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LS4P and TPEMIP:

Land Surface and Subsurface Temperatures in the Third Pole May Have Substantial Remote Predictive Capability for Subseasonal to Seasonal Precipitation

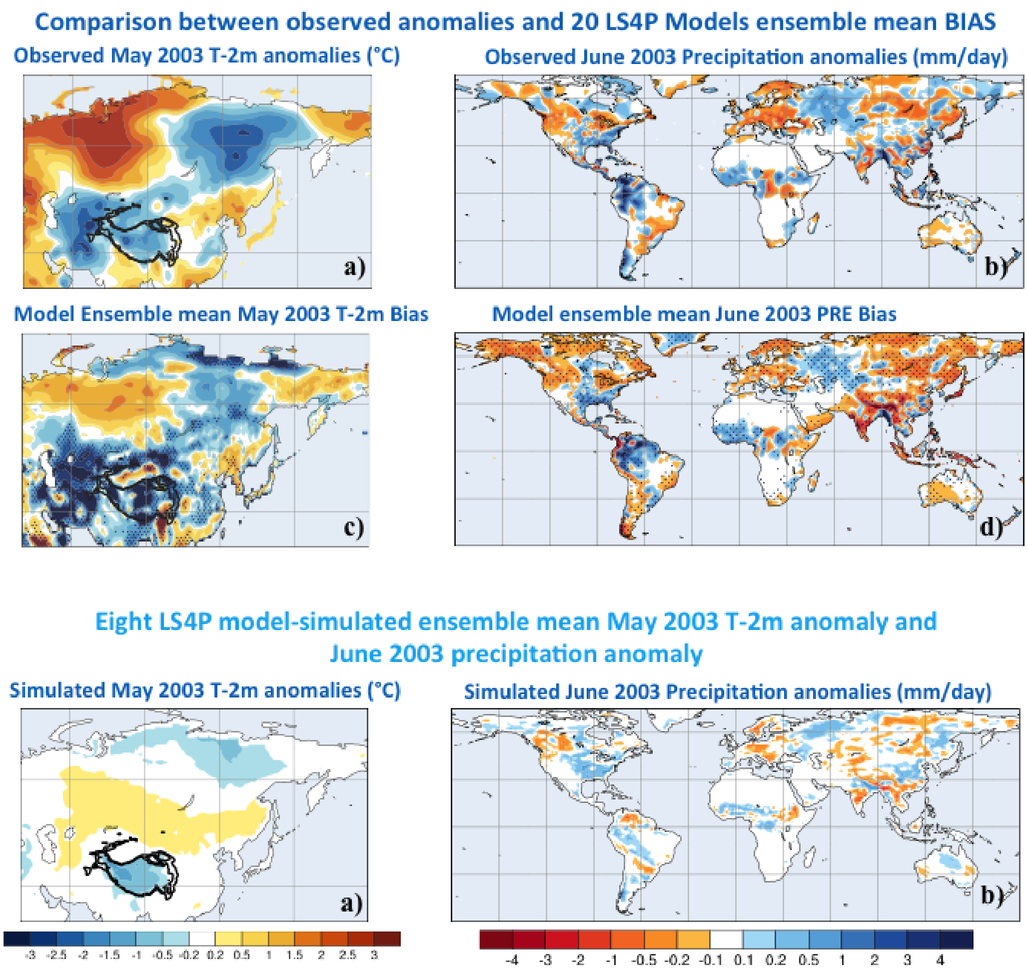

Figure 1 (top). Figure 1. Comparison between observed anomalies and LS4P 20-Model Ensemble mean bias. 1(a) and 1(b) Observed May 2003 T-2m and June 2003 precipitation anomalies, respectively; 1(c) and 1(d) LASP model ensemble mean May 2003 T-2m bias and June 2003 precipitation bias when models have cold bias over the TP. Every model has a large T-2m bias over the Tibetan Plateau area. For models with positive T-2m bias, the T-2m and precipitation biases are multiplied by -1 to be included in the composite. Note: color scales are shown in Figure 2.

Figure 2(a) and 2(b) (bottom). Eight LS4P model ensemble mean for the May 2003 T-2m anomaly and June 2003 precipitation anomalies, respectively, after imposing an LST/SUBT anomaly at the first model integration step.

