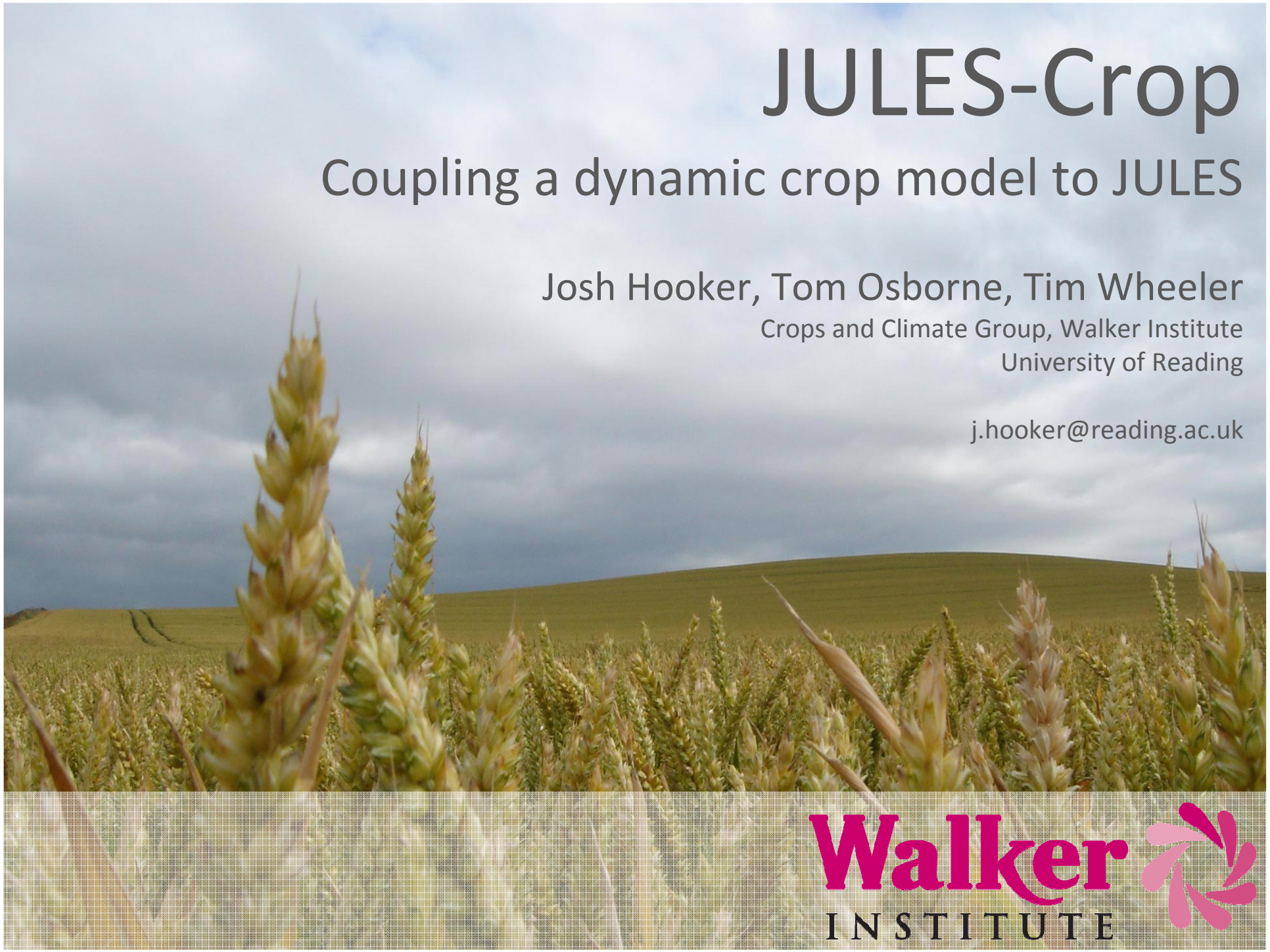


JULES-Crop

Coupling a dynamic crop model to JULES

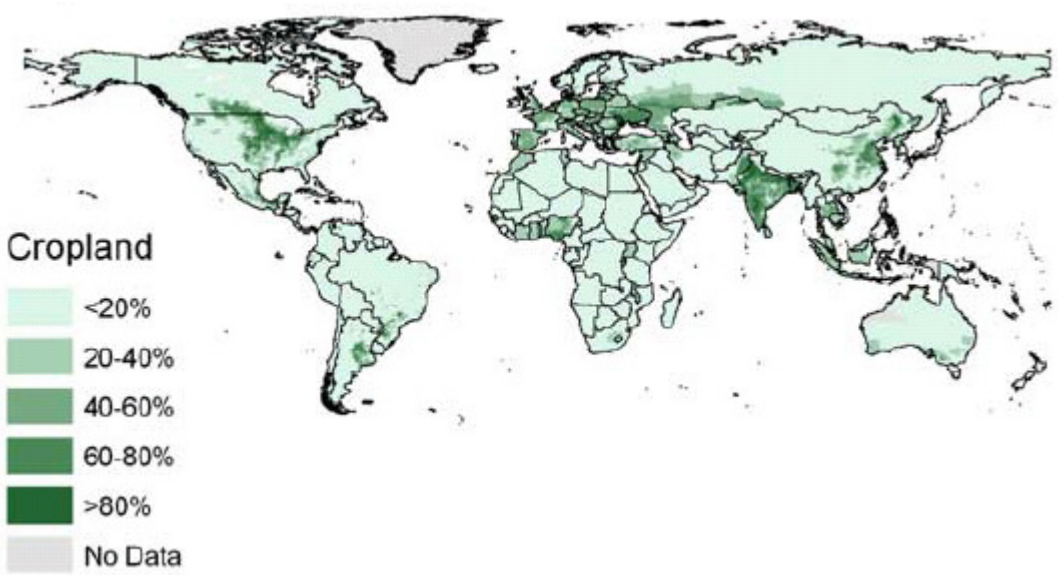
Josh Hooker, Tom Osborne, Tim Wheeler
Crops and Climate Group, Walker Institute
University of Reading

