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Tackling Climate Change with ML

High-resolution global irrigation prediction with Sentinel-2 30m data

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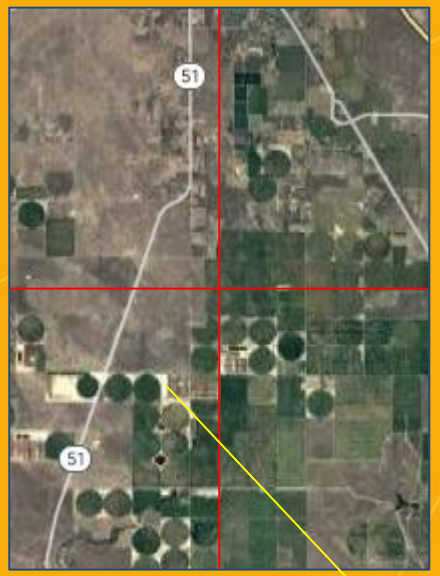
Irrigation impacts climate change

- Irrigation is highly energy-intensive and accounts for 70% of global fresh water usage

- Current irrigation data sources are:
  - Out-of-date
  - Unreliable
  - Low resolution (1km+)

- Irrigation data enables
  - Public Policy → Ensure sustainable water usage
  - Optimize agricultural yield
  - Predict water budgets
  - Climate and Weather modeling

Low Resolution
Each Quadrant: ~8km^2



High Resolution (30m)

Objective: Develop a model to generate 30m-res irrigation predictions of cropland worldwide.

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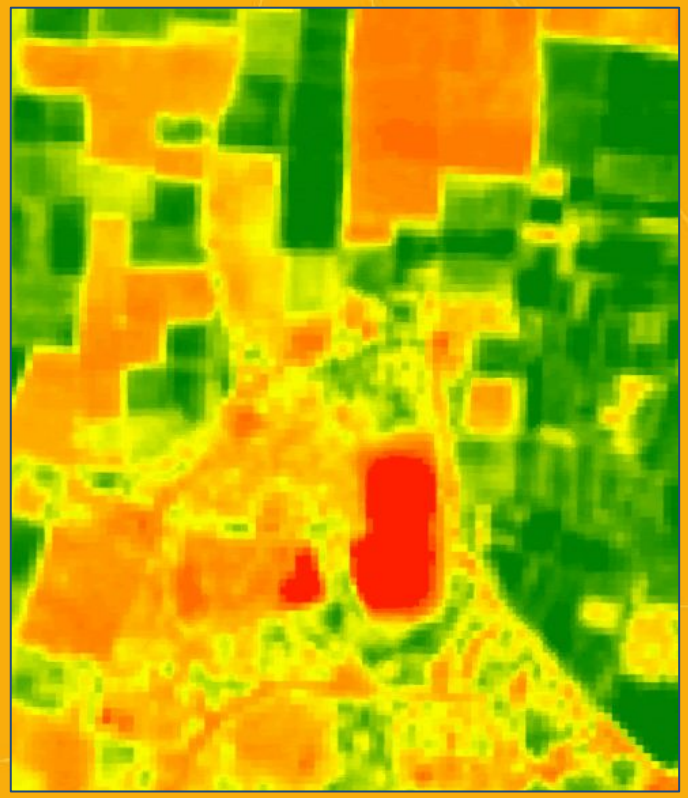
Data Sources

Sentinel-2 @ 10-60m
2015-Current, 5-day revist.



