Jason-3

Near Real-Time Data Annual Quality Report 2016-2017

February, 2017

Prepared by:

U.S. Department of Commerce
National Oceanic and Atmospheric Administration (NOAA)
National Environmental Satellite, Data, and Information Service (NESDIS)

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Preface

This document comprises the initial National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data, and Information Service (NESDIS) baseline publication of the Jason-3 *Near Real-Time Data Annual Quality Report 2016-2017* (February 10, 2017 issue).

The purpose of this document is to assess the overall quality of the Jason-3 near real-time products, Operational Geophysical Data Records (OGDRs), which are produced by NOAA and EUMETSAT. For each 10-day cycle, five primary parameters are displayed, divided into ascending and descending passes: sea surface height, significant wave height, ocean surface wind speed, altimeter-based ionosphere correction, and radiometer-based wet troposphere correction. All anomalies evident in these plots, such as orbital maneuvers or data gaps from calibration exercises, are described and documented based upon operational processing logs, etc. Statistics for data latency and data return are presented to demonstrate that high-level mission requirements have been met.

Future updates and revisions to this document will be produced and controlled by NOAA/NESDIS.

Table of Contents

Appendices

List of Figures

Section 1.0 Introduction

The Jason-3 mission is the successor to the Topex/Poseidon, Jason-1, and Jason-2/OSTM radar altimetry missions. Jason-3 was launched from Vandenberg AFB on 17-Jan-2016, and the onboard instruments began producing data shortly thereafter. Prior to achieving its final ~10-day exact repeat orbit, Jason-3 executed a series of maneuvers after injection into orbit. The exact repeat orbit was finally achieved on 12-Feb-2016. Since this resulted in a partial 10-day cycle, it was dubbed cycle-0. All subsequent cycles (beginning with cycle-1) are comprised of 254 half-revolution 'passes' with odd-numbered ascending passes extending from south to north, and even-numbered descending passes going north to south.

The primary instrument on-board Jason-3 is a dual-frequency radar altimeter (Ku-band & C-band) that provides measurements of sea surface height, significant wave height, and ocean surface wind speed. Three independent orbit determination systems are provided by the DORIS, GPSP, and passive laser retro-reflector instruments. Sea surface height is computed from the difference in orbital altitude from these systems and the fundamental range measurement (from round-trip travel time) made by the altimeter. Finally, a three-frequency passive microwave radiometer provides measurements of integrated total precipitable water, which is used to correct the sea surface height measurements for path delays due to atmospheric water vapor. Path delay corrections for the ionosphere are based on the dual-frequency altimeter measurements, and for the dry troposphere based on ECMWF model surface pressure fields. Finally, sea surface heights are corrected for signals not associated with large-scale ocean circulation (tides, inverse barometer, and sea state bias).

The Jason-2 and Jason-3 missions are a four-partner collaboration between NOAA, NASA, CNES and EUMETSAT. As partner operational agencies, NOAA and EUMETSAT share responsibility for production of near real-time data sets. These data, the Operational Geophysical Data Records (OGDRs) are the focus of this quality assessment report. OGDRs are typically produced 1-3 hours after the telemetry are received from the spacecraft, leading to nominal data latencies of 3-5 hours after accounting for two hours of data acquisition on board between data dumps to the ground. The data latency statistics over the first year of mission operations are discussed in the next section.

Section 2.0 Data Latency Statistics

The four project partners hold Operational Coordination Group (OCG) meetings weekly, and NOAA routinely reports statistics for near real-time product latency. The latency is computed for each OGDR, based on the time difference between the data itself (measurement time) and the time of availability of the product to end users. The overall latency of the OGDRs, produced by both NOAA and EUMETSAT, is accumulated over the previous week for reporting at the OCG.

In this year's report we use the same methodology as in recent Jason-2 analyses, for reporting data latency: the "PROPRO-005" algorithm[1]. Each OGDR is evaluated to determine if 75% of the 1-Hz data records inside the file have a latency of < 3 hours. If so, that OGDR is "good". If not (< 75% of data < 3 hours old) that OGDR is considered "bad". Each week the percentage of files that are good is reported, compared to the algorithm goal of 90%.

Figure 1 illustrates the weekly latency statistics during the first year of operations. At each weekly interval along the x-axis, the percentage of files meeting the 75% < 3 hours criteria is plotted. It is apparent that the percentage was initially low, after the launch of Jason-3, when ground operations were shared between the two missions, passing over the ground stations nearly simultaneously. However, after June 2016, the 90% weekly goal is clearly met with only 2 instances falling below 90%.

The overall percentage of low-latency OGDRs from 2016-02-12 to 2017-02-08 was 92.3%.

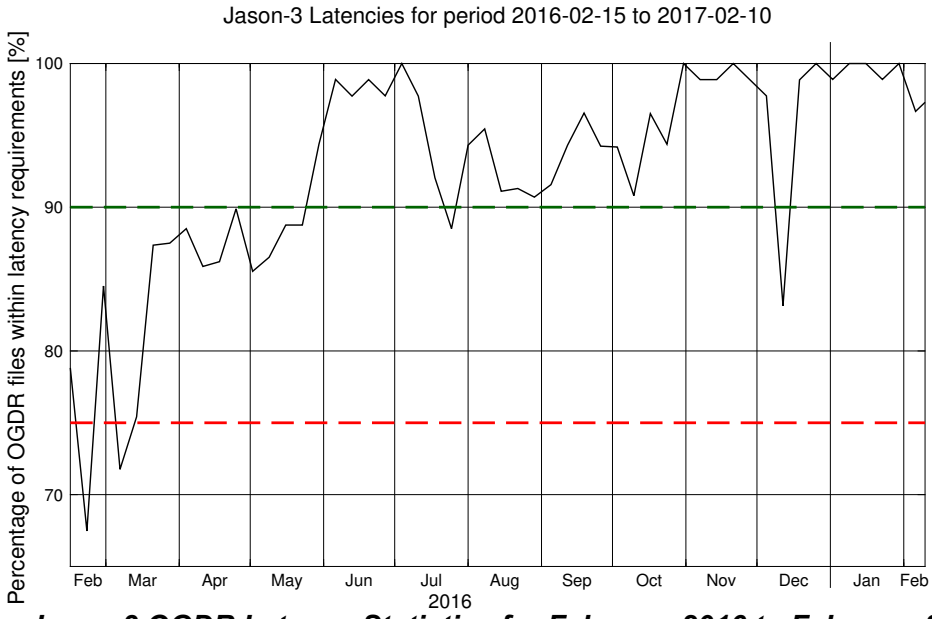


Figure 1 – Jason-3 OGDR Latency Statistics for February 2016 to February 2017. The dashed red line is the 75% requirement and the dashed green line is the 90% goal.

[1] Algorithms About Jason-3 Telemetry Data Availability And OGDR Data Latency: TP4-J0-NT-86-CNES, Christophe Jouan & John Lillibridge, 2011.

Section 3.0 Data Quality Analysis Plots

In this section data from the first year of operations are analyzed, covering the time period from 2016-02-12 to 2017-02-08: cycles 1-36. We focus the analysis on five primary geophysical parameters measured by the on-board instruments: sea surface height anomaly (relative to a multi-year altimetric mean sea surface), significant wave height, ocean surface wind speed, wet tropospheric path delay from the radiometer, and ionospheric path delay based on dual-frequency altimeter measurements.

Each of the five geophysical parameters are analyzed on a per-cycle basis, with data from ascending and descending portions of the ground track plotted separately to prevent overlapping points. The start and end times of each cycle are based on an average cycle duration of 9d 21h 58m 31.612s (856711.612 seconds). The start and end times in the plot labels are rounded to the nearest second, and agree within a few seconds with the actual cycle boundaries. The individual 1-second data points, read from the NetCDF formatted OGDR files, are reported every 10-seconds along track. Each of these 10-second values is plotted as a filled circle, color coded by the vertical scale bar, which is based on a prescribed maximum-minimum range for that variable. For each ~10-day cycle, the five parameters are plotted on a single page as ten subplots (separate ascending/descending data) in Appendix-A. Each cyclic subplot represents a map view of a single variable, over the region 22°-382° longitude, ± 70° latitude. The longitude axis is offset by 22° to split the plots at Cape Agulhas, where there is minimal oceanic latitudinal extent between the Atlantic and Indian basins.

Plots for cycles 1-36 are contained in Appendix-A. These plots provide an excellent means of assessing the overall data coverage (or data gaps) as well as anomalies in the data values of the five analyzed parameters. If a parameter map has long stretches of data that are ‘off-scale’ in either the positive (red) or negative (blue) directions, there is a clear indication of degraded quality. These 36 plots form the basis of the quality assessment provided in the following sections.

Section 4.0 Anomalies Impacting Quality

Since the launch of Jason-3 a variety of anomalies have occurred which impact the quality of the data. These can be related to spacecraft maneuvers, instrumental problems, telemetry transmission difficulties, ground station anomalies, or data processing errors. The anomalies impacting data quality from February 2016 to February 2017 are presented in chronological order below, including the names of the impacted OGDR files. The detailed explanations are based on the cyclic GDR reports kindly provided by CNES, as well as the weekly OCG reports.

A general observation regarding the SSHA figures at the top of each page is that there are numerous data dropouts distributed randomly across the globe, which are not observed in the other four variables. The Jason-2 annual reports for 2008–2012 didn't exhibit this SSHA data loss while the 2013–2015 reports, based on OGDR-D, did. It is due to the fact that SSHA values are now defaulted whenever the rain flag is set. This began with OGDR-D, since OGDR-C didn't have a usable rain flag. SSHA values were NOT defaulted when edit flags were set, prior to Jason-2 cycle-151. Flags are provided so end users can edit according to their needs; the SSHA data itself should not be set to a default value when flags are set. The rain flag issue was in any case fixed in Jason-3 cycle-21, with the release of OGDR-D patch 9. This is also apparent in the SSHA figures with significantly less data dropouts.

Jason-3 Cycle-001 2016-02-17 10:28:45 - 2016-02-27 08:27:17

Missing real time data from CNES-DMZ. Real time TLM data were not received from CNES-DMZ during Usingen passes on revs 350, 451, 452, (night of 18-19), and 464 (night of 22-23).

Station keeping maneuver executed on Feb23-0245z, impacting pass 146:

JA3_OPR_2PTS001_143_20160223_002715_20160223_035816

Cross maneuver executed on Feb 24 0356-0414z, impacting pass 170:

JA3_OPR_2PTS001_170_20160224_005001_20160224_042037

Jason-3 Cycle-002 2016-02-27 08:27:17 - 2016-03-08 06:25:49

Gyros calibration detected in OGDR SSHA, with a significant anomaly in the Gulf of Thailand.

Jason-3 Cycle-003 2016-03-08 06:25:49 - 2016-03-18 04:24:20

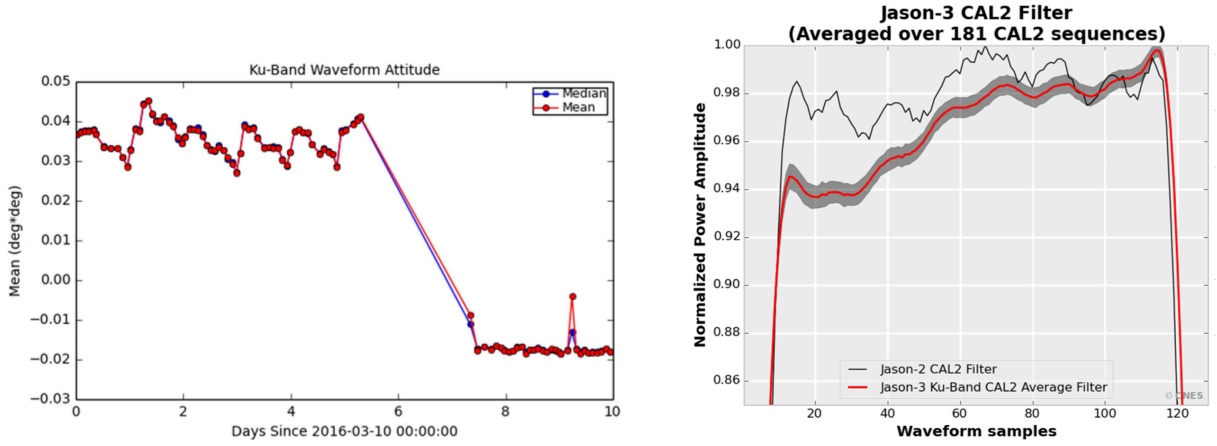
AMR calibration executed on March 11 at 05:09:50; ended at 05:17:14.

GPS S/W upload.
This operation took place from Mar15-0710z until Mar17-08:10z. During the whole sequence,

instruments were switched to STAND-BY mode: electrically powered but no PLTM data available. Due to this operation, passes 182 to 232 are entirely missing, as well as part of passes 181 and 233. There are therefore only 203 passes in the cycle.
On March 17 USG pass 1206z, CNES control center acknowledged the previous dump after receiving all nominal parameters from previous dump. This resulted in some TLM loss: HKTMR=2016/03/17 06:25:39 to 2016/03/17 08:54:27, PLTM1 = 2016/03/17 08:14:57 to 2016/03/17 08:54:27, PLTM2= 2016/03/17 08:18:23 to 2016/03/17 08:54:19.

During this cycle, a gyro calibration was performed: One of the on-board star trackers did not have appropriate parameters, which caused the platform to be tilted. This was clearly noticeable in retracking. The estimated attitude by the MLE-4 retracker went from significantly positive and highly variant, to negative, see Figure 2(a). This originated an investigation leading to the modification of the CAL2 calibration, Figure 2(b).

From Figure 3, it is apparent that the on-board star tracker correction had a significant impact on the sigma-0 estimation for both MLE3 and MLE4. Likewise, the erroneous CAL2 filter created discrepancies between the sigma-0 estimation from MLE3 and MLE4, which disappear after the correct CAL2 filter was applied, around OGDR cycle 14.



(a) (b)

Figure 2: (a) Ku-Band Waveform Attitude from Near-Real Time Altimeter Validation System (NRTAVS); (b) Averaged CAL2 filter for Jason-3 (average over 181 calibration sequences in red, standard deviation in grey) and for Jason-2 (black). Both images were included in the CNES' Document Analysis of Apparent Mispointing Observed on Jason-3, REF. TP4-JPOS3B-NT-1497-CNES, and reported during the Jason-3 Near Real-Time Verification Workshop, held at NOAA Center for Weather and Climate Prediction, College Park, MD, USA, on June 21, 2016.

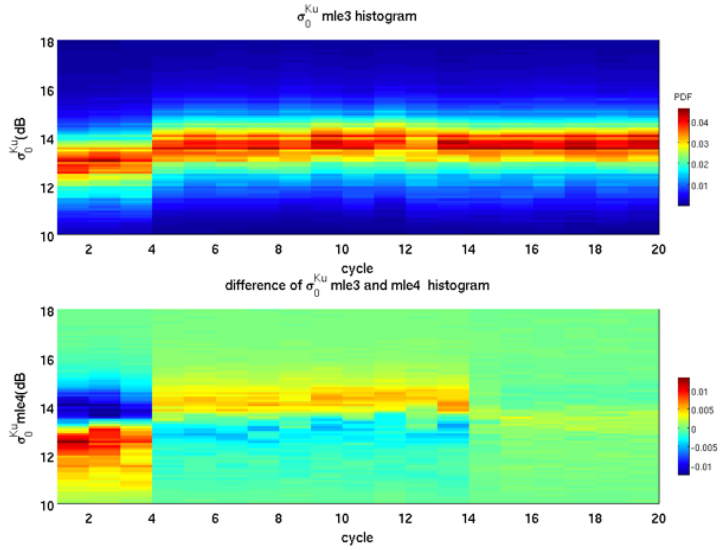


Figure 3: Jason-3 Sigma-0 distribution as a function of cycle. From The Jason Rain-Flag Revisited, J. Lillibridge and J. Tournadre, OSTST Meeting 2016, La Rochelle, France.

Jason-3 Cycle-006 2016-04-07 00:21:23 - 2016-04-16 22:19:55

Data gap due to satellite autonomous failover to REDUCED mode on 04/09 at 12:43:36, after an autonomous GPS reset, affecting pass 65, OGDR file:

JA3_OPR_2PTS006_063_20160409_111226_20160409_131113

Data gap due GPS restart. Some instrument data were missed for several seconds (1243z -1244z), affecting pass 116, OGDR file:

JA3_OPR_2PTS006_113_20160411_100029_20160411_115937

Jason-3 Cycle-007 2016-04-16 22:19:55 - 2016-04-26 20:18:27

Nothing to report from OGDR cyclic plots. However, in the cyclic GDR report CNES points out that:

Processing on SSALTO on September 14. No missing pass, but passes 172, 233, 216, 181, 157, 242, 248, 218, 183 have 29.60%, 29.51%, 29.51%, 29.38%, 29.35%, 29.25%, 29.16%, 29.03%, and 28.16%, respectively, of missing measurements over land, due to CAL2 calibrations.

Calval output:
Due to cross calibration maneuver (±0.3° in roll and pitch) on 20-04-2016 at 04:23:00, the apparent squared mispointing is slightly increased for pass 084, but is still within thresholds.

Jason-3 Cycle-008 2016-04-26 20:18:27 - 2016-05-06 18:16:58

Data Gaps:

- pass 17 has 49.39% of missing measurements (42.44% over ocean) on 2016-04-27 from 11:38:11 to 12:05:55 due to OPS error. OGDR file affected:

  JA3_OPR_2PTS008_017_20160427_120555_20160427_141217

- pass 144 has 20.33% of missing measurements (13.27% over ocean, Norwegian Sea) on 2016-05-02 from 10:17:04 to 10:28:14:

  JA3_OPR_2PTS008_144_20160502_102812_20160502_134854

- pass 148 has 6.60% of missing measurements over ocean (western African coast) on 2016-05-02 from 14:34:22 to 14:37:28 due to operations around the POS3B restart linked to DEM patch upload:

  JA3_OPR_2PTS008_148_20160502_143728_20160502_155845

Jason-3 Cycle-009 2016-05-06 18:16:58 - 2016-05-16 16:15:30

As reported by CNES in the GDR report, for cycle 9 Jason-3 operated in DIODE/DEM mode until mid-pass 248 (2016-05-16 10:00) and in DIODE acquisition/autonomous tracking mode from mid-pass 248 to end of cycle. This has no apparent effect on OGDRs.

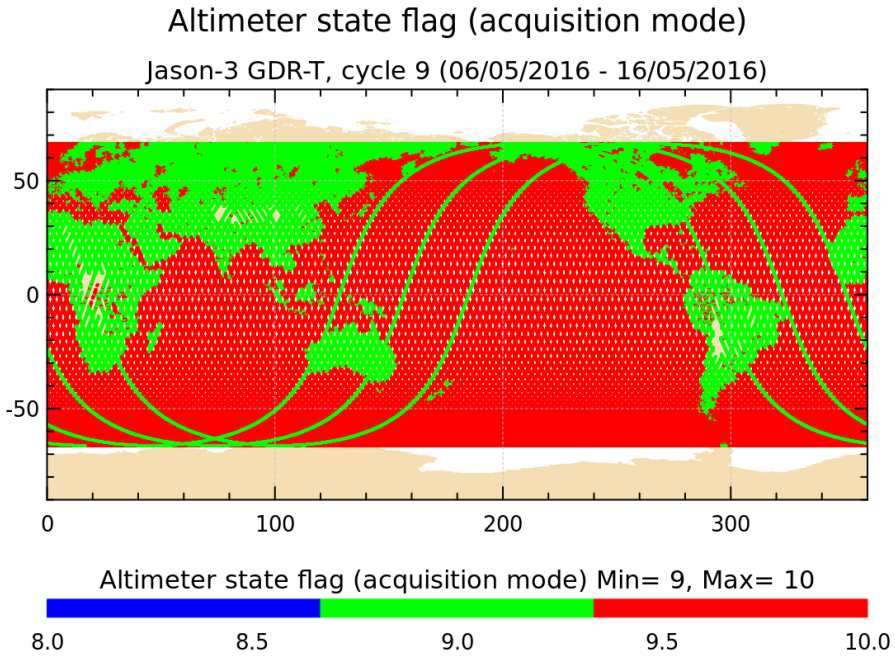


Figure 4: Jason-3 Acquisition mode for cycle-9. Altimeter state flag 9 corresponds to DIODE acquisition / autonomous tracking mode, and state flag 10 is DIODE/DEM mode.