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Remote Effects of Tibetan Plateau Spring Land Surface Temperature on Global Summer Precipitation and its S2S Prediction: Second Workshop on LS4P and TPEMIP

Nanjing, China
7–9 July, 2019

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After the first workshop on the "Impact of initialized land temperature and snowpack on sub-seasonal to seasonal prediction" (LS4P) and "Third Pole Experiment Multi-Model Intercomparison" (TPEMIP) during the 2018 American Geophysical Union (AGU) Fall Meeting in Washington, D.C., USA (Xue et al., 2019), more observational and modeling studies have supported the concept that the high elevation land surface temperature/subsurface temperature (LST/SUBT) in the Third Pole region (TP) has a substantial remote predictive capability for precipitation at subseasonal to seasonal scales (S2S). Following recommendations from the first LS4P Workshop in Washington, D.C., the second workshop on LS4P and TPEMIP was held at Nanjing University in China from 7–9 July 2019. Its aim was to engage the broader international scientific community in order to review the progress and issues in using Earth system models (ESMs) and regional climate models (RCMs) to a) identify the role of TP LST/SUBT on S2S prediction, b) initiate research on the effect of light absorbing aerosols (LAA) in the snow on the LST anomaly in the TP and on S2S prediction and c) promote and pursue RCM intercomparison TP studies.

Attended by 47 participants from different institutions around the world, the workshop was very productive with five sessions and many inspiring presentations. GEWEX, the Third Pole Experiment (TPE) program, UCLA and Nanjing University sponsored the event. The workshop information and relevant materials can be found on the LS4P project website (*http://ls4p.geog.ucla.edu*). Dr. Tandong Yao, Co-Chair of the TPE program, presented the TPE scientific and societal foci and interdisciplinary research activities in the TP. Dr. Peter Van Oevelen of the International GEWEX Project Office reported on GEWEX's current and planned high mountain activities. Various measurements from TPE and the Third Tibetan Plateau Atmospheric Scientific Experiment (TIPEX-III), as well as satellite remote sensing of components of the water cycle, cryosphere, vegetation, radiation, land surface properties, aerosols and planetary boundary layer in the TP, were presented during the workshop. Dr. Xin Li of the Institute of Tibetan Plateau Research, China, provided an overview of the Big Data Center for the TP, which not only provides various data sets for TP research, but will also host the database that will store the LS4P model products. Dr. Chunxiang Shi of the Chinese National Meteorological Information Center discussed efforts to produce the most up-to-date TP 2-meter temperature data set spanning the past 30+ years with half degree resolution and adequate topographic information. This data set will be used by the LS4P for model evaluation and experimental design.

After the first workshop, the LS4P teams succeeded in accomplishing major tasks assigned during the first phase of activity, and the preliminary analyses were reported. Twenty LS4P ESM groups submitted Task 1 results, which aim to show the relationship between the ESM-produced May 2003 T-2m temperature bias in the TP and the June 2003 precipitation bias. May 2003 was a very cold month in the TP. Figures 1a and 1b (see cover for all figures) show the observed cold T-2m anomaly in the TP in May 2003 and the observed global June 2003 precipitation anomaly patterns, respectively. Every ESM has a large T-2m bias in the TP. Eleven (nine) LS4P models have positive (negative) May 2003 T-2m biases, respectively. For models with positive May T-2m bias, their temperature and precipitation biases are multiplied by -1 to be included in the ensemble mean composite, which is compared with the observed anomalies. Figures 1c and 1d show the simulation biases from the 20-ESM ensemble means for the May 2003 T-2m and June 2003 precipitation, respectively. Both Figure 1a and Figure 1c show that with a cold May TP, the Iranian Plateau to the west of the TP was also cold, and the Eurasian continent shows planetary wave-like warm-cold-warm patterns. The observed 2003 June precipitation anomaly and June precipitation simulation bias as shown in Figures 1b and 1d, respectively, have a remarkable similarity, with the global spatial correlation coefficient being 0.57. In particular, the precipitation bias patterns in the U.S. and southern Canada, northern South America, West Africa, Western and Eastern Europe and the Eurasian Russia continent, South Asia, Indonesia and Australia are generally consistent. East Asia, which was our original focus area (Xue et al., 2018), only constitutes a small portion of all these similar patterns. The agreement between model results and observations from diverse independent sources greatly stimulates our scientific curiosity to extend our assessment of the TP LST/SUBT effect expanding from our original focus on East Asia to the entire globe.

