



APCC 기후정보서비스 소개

An Introduction to APCC Climate Information Service

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2020. 10. 6 ~ 7

2020 APCC 기후예측정보 활용을 위한 이론 및 기술교육 워크숍



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| 날씨 vs. 기후

[날씨]

특정지역에서 시시각각 변하는 기상현상
(짧은 주기, 변화속도가 빠름)

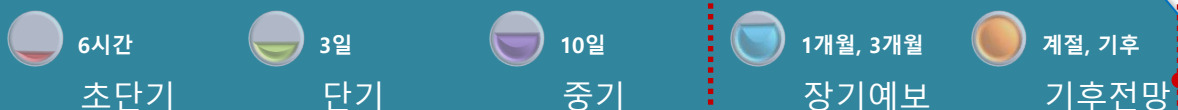
[기후]

상대적으로 넓은 지역에 오랫동안
나타나는 날씨의 평균상태
(긴 주기, 변화속도가 느리고 일정)

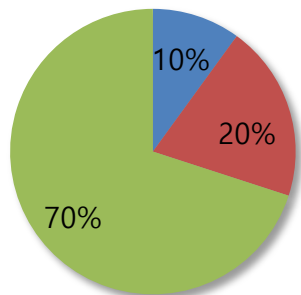
기후변화란?

기후시스템이 아래 요인에 의하여 점차 변하는 것을 말함,

- 인위적 요인: 인간의 활동에 의한 온실가스 효과
- 자연적 요인: 화산폭발로 인한 성층권 에어로졸 증가 등



강수량, 평년¹보다



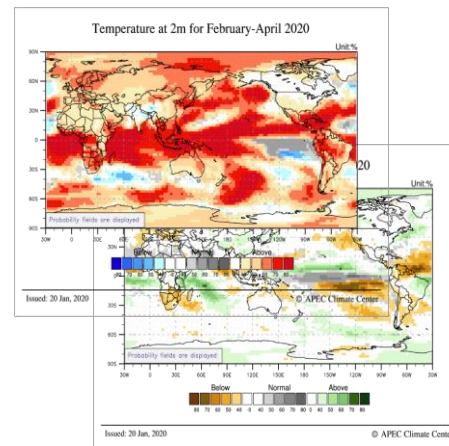
- 적을 확률
- 비슷할 확률
- 많을 확률

¹ 평년: 기후평균

과거 데이터를 기반으로 평년 기준 가능성을 '확률'로 전망

10개국
14개 모델

● | APCC 기후예측



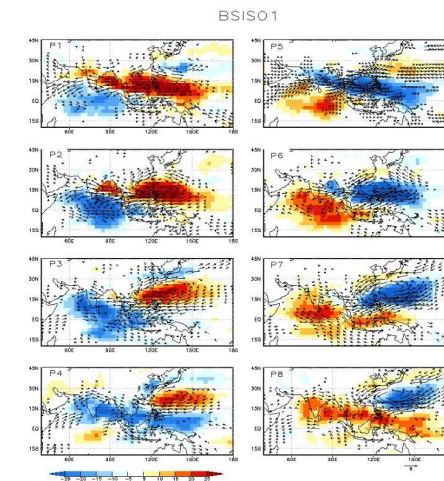
각 국가의 고비용 기후예측정보들의 실시간 수집, 분석

다중모델앙상블
(Multi-Model Ensemble) 기법 활용하여 기후예측정보 생산

아태지역 이상기후 대응을 위한
기후예측정보 공유 및 생산 서비스

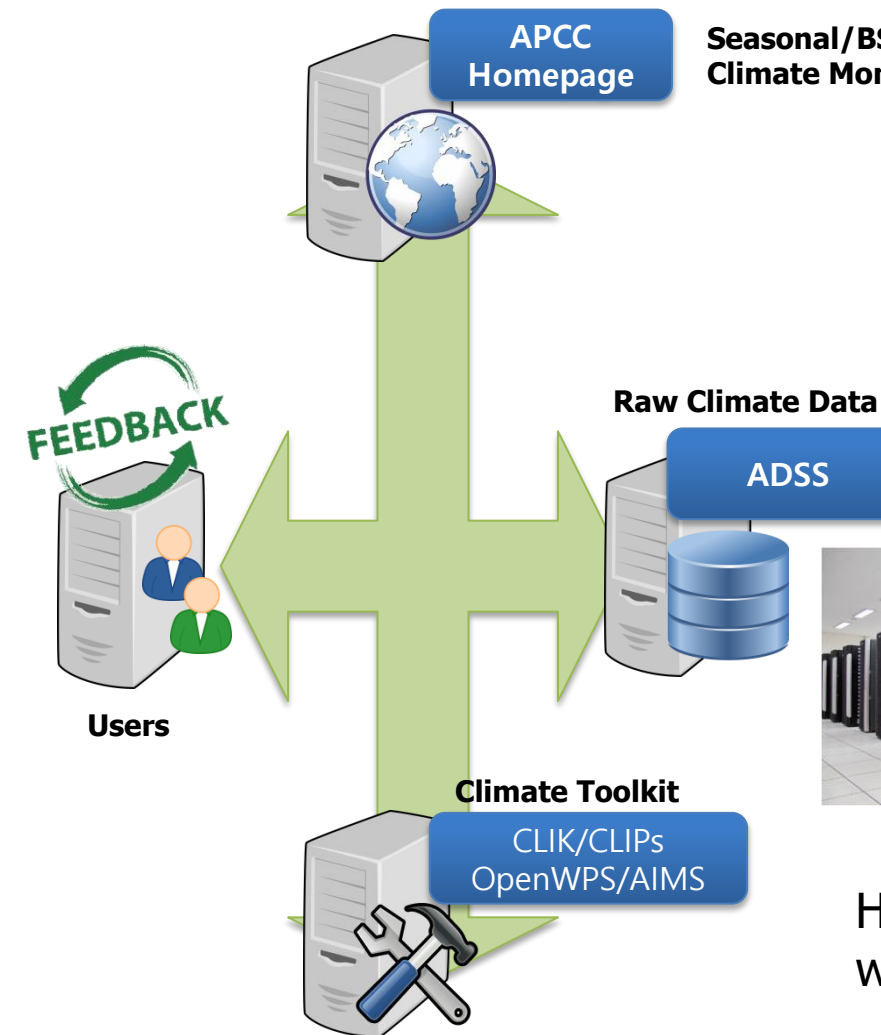
다양한 모델 결과의 통합, 재해석을 통한
예측성능 개선 및 불확실성 진단

