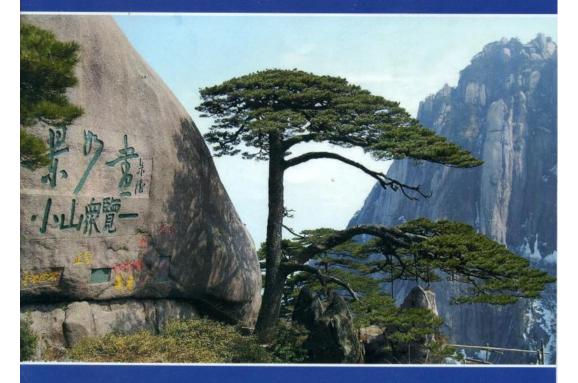
欧盟第七框架计划 7th Framework Programme

> "发展中国家基于电子农业工具的 农作物监测"项目座谈会

International Workshop on Crop Monitoring as an E-agriculture Tool in Developing Countries

会议手册 CONFERENCE MANUAL



2011年11月2日-4日 中国•合肥 November 2-4 2011

Hefei · China





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1. Thanks

Many thanks to the Prof. Hu Zaisheng, Director of the Anhui Institution For Economic Research, for the invitation and the support and the hospitability. Thanks to Dr. Dong QINGHAN and Dr. Yang QING for the excellent organization of this workshop. Many thanks also to Dr. Allard de Wit and ir. Raymond van der Wijngaart for their presentations and their technical contribution to the E-Agri Project.

2. List of participants and their representatives

• Political leaders and experts:
Wu Jingsong: Vice Chairman, Anhui Development and Reform Commission
Frank Greco: First Counsellor, Head of Information Society and Media Section, EU
Delegation
Jiang Yan: Assistant to First Counsellor, EU Delegation
Yang Bo: Ph.D, Director, Information Office, The General Office of the People's
Government of Anhui Province
Yang Xiaoyang: Director, International Cooperation Office, Science and Technology
Department of Anhui Province
Chen Youping: Deputy Director, Anhui Provincial Science & Technology Exchange
Center with Foreign Countries
Prof. Dong Qinghan: VITO, Belgium
Prof. Allard de Wit: ALTERRA, Netherlands
Prof. Raymond van der Wijngaart: ALTERRA, Netherlands
Prof. Charles Situma: Ministry of Environment and Mineral Resources, Kenya
Prof. Hicham Marzouki: National Meteorological Direction, Morocco
Prof. Wei Guo: School of Information Science and Technology, University of
Science and Technology of China
Teng Fei: Ph.D, Chinese Academy of Agricultural Sciences
• Members from Anhui province:
Prof. Hu Zaisheng: Director, Anhui Institution for Economic Research
Prof. Ma Zhongmo: Deputy Director, Anhui Institution for Economic Research
Jiang Xudong: Associate Prof., Assistant Director, Head of Institute of Geographical

Information, Anhui Institution for Economic Research

Wang Xueping: Senior Economist, Head of Institute of Training Department, Anhui Institution for Economic Research

Xu Zhenyu: Associate Prof., Head of Institute of Regional Development and Environment Resource, Anhui Institution for Economic Research

3. Introduction

- E-Agri Project:: small description + liste of partenar institutions (JRC, DMN, INRA, DSS, European Commission,).
- The first workshop in Rabat: satellite images and yield estimation
- The objective of this workshop

4. Agenda of the workshop

Tuesday, November 1st

Registration

Wednesday, November 2nd

Time: 08:30-18:30

Place: Gui Yuan, No. 1 Meeting Room

Chair: Prof. Ma Zhongmo

Time Slot	Agenda	Speaker
8:30-8:40	Welcome Address	Hu Zaisheng
8:40-9:00	Speech	Wu Jingsong
9:00-9:30	Collaboration in the ICT sector between EU and China; some flagship projects	Frank Greco
9:30-9:50	Presentation of the information development in Anhui	Yang Bo
9:50-10:10	Introduction of ICT project	Wei Guo
10:10-10:30	Coffee Break(Take a group photo)	
10:30-11:00	Introduction of E-AGRI project	Dong Qinghan
11:00-11:30	Crop monitoring using agro-meteorological models in Europe	Allard de Wit
11:30-12:00	Crop monitoring in Anhui province	Xu Zhenyu
12:00-14:30	Dinner(Gui Yuan, Bai Lu Hall)	Wu Jingsong
14:30-18:30	Social activity (city -tour)	
18:30	Supper(Liangyuan Revolving Restaurant)	

Thursday, November 3rd

Time: 08:30-17:50 Place: Gui Yuan, No. 2 Meeting Room Chair: Prof. Dong Qinghan

Time Slot	Agenda	Speaker
8:30-10:00	Introduction to the WOFOST model: principles, processes, parameters Exercises with the WOFOST Control Centre	Allard de Wit Raymond van der Wijngaart
10:00-10:20	Coffee Break	
10:20-11:50	Introduction to the WOFOST model: principles, processes, parameters Exercises with the WOFOST Control Centre	Allard de Wit Raymond van der Wijngaart
12:00-14:30	Lunch(Daoxianglou Hotel, East Building Restaurant)	1.00
14:30-16:00	Introduction to the Crop Growth Monitoring System (CGMS) and its database	Allard de Wit Raymond van der Wijngaart
16:00-16:20	Coffee Break	
16:20-17:50	Introduction to the Crop Growth Monitoring System (CGMS) and its database	Allard de Wit Raymond van der Wijngaart
18:00	Dinner(Yintong Hotel)	

Friday, November 4th

Time: 08:30-17:50

Place: Gui Yuan, No. 2 Meeting Room

Chair: Prof. Dong Qinghan

Time Slot	Agenda	Speaker
8:30-10:00	CGMS operations and maintenance, understanding and visualizing CGMS output	Allard de Wit Raymond van der Wijngaart
10:00-10:20	Coffee Break	
10:20-11:50	CGMS operations and maintenance, understanding and visualizing CGMS output	Allard de Wit Raymond van der Wijngaart
12:00-14:30	Lunch(Daoxianglou Hotel, East Building Restaurant)	
14:30-16:00	Introduction to and exercises with the statistical toolbox for crop yield forecasting	Allard de Wit Raymond van der Wijngaart
16:00-16:20	Coffee Break	
16:20-17:50	Introduction to and exercises with the statistical toolbox for crop yield forecasting	Allard de Wit Raymond van der Wijngaart
18:00	Dinner (Huadu Hotel)	

Saturday, November 5th

Airport See Off

5. Daily reports

5.1. Day 1: Wednesday, November 2nd

5.2. Day 2: Thursday, November 3nd

5.2.1. PART1: The WOFOST.

The main objectives of this day are to learn the principals of the WOFOST model, how it can be implemented, how to configure different parameters and to practice some examples of use.

There is an inter-annual of yield variability of crops over regions and countries of the world. That's because the field is depending on multiple parameters: weather, meteorological data's, simulated yield data. All this parameters are used as predictors for the regional crop yield model (CGMS).

a) Installation of WOFOST

First, the WOFOST software should be downloaded from the web site: <u>www.wofost.wur.nl</u>. In this dedicated web site, we can also find the manuals and different slide presentations to learn more about how to implement WOFOST correctly. There is also a wiki page for this software: <u>http://wofost.wikispaces.com</u>, where we can find FAQ pages, the FORTRAN source codes, the hard ware requirements and much other useful information.

How to install it?

• 1: to start the installation, we just lunch the setup8WCC18.exe, and click on Next button.



• 2: Accept the terms in the license agreement and click **Next** button.

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J∗ I accept th	p://www.osor.eu/eupl> le terms in the license agreement ccept the terms in the license agreement	- Print
InstallShield —	< Back Next >	Cancel

• **3:** After reading the readme information's, click on **Next** button.

