REMOTE SENSING INDICATORS FOR YIELD ESTIMATION IN HUAIBEI PLAIN AND IN MOROCCO

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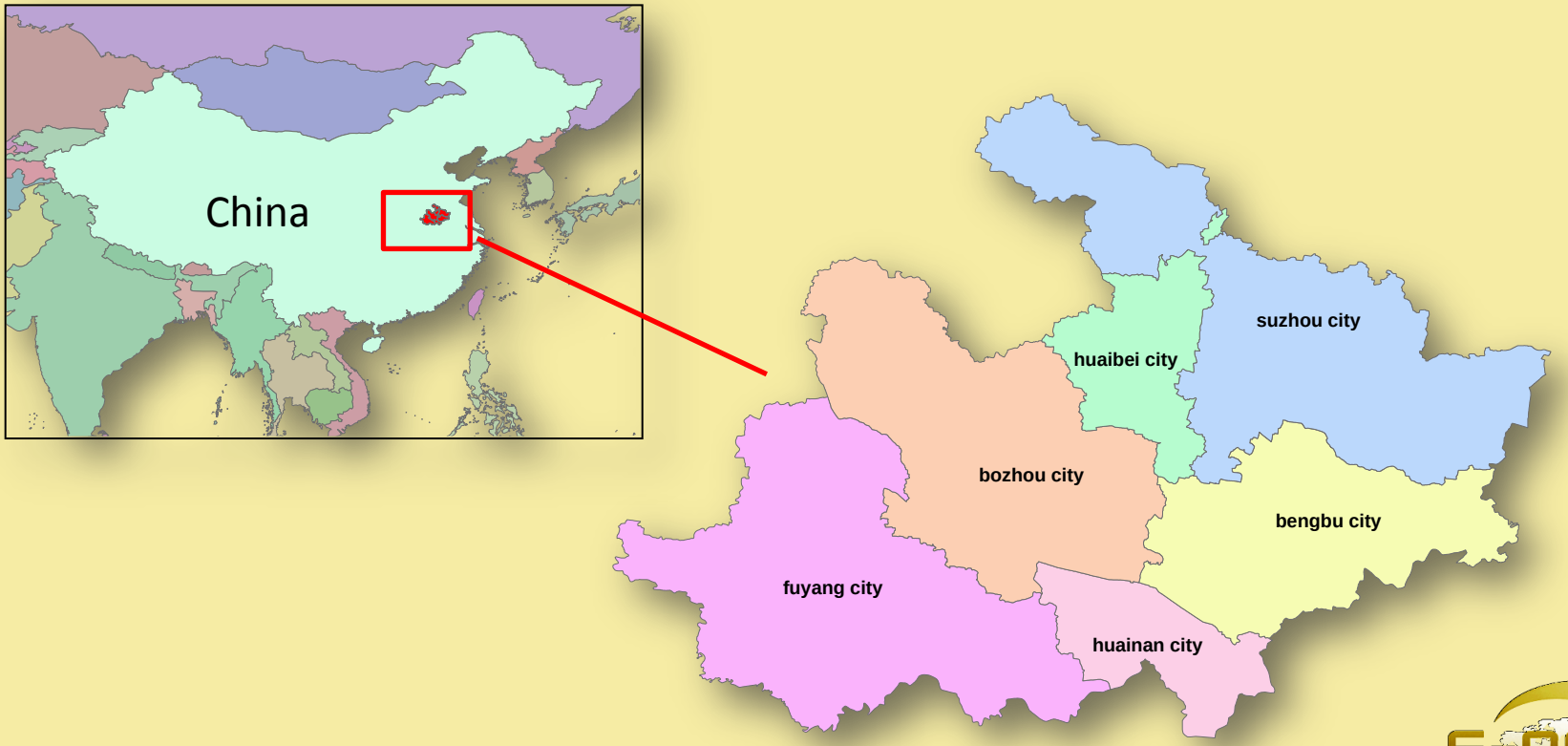
Data & Methodology

SPOT – VEGETATION images extracted from global VITO archive.

- **Ten-daily series :** (3 per month, 36 per year), ranging from 1999-dekad 1 until 2009-dekad 24). In total 396 dekads.
- **Five variables:**
  - Non-smoothed i-NDVI and a-fAPAR
  - Smoothed k-NDVI and b-fAPAR (all cloudy and missing observations were detected and replaced with more logical, interpolated values).
  - y-DMP: Dry Matter Productivity from smoothed b-fAPAR and *European Centre for Medium-Range Weather Forecasts* (ECMWF) meteodata.

Data & Methodology

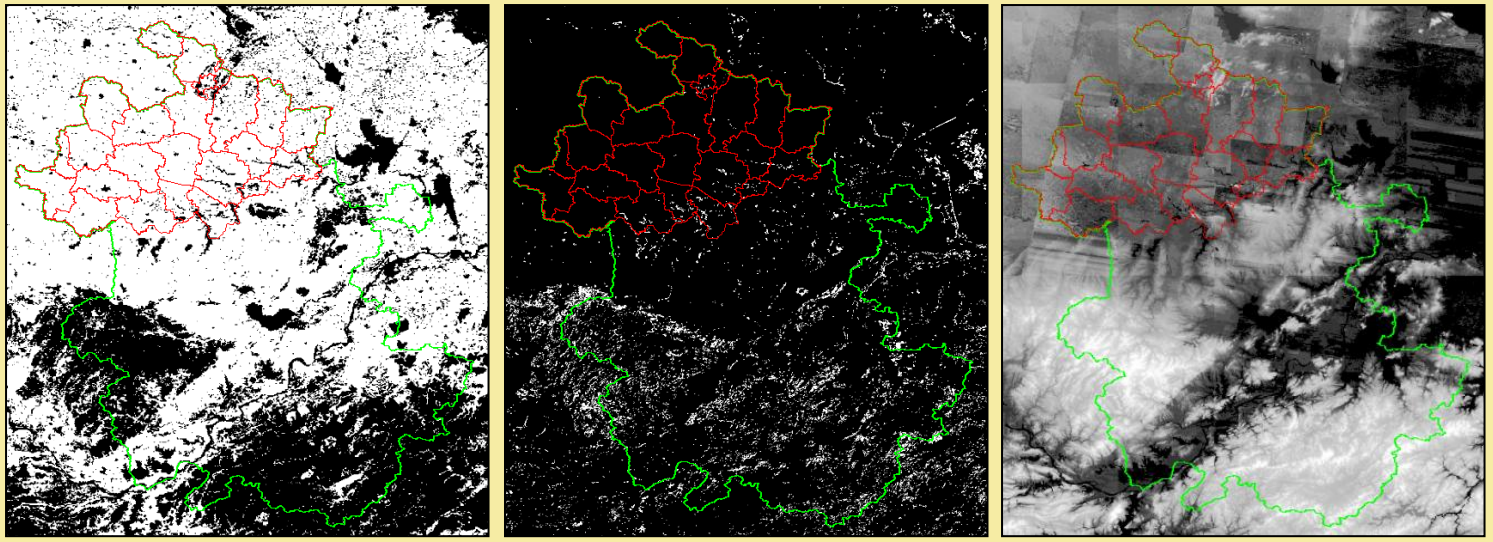
China : 6 districts in Huabei (Huaibei, Bozhou, Suzhou, Bengbu, Fuyang and Huainan).



Data & Methodology

Cropmask (JRC-MARSOP project) applied to SPOT Images, derived from the 300m-resolution Land Use map GlobCover-v2.2, but JRC adapted/corrected it in many ways.

