VAF INSTRUMENTS

Propulsion Performance

using propeller thrust and virtual speedlog

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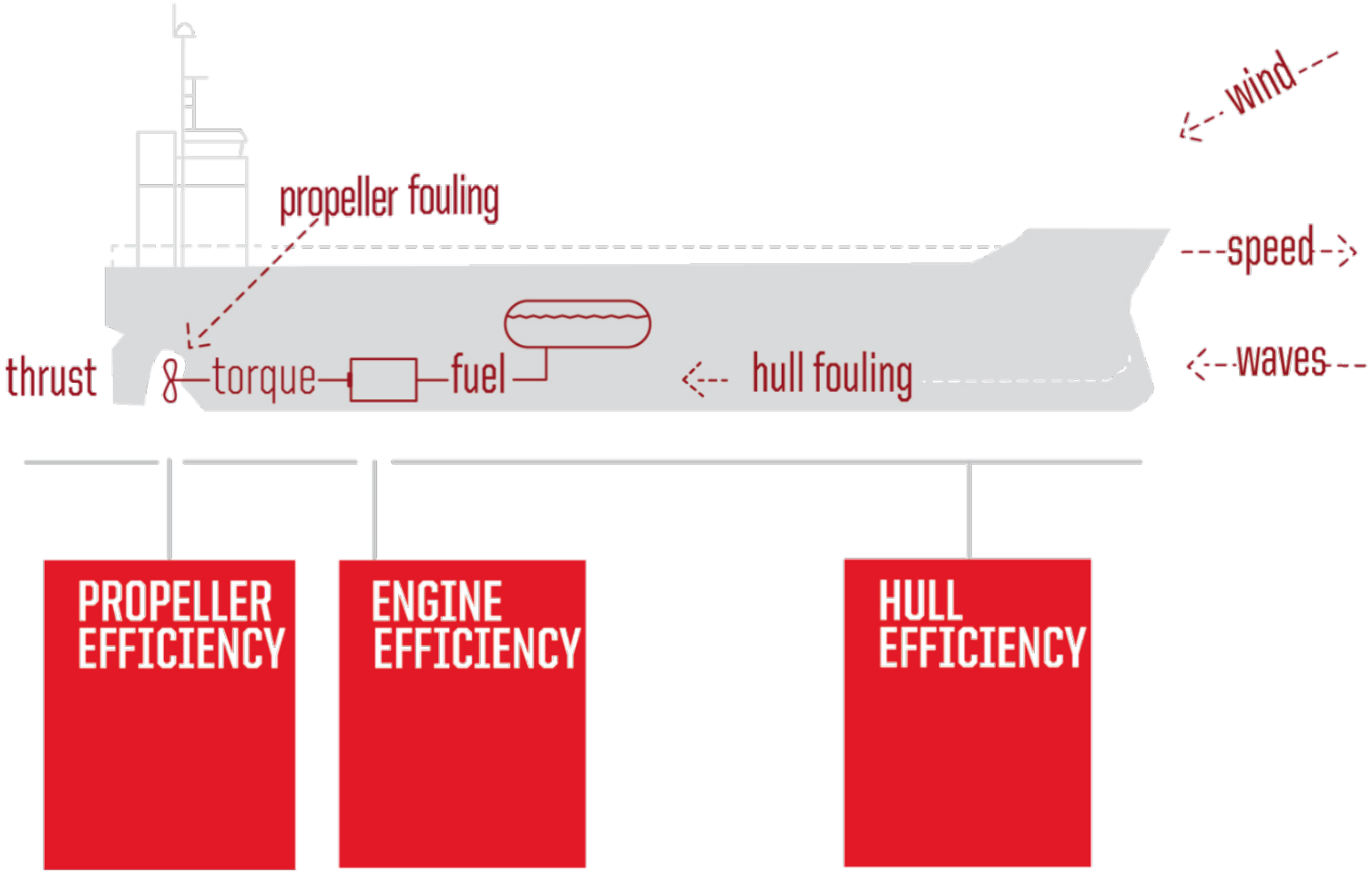
VAF INSTRUMENTS

Performance Monitoring



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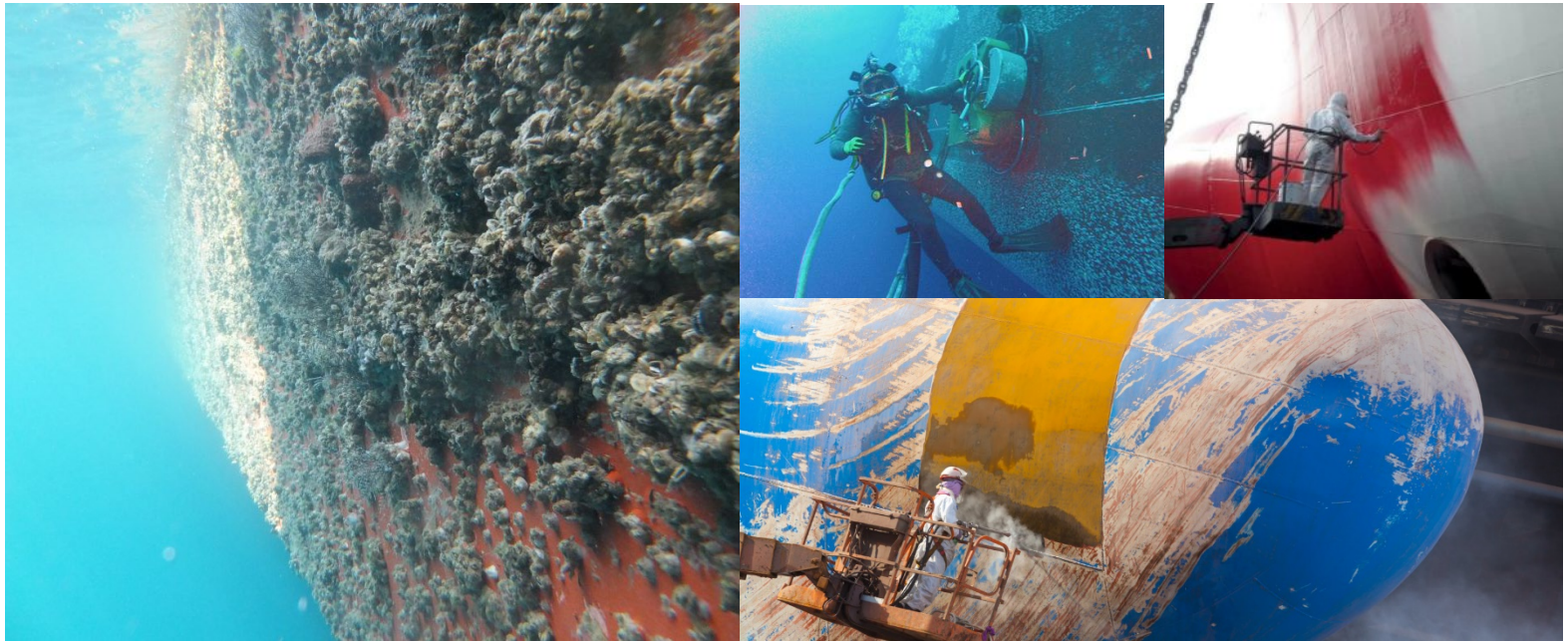
VAF INSTRUMENTS

FUEL > ENGINE > TORQUE > PROPELLER > THRUST > SHIP HULL > SHIP SPEED

Thrust to separate the propeller performance from the hull performance

- The **hull**
  - Coating
  - Fouling
  - Damages
  - Energy Saving Devices on hull
  - Trim
  - Design



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VAF INSTRUMENTS

FUEL > ENGINE > TORQUE > PROPELLER > THRUST > SHIP HULL > SHIP SPEED

Thrust to separate the propeller performance from the hull performance

- The **propeller**
  - Fouling
  - Damages of leading edges or on the surface due to corrosion
  - Cavitation
  - Design

