Aquatic Transfer Facility (ATF) – San Pablo Bay (SPB)

Proposed Region of ATF

Proposed Seabed Pipeline

Technical Studies – An Overview

Scope: Provide background and new scientific information and analysis for technical evaluation of ATF in San Pablo Bay. Focus on hydrodynamic and sedimentological processes affected by the location and operation of the ATF.

Guidance: Specific topics incorporated in the technical report were decided upon by steering committee including representatives from ACOE, Coastal Conservancy, BCDC, Jones and Stokes, and CME (D. Cacchione).

Technical Studies:

1. ***Long-term erosion rates and mercury-rich deposits in SPB***
   - Bruce Jaffe and Theresa Fregoso, USGS Coastal & Marine Geology, Santa Cruz, CA

2. ***Suspended sediment concentrations and transport in SPB***
   - David Schoellhamer, Neil Ganju, and Greg Shellenbarger, USGS Water Resources Division, Sacramento, CA

3. ***Tidal hydrodynamic modeling in SPB***
   - Michael MacWilliams, Environmental Consultant, San Francisco, and Ralph Cheng, USGS Water Resources Division, Menlo Park, CA

4. ***Sediment properties, erosion, and accumulation within the ATF***
   - Craig Jones, Sea Engineering Inc., Santa Cruz, CA

5. ***Loss of dredged material during discharge operations***
   - Engineering Research and Development Center, Army Corps of Engineers, Vicksburg, MS

Major Considerations for ATF Site Selection:

1. ATF would be located northwest of the main navigation channel in SPB.

2. A bay-floor pipeline would be constructed from ATF to Hamilton Restoration Area.

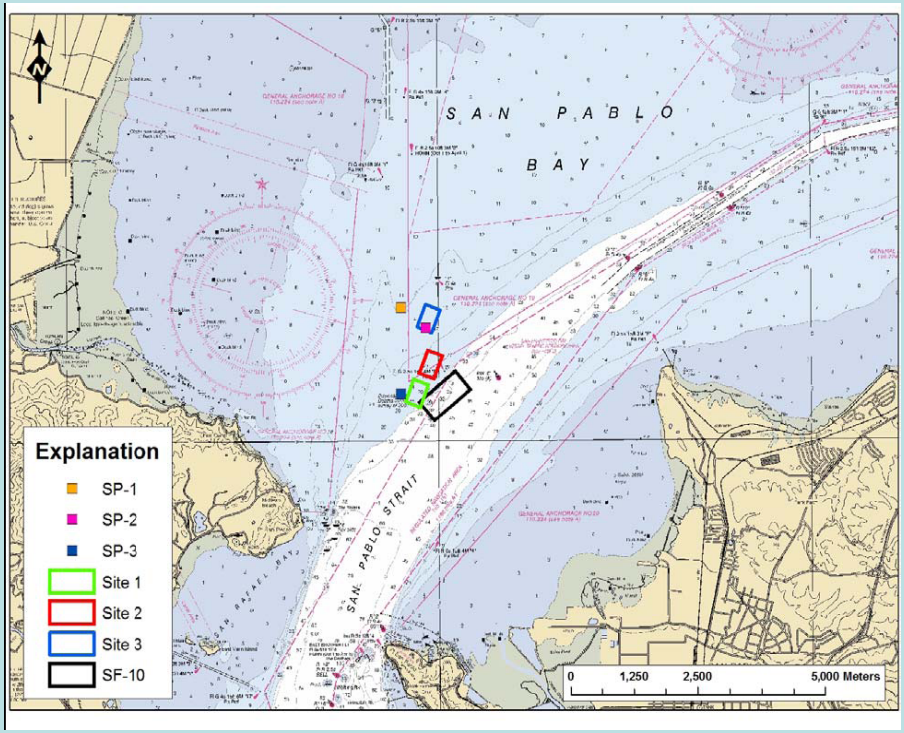
3. Dredging vessels would have safe navigable access to the ATF with no or minimal newly dredged channel required for entry or egress.

4. ATF maximum depth and horizontal dimensions would accommodate required material volume for wetland restoration.

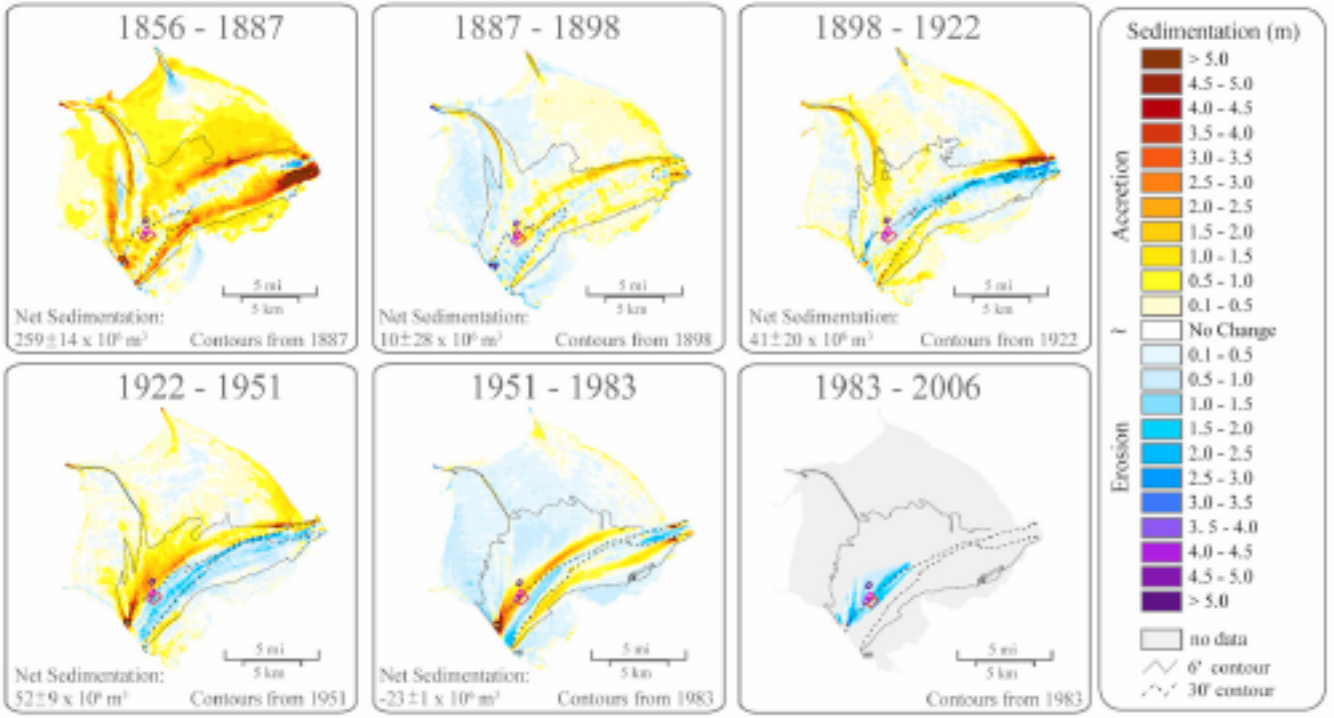
5. ATF would be located in a region of low volumes of buried mercury-rich sediment (hydraulic mining debris).

6. Erosive loss of sediment within ATF due to the action of waves and currents.must be minimized

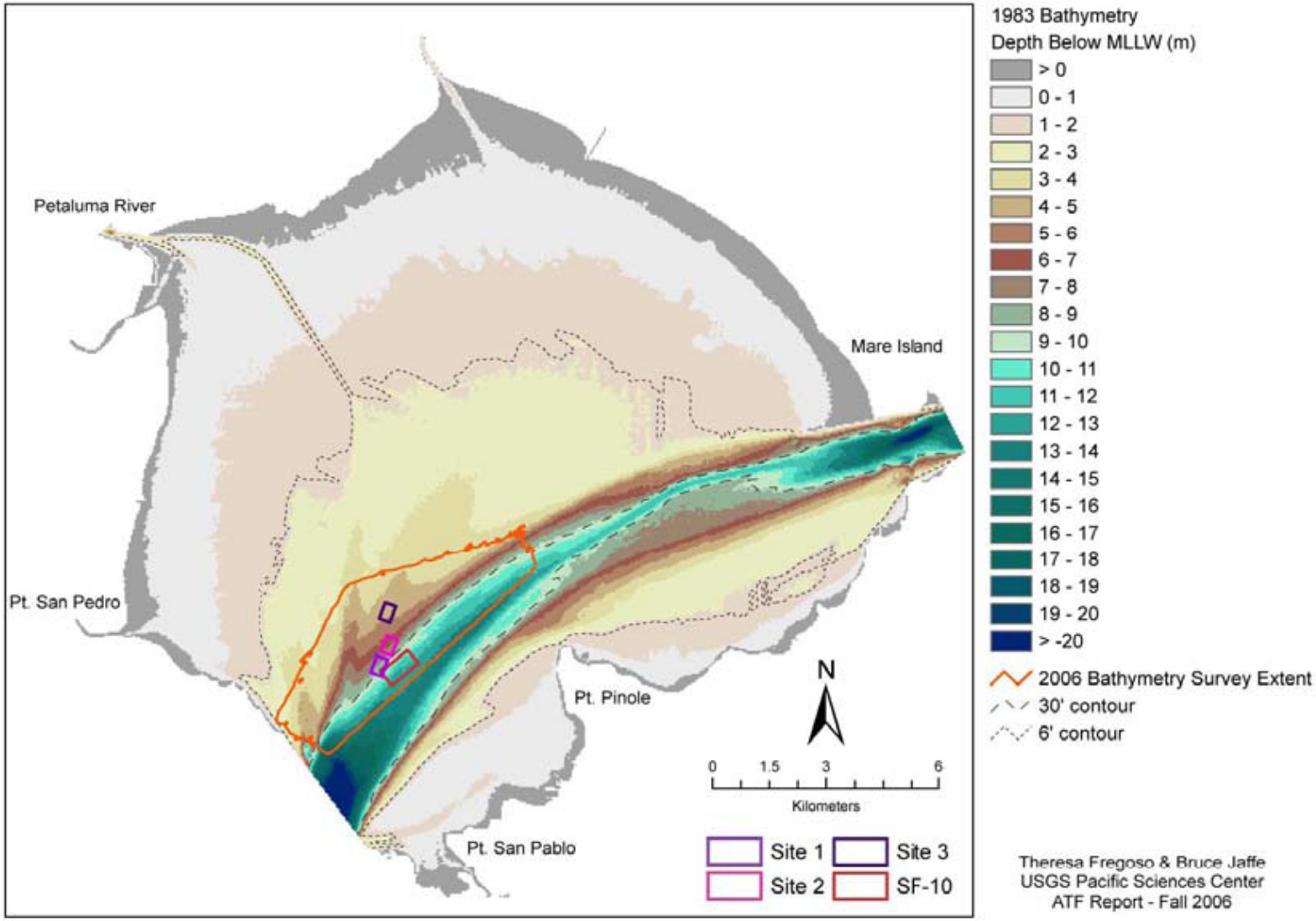
7. Alterations to tidal flows and sediment dispersal in SPB must be minimized.



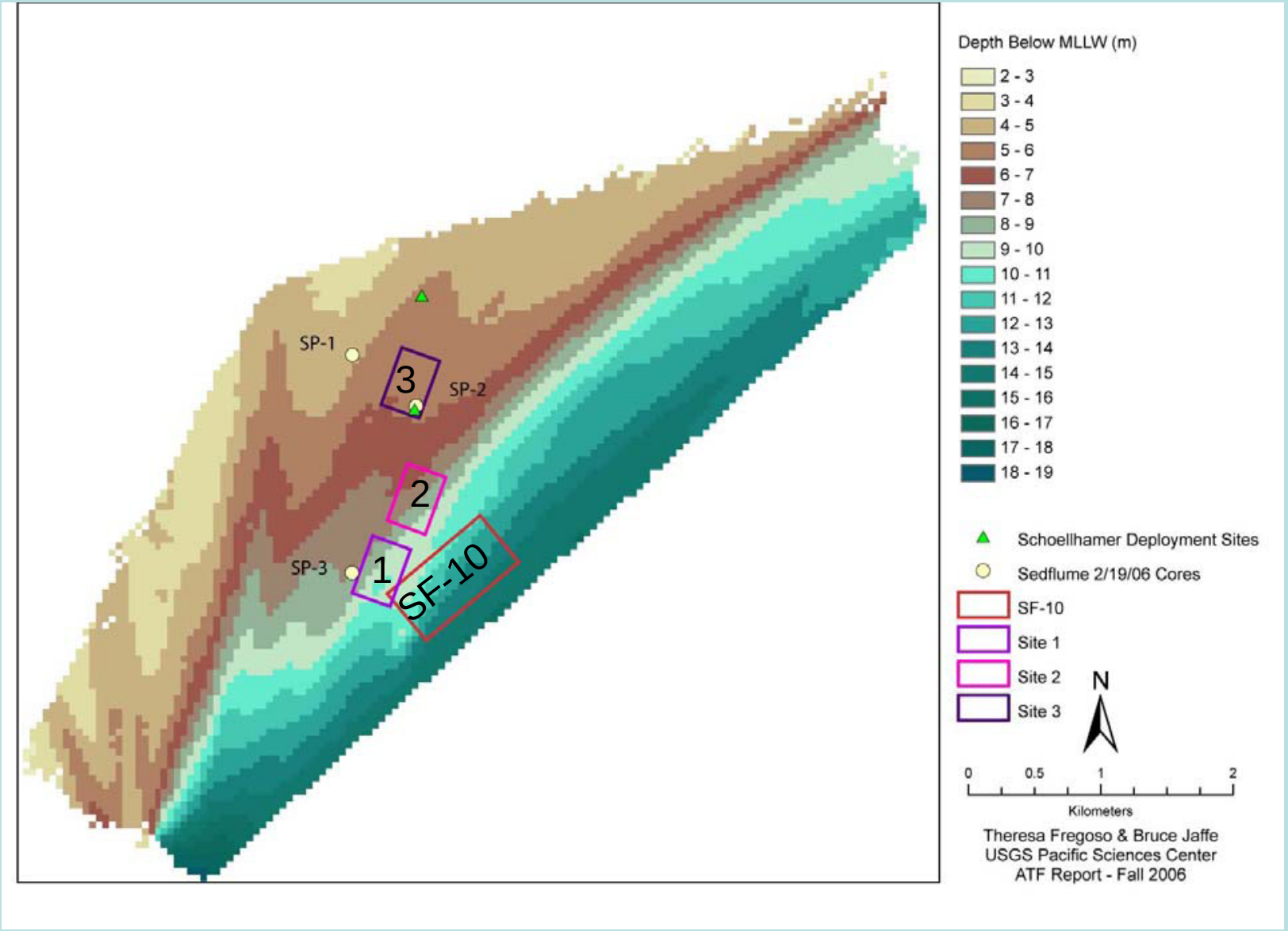
Bathymetric Change Analysis -- Accretion in Red/Yellow; Erosion in Blue/Orchid
San Pablo Bay



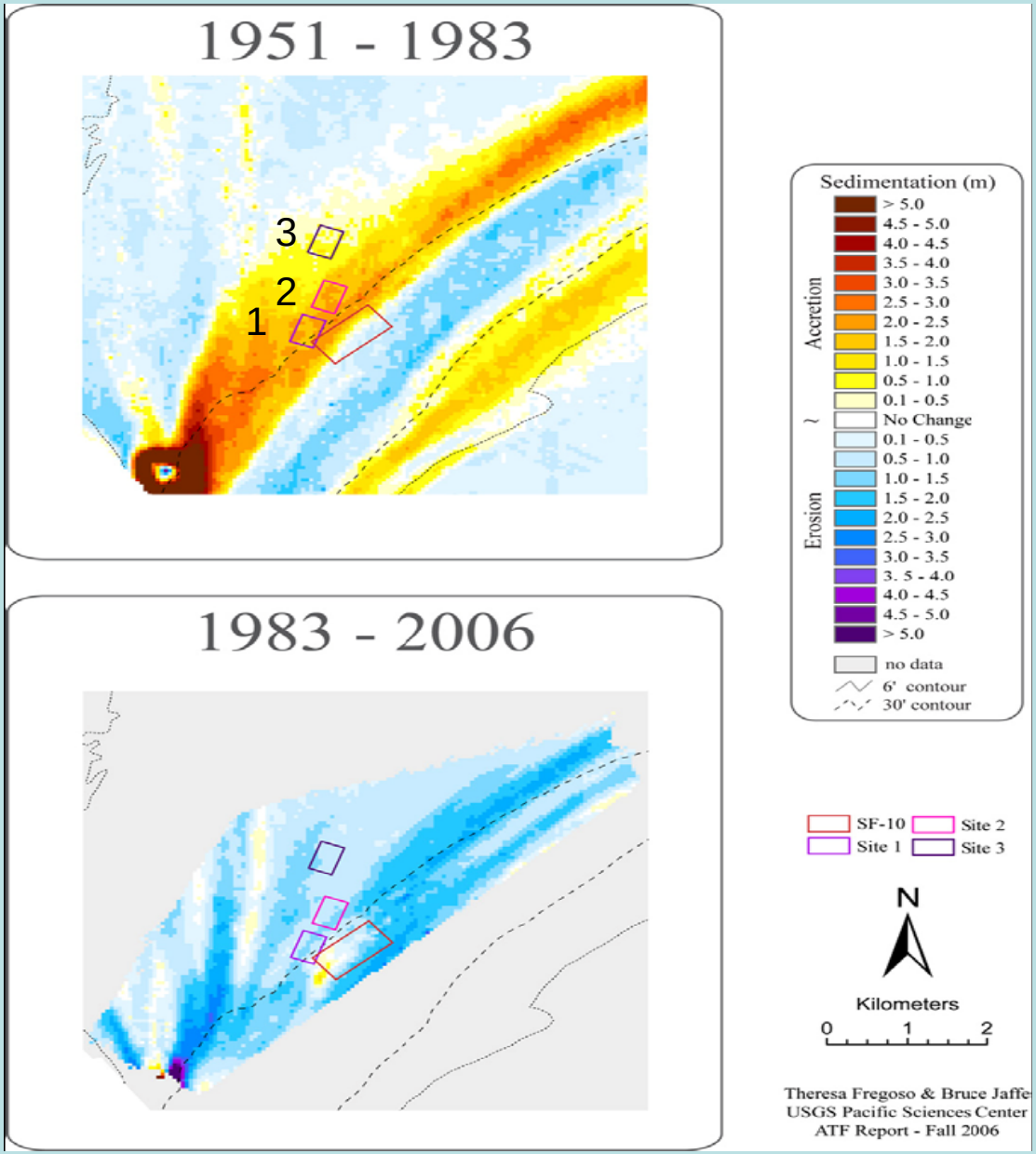
SPB Bathymetry and Locations of Potential ATF Sites



