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1. INTRODUCTION

(1) Background

Limitation of Previous Research

| Research Site | There is no way to bring vast amounts of data, so most are limited to one province areas. |
|---------------|--|
| Factors | Some study excludes important factors that affect actual solar power generation. |
| Correlation | Rather than factors independently affecting the amount of power generation, close relationships between factors affect the amount of power generation. However, almost all studies have overlooked this point. |

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GIS를 이용한 태양광시설 설치를 위한 적정지역 선정에 관한 연 윤성욱 · 백이 · 장재경 · 최덕규 · 강동현 · 손진관 · 박민정 · 강석원 · 권진경*

노촌진호청 군립농업과하워 농업공항부

A Study for Planning Optimal Location of Solar Photovoltaic Facilities using GIS

WHREE 科学研修報学会は 第18巻 第2號 2010年 6月 pp. 99-105

GSIS 기술을 활용한 태양광시설 입지선정에 관한 연구

A Study of PV System Facilities Using Geo-Spatial Information

이지영* · 강인준**

Lee, Ji Young · Kang, In Joon

대학과요 : 저타스 논색서자 이 해서 시계생해나지의 하나이며 오십가스 가족이라는 다미라세트 세계한 참 받아야 화경은 고려하 전전하 인지를 찾는 것이 인지 않은 상황이어서 체계적이 여구가 된반히 되어야 한 것이다. 본 여 구의 목적은 태양광 시설 설치에 있어, 입지분석을 위한 방법론을 계획단계에서 제시하는 것이다. 이를 위해서 제 약기준과 입지기준은 설정하고 AHP기법은 사용하여 가준치를 부여하고 각 요인들은 정략화하였다. 등히 지속가 가게 많게 많게 많으면 물 등에요. 세계기계를 가장하기 가능하는 가득하고 되고 말을 등 33회에서가 구하는 기계기가 능한 계할 건박이 요구되는 부산을 대상으로 하여 도심시대의 대양화시설 입지원석을 실시하였다. 분석결과 3개의 등 등급으로 분류하였으며 장사구와 가장군 일대가 후보지비율이 높게 나타났으며 증구와 연제구가 가장 낮게 나

핵심용어 : GSIS, 신재생에너지, 태양광, AHP, 입지분석

Abstract

Photovoltaic system is the core one among the new and renewable energy of the low Carbon and green growth. Recently, the necessity developing PV is emerging since its of less green hose gas emissions. However, a survey or research on the PV system has been hardly performed. It's not easy to find a appropriate location in consideratio of environment. These circumstances encourages a systematic approach for the PV system development. The purpose of this study is to propose a methodology of the location analysis for developing PV system. With this, constrain and location criteria with weights of Analytic Hierarchy Process are established and quantification method of each actor is presented. The location analysis of PV system using the GIS were generalized and the results of analysis for redundant tonographic features were presented as 3 criteria of the suitability rank.

Keywords: GSIS, New and Renewable Energy, Photovoltaic System, AHP, Location Analysis

1.1 연구배경 및 동향

전 세계적으로 화경에 대한 관심이 확산되고 있는 추 대한 연구가 활발히 진행되고 있다. 특히, 무공해이며 가할 것으로 예상된다.

대행은 고려한 수 인지만 대도시내 시설은 설치하기 위해 일차적으로 고려할 수 있는 것은 입지기준 설정이 세른 본 때 저만스 녹색기술은 활용하 신개생에너지에 수요 최저하/건이선 2000(하거나 생과선는 상하은 본 하여 개발된 채광시스템의 채광적 효용성을 입증하고 청정에너지인 태양광에너지는 신재생에너지에서 차지 우리나라의 적용가능성을 접증한 바(정유근 외, 2002) 하는 비중이 전체 49%에 이른다. 이와 같은 수치는 항 입다. 또한 자연채광 시스템과 인공조명의 통합기술과 후에도 지속적인 개발로 인해 잠재적 가치는 꾸준히 중 - 운용기법(김정태 외, 2002), 태양광발전시스템의 효율 적인 발전시스템(박세준 외, 2008) 등 주로 기술개발과

이 같은 전망을 극대화하기 위해 여러 가지 기술개발

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GIS와 계층분석법을 이용한 태양광 발전소 입지 분석

이기림¹ · 이원희¹®

Solar Power Plant Location Analysis Using GIS and Analytic Hierarchy Process

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GIS를 활용한 수상 태양광 발전소 입지 분석

Floating Photovoltaic Plant Location Analysis using GIS

이기림* · 이원희* Lee, Ki Rim · Lee, Won Hee

전 세계 화석 에너지의 사용량은 지속적으로 증가하고 있다. 기존의 화석 에너지 사용 국가뿐만 아니라 개발도상 국의 화석 에너지 사용량 또한 중대되면서 유한한 화석 에너지의 고감에 대한 봉안감은 커지고 있다. 또한 화석 에너지로 인한 환경오염, 경제작사회적 문제는 해결해야 할 과제로 남아있다. 태양광은 환경을 해치지 않는 청정 에너지이지만, 태양광 발전소를 설치하는 과정에서 여러 문제가 발생한다. 이러한 문제점들을 해결하기 위해 수상 태양광 발전소가 대안으로 떠오르고 있다. 하지만 아직까지 수상 태양광 발전소에 대한 입지 분석이 이루어지지 않고 있다. 본 연구에서는 수상 태양광 발전소의 입지 조건을 지형 및 기후 인자를 이용한 계충분석법을 통해 결 과를 분석하였다. 그리고 적합분류표에 따라 각각 인자들의 속성정보에 점수를 부여하고, 여기에 가중치를 곱한 뒤 점수를 시각화하여 분석하였다. 그 결과 경상복도 북부지역의 점수 분포가 남부지역보다 높게 나왔다. 특히 안 동시의 안동호와 영양군의 저수지가 최적입지로 추출되었다. 낮은 점수가 나온 곳은 강, 하천의 중심부가 아닌 하 천의 경계면이었다. 본 연구를 통해 더욱 정확한 수상 태양광 발전소 입지 분석이 될 것이라고 기대한다.

핵심용어 : 수상 태양광 발전소, 신재생에너지, 입지분석, 지리정보시스템, 계층분석법

Global consumption of fossil fuels continues to increase. As developing countries use fossil fuel as much as the existing fossil fuel using countries, the total amount of fossil fuel consumed has risen. The finite fossil energy depletion insecurity have become serious. In addition, fossil energy is caused by environmental pollution, economic and social problems remain in assignments that need to be addressed. Although solar power is clean and has many benefits, there are several problems in the process of installing a solar power plant. To solve these problems, floating photovoltaic plants has emerged as an alternative. This floating photovoltaic plants location analysis has not been made yet. In this study, the conditions of the floating photovoltaic plants location is analyzed with the Analytic Hierarchy Process using the terrain and climate factors. The score is assigned to the attribute information of each factor by the classification table. After multiplied by the weight the result is analyzed by visualization of the score. As the result, the score of the northen part of Gweonesanshuk-do province is higher than the southern part of Gyeongsangbuk-do province. Especially Andongho lake in Andong City and the reservoir in Yeongyang-Gun are extracted as the optimal location. The score of the river boundary is low not the center of the river stream. It is expected that this study would be a more accurate floating solar power plant location analysis.

