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Bioenergy & Climate Change

*Towards a Sustainable Development*

# BIOMASS BLENDING AS A WAY TO REDUCE $NO_X$ EMISSIONS DURING THE COMBUSTION OF BIOMASS RESIDUES

Brice Piednoir, Jean-Michel Commandré, Anthony Benoist, Sarah El Fassi, Gilles Vaitilingom

Research Unit BioWooEB, Montpellier

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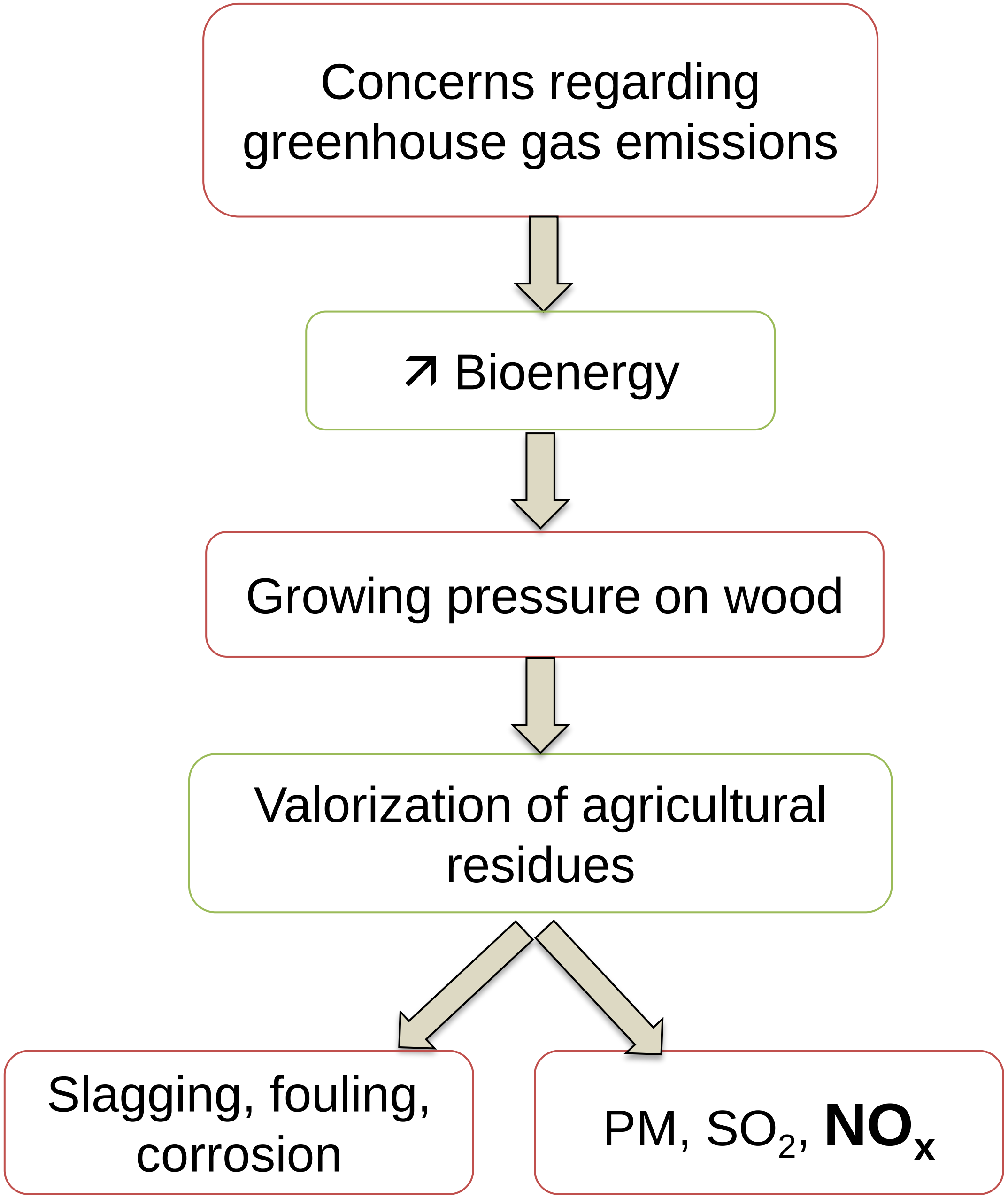
Concerns regarding greenhouse gas emissions
↗ Bioenergy
Growing pressure on wood
Valorization of agricultural residues
Slagging, fouling, corrosion
PM, $SO_2$, **$NO_x$**

# Approach

- Which compounds contained in biomass can influence $NO_x$ emissions ?
- Can synergies be implemented by biomass blending to reduce NO emissions ?

