Crop monitoring as an E-agriculture tool in developing countries (E-AGRI)

FP7 STREP Project (GA 270351)

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E-AGRI (content)

- Background (what)
- Objectives (how far)
- Study areas (where)
- Partnership (who)
- State of the art (how)
- Structure and Planning

E-AGRI :Background

Agriculture: one of the principal shares of EU's competency (60 over 130 billion EUR):

- **Within 27 member states: to implement its CAP**

- **Global market**: to strengthen the competitive position of European agriculture
  - How to feed 7 billion people (food security)
  - How to deal with surging agricultural commodity prices (trade)

E-AGRI: General objectives

- Transfer and adaptation of European agricultural monitoring technology in developing countries (DEMONSTRATION)
- Establishing networks of users on the crop monitoring technology (DISSEMINATION)
- Providing the feedback and improvement for European expertise and know-how (ADDED VALUES for EU)
- Creating synergy with other European crop monitoring actions (MARS-Food, GMFS…) (MORE COLLABORATION)

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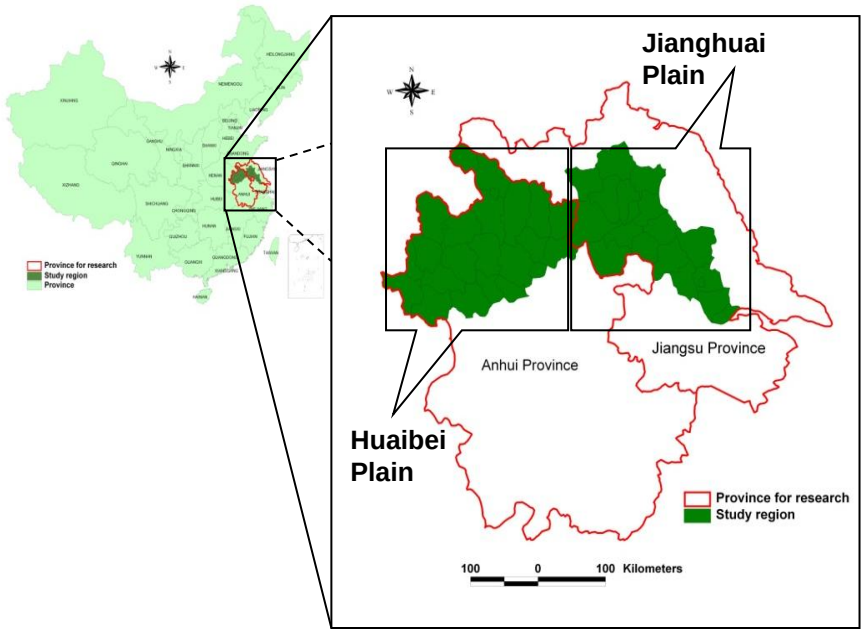
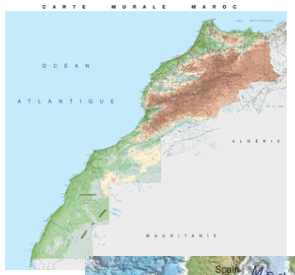
E-AGRI: 3 study areas

