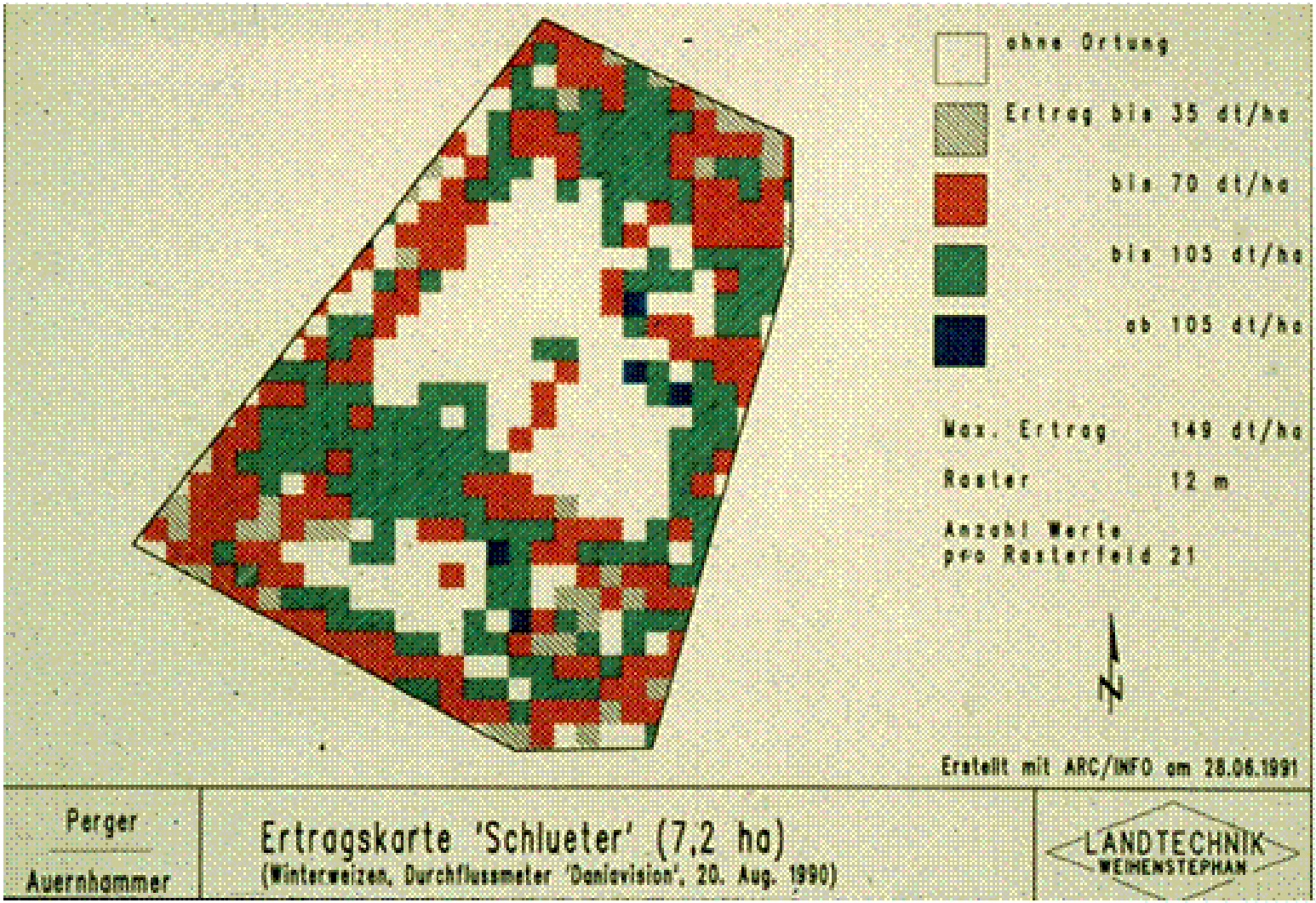
Yield Map 1990



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Review

- GPS available for private use since late 1980s
- Yield Mapping was introduced in early 1990s and revealed yield differences in a subfield level
- The idea of variable rate application (VRA) was born
- The discussion on how to best generate application maps from soil and yield maps is still ongoing without a consensus. Lack of standards blocks dissemination.
- Parallel Swathing systems appeared as of 2000
  - simple to use
  - Instant effect on costs
- Automatic Steering Steering evolved from Parallel Swathing as of 2003
- Boom section control systems available since 2005

Rapid market adoption and dissemination

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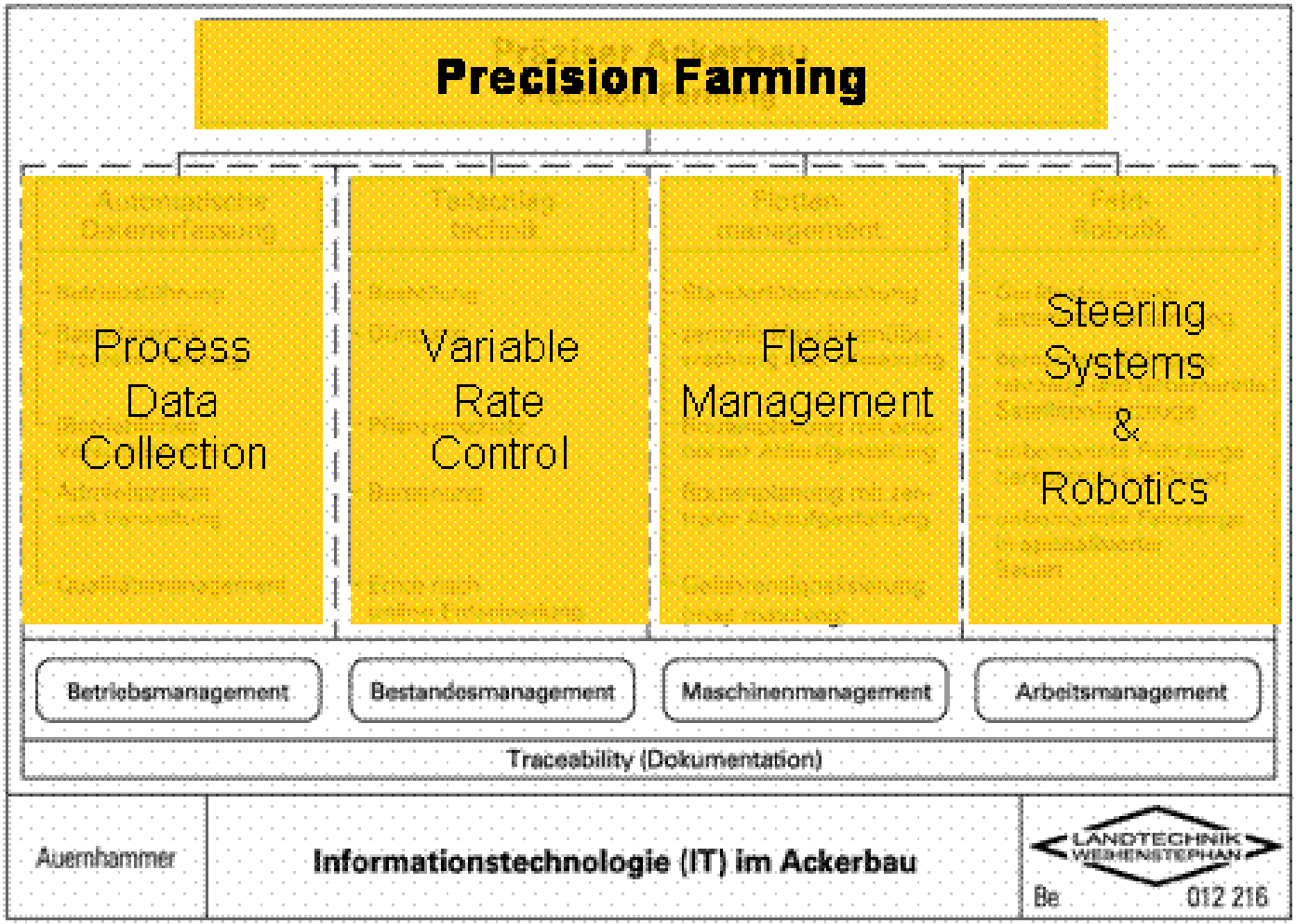
Precision Farming - Overview



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Analog und Digital Precision Farming

Analog PF is associated with

High Interface Requirements

High variability in Space and Time

Agronomic Precision Farming

Digital PF is associated with

Low/Medium Interface Requirements

More or less stable in Space and Time

Technical Precision Farming

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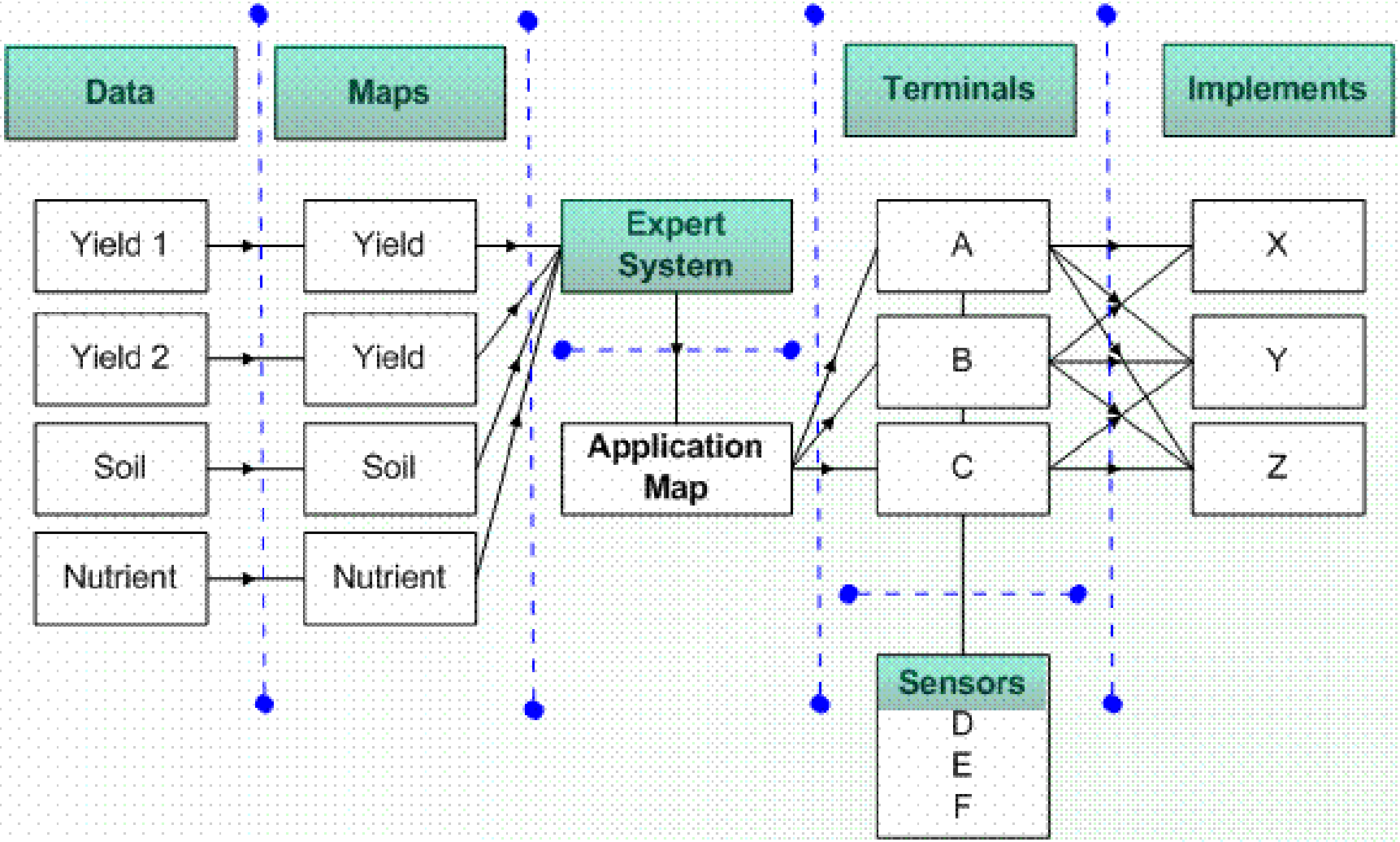
Interfaces Analog Precision Farming