j.hooker@reading.ac.uk

Walker INSTITUTE

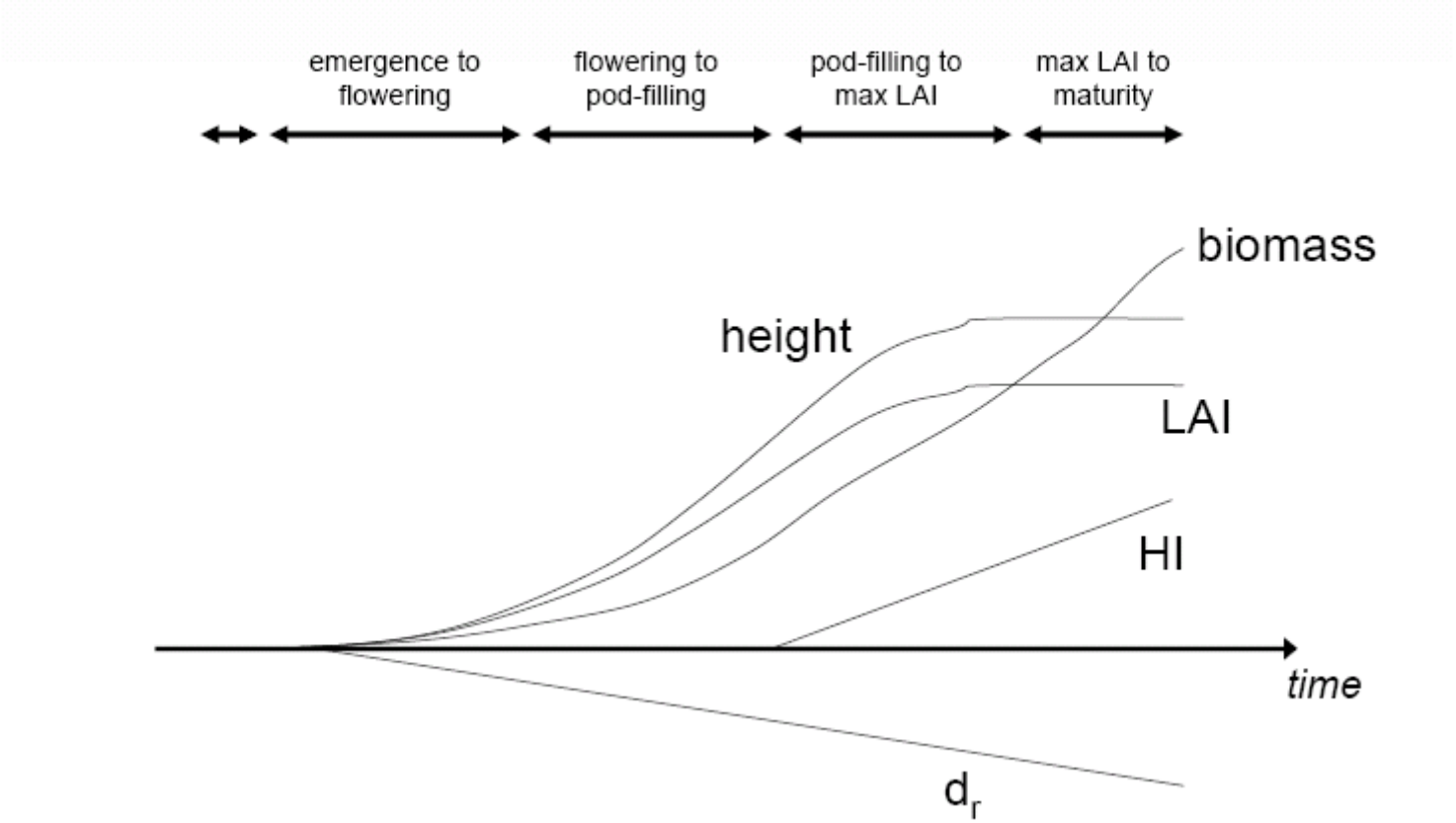
WHY INCLUDE CROPS?

12% of ice-free land surface covered with crops in year 2000 (Ramankutty et al. 2008)



WHY INCLUDE CROPS?

The timings and patterns of crop growth are rather different to those of natural vegetation.



WHY INCLUDE CROPS?

Recent work has shown crops to influence regional climate through land surface feedbacks.
(e.g. Cooley et al. 2005, Osborne et al. 2007)

JULES-Crop: a source-driven crop model.

Aims:

1. To design a crop model that allows JULES to more accurately simulate land surface processes over croplands.

2. To describe water and carbon fluxes over agricultural land

3. To simulate ‘farm-level’ crop productivity.

GLOBAL COVERAGE

Which crops?

