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Space Weather Services' GIC Products

Dr Jeanne Young

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Introduction

- The Geomagnetic Induced Current (GIC) Index
- Modeling GICs and pipe-to-soil potentials (PSPs)
- Space Weather Application Programming Interface (API)
- Example interfaces using the API for pipeline and power networks

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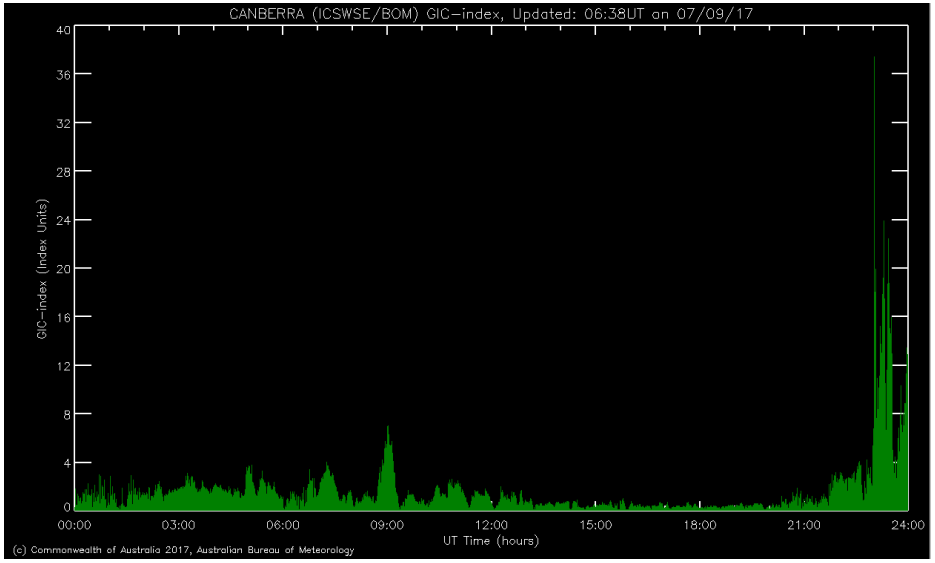
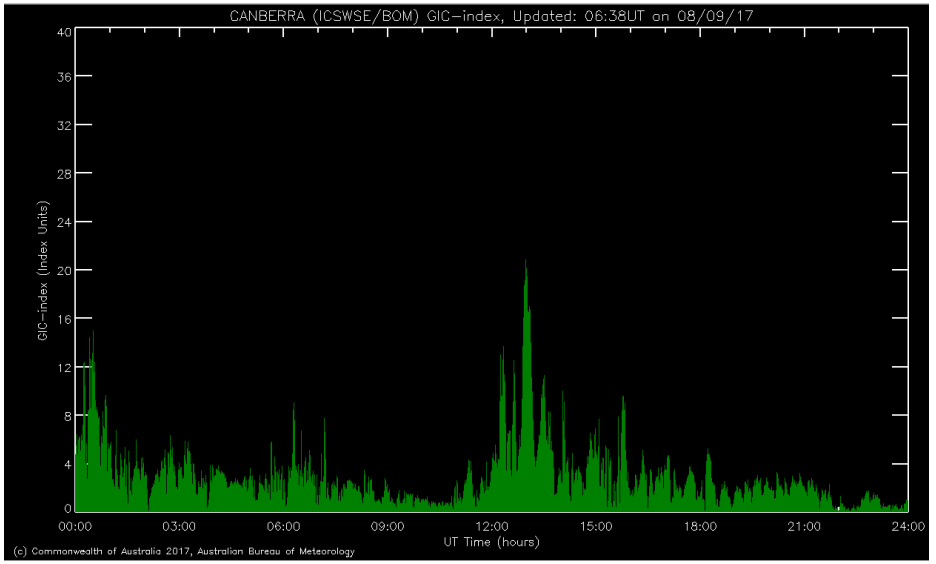
GIC Index Time Series

- Time series plot of the GIC index at Canberra during the geomagnetic storm on September 07-08 2017.
- The GIC index is calculated from magnetic field data and it is used to model the geoelectric field.





