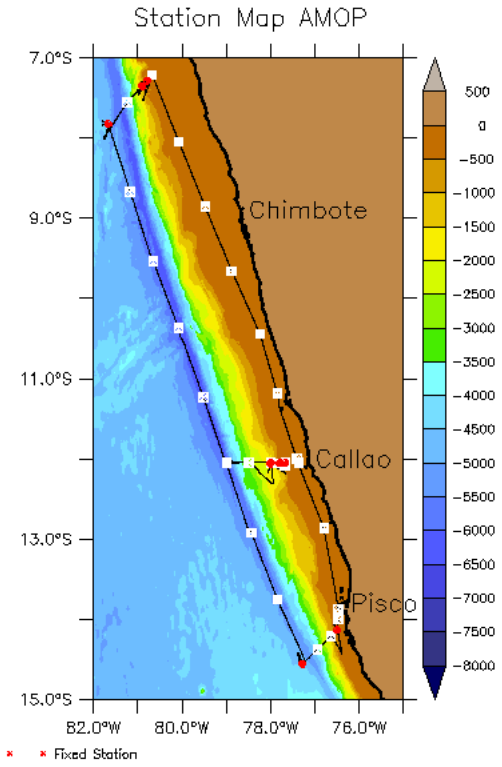
Dr Christophe Maes
Laboratoire d'Etudes en Géophysique et Océanographie Spatiales
LEGOS UMR5566 CNES-CNRS-IRD-UPS
18 Avenue Belin
Fr-31401 Toulouse
E-mail: Christophe.Maes@ird.fr

Short Cruise Report

R/V L'Atalante

South Eastern Pacific – Callao (Peru)
January 26 – February 22 2014

Chief of the Project: Dr Aurélien Paulmier (LEGOS)
co-P.I.s: Dr Boris Dewitte & Dr Véronique Garçon (LEGOS)
Captain: Philippe Moimeux (GENAVIR)



Tuesday, May 27, 2014

Important Note

This document is a working document that has been established to provide a broad view of the hydrological data collected during the AMOP cruise staged in Jan-Feb 2014 offshore the coasts of Peru. Note that the main P.I.s of the AMOP project and cruise request to be informed if you intend to use the CTD-O2 data set presented in this document.

PLAN

How to cite this document:

Maes, C., J. Grelet, A. Paulmier, B. Dewitte and V. Garçon, AMOP Cruise Preliminary Report of the CTD-O_2 raw data, internal report, pp 174, 2014.

1. Scientific objectives

Ocean deoxygenation is not only a "hot topic" currently in debate within the scientific community, it is also of the utmost importance for the future of marine ecosystems, arguably of comparable or greater significance to ocean acidification as a potential impact on marine biogeochemical cycles and ecosystems. Although there is a growing number of initiatives in the world that start to address this key topic, observational multidisciplinary approaches are still limited.

The AMOP project will focus on a highly variable and intense biological oceanic area off Peru in the Eastern Tropical Pacific, which is well representative of the deoxygenated oceanic areas since it is one of the largest Oxygen Minimum Zones (OMZs), covering 68% of the total OMZs area. AMOP is based on the Central Hypothesis that most of the coupling between physics and biogeochemistry takes place in an upper layer encompassing the oxycline and upper OMZ core, that is, advection and diffusion of O2 changes balance the production and consumption of O2 to form the rate of O2 changes. On the other hand, the lower core of the OMZ variability is mainly determined by physical processes. To test the Central Hypothesis, the AMOP objectives propose a comprehensive mean O_2 budget within the OMZ off Peru, considering the local and remote physical and biogeochemical O_2 contributions and their spatio-temporal variability. In particular, this budget will take into account the ocean advection and diffusion processes as well as the consumption and production of O_2 through bacteria, phytoplankton, zooplankton and particles degradation.

