CMS WAVE & FLOW MODELING AND VALIDATION IN THE COASTAL MODEL TEST BED

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DISCOVER | DEVELOP | DELIVER

BLUF

- CMS wave and flow setup in CMTB automated environment
- To evaluate nearshore performance of circulation models, we focused on automating and evaluating established methods for retrieving surface currents from optical imagery.
  - Chickadel et al., 2013
  - Almar et al., 2106

Test bed: CMS Wave and Flow

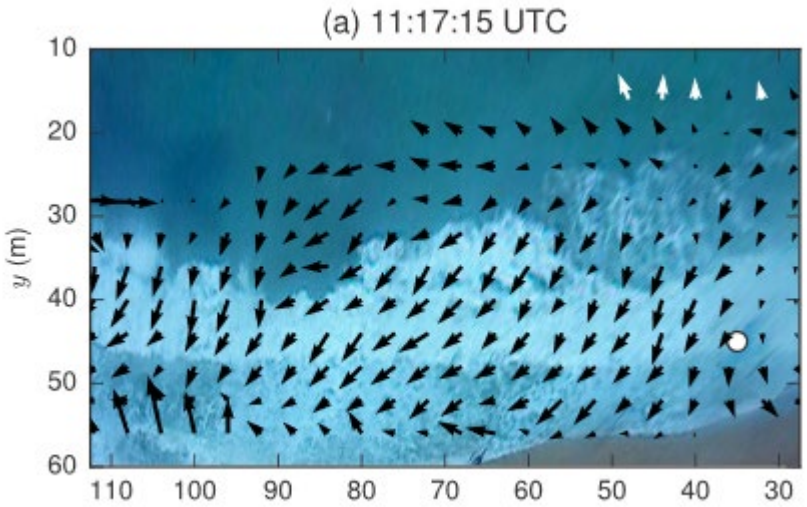
- **Model work-flow developed for CMS Flow**
  - Running CMS flow model at the FRF
  - Work flow developed separately from CMS-Wave
    - Due to initial questions with CMS coupling bug

- **Work remaining**
  - refine work-flow to run coupled
    - Minor path adjustment and steering file adjustments
  - Test coupled model setup and submit CHETN on model setup and short time period evaluation (*in draft)*

- **Where we're going:**
  - Update bathy model interpolation scheme (other funded efforts)
  - Run CMS-wave hindcast
  - Multiple wave-model evaluation
  - Begin/test circulation coupled with waves

Coastal Model Test Bed: surface currents

- **Problem:** Few continuous measurements of currents in the surfzone at the FRF for model evaluation
- **Solution:** Use remotely sensed observations of surface currents to enhance surfzone flow measurements
  - Chickedel et al 2003 (2D FFT)
  - Almar et al 2016 (radon transform)
- **Approach:**

