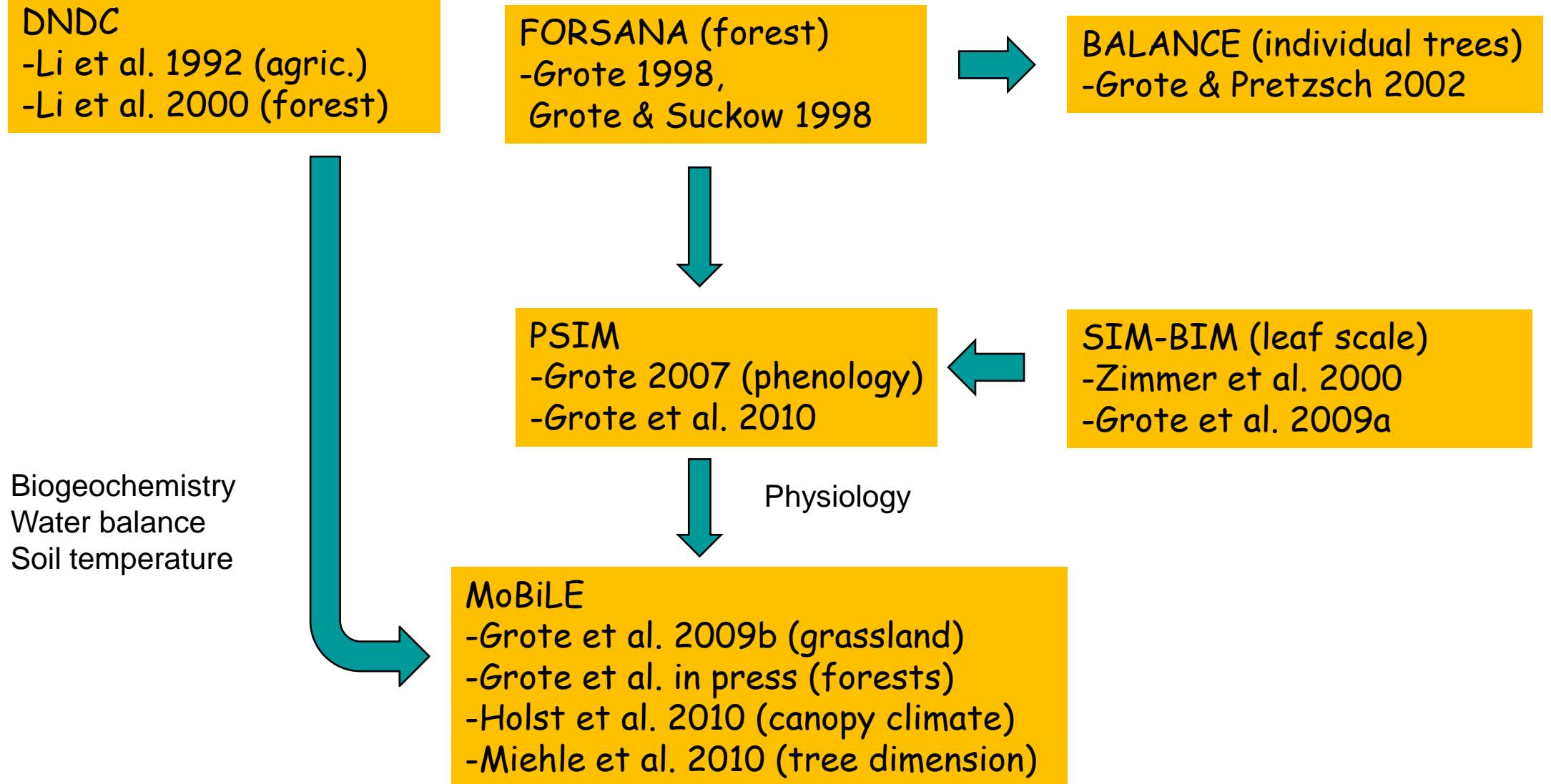# MoBiLE – Modular Biosphere simuLation Environment

