문서번호 APCC-출장-17-1077(2017-09-19)

결재	팀장	부서장	원장	
	09/18 이우섭	09/19 유진호	09/19 정홍상	
협조	팀장	부서장		
	09/19 조재필	09/19 김형진		

TRAVEL REPORT FORM
출장보고서

I. **Reporter** 보고자

Department 소속	Position 직위(직급)	Name 성명	Travel Date 날짜	Note 비고
기후예측본부	팀장	이우섭	9/3~9/10	
응용사업본부	선임연구원	전종안	9/3~9/10	

II. **Major Activities** 주요업무 수행내용

1. Main Contents and Activities 주요내용 및 활동

○ 학회명: European Conference for Applied Meteorology and Climatology 2017
○ 목 적: 대기과학 및 응용연구와 관련된 다양한 연구발표와 토의를 목적으로 함
○ 발표명
- 이우섭: Variability of Extreme temperature over East Asia and its relationships with teleconnection patterns
- 전종안: Impact of Sea-Level Rise and Climate Change on Saltwater Intrusion through a Modelling Approach

2. Relevance to APEC Climate Center's Activities 결론 및 소감

- EMS Annual Meeting 2017은 "Serving Society with better Weather and Climate Information"이라는 주제로 기상/기후 및 응용분야 전반에 걸쳐있는 학회로 기후서비스를 담당하는 APCC에 적합한 국제학회라 할 수 있음
- 기상과 기후에 있어서 불확실성을 정량화하고 이러한 불확실성 정보를 바탕으로 기후정보를 좀 더 유용한 정보화 하는 주제의 발표가 다수 있었으며, APCC MME 및 S2S자료의 활용성 극대화에 도움을 줄 것으로 기대 됨
- 동아시아 폭염의 발생원인 규명에 대한 연구들을 토대로, 유럽 밋 동아시아 폭염의 발생 원인을 이해하고 향후 유라시아 지역 폭염 예측 에 도움이 될 것으로 판단됨.
- 기후변화에 따른 해수면상승을 전망하고, 각 시나리오 별 강수전망자료로부터 지하수 함양율을 추정으로, 지하수 해수침투영향을 정량화 하고, 적절한 해수침투 감소

방안을 제시한 발표에 농민들에게 유용한 정보를 제공할 수 있는 연구라는 평가를 받음

III. References 참고사항

(with attachment of any information or report in case of attendance of conferences, workshops and meetings) 학술대회, 워크숍, 회의 등 참석 시 관련 정보 및 문서 첨부

1. Presented and Collected Materials 주요 수집자료

2. Suggestions and Remarks 건의사항

Impact of Sea-Level Rise and Climate Change on Saltwater Intrusion through a Modelling Approach

J. Chun (jachun@apcc21.org)[1], **C. Lim** [1]

[1] *APEC Climate Center, Busan, South Korea*

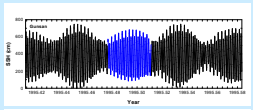
BACKGROUND

- Sea-level can rise by expanding seawater resulting from the ocean warm and by melting ice over land due to climate change.
  - Global Sea-level Rise (SLR) projections for 2081-2100 (IPCC, 2013)
    - Under RCP 4.5 approximately 47cm
    - Under RCP 8.5 approximately 63cm
  - SLR projections in Korea by 2100 (KMA, http://climate.go.kr)
    - Under RCP 4.5 approximately 65cm (East sea of Korea: 79.5cm, South sea of Korea: 58.1cm, West sea of Korea: 57.3cm)
    - Under RCP 8.5 approximately 83.3cm (East sea of Korea: 108.1cm, South sea of Korea: 70.8cm, West sea of Korea: 72.4cm)
- It is widely known that sea-level rise contributes to the enhancement of seawater intrusion to coastal groundwater systems.