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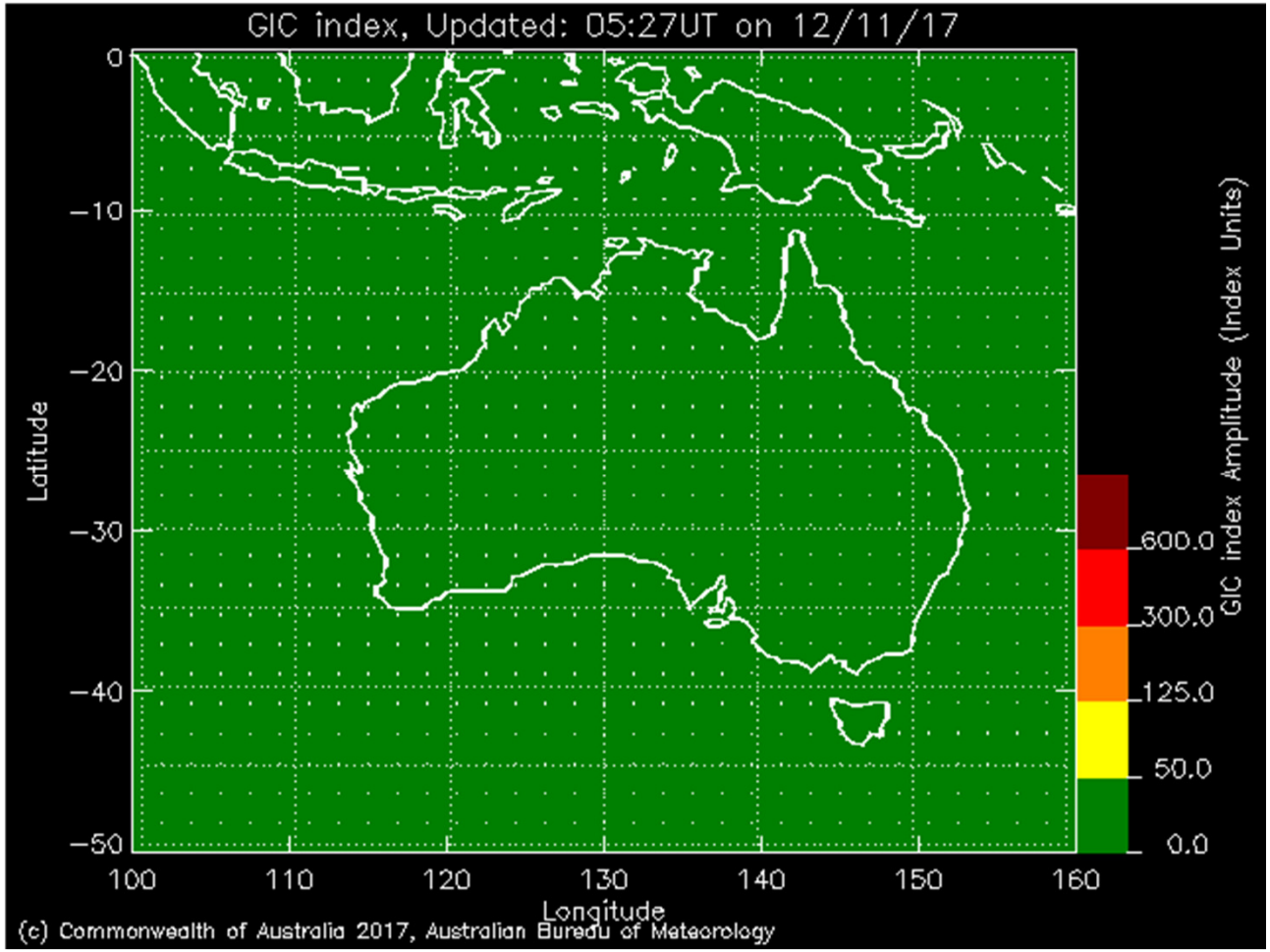
GIC Index Map

GIC index map for the Australian region during a quiet period on November 12, 2017. The map displays contours of the GIC index magnitude with an overlay of the GIC index vectors.



Colour Scale:
Green – No risk
Yellow – Low risk
Orange – Moderate risk
Red – High risk
Dark Red – Extreme risk

Australian Oil & Gas Pipelines

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Geoscience Australia

APPLYING GEOSCIENCE TO AUSTRALIA'S MOST IMPORTANT CHALLENGES

Oil and Gas Pipelines

Updated: 2017

Abstract:

The Oil and Gas Pipelines Database contains known spatial locations of onshore and offshore pipelines or pipeline corridors used to transport natural gas, oil and other liquids within Australia's mainland and territorial waters.

Onshore pipelines are represented as polylines for Qld, NSW, Vic Tas, and SA, and polygons/corridors for WA and NT.

Offshore pipelines are represented as polygons and polylines for WA. For the NT and Vic they are represented as polylines.

This database contains data, as received, from the States, Territories and National Offshore Petroleum Titles Administrator (NOPTA). Minimal effort was made to revise, value add and/or spatially improve the datasets. All changes were captured in the metadata.

For more information about this dataset please refer to the Product's Metadata Document.