Detailed Bathymetry and Site Locations



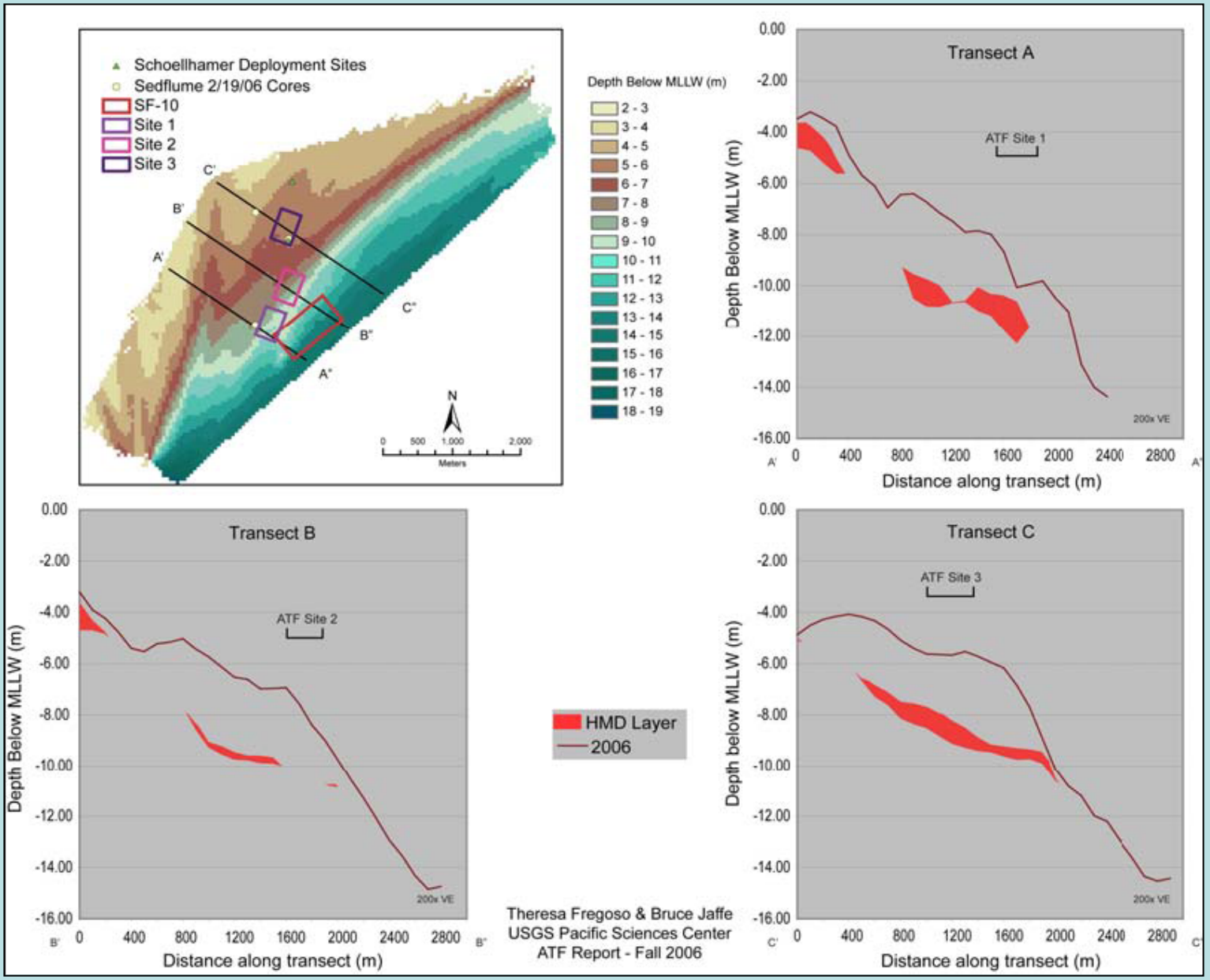
Seafloor Erosion and Accretion based on Detailed Bathymetric Analysis



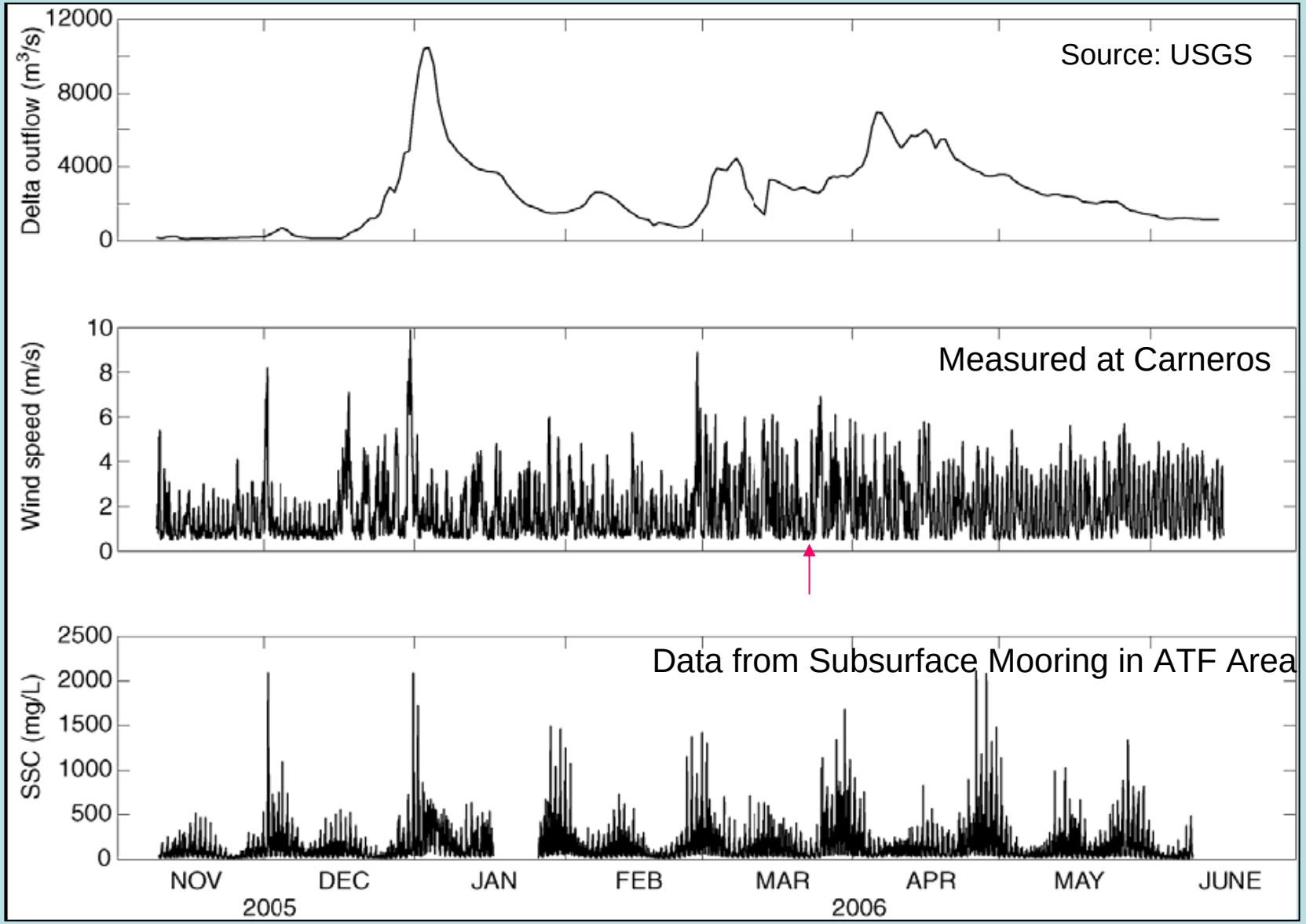
Net Bed Level Changes at Selected ATF Sites

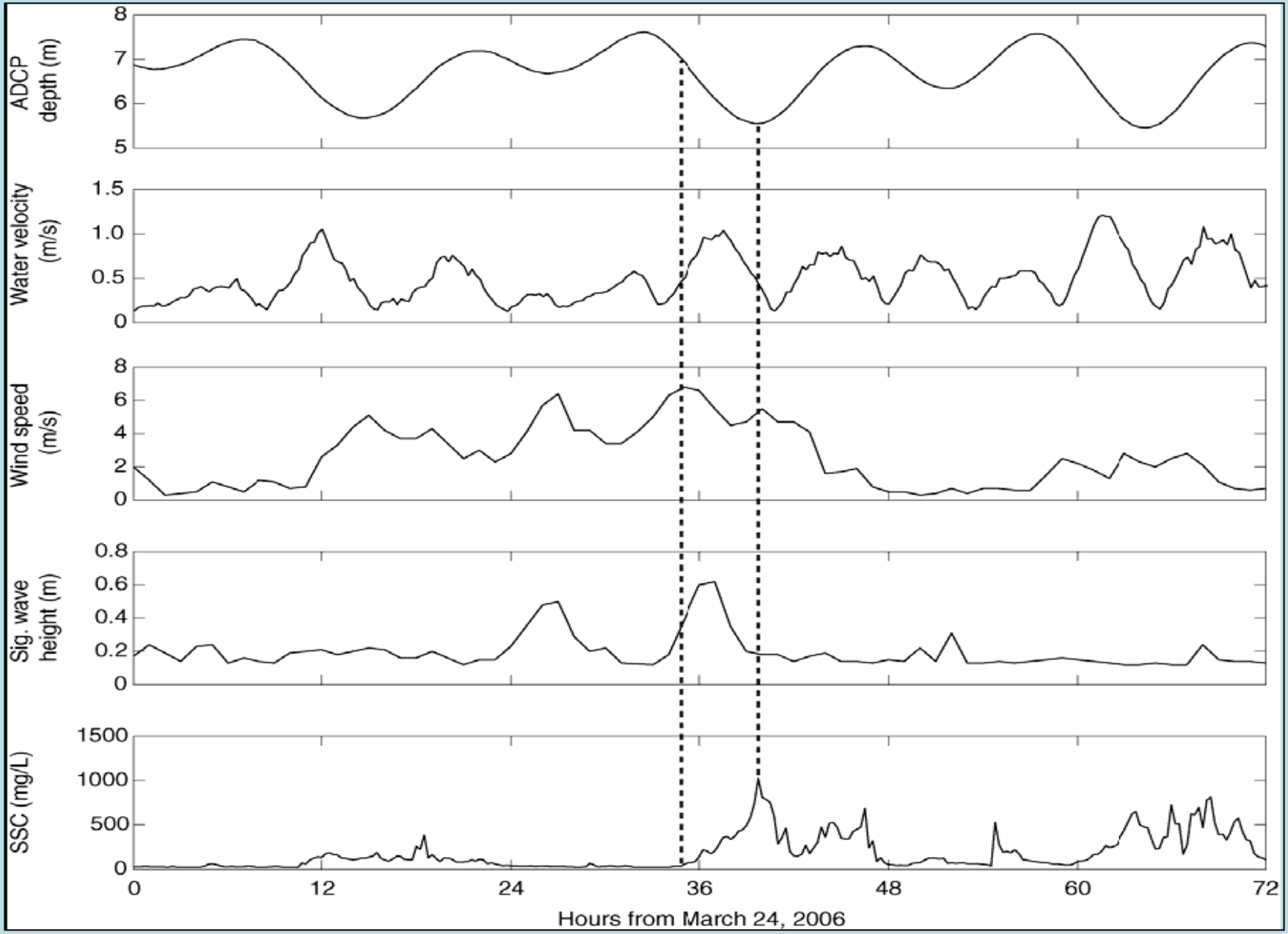
Period	ATF Site	Average Change, cm	Rate, cm/yr
1951-1983	1	200	6.1 ± 0.5
	2	198	6.0 ± 0.7
	3	56	1.7 ± 0.6
1983-2006	1	-81	-3.4 ± 1.2
	2	-87	-3.6 ± 0.9
	3	-84	-3.5 ± 0.7

Mercury-Rich Deposits from Hydraulic Mining Debris (HMD)

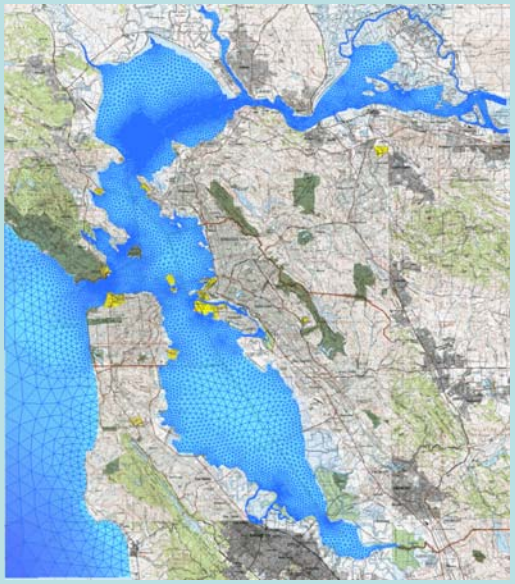


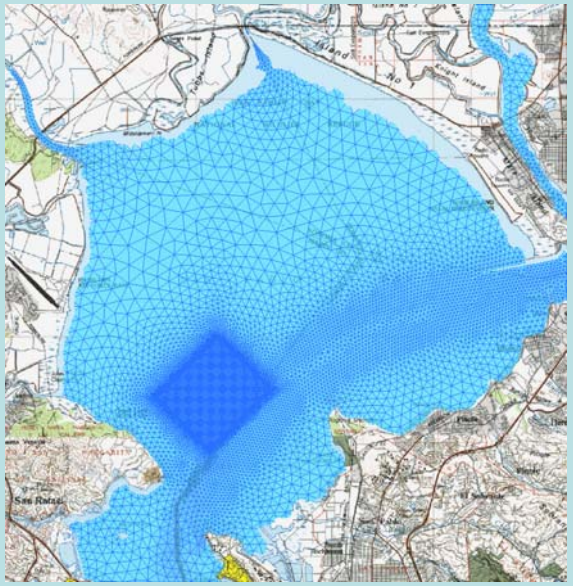
Delta Water Discharge, Wind Speed, and Suspended Sediment Concentration (SSC)

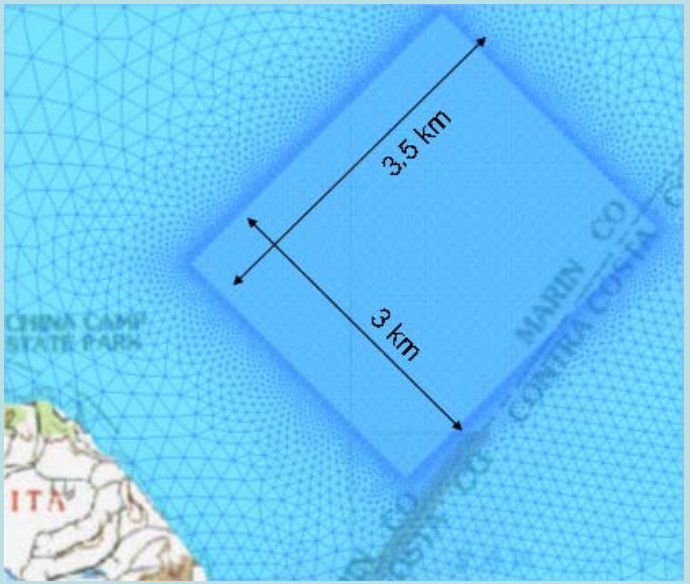



ADCP depth (m)
8
7
6
5
Water velocity (m/s)
1.5
1.0
0.5
0
Wind speed (m/s)
8
6
4
2
0
Sig. wave height (m)
0.8
0.6
0.4
0.2
0
SSC (mg/L)
1500
1000
500
0
0
12
24
36
48
60
72
Hours from March 24, 2006

