

AI for Spatial Problems: Challenges & Opportunities

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Acknowledgements:



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What to Consider?

- **Problem**
 - Input, output
 - Measure of success...
- **AI model**
 - Capacity & representation
 - Spatial-awareness
 - Fairness...
- **Data**
 - Ground-truth volume
 - Spatial coverage...
- **Auxiliary**
 - Knowledge...

Too much...

“Simple” Recipe for Success

- Rising excitement and expectation
 - Deep learning, Self-driving...
 - Alpha Go, ChatGPT...

Large Enough Model + **Spatial awareness**
And **Spatial fairness**
Large Enough Data

Why Spatial-Awareness?

- One-size AI does NOT fit all

Which is snow?

Attr: Shashi Shekar, UMN



Runn of Kutch, Gujarat, India



White Sands, NM, USA



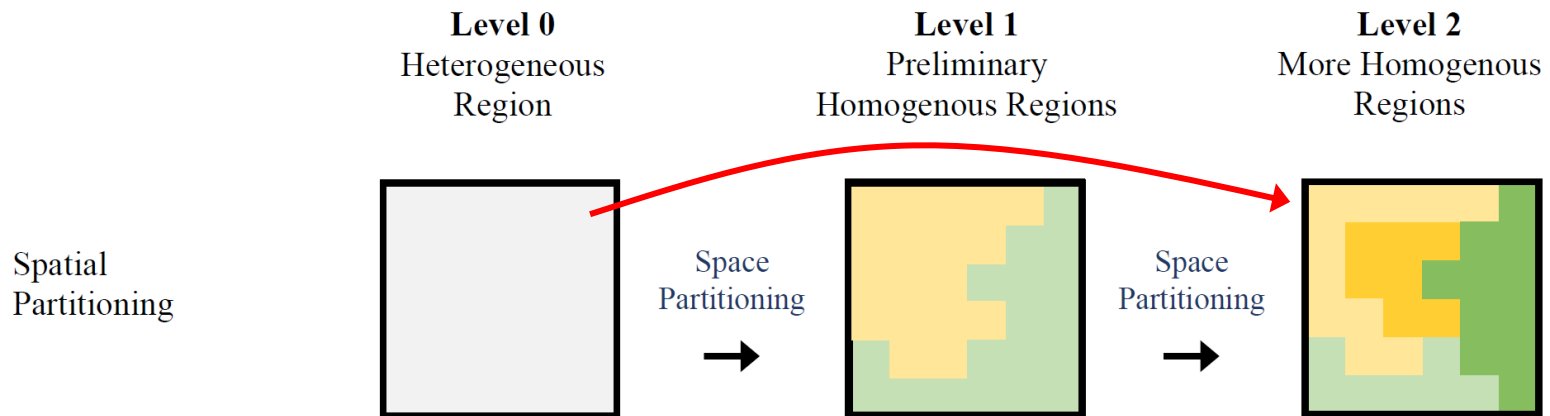
Snow

Spatial-Aware AI

Automatically recognize the conflicts
Learn multiple local models



Best Paper Award,
IEEE Intl. Conf. on
Data Mining 2021



Spatial Fairness

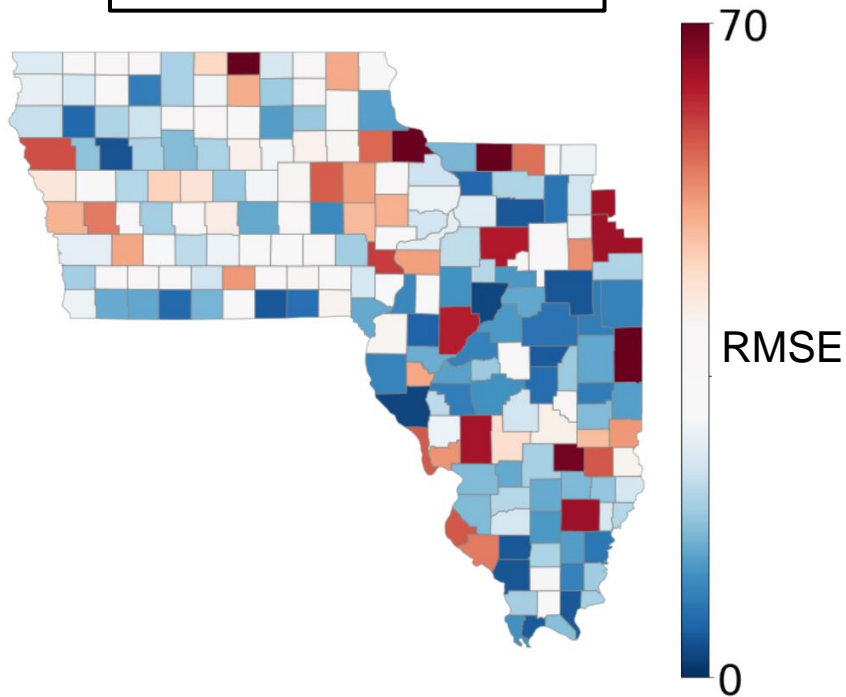
- AI models are **NOT fair** by themselves
- AI **can & will** compromise some locations to favor others
 - Unless we explicitly make it fair

