



# Calculation Actual and Potential Evapotranspiration by developing a Tool for MODIS Product - MOD16A2

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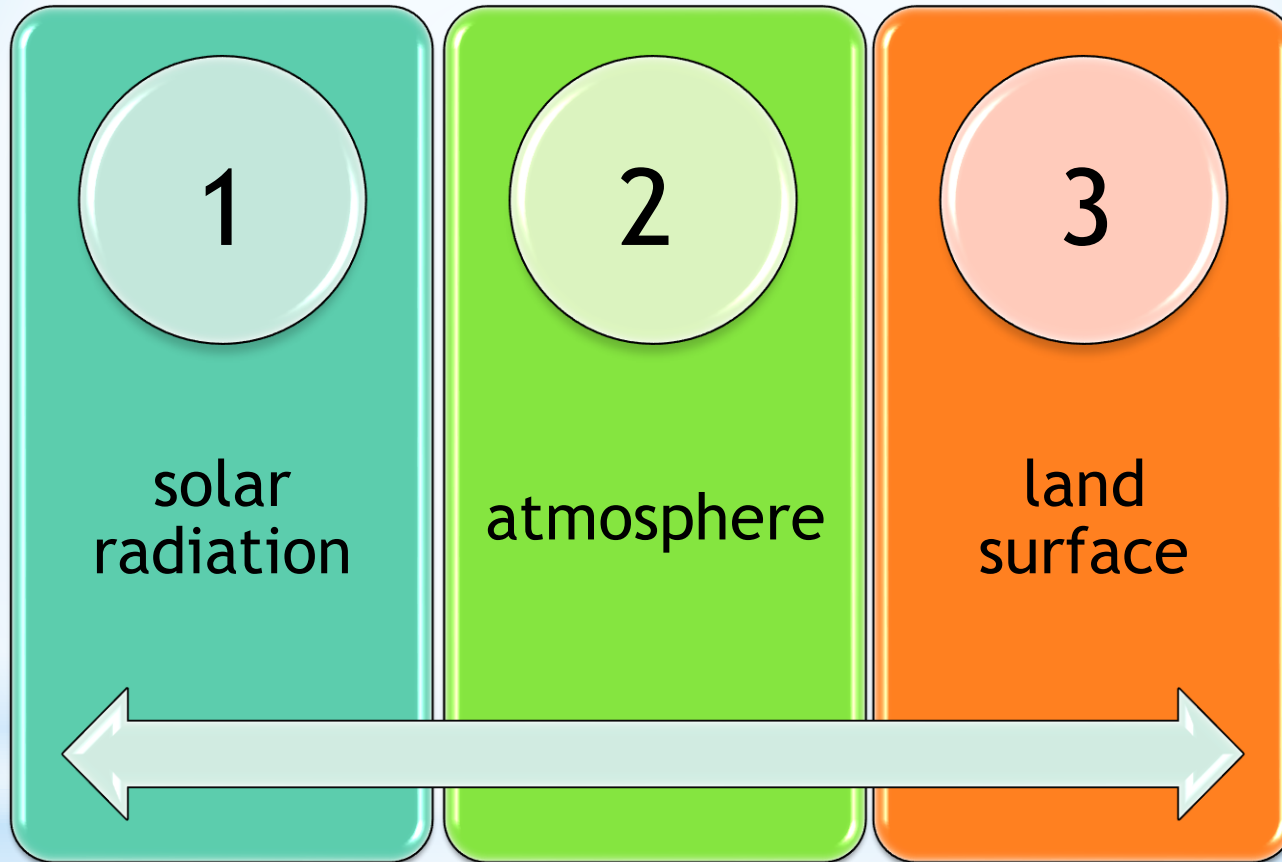
International Conference, Climate Smart Agriculture: the Way  
of Farming for 21<sup>st</sup> Century

# Introduction

- Monitoring and estimating of daily evapotranspiration (ET) is vital and necessary for allocating and managing water resources in agricultural areas.
- Actual evapotranspiration (AET) is the quantity of water that is actually removed from a surface due to the processes of evaporation and transpiration.



# AET



Estimating and calculating the value of AET is complex and not an easy process.

## Our objective

- To develop a complete tool for extracting different data from MOD16A2 products and analyzing the data
- Test the tool on a specific sugarcane field in the southwest of Iran.





# ET measurement techniques



# Material and Methods

- The MOD16A2 product includes actual evapotranspiration (AET), latent heat flux (LE), potential evapotranspiration (PET) and potential latent heat flux (PLE) datasets at 1 km spatial resolution, for 8-day, monthly and annual intervals.
- The 8-day ET is the sum of ET during these 8-day time periods. We used the year of 2015 on a daily scale and 8-day intervals.



❖ There are two fundamental concepts in calculation evapotranspiration's concepts in MOD16:

Energy  
Partitioning Logic

Penman-Monteith  
Logic.