Legend:

- National Gas Oil Pipelines
- National Gas Oil Polygons
- Australian Mainlands

0 195 390 780 1,170 Km

Contact: clientservices@ga.gov.au

This map was created by Geoscience Australia on: Monday, 10 April 2017

eCat No. 104762

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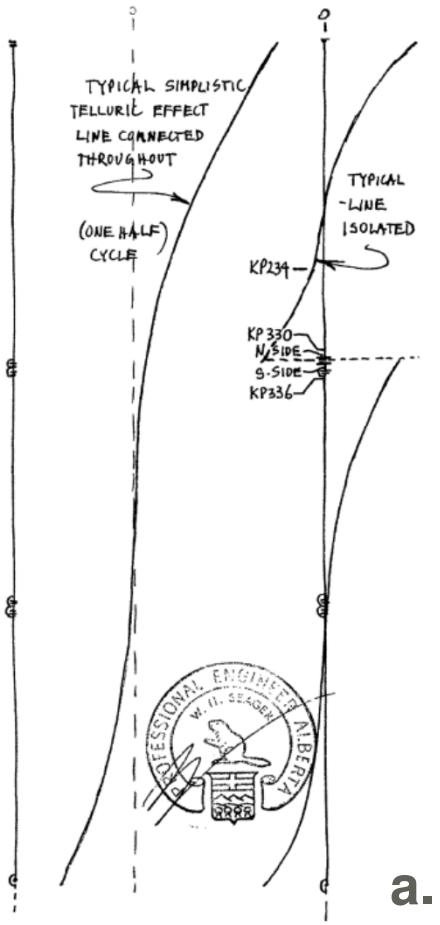
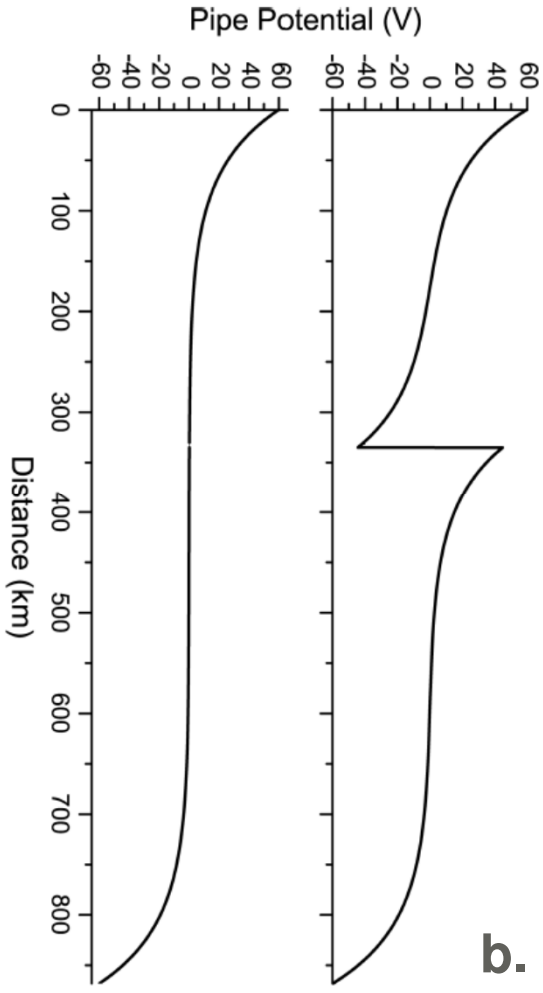
Modeling Pipe-to-Soil Potentials

Pipe-to-soil potentials (PSPs) on a long pipeline, with and without an insulating flange (From Boteler, 2013).

a. Measurements on the Norman Wells-Zama pipeline.

b. Results from model calculations for an electric field of 1 V/km parallel to the pipeline.





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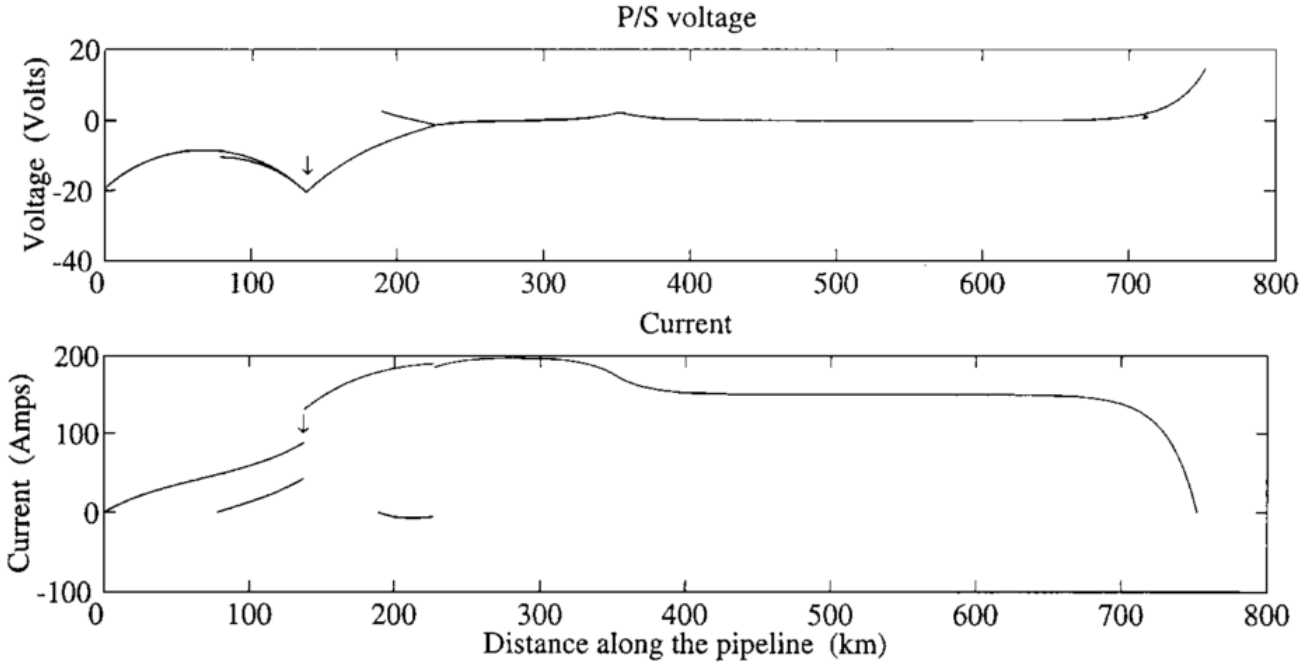
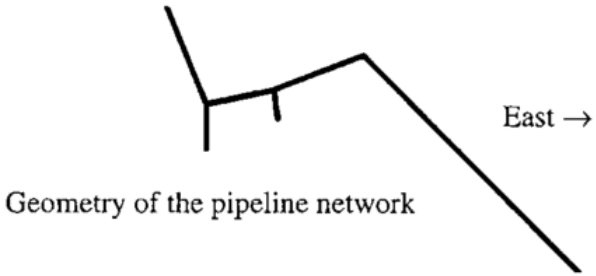
Modeling Pipe-to-Soil Potentials

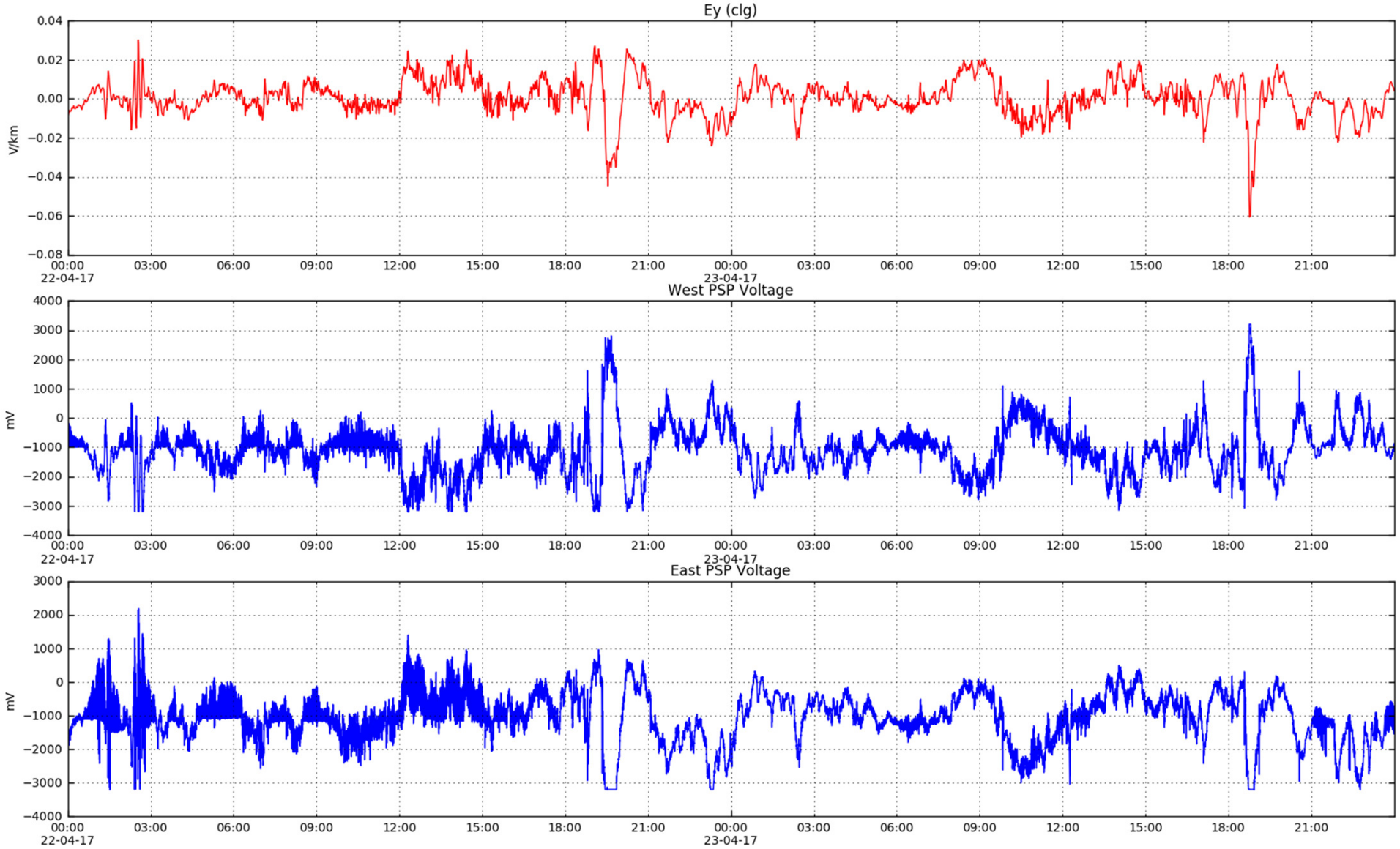
Calculated GIC and pipe-to-soil voltage profiles in the Finnish-Russian natural gas pipeline as functions of the distance measured along the pipeline. The geoelectric field is spatially constant and eastward with a magnitude of 1 V/km. Modeling requires knowledge of the electrical properties and geometrical structure of the pipeline. (From Pirjola et al., 1999).





Geometry of the pipeline network

Comparison of PSP with Electric Field Parallel to the Pipeline



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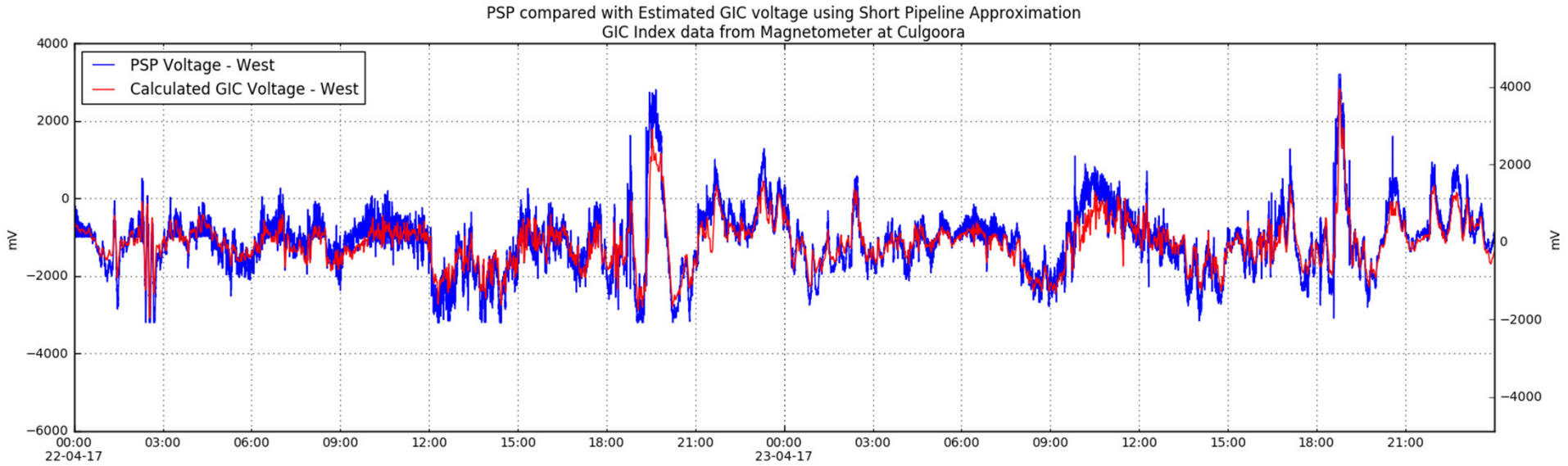
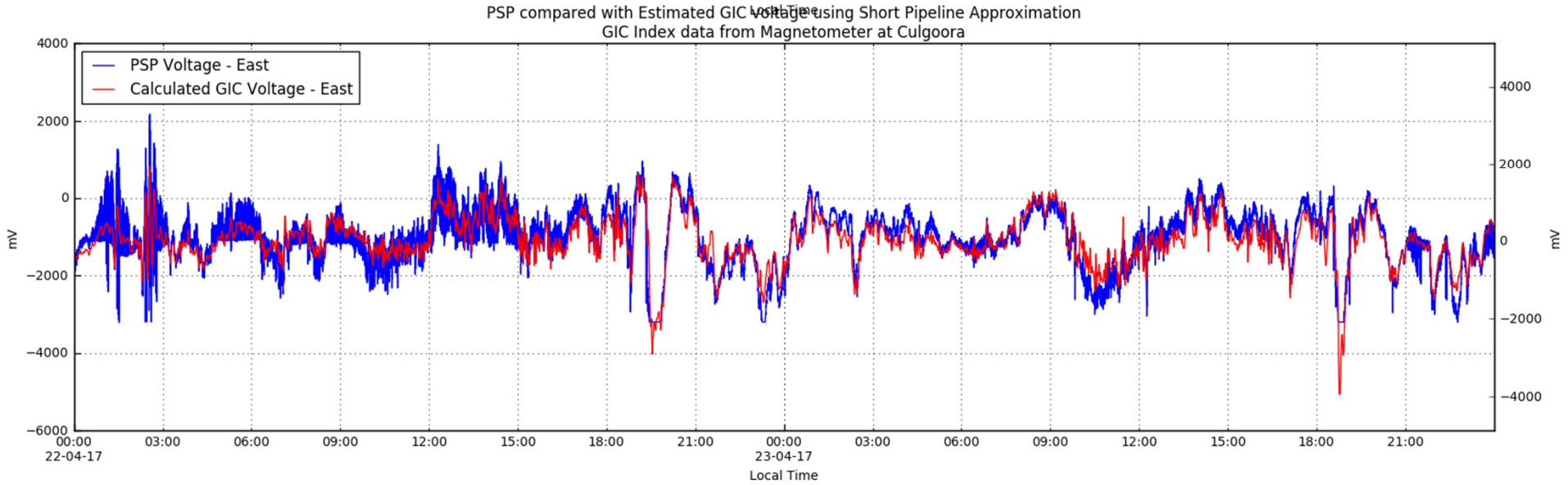
PSP Modelling Results





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Space Weather API

- The Space Weather API provides access to near real-time data from the SWS section of the Australian Bureau of Meteorology . This API is under development. We have made it available for testing and to seek feedback.
- The API currently includes the following data:.
  - the current K index for the Australian region or for one of the observing sites
  - details of any magnetic alert current for the Australian region
  - details of any geophysical warning currently active for the Australian region
  - details of any aurora notice (alert, watch, outlook) current for the Australian region

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Space Weather API

Data can be obtained using an HTTP POST request to the appropriate URL. An API key and any relevant options must be included in the request body. The request body and the response are in JSON. The character encoding is UTF-8.

Request

Request URL

```
http://sws-data.sws.bom.gov.au/api/v1/get-k-index
```

Content-Type header

```
application/json; charset=UTF-8
```

Request JSON (indentation shown only for convenience)

```
{
  "api_key": "3f723484-5188-475d-bd35-d969324a4926",
  "options": {
    "location": "Australian region"
  }
}
```

Response JSON (indentation shown only for convenience)

```
{
  "data": [
    {
      "valid_time": "2017-11-06 21:00:00",
      "analysis_time": "2017-11-06 23:09:14",
      "value": 1
    }
  ]
}
```

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Response Example – Time Series

Request:

- Date & location

Response:

- Time series of GIC voltage or current for that date & location.

Plot | Response

Response JSON (indentation shown only for convenience)


```
{
 "location": "KP0",
 "data": [
  {
   "valid_time": "2017-04-22T00:00:00.000Z",
   "value": 0.14834152599098244
  },
  {
   "valid_time": "2017-04-22T00:01:00.000Z",
   "value": 0.2373464415855719
  },
  {
   "valid_time": "2017-04-22T00:02:00.000Z",
   "value": 0.38568796757655444
  },
  {
   "valid_time": "2017-04-22T00:03:00.000Z".
```

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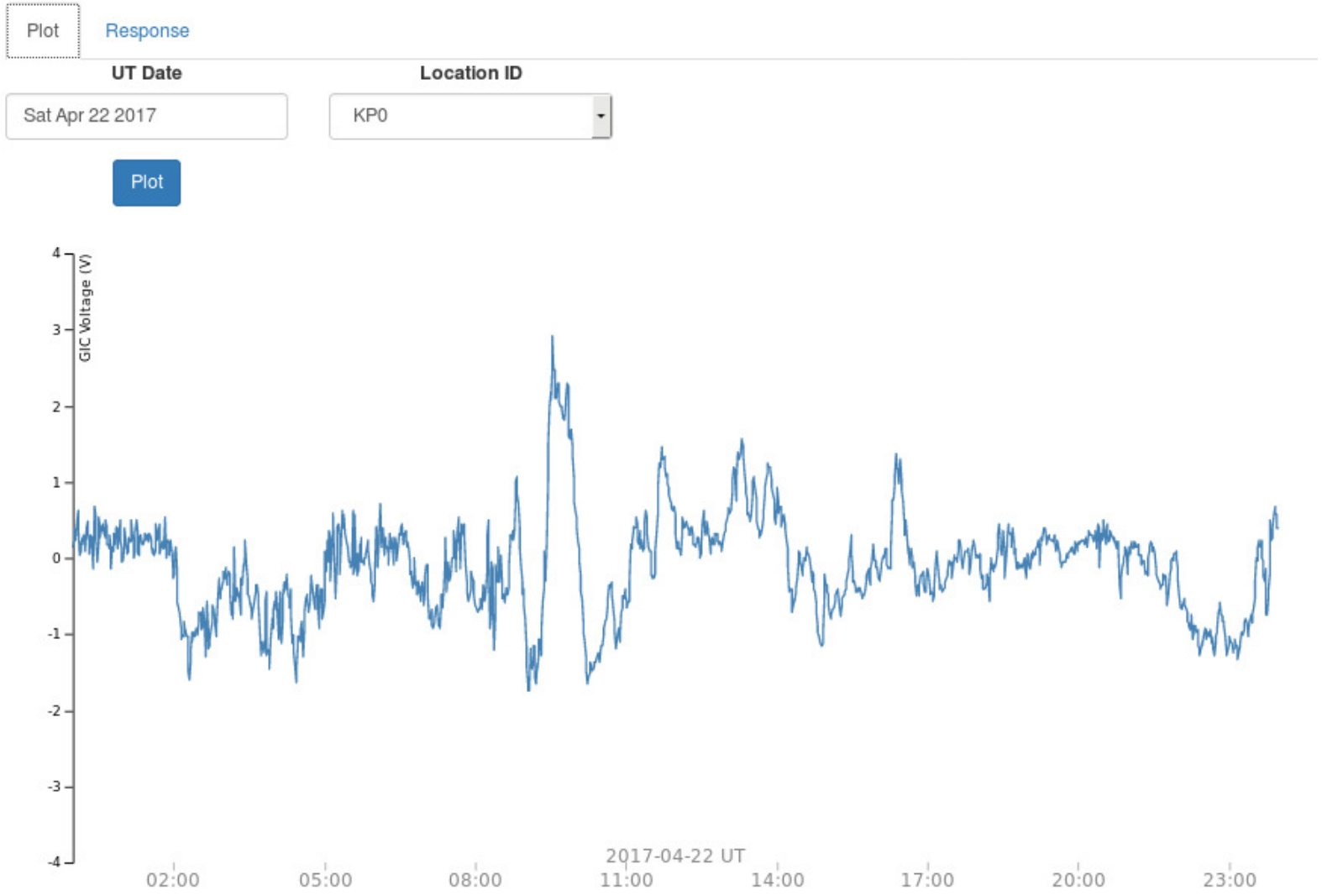
Example Interface
Modelled PSP Time Series



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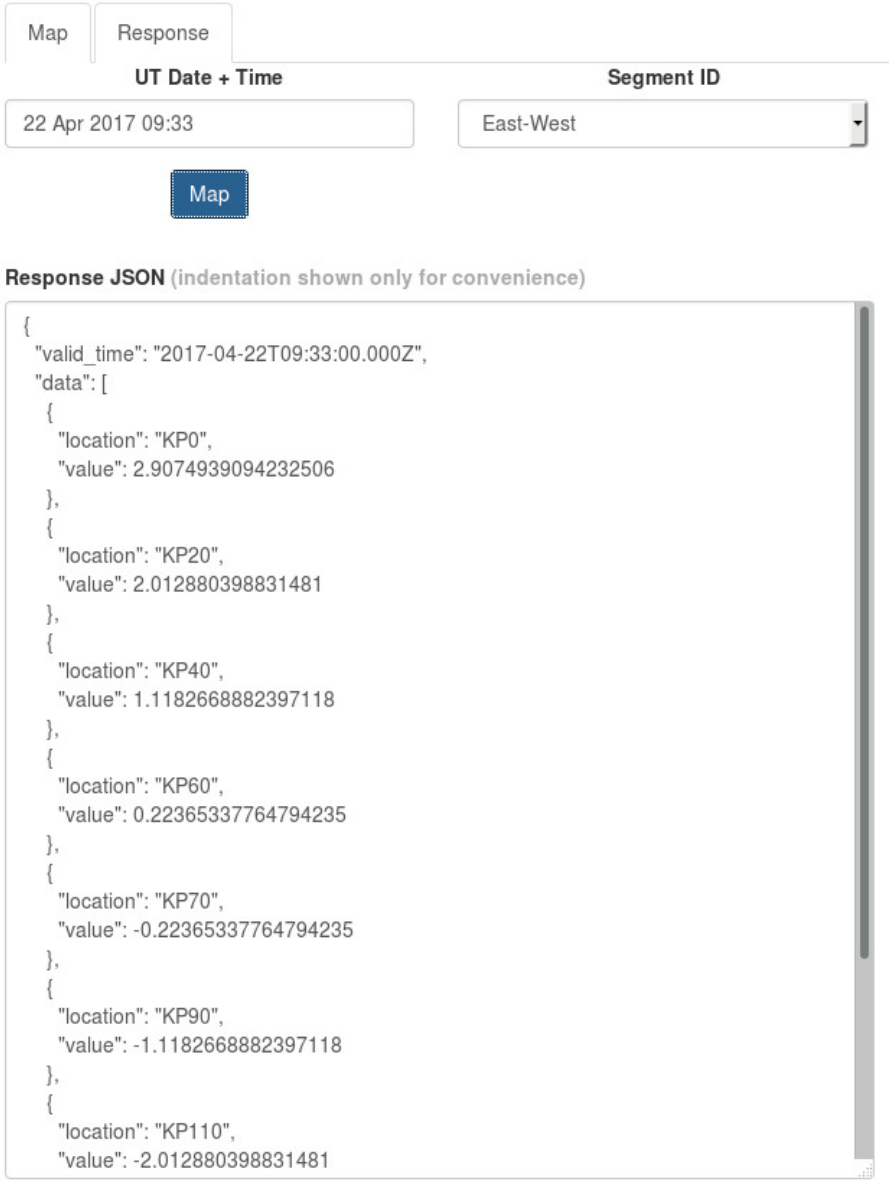
Response Example – A Snapshot in Time

Request:

- Date, time & network/section

Response:

- GIC voltage or current at each station/location in the network/section for that date and time.



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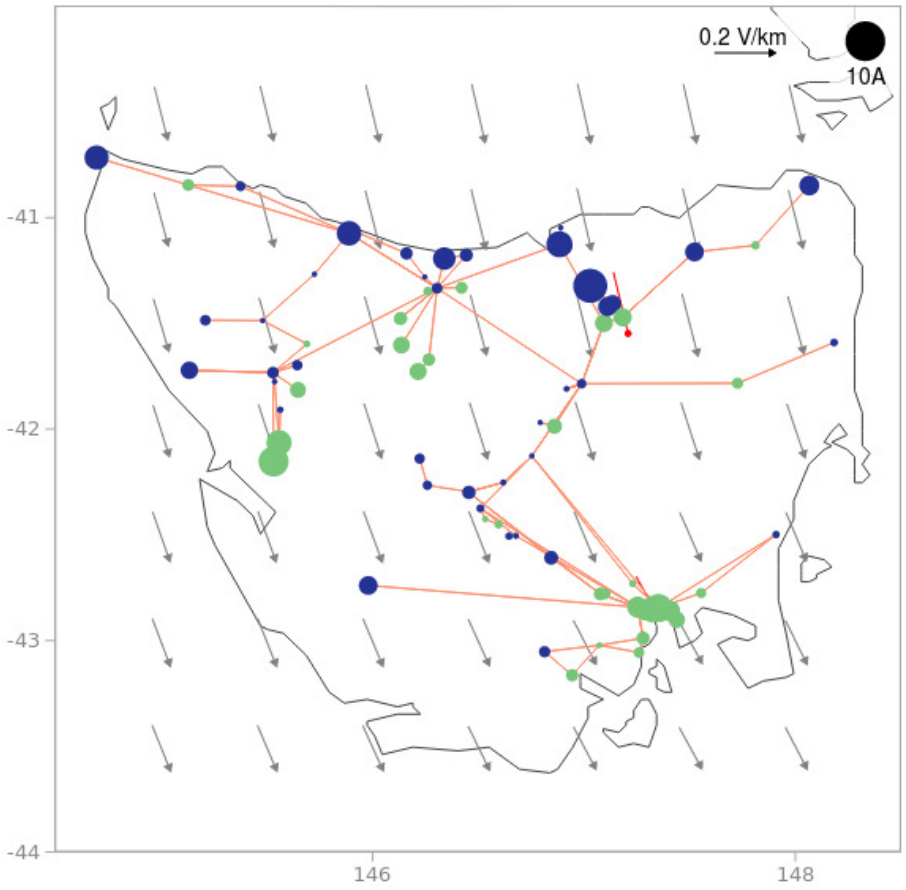
Example Interface – Power Network

UT Date: Wed Oct 02 2013

UT Time: 01:58

Power network & modelled geoelectric field at 2-Oct-2013 01:58 UT



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Future Plans

- Finish implementing the pipeline and power network models.
- Test the models with measured data.
- Add the new GIC data products to the Space Weather API.

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Acknowledgments

- Some of the magnetic data used in this presentation were obtained in cooperation with the following organisations:
  - Geoscience Australia,
  - University of Newcastle Space Physics Group,
  - Australian Government Antarctic Division,
  - International Center for Space Weather Science and Education, Japan.
- Pipeline data used in this study were provided by Anode Engineering and APA Group, and are proprietary.
- Power network and GIC monitoring data used in this study were provided by Powerlink, Energex, Ergon, TasNetworks, and AEMO, and are proprietary.

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Thank you…

Dr Jeanne Young

jeanne.young@bom.gov.au