13.10.2010

Rüdiger Grote
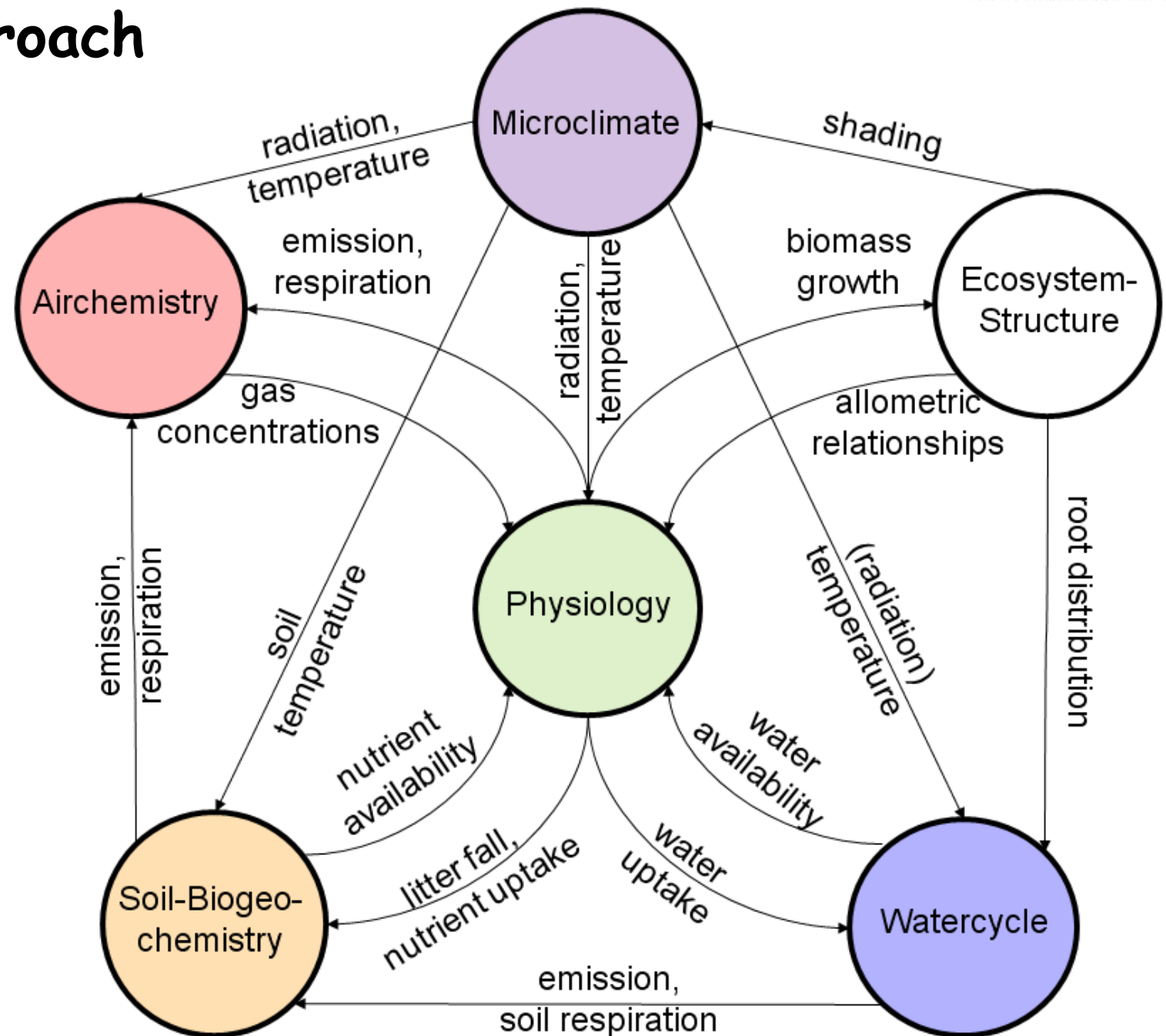
Karlsruhe Institute for Technology (KIT)
Institute for Meteorology and Climate Research (IMK-IFU)
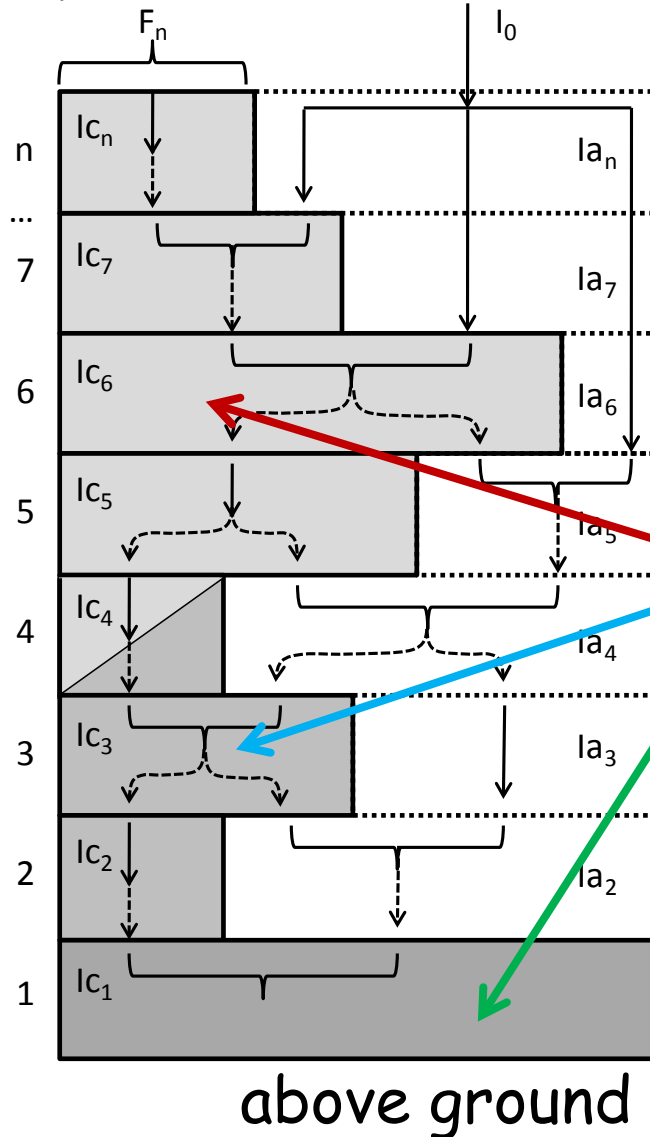Garmisch-Partenkirchen, Germany

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1.History

DNDC
-Li et al. 1992 (agric.)
-Li et al. 2000 (forest)

