# AIS Validation

- Combine all vessels data and Remove any invalid MMSI entries
- Scrub Broadcast and Voyage Data based on valid vessels
- Combine Broadcast and Voyage Data by Year
- Output consolidated files

In [1]:

```
# from IPython.display import Image, HTML
import os
import numpy as np
import pandas as pd
import datetime
import warnings
from glob import glob

warnings.filterwarnings("ignore")           # Suppress Warning
```

In [2]:

```
# s3://vault-data-corpus/vessel data/Cleaned AIS/
WorkingFolder = "data/vessel data/Cleaned AIS/"
```

In [3]:

```
# s3://vault-data-corpus/vessel data/ValidAIS/
OutputDir = "data/vessel data/ValidAIS/"
```

## Combining Vessels Data

In [18]:

```
# Combining all Vessels Data
df_list = list()

for folder in glob(WorkingFolder + "*/"):

#     #******** Temp hack for testing
#     folder = "/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone03_2017_01/"
#     #************

    print(folder)
    df = pd.read_csv(folder + "Vessel.csv", sep=",")

    print("Rows:", len(df))

    df_list.append(df)

#     break

Vessel = pd.concat(df_list, ignore_index=True)
print("Total Rows:", Vessel.shape)

# Remove duplicate vessel records after combining all the zones/years
Vessel.drop_duplicates(inplace=True)

print("Non-Dup Total Rows:", Vessel.shape)
# Vessel.reset_index(inplace=True)
```

```
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone03_2015_01/
Rows: 849
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone02_2015_01/
Rows: 612
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone10_2011_01/
Rows: 2035
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone10_2010_01/
Rows: 1964
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone10_2014_01/
Rows: 2334
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone01_2015_01/
Rows: 143
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone10_2013_01/
Rows: 1927
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone01_2016_01/
Rows: 48
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone01_2017_01/
Rows: 58
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone10_2012_01/
Rows: 1971
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone10_2009_01/
Rows: 1972
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone02_2016_01/
Rows: 383
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone03_2017_01/
Rows: 823
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone02_2017_01/
Rows: 426
/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone03_2016_01/
Rows: 836
Total Rows: (16381, 7)
Non-Dup Total Rows: (10658, 7)
```

In [19]:

```
Vessel.shape
```

Out[19]:

```
(10658, 7)
```

In [20]:

```
Vessel.head()
```

Out[20]:

|  | mmsi_id | imo | call_sign | vessel_name | vessel_type | length | width |
|---|---|---|---|---|---|---|---|
| 0 | 303159000 | IMO8315724 | WAP2210 | ARCTURUS | 1001.0 | 39.93 | 9.76 |
| 1 | 367011410 | IMO8856510 | WAJ6882 | KUSTATAN | 1001.0 | 26.76 | 8.53 |
| 2 | 366499000 | IMO6931055 | WASF | KATIE ANN | 1001.0 | 89.92 | 13.52 |
| 3 | 367528690 | IMO7742358 | WDG3692 | ALASKAN LADY | 1001.0 | 51.08 | 9.76 |
| 4 | 371542000 | IMO8714944 | 3FSS6 | NO1 POHAH | 70.0 | 115.00 | 16.00 |

In [21]:

```
Vessel.tail()
```

Out[21]:

| | mmsi_id | imo | call_sign | vessel_name | vessel_type | length | width |
|---|---|---|---|---|---|---|---|
| 16376 | 1033360095 | NaN | NaN | NaN | NaN | NaN | NaN |
| 16377 | 338982000 | IMO8835229 | AAHK | USAV WORTHY | 1018.0 | 68.28 | 13.1 |
| 16378 | 370078000 | NaN | NaN | NaN | NaN | NaN | NaN |
| 16379 | 159011837 | NaN | NaN | NaN | NaN | NaN | NaN |
| 16380 | 366588908 | NaN | NaN | NaN | NaN | NaN | NaN |

