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Combined modelling tools to evaluate the impact of flock mobility on GHG emissions in sheep farms

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Context

Southern Alpes areas, with diversity of pastoral resources, few cropping areas

→ Pastoral farming systems based on moving flocks to adapt to seasonal availability of forages

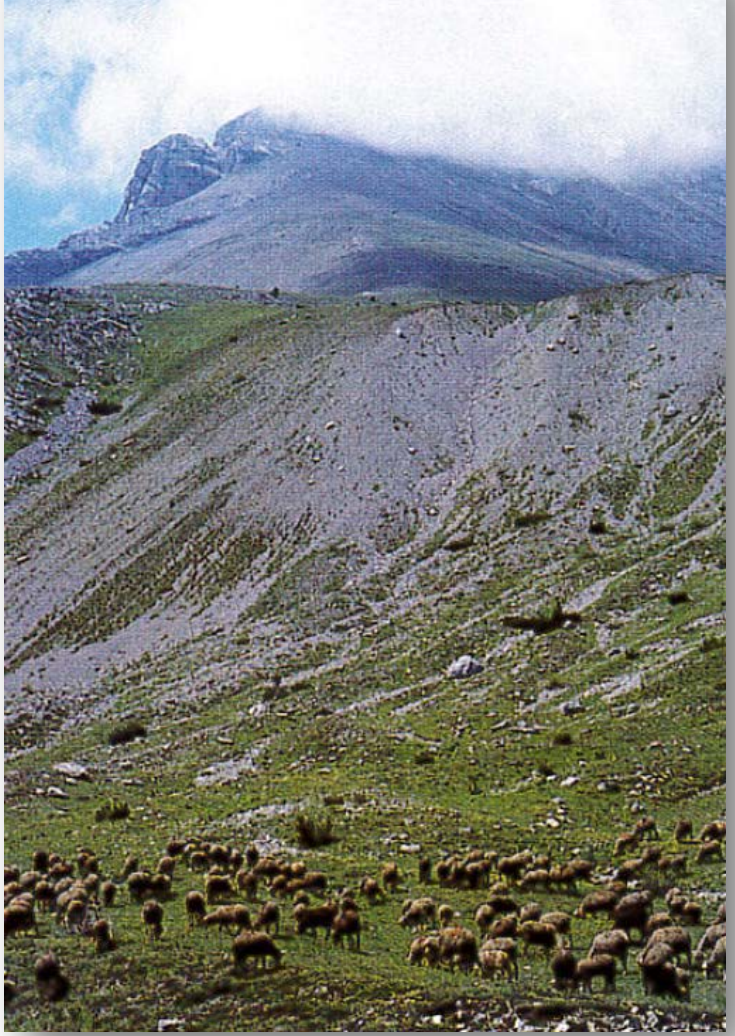
→ Opportunity to increase flock size without feed purchase

➡ In this context: Is flock **mobility** a possible **mitigating strategy** about **GHG emissions**?

Objectives

- Identify the major methodological challenges: evaluation of ***CH_4 emissions*** and ***carbon sequestration*** in a context of great diversity of pastoral resources
- Assess the GHG emissions levels of various farming systems types (lambing seasonality, type of resources used, degree of mobility)
- Study the impact of grazing practices on soil and biomass carbon flows on rangelands

