

First Annual Partners' Meeting

Yukon-Kuskokwim Storm Surge Nowcast/Forecast Model and Preliminary Norton Sound Storm Surge Model

Arctic Domain Awareness Center (ADAC)
A DHS Center of Excellence



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at  UNIVERSITY of ALASKA ANCHORAGE

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June 29 & 30, 2015



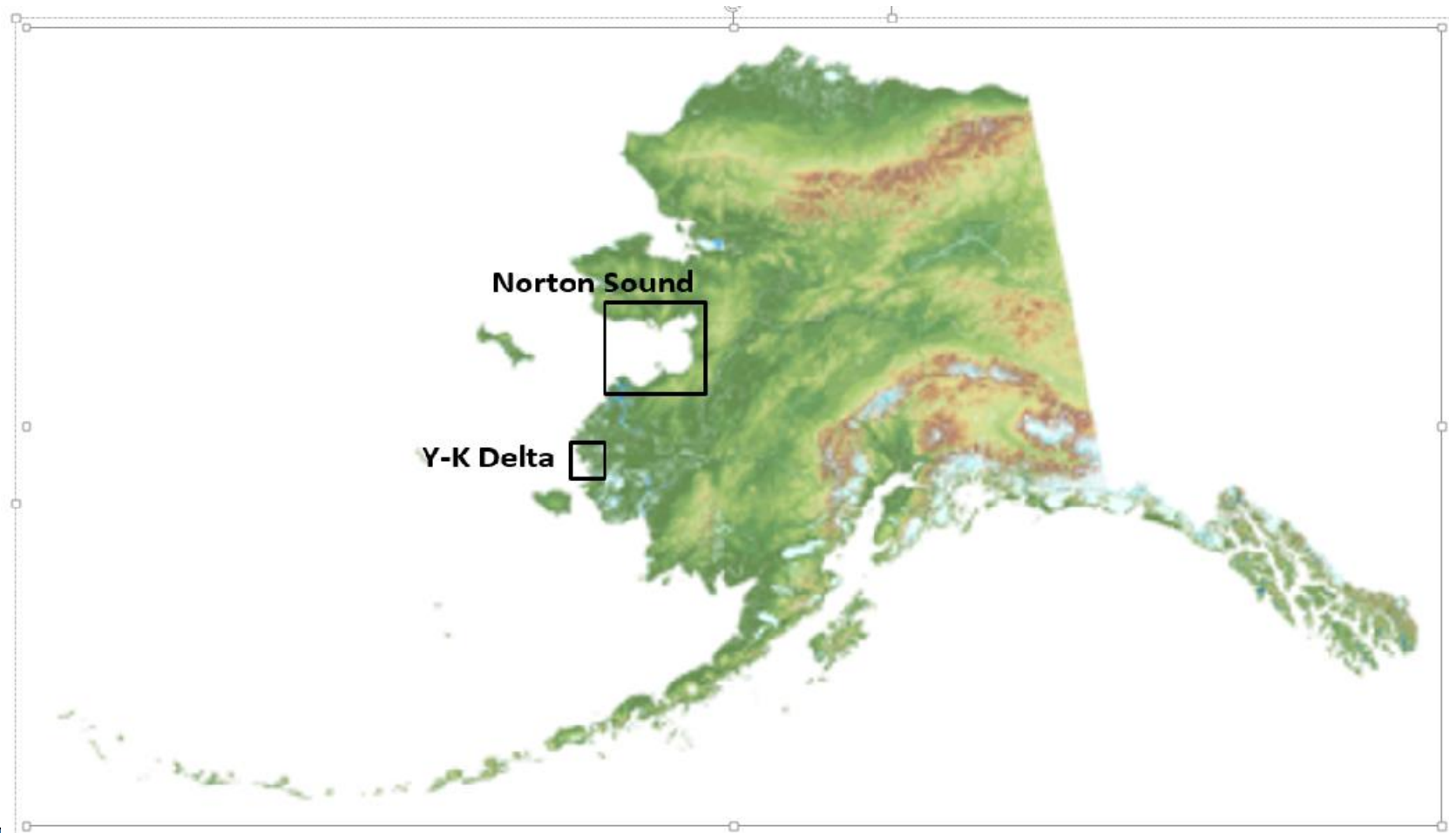
Overview:

- The Federal Emergency Management Authority (FEMA) works to “Prepare, Plan, and Mitigate before, during, and after a Disaster.”
- The western coast of Alaska lacks transportation infrastructure for rapid evacuation.
- An existing and validated hindcast circulation model of the YK Delta is transformed into a robust and automated nowcast/forecast model
- Several types of output are generated and distributed online to stakeholders and relevant agencies.
- A preliminary storm surge model for the Norton Sound has been developed.



