



# Autonomous vehicles: The Canadian Hydrographic Service Journey



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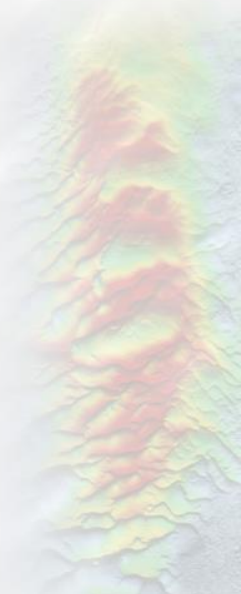
Les cartes marines protègent la vie, la propriété et l'environnement marin  
Nautical charts protect life, property and the marine environment





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# Context – Department of Fisheries and Oceans

- DFO Minister message (extracts)
  - DFO's Canadian Hydrographic Service (CHS) will deliver modern hydrography and charting in key areas... Innovation...
  - ...experimenting with new approaches to resolving problems...
  - ...create stronger partnerships with Indigenous and coastal communities and protect our coastlines and marine environment for generations to come...
- Science renewal – Reinvestment program (capital)
  - ~\$4.0M for 3 years (2016-17 to 2018-19) for autonomous vehicles



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## Context – Getting more data...

- Diversifying data input – Discovery & partnership
- Crowdsource – 3 level of sources
  - Controlled data providers – professionally collected – Invest time
  - Targeted data providers – work with targeted partners (e.g.: Power Squadrons, Fishermen group, Pilots, etc.) – Agreements
  - Public data providers – Boaters, Marinas, Waterfront owners, Etc.
- Within CHS – National assets
  - Portable multibeam systems – 5+1 Norbit MB systems
  - From BCIP (Build in Canada Innovation Program) – 3DSS (3) & Hydroballs (9)



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# Example of partnership with small communities

- Crowdsource – Case of Lake Memphrémagog

- New surveys done in 2011 and 2012
- Partnership with U.S. Vermont Department of Environmental Conservation
- Data exchange with benefits for both parties
- Winter 2017, request from the 'Corporation of Bay Fitch Conservation' to chart the Bay Fitch for a recreational project.
- CHS trained 2 members of this group on Hydroball
- Data collected in 2 weeks
- Data checked and validated at CHS – BDB – Chart Patch in 2018 (student)

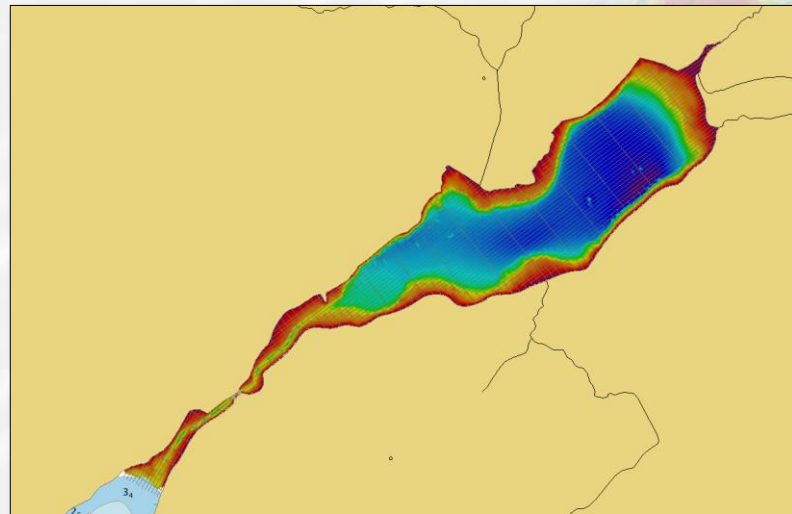
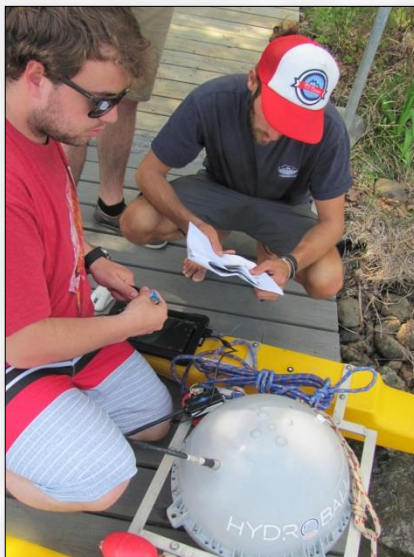


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# Example of partnership with small communities