Summer grazing in
high mountain area



Half mountain pasture lands

Lowlands in Provence area
Winter grazing and land with box tree (*buxus)*

Merinos d'Arles breed

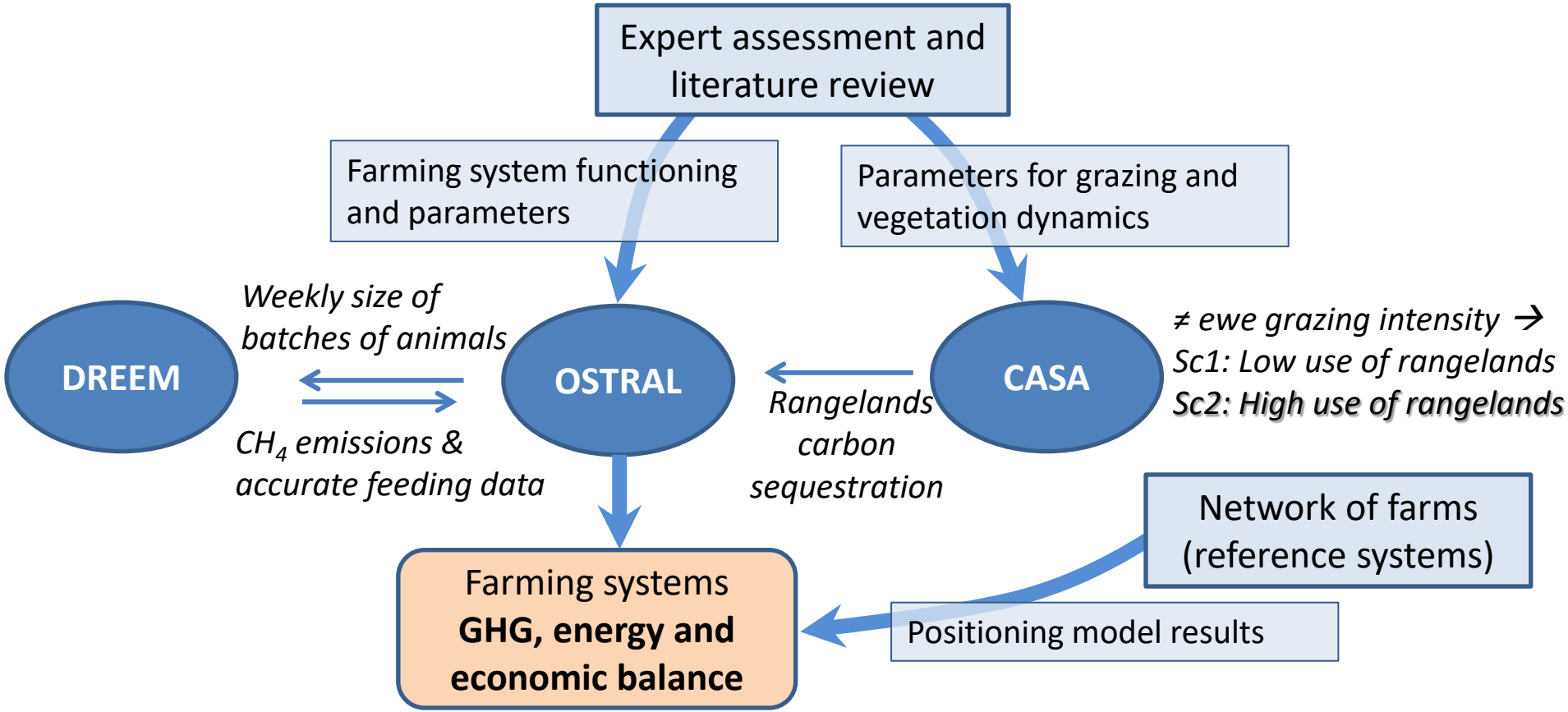
Low weight (50kg) and prolificacy (110)

Methods

Combination of 3 models

- OSTRAL: farm scale simulation software (structure, functioning, performances of farms, for sheep farming system)
- DREEM: accurate assessment of CH_4 emissions: level of intake and characteristics of feeding components, for each type of animals, weekly along the year → See poster N° 23699
- CASA: long term carbon balance simulation according to land cover dynamics and grazing intensity. Evaluation of carbon regulation and sequestration on rangelands

