2.2. METHODOLOGY: CROPS

FROGS (French Refinement Of Groundwater Scenarios)
UIPP Training

Paris, 16 November 2011

UIPP Environmental Methodology Working Group

Main objective of crop parameterisation

Objective of realism: be as representative as possible of the actual environmental conditions in France

- Crop rotations instead of monoculture
- Realistic emergence and harvest dates depending on geographical location
- BBCH growth stages option for timing of the pesticide applications

French Refinement Of Groundwater Scenarios
Crop rotations selection method

- **For each « main crop » considered in FROGS, the most probable crop rotation within each relevant AU was determined**
  - Survey conducted with local field experts from the companies and Arvalis
  - 1 to 5 possible crop rotation types for each AU
  - 1-year to 4-year crop rotations, most of them being 3-year crop rotations

- **Reality check and selection of most representative rotation performed by comparing to most probable rotation based on 2001 regional Agreste data (Ministry of Agriculture)**
  - Probabilistic approach based on information available for crop grown the previous year
  - Data not available for potatoes and sunflower
  - 3 year-crop rotation probabilities of occurrence were calculated for each region for 12 possible crop rotation types

- **Final validation of the crop rotation type for each main crop in each AU was performed by field specialists within the companies**

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Examples of selected crop rotations

Table 8 Crop rotations implemented in FROGS for each AU and each primary crop

AU code	AU Name	Primary crop	Crop rotation	Rotation length (years)
1	Collines molassiques - Lauragais	Winter Wheat	Winter Wheat-Sunflower	2
		Oilseed rape	Oilseed rape-Winter Wheat-Sunflower	3
		Maize fodder	Maize fodder	1
		Maize grain	Maize grain-Winter Wheat	2
		Barley	Barley-Winter Wheat-Sunflower	3
		Sunflower	Sunflower-Winter Wheat	2
2	Bretagne sud	Winter Wheat	Winter Wheat-Maize fodder-Barley	3
		Oilseed rape	Oilseed rape-Winter Wheat-Maize fodder	3
		Maize fodder	Maize fodder-Winter Wheat-Barley	3
		Maize grain	Maize grain-Winter Wheat	2
		Barley	Barley-Maize fodder-Winter Wheat	3
		Sunflower	Sunflower-Winter Wheat	2
3	Limagnes - Plaine du Forez	Sugar beet	Sugar beet-Winter Wheat-Winter Wheat	3
		Winter Wheat	Winter Wheat-Maize fodder	2
		Oilseed rape	Oilseed rape-Winter Wheat-Barley	3
		Maize fodder	Maize fodder-Winter Wheat	2
		Maize grain	Maize grain-Barley-Winter Wheat	3
		Barley	Barley-Winter Wheat-Sugar beet	3
		Sunflower	Sunflower-Winter Wheat	2
4	Bordure Nord - Picardie - Normandie	Sugar beet	Sugar beet-Winter Wheat-Winter Wheat	3
		Winter Wheat	Winter Wheat-Barley-Maize fodder	3
		Oilseed rape	Oilseed rape-Winter Wheat-Barley	3
		Maize fodder	Maize fodder-Winter Wheat-Barley	3
		Maize grain	Maize grain-Winter Wheat	2
		Barley	Barley-Winter Wheat-Sugar beet	3
		Potato	Potato-Winter Wheat-Barley	3
		Sugar beet	Sugar beet-Maize grain-Maize grain	3

Implementation of the crop rotations in FROGS

- Assignment of main crop events in the different AUs
  - Emergence and harvest dates (constant over the simulation period)
  - Data collected from expert knowledge and Agreste data
  - When not available, default FOCUS values were selected (Chateaudun for Northern France and Piacenza for Southern France)
  - Due to some limitations of SWASH/PEARL, a shift in the emergence/harvest dates had to be performed for a small number of situations.