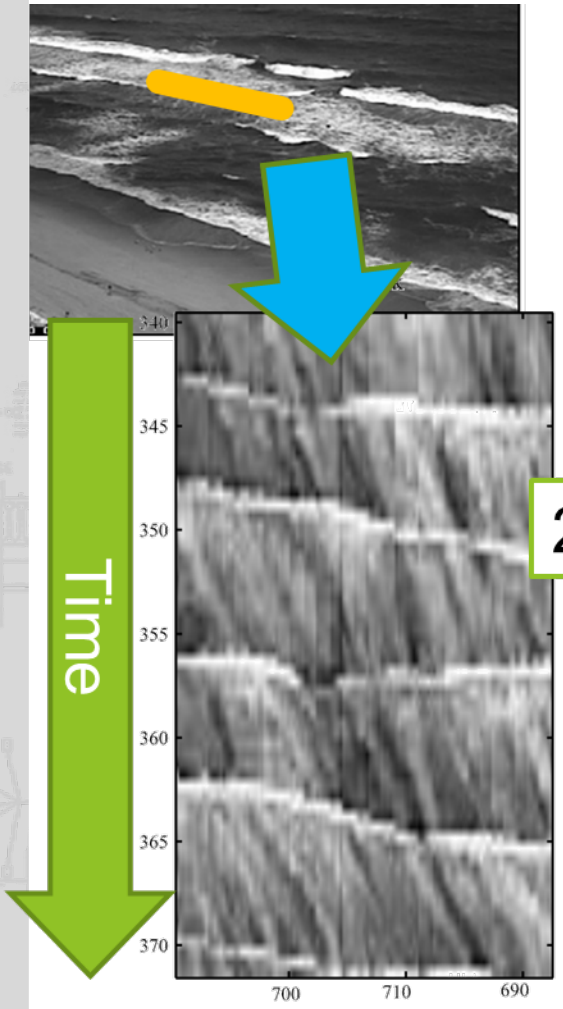


1. Need to understand when we can trust the observations to make appropriate model – data comparisons
   - Data have been collected since inital publication but algorithms never run as operational before

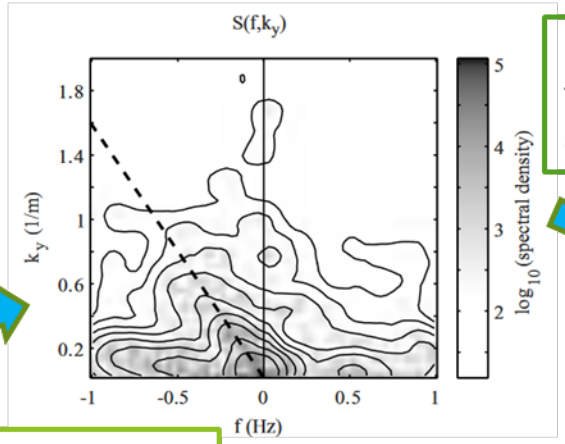
2. 2DH models output depth average values; need to convert surface currents to depth using velocity profile model

Optical Current Method
Spatial FFT

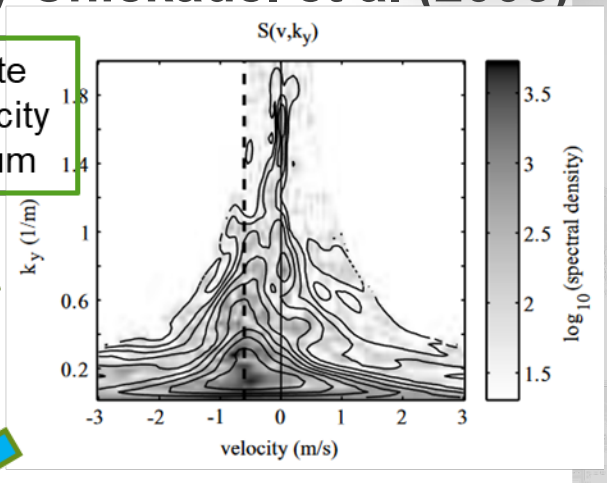
- Published by Chickadel et al (2003)

