

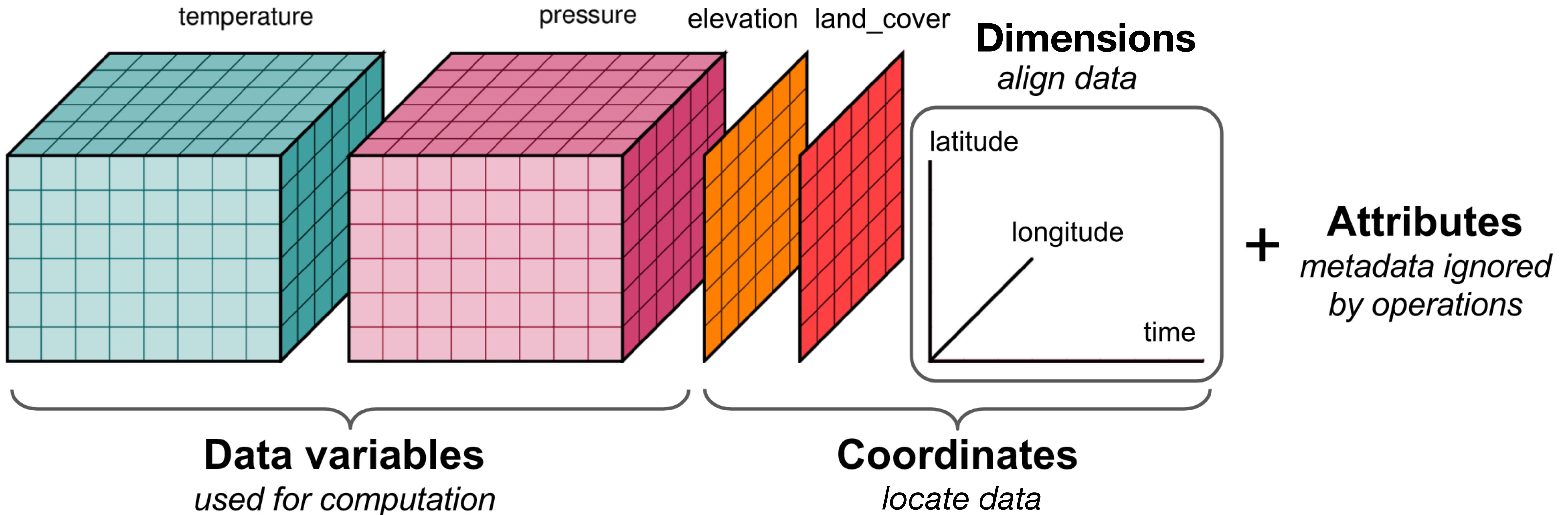
Tuesday, November 10, 2020 | Class #11

xarray, histograms, and what to do when things go wrong

OCEAN 215 | Autumn 2020
Ethan Campbell and **Katy Christensen**

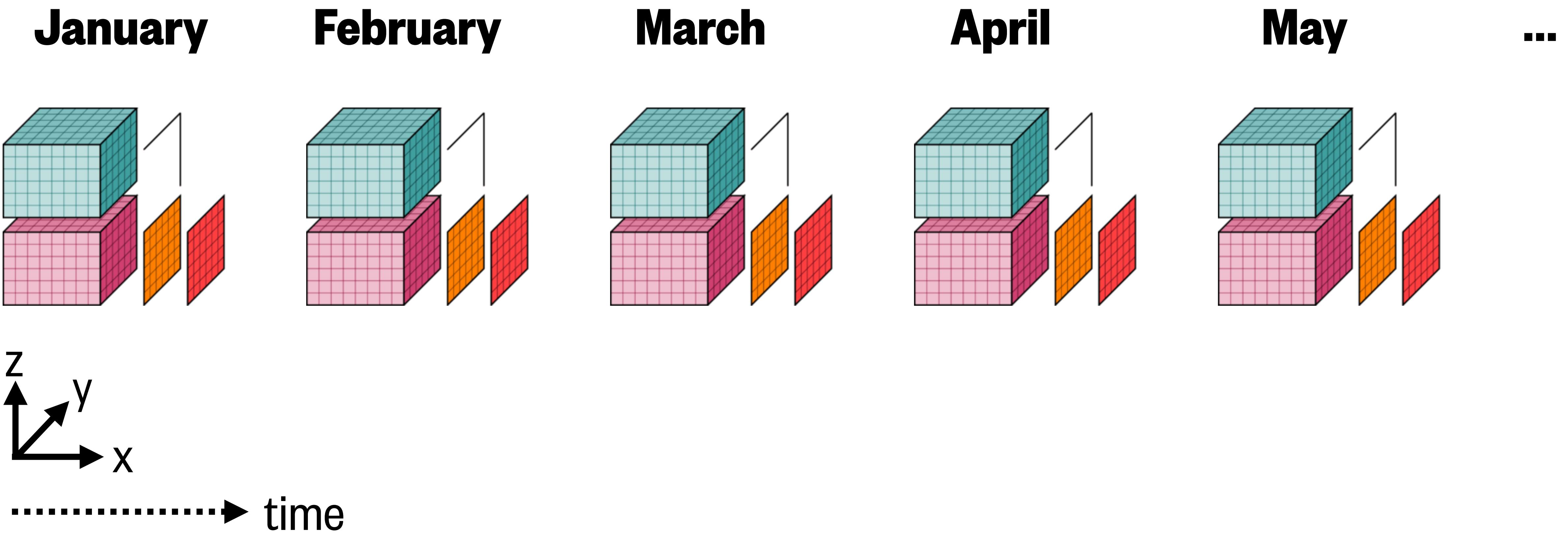
xarray lets us deal with gridded data...

... and gridded data is usually provided in a **netCDF file (.nc)**



Source: [Matthew Rocklin](#)

4-D data is usually 3-D in space (x, y, z) + time



Source: [xarray](#)

Demo: Southern Ocean current velocities from a climate model

File (~400 MB):

`bsose_monthly_velocities.nc`

Data source:

B-SOSE (Southern Ocean State Estimate) model output

Data resolution:

Time: monthly for 2012

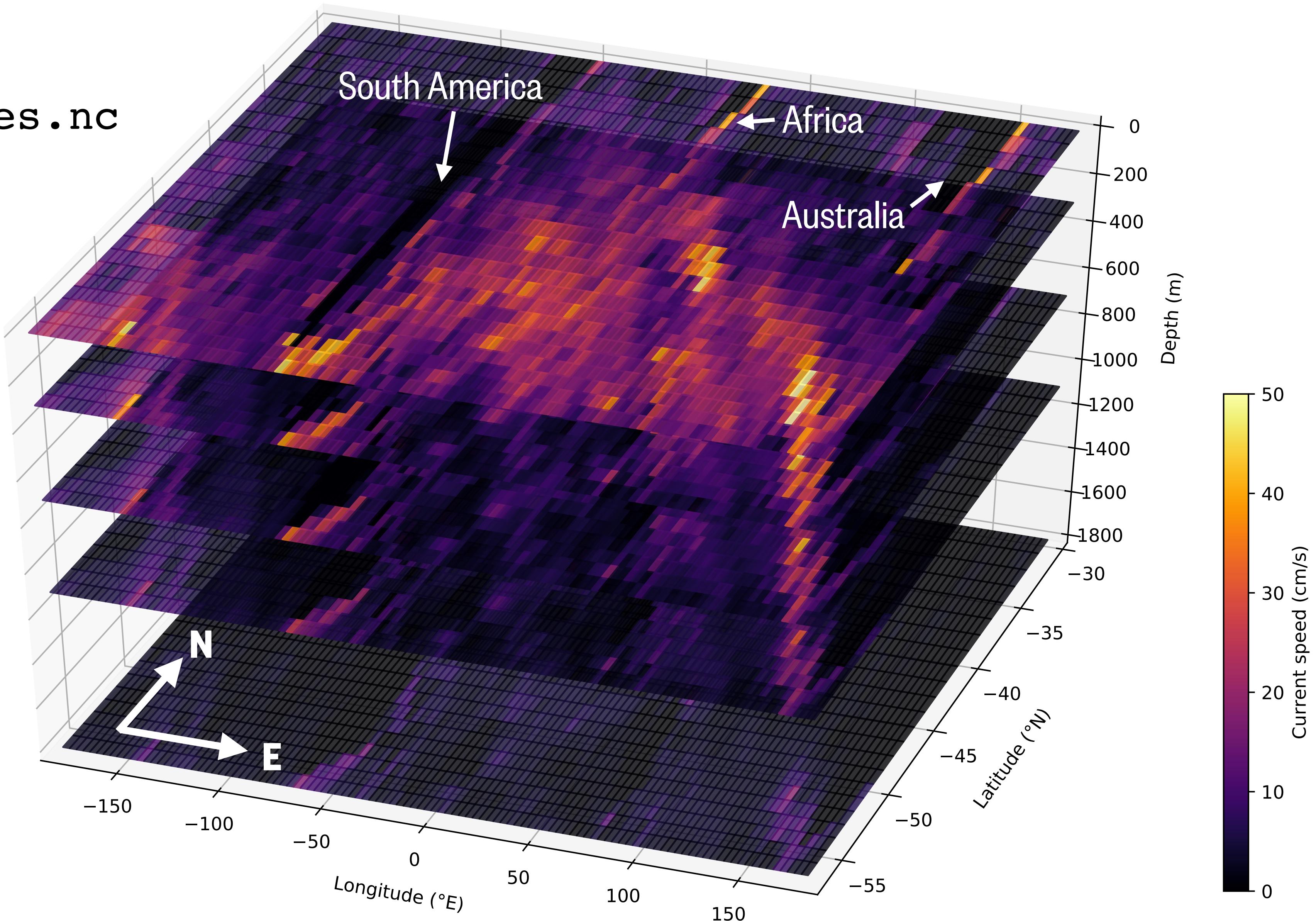
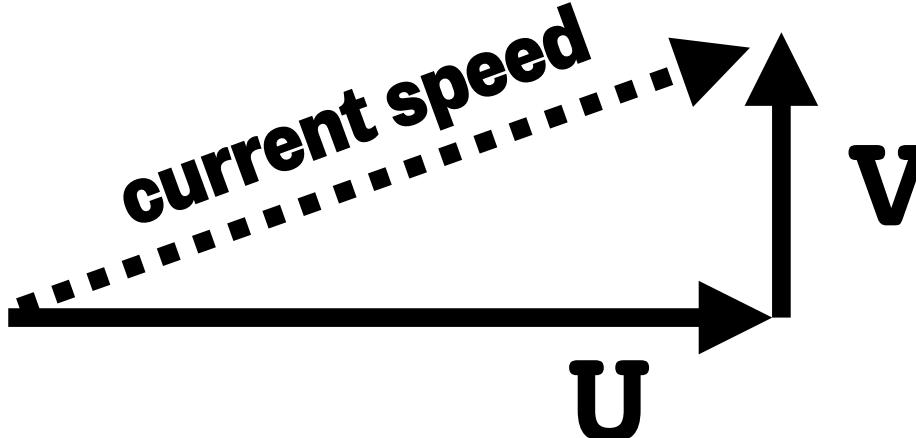
Horizontal: $1/3^\circ$ lat-lon grid

Vertical: 13 depth levels

Variables:

U: eastward velocity

V: northward velocity



Getting information about a Dataset

`display(<Dataset variable>)`

xarray.Dataset

► Dimensions: (**depth: 13, lat: 294, lon: 1080, time: 12**)

▼ Coordinates:

time	(time)	datetime64[ns]	2012-01-30T20:00:00 ... 2012-12-30T1...	 
lat	(lat)	float32	-77.96525 -77.89555 ... -29.789328	 
lon	(lon)	float32	-179.66667 -179.33333 ... 180.0	 
depth	(depth)	float32	2.1 26.25 65.0 ... 3000.0 4600.0	 

