

Quantification of variations in annual emissions of NH₃ and GHG in dairy cows housed in a compost-bedded pack system

E. Fuertes, G. de la Fuente, J. Balcells, J. Maynegre, J.C. Melo & A.R. Seradj

University of Lleida

esperanza.fuertes@udl.cat

Introduction



Cubicles



- Traditional system in Spain.
- Manure is stored for months on an open air pool.

Vs.

Compost-bedded pack (CBP)



- Its use is being extended.
- Benefits for animal health and welfare.
- **EMISSIONS?**

Objectives



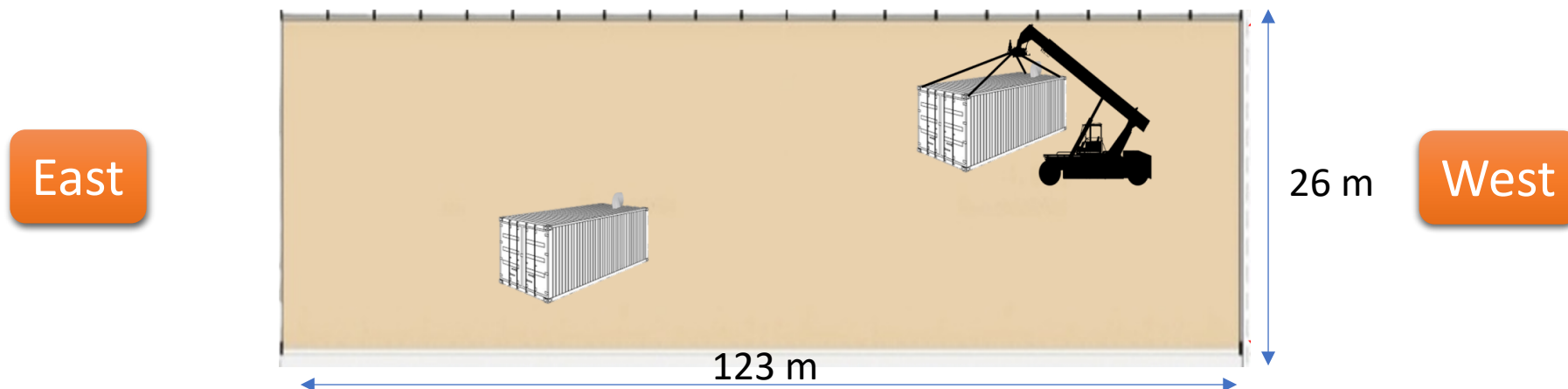
- Determination of NH_3 and GHG (CO_2 , CH_4 and N_2O) emissions from CBP system.
- Analyse separately emissions when the bed is being composted than when it is kept at rest.
- Annual scale evaluation of Seasonal effect upon those emissions.



Material & Methods



- CBP farm, 500 animals, Lleida province.
- Gaseous sampling: bimonthly → January-December.
- Two sampling areas (East and West).
- Surface and deep pH measurement.



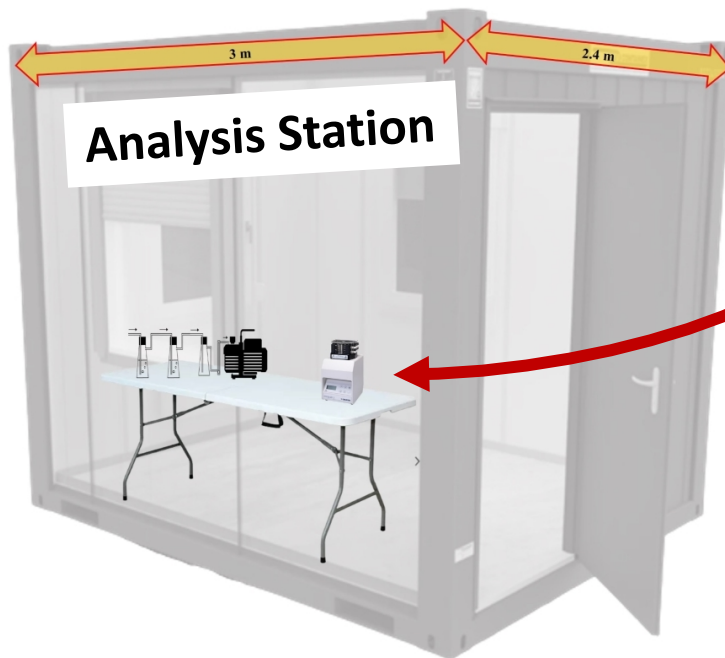
Material & Methods



1. Static Phase (SP, 23h)

2. Dynamic Phase (DP, 1h)

(Fuertes et al., 2023)