Huabei in China : *cropland is predominant, while grassland is rather exceptional*



Data & Methodology

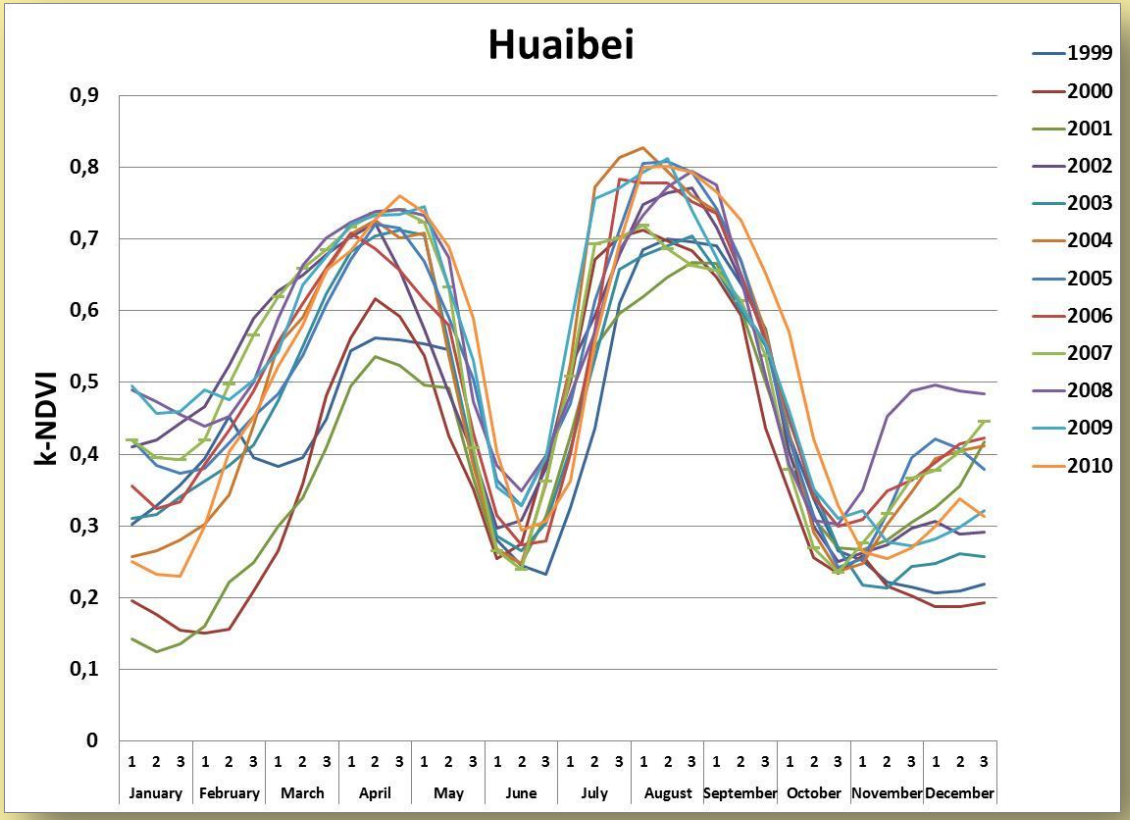
Example : k-NDVI in Huaibei district

	January			February			March			April			...	...	...	November			December			Wheat yield
	1	2	3	1	2	3	1	2	3	1	2	3	...	...	...	1	2	3	1	2	3	
1999	0,302	0,328	0,357	0,394	0,453	0,395	0,383	0,396	0,449	0,544	0,562	0,56	...	...	...	0,252	0,221	0,215	0,206	0,21	0,219	
2000	0,196	0,177	0,155	0,151	0,156	0,21	0,265	0,358	0,482	0,562	0,617	0,592	...	...	...	0,258	0,216	0,202	0,188	0,187	0,193	3,6945
2001	0,142	0,125	0,135	0,16	0,221	0,249	0,299	0,339	0,409	0,495	0,536	0,524	...	...	...	0,267	0,281	0,305	0,325	0,356	0,417	5,2690
2002	0,41	0,42	0,443	0,467	0,524	0,59	0,628	0,65	0,678	0,703	0,722	0,657	...	...	...	0,263	0,274	0,297	0,307	0,289	0,291	4,6574
2003	0,31	0,316	0,341	0,363	0,385	0,413	0,474	0,55	0,624	0,682	0,704	0,713	...	...	...	0,217	0,213	0,243	0,247	0,261	0,257	4,2794
2004	0,257	0,265	0,281	0,302	0,344	0,441	0,552	0,591	0,655	0,707	0,726	0,702	...	...	...	0,248	0,303	0,348	0,394	0,405	0,412	5,3774
2005	0,42	0,385	0,374	0,38	0,416	0,453	0,484	0,538	0,609	0,672	0,721	0,716	...	...	...	0,255	0,317	0,396	0,422	0,408	0,379	5,3295
2006	0,356	0,324	0,334	0,386	0,433	0,489	0,557	0,61	0,659	0,709	0,686	0,656	...	...	...	0,309	0,349	0,364	0,389	0,415	0,423	6,0515
2007	0,42	0,396	0,392	0,42	0,498	0,567	0,619	0,66	0,685	0,717	0,736	0,742	...	...	...	0,277	0,318	0,367	0,377	0,403	0,446	5,8683
2008	0,49	0,473	0,455	0,439	0,453	0,5	0,59	0,664	0,702	0,723	0,738	0,741	...	...	...	0,35	0,453	0,489	0,497	0,489	0,484	6,4350
2009	0,495	0,457	0,459	0,49	0,476	0,503	0,543	0,636	0,676	0,721	0,733	0,735	...	...	...	0,322	0,278	0,272	0,282	0,298	0,321	6,3967

Data & Methodology

K-NDVI Profile: 2 growth cycles per year (and that holds for all the 6 districts)**:**

- *Spring (May-June): spring wheat is the major crop.*
- *June (dekads 16-18): transition month.*
- *Summer (July-October): maize is the major crop (+ many other secondary crops).*



Data & Methodology

冬小麦物候期（月/日）
Crop calendar of winter wheat（MM/DD）

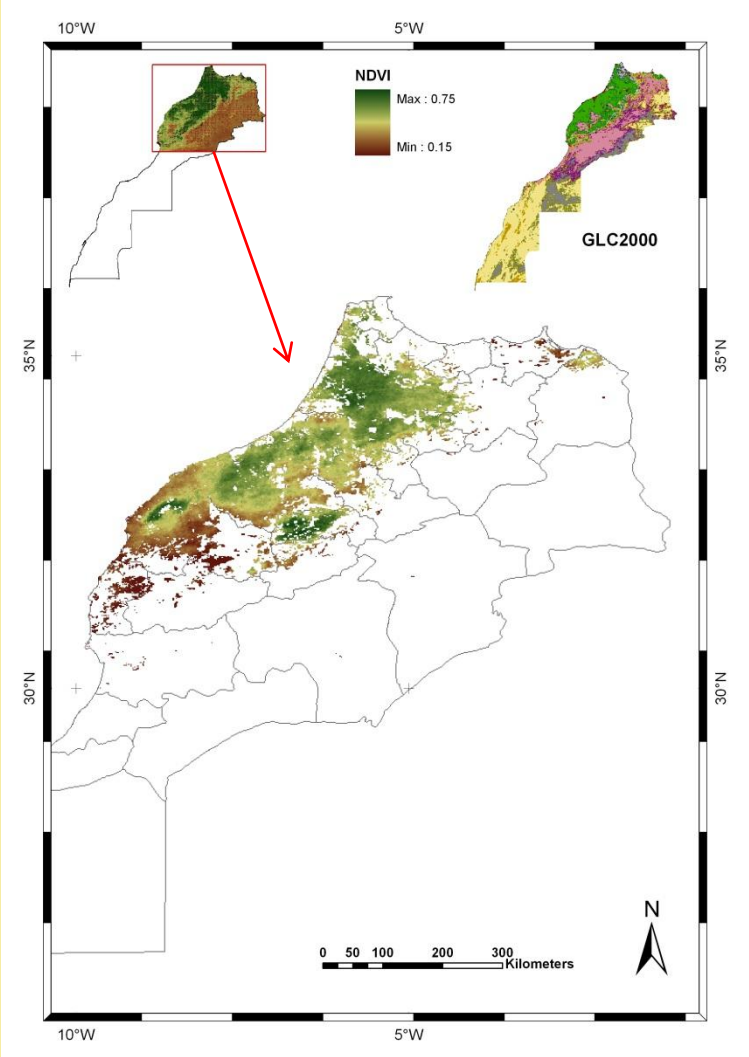
播种	出苗	三叶期	越冬	返青	拔节	孕穗	抽穗	扬花	成熟
Sowing time	emergence	three leaf	Wintering period	turning green	Jointing	booting	heading	flowering	maturity
10/12	**10/19**	**11/2**	**12/20**	**2/10**	**3/10**	**4/10**	**4/22**	**4/25**	**6/1**

