AMV extraction algorithm in preparation for MTG

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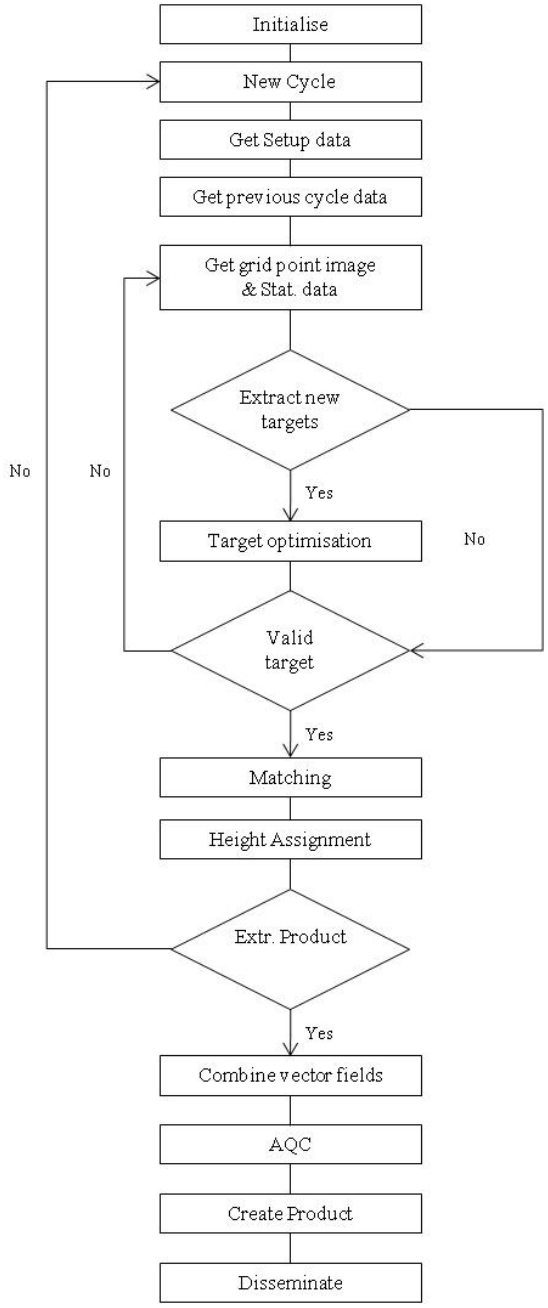
OUTLINE

- ✓ Main changes from MSG Algorithm
- ✓ Preliminary tests using OCA product for HA

Atmospheric Motion Vectors (AMV)

- ✓ Wind product consists of
  - speed, direction, height, quality indicator
- ✓ Currently extracted using MSG channels
  - VIS0.8 during daytime, HRV during daytime for low clouds
  - IR10.8, WV6.2. WV7.3
- ✓ Corresponding MTG channels
  - VIS0.8 , IR10.5, WV6.3, WV7.3
  - Plus IR1.3 (for cirrus) and IR3.8 (to be tested)



Data preparation

Target identification and Tracking

Height Assignment

Automatic Quality Control

Two main assumptions and 'limitations'

- Clouds are passive tracers. The feature tracked travels at the exactly same speed and direction than the local wind.

- Detected motion represents the 'cloud top' motion. Therefore CTH methods are used to set the altitude

Changes from MSG AMV scheme

- Use of a triplet of MTG repeat cycles
  - No averaging
  - Possibly ½ hourly product
  - Central image used as reference (time, location, HA)
- No image enhancement process for IR10.5 channel
- Set the final AMV speed and direction to the speed and direction of the last intermediate component

Changes from MSG AMV scheme

- CCC height assignment scheme (R. Borde & R. Oyama, 2008)
  - Keep clear link between tracking and HA
- Use a cloud top height (CTH) product to set the AMV height
- Calculation of AMV pressure error in hPa

NB: CCC scheme recently implemented in:

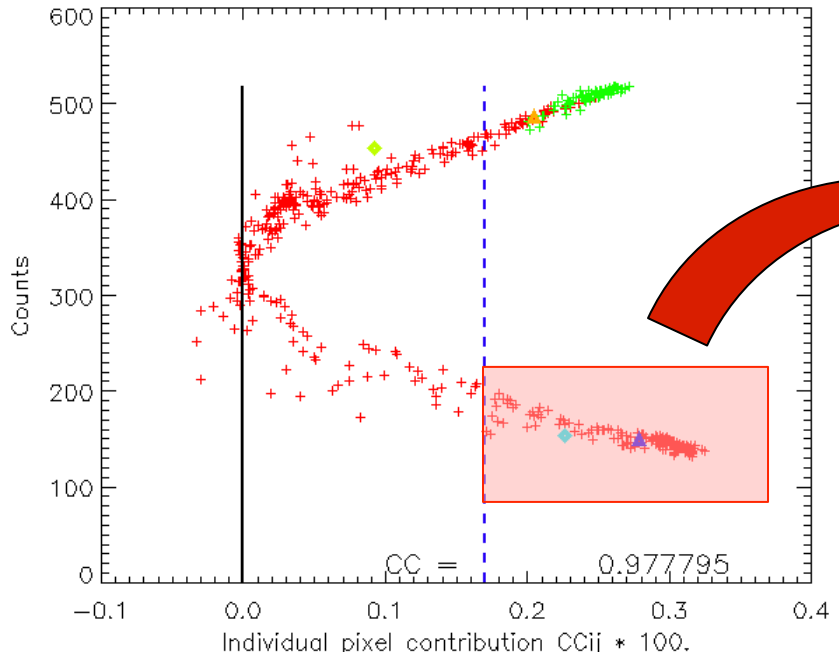
- EUMETSAT MSG operational algorithm

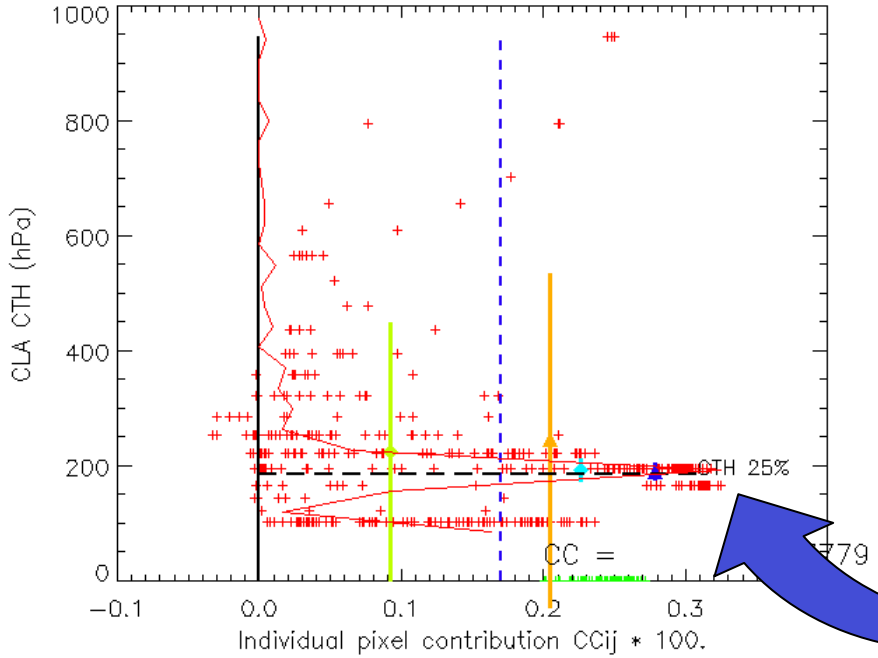
See in this session: M. Doutriaux-Boucher et al., Operational retrieval of MSG AMVs using the new CCC method for Height Assignment.

- NWCSAF HRW software

See in this session: J. García-Pereda and R. Borde, Latest developments in NWCSAF High Resolution Winds product.

