Finding and Lessons learned of pilot applications of geo-indicators for drought monitoring

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Contents

1. Briefing on National Drought information System of Korea

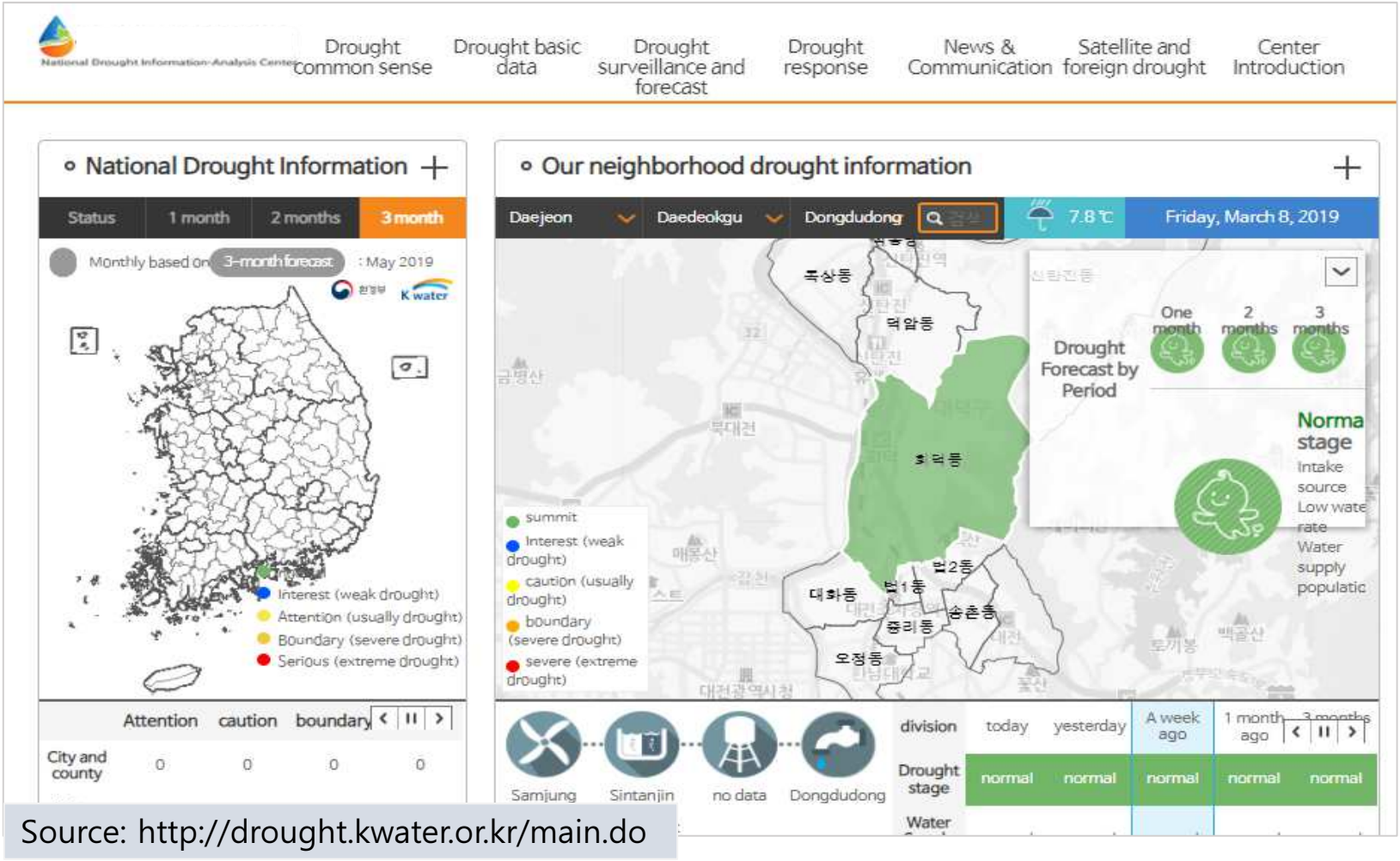
2. An approach on geo-indicator development for drought monitoring and early warning
   - How we can develop a user friendly decision supporting tool?
   - How to develop a repository for spatial data in a pilot country?

1. National Drought information System of Korea

- System overview
- Satellite-based drought indices

National Drought Information-Analysis Center (KNDIC)

operated by K-water in charge of national water resource.



Source: http://drought.kwater.or.kr/main.do

National Drought Information-Analysis Center (KNDIC)

4 Main Contents

Our neighborhood drought information

provides contents based on GIS map + user location + drought information.

Basic information on drought

provides information on water shortage, weather, water source, water supply system, water supply, water quality, and so on..

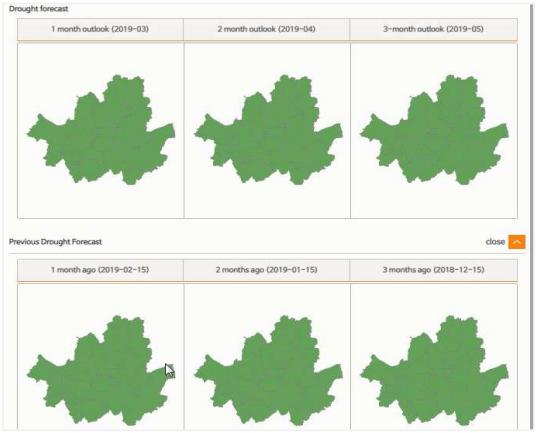
Drought surveillance and forecast

provides current drought status and forecasted ones which will show how the drought will progress after 1 month, 2 months and 3 months.

Drought statistics

is to analyze statistical analysis of basic information and analytical value of drought with various specimens and conditions.

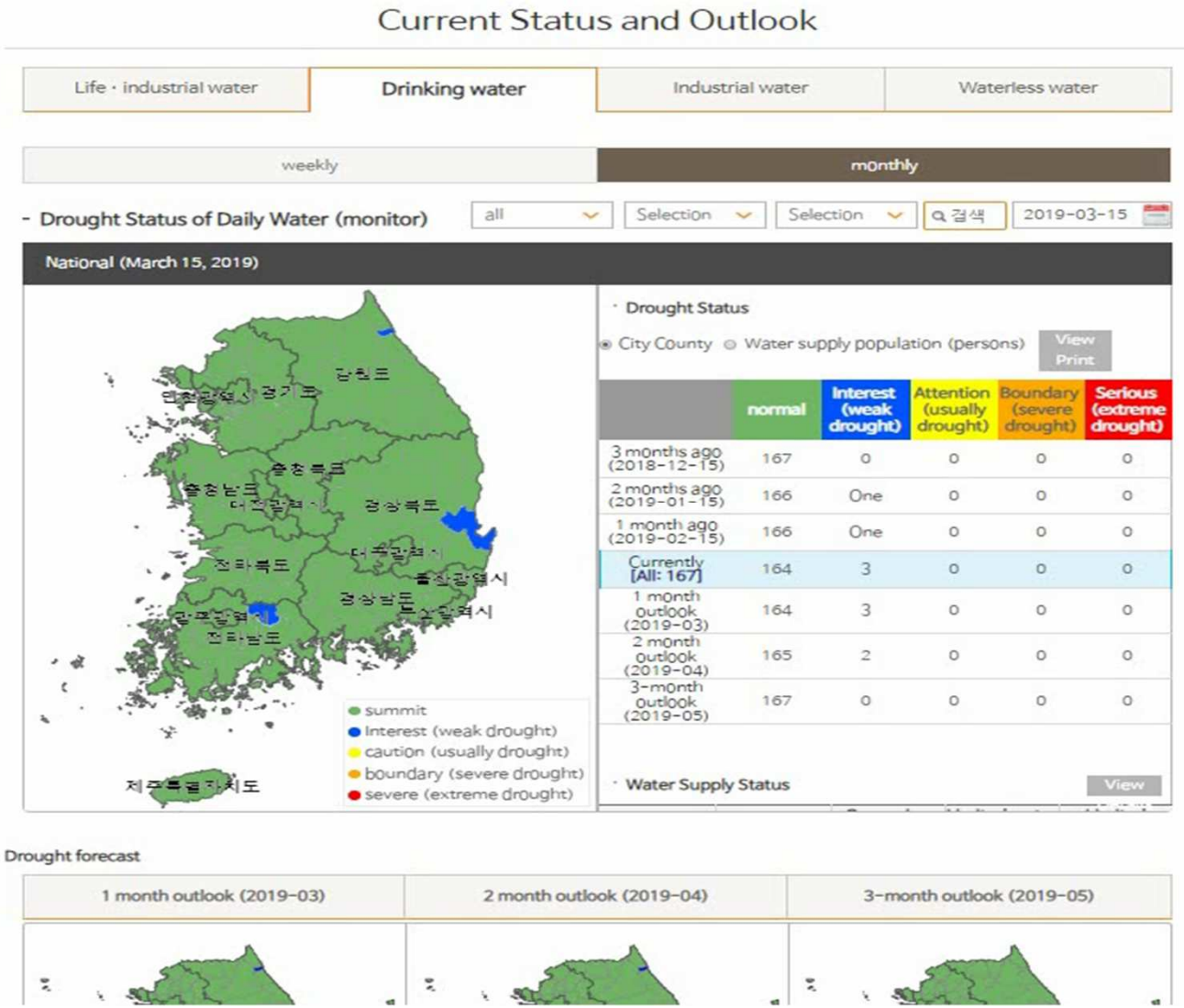
Forecasting drought of Seoul for coming 3 months