# Equations

$$H = \rho C_p \frac{T_s - T_a}{r_a}$$

$$\lambda E = \frac{\rho C_p (e_{sat} - e)}{\lambda (r_a + r_s)}$$

$$A' = R_{net} - \Delta S - G = H + \lambda E$$

The second equation is the Penman-Monteith that

$$\lambda E = \frac{sA' + \rho C_p \frac{VPD}{r_a}}{s + \gamma (1 + r_s/r_a)}$$



# Case Study

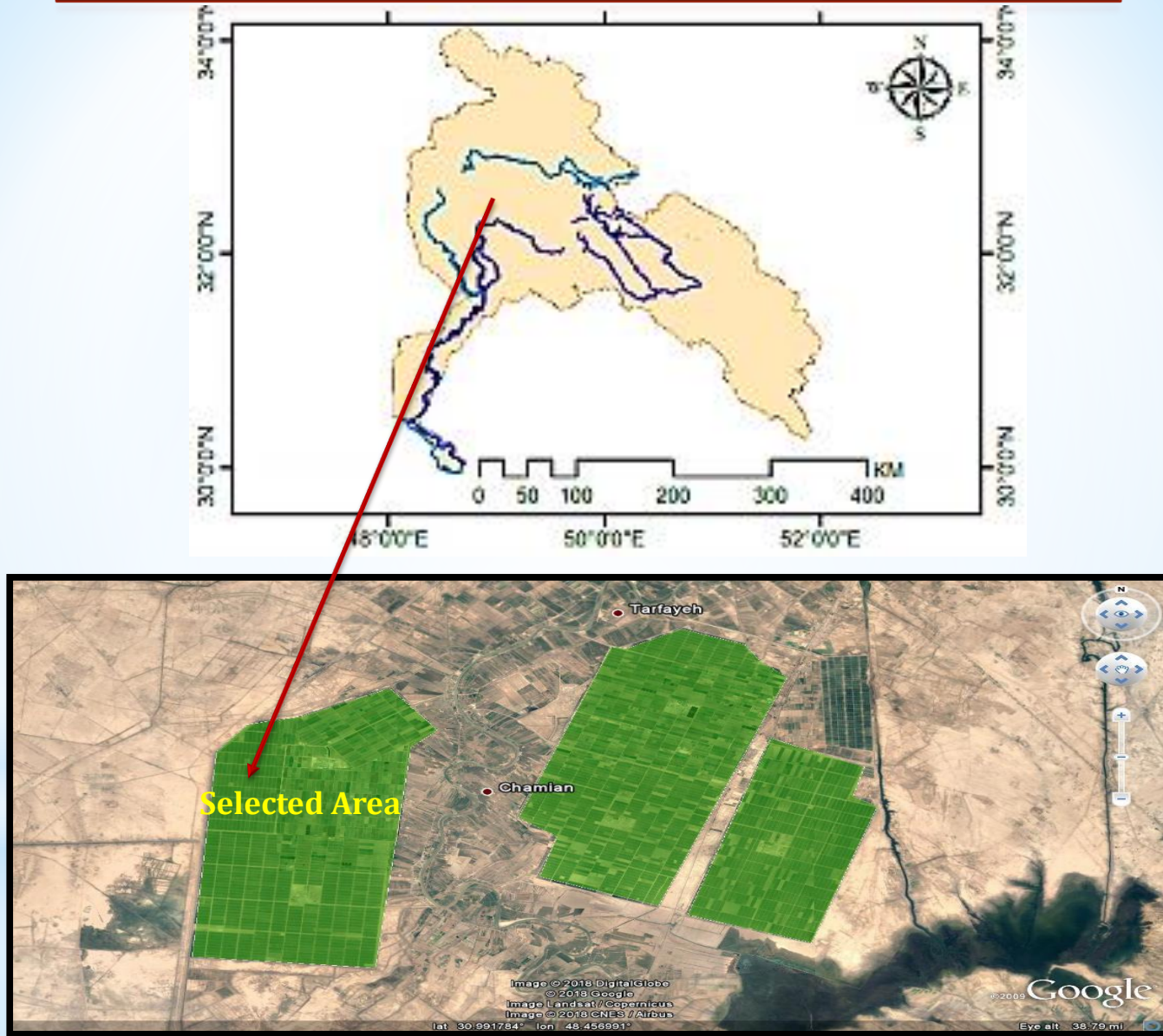


Fig. 1 The selectd area in the Khuzestan province which is planted by sugarcane