Data & Methodology

MOROCCO

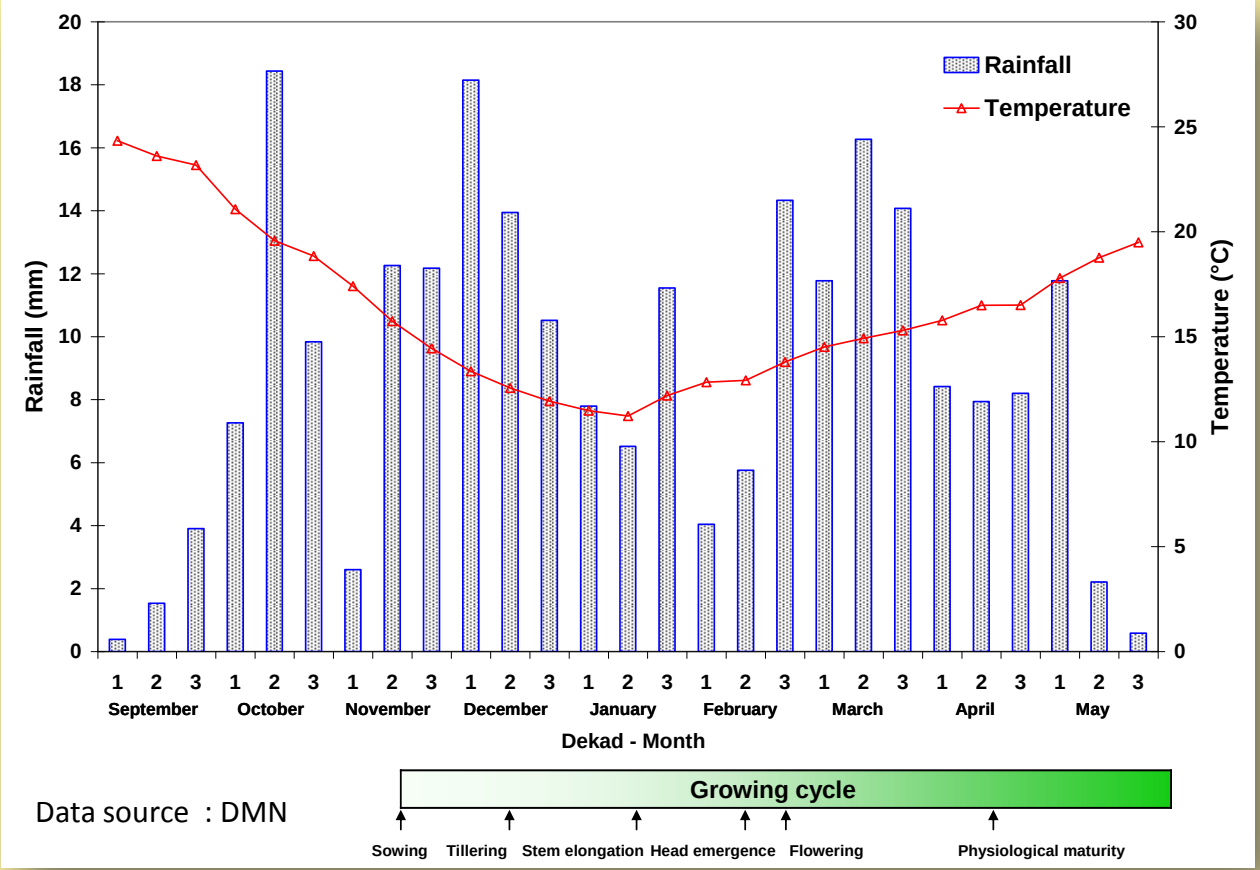
- Total agricultural area : 8,7 million hectares ;
- Total cereals area (bread wheat, durum wheat and barley) : 4,7 million hectares (data from 1990 to 2010) ;
- Total cereal production : 5,6 million tons (data from 1990 to 2010) ;
- Yields data from 1990 to 2010 :
  - Bread wheat : 1,4 T/ha
  - Durum wheat : 1,2 T/ha
  - Barley : 1,0 T/ha

Data source : DSS



Data & Methodology

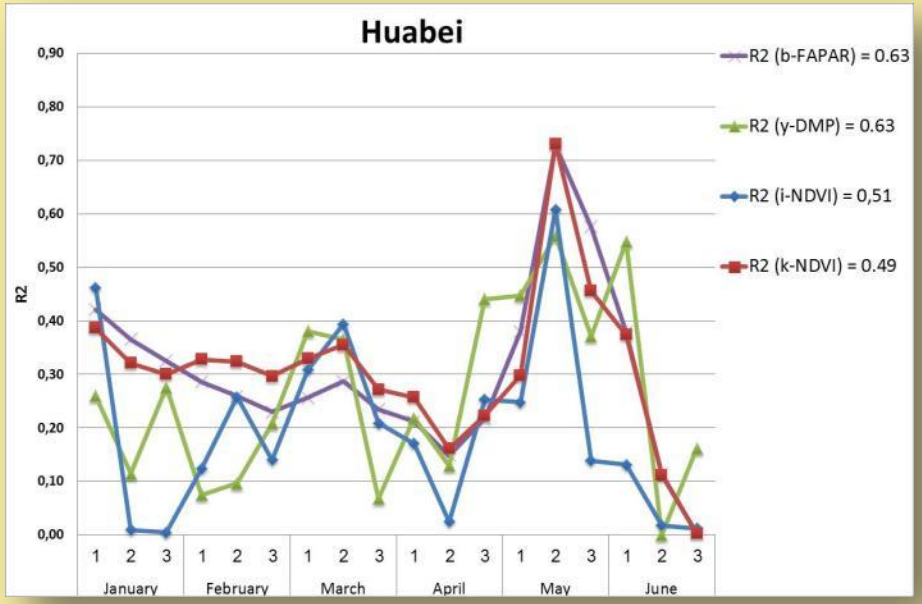
Typical weather conditions during the wheat growing cycle in Morocco

