


Practical Experiences of Commercial Coastal Dye Tracing Surveys

Presented by EMU Limited
Oceanography
Robin Newman




Emu Ltd

- Established in 1997
Southern Water management buy-out
- Work in over 40 countries
UK, Ireland, The Netherlands, Tunisia, Bahrain, Kuwait, UAE
- Highly skilled and qualified team
60 staff: 45% BSc., 35% MSc., 20% Ph.D.
- 3 survey vessels and in-house equipment
Owned, maintained and operated by Emu Ltd
- Head office: Durley, UK
Laboratories and warehouses in Hayling Island
- Commitment to quality
e.g., ISO 9001:2000





Oceanography Department

- Hayling Island, Hampshire
 - Offices
 - Warehouse
 - Equipment storage
 - Testing Facilities





Why Dye

- Langrangian flow measurement
 - Advection
 - Convection
- Mapping Plumes



Sewage Outfalls

- Effluent Dispersion Monitoring
 - existing & projected outfalls
 - potential impact sites
- Quantitative Dilution Measurements
- Protection of Habitats



Power Stations

- Thermal Plume Tracking
 - environmental protection
 - preventing re-intake
 - minimising positive chemical feedback



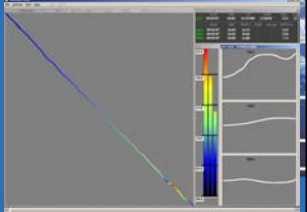
Equipment

- Fluorimeter
 - Vessel mounted over-side
 - AquaTracka Mk III
 - YSI
 - Turner - onboard
- DGPS (vessel mounted)
- Logging capability
- Dye
- Drogue system
- Vessel




Software

- DATA CAPTURE
 - EMU bespoke system
 - EMU Trace
 - DyeLog
 - DGPS Monitoring
- DATA PROCESSING
 - EMU Suite
 - Ocean V3
 - DyeLog
 - Mapping



Dyes

- Rhodamine
 - Rhodamine B – inexpensive
 - Rhodamine WT – low absorption
- Fluorescein
 - high absorption
- Anything with a signal can be used as tracer
 - Radionucleoides
 - Fruit
 - Coloured sand



Famously, Fluorescein is said to have been used to dye the Chicago River Green for St. Patrick's Day in 1962.

Calibration Standards

- Appropriate calibration
 - known dilutions – deionised water
 - calibration curve
 - mV to dye concentration
- Batch Specific



Concentrate 1 x 10⁻² 1 x 10⁻³ 1 x 10⁻⁴ 1 x 10⁻⁵ 1 x 10⁻⁶ 1 x 10⁻⁷ 1 x 10⁻⁸ 1 x 10⁻⁹ 1 x 10⁻¹⁰ 1 x 10⁻¹¹
Rhodamine WT Calibration Standards

H&S, PPE

- Health & Safety
- Extensive PPE
 - rubber gloves, goggles, boots
 - full disposable suit (inc.hood),
- Spillage Kits
 - freshwater, detergent, sand,
 - newspaper, plastic bags



Permissions & Licences

- Permissions
 - DEFRA
 - Environment Agency
 - Local Stakeholders
- Valid Licence
- COSHH
 - Control of Substances
 - Hazardous to Health


Volumes of Dye Required

- Dye = Pollutant
 - minimise discharge
 - environment vs. results balance
- Mixing Dye
 - specific to local density




Vessel Configuration

- Survey vessel
 - Size
 - Manoeuvrability
- Configure Instrumentation
 - Over-the-side rig for fluorimeter
 - DGPS position
- Deck space
 - Preparation
 - Injection
 - Minimise cross-contamination




Dye Injection

- Techniques:
 - Poured into vessel wake
 - Existing outfall discharges
 - Seabed release
 - Pumped
- Selected by relevance to study
 - Modelling proposed outfall
 - Mapping effluent from existing outfall
 - Monitoring for leaks in pipelines
 - Complex stratified water columns




Tracking

- Drogue deployment – centre of dye patch
- Design survey pattern
 - zig-zag pattern through dye patch
 - major axial line
- Define boundaries
- Background values recorded
- Aim for high concentration point
- Drogue position logging
- Meteorological conditions