HuaiBei (Anhui) and Jianghuai (Jiangsu) Plains



Morocco



Kenya

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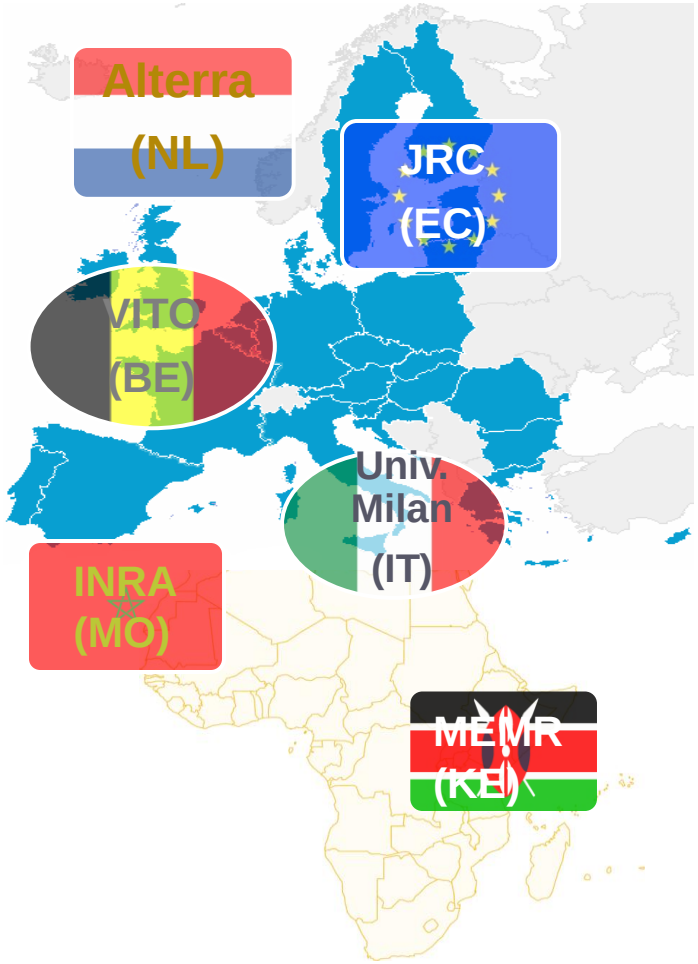
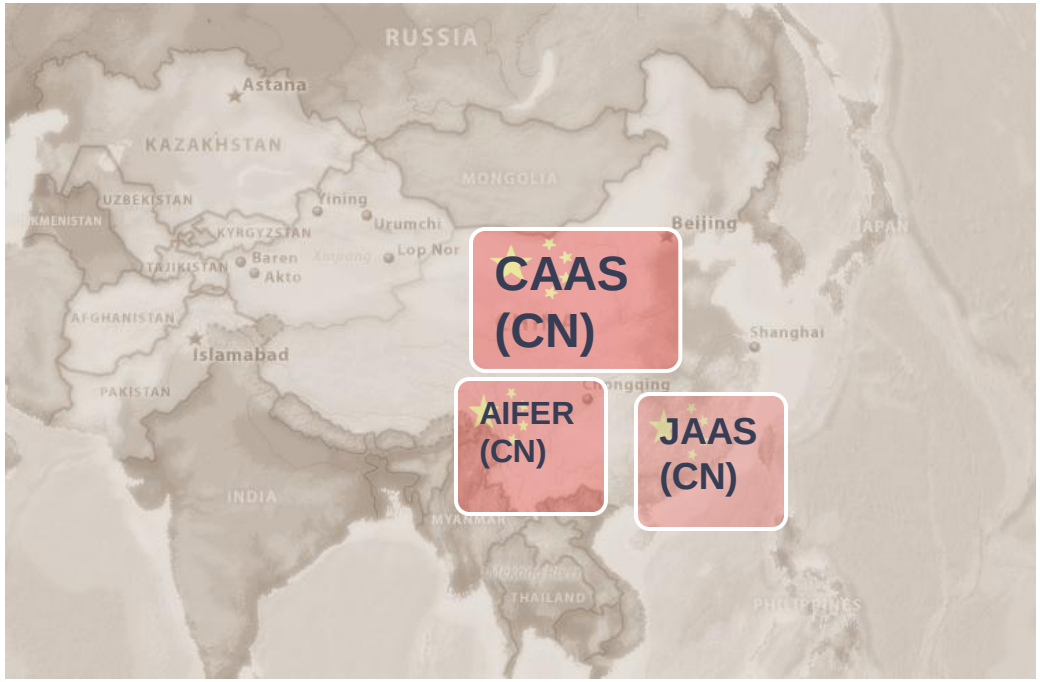
E-AGRI: 9 partner organizations





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Approaches from 3 different angles

Total production (t or Mio t)

Yield estimates (t/ha)

- Agro-meteorological modelling
- Assimilation by remote sensing

Acreage (ha)

- Remote sensing

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E-AGRI: Specific objectives

- Implementing CGMS approach targeting wheat *(Alterra)*
- Monitoring Using BioMA approach (UMI& JRC)
- Wheat yield estimation Using RS for
- Acreage assessment
- Statistic Integration (Alterra)
- Capacity building (Kenya) and international networking (VITO & DRSRS)

→ Anhui (AIFER)

→ Morocco (INRA)

→ targeting wheat in Morocco (INRA)

→ targeting rice in Jiangsu (JAAS)

→ Anhui (VITO & AIFER)

→ Morocco (INRA & VITO)

→ Anhui (CAAS &VITO)

→ Morocco (INRA&CAAS)