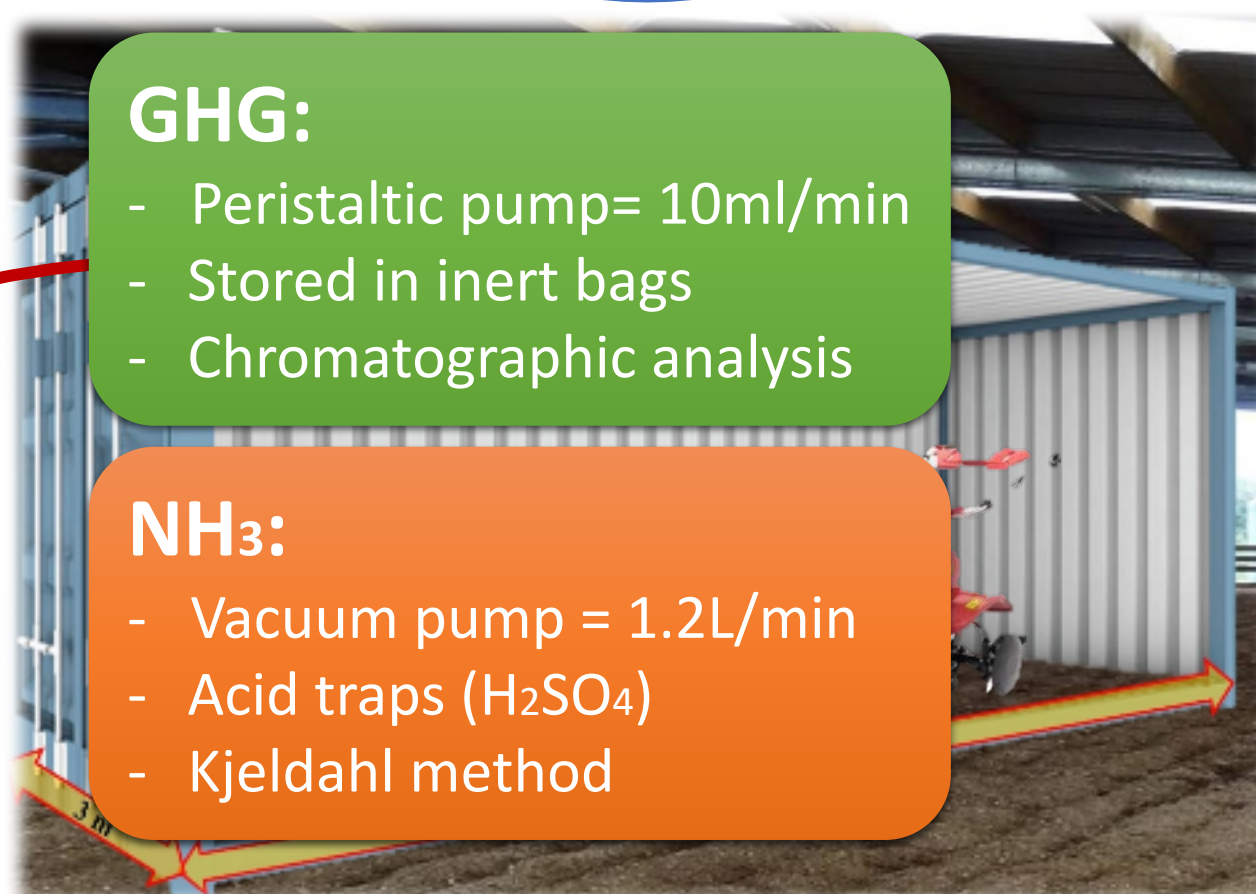
**Gaseous
sampling**

GHG:

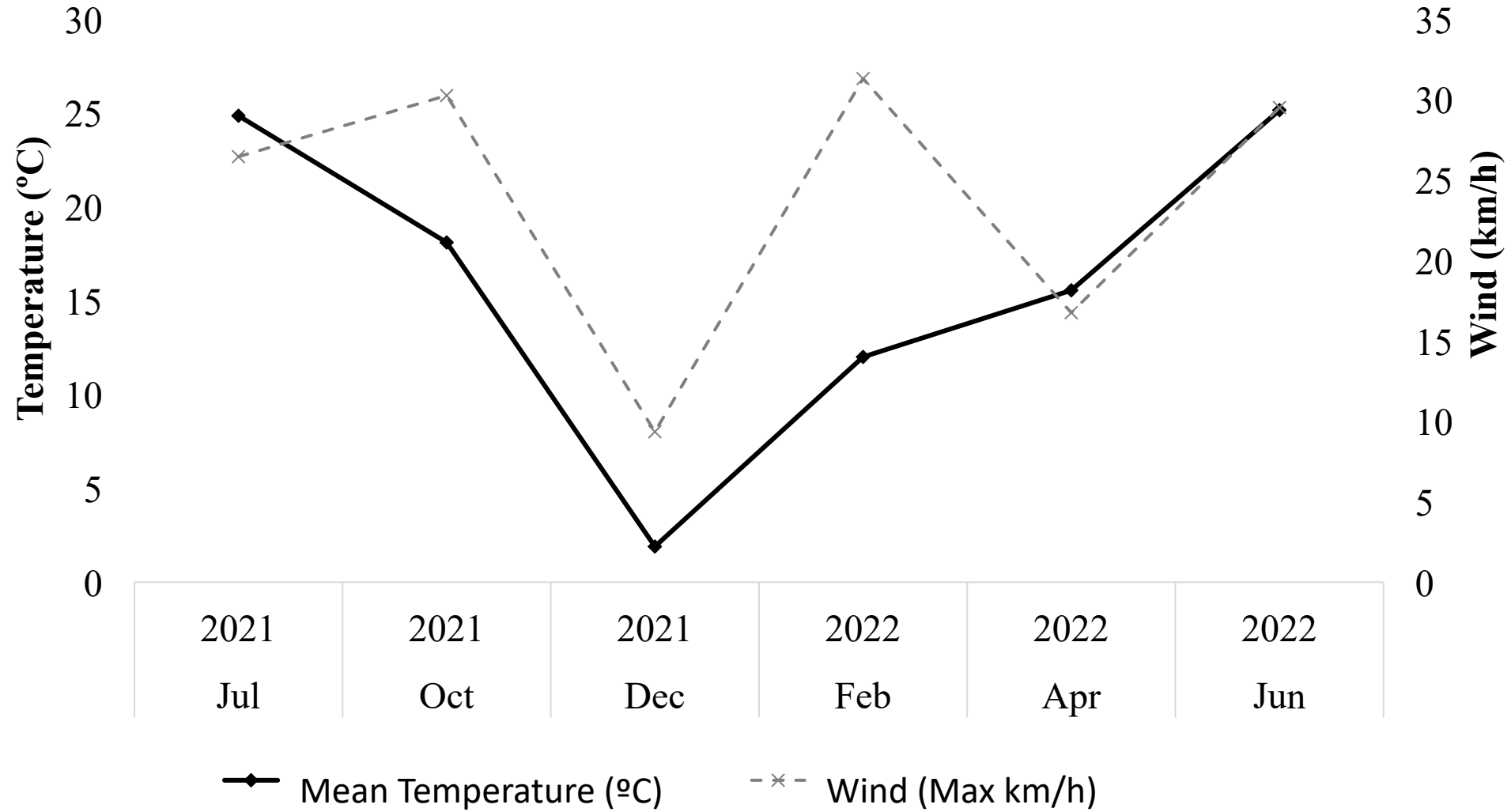
- Peristaltic pump = 10ml/min
- Stored in inert bags
- Chromatographic analysis

NH₃:

- Vacuum pump = 1.2L/min
- Acid traps (H₂SO₄)
- Kjeldahl method



Material & Methods



Results



Table 1. Daily emissions (DP + SP) of GHG (CO₂, CH₄, N₂O) and NH₃ recorded bimonthly in an annual cycle.