OBJECTIVES

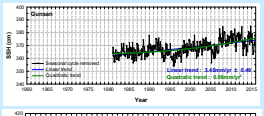
- To investigate the impacts of sea-level rise on coastal groundwater systems
- To provide recommendations to control seawater wedge through the SUTRA model

MATERIALS AND METHODS

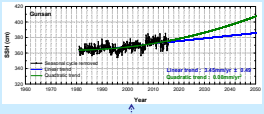


Filling missing tidal elevation records at the Gusan station

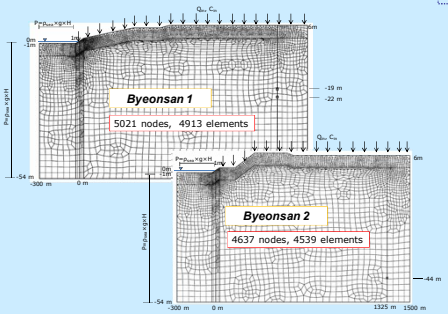
Location map of the monitoring wells



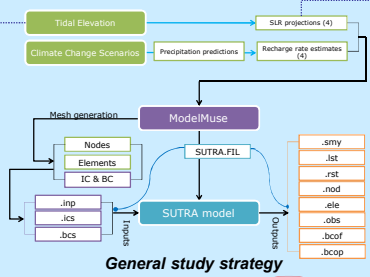
Sea-level rise trend with linear regression



Sea-level rise trend with polynomial regression of order 2



Boundary and initial conditions at the monitoring wells



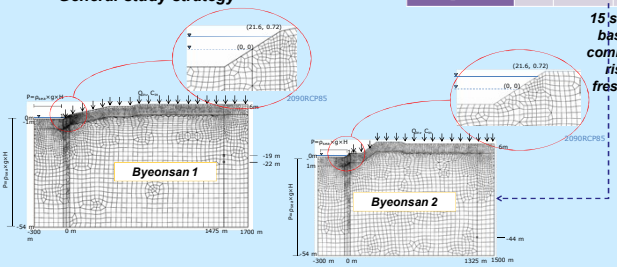
General study strategy

Denotation	SLR (m)	Recharge Rate (kg/s)	Case
Baseline	0	0.00603	2005-2015
RR2050RCP4S	0	0.00627	2050s, Precipitation under RCP4.5 (1)
RR2050RCP8S	0	0.0058	2050s, Precipitation under RCP8.5 (2)
RR2090RCP4S	0	0.00549	2090s, Precipitation under RCP4.5 (3)
RR2090RCP8S	0	0.00694	2090s, Precipitation under RCP8.5 (4)
2050L	0.12	0.00603	Sea-level rise by 2050 with linear regression (5)
2050C	0.32	0.00603	Sea-level rise by 2050 with polynomial regression of order 2 (6)
2090RCP4S	0.57	0.00603	KMA SLR projection under RCP4.5 (7)
2090RCP8S	0.72	0.00603	KMA SLR projection under RCP8.5 (8)
2050L_RR2050RCP4S	0.12	0.00627	(5) + (1)
2050L_RR2050RCP8S	0.12	0.0058	(5) + (2)
2050C_RR2050RCP4S	0.32	0.00627	(6) + (1)
2050C_RR2050RCP8S	0.32	0.0058	(6) + (2)
2090RCP4S_RR2090RCP4S	0.57	0.00549	(7) + (3)
2090RCP8S_RR2090RCP8S	0.72	0.00694	(8) + (4)

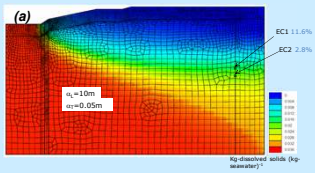
15 scenarios including the baseline period with the combinations of 4 sea-level rise projections and 4 freshwater recharge rates

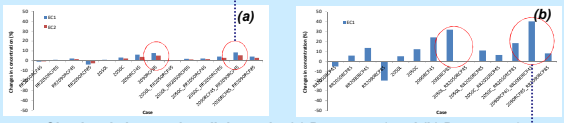
The effect of the Saline Groundwater Extraction method on seawater intrusion