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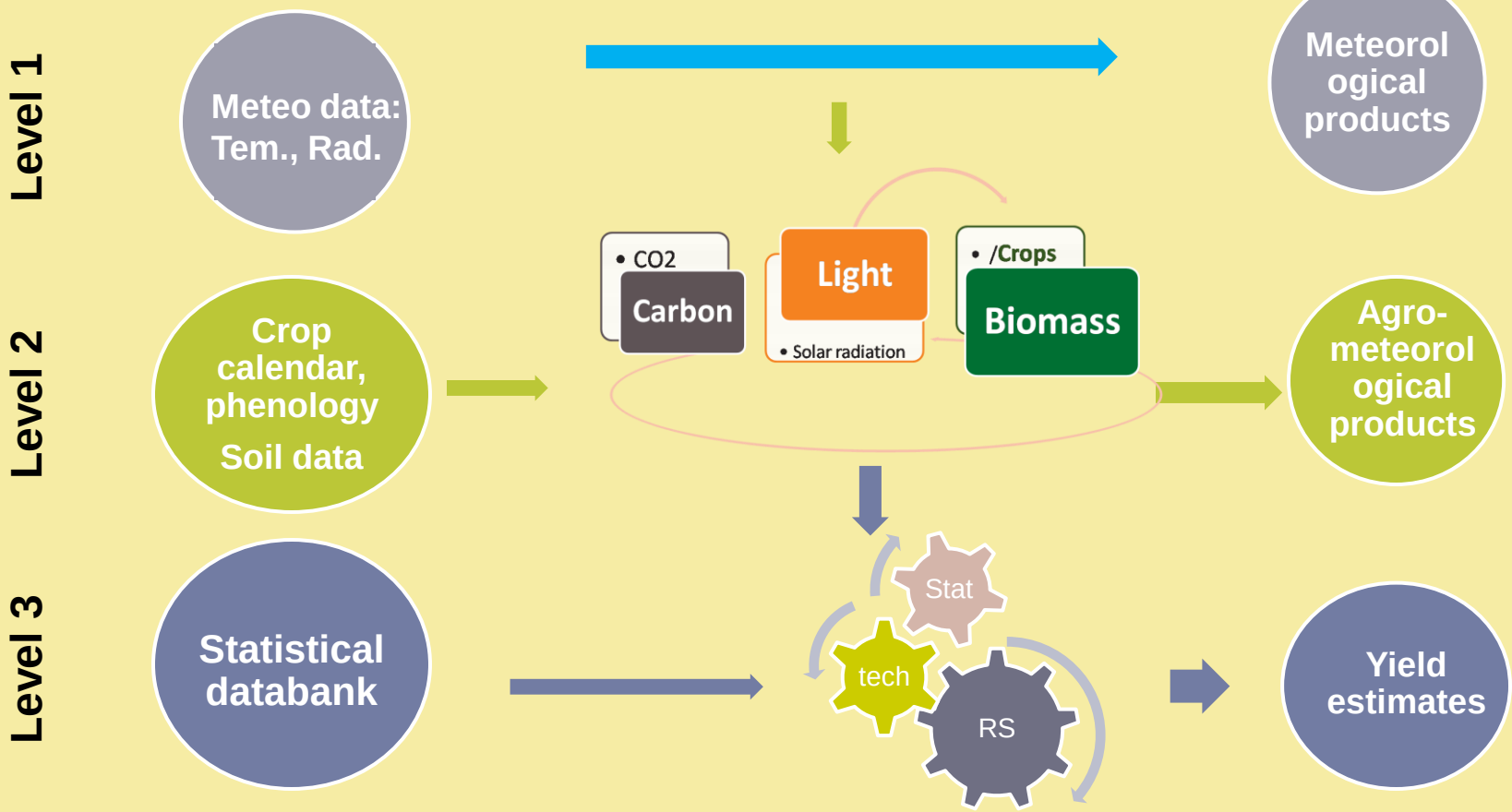
Methodology: Yield estimation:
Agro-meteorological modelling - CGMS



Methodology: Yield estimation:
Agro-meteorological modelling - CGMS

	Actors partners	Ground data	research	Main Output Deliverables	dissemination
CGMS	SDLO (NL) INRA (MO) AIFER (CN)	Crop calendar Crop mask Meteo INRA (MO) AIFER (CN)	Identifying local crop growth drivers Adapted crop parameters Meteo data interpolation	Regional statistic databases Adapted CGMS models	Training workshop Piloting demo.