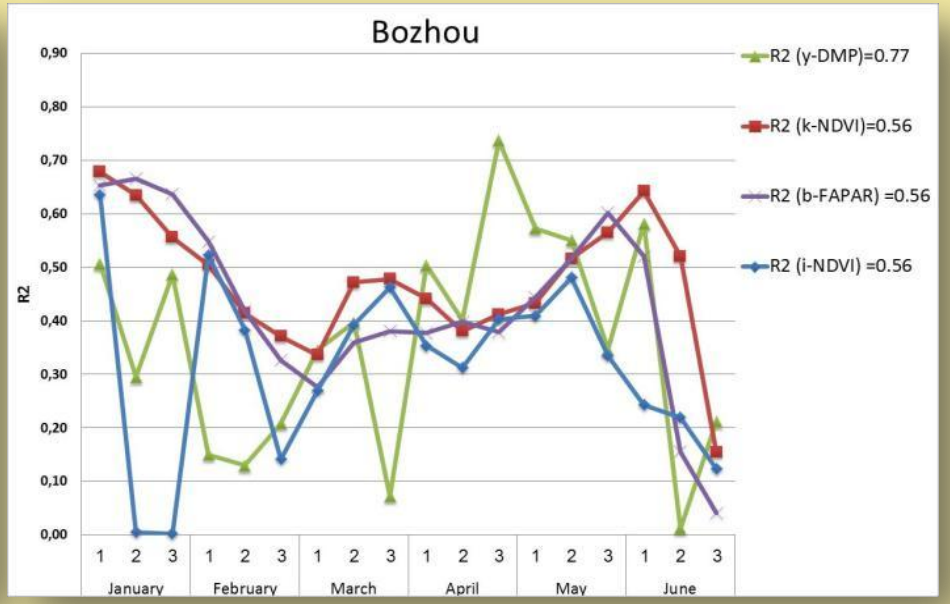


Data source : DMN

Remote sensing indicators for yield estimation in HuaiBei plain

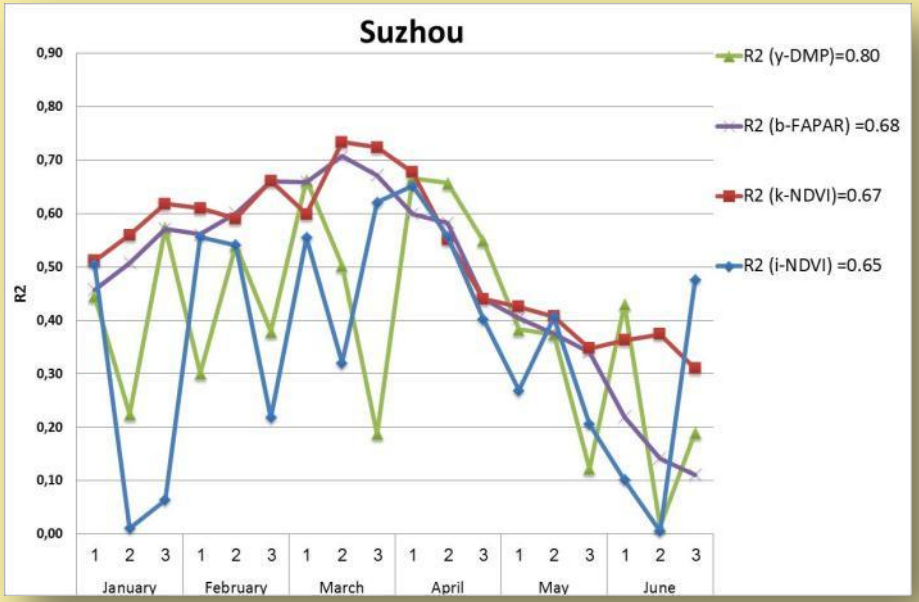
- Good correlations between Remte sensing indicators (b-FAPAR, y-DMP, i-NDVI and k-NDVI) and wheat yields in the 6 disctricts of Anhui ;
- Best correlations obtained with y-DMP ;
- Most consistant correlations with k-NDVI,

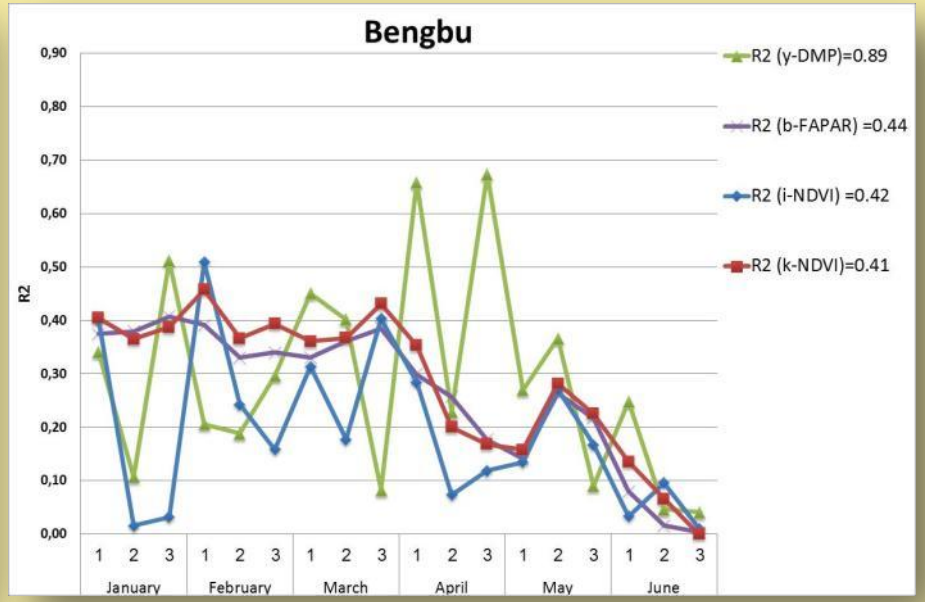




Remote sensing indicators for yield estimation in HuaiBei plain

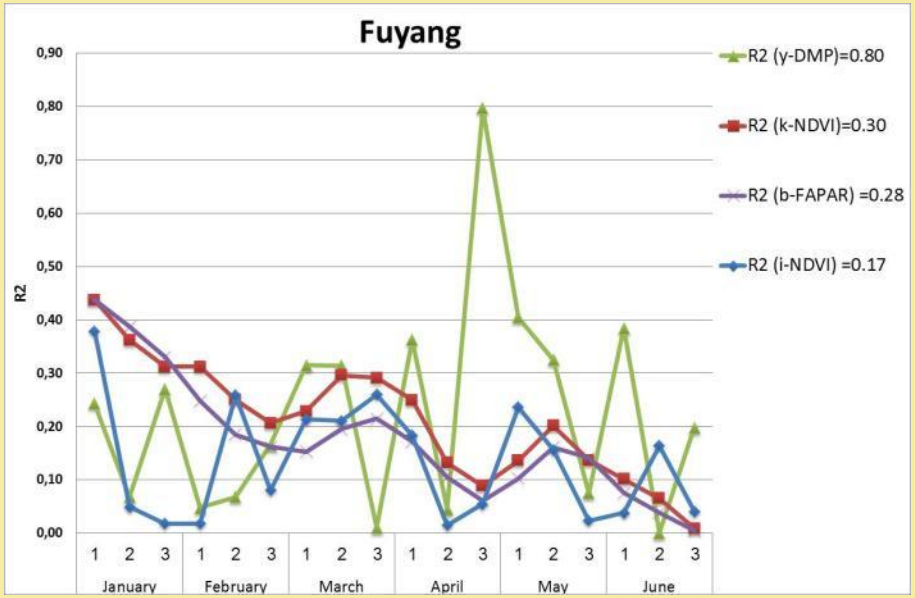
- Best correlations obtained in Suzhou and Bengbu districts for all indicators.

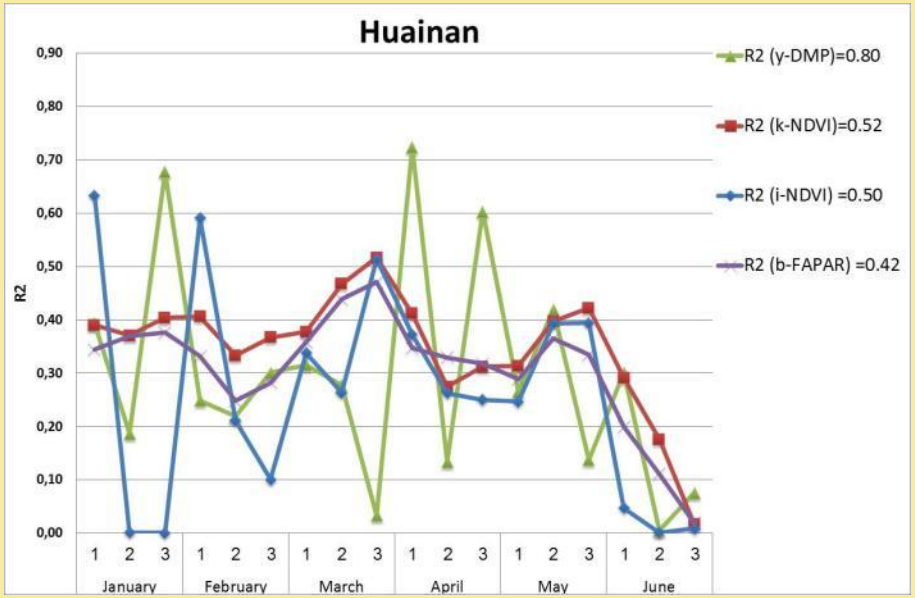




Remote sensing indicators for yield estimation in HuaiBei plain

- Only y-DMP is well correlated to wheat yields in Fuyang and Huainan districts.

