2024년 9월 26-27일
APCC 기후정보 생산 및 활용 사용자워크숍

[실습] 상세화 예측 실습

예측운영과 정다은

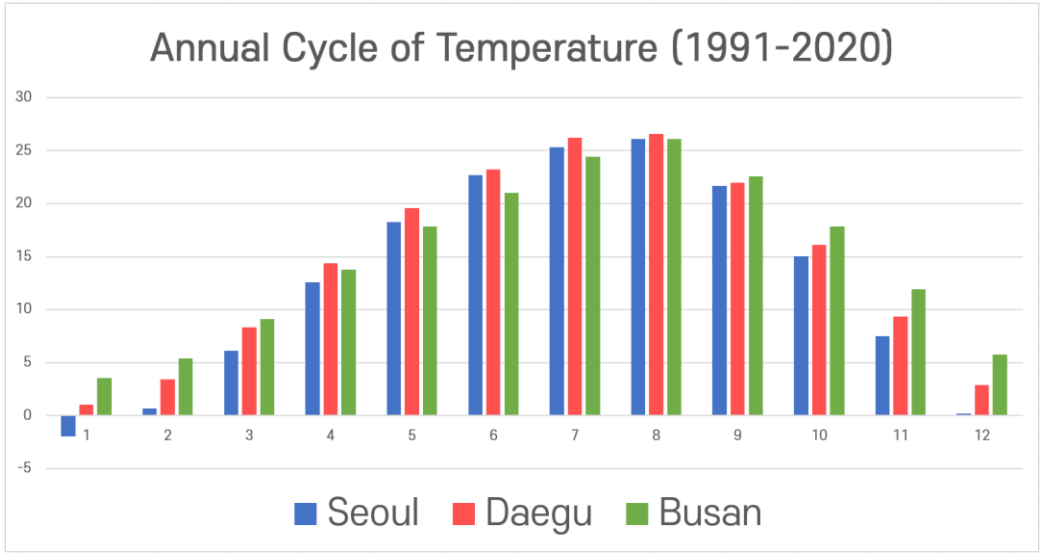
APCC APEC CLIMATE CENTER

1. 왜 상세화 예측이 필요한가?
2. 자료 처리 실습
3. 상세화 예측 실습
4. 아웃룩 만들어 보기

1. 왜 상세화 예측이 필요한가?
2. 자료 처리 실습
3. 상세화 예측 실습
4. 아웃룩 만들어 보기

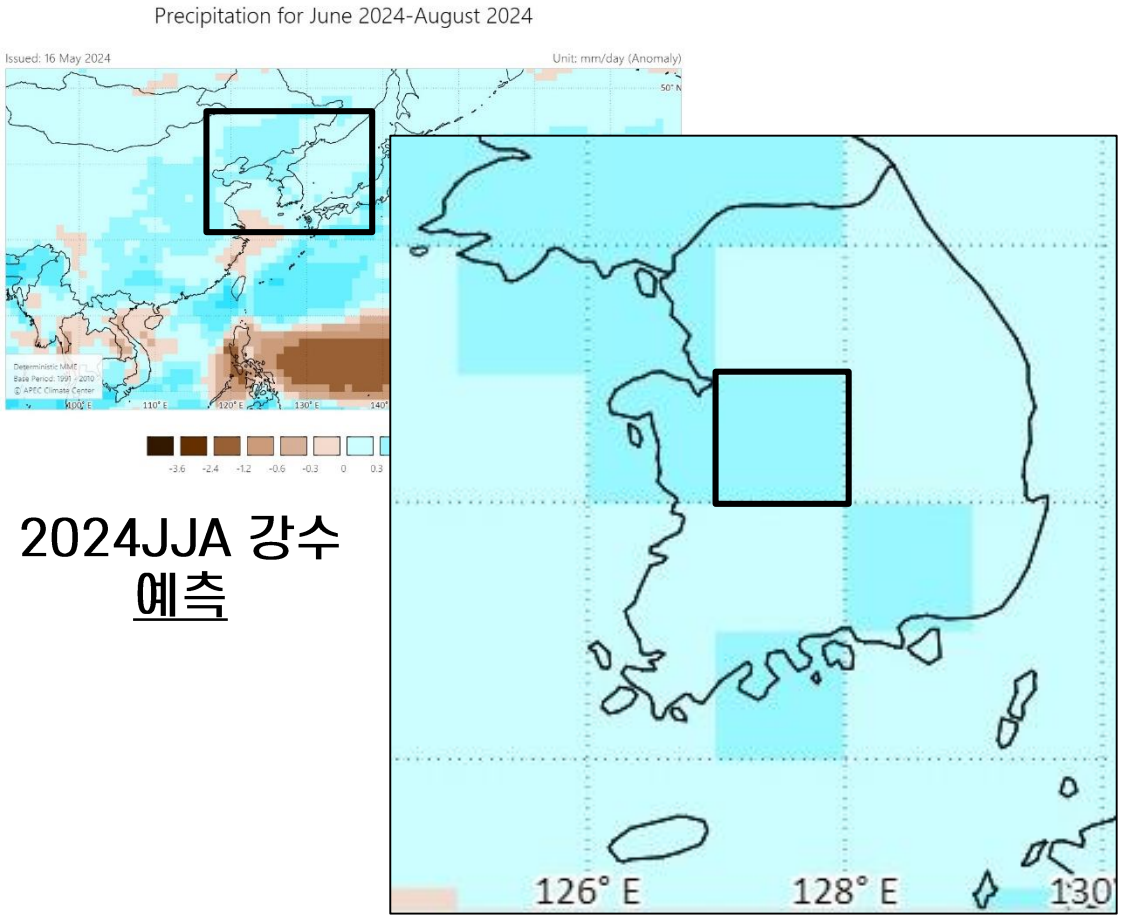
Why downscaled forecast?

① 지역마다 기후 특성이 다르다.

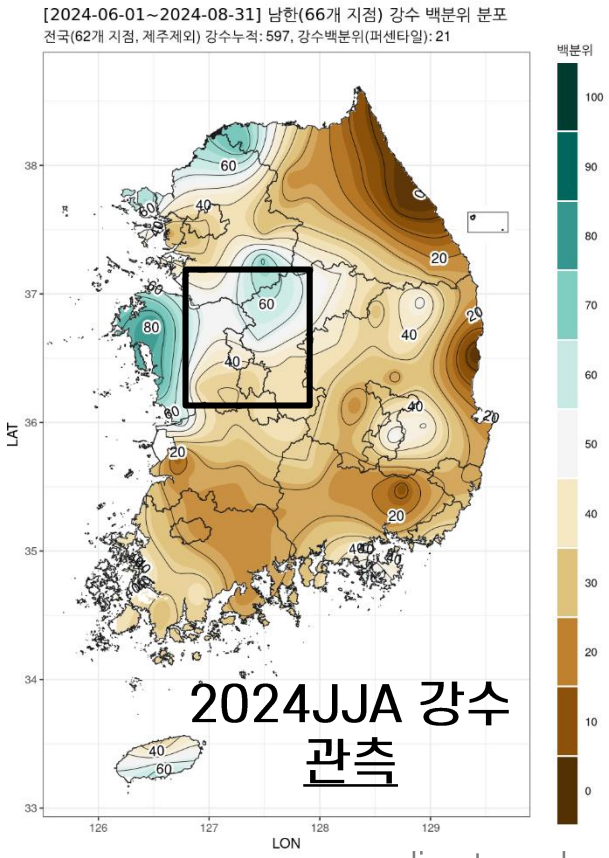


Why downscaled forecast?

② MME 예측의 해상도와 관측소 해상도의 차이가 크다.



2024JJA 강수 예측



2024JJA 강수 관측

www.climate.go.kr

1. 왜 상세화 예측이 필요한가?
2. 자료 처리 실습
3. 상세화 예측 실습
4. 아웃룩 만들어 보기

2024년 6월-8월(JJA)
서산의 강수량은?

Downscaling procedure in CLIK:
Precipitation over Seosan for JJA 2024

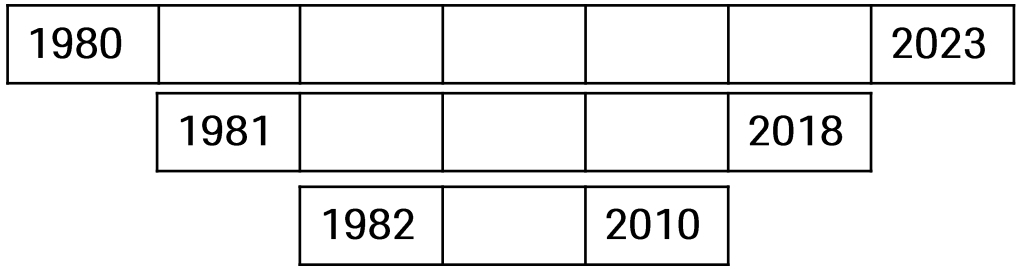
지점자료

- Point

전지구 재분석 자료

- Grid (built-in)
- Reanalysis, CAMS OPI, and OISST

모델 과거예측자료

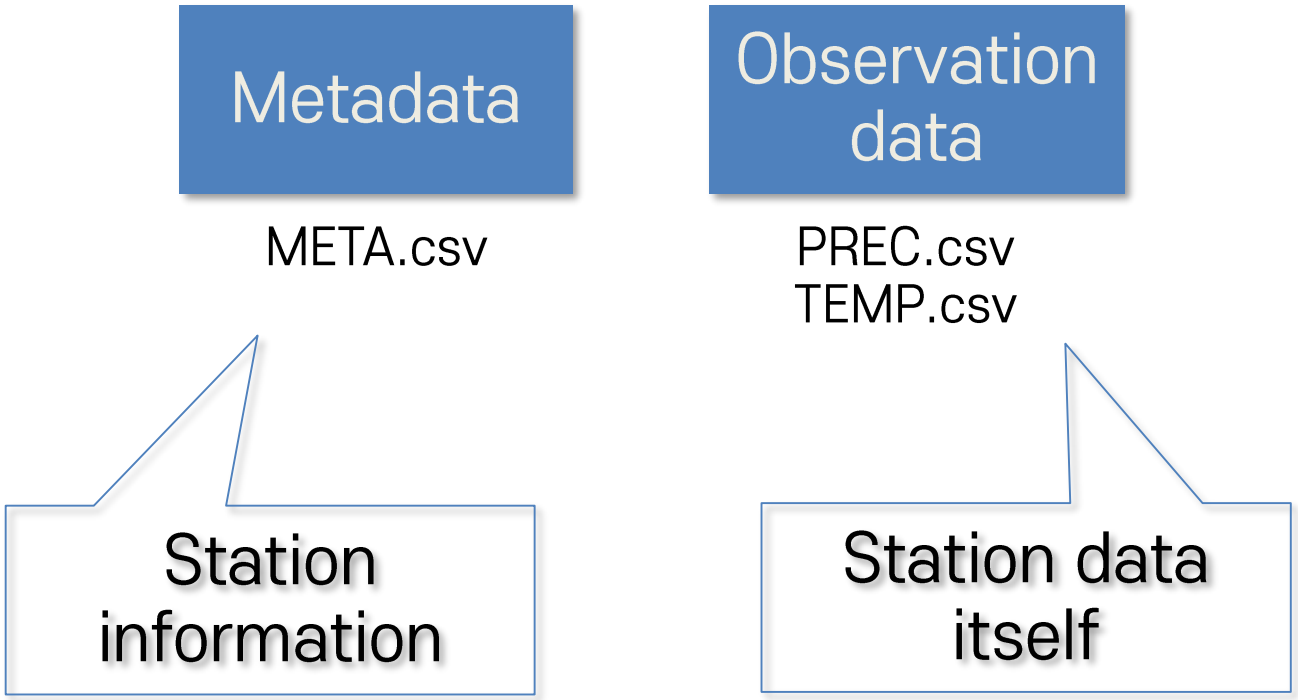


- Grid (built-in)
- Hindcast of dynamical models

Data Processing

Step 1. Prepare input data

기상자료개방포털 (data.kma.go.kr)



Data Processing

Step 1. Prepare input data

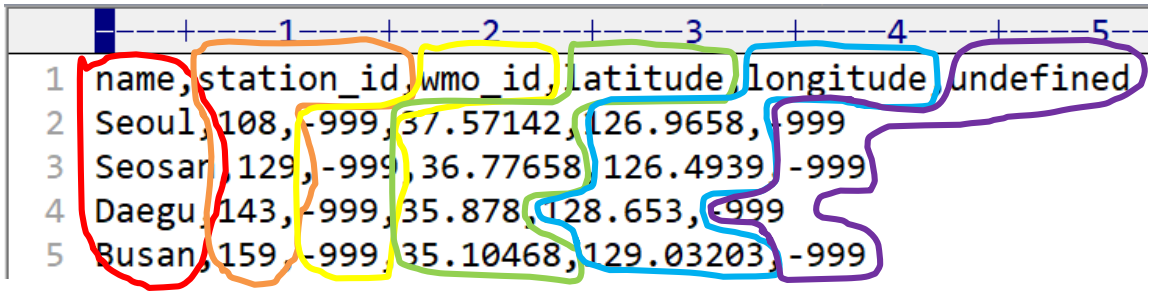
기상자료개방포털 (data.kma.go.kr)

Metadata

META.csv

Observation data

PREC.csv
TEMP.csv



```
1 name,station_id,wmo_id,latitude,longitude,undefined
2 Seoul,108,-999,37.57142,126.9658,-999
3 Seosan,129,-999,36.77658,126.4939,-999
4 Daegu,143,-999,35.878,128.653,-999
5 Busan,159,-999,35.10468,129.03203,-999
```

- Name: name of the station
- Station_id: unique id for the station (integer)
- WMO_id: WMO_id for station (integer, any number)
- Latitude: latitude for this station (float, for mapping)
- Longitude: longitude for this station (float, for mapping)
- Undefined: missing data (numeric)

Data Processing

Step 1. Prepare input data

기상자료개방포털 (data.kma.go.kr)