Comparison of three regions' drought statistics

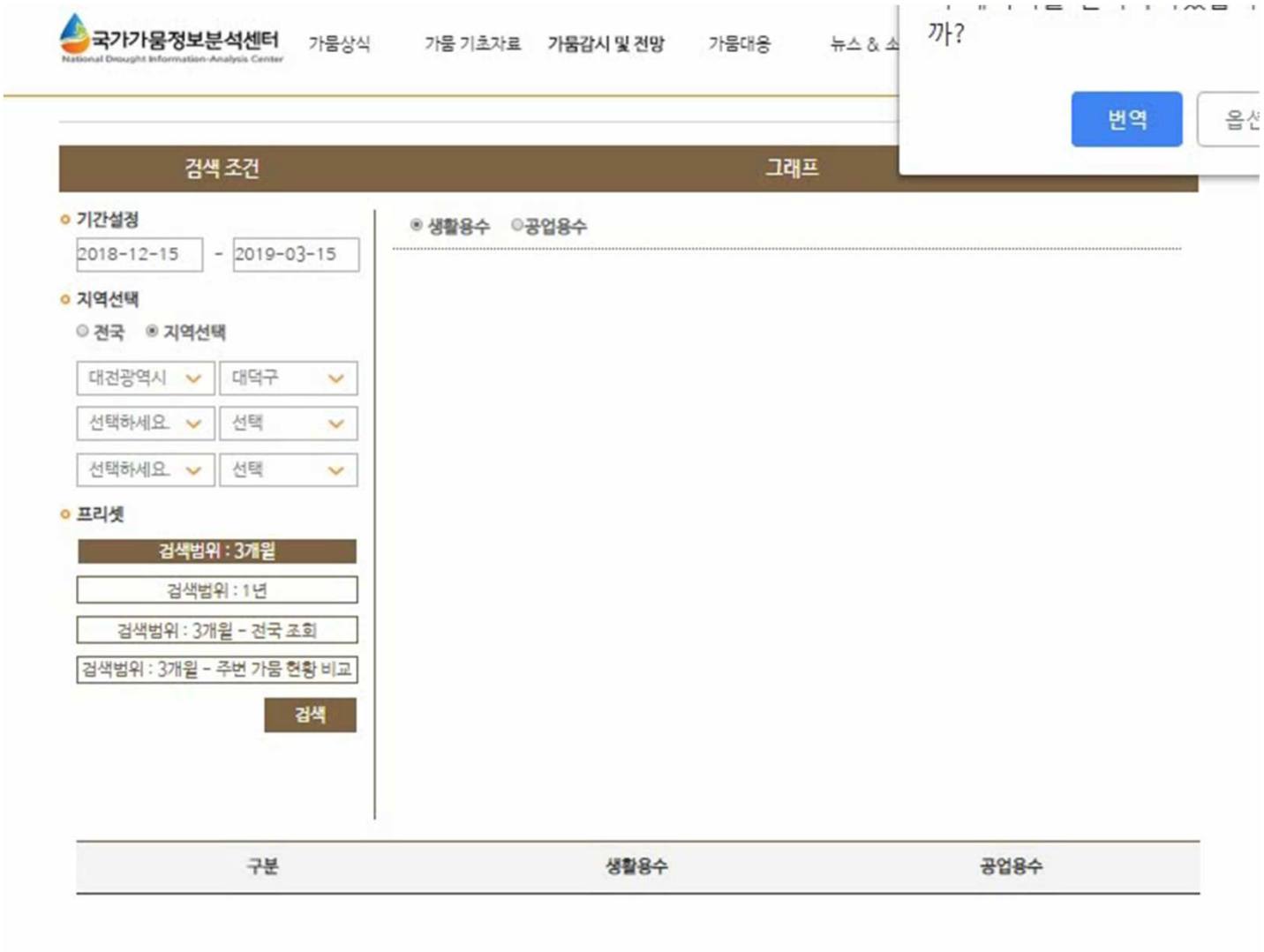
National Drought Information-Analysis Center (KNDIC)

Drought surveillance and Forecast (demo)



National Drought Information-Analysis Center (KNDIC)

Drought Statistics (demo)



