

A Potential Modelling Strategy for Emergency Response in the Gulf

Stewart Cutchey and Jon Rees

stewart.cutchey@cefas.co.uk, jon.rees@cefas.co.uk



Centre for Environment
Fisheries & Aquaculture
Science



Cefas

Part of UK Government, providing applied marine scientific services to customers globally

Established for 115 years, world class reputation, top 5% marine science organisation globally, Cefas was responsible for pioneering fisheries science protocols that are now used routinely around the world



Centre for Environment
Fisheries & Aquaculture
Science



Cefas

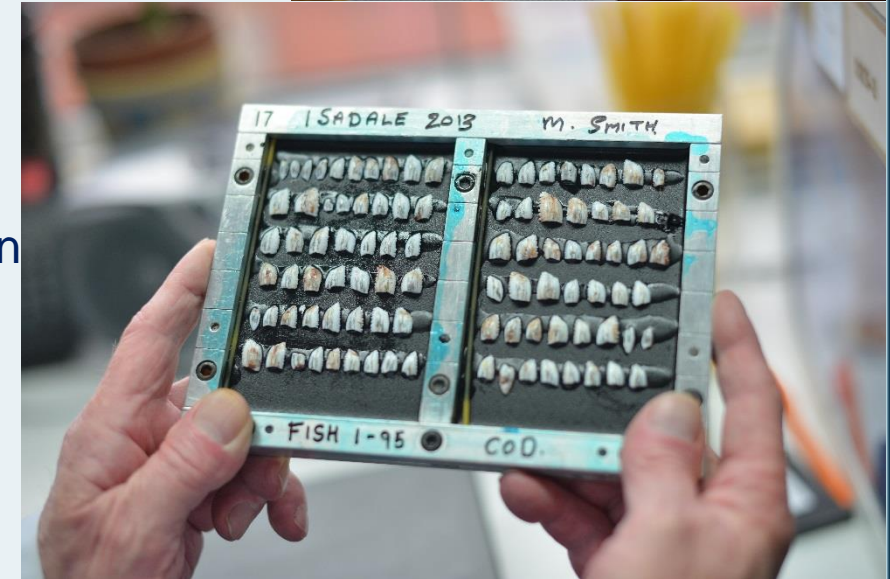
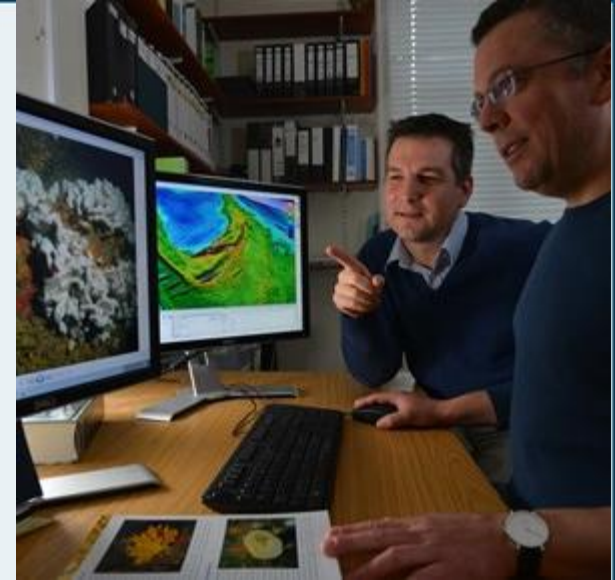
Who we work with

- A wide range of UK government departments and agencies, including Defra and DECC, Natural Resources Wales, Scotland, Northern Ireland.
- Industries across a range of sectors including offshore renewable energy, oil and gas emergency response, marine surveying, fishing and aquaculture.
- International governments and institutions, with a growing emphasis on the Middle East and Southeast Asia.
- Other scientists from research councils, universities and EU research programmes.
- NGOs interested in marine and freshwater.
- Local communities and voluntary groups, active in protecting the coastal, marine and freshwater environments.