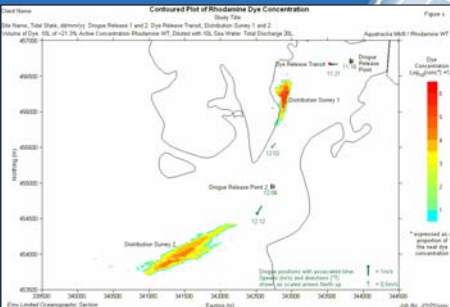
Data Processing

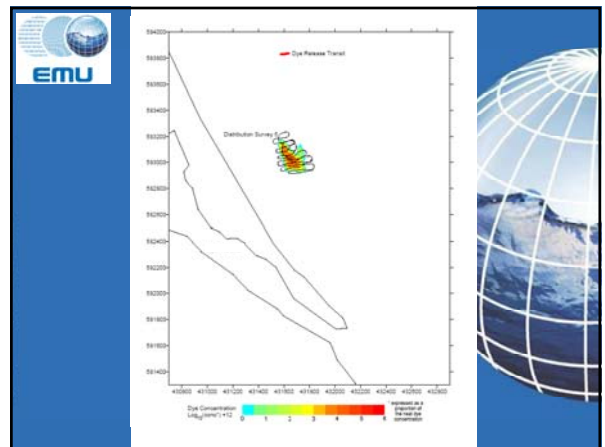
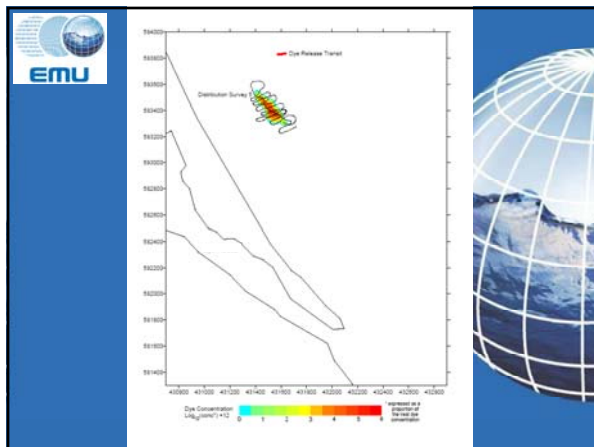
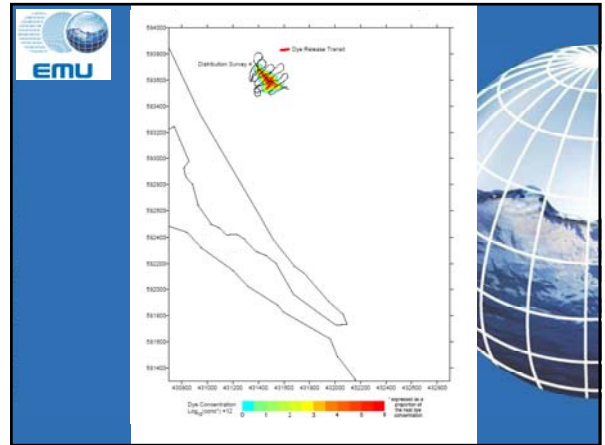
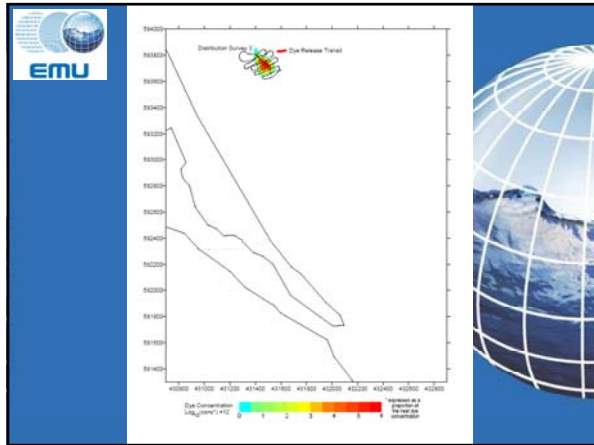
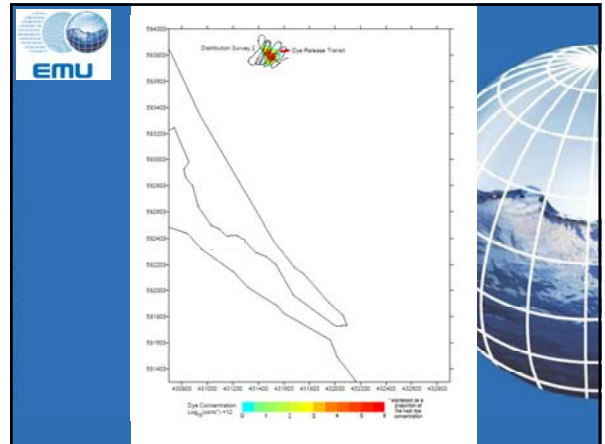
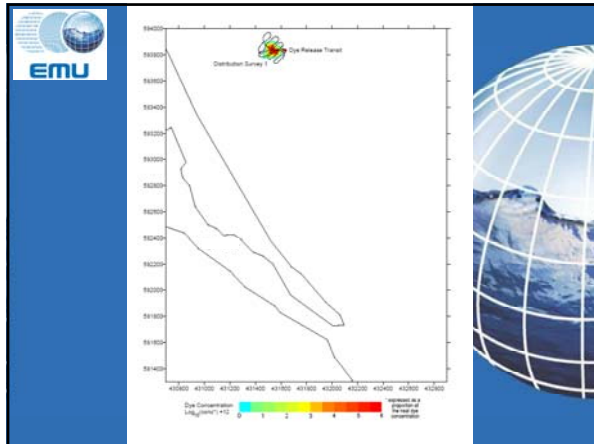
- Apply calibration coefficients
- Remove background fluorescence
- De-spike fluorescence & positional data
- Apply current correction
- Produce instantaneous dye patch