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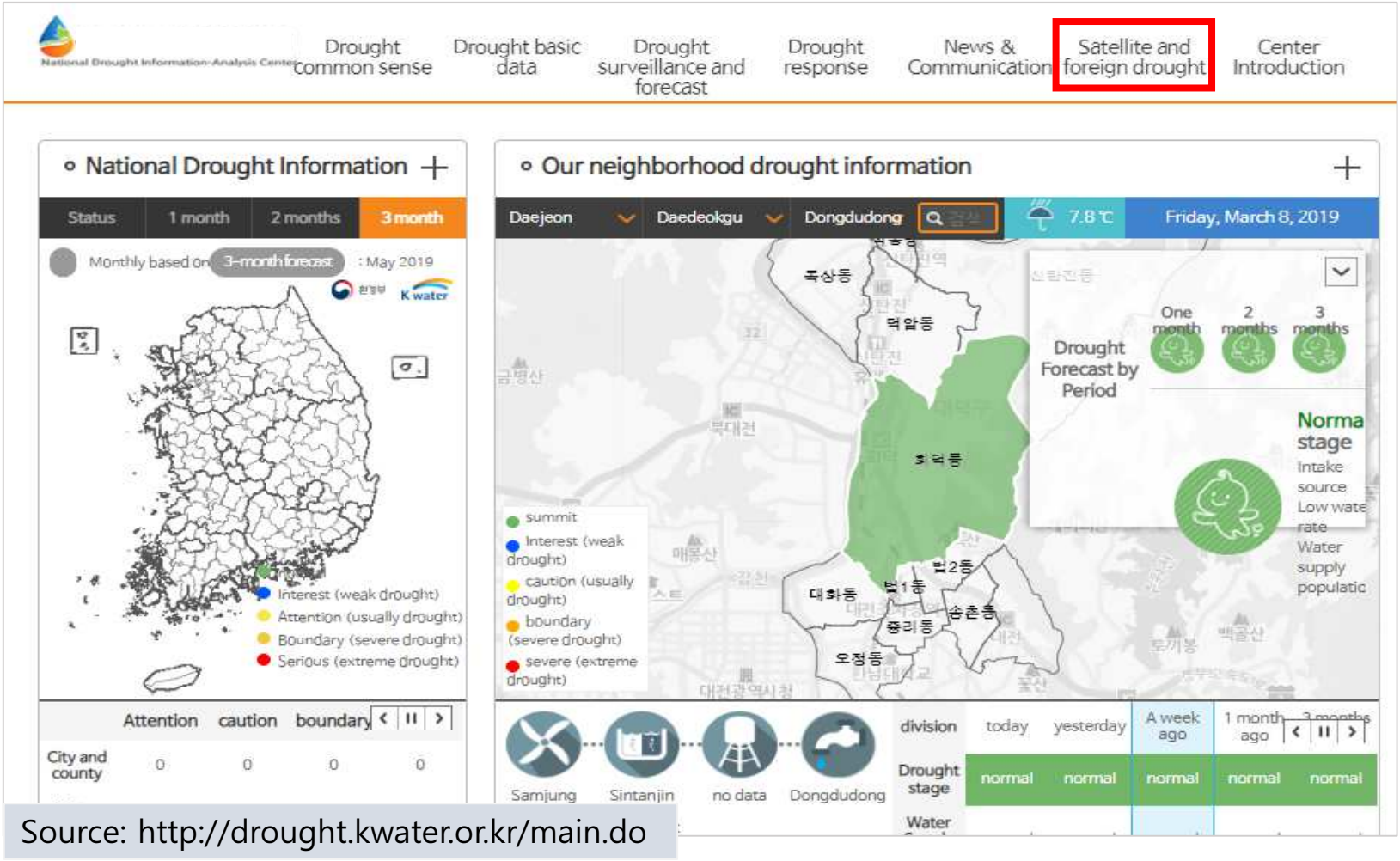
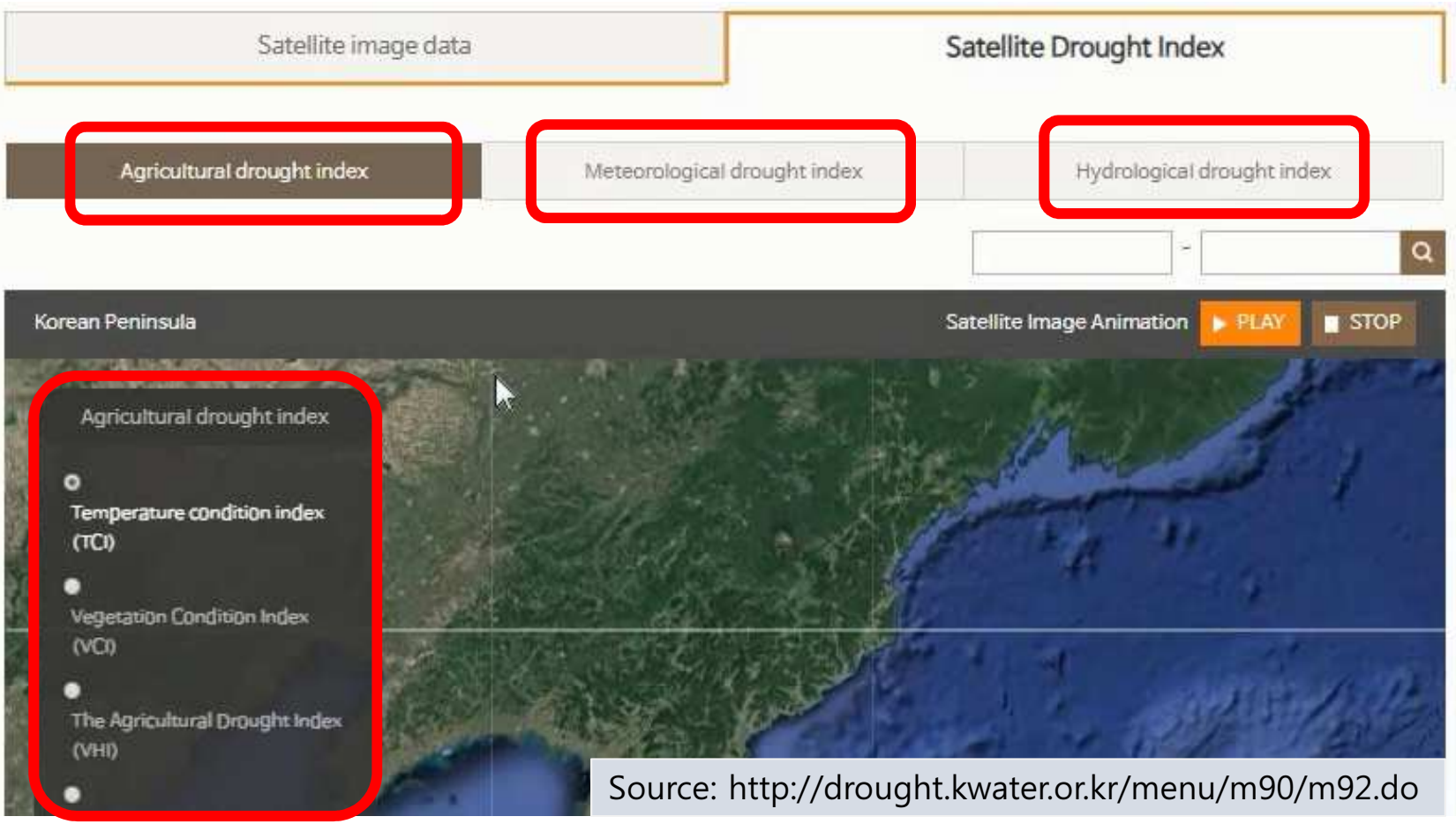


Source: http://drought.kwater.or.kr/main.do

National Drought Information-Analysis Center (KNDIC)

Satellite-based indics provided by KNDIC to identify the drought status on the Korean peninsula can be categorized into **three** groups.



Source: http://drought.kwater.or.kr/menu/m90/m92.do

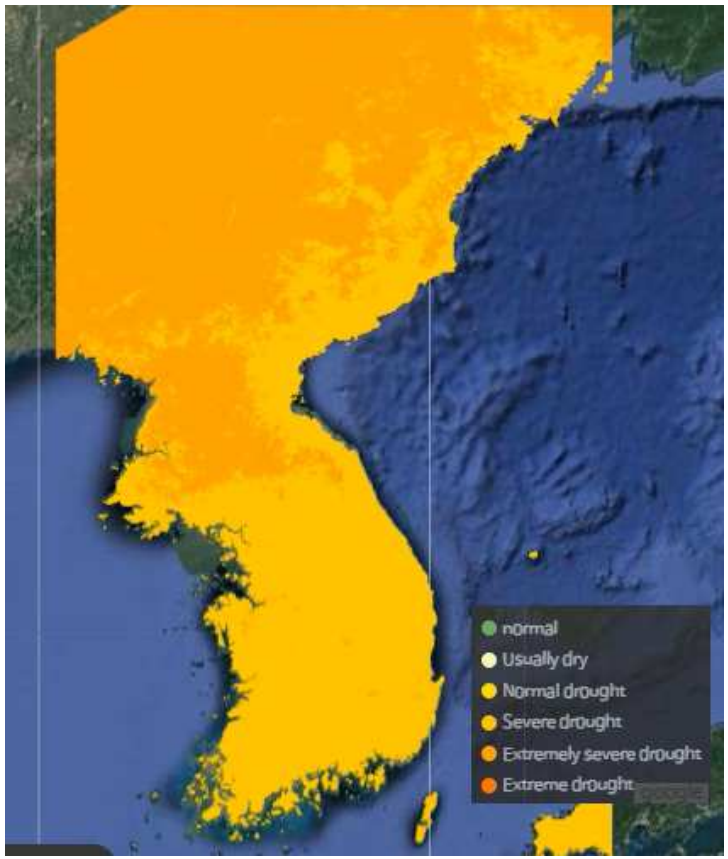
National Drought Information-Analysis Center (KNDIC)

