



# The International Maritime Transport and Logistics Conference

## “MARLOG 12”

**Sustainable & Innovative  
Technologies**  
Towards a Resilient Future  
12 - 14 March, 2023 Alexandria - EGYPT



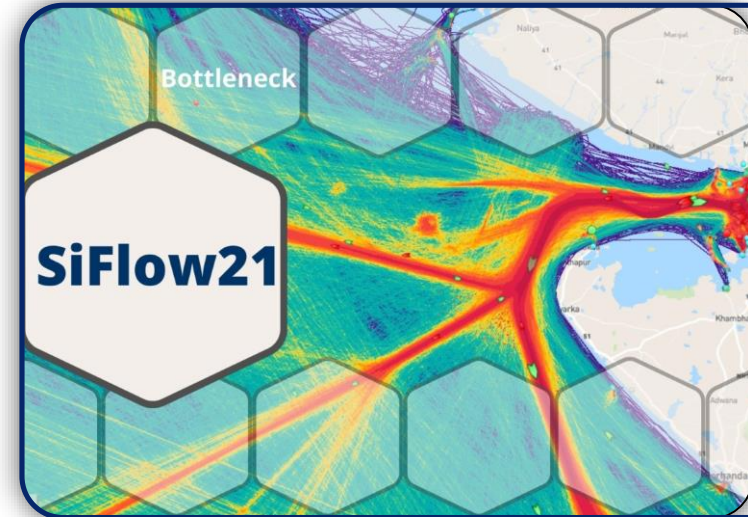


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## **Siflow21.**

**Predictive Simulation of Navigation  
Channels and Port Infrastructure Capacity  
with Automatic Identification System (AIS)  
Data Assessment**



# Siport21

Port consultancy company (Madrid, Spain)



23 years



1300+  
projects



58  
countries



22  
workers

## Ship maneuvering simulation center



1800+  
sailors



600 training  
courses



50 international  
shipping lines



# Bases

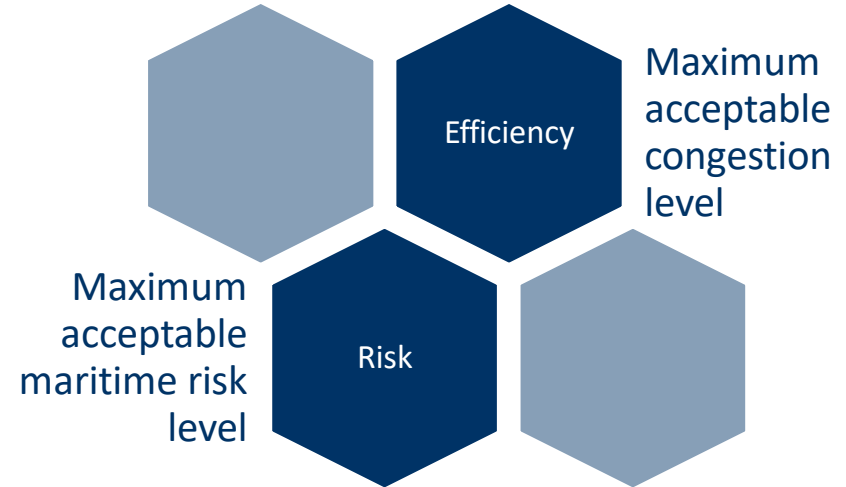
## Projects involving port infrastructure developments

- ↳ Dredging to deepen access channels
- ↳ Masterplans – new terminals
- ↳ Maritime traffic increase
- ↳ Changes in rules and regulations
- ↳ ...

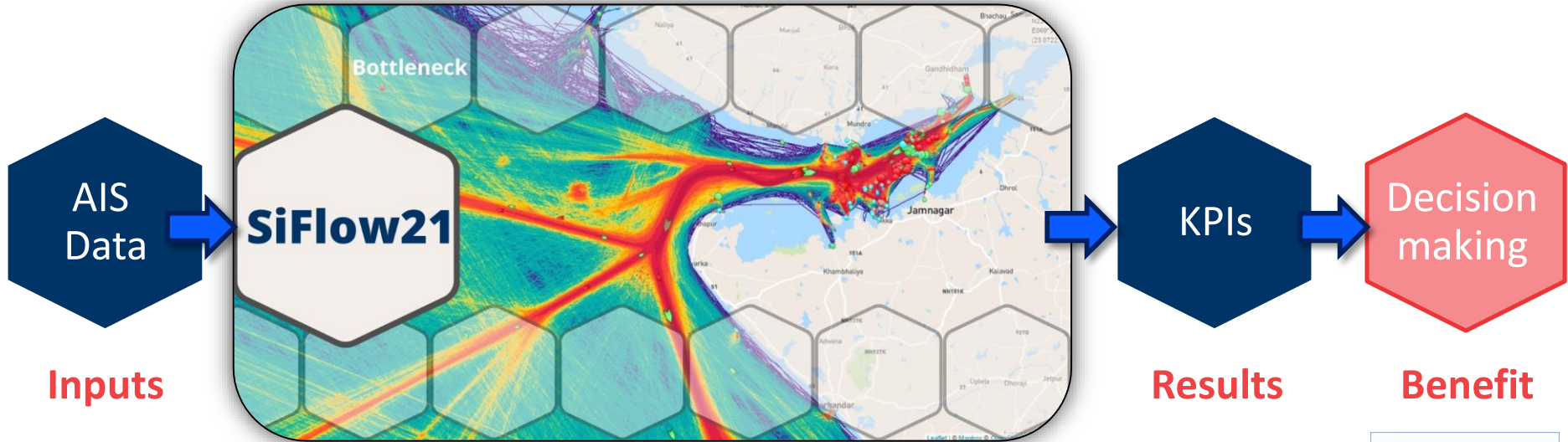
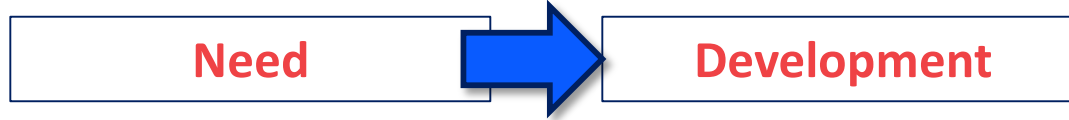