# Procedure

Selection of biomass residues | Lab scale pelletization | Combustion experiments

# NO emissions: blending strategy

**Influence of N**

Combustion of « pure » samples

↓

Blend: extremal N-content samples

Pine Bark & Grape Marc

**Influence of Ca**

| | | | |
|---|---|---|---|
| **Ca** | CST | ⇔ | ⇔ |
| **N** | ⇔ | CST | ⇔ |
| **Ca/N** | ⇔ | ⇔ | CST |

Rice Husk & Rape Straw

Rice Husk & Olive Pomace

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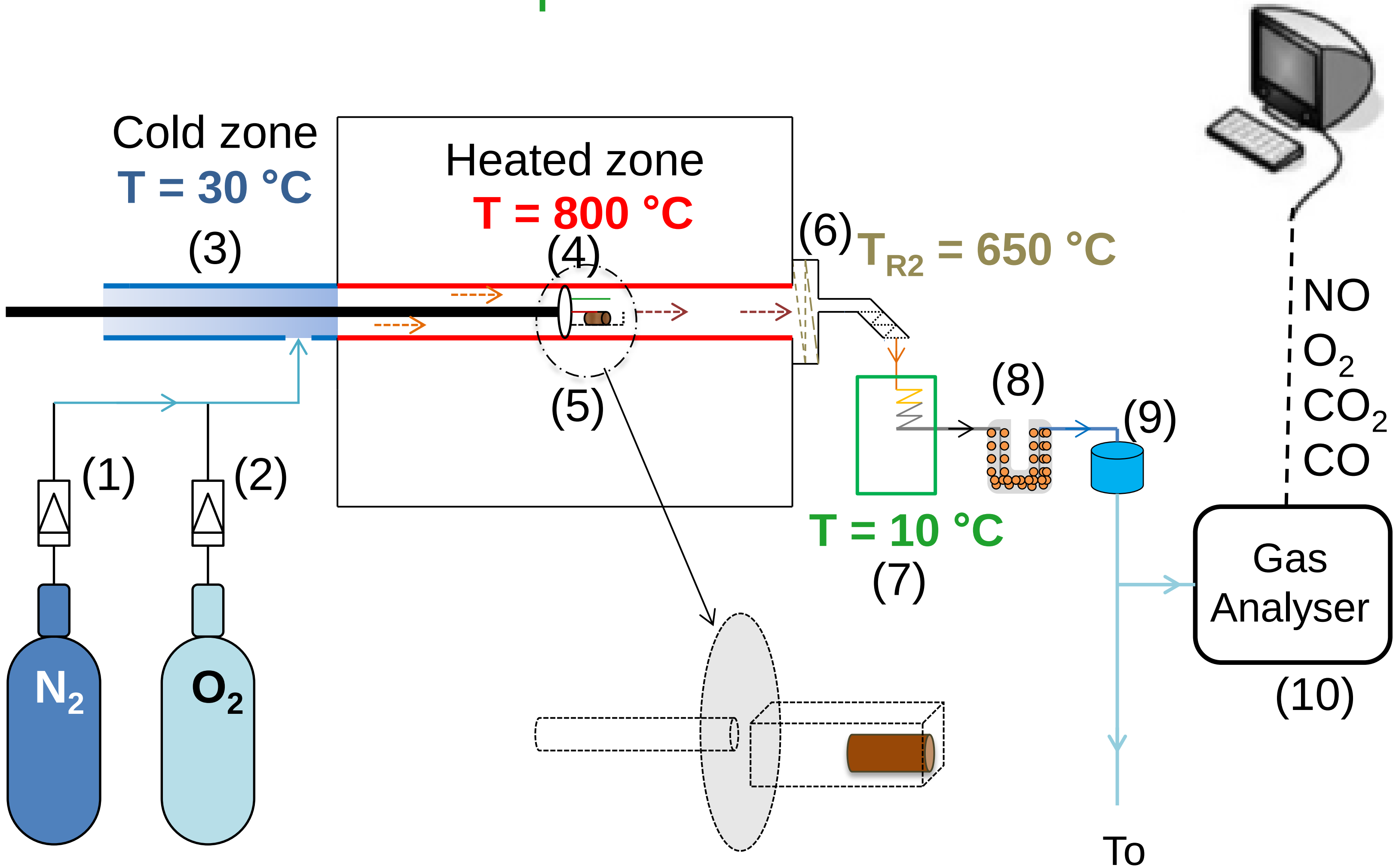
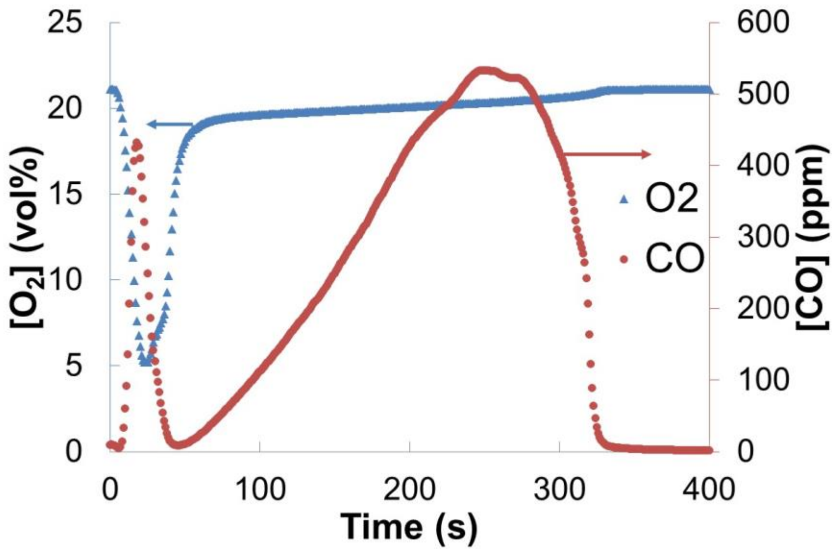
# Combustion setup