Agricultural Dry Condition Index group = { TCI, VCI, VHI, ADCI }

Temperature Condition Index (TCI)

is the quantified index of thermal and brightness temperature with a range of 0~100(Kogan, 1990)

Color	Range
normal	1.0
usually dry	0.75 < ~< 1
normal drought	0.5< ~=< 0.75
severe drought	0.25 < ~ =0.5
extremely severe drought	0 < ~ = 0.25
extreme drought	0



Source: http://drought.kwater.or.kr/menu/m90/m92.do

National Drought Information-Analysis Center (KNDIC)

Agricultural Dry Condition Index group = { TCI, VCI, VHI, ADCI }

Vegetation Condition Index (VCI)

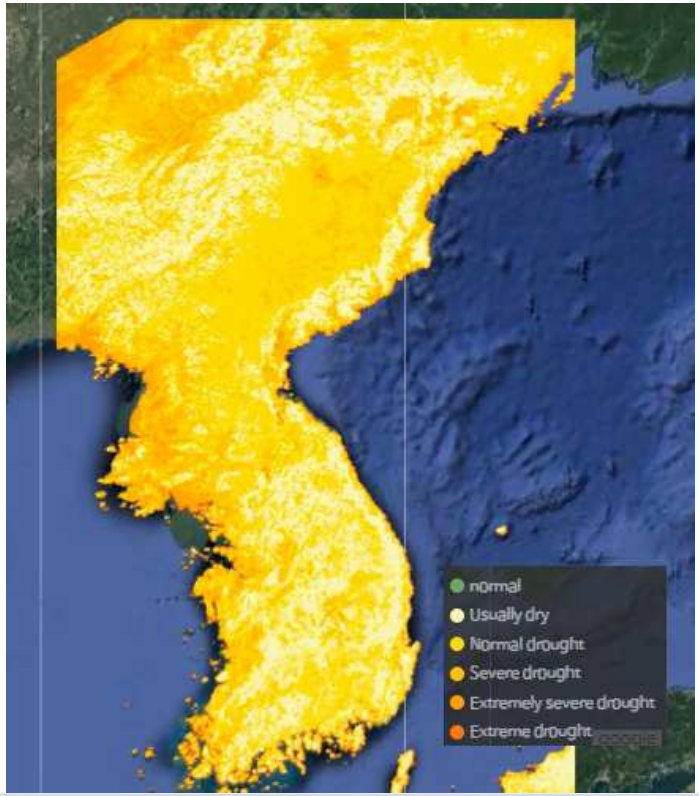
is the quantified index presented with the range of 0 ~ 100, using the minimum and maximum values from the minimum 4-year ~ maximum 12-year long NDVI data (Kogan, 1990).

$$VCI = 100 \times \frac{NDVI_i - NDVI_{min}}{NDVI_{max} - NDVI_{min}}$$

$$\mathrm{NDVI} = \frac{(\mathrm{NIR} - \mathrm{Red})}{(\mathrm{NIR} + \mathrm{Red})}$$

NIR: spectral reflectance measurements acquired in the near-infrared regions.

Red : spectral reflectance measurements acquired in the red (visible)-infrared regions.



Source: http://drought.kwater.or.kr/menu/m90/m92.do

* Legend is the same with TCI's.

National Drought Information-Analysis Center (KNDIC)

Agricultural Dry Condition Index group = { TCI, VCI, VHI, ADCI }

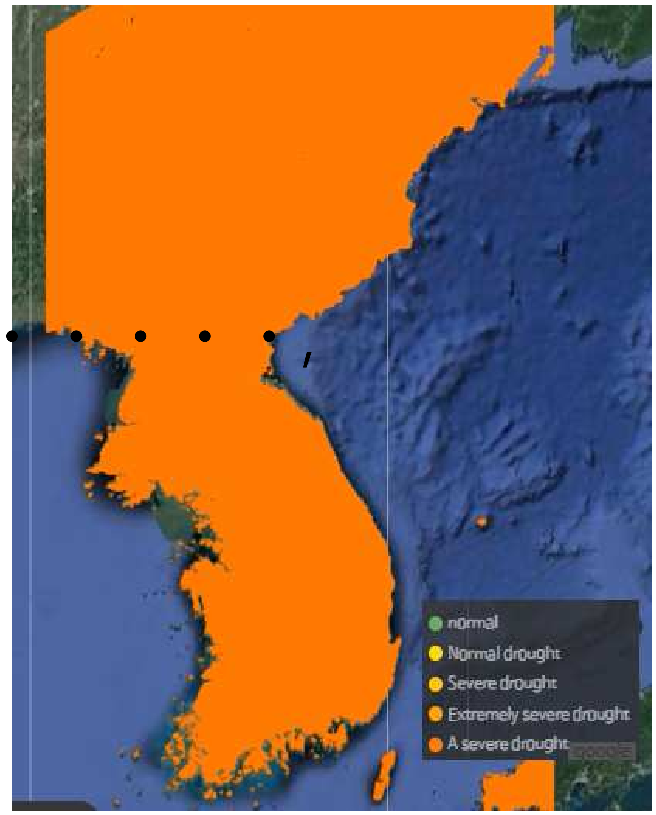
Agricultural Dry Condition Index (VHI)

is the index presents vegetation stress level and crop production and the standardized NDVI, VCI and standardized land surface temperature, TCI are lineally combined (Kogan, 1995). AQUA and TERRA used.

• • • • • • • • • • • • • • • • • ,

- = 0.7 or AVG(VCI, TCI)

Color	Range
normal	< 40
normal drought	30 ~ 40
severe drought	20 ~ 30
extremely severe drought	10 ~ 20
extreme drought	0 ~ 10



Source: http://drought.kwater.or.kr/menu/m90/m92.do

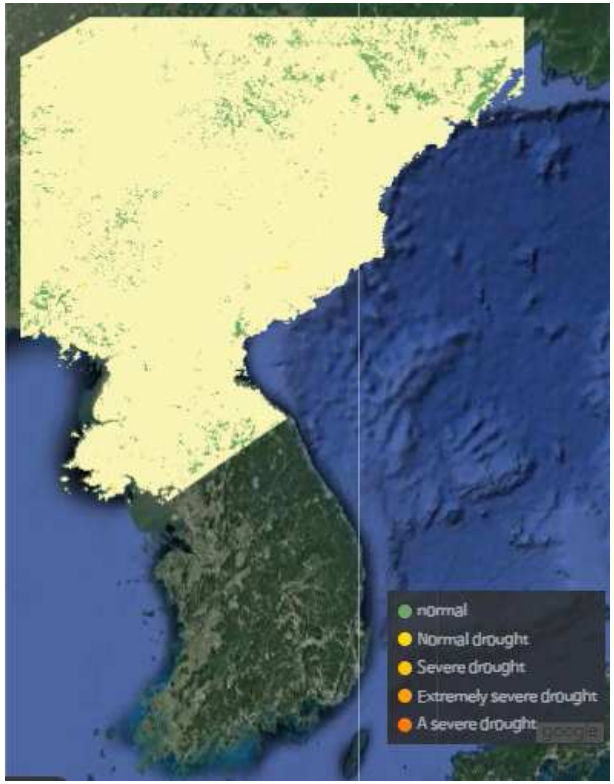
National Drought Information-Analysis Center (KNDIC)

Agricultural Dry Condition Index group = { TCI, VCI, VHI, ADCI }

Agricultural Dry Condition Index (ADCI)

is High temperature heats up land surfaces and the excessive land surface temperatures cause soil water shortage, which in turn reduces vegetation vibrancy. This continued phenomenon causes agricultural drought, which is expressed as drought index.