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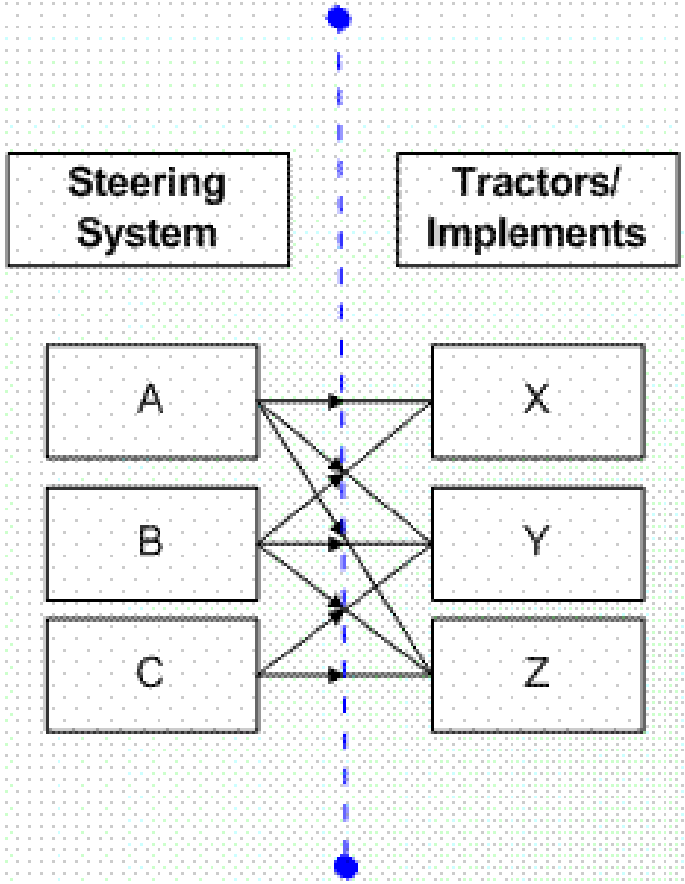
Interfaces Digital Precision Farming



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Stop Block: Missing Standards

- Proprietary interfaces forces eveybody to adopt everybody elses standards
- Propietary interfaces prevent the use of components for different applications/on different machines
- Propietary standards block the development of universally applicable solutions
- Diesen Satz verstehen nicht alle im Auditorium.

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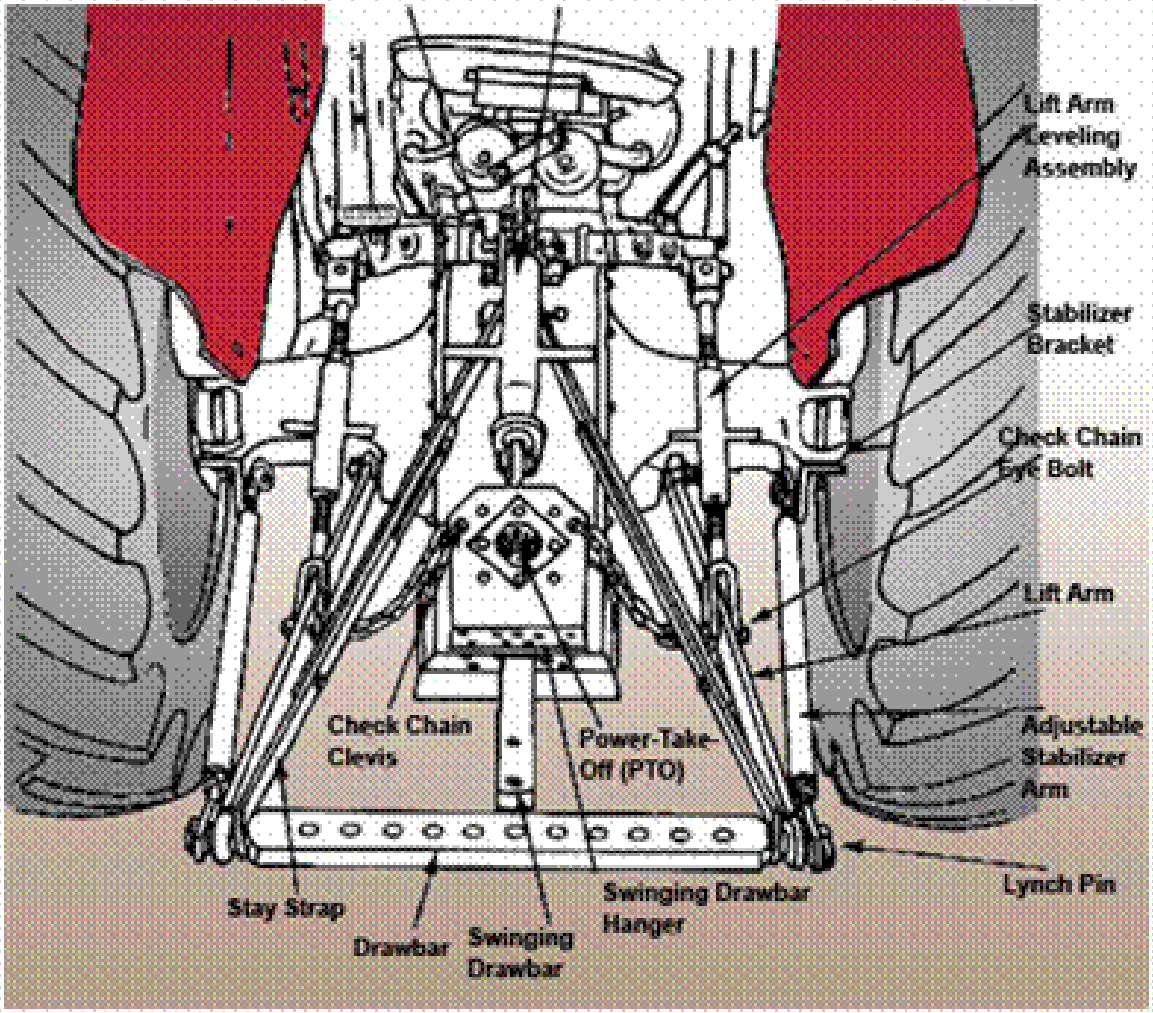
Interfaces



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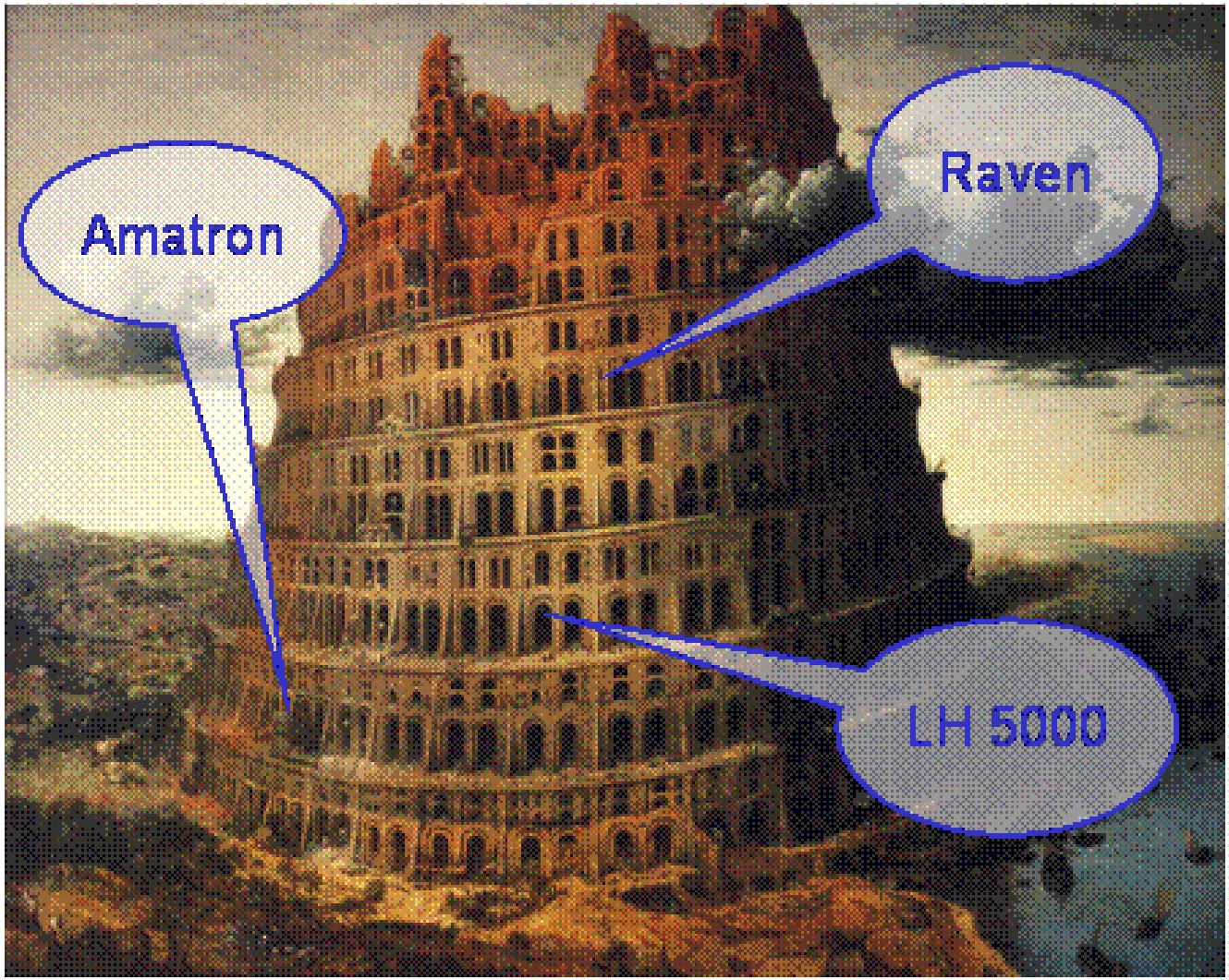
Tower of Babel