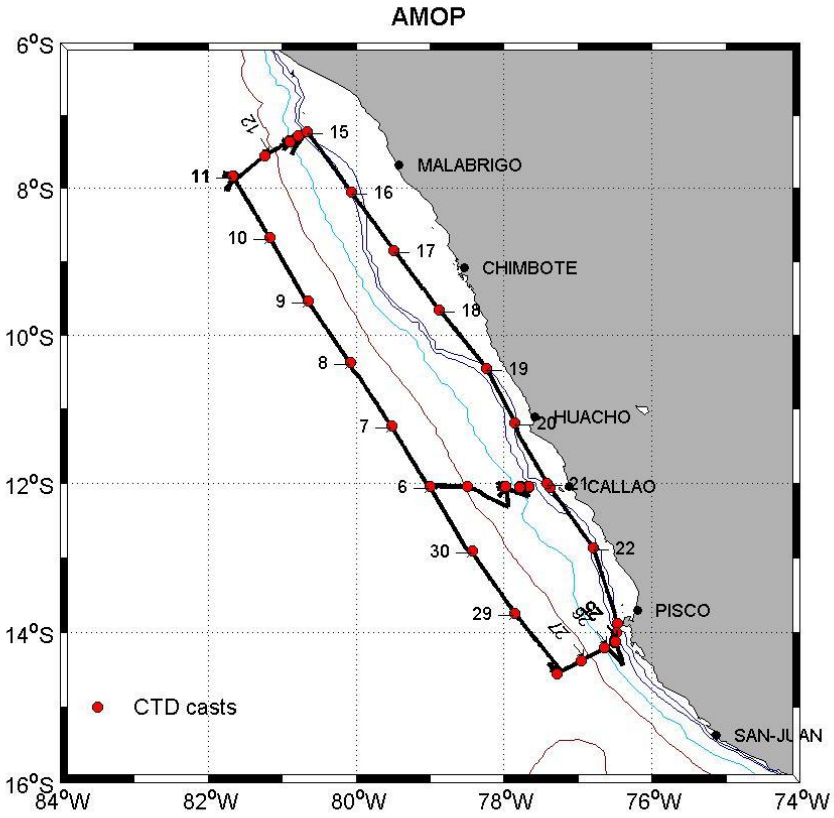
AMOP will combine observations (cruise and anchored mooring) and high-resolution model outputs to document the O_2 tendency terms at a variety of timescales, from hourly to centennial. The combined use of in situ experiments and models outputs will allow deciphering the contributions of the physical processes versus the biogeochemical processes to the rate of O_2 changes within the different OMZ layers.

In particular, by defining a coupling efficiency, CE, as the ratio between the tendency terms associated to biogeochemical and physical processes, we will characterize regions where either biogeochemistry (CE >1) or physics (CE<1) controls the OMZ equilibrium, and regions where the deviation from equilibrium leads to an O2 variability. AMOP targets the identification of OMZ regimes associated to specific environmental forcing (remote and local).

The main important scientific difficulty that we expect to face within AMOP regards the closure of the O_2 budget, and inherently to such an approach, the physical and biogeochemical interpretation of the residual that may result. The modelling framework will be instrumental to reach a balanced budget, and the budget analysis will then allow stressing forward the different contributions (physical vs. biogeochemical) by opposing the different regimes of the variability into the different OMZ layers. From a technical point of view, the AMOP project will provide a unique benchmark, in real conditions at sea, for extremely precise measurements of O_2 with several methods enabling to reduce as much as possible error bars in the budget.

In order to document
i) the O_2 OMZ structure,
ii) the physical O_2 contribution (advection/diffusion), and
iii) the biogeochemical O_2 contribution (consumption/production), the AMOP global work strategy is based on a process-oriented cruise of ~30 days, the AMOP cruise.

The outreach is to provide an adequate documentation of the O_2 budget for each component of the Peruvian OMZ system as well as the coastal and open ocean configurations, forcing and responses.



2. Chronology of the cruise

The cruise has been staged from Callao to Callao with a departure on the 26 January and arrival on the 22 February 2014. The scientists were able to embark on the ship on the 25 January. All the participants are listed in the following table. The first stations have been done near the coast, following the 12°S transect that corresponds to the historical stations operated by IMARPE. The series of the first fixed stations (stations 2, 3, and 4) were set along this transect in concordance with such historical stations at 77°40'W - 77°47'W – 78°W (see the above figure). Each fixed station was occupied for more than 48 hours that corresponds approximately to the time required to span a full diurnal cycle. During the fixed stations a cast has been operated every 3-hr most of the time. The section ends at the offshore station 6 (12°S – 79°W) where the first PROVOR float of the Argo international network was deployed (a total of 9 Argo floats has been deployed during the AMOP cruise, more informations are available on the CORIOLIS internet centre: www.coriolis.eu.org). The cruise continues northward with typical offshore stations (0-2000m depth), up to the next fixed station (11) at 7°50'S - 81°41'W. Going back to the coast, two more fixed stations were operated (stations 13 and 14), following approximately the main gradient of the bathymetry. Then, the ship goes back southward with stations on the shelf (typical maximum depths around 150m) until the

sector of Pisco. The next transect was then operated offshore up to station 28, 14°34'S-77°16'W, that represents the most southern point of the AMOP cruise. The last fixed stations were done during the stations 25 and 28. From the station 28, the vessel goes back to the position of station 6 in order to close the overall domain, and then on its way back to Callao, re-operating the stations done during the way in.

