Project 2: Tracer transport - examples from the ocean & the atmosphere

Ocean

Plastics in the of ocean and the 'garbage patches':

- Compute trajectories using the EsGlobe
- Compare them to tank experiment

EsGlobe new link - <u>http://eddies.mit.edu/307</u>

Atmosphere

Dust from the Sahara:

- build by hand your own Lagrangian trajectories and
- verify them using the EsGlobe
- compare the winds at different levels

Temperature Advection:

• few examples during winter

Ocean gyres and ocean currents in relation to the prevailing winds



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Fig. 10.20 from Marshall and Plumb book – see Chapter 10

Climatological surface currents from drifters (NOAA)



Saharan Dust - June 2018





Case study: June 20⁻ 21, 2018

- build by hand trajectories using 850 mb wind (GFS analyses)
- verify your calculation by using EsGlobe atmospheric patch of particles.



Note: winds are plotted in m/s with full barb = 10 m/s and half barb = 5 m/s







Other examples

DISPERSION OF VOLCANIC PLUME

Icelandic volcano Eyjafjallajökull

Time: 2010052508 UTC

10 m/s: 🔔

May, 2010



The graphics show the amount of air pollution from ground level up to 20 km height on a relative scale where there is a factor 5000 between the lowest concentrations (dark green) and the highest concentrations (red). The prognosis is based on the assumption that the ash plume has been emitted to a height of 3 km according to reports from Iceland.

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Lagrangian vs Eulerian derivative





Temperature changes at Boston and Temperature Advection

If we assume that Temperature T is conserved:

$$\frac{D}{Dt}T=0,$$

then:

$$(\partial T/\partial t)_{\text{at Boston}} = -u\partial T/\partial x - v\partial T/\partial y$$



Wind symbols convention in meteorology: (knots are mainly used at the surface where winds are weaker, m/s are instead used at upper levels where winds are stronger)

Wind is plotted in increments of 5 knots (kts), with the outer end of the symbol pointing toward the direction from which the wind is blowing. The wind speed is determined by adding up the total of flags, lines, and half-lines, each of which have the following individual values:

Flag: 50 kts Line: 10 kts Half-Line: 5 kts

WIND

If there is only a circle depicted over the station with no wind symbol present, the wind is calm. Below are some sample wind symbols:

50 + 10 + 10 + 5

Wind blowing from the west at 75 knots

Temperature advection winds carry their properties as they move around the globe

Temperature at 850 mb, ~1.5 km

Color scale: red =hot, blue=cold



GFS analyses loop - winter 2009

Case Study of January 22, 2013

Compute:

$$(\partial T/\partial t)_{\text{at Chicago}} = -u\partial T/\partial x - v\partial T/\partial y$$

$$(\partial T/\partial t)_{\text{at Pittsburg}} = -u\partial T/\partial x - v\partial T/\partial y$$

Insight on how a Numerical Weather Prediction Model (NWP) is built



Current example - forecast f



The end