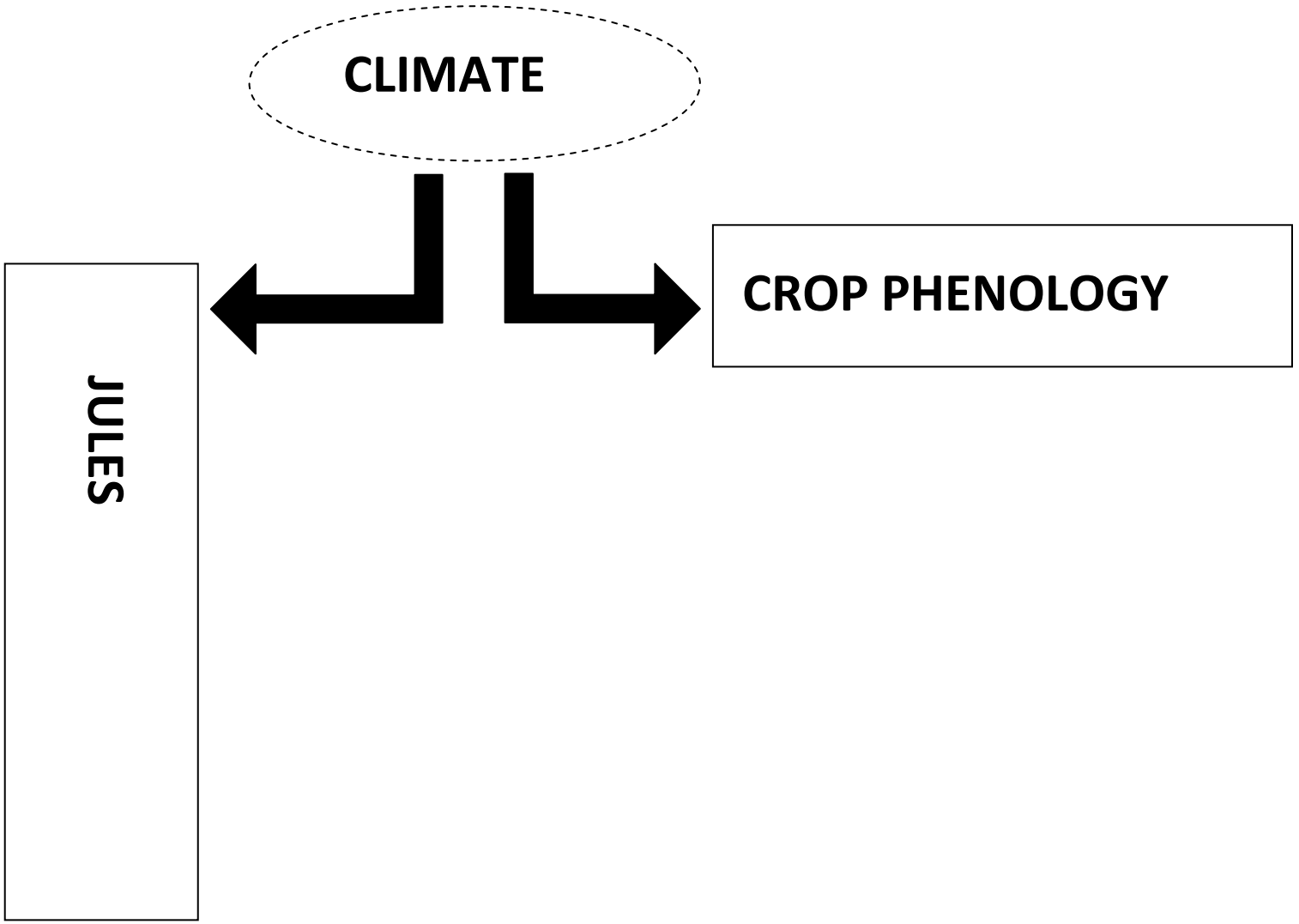
We have opted for a scheme that accommodates most different crops, as 12 crop functional types (CFTs).

