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# Super-Resolution For Satellite Imagery

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# INTRODUCTION



## THE PRODUCT

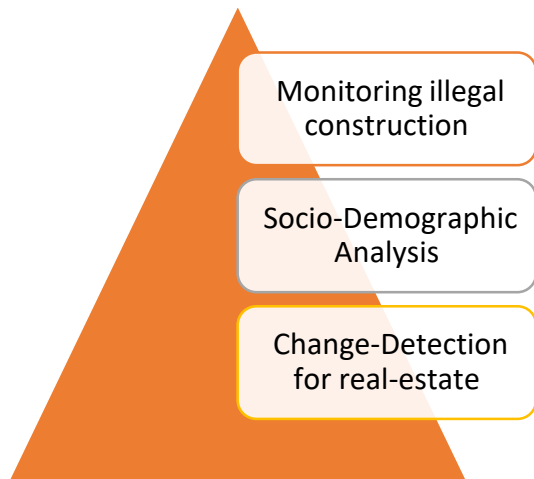
- An app to enhance satellite imagery resolution
- The resolution can be increased by a factor of 2, 3 or 4 times
- Using *Deep Learning* models and after extensive training, machines can be taught how to learn high-resolution spatial features
- Geographically-intelligent model that can learn to enhance images of various landscapes

## PRODUCT GOALS

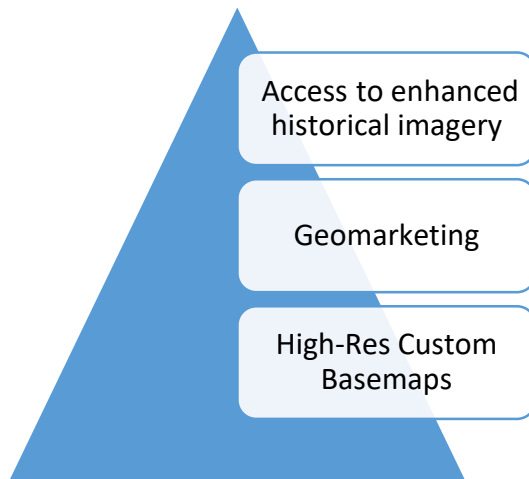
- Enabling low-resolution imagery to be used for micro-level analysis, especially in urban areas
- Overcoming the hardware-level limitations of cost/development to acquire high-quality data
- Democratizing the access of high-quality data
- Enhancing data quality beyond RGB bands and providing high-resolution multi-spectral bands

# USE-CASES, ANY?

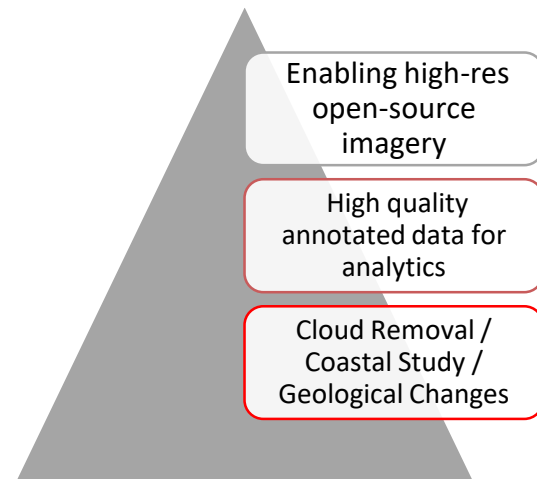
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**Urban Monitoring**



**Location Intelligence**



**Research**

# DATA DEPENDENCY

## 4.1.7 Impact of Sentinel data

This section examines how the use of Sentinel data has influenced the businesses in the survey.

**Q12. Which of the following describe the impact of free and open Sentinel data on your business?**

The following responses were possible (multiple choice, multiple selection):

1. Sentinel data has provided the **basis for my company's competitive advantage**
2. My business model **would not be possible without Sentinel data**
3. My business model would be **possible without Sentinel data, but less efficient**
4. My business model would be **possible without Sentinel data, but less profitable**
5. **None of the above** fully or accurately describes the impact of Sentinel data on my business

| 1                     | 2                                   | 3                        | 4                         | 5                 |
|-----------------------|-------------------------------------|--------------------------|---------------------------|-------------------|
| Competitive advantage | Business model not possible without | Possible, less efficient | Possible, less profitable | None of the above |
| 33%                   | 23%                                 | 39%                      | 24%                       | 8%                |

