Oil Spill Response:
Real-time Determination of the Mixing of Oil and Sea Water Using Airborne Mapping Radar

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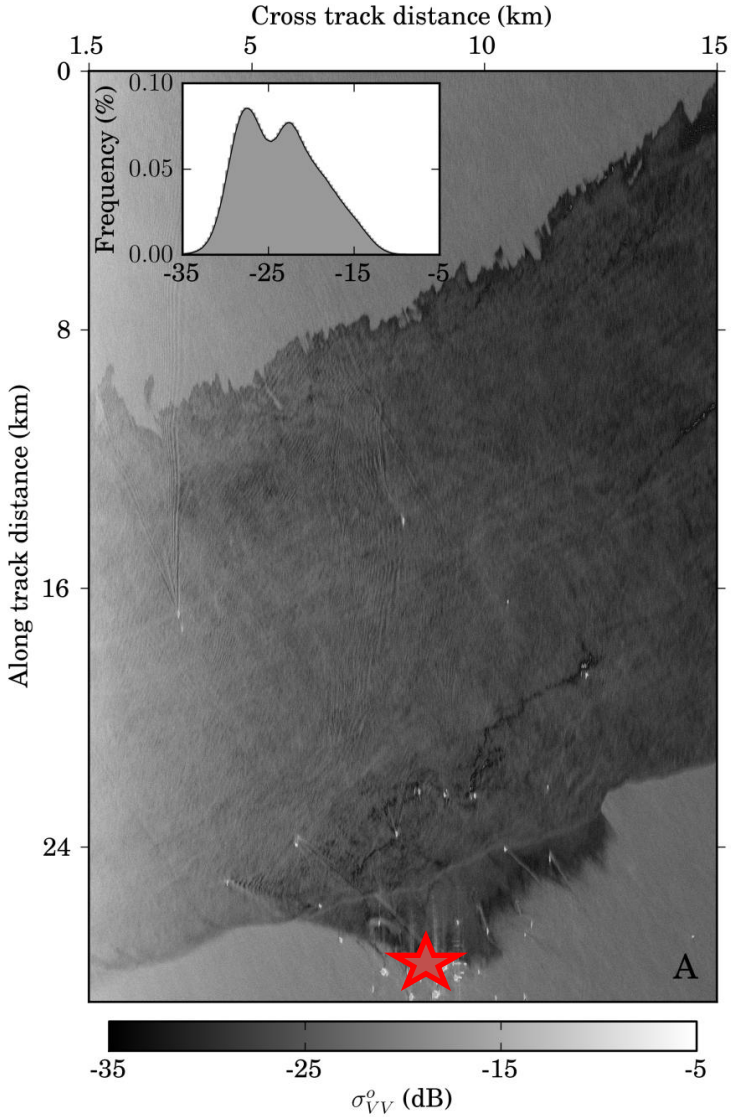
Overview/Motivation

- Result of Deepwater Horizon oil spill in the Gulf of Mexico in 2010
- Address a need to bring the skills and tools of academia to crisis response:
  - Common time scale
  - Common communication mode (jargon)
- Focus on a specialized technique that also benefits my science (glaciology)

Maritime Oil Spills

- Spills are inevitable
- Wreak havoc on the environment/wildlife
- Mitigating damage requires:
  - Constant/up-to-date/reliable information
  - Effective communication
- One tool that can help: radar remote sensing
  - Active sensor
  - Meter-scale resolution; km-scale coverage
  - Impervious to cloud cover
  - Only weather requirement: moderate winds

