NPP Grassland: Shortandy, Kazakhstan, 1977-1980, R1

Get Data

Revision date: May 1, 2015

Summary:

This data set provides two data files in text format (.txt). One file contains biomass measurements and cumulative ANPP calculations made between 1977 and 1980 on a dry continental steppe at Shortandy Biological Station in Kazakhstan. The second file contains monthly and annual climate data for the study site for the period 1976-1980.

Measurements of above- and below-ground live and dead matter were made at biweekly to monthly intervals during the growing season at Shortandy from 1975 to 1980. Cumulative ANPP estimates are calculated from these measurements. The study site is one of eight major grassland types of Eurasia which encompass an extremely wide climatic gradient in the direction of increasing maximum summer temperatures and continentality and decreasing precipitation in a north-west to the south-east band of steppes in the European and Asian parts of the former USSR (Commonwealth of Independent States). Shortandy represents the semiarid continental grass-forb steppe found on the southern chernozem soils of northern Kazakhstan. The site had annual mean maximum/minimum temperatures of 27.7/-24.6 degrees C and annual mean precipitation of 349.8 mm for the period 1976-1980.

Revision Notes: Only the documentation for this data set has been modified. The data files have been checked for accuracy and are identical to those originally published in 1996.

Figure 1. One of the last square kilometers of "virgin" typical steppe in northern Kazakhstan, at the Shortandy grassland study site, pictured at the beginning of the growing season. (Note the substantial amount of standing dead matter and litter remaining from the previous year. The instruments shown are a Bowen Ratio - Energy Balance monitoring system. Photograph taken mid-May 1988 by Dr. Nicanor Saliendra, USAID Global Livestock-Collaborative Research Support Program, Utah State University, USA).

Additional Documentation

The NPP data collection contains field measurements of biomass, estimated NPP, and climate data for terrestrial grassland, tropical forest, temperate forest, boreal forest, and tundra sites worldwide. Data were compiled from the published literature for intensively studied and well-documented individual field sites

and from a number of previously compiled multi-site, multi-biome data sets of georeferenced NPP estimates. The principal compilation effort (Olson et al., 2001) was sponsored by the NASA Terrestrial Ecology Program. For more information, please visit the NPP web site at http://daac.ornl.gov/NPP/npp_home.shtml.

Data Citation:

Cite this data set as follows:

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Table of Contents:

1. Data Set Overview:

Project: Net Primary Productivity (NPP)

Long-term ecological research at grasslands within the former USSR collected a large amount of data on phytomass, productivity and element cycling, together with climatic and soil regimes for various types of grassland ecosystems. These grasslands are found in different natural "continentality" climatic zones in the direction of increasing maximum summer temperatures, decreasing precipitation north-west to the south-east. The grassland types range from the luxuriant highly productive meadow-steppes of Central Russia to the ultracontinental steppes of Central Asia and the arid ephemeral grasslands in the Middle-Asian republics of the former USSR.

The results of the USSR studies are mostly reported in the Russian literature but were summarized and used more recently by Gilmanov et al. (1997) to assess grassland differences and CENTURY model robustness across this wide environmental gradient.

Measurements of above- and below-ground live and dead matter were made at biweekly to monthly intervals during the growing season (April-September) at Shortandy from 1977 to 1980. Cumulative ANPP estimates are calculated from these measurements. Climate data for Shortandy were recorded for the period 1976-1980. Data for this study site were originally reported [in Russian] in Titlyanova et al. (1984) and Shatokhina (1980; 1988).

Averaged over the time series, above-ground live phytomass, standing dead, and litter biomass were estimated to be 142, 152, and 376 g/m2 (dry matter weight), respectively, while below-ground phytomass and mortmass were estimated to be 1,686 and 1,747 g/m2 (dry matter weight), respectively (Table 3, Gilmanov et al., 1997). ANPP was estimated to be 335 g/m2/yr and BNPP was estimated to be 1,745 g/m2/yr (Table 3, Gilmanov et al., 1997). These estimates agree with values published in Scurlock and Olson (2013). However, ANPP and BNPP estimates published in Olson et al. (2013a, b) are much lower due to different calculation methods. When converted to grams of carbon per meter square per year, ANPP and BNPP reported in Olson et al. (2013a, b) are 65 and 106 gC/m2/yr, respectively.