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Source: USGS
http://minerals.usgs.gov/Alaska/images/AK_webimage.png, retrieved June 24, 2015



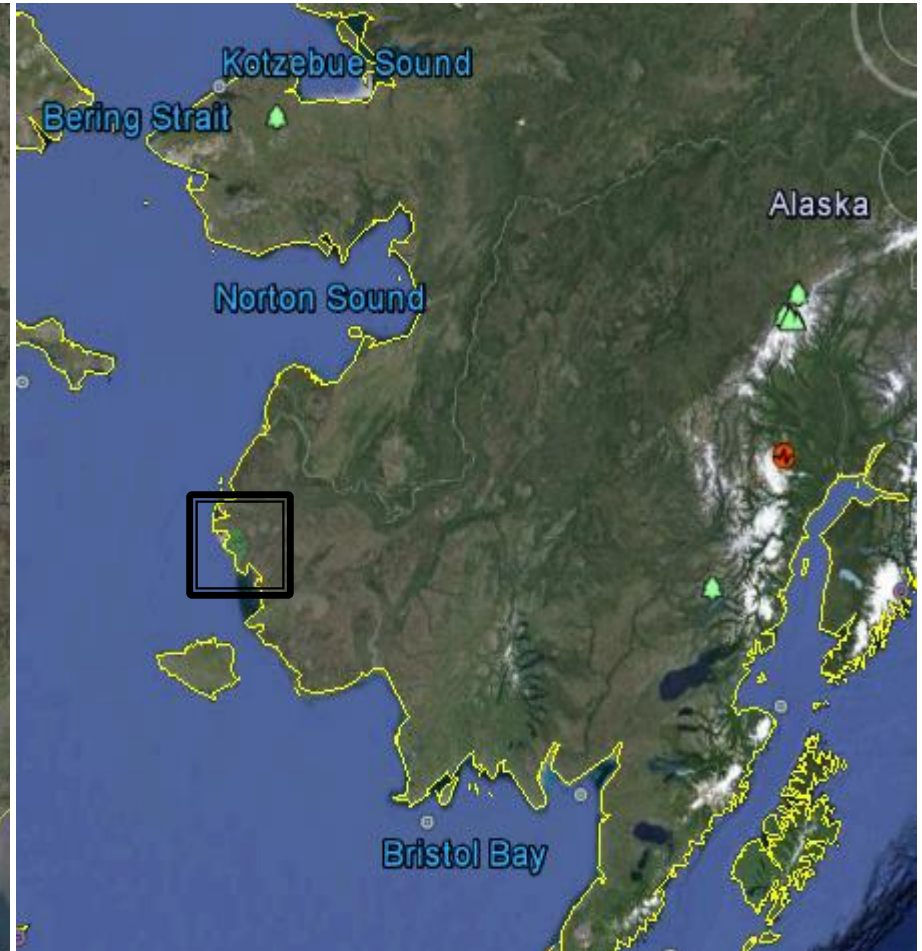
Accomplishments (YK Delta):

- ▶ Completed code for real-time collection of ocean boundary forcing data for YK Delta model.
- ▶ Completed code for operation of the fine-scale surge and flood model in real time and in forecast mode.
- ▶ Variety of output files generated for diverse applications.
- ▶ Automated master script is robust and stable.



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Location





Accomplishment 1

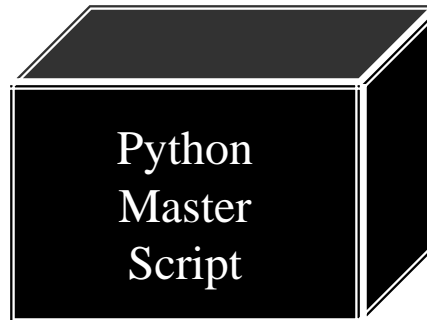
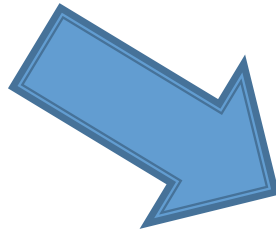
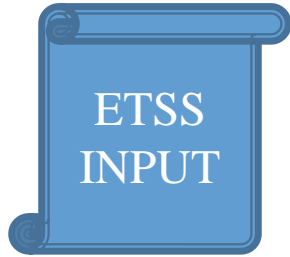
- Completed code for real-time collection of ocean boundary forcing data for YK Delta model.
- Retrieved in real-time online from NOAA/NWS ETSS (Extra-Tropical Storm Surge)

```
← → ↻ www.nws.noaa.gov/mdl/etsurge/msl/data/akromn.txt
#Cape Romanzof, AK : 06/24/2015 18:20:29 GMT (units in feet MSL)
#Date(GMT), Surge, Tide, Obs, Fcst, Anom, Comment
#-----
06/23 00Z, 0.00, -2.14, 99.90, -2.14, 0.00, (min)
06/23 01Z, 0.00, -1.69, 99.90, -1.69, 0.00,
06/23 02Z, 0.00, -1.02, 99.90, -1.02, 0.00,
06/23 03Z, 0.00, -0.26, 99.90, -0.26, 0.00,
06/23 04Z, 0.00, 0.51, 99.90, 0.51, 0.00,
06/23 05Z, 0.00, 1.14, 99.90, 1.14, 0.00,
06/23 06Z, 0.00, 1.45, 99.90, 1.45, 0.00, (max)
06/23 07Z, 0.00, 1.21, 99.90, 1.21, 0.00,
06/23 08Z, 0.00, 0.38, 99.90, 0.38, 0.00,
```