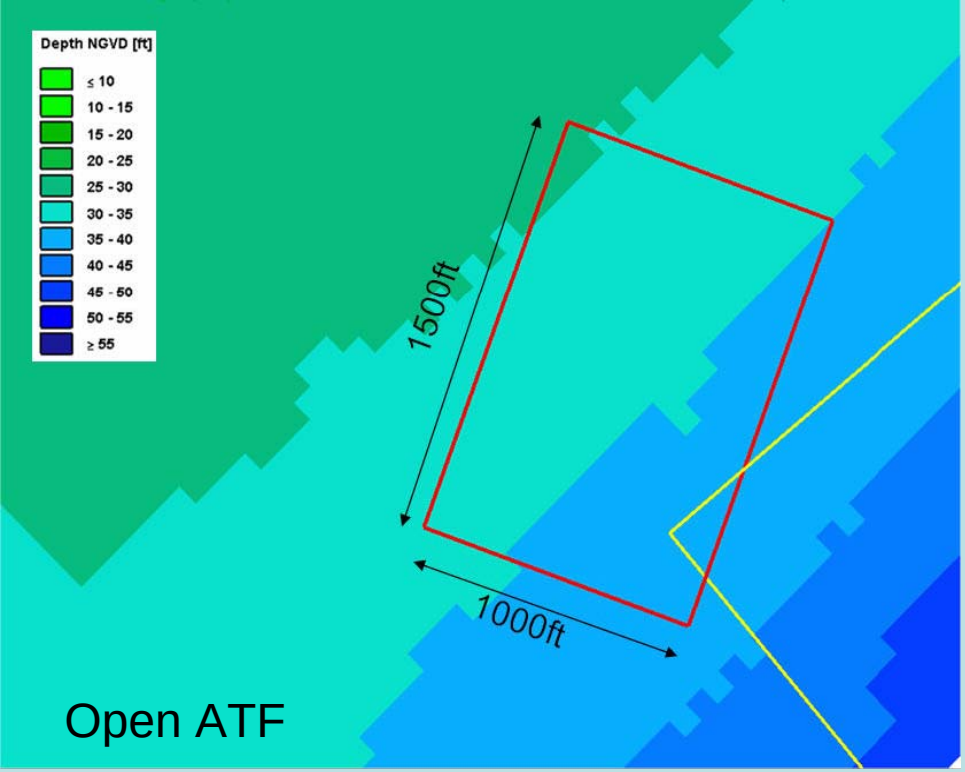
UnTRIM Model Overview



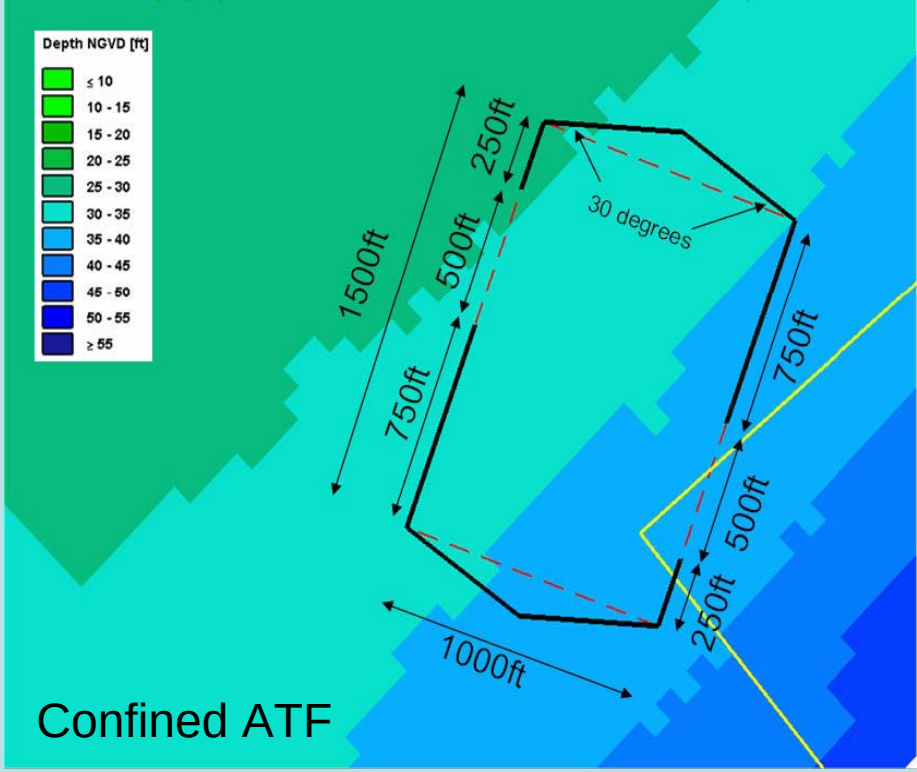




- Model includes San Francisco Bay and extends into Pacific Ocean.
- Highly refined project area in San Pablo Bay with 25 m grid resolution (64% of total grid cells in San Pablo Bay).
- Model calibrated and validated using two independent data sets (Calibrated for 1998; validated using velocity data from 1980).
- 7 ATF Configurations modeled and compared to existing conditions.
- Results presented show velocity changes and scalar tracer analysis for preferred ATF alternative.



Open ATF



Confined ATF

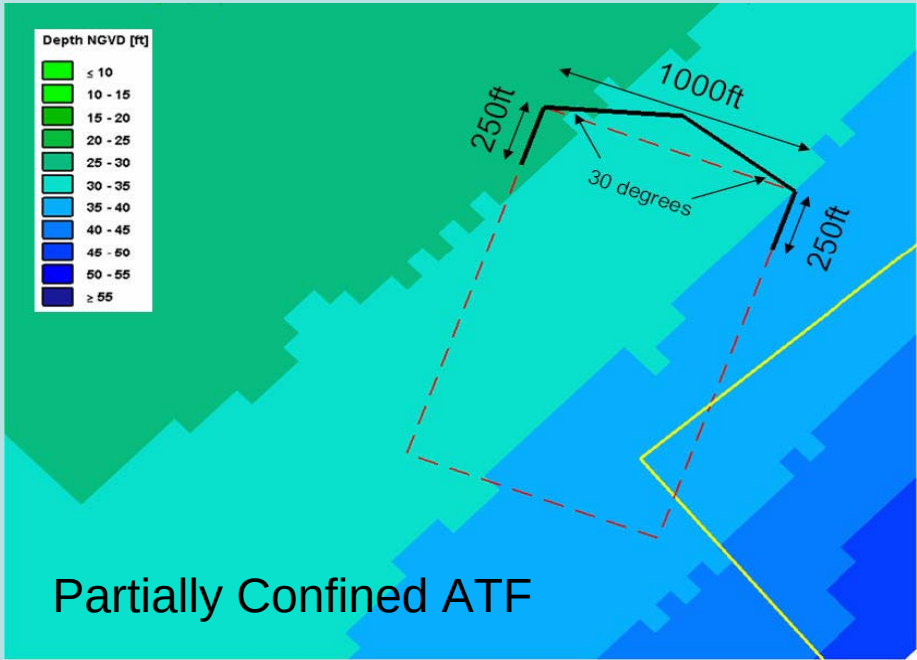
Tidal Flow Model Runs (7 total)

Open ATF (sites 1, 2, 3)

Half-filled Open ATF (site 2)

Partially Confined ATF (site 1)

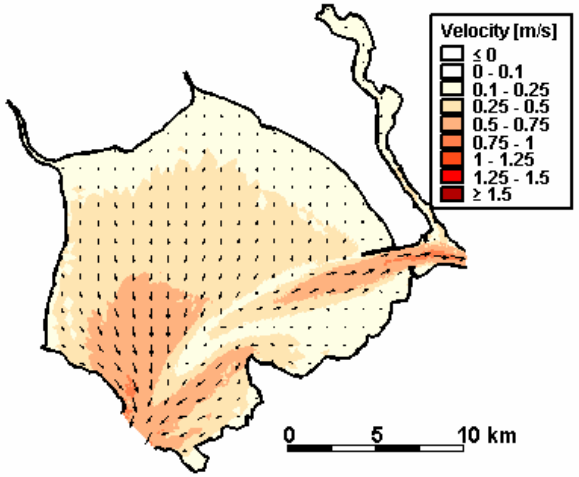
Confined ATF (sites 1, 2)



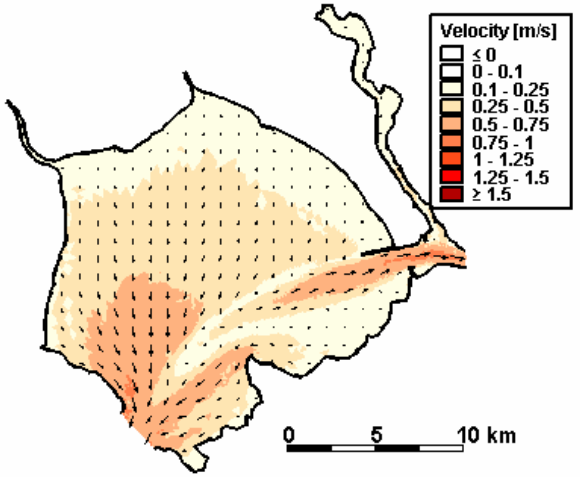
Partially Confined ATF

Preferred ATF Velocity Comparison

Existing



Unconfined ATF



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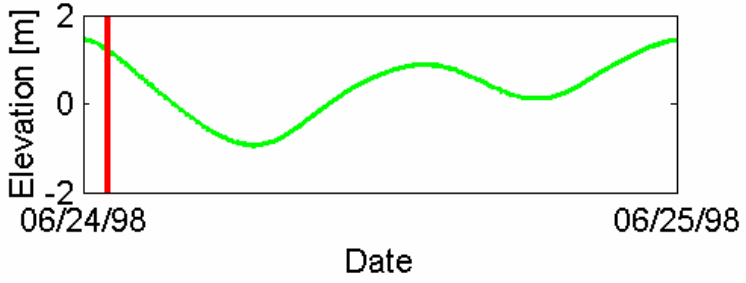
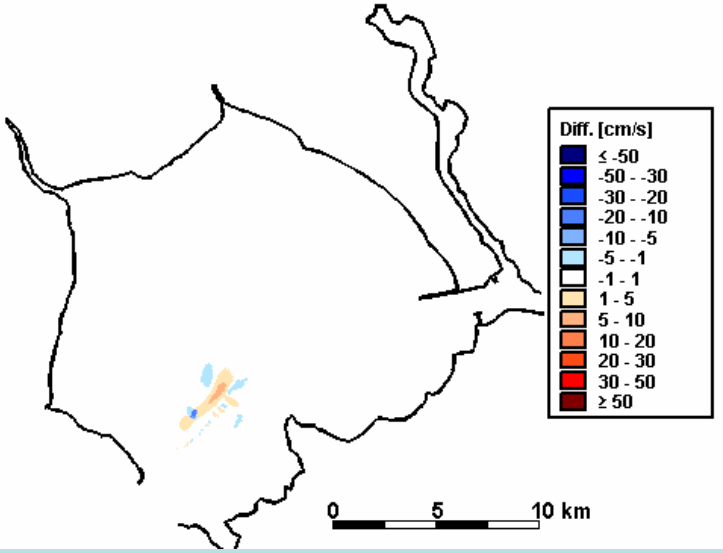


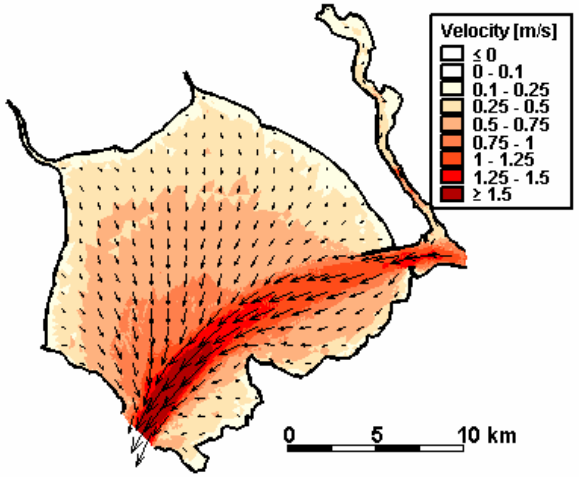
Start Ebb

Difference

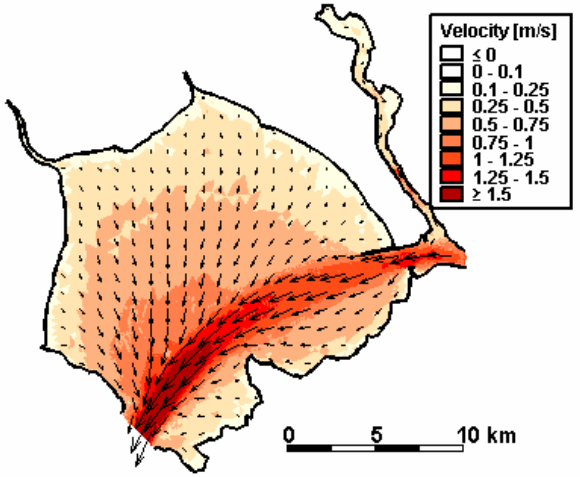


Preferred ATF Velocity Comparison

Existing



Unconfined ATF



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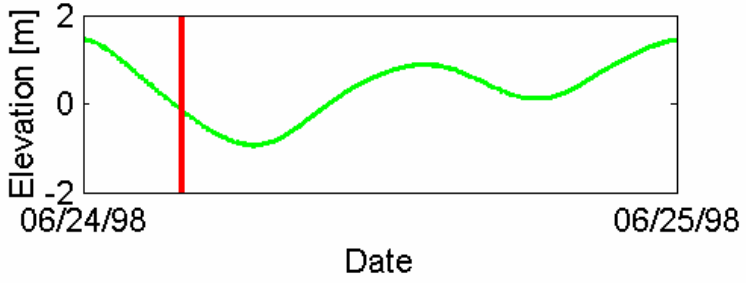
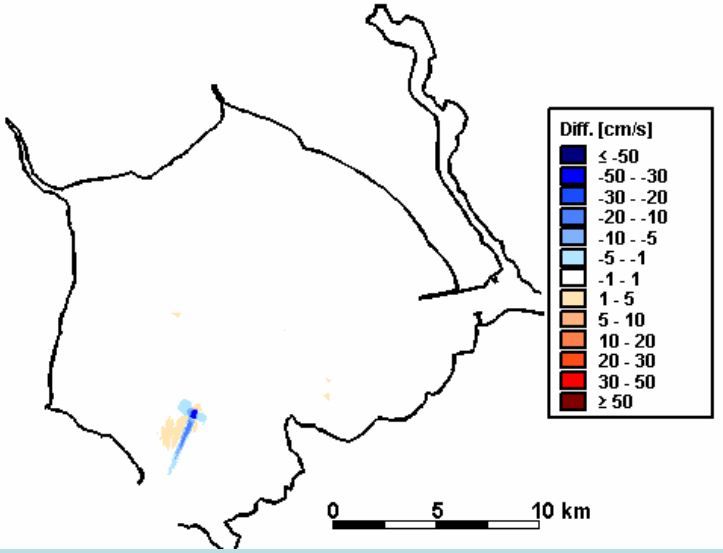


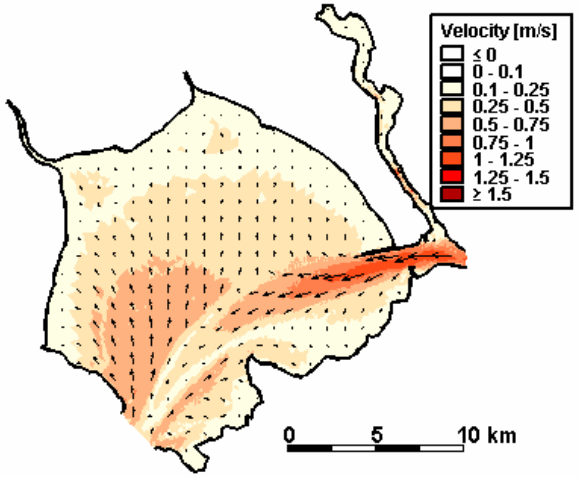
Peak Ebb

Difference

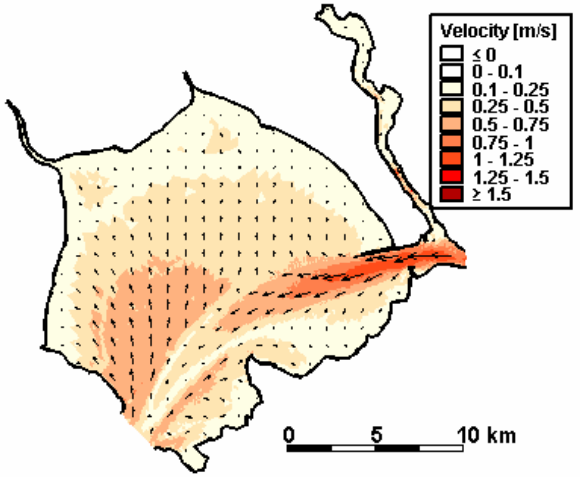


Preferred ATF Velocity Comparison

Existing



Unconfined ATF



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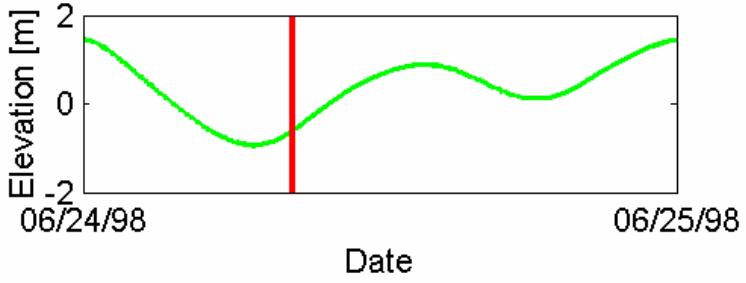
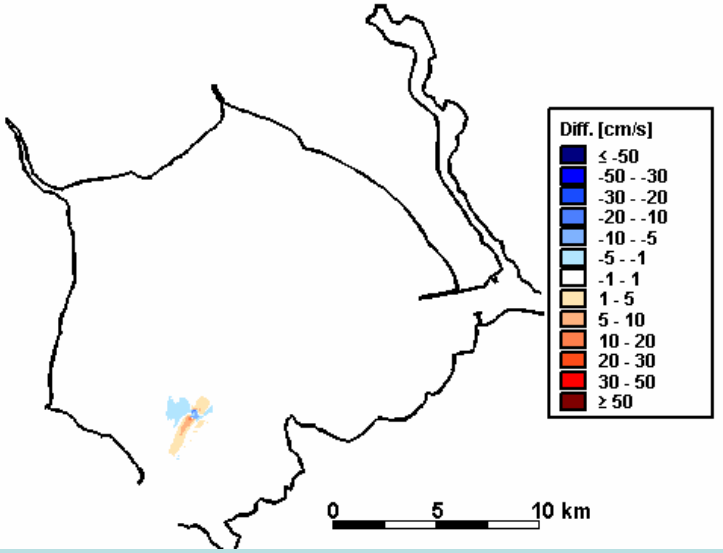