예측정보 개선 및 활용성 강화를 위한
연구개발 및 온라인 서비스



| APCC 기후예측정보 제공 시스템 구조

| 기후모델과 예측



Seasonal/BSISO Forecast
Climate Monitoring

$$r: \rho \left(\frac{\partial u_r}{\partial t} + u_r \frac{\partial u_r}{\partial r} + \frac{u_\phi}{r \sin(\theta)} \frac{\partial u_r}{\partial \phi} + \frac{u_\theta}{r} \frac{\partial u_r}{\partial \theta} - \frac{u_\phi^2 + u_\theta^2}{r} \right) = -\frac{\partial p}{\partial r} + \rho g_r +$$

$$\mu \left[\frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial u_r}{\partial r} \right) + \frac{1}{r^2 \sin(\theta)^2} \frac{\partial^2 u_r}{\partial \phi^2} + \frac{1}{r^2 \sin(\theta)} \frac{\partial}{\partial \theta} \left(\sin(\theta) \frac{\partial u_r}{\partial \theta} \right) - 2 \frac{u_r}{r^2} + \frac{\partial u_\phi}{\partial \theta} + u_\theta \cot(\theta) - \frac{2}{r^2} \frac{\partial u_\phi}{\partial \phi} \right]$$

$$\phi: \rho \left(\frac{\partial u_\phi}{\partial t} + u_r \frac{\partial u_\phi}{\partial r} + \frac{u_\phi}{r \sin(\theta)} \frac{\partial u_\phi}{\partial \phi} + \frac{u_\theta}{r} \frac{\partial u_\phi}{\partial \theta} + \frac{u_r u_\phi}{r} \cot(\theta) \right) = -\frac{1}{r \sin(\theta)} \frac{\partial p}{\partial \phi} + \rho g_\phi +$$

$$\mu \left[\frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial u_\phi}{\partial r} \right) + \frac{1}{r^2 \sin(\theta)^2} \frac{\partial^2 u_\phi}{\partial \phi^2} + \frac{1}{r^2 \sin(\theta)} \frac{\partial}{\partial \theta} \left(\sin(\theta) \frac{\partial u_\phi}{\partial \theta} \right) - \frac{2 \sin(\theta)}{r^2} \frac{\partial u_r}{\partial \phi} + 2 \cos(\theta) \frac{\partial u_\theta}{\partial \phi} - u_\theta \right]$$

$$\theta: \rho \left(\frac{\partial u_\theta}{\partial t} + u_r \frac{\partial u_\theta}{\partial r} + \frac{u_\phi}{r \sin(\theta)} \frac{\partial u_\theta}{\partial \phi} + \frac{u_\theta}{r} \frac{\partial u_\theta}{\partial \theta} + \frac{u_r u_\theta}{r} \cot(\theta) \right) = -\frac{1}{r} \frac{\partial p}{\partial \theta} + \rho g_\theta +$$

$$\mu \left[\frac{1}{r^2} \frac{\partial}{\partial r} \left(r^2 \frac{\partial u_\theta}{\partial r} \right) + \frac{1}{r^2 \sin(\theta)^2} \frac{\partial^2 u_\theta}{\partial \phi^2} + \frac{1}{r^2 \sin(\theta)} \frac{\partial}{\partial \theta} \left(\sin(\theta) \frac{\partial u_\theta}{\partial \theta} \right) + \frac{2}{r^2} \frac{\partial u_r}{\partial \theta} - \frac{u_\phi}{r^2} + 2 \cos(\theta) \frac{\partial u_\phi}{\partial \theta} \right]$$

Dynamics

```

age )
endif
endif
z_force = z_force + dt*z_force_tend
u_g = u_g + dt*u_g_tend
v_g = v_g + dt*v_g_tend
tau_x = tau_x + dt*tau_x_tend
tau_y = tau_y + dt*tau_y_tend
tau_largescale = tau_largescale + dt*tau_largescale_tend
if ( scm_th_adv .AND. th_upstream_x(1) > 0.) then
th_upstream_x = th_upstream_x + dt*th_upstream_x_tend
th_upstream_y = th_upstream_y + dt*th_upstream_y_tend
endif
if ( scm_qv_adv .AND. qv_upstream_x(1) > 0.) then
qv_upstream_x = qv_upstream_x + dt*qv_upstream_x_tend
qv_upstream_y = qv_upstream_y + dt*qv_upstream_y_tend
endif
if ( scm_q1_adv .AND. q1_upstream_x(1) > 0.) then
q1_upstream_x = q1_upstream_x + dt*q1_upstream_x_tend
q1_upstream_y = q1_upstream_y + dt*q1_upstream_y_tend
endif
if ( scm_wind_adv .AND. u_upstream_x(1) > -900.) then
u_upstream_x = u_upstream_x + dt*u_upstream_x_tend
u_upstream_y = u_upstream_y + dt*u_upstream_y_tend
v_upstream_x = v_upstream_x + dt*v_upstream_x_tend
v_upstream_y = v_upstream_y + dt*v_upstream_y_tend

```



과거 기후자료를 토대로 미래 기후예측

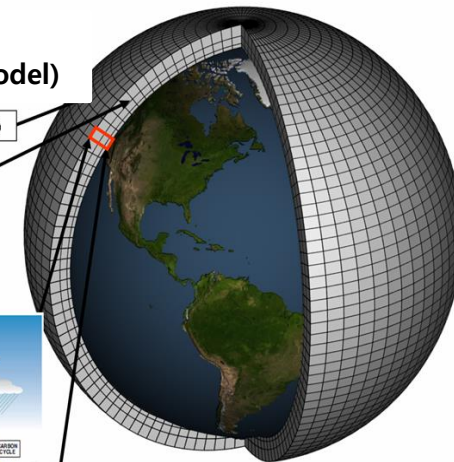
HPC (High Performance Computing)
with Mass Climate Data Storage @ APCC