Monitoring Well	Top			Bottom		
	Distance from coastline (m)	Depth (m)	Pumping Rate (kg s^{-1})	Distance from coastline (m)	Depth (m)	Pumping Rate (kg s^{-1})
Byeonsan 1	490	-20	0.3472	490	-40	0.9259
Byeonsan 2	370	-33	0.3472	370	-44	0.9259

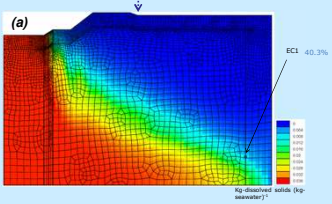


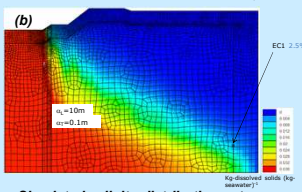
RESULTS AND DISCUSSION





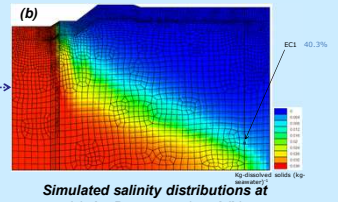
Simulated changes in salinity at the (a) Byeonsan 1 and (b) Byeonsan 2 monitoring wells with each case scenario



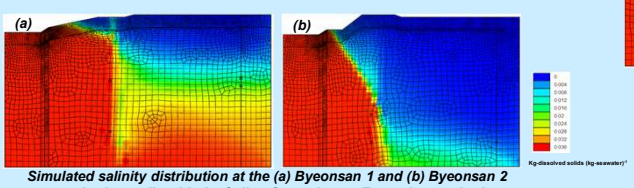


Simulated salinity distributions at the (a) Byeonsan 1 and (b) Byeonsan 2 monitoring wells for the baseline period

While 0.72 sea-level rise contributed to the largest increase in salinity at monitoring wells without consideration of the changes in freshwater recharge rates, 0.57m sea-level rise with a freshwater recharge rate of 0.0058kg s^{-1} contributed to the larges salinity increase.



Simulated salinity distributions at (a) the Byeonsan 1 and (b) Byeonsan 2 monitoring wells for 2090RCP45_RR2090RCP45



Simulated salinity distribution at the (a) Byeonsan 1 and (b) Byeonsan 2 monitoring wells with the Saline Groundwater Extraction method

1. *The effect of the Saline Groundwater Extraction method on seawater intrusion was also investigated through the SUTRA model*
2. *The results showed that when both top and bottom extraction pumps were run, the seawater wedge could be effectively controlled*

- It is concluded that this study can be useful to secure water resources by efficaciously controlling the seawater wedge and subsequently leading to the reduction of saline damages to crops.

Variability of Extreme temperature over East Asia and its relationships with teleconnection patterns

Woo-Seop Lee[a] · Hyun-Ju Lee[a] · Myong-In Lee[b]

[a]**APEC Climate Center(APCC), Busan,** Republic of **Korea,** [b]Ulsan National Institute of Science and Technology(UNIST) Ulsan, Republic of Korea.

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Introduction

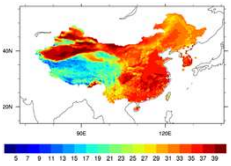
As climate change, extreme weather events such as heat waves, droughts, heavy rain/snow, storms/floods have become more frequent and severe all around the world. In the future, high temperatures or heat waves are expected to occur more intensely and longer lasting due to global warming (Meehl and Tebaldi, 2004).