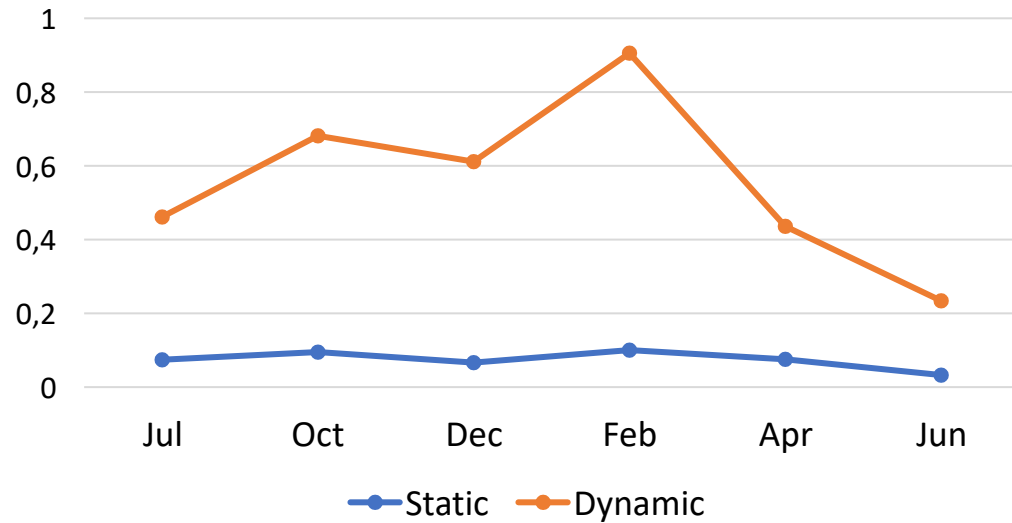
g gas/m ² & day	July	October	December	February	April	June	SE	<i>P</i>
CH ₄	0.53 ^{bc}	0.77 ^{ab}	0.67 ^{ab}	1.00 ^a	0.51 ^{bc}	0.26 ^c	0.11	0.04
CO ₂	3.11 ^a	1.53 ^c	1.09 ^c	1.12 ^c	1.58 ^c	2.27 ^b	0.18	0.001
N ₂ O (mg/m ² & day)	13.94 ^{ab}	4.99 ^{bc}	1.43 ^c	2.30 ^c	5.65 ^{bc}	24.08 ^a	3.19	0.01
NH ₃	0.84 ^a	0.22 ^b	0.34 ^{ab}	0.38 ^{ab}	0.62 ^{ab}	0.84 ^a	0.17	0.16

- No differences between orientation E/W.
- Significantly greater emissions during DP vs. SP.
- Winter decreased all gaseous emissions except for CH₄.