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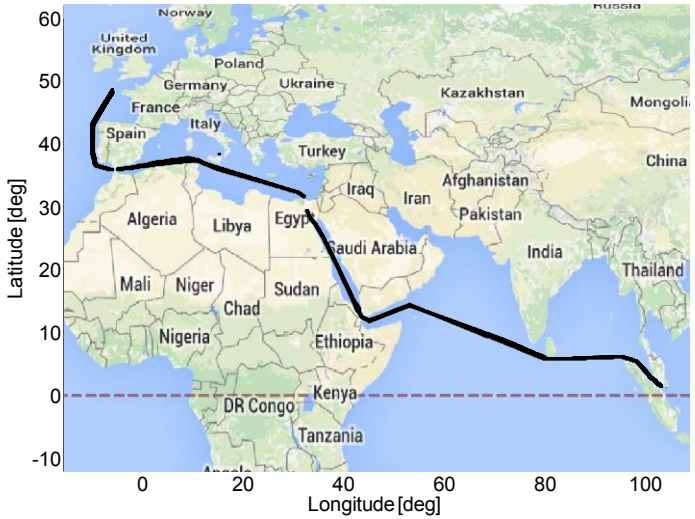
Case study: 14,000+ TEU container vessel

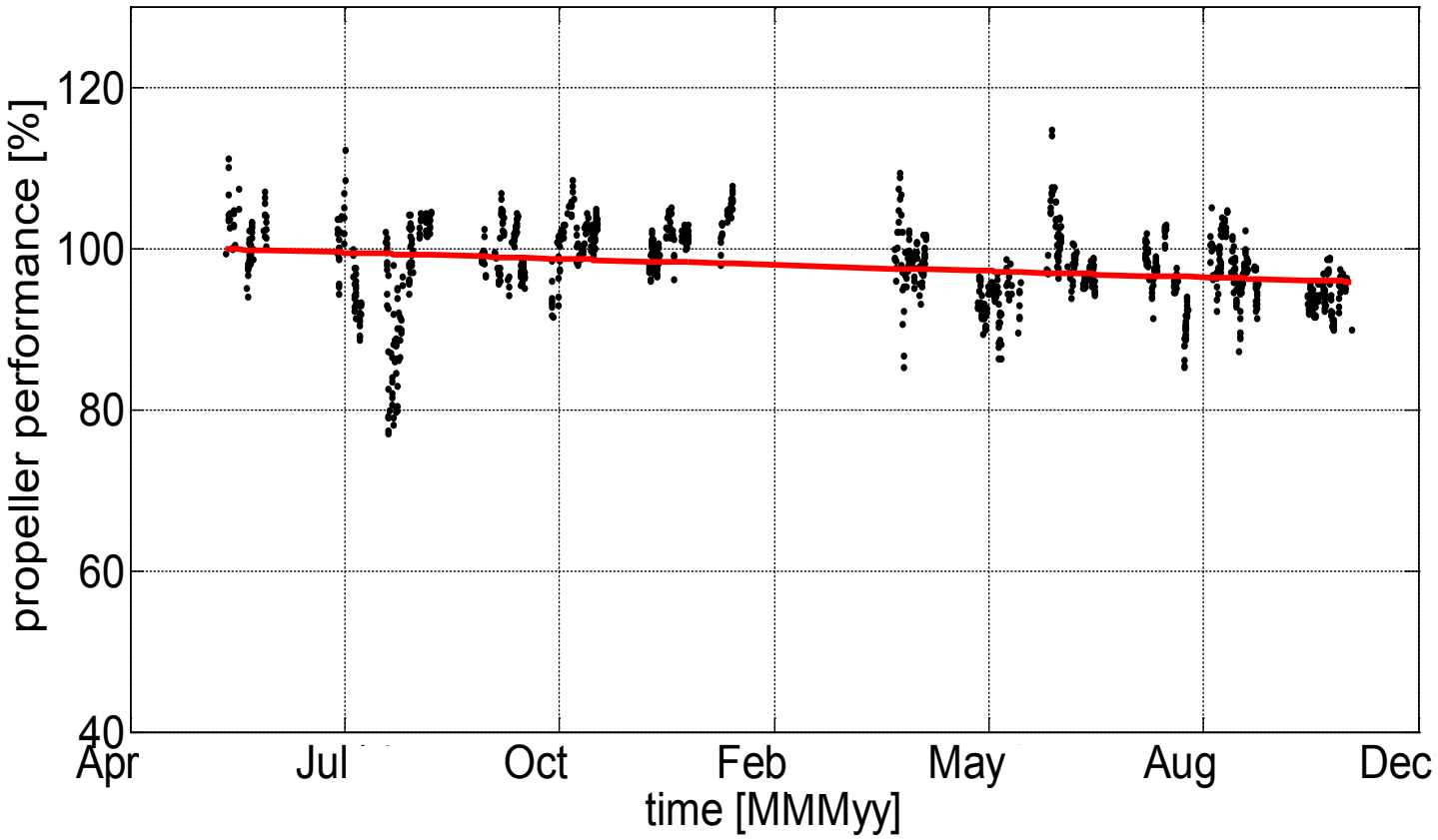


Measurements over a period of 1,5 years. Analysis of:

- Propeller efficiency
- Hull resistance

VAF INSTRUMENTS

FUEL > ENGINE > TORQUE > PROPELLER > THRUST > SHIP HULL > SHIP SPEED



Propeller performance >3000 individual measurement points.
Decrease 3.7% over 18 months (**2.6%** per year)

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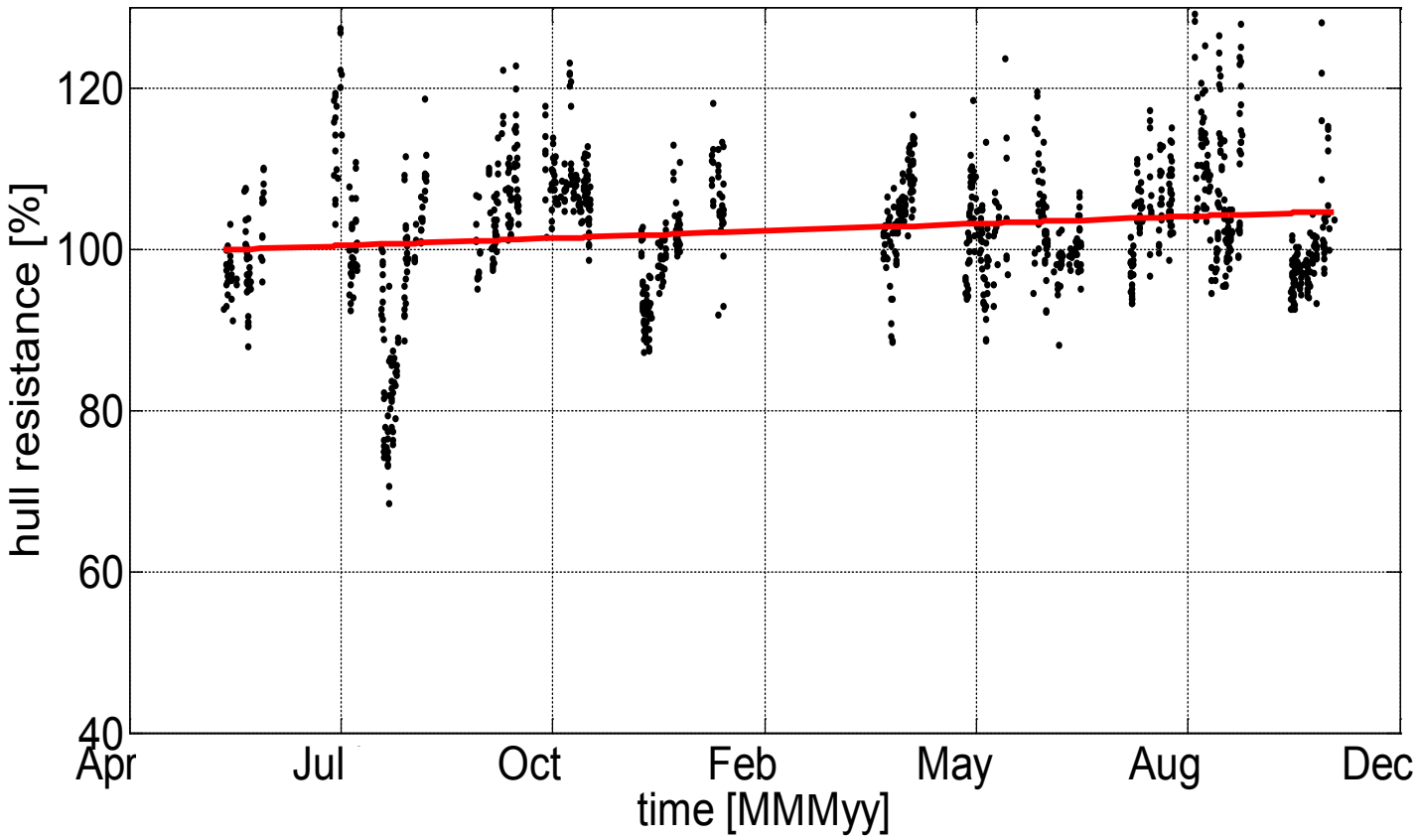
VAF INSTRUMENTS