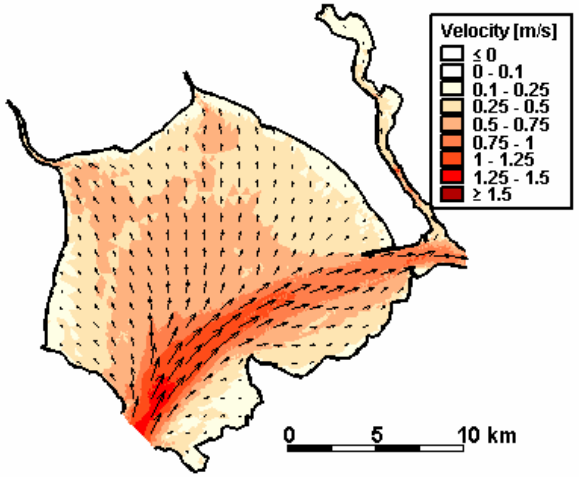
Start Flood

Difference

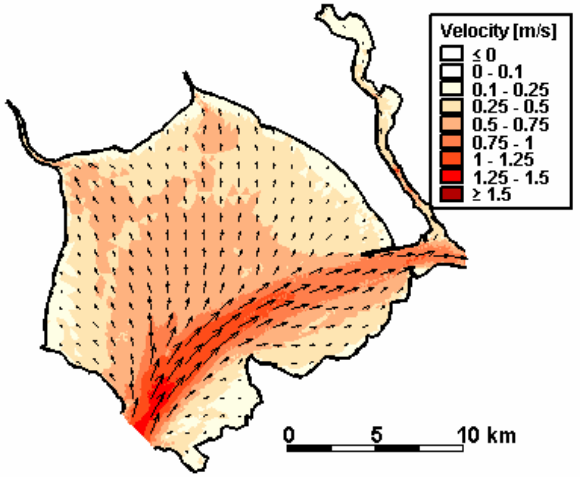


Preferred ATF Velocity Comparison

Existing



Unconfined ATF



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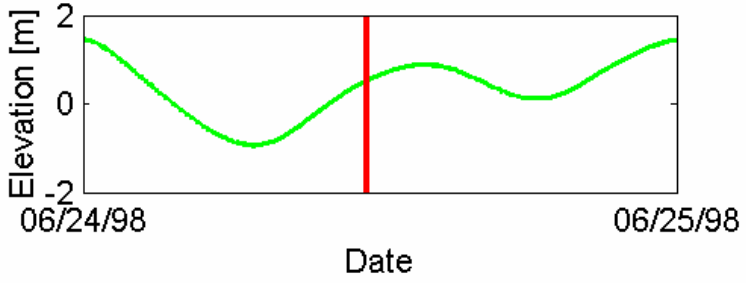
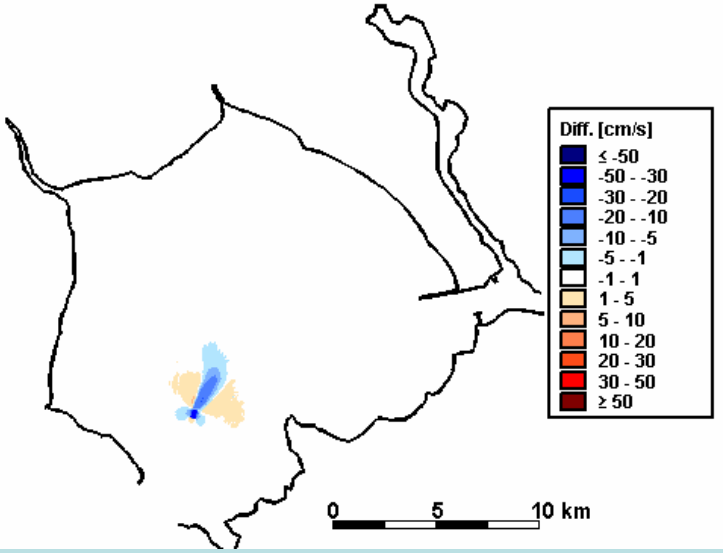
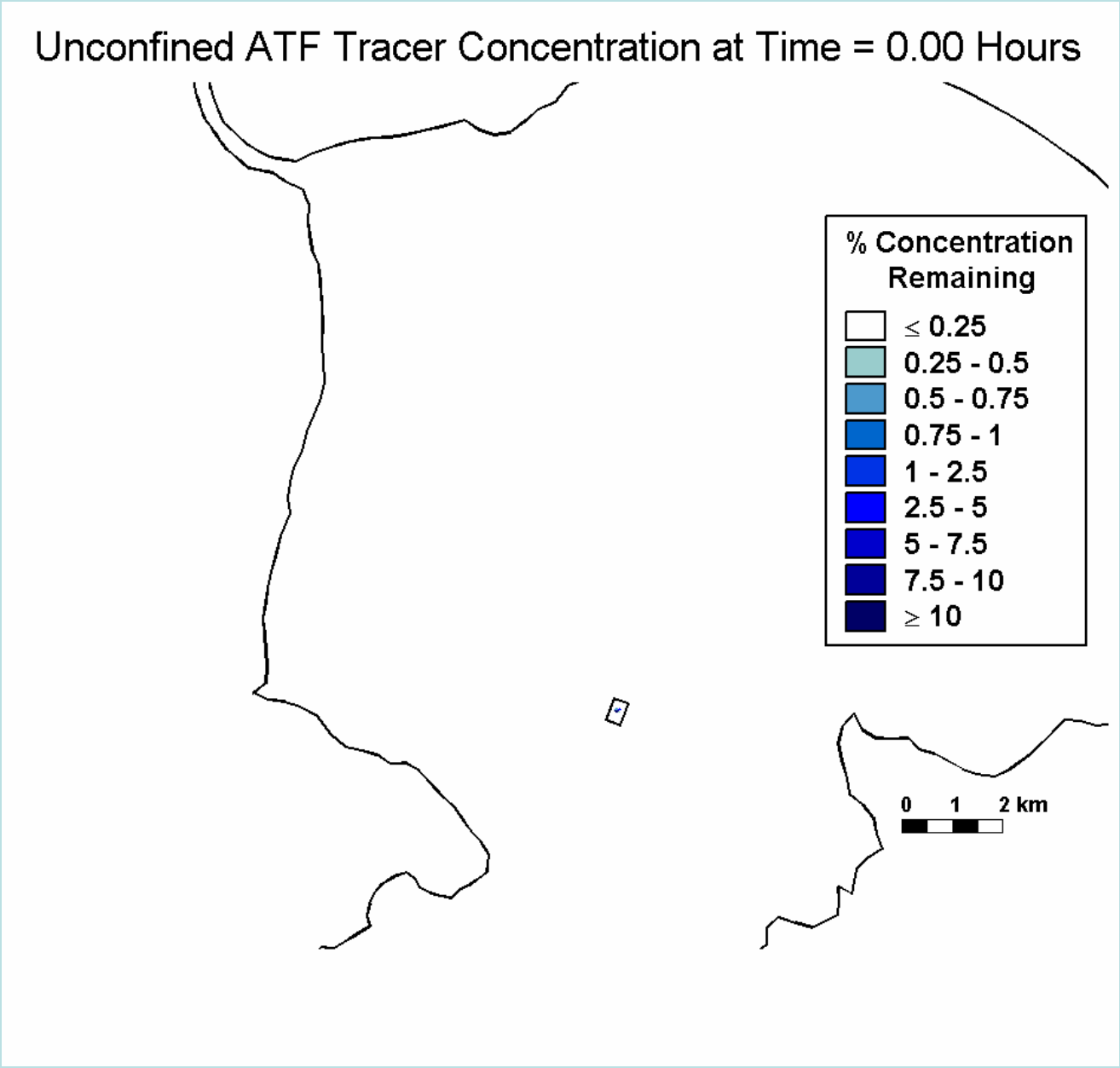


Peak Flood

Difference



Tracer Plume: Low Water Release



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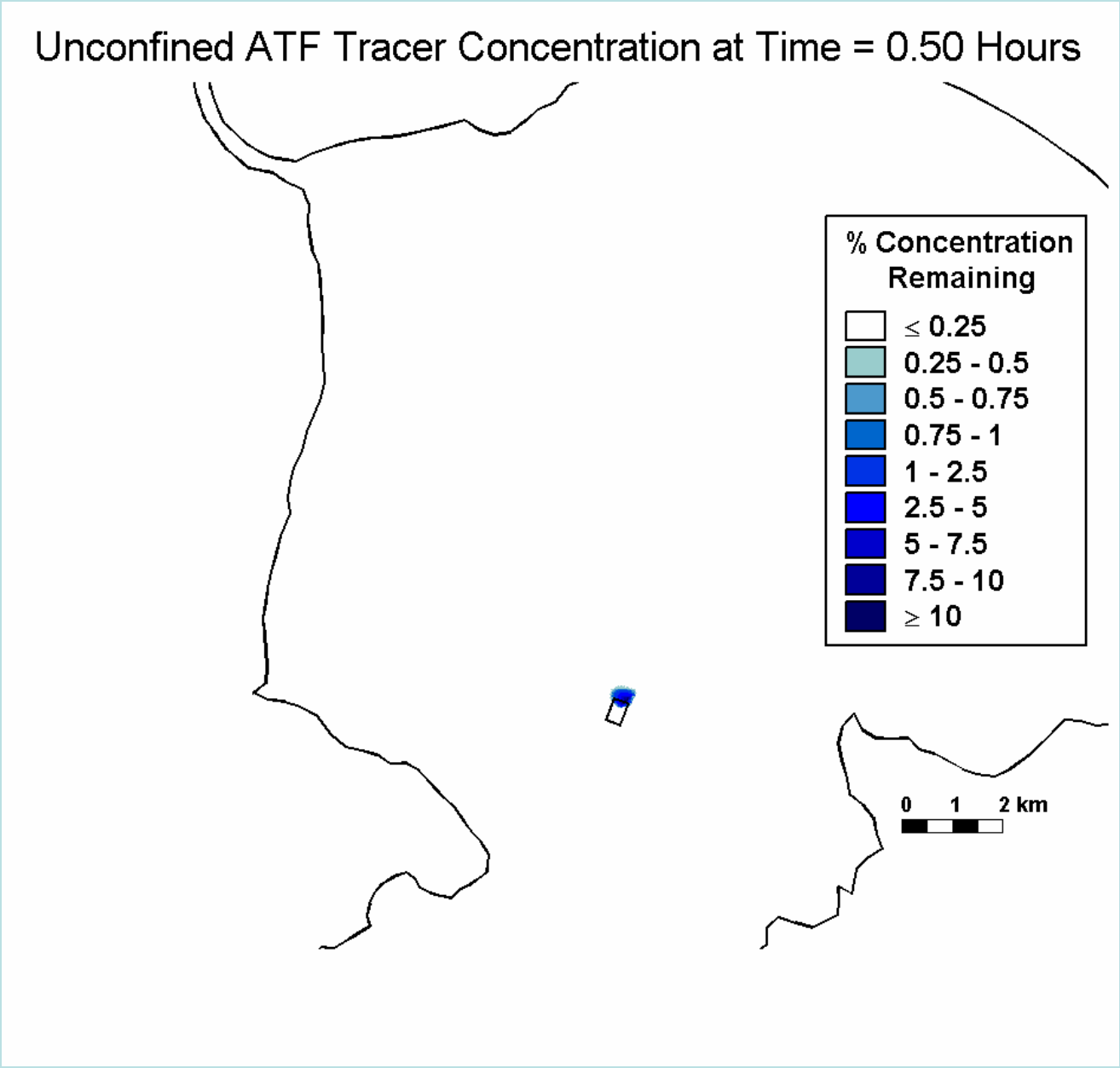

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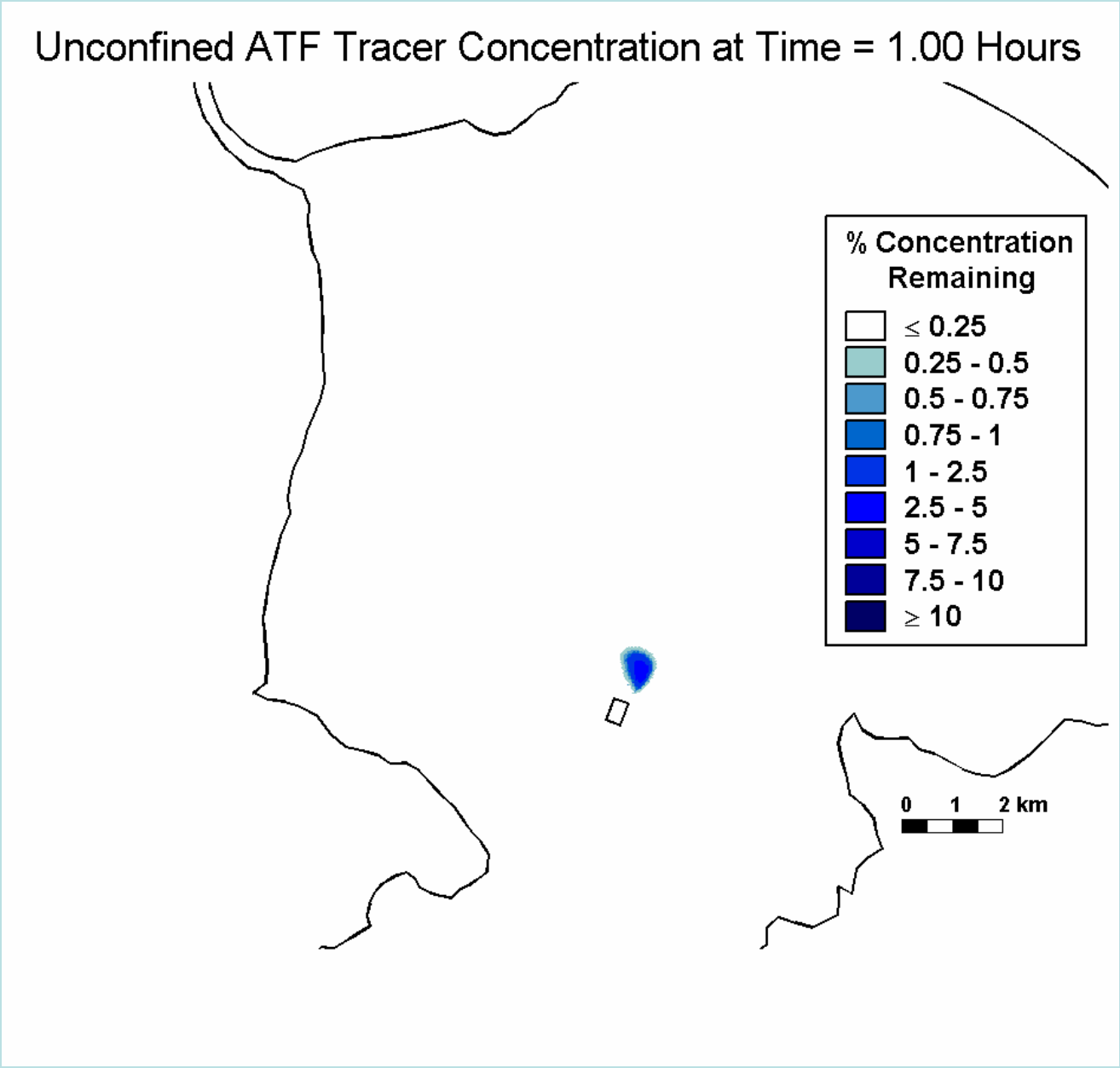

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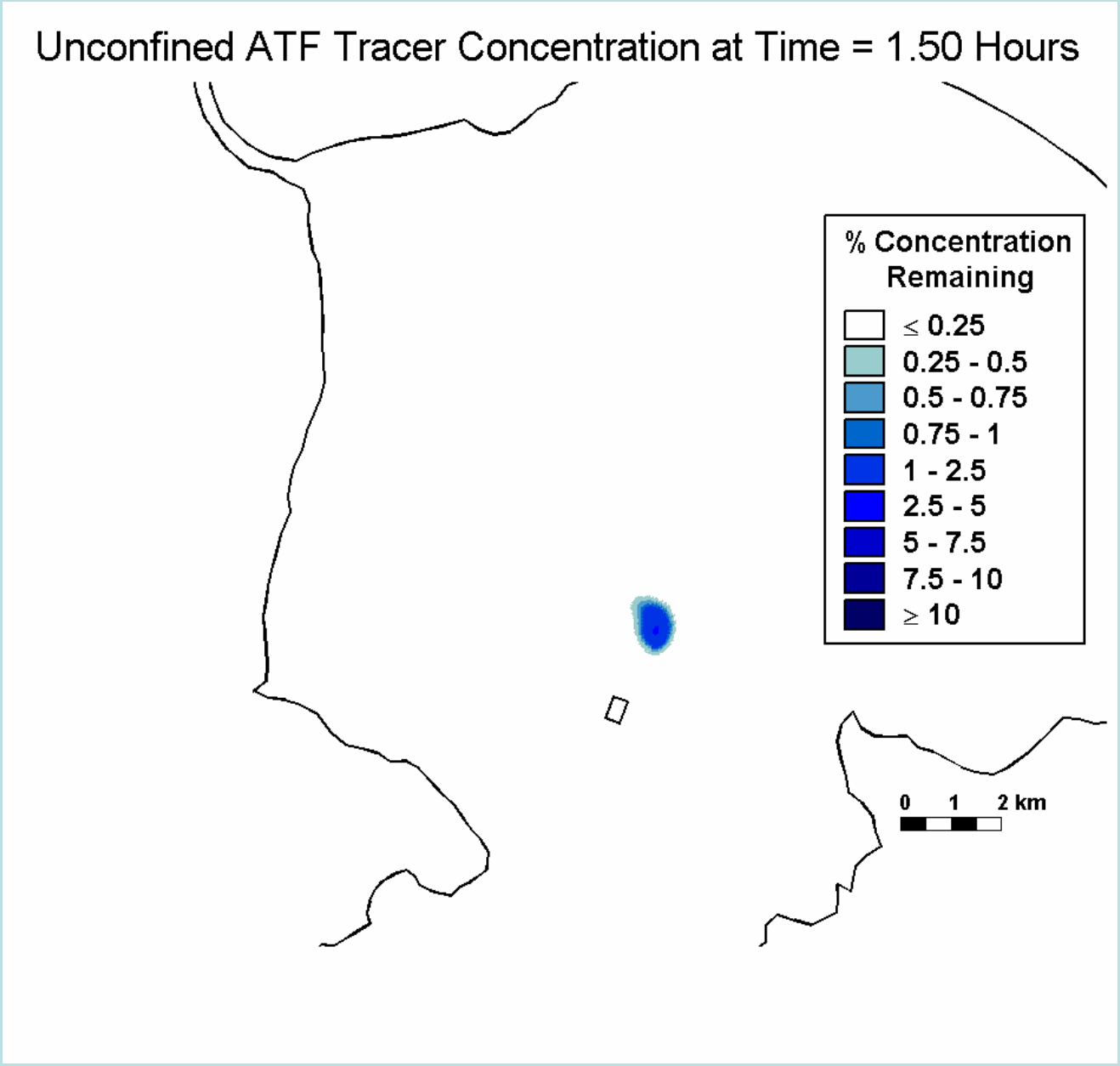

