

# WTIMTS

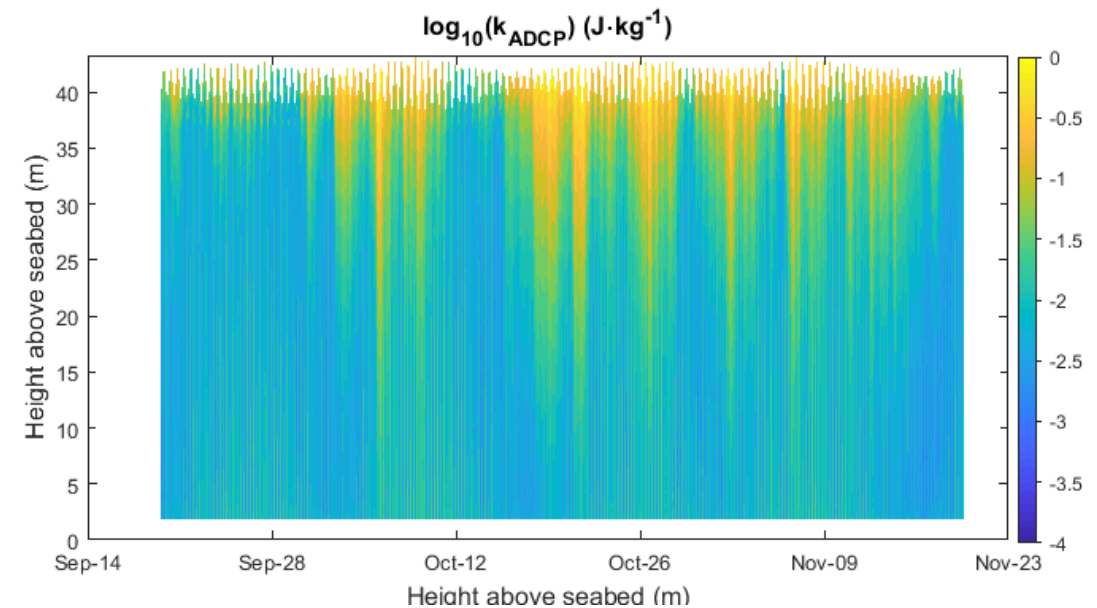
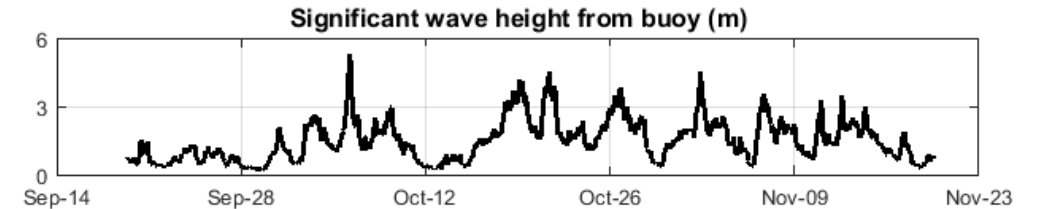
## Wave and turbulence interaction and measurement at tidal sites