Keywords: Floating Photovoltaic Plant, New Renewable Energy, Location Analysis, Geographic Information

있다. 화석에너지로 발생하는 온실가스는 매년마다 지 구온난화와 기후변화의 문제를 일으켜 전 세계의 이슈 석유, 석탄 등의 화석 에너지원은 인류에게 매우 중 가 되고 있다. 화석 에너지에서 나오는 이산화판소를 요한 자원이지만 머지않은 미래에 고갈될 위기에 놓여 - 줄이지 못할 경우 2100년까지 지구의 평균온도는

정희의 · 정봉대학교 유봉합시스明공학부 연구원(Member, Researcher, School of Convergence & Fusion System Engineering,

Kyungpook National University, geolee@kmu.ac.kr) 교신적자 · 정희원 · 정복대학교 음복합시스캠공학부 교수(Corresponding Author, Member, Professor, School of Convergence

& Fusion System Engineering, Kyungnook National University, wlee33@knu.ac.kr)

1. INTRODUCTION

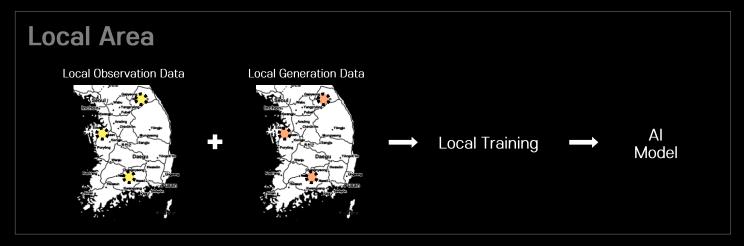
(2) Research scope and method

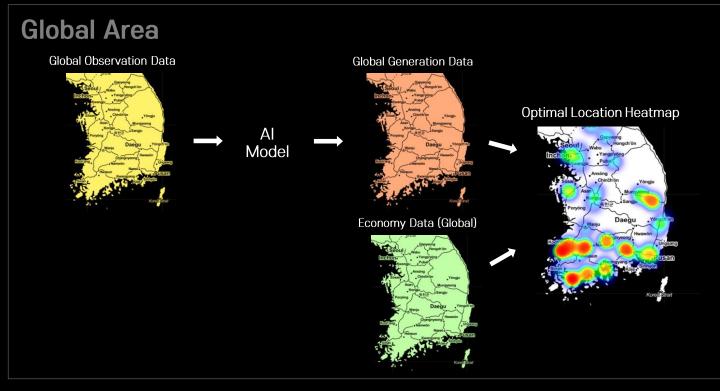
Local Area

In this study, "Local" represents certain regions where we can get not only observation data (features) but also solar power generation data (target). Through machine learning techniques, we can get AI model which will be used to predict global (unknown) solar power generation data.

Global Area

In this study, "Global" represents unknown regions where we can get just observation data (features). By using AI model that we made in Local Training, we could predict solar power generation data which we never knew.





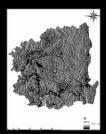
2. RELATED WORK

(1) Geographic Conditions



(a) Slope

When installing a solar power plant, it should be installed in an area with a slope of less than 10 degrees (Kwon et al. 2008).



(b) Aspect

The results of the in-depth analysis results, the south, southeast, southwest, and flat terrain is good for sunlight.



(c) Hillshade

In the case of the shading corridor, Azimuth was applied at 230° and Altitude at 10° as of the winter solstice day.

(2) Economic Conditions

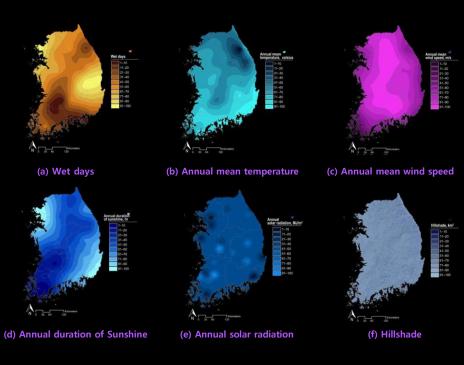


Economic factors can also be important factors in selecting the optimal location for solar power plants.

In previous study, land purchase costs were expressed using the Kriging interpolation technique using Biz-gis' GIS DB branch data (as of 2011) based on the official land price standarad of the Ministry of Land, Infrastructure and Transport.

However, since this paper was made only in Daegu, the land costs were all similar, so economy couldn't an effective factor in most previous research.

(3) Weather Conditions



The most important thing in solar power plants is climate.

The factors commonly used in previous studies are solar radiation, mean temperature, wind speed, duration of sunshine, humidity.

We could see how these factors correlate with solar power generation, but we did not know the close relationship between each factor.

3. DATA ANALYSIS

(1) Weather Observation Data

Correlation of weather observation features

Correlation Analysis is a technique for analyzing whether there is an alignment relationship between two variables. The correlation coefficient resulting from the correlation analysis is a number with a range of "-1 to +1", representing the linearity of the two variables.

A large correlation coefficient means that the linearity between the two variables is very high and a low correlation coefficient means that the linearity between the two variables is weak.

Correlation analysis of the variables confirms that air pressure and sea pressure, vapor pressure and dew point, air temperature and surface temperature come close to 1, which means that they are almost identical and therefore do not need to be regressed between them.

| temp - | 1 | 0.072 | 0.23 | 0.11 | -0.11 | 0.82 | 0.86 | -0.77 | -0.79 | 0.23 | 0.37 | -0.22 | 0.26 | 0.12 | 0.95 |
|------------------|---------|-----------------|--------------|------------------|------------|------------------|-------------|------------------|----------------|------------|-------------|---------|--------|---------------|-------------|
| precipitation - | 0.072 | 1 | 0.01 | 0.023 | 0.12 | 0.14 | 0.12 | -0.13 | -0.12 | -0.076 | -0.065 | -0.0055 | 0.15 | -0.19 | 0.049 |
| wind_speed - | 0.23 | 0.01 | 1 | 0.4 | -0.6 | -0.09 | -0.099 | -0.21 | -0.21 | 0.42 | 0.46 | -0.027 | -0.035 | 0.29 | 0.27 |
| wind_direction - | 0.11 | 0.023 | 0.4 | 1 | -0.31 | -0.041 | -0.057 | -0.087 | -0.089 | 0.23 | 0.25 | -0.011 | -0.015 | 0.16 | 0.14 |
| humidity - | -0.11 | 0.12 | -0.6 | -0.31 | 1 | 0.36 | 0.4 | -0.056 | -0.047 | -0.64 | -0.6 | 0.031 | 0.29 | -0.55 | -0.2 |
| pressure_vapor - | 0.82 | 0.14 | -0.09 | -0.041 | 0.36 | 1 | 0.94 | -0.71 | -0.73 | -0.11 | 0.016 | -0.15 | 0.35 | -0.12 | 0.73 |
| dew_point - | 0.86 | 0.12 | -0.099 | -0.057 | 0.4 | 0.94 | 1 | -0.73 | -0.75 | -0.12 | 0.025 | -0.19 | 0.39 | -0.16 | 0.76 |
| pressure_local - | -0.77 | -0.13 | -0.21 | -0.087 | -0.056 | -0.71 | -0.73 | 1 | 1 | 0.0028 | -0.13 | 0.16 | -0.3 | 0.018 | -0.69 |
| pressure_sea - | -0.79 | -0.12 | -0.21 | -0.089 | -0.047 | -0.73 | -0.75 | 1 | 1 | -0.011 | -0.15 | 0.17 | -0.3 | 0.01 | -0.72 |
| sunshine - | 0.23 | -0.076 | 0.42 | 0.23 | -0.64 | -0.11 | -0.12 | 0.0028 | -0.011 | 1 | 0.83 | -0.023 | -0.31 | 0.37 | 0.38 |
| radiation - | 0.37 | -0.065 | 0.46 | 0.25 | -0.6 | 0.016 | 0.025 | -0.13 | -0.15 | 0.83 | 1 | -0.042 | -0.14 | 0.33 | 0.58 |
| snow - | -0.22 - | -0.0055 | -0.027 | -0.011 | 0.031 | -0.15 | -0.19 | 0.16 | 0.17 | -0.023 | -0.042 | 1 | -0.012 | -0.08 | -0.18 |
| doud - | 0.26 | 0.15 | -0.035 | -0.015 | 0.29 | 0.35 | 0.39 | -0.3 | -0.3 | -0.31 | -0.14 | -0.012 | 1 | -0.38 | 0.2 |
| air_opacity - | 0.12 | -0.19 | 0.29 | 0.16 | -0.55 | -0.12 | -0.16 | 0.018 | 0.01 | 0.37 | 0.33 | -0.08 | -0.38 | 1 | 0.19 |
| temp_surf - | 0.95 | 0.049 | 0.27 | 0.14 | -0.2 | 0.73 | 0.76 | -0.69 | -0.72 | 0.38 | 0.58 | -0.18 | 0.2 | 0.19 | 1 |
| | - dwat | precipitation - | wind_speed - | wind_direction - | humidity - | pressure_vapor - | dew_point - | pressure_local - | pressure_sea - | sunshine - | radiation - | - wous | - pnop | air_opacity - | - Juns dwat |