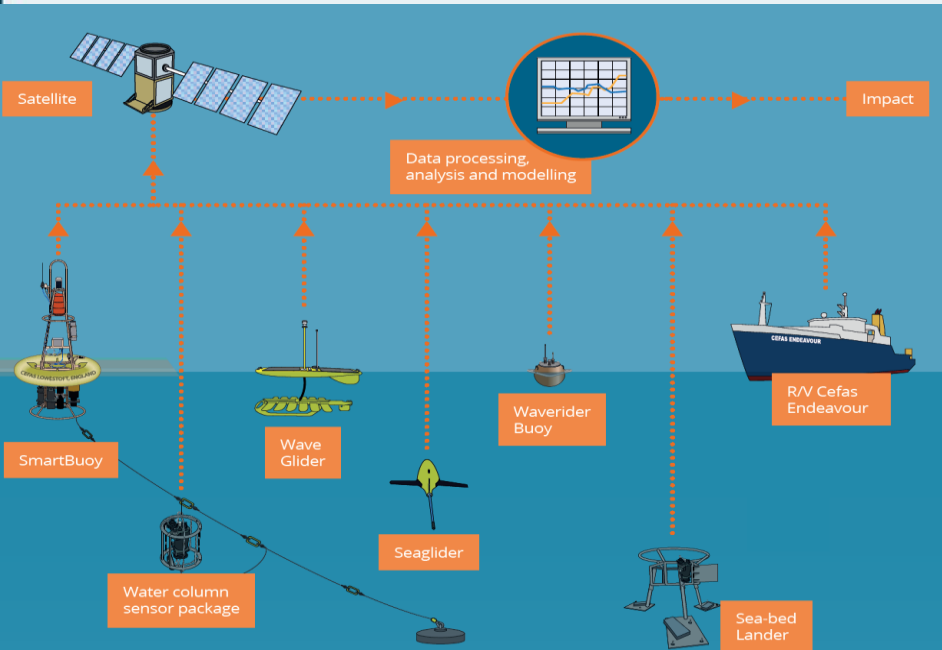
Our science

- Our capability spans natural and social sciences, modelling and technology, oceanography and programme management.
- Approximately 20% of our annual budget spent on applied research and developmental activities, directly supporting customer needs. These projects drive innovation and scientific excellence across all our activities.
- Significant impact on the science community through its published work, regularly producing over 170 peer-reviewed papers in the scientific literature.
- Based on citations in science journals, Cefas is the leading European laboratory in projects covering Marine and Freshwater Biology and Fisheries.
- Cefas ranks in the top 5% of over 2,500 international institutes publishing in the same fields.



Our technology and facilities

- Research vessel
- Autonomous platforms
- Specialist laboratories



Centre for Environment
Fisheries & Aquaculture
Science



Cefas

Our People

- We attract top scientific talent from the UK and across the world. We number 522 FTE staff of which some 480 are scientists and technologists, based in Lowestoft, Weymouth, Kuwait and Oman.
- Over 85 PhD students with about 30 UK universities, and strong links with academic institutions in Europe, Kuwait, Oman and Singapore.
- Continually high staff engagement scores, with Cefas remaining one of top civil service organisations for staff engagement



Our Middle East Work



- Kuwait – Environmental Public Authority
- Cross GCC – Gulf Marine Environment Partnership(GMEP) Programme



eMISK_{Marine}

- 4-5 years project in collaboration with Kuwait Environment Public Authority (KEPA).
- 2 resident Cefas in Kuwait staff
- 20+ UK based 'Theme Experts'
- Project Aim - "To develop a comprehensive marine inventory for Kuwait"
- What that really means –
"Develop a marine environmental strategy for Kuwait and help them to implement a monitoring program to support it"



eMISK_{Marine} Objectives

- Develop a comprehensive marine environmental database
 - Design a characterization survey + ongoing monitoring program
 - Design facilities for EPA to conduct these monitoring works
 - Oversee implementation
 - Training EPA staff to conduct works
- + anything flexible support for additional tasks

eMISK_{Marine} Themes

What does it mean for Cefas and the EPA?

Biodiversity

**Coastal Processes &
Oceanography**

**Food & Water Quality –
Human Health**

Eutrophication & HABs

Pollutants

Fisheries

Human Activities



Cefas Role in Emergencies

- Marine Oil/Chemical/Radiological spills
- 365/24/7 – multi disciplinary ER Team
- Fate of oil and chemical plumes and expected concentrations/quantities
- Work directly to the key responder community (Coastguard)
- Environmental Impacts e.g. water quality
- Advise on Dispersant approvals
- Fisheries/Shellfish implications e.g. Closures
- Mitigation actions
- Expert Advice/ Monitoring/ underpinning research (Premium – post spill monitoring)



Background - Track Record

Spills

- Braer (Shetlands)
- Sea Empress (Milford Haven)
- Athos 1 (Delaware – expert witness)
- MSC Napoli (English Channel) – 2318 containers and bunker oil
- Tasman Spirit (Pakistan – expert witness)

