Lagrangian Paths in OSCAR Surface Currents

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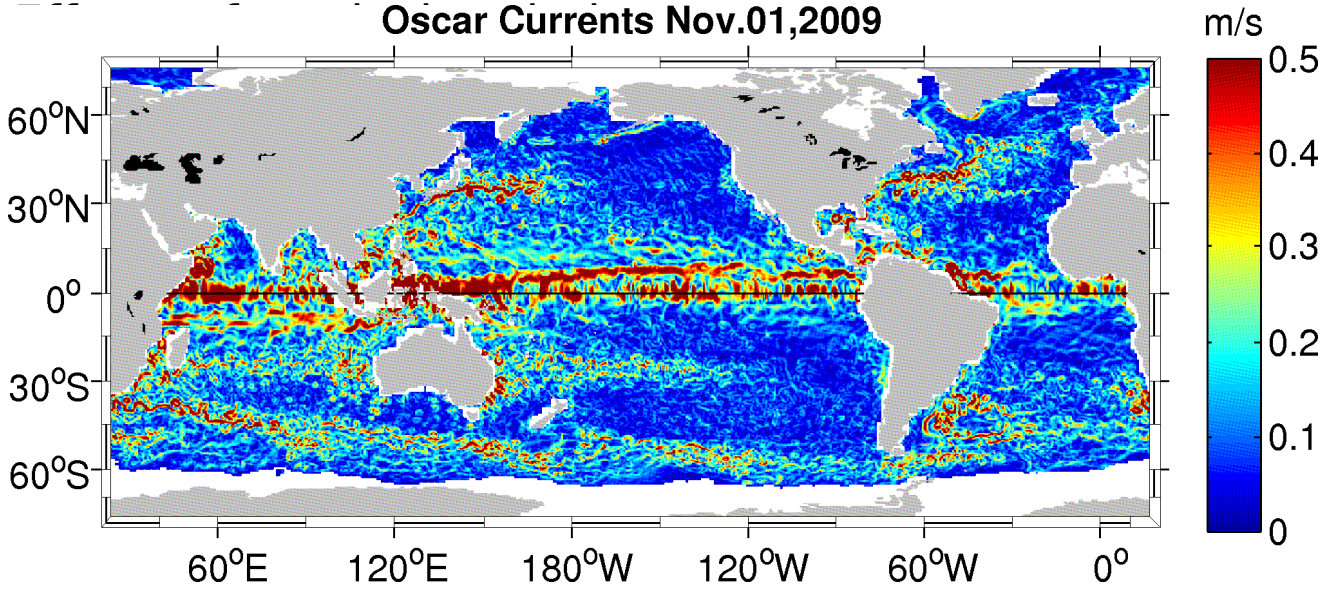
OSCAR surface currents

- Ocean Surface Currents Analyses-Realtime processing system (OSCAR) is a satellite-derived surface current database provided in near-real time.
  - geostrophic term is computed from the gradient of ocean surface topography fields (AVISO/CLS)
  - wind-driven velocity components are computed from an Ekman/Stommel formulation with variable eddy viscosity using QuikSCAT vector winds (FSU/COAPS) and NCEP winds
  - thermal wind adjustment using Reynolds OI SST data.
  - Source data is continually updated.
- Data is available at http://podaac.jpl.nasa.gov and http://www.oscar.noaa.gov.
- Areas of development:
  - Time-dependent wind-driven dynamics
  - Turbulent mixing scheme
  - Vertical variation
  - Coastal areas

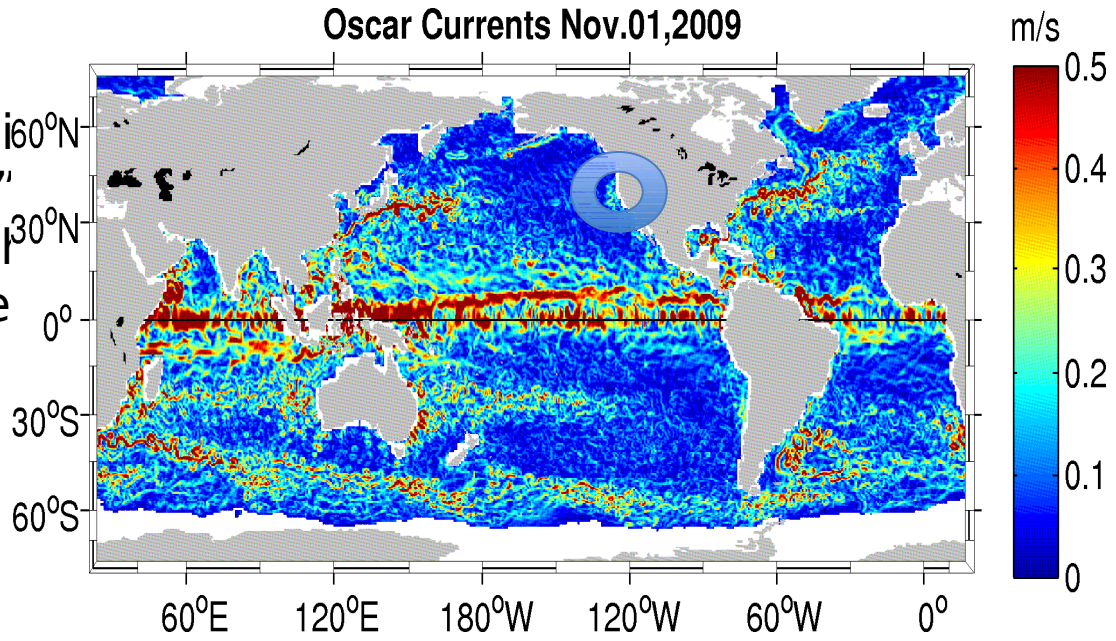
OSCAR surface currents

- OSCAR surface currents (Ocean Surface Current Analyses-Realtime) are global ocean surface velocities calculated from satellite-sensed SSH, wind, and SST (SSS).
- The dataset is produced on a 5-day timebase, on a 1/3 degree regular grid.
- Here:
  - OSCAR currents in the convergent zones
  - How best to describe the convergent zones?
  - Eulerian vs Lagrangian views
    - Compare with drifters



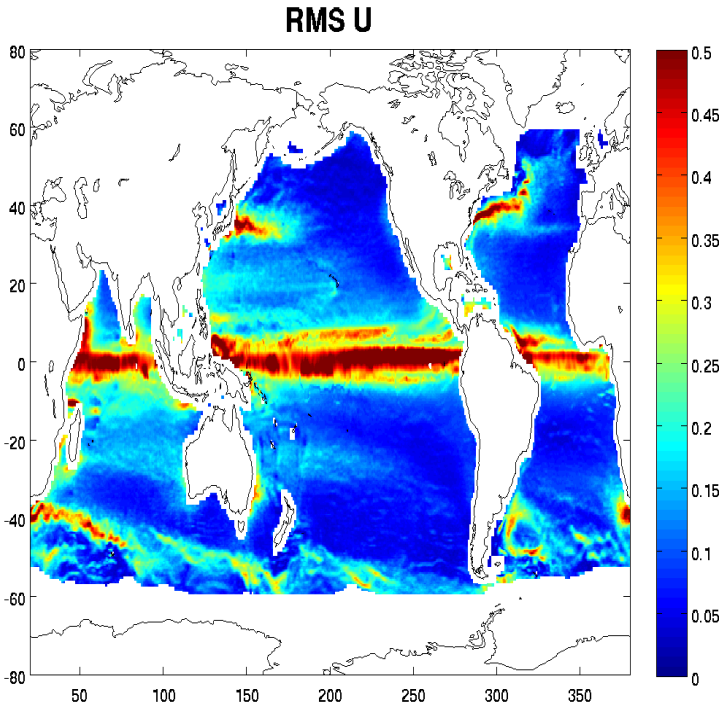
Motivation

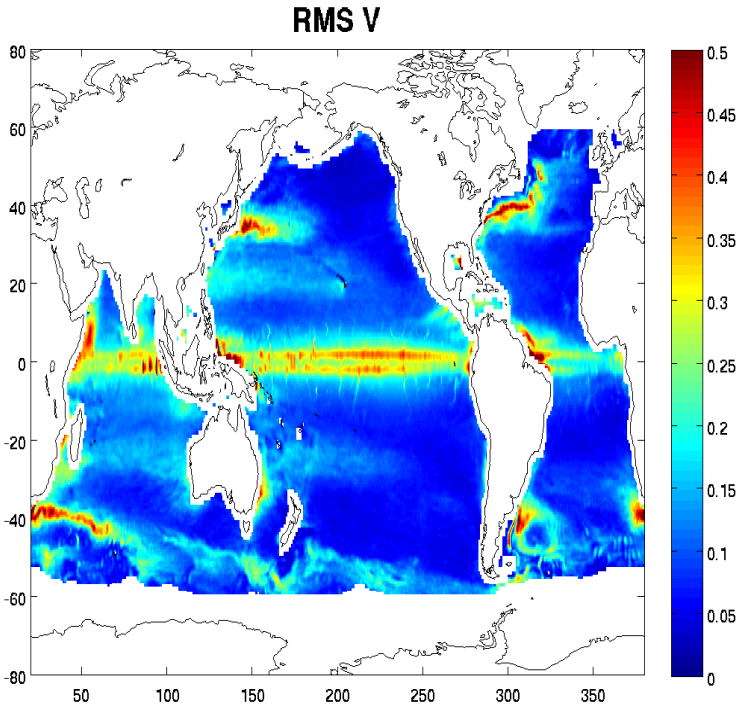
- OSCAR surface currents from satellite measurements
  - 1/3o regular gridding, 5-day timebase, NRT
  - Eulerian
- Global validation with drifters
  - Lagrangian
- Convergent zones in basi
  - “Pacific Trash Vortex”
  - “Great Garbage Patch”
  - How best to describe and analyze
- Issues
  - Small-scale
  - Fast timescales
  - Coastal
  - Vertical variation



Eulerian Viewpoint

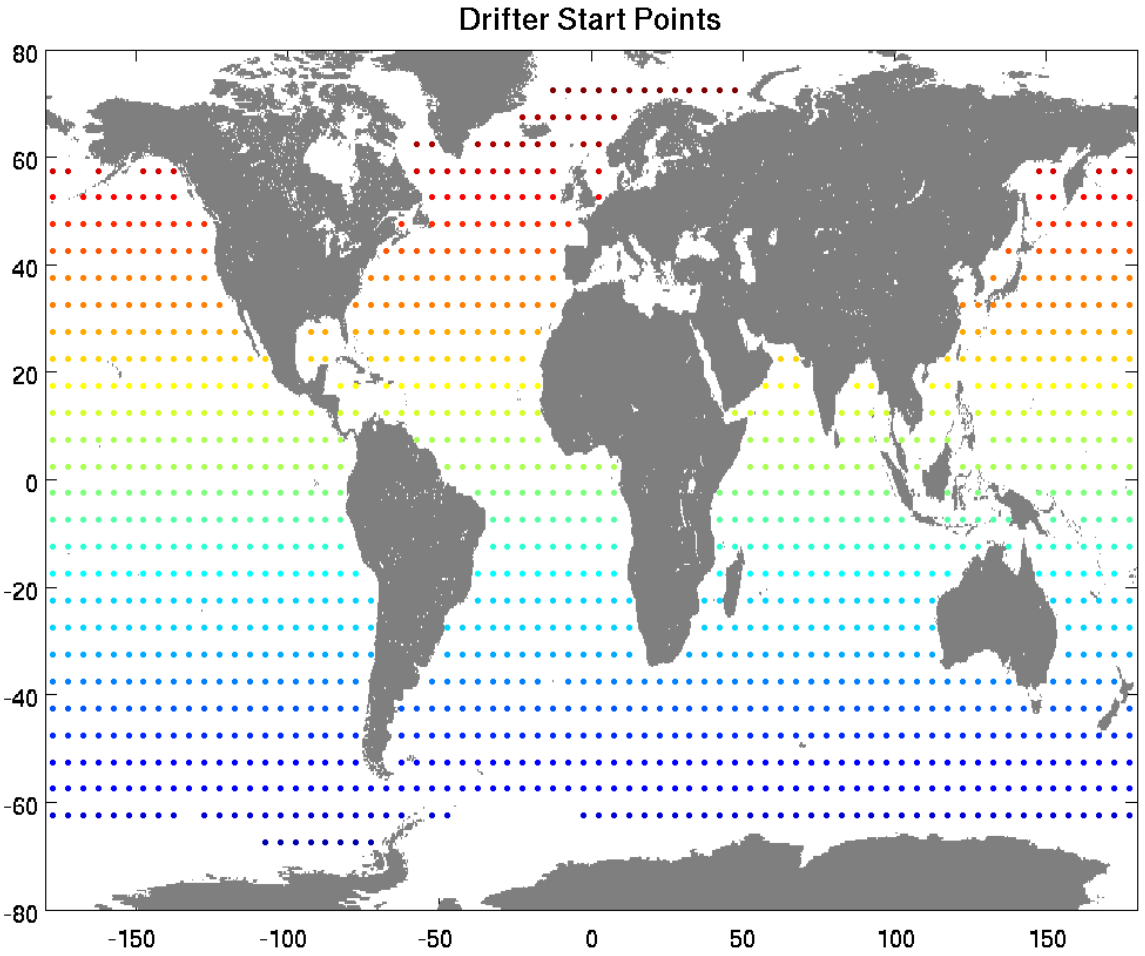
- Regular grid in time and space
- EKE plots, transport into regions, timeseries
- Regularly compare OSCAR with drifting buoy velocities from drifter paths





