

Landuse and Agricultural Management Practices web-Service (**LAMPS**)

for agroecosystem modeling and conservation planning
using Cloud Service Innovation Platform (CSIP)

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Watershed

Slope

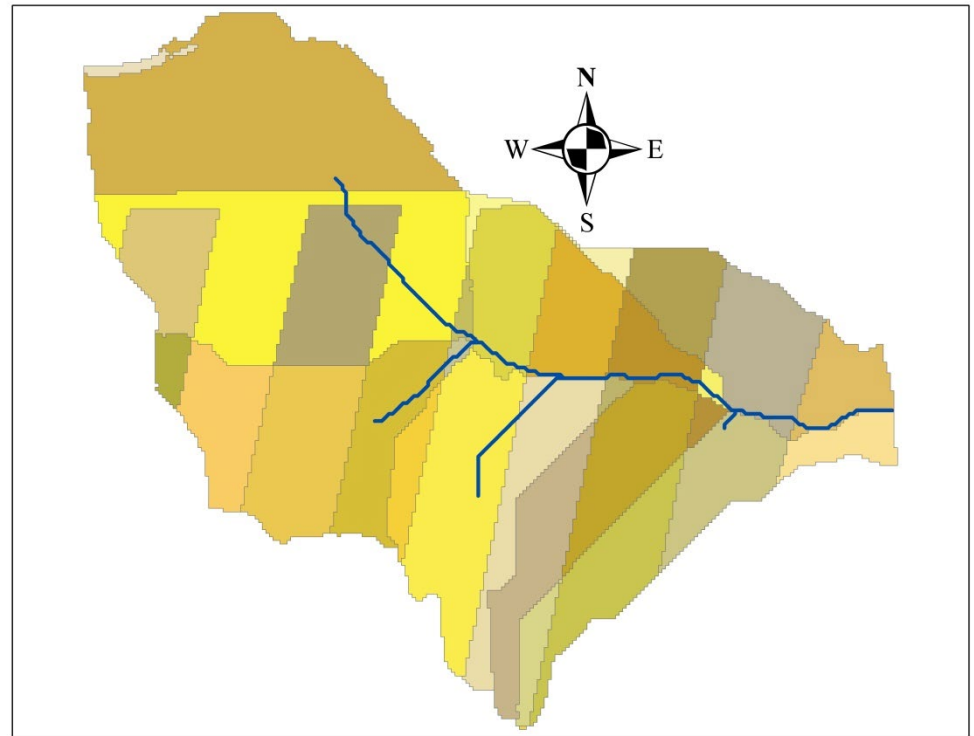
Soil

Landuse

Aspect

Hydro-
Geology

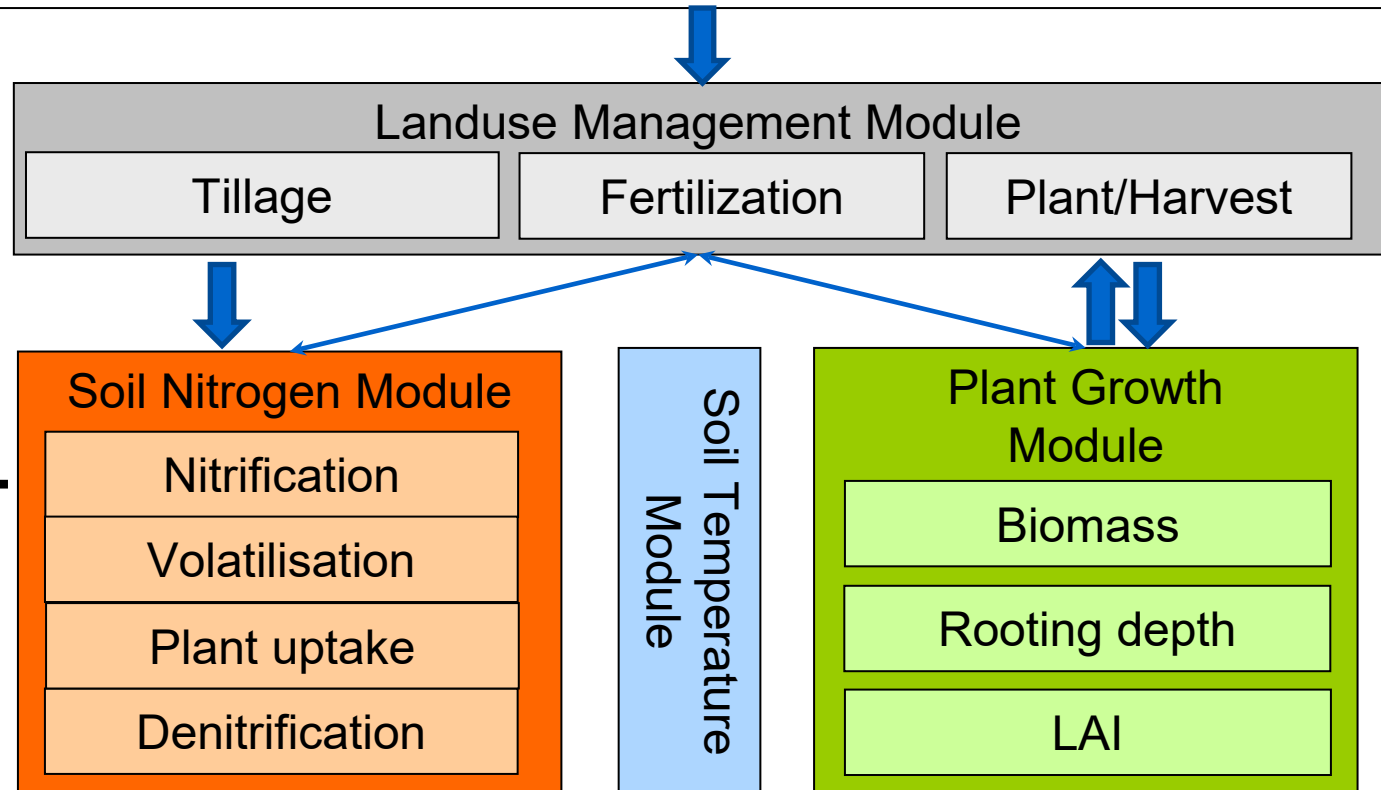
Hydrological Response Units (HRUs)
as modelling entities derived from
an overlay of several layers



