Drone-based remote sensing of sward structure and biomass for precision grazing: state of the art and future challenges

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Grasslands are key ecosystems

How can UAS enable novel decision support tools for grazing management?

What is grazing?


For the plants, a sudden reduction in above ground foliage

Leaf area index


Rising plate meter

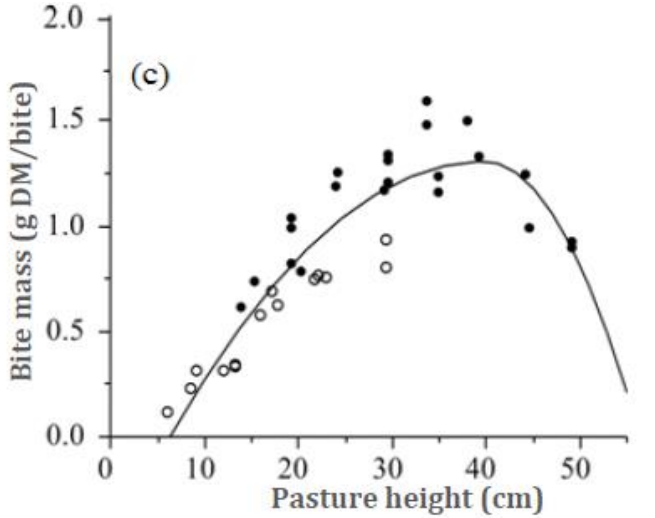

Sward stick

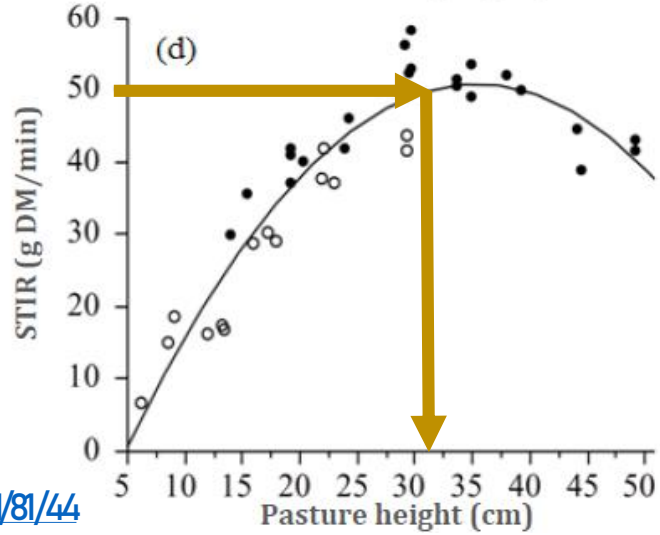
Importance of regrowth