Normalized difference vegetation index (NDVI)

TerraClimate @ ~4.2km.
1958-Current, monthly

GFSAD30 Global Cropland Map @ 30m.
2015

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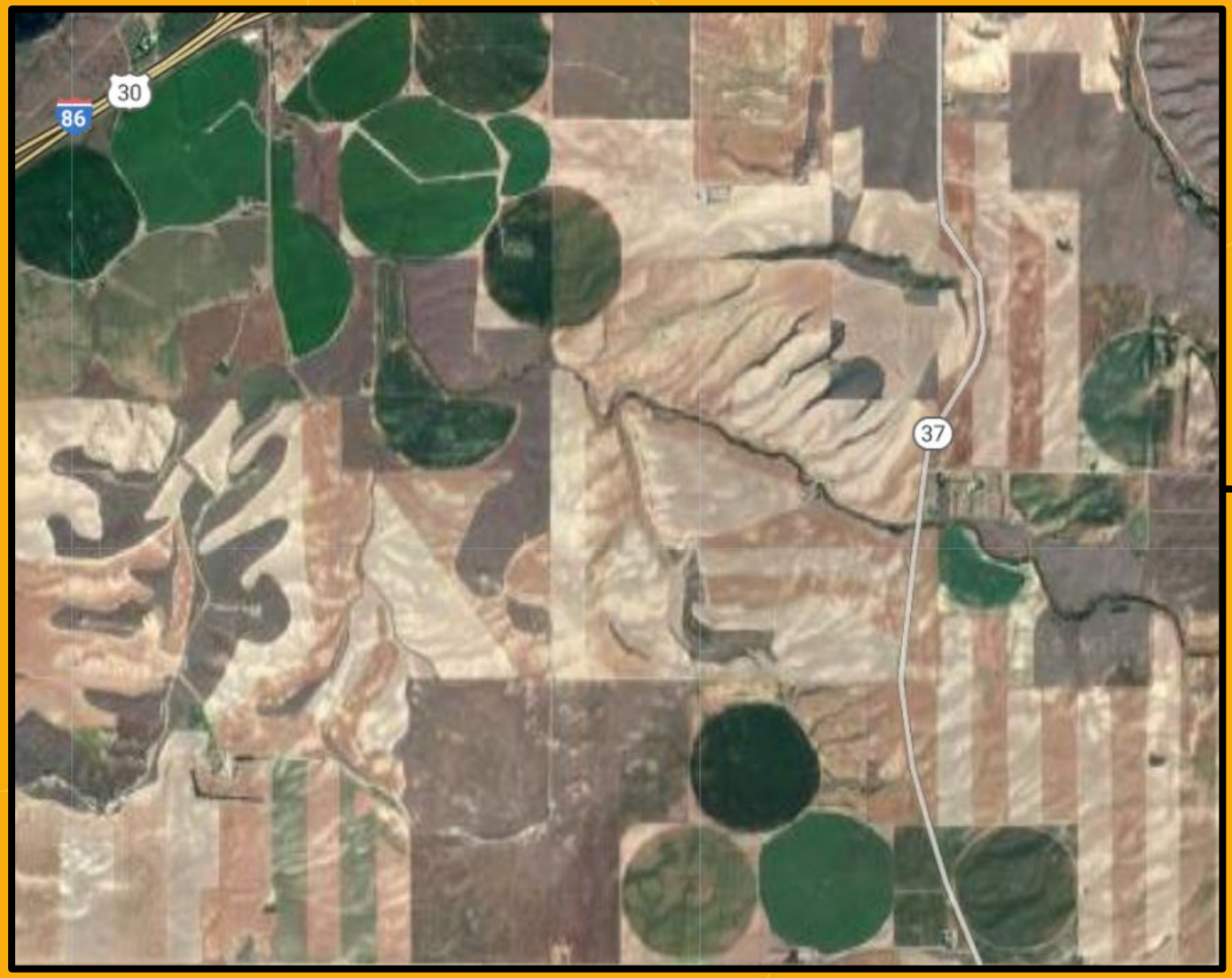
Localized Approach: *specify an area of interest*