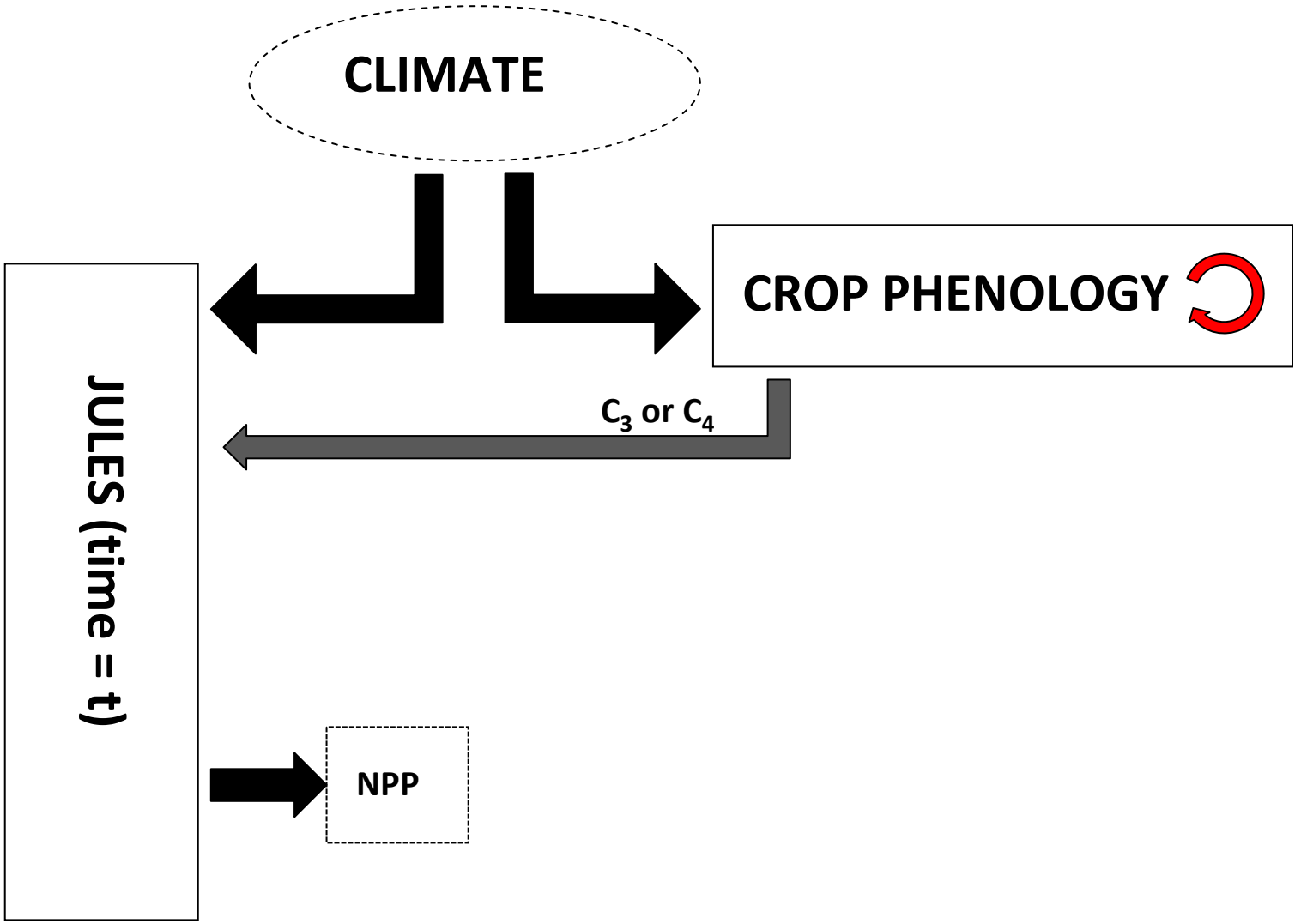
PHOTO SYNTHESIS	PHOTO SENSITIVITY	C / L / O	OTHER	CFT	EXAMPLE
C_3	LONG DAY SENSITIVE	CEREAL	----------	1	WHEAT, BARLEY, RYE, OAT
		LEGUME	OILSEED	2	GROUNDNUT
			NOT	3	LENTIL, CHICKPEA, DRYBEAN
		OTHER	ROOT / TUBER	4	POTATO, SUGARBEET
			NOT	5	RAPE
	SHORT DAY SENSITIVE	CEREAL	----------	6	RICE
		LEGUME	----------	7	SOYBEAN
		OTHER	ROOT / TUBER	8	CASSAVA, SWEET POTATO
			NOT	9	COTTON
C_4	----------	CEREAL	SMALL GRAIN	10	SORGHUM, MILLET
			LARGE GRAIN	11	MAIZE
		OTHER	----------	12	SUGARCANE

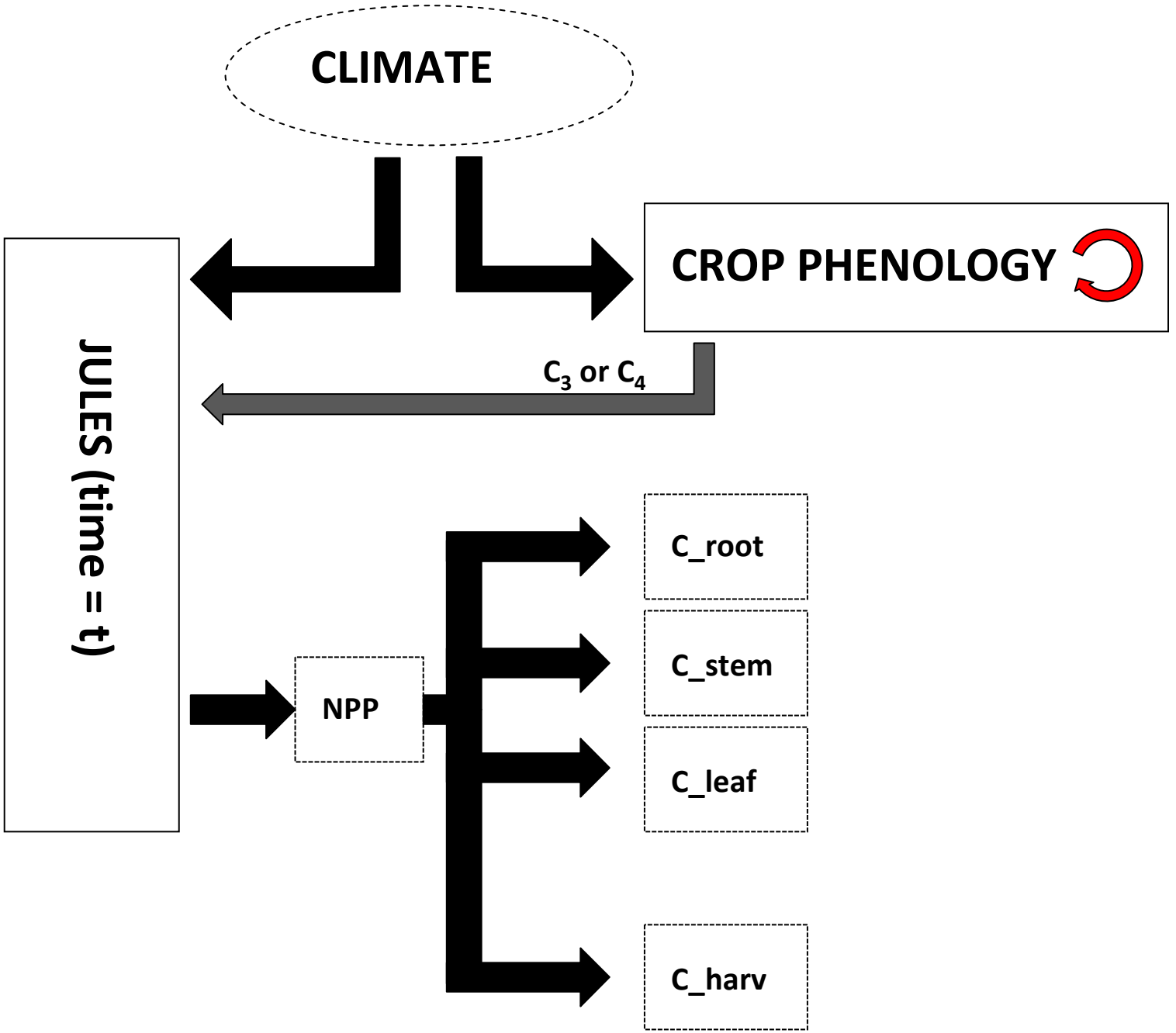
These end up being rather similar to the CFTs in **LPJ-mL** (Bondeau et al. 2007).