Lagrangian approach: Particles in OSCAR

- Simple advection of initial seeding of “drifters” by interpolated currents



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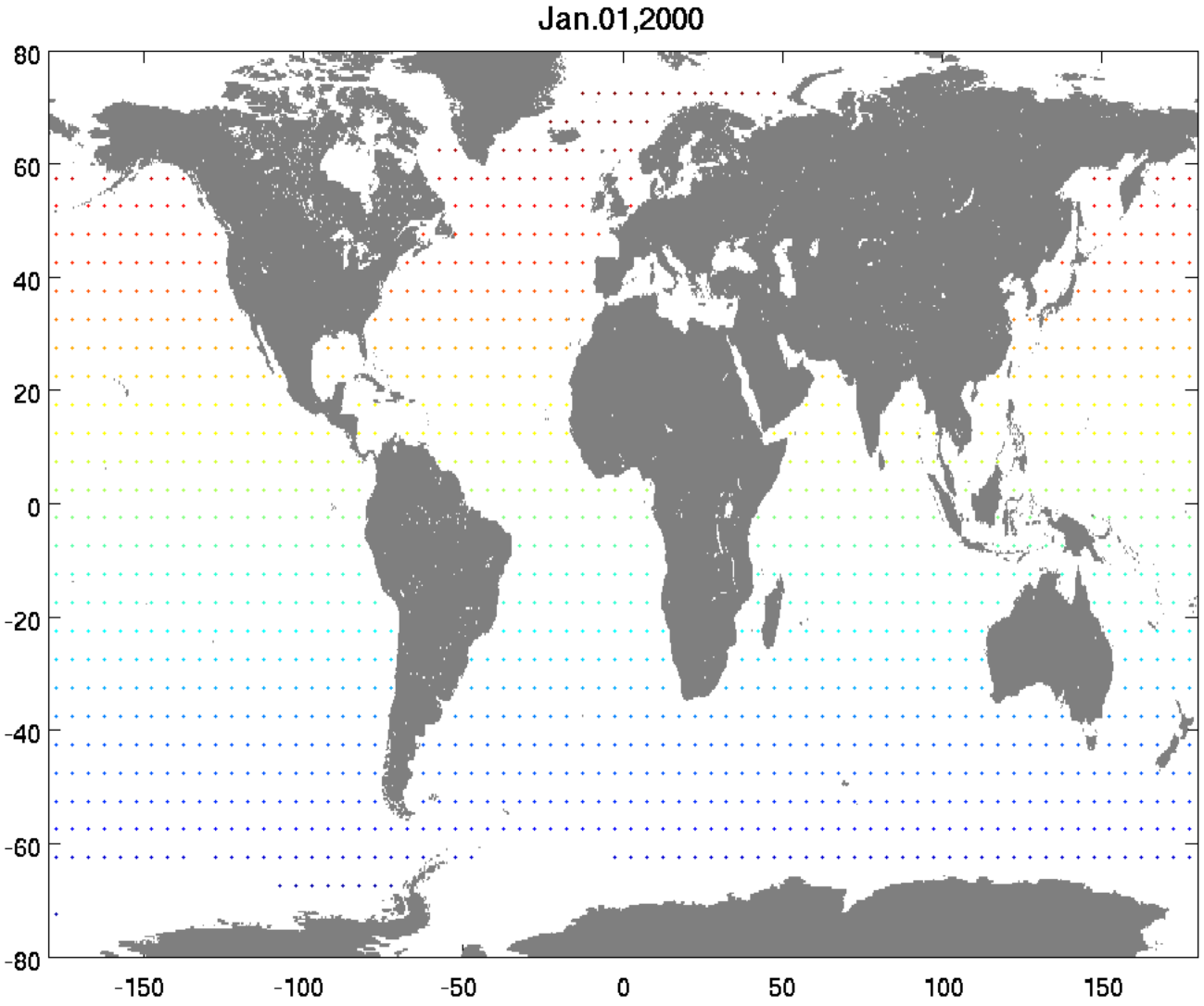
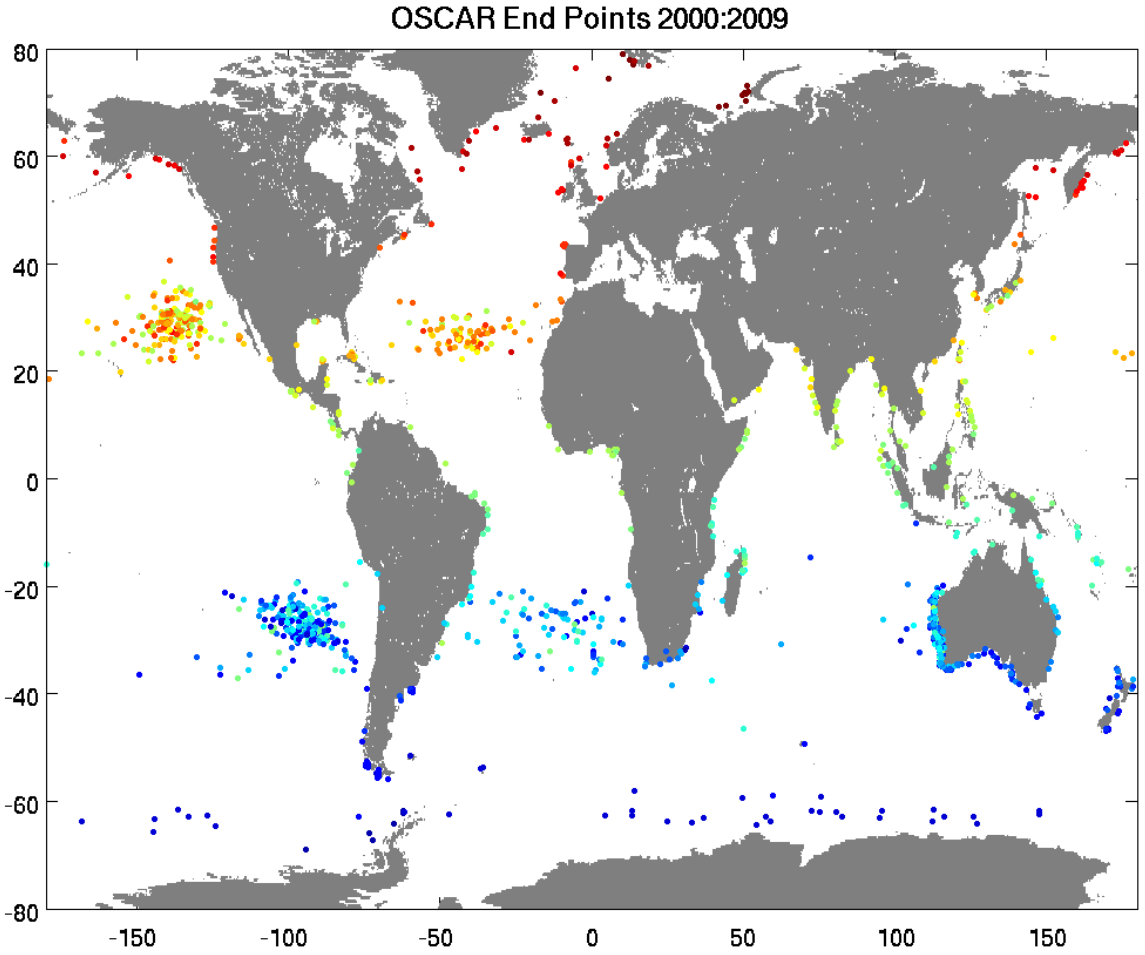


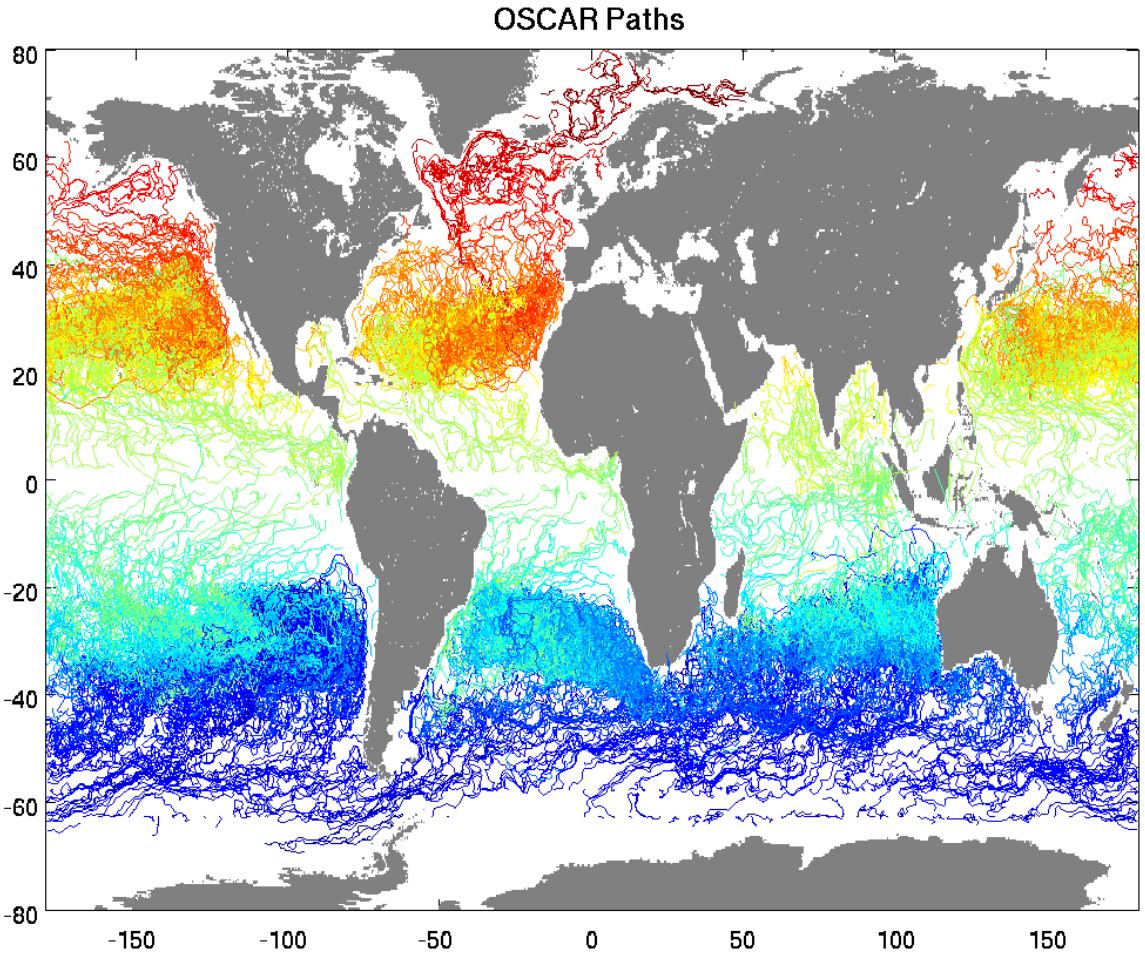
Particles in OSCAR

- Final positions after running from 2000 to end of 2009
- Stop when drifters approach coasts (NaN velocities)