Jason-3 Cycle-015 2016-07-05 06:08:08 - 2016-07-15 04:06:40

Data gap on pass 061 following AMR internal error, impacting on SSHA and AMR wet troposphere correction. OGDR file affected:

JA3_OPR_2PTS015_061_20160707_150146_20160707_170040.nc

Commands had to be sent to power cycle AMR.

No noticeable impact in OGDR SSH due to AMR calibration in cycle 178, and/or yaw flip on pass 224.

Jason-3 Cycle-017 2016-07-25 02:05:11 - 2016-08-04 00:03:43

Maneuver burn on 2016-07-25 not observed in SSHA OGDR.

Jason-3 Cycle-021 2016-09-02 17:59:18 - 2016-09-12 15:57:49

AMR calibration, pass 063, not observed in OGDR SSHA values.

The rain flag was fixed in Jason-3 cycle-21, with the release of OGDR-D patch 9. This is also apparent in the SSHA figures with significantly less data dropouts.

Jason-3 Cycle-022 2016-09-12 15:57:49 - 2016-09-22 13:56:21

Maneuver burn on 2016-09-14 from 20:51:46 to 20:51:48 (Pass 057), significantly impacts SSHA values. OGDR affected:

JA3_OPR_2PdS022_056_20160914_193034_20160914_225626.nc

Jason-3 Cycle-024 2016-10-02 11:54:52 - 2016-10-12 09:53:24

Significant data gap on pass 013:

JA3_OPR_2PdS024_013_20161002_235916_20161003_015709

due to missing OGDR file, reported in weekly Operations Coordination Group:

J03 3320 Usingen-2 235430 HKTMR, PLTM1, PLTM2 100%, GS, SC nominal. Note: Don Richardson reported missing OGDR file at 0315Z. EUMETSAT engineers investigating. ESPC shows red flags. (JH)

Jason-3 Cycle-030 2016-11-30 23:46:02 - 2016-12-10 21:44:34

Due to the AMR anomaly, no AMR data were available from 04:38:21 UTC on December 8 to 14:51:26 UTC on December 9. As a result, sea surface height data was not computed for the following associated OGDRs:

JA3_OPN_2PdS030_185_20161208_044828_20161208_064101.nc
JA3_OPN_2PdS030_187_20161208_064100_20161208_083820.nc
JA3_OPN_2PdS030_187_20161208_064100_20161208_093508.nc
JA3_OPN_2PdS030_190_20161208_093507_20161208_123508.nc
JA3_OPN_2PdS030_190_20161208_093507_20161208_131152.nc
JA3_OPN_2PdS030_190_20161208_093507_20161208_115628.nc
JA3_OPN_2PdS030_193_20161208_115626_20161208_153658.nc
JA3_OPN_2PdS030_197_20161208_153657_20161208_191310.nc
JA3_OPN_2PdS030_201_20161208_191309_20161208_215020.nc
JA3_OPN_2PdS030_201_20161208_191309_20161208_224852.nc
JA3_OPN_2PdS030_201_20161208_191309_20161208_225056.nc
JA3_OPN_2PdS030_204_20161208_224851_20161209_010005.nc
JA3_OPN_2PdS030_207_20161209_010004_20161209_035848.nc
JA3_OPN_2PdS030_207_20161209_010004_20161209_044038.nc
JA3_OPN_2PdS030_211_20161209_044037_20161209_073528.nc
JA3_OPN_2PdS030_214_20161209_073527_20161209_102109.nc
JA3_OPN_2PdS030_214_20161209_073527_20161209_105838.nc
JA3_OPN_2PdS030_217_20161209_105837_20161209_145126.nc

Significant wave height and wind speed were not impacted.

Section 5.0 Analysis of Data Gaps in the OGDRs

There is a high-level Jason-3 mission/system requirement that is relevant to the anomalies discussed in the previous section:

The GDR shall contain 95% of all possible over-ocean data (acquisition and archive) during any 12 month period, with no systematic gaps.

To assess our performance with regard to this requirement, based on the near real-time OGDRs, all of the data for cycles 1-36 were checked for data gaps between measurements (and between files) when either of the two measurements was over the ocean. Using a nominal inter-record spacing of $\Delta t = 1.02$ seconds, a gap is identified whenever two measurements are separated by more than $2*\Delta t$. Duplicate data, associated with re-dumping of data stored on-board Jason-3 (i.e. when two OGDRs have the same start time) were skipped during gap detection.

The cumulative result over the 4309 analyzed OGDRs is a total of 21,428,316 over-ocean records (out of a total 30,386,257 records) with data gaps totaling 193,858 records. This equates to 54h 55m 35s of missing data over the course of the year, and an over-ocean data return of 99.095 %. Nearly 48 hours of this data gap is associated with the GPS software upload that affected cycle-003, during which the instruments were switch to stand-by mode.

The following OGDRs had cumulative data gaps (both internally and relative to the previous file) in excess of 100 seconds. OGDRs are not reported in this list if the data were redumped on a subsequent pass, but they are included in the statistics reported above.

```
JA3_OPR_2PTS003_233_20160317_080613_20160317_081458 172424
JA3_OPR_2PdS024_013_20161002_235916_20161003_015709  6996
JA3_OPR_2PdS020_203_20160831_172549_20160831_194553  3541
JA3_OPR_2PTS003_234_20160317_085419_20160317_113351  2315
JA3_OPR_2PTS003_018_20160308_222622_20160309_015208  1774
JA3_OPR_2PTS008_017_20160427_120555_20160427_141217  1633
JA3_OPR_2PTS010_044_20160518_083529_20160518_120441   957
JA3_OPR_2PTS010_037_20160518_024254_20160518_044200   957
JA3_OPR_2PTS010_029_20160517_192459_20160517_212116   957
JA3_OPR_2PTS008_144_20160502_102812_20160502_134854   659
JA3_OPR_2PTS002_109_20160302_133855_20160302_160849   186
JA3_OPR_2PTS008_148_20160502_143728_20160502_155845   181
JA3_OPR_2PTS006_113_20160411_100029_20160411_115937   128
JA3_OPR_2PTS006_063_20160409_111226_20160409_131113   117
JA3_OPR_2PdS019_047_20160815_175142_20160815_180204   101
```

Section 6.0 Summary

The overall quality of the Jason-3 near real-time OGDR data is extremely good. The amount of missing data, attributed to all of the anomalies discussed in sections 4 and 5 is about 55 hours 55 minutes. **This represents an over-ocean data return of 99.1%, over the time period of 360 days analyzed in this report.**

In addition to the high overall data return, the data availability in terms of latency is also meeting the weekly 90% goal, with an **overall percentage of low-latency OGDRs of 92.3%.**

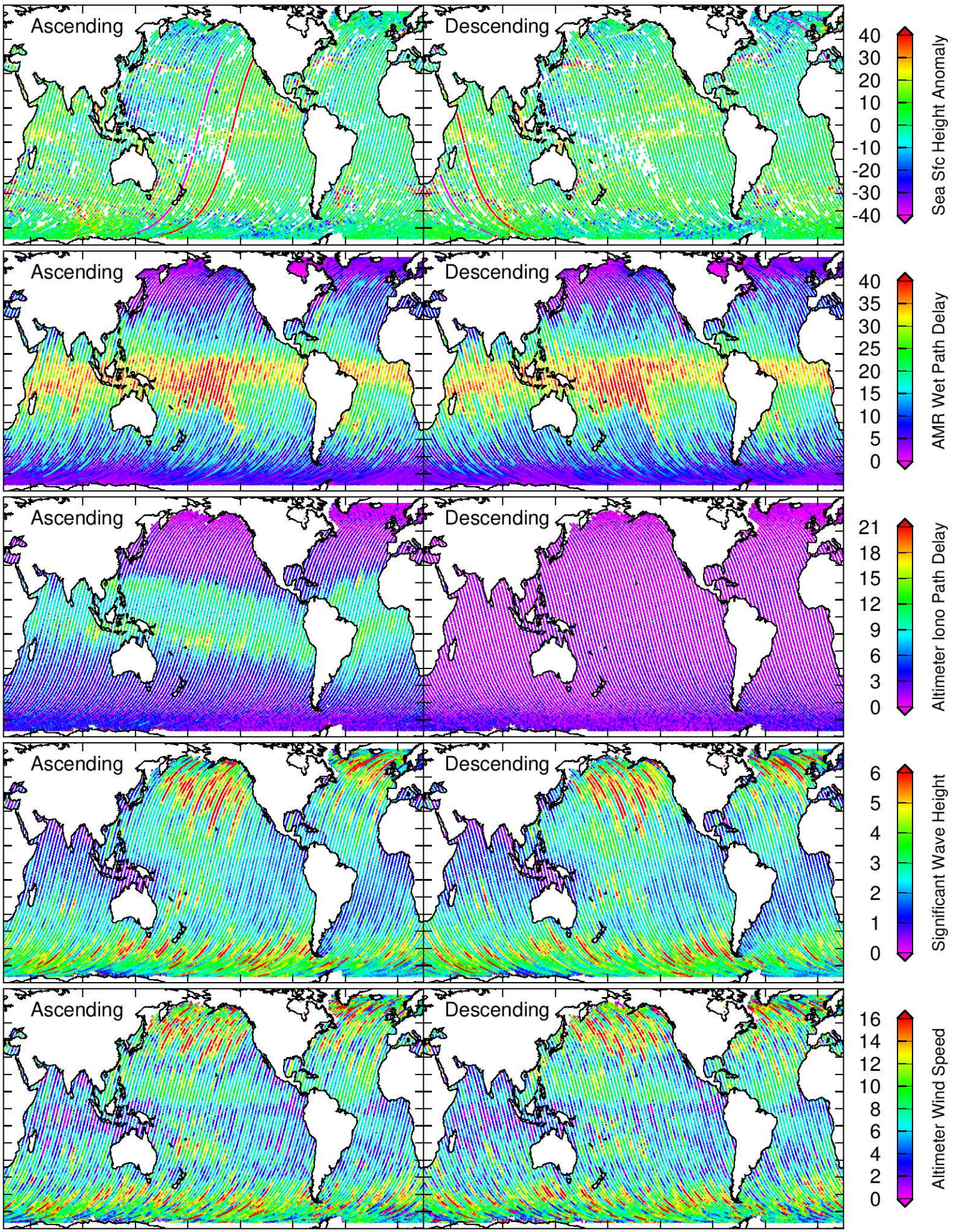
Appendix A. Cyclic Parameter Plots Cycle-001 to Cycle-036

See individual plots on the following 36 pages.

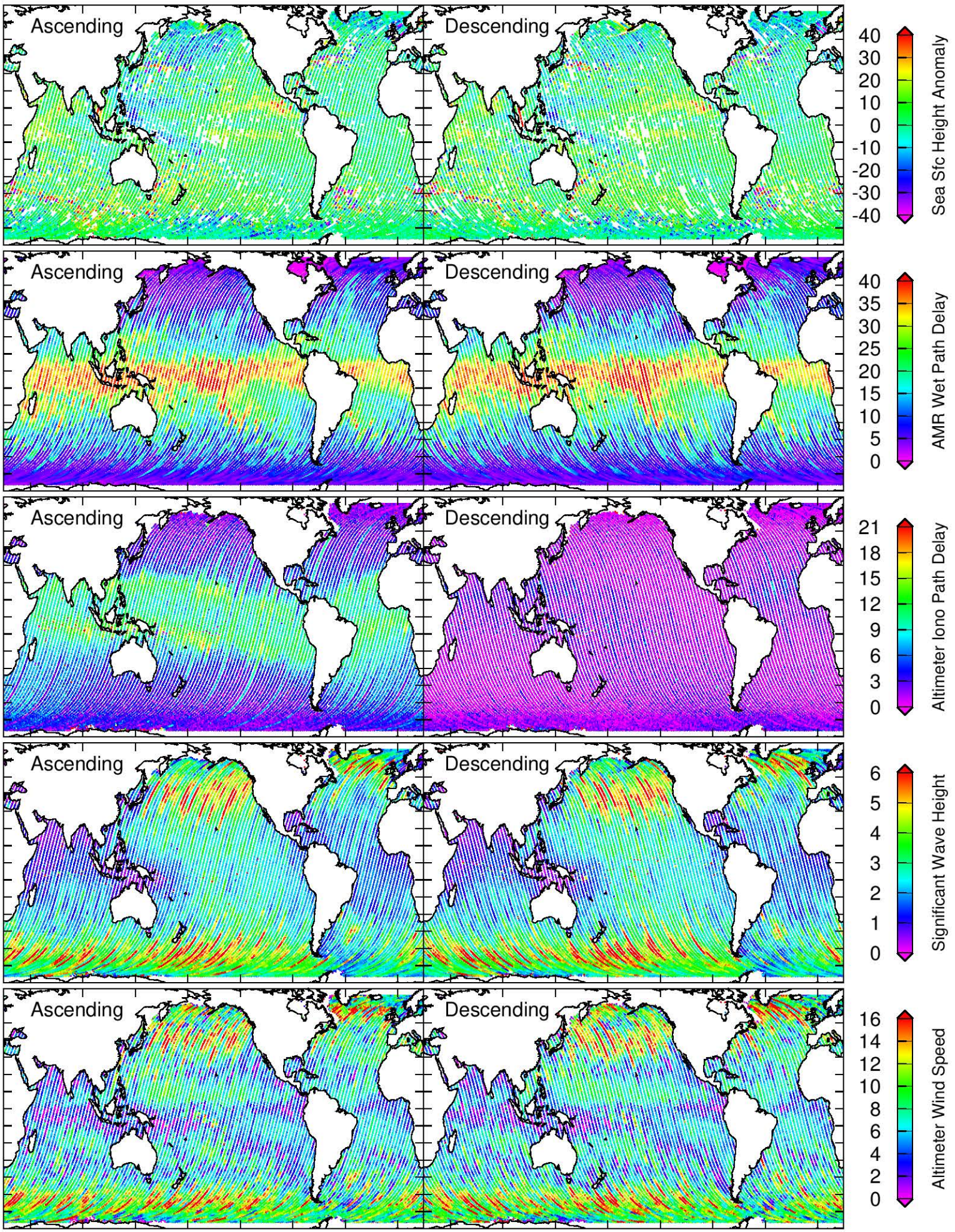
Appendix B. Acronyms

Acronym	Definition
AMR	Advanced Microwave Radiometer
CLS	Collecte Localisation Satellites
CNES	Centre National d'Etudes Spatiales
CNG	Consigne Numerique de Gain (altimeter gain calibration)
DEM	Digital Elevation Model
DMZ	Demilitirized Zone
DORIS	Doppler Orbitography and Radiopositioning Integrated by Satellite
ECMWF	European Centre for Medium-range Weather Forecasting
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
GPSP	Global Positioning System Payload
HKTMR	Housekeeping Telemetry
J2TCCS	Jason-2 Tele-Command and Control System
JPL	Jet Propulsion Laboratory
NASA	National Aeronautics and Space Administration
NESDIS	National Environmental Satellite Data and Information Service
NOAA	National Oceanic and Atmospheric Administration
NRTAVS	Near Real-Time Altimeter Validation System
OGDR	Operational Geophysical Data Records
OSTM	Ocean Surface Topography Mission
OPS	Operations
PLTM	Payload Telemetry
POS3B	Poseidon 3B
SOCC	Satellite Operations Control Center
SSH(A)	Sea Surface Height (Anomaly)
SWH	Significant Wave Height
TM-NRT	Telemetry analyzer Near Real-Time

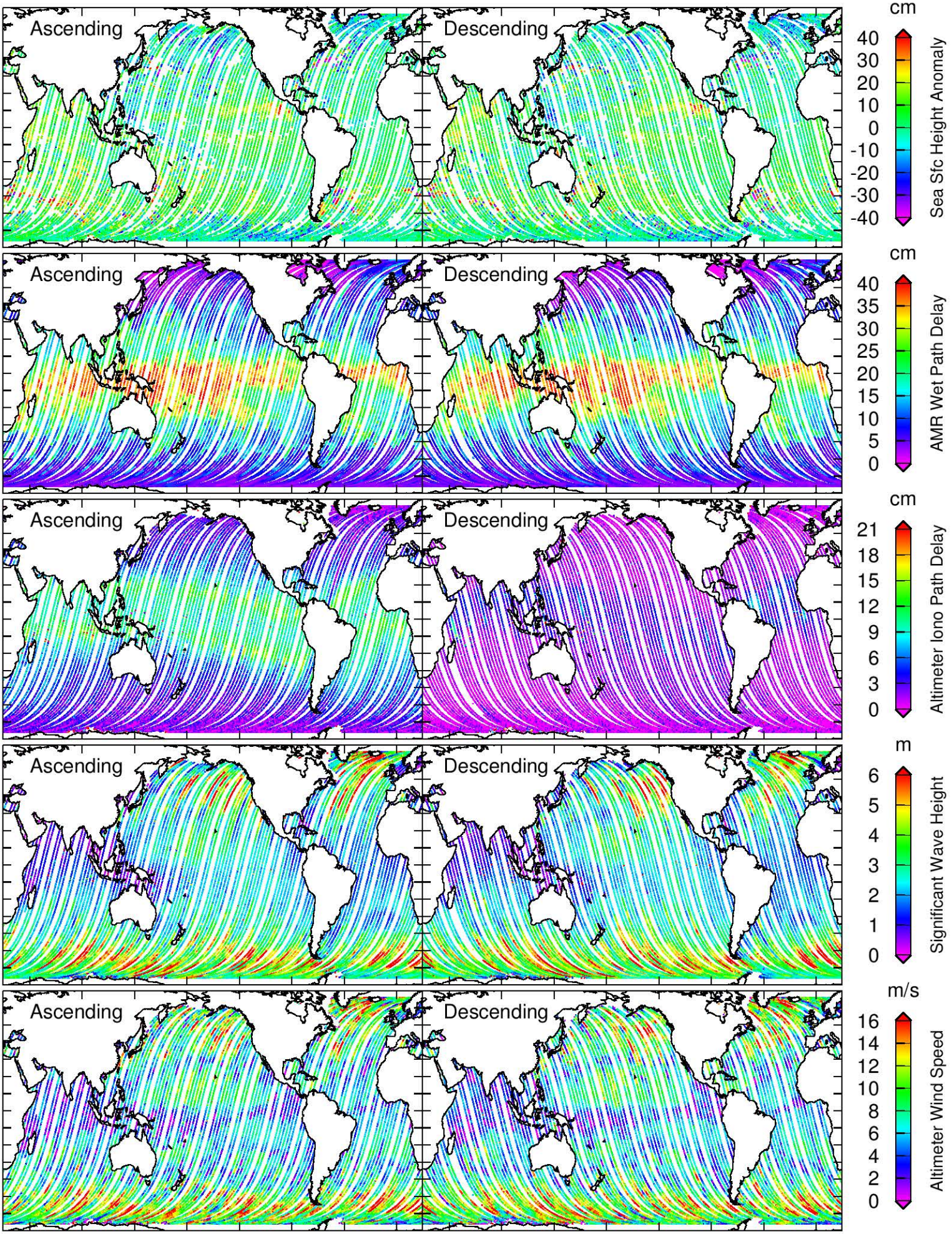
Jason-3 Cycle-001 2016-02-17 10:28:45 - 2016-02-27 08:27:17