For the herbivore, constant choice between a multitude of potential bites

For the herbivore, constant choice between a multitude of potential bites

Time, a critical currency for the grazing herbivore



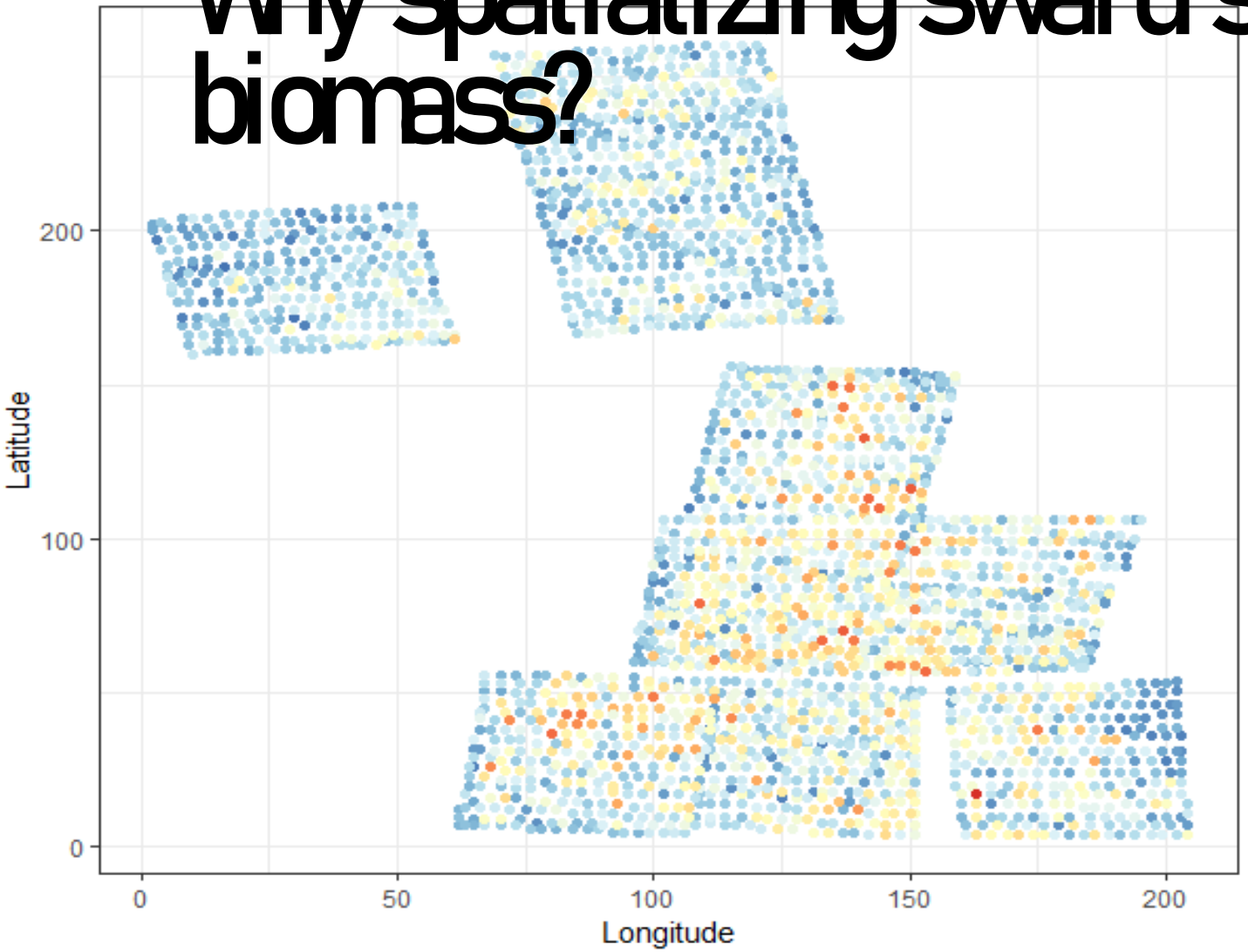


Bite mass and short-term intake rate (STIR) as a function of pasture height in *Avena strigosa*

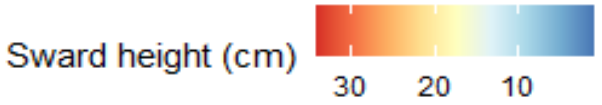
Carvalho, 2013
https://www.tropicalgrasslands.info/index.php/tgft/article/download/81/44

Sir John Tenniel

Why spatializing sward structure and biomass?

