

Utilizing Spatio-Temporal Text Information for Cyclone Eye Annotation in Satellite Data

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Outline

- Motivation
- Related Work
- Information Sources Description
- System Design
- Methodology
- Preliminary Results
- Future Work

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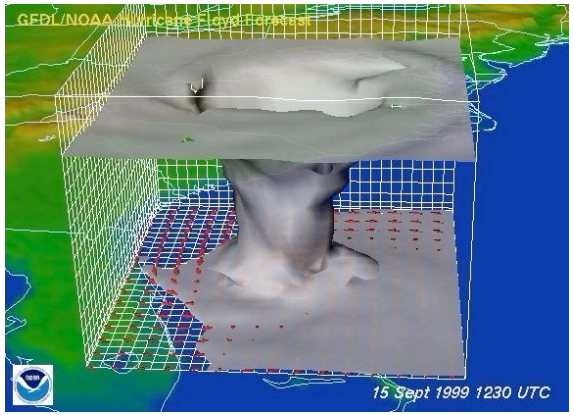
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Motivation

- Ad-hoc user query system with satellite data retrieval capability
  - "List all previous hurricanes and their tracks most similar (based on some similarity measure) to (current) hurricane X and retrieve satellite data from multiple sources"
- Satellite data as evidence to support scientific hypothesis for weather phenomenon.
- Capability to relate the different information sources to each other.
- Cross-media summarization to fill "information gap" in existing hurricane track information.



Hurricane Ike,
Sep. 7, 2008

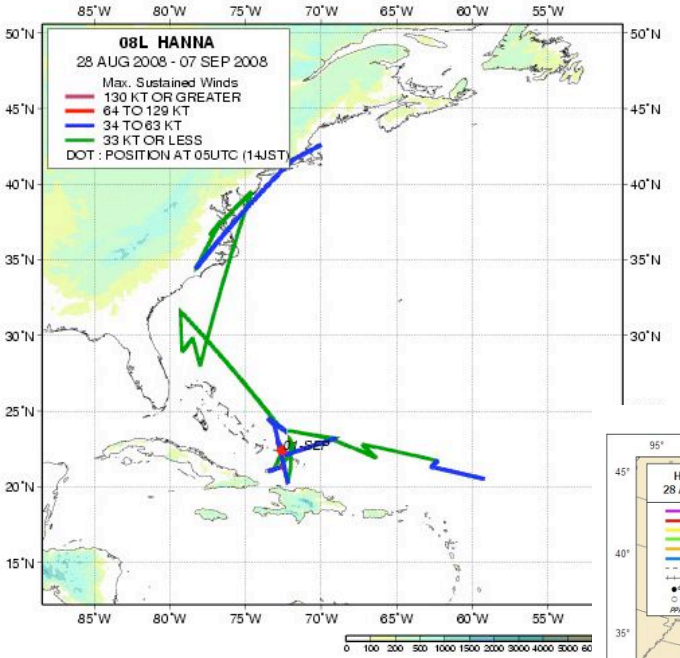


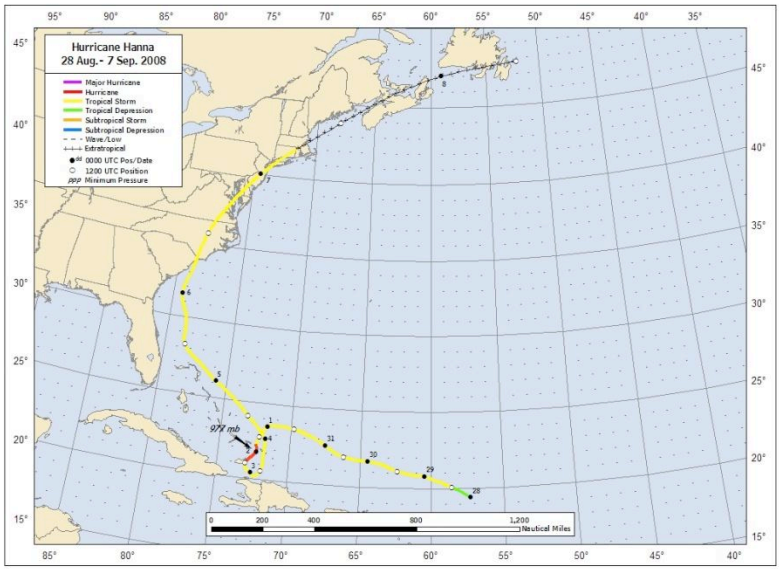
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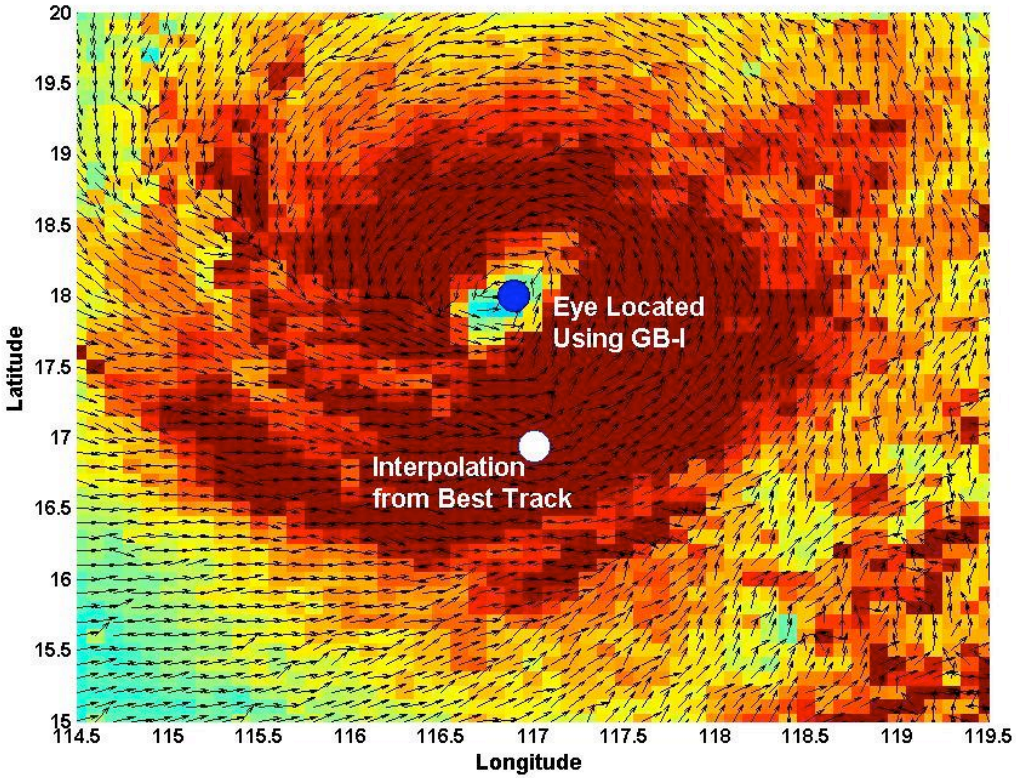
Motivation