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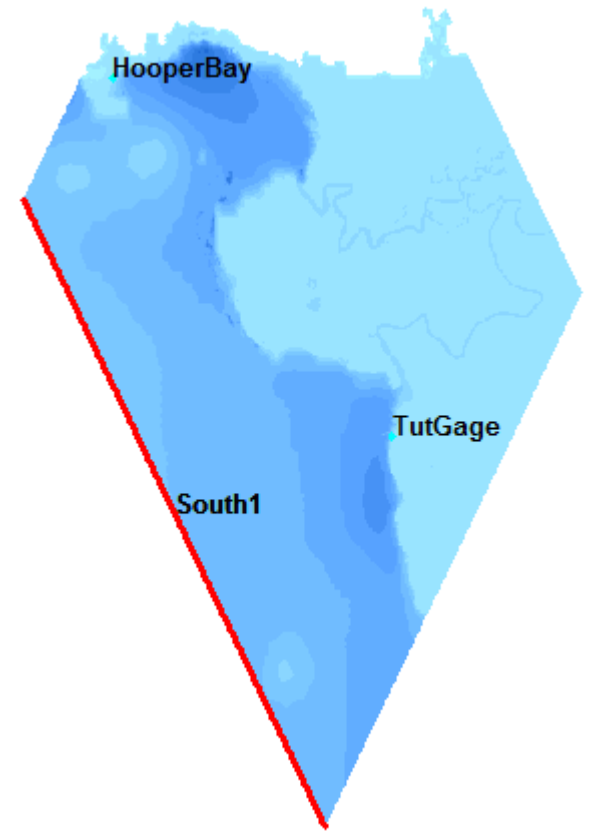
Model Flow





Accomplishment 2

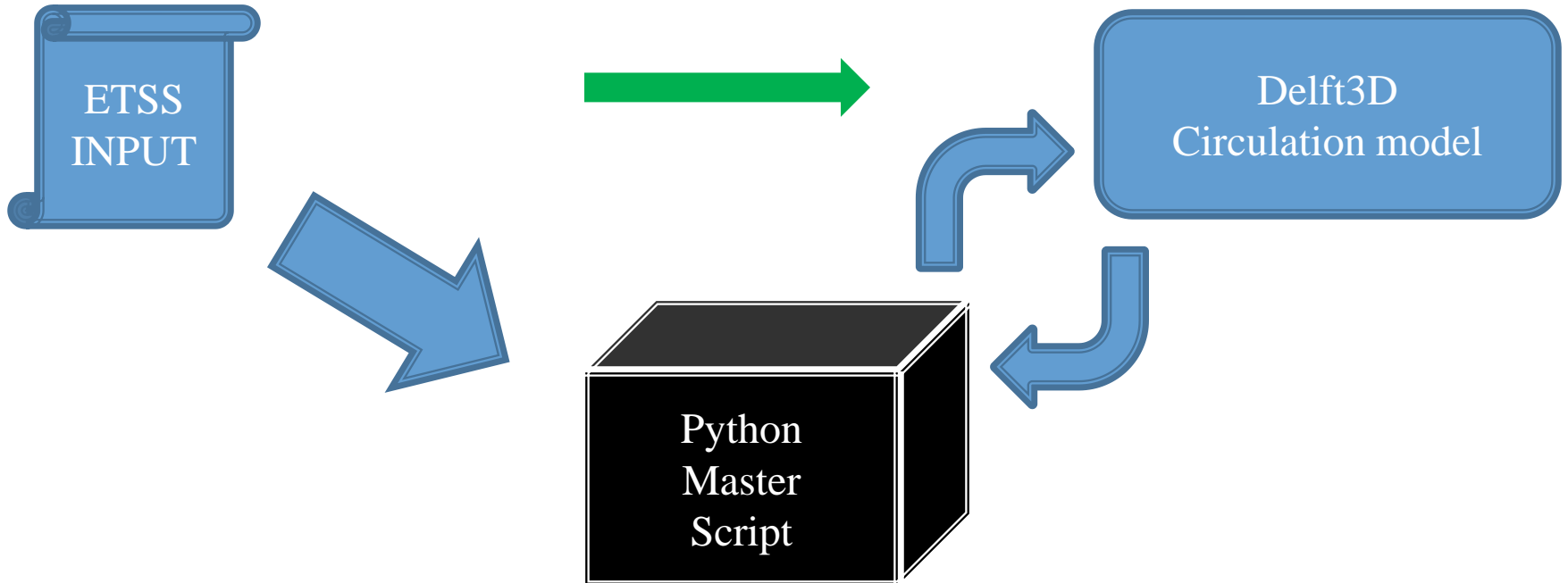
- Completed code for operation of the fine-scale surge and flood model in real time and in forecast mode.
- Master script verifies downloaded data, builds model setup files and launches Delft3D circulation model
- Fine-grid 150-200 m resolution