Scott Field, Drake Farm near Ft Collins, CO

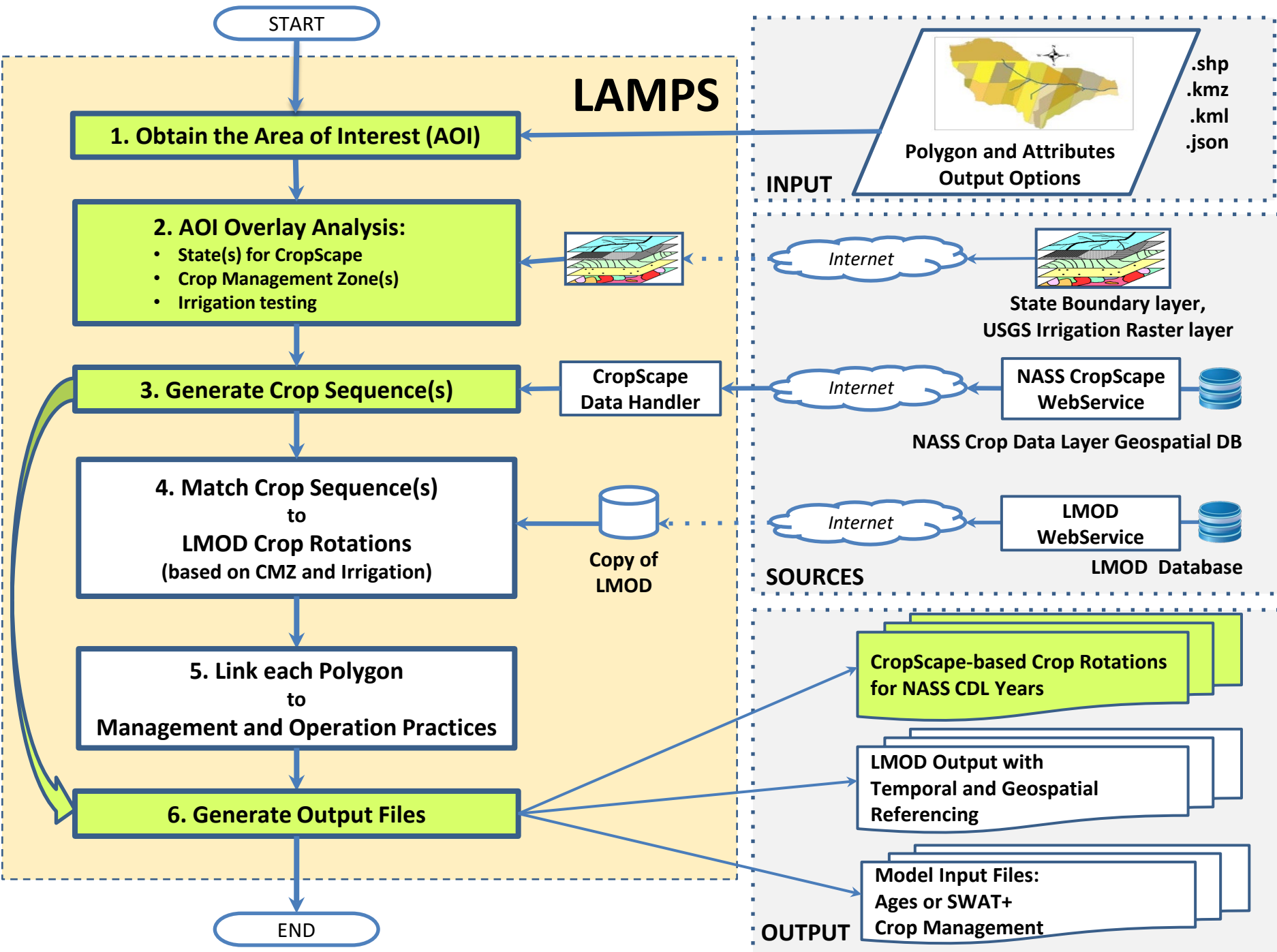
Required crop rotation management inputs:

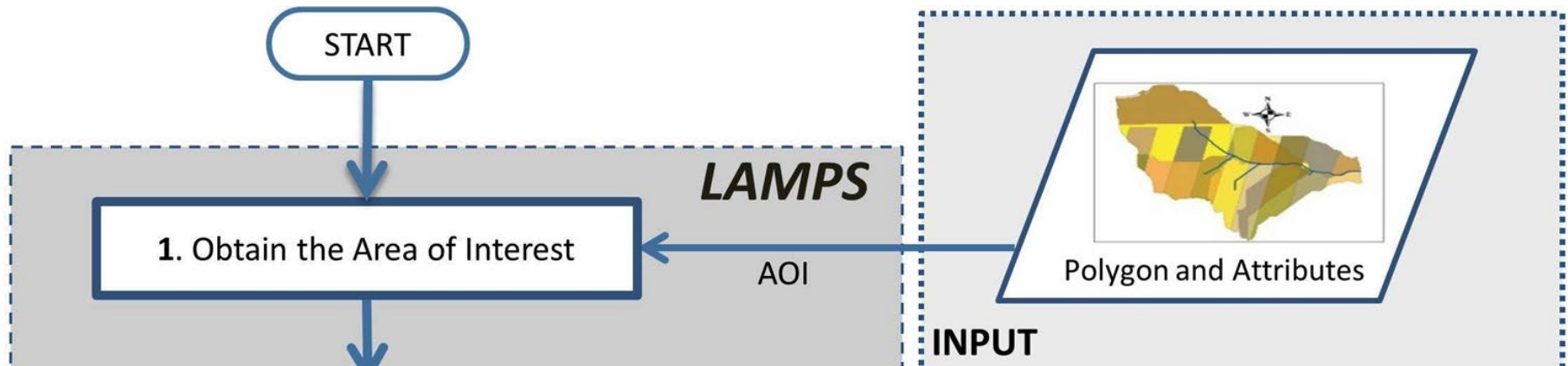
- **Tillage:** operation date; tillage intensity; tillage depth
- Fertilization: date; fertilizer type; amount
- **Plant/Harvest:** date, crop type, harvest fraction



Hydrological
Modelling
with
Ages or
SWAT+
linked
Modules

+

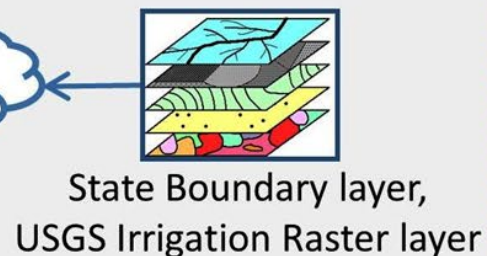




- Current input file options **.shp**, **.geojson**, **.kmz** or **.kml** to define polygon(s)

2. AOI Overlay Analysis:

- State(s) for CropScape
- Crop Management Zone(s)
 - Irrigation testing



- Input data geo-referencing (and re-projection)
- Overlay the Area of Interest with a State Boundary layer, with a CMZ layer and with a USGS Irrigation raster layer
- State information is required for the NASS CropScape web service
- CMZ and Irrigation information are required for the LMOD query

