



Global NH_3 emissions from livestock management :

Development of an agricultural module within a land surface model and the impacts on atmospheric chemistry

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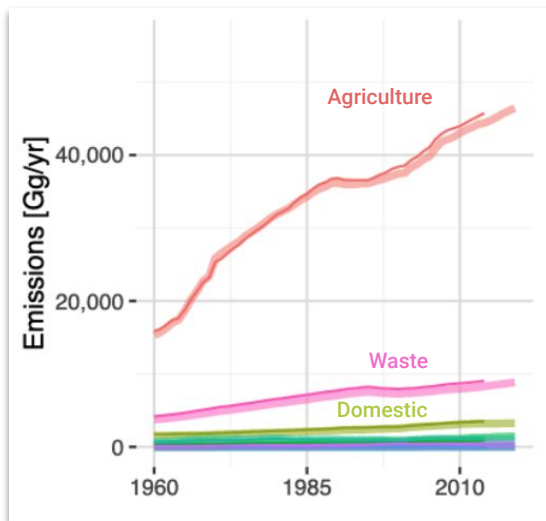
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Context

Annual trends of the global NH_3 emissions by sector



CEDS : Community Emissions Data System (Mc Duffie, et al., 2021)

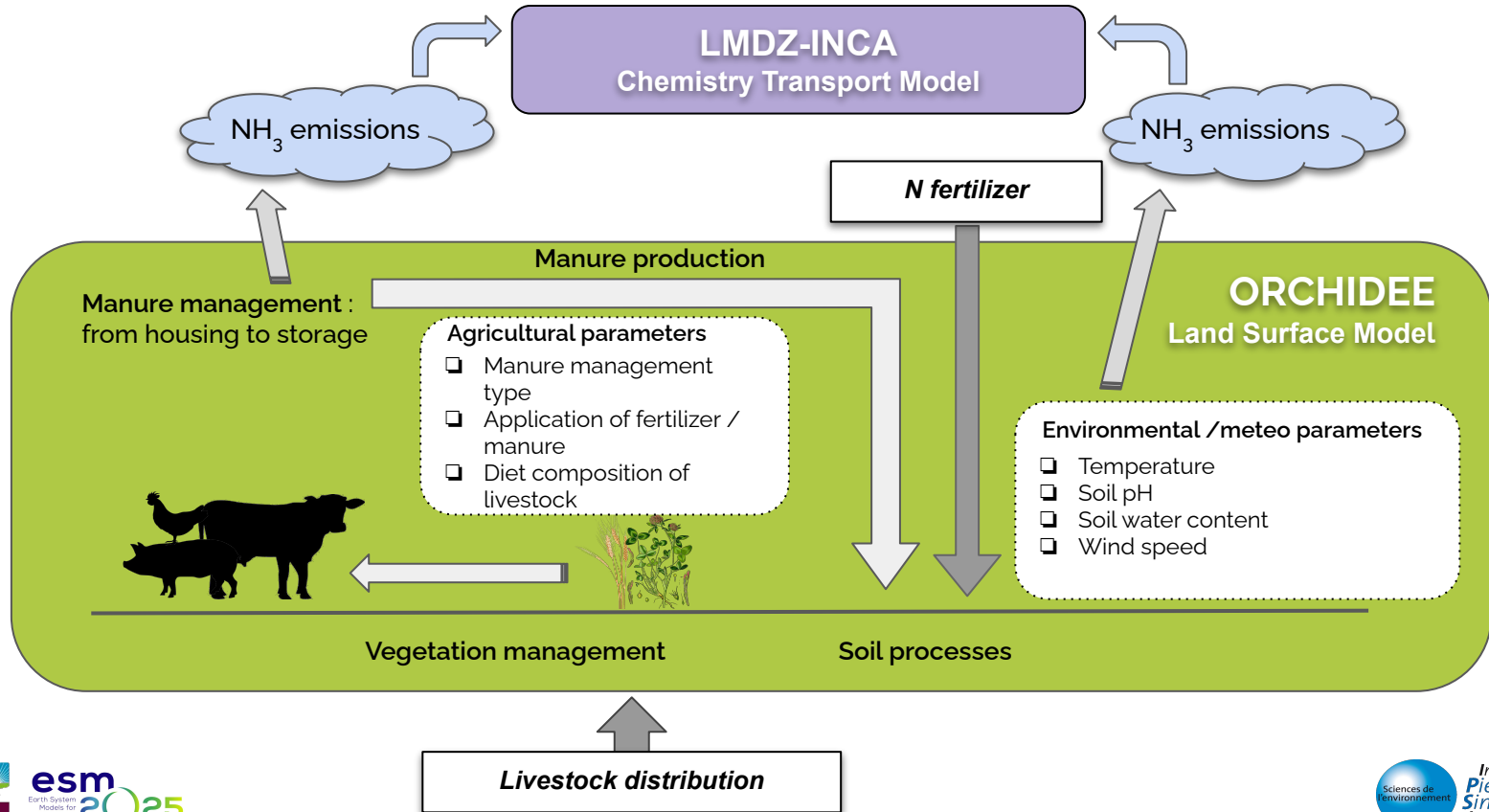
- **Agricultural sector** accounts for around **90% of the global anthropogenic emissions** (Behera et al., 2013)
- **Global estimates for agriculture** range from **35 to 48 Tg N /yr** (CEDS, EDGAR, HTAP, FANv2)
- **Volatilizations depend on a diversity of parameters** :
agricultural practices, environmental and meteorological conditions
→ **Uncertainties in the existing estimations** (global inventories or global modeling approaches)
- Because NH_3 emissions **impact the chemistry** through the formation of secondary aerosols → Important of making effort in the improvement of estimations



