

Wind Wave **Footprint** of Tropical Cyclones based on satellite data

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Universidad de Cantabria

Why?

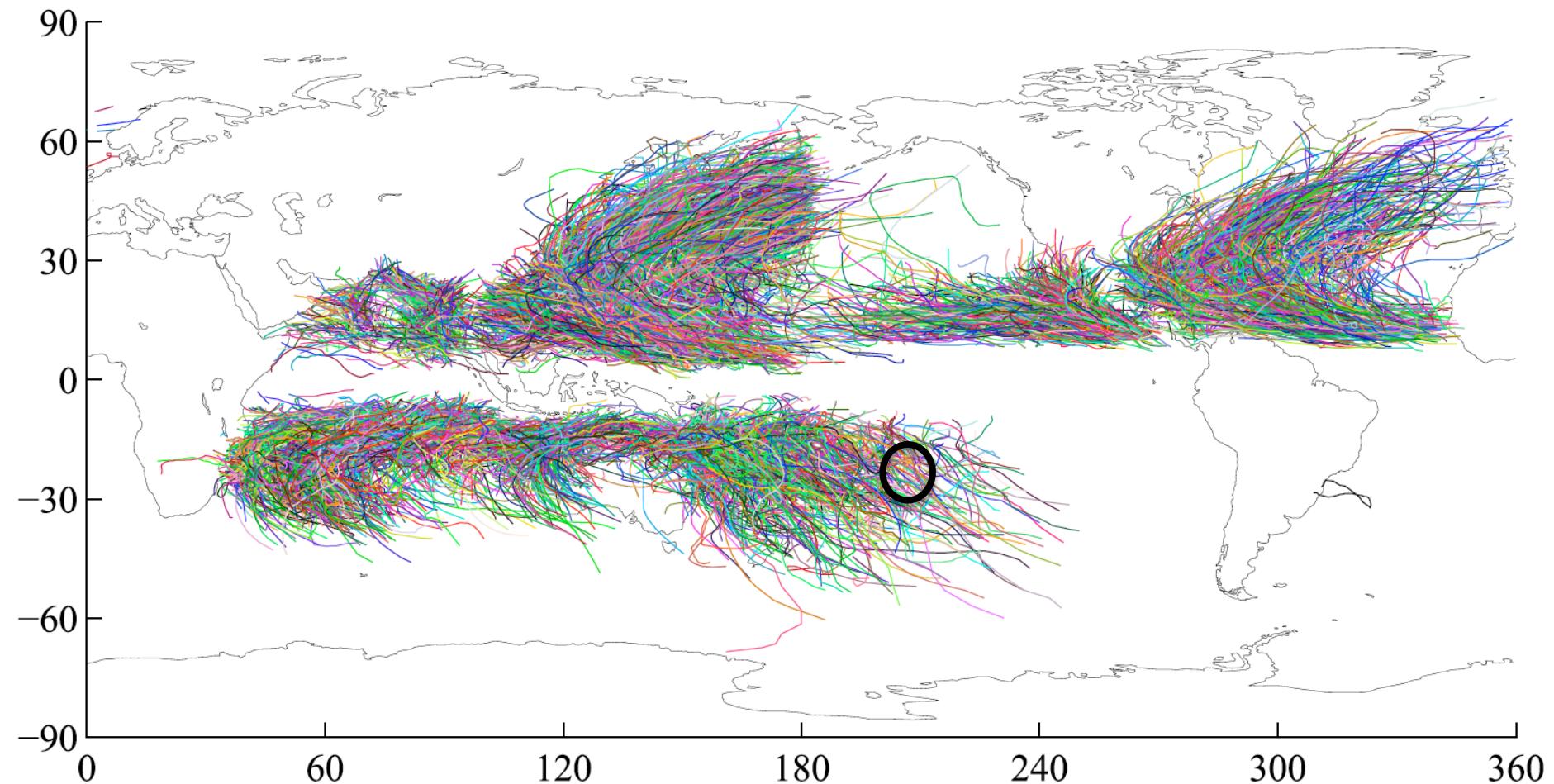
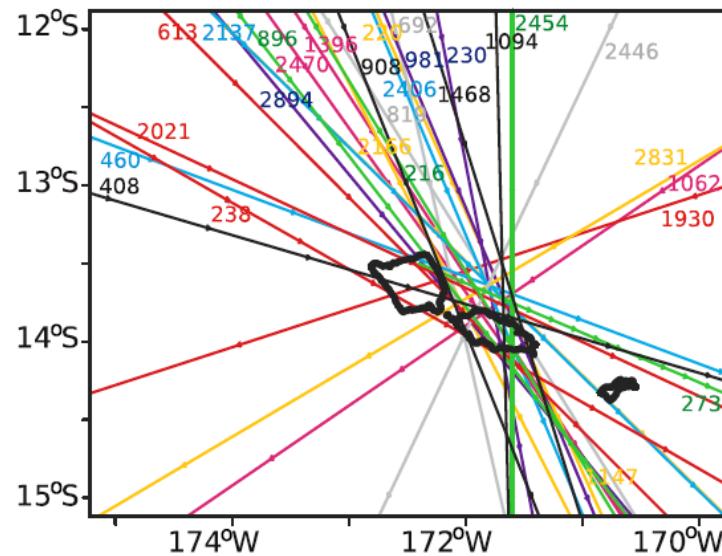