The cruise ends by the recovery of a subsurface mooring at the station 36 on the 12°S historical transect, being the reference station for a high temporal resolution monitoring of the OMZ structure. The mooring has been deployed since the 5th January 2013.

3. CTD-O2 material

The material used during the AMOP cruise is composed by a SBE911+ from INSU with the following sensors:
- Pressure digiquartz,
- Temperature, conductivity and dissolved oxygen on the first and secondary circuits,
- Turbidity Meter (Seapoint), fluorescence (Chelsea aqua 3), Transmissiometer (WET labs C-Star) and PAR/irradiance (biospherical/licor)

The frequency of acquisition is 24Hz, and the final observed profiles are binned every decibar. The rosette was equipped with an altimeter Tritec (S/N 166877) and most of the profiles operated over the shelf or the slope have been stopped 15-20 m before the depth of the bottom of the ocean. The maximum depth of the offshore profiles was set to 2000 m.

The SBE-processing was launched with a perl script from command line on the PC and split in specialized batch file for L_ADCP conversion, standard seabird process with filtering and reduction, bottle step and preliminary plots processing.

List of the sensors

Parameter	Date of calibration	ID sensor
Pressure	25/10/2000	50047
Temperature (1st)	21/01/2013	30970
Temperature (2nd)	21/01/2013	31328
Conductivity (1st)	21/01/2013	40606
Conductivity (2nd)	21/01/2013	41073
DO (1st)	12/11/2013	2737
DO (2nd)	16/07/2013	230
Change at station 26001	12/11/2013	2746
Fluorescence	26/01/2013	088-235
Transmissiometer	26/04/2011	1110DR
PAR	N/A	4356
SPAR	16/02/2010	6287
Turbidity Meter	N/A	11949

4. Preliminary results

Vertical profiles of standard parameters are given for each cast in the appendice. The units are standard, i.e., in °C for temperature, unitless for salinity, umol/kg for the dissolved concentration of O_2, ug/l for fluorescence, Formazin Turbidity Units or FTU for turbidity meter, 1/m for the attenuation and W/m^2 for the PAR/irradiance. Only the primary and secondary sensors are shown for O_2. A few profiles exhibit some spikes that are probably not realistic. More important or spurious spikes are reported in the following tables that also summarized the main observed problems for specific casts. Note the change of the DO sensor on the secondary circuit after the cast 02601. The data quality for the data acquired directly on board (CTD sensors, Thermosalinograph, ADCP, etc…) has been monitored constantly and regularly, but all observed parameters require a dedicated calibration process.

* Specific profiles with main problems and/or changes

Stations	Description	Possible actions
00203, 00204 & 00206	Data starts at 30 m (early acquisition)	Need to be corrected
00402	wrong profiles for DO (1st) and salinity (2nd) – jelly organisms found in the main pump circuit	
01309	spurious spike in turbidity	Need to be confirmed
01314	wrong profil at the bottom for DO (1st)	
01601	spurious spike in turbidity	Need to be confirmed
01801	spurious spike in turbidity	Need to be confirmed
02601	Install SBE43 2746 on the primary circuit	
02815	wrong profil for salinity (2nd) and DO (1st)	
03005	detection of wrong plugging for the turbimeter	Corrected
04002	Presence of jelly organisms in the primary circuit	Corrected
26001	Change the SBE43 on the primary circuit (2746)	

5. Concluding remarks

The AMOP cruise has collected a very rich data set in oceanography but it also includes a large and unique set of biogeochemical and atmospheric parameters. Some observations have been recorded through continuous acquisition and will be analysed further in conjunction with the different observations.

Acknowledgments
We like to thank captain Philippe Moimeux, his officers and all the crew of R/V L'Atalante for their help and support of our measurements on board. The National Fleet Commission from France provided the ship time for the AMOP cruise and we have especially appreciated the help of Jean-Xavier Castrec. Financial support was mostly provided by IRD and INSU. We would like especially to thank the director of LEGOS, Yves Morel, for his greaful help and support, as well as the staff of the administration, Nadine, Brigitte and Agathe. We like to thank the authorities of Peru for their permission to carry out scientific work in their territorial waters. A special thank to French Ambassador Jean-Jacques Beaussou and to Cécile Henry for her powerfull energy for their help with the authorities at Lima. We like also to thank the IRD representation at Lima, his director Jean-Loup Guyot and the powerful knowledge of Miriam Soto Alvariño. We would like to thank the NIOZ for their loan of the special container, as well as the SHOM and DT-INSU from Brest for the different materials. We gratefully acknowledge all this support.