Combination of models and implementation



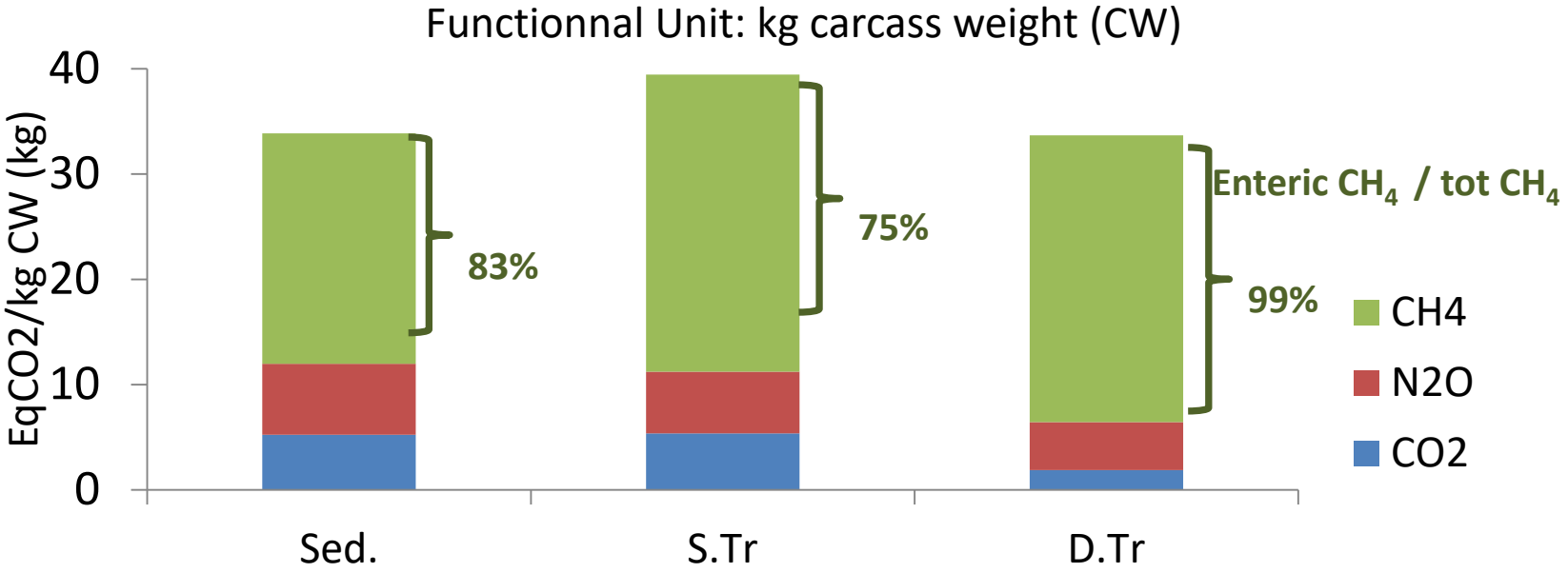
Implementation

Three sheep farming system studied

Sedentary - *Single Transh.* *(summer)*- *Double Transh.* *(S+W)*

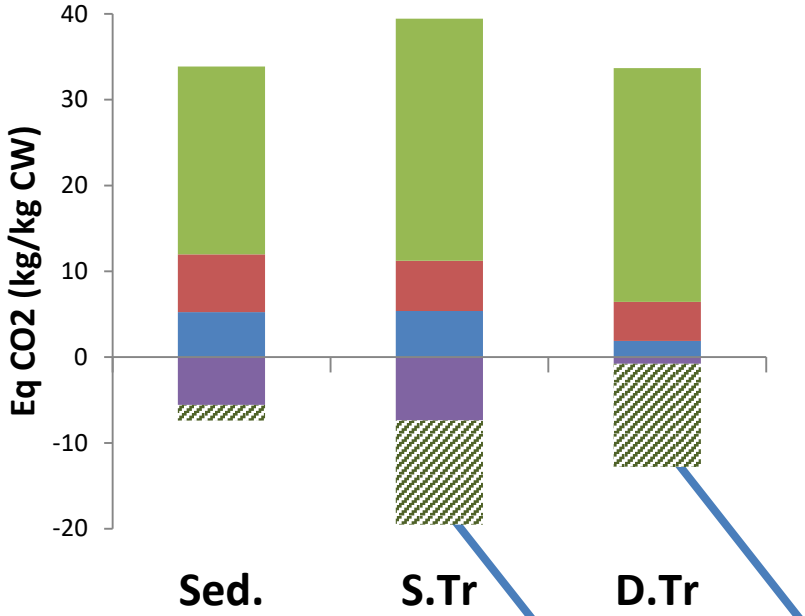
	Sedent.	S.Tr	D.Tr
Number ewes	223	243	1904
Ewe productivity	1.20	1.01	0.92
Meat /ewe (kg CW)	17.1	14.2	12.8
Stocking rate (LU/ha)	0.16	0.15	0.07
% Rangelands/AA	76%	88%	97%
Concentrate/ewe (kg)	45	41	0
Forage self suff. (%)	91%	91%	100%

Results – Gross GHG emissions



- CH_4 is major gas…with 80% of tot gas for D.Tr: low CO_2 (high feed self-sufficiency and large contribution of pasture; low-no mechanisation)
- "Only" 22 kg CH_4 For D.Tr (although low kg CW/ewe): No CH_4 from litter/manure

Results – Net GHG emissions



Rangelands sequestration:
Scenario S2 “High use of rangelands”