😸 WOFOST Control Center 1.8 - InstallShield Wizard	
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Alterra Wageningen University & Research Centre Droevendaalsesteeg 3 P.O. Box 47 NL-6700 AC Wageningen The Netherlands phone: +31 317 481914 www.wofost.wur.nl Copyright Alterra, Wageningen University & Research Ce	entre, 2011
This file is part of:	
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<back next=""></back>	Cancel

• **4:** Specify the destination folder, and click on **Next** button.

Control Center 1.8 - InstallShield Wizard
ion Folder kt to install to this folder, or click Change to install to a different folder.
Install WOFOST Control Center 1.8 to: C:\Program Files\Alterra\WOFOST Control Center\ Change
< Back Next > Cancel

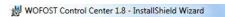
• **5:** click on **Install** button.

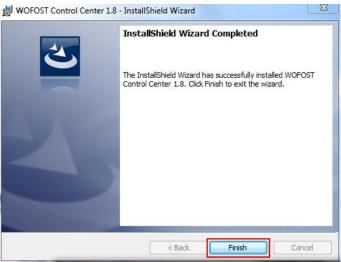
Ready to Install the Program The wizard is ready to begin installation	3
If you want to review or change any of exit the wizard.	your installation settings, click Back. Click Cancel to
Current Settings:	
Setup Type:	
Typical	
Destination Folder:	
C:\Program Files\Alterra\WOFOST	Control Center\
User Information:	
Name: user	
Company: Hewlett-Packard Compa	ny
l tallShield	
Summer meaner	< Back Cancel Cancel

6: Just wait the installation of the WOFOST Control Center (WCC) v1.8. ٠

👸 WOFOST	Control Center 1.8 - InstallS	hield Wizard		
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17	Please wait while the InstallS 1.8. This may take several mi		s WOFOST Control	Center
	Status:			
InstallShield				
and there		< Back	Next >	Cancel

7: Click on Finish button, to exit the wizard. •





8: A quick launch of WCC should be on Desktop. •



9: This is the main page of WCC. •

L Exit	C Reset	💋 Run	Result detailed	Result summary	? Help
C Simulation o C and simulatio	<u>C</u> rop <u>We</u> cessive production lev f gotential crop growth on of water-limited cro	n p growth	C No summa C Whole sys	tem (1-D column)	•
Start date wate	1	gen shortage	Output	al in days:	

• **10:** This is the personnel directories installed for the WCC:

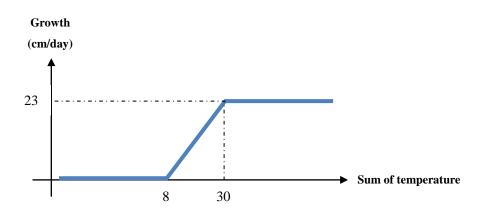
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b) What is WOFOST?

WOFOST is a semi-deterministic crop simulation model. It can be run's in daily time steps. We can use single value parameters types for a specified point or tabular one's for regional scale. To manage the crop phonology evolution, WOFOST use the DVS parameter: the value zero is for the emergence step, the other values (1, 2, and 3) are used for others (maturity...etc).

c) The growth

The following graph shows the growth evolution (cm/j) per day depending of the sum of temperature of crops:



d) Light interception

The light interaction depends on three parameters: the first one is the solar radiation (Direct/diffuse...), the second is the LAI parameter (Leaf Area Index). The last one is the CO2 assimilation. WOFOST can manage the Leaf Area Dynamics, by using two parameters:

- The senescence which depend on the heat sum (SPAN), the PERDL or water stress, and KDIFTB (LAI>LAIcritic, LAIcritic=3.2/KDLF~5.5).
- LSUM, which is the $\sum_{class=1}^{n}$ biomass * SLA
- e) Transpiration

The crop's transpiration depends on the reference evapo-transpiration, the LAI and the humidity of soils.

f) Soil fertility

The soil fertility is not yet implemented in CGMS model.

g) CGMS limitations

The limitations of CGMS are:

- It's inherent to simulation techniques
- The chosen generalization
- The chosen system boundaries
- The limited knowledge of crop response relations.
- The observation data's are needed for a quick configuration of CGMS-WOFOST.

h) Trainings

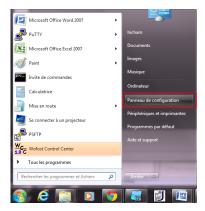
All the trainings are described in the file named "WOFOST_Training_Anhui.pdf"

i) The first simulation

The WOFOST software can be installed just by executing the file already downloaded from the web site: <u>www.wofost.wur.nl</u>. Then we can launch the WCC (WOFOST Control Center) by double clicking on the quick link named "wcc" in the desktop. Then, the control center appears.

But before we can start our first simulation, we should make an ODBC connection to the mdb database used by the WCC, by following these few steps:

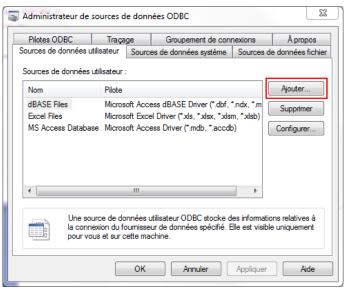
• First go to the **Control Panel**:



• Then go to Administration tools, then to ODBC Data Sources:

juster les paramètres de l'ord	🔿 🗑 « Tous les Panneaux de configura	tion + Outils d'administration • 49	hercher dans : Outils d	odministrat	
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Gestionnaire audio HD Realtek	Téléchargements	Initiateur iSCSI	14/07/2009 05:41	Raccourci	
HP ProtectTools Security Manager	- Telechargements	Kit d'administration de Connection Man	08/09/2011 09:28	Raccourci	
	🕞 Bibliothèques	Observateur d'événements	14/07/2009 05:42	Raccourci	
Java	Documents	Pare-feu Windows avec fonctions avancé	14/07/2009 05:41	Raccourci	
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Système	🏭 OS (C:)	😹 Windows PowerShell Modules	14/07/2009 05:52	Raccourci	
e systeme	- HD RECOVERY (D-)			•	

• Click on Add button:



• Select Driver do Microsoft Access (*.mdb), then click on Finish button:

Créer une nouvelle source o	de données	×
	Sélectionnez un pilote pour lequel vous souhaitez défi de données.	nir une source
	Nom	Version 🔺
011	Driver da Microsoft para arguivos texto (*.bd; *.csv)	6.01.760
	Driver do Microsoft Access (*.mdb)	6.01.760 ⁻
	Driver do Microsoft dBase (*.dbf)	6.01.760
	Driver do Microsoft Excel(*xls)	6.01.760
	Driver do Microsoft Paradox (*.db)	6.01.760
	Driver para o Microsoft Visual FoxPro	1.00.02.0
	Mismaaft Access dDASE Driver (* dbf * odv * mdv)	12 00 64
		r
	< Précédent Terminer	Annuler

• Then **Select** button, to choice the mdb database for WCC:

Installation ODBC pour Microsoft Access	? ×
Nom de la source de données :	ОК
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Base de données système	Options>>

• Now select where this mdb database is located:

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In our case:

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🖈 Favoris	Nom	Modifié le	Type	Taile	
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	🛃 readme	24/03/2011 12:44	Rich Test Format	47 K.o	
Bibliothèques	User_manual_WOFOST_CONTROL_CENT	07/03/2011 10:00	Adobe Acrobat D	1 720 Ko	
	the wcc	30/03/2011 11:05	Application	1.580 Ko	
🗣 Ordinateur	WCC_VAR.DBF	10/07/1998 16:15	Fichier DBF	20 Ko	
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• Then tape a name for this ODBC connection:

Installation ODBC pour Microsoft Access	? ×
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Base de données système	
Aucun	
O Base de données :	
Base de données système	Options>>

• Finally, click on **OK** button, to finish this installation:

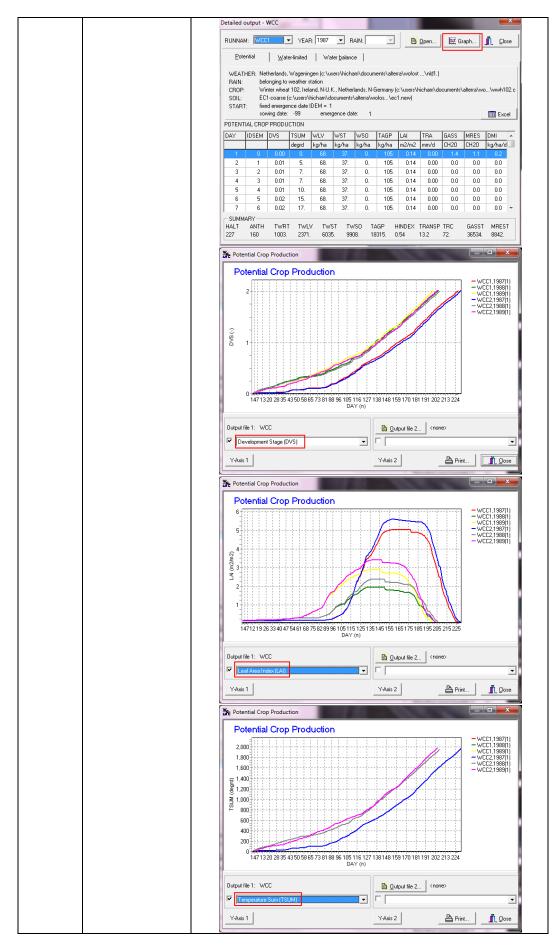
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	la conn		utilisateur ODBC stocke d ur de données spécifié. E chine.		
		ОК	Annuler	Appliquer	Aide

Following is first simulation that we tested:

steps	Menu	To do
1	General	× WOFOST
1	Conorai	File Result Help
		Exit Reset Run Result detailed Result summary Help
		<u>G</u> eneral <u>C</u> op <u>W</u> eather <u>S</u> oil <u>B</u> eruns Number of successive production levels ⊂ Summary seasonal soil water balance
		Simulation of gotential crop growth C No symmatry
		C and simulation of water-limited crop growth C Whole system (1-D column) C and cajculation of nutrient-limited crop growth C Boot zone
		What is a state of the sta
		WATER-LIMITED crop growth
		Start date water balance: Quiput interval in days: 1
		C Effects of grought only
		C Effects of both drought and oxygen shortage
2	Crop: winter	WOFOST Control Center - Session: WCC
	wheat	<u>i</u> C / E E ?
		Exit Reset Run Result detailed Result summary Help
		General Crop Weather Soil Beruns Available crops Figed Emergence:
		Soybean 904, S-France
		Soybean,(original W41) Sugar beet 601, NEC Supar beet 602, Central EC Fixed sgwing date Fadiest Sowing
		Sugar beet 603, S-EC Sugar beet 604, Greece Sugarcane (Variable source) Ultimate Soving:
		Swnet polato (Van Heemst, 1988)
		Vorter wieder 101: MULK, Desmark Worter wieder 102: Nederskilt ALK, Rehenlands, N. Germany Worter wieder 102: Bedgam, Luxembourg Worter wieder 102: Bedgam, UKernbourg Worter wieder 104: Central Germany. N. France
		Winter wheat 105, France, N-Italy, N-Spain, N-Portugal Winter wheat 106, S-Italy, Central and E-Spain, S-Portugal
		Writer Writer (107, 5-5)art, 5-citeboo
3	Weather	WOFOST Control Center - Session: WCC
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		Netherlands, De Koou Netherlands, Wageningen
		1987
		Consecutive gears:
		1

4	G :1	💑 WOFOST Control Center - Session: WCC
4	Soil	File Result Help
	parameterization	L C / Karal Andrew P
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		BUNNAM TSUM1 WCC1 900
		WCC2 950
		Add rerun Select yariables
		Remove rerun Remove variable
6	Running	WOFOST Control Center - Session: WCC
	WOFOST CC	File Result Help
		III. CP III. III. Provide a constraint of the state of th
		General Crop Weather Soil Beruns
		C.WWindows/system32/cmd.exe Vorost Control Conter, Release: 1.8 (narch 201)

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		Butter in Article of Constant and State
		Appuyez sur une touche pour continuer
		-
		Information
		Simulation succesful
		ОК
7	Result detailed	👺 WOFOST Control Center - Session: WCC
		File Result Help
		II C I III ? Exit Reset Run Result detailed Result summary Help
1	1	



The reruns can be used to calculate the sum of temperature that a crop needs to arrive in certain phonology step. For example, if we use the reruns (900, 950, 1000, 1050...) and run the WOFOST, then we can use the graph menu to select the DVS one. Then if we know the exact date (Julian day) corresponding to those phonological steps, then we can visually determines that 900°C is the sum of temperature that correspond to the maturity step, and that 950°C is the emergency's one.

j) Configuration files

To configure the WOFOST, we just edit the file DIRECT located in: "C:\Programme Files\Alterra\WOFOST Control Centres\".

DIRECT - Bloc-notes		• X
Fichier Edition Format Affichage ?		
[Directory settings for WOFOST]		~
DBMDIR='-' DBRDIR='C:\Users\hicham\Documents\Alterra\WOFOST Control WTRDIR='C:\Users\hicham\Documents\Alterra\WOFOST Control SOLDIR='C:\Users\hicham\Documents\Alterra\WOFOST Control CRPDIR='C:\Users\hicham\Documents\Alterra\WOFOST Control	Center\meteo\cabowe\' Center\soild\'	
CLMDIR='C:\Users\hicham\Documents\Alterra\WOFOST Control RUNDIR='C:\Users\hicham\Documents\Alterra\WOFOST Control OUTDIR='C:\Users\hicham\Documents\Alterra\WOFOST Control DCGDIR='-' DRVDIR='-' GEODIR='-'	Center\meteo\climd\' Center\runio\'	
TMPDIR='C:\Users\hicham\Documents\Alterra\WOFOST Control CURDIR='-' EUSDIR='-'	Center\output\tmp\'	

Then, we can copy the file: "C:\Documents\Alterra\WCC\WWH.102N.CAB" in "C:\ Programme Files\Alterra\WOFOST Control Centres\CROPD\". Then we can modify this file by using a text editor:

- The line started by "CRPNAM=" (line n° 19) can be changed into to "CRPNAM='TEST SIMULATION for Winter wheat 102'". This is the name of this test simulation that will appear on the WOFOST application.
- The lines defining "∑T" (line n° 31 and 32) can also be changed to specify the SUM1 and SUM2 constants. For our example, TSUM1=900 and TSUM2=950.

J Jext - WWH102new.CAB [Default]			
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	Plain Text 👻		
<pre>6 ** Regions: Ireland, central en southern UK (R72-R79),</pre>			
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<pre>File Edit Search Tools Plugins Jext File Edit Search Tools Plugins Jext File UMH102new.CAB 1** {Td: wwh102.cAB 1** {Td: wwh102.cAB 3** CROP DATA FILE for use with W0F0ST Version 5.4, June 1992 4** 6** WHEAT, WINTER 102 6** Regions: Iteland, central en southern UK (R72-R79), 7** Netherlands (not R47), northern Germany (R11-R14) 6** start date 1 January 9** meen date of flowering 10 Jun, mature 1-25 Aug 1** Calibrated for use in W0F0ST model at the Centre for Agrobiological 1** Purpose of application: Crop growth monitoring with agrometeorological 1** Purpose of application: Crop growth monitoring with agrometeorological 1** model in the EC. 1** Derived from SUCROSS7 data set for wheat. 1** Calibrated for use in W0F0ST model at the Centre for Agrobiological 1** hasis of daily weather data. 1** Purpose of application: Crop growth monitoring with agrometeorological 1** model in the EC. 1** Derived in the framework of JRC Agriculture Project Action 3. 1* CRPNAM=''TEST SIMULATION for Winter wheat 102' 1** temergence 2* TBASEM = -10.0</pre>			
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	ш — Ц		
41 LAIEM = 0.1365 ! leaf area index at emergence [ha ha-1]			
42 RGRLAT = 0.00817 ' maximum relative increase in LAT [ha ha-] d-1] DOS ▼ ◀	_		
14:71 - 32/148 - [DOS] - 21%			

• To run WOFOST with the new parameters, first we should delete all the RERUNS, and then, we can select the CROP "test Sim". In the end, we can launch the WOFOST application by clicking on the RUN button.