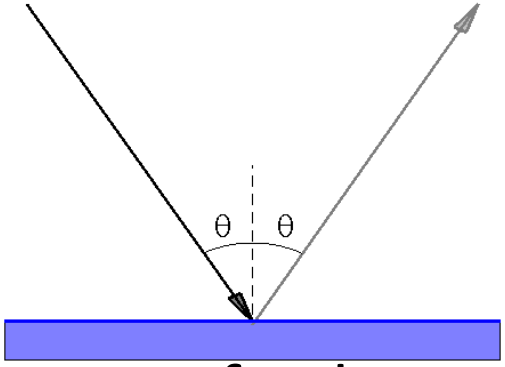
Radar Image of Oil Spill



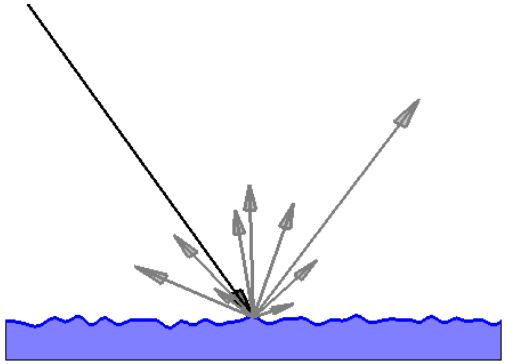
Radar Scattering

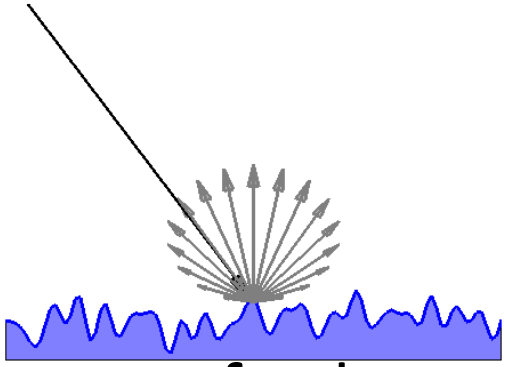
2 ways for oil to reduce radar backscatter power:

- Smoothing surface roughness (decreasing surface tension)



perfectly smooth

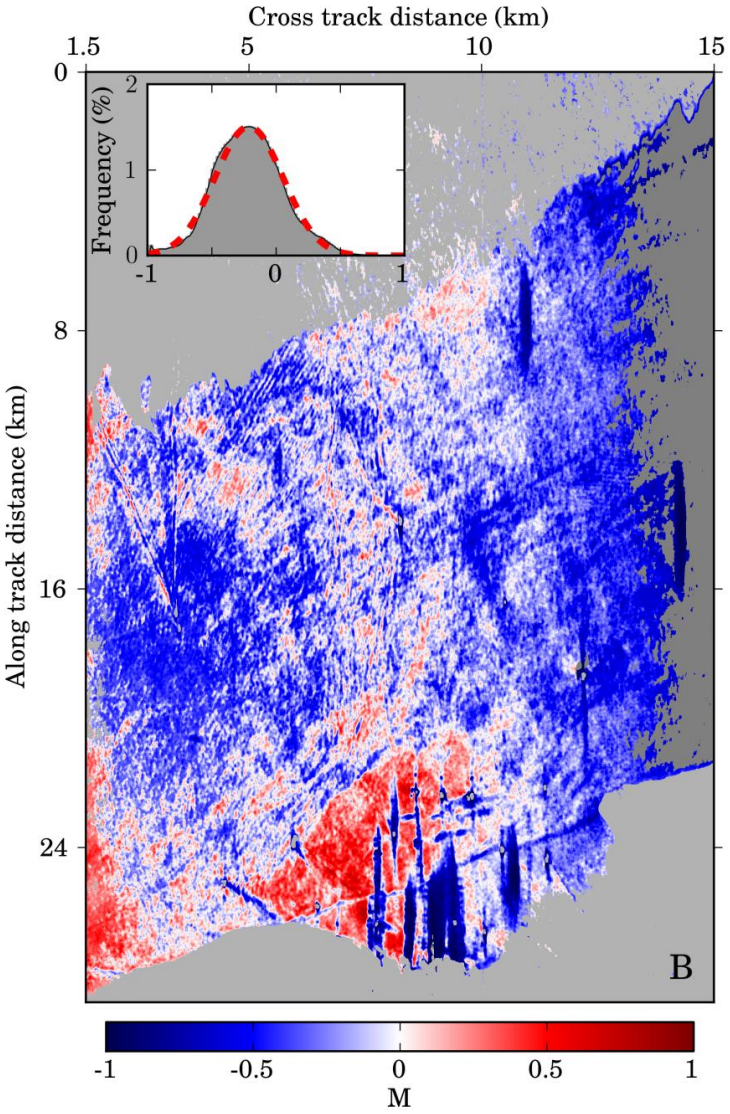




perfectly rough

- Reducing total scattered power (only when mixed)