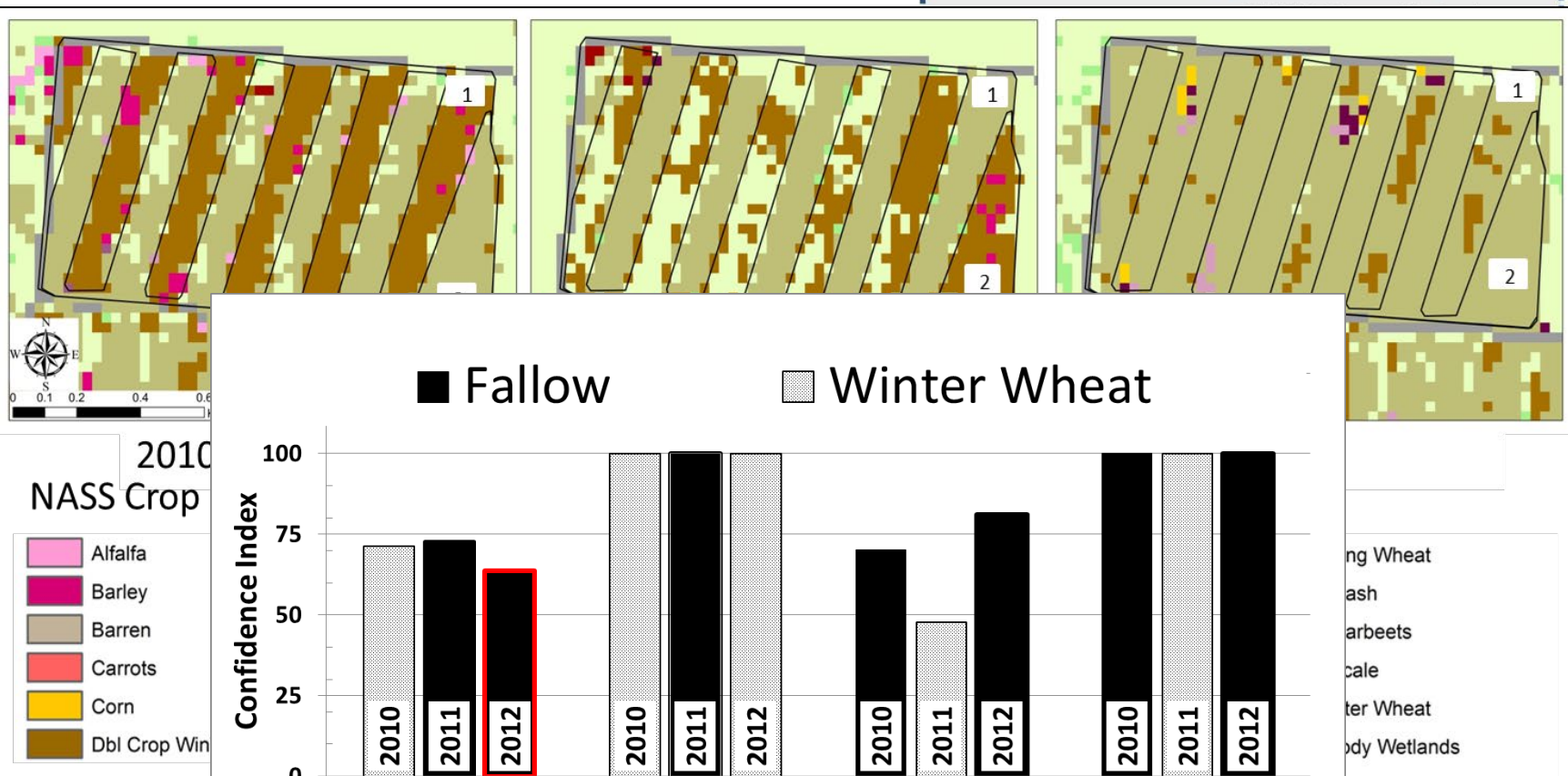
LAMPS Workflow Step 3 Example 2

3. Generate Crop Sequence(s)

CropScope
Data
Handler

Internet

NASS
CropScope
WebService

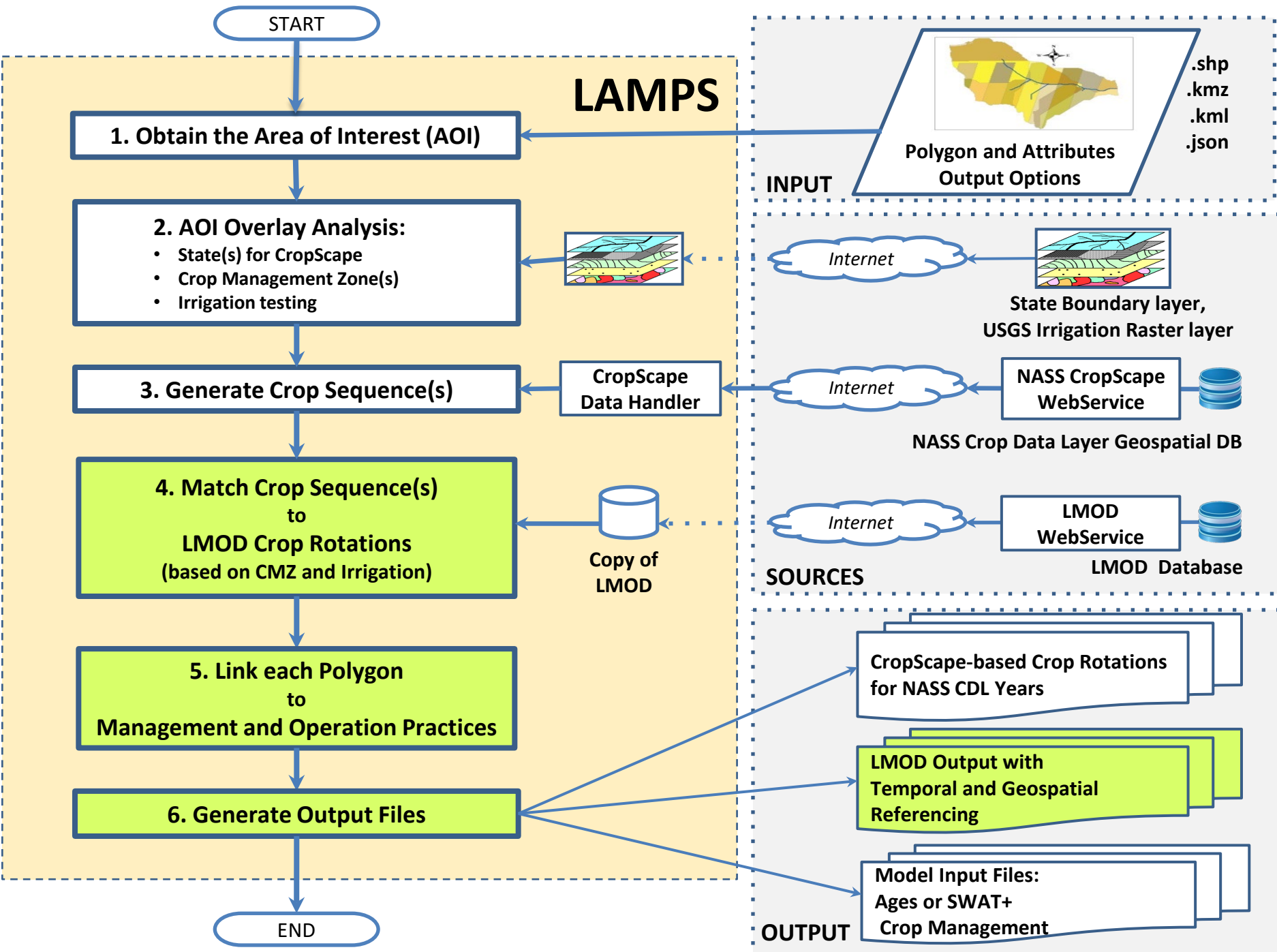


LAMPS Workflow (skipping 4 & 5) Step 6

PolygonID	NASS-Year	Dominant-Crop	Confid.(0-100)	Irrig. area > 40%	Irrigated Area (%)	2nd dominant crop	2nd crop Conf.Index
1	2008	Grass/Pasture	48	No	0	Winter Wheat	36
1	2009	Fallow/Idle Cropland	79	No	0	Grass/Pasture	3
1	2010	Winter Wheat	71	No	0	Fallow/Idle Cropland	9
1	2011	Fallow/Idle Cropland	72	No	0	Grass/Pasture	2
1	2012	Fallow/Idle Cropland	63	No	0	Winter Wheat	10
1	2013	Corn	46	No	0	Sugarbeets	9
2	2008	Grass/Pasture	88	No	0	Winter Wheat	7
2	2009	Fallow/Idle Cropland	44	No	0	Winter Wheat	19
2	2010	Fallow/Idle Cropland	70	No	0	Grass/Pasture	6
2	2011	Winter Wheat	47	No	0	Grass/Pasture	18