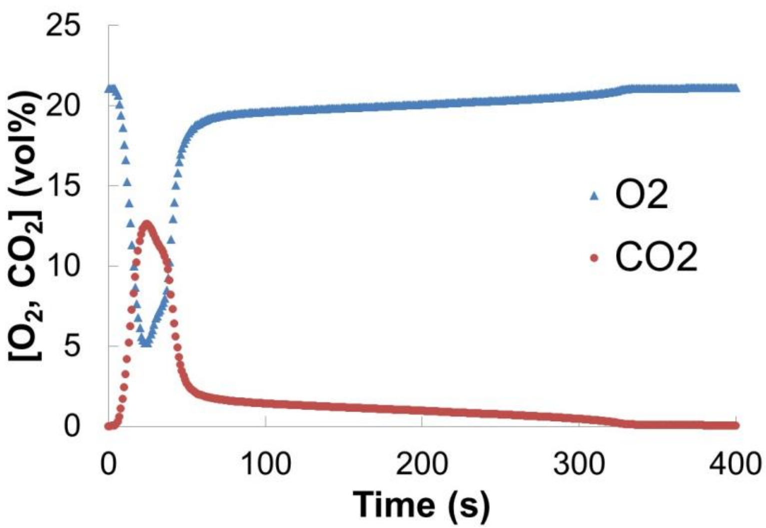



$N_2$: 79% $O_2$: 21%

Total flow rate: 3,8 $Nl.min^{-1}$

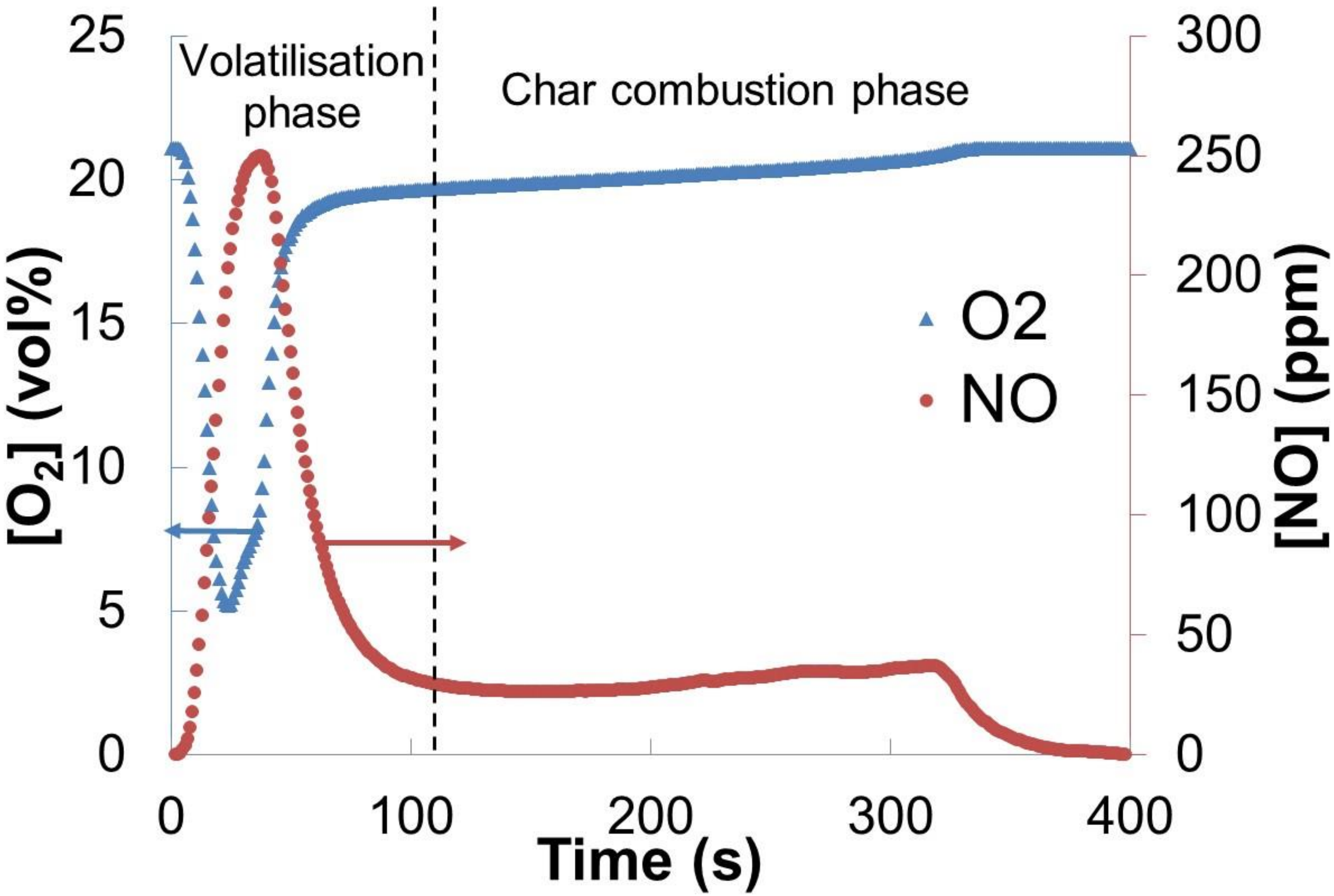
# Typical emission profiles: CO and $CO_2$