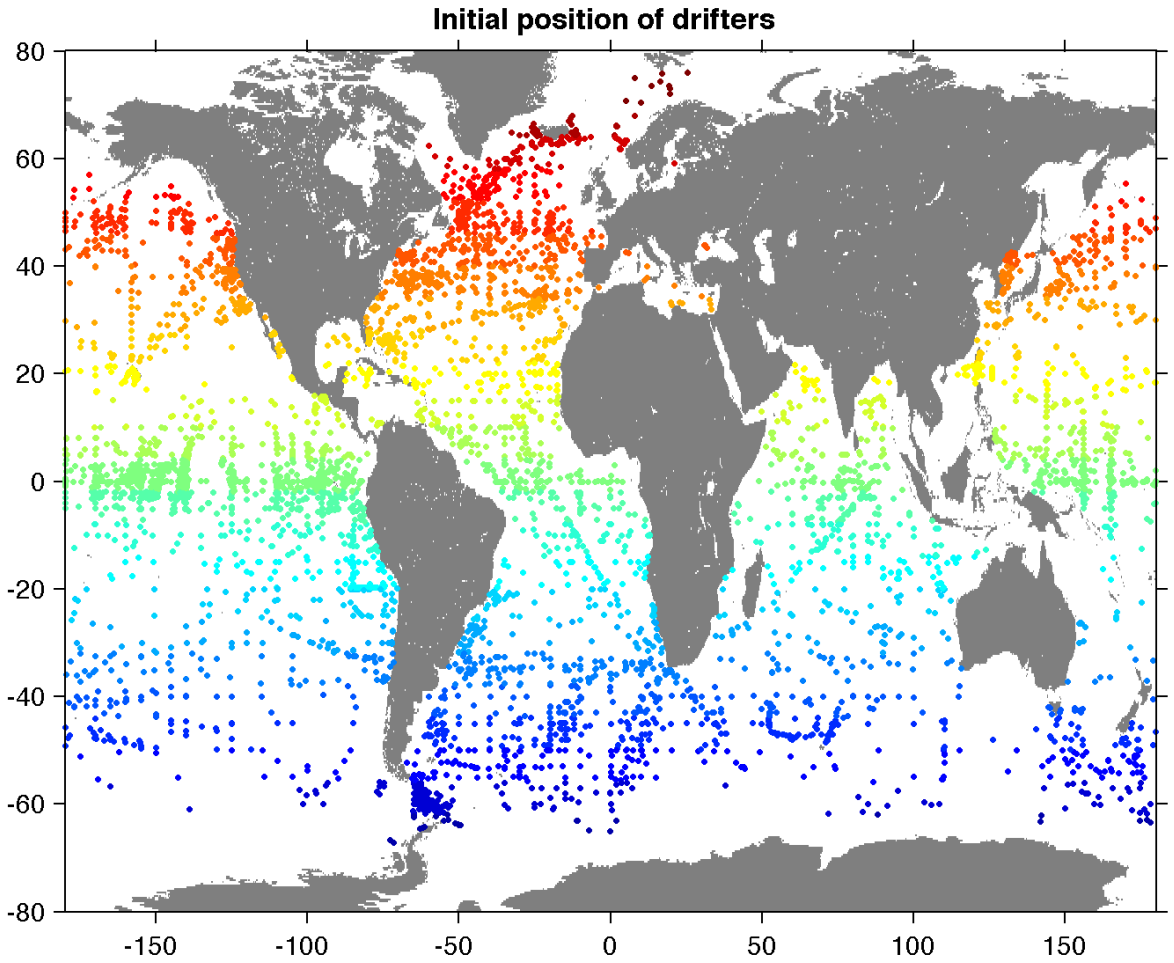
Particles in OSCAR

- Drifter paths, color coded by initial position



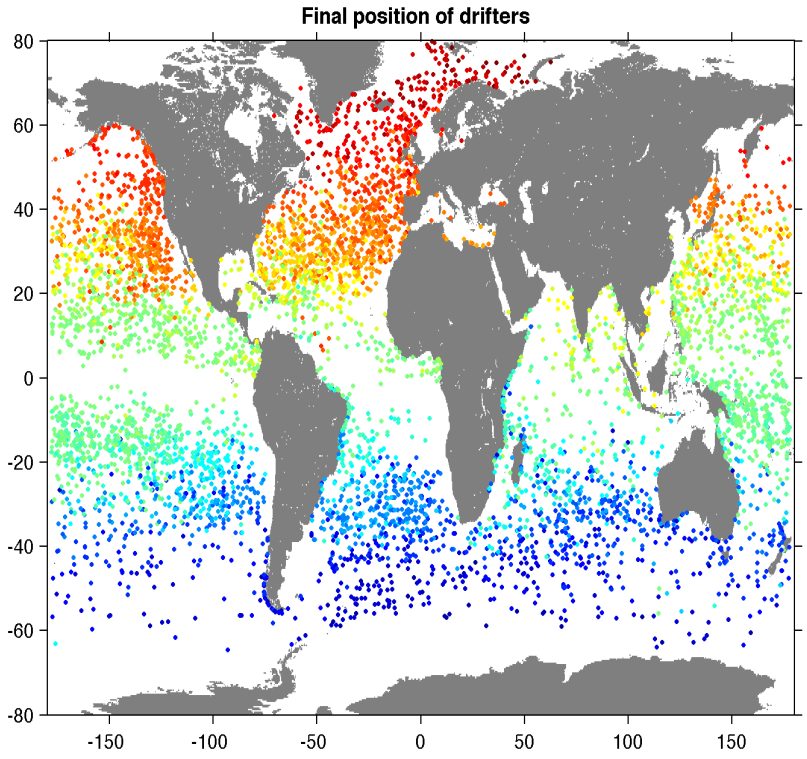
Compare with AOML drifters

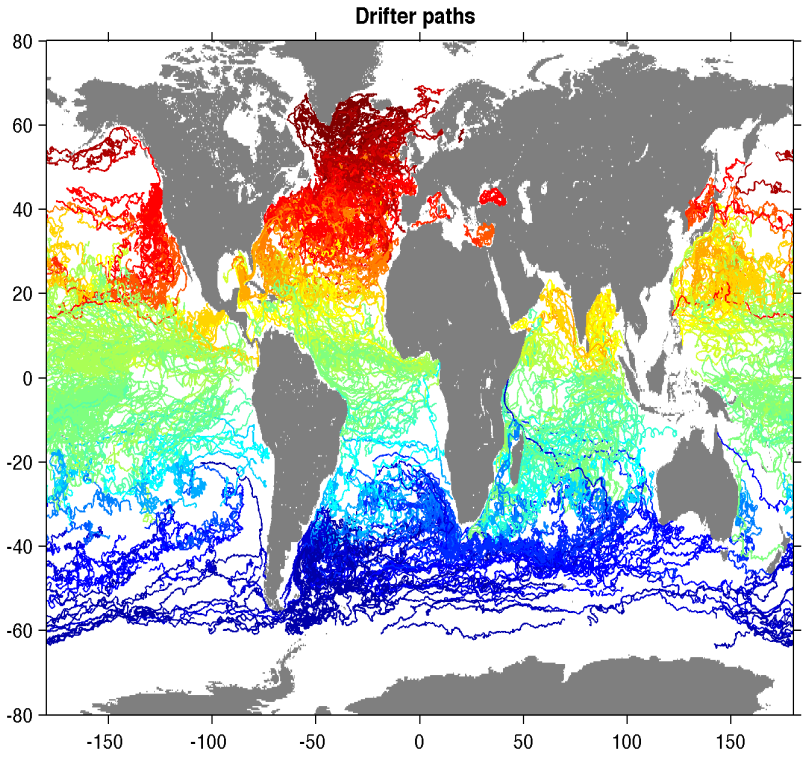
- Initial position of drifter array



Compare with AOML drifters

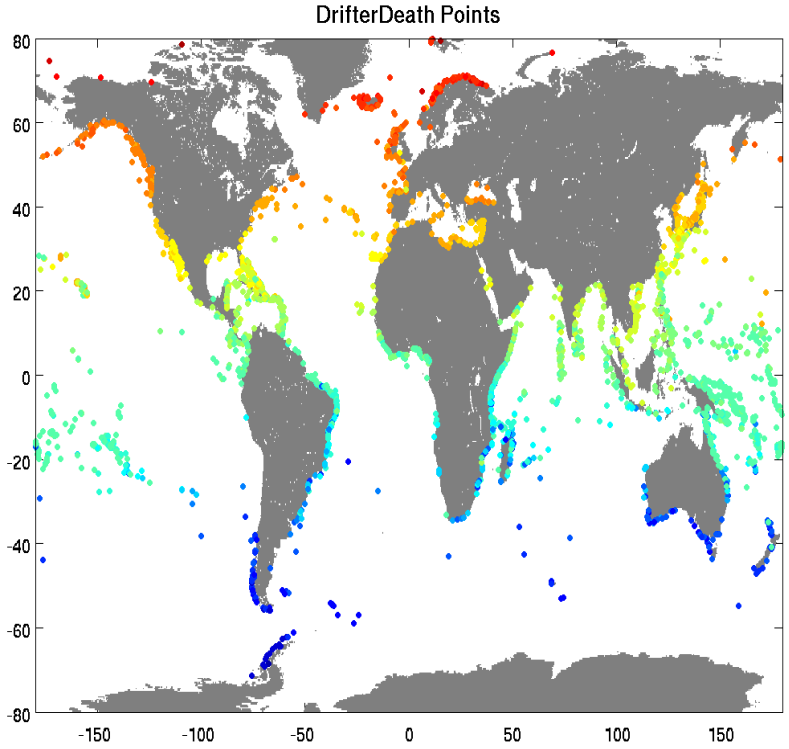
- Final position of drifter array
- Function of seeding positions and times

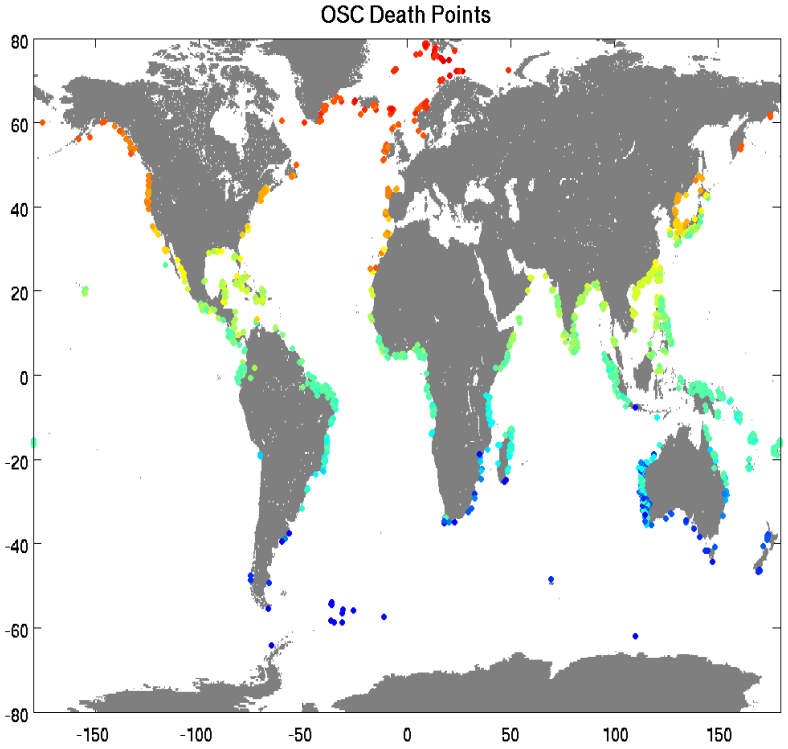




Compare with AOML drifters: Drifters which have hit land

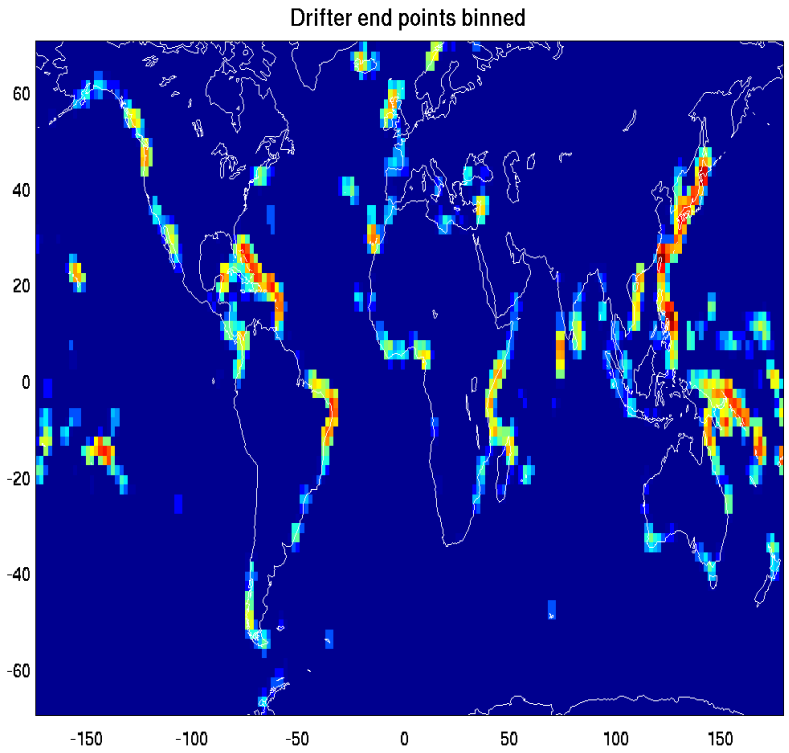
- All drifters that have landed, courtesy of Rick Lumpkin AOML
- OSCAR end points after 10 years