- 0.6

- 0.2

-0.2

3. DATA ANALYSIS

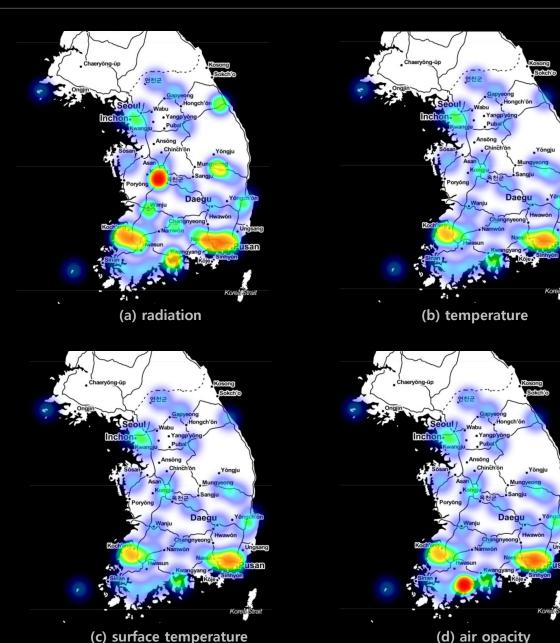
(1) Weather Observation Data

Heatmap using sampled variables

Heatmap is a representation of data in the form of a map or diagram in which data values are represented as colors.

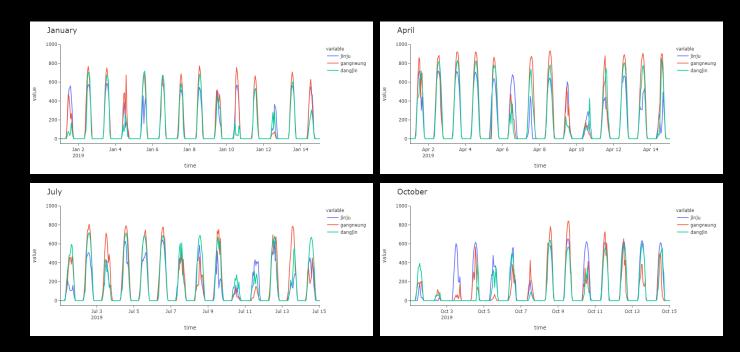
We made a heatmap by sampling variables that are more likely to affect power generation relatively much. When analyzing the solar radiation, temperature, and visibility heatmap, it is predicted that the power generation in the south will be greater than in the north.

As the correlation analysis suggests, the heatmap of air temperature heatmap and surface temperature heatmap is almost identical. Since the region with zero solar radiation data was removed and visualized, there are many areas with no data at all.

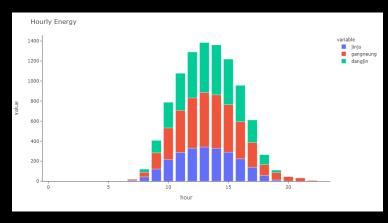


3. DATA ANALYSIS

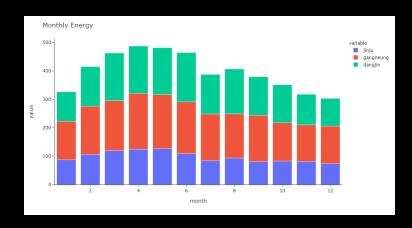
(2) Solar Power Generation Data



Target values are needed for model learning, and solar power generation data could be easily received from public data portals. However, there were constraints: there should not be many missing values, and the weather data provided by the Korea Weather Station should match the region. Power generation data exploratory data analysis was essential, and insight was sought through various visualizations. By visualizing amount of power generation per month, data trend of amount of power generation analyzed. It was possible to confirm that regional power generation was independent, and different aspects could be seen every day.



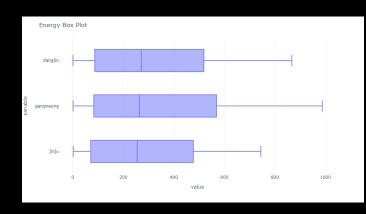
Hourly power generation was highest between 1:00 and 2:00, and before 7:00 a.m. and after 8:00 p.m., power generation converged to zero.

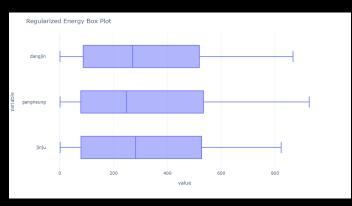


After analyzing the monthly power generation, we expected that there would be more power generation in July and August, when solar radiation was the highest, but 11 we could see that power generation was higher in April and May.

3. DATA ANALYSIS

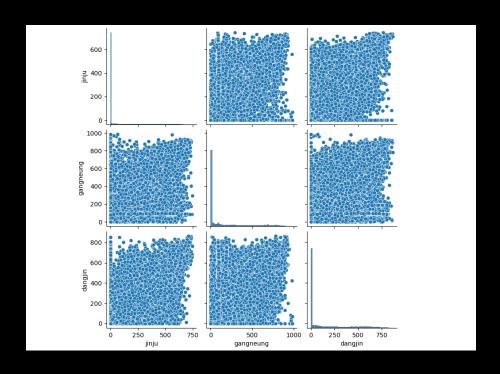
(2) Solar Power Generation Data





We drew a box plot of solar power generation in each region. If you see the left image, the mean and variance were different. But we can see surprising result from using "Normalization".

After normalizing to the maximum solar power generation (Jinju: 905MW, Gangneung: 1065MW, Dangjin: 1000MW), the mean and variance of each region were almost identical. Judging from this, we could see that the maximum power generation of each solar power plant is linearly proportional.



Pairplot shows us grid of Axes such that each numeric variable in data will by shared across the y-axes across a single row and the x-axes across a single column.

The diagonal plots are treated differently: a univariate distribution plot is drawn to show the marginal distribution of the data in each column. By analyzing pairplot, each generation has regional independence, so we could conclude that it's suitable for model training.

3. DATA ANALYSIS

(3) Economic Data

| | PNU | BASE_YEAR | STDMT | PNILP | PJJI_YN | PANN_YMD |
|----------|---------------------|-----------|-------|---------|---------|----------|
| 0 | 1111010600100070038 | 2021 | 1 | 7460000 | 1 | 20210531 |
| 1 | 1111010600100070040 | 2021 | 1 | 2008000 | 0 | 20210531 |
| 2 | 1111010600100070045 | 2021 | 1 | 4535000 | 0 | 20210531 |
| 3 | 1111010600100080000 | 2021 | 1 | 4916000 | 0 | 20210531 |
| 4 | 1111010600100090001 | 2021 | 1 | 4820000 | 0 | 20210531 |
| | | | | | | |
| 909146 | 1174010800104370032 | 2021 | 1 | 4375000 | 0 | 20210531 |
| 909147 | 1174010800104370033 | 2021 | 1 | 4375000 | 0 | 20210531 |
| 909148 | 1174010800104370034 | 2021 | 1 | 1364000 | 0 | 20210531 |
| 909149 | 1174010800104370036 | 2021 | 1 | 5748000 | 0 | 20210531 |
| 909150 | 1174010800104380008 | 2021 | 1 | 5244000 | 0 | 20210531 |
| 909151 r | rows × 8 columns | | | | | |