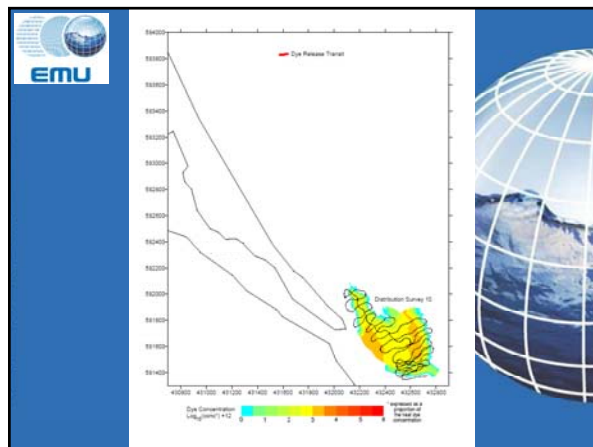
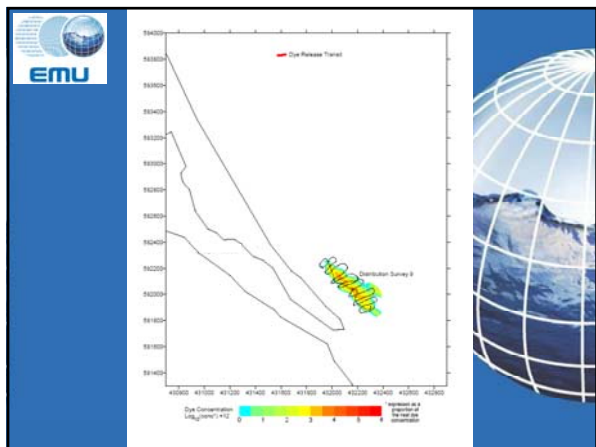
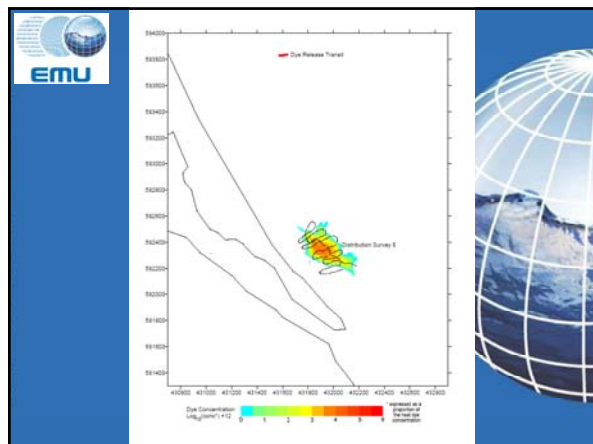
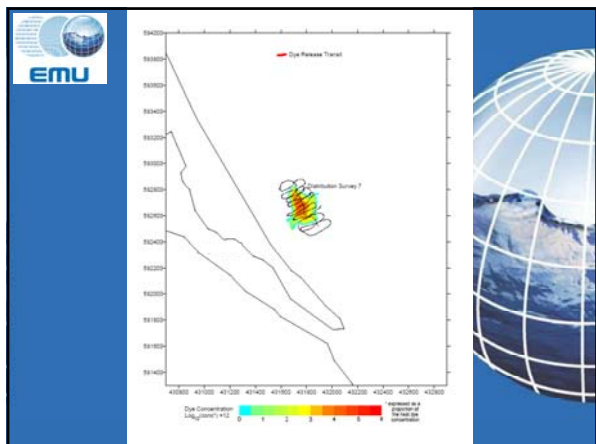


Data Presentation

Concentration Maps







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