2	2012	Fallow/Idle Cropland	81	No	0	Grass/Pasture	3
2	2013	Winter Wheat	72	No	0	Fallow/Idle Cropland	5

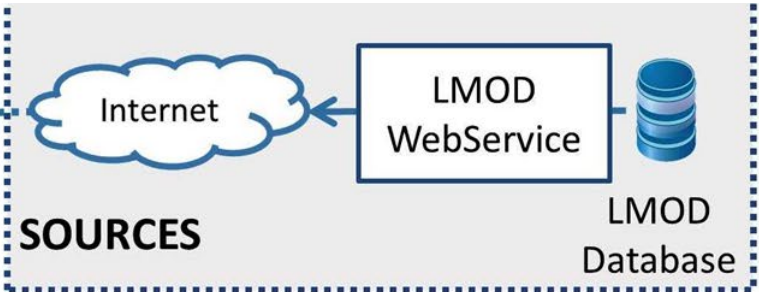
- Detected dominant crops for Scott Field at Drake Farm, based on NASS CropScape and NASS provided crop accuracy values





4. Match
Crop Sequence(s)
to
LMOD Crop Rotations
(based on Crop Management
Zone and Irrigation)

Copy of
LMOD



Source: NASS detected vegetation sequence

East part Scott Field:

2009	Fallow
2010	Fallow
2011	Winter Wheat
2012	Fallow
2013	Winter Wheat

Translation to a
common
'language':

Fa : Fallow
Ww : Winter Wheat

Source: LMOD crop rotations (CMZ 5 & Irrigated: False)

Management options (all CMZs 30000) :

- *Irrigated or non-irrigated*

- **Wheat, winter & Corn, grain**
- **Wheat, winter & Corn, grain & Millet**
-

Genetic Algorithm matches the two sequences.