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Benefit of Standards for Farmers

- Pick optimal solution for requirements
- Best combination of components with respect to price and functionality
- Hardware and software solutions independent of brand and models
- Add/replace components when required
- Easy Installation
- Investments are safe for future use

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Benefit of Standards for Manufacturers

- Focus on core capabilties
- Save R&D costs
- Lower production costs
- Independance of suppliers for core components
- Ability, but not necessity to offer ex-factory solutions

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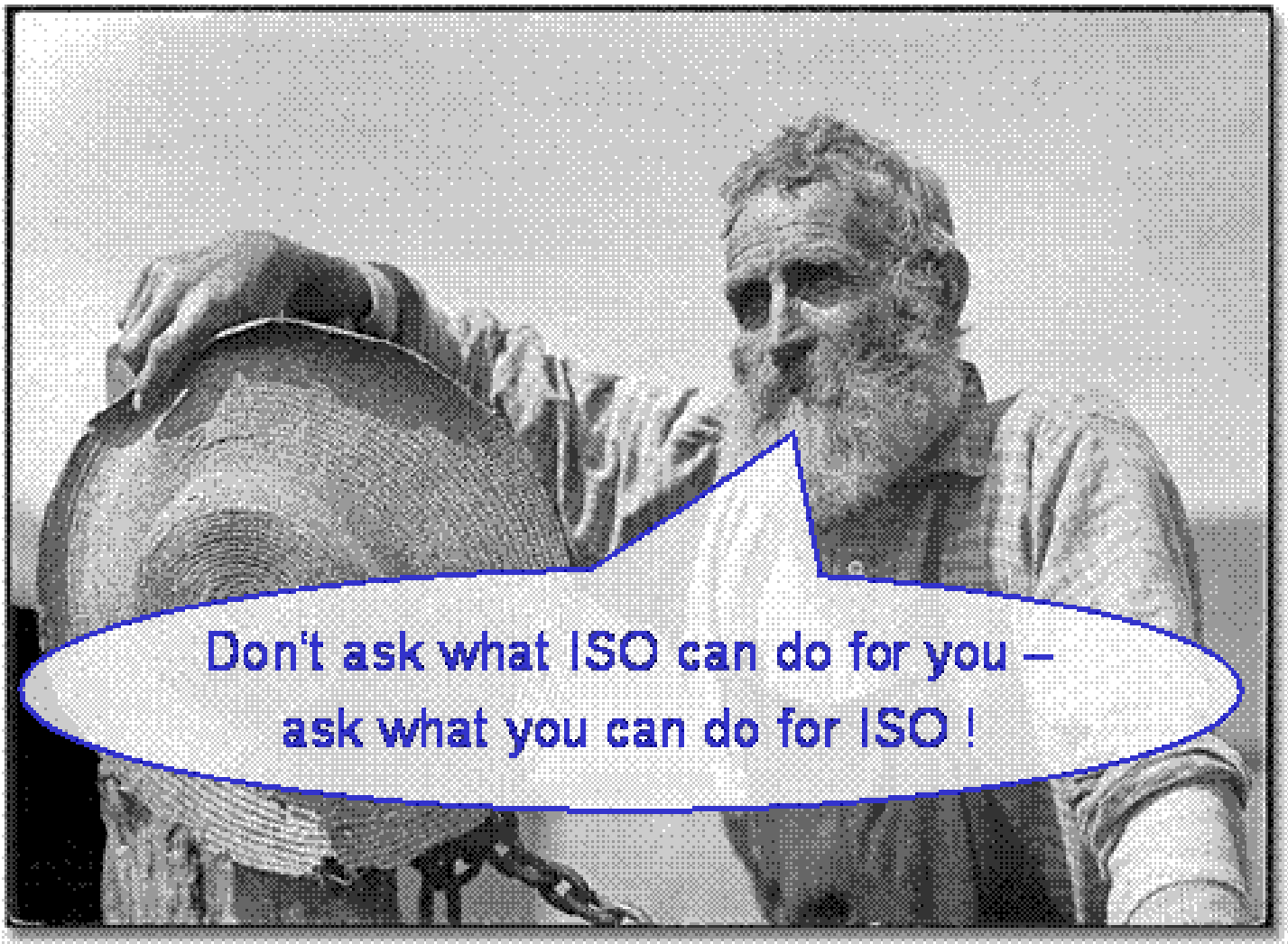
What the Farmer says



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Benefit of Standards for Precision Farming

- Easy adoption of steering and control systems – ex-factory and retrofit
- Office Software Solutions/Expert Systems with less overhead and development costs
- Small companies are given way to develop specialized modules and expert systems
- Raising competition lowers prices and enforces innovation
- The adoption of Precision Farming in the office and on the tractor is easier to handle and will gain acceptance
- **Separation of Agronomy from Technology**

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Expert Systems

- Expert Systems are expensive to develop
- Expert Systems turn data into information
- The knowledge contained in Expert Systems is generally applicable
- Expert Systems rely on input data
- The ability to deploy Expert Systems on a broad level is dependant on a standardised input and output
- The development of Expert Systems will only pay back with standardized interfaces

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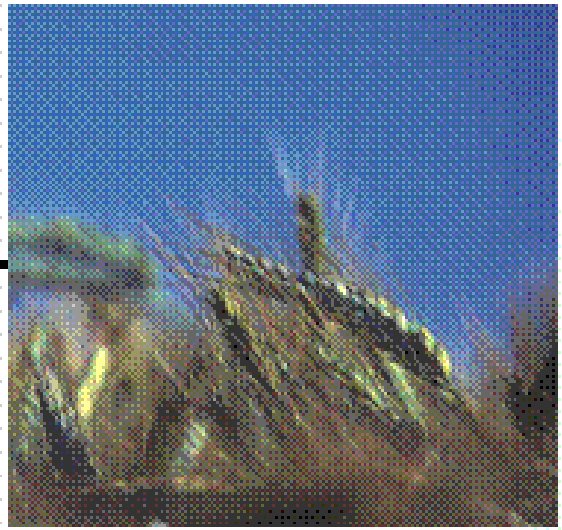
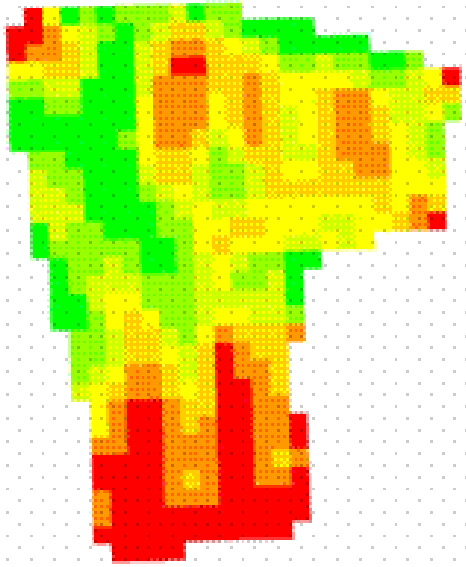
Data and Information





