

Global Ocean Modeling And Links To National Inventories

Eric P. Chassignet

Center for Ocean-Atmospheric Prediction Studies

Florida State University

Tallahassee, FL, 32306-2840



- **Marine debris makes its way into the marine environment by way of numerous land-based and at-sea sources.**
- **Due to the relative immensity of the ocean, observations of marine debris or other floating/drifting objects, and direct measurements of ocean surface currents that move them, are relatively sparse.**

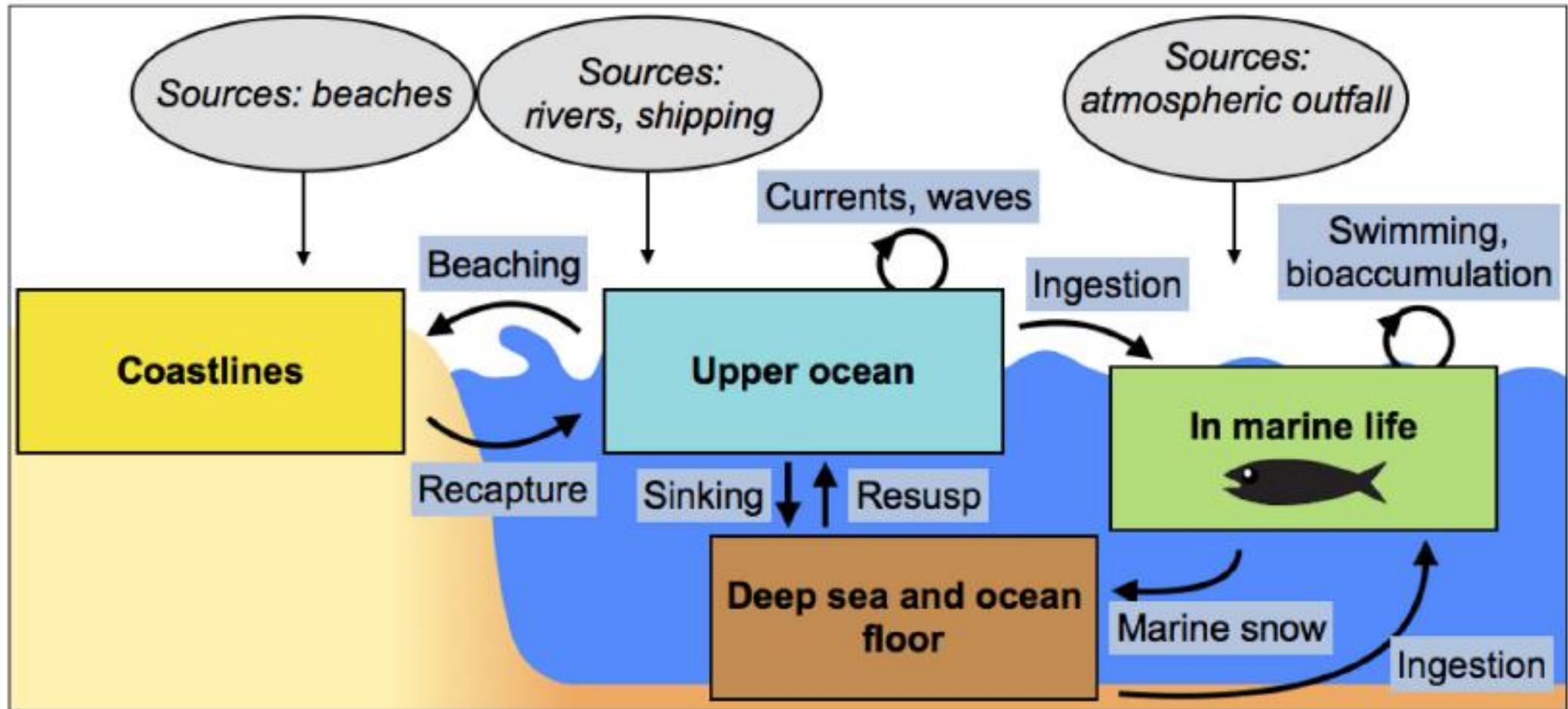
Ocean numerical models can be utilized to simulate the movement of debris for a number of different purposes.