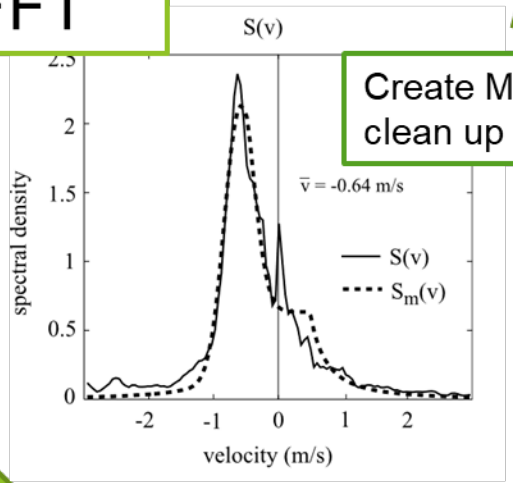


2D FFT

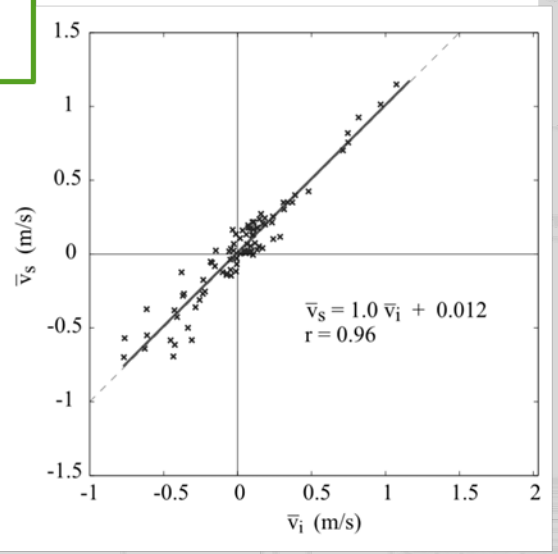


Integrate to Velocity spectrum

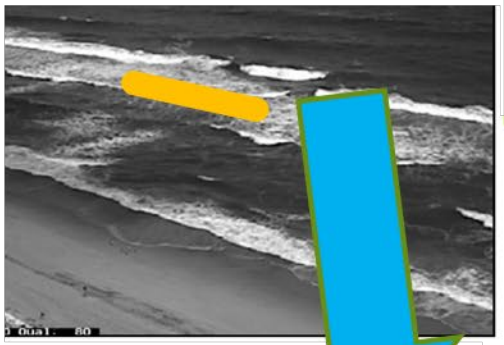




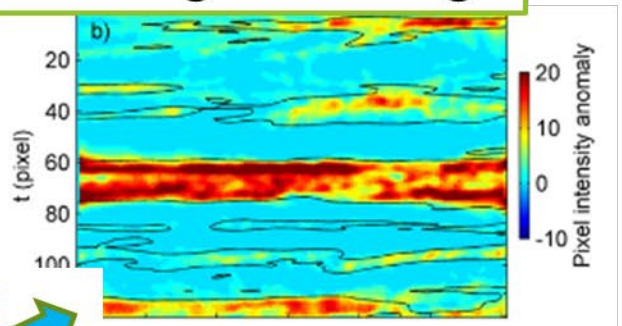
Create Model to clean up signal

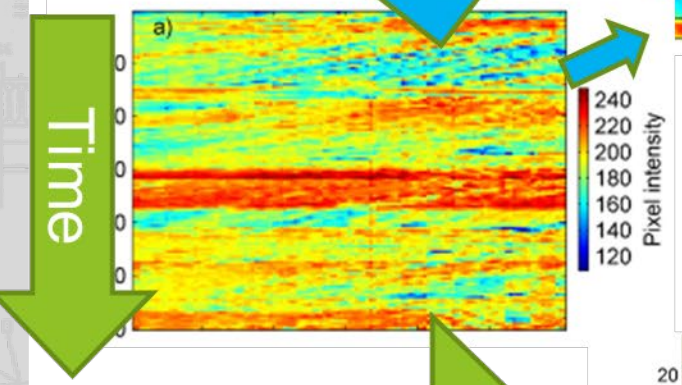


Optical Current Method Radon Transform

