

# 36TH INTERNATIONAL CONFERENCE ON COASTAL ENGINEERING 2018

Baltimore, Maryland | July 30 – August 3, 2018

The State of the Art and Science of Coastal Engineering

# New Wave Hindcast for the Río de la Plata Estuary



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- Introduction
- Peculiarities of the Río de la Plata
- Improvements of the new wave hindcast
- Input of water levels and currents
- Validation of CFSR Winds
- The wave model
- Results
- Conclusions and future work





Long-term and good quality wave data series are required for multiples activities.





Observations are commonly sparse and don't cover long periods.

So Wave Hindcast often is the best source for long-term wave data series.

There are valious global wave hindcast where we can freely download wave data. e.g.: CAWCR Wave Hindcast iowaga

But, in order to: Improve the resolution and take advantage of local data (bathymetry, bed composition, wave and wind observations, etc.)

A local hindcast is necessary.



Introduction Río de la Plata Improvements Currents and Water levels Winds Calibration Wave model Conclusions





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It is a large estuary formed by the confluence of Paraná and Uruguay rivers that discharge into the Atlantic Ocean. It is 290 km long and has a NW-SE orientation.



The <u>outer zone</u> is wide (O(200 km)), the depth varies between 10 and 20 m and the bottom is composed by sand,

intermediate and inner The zone İS narrower (O(50 km)), shallower (O(5 m)) and the bottom is composed by fine sediment.

ENGINEERING 2018



Scheme of the 1st hindcast

Inputs:CFSR WindsBathimetry: GEBCOCurrents and water level0.5°x 0.5° and 6 hand nautical chartsvariations: No

*Model:* Wavewatch III v3.14, multi-grid mode (Global-Regional-Local), ST3 parametrization

**Outputs:** Bulk wave paremeters (Hs, Tm, Tp, Dm, Dp,...) with 1'x 1' spatial resolution and 3 h time step. Spectra series on 20 points.



Introduction Río de la Plata Improvements of the new wave hindcast Cur & WL Winds Wave model Results Conclusions



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# GIS with all the

- Incorporation of water levels and currents
- Inp
- Winds with higher resolution
- Higher resolution of the wave model (spatial and spectra).
- Mo
- New Parametrizations
- *Out* Calibration taken into account the Río de la Plata.
  - More outputs with higher resolution.

# 50 points



## TELEMAC 2D.

Non-structured grid ~1km resolution along the uruguayan coast



## Forcings:

- Diary mean discharge of Uruguay and Paraná Rivers.
- Surface winds and pressure from CFSR
- Tides from AsTide

# **Calibration**

Manning (n) and Wind Drag (C<sub>D</sub>). Considering water level observations







Introduction Río de la Plata Improvements Cur & WL Validation of CFSR Winds Calibration Wave model Conclusions



## Analysis for sub-regions considering altimetry data

#### Configuration

WAVEWATCH III <sup>®</sup> 5.16. Multi-grid mode. Two-way nesting. 5 regular grids. Forcings:

CFSR winds ~0.31° for all the grids.

TELEMAC wáter levels 2' for high Rank grids (Green and yellow) TELEMAC currents 1' for high Rank grids (Green and yellow)





50°

#### Parametrization

Stopa et al. (2016). 1 year global hindcast for diferent parametrizations (ST2, ST3, **ST4** and ST5) contrasted with Hs altimeter data.





ter indices (in percentage) for ST2, ST ST3, ST4, and ST6 using co-located mean squared slopes from ENVISAT for 2011 gridded in 2° bins.

**ST4** shows the best results for the western South Atlantic.

Fig. 3. Normalized wave height bias (in percentage) for ST2, ST3, ST4, and ST6 using co-located wave heights from ENVISAT for 2011 gridded in 2° bins.