NASS CropScape : FaFaWwFaWw

LMOD record : FaWw □ Fallow; Wheat, winter

5. Link AOI to Management and Operation Practices

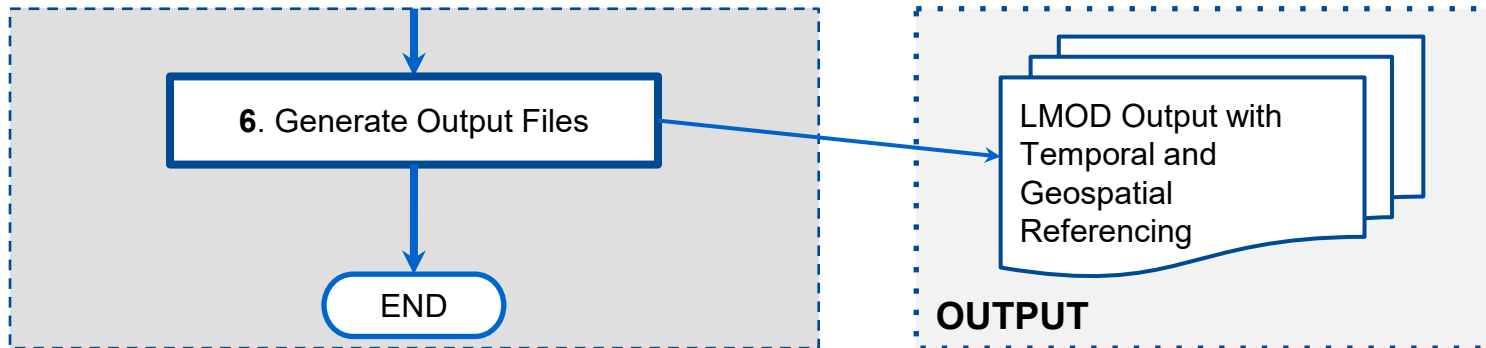


PolygonID	NASS-Year	Dominant-Crop	Confidence-Value(0-100)	Irrigated	Irrigated Area	2nd crop	2nd Conf.Index
7	2008	Alfalfa	71	Yes	82	Grass/Pasture	11
7	2009	Alfalfa	73	Yes	82	Corn	7
7	2010	Alfalfa	73	Yes	82	Dry Beans	2
7	2011	Alfalfa	77	Yes	82	Sugarbeets	5
7	2012	Alfalfa	73	Yes	82	Corn	12
7	2013	Alfalfa	80	Yes	82	Corn	9

LMOD KEY	CMZ	IRRIGATED	w/Cover-Crop	Crop sequence
"9177684190369908892	5	TRUE	non-cover	Alfalfa;Alfalfa;Alfalfa;Alfalfa;Alfalfa

MANKEY	OPKEY	DATE	SEED_HARV	VEGETATION	HARV_FRA
9177684190369908892"	8708124062829849131"	0000.08.30	Seeding	Alfalfa	
9177684190369908892"	8708124062829849219"	0001.05.25	Harvest	Alfalfa	
9177684190369908892"	8708124062829849219"	0001.07.01	Harvest	Alfalfa	
9177684190369908892"	8708124062829849219"	0001.08.20	Harvest	Alfalfa	
9177684190369908892"	8708124062829849219"	0002.05.25	Harvest	Alfalfa	

OPKey	Till_Intensity	Till_Depth_Max	Till_Depth_Min	Harvest_Amount	Harvest_Loss
	1	10	6		



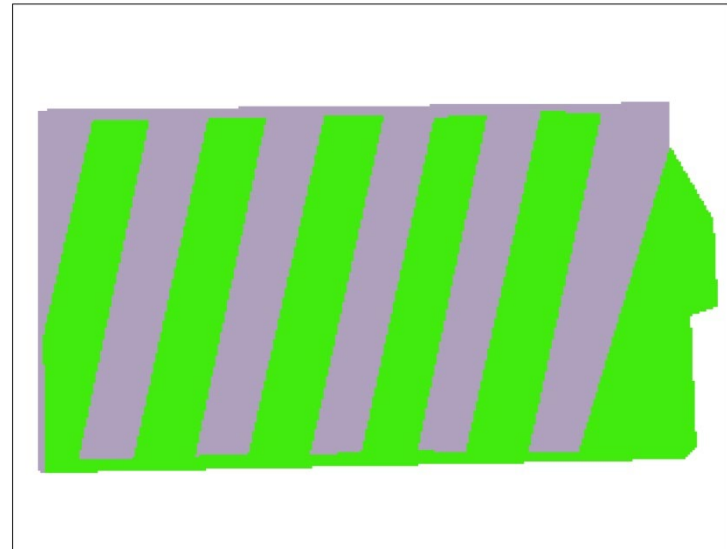
PolygonID	NASS-Year	LMOD DB_record
7	2008	9177684190369908892"
7	2013	9177684190369908892"

Alfalfa; Alfalfa; Alfalfa; Alfalfa; Alfalfa;
Alfalfa

LAMPS-CSIP Service Request for scott.json

scott.json

```
{
  "metainfo": {},
  "parameter": [
    {
      "name": "geometry",
      "value": "scott.kmz"
    }
  ]
}
```



Call Webservice:

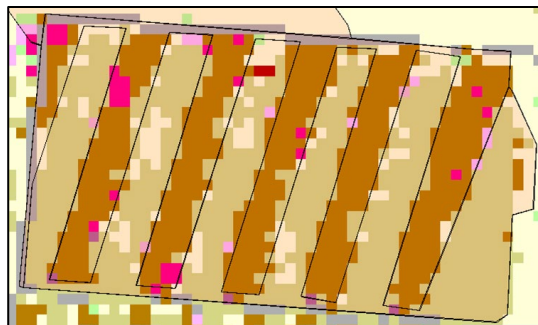
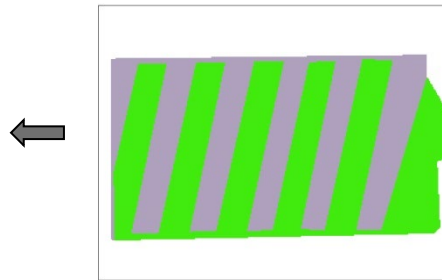
```
curl -X POST -dparam=@scott.json -d file1=@scott.kmz@
http://csip.engr.colostate.edu:8088/csip-lamps/m/lamps/1.0
```

LAMPS-CSIP Service Response for scott.json

```

"parameter": [{
  "name": "geometry",
  "value": "scott.kmz"
}],
"result": [
  ...
  {
    "name": "NASS_dominant_crop.csv",
    "value": "http://localhost:8080/csip-lamps/q/74ef0055-ea8f-11e3-b286-f554bca29d2f/NASS_dominant_crop.csv"
  },
  {
    "name": "NASS_2010.tif",
    "value": "http://localhost:8080/csip-lamps/q/74ef0055-ea8f-11e3-b286-f554bca29d2f/NASS_2010.tif"
  },
  ...