Calculation of CCij weighted pressure and STD from CTH (CCC method)





$$P = \frac{\sum_{\substack{cold\_branch \\ CC_{i,j} > \overline{CC_{i,j}}}} CC_{i,j}.CLA\_CTH_{i,j}}{\sum_{\substack{cold\_branch \\ CC_{i,j} > \overline{CC_{i,j}}}} CC_{i,j}}$$

EUMETSAT
Monitoring weather and climate from space
Surveiller le temps et le climat depuis l'espace

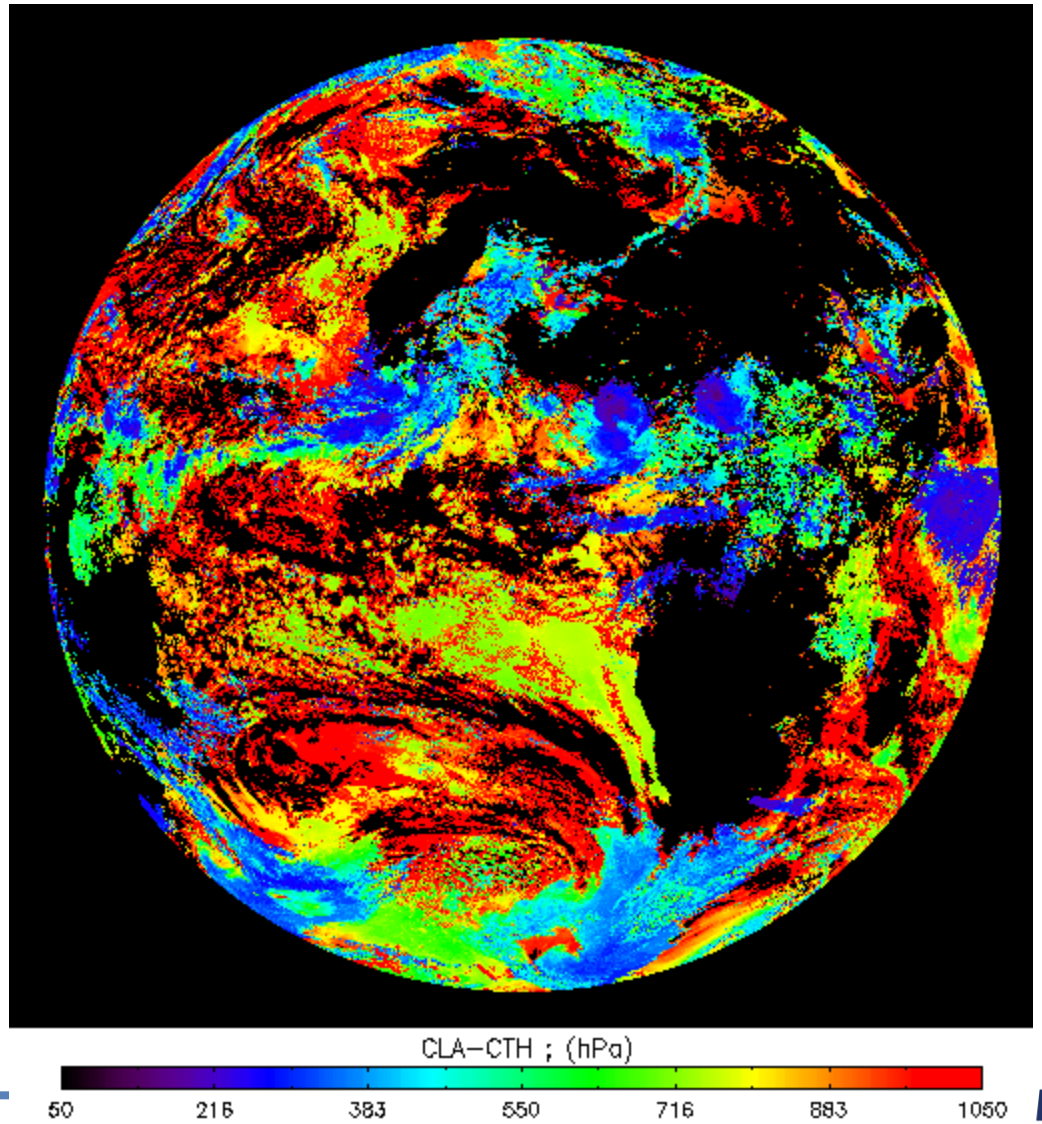
Changes from MSG AMV scheme

- Use OCA product (Optimal Cloud Analysis)
  - Based on Optimal Estimation approach
  - Contains error estimates (JM factor)
  - Can deal with multilayer situations (not used in this study)

(Watts, P. D., R. Bennartz, and F. Fell (2011), Retrieval of two-layer cloud properties from multispectral observations using optimal estimation, J. Geophys. Res., 116, D16203, doi:10.1029/2011JD015883)

Comparisons OCA-CTH versus CLA-CTH

10/08/2006
12h00 UTC
Meteosat-8



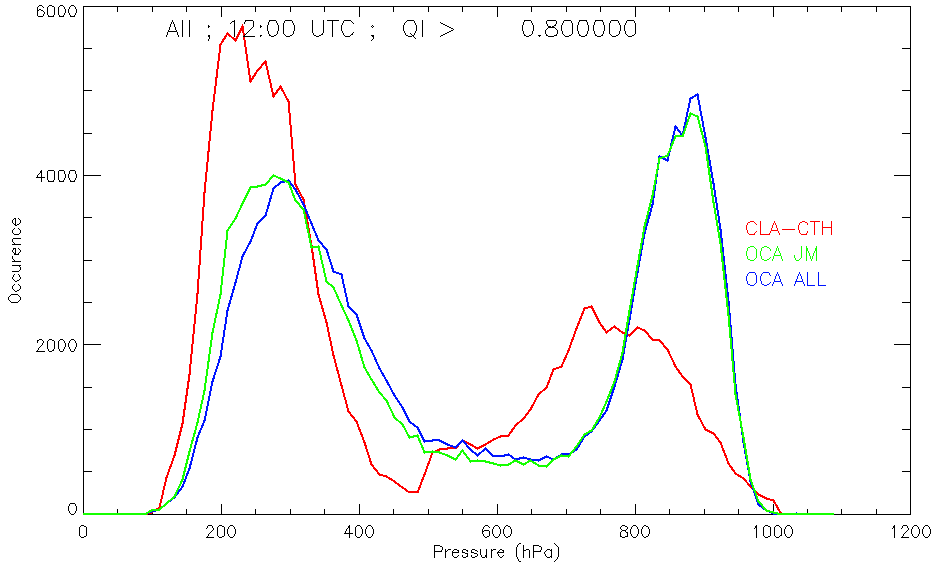
Changes from MSG AMV scheme

- Set the final AMV coordinates to the position of the tracked feature
  - Improve quality control (CGMS and FC comparisons)
  - Improve mapping (AMV plotted on the clouds)