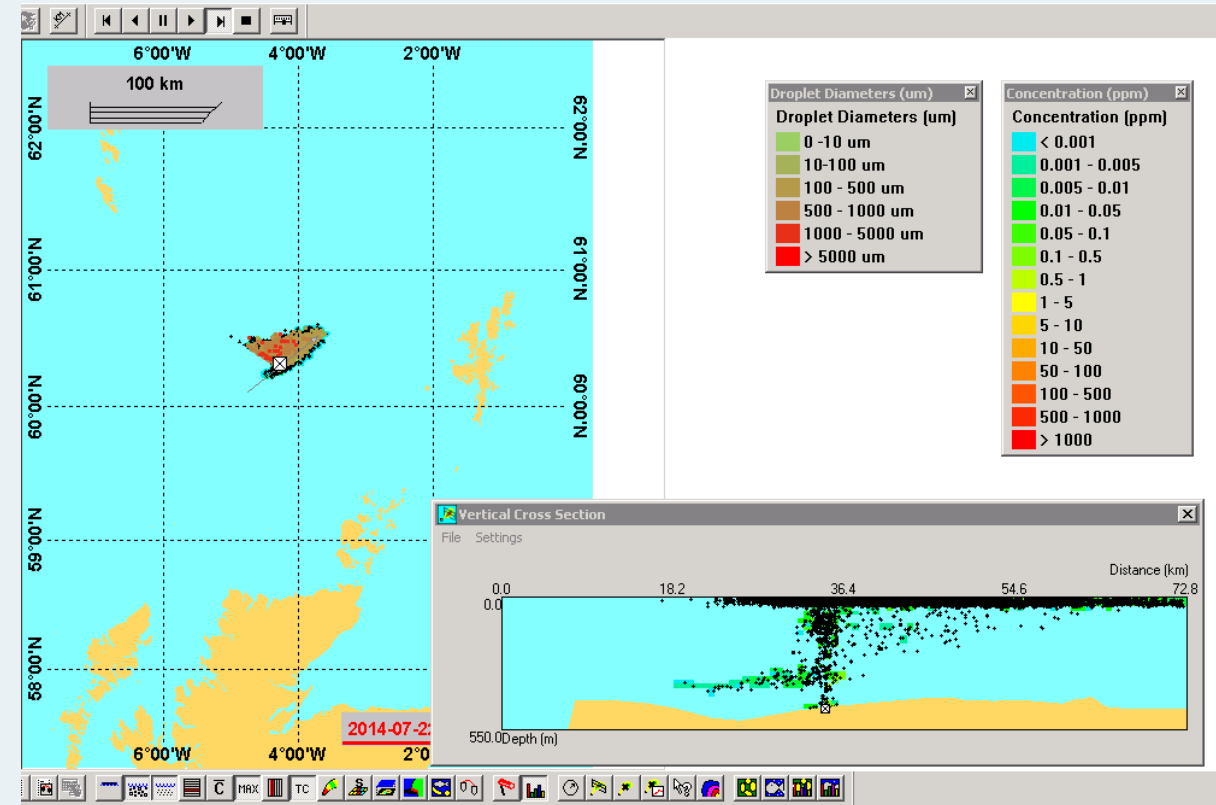
Other Emergencies

- Bird Flu (H5N1 – Fife Dead swan)
- Ice Prince (Wood Slick)
- Hoegh Osaka (Southampton Water Jan 2015)
- Container tracking
- Forensic Oceanography



Cefas Emergency Response Modelling

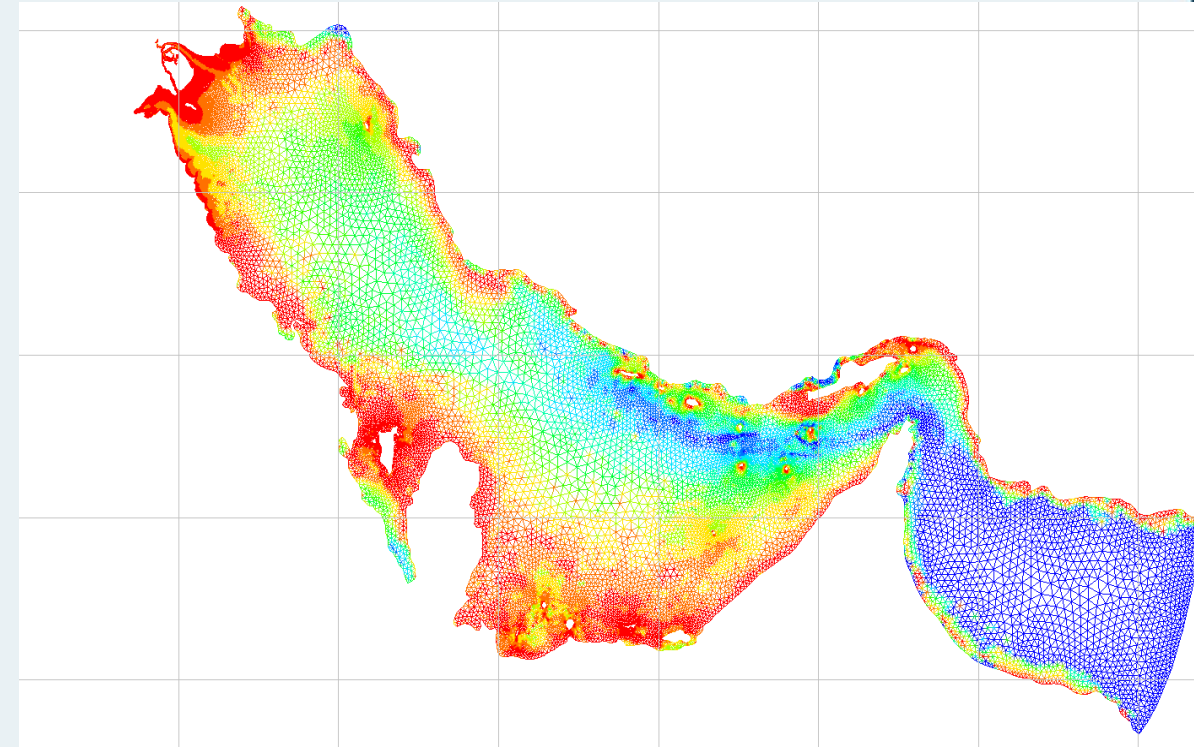
- Industry standard models OSCAR(Sintef), Chemmap (ASA) and Cefas Spill
- Variety of flow fields – Tidal databases, Telemac high resolution models and Copernicus/GMES EU Open source
- Operating in 2D or 3D depending on situation
- Operated by team of Oceanographers and modellers
- Operated from central cluster to allow 365/24/7 operation
- Regular training exercises (internal and external)
- Dispersant approval
- Target 1 hour response



The Challenge 1

Why do we need a framework?