Data

Information

```
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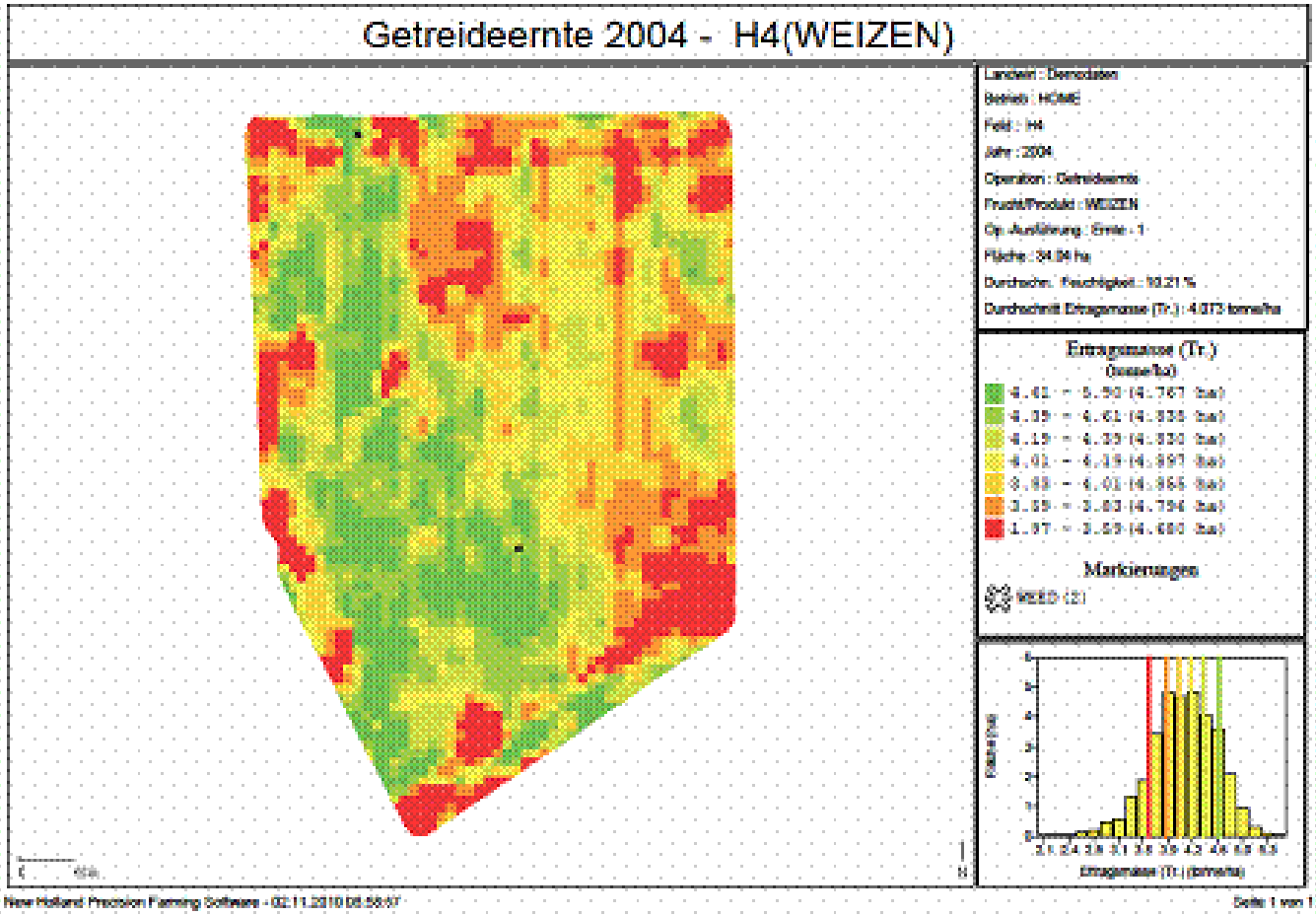
Yield Map I



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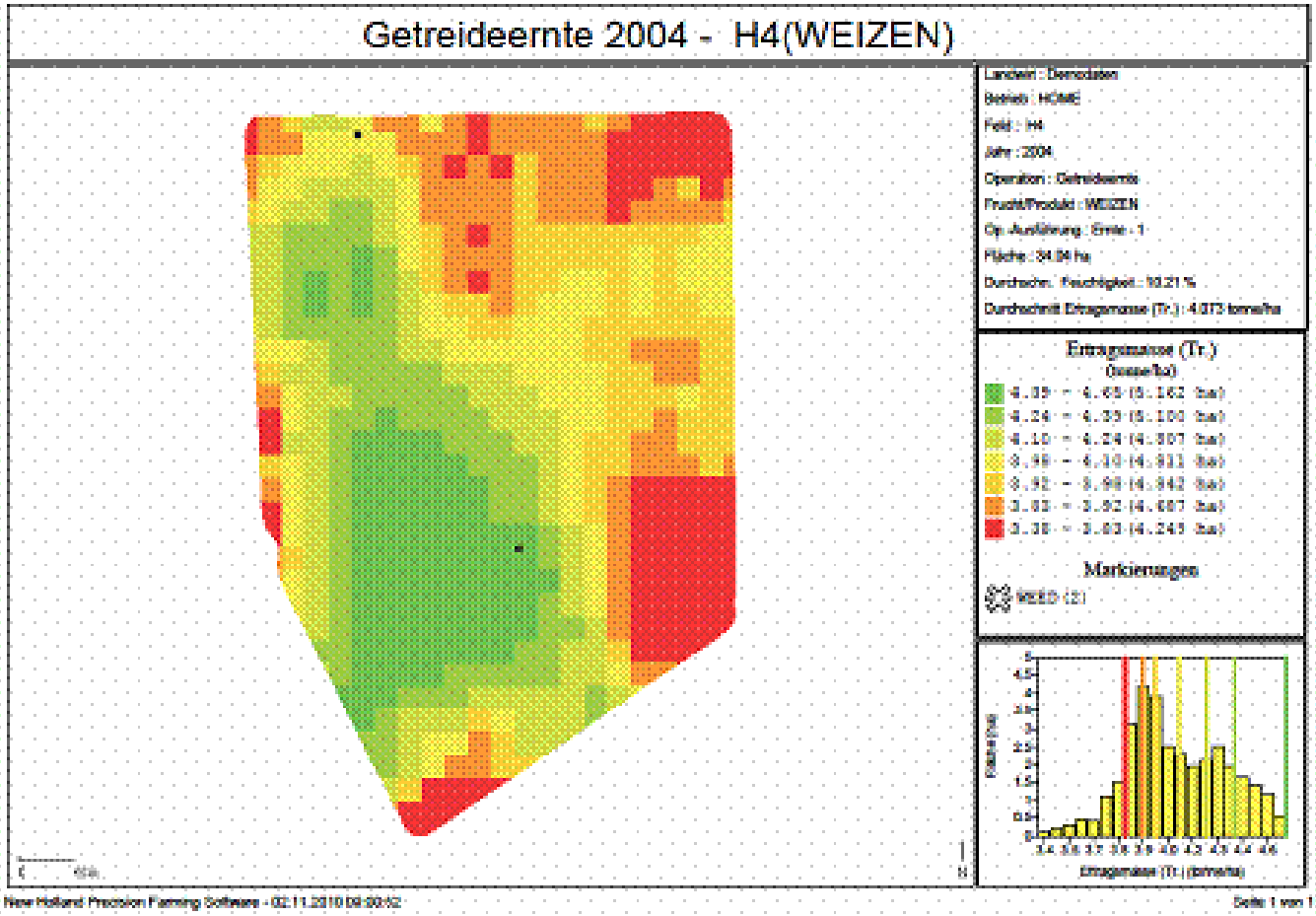
Yield Map II



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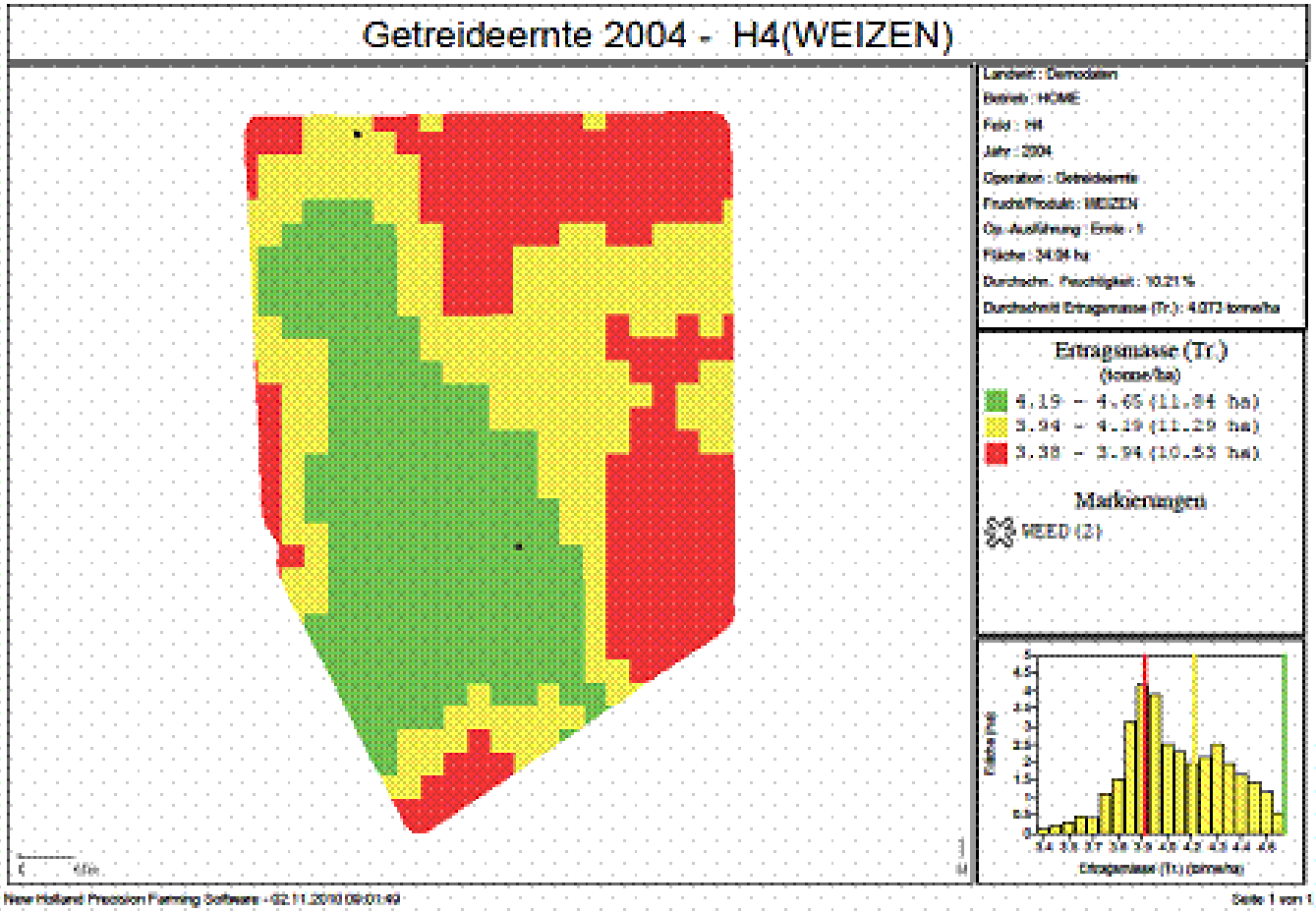
Yield Map III



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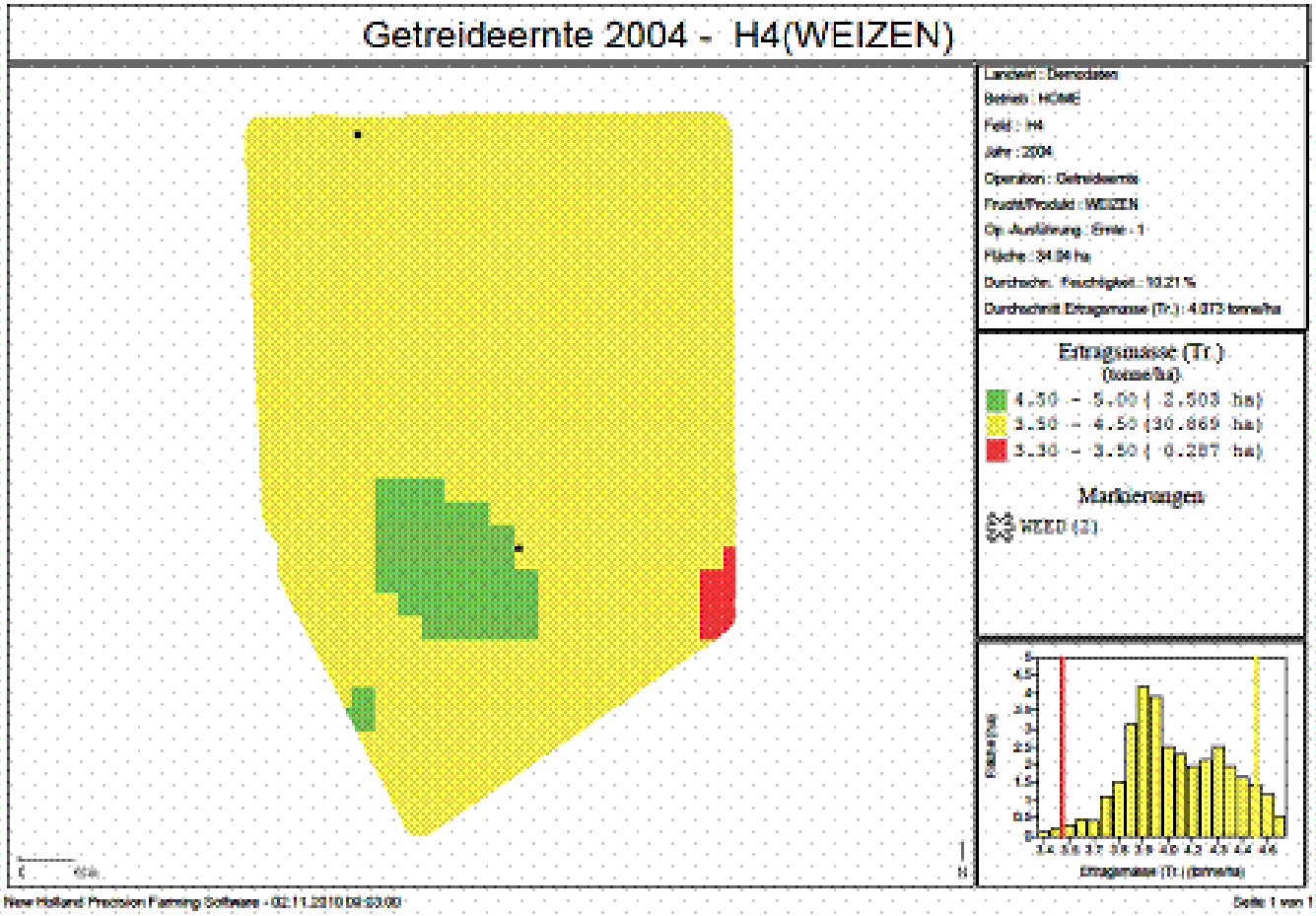
Yield Map IV



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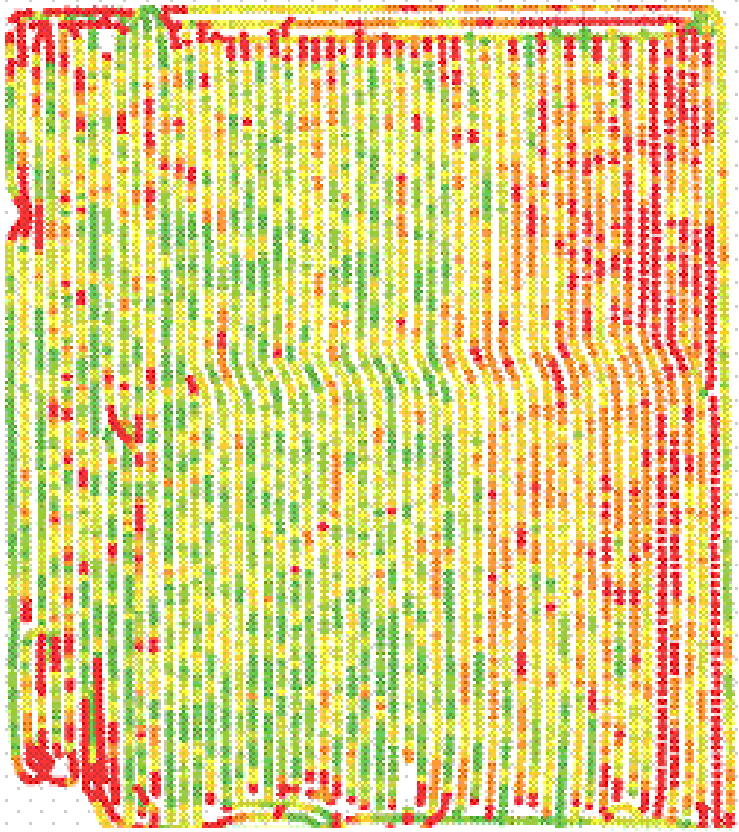
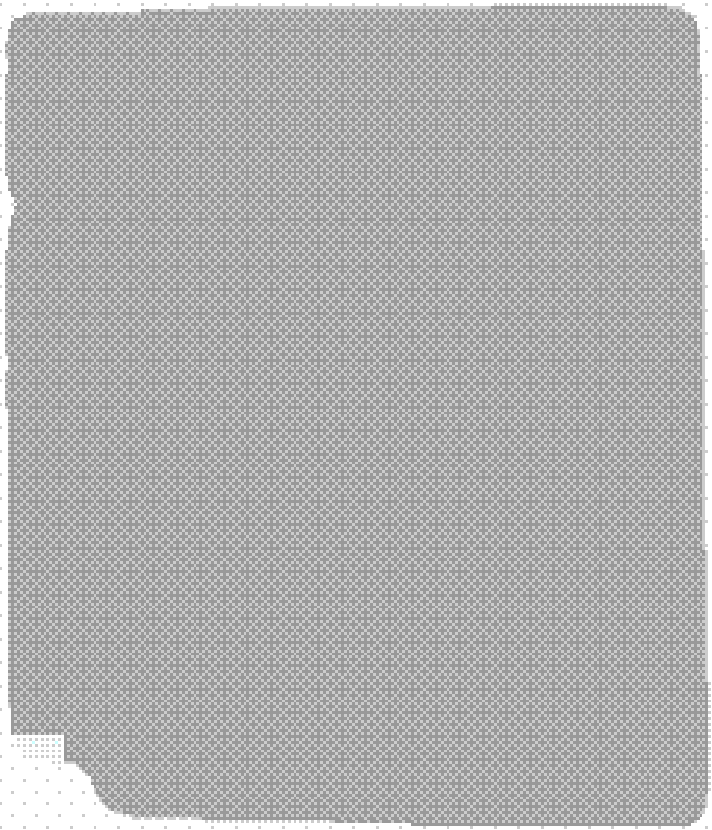
Yield maps - revisited





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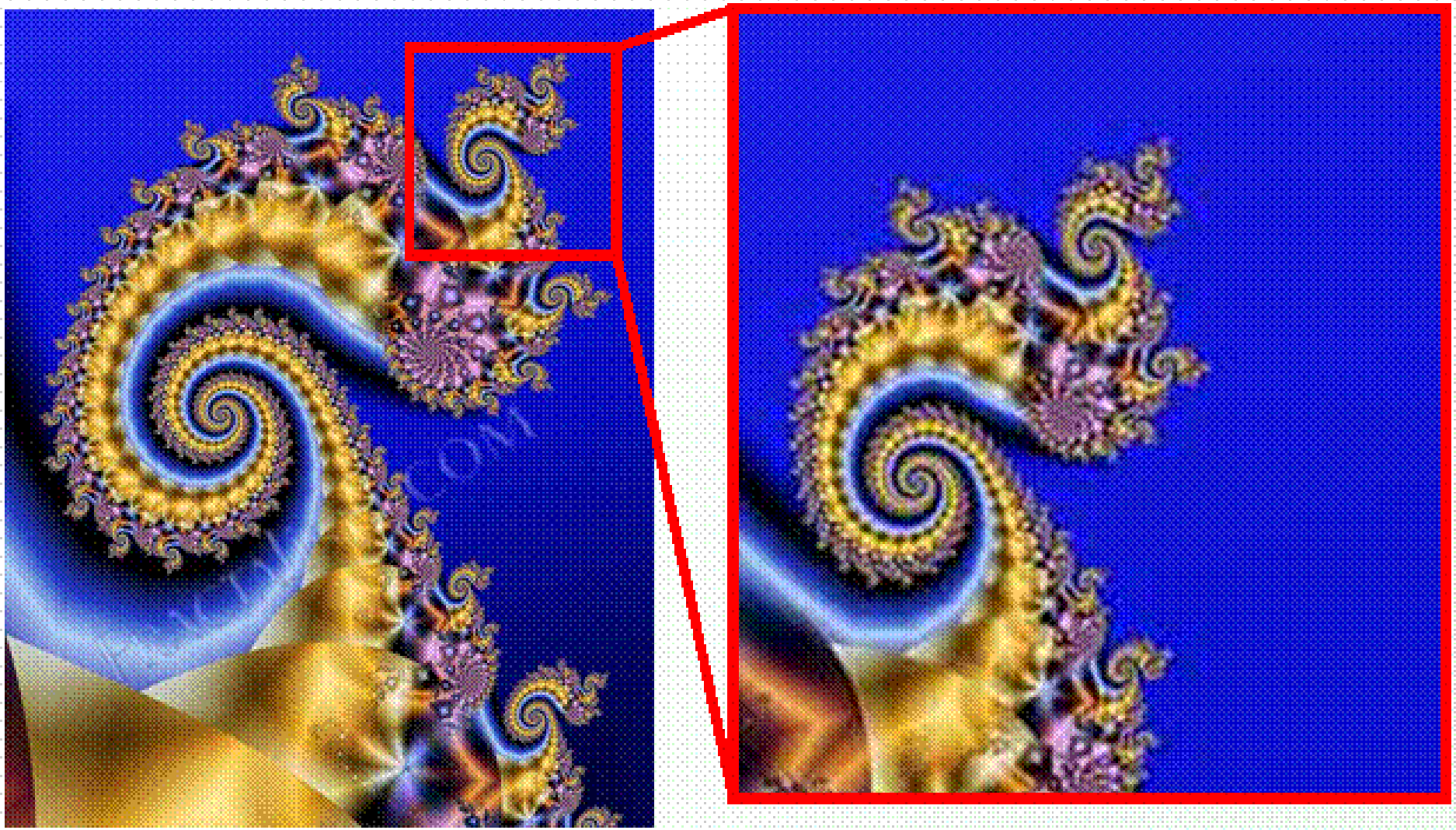
Scale, Borders and Limits



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Precision Farming without VRA