5.2.2. PART2: The CGMS.

CGMS is the implementation of WOFOST for a hall region. First, we started this presentation by looking at the development (growth) for a crop, by using the fint formula:

 $D = 1 - e^{(-0.6 * LAI)}$

CGMS manage three levels:

- a) Weather mapping: for all climatologically parameters (Tmax, Tmin...etc).
- **b) Crop simulation:** for crop, soil and the land use. All this parameters can be visualized in maps.
- c) Yield forecasting: for official harvested yields and other statistical tools. The result can also be visualized in maps.

d) CGMS mdb Database:

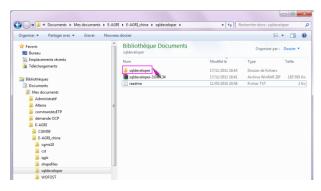
In CGMS, we transform the point model (WOFOST) into a regional one. The files are changed into tables in the CGMS database. It's a relational database containing:

- Base and derived tables and views.
- Different domains to control and manage extreme values for example.
- All table constraints.
- Other database specifications: Primary keys, procedures, indices for faster access to data.

5.2.2.1. SQL Developer 3.0.04

CGMS can use also an oracle database. Sql Developer can also be used to access to the oracle DB data's:

• First, we should unzip the file: **sqldeveloper-3.0.04.34.zip** in, for example, *C:\Users\hicham\Documents\E-AGRI\E-AGRI_chine\sqldeveloper*



• Then just start the program: sqldeveloper.exe

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A WOFOST	a readme	25/03/2011 14:59	Document HTML	24	
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🗼 Temp	view-source-paths.lis	18/03/2011 00:24	Fichier LIS	3	Ke

• Then, select all file types to associate to SQL Developer, and click on **OK** button.

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• This is the first interface of the Oracle SQL Developer:

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Connexions × BRapports ×	
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Connexions	

• Now, we can establish a connection to our mdb database:

Oracle SQL Developer	
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• We can test this connection, by clicking on **Test** button: if it works, we should have the status **success**:

Connexions ~	Créer / Sélectionne				tin,
i2, Connexions	Statut : succès	Détais de connexion		WOFOST Control Center/CGMS_ANPLILmeb	Prout
	Statut : succès	Enregistr	er Elfaçer	Tester Commexion	Annuler

• Now, we can connect to that database, and make a simple SQL query on it:

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Connexions ×	- Anhui mdb	connection ×					,		
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anhui mdb connection		* from METDATA;			_				
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TABLE GREGATION_AREAS	Résultat d								
. CALCULATED_WEATHER		· · · · · · · · · · · · · · · · · · ·							
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	2	1000 2000-01-01		(null)	5.9	0.82			
	3	1000 2000-01-02		(null)	3.35	1.88			
CROP_YIELD	4	1000 2000-01-03		(null)	3.29	1.00			
ia	5	1000 2000-01-05		(null)	3.13	1.05			
DATA_FOR_YIELD_FORECAST	6	1000 2000-01-06		(null)	6.92	0.46			
	7	1000 2000-01-07		(null)	6.65	0.49			
	8	1000 2000-01-08	00:00:00.0	(null)	3.27	0.82	-24.93	-12.74	0.09
	9	1000 2000-01-09	00:00:00.0	(null)	5.2	1.07	-18.85	-13.28	0.0
	10	1000 2000-01-10	00:00:00.0	(null)	1.81	1.02	-20.84	-8.37	0.37
	11	1000 2000-01-11		(null)	3.02	2.18			
EUROSTAT	12	1000 2000-01-12		(null)	3.78	1.25			
GRID GRID GRID_WEATHER	13	1000 2000-01-13		(null)	1.85	0.94			
	14	1000 2000-01-14		(null)	3.88	1.16			
	15	1000 2000-01-15		(null)	3.43	1.1			
INITIAL_SOIL_WATER	16	1000 2000-01-16		(null)	2.28	0.96			
Iong_term_average_grid_weather METDATA	17	1000 2000-01-17		(null)	3.44		-21.16		
	18	1000 2000-01-18		(null)	5.37	0.85			
I MUTS_YIELD	20	1000 2000-01-19 1000 2000-01-20		(null) (null)	4.93	0.74			
PARAMETER_DESCRIPTION	20	1000 2000-01-20		(null) (null)	2.66		-26.8		
	22	1000 2000-01-21		(null)	3.87		-15.61	-9.49	
	23	1000 2000-01-22		(null)	3.72	0.76			
	23	1000 2000-01-23		(null)	4.53	0.59			
	25	1000 2000-01-25		(null)	5.68	0.75			
	26	1000 2000-01-26		(null)	4.74	0.93			
	27	1000 2000-01-27		(null)	2.72	0.95			
	28	1000 2000-01-28		(null)	3.04	0.93			
	29	1000 2000-01-29	00:00:00.0	(null)	6.16	0.75	-24.56	-17.0	0.07
STAT_CROP	30	1000 2000-01-30	00:00:00.0	(null)	5.26	0.6	-26.75	-19.47	0.0
STATIONS_PER_GRID STATIONS_PER_GRID_CURRENTYEAR	31	1000 2000-01-31	00:00:00.0	(null)	3.81	0.65	-27.73	-16.9	0.0
STATIONS_PER_GRID_CORRENTTEAR STOP_AND_START_DAYS	32	1000 2000-02-01		(null)	3.54	0.71			
. SUITABILITY	33	1000 2000-02-02		(null)	4.22	0.78			
UPIT_CONSTANTS	34	1000 2000-02-03		(null)	3.64	0.81			
SUPIT_REFERENCE_STATIONS SYSCON	35	1000 2000-02-04		(null)	2.33	0.76			
VARIETY_PARAMETER_VALUE	36	1000 2000-02-05		(null)	2.94		-19.33		
WEATHER_DATA_AVAILABILITY	37	1000 2000-02-06		(null)	3.77	1.17			
WEATHER_STATION	38	1000 2000-02-07		(null)	5.8		-22.14		
	39 40	1000 2000-02-08			4.22	0.67	-26.7	-13.02	
GRID_WEATHER_SELECTION GRID_YIELD_SELECTION	40	1000 2000-02-09		(null) (null)	2.14		-22.5		

5.2.2.2. Cgms.exe v10

Cgms.exe is a quick launch for CGMS. It can be used just by double clicking on it:

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buleau		Bibliothèque Documents		Organiser par :	Dossier 🔻
Emplacements récents		Nom	Modifié le	Туре	Taille
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Mes documents		Ita_grid_weather	06/01/2011 17:05	Fichier SQL	10 1
Administratif		aggr_grid_yield	14/10/2010 22:14	Fichier SQL	12
Alterra	=	Get_CGMS_LogFiles_Level1	20/01/2009 00:05	Fichier de comma	1)
commandesETP					
🎉 demande OCP					
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E-AGRI_chine					

• This is the first page of CGMS:

Cop down monitoring system * balabase togin	User Information Usemame : Password : Please enter your usemame and password as required for the database. ODBC Settings Data Source : Please select the Data Source Name of the database.
	Suivant > Annuler Aide

• Let's make a connection to our database:

Crop Growth Monitoring System - Database Login Crop Growth Monitoring System - Database Login	User Information Usemane : Password : Please enter your usemame and password as required for the database. DDBC Settings Data Source : Source : Source : Source : Source Name of the database.
	Suivant > Annuler Aide

• This the first Crop Growth Monitoring System step:

Crop Growth Monitoring System - Execution Steps	
	What would you like to do ? C Weather data calculation C Crop simulation Aggregation Preparation of data yield forecast calculation Import external data to database Export data
< Précéde	ent Suivant > Annuler Aide

Many other tools were developed for the CGMS:

- Supiconstant.exe to make forecast of yield crops.
- CgmsStatTool.exe to make statistics on yields estimation.
- Scripts, procedures and packages...etc

To visualize the CGMS outputs, we can use ArcGis/FME/OGIS or Custom Build Viewer.