- Framework vs single model
- Increasingly sophisticated oil behavioural models (e.g. weathering, application of dispersants etc)
- Increasing expectations in terms accuracy and timings as well as response times
- Numerical models part of essential “toolkit” for responders
- Whilst SAR satellite technology has significantly improved after the last decades (**nowcast**), numerical models are the only way to **forecast** potential stranding

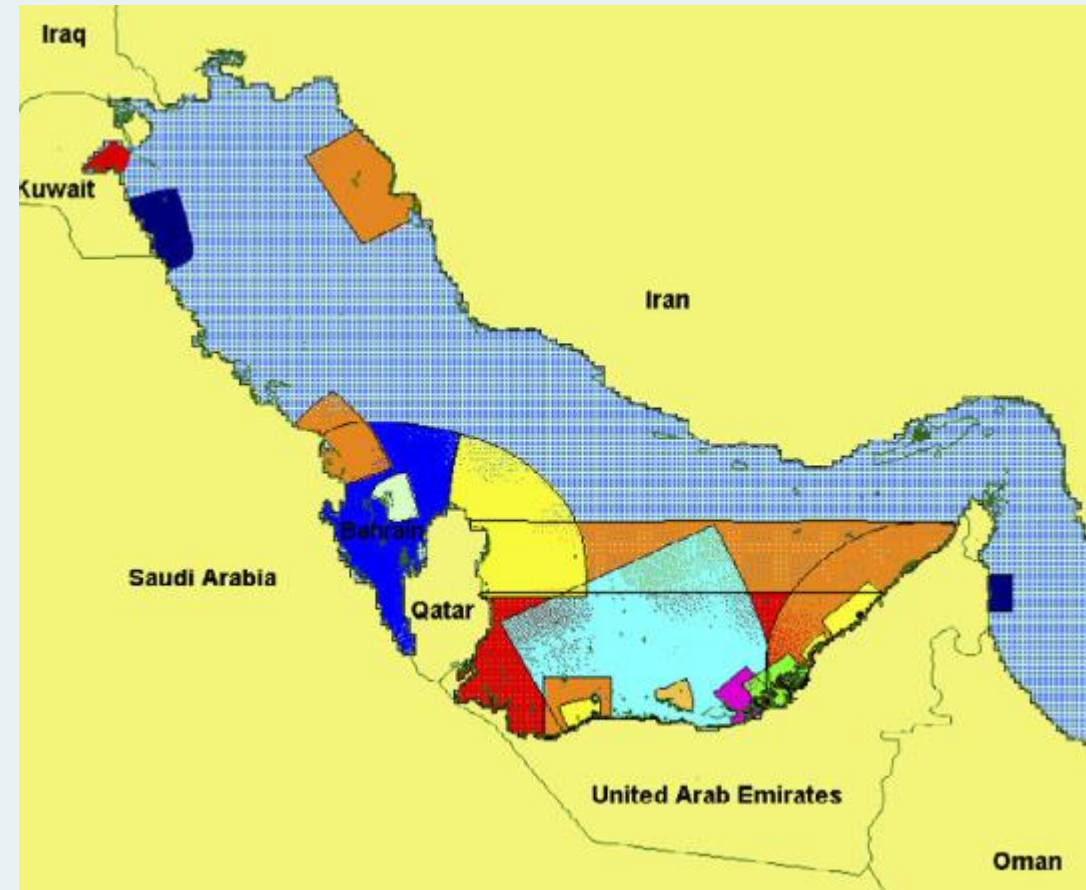


Cefas Gulf Model (Telemac)

The Challenge 2

Within the “Oil spill modelling community”

- There are a wide range of models – resolutions, domains and time steps
- Experience from Deep Water Horizon has shown a wide range of numerical models are available and unused
- As models get more sophisticated there is greater need (and hence cost) for high performance clusters



Source: AgmCommunity.org

The Opportunity

The whole MEMAC/ROPME community can benefit by

- Use of a trusted and reliable core system that is scalable as investment becomes available
- Easily share predictions in near real-time resulting in improved transparency and driving up standards
- Open and Flexible structure allows new approved users to join
- Maximising the effectiveness of dispersants
- Virtual connectivity, storage and processing power significantly increased in last decade