This study investigates interdecadal and interannual variability in the occurrence of heat waves over East Asia in summer between 1973 and 2012. In particular, this study examines the dominant heat wave patterns, as obtained through empirical orthogonal function (EOF) analysis, and the associated variability in heat wave occurrence. In this study, heat wave days is defined as the number of days with temperatures in the highest 10th percentile of June to August (JJA) daily maximum temperatures. The regions where the 90th percentile of maximum temperature is below 29°C were excluded. We separated the heat wave days into low-frequency variation and high-frequency variation by using a band pass filter. The dominant variation modes of heat waves are related large-scale oceanic and atmospheric circulation. The low-frequency variation of heat waves in East Asia is highly correlated with the Atlantic Multidecadal Oscillation (AMO), which shows significant decadal changes before and after mid-1990s. In particular, the positive phase of the AMO leads to heat waves earlier in the summertime while also increasing their magnitude, frequency, and duration in East Asia. It is suggested that the likelihood of heat wave events will increase with further long-term climate warming, modified by low-frequency oceanic variations such as the AMO. In the high-frequency variation, two dominant modes are shown in East Asia. One is related with the Scandinavia pattern (SCAND) and the other with Circum Global Teleconnection pattern (CGT). These two teleconnection pattern seem to affect the location of convection and subsidence of the atmosphere and are a key process during heat wave events in the East Asian region.

Data & Methods

DATA

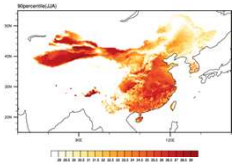
- The daily maximum temperature in China is from 0.25 degree gridded daily meteorological VIC forcing dataset. It is from 756 ground monitoring station data and derives interpolating gauged maximum temperature. It covers January 1952 to December 2012.
- Korean daily maximum temperature is provided by 61 ASOS data in South Korea and 13 station data in North Korea.



- Sea surface temperature (SST) of NOAA Optimum Interpolation (OI) SST version 2
- NOAA also provided interpolated outgoing longwave radiation (OLR) data.
- The NCEP R1 data is Used for atmospheric variables.

Definition of Heatwave

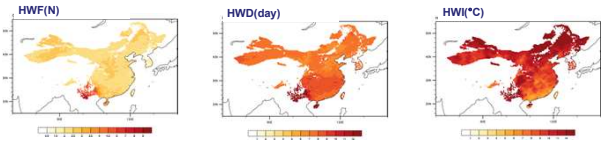
- Heat wave is defined as the number of day that the maximum temperature is over 90th percentile of June-July-August daily maximum temperature and we excluded region where the 90th percentile of Maximum temperature is below 29°C.



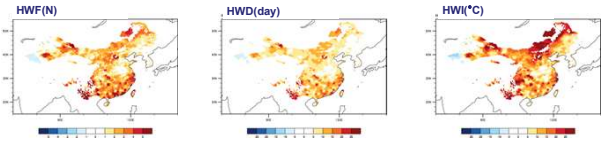
- HWI = A period of at least 2 consecutive days whose T^{max} exceeds 90^{th} *percentile*
- $HWD = \frac{1}{n}\sum_j^n I(T_j^{max} \geq 90^{th}\ \text{percentile})$, I(·) = 1 if the argument is true and is zero otherwise.
- $HWI = \frac{1}{n}\sum_j^n (T_j^{max} - 90^{th}\ percentile)$, *where* $T_j^{max} \geq 29°C$.

Climatology and Trend (HWF, HWD, HWI : 1973~2012)

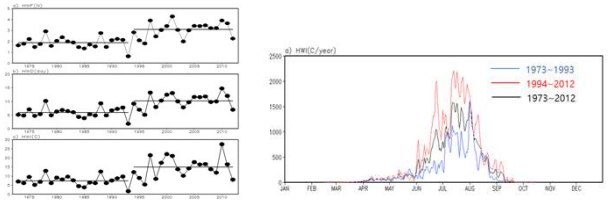
Summer Climatology



Trend

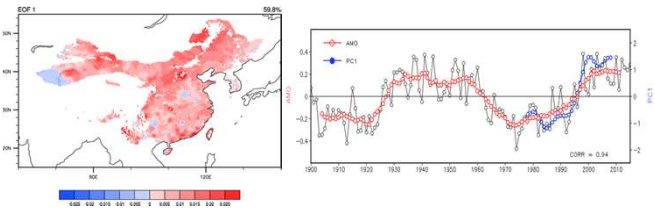


Decadal Changes in Heat wave (JJA)



