Coastal Management Plan Development
Fort Myers Beach, Florida

FSBPA Technical Conference

February 5, 2015

Town of
FORT MYERS BEACH

COAST & HARBOR ENGINEERING
A Division of Hatch Mott MacDonald

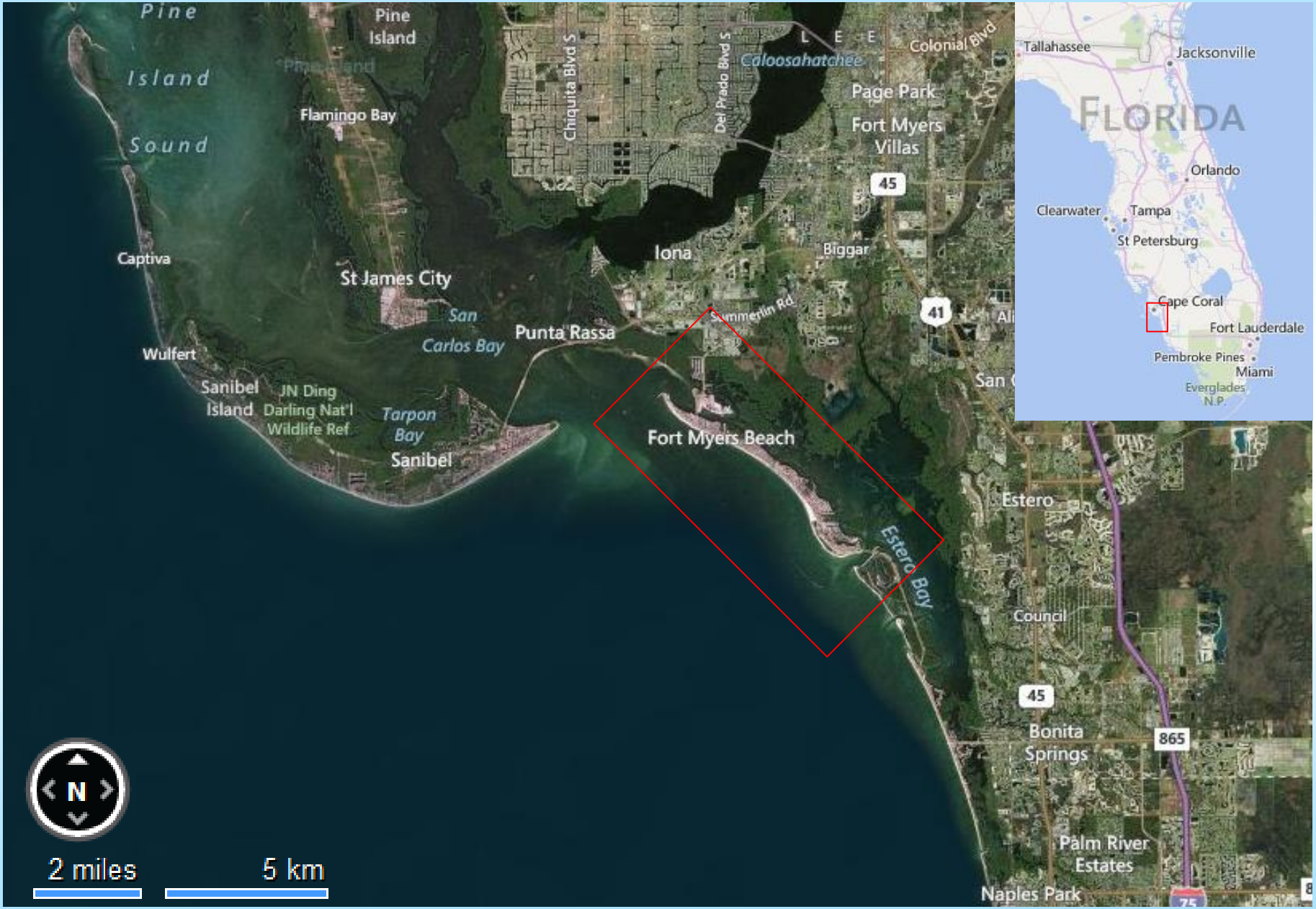
Overall Goals

- Develop an understanding of coastal processes and anthropogenic factors that control short and long term shoreline morphology of Estero Island.
- Develop and Evaluate a set long-term engineering solution(s) that maximize coastal stability for the Estero Island Gulf shoreline.

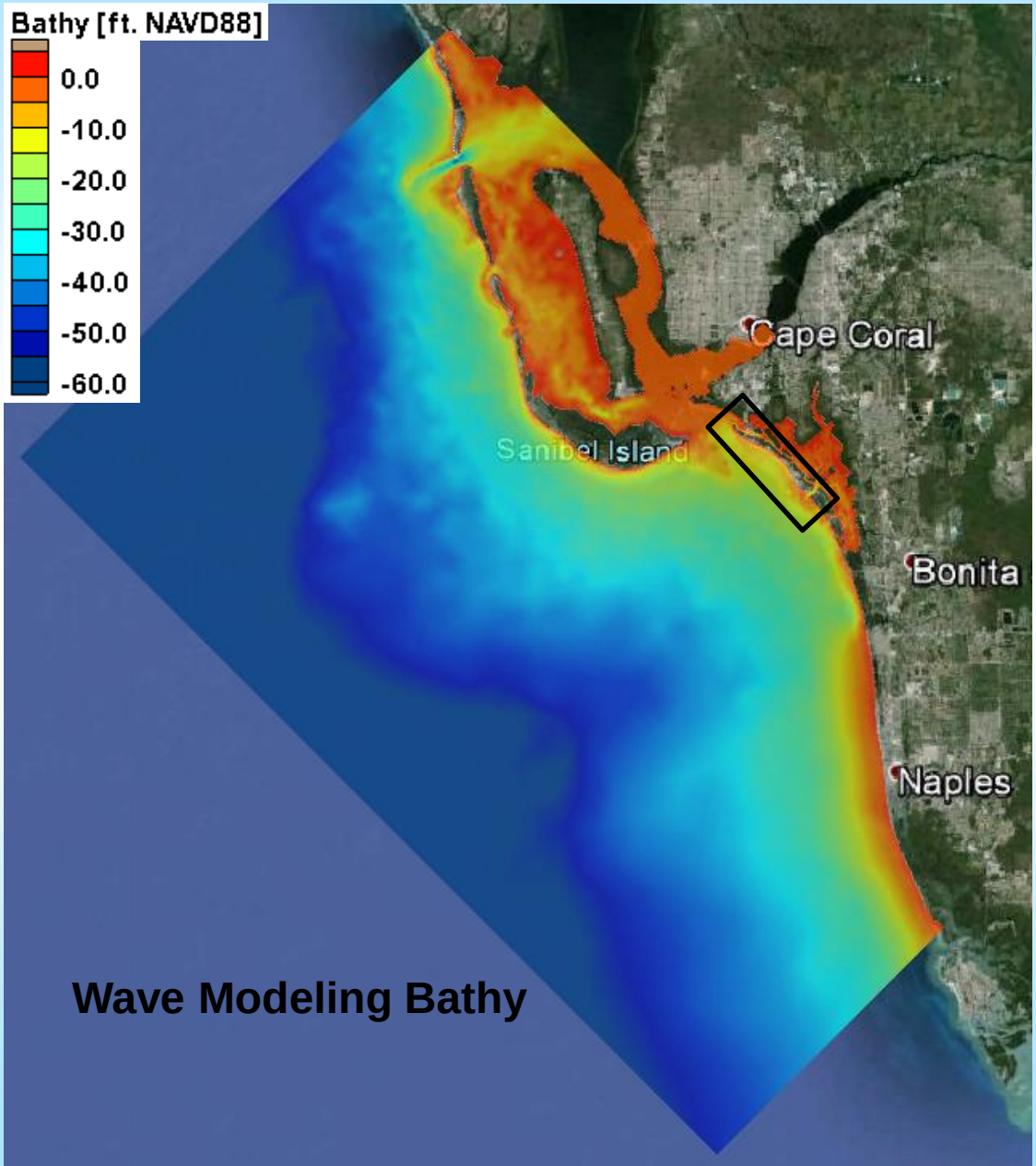
Driving Forces

- During discussions of the Estero Island Beach Restoration Plan, residents and Council were interested in coastal management and “innovative solutions”
- To evaluate coastal management solutions, a holistic understanding of Estero Island coastal processes was needed

Project Site



Project Vicinity Bathymetry



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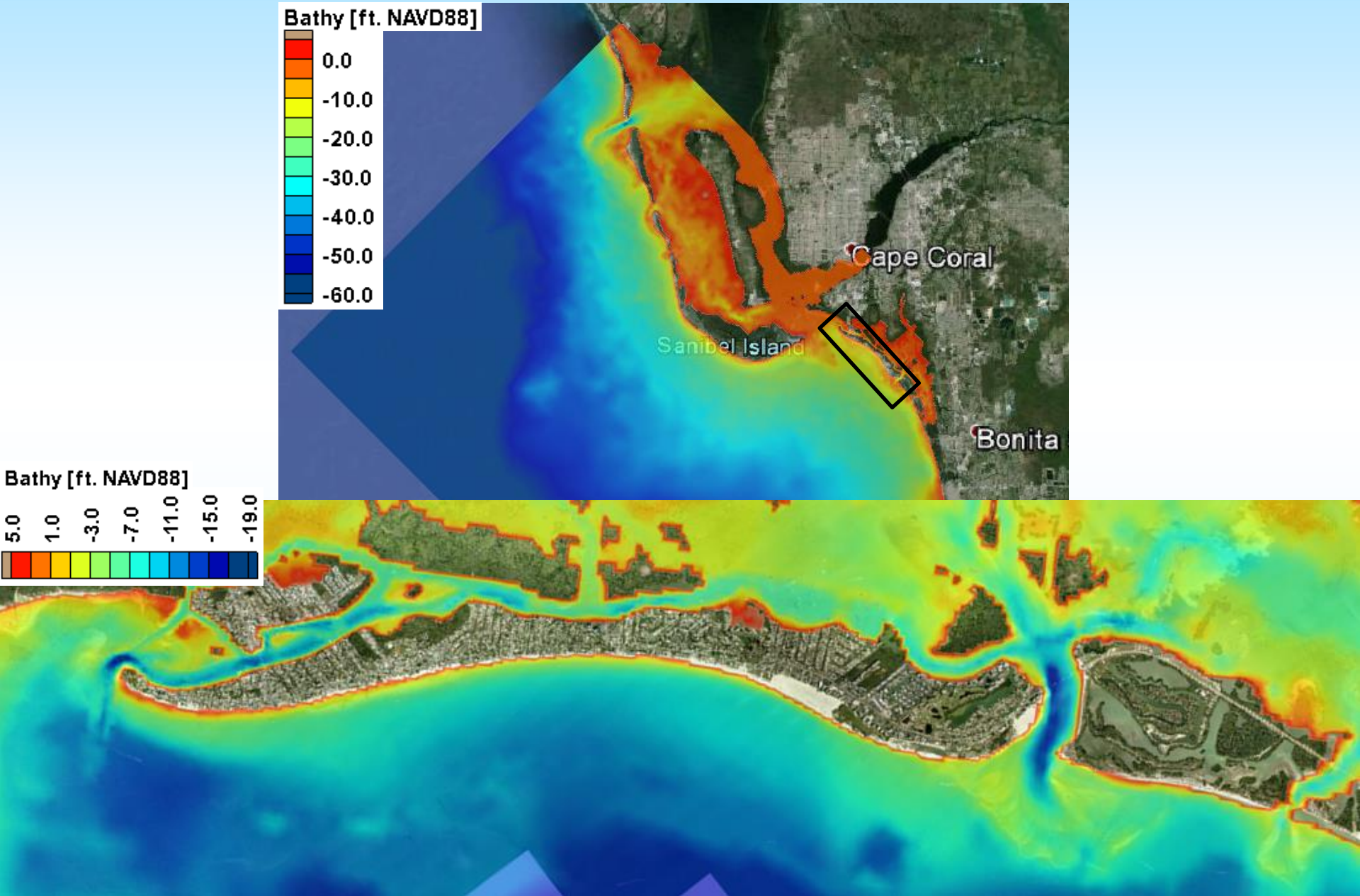
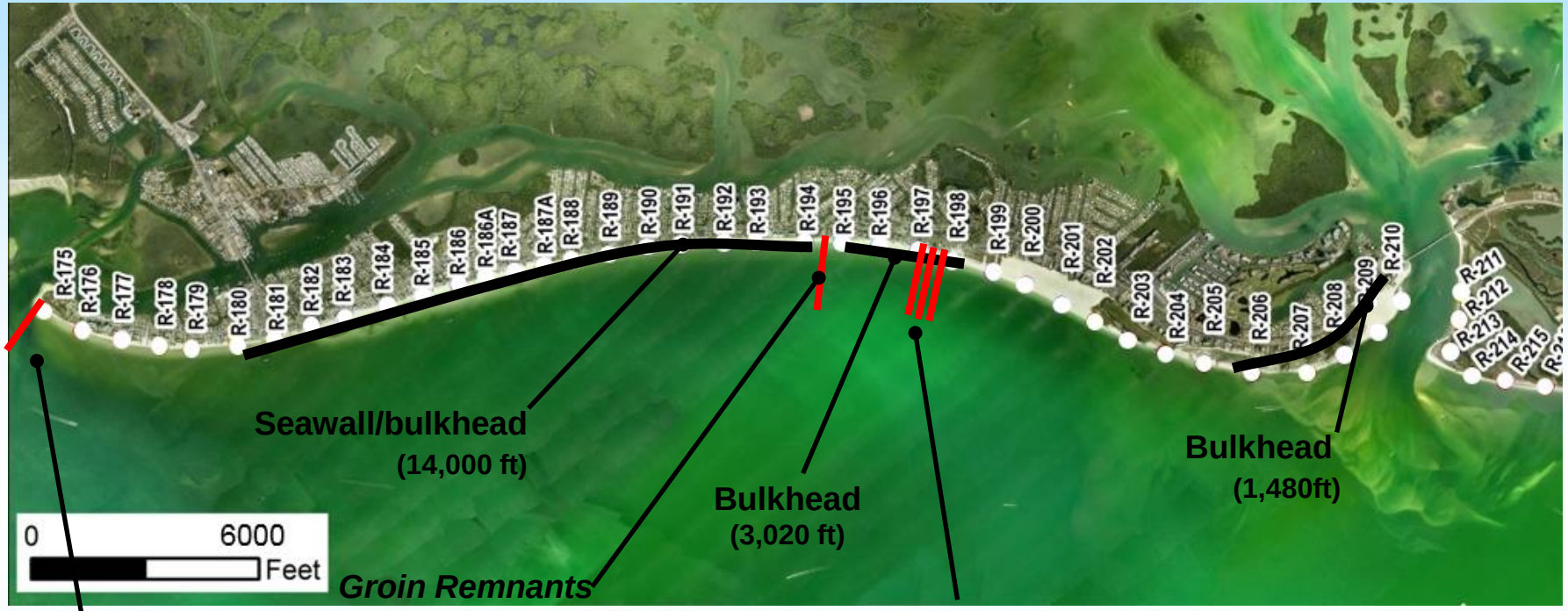
Project Vicinity Bathymetry



Previous Coastal Projects: Structures



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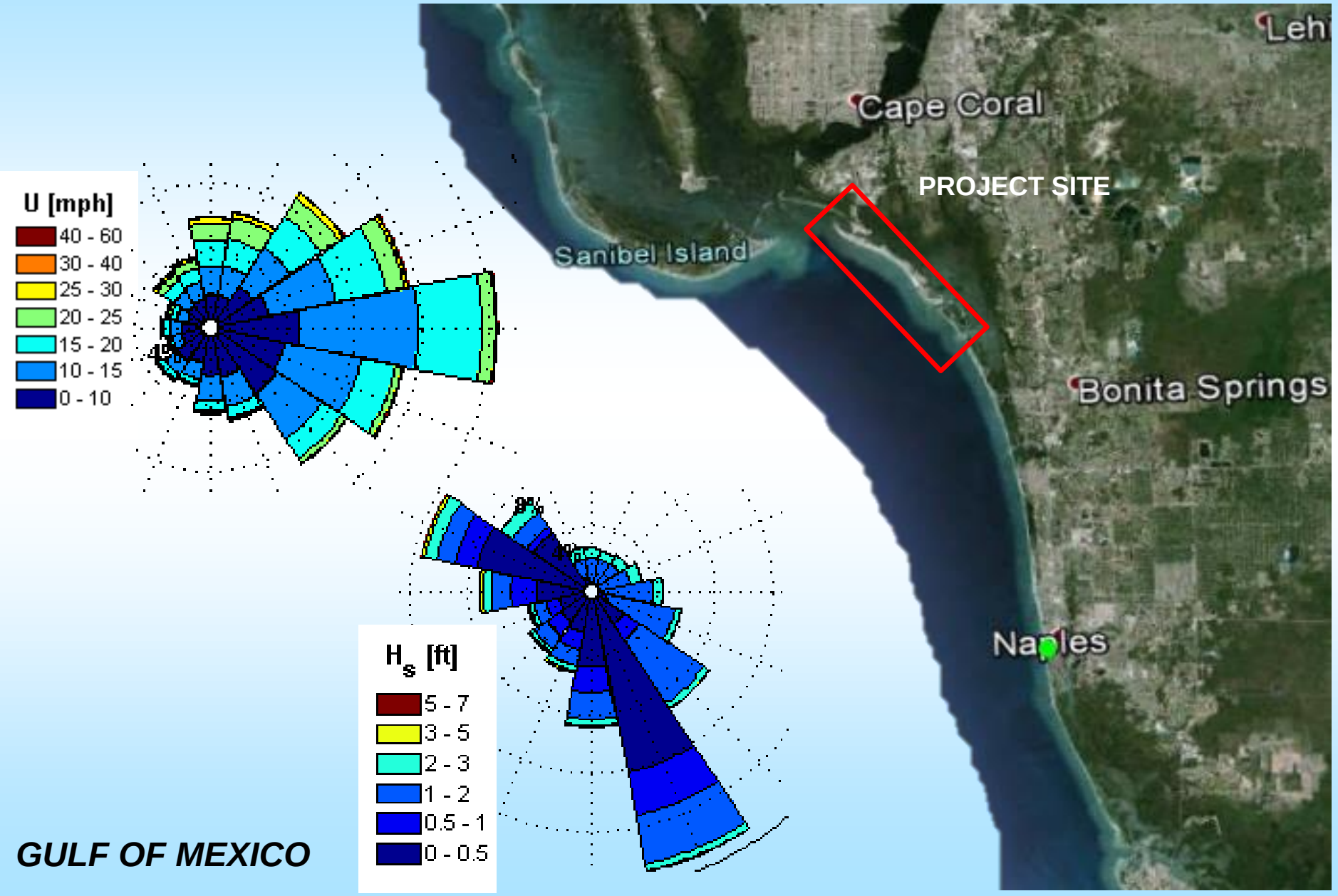
Previous Nourishment Projects

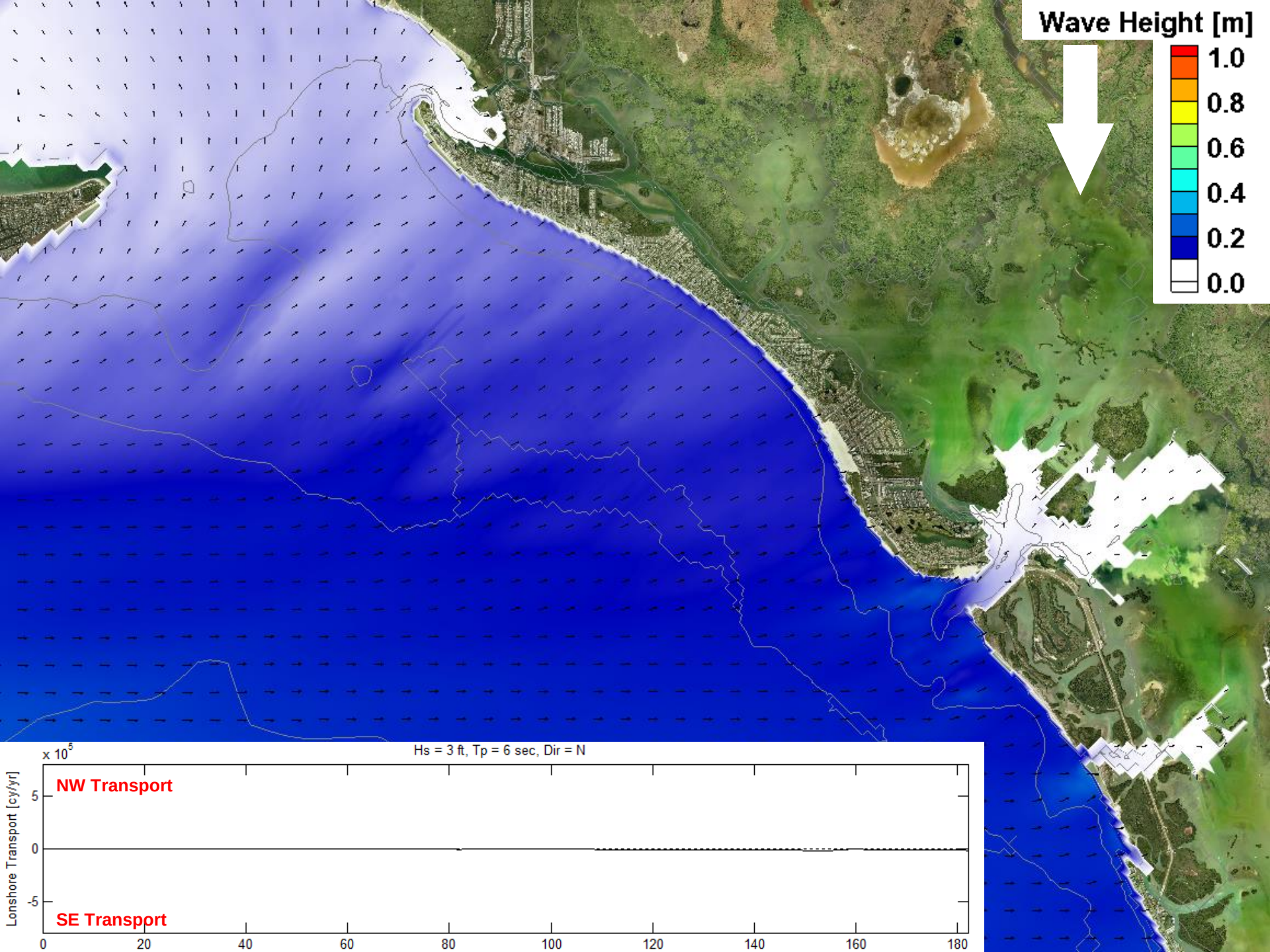
Date	Volume [cy]	Project	Placement
2/1961 to 3/1961	265,000	MP Dredge & BN	R-178.2 to R-180.5
8/1961 to 11/1961	52,000	MP Dredge & BN	R-178.2 to R-180.5
1972	110,000	MP Dredge & BN	R-178.2 to R-180.5
11/1979 to 4/1980	192,000	MP Dredge & BN	R-178.2 to R-180.5
10/1982 to 10/1983	71,000	MP Dredge & BN	R-178.2 to R-180.5
11/1985 to 6/1986	96,000	MP Dredge & BN	R-178.2 to R-180.5
4/1996 to 5/1996	188,712	MP Dredge & BN	R-179.1 to R-183.7
2001	187,800	MP Dredge & BN	R-178.2 to R-185.5
2009	229,313	MP Dredge & Nearshore Placement	R-182 to R-187A
2011	402,805	Offshore Dredge & BN	R-174.6 to R-181.5

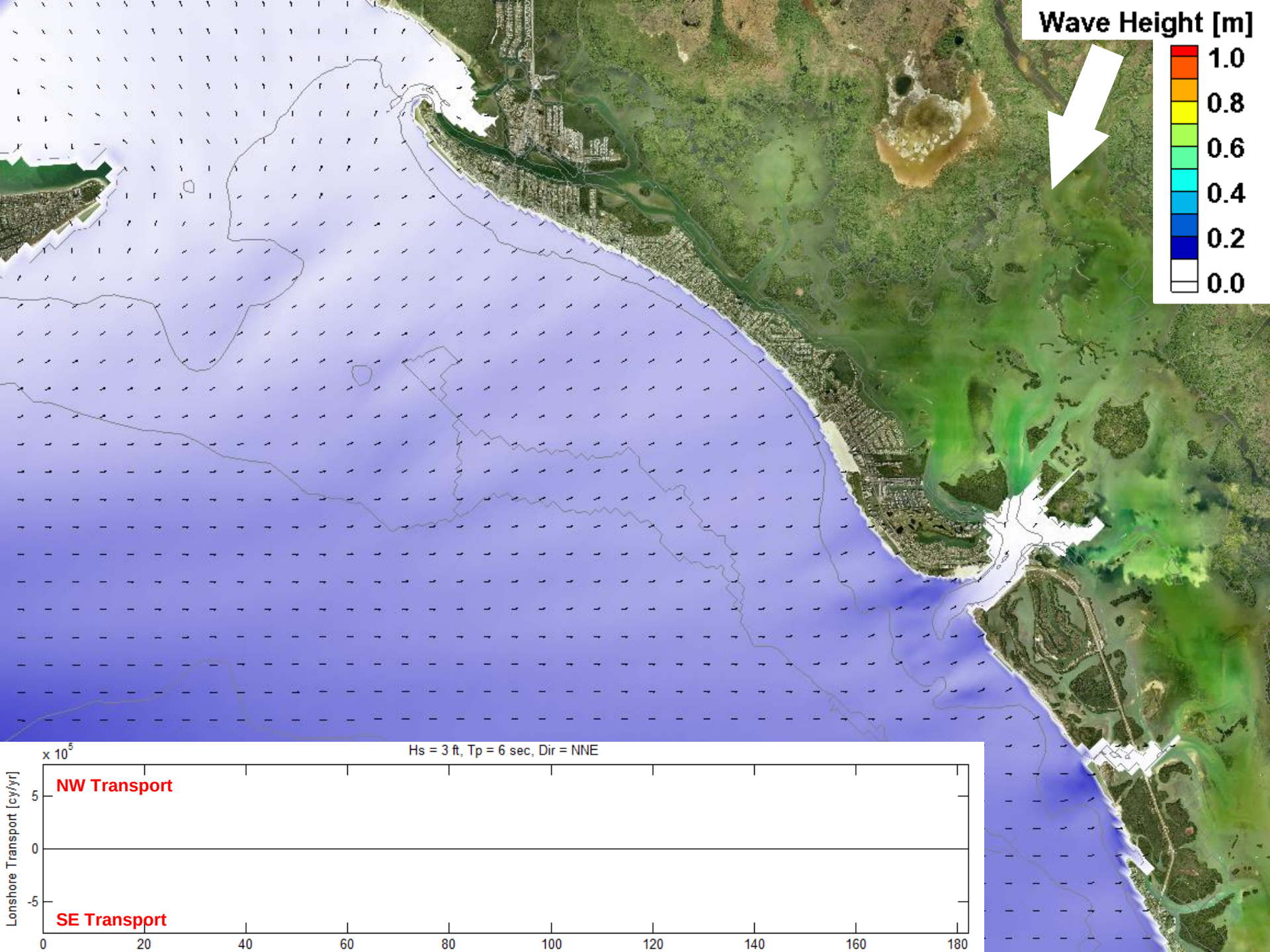
Wind and Waves



Coastal Processes Extremes

Return Period [yrs]	Water Level at Naples [ft NAVD88]	Wind Speed [mph]	Wave Height [ft]
1	2.1	34	5.0
2	2.4	38	5.4
5	3.2	84 (Cat1)	5.9
10	4.1	103 (Cat2)	6.2
20	5.3	126 (Cat3)	6.4
25	5.7	133	6.5
50	7.2	148 (Cat4)	6.8