### Validate MMSI Id

In [22]:

```
# Cast MMSI Id field to string
Vessel['TempId'] = Vessel['mmsi_id'].map(lambda x: str(x))
# Fetch the field lengh (number of digits)
Vessel['Id_len'] = Vessel['TempId'].map(lambda x: len(x))
# Fetch starting digit
Vessel['StartDigit'] = Vessel['TempId'].map(lambda x: int(x[0]))

df.head()
```

Out[22]:

| | mmsi_id | imo | call_sign | vessel_name | vessel_type | length | width |
|---|---|---|---|---|---|---|---|
| 0 | 366993150 | IMO7933579 | WDI5834 | SAGA | 1001.0 | 28.75 | 9.15 |
| 1 | 366182680 | NaN | WDD3084 | BRENNA A | 30.0 | 35.00 | 10.00 |
| 2 | 374275000 | IMO9722455 | 3FAO8 | IYO SEA | 1004.0 | 179.97 | NaN |
| 3 | 367098030 | IMO8852667 | WBS9245 | KONA KAI | 1001.0 | 24.26 | 7.92 |
| 4 | 432567899 | NaN | NaN | NaN | NaN | NaN | NaN |

In [23]:

```
# MMSI Id NOT 9 digits
Vessel.loc[Vessel['Id_len'] != 9].head()
```

Out[23]:

| | mmsi_id | imo | call_sign | vessel_name | vessel_type | length | width | TempId | Id_len | StartDigit |
|---|---|---|---|---|---|---|---|---|---|---|
| 317 | 43676060 | IMO0964016 | WCD8162 | SILVER SPRAY | 0.0 | 32.0 | 9.0 | 43676060 | 8 | 4 |
| 718 | 32767 | NaN | NaN | NaN | NaN | NaN | NaN | 32767 | 5 | 3 |
| 1070 | 1073502465 | NaN | NaN | NaN | NaN | NaN | NaN | 1073502465 | 10 | 1 |
| 1278 | 1009252285 | NaN | NaN | NaN | NaN | NaN | NaN | 1009252285 | 10 | 1 |
| 1748 | 12348576 | NaN | NaN | NaN | 0.0 | 0.0 | 0.0 | 12348576 | 8 | 1 |

In [24]:

```
# Purge - MMSI Id NOT 9 digits
Vessel = Vessel.loc[Vessel['Id_len'] == 9]
print("Remaining Rows:", Vessel.shape)
```

```
Remaining Rows: (10397, 10)
```

In [25]:

```
# MMSI Id starting digit NOT from 2 to 7
Vessel.loc[(Vessel['StartDigit'] < 2) | (Vessel['StartDigit'] > 7)].head()
```

Out[25]:

| | mmsi_id | imo | call_sign | vessel_name | vessel_type | length | width | TempId | Id_len | StartDigit |
|---|---|---|---|---|---|---|---|---|---|---|
| 103 | 970113380 | NaN | NaN | NaN | NaN | NaN | NaN | 970113380 | 9 | 9 |
| 104 | 970113086 | NaN | NaN | NaN | NaN | NaN | NaN | 970113086 | 9 | 9 |
| 330 | 972122919 | NaN | NaN | NaN | NaN | NaN | NaN | 972122919 | 9 | 9 |
| 332 | 972122997 | NaN | NaN | NaN | NaN | NaN | NaN | 972122997 | 9 | 9 |
| 369 | 972122921 | NaN | NaN | NaN | NaN | NaN | NaN | 972122921 | 9 | 9 |

In [26]:

```
# Purge - MMSI Id starting digit NOT from 2 to 7
Vessel = Vessel.loc[(Vessel['StartDigit'] > 1) & (Vessel['StartDigit'] < 8)]
print("Remaining Rows:", Vessel.shape)
```

```
Remaining Rows: (10245, 10)
```

In [27]:

```python
# Duplicate MMSI Id
df = Vessel.groupby(['mmsi_id']).size().reset_index(name='counts')
df.sort_values(by=['counts'], ascending=False).head()
```