FORSANA (forest)
-Grote 1998,
 Grote & Suckow 1998

BALANCE (individual trees)
-Grote & Pretzsch 2002

PSIM
-Grote 2007 (phenology)
-Grote et al. 2010

SIM-BIM (leaf scale)
-Zimmer et al. 2000
-Grote et al. 2009a

Biogeochemistry
Water balance
Soil temperature

Physiology

MoBiLE
-Grote et al. 2009b (grassland)
-Grote et al. in press (forests)
-Holst et al. 2010 (canopy climate)
-Miehle et al. 2010 (tree dimension)

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2. Ecosystem approach

a) feedbacks

2. Ecosystem approach

b) Spatial scaling and competition (in 2D cohort structure)
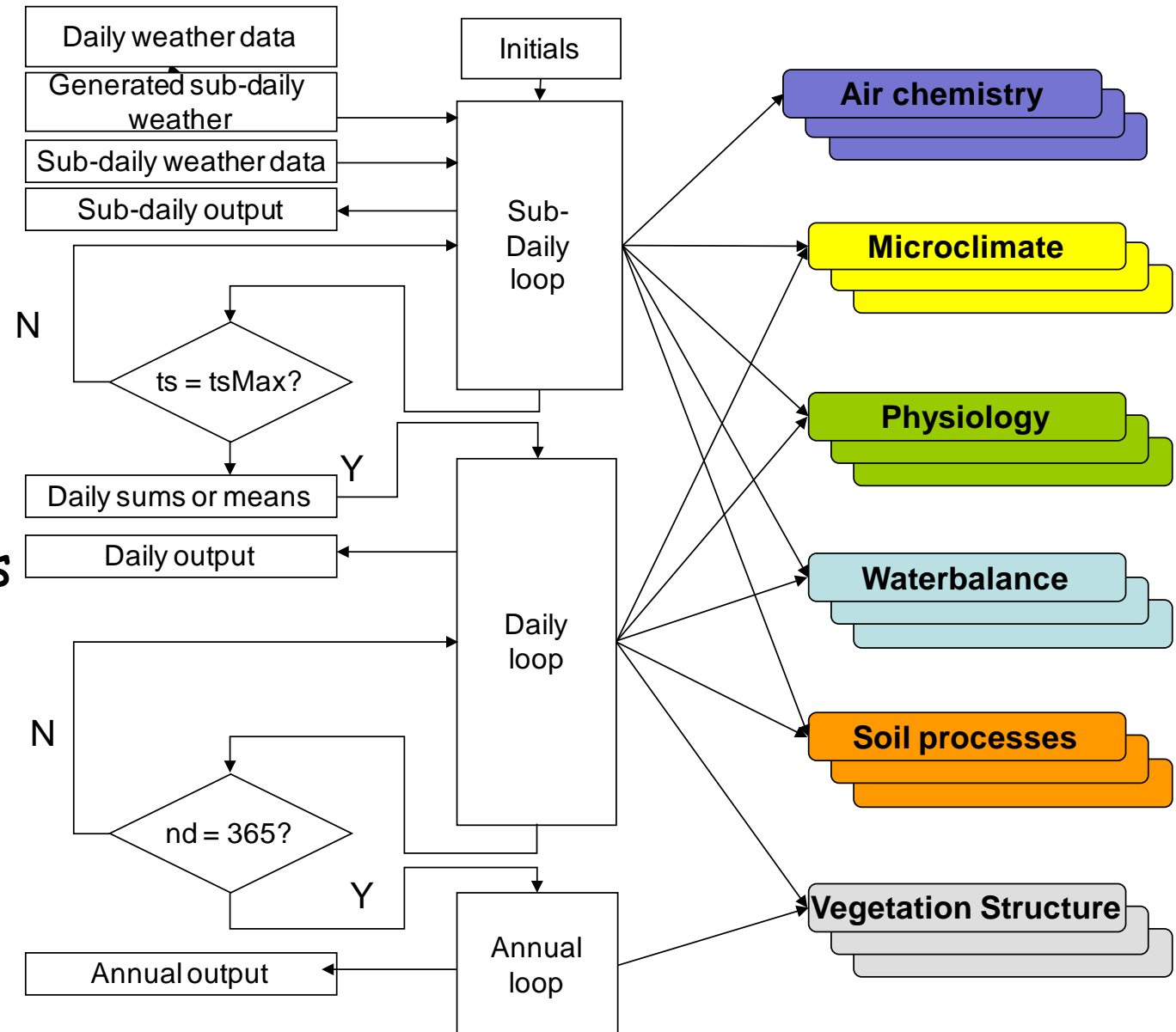

above ground

below ground

Cohorts (vegetation types)

2. Ecosystem approach

c) Implementation

- C++
- GUI
- platform independent
- multiple site calculations
- selectable modules

2. Ecosystem approach

d) Input

Mandatory:
- Setup (file list, module selection, run length)
- Site (general, soil, vegetation)