- Limitation on the 4-year rotations (11 combinations concerned)
  - Require 86 years of simulation (6-year warm-up period + 4 x 20 years)
  - PEARL 3.3.3 is limited to a simulation period of 70 years
  - Next PEARL version restriction is extended to 100 years
  - Meanwhile, it was decided to convert these 4-year crop rotation to 3-year crop rotation
  - The consequence of this change is considered to give out more conservative results and has been validated by ANSES

The BBCH application sub-model

FOCUS: applications on fixed dates

- Same dates of application repeated over the whole period of simulation
- Absolute or relative application dates (emergence or harvest)

FROGS: additional option for applications relative to BBCH growth stages using phenological models

- Plant growth and consequently application dates vary depending on weather conditions for each AU and each individual year of simulation
- More realistic approach
- Application scenario will match exactly the product GAPs, no more arguments on timing of applications

Description of plant growth

Standard phenological sub-models based on temperature sums

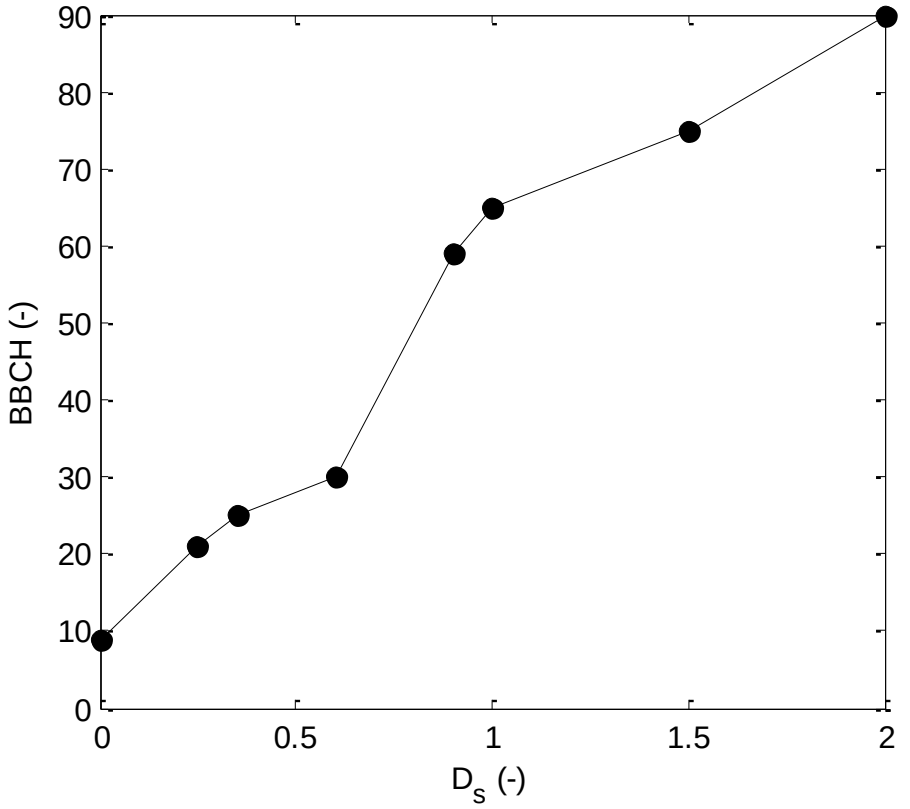
- Same algorithms as in PEARL (FOCUS excluded) and as EU model WOFOST used by JRC for the CGMS (European Crop Growth Monitoring System)
- Phenological parameters from Boons-Prins et al. (1993)[1] for cereals, maize, sugar beet, potatoes and sunflower (dependent only on temperature sums)
- Sub-model and parameters from Habekotté (1997)[2] for oil seed rape (more complex, dependent on both temperature sums and degree of vernalization)

[1] Boons-Prins, E.R., G.H.J. de Koning, C.A. van Diepen and F.W.T. Penning de Vries, 1993. Crop specific simulation parameters for yield forecasting across the European Community. Simulation Rep. 32, CABO-DLO and SC-DLO, Wageningen, The Netherlands.
[2] Habekotté, B. 1997. A model of the phenological development of winter oilseed rape (Brassica napus L.). Field Crops Research 54: 127-136.