Mask Cropland

using GFSAD30

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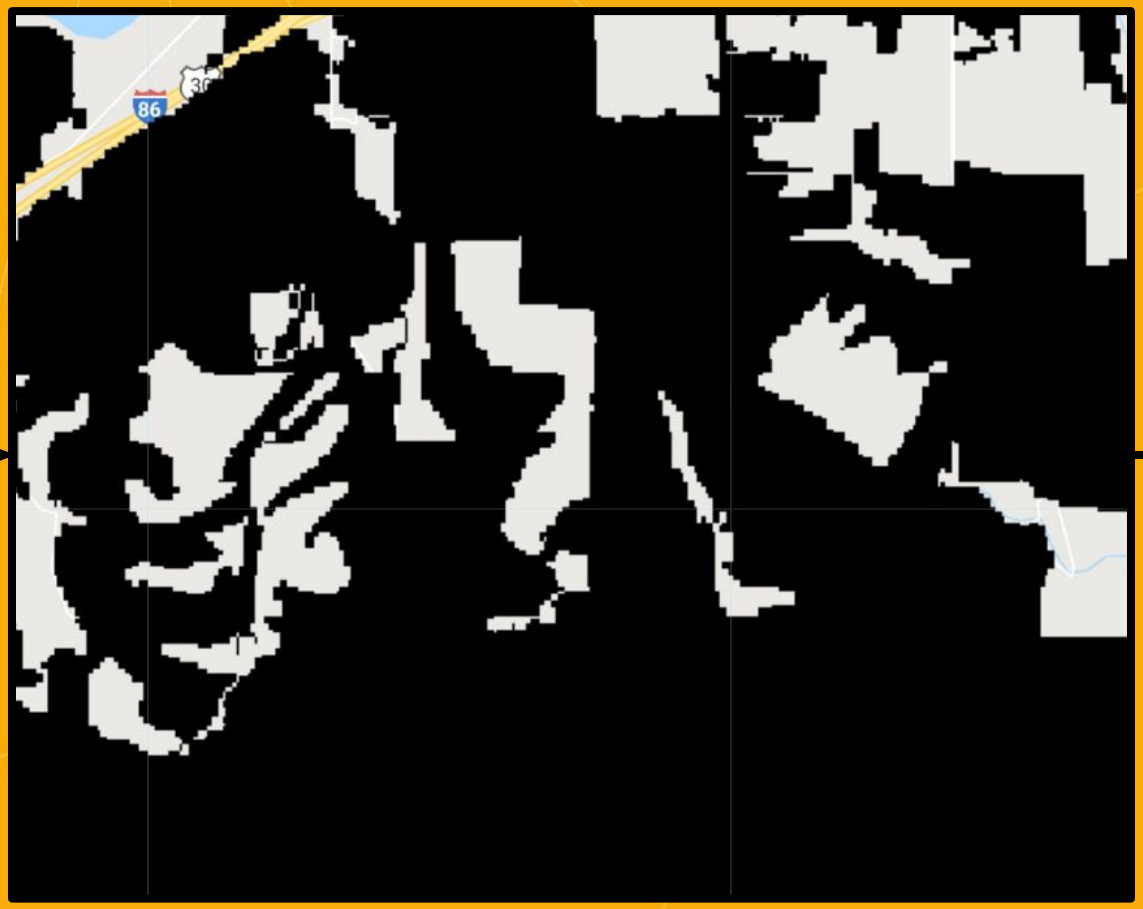
Localized Approach: *identify cropland*

Mask Cropland using GFSAD30



Calc. monthly NDVI using Sentinel-2

Cropland

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Localized Approach: *monthly vegetation index*