Preliminary results
CLA versus OCA

- August 2006, 12:00 UTC
- QI > 0.8

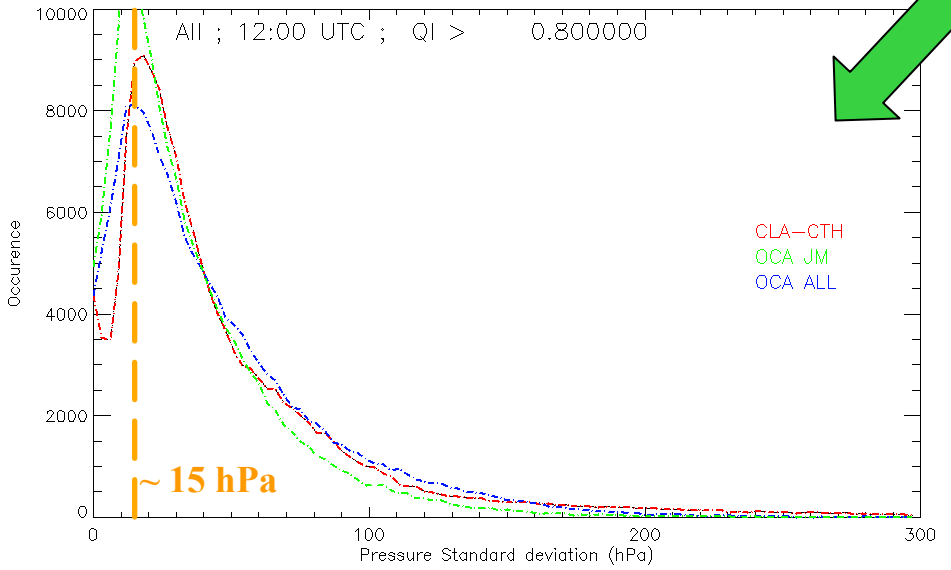
August 2006, 12:00 UTC ; QI > 0.8

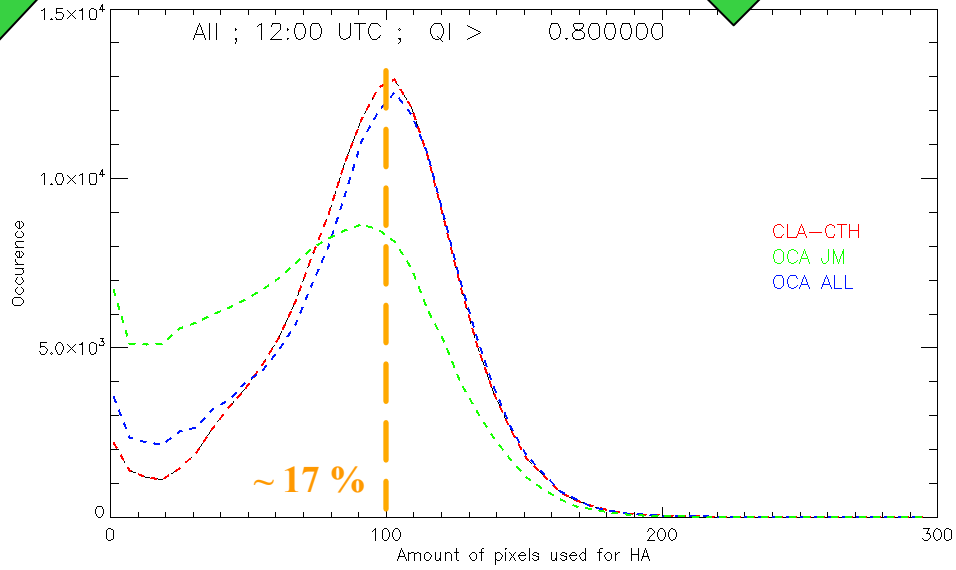


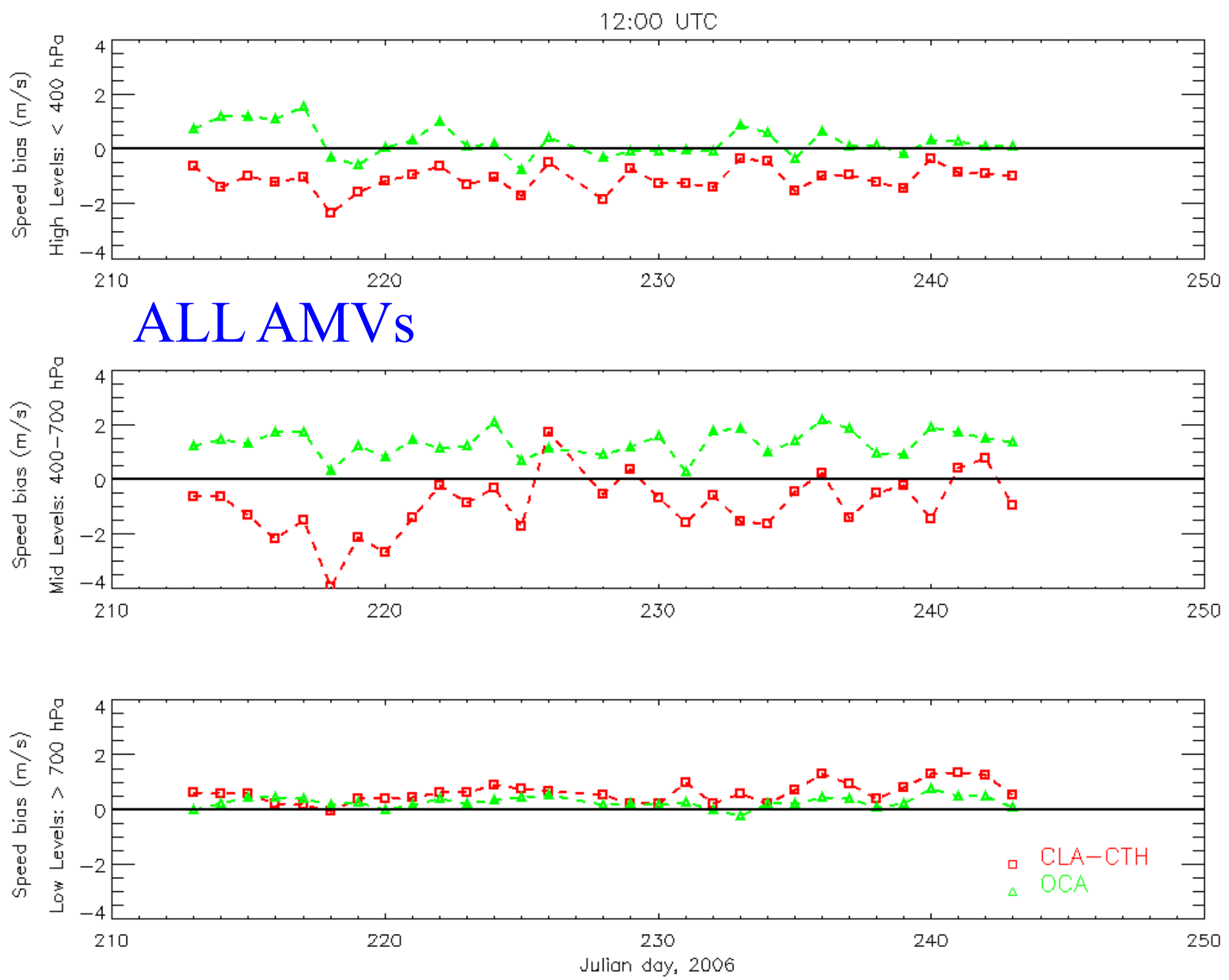
AMV pressure

Pressure STD

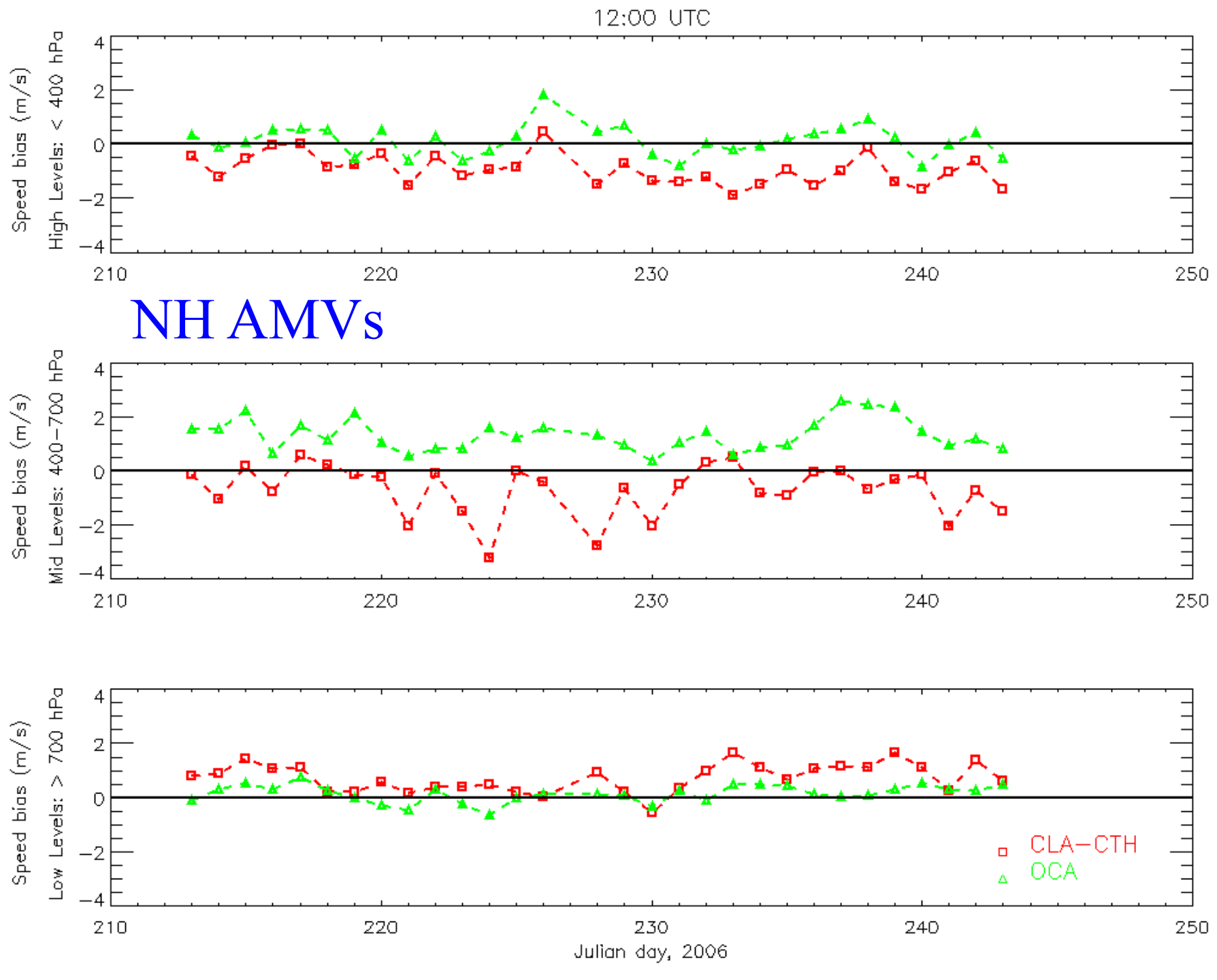
Nb pixel used for HA



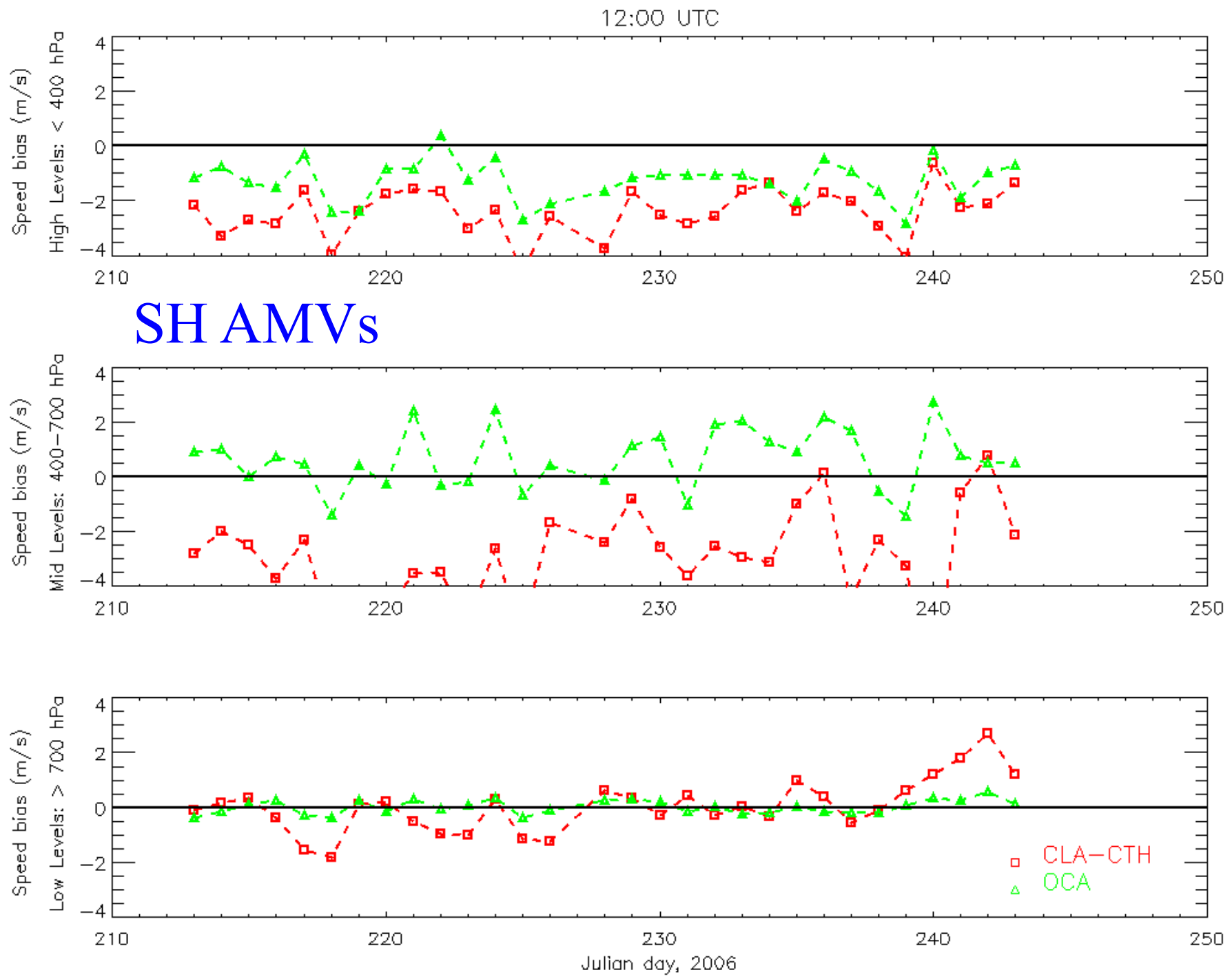



12:00 UTC
Speed bias (m/s)
High Levels: < 400 hPa
Mid Levels: 400–700 hPa
Low Levels: > 700 hPa
4
2
0
−2
−4
210
220
230
240
250
Julian day, 2006
CLA–CTH
OCA

ALL AMVs


12:00 UTC
Speed bias (m/s)
High Levels: < 400 hPa
Mid Levels: 400–700 hPa
Low Levels: > 700 hPa
4
2
0
−2
−4
210
220
230
240
250
Julian day, 2006
CLA–CTH
OCA