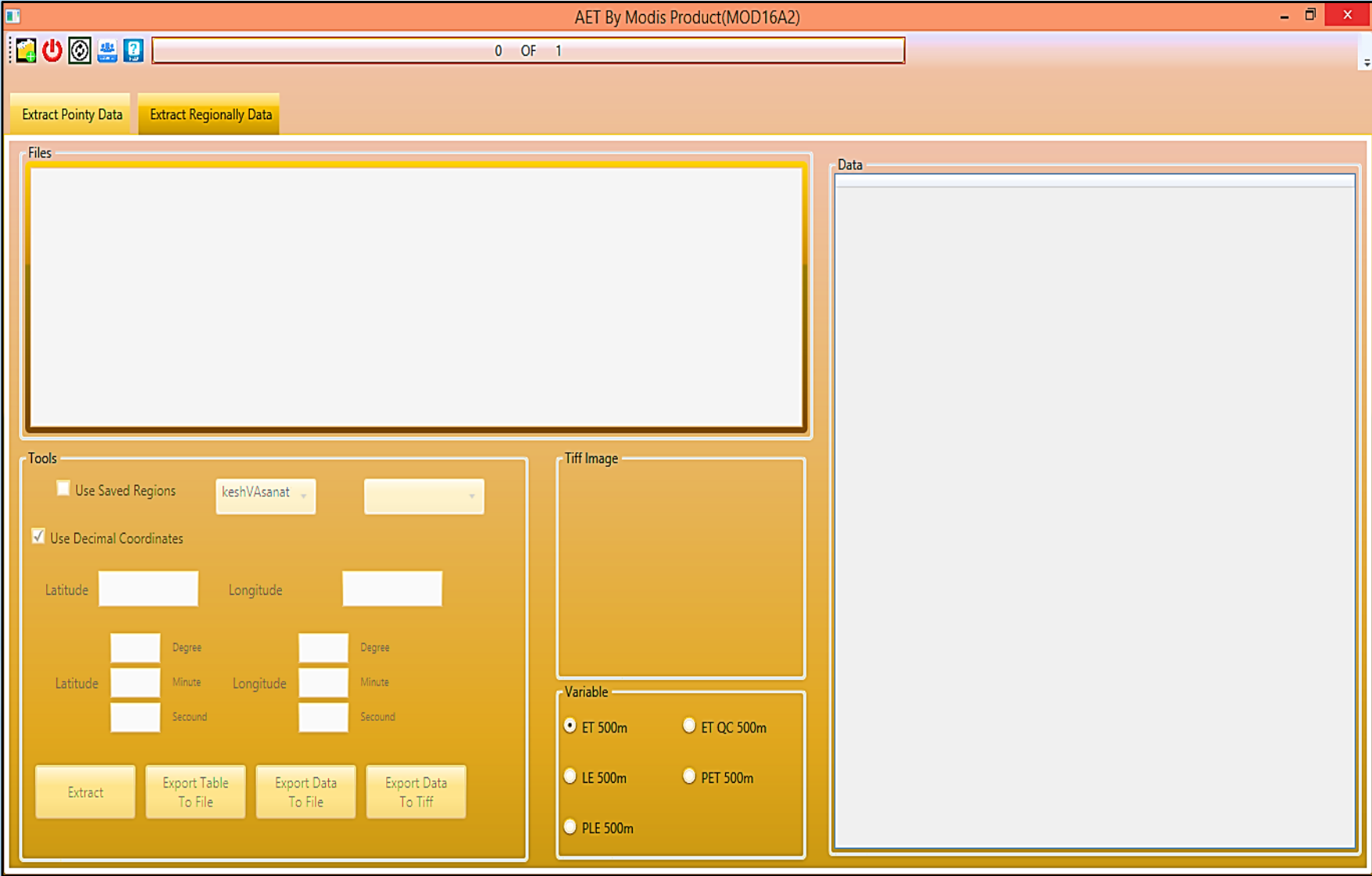


*Applicable and Useful Software Tool*



**MOD16A2 tool**

## MOD16A2 Tool



**Fig. 2** The Main screen of the MOD16A2 tool

# MOD16A2 Tool

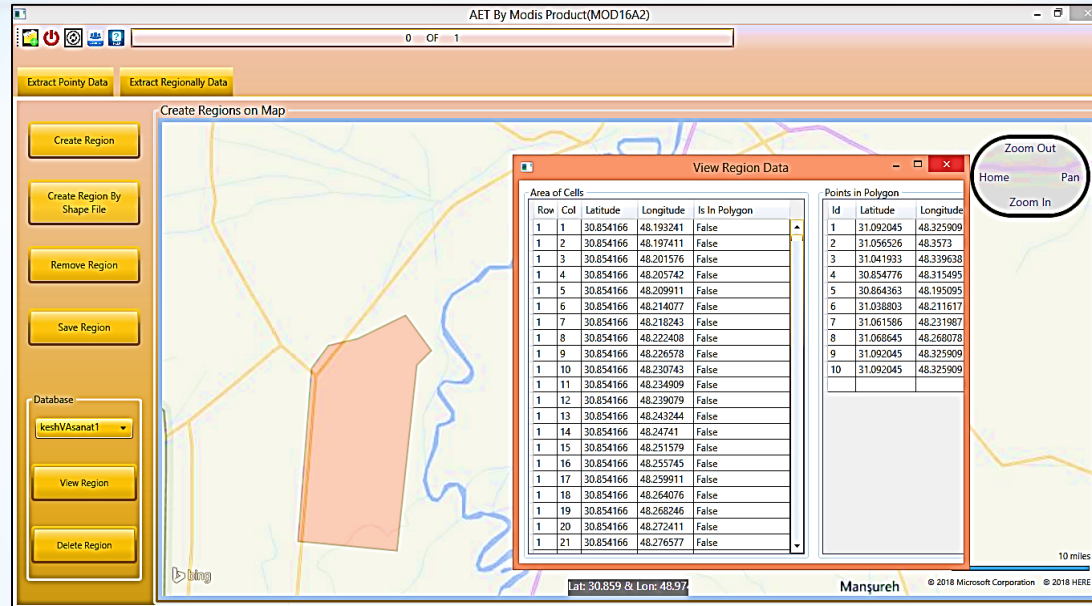


Fig. 3 Create a region on the map for extracting MOD16A2 data.

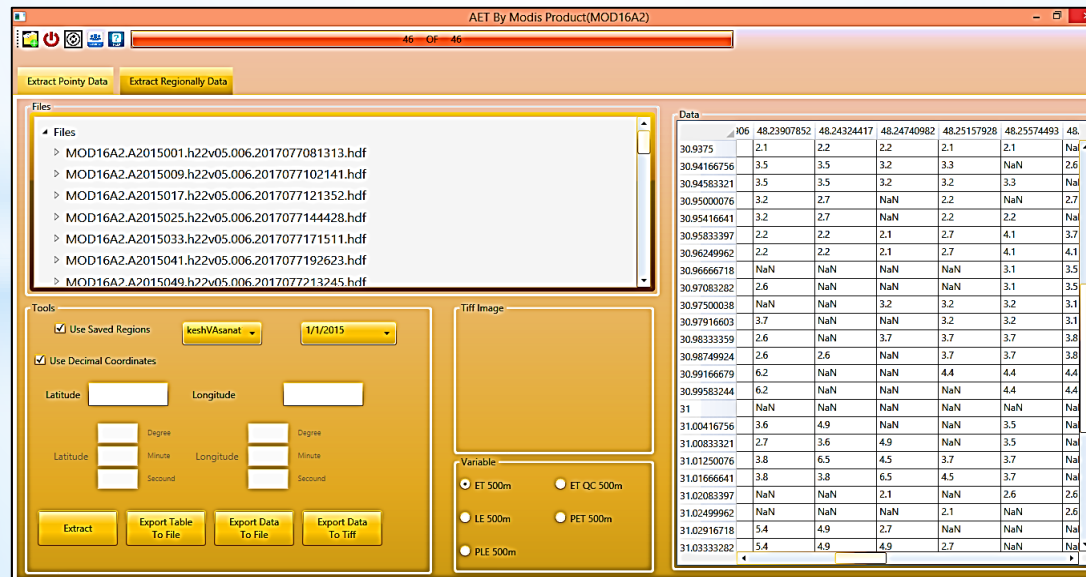


Fig. 4 Load the hdf files of the selected region from MOD16A2 data.



# MOD16A2 Tool

AET By Modis Product(MOD16A2)

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Extract Pointy Data Extract Regionally Data

Files

- MOD16A2.A2015001.h22v05.006.2017077081313.hdf
- MOD16A2.A2015009.h22v05.006.2017077102141.hdf
- MOD16A2.A2015017.h22v05.006.2017077121352.hdf
- MOD16A2.A2015025.h22v05.006.2017077144428.hdf
- MOD16A2.A2015033.h22v05.006.2017077171511.hdf
- MOD16A2.A2015041.h22v05.006.2017077192623.hdf
- MOD16A2.A2015049.h22v05.006.2017077213245.hdf