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20080823	1200	19.1	312.3	25	1014
20080824	0000	20.3	308.2	30	1013
20080824	1200	21.5	305.0	25	1012
20080824	1800	22.1	303.3	25	1011
20080825	1800	18.0	306.7	25	1011
20080826	1800	20.4	302.7	25	1009
20080827	0600	21.0	302.0	25	1009
20080827	1200	19.7	302.5	25	1009
20080827	1800	19.4	302.6	25	1009
20080828	0000	19.5	302.7	30	1007
20080828	0600	19.7	302.3	30	1004
20080828	1200	20.3	301.3	35	1002
20080828	1800	20.6	300.4	35	1003
20080829	0600	21.1	298.2	45	1000
20080829	1200	21.0	297.6	45	1000
20080829	1800	21.5	296.7	45	1000
20080830	0000	21.9	295.3	45	1002
20080830	0600	21.8	294.2	45	1001
20080830	1200	21.8	293.9	45	1000
20080830	1800	22.2	293.0	45	1000
20080831	0000	22.7	292.6	45	1000
20080831	1200	24.0	290.0	45	1000
20080831	1800	23.5	288.9	40	997
20080901	0000	23.7	288.1	40	997
20080901	1800	22.4	287.4	65	985
20080902	0000	21.9	287.7	70	980
20080902	0600	21.3	287.4	70	978
20080902	1200	21.2	286.8	60	987
20080903	0000	20.5	287.6	55	988
20080903	0600	20.1	287.5	55	990
20080903	1700	22.1	287.5	55	990
20080903	1800	21.4	288.0	50	994
20080904	0000	22.7	288.2	55	989
20080904	0600	23.3	287.7	60	990
20080904	1200	24.1	286.9	55	989
20080904	1800	25.1	285.8	55	989
20080905	0000	25.9	284.1	55	987
20080905	0600	27.3	282.7	55	984
20080905	1200	28.2	281.2	55	980
20080905	1800	29.9	281.5	60	981
20080906	0000	31.5	280.7	60	981
20080906	0600	33.4	281.2	60	983
20080906	1200	35.7	281.9	45	985
20080906	1800	37.7	283.3	45	994
20080907	0000	39.5	285.4	50	992
20080907	0600	41.7	288.3	45	995





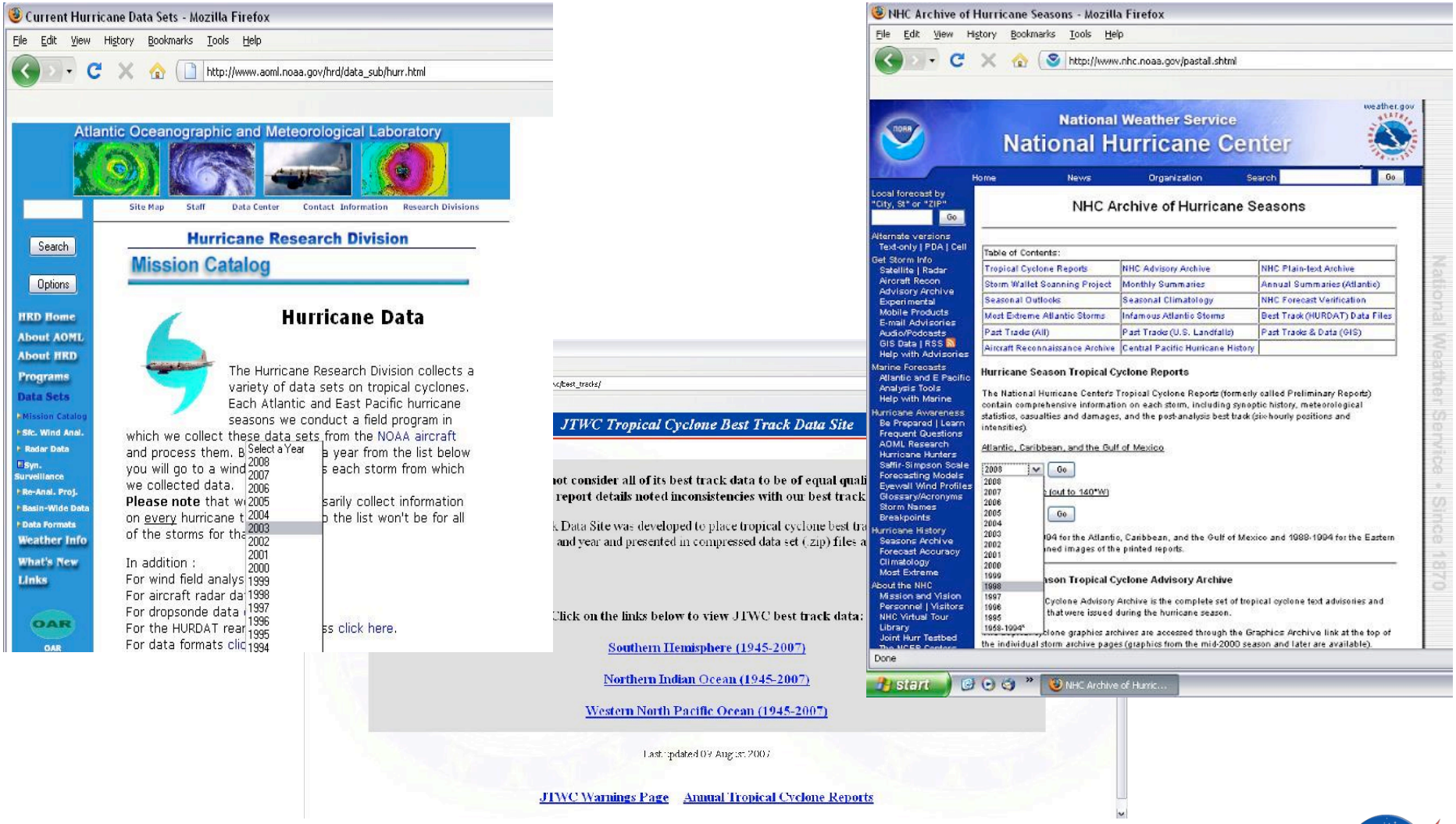
Motivation


Eye Located
Using GB-I
Interpolation
from Best Track
Latitude
Longitude
20
19.5
19
18.5
18
17.5
17
16.5
16
15.5
15
114.5
115
115.5
116
116.5
117
117.5
118
118.5
119
119.5

