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# A conceptual prediction model for seasonal drought processes using atmospheric and oceanic standardized anomalies: application to regional drought processes in China

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**S1: the detailed information of retrieving 200 hPa/500 hPa HGT and SST datasets from CFSv2 and CFS**

For the drought process prediction before 1/4/2011, we retrieved reforecast 200 hPa/500 hPa HGT and SST datasets from the website (http://nomads.ncdc.noaa.gov/modeldata/cfs_reforecast_6-hourly_9mon_pgbf/) and the website (http://nomads.ncdc.noaa.gov/modeldata/cmd_ts_9mon/), respectively. For the drought process prediction after 1/4/2011, we retrieved relevant datasets from the website (http://nomads.ncdc.noaa.gov/modeldata/cfsv2_forecast_6-hourly_9mon_pgbf/) and the website (http://nomads.ncdc.noaa.gov/modeldata/cfsv2_forecast_6-hourly_9mon_ocnf/), respectively. Because we focus on the prospective 90 day seasonal drought process prediction during four severe drought processes in this study, prospective 90 day forecast data subsets for 200 hPa/500 hPa HGT and SST are retrieved from CFSv2 and CFS. All the relevant reforecast and forecast datasets are in the 6-hourly form, and then they are transformed into daily forecasts with a simple time-weighted mean based on UTC 00 and UTC 12 forecast files. For example, for the drought process prediction initialized on 11/4/2011, we need to download prospective 90 day forecasted SST files from the website (http://nomads.ncdc.noaa.gov/modeldata/cfsv2_forecast_6-hourly_9mon_ocnf/2011/201104/20110411/2014041100/). The 180 (90×2) files are named as "ocnf2011MMDDSS.01.2014041100.grb2", while "MMDD" ranges from "0411" (April 11) to "0709" (July 9), while "SS" are "00" or "12". In addition, for the four drought processes presented in the study, initial prediction time are as follows:

| Drought Processes | Initial Time | Initial Time | Initial Time |
|---|---|---|---|
| the 2009/2010 drought in Southwest China | 30/6/2009 | 28/9/2009 | 11/1/2010 |
| | 10/7/2009 | 18/10/2009 | 21/1/2010 |
| | 20/7/2009 | 2/11/2009 | 31/1/2010 |
| | 30/7/2009 | 12/11/2009 | 10/2/2010 |
| | 9/8/2009 | 22/11/2009 | 20/2/2010 |
| | 19/8/2009 | 2/12/2009 | 2/3/2010 |
| | 29/8/2009 | 12/12/2009 | 12/3/2010 |
| | 8/9/2009 | 22/12/2009 | 22/3/2010 |
| | 18/9/2009 | 1/1/2010 | - |
| the 2011 summer drought in East China | 1/1/2011 | 2/3/2011 | 1/5/2011 |
| | 11/1/2011 | 12/3/2011 | 11/5/2011 |
| | 21/1/2011 | 22/3/2011 | 21/5/2011 |
| | 31/1/2011 | 1/4/2011 | 1/6/2011 |
| | 10/2/2011 | 11/4/2011 | 11/6/2011 |
| | 20/2/2011 | 21/4/2011 | 21/6/2011 |
| the 2011 summer drought in Southwest China | 11/4/2011 | 1/7/2011 | 21/9/2011 |
| | 21/4/2011 | 11/7/2011 | 1/10/2011 |
| | 1/5/2011 | 21/7/2011 | 11/10/2011 |
| | 11/5/2011 | 1/8/2011 | 21/10/2011 |
| | 21/5/2011 | 11/8/2011 | 1/11/2011 |

| | | | |
|---|---|---|---|
| | 1/6/2011 | 21/8/2011 | 11/11/2011 |
| | 11/6/2011 | 1/9/2011 | 21/11/2011 |
| | 21/6/2011 | 11/9/2011 | - |
| the 2014 summer drought in North China | 1/6/2014 | 11/7/2014 | 21/8/2014 |
| | 11/6/2014 | 21/7/2014 | 1/9/2014 |
| | 21/6/2014 | 1/8/2014 | 11/9/2014 |
| | 1/7/2014 | 11/8/2014 | 21/9/2014 |