*End of project summary*

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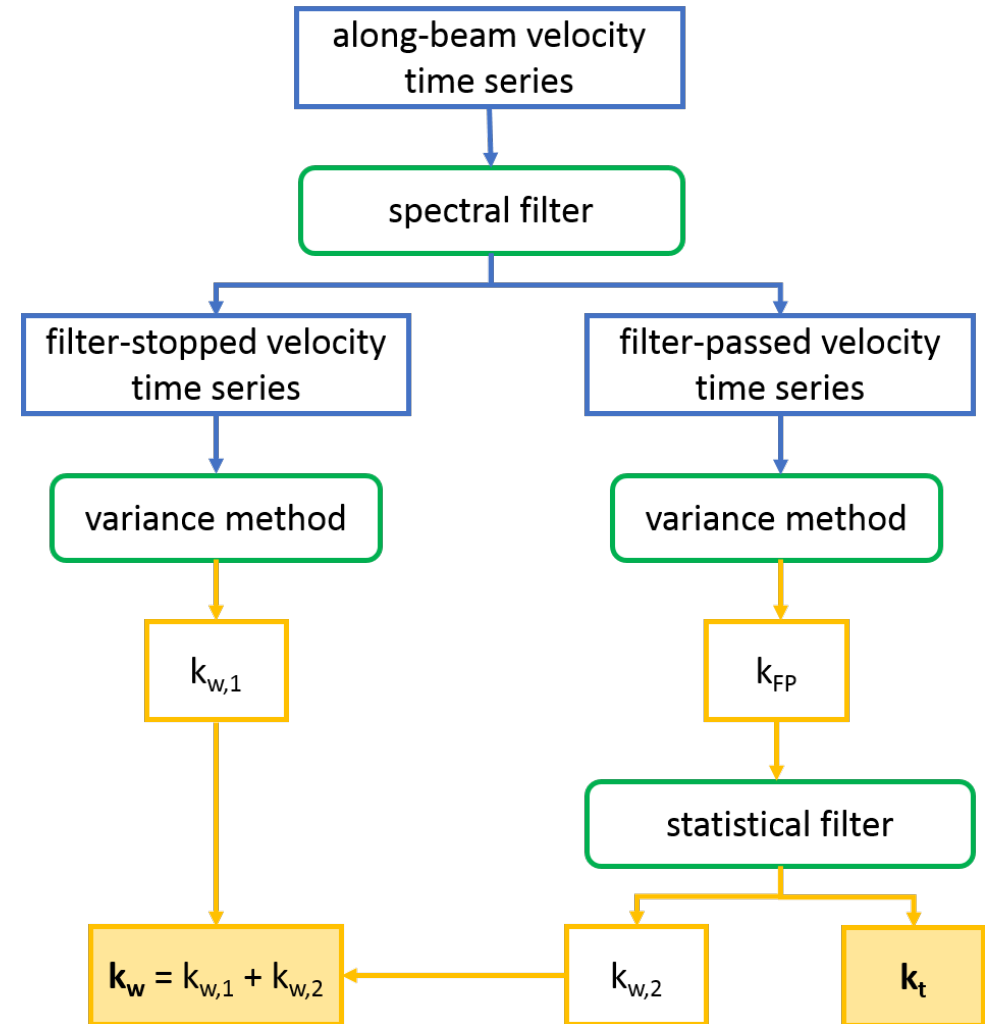
# What need does WTIMTS address?

- ADCPs are the most important tool for measuring turbulence at tidal energy sites
- However, it is difficult for an ADCP to distinguish real turbulence from wave-related pseudo-turbulence
- At sites with significant waves, estimates of turbulent kinetic energy  $k$  can be two orders of magnitude above the true level
- WTIMTS addresses the need for a consistent, broadly-applicable method to separate wave & turbulence effects