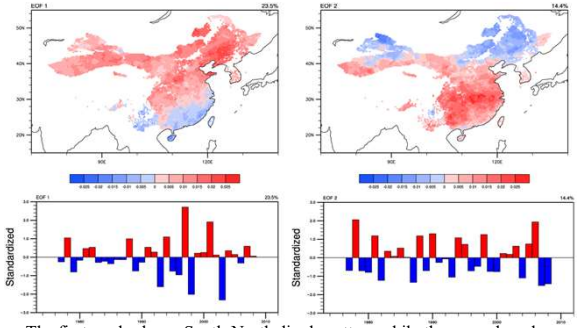
Results

Interdecadal variation of Heat wave (Low pass filter)



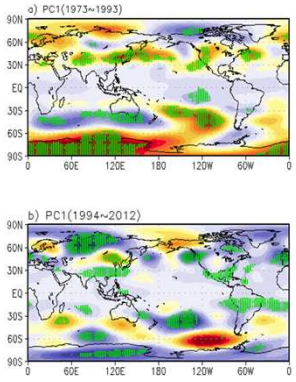
- The PC-timeseireis of multi-decadal oscillation is similar with the Atlantic Multidecadal Oscillation (AMO). This AMO signal for heatwave over the China is already known from Xia et al., 2015.

Interannual variation of Heat wave (High pass filter)



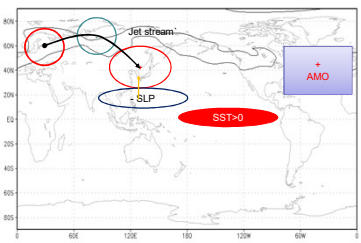
- The first mode shows South-North dipole pattern while the second mode seems monopole sign.

Decadal change of Interannual variation of Heat wave (High pass filter)



- Figure a shows atmospheric teleconnection patterns associated with the 1st mode from 1973 to 1993. This pattern looks like circumglobal teleconnection patten(CGT, ⬭ing and Wang, 2005).
- Figure 2b show strong teleconnection pattern from the Europe to East Asia. This pattern is known as Scandinavian pattern (SCAND pattern, Bueh and Nakamura, 2007). And the correlation coefficient between PC 1 of high-frequency and SCAND is high as 0.5.

Conclusion



- In this study, the dominant variation modes of heat wave are related large-scale oceanic and atmospheric circulation. In low-frequency variation of heat wave in East Asia is highly correlated with the AMO. In high-frequency variation, two dominant modes are shown in East Asia. One is related with the SCAND pattern and the other is CGT. This two teleconnection pattern seems to affect the location of convection and subsident of atmosphere and key process to occur heat wave event in East Asian region..
- Since 1994, the East Asian storm pattern has been combined with a wave-train pattern induced by the Scandinavia pattern and a wave pattern propagating in the South China Sea, resulting in more intense heat waves in recent years.
- This pattern is accompanied by sustained downward currents, increases the stability of the atmosphere, and causes strong heat waves in northern China and the Korean peninsula.

Reference

- Ding Q. and Wang B. 2005 Circumglobal teleconnection in the Northern Hemisphere summer J. Clim. 18 3483–505.
- Lee, W. S., & Lee, M. I. (2016). Interannual variability of heat waves in South Korea and their connection with large-scale atmospheric circulation patterns. International Journal of Climatology. ,
- Wenju Cai, 2012: Severe heat waves in Southern Australiea: synoptic climatolgoy and large scale connections, Clim. Dyn. 38:209-224.
- Alexander L., 2011: Extreme heat rooted in dry soils, Nat. Geosci. 4, 12-13.
- Meehl G.A., Tebaldi C., 2004: More intense, more frequent, and longer lasting heat waves in the 21st century. Science 303, 1499-1503.