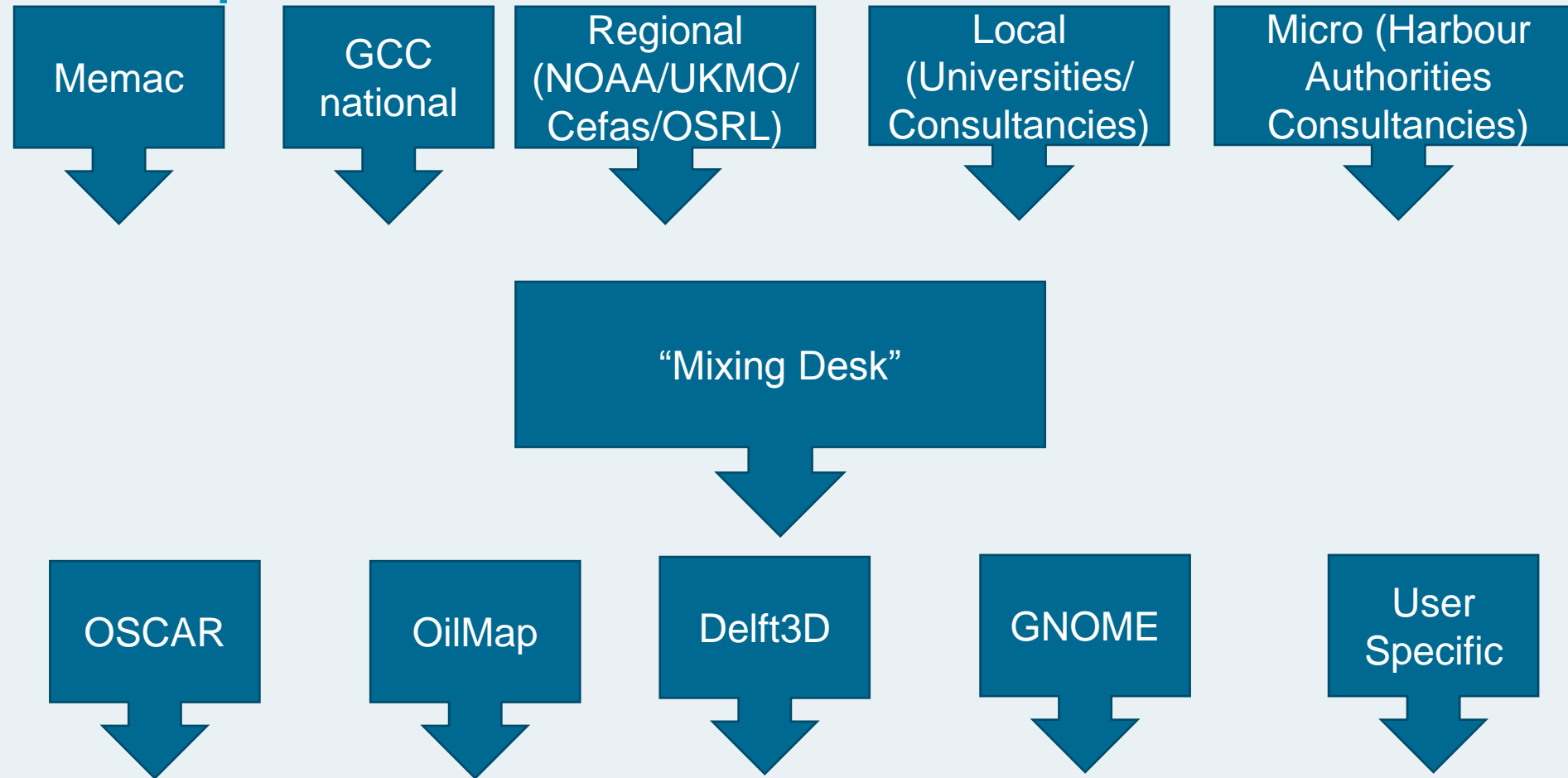


Deep Water Horizon



Exercise Sula
Source:
Shetland News

A potential framework



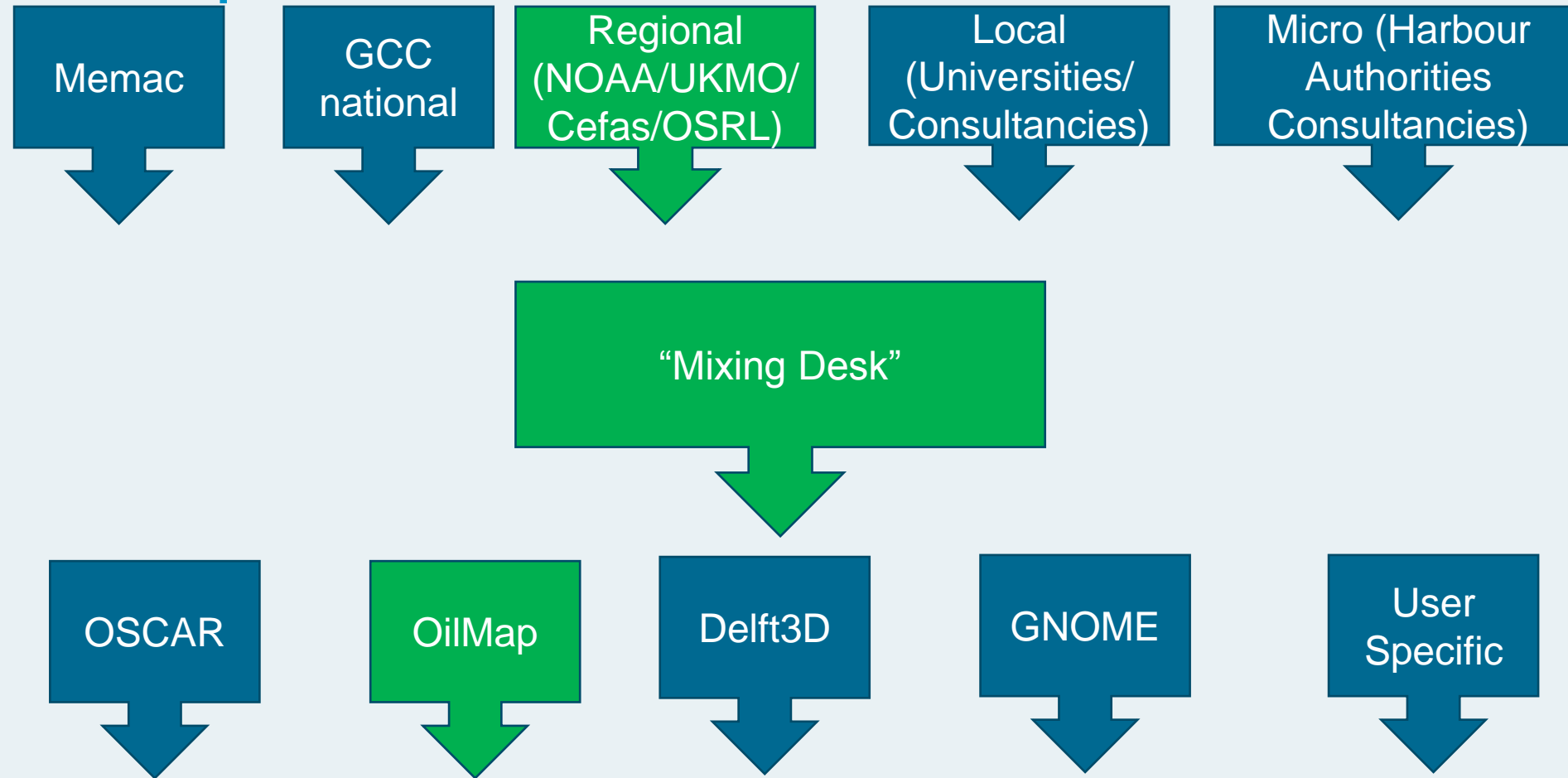
“The Mixing Desk”

A variety of roles:

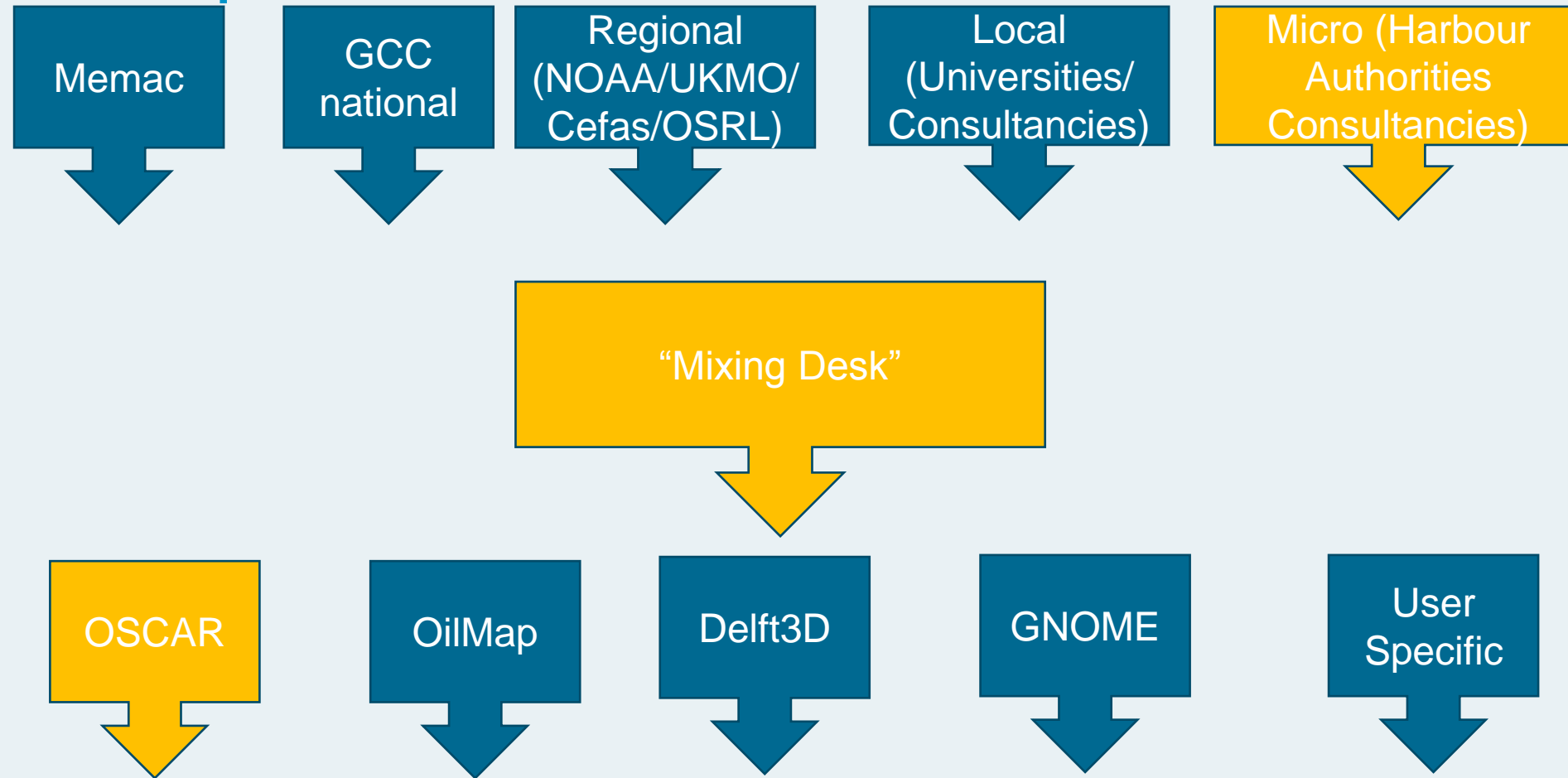
- “One stop shop”
- Ensures Redundancy
- Sense check in terms of strengths, directions and residuals of currents (and winds)
- Validation with ground truthing sites (need for real-time wave, current and wind measurements at key locations)
- Whilst nesting probably not possible in emergencies, tools could be developed to ensure continuity and patterns/pathways are consistent
- Performance Indices of models



