# Oil Flow Rate Analysis

## Deepwater Horizons Accident

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# Manual Feature Tracking

Not rocket science—identify features in the image and see where they go as time elapses

# Computer Analysis (PIV)


***Calculated*** displacement: 10.2 pixels

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# Convert to Barrels per Day

- Find average plume velocity

$$10.2\ \frac{pixels}{frame} \times \frac{1\ frame}{0.067\ sec} \times \frac{21in}{124pixels} = 25.8\ \frac{in}{sec}$$

- Multiply by cross-sectional area to find volume flow rate

$$25.8\ \frac{in}{sec} \times \frac{\pi}{4} \times (20in)^2 = 8105\ \frac{in^3}{sec}$$

- Convert to barrels per day

$$8105\ \frac{in^3}{sec} \times \frac{60 \times 60 \times 24sec}{day} \times \frac{1gal}{231\ in^3} \times \frac{1bbl}{42gal} = \boxed{72179\ \frac{bbl}{day}}$$

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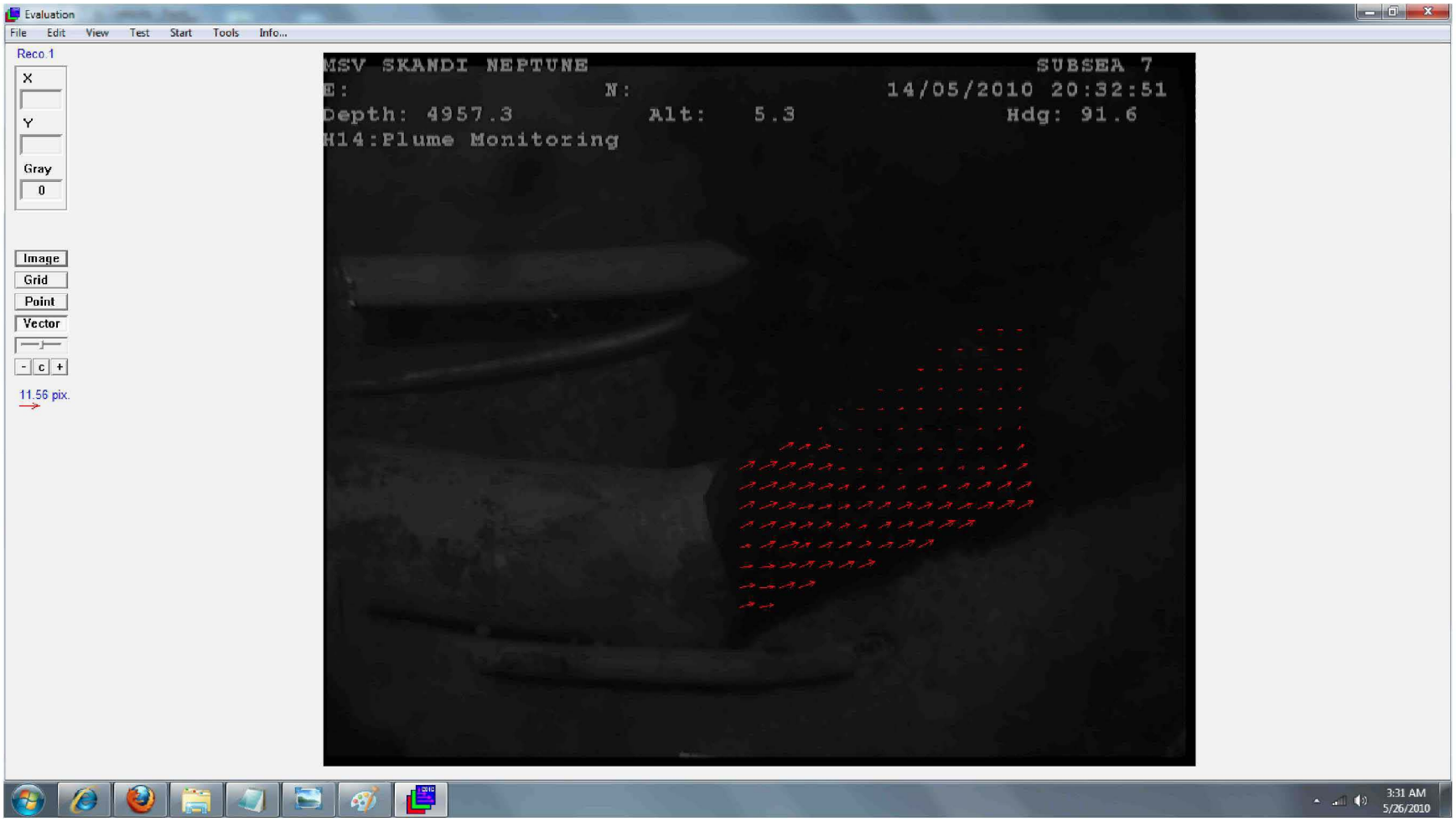
## May 14 2010 2024 H14 Riser End Plume 91 deg