Appendice-1: List of the participants

APELLIDO	NOMBRE	INSTITUTION
MAES	CHRISTOPHE	LEGOS
PAULMIER	AURELIEN	LEGOS
GIRAUD	MELANIE	LEMAR/FEM
GARCIA-ROBLEDO	EMILIO	Aarhus University
BARUS	CAROLE	LEGOS
WIKIEL	AGATA	LEGOS
LACOMBE	MARIELLE	OMP UMS 831
DEWITTE	BORIS	LEGOS
ELDIN	GERARD	LEGOS
VERGARA	OSCAR	LEGOS
SUDRE	JOEL	LEGOS
GRELET	JACQUES	US IMAGO
LEFEVRE	DOMINIQUE	MIO
PANAGIOTOPOULOS	CHRISTOS	MIO
RAMOUT	BARBARA	MIO
DUGENNE	MATHILDE	MIO
GOJAK	CARL	DT-INSU
HERNANDEZ-AYON	JOSE MARTIN	Universidad Autonoma de Baja California
MASKE	HELMUT	CICESE
PUJO-PAY	MIREILLE	LOMIC
CAPARROS	JOCELYN	LOMIC
MARIA	ERIC	LOMIC
VILLEGAS MENDOZA	JOSUE	Universidad Autonoma de Baja California
BARROIS	HERVE	DT-INSU
CAMBRA	REMI	LATMOS
MOSQUERA	KOBI	IGP
PINEDO ARTEAGA	ELDA LUZ	IMARPE
NAKAZAKI LAO	CARMELA ROSA	IMARPE
FRANCO	AUGUSTO	IMARPE
LEDESMA	JESUS	IMARPE

List of main contacts:

LEGOS
Laboratoire d'Etudes en Géophysique et Océanographie Spatiales
LEGOS UMR5566 CNES-CNRS-IRD-UPS
18 Avenue Belin
Fr-31401 Toulouse
Phone: (+33)561332902
http://www.legos.obs-mip.fr

IMARPE
Esquina Gamarra y General Valle S/N Chucuito
Callao Peru
Telf: (+051)208-8650.
http://www.imarpe.pe

IGP
Calle Badajoz #169 - Mayorazgo IV Etapa - Ate Vitarte
Lima - Peru
Telf: (+051)317-2300
http://www.igp.gob.pe

MIO
Mediterranean Institute of Oceanography (MIO)
CNRS UMR 7294 – IRD 235 - Aix-Marseille Université
163 Avenue de Luminy Bat TPR1 entré F 1er étage
Fr-13288 Marseille Cedex 09
Phone: (+33)491829049
http://mio.pytheas.univ-amu.fr

LOMIC
Laboratoire d'Océanographie Microbienne (LOMIC)
Laboratoire Arago
Avenue du Fontaulé
Fr-66650 Banyuls sur Mer
Phone: (+33)468887351

CICESE
Oceanografía Biológica
Carretera Tijuana-Ensenada No. 3918
Fraccionamiento Zona Playitas Ensenada, Baja California
Mexico, CP 22860
Phone (from USA): 011-52-646-1750500 ext. 24260

Universidad Autonoma de Baja California
Universidad Autonoma de Baja California
Ensenada, Baja California. Mexico,
Phone: (+646) 1744601 ext.120

Aarhus University
Department of Bioscience - Microbiology
Ny Munkegade 116
8000 Aarhus C
Denmark
Phone: (+45) 60517010 / 87154335

DT-INSU
INSU/CNRS Division Technique
Bâtiment IPEV - BP74
Technopôle Brest-Iroise
Fr-29280 Plouzané
Phone : (+33)298056535

US-IMAGO
IRD Bretagne
Technopole de Brest-Iroise - Site de la Pointe du Diable - BP 70
Fr-29 280 Plouzané
Phone : (+33)298224510

