

# SOIL BIOGEOCHEMICAL CYCLES UNDER CLIMATE CHANGE: A MODEL SCHEME IMPLEMENTATION

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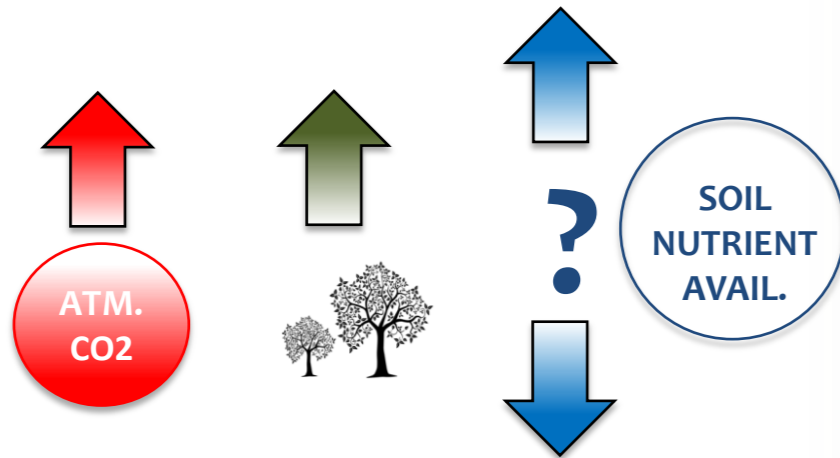
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## BACKGROUND



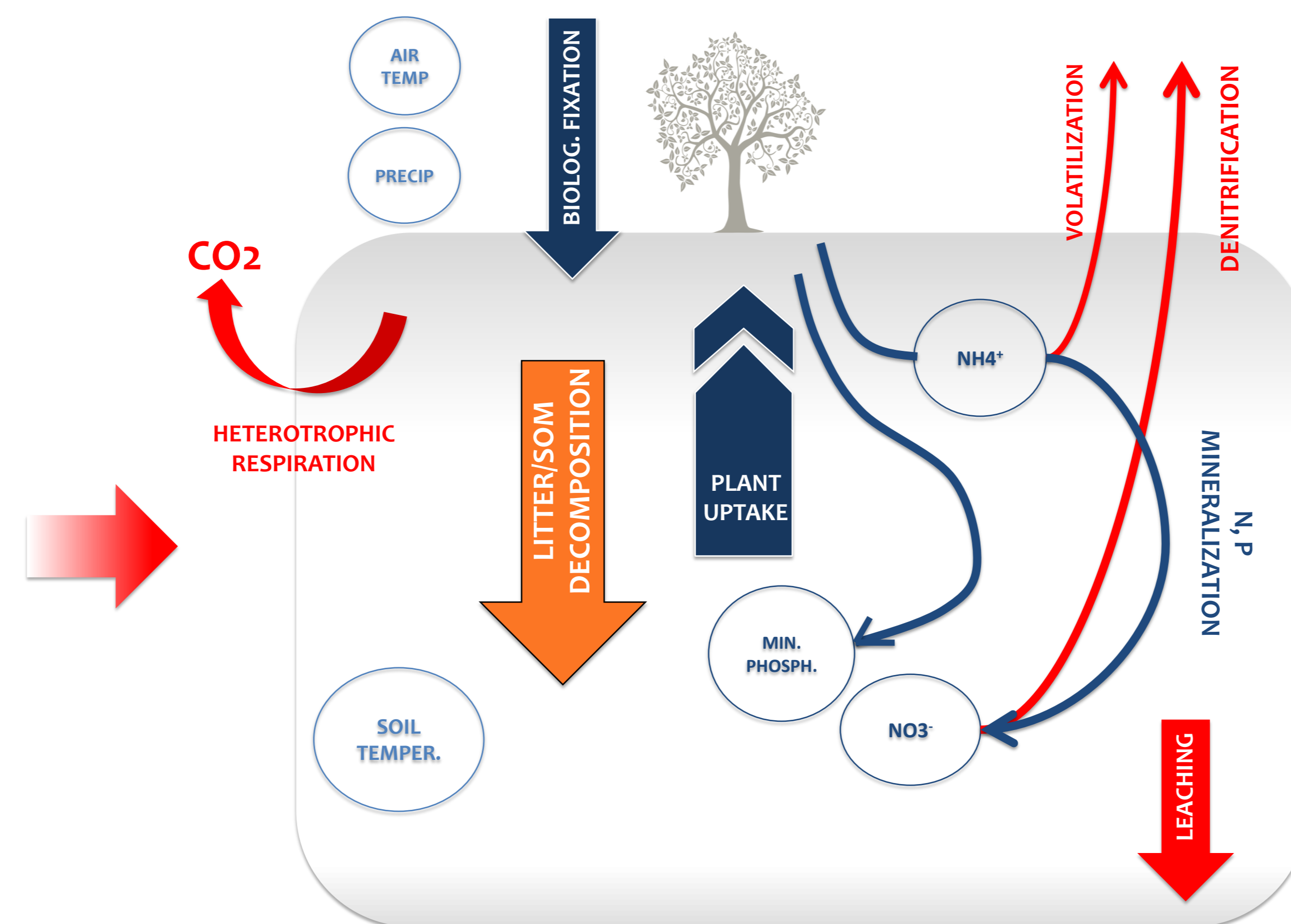
THE PHD RESEARCH PROJECT FOCUSES ON THE STUDY OF THE CYCLE OF NUTRIENTS IN THE SOIL UNDER CLIMATE CHANGE. THE STUDY IS MAINLY APPLIED TO FOREST ECOSYSTEMS AND IS CARRIED OUT USING MODELLING TOOLS.