Metadata

Observation data

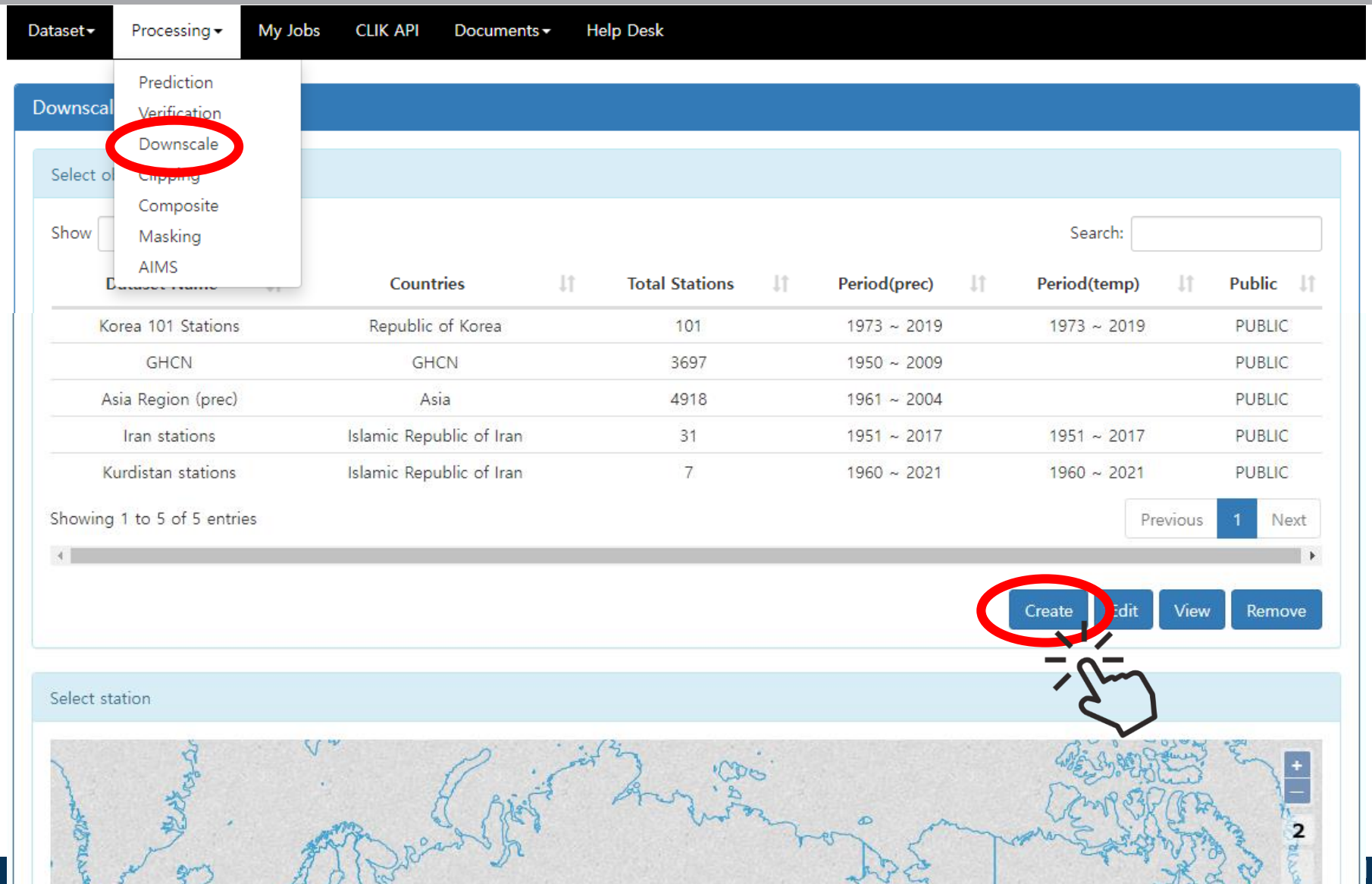
META.csv

PREC.csv
TEMP.csv

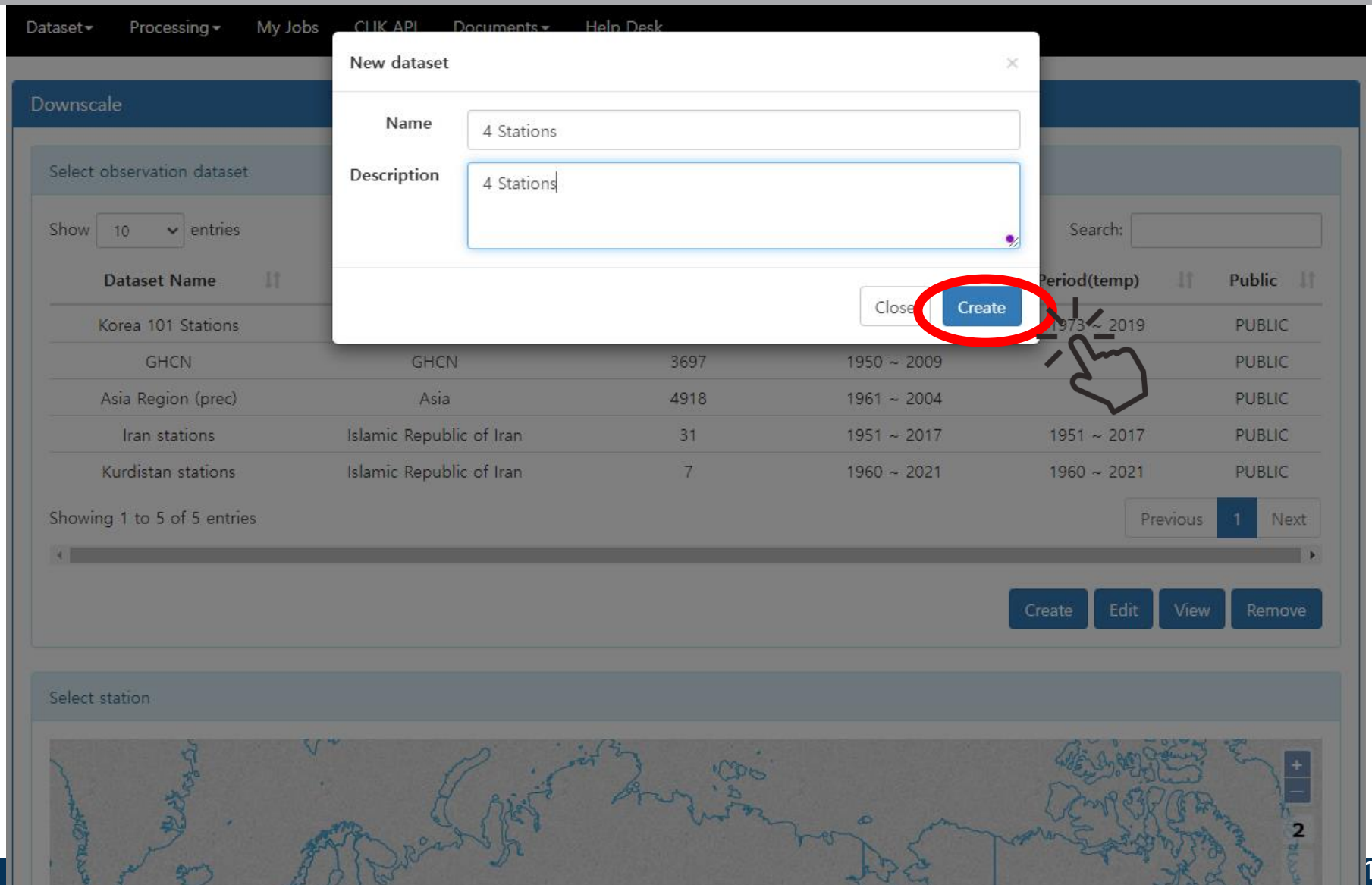
```
station_id,year,jan,feb,mar,apr,may,jun,jul,aug,sep,oct,nov,dec
108,1973,6.9,3.7,13.7,133,82.5,107.9,191.3,188.4,88.1,26.5,24.7,11.4
108,1974,15.1,23.8,27.7,144.8,239.8,64.3,256.9,319,96.3,36.2,10.6,16.2
108,1975,17.4,6.4,64.2,103,83.7,50.5,384.5,96.2,181.3,21,36.3,22.9
108,1976,4,108.3,6.8,58.4,41.5,49.2,176.7,462.3,78.7,60.7,30.7,32.2
108,1977,2.2,0.2,36.5,228.8,63.7,46.4,405.4,101,96.2,15.7,96,55.4
108,1978,11.6,13.6,52.2,13,25.4,374.7,242.2,270.7,80.9,40,7.5,29.1
108,1979,19.6,32.6,60.3,138.6,116,354.4,204.3,237.8,46.8,3.5,30,35.5
108,1980,28,5,32.8,216.7,90.3,118.8,259.2,331.5,58.3,44.9,10.6,46.3
108,1981,21,12,55.4,55.4,80.8,109.1,463.8,192.9,129,34.1,46.7,16
108,1982,26,2.9,46,8.1,134.6,15.7,195.5,255.8,4.8,46.5,164.8,48.6
108,1983,11.1,11.7,67.5,113.4,69,27.4,398.6,132.2,253.4,82.2,28.7,9.9
108,1984,10.7,14.9,11.4,41.8,35.2,105.5,269.9,330.9,348.1,21.4,35.5,24.2
108,1985,31.2,25.9,57.8,69,177.4,85.4,185.2,438.9,171.7,177.8,82.4,41.9
108,1986,11.7,8.3,44.3,20.6,71.5,117.1,351.8,370.3,101,79.6,39.3,31.9
108,1987,43.4,36.2,34.2,55.3,126.6,130.3,651.2,521.8,61.1,21.9,66.8,2.6
108,1988,3.3,4.5,31.3,60.5,42.8,73.7,382.3,81.3,39.7,8.4,21.1,11.9
108,1989,44.6,32.7,116.7,14,41.1,177.1,343.5,329.4,101.2,69.9,154.5,12.4
108,1990,62.2,64.8,92.3,94.2,122.8,497.2,486.5,283.5,570.1,0,56,23.9
```

- One year per row.
- Data should be delimited by comma (,), space ( ), tab ( ), or colon (:).

Data Processing
Step 2. Upload data to CLIK



Data Processing
Step 2. Upload data to CLIK



Data Processing
Step 2. Upload data to CLIK

Dataset ▾ | Processing ▾ | My Jobs | CLIK API | Documents ▾ | Help Desk

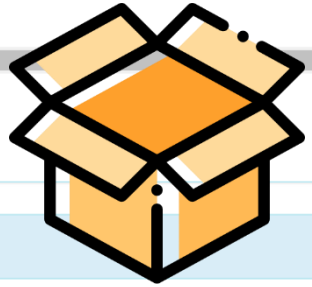
Downscale

Select observation dataset

Show 10 entries Search:

Dataset Name	Countries	Total Stations	Period(prec)	Period(temp)	Public
Korea 101 Stations	Republic of Korea	101	1973 ~ 2019	1973 ~ 2019	PUBLIC
GHCN	GHCN	3697	1950 ~ 2009		PUBLIC
Asia Region (prec)	Asia	4918	1961 ~ 2004		PUBLIC
Iran stations	Islamic Republic of Iran	31	1951 ~ 2017	1951 ~ 2017	PUBLIC
Kurdistan stations	Islamic Republic of Iran	7	1960 ~ 2021	1960 ~ 2021	PUBLIC
4 Stations		0			

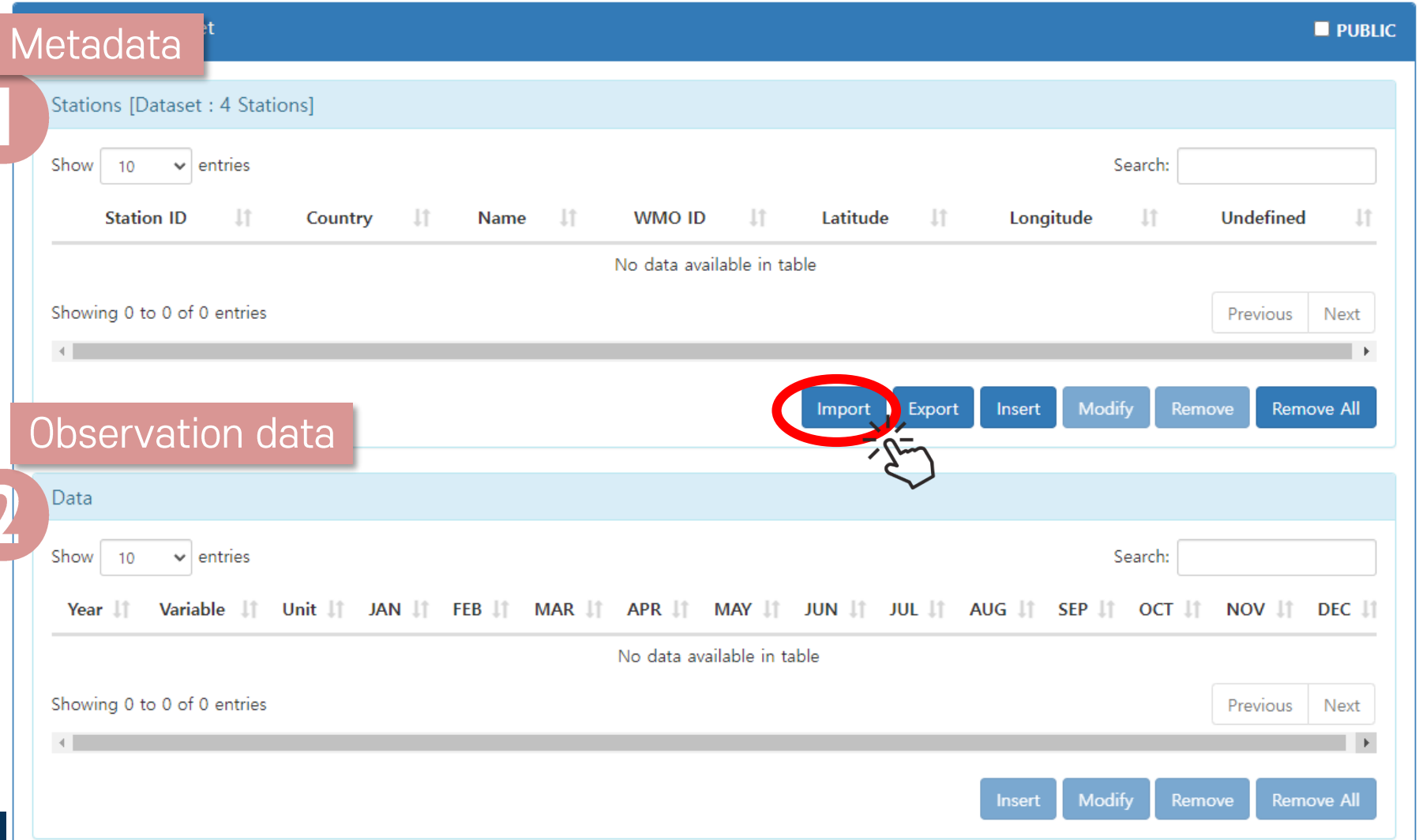
Showing 1 to 6 of 6 entries Previous 1 Next



