北米西海岸設置のウェブカメラによる漂着物挙動解析
Webcam monitoring of landed marine debris

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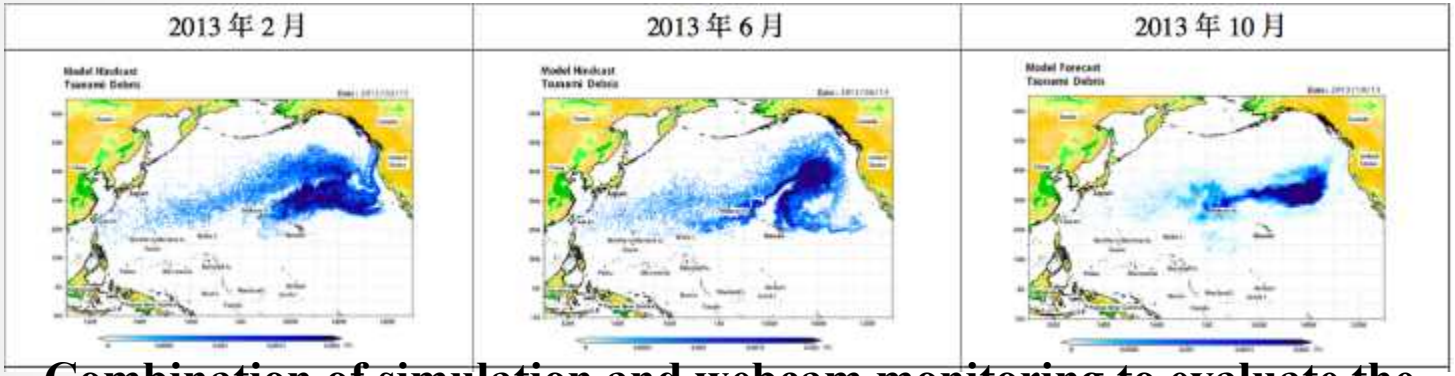
私たちの戦略
Our strategy

「震災漂着物が運ぶ外来生物は、北米ハワイの海洋・海岸生物に脅威となるか？」

そもそもinvasive species は震災漂着物でなくても運ばれるもの。震災漂着物由来に限定した環境影響評価ができるのか？

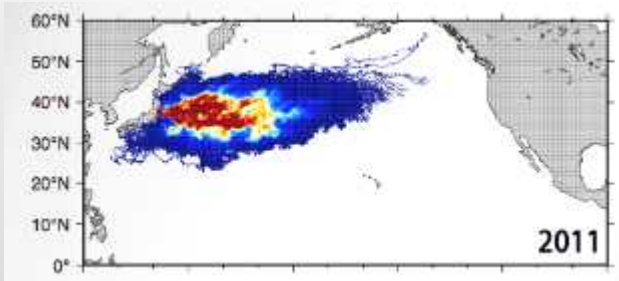
→ 震災漂着物の漂着場所や時期を特定することが重要

震災漂着物の漂流経路再現は、大気や海洋の同化プロダクト＋粒子追跡モデルで、そこそこいけるはず(下は震災直後に環境省が発表したもの[JAMSRTEC,気象研,京都大])。ただ海岸漂着までは解像できず(波浪や海浜流)、あくまで沖合漂流量の推定である。また再漂流も表現できず、漂着と再漂流を繰り返す海岸漂着量の評価は難しい。



Combination of simulation and webcam monitoring to evaluate the abundance of JTMD

大気や海洋の同化プロダクト＋粒子追跡モデル



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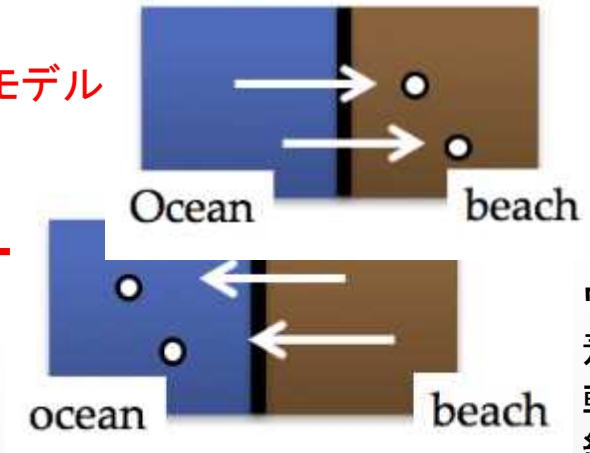
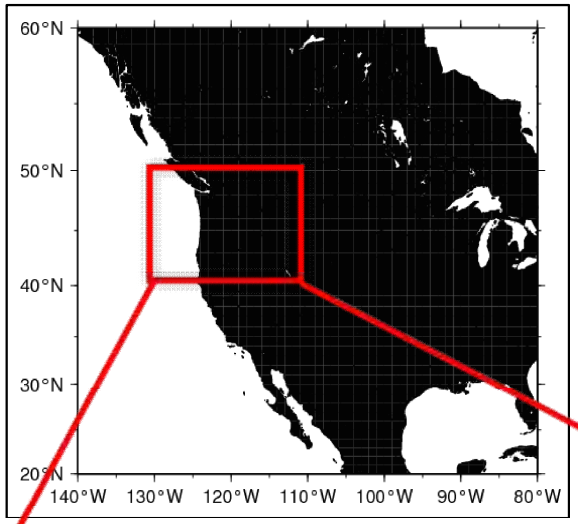