Calibration



#### Altimetry data as reference



#### <u>2002</u>: More data than the average, and also more extreme data tan the average for all the sub-regions

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	\Average
Int2	0	52	102	91	187	156	64	84	99	108	11	121	210	108	155	102	121	109	203	29	55	201	41	109
Med2	0	241	570	598	728	734	625	617	610	686	73	1011	766	766	740	646	751	977	741	673	676	918	134	649
EztU	0	257	561	461	783	736	581	587	542	662	78	1007	1234	715	1016	603	558	666	919	932	883	872	147	674
EztA	0	378	640	605	932	914	689	720	691	896	101	1152	1057	967	971	831	839	961	742	671	737	1164	169	771
Atl1	88	1186	857	1547	1137	1024	814	752	821	871	98	1389	1405	1166	1196	1041	1091	1252	1058	978	897	1470	315	1015
Atl2	19	892	1460	1689	1672	1691	1440	1536	1470	1998	211	2925	2357	2202	2330	2069	1907	2437	1830	1826	1840	2272	286	1750
Atl3	0	474	1072	1092	1393	1234	1037	1139	1082	1335	148	2237	2114	1470	1921	1424	1270	1607	1575	1638	1699	1892	310	1326
Atl4	0	219	385	257	588	559	352	386	393	652	91	1110	1410	815	1249	753	623	540	784	826	896	720	113	633
Atio	0	254	451	328	673	609	485	460	453	811	101	1368	1730	943	1535	861	733	645	1073	1108	1165	812	122	/6/
A06	0	303	407	370	836	719	4/1	431	498	200	101	1909	2334	928	1989	828	1000	619	1704	1817	1835	1221	200	347
reci	0	220	757	700	1051	026	745	701	762	2166	299	3228	2007	2338	2309	2172	040	2960	1100	1002	1020	2182	200	1820
1002	24	925	576	959	912	000	740 E97	569	702 692	000	90	1020	214.2	920	1725	050	043 751	702	100	1210	1352	114.9	232	951
reco	27	959	1705	1961	2049	1926	1700	1007	1752	2200	240	2500	2557	2262	2519	2272	2152	2009	1000	1000	19.4.2	2200	215	1950
rect	0	513	1247	1267	154.9	1542	1209	1279	1272	1454	156	2225	1722	1523	1602	1419	1466	1929	14.4.9	1445	1452	2000	299	1289
recfi	0	535	1086	830	14.98	1312	1032	1134	1087	1569	182	2406	2627	1729	2326	1638	1388	1603	1633	1645	1665	1608	264	1410
rec7	36	763	558	1054	876	709	596	578	598	973	121	1780	2098	1165	1828	1077	306	859	1285	1344	1563	1292	204	1016
rec8	67	1083	1420	1902	1724	1663	1477	1491	1472	1574	159	2394	1760	1549	1596	1491	1543	1989	1519	1486	1533	2068	313	1509
rec9	27	952	1324	1479	1676	1577	1342	1377	1379	1610	175	2436	2118	1673	1869	1576	1519	1839	1542	1486	1382	1840	278	1481
re10	76	921	456	1097	750	669	491	460	498	994	117	1639	2187	1093	1895	1032	863	693	1188	1361	1367	1077	205	965
re11	81	1127	483	1372	762	670	513	474	514	752	88	1429	2350	817	1850	731	671	569	1578	1750	1911	1163	228	986
Total	465	12929	17926	21254	23773	22093	18069	18499	18358	24033	2718	37863	8476	26303	34166	24389	22744	26085	26999	27107	27826	29762	4671	
1.10	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