Tools

☒ Use Saved Regions keshVAsanat 1/1/2015

☒ Use Decimal Coordinates

Latitude Longitude


Latitude Degree Longitude Degree

Latitude Minute Longitude Minute

Latitude Second Longitude Second

Extract Export Table To File Export Data To File Export Data To Tiff

Tiff Image



Variable

☒ ET 500m ☐ ET QC 500m

☐ LE 500m ☐ PET 500m

☐ PLE 500m

Data

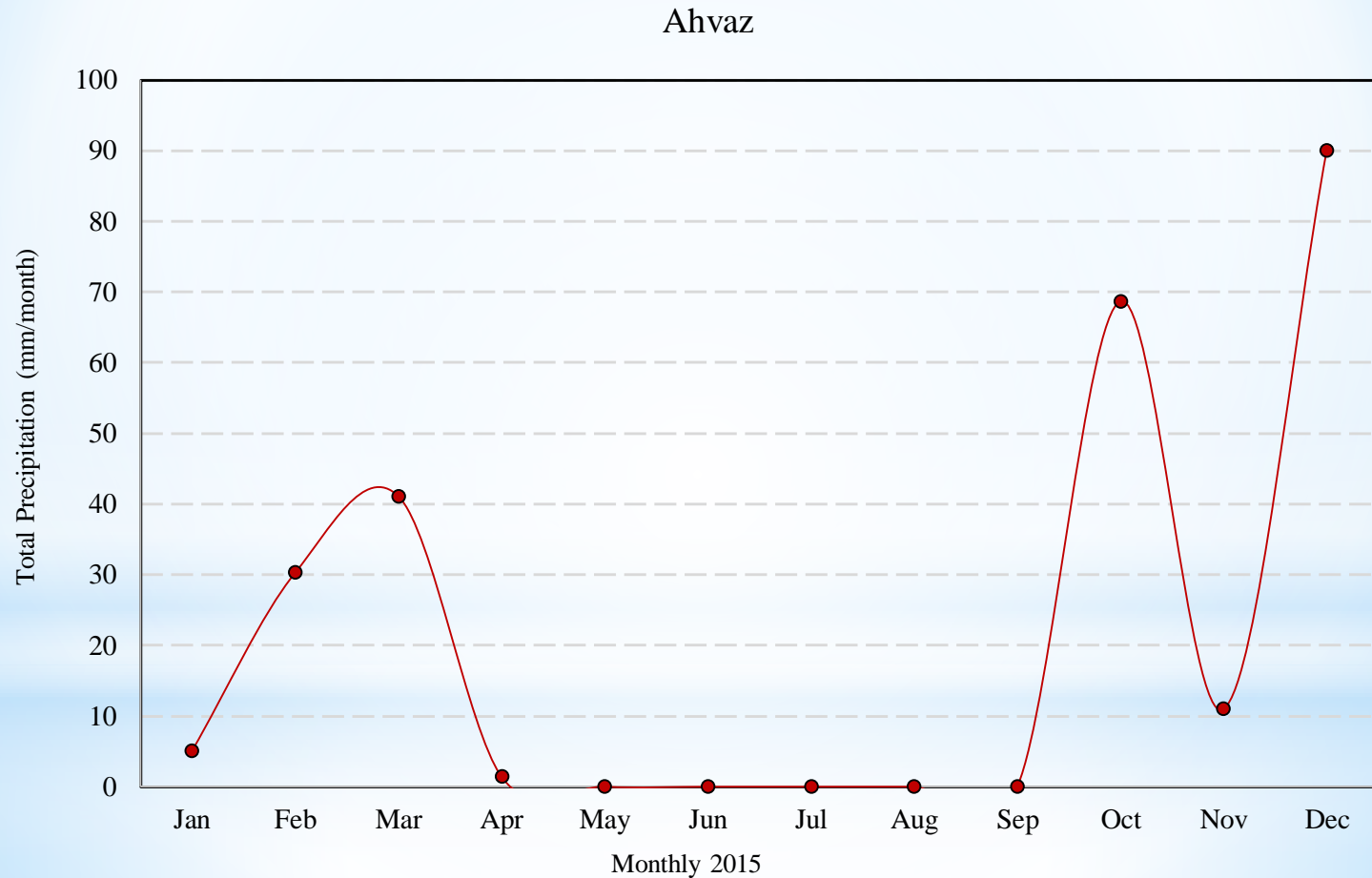
	06	48.23907852	48.24324417	48.24740982	48.25157928	48.25574493	48.
30.9375	2.1	2.2	2.2	2.1	2.1	NaN	
30.94166756	3.5	3.5	3.2	3.3	NaN	2.6	
30.94583321	3.5	3.5	3.2	3.2	3.3	NaN	
30.95000076	3.2	2.7	NaN	2.2	NaN	2.7	
30.95416641	3.2	2.7	NaN	2.2	2.2	NaN	
30.95833397	2.2	2.2	2.1	2.7	4.1	3.7	
30.96249962	2.2	2.2	2.1	2.7	4.1	4.1	
30.96666718	NaN	NaN	NaN	NaN	3.1	3.5	
30.97083282	2.6	NaN	NaN	NaN	3.1	3.5	
30.97500038	NaN	NaN	3.2	3.2	3.2	3.1	
30.97916603	3.7	NaN	NaN	3.2	3.2	3.1	
30.98333359	2.6	NaN	3.7	3.7	3.7	3.8	
30.98749924	2.6	2.6	NaN	3.7	3.7	3.8	
30.99166679	6.2	NaN	NaN	4.4	4.4	4.4	
30.99583244	6.2	NaN	NaN	NaN	4.4	4.4	
31	NaN	NaN	NaN	NaN	NaN	NaN	
31.00416756	3.6	4.9	NaN	NaN	3.5	NaN	
31.00833321	2.7	3.6	4.9	NaN	3.5	NaN	
31.01250076	3.8	6.5	4.5	3.7	3.7	NaN	
31.01666641	3.8	3.8	6.5	4.5	3.7	NaN	
31.02083397	NaN	NaN	2.1	NaN	2.6	2.6	
31.02499962	NaN	NaN	NaN	2.1	NaN	2.6	
31.02916718	5.4	4.9	2.7	NaN	NaN	NaN	
31.03333282	5.4	4.9	4.9	2.7	NaN	NaN	