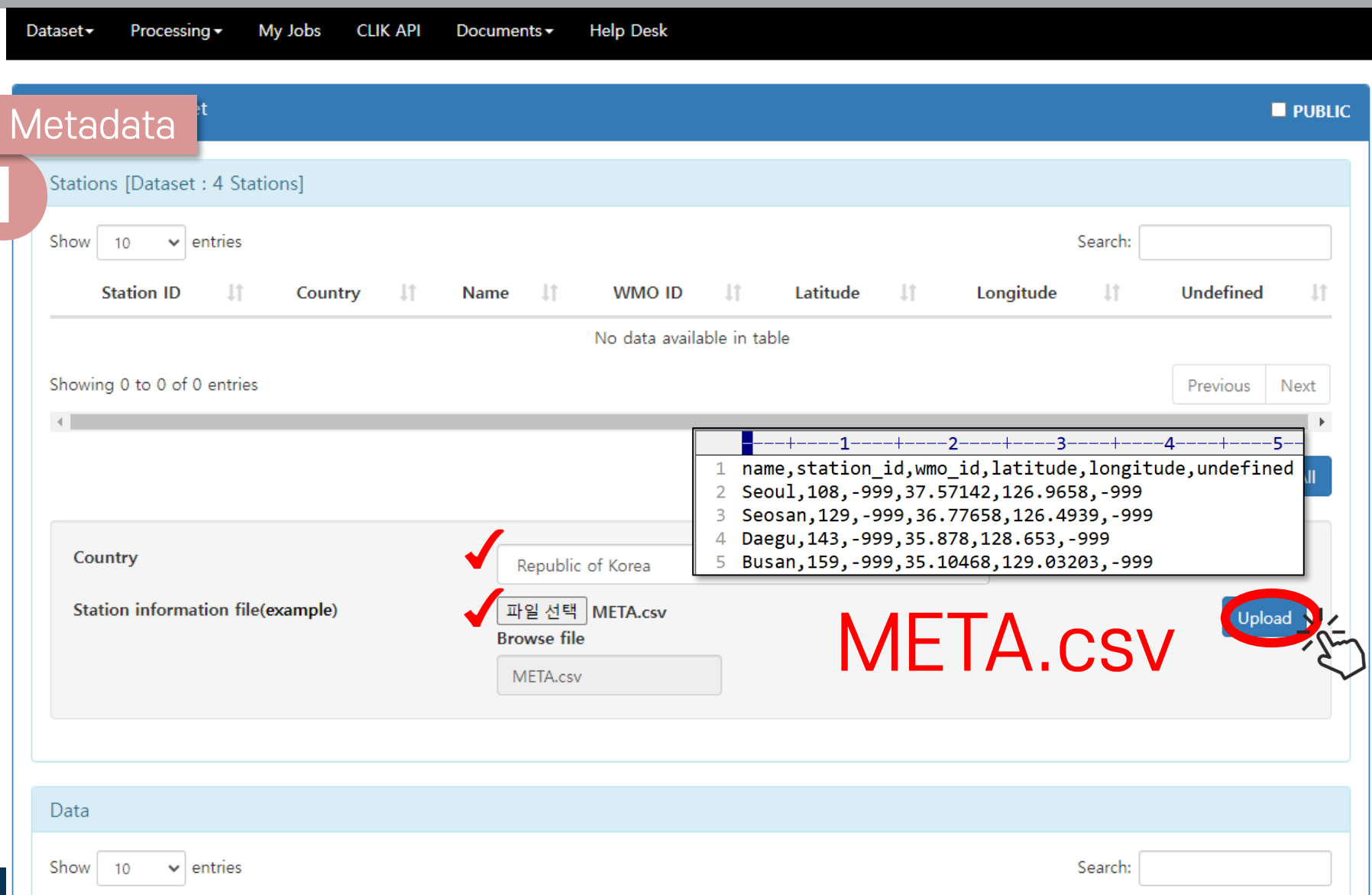
Create | Edit | View | Remove

Select station

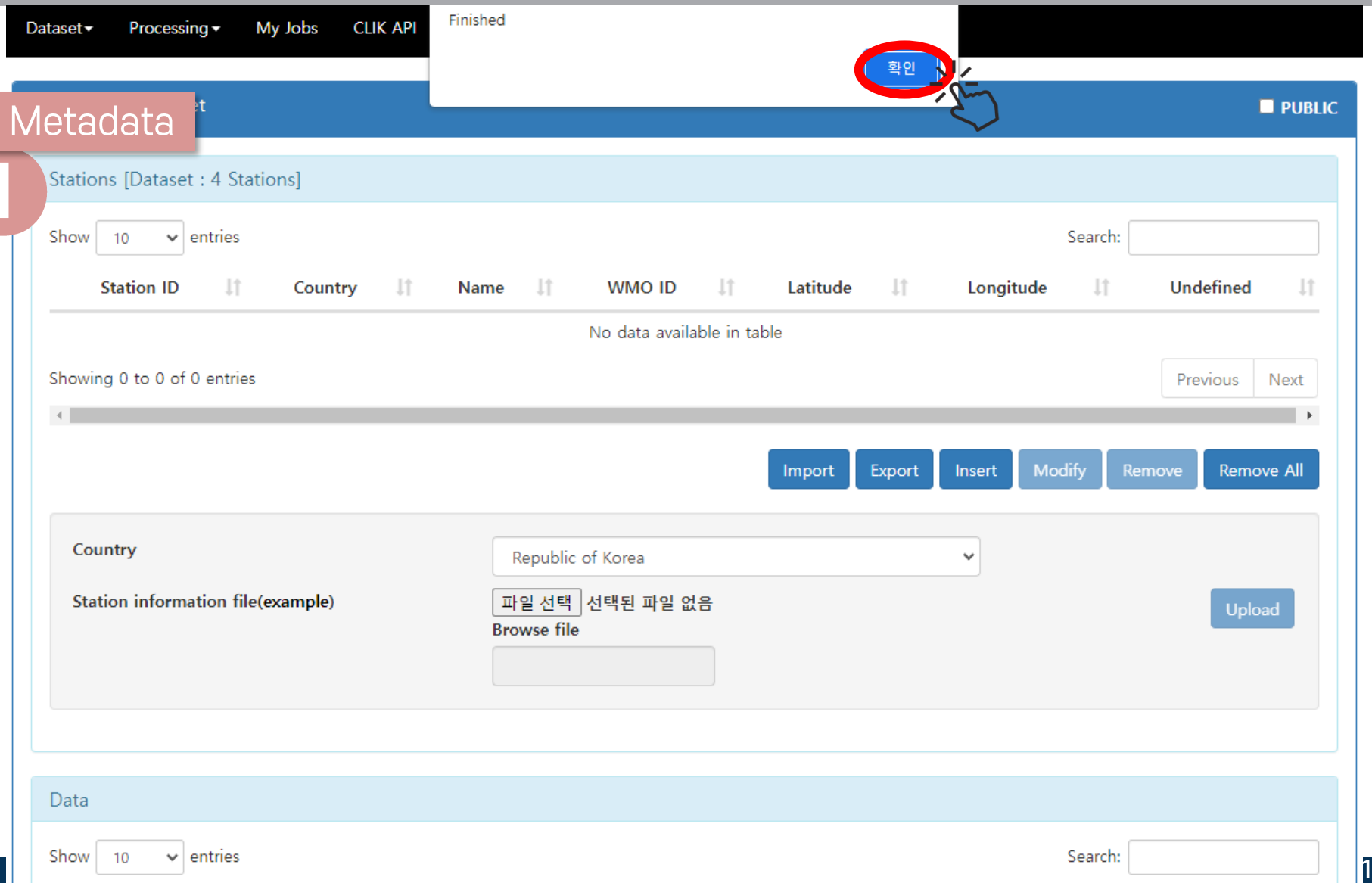
Data Processing
Step 2. Upload data to CLIK



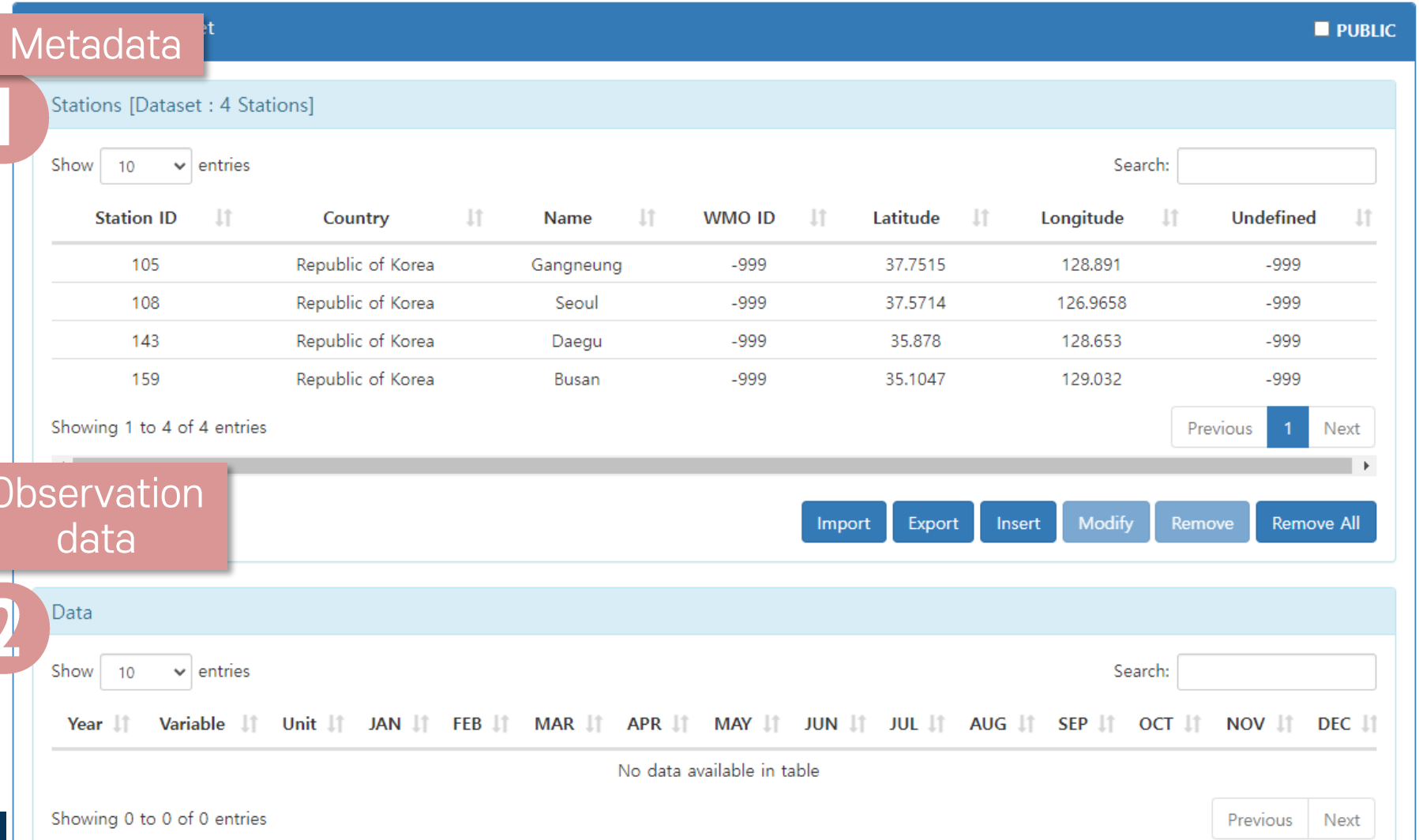
Data Processing
Step 2. Upload data to CLIK



Data Processing
Step 2. Upload data to CLIK



Data Processing
Step 2. Upload data to CLIK



Data Processing
Step 2. Upload data to CLIK

Dataset ▾ | Processing ▾ | My Jobs | CLIK API | Documents ▾ | Help Desk

Observation data

2

Show 10 entries

Year	Variable	Unit	JAN	FEB

Showing 0 to 0 of 0 entries

Import observed data | Export observed data

```
station_id,year,jan,feb,mar,apr,may,jun,jul,aug,sep,oct,nov,dec
108,1973,56.9,3.7,13.7,133,82.5,107.9,191.3,188.4,88.1,26.5,24.7,11.4
108,1974,15.1,23.8,27.7,144.8,239.8,64.3,256.9,319,96.3,36.2,10.6,16.2
108,1975,17.4,6.4,64.2,103,83.7,50.5,384.5,96.2,181.3,21,36.3,22.9
108,1976,4,108.3,6.8,58.4,41.5,49.2,176.7,462.3,78.7,60.7,30.7,32.2
108,1977,2.2,0.2,36.5,228.8,63.7,46.4,405.4,101,96.2,15.7,96,55.4
108,1978,11.6,13.6,52.2,13,25.4,374.7,242.2,270.7,80.9,40,7.5,29.1
108,1979,19.6,32.6,60.3,138.6,116,354.4,204.3,237.8,46.8,3.5,30,35.5
108,1980,28,5,32.8,216.7,90.3,118.8,259.2,331.5,58.3,44.9,10.6,46.3
108,1981,21,12,55.4,55.4,80.8,109.1,463.8,192.9,129,34.1,46.7,16
108,1982,26,2.9,46,8.1,134.6,15.7,195.5,255.8,4.8,46.5,164.8,48.6
108,1983,11.1,11.7,67.5,113.4,69,27.4,398.6,132.2,253.4,82.2,28.7,9.9
108,1984,10.7,14.9,11.4,41.8,35.2,105.5,269.9,330.9,348.1,21.4,35.5,24.2
108,1985,31.2,25.9,57.8,69,177.4,85.4,185.2,438.9,171.7,177.8,82.4,41.9
108,1986,11.7,8.3,44.3,20.6,71.5,117.1,351.8,370.3,101,79.6,39.3,31.9
108,1987,43.4,36.2,34.2,55.3,126.6,130.3,651.2,521.8,61.1,21.9,66.8,2.6
108,1988,3.3,4.5,31.3,60.5,42.8,73.7,382.3,81.3,39.7,8.4,21.1,11.9
108,1989,44.6,32.7,116.7,14,41.1,177.1,343.5,329.4,101.2,69.9,154.5,12.4
108,1990,62.2,64.8,92.3,94.2,122.8,497.2,486.5,283.5,570.1,0,56,25.9
```

Variable: ✓ Precipitation ○ Temperature

Unit: ✓ mm/month ○ mm/day ○ others:

Observed data file(example): ✓ 파일 선택 PREC.csv

Browse file

PREC.csv

PREC.csv

Upload

Close

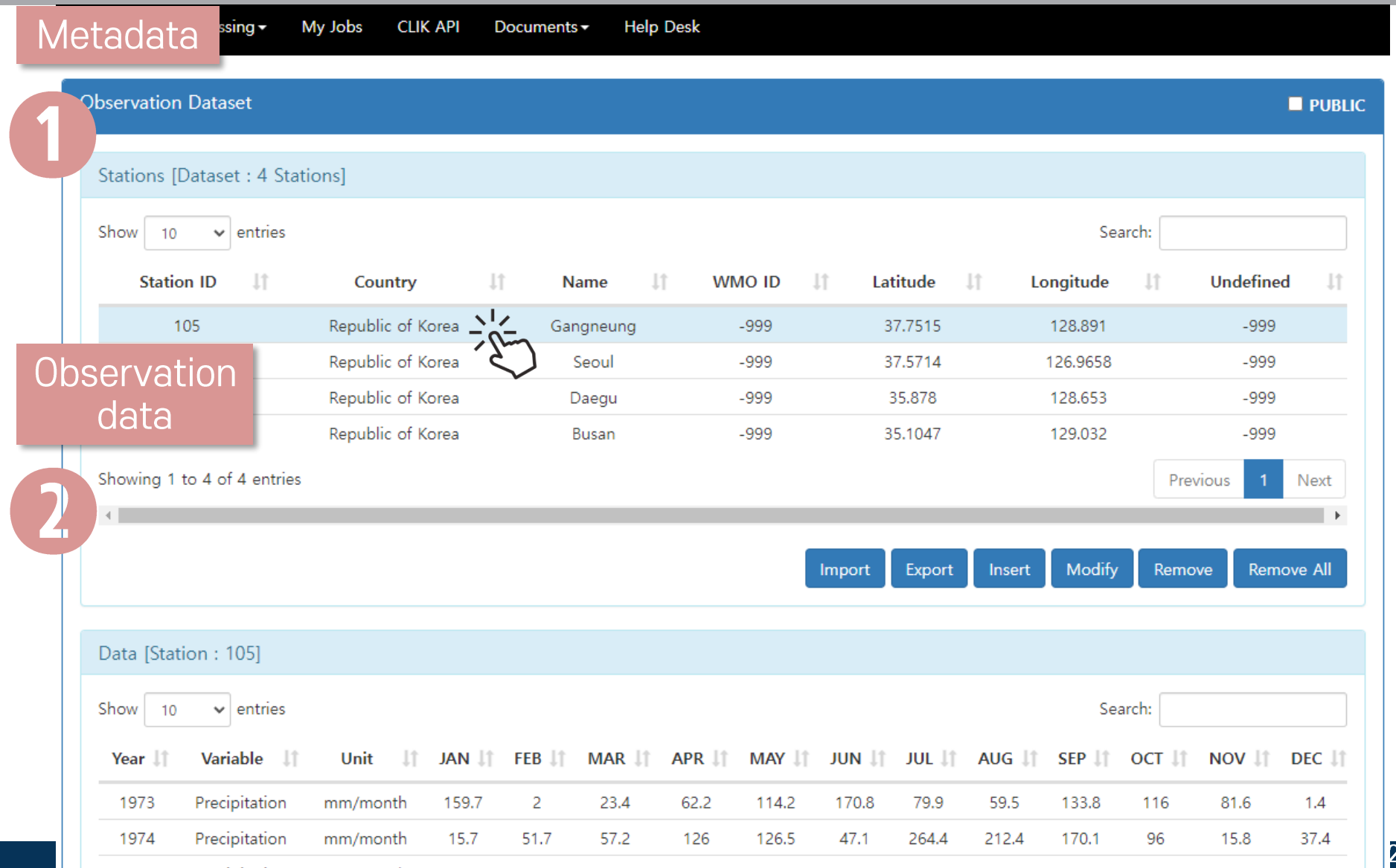
Data Processing
Step 2. Upload data to CLIK

Metadata

Observation data

1

2



Data Processing
Step 2. Upload data to CLIK

Dataset ▾ Processing ▾ My Jobs CLIK API Documents ▾ Help Desk

Observation data

2

Show 10 entries

Year	Variable	Unit	JAN	FEB
1981	Precipitation	mm/month	16.8	
1982	Precipitation	mm/month	27.7	

Showing 1 to 10 of 51 entries

Import observed data | Export observed data

```
station_id,year,jan,feb,mar,apr,may,jun,jul,aug,sep,oct,nov,dec
108,1973,0.4,0.6,4.5,12.4,17.4,21.4,26.8,25.9,20.3,13,4.7,-3
108,1974,-2.4,-2.1,3.7,10.7,16.7,19.7,23.5,25.1,20.6,12.6,5.4,-0.5
108,1975,-2.7,-0.8,4.4,13.3,16.7,21.4,24.9,27,22.6,15.4,9,-1.6
108,1976,-3.8,2.8,4.8,11.3,16.7,21.3,23.1,23.7,19.9,13.7,3.5,0.4
108,1977,-6.7,-2.4,5.4,12.5,17.4,22.5,26,24.6,21.5,16.7,7.6,2.4
108,1978,-2.4,-2.5,4.2,11.5,18.5,21.9,26.4,25.8,20.9,14.5,7.9,1.6
108,1979,0.9,0.6,6,11.2,16.5,21.4,24.3,25.4,20.1,15.9,5.7,1.4
108,1980,-3.7,-3.1,5.2,10.1,16.5,21.6,22.7,22.8,19.6,13,8.6,-3.8
108,1981,-7,-1.4,5.7,11.9,15.9,21.8,25.4,24.5,20,13.4,3.6,0.1
108,1982,-3.5,0.6,5.9,12.3,17.9,21.9,25.1,25.4,20.8,15.8,7.9,-0.1
108,1983,-1.7,-1.7,6.4,13.6,18.5,22.2,23.6,26,22,14.2,6.7,-1.1
108,1984,-5.9,-3.5,2.5,12.1,18.2,22.6,25.2,26.3,20.1,13.8,8.1,-0.9
108,1985,-5.9,-0.3,4.3,11.6,18.1,22.1,25.3,26.3,20.2,14.7,5.6,-3.4
108,1986,-5.4,-3.3,4.9,11.9,17.1,21.9,23.5,24.5,19.9,12.7,5.2,1.9
108,1987,-3,-0.1,4,10.8,17,22.4,23.7,24.4,20.1,15.5,7.5,0.9
108,1988,-2.1,-1.5,4.3,11.3,17.9,22.3,24.4,26.4,21.4,15,5.5,0.1
108,1989,0.8,2.4,6.1,14.3,17.9,21.2,24.5,25.5,20.7,13.6,7.1,1.4
108,1990,-3.2,2.7,7.2,11.3,16.2,20.7,24.9,26.4,21.1,15.4,10,0.8
```

TEMP.csv

Variable ✓ ○ Precipitation ◉ Temperature

Unit ✓ ◉ degC ○ degK ○ others:

Observed data file(example) ✓ 파일 선택 TEMP.csv

Browse file

TEMP.csv

Upload

Data Processing
Step 2. Upload data to CLIK

Dataset ▾ | Processing ▾ | My Jobs | CLIK API | Documents ▾ | Help Desk

Downscale

Select observation dataset

Show 10 entries Search:

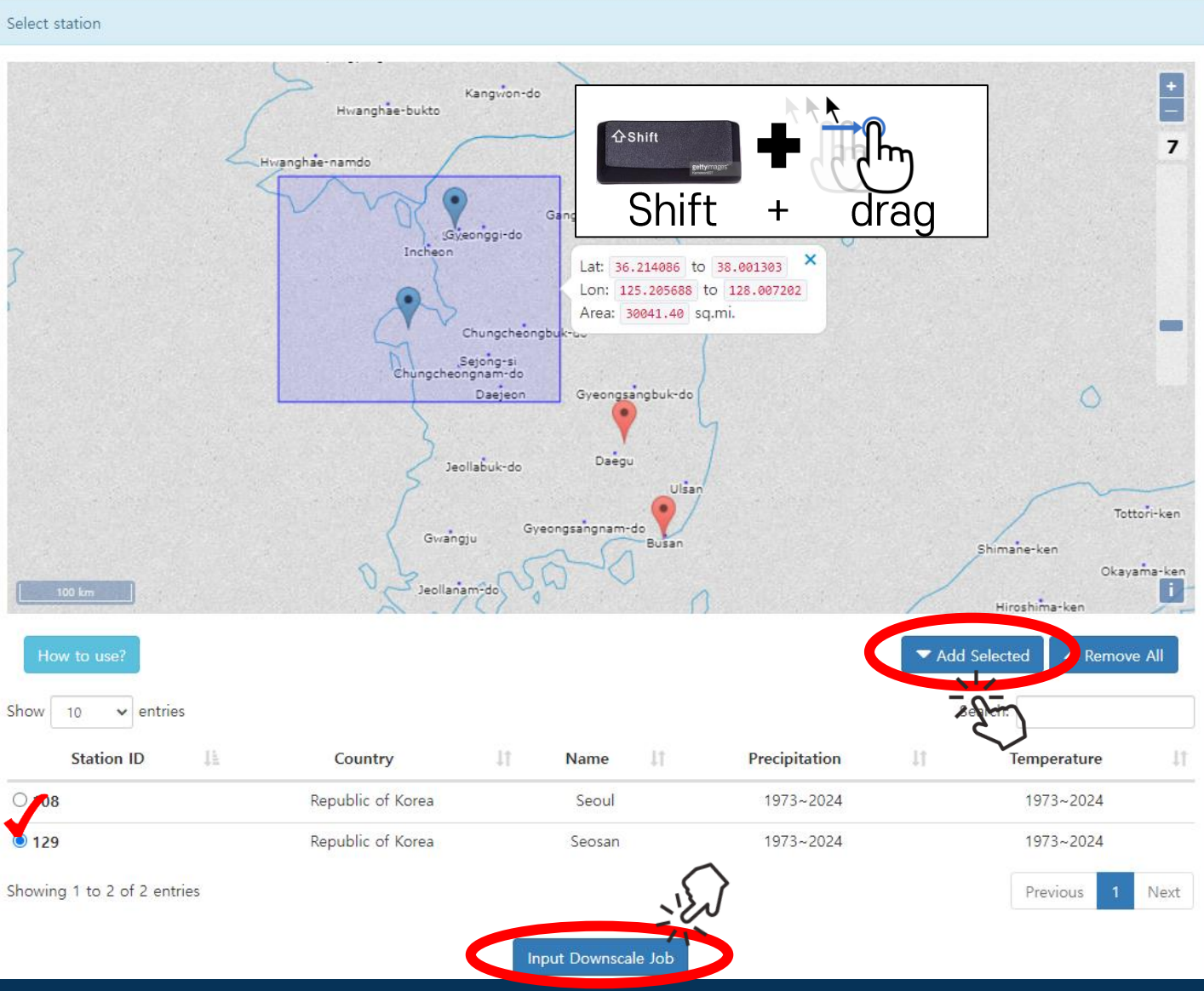
Dataset Name	Countries	Total Stations	Period(prec)	Period(temp)	Public
Korea 101 Stations	Republic of Korea	101	1973 ~ 2019	1973 ~ 2019	PUBLIC
GHCN	GHCN	3697	1950 ~ 2009		PUBLIC
Asia Region (prec)	Asia	4918	1961 ~ 2004		PUBLIC
Iran stations	Islamic Republic of Iran	31	1951 ~ 2017	1951 ~ 2017	PUBLIC
Kurdistan stations	Islamic Republic of Iran	7	1960 ~ 2021	1960 ~ 2021	PUBLIC
4 Stations	Republic of Korea	4	1973 ~ 2023	1973 ~ 2023	