Out[27]:

| | mmsi_id | counts |
|---|---|---|
| 4721 | 367098250 | 5 |
| 3788 | 366360509 | 5 |
| 5491 | 367740200 | 5 |
| 7833 | 563020027 | 5 |
| 3166 | 355007701 | 5 |

In [32]:

```python
print("Duplicate MMSI:", df.loc[df.counts > 1].shape)
```

```
Duplicate MMSI: (1183, 2)
```

In [33]:

```python
Vessel.loc[Vessel['mmsi_id'] == 367098250]
```

Out[33]:

| | mmsi_id | imo | call_sign | vessel_name | vessel_type | length | width | TempId | Id_len | StartDigit |
|---|---|---|---|---|---|---|---|---|---|---|
| 3685 | 367098250 | NaN | NaN | NaN | 30.0 | 30.0 | 10.0 | 367098250 | 9 | 3 |
| 5943 | 367098250 | NaN | NaN | NaN | 30.0 | 28.0 | 11.0 | 367098250 | 9 | 3 |
| 10695 | 367098250 | NaN | NaN | NaN | 30.0 | 30.0 | 12.0 | 367098250 | 9 | 3 |
| 13567 | 367098250 | 7110866 | WDC1950 | NEW ENGLAND COAST | 52.0 | 0.0 | 0.0 | 367098250 | 9 | 3 |
| 13596 | 367098250 | 711086600 | WCW6137 | NEWENGLAND COAST | 35.0 | 0.0 | 0.0 | 367098250 | 9 | 3 |

In [34]:

```python
Vessel.drop_duplicates("mmsi_id", inplace=True)
print("Remaining Rows:", df.shape)
```

```
Remaining Rows: (8817, 2)
```

In [35]:

```python
Vessel.head()
```

Out[35]:

| | mmsi_id | imo | call_sign | vessel_name | vessel_type | length | width | TempId | Id_len | StartDigit |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 303159000 | IMO8315724 | WAP2210 | ARCTURUS | 1001.0 | 39.93 | 9.76 | 303159000 | 9 | 3 |
| 1 | 367011410 | IMO8856510 | WAJ6882 | KUSTATAN | 1001.0 | 26.76 | 8.53 | 367011410 | 9 | 3 |
| 2 | 366499000 | IMO6931055 | WASF | KATIE ANN | 1001.0 | 89.92 | 13.52 | 366499000 | 9 | 3 |
| 3 | 367528690 | IMO7742358 | WDG3692 | ALASKAN LADY | 1001.0 | 51.08 | 9.76 | 367528690 | 9 | 3 |
| 4 | 371542000 | IMO8714944 | 3FSS6 | NO1 POHAH | 70.0 | 115.00 | 16.00 | 371542000 | 9 | 3 |

In [38]:

```python
# Save valid Vessels to csv
Vessel.to_csv(OutputDir + "Valid_Vessels.csv", index=False)
```

## Purge Broadcasts for Invalid MMSI

In [107]:

```python
folder = WorkingFolder + "Zone03_2016_01/"
outputfile = "data/vessel data/ValidAIS/Broadcast_Zone03_2016_01.csv"

Broadcast = pd.read_csv(folder + "Broadcast.csv", sep=",")
Broadcast.head()
```

Out[107]:

| | mmsi_id | date_time | lat | lon | speed_over_ground | course_over_ground | voyage_id | heading | status |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 366993150 | 2016-01-01T00:01:17 | 53.90715 | -166.51023 | 0.0 | -143.5 | NaN | 199.0 | undefined |
| 1 | 366182680 | 2016-01-01T00:02:26 | 53.94988 | -166.48963 | 0.3 | -74.5 | NaN | 511.0 | under way using engine |
| 2 | 366993150 | 2016-01-01T00:02:27 | 53.90713 | -166.51027 | 0.0 | -151.6 | NaN | 200.0 | undefined |
| 3 | 366993150 | 2016-01-01T00:05:57 | 53.90713 | -166.51027 | 0.0 | -176.1 | NaN | 199.0 | undefined |
| 4 | 366993150 | 2016-01-01T00:13:58 | 53.90713 | -166.51027 | 0.0 | -173.5 | NaN | 199.0 | undefined |

```
In [108]: print("Raw Count:", Broadcast.shape[0])
```

```
Raw Count: 2575263
```

```
In [109]: # Purge any Broadcast entry from Invalid MMSI
          Broadcast = Broadcast.loc[Broadcast.mmsi_id.isin(Vessel.mmsi_id)]
          print("After Invalid MMSI Purge:", Broadcast.shape[0])
```

```
After Invalid MMSI Purge: 2572882
```

```
In [111]: Broadcast.sort_values(by=['date_time'], ascending=False).head()
```