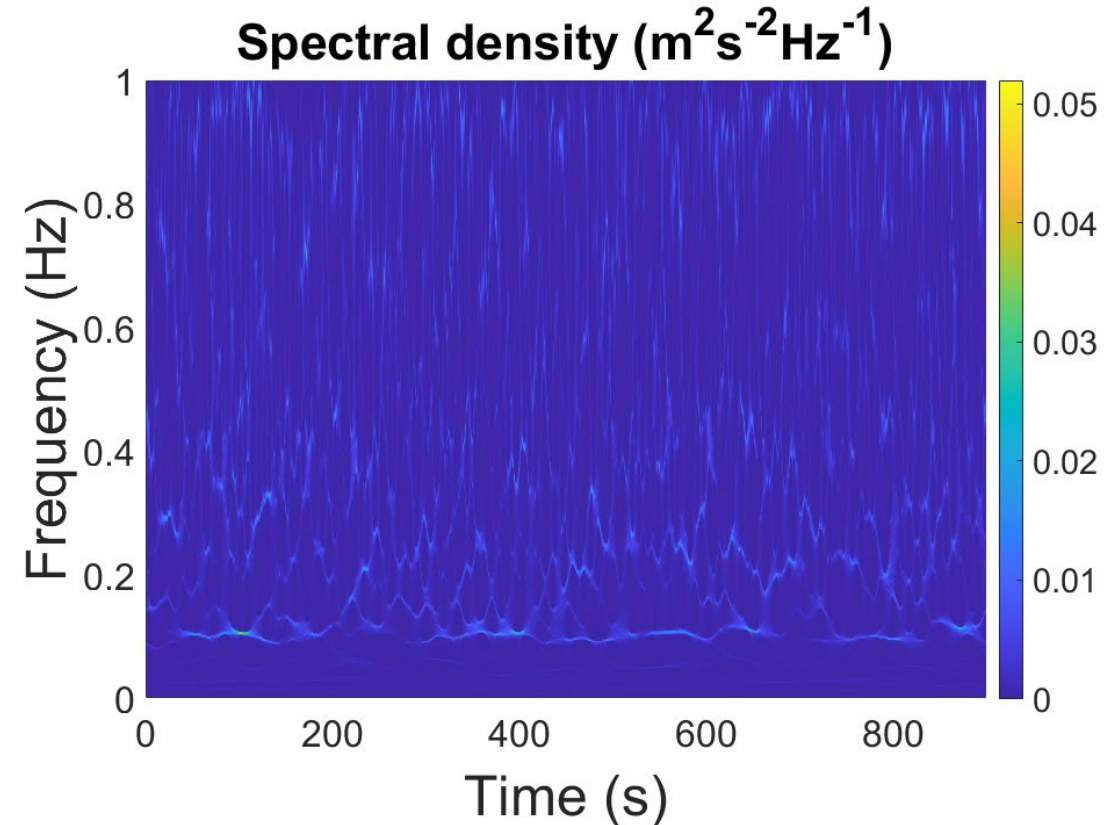
# How does WTIMTS address this?

- Previous solutions have used one of two properties of waves measured by ADCPs:
  - They are spectrally local, *OR*
  - They are correlated with other wave estimates
- This has motivated either a *spectral* or *statistical* filtering approach
- However, there is no technical barrier to using both types of filter: WTIMTS improves on past efforts using a combined filter
- A spectral filter partially isolates wave activity from velocity records, then a statistical filter is applied to the whole record of  $k$  values