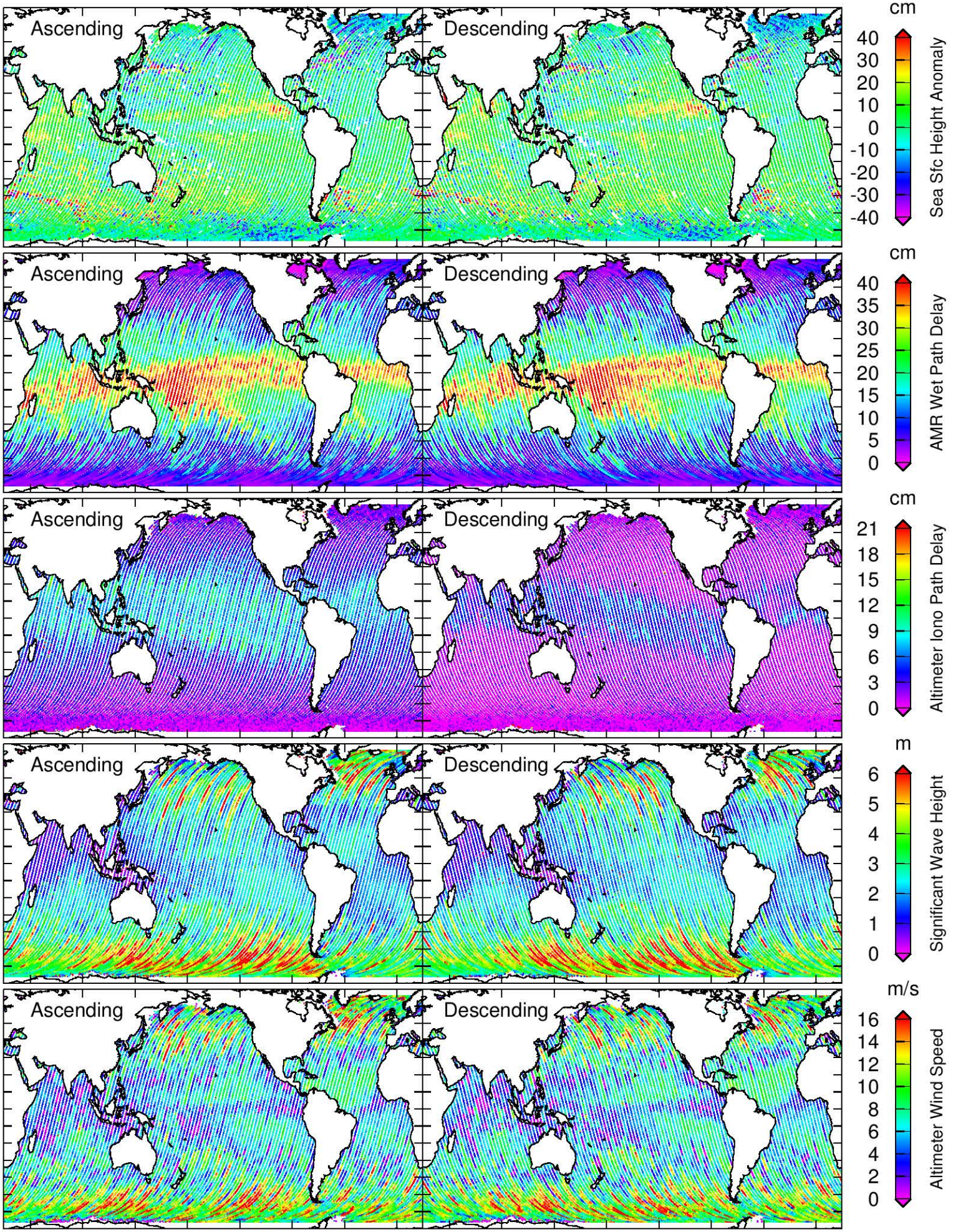
Jason-3 Cycle-002 2016-02-27 08:27:17 - 2016-03-08 06:25:49



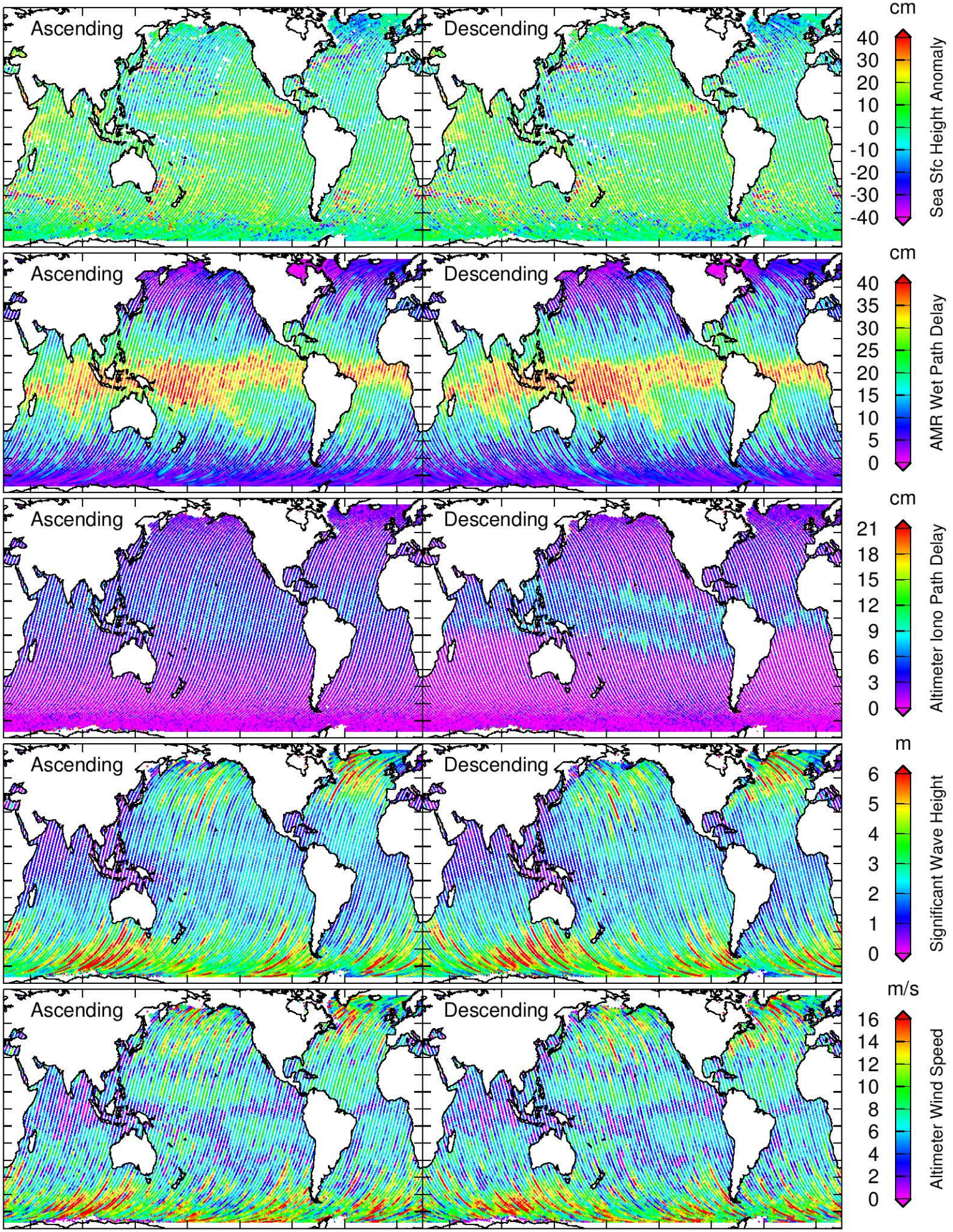
Jason-3 Cycle-003 2016-03-08 06:25:49 - 2016-03-18 04:24:20



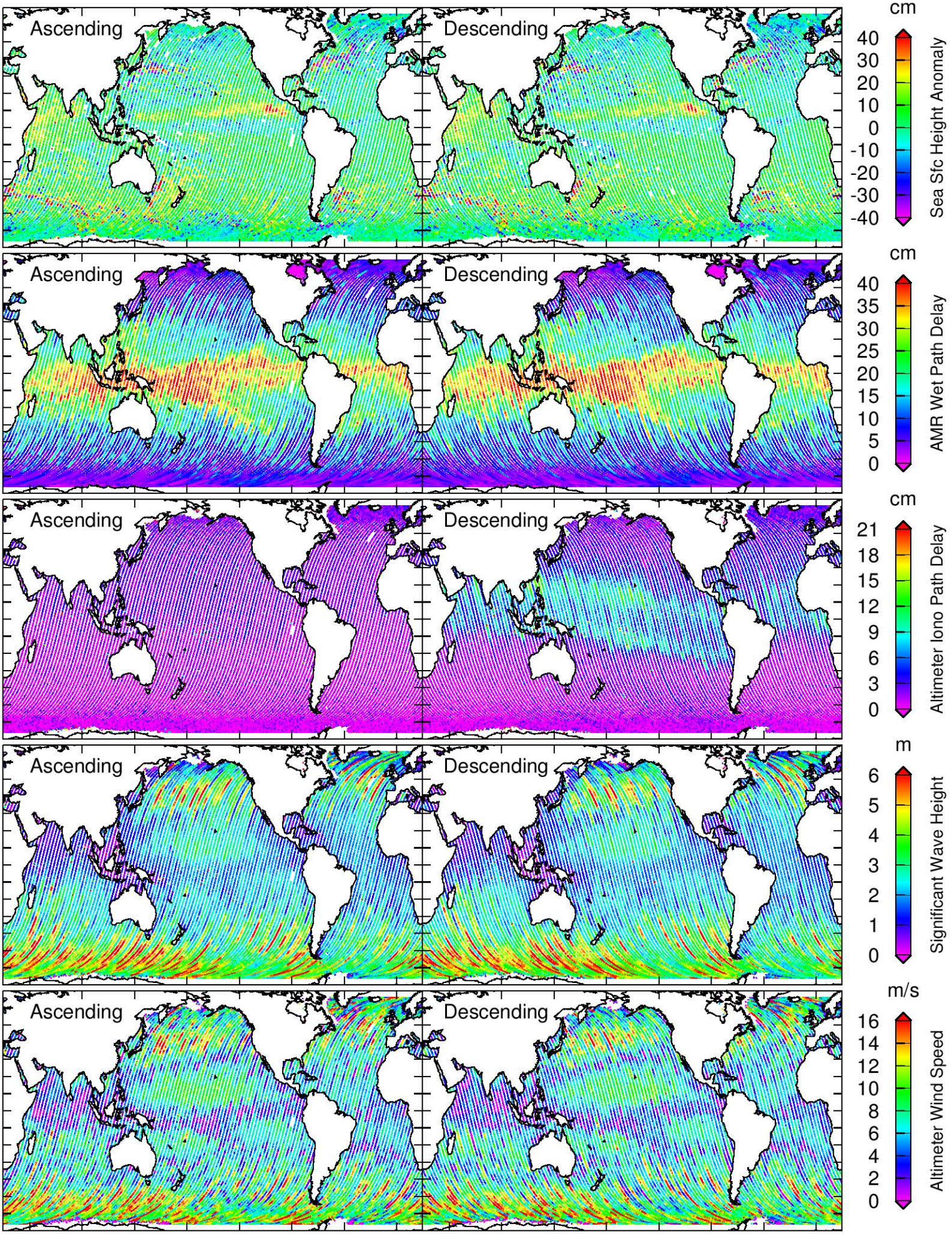
Jason-3 Cycle-004 2016-03-18 04:24:20 - 2016-03-28 02:22:52



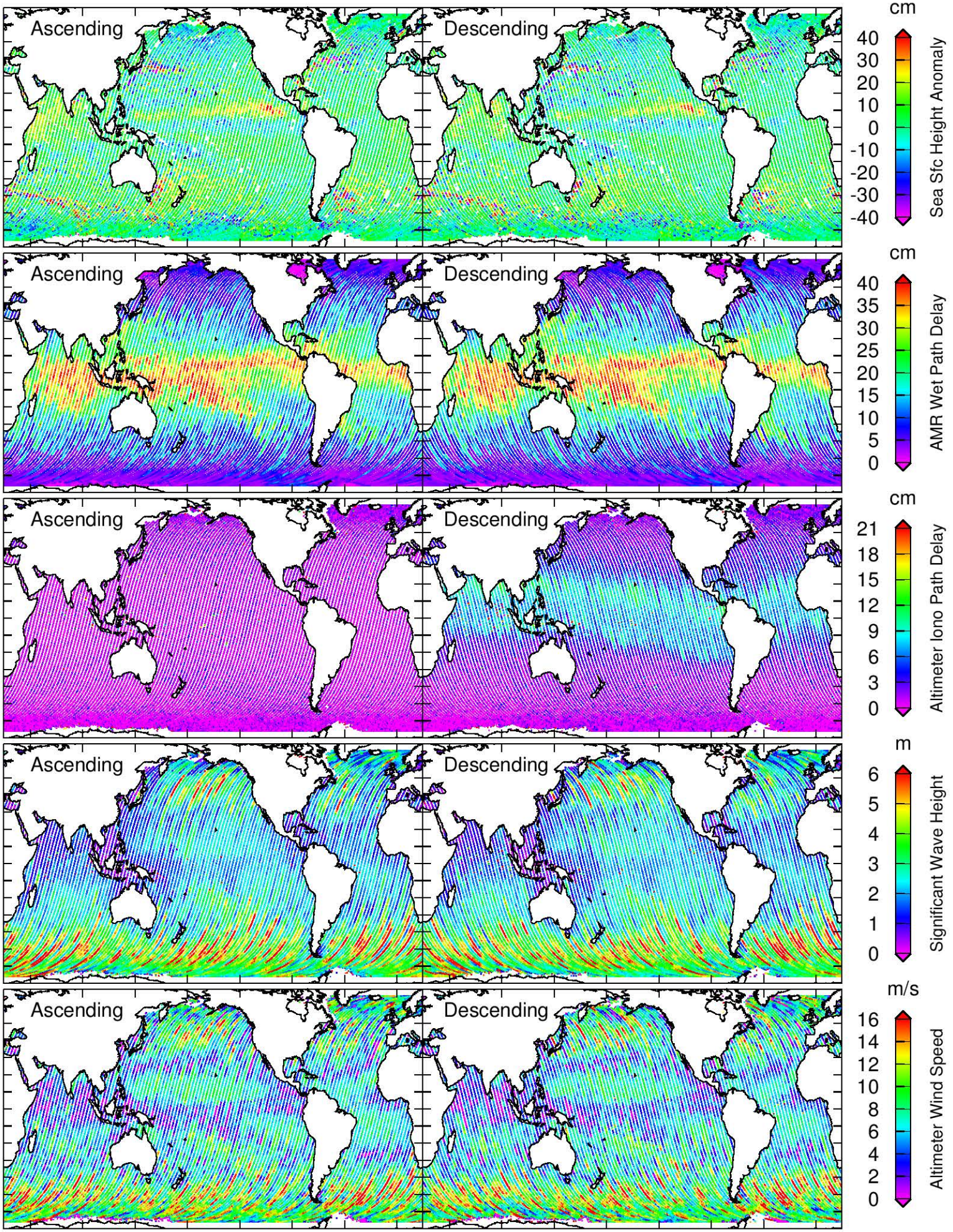
Jason-3 Cycle-005 2016-03-28 02:22:52 - 2016-04-07 00:21:23



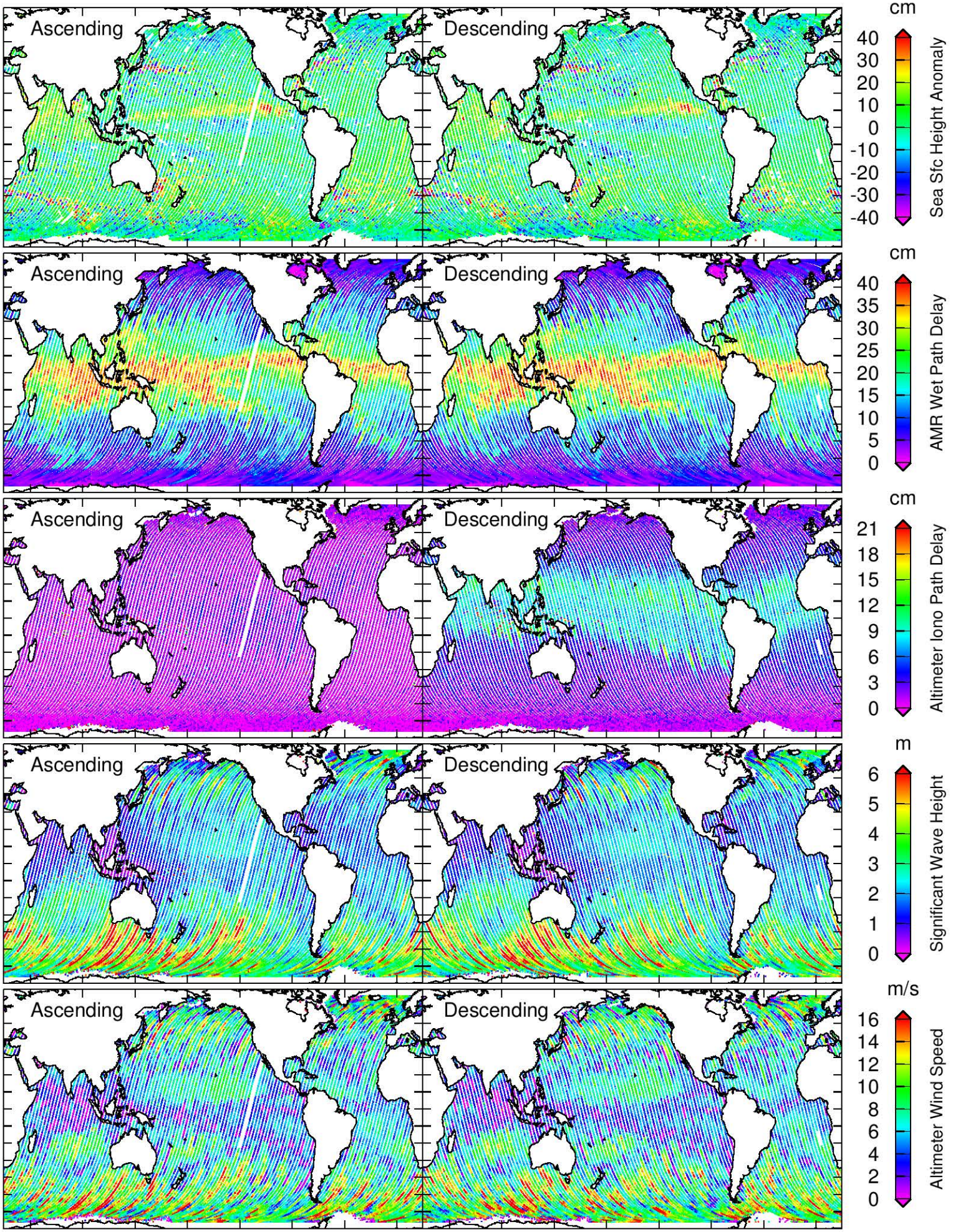
Jason-3 Cycle-006 2016-04-07 00:21:23 - 2016-04-16 22:19:55



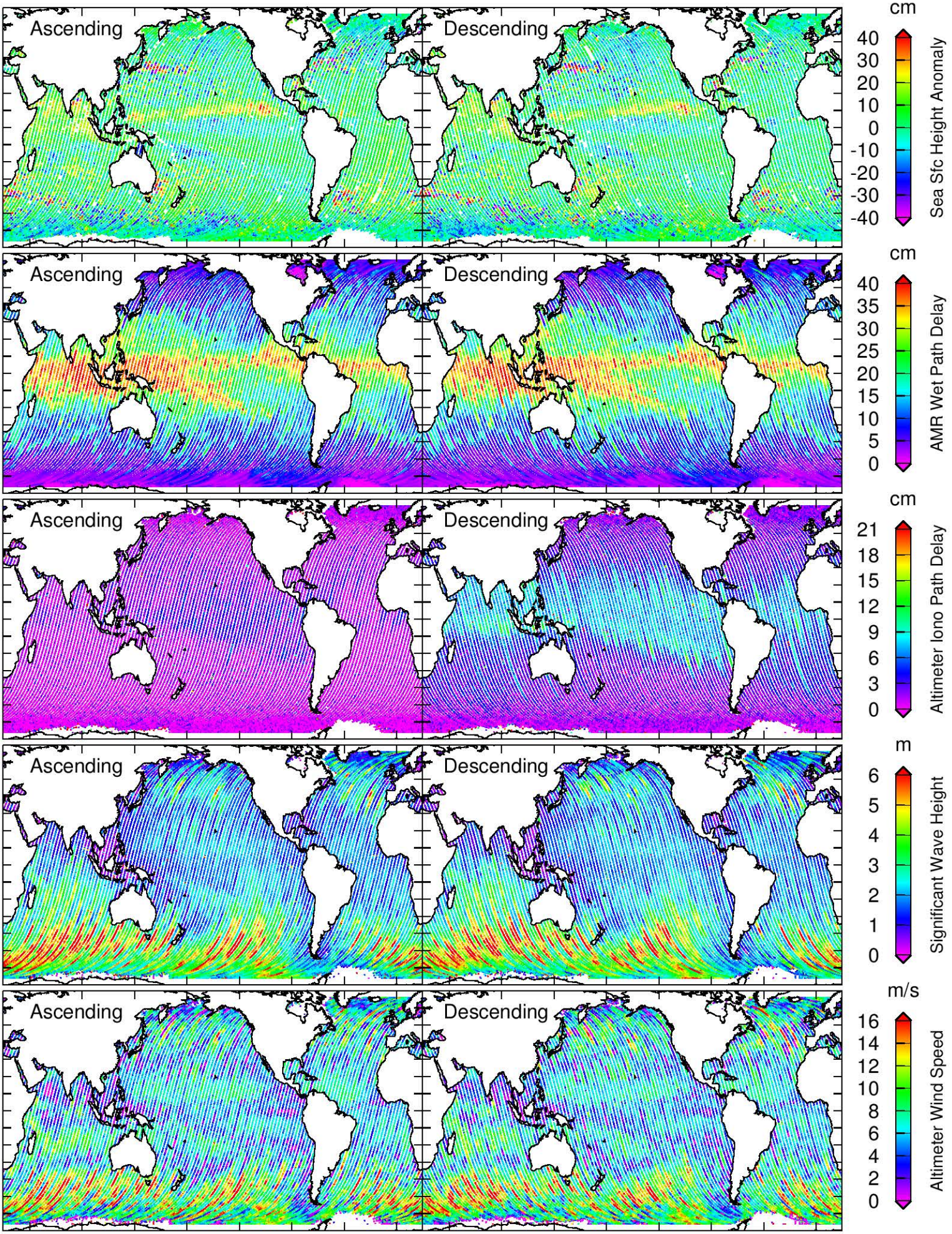
Jason-3 Cycle-007 2016-04-16 22:19:55 - 2016-04-26 20:18:27