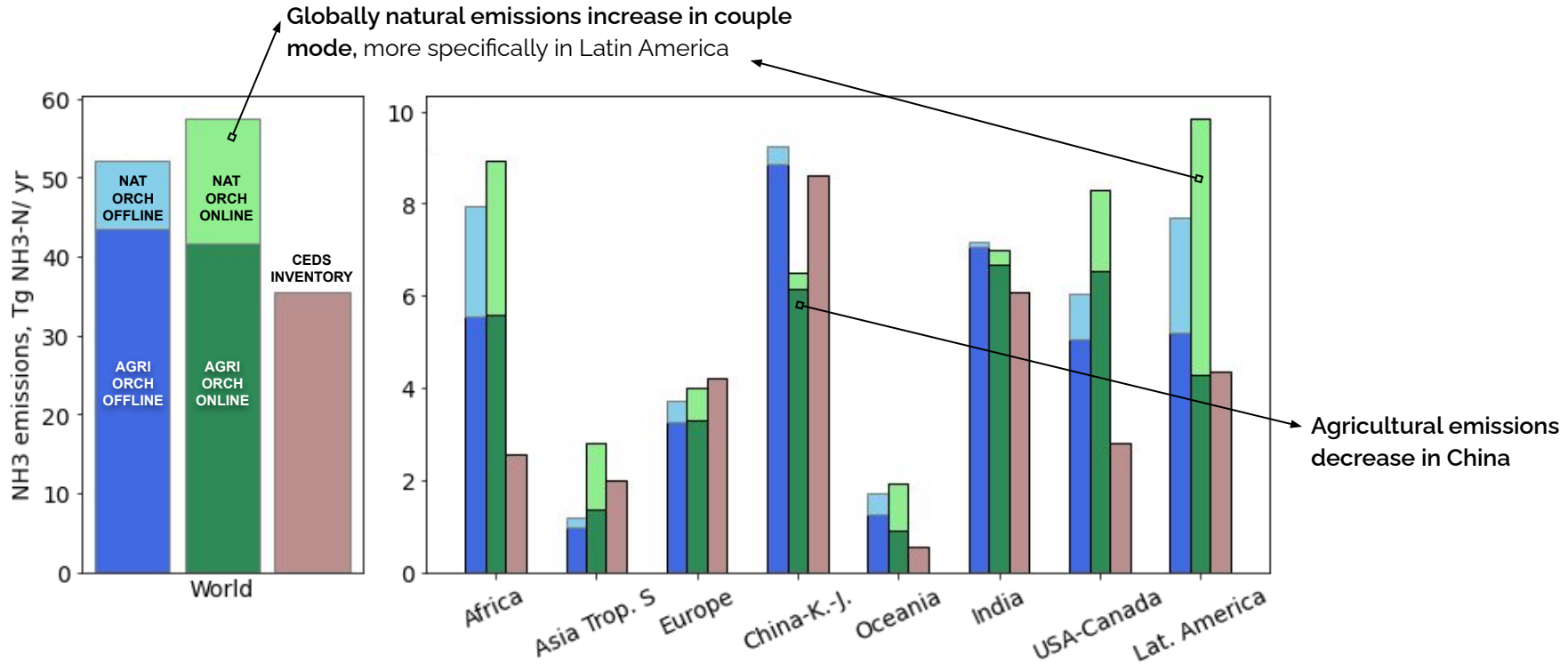
OBJECTIVES :