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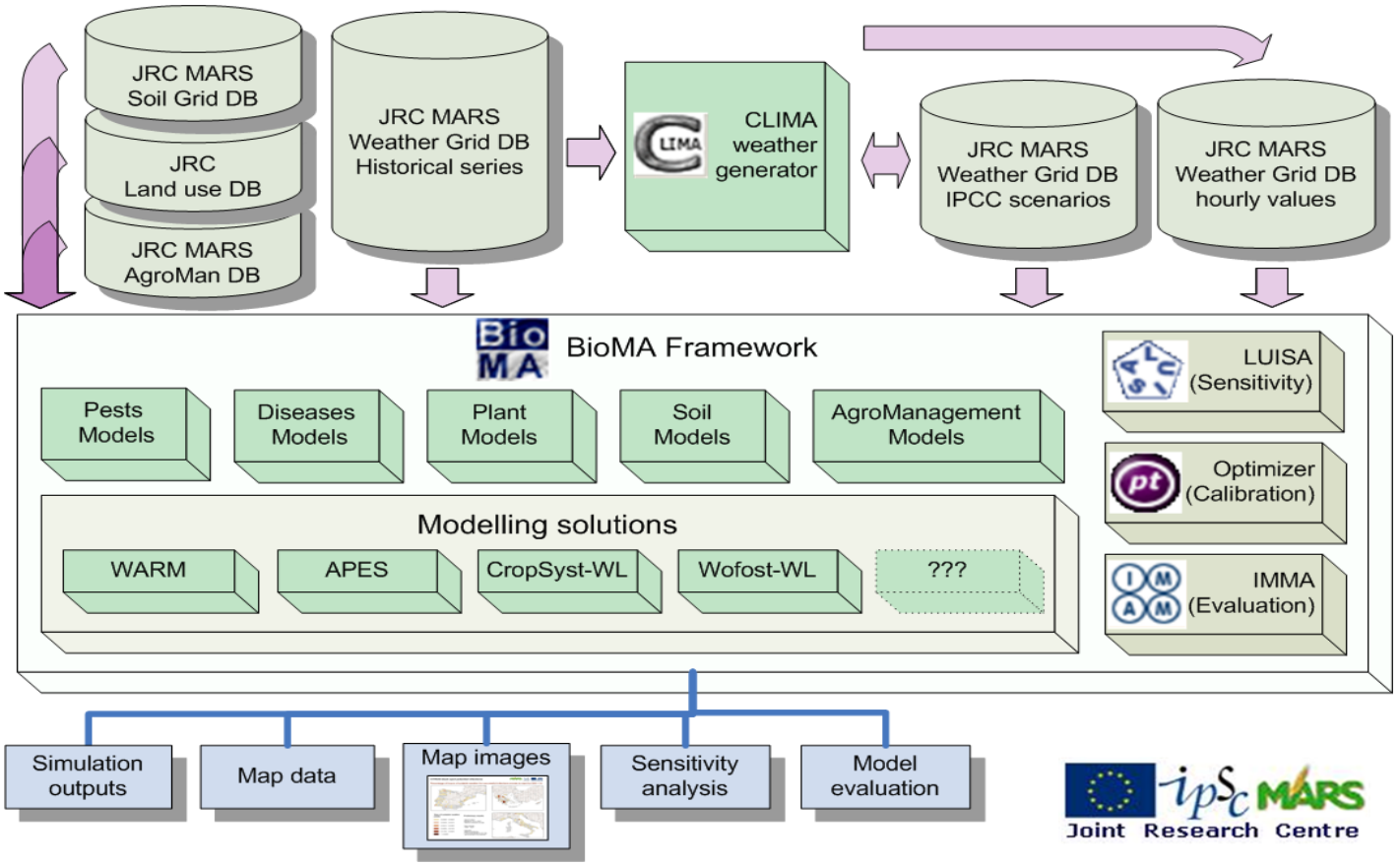
Methodology: Yield estimation:
Agro-meteorological modelling - BioMA



ipsc MARS
Joint Research Centre

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Methodology: Yield estimation:
Agro-meteorological modelling - BioMA

	Actors partners	Ground data	research	Main Output Deliverables	dissemination
BioMA	**UMI** JRC INRA JAAS	Crop calendre; Phenological parameters of cultivars	Spatially distribited sensitivity analysis; Calibration of rice /wheat parameters	Database for model parameters Multi-model platforms for rice/wheat simulation User guide for local crop monitoring application	Training workshop Pilot demo (field and regional scales)

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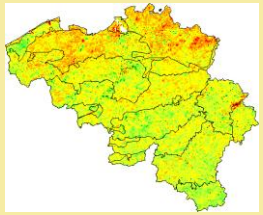
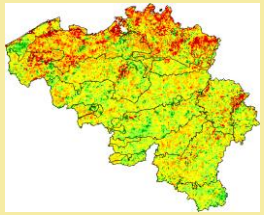
Methodology: Yield estimation
Remote sensing – LoRes Imagery

Product P (Segment)

S10 (Ten daily synthesis)

SPOT-VEGETATION
Spatial:1°/112 resolution (+/- 1km)
Time series: Since 1998
Derived vegetation/crop indices:
NDVI, fAPAR, DMP…





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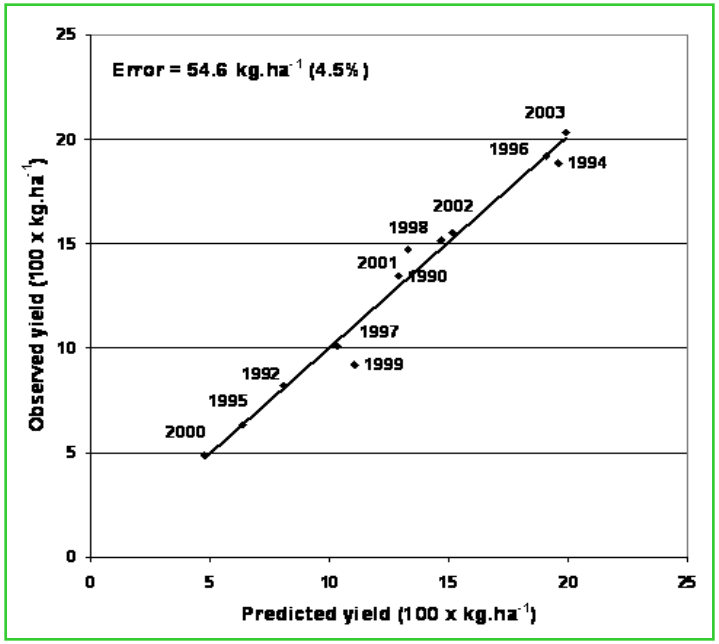
Methodology: Yield estimation Using RS vegetation indicators