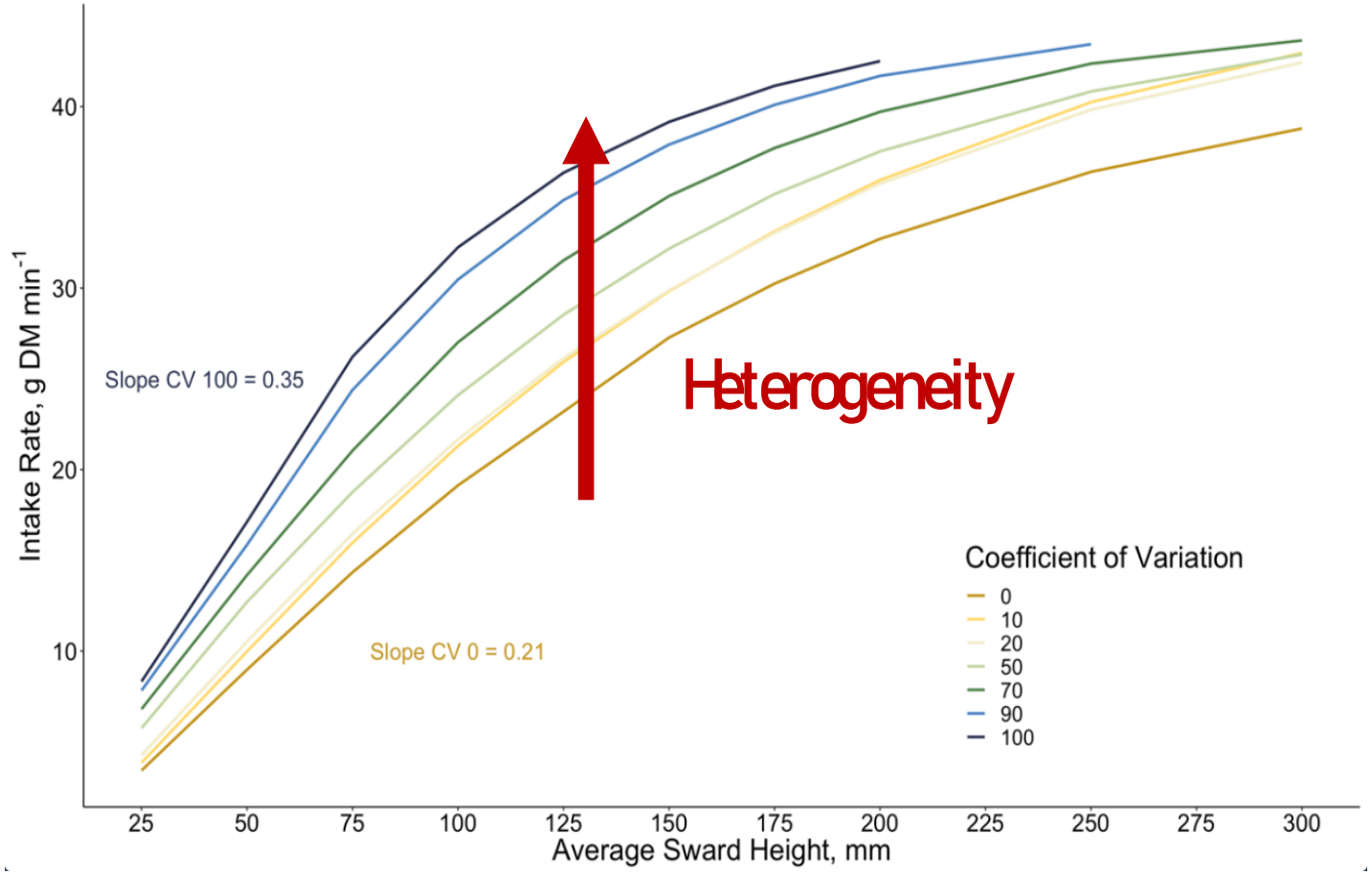


Courstesy of Livia Chagas De Lima



Grazed grasslands are necessarily heterogeneous

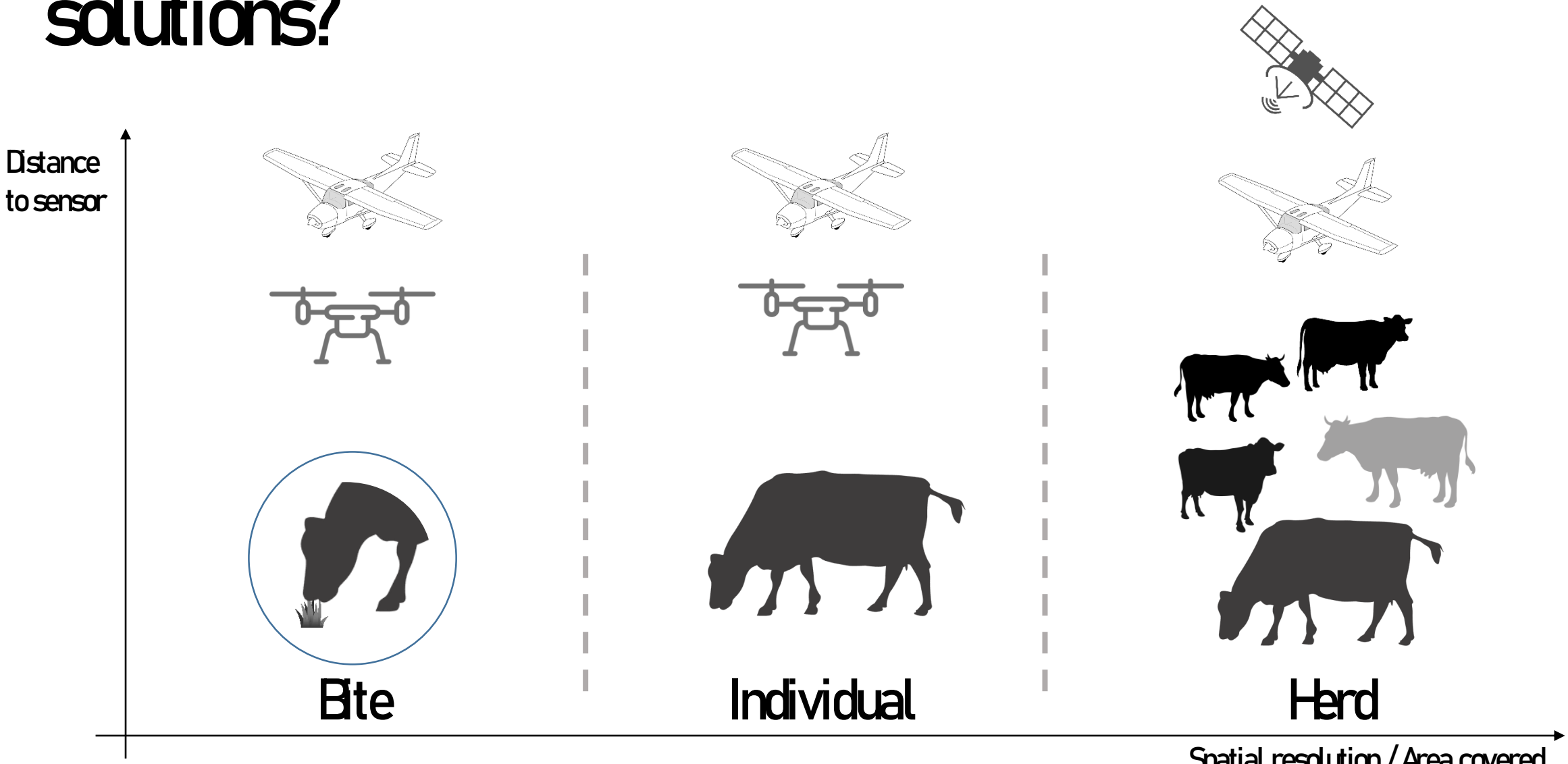
Heterogeneity can benefit the herbivore