Wave Height [m]
1.0
0.8
0.6
0.4
0.2
0.0
Hs = 3 ft, Tp = 6 sec, Dir = N
x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
5
0
-5
0
20
40
60
80
100
120
140
160
180


Wave Height [m]
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0.8
0.6
0.4
0.2
0.0
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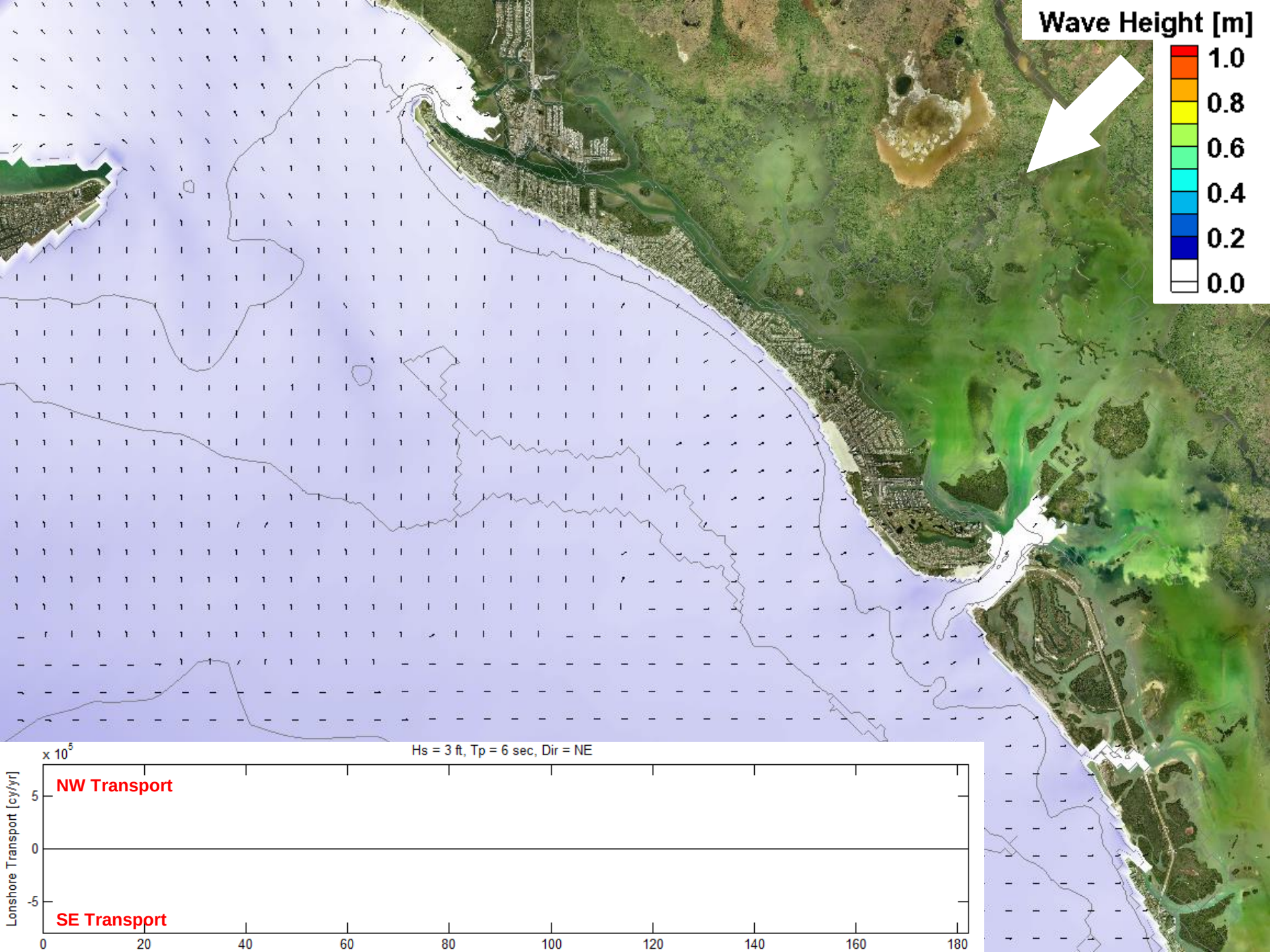
x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
5
0
-5
0
20
40
60
80
100
120
140
160
180


Wave Height [m]
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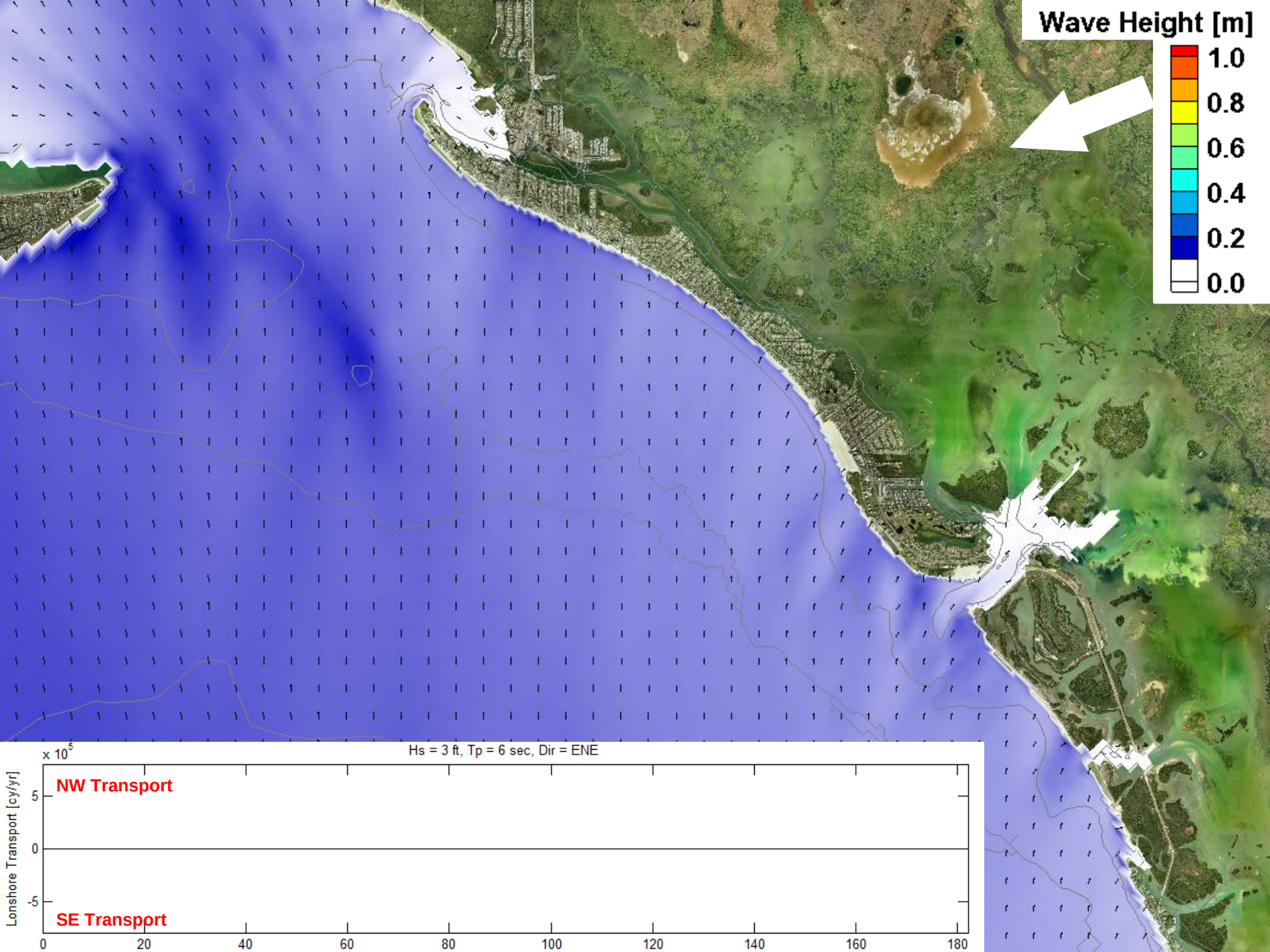
0.8
0.6
0.4
0.2
0.0
Hs = 3 ft, Tp = 6 sec, Dir = NE
x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
5
0
-5
0
20
40
60
80
100
120
140
160
180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0.6
0.4
0.2
0.0
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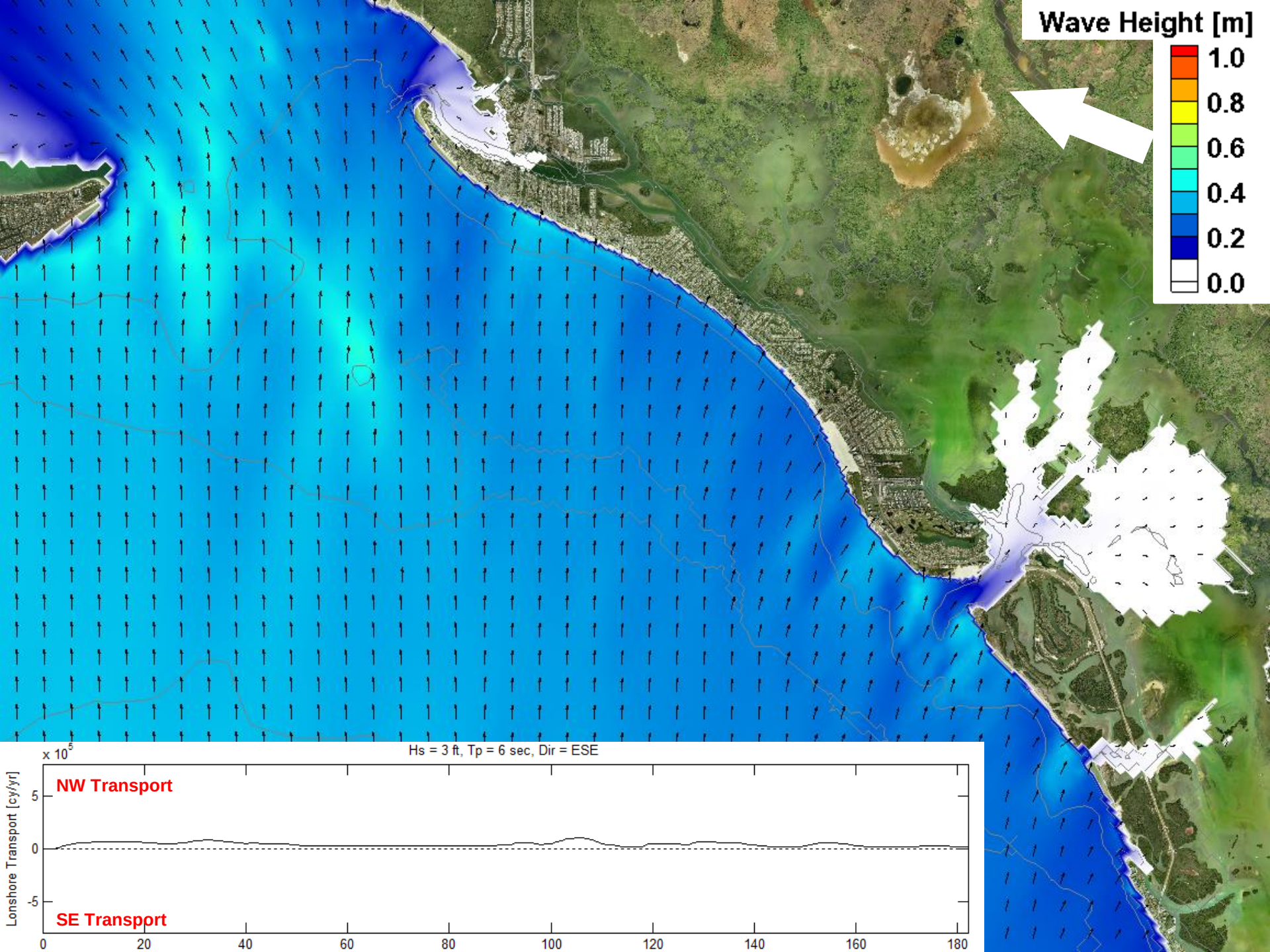
x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
5
0
-5
0
20
40
60
80
100
120
140
160
180


Wave Height [m]
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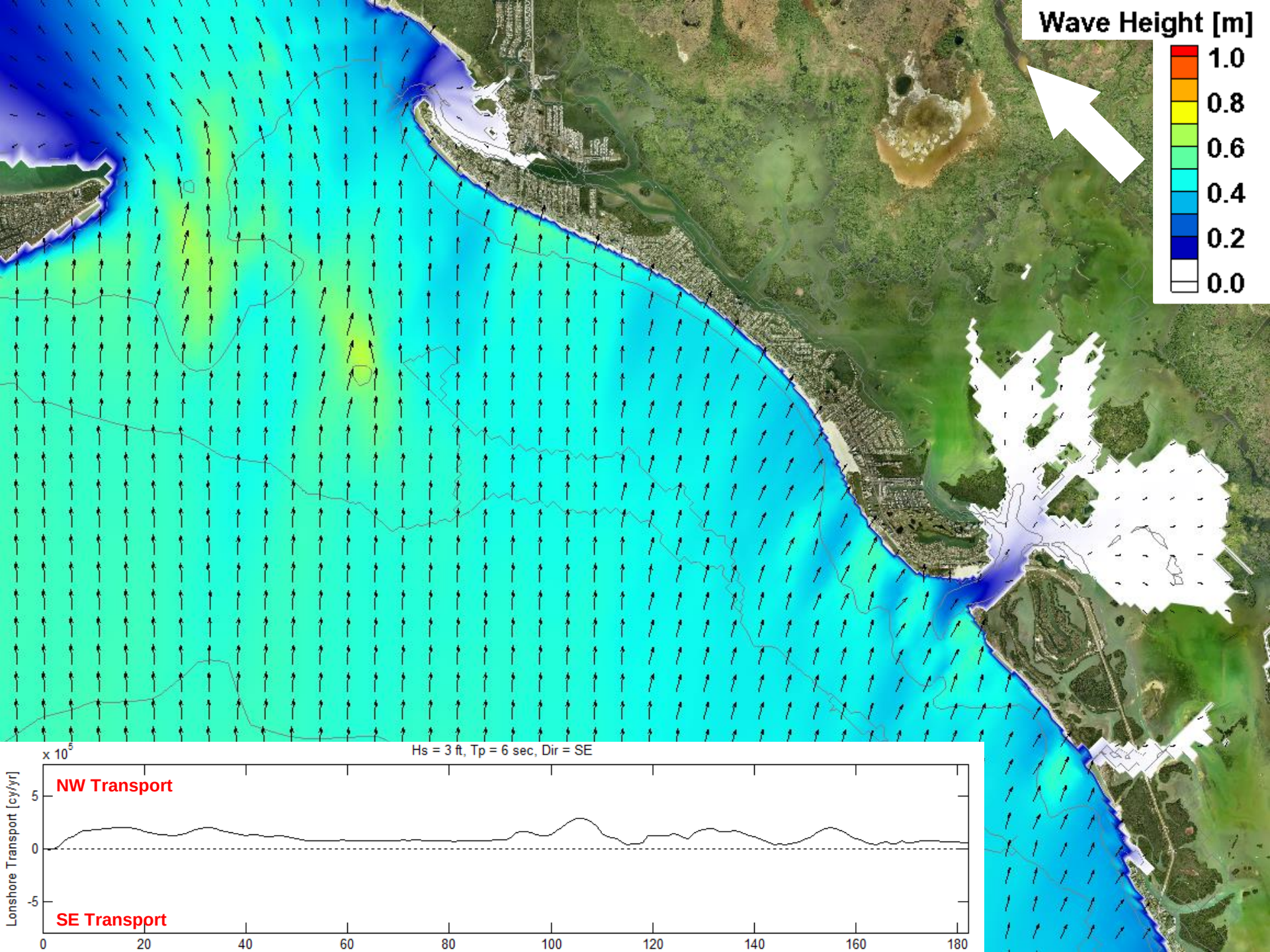
0.8
0.6
0.4
0.2
0.0
Hs = 3 ft, Tp = 6 sec, Dir = ESE
x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
5
0
-5
0
20
40
60
80
100
120
140
160
180


Wave Height [m]
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0.6
0.4
0.2
0.0
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x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
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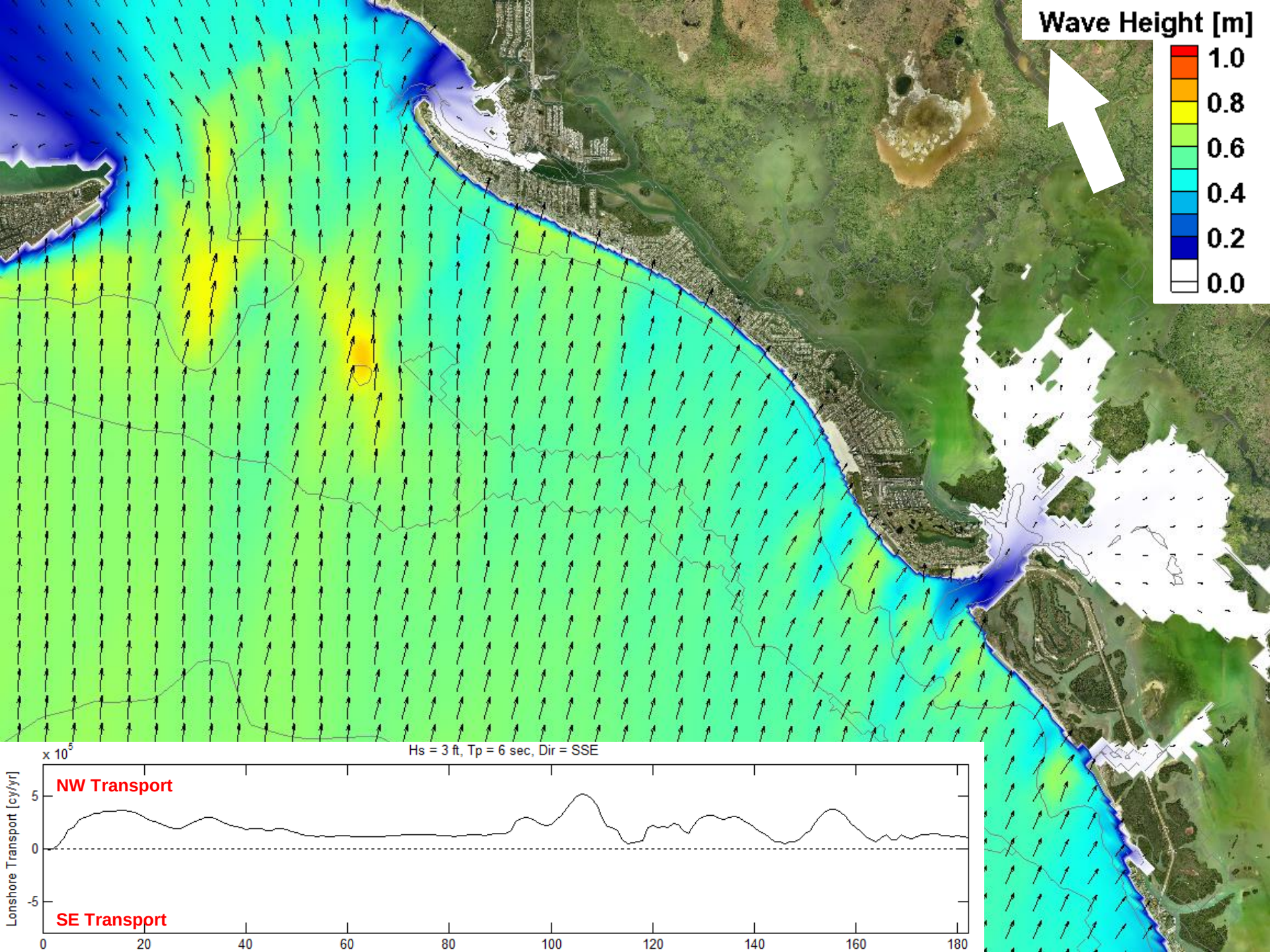
0
-5
0
20
40
60
80
100
120
140
160
180


Wave Height [m]
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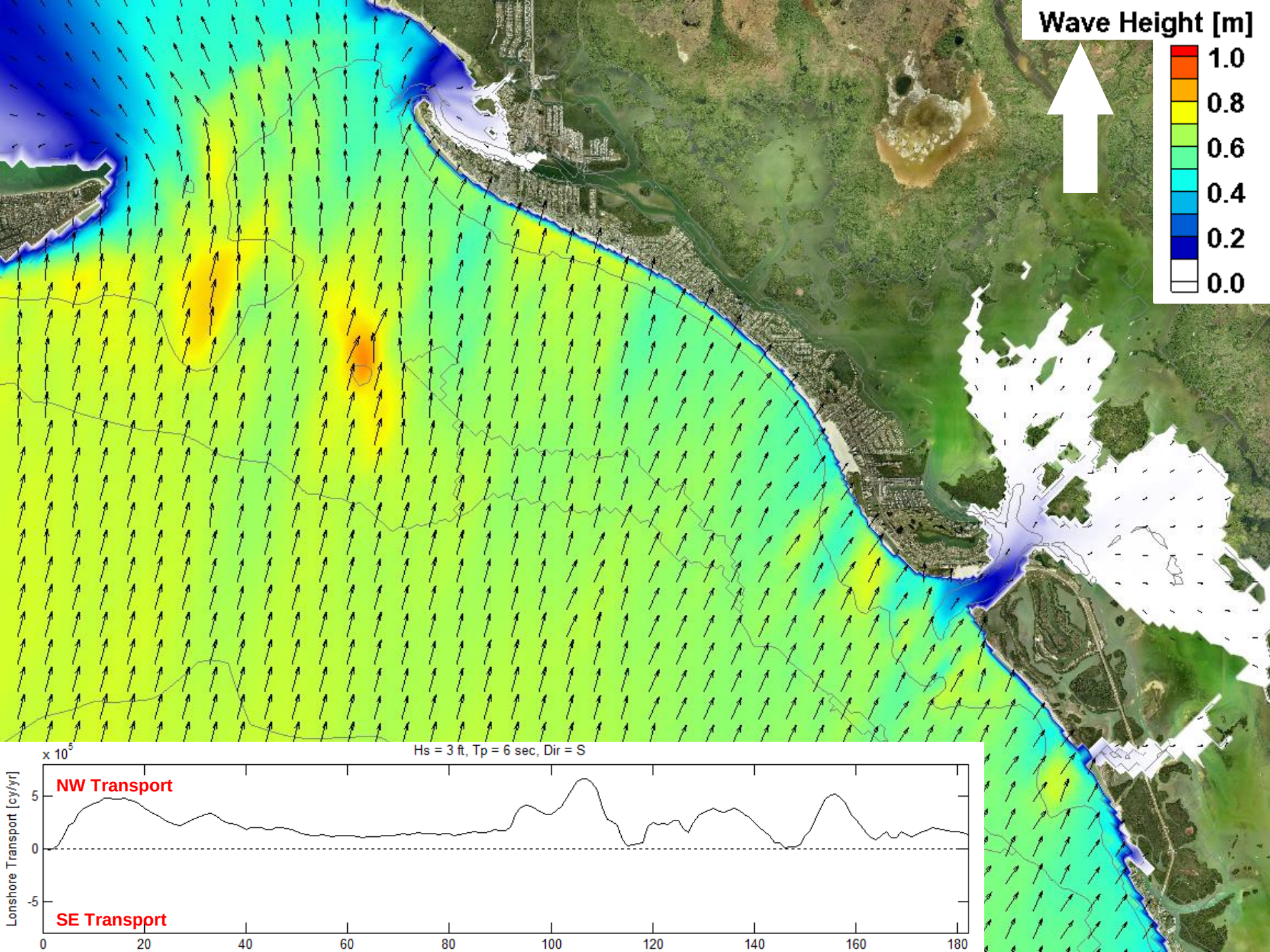
0.8
0.6
0.4
0.2
0.0
Hs = 3 ft, Tp = 6 sec, Dir = SSE
x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
5
0
-5
0
20
40
60
80
100
120
140
160
180