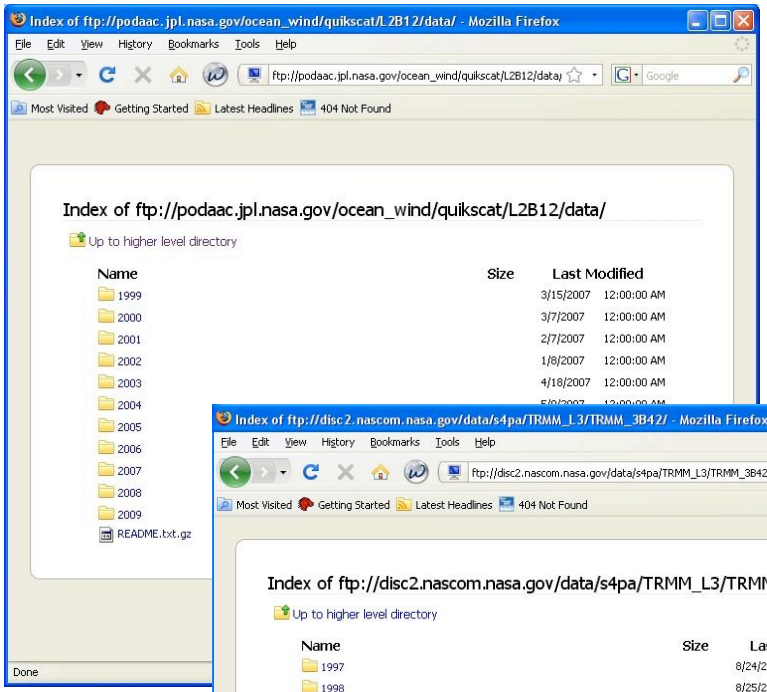
Related Work

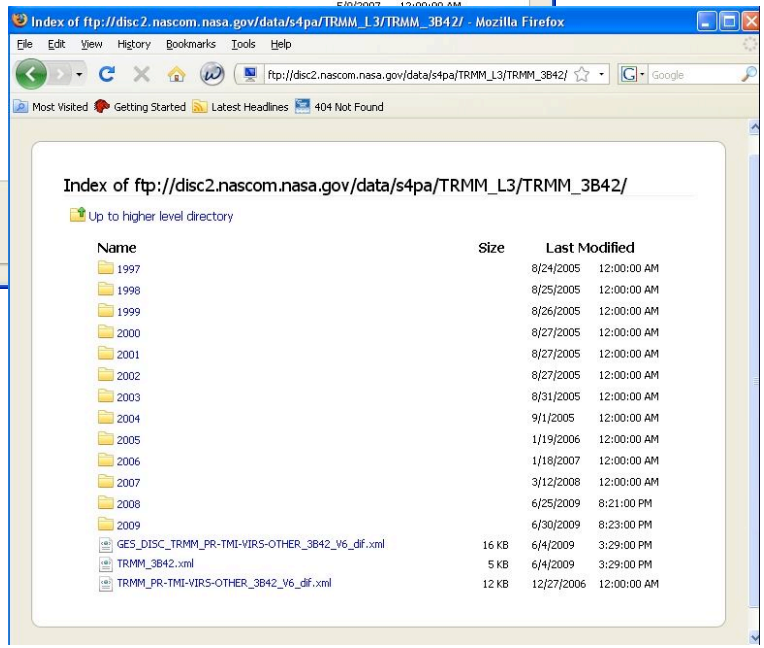
- Summarization of spatio-temporal deformable (non-rigid) event (object) [Agouris and Stefanidis, 2003].
- Detection and analysis of moving object behavior from an airborne moving platform [Medioni et al., 2001].
- Cyclone eye location from satellite images [Halterman and Long, 2006; Pao and Yeh, 2008; Wong et al., 2004, 2008; Wong and Yip, 2005; Yip and Wong, 2006]