Description of plant growth

Correspondence between development stage and BBCH code (base JRC [http://agsys.cra-cin.it/tools/cropml/help/])

	D_s	BBCH
Emergence:	0	9
Beginning of tillering:	0.25	21
Mid tillering:	0.35	25
Panicle initiation:	0.6	30
Full Heading:	0.9	59
Full Flowering:	1	65
Full Grain filling:	1.5	75
Physiological maturity:	2	90

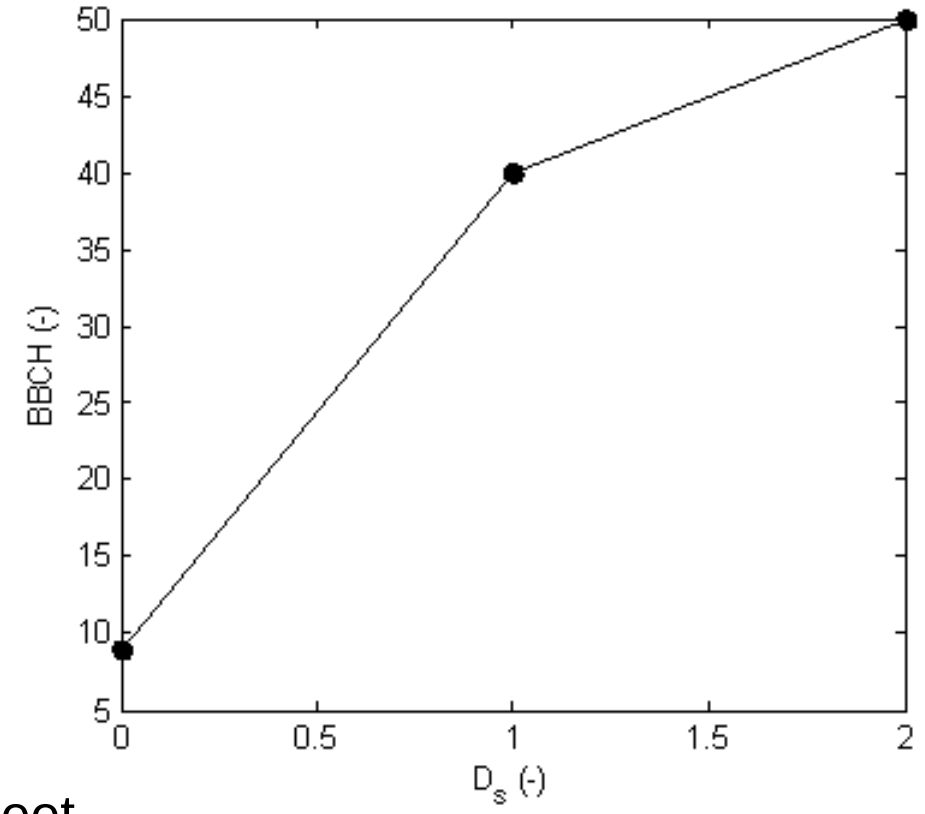


All crops except sugar beet
(bi-annual crop)

Description of plant growth

Correspondence between development stage and BBCH code (base JRC [http://agsys.cra-cin.it/tools/cropml/help/])

	D_s	BBCH
Emergence:	0	9
Full ground cover (LAI = 2.5):	1	40
Harvest:	2	50



Sugar beet

Validation of the BBCH sub-model

- Compilation of growth stage information gathered during biological trials performed by industry on a 20-year period (non-published data under Access format): >150000 entries covering most crops and Aus
- Correspondence with the 31 AUs based on postal codes and canton information
- Comparison made with the simulated BBCH events for the same years using MARS weather data selected for each individual AU

<u>Conclusion:</u> Phenological models are in excellent adequation with the observed data