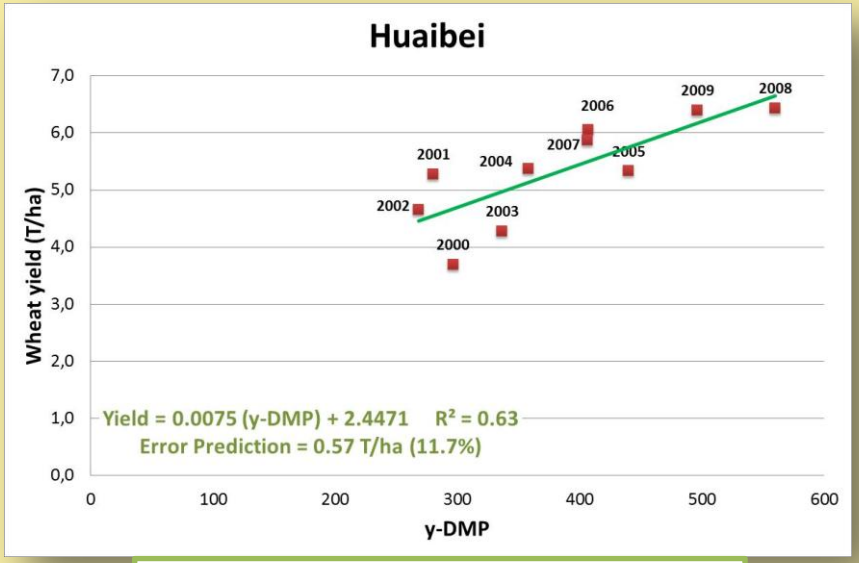




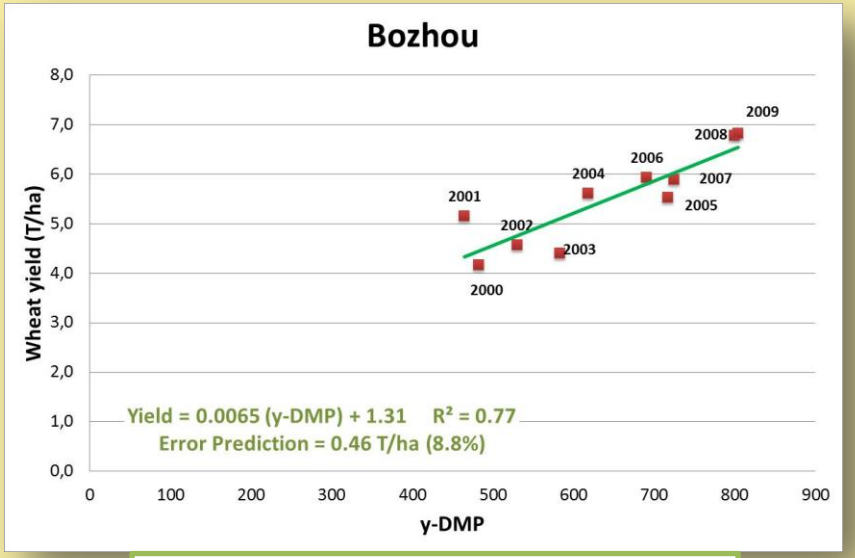
Remote sensing indicators for yield estimation in HuaiBei plain

Regression : Wheat yield = a * (y-DMP) + b

- Good wheat yield prediction in the 6 districts, using y-DMP ;
- Prediction error ranges from 8.4 to 11.7%.