Wheat (Morocco) – using vegetation indicators

Province	ΣNDVI	Rainfall		Temperat.	df	R^2	R_p^2
Safi	-11.053 + 3.137 ΣNDVI (79)	+ 0.058 s1o2 (7)	+ 0.052 f1a2 (10)		10	97***	92***
El Jadida	-1.781 + 3.579 ΣNDVI (78)	+ 0.011 o3j3 (12)			10	90***	82***
Fes	-12.196 + 3.140 ΣNDVI (76)	+ 0.095 n1d1 (18)	+ 0.028 j3a1 (3)		10	97***	93***
Khouribga	-8.539 + 2.400 ΣNDVI (74)	+ 0.034 n3d2 (4)	+ 0.028 j3a3 (20)		11	97***	92***
Kenitra	-27.561 + 7.992 ΣNDVI (74)	+ 0.127 m3a1 (11)	+ 0.564 y2y3 (8)		10	93***	86***
Essaouira	-6.812 + 3.074 ΣNDVI (73)	+ 0.014 j3a3 (12)			11	85***	80***
Taza	6.276 + 4.096 ΣNDVI (69)	+ 0.029 n3d3 (20)		- 1.186 t04 (6)	11	96***	90***
Meknès	15.790 + 5.886 ΣNDVI (67)	+ 0.170 y2y3 (26)		- 1.995 t03t04 (5)	11	98***	94***
Settat	-5.096 + 1.359 ΣNDVI (66)	+ 0.064 o3n2 (7)	+ 0.076 j1m3 (24)		10	97***	91***
Casablanca	-13.319 + 5.667 ΣNDVI (65)	+ 0.054 j3f2 (12)			11	78**	62**
Nador	-8.029 + 4.988 ΣNDVI (62)	+ 0.077 a1a2 (18)			11	80***	51**
Rabat	-30.560 + 7.213 ΣNDVI (42)	+ 0.065 n2n3 (14)	+ 0.158 m2a2 (32)		11	88***	38*



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Methodology: Yield estimation:
Yield forecasting using remote sensing

	Actors partners	Ground data	Research	Main Output Deliverables	Dissemination
Yield forecast using RS	VITO INRA AIFER	Official Statistics Time series of vegetation indicators	Best indictors or combination of indicators for assimilating the cereal yields in the target regions	Best regression models for forecasting the cereal yields in two regions.	Training Worshop Exchange of experts Bulltins

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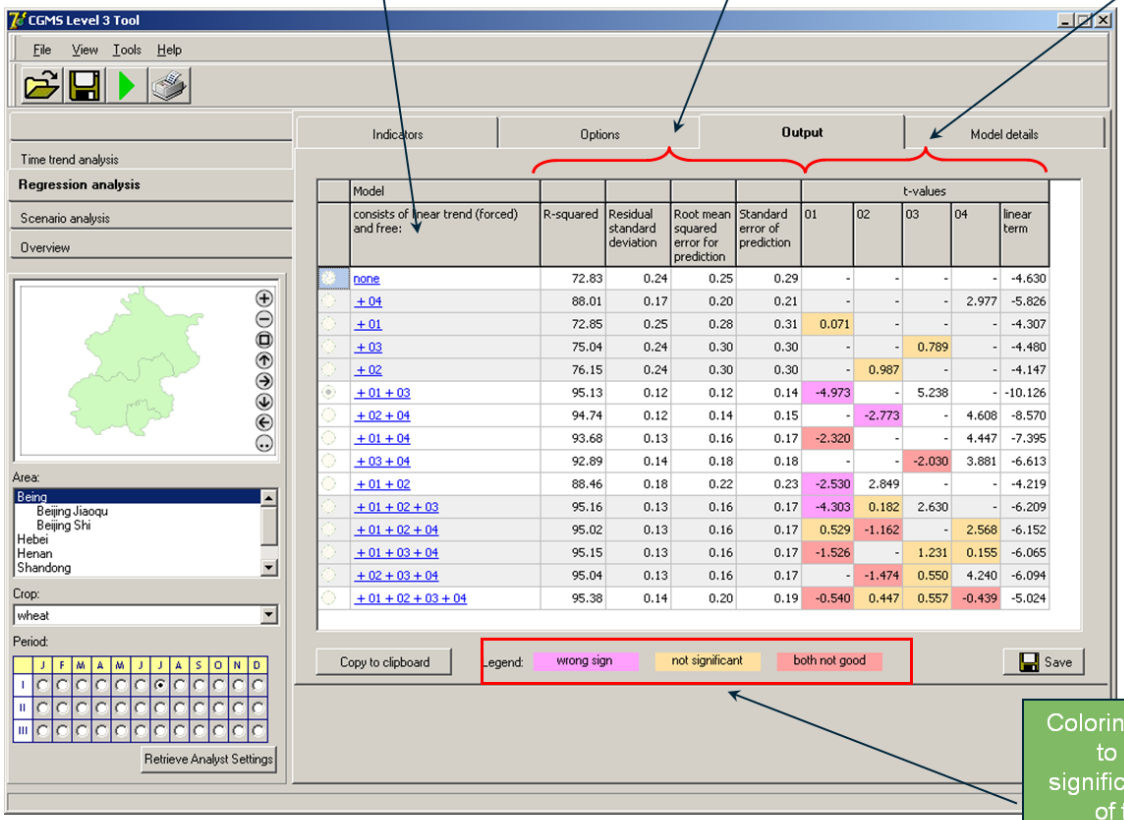
E-AGRI: Statistic Integration