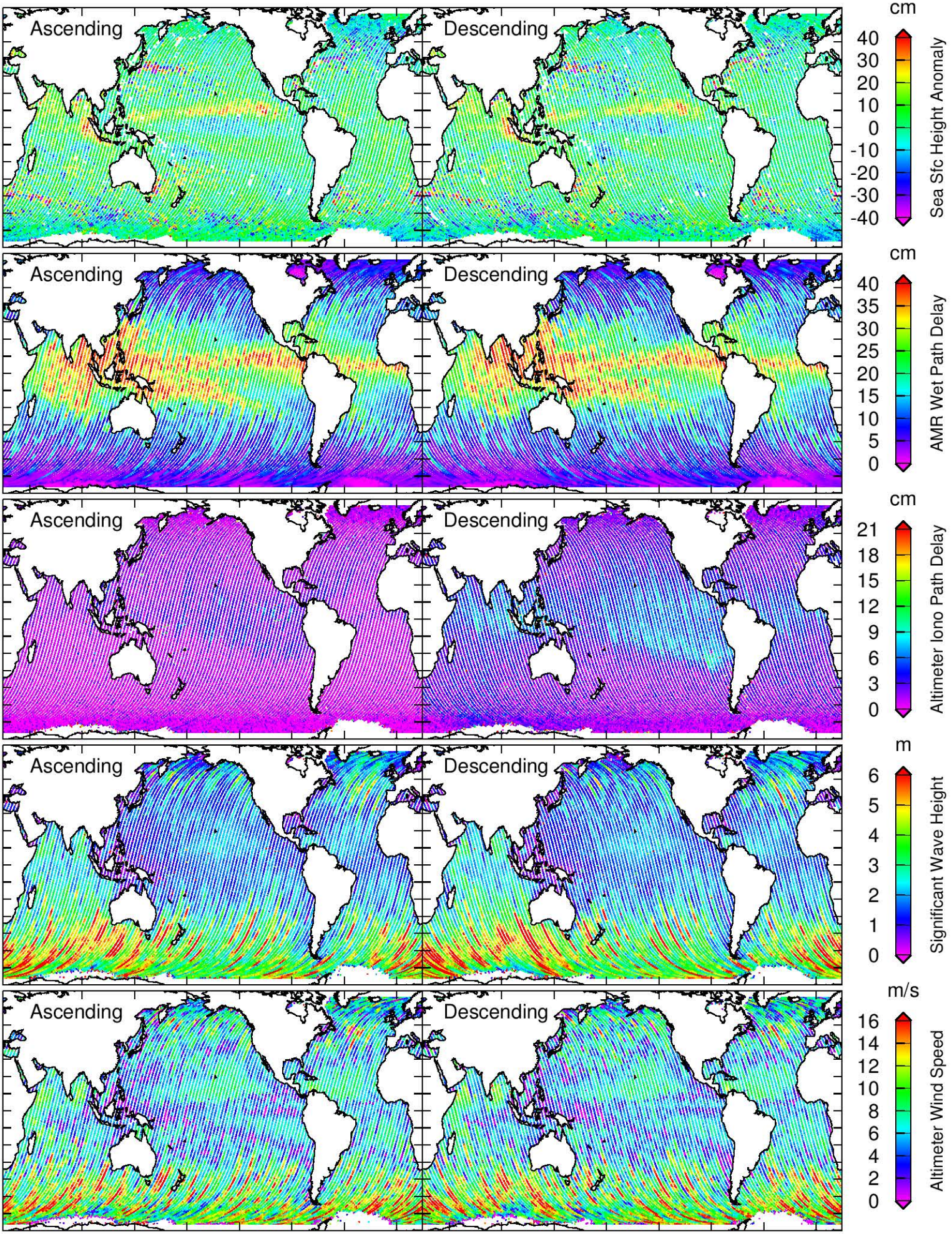
Jason-3 Cycle-008 2016-04-26 20:18:27 - 2016-05-06 18:16:58



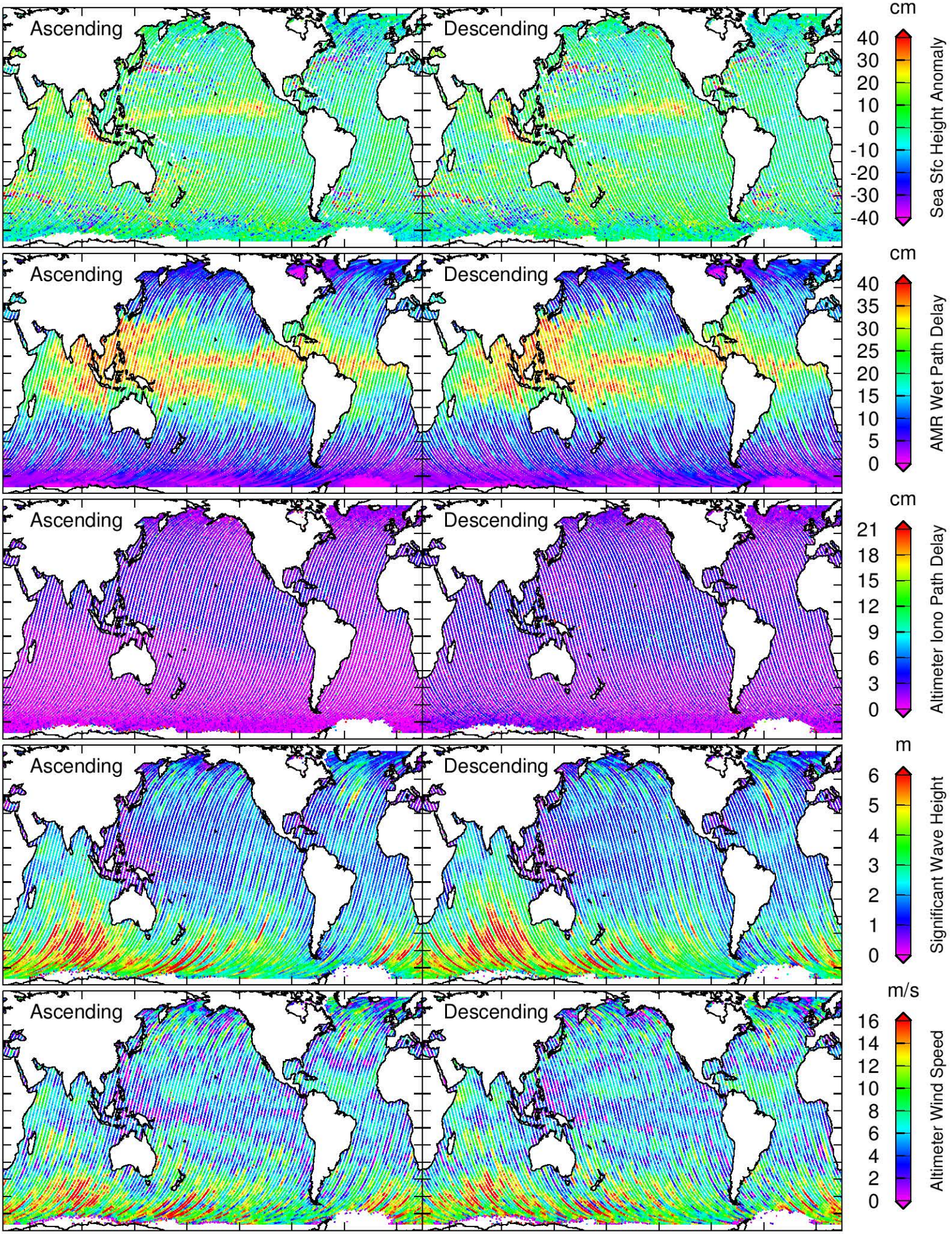
Jason-3 Cycle-009 2016-05-06 18:16:58 - 2016-05-16 16:15:30



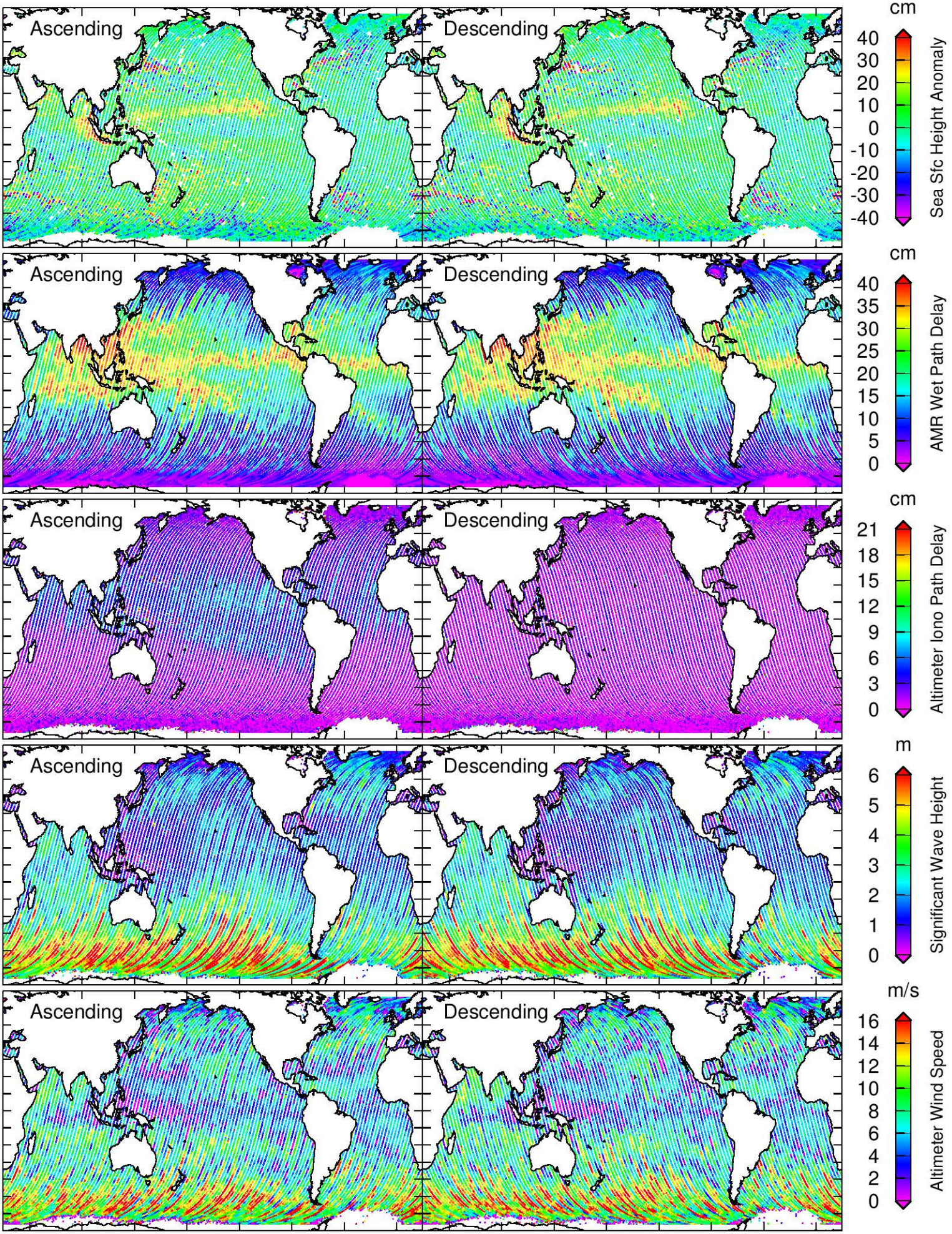
Jason-3 Cycle-010 2016-05-16 16:15:30 - 2016-05-26 14:14:01



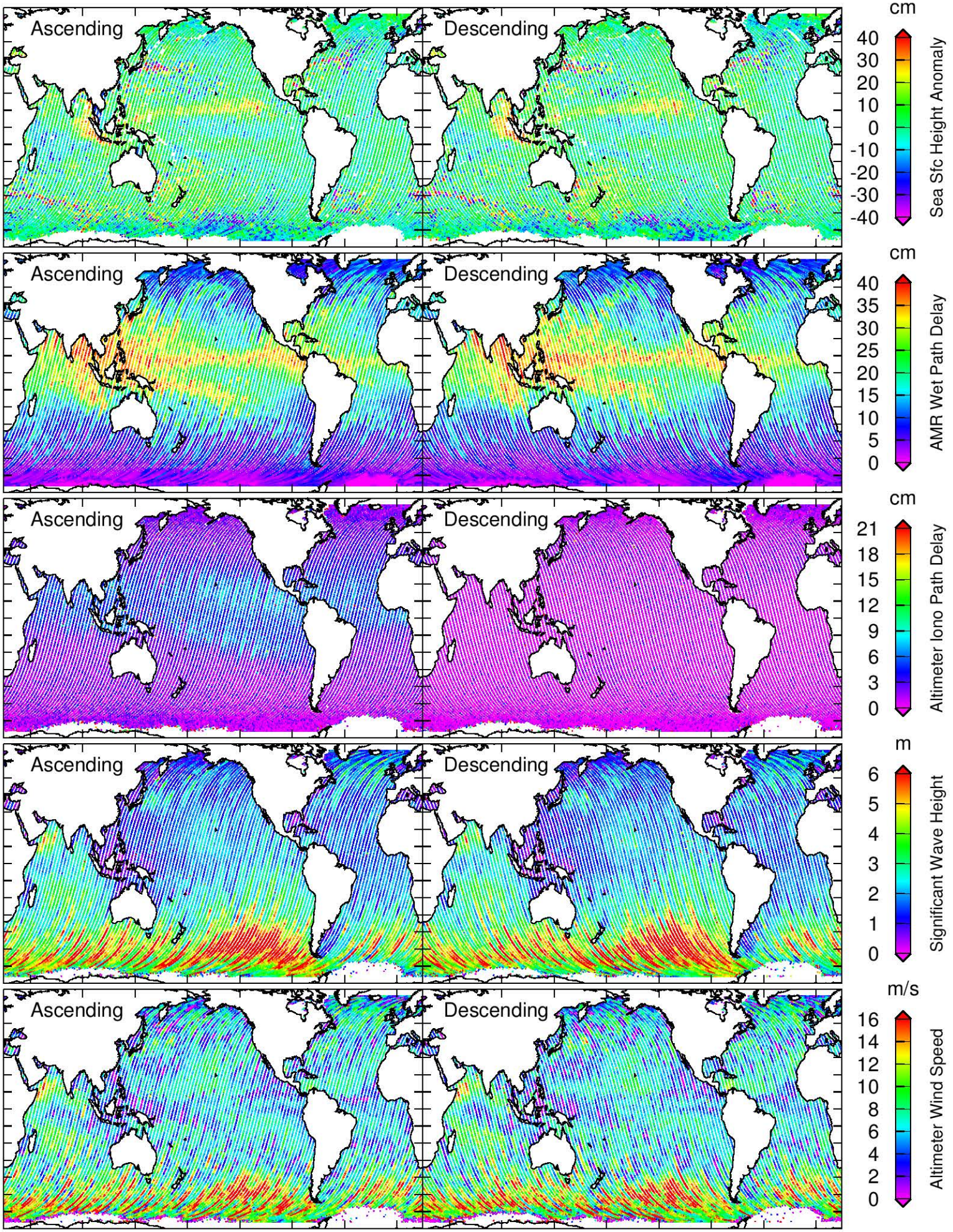
Jason-3 Cycle-011 2016-05-26 14:14:01 - 2016-06-05 12:12:33



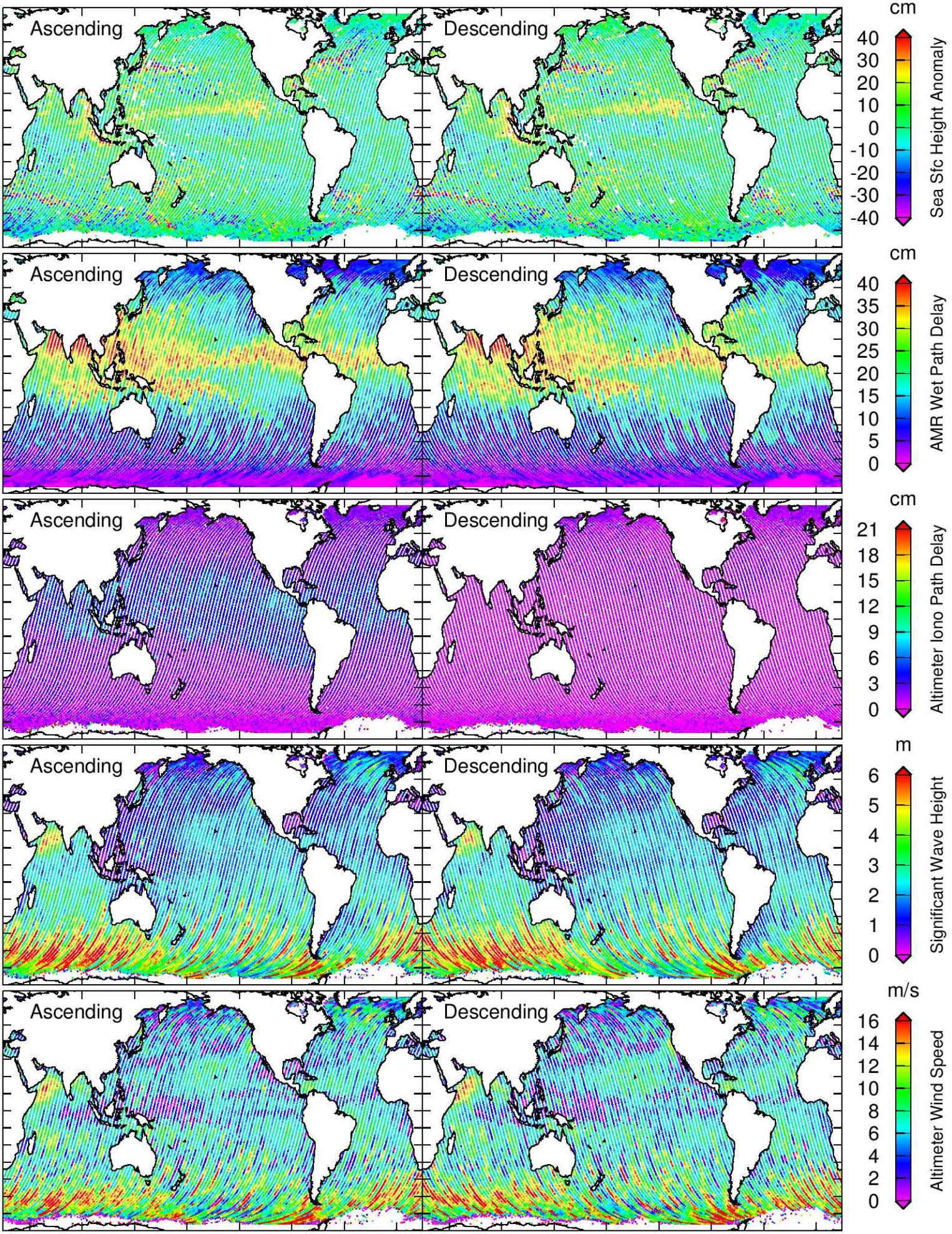
Jason-3 Cycle-012 2016-06-05 12:12:33 - 2016-06-15 10:11:05