- Models can be used to “fill in the gaps” where few observations are available. Models can also be used to evaluate “what if ” scenarios by varying conditions or parameters one at a time and observing the outcome.
- Models can be applied to forecast the probable trajectories of debris of known origin, or to identify potential sources of debris by predicting the likely paths taken. They also can be used to assess optimal removal locations.

Goals

- **Development of an initial model of marine litter with a focus on West Africa**
- **Validation of the model**
- **Identification of the sources of marine litter in the West African EEZs**

- Many contributing sources of debris in the ocean
- Unknown fate of the debris in the ocean



MAPPING FLOATING PLASTIC DEBRIS EXCHANGES BETWEEN REGIONS

WEU

Belgium
Cyprus
Denmark
Finland
France
Germany
Greece
Iceland
Ireland
Italy
Malta
Netherlands
Norway
Portugal
Spain
Sweden
Turkey
UK

EEU

Albania
Bosnia
Bulgaria
Croatia
Poland
Romania
Slovenia

FSU

Estonia
Georgia
Latvia
Lithuania
Russia
Ukraine

CPA

Cambodia
China
North Korea
Vietnam

PAS

Solomon Is.
Brunei
Myanmar
French Polynesia
Indonesia
South Korea
Malaysia
New Caledonia
Vanuatu
PNG
Philippines
East Timor
Singapore
Thailand
Samoa

MEA

Algeria
Bahrain
Iran
Iraq
Israel
Jordan
Kuwait
Lebanon
Libya
Morocco
Oman
Qatar
Saudi Arabia
Sudan
Syria
UAE
Tunisia
Egypt
Yemen

LAM

Argentina
Bahamas
Barbados
Brazil
Belize
Chile
Colombia
Costa Rica
Cuba
Dom. Rep.
Ecuador
El Salvador
Guadeloupe
Guatemala
Guyana
Haïti
Honduras
Jamaica
Martinique
Mexico
Nicaragua
Panama
Peru
Suriname
Trin.and Tob.
Uruguay
Venezuela