Fig. 5 All the AET data of the selected region is presented in the right table.

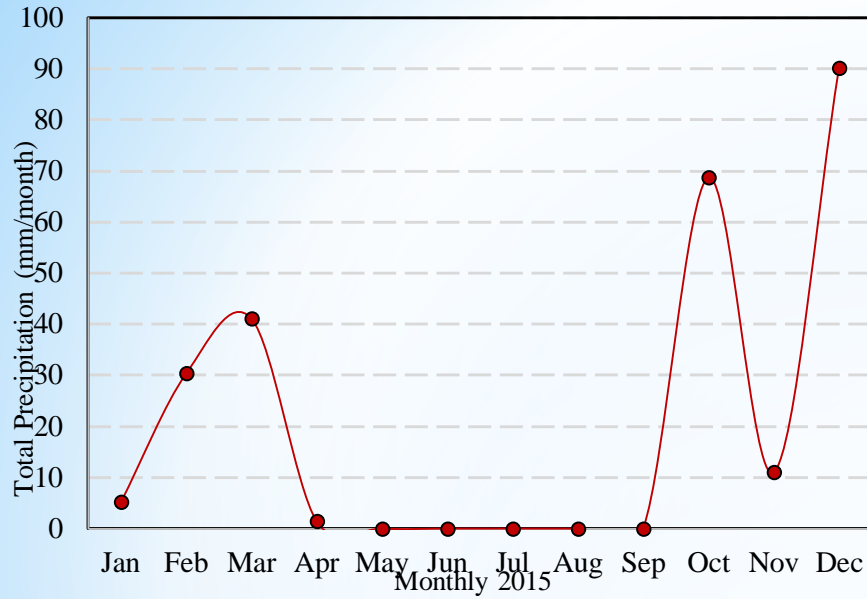


# Results and Discussion

The nearest station to the selected field is the Ahvaz synoptic station.