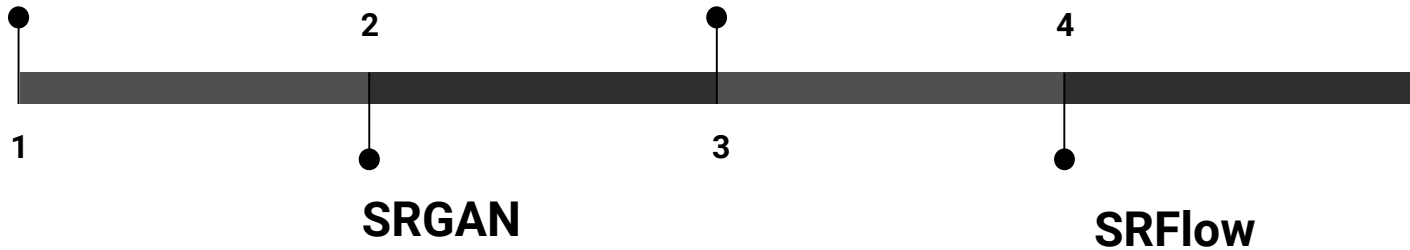
Figure 29: Free and open data impact - distribution of responses.

# STATE-OF-THE-ART ALGORITHMS



**SRResNet**

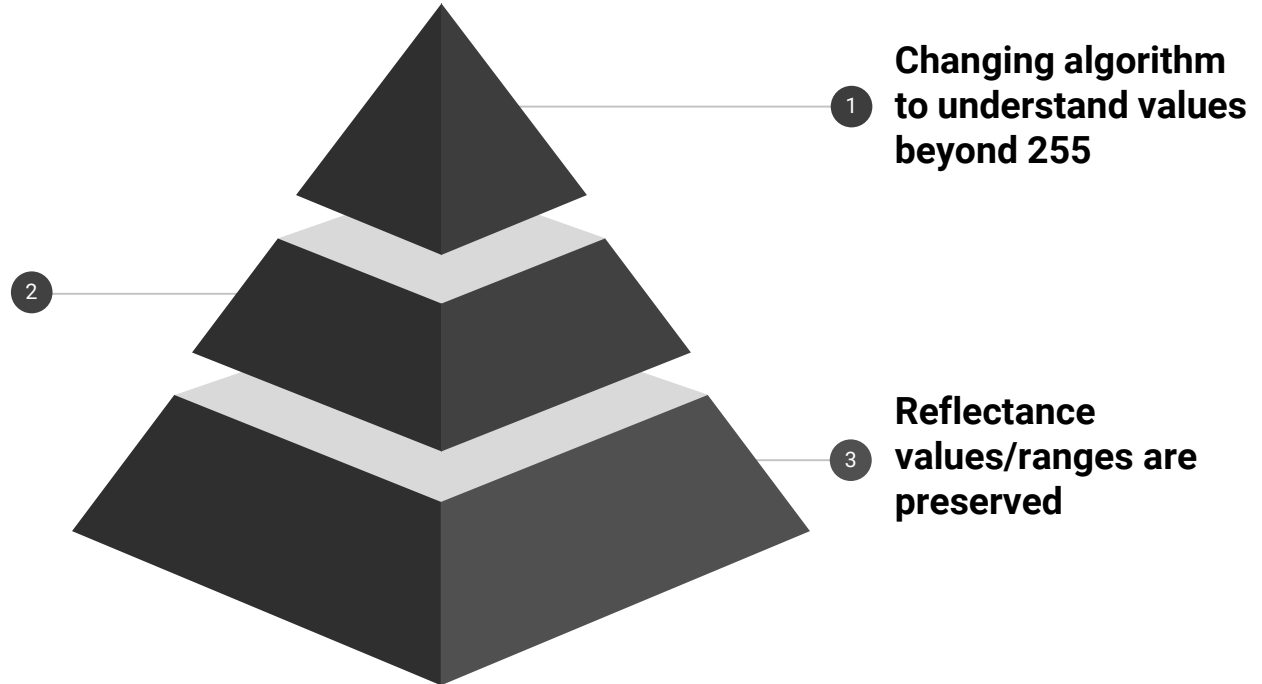
**StyleGAN**



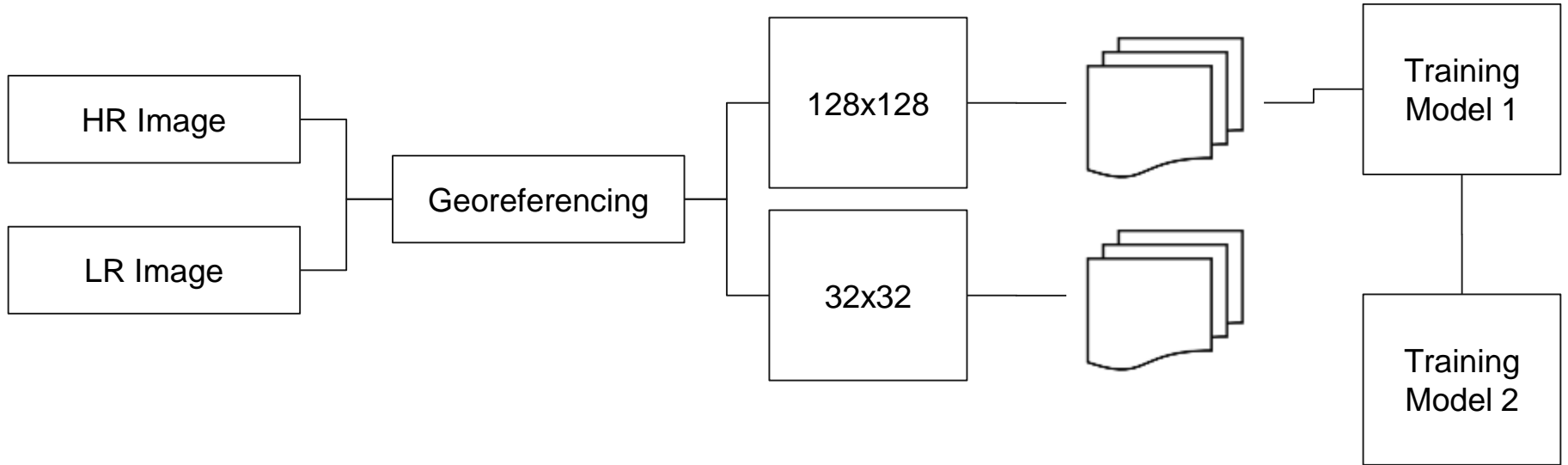
# WHAT'S NEW IN ALGORITHM?



**Multispectral In  
High-Resolution**



# TOOL METHODOLOGY





# TESTING REGIONS



# RESULTS AND OBSERVATIONS

|    | Feat. | Iterations | Best Iter. | LR     | PSNR   | SSIM   |
|----|-------|------------|------------|--------|--------|--------|
| T1 | 64    | 80K        | 55K        | 0.0001 | 27.23  | 0.6022 |
| T2 | 64    | 50K        | 5K         | 0.0002 | 23.157 | 0.4968 |
| T3 | 32    | 50K        | 5K         | 0.0001 | 25.428 | 0.534  |
| T4 | 32    | 100K       | 10K        | 0.0003 | 25.08  | 0.457  |
| T5 | 16    | 100K       | 40K        | 0.0002 | 26.588 | 0.5575 |
| T6 | 16    | 100K       | 30K        | 0.0003 | 26.718 | 0.5739 |

10M -> 2.5M

|    | Feat. | Iterations | Best Iter. | LR     | PSNR   | SSIM   |
|----|-------|------------|------------|--------|--------|--------|
| T1 | 64    | 100K       | 40K        | 0.0001 | 37.177 | 0.8852 |
| T2 | 64    | 50K        | 40K        | 0.0002 | 37.45  | 0.8931 |
| T3 | 32    | 100K       | 5K         | 0.0001 | 36.721 | 0.8798 |
| T4 | 32    | 50K        | 5K         | 0.0002 | 36.447 | 0.8889 |
| T5 | 16    | 100K       | 5K         | 0.0001 | 36.981 | 0.8883 |
| T6 | 16    | 100K       | 5K         | 0.0002 | 36.488 | 0.8638 |