NAM

Canada
Puerto Rico
United States

PAO

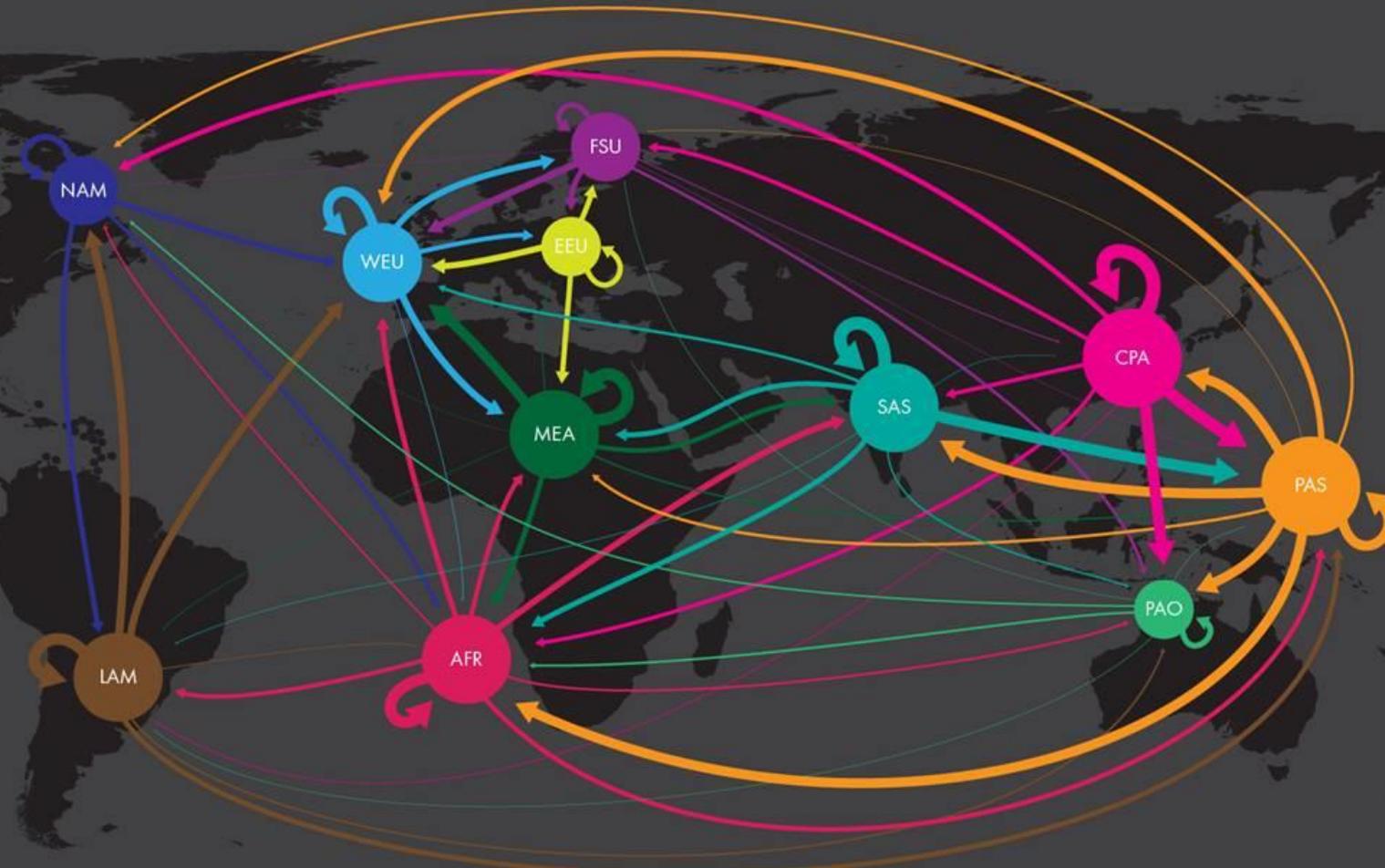
Australia
Japan
New Zealand

AFR

Angola
Cameroon
Cape Verde
Comoro Islands
Rép. du Congo
Dem Rep of Congo
Benin
Equatorial Guinea
Eritrea
Djibouti
Gabon
Gambia
Ghana
Guinea
Ivory Coast
Kenya
Liberia
Madagascar
Mauritania
Mauritius
Mozambique
Namibia
Nigeria
Guinea Bissau
Réunion
Senegal
Sierra Leone
Somalia
South Africa
Togo
Tanzania

SAS

Bangladesh
Sri Lanka
India
Maldives
Pakistan



Mismanaged Plastic Waste 2010
(x1000 Tonnes)