| | 법정동코드 | 시도명 | 시군구명 | 읍면동명 | 동리명 | 생성일자 | 말소일자 |
|---------|---------------|---------|------|------|-----|----------|------|
| 0 | 1100000000 | 서울특별시 | NaN | NaN | NaN | 19880423 | NaN |
| 1 | 1111000000 | 서울특별시 | 종로구 | NaN | NaN | 19880423 | NaN |
| 2 | 1111010100 | 서울특별시 | 종로구 | 청운동 | NaN | 19880423 | NaN |
| 3 | 1111010200 | 서울특별시 | 종로구 | 신교동 | NaN | 19880423 | NaN |
| 4 | 1111010300 | 서울특별시 | 종로구 | 궁정동 | NaN | 19880423 | NaN |
| | | | | | | | |
| 20558 | 5013032022 | 제주특별자치도 | 서귀포시 | 표선면 | 하천리 | 20060701 | NaN |
| 20559 | 5013032023 | 제주특별자치도 | 서귀포시 | 표선면 | 성읍리 | 20060701 | NaN |
| 20560 | 5013032024 | 제주특별자치도 | 서귀포시 | 표선면 | 가시리 | 20060701 | NaN |
| 20561 | 5013032025 | 제주특별자치도 | 서귀포시 | 표선면 | 세화리 | 20060701 | NaN |
| 20562 | 5013032026 | 제주특별자치도 | 서귀포시 | 표선면 | 토산리 | 20060701 | NaN |
| 20563 r | rows × 7 colu | ımns | | | | | |

Official Land Price Data

The publicly announced land price is a system in which the Ministry of Land, Infrastructure and Transport of the Republic of Korea investigates and appraises the price of land and discloses it.

After adding all the prices included in the same region, the average land price in the region was calculated by dividing it by the number of each data.

Legal Code Data

Legal dong means dong determined by law, as stated in the administrative district unit designated by law.

This data includes PNU code and region name. Thus, we can merge this data with official land price data. By doing that, we can have "Economy Data" which is equal to the right image.

Economy Data

| | PNU | price | loc_name |
|-------|-------|---------|-----------------|
| 0 | 1111 | 5789.0 | Jongno |
| 1 | 1117 | 6553.0 | Yongsan |
| 2 | 1120 | 4353.0 | Seongdong |
| 3 | 1121 | 4157.0 | Gwangjin |
| 4 | 1123 | 3587.0 | Dongdaemun |
| | | | |
| 256 | 4889 | 20.0 | Gyeongsangnamdo |
| 257 | 4889 | 20.0 | Hapcheon |
| 258 | 5011 | 223.0 | Jeju |
| 259 | 5013 | 137.0 | Jeju |
| 260 | 5013 | 137.0 | Seogwipo |
| 261 r | ows × | 3 colum | ins |

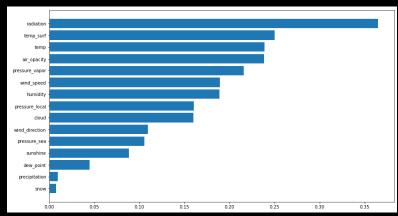
4. MODELING (1) LightGBM

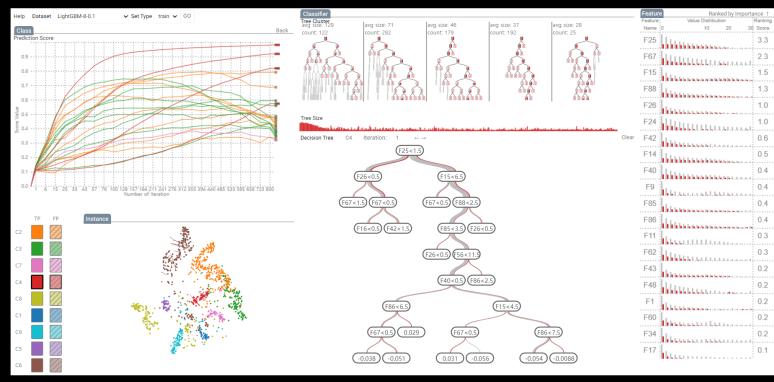
Advantages of using LightGBM

- Faster training speed and higher efficiency
- Lower memory usage
- Better accuracy
- Support of parallel and GPU learning
- Capable of handling large-scale data

We have too much data, three years' worth of observation data, to run machine learning. So we have no choice but to choose LGBM Model which is faster and more accurate than other models.







4. MODELING

(2) Local Training

For more efficient model learning, custom mattresses have been created to prevent actual solar power generation from being reflected in learning when it is less than 10% of maximum power generation. This is because overfitting can occur if you include very little power generation in your learning.

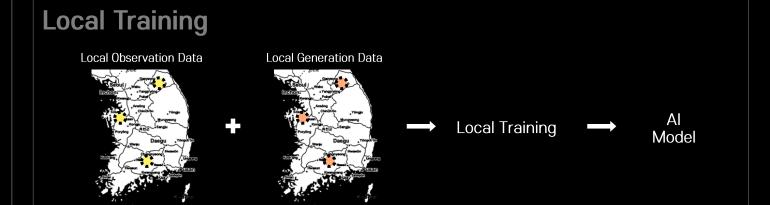
To see how well the model trained during the training, we set the verbose-eval parameter to 500. The final loss value is distributed about 5-6 for each region, so we could see that the training was done well.

Gangneung Data (Sample)

Features (Local Observation Data)

Target (Local Generation Data)