Great investment

Cost-benefit

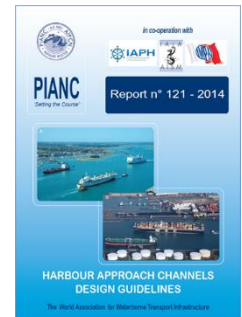


# Methodology

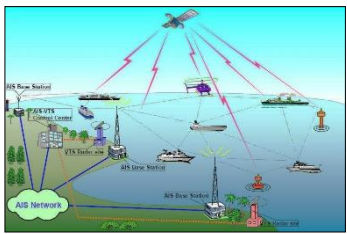


Simulation of Maritime Traffic Flow

Work methodology for the cost / benefit assessment



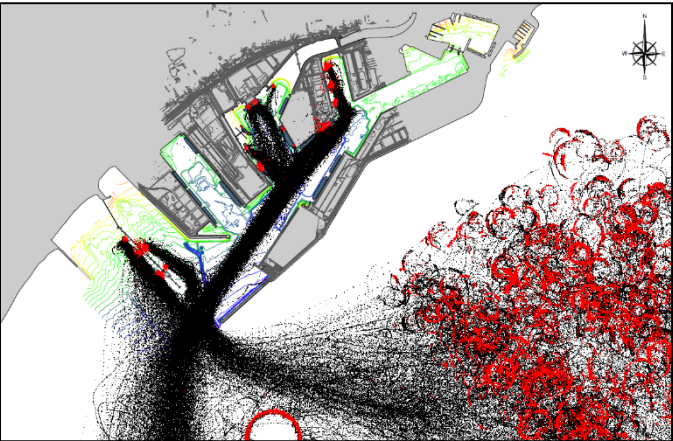
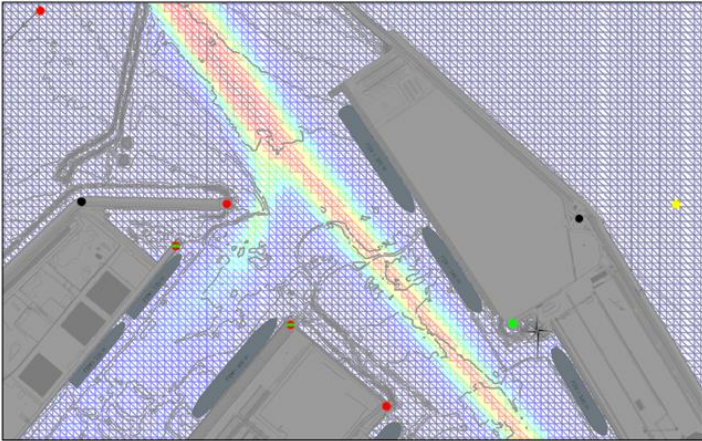
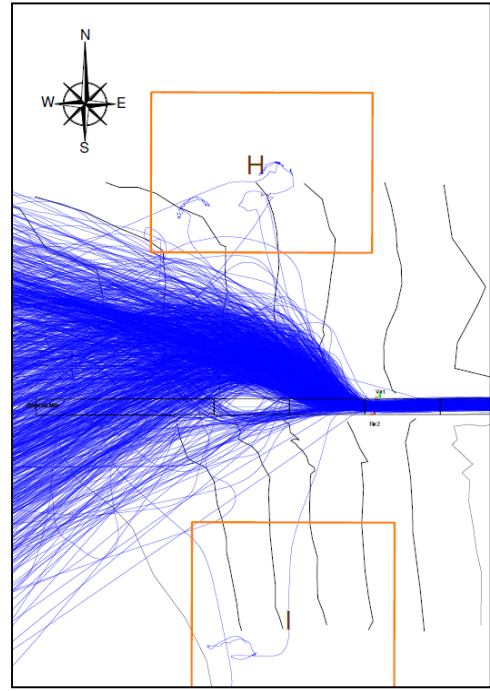
# AIS Data analysis