2. Data Description:

Spatial Coverage

Site: Shortandy, Kazakhstan

Site Boundaries: (All latitude and longitude given in decimal degrees)

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Elevation (m)
Shortandy, Kazakhstan	71.0	71.0	51.67	51.67	367

Spatial Resolution

Information not available

Temporal Coverage

1975-1980

Temporal Resolution

Biweekly to monthly harvests of biomass during the growing season (April-September) of each year

Data File Information

Table 1. Data file descriptions

FILE NAME	TEMPORAL COVERAGE	FILE CONTENTS
shr_npp.txt	1977/05/22-1980/07/31	Above- and below-ground biomass and cumulative ANPP data for the Shortandy grassland site
shr_cli.txt	1976/01/01-1980/12/31	Climate data from a weather station near the Shortandy grassland site

NPP Data. Biomass and ANPP estimates are provided in one text file (.txt format) (Table 2). The variable values are delimited by semicolons. The first 18 lines are metadata; data records begin on line 19. Missing data are denoted by the value -999.9. All biomass units are expressed in g/m2 (dry matter weight). Cumulative ANPP units are expressed as g/m2 per sampling period (dry matter weight).

Table 2. Column headings in NPP file.

COLUMN HEADING	DEFINITION	UNITS
Site	Site where data were gathered (code refers to site identification)	text
Treatmt	Long term management of site (code refers to treatment described in metadata in data file)	
Year	Year in which data were collected	yyyy
Mn	Month in which data were collected	mm
Dy	Day on which data were collected	dd
Tyear	Date in decimal year (year plus the Julian date divided by 365)	numeric
AGbiomass	Above-ground biomass	g/m2
Stdead	Standing dead matter	
Litter	Litter found above ground	
AGtotmatter	Total above-ground biomass (live + dead + litter)	
BGbiomass	Below-ground live biomass	
BGdead	Below-ground dead biomass	
BGtotmatter	Total below-ground biomass (live + dead)	
CUMANPP	Cumulative above-ground net primary production	g/m2/per sampling date

Sample NPP Data Record

```
shr;lngtrm ;1977;05;22;1977.390; 71.0; 150.0; 450.0; 671.0;1210.0;1100.0;2310.0; 48.0
shr;lngtrm ;1977;06;24;1977.480; 98.0; 119.0; 400.0; 617.0;2090.0;1258.0;3348.0; 98.0
shr;lngtrm ;1977;07;12;1977.530; 134.0; 105.0; 398.0; 637.0;2060.0;1062.0;3122.0; 116.0
shr;lngtrm ;1977;08;03;1977.590; 121.0; 101.0; 406.0; 628.0;2660.0; 725.0;3385.0; 134.0
shr;lngtrm ;1977;08;25;1977.650; 70.0; 206.0; 392.0; 668.0;2223.0; 953.0;3176.0; 188.0
shr;lngtrm ;1977;09;16;1977.710; 40.0; 119.0; 352.0; 511.0;1620.0;1192.0;2812.0; 286.0 ...
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Climate Data. Climate data are provided in one text file (.txt format). The first 18 lines are metadata; data records begin on line 19. The variable values are delimited by semicolons. There are no missing values.

Sample Climate Data Record

```
Site;Temp;Parm; Jan; Feb; Mar; Apr; May; Jun; Jul; Aug; Sep; Oct; Nov; Dec; Year

shr;mean;prec; 16.6; 14.4; 11.4; 32.0; 37.6; 47.4; 53.2; 37.4; 19.2; 29.2; 26.0; 25.4; 349.8
shr;mean;tmax;-15.5;-11.3; -3.0; 8.2; 21.2; 26.7; 27.0; 23.6; 20.3; 7.4; -1.1; -7.6; 27.7
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shr;mean;tmin;-24.5;-21.6;-13.8; -1.6; 5.5; 11.7; 12.7; 9.3; 5.9; -2.8; -5.5;-17.4; -24.6
shr;numb;prec; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0
shr;numb;tmax; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0
shr;numb;tmin; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0; 5.0
shr;stdv;prec; 4.8; 4.7; 5.9; 37.0; 18.2; 17.8; 30.5; 41.9; 6.1; 16.2; 14.5; 8.9; 65.9
shr;stdv;tmax; 4.3; 2.1; 3.5; 4.3; 2.7; 2.5; 0.3; 0.4; 2.2; 1.5; 2.2; 2.4; 1.5
shr;stdv;tmin; 4.1; 2.3; 3.5; 2.7; 2.9; 2.5; 0.2; 0.4; 2.2; 1.4; 9.5; 1.8; 4.0
shr;1976;prec; 20.0; 18.0; 20.0; 11.0; 26.0; 48.0; 31.0; 7.0; 21.0; 19.0; 15.0; 14.0; 250.0
shr;1976;tmax;-13.7;-11.9; -6.9; 9.8; 21.4; 27.0; 26.7; 23.7; 18.0; 7.2; -3.7;-10.4; 27.0
shr;1976;tmin;-22.9;-22.4;-17.7; -2.0; 4.3; 11.2; 12.5; 9.2; 3.5; -3.0;-12.3;-19.9; -22.9
…