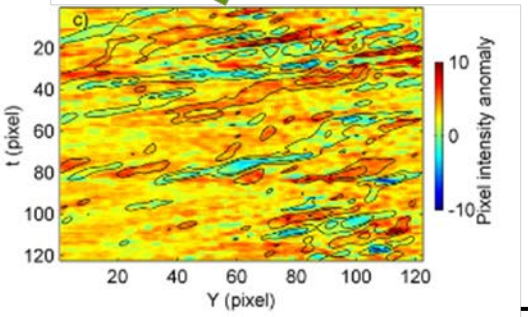


Remove Waves Through filtering



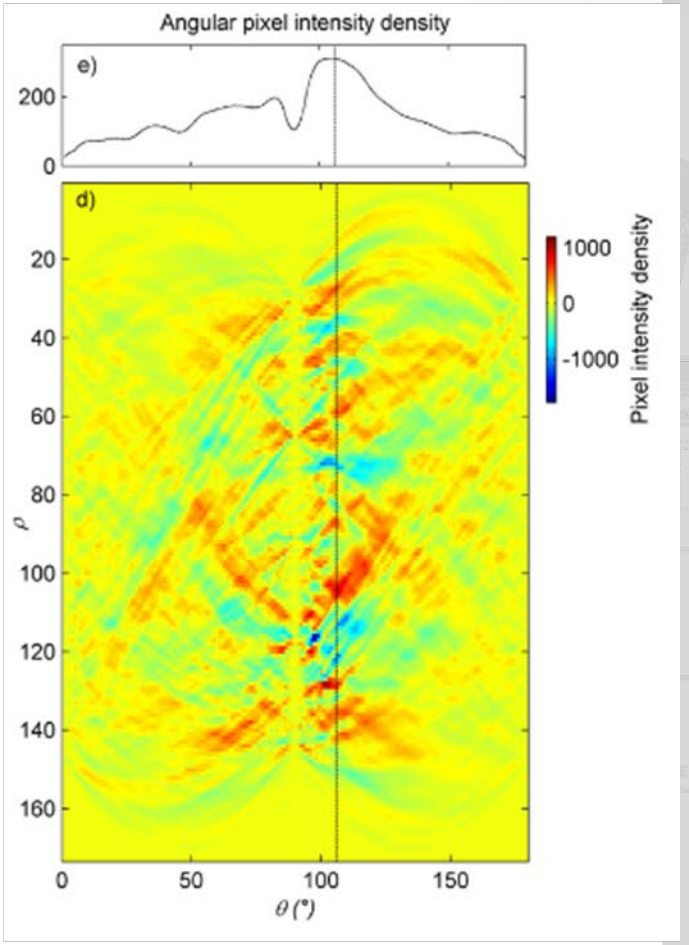


Leaves
Background
Foam traces



Alongshore Position

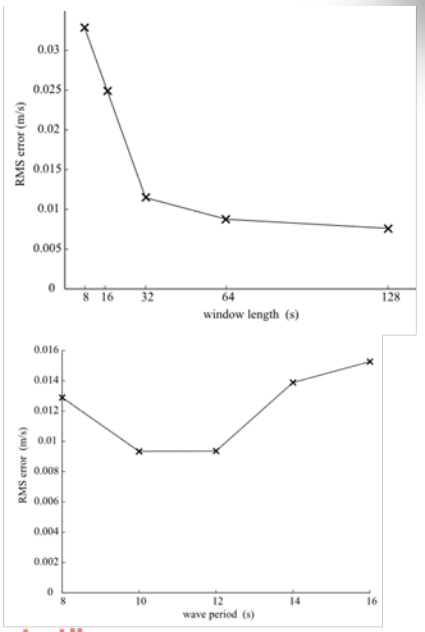
Published by Almar et al (2016)



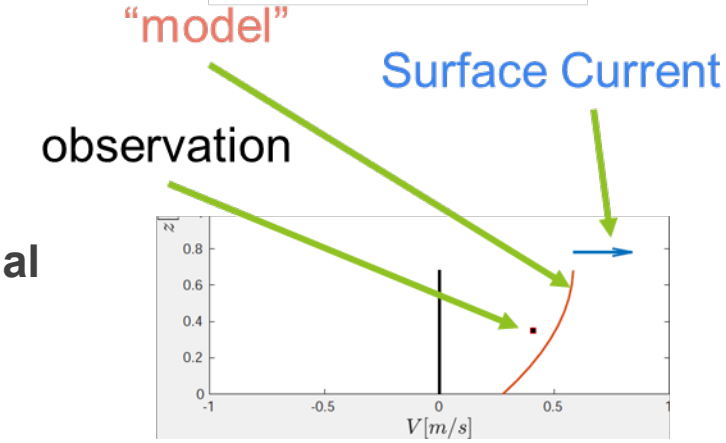
Optical Current Method (OCM)