THE AIM IS TO UNDERSTAND IF THE INCREASE OF FOREST PRODUCTIVITY, DUE TO THE INCREMENT OF ATMOSPHERIC CO<sub>2</sub> CONCENTRATION, AS A RESULT OF ANTHROPOGENIC ACTIVITIES, IS SUPPORTED BY AVAILABILITY OF NUTRIENTS IN THE SOIL.



### RESEARCH PROJECT GOALS

1. DEFINE THE ROLE OF MACRONUTRIENTS AS A FACTOR LIMITING THE RISE OF FOREST GROWTH UNDER CLIMATE CHANGE
2. ESTABLISH HOW SOIL NUTRIENTS AND ATMOSPHERIC CARBON AVAILABILITIES INTERACT EACH OTHER AND INFLUENCE FOREST PRODUCTIVITY
3. EVALUATE HOW FOREST MANAGEMENT INFLUENCES THE PRESENCE AND EVOLUTION OF NUTRIENTS FOR THE PLANTS



C, N, P MAIN SIMULATED PROCESSES LINKED TO SOIL BIOGEOCHEMICAL CYCLES

1 THE FIRST PHASE OF PHD RESEARCH PROJECT FOCUSES ON A BIBLIOGRAPHIC STUDY ON THE CYCLE OF CARBON AND MACRONUTRIENTS (NITROGEN AND PHOSPHORUS) IN THE SOIL. THE AIM IS TO FRAME THE MAIN MODELLED PROCESSES OF THE SOIL BIOGEOCHEMICAL CYCLES AND TO FIND NEW DYNAMICS TO IMPLEMENT.

- DEAD BIOMASS FROM DIFFERENT PLANT SPECIES
- SIMULATING SECONDARY PROCESSES OF NITROGEN CYCLE
- SIMULATING PROCESSES LINKED TO RHIZOSPHERE AND MYCORRHIZA
- MODELLING OZONE DYNAMICS

NEW DYNAMICS TO IMPLEMENT

2 THE STUDY CARRIES OUT ON THE MAIN PHYSICAL, CHEMICAL AND BIOLOGICAL FACTORS ANALYZING THEIR INFLUENCE ON EACH PROCESS.

FACTORS	NUMBER OF INFLUENCED PROCESSES
SOIL TEMPERATURE	10
PRECIPITATION	2
SOIL MOISTURE	10
SOIL TEXTURE	10
pH	10
C:N, C:P RATIO	9

