# Standalone MASS-data processor Reference Manual

2.16

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# Contents

# Chapter 1

# Standalone ATMOS

## 1.1 Introduction

This program makes off-line processing of the MASS files. In the version 2.1 and later it contains the full pipeline starting from calculation of the instant scintillation indices. This means that all the parameters which affect the data processing in MASS observations play role here and may be altered.

The program uses the procedures and function which are identical to those used in Turbina program (v2.04 and later) which are called in the same order as in Turbina. The parameters which affect the data processing are read solely from the preamble ('P'-started) lines of the input mass-file, so, if one wants to modify, e.g., the magnification, the respective line in the mass-file should be edited.

The program outputs the atmospheric parameters in the same format as Turbina does. The standard output is used which should be redirected to the new mass-file. The original mass-file and statistic moments (stm) file constitute the input of the program. Since each line contains the UT moment reference and the unique line prefix, two files may be concatenated and sorted in a single input file (as is expected in a future Turbina generation).

## 1.2 Parameters used in data processing

Since the currently utilized versions of Turbina do not output all the needed parameters in the MASS-file, the extraction of the following device parameters in the header of the mass-file is obligatory (with help of a script cfg2mass.awk for example):

- Bicounters\Bicounter 1(2)\NonLinearityA(B)
- Bicounters\Bicounter 1(2)\NonPoissonA(B)

These parameters are assigned to the characteristics of the specific device channel (A,B,C,D) with help of four cross-linking parameters which are normally written in the mass-file:

- Bicounters\Channels\ChannelA(B,C,D)=Counter 1(2)A(B)

Alternatively, the "device-independent" form is also accepted for reprocessing (and overrides former definitions if both are present):

- Channels\ChannelA(B,C,D)\NonPoisson
- Channels\ChannelA(B,C,D)\NonLinearity
- Channels\ChannelA(B,C,D)\Scatter

This form is generated by the script param.awk. The last parameter is a new capability of the program which allows to take into account the scattered light fraction in a given channel. See SCIND module description about changes in the scintillation indices formulii.

Timing of measurements (number of base-times in an accumulation time and number of microexposures in a base-time) is taken from:

- Operations\Normal mode\BaseTime
- Operations\Normal mode\AccumTime
- Operations\Normal mode\Exposition

Together with the background fluxes taken from the line

- Operations\Background measurement\Background

all the mentioned parameters participate in calculation of scintillation indices.

Apertures geometry is taken from following 9 parameters:

- Segmentator\Channel A(B,C,D)\Inner
- Segmentator\Channel A(B,C,D)\Outer
- Optics\Common\Magnification

Given the provided paths to spectral energy distribution files (option -s) and spectral response file (option -r), this information is used for checking and calculation of the scintillation weight functions.

The altitude grid for the turbulence altitude moments decomposition if read from

- WeightFunction\MinAltitude
- WeightFunction\MaxAltitude
- WeightFunction\Step
- WeightFunction\MinStep

OR, preferentially, from 4-numbers parameter

- Data processing\Integrals\AltitudeGrid

Restoration of the turbulence profiles by 2 methods is performed on the grid from:

- Data processing\Floating Layers\AltitudeGrid
- Data processing\Fixed Layers\AltitudeGrid

These AltitudeGrid-parameters define the grid of altitudes (in [km]) on which the restoration and SVD of moments are performed. They are either "Z0, Zmax, dZ, dZmin" (see wf_t::setzgrid()) or simply a ascending-sorted list of altitudes like "1, 2, 4, 8, 16". In case when these parameters (Data processing or WeightFunction) are absent, atmos uses the default grids specified in its header file. Maximal altitude is also restricted to 40km or more.

The correction of the results by the airmass is performed. For this, the airmass is computed using the UT, star coordinates from the last O-line, and from the site geographic coordinates from

- General\Site\Longitude
- General\Site\Latitude

## 1.3 Input data line types and process organization

The input lines which are considered by the atmos-processor are following:

- P - parameter lines;
- M - mode lines (only Normal mode is processed)
- O - object lines
- m - stm-file data for Normal mode
- I - index lines (used only for swapping the read from mass- and stm-files)

All the rest data is ignored. O-, P- and M-lines are printed in the output making the repetitive reprocessing possible. Processing of Generalized mode (mode Generalized and s-lines stm-file data for shifted part of data) is also supported but still not tested.

Old format of the mass-file where the instant indices are given as i-lines is still supported, but needs the UT-stamps modification in the mass-file. This possibility is retained but currently was not tested.

The work of the processor consists of the line-by-line reading of the input. The statistics file lines are read whenever the I-line with the UT moments span (beginning and end of the accumulation time) is encountered.

Each line is parsed and then processing depends on the line prefix. First of all, the following condition is tested: prefix is be either 'M' or 'O' or end-of-file is true, and some scintillation data are already collected (see below) and time passed since beginning of mode is equal or more than accumulation time. If condition is met, then interpretation of accumulation-time data set is made. It consists of calculation of the middle-UT time reference (from first- and last-measurement UT references, see below), averaging the scintillation indices and turbulence integral moments, restoration of the turbulence profile by Fixed and Floating layers methods and writing the resulting indices (I-line), integral characteristics (A-line), profiles restored (two T-lines) and relative O-C of indices (two R-lines). Header line for each of these line types is output only once per program start (unless -H option is specified). The interpreted data are finally reset.

After this, the processing is made depending on the prefix only:

- In case of P-line, the parameters are read into the internal text variables and echoed in the output as well. No calculations are made.

- O-lines data are converted into the star coordinates and spectrum type, used for selection of the proper weight function file and spectrum energy distribution file for its checking or calculation.

- M-lines are processed only for Normal (or Generalized) modes; all the rest modes are simply printed in the output for reference. If any parameter line was read after last M-line, then all the parameters used in calculations (see above section) are re-read from their saved text representation. Then the airmass value is recomputed and the first-measurement UT reference is saved. In case star changed, the weight file is checked and, if not found or found differing in parameters, it is recomputed (running percentage is output on the standard error output). Finally, an Update of the altitude grids (according to the new airmass value) and some other quantities for turbulence restoration is made and the mode line is printed.

- m-lines (and 's' for shifted altitude data) give the count statistics which are read from the line and the instant scintillation indices are computed. The turbulence moments according to their decompositions performed in Update are generated. The last-measurement UT reference is updated.

- i-lines (and 'j' for shifted altitude mode) originating for old mass-files are read into the internal array of instant scintillation indices; no recomputation is possible even if the detector characteristics changed. The turbulence moments according to their decompositions performed in Update are calculated. The last-measurement UT reference is updated.

- #-lines are echoed in the output if the second character in the line is also '#'. Thus, the messages from the filtering scripts are visible in the processed data.

The use of the processor is following:

1. Compilation in Turbina directory: make atmos
2. Usage: see ./atmos -h

**Note:**

This version of a Standalone ATMOS acts like Turbina respecting the checks and computation of weights (unless -n option is given). To specify where to take the spectra and response curve, use the -s and -r options; the place to take weights from is given by -w option. Finally, if all three kinds of information is stored in standard directories/files data/mass.crv, spectra/..sp and weight/..wf in the single parent catalogue, this catalogue (/opt/turbina/data by default) may be given by -d option. If no parameters are given at all, the weights are checked and computed in /opt/turbina/data weight using spectra from /opt/turbina/data/spectra and response function from /opt/turbina/data/data/mass.crv).