Python seminar Homework for Chap. 7.3 No.3

Please plot δ^{18}O field which will be precipitated to otolith of fish from a data assimilated ocean model simulation output.
For the data assimilated ocean model data, FORA-WNP30 (Four-dimensional Variational Ocean ReAnalysis for the Western North Pacific) will be used.
FORA-WNP30 data can be available from
https://data.diasjp.net/dl/storages/filelist/dataset:269

The user registration is needed to login to DIAS.

Now we assume that we have otolith δ^{18}O data which corresponds to 21-30 June 2014 (correct otolith powder from 10-day rings and analyzed) and the data showed -1.5‰. Please draw map for the possible distribution of the fish during the period with an assumption the fish is in the surface.

First, please download FRA-WNP30 during 21st – 30th June 2014.

To see the variables in a netcdf file, the following commands are helpful.
        print (nc.dimensions)
        print (nc.variables)
The time in the data is "days since 1970-01-01". You can convert the value using following command.
adate=pd.to_timedelta(time[:],unit='D')+pd.to_datetime("1970/01/01")

Please pay attention that
1. Temperature is potential temperature and off set is 273.15.
   If you want to calculate in the deep ocean, you should convert to in situ temperature.
2. Salinity is psu. Please convert to normal salinity divided by 1000.

Based on Legrande and Schmidt (2006, GRL), δ^{18}O of water (‰) : d18o_water = 0.44*salinigy -15.13 for North Pacific.
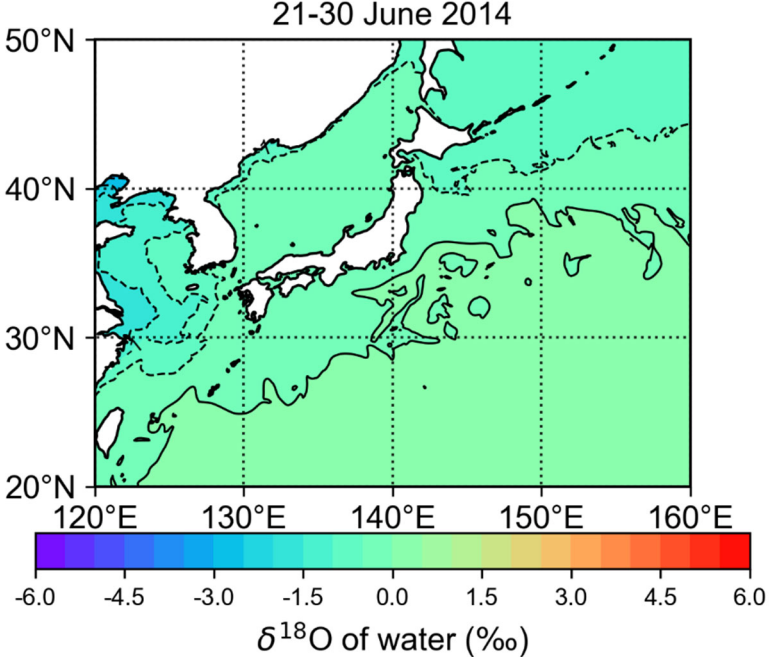Based on Enomotomo et al. (submitted to Prog. Oceanogr.), Temperature (°C) = $-2.92 \times (\delta18Ootolith - d18o\_water(‰)) + 16.32$, where $\delta18Ootolith$ is δ^{18}O of otolith if the fish is jack mackerel.
Assume the accuracy of δ^{18}O is 0.2 ‰.

Step 1: draw temperature and salinity field
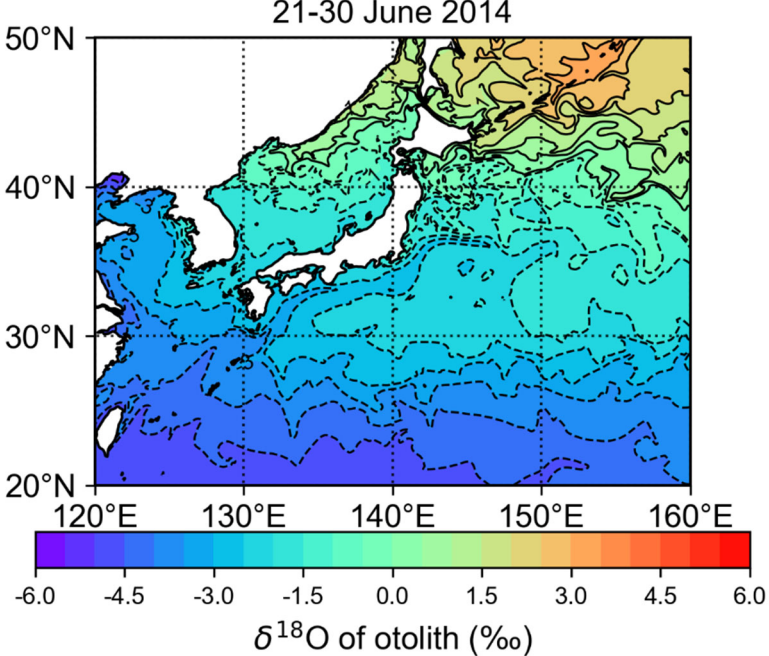