Facultative:
- Weather
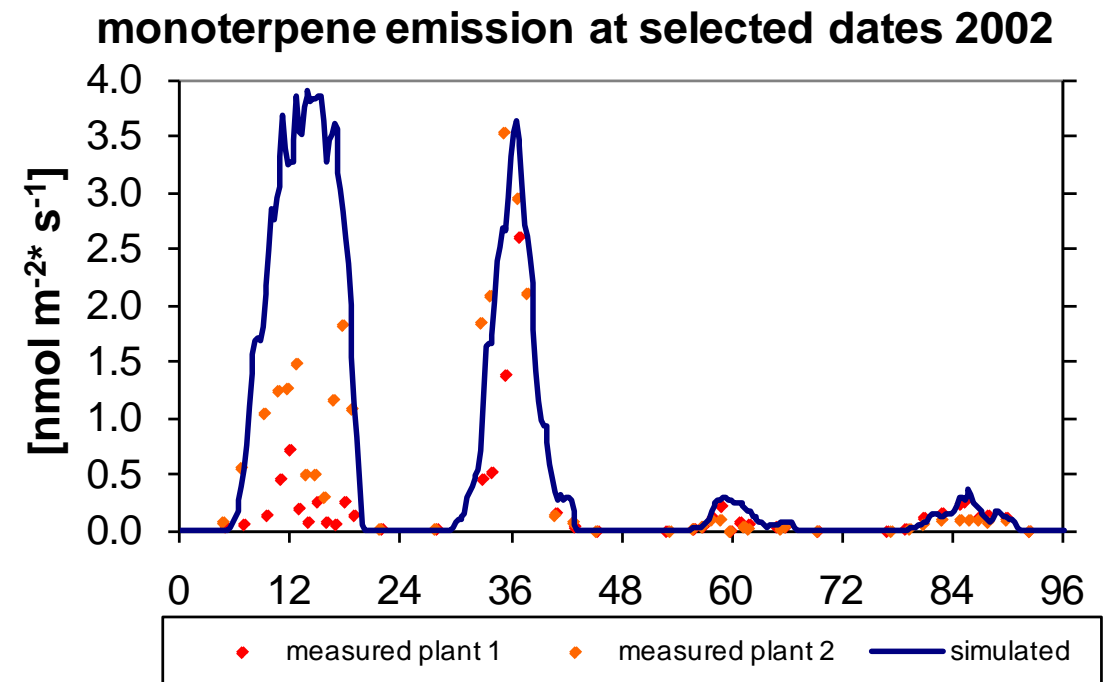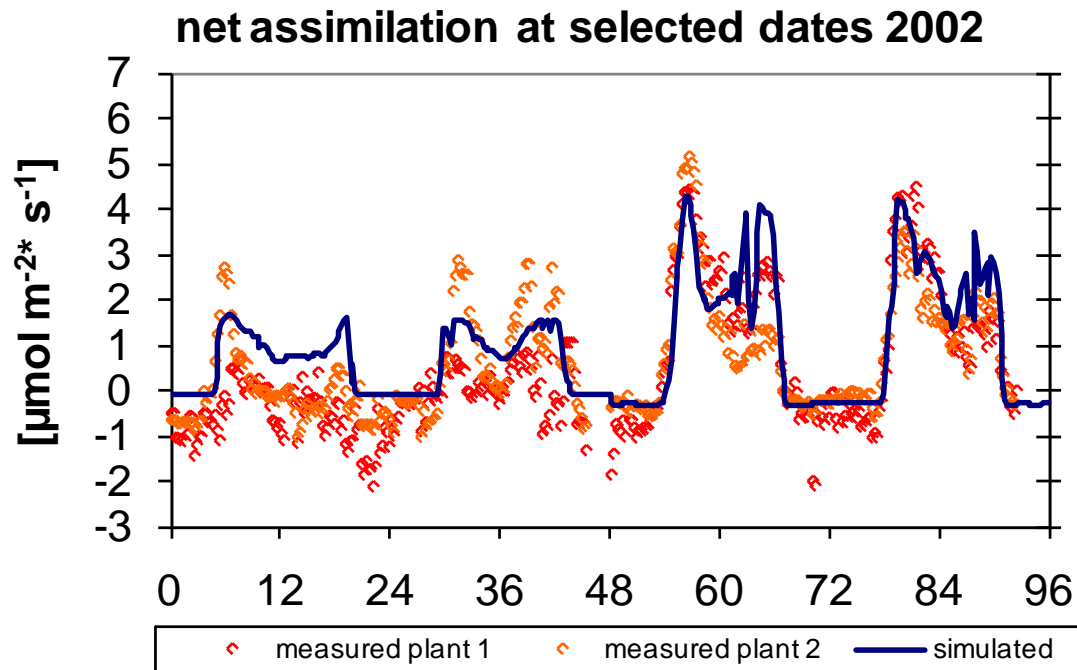- Air chemistry
- Ground water table
- Management

SITE	
Variable	Description
General site properties	
LAT	geographical latitude
LONG	geographical longitude
ZONE	GMT time
ELEV	site elevation above sea level (m)
SLOPE	slope (degree)
ASPECT	aspect (degree)
CLOUD	reduction of maximum solar radiation (0-1)
TAVG, TAMP	annual mean temperature (^{o}C) and temperature amplitude (^{o}C)
PSUM, RIREF	annual average precipitation (mm) and standard precipitation intensity (mm h^{-1})
WAVG	site specific wind speed (m s^{-1})
CAVG[1-6]	site specific average concentration of NH4, NO3, SO4, basic cations, natrium, and chlorid in precipitation (kg l^{-1})
WTDEPTH	average depth of the water table (m)
Initial vegetation type properties	
name [1-5]	name of the vegetation type
hMax [1-5]	height (m)
hMin [1-5]	height at which the foliage starts (m)
dbh [1-5]	diameter in 1.3 m height (m)
mTot [1-5]	Total aboveground biomass (kg m^{-2})
depth [1-5]	rooting depth (m)
fni [1-5]	nutrient reduction factor (0-1)
General soil properties	
SOILT	soil type (SAND, SILT, LOAM, ...)
HUMUST	humus type (MULL, MODER, RAWHUMUS)
H_LIT	litter height (mm)
CORG05	relative organic carbon content in 5cm mineral soil depth (%)
CORG30	relative organic carbon content in 30cm mineral soil depth (%)
STMAX	number of following soil strata descriptions
Specific soil parameters (in 'STMAX' paragraphs)	
DEPTH [1-STMAX]	depth of the soil profile (mm)
HSL [1-STMAX]	height of the soil layers (mm)
PH [1-STMAX]	average pH value of this soil strata
STONEF [1-STMAX]	stone fraction (0-1)
DENS [1-STMAX]	soil bulk density (kg dm-3)
SKS [1-STMAX]	saturated hydraulic conductivity (cm min^{-1})
NORG [1-STMAX]	organic nitrogen content (0-1)
CORG [1-STMAX]	organic carbon content (0-1)
CLAY [1-STMAX]	clay content (0-1)
WCMAX [1-STMAX]	water holding capacity (mm m^{-3})
WCMIN [1-STMAX]	water content at wilting point (mm m^{-3})

