J-DISTAS: a new tool to predict field readiness to ensure efficiency of field operations and avoid soil compaction

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J-DISTAS: a new tool to predict field readiness to ensure efficiency of field operations and avoid soil compaction.

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1. Context & objectives

- Sustainable crop production requires high efficiency of field operations and natural resources protection (soil).
- Soil compaction is a major threat for soils, inducing yield losses on spring and summer crops.
- Size and weights of agricultural machinery have significantly increased during the last decades.

➢ An evaluation tool is needed to evaluated **Soil Readiness**, considering soil compaction risk.

Workability
Soil suitability for cultural operations (defined by soil properties & climate).

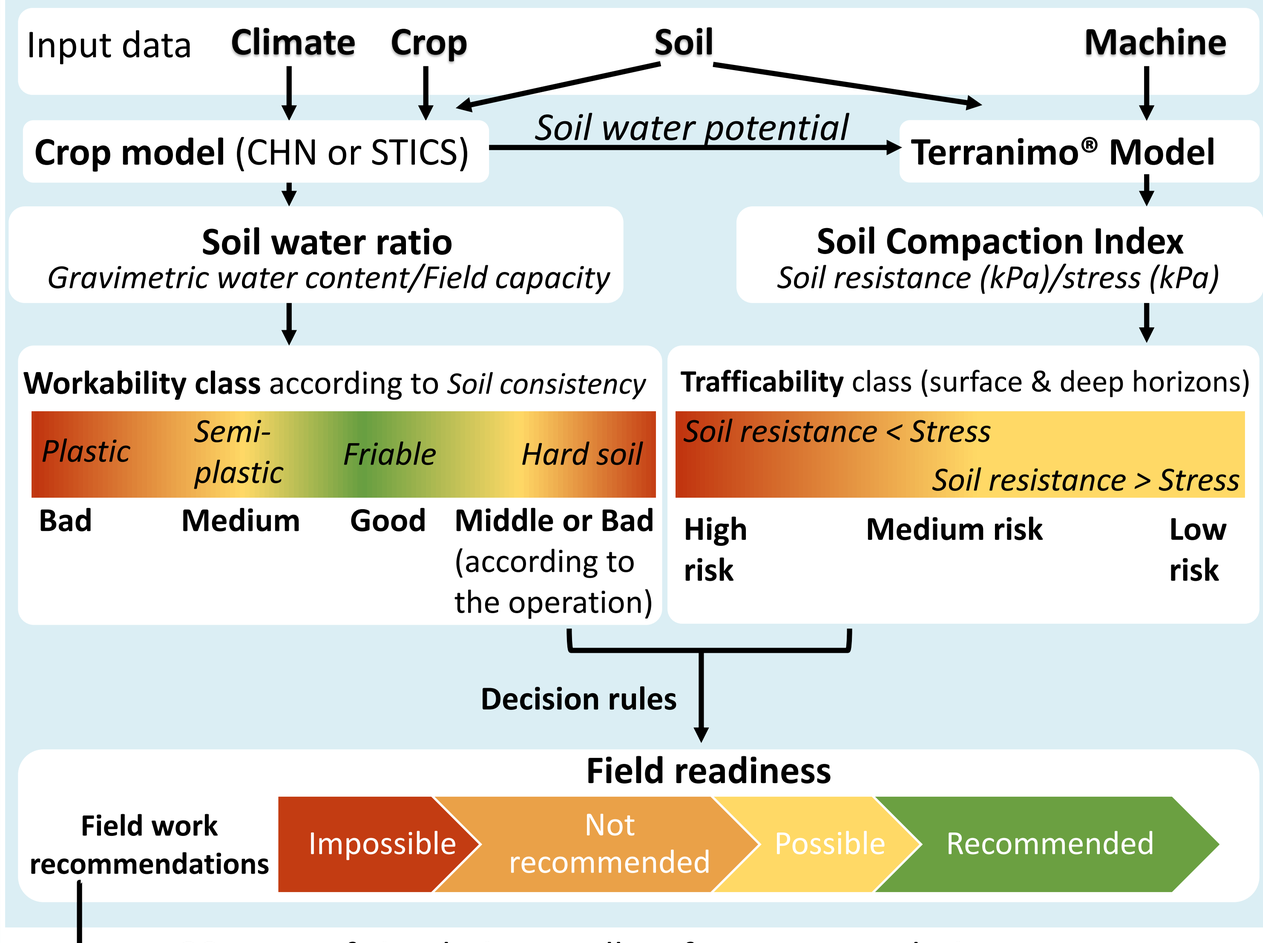
Trafficability
Soil capacity to support machinery during traffic without soil physical degradation (to avoid soil compaction).