36% of gross emissions

30% of gross emissions

Discussion – Conclusion 1/2

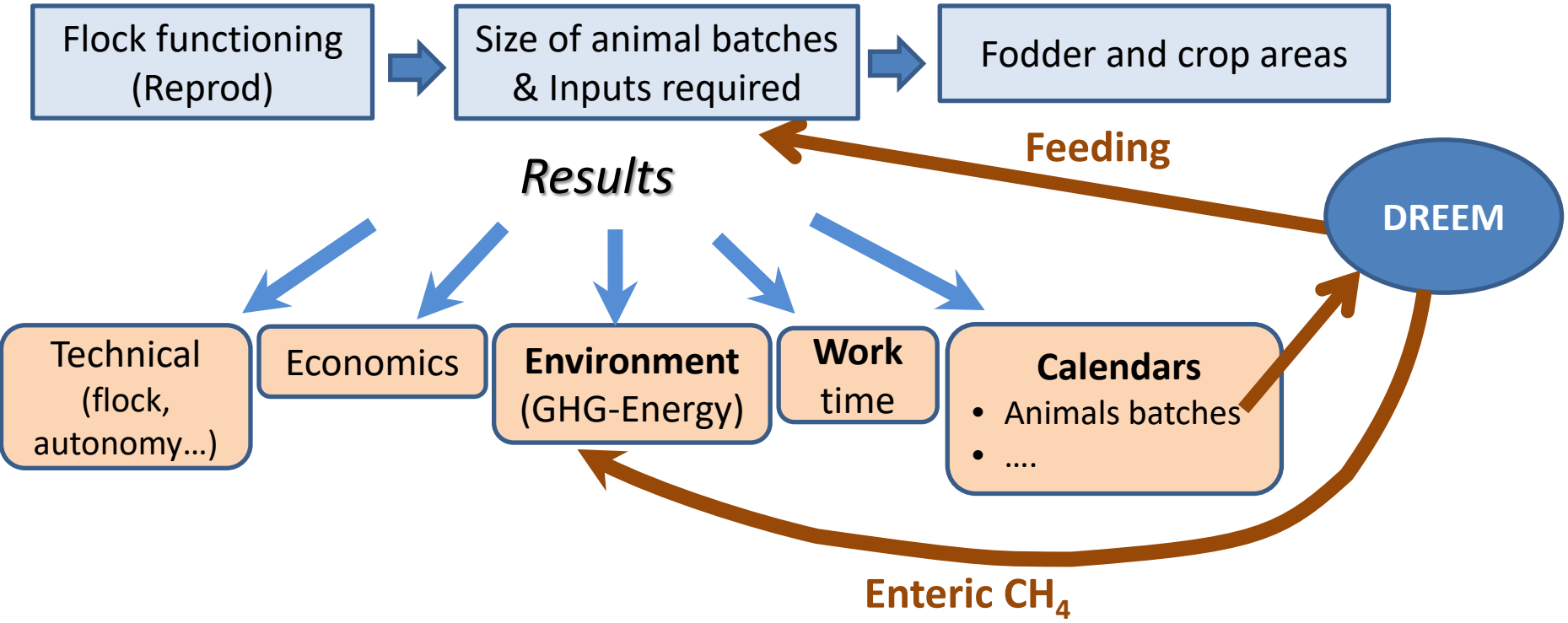
- About results
  - Higher technical performances (ewe prod.) for Sed. and S.Tr: less moving, temporary pastures, concentrates…
  - D.Tr, a drastic decrease in inputs, and low level of GHG emissions, with a high contribution of rangelands for feeding (85% of annual needs)…and counterbalance 1/3 of GHG emissions.
- A special notification for “D.Tr”
  - An amazing capacity to produce with low or no inputs
  - Both meat production, landscape maintenance, low negative environmental impacts, fire protection
  - A well adapted breed (Merinos Arles)…but an outstanding technical knowledge
  - Two obstacles: **1/** Special way of life with 2 or 3 moving per year for the family, **2/** Conflict with other actors. Pb of wolf presence: psychologic pressure, protection devices, time spent and other related issues.