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Model Flow





Accomplishment 3

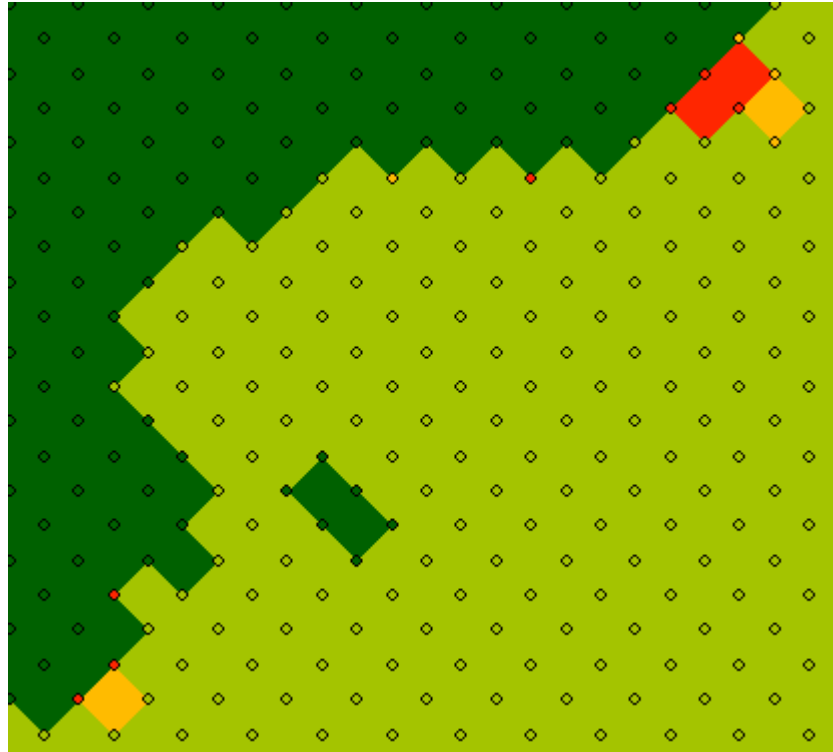
- Variety of output files generated for diverse applications at twelve model timesteps.
- Shapefiles designed for use by researchers
- ASCII text files for automated applications
- KML Google Earth overlay designed for quick reference
- Output files are downloadable from dedicated website



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Accomplishment 3 Shapefiles

- ▶ Contains all model nodes, including sea and land
- ▶ Separate point and polygon shapefiles produced





Accomplishment 3

ASCII files

- ▶ Contains all model nodes, including sea and land

ID	Latitude	Longitude	Elevation	LandMask	SurfElev	WaterDepth	FloodLevel
1	-166.238556	61.429558	-9.022701	0	0.768917	9.791618	-999
2	-166.237137	61.428146	-9.048881	0	0.773006	9.821887	-999
3	-166.235733	61.426731	-9.057715	0	0.775706	9.833421	-999
4	-166.234314	61.425316	-9.057715	0	0.777662	9.835378	-999
5	-166.232895	61.423901	-9.041731	0	0.779041	9.820772	-999
6	-166.231491	61.422489	-9.007029	0	0.780050	9.787079	-999
7	-166.230072	61.421074	-9.000000	0	0.780893	9.780893	-999
8	-166.228653	61.419659	-9.000000	0	0.781769	9.781769	-999
9	-166.227249	61.418247	-9.000000	0	0.782990	9.782990	-999
10	-166.225830	61.416832	-9.000000	0	0.784664	9.784664	-999
11	-166.224411	61.415417	-9.000000	0	0.786404	9.786404	-999