Out[111]:

| | mmsi_id | date_time | lat | lon | speed_over_ground | course_over_ground | voyage_id | heading | status |
|---|---|---|---|---|---|---|---|---|---|
| 21606 | 367161350 | 2016-01-31T23:59:59 | 53.87737 | -166.54882 | 0.0 | -68.2 | NaN | 511.0 | under way using engine |
| 67751 | 303683000 | 2016-01-31T23:59:59 | 53.90905 | -166.51354 | 0.1 | -155.6 | NaN | 214.0 | under way using engine |
| 2363119 | 366556140 | 2016-01-31T00:27:49 | 53.91214 | -166.50862 | 0.0 | -94.7 | NaN | 228.0 | engaged in fishing |
| 1704312 | 367098030 | 2016-01-31T00:27:48 | 53.91194 | -166.50688 | 0.0 | -111.3 | NaN | 511.0 | under way using engine |
| 1223676 | 303429000 | 2016-01-31T00:27:48 | 53.91221 | -166.50872 | 0.0 | -65.2 | NaN | 232.0 | under way using engine |

```
In [112]: Broadcast.sort_values(by=['date_time'], ascending=True).head()
```

Out[112]:

| | mmsi_id | date_time | lat | lon | speed_over_ground | course_over_ground | voyage_id | heading | status |
|---|---|---|---|---|---|---|---|---|---|
| 248 | 303539000 | 2016-01-01T00:00:01 | 53.87878 | -166.54157 | 0.0 | -66.4 | NaN | 129.0 | under way using engine |
| 1414 | 338568000 | 2016-01-01T00:00:01 | 53.84571 | -166.57939 | 0.0 | -114.8 | NaN | 328.0 | undefined |
| 629 | 368466000 | 2016-01-01T00:00:01 | 53.86843 | -166.55425 | 0.0 | 10.8 | NaN | 511.0 | under way using engine |
| 3305 | 367045260 | 2016-01-01T00:00:01 | 54.07597 | -166.68953 | 9.4 | -90.6 | NaN | 318.0 | under way using engine |
| 1783 | 367094420 | 2016-01-01T00:00:01 | 53.88336 | -166.53113 | 0.0 | -77.4 | NaN | 47.0 | under way using engine |

```
In [113]: Broadcast.loc[Broadcast.mmsi_id==367045260].shape
```

```
Out[113]: (4766, 9)
```

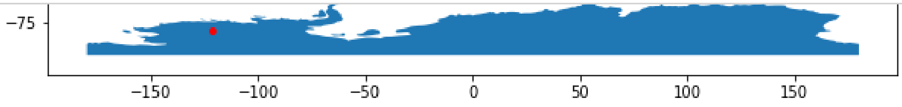
```
In [110]: # Save valid Broadcast to csv
          Broadcast.to_csv(outputfile, index=False)
```