NUMBER OF C, N, P CYCLE PROCESSES INFLUENCED BY THE MAIN PHYSICAL, CHEMICAL AND BIOLOGICAL FACTORS

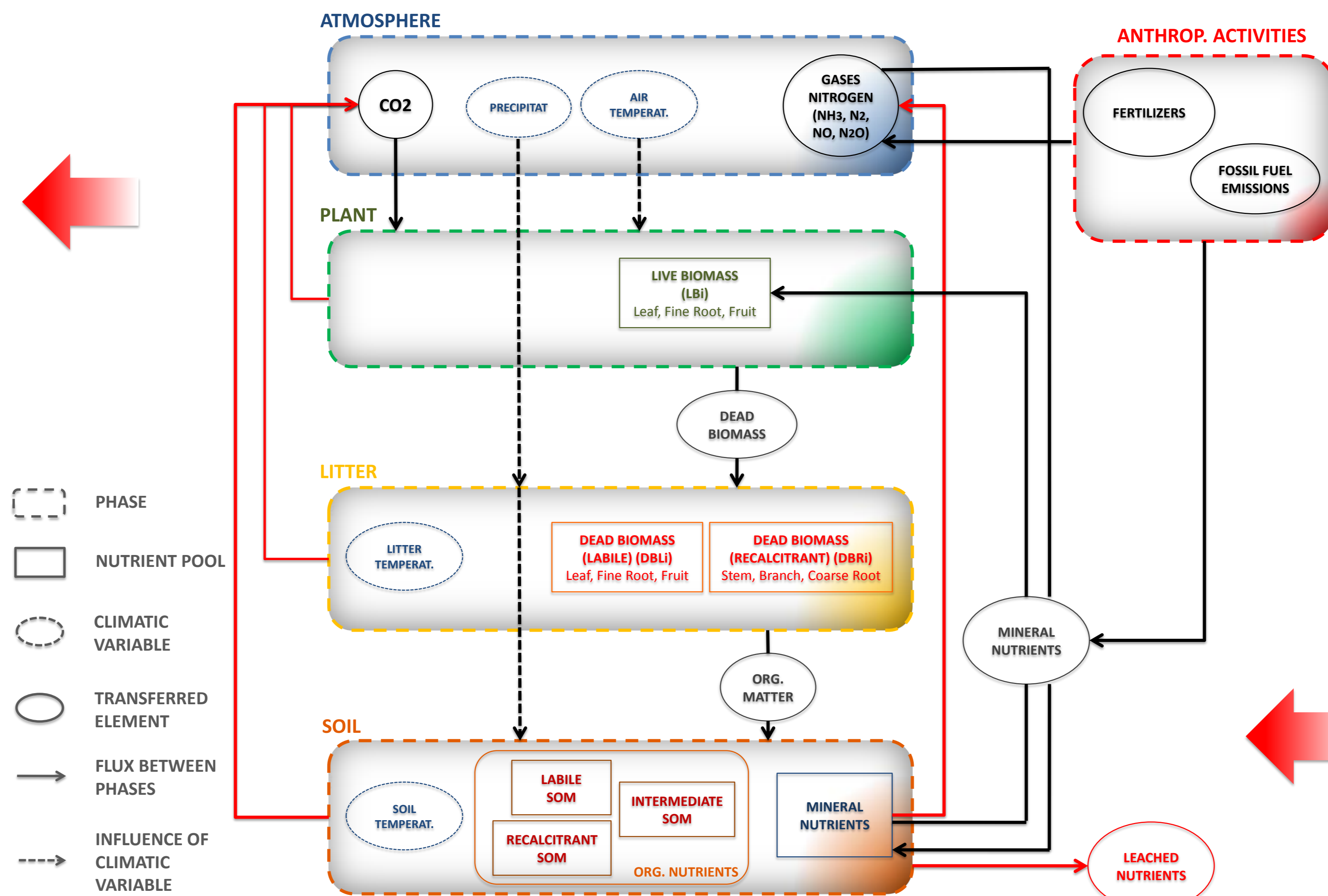
## LITTER/SOM DECOMPOSITION PROCESS

	CENTURY	BIOME-BGC	...
EQUATIONS	FIRST ORDER KINETIC $dC/dt = K * L_c * A * C$ (Struct. Pool) $dC/dt = K * A * C$ (Other Pools)	FIRST ORDER KINETIC $dC/dt = K * C * t\_scal * w\_scal$	...
PARAMETERS	K, INTRINSIC DECAY RATE (1/YEAR) L <sub>c</sub> , LIGNIN CONTENT OF STR. MAT. A, ABIOTIC FACTOR (SOIL T AND MOISTURE)	K, DECAY RATE BASE (1/DAY) T <sub>scal</sub> , SOIL TEMP. FACTOR W <sub>scal</sub> , SOIL MOISTURE FACTOR	...
ASSUMPTIONS	-IMMOBILIZATION OR MINERALIZATION OCCUR ON THE BASE OF C:N, C:P RATIOS ...	- PLANT-MICROBIAL NUTRIENT COMPETITION. -NO DECOMPOSITION OCCURS IF SOIL <sub>T</sub> < 10°C ...	...

THE NEXT STEP OF THE PROJECT FORECASTS A MORE DETAILED ANALYSIS WITH A SCHEMATIC DEFINITION OF ASSUMPTIONS, EQUATIONS AND PARAMETERS FOR EACH SIMULATION MODEL. THE AIM IS TO CARRY OUT A SENSITIVITY ANALYSIS TO STUDY THE INFLUENCE OF PARAMETERS ON THE BIOGEOCHEMICAL CYCLE PROCESSES.

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## 3D-CMCC-SOIL MODEL FLOWCHART