Showing 1 to 6 of 6 entries Previous 1 Next

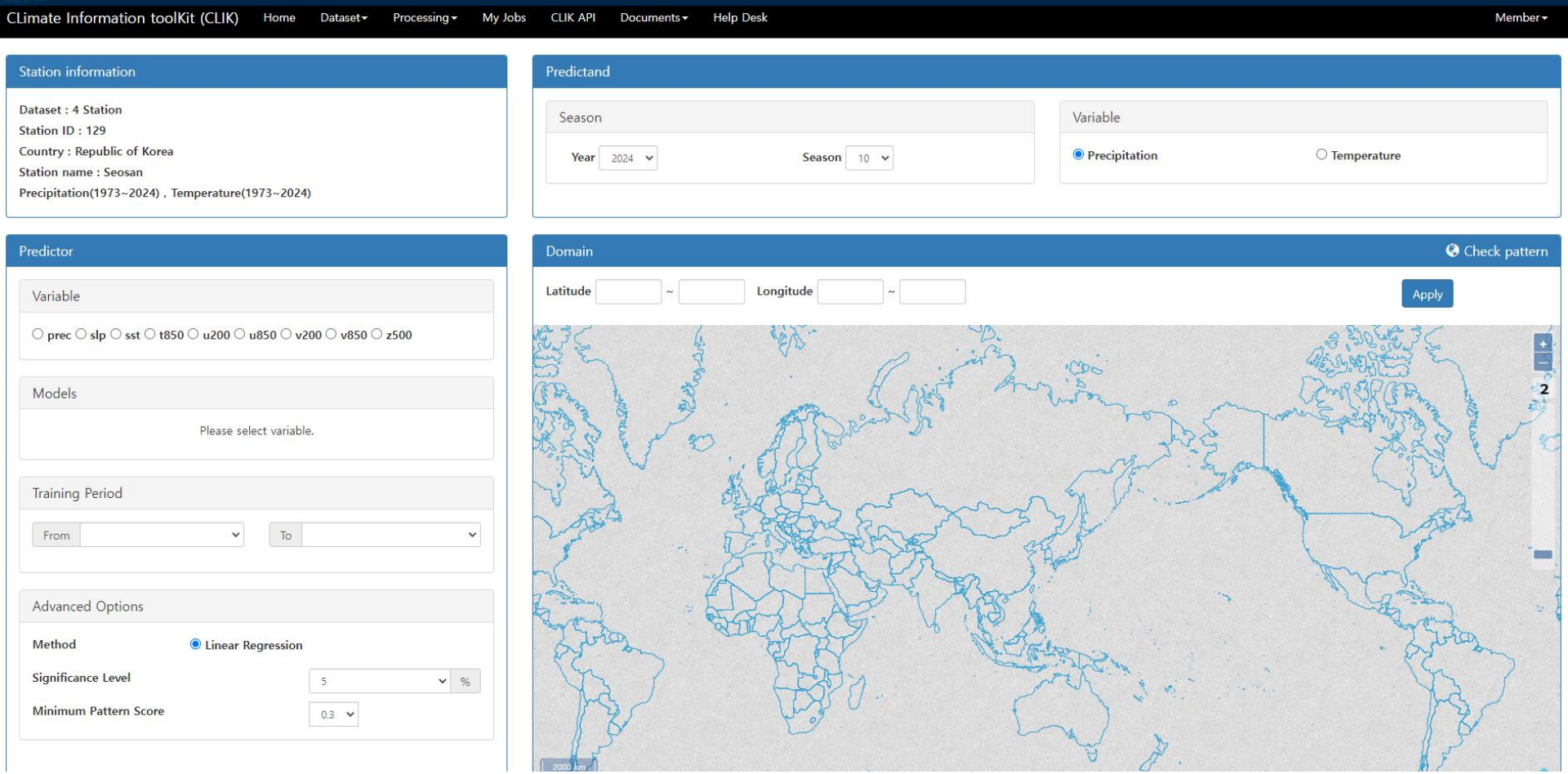
Create | Edit | View | Remove

Data Processing

Step 2. Upload data to CLIK



Data Processing
Step 2. Upload data to CLIK



1. 왜 상세화 예측이 필요한가?
2. 자료 처리 실습
3. 상세화 예측 실습
4. 아웃룩 만들어 보기

Downscaling procedure in CLIK:
Precipitation over Seosan for JJA 2024

지점자료

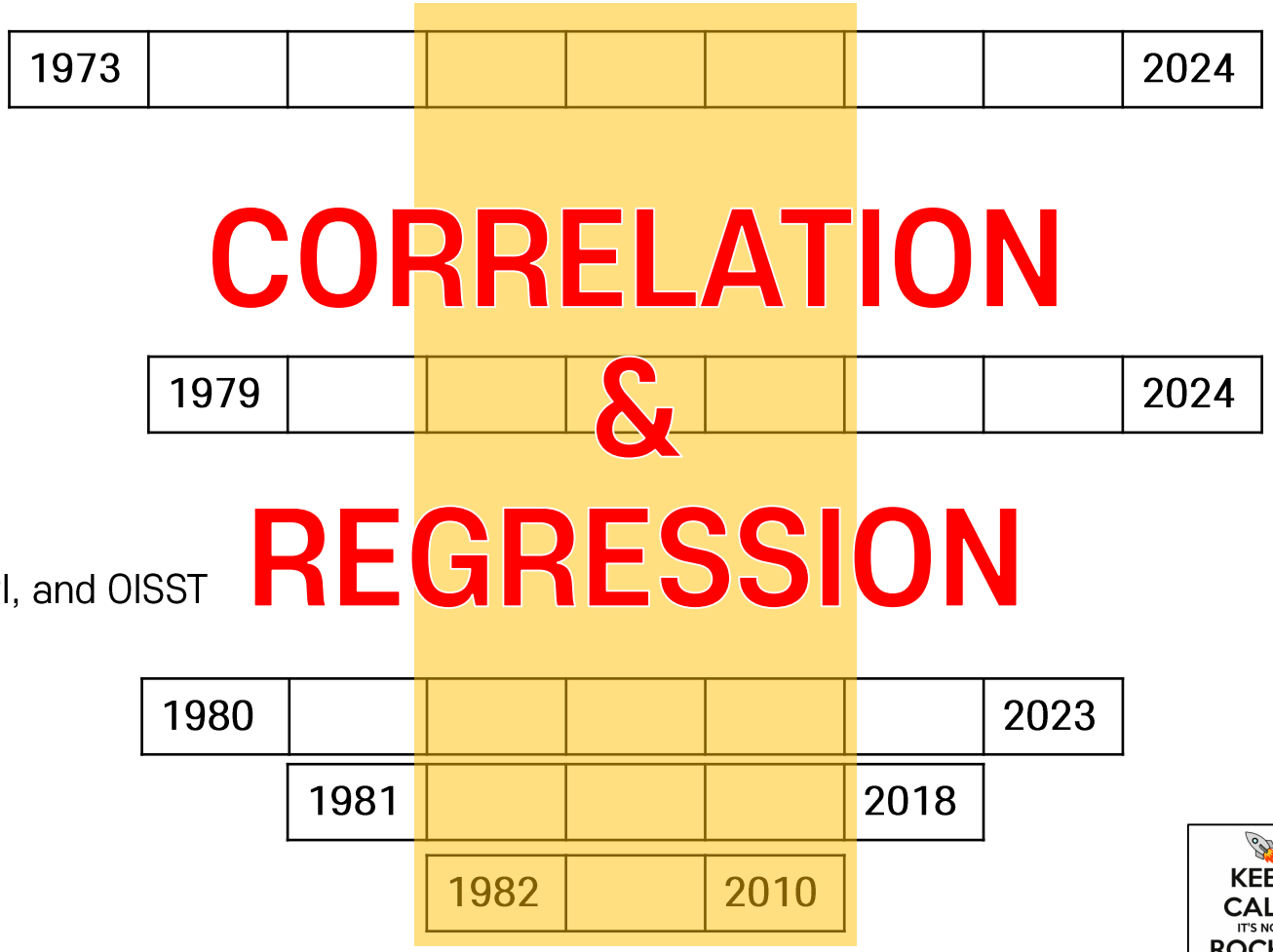
- Point

전지구 재분석 자료

- Grid (built-in)
- Reanalysis, CAMS OPI, and OISST

모델 과거예측자료

- Grid (built-in)
- Hindcast of dynamical models



Correlation does not imply causation!

CORRELATION

자동차 판매량

해외여행객수

남극 기압

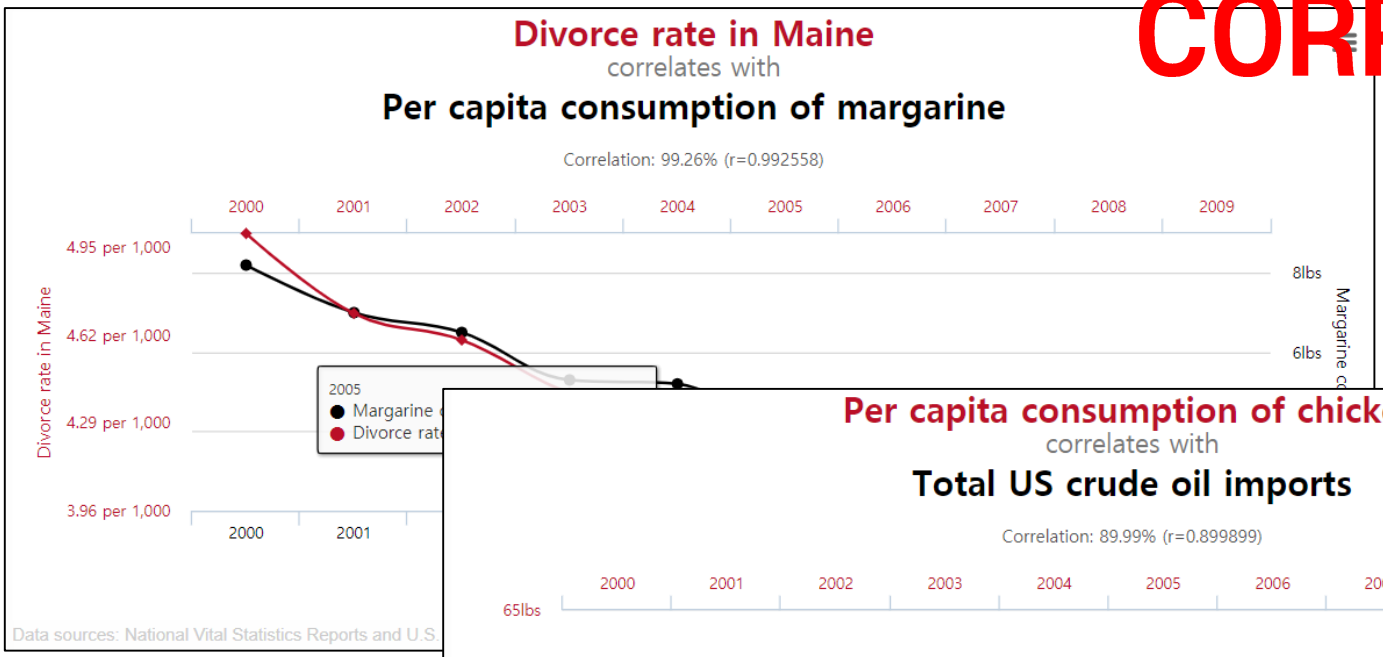
서산 강수량

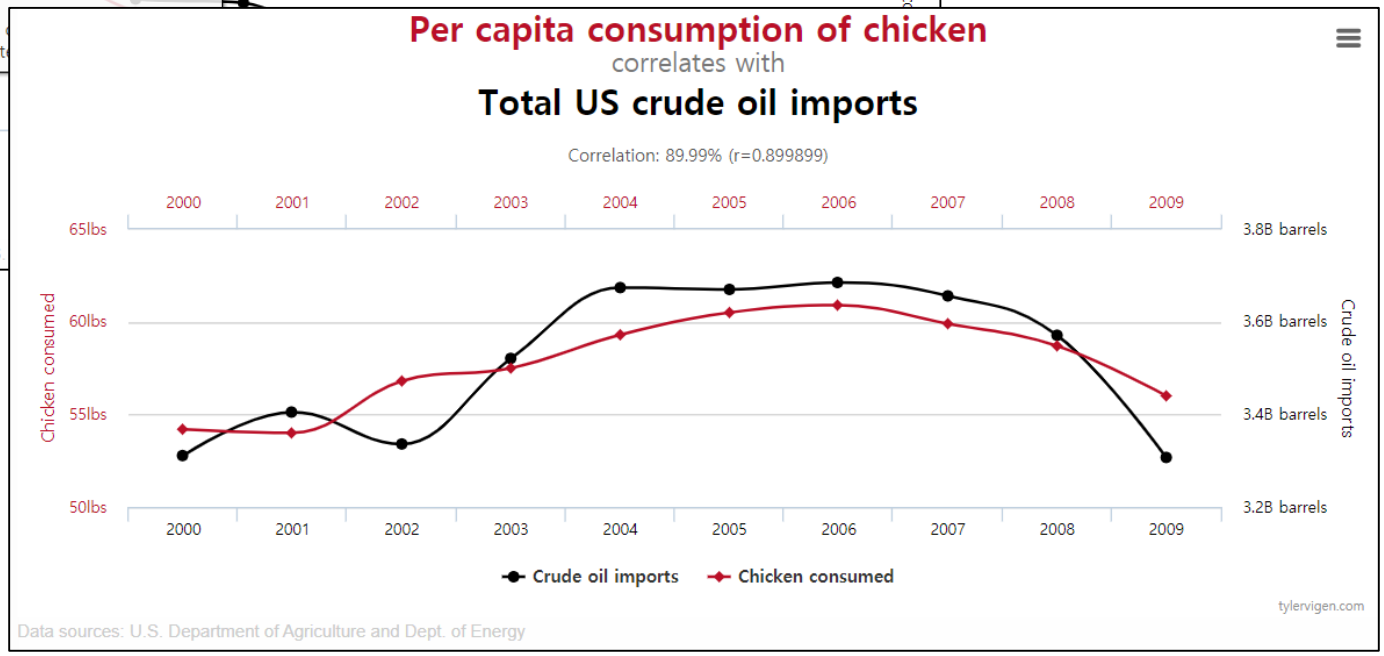
북태평양 기압

코로나 확진자수

Correlation does not imply causation!

CORRELATION





Correlation does not imply causation!

CORRELATION

자동차 판매량

해외여행객수

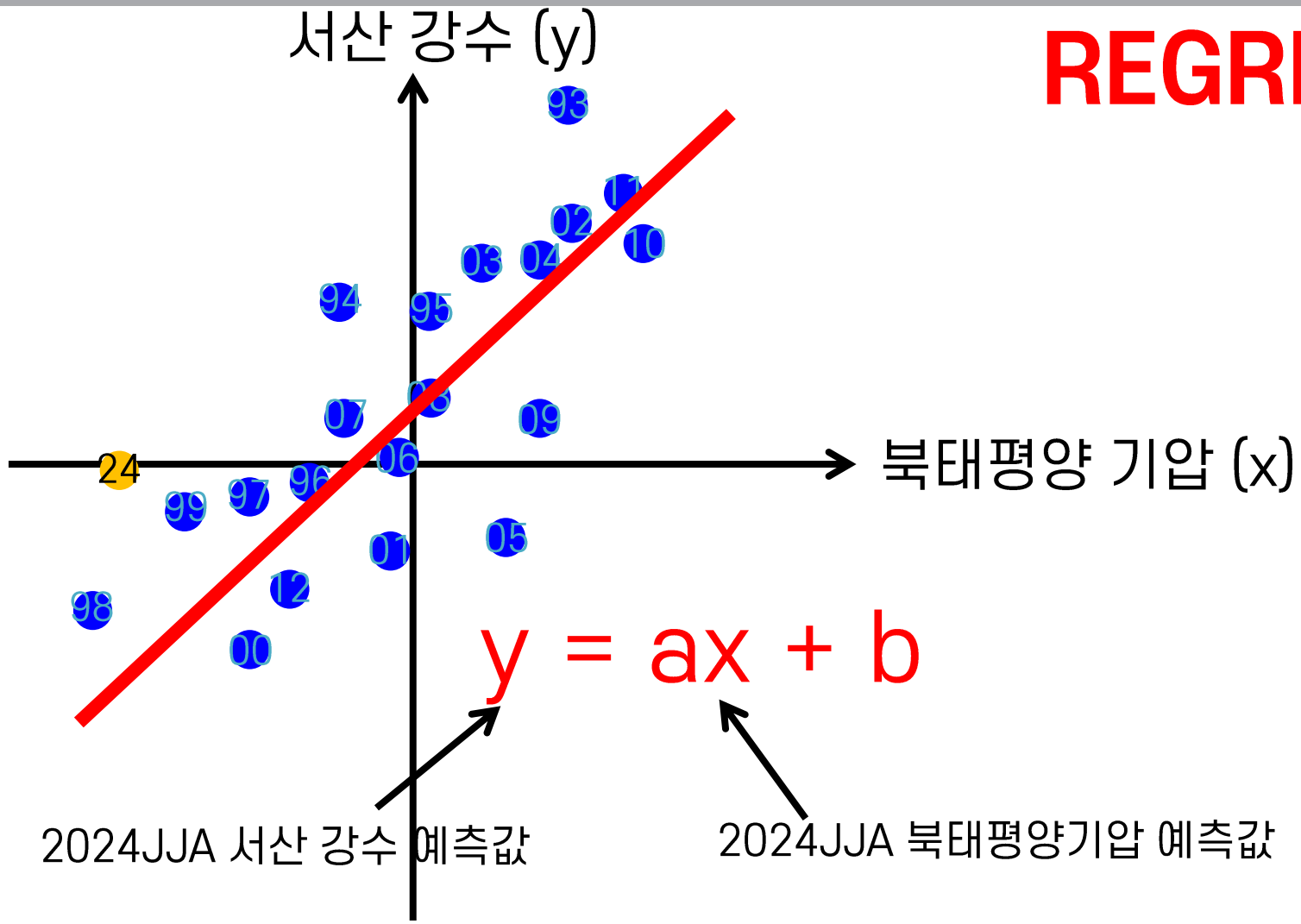
남극 기압

서산 강수량

북태평양 기압

코로나 확진자수

Correlation does not imply causation!