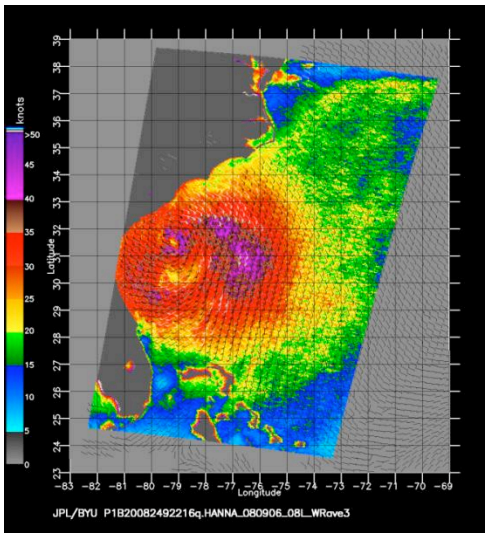
Information Sources

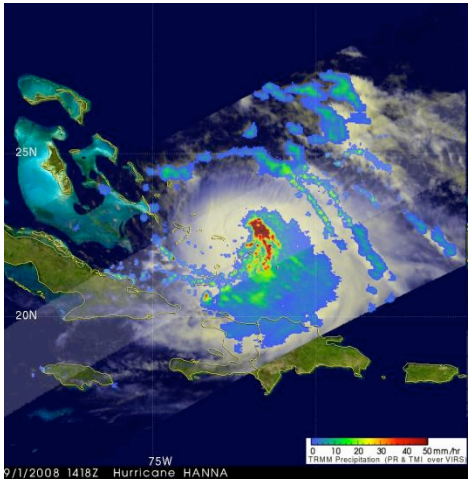


Information Sources







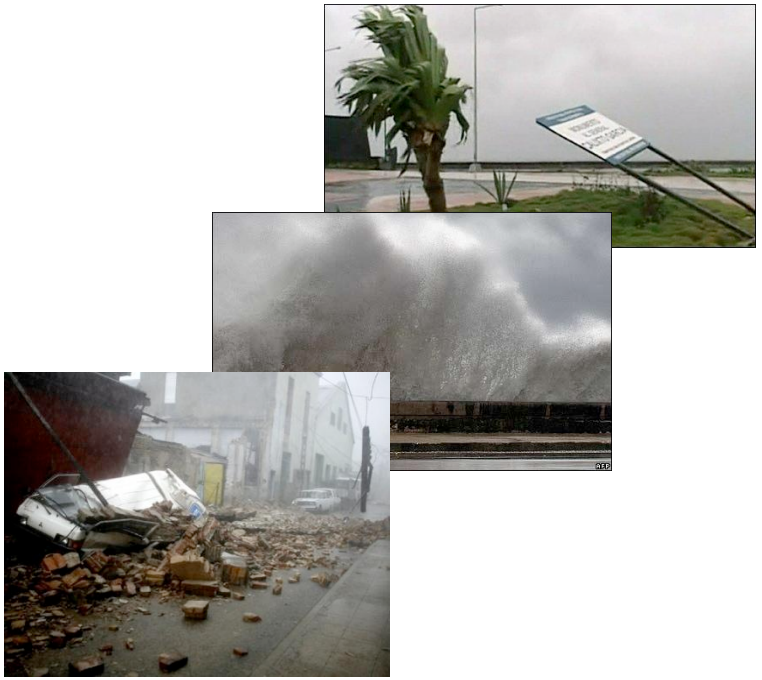


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Information Sources





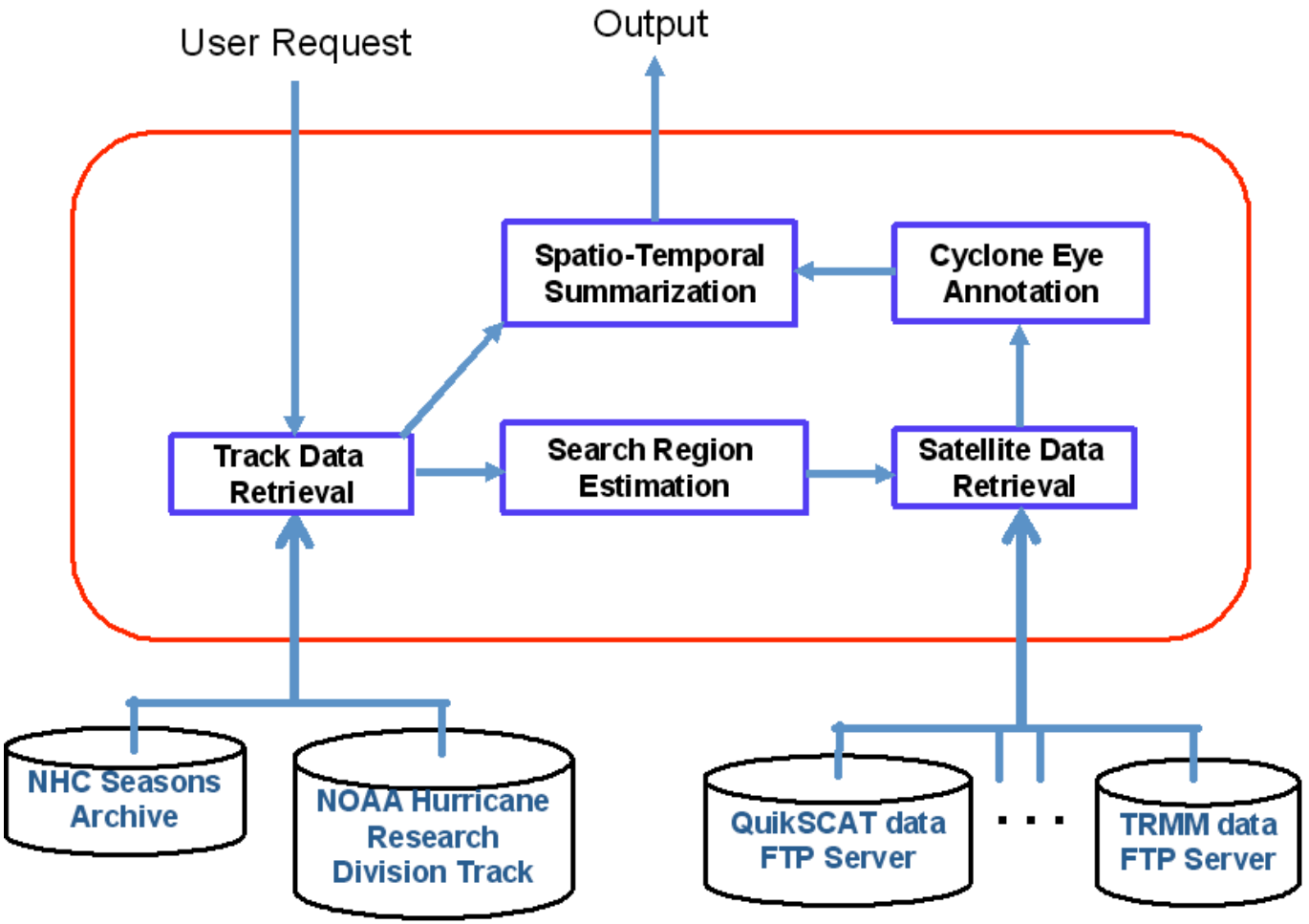
Images from the web for Hurricane Ike at different locations (Cuba, Texas, Bahamas)