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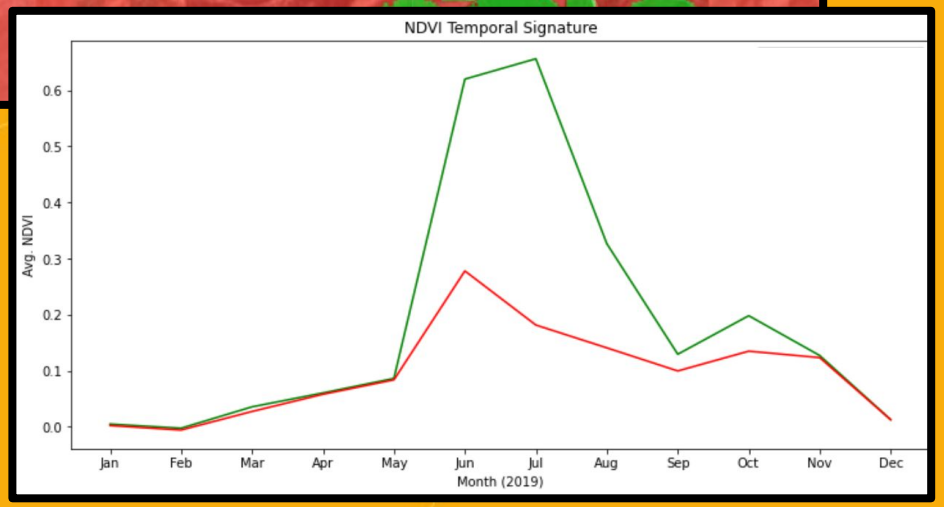
Localized Approach: *cluster output => prediction*