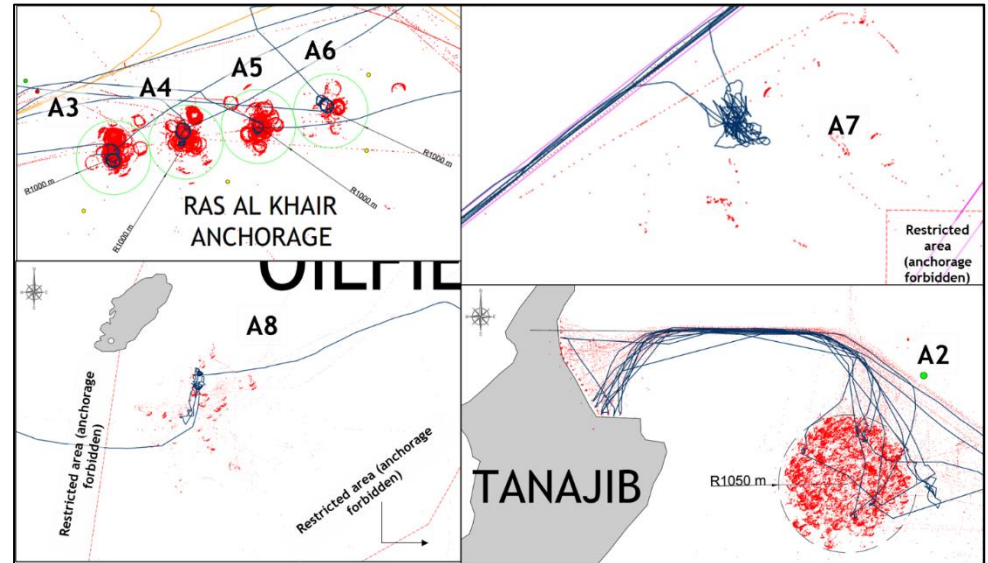
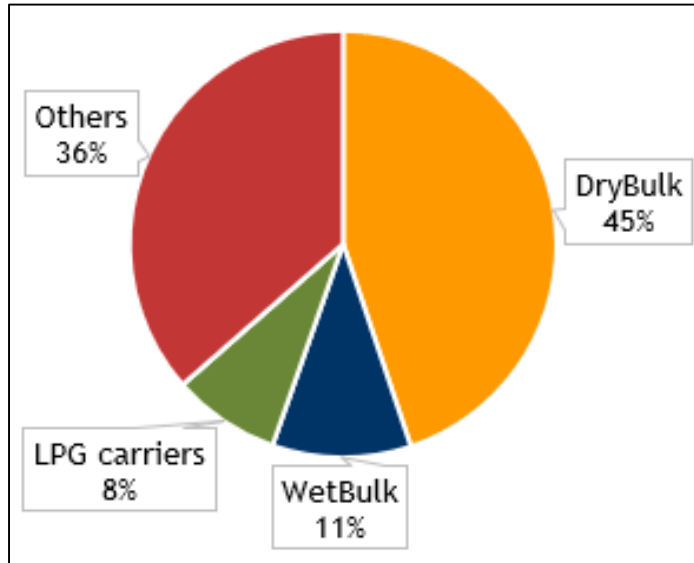
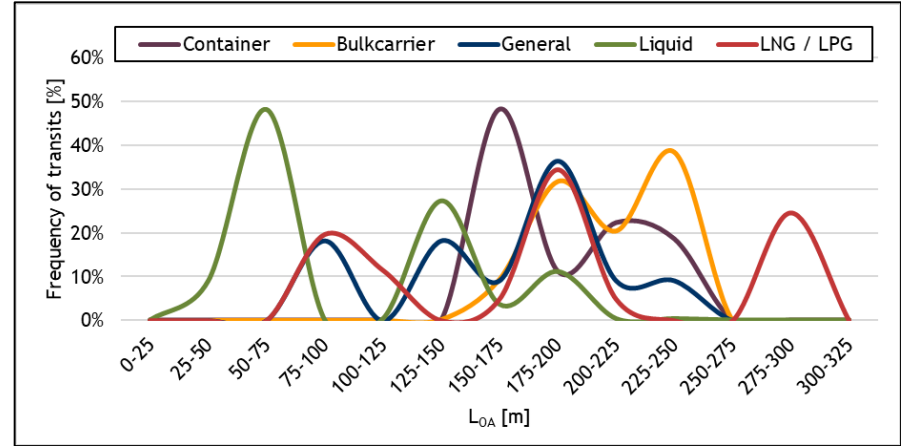
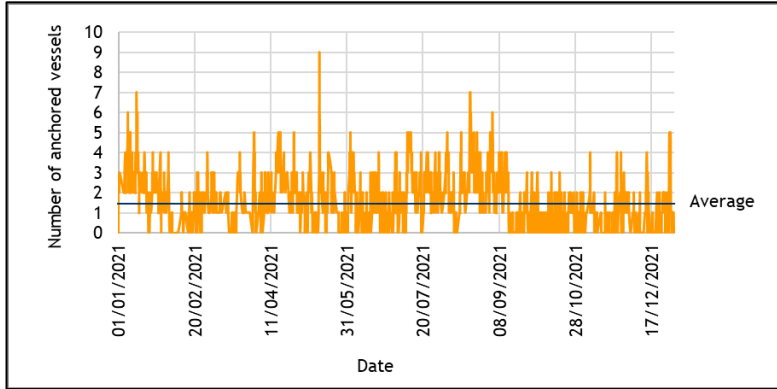
**Large data volume** •  
**Big Data, DataAnalytics & DataViz techniques** •  
**Detailed quantitative description of the traffic flow** •