NH AMVs


12:00 UTC
Speed bias (m/s)
High Levels: < 400 hPa
Mid Levels: 400–700 hPa
Low Levels: > 700 hPa
4
2
0
−2
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210
220
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Julian day, 2006
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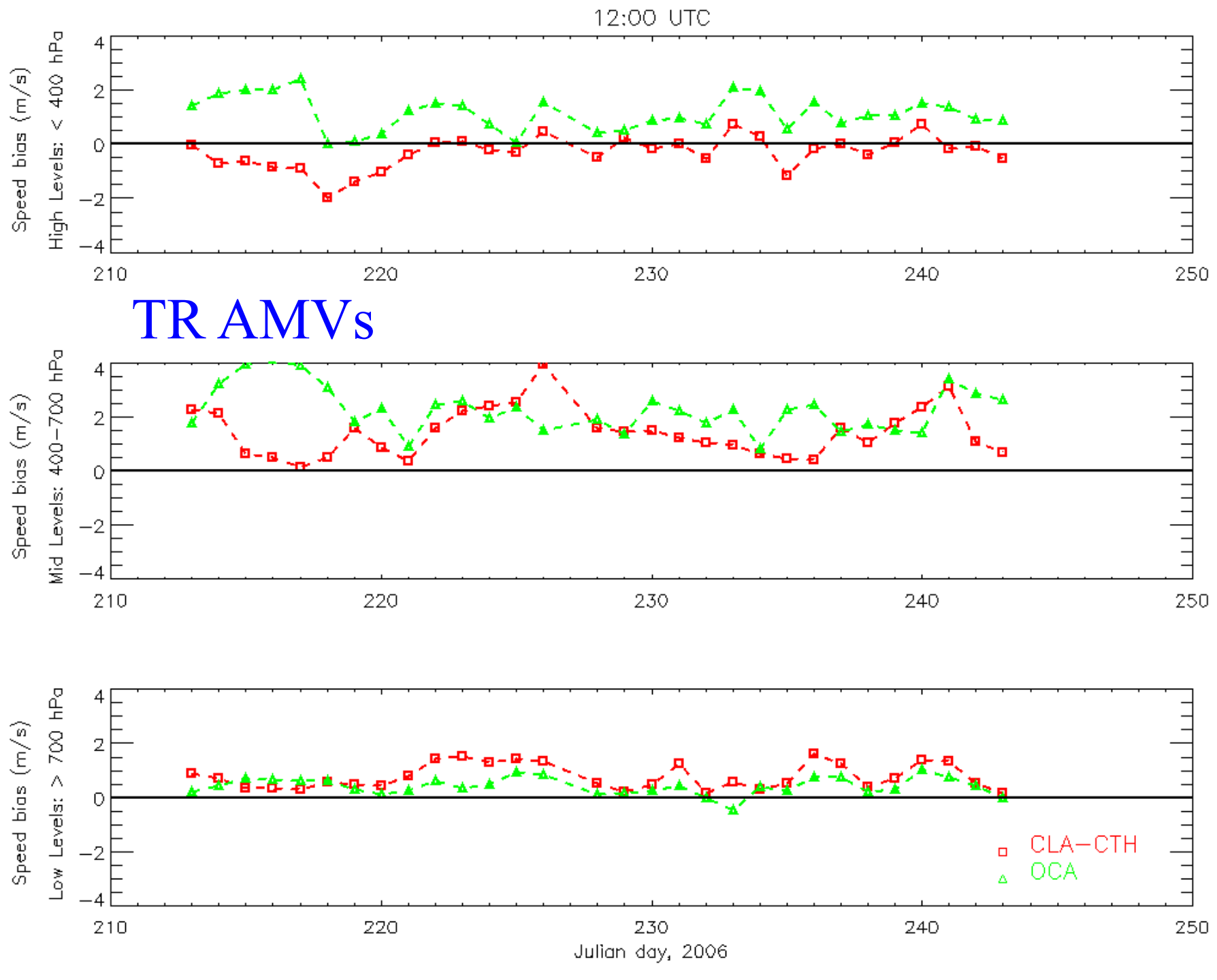
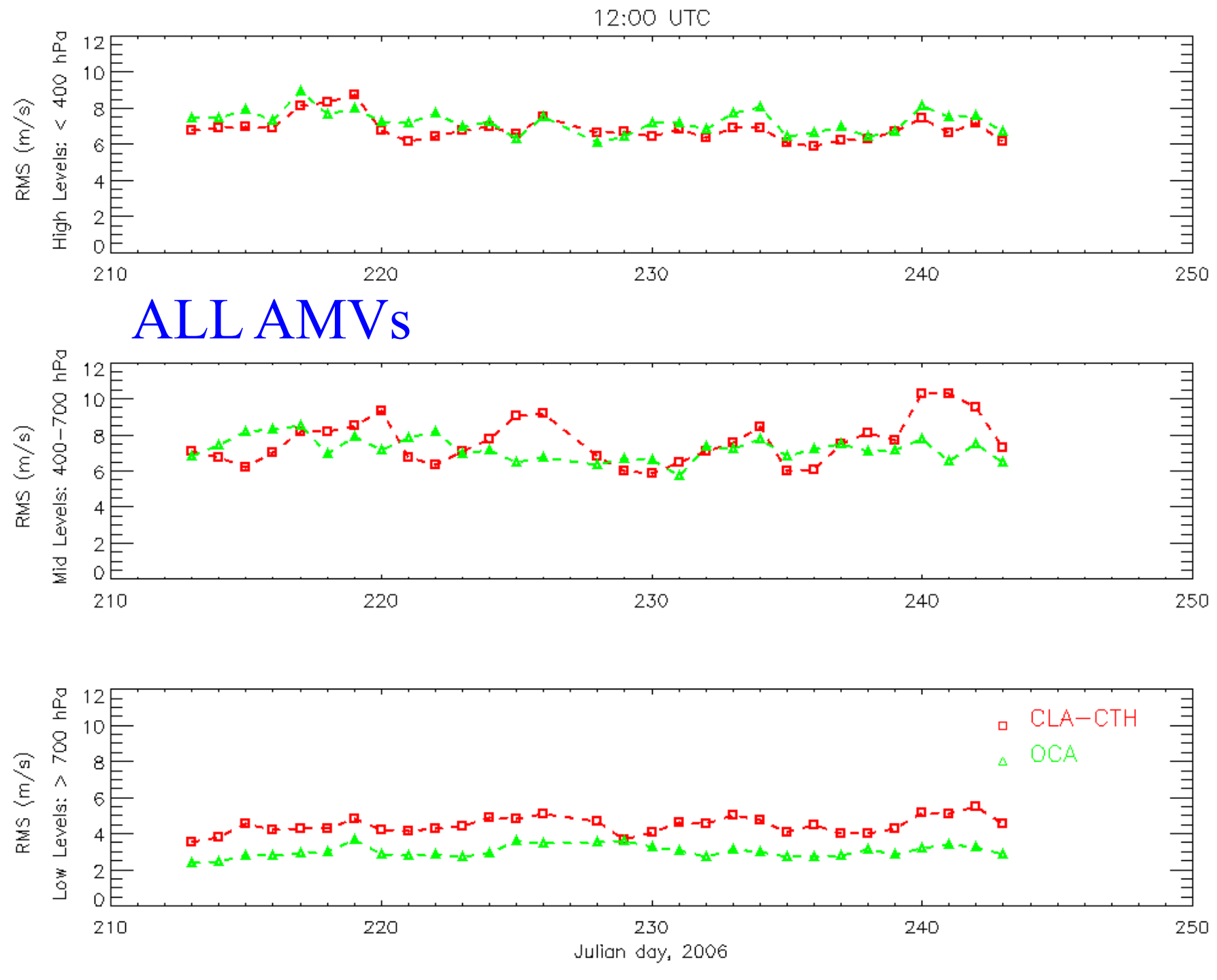
OCA

SH AMVs


12:00 UTC
Speed bias (m/s)
High Levels: < 400 hPa
Mid Levels: 400–700 hPa
Low Levels: > 700 hPa
4
2
0
−2
−4
210
220
230
240
250
CLA–CTH
OCA
Julian day, 2006