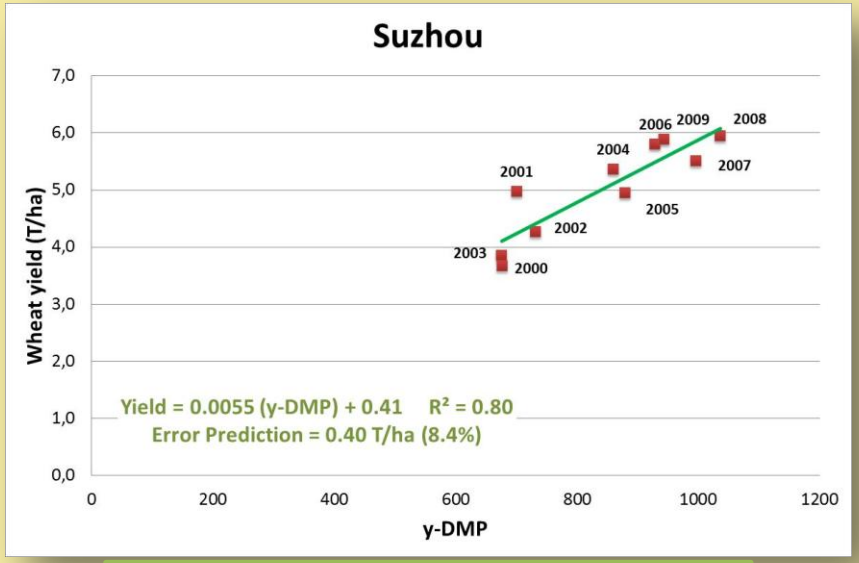


Σ(y-DMP) : 3rd dekad April – 1st dekad June

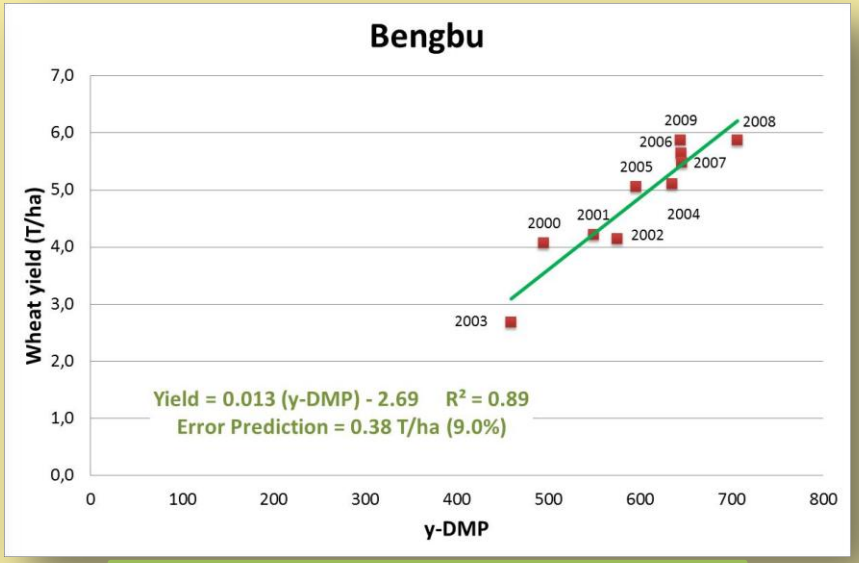


Σ(y-DMP) : 1st dekad April – 1st dekad June

Remote sensing indicators for yield estimation in HuaiBei plain

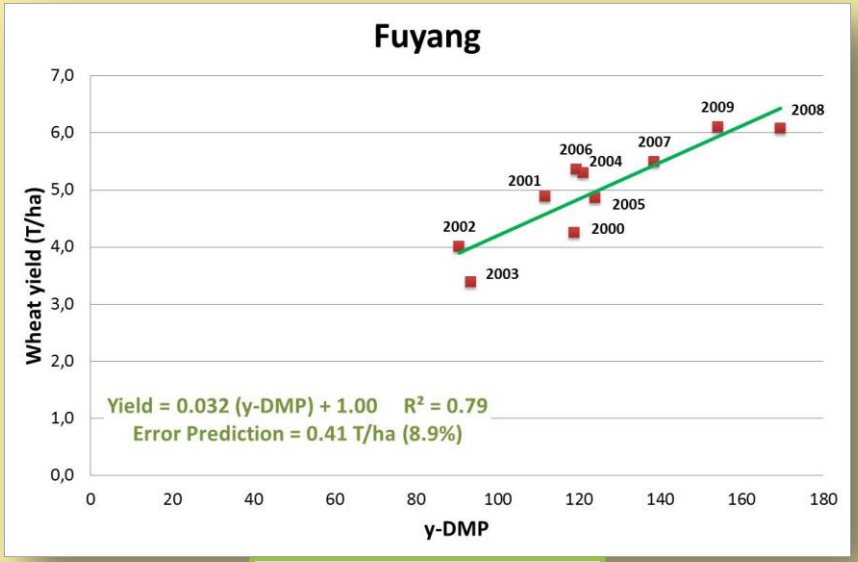


Σ(y-DMP) : 2d dekad February – 2d dekad May

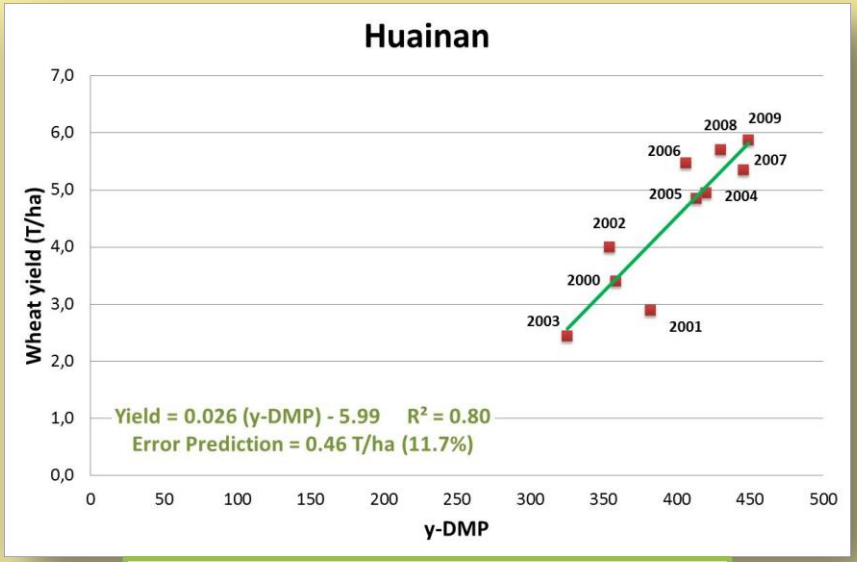


Σ(y-DMP) : 1st dekad March – 3rd dekad April

Remote sensing indicators for yield estimation in HuaiBei plain



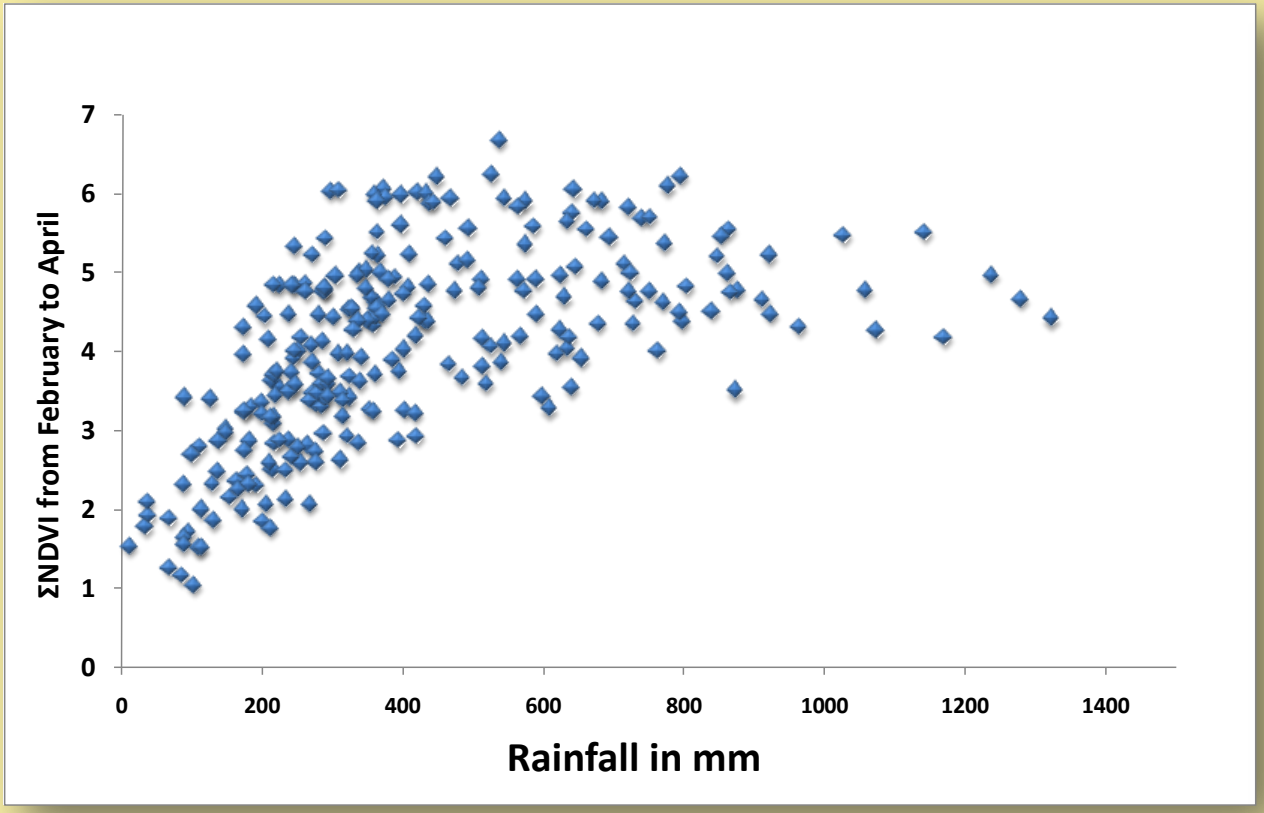
y-DMP : 3rd dekad April

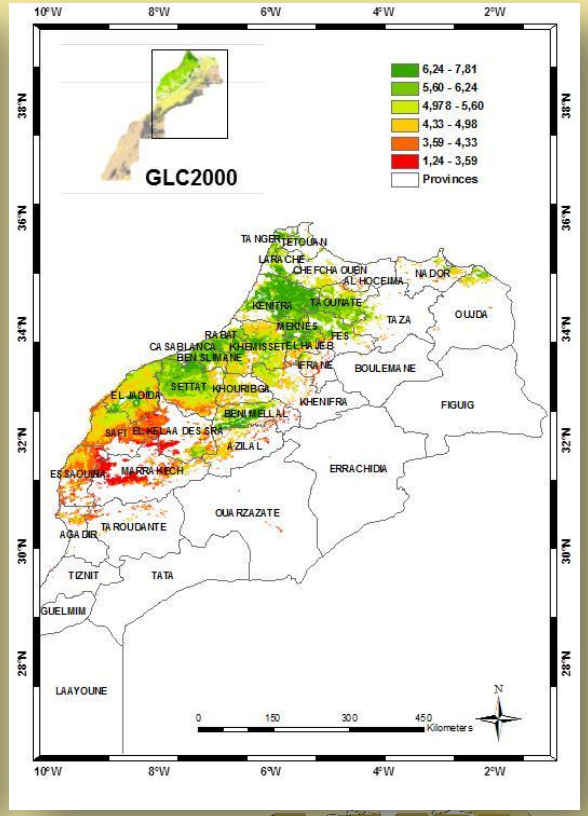


Σ(y-DMP) : 1st dekad April– 3rd dekad April

Remote sensing indicators for yield estimation in Morocco