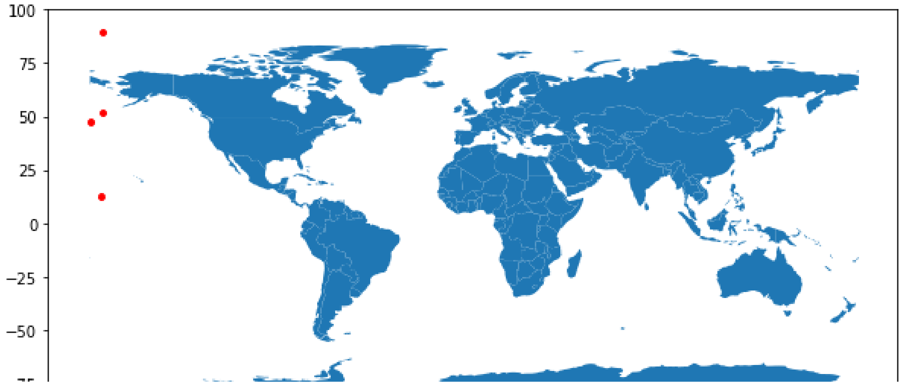
## Validate Broadcast Coordinates

- pip install shapely
- pip install geopandas
- pip install descartes

```
In [4]: from shapely.geometry import Point
        import geopandas as gpd
        from geopandas import GeoDataFrame
```

In [13]:
```
# Plotting boundary coordinates to visually identify Lat/Long anomally
count = 0
for folder in glob(WorkingFolder + "*/"):
    data_array = list()
#     #********* Temp hack
#     folder = "/Users/cv0361/Desktop/TechChallenge/Data/csv/AIS_Processed/Zone02_2017_01/"
#     #*************

    print(folder)
    Broadcast = pd.read_csv(folder + "Broadcast.csv", sep=",")

    print("Rows:", len(Broadcast))

    # Fetch Lat extreme values
    Broadcast = Broadcast.sort_values(by=['lat'], ascending=True)  # Sort by Lat
    temp = Broadcast.head(1)     # get lowest value
    data_array.append(temp[['lat', 'lon']].values[0])
    temp = Broadcast.tail(1)     # get highest value
    data_array.append(temp[['lat', 'lon']].values[0])

    # Fetch Lon extreme values
    Broadcast = Broadcast.sort_values(by=['lon'], ascending=True)  # Sort by Lon
    temp = Broadcast.head(1)     # get lowest value
    data_array.append(temp[['lat', 'lon']].values[0])
    temp = Broadcast.tail(1)     # get highest value
    data_array.append(temp[['lat', 'lon']].values[0])

    # df of lat/lon pairs
    df = pd.DataFrame(data_array, columns=['Latitude', 'Longitude'])

    # Plotting interested boundary coordinates
    geometry = [Point(xy) for xy in zip(df['Longitude'], df['Latitude'])]
    gdf = GeoDataFrame(df, geometry=geometry)

    #this is a simple map that goes with geopandas
    world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))
    gdf.plot(ax=world.plot(figsize=(10, 6)), marker='o', color='red', markersize=15);

#     count += 1
#     if count > 4:
#         break
```





In [6]:
```
Broadcast.head()
```

Out[6]:

| | mmsi_id | date_time | lat | lon | speed_over_ground | course_over_ground | voyage_id | heading | status |
|---|---|---|---|---|---|---|---|---|---|
| 14739662 | 366050800 | 2014/01/19 23:03:05 | 42.370213 | -126.00000 | 15.1 | 178.39999 | 10553 | 177 | 0 |
| 14397328 | 366050800 | 2014/01/19 12:45:54 | 44.957890 | -126.00000 | 15.0 | 180.60001 | 10553 | 178 | 0 |
| 14426442 | 366050800 | 2014/01/19 13:07:17 | 44.869218 | -126.00000 | 14.8 | 178.70000 | 10553 | 178 | 0 |
| 14546779 | 366050800 | 2014/01/19 17:00:05 | 43.907422 | -126.00000 | 15.3 | 179.60001 | 10553 | 179 | 0 |
| 14547804 | 366050800 | 2014/01/19 17:39:47 | 43.739725 | -125.99999 | 15.0 | 179.39999 | 10553 | 176 | 0 |

In [7]:
```
sample = Broadcast[['lat', 'lon']].drop_duplicates()
sample.shape
```