3.47GHz * 1,260 Cores
4 Peta Bytes (4,000 Tera Bytes) Storage

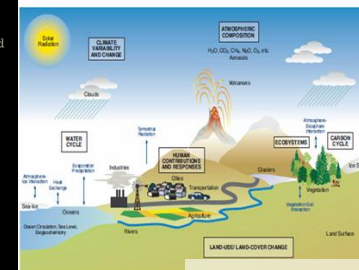
GCM
(General Circulation Model)

Horizontal Grid (Latitude-Longitude)

Vertical Grid (Height or Pressure)

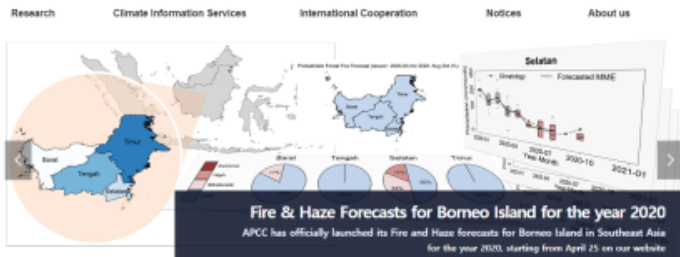


Physics (parameterization)



| APCC 기후정보서비스 (기후정보 제공)

<http://www.apcc21.org>



CLIMATE INFORMATION SERVICES



기후예측정보 제공: 홈페이지

ADSS APCC Data Service System

LOGIN REGISTER CONTACT US

The APCC Climate Center Data Service System was developed for real-time climate monitoring and provision of digital data service to APEC member economies. This system underscores the role of APCC in playing an important role as a hub of climate data and services in the region. The main objective of the ADSS is to provide a comprehensive set of models and observational climate data to various researchers and users to establish a scientific basis for climate prediction. ADSS also aims to monitor climate information using near real-time in-situ observation and prediction data in a standardized and accessible format for various users.

NOTICE

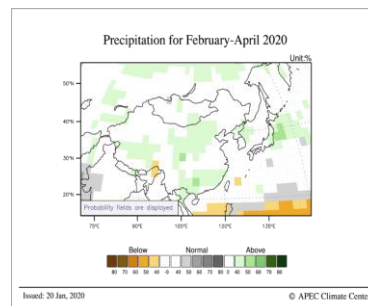
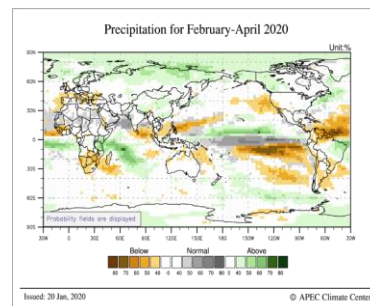
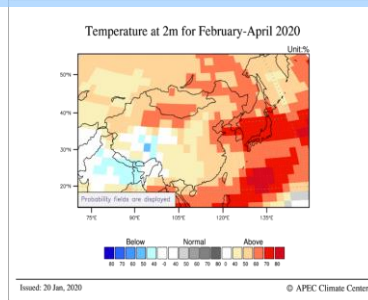
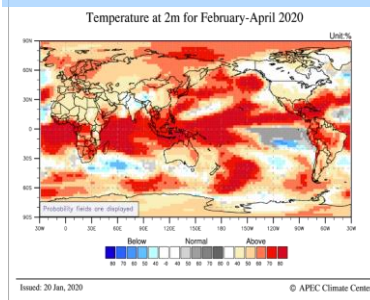
1. When you use MMET and individual model data, please acknowledge us by include following text, "The authors acknowledge that the APCC Multi Model Ensemble(MMET) Producing Centers for making their data available for analysis and the APCC Climate Center for collecting and archiving them and for organizing APCC MMET prediction."

2. When you use BSISO index, please acknowledge us by include following text, "The authors acknowledge the participating operation centers for making their forecast data available for analysis, as well as the APCC Climate Center for collecting, archiving, and organizing the APCC BSISO forecast."

Dataset	Areal Coverage	Grid Size	Time Step	Access	Source	Requirements
APCC MMET(S-MON)	Global	2.5-2.5(degrees)	Monthly	Web FTP OpenWPS	APCC	Login
APCC ARMET(S-MON)	Global	2.5-2.5(degrees)	Monthly	Web FTP OpenWPS	APCC	Login
INDIVIDUAL MODEL(S-MON)	Global	2.5-2.5(degrees)	Monthly	Web FTP OpenWPS	APCC	Login

기후예측자료 제공: ADSS

APCC에서 생산/수집/가공된 기후자료를 사용자가 보다 효과적으로 활용할 수 있도록 다양한 기후정보서비스를 운영 중



3개월, 6개월 기후예측

BSISO1

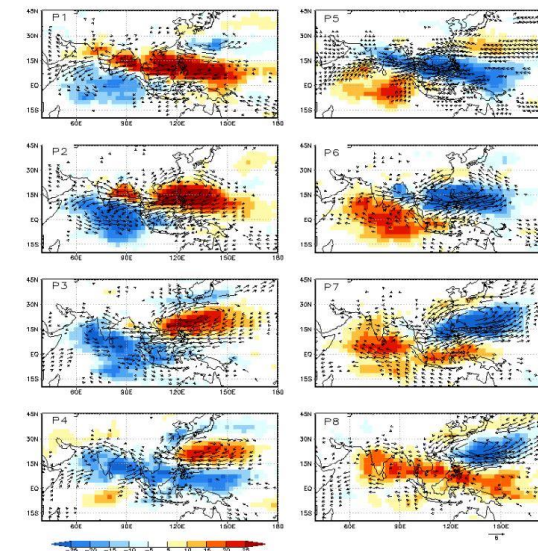


그림 1. BSISO1의 8가지 위상에 따른 상향강파복사와 850hPa 바람 편향의 재구성

하계기간 내 아시아지역 기후변동 예측

ADSS (APCC Data Service System)