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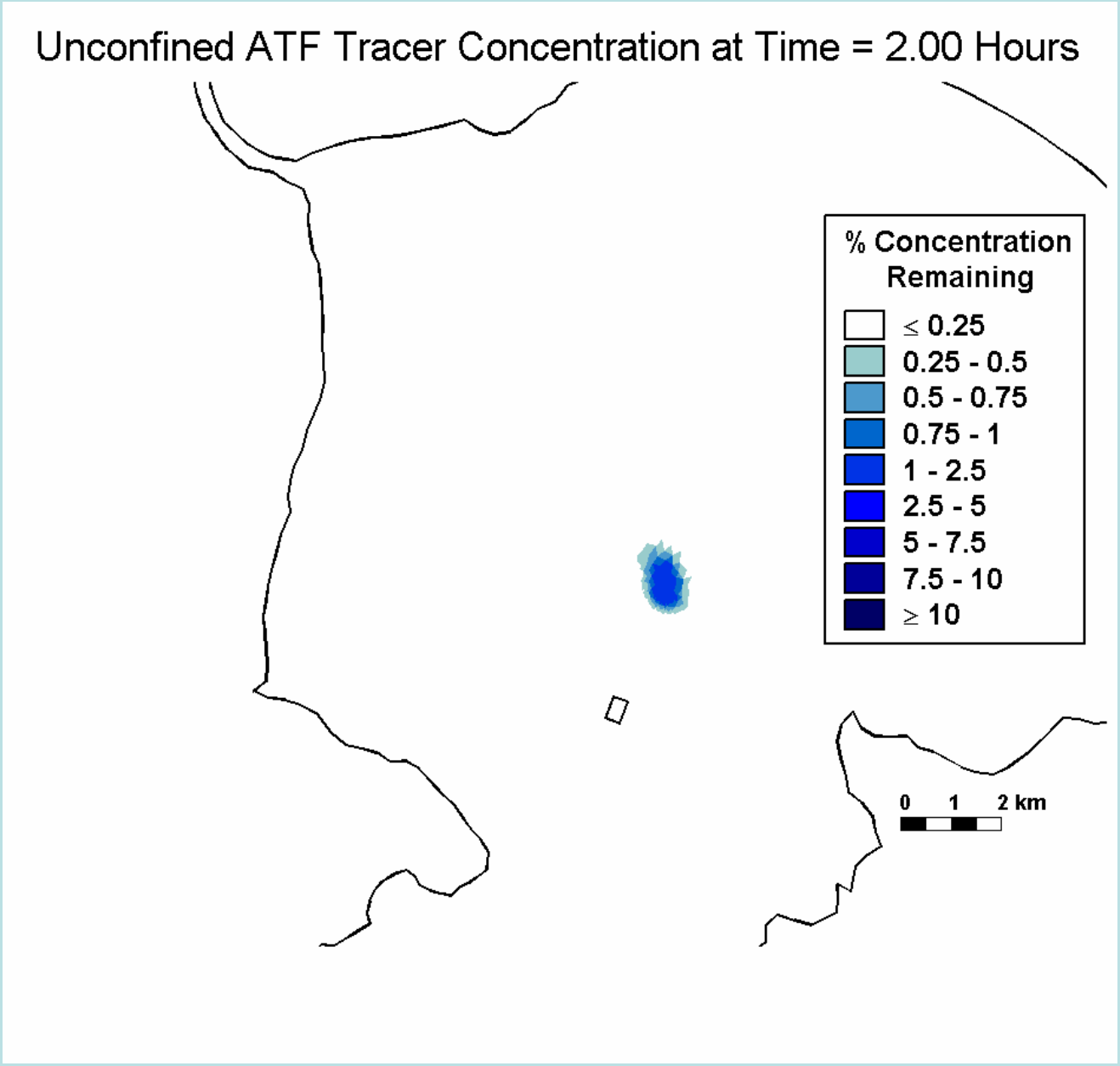

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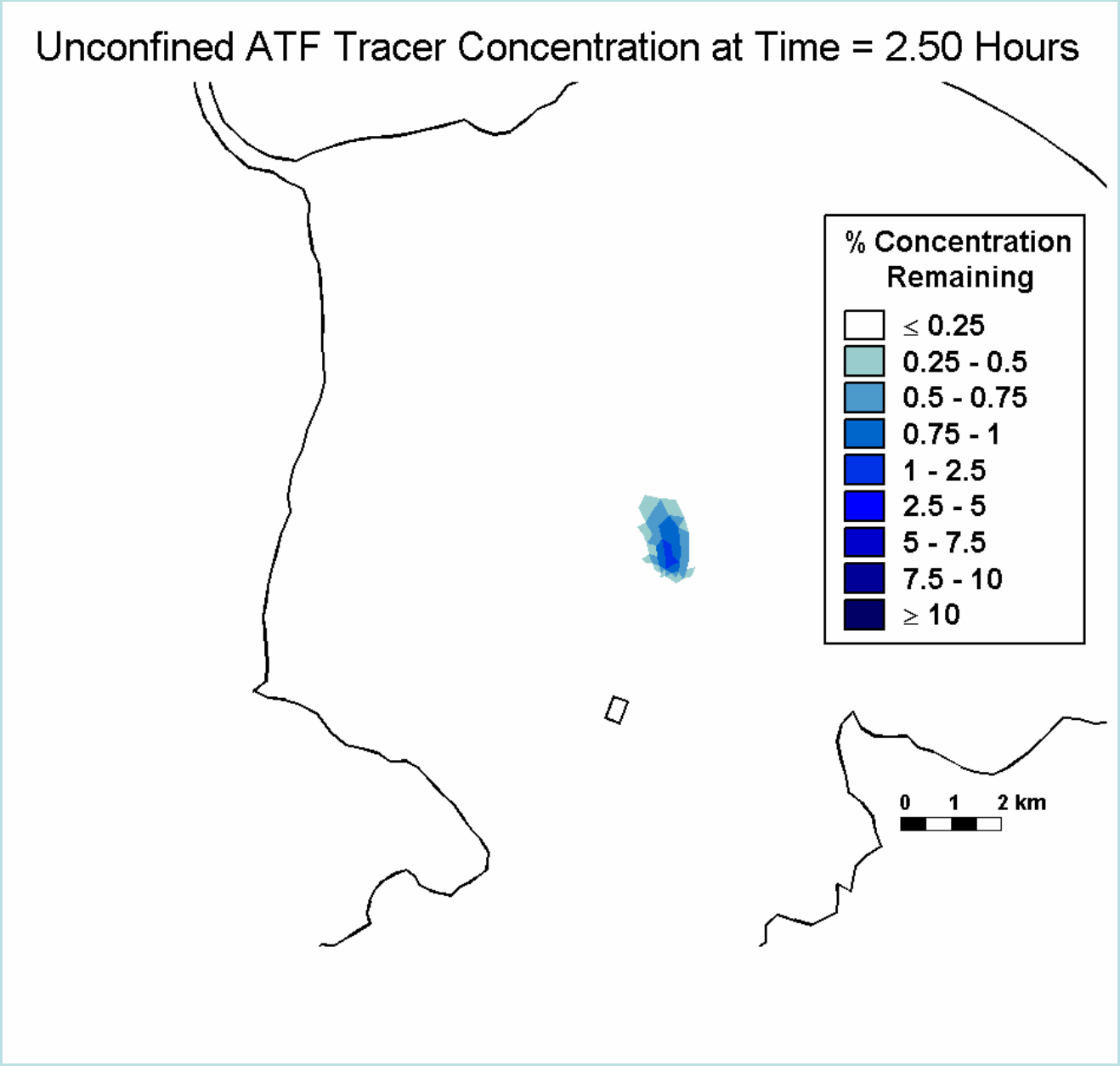

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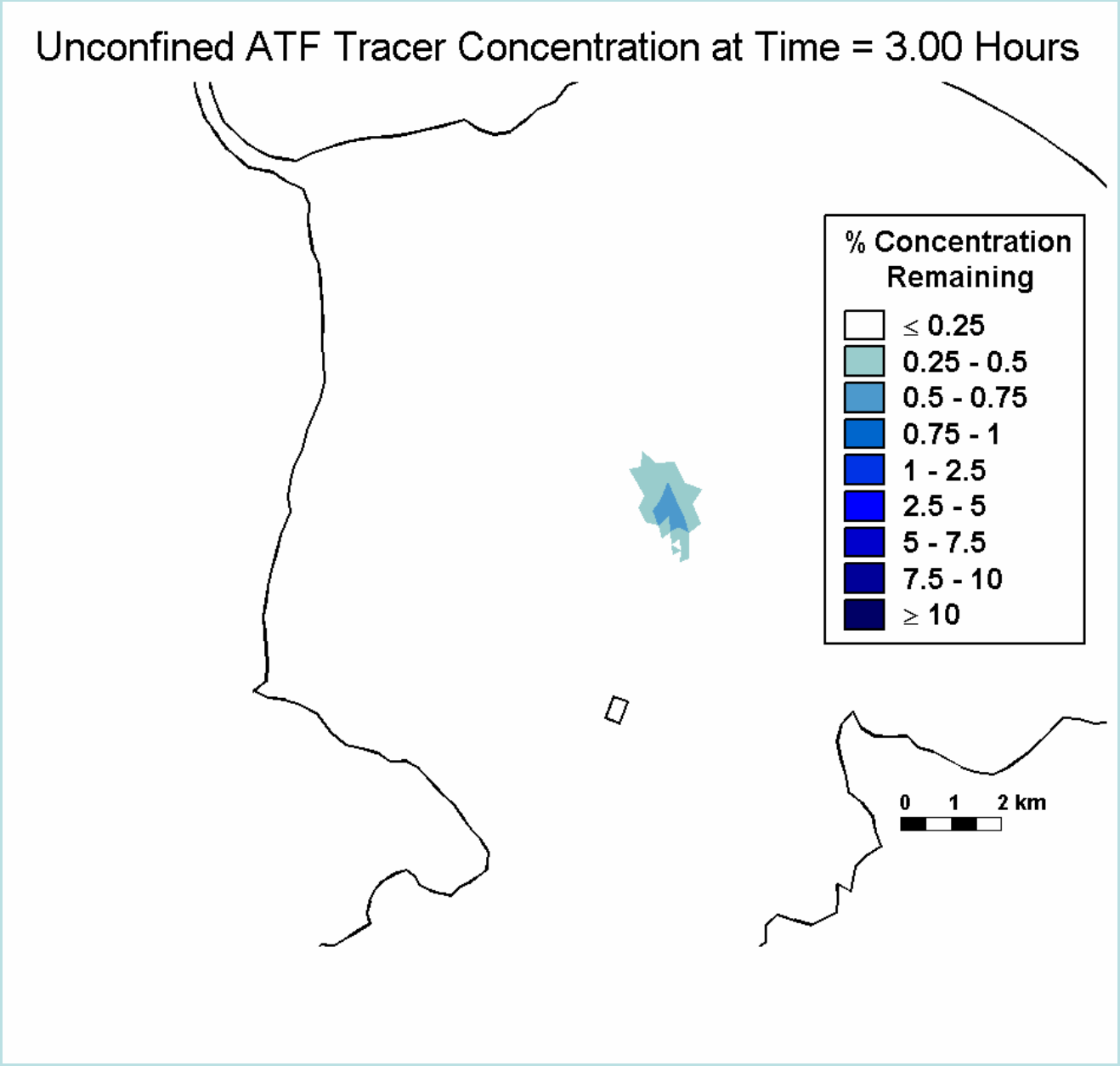

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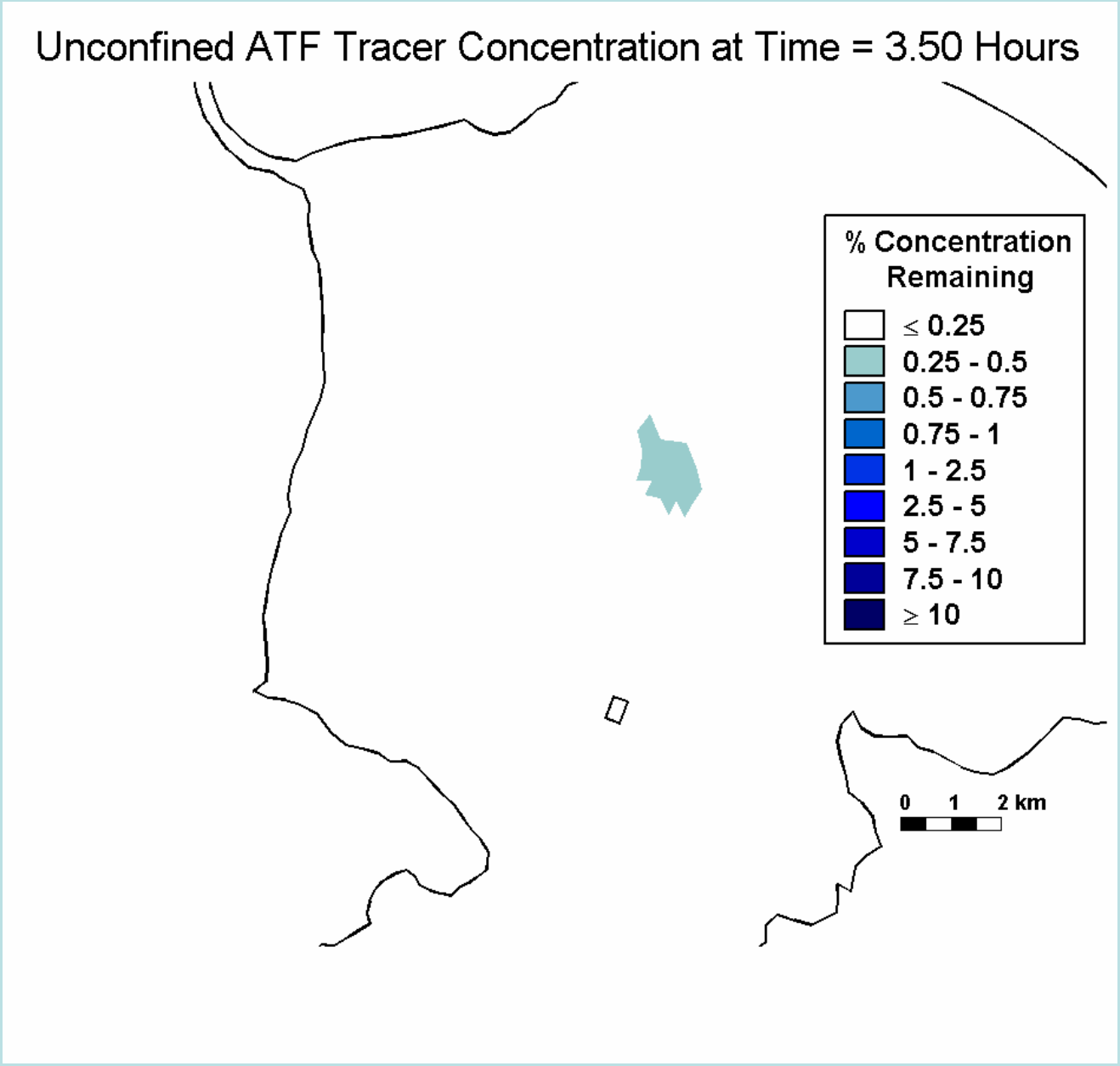
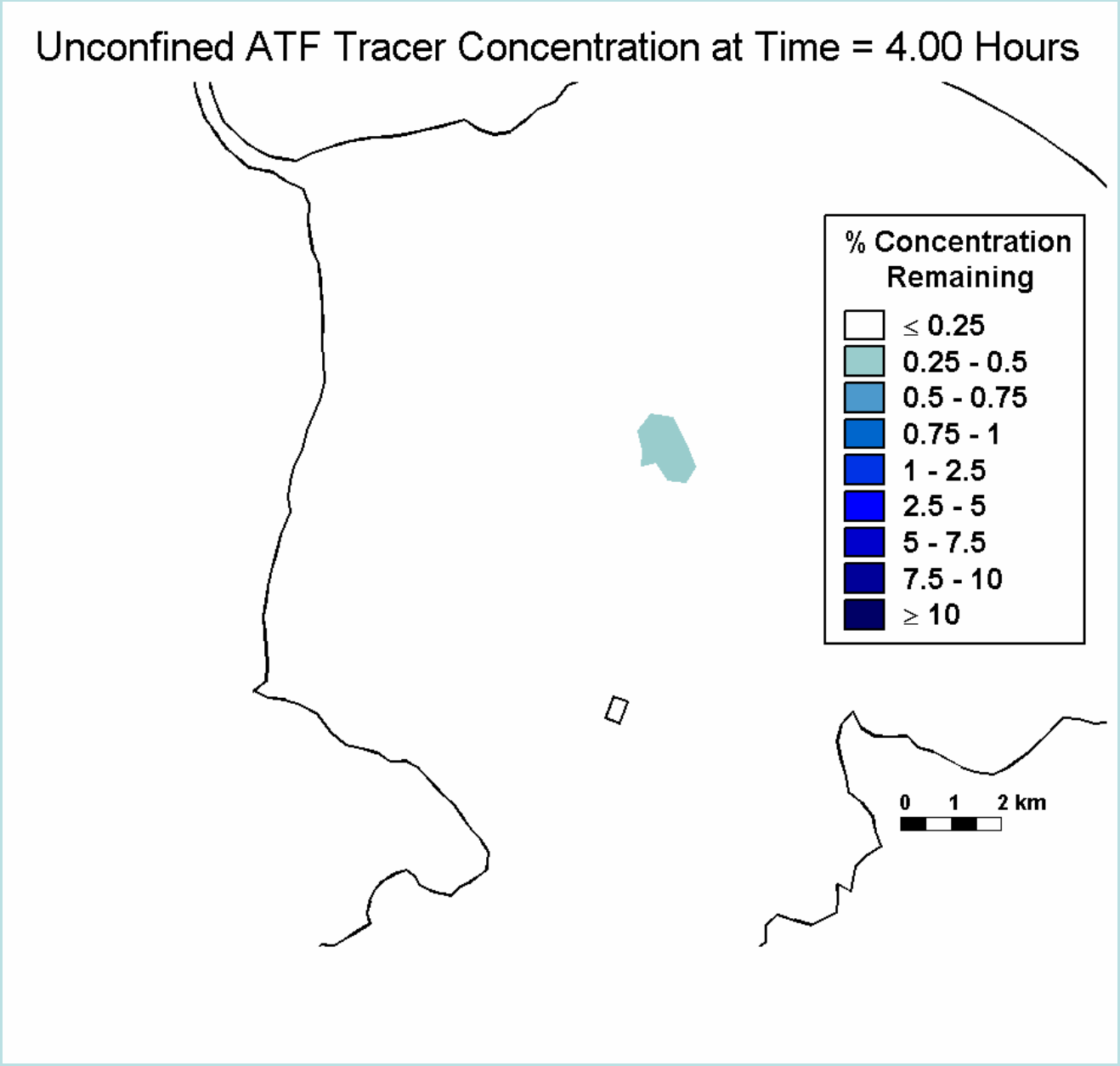
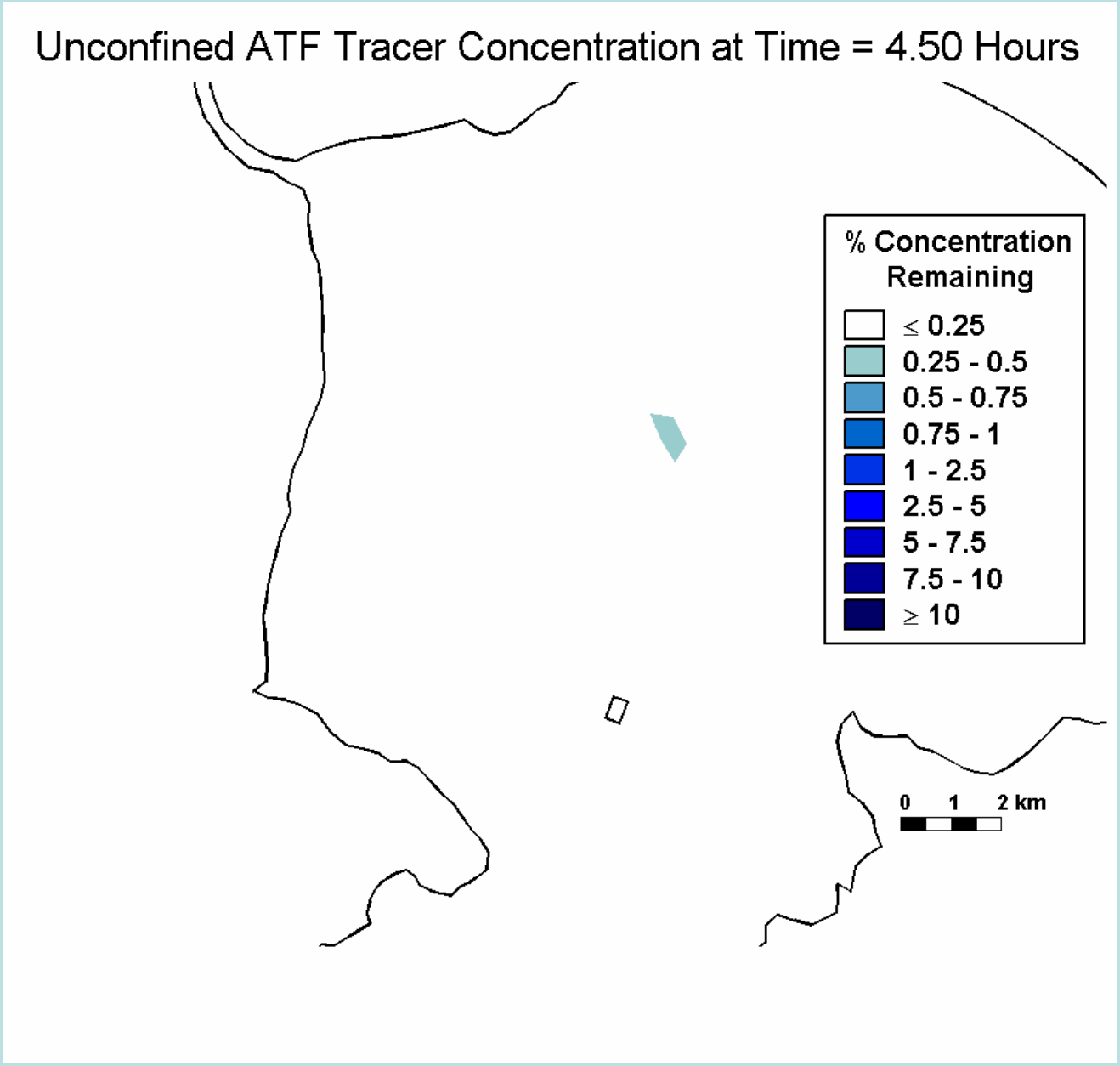