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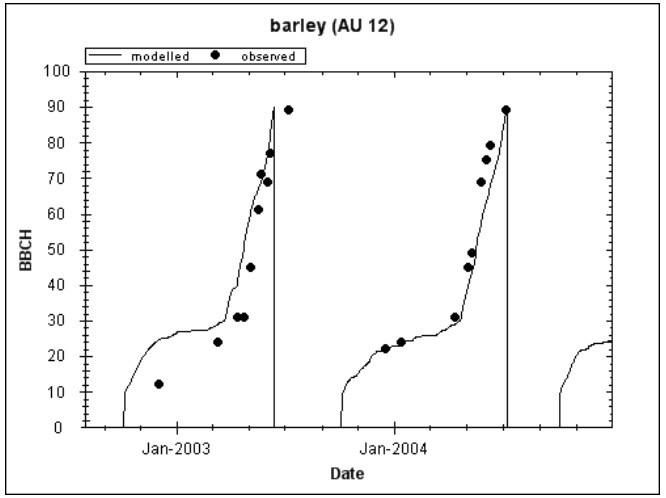
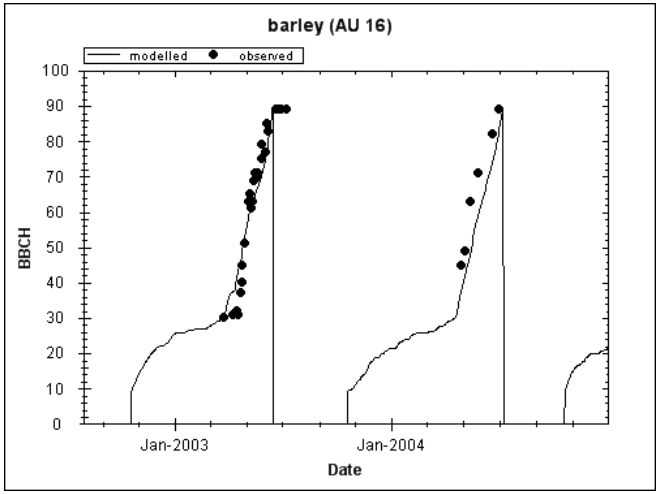
Validation of the BBCH sub-model

