Application of Remote Sensing derived land surface information to enhance implementation of management practices in SWAT

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OUTLINE

- BACKGROUND OF THE STUDY
- OBJECTIVE
- OVERALL METHODOLOGY
- RESULTS AND DISCUSSION
- CONCLUSION
- FUTURE WORK
Water management and water saving are evolving as crucial factors in the context of sustainable development.

Distributed hydrological models are widely used for water balance studies.

The accuracy of estimation of these water balance components are more dependent on the availability of the input data.

Mainly in agricultural dominated region the land use representation and the crop management practices play a dominant role.
WATER USE IN INDIAN CONTEXT

- India is an agricultural dominated country and 90% water consumption is accounted by agriculture.
- Heterogeneity in landuse and spatio-temporal variability in agricultural practices needs to be addressed in Hydrologic models.
- Accounting these variability in Hydrological models will increase the models performance in simulating the water balance components effectively.
- Conventional methods of acquiring land management related information through field scale surveys, cropping related reports etc., are appropriate for model simulations at a field scale.
The LULC map of 2007-08

The LULC map represents agricultural cultivated areas as season specific classes, namely:

- kharif only,
- rabi only,
- zaid only and
- double/triple cropped areas.

Source: NRSC
# Cropping Seasons in India

<table>
<thead>
<tr>
<th>Cropping Season in INDIA</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
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<th>Feb</th>
<th>Mar</th>
<th>April</th>
<th>May</th>
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<tbody>
<tr>
<td>Kharif</td>
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<td>Rabi</td>
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</tbody>
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CROP PHENOLOGY USING REMOTE SENSING

- Times series of MODIS NDVI 16-day composites @ 250m spatial resolution

MODIS VI LAYERSTACKING

- Sowing date
- Harvesting date
- Length of the growing season
OBJECTIVE

- Developing an automated algorithm to extract the crop phenology parameters from remote sensing data to prepare a crop calendar for the whole nation.

- Improving the parameterization of the agro-hydrological model SWAT by incorporating the crop related information and management practices.
METHODOLOGY

MODIS VEGETATION INDICES DATA

DISTRICT WISE SEASONAL CROP STATISTICS

DENOISING NDVI

CROP MAPPING & CROP CALENDAR FOR NATIONAL SCALE

AUTOMATED ALGORITHM USING DERIVATIVE METHOD

EXTRACTION OF CROP SOWING, HARVESTING DATES & CROP GROWTH LENGTH

District Wise Seasonal Crop Statistics

Crop Mapping & Crop Calendar for National Scale
DENOISING OF TIME SERIES DATA

- Removal of Cloudy pixels
- Masking of agricultural pixels from NRSC LULC data
- Gap filling
- Smoothening of the time series data
- Removal of contaminated pixels

Savitzky-Golay Filter

\[ g_i = \sum_{n=-n_L}^{n_R} c_n f_{i+n} \]
Time series raw NDVI and smoothened NDVI
The 1st derivative of Lagrangian interpolation,

\[ L^1(x) = \sum_{j=0}^{k} y_j l_j^1 \]

\[ l_j^1 = \sum_{i=0}^{k} l[j = i \prod_{m=0}^{k} x - x_i \prod_{m=0}^{k} x - x_m] \]

Where \( y \) represents the NDVI value and \( x \) represents the composite day of the year of the \( i \).

The 3-point lagrangian interpolation is used for the study, the 1st derivative at point \( j \) along the NDVI time series calculated
2009-10 crop year is selected for the preliminary study.

NDVI and Derivative profile
Kharif Season

**Paddy Pixel**

<table>
<thead>
<tr>
<th>Sow_date</th>
<th>Harv_date</th>
<th>CGP: 120 DAYS</th>
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<tbody>
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<td>10/06/2009</td>
<td>14/10/2009</td>
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**Sugar Cane**

<table>
<thead>
<tr>
<th>Sow_date</th>
<th>Harv_date</th>
<th>CGP: 232 DAYS</th>
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<tbody>
<tr>
<td>31/4/2009</td>
<td>19/12/2009</td>
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MIXED PIXEL – RICE MIXED WITH PLANTATION

Sow_date | Harv date
---|---
15/4/2009 | 20/01/2010
CGP: 280 DAYS
Double crop - Paddy with another crop

Double crop - Paddy - Paddy
SPATIAL VARIABILITY OF SOWING & HARVESTING DATES
CONCLUSIONS

- The algorithm was effective for pure pixels of single and double crops.
- Exception handling is required for various degrees of mixed pixel.
The algorithm will be applied for the time series of MODIS composite data from the period of 2000 – till date

Also, it will be implemented and validated for various seasons and crops across India.

The crop information extracted using this methodology will be used in SWAT for modelling large river basins.
Thank you