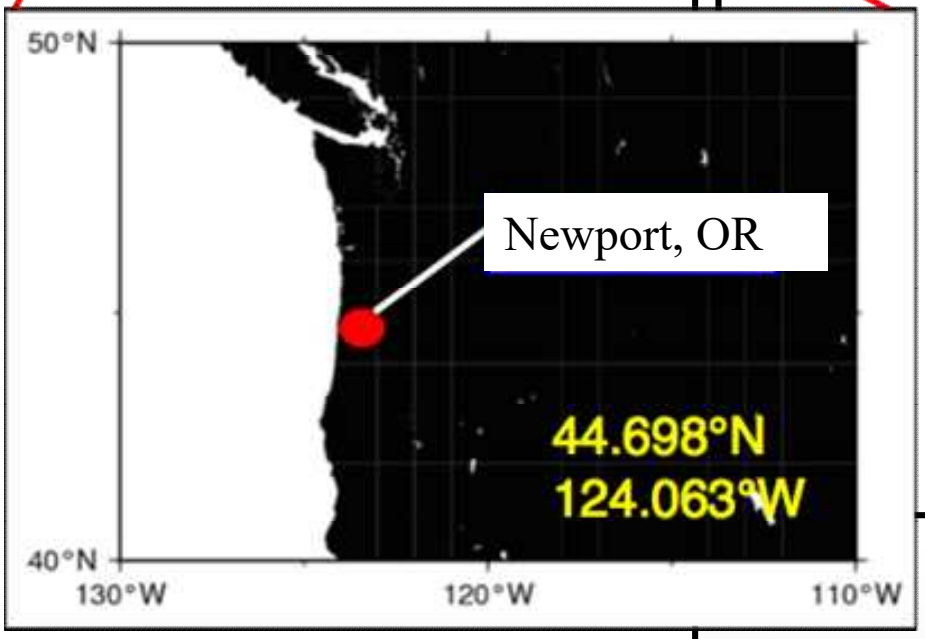
空撮画像(NOAA)によるモデルの妥当性評価

ウェブカメラで監視したゴミ漂着量と海況・風況データを比較しサブモデルを構築、これを組み合わせる。

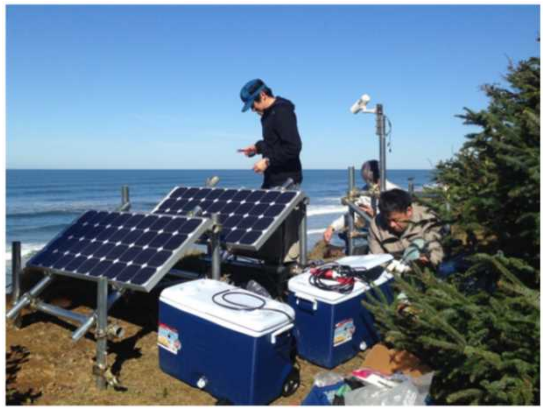
Webcam monitoring

location





specifications



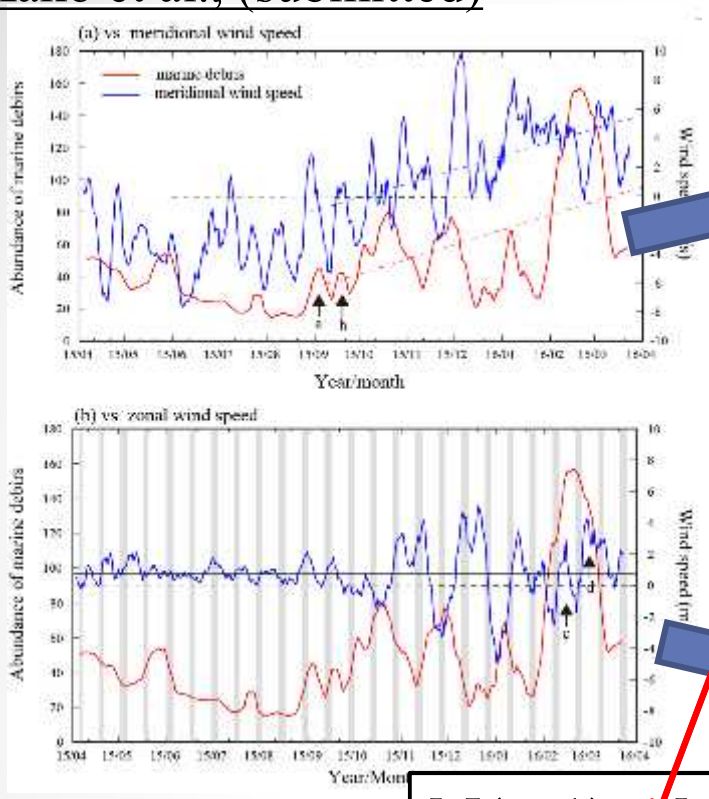
interval：
9:00~18:00 once at each hour

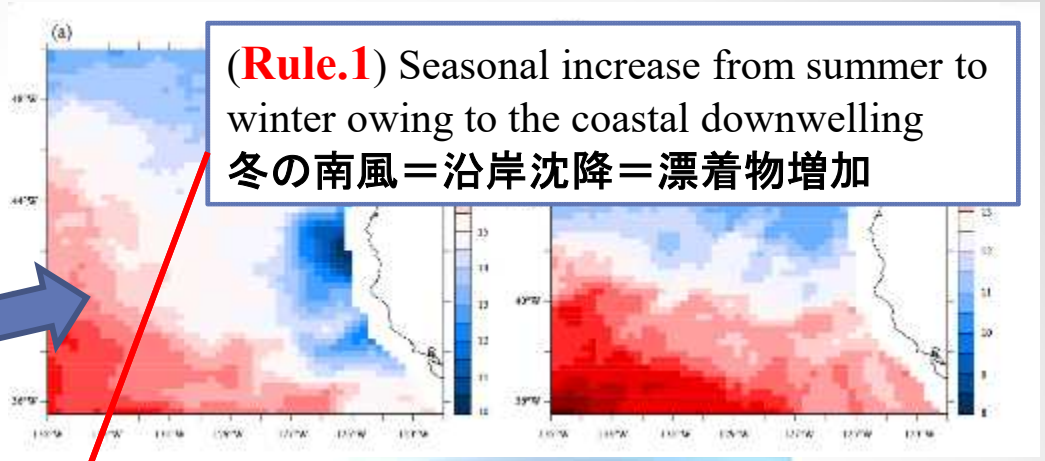
resolution：
1920 × 1080 pixels

period：
2015/Apr～on-going

Summary of webcam monitoring

Kako et al., (submitted)