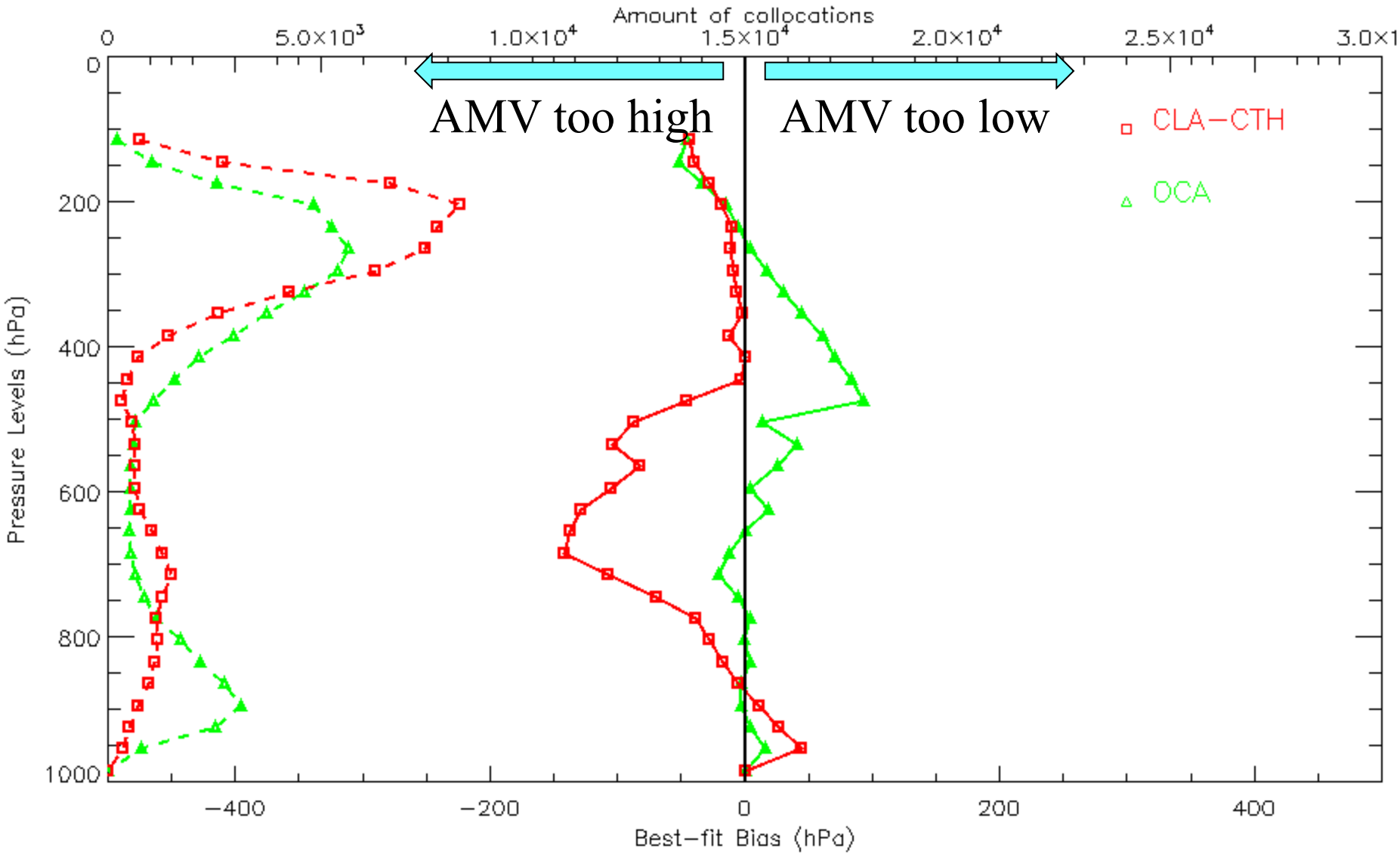
TR AMVs


12:00 UTC
RMS (m/s)
High Levels: < 400 hPa
Mid Levels: 400–700 hPa
Low Levels: > 700 hPa
0
2
4
6
8
10
12
210
220
230
240
250
Julian day, 2006
CLA–CTH
OCA

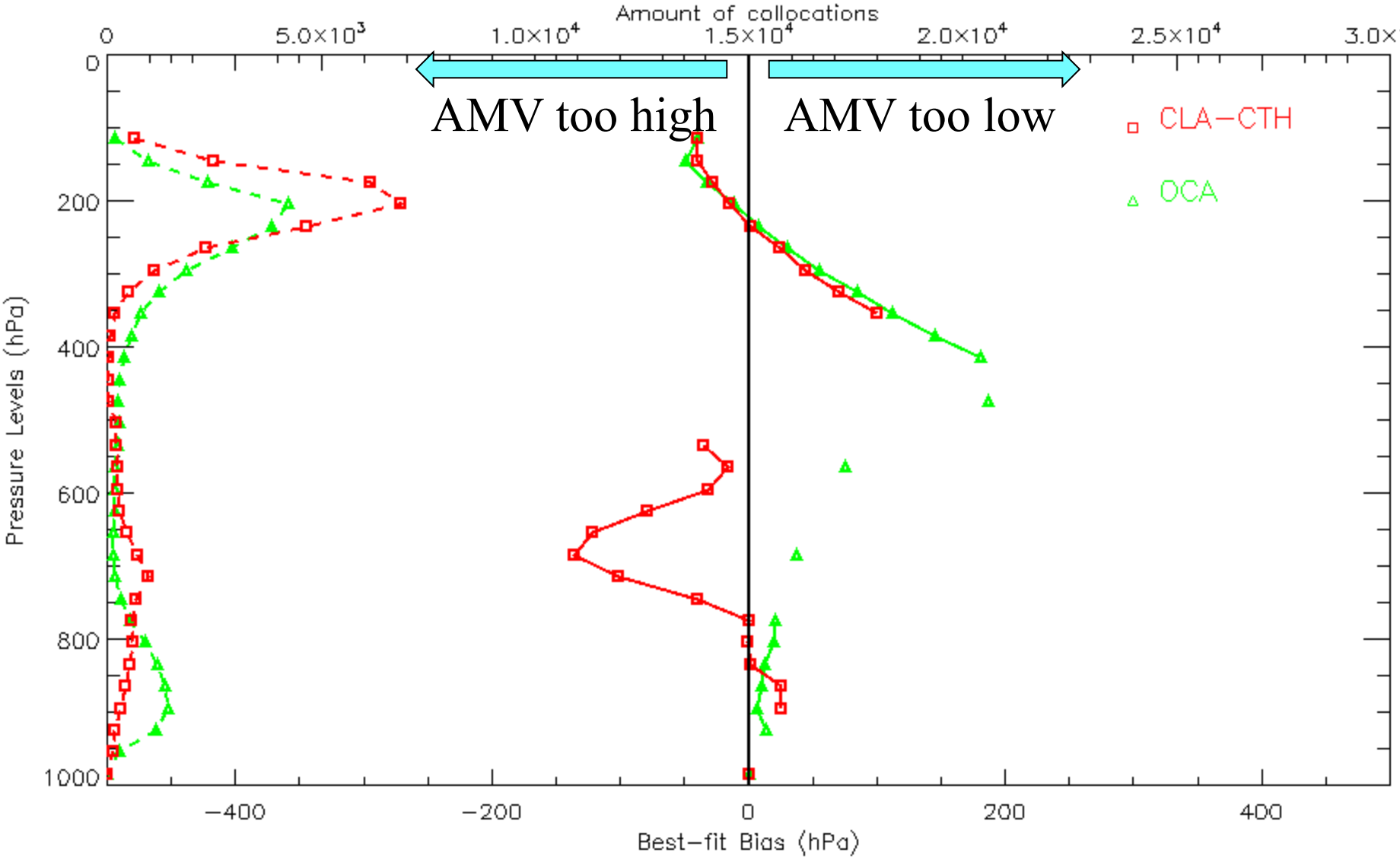
ALL AMVs

Best-Fit against FC

- August 2006, 12:00 UTC
- QI > 0.8
- Abs($u-u_{fc}$) < 4 ; Abs($v-v_{fc}$) < 4
- No secondary peak outside 100 hPa layer


Amount of collocations
0
5.0×10³
1.0×10⁴
1.5×10⁴
2.0×10⁴
2.5×10⁴
3.0×10⁴
AMV too high
AMV too low
CLA−CTH
OCA
Pressure Levels (hPa)
0
200
400
600
800
1000
−400
−200
0
200
400
Best−fit Bias (hPa)

ALL AMVs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400
Best−fit Bias (hPa)