Lists the models that were analyzed

Lists the statistical indicators of each model

Lists the t-values of each component in each model (significance testing)



Model consists of linear trend (forced) and free:	R-squared	Residual standard deviation	Root mean squared error for prediction	Standard error of prediction	t-values 01	02	03	04	linear term
none	72.83	0.24	0.25	0.29	-	-	-	-	-4.630
+ 04	88.01	0.17	0.20	0.21	-	-	-	2.977	-5.826
+ 01	72.85	0.25	0.28	0.31	0.071	-	-	-	-4.307
+ 03	75.04	0.24	0.30	0.30	-	-	0.789	-	-4.480
+ 02	76.15	0.24	0.30	0.30	-	0.987	-	-	-4.147
+ 01 + 03	95.13	0.12	0.12	0.14	-4.973	-	5.238	-	-10.126
+ 02 + 04	94.74	0.12	0.14	0.15	-	-2.773	-	4.608	-8.570
+ 01 + 04	93.68	0.13	0.16	0.17	-2.320	-	-	4.447	-7.395
+ 03 + 04	92.89	0.14	0.18	0.18	-	-	-2.030	3.881	-6.613
+ 01 + 02	88.46	0.18	0.22	0.23	-2.530	2.849	-	-	-4.219
+ 01 + 02 + 03	95.16	0.13	0.16	0.17	-4.303	0.182	2.630	-	-6.209
+ 01 + 02 + 04	95.02	0.13	0.16	0.17	0.529	-1.162	-	2.568	-6.152
+ 01 + 03 + 04	95.15	0.13	0.16	0.17	-1.526	-	1.231	0.155	-6.065
+ 02 + 03 + 04	95.04	0.13	0.16	0.17	-	-1.474	0.550	4.240	-6.094
+ 01 + 02 + 03 + 04	95.38	0.14	0.20	0.19	-0.540	0.447	0.557	-0.439	-5.024

Coloring of according to statistical significance and sign of the model coefficient

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Methodology: Yield estimation:
Statistic Tool-box

	Actors partners	Ground data	Research	Main Output Deliverables	Dissemination
Statistical integration for E-Agriculture service	SDLO INRA	Official Statistics	time trend analyses, (multiple) regression analyses and scenario analyses Efficiency of models relative to the trend only Hypothesis testing for determining significance of results	Statistic toolbox	Demo Workshop Training sessions

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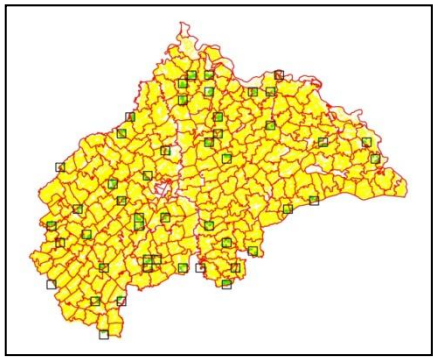
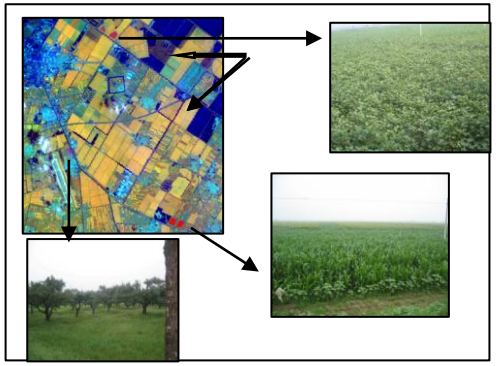
Methodology: *Area estimation*
Ground surveys + Remote sensing

Sampling design



Ground survey



Stratified Area Frame Sampling

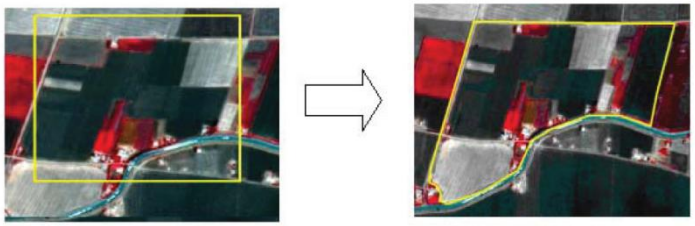
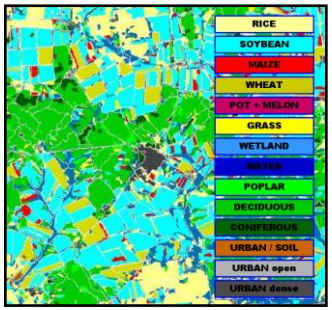


Image classification



Acreage estimation = Area frame estimator + image classification estimator

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Methodology: Area estimation

