
Proppy

User Documentation

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Abstract

This document describes the use of the *propy* web-application to perform HF Circuit analysis for both Point-to-Point Circuits and Area Coverage. Predictions are performed in accordance with the with ITU Recommendation P.533 (Method for the prediction of the performance of HF circuits) [ITU-R P.533] using the ITURHFPROP application, software method for the prediction of the performance of HF circuits implementing Recommendation ITU-R P.533-13.

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Introduction

The Proppy web site is designed to serve as a convenient front end to the ITURHFProp application; a software method for the prediction of the performance of HF circuits in accordance with Recommendation ITU-R P.533-13.

This document describes the operation of the web application and the procedures required to produce Point-to-Point (P2P) and Area Predictions. The prediction results are graphically displayed in the browser. P2P predictions may be presented either individually or as multiple charts on a monthly planner.

Point-to-Point Predictions

The Point-to-Point (P2P) page [<https://soundbytes.asia/propy/p2p>] supports predictions for a specified path for a 24 hour period throughout a given month.

The main page comprises a map display which may be used to select the Transmit and Receive sites. Additional entry fields are provided to specify the input data set. Prediction results are plotted alongside the map.

The P2P page supports predictions for Signal Noise Ratio (SNR), Basic Circuit Reliability (BCR) and E-Field Strength predictions. In addition, the OPMUF, “the highest frequency that would permit acceptable performance of a radio circuit by signal propagation via the ionosphere between given terminals at a given time under specified working conditions” [ITU-R P.373-9], is displayed on the graph. The Basic MUF (BMUF) represents “the highest frequency by which a radiowave can propagate between given terminals, on a specified occasion, by ionospheric refraction alone”. The OPMUF is usually a higher value than the associated BMUF from which it's derived via the application of a correction factor to allow for propagation mechanisms at frequencies above the basic MUF [ITU-R 1240-2]. Absorption effects at lower frequencies mean that communications are generally more efficient at the highest possible frequency supporting the required traffic, i.e. the OPMUF is of most interest when planning HF links.

Procedure 1. Point to Point Predictions

1. Specify the Transmit location. The Transmit location may be specified using one of the following methods;
 - i. Directly from the map by dragging the red map pin (📍) to the required location.
 - ii. Using the Latitude / Longitude entry fields in the Tx. Site Panel.
 - iii. Using the browser's geolocation support and clicking on the map marker button Tx. Site's entry panel. This will set the Tx. site to the user's current location (reported by the browser).

Privacy

Due to privacy concerns, most browsers only support geolocation services when securely connected to a site using https. Geolocation services may not be supported when connecting to the site via http.

2. Specify the Receive location. The Receive location may be specified using one of the following methods;
 - i. Directly from the map by dragging the blue map pin (📍) to the required location.
 - ii. Using the Latitude / Longitude entry fields in the Rx. Site Panel.
 - iii. Using the browser's geolocation support and clicking on the blue geolocation icon in the Rx. Site's entry panel. This will set the Rx. site to the user's current location (reported by the browser).

Privacy

Due to privacy concerns, most browsers only support geolocation services when securely connected to a site using https. Geolocation services may not be supported when connecting to the site via http.

3. If required, toggle the Source Text button ON to reveal the raw ITURHFProp input / output text files along with the results which may be useful for debugging purposes. This data may be copied to the system clipboard by clicking the clipboard icon in the Input File and Output File header bars.
4. Specify the system parameters from the System panel;

Date Specify the month / year for the prediction. Note: The datetimepicker is configured to only permit dates for which SSN values are available. The range of SSN values may be viewed on the Help - SSN Data page.

Power Specify the net power, expressed in Watts delivered to the antenna.

Traffic Specify the traffic type. Bandwidth and required SNR values for this entry field are derived from [ITU-R F.339-8] and [Lane 1997].

Manmade Noise Specifies the level of man-made noise at the receive location.

5. Specify the Transmit antenna gain using the Tx. Site Antenna Gain entry field. An isotropic antenna is assumed for P2P predictions. The default value of 2.16dBi corresponds to the gain of a dipole over an isotropic radiator.
6. Specify the Receive antenna gain using the Rx. Site Antenna Gain entry field. An isotropic antenna is assumed for p2p predictions. The default value of 2.16dBi corresponds to the gain of a dipole over an isotropic radiator.