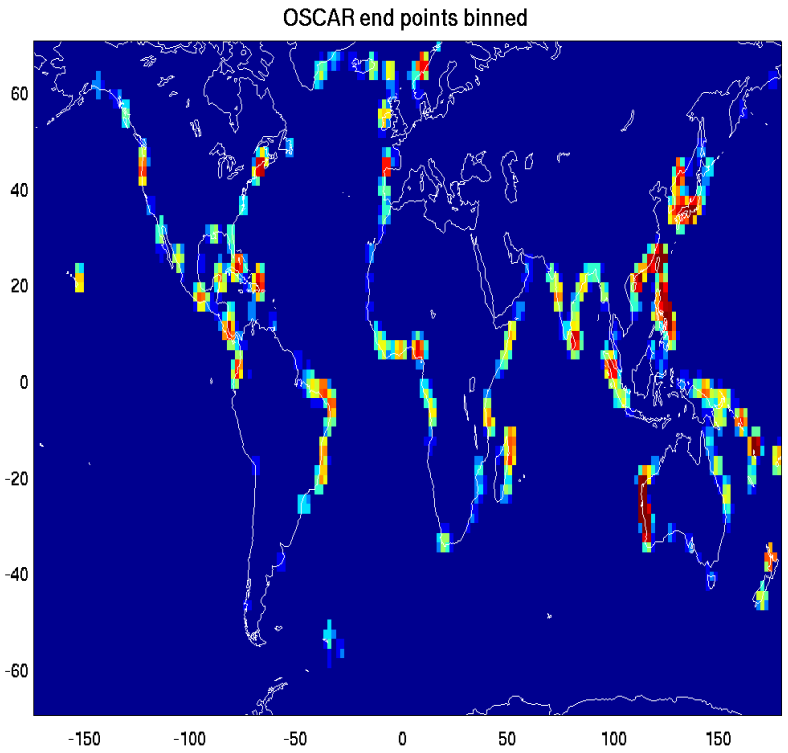




Compare with AOML drifters

- Amount of time drifter tracks are in bins

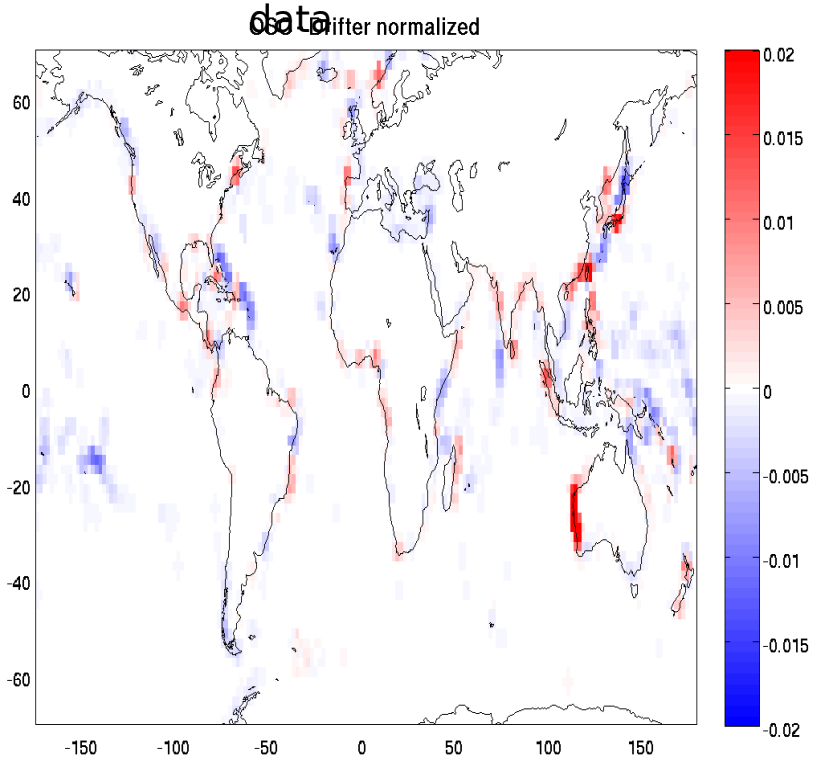




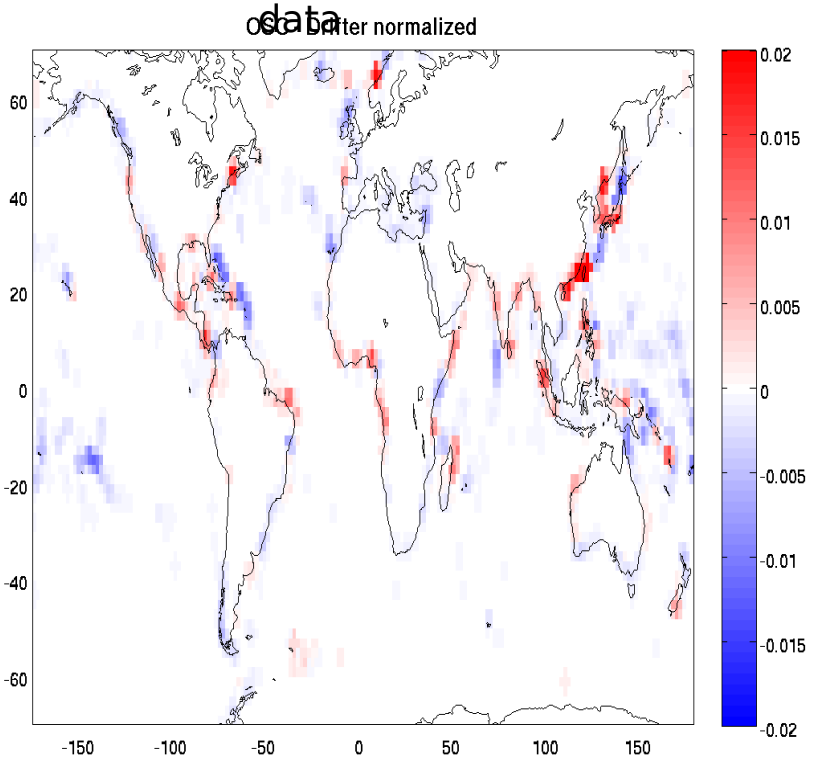
Compare with AOML drifters

- Amount of time drifter tracks are in bins

10 yrs of data



2 yrs of data



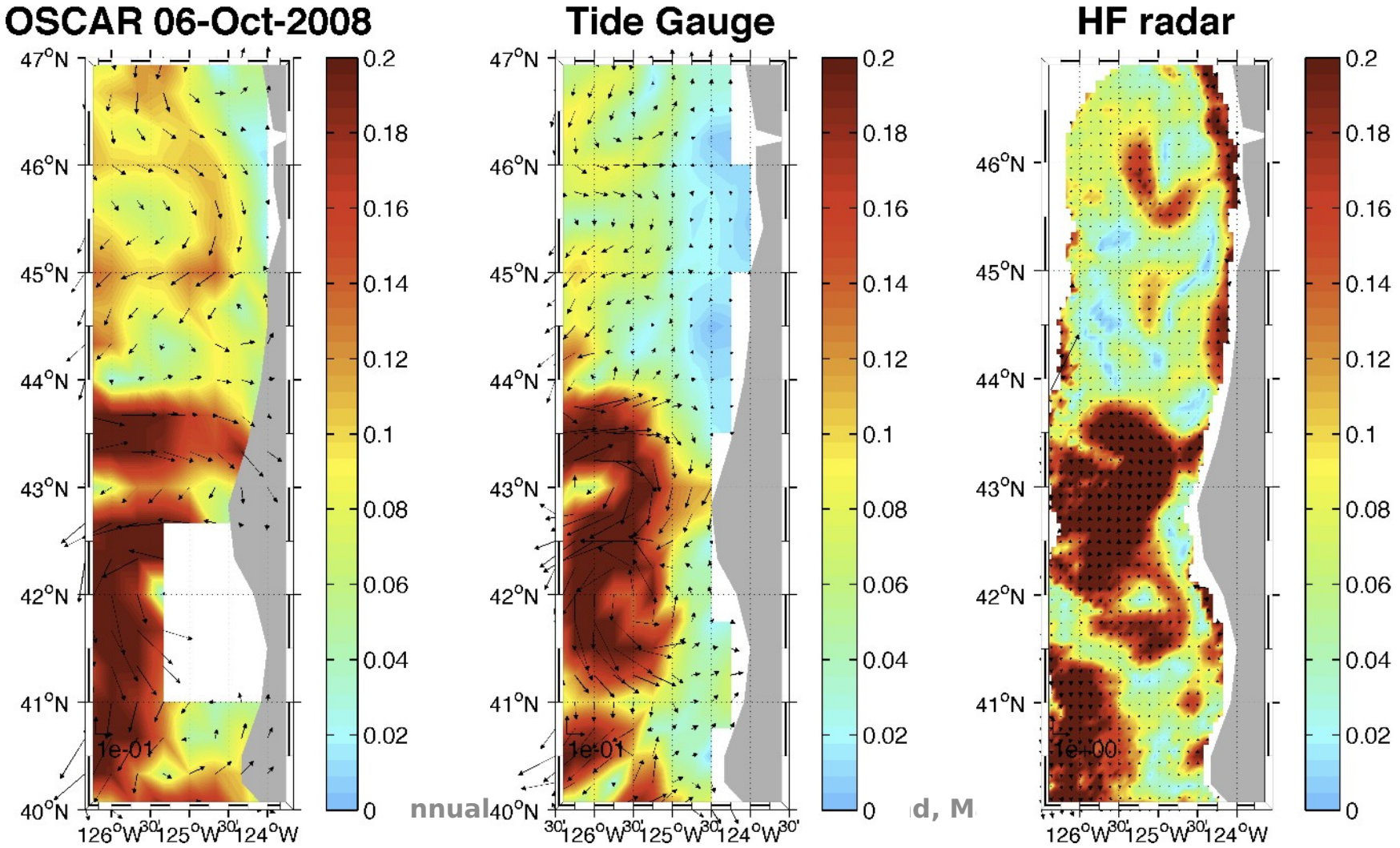
Future Development Along Coasts

Explore the possibility of extending OSCAR closer to the coast. Work with OSU group: Ted Strub, Mike Kosro, Craig Risien, Corrine James to develop methods for OSCAR, starting with the area off of Oregon.