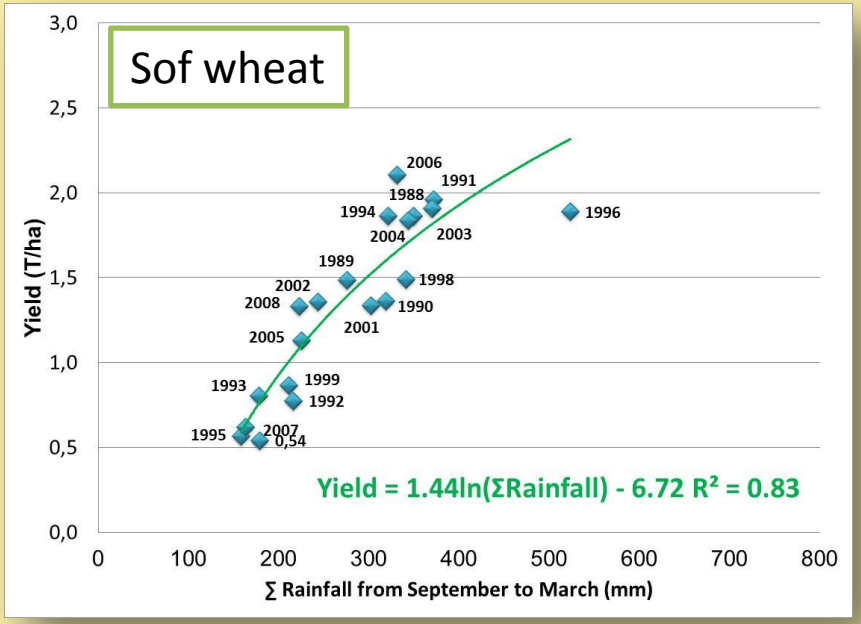
- NDVI correlated to rainfall till 500mm/year ;
- NDVI suitable for semi-arid areas (most of agricultural lands in Morocco).

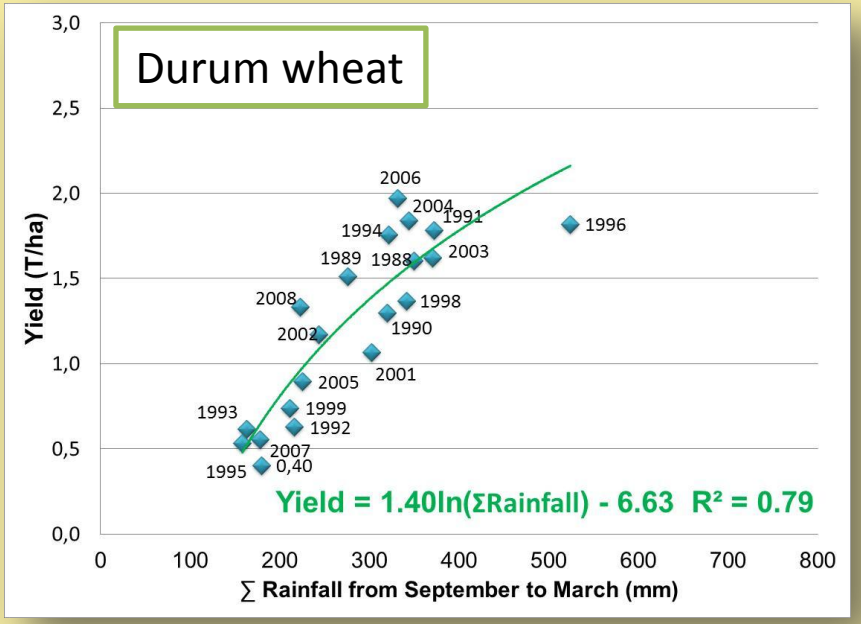




Rainfal indicators for yield estimation in Morocco

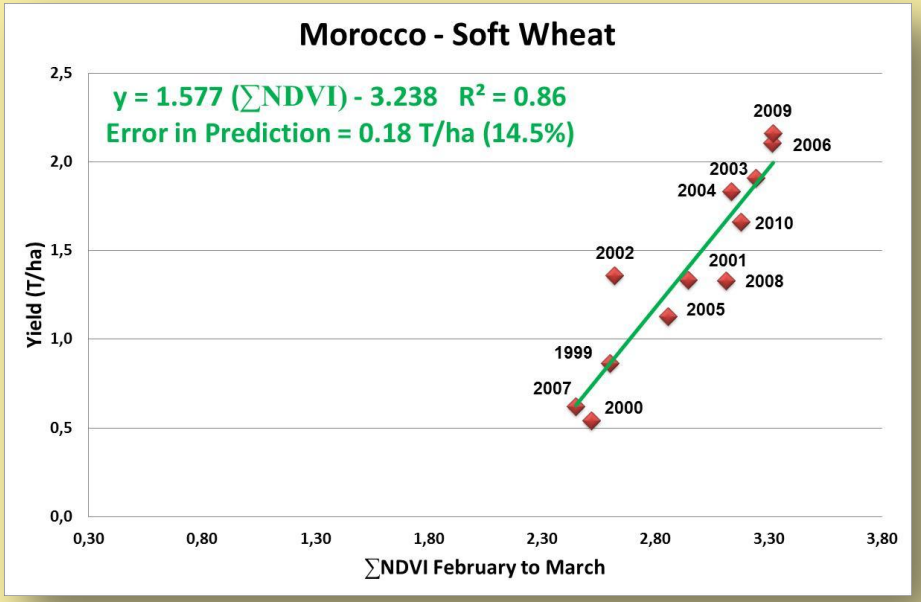
- The shape of the relationship between cumulated rainfall from September to March is lognormal for the soft wheat, durum wheat and barley ;
- At national level, the lognormal model has highly significant R^2-values ranging from 0.83 for soft wheat to 0.79 and 0.73 for durum wheat and barley





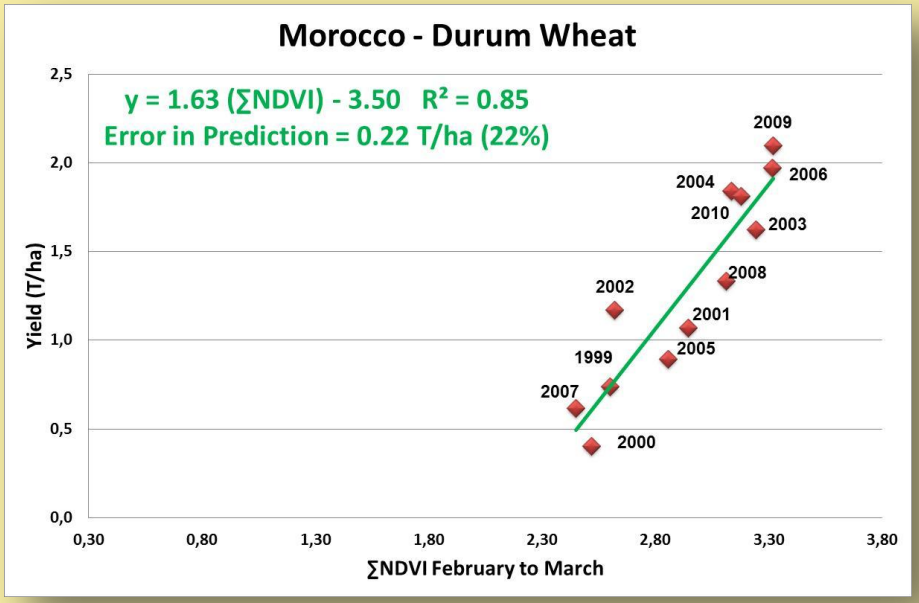
Remote sensing indicators for yield estimation in Morocco