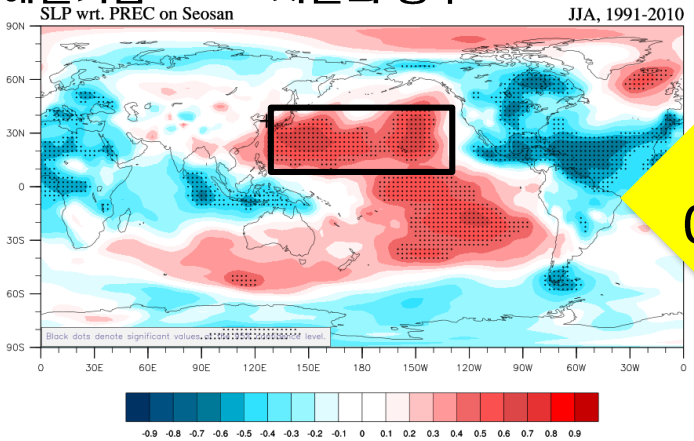


REGRESSION

Downscaling procedure in CLIK:
Precipitation over Seosan for JJA 2024

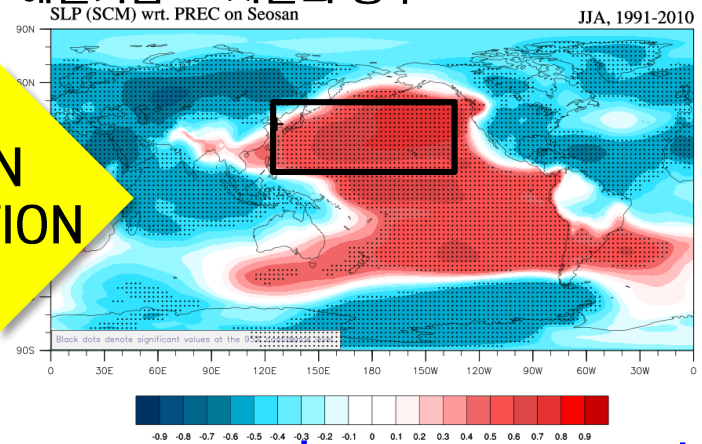
① 재분석자료와 지점자료의 상관관계

해면기압 서산의 강수

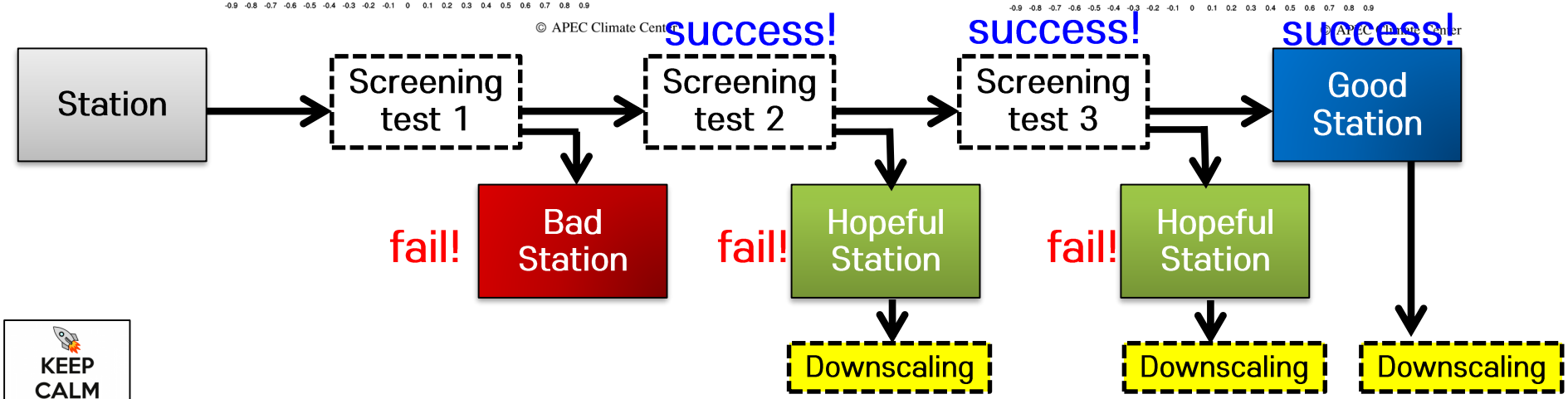


② 모델자료와 지점자료의 상관관계 계산

해면기압 서산의 강수

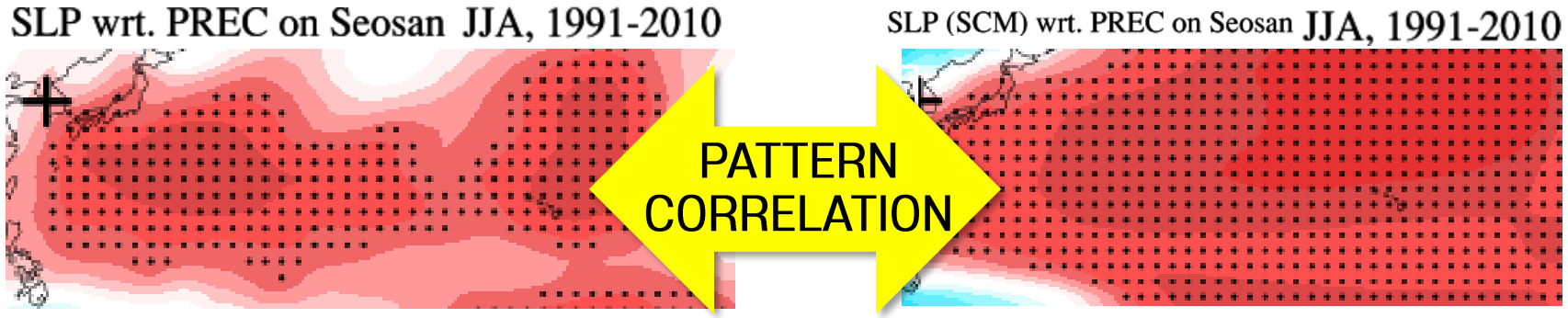


③ PATTERN CORRELATION



Downscaling procedure in CLIK:
Precipitation over Seosan for JJA 2024

Relationship between
서산 강수 & 북태평양 기압



from 관측자료 from 예측자료

① 과거 서산 강수가 과거 북태평양 기압과 상관관계가 있고,

② 과거 서산 강수가 모델이 예측했던 과거 북태평양 기압과 상관관계가 있으며,

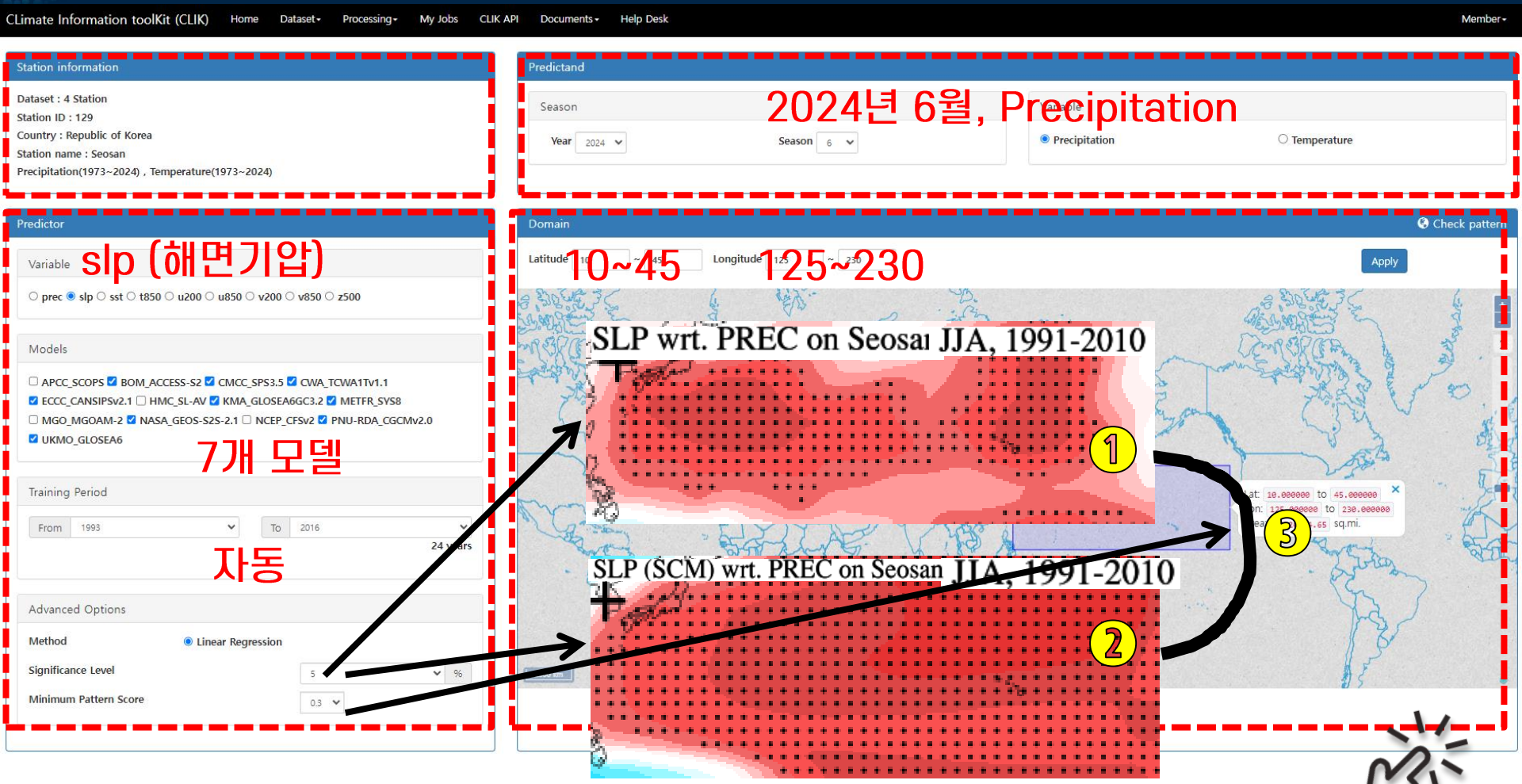
③ 그 상관관계의 모습이 유사하다면,

Successful downscaling…?

2024년 6월-8월(JJA)
서산의 강수량은?

Produce a downscaled forecast:

Precipitation over Seosan for JJA 2024

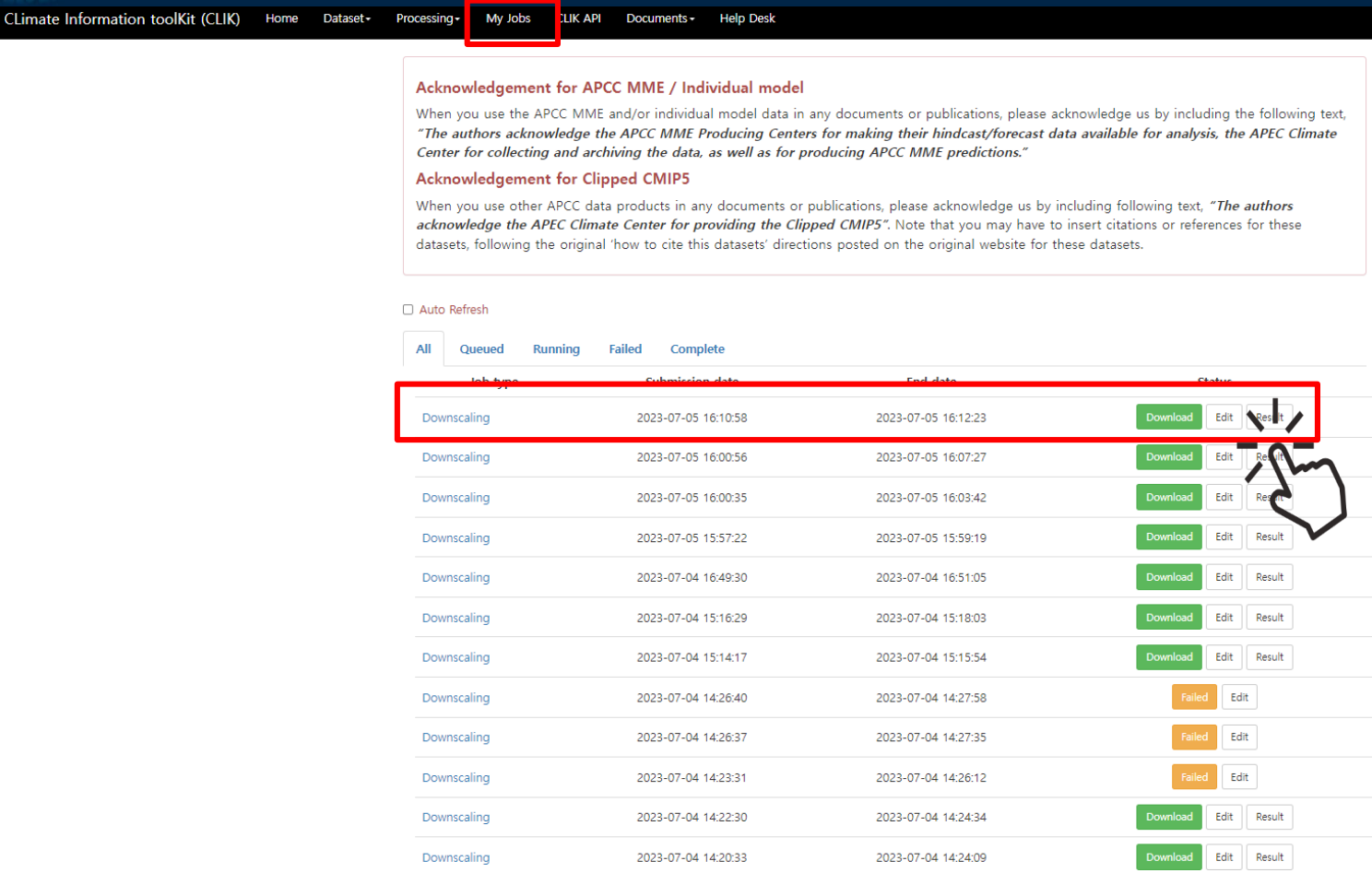


Predictor

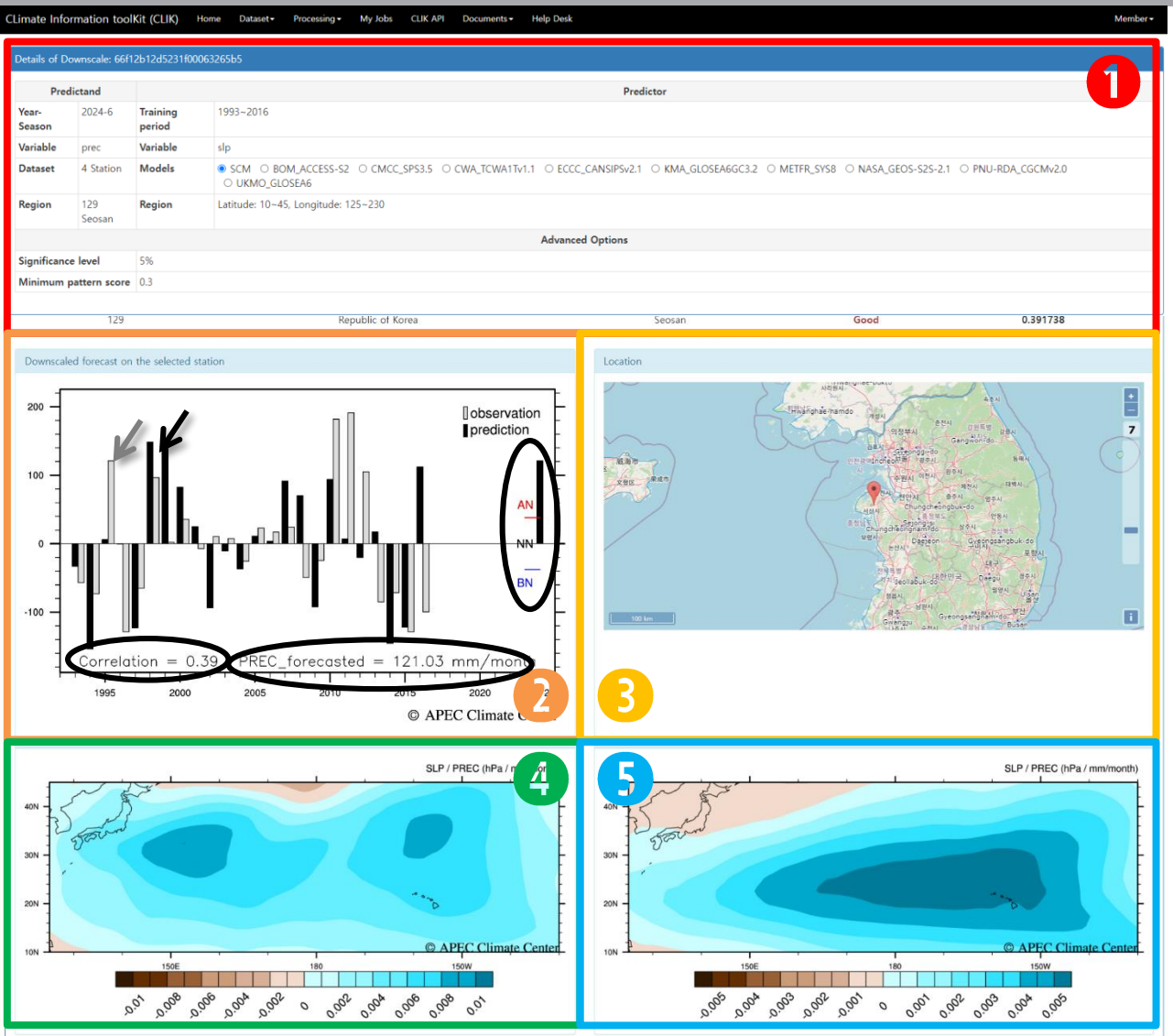
Advanced Options: Linear Regression, Sig. Level, Min. Pattern Score

Produce a downscaled forecast:

Precipitation over Seosan for JJA 2024



Produce a downscaled forecast:
Precipitation over Seosan for JJA 2024



1. Job summary
2. Historical time series of downscaled prediction/observation data, correlation coefficient between them, deterministic forecast, and tercile category of the forecast
3. Location of station
4. Regressed predictor (SLP; observation) field onto the predictand (precipitation) over the selected domain
5. Regressed predictor (SLP; model) field onto the predictand (precipitation) over the selected domain

Produce a downscaled forecast:
Precipitation over Seosan for JJA 2024

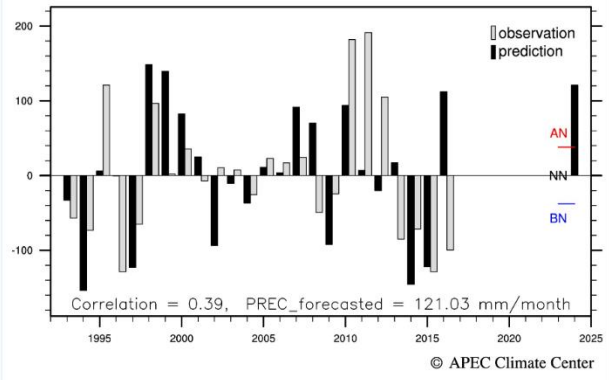
CLimate Information toolKit (CLIK) Home Dataset Processing My Jobs CLIK API Documents Help Desk Member

Details of Downscale: 66f12b12d5231f00063265b5

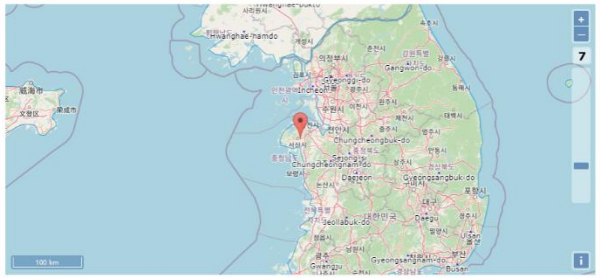
Predictand		Predictor	
Year-Season	2024-6	Training period	1993~2016
Variable	prec	Variable	slp
Dataset	4 Station	Models	SCM BOM_ACCESS-S2 CMCC_SPS3.5 CWA_TCWA1Tv1.1 ECCC_CANSIPSv2.1 KMA_GLOSEA6GC3.2 METFR_SYS8 NASA_GEOS-S2S-2.1 PNU-RDA_CGCMv2.0 UKMO_GLOSEA6
Region	129 Seosan	Region	Latitude: 10~45, Longitude: 125~230
Advanced Options			
Significance level	5%		
Minimum pattern score	0.3		

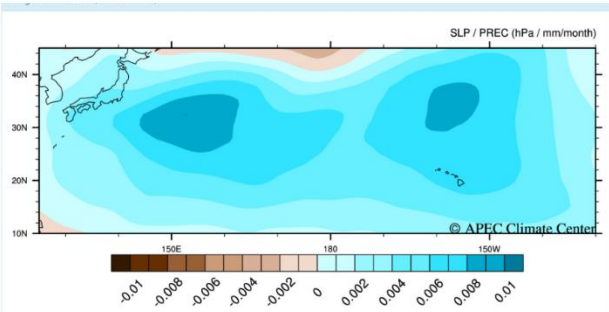
129 Republic of Korea Seosan Good 0.391738

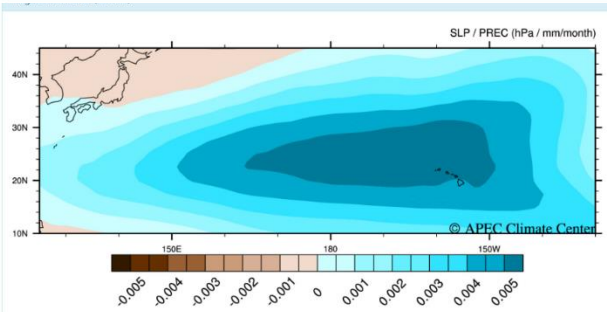
Downscaled forecast on the selected station



Location

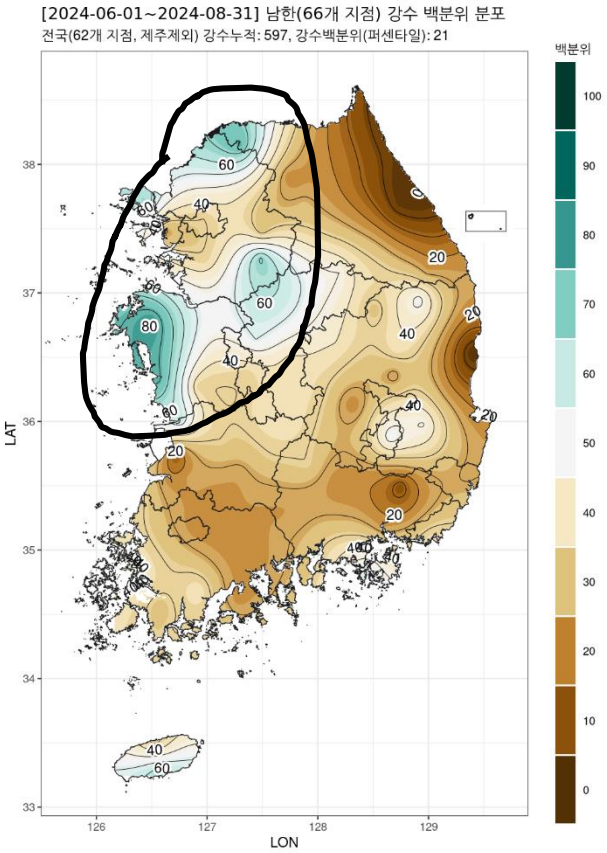






- SCM
- Above-normal prec
- Good
- Cor. Coeff: 0.39

Produce a downscaled forecast:
Precipitation over Seosan for JJA 2024



붙임 2 2024년 여름철 주요 기압계

【그림 1】 2024년 6월하순~7월중

- 이번 장마철 강수는 **좁은 영역에서 강하게 내리는 특징**을 보였는데, 1시간 최다강수량이 100 ㎜ 를 넘는 사례가 9개 지점에서 관측되었다.

※ 2024년 장마철 1시간최다강수량 100 ㎜ 이상 발생 사례

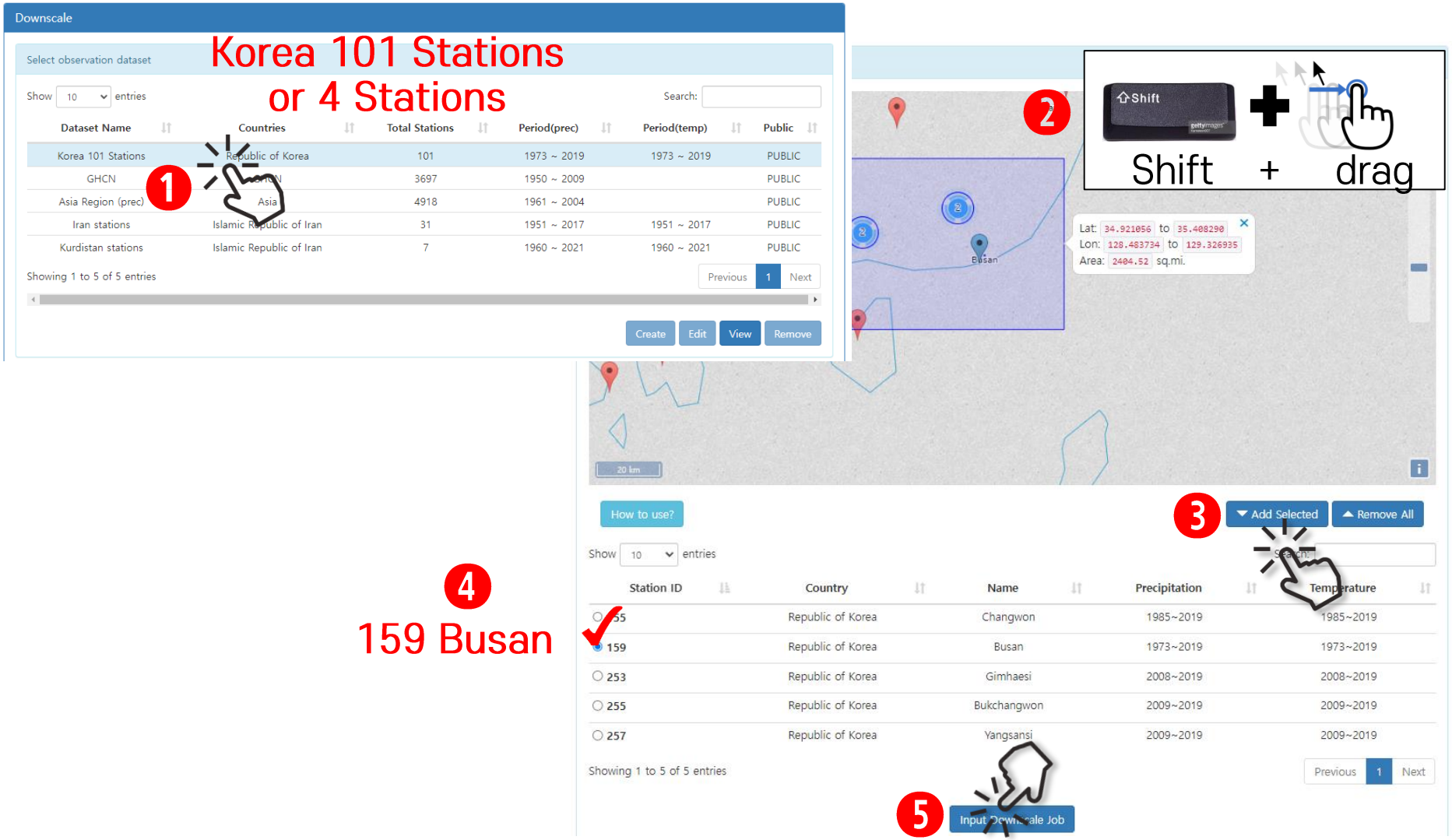
날짜	지점명	1시간최다 강수량	날짜	지점명	1시간최다 강수량
7.10.	어청도(전북 군산시)	146.0 mm	7.16.	의신(전남 진도군)	103.5 mm
	군산(전북 군산시)	131.7 mm	7.17.	신곡(경기 의정부시)	103.5 mm
	함라(전북 익산시)	125.5 mm		파주(경기 파주시)	101.0 mm
	서천(충남 서천군)	111.5 mm	7.24.	사하(부산 사하구)	112.5 mm
	양화(충남 부여군)	106.0 mm			

- **북태평양고기압 가장자리를 따라 유입된 수증기**와 우리나라 북쪽에서 유입된 **상층의 찬 공기가 정체전선상에서 충돌**하면서 비구름이 강하게 발달하여 **좁은 지역에 강하게 내리는 비가 자주 발생**했다.