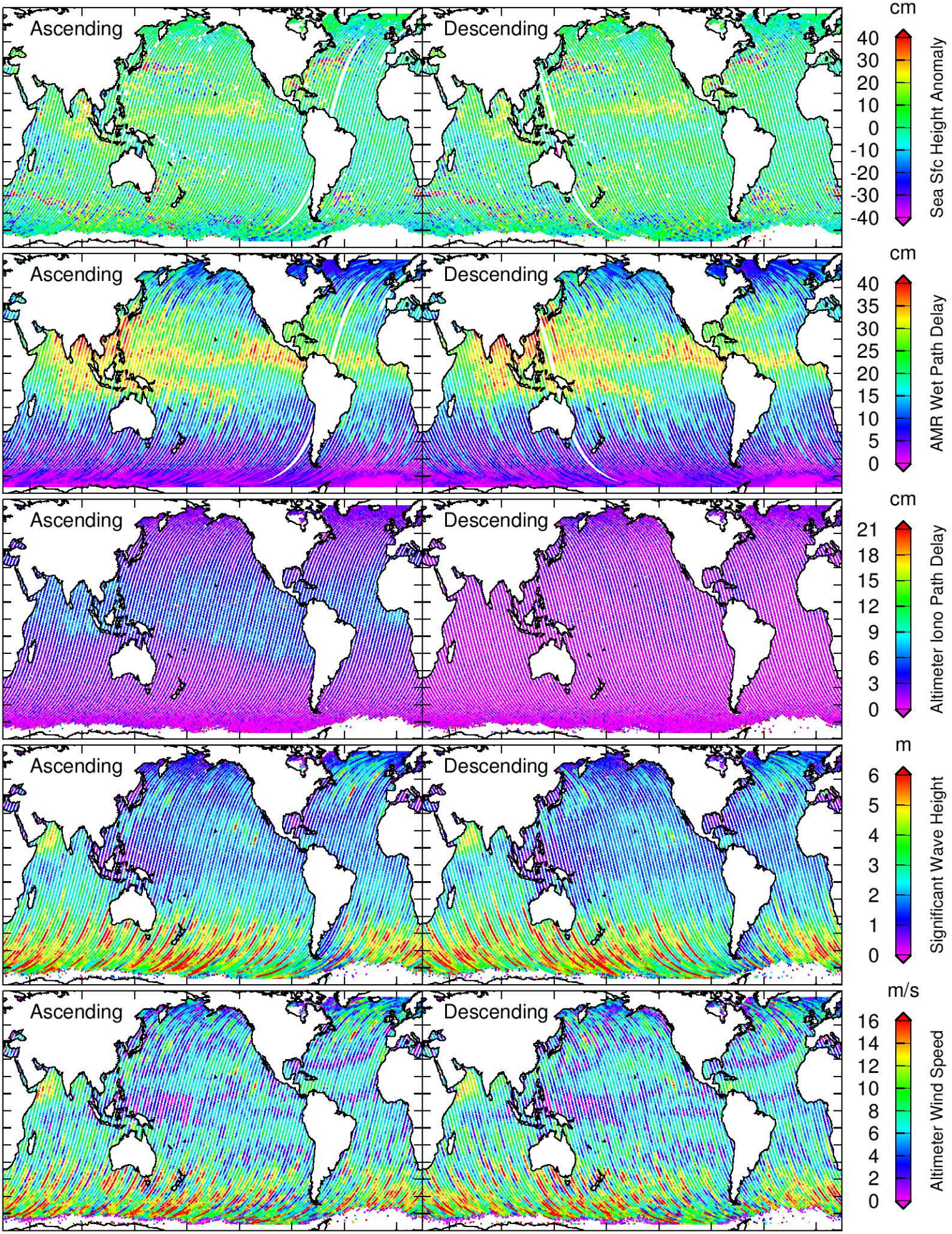
Jason-3 Cycle-013 2016-06-15 10:11:05 - 2016-06-25 08:09:36



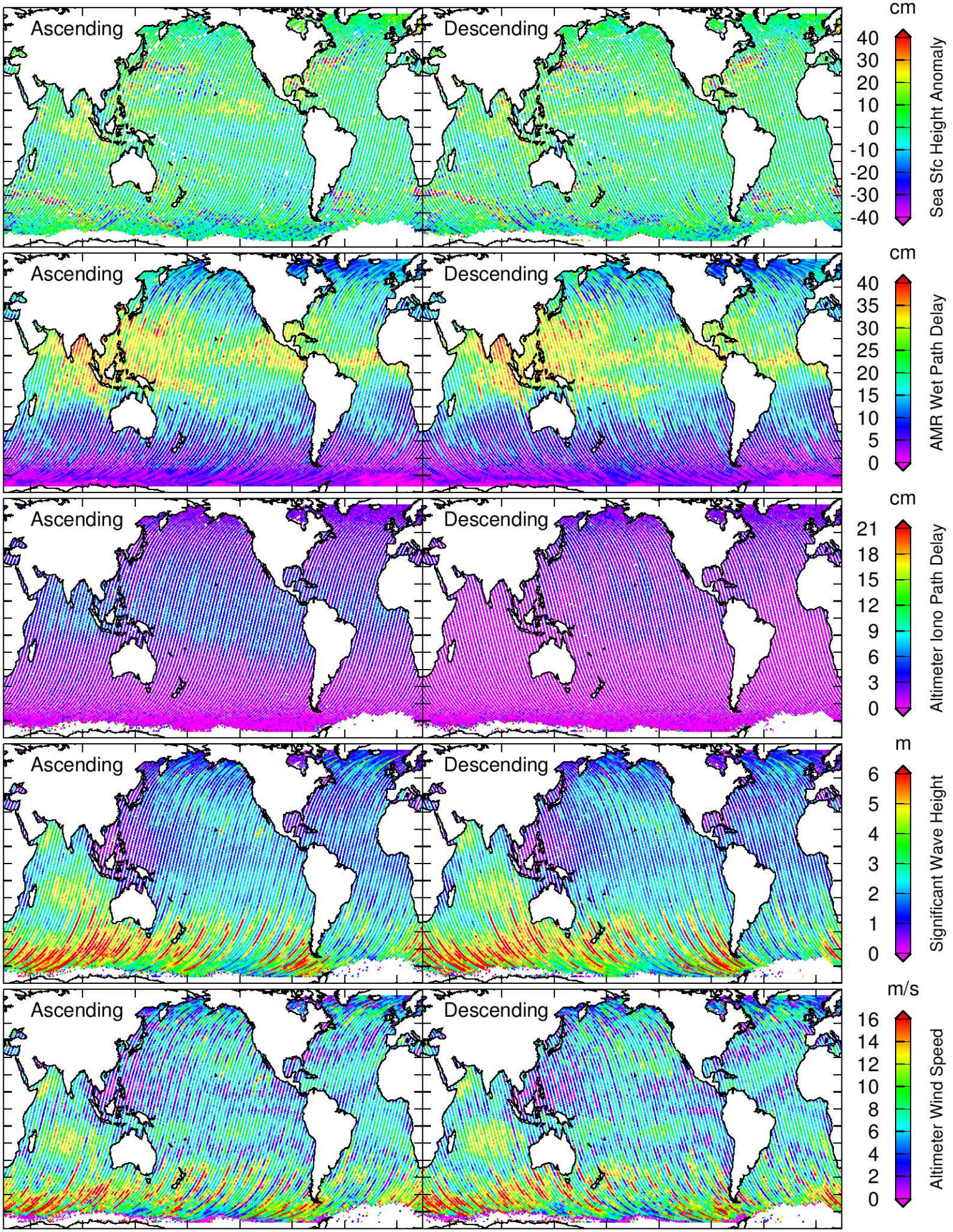
Jason-3 Cycle-014 2016-06-25 08:09:36 - 2016-07-05 06:08:08



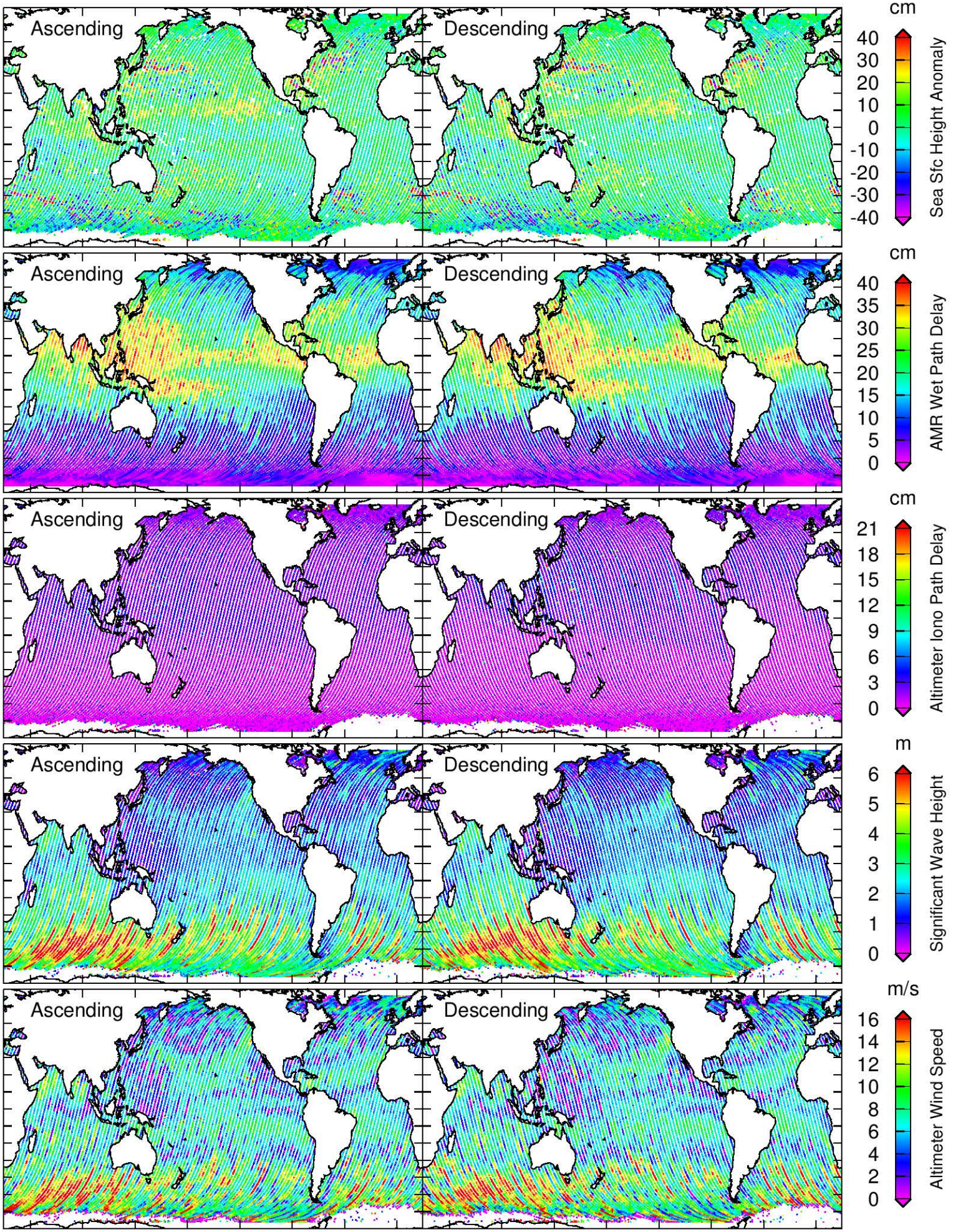
Jason-3 Cycle-015 2016-07-05 06:08:08 - 2016-07-15 04:06:40



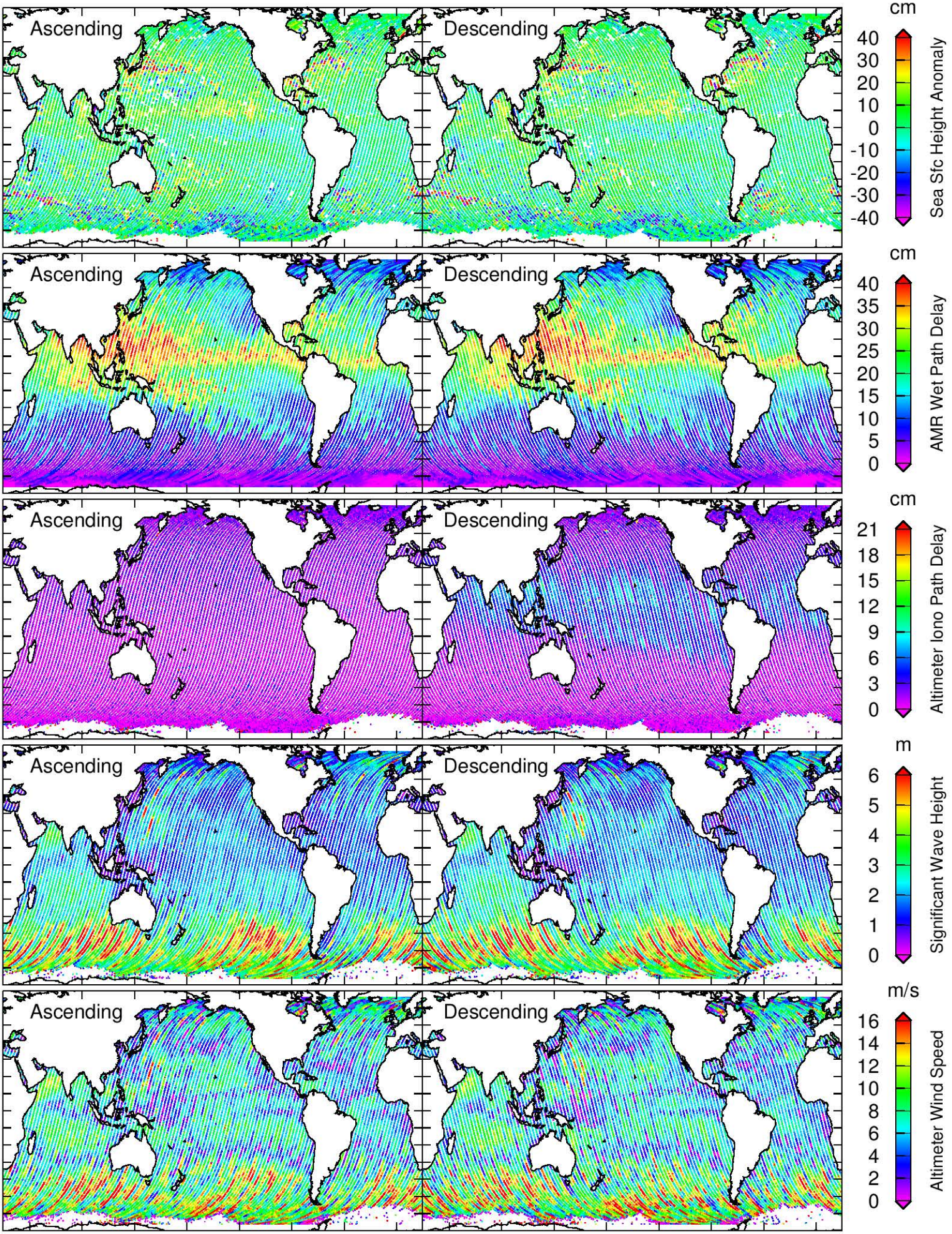
Jason-3 Cycle-016 2016-07-15 04:06:40 - 2016-07-25 02:05:11



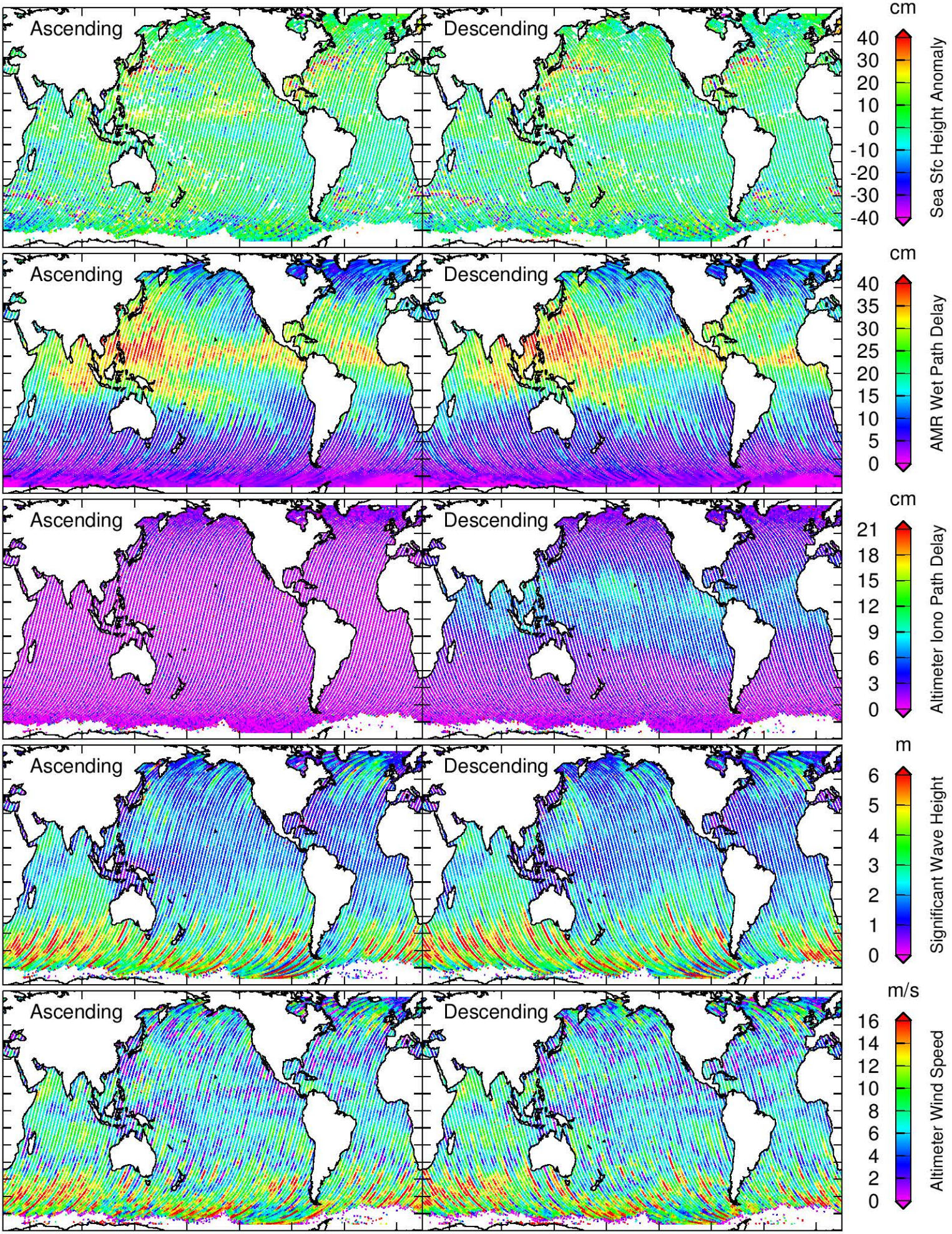
Jason-3 Cycle-017 2016-07-25 02:05:11 - 2016-08-04 00:03:43