<http://adss.apcc21.org>

| APCC에서 생산/수집/가공된 기후정보를 디지털 형식으로 다운로드 받을 수 있습니다.

| Web FTP, OPeNDAP을 이용한 다운로드

| 2020년 12월까지 운영 후 서비스 종료 예정

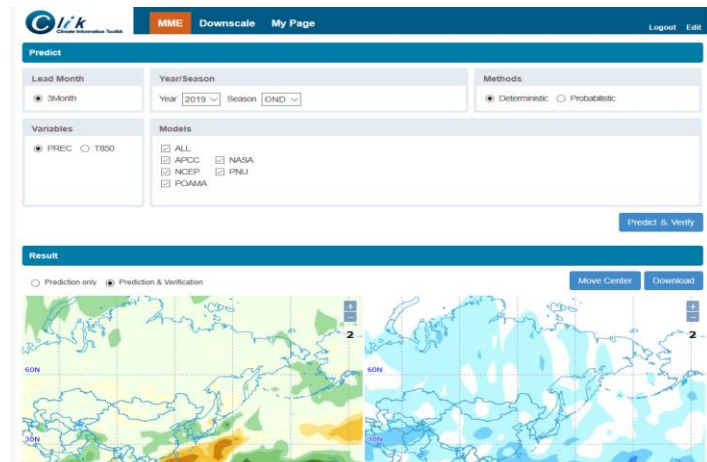
| 플랫폼 기반 기후자료서비스로 대체

2. APCC 기후정보서비스 | 기후정보 생산/제공/처리 도구

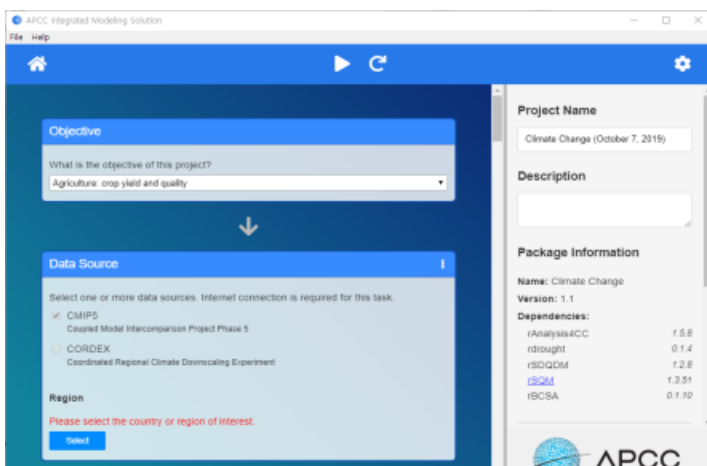
APCC 기후예측정보 활용을 위한 이론 및 기술교육 워크숍 (2020.10.6~7)

03

| APCC 기후정보서비스 (기후정보 생산/제공)



기후예측정보 생산 제공: CLIK

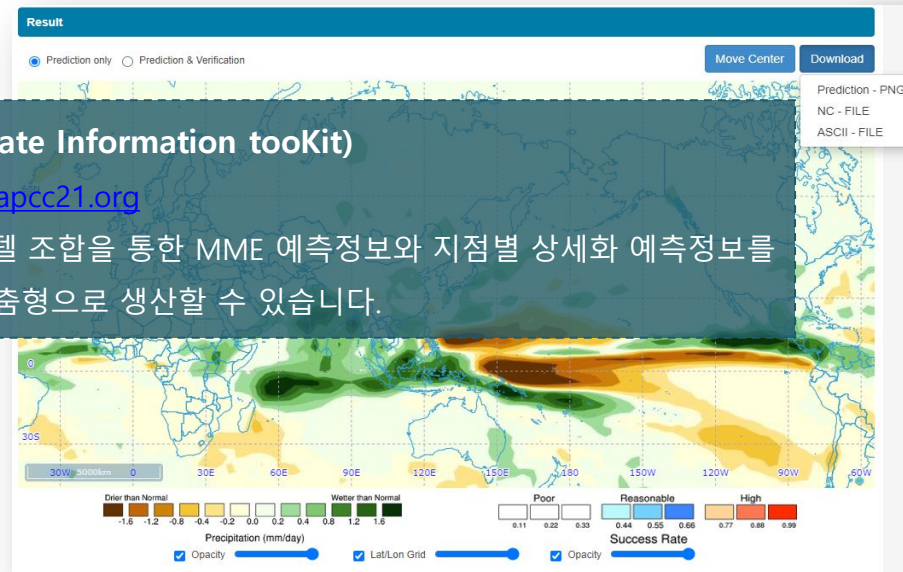


통계적 상세화 정보 제공: AIMS

CLIK (Climate Information tooKit)

| <http://clik.apcc21.org>

| 다양한 모델 조합을 통한 MME 예측정보와 지점별 상세화 예측정보를 사용자 맞춤형으로 생산할 수 있습니다.

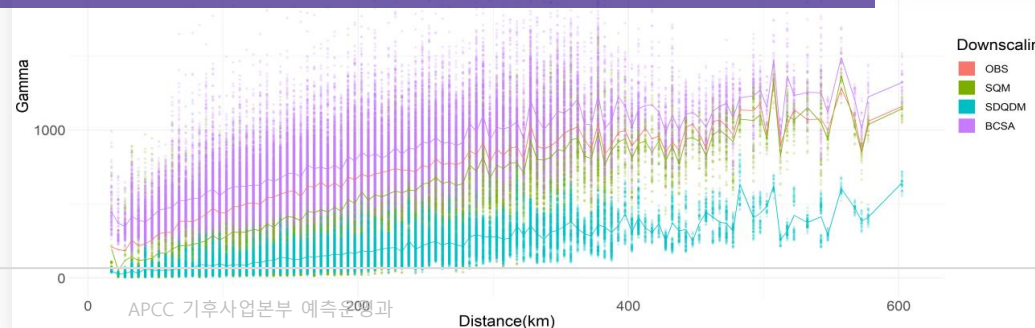


AIMS (APCC Integrated Modeling Solution)

| <http://aims.apcc21.org>

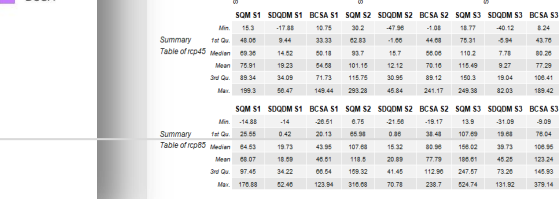
Variogram of Precipitation

| 계절예측 및 기후변화 시나리오에 대한 통계적 상세화/평가 정보를 생산할 수 있습니다.