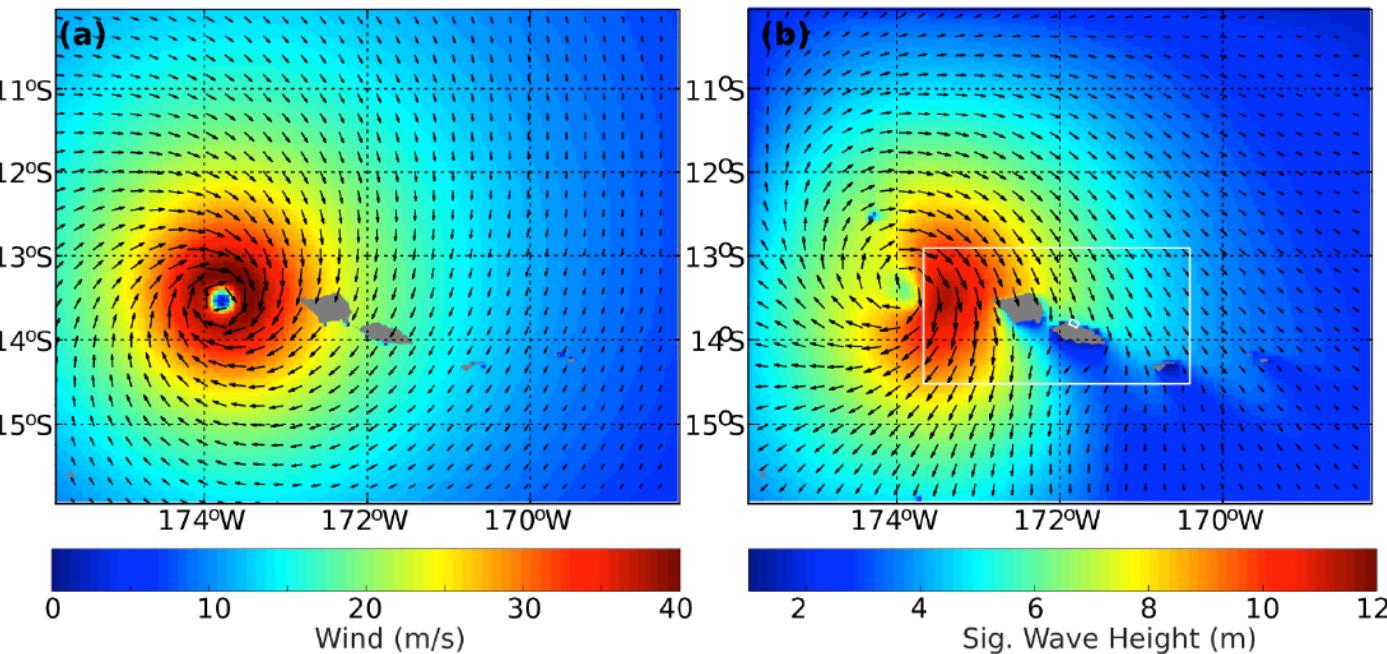
FIG. 10. Tracks of observed TCs in IBTrACS (1950–2000).