Antenna Gain

The current implementation uses the specified gain uniformly for all frequencies in the analysis (2-30MHz). This is unlikely to be a realistic assumption for most practical antenna types.

7. Click the Run Prediction button to start the prediction procedure. The Run Prediction button is enabled whenever the input panel settings become unsynchronised with the plotted results, providing a visual cue that the input data no longer corresponds to the plotted results.

Displaying the Results

The predicted results are displayed on a 2D plot adjacent to the map. The selected data set (SNR, BCR or Field Strength) is displayed on the background of the plot with the Operational Maximum Usable Frequency (OPMUF). The toolbar below the plot and the plotly toolbar that appears above the plot when hovering may be used to tailor the display and download the plotted data as a .png image file (using the 'camera' button at the left of the Plotly toolbar).

The plot configuration toolbar (below the plot) incorporates the following functions;

Colour The colourmap may be selected from the list of predefined Plotly colour scales. Default: Portland.

Data Type Select from Basic Circuit Reliability (BCR), Signal to Noise Ratio (SNR) or E-Field strength.

Zoom Click the zoom button to open a larger modal window containing the plot.

Saving the Results

The Plotly Modebar appears in the top right of the plot when the cursor enters the plot canvas. The 'camera' button at the left of the menu may be used to download a static image of the plot.

Area Predictions


The Area page [<https://soundbytes.asia/proppy/area>] provides coverage predictions for a specified transmit site and traffic.

The main page comprises a map display used to select the Transmit site and display the prediction results, a toolbar to select the data displayed and a series of panels to define prediction input parameters.

The map toolbar is used to define the data to display on the map (Basic Circuit Reliability (BCR), Signal to Noise Ratio (SNR) or Signal Strength (S-Units)). The Day/Night button activates the day/night overlay and the Run Prediction button is used to initiate the prediction. This button is enabled

whenever the input panel settings becomes unsynchronised with the map overlay. A refresh is also displayed in the top right corner of the map whenever the map display does not correspond to the setting in the input panels.

Procedure 2. Area Predictions

1. Specify the Transmit location. The Transmit location may be specified using one of the following methods;
 - i. Directly from the map by dragging the red map pin () to the required location.
 - ii. Using the Latitude / Longitude entry fields in the Tx. Site Panel.
 - iii. Using the browser's geolocation support and clicking on the blue geolocation icon in the Tx. Site's entry panel. This will set the Tx. site to the user's current location (reported by the browser).

Privacy

Due to privacy concerns, most browsers only support geolocation services when securely connected to a site using https. Geolocation may not be supported when connecting to the site via http.

2. If required, toggle the Source Text button ON to reveal the raw ITURHFProp input / output text files which may be useful for debugging purposes. Once displayed, this data may be copied to the system clipboard by clicking the clipboard icon in the Input File and Output File header bars.
3. Select the plot resolution from “Low”, “Medium” and “High”, corresponding to 15°, 10° and 5° respectively.

High Resolution Images

Increasing resolution significantly increases processing time. Low resolution plots specify data points at 15° intervals, requiring 325 points for global coverage. At High resolution (5° intervals) this increases to 2,701 data points.

4. Toggle the Day/Night display as required. This input has no effect on the prediction. The displayed day / night regions correspond to the time of the displayed prediction.
5. Specify the system parameters from the System panel;

Date / Time	Specify the month / year for the prediction. The datetimepicker is configured to only permit dates for which SSN values are available.
Traffic	Specify the traffic type from the drop down menu of options. The Bandwidth and SNR values in this menu are specified by [ITU-R F.339-8] and [Lane 1997].
Frequency	Specify the frequency in MHz of the radiated signal in the range $2 < f < 30$.
Power	Specify the net power, expressed in Watts at the antenna.
Manmade Noise	Specifies the level of man-made noise at the receive location.

6. Specify the Transmit antenna type using the Tx. Site entry panel.
 - i. If an isotropic antenna is specified, an antenna gain may also be defined. The default value of 2.16dBi corresponds to the gain of a dipole over an isotropic radiator
 - ii. If a specific antenna type is selected, the bearing may also be defined.

- Specify the Receive antenna gain using the Rx. Site Antenna Gain entry field. An isotropic antenna is assumed. The default value of 2.16dBi corresponds to the gain of a dipole over an isotropic radiator.