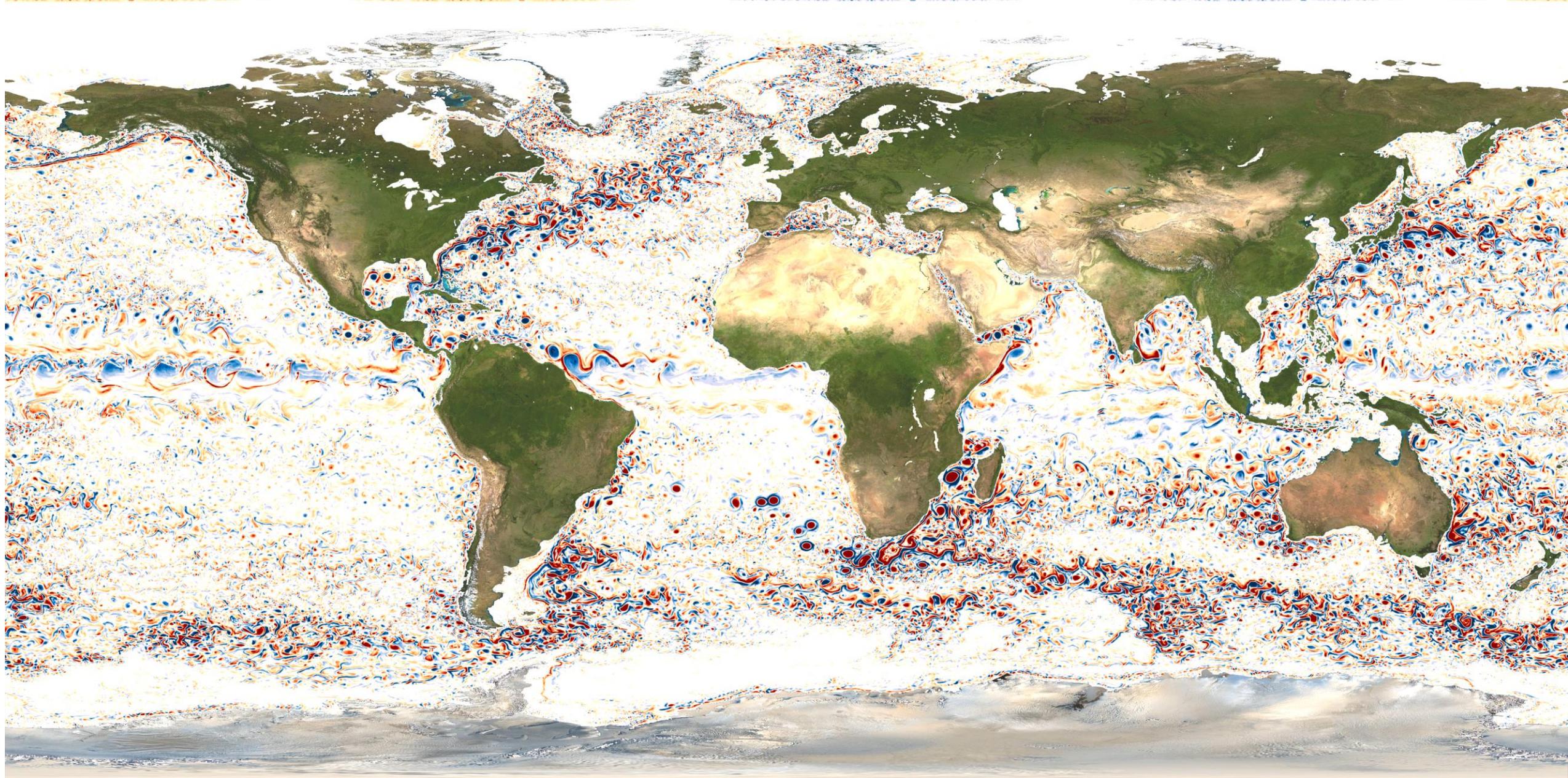


Rate of exchange
(particles per day in EEZ)