Where,
Temp (temporal) - specific year or long-term statistic:
  mean = mean based on all years
  numb = number of years
  stdv = standard deviation based on all years
Parm (parameter):
  prec = precipitation for month or year (mm)
  tmax = mean maximum temperature for month or year (C)
  tmin = mean minimum temperature for month or year (C)
```

3. Data Application and Derivation:

Data on biomass dynamics and productivity were recently assembled and checked as part of a series of grassland data sets covering a wide range of climate and "continentality" (increasing maximum summer temperatures, decreasing precipitation) from the north-west to the south-east in the Commonwealth of Independent States (former USSR) (Gilmanov et al., 1997). These grasslands represent a wide environmental gradient from the luxuriant highly productive meadow-steppes of Central Russia to the ultracontinental steppes of Central Asia and the arid ephemeral grasslands in the Middle-Asian republics of the former USSR. The field data from these study sites were used by Gilmanov et al. (1997) to assess grassland differences and CENTURY model robustness.

Grassland biomass dynamics data are provided for comparison with models and estimation of NPP. Climate data are provided for use in driving ecosystem/NPP models.

4. Quality Assessment:

NPP of grasslands is subject to a number of different methods of estimation from biomass data, some of which may be inappropriate for particular biome types. Methodology of estimation/calculation needs to be taken into account, as well as methodology of measurement, when making comparisons between different regions. Errors in biomass measurement may also occur between different study sites. For short time series of data it may be assumed that measurement methodology remains consistent; however, over very long time series changes in staff, tools, etc. may lead to "calibration" errors.

The Shortandy site has a short time series of phytomass observations (1977-1979). However, there is good agreement between the above-ground live phytomass dynamics of this ecosystem and simulations by the CENTURY model, and the representation of the dynamics of the above-ground mortmass is quite satisfactory. The good performance of the CENTURY model on this data set is partly due to the fact that the natural conditions of the dry steppe at Shortandy are very similar to the shortgrass prairie of Colorado, for which the model was initially developed.

Field data on live and dead below-ground phytomass dynamics at the Shortandy dry continental steppe were also compared to CENTURY modeling results. Calculations of the average amounts of live and dead below-ground phytomass and characteristics of seasonal dynamics (especially the late summer peak on the live root phytomass) were in close agreement.

5. Data Acquisition Materials and Methods:

Site Information

The Shortandy study site is located in the Shortandy Research Station near the city of Aqmola (former name Akmolinsk). It is a dry continental steppe that is typically grazed annually. The grassland is representative of the semiarid continental grass-forb steppes that are found on the southern chernozem soils of northern Kazakhstan (Titlyanova et al., 1984; Shatokhina, 1980; 1988). The dominant plant species are Stipa zalesskyi, Helicotrichon desertorum, Stipa lessingiana, Peucedanum alsaticum, Jurinea multiflora, Salvia stepposa, Artemisia dracunculus, Galium verum. Species richness is 12-20 species per 1-m2 and 42-62 species per 100-m2.

Table 3. Site characteristics

Description	Values
mean annual precipitation	351 mm

mean monthly minimum temperature	-24.5 degrees C (Jan)
mean monthly maximum temperature	27.0 degrees C (July)
vegetation type	ultracontinental semiarid / cryoarid steppe
dominant species	Stipa zalesskyi (C3)
historical long-term management regime	annual grazing
max above-ground live biomass (typical month)	142 g/m2 (July)
soil type	calciboroll/calciustosol
soil pH	7.4
soil texture (sand/ silt/ clay)	0.36 / 0.27 / 0.37
soil carbon content	5,600 g/m2 (0-20 cm)
soil nitrogen content	500 g/m2 (0-20 cm)

Methods