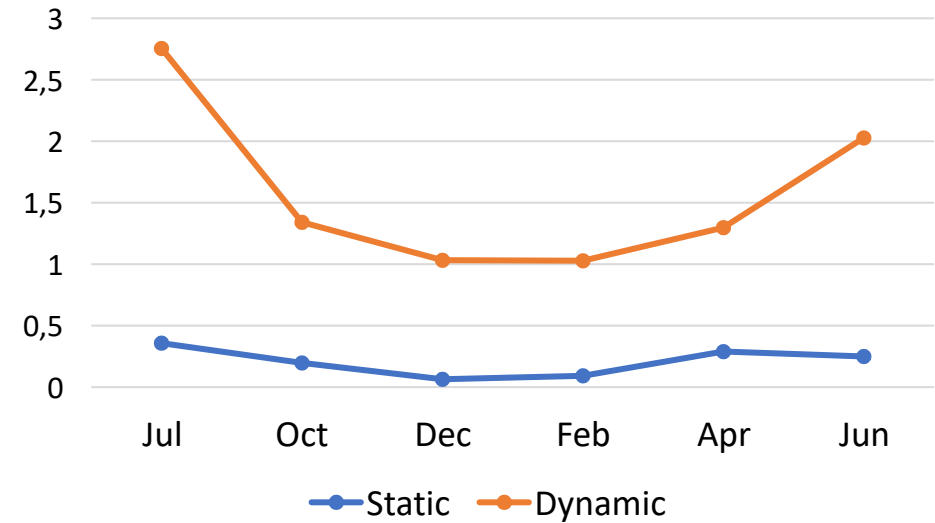
pH → no stat. differences

Results

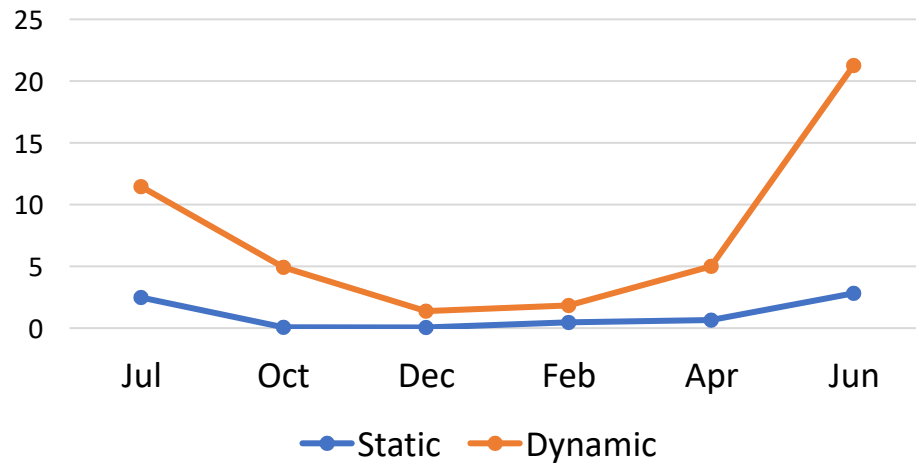
g CH₄/m²



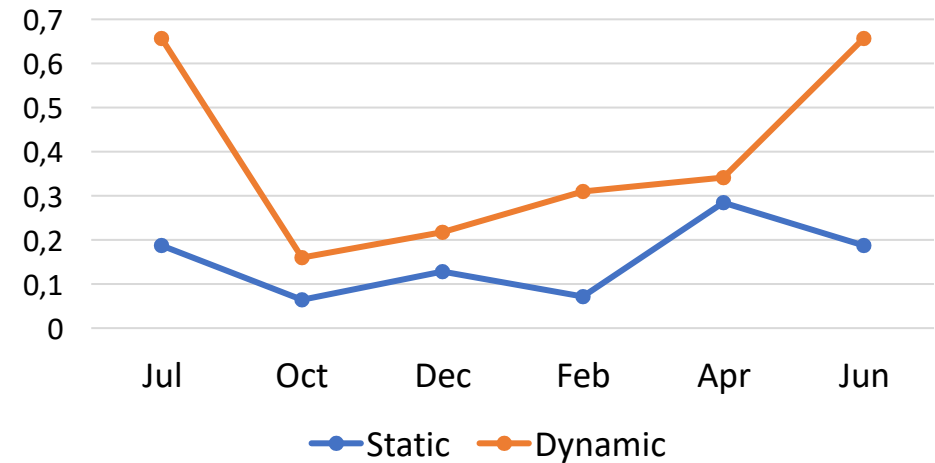
g CO₂/m²



mg N₂O/m²



g NH₃/m²



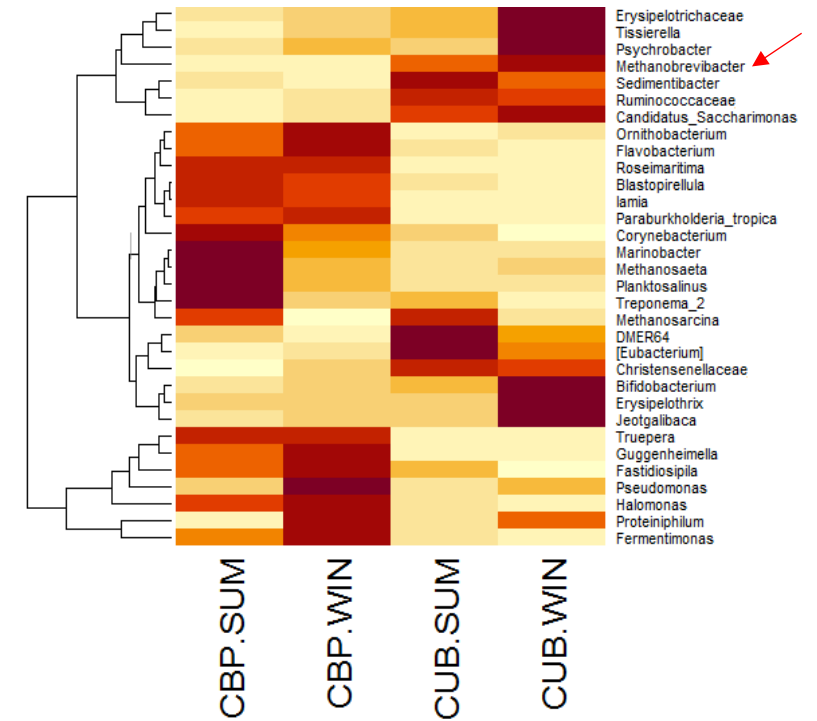
Discussion

- Gaseous emissions are deeply influenced by environmental T^a.
- **CBP** → composting process warms up manure → warm bed T^a even in Winter.
- Warmer months → Significantly rose CO₂ and N₂O emissions, with a trend for NH₃.
- **CH₄** → experienced a rise during colder months.

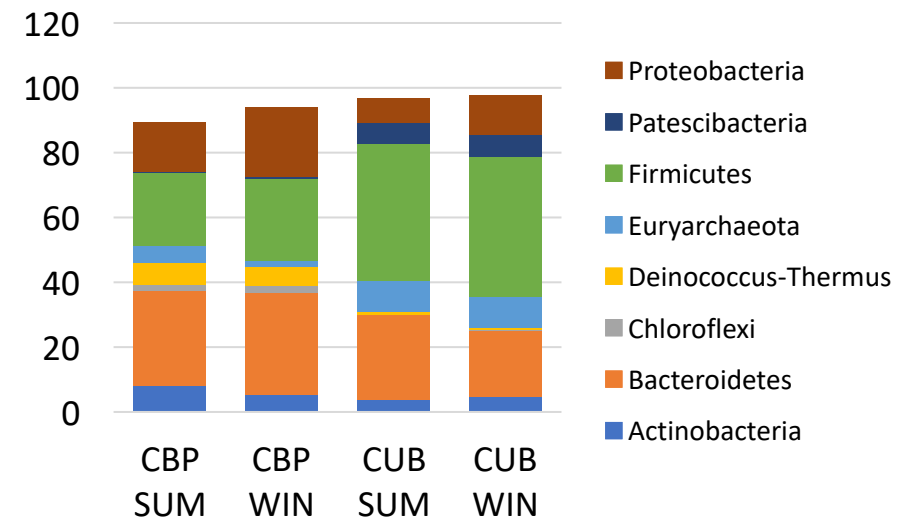
Microbial sequencing of CBP manure → rose in certain populations during Winter months.

- **DP vs. SP** → 7 times greater emissions for GHG, 3 times higher for NH₃ (Fuertes et al., 2023).

Microbial genus profile in CBP and CUB during two seasons



Most abundant phyla in CBP and CUB during two seasons



Conclusions



- Dynamic phase of emission is the main responsible for GHG and NH₃ release from CBP manure.
- There are annual variations on gas emissions and they seem to be linked to Temperature changes.
- Warmer months increased CO₂, N₂O and NH₃ emissions but decreased CH₄.
- Deeper studies need to be done regarding pollutant emissions derived from CBP systems, especially regarding the composting phase.

Thank you for
your attention!

esperanza.fuertes@udl.cat



Generalitat
de Catalunya
**Departament
d'Agricultura,
Ramaderia,
Pesca, Alimentació
i Medi Natural**



**Universitat
de Lleida**