# PC8 – CYCL-ESM
Biogeochemistry

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CYCL-ESM

Objectives

- Integration of a complete interactive **N** cycle and **CH4** cycle in both Earth System Models. Study of their impacts on ecosystem functions and interactions with others components

- Integrate **Fire** impacts (P, N, and VOCs) into the ESM; reintroduce SPITFIRE into the ORCHIDEE model. Develop and calibrate a fire module with ignition, propagation and injection height (possibty based on AI)

- Role of **biogenic VOC** emission in the atmospheric composition and evaluation of their climate effect

- Integrate land management features (forest, crop) more comprehensively!
Impact of agricultural emissions in the coupled N-CH4 IPSL-ESM on air pollution and climate, and land feedbacks
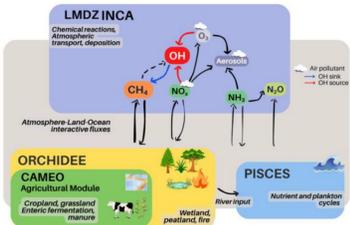
- Develop **emulators** both for the marine biogeochmisty and for plant phenology and functional / species-level traits

Results/Milestones

N cycle: complete cycles in each compartment and coupled simulation running with the IPSL model. First version of the nitrogen cycle in ISBA (Postdoc work of J. Decayeux)

CH4 cycle: Inclusion in ARPEGE-Climat (M.Cussac & coworkers), 1st version of dynamical wetlands and associated emissions in ISBA; Integration of past development in ORCHIDEE Trunk version

Introduction of dynamic density for grasslands in ORCHIDEE and coupling with dust emission models (thèse S. Xu, Xu et al., GMD, 2026)

Ocean: Interfacing of PISCES-simple version with a gas module; rewriting of oceanic module for N2O; AI emulator developed for PISCES (Postdoc work of E. Gow-Smith) (with PC5)

Synergies/Outreach

- Equilibrium/spinup strategies with PC5

- European project ESM2025, coordinator R. Seferian

- Synergies of LSMs ORCHIDEE and ISBA with EU projects: ISEYE-CLIMA, NextGenCarbon and AI4PEXments

- Links between PEPR TRACCS et FAIR-CarboN: Treatment of the carbon cycle in bogs

- Links with society: impact of agriculture on the N-cycle

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Transformative aspects include co-developing new interoperable biogeochemical process modules between IPSL /CNRM ESMs, making use of advanced tools such as emulators to speed up biogeochemical processes. Colors in the text are dark blue for ocean, green for land, and yellow for atmospheric chemistry, black for ESMs.

Pisces Agile Configuration
Integration of Nitrogen and Phosphorus Atmospheric Cycle
VOC emissions
Calibration and spinup Strategies with PC5 QUINTET
Nitrogen and Phosphorus Cycles in ESMs
Paper on Calibration and Spinup Strategies with PC5
Impact/Vulnerabilities On Food Production
Dynamic Density for Grasslands
Integration of Phosphorus Cycle in all Compartments
Impact of Fires On Atm. Composition and Climate
Fire Module in Both LSMs
CH4 Cycle in LSMs
Land Management Impacts
CH4 Cycle in ESMs
Effects of Aerosols On Monsoons

2024   2028   2032