Winter Barley

Barrois – Plateaux bourguignons

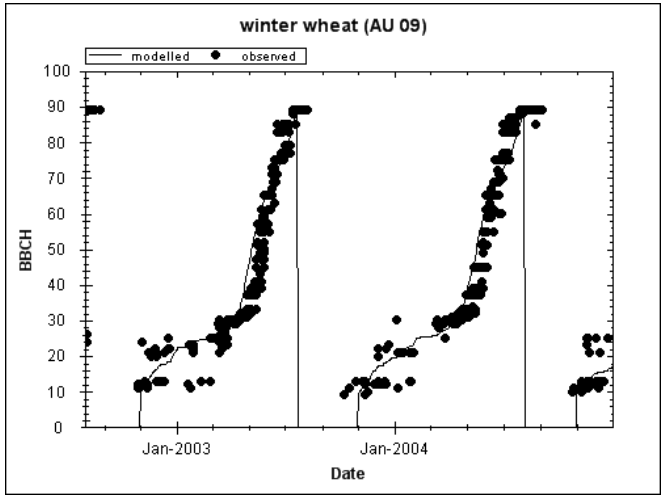


Champagne crayeuse

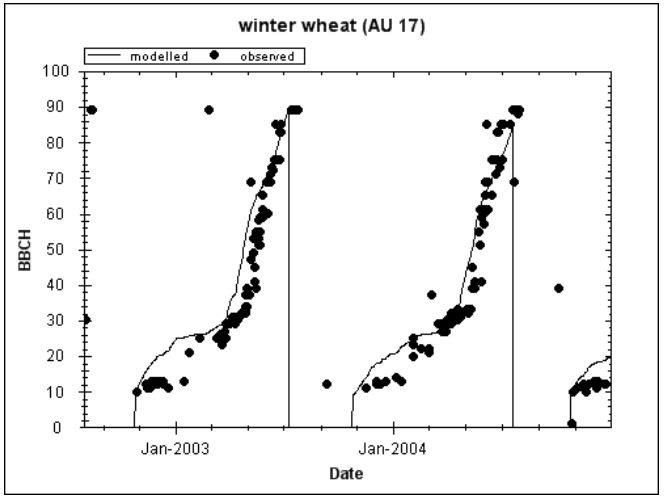


Winter wheat

Picardie-Nord-Pas de Calais



Beauce – Drouais - Gâtinais



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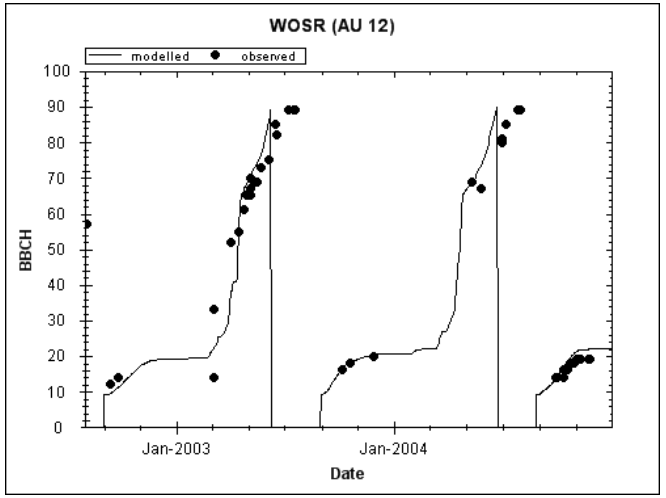
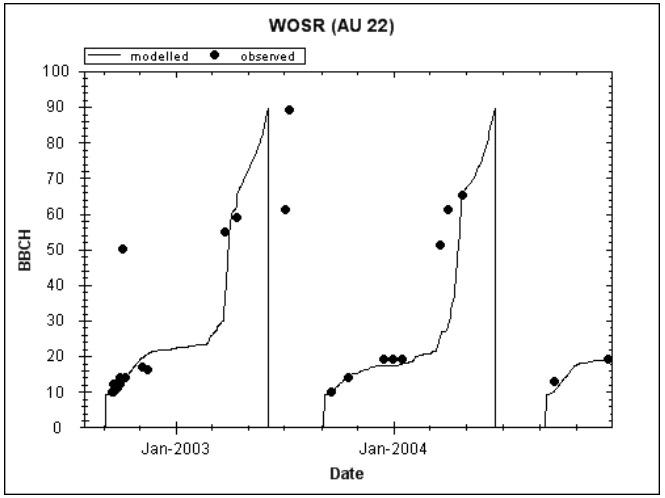
Validation of the BBCH sub-model