Fairness-Aware Learning in Space

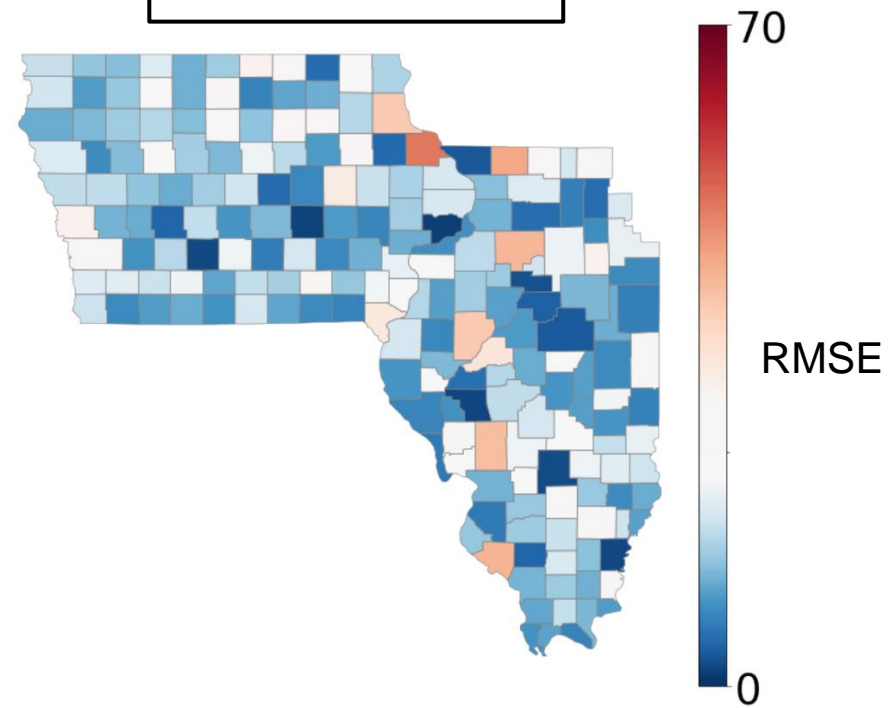
Example: Crop Yield Prediction



Without Fairness



With Fairness



Xie, Y., He, E., Jia, X., Chen, W., Skakun, S., Bao, H., Jiang, Z., Ghosh, R. and Ravirathinam, P.. Fairness by “Where”: A Statistically-Robust and Model-Agnostic Bi-level Learning Framework. AAAI 2022.

Erhu He*, Yiqun Xie*, Licheng Liu, Weiye Chen, Zhenong Jin and Xiaowei Jia. Physics Guided Neural Networks for Time-aware Fairness: An Application in Crop Yield Prediction. Accepted by: AAAI 2023.

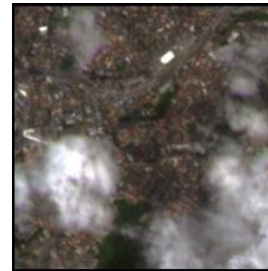
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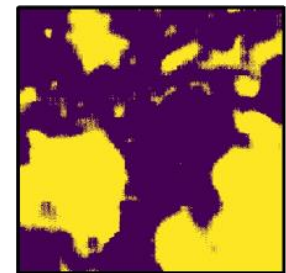
Large Enough Model

And

Large Enough Data



Input & **Output**



“Output” Labels are Hard to Get

- Often human-labeled
 - Limited
 - **Highly-localized**
- **ChatGPT \neq Spatial**
 - Success is non-trivial to replicate

Data distribution in space



LLM

TB/PBs
of:



WIKIPEDIA
The Free Encyclopedia

stackoverflow



...

Raw data already
contain human labels

Spatial

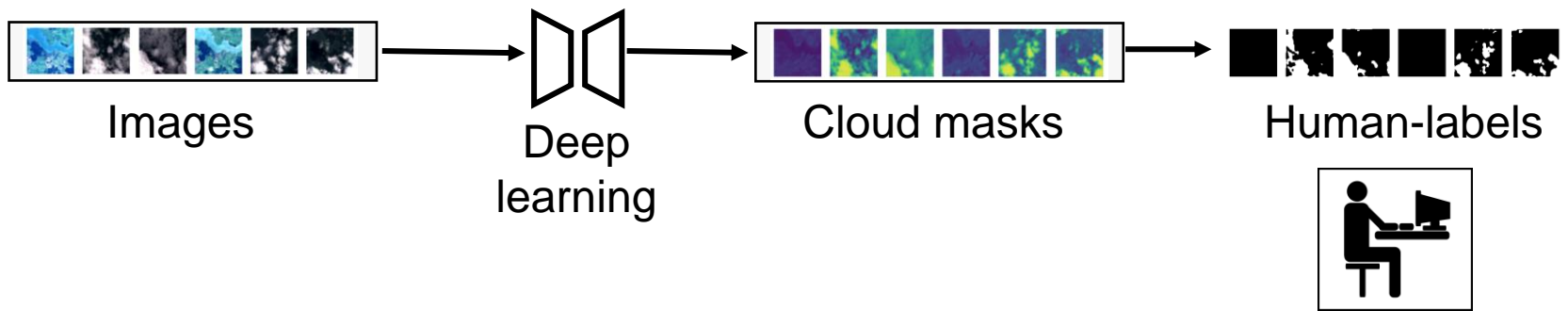


...

Often do not contain
human labels

Turning Inputs to Outputs

Example: Self-supervised cloud masking



Turning Inputs to Outputs

Example: Self-supervised cloud masking