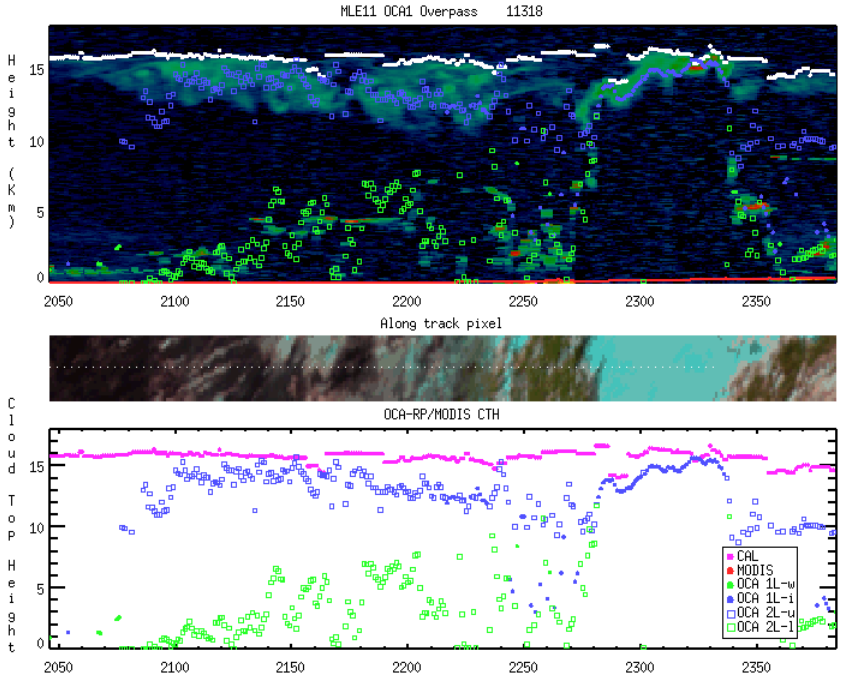
TR AMVs

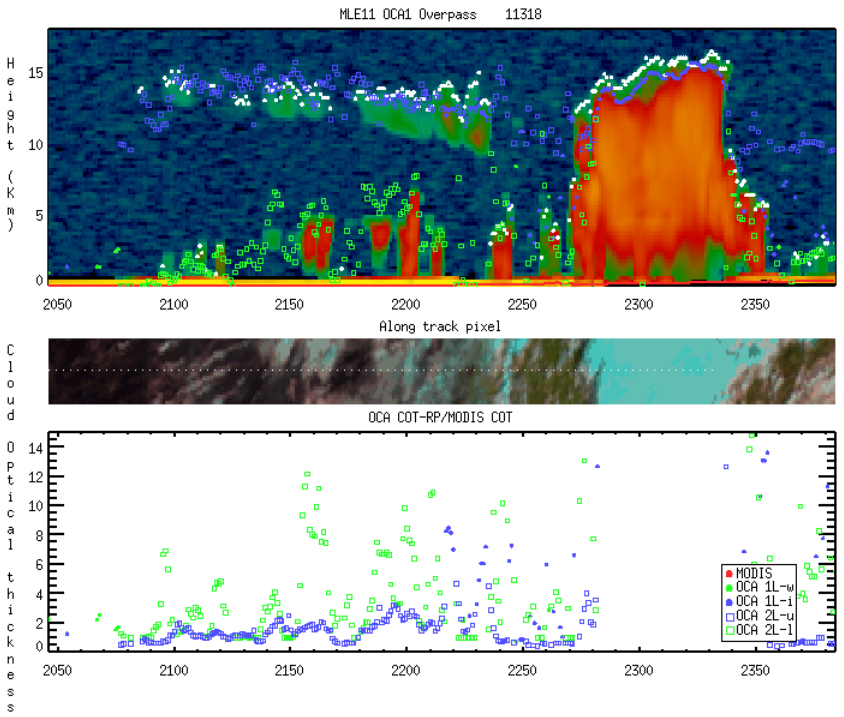
Summary of main changes from MSG

- Use of a triplet of MTG repeat cycles (1/2 hourly product)
- CCC height assignment scheme for HA
- Use OCA product to set the AMV height
- Calculation of AMV height STD and possibly height error
- Set the final AMV speed and direction to the speed and direction of the last intermediate component
- Set the final AMV coordinates to the position of the tracked feature

Prospectives

- Use MTG proxy data.
- Test the last version of OCA product that can treat multilayer situations.(Watts, P. D., R. Bennartz, and F. Fell (2011), Retrieval of two-layer cloud properties from multispectral observations using optimal estimation, J. Geophys. Res., 116, D16203, doi:10.1029/2011JD015883)