INCZ Mod2	0	10	01	49	3 50	23	26		40	77		05	3	4	121	4	72	110	74	70	0	IU EC	12	62
Meuz Cetil	0	20	01	43	50	or	30		40			00	- C 24	01	141	40	1.0	110	- C#	10	01	00	14	63
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A H1	0	17	49	32	116 81	54 86	28 50	46	35	31	4	111 73	135	109	96 109	51 53	52 61	42	131 97	161 73	98 86	93 96	5	67
	0	17 107	49 105 51	32 61 114	116 81 117	54 86 55	28 50 51	46 82 86	35 74 103	31 102 73	4	111 73 307	135 75 93	109 103 173	96 109 66	51 53 88	52 61 101	42 124 126	131 97 90	161 73 95	98 86 91	93 96 94	5 14 59	67 76 100
Atl2	0 2 0	17 107 77	49 105 51 154	32 61 114 166	116 81 117 182	54 86 55 154	28 50 51 145	46 82 86 117	35 74 103 106	31 102 73 283	4 12 16 23	111 73 307 271	135 75 93 268	109 103 173 201	96 109 66 159	51 53 88 132	52 61 101 184	42 124 126 294	131 97 90 170	161 73 95 159	98 86 91 284	93 96 94 218	5 14 59 24	67 76 100 173
Atl2 Atl3	0 2 0	17 107 77 13	49 105 51 154 139	32 61 114 166 88	116 81 117 182 159	54 86 55 154 91	28 50 51 145 99	46 82 86 117 117	35 74 103 106 104	31 102 73 283 141	4 12 16 23 15	111 73 307 271 208	135 75 93 268 250	109 103 173 201 170	96 109 66 159 153	51 53 88 132 118	52 61 101 184 109	42 124 126 294 124	131 97 90 170 122	161 73 95 159 160	98 86 91 284 286	93 96 94 218 187	5 14 59 24 15	67 76 100 173 131
Atl2 Atl3 Atl4	0 2 0 0	17 107 77 13 44	49 105 51 154 139 81	32 61 114 166 88 19	116 81 117 182 159 115	54 86 55 154 91 57	28 50 51 145 99 34	46 82 86 117 117 29	35 74 103 106 104 48	31 102 73 283 141 64	4 12 16 23 15 7	111 73 307 271 208 108	135 75 93 268 250 120	109 103 173 201 170 89	96 109 66 159 153 75	51 53 88 132 118 84	52 61 101 184 109 47	42 124 126 294 124 30	131 97 90 170 122 79	161 73 95 159 160 97	98 86 91 284 286 89	93 96 94 218 187 51	5 14 59 24 15 4	67 76 100 173 131 63
Atl2 Atl3 Atl4 Atl5	0 2 0 0 0	107 107 77 13 44 45	49 105 51 154 139 81 57	32 61 114 166 88 19 18	116 81 117 182 159 115 137	54 86 55 154 91 57 89	28 50 51 145 99 34 26	46 82 86 117 117 29 38	35 74 103 106 104 48 60	31 102 73 283 141 64 60	4 12 16 23 15 7 1	111 73 307 271 208 108 111	135 75 93 268 250 120 75	109 103 173 201 170 89 122	96 109 66 159 153 75 181	51 53 88 132 118 84 59	52 61 101 184 109 47 53	42 124 126 294 124 30 61	131 97 90 170 122 79 144	161 73 95 159 160 97 129	98 86 91 284 286 89 103	93 96 94 218 187 51 84	5 14 59 24 15 4 0	67 76 100 173 131 63 77
Atl2 Atl3 Atl4 Atl5 Atl6	0 2 0 0 0 0 0	17 107 77 13 44 45 26	49 105 51 154 139 81 57 46	32 61 114 166 88 19 18 18 14	116 81 117 182 159 115 137 130	54 86 55 154 91 57 89 80	28 50 51 145 99 34 26 54	46 82 86 117 117 29 38 40	35 74 103 106 104 48 60 55	31 102 73 283 141 64 60 78	4 12 16 23 15 7 1 7	111 73 307 271 208 108 111 106	135 75 93 268 250 120 75 243	109 103 173 201 170 89 122 117	96 109 66 159 153 75 181 181 147	51 53 88 132 118 84 59 80	52 61 101 184 109 47 53 42	42 124 126 294 124 30 61 55	131 97 90 170 122 79 144 113	161 73 95 159 160 97 129 346	98 86 91 284 286 89 103 149	93 96 94 218 187 51 84 148	5 14 59 24 15 4 0 0	67 76 100 173 131 63 77 93
