Hindcast experiments of the summer climate prediction on frequencies of heavy precipitation over LYRV during the period of 2003-2012

Weather and Climate Laboratory of Jiangsu Meteorological Science Institute October 29, 2013

1.Variations on stratospheric zonal wind in earlier winters influencing heavy precipitation over LYRV in summers

Cause and effect does exist on actual physical drive between stratospheric processes in earlier periods and the formation of heavy precipitation over LYRV in latter summers (low frequency waves stimulated by stratospheric circulation anomalies will be communicated to tropospheric levels in some circumstances). It will significantly enhance the prediction accuracy on frequencies of heavy precipitation over LYRV from June to August and drought and flood disasters, and will be beneficial to predict interannual variations of the 20-30 day oscillation intensity closely related to heavy precipitation and enhance the accuracy of the 10-30 day extended-range forecast of heavy precipitation to conduct a deep study on stratospheric disturbance's influence on intraseasonal variations and interannual variations in its strength of the circulation in summer in East Asia.

Figure 1 shows the spatial distribution of the correlation coefficients between frequencies of heavy precipitation over LYRV and global 50hPa zonal wind in earlier winter for the period from 1961 to 2011, finding that among key zones, positive correlations mainly exist in high latitudes in the Southern Hemisphere and midlatitudes in Northern Pacific while negative correlation exists around the North Pole, both with 0.05 as the threshold of the significance.

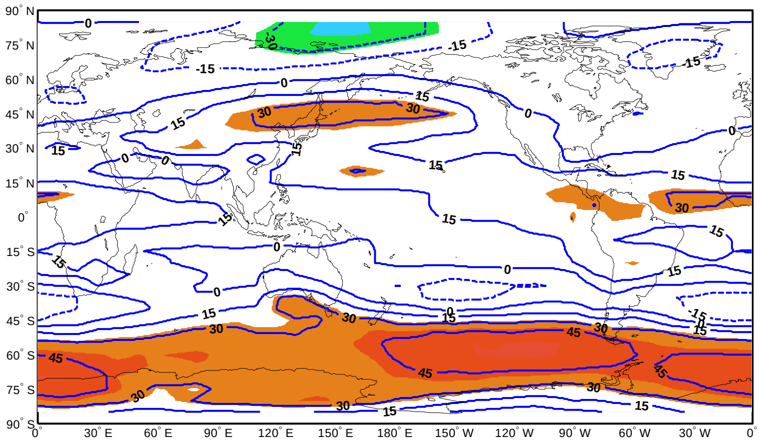

Figure 1 Correlated spatial distribution between frequencies of heavy precipitation over LYRV in summers (June to August) from 1961 to 2011 and global 50hPa zonal wind in earlier winter (December to February)

Shadows in Figure 1 are zones with 0.05 as the value of correlation significance

2.Prediction experiments of frequencies of heavy precipitation over LYRV based on variations on stratospheric zonal wind

Based on KLM filter, targeting 50hPa stratospheric zonal wind in three key zones above, shown as three factors here, x1, x2, x3 (x1: 80°-85°N, 140°-150°E, around the North Pole; x2: 45°N, 140°-170°E, midlatitudes in Northern Pacific; x3: 55°-60°S, 120°-140°W, high latitudes in Southeastern Pacific (regional average)), constructs the linear regression equation to conduct recursive estimation and establishes the prediction model with variable coefficients, thus to conduct the experiments on frequencies of heavy precipitation over LYRV from June to August, and to compare the results with those from the multiple linear regression model.

Construct an equation with stratospheric zonal wind data (x1, x2, x3) from December to February in 1960/1961, …, 2011/2012 (52 winters in total) and frequencies of heavy precipitation over LYRV from June to August in 1961, …, 2012 (y), $y = b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3$, to conduct KLM recursive forecasts. Prediction results for the last decade (2003-2012) are shown in Table 1. It can be seen in this Table that forecast and observed values are very close. The calculation shows that mean absolute error of the forecasts is 0.96 day, meaning a very good prediction effect. Besides, when b1<0, b3>0, there is a small variance for regression coefficients, showing, in the last decade, it has a stable negative and positive correlation with zone wind around the North Pole and in high latitudes in the Southern Hemisphere, while it is significantly negative in the last decade when b2<0, showing that it turns into significant negative correlation with zonal wind in midlatitudes in Northern Pacific (different from positive correlation within the whole 52 years) and that the correlation is not stable to some degree, with the signs changed. Establish the multiple linear regression equation with data of 42 years (1961-2002), to conduct independent forecasts on the last decade (2003-2012), with the result that mean absolute error of the forecasts is 1.26 days (Table 2), larger than that from KLM, mainly because the multiple linear regression equation cannot reflect relevant decadal variations among variables (especially on x2, zonal wind in midlatitudes in Northern Pacific).

Table 1: Prediction on frequencies of heavy precipitation over LYRV in summer based on KLM filter

years	observation	prediction	coefficients			
			b_0	b_1	b_2	b_3
2003	5.0	5.2	4.9	−1.0	−.4	1.5
2004	6.0	6.8	4.8	−.7	−.3	1.6
2005	2.0	4.2	3.8	−1.4	−.3	1.8
2006	5.0	6.0	3.5	−1.2	−.5	1.7
2007	5.0	4.8	3.6	−1.1	−.5	1.7
2008	4.0	5.8	3.4	−.7	−.8	1.2
2009	7.0	5.6	3.5	−1.2	−1.4	1.3
2010	5.0	4.6	3.7	−1.3	−1.4	1.2
2011	7.0	7.7	3.6	−1.3	−1.3	1.0
2012	4.0	3.0	4.0	−1.2	−.8	1.1

Table 2: Multiple linear regression Prediction on frequencies of heavy precipitation over LYRV in summer

years	servation	prediction
2003	5.0	4.4
2004	6.0	6.8
2005	2.0	4.1
2006	5.0	6.6
2007	5.0	6.2
2008	4.0	7.0
2009	7.0	6.7
2010	5.0	5.2
2011	7.0	7.8
2012	4.0	5.9

Reference

YANG Qiuming,Climate Prediction model of the number of the heavy precipitation over lower reaches of the Yangtze River Valley in summer based on the variations of stratospheric circulation.Science Technology and Engineering,2013,13(26):7609-7612.