- **Use of tide gauges**
  - Craig Risien's geostrophic velocities calculated along the US West Coast, following method of Saraceno, Strub and Kosro JGR 2008, where the near-coast altimeter data is removed and replaced by interpolation to tide gauge SSH data. Hosted at PO.DAAC. Wind dataset as well.
- **High frequency radar**
  - Data from Mike Kosro, part of the US West Coast HF mapping system.
- Along track
- Coastal mask
  - Mask out AVISO gridded SSH as function(distance from coast, bathymetric features, in situ disagreement…)

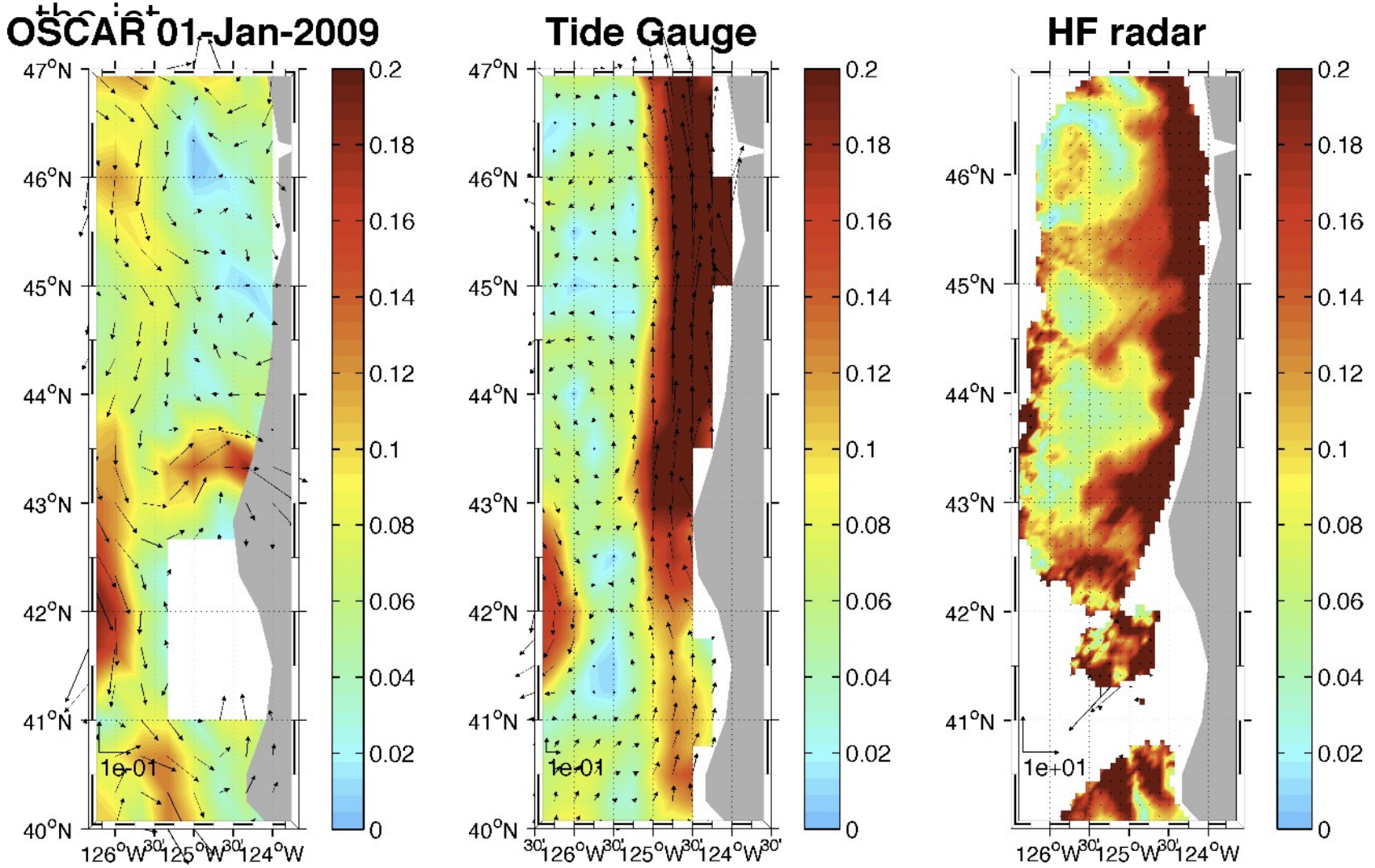
Coastal Issues

- Sample comparison between OSCAR, tide gauge geostrophic currents (Risien and Strub), and HF radar currents, all treated in time as in OSCAR (10-day timescale smoothing, 5-day timebase).

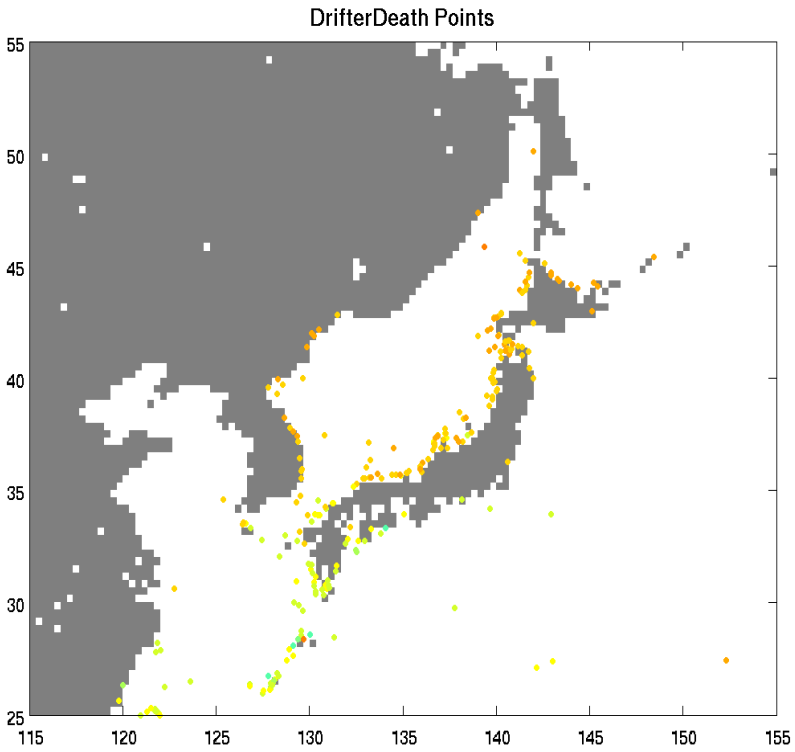


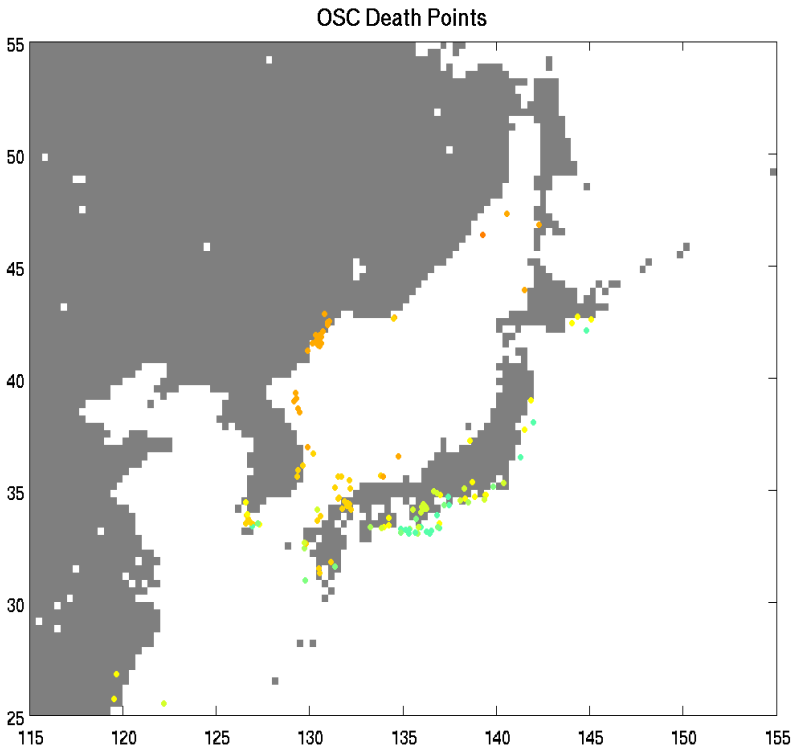
Coastal Issues

- Worst case example. OSCAR (AVISO mapping) completely missed the jet



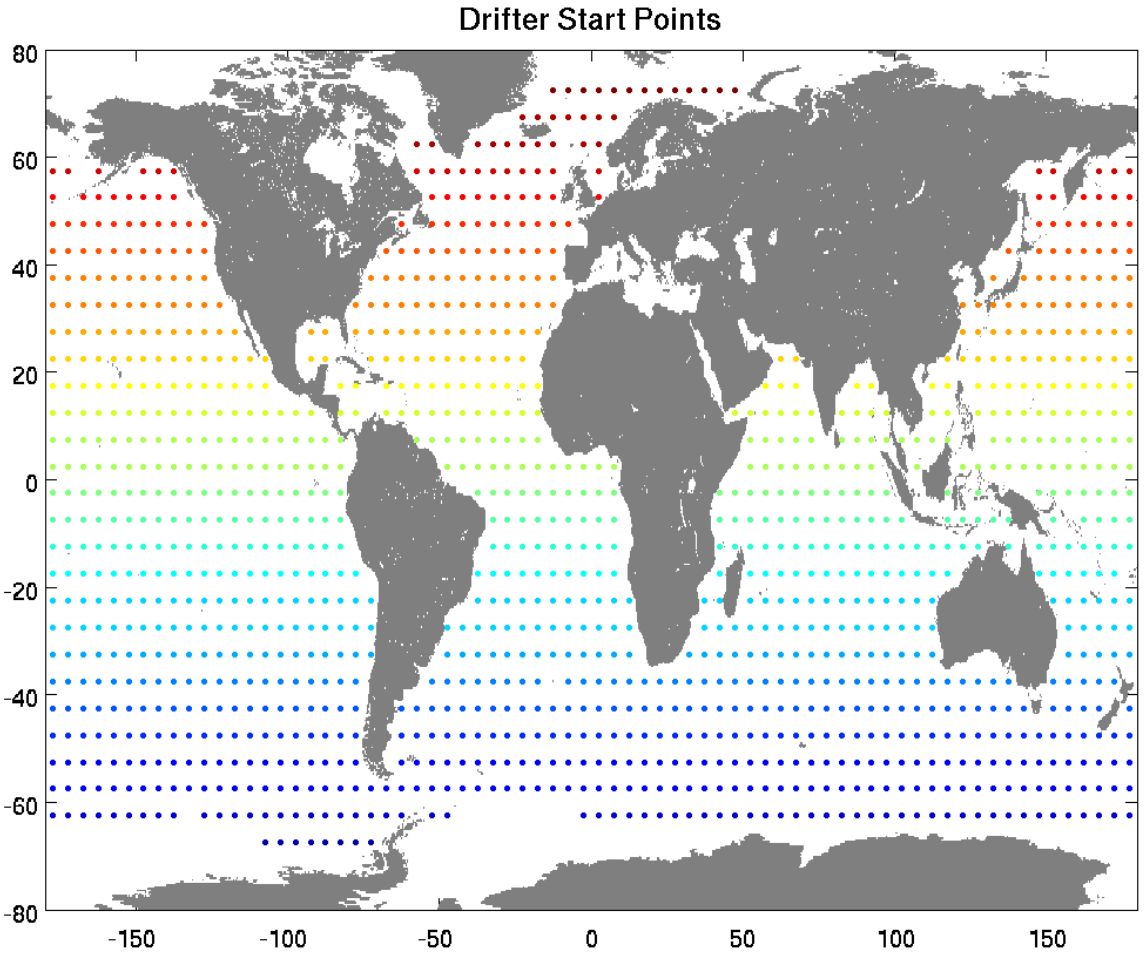
Issues: Coasts





Issues: Small Scale

- Compare OSCAR with 5d timestep, 10 day smoothing to OSCAR with daily winds, no smoothing on the winds