Since every ESM has large positive/negative bias in the TP May T-2m simulation, in order to generate the observed May 2003 T-2m cold anomaly in the TP, each modeling group participating in LS4P Task 3 imposed a LST/SUBT anomaly in the TP at the initial time step aiming to reproduce the observed May 2003 cold anomaly. Due to current models' inability to preserve the surface temperature anomaly, the ESMs still

Participants of the Second LS4P atnd TPEMIP Workshop

have difficulty fully reproducing the observed May 2003 T-2m anomaly. Nevertheless, 10 model groups have submitted their preliminary results for Task 3, which reproduced the observed May 2003 TP T-2m anomaly to various degree of realism. These modeling groups and ESMs include the Bureau of Meteorology Australian Community Climate and Earth-System Simulator version S2 (BOM-ACCESS-S2), the European Centre for Medium-Range Weather Forecasting Integrated Forecasting System (ECMWF-IFS), the Institute of Atmospheric Physics/Chinese Academy of Sciences (IAP/CAS), the Climate Forecast System of the Indian Institute of Tropical Management (CFS_IITM), the Japan Meteorological Agency (JMA)/Meteorological Research Institute (MRI), the Korea Institute of Atmospheric Prediction Systems (KIAPS)/ Korea Meteorological Administration (KMA), the State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics (LASG)/CAS in China, Météo-France and the Centre National de Recherches Météorologiques-Climate Model 6 (CNRM-CM6), the Lawrence Livermore National Laboratory(LLNL)/U.S. Department of Energy (DOE) Energy Exascale Earth System Model (E3SMv1), and the University of California, Los Angeles (UCLA)-Climate Forecast System (CFS)/Simplified Simple Biosphere (SSiB) model in the U.S. Figure 2a shows that after imposing the LST/SUBT anomaly at the first integration time, the model ensemble mean produces a clear but weaker May 2003 T-2m anomaly in the TP. Please note that the results in Figures 2a and 2b correspond to those reported at the workshop, which were based on results from an 8-model mean. The simulated ensemble mean of the June 2003 precipitation anomaly is shown in Figure 2b. By comparing Figures 1b and 2b, the potential hot spots of Tibetan Plateau effects are identified. The areas having the most possible effects from the TP LST/SUBT are: the eastern part of China, South Asia, the continental U.S. and southern Canada, northern South America, West Africa, Western and Eastern Europe and the Eurasian Russian continent, Indonesia and Australia. In Figure 2b, the signals are weaker over some areas than what is shown in Figure 1b, which seems to be consistent with the weaker May T-2m anomaly in the ensemble mean (Figure 2a). We started the LS4P initiative for East Asia. Within the past year, we have found that it turns out to be a global issue. Since the Task 3 test is still ongoing and the model-produced LST anomaly is still weaker than observed, more tests with improved modeling are required to further confirm TP LST/SUBT effects. However, from the preliminary results from Task 1 and Task 3, as well as from Task 2 and other data analyses based on observations (not shown), for the first time it has been suggested that the spring LST/SUBT in the TP may have a global impact on summer precipitation and its S2S prediction. All these findings provide assurance that our approach is in the right direction.

In addition to the LST/SUBT, another factor under investigation in LS4P is the LAA in the snow, which affects the snow melt and spring LST/SUBT in the TP and the monsoon in South and East Asia. A review of measurements and modeling of light-absorbing particles in snow/ice over the TP and their climatic and hydrological impact was reported by Dr. Yun Qian of the Pacific Northwest National Laboratory. Dr. Shichang Kang of the State Key Laboratory of Cryospheric Science at the Chinese Academy of Sciences discussed the sources and temporal and spatial characteristics of some aerosols in the TP. Dr. William Lau of the University of Maryland and Dr. Xiaohong Liu of the University of Wyoming presented the impact of LAA in terms of the impact of snow effects on the monsoon and possible underlying mechanisms.

In addition to the ESM, the RCM is also an important tool in identifying the LST/SUBT effect (Xue et al., 2018). While RCMs have exhibited skillful downscaling ability in S2S regional prediction in different regions of the world, Dr. Guiling Wang of the University of Connecticut showed that modeling of S2S TP weather/climate and associated prediction of rainfall in downwind regions remain scientifically challenging. Drs. Deliang Chen of the University of Gothenburg, Shiori Sugumoto of the Japan Agency of Marine-Earth Science, and Tomonori Sato of Hokkaido University all demonstrated the urgent need to conduct high-resolution RCM downscaling in TP research. Dr. Kun Yang of Tsinghua University has demonstrated that some features, such as complex terrain effects and west-east precipitation oscillation in lake areas caused by lake-air interaction in the TP, can only be produced by fine-resolution RCMs. However, he also pointed out that using high-resolution models requires high computational cost and sometimes is associated with less numerical stability. In addition to RCM downscaling, some promising results from preliminary testing using the RCM with a larger domain to test LST/SUBT effect in the TP were also reported.