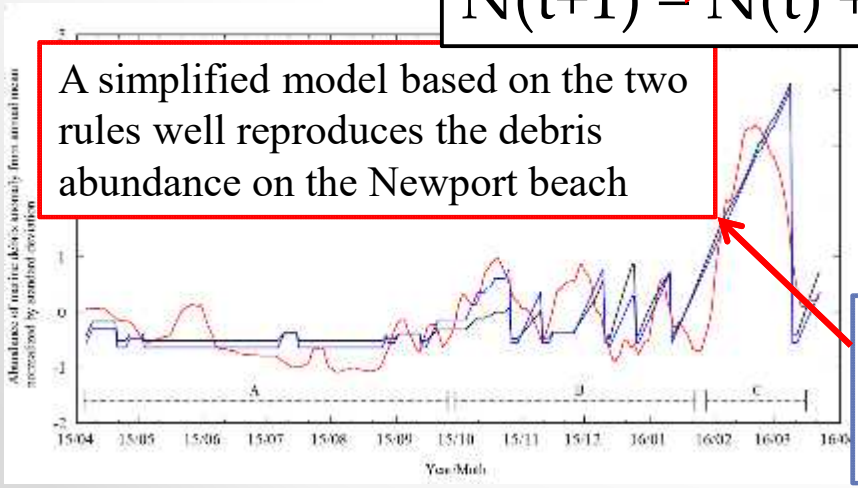




(**Rule.1**) Seasonal increase from summer to winter owing to the coastal downwelling
冬の南風＝沿岸沈降＝漂着物増加

$$N(t+1) = N(t) + \alpha R(t)$$

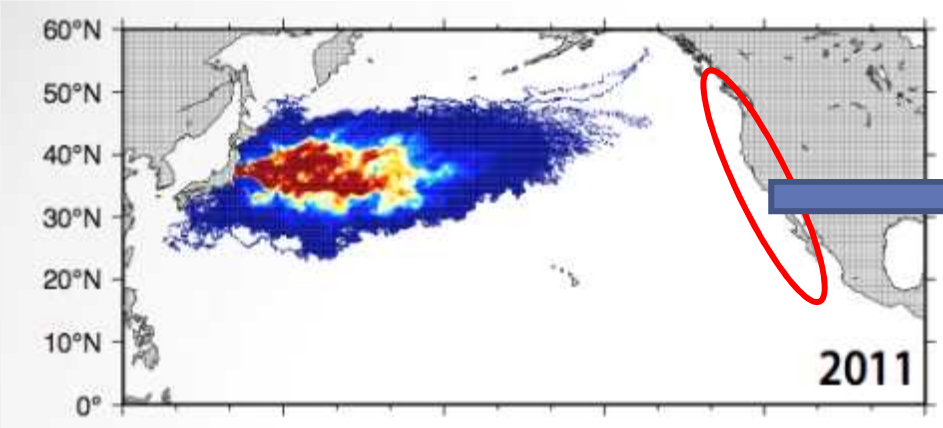
A simplified model based on the two rules well reproduces the debris abundance on the Newport beach



(**Rule.2**) Rapid decrease owing to the wind setup (at spring tides) during the westerly (onshore-ward) winds
大潮での向岸風＝潮位の増加＝再漂流

Model setup by a combination of a particle-tracking model and sub-model

Particle-tracking model using an ocean re-analysis data and satellite wind to reproduce the debris motion in the ocean