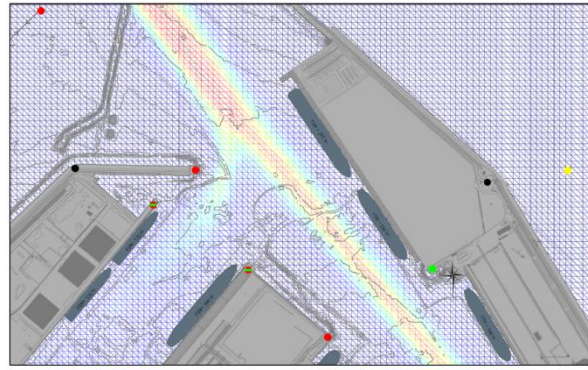
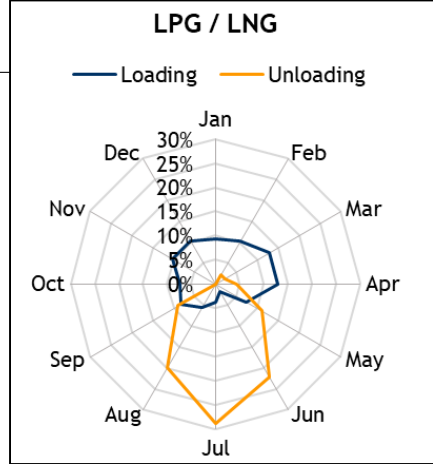
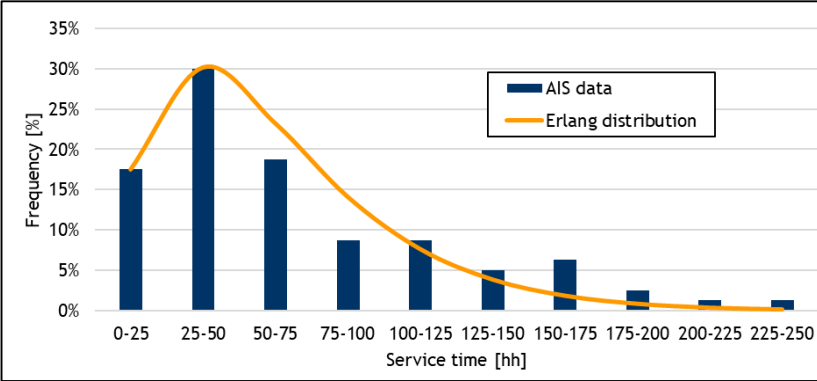
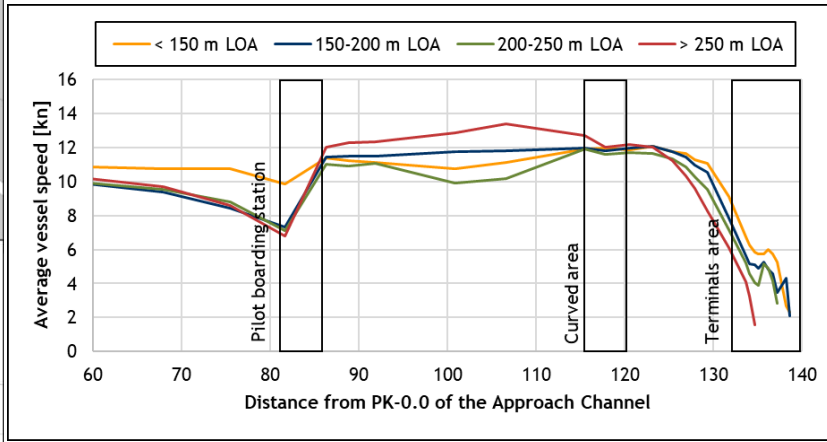
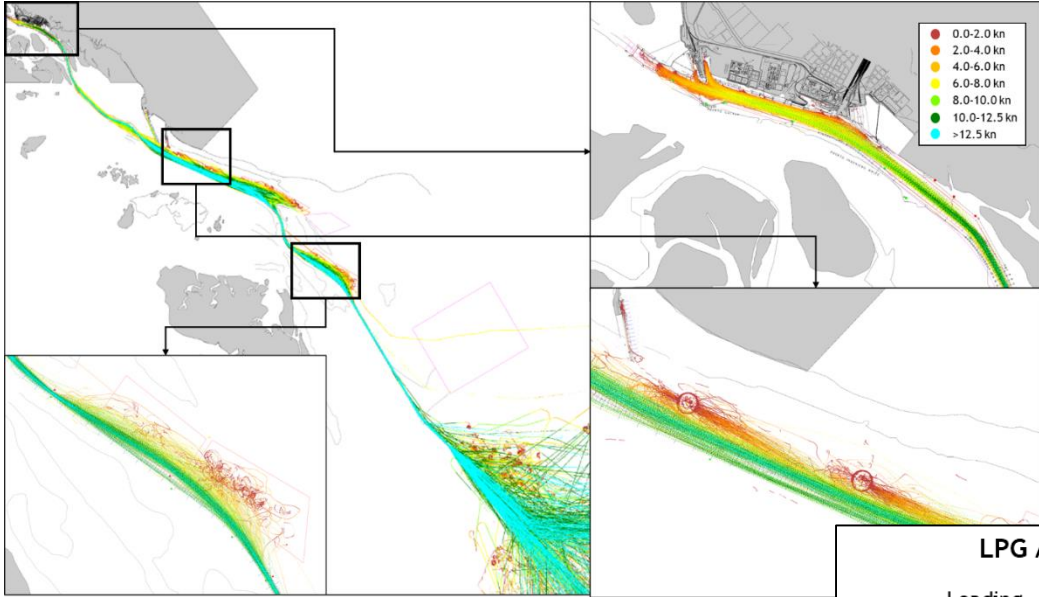
- **Vessel types, sizes and loading conditions**
- **Maneuvering strategy: routes, speed, seasonality**
- **Traffic interferences - encounters**
- **Anchorage / berths stay (number + time)**