Downscaling

OBS
SQM
SDQDM
BCSA



| APCC 기후정보서비스 (기후정보 처리/제공)

Objectives

Climate and climate application data not only have numerous file formats, but also require enormous time and resources to process. Researchers and policy makers need user-friendly file formats and data extraction services to conveniently utilize climate data. The average user tends to have difficulty dealing with climate data because a single climate data set includes time information, geographical information, and various factor values. Due to these various factors, expertise in data extraction is required. Therefore, the APCC Climate Center (APCC) Climate Information Application Team has developed the Climate Information Processing System (CLIPs), which enables the average user to conveniently extract the specific data necessary for their research.

Results

APCC CLIPs provides functions that empower researchers that are unfamiliar with processing mass data, to effortlessly extract necessary data for specific regions including climate index and time-scale information. This service helps researchers reduce time spent on data processing and renders it unnecessary to budget for high-end hardware and software. This service is expected to be widely used in Korea as well as developing countries that lack appropriate IT infrastructures.

Material

1.48 million climate change scenarios, climate forecast MVD data, climate change scenarios, NOAA station observation data, and NOAA satellite data all from 1980 to 2020, are collected and available on CLIPs. The collected data were formatted with NetCDF, CSV, H5P, T3T, and various different formats relative to the characteristics of each dataset and institution.

To provide standardized data, all the data are reformatted with NetCDF (widely used in climate research) and the numerous attributes and units of the data have been converted into standardized units. Additionally, the team has built the database with the extracted temperature, precipitation, wind data and global climate factors.

In order to process large amounts of climate data, the system has two distinct functions: CLIST (Climate data Standardization Toolset) and CLIPs (Climate Information Processing system) that collect and standardize data, then makes the data available to users. CLIST transforms various file formats into standardized file formats while CLIPs enables users to search for specific locations or values with the installed application on their PCs. Then the combination of these two systems conveys the search results to the users. Finally, for those users residing in those place that lack high speed internet infrastructure, APCC has applied compression technology to CLIPs so that they can easily access this service.

변수, 지역 추출 자료 제공: CLIPs

What is OpenWPS?

OpenWPS is a climate-data-specific service using OGC (Open geospatial consortium) WPS (web processing service) that is an international standard in spatial information field. Users can use OpenWPS using three operations that are GetCapabilities, DescribeProcess, and Execute on any environment (e.g. graphical user interface program, server system, web service, etc.) more easily and conveniently.

WPS Services

You point your WPS client to <http://openwps.apcc21.org/next>

OpenWPS:CV.VisualizeNonSeries returns map-based plot image based on the inputs doc

Input Parameter	Description	Data Type
inputData	climate data for visualization in geoscientific format	application/json
plotOption	Plot options for visualization	application/json

지역 마스크 정보 제공: OpenWPS

CLIPs (CLimate Information Processing System)

| <http://clips.apcc21.org>

| 사용자가 설정한 지역, 변수, 기간에 대해 필요한 자료만 추출할 수 있습니다.

New Data Processing

Create a new data processing sheet.

CLIPs Server Desktop(Only CLIPs files allowed)

Coordinate

51.0000
115.0000 Global 145.0000
23.0000

Data Information

Dataset CMIP5-DAILY
Model RCP85
Time Period Daily
Start Date 2000-01-01 09:00:00
End Date 2205-11-13 09:00:00
Parameter lat_bnds, lat_bounds, lon_bnds, lon_bounds ...

Period Information

Period Period of time
Year 2000 Month 1 ~ Year 2205 Month 11

Format Conversion

Output File NetCDF

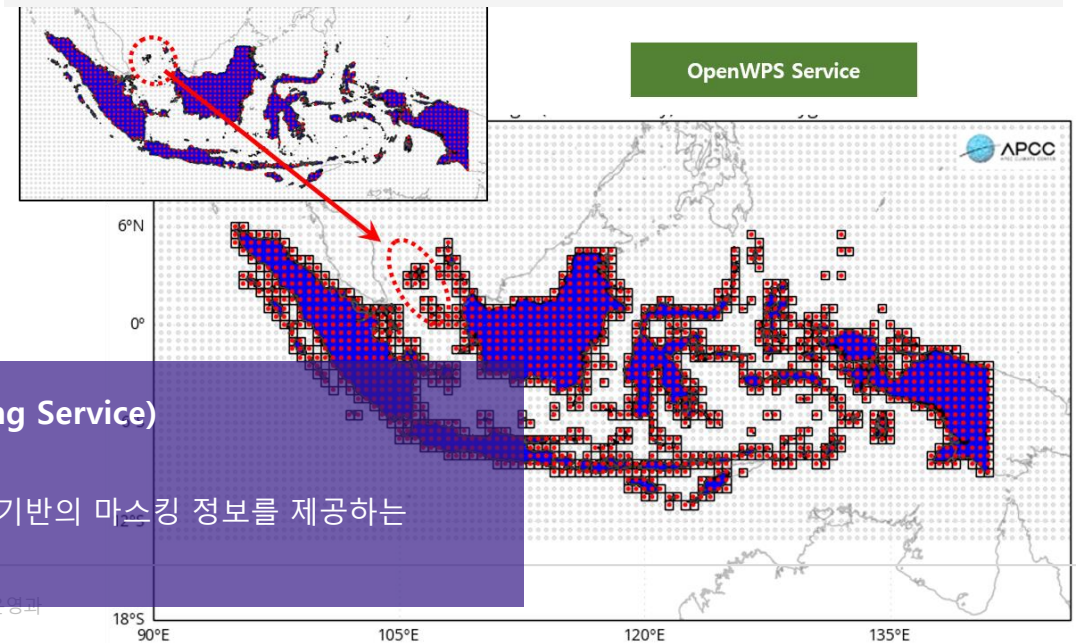
OK 취소

Select an area by dragging mouse.
Resize or move the selected area.