- Methods uses time and alongshore window and overlap to strengthen statistics

- From Chickadel et al (2003) method shown to be sensitive to
  - time window, T_{win}
  - wave period, T_p
  - wind speed/direction
  - Camera/light properties (I_{range}/QC_{span})



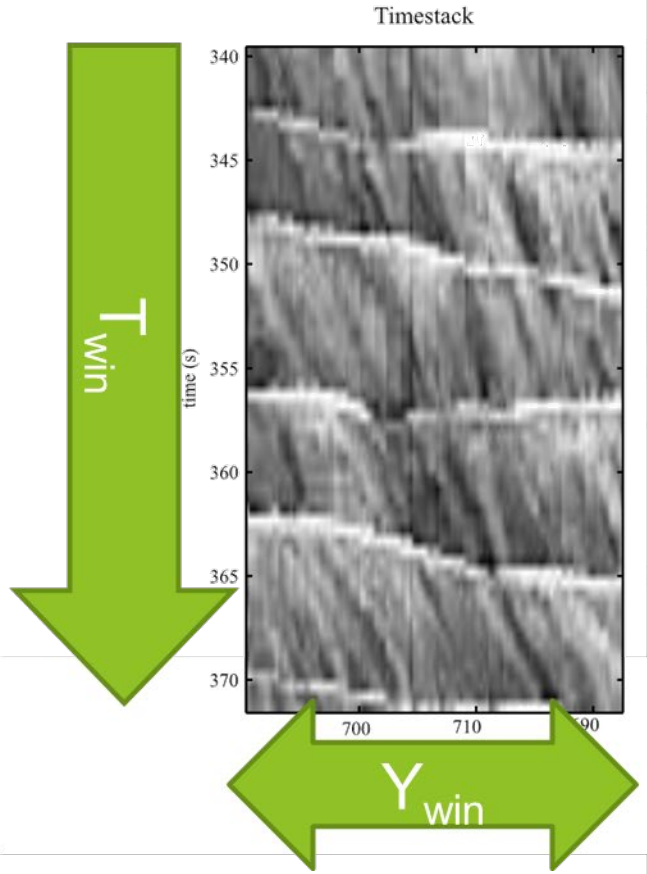
- Only measures surface current so we will convert to depth using:
  - Wind stress, τ_{sy}
  - Wave radiation stress, S_{xy} (linear in depth)
  - Depth invariant eddy viscosity (Svendsen et al 1987)



OCM – Sensitivity Analysis

- **Use Multiple datasets with ADVs deployed in surfzone from 2 time periods**
  - **Elgar et al.**
- **Vary processing metrics to understand OCM sensitivity to:**
  - **Processing Factors: T_{win}, T_{step}, Y_{win}, Y_{step}**

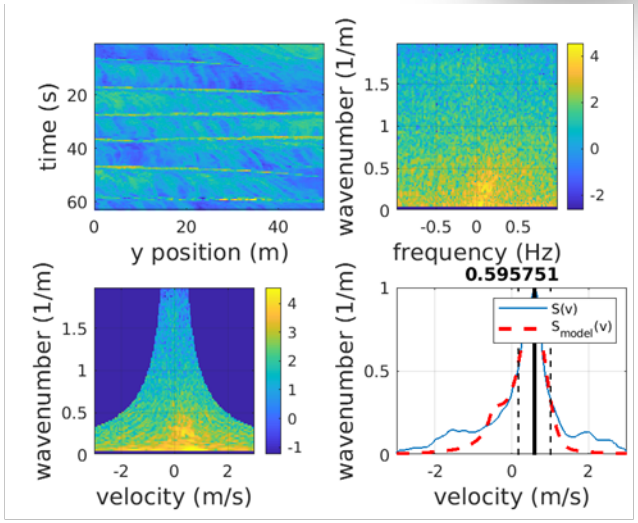
Quality Control (QC) factors:	Environmental Factors
QC_{span} (I_{range})	wave period, T_p
Confidence Interval span	Wind speed/direction
Probability of fit	Current speed/direction



