→ 5th ESA ADVANCED TRAINING ON OCEAN REMOTE SENSING AND SYNERGY

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Author

Interactive lecture 14

Atmosphere – ocean (Air-sea) CO_2 fluxes

The air-sea flux of CO_2 is estimated using:

$$F = k\,(\alpha_w\, pCO_{2w} - \alpha_s\, pCO_{2a}\,)$$

α = solubility, at depth (w), at the interface or skin (s)
k = gas transfer velocity
pCO_2 = partial pressure of CO_2, at depth (w), at the interface (a)

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All of this equation can be parameterised to use a combination of EO, in situ and model data to allow Earth observation-based estimates of air-sea gas fluxes

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Now, we are all going to do this!

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First we need to calculate the gas transfer velocity, k.

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Dataset file: OF-climatology-v095.tgz

The zip file contains a series of directories and netcdf files in month directories.

In SNAP, choose one NetCDF file.

1. File-> open product (CF compliant NetCDF) ->WS1_mean ->open image window.
2. File-> open product (CF compliant NetCDF) ->ST1_mean ->open image window.
3. These are 1x1 degree wind (WS1) and SST (ST1) datasets.
4. For each layer/dataset:
    1. Layer -> world map overlay to add land.
    2. View their histograms, what are the mean and upper and lower values of each distribution?
    3. View -> tool windows -> color manipulation. Import and apply the 7_colors.cpd palette.
5. Now we can use empirical relationships to exploit these data in synergy.

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The Schmidt number (Sc) scaling:

$$Sc = 2073.1 - (125.62 * sst) + (3.6276 * (sst * sst)) - (0.043219 * (sst * sst * sst))$$

Where SST is in ^{o}C.

The Gas transfer velocity :

$k = (660.0/Sc)^{0.5}\ 0.26U_{10}^{2}$ (in cm hr^{-1}) and wind speed at 10m is in ms^{-1}

1. Raster -> band maths. Use the wind dataset to calculate the schmidt number and then the gas transfer velocity.
2. Check your results. The SC data layer in the NetCDF file is the Schmidt number. The OK3 data layer in the NetCDF file is the gas transfer velocity. E.g. Use 'band maths' to difference your result with that in the NetCDF file.
3. Now calculate the air-sea CO_2 flux. In the NetCDF file, OSFC is the waterside concentration, OIC1 is the airside. So your 'gas transfer x (OSFC – OIC1)' = the air-sea CO2 gas flux.
4. Check your results. The OF field in the NetCDF file is the air-sea flux. Is your result the same as the OF field? Why are they different?
5. Units. Work out the unit issue and apply a correction into your 'band maths'. Check your results again.
6. You can now use SNAP to exploit SST and Wind EO data in synergy through empirical algorithms.