FUEL > ENGINE > TORQUE > PROPELLER > THRUST > SHIP HULL > SHIP SPEED



Hull resistance >3000 individual measurement points
Increase 5.2% over 18 months, (**3.6%** per year).

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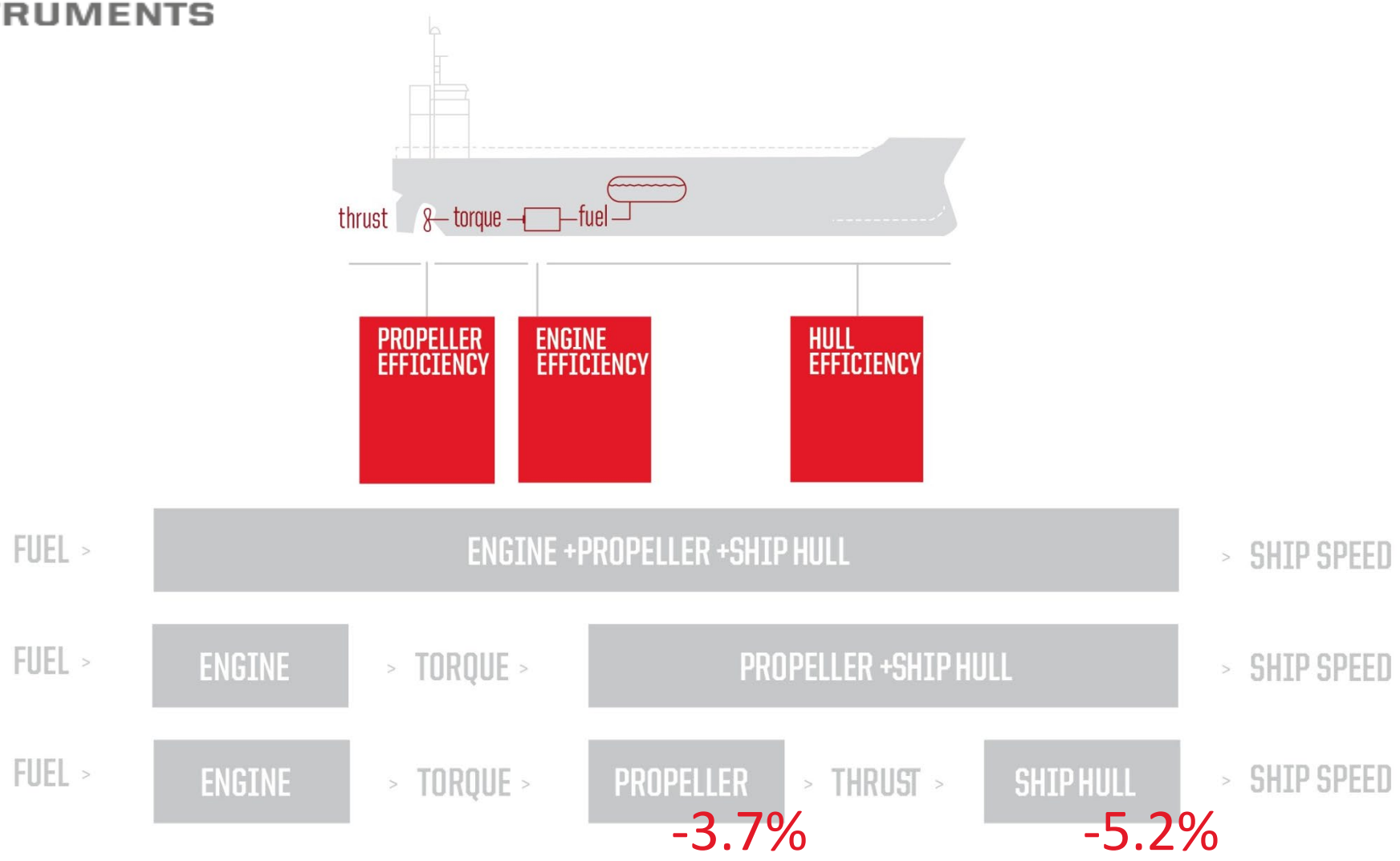
Performance Monitoring



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Energy/cost saving potential

	Efficiency decrease	Fuel increase tn / year
Propeller efficiency decrease Hull resistance increase	3,7% 5,2%	1000+ 1500+

- Large cost and energy saving potentials
- The propeller contributes significantly to the increased fuel costs: +/- 40% of total