# AIS Data analysis



# AIS Data analysis





# KPIs Definition

Key Performance Indicators ad-hoc for each project  
Aligned with individual project aims and particularities

Parameters for calibration (base model) & evaluation (alternate scenarios)



## Efficiency

- Anchorage occupancy level
- Terminals occupancy level
- Service time (loading / unloading)
- Waiting time & causes (bottlenecks)



## Safety

- Number of crossing manoeuvres
- Distance to travel (direct / optimizable route)
- Vessels' speed



## Financial

- Access fees
- Service fees
- Required system sources (pilots, tugs, launches etc.)



## Environmental

- Emissions based on:
  - Number of vessels
  - Type of vessels
  - Vessels' speed
  - Waiting events

# Model building



- **Siflow21: Simulation of Maritime traffic flow**
- **Traffic movements within a harbour area**
- **DES = Discrete Event Simulator**
- **Simulation:**

**Sequential process**

**Joint decisions-making: rules, sources availability, climate, ...**

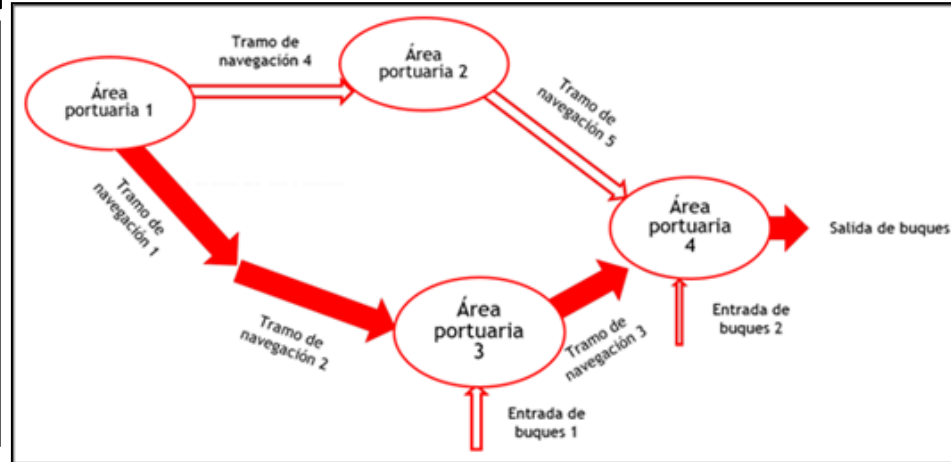
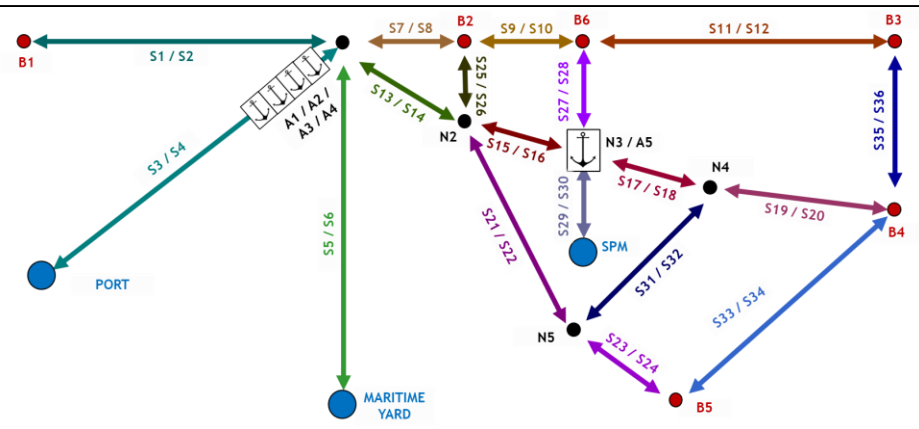
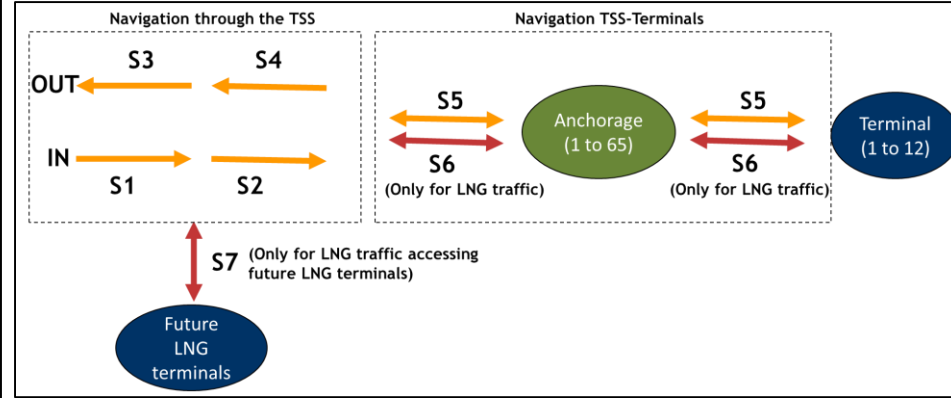
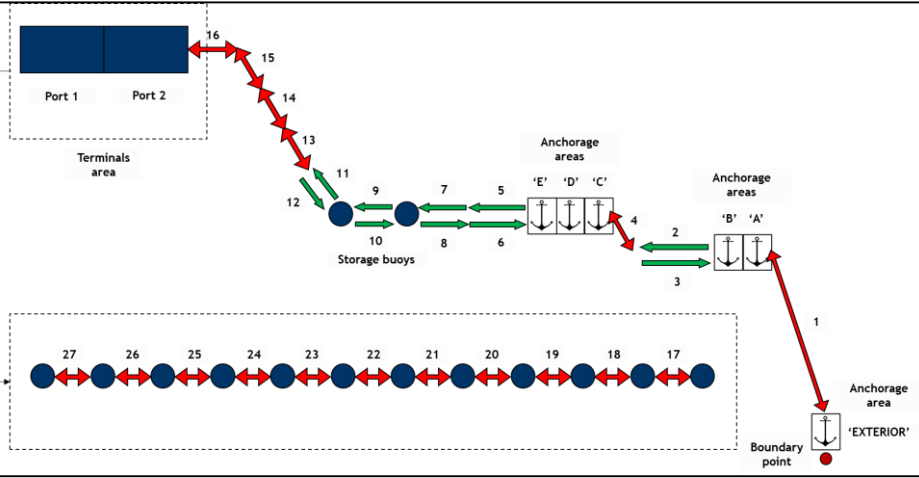
**Analyzed period: typically, 1 year (seasonality), several random repetitions (statistical analysis)**