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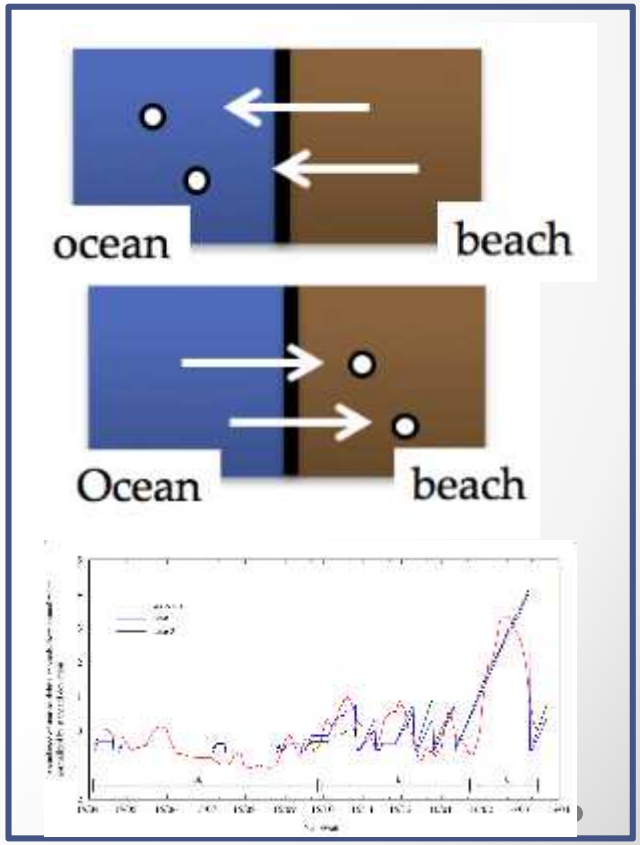
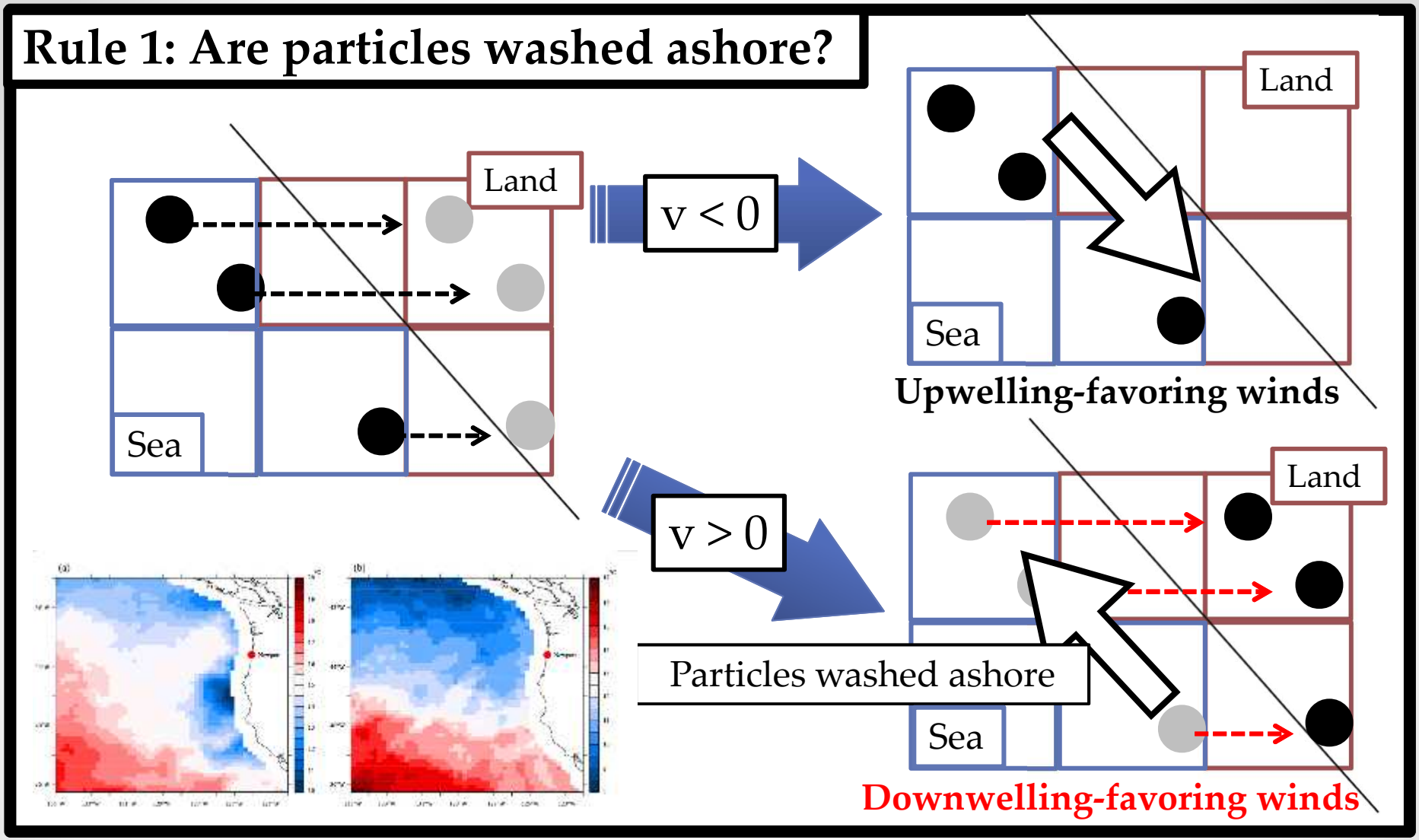
Sub-model based on the two rules associated with satellite winds at the nearest grid cell to reproduce the debris washing ashore and re-drifting (nearshore processes).



Objective of the present study

>>To estimate the abundance of tsunami debris washed ashore on the western coasts of US and Canada?

>>To find the beaches on which the massive amount of tsunami debris has been washed ashore (→ "hazard map" of invasive species)



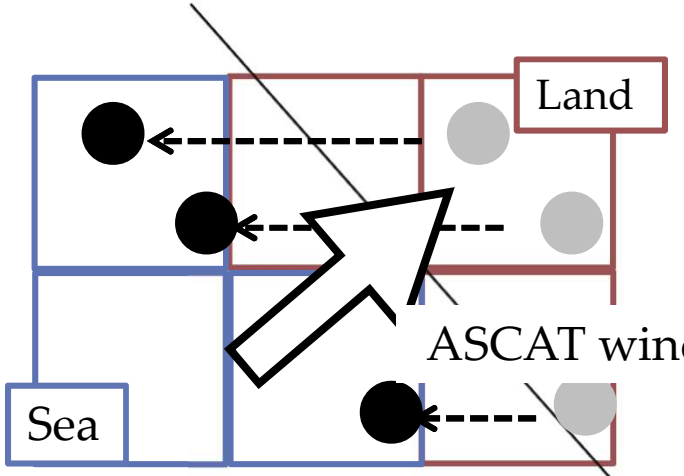
サブモデル

沿岸沈降を起こす南風の際に、岸に近づく仮想粒子を漂着させる

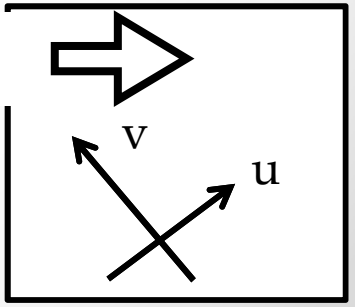
サブモデル
岸向きの風が強い大潮時に、岸に漂着した仮想粒子を海に戻す

When intense **onshore-ward winds** (> average + SDV) occurred at **spring tides** (i.e., the occurrence of the **wind setup**), all debris "littered" on land cells returns to the oceanic cells.