- Low CO concentration:
  - < 1 000 ppm (0,1%vol)
- Efficient combustion:
  - $\frac{CO+CO_2}{Fuel-C} > 90\%$
  - $\frac{CO}{CO+CO_2} < 1{,}5\%$

# Typical emission profile : NO

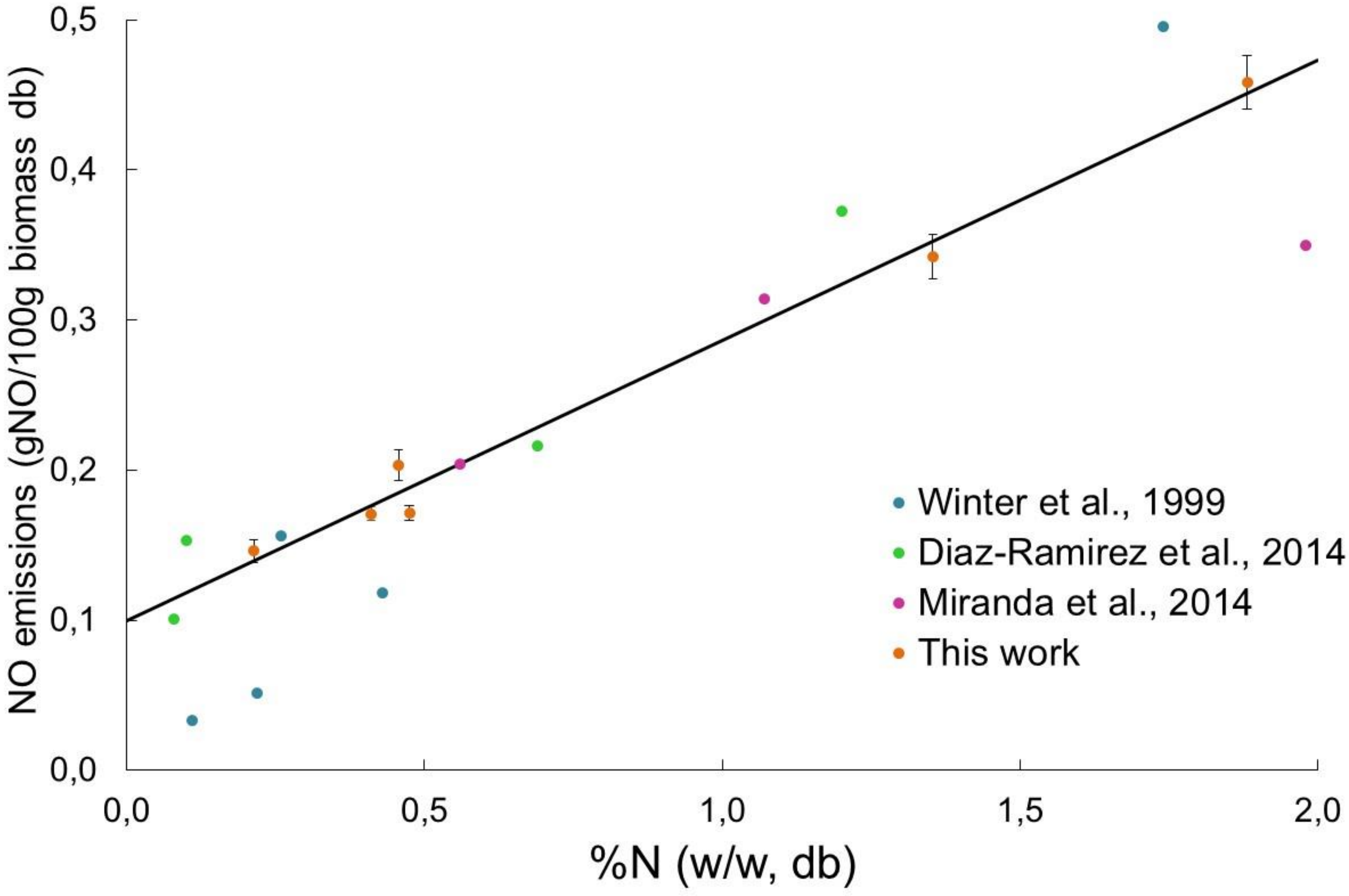


# Blending strategy

Influence of N

Combustion of « pure » samples