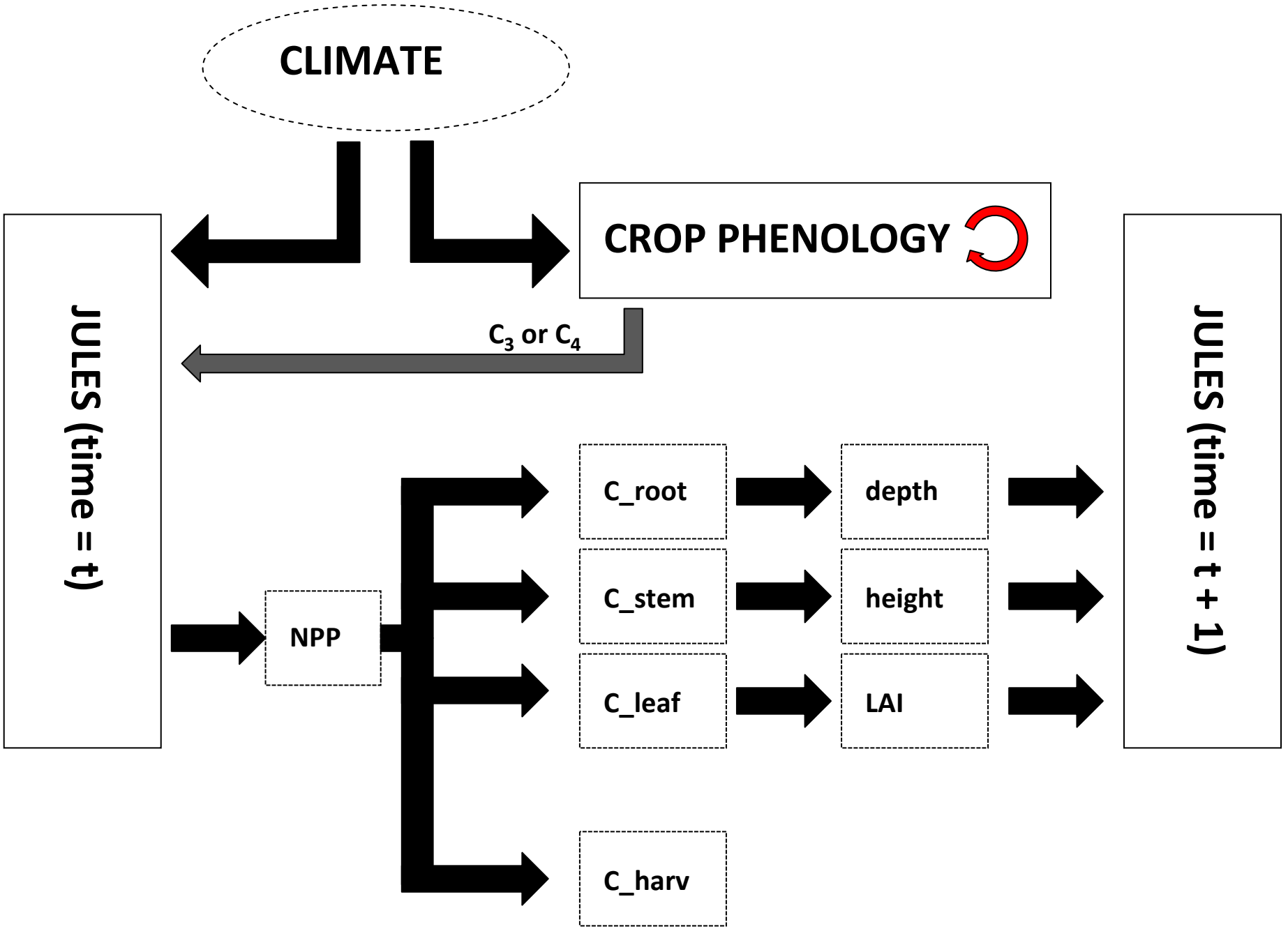
They are also representative of the crops with known (gridded) geographic distributions.
(e.g. Leff et al. 2004, Monfreda et al. 2008).