Atl2 Atl3 Atl4 Atl5 Atl6 rec1	0 2 0 0 0 0 0 0 0	17 107 77 13 44 45 26 43	49 105 51 154 139 81 57 46 239	32 61 114 166 88 19 18 18 14 143	116 81 117 182 159 115 137 130 261	54 86 55 154 91 57 89 80 124	28 50 51 145 99 34 26 54 108	46 82 86 117 117 29 38 40 189	35 74 103 106 104 48 60 55 133	31 102 73 283 141 64 60 78 222	4 12 16 23 15 7 1 7 7 27	111 73 307 271 208 108 111 106 222	135 75 93 268 250 120 75 243 371	109 103 173 201 170 89 122 117 310	96 109 66 159 153 75 181 147 217	51 53 88 132 118 <b>84</b> 59 80 <b>250</b>	52 61 101 184 109 47 53 42 183	42 124 126 294 124 30 61 55 228	131 97 90 170 122 79 144 113 102	161 73 95 159 160 97 129 346 129	98 86 91 284 286 89 103 149 224	93 96 94 218 187 51 84 148 177	5 14 59 24 15 4 0 0 20	67 76 100 173 131 63 77 93 181
Atl2 Atl3 Atl4 Atl5 Atl6 rec1 rec2	0 2 0 0 0 0 0 0 0 0 0	17 107 77 13 44 45 26 43 43	49 105 51 154 139 81 57 46 239 107	32 61 114 166 88 19 18 18 14 143 81	116 81 117 182 159 115 137 130 261 196	54 86 55 154 91 57 89 80 124 72	28 50 51 145 99 34 26 54 108 82	46 82 86 117 117 29 38 40 189 81	35 74 103 106 104 48 60 55 133 44	31 102 73 283 141 64 60 78 222 67	4 12 16 23 15 7 1 7 27 11	111 73 307 271 208 108 111 106 222 105	135 75 93 268 250 120 75 243 371 196	109 103 173 201 170 89 122 117 310 168	96 109 66 159 153 75 181 147 217 135	51 53 88 132 118 84 59 80 250 84	52 61 101 184 109 47 53 42 183 95	42 124 126 294 124 30 61 55 228 83	131 97 90 170 122 79 144 113 102 71	161 73 95 159 160 97 129 346 129 98	98 86 91 284 286 89 103 149 224 115	93 96 94 218 187 51 84 148 177 134	5 14 59 24 15 4 0 0 20 20 32	67 76 100 173 131 63 77 93 181 96
Atl2 Atl3 Atl4 Atl5 Atl6 rec1 rec2 rec3	0 2 0 0 0 0 0 0 0 0 0 0 0	17 107 77 13 44 45 26 43 43 43 59	49 105 51 154 139 81 57 46 239 107 59	32 61 114 166 88 19 18 18 14 143 81 103	116 81 117 182 159 115 137 130 261 196 137	54 86 55 154 91 57 89 80 124 72 41	28 50 51 145 99 34 26 54 108 82 56	46 82 86 117 117 29 38 40 189 81 26	35 74 103 106 104 48 60 55 133 44 83	31 102 73 283 141 64 60 78 222 67 66	4 12 16 23 15 7 1 7 27 11 7	111 73 307 271 208 108 111 106 222 105 144	135 75 93 268 250 120 75 243 371 196 264	109 103 173 201 170 89 122 117 310 168 131	96 109 66 159 153 75 181 147 217 135 238	51 53 88 132 118 84 59 80 250 84 84	52 61 101 184 109 47 53 42 183 95 75	42 124 126 294 124 30 61 55 228 83 71	131 97 90 170 122 79 144 113 102 71 127	161 73 95 159 160 97 129 346 129 98 112	98 86 91 284 286 89 103 149 224 115 116	93 96 94 218 187 51 84 148 177 134 76	5 14 59 24 15 4 0 0 20 20 32 42	67 76 100 173 131 63 77 93 181 96 95