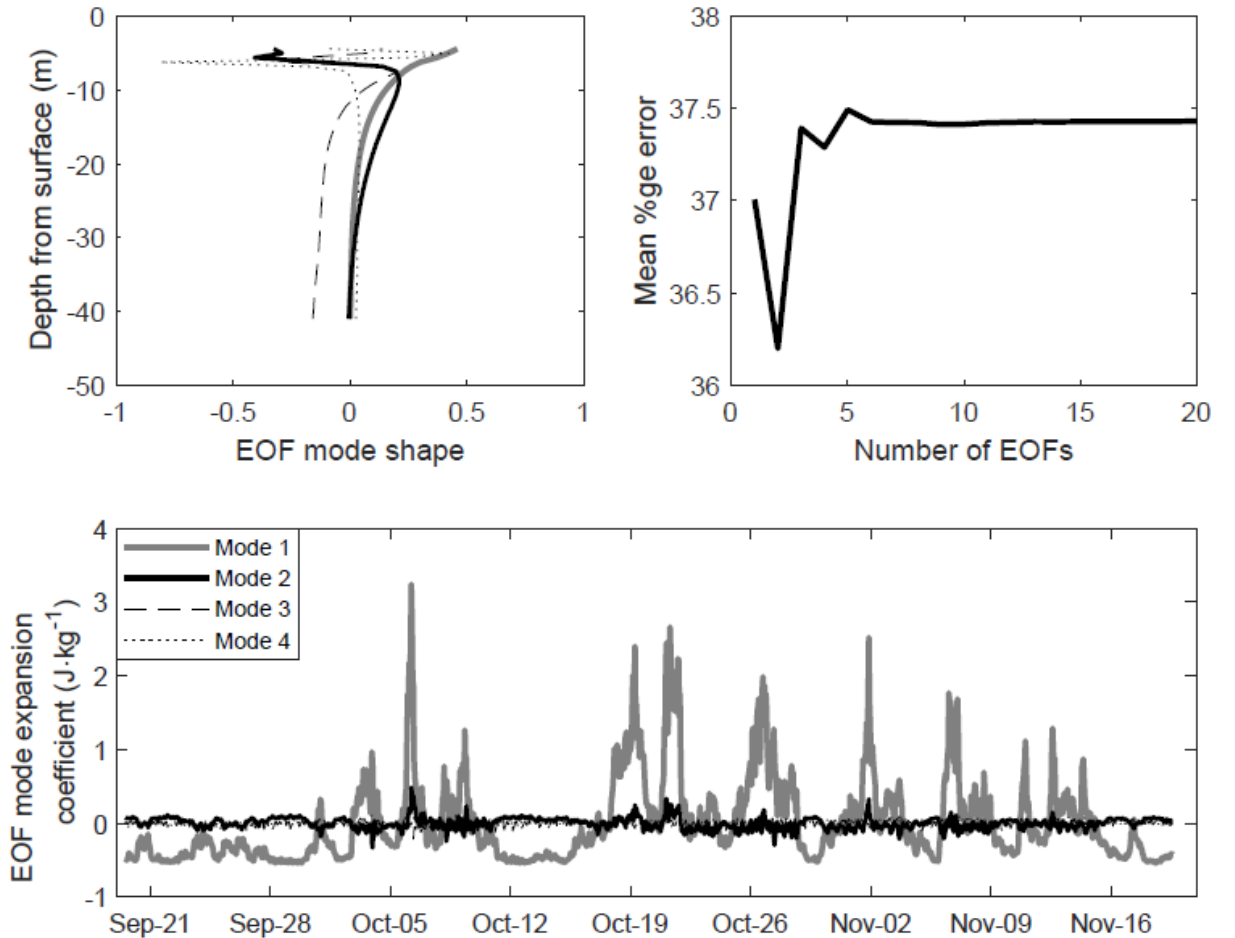
# How does the spectral filter work?

- A wavelet synchro-squeeze transform is used to obtain a periodogram-like representation of the spectral peaks for short bursts of velocity measurements (typically 15 minutes)
- We find the peak at each moment in time, decide if it is wave-related, and if it is we apply a band-stop filter at that frequency
- The stopped velocities contain only wave activity, the passed velocities contain turbulent activities with a remainder of waves