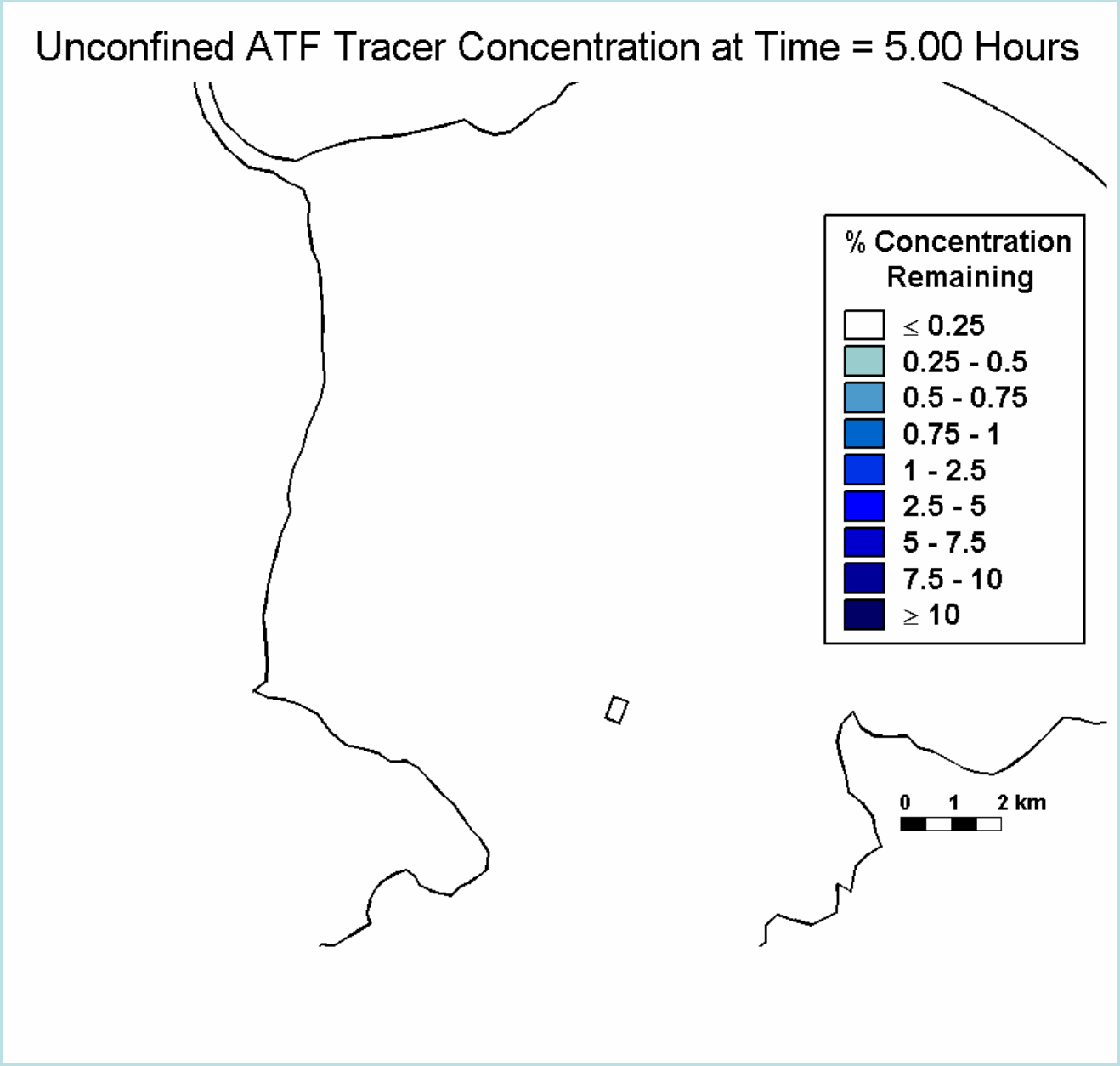
Tracer Plume: Low Water Release



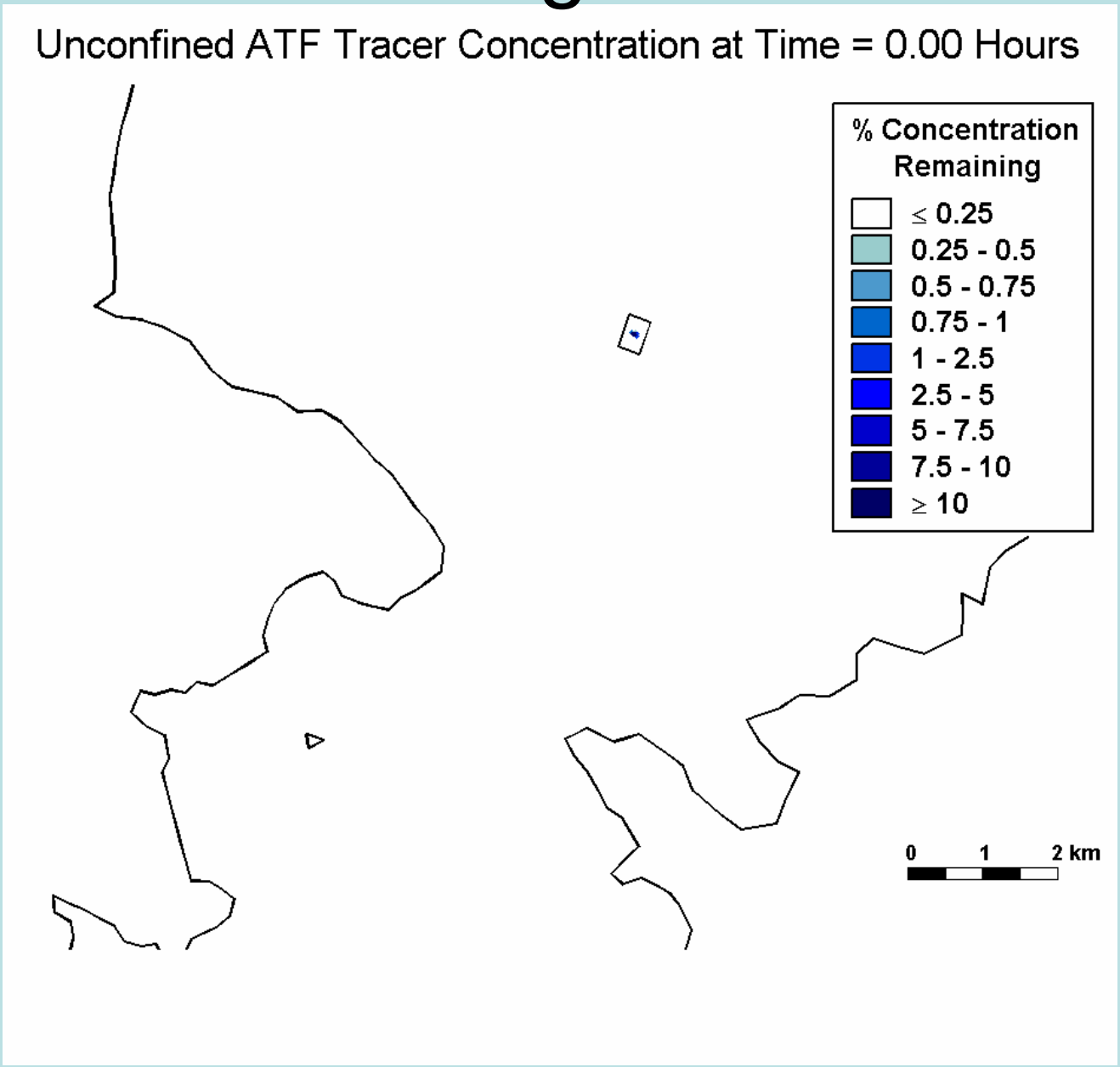
Tracer Plume: Low Water Release



Tracer Plume: Low Water Release



Tracer Plume: High Water Release



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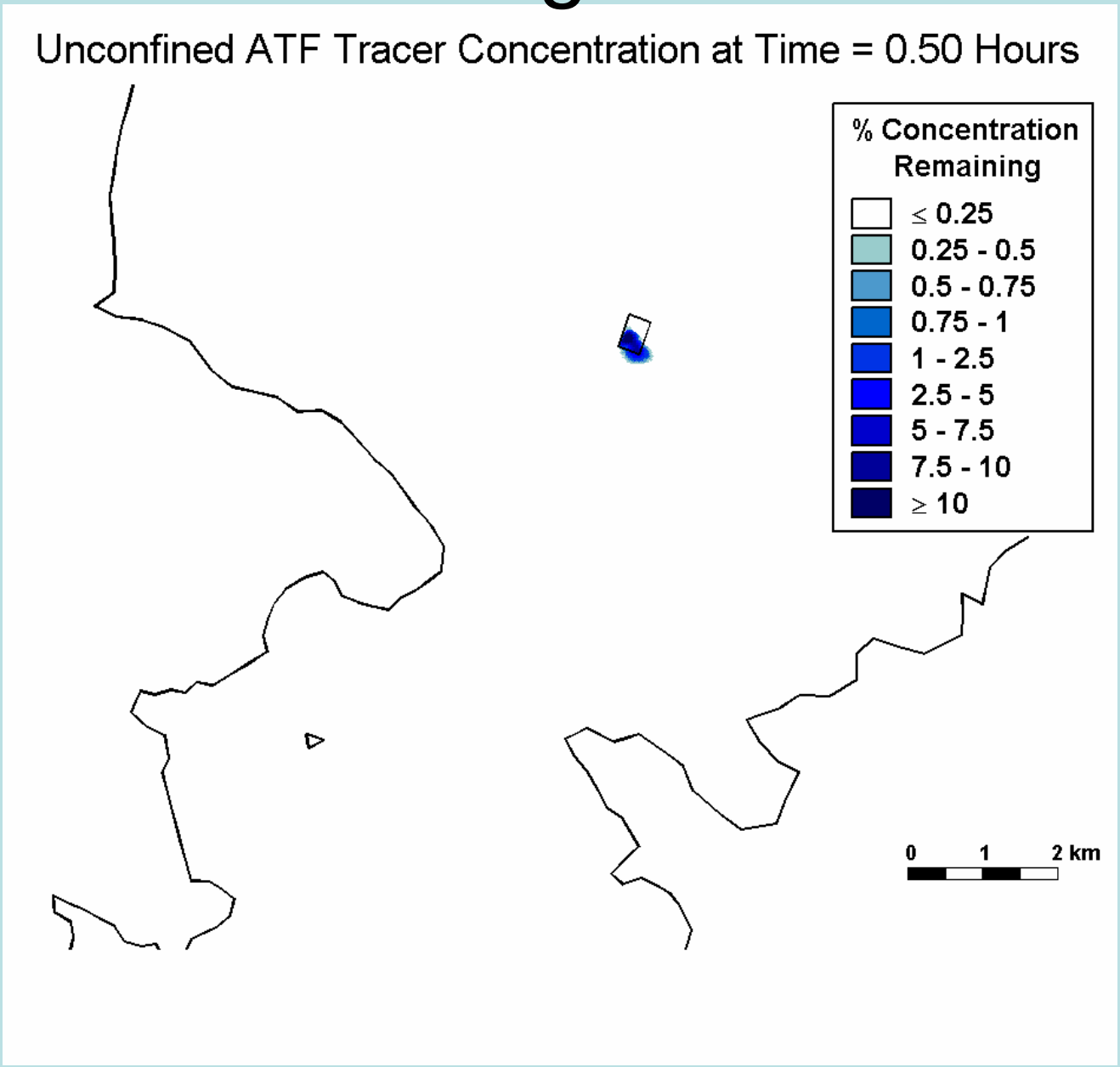