21-30 June 2014

salinity

21-30 June 2014

temp. ($^{\circ}C$)
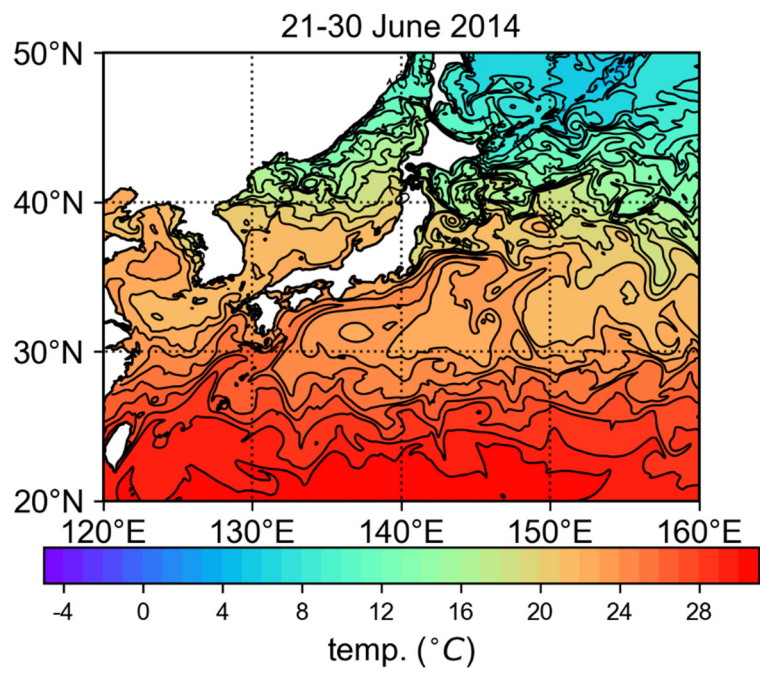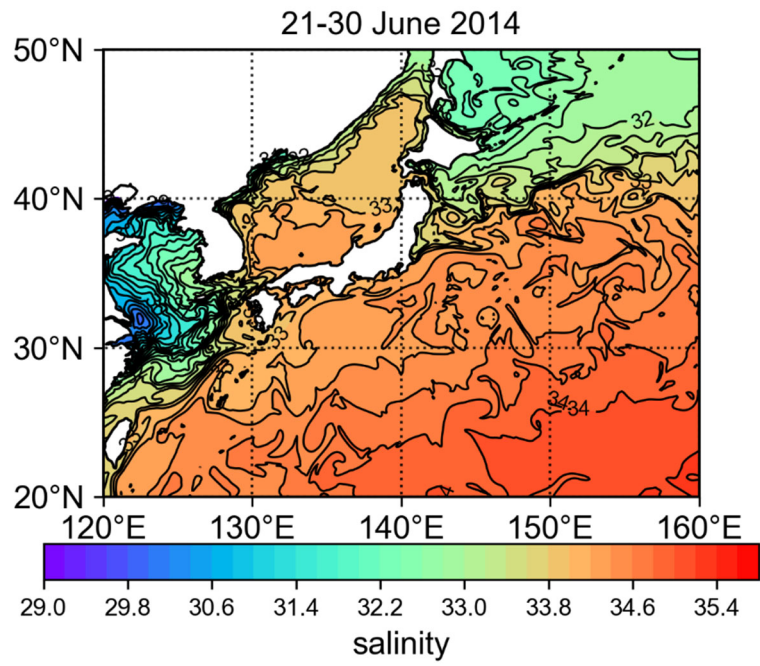
Step 2: calculate δ¹⁸O of water (‰) from salinity

21-30 June 2014

$\delta^{18}O$ of water (‰)

Step 3: calculate δ¹⁸O of otolith (‰) from temperature and δ¹⁸O of water (‰).

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$\delta^{18}O$ of otolith (‰)

Step 4: Draw possible distibution.

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$\delta^{18}O$ of otolith deviation (‰)