- Crowdsource – Case of Lake Memphrémagog



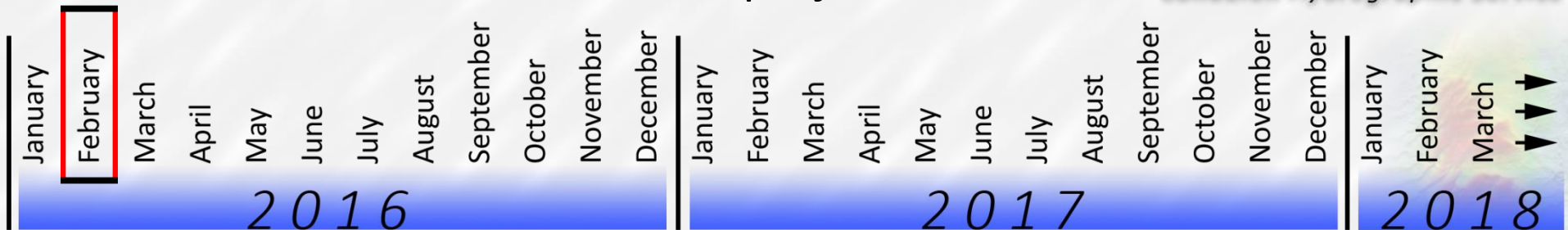
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# Timeline – Autonomous vehicles project

Service hydrographique du Canada  
Canadian Hydrographic Service



- Budget 2016-2017
  - \$1.4M to be spent on autonomous vehicles
  - 2 vehicles 1 to 2 meter long
  - 2 vehicles 2 to 3 meter long



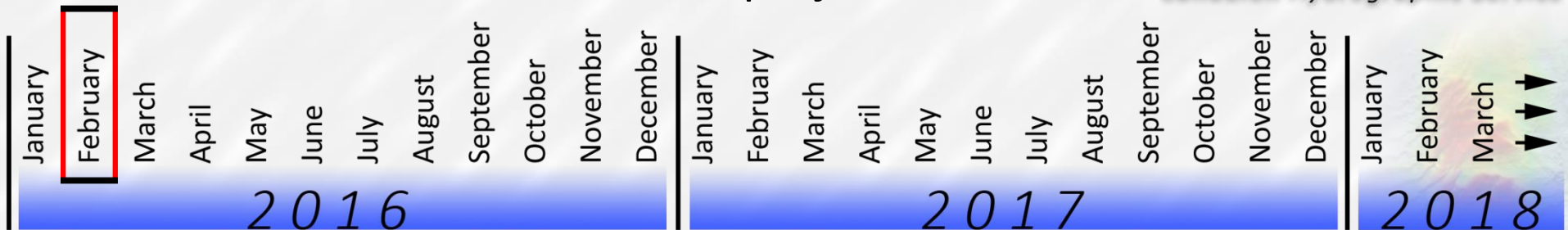
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# Timeline – Autonomous vehicles project

Service hydrographique du Canada  
Canadian Hydrographic Service



- **Start of the project**

- Roger Côté project lead, assisted by Éric Lebel & Bernard Tessier + HSWG + HOC + CEC + CHC 2016
- Final decision on CHS plan made a few weeks after CHC 2016
  - 2 catamarans: 2 to 3 m long + 1 conversion of existing survey launch
    - Autonomous Hydrographic Surface Vehicles (AHSV)
    - Autonomous Hydrographic Survey Launch (AHS�)
- Writing of the Technical Statement of Requirements (TSOR) begins



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# Timeline – Autonomous vehicles project

Service hydrographique du Canada  
Canadian Hydrographic Service



- **May to August 2016**

- Writing based on the TSOR of the Kanter boats & Norbit MB's
- Meeting with Transport Canada and Canadian Coast Guard
- Public Services & Procurement Canada Supply officer named mid-July
- Translation of the catamaran TSOR
- Catamarans TSOR sent and final review with PSPC starts
- Writing of the launch conversion started (July)



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## Timeline – Autonomous vehicles project

Service hydrographique du Canada  
Canadian Hydrographic Service



- August to October 2016
  - Catamarans request For Proposal posted on September 12<sup>th</sup> until October 25<sup>th</sup>.
  - Answer questions from contractors
  - Finalize the TSOR on the launch conversion (October) – Translation
  - Technical evaluation of the catamarans proposals



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# Timeline – Autonomous vehicles project

Service hydrographique du Canada  
Canadian Hydrographic Service



- October to December 2016
  - Conversion Request For Proposal posted on November 11<sup>th</sup> until mid-December
  - Answer questions on the conversion RFP
  - Technical evaluation of the catamarans proposals  
The winner is: SeaRobotics
  - Technical evaluation of the launch conversion proposals (January)  
The winner is: ASV Global