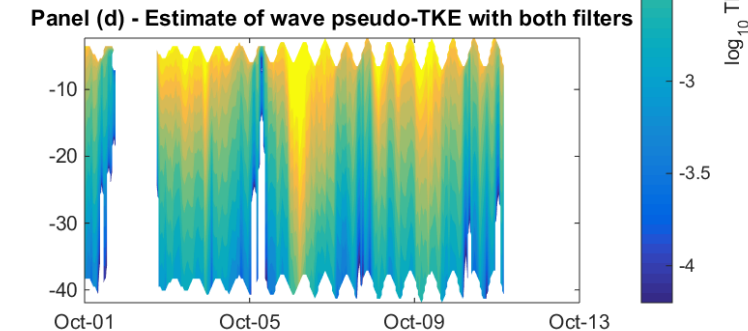
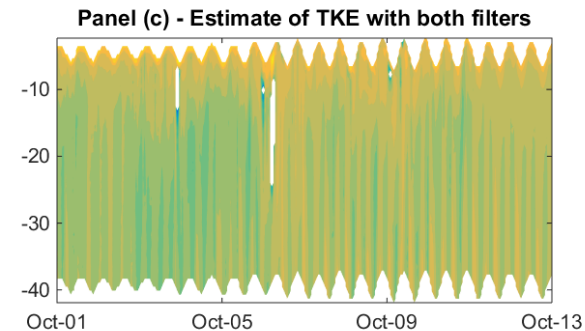
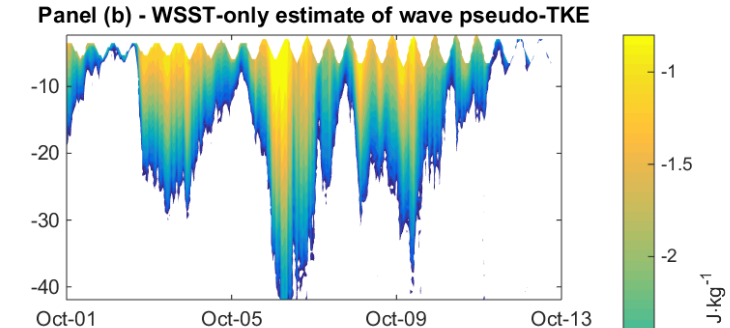
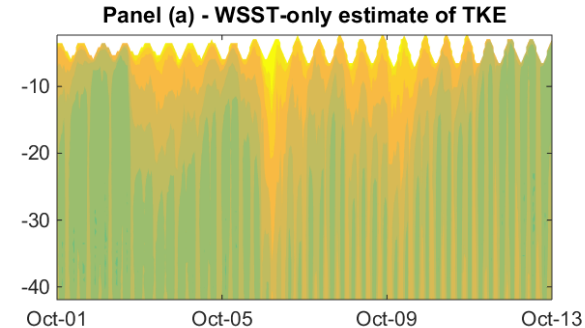
# How does the statistical filter work?

- Empirical orthogonal function analysis separates the calculated  $k$  values into a sum of space and time modes
- The largest modes explain the largest proportion of the autocovariance
  - If waves dominate, they will be very strongly associated with the first mode
  - This can be confirmed by correlation of first mode with other wave measures
- Subtracting the first mode therefore removes most remaining wave effects