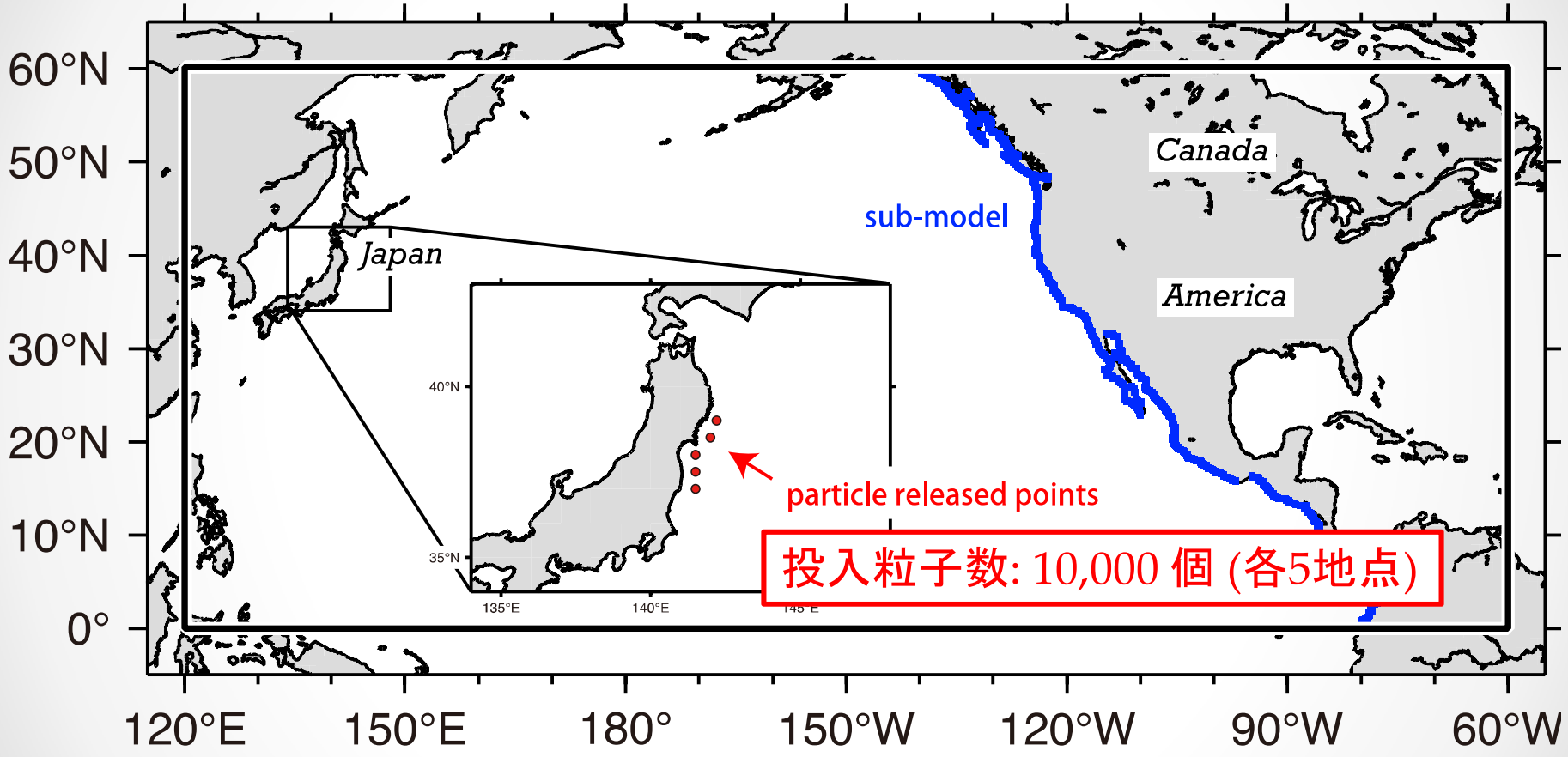
Rule. 2: re-drifting ?



ASCAT winds at the nearest grid cell



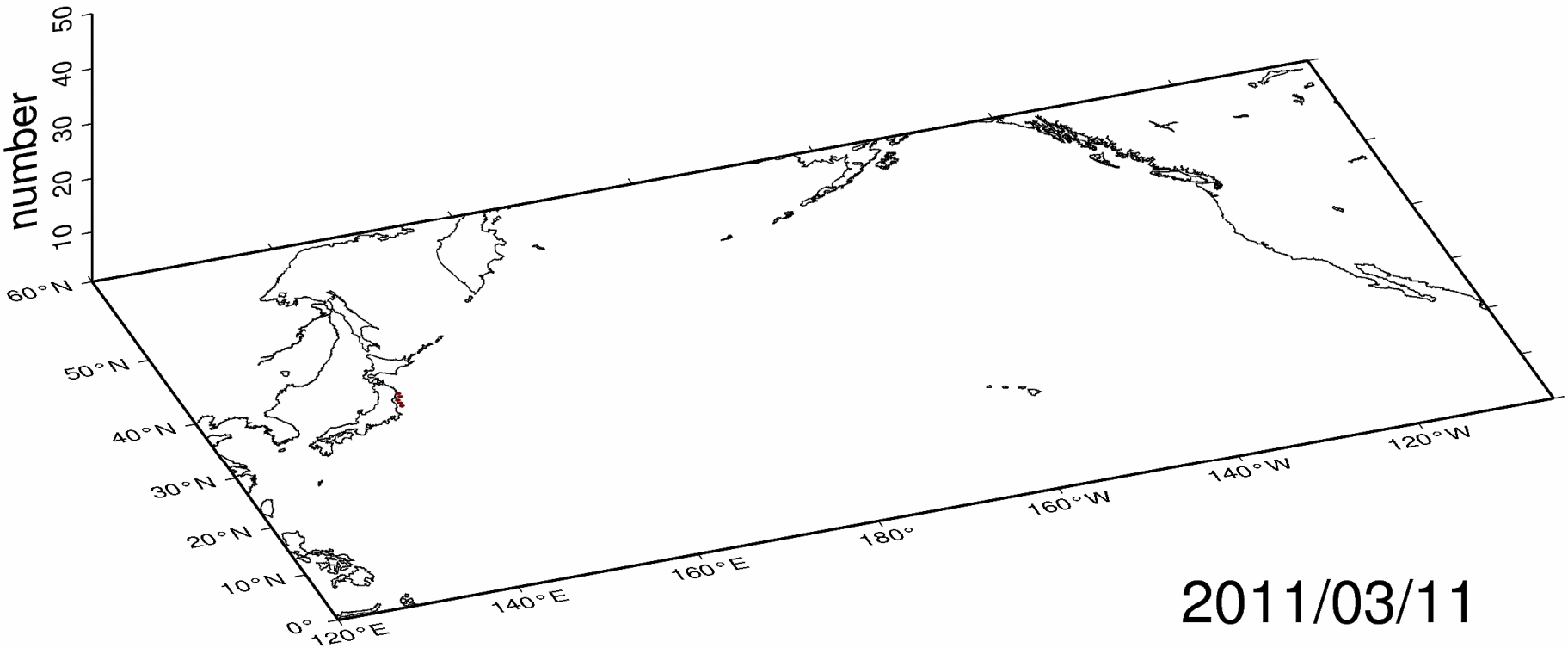
モデル領域 (0°-60°N, 120°E-60°W)