OpenWPS (Open Web Processing Service)

| <http://openwps.apcc21.org>

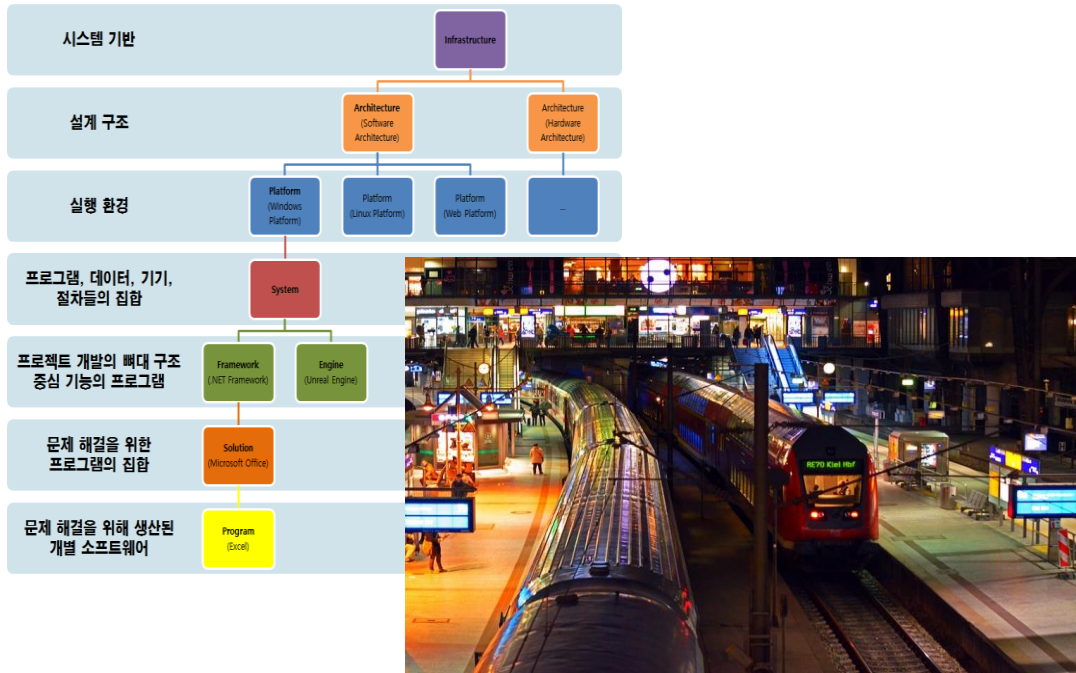
| 정밀한 자료추출을 위한 지리정보 기반의 마스크 정보를 제공하는 서비스입니다.



| 플랫폼

플랫폼 정의

| 응용프로그램(Application) 혹은 서비스(Service)를 실행하는데 사용되는 하드웨어 및 소프트웨어 환경



| 기후서비스

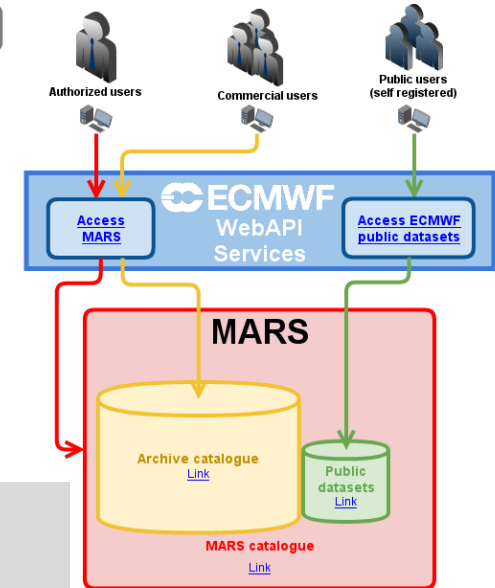
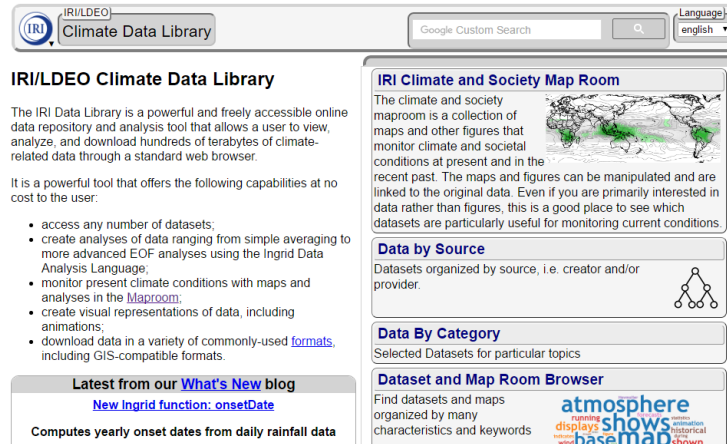
기후서비스 정의

| 개인 혹은 기관의 의사결정을 도와주기 위한 기후정보의 제공

| 기후서비스 플랫폼

기후서비스 플랫폼 정의

| 기후서비스(Climate Service)를 실행하는데 사용되는 하드웨어 및 소프트웨어 환경



기후서비스 개발 과정부터 기능 재사용 고려 필요

라이브러리 및 모듈의 재사용 → 생태계 구축

서비스간의 mesh up을 위한 효과적이고 일관된 방법 필요

기후예측, 수자원, 농업, 보건

개발생산성 향상을 위한 정형화된 가이드라인 필요

집약 시스템(Monolithic system)의 한계 극복 필요

Climate services provide climate information in a way that assists decision making by individuals and organizations. Such services require appropriate engagement along with an effective access mechanism and must respond to user needs.