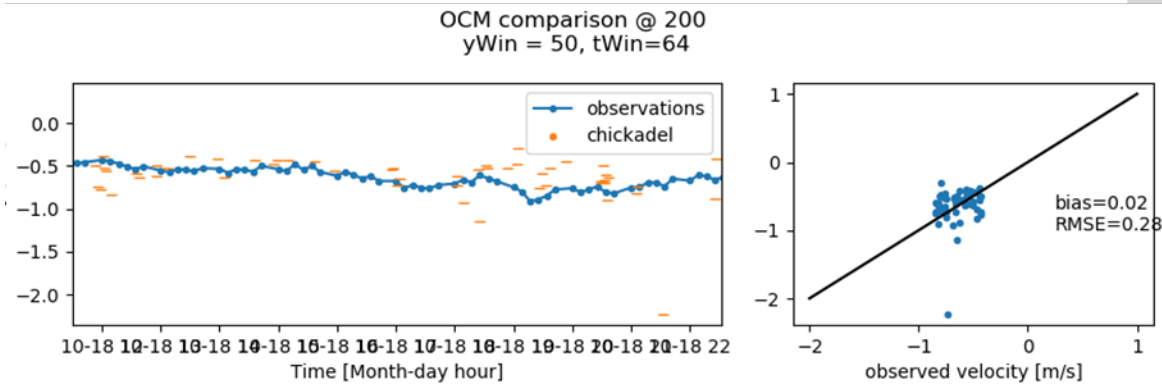
- **Fuse methods**
  - **Filtering from Almar et al**
    - **Develop QC**
  - **Established QC from Chickadel et al**

Initial Results

- Evaluated algorithm over XX days
  - Mixed results
    - Example “good” result below
    - Need to develop a better QAQC metric to identify “poor” results
  - Complicated processes:
    - Wave breaking near gauge
    - Time periods with adequate conditions
    - Need measurement near surface