2.4M -> 0.6M

*better and stable results with higher base-resolution*

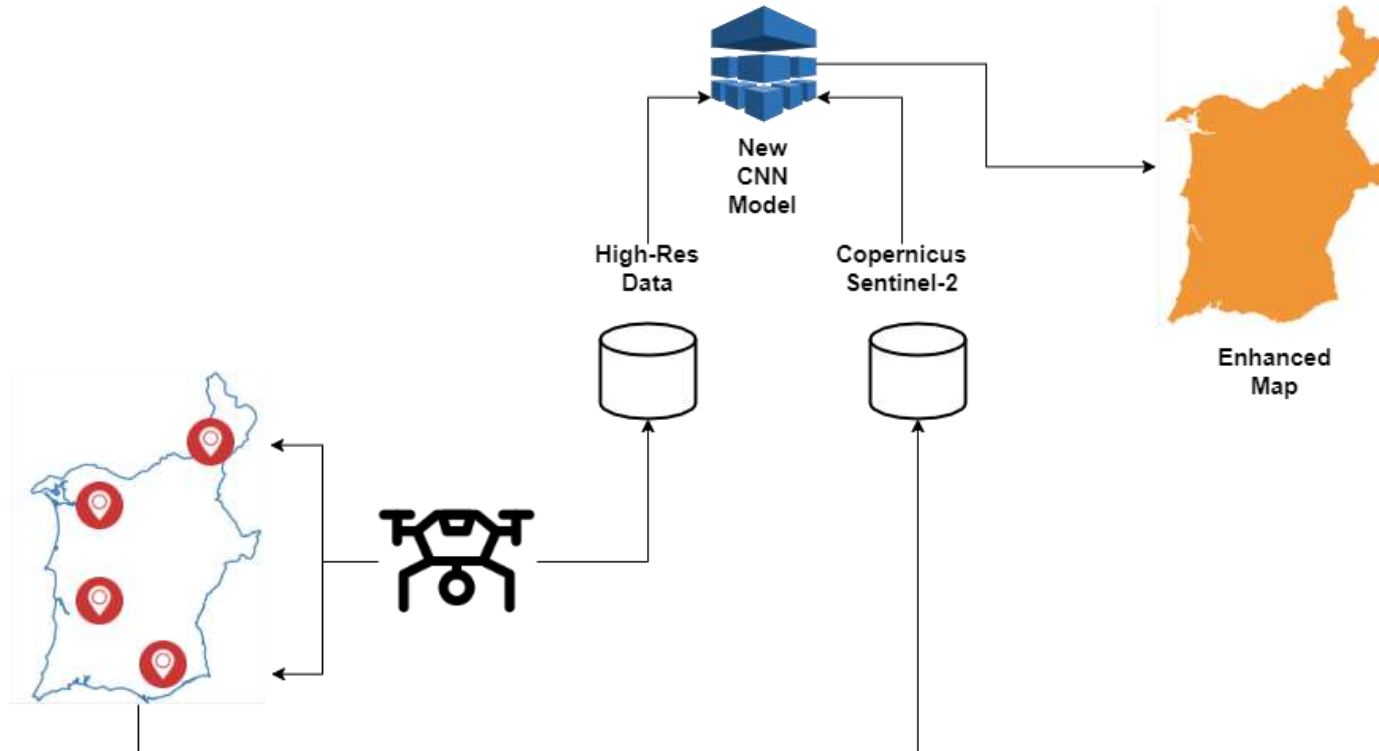
# VISUAL COMPARISON: 10M -> 2.5M



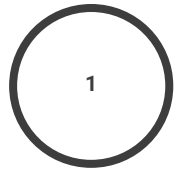
# VISUAL COMPARISON: 2.4M -> 0.6M



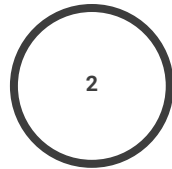
# REAL-LIFE USE-CASE



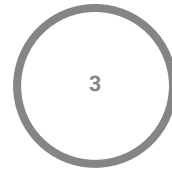
# CONCLUSIONS



**Region/Time  
Specific**



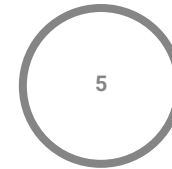
**Data is Always  
Synthetic**



**Computationally  
Heavy**



**Sensor Agnostic  
Algorithm**



**Base-Resolution  
Matters**



**THANK YOU!**