Att2 Att3 Att4 Att5 Att6 rec1 rec2 rec3 rec4	0 2 0 0 0 0 0 0 0 0 0 0 0 0	17 107 77 13 44 45 26 43 43 43 59 78	49 105 51 154 139 81 57 46 239 107 59 173	32 61 114 166 88 19 18 14 143 81 143 81 103 185	116 81 117 182 159 115 137 130 261 196 137 265	54 86 55 154 91 57 89 80 124 72 41 168	28 50 51 145 99 34 26 54 108 82 56 200	46 82 86 117 117 29 38 40 189 81 26 157	35 74 103 106 104 48 60 55 133 44 83 170	31 102 73 283 141 64 60 78 222 67 66 242	4 12 16 23 15 7 1 7 27 11 7 29	111 73 307 271 208 108 111 106 222 105 144 353	135 75 93 268 250 120 75 243 371 196 264 258	109 103 173 201 170 89 122 117 310 168 131 221	96 109 66 159 153 75 181 147 217 135 238 278	51 53 88 132 118 <b>84</b> 59 80 <b>250</b> 84 84 84	52 61 101 184 109 47 53 42 183 95 75 75 161	42 124 126 294 124 30 61 555 228 83 71 259	131 97 90 170 122 79 144 113 102 71 127 210	161 73 95 159 160 97 129 346 129 98 112 168	98 86 91 284 286 89 103 149 224 115 116 166	93 96 94 218 187 51 84 148 177 134 76 269	5 14 59 24 15 4 0 0 20 32 32 42 34	67 76 100 173 131 63 77 93 181 96 95 195
Att2 Att3 Att4 Att5 Att6 rec1 rec2 rec3 rec4 rec5	0 2 0 0 0 0 0 0 0 0 0 0 0 0	17 107 77 13 44 45 26 43 43 59 78 53	49 105 51 154 139 81 57 46 239 107 59 173 233	32 61 114 166 88 19 18 14 143 81 103 185 185	116 81 117 182 159 115 137 130 261 196 137 265 192	54 86 55 154 91 57 89 80 124 72 41 168 107	28 50 51 145 99 34 26 54 108 82 56 200 130	46 82 86 117 117 29 38 40 189 81 26 157 119	35 74 103 106 104 48 60 55 133 44 83 170 121	102 73 283 141 64 60 78 222 67 66 242 242 116	4 12 16 23 15 7 1 7 27 11 7 29 15	111 73 307 271 208 108 108 106 222 105 144 353 142	135 75 93 268 250 120 75 243 371 196 264 258 236	109 103 173 201 170 89 122 117 310 168 131 221 223	96 109 66 159 153 75 181 147 217 135 238 278 278 142	51 53 88 132 118 <b>84</b> 59 80 <b>250</b> 84 84 84 183 132	52 61 101 184 109 47 53 42 183 95 75 161 112	42 124 126 294 124 30 61 55 228 83 71 259 205	131 97 90 170 122 79 144 113 102 71 127 210 111	161 73 95 159 160 97 129 346 129 98 112 168 102	98 86 91 284 286 89 103 149 224 115 116 166 181	93 96 94 218 187 51 84 148 177 134 76 269 216	5 14 59 24 15 4 0 0 20 20 32 42 34 7	67 76 100 173 131 63 77 93 181 93 181 96 95 195 138
