

SEBAL for quantifying  
water productivity for wheat worldwide  
with emphasis on the Yaqui Valley in  
Mexico

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## 1. Introduction

Water Productivity

Research area

Methodological framework

Results in the Yaqui Valley, Mexico

Wheat water productivity in other systems

Conclusions



# Water Productivity

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Growing world population that demands more food

Less fresh water resources available to agriculture due to increased use by other sectors (industry, domestic, etc.)

solution is to increase the productivity of water

$$\text{water productivity} = \frac{\text{harvestable yield}}{\text{water consumption}} \quad (\text{kg/m}^3)$$

HOW DO WE MEASURE WATER PRODUCTIVITY?



# Water Productivity

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Purpose of this research:

develop a methodological framework to estimate field level WP for wheat at a regional scale from low and high resolution satellite images using the SEBAL algorithm

get better insight in WP in other irrigated wheat systems worldwide by applying the methodology in seven other systems

provide a powerful accurate tool to water managers, policy makers, etc. to improve water management



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# Methodological framework

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Use the SEBAL algorithm to estimate:

- 1) Actual evapotranspiration (water use)
- 2) Harvestable grain yield

$$\text{Bio} = \text{APAR} \circ E_{\text{max}}$$

$$\text{APAR} = f \circ \text{PAR}$$

PAR function of incoming radiation  
f is a function of the NDVI

$$\text{WP} = \frac{\text{Bio} \circ \text{H.I.}}{\text{ET}_{\text{act}}}$$



# Methodological framework

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## Low resolution images

- Advantage: frequent image acquisition
- Disadvantage: little spatial detail  
e.g. MODIS, NOAA-AVHRR

## High resolution images

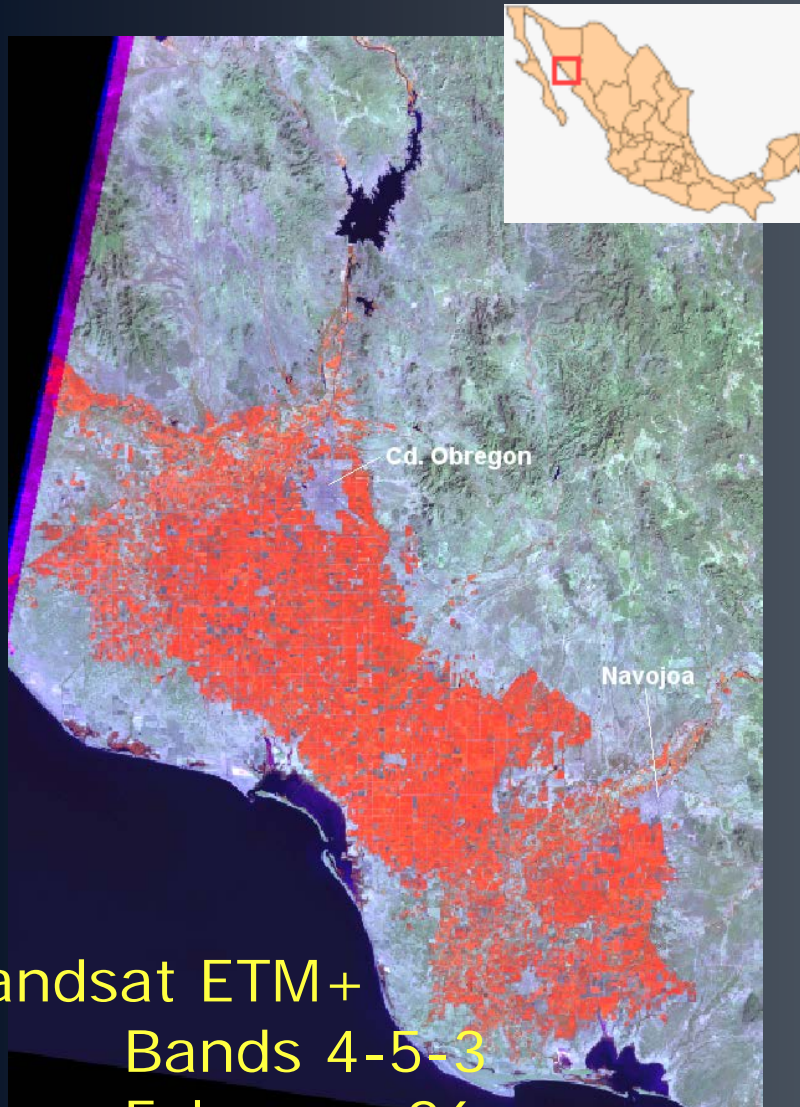
- Advantage: spatial detail
- Disadvantage: low temporal resolution  
e.g. Landsat ETM, Aster