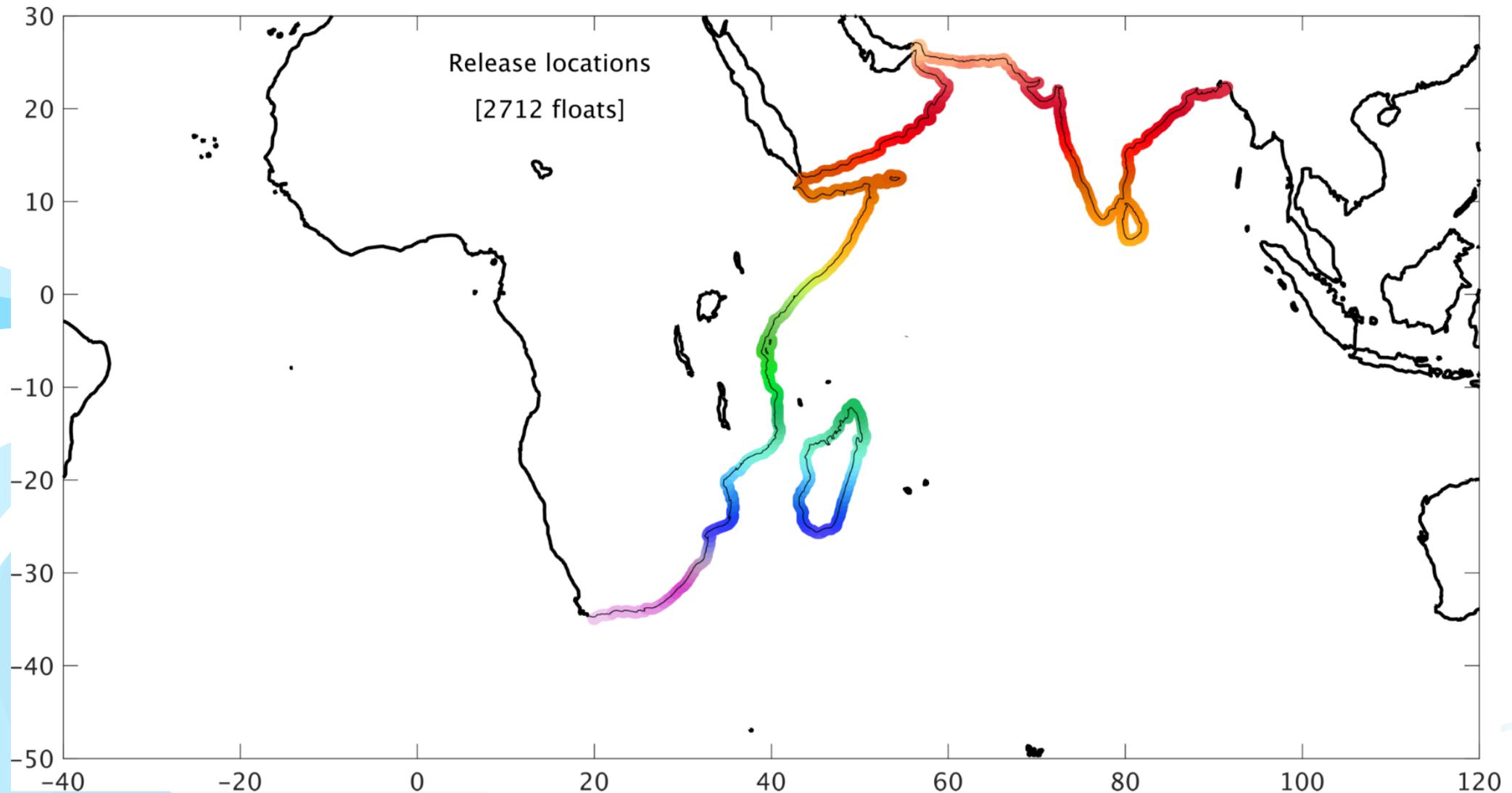
Strategy to simulate the movement of marine litter off Africa

- 1) seed particles for each coastal countries with the number of particles proportional to the estimate based on Jambeck et al. (2015; 2018), taking into account the per capita waste generated annually, percentage of plastic in the waste, and percentage of mismanagement (ended in the ocean).
- 2) simulate/track the movement of the waste using the latest Parcels Lagrangian framework and the surface ocean circulation based on the data-assimilated 1/12° global reanalysis system, with a high output frequency (3 hourly).