# NO emissions and N-content for the fuels selected in this study



# Blending strategy

Influence of N

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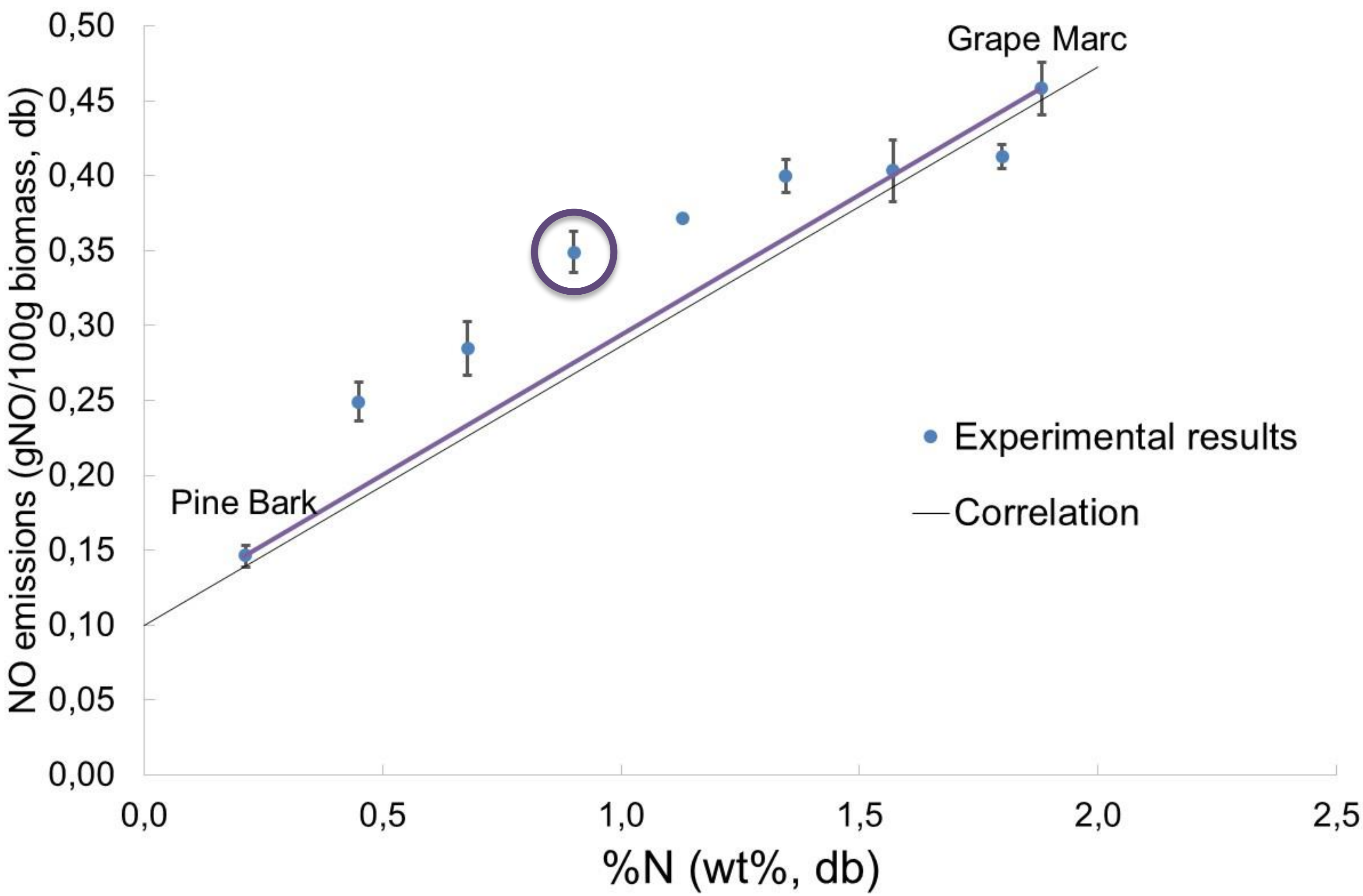
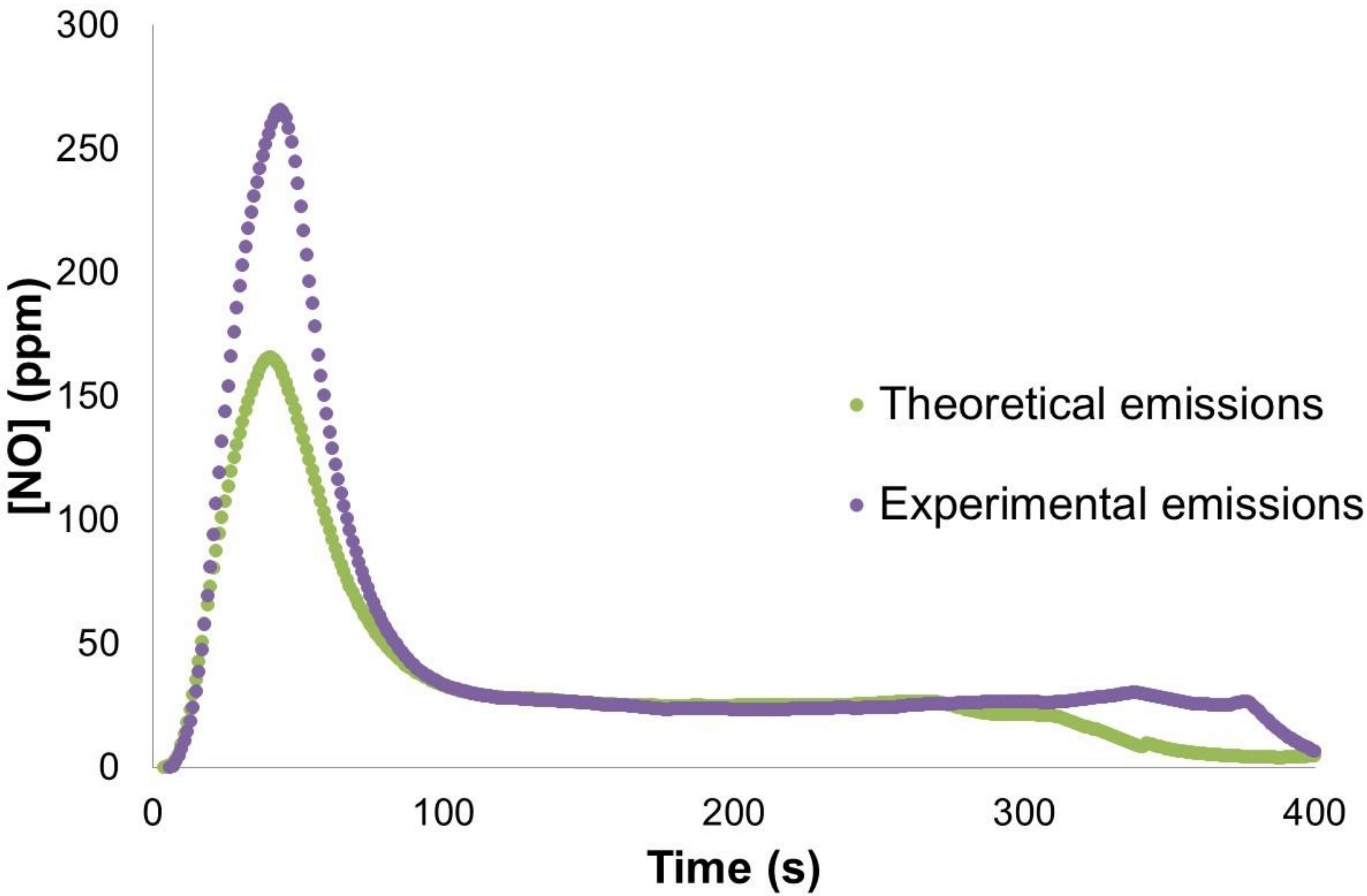
Blend: extremal N-content samples