Pontes-Prates et al., 2020
https://doi.org/10.3390/su12208676

Remote sensing of grazing conditions

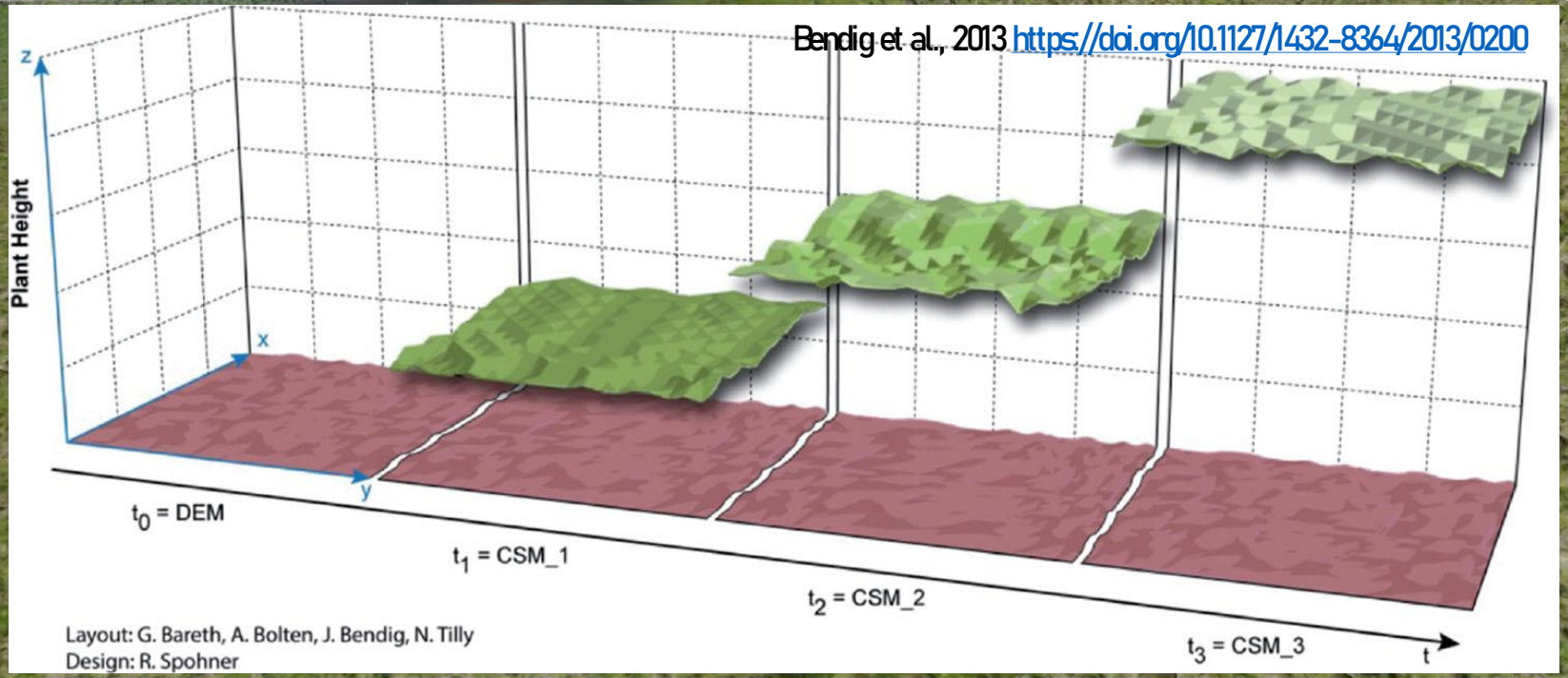
Where do UAS fit in the range of remote sensing solutions?