|                                          |                                                                                                                                                                                                                                                             |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>VESSELS (Dynamic)</b>                 | <ul style="list-style-type: none"><li>• <b>SIZE:</b> length, beam, draught (in / out)</li><li>• <b>ROUTE:</b> destination, service time at berth, vessel speed</li><li>• <b>SEASONALITY</b></li></ul>                                                       |
| <b>Port Elements (static)</b>            | <ul style="list-style-type: none"><li>• <b>CHANNEL SECTIONS</b> (depth, length, capacity)</li><li>• <b>BERTHS</b> (number of berths, berthing length, depth, capacity)</li><li>• <b>ANCHORAGE AREAS</b> (number, available area, depth, capacity)</li></ul> |
| <b>Regulations (VTS, DST, Prácticos)</b> | <ul style="list-style-type: none"><li>• <b>CROSSING / OVERTAKING</b></li><li>• <b>UKC</b></li><li>• <b>CLIMATE</b> (tides, current, wind, waves)</li></ul>                                                                                                  |
| <b>Metocean conditions</b>               | <ul style="list-style-type: none"><li>• <b>WIND</b></li><li>• <b>TIDE</b> (current / water level)</li><li>• <b>WAVES</b></li></ul>                                                                                                                          |

**COMPONENTS**

# Model building



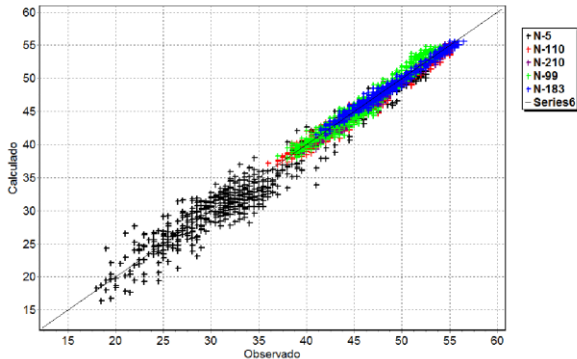
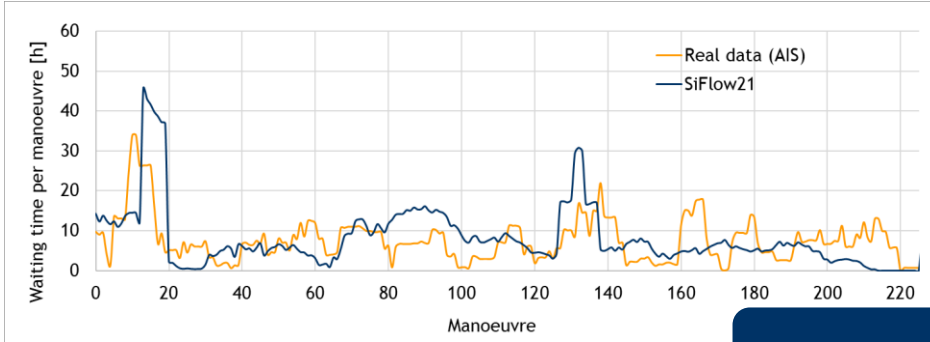
# Model Calibration