Out[7]:
```
(13392752, 2)
```

In [8]:
```
sample['lat'] = sample['lat'].map(lambda x: round(x, 3))
sample['lon'] = sample['lon'].map(lambda x: round(x, 3))
sample.drop_duplicates(inplace=True)
sample.shape
```

Out[8]:
```
(2675294, 2)
```

In [9]:
```
sample.head()
```

Out[9]:

| | lat | lon |
|---|---|---|
| 14739662 | 42.370 | -126.0 |
| 14397328 | 44.958 | -126.0 |
| 14426442 | 44.869 | -126.0 |
| 14546779 | 43.907 | -126.0 |
| 14547804 | 43.740 | -126.0 |

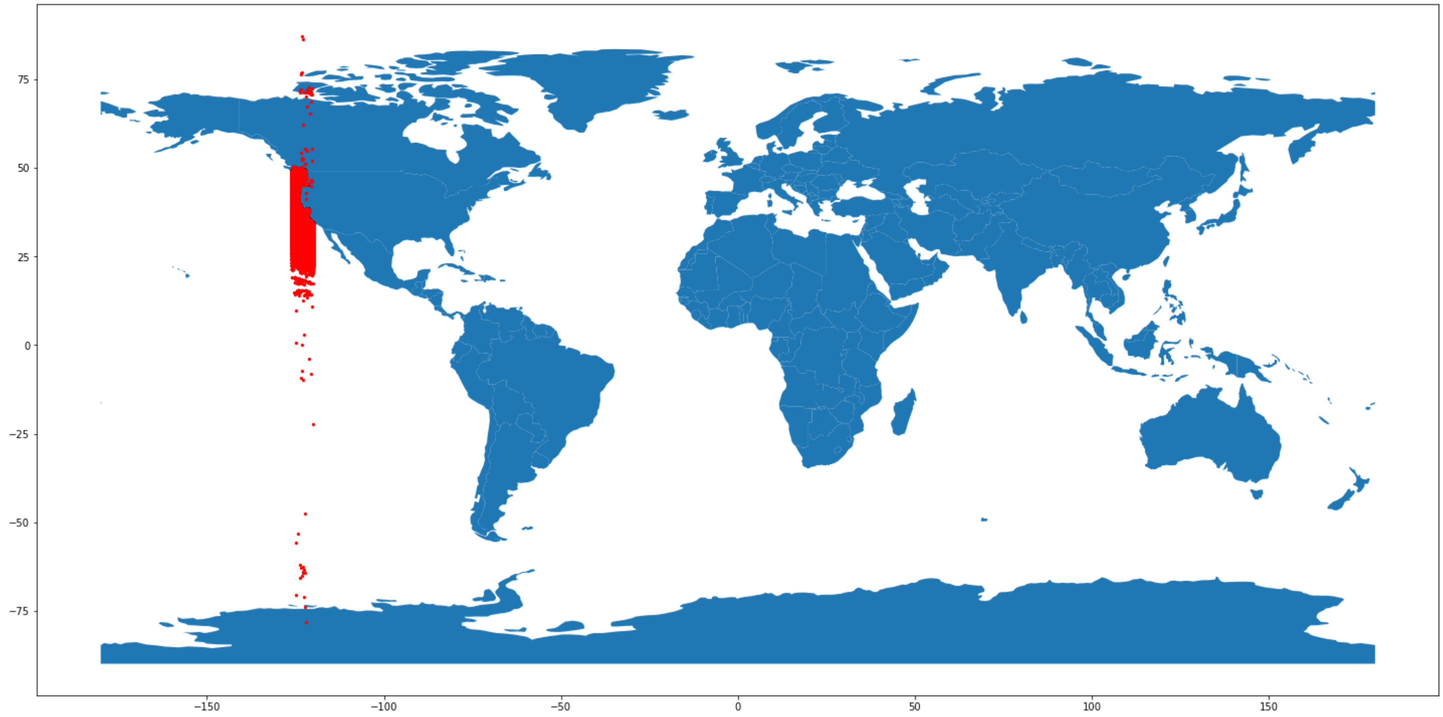
In [10]:
```
# Plotting interested boundary coordinates
geometry = [Point(xy) for xy in zip(sample['lon'], sample['lat'])]
gdf = GeoDataFrame(sample, geometry=geometry)
```