▼ Data variables:

U	(time, depth, lat, lon)	float32	0.0 0.0 0.0 0.0 ... 0.0 0.0 0.0 0.0	 
V	(time, depth, lat, lon)	float32	0.0 0.0 0.0 0.0 ... 0.0 0.0 0.0 0.0	 

► Attributes: (0)

Selecting data from xarray objects using .sel() (selection by coordinate value)

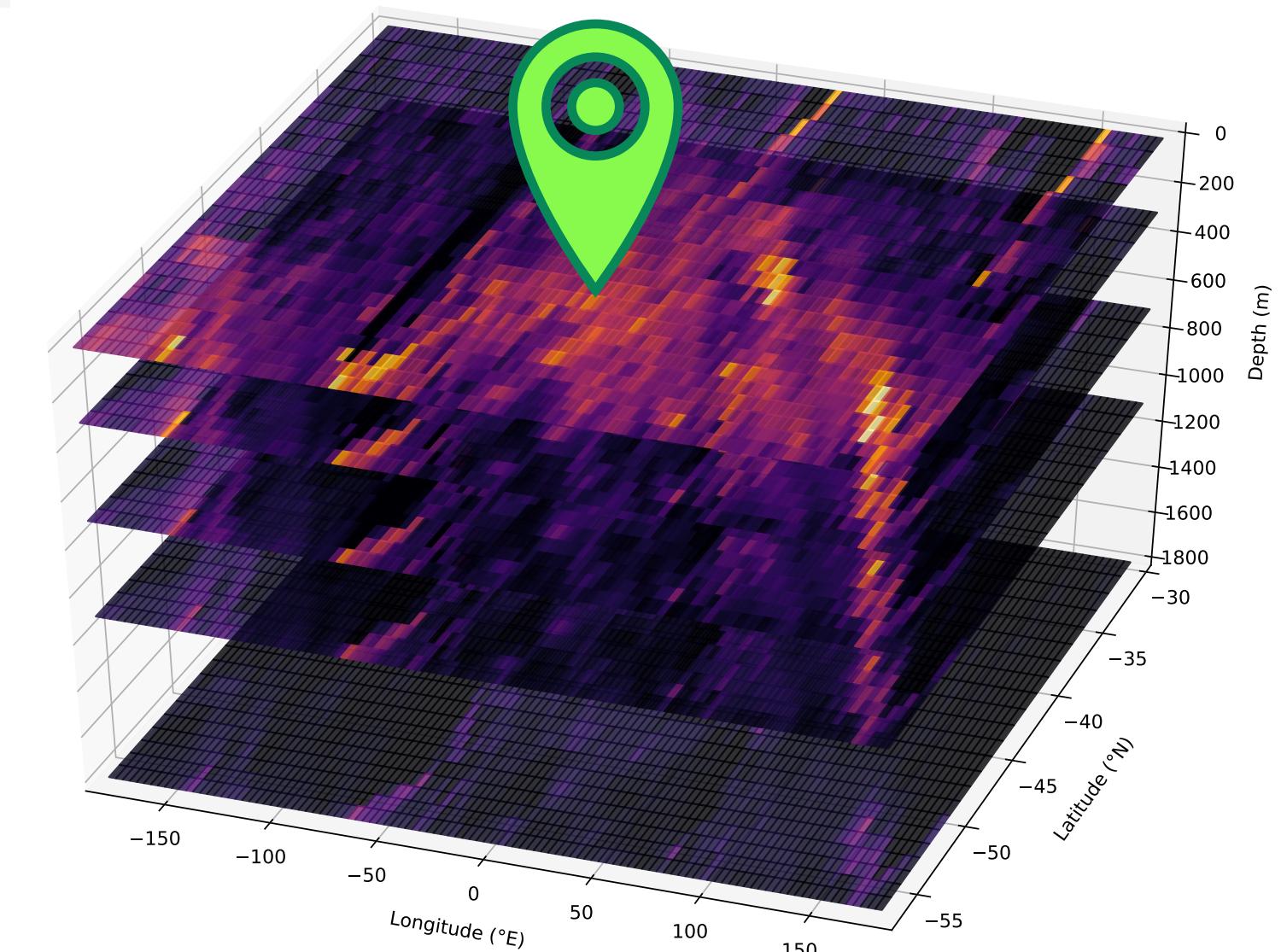
Use method='nearest' when you don't know the exact coordinate values...

