# NPP Grassland: Tuva, Russia, 1978-1985, 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 above-ground net primary production (ANPP) estimates made between 1978 and 1985 at an ultracontinental steppe at the Tuva Research Station in Russia. The second file contains monthly and annual climate data for the study site for 1976-1985.

Monthly measurements of above-ground live phytomass, standing dead, and litter biomass were made during each growing season (May-August) of the eight-year study period. Harvests of below-ground biomass were made at the end of the growing season in some years. A year-end measurement of above-ground biomass (particularly standing dead and litter) was also made in 1980. 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). Tuva, on light-textured chestnut soils, is a semiarid/cryoarid steppe with annual mean maximum/minimum temperatures of 26.6/-35.1 C (1976-1979) and annual mean precipitation of 285.3 mm (1976-1985).

Averaged over the time series, above-ground live phytomass, standing dead, and litter biomass were estimated to be 103, 57, and 38 g/m$^2$ (dry matter weight), respectively, while below-ground phytomass and mortmass were estimated to be 725 and 3,915 g/m$^2$ (dry matter weight), respectively. ANPP was estimated to be 150 g/m$^2$/yr. BNPP was not estimated in this data set.

**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. Southern slopes of the Eastern Tannu-Ola Range, near the Tuva grassland site, Russia. (Note: the vegetation cover is typical of the forest-steppe altitudinal belt. Photograph taken in August 1985 by Dr. Ivan Vtorov, Institute of Geography, USSR Academy of Science, Moscow).

## 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:**

Gilmanov, T.G. 2015. NPP Grassland: Tuva, Russia, 1978-1985, R1. Data set. Available on-line [http://daac.ornl.gov] from the Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/155

This data set was originally published as:

Gilmanov, T.G. 1996. NPP Grassland: Tuva, Russia, 1978-1985. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

## 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 ultra continental 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.

The Tuva data set contains biomass measurements and cumulative ANPP estimates made between 1978 and 1985. Monthly measurements of above-ground live biomass, standing dead matter, and litter were made by harvest methods during each growing season (May-August) of the eight-year study period. Harvests of below-ground biomass were made at the end of the growing season in some years. A year-end measurement of above-ground biomass (particularly standing dead and litter) was also made in 1980. Monthly and annual mean climate records for maximum/minimum temperatures are available for 1976-1979. Monthly and annual records for precipitation amount are available for 1976-1985. Data for the Tuva site were originally reported [in Russian] in Nosin (1963), Volkovincer (1978), Gorshkova (1982; 1986), Stebayev et al. (1964), Stebayev (1976; 1986), and Stebayev and Pshenicyna (1984).

Averaged over the time series, above-ground live phytomass, standing dead, and litter biomass were estimated to be 103, 57, and 38 g/m$^2$ (dry matter weight), respectively, while below-ground phytomass and mortmass were estimated to be 725 and 3,915 g/m$^2$ (dry matter weight), respectively (Table 1, Gilmanov et al., 1997). ANPP was estimated to be 150 g/m$^2$/yr (Table 1, Gilmanov et al., 1997) which agrees with values published in Scurlock and Olson (2013). BNPP was not estimated in this data set or in Gilmanov et al. (1997). Using different calculation methods, Olson et al. (2013a, b) report much lower ANPP and BNPP values of 36 and 101 gC/m$^2$/yr, respectively, for the Tuva study site.

## 2. Data Description:

**Spatial Coverage**

**Site:** Tuva, Russia

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

| Site (Region) | Westernmost Longitude | Easternmost Longitude | Northernmost Latitude | Southernmost Latitude | Elevation (m) |
|---|---|---|---|---|---|
| Tuva, Russia | 94.42 | 94.42 | 51.83 | 51.83 | 800 |

**Spatial Resolution**

Information not available

**Temporal Coverage**

May 1978 to August 1985

**Temporal Resolution**

Monthly measurements of above-ground biomass were made during each growing season (May-August) of the eight-year study period. Additional end-of-the-growing-season below-ground biomass measurements were made in some years as was a year-end measurement of above-ground biomass (particularly standing dead and litter) in 1980.