Inferring Mixing



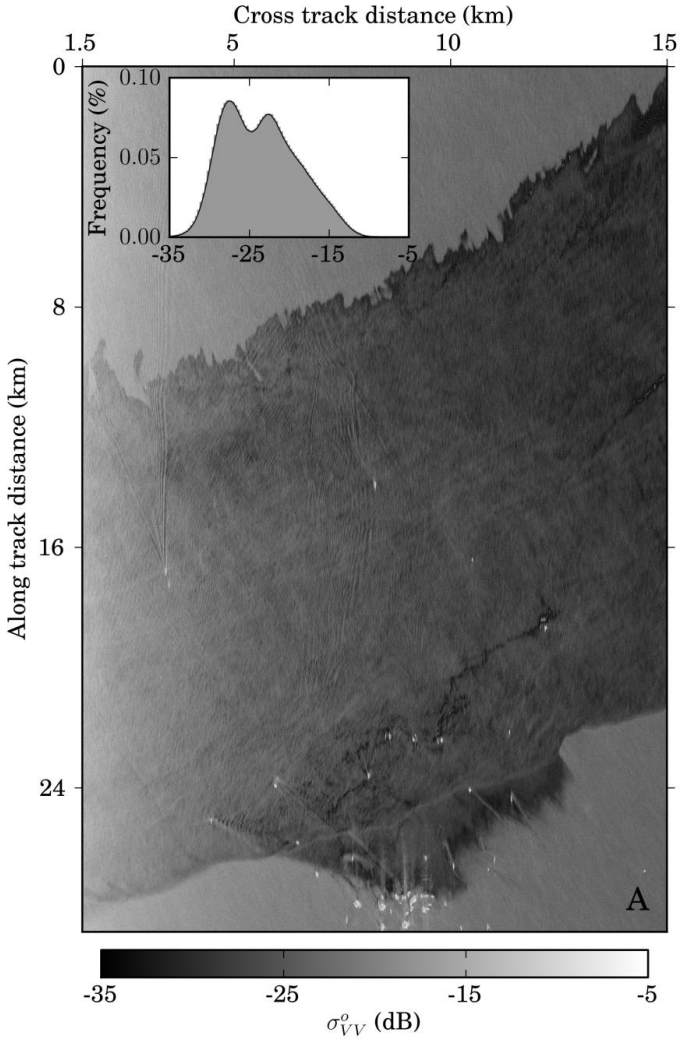
Computation

Challenges:

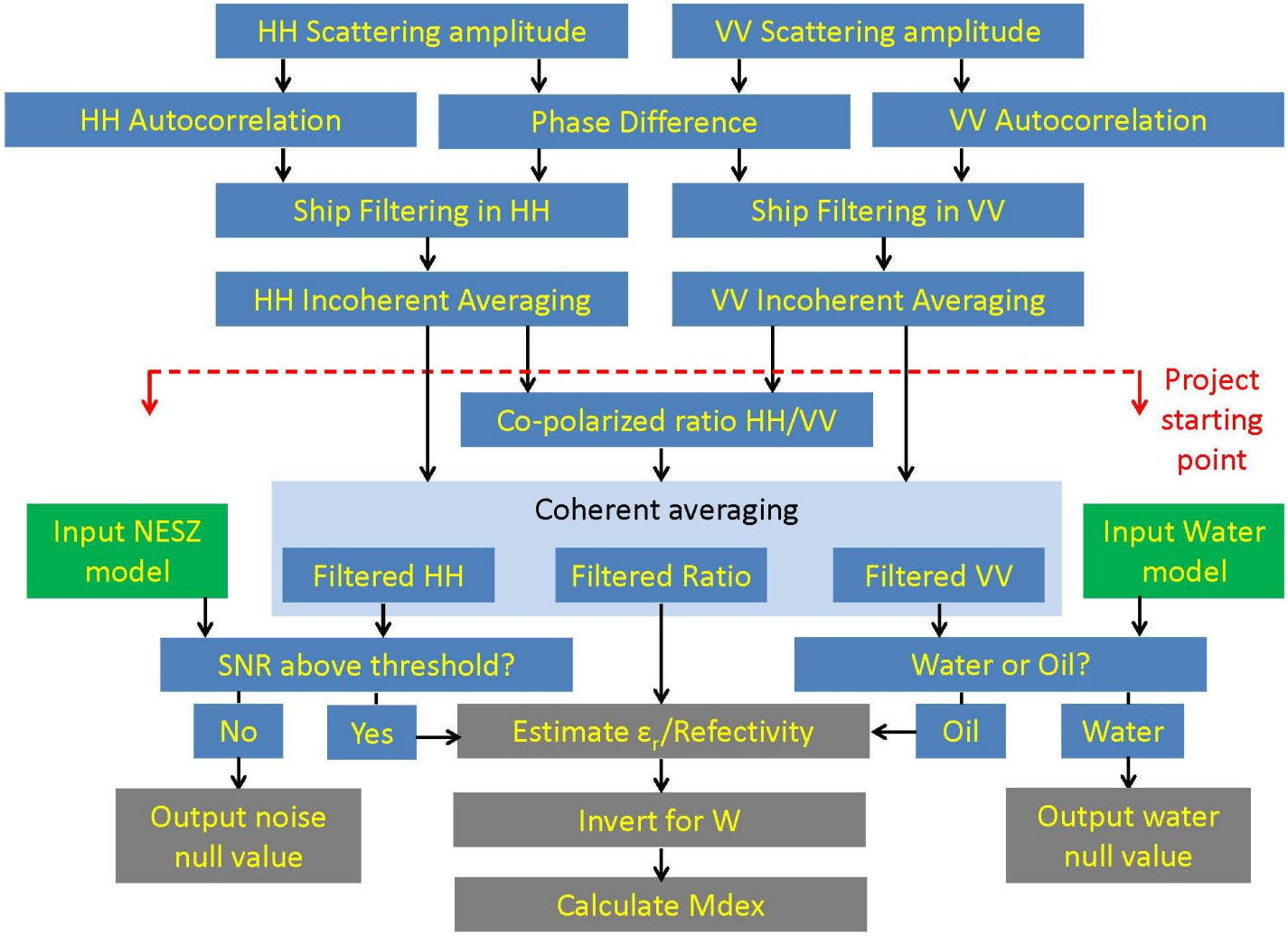
- Large data sets
  ~10s to 100s of GB
- Frequent data takes
- Real-time processing is essential