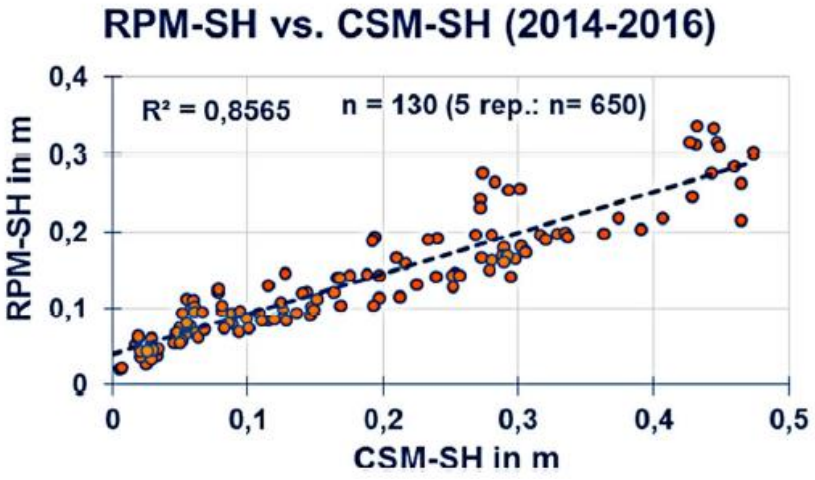
UAS applications are mainly driven by the sensor

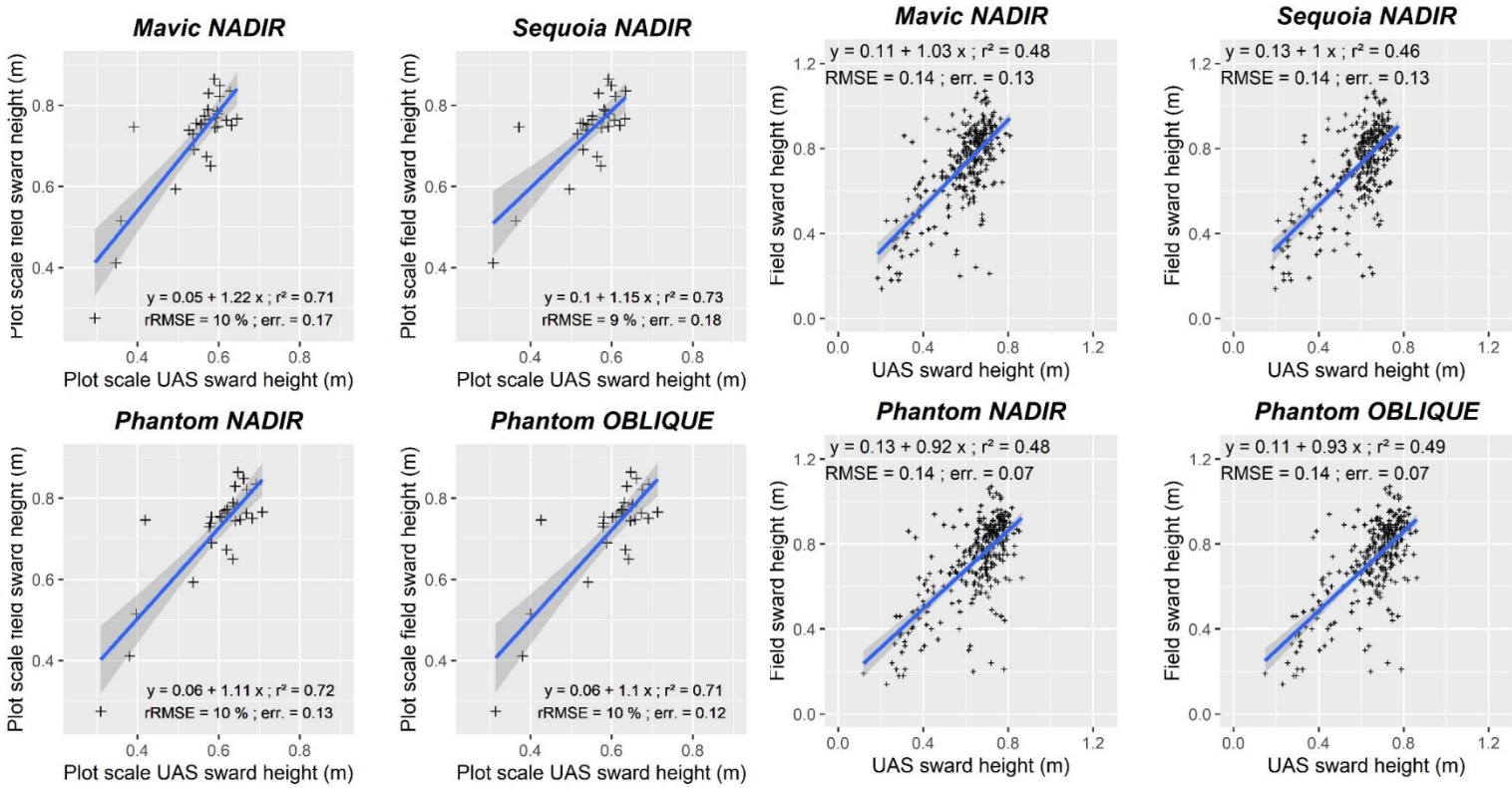
Visible	*Thermal*	*Multispectral*	*Hyperspectral*	*LiDAR*
3D: ++ Spectral : +	3D: + Spectral : ++	3D: ++ Spectral : ++	3D: + Spectral : +++	3D: +++ Spectral : +
				