Antenna Gain

The current implementation uses the specified gain uniformly for all frequencies in the analysis (2-30MHz). This is unlikely to be a realistic assumption for most practical antenna types.

Displaying the Results

The predicted results are displayed directly onto the main map. The toolbar below the map may be used to modify the presentation of the results;

Colour	Selects the colormap used to represent the data from a dropdown menu containing a number of Plotly colour maps.
Plot Type	Selects the plot type from a series of radio buttons, Basic Circuit Reliability (BCR), Signal to Noise Ratio (SNR) or Signal Strength (in S Units). Further information on S-Units may be found in the section called “S-Meter Values”.
Day / Night	Toggles the Day / Night display, corresponding to the prediction UTC value.
Image Download	Initiates a download of the map image in the specified format, see the section called “Saving the Results” for further details.

If the values in the input form are modified and no longer correspond to the displayed data, a 'refresh' icon is displayed in the top right hand corner of the map.

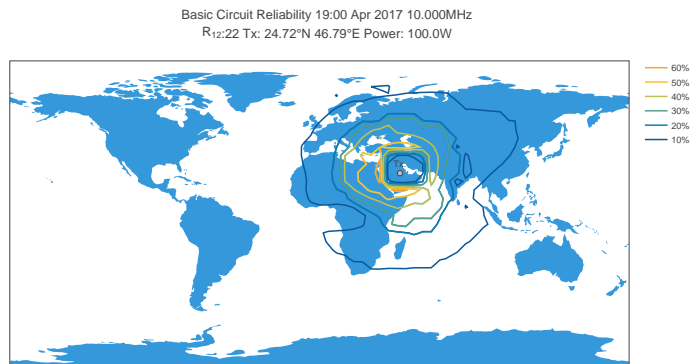
Saving the Results

The download below the map is enabled whenever valid data is displayed. Clicking the button initiates a download of the image in the specified format.

Browser Limitations

The download button is not displayed on browsers for which the Plotly `downloadImage()` function is not supported (e.g. MSIE and Edge browsers).

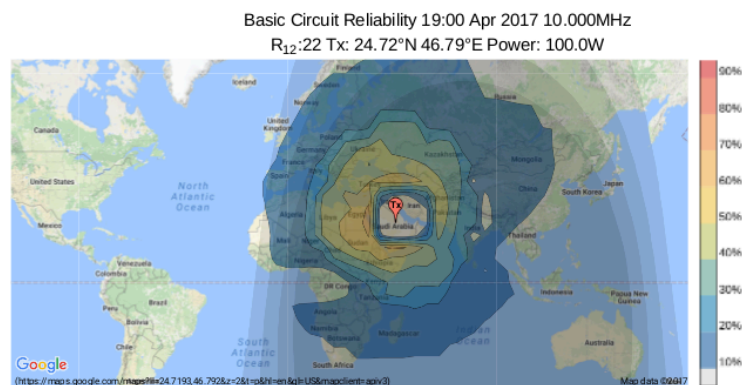
Figure 1. Saved SVG Image File



The image may also be saved via the browser's print function. Media specific targets in the CSS file hide most of the page's content to reduce clutter, replacing the entry form with a title above the image.

Figure 2. Printing via the Browser's Print Menu

Proppy HF Circuit Prediction: Area




Planner Plots

`Planner' charts [<https://soundbytes.asia/proppy/planner>] contain multiple P2P plots on a single pdf sheet suitable for printing and retaining as a quick reference. All P2P plots on the chart are for a single Month/Year.

Processing Time

Planner charts are computationally expensive to create and take longer to process than individual P2P and Area plot types, up to 30 seconds for a full 12 chart plot.

Procedure 3. Planner Predictions

1. Specify the Transmit location using one of the following methods;
 - i. Directly from the map by dragging the red `Tx' map pin () to the required location.
 - ii. Using the Latitude / Longitude entry fields in the Tx. Site Panel.
 - iii. Using the browser's geolocation support and clicking on the blue geolocation icon in the Tx. Site's entry panel. This will set the Tx. site to the user's current location (reported by the browser).

Privacy

Due to privacy concerns, most browsers will require a secure (i.e. https) connection to the site. Geolocation may not be supported when connecting to the site via http.