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Accomplishment 3

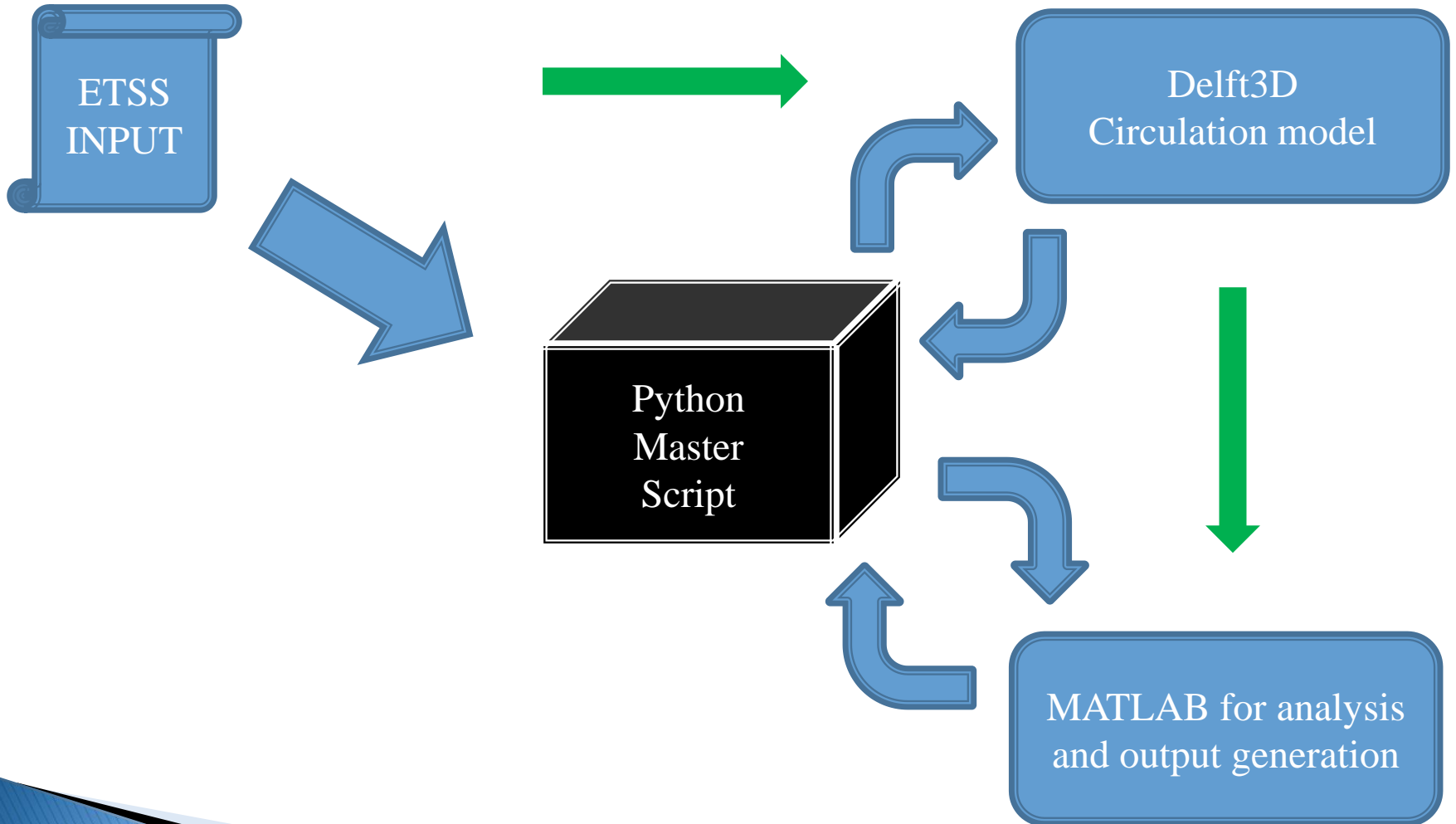
KMLs

- ▶ KMLs only contain land nodes
- ▶ KML Google Earth images allow for quick visual assessment