COUNTY	FUYUAN	TON-JIANG	SUIBIN	FUJIN	RAOHE	YOUYI	TOTAL
SOYBEAN	23.90	33.17	36.53	39.96	17.79	17.77	28.85
MAIZE	0.75	1.44	5.07	0.90	0.83	0.00	1.22
WHEAT	1.83	3.36	2.66	4.45	3.26	15.41	3.50
MELON	1.03	1.69	1.22	5.77	0.53	3.42	3.00
POTATO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RICE	17.77	28.24	29.04	32.39	27.77	58.08	28.18
WETLAND	48.45	19.60	2.83	9.24	13.82	1.14	19.21
WATER	0.00	0.52	5.31	0.01	0.00	0.00	0.93
GRASS	0.62	0.52	0.03	0.35	1.16	0.00	0.53
POPLAR	0.30	0.67	0.13	1.03	1.74	0.24	0.88
DECI. FOR.	1.19	6.18	1.70	1.47	20.98	0.01	6.71
PINE	0.01	0.13	0.28	0.14	0.12	0.00	0.15
CONI. FOR.	2.48	0.54	1.51	0.81	9.99	0.08	2.73
URB open	0.56	1.18	2.39	1.32	0.53	0.22	1.15
URB+SOIL	0.38	0.79	6.09	1.03	0.84	1.72	1.43
URB dense	0.71	1.96	5.20	1.14	0.62	1.89	1.54
TOTAL %	100.00	100.00	100.00	100.00	100.00	100.00	100.00
km² - CLAS	1040	5357	1010	6337	3703	155	
km² - CTY	6238	6074	3332	8068	6338	1663	
km² %	17	88	30	79	58	9	

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Methodology: Yield estimation:
Crop Area Estimation

	Actors partners	Ground data	Research	Main Output Deliverables	Dissemination
Area estimation using smapling technique and RS	CAAS VITO AIFER INRA	Official Statistics Ground samples	Most accurate statistic models for each target region. The most cost-efficient way in sampling and using remote sensing estimators.	Field sample databases Validation with official statisticas	Training Workshop

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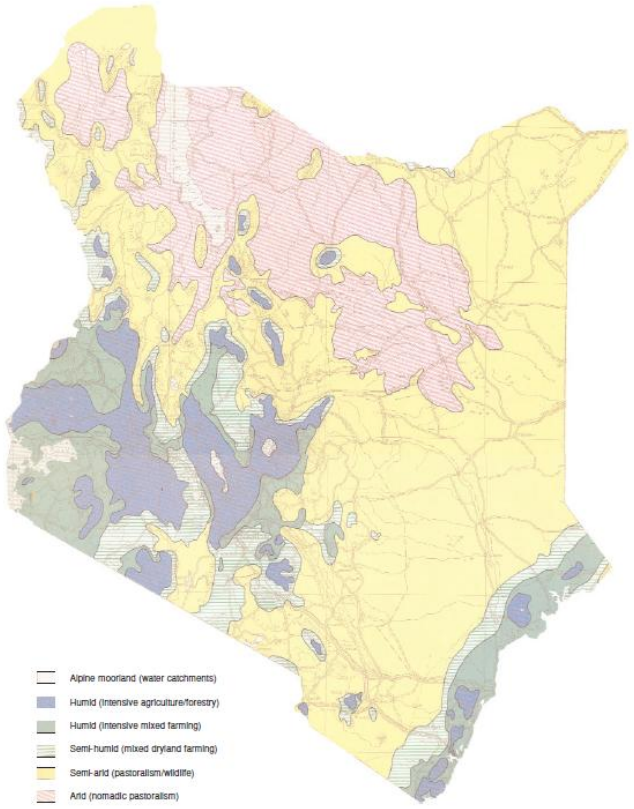
E-AGRI: Capacity building in Kenya

Capacity building for a third developing country: Kenya
In collaboration with other projects



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Capacity building in Kenya

	Actors partners	Ground data	Research	Main Output Deliverables	Dissemination
Networking and capacity building – targeted country: Kenya	MEMR VITO INRA JRC		Applicability of yield estimation using RS indicators Improving area estimation approach	Feasability and capacity building reports	Networking and exchange with experts from Morocco and China