Appendice-2: List of the stations for the AMOP cruise

STATION	DATE – TIME (GMT)	LATITUDE	LONGITUDE	Pres. Max (db)	Depth Max (m)
Sta 00101	Jan 26 2014 18:53:05	12 03.03 S	077 22.39 W	117.00000	116.29800
Sta 00201	Jan 26 2014 22:46:00	12 02.99 S	077 40.15 W	177.00000	175.91200
Sta 00202	Jan 27 2014 02:22:01	12 02.86 S	077 40.04 W	179.00000	177.89900
Sta 00203	Jan 27 2014 05:57:51	12 03.00 S	077 40.15 W	180.00000	178.89200
Sta 00204	Jan 27 2014 09:30:40	12 03.04 S	077 40.22 W	180.00000	178.89200
Sta 00205	Jan 27 2014 15:32:02	12 03.01 S	077 40.37 W	184.00000	182.86600
Sta 00206	Jan 27 2014 18:38:56	12 03.14 S	077 40.17 W	181.00000	179.88499
Sta 00207	Jan 27 2014 21:17:02	12 02.95 S	077 40.23 W	176.00000	174.91800
Sta 00208	Jan 28 2014 01:17:31	12 03.02 S	077 40.22 W	182.00000	180.87900
Sta 00209	Jan 28 2014 04:14:25	12 03.01 S	077 40.12 W	180.00000	178.89200
Sta 00210	Jan 28 2014 07:15:59	12 03.05 S	077 40.21 W	181.00000	179.88499
Sta 00211	Jan 28 2014 10:06:05	12 03.01 S	077 40.10 W	177.00000	175.91200
Sta 00212	Jan 28 2014 13:12:50	12 02.90 S	077 40.16 W	180.00000	178.89200
Sta 00213	Jan 28 2014 15:53:50	12 03.09 S	077 40.19 W	181.00000	179.88499
Sta 00214	Jan 28 2014 19:26:28	12 02.99 S	077 40.14 W	182.00000	180.87900
Sta 00301	Jan 29 2014 01:20:15	12 03.15 S	077 47.05 W	394.00000	391.37201
Sta 00302	Jan 29 2014 04:19:59	12 02.91 S	077 47.11 W	376.00000	373.50900
Sta 00303	Jan 29 2014 08:00:36	12 02.98 S	077 46.76 W	351.00000	348.69501
Sta 00304	Jan 29 2014 12:37:25	12 03.18 S	077 46.96 W	392.00000	389.38800
Sta 00305	Jan 29 2014 15:53:00	12 02.92 S	077 47.02 W	373.00000	370.53101
Sta 00306	Jan 29 2014 19:06:32	12 02.93 S	077 46.82 W	345.00000	342.73999
Sta 00307	Jan 29 2014 22:00:33	12 02.96 S	077 46.93 W	363.00000	360.60599
Sta 00308	Jan 30 2014 00:29:50	12 03.04 S	077 47.08 W	382.00000	379.46301
Sta 00309	Jan 30 2014 02:41:27	12 03.17 S	077 47.11 W	400.00000	397.32700
Sta 00310	Jan 30 2014 05:43:07	12 03.02 S	077 47.11 W	383.00000	380.4559
Sta 00311	Jan 30 2014 08:41:55	12 02.95 S	077 46.86 W	355.00000	352.66599
Sta 00312	Jan 30 2014 11:32:04	12 03.07 S	077 47.20 W	401.00000	398.31900

Sta 00313	Jan 30 2014 14:44:45	12 03.04 S	077 47.12 W	389.00000	386.41000
Sta 00314	Jan 30 2014 17:44:55	12 03.12 S	077 46.55 W	340.00000	337.77600
Sta 00315	Jan 30 2014 20:40:04	12 03.08 S	077 47.08 W	380.00000	377.47800
Sta 00316	Jan 30 2014 23:32:00	12 02.87 S	077 46.94 W	358.00000	355.64301
Sta 00317	Jan 31 2014 02:41:09	12 03.02 S	077 47.16 W	390.00000	387.40302
Sta 00401	Jan 31 2014 09:23:02	12 02.89 S	077 59.89 W	1803.0000	1784.9771
Sta 00402	Jan 31 2014 13:15:21	12 03.00 S	077 59.91 W	1820.0000	1801.7350
Sta 00403	Jan 31 2014 16:44:02	12 03.06 S	078 00.06 W	1807.0000	1788.9200
Sta 00404	Jan 31 2014 20:16:24	12 02.85 S	077 59.81 W	1799.0000	1781.0341
Sta 00405	Jan 31 2014 23:48:32	12 03.25 S	077 59.78 W	1803.0000	1784.9771
Sta 00406	Feb 01 2014 03:10:17	12 03.06 S	078 00.10 W	1815.0000	1796.8060
Sta 00407	Feb 01 2014 06:49:27	12 03.38 S	077 59.87 W	1777.0000	1759.3440
Sta 00408	Feb 01 2014 13:04:05	12 03.09 S	078 00.00 W	1814.0000	1795.8199
Sta 00409	Feb 01 2014 16:51:13	12 02.99 S	078 00.08 W	1792.0000	1774.1331
Sta 00410	Feb 01 2014 20:27:50	12 03.58 S	077 59.71 W	1794.0000	1776.1040
Sta 00411	Feb 02 2014 00:27:44	12 02.85 S	077 59.97 W	1803.0000	1784.9771
Sta 00412	Feb 02 2014 03:53:19	12 03.05 S	078 00.03 W	1809.0000	1790.8920
Sta 00413	Feb 02 2014 07:19:22	12 03.01 S	077 59.74 W	1794.0000	1776.1050
Sta 00414	Feb 02 2014 10:13:20	12 02.83 S	077 59.07 W	1709.0000	1692.2920
Sta 00501	Feb 02 2014 19:00:05	12 02.89 S	078 29.92 W	2025.0000	2003.7140
Sta 00601	Feb 03 2014 02:17:44	12 02.83 S	078 59.99 W	2024.0000	2002.7290
Sta 00701	Feb 03 2014 10:29:46	11 13.98 S	079 31.10 W	2002.0000	1981.1210
Sta 00801	Feb 03 2014 17:51:08	10 21.91 S	080 04.97 W	2025.0000	2003.832
Sta 00901	Feb 04 2014 02:00:06	09 31.99 S	080 38.99 W	2022.0000	2000.9290
Sta 01001	Feb 04 2014 09:52:47	08 40.11 S	081 09.91 W	2004.0000	1983.250
Sta 01101	Feb 04 2014 17:22:36	07 49.42 S	081 40.02 W	2023.0000	2002.009
Sta 01102	Feb 04 2014 22:50:43	07 49.40 S	081 40.04 W	2004.0000	1983.2939
Sta 01103	Feb 05 2014 03:51:03	07 49.43 S	081 40.00 W	2023.0000	2002.0081
Sta 01104	Feb 05 2014 08:21:03	07 49.45 S	081 40.14 W	2009.0000	1988.2190

