

**WP 9:
MetOcean services to the
marine transport sector**

MetOcean services

- Improved surface currents (research)
- Improved ship arrival time estimates (with InterTransIS, iPort?)
- New: workability assessments (with Eko-vation)

Data

- AIS (Automatic Identification System)
- Model forecasts/hindcasts
 - Wind (10 m speed, direction)
 - Waves (height, direction (,spectral))
 - Currents (surface speed, direction, tidal constants)
- Satellite altimeter (sea level anomalies)
- In situ (buoy/ADCP currents)

AIS data

- Broadcasted by almost all ships (every 6-10 sec)
- Picked up by satellites worldwide (expensive)
- Picked up by ground stations (coastal regions only)
 - Full data: commercial service
 - Summary: free (good enough)

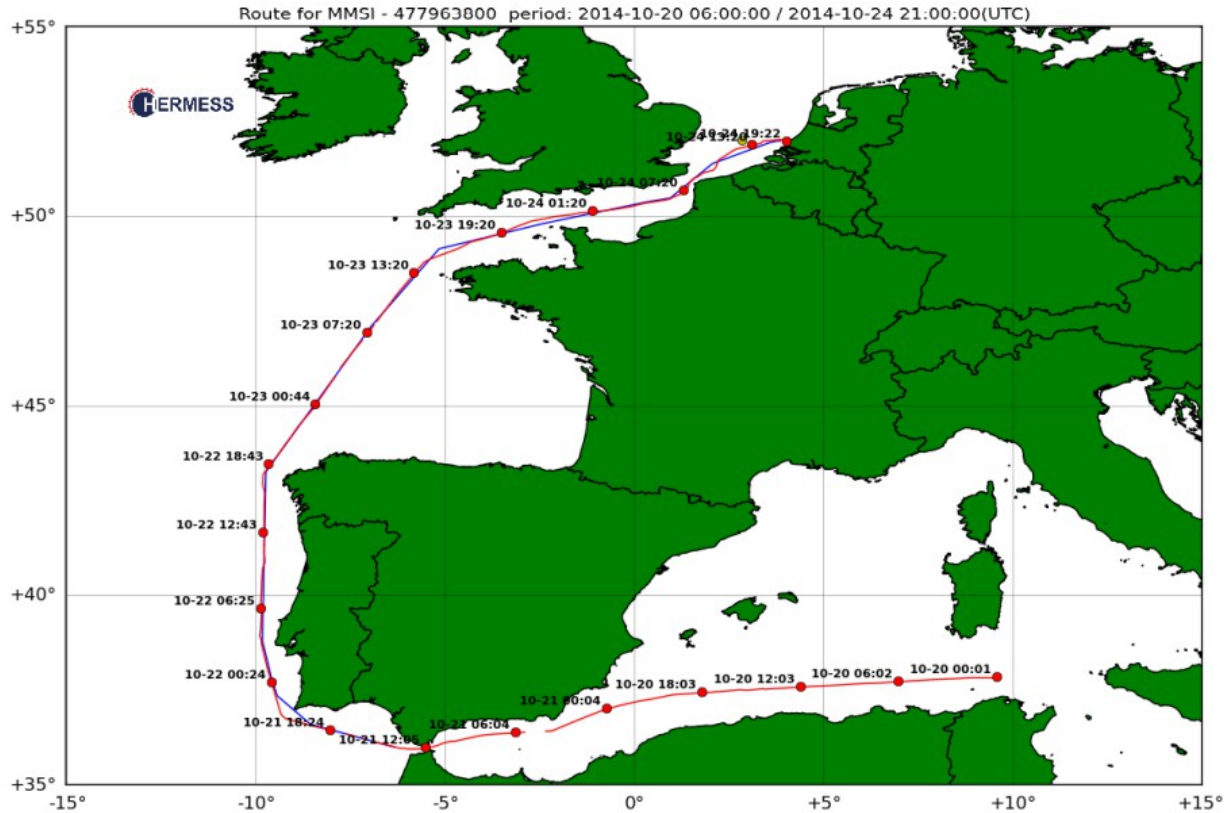
- Example:

```
<POS LON="-9.6188498" LAT="37.94323" SPEED="173"  
COURSE="351" TIMESTAMP="2014-11-05T02:00:32" />
```