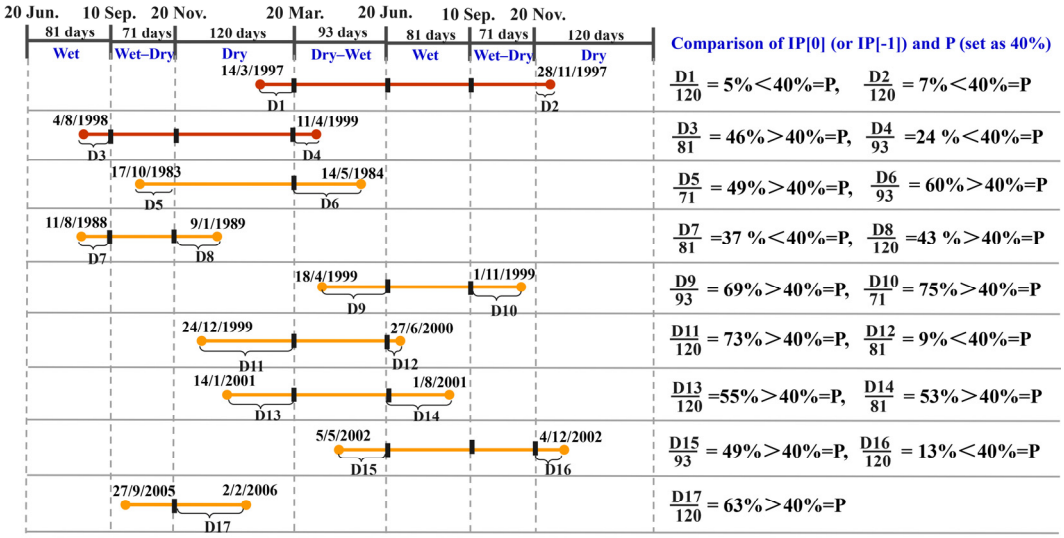


**Figure S1.** Comparison results of P, "IP[0]" and "IP[-1]" for drought processes during 1979–2008 in North China. The start dates of these drought processes have been shifted 90 days in advance. IP represents Intersection Proportion, while P refers to critical Proportion. The terms "IP[0]" and "IP[-1]" express IP associated with the start and end segments, respectively.