**Data File Information**

**Table 1. Data file descriptions**

| FILE NAME | TEMPORAL COVERAGE | FILE CONTENTS |
|---|---|---|
| tva_npp.txt | 1978/05/15-1985/08/30 | Above- and below-ground biomass data and cumulative ANPP estimates for the Tuva grassland site |
| tva_cli.txt | 1976/01/01-1979/12/31 | Climate data from the Chapingo weather station 5-km from the grassland study site |
| | 1976/01/01-1985/12/31 | Precipitation data from a weather station near the Tuva grassland site |

**NPP Data.** Biomass and ANPP estimates are provided in one text file (.txt format) (Table 1). 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 $g/m^2$ (dry matter weight). Cumulative ANPP units are expressed as $g/m^2$ 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 biomass | |
| Litter | Litter found above ground | |
| AGtotmatter | Total above-ground biomass (live + dead + litter) | |
| BGbiomass | Below-ground live biomass | |
| ANPP | Above-ground net primary production [1] | g/m2/sampling date |
| CUMANPP | Cumulative above-ground net primary production | |

Note: [1]ANPP results not available. Parameter included for format consistency with other NPP data sets.

Sample NPP Data Record

```
tva;lngtrm ;1978;05;15;1978.370; 10.0; 80.0; 130.0; 220.0;-999.9;-999.9; 91.0
tva;lngtrm ;1978;06;07;1978.430; 101.0; 60.0; 104.0; 265.0;-999.9;-999.9; 91.0
tva;lngtrm ;1978;07;08;1978.520; 93.0; 66.0; 73.0; 232.0;-999.9;-999.9; 101.0
tva;lngtrm ;1978;08;05;1978.590; 85.0; 62.0; 95.0; 242.0; 738.0;-999.9; 101.0
tva;lngtrm ;1979;04;28;1979.320; 24.0; 82.0; 8.0; 114.0;-999.9;-999.9; 60.8
tva;lngtrm ;1979;06;07;1979.430; 84.4; 20.0; 70.4; 174.8;-999.9;-999.9; 60.8
tva;lngtrm ;1979;06;23;1979.480; 78.4; 16.0; 73.2; 167.6;-999.9;-999.9; 75.2
tva;lngtrm ;1979;07;07;1979.520; 81.6; 27.2; 64.0; 172.8;-999.9;-999.9; 89.6
tva;lngtrm ;1979;08;08;1979.600; 82.0; 30.0; 64.0; 176.0; 725.0;-999.9; 89.6 ...
```

**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. Monthly and annual mean climate records for maximum/minimum temperatures are available for 1976-1979 (with no records for 1980-1985). Records for precipitation are available for 1976-1985.

Sample Climate Data Record

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

tva;mean;prec; 10.2; 6.3; 4.7; 11.8; 34.8; 46.6; 60.3; 55.4; 23.7; 6.9; 13.4; 11.2; 285.3
tva;mean;tmax;-24.5;-16.1; -3.5; 9.4; 17.7; 26.6; 25.9; 22.6; 18.1; 7.8;-10.3;-19.3; 26.6
tva;mean;tmin;-34.9;-29.5;-18.5; -3.3; 2.8; 12.2; 12.1; 8.8; 3.5; -5.9;-20.1;-29.1; -35.1
tva;numb;prec; 10.0; 10.0; 10.0; 10.0; 10.0; 10.0; 10.0; 10.0; 10.0; 10.0; 10.0; 10.0; 10.0
tva;numb;tmax; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0
tva;numb;tmin; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0; 4.0
tva;stdv;prec; 6.2; 2.6; 3.7; 7.3; 20.0; 25.6; 27.3; 15.2; 8.4; 5.1; 12.0; 3.4; 87.9
tva;stdv;tmax; 4.4; 3.7; 1.2; 1.6; 1.1; 1.8; 2.1; 1.5; 1.0; 2.1; 3.2; 1.2; 1.8
tva;stdv;tmin; 4.4; 3.7; 1.2; 0.7; 0.7; 1.8; 2.4; 1.5; 1.0; 2.1; 3.2; 1.2; 4.3
tva;1976;prec; 3.0; 12.7; 7.7; 20.1; 75.1; 41.6; 53.1; 70.1; 17.4; 19.2; 16.8; 11.0; 347.8
tva;1976;tmax;-20.6;-12.5; -4.8; 8.5; 16.1; 24.2; 22.7; 20.5; 16.7; 4.6;-14.0;-18.9; 24.2
tva;1976;tmin;-31.0;-25.9;-19.8; -3.9; 1.9; 9.8; 8.7; 6.7; 2.1; -9.0;-23.8;-28.7; -31.0
…
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 ultra continental 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:

Net primary production 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 Tuva ultracontinental steppe data were compared to CENTURY model dynamics (Gilmanov et al., 1997). The results were of particular interest because the climatic, physiognomic, and bionomic properties of this cryoarid ecosystem are considerably different from those of the grasslands of North American Great Plains for which the model parameters were identified originally. The observed data and model simulations agree fairly well at the year-to-year level [i.e., with respect to the response of the above-ground phytomass to the weather conditions of a given year, whether it is a bad year (1981), a moderate year (1978, 1979, and 1982), or a good year (1983-1985)]. Within the particular growing season, however, the differences between the model and observations may be

substantial but without definite bias to the negative or the positive side (cf. years 1980 and 1984). The seasonal differences reflect the sensitivity of certain grassland systems to episodic rainfall events that cannot be resolved with the monthly time step model. Overall, there was a poorer agreement between the observed data for this ecosystem and the model simulations as compared to the results for other 7 sites described in Gilmanov et al. (1997).