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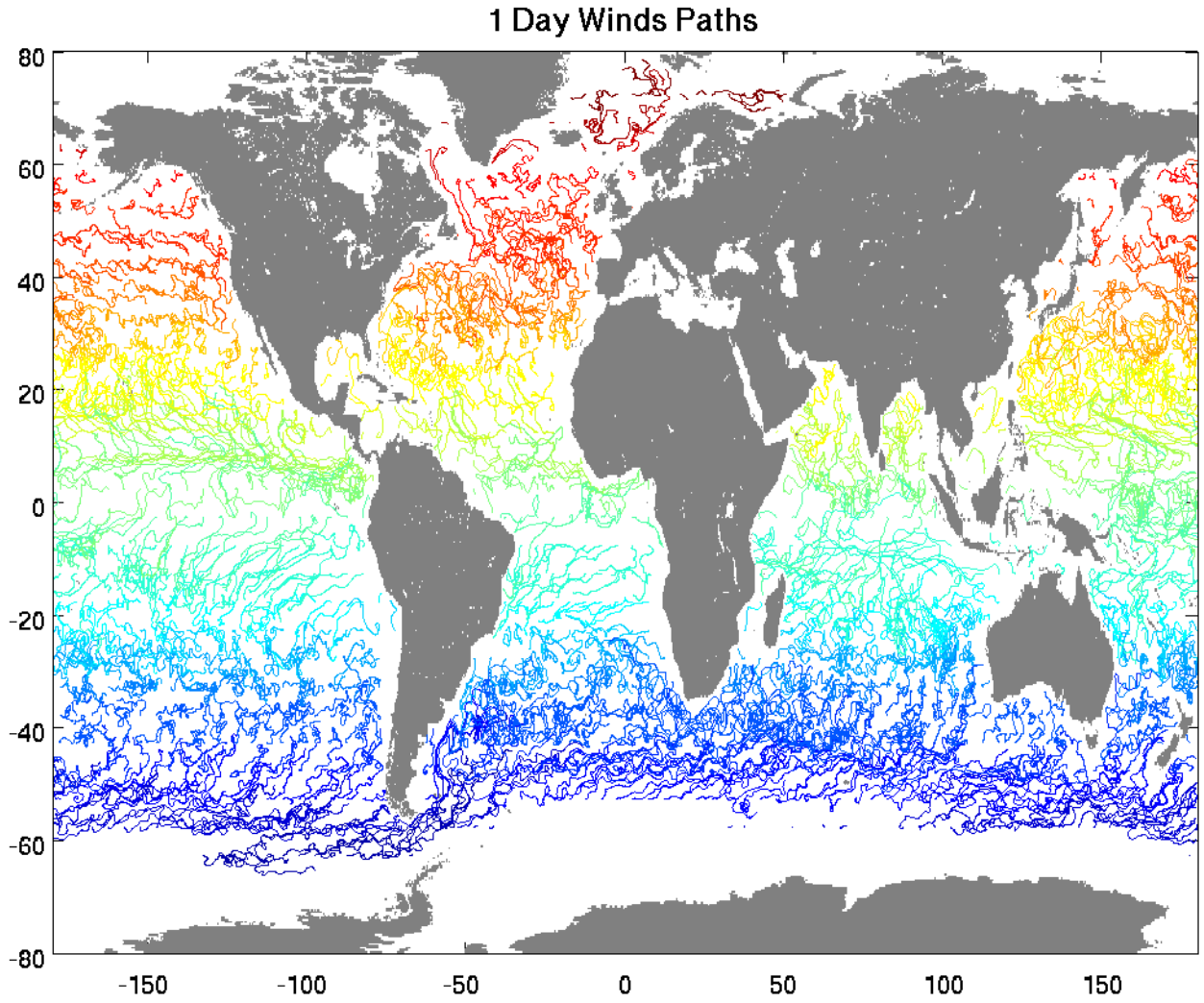
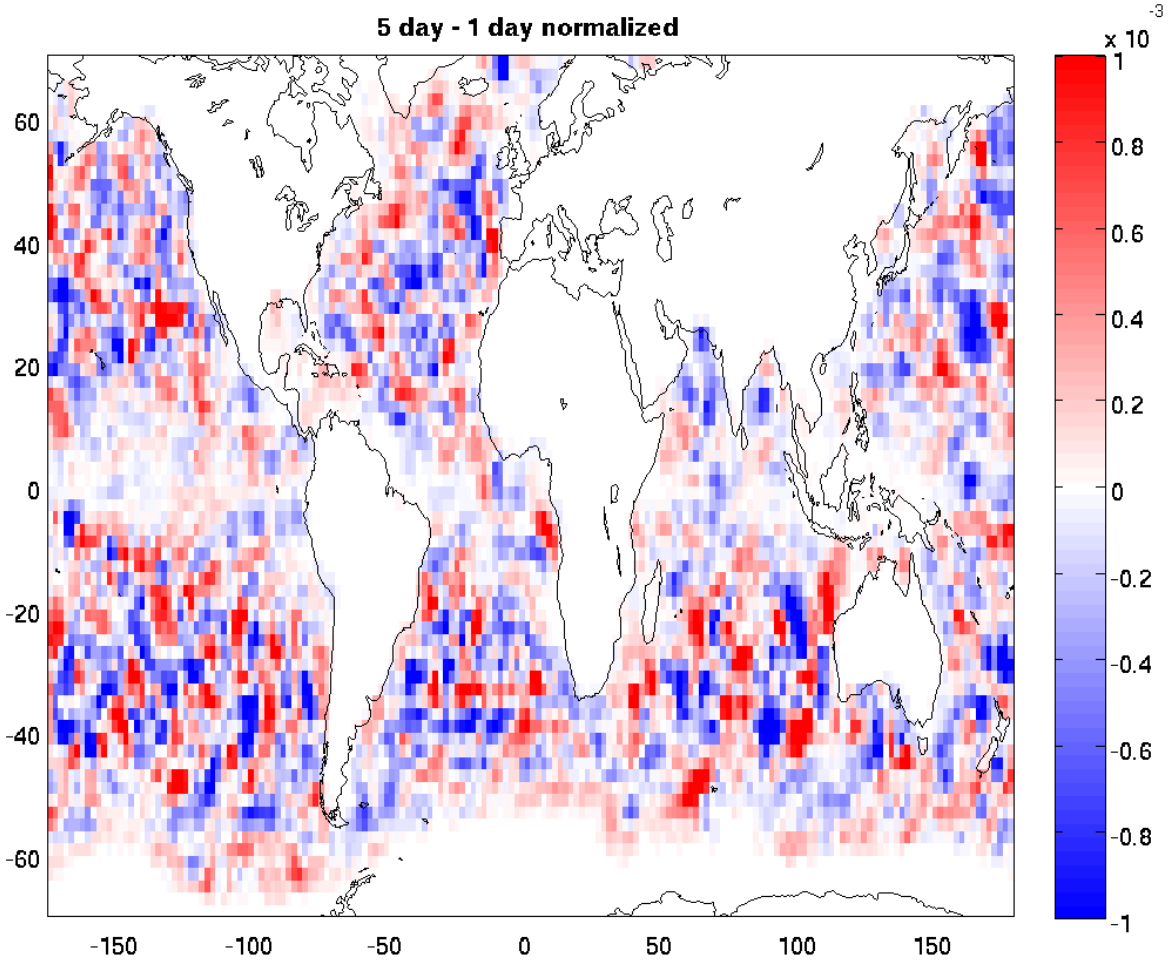


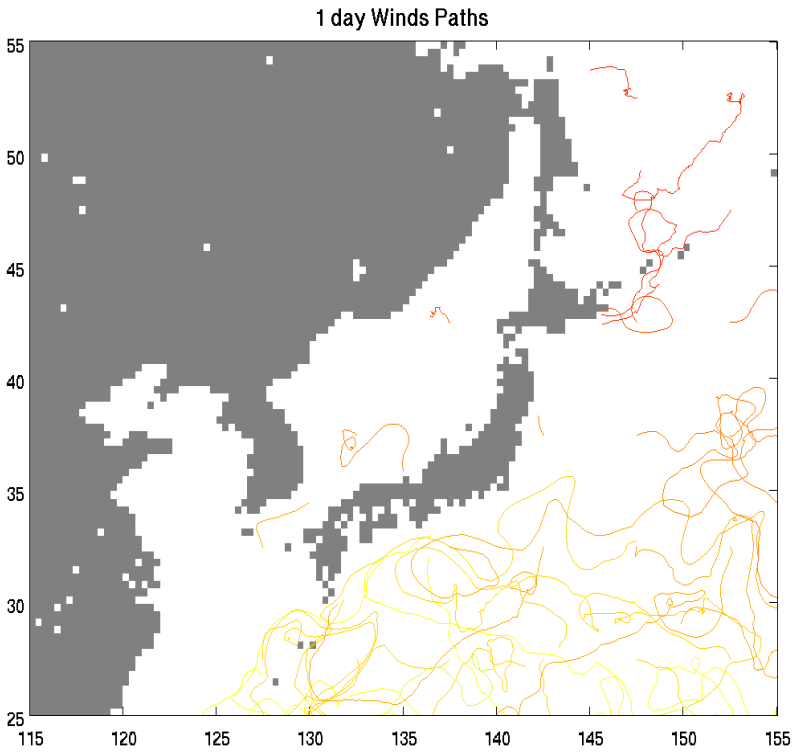
Issues: small scale

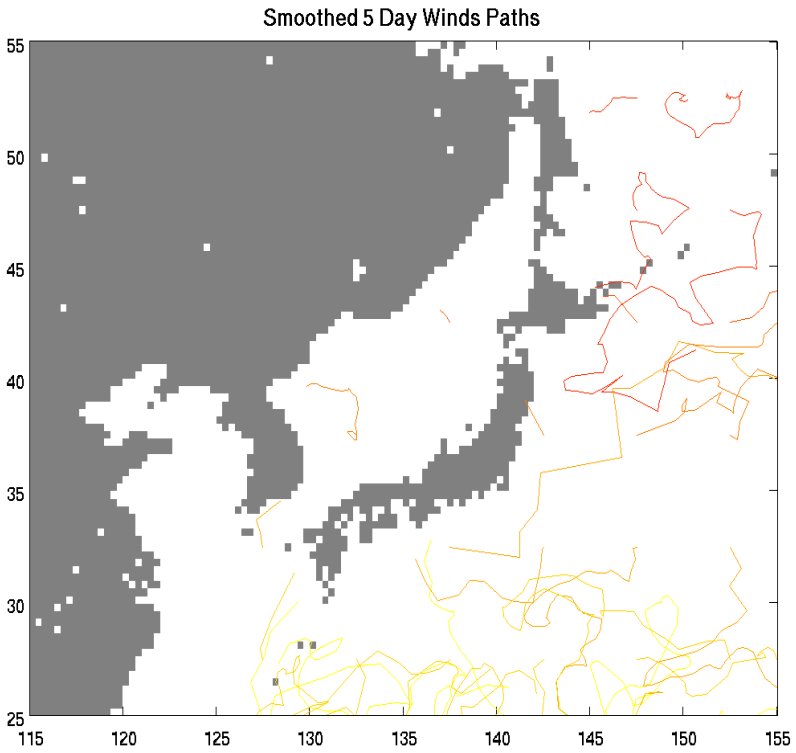
- Amount of time drifter tracks are in bins, 5day OSCAR – 1 day OSCAR