Attl2 Attl3 Attl4 Attl5 Attl6 rec1 rec2 rec3 rec4 rec5 rec6	0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	17 107 77 13 44 45 26 43 43 43 59 78 53 34	49 105 51 154 139 81 57 46 239 107 59 173 233 132	32 61 114 166 88 19 18 14 143 81 103 185 185 144 766	116 81 117 182 159 115 137 130 261 196 137 265 192 233	54 86 55 154 91 57 89 80 124 72 41 168 107 108	28 50 51 145 99 34 26 54 108 82 56 <b>200</b> 130 109	46 82 86 117 117 29 38 40 189 81 26 157 119 119	35 74 103 106 104 48 60 55 133 44 83 170 121 98	31 102 73 283 141 64 60 78 222 67 66 242 66 242 116 176	4 12 16 23 15 7 1 7 27 11 7 29 15 18	111 73 307 271 208 108 111 106 222 105 144 353 142 193	135 75 93 268 250 120 75 243 371 196 264 258 236 278	109 103 173 201 170 89 122 117 310 168 131 221 223 173	96 109 66 159 153 75 181 147 217 135 238 278 142 152	51 53 88 132 118 84 59 80 250 84 84 84 183 132 132	52 61 101 184 109 47 53 42 183 95 75 161 112 112	42 124 126 294 124 30 61 55 228 83 71 259 205 81	131 97 90 170 122 79 144 113 102 71 127 210 111 106	161 73 95 159 160 97 129 346 129 98 112 168 102 125	98 86 91 284 286 89 103 149 224 115 116 166 181 288	93 96 94 218 187 51 84 148 177 134 76 269 216 160	5 14 59 24 15 4 0 0 20 32 42 34 7 53	67 76 100 173 131 63 77 93 93 181 96 95 195 138 138 140
Atl2 Atl3 Atl4 Atl5 Atl6 rec1 rec2 rec3 rec4 rec5 rec6 rec6	0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	17 107 77 13 44 45 26 43 43 43 59 78 53 34 62	49 105 51 154 139 81 57 46 239 107 59 173 293 132 49	32 61 114 166 88 19 18 14 143 81 103 185 185 144 76 110	116 81 117 182 159 115 137 130 261 196 137 265 192 233 100	54 86 55 154 91 57 89 80 124 72 41 168 107 108 29	28 50 51 145 99 34 26 54 108 82 56 200 130 109 41	46 82 86 117 117 29 38 40 189 81 26 157 119 119 48	35 74 103 106 104 48 60 55 133 44 83 170 121 98 53	102 73 283 141 64 60 78 222 67 66 242 67 66 242 116 176 89	4 12 16 23 15 7 1 7 27 11 7 29 15 18 11	111 73 307 271 208 108 111 106 222 105 144 353 142 193 202	135 75 93 268 250 120 75 243 371 196 264 258 236 278 209	109 103 173 201 170 89 122 117 310 168 131 221 223 173 217	96 109 66 159 153 75 181 147 217 135 238 278 278 142 152 238	51 53 88 132 118 84 59 80 250 84 84 84 183 132 198 96	52 61 101 184 109 47 53 42 183 95 75 161 112 161 666	42 124 126 294 124 30 61 55 228 83 71 259 205 81 101	131 97 90 170 122 79 144 113 102 71 127 210 111 106 123	161 73 95 159 160 97 129 346 129 98 112 168 102 125 110	98 86 91 284 286 89 103 149 224 115 116 166 181 288 121	93 96 94 218 187 51 84 148 177 134 76 269 216 160 150 132	5 14 59 24 15 4 0 0 20 32 42 34 7 53 24	67 76 100 173 131 63 77 93 181 96 95 195 195 138 140 101
Atl2 Atl3 Atl4 Atl5 Atl6 rec1 rec2 rec3 rec4 rec5 rec6 rec7 rec8	0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	17 107 77 13 44 45 26 43 43 59 78 53 34 62 91	49 105 51 154 139 81 57 46 239 107 59 107 59 173 233 132 49 147	32 61 114 166 88 19 18 14 143 81 103 185 144 76 110 208	116 81 117 182 159 115 137 261 196 137 265 192 233 100 213	54 86 55 154 91 57 89 80 124 72 41 168 107 108 29 138 29 138	28 