5.2.2.3. Weather monitoring

The first level of CGMS is to monitor climatologically weather data's. We can also evaluate abnormal or alarming situations climatologically. Other useful thing in CGMS is to manage drought, extreme temperatures, and extreme rainfall during flooding or harvest.

This weather data will serve later as input for the crop simulations, after a quality testing and checking of course before any later use. Other important functionality of CGMS is the generation of a complete spatial and temporal coverage for a hall region. It's also possible to make interpolation of the climatologically data's to the grid, and also, to make downscaling easily.

a) Observed weather data:

To run CGMS, we need this daily data's: Precipitation, Temperature (maximal and minimal), Radiation or sunshine, cloud cover, Vapor pressure or humidity (maximal and minimal), Wind speed and Snows.

For this observed data's, CGMS will calculate new weather data's such as:

- The radiation at the surface of the ground, by using one of the three formulas (Angstrom, Supit, or Hargreaves). The Supit method uses sunshine, Tmax, Tmin, Longitude and Latitude.
- The evaporation of water at the surface (EO) and the evaporation of wet bare soil (ESO);
- The evapo-transpiration by using Penman Montith methode for the daily ETO, or other one if the data are not complete.

b) Weather monitoring:

Initially, we use ECMWF forecasts and analyses data's that we downscaled to generate climate data's in the CGMS grid. Then, we can use GIS tools for visualization of this new data's.

The ms access database contains 25x25 km grid, with administrative regions and pseudo stations. The tables that are used for managing the observed data's are:

- GRID: CGMS uses Albert projection for gridded observed data's.
- WEATHER_STATION
- METDATA

These last three tables are important to run CGMS.

- SYSCON
- SUPIT_REFERENCE_STATIONS
- CROP
- CROP_GROUP
- STAT_GROUP
- STAT_CROP
- NUTS

c) Similarity score:

There are three groups of similarities: RAIN, TEMP and REST. To calculate scores, CGMS use's the average functionality by calculating for each grid point:

- The distance is calculated using weighting average with only four nearest observations.
- The distance to the coast.
- If there is any difference or same uniform region (EMU).
- Distance between grid and center of gravity of stations.

d) Output tables of CGMS:

- GRID_WEATHER
- STATIONS_PER_GRID
- STATIONS_PER_GRID_CURRENTYEAR
- LONG_TERM_AVERAGE_GRID_WEATHER
- SUPIT_REFERENCE_STATIONS

All these last five tables are very important, and contain constants that should be specified for Morocco.

- CGMS_SYSLOG
- SUPIT_CONSTANTS: contains all constants used, not only by SUPIT method, but by the entire system.
- CALCULATED_WEATHER: to calculate even statistical means or the 360 records per station.
- REFERENCE_WEATHER
- WEATHER_DATA_AVAILABILITY

5.3. Day 3: Friday, November 4nd

5.3.1. PART1: CGMS system for crop simulations

The GRID_WEATHER table is the most important table that contains observation data's from the table METDATA, and also the weather calculated from observations (radiation, ETO...etc) available in CALCULATED_WEATHER.

a) Input data:

The weather data observation's are of course important, and should be available at the database. Then, we need crop parameter files to be correctly modified and upgraded. The third input data is the soil map files that should also be carefully implemented in the different tables of the CGMS database. We need also to configure administrative regions and special schematization.

b) Crop parameters:

These parameters are described in different CGMS database tables:

- CROP_PARAMETER_VALUE: where the different crops are described and where to go if we would like to add a new variety of crops.
- PARAMETER_DESCRIPTION: to describe the crop growth.
- VARIETY_PARAMETER_VALUE: here we can specify crop varieties. For example, the parameters TSUM1 and TSUM3 are specified in this table for the winter wheat.
- CROP_CALENDAR: this table is dedicated to specify the crop calendars. Also, we can identify, in this table, which crop is growing in which cell zone.
- CROP_GROUP: here we can specify the suitability of soil and spatial/temporal variations.

c) Soil map:

Soil characteristics	Spatial distribution or STU's
• SOIL_TYPOLOGIE_UNIT (STU):	• SOIL_MAPPING_UNIT (SMU): to define
where we can define soil	the geographic regions mapping.
parameterizations.	• SOIL_ASSOCIATION_COMPOSITION:
ROOTING_DEPTH	to determine which STU is included in
SOIL_PHYSICAL_GROUP	which SMU.
• SUITABILITY: to define the	
suitable STU per CROP_GROUP.	
• SITE: this table is dedicated to	
define infiltration of soil.	

d) Administrative regions:

In CGMS, regions are hierarchically structured, by using Nuts and different levels (country, city, province...). This is important for the aggregation of crop yields in AGGREGATION_AREA table.

e) Spatial schematization:

WOFOST combine spatially the weather, the soil and the crop by using a unique intersection between SMU (grid table, soil map) and EMU.

For example, for the grid number (GRID_NO) 69163, we can see in SIMULATION_UNIT table that this number exist in the field GRID, and correspond to 5 values in the field STU_NO, which means that WOFOST has been running 5 times for that grid. Now, in the table ELEMENTARY_MAPPING_UNIT, we can find these SMU_NO values. The soil map table SOIL_ASSOCIATION_COMPOSITION contains also these SMU_NO's and STU_NO's. That's simply how we can associate spatially weather, soil and crop.

f) Output table:

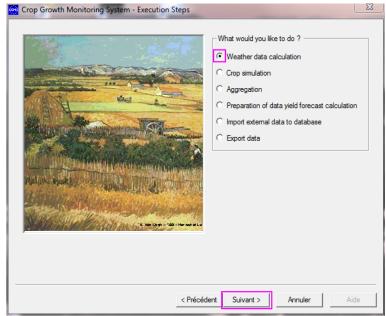
The output tables for CGMS are:

- INITIAL_SOIL_WATER
- CROP_YIELD
- GRID_YIELD
- NUTS_YIELD: for level 1(region), 2 and 3(country).

5.3.1.1. Crop simulation

5.3.1.1.1. Weather data calculation

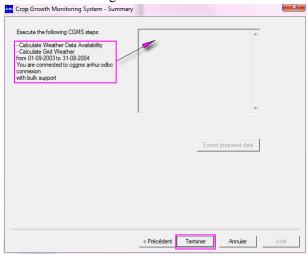
• Start by double clicking on **Cgms.exe**, then select **Weather data calculation**, and then on **Next** button.