<1000	4000	6000	>50000	>50000 $

3D modelling, a key to sward height



Prediction performances of pasture sward height

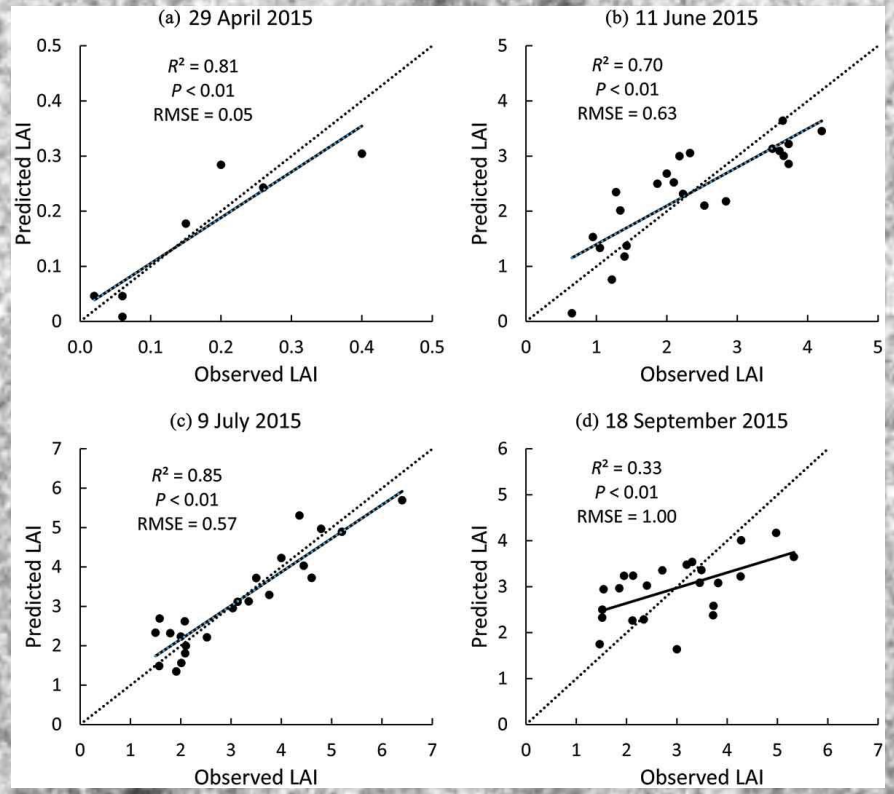


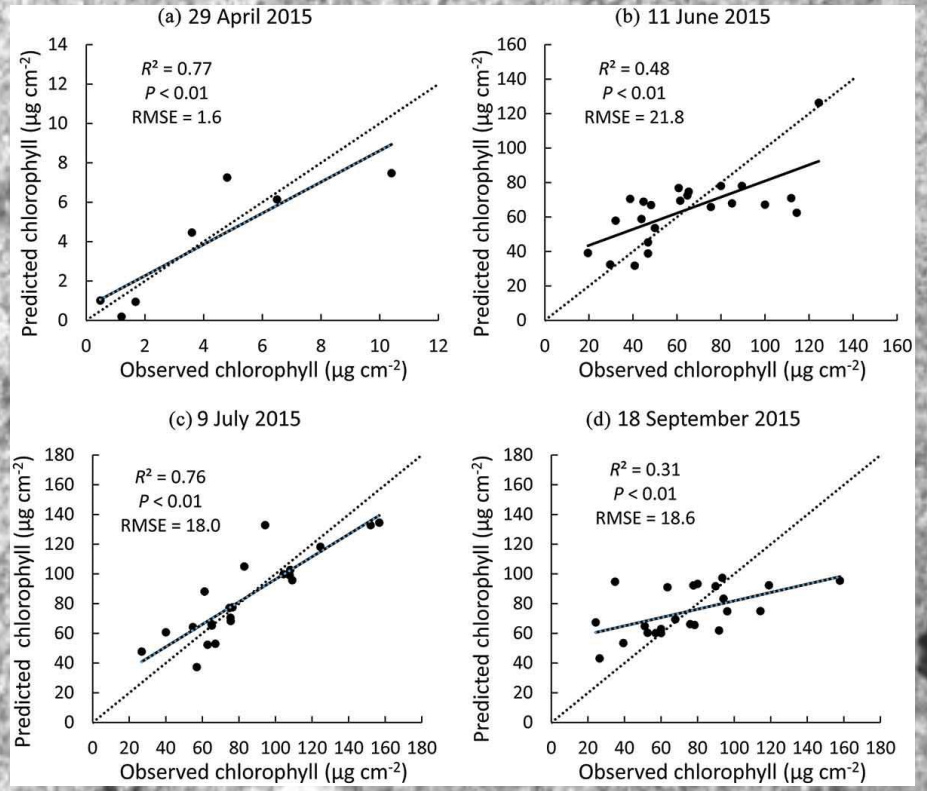


Bareth & Schellberg, 2018. https://doi.org/10.1007/s41064-018-0055-2

Michez et al., 2020. https://doi.org/10.3390/rs12101650

Prediction of other pasture structural characteristics using spectral information