- Analysis based on ensemble of 50 images
- Starting 516.007 secs from start of video
  - Clear observation of plume at that point
  - Mostly liquid flow
- Average velocity 36.8 in/sec (0.935 m/s)
- Plume diameter immediately outside pipe
  - 18.12 in
  - Accounts for 30% area reduction
  - Ignored drill pipe presence
- Total liquid flow:  84423 bbl/day

# Velocity field

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# Flow at kink on top of BOP


Manual tracking:
Kink oil flow rate:
25,000 bbl/day
35% of riser flow


1.2 in hole

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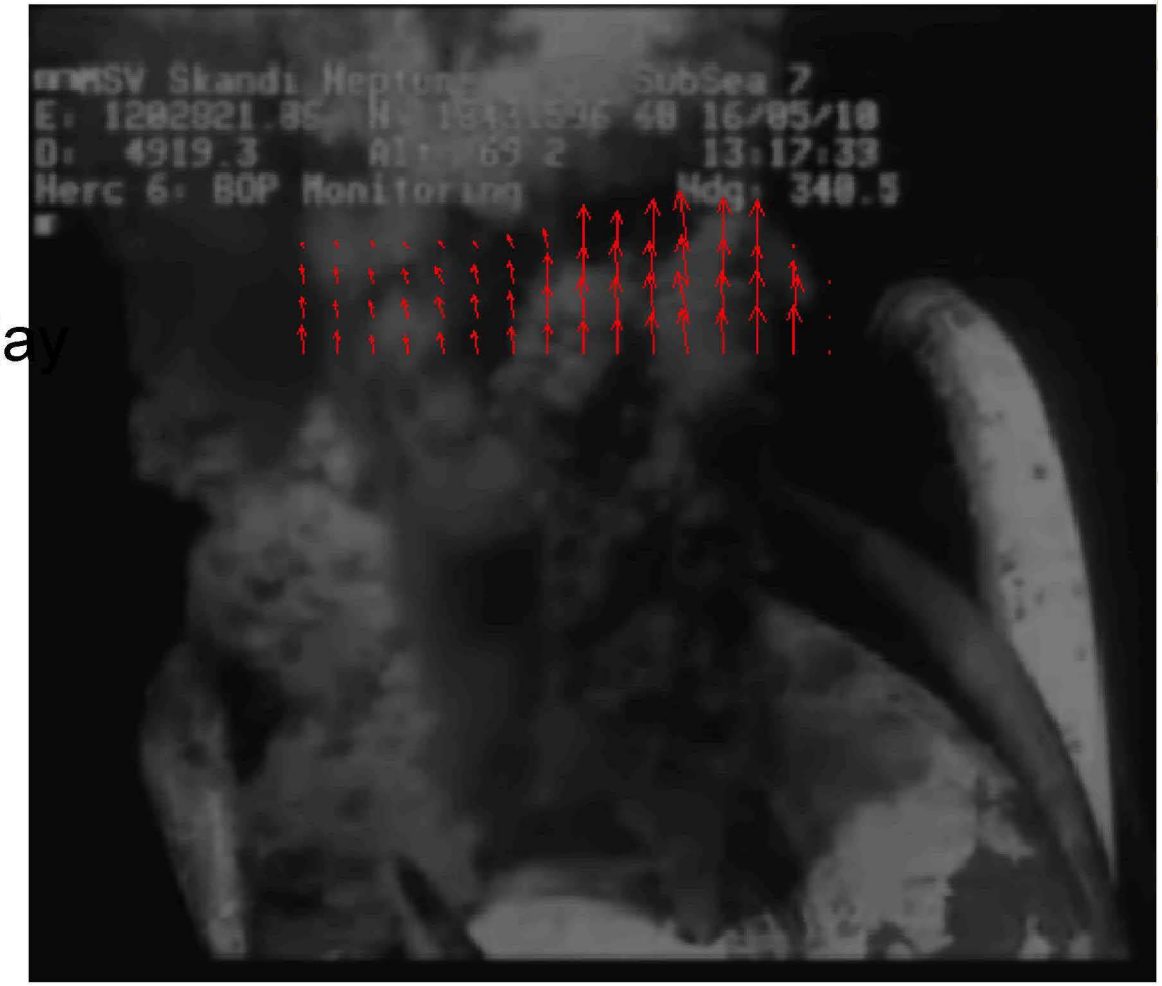
# Kink PIV

Avg disp: 10.7 pix
Avg vel: 10.3 in/sec
Jet diam: 192 pix
Jet Xsect: 121 $in^2$
Volume flow: 11,000 bbl/day