- Precision Farming is effective without site specific agronomy
- Positive effects of steering, digital controlling and data aquisition
  - Implement Steering
  - Controlled Traffic Farming
  - Strip Tillage
  - Grid Seeding
  - Automation of Parcel Plot Trials
  - Electronic Tow Bar
  - Transborder Farming

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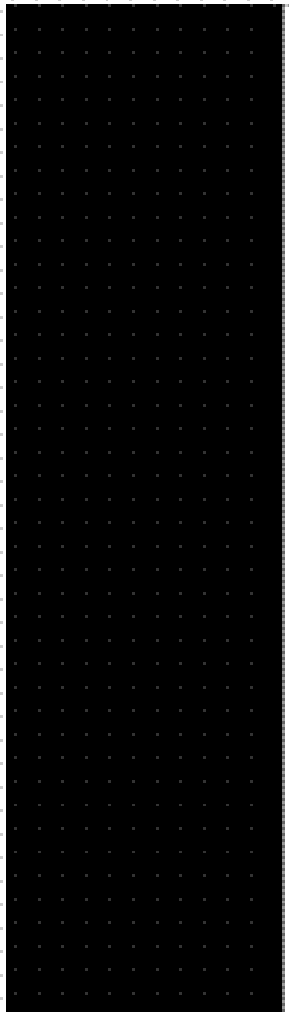
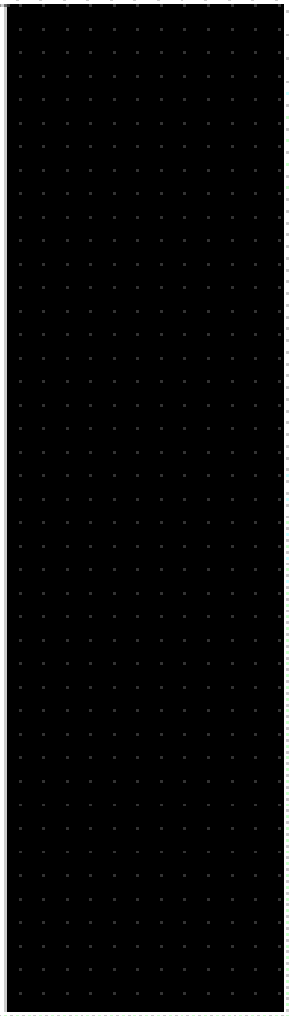
Implement Steering





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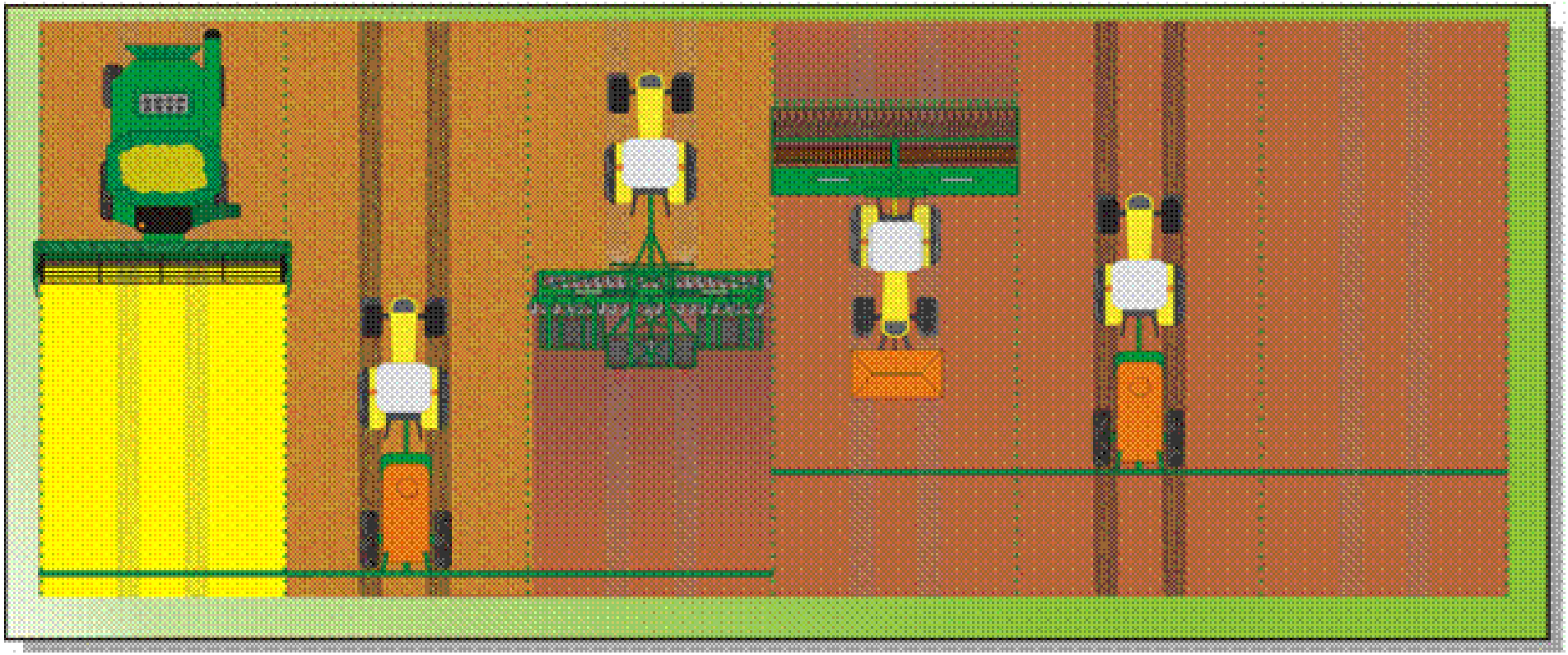
Controlled Traffic Farming



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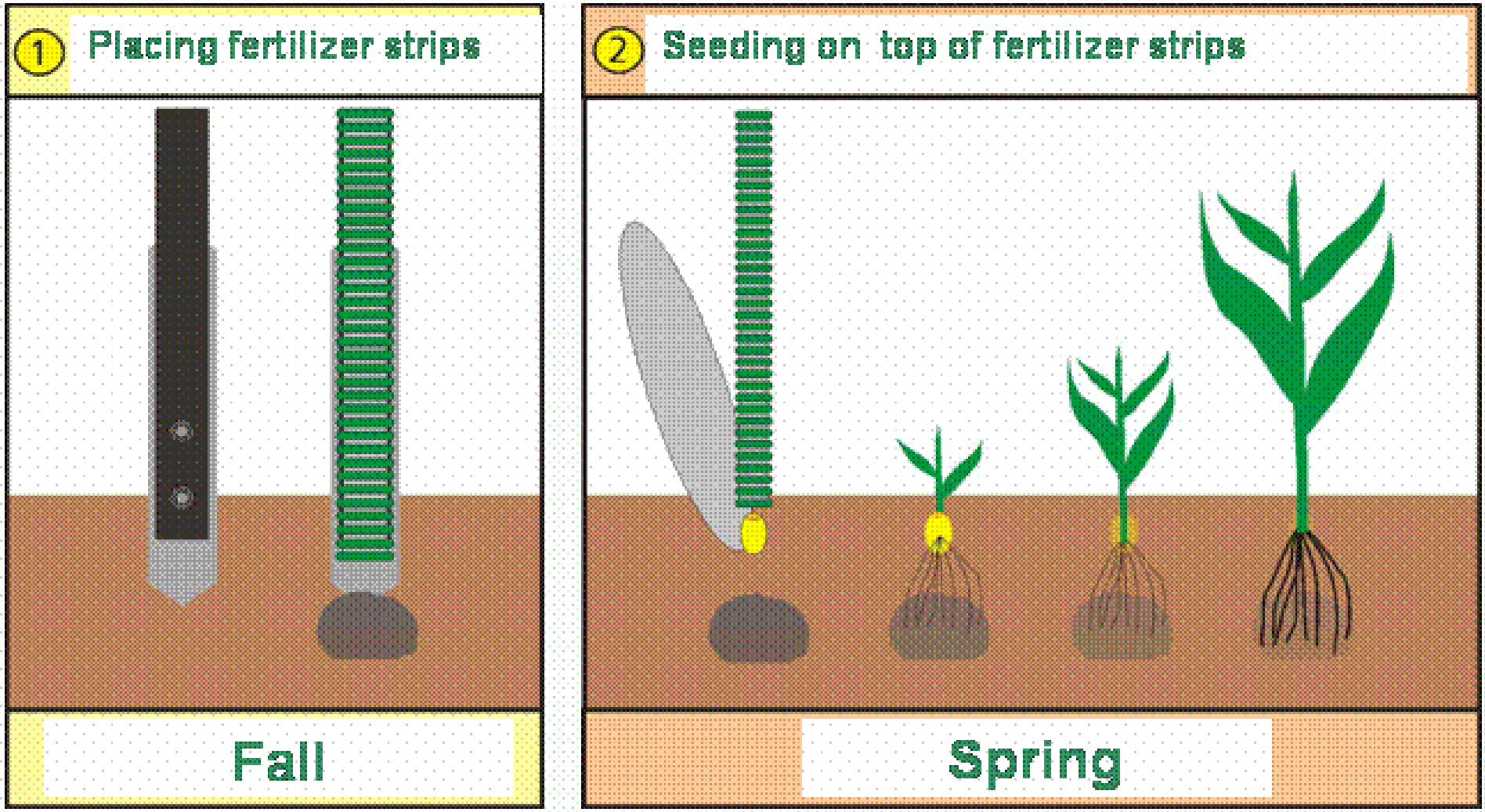
Strip Tillage



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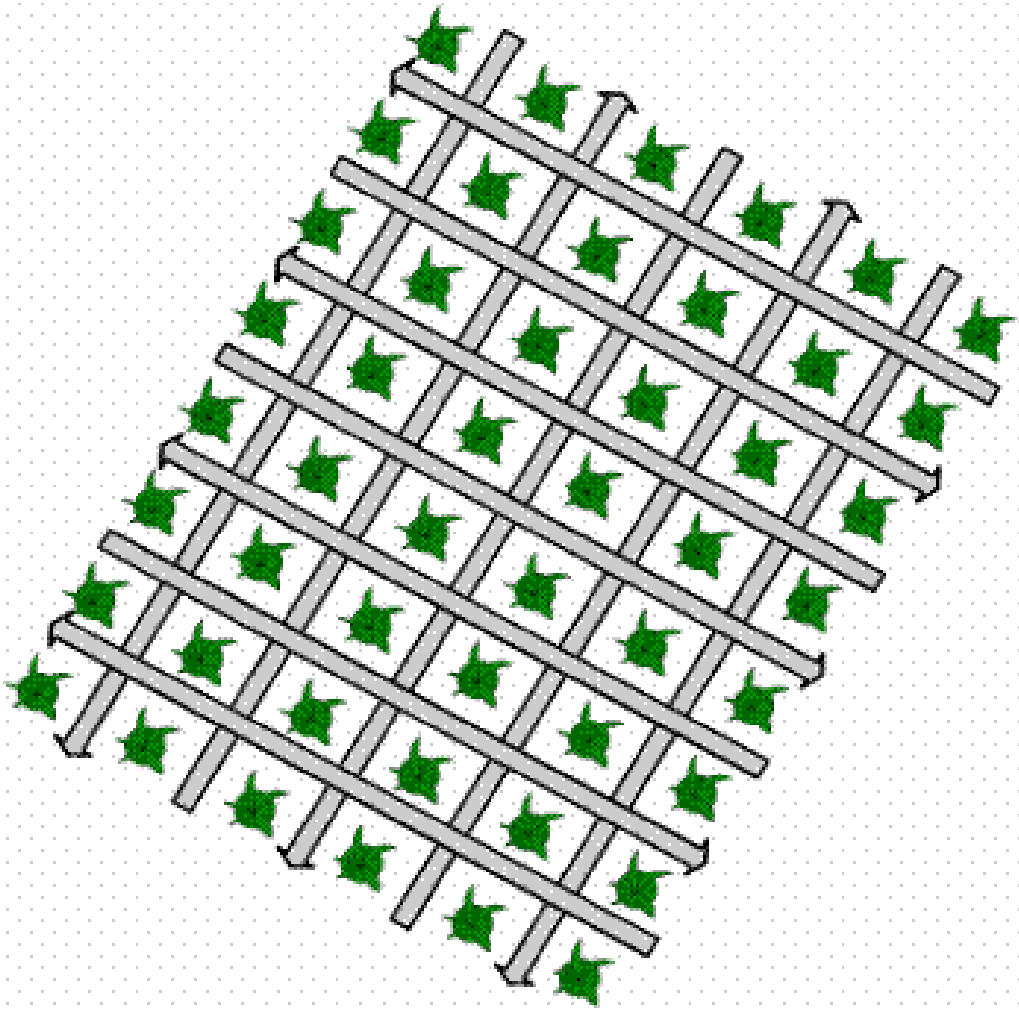