Color	Range
normal	< 40
normal drought	30 ~ 40
severe drought	20 ~ 30
extremely severe drought	10 ~ 20
extreme drought	0 ~ 10



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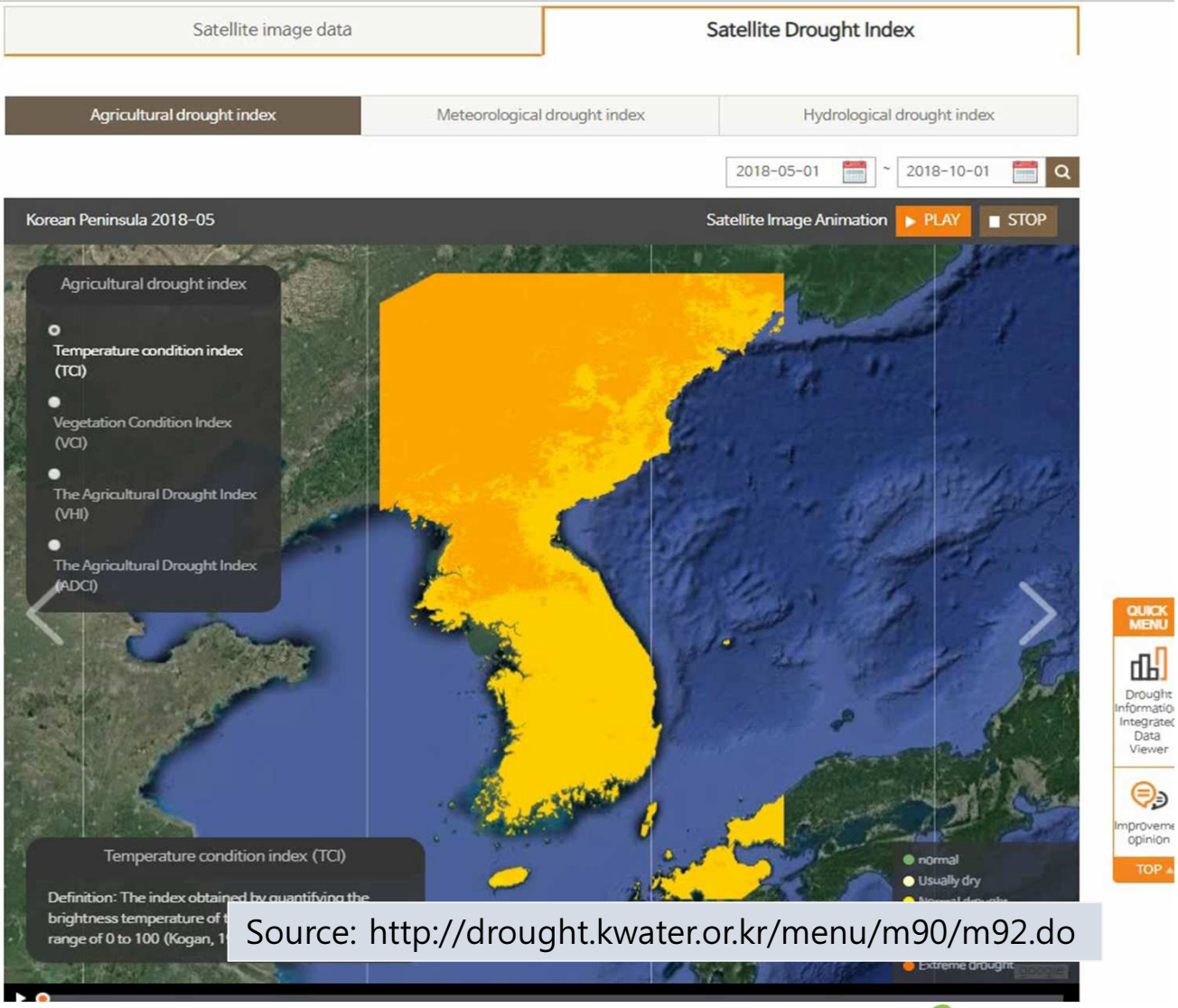
National Drought Information-Analysis Center (KNDIC)

Agricultural Dry Condition Index group
=
{ TCI, VCI,
VHI, ADCI }

(Demo)



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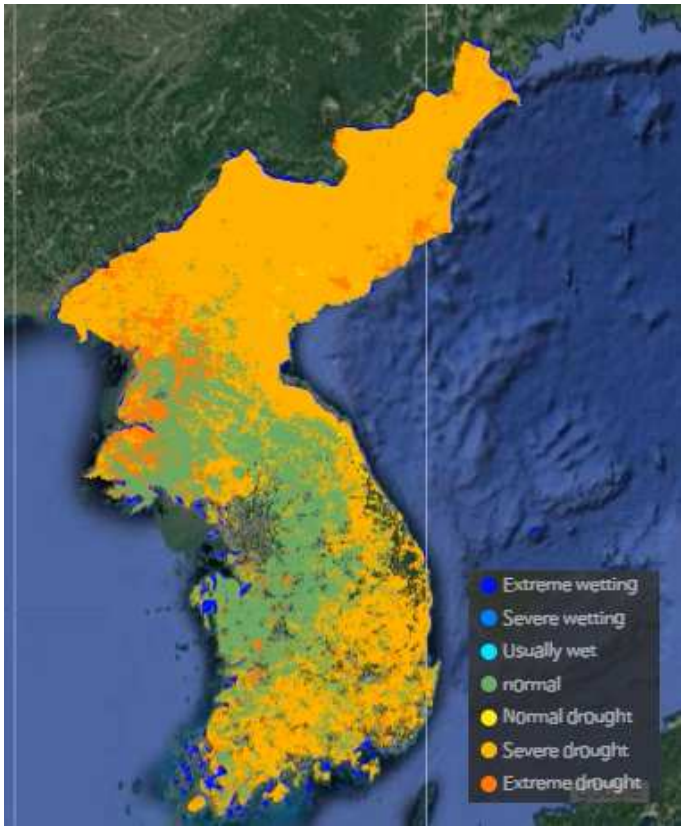
National Drought Information-Analysis Center (KNDIC)

Meteorological Drought Index group = { SPI, EDI }

Standardized Precipitation Index (SPI) :

Mckee et al. (1993, 1995) developed the SPI Drought Index considering that precipitation decline causing water shortages as measured against water demands causes drought.