Wave Height [m]
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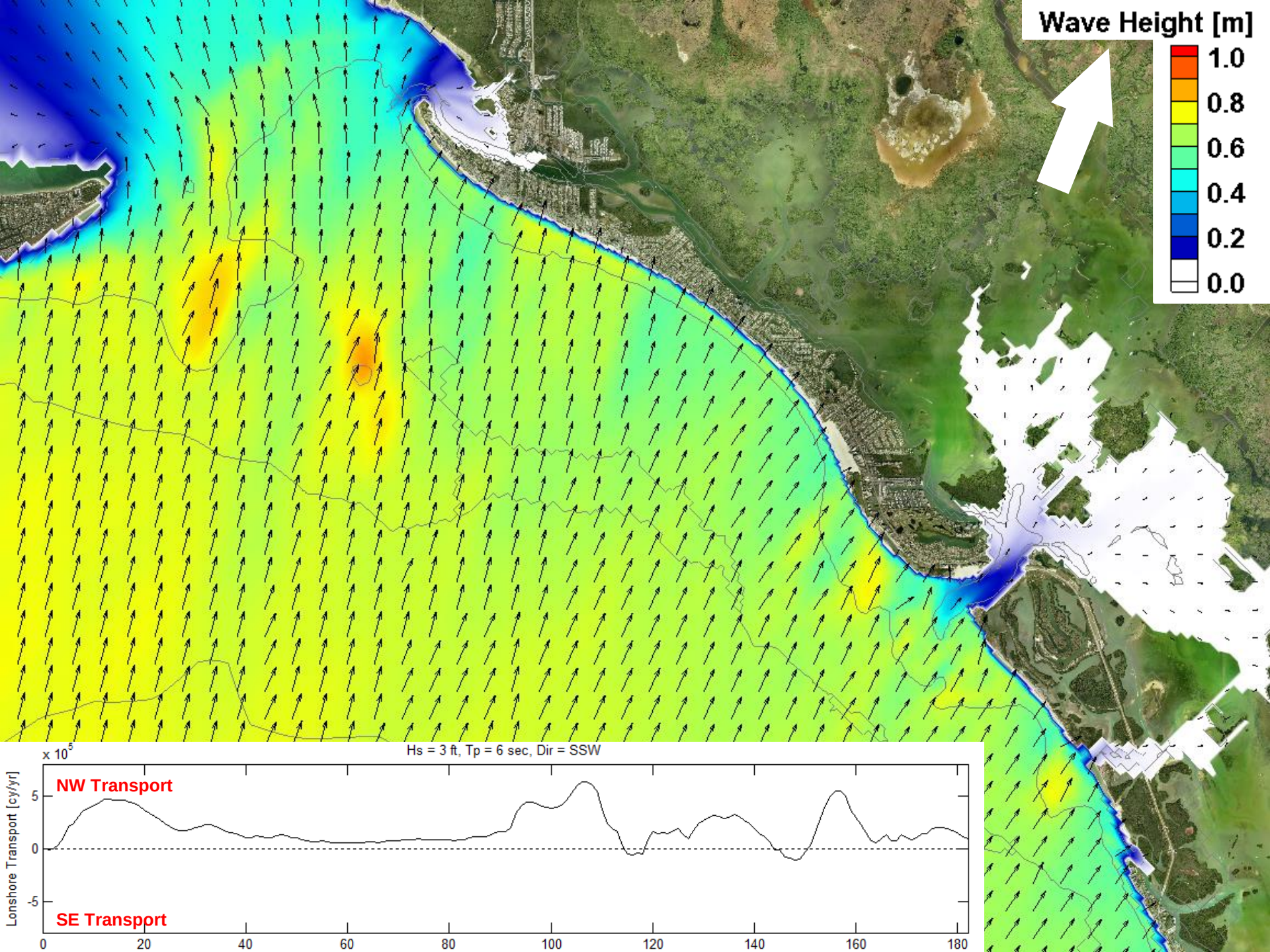
0.8
0.6
0.4
0.2
0.0
Hs = 3 ft, Tp = 6 sec, Dir = S
x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
5
0
-5
0
20
40
60
80
100
120
140
160
180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0.6
0.4
0.2
0.0
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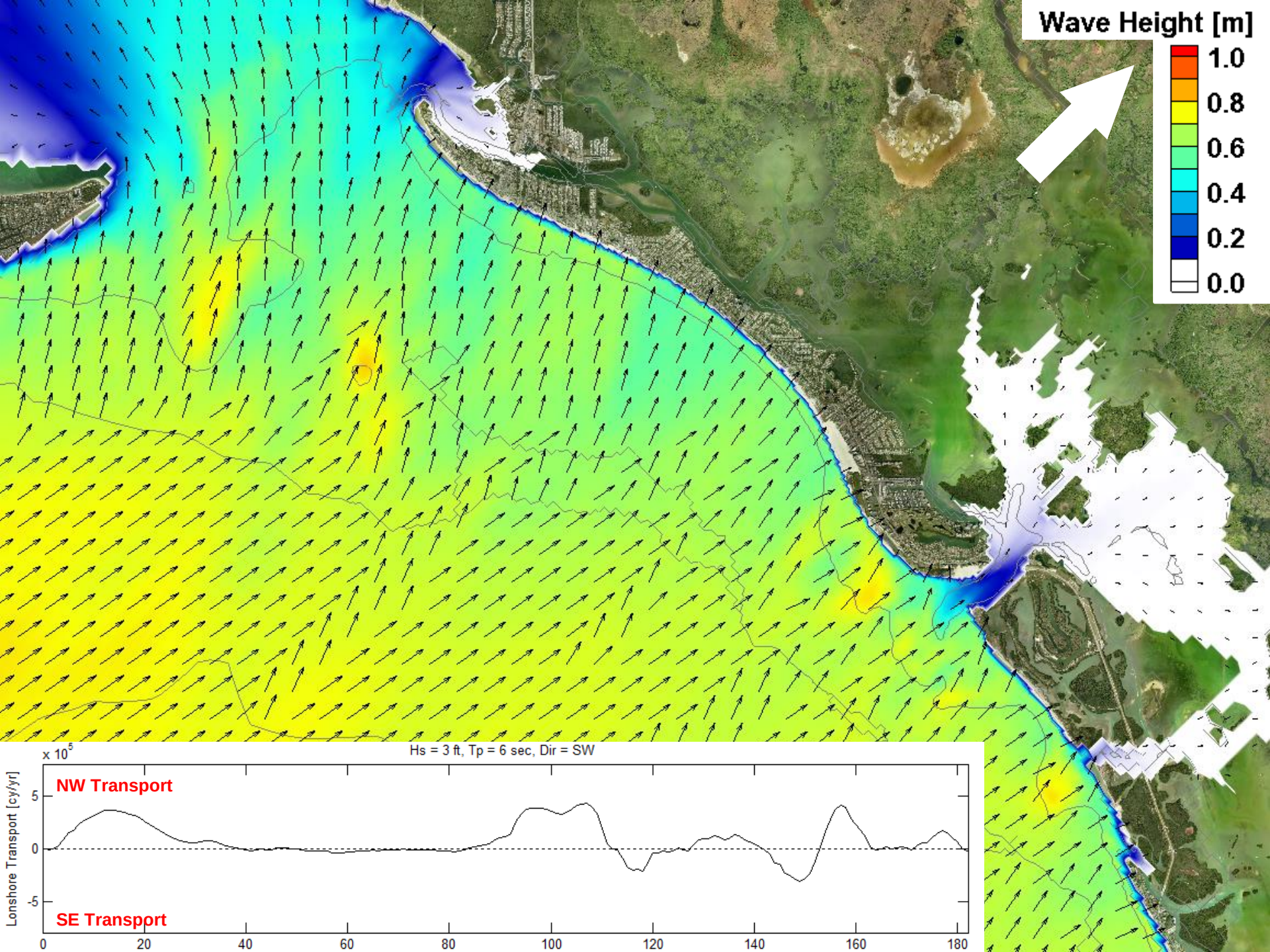
x 10^5
Lonshore Transport [cy/yr]
NW Transport
SE Transport
5
0
-5
0
20
40
60
80
100
120
140
160
180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0.4
0.2
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x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
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0
-5
0
20
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60
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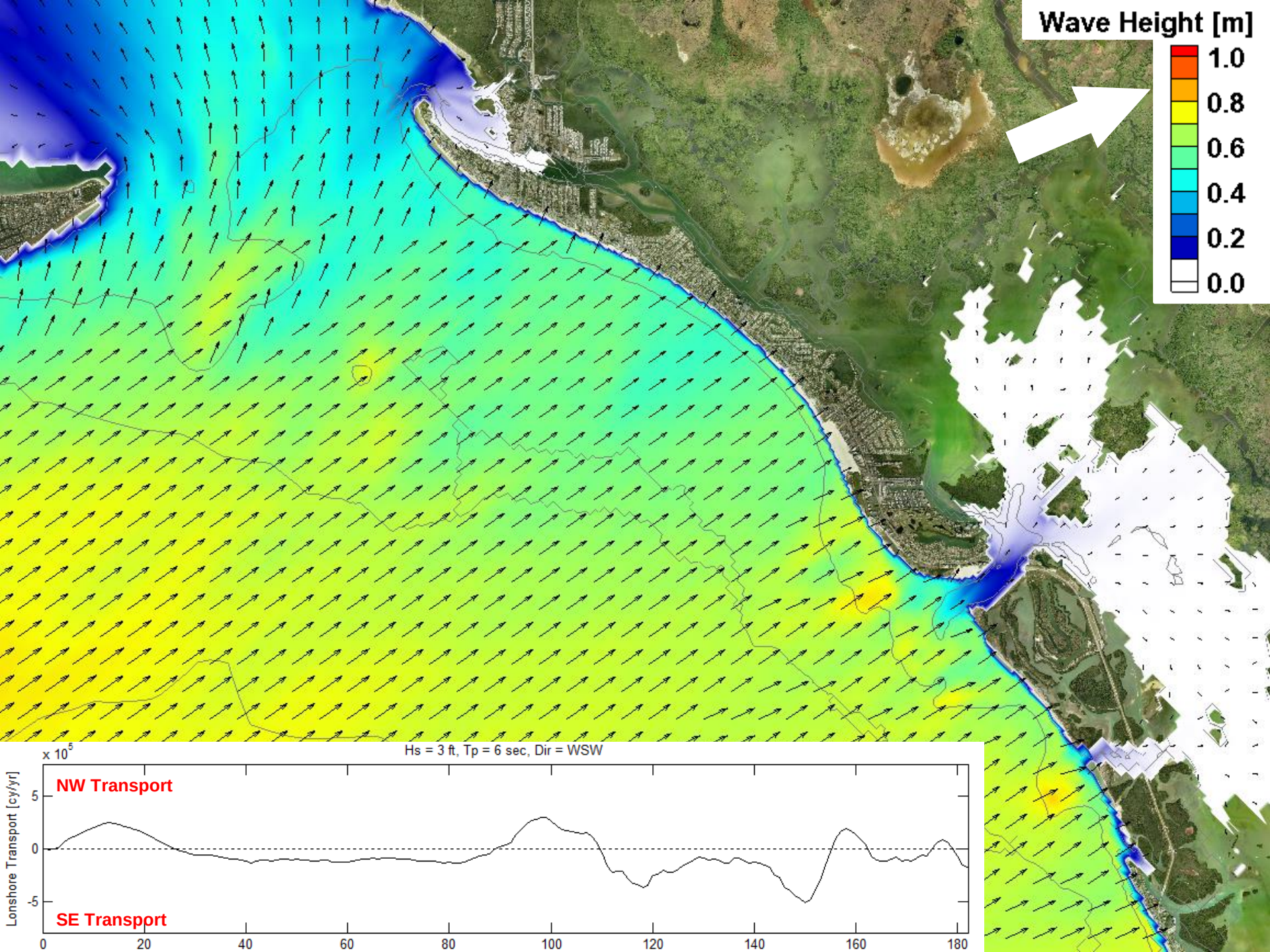
100
120
140
160
180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0.4
0.2
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x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
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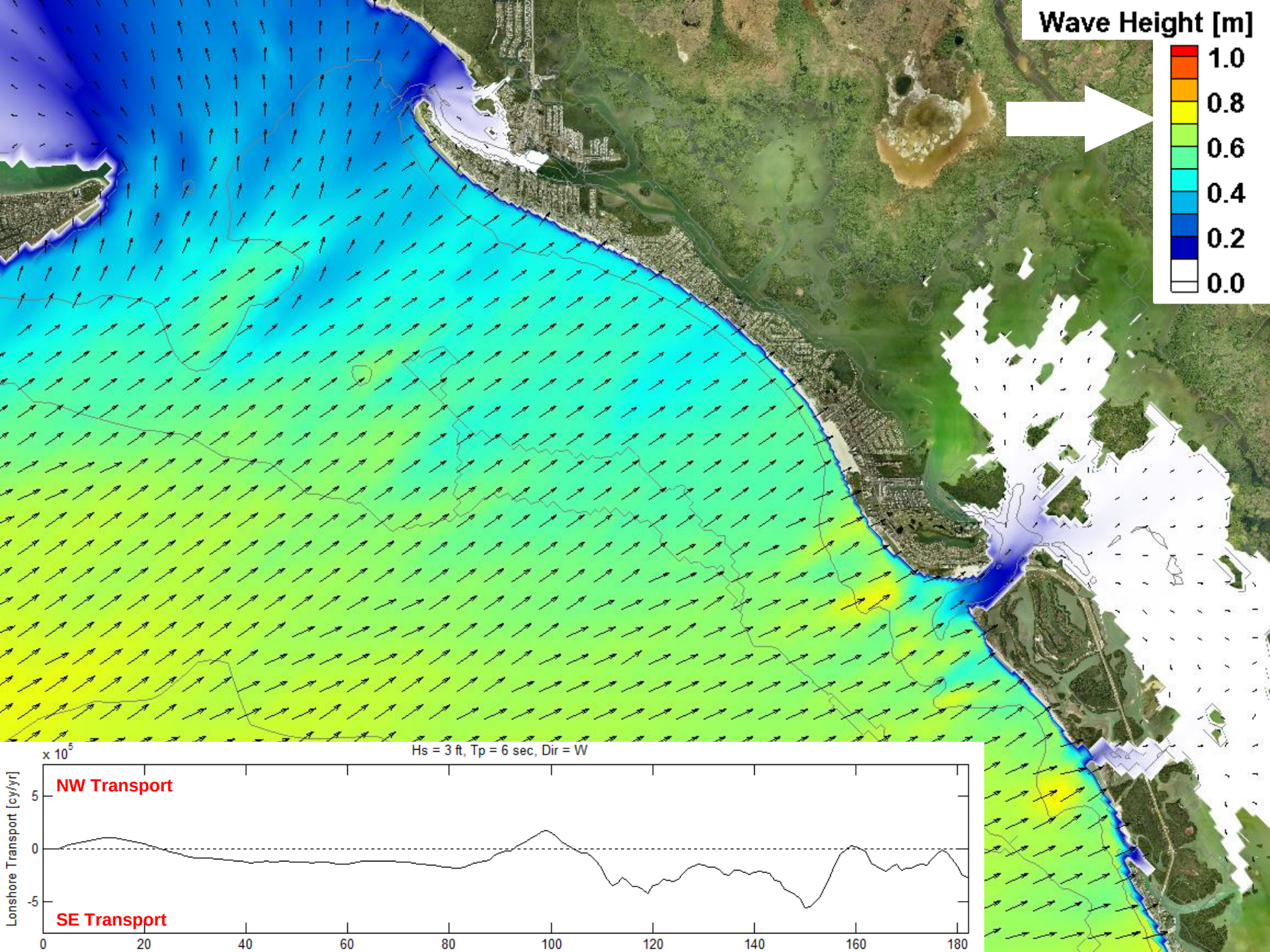
0
-5
0
20
40
60
80
100
120
140
160
180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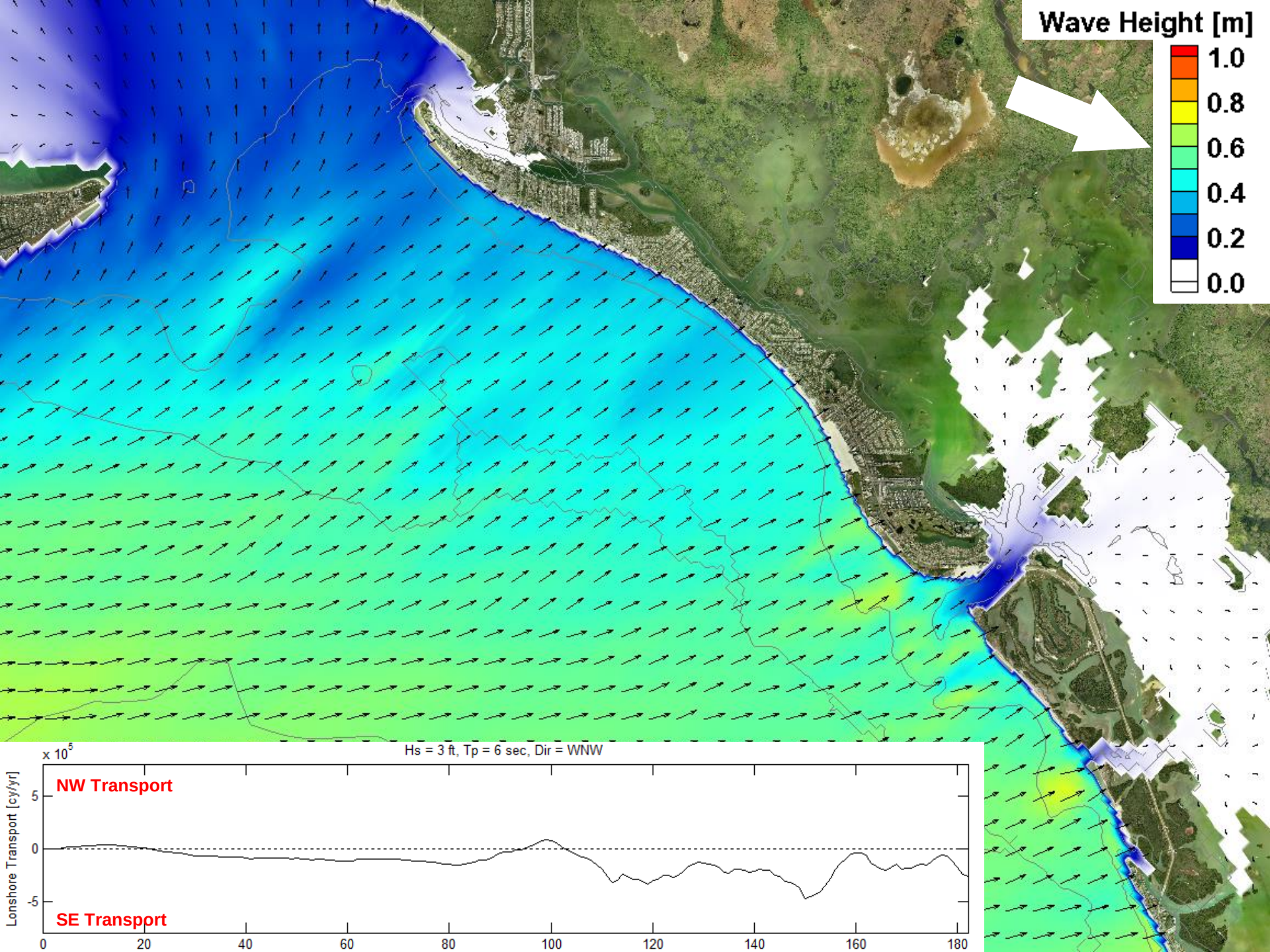
0.8
0.6
0.4
0.2
0.0
Hs = 3 ft, Tp = 6 sec, Dir = W
x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
5
0
-5
0
20
40
60
80
100
120
140
160
180


Wave Height [m]
1.0
0.8
0.6
0.4
0.2
0.0
Hs = 3 ft, Tp = 6 sec, Dir = WNW
x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
5
0
-5
0
20
40
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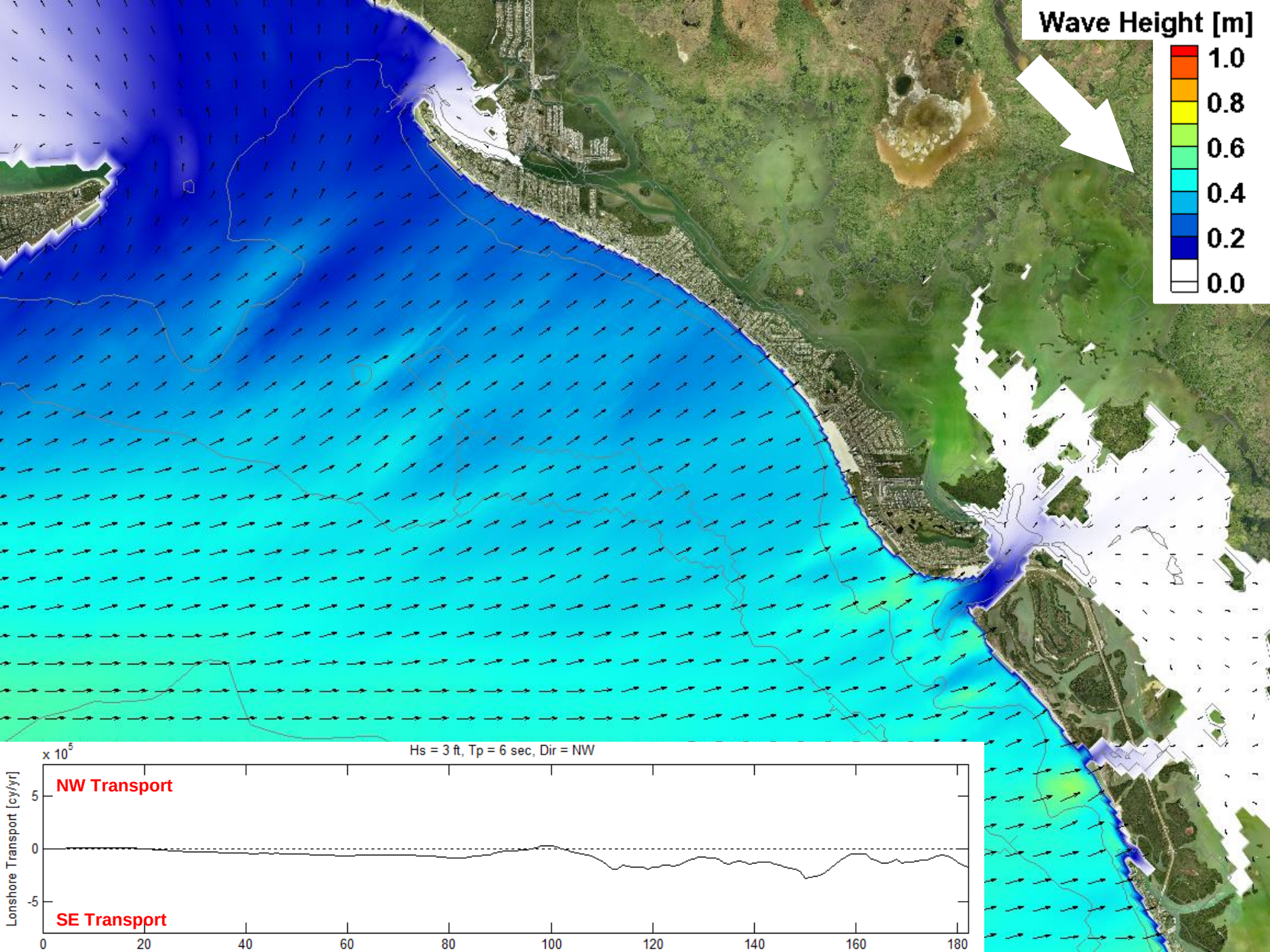
100
120
140
160
180


Wave Height [m]
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0.8
0.6
0.4
0.2
0.0
Hs = 3 ft, Tp = 6 sec, Dir = NW
x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
5
0
-5
0
20
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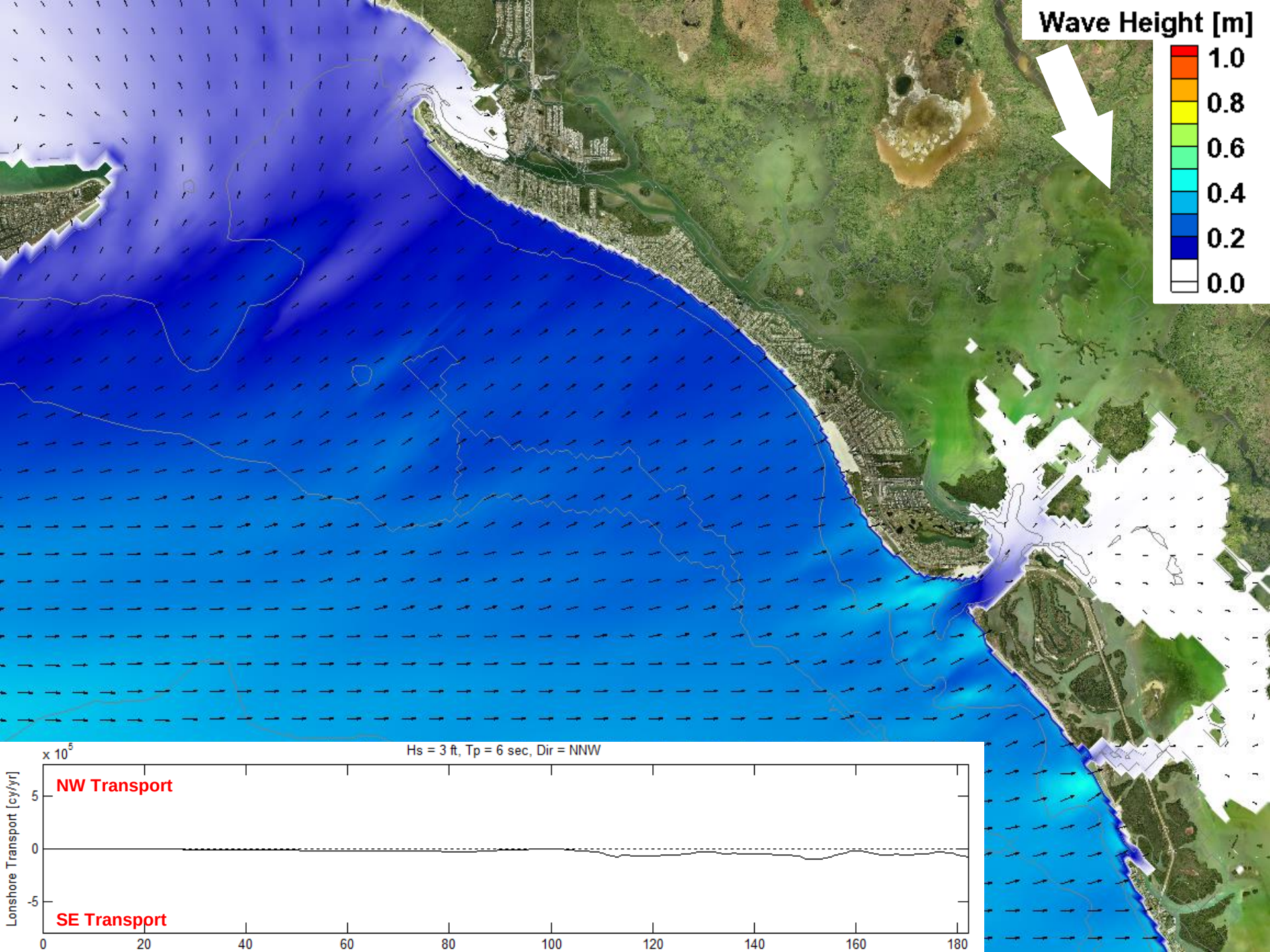
80
100
120
140
160
180


Wave Height [m]
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0.8
0.6
0.4
0.2
0.0
Hs = 3 ft, Tp = 6 sec, Dir = NNW
x 10^5
NW Transport
SE Transport
Lonshore Transport [cy/yr]
5
0
-5
0
20
40
60
80
100
120
140
160
180