From Nakajo et al 2014

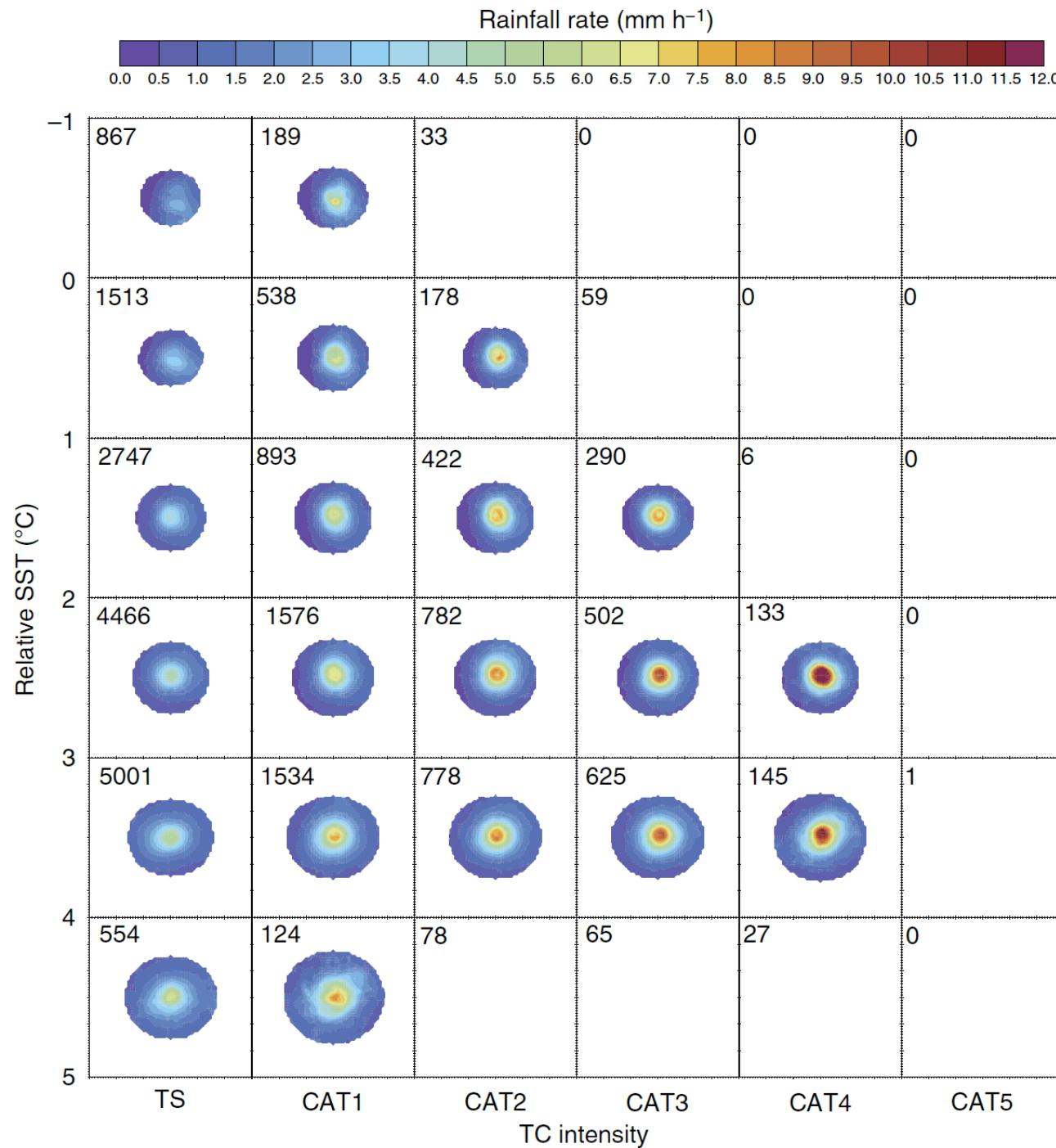
Synthetic Generation of Tropical Cyclones (Hoeke et al 2016)



+ Numerical Modeling of each tropical cyclone....