```



PolygonID	NASS-Year	Dominant-Crop	Confidence	Irrigated	Irrigated Ar	2nd domi	2nd crop
1	2008	Grass/Pasture	48	No	0	Winter W	36
1	2009	Fallow/Idle Cropland	79	No	0	Develope	4
1	2010	Winter Wheat	71	No	0	Fallow/Id	9
1	2011	Fallow/Idle Cropland	72	No	0	Grass/Pas	2
1	2012	Fallow/Idle Cropland	63	No	0	Winter W	10
1	2013	Corn	46	No	0	Sugarbee	9
2	2008	Grass/Pasture	88	No	0	Winter W	7
2	2009	Fallow/Idle Cropland	44	No	0	Winter W	19
2	2010	Fallow/Idle Cropland	70	No	0	Grass/Pas	6
2	2011	Winter Wheat	47	No	0	Grass/Pas	18

Management ID 11 = Winter Wheat – Fallow

MID	CID	Date	TID	FID	Famount kg/ha	PLANT	HARVEST	FRACHARV
11	27	03-16	76	-	-	-	-	-
11	27	03-17	-	??	???	-	-	-
11	27	03-21	-	-	-	1	-	-
11	27	05-02	-	??	???	-	-	-
11	27	08-22	-	-	-	-	1	0.9
11	27	08-23	1	-	-	-	-	-
11	27	01-01	-	-	-	-	-	-
11	27	12-31	-	-	-	-	-	-

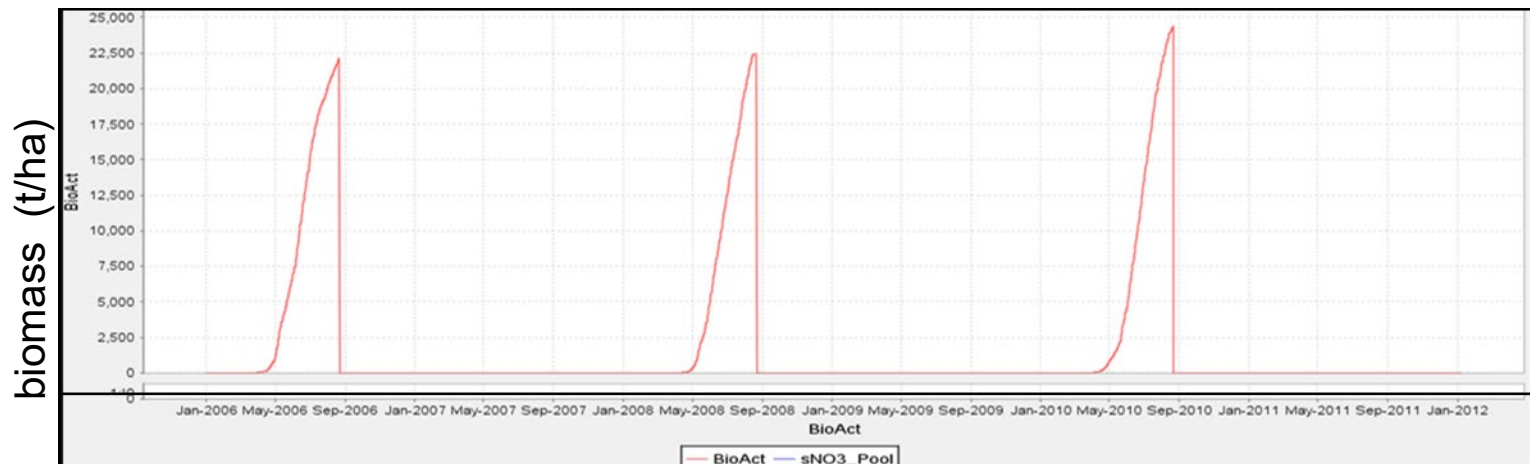
CID 27 = Crop ID
Winter Wheat;

TID = Tillage operation
1 FALLPLOW,
76 BEETCULT;

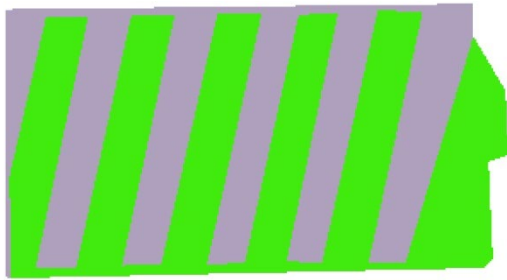
FID = Fertilizer ID
45 Beef-Fresh Manure
21 15-15-15 N-P-K