In [11]:
```
sample.head()
```

Out[11]:

| | lat | lon | geometry |
|---|---|---|---|
| 14739662 | 42.370 | -126.0 | POINT (-126.00000 42.37000) |
| 14397328 | 44.958 | -126.0 | POINT (-126.00000 44.95800) |
| 14426442 | 44.869 | -126.0 | POINT (-126.00000 44.86900) |
| 14546779 | 43.907 | -126.0 | POINT (-126.00000 43.90700) |
| 14547804 | 43.740 | -126.0 | POINT (-126.00000 43.74000) |

In [12]:
```
#this is a simple map that goes with geopandas
world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))
gdf.plot(ax=world.plot(figsize=(25, 30)), marker='o', color='red', markersize=5);
```



## Validate Voyage Data

In [4]:

```
# # Fetch valid Vessel data
# Vessel = pd.read_csv("/Users/cv0361/Desktop/TechChallenge/Data/csv/ValidAIS/Valid_Vessels.csv", sep=",")
# Vessel.head()
```

Out[4]:

|  | mmsi_id | imo | call_sign | vessel_name | vessel_type | length | width | TempId | Id_len | StartDigit |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 303159000 | IMO8315724 | WAP2210 | ARCTURUS | 1001.0 | 39.93 | 9.76 | 303159000 | 9 | 3 |
| 1 | 367011410 | IMO8856510 | WAJ6882 | KUSTATAN | 1001.0 | 26.76 | 8.53 | 367011410 | 9 | 3 |
| 2 | 366499000 | IMO6931055 | WASF | KATIE ANN | 1001.0 | 89.92 | 13.52 | 366499000 | 9 | 3 |
| 3 | 367528690 | IMO7742358 | WDG3692 | ALASKAN LADY | 1001.0 | 51.08 | 9.76 | 367528690 | 9 | 3 |
| 4 | 371542000 | IMO8714944 | 3FSS6 | NO1 POHAH | 70.0 | 115.00 | 16.00 | 371542000 | 9 | 3 |

In [54]:

```
outputfile = OutputDir + "Voyage_Zone10_2014_01.csv"

# Fetch Voyage Data
Voyage = pd.read_csv(WorkingFolder + "Zone10_2014_01/Voyage.csv", sep=",")
Voyage.head()
```

Out[54]:

|  | mmsi_id | voyage_id | draft | cargo |
|---|---|---|---|---|
| 0 | 235469970 | 337 | 120 | 71 |
| 1 | 367870800 | 232 | 45 | 32 |
| 2 | 576110500 | 113 | 93 | 70 |
| 3 | 316004579 | 306 | 32 | 52 |
| 4 | 477221200 | 519 | 70 | 70 |

In [55]:

```
# Purge any Voyage entry from Invalid MMSI
Voyage = Voyage.loc[Voyage.mmsi_id.isin(Vessel.mmsi_id)]

Voyage = Voyage.drop_duplicates()   # Make sure no dup

print(outputfile)
print("Rows:", Voyage.shape[0])
print("After Invalid MMSI Purge:", Voyage.shape[0])
```

```
/Users/cv0361/Desktop/TechChallenge/Data/csv/ValidAIS/Voyage_Zone10_2014_01.csv
Rows: 15825
After Invalid MMSI Purge: 15825
```

In [56]:

```
# Save valid Broadcast to csv
Voyage.to_csv(outputfile, index=False)
```