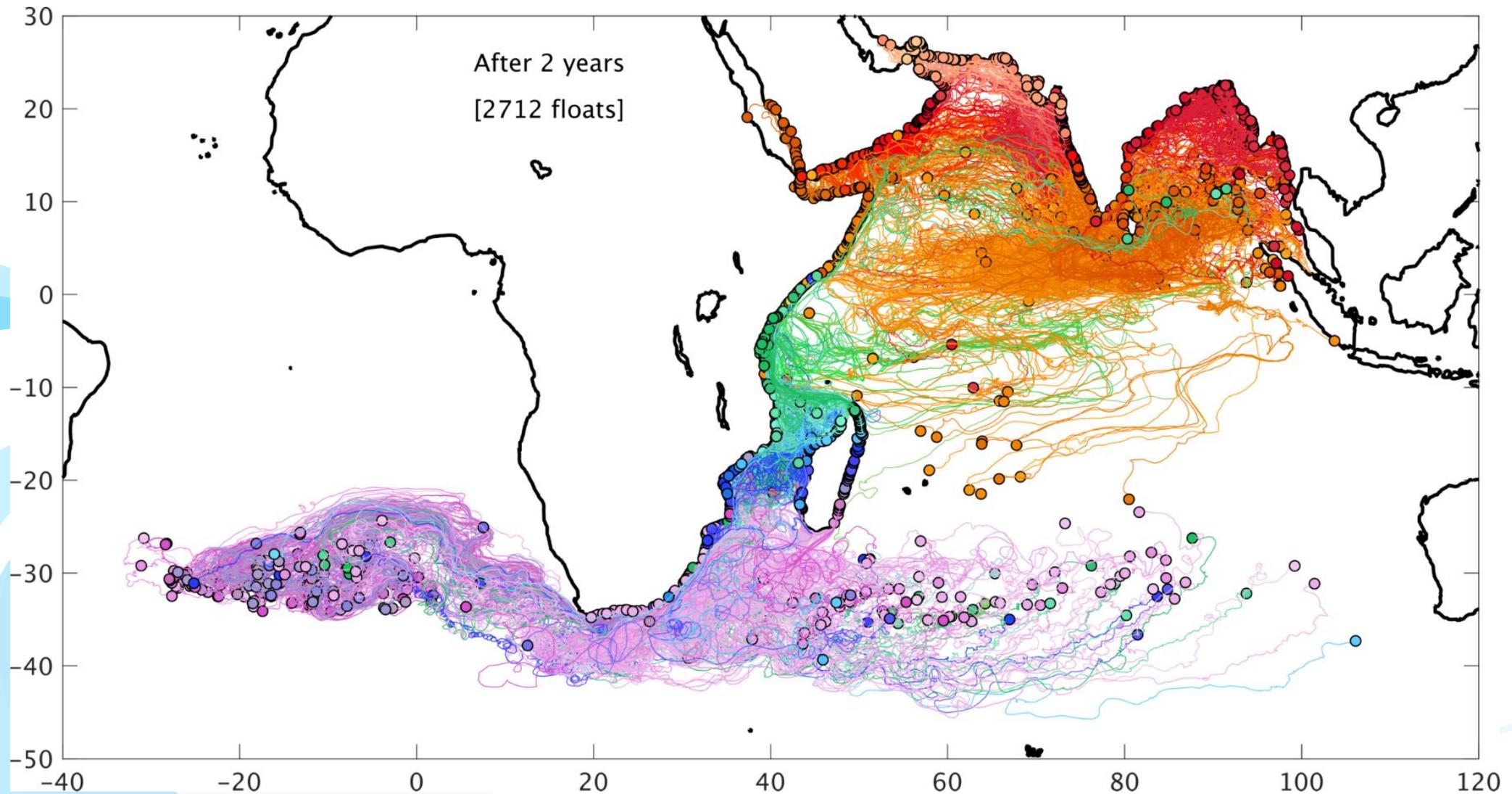


State of the art high resolution global model (~4 km grid spacing)