- ☐ Implement a dynamical calculation of the emissions in a ESM
- ☐ Improving the spatial and seasonal representation of the simulated $[\text{NH}_3]$
- ☐ Study the impact on the atmospheric chemistry

Our approach : Modeling Nitrogen fluxes within land-housing-soil continuum

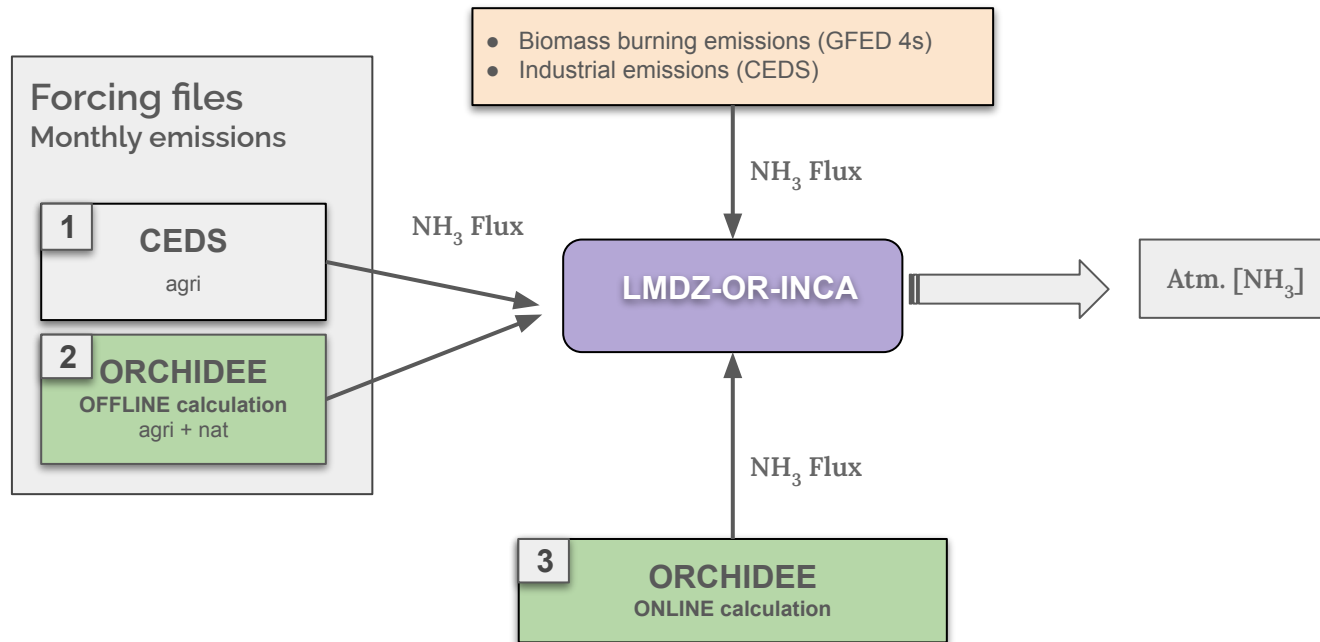


Evaluation : Emissions in offline and online mode

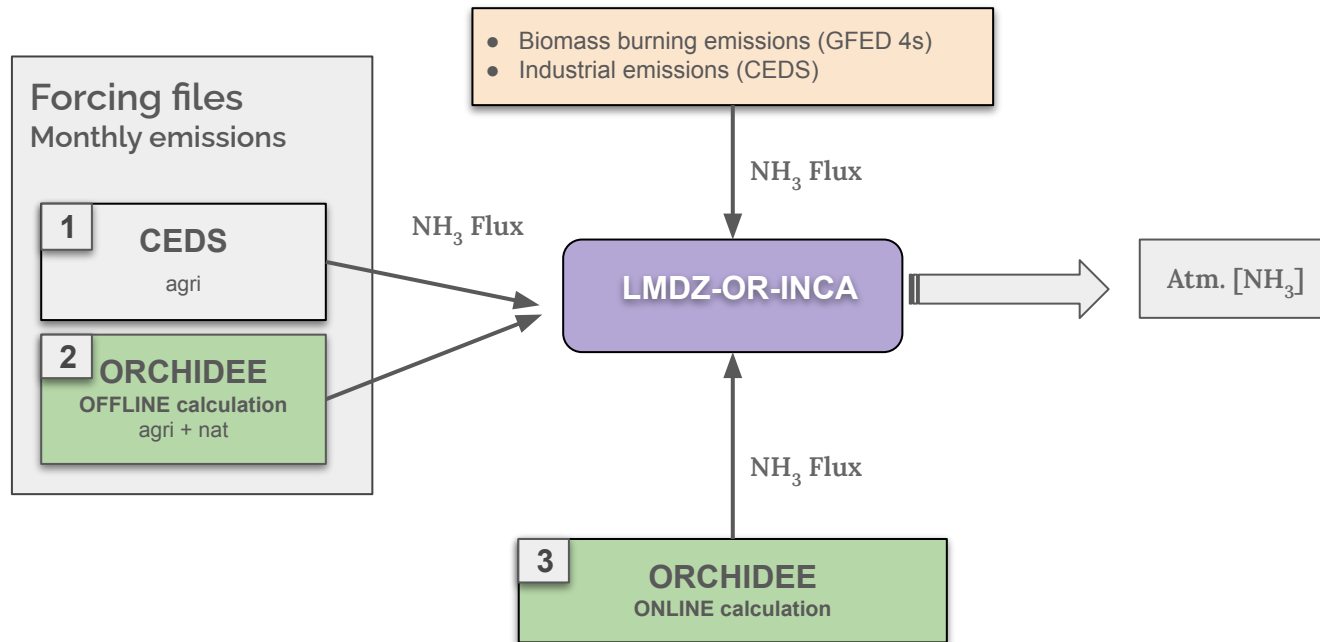


Offline emissions → [Publication in prep. Beaudor et al., 2022](#)