Lu et al. 2018. https://doi.org/10.1080/01431161.2017.1363441

Next steps? Exploring the vertical distribution of the forage resource...

Bremmet al., 2012
http://dx.doi.org/10.1016/j.applanim.2012.08.008


...enabling precision grazing

Shaping pastoral environments...

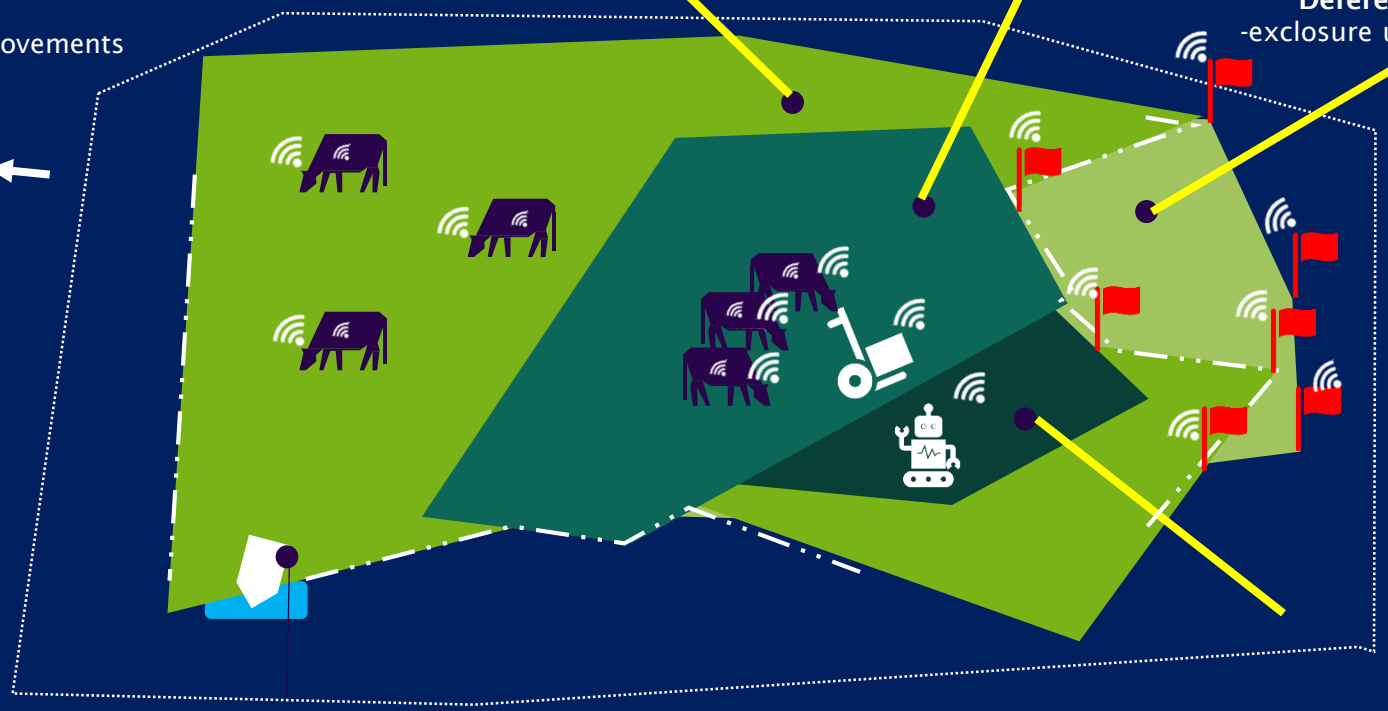
Monitoramento (satélite e/ou drone)
-h, biomass, quality-