Winter Oil Seed Rape

Barrois – Plateaux bourguignons

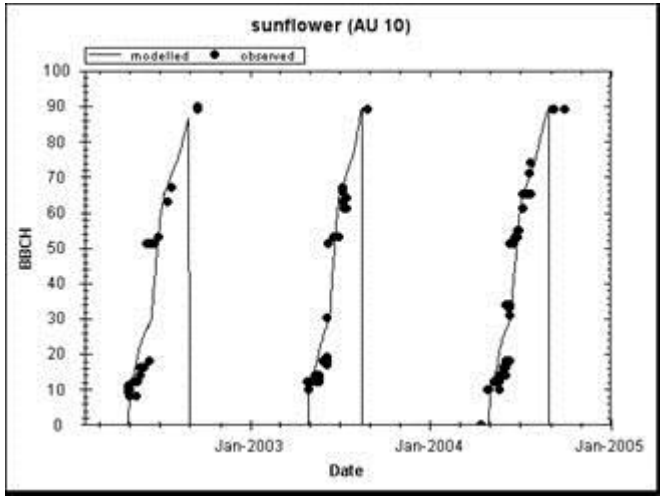


Champagne berrichonne - Boischault

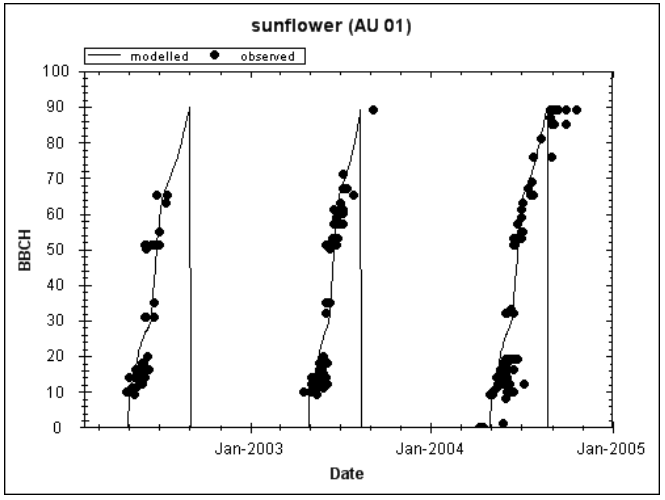


Sunflower

Charentes



Collines molassiques - Lauragais



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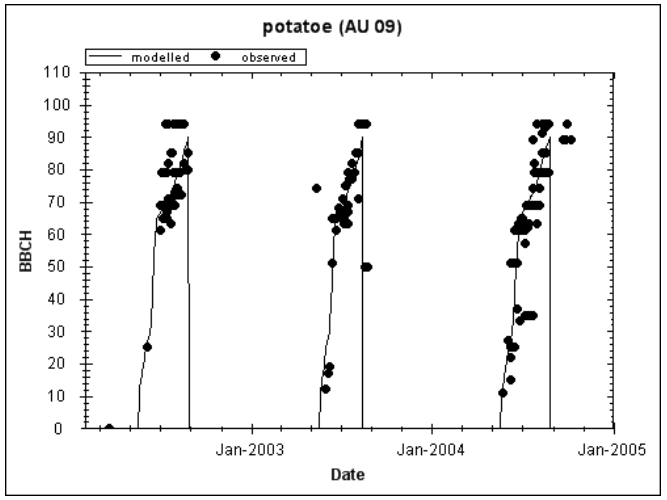
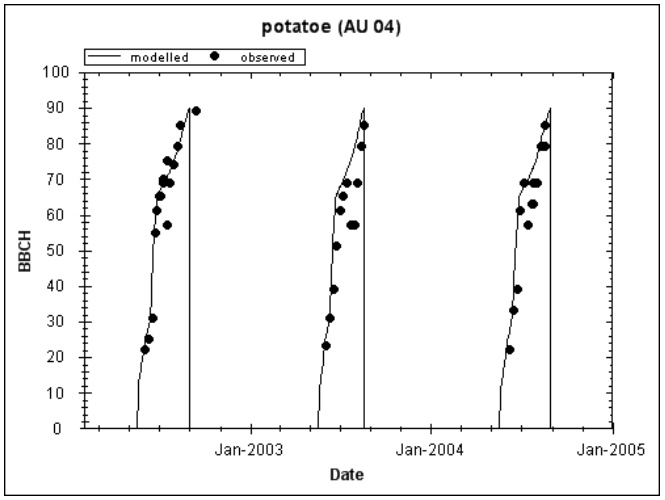
Validation of the BBCH sub-model