50 51 145 99 34 26 54 108 82 56 200 130 109 41 126	46 82 86 117 29 38 40 189 81 26 157 119 119 48 104	35 74 103 106 104 48 60 55 133 44 83 170 121 98 53 144	31 102 73 283 141 64 60 78 222 67 66 242 116 176 89 181	4 12 23 15 7 1 7 7 29 15 18 11 19	111 73 307 208 108 111 106 222 105 144 353 144 353 142 193 202 253	135 75 93 268 250 120 75 243 371 196 264 258 236 278 209 147	109 103 173 201 170 89 122 117 310 168 131 221 223 173 217 148	96 109 66 159 153 75 181 147 217 135 238 278 278 142 152 238 142 152	51 53 88 132 118 84 59 80 250 250 84 84 84 183 132 198 96 134	52 61 101 184 109 47 53 42 183 95 75 161 112 151 66 173	42 124 126 294 124 30 61 55 228 83 71 259 205 81 101 181	131 97 90 170 122 79 144 113 102 71 127 210 111 106 123 154	161 73 95 159 160 97 129 346 129 98 81 12 168 102 125 110 125	98 86 91 284 286 89 103 149 224 116 166 181 288 121 151	93 96 94 218 187 51 84 148 177 134 76 269 216 160 132 218 180	5 14 59 24 15 4 0 0 20 32 42 42 32 42 35 53 24 35	67 76 100 173 131 63 77 93 181 96 95 195 195 138 138 140 101 148
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Atta Atta Atta Atta Atta Atta Atta Atta		17 107 77 13 44 45 26 43 43 59 78 53 34 62 91 116 102	49 105 51 154 39 81 57 46 239 107 59 107 59 107 59 107 59 107 59 107 59 112 233 132 49 147 121 58	32 61 114 166 88 19 18 14 143 81 103 185 144 76 110 208 178 178	116 81 117 182 183 115 137 130 261 136 137 265 132 233 100 213 151 109 109	54 86 55 154 91 57 89 80 124 72 41 168 108 29 138 29 138 122 51	28 50 51 145 99 34 26 54 108 82 56 <b>200</b> 109 109 41 126 121 39 90	46 82 86 117 129 38 40 189 81 26 157 119 48 104 130 19 19	35 74 103 106 104 48 60 55 133 44 83 170 121 98 53 144 102 71	31 102 73 283 141 64 60 78 222 67 66 242 116 176 89 116 176 89 181 193 84	4 12 16 23 15 7 1 7 27 11 7 29 15 18 11 19 17 16	111 73 307 271 208 108 111 106 225 106 235 144 353 142 193 202 253 256 230 256 230	135 75 93 268 250 120 75 243 371 196 264 258 236 278 209 147 229 169	109 103 173 201 170 89 122 117 310 168 131 221 223 173 217 148 225 134	96 109 66 159 153 75 181 147 217 135 238 278 142 152 238 142 152 238 145 157	51 53 88 132 118 89 80 250 84 84 84 183 132 198 96 134 103 43	52 61 101 184 103 47 53 42 183 95 75 161 112 151 66 173 159 86 86	42 124 126 294 124 120 61 55 228 83 71 205 81 101 181 173 105	131 97 90 170 122 79 144 113 102 71 127 210 111 106 123 154 150 101	161 73 95 159 160 97 129 346 129 98 112 168 102 125 110 113 157 119	98 96 91 284 286 99 103 149 224 115 116 166 181 288 121 151 152 84	93 96 94 218 187 51 84 148 177 134 76 269 216 160 132 218 171 82	5 14 59 24 15 4 0 0 20 20 20 20 20 20 20 20 20 20 20 20	67 76 100 173 131 63 77 93 93 181 96 95 195 138 140 101 148 147 96