Discussion – Conclusion 2/2

- In contexts where feeding is highly dependent on rangelands pasture: close relationship between *farming system* and (i) *diversity of animal intake* and (ii) *ecological process* in rangelands →2 additional models
- However, measurements « on fields » are requested (intake and digestibility), on each type of land cover
- For CASA, main challenge is to choose the appropriate temporal and spatial scales, with wide diversity of situations.
- High amount of C sequestrated by forest… but fire risk must be included, with grazing practices to face it

Thank you for your attention

OSTRAL

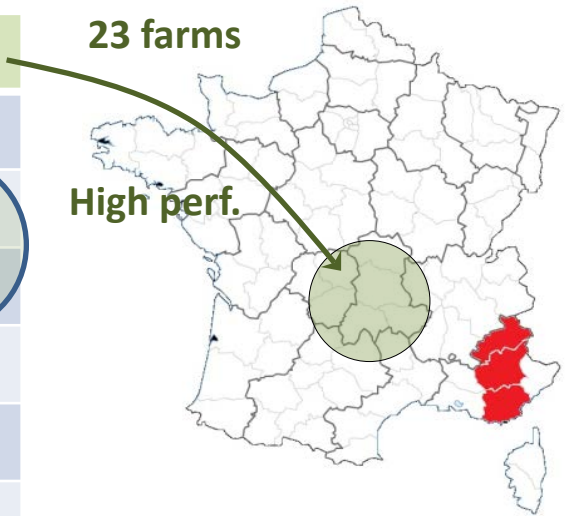

Flock functioning (Reprod)
Size of animal batches & Inputs required
Fodder and crop areas
Feeding
DREEM
Results
Technical (flock, autonomy…)
Economics
Environment (GHG-Energy)
Work time
Calendars
• Animals batches
• ….
Enteric CH_4