Color	Range
extreme wetting	<=2.0
severe wetting	1.5 ~ 2.0
usual wet	1.0 ~ 1.5
Normal	-1.0 ~ 1.0
normal drought	-1.5 ~ -1.0
severe drought	-2.0 ~ -1.5
extreme drought	>= -2.0



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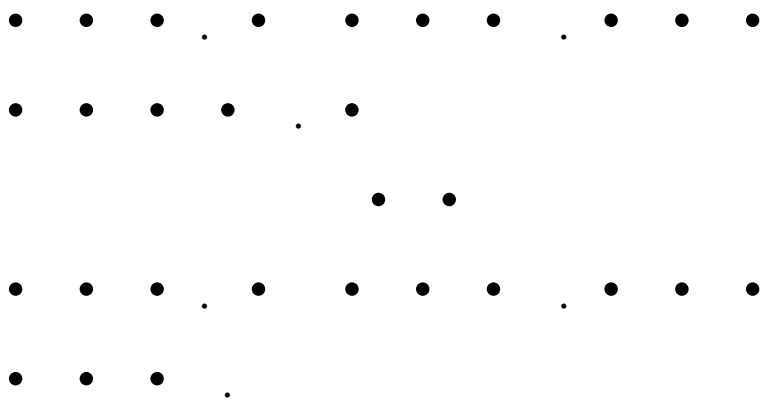
National Drought Information-Analysis Center (KNDIC)

Meteorological Drought Index group = { SPI, EDI }

Effective Drought Index (EDI) :

Considering water loss such as discharge or evaporation over time, available water resources from precipitation is accumulated for a period of one year or more and the average accumulation is compared with the normal year value to tell drought level.



Color	Range
extreme wetting	<=2.0
severe wetting	1.5 ~ 2.0
usual wet	1.0 ~ 1.5
Normal	-1.0 ~ 1.0
normal drought	-1.5 ~ -1.0
severe drought	-2.0 ~ -1.5
extreme drought	>= -2.0

National Drought Information-Analysis Center (KNDIC)

Meteorological Drought Index group
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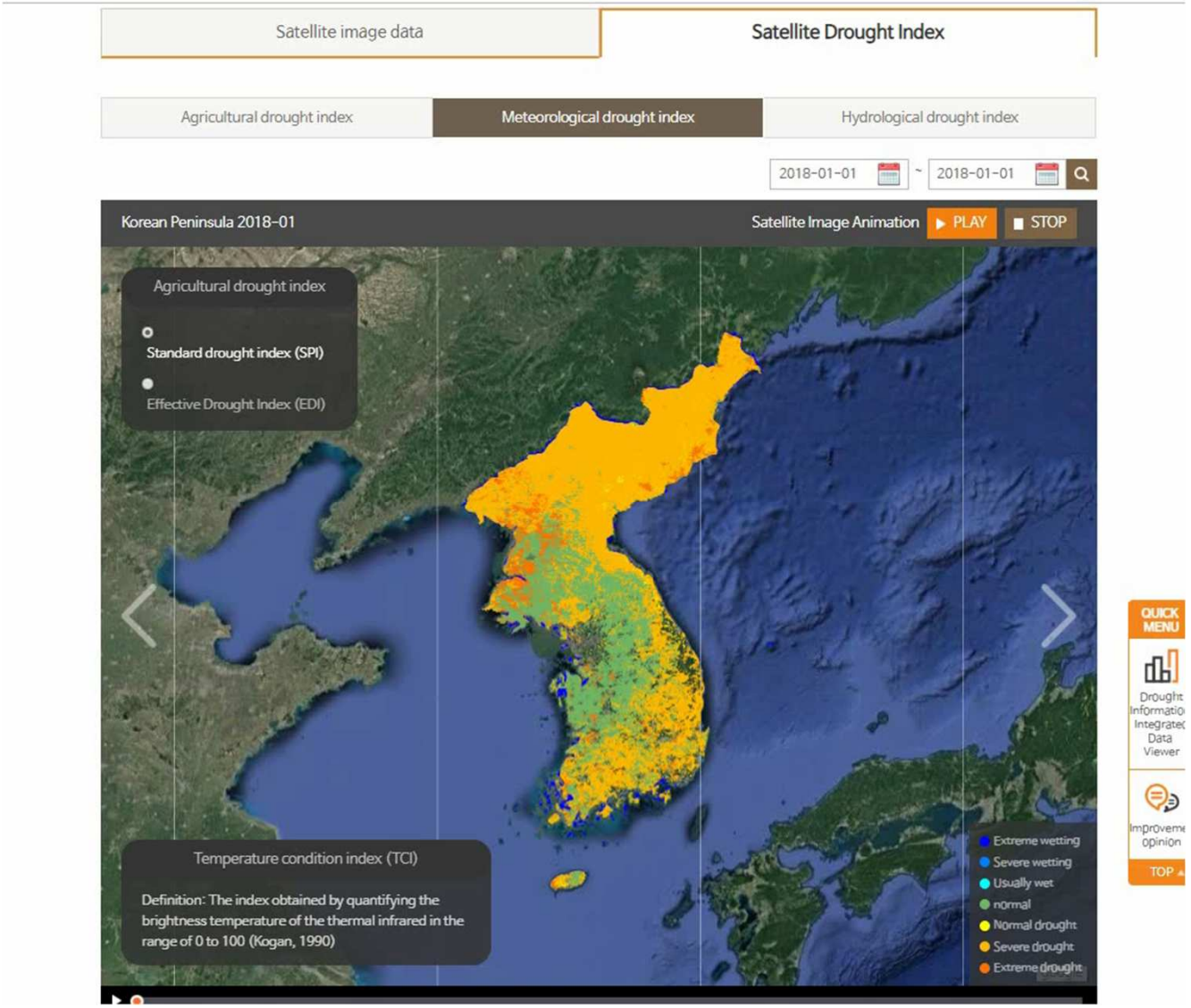
(Demo)



National Drought Information-Analysis Center (KNDIC)

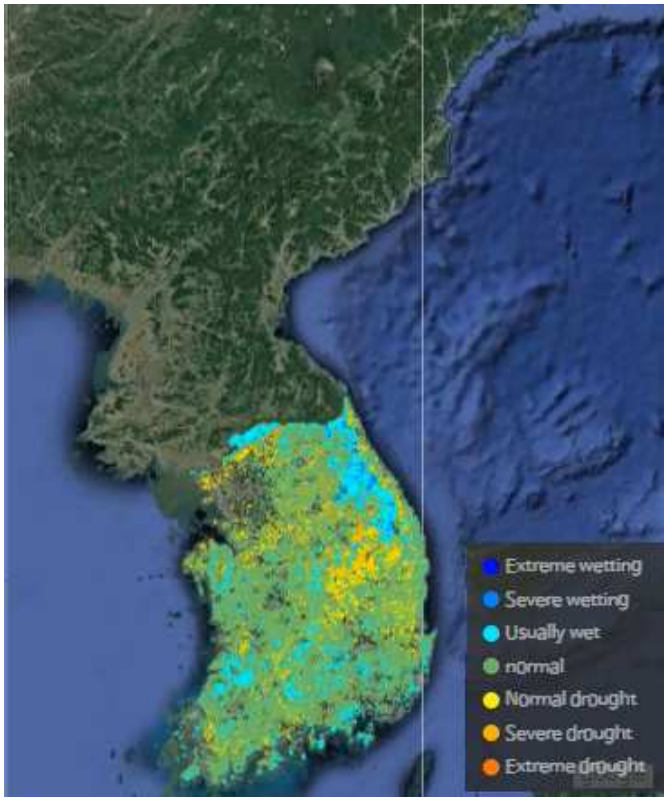
Hydrologic Drought Index group = { EWDI, WBDI, DDDI }

Energy-based Drought Index (EWDI)

As a hydrologic drought index based on energy balance combining evaporation and soil water data observed from satellite, potential water retention power is presented as drought index considering natural environmental changes

Color	Range
extreme wetting	<=1.5
severe wetting	1.0 ~ 1.5
usual wet	0.5 ~ 1.0
Normal	-0.5 ~ 0.5
normal drought	-1.0 ~ - 0.5
severe drought	-1.5 ~ -1.0
extreme drought	>= -1.5

* WBDI is the same.