기상청 보도자료: 2024년 여름철 기후특성

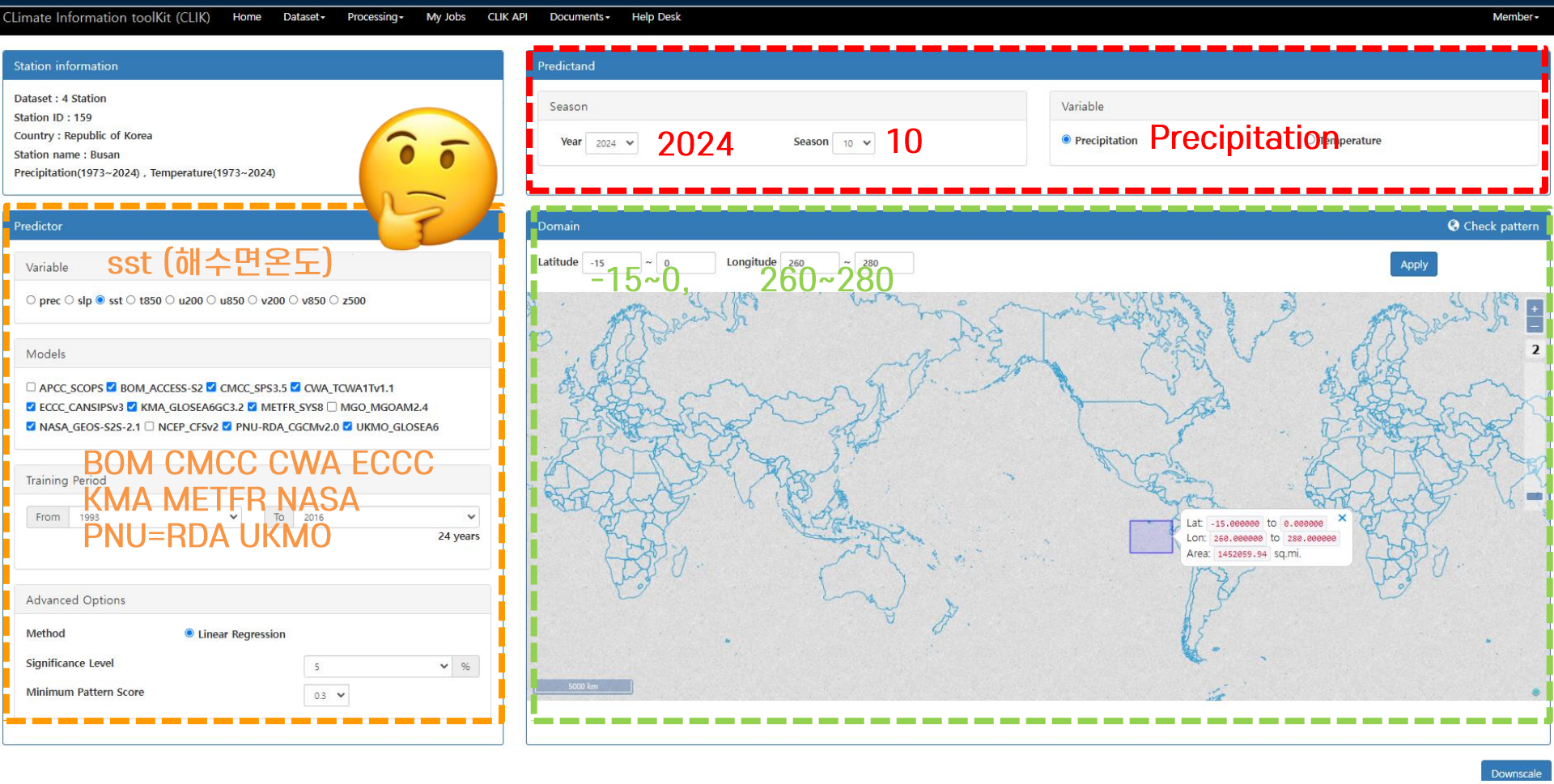
Produce a downscaled forecast:

Precipitation over Busan for 2024 OND



Produce a downscaled forecast:

Precipitation over Busan for 2024 OND

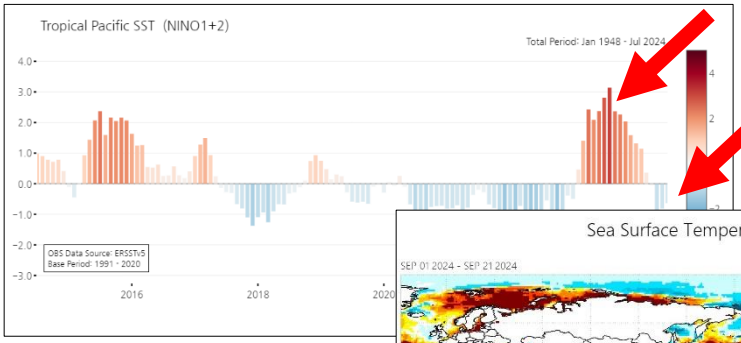


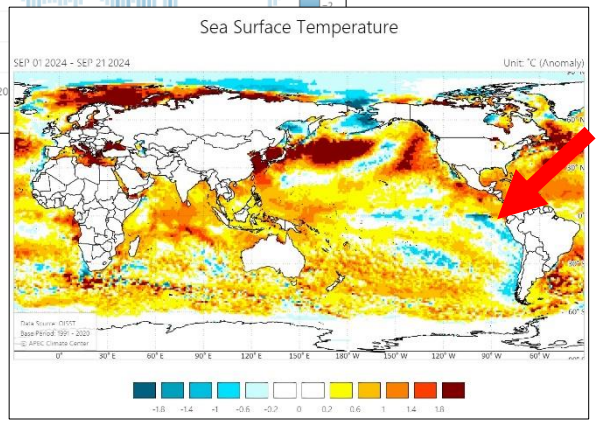
Predictand: 2023 OND / Precipitation

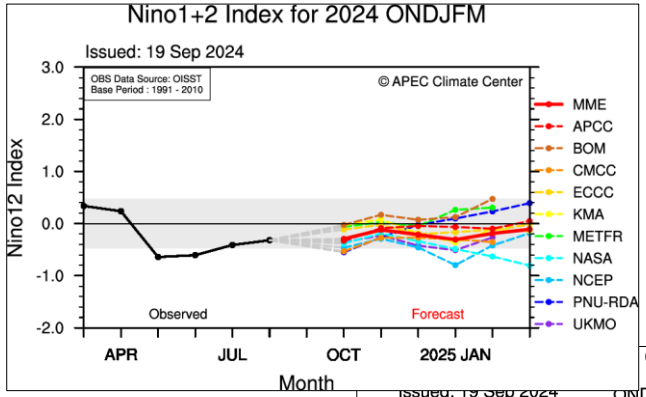
Predictor: sst / 9개 모델 / 열대 동태평양 (-15~0, 260~280)

Produce a downscaled forecast:
Precipitation over Busan for 2024 OND

Nino1+2 관측







Nino1+2 예측

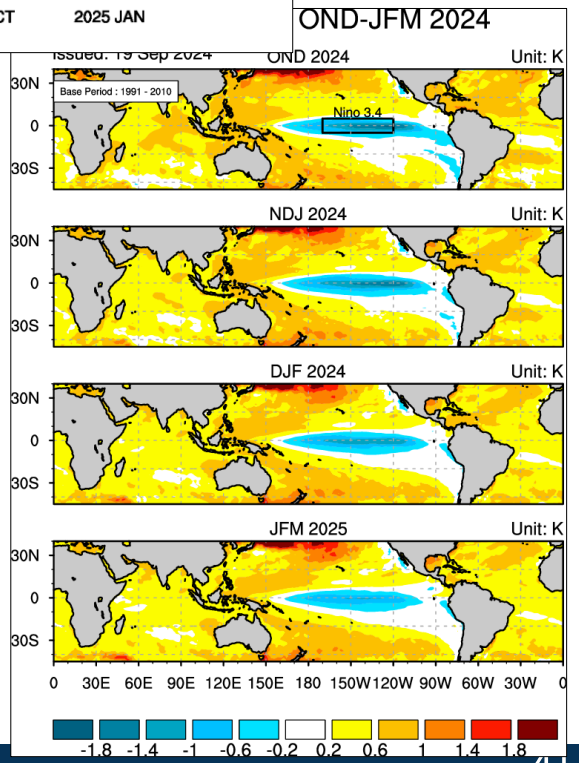
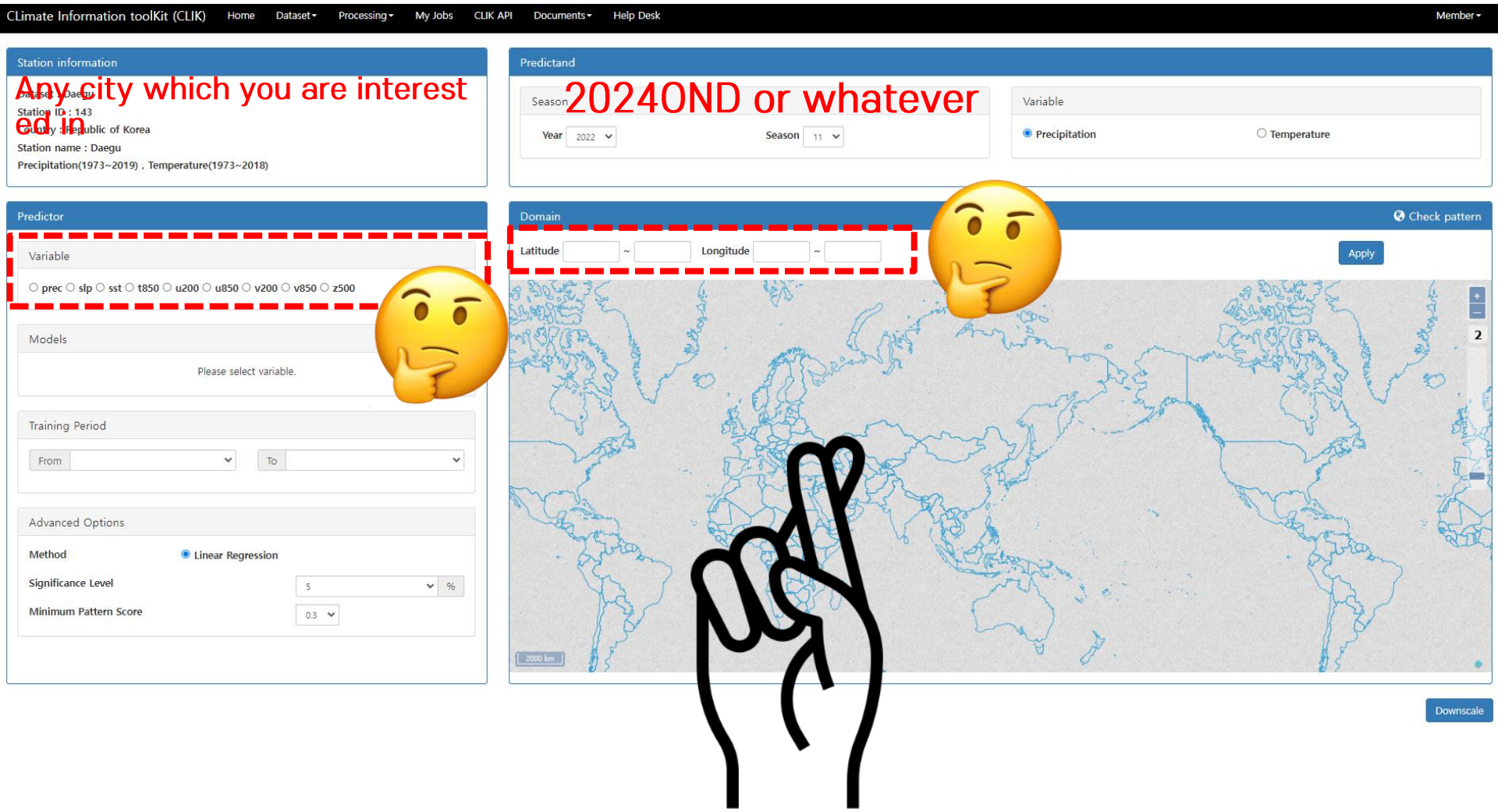


그림 107. 엘니뇨·라니냐 해의 강수량 경향성 종합. 녹색채색: 평년보다 강수가 많은 경향성, 갈색채색: 평년보다 강수가 적은 경향성. 라니냐 Year1과 Year2의 경우, 2년 이상 라니냐가 지속되는 사례를 위의 박스에, 1년 내외로 지속되는 사례를 아래 박스에 경향성을 나타냄. 이 경우 그 사례가 적어 경향성을 연한 색으로 표시함

1. 왜 상세화 예측이 필요한가?
2. 자료 처리 실습
3. 상세화 예측 실습
4. 아웃룩 만들어 보기

Exercise

Make your own seasonal climate outlook!



කාලගුණ විද්‍යා දෙපාර්තමේන්තුව
வளிமண்டலவியல் திணைக்களம்
DEPARTMENT OF METEOROLOGY
ශ්‍රී ලංකාව இலங்கை SRI LANKA

Consensus Seasonal Weather Outlook

July, August and September(JAS)

Seasonal Rainfall and Temperature for Sri Lanka

This forecast was prepared using

- The prevailing global climate conditions.
- Forecasts from different climate models from around the world.
- Statistical downscaling of GCM output using CPT

Issued by Centre for Climate Change Studies (CCCS)

And

Research Division

1 | Page

(b.4) Probabilistic Forecast for JAS season 2019 using Climate Information Toolkit

A climate information toolkit which has developed by APCC is used for following forecast. For the tool kit APCC has used Collection of Dynamic ensemble seasonal prediction data from National Meteorological and Hydrological Services and research institutes. This includes 14 operations and the models developed by institutes from 10 countries.

Areal rainfall data used as input data to ''CLIK'' toolkit and Downscaled to districts .SST selected as predictor for all the models. (APCC, MSC, NASA, NCEP, PNU, POAMA).

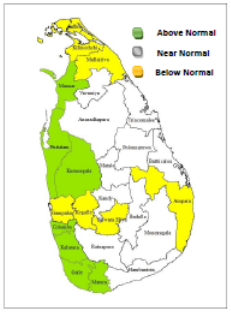


Fig 13: CLIK Multi model Ensemble Probabilistic Forecast for JAS season 2019

According to the CLIK tool there is a higher chance of receiving above normal rainfall in Mannar, Puttalam, Kurunegala, Colombo, Kalutara, Galle and Matara districts (Fig.13). And there is a higher chance of receiving below normal rainfall in Jaffna, Kilinochchi, Mulativu, Ampara, Gampaha, Kegalle and Nuwaraeliya districts. There is no signal in other districts and it indicates equal chances of receiving below normal, near normal and above normal rainfall for these districts.

14 | Page

Sri Lanka's seasonal climate outlook for July – September 2019

Take-home message

1. 상세화 예측의 필요성
2. 기후예측을 위한 다양한 모델: 역학모델/통계모델
3. 예측인자 선정시 역학관계를 고려하라


Thank you!