Clustering



Irrigation

Rainfed

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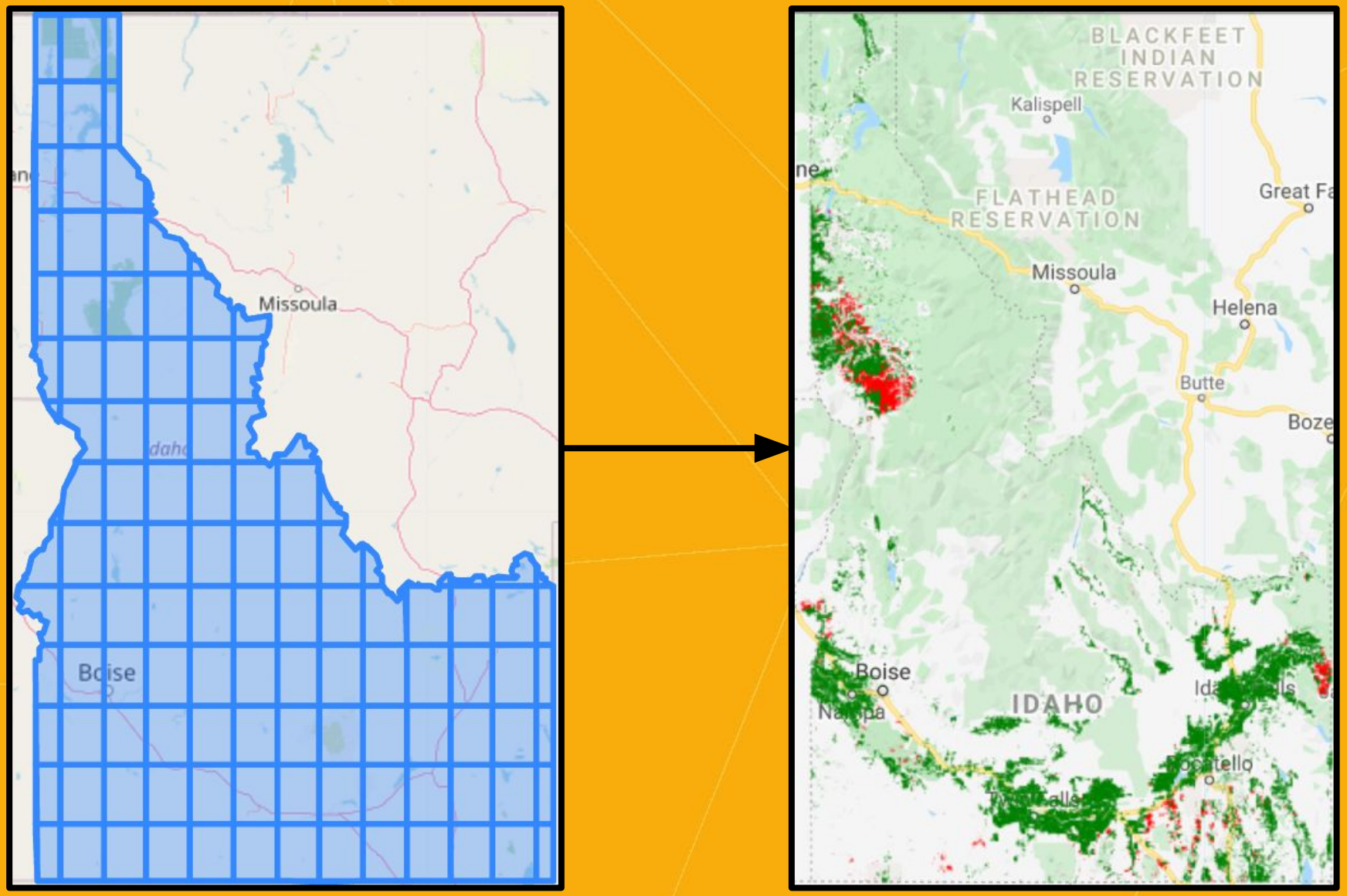
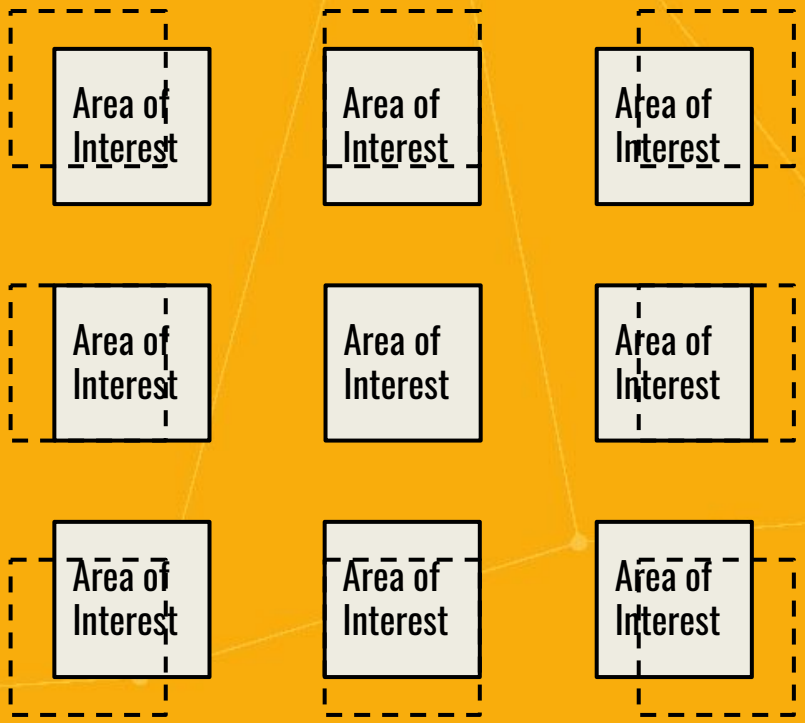
Global Approach: *POC on Idaho, USA*



Evaluation

Consistency Metric



Test cases: 12
Consistency: 97%

Accuracy Metrics

Test cases: 25
# of Countries: 16
Accuracy: 92%

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Conclusion

Important to track global irrigation for climate change

- We use a combination of unsupervised learning and custom heuristics to predict the irrigation status of cropland
- Accuracy of 92% in crowdsourced case study
- Consistent for 97% of pixels

Future Work

- Adapt heuristic thresholds based on known crop types and precipitation in specific geolocations
- Self-supervised contrastive learning for irrigation modeling

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