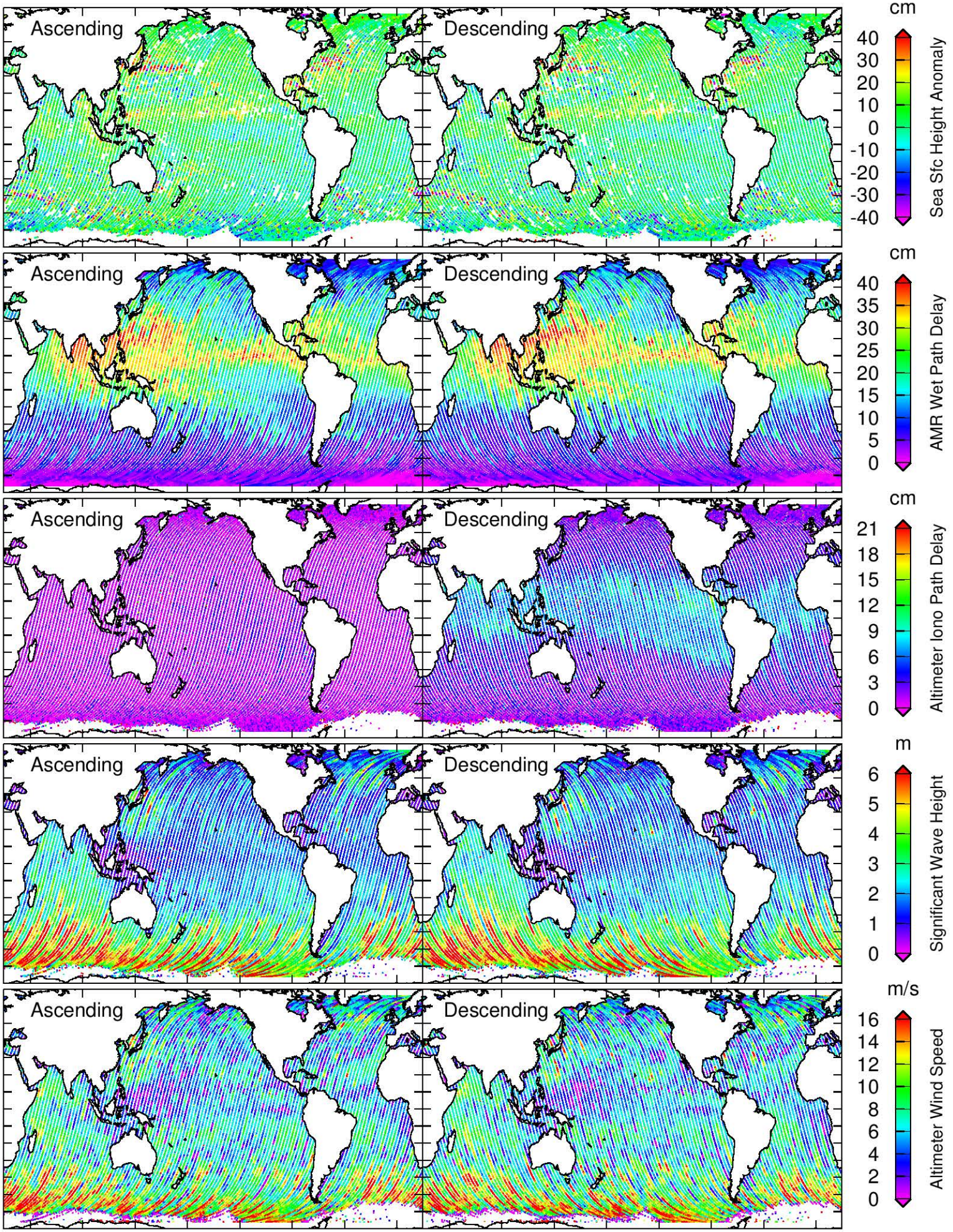
Jason-3 Cycle-018 2016-08-04 00:03:43 - 2016-08-13 22:02:14



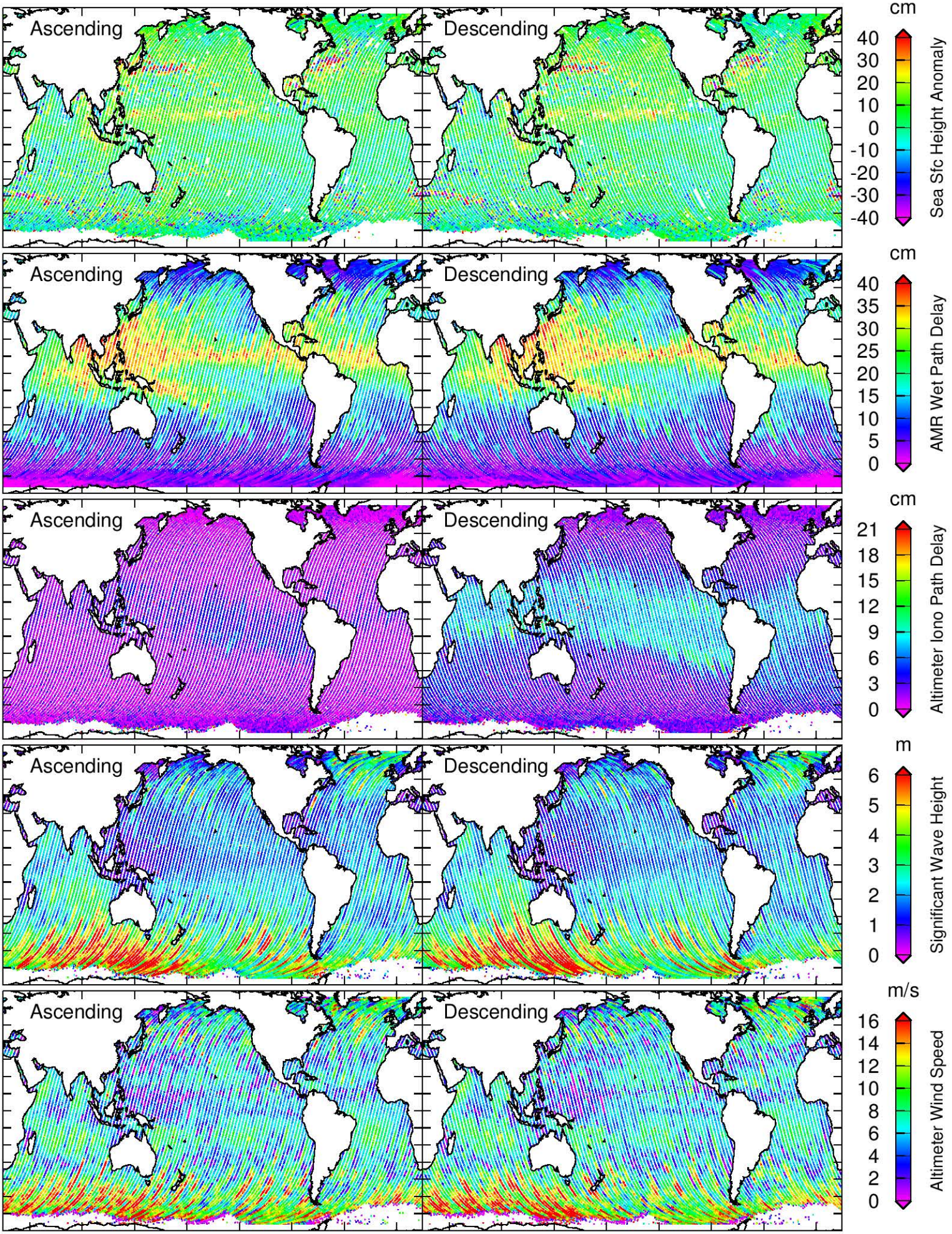
Jason-3 Cycle-019 2016-08-13 22:02:14 - 2016-08-23 20:00:46



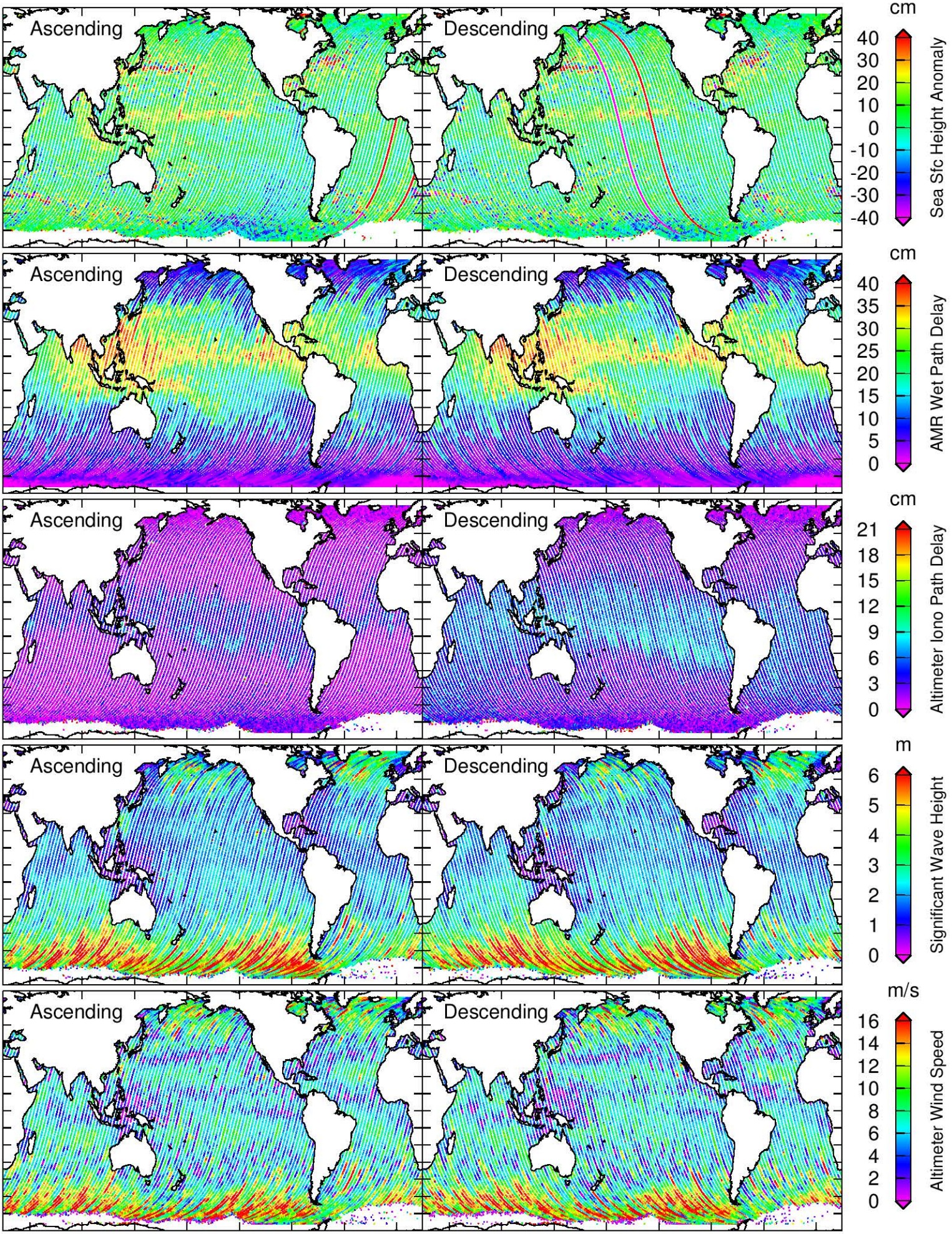
Jason-3 Cycle-020 2016-08-23 20:00:46 - 2016-09-02 17:59:18



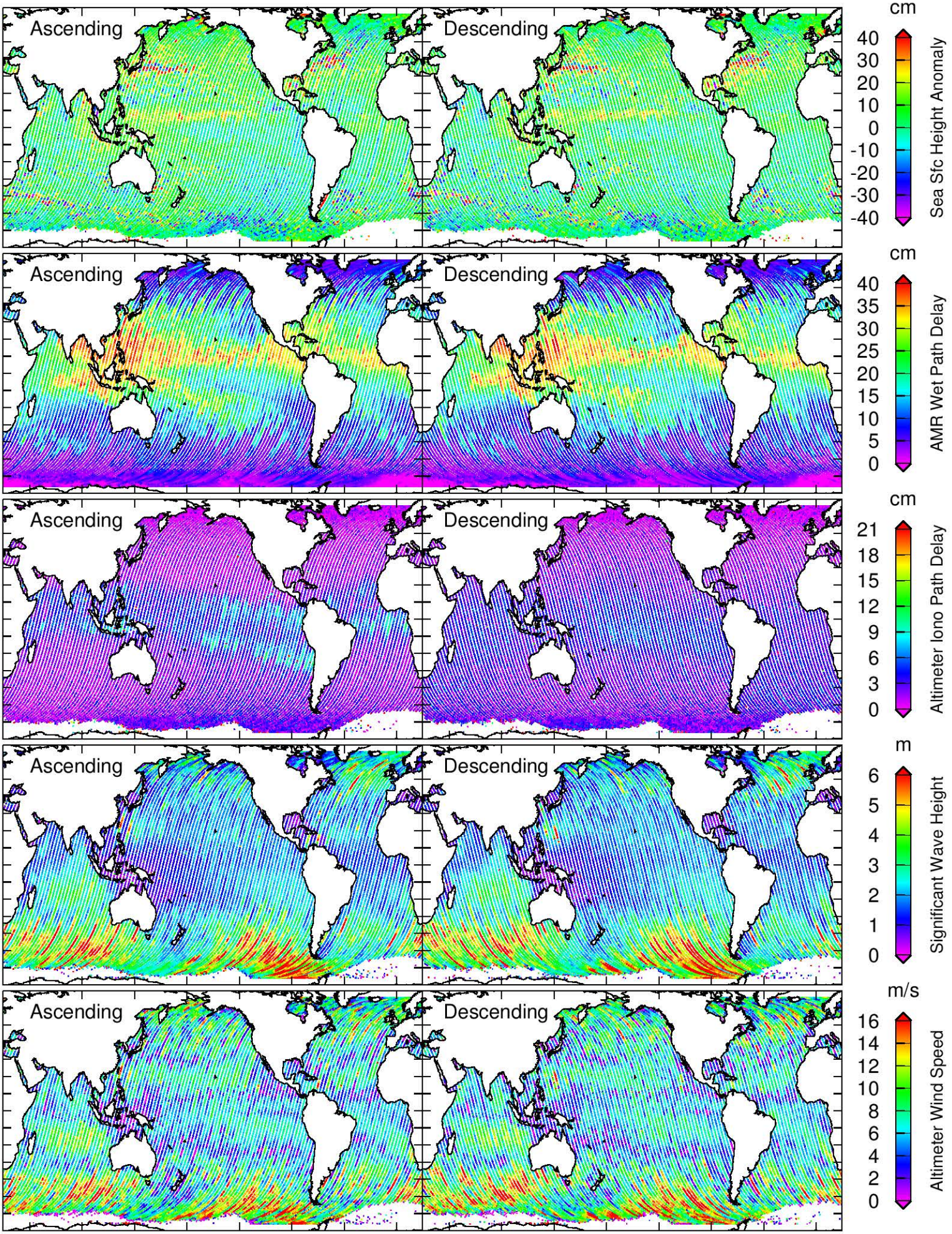
Jason-3 Cycle-021 2016-09-02 17:59:18 - 2016-09-12 15:57:49



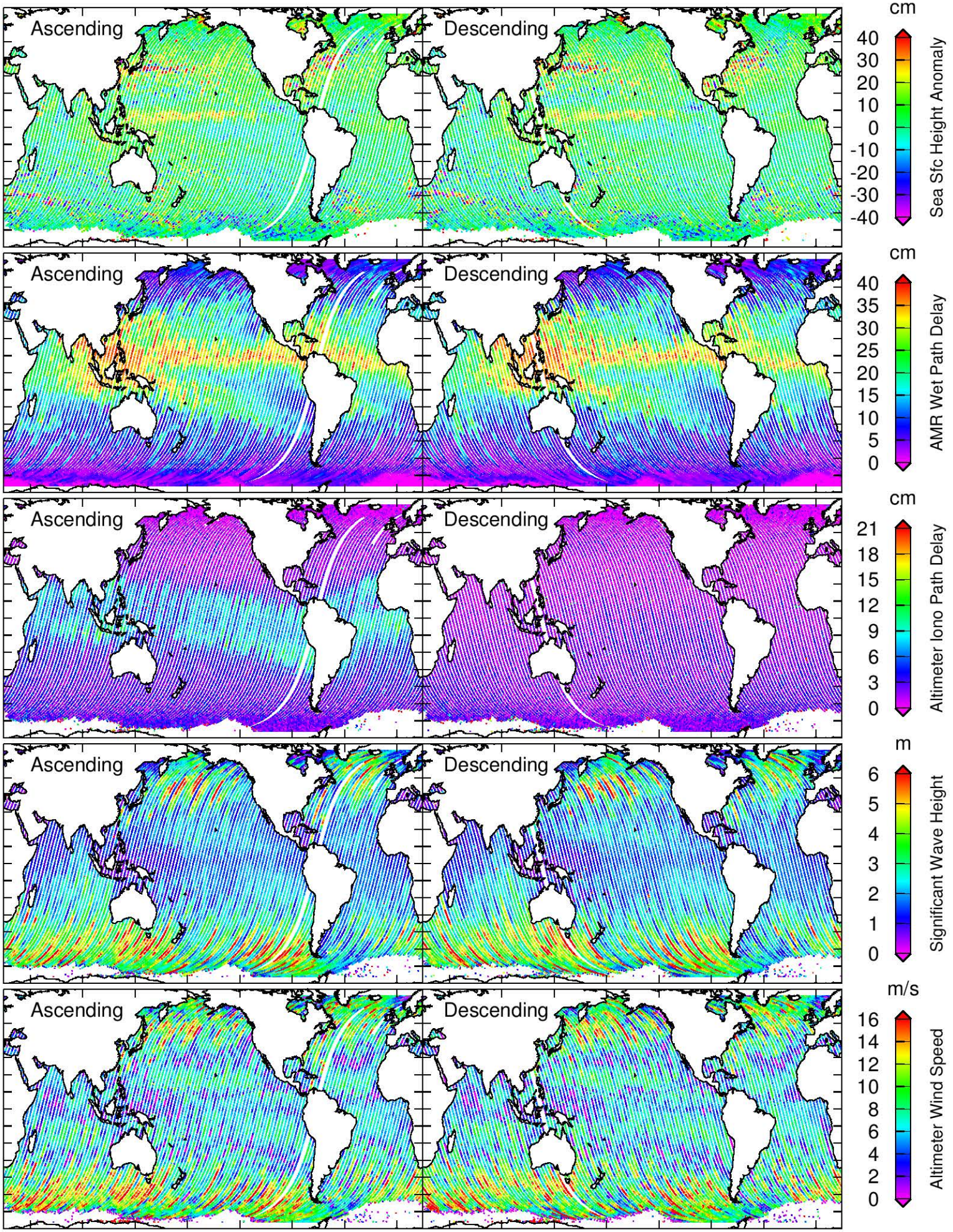
Jason-3 Cycle-022 2016-09-12 15:57:49 - 2016-09-22 13:56:21