Set up LMDz-OR-INCA simulations & Evaluation



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Global evaluation

IASI observations



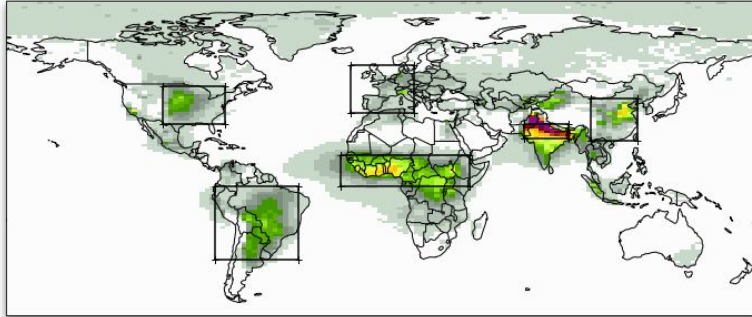
Monthly gridded
distributions using AM data
of IASI-A and IASI-B

2011-2017

Evaluation : impact on atmospheric NH₃

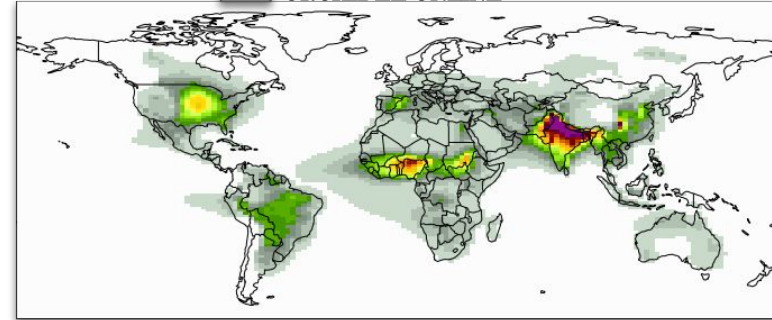
Annual NH₃ columns (2011-2014) (molecules x10¹⁶/cm²)

IASI



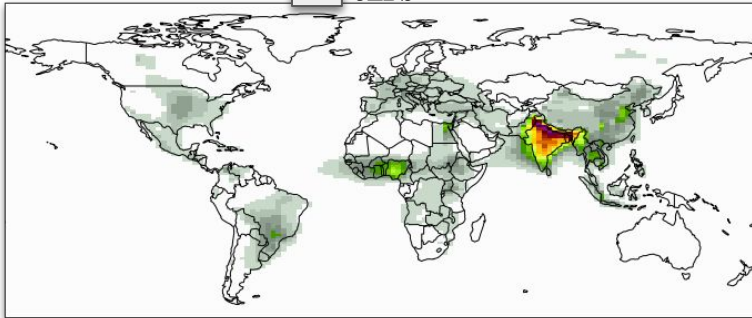
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ORCHIDEE ONLINE