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System Overview



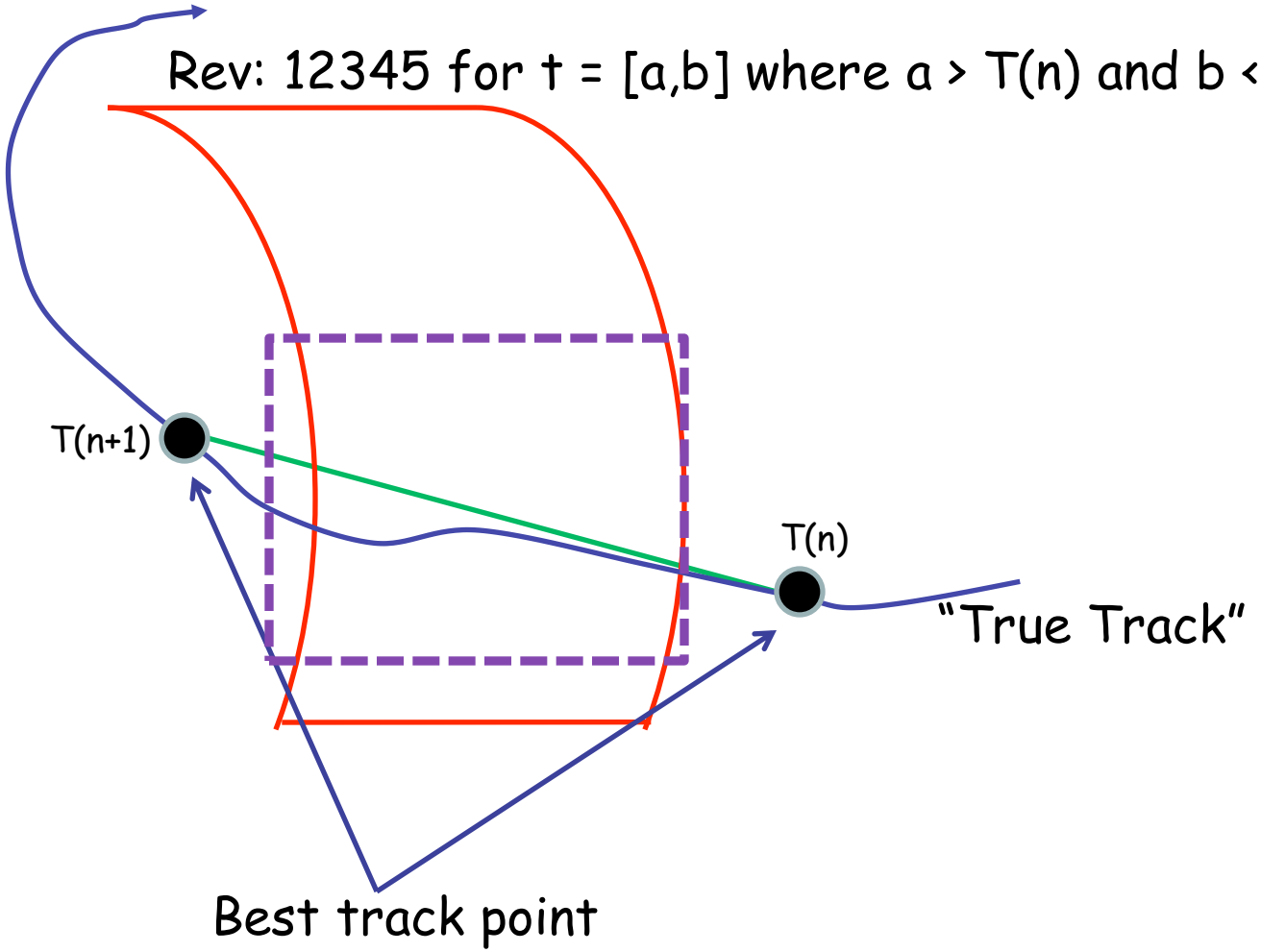
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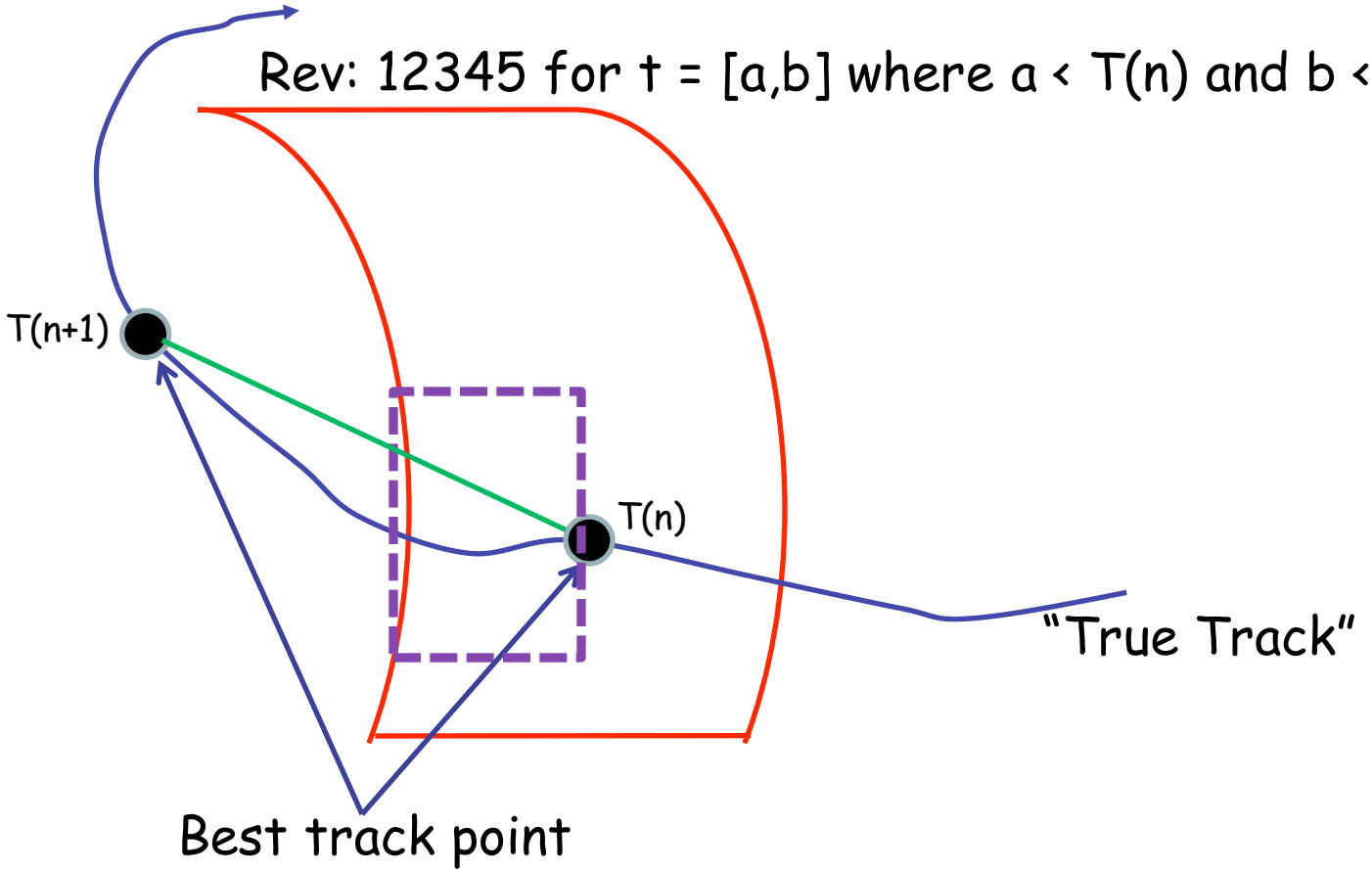
Methodology

- Track data retrieval
- Search region estimation
- Satellite data retrieval and preprocessing
- Cyclone eye annotation
- Spatio-temporal summarization