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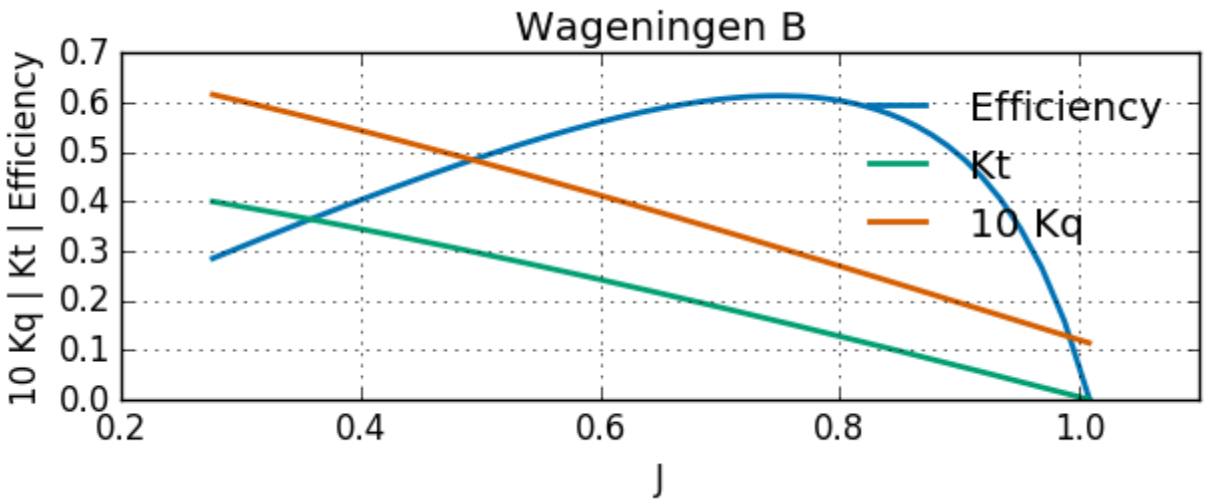
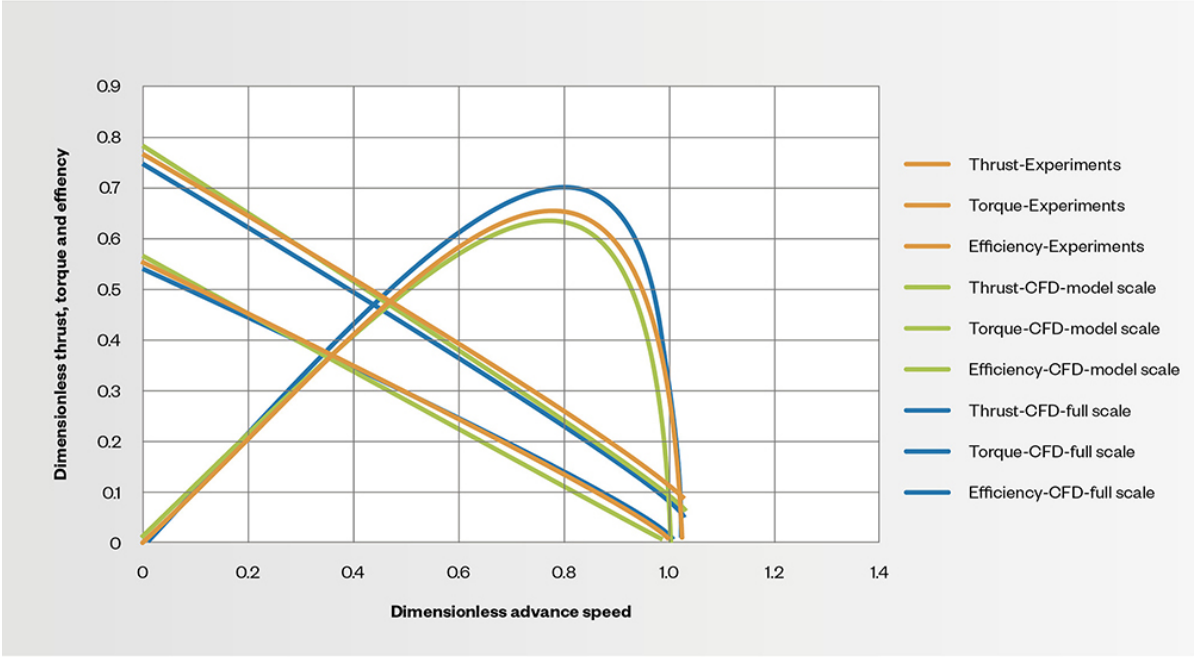
Why not use a reference curve?





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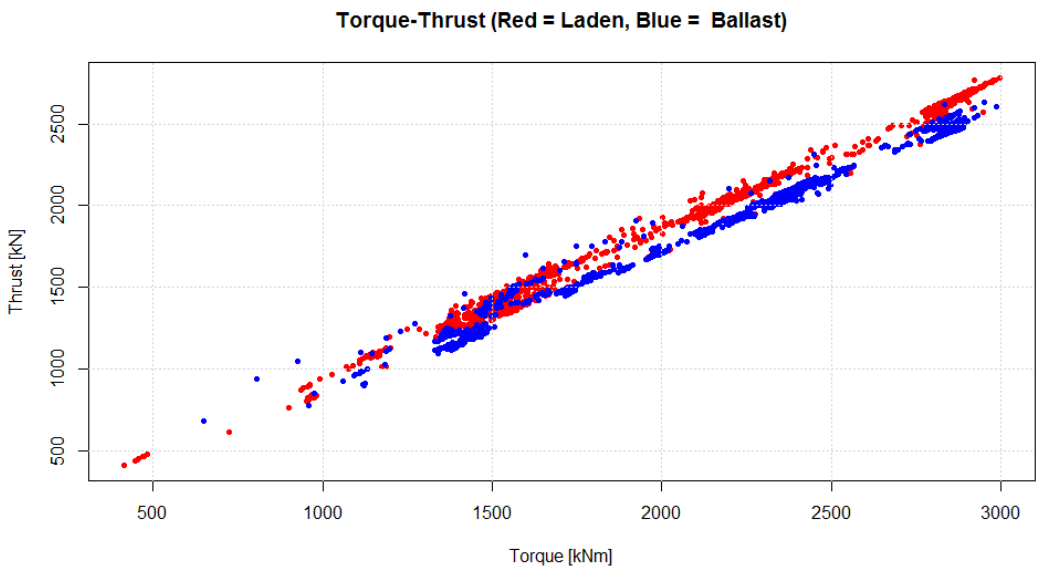
Hydrodynamic Model

Too many parameters

Windspeed
Current
Trim
Water depth
Water temperature
…



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Speed through water (STW)

- Speed logs often have errors in accuracy
  - Wrong calibration
  - Sensitive to environmental changes:
    - Fouling
    - Temperature and salinity
    - Changes in boundary layer

Doppler Speedlog, artist impression

Performance metrics are biased by inaccurate speedlogs

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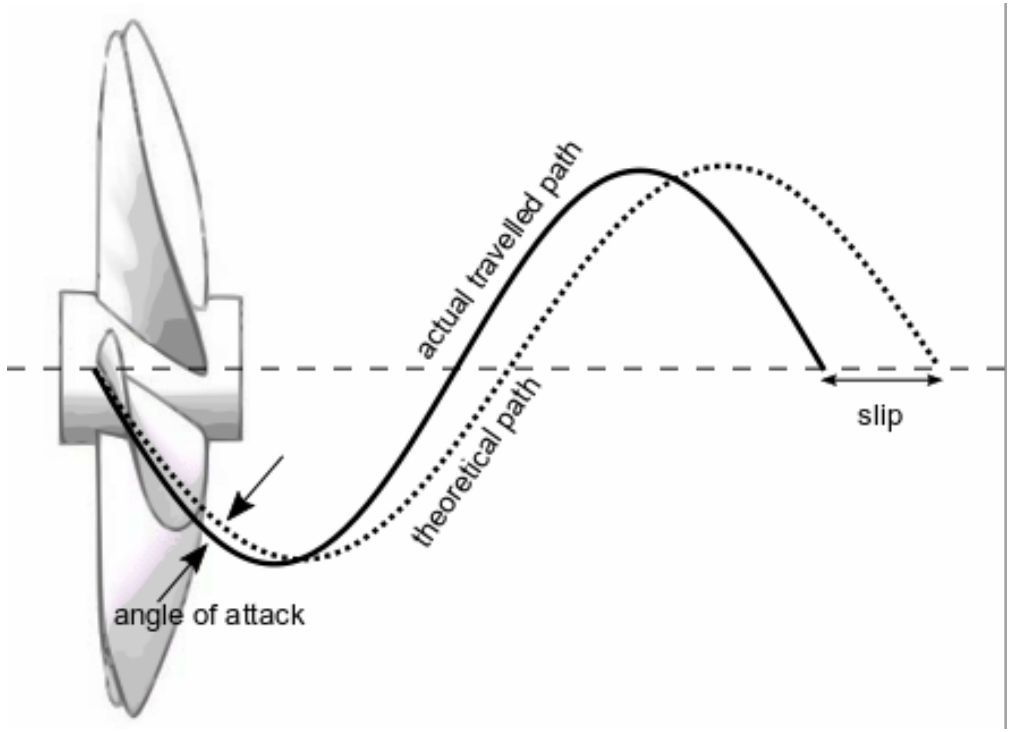
VAF INSTRUMENTS

Speed through water (STW)



- Propeller revolutions are used to determine travelled distance
- Thrust measurement accurately indicates the amount of slip