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#### Calibration



Results with default parameters (4 month simulation)

**BETAMAX** from ST4 wind input parametrization and **GAMMA** from JONSWAP bottom friction parametrization were chosen to tune.



#### Calibration









2018



#### Calibration

BIAS (m)

#### **RDP Med e Int**

**RDP Ext** 

	BETAMAX=1.43	BETAMAX=1.55	BETAMAX=1.66		BETAMAX=1.43	BETAMAX=1.55	BETAMAX=1.66
GAMMA=0	0.4	0.43	0.45	GAMMA=0	0.12	0.15	0.17
GAMMA=-0.03	-0.19	-0.16	-0.14	GAMMA=-0.03	-0.17	-0.14	-0.12
GAMMA=-0.067	-0.32	-0.29	-0.27	GAMMA=-0.067	-0.30	-0.27	-0.25

#### Atl3

Atl2

	BETAMAX=1.43	BETAMAX=1.55	BETAMAX=1.66		BETAMAX=1.43	BETAMAX=1.55	BETAMAX=1.66
GAMMA=0	0.02	0.06	0.10	GAMMA=0	-0.01	0.02	0.06
GAMMA=-0.03	-0.07	-0.02	0.01	GAMMA=-0.03	-0.1	-0.11	-0.08
GAMMA=-0.067	-0.15	-0.11	-0.07	GAMMA=-0.067	-0.26	-0.23	-0.20



SI

#### Calibration

#### **RDP Med e Int**

**RDP Ext** 

	BETAMAX=1.43	BETAMAX=1.55	BETAMAX=1.66		BETAMAX=1.43	BETAMAX=1.55	BETAMAX=1.66
GAMMA=0	27	27	27.1	GAMMA=0	39.6	40.3	40.9
GAMMA=-0.03	22.5	22.9	23.3	GAMMA=-0.03	31.3	31.9	32
GAMMA=-0.067	21.7	21.6	21.5	GAMMA=-0.067	31.8	32.2	32.6

#### Atl3

Atl2

	BETAMAX=1.43	BETAMAX=1.55	BETAMAX=1.66		BETAMAX=1.43	BETAMAX=1.55	BETAMAX=1.66
GAMMA=0	15.8	16.5	17.2	GAMMA=0	15.7	16	16.3
GAMMA=-0.03	15.1	15.7	16.4	GAMMA=-0.03	15.2	15.3	15.6
GAMMA=-0.067	15.3	15.9	16.5	GAMMA=-0.067	16	16	16.2



## Calibration

BIAS		BETAMAX=1.43	BETAMAX=1.55	BETAMAX=1.66	
	GAMMA=0	+	+	+	
	GAMMA=-0.03	-	-	-	Zero Bias, GAMMA between 0 and -0.03 m <sup>2</sup> s
	GAMMA=-0.067	-	-	-	





We set **BETAMAX = 1.55**, and continue tunning GAMMA. Obtaining the better results for **GAMMA=-0.012 m<sup>2</sup>s<sup>-3</sup>** 



**RDP Med e Int RDP Ext** Río de la Plata Medio e interior Río de la Plata Exterior 2.5 3.5 NObs= 784 NObs= 2264 3 Mean Obs/Mod =0.698/0.583 2 Mean Obs/Mod = 0.941/0.935 Std Obs/Mod = 0.312/0.38 Std Obs/Mod = 0.448/0.471 (m) pelepoy 2.5 1.5 (m) 1.5 BIAS =-0.115 BIAS =-0.00671 RMSE =0.348 RMSE =0.333 SI =35.4 ... SI =47.1 r =0.562 RDP Med e RDP Ex 0.5 0.5 1.5 2.5 0.5 2 1.5 2.5 3.5 0.5 2 3 Observed (m) Observed (m)



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Atl3

Atl2

2018







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- A new wave hindcast for Uruguay was recently developed.
- It has a better performance than the previous one, particularly for the Río de la Plata.
- Results show the key role of bottom friction. So, parametrizations newer than JONSWAP must be tested, and more research is needed.
- A big portion of the errors that still persist are inherited from the wind fields. So improving them must be included on future works.
- In-situ measures are necessary to have better reference data than the provided by altimetry.



4 | + |



No altimetry data for the Inner RDP.

We recently deployed a GPS buoy Datawell (DWG-4)













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# Thanks for your attention!



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