| | temp | precipitation | wind_speed | wind_direction | humidity | pressure_vapor | dew_point | pressure_local | pressure_sea | sunshine | radiation | snow | cloud | air_opacity | temp_sur | f energy |
|-----|-----------|---------------|------------|----------------|----------|----------------|------------|----------------|--------------|----------|-----------|----------|-----------|-------------|-----------|------------|
| 0 2 | 21.203125 | 0.000000 | 1.000000 | 90.0 | 68.0 | 17.000000 | 15.000000 | 1010.0 | 1013.0 | 1.000000 | 1.240234 | 0.000000 | 0.000000 | 1447.0 | 22.796875 | 71.571831 |
| 1 | 18.593750 | 0.000000 | 5.699219 | 230.0 | 23.0 | 4.898438 | -2.900391 | 1004.0 | 1007.0 | 0.099976 | 0.330078 | 0.000000 | 5.000000 | 721.0 | 16.093750 | 37.138028 |
| 2 | 13.898438 | 0.000000 | 0.500000 | 20.0 | 89.0 | 14.101562 | 12.101562 | 1024.0 | 1027.0 | 0.199951 | 0.500000 | 0.000000 | 9.000000 | 1097.0 | 16.593750 | 67.605634 |
| 3 | 0.899902 | 0.000000 | 4.601562 | 250.0 | 12.0 | 0.799805 | -25.296875 | 1025.0 | 1028.0 | 1.000000 | 1.490234 | 0.000000 | 1.000000 | 5008.0 | 2.500000 | 532.912676 |
| 4 | 5.898438 | 0.000000 | 2.099609 | 230.0 | 44.0 | 4.101562 | -5.398438 | 1020.5 | 1024.0 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 1628.0 | 2.000000 | 0.090141 |
| 5 | 4.500000 | 0.099976 | 2.199219 | 230.0 | 93.0 | 7.800781 | 3.400391 | 1021.0 | 1024.0 | 0.000000 | 0.140015 | 0.000000 | 9.000000 | 1031.0 | 5.000000 | 1.892958 |
| 6 | 21.406250 | 0.000000 | 1.500000 | 360.0 | 82.0 | 20.796875 | 18.093750 | 1002.0 | 1005.0 | 0.000000 | 0.459961 | 0.000000 | 5.000000 | 1653.0 | 24.406250 | 145.667606 |
| 7 | 6.601562 | 0.000000 | 5.500000 | 230.0 | 19.0 | 1.799805 | -15.398438 | 1019.5 | 1022.5 | 1.000000 | 2.029297 | 0.000000 | 0.000000 | 5008.0 | 12.898438 | 440.247887 |
| 8 | 9.000000 | 0.700195 | 2.900391 | 320.0 | 91.0 | 10.398438 | 7.601562 | 1011.0 | 1014.5 | 0.000000 | 0.059998 | 0.000000 | 10.000000 | 1120.0 | 9.898438 | 0.360563 |
| 9 | 18.593750 | 0.000000 | 2.099609 | 90.0 | 69.0 | 14.703125 | 12.703125 | 1012.5 | 1015.5 | 0.000000 | 1.809570 | 0.000000 | 10.000000 | 764.0 | 31.593750 | 400.315493 |
| 10 | 24.906250 | 0.000000 | 1.000000 | 230.0 | 58.0 | 18.203125 | 16.000000 | 1004.0 | 1007.0 | 0.000000 | 0.059998 | 0.000000 | 6.000000 | 1418.0 | 22.593750 | 9.374648 |
| 11 | 5.500000 | 0.000000 | 2.400391 | 250.0 | 45.0 | 4.101562 | -5.500000 | 1029.0 | 1033.0 | 1.000000 | 0.649902 | 0.000000 | 0.000000 | 2296.0 | 6.199219 | 131.245070 |
| 12 | 6.500000 | 0.000000 | 3.199219 | 230.0 | 28.0 | 2.699219 | -10.703125 | 1019.0 | 1022.5 | 1.000000 | 1.000000 | 0.000000 | 2.000000 | 5000.0 | 4.101562 | 394.276056 |
| 13 | 10.500000 | 0.000000 | 1.299805 | 90.0 | 50.0 | 6.300781 | 0.399902 | 1023.0 | 1026.0 | 0.899902 | 0.830078 | 0.000000 | 7.000000 | 5008.0 | 9.203125 | 243.019718 |
| 14 | 6.000000 | 0.000000 | 1.599609 | 250.0 | 18.0 | 1.700195 | -16.500000 | 1022.0 | 1025.0 | 1.000000 | 1.500000 | 0.000000 | 3.000000 | 5008.0 | 4.300781 | 371.380282 |
| 15 | 19.593750 | 0.000000 | 1.799805 | 250.0 | 73.0 | 16.593750 | 14.601562 | 1011.0 | 1014.0 | 1.000000 | 0.799805 | 0.000000 | 3.000000 | 5008.0 | 20.703125 | 73.194366 |
| 16 | 22.406250 | 0.000000 | 2.900391 | 90.0 | 66.0 | 17.796875 | 15.703125 | 1005.5 | 1008.5 | 1.000000 | 2.599609 | 0.000000 | 4.000000 | 1161.0 | 31.203125 | 647.211268 |
| 17 | 30.000000 | 0.000000 | 1.200195 | 70.0 | 74.0 | 31.296875 | 24.796875 | 1008.0 | 1010.5 | 1.000000 | 2.650391 | 0.000000 | 8.000000 | 5008.0 | 34.000000 | 537.600000 |
| 18 | 16.500000 | 0.000000 | 2.500000 | 250.0 | 80.0 | 15.000000 | 13.000000 | 1014.5 | 1017.5 | 0.000000 | 0.090027 | 0.000000 | 3.000000 | 4496.0 | 17.406250 | 8.292958 |
| | | | | | | | | | | | | | | | | |



4. MODELING

(2) Local Training

For more efficient model learning, we invented custom metric to prevent actual solar power generation from being reflected in learning when it is less than 10% of maximum power generation. This is because overfitting can occur if you include very little power generation in your learning.

To see how well the model trained during the training, we set the verbose-eval parameter to 500. The final loss value is distributed about 5-6 for each region, so we could see that the training was done well.

Custom Metric

```
def nmae_10(y_pred, dataset):
    y_true = dataset.get_label()

    absolute_error = abs(y_true - y_pred)
    absolute_error /= 1000

    target_idx = np.where(y_true>=100)

    nmae = 100 * absolute_error[target_idx].mean()

    return 'score', nmae, False
```

```
def sola_nmae(answer, pred):
   absolute_error = np.abs(answer - pred)

absolute_error /= 1000

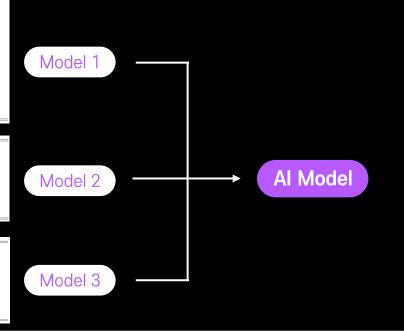
target_idx = np.where(answer>=100)

nmae = 100 * absolute_error[target_idx].mean()

return nmae
```

Schemetic Model

```
LightGBM] [Info] Total Bins 2281
 LightGBM][Info] Number of data points in the train set: 11621, number of used features: 18
[LightGBM] [Info] Start training from score 313.387058
 raining until validation scores don't improve for 200 rounds
 500] valid_0's score: 6.14567
 10001 valid 0's score: 5.77038
       valid_0's score: 5.58683
       valid_0's score: 5.4754
       valid 0's score: 5.40042
       valid 0's score: 5.3485
       valid_0's score: 5.31184
       valid_0's score: 5.27776
       valid 0's score: 5.24603
       valid_0's score: 5.22724
      valid_0's score: 5.21488
      valid 0's score: 5.19617
Early stopping, best iteration is
                                        = Dangiin Training Finish
                                        == Gangneung Training Start
 ightGBM] [Info] Number of data points in the train set: 6759, number of used features: 17
 LightGRM] [Info] Start training from score 299 112368
 raining until validation scores don't improve for 200 rounds
       valid_0's score: 6.19167
 10001 valid 0's score: 6.04034
      valid 0's score: 5.99863
       valid_0's score: 5.95411
 2500] valid_0's score: 5.92756
arly stopping, best iteration is
      valid_0's score: 5.9218
                                          = Jinju Training Start
 ightGBM1 [info] Total Bins 1983
LightGBM] [Info] Number of data points in the train set: 6801, number of used features: 17
 ightGBM] [Info] Start training from score 233.619984
 aining until validation scores don't improve for 200 counds
      valid_0's score: 5.87133
      valid_0's score: 5.25439
       valid 0's score: 5.09687
 [500] valid_0's score: 5.04748
 [362] valid_0's score: 5.04584
```



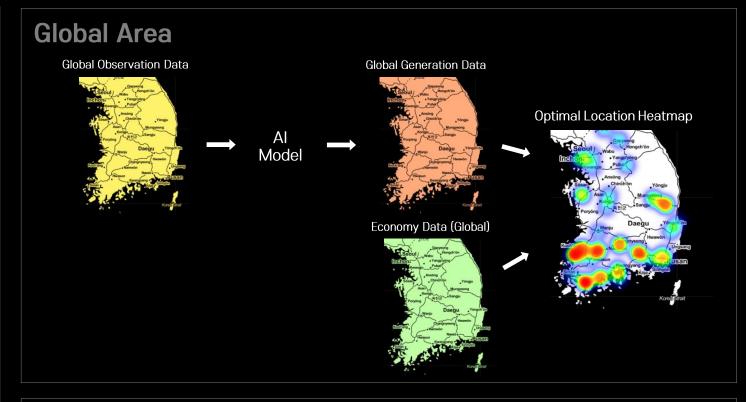
4. MODELING

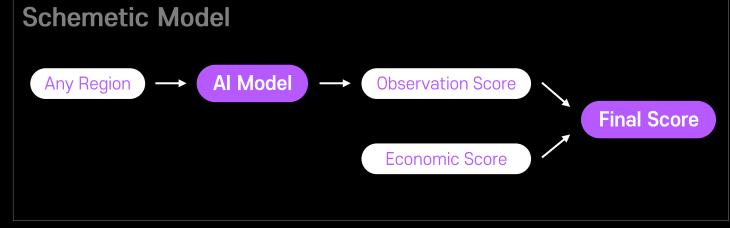
(3) Global Prediction

By using AI model that we just made in Local Training, we could predict solar power generation data. Let's define this as "Observation Score" because it is determined by unknown region's observation data.

