The Tendency of Atmospheric Temperature and Precipitation from a Viewpoint of the Climatic Variation Indices

著者	Yamakawa Shuji, Hisamochi Ryo
出版者	Japan Climatology Seminar
journal or publication title	Japanese progress in climatology
volume	2014
page range	29-32
year	2014-12
URL	http://hdl.handle.net/10114/10076

Reprinted from *Proceeding of IGU 2013(KRC).*, Aug. 2013

Proceedings of IGU 2013 Kyoto Regional Conference (KRC) 5-7 Aug. 2013

The Tendency of Atmospheric Temperature and Precipitation from a Viewpoint of the Climatic Variation Indices

Shuji Yamakawa＊ and Ryo Hisamochi**

* Department of Geosystem Sciences, College of Humanities and Sciences, Nihon Univ.

** Graduate, Division of Earth and Planetary Sciences, Graduate School of Science, Kyoto Univ.

Abstract

Surface air temperature (AT) and precipitation are important in studying global climate system. AT and precipitation are related with climatic variation indices, such as SOI (Southern oscillation index; Philander,1990), PDO (Pacific decadal oscillation; Mantua, *et al.*, 1997), AO (Arctic oscillation; Yamakawa, 2005), AAO (Antarctic oscillation; Tompson & Wallace, 2000) and QBO (quasi- biennial oscillation) which are dealt with in this study. Inoue & Yamakawa (2010) analyzed the precipitation of Asia in the warm half year. This research focuses mainly on the relation between teleconnections (Glbntz, *et al.*, 1991) and AT. Multiple regressions are used to determine the relationships between the climatic indices and AT in summer. A multiple regression including QBO should be taken into consideration to improve summer weather forecast.

Key words: teleconnection, PDO (Pacific decadal oscillation), AO (Arctic oscillation), QBO (quasi- biennial oscillation), climatic variation index

1. Data and Methods

The monthly average temperature of the NCEP/NCAR reanalysis data are used. Partial correlation at lag zero to six months are calculated to remove the effect of other variables. In this study, surface temperatures in the area of 30-46°N, 128-148°E around Japan are used as indices of AT.

2. Results

〔1〕 SOI, PDO and Temperature (AT)

The southern oscillation Index (SOI) is regarded as a teleconnection of sea surface temperature (SST) in the low latitudes. PDO, that is a decadal oscillation of SST in the Pacific, is accompanied with regime shifts (Kawasaki, 2013). The partial correlation coefficients (PCC) between SOI, PDO and AT are calculated and illustrated (Fig.1).