A potential framework



A potential framework



Framework Advantages

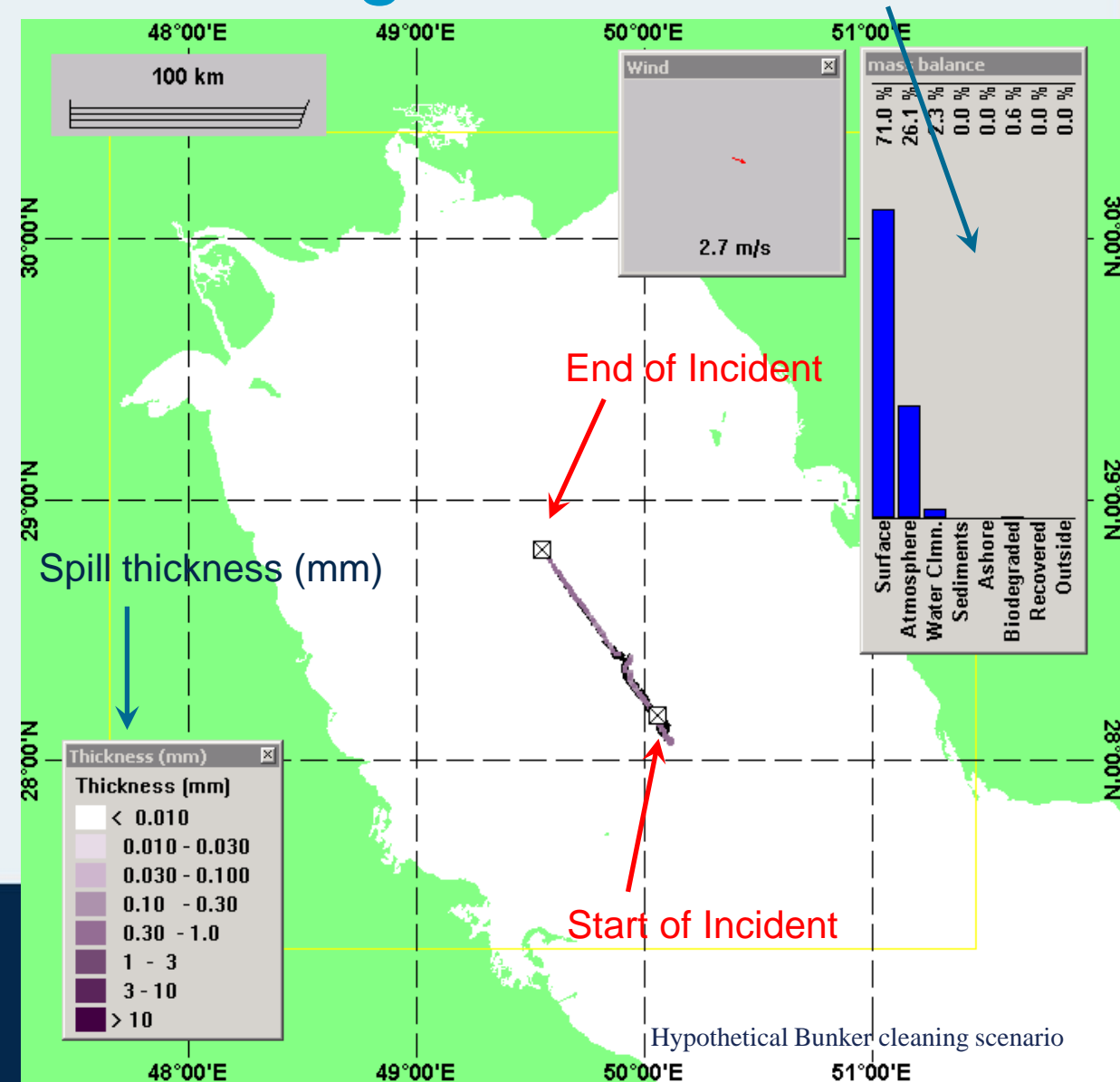
- Independent from any one modelling system – potential for “ensemble modelling”
- Flexible system to allow ingestion of data from a variety of sources based on the industry NetCdf standard
- Virtual system allows all MEMAC members and approved users access to the same system
- Allows end-users to choose their favourite oil response model
- Future proofed as Mixing desk allows inputs and output systems to change over time
- Operated from virtual cluster to allow true 365/24/7 operation
- Government organisations need to assess both the predictions and the confidence of the predictions