**Current situation**  
**Inputs from analysed info (AIS data)**  
**Other aspects to consider**

- 
- 
- 

Calibration  
simulations

Siflow21



Fine-tuning

Comparison  
(AIS) (KPIs)

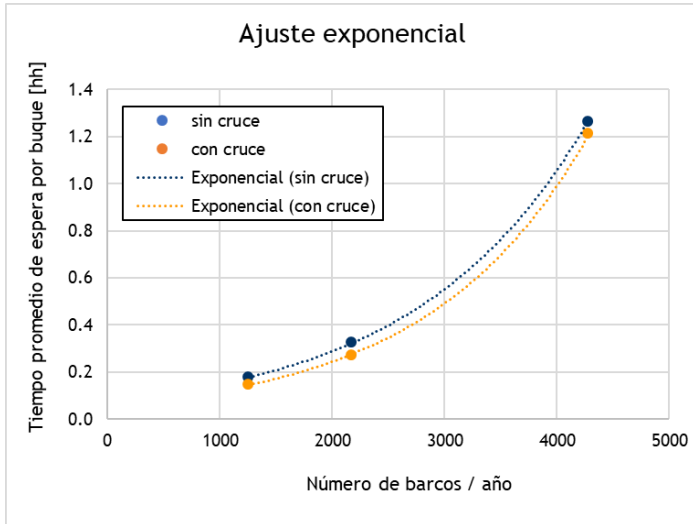
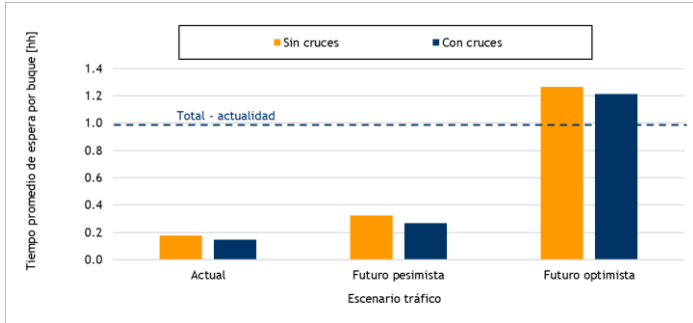
**Model parameters**  
**Level of detail**  
**Additional inputs**

- 
- 
- 

**Model results Vs.**  
**Reality (AIS data)**  
**Acceptable deviations**

- 
- 
-

# Alternate scenarios



Alternate scenarios definition  
Potential impact on current traffic flow

**VERSATILITY**

Examples:

- New infrastructures
- Traffic volume increase
- Rules modification
- New system sources (anchorage, channels, ...)

Lifespan:

- Traffic forecast
- Historical data
- Masterplans

**CURRENT + FUTURE (OPTIMISTIC + PESIMISTIC)**

Siflow21

KPIs

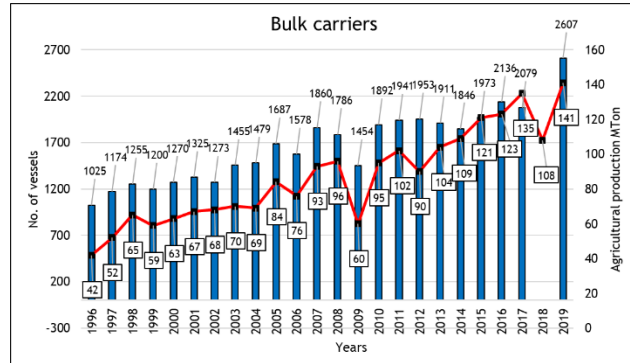
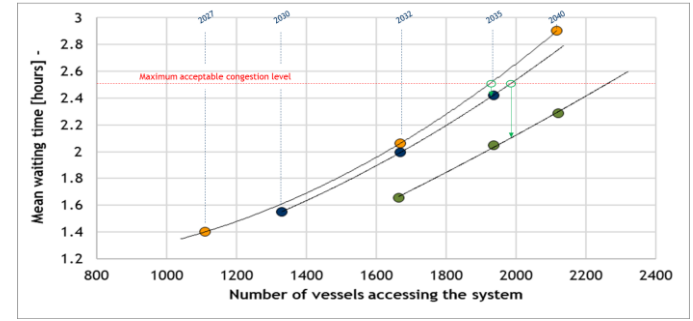
Justified decision-making



# Outstanding projects

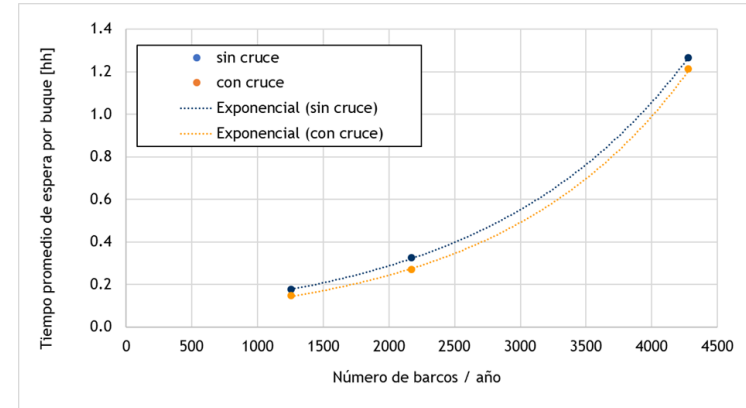
## Bahia Blanca (Argentina) x 2

- Channel deepening (tidal windows)
- Channel widening (new crossing areas)