## 5. Data Acquisition Materials and Methods:

**Site Information**

The Tuva study site (51.83 N 94.42 E) is situated near the city of Kyzyl, close to the geographical centre of the Asian continent. The steppe belongs to the region of ultracontinental semiarid and cryoarid steppes of the inland depressions of Central Asia, formed on the light-textured chestnut soils (Table 1). The plant community is dominated by *Agropyron crystatum*, *Cleistogenes squarrosa*, *Festuca valesiaca*, *Helictotrichon altaicum*, *Koeleria cristata*, *Stipa krylovii*, *Carex supina*, *Potentilla bifurca*, *Artemisia eommutata*, *Artemisia frigida*, *Caragana splendens*. This kind of steppe is typically grazed annually. The data on natural environmental conditions, soils, and composition and productivity of plant and animal communities are reported in Nosin (1963), Volkovincer (1978), Gorshkova (1982; 1986), Stebayev et al. (1964), Stebayev (1976; 1986), Stebayev and Pshenicyna (1984) (In Russian).

Figure 2. Grazed dry steppe near the Tuva grassland study site, Russia. (Photograph taken mid-July 1988 by Dr. T.G. Gilmanov, South Dakota State University, USA).

**Table 3. Site characteristics**

| Description | Values |
|---|---|
| mean annual precipitation | 214 mm |
| mean monthly minimum temperature | -39.2 degrees C (Jan) |
| mean monthly maximum temperature | 26.7 degrees C (July) |
| vegetation type | ultracontinental semiarid / cryoarid steppe |
| dominant species | Agropyron crystatum (C3) |
| historical long-term management regime | annual grazing |
| max above-ground live biomass (typical month) | 103 g/m2 (July) |
| soil type | haplustosol/calciustosol |
| soil pH | 7.3 |
| soil texture (sand/ silt/ clay) | 0.74 / 0.17 / 0.09 |
| soil carbon content | 4,030 g/m2 (0-20 cm) |
| soil nitrogen content | 430 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). Data for the Tuva site were originally reported [in Russian] in Nosin (1963), Volkovincer (1978), Gorshkova (1982; 1986), Stebayev et al. (1964), Stebayev (1976; 1986), and Stebayev and Pshenicyna (1984).

## 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

Gorshkova, A.A. (ed.). 1982. Steppe vegetation of Siberia and some features of its ecology. Nauka, Novosibirsk. 134 pp. (In Russian).

Gorshkova, A.A. 1986. Steppe grazing lands of Siberia and their rational use, pp. 123-129. IN: Titlyanova, A.A. (ed.). Productivity of Haymows and Pastures. Nauka, Novosibirsk. (In Russian).

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

Nosin, V.A. 1963. The soils of Tuva. Academy of Sci. Publ. House, Moscow. 342 pp. (In Russian).

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

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.

Stebayev, I.V. 1976. Spatial structure of the animal population and of the biogeocoenoses in the transit geochemical series of landscapes. Zool. Zh. 55: 191-204. (In Russian).

Stebayev, I.V. 1986. Ecology of the castanean soils and their zoological complexes in the north-eastern part of the Ubsunur basin, pp. 16-49. IN: Informational Problems of Studying of the Biosphere. Experiment Ubsu-Nur. Pushchino. (In Russian).

Stebayev, I.V., and L.B. Pshenicyna. 1984. Possibilities of studying of the trophic specialization of the locusts (Orthoptera, Acrididae) basing of the analysis of excrements. Entomol. Obozr. 12: 433-446. (In Russian).

Stebayev, I.V., N.N. Naplyekova, and A.B. Gukasyan. 1964. Locusta (Acrididae) and black beetles (Tenebrionidac) as stimulators of microbiological processes in soils of dry steppes of the Tuva autonomous republic. Pochvovedenie 9: 89-95. (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).

Volkovincer, V.I. 1978. Steppe cryoarid soils. Nanka, Novosibirsk. 208 pp. (In Russian).