計算期間: 2011/03/11-2016/12/31

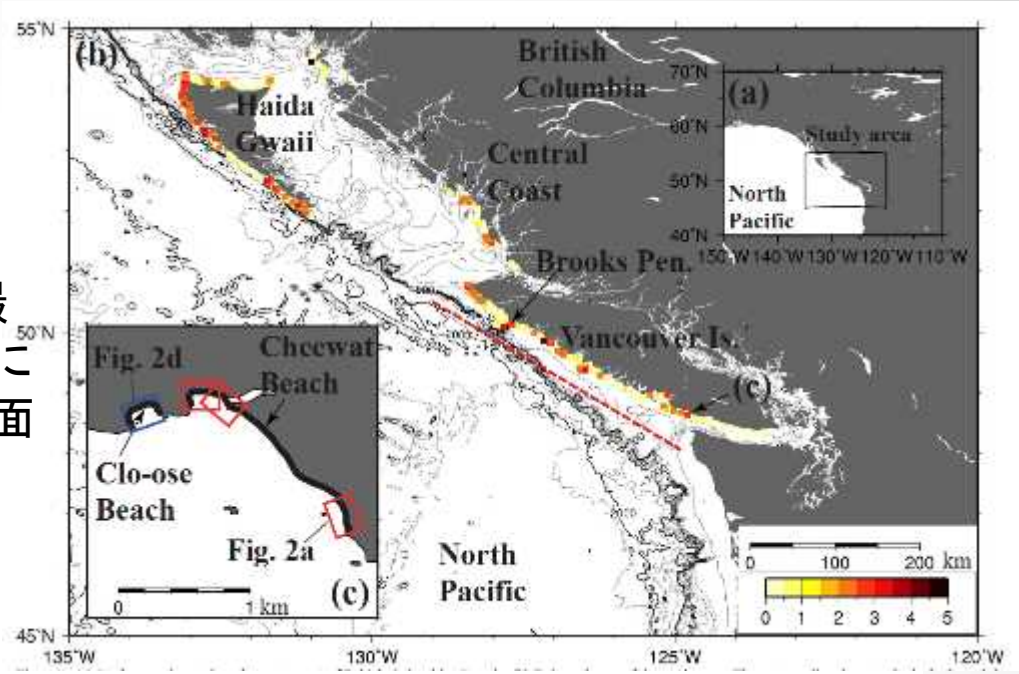
実験のアニメーション　(2013/01/01-2016/12/31)