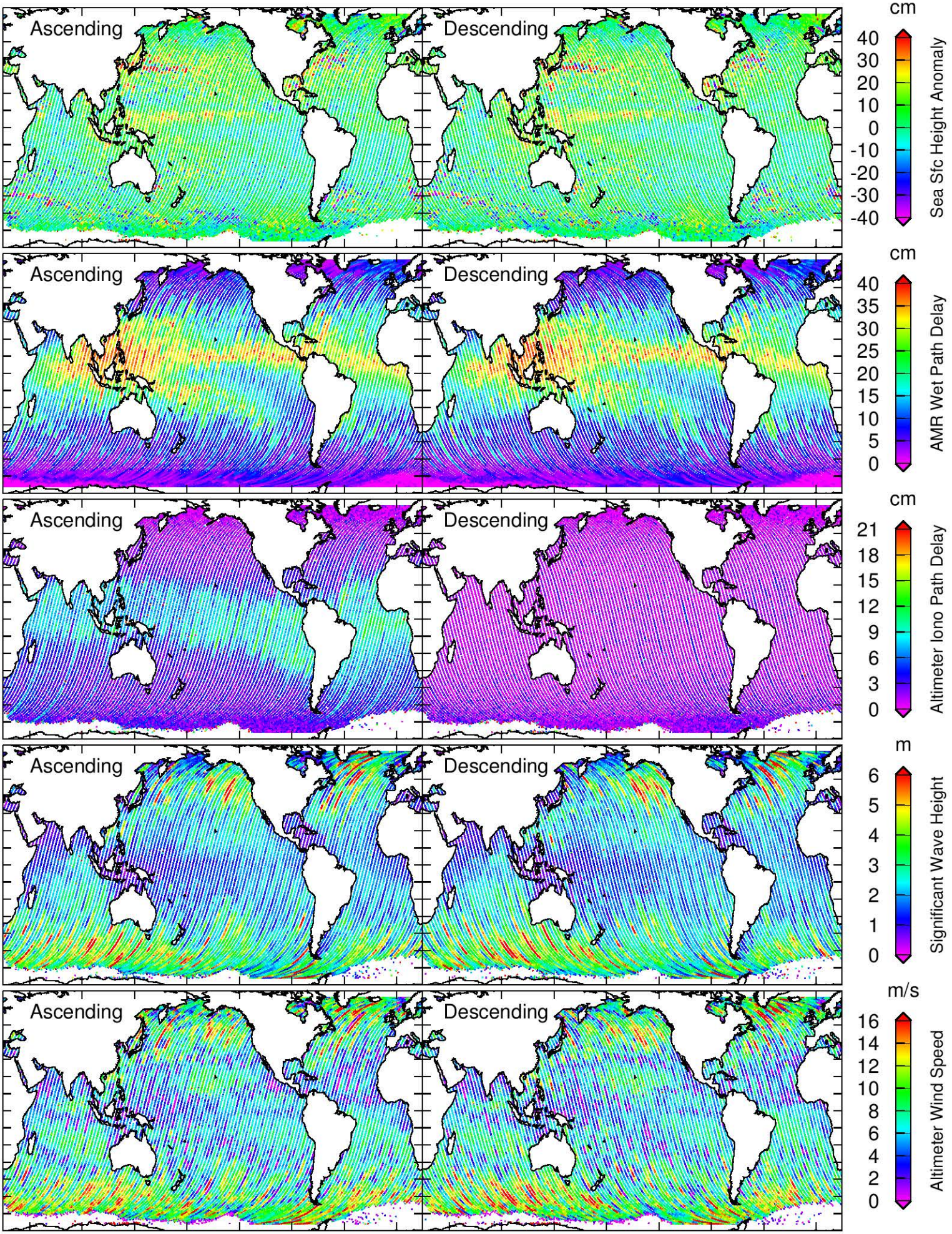
Jason-3 Cycle-023 2016-09-22 13:56:21 - 2016-10-02 11:54:52



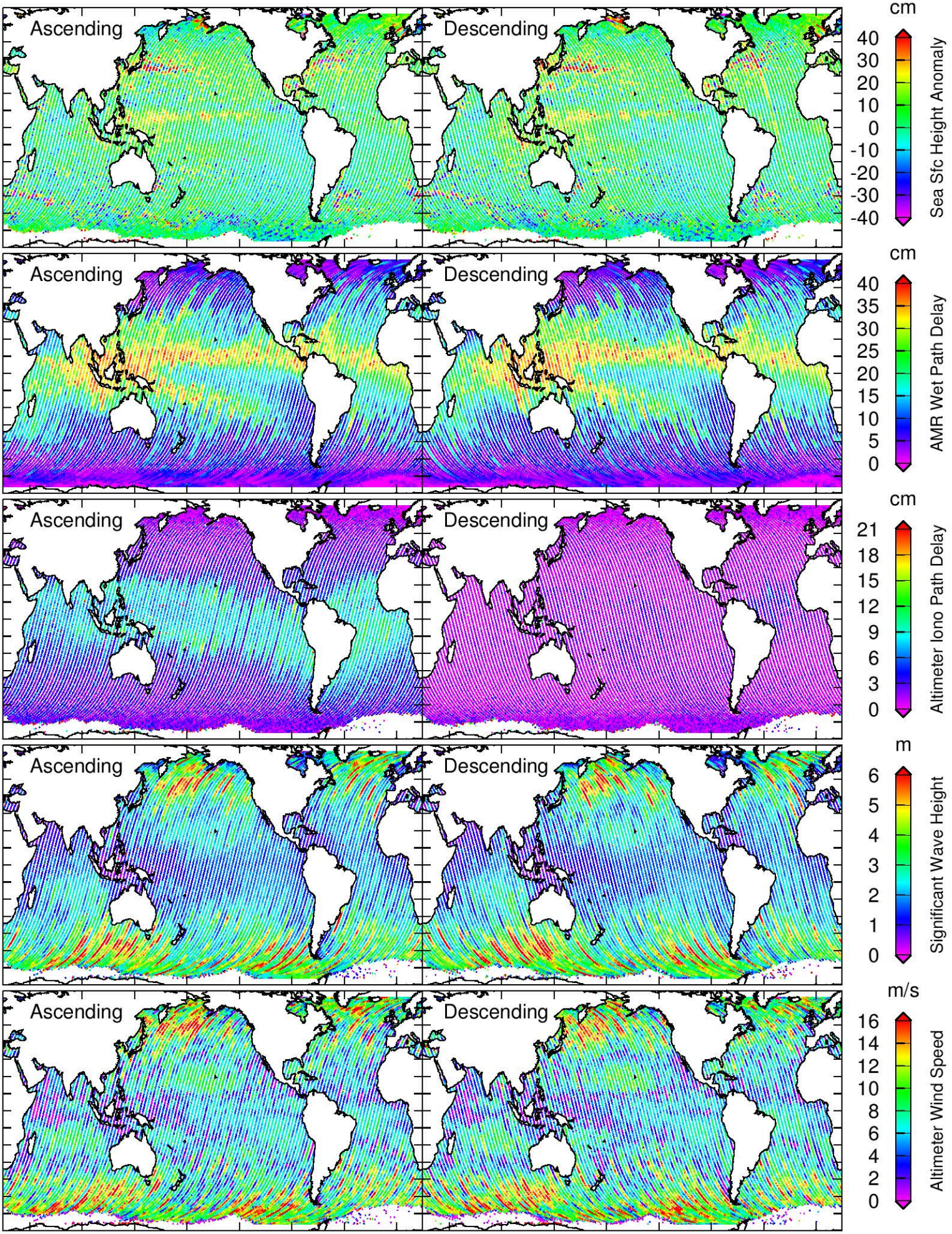
Jason-3 Cycle-024 2016-10-02 11:54:52 - 2016-10-12 09:53:24



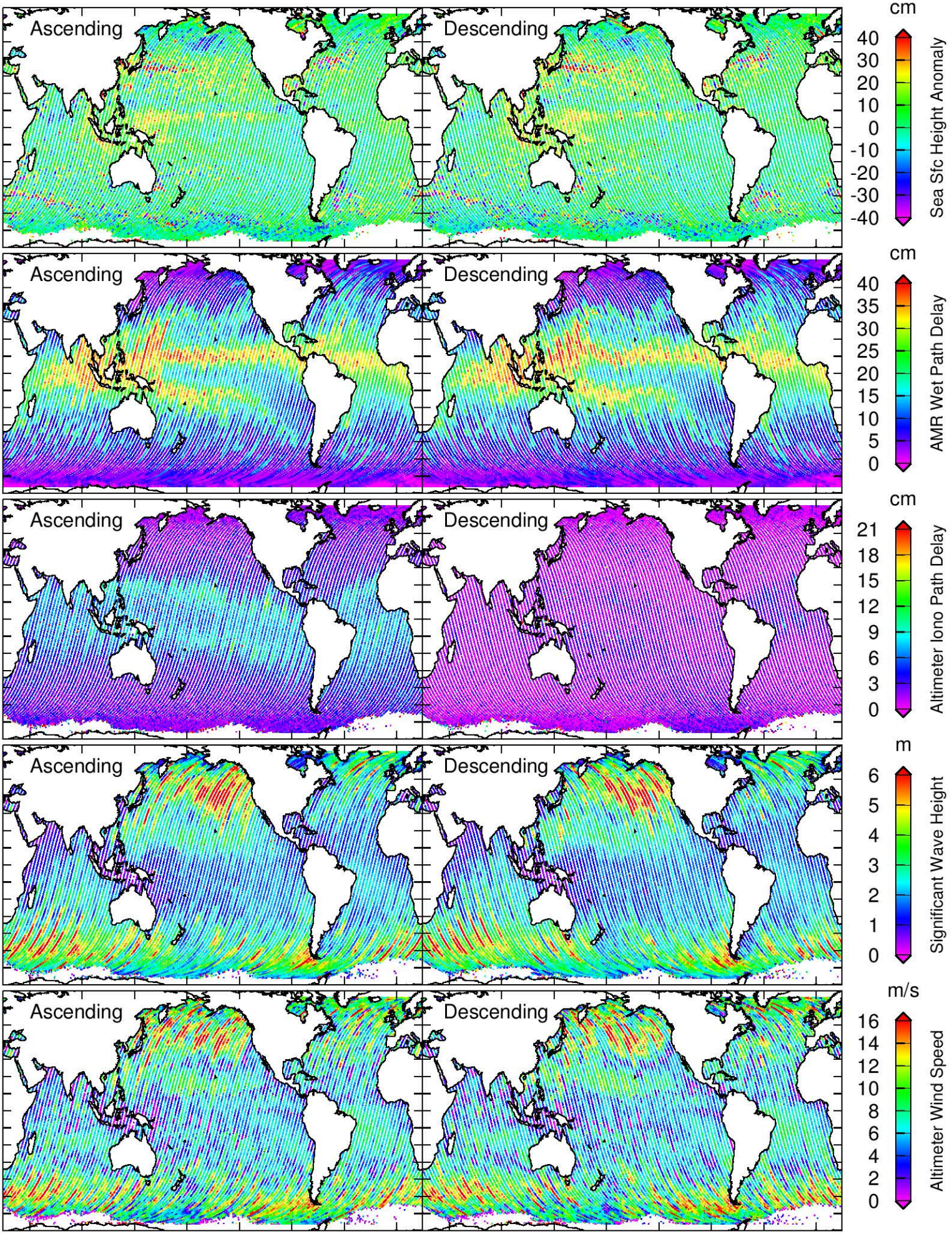
Jason-3 Cycle-025 2016-10-12 09:53:24 - 2016-10-22 07:51:56



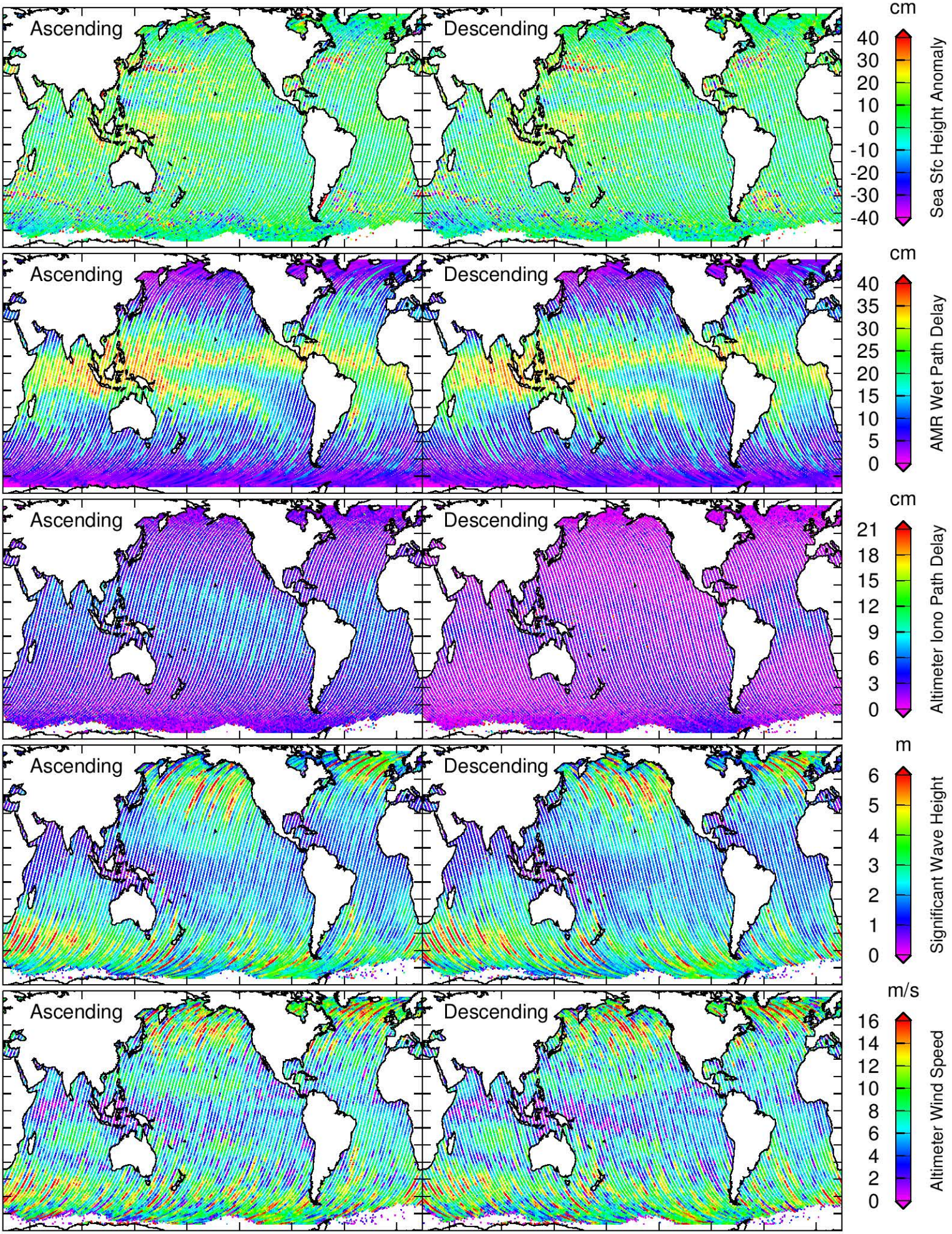
Jason-3 Cycle-026 2016-10-22 07:51:56 - 2016-11-01 05:50:27



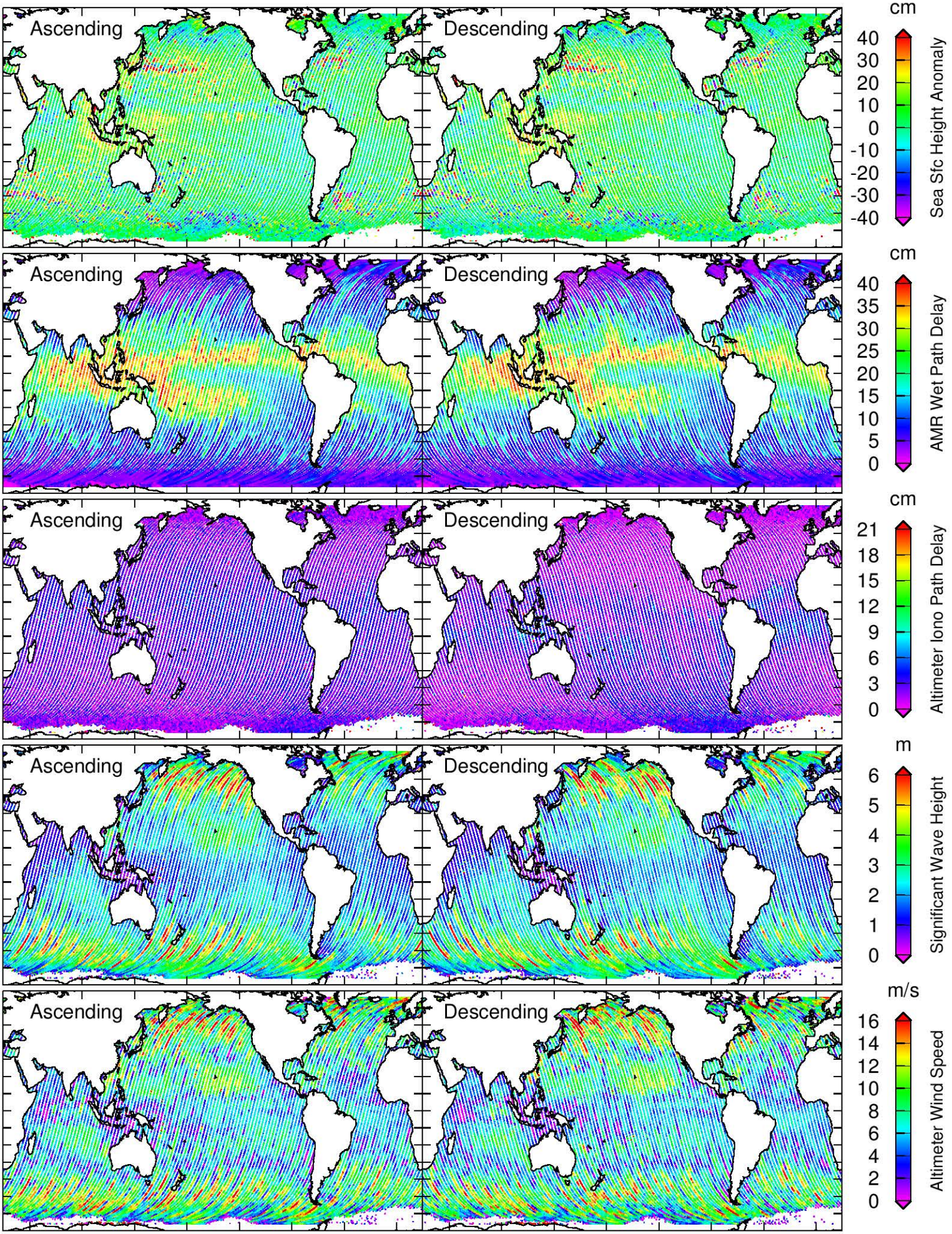
Jason-3 Cycle-027 2016-11-01 05:50:27 - 2016-11-11 03:48:59



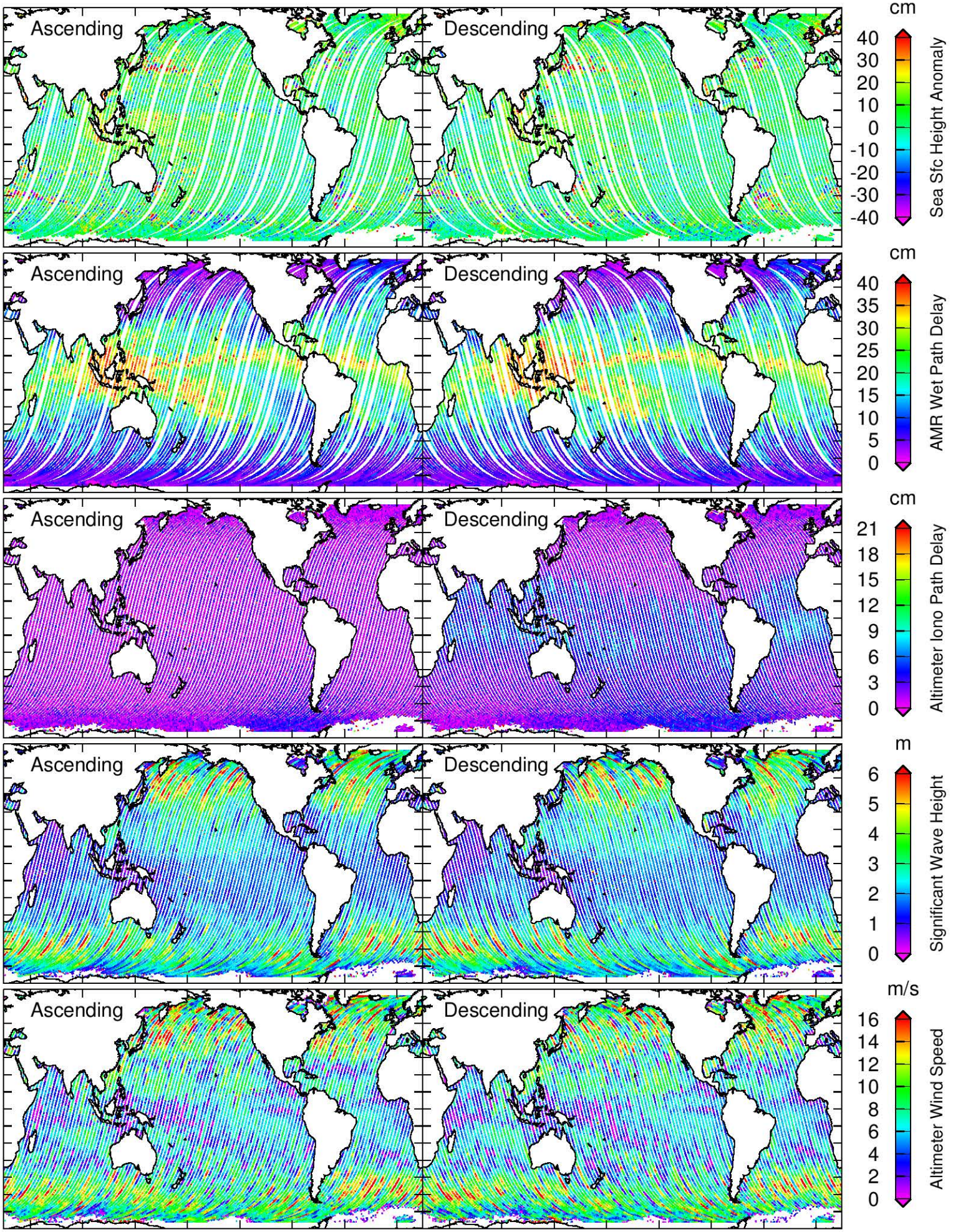
Jason-3 Cycle-028 2016-11-11 03:48:59 - 2016-11-21 01:47:30



