# Using MODUS toolbox with ReDAPT MetOcean data

* MATLAB processing scripts are provided for use to streamline processing of sub-sets of MetOcean data from the ReDAPT project
  + The available ‘Data query’ script must be used to extract desired data sub-set from CUBE
* Tools for different steps in processing turbulence metrics have been kept separate to allow each to be used in isolation or modified/adapted as desired, making the toolbox as modular as possible.
* Functions have been developed to process one sensor direction/beam at a time. Processing of multiple directions/beams in series must be implemented by the user
* An example script that implements all sub-functions to process a dataset is included in the toolbox folder – see: ‘Process\_data\_v1.mat’
* An example script to consolidate results values across multiple processed datafiles is included in the toolbox folder – see: ‘Consolidate\_Data\_v1.mat’
* Further information and relevant references or description of method is provided in the documentation specific to each function/script.

**Nomenclature:**

|  |  |
| --- | --- |
|  |  |
| CUBE | The CUBE dataset – ALL available post-processed data from the ReDAPT project ( >200 GB) |
| Hm0 | Significant wave height |
| Ref (data) | Reference data regarding sensor/data properties as included with extracted subsets of MetOcean data from CUBE – eg. Uref, hm0 |
| PSD | Power Spectral Density |
| QC | Quality Control |
| Rstress | Reynolds stress |
| TI | Turbulence intensity |
| TKE | Tubulent kinetic energy |
| Tref | Reference timestamp (for reference data values) – in increments equal to length of Tstat |
| Tstat | Period of stationarity (default is 5 minutes) |
| Uref | Reference velocity – Mean rotor average inflow for each Tstat |

## Function List

|  |  |
| --- | --- |
| **Function** | **Description** |
| get\_hm0\_ | Gets significant wave height from CUBE\_lite reference dataset that matches data in subset that is to be processed (requires path to ‘cube\_refs.mat’) |
| trim\_refdata | Trims reference data (Tref, Uref) to match only periods when measured sensor data is available in dataset. |
| Tstat\_reshape\_ | Reshapes measured datasets into periods of stationarity – adds additional dimension to measured data arrays. |
| interp\_QC\_ | Interpolates across small gaps in data, ‘kills’ Tstat ensembles that contain more than the user defined percentage of NaN values (sets all values to NaN) |
| detrend\_lin3D\_ | Uses least squares regression to remove linear trend from each Tstat, ignoring any NaN values. Also outputs mean and standard deviation of Tstats. |
| PSD\_noisebias\_ | Finds sensor Doppler noise bias using fits to PSD plots (Richard, 2013) |
| calc\_Lscale\_ | Calculates integral lengthscales using autocorrelation function method for each Tstat |
| calc\_TI\_ | Calculates noise-corrected TI values for each Tstat. |
| calc\_TKE\_Rstress | Calculates TKE and Reynolds stresses (xz & yz) for each Tstat |

## Supporting Functions/Files:

These must be in same folder, or on MATLAB filepath:

|  |  |
| --- | --- |
| Interp1gap.mat | Function used in interp\_QC\_ |
| Cube\_refs.mat | Used by get\_hm0\_ – contains reference values for all data in CUBE. Can also be used to get other reference data if desired |
|  |  |

## Process Flowchart

Recommended/example order of use of functions. Steps that must be user-implemented are noted with yellow border. It is assumed that data has already been extracted from CUBE using the available Query script (as per Brian Sellar) and resulting ‘datafiles’ are located in the same folder.

Load (next) datafile

Copy reference data from datafile to results struct

get\_hm0\_v1

trim\_refdata\_v1

Detrend\_lin3D\_v2 (direction/beam )

Find/collate only slack water Tstat’s

PSD\_noisebias\_v1

calc\_Lscale\_v1

**ONLY SBD**

calc\_TI\_v2

Calc\_TKE\_Rstress\_v1 **ONLY ADCP**

Save output data

For each beam/direction

For each datafile

## Further Work

* Smoothing of ACF for lengthscale calculation – is it appropriate? Does it improve values?
* Definition of integral lengthscale from ACF – check ESDU guidance? – centrum of area under ACF or zero crossing point?
* Pitch & roll corrections for TKE & Rstress – is it possible for ADCP data? Does it make significant difference?
* Effect of ADCP heading on TKE & Rstress – how big is effect? How does it bias results?