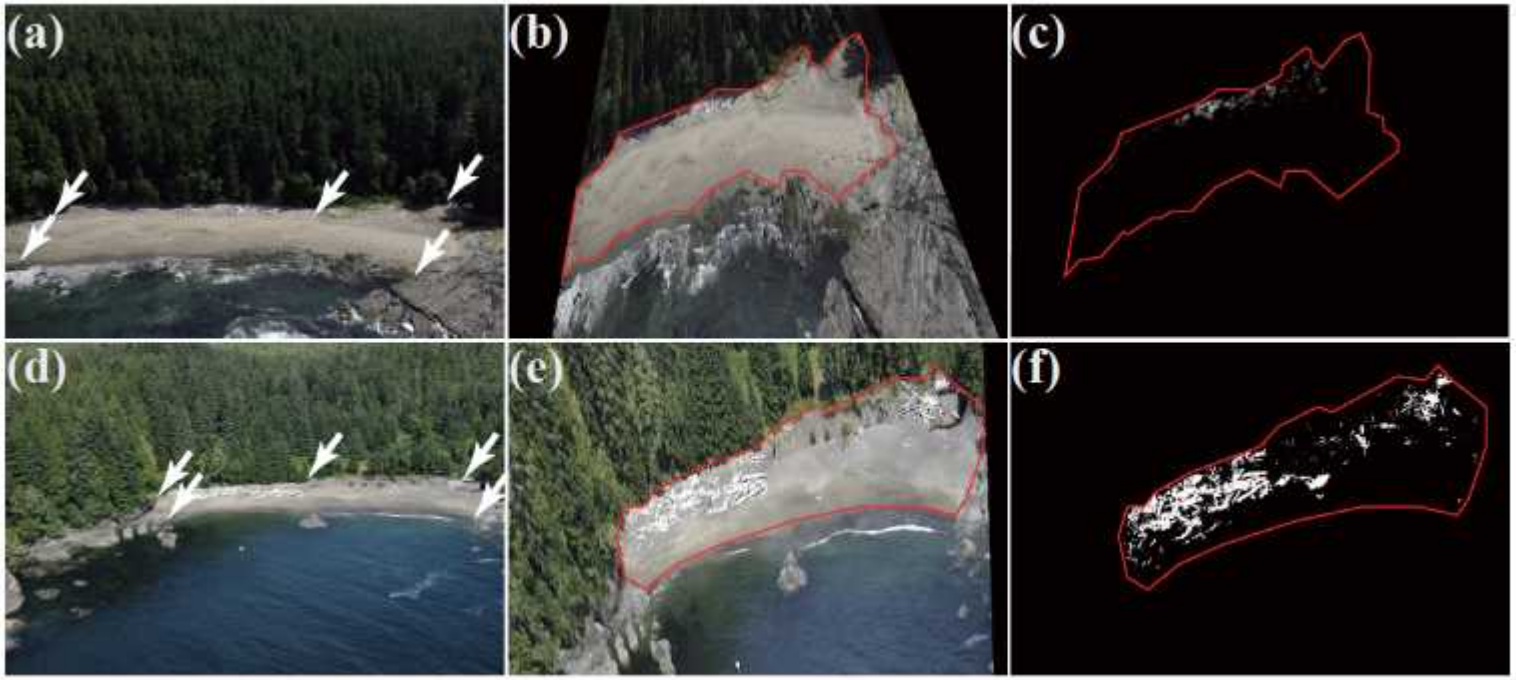
10日毎



Model validation with aerial photography using a Cessna plane

Kataoka et al. (submitted)
北米西海岸のセスナ機による海岸空撮写真を射影変換処理してデカルト座標に落とし込み、漂流物の被覆面積と海岸面積の比を求めた。Using the aerial photographs, we computed the ratio between areas of beach litter and beaches