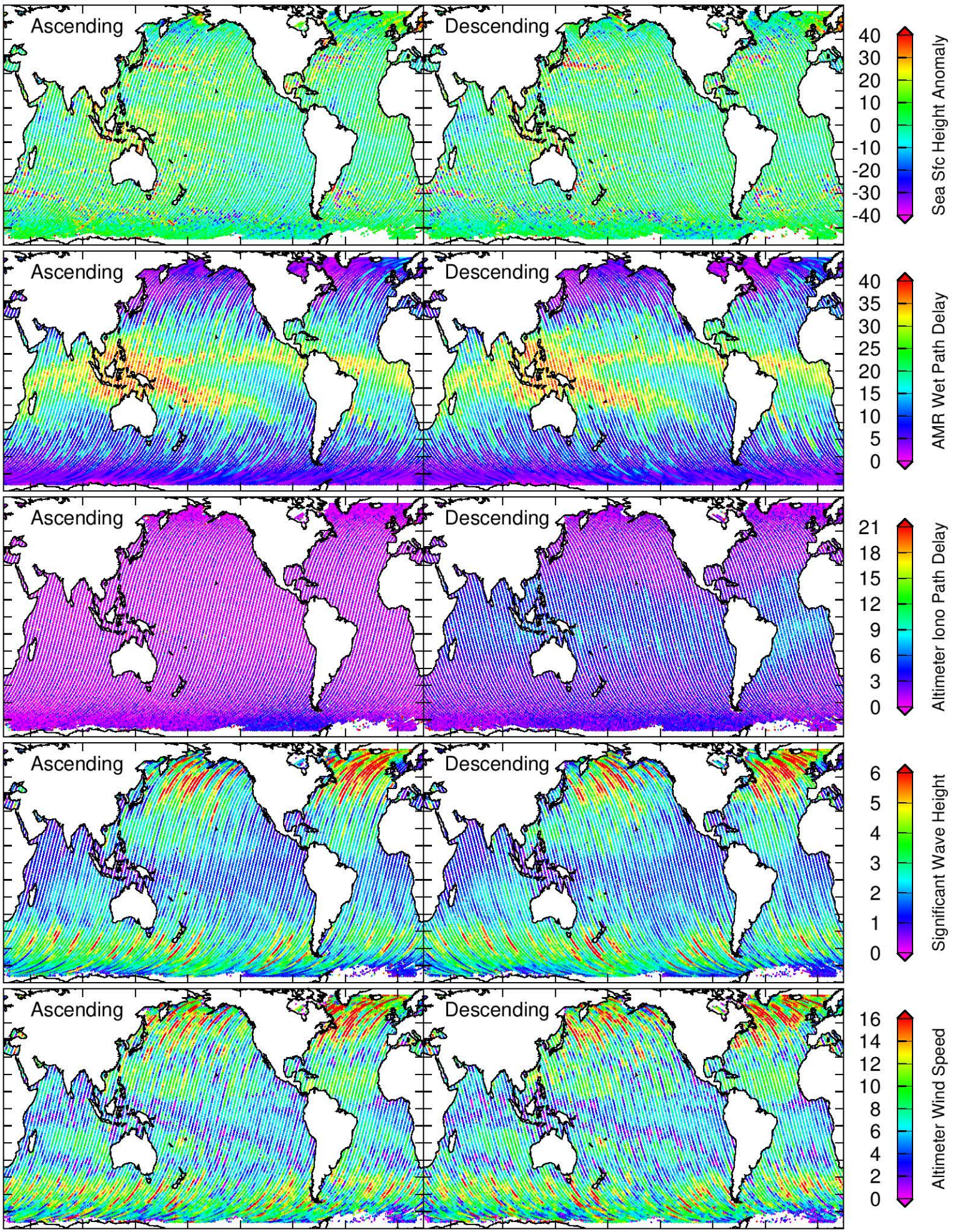
Jason-3 Cycle-029 2016-11-21 01:47:30 - 2016-11-30 23:46:02



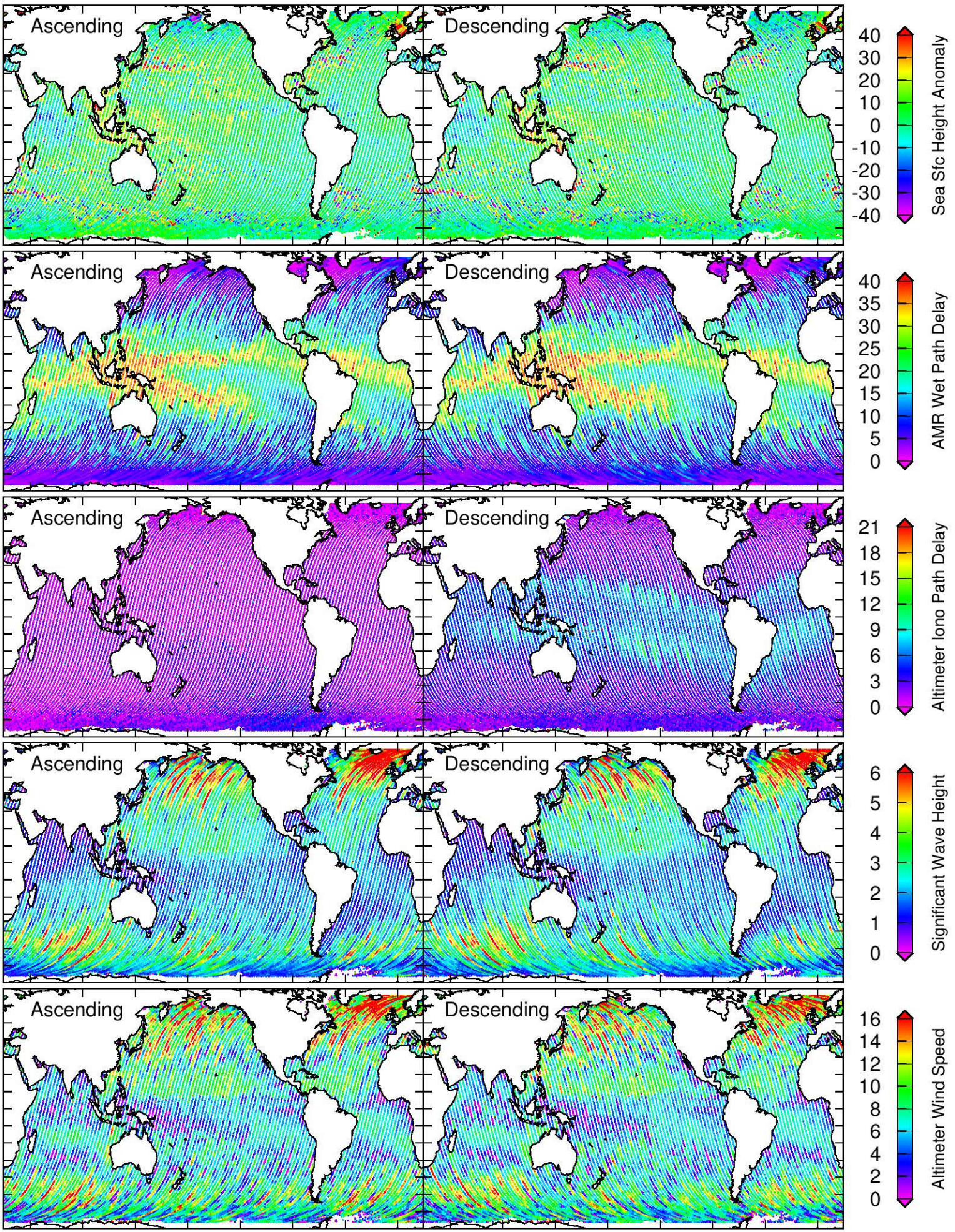
Jason-3 Cycle-030 2016-11-30 23:46:02 - 2016-12-10 21:44:34



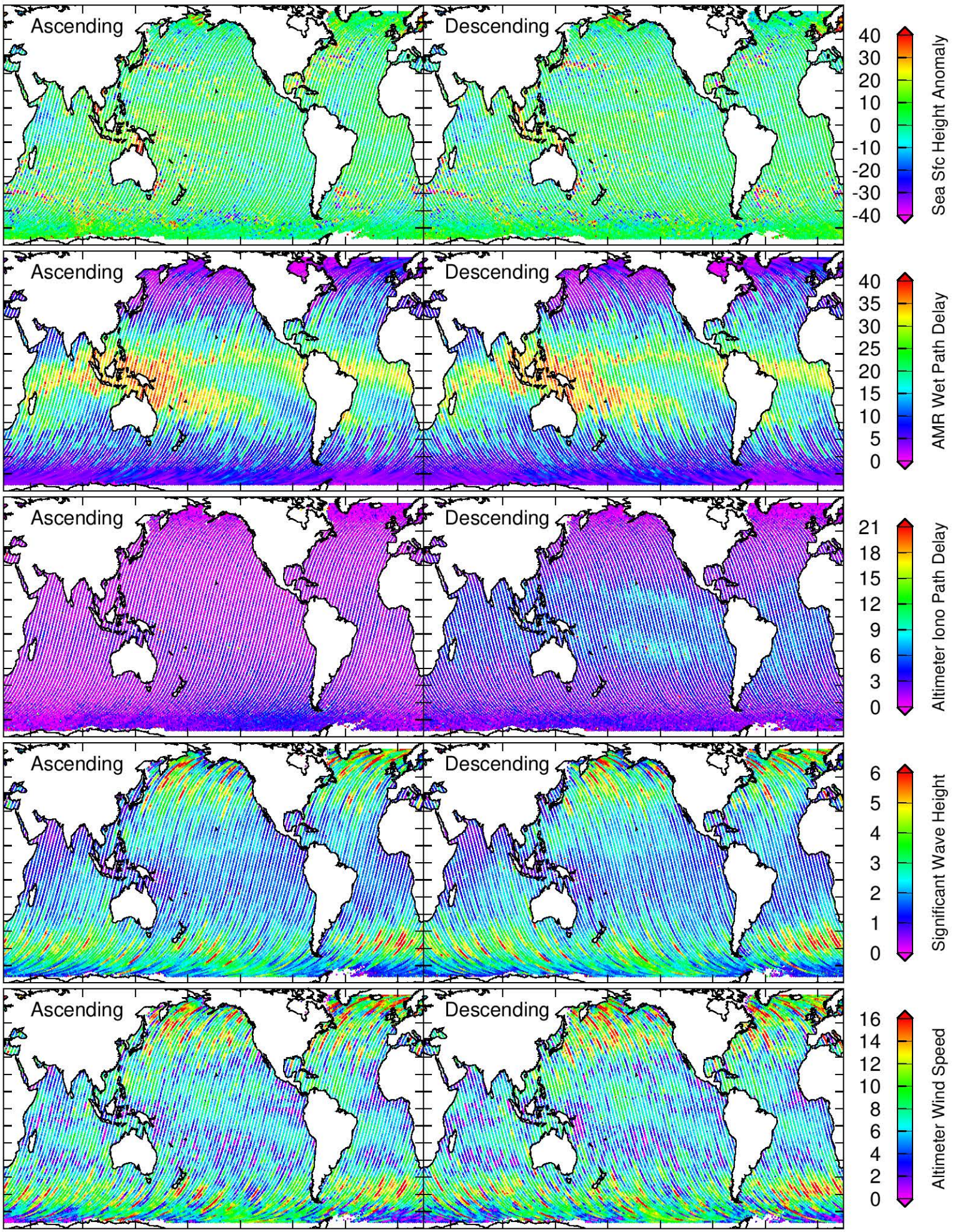
Jason-3 Cycle-031 2016-12-10 21:44:34 - 2016-12-20 19:43:05



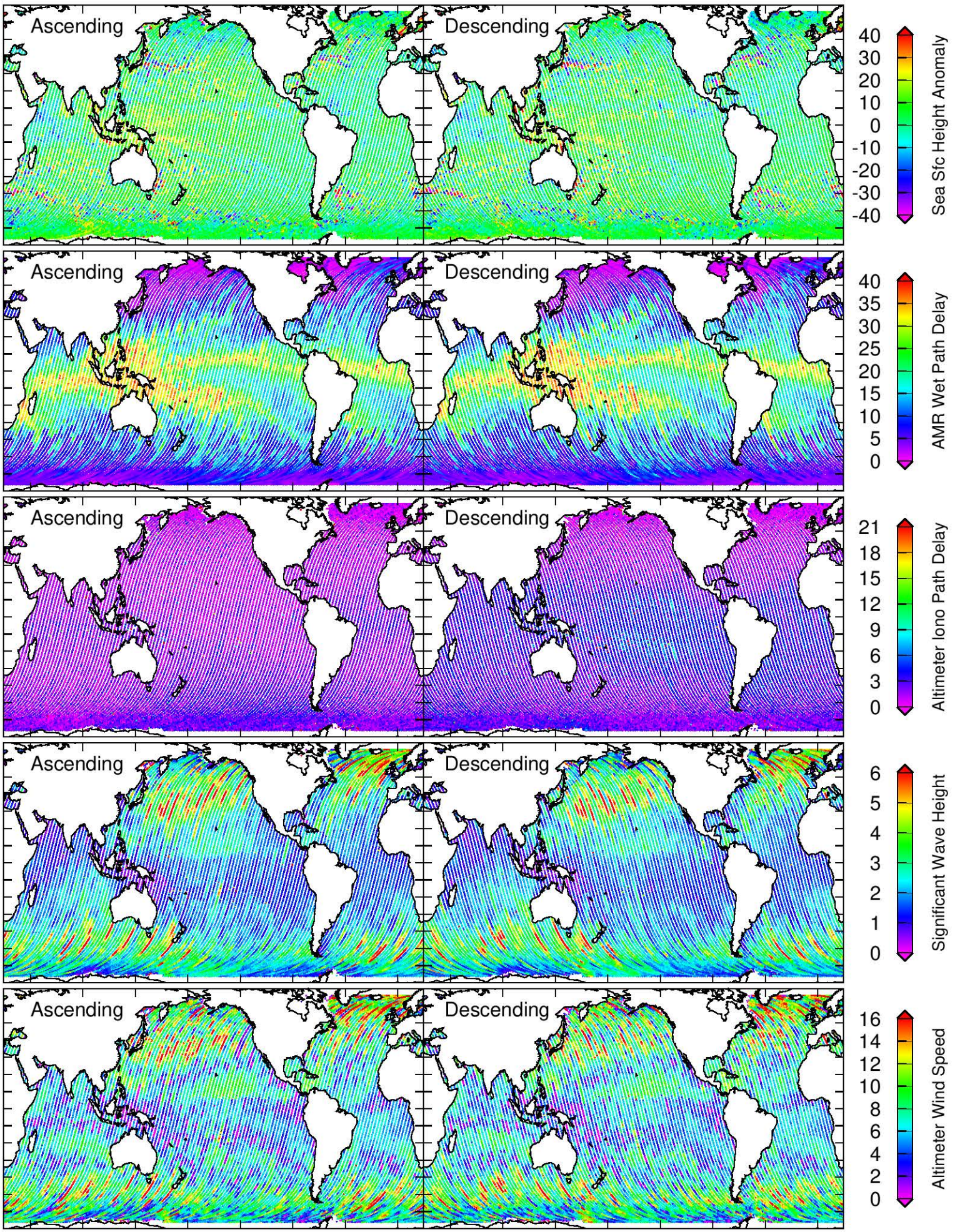
Jason-3 Cycle-032 2016-12-20 19:43:05 - 2016-12-30 17:41:37



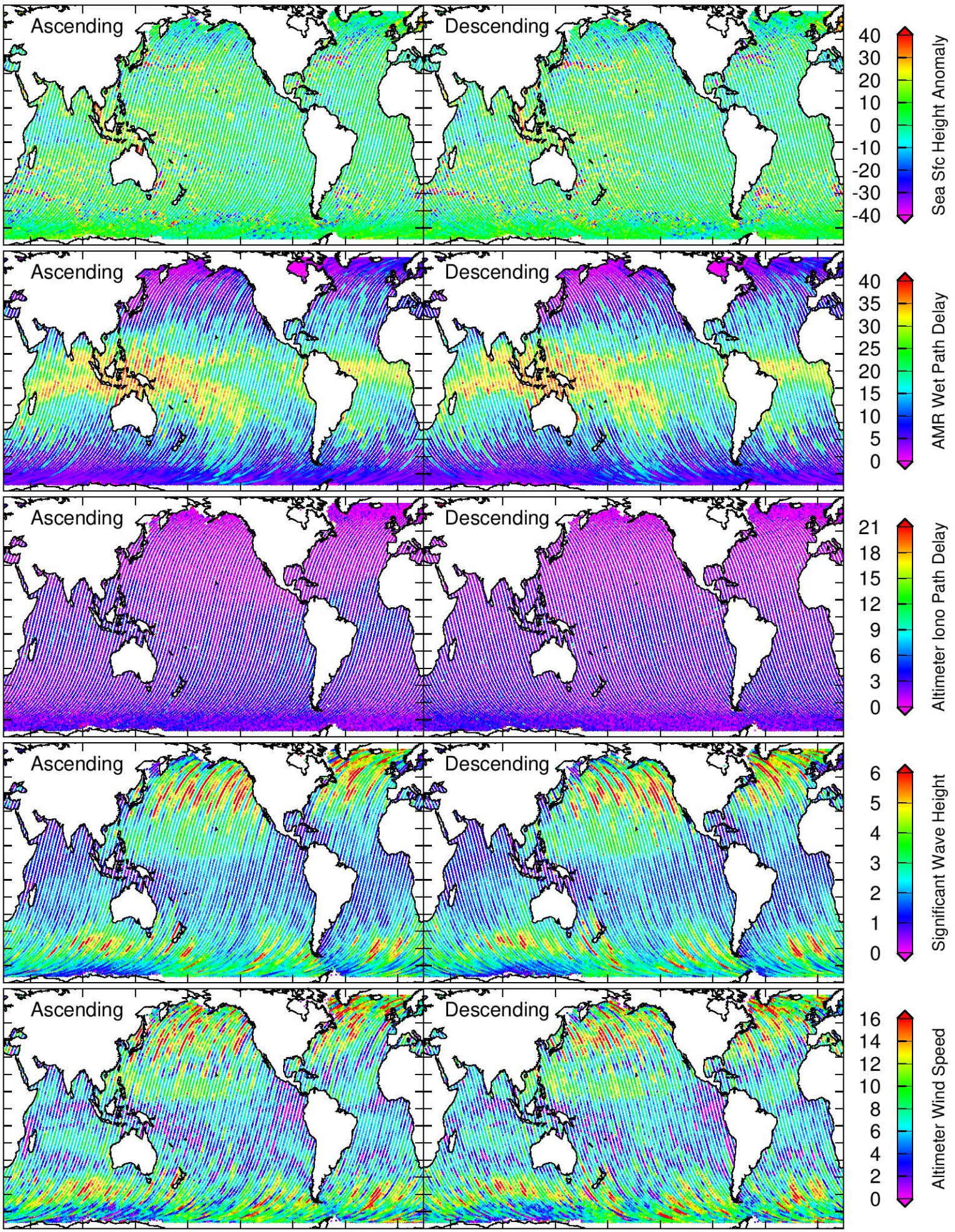
Jason-3 Cycle-033 2016-12-30 17:41:37 - 2017-01-09 15:40:09



Jason-3 Cycle-034 2017-01-09 15:40:09 - 2017-01-19 13:38:40



Jason-3 Cycle-035 2017-01-19 13:38:40 - 2017-01-29 11:37:12



Jason-3 Cycle-036 2017-01-29 11:37:12 - 2017-02-08 09:35:43