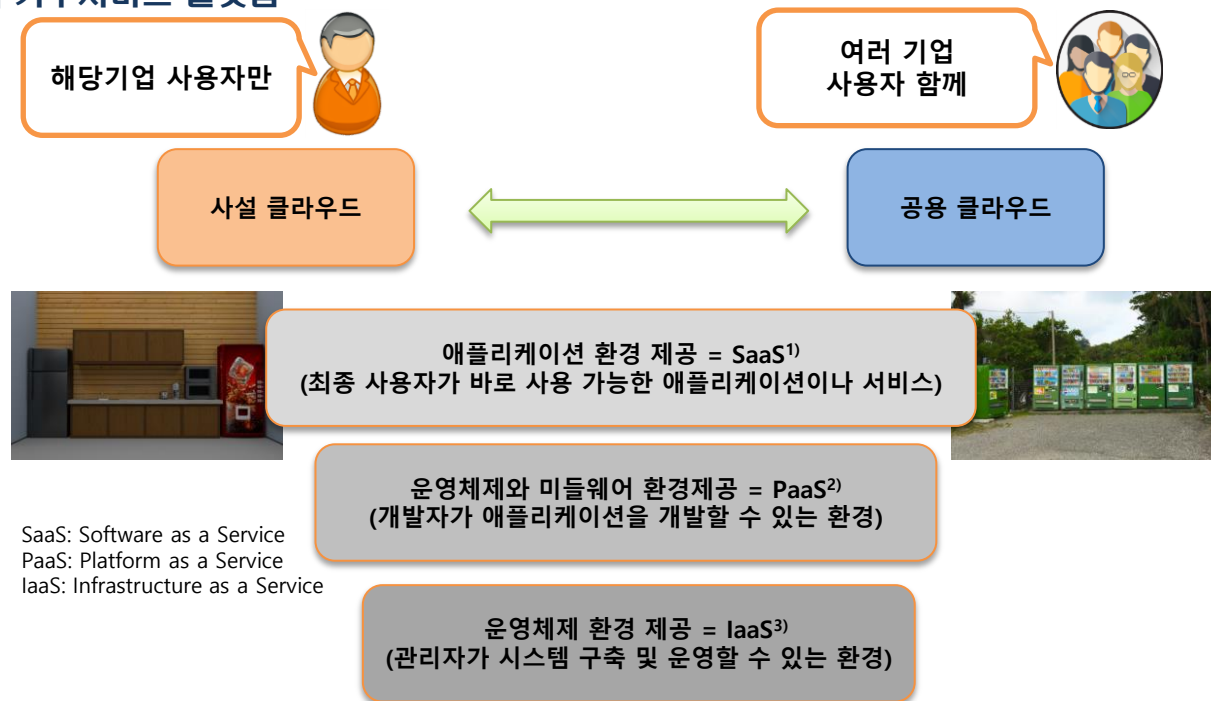
Such services involve high-quality data from national and international databases on temperature, rainfall, wind, soil moisture and ocean conditions, as well as maps, risk and vulnerability analyses, assessments, and long-term projections and scenarios. Depending on the user's needs, these data and information products may be combined with non-meteorological data, such as agricultural production, health trends, population distributions in high-risk areas, road and infrastructure maps for the delivery of goods, and other socio-economic variables.

https://www.wmo.int/gfcs/what_are_climate_weather_services

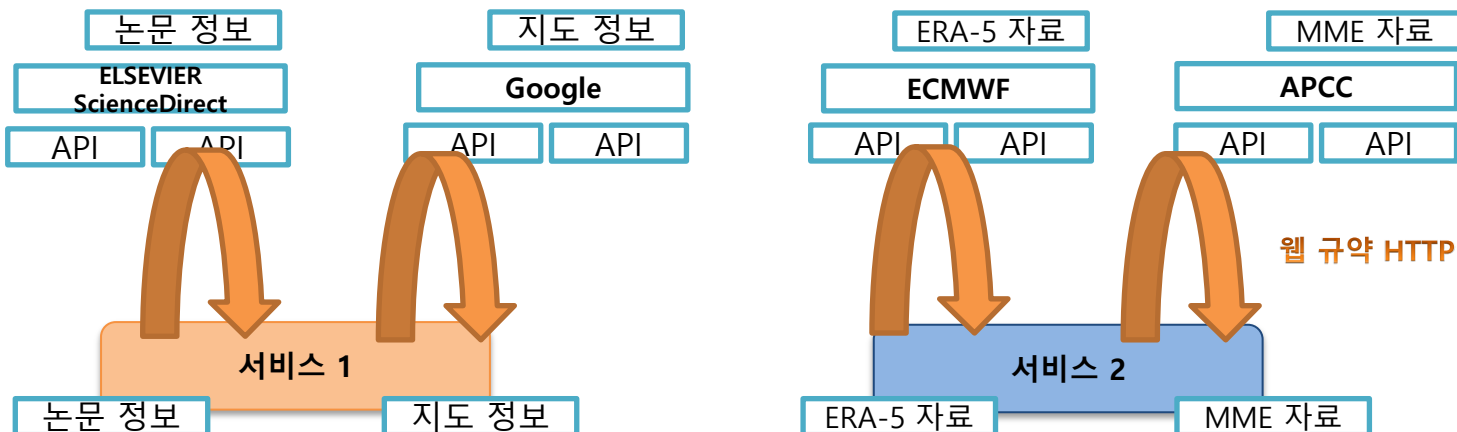
| 클라우드 컴퓨팅



| 기후서비스 플랫폼



| API (Application Programming Interface, 응용 프로그래밍 인터페이스)