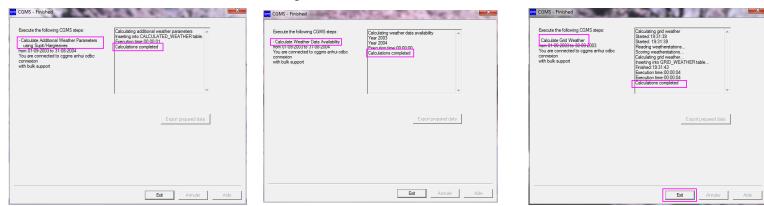
• Weather Data Calculation: Select the period from 1/9/2003 to 31/8/2004

Crop Growth Monitoring System - Settings Weather Data Calculation Period Day Month Year Start date 1 1 9 1 End date 31 8 2004 1 Image: Calculation Image: Calculation Image: Calculation Image: Calculation Image: Calculation Additional Weather Data Availability Image: Calculation Model Image: Calculation Image: Calculation Data Availability Image: Calculation Model Image: Calculation Model Image: Calculation Model Image: Calculation Data Availability Image: Calculation Model Image: Calculation Model Image: Calculation Model Image: Calculation Data Availability Image: Calculation Model Image: Calculation Model Image: Calculation Data Availability Image: Calculation Data Availability Image: Grid Weather Image: Calculation Data Availability Image: Calculation Data Availability Image: Calculation Data Availability Image: Calculation Data Availability Image: Calculation Data Availability Image: Calculation Data Availability Image: Calculation Data Availability Image: Calculation Data Availability Image: Calculation Data Availability
< Précédent Suivant > Annuler Aide

• Now, CGMS will calculate the weather data and the grid weather for that period. That takes few minutes. Don't forget to click on **Finish** to start running CGMS:

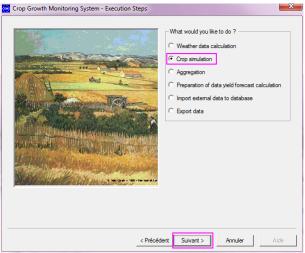


• If CGMS finish running this simulation, we should have this:



5.3.1.1.2. Crop simulation

• Start by double clicking on **Cgms.exe**, then select **Weather data calculation**, and then click on **Next** button.



• Crop Simulation: Choose Winter Wheat:

Vinter wheat	Administrative region of interest
Grain maize Rice_first sesaon	All available
Rice_second season	level 1
Soy bean Spring wheat	All available 💌
	level 2
	All available
	Simulation output
Select simulations	Use SQL Loader
Vertical Verterlimited	
]

• Additional options: just choose the start year and other specifications as below:

Campaign Start year: Number of campaign years:	 Ground Model w 	ISMeteoProvider.DLL Ind weather	
No initialisation Automatic, use all weather available prior to Fixed number of days prior to emergence Fixed date available in table INITIAL_SOIL.	1	groundwater influence	
Produce output for current year Start decade: 1 month: 9 End decade: 3 month: 12			
			-

• Now, CGMS will start a winter wheat simulation for that period. That takes few minutes. Don't forget to click on **Finish** to start running CGMS:

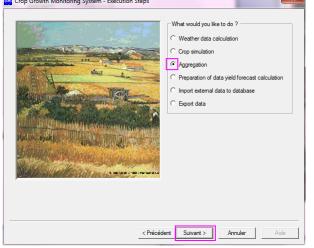
Execute the following CGMS steps:			*	
- Simulate Crop Growth for campaign year 2003				
Simulation is carried out for: - Winter wheat, starts in month 9				
You are connected to cggms anhui odbc connexion with bulk support				
			Ŧ	
		Export prepar	ed data	
	< Précédent	Terminer An	nuler	Aide

If CGMS is running, we should have this, just wait until it finished:
 CGMS - In progress...

Execute the following CGMS steps: - Simulate Crop Growth for campaign year 2003 Simulation is carried out for: - Winter wheat, starts in month 9 You are connected to cggms anhui odbc connexion with bulk support	Smulate crop growth Reading EMUs Preparing data for aggregation Reading SACs Creating indexes for SAC - Crog group of unique SMUs in EMU Peading STUs Reading STUs Reading SUI Cop Writer wheat stated: 19:12:31 Reading simulation units	
	Inserting into CROP_YIELD	
	Export prepared dat	a
	Please Wait Annuler	Aide

5.3.1.1.3. Aggregation

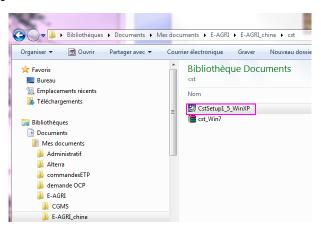
Start CGMS and select Aggregation. Then click on Next button.
 Crop Growth Monitoring System - Execution Steps



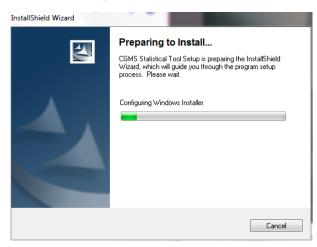
rop Growth Monitoring System	Settings
Aggregation	
- Schematization	
C Land cover (climate grid ce	I/SMU/land cover/admin. region)
Soil suitability (climate grid of a state	ell/SMU/admin. region)
Ca séallanal	Period
Spatial level	Start year End year
Administrative region	2003 - 2004 -
C Climate grid cells	
Select indicator	
 Simulated crop yield 	C Ground weather
C FAO	Model weather:
C NDVI	C Daily C 10-Daily
	< Précédent Suivant > Annuler Aide
	Checeden Suvan / Ander Alde
rop Growth Monitoring System	Summary
	Summary
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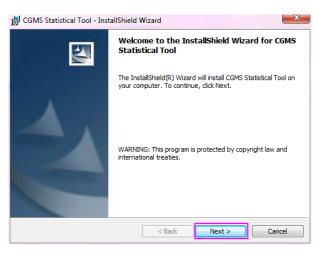
5.3.1.1.4. The CGMS Statistical Tool CST

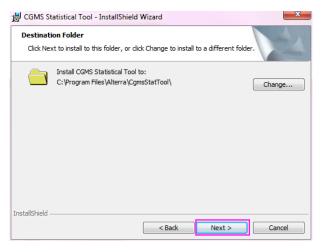
• First, we have to install the CST, by just double clicking on CstSetup1_5_WinXP.exe:



• Then, follow these few steps:







👸 CGMS St	atistical Tool - InstallShield Wizard	X
Ready to	Install the Program	с. 1
The wiza	rd is ready to begin installation.	
If you wa	ant to review or change any of your installation settings, click Back. Click Cancel wizard.	to
Current S	ettings:	
Setup T	/pe:	
	tion Folder: 'rogram Files\Alterra\CgmsStatTool\	
	ormation:	
	ormation: ie: user	
	npany: Hewlett-Packard Company	
nstallShield -		
	< Back Install Cancelland Canc	el
Installing	atistical Tool - InstallShield Wizard	23
The prog	gram features you selected are being installed.	-
1 7	Please wait while the InstallShield Wizard installs CGMS Statistical Tool. This may take several minutes.	
	Status:	
	Copying new files	
nstallShield -		
	< Back Next > Canc	el
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Remark: the next steps of CST are inspired from the presentation: The CGMS crop yield forecasting system. By: Steven Hoek & Allard de Wit.