2. A site name may optionally be entered. This has no effect on the computation but if present will be used in the sub-plot labels; e.g. "transmit_label to receive_label".
3. Specify the Receive location(s). Up to 12 receive locations may be defined, although readability of the chart decreases with the number of receive locations. Receive locations are displayed on the map and in the table below the map. Each Receive Location is identified by a unique identity and comprises a label (optional) and latitude and longitude. One receive location (ID0) is created label when the page opens. Additional locations may either created manually using the Add Site button at the foot of the table or by importing a saved or preset list. Once created, receive locations may be moved by either dragging on the map or direct entry in the appropriate latitude / longitude fields.

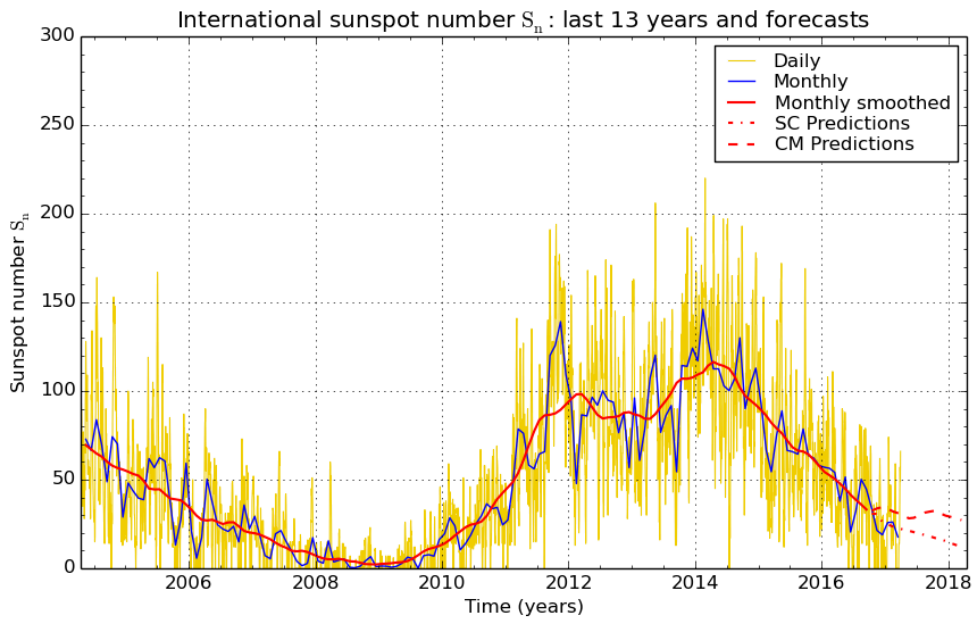
4. **Preset Lists** Preset lists contained a set of predefined locations, e.g. 'Worldwide', 'Europe' etc. These are selected using the drop down menu at the lower left of the table and clicking on the Load Preset button. Once loaded, the receive sites may be edited by either dragging the map markers or direct entry into the appropriate latitude / longitude fields.
- Saved Lists** The contents of the table may be saved in the browser's 'localStorage' for later retrieval. This requires browser support for localStorage; on unsupported browsers, the Load / Save buttons are not displayed. The Save button is used to save the current contents of the table to the browser's localStorage. The Load is used to retrieve the saved set of receive sites.
- i. Directly from the map by dragging the appropriate blue map pin (📍) to the required location.
 - ii. Using the Latitude / Longitude entry fields in the Receive sites table.
5. Specify the system parameters from the System panel;
- Date** Specify the month / year for the prediction.
- Power** Specify the power, expressed in Watts delivered to the antenna.
- Traffic** Specify the traffic type. Bandwidth and required SNR values are specified by [ITU-R F.339-8] and [Lane 1997].
- Manmade Noise** Specifies the level of man-made noise at the receive location.
6. Specify the Transmit antenna gain using the Tx. Site Antenna Gain entry field. An isotropic antenna is assumed for p2p predictions. The default value of 2.16dBi corresponds to the gain of a dipole over an isotropic radiator.
7. Click the Generate Plan button to generate the predictions. Once complete, a link to the pdf document will be displayed in a modal box. The link will be valid for up to one hour from the plots being generated.