Advantages:

- Finest grain tasks are individual pixels
- No communication requirements



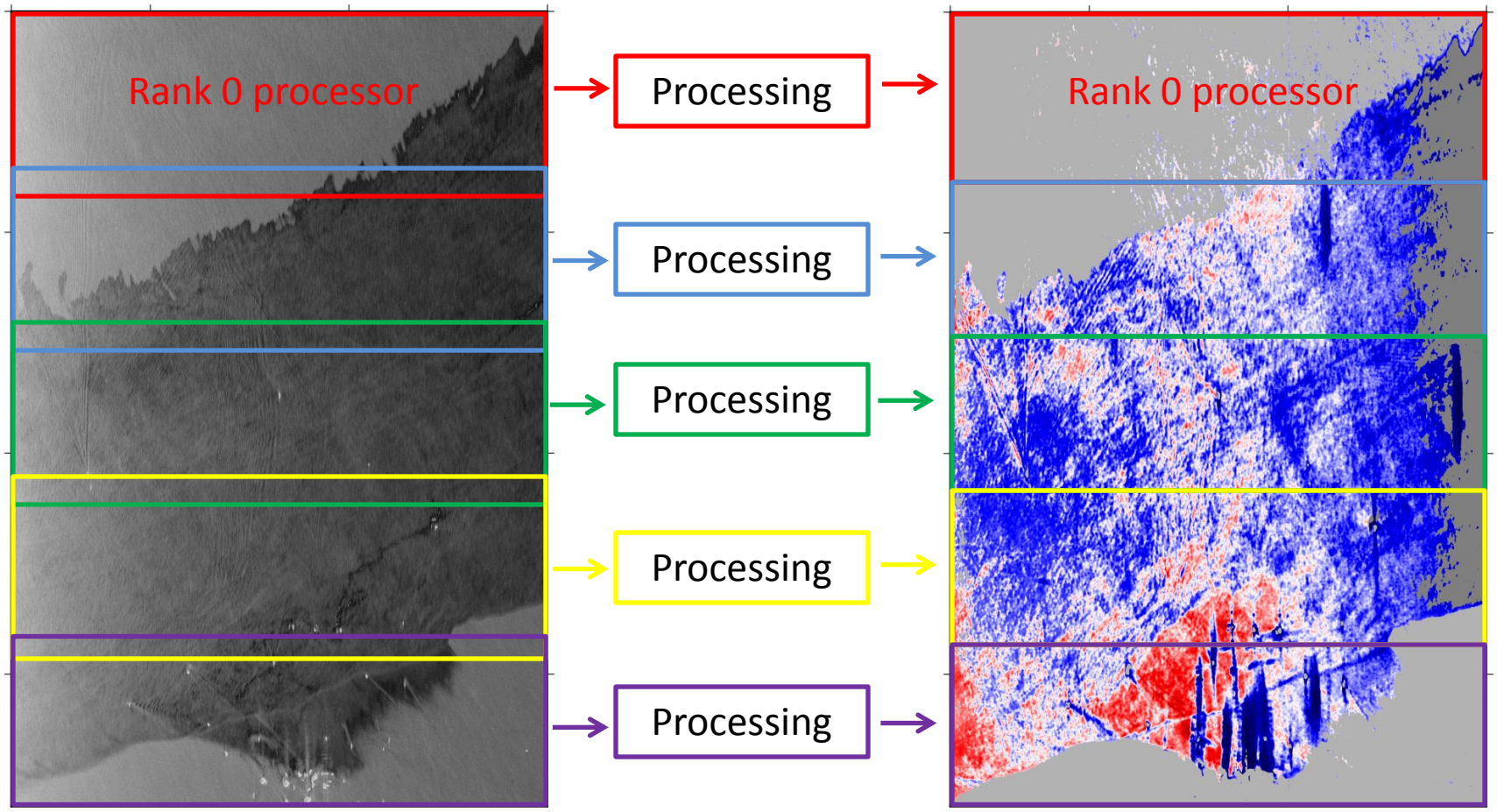
Conceptual Work Flow



Parallelization Strategy

Each processor reads its own data

Assembly takes place in Rank 0



Future Work

- Current implementation uses only MPI
- Extend to hybrid MPI + pthreads
- (Possibly add GPU capability)
- Add modules to incorporate more of the overall processing chain
- Compressed signal processing (not this quarter!)