Issues: small scale

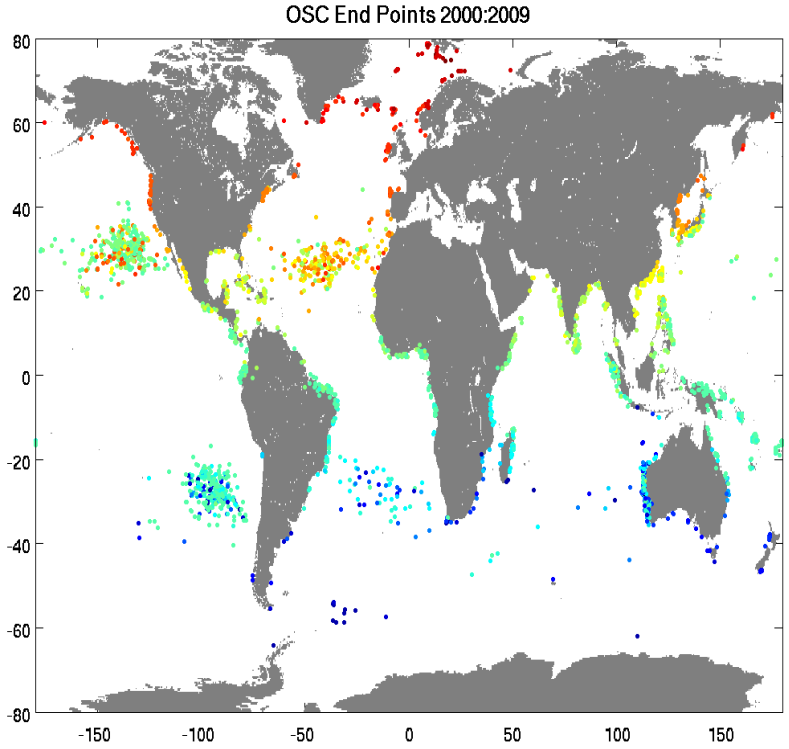
- Close view of drifter paths

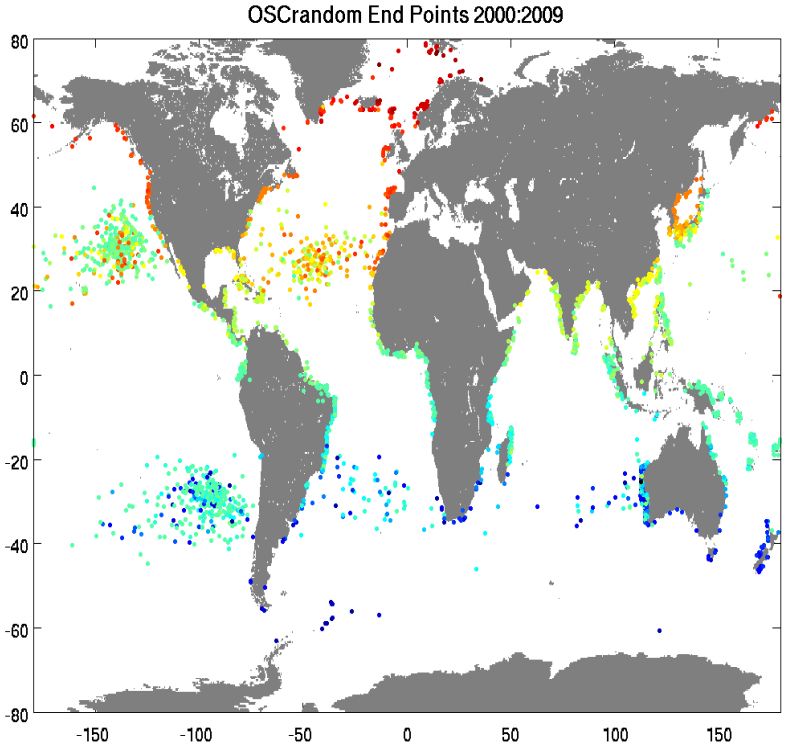




Adding noise to the advection

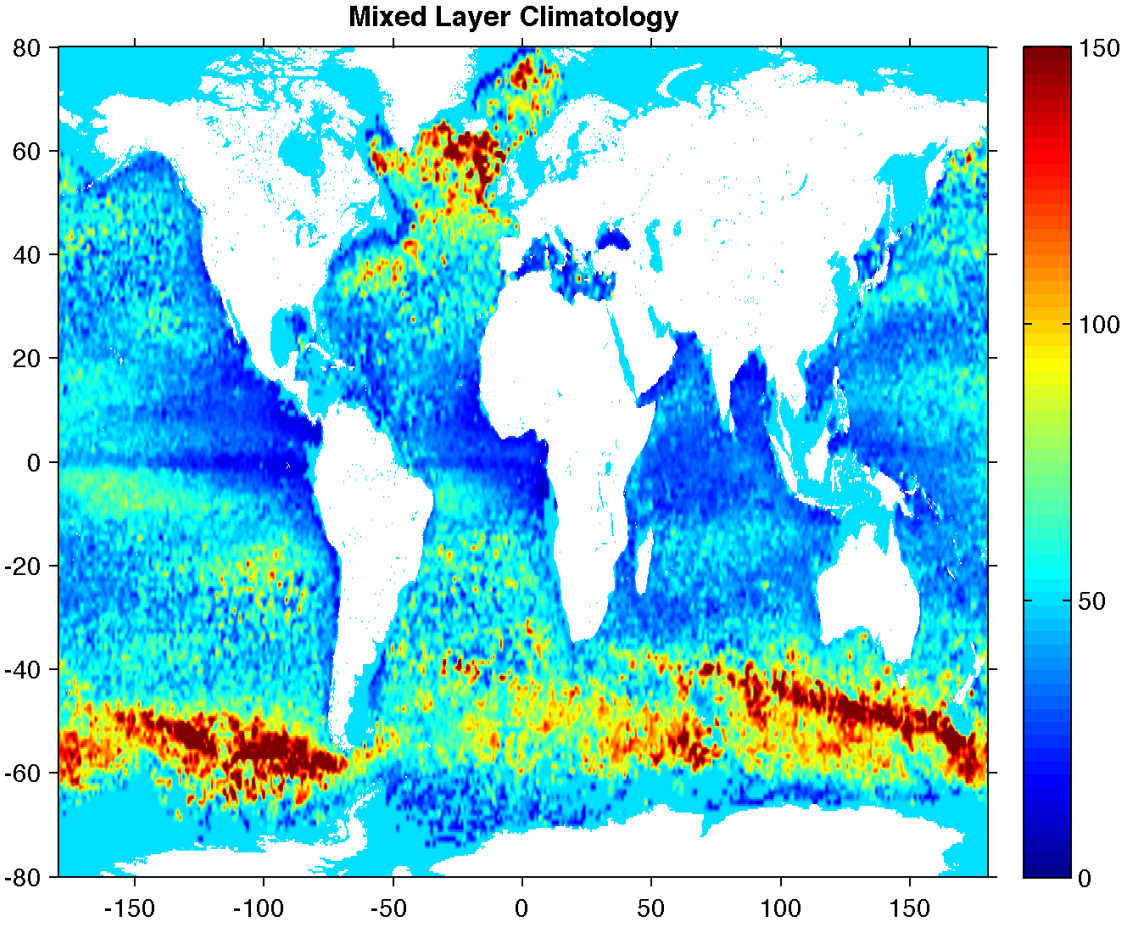
- End points after 10 years: OSCAR and OSCAR + 10cm/s amplitude random noise





Issues: Vertical Variation

- Extreme test case of surface wind-driven **u** scaled by depth of mixed layer
  - U wind = U wind * 30m/MLD
  - Using Holte mixed layer climatology from Argo



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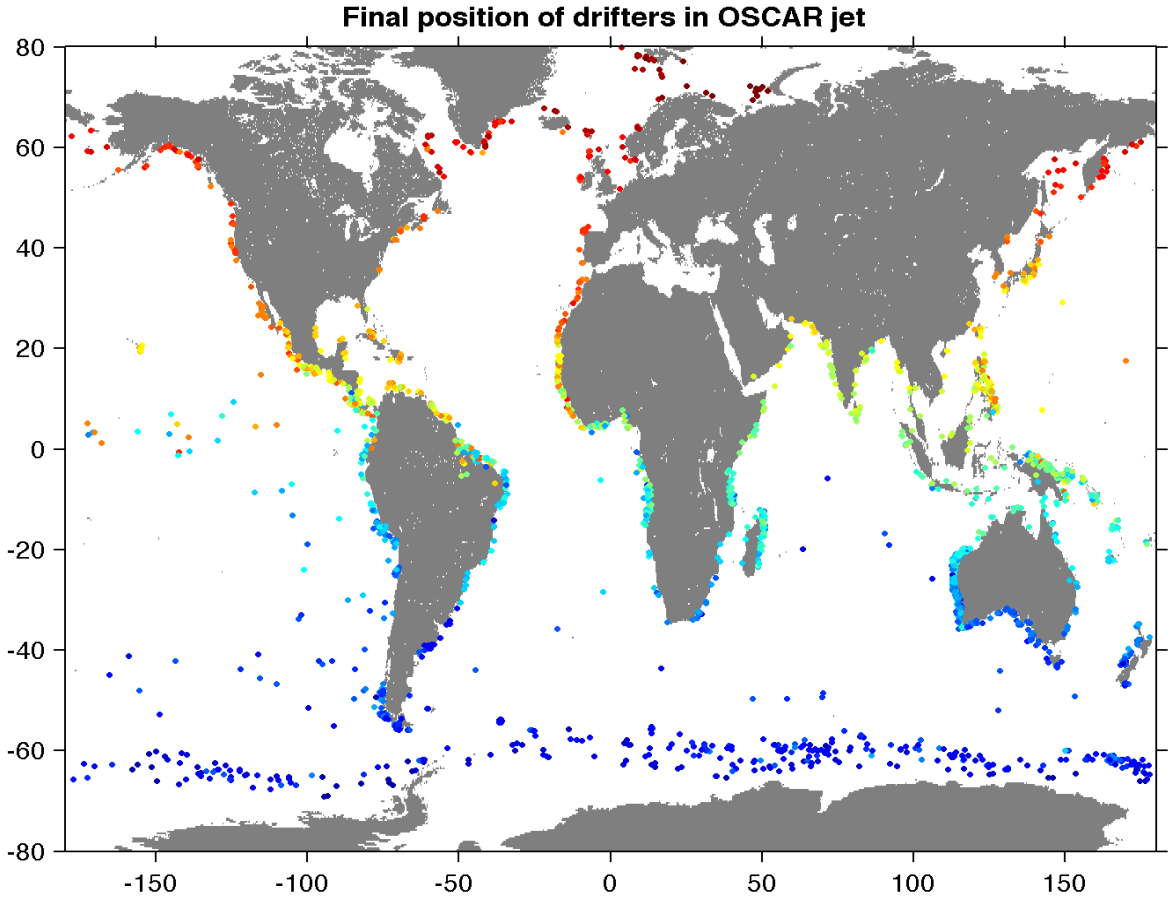
Issues: Vertical Variation

- Test case of surface wind-driven **u** scaled by depth of mixed layer
  - U wind = U wind * 30m/MLD
- Idea of momentum being distributed over well-mixed layer



Summary

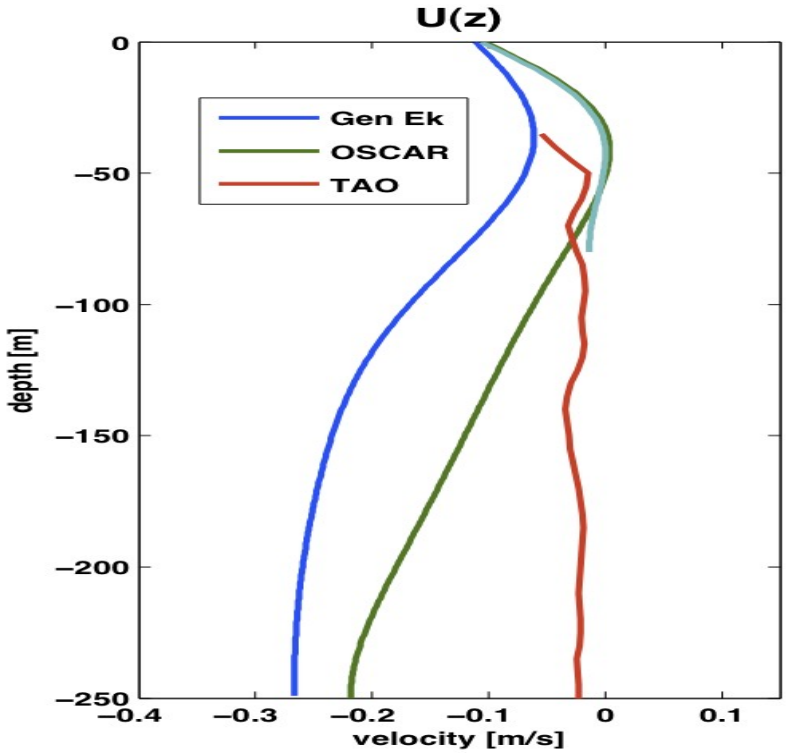
- Are coarse velocity fields enough to measure Lagrangian pathways?
  - Turbulent small-scale processes
  - Filaments
  - Eddies

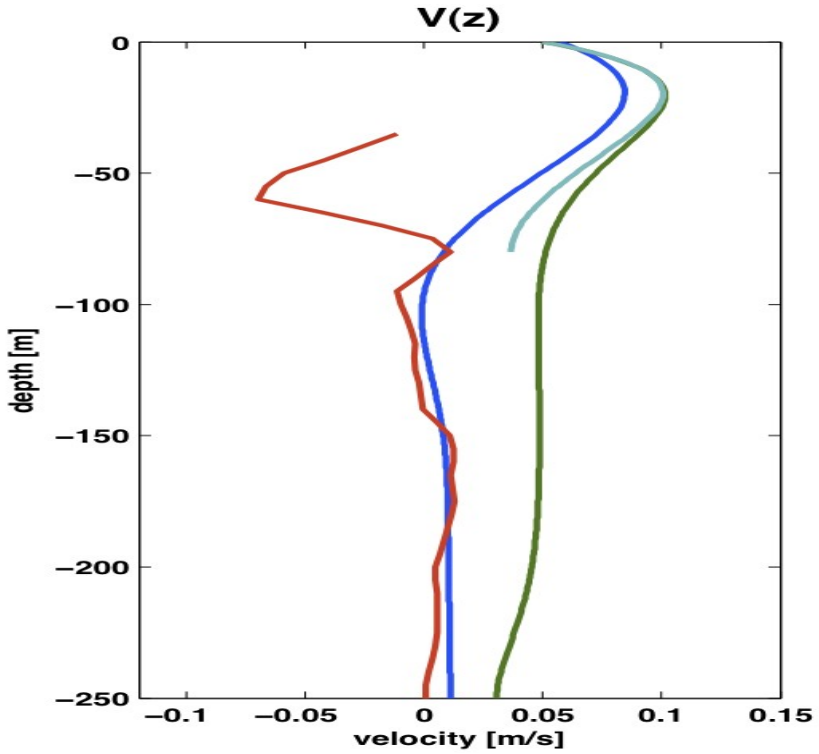
- Coasts
  - Offshore transport
  - Coastal jets
  - Topographic steering
  - Coastal products

- How reliant are any calculations of transport on the vertical profile?
  - How deep do particles reside?