model
input

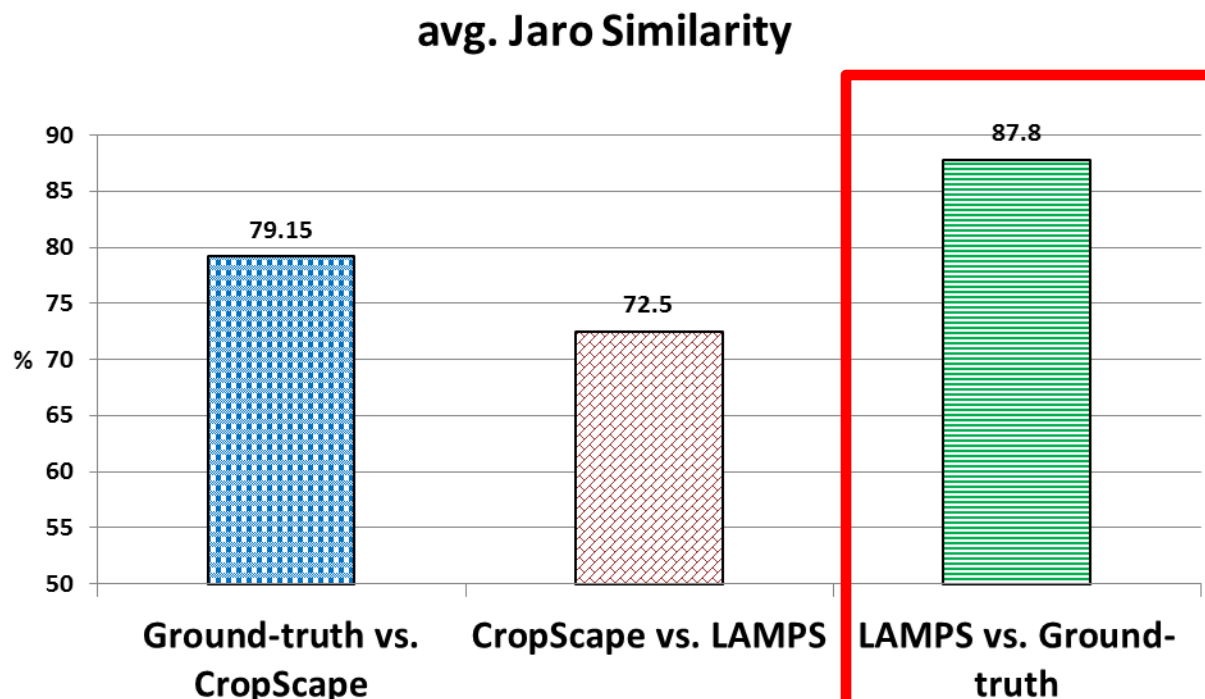
model
output



Scott Field:



	West part	East part
Ground-truth:	WwFaWwFaWwFa	FaCoFaWwFaWw
NASS CropScape:	GrFaWwFaFaCo	GrFaFaWwFaWw
LAMPS rebuilt:	WwFaWwFaWwFa	FaWwFaWwFaWw



Co: Corn
 Fa: Fallow
 Gr: Grassland
 Ww: Winter Wheat

Summary & Future Work

- LAMPS links a specific geospatial area (a catchment distributed with HRUs) by using a high-resolution crop data layer to obtain detailed crop rotation management and operation database information.
- LAMPS is designed to provide management input data for the Ages & SWAT+ model.
- LAMPS is available as a CSIP web service and widely used to detect crop management histories
- LAMPS will be extended to fully support SWAT+ input files requirements

```
{
  "name": "management",
  "value": [
    {
      "name": "MNMOFS_41",
      "events": [
        {
          "date": "2002-05-12",
          "type": "op-tillage",
          "op_id": 22959,
          "name": "Cultivator, field 6-12 in sweeps"
        },
        {
          "date": "2002-05-12",
          "type": "op-amendment-fertilizer",
          "op_id": 22691,
          "name": "Fert applic. shank low disturb, 15 in spacing",
          "min_n_lbs_ac": 25,
          "min_p_lbs_ac": 0,
          "nh4_fraction": 0.25
        },
        {
          "date": "2002-05-15",
          "type": "op-plant",
          "op_id": 22922,
          "name": "Planter, double disk opnr",
          "crop_id": 763,
          "crop_name": "Corn, grain, seed"
        }
      ]
    }
  ]
}
```

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Development of the Land-use and Agricultural Management Practice web-Service (LAMPS) for generating crop rotations in space and time



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ABSTRACT

Agroecosystem models and conservation planning tools require spatially and temporally explicit input data about agricultural management operations. The Land-use and Agricultural Management Practices web-Service (LAMPS) was developed to provide crop rotation and management information for user-specified areas within the 48 contiguous states of the USA. LAMPS links three data sources: (1) annual Cropland Data Layers (CDLs) from the CropScape Web service based on high-resolution remote sensing data for recent years provided by the National Agricultural Statistical Service (NASS), (2) maps of irrigated areas compiled by the U.S. Geological Survey, and (3) the Land Management and Operation Database (LMOD) by the USDA Natural Resources Conservation Service containing agricultural management practices. The workflow within LAMPS for generating crop rotation and management information is described in detail, including details of the algorithm for matching annual crop sequences from CropScape to regional rotations in LMOD. Instructions for using the Web service are specified with example input and response listings. A study area of 15 fields in Colorado, USA is presented to demonstrate and evaluate LAMPS outputs using ground observations of crop types. LAMPS automatically detected actual crop rotations with a similarity to the ground observations better than using only CropScape detected dominant crop sequences. LAMPS is available for public use, further nation-wide evaluation, and extension to other spatial data provisioning related to agroecosystem modelling.

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Thank you!

Questions?

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