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National Drought Information-Analysis Center (KNDIC)

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Water Balance-based Drought Index (WBDI)

As a hydrologic drought index calculated with the application of the precipitation and evaporation observed from satellite to the concept of water balance, the potential outflow discharge is marked as the drought index

Water Balance Form: P – E = dS + R

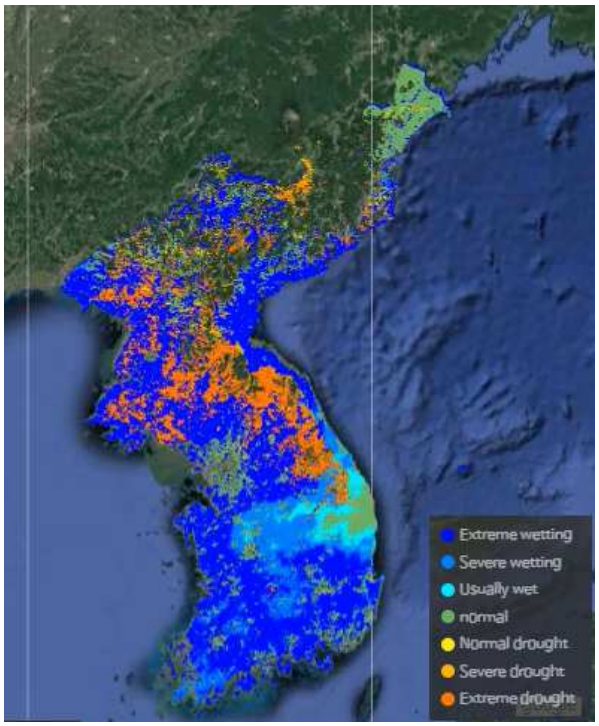
where

P : precipitation

E: evapotranspiration

dS: soil moisture change

R: Possible outflow



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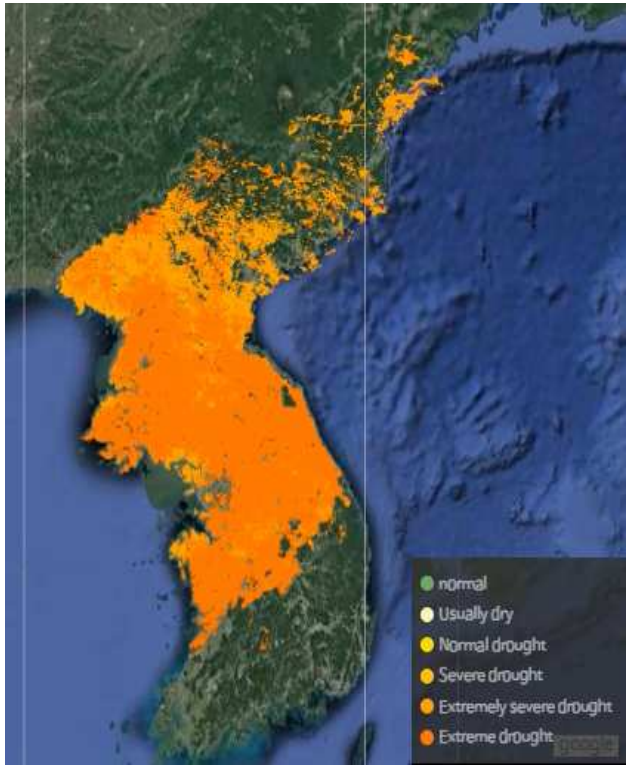
National Drought Information-Analysis Center (KNDIC)

Hydrologic Drought Index group = { EWDI, WBDI, DDDI }

Machine Learning-based Drought Index (DDDI)

Satellite data is used for input data to monitor hydrologic drought in ungagged location, the hydrologic drought step estimation technology shows water flow as a percentage based on machine learning methodology

Color	Range
normal	< 30
normal dry	20 ~ 30
normal drought	10 ~ 20
severe drought	5 ~ 10
extremely severe drought	2 ~ 5
extreme drought	0 ~ 2



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National Drought Information-Analysis Center (KNDIC)

Hydrologic Drought Index group
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{ EWDI,
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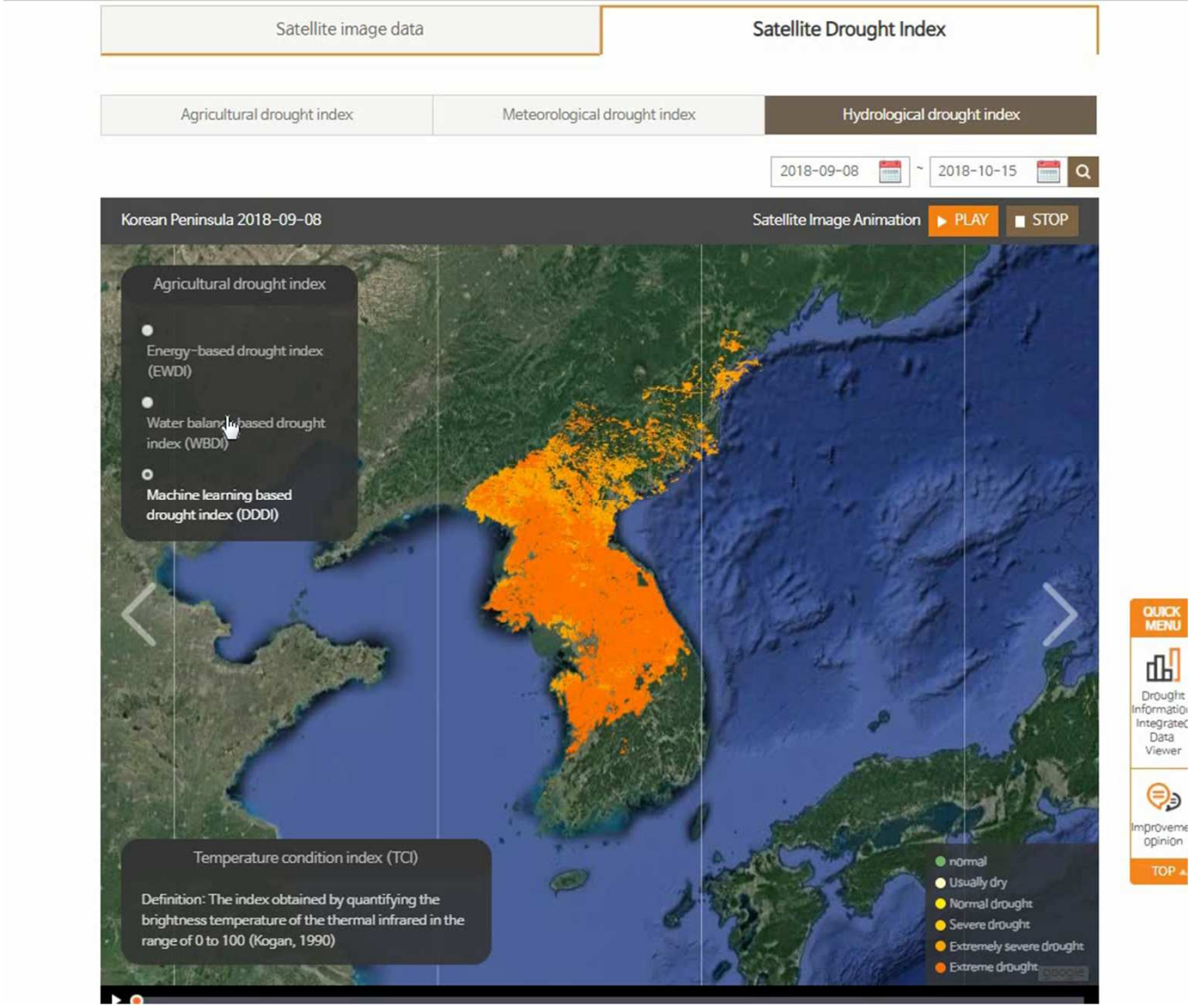
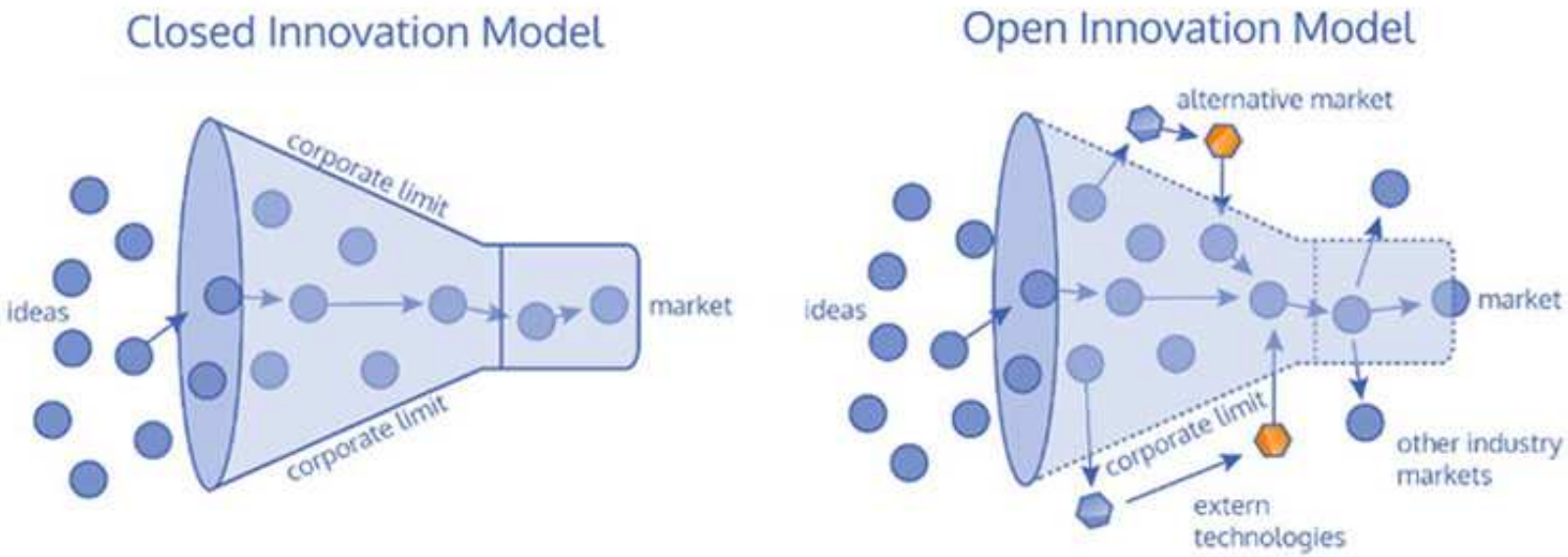
DDDI }