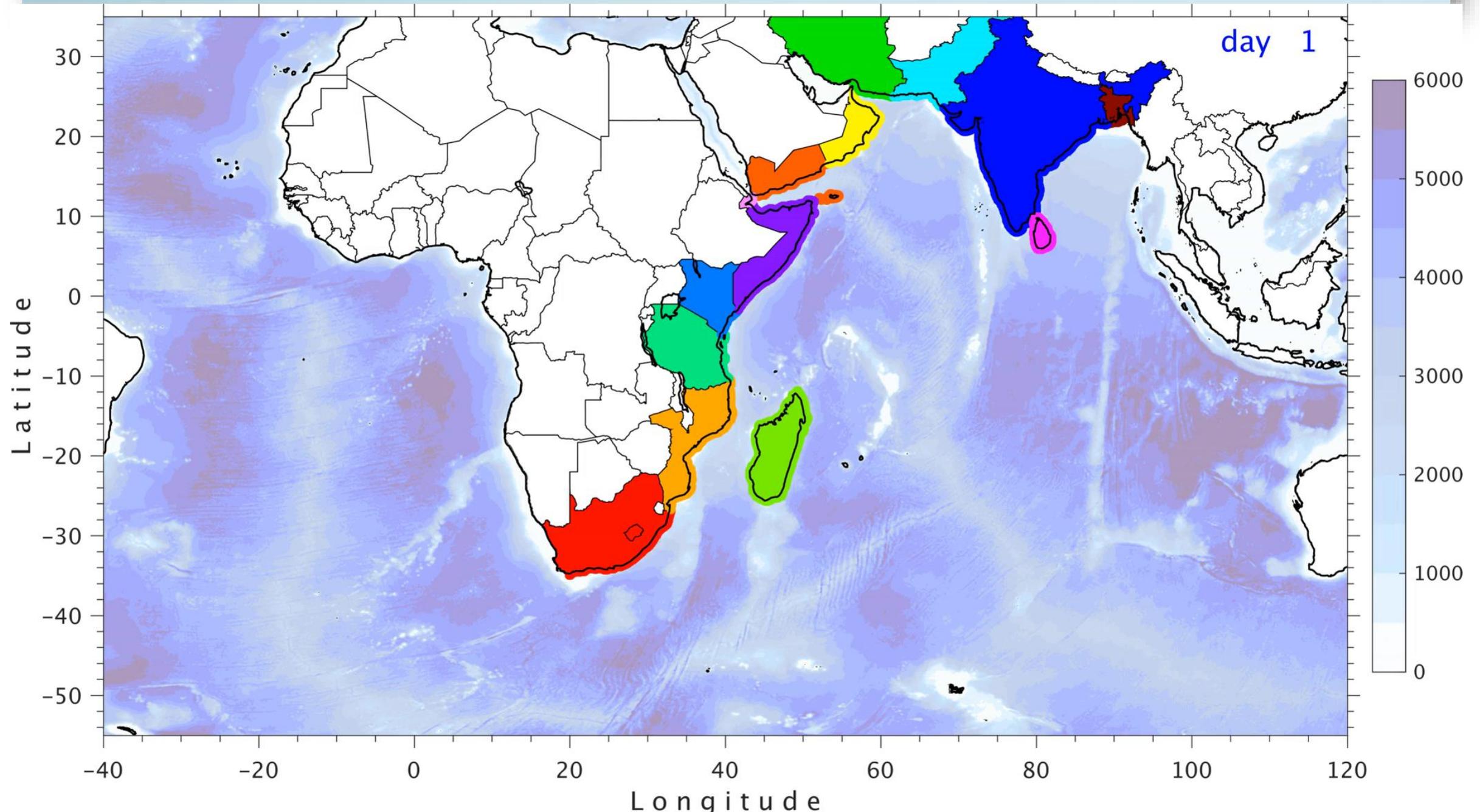
Marine debris can be modeled as a particle or float