After collecting the data obtained by the Korea Meteorological Administration, around 40 regions have adequate observation data without missing values which are found to be suitable for global regions.

Once we get observation score, we can get final score by merging with economic score. Each region's score is equal to "Observation Score / $\sqrt[3]{\text{Economic Score}}$ "

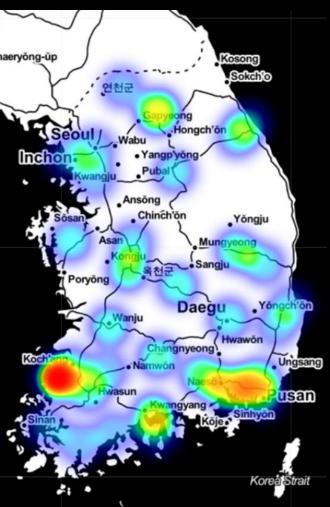




5. RESULTS (1) Visualization

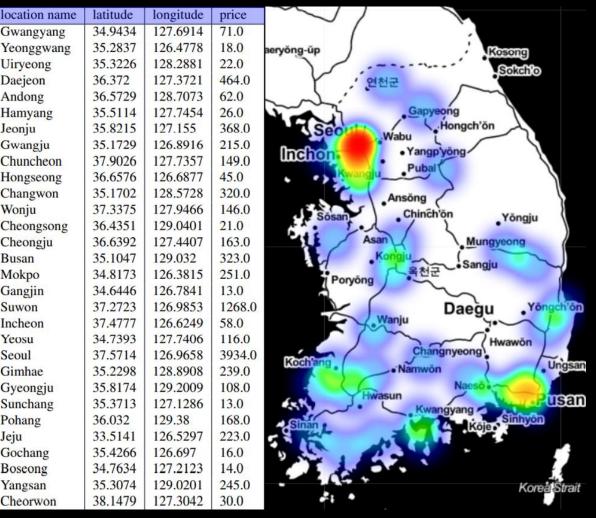
Observation Score

| location name | latitude | longitude | score | ~ |
|---------------|----------|-----------|-------|-----------|
| Gwangyangsi | 34.943 | 127.691 | 509 | / |
| Yeonggwanggun | 35.284 | 126.478 | 503 | |
| Uiryeonggun | 35.323 | 128.288 | 503 | haeryŏng- |
| Daejeon | 36.372 | 127.372 | 500 | nacryong- |
| Andong | 36.573 | 128.707 | 499 | |
| Hamyanggun | 35.511 | 127.745 | 496 | |
| Jeonju | 35.822 | 127.155 | 493 | |
| Gwangju | 35.173 | 126.892 | 493 | |
| Chupungnyeong | 36.220 | 127.995 | 493 | |
| Chuncheon | 37.903 | 127.736 | 491 | - 4 |
| Hongseong | 36.658 | 126.688 | 491 | |
| Daegu | 35.885 | 128.619 | 490 | Inc |
| Changwon | 35.170 | 128.573 | 490 | |
| Wonju | 37.338 | 127.947 | 487 | |
| Cheongsonggun | 36.435 | 129.040 | 484 | |
| Cheongju | 36.639 | 127.441 | 483 | |
| Daegwallyeong | 37.677 | 128.718 | 482 | |
| Busan | 35.105 | 129.032 | 479 | |
| Mokpo | 34.817 | 126.382 | 471 | - 5 |
| Bukchuncheon | 37.948 | 127.755 | 468 | |
| Bukgangneung | 37.805 | 128.855 | 468 | 1 |
| Gangjingun | 34.645 | 126.784 | 467 | |
| Suwon | 37.272 | 126.985 | 466 | |
| Incheon | 37.478 | 126.625 | 466 | |
| Yeosu | 34.739 | 127.741 | 461 | |
| Seoul | 37.571 | 126.966 | 461 | |
| Gimhaesi | 35.230 | 128.891 | 457 | |
| Gyeongjusi | 35.817 | 129.201 | 452 | |
| Sunchanggun | 35.371 | 127.129 | 451 | Koch |
| Pohang | 36.032 | 129.380 | 449 | |
| Jeju | 33.514 | 126.530 | 446 | |
| Heuksando | 34.687 | 125.451 | 445 | Sex. |
| Gochanggun | 35.427 | 126.697 | 441 | |
| Bukchangwon | 35.227 | 128.673 | 441 | Sin |
| Gochang | 35.348 | 126.599 | 436 | |
| Gosan | 33.294 | 126.163 | 433 | 1,1 |
| Boseonggun | 34,763 | 127,212 | 428 | |
| Yangsansi | 35,307 | 129.020 | 411 | |
| Baengnyeongdo | 37.974 | 124.712 | 372 | |
| Ulleungdo | 37.481 | 130.899 | 364 | |
| Cheorwon | 38.148 | 127.304 | 323 | |
| | | | , | |



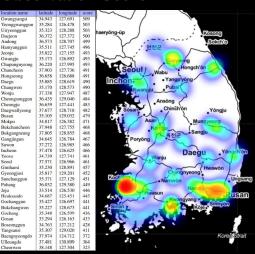
Economic Score

| latitude | longitude | price |
|----------|---|---|
| 34.9434 | 127.6914 | 71.0 |
| 35.2837 | 126.4778 | 18.0 |
| 35.3226 | 128.2881 | 22.0 |
| 36.372 | 127.3721 | 464.0 |
| 36.5729 | 128.7073 | 62.0 |
| 35.5114 | 127.7454 | 26.0 |
| 35.8215 | 127.155 | 368.0 |
| 35.1729 | 126.8916 | 215.0 |
| 37.9026 | 127.7357 | 149.0 |
| 36.6576 | 126.6877 | 45.0 |
| 35.1702 | 128.5728 | 320.0 |
| 37.3375 | 127.9466 | 146.0 |
| 36.4351 | 129.0401 | 21.0 |
| 36.6392 | 127.4407 | 163.0 |
| 35.1047 | 129.032 | 323.0 |
| 34.8173 | 126.3815 | 251.0 |
| 34.6446 | 126.7841 | 13.0 |
| 37.2723 | 126.9853 | 1268.0 |
| 37.4777 | 126.6249 | 58.0 |
| 34.7393 | 127.7406 | 116.0 |
| 37.5714 | 126.9658 | 3934.0 |
| 35.2298 | 128.8908 | 239.0 |
| 35.8174 | 129.2009 | 108.0 |
| 35.3713 | 127.1286 | 13.0 |
| 36.032 | 129.38 | 168.0 |
| 33.5141 | 126.5297 | 223.0 |
| 35.4266 | 126.697 | 16.0 |
| 34.7634 | 127.2123 | 14.0 |
| 35.3074 | 129.0201 | 245.0 |
| 38.1479 | 127.3042 | 30.0 |
| | 34.9434 35.2837 35.3226 36.372 36.5729 35.5114 35.8215 35.1729 37.9026 36.6576 35.1702 37.3375 36.4351 36.6392 35.1047 34.8173 34.6446 37.2723 37.4777 34.7393 37.5714 35.2298 35.8174 35.3713 36.032 33.5141 35.4266 34.7634 35.3074 | 34.9434 127.6914 35.2837 126.4778 35.3226 128.2881 36.372 127.3721 36.5729 128.7073 35.5114 127.7454 35.8215 127.155 35.1729 126.8916 37.9026 127.7357 36.6576 126.6877 35.1702 128.5728 37.3375 127.9466 36.4351 129.0401 36.6392 127.4407 35.1047 129.032 34.8173 126.3815 34.6446 126.7841 37.2723 126.9853 37.4777 126.6249 34.7393 127.7406 37.5714 126.9658 35.2298 128.8908 35.8174 129.2009 35.3713 127.1286 36.032 129.38 33.5141 126.5297 34.7634 127.2123 35.3074 129.0201 |