Methodological aspects of field experimental studies of biomass and production of grassland ecosystems in the Commonwealth of Independent States (former USSR) were summarized by Titlyanova (1988) [in Russian]. The methods of field measurements of above-ground and below-ground biomass in Russian grasslands are based on the harvest technique and with respect to sampling area, replication, etc., are very close to the methods used by western ecologists during the International Biological Programme (IBP) studies (e.g., Milner and Hughes, 1968; Sims and Coupland, 1979). The Russian approach to estimation of the annual production of grassland plant communities (with subdivision on above- and below-ground components) is based on a calculation procedure utilizing data of repeated sampling (usually biweekly) during the season of live, standing dead and litter fractions of phytomass. This method of calculation gives the estimates of production which are 1.6 to 2.0 times higher than the seasonal maximum of the standing crop of the corresponding phytomass fraction (Titlyanova, 1988).

This data set is part of a series of grassland data sets assembled and checked by Dr. Tagir Gilmanov (Gilmanov et al., 1997) from primary sources originally reported [in Russian] in Titlyanova et al. (1984) and Shatokhina (1980; 1988). Noteworthy are the quantitative studies of below-ground phytomass dynamics and production made through repeated soil monolith sampling by Titlyanova (1977) and modified by Shatokhina (1980; 1988).

6. Data Access:

This data set is available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

Data Archive:

Web Site: http://daac.ornl.gov

Contact for Data Center Access Information:

E-mail: uso@daac.ornl.gov
Telephone: +1 (865) 241-3952

7. References:

Gilmanov, T.G., W.J. Parton and D.S. Ojima. 1997. Testing the CENTURY ecosystem level model on data sets from eight grassland sites in the former USSR representing a wide climatic/soil gradient. Ecological Modelling 96: 191-210. doi: 10.1016/S0304-3800(96)00067-1

Milner, C., and R.E. Hughes. 1968. Methods for the Measurement of the Primary Production of Grassland. IBP Handbook No.6. Blackwell, Oxford.

Olson, R.J., K.R. Johnson, D.L. Zheng, and J.M.O. Scurlock. 2001. Global and Regional Ecosystem Modeling: Databases of Model Drivers and Validation Measurements. ORNL Technical Memorandum TM-2001/196. Oak Ridge National Laboratory, Oak Ridge, Tennessee, U.S.A.

Olson, R.J., J.M.O. Scurlock, S.D. Prince, D.L. Zheng, and K.R. Johnson (eds.). 2013a. NPP Multi-Biome: Global Primary Production Data Initiative Products, R2. Data set. Available on-line [http://daac.ornl.gov] from the Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/617

Olson, R.J., J.M.O. Scurlock, S.D. Prince, D.L. Zheng, and K.R. Johnson (eds.). 2013b. NPP Multi-Biome: NPP and Driver Data for Ecosystem Model-Data Intercomparison, R2. Data set. Available on-line [http://daac.ornl.gov] from the Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/615

Shatokhina, N.G. 1980. Production process and the cycling of nitrogen and ash elements in the meadow steppes and wheat agrocoenoses at Baraba. Ph.D. thesis. Tomsk. 19 pp. (In Russian).

Shatokhina, N.G., 1988. The authentic steppe of Kazakhstan, Tselinograd region, pp. 32-42. IN: Ilyin, V.B. (ed.). Biological productivity of herbaceous ecosystems. Nauka, Moscow. (In Russian).

Scurlock, J.M.O., and R.J. Olson. 2013. NPP Multi-Biome: Grassland, Boreal Forest, and Tropical Forest Sites, 1939-1996, R1. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.doi:10.3334/ORNLDAAC/653

Sims, P.L., and R.T. Coupland. 1979. Producers, pp. 49-72. IN: Coupland, R.T. (ed.). Grassland Ecosystems of the World: Analysis of Grassland and Their Uses. Cambridge University Press. 432 pp.

Titlyanova, A.A. 1977. Biological cycling of carbon in herbaceous biogeocoenoses. Nauka, Novosibirsk. 221 pp. (In Russian).

Titlyanova, A.A. 1988. Methodology and methods of studying of the production-destruction processes in herbaceous ecosystems, pp. 3-10. IN: Ilyin, V.B. (ed.). Biologicheskaya produktivnost' travyanykh ecosistem [Biological productivity of herbaceous ecosystems]. Nauka, Novosibirsk (In Russian).

Titlyanova, A.A., Kiryushin, V.I., Okhin'ko, I.P. et al., 1984. Agrocoenoses of the steppe zone. Nauka, Novosibirsk., 247 pp. (In Russian).