Pine Bark & Grape Marc

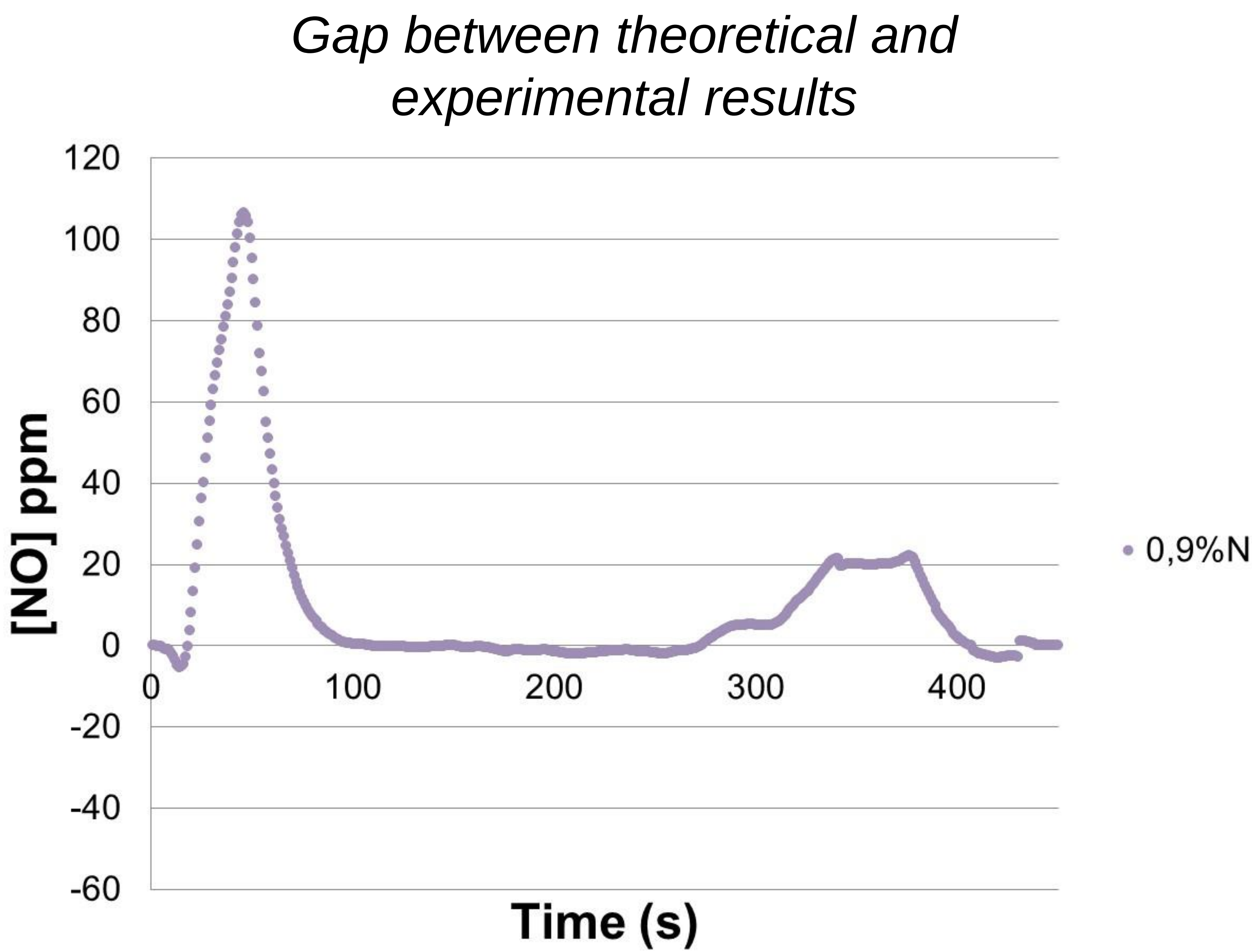
# NO emissions: Pine Bark & Grape Marc blends