5. RESULTS (1) Visualization

Observation Score

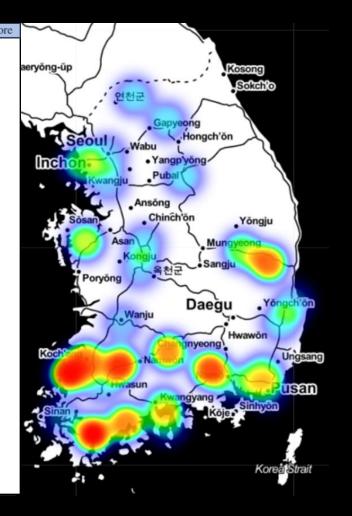


Economic Score

| location name | latitude | longitude | price | |
|---------------|----------|-----------|--------|--|
| Gwangyang | 34.9434 | 127.6914 | 71.0 | |
| Yeonggwang | 35.2837 | 126.4778 | 18.0 | seryŏng-ŭp / Kosong |
| Uiryeong | 35.3226 | 128.2881 | 22.0 | Goldolo |
| Daejeon | 36.372 | 127.3721 | 464.0 | , '연천군 |
| Andong | 36.5729 | 128.7073 | 62.0 | |
| Hamyang | 35.5114 | 127.7454 | 26.0 | Gapyeong |
| Jeonju | 35.8215 | 127.155 | 368.0 | Seo Wabu Hongch'ön |
| Gwangju | 35.1729 | 126.8916 | 215.0 | |
| Chuncheon | 37.9026 | 127.7357 | 149.0 | Inchon • Yangp'yōng Pubal |
| Hongseong | 36.6576 | 126.6877 | 45.0 | Kwanglu |
| Changwon | 35.1702 | 128.5728 | 320.0 | Ansöng |
| Wonju | 37.3375 | 127.9466 | 146.0 | Chi-Shin- |
| Cheongsong | 36.4351 | 129.0401 | 21.0 | · · · · · · · · · · · · · · · · · · · |
| Cheongju | 36.6392 | 127.4407 | 163.0 | Asan Mungyeong |
| Busan | 35.1047 | 129.032 | 323.0 | Kongju |
| Mokpo | 34.8173 | 126.3815 | 251.0 | Poryong Sangu |
| Gangjin | 34.6446 | 126.7841 | 13.0 | , anjuma |
| Suwon | 37.2723 | 126.9853 | 1268.0 | Daegu Yongch |
| Incheon | 37.4777 | 126.6249 | 58.0 | Wanju |
| Yeosu | 34.7393 | 127.7406 | 116.0 | Hwawon |
| Seoul | 37.5714 | 126.9658 | 3934.0 | Koch'ang Changnyeong |
| Gimhae | 35.2298 | 128.8908 | 239.0 | • Namwon |
| Gyeongju | 35.8174 | 129.2009 | 108.0 | Hwasun Naesō |
| Sunchang | 35.3713 | 127.1286 | 13.0 | CALL LINE US |
| Pohang | 36.032 | 129.38 | 168.0 | Sinan Köje Sinhyön |
| Jeju | 33.5141 | 126.5297 | 223.0 | |
| Gochang | 35.4266 | 126.697 | 16.0 | U de la companya de l |
| Boseong | 34.7634 | 127.2123 | 14.0 | |
| Yangsan | 35.3074 | 129.0201 | 245.0 | KorealStr |
| Cheorwon | 38.1479 | 127.3042 | 30.0 | 41 * |

Final Score

| location | latitude | longitude | score | price | final sco |
|------------|----------|-----------|-------|--------|-----------|
| Gangjin | 34.6446 | 126.7841 | 467.0 | 13.0 | 107.77 |
| Sunchang | 35.3713 | 127.1286 | 451.0 | 13.0 | 104.08 |
| Boseong | 34.7634 | 127.2123 | 428.0 | 14.0 | 91.71 |
| Yeonggwang | 35.2837 | 126.4778 | 503.0 | 18.0 | 83.83 |
| Gochang | 35.4266 | 126.697 | 441.0 | 16.0 | 82.69 |
| Cheongsong | 36.4351 | 129.0401 | 484.0 | 21.0 | 69.14 |
| Uiryeong | 35.3226 | 128.2881 | 503.0 | 22.0 | 68.59 |
| Hamyang | 35.5114 | 127.7454 | 496.0 | 26.0 | 57.23 |
| Hongseong | 36.6576 | 126.6877 | 491.0 | 45.0 | 32.73 |
| Cheorwon | 38.1479 | 127.3042 | 323.0 | 30.0 | 32.3 |
| Andong | 36.5729 | 128.7073 | 499.0 | 62.0 | 24.15 |
| Incheon | 37.4777 | 126.6249 | 466.0 | 58.0 | 24.1 |
| Gwangyang | 34.9434 | 127.6914 | 509.0 | 71.0 | 21.51 |
| Gyeongju | 35.8174 | 129.2009 | 452.0 | 108.0 | 12.56 |
| Yeosu | 34.7393 | 127.7406 | 461.0 | 116.0 | 11.92 |
| Wonju | 37.3375 | 127.9466 | 487.0 | 146.0 | 10.01 |
| Chuncheon | 37.9026 | 127.7357 | 491.0 | 149.0 | 9.89 |
| Jeju | 33.5141 | 126.5297 | 446.0 | 137.0 | 9.77 |
| Cheongju | 36.6392 | 127.4407 | 483.0 | 163.0 | 8.89 |
| Pohang | 36.032 | 129.38 | 449.0 | 168.0 | 8.02 |
| Gwangju | 35.1729 | 126.8916 | 493.0 | 215.0 | 6.88 |
| Jeju | 33.5141 | 126.5297 | 446.0 | 223.0 | 6.0 |
| Gimhae | 35.2298 | 128.8908 | 457.0 | 239.0 | 5.74 |
| Mokpo | 34.8173 | 126.3815 | 471.0 | 251.0 | 5.63 |
| Yangsan | 35.3074 | 129.0201 | 411.0 | 245.0 | 5.03 |
| Changwon | 35.1702 | 128.5728 | 490.0 | 320.0 | 4.59 |
| Gwangju | 35.1729 | 126.8916 | 493.0 | 326.0 | 4.54 |
| Busan | 35.1047 | 129.032 | 479.0 | 323.0 | 4.45 |
| Jeonju | 35.8215 | 127.155 | 493.0 | 368.0 | 4.02 |
| Daejeon | 36.372 | 127.3721 | 500.0 | 464.0 | 3.23 |
| Suwon | 37.2723 | 126.9853 | 466.0 | 1268.0 | 1.1 |
| Seoul | 37.5714 | 126.9658 | 461.0 | 3934.0 | 0.35 |



5. RESULTS

(2) Optimal Locations







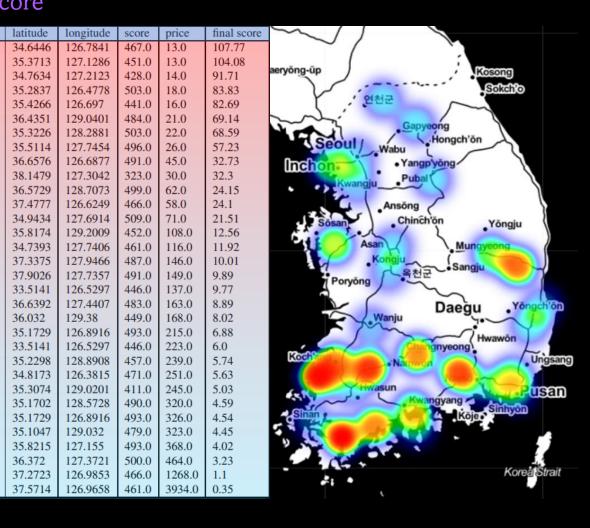


Final optimal regions considering observation data and economic data were derived.