## Combine Voyage Yearly

In [75]:

```
outputfile = "/Users/cv0361/Desktop/TechChallenge/Data/csv/ConsolidatedAIS/Voyage_2017.csv"
print(outputfile)
VoyageList = list()

# Fetch Voyage Data for all zone in a year
VoyageList.append(pd.read_csv("data/vessel data/ValidAIS/Voyage_Zone01_2017_01.csv", sep=","))
VoyageList.append(pd.read_csv("data/vessel data/ValidAIS/Voyage_Zone02_2017_01.csv", sep=","))
VoyageList.append(pd.read_csv("data/vessel data/ValidAIS/Voyage_Zone03_2017_01.csv", sep=","))

Voyage = pd.concat(VoyageList, ignore_index=True)

print("Combined Rows:", Voyage.shape[0])

Voyage.head()
```

```
/Users/cv0361/Desktop/TechChallenge/Data/csv/ConsolidatedAIS/Voyage_2017.csv
Combined Rows: 1307
```

Out[75]:

|   | mmsi_id | voyage_id | draft | cargo |
|---|---|---|---|---|
| 0 | 366940480 | NaN | 4.0 | 31.0 |
| 1 | 477444700 | NaN | 10.5 | 70.0 |
| 2 | 370024000 | NaN | 10.0 | 70.0 |
| 3 | 273898000 | NaN | 6.0 | 30.0 |
| 4 | 477027500 | NaN | NaN | NaN |

In [76]:

```
Voyage = Voyage.drop_duplicates()   # Make sure no dup
print("After Removed Dup:", Voyage.shape[0])
```

```
After Removed Dup: 866
```

In [77]:

```
Voyage = Voyage.drop_duplicates(['mmsi_id', 'voyage_id'])   # Make sure no dup
print("After Removed mmsi_id, voyage_id Dup:", Voyage.shape[0])
```

```
After Removed mmsi_id, voyage_id Dup: 859
```

In [78]:

```
# Save valid Broadcast to csv
Voyage.to_csv(outputfile, index=False)
```

## Combine Broadcast Yearly

In [85]:

```
outputfile = "data/vessel data/ConsolidatedAIS/Broadcast_2015.csv"
print(outputfile)
BroadcastList = list()

# Fetch Voyage Data for all zone in a year
BroadcastList.append(pd.read_csv("data/vessel data/ValidAIS/Broadcast_Zone01_2015_01.csv", sep=","))
BroadcastList.append(pd.read_csv("data/vessel data/ValidAIS/Broadcast_Zone02_2015_01.csv", sep=","))
BroadcastList.append(pd.read_csv("data/vessel data/ValidAIS/Broadcast_Zone03_2015_01.csv", sep=","))

Broadcast = pd.concat(BroadcastList, ignore_index=True)

print("Combined Rows:", Broadcast.shape[0])

Broadcast.head()
```

```
/Users/cv0361/Desktop/TechChallenge/Data/csv/ConsolidatedAIS/Broadcast_2015.csv
Combined Rows: 3180990
```

Out[85]:

|   | mmsi_id | date_time | lat | lon | speed_over_ground | course_over_ground | voyage_id | heading | status |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 235091871 | 2015-01-01T00:08:26 | 52.78763 | -175.62761 | 10.3 | 74.5 | NaN | 86.0 | under way using engine |
| 1 | 247119100 | 2015-01-01T05:36:17 | 52.87994 | -176.21738 | 10.7 | -148.8 | NaN | 263.0 | under way using engine |
| 2 | 247119100 | 2015-01-01T06:28:57 | 52.83234 | -176.46662 | 11.0 | -160.8 | NaN | 254.0 | under way using engine |
| 3 | 247119100 | 2015-01-01T06:32:27 | 52.82851 | -176.48291 | 11.0 | -160.6 | NaN | 254.0 | under way using engine |
| 4 | 247119100 | 2015-01-01T06:36:07 | 52.82446 | -176.50022 | 11.0 | -160.0 | NaN | 254.0 | under way using engine |

```
In [86]: Broadcast = Broadcast.drop_duplicates()   # Make sure no dup
         print("After Removed Dup:", Broadcast.shape[0])
```

```
After Removed Dup: 3143096
```

```
In [87]: # Save valid Broadcast to csv
         Broadcast.to_csv(outputfile, index=False)
```