Sta 01105	Feb 05 2014 14:45:27	07 49.35 S	081 39.83 W	2025.0000	2003.9780
Sta 01106	Feb 05 2014 18:22:01	07 49.42 S	081 40.10 W	2023.0000	2002.0081
Sta 01107	Feb 05 2014 21:38:00	07 49.47 S	081 39.98 W	2005.0000	1984.2791
Sta 01108	Feb 06 2014 01:50:38	07 49.59 S	081 40.06 W	2021.0000	2000.0380
Sta 01109	Feb 06 2014 05:28:04	07 49.58 S	081 39.84 W	2020.0000	1999.0540
Sta 01110	Feb 06 2014 08:25:08	07 49.47 S	081 40.03 W	2024.0000	2002.9930
Sta 01111	Feb 06 2014 11:34:30	07 49.38 S	081 39.89 W	2003.0000	1982.3090
Sta 01112	Feb 06 2014 15:22:59	07 49.55 S	081 39.79 W	2028.0000	2006.9330
Sta 01113	Feb 06 2014 18:36:57	07 49.40 S	081 39.95 W	2024.0000	2002.9930
Sta 01114	Feb 06 2014 22:02:22	07 49.44 S	081 39.90 W	2002.0000	1981.3240
Sta 01201	Feb 07 2014 07:14:01	07 33.14 S	081 14.03 W	2022.0000	2001.0370
Sta 01301	Feb 07 2014 12:19:18	07 21.28 S	080 53.35 W	961.00000	953.43103
Sta 01302	Feb 07 2014 15:09:05	07 21.25 S	080 53.34 W	989.00000	981.14502
Sta 01303	Feb 07 2014 18:12:58	07 21.39 S	080 53.36 W	977.00000	969.26801
Sta 01304	Feb 07 2014 21:18:24	07 21.30 S	080 53.34 W	973.00000	965.30902
Sta 01305	Feb 08 2014 00:38:28	07 21.32 S	080 53.51 W	991.00000	983.12402
Sta 01306	Feb 08 2014 03:10:52	07 21.17 S	080 53.38 W	988.00000	980.15503
Sta 01307	Feb 08 2014 06:00:09	07 21.24 S	080 53.54 W	1000.0000	992.03101
Sta 01308	Feb 08 2014 09:08:46	07 21.35 S	080 53.52 W	974.00000	966.29797
Sta 01309	Feb 08 2014 11:58:40	07 21.36 S	080 53.53 W	980.00000	972.23700
Sta 01310	Feb 08 2014 15:43:13	07 21.33 S	080 53.52 W	993.00000	985.10400
Sta 01311	Feb 08 2014 18:09:44	07 21.39 S	080 53.50 W	990.00000	982.13397
Sta 01312	Feb 08 2014 21:05:14	07 21.33 S	080 53.62 W	1000.0000	992.03101
Sta 01313	Feb 09 2014 00:00:14	07 21.29 S	080 53.58 W	994.00000	986.09302
Sta 01314	Feb 09 2014 03:25:11	07 20.79 S	080 54.09 W	1141.0000	1131.5280
Sta 01315	Feb 09 2014 06:20:20	07 21.36 S	080 53.55 W	999.00000	991.04199
Sta 01316	Feb 09 2014 09:26:01	07 21.42 S	080 53.49 W	978.00000	970.25702
Sta 01317	Feb 09 2014 12:15:02	07 21.47 S	080 53.58 W	971.00000	963.32898
Sta 01318	Feb 09 2014 15:11:20	07 21.33 S	080 53.47 W	982.00000	974.21698