Low resolution products are used to calculate total seasonal ET and biomass production.

High resolution products are used to disaggregate the low resolution products



# Research area



- Yaqui river basin
- 3 reservoirs
- Original centre of the "Green Revolution"



Landsat ETM+  
Bands 4-5-3  
February 26  
(2000)



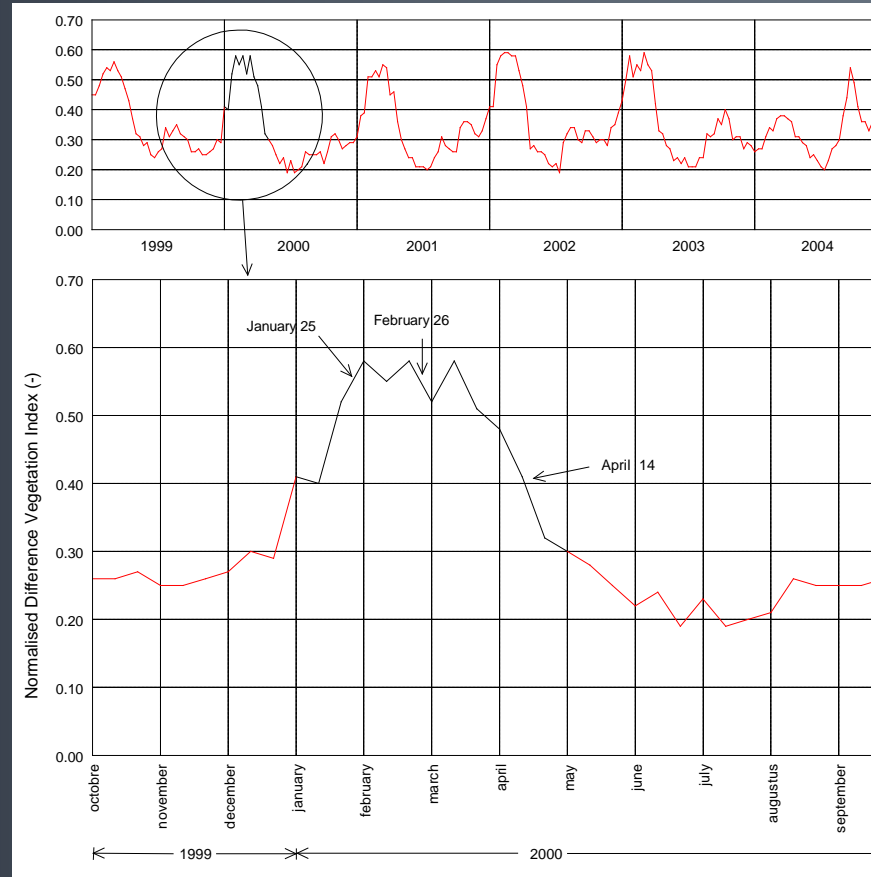
# Research area

## NDVI

averaged for the entire irrigation district

1 growing season

80% of the area is wheat



SPOT VEGETATION satellite



# Methodological framework

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SEBAL was applied on:

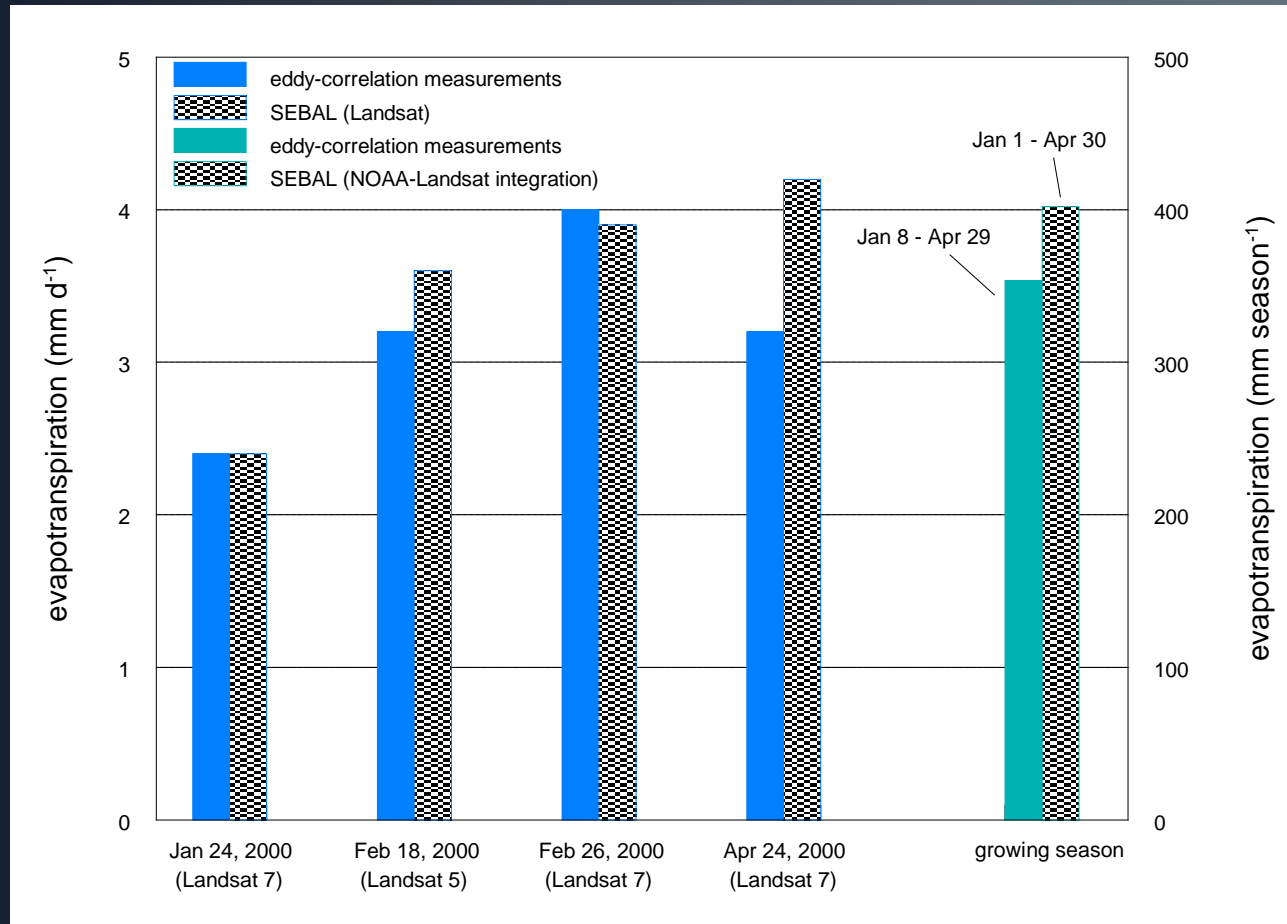
3 high resolution Landsat images (30x30m)  
(to make the biomass and  $ET_A$  distribution maps)

10 low resolution NOAA-AVHRR images (1x1 km)  
(to quantify total  $ET_a$ )



# Results in the Yaqui Valley

Validation of ET on individual Landsat days and the total seasonal ET with eddy-correlation measured ET-fluxes