Total flow: 83,000 bbl/day (gas + oil)
Oil (using BP's GOR): 41,500 bbl/day

# H14 BOP Plume May 15 1920-1945

- Used ensemble of 25 images
- Only measured flow from one source
  - Left source too difficult to measure
  - Seems of comparable flow
- Average velocity: 6.95 in/s
- Diameter at that location: 7.61 in
- Volume flow:  2814 bbl/day

# Overlapped image to show jet boundaries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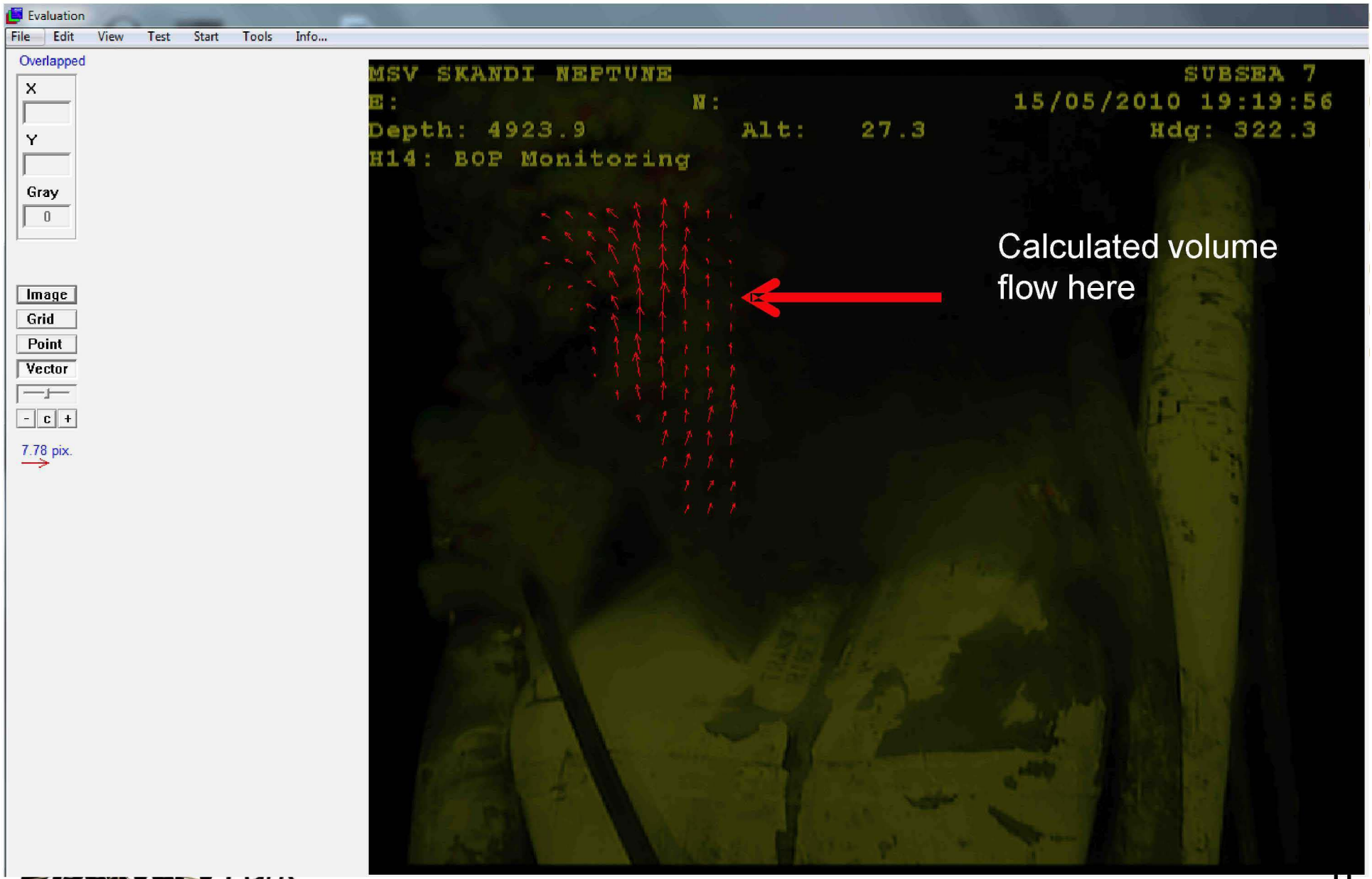
# Vector field



# How can these results be improved?

- Calculations are total flux (gas + oil)
- Better values for
  - Gas/Oil Ratio
    - Independently verified
  - Riser cross section area
    - Need photo, shape matters
- Better quality, longer videos
  - Existing videos are
    - low quality
    - compressed
    - screen captures