Existing Data: Aerial Photos

YEAR	Exact Date	Source	Coverage
1944	4/13/1944	NARA	ALL
1953	unknown	Lee County	ALL
1953	2/9/1953	NARA	ALL
1958	1/18/1958	USDA	north and south
1958	3/15/1958	USDA	central
1968	11/22/1968	Lee County	ALL
1968	3/18/1968	FDOT	ALL
1970	2/14/1970	USDA	north
1970	2/26/1970	USDA	South
1972	3/9/1972	Lee County	ALL
1972	3/3/1972	FDOT	ALL
1975	10/22/1975	Lee County	ALL
1975	10/22/1975	FDOT	South
1975	10/24/1975	FDOT	North and Central
1977	4/9/1977	USDA	ALL
1979	3/7/1979	Lee County	ALL
1979	3/7/1979	FDOT	Central and South
1979	3/13/1979	FDOT	North
1980	12/13/1980	USDA	ALL
1985	3/3/1985	USDA	ALL
1986	2/26/1986	Lee County	ALL
1986	2/25/1986	FDOT	ALL
1990	1/14/1990	Lee County	ALL
1990	1/14/1990	FDOT	ALL
1994	3/15/1994	USDA	North
1995	**1/27/1995**	**USDA**	**South**
1996	2/5/1996	Lee County	ALL
1996	2/5/1996	FDOT	North and Central
1996	3/13/1996	FDOT	Central and South
2002	4/1/2002	Lee County	ALL
2004	**unknown**	**Lee County**	**Partial (Estero)**
2005	**1/18/2005**	**Lee County**	**ALL**
2007	**8/22/07 - 11/11/07**	**Lee County**	**ALL**
2008	1/1/2008	Lee County	ALL
2011	**unknown**	**Lee County**	**ALL**

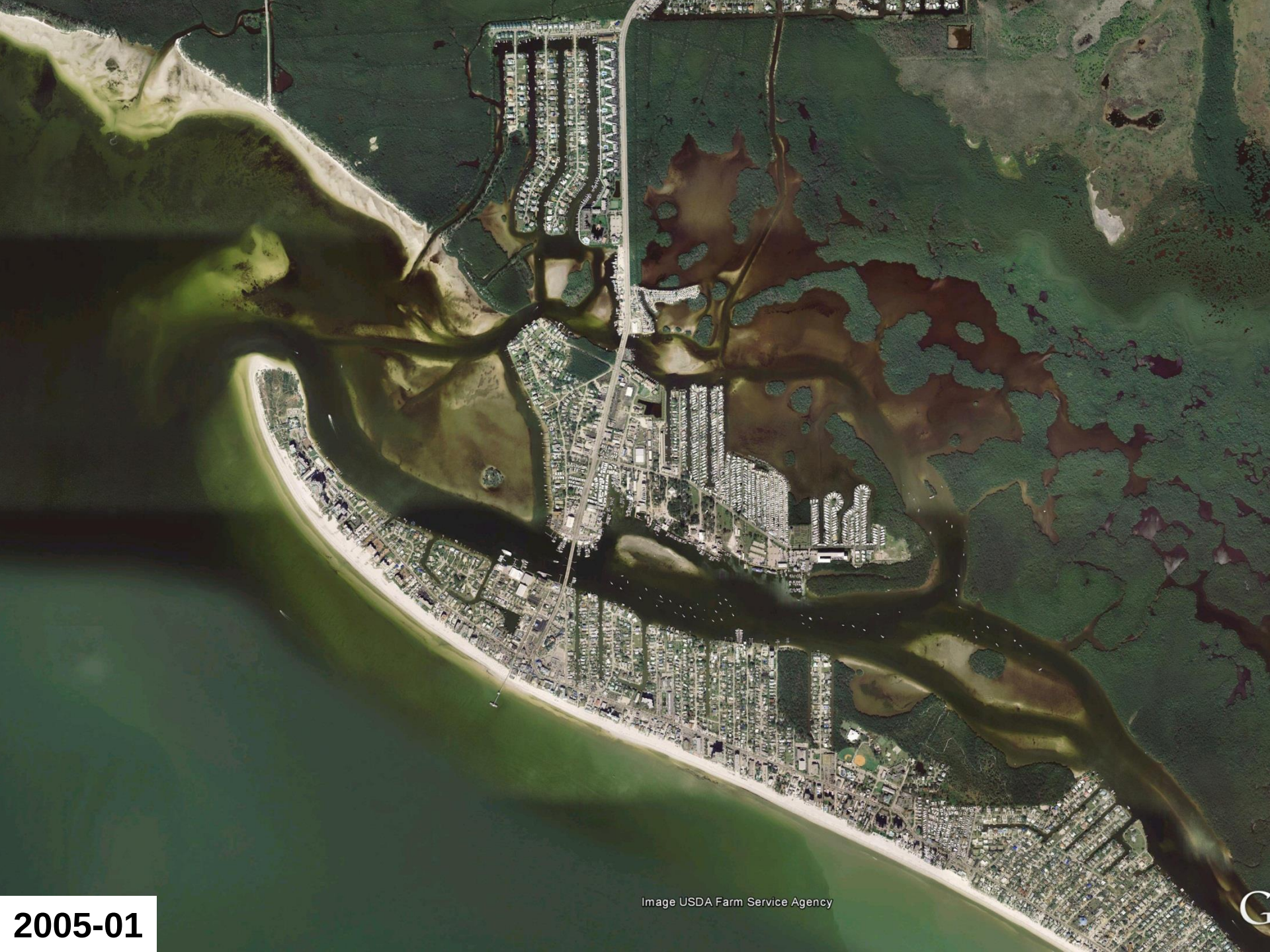
1953

1995-01

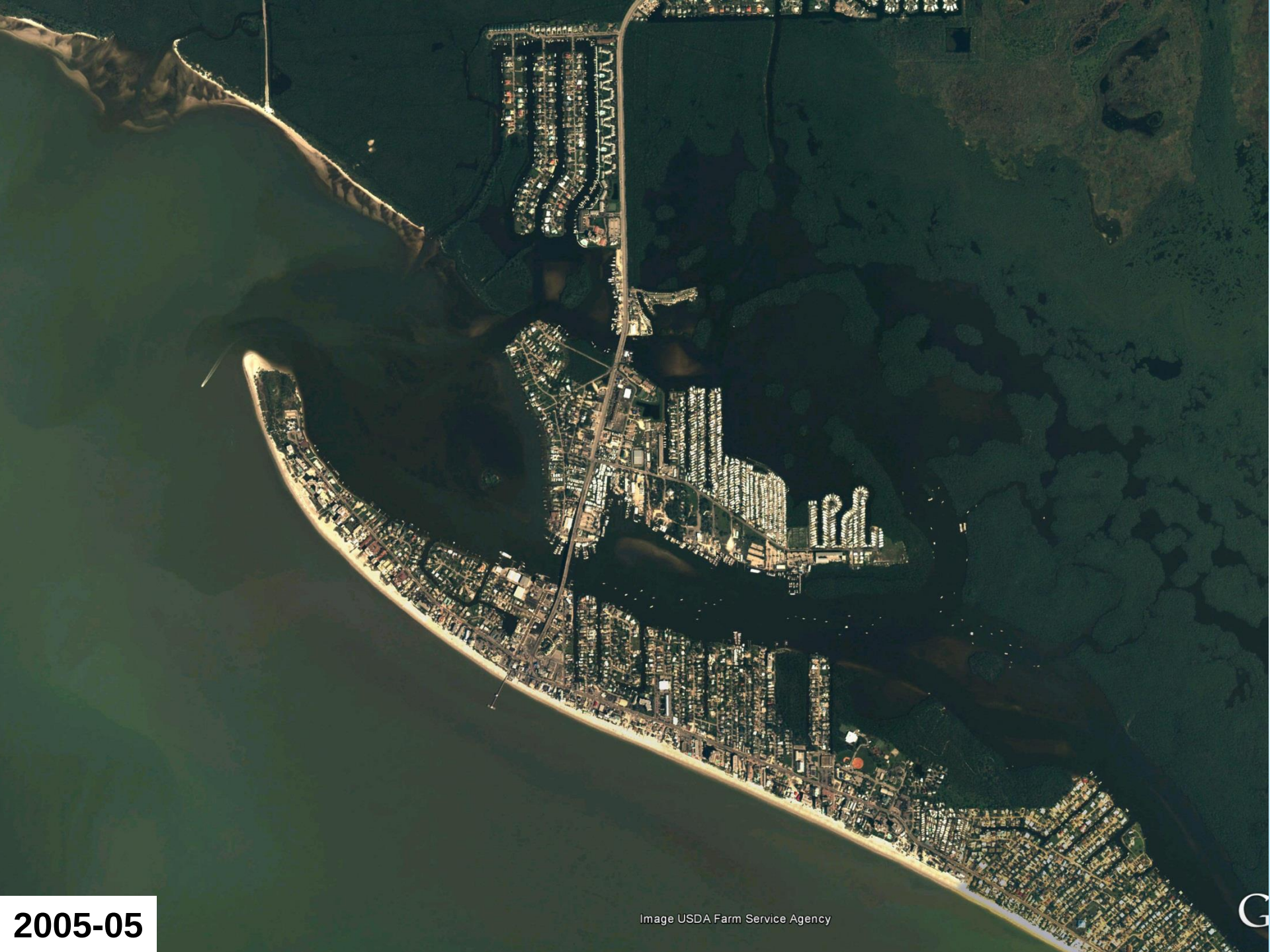
1999-01

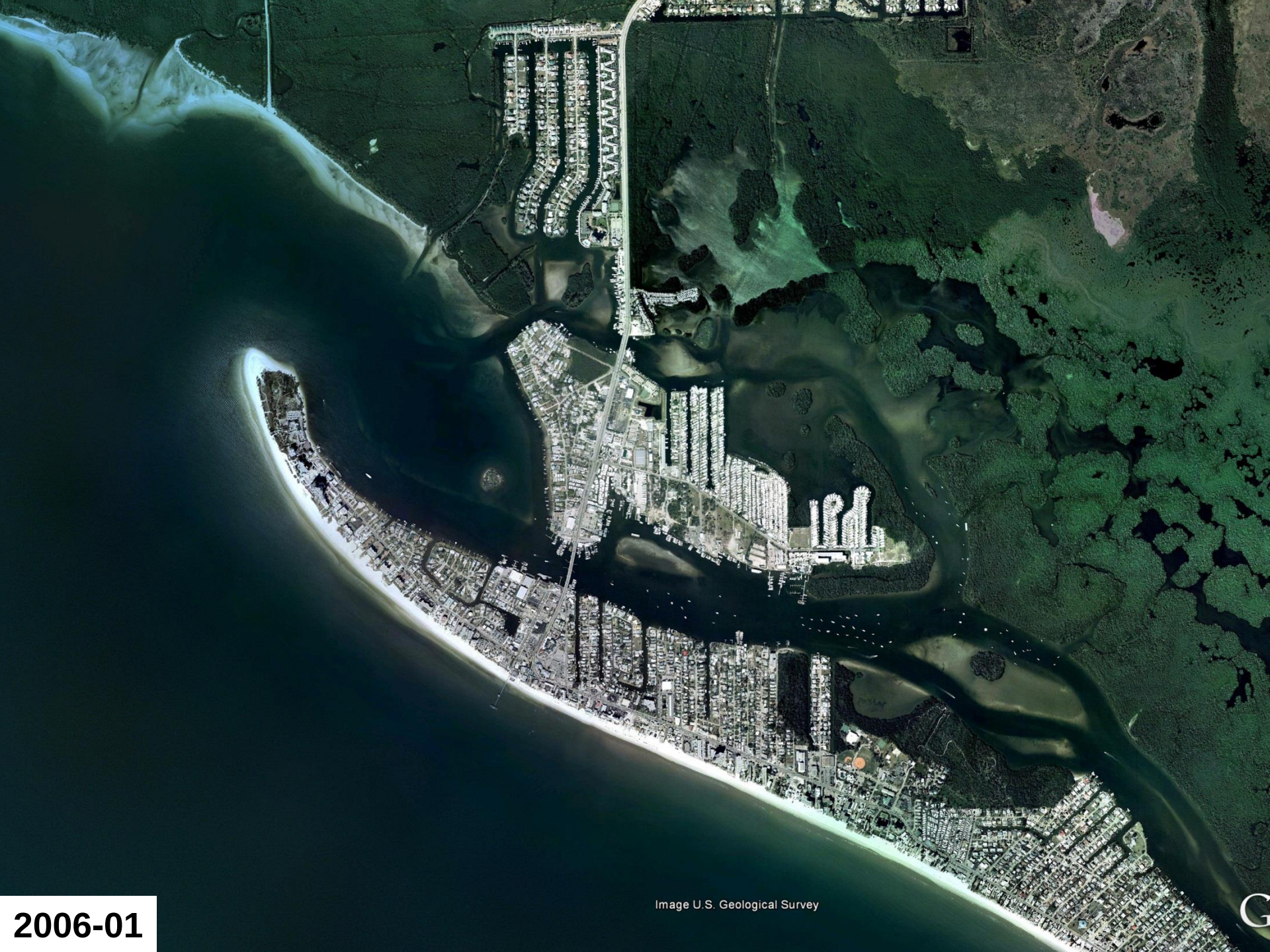

Image © 2012 The Florida Department of Environmental Protection

2004-01

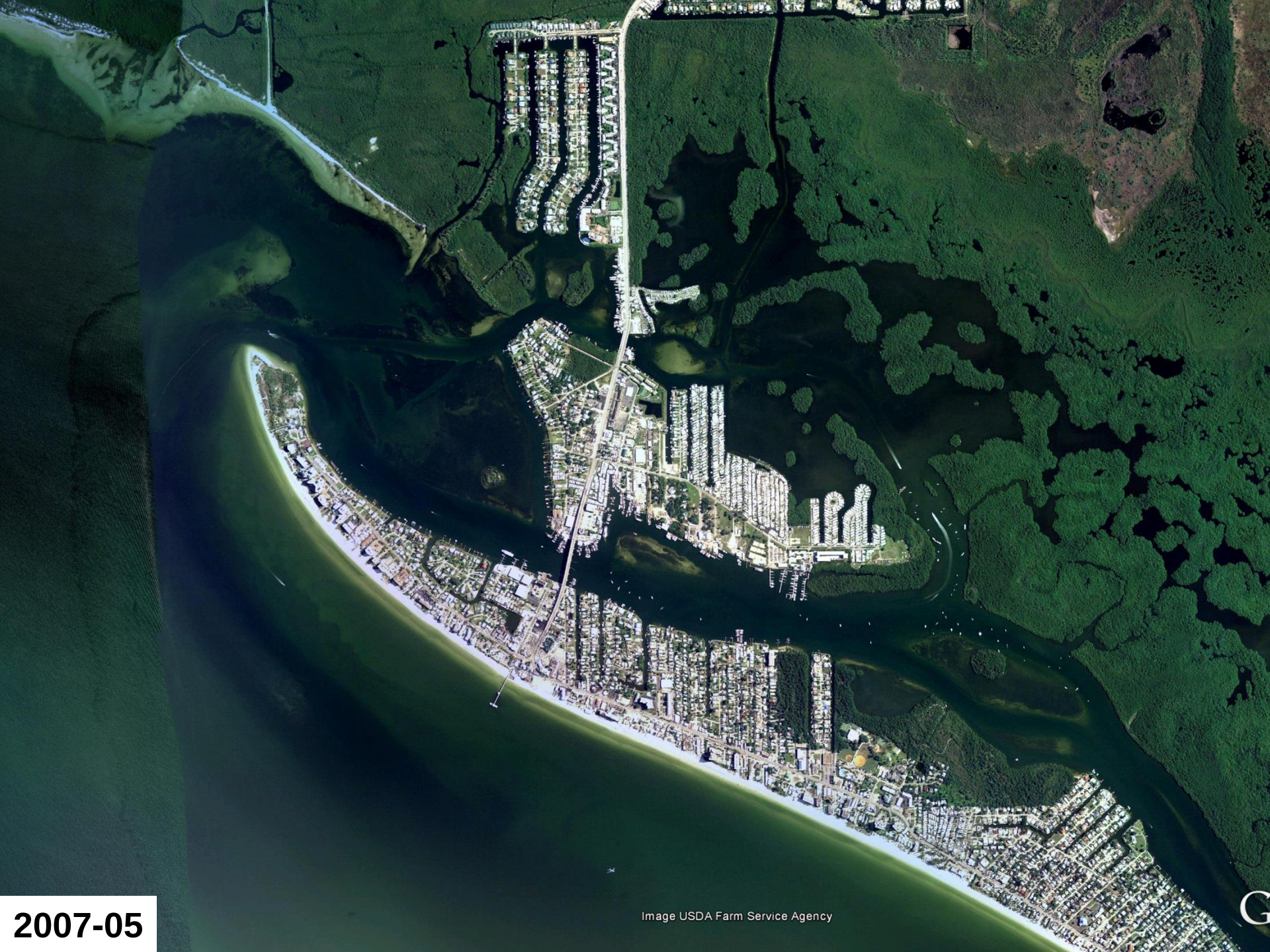


2005-01


2005-05
Image USDA Farm Service Agency



2006-01


2007-05
Image USDA Farm Service Agency

2007-12


2010-04


2012-04

Pre-Nourishment Construction

2010-04

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Post-Nourishment Construction

2012-04

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1953

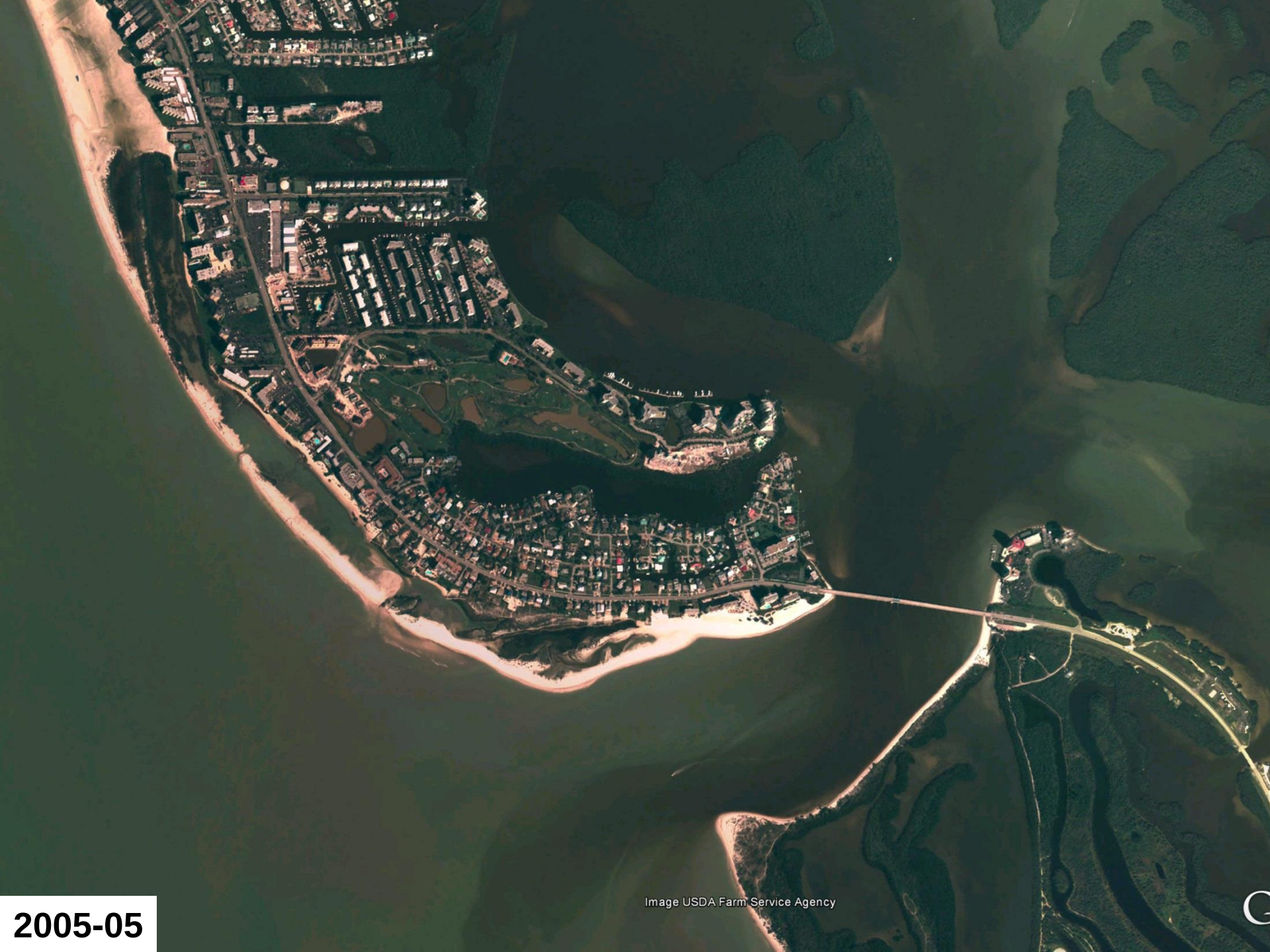
1995-01

1999-01


Image © 2012 The Florida Department of Environmental Protection

2004-01


2005-01
Image USDA Farm Service Agency



2005-05

2006-01

2007-08

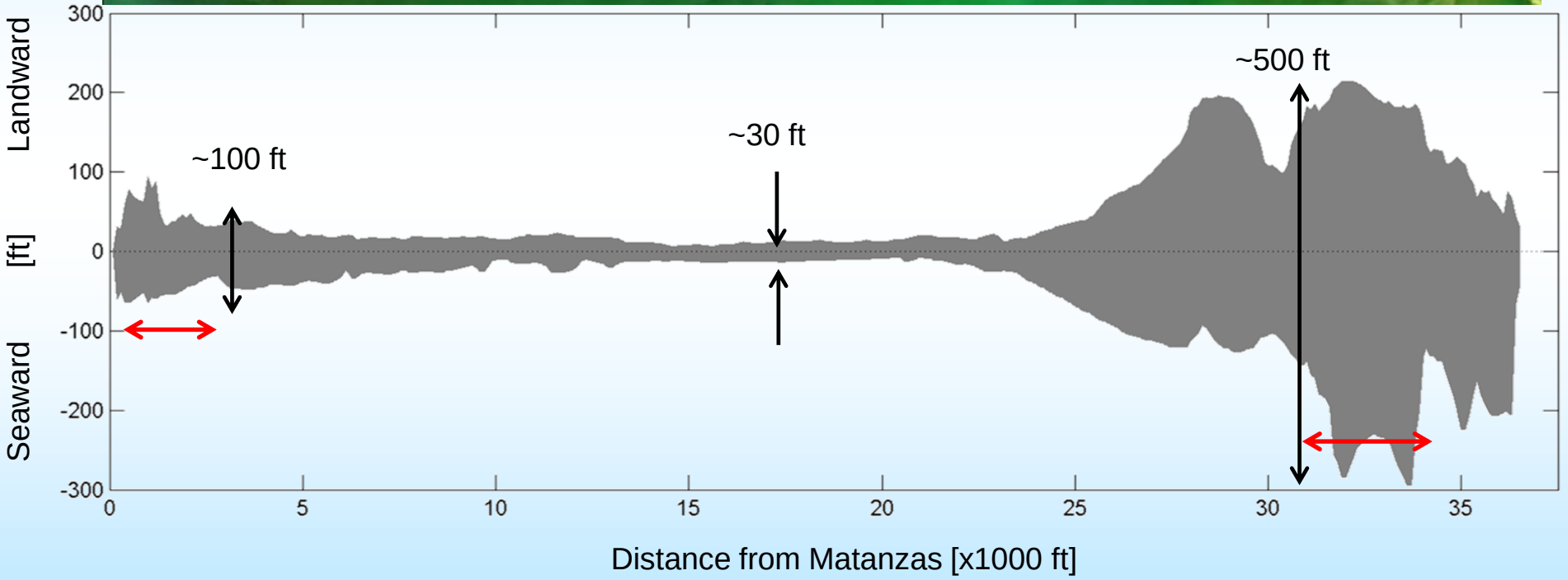
2007-12

2009-01

2010-04

2012-04

Shoreline Positions



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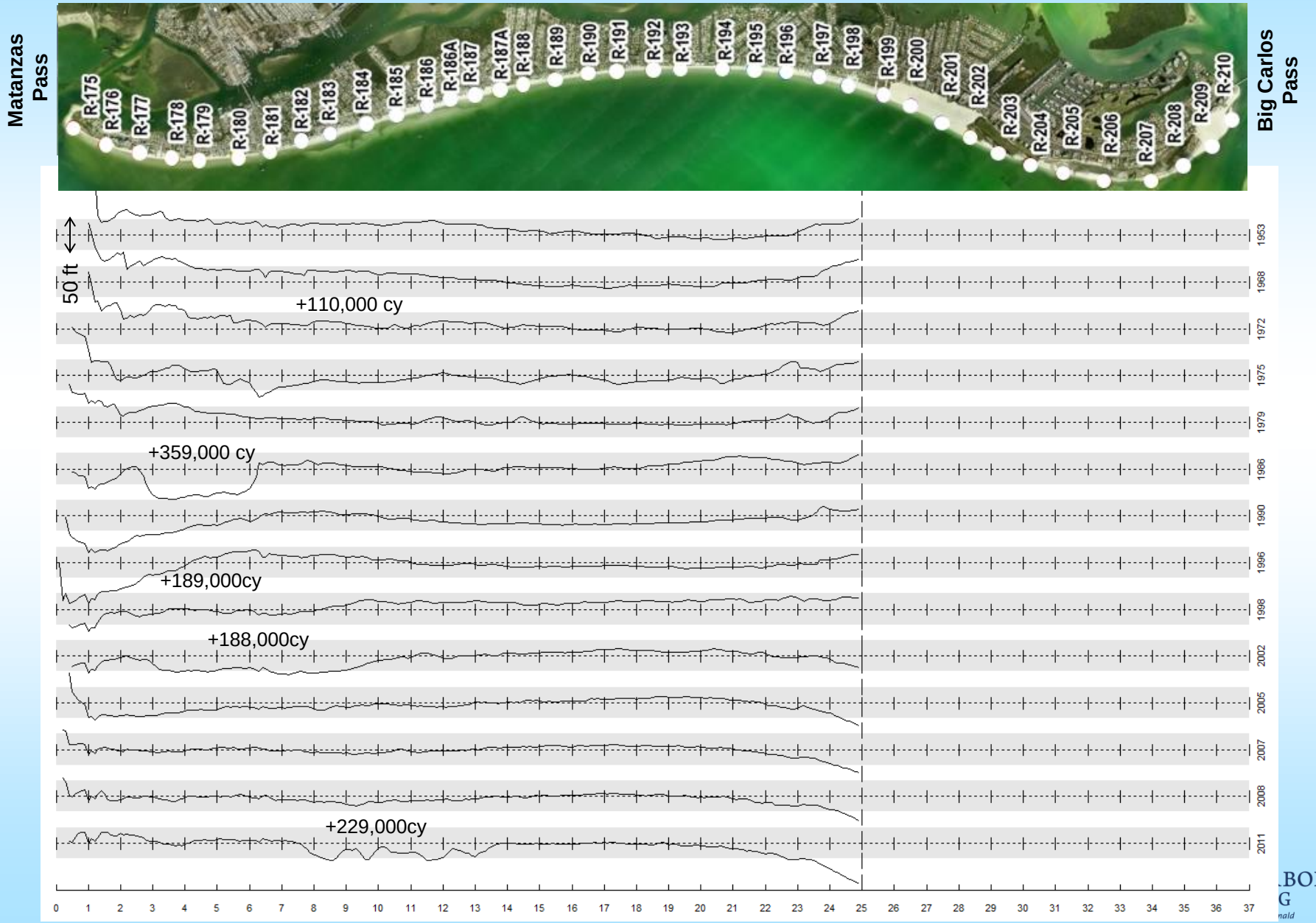
Shoreline Positions