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## Timeline – Autonomous vehicles project

Service hydrographique du Canada  
Canadian Hydrographic Service



- December 2016 to March 2017
  - Construction of the catamarans started
  - March: Catamarans sea trials and acceptance tests (Florida)
  - ASV Global faces supply delay of some equipment  
Delivery delayed until June 2017



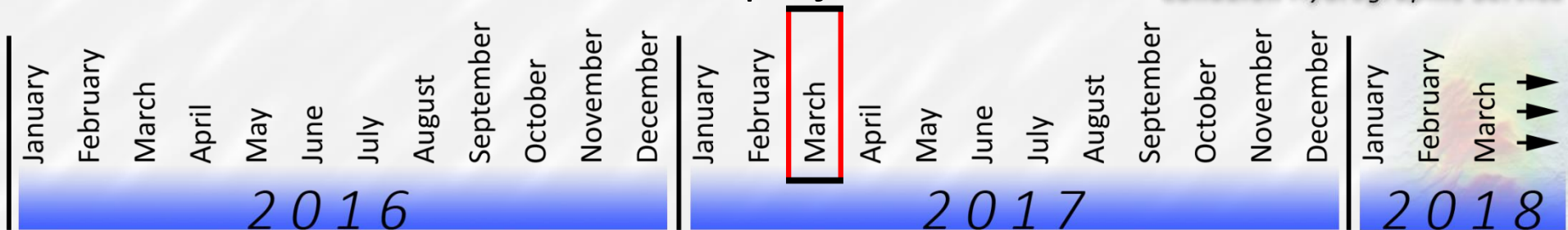
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# Timeline – Autonomous vehicles project

Service hydrographique du Canada  
Canadian Hydrographic Service



- March to June 2017
  - May: Delivery of the 2 catamarans to Mont-Joli + Training of CHS Staff (national) and Electronic Technicians
  - June: Installation of the launch conversion's gear (ASV Global)  
New problems occurred , delivery postponed to September



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# Timeline – Autonomous vehicles project

Service hydrographique du Canada  
Canadian Hydrographic Service



- June to October 2017

- Summer: Operationalization of both catamarans by GTS
- July: System problem design with the conversion
- August: Apply contract options to acquire 2 new catamarans
- September: Successful Sea trials and acceptance tests of the launch conversion in Mont-Joli + Training of CHS Staff and Electronic Technicians
- September: First official survey with one of the catamarans (1 week)
- October: Survey of the Richelieu River (5 weeks)



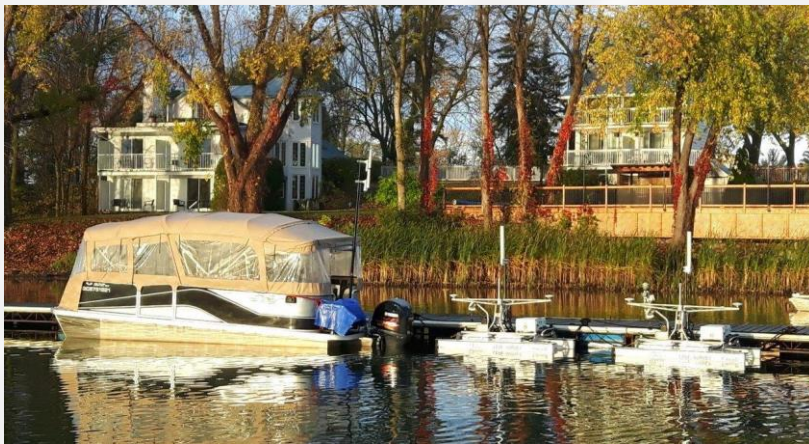
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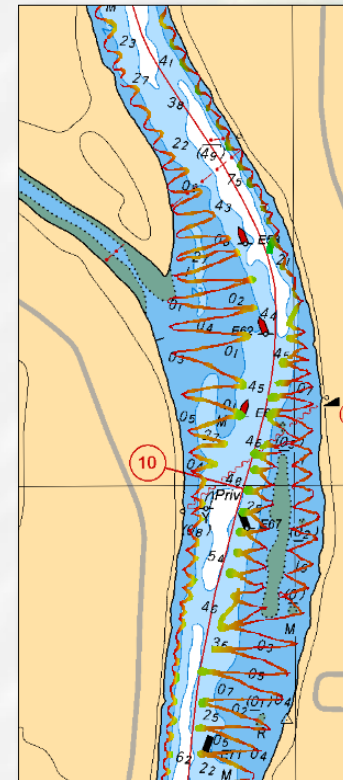
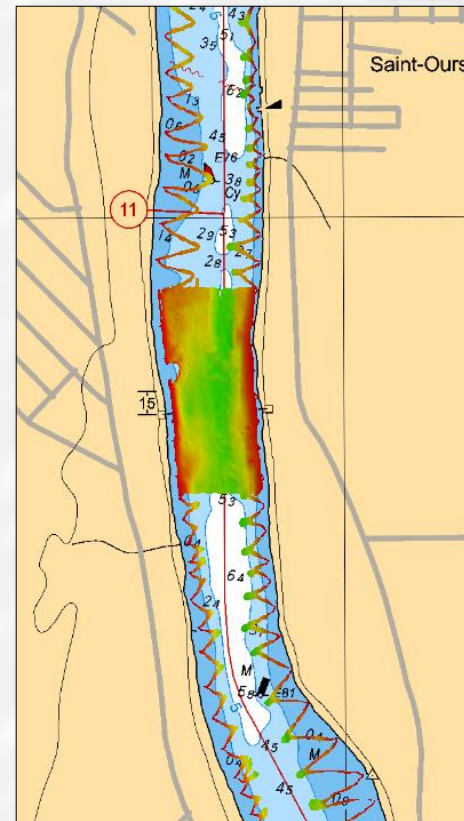