Soil Readiness or **Workable days**

Decision support tool for strategic application:
- Conception of cropping systems (global change context).
- Optimization of mechanical (machinery) and labour force costs.
- Soil physical quality protection.

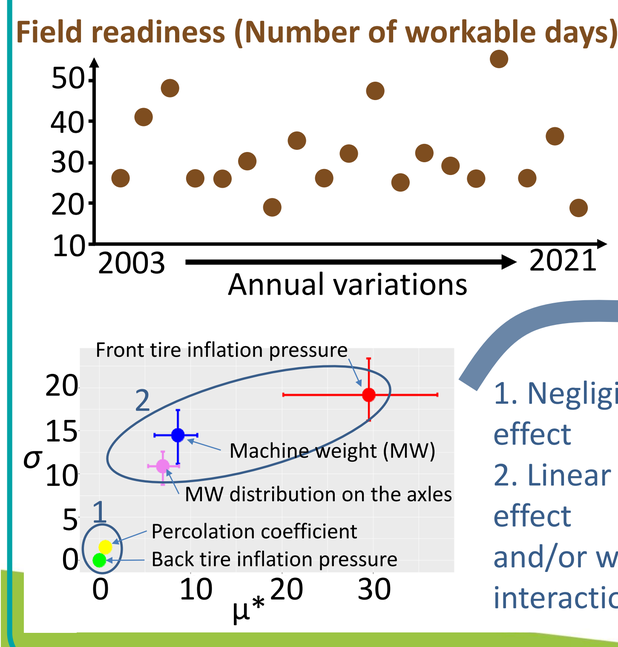
Possible uses and users:
- Modelling tool: technical institutes, research, specialist advisers.
- References for agricultural system design: cooperatives for the use of agricultural equipment, farmers, farm advisers, agricultural machinery sellers.

2. Global approach to predict field readiness for agronomical strategy



20 years of simulation to allow frequency analysis.

3. Morris global sensitivity analysis (on going)



Context
- Loamy-clay soil.
- Maize sowing (15/04).
- Cover destruction (01/12-31/03).

→ Climate induces an interannual variability.

→ First results (3 years simulations): field readiness sensible to 3 input data determining the **weight on each wheel** (front tire inflation pressure, MW, MW distribution on the axles).

1. Negligible effect
2. Linear effect and/or with interactions

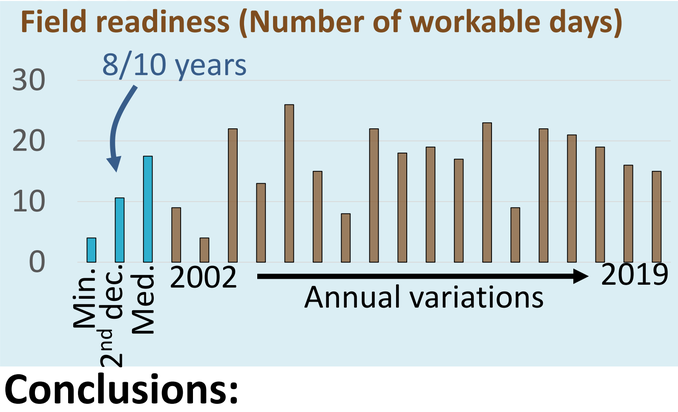
4. Example of application

Question: there is a need to renew a Corn planter. Should we take advantage of it to go from 6 to 8-rows?

Data:
- Area to be sown: 200 ha
- Sowing period: from April 1st to 30th
- Traction time: 8 h/day
- Working speed: 6 km/h

} 21.6 ha/day with a 6-rows seeder; 28.8 ha/day with a 8-rows seeder

Results:



Area that can be sown on workable days	6-rows	8-rows
Min.	86 ha	115 ha
2nd decile	229 ha	305 ha

Conclusions:
➢ The type of seeder had no impact on the number of workable days.
➢ The 6-rows seeder is sufficient for 8/10 years. There is no need to invest in larger/heavier equipment if the risk is accepted.

5. Where we are and were we go

- J-DISTAS is an **interoperable tool** combining several models (crop and soil compaction models) and databases (describing soil, machine and climate).
- J-DISTAS offers major improvements compared to previous tools used to estimate field readiness, considering soil **compaction risk**, and including a range of cultural operations suitable for the **evaluation of innovative crop systems**.
- Currently, a stable but not friendly version exists. An application programming interface (API) will be developed to make the use of the J-DISTAS tool easier (expected in 2023).
- Interest in using the J-DISTAS tool: economic, technical, scientific, social and environmental.

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