Example: traffic snapshot



Example: track individual ship (CSCL STAR)



Overlay wave conditions



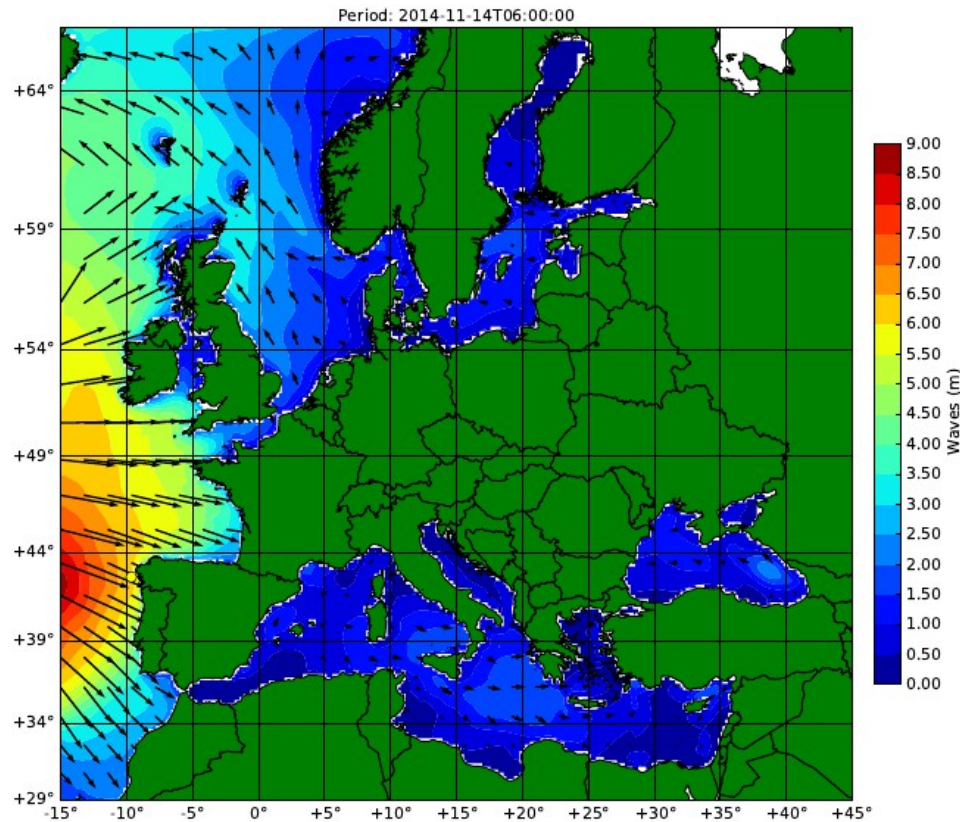
Overlay wind conditions



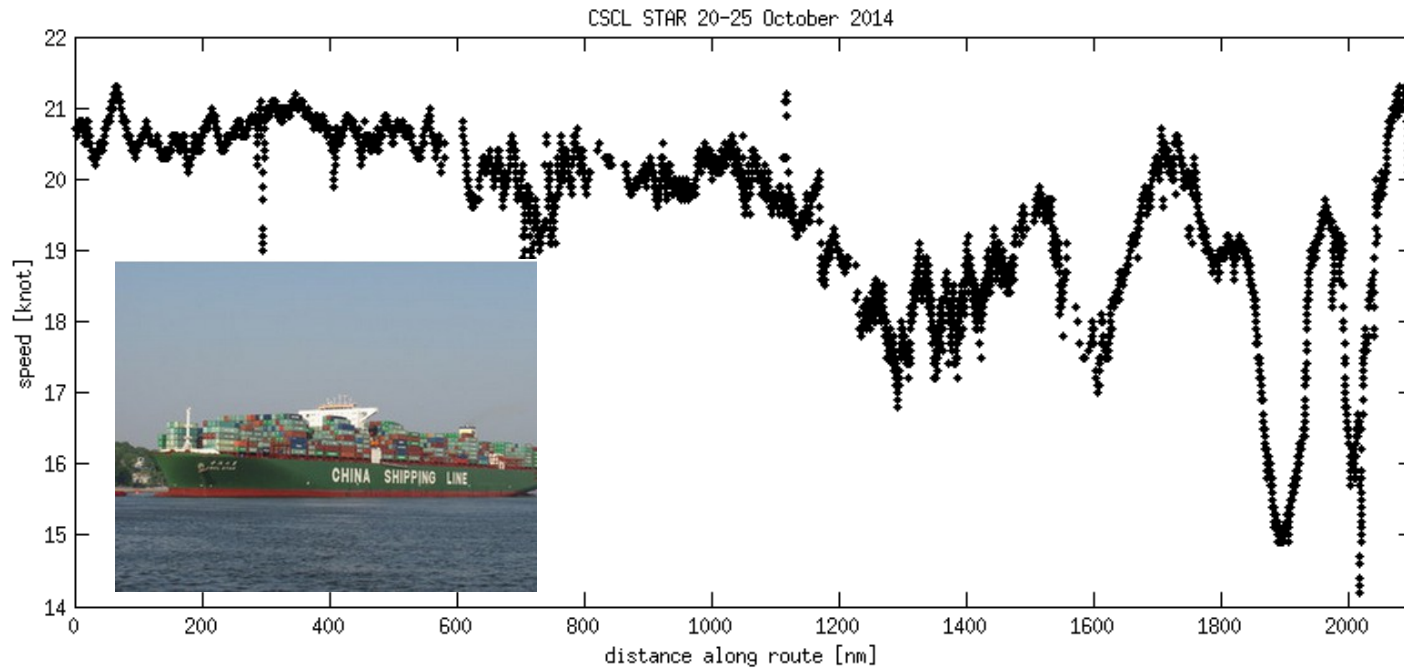
Overlay surface currents



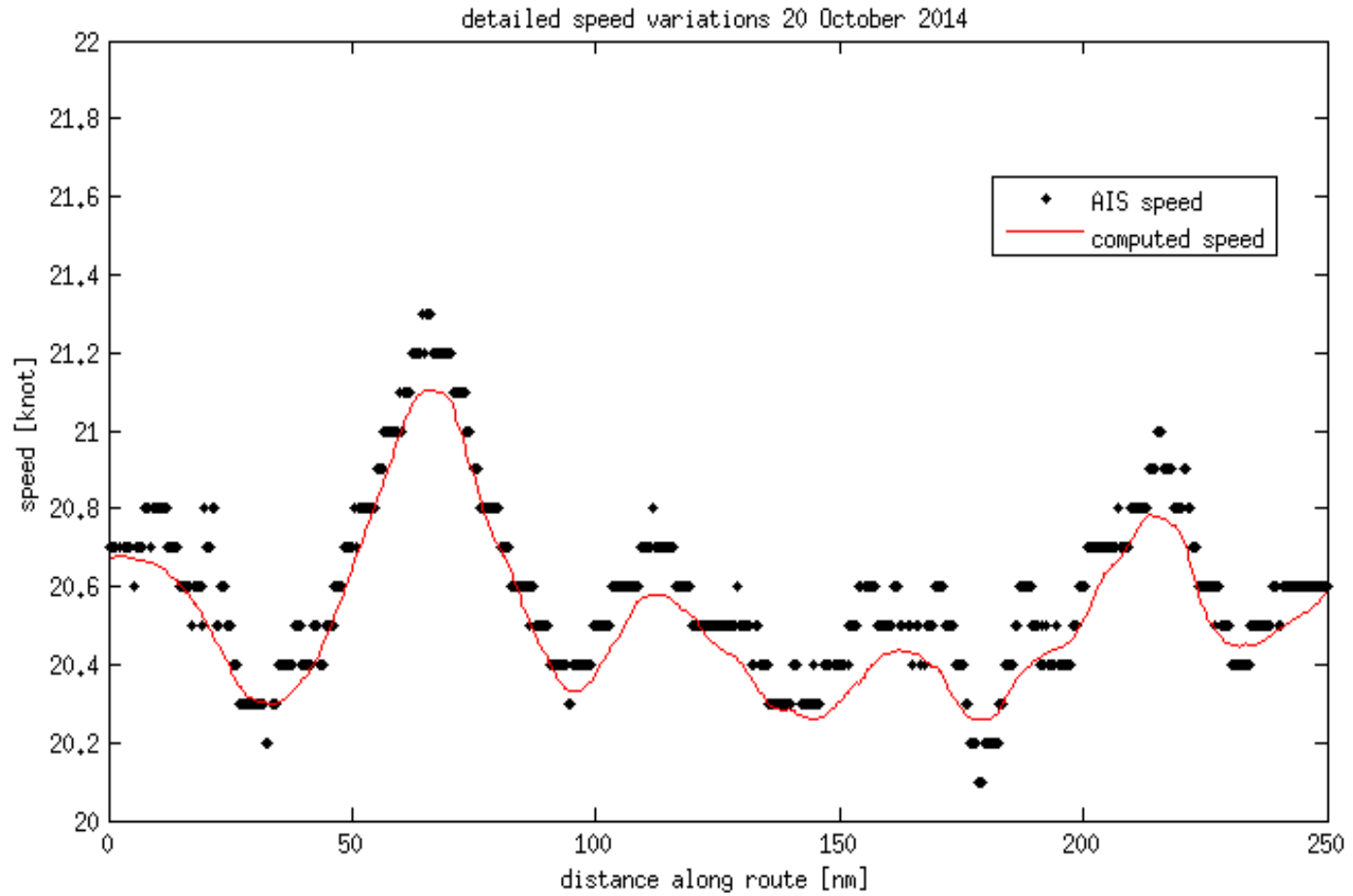
Example: more extreme wave conditions



Ship speed along route



Ship speed (detail)



Simple model for speed variations

$$\text{speed_over_ground} = \text{log_speed} + \text{surface_current}$$

$$\frac{d \text{ log_speed}}{d t} = \text{Engine} - \text{friction}(\text{wave_height}) * \text{log_speed} + C * \text{wind_speed}$$

Assumption: Engine power varies little on open seas.

After corrections for wind and waves:

$$\text{speed_variation} = \text{current_variation}$$

Applications

- Assimilation in regional ocean circulation models
- Assimilation in tidal models (coastal regions)
- Detection (in combination with satellite images):
 - Internal waves (e.g. near Gibraltar)
 - Gyres (Brasil, south and east Africa)

Todo (short term)

Validation study:

- Find in-situ current measurements (US coast?)
- Collect large AIS data set
- Quantify reliability of AIS current assessments

Ship arrival time estimates

- Important for planning harbour activities (logistics)
 - Too early: ships have to wait
 - Too late: time slot expires, transshipment facilities wait
- Customers:
 - harbour authorities
 - Logistic service providers (InterTransIS)