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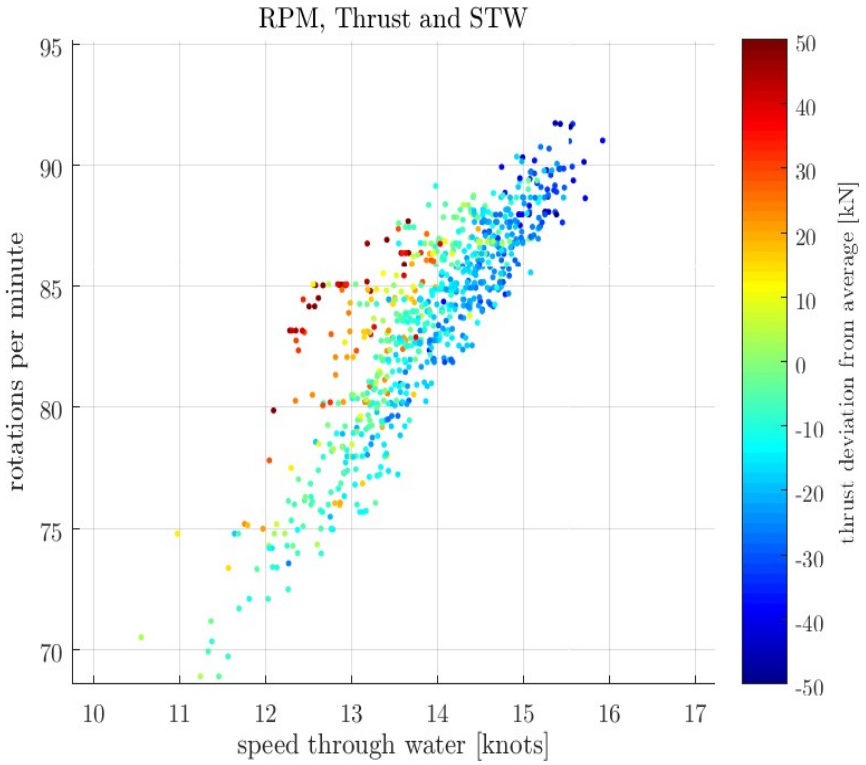
Speed through water (STW)

- Slip is calculated by establishing the relation between RPM, thrust and speed over ground by a statistical analysis of collected data

- Speed through water is determined with values for slip and rpm



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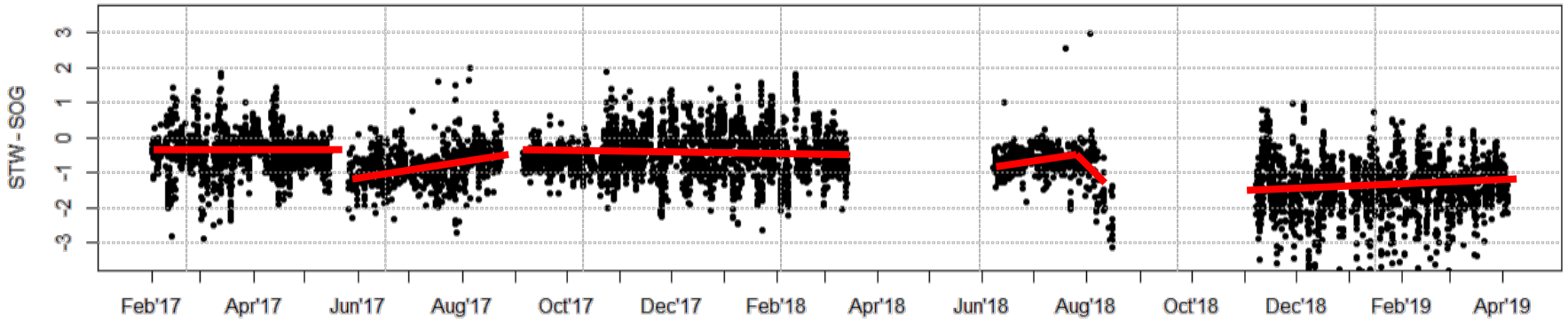
STW Correction

Speedlogs show long-term variation, which leads to wrong KPIs



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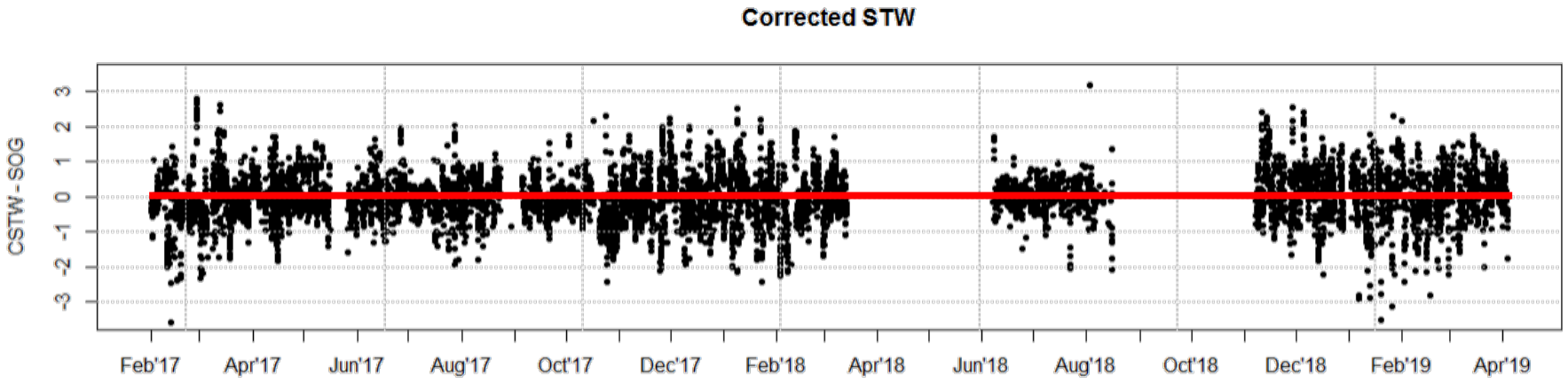
STW Correction

Correct using TT-Sense data



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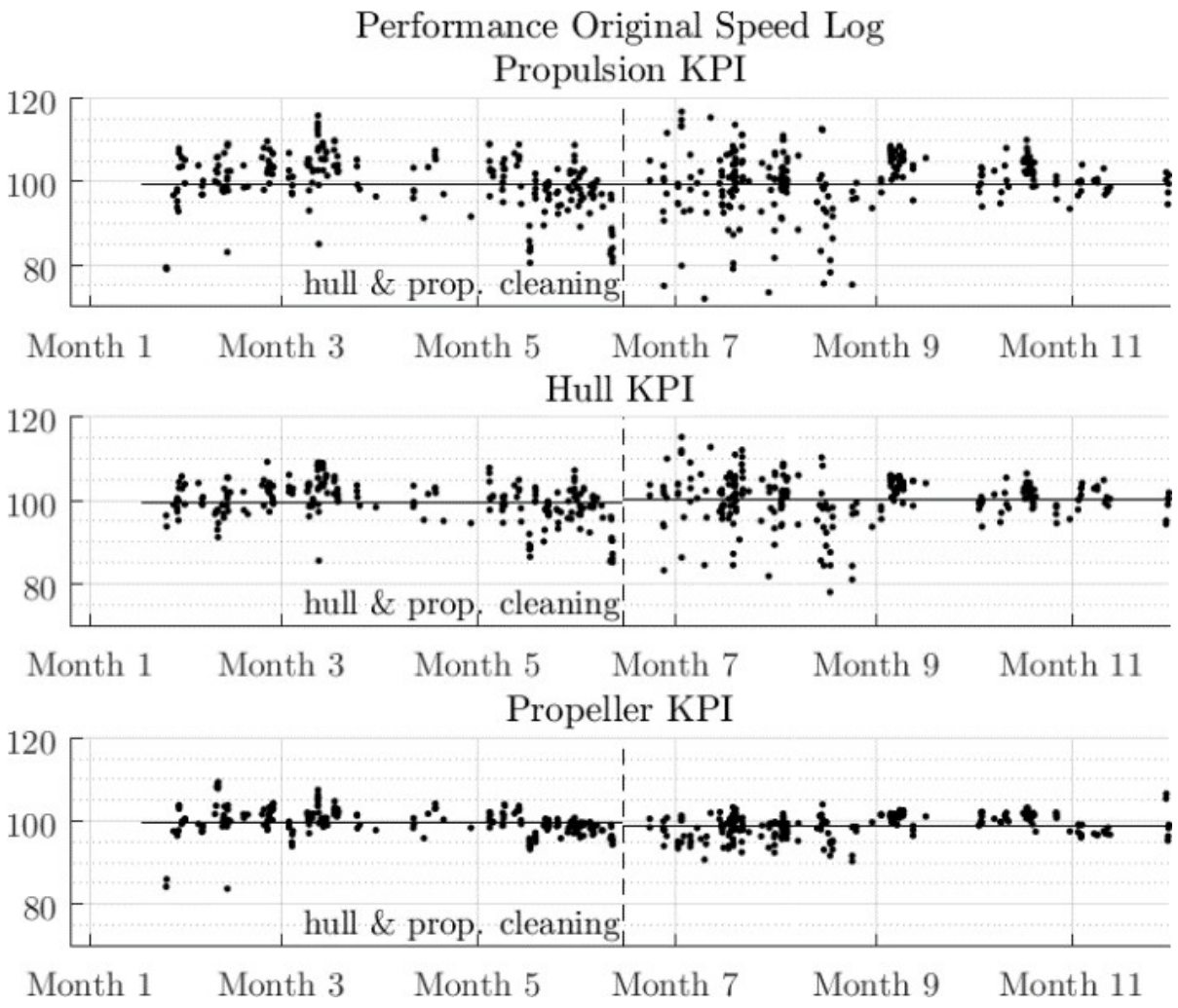
Case studies