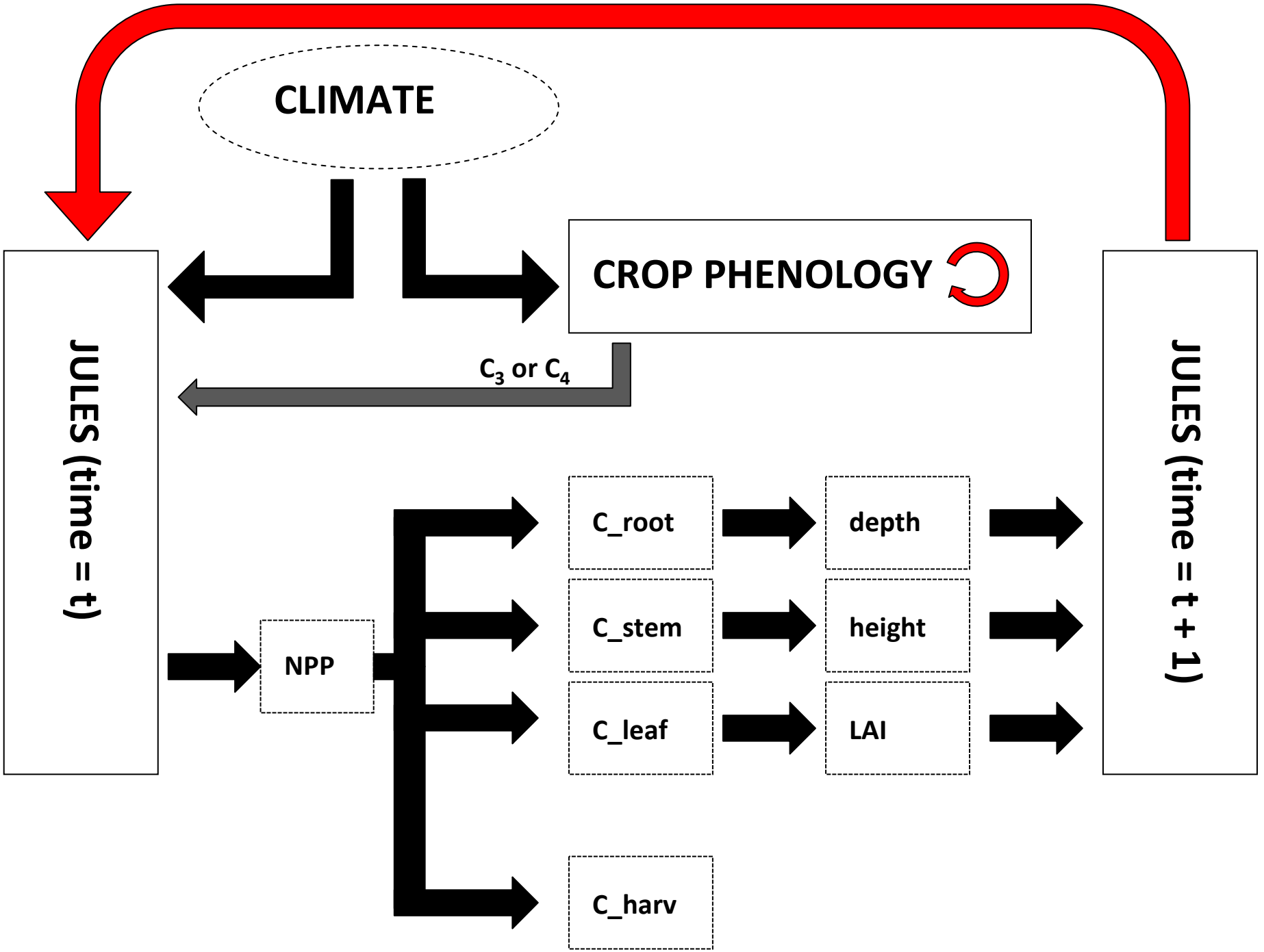
BRIEF JULES-Crop SCHEMATIC…

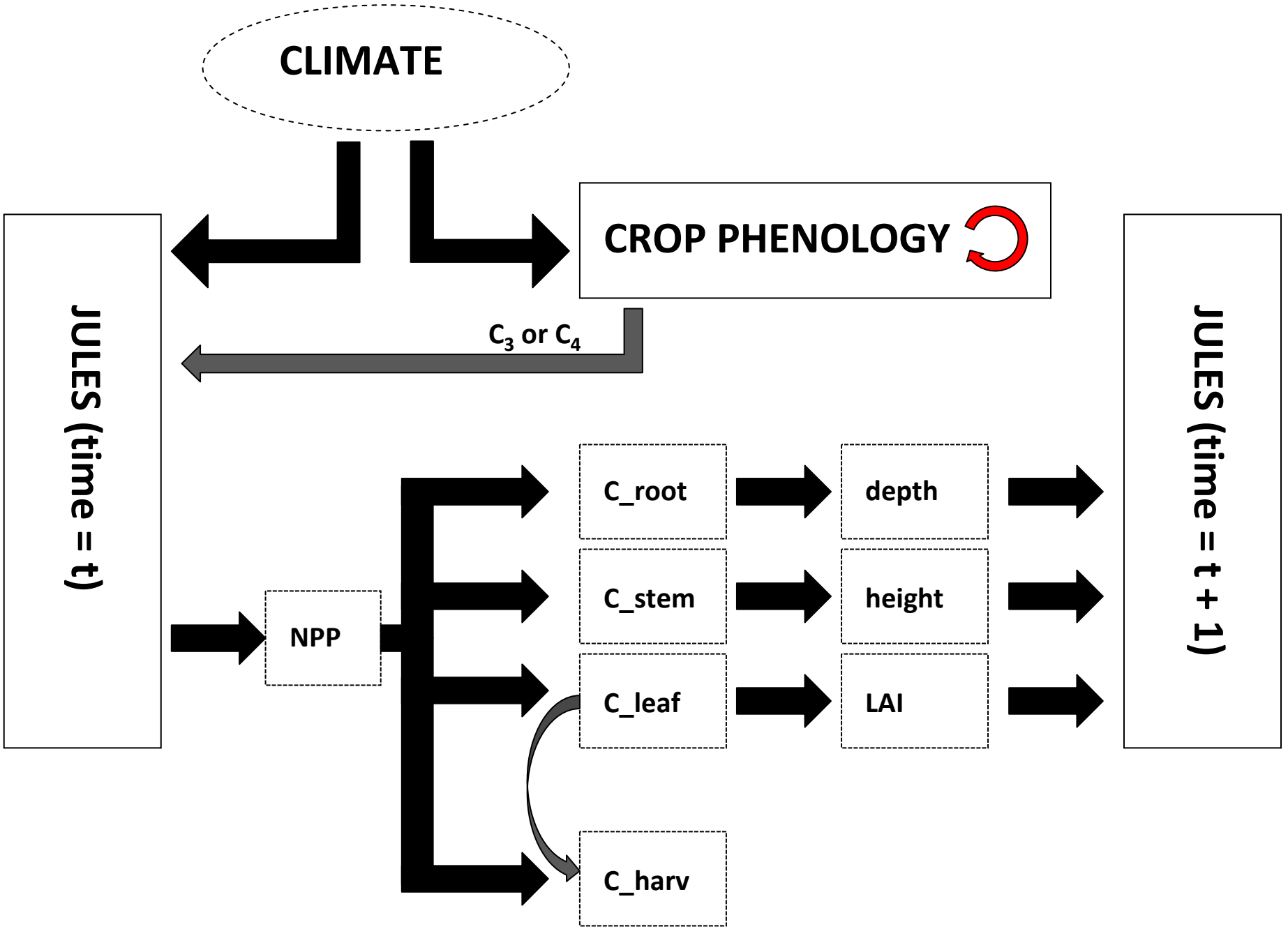

CLIMATE
CROP PHENOLOGY
JULES

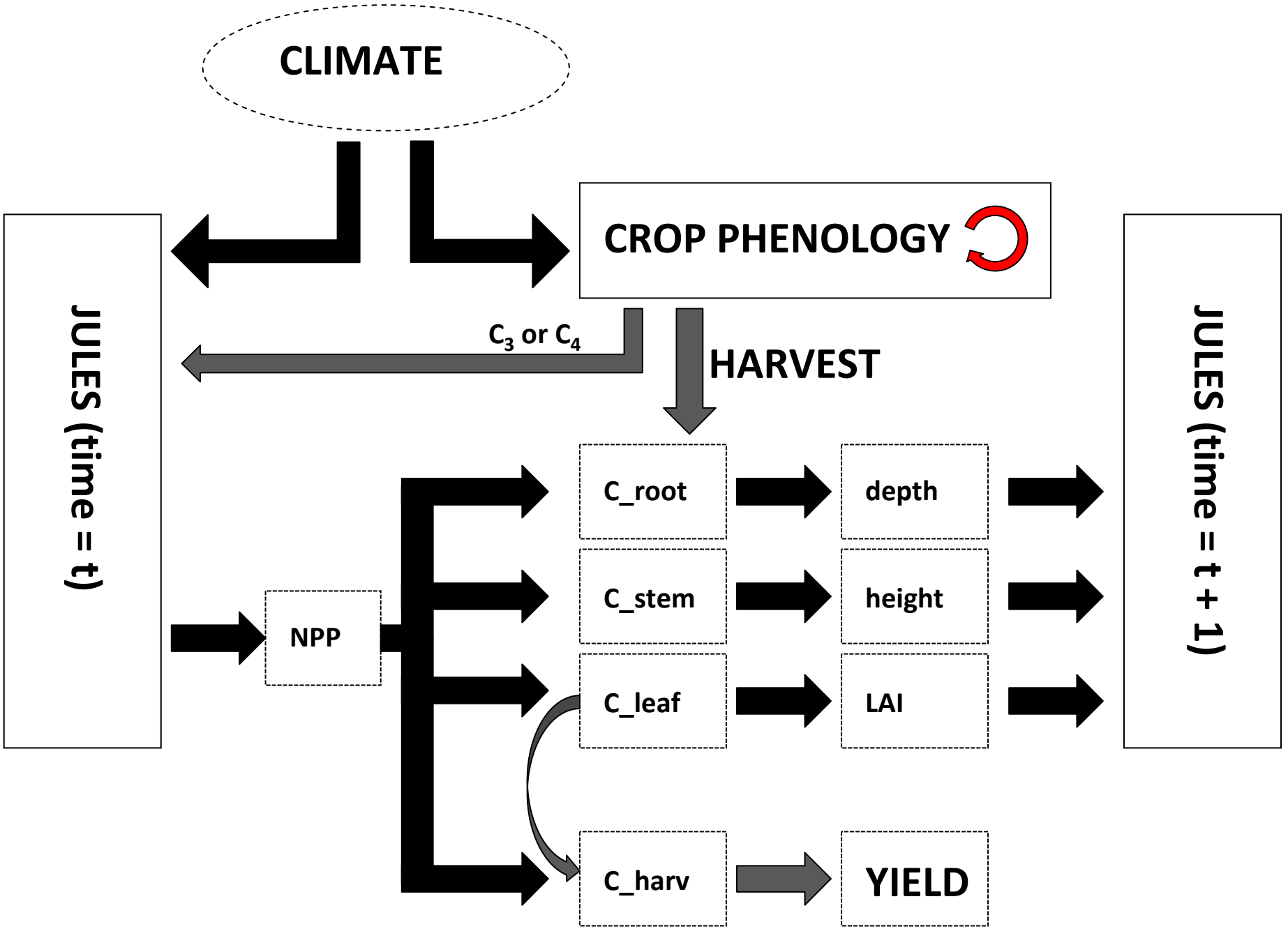

CLIMATE
CROP PHENOLOGY
C_3 or C_4
JULES (time = t)
NPP

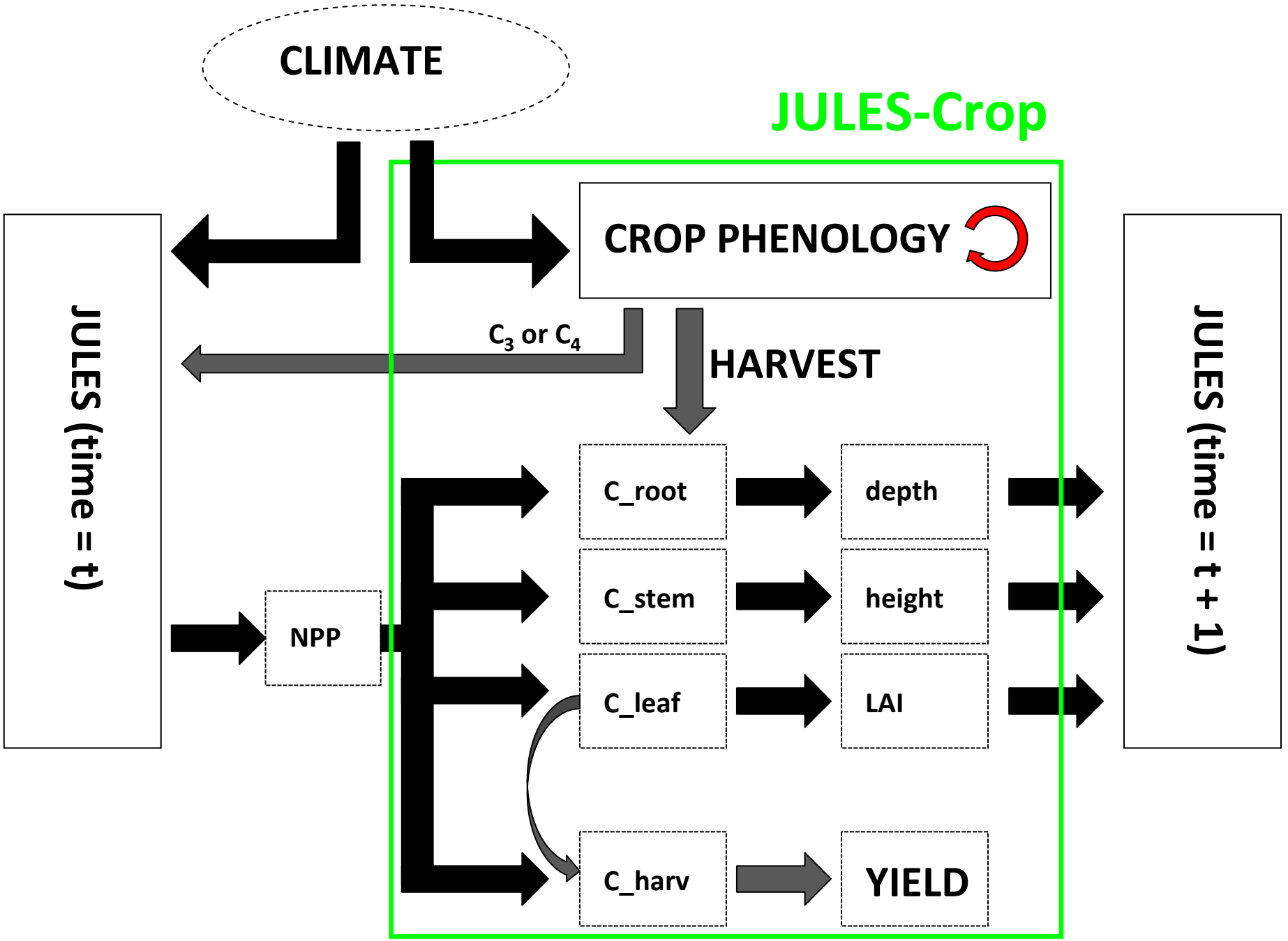

CLIMATE
CROP PHENOLOGY
JULES (time = t)
C_3 or C_4
NPP
C_root
C_stem
C_leaf
C_harv


CLIMATE
CROP PHENOLOGY
JULES (time = t)
C_3 or C_4
NPP
C_root
C_stem
C_leaf
C_harv
depth
height
LAI
JULES (time = t + 1)


CLIMATE
CROP PHENOLOGY
JULES (time = t)
JULES (time = t + 1)
C_3 or C_4
NPP
C_root
C_stem
C_leaf
C_harv
depth
height
LAI


CLIMATE
CROP PHENOLOGY
JULES (time = t)
C_3 or C_4
NPP
C_root
C_stem
C_leaf
C_harv
depth
height
LAI
JULES (time = t + 1)


CLIMATE
JULES (time = t)
CROP PHENOLOGY
C_3 or C_4
HARVEST
NPP
C_root
C_stem
C_leaf
C_harv
depth
height
LAI
YIELD
JULES (time = t + 1)


CLIMATE
JULES-Crop
JULES (time = t)
CROP PHENOLOGY
C3 or C4
HARVEST
NPP
C_root
depth
C_stem
height
C_leaf
LAI
C_harv
YIELD
JULES (time = t + 1)

FURTHER ISSUES

- Irrigation
- N / P limitation
- Land management

Walker INSTITUTE

Thank you.

j.hooker@reading.ac.uk

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