# NO emissions: Pine Bark & Grape Marc 0,9%N



# NO emissions: Pine Bark & Grape Marc



# Blending strategy

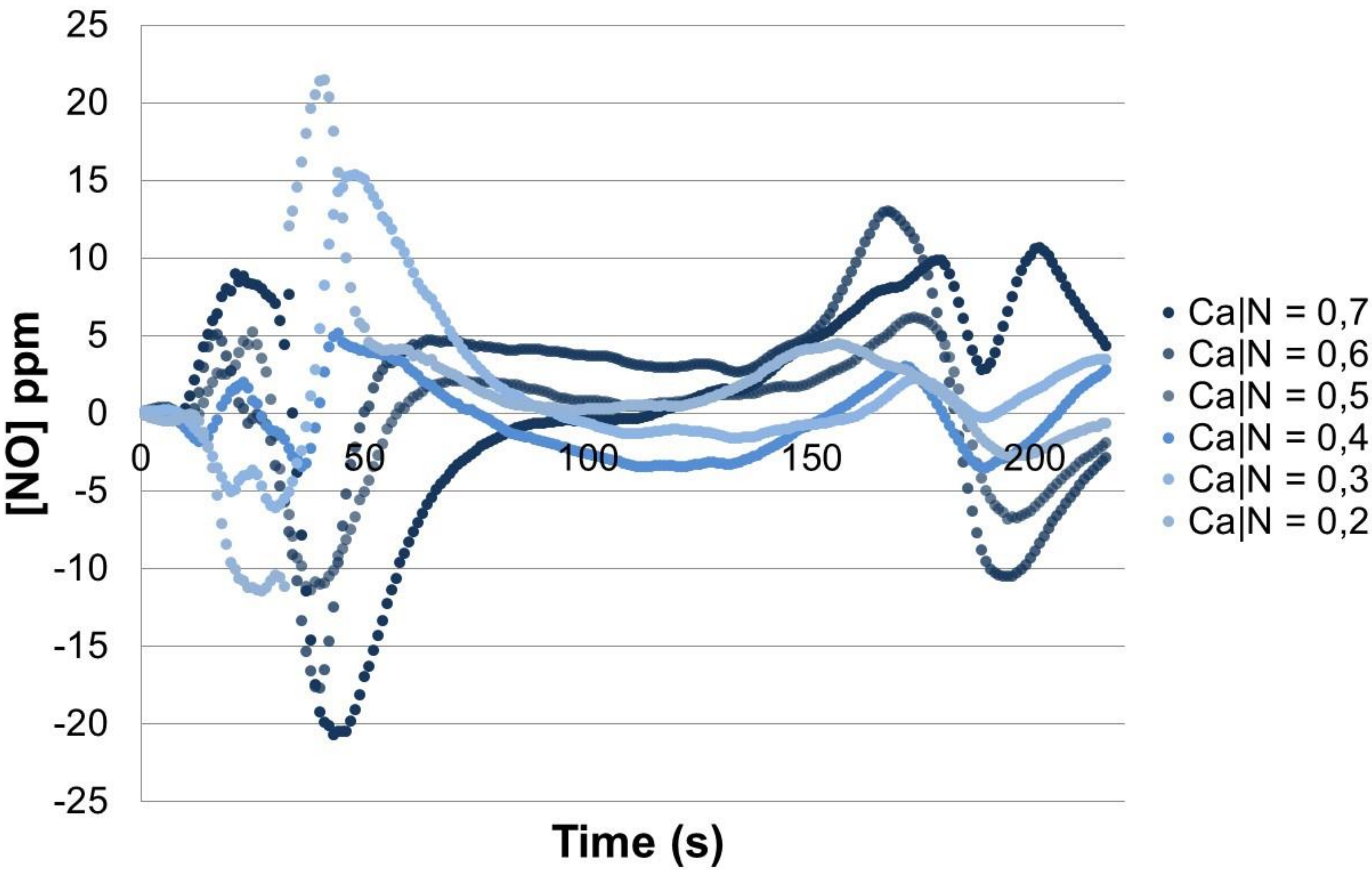
Influence of Ca

| | | | |
|---|---|---|---|
| **Ca** | CST | ⇔ | ⇔ |
| **N** | ⇔ | CST | ⇔ |
| **Ca/N** | ⇔ | ⇔ | CST |

Rice Husk & Rape Straw

# NO emissions: Rice Husk & Rape Straw

*Gap between theoretical and experimental results : fixed %N*

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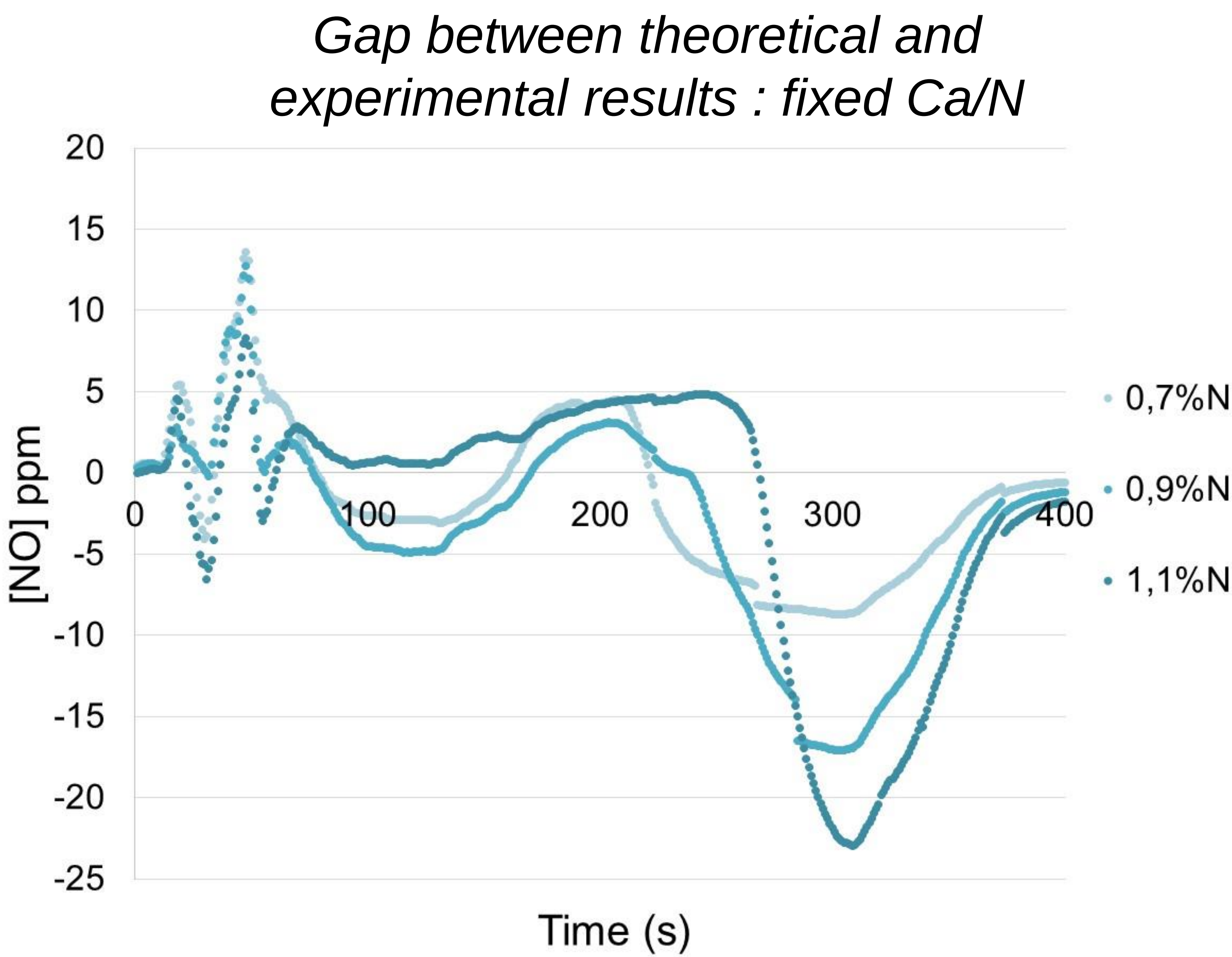
# Blending strategy

Influence of Ca

| | | | |
|---|---|---|---|
| **Ca** | CST | ⇔ | ⇔ |
| **N** | ⇔ | CST | ⇔ |
| **Ca/N** | ⇔ | ⇔ | CST |

Rice Husk & Olive Pomace

# NO emissions: Rice Husk & Olive Pomace



# Conclusions on NO emissions

## Influence of N

Correlation on « pure » samples

↓

Non linearity for blends

## Influence of Ca

| | | | |
|---|---|---|---|
| **Ca** | CST | ⇔ | ⇔ |
| **N** | ⇔ | CST | ⇔ |
| **Ca/N** | ⇔ | ⇔ | CST |
| **Vol-NO** | | Low nonlin. | No effect |
| **Char-NO** | ? | Low nonlin. | Nonlin |
| **Global NO** | | No effect | Reduc-tion |

# Thank you for your attention

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**Contact:**
**brice.piednoir@cirad.fr**