-0.2%

0.7%

-0.8%

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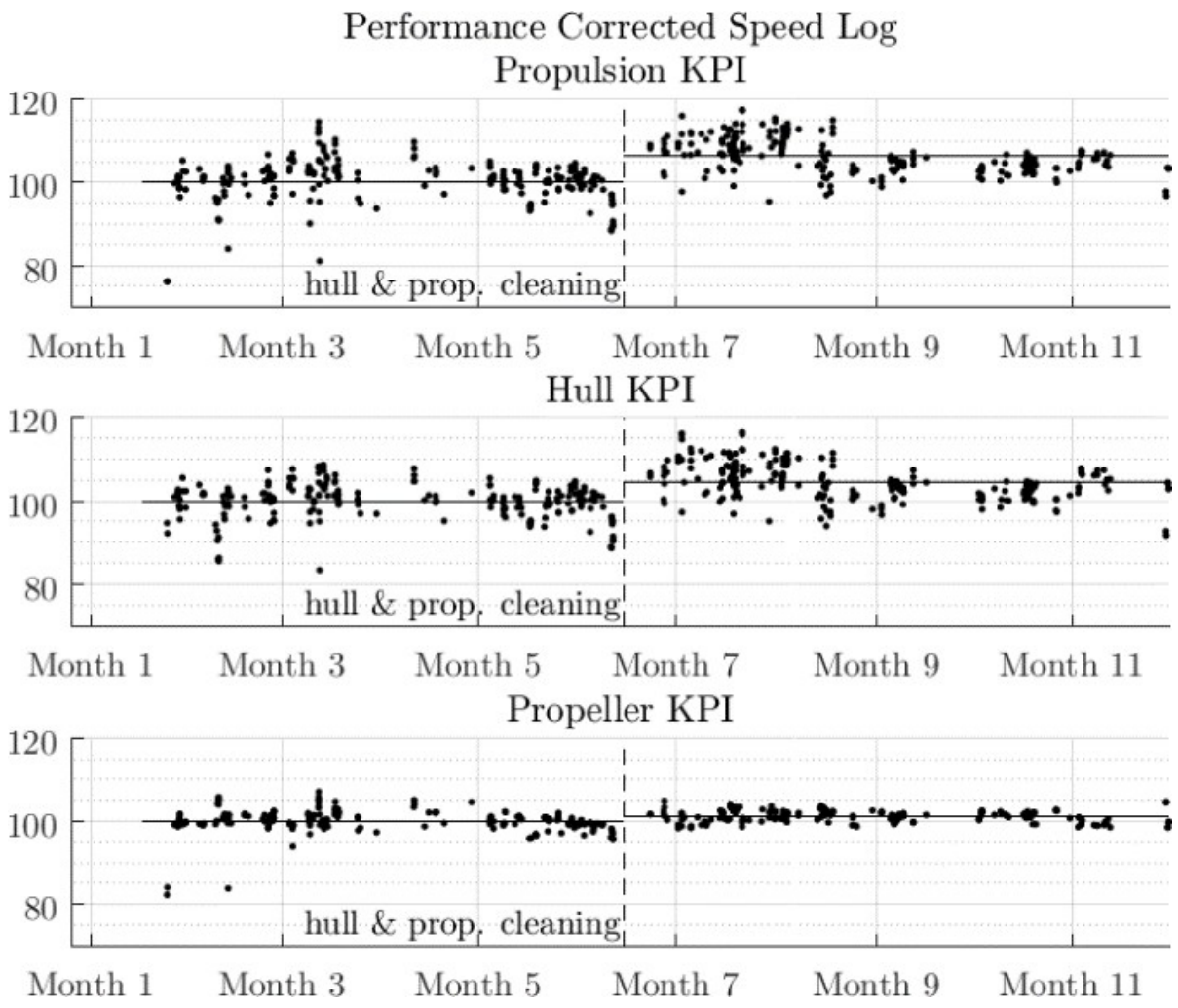
VAF INSTRUMENTS

Case studies



6.1%

4.6%

1.3%

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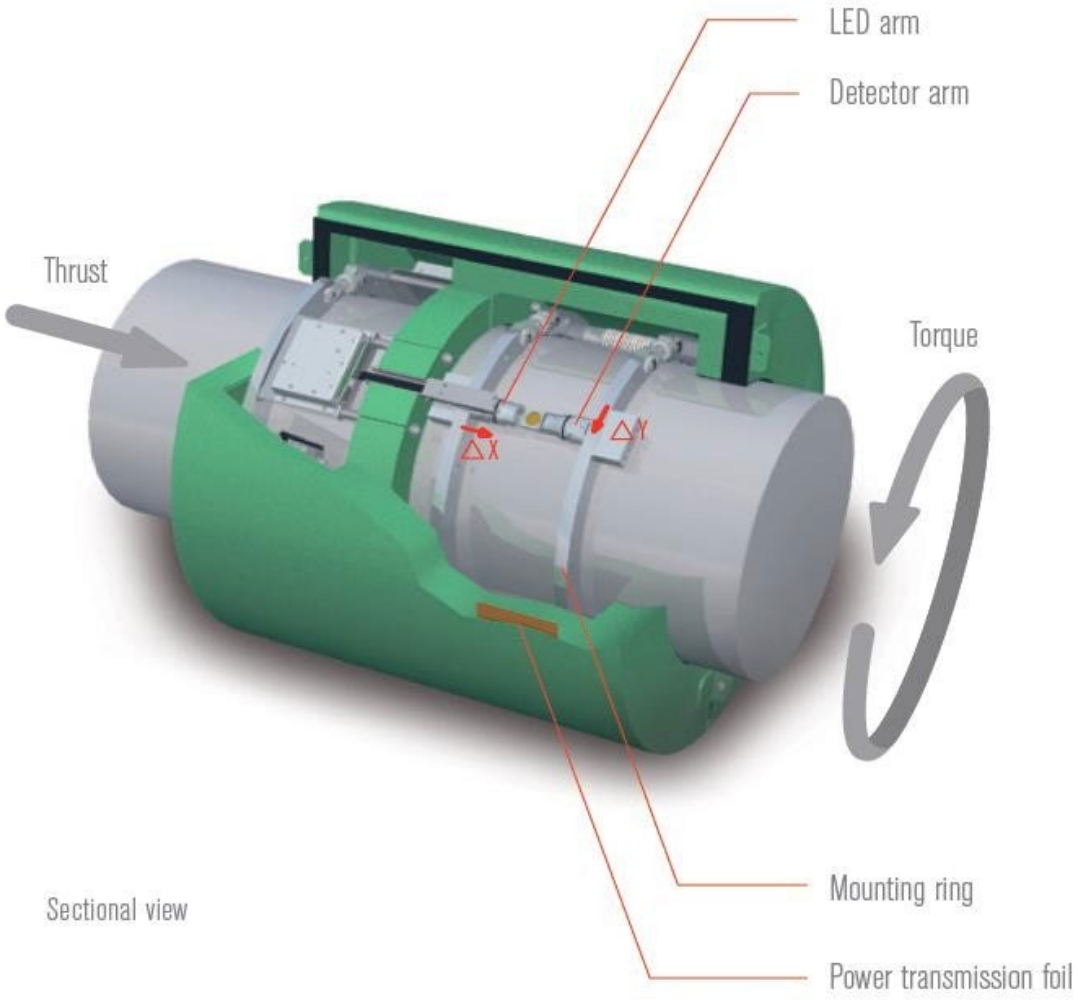
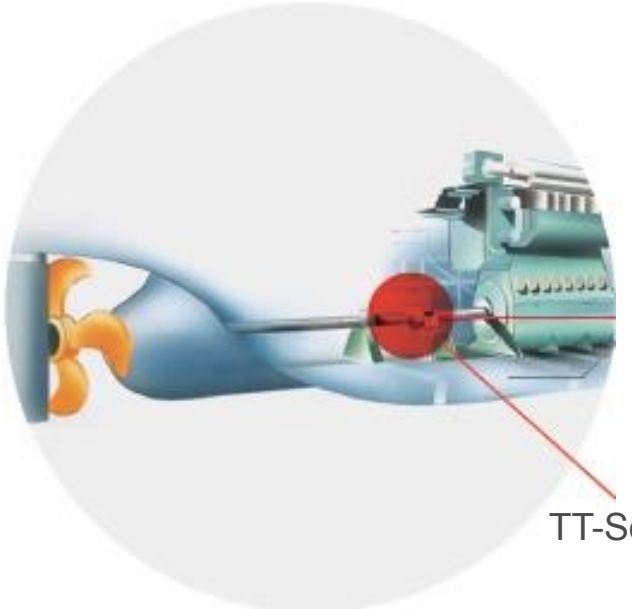
Measuring Thrust