Search and Data Retrieval

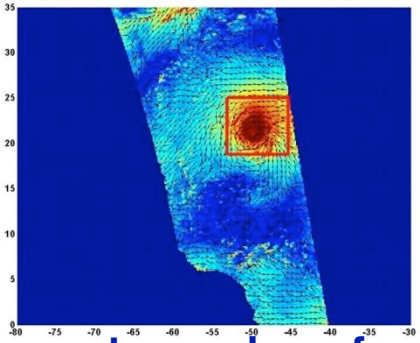


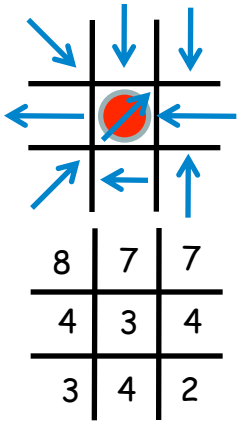
Search and Data Retrieval



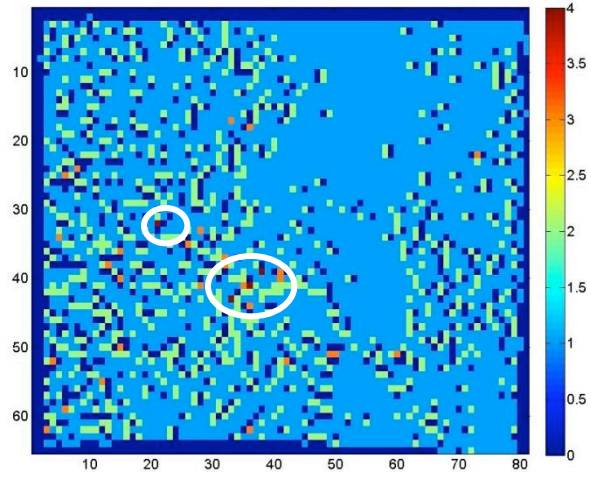
Graph-based Eye Locator

1) Segmentation and classification to locate cyclone region

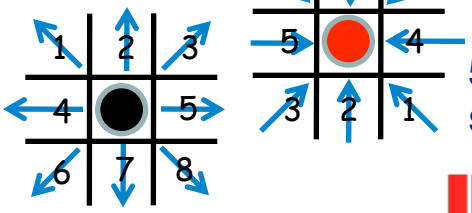




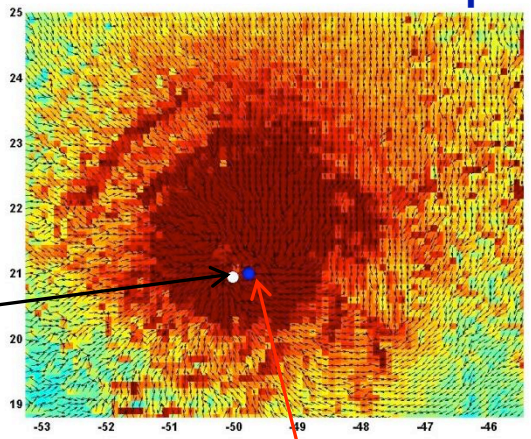
3a) Compute number of nearest neighbors pointing to each pixel



3b) Assign a label to each pixel to identify where that pixel is pointing

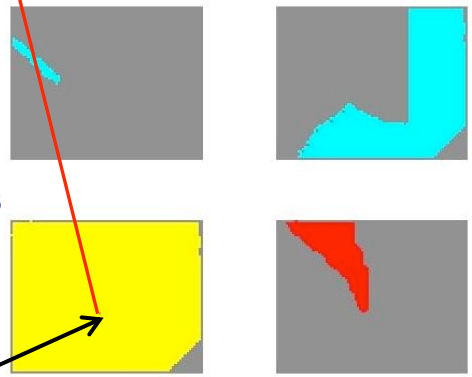


2) Compute normal vector to the directional vector for each pixel



NHC Best Track

4) Construct spanning trees for pixels having the highest number of pointing neighbors



5) The pixel that grows the largest spanning tree is the cyclone eye

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Summarization

- Merging information from different sources

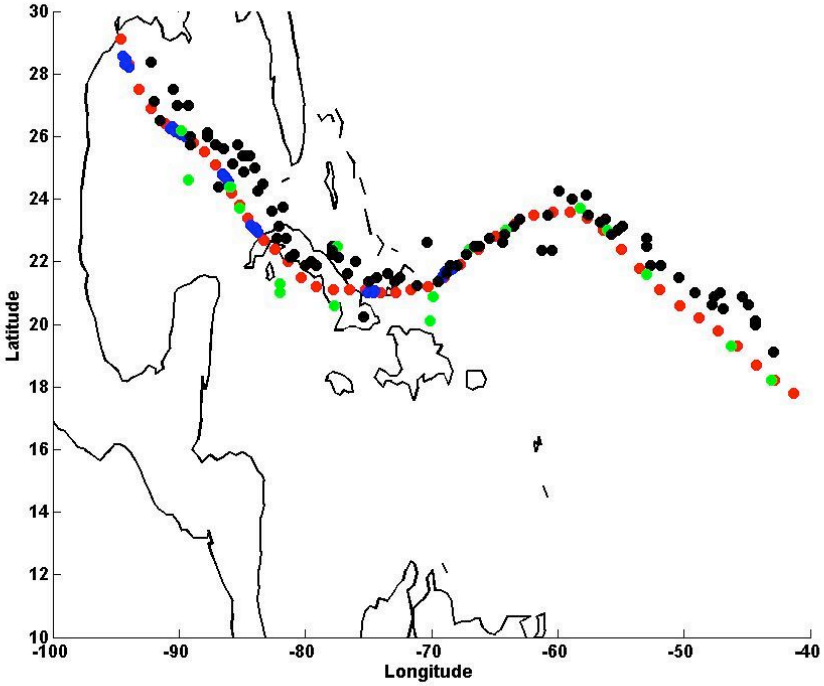
Confidence Level	Data Sources
1	NOAA HRD aircraft eye fixes
2	NOAA NHC best track
3	QuikSCAT wind field
4	TRMM precipitation rate