Shoreline Positions



Shoreline Change Rate

2000 to Present

Erosion Rate [FT/YR]

- -20 +
- -15 to -20
- -10 to -15
- -8 to -10
- -6 to -8
- -4 to -6
- -2 to -4
- -1 to -2
- 0
- +1 to +2
- +2 to +4
- +4 to +6
- +6 to +8
- +8 to +10
- +10 to +15
- +15 to +20
- +20 +

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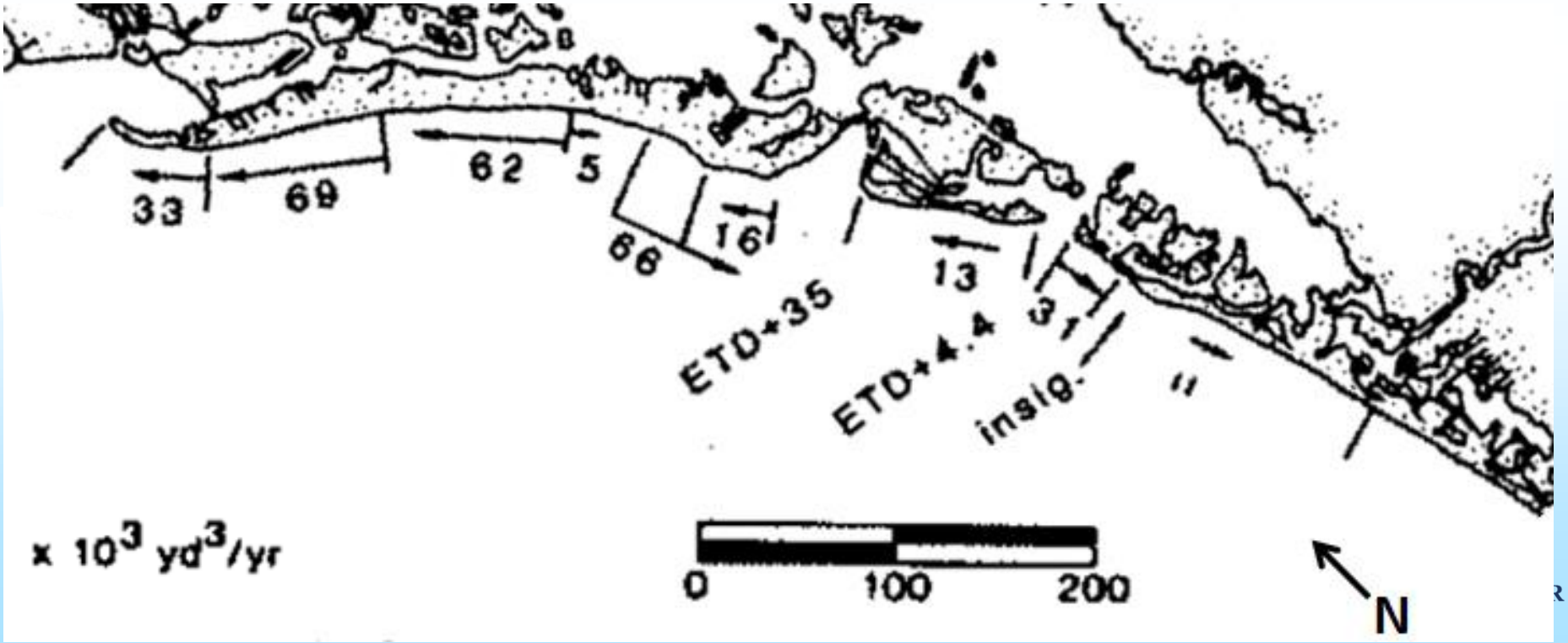
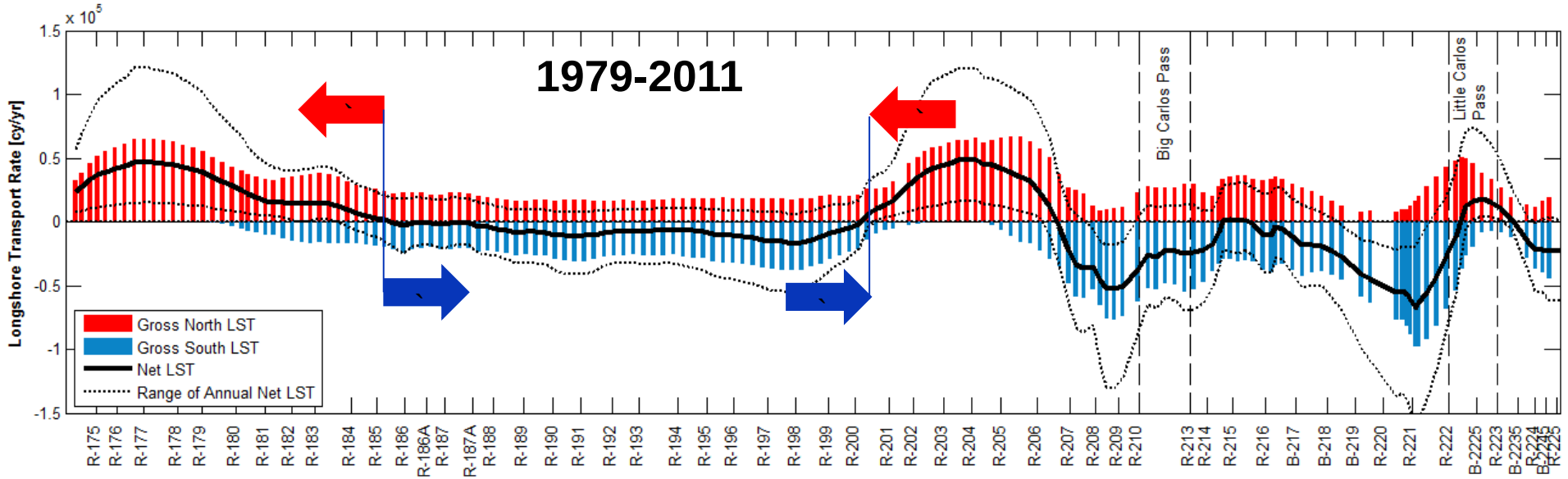
Longshore Transport

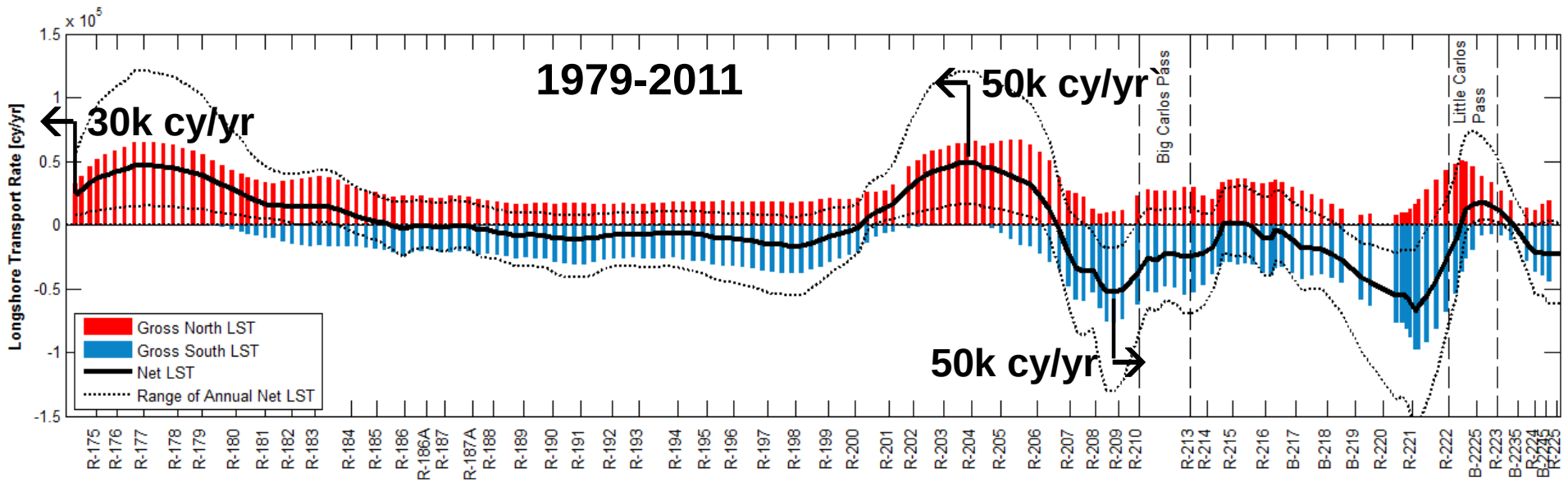
- Complicated due to geographic setting and low wave energy
- Trend: to N on N end and to S on S end; nodal point somewhere in the middle
- Reversals in directions may occur on yearly time scale
- G&A estimate:



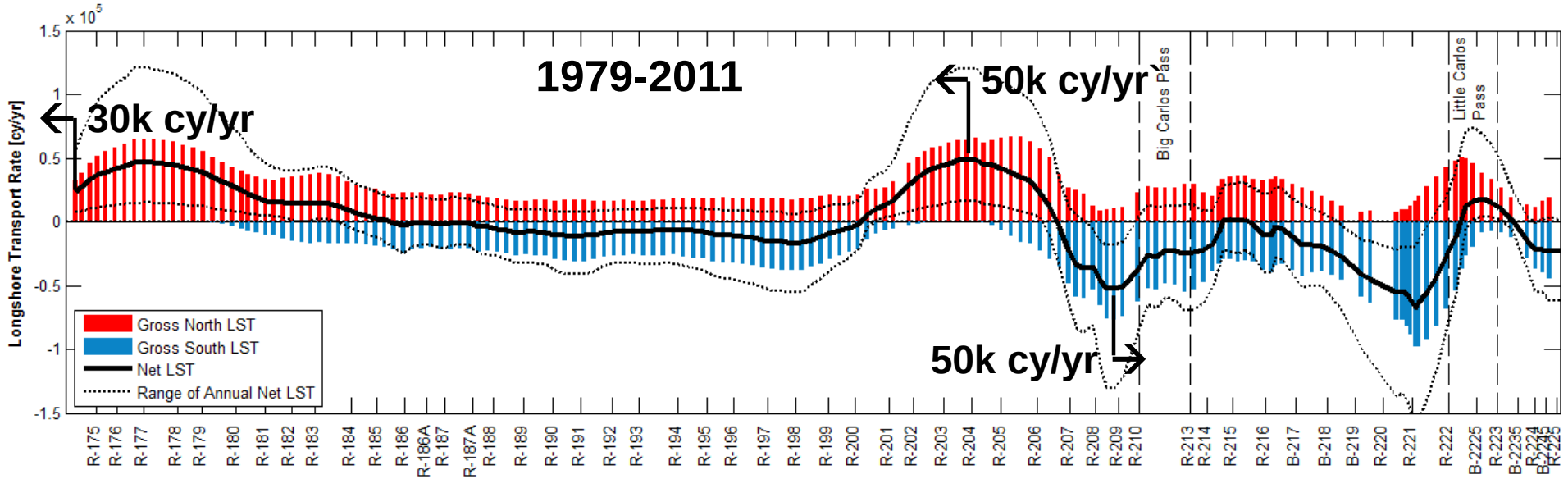
Existing Shoreline Transport Patterns

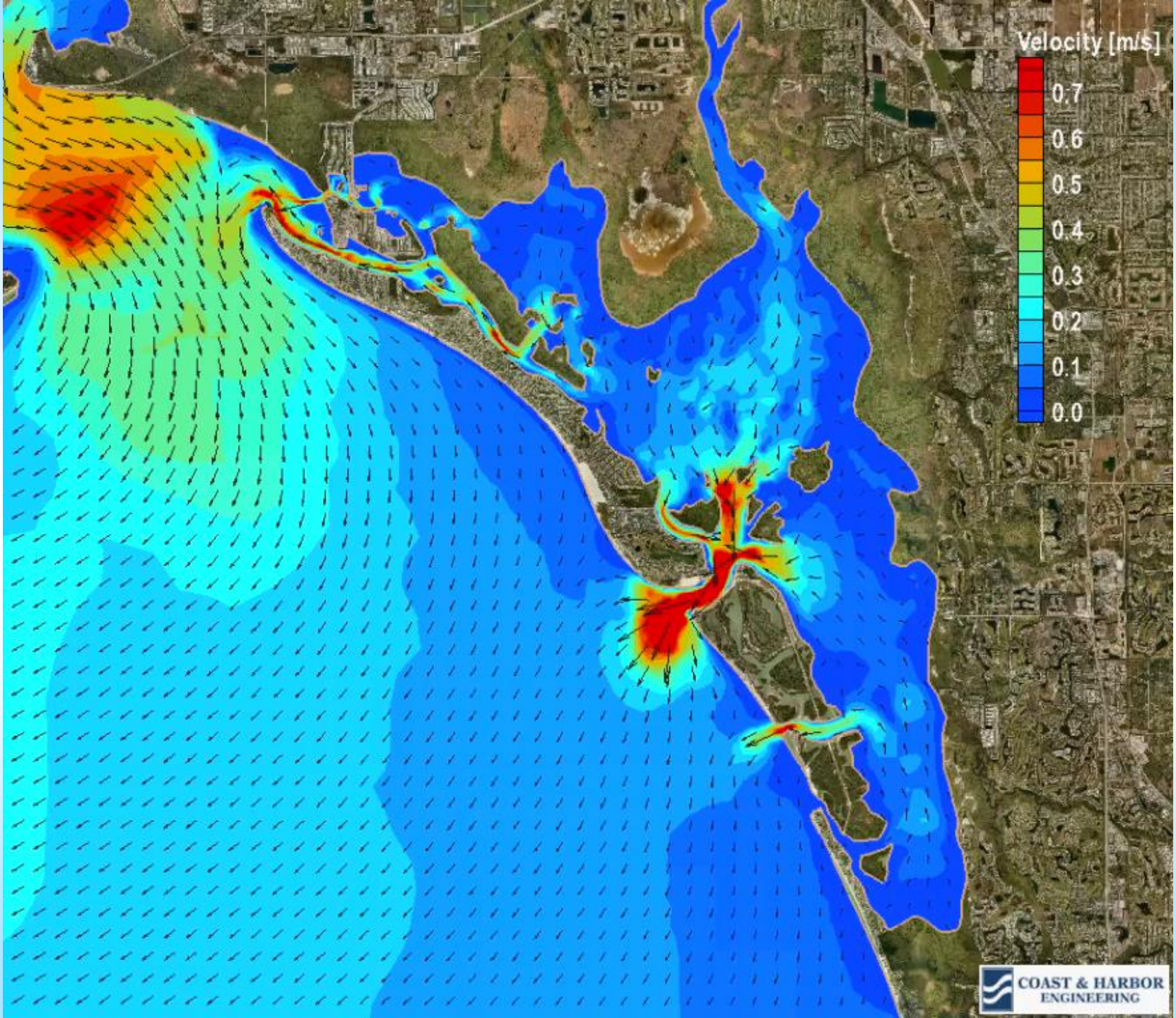


Existing Shoreline Transport Patterns



Existing Shoreline Transport Patterns




Velocity [m/s]
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
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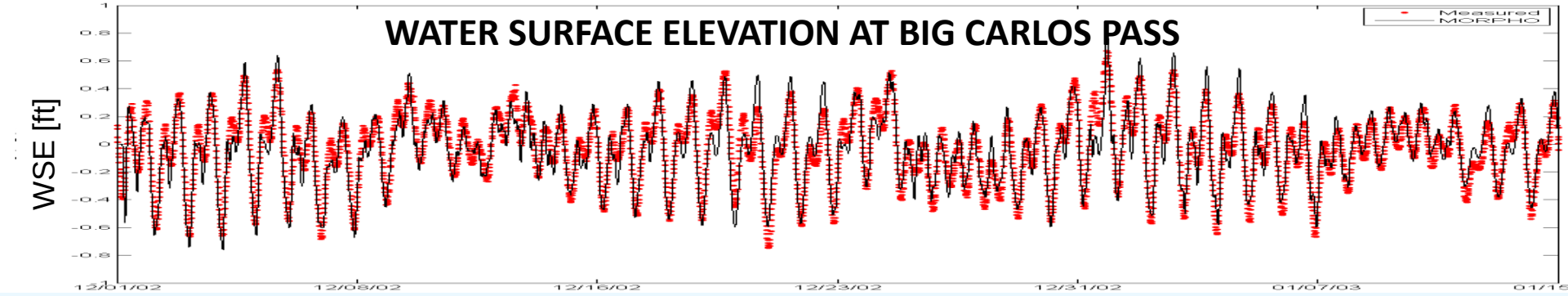
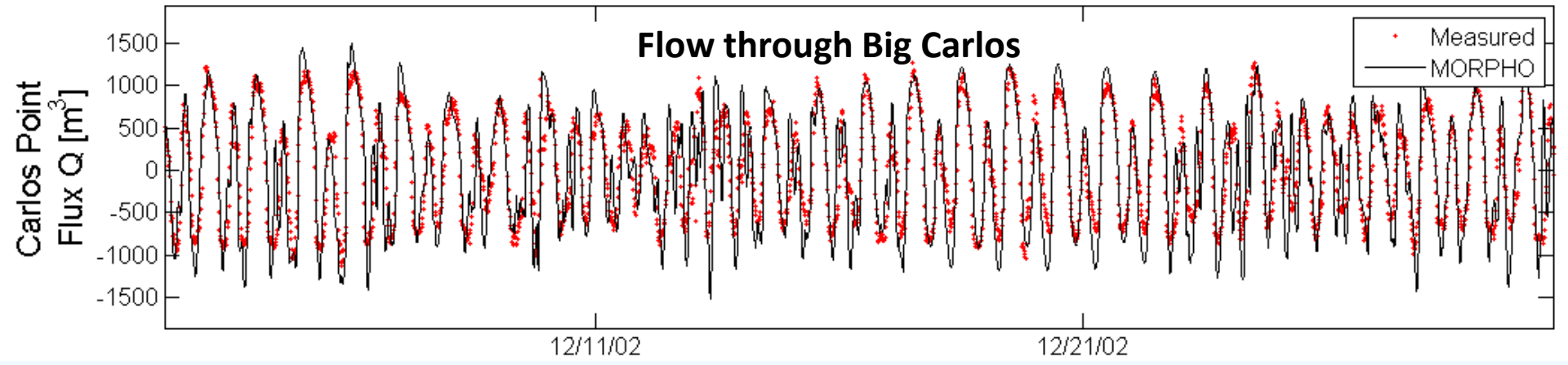
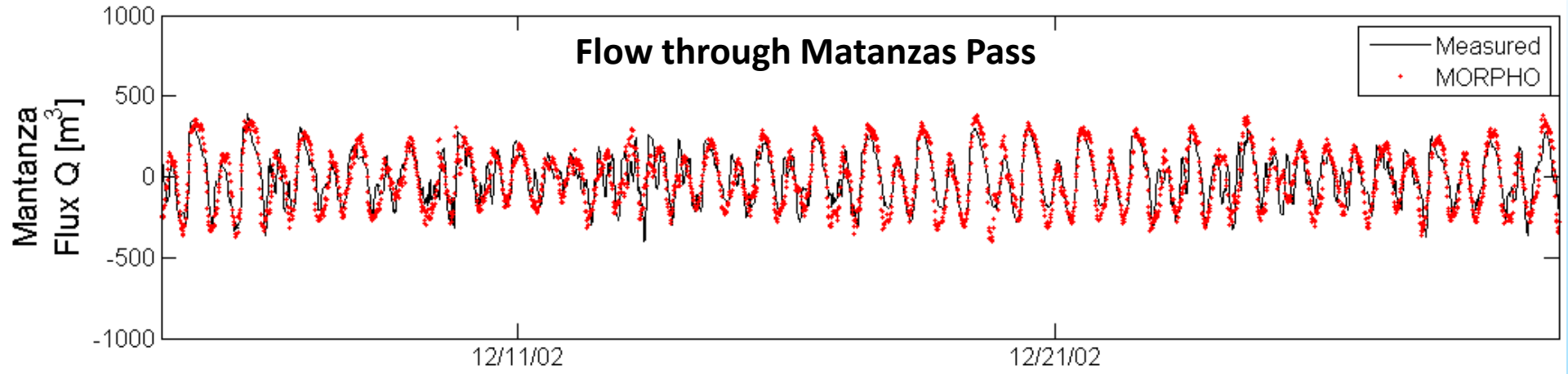
ENGINEERING

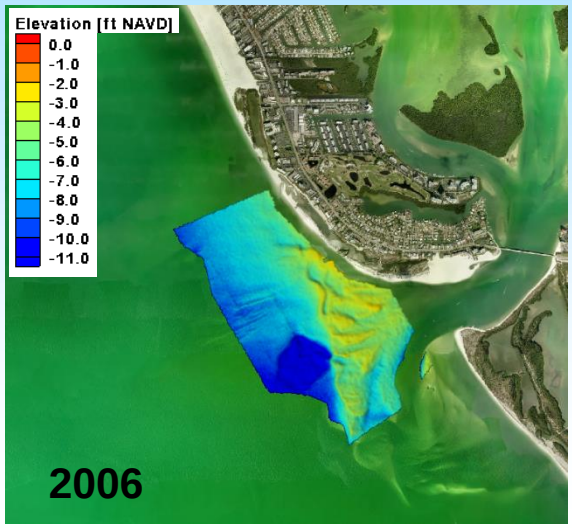
Inlet Dynamics – Model Validatin

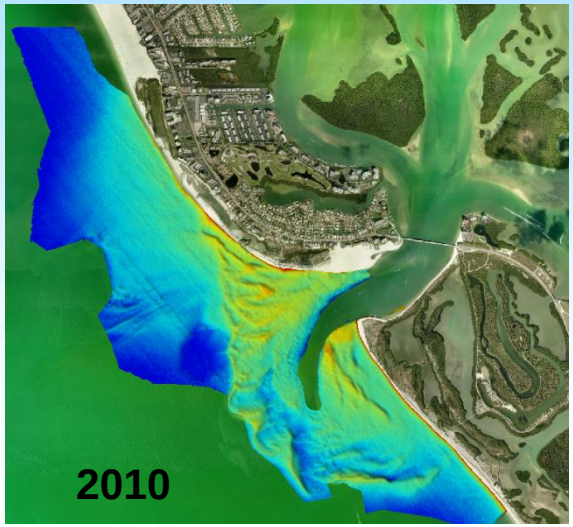


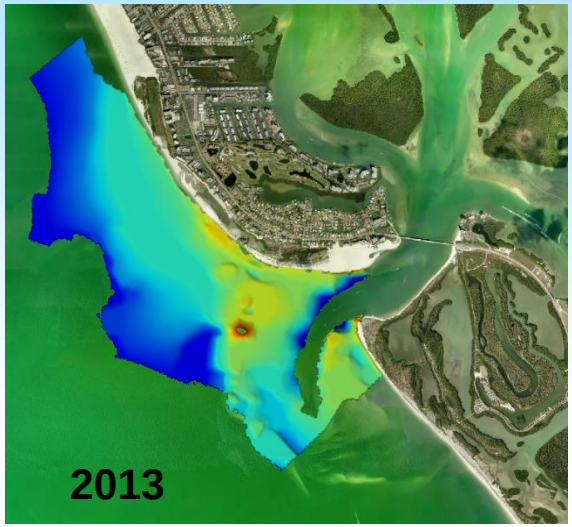


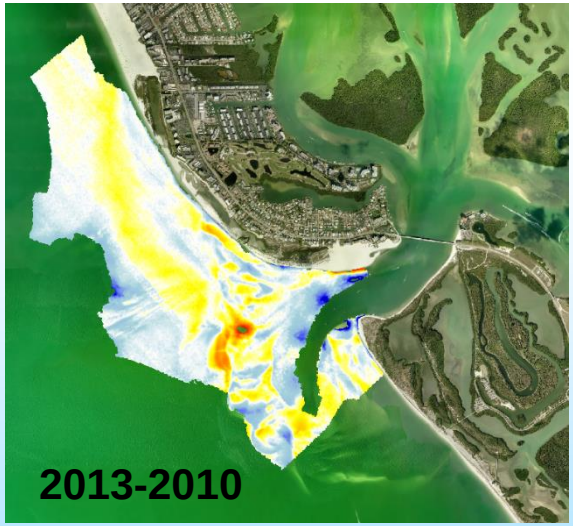


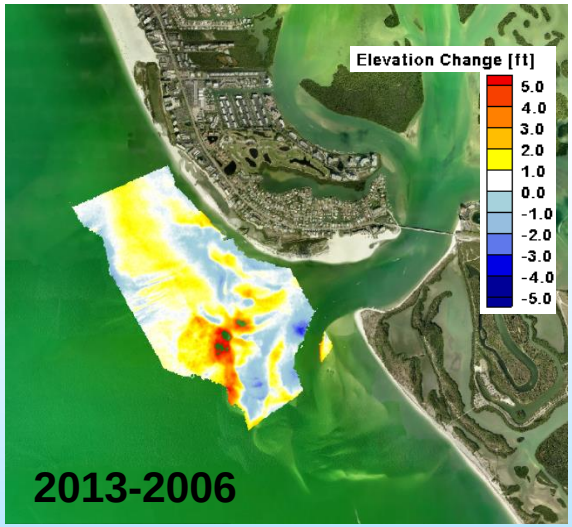
Inlet Morphology











Shoal Volume 7.5 M cy to 10 M cy
Change Rate: ± 40,000 cy/yr from 2006-2013 (some uncertainty)

COAST & HARBOR ENGINEERING
A Division of Hatch Mott MacDonald

Development of Alternatives

- Goal: maximize shoreline stability (keep shoreline stable for least $$)
- Accomplished by:
  - Adding sand to the system
  - Keep existing sand in system longer
- Challenges:
  - Wild inlet → very dynamic adjacent shorelines
  - Sensitive habitat in most dynamic region
- Positives:
  - Two nearby renewable sources of sand (Matanzas and Big Carlos Ebb Shoal)
  - Recent large nourishments on north