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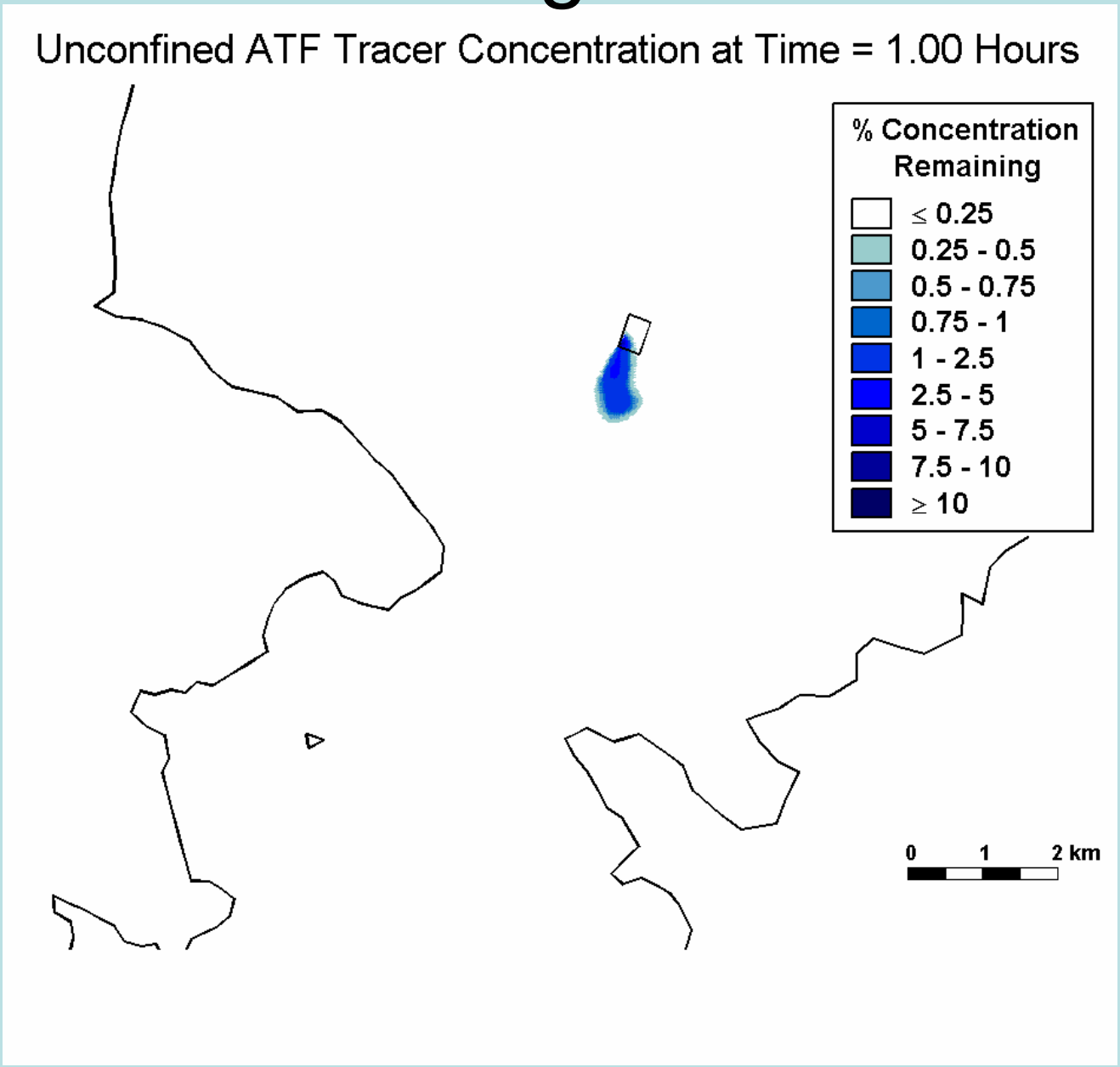

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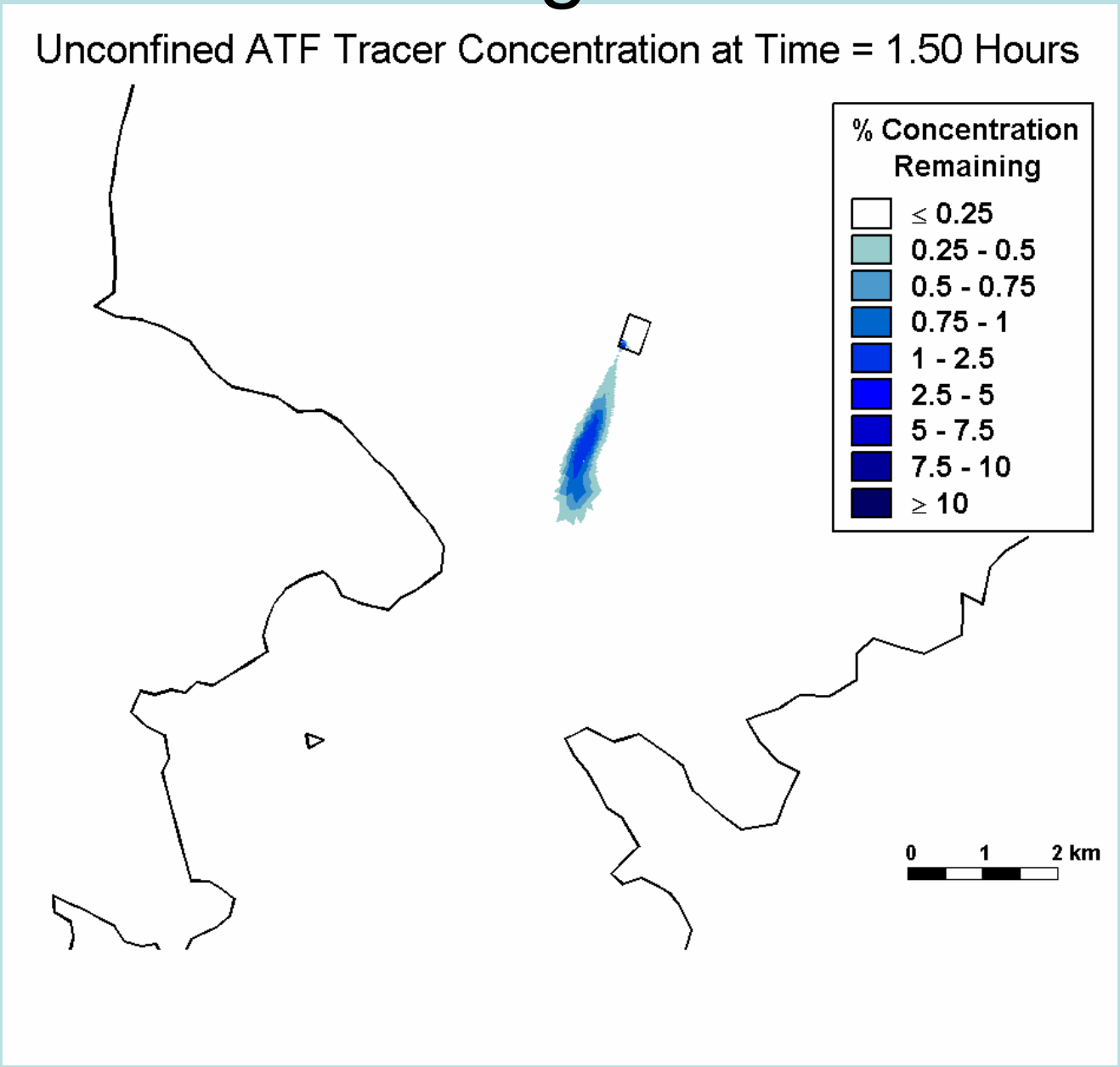

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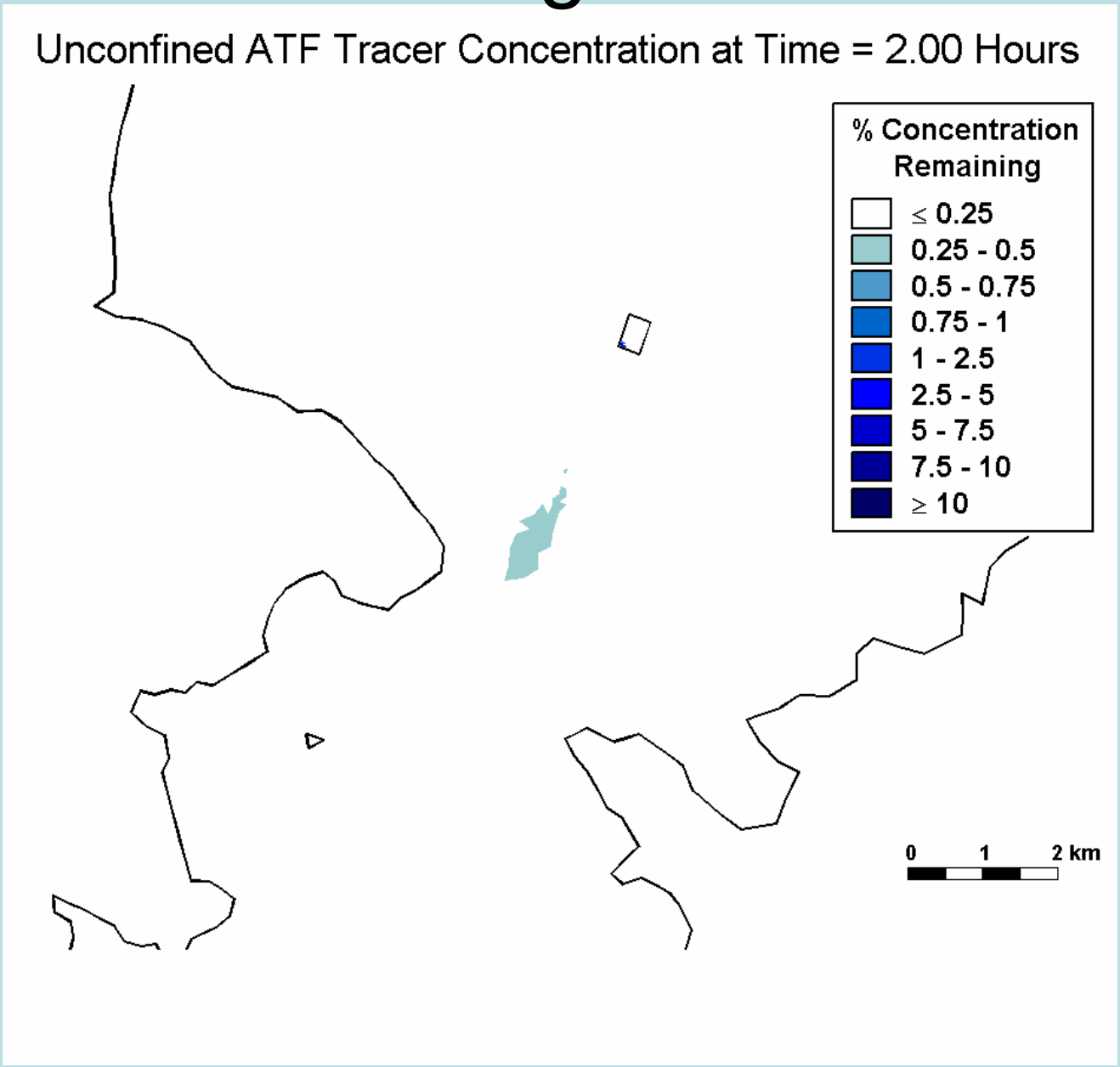

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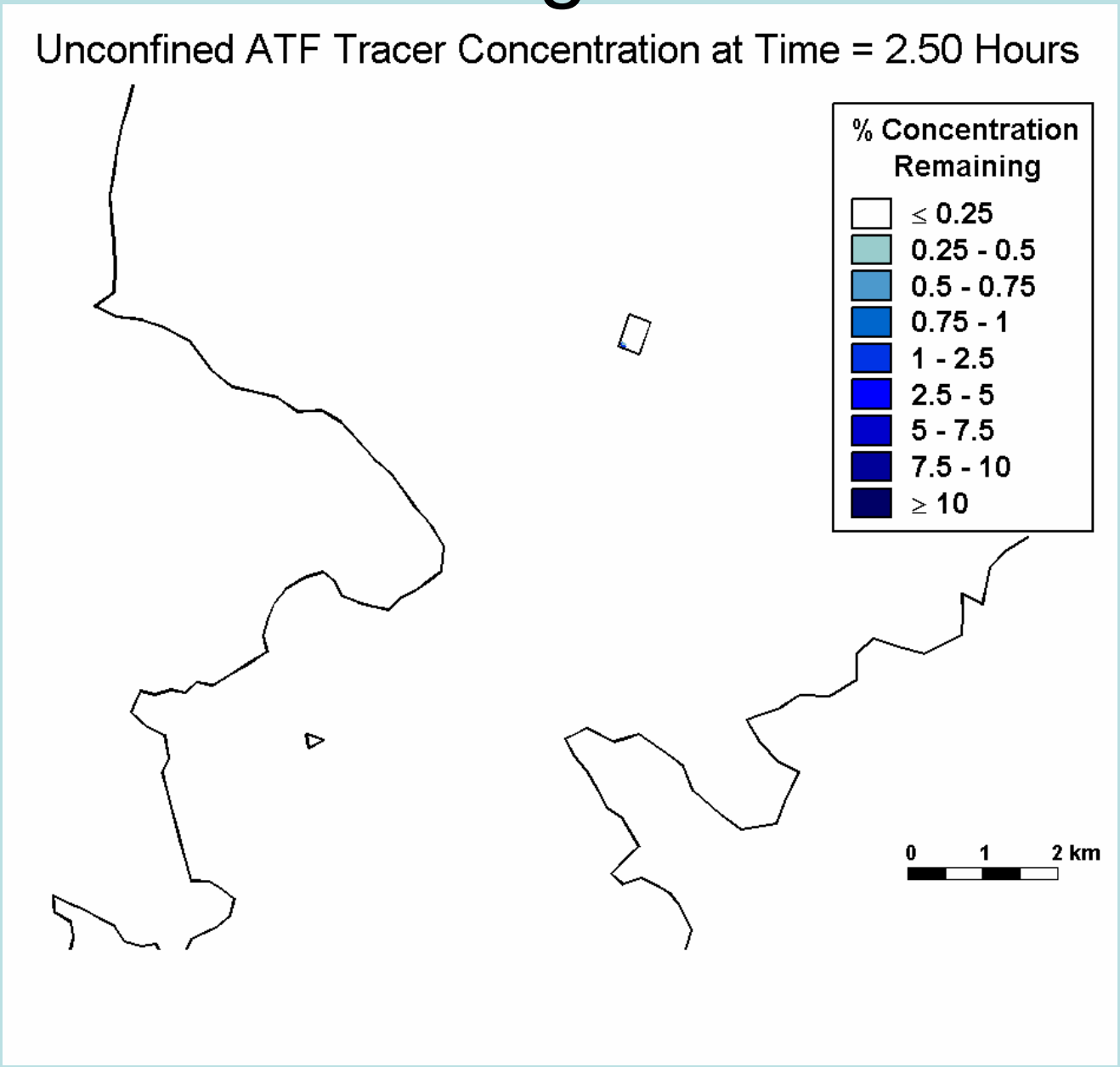

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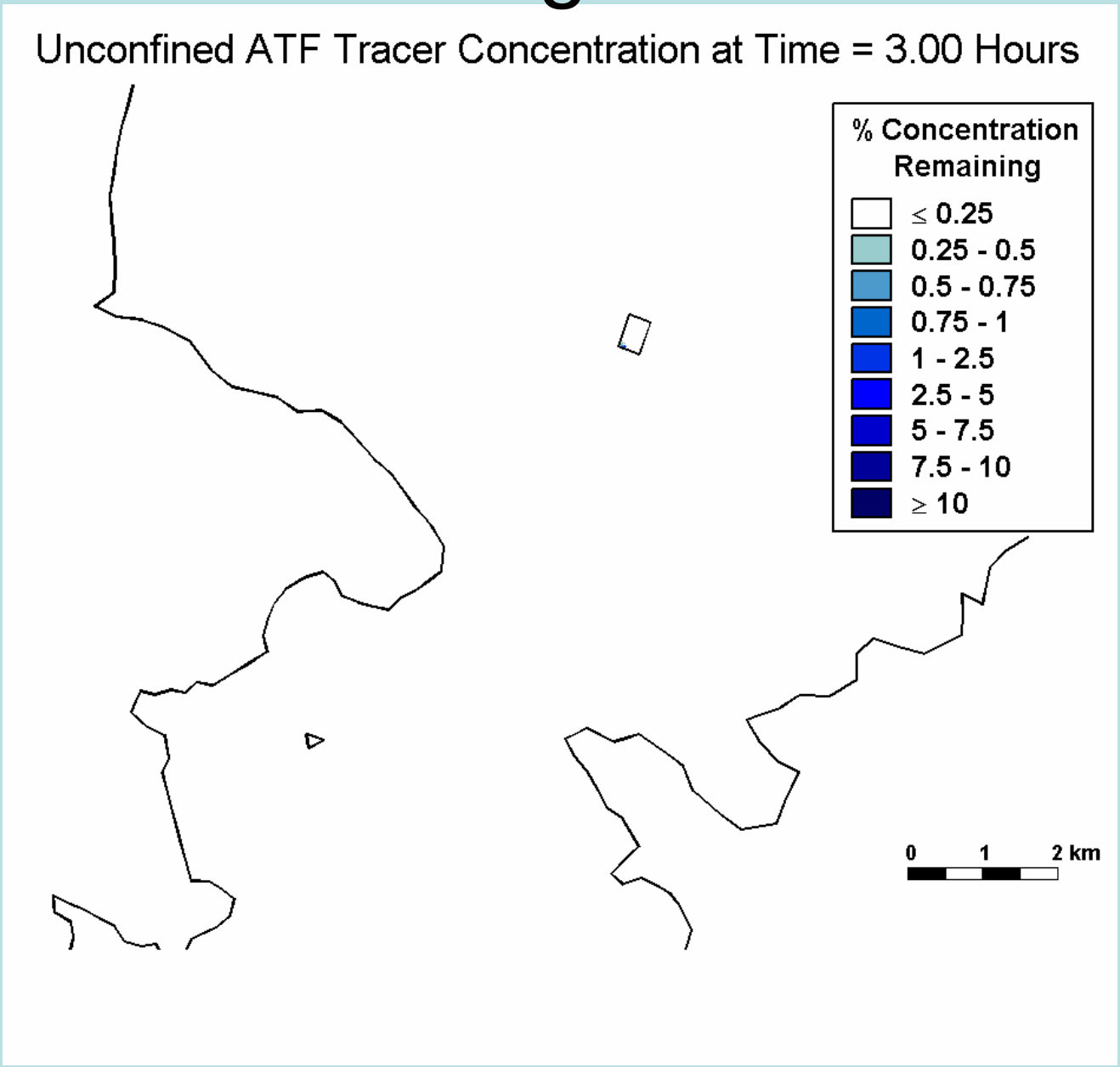