Model Flow



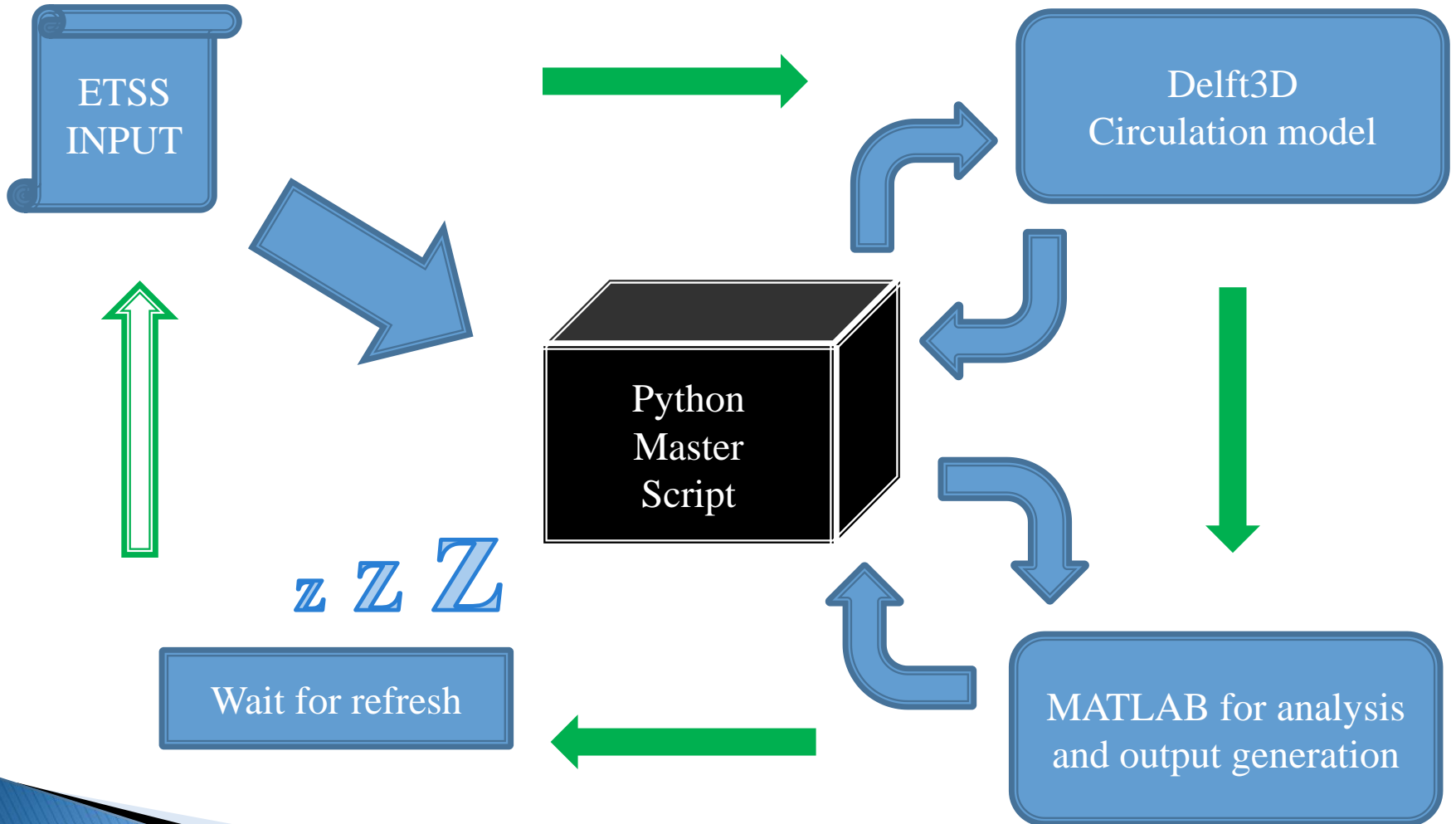


Accomplishment 4

- Automated master script is robust and stable.
- Minor errors adjust refresh rate
 - Invalid downloaded data
 - Model failure due to large attempted timestep
 - Model output invalid
 - Multiple consecutive failures terminate master script
- Major errors immediately terminate master script
 - Invalid operating system detected
 - Template directories missing
 - Invalid or missing initialization variables
- Memory management
 - User may automate removal of old directories