Grid Seeding & Cross Hoeing



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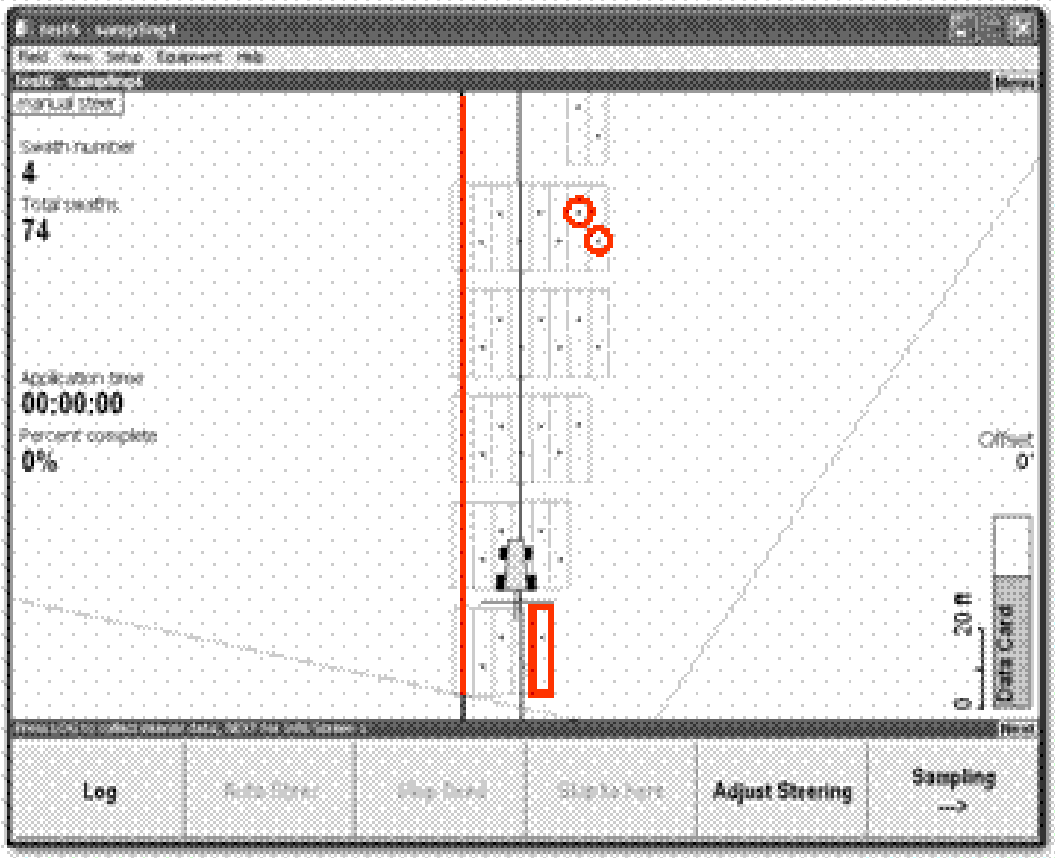
Parcel Plot Trials



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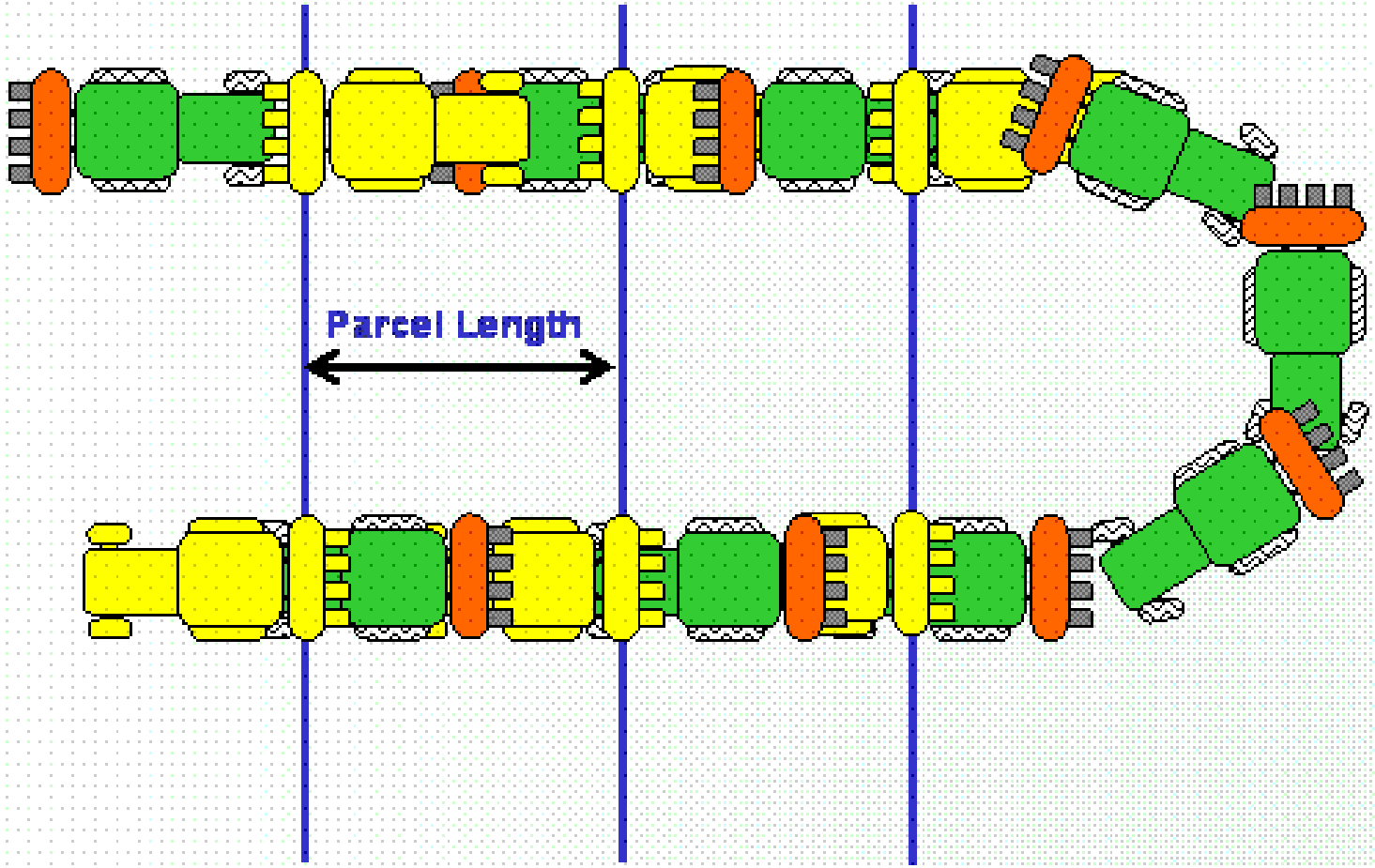
Parcel Plot Trials



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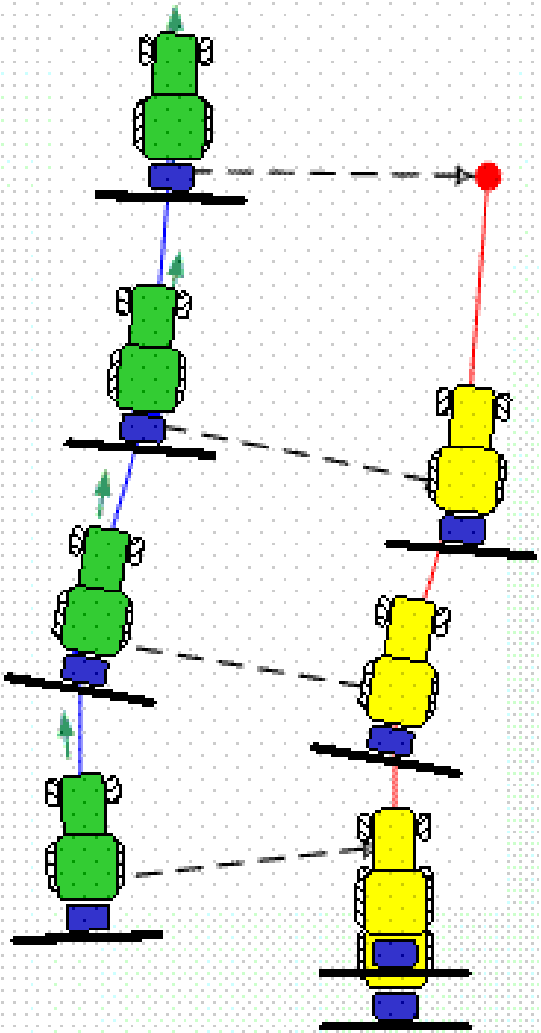
Electronic Tow Bar



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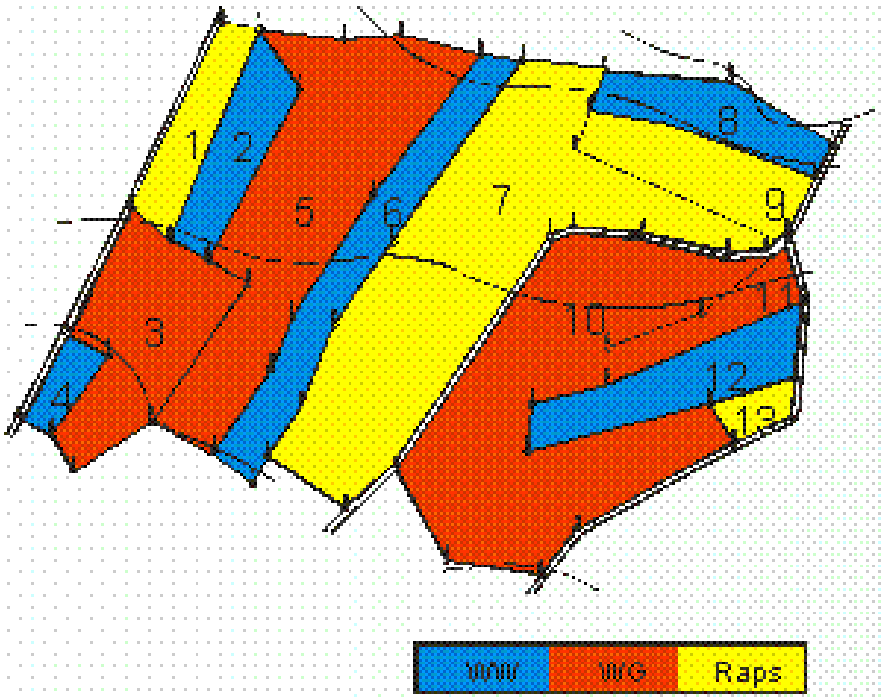
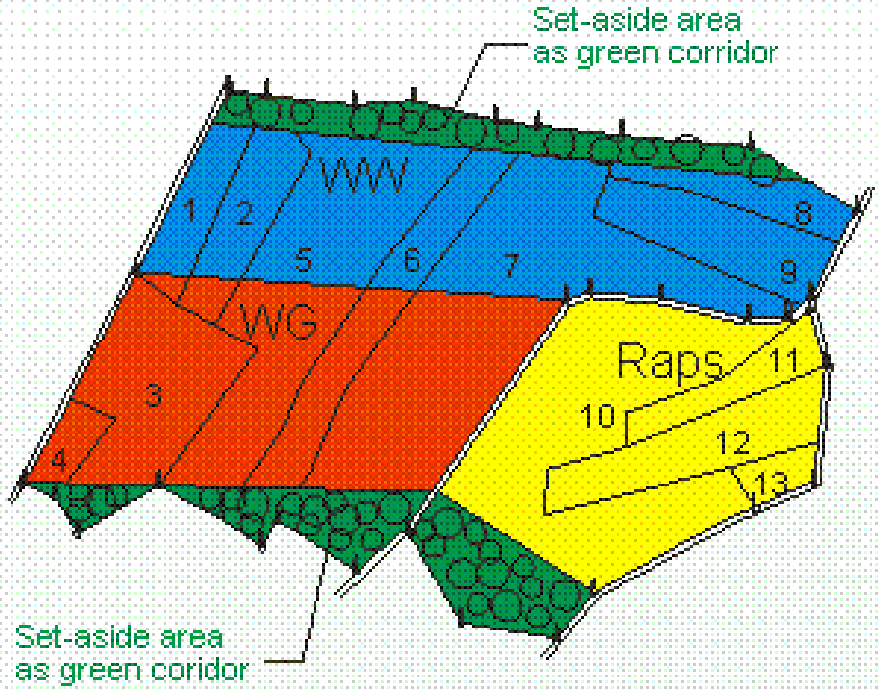
Transborder Farming





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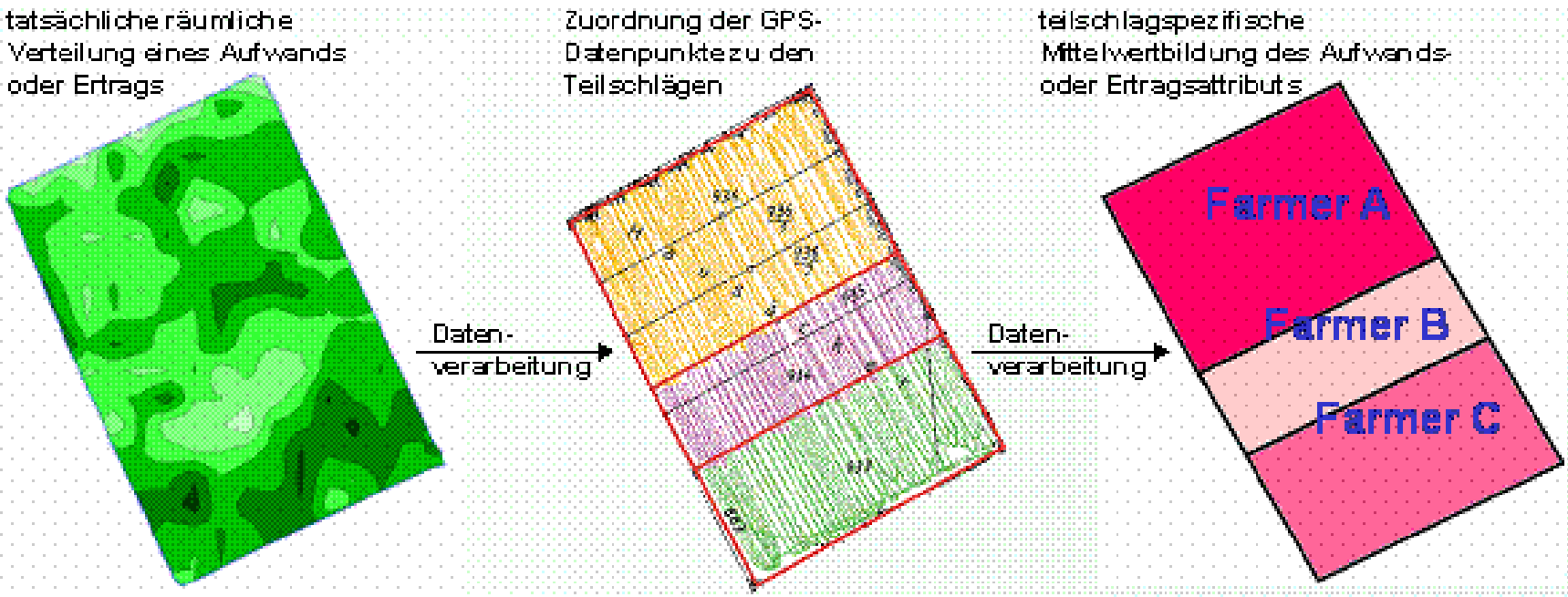
Transborder Farming II



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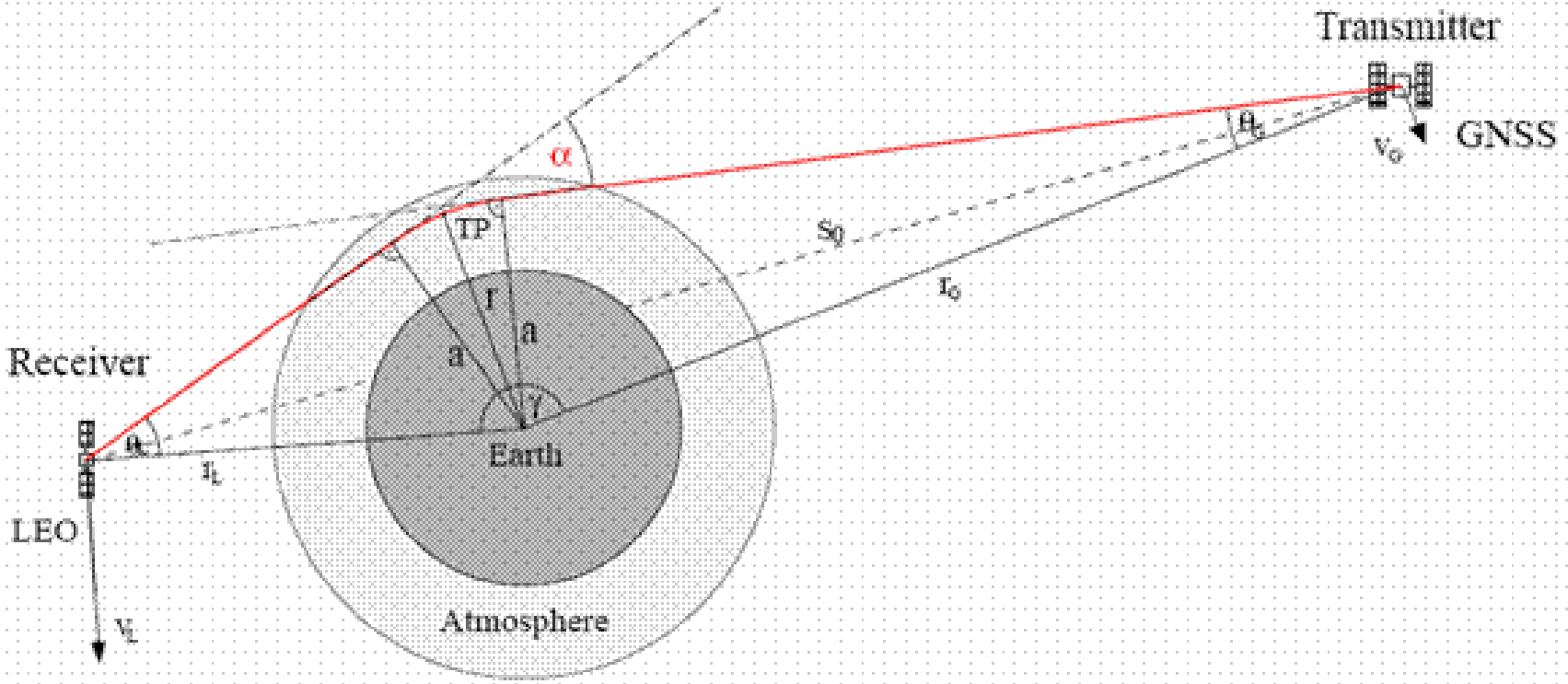
Weather and GNSS



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Outlook: Effects of Weather on PF

- Yield is a function of spatially variable factors such as soil type and soil nutrient content
- Precipitation and radation are not spatially variable on a field level
- The temporal variation of radiation and precipitation interact with soil and plants and affect nutrient and energy availablity
- Precision Farming will be able to adapt much better to the needs of plants when accounting for historical, current and future impacts of precipitation and radiation
- Ongoing research projects will help to model current and future local wheather conditions based on global circulation models, digital terrain models and local wheather stations

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Summary

- The lack of standards is a major stop block for Precision Farming
- It limits the development and deployment by limiting the interoperability between tractors, implements, controllers and Office Software
- Technical/Digital Precision Farming is less dependant on interfaces and has thus been more widely adopted. It has more to offer than steering along straight lines
- The adoption of Agronomic/Analog Precision Farming has more complex requirements with respect to interfaces and expert systems
- The acceptance of Precision Farming will only grow with the implementation of standards
- Modelling local wheather may play a more important role when Agronomic Precision Farming evolves further

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Thanks for your attention

...and sorry for the confusion !