Development of Alternatives

COAST & HARBOR ENGINEERING
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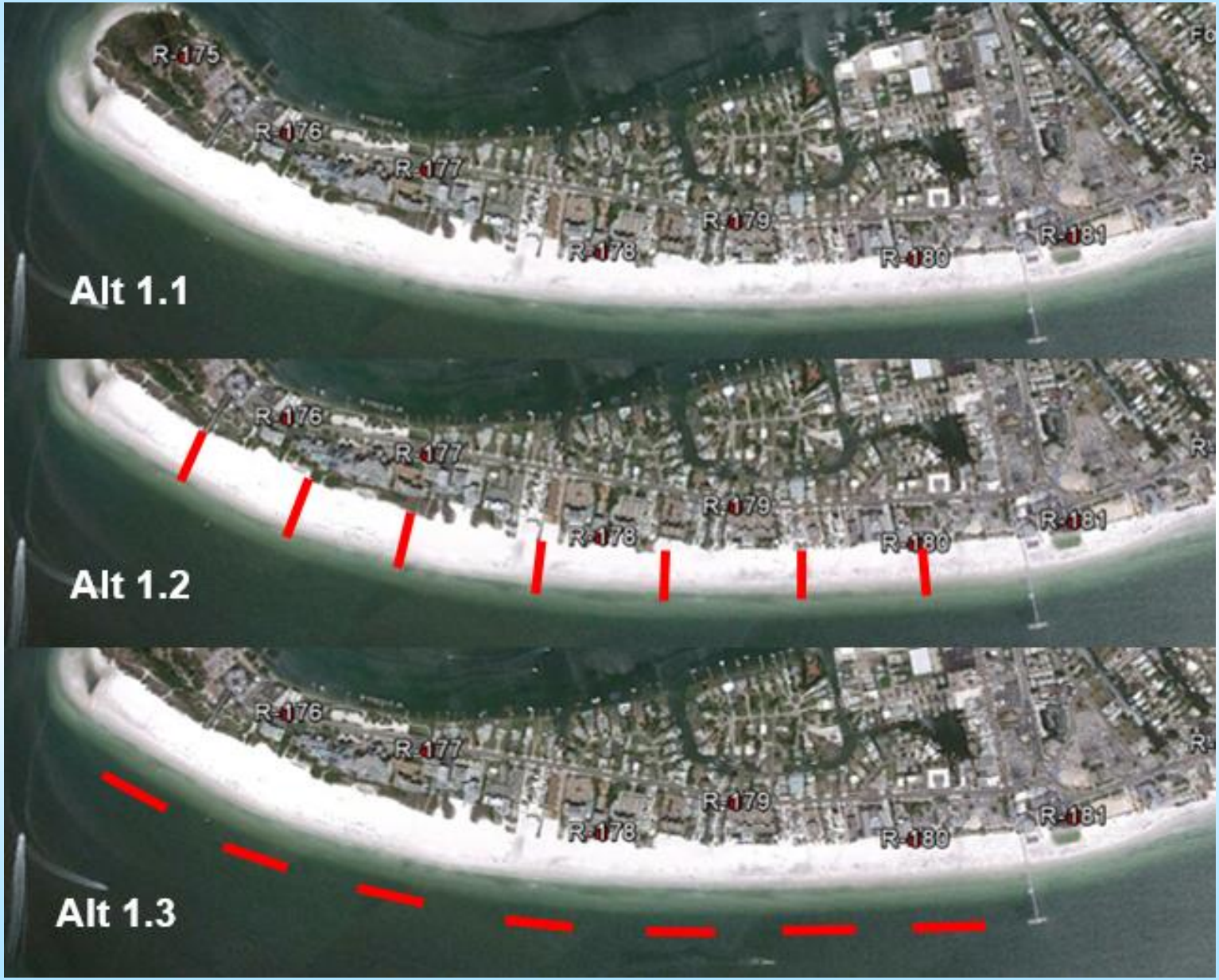
Development of Alternatives

1. **Prevent Erosion on North**
   - **1.1: Beach nourishment (FWOP)**
   - **1.2: Short groins**
   - **1.3: Nearshore breakwaters**

Development of Alternatives



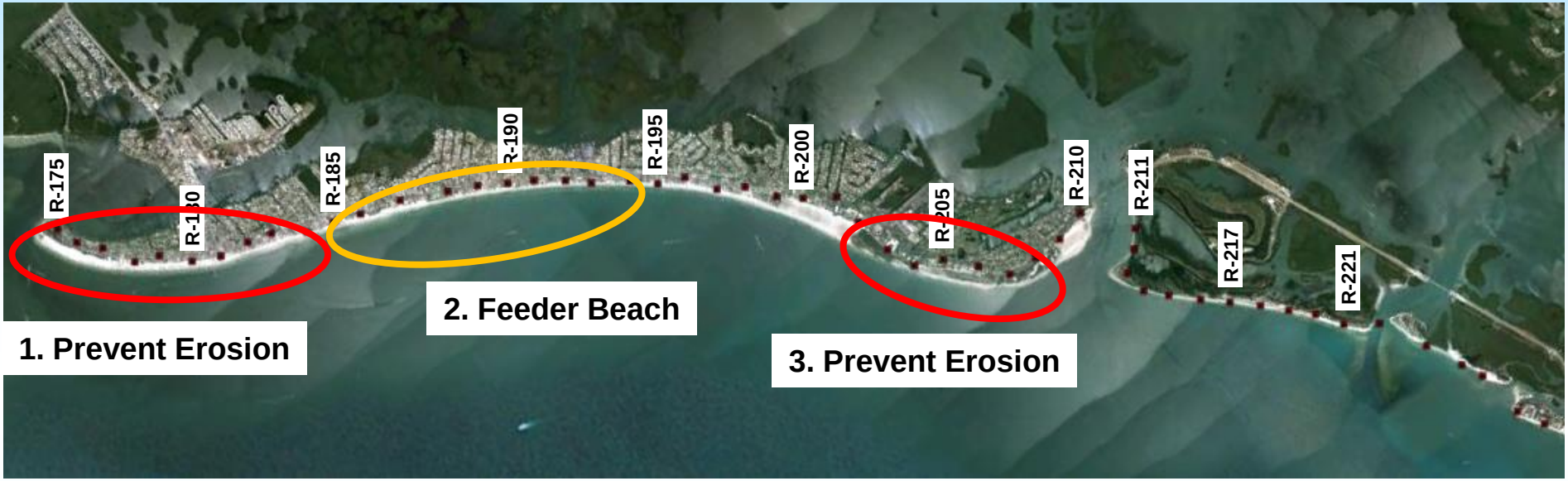
Development of Alternatives

1. **Prevent Erosion on North**
   - 1.1: Beach nourishment (FWOP)
   - 1.2: Short groins
   - 1.3: Nearshore breakwaters

2. **Feeder Beach**
   - 2.1: Onshore nourishment from Matanzas
   - 2.2: Nearshore placement from Matanzas
   - 2.3: Offshore placement from Matanzas

Development of Alternatives

Development of Alternatives



1. Prevent Erosion on North
   - 1.1: Beach nourishment (FWOP)
   - 1.2: Short groins
   - 1.3: Nearshore breakwaters

2. Feeder Beach
   - 2.1: Onshore nourishment from Matanzas
   - 2.2: Nearshore placement from Matanzas
   - 2.3: Offshore placement from Matanzas

3. Prevent Erosion on Habitat Area (?)
   - 3.1: Nearshore breakwaters
   - 3.2: Beach nourishment from Big Carlos
   - 3.3: Beach nourishment with breakwaters
   - 3.4: Nearshore placement

Development of Alternatives

Alternatives Evaluation – Reach 1

Alt 1.1
Nourishment

In 8 years

Lifetime ~ 8 yrs

Alternatives Evaluation – Reach 1

Alt 1.2
Groins

In 8 years

Lifetime ~ 12 yrs

Alternatives Evaluation – Reach 1

Alt 1.3 Breakwaters

In 8 years

Lifetime ~ 14 yrs

Alternatives Evaluation

Alternative	Lifetime Estimate [yr]	Cost Estimate [M]
1.1 Beach Nourishment	8	$4.6
1.2 Short Groin Field	12	$4.4
1.3 Breakwater Field	14	$10.0
2.1 Onshore Beach Nourishment	~20	$2.5
2.2 Nearshore Nourishment	10	$2.3
2.3 Offshore Nourishment	n/a	$2.3
3.1 Breakwater Field	11	$8.6
3.2 Onshore Beach Nourishment	12	$2.8
3.3 Onshore Nourishment & Breakwater	15	$14.7
3.4 Nearshore Beach Nourishment	6	$2.6

Recommendations

1. Reach 1:
   - Continue support of renourishment program
   - Build Alt 1.2 short groins
2. Reach 2:
   - Use Matanzas Maintenance for Alt 2.2, nearshore placement. Priority placement northern end of Reach
3. Reach 3:
   - Construct Alt 3.2 onshore nourishment utilizing sediment dredged from Big Carlos Pass
   - If 3.2 not possible for environmental concerns, build Alt 3.4 nearshore placement and closely monitor results
4. Monitoring
   - Implement consistent with survey transects at island R-monuments.
   - Implement monitoring of Big Carlos Pass to determine if is a long-term sustainable borrow site; optimize location(s) for the borrow site, and determination of rate of bypassing

Coastal Management Plan Development
Fort Myers Beach, Florida

Acknowledgements

- Ft. Myers Beach Town Council
- Keith Laakkonen, Town of Ft. Myers Beach
- Steve Boutelle, Lee County
- CHE Team:
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  - Matt Campbell, PE
  - Casey Connor, PE
  - Scott Fenical, PE, D.CE

Town of
FORT MYERS BEACH

COAST & HARBOR ENGINEERING
A Division of Hatch Mott MacDonald

Coastal Management Plan Development
Fort Myers Beach, Florida

FSBPA Technical Conference

February 5, 2015

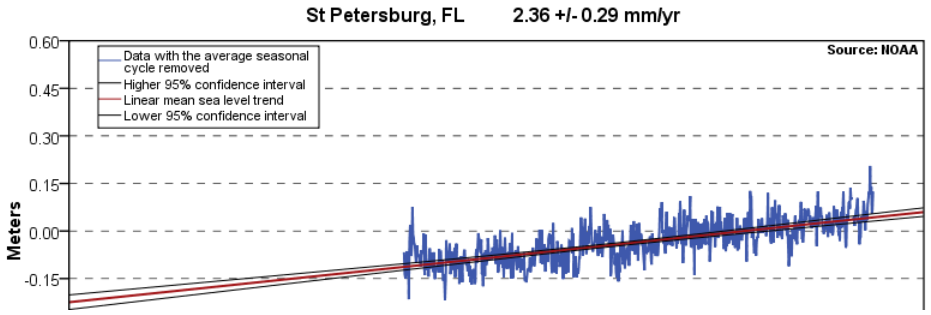
Town of
FORT MYERS BEACH

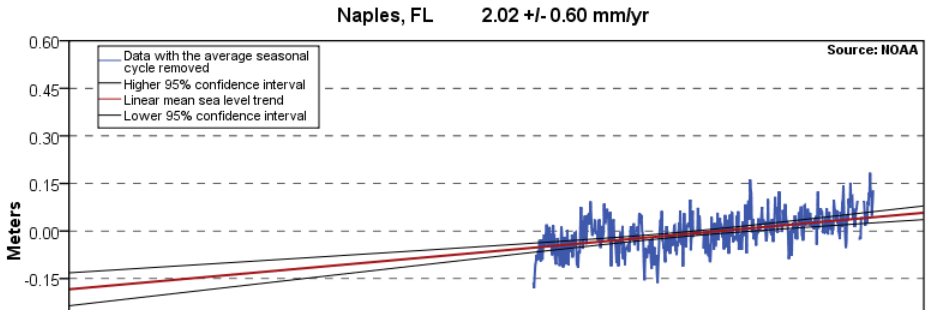
COAST & HARBOR ENGINEERING
A Division of Hatch Mott MacDonald

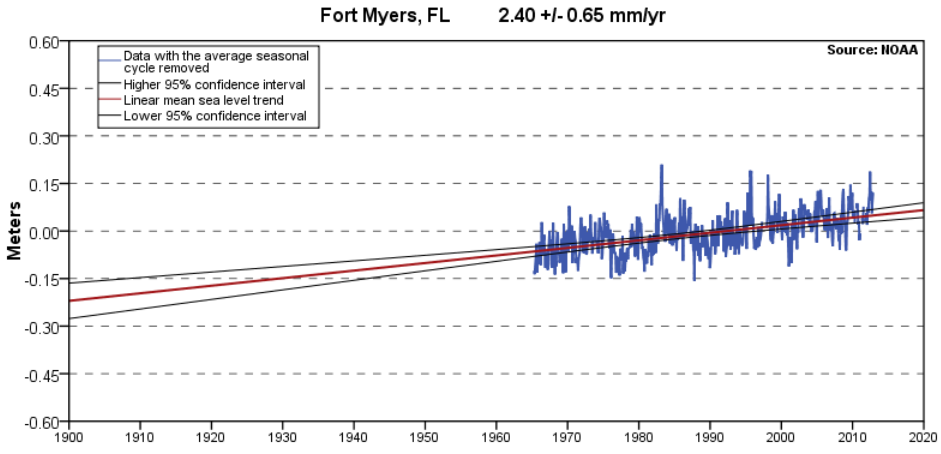
Relative Sea Level Rise

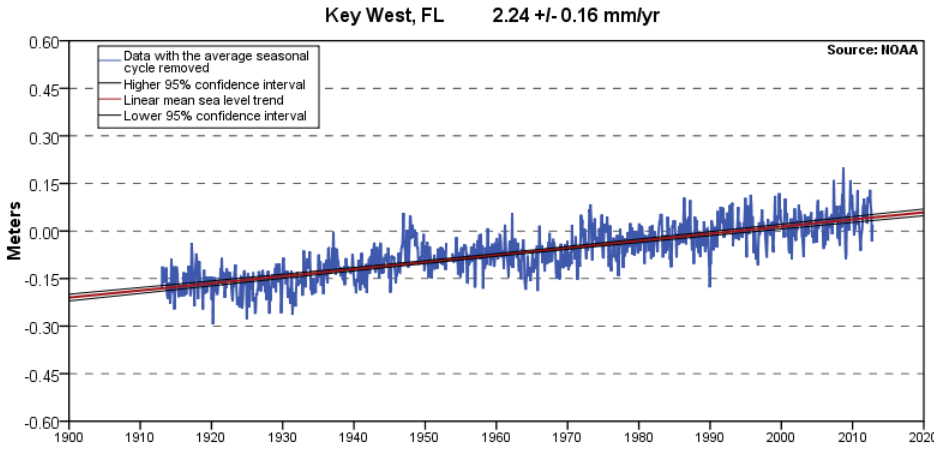
- St Petersburg: 2.36 ± 0.29 mm/yr from 1948 to 2012
- Ft. Myers: 2.40 ± 0.65 mm/yr from 1965 to 2012
- Naples: 2.02 ± 0.6 mm/yr from 1965 to 2012

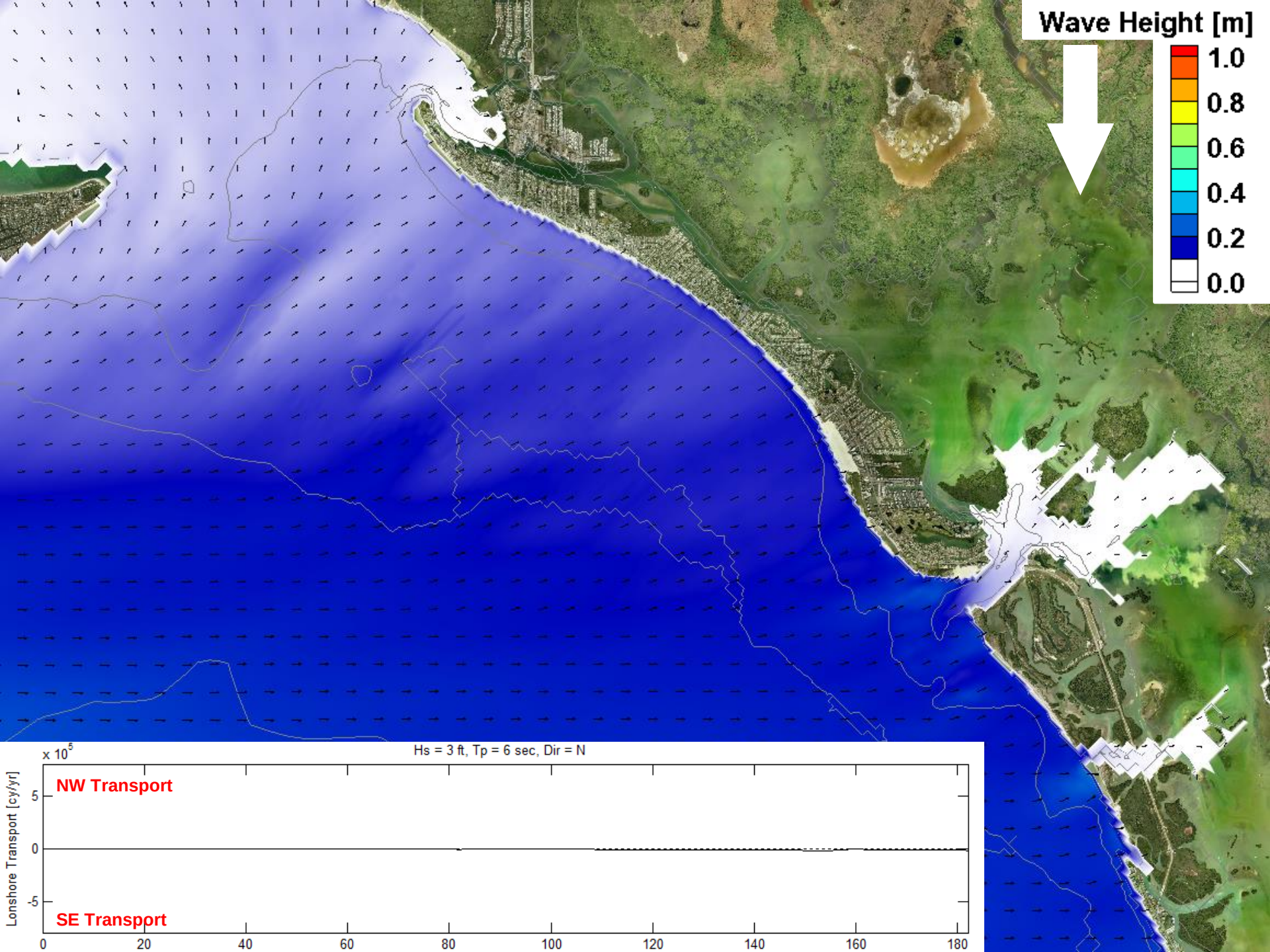
→ In **25 years**, sea level at **0.2 ft** higher than today