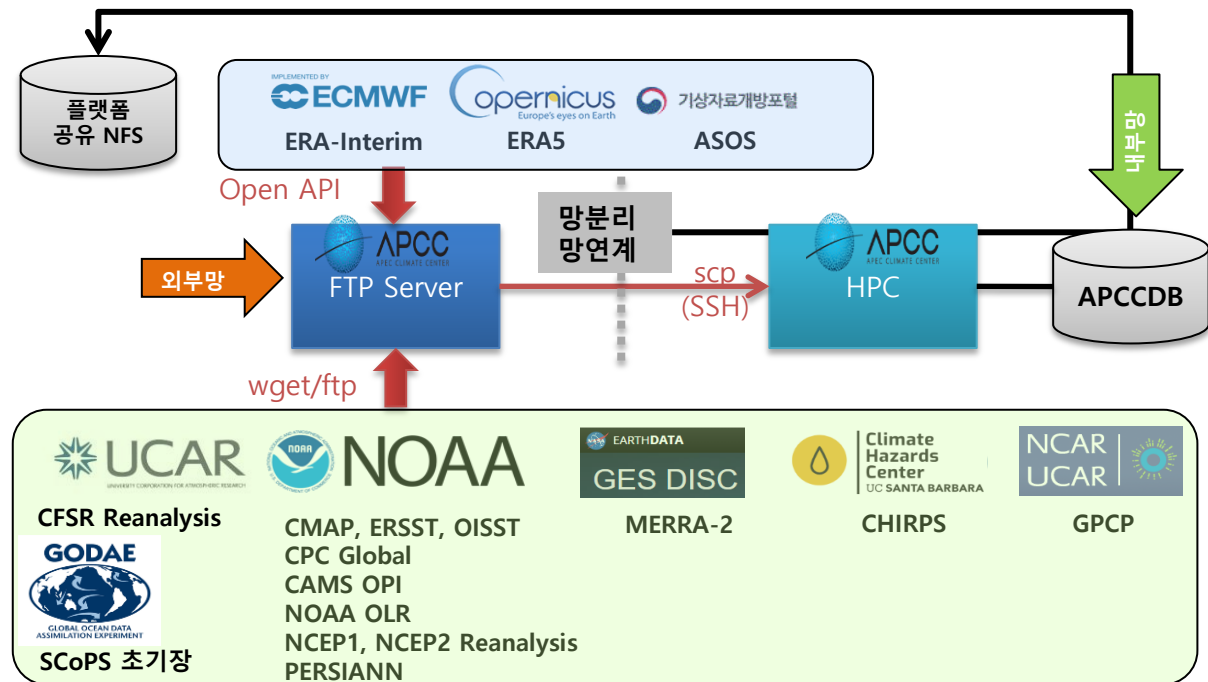


3. APCC 기후서비스 플랫폼 | 기후자료서비스 플랫폼

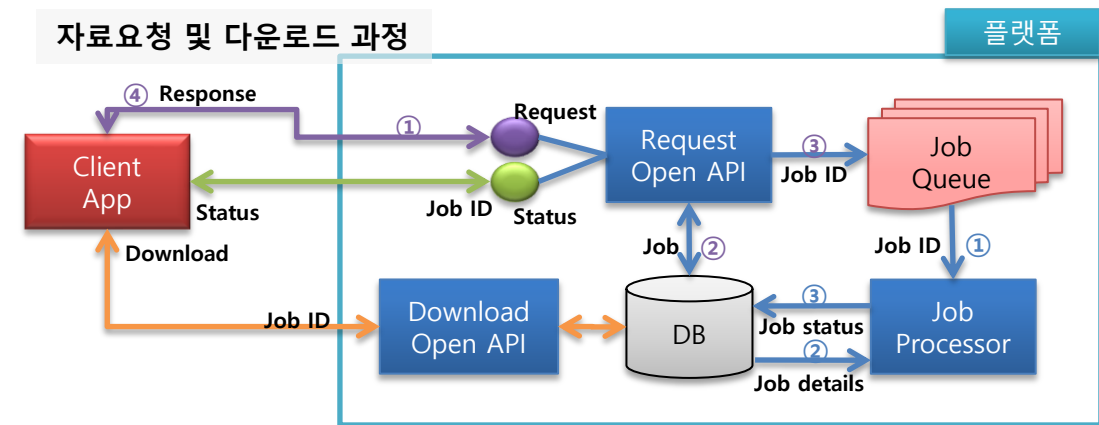
APCC 기후예측정보 활용을 위한 이론 및 기술교육 워크숍 [2020.10.6~7]

03

| 인프라서비스(IaaS) 및 플랫폼서비스(PaaS) 기후자료 공유체계 구축

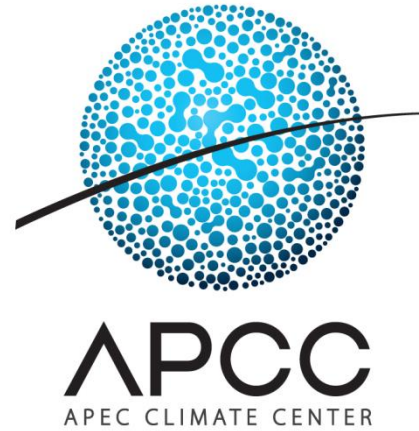


자료요청 및 다운로드 과정



| 기후자료서비스 플랫폼

The screenshot shows the APCC Climate Data Service (ACDS) website. The header includes the site name, navigation links (Home, Dataset, Requests, Open API, FAQ), a search bar, and a Member link. The main banner features the text: "APCC Climate Data Service(ACDS). ACDS is provided with climate prediction data produced and managed by APCC. Users can download digitized climate data in familiar ways." with a "Download Data" button. Below the banner, there are sections for "Notice", "APCC Open API", and "Help Desk", each with a "Learn More" button. The "Lasted Dataset" section displays the "2019 NDJ APCC MME Prediction Dataset(Temperature)" with a "New" tag and a description: "Probabilistic MME forecasts of 2m temperature for November 2019 - January 2020. Normal conditions are computed with respect to the comon base period of participating models in the APCC MME prediction (1983-2010)".



Thank You !!

An Introduction to APCC Climate Information Service