Model Flow





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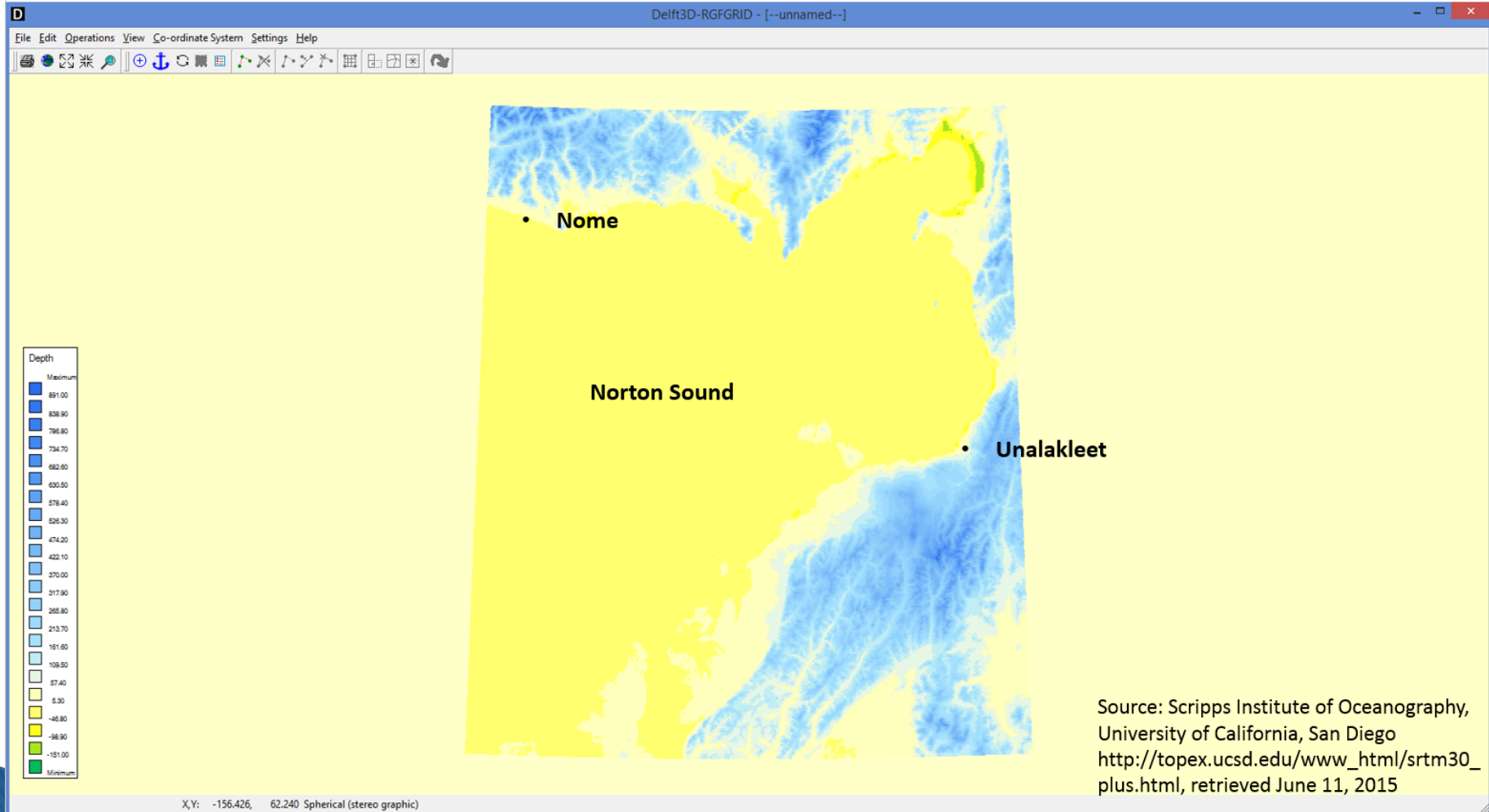
Accomplishments [Norton Sound]

- ▶ Collected, analyzed, and incorporated available bathymetric and topographic data for use in Delft3D storm surge model.
- ▶ Defined model domain and set up computational grid.
- ▶ Gathered ETSurge forcing data (from Nome) and used it to “force” the model’s ocean boundary.



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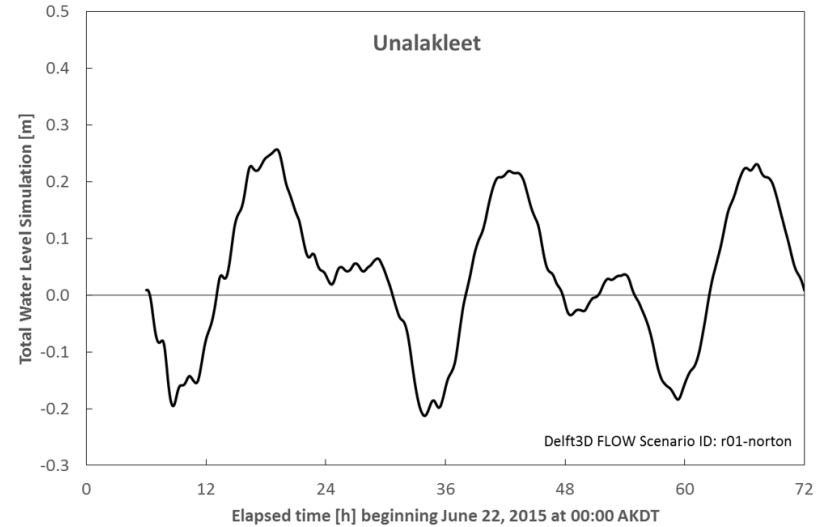
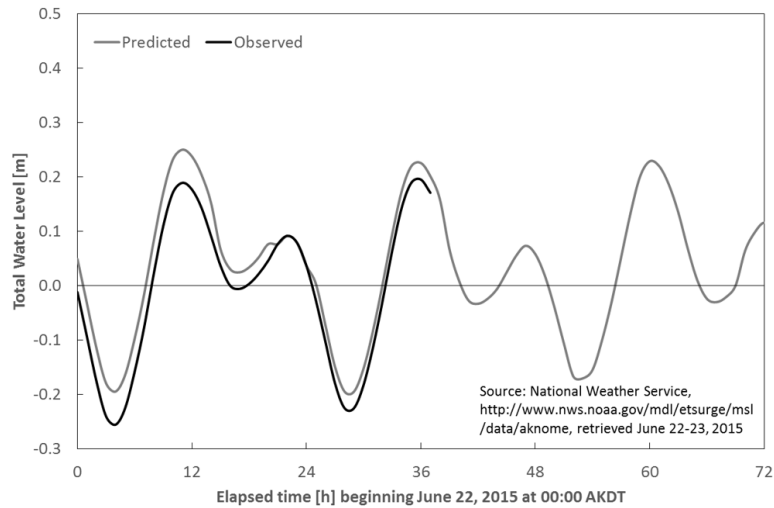
Accomplishments [Norton Sound bathymetry and topography brought into Delft3D]