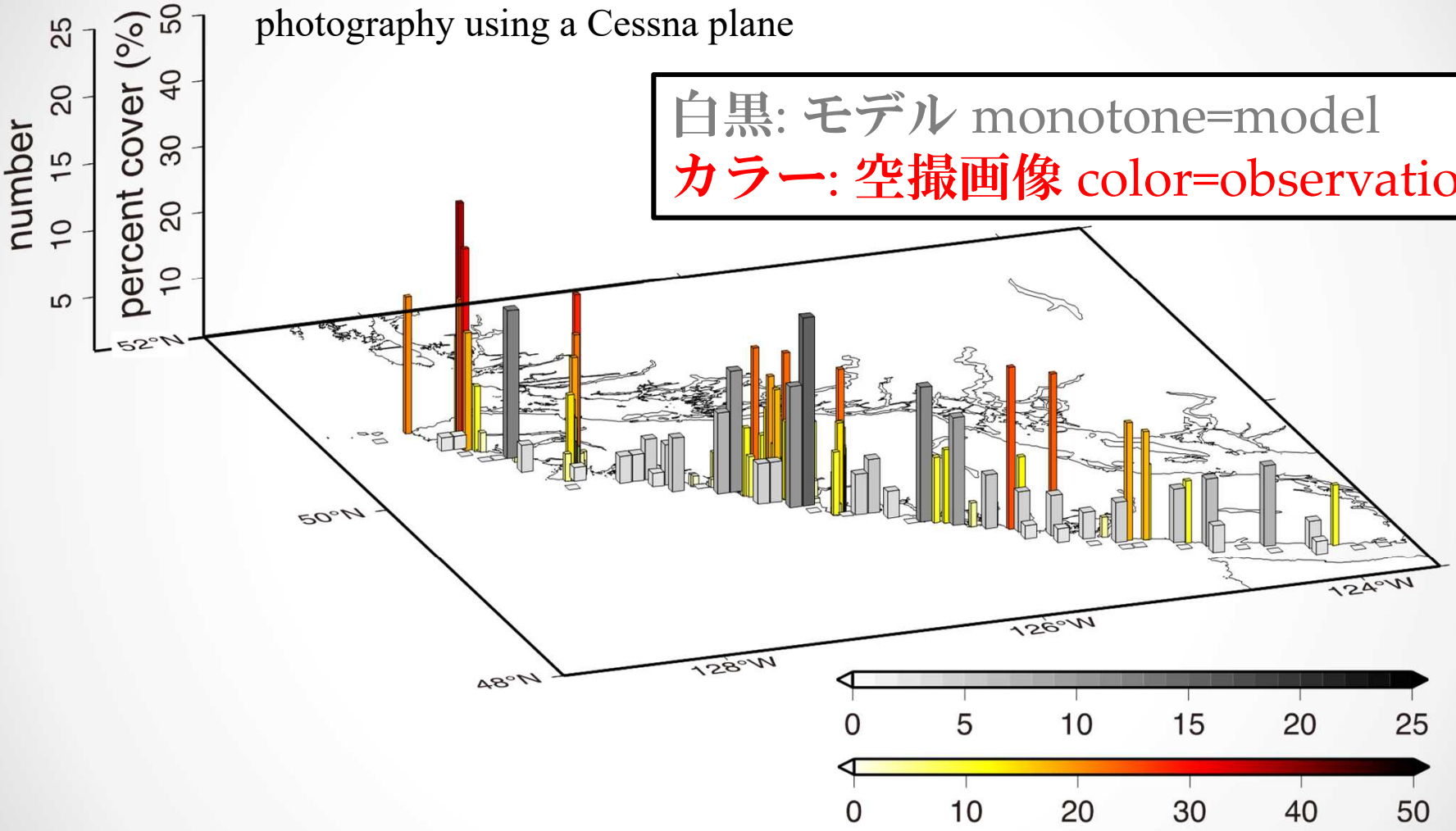
観測データとの比較

2014/10/7, 2014/12/3

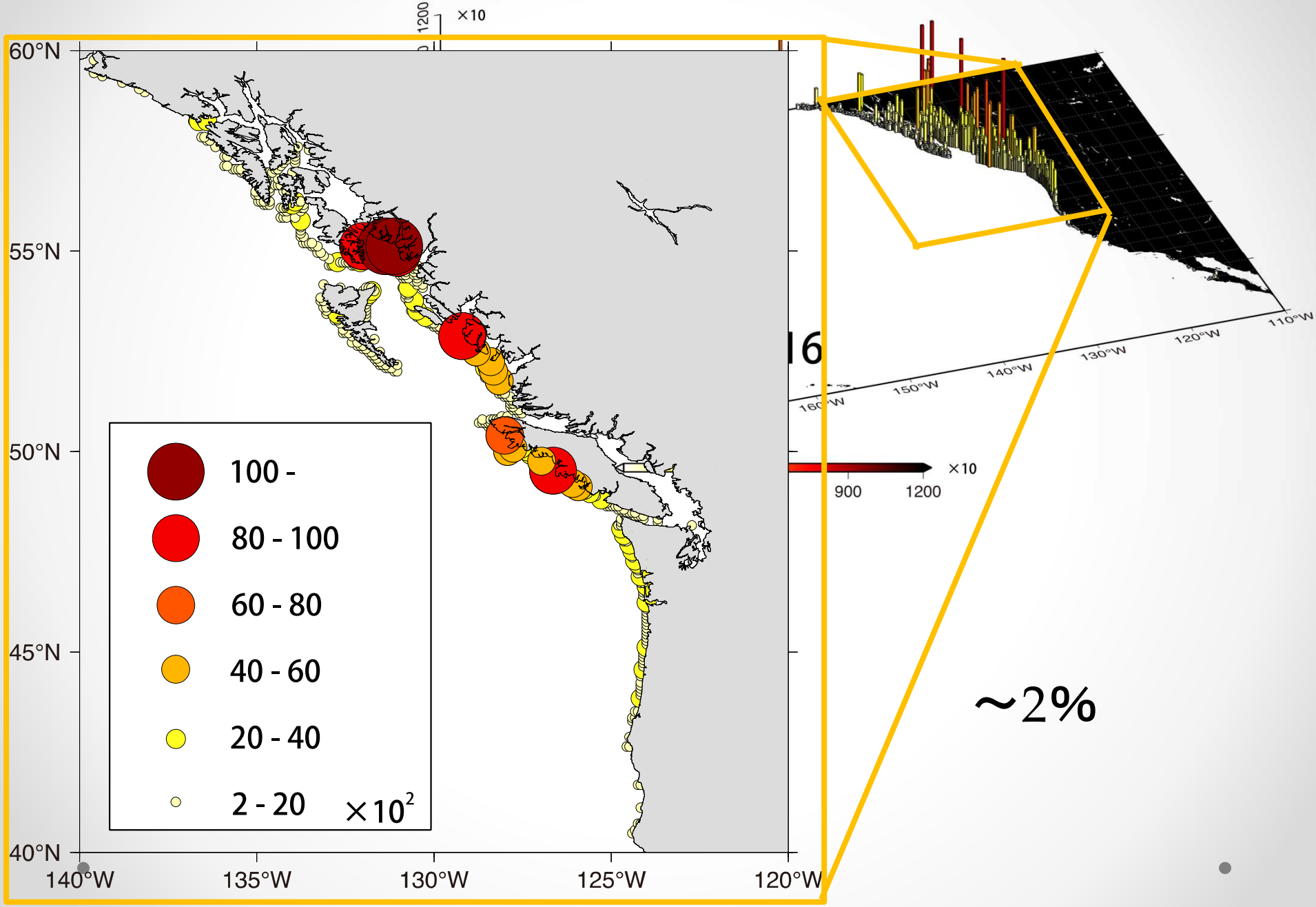
Model validation with aerial photography using a Cessna plane

白黒: モデル monotone=model

カラー: 空撮画像 color=observation



累積漂着数 (2011/03/11-2016/12/31)



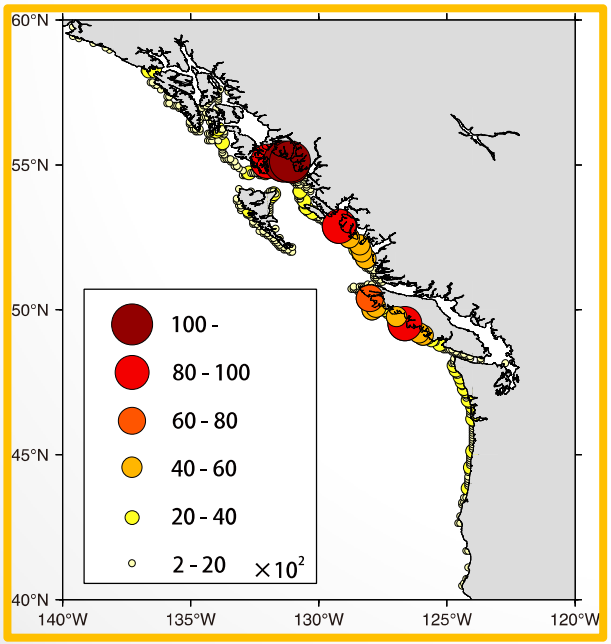
~2%

Conclusions

- A webcam-based sub-model was combined with a particle tracking model to estimate the abundance of 3.11 tsunami debris washed ashore on the US and Canadian beaches.

- In total, 30,000 tons (2%) of debris potentially exist on the beaches at the present time.

- The model result states that the invasive spices carried by tsunami debris were unlikely to wash ashore widely on the entire US and Canadian beaches. They have been washed ashore on the relatively narrow area (<1000 km) around the south of BC and the north of WA, which might act as a "gate" of the invasive spices carried by the tsunami debris.



震災漂流物のうち2%程度が、米国とカナダの国境1000km程度の海岸に集中して漂着したことが示唆された。この場所で日本原産の「外来種」が多く確認されるならば、それは震災漂流物が運んだ可能性が高い。