**TETYN: An Easy to Use Tool for Extracting Climatic Parameters from Tyndall Data Sets**

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**Abstract**

The recent and rapid change in climate seems to have strong impact on many aspects of agriculture, health, ecology, economy and the society. To model these impacts researchers need access to future and past climate databases, some of which are publicly available. One possible source of climate data sets is the collection of the Tyndall Centre for Climate Change Research. We developed an easy to use tool to obtain required climatic parameters from the Tyndall future (TYN SC) and past (CRU TS) data sets. Results of the query can be exported as comma separated value or as ESRI shape files.

**Keywords:** climate change, climate data, extracting tool, TETYN

**Introduction**

In recent years the importance of climate change has been rapidly growing in most disciplines, including agriculture, health, ecology, economy and sociology. Many publications deal with the necessity of adaptation to climate change, therefore researchers and decision makers need adequate data-sources to analyse, model or forecast consequences of these changes. Realising this some institutions and organisations produced data-sets of a projected future climate. One of these is the Prediction of Regional scenarios and Uncertainties for Defining EuropeaN Climate change risks and Effects (PRUDENCE), which contains datasets from different models for the interval 2071-2100. Although this data-source is very useful for long-term modelling, it can not be used for near-term climate change based analyses. For those who would work on near-term modelling, the Tyndall Centre for Climate Change Research produced two future climate data-sets the TYN SC 1.0 and the TYN SC 2.0. The CRU TS is useful to those, who are trying to find analogies from past climate patterns applicable to the future climate of certain geographical areas. For our studies the near-term modelling is more interesting. Unfortunatelly, the reading of the Tyndall datasets is not too easy for people without programming knowledge. In our research group most people needs data tables readable by convenient tools (e.g. R, MS Excel).

With TETYN, the user can obtain data from the TYN SC 1.0, TYN SC 2.0 and the CRU TS climate datasets. In the following sections we shortly describe the datasets, the calculation algorithm of the future climate parameters.
Future climate scenario datasets

The future climate scenarios are based on global climate (or general circulation) models (GCM) and future greenhouse gas (GHG) emission scenarios. GCMs describe the interactions of the components of the climate system: the atmosphere, the oceans, the terrestrial and marine biospheres, the cryosphere and the land surface. The different GCMs are varying in parameterization of physical processes. The Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios (SRES) provides a comprehensive set of 40 different scenarios for GHG emission sorted into four storylines. The four storylines represent different demographic, social, economic, technological and environmental developments. Since storing the parameters for all scenarios and all time and space points in a pre-calculated form requires too much hard disc space, the developers organized the datasets into base files. From these files the user can calculate any of the five parameters. In this form the datasets need much less disc space. In the data-set there are six types of data files: key values of model-scenario combinations (scenario selector file), GCM patterns of change between 2070-2099 (response pattern files), time-series of global temperature change between 2001-2100 (global warming files), de-trended inter-annual variability from 1901-2000 (residual files), the 1961-1990 average climate data (climatology files), and the minimum and maximum permissible value (minimum and maximum files). For the different GCMs (PCM, CGCM2, CSIRO2, HadCM3, ECHam4), emission scenarios (A1FI, A2, B2, B1) and climate parameters different files also contain the necessary data sources. Files are identified by the combinations of these three elements in their names. The five parameters (and their mark) are the temperature (TMP), precipitation (PRE), diurnal temperature range (DTR), vapour pressure (VAP) and cloud cover (CLD). Structure of data files. The scenario selector file is an ASCII ordered list. The global warming files are ASCII columns with four line headers. The other file format is a standard grid with a five line header. The response pattern, the climatology, the minimum and maximum files contain two lines for every grid boxes. The grid identifier is stored in the first line (e.g. Grid-ref= 4, 109). The second line contains twelve five-character width fields respectively for the months. In the residual files for every grid-box the first line is the same as in the other grids. The grid identifier line is followed by one hundred lines for the years between 2001-2100 respectively. Every year-line contains twelve five-character width fields for the months.

The TYN SC 1.0 contains data files for calculation of the five parameters for all possible combinations (16) of the four emission scenarios and four GCMs (PCM, CGCM2, CSIRO2, HadCM3). The dataset is on a 10 minute spatial resolution grid, which has 31,143 grid boxes. The spatial range of the grid is between 11.00°-32.00° in longitude and 34.00°-72.00° in latitude. The dataset is free on request: http://www.cru.uea.ac.uk/~timm/grid/TYN_SC_1_0.html

The TYN SC 2.0 contains data files for calculation of the five parameters for all possible combinations (20) of the four emission scenarios and four GCMs (PCM, CGCM2, CSIRO2, HadCM3, ECHam4). The dataset is on a 30 minute spatial resolution grid over the globe (excluding Antarctica), which has 67,420 grid boxes. The dataset is free on request: http://www.cru.uea.ac.uk/~timm/grid/TYN_SC_2_0.html

The CRU TS 2.0 contains data of the observed monthly meteorological data in the twentieth century containing nine parameters (with extension): cloud cover (.cld), diurnal temperature
range (.dtr), ground frost frequency (.frs), precipitation (.pre), temperature (.tmp), minimum temperature (.tmn), maximum temperature (.tmx), vapour pressure (.vap), wet day frequency (.wet)

**Parameter calculation**

The following equation was defined for the calculation of all parameters:

\[ x_{vgsiy} = o_{vim} + o'_{viym} + (p_{vgsim} \times t_{gsy}) \]

where \( x \) is the datum in any scenario, defined by the parameter \( (v) \), GMC \( (g) \), grid box \( (i) \) year \( (y) \) and month \( (m) \). The \( o \) is the observed climatology, \( o' \) residual of the observed climatology, \( p \) is the normalised response pattern and \( t \) is the global warming.

![Fig. 1 TETYN opening window.](image-url)
Fig. 2 Scenario, time and parameter selector.

Fig. 3 Location selector.
Discussion

Our tool for extracting climatic parameters from Tyndall datasets (TETYN) was developed with an aim to make it easier to extract certain parts of the above described datasets. The climatic datasets contain precursors for the different parameters which are actually calculated from these precursors by an algorithm based on the equation published by Mitchell et al (2004). The results of TETYN queries can be saved as comma separated values (CSV) or ESRI shape files. In both formats the records represent the gridboxes and columns contain the monthly data. The most prominent advantages of using TETYN over other tools are as follows:

- TETYN does not require programming facilities and knowledge of the various data structures. The user can set up a complex query using an easy to use graphical interface.
- Results of the queries are easy to import into spreadsheet management software, and GIS tools.
- TETYN allows the user to build data queries with both temporal and spatial aspects. Spatial queries can be performed by one geolocation, by bounding box, by Tyndall grid coordinates and by choosing one or more countries depending on interest.

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