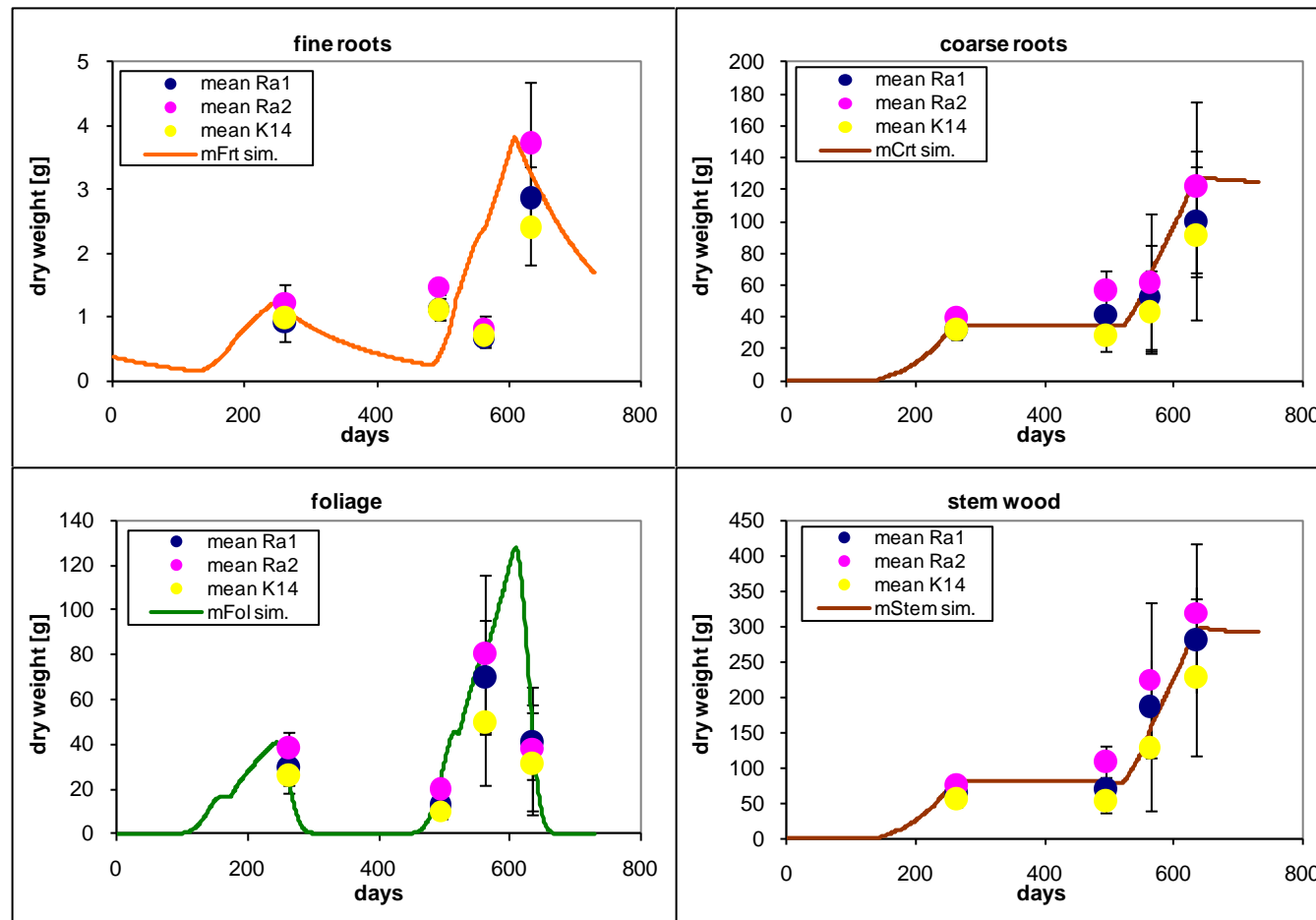# 3. Examples: Experiments

a) VOC emission (Grote et al. 2006)