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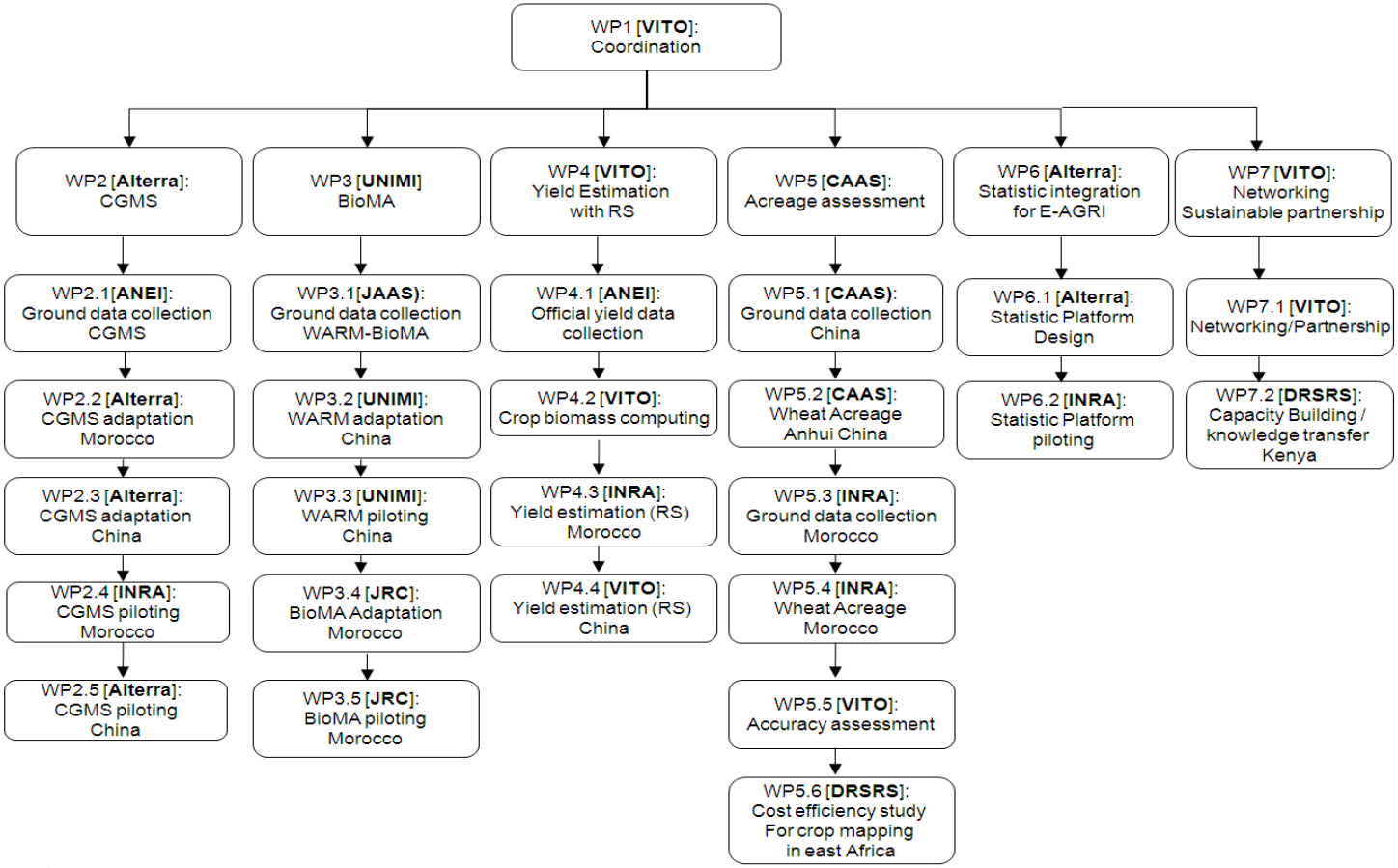
E-AGRI: Project structure

Crop monitoring as an E-agriculture tool in Developing Economies (E-AGRI)



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E-AGRI: Project Planning

			T0	T0+6	T0+12	T0+18	T0+24	T0+30
WP 1	**COORDINATION**	**VITO**						
WP 2	**CGMS**	**ALTERRA**						
WP 21	Ground data collection	APEI						
WP 22	CGMS adaptation in MOROCCO	ALTERRA						
WP 23	CGMS adaptation in CHINA	ALTERRA						
WP 24	CGMS pilot in CHINA	ALTERRA						
WP 25	CGMS pilot in MOROCCO	INRA						
WP 3	**BIOMA/WARM**	**UNIMI**						
WP 31	Ground data collection WARM-BioMA	JAAS						
WP 32	WARM adaptation in CHINA	UNIMI						
WP 33	WARM pilot in CHINA	UNIMI						
WP 34	BIOMA adaptation in MOROCCO	JRC						
WP 35	BIOMA pIlot in MOROCCO	JRC						
WP 4	**Yield Estimation with RS**	**VITO**						
WP 41	Official yield data collection	APEI						
WP 42	Crop biomass computing	VITO						
WP 43	Yield estimation in MOROCCO	INRA						
WP 44	Yield estimation in CHINA	VITO						
WP 5	**Acreage assessment**	**CAAS**						
WP 51	Ground data collection in CHINA	CAAS						
WP 52	Wheat acreage in CHINA	CAAS						
WP 53	Ground data collection in MOROCCO	INRA						
WP 54	Wheat acreage in MOROCCO	INRA						
WP 55	Accuracy assessment	VITO						
WP 56	Cost Eff.for crop mapping in E.A.	DRSRS						
WP 6	**Statistic platform**	**ALTERRA**						
WP 61	Statistic platform design	ALTERRA						
WP 62	Statistic platform pilot	INRA						
WP 7	**Networking sustainable partnership**	**VITO**						
WP 71	Networking/Partnership	VITO						
WP 72	Capacity building in KENYA	DRSRS						

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A fruitful Collaboration

Grazie

Merci

Bedankt

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