Implementation

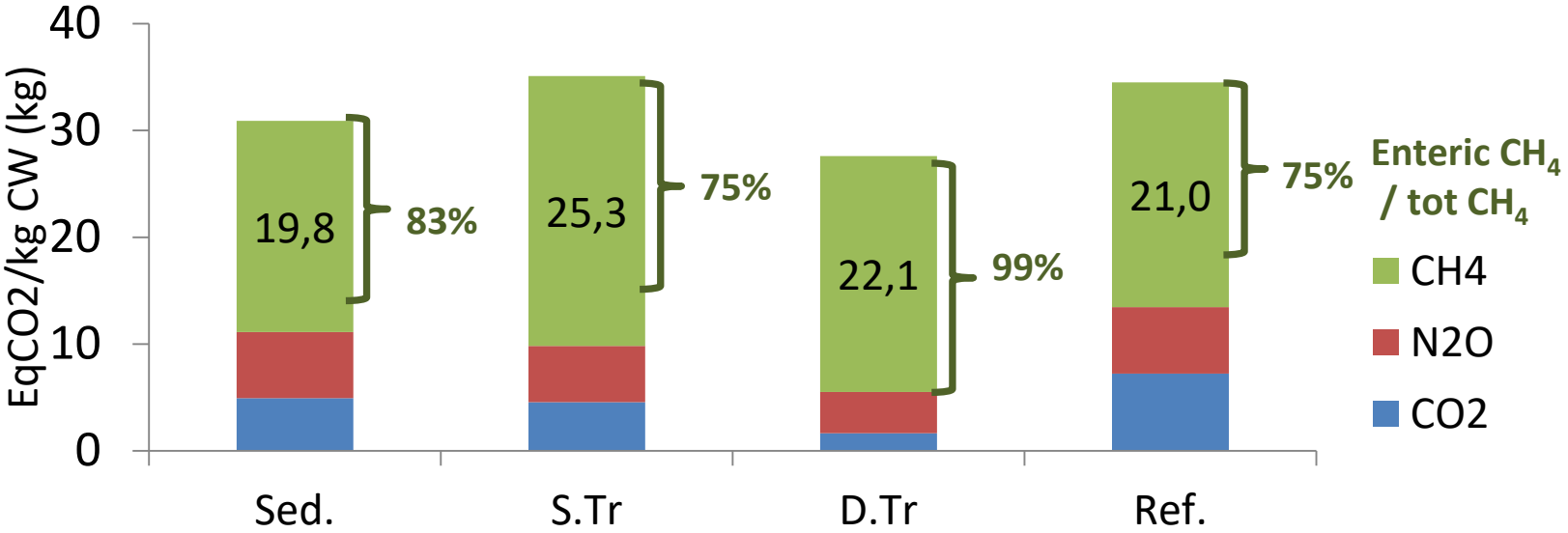
Three sheep farming system studied

Sedentary - Single transhumance - Double transhumance

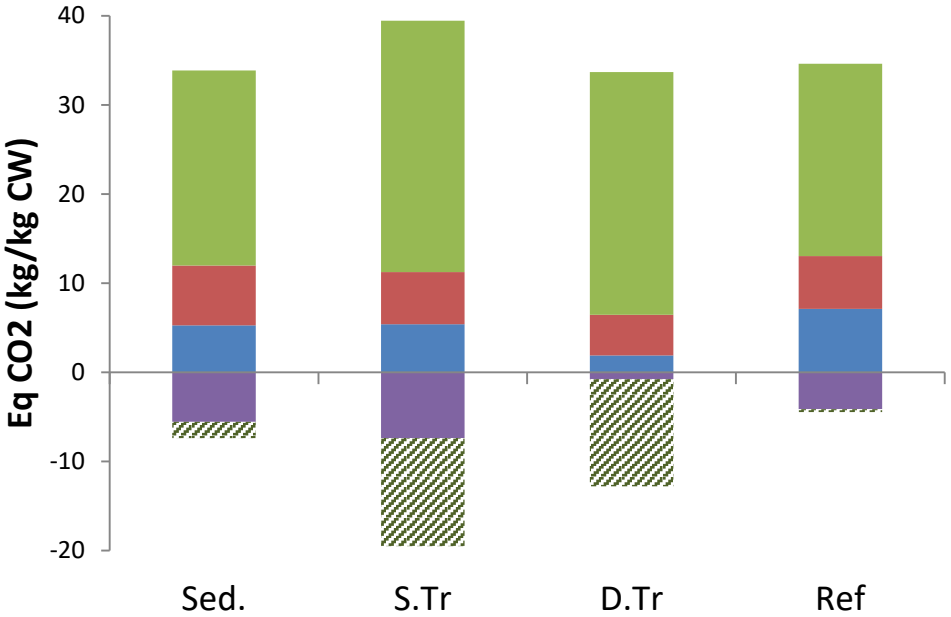
	Sedent.	S.Tr	D.Tr	Ref
Number ewes	223	243	1904	491
Ewe productivity	1.20	1.01	0.92	1.45
Meat /ewe (kg CW)	17.1	14.2	12.8	21.6
Stocking rate (LU/ha)	0.16	0.15	0.07	0.96
% Rangelands/AA	76%	88%	97%	30%
Concentrate/ewe (kg)	45	41	0	169
Forage self suff. (%)	91%	91%	100%	70%