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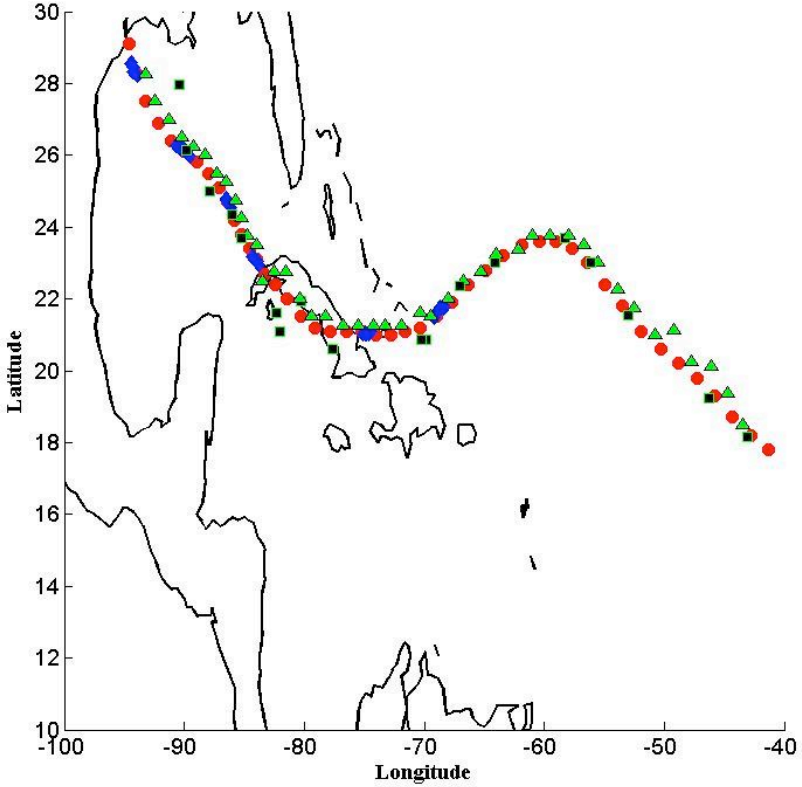
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Preliminary Results

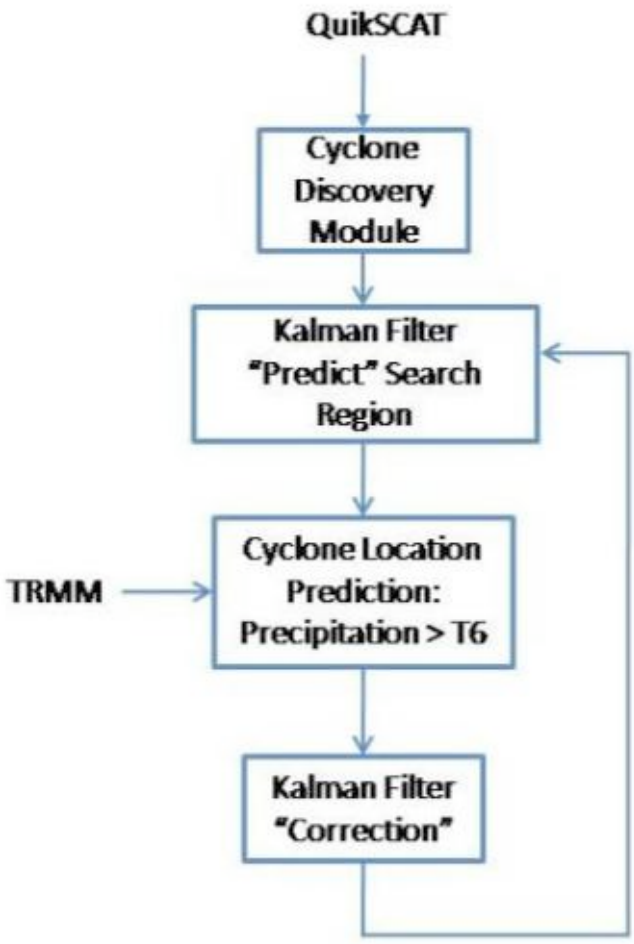
Using methodology in [Ho and Talukder, 2008]



Using text information



Why previous method has poorer performance?



- Method using only observations from the images
- Historical track summarization should use as much information as possible

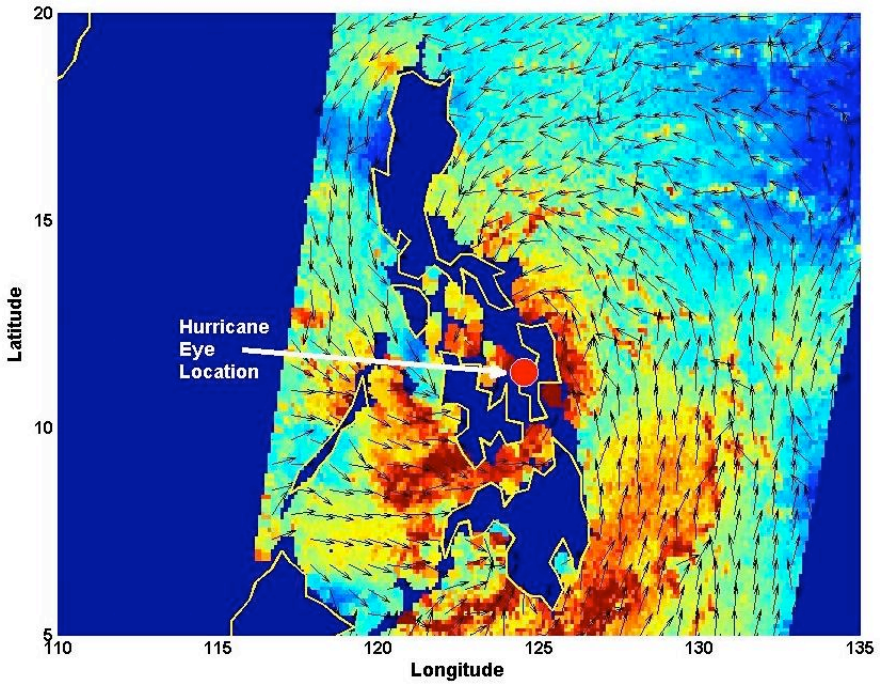
S.-S. Ho and A. Talukder, Automated Cyclone Discovery and Tracking using Multiple Heterogeneous Satellite Data, KDD, 2008

