Assessing Changes in Eurasian Hydroclimatology

A workshop on 'Eurasian Hydroclimatology: observations, change, attribution, and impacts' was held ***12–14 November 2007*** at the International Arctic Research Center (IARC) at the University of Alaska Fairbanks with support from NASA's Hydrology Program and NSF. This workshop contributed to and built on the goals and achievements of existing efforts such as the International Polar Year (IPY), the Northern Eurasia Earth Science Partnership Initiative (NEESPI), the Global Energy and Water Cycle Experiment (GEWEX), Sustained Arctic Observing Networks (SAON), International Study of Arctic Change (ISAC), and Fresh Water Integration (FWI). Nearly half of the participants were early career scientists.

Observations of increasing discharge, thawing permafrost at the discontinuous margin, and trends of incoming radiation over Eurasia have prompted researchers to consider the mechanisms behind hydroclimatological change in the region. Limitations of these observations include those introduced by biased or malfunctioning sensors, sparse networks with spatial heterogeneity, immature satellite algorithms, and poorly parameterized/weakly constrained reanalyses. However, future availability of water and climate resources, as well as the impact of changes in water storage on land and fluxes to the ocean and atmosphere, are likely to have a very important impact on human in the coming decades. Because of the above measurement challenges and complex feedbacks in the climate system, identifying all of the changes and attributing them to specific mechanisms is nontrivial.

This workshop brought together experts in field observations (permafrost, snow, hydrology), remote sensing (of climate and hydrology), and both global and catchment-scale modeling to discuss changes in climate and the water cycle over the Eurasian continent. Scientists from the CliC and GEWEX communities contributed to the workshop with the latest results related to the scope of these two WCRP core projects.

The workshop objectives were not only to describe observed changes in the Eurasian hydroclimatological system over the instrumental period from stations, gridded data, reanalyses and remote sensing, but also attribute changes to specific physical processes in both the regional and global domain and discuss the implications of these changes.

The question of the relative roles of regional land-atmosphere interactions versus large-scale atmospheric circulation is difficult to answer with direct observations or existing atmospheric reanalyses. High quality regional reanalyses using state-of-the-art models are necessary to tease apart these processes. Despite the uncertainty about the relative roles of regional feedbacks and hemispheric circulation, it is clear that many processes including changes in surface air temperatures and precipitation are linked to large scale advection of air masses from lower latitudes, even deep in the interior of the Eurasian continent.

Long-term changes in precipitation and evapotranspiration are likely contributors to changes in runoff, but detection is nearly impossible with biased gauge-based networks (precipitation) or sparse pan-evaporation records. Changes in subsurface storage are likely important contributors to changes in areas outside the continuous permafrost zone and are consistent with observed changes in aufeis distribution. Where subsurface storage has increased and is connected, it is likely contributing to river runoff. Where subsurface

storage has increased via talik formation, but is not connected, it has little ability to contribute to baseflow runoff. Increases in active layer depth may enhance near surface water storage that could contribute to evapotranspiration and influence runoff partitioning.

Recent research progress include:

- Freshwater runoff from rivers may not be the crucial factor for meridional overturning circulation in the North Atlantic. Condition of Greenland ice cap is likely more important.
- Detailed factor analysis suggests that changes in subsurface storage of water, hydro-engineering, and precipitation have differing relative influences over runoff in individual basins across Eurasia.
- Calculations using observed corrected-gauge precipitation and standard atmospheric reanalyses show inconsistencies between precipitation and runoff trends that are more likely the cause of errors in these products rather than changes in evapotranspiration or storage.
- Anomalies in Eurasian snow cover extent may contribute to troposphere-stratosphere couplings and large-scale circulation of the atmosphere.
- Dynamic remote sensing algorithms show promise for better estimating snow water equivalent on the ground. New snowfall reconstructions may circumvent gauge-based measurement problems.

More details about the workshop results are available online at: http://www.iarc.uaf.edu/workshops/2007/eurasian_hydro_07/extended_report.php

—JESSICA CHERRY, International Arctic Research Center and Arctic Region Supercomputing Center, University of Alaska Fairbanks and WORKSHOP PARTICIPANTS