(Demo)

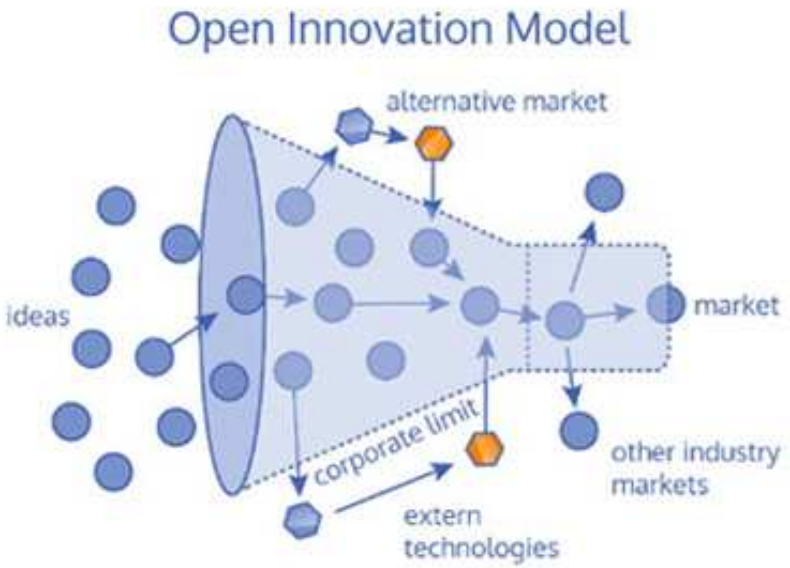


2. An approach on geo-indicator development for drought monitoring and early warning

Open Innovation and Technology



Open Innovation and Technology



Open Geospatial Standards

Open Source Software

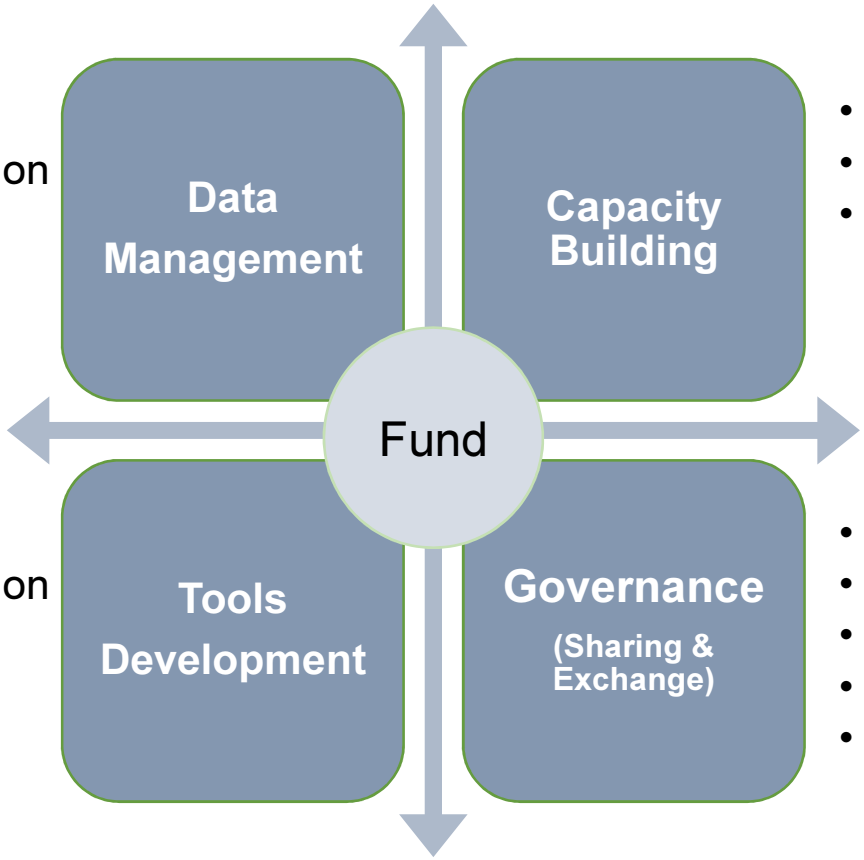
Open Data and Information

Capacity Building

Open Innovation Strategy

Open Approach

- ✓ for sharing and expanding outcomes ,
- ✓ for reducing maintenance costs,
- ✓ for sustainability



- Specification
- H/W, S/W
- Operators

- Training Programs: Online/Offline
- Tutors
- Educational material

for UN staff: UN University, UN training programs
for country experts: collaboration with NGOs, educational facilities in country

- Specification
- H/W, S/W
- Operators

- Pilot sites
- Sharing technologies
- Sharing knowledge
- Exchange experts
- Develop knowledge

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

Finding and Lessons learned of pilot applications of geo-indicators for drought monitoring

Thank you.

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