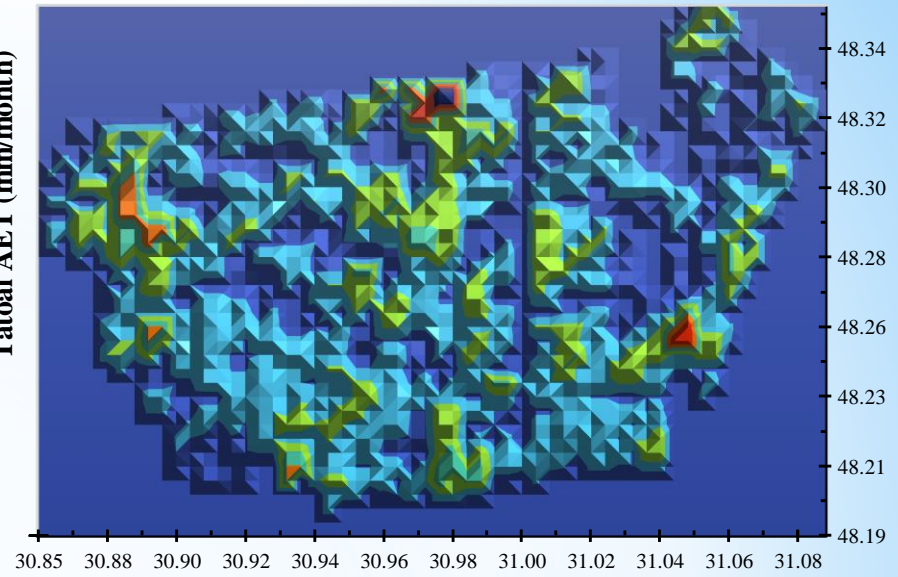


# Ahvaz



0-5 5-10 10-15 15-20 20-25 25-30 30-35

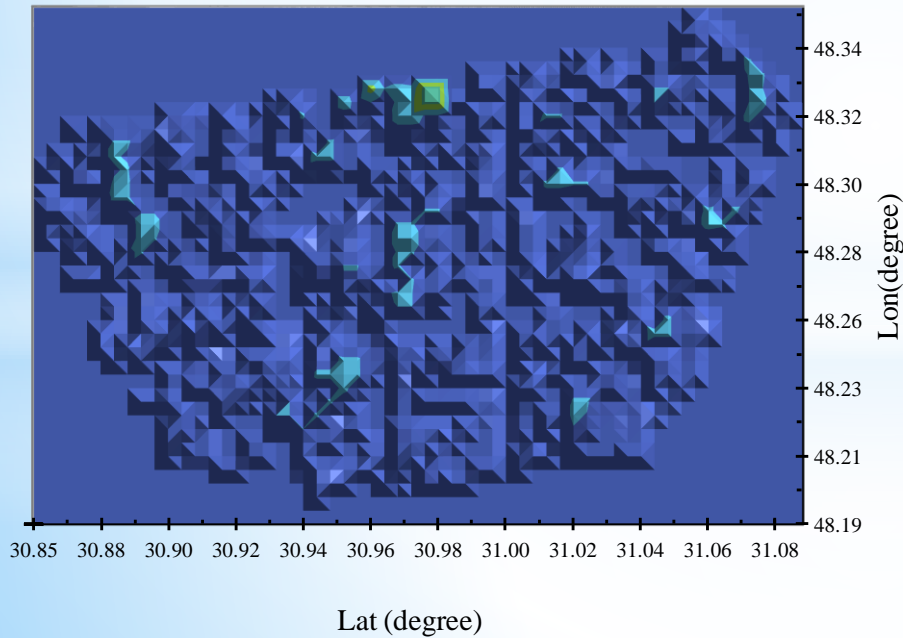
Tatoal AET (mm/month)