4 AT THE END OF THE FIRST PHASES, A GENERAL SCHEME OF A NEW SIMULATION MODEL OF SOIL BIOGEOCHEMICAL CYCLES IS DEFINED, IN WHICH ARE INDICATED THE MAIN PHASES (ATMOSPHERE, PLANT, LITTER, SOIL AND ANTHROPOGENIC ACTIVITIES), AS WELL AS THE ORGANIC AND INORGANIC NUTRIENT POOLS. PHASES INTERACT WITH EACH OTHER BY FLUX EXCHANGES.

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SIMULATION MODELS	NUTRIENTS	REFERENCES
CENTURY	C, N, P	PARTON ET AL., 1993
BIOME-BGC	C, N	GOLINKOFF, 2010
YASSO15	C	REPO ET AL., 2017
CLM	C, N	CLM TECHNICAL NOTE
CENW	C, N	KIRSCHBAUM & PAUL, 2002
SOMM	C, N	CHERTOV & KOMAROV, 1997
DOCMOD	C, N	CURRIE & ABER, 1997
FOREST-DNDC	C, N	LI ET AL., 2000
CASA-CNP	C, N, P	WANG ET AL., 2010
JSBACH-CNP	C, N, P	GOLL ET AL., 2012
N14CP	C, N, P	DAVIES ET AL., 2016
N-COM	C, N, P	ZHU ET AL., 2016
CASTANEA	C	DUFRENE ET AL, 2005
ROTHC	C	KOLEMAN & JENKINSON, 2014

SIMULATION MODELS

3 14 SIMULATION MODELS ARE CONSIDERED, ANALYZING THE MAIN PROCESSES OF SOIL BIOGEOCHEMICAL CYCLES REPRODUCED BY THEM.

	NUMBER OF MODELS IN WHICH THE PROCESS IS SIMULATED
<b>DYNAMICS OF</b>	
CARBON	14
NITROGEN	10
PHOSPHORUS	5
<b>DECOMPOSITION</b>	
LITTER & SOM DECOMPOSITION	12
<b>CARBON</b>	
SOIL HETEROTROPHIC RESPIRATION	14
<b>NITROGEN</b>	
MINERALIZATION	11
IMMOBILIZATION	9
BIOLOGICAL FIXATION	8
DENITRIFICATION	9
LEACHING	8
PLANT UPTAKE	9
<b>PHOSPHORUS</b>	
MINERALIZATION	5
IMMOBILIZATION	5
LEACHING	4
PLANT UPTAKE	5

C, N, P PROCESSES SIMULATED BY THE MODELS