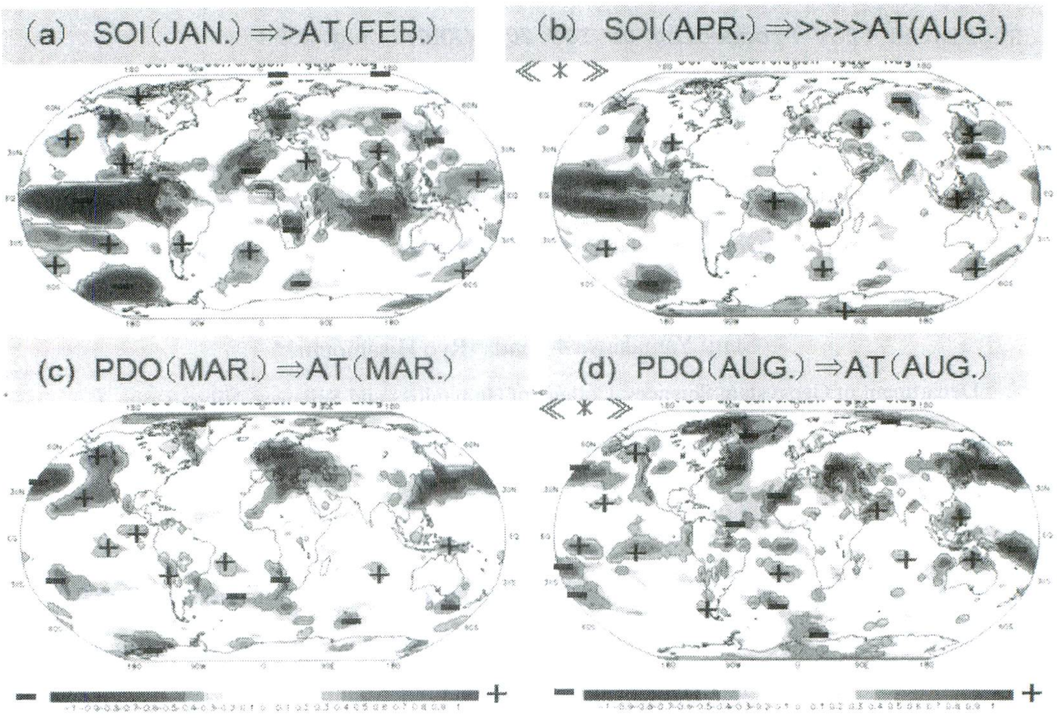

Fig.1 The partial correlation coefficients (PCC) between SOI (a,b) / PDO (c,d) and AT. Both SOI and PDO are related with weather in the mid- and high latitudes. Green lines indicate the 5% significant level. (a) AT in February with one-month lag of SOI in January. Wide spread areas of cold weather cover most of East Asia due to active winter monsoon in the La Nina phase. (b) PCC in August with four-month lag. High positive and negative areas are located to the north, and to the south of Japan, respectively. When El Nino occurs in April, north-low, west-high AT pattern tends to appear in August. (c) The simultaneous PCC in March. In the vicinity of Japan, a high negative area is recognized. If the PDO is negative in March, it would bring a warmer weather. (d) The simultaneous PCC in August. In the vicinity of Japan, a high negative PCC prevails. If the PDO is negative in August, it would lead to a hotter weather. The panels with ≪* ≫are used in Fig.3

〔2〕**QBO and Temperature (AT)**

The QBO at 30hPa of the mid-stratosphere is regarded as a teleconnection to have some influences on the whole globe as far as the high latitudes. QBO in the zonal wind of the tropical stratosphere switches between westerly (w) and easterly (e) phases on an approximately 27-month periodicity. The alternating wind regimes propagate about 1km per month. The partial correlation coefficients (PCC) between QBO and AT are calculated and illustrated (Fig.2) .