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	0.0469		
5-2010			0.87
	0.0640		0.83
7-2010	0.0660		0.92
3-2010	0.1273		0.66
9-2010	0.1489		0.65
0-2010	0.1722		0.64
1-2010	0.2062		0.61
2-2010	0.3982		0.27
3-2010	0.3888		0.29
4-2010	0.4963		0.18
5-2010	0.5936		0.11
5-2010	0.6227		0.08
7-2010	0.4347		0.15
3-2010	0.5269		0.09
9-2010	0.3374		0.18
0-2010	0.2554		0.27
	-2010 • • • • • • • • • • • • • • • • • •	-2010 0.2062 -2010 0.3982 -2010 0.3883 -2010 0.4963 -2010 0.4963 -2010 0.4963 -2010 0.4963 -2010 0.4963 -2010 0.4347 -2010 0.5269 -2010 0.5374	-2010 0.2062 -2010 0.3982 -2010 0.388 -2010 0.4963 -2010 0.4963 -2010 0.4947 -2010 0.4347 -2010 0.5256 -2010 0.5356 -2010 0.5256 -2010 0.5256

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	Indicators	Options		Output	Model details
Time trend analysis	Available indicators:			Free indicators:	
Regression analysis	Indicator name:	Missing:		Indicator name:	Missing:
Scenario analysis		inteering.	>	01 Potential Above Ground Biomass 02 Potential Storage Organs 03 Water Limited Above Ground Biomass 04 Water Limited Storage Organs	0
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				Forced indicators:	
ea:	_			Indicator name:	Missing:
I Djazari Maghridiya Centre (005) Centre (010) Centre (013) Centre +North (003)			>		
	*		>>		
rop: vheat	ㅋ		<<		
	kPace		_	1	
	19'ace 5 234 mins 4.06 mins 4.29 hours			Correlation matrix	Next

• Then, we can choose indicators:

• Correlation with indicators:

Only display	correlations with	absolute valu	es greater tha	an:	0.2	Show correl	ation with year cor	rected for:	No trend
	yield	01	02	03	04	year			
yield	1.000								
01	-	1.000							
02	-	0.924	1.000						
03	0.265	0.741	0.696	1.000					
04	0.290	0.578	0.620	0.959	1.000				
year	0.333	-0.504	-0.554	-0,412	-0.395	1.000			

• Choose options for regression analysis:

🚔 🔛 🕨 🐗 🏨								
	Indicators	Options	Output			Model	details	
Time trend analysis Regression analysis	C Single free indicators	Ordering and Sign of regressio	on coeffici	ents:				
Regression analysis	 Best subset selection 					legative Unknown		
Scenario analysis			01 Potential Above Ground	0	0	۲	Free	
	Ordering of models:		02 Potential Storage Organs	0	õ	۲	Free	
	ordening or models.		03 Water Limited Above	Ó	ŏ) ()	Free	
		Root mean squared error for predict 💌	04 Water Limited Storage	6	0	0	Free	
A REAL	Highlight indicators with	incorrect sign	05	0	0	۲		
C BALL O	 Highlight terms which a 	-	06	0	Ö	۲		
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	Summary statistics to displa	9 R-squared	08	0	0	۲		
	(max. 4)	Adjusted R-squared Mallows Cp	09	0	0	۲		
e		Residual standard deviation	10	\odot	0	۲		
\odot		Residual degrees of freedom Root mean squared error for prediction	11		0	۲		
wea:		Prediction for target year	12	\odot	0	۲		
al Djazair		Standard error of prediction for mean Standard error of prediction	13		0	۲		
al-Maghribiya Centre (005)		Maximum VIF of indicators						
Centre (010) Centre (013) Centre-North (003) +	Only display models with							
wheat	Maximum number of free inc	dicators in each modet 🛛 🗍 🖨						
Period: WorkPace				п	\wedge			
J F.M.A.M. J J A.S. 2 2 2 □ C C C C C C C C C 0 1344 □ C C C C C C C C C 0 1344 □ C C C C C C C C C 0 1344 □ C C C C C C C C C 0 337 Ⅲ C C C C C C C C C 2 428 ■ Retieve Anal > 160 k	simum number of best m nins nours	odels in each subset. 5 文		₽	T		Next	

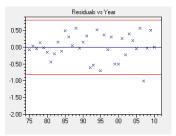
• Select the best model:

File View Iools Help											
	Indicators		Options			Output			Model details		
Time trend analysis Regression analysis											
		Model							t-values		
Scenario analysis		consists of linear trend (for and free:	rced) R-square	d Residual standard deviation	Root mean squared error for prediction	Standard error of prediction	01	02	03	04	linear term
	0	none	11.1	2 0.45	0.46	0.47		-	-	-	2.063
the second secon	۲	+04	32.1	.7 0.40	0.41	0.42	-	-	-	3.200	3.400
	\odot	+03	30.5	i6 0.40	0.41	0.43	-	-	3.039	-	3.346
	\odot	+01	13.2	9 0.45	0.46	0.47	0.909		-	-	2.235
	\odot	+02	13.0	2 0.45	0.47	0.48	-	0.849	-	-	2.180
	0	+01+03	34.8	0 0.39	0.41	0.42	-1.442		3.249	-	2.748
Ě	0	+01+04	32.8	4 0.40	0.42	0.42	-0.565		-	3.052	2.921
ö	0	+02+03	33.4	7 0.40	0.42	0.43		-1.184	3.136	-	2.587
	0	+02+04	33.6	4 0.40	0.42	0.43	-	-0.842	-	3.153	2.695
Area:	0	+03+04	32.1	9 0.40	0.42	0.43		-	0.096	0.877	3.333
al-Maghribiya	\odot	+01+03+04	34.9	3 0.40	0.43	0.44	-1.142		0.997	-0.249	2.469
Centre (005) Centre (010)	\odot	+01+02+03	34.8	0 0.40	0.43	0.44	-0.794	-0.004	3.197	-	2.605
Centre (013)	\odot	+02+03+04	34.2	3 0.40	0.43	0.44	-	-0.979	0.525	0.596	2.610
Centre-North (003) -	0	+01+02+04	33.8	5 0.40	0.43	0.44	0.311	-0.687		3,103	2.647
		+01+02+03+04	35.8	2 0.40	0.44	0.45	-0.863	0.645	0.960	-0.690	2.328
Crop: wheat	0								0.960		
Period:		Secure all the second of the second	arend: wrong :	im	not significa	~	oth not go	bo			
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• Analyze the model details:

CGMS Statistical Tool	name income tax. Name 1	Spot Anapire		
<u>File View Tools H</u> elp				
🖻 🖬 🕨 🗳 🏚				
	Indicators	Options	Output	Model details
Time trend analysis				
Regression analysis	Description of model			
Scenario analysis	NUTS area	al-Maghribiya		=
	Crop	wheat		
	Decade		13	
() () () () () () () () () ()	Included years		36	
	Start Year		1975	
	End Year		2010	
	Target Year		2011	
	Transformation of years	None		
Area	Offset for years		1965.00	
al Djazair	Excluded years	-		
Centre (005) Centre (010)	Timetrend	Linear		
Centre (013) Centre-North (003)	Included indicators	04 Water Limited Stora Organs	ge	
wheat	Summary Statistics			
	R-squared		32.171	
	1		I	

• Analysis of residuals, Correct model by excluding one/more year(s), Build and Evaluate the final model:



luts area:	al-Maghribiya	ded for the set	ecteu alea, c	iop and deca	De	cade:	or particular years by unchecking the boxes on the left. 13
Crop:	wheat				Inc	luded years:	1975-2010
Included	Year	Official Yield	01 Potential Above Ground	02 Potential Storage Organs	03 Water Limited Above Ground	04 Water Limited Storage Organs	
V	1985	1.245	14920.531	9134.584	10806.201	5484.217	
V	1986	1.714	17026.259	10640.808	15565.651	9187.613	
V	1987	1.061	15212.344	9532.204	12320.478	6692.539	
V	1988	1.735	16502.842	10088.439	13894.148	7559.507	
V	1989	1.493	16796.405	10586.994	15599.219	9459.105	
V	1990	1.329	16246.237	10189.433	13056.819	7248.636	
V	1991	1.87	16550.871	9907.813	15943.374	9311.368	
V	1992	0.701	15900.447	9815.308	13639.695	7795.959	
V	1993	0.681	16298.023	9771.948	13561.638	7092.953	
V	1994	1.811	17058.591	10429.724	13952.8	7398.674	
V	1995	0.554	15079.549	9151.605	12862.273	7064.661	
V	1996	1.842	14398.321	8924.108	13661.818	8188.561	
V	1997	0.929	14372.021	8828.763	10571.652	5227.735	
V	1998	1.418	14118.485	8913.758	10909.033	5801.088	
V	1999	0.8	16933.929	9948.879	13718.114	6785.323	
V	2000	0.476	15657.947	9805.458	10189.12	4713.456	
V	2001	1.228	15499.512	9386.249	10419.356	4527.789	
V	2002	1.279	15082.262	9306.406	13045.378	7613.847	
	2003	1.889	15674.579	9401.927	13396.972	7328.762	
~	2004	1.808	16006.143	10007.524	13783.501	7932.272	
V	2005	1.026	13525.18	7844.968	10050.957	4521.814	
V	2006	2.036	15908.949	9085.464	13513.279	6751.647	
	2007	0.615	15932.346	10166.587	13162.264	7547.81	
V	2008	1.329	14662.399	9205.703	11179.314	5871.278	
V	2009	2.14	16042.875	9862.958	13469.521	7367.78	
V	2010	1.71	13303.72	8367.646	12615.822	7681.175	
Target	2011	*	15054.422	8757.636	13114.903	6944.363	