Jan

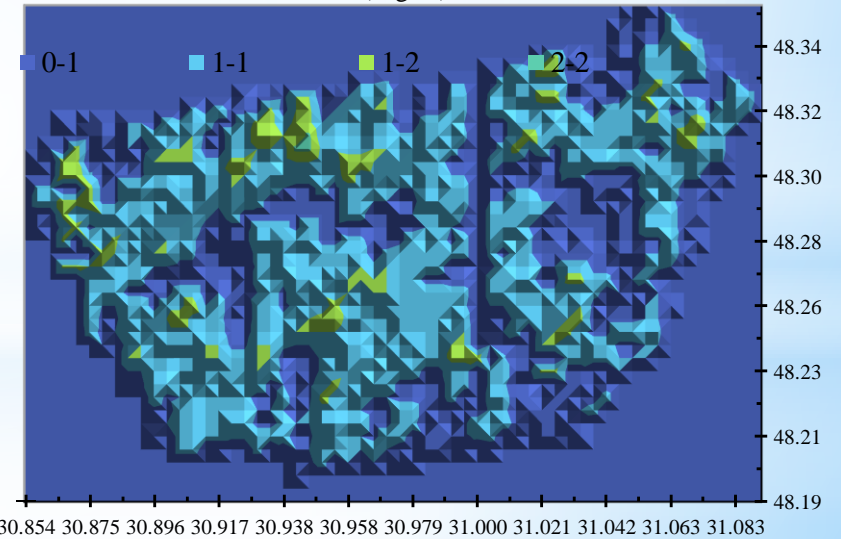
0-10 10-20 20-30 30-40

Feb

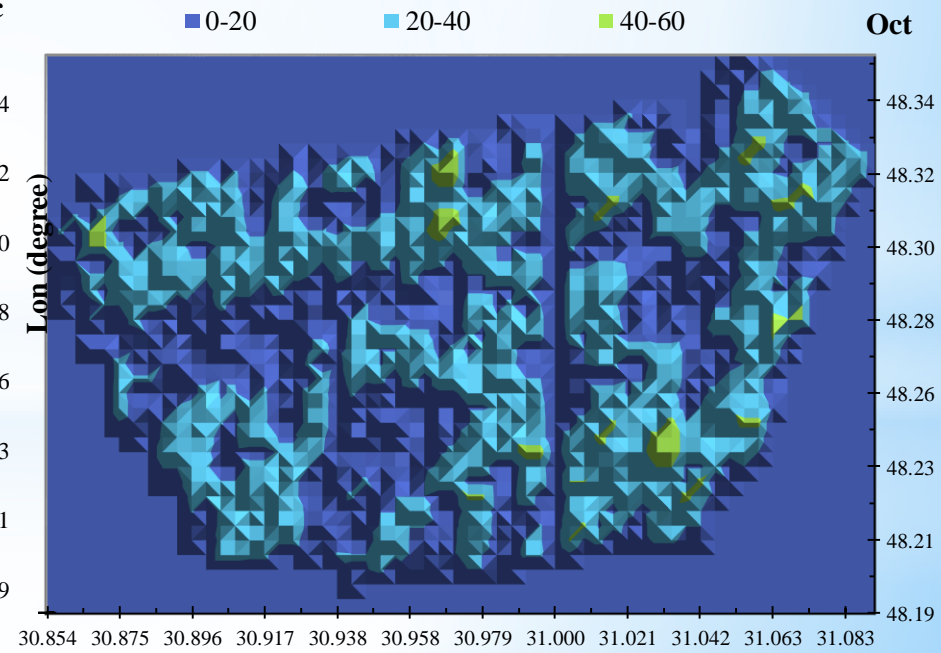
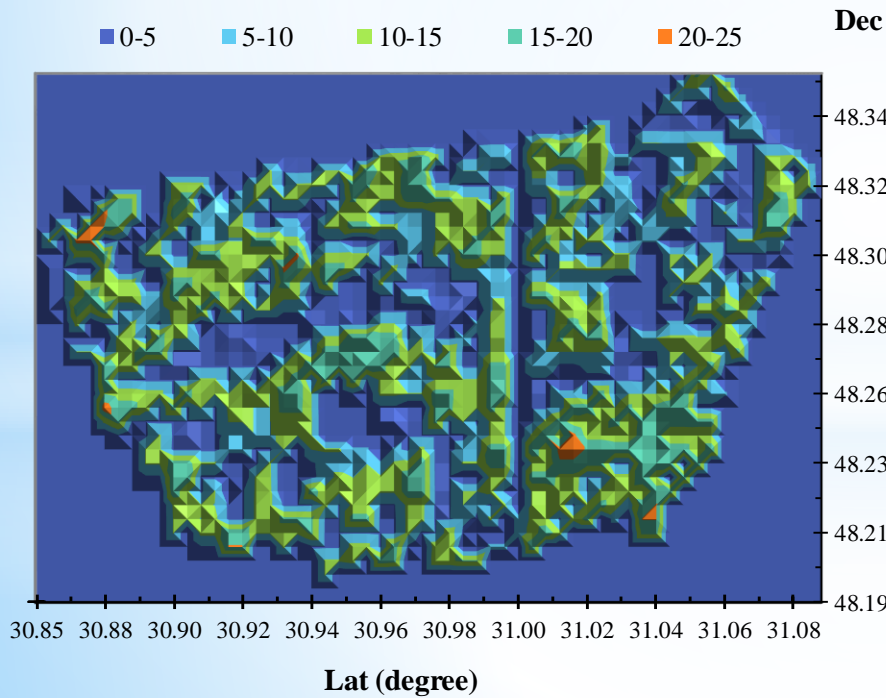
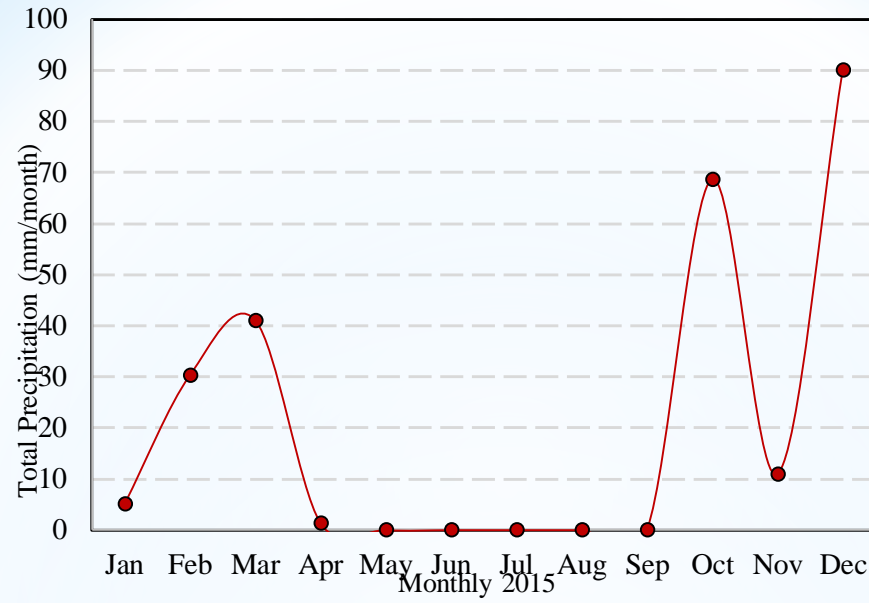


Lat (degree)

Jun



# Ahvaz



# Conclusion

- ✓ Estimation of Actual Evapotranspiration (AET) is of vital importance in water resources management and planning in Iran.
- ✓ Calculating AET from direct and indirect methods are not easy and normally costly and time-consuming. So, remote sensing products are preferable.
- ✓ we developed a tool for extracting MOD16A2.
- ✓ The maximum amount of AET is equal to 60 mm/month and was happened in Oct., also the maximum amount of total precipitation was happened in Oct. and Dec. at 2015 with the amount of 91 and 63 mm/month.

## Conclusion

- ✓ The archived results showed that we can use the tool for extracting AET and other variables including ET, PET, and LE.



Thanks for your attention