Results – Gross GHG emissions

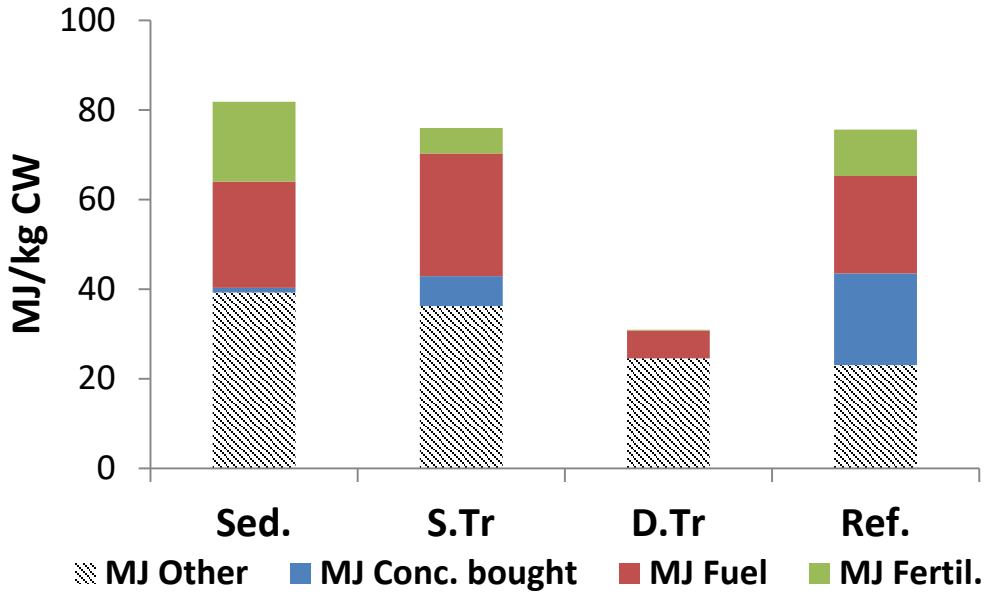


Results – Net GHG emissions



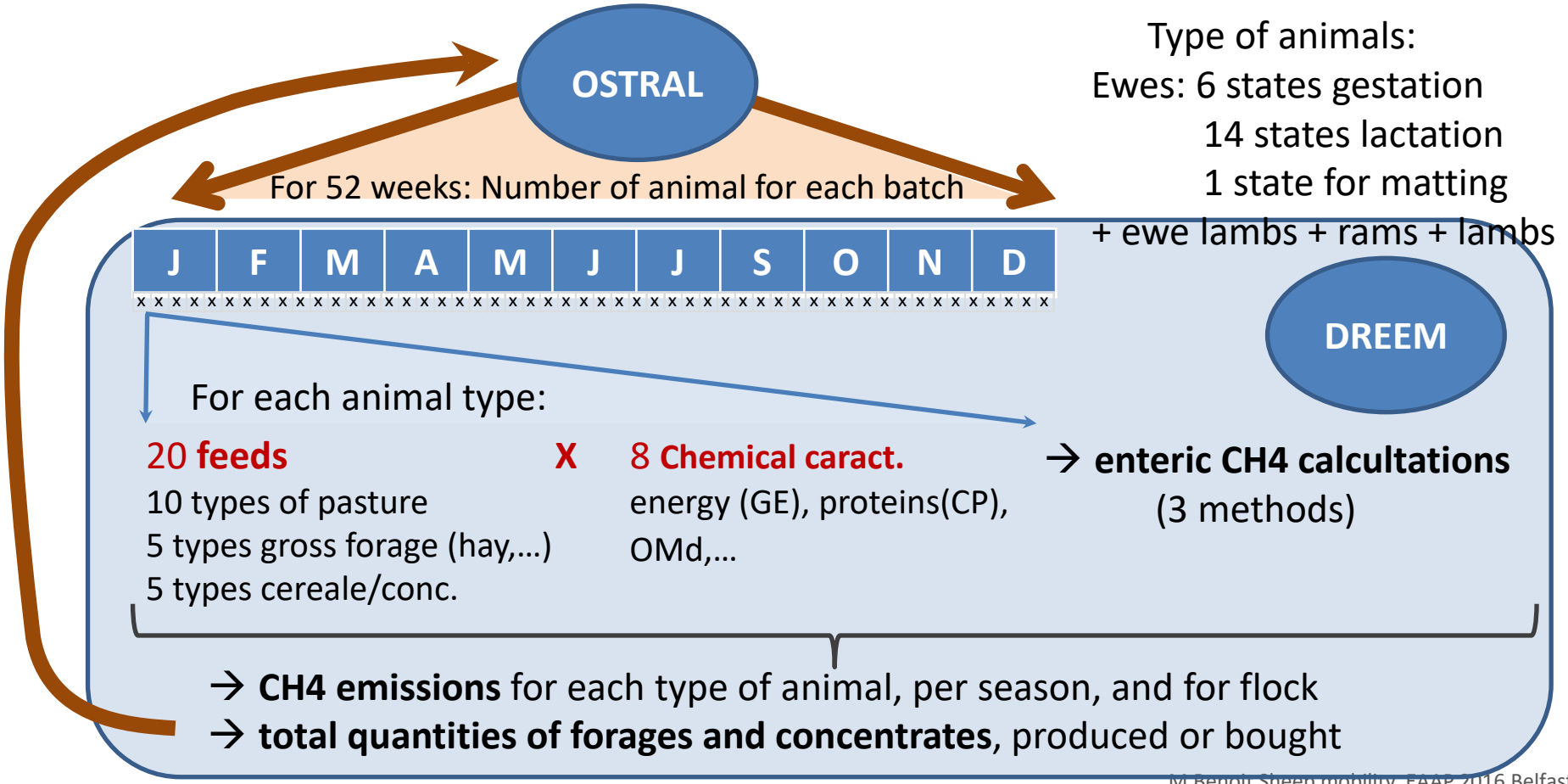
S2 (Sequestration Scenario)
"High use of rangelands by ewes"