## Río de la Plata-Hidrovia (Argentina)

- Strong draught limitations
- Complex rules / regulations
- New traffics + volume increase → saturation



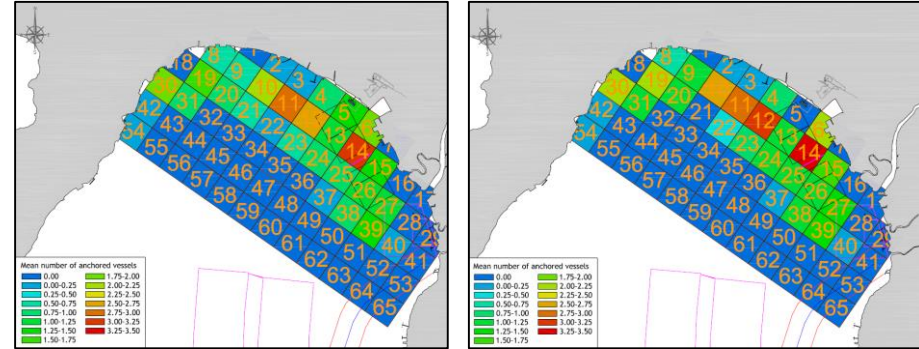
## Buenaventura (Colombia)

- Cost-benefit of a great dredging project (Optimum dredging)
- Efficiency Vs. Risk (crossing areas)

# Outstanding projects

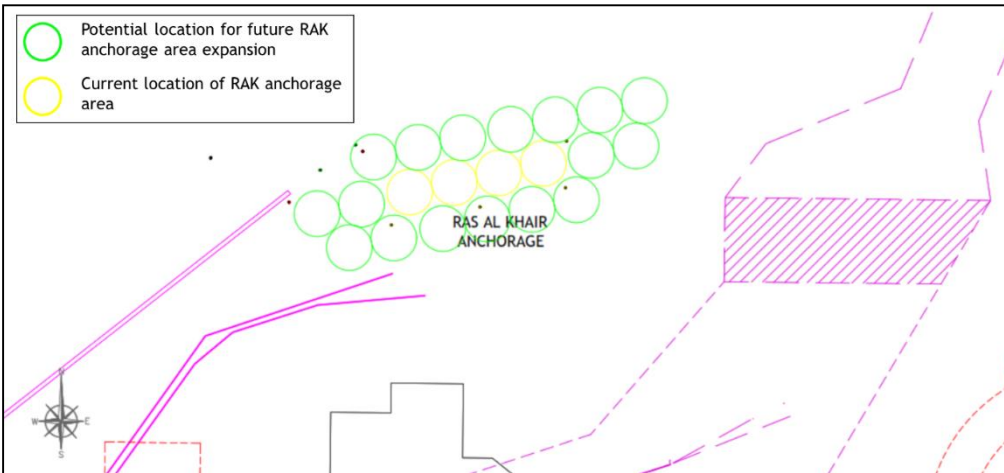
## Philippines Bays

- Sheltered area
- High congestion of anchorages
- Use of anchorages / routes optimization
- New LNG traffic impact



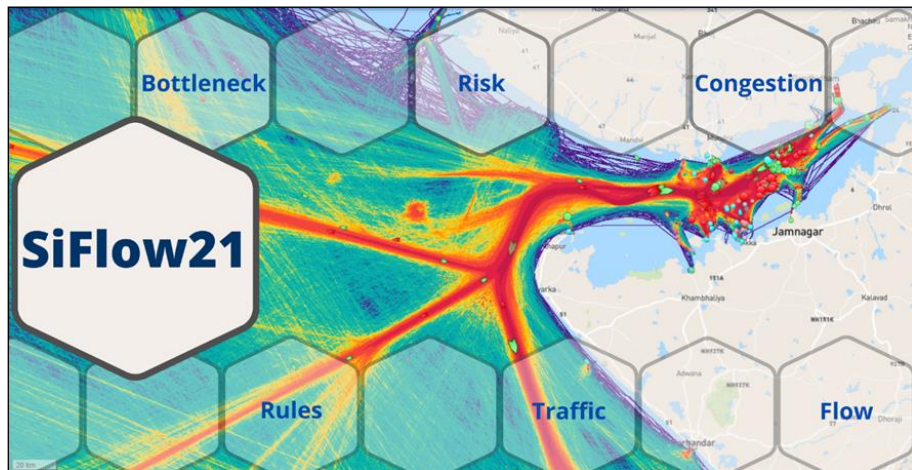
## Saudi Arabia

- Sheltered area
- High congestion of anchorages
- Use of anchorages / routes optimization
- New LNG traffic impact
- Efficiency Vs. Risk → rerouting



# Conclusions

- **Siflow21: pioneering tool - versatility**
- **Used for a wide variety of relevant international projects**
- **Combining:**
  - **Siport21 specialized experience**
  - **SmartPorts working methodologies**
- **Incorporates: port design, operations, safety, risk assessment**
- **Advance tool for traffic management**
- **Utilization for risk – efficiency optimum balance**





# Thank You

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