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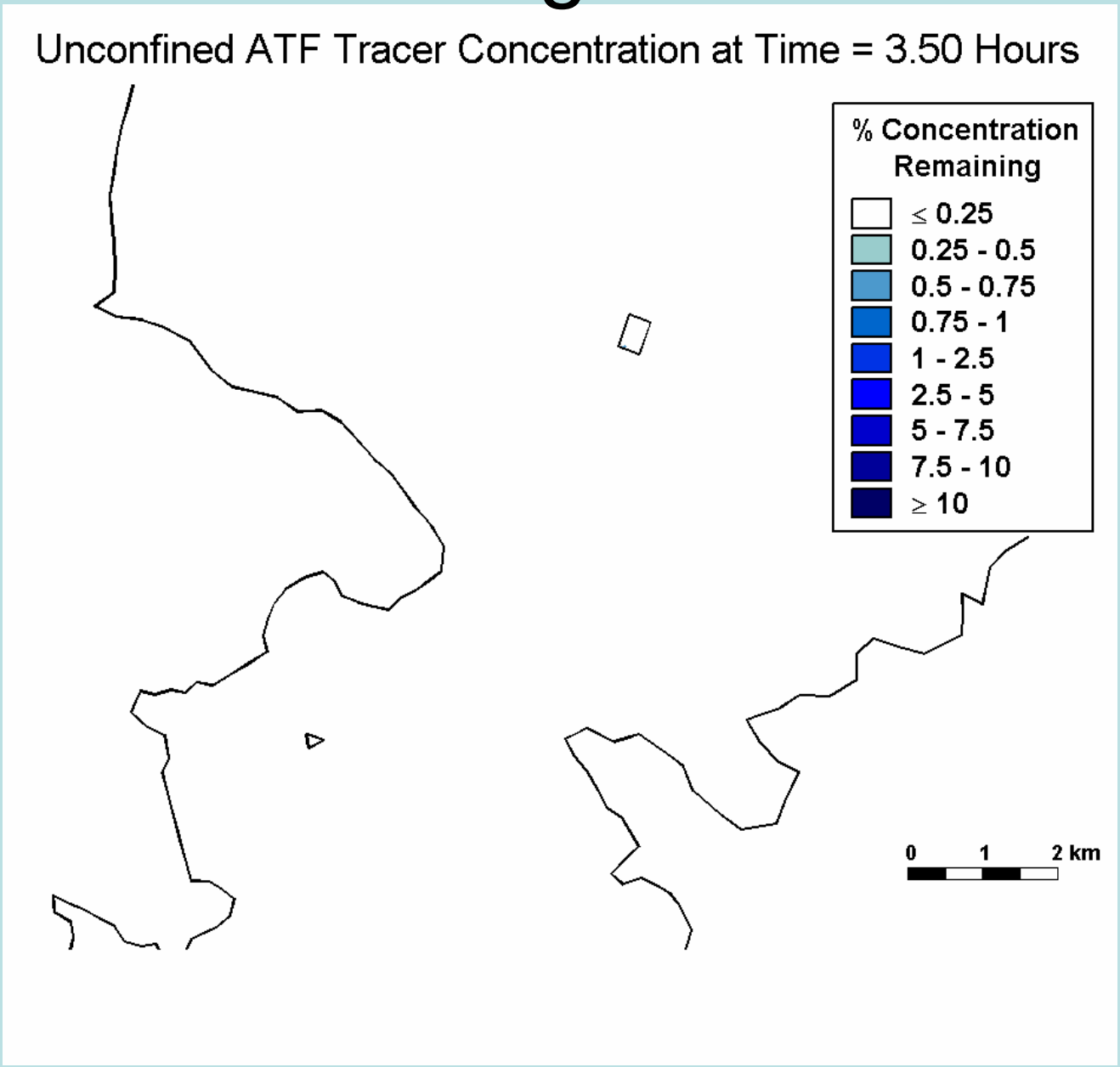

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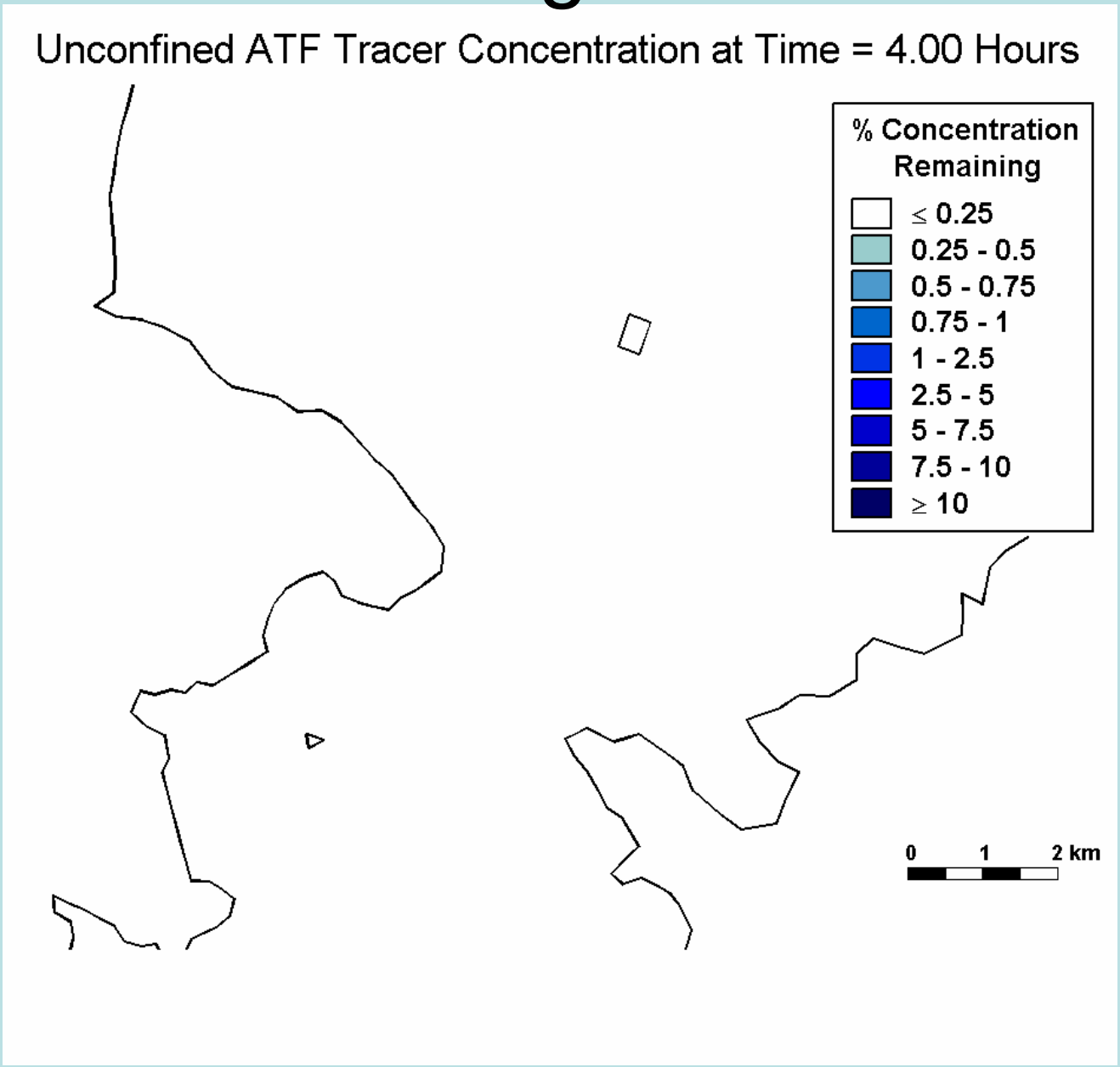


Table 1. Sedflume core locations.

Core Designation	Coring Date	Coring Time	Depth (m)*	Lat (deg min)	Long (deg min)
SP-1	2/19/2006	9:14	4.7	38 01.3791	122 25.4292
SP-2	2/19/2006	10:07	6.2	38 01.1703	122 25.1015
SP-3	2/19/2006	12:10	8.0	38 00.4928	122 25.4381

* Depths are corrected to MLLW from nearest NOAA tide predictor (Point San Pedro).

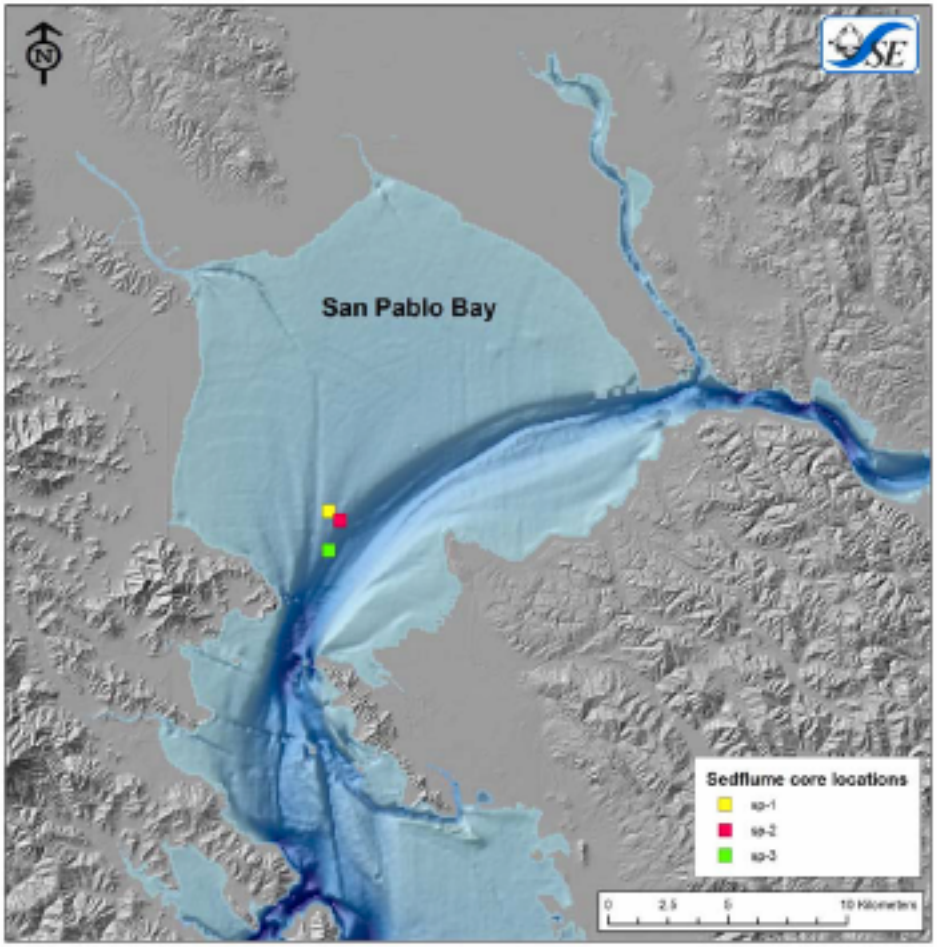


Figure 1. Locations of the three Sedflume cores in San Pablo Bay.

Table 2 summarizes all measurements conducted during the Sedflume analysis.

Table 2. Parameters measured and computed.

Measurement	Definition	Units	Detection Limit
Bulk Density, ρ_b (wet/dry weight)	$\rho_b = \frac{\rho_w \rho_s}{\rho_w + (\rho_s - \rho_w)W}$	g/cm³	Same as water content
Water Content	$W = \frac{M_w - M_d}{M_w}$	unit less	0.1g in sample weight ranging from 10 to 50 g
Particle Size Distribution	Distribution of particle sizes by volume percentage using laser diffraction	μm	0.04 μm – 2000 μm
Erosion Rate	$E = \Delta z / T$	cm/s	$\Delta z > 0.5$mm $T > 15$s
Critical Shear Stress τ_{cr}	Shear stress when erosion rate equals 10^{-4} cm/s	N/m²	0 to 10.0 N/m² This value is interpolated as described in the text.

W = water content

M_w = wet weight of sample

M_d = dry weight of sample

Δz = amount of sediment eroded

T = time

ρ_w = density of water (1 g/cm³)
ρ_s = density of sediment (2.65 g/cm³)

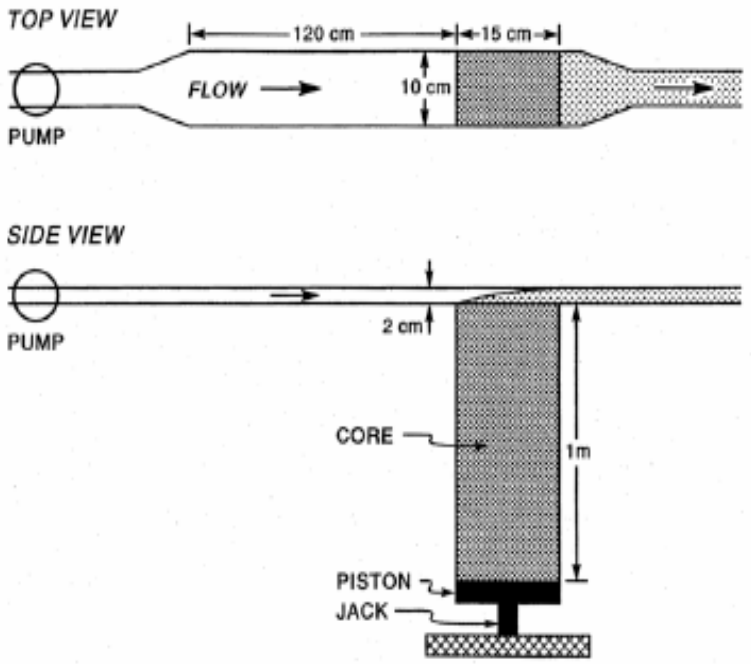
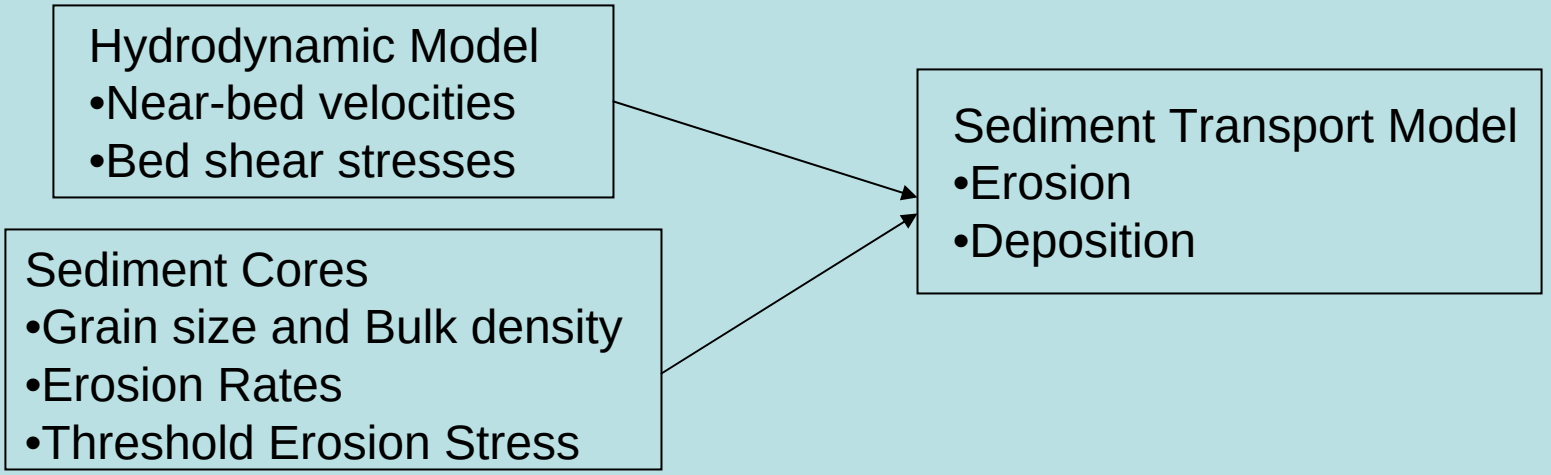


Figure 2. Sedflume Diagram

Sediment Transport Modeling



Major Results

1. For full basins erosion depths based on 1-day consolidation of dredged sediment at ATF Site 2 are comparable to erosion of native sediment. ATF Site 1 has over twice the maximum depth of erosion as the other Sites.

2. Erosion of dredged sediment consolidated over 1 day is nil for half- and full-depth ATF basins at all locations.

3. Dredged sediment consolidated over 7 days and longer is much stiffer than the native material, likely due to the absence of a developed biotic community, and is essentially unerodable at all ATF Sites.

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4. Deposition rates within half- and full-depth ATF basins would increase by at least a factor of 3 over the natural setting at ATF Site 2, and by at least a factor of 20 at ATF Site 1.

Erosion

Table 7. Model results for 30-day simulations at each location and ATF configuration.

Model Case	Model Location	Sediment Properties	Max Depth Eroded (cm)	Avg. Shear Stress (dynes/cm^2)
Native Baseline	SP-1	SP-1	0.4	1.0
Native Baseline	SP-2	SP-2	1.0	1.4
Native Baseline	SP-3	SP-3	2.6	1.7
Baseline	Min Hg	SD1	1.4	1.6
Baseline	Min Hg	SD7	0.0	1.6
Baseline	Near SF10	SD1	3.8	1.9
Baseline	Near SF10	SD7	0.0	1.9
Unconfined Full Depth	Min Hg	SD1	0.0	0.4
Unconfined Full Depth	Min Hg	SD7	0.0	0.4
Unconfined Half Depth	Min Hg	SD1	0.0	0.7
Unconfined Half Depth	Min Hg	SD7	0.0	0.7
Confined Full Depth	Min Hg	SD1	0.0	0.0
Confined Full Depth	Min Hg	SD7	0.0	0.0
Unconfined Full Depth	Near SF10	SD1	0.0	0.5
Unconfined Full Depth	Near SF10	SD7	0.0	0.5

Deposition
long term (Jaffe)

Table 8. Deposition parameters for each location of interest.

Locations	Deposition (1951-1983)	Deposition Rate (cm/yr)	Avg. Shear Stress (dynes/cm^2)	Probability
SP-1	34	1.1	1.1	0.48
SP-2	49	1.6	1.4	0.32
SP-3	211	7.0	1.7	0.13
Near SF10	100	3.3	1.9	0.03
Min Hg	150	5.0	1.6	0.21

Deposition
in ATF (Jones)

Table 9. Scaled deposition rates for ATF pits.

Location	Avg. Shear Stress (dynes/cm^2)	Scaled Probability	Deposition Rate (cm/yr)
Min Hg (half depth)	0.7	3.2	16.1
Min Hg (full depth)	0.4	3.9	19.5
Near SF10 (full depth)	0.5	24.3	81.1

TECHNICAL STUDIES for the ALTERNATIVE TRANSFER FACILITY, HAMILTON WETLANDS RESTORATION PROJECT

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