Sta 01401	Feb 09 2014 22:13:29	07 16.89 S	080 47.17 W	235.00000	233.55600
Sta 01402	Feb 10 2014 01:10:13	07 16.99 S	080 47.03 W	234.00000	232.56300
Sta 01403	Feb 10 2014 04:02:19	07 16.98 S	080 47.12 W	238.00000	236.53600
Sta 01404	Feb 10 2014 07:08:28	07 17.09 S	080 47.11 W	240.00000	238.52299
Sta 01405	Feb 10 2014 10:03:17	07 17.04 S	080 46.99 W	232.00000	230.57600
Sta 01406	Feb 10 2014 13:21:26	07 16.98 S	080 46.97 W	230.00000	228.59000
Sta 01407	Feb 10 2014 16:16:20	07 17.05 S	080 47.04 W	235.00000	233.55600
Sta 01408	Feb 10 2014 19:12:23	07 17.11 S	080 47.02 W	234.00000	232.56300
Sta 01409	Feb 10 2014 22:03:34	07 17.05 S	080 46.90 W	222.00000	220.64301
Sta 01410	Feb 11 2014 01:16:07	07 16.97 S	080 47.03 W	234.00000	232.56300
Sta 01411	Feb 11 2014 04:17:18	07 16.93 S	080 47.04 W	236.00000	234.55000
Sta 01412	Feb 11 2014 07:12:51	07 17.10 S	080 46.99 W	232.00000	230.57600
Sta 01413	Feb 11 2014 13:13:39	07 17.05 S	080 46.91 W	229.00000	227.59599
Sta 01414	Feb 11 2014 16:09:14	07 16.99 S	080 47.00 W	232.00000	230.57600
Sta 01415	Feb 11 2014 19:05:28	07 16.98 S	080 47.02 W	232.00000	230.57600
Sta 01416	Feb 11 2014 22:01:10	07 17.02 S	080 46.96 W	232.00000	230.57600
Sta 01417	Feb 12 2014 01:10:51	07 16.96 S	080 46.94 W	233.00000	231.57001
Sta 01501	Feb 12 2014 08:05:05	07 13.03 S	080 40.11 W	132.00000	131.22200
Sta 01601	Feb 12 2014 14:37:08	08 03.00 S	080 03.94 W	163.00000	162.02400
Sta 01701	Feb 12 2014 21:01:53	08 51.04 S	079 29.04 W	96.000000	95.438004
Sta 01801	Feb 13 2014 04:12:37	09 39.41 S	078 53.02 W	135.00000	134.19501
Sta 01901	Feb 13 2014 11:18:57	10 26.53 S	078 14.46 W	141.00000	140.15300
Sta 02001	Feb 13 2014 17:25:07	11 11.01 S	077 50.95 W	124.00000	123.25700
Sta 02101	Feb 14 2014 00:22:21	11 59.96 S	077 24.77 W	116.00000	115.30400
Sta 02201	Feb 14 2014 07:59:51	12 52.00 S	076 47.89 W	132.00000	131.19901
Sta 02301	Feb 14 2014 14:35:46	13 52.94 S	076 28.11 W	92.000000	91.445999
Sta 02401	Feb 14 2014 15:56:27	14 00.05 S	076 28.67 W	161.00000	160.00400
Sta 02501	Feb 14 2014 17:43:18	14 07.95 S	076 30.07 W	292.00000	290.09900
Sta 02502	Feb 14 2014 20:40:08	14 07.97 S	076 29.93 W	284.00000	282.15701