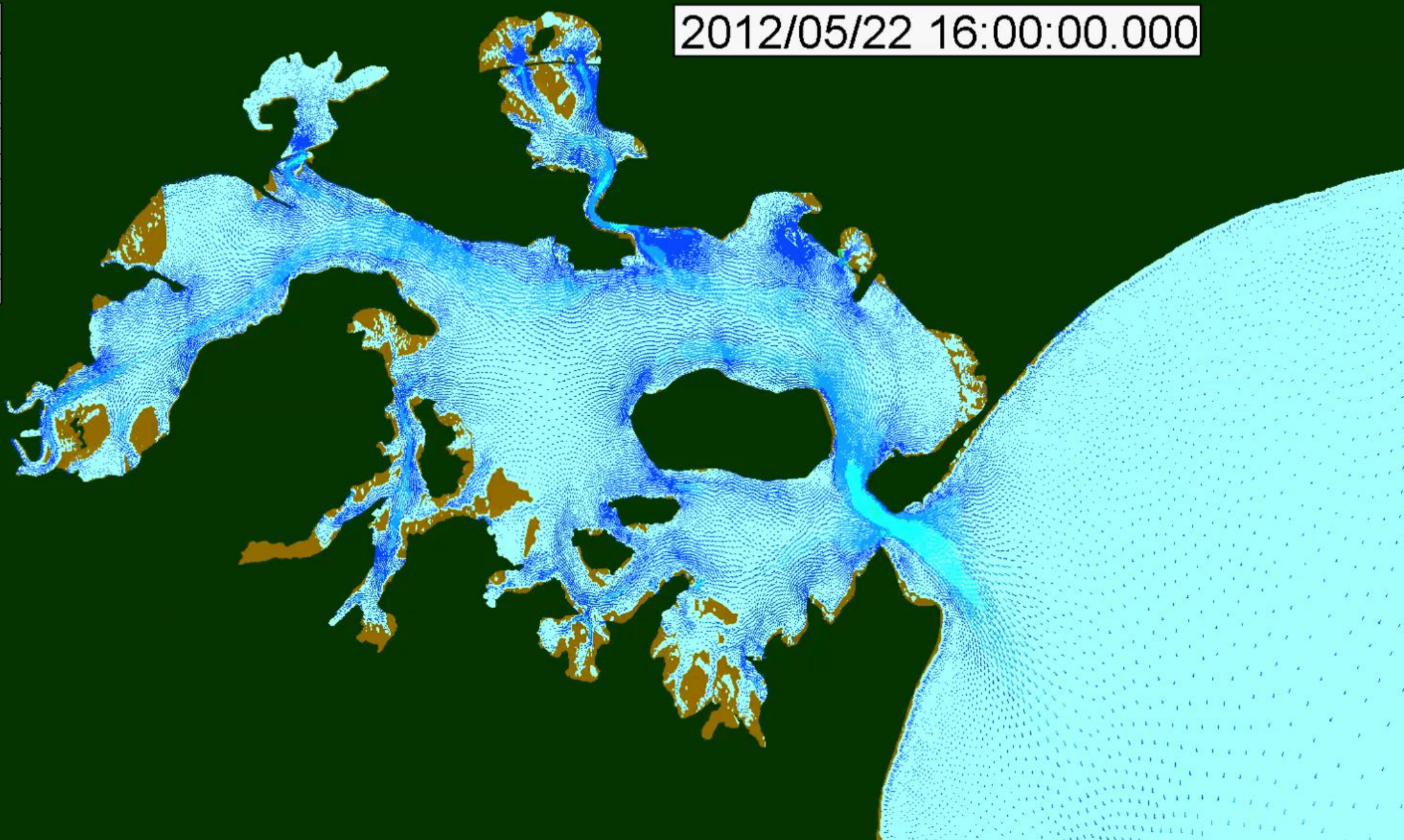
Cefas Emergency Response Modelling

- Hypothetical Bunker cleaning scenario
- Uses Cefas High resolution Telemac model of the Gulf
- Strong Shamal wind
- Source 1000 tonnes light crude released over 12 hours
- Vessel moving NNW at 3 knots
- Allows direct comparison of satellite imagery and model outputs

Mass balance – surface/
atmosphere/sediments/
ashore etc



2012/05/22 16:00:00.000



Conclusions

- Framework vs. single model approach
- More cost effect & easier training
- Proposed framework responds to increasing challenges from stakeholders
- Opportunity for open and transparent system that allows MEMAC to lead regional approach
- Futureproofed to allow for increased technological developments in both hardware and software
- Whilst Oil spills are the highest priority, the latest generation of container vessels are just as large a challenge due to the number of containers and volumes of pesticides and herbicides carried (HNS)



MSC Oscar– 19, 224 TEU containers

Thank you for your attention