Potato

Picardie – Nord – Pas de Calais

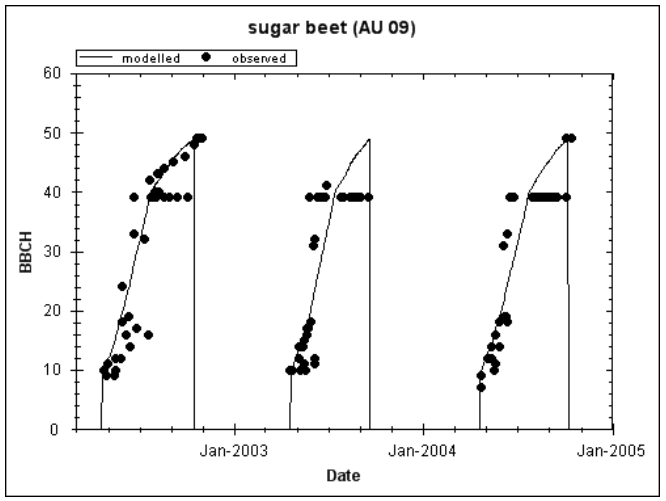


Bordure maritime Nord – Picardie - Normandie

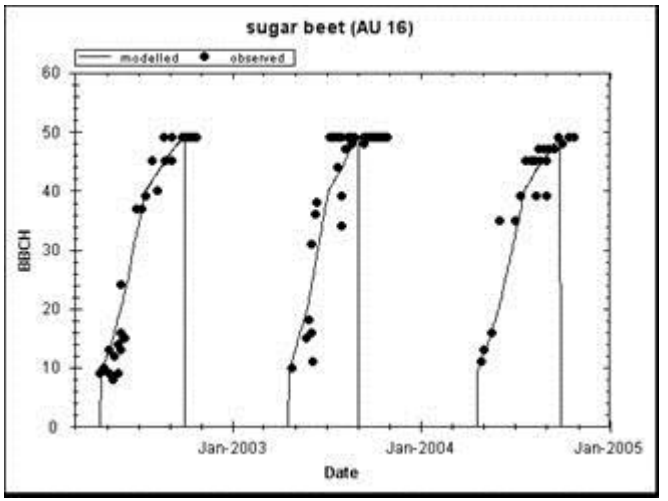


Sugar Beet

Picardie – Nord – Pas de Calais



Champagne crayeuse



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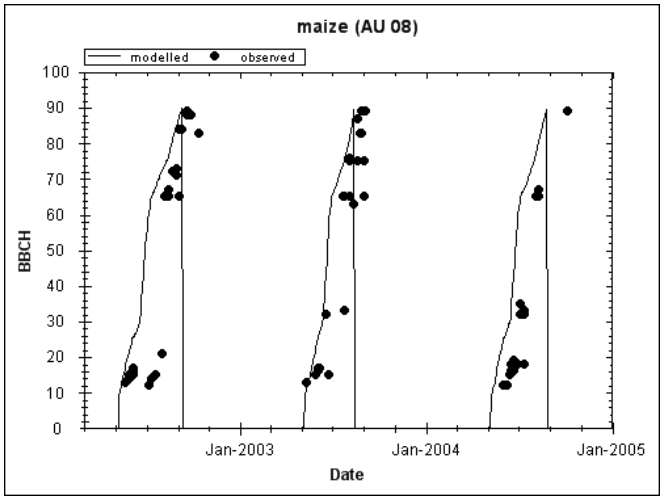
Validation of the BBCH sub-model

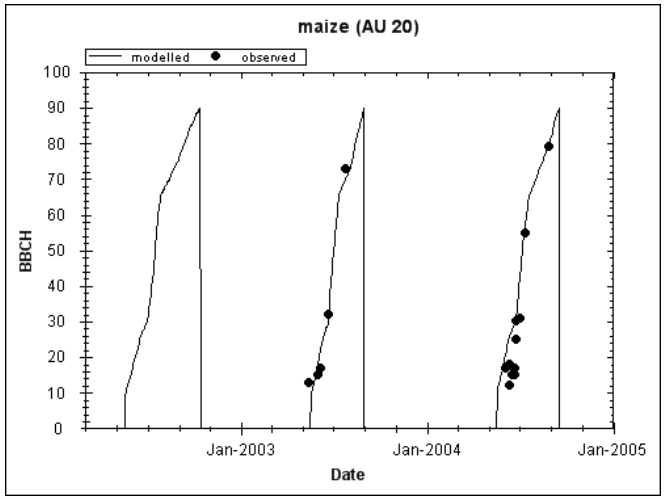
Grain Maize

Collines molassiques - Lauragais



Fodder maize

Bocages de l'Ouest



Other crop parameters

A number of crop-specific parameters are required for the modeling of water and pesticide fluxes

- Leaf Area Index (LAI)
- Rooting depth
- Crop height

Because of the lack of available data, default FOCUS values were selected for some of the crop parameters

- Values from Châteaudun or Piacenza
- Room for improvement in future versions of FROGS

Thank you very much for your kind attention