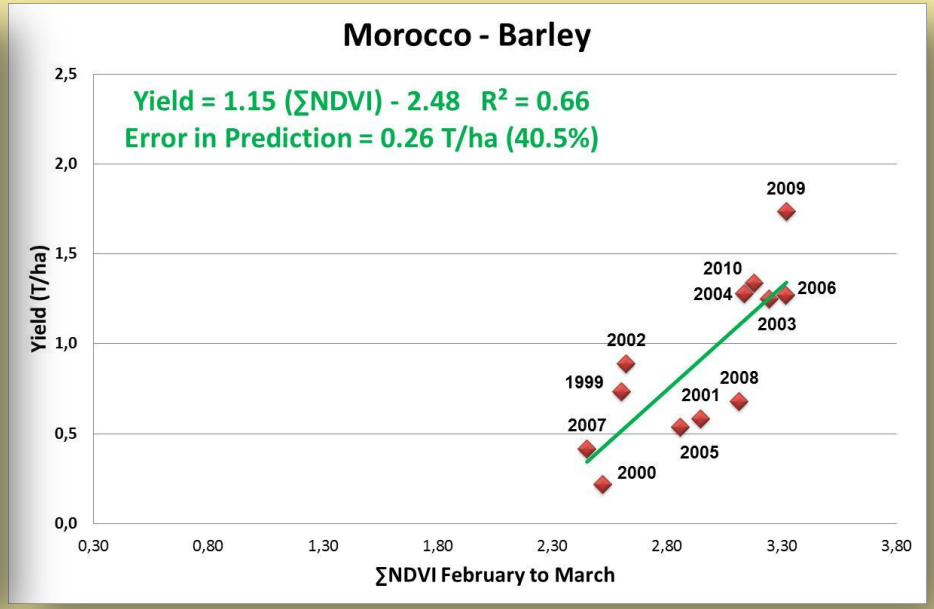
- NDVI of croplands is a strong indicator of cereal yields at national as well as at agro-ecological zone levels.
- The relationship between cereal yields and cumulated NDVI (from February to March) is linear for soft wheat, durum and barley.



Remote sensing indicators for yield estimation in Morocco

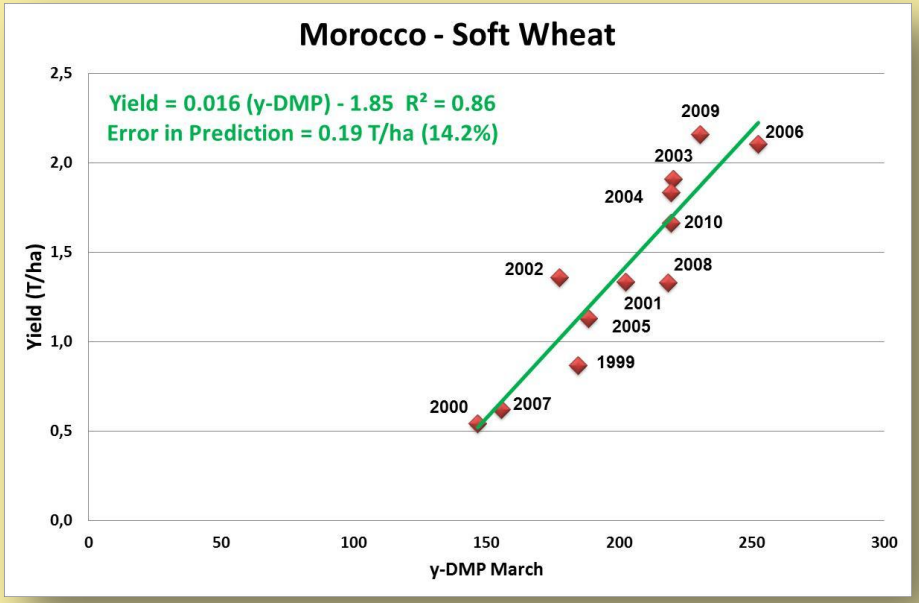
- The correlation between barley yields and ΣNDVI (from February to March) is lower ;
- Prediction error is relatively low, for soft wheat and durum wheat, except for barley.

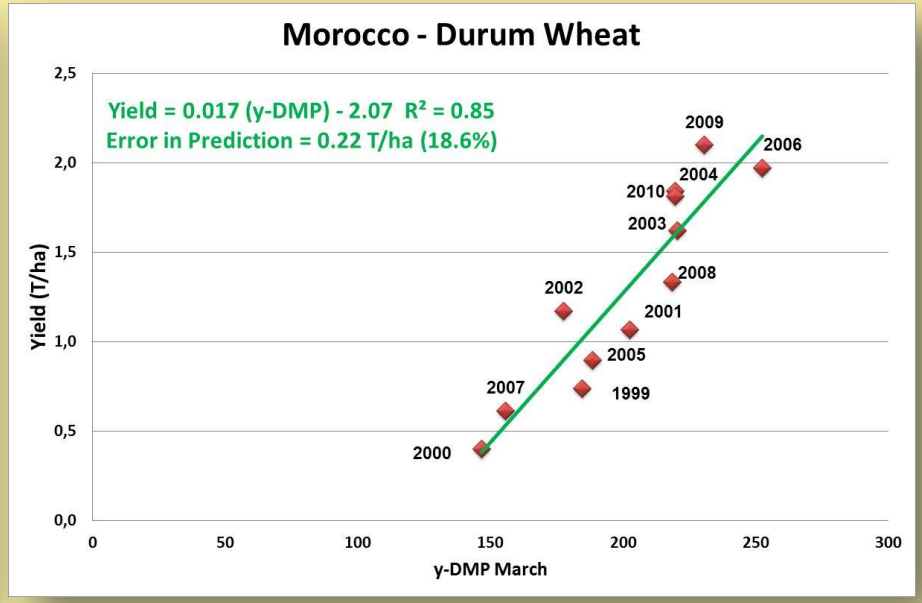




Remote sensing indicators for yield estimation in Morocco

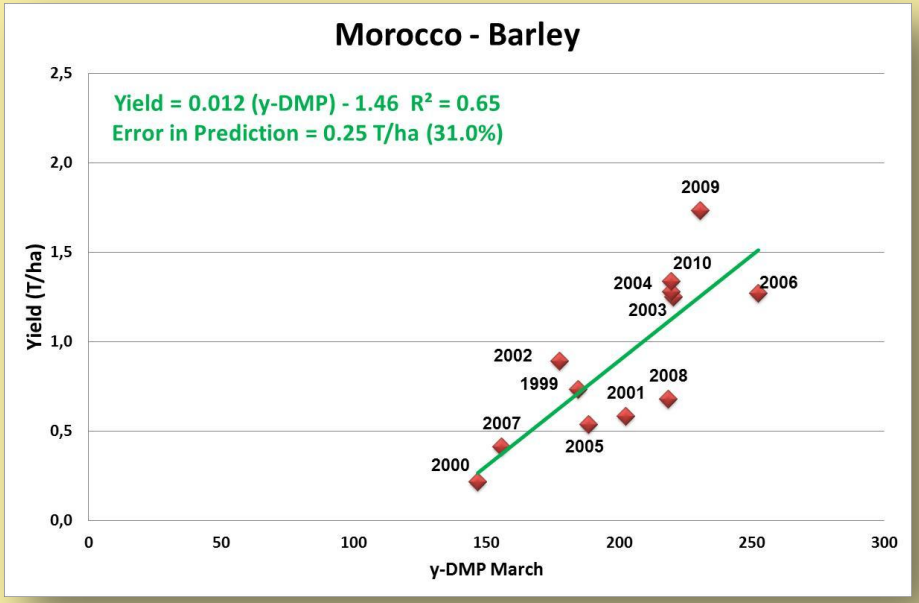
- ΣY-DMP (from February to March) is a better indicator than ΣNDVI for cereal yields ;
- The relationship between cereal yields and ΣY-DMP (from February to March) is linear for soft wheat, durum and barley.





Remote sensing indicators for yield estimation in Morocco

- Prediction error is lower for ΣY-DMP than for ΣNDVI , for soft wheat, durum wheat and barley.



Conclusion

- Remote sensing can be used for crop forecasting in China and in Morocco ;
- Σ(Y-DMP) is the best indicator for wheat yields in both countries ;
- Σ(k-NDVI) seems to be a consistent indicator and gives also good results ;
- February to march is the significant period over which Y-DMP and k-NDVI should be cumulated in Morocco ;
- In China, the significant period depends on districts ;
- Cumulated Rainfall over all agricultural season is also a good indicator for cereal yields.

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謝謝您

Thank you