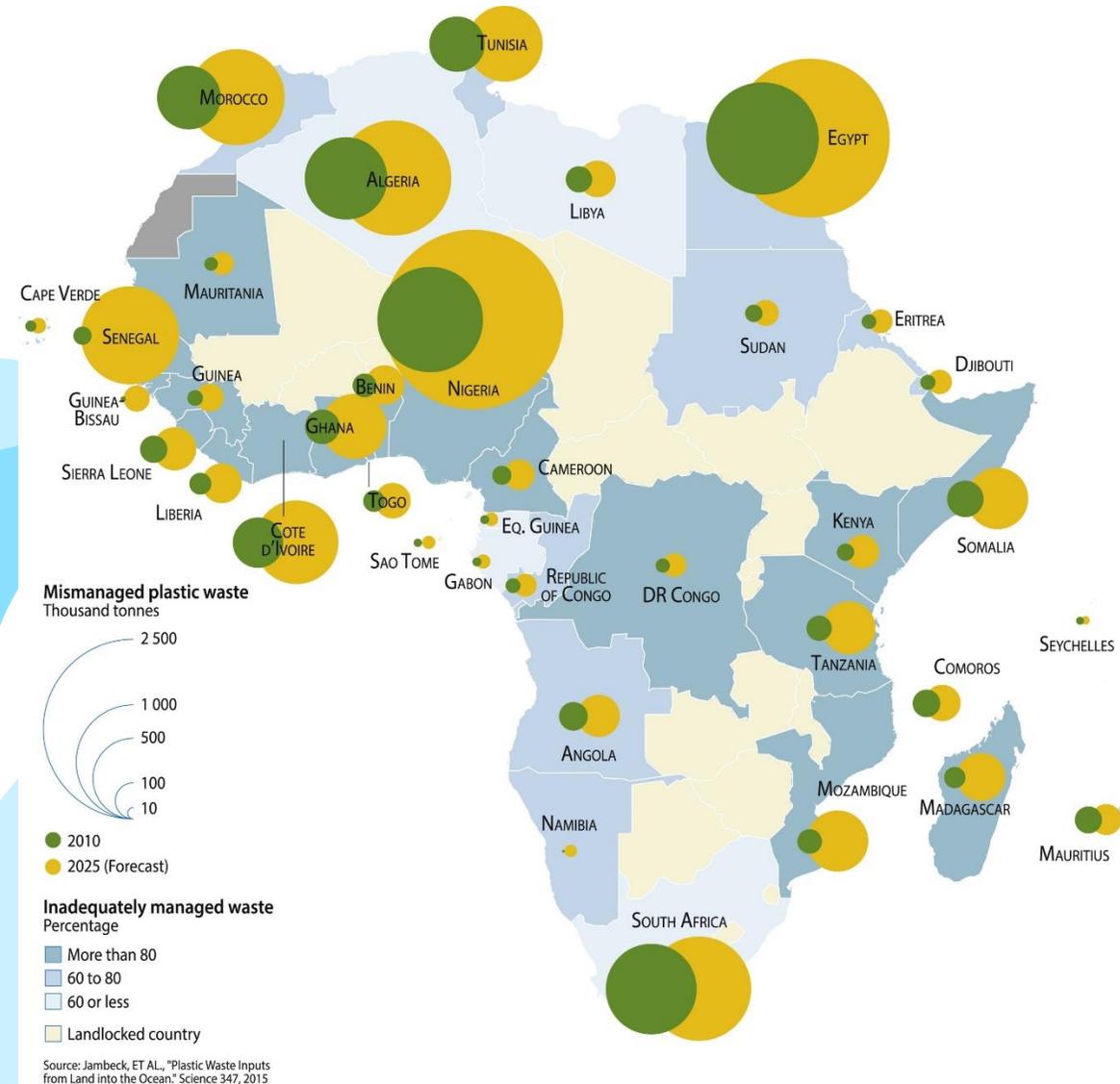
Marine debris can be modeled as a particle or float



Preliminary attempt to link to national source inventory



Plastic waste in Africa: Estimates and sources



- Mismatched waste in tons/year estimated for 2010 and projected for 2025 (Approximately 80% are plastics entering the ocean).
- Source location for the model are located near river mouths and/or major cities (roughly 4 km from the coast)
- For countries without many rivers or major coastal towns, sources are uniformly distributed along the coast.