Working principle:

- Torsion (torque)
- Compression (thrust)

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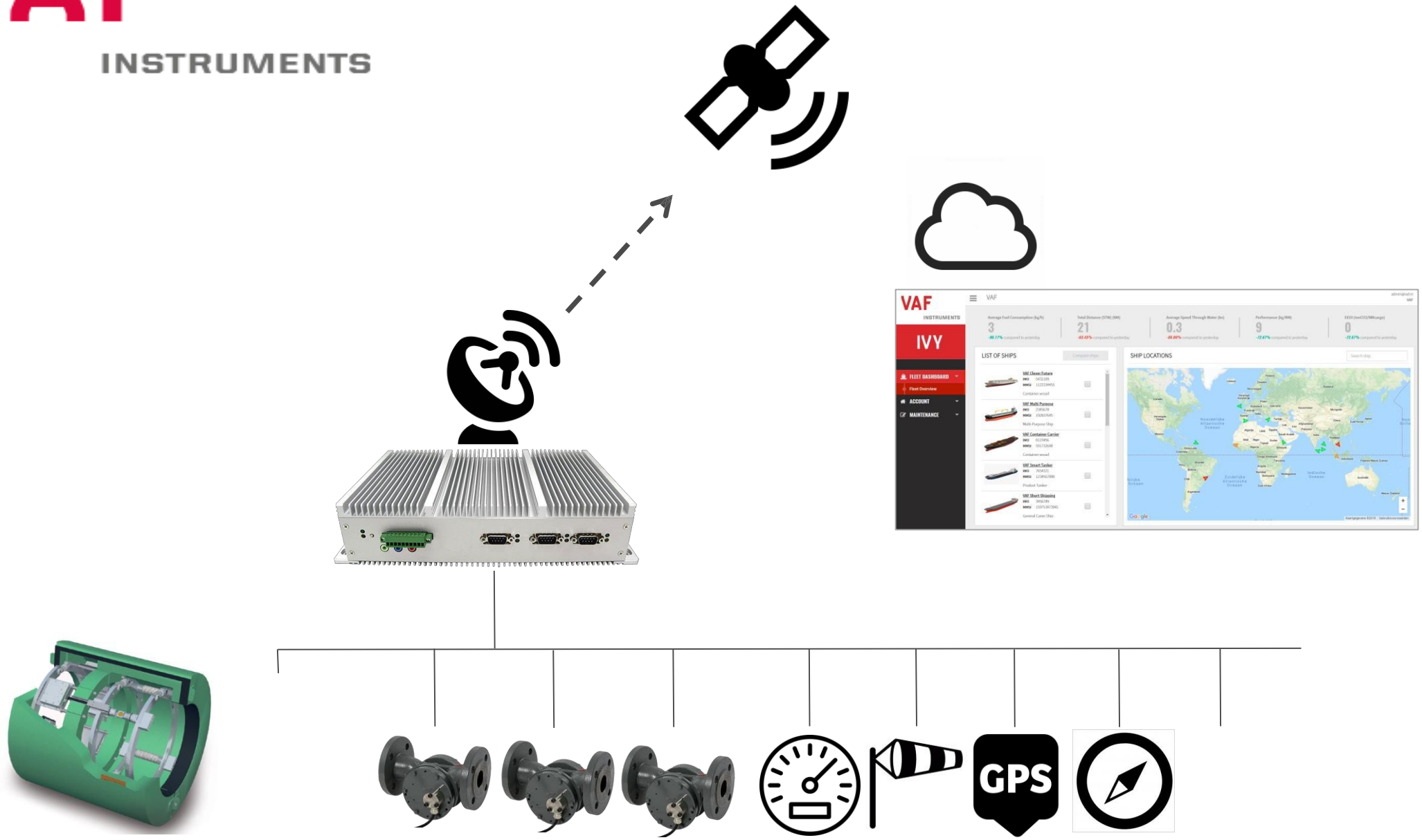
IVY® solution



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VAF INSTRUMENTS

Measuring Thrust

Measurement thrust ➔ separate propeller from hull performance

Hull Propeller Fouling | Fuel

HULL KPI

Start to date	✓ 4.30 %	Estimated additional FOC due to hull fouling	1452 $/day
Rate of change	-0.29 %/month	Total since last maintenance	311399 $

Last maintenance 2018/01/01 (429 days ago)

PROPELLER KPI

Start to date	✓ 2.48 %	Estimated additional FOC due to propeller fouling	836 $/day
Rate of change	-0.17 %/month	Total since last maintenance	179336 $

Last maintenance 2018/01/01 (429 days ago)

Fuel price ($/ton): 435

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INSTRUMENTS

TT-Sense®

Thrust & Torque Measurement
To separate propeller performance from hull resistance

T-Sense®

Torque Measurement
To provide engine performance related to fuel consumption

ViscoSense®3D

Viscosity & Density Measurement
To enable mass flow measurement

PT2 Flowmeters

Highly Accurate Flow Measurement
To monitor fuel consumption

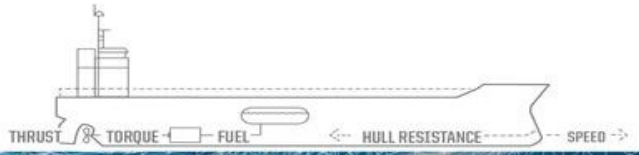
IVY®

Ship-to-Shore Data Collection, Enrichment & Analysis
To manage and improve propulsion performance

Oilcon®

Oil Discharge Monitoring
To ensure environmental compliance

Improve Ship Efficiency
Reduce Environmental Impact
Save up to 20% Fuel & Maintenance Costs



PROPELLER EFFICIENCY	FUEL EFFICIENCY	HULL EFFICIENCY

Solutions for:

- Propulsion Performance
- Fuel Efficiency
- Environmental Compliance

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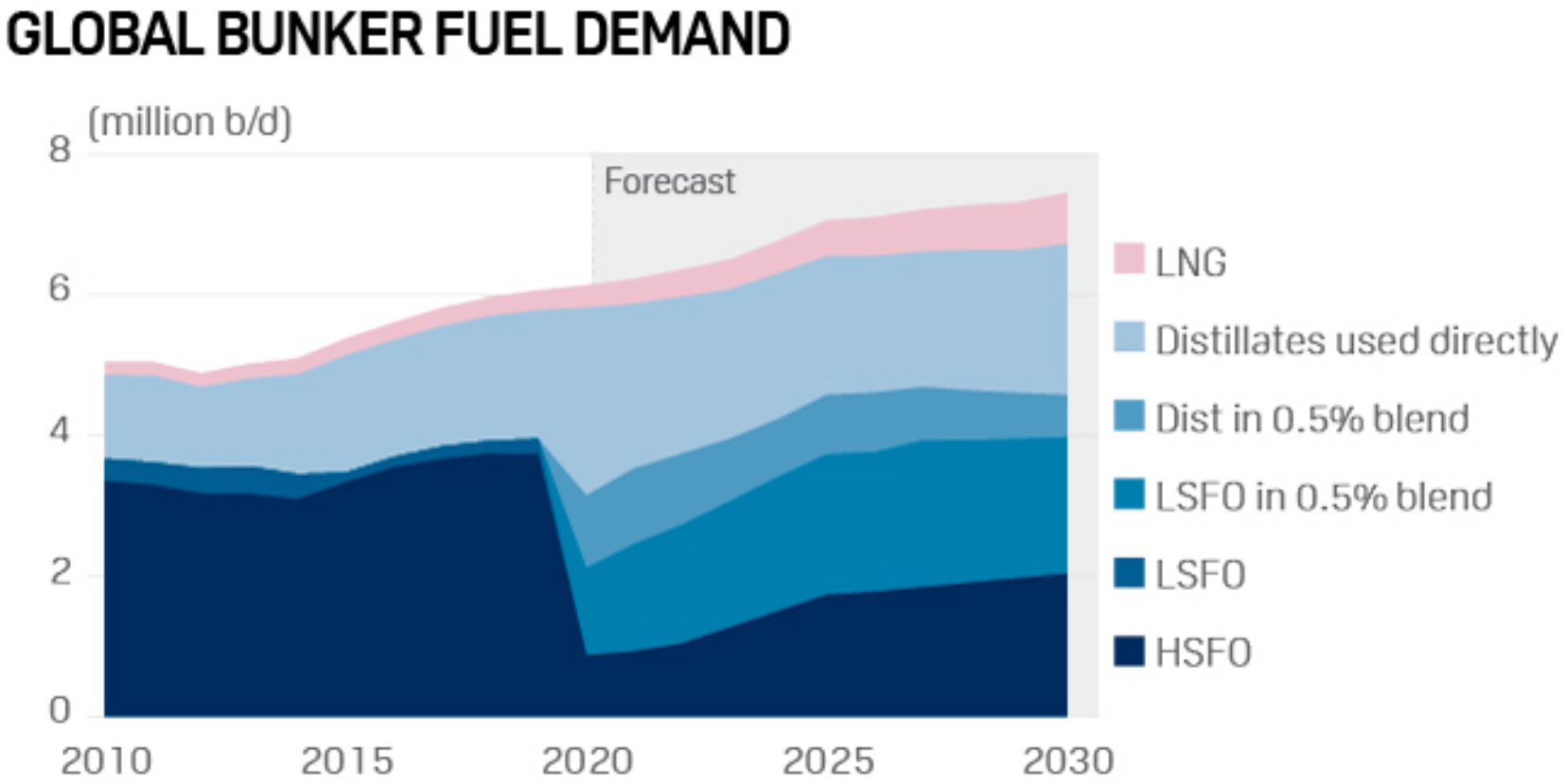
Properties of fuel blends?



Source: S&P Platts Analytics

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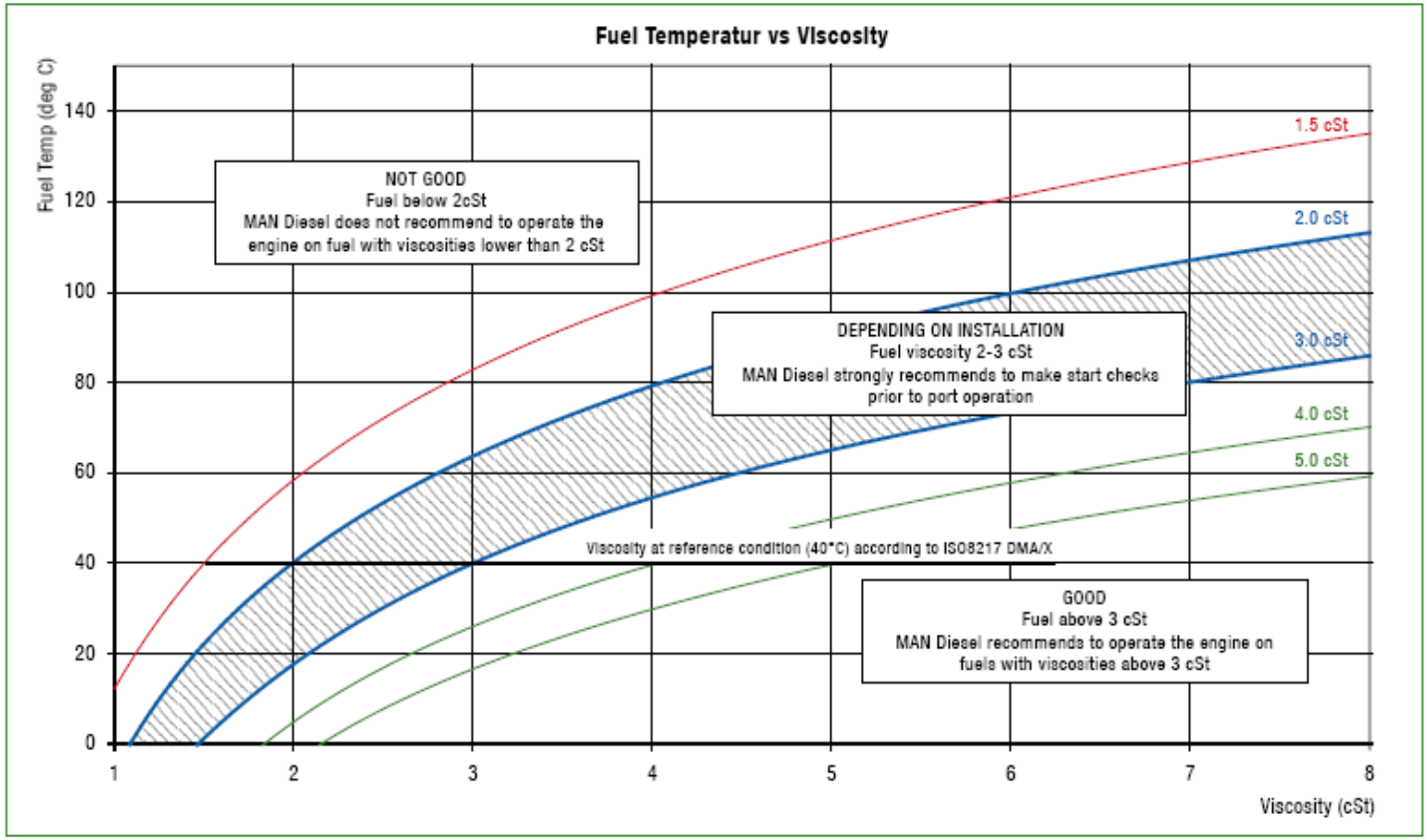
Viscosity measurement



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Thank you for your attention

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