ATMOSPHERIC ISOTOPES: PROJECT LOG

17/01/2018
Participants: Anežka, Karo, James, Mantas
Reading, understanding and highlighting the key points of the main reference article

G. Torri, D. Ma, Z. Kuang Stable water isotopes and large-scale vertical motions in the tropics, Journal of Geophysical Research: Atmospheres Volume 122, Issue 7, pages 3703-3717, 2017

Project plan discussion
Signing up with the GNIP database to assess the data
Making familiar with the GNIP database and the format of the datasets

By the next week:
Acquiring theoretical background (references): *Anežka, Karo, James, Mantas*
Formatting data in MATLAB to process it: *James*
Ideas what we want to do (project plan): *Anežka, Karo*
GitHub setup option: *Anežka*

24/01/2018
Participants: Anežka, James

From the last week:
GitHub setup: *Anežka*
Creating a function in MATLAB to import the datasets-ultimately: *James*
'Readtable' function more effective: *Anežka, James*

Today's session:
Project plan write-up: finalising the steps, discussing the project outline
Further understanding of the article and presented data analysis
Key formulae:

$$\delta D = \left(\frac{R_{\text{sample}}}{R_{\text{VSMOW}}} - 1 \right) \cdot 1000‰,$$

(the abundance of deuterium)

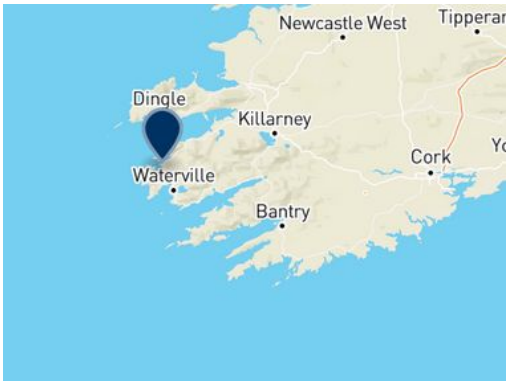
$$p_\omega = \frac{1}{N} \int_{p_s}^{p_t} p\omega \, \mathrm{d}p,$$

(bottom-heaviness index - pressure velocity-weighted average pressure)

!! GNIP stations do not contain information about the pressure velocity profiles - we will contact the paper's authors to obtain missing data.

Using readtable function to easily extract data
Investigating the possibilities of the Mapping Toolbox:

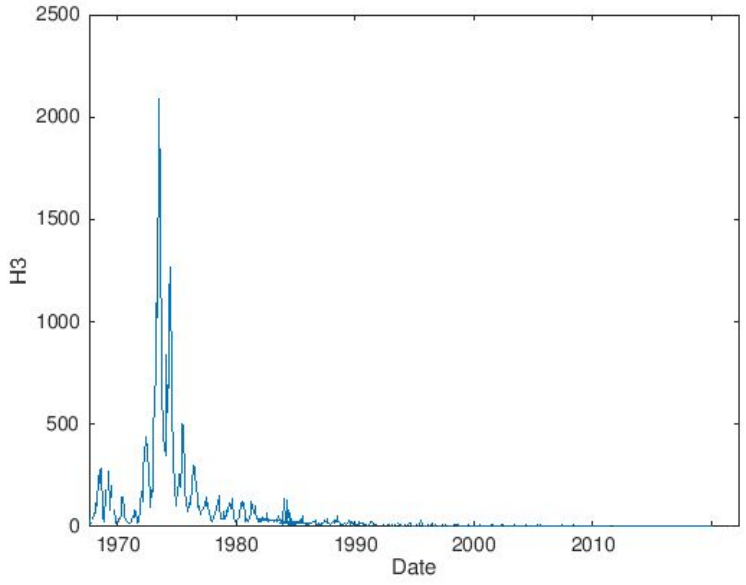
https://uk.mathworks.com/products/mapping.html
Start of simple analysis with GNIP-Monthly Valentia Observatory (Ireland)



Initial visualisation of variance w.r.t time:

```
clear all
clf
% first manually delete tab References
v = 'valentia.xlsx';

s = readtable (v); % reading data from the specific Data File
d = datenum(s.Date, 'yyyy-mm-dd'); % converting date to machine readable serial code

% convenient labelling of variables
H3 = s.H3;
H2 = s. H2;
O18 = s.O18;

figure (1)
plot (d, H2);
% make x-axis more human-readable
xticks (712224:3650:735965);
xticklabels(1960:10:2015);
xlabel ('Date');
ylabel ('H2')

figure (2)
plot (d, H3);
% make x-axis more human-readable
xticks (712224:3650:735965);
xticklabels(1960:10:2015);
xlabel ('Date');
ylabel ('H3');

figure (3)
plot (d, O18);
% make x-axis more human-readable
xticks (712224:3650:735965);
xticklabels(1960:10:2015);
xlabel ('Date');
ylabel ('O18')
```