- Leaf scale carbon exchange on holm oak (q.ilex)

net assimilation at selected dates 2002

monoterpene emission at selected dates 2002

3. Examples: Experiments

b) Poplar research
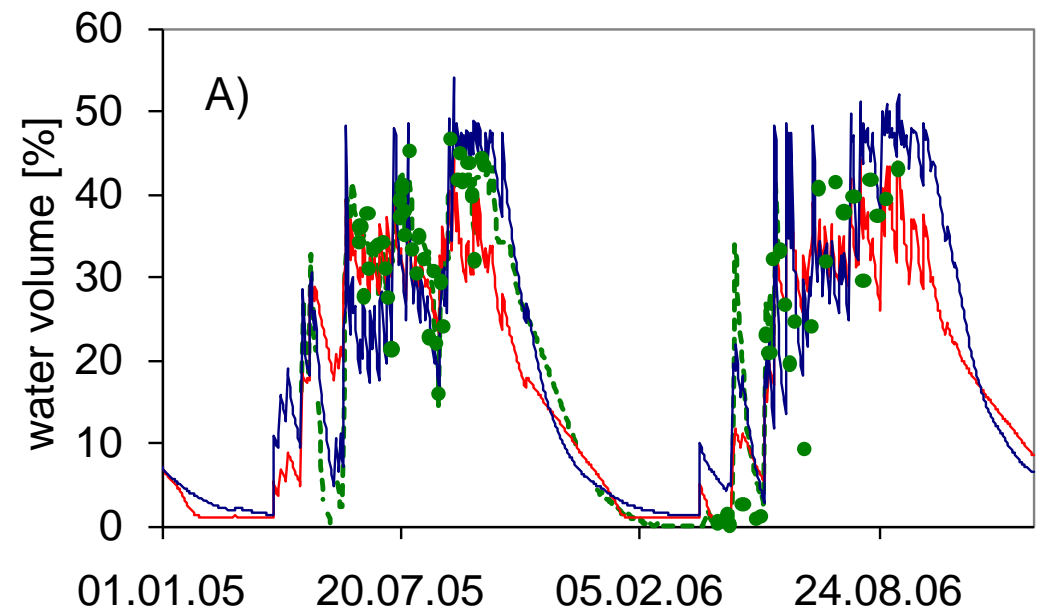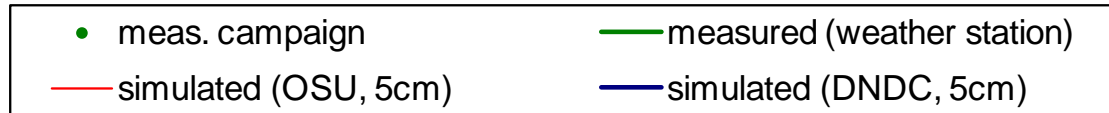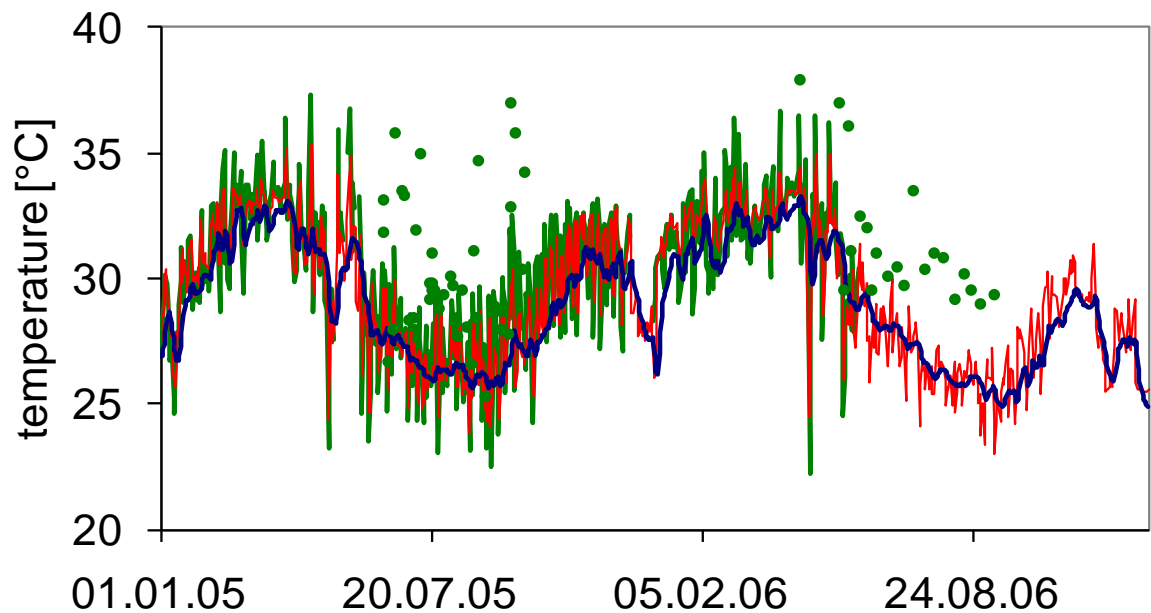
- Carbon balance of two different poplar clones