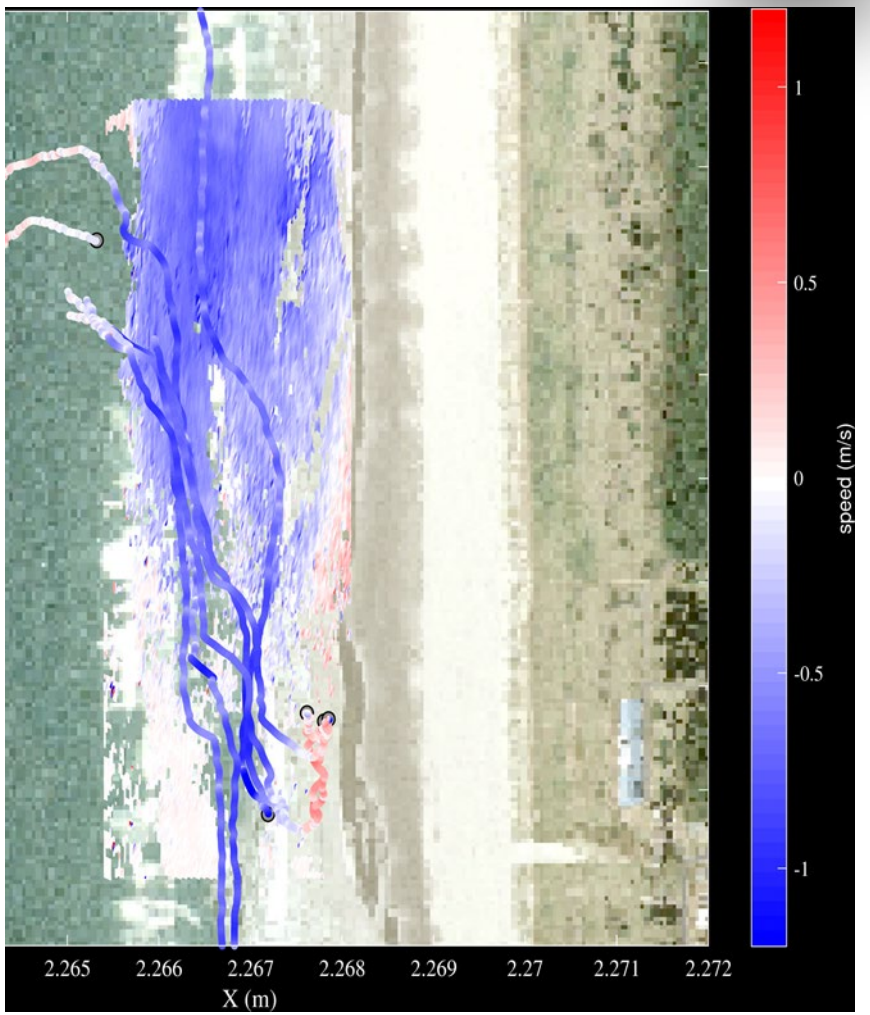


- DUNEX offers opportunity to leverage academic measurements, focused deployments



Leveraged Work

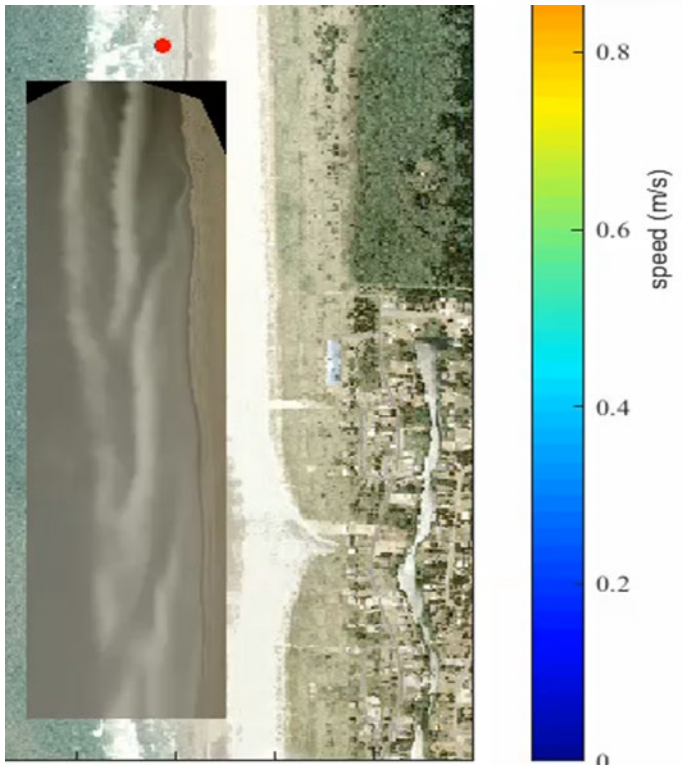
- **New Post doc with extensive experience measuring surfzone currents**
  - **Compared optical & drifter surface current measurements**
  - **Spatial variability in currents compare well**
  - **Drifters even capture flow reversal**
- **Dunex Pilot/Experiment deployment**
  - **Specific deployment**
  - **Collaborate with Moulton and Thompson**
  - **Evaluate & combine both methods for optical surface current measurements**



Summary

FY19 Accomplishments

- **CMS flow setup in CMTB -- small tweaks required to couple to waves (Technote submitted EOY)**
  - **Turn on morphology (EOY)**
- **Established a framework for automated evaluation of optical current measurements**
- **Developed a framework for shear stress balance model for estimating profiles with surface current measurement**



Where are we going?

- **Test evaluate coupled Wave-Flow**
  - **Potentially separate coupling allows for study of affects of different model predictions on nearshore currents using CMS-Flow**
- **Resolve coupling bug**
- **Technote documenting performance of morphology evolution**
- **Leverage DUNEX data collection to collect better data set for refining surface currents**