InterTransIS service

ETA Roads		ETA Berth	IMO	Name	From port	EP	To berth	Agent
<input type="text" value="search"/>	<input type="text" value="search"/>	<input type="text" value="search"/>	<input type="text" value="search"/>	<input type="text" value="search"/>	<input type="text" value="search"/>	<input type="text" value="search"/>	<input type="text" value="search"/>	<input type="text" value="search"/>
I	2014-11-07 11:45	2014-11-07 17:05	9071052	KATJA	KHERSON (UA)	LL	MOERD CINSTH DMT: 4259	LBH NETHERLANDS
I	2014-11-07 14:30	2014-11-07 16:00	9339026	MARNEDIJK	GÖTEBORG (SE)	LL	EUROH APM TERMINALS: 8191	BURGER FS
I	2014-11-07 14:45	2014-11-07 16:30	9410765	CMA CGM CASSIOPEIA	BREMERHAVEN (DE)	LL	AMAZH ECT DDE: 8159	CMA-CGM
I	2014-11-07 15:00	2014-11-07 17:25	9401556	STAV VIKING	TERNEUZEN (NL)	LL	PET 3 ESSO 1: 4078	MARITEAM SHIPPING
I	2014-11-07 15:15	2014-11-07 17:20	9157284	SELANDIA SEAWAYS	FELIXSTOWE (GB)	LL	VULCH DFDS SW. RAMP2: 614	DFDS SEAWAYS
I	2014-11-07 15:30	2014-11-07 17:35	9143415	ORION	IMMINGHAM (GB)	LL	MOERD CINSTH CCT OZ: 4330	EURO NORDIC
P	2014-11-07 15:30	2014-11-07 17:15	9448669	E.R. RIGA	ZEEBRUGGE (BE)	LL	YANGK EUROMAX: 9827	S5 AGENCY WORLD
I	2014-11-07 15:45	2014-11-07 17:50	9419175	STENA BRITANNICA	HARWICH (GB)	LL	HOEK STENA LINE: 910	STENA LINE
E	2014-11-07 16:00		9539080	WILHELMINE	TEESPORT (GB)	LL	BENEL P+O NSF OZ N: 5802	P+O NSF
E	2014-11-07 16:00		9539078	SEVERINE	HARWICH (GB)	LL	BENEL STENA LINE WZ: 5812	STENA LINE
P	2014-11-07 16:45		9669653	CIELO DI GAETA	ROTTERDAM (NL)	LL	WAALH B 34: 34	GRAYPEN
E	2014-11-07 17:00		8315449	LIFANA	IJMUIDEN/VELSEN (NL)	OM	MOERD CINSTH DMT: 4259	LBH NETHERLANDS
E	2014-11-07 17:10		9475698	HYUNDAI SPEED	AS SUWAYS (SUEZ) (EG)	LL	AMAZH ECT DDE: 8155	HYUNDAI

ETA's

The InterTransIS website shows ships bound for Rotterdam harbour (mainly).

Two ETA's are shown:

- Captains estimate (based on experience)
- Agents estimate (based on planning)

HERMESS will add a third estimate, based on forecasted wind, wave, and current conditions.

Methodology

Arrival time estimation involves extrapolation.

Basic assumption: engine power is constant. The ship's speed can be estimated when the environmental conditions are known.

Then:

$$d t/d s = 1/\text{speed}(t,s)$$

This differential equation can be solved numerically.

Procedure

1. Get latest AIS position ($s=0$, $t=t_0$)
2. Construct route to final position (Noordhinder, $s=L$)
3. Tune ship response parameters (relation between speed and wind, wave) with measurements in last three hours
4. Connect wind, wave, current databases to estimate speed(s,t) along the route
5. Solve differential equation between $s=0$ and $s=L$

This procedure is operational as prototype

Arrival time service

- Client places ship identifiers on a request list
- This list is polled every hour
- For all ships on the lists hourly AIS data are collected
- For all ships a new arrival time is estimated every 3 hours
- Results are made available to the clients

Parts of this service are operational as prototype

Todo (short term)

- Produce validation/reliability estimates
 - Collect AIS data for all ships going to Rotterdam harbour (from southern directions)
 - Analyse data to estimate ship response parameters per ship class
 - Produce arrival time estimates in hindcast mode
 - (from Feb 2015) produce arrival time estimates in forecast mode.
 - Analyse results

Workability service (new service)

In the Eko-vasion project a multi-functional ship is being developed.

The workability service helps planning tasks.

Forecasts of conditions at sea will be analysed to determine if tasks can be completed. If not: go somewhere else or do something else.