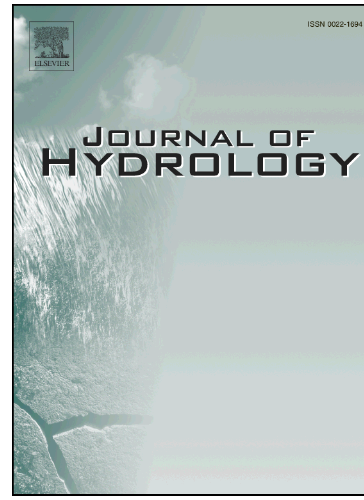
## Accepted Manuscript




# Long-Term Patterns of Air Temperatures, Daily Temperature Range, Precipitation, Grass-Reference Evapotranspiration and Aridity Index in the USA Great Plains: Part II. Temporal Trends

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PII: S0022-1694(16)30359-6
DOI: http://dx.doi.org/10.1016/j.jhydrol.2016.06.008
Reference: HYDROL 21326

To appear in: *Journal of Hydrology*

Please cite this article as: Kukal, M., Irmak, S., Long-Term Patterns of Air Temperatures, Daily Temperature Range, Precipitation, Grass-Reference Evapotranspiration and Aridity Index in the USA Great Plains: Part II. Temporal Trends, *Journal of Hydrology* (2016), doi: http://dx.doi.org/10.1016/j.jhydrol.2016.06.008

# LONG-TERM PATTERNS OF AIR TEMPERATURES, DAILY TEMPERATURE RANGE, PRECIPITATION, GRASS-REFERENCE EVAPOTRANSPIRATION AND ARIDITY INDEX IN THE USA GREAT PLAINS: PART II. TEMPORAL TRENDS

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***Abstract:*** *Detection of long-term changes in climate variables over large spatial scales is a very important prerequisite to the development of effective mitigation and adaption measures for the future potential climate change and for developing strategies for future hydrologic balance analyses under changing climate. Moreover, there is a need for effective approaches of providing information about these changes to decision makers, water managers and stakeholders to aid in efficient implementation of the developed strategies. This study involves computation, mapping and analyses of long-term (1968-2013) county-specific trends in annual, growing-season ($1^{st}$ May- $30^{th}$ Sept.) and monthly air temperatures [(maximum ($T_{max}$), minimum ($T_{min}$) and average ($T_{avg}$)], daily temperature range (DTR), precipitation, grass reference evapotranspiration ($ET_o$) and aridity index (AI) over the USA Great Plains region using datasets from over 800 weather station sites. Positive trends in annual $T_{avg}$, $T_{max}$ and $T_{min}$, DTR, precipitation, $ET_o$ and AI were observed in 71, 89, 85, 31, 61, 38 and 66% of the counties in the region, respectively, whereas these proportions were 48, 89, 62, 20, 57, 28, and 63%, respectively, for the growing-season averages of the same variables. On a regional average basis, the positive trends in growing-season $T_{avg}$, $T_{max}$ and $T_{min}$, DTR, precipitation, $ET_o$ and AI were 0.18°C decade$^{-1}$, 0.19°C decade$^{-1}$, 0.17°C decade$^{-1}$, 0.09°C decade$^{-1}$, 1.12 mm yr$^{-1}$, 0.4 mm yr$^{-1}$ and 0.02 decade$^{-1}$, respectively, and the negative trends were 0.21°C decade$^{-1}$, 0.06°C decade$^{-1}$, 0.09°C decade$^{-1}$, 0.22°C decade$^{-1}$, 1.16 mm yr$^{-1}$, 0.76 mm yr$^{-1}$ and 0.02 decade$^{-1}$, respectively. The temporal trends were highly variable in space and were appropriately represented using monthly, annual and growing-season maps developed using Geographic Information System (GIS) techniques. The long-term and spatial and temporal information and data for a large region provided in this study can be used to analyze county-level trends in important climatic/hydrologic variables in context of climate change, water resources, agricultural and natural resources response to climate change.* ***Keywords.*** *Climate variables, spatial, temporal, air temperature, daily temperature range, precipitation, aridity index, evapotranspiration.*

## INTRODUCTION

The Fourth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC, 2007) established that there has been a warming effect in our climate system during the recent decades. Moreover, Fifth Assessment Report (IPCC, 2013) stated that for the average annual Northern Hemisphere temperatures, the period of 1983-2012 was the warmest 30-year span over the last 800 years. During the last century, the air temperature at the earth's surface rose by 0.74$^{o}$C and this increase was attributed to the increase in the concentrations of the greenhouse gases in the atmosphere.