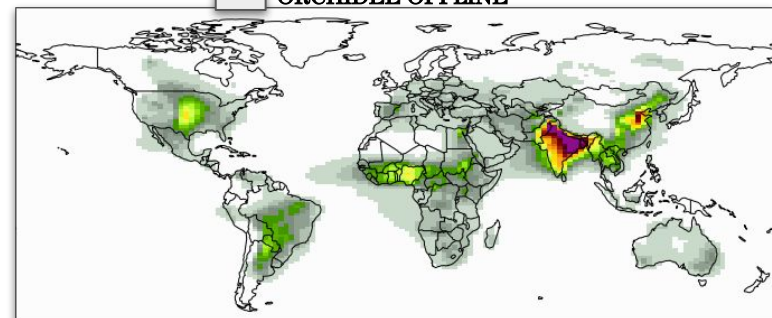
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CEDS



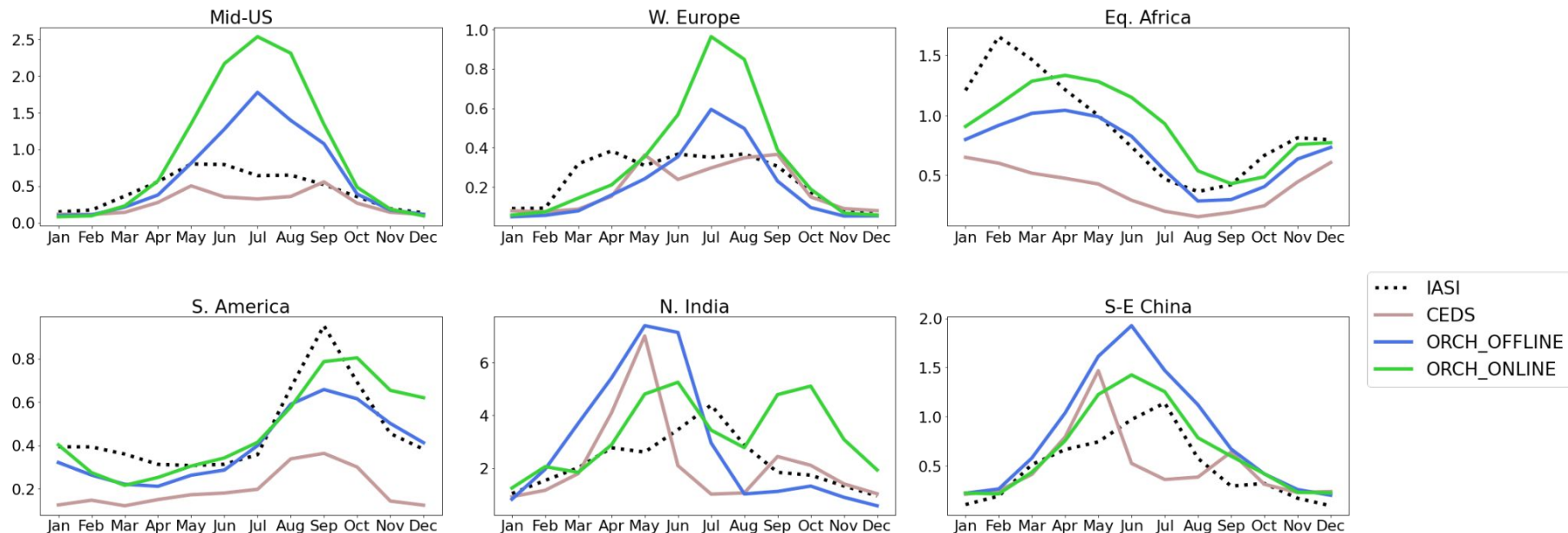
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ORCHIDEE OFFLINE



Evaluation : impact on atmospheric NH₃

Regional NH₃ columns (2011-2014) (molecules x10¹⁶/cm²)



Discussions & Conclusions

→ Further investigate the key factors influencing the emissions :

Run	1- Budget of emissions (TgN.y ⁻¹) <u>AGRICULTURAL</u> <u>NATURAL SOIL</u>		2- Type of parameters used in the emission calculation	3- Timestep of the emission transmission/calculation to/in LMDz-INCA
CEDS	35.5	0	Static factors	Monthly
Offline ORCHIDEE	43.5	8.5	Dynamic but from reanalysis : T, humidity, friction velocity etc..	Monthly
Online ORCHIDEE	41.6	15.9	Dynamic from LMDz model : T, humidity, friction velocity	30 minutes

→ Improve the coupling framework :

Bidirectional fluxes : NH_x and NO_y depositions & surface $[\text{NH}_3]$ influence emissions



Thank you a lot for your attention.

Do not hesitate if you have any questions !

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