3. Examples: Agriculture and Grasslands
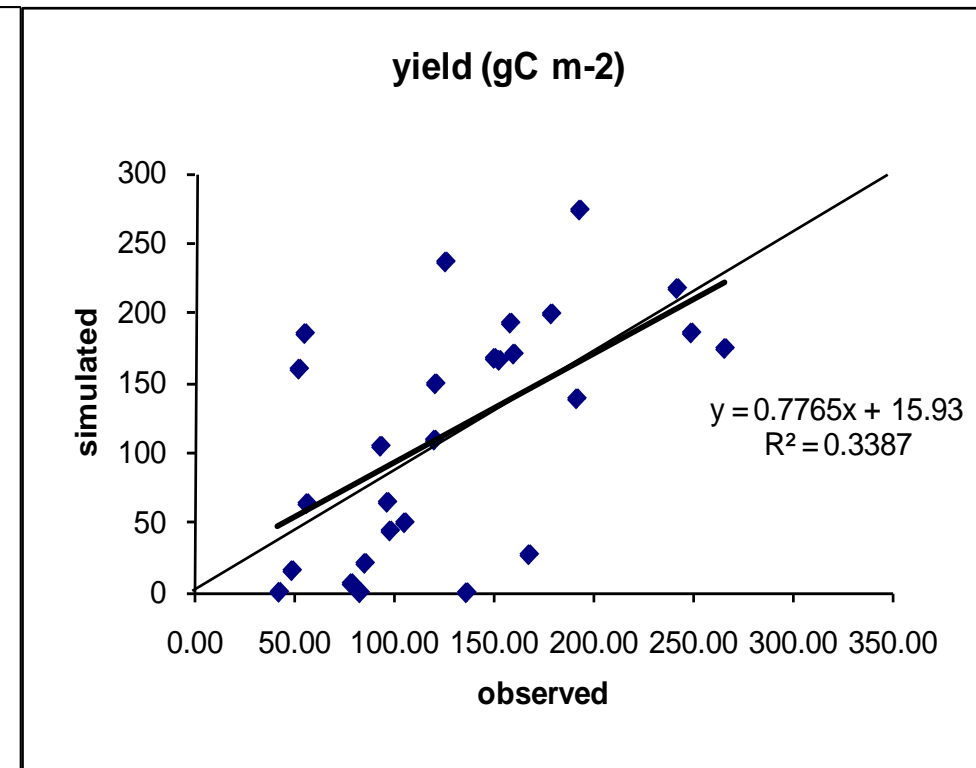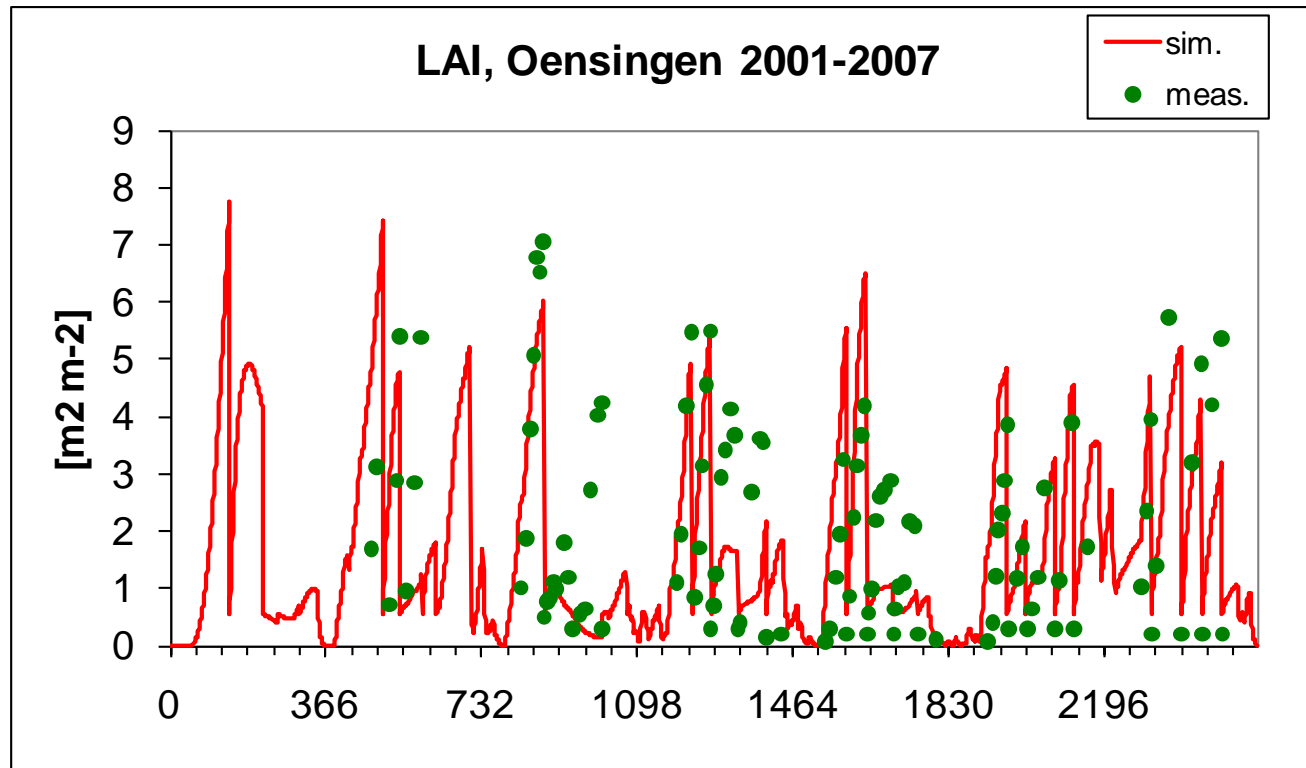
a) Bontioli, Savanna (Grote et al. 2009b)