Sta 02503	Feb 15 2014 00:20:55	14 08.15 S	076 30.15 W	293.00000	291.09201
Sta 02504	Feb 15 2014 03:05:56	14 07.80 S	076 30.00 W	289.00000	287.12100
Sta 02505	Feb 15 2014 06:07:35	14 07.87 S	076 30.02 W	285.00000	283.14999
Sta 02506	Feb 15 2014 11:24:21	14 08.06 S	076 30.15 W	297.00000	295.06299
Sta 02507	Feb 15 2014 14:07:01	14 07.89 S	076 30.03 W	292.00000	290.09900
Sta 02508	Feb 15 2014 17:15:07	14 07.93 S	076 30.06 W	290.00000	288.11401
Sta 02509	Feb 15 2014 20:10:15	14 07.94 S	076 29.98 W	288.00000	286.12799
Sta 02510	Feb 15 2014 23:11:31	14 08.13 S	076 30.15 W	296.00000	294.07101
Sta 02511	Feb 16 2014 02:06:31	14 07.92 S	076 30.05 W	293.00000	291.09201
Sta 02512	Feb 16 2014 05:15:51	14 07.89 S	076 30.10 W	288.00000	286.12799
Sta 02513	Feb 16 2014 08:12:09	14 07.88 S	076 30.05 W	289.00000	287.12100
Sta 02514	Feb 16 2014 11:00:56	14 07.87 S	076 30.11 W	291.00000	289.10699
Sta 02515	Feb 16 2014 14:06:40	14 07.97 S	076 30.11 W	295.00000	293.07800
Sta 02516	Feb 16 2014 17:11:35	14 08.01 S	076 29.98 W	289.00000	287.12100
Sta 02517	Feb 16 2014 20:06:35	14 07.91 S	076 29.93 W	289.00000	287.12100
Sta 02518	Feb 16 2014 22:58:16	14 07.88 S	076 29.92 W	284.00000	282.15701
Sta 02601	Feb 17 2014 05:44:54	14 12.54 S	076 38.31 W	1000.0000	991.80200
Sta 02701	Feb 17 2014 09:15:04	14 22.67 S	076 57.16 W	2005.0000	1983.8270
Sta 02801	Feb 17 2014 14:44:31	14 33.49 S	077 16.88 W	2024.0000	2002.5210
Sta 02802	Feb 17 2014 18:02:39	14 33.42 S	077 17.18 W	2024.0000	2002.5210
Sta 02803	Feb 17 2014 21:06:35	14 33.45 S	077 17.04 W	2010.0000	1988.7350
Sta 02804	Feb 18 2014 01:19:16	14 33.56 S	077 16.95 W	2023.0000	2001.5360
Sta 02805	Feb 18 2014 04:09:04	14 33.54 S	077 16.96 W	2022.0000	2000.5520
Sta 02806	Feb 18 2014 06:36:46	14 33.49 S	077 17.09 W	2022.0000	2000.5520
Sta 02807	Feb 18 2014 13:16:29	14 33.52 S	077 16.91 W	2021.0000	1999.5670
Sta 02808	Feb 18 2014 16:42:06	14 33.57 S	077 16.80 W	2022.0000	2000.5520
Sta 02809	Feb 18 2014 19:55:11	14 33.53 S	077 17.03 W	111.00000	110.32400
Sta 02810	Feb 18 2014 20:40:32	14 33.47 S	077 16.97 W	2002.0000	1980.8571
Sta 02811	Feb 18 2014 23:46:45	14 33.79 S	077 16.79 W	2003.0000	1981.8409

Sta 02812	Feb 19 2014 03:25:35	14 33.50 S	077 17.03 W	2024.0000	2002.5210
Sta 02813	Feb 19 2014 07:19:59	14 33.40 S	077 16.92 W	2027.0000	2005.4750
Sta 02814	Feb 19 2014 10:48:17	14 33.41 S	077 16.82 W	2012.0000	1990.7050
Sta 02815	Feb 19 2014 14:01:54	14 33.41 S	077 17.11 W	2025.0000	2003.5060
Sta 02816	Feb 19 2014 18:33:56	14 33.53 S	077 17.09 W	2021.0000	1999.5670
Sta 02817	Feb 19 2014 22:03:50	14 33.45 S	077 17.10 W	2015.0000	1993.6591
Sta 02901	Feb 20 2014 08:11:12	13 45.07 S	077 51.03 W	2023.0000	2001.6071
Sta 03001	Feb 20 2014 18:20:33	12 55.11 S	078 26.03 W	2023.0000	2001.6760
Sta 03101	Feb 21 2014 04:09:10	12 03.00 S	079 00.01 W	2025.0000	2003.7130
Sta 03201	Feb 21 2014 11:15:06	12 03.05 S	078 29.98 W	2003.0000	1982.0470
Sta 03301	Feb 21 2014 22:13:45	12 05.08 S	077 40.52 W	200.00000	198.75900
Sta 03401	Feb 22 2014 02:11:25	12 02.87 S	078 00.03 W	1789.0000	1771.1760
Sta 03501	Feb 22 2014 08:09:32	12 03.09 S	077 47.09 W	384.00000	381.44800
Sta 03601	Feb 22 2014 11:21:26	12 02.14 S	077 39.89 W	171.00000	169.95100