Issues: Vertical Variation

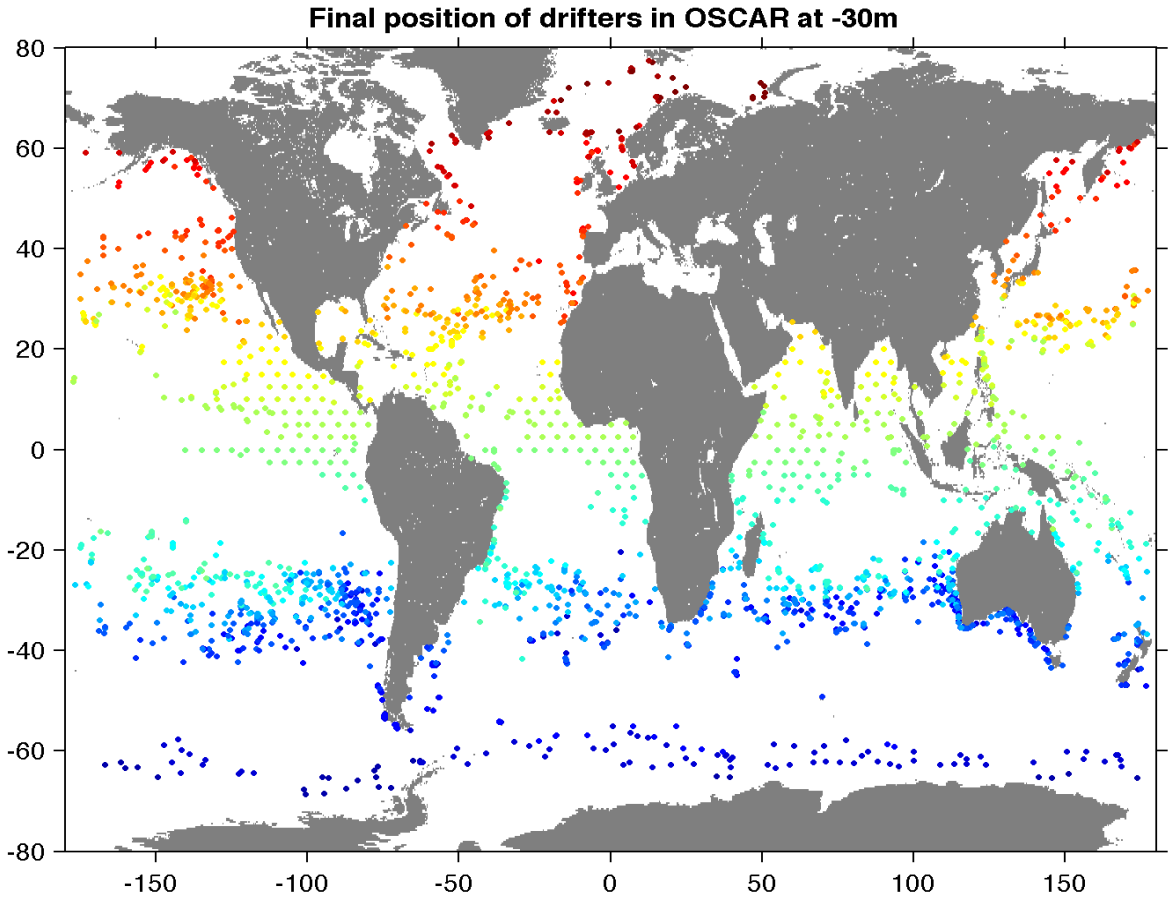
- Green and cyan (OSCAR) show the vertical variation implicit in OSCAR. Blue compares with using a vertically varying eddy viscosity.





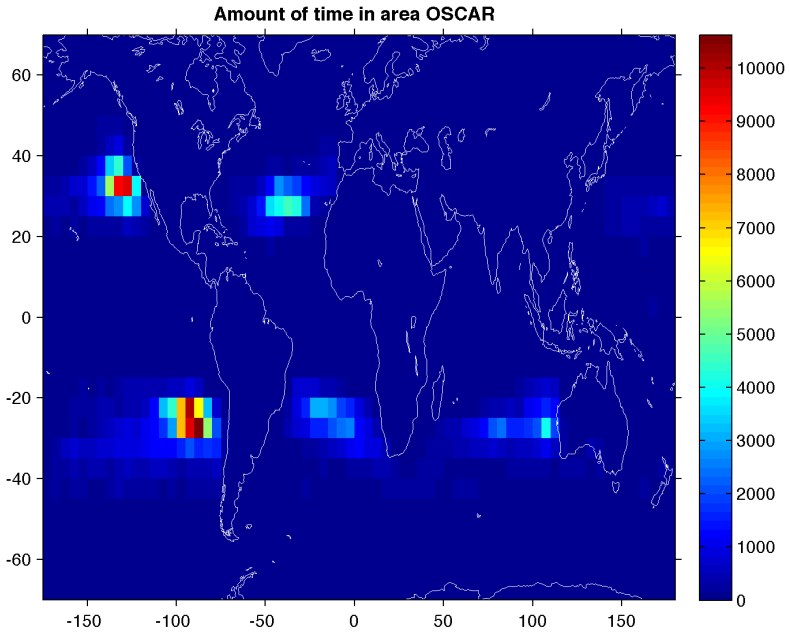
Linearly decaying currents to depth of mixed layer

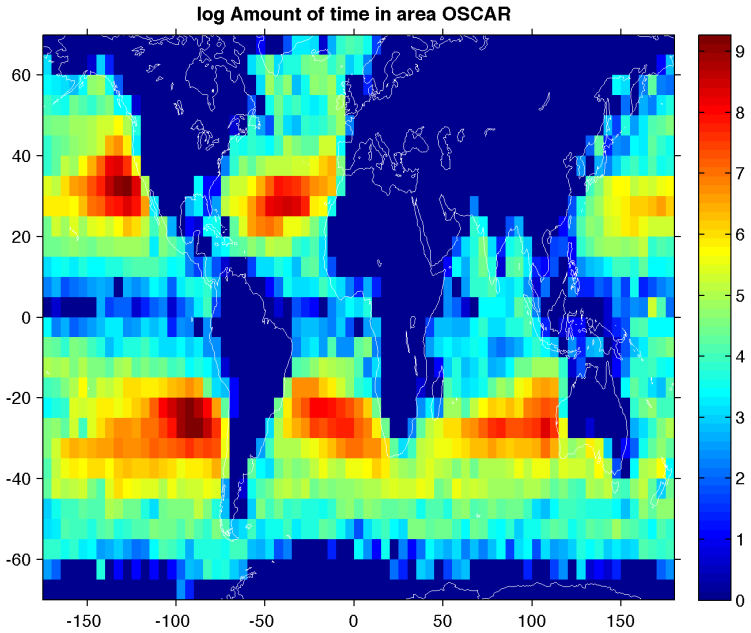
- Extreme test case of linearly decaying **u** with depth to base of mixed layer
- Lose the convergent zones (albeit unrealistic)



OSCAR

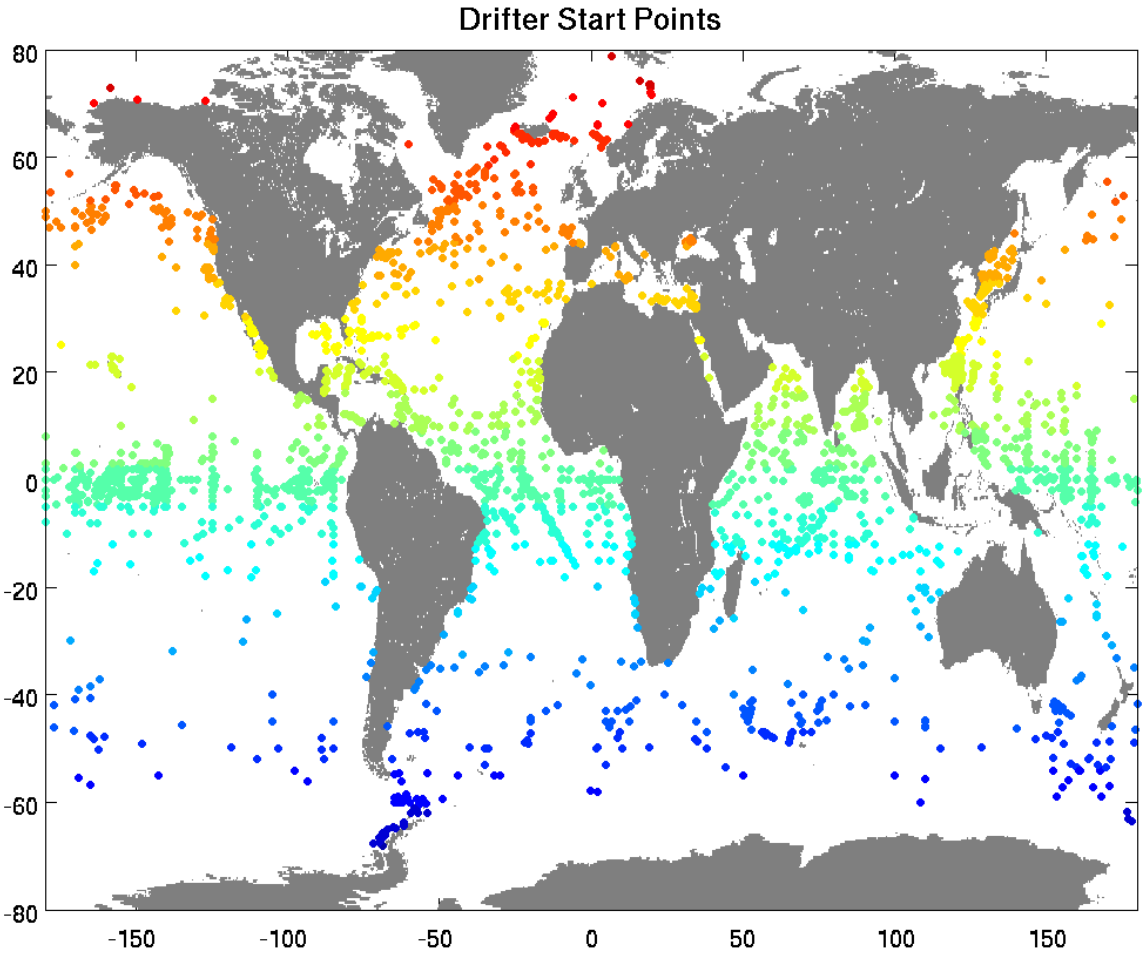
- Same plot for OSCAR drifters





Compare with AOML drifters: Drifters which have hit land

- Initial position of all drifters that have landed, courtesy of Rick Lumpkin AOML



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