In the breakout discussion session, the ESM, RCM and LAA groups discussed issues and future plans for the next stage of research. For the ESM group, modeling groups will work on the improvement of the LST memory simulation to produce a more stable T-2m anomaly close to the observed one. This problem may be rooted in the deficiency in producing proper soil memory and land/atmosphere interaction. To improve the simulation, some technical suggestions were distributed to the ESM group members. Meanwhile, a test of the sea surface temperature effect will be conducted as Task 4 for comparison with the LST/SUBT effect. For the LAA group, the objectives are better understanding of the relationship among LAA deposition, snowmelt/albedo reduction, TP land-atmosphere coupling and Asian summer Monsoon rainfall variability and predictability. The focus will be on the relationship between snow darkening effect and LST/SUBT anomalies, surface energy and water balance (including runoff) and S2S prediction. The LAA experiments will be coordinated with the main LS4P experiments. The RCM group discussed issues in RCM intercomparison and the experiment to test the LST/SUBT remote effect. The RCM domain size and resolution were reviewed, and the RCM model output list is available on the LS4P website. LS4P will complete the first three tasks around the end of 2019. There are two LS4P sessions at the 2019 AGU Fall Meeting along with a mini-workshop in order to discuss the LS4P main results, a special issue in Climate Dynamics, and a possible LS4P article in a high impact journal.

References

Xue, Y., I. Diallo, W. Li, J.D. Neelin, P.C. Chu, R. Vasic, W. Guo, Q. Li, D.A. Robinson, Y. Zhu, C. Fu and C.M. Oaida, 2018. Spring land surface and subsurface temperature anomalies and subsequent downstream late spring-summer droughts/floods in North America and East Asia. *J. Geophys. Res. Atmos.*, 123, 5001-5019. *https://doi.org/10.1029/2017JD028246*.

Xue, Y., A. Boone and T. Yao, 2019. Remote effects of high elevation land surface temperature on S2S precipitation prediction—International Workshop of First Phase of GEWEX/GASS LS4P Initiative and TPEMIP. *GEWEX News*, Vol. 29, No. 1, 14-16. International GEWEX Project Office, Washington, D.C, USA.

The GEWEX Water Vapor Assessment (G-VAP): Summary of the 8th Workshop

Madrid, Spain
13–14 June 2019

Marc Schröder[1], Hélène Brogniez[2], Shu-peng Ho[3] and Participants of the 8th G-VAP Workshop
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The major purpose of G-VAP is to quantify the state-of-the-art in water vapor products being constructed for climate applications, and by this, support the selection process of suitable water vapor products by the GEWEX Data and Analysis Panel (GDAP) for its production of globally-consistent water and energy cycle products. Workshops are carried out on an annual basis to discuss recent findings, to further refine the plan and to implement new activities as well as to draft and consolidate the assessment reports. The 8th G-VAP workshop was hosted by the Agencia Estatal de Meteorologia (AEMET) in Madrid, Spain, and took place on 13 and 14 June 2019. Approximately 20 participants from research institutes [Consiglio Nazionale delle Ricerche (CNR), Laboratoire de Météorologie Dynamique-Institut Pierre Simon Laplace (LMD-IPSL), Karlsruhe Institute of Technology (KIT), Max Planck Institute for Chemistry (MPI-C)], universities (Free U. Berlin, U. of Bremen, U. of Cologne, Colorado State U., U. of Leicester, U. of Miami, U. of Michigan, U. of Paris-Saclay, Vanderbilt U.), from weather services [AEMET, the Danish Meteorological Institute (DMI), Deutscher Wetterdienst (DWD), the National Oceanic and Atmospheric Administration (NOAA)] as well as from space agencies [the European Space Agency (ESA), the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)] attended the workshop. A group photo of workshop participants is shown in figure 1. The presentations of the 8th G-VAP workshop are available at *www.gewex-vap.org*. The main objectives of the 8th workshop were to present updates on water vapor data records and associated retrievals; to present and discuss results from the analysis and the characterization of water vapor products; to discuss the next steps of G-VAP, including potential new activities; to initiate a special issue in a peer-reviewed journal; and to discuss time line changes and the G-VAP data archive.

The workshop started with a welcome address by AEMET and introductory presentations on G-VAP and on the objectives of the meeting. After an overview talk on water vapor in the climate system, the first block of presentations focused on user needs and applications, i.e., from GEWEX and the climate modeling community. Participants discussed gathering feedback from climate modeling groups, including the Climate Modeling User Group of the ESA Climate Change Initiative (CCI) program, on how to intercompare data records in order to provide useful information to them.

A series of presentations provided updates on retrievals, data records and related validation results. Also, uncertainty esti-