# Results in the Yaqui Valley

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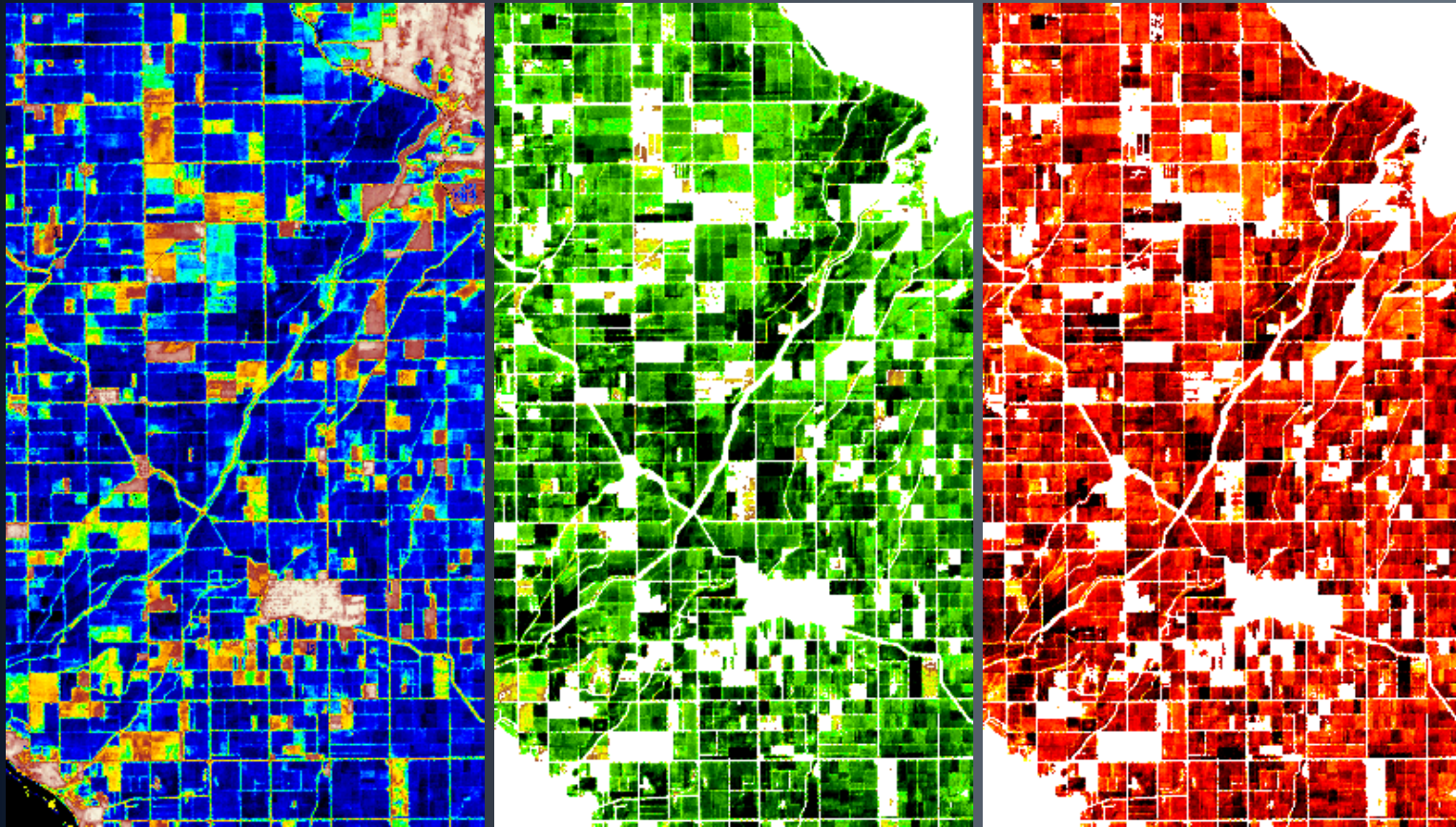
Validation of biomass production with measurements of field trials, farmer reported yields and official statistics





# Results in the Yaqui Valley

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# Water productivity in other systems

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blah





# Conclusions

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blah

