# Processing FCS .sat files

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FCS turbulence data are transmitted within .sat files. For the Arcterx23 cruise, there were two units: 4002 and 4003. Hence, two files: 4002.sat and 4003.sat. These are plain text files that, after hundreds of profiles, are tens of thousands of lines.

The files are saved on Ganges at ganges/data/arcterx23/sat/

A single dive (upcast, downcast, and surface wave spectrum) produces approximately 5000 bytes of turbulence data. This is split up into packets of 1920 bytes. Hence, there are typically two full packets and a third partial packet. These packets are reported as a sequence of hexadecimal strings.

The file **parse\_fcs\_sat\_file.m**

* takes the 2 (or 3 or 4) packets
* combines them into one full dive packet
* separates them out into downcast, upcast and surface wave profile
* reads the timestamps within the packets
* converts from hexadecimal to a binary format that can be read by comp\_load\_solo2.m
* creates a mat file with dive locations

Ultimately, **parse\_fcs\_sat\_file.m** takes a .sat file and creates exactly the same files that are saved on the SD card. It saves the files to the directory defined by binary\_out\_directory near the start of the function. This directory should include the subdirectory 4002/ or 4003/ at the end

The script **convert\_comp\_to\_mat.m** then processes the compressed binary files to get turbulence quantities. It does this using the processing code on Github: github.com/OceanMixingGroup/flippin-chi-solo. The output of the conversion script is a cell array with a length equal to the number of profiles. Each element of the cell array is a struct with variables such as P, T1, T2, Wspd, eps1, eps2, dTdz, etc.

The output of **convert\_comp\_to\_mat.m** is then fed into **arcterx23\_create\_mat\_summary.m** to create a gridded dataset.

For future deployments, the following things will need to be updated:

1. File paths, which are always defined near the top of the files.
2. Values for ignore\_dives, defined in parse\_fcs\_sat\_file.m
3. Details within parse\_fcs\_sat\_file.m: function manually\_remove\_bad\_bits
4. Details within arcterx23\_create\_mat\_summary.m: function manually\_remove\_bad\_vals

## Details of the .sat file

A full packet (60 lines) within the .sat file looks like either

HX00 140 3840 64 1

+ffff0000ffff0000a8137764220007000300010002000200030005000c007000

+ac0037009a00be017f012f021e044201820070025401c1011a026e01d1001902

+a9028a007a02ef003900b8009c022e04d201580227012d0021009e000901ce00

+6b0108018c005500f300c9009700c40085005e0085005c006300a6000a012501

+030189003c00840083010b01ffffffff41147764521c00000000000000000000

+000000000000000000000000000bcbc7c7c1a4a0a4a0e5c51ac6d50c0104bcb9

+bbb16b686b647ac6adc6e70c0201c6bbc9b187818b848fc6c2c6110d0301bfc2

HX00 140 3840 64 2   
[… n lines starting with +]

+80745556534cceb696b653a994347e747e7f5d56605bc9b691b66caa952f827d

+89826d606b64d7b69fb686abffffffffa7187764501c00000000000000000000

+0000000000000000000000000075a29a9d97605a625c4ab81cb82a9a01728485

+8584686364657ab84eb8c597027390878f84756f776f79b955b960950371a29b  
[… (56-n) more lines starting with +]

A partial packet might look something like

HX00 140 368 64 3   
[… some number of lines starting with +]+c3b5bbb1b9b05cbfa4c07b0b4401c9c8d1c8ada5aba704c0f6c0520b4500d3d3

+d9d6c0b9beb883c1e3c1610b4600dbd8dbd5b8b1b7b1f4c263c3500b4701dbd2

+d7d0b4adb2aeeec1a4c2500b4801d1d0cfd7b7b3b7b2cbbdb4be4e0b4900c6c3

+c5bfa9a5a4a3b4bc08be740b

140 is the dive number. The 1, 2, and 3 are the packet numbers. In the sat file, the packets are not always in order.

ffff0000ffff0000 is a key defining the start of a surface wave spectrum. The next 8 characters (4 bytes) is a date. The next 256 characters (128 bytes) are 64 values of the wave acceleration spectrum. Sometimes this information is missing from a dive, so the packet starts with ffffffff instead.

ffffffff is a key defining the start of a profile (either up or down). The next 8 characters is a date. Then 4 nonzero characters (?) and 46 zeros. After that are blocks of 32 characters (16 bytes). See comp\_load\_solo2.m for details.

Also in the sat file is the location data.

G 140 1 31 May 2023 09:30 +19 30.10 +141 34.73 20 13 33 39 48 0.7 0 19.50159 141.57889

There are actually two G lines (start and end of dive). Which one we use doesn’t really matter.