<dataArray or Dataset> . sel (<coordinate name>=<a single coordinate value>, ... ,
method= ' nearest ')

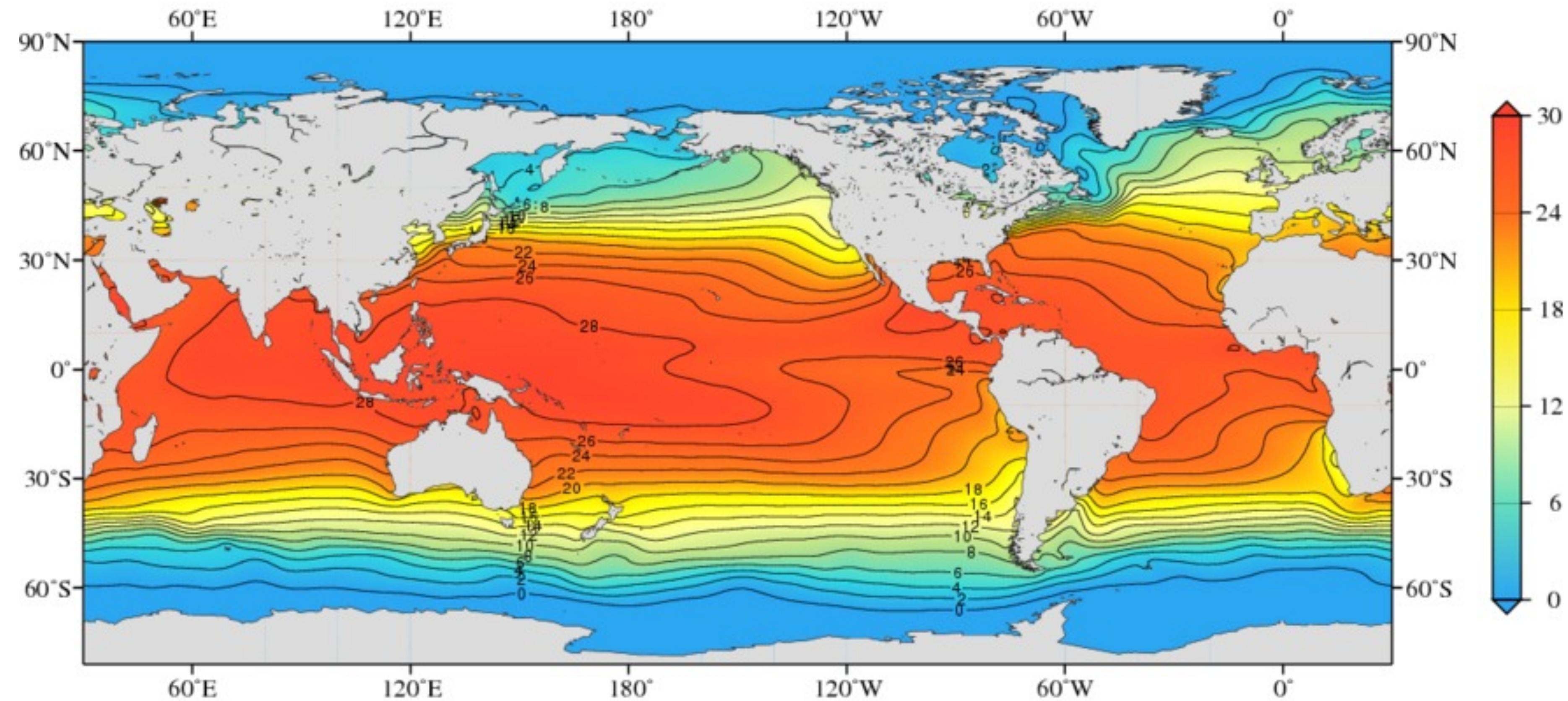
Example:

```
1 data['U'].sel(time=datetime(2012,1,30),lat=-53,lon=-13,depth=2,method='nearest')
```

```
xarray.DataArray 'U'  
0.12865335  
▼ Coordinates:  
time      () datetime64[ns] 2012-01-30T20:00:00  
lat       () float32 -52.90755  
lon       () float32 -13.0  
depth     () float32 2.1  
▼ Attributes:  
units :      meters/second  
long_name :  Zonal Component of Velocity (m/s)  
standard_name : UVEL  
mate :       VVEL
```