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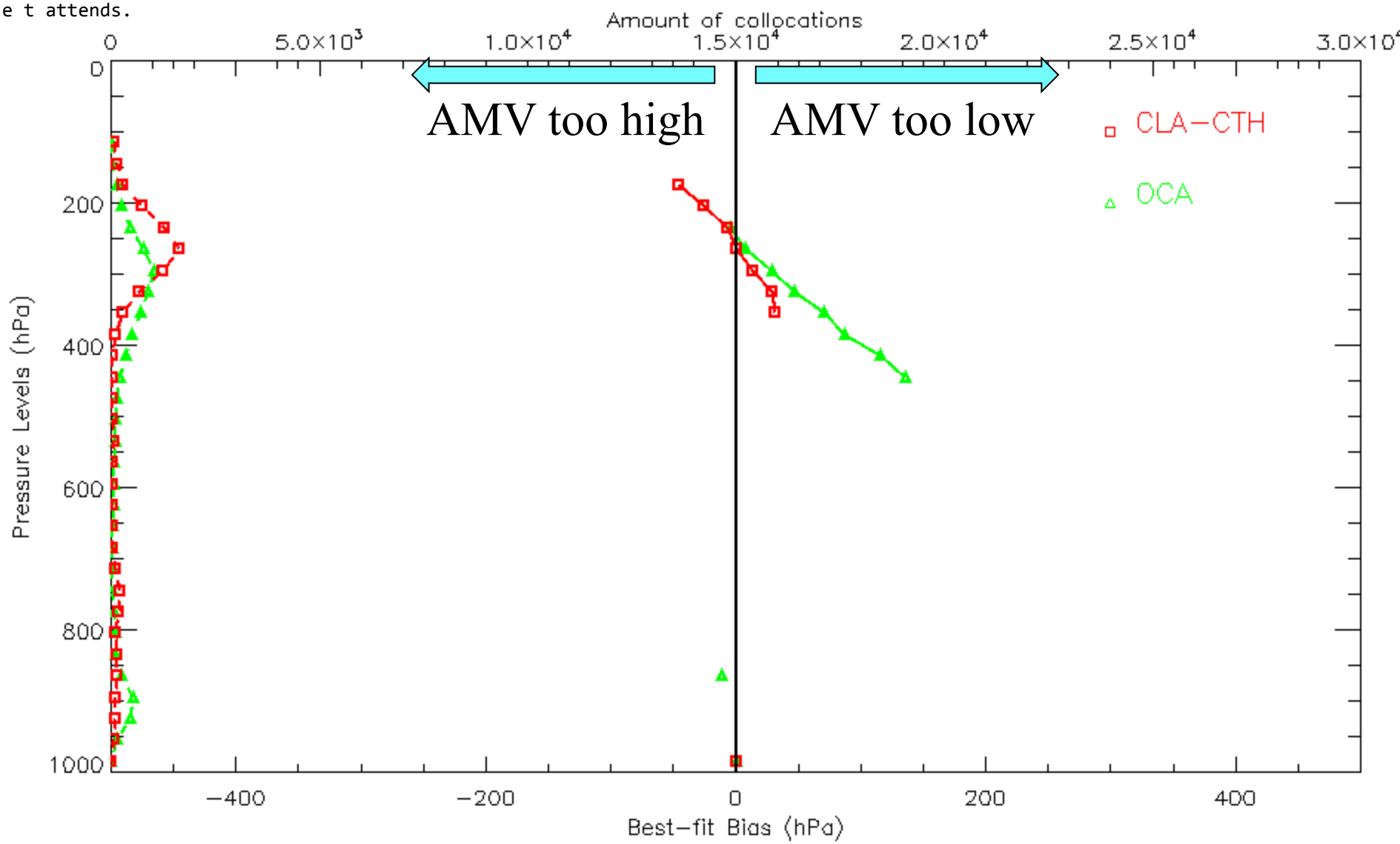
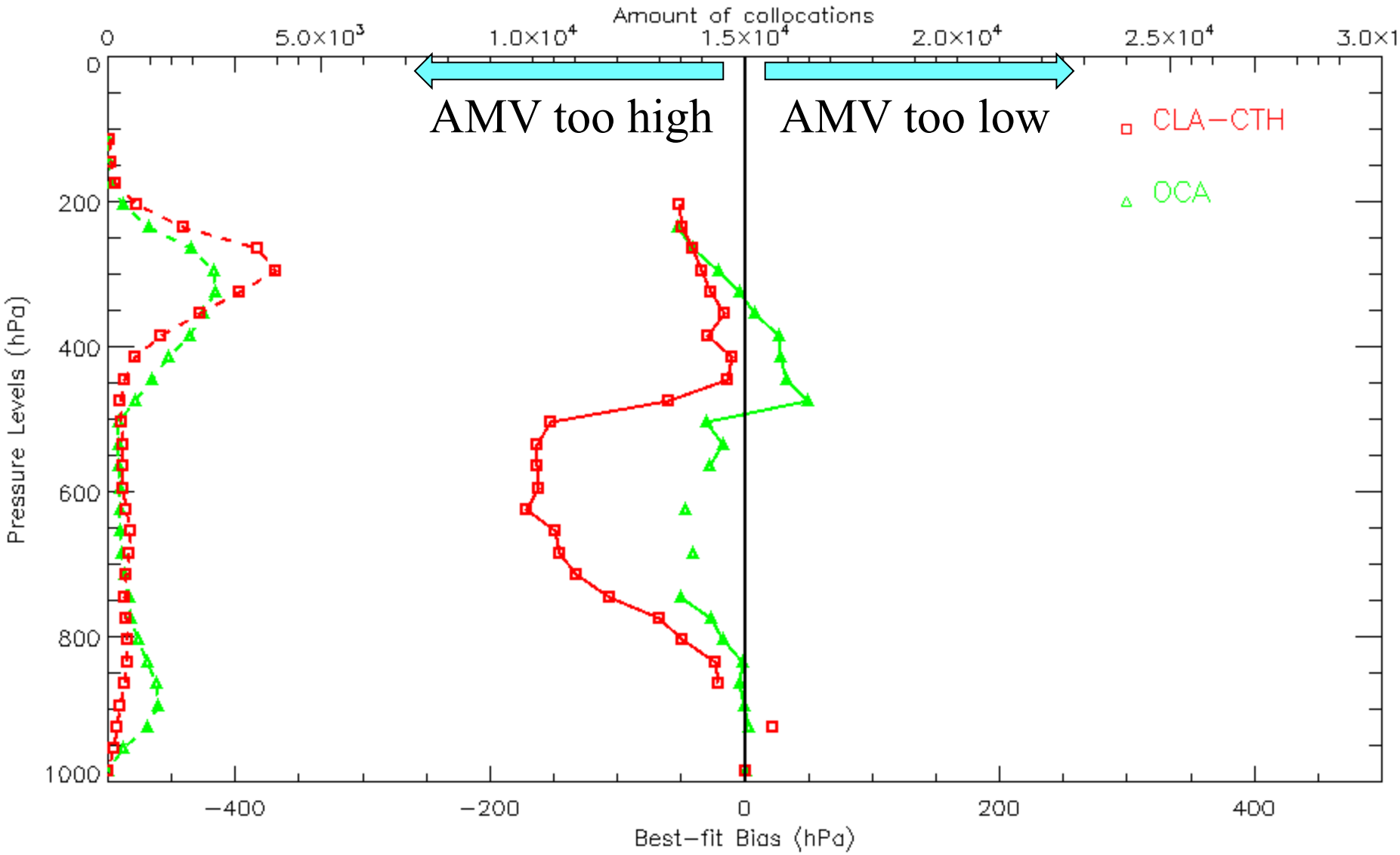


NH AMVs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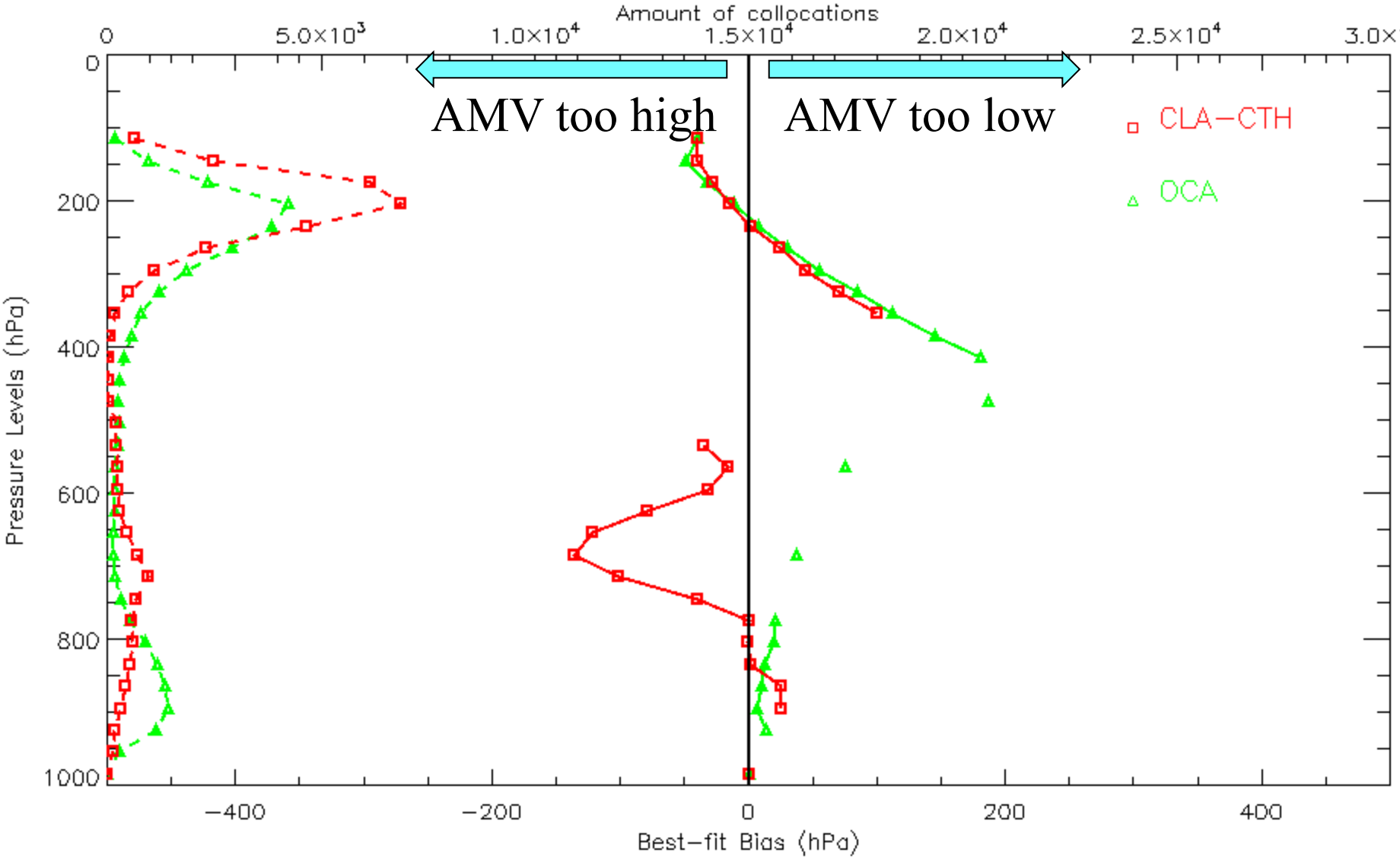
SH AMVs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Best−fit Bias (hPa)

TR AMVs

Final AMV location