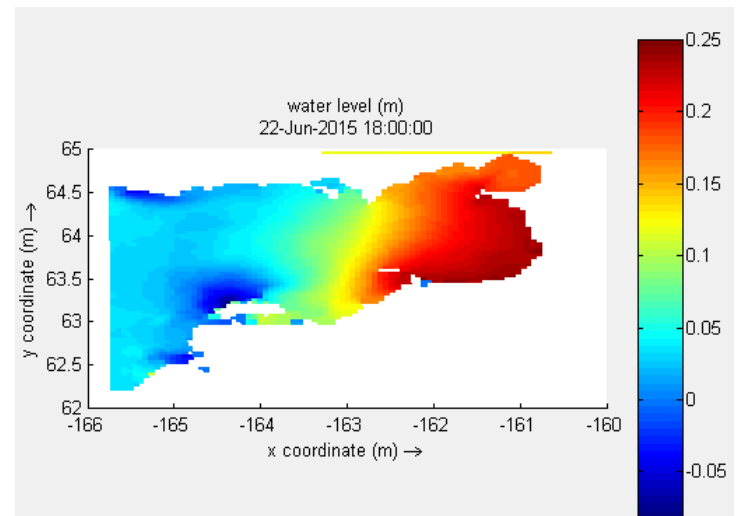
Accomplishments [Boundary conditions and output.]

Ocean boundary condition applied near Nome on west side of domain.

Calculated Unalakleet water level.



Snap shot of domain wide water level.





Metrics:

- ▶ Accuracy of surge and flooding forecasts relative to measured data. Surge calculations currently have errors in the range of 0.5 to 1.0 m. The target error is 0.25 m to 0.5 m. **Not yet measured.**
- ▶ Number of months (or storms) for which YK Delta surge and flooding model is operational in year 2. The number of operational months will range from 12 months (meaning the model was operational for year 2) to 0 months (meaning we did not succeed in making the model operational). **2 weeks in yr 1.**
- ▶ Number of months (or storms) for which Norton Sound surge and flooding model is operational. The range of operational months will range from 0 (meaning we did not manage to get the model operational) to 6 months (meaning the model was operational for 6 months). **Preliminary model complete in yr 1.**



Milestones achieved

- ▶ Completed code for real-time collection of ocean boundary forcing data for YK Delta model. **Achieved.**
- ▶ Completed code for operation of the “fine scale” surge and flood model in real time and in forecast mode (for YK Delta). **Achieved.**
- ▶ Completed assessment of the model by comparing modeled and observed water level. **In progress.**
- ▶ Completed integration of model data into the DHS Center for Maritime Research (system of system) control center. **No.**
- ▶ Push model data out to stakeholders including FEMA and NWS. **Presentation to NWS on 6/24.**
- ▶ Completed reproduction of the above milestones for Norton Sound model. **In progress.**



Key Stakeholder Engagement

- ▶ Mr. Mark Everett (US Coast Guard, 17th Coast Guard District), Mr. Robert Forgit, Federal Emergency Management Agency, U.S. Department of Homeland Security, Alaska Region. Mr. Kenneth Murphy, Regional Administrator, Region X, Federal Emergency Management Agency, U.S. Department of Homeland Security. Aimee Fish, NOAA National Weather Service (NWS) - Alaska Region Headquarters Decision Support, National Weather Service, Alaska; Decision Support and Societal Impacts.
- ▶ **Have presented YK Delta nowtime surge model to Aimee Fish and James Nelson (NWS). Have engaged with Arthur Taylor (Lead NWS surge modeler for Alaska).**



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Gaps and lessons learned.

- ▶ **Lessons Learned:**
- ▶ **It is extremely valuable to reach out to stakeholders.**
- ▶ **Engaging with our stakeholders ensures that we are on track and effective, and may lead to other opportunities.**



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Next steps

- ▶ **Include wind in YK Delta model.**
- ▶ **Validate YK Delta model.**
- ▶ **Further develop Norton Sound model.**
- ▶ **Convert software from Delft3D to ADCIRC as necessary.**
- ▶ **Include wave action as necessary.**
- ▶ **Ensure that sufficient computers are available.**