Results – Non renewable energy consumption

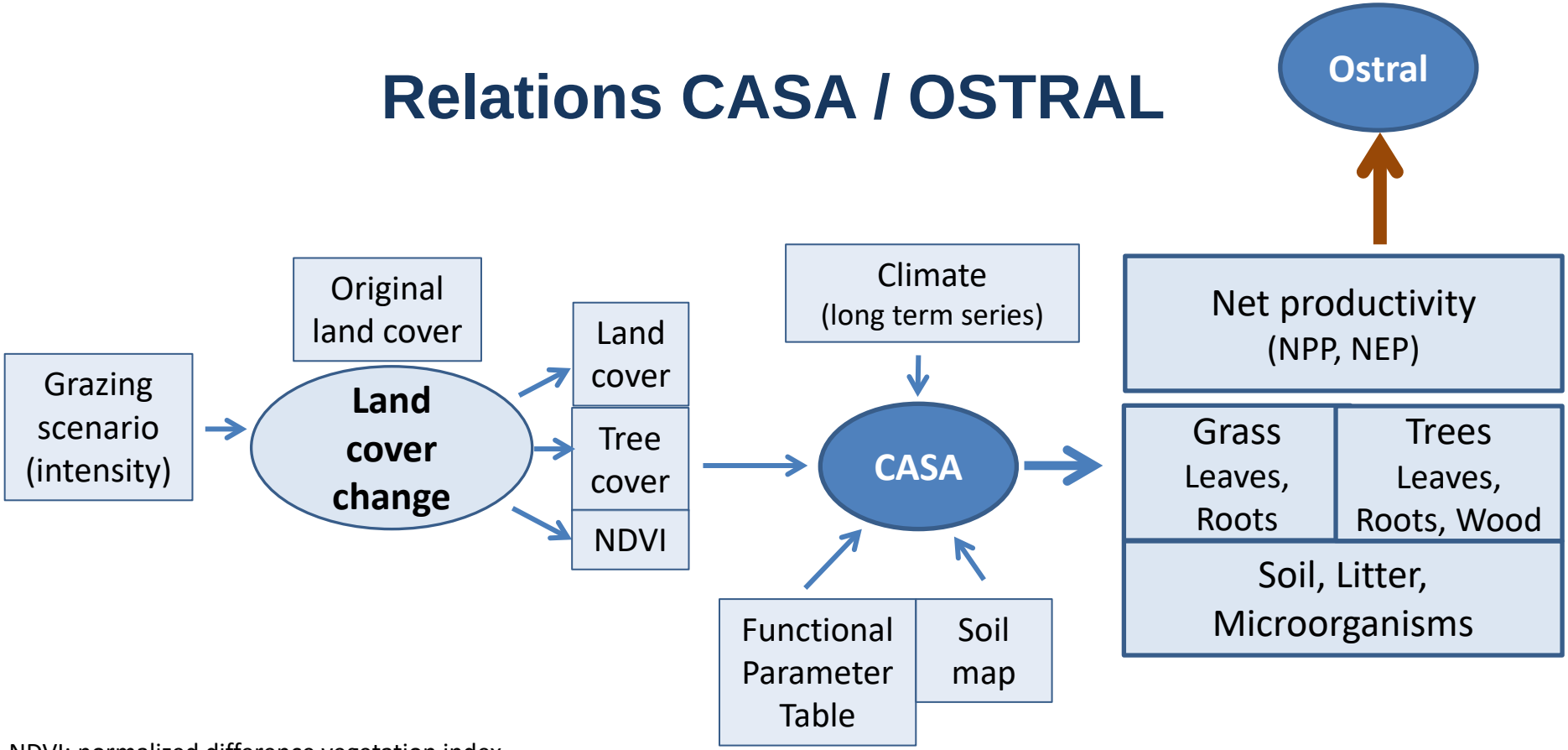


- Sed. and S.Tr: same ∑MJ than Ref. Less concentrates but lower CW produced/ewe
- D.Tr: far lower than Ref (-60%) …event if lower CW: only pasture, no fertiliser, no vets

Relations DREEM / OSTRAL

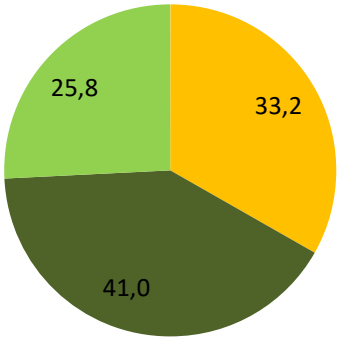


Relations CASA / OSTRAL

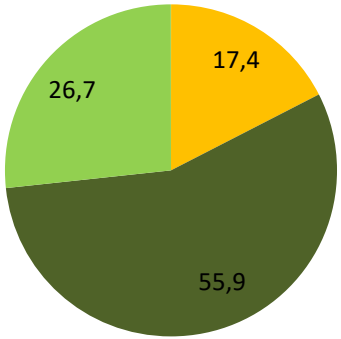


NDVI: normalized difference vegetation index
NPP: net primary productivity
NEP: net ecosystem productivity
hresp: soil respiration

1. Sédentaire



2. ST



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