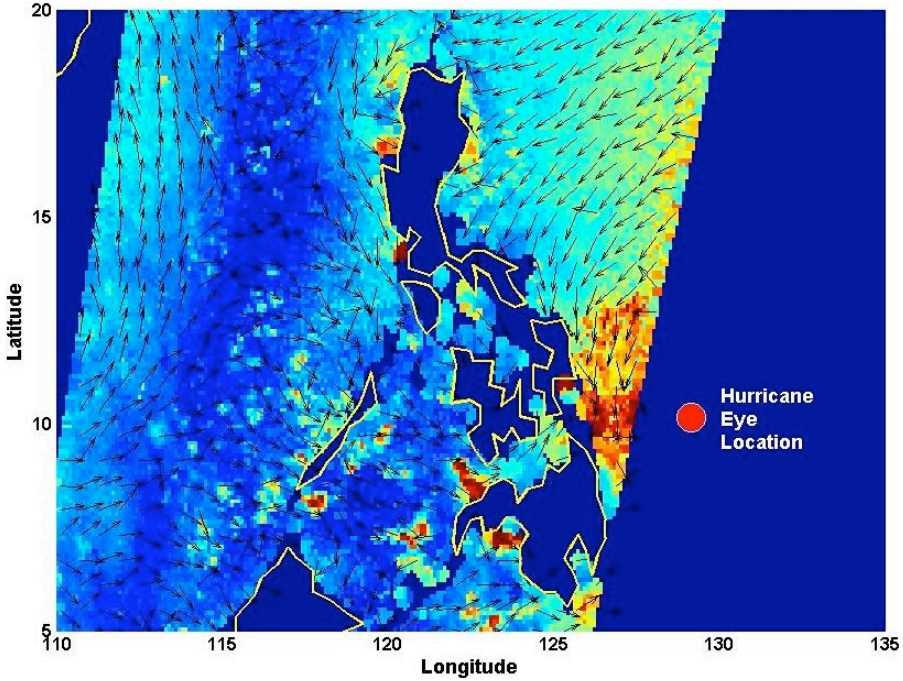
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Future Work

- Improve cyclone eye estimation for satellite images via cross-media spatio-temporal knowledge



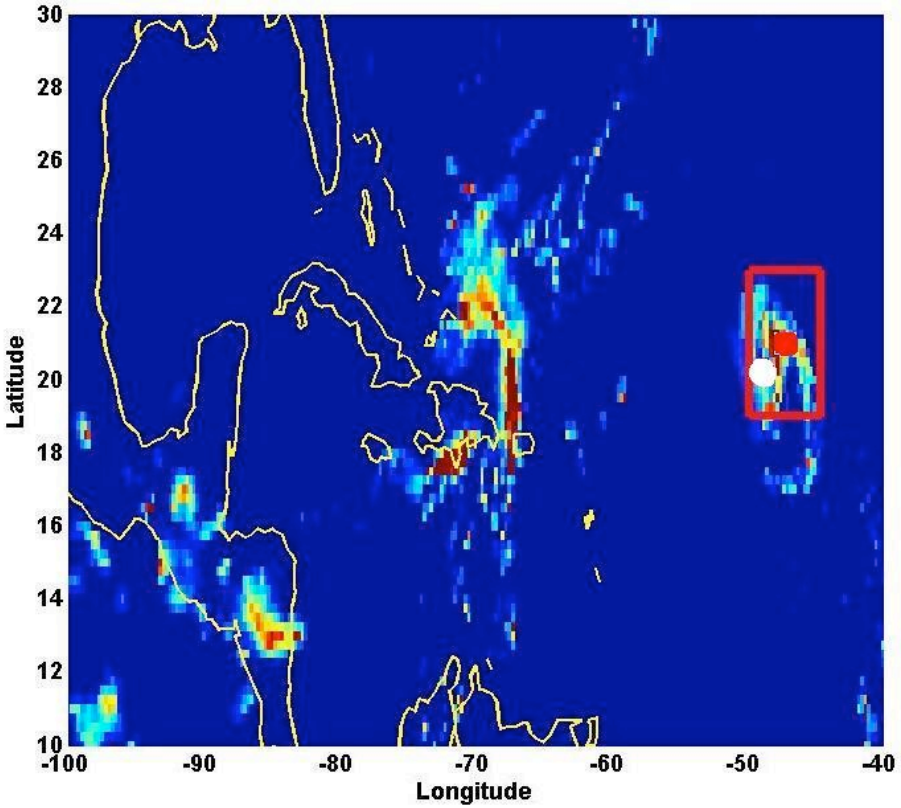


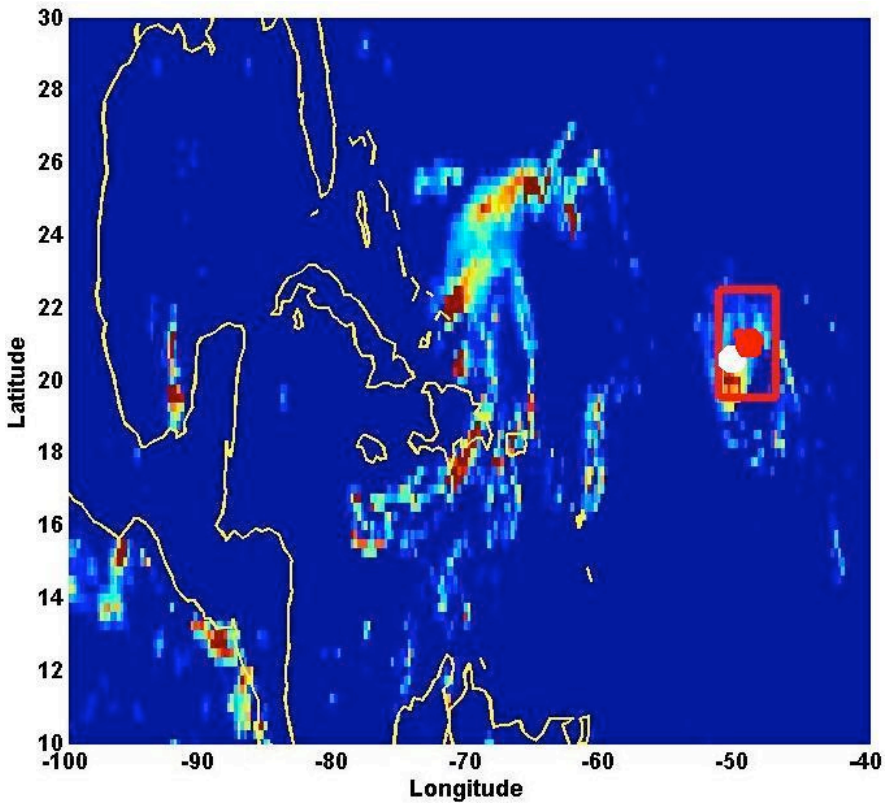
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Future Work

- Feature learning via cross-media annotation





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Future Work

- Information (evidence) and data retrieval from multiple satellite sources.
- News and image retrieval based on spatio-temporal weather event summarization



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