Gangjin, Sunchang, Boseong, Yeongguang is the optimal location for solar power plant in order. Overall, it is distributed at the bottom of the map.

Final Score

| location | latitude | longitude | score | price | nnai sc |
|------------|----------|-----------|-------|--------|---------|
| Gangjin | 34.6446 | 126.7841 | 467.0 | 13.0 | 107.77 |
| Sunchang | 35.3713 | 127.1286 | 451.0 | 13.0 | 104.08 |
| Boseong | 34.7634 | 127.2123 | 428.0 | 14.0 | 91.71 |
| Yeonggwang | 35.2837 | 126.4778 | 503.0 | 18.0 | 83.83 |
| Gochang | 35.4266 | 126.697 | 441.0 | 16.0 | 82.69 |
| Cheongsong | 36.4351 | 129.0401 | 484.0 | 21.0 | 69.14 |
| Uiryeong | 35.3226 | 128.2881 | 503.0 | 22.0 | 68.59 |
| Hamyang | 35.5114 | 127.7454 | 496.0 | 26.0 | 57.23 |
| Hongseong | 36.6576 | 126.6877 | 491.0 | 45.0 | 32.73 |
| Cheorwon | 38.1479 | 127.3042 | 323.0 | 30.0 | 32.3 |
| Andong | 36.5729 | 128.7073 | 499.0 | 62.0 | 24.15 |
| Incheon | 37.4777 | 126.6249 | 466.0 | 58.0 | 24.1 |
| Gwangyang | 34.9434 | 127.6914 | 509.0 | 71.0 | 21.51 |
| Gyeongju | 35.8174 | 129.2009 | 452.0 | 108.0 | 12.56 |
| Yeosu | 34.7393 | 127.7406 | 461.0 | 116.0 | 11.92 |
| Wonju | 37.3375 | 127.9466 | 487.0 | 146.0 | 10.01 |
| Chuncheon | 37.9026 | 127.7357 | 491.0 | 149.0 | 9.89 |
| Jeju | 33.5141 | 126.5297 | 446.0 | 137.0 | 9.77 |
| Cheongju | 36.6392 | 127.4407 | 483.0 | 163.0 | 8.89 |
| Pohang | 36.032 | 129.38 | 449.0 | 168.0 | 8.02 |
| Gwangju | 35.1729 | 126.8916 | 493.0 | 215.0 | 6.88 |
| Jeju | 33.5141 | 126.5297 | 446.0 | 223.0 | 6.0 |
| Gimhae | 35.2298 | 128.8908 | 457.0 | 239.0 | 5.74 |
| Mokpo | 34.8173 | 126.3815 | 471.0 | 251.0 | 5.63 |
| Yangsan | 35.3074 | 129.0201 | 411.0 | 245.0 | 5.03 |
| Changwon | 35.1702 | 128.5728 | 490.0 | 320.0 | 4.59 |
| Gwangju | 35.1729 | 126.8916 | 493.0 | 326.0 | 4.54 |
| Busan | 35.1047 | 129.032 | 479.0 | 323.0 | 4.45 |
| Jeonju | 35.8215 | 127.155 | 493.0 | 368.0 | 4.02 |
| Daejeon | 36.372 | 127.3721 | 500.0 | 464.0 | 3.23 |
| Suwon | 37.2723 | 126.9853 | 466.0 | 1268.0 | 1.1 |
| Seoul | 37.5714 | 126.9658 | 461.0 | 3934.0 | 0.35 |



6. FUTURE WORK

Increase the amount of Local Region

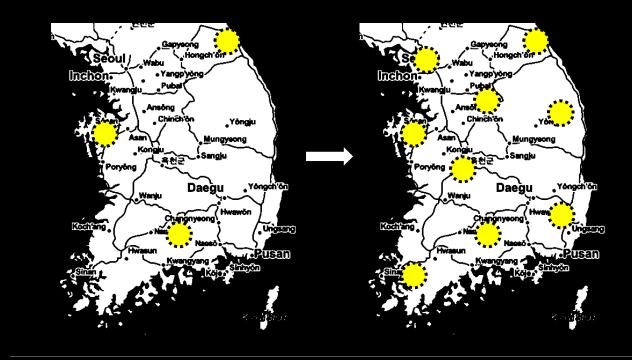
In this paper, we made AI model using just three local areas (gangneung, jinju, dangjin) because it's difficult to get solar power generation data (target data).

In the future, we'll increase the local area as much as possible. By doing that, we can get a more accurate AI model and a more accurate observation score.

Apply AI model to all over the world

The the way we get the global data in Korea, we could predict other countries like USA, England, China...

We could suggest the optimal location for solar power plants for them just by getting observation data of their regions.





Reference

- [1] Lars Buitinck et al. "API design for machine learning software: experiences from the scikit-learn project". In: arXiv preprint arXiv:1309.0238 (2013).
- [2] Nicholas Cox. "PAIRPLOT: Stata module for plots of paired observations". In: (2007).
- [3] Md Ziaul Hassan et al. "Forecasting day-ahead solar radiation using machine learning approach". In: 2017 4th Asia-Pacific World Congress on Computer Science and Engineering (APWC on CSE). IEEE. 2017, pp. 252–258.
- [4] Ju-Hee Jang et al. "A preliminary research of the bifacial PV system under installation conditions". In: Journal of the Korean Solar Energy Society 38.6 (2018), pp. 51–63.
- [5] Guolin Ke et al. "Lightgbm: A highly efficient gradient boosting decision tree". In: Advances in neural information processing systems 30 (2017), pp. 3146–3154.
- [6] Chang Ki Kim et al. "Derivation of typical meteorological year of Daejeon from satellite-based solar irradiance". In: Journal of the Korean Solar Energy Society 38.6 (2018), pp. 27–36.
- [7] YH Kwon, JY Kim, and MJ Lee. "Environmental considerations in the siting of solar and wind power plants". In: Korea Environment Institute (2008).

- [8] J Lee, HM Chung, and SS Lee. "Analysis on the location of the sunray energy power plants". In: Korea Knowledge Information Technology Society 3.3 (2008), pp. 31–37.
- [9] Kirim Lee and L. Hee. "Solar Power Plant Location Analysis Using GIS and Analytic Hierarchy Process". In: 2015.
- [10] Sung-Hun Lee et al. "Economic evaluation method for photovoltaic system development using insolation data analysis". In: Journal of the Korean Institute of Illuminating and Electrical Installation Engineers 25.10 (2011), pp. 38–46.
- [11] JI Park, MH Park, and SY Choi. "A study on GIS based suitability analysis of solar photovoltaic power generation using correlation analysis". In: The Korean Society of Cadastre 28 (2012), pp. 91–107.
- [12] Wim CM Van Beers and Jack PC Kleijnen. "Kriging interpolation in simulation: a survey". In: Proceedings of the 2004 Winter Simulation Conference, 2004. Vol. 1. IEEE. 2004.
- [13] Sung-Wook Yun et al. "A Study for Planning Optimal Location of Solar Photovoltaic Facilities using GIS". In: (2019).

Code Link (Jupyter Notebook)



Get Weather Data Code

https://nbviewer.org/github/Aldward/optimalenergy-locationanalysis/blob/master/code/get_weather_data.ipynb

Get Economy Code

https://nbviewer.org/github/Aldward/optimalenergy-locationanalysis/blob/master/code/get economy data.ipynb



Get Solar Power Generation Code

☐ Aldward / optimal-energy-location-analysis Public

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dacon_competition.ipynb
exploratory_data_analysis.ipynb

get_energy_data.ipynb

get_weather_data.ipynb

https://nbviewer.org/github/Aldward/optimalenergy-locationanalysis/blob/master/code/get_energy_data.ipynb



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Visualization Code

https://nbviewer.org/github/Aldward/optimalenergy-locationanalysis/blob/master/code/visualization.ipynb



Modeling Code

https://nbviewer.org/github/Aldward/optimalenergy-locationanalysis/blob/master/code/modeling.ipynb