Area of increase attraction (20 - 26 cm)
-automated mobile feeding troughs-
-sparying of molasses-
-distribution of supplements-

Ideal structure (10 - 20 cm)
-free grazing

Defered area (<10 cm)
-exclosure using virtual fencing-

Sensors
- Location & movements
- Eartags
- Rumen



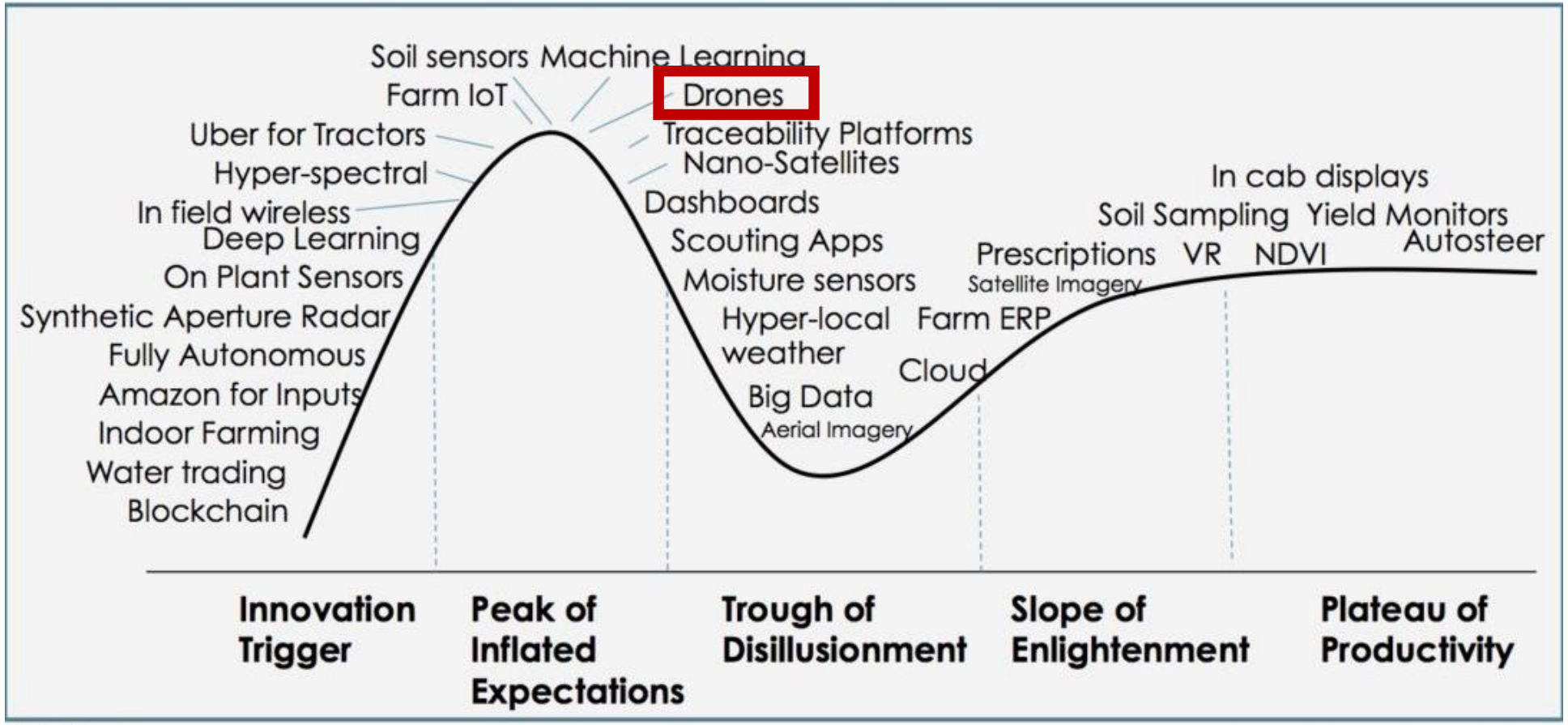
Área for mechanical intervention (> 26 cm)
-mowing robot with IR measurements for height-

Free access to water
-automated weighting, BCS, download of data-

...enabling optimal grazing

The concept of Rotatiuous Grazing exploiting IT solutions (Italian ryegrass or Tifton 85)

Hype curve of precision agriculture



Notes:

Send feedback to
ryan.rakestraw@monsanto.com

Thank you very much for your kind attention!