# How well does the filter perform?

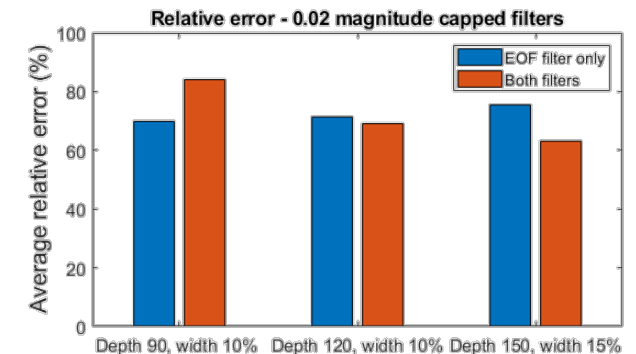
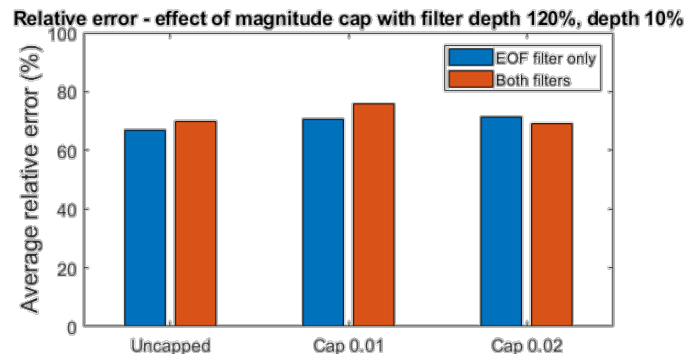
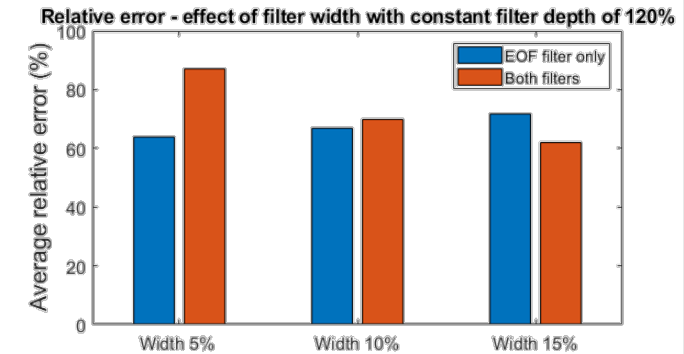
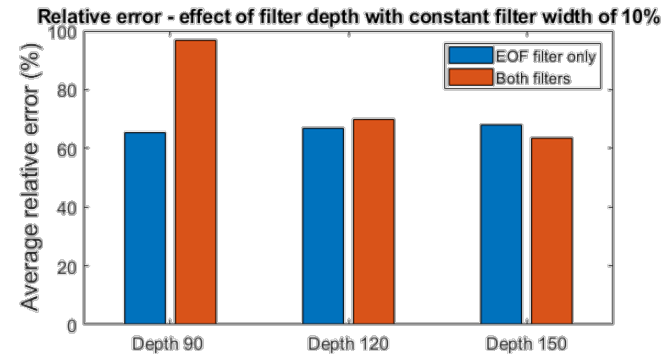
- Compared to both single-filter methods, the combined filter clearly improves removal of wave influence from estimated  $k$ :
  - Near-surface maxima are reduced
  - Removal of strong wave events is more complete
- Wave-driven pseudo- $k$  is also more satisfactory:
  - No significant semidiurnality
  - Correctly vanishes at times of low wave action





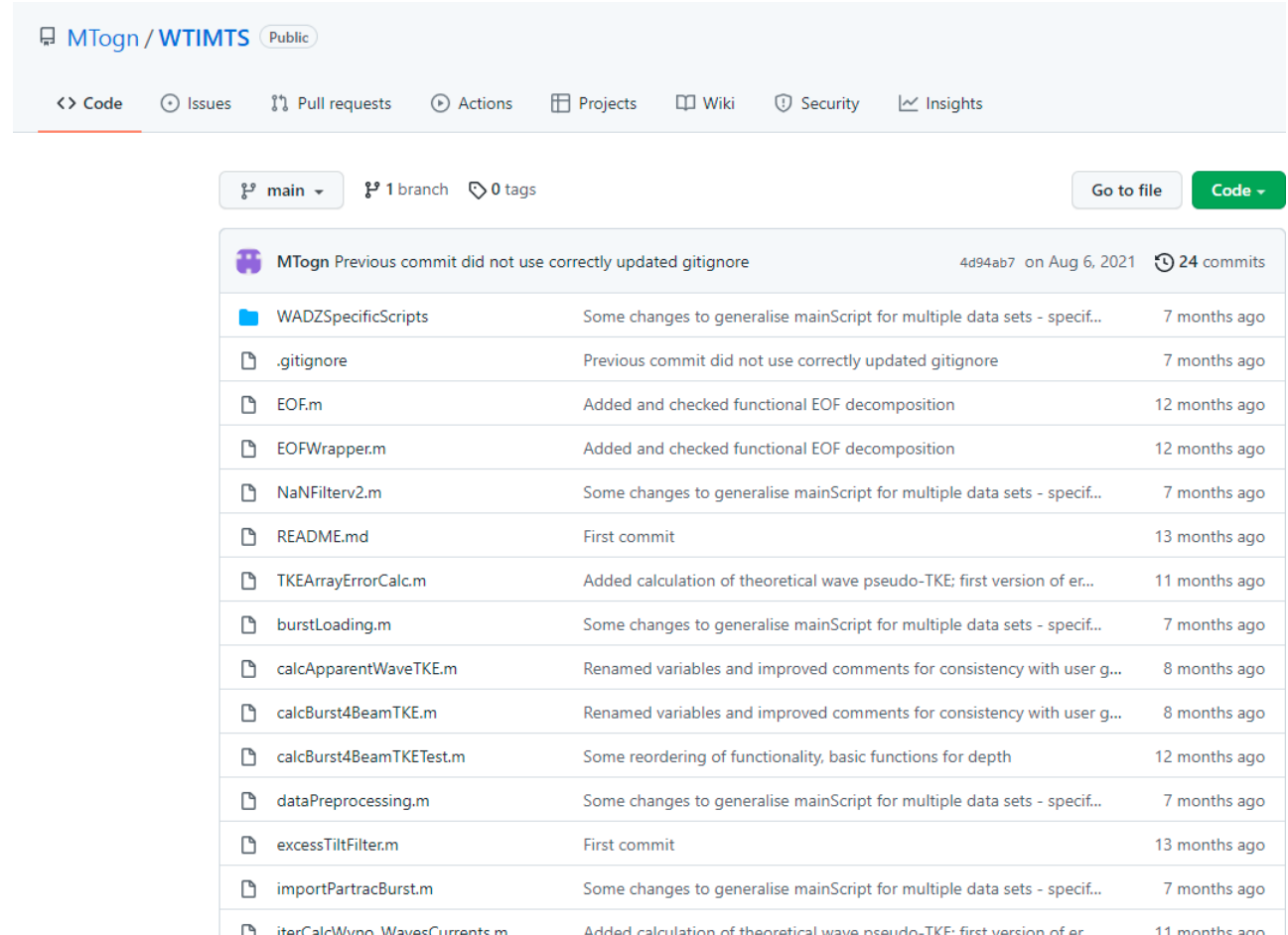
# How well does the filter perform?