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0.6
0.4
0.2
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x 10^5
NW Transport
SE Transport
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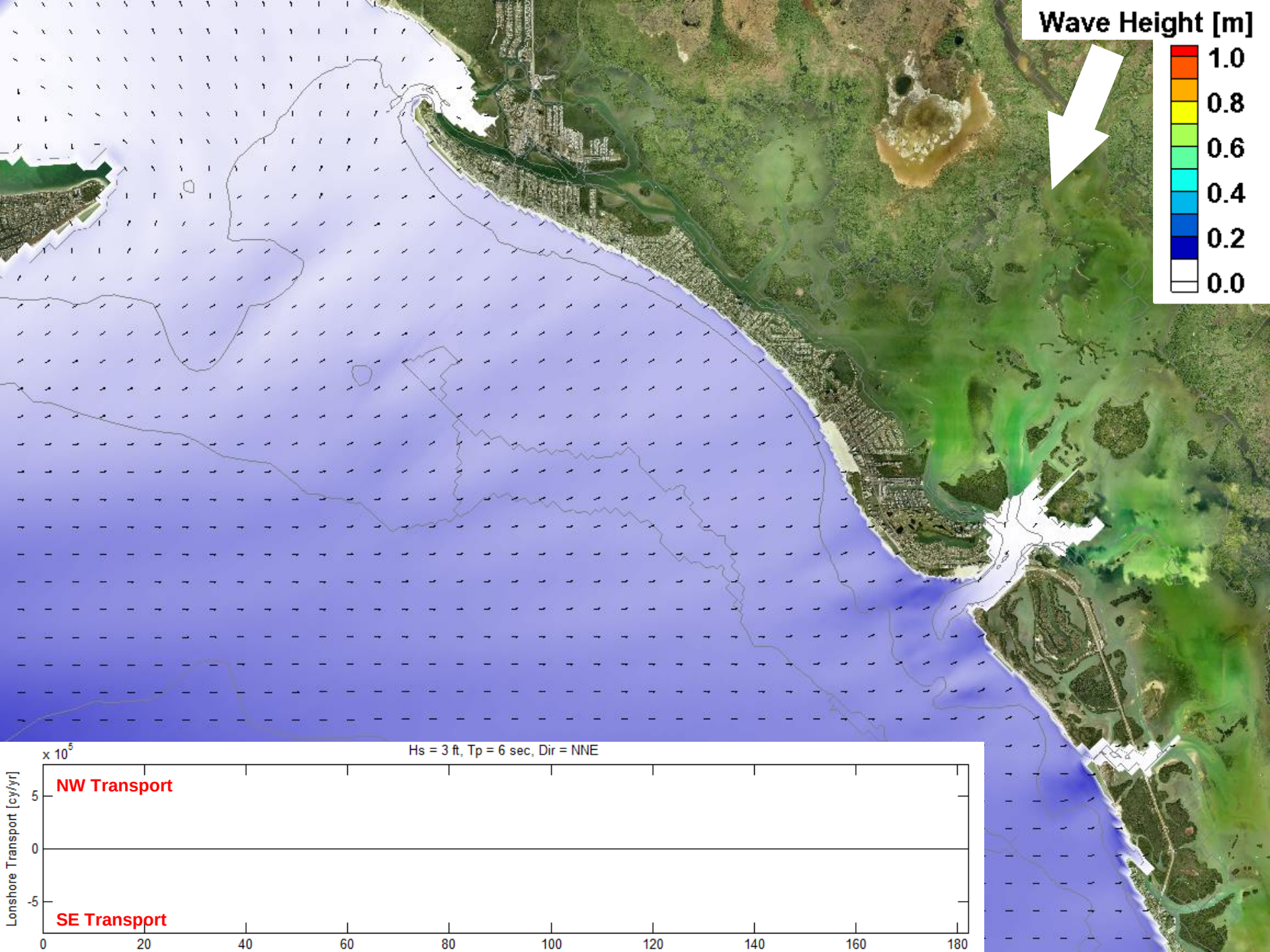
180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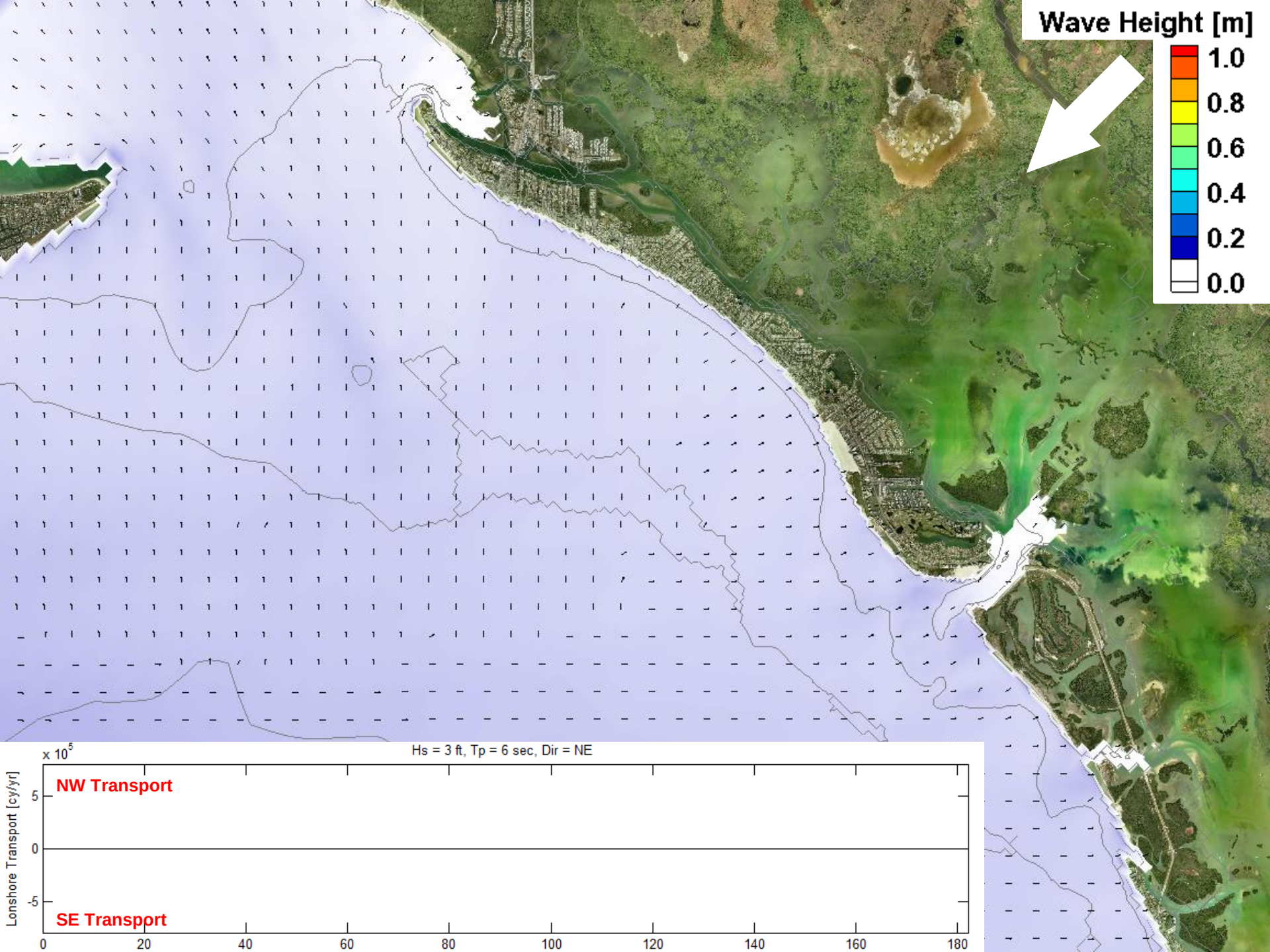
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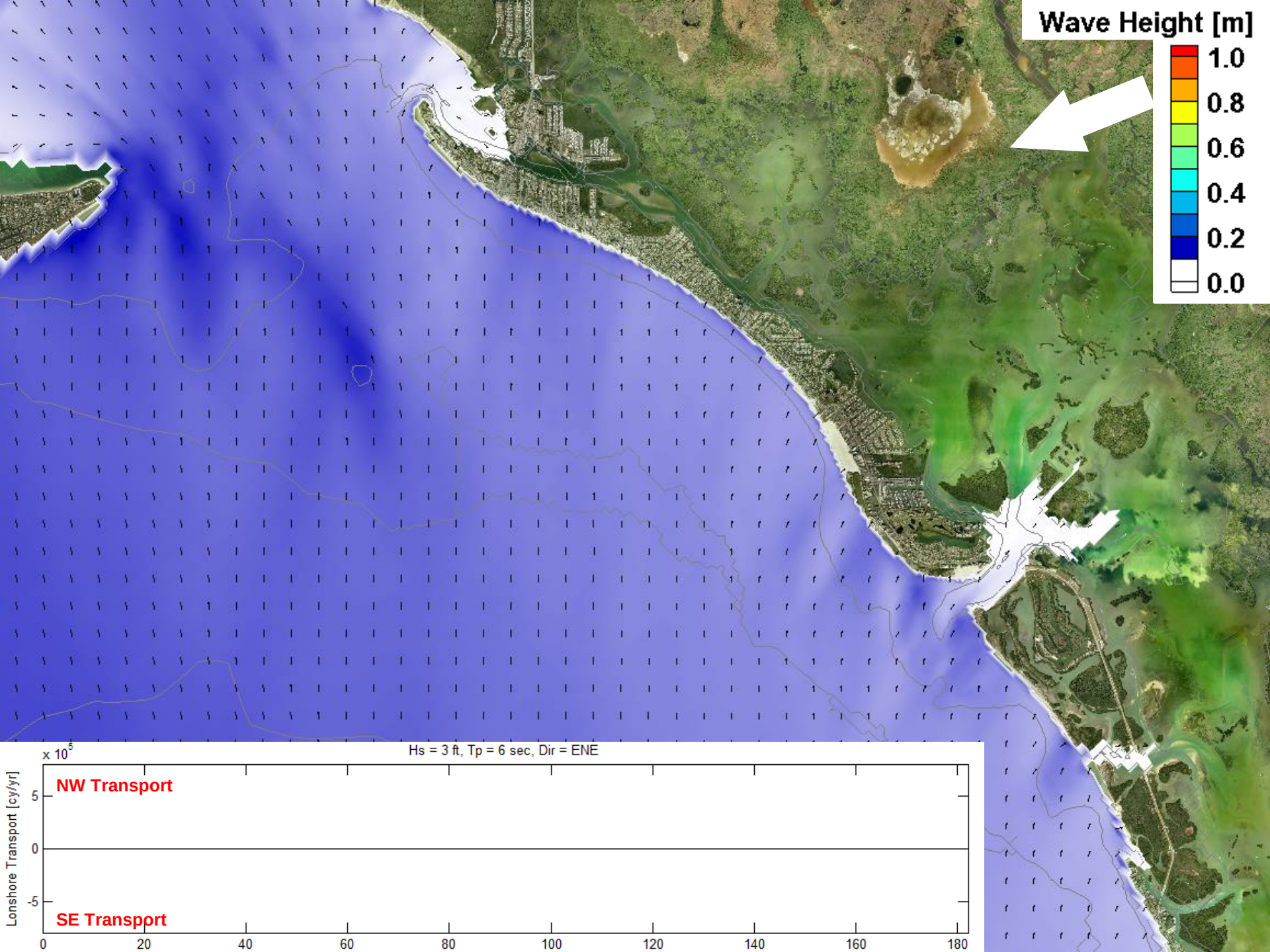
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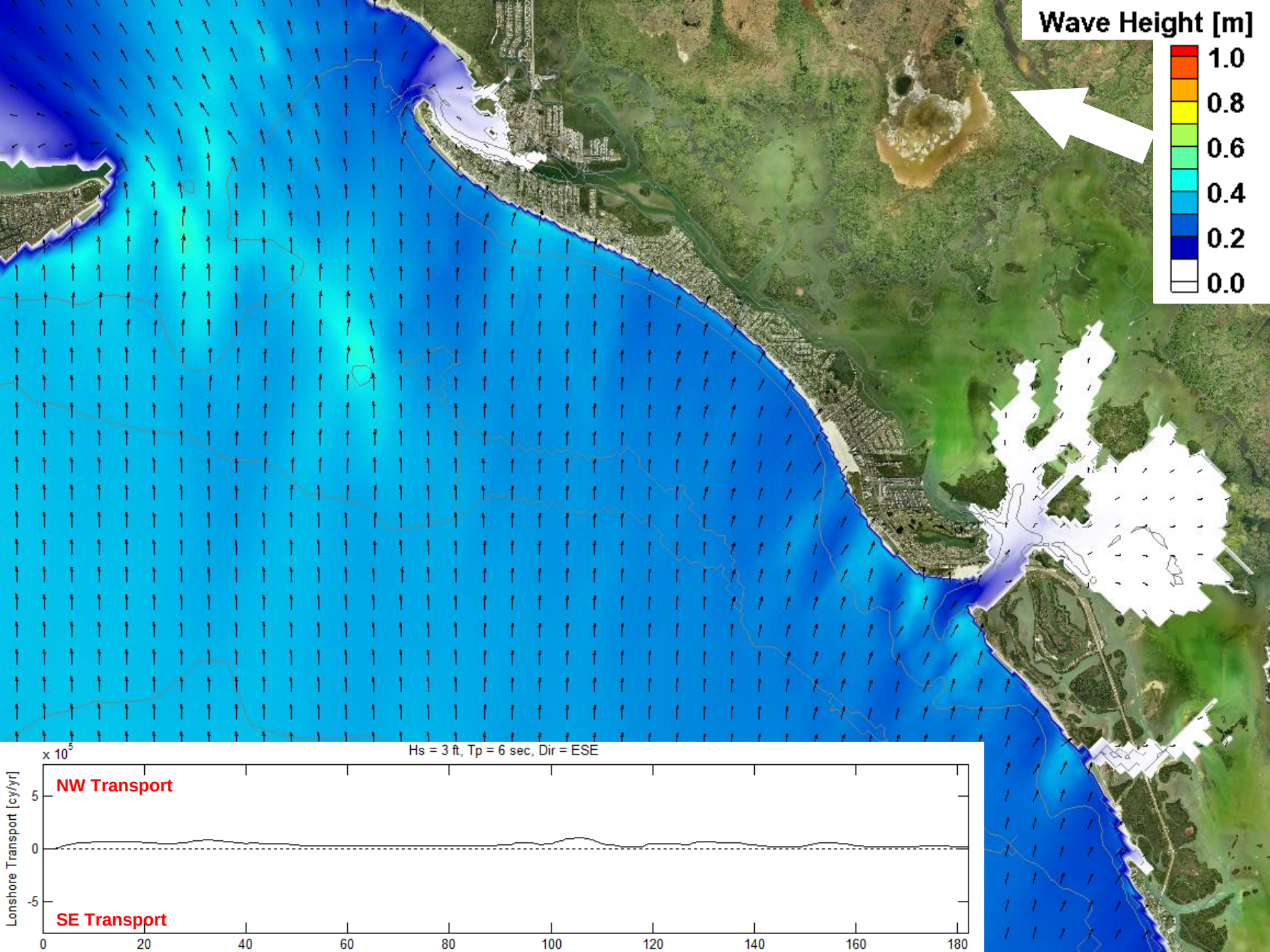
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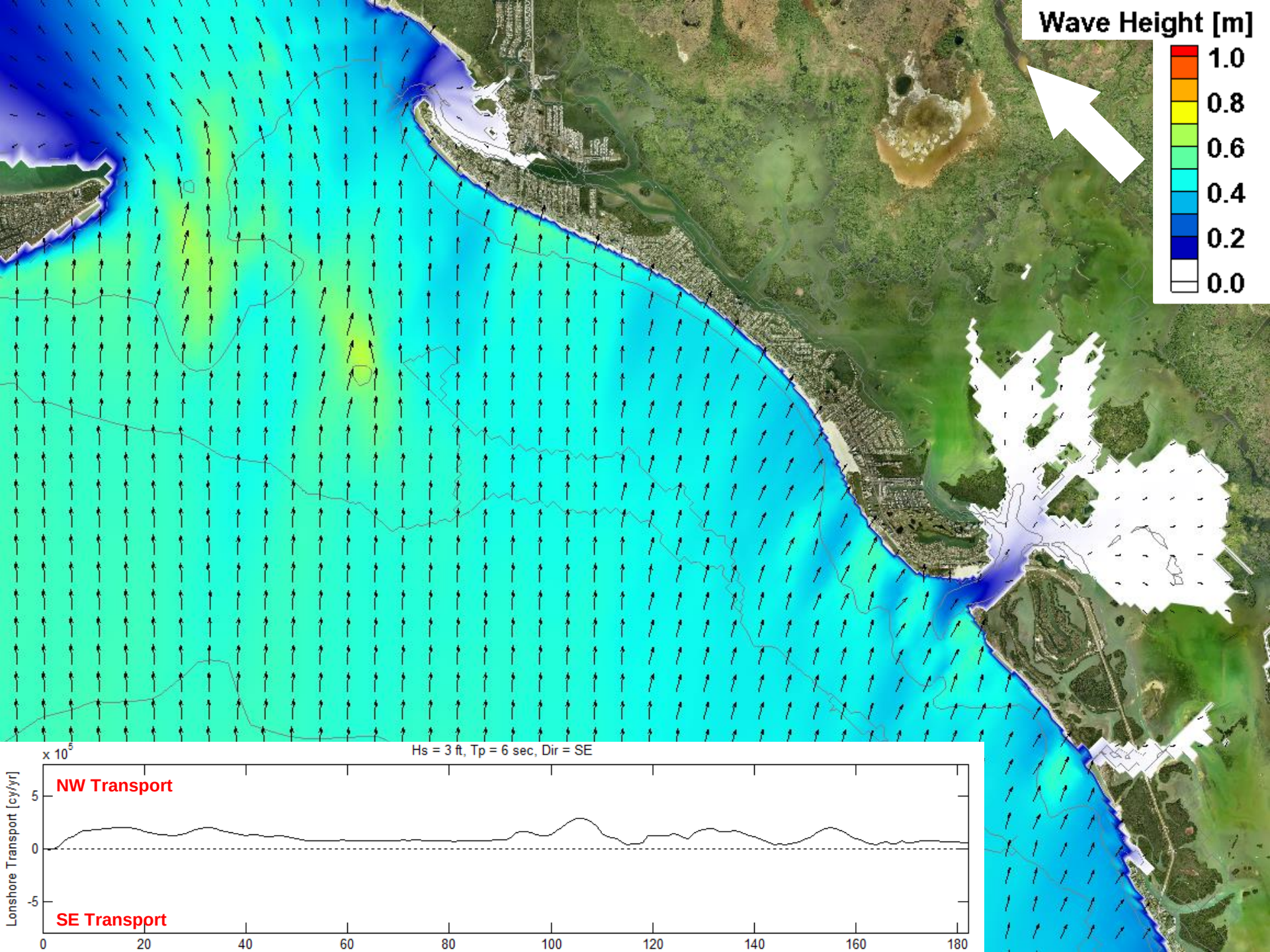
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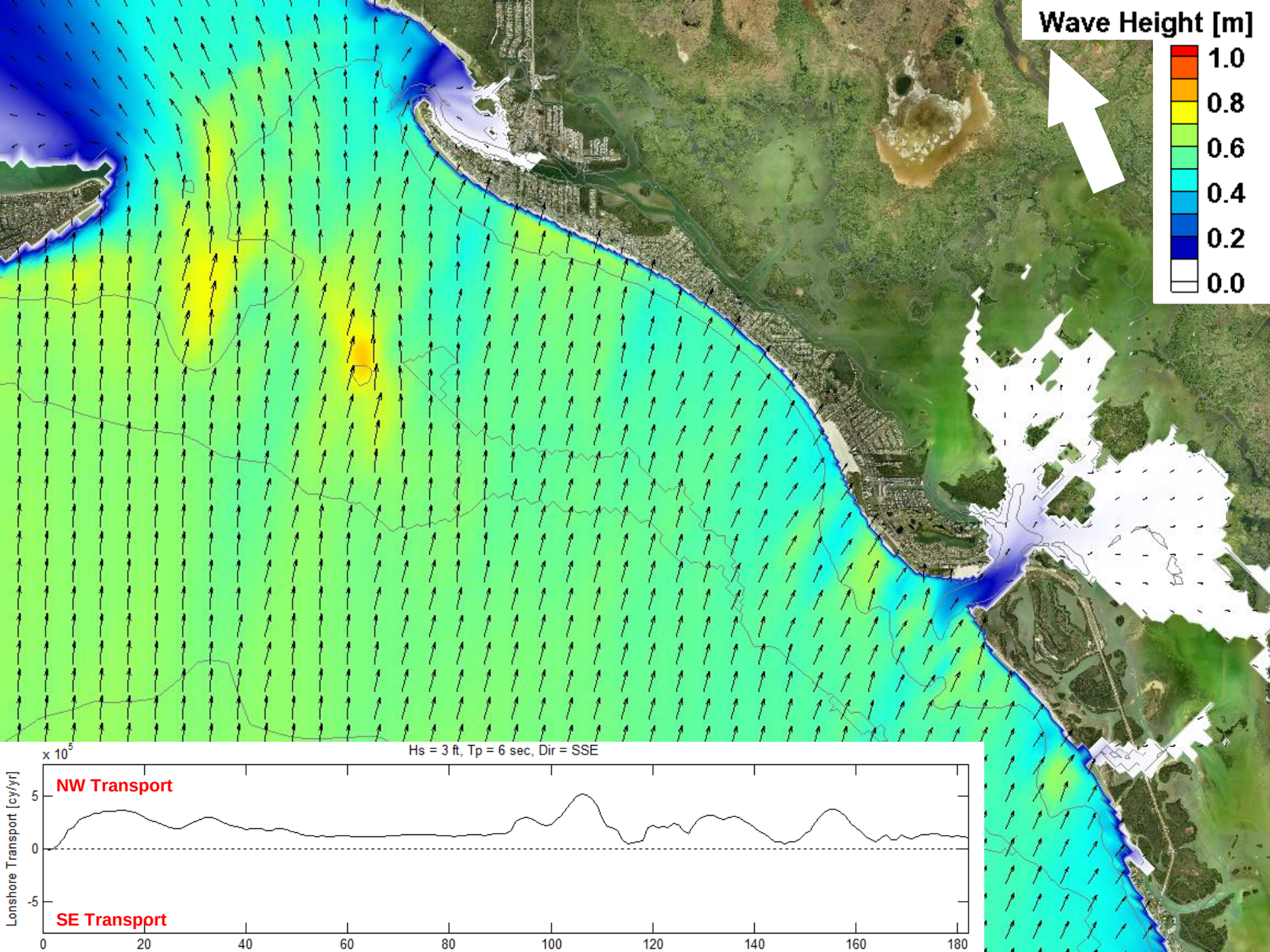
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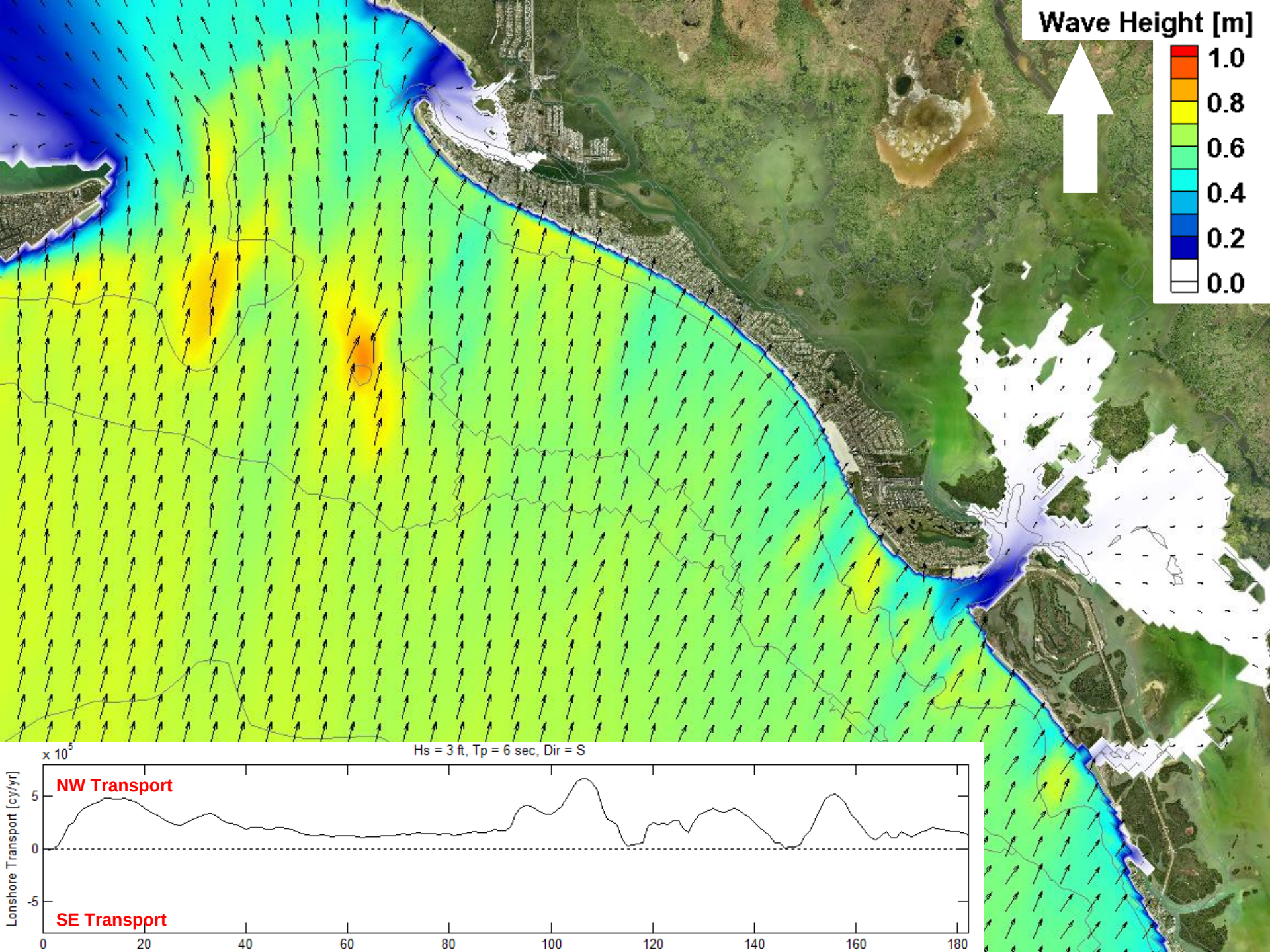
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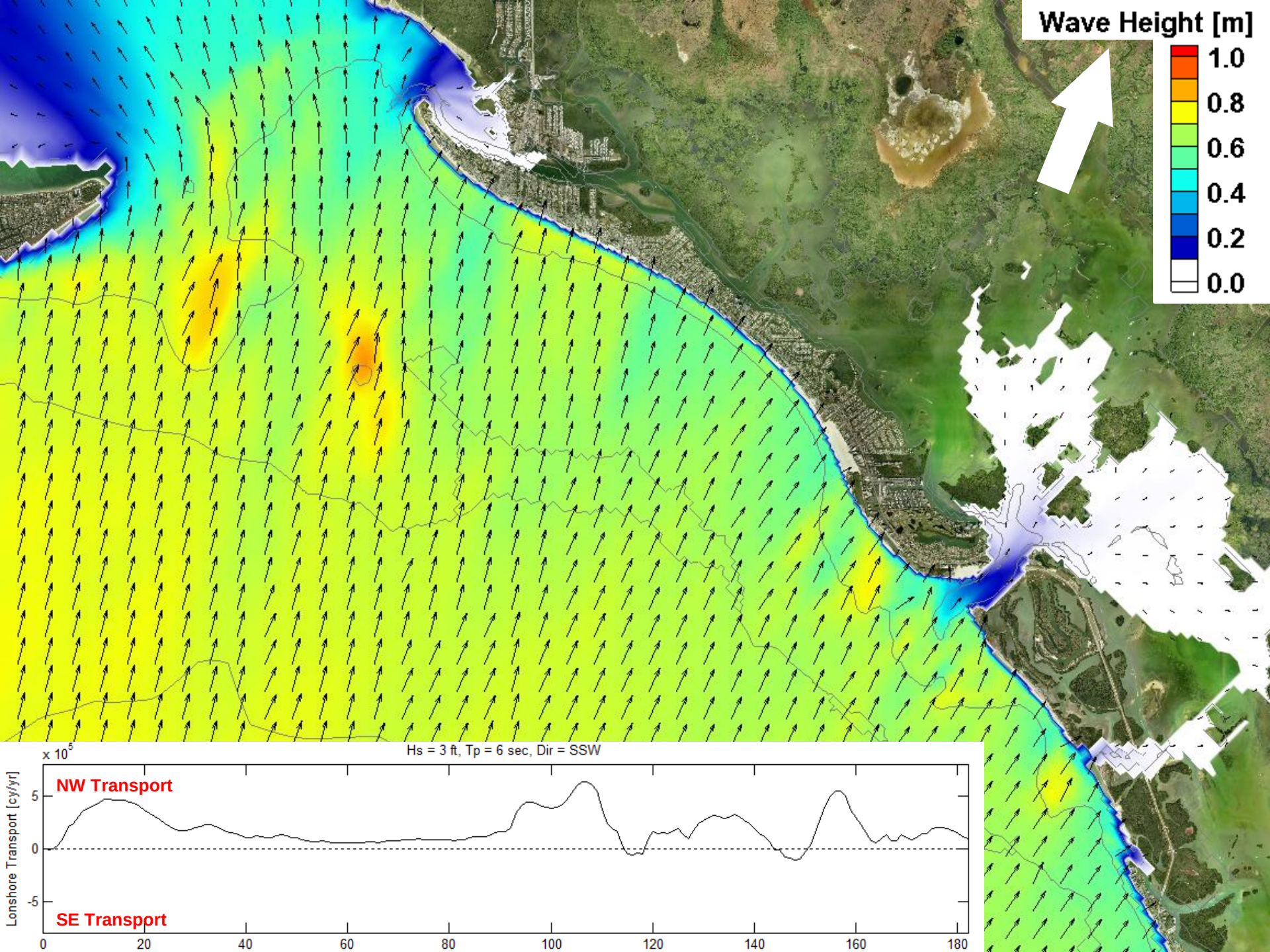
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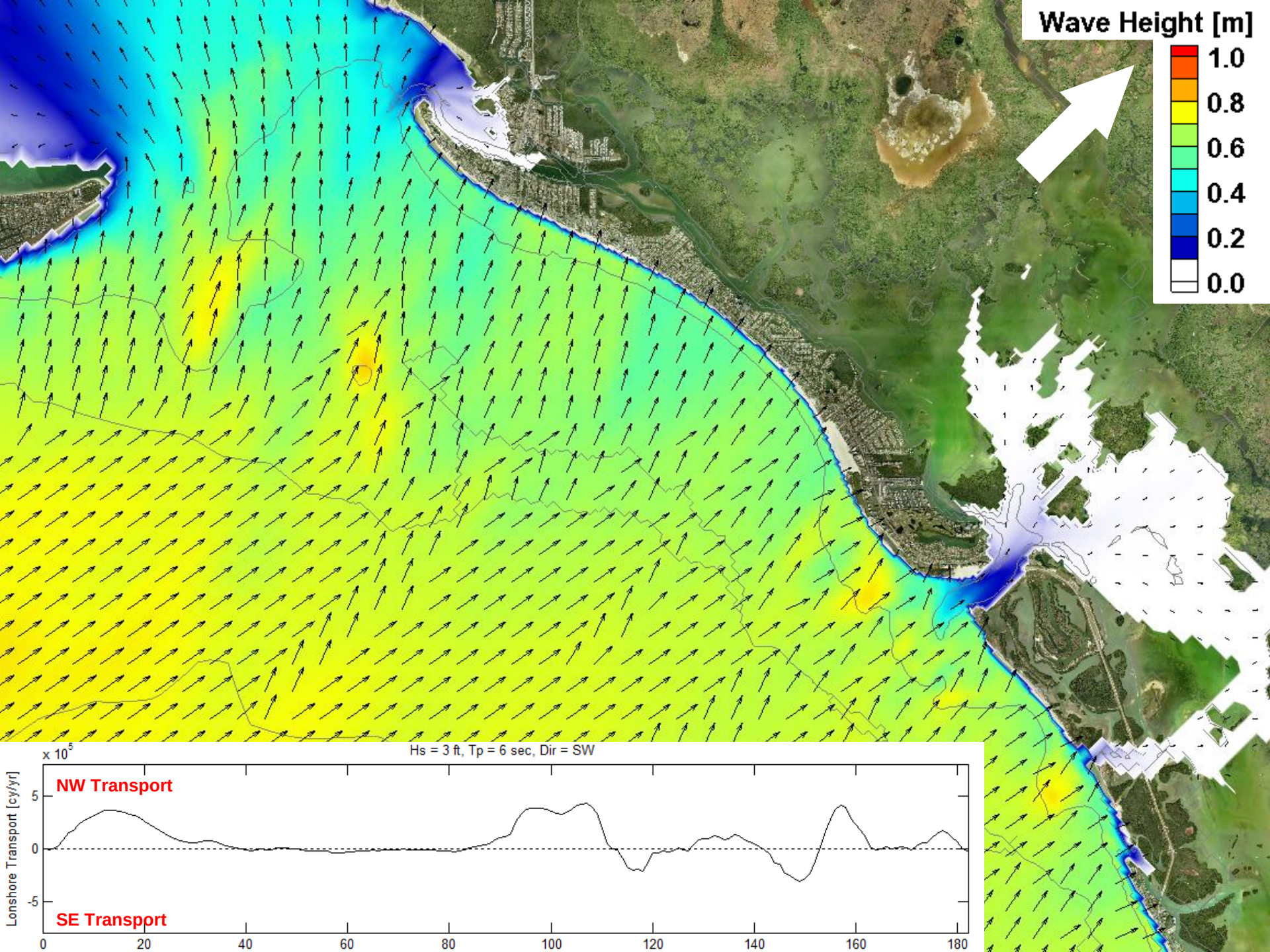
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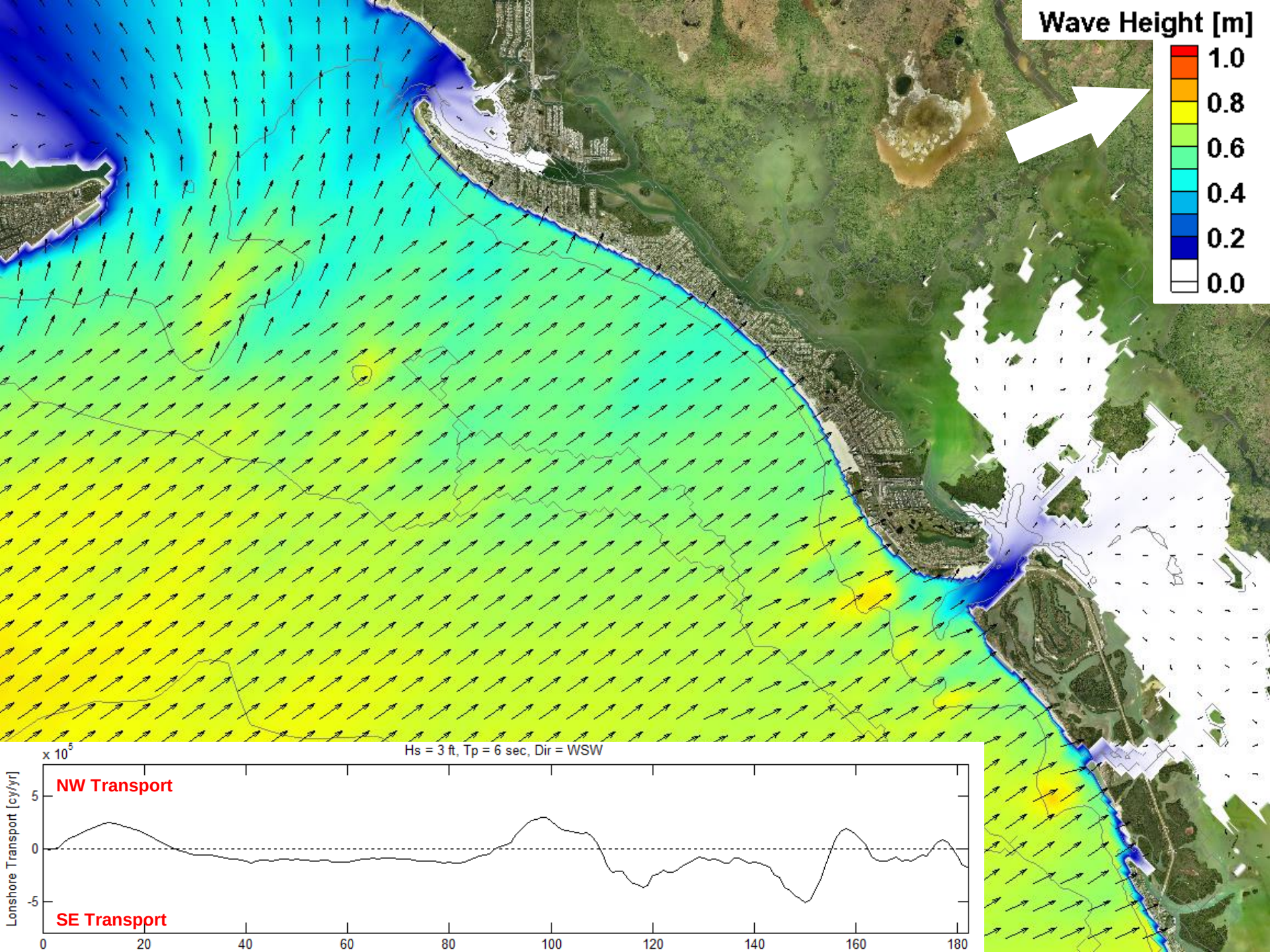
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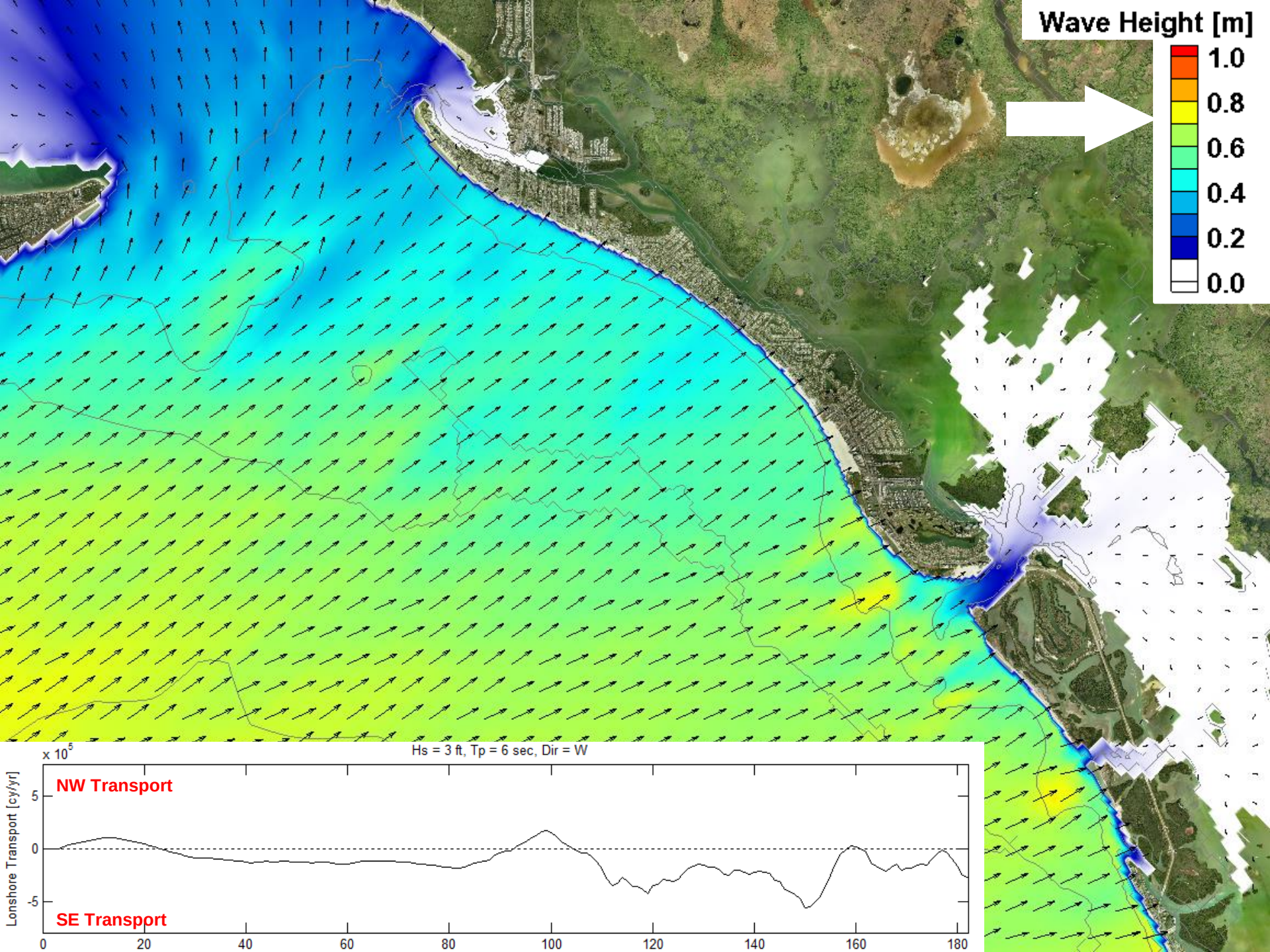
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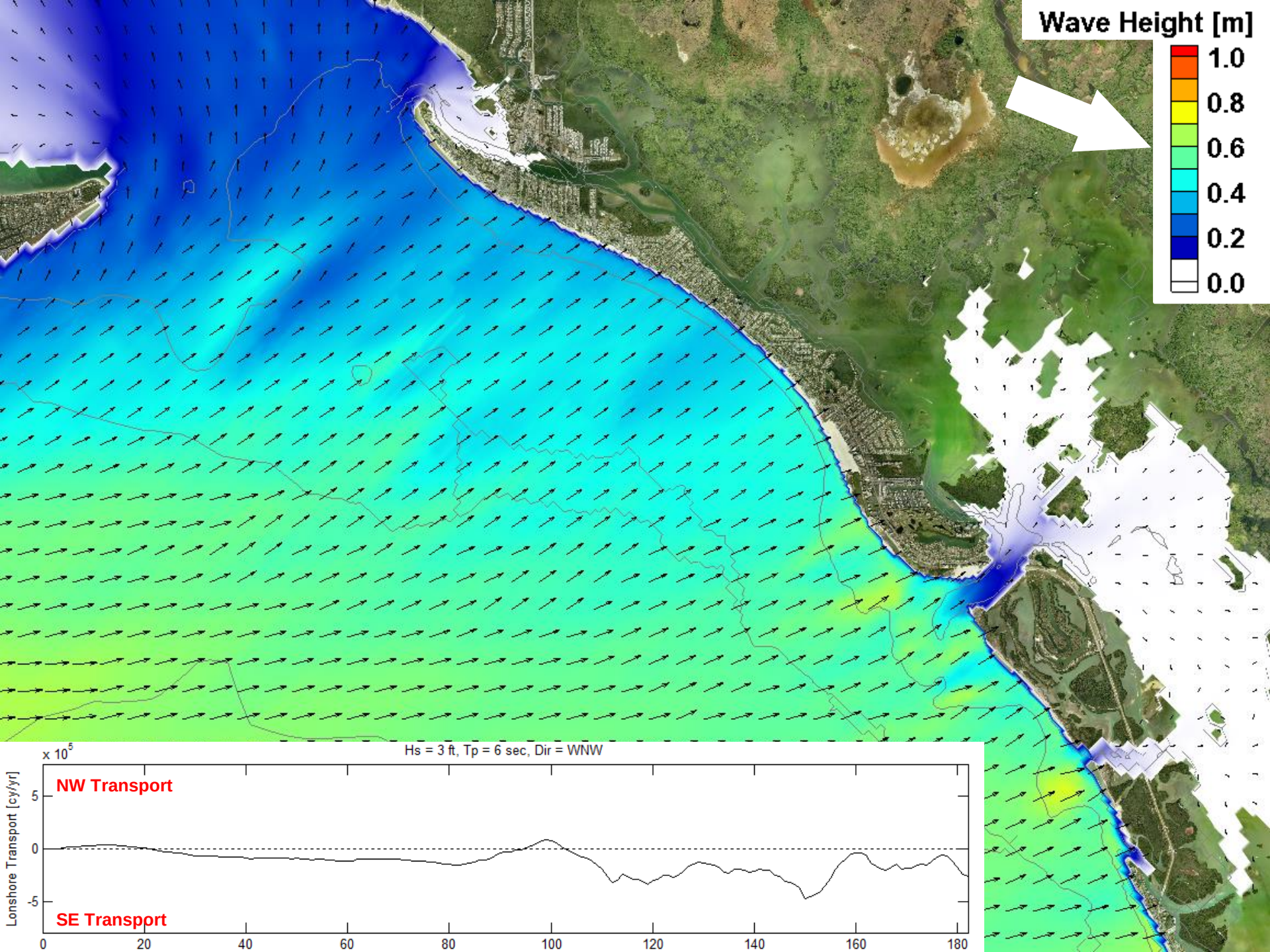
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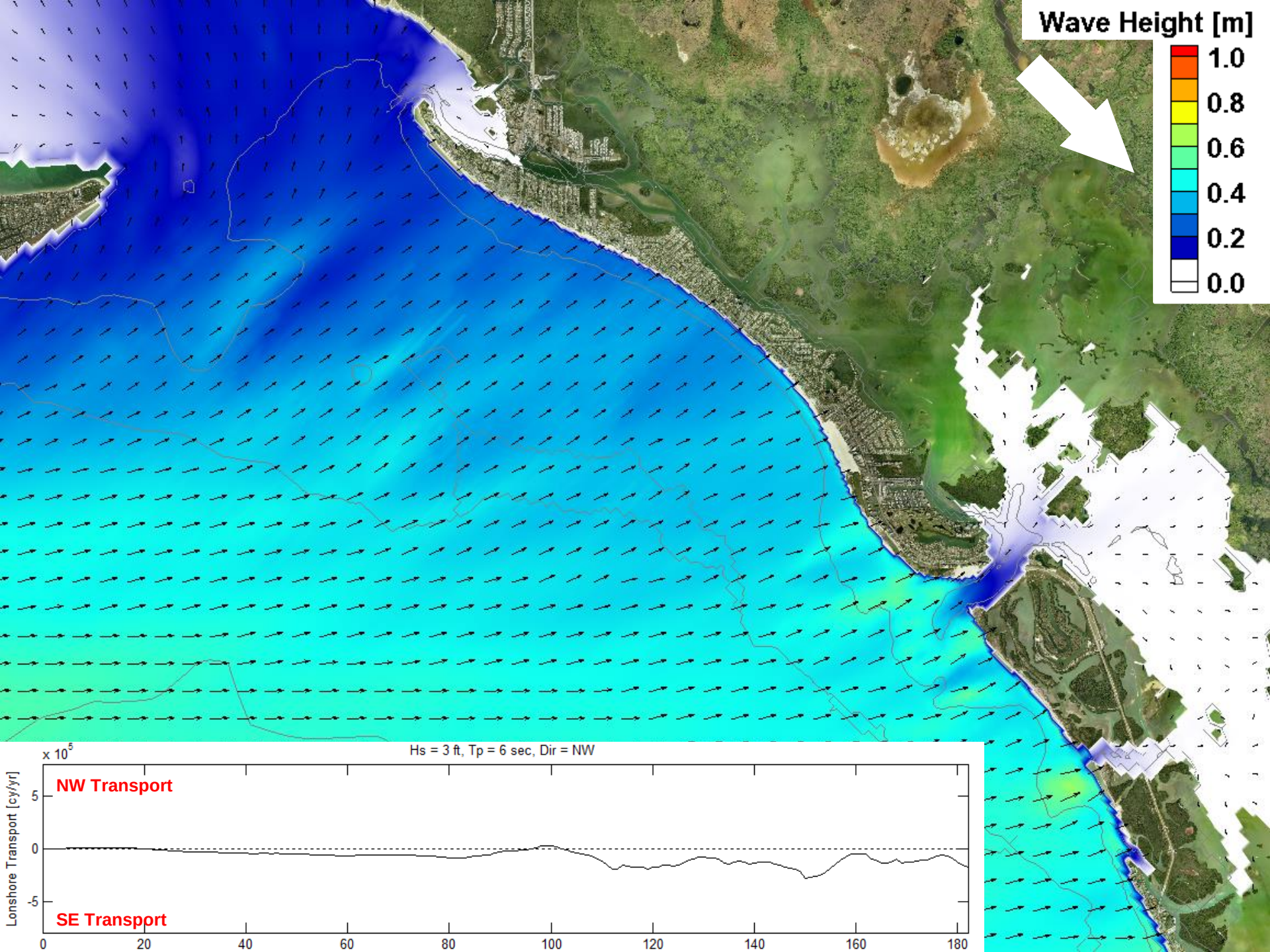
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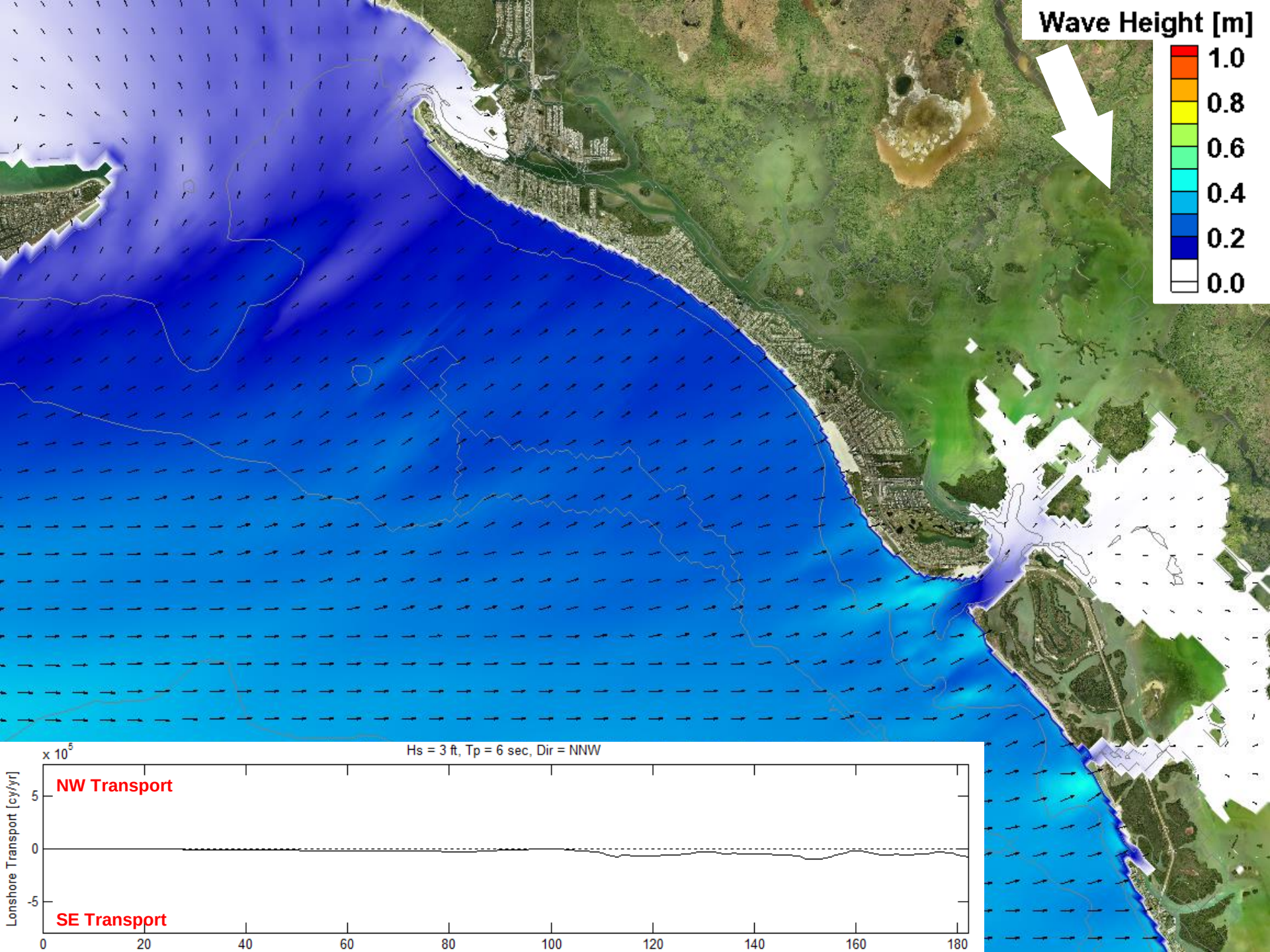
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Lonshore Transport [cy/yr]
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180