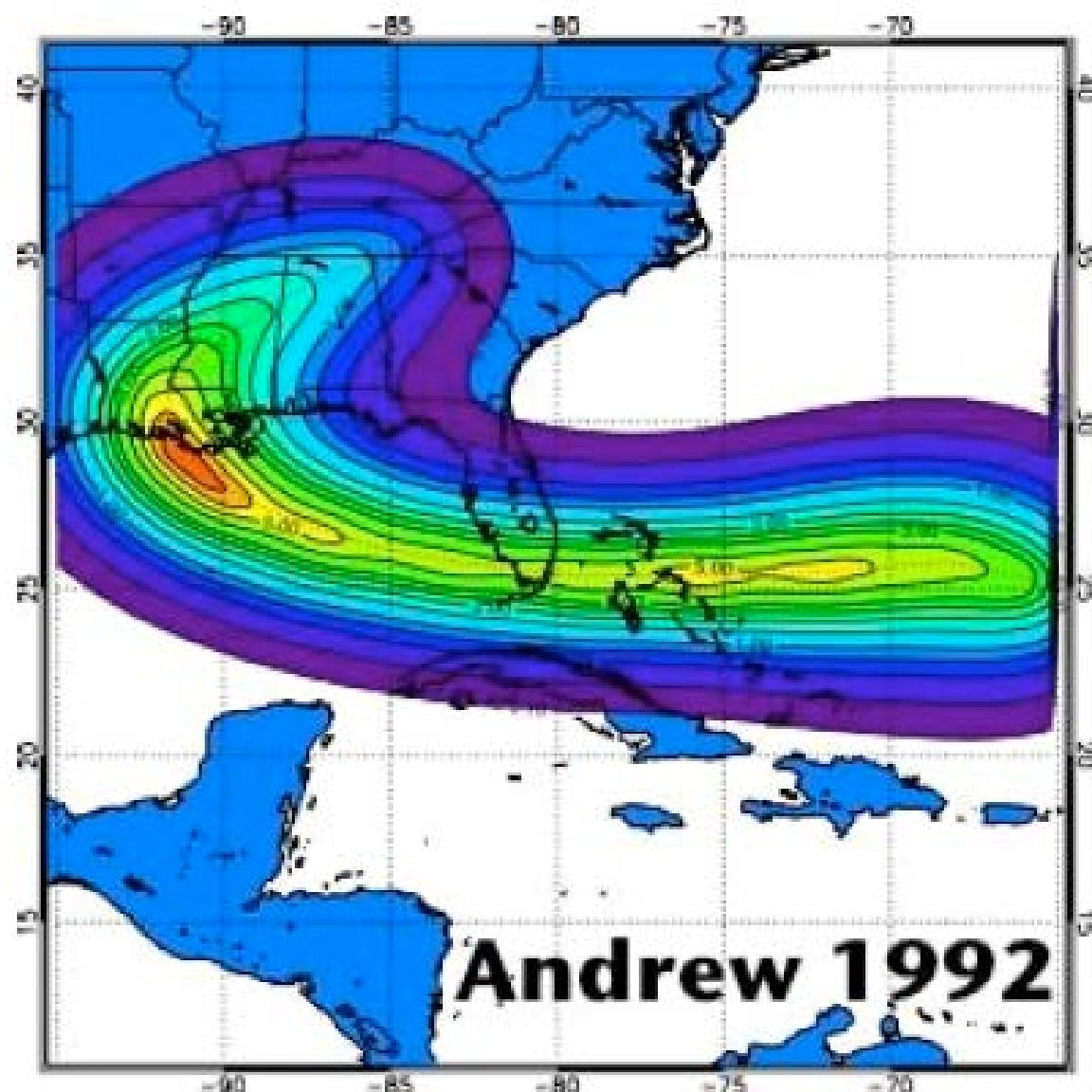
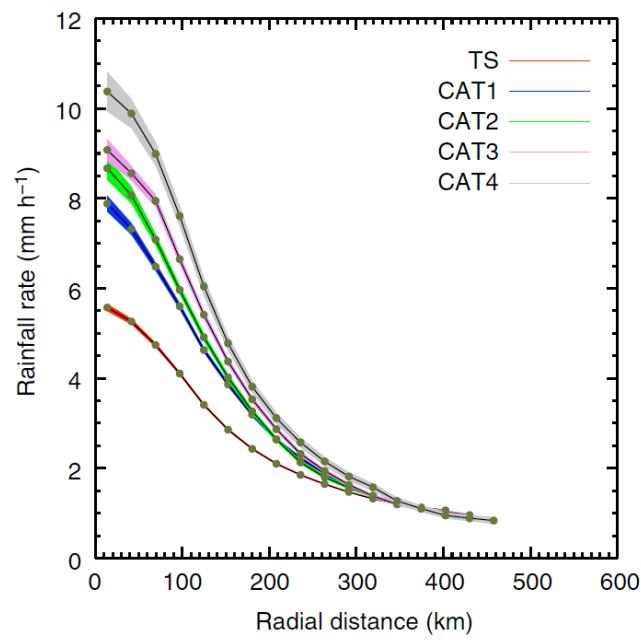


The idea...