- As well as qualitative assessment, if we have independent wave data we can quantify the improvement in estimates of wave pseudo- $k$
- More aggressive spectral filters (covering a wider frequency range and removing more power) show better improvements
- Improvement in  $k$  cannot be directly quantified, because independent estimates of  $k$  are not available



# What happens next?

- The code for the filter has been documented and made freely available:  
[github.com\MTogn\WTIMTS](https://github.com/MTogn/WTIMTS)
- Virtual velocity data could allow quantifying filter improvement in estimates of  $k$
- Analyse data from other sites to see how method performs at more/less sheltered locations



The screenshot shows the GitHub repository page for MTogn/WTIMTS. The repository is public and has 24 commits. The commit history is as follows:

File	Commit Message	Time
WADZSpecificScripts	Some changes to generalise mainScript for multiple data sets - specif...	7 months ago
.gitignore	Previous commit did not use correctly updated gitignore	7 months ago
EOF.m	Added and checked functional EOF decomposition	12 months ago
EOFWrapper.m	Added and checked functional EOF decomposition	12 months ago
NaNFilterv2.m	Some changes to generalise mainScript for multiple data sets - specif...	7 months ago
README.md	First commit	13 months ago
TKEArrayErrorCalc.m	Added calculation of theoretical wave pseudo-TKE; first version of er...	11 months ago
burstLoading.m	Some changes to generalise mainScript for multiple data sets - specif...	7 months ago
calcApparentWaveTKE.m	Renamed variables and improved comments for consistency with user g...	8 months ago
calcBurst4BeamTKE.m	Renamed variables and improved comments for consistency with user g...	8 months ago
calcBurst4BeamTKETest.m	Some reordering of functionality, basic functions for depth	12 months ago
dataPreprocessing.m	Some changes to generalise mainScript for multiple data sets - specif...	7 months ago
excessTiltFilter.m	First commit	13 months ago
importPartracBurst.m	Some changes to generalise mainScript for multiple data sets - specif...	7 months ago
iterCalcWvno_WavesCurrents.m	Added calculation of theoretical wave pseudo-TKE; first version of er...	11 months ago