# Richelieu River survey

- 2 AHSV (R2 & D2)
- 1 Pontoon boat
- 1 GNSS base Station
- 3 hydrographers
- 1 coxwain



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# Timeline – Autonomous vehicles project

Service hydrographique du Canada  
Canadian Hydrographic Service



- October 2017 to March 2018
  - Survey with converted launch didn't occurred (timeline + weather)
  - Transfer of 1 catamaran in Sidney, BC + training
  - Transfer of the other to St-John's, NFL + training
  - Successful Sea trials and acceptance tests of 2 new catamarans



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# Results

- AHSV's (R2, D2, #3 & #4)



Length: 2,5 m  
Width: 1,5 m  
Weight: 150 kg  
Speed: 3,5 kts oper., 5 kts max.  
Autonomy: 6 hrs per battery set  
Reach: 5 km from base station  
Equipement:

- R2Sonic 2020
- PosMV SurfMaster
- SVP winch + AML Base X + Micro X
- Anti-grounding, Anti-collision
- Caris OnBoard
- Enclosed trailers



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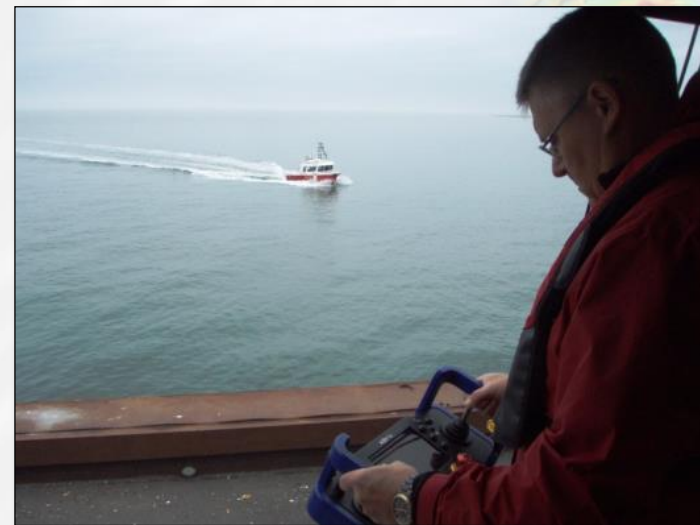


# Results

- Launch conversion



- 'Garrot', 26 foot launch
- Manned / Unmanned
- manual and/or autonomous control modes
- Comm. Reach: 10km+
- Track line: <1m
- Anti-grounding / Anti-collision



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## • What's next?

- Operationalization of new catamarans in Mont-Joli and one will be transferred in Burlington office + training
- Each CHS office will integrate their units into their survey operation
- Start using the Garrot in unmanned mode
- Continue work with CCG and TC on unmanned related concerns (regulation, acceptance, confidence, safety, etc.)
- Funds, at the moment, aren't sufficient to apply new options (AHSV or AHSL)



# Lessons learned

- Procurement process
- Operational efficiencies – still a lot to be learned
  - HOW/WHEN/WHERE ?  
(Shallower areas, harbors, multiplication factor, etc.)
  - Greater efficiencies between data acquisition software and autonomous vehicle control (AI)
  - Reduce manpower / increase data acquisition
- Share our experience and provide feedback to the industry  
(involvement, development, understanding HO's needs, etc.)



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# Questions ?



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