Example: Graph of H3



By the next week:
Email Giuseppe Torri (First Author of Research Article 'Stable water isotopes and large-scale vertical motions in the tropics') about the exact data sets they used in the paper and discuss any remaining questions: *James*
Finish the project plan: *Anežka, Karo, James, Mantas*
Further references research: *Karo*
Update Project Log: *Anežka*
Understanding of the formulas and first attempts to plot data using formulas above: *Anežka, James*

28/01/2018
Participants: Anežka, Karo, James, Mantas

Further references: *Karo, James*

Galewsky, J., H. C. Steen-Larsen, R. D. Field, J. Worden, C. Risi, and M. Schneider, Stable isotopes in atmospheric water vapor and applications to the hydrologic cycle, Rev. Geophys., 54, pages 809–865, 2016

Sutanto, S. J., G. Hoffmann, J. Worden, R. A. Scheepmaker, I. Aben, and T. Röckmann, Atmospheric processes governing the changes in water isotopologues during ENSO events from model and satellite measurements, J. Geophys. Res. Atmos., 120, pages 6712–6729, 2015

J. Lee, I. Fung, D. DePaolo, C. Henning, Analysis of the global distribution of water isotopes using the NCAR atmospheric general circulation model, Journal of Geophysical Research, Vol 112, D16306, 2007

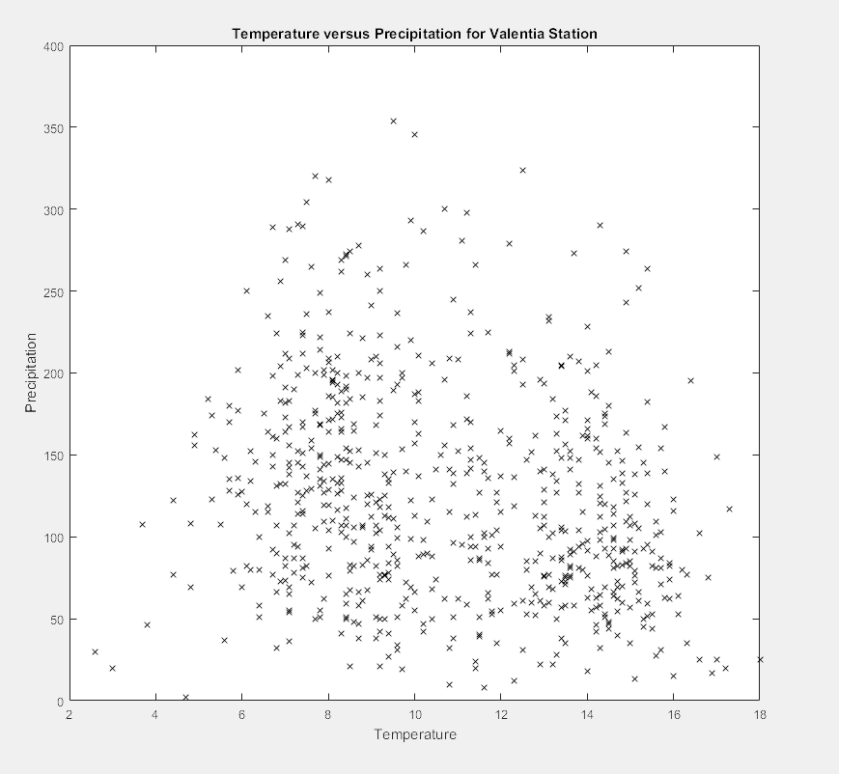
Project plan write-up: *Anežka, Karo, James*
Finalizing the project plan and project log for submission: *Anežka, Mantas*
Project plan and project log submission: Anežka

31/01/2018
Participants: Anežka, Karo, James, Mantas

The data from Valentia GNIP station are not chronological:

Ordering data by date from Valentia GNIP station: teamwork search
Use of sort function (http://uk.mathworks.com/help/matlab/ref/sort.html): *Mantas*

Investigating temperature dependence of precipitation (scatter plot) for Valentia data: *James, Anežka*



Driving test*: Anežka, Karo*

Visualizing data:
Precipitation against temperature: *James, Anežka*
Temperature against time: *James*
Precipitation against time: *Anežka*
Precipitation against vapour pressure: *James*
Delta D versus precipitation rate per day, histogram: *Anežka*
GitHub sharing: *Anežka, Karo, James, Karo*
Project log: *Anežka*

By the next week:
Visualizing data: *James, Anežka*
Sorting function: *Mantas*
Using a Mapping Toolbox investigate temperature dependence of precipitation per unit volume: *Karo* (Using a reference: *J. Lee, I. Fung, D. DePaolo, C. Henning, Analysis of the global distribution of water isotopes using the NCAR atmospheric general circulation model, Journal of Geophysical Research, Vol 112, D16306, 2007.)*

07/02/2018
Participants: Anežka, Karo, Mantas

Since last week:
We intended to start mapping our data with the mapping toolbox, but found that we can't access this licensed feature. We plan to get help during our next session.