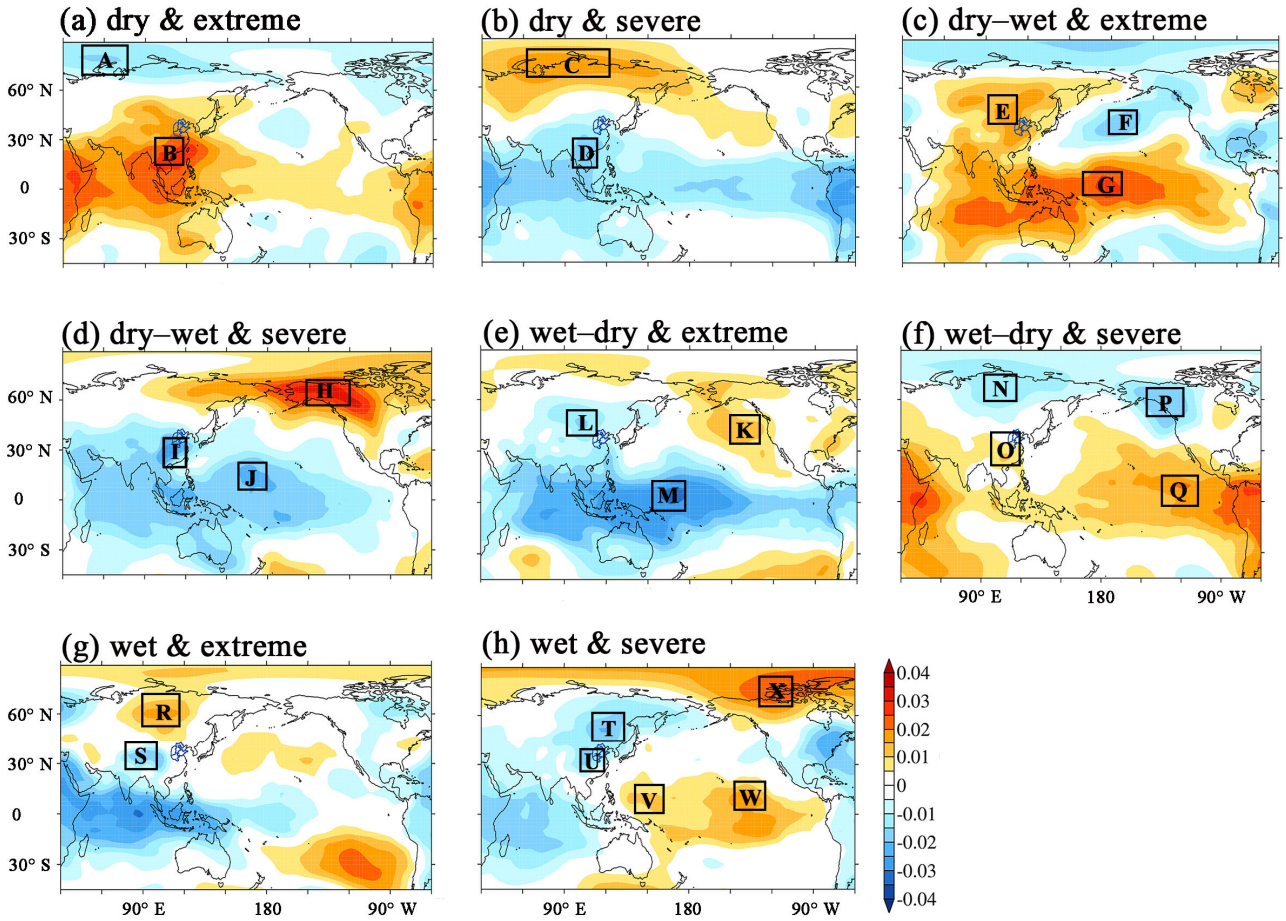


**Figure S2.** Same as Fig. 7, but for Standardized Anomalies (SA) of 200 hPa geo-potential height fields (HGT).

**Table S1.** List of the selected predictors and relevant coefficients during different calibration periods in North China. Types and codes correspond to Table 5.

| Type | Code | Calibration period (1983–) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| SST | 0 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.001 |
| | 1 | -0.005 | -0.004 | -0.004 | -0.003 | -0.003 | -0.002 |
| | 2 | 0.002 | 0.003 | 0.003 | 0.002 | 0.002 | 0.003 |
| | 3 | 0.002 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 |
| | 4 | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 | -0.004 |
| | 5 | - | - | 0.000 | 0.001 | 0.001 | - |
| | 6 | -0.001 | 0.000 | -0.001 | -0.001 | -0.001 | - |
| | 7 | -0.001 | -0.001 | -0.002 | -0.002 | -0.001 | - |
| | 8 | -0.003 | -0.003 | -0.003 | -0.003 | -0.003 | -0.003 |
| | 9 | 0.003 | 0.004 | 0.006 | 0.004 | 0.003 | 0.002 |
| | 10 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.000 |
| | 11 | - | - | -0.002 | -0.001 | - | - |
| | 12 | -0.002 | -0.001 | -0.001 | -0.001 | 0.000 | -0.001 |
| | 13 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | - |
| | 14 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 |
| 200 hPa HGT | 0 | - | - | - | - | - | -0.001 |
| | 1 | 0.003 | 0.002 | 0.003 | 0.003 | 0.003 | 0.002 |
| | 2 | 0.015 | 0.013 | 0.015 | 0.015 | 0.015 | 0.015 |
| | 3 | -0.003 | - | -0.002 | -0.003 | -0.003 | -0.003 |
| | 4 | -0.001 | - | - | - | - | - |
| | 5 | 0.009 | 0.008 | 0.008 | 0.008 | 0.008 | 0.008 |
| | 6 | -0.003 | -0.004 | -0.003 | -0.003 | -0.004 | -0.003 |
| | 7 | 0.015 | 0.013 | 0.014 | 0.014 | 0.014 | 0.014 |
| | 8 | -0.008 | -0.007 | -0.007 | -0.007 | -0.006 | -0.006 |
| | 9 | 0.005 | 0.004 | 0.004 | 0.004 | 0.005 | 0.005 |
| | 10 | 0.009 | 0.009 | 0.008 | 0.008 | 0.008 | 0.009 |
| | 11 | - | -0.002 | - | - | - | - |
| | 12 | 0.003 | 0.003 | 0.003 | 0.003 | 0.002 | 0.001 |
| | 13 | -0.004 | -0.003 | -0.004 | -0.004 | -0.004 | -0.004 |
| 500 hPa HGT | 0 | -0.002 | -0.002 | -0.002 | -0.002 | -0.002 | -0.002 |
| | 1 | -0.009 | -0.008 | -0.008 | -0.008 | -0.008 | -0.008 |
| | 2 | - | - | - | - | - | 0.003 |
| | 3 | 0.007 | 0.007 | 0.007 | 0.007 | 0.007 | 0.005 |
| | 4 | 0.014 | 0.013 | 0.012 | 0.012 | 0.012 | 0.009 |
| | 5 | -0.004 | -0.003 | -0.003 | -0.003 | -0.003 | -0.002 |
| | 6 | 0.016 | 0.015 | 0.016 | 0.016 | 0.016 | 0.013 |
| | 7 | -0.018 | -0.017 | -0.018 | -0.017 | -0.017 | -0.014 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 8 | -0.018 | -0.018 | -0.018 | -0.017 | -0.018 | -0.018 |
| 9 | 0.009 | 0.009 | 0.009 | 0.008 | 0.008 | 0.008 |
| 10 | -0.010 | -0.010 | -0.010 | -0.009 | -0.010 | -0.010 |
| 11 | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 | -0.005 |
| 12 | -0.016 | -0.014 | -0.015 | -0.014 | -0.015 | -0.013 |
| 13 | -0.011 | -0.012 | -0.011 | -0.011 | -0.010 | -0.010 |

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