Shoreline Morphology Modeling

FWOP
In 8 years

Shoreline Morphology Modeling

FWOP
In 8 years

Shoreline Morphology Modeling

FWOP
In 8 years

Alternatives Evaluation – Reach 2

Alt 2.1
Onshore
Nourishment

In 8 years

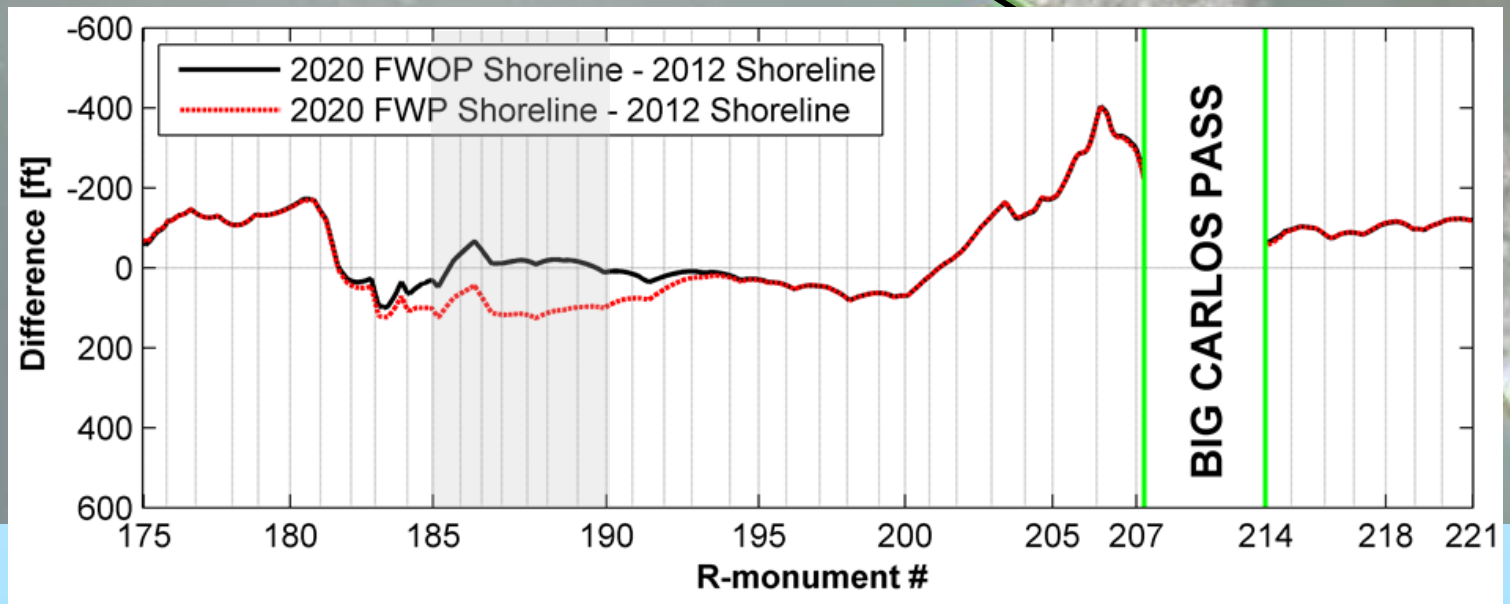
Lifetime
> 20 yrs

Alternatives Evaluation – Reach 2

Alt 2.1 Onshore Nourishment

In 8 years

Lifetime > 20 yrs



Alternatives Evaluation – Reach 2

Alt 2.2– Nearshore Placement

- Available tools not applicable for evaluation
- 2009 nearshore placement best model for performance.
- Monitoring by Brutsche and Wang (2010-2013) provide best indication of performance
- For 6 years, shoreline in lee is stable
- At year 6, 10% of placement volume attached to shoreline and is expected to act as nourishment
- Lifetime ~ 10 years

Alternatives Evaluation – Reach 2

Alt 2.3 – Offshore Placement

- Available tools not applicable for evaluation
- No model for performance
- Performed sediment transport modeling
- Offshore placement 80% less mobile than nearshore placement, and substantially farther offshore
- Benefit to shoreline assumed negligible

Alternatives Evaluation – Reach 3

FWOP

In 12 years

Alternatives Evaluation – Reach 3

Alt 3.1
Breakwaters

In 12 years

Lifetime ~ 11 yrs

Alternatives Evaluation – Reach 3

Alt 3.2
Nourishment

In 12 years

Lifetime ~ 12 yrs

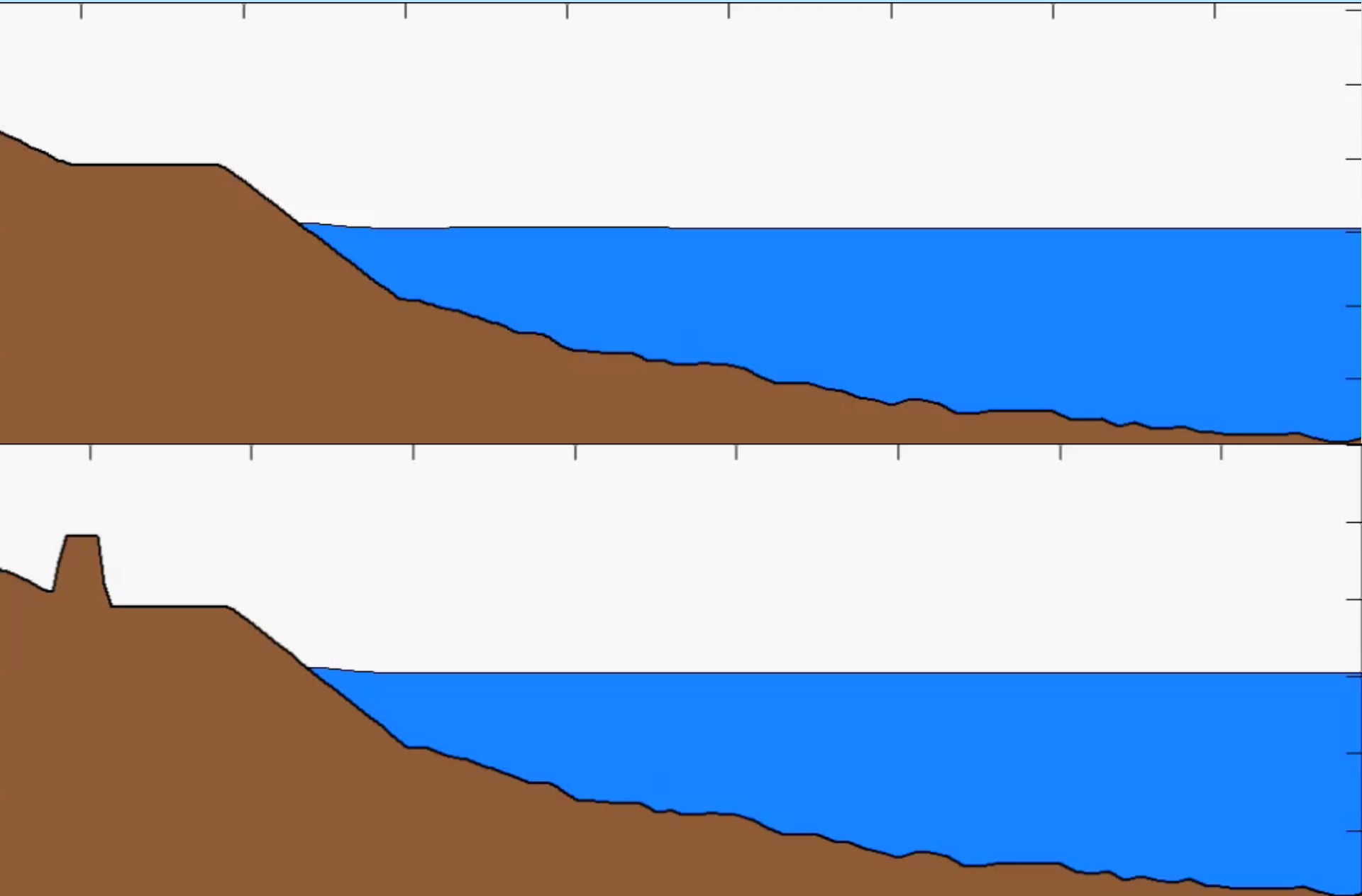
Alternatives Evaluation – Reach 3

Alt 3.3
Nourishment with Breakwaters

In 15 years

Lifetime ~ 15 yrs

Alternatives Evaluation – Dune



Alternatives Evaluation – Dune