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	Indicators	Options	Output	Model details
ime trend analysis	Description of m	- 4-1		-
egression analysis	NUTS area			
Scenario analysis		al-Maghribiya		
	Crop	wheat		
	Decade		13	
			35	
	Start Year		1975	
	End Year		2010	
	Target Year		2011	
	 Transformation o years 	f None		
ea:	Offset for years		1965.00	
Djazair	 Excluded years 	2007		
Maghribiya Centre (005)	Timetrend	Linear		
Centre (010) Centre (013) Centre-North (003)	- Included indicato	rs 04 Water Limited Sto Organs	orage	
op: 	Summary Statist	ics		
J F M. A M J J A S O N C C	R-squared		44.018	

		127		-				х
Indicators Options			Output			Model details		
Summer Statistics								^
			44.010	1				
· ·								
Residual Standard deviation			0.356					
Root mean squared error for prediction			0.364					Е
Mallows Cp			0.872					
Maximum of VIF			1.207					
Prediction for target year			1.736					
Standard Error of Prediction (Mean)			0.131					
Standard Error of Prediction (New)			0.379					
Residual Degrees of F	32.000							
				1				
Regression coefficien	its							
Parameter		estimate	s.e.	tvalue	t pr.	vif		
Constant		-0.887	0.451	-1.966	0.06	*		
Timetrend linear		0.029	6.45E-003	4.452	9.68E-005	1.21		
04 Water Limited Stor	age Organs	1.87E-004	4.75E-005	3.947	4.07E-004	1.21		
<u> </u>								-
	Summary Statistics R-squared Adjusted R-squared Root mean squared er Mallows Cp Maximum of VIF Prediction for target y Standard Error of Pre- Standard Error of Pre- Standard Error of Pre- Residual Degrees of F Regression coefficien Parameter Constant Timetrend linear	Summary Statistics R-squared Adjusted R-squared Residual Standard deviation Root mean squared error for pred Mallows Cp Maximum of VIF Prediction for target year Standard Error of Prediction (Mee Standard Error of Prediction (Mee Standard Error of Prediction (Mee Residual Degrees of Freedom Regression coefficients Parameter Constant Timetrend linear	Summary Statistics R-squared Adjusted R-squared Rosidual Standard deviation Root mean squared error for prediction Mallows Cp Maximum of VIF Prediction for target year Standard Error of Prediction (Mean) Standard Error of Prediction (New) Residual Degrees of Freedom Regression coefficients Parameter Constant -0.887 Timetrend linear	Summary Statistics R-squared 44.018 Adjusted R-squared 40.519 Residual Standard deviation 0.356 Root mean squared error for prediction 0.364 Mallows Cp 0.872 Maximum of VIF 1.207 Prediction for target year 1.736 Standard Error of Prediction (Mean) 0.313 Standard Error of Prediction (New) 0.379 Residual Degrees of Freedom 32.000 Regression coefficients Parameter Constant -0.887 0.4615 Timetrend linear 0.020 6.45E-003	Summary Statistics R-squared 44.018 Adjusted R-squared 40.519 Residual Standard deviation 0.356 Root mean squared error for prediction 0.364 Mallows Cp 0.872 Maximum of VIF 1.207 Prediction for target year 1.736 Standard Error of Prediction (New) 0.379 Residual Degrees of Freedom 32.000 Regression coefficients Parameter Constant -0.887 0.451 Constant 0.029 6.45E-003 4.452	Summary Statistics R-squared 44.018 Adjusted R-squared 40.519 Residual Standard deviation 0.356 Root mean squared error for prediction 0.364 Mallows Cp 0.872 Maximum of VIF 1.207 Prediction for target year 1.736 Standard Error of Prediction (Mean) 0.131 Standard Error of Prediction (New) 0.379 Residual Degrees of Freedom 32.000 Regression coefficients Parameter Parameter estimate s.e. tralue t pr. Constant -0.887 0.451 -1.966 0.06 Timetrend linear 0.029 6.452-003 4.452 9.68E-005	Summary Statistics R-squared 44.018 Adjusted R-squared 40.519 Residual Standard deviation 0.356 Root mean squared error for prediction 0.364 Mallows Cp 0.872 Maximum of VIF 1.207 Prediction for target year 1.736 Standard Error of Prediction (Mean) 0.131 Standard Error of Prediction (New) 0.379 Residual Degrees of Freedom 32.000 Regression coefficients Parameter estimate Parameter estimate s.e. trpt. vf Constant -0.887 0.451 -1.966 0.06 *	Indextors Options Output Model details Summary Statistics Resquared 44.018 Adjusted R-squared 40.519 Resequared Root mean squared error for prediction 0.356 Root mean squared error for prediction 0.364 Mallows Cp 0.8572 Rost mean squared error of prediction (Nean) 0.131 Standard Error of Prediction (New) 0.379 Residual Degrees of Freedom 32.000 Regression coefficients Parameter estimate s.e. t/t/t = 1.206 0.06 * Constant -0.887 0.451 -1.966 0.06 * Timetrend linear 0.029 6.45E-003 1.21

5.3.2. PART 2: Inventory of usability of CGMS for

Morocco

5.3.2.1. Inventory of available data sources and their suitability for applying CGMS

5.3.2.1.1. Meteorological available data's

- Locations of meteo stations and attributes:
 - Data from 42 stations of all the Moroccan Meteorological Agency can deliver daily data.
- List of available meteo variables:
 - o TMAX
 - o TMIN
 - o RAIN
 - $\circ\quad$ WIND (to precise which one: Daily Mean or Maxi or Mini)
 - Humidity Maxi and Mini
 - SUNSHINE
- Archive of daily meteo data for the period 1990-2010:
 - Archive data can be retrieved from the Oracle meteorological database of the MMA (Moroccan Meteorological Agency).
 - MMA will grant the use of interpolated observation data's product for Moroccan grid cells (resolution: 25x25 km).
- Regular updates of the meteo data : 10-daily may be possible (to be confirmed later):
 - It's possible that daily data will become available in MMA during the project. At least with a 1 month delay.
- Classical interpolation approach OR AURELHY approach (only 10-daily temp, rain):
 - o Classical CMGS interpolation immediately.
 - AURELHY method will be used in a second level to compare with.

5.3.2.1.2. Setup a database system

- ORACLE (well-tested but expensive & complicated):
 - Oracle 8i is available. We have a good experience with Oracle 9i and 10g, but not installed yet.
 - \circ $\;$ OS: Microsoft Windows Server 2008 Service Pack 2, Standard
 - HW: IBM Server, Raid5.

5.3.2.1.3. Inventory of factors explaining

regional yield variability in Morocco:

irrigation, fertilizer, disease, heat damage

• To be done by INRA

5.3.2.1.4. Inventory of technical constraints

• MMA: no technical constraints.

5.4. Conclusion and perspectives