- Comparison DNDC, OSU
- Focus on energy and water exchange

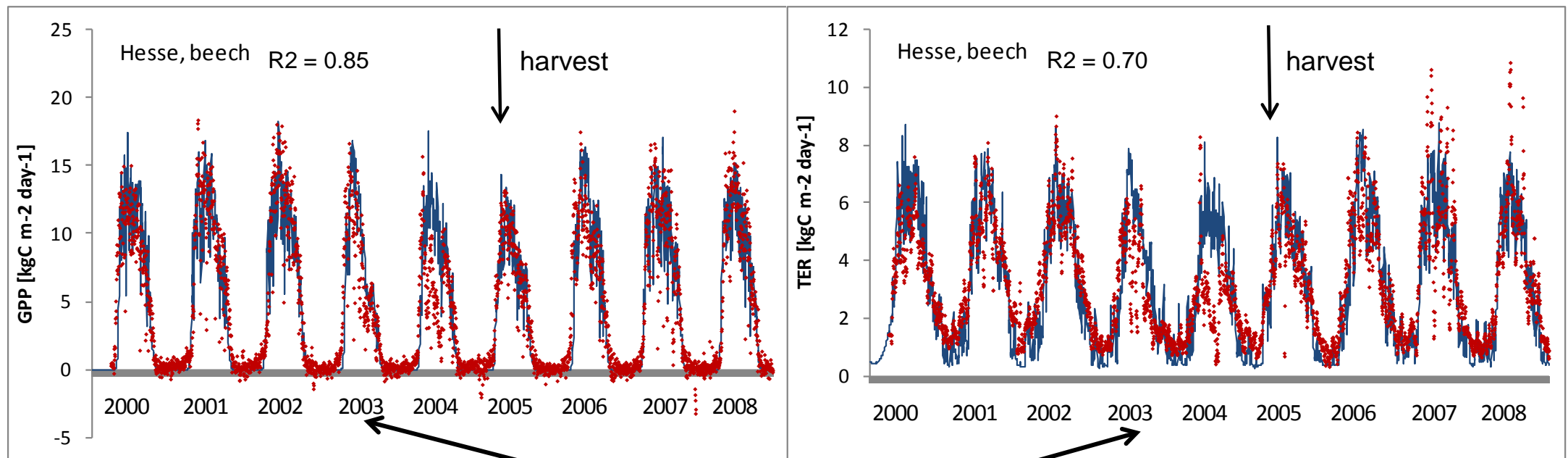# 3. Examples: Agriculture and Grasslands

b) Oensingen, meadow

- Full DNDC application (not PSIM yet)
- Focus on N emission, part of NitroEurope evaluation

3. Examples: Forests

a) Hesse, beech forest (Grote et al. AFM in press)

- \> 10 year evaluation of Eddy Flux data
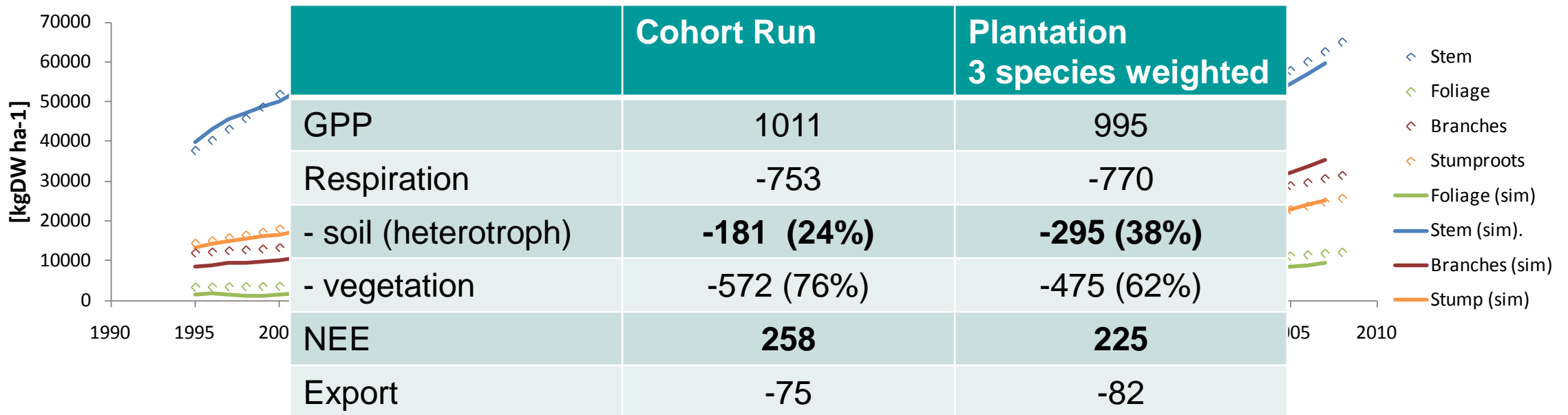- constrained by soil water and forest inventory data

3. Examples: Forests

b) Hyytiaelae, pine/spruce/birch forest

- Comparison of explicitly accounted competition or weighted area approach

	Cohort Run	Plantation 3 species weighted
GPP	1011	995
Respiration	-753	-770
- soil (heterotroph)	**-181 (24%)**	**-295 (38%)**
- vegetation	-572 (76%)	-475 (62%)
NEE	**258**	**225**
Export	-75	-82

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4. Outlook

General
- Increasing number of species parameterization
- Generalizing modules to be freely exchangeable
- Improving process descriptions

In projects:
- NitroEurope: Emission cataster of nitrogen fluxes for arable and forest sites at the European scale (Butterbach-Bahl)
- Coupling with (small scale) regional hydrological models (Butterbach-Bahl)
- Improving dimensional growth and competition between vegetation types (Grote)

Future objectives
- Impacts of land-use changes on biosphere-atmosphere exchange
- coupling with regional meteorological transport models

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