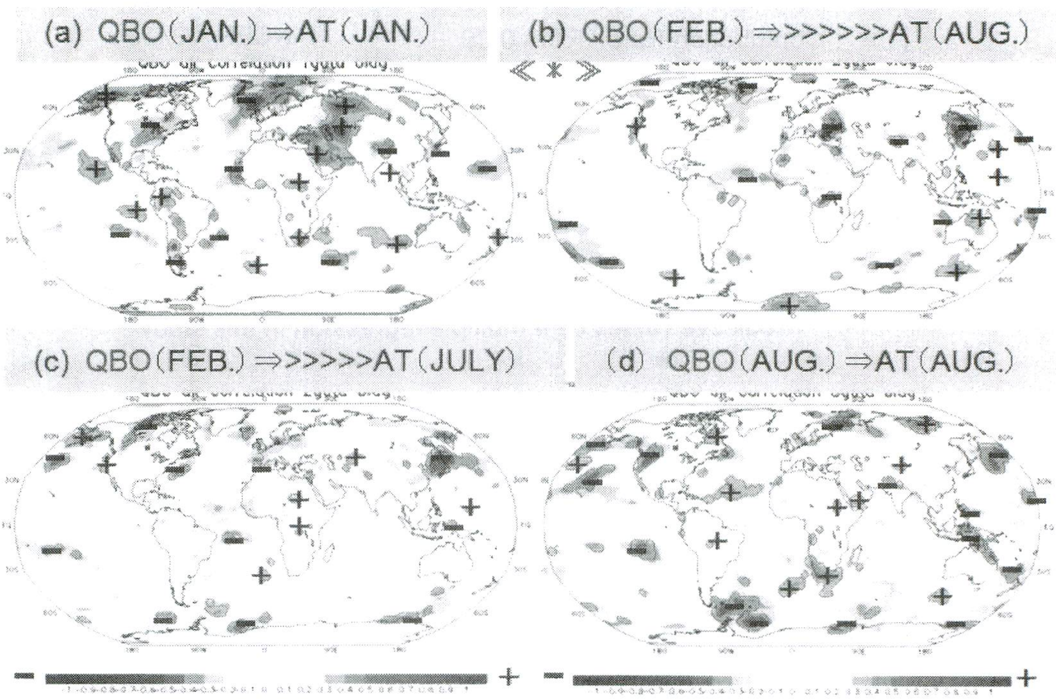

Fig.2 The PCC between QBO and AT. The QBO affects the weather not only in the low latitudes but also mid- and high latitudes. Gray lines indicate the 5% significant level. (a) The simultaneous PCC in January. A high positive area is recognized widely in the central Eurasian continent, so that the west part of Siberian high becomes weaker. (b) PCC in August with distinct negative area around Japan in the w-phase. When w-phase prevails at 30hPa in February, and shifts to the lower stratosphere in early summer, it would be cooler summer than normal. (c) PCC between QBO in February and AT in July with a high negative area in Japan. The w-phase prevails at 30hPa in February, and propagated down to the lower stratosphere in early summer, which results in a cooler weather in August. (d) PCC between QBO and AT in August. The area of the Arctic sea ice tends to get smaller in the e-phase at 70hPa due to the high AT in the coastal zone of Siberia. The panels with ≪* ≫are used in Fig.3

〔3〕 Prediction based on Multiple regression

Multiple regressions are calculated between some teleconnection elements and AT. As a results, a close relationship (Fig.3) is found in August. The predictive values by a multiple regression in these analyses are similar to the observational air temperatures (AT) in the area around Japan.

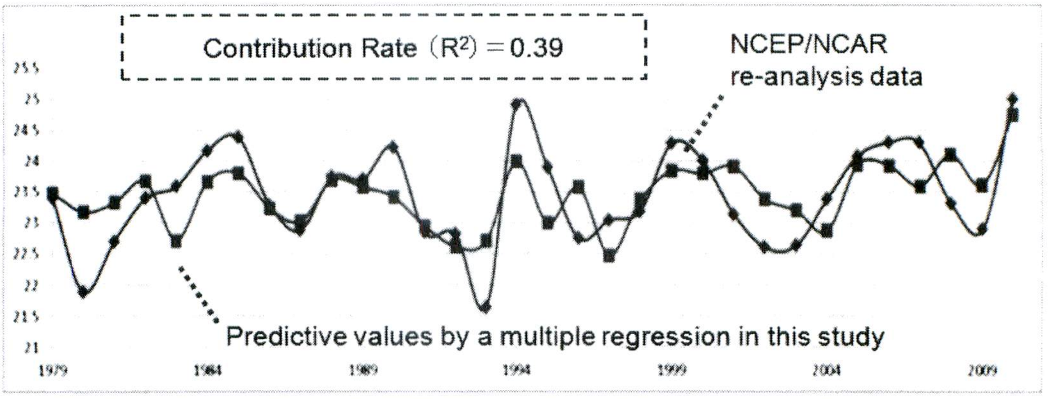

Fig.3 As for AT in August, a multiple regression is calculated by 5 factors, *i.e.* SOI in April, PDO in Aug., QBO in Feb. , AO in Feb. and AAO in Feb.

3. Summery

This study focuses mainly on the relation between teleconnections and surface air temperatures (AT). It is suggested that a seasonal climate in a certain area would be probably predicted by the teleconnection indices. AT in and around Japan in August could be estimated by QBO, AO and AAO in February and SOI in April, and PDO in August. If PDO in August is predicted a few months before, AT of Japan in coming August would be forecasted.

References

Glantz,M.H., Katz,R.W. and Nicholls,N. (1991): *Teleconnections linking worldwide climate anomalies.* Cambridge, 535pp.

Inoue,M. and Yamakawa,S. (2010) : Relationships between stratospheric quasi-biennial oscillation (QBO) and precipitation activities in Asia. *Jour. of Geography*, 119 (3), 441-450. (in Japanese with English abstract)

Kawasaki,T. (2013): *Regime Shift —Fish and climate change—*. Tohoku Univ. Press, 162pp.

Mantua,N.J. Hare,S.R., Zhang,Y., Wallace,J.M. and Francis,R.C. (1997): A Pacific decadal climate oscillation with impacts on Salmon production. *Bull.Amer.Meteor.Soc.*, 78, 1069-1079.

Philander,S.G.(1990): *El Nino, LaNina, and the southern oscillation.* Academic Press, 293pp.

Tompson,D.W. and Wallace,J.M. (2000): Annular modes in the extratropical circulation. PartI: Month-to- month variability. *Jour. of Climate*, 13, 1000-1016.

Yamakawa,S. (2005) : Climate variations from the viewpoint of seasonal to multi-decadal scale. *Jour. of Geography*, 114 (3), 460-484. (in Japanese with English abstract)

Reprinted from ***Proceeding of IGU 2013(KRC).***, Aug. 2013