Mantas successfully completed and shared the sort function.

Anežka conducted additional elemental data visualisation - mainly the delta D versus precipitation rate per day, histogram and fitted normal distribution.

$$\delta D = \left(\frac{R_{\text{sample}}}{R_{\text{VSMOW}}} - 1 \right) \cdot 1000‰,$$

(the abundance of deuterium)

(Using the main reference: *G. Torri, D. Ma, Z. Kuang Stable water isotopes and large-scale vertical motions in the tropics, Journal of Geophysical Research: Atmospheres Volume 122, Issue 7, pages 3703-3717, 2017)*

Delta D is included in the downloaded IAEA WISER data.

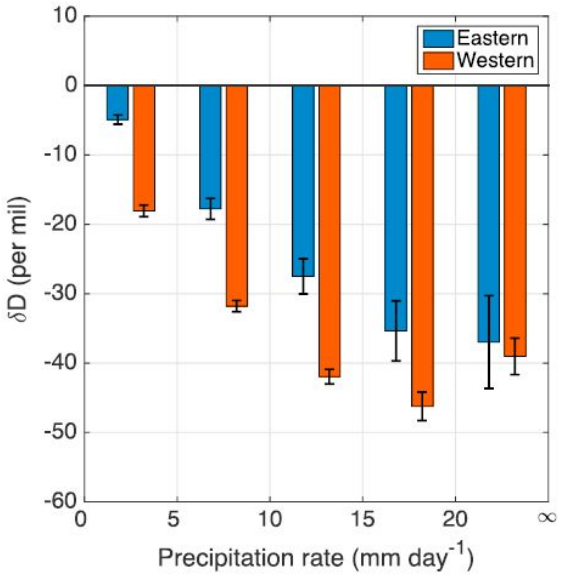
Karo reproduced some of the findings from one of our references: *J. Lee, I. Fung, D. DePaolo, C. Henning, Analysis of the global distribution of water isotopes using the NCAR atmospheric general circulation model, Journal of Geophysical Research, Vol 112, D16306, 2007*

We plot the average temperature of a small initial sample group of countries against the isotope concentration in precipitation for all three isotopes. As in the paper, we can see a proportionality between climate and isotope precipitation, which disappears for average temperatures above 15°C for H2. Furthermore, we extended our investigation to H3 and O18: O18 exhibits the same behaviour, while H3 seems uncorrelated. We used both mean and median values in our data, the average temperatures by country have been taken from the World Bank Group Climate Change Knowledge Portal:

http://sdwebx.worldbank.org/climateportal/index.cfm?page=downscaled_data_download&menu=historical

Today:

Anežka starts on reproducing a graph from the reference *G. Torri, D. Ma, Z. Kuang Stable water isotopes and large-scale vertical motions in the tropics, Journal of Geophysical Research: Atmospheres Volume 122, Issue 7, pages 3703-3717, 2017,* page 3714: precipitation rate vs. delta D.



Mantas (mainly) and *Anežka*: solving data sharing/ GitHub issues.
Mantas: searching for literature sources to properly understand the topic, and further extend our knowledge.
Karo is writing documentation and expanding the climate dependence code with more countries. It becomes apparent that we need a better method to upload large quantities of files into Matlab.
We all seek help for accessing the licensed mapping toolbox, which is revealed to be accessible in the desktop version of Matlab, which *Anežka* already has.

By the next week:
Mantas and *Karo* will install the desktop version of MATLAB.
Anežka will continue and finish the reproduction of the graph from the reference.
Karo will extend the climate dependence code to a larger sample size.
Everyone will familiarise themselves with the mapping toolbox.

13/02/2017
Participants: Anežka, Karo

Anežka: To reproduce a graph from the main reference:
G. Torri, D. Ma, Z. Kuang Stable water isotopes and large-scale vertical motions in the tropics, Journal of Geophysical Research: Atmospheres Volume 122, Issue 7, pages 3703-3717, 2017,
i.e. delta D versus precipitation rate for Eastern and Western Pacific

DOWNLOAD the IAEA WISER data for West and East Pacific.

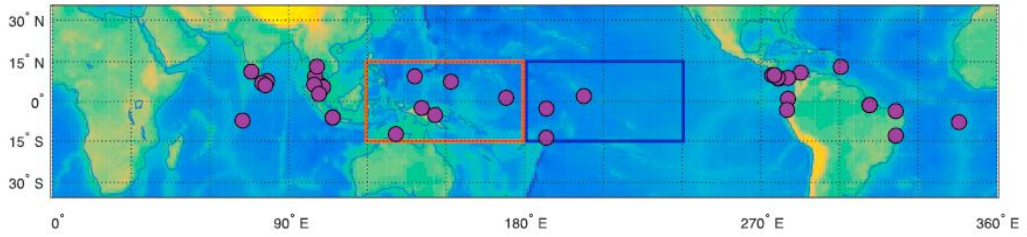


Figure 1. Portion of projected world map showing the GNIP stations used in this study. The orange and the blue rectangles encircle what we define in this manuscript as West (15°N–15°S; 120°E–180°E) and East Pacific (15°N–15°S; 180°E–240°E), respectively.

West: (15° N - 15° S, 120° E - 180° E): Darwin, Jayapura, Madang, Tarawa, Truk, Yap
East: (15° N - 15° S, 180° E - 240° E): Apia, Canton Island, Christmas Island

Data: imported to Matlab and sorted using sorting function (following the process done with Valentia GNIP station case from before).

Karo: Designed a function to upload an entire folder of excel files into Matlab with effectively one line, downloading of almost the entire GNIP database to be able to compute statistically significant amounts of data.

21/02/2018
Participants: Anežka, Karo, James, Mantas

Anežka, Karo:
Reproducing the graph from the main reference: clearing questions about given data (deltaD or Rsample in the table?)
Calculation of deltaD - misconception that we are not given it (actually, it is present in the table)

Making an array of precipitation and deltaD for West and East Pacific

James:
Reproducing the graph from the main reference: calculation of precipitation rate per day and means, binning the data and plotting it for each station

Mantas:
Creating a loop for sorting the data and making an array for the data to reproduce the graph from the main reference and further general use.

By the next week:
Karo: Extending the visualisation for the temperature dependence to a representable sample size (almost the whole database), implementing the new neat way to upload large quantities of excel files into Matlab (which could be used in other parts of the project as well)
Anežka, James: finish the reproduction of the graph from main reference
Mantas: finish the loop

28/02/2018
Participants: Anežka, James, Karo, Mantas

Project draft write-up and discussion of results so far: *Anežka, Karo*
James: finishing the reproduction of the graph from main reference
Mantas: implementing the loop (running the data for different datasets)

01/03/2018
Participants: Anežka, James, Karo, Mantas

Anežka, Karo: draft write-up and feedback requests
Karo: Quantification of the temperature-isotope fraction relationship by fitting lines of best fit to the scatterplots via the curve fitting toolbox
James: Commenting the code for the reproduction of the graph from the lead reference
Mantas: Writing the introduction for the draft
Anežka: finalising the sections of the draft

02/03/2018
Participants: Anežka, Karo

- finalising and submitting the draft

07/03/2018
Participants: Anežka, Karo, James, Mantas

James: error bars
Mantas: generalising the code (using loops and cell structures)
Karo: Exploring possibilities of the Mapping Toolbox, first coding attempts and designing plan for how it could be used in our project
Anežka: W. Dansgaard, Stable isotopes in precipitation,Tellus XVI (1964), 4 November 1964

14/03/2018
Participants: Anežka, Mantas
Anežka: introduction
En.wikipedia.org. (2018). Tritium. [online] Available at: https://en.wikipedia.org/wiki/Tritium [Accessed 14 Mar. 2018].

Met Eireann (2005). Annual Report. [online] Valentia Observatory. Available at: https://www.met.ie/publications/met_ar2005.pdf [Accessed 18 Mar. 2018].

En.wikipedia.org. (2018). Nuclear weapon design. [online] Available at: https://en.wikipedia.org/wiki/Nuclear_weapon_design#Tritium_production [Accessed 14 Mar. 2018].

Begemann, F. and Libby, W. (1957). Continental water balance, ground water inventory and storage times, surface ocean mixing rates, and world-wide water circulation patterns from cosmic ray and man-made tritium. The International Journal of Applied Radiation and Isotopes, 2(3-4), pp.263-264.

Chamberlain, A. (2004). Radioactive aerosols. Cambridge, UK: Cambridge University Press.

Mantas: loops, generalisation of the code

18/03/2018
Participants: Anežka, Karo, James, Mantas
James: reproduction of the graph for the UK
Mantas: generalisation of the code
Karo: fixing last bugs in section 2, write up of section 2
Anežka: introduction, code-comments, formatting, discussion write-up, references

19/03/2018
Participants: Anežka, Karo, James, Mantas

- finalising and submitting the project

Karo: project log edit
Anežka: project edit, creation of the script file with the code
James and Mantas: generalisation of the code
Anežka + Mantas: abstract