Sun Spot Numbers (SSNs)

Determination of ionospheric characteristics related to HF propagation requires knowledge of the prevailing levels of solar activity [ITU-R P.1239-3]. The Sunspot Number (SSN), quantifying of the number of dark spots visible on the Sun's surface, has historically served as the primary proxy of solar activity [Clette et al. 2015]. Records of SSNs date back over 400 years, providing a valuable insight into the sun's quasi periodic 11-year cycle of activity. Superimposed onto this cycle are shorter term variations that can result in large fluctuations in day-to-day values. More recent research suggests that the 11 year cycle is itself modulated by the interaction of two solar dynamos, accounting for the fluctuations in the level of activity observed during each cycle [Zharkova et al., 2015].

The figure below illustrates how daily values (yellow) may be averaged over month (blue) and monthly smoothed (12-month) (red) periods, eliminating complex short term variations to yield a more predictable indicator of solar activity. The preferred ionospheric metric when determining the critical frequencies of the various layers and the MUF factor $M(3000)F_2$ is a 12-month running mean sunspot number, R_{12} [ITU-R P.1239-3]. R_{12} values are a function of sunspot values extending at least six months either side of the month of interest [ITU-R P.371-8]. (Note that this has the unfortunate side effect that an R_{12} value for a given month "m" cannot be absolutely determined until "m+6" (six months later)).

Figure 3. SSN Values



SILSO graphics (<http://sidc.be/silso>) Royal Observatory of Belgium 2017 April 1

SSN Data

In accordance with Recommendation ITU-R P.371-8, the site uses SSN (R_{12}) values presented in the ITU's Circular of Basic Indices for Ionospheric Propagation, derived from SSN data provided by WDC-SILSO, Royal Observatory of Belgium, Brussels. The SSN values used in Proppy are updated at the beginning of each month directly from the source data available at <http://sidc.oma.be/silso/INFO/snmstotcsv.php> (historical) and <http://sidc.oma.be/silso/FORECASTS/prediSC.txt> (predicted).

The SSN values used by Proppy are presented at <https://soundbytes.asia/propy/help/ssn>. These values extend from 2005 to the latest available prediction date (typically 12 months ahead).

S-Meter Values

S-Meter values are commonly used to express received signal levels. ITURHFProp presents Field Strength values expressed terms of dB(1uV/m). For convenience, the propy application converts these to S-Meter values, more commonly used to express the Strength portion of a Readability, Strength, Tone (RST) report.

S-Meter	dB(1uV/m)	Subjective Assessment
S9	33.98	Very strong signals
S8	27.96	Strong
S7	21.94	Moderately strong
S6	15.92	Good
S5	9.90	Fairly good
S4	3.88	Fair
S3	-2.14	Weak
S2	-8.16	Very weak
S1	-14.19	Faint signal, barely perceptible

Troubleshooting

Cache

The site is under constant development and it is possible that cached resources conflict with newer resources on the site. Many problems can therefore be resolved by simply reloading a fresh copy of the page. The procedure for this varies by browser / platform but often based around the Ctrl-F5 key combination. Further information on this process may be found at https://en.wikipedia.org/wiki/Wikipedia:Bypass_your_cache#Bypassing_cache.

Validation Error: [csrf_token] The CSRF token has expired.

The site is protected against Cross-site request forgery (CSRF), also known as one-click attack or session riding, a type of malicious exploit of a website where unauthorized commands are transmitted from a user that the website trusts. This requires a token to be issued to the client browser for each session. If this token expires, data submitted by the client will fail to validate.

If this error message is seen, simply reload the page.

Geo Location Error

In order to protect user's privacy, most current browsers prevent the transmission of personal data over unsecured channels. If this error message is seen, reconnect to the website using the https protocol , e.g. <https://soundbytes.asia/proppy/>.

Privacy

Google Analytics

The site uses Google Analytics to help analyse how visitors use the site's services. Google Analytics uses "cookies", small text files placed on the client's computer, to collect standard internet log information and visitor behaviour information in an anonymous form. No personally identifiable information is collected about visitors to this website.

The anonymous information generated by Google Analytics is transmitted directly to Google and processed to compile statistical reports on activity as it relates to this site. The aggregated information is used by myself to determine the relative popularity of the site's services, informing future decisions on where best to spend development time to better meet visitor's needs.

Google's privacy policy is formally defined at <https://www.google.com/intl/en/policies/privacy/>.

Users wishing to prevent their data from being used by Google Analytics may install the Google Analytics Opt-out Browser Add-on, available from <https://tools.google.com/dlpage/gaoptout>.

Cookies

The website uses "cookies", to retain user preferences between visits. These are stored on the user's machine so that subsequent page loads are initialised with the user's preferences and language. The values of the cookie are not stored by the server nor distributed to any third party.

The cookies ('locale', 'txlat', 'txlng', 'rxlat', 'rxlng') are not encrypted and may be readily examined using a browser's cookie manager. These cookies are designed to persist between sessions for up to six months but may be deleted by the user at any time.

txlat, txlng Coordinates of the preferred Transmit location.

rxlat, rxlng	Coordinates of the preferred Receive location.
traffic	A string representing the preferred traffic type, used to set the Traffic drop down menus when a page is opened.
mute-wwv-msg	This cookie is set when a user closes a WWV warning message and is used to suppress further messages for three hours (the interval at which WWV warnings are published).
locale	Used by the site to store an ISO code identifying a user's preferred language (e.g. 'de', 'es' etc.). Users who only use English may not see this cookie.

In addition to the above cookies which are used directly by the Proppy application, the following cookies are associated with the site.

session	Created by the Flask Framework used to build the site and is used to store the variables '_id' and the 'csrf_token'. This is a HTTP Only cookie and inaccessible to the Javascript. Proppy does not store any values in this cookie.
_ga, _gat	Used by Google Analytics to distinguish (not identify) users and throttle requests respectively. Further details of these cookies may be found at the Google Developers page, https://developers.google.com/analytics/devguides/collection/analyticsjs/cookie-usage .

HTTPS

It is recommended that users access the site using the secure https protocol; <https://soundbytes.asia/proppe>.

Language Preferences

Proppy's calculation pages are offered in the following languages;

- Arabic (ar)
- English (en-gb)
- Finnish (fi)
- French (fr)
- German (de)
- Spanish (es)

Language selection is made via the menu presented at the foot of each page. This will set a cookie ('locale') to preserve the user's language preference between visits.

In the event that a 'locale' cookie is not found, the value of the request header's 'Accept-Language' parameter is used to identify the required language.

Bibliography

[Clette et al. 2015] Frederic Clette, Leif Svalgaard, Jose Vaquero, and Edward Cliver. 2015. The Solar Activity Cycle. 35-103. *Revisiting the sunspot number*. <https://arxiv.org/pdf/1407.3231.pdf>.

[ITU-R P.533] Recommendation P.533-13. July 2015. International Telecommunication Union. *Method for the prediction of the performance of HF circuits*. <https://www.itu.int/rec/R-REC-P.533-13-201507-I/en>.

- [ITU-R F.339-8] Recommendation F.339-8. February 2013. International Telecommunication Union. *Bandwidths, Signal-to-Noise Ratios and Fading Allowances in HF Fixed and Land Mobile Radiocommunication Systems*. <https://www.itu.int/rec/R-REC-F.339/en>.
- [ITU-R P.373-9] Recommendation P.373-9. July 2015 2013. International Telecommunication Union. *Definitions of maximum and minimum transmission frequencies*. <https://www.itu.int/rec/R-REC-P.373/en>.
- [ITU-R P.1239-3] Recommendation P.1239-3. February 2012. International Telecommunication Union. *ITU-R reference ionospheric characteristics*. <https://www.itu.int/rec/R-REC-P.1239/en>.
- [ITU-R 1240-2] Recommendation P.1240-2. September 2013. International Telecommunication Union. *ITU-R methods of basic MUF, operational MUF and ray-path prediction*. <https://www.itu.int/rec/R-REC-P.1240-2-201507-I/en>.
- [Lane 1997] George Lane. 1997. Radio Science. 32(5). 2091-2098. *Required Signal-to-Interference Ratios for Shortwave Broadcasting*. <http://onlinelibrary.wiley.com/doi/10.1029/97RS00843/pdf>.
- [Lane 2005] George Lane. 2005. Ionospheric Effects Symposium, Alexandria VA USA. 3B-4. *Improved guidelines for automatic link establishment operations..* http://www.voacap.com/documents/GLane_ALE.pdf.
- [Zharkova et al., 2015] V V Zharkova, S J Sheperd, E Popova, and S I Zharkov. 2015. Scientific reports. 5. *Heartbeat of the Sun from Principal Component Analysis and prediction of solar activity on a millennium timescale*. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4625153/>.