xarray activity: World Ocean Atlas ocean temperatures



Google Doc with activities (also accessible from Canvas Modules or Google Drive folder):

<https://tinyurl.com/OCEAN215-Class11>

Interpreting error messages

What to do when things go wrong:

```
1 import numpy as np
2
3 array1 = np.array([1,2,3,4,5,6])
4 print(arral)
```

```
NameError                                Traceback (most recent call last)
<ipython-input-2-c46f69a08ac5> in <module>()
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      3 array1 = np.array([1,2,3,4,5,6])
----> 4 print(arral)

NameError: name 'arral' is not defined
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1 import numpy as np
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3 string1 = 'This is a string'
4 print(string1)
5 print(array1)
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```
File "<ipython-input-11-0802b516da26>", line 5
    print(array1)
^

SyntaxError: invalid syntax
```

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1 list1 = [1,2,3,4,5,6]
2 sub_list = list1-1
3 print(sub_list)
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<ipython-input-12-732eed5f4882> in <module>()
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Error messages tell you what line your error is on! ***mostly***
Error messages also tell you what went wrong in the code.

My code isn't working :-(

Start here...

yes

Do you get an error when you run the code?

no

Does the code use loops or if statements?

if

A variable that should contain a value does not
You are storing the return value of a function which changes the variable itself (e.g. sort)

A number which should be a fraction is coming out as zero in Python 2
You are dividing integers rather than floats.
Convert the numbers to floats or from __future__ import division

I am reading a file but getting no input
You have already read the contents of the file earlier in the code, so the cursor is at the end.

neither

A list which should have a value for every iteration only has a single value
You have defined the list inside the loop: move it outside

A loop which uses the range function misses out the last value
The range function is exclusive at the finish: increase it by one.

loops

I'm trying to print a value but getting a weird-looking string
You are printing an object (e.g. a FileObject) when you want the result of calling a method on the object

A regular expression is not matching when I expect it to
You have forgotten to use raw strings or escape backslash characters

I am trying to loop over a collection of strings, but am getting individual characters
You are iterating over a string by mistake

I am trying to write multiple lines to a file but only getting a single one
You have opened the file inside the loop: move it outside

also check...

Attribute Error

You are calling a method on the wrong type of object

SyntaxError

You've forgotten the quotes around a string

You have forgotten to put a colon at the end of a def/if/for line

You have different number of open and close brackets in a statement

TypeError

You're trying to use an operator on the wrong type of objects

An object which you expect to have a value is actually None

You've used non-integer numbers in a list slice

You've called a method/function with the wrong number or type of arguments

Indentation Error

You've used a mixture of tabs and spaces

You haven't indented all lines in a block equally

What type of error do you get?

NameError

You've misspelt a variable, function or method name

You've forgotten to import a module

You've forgotten to define a variable

Your code uses a variable outside the scope where it's defined

Your code calls a function before it's defined

You're trying to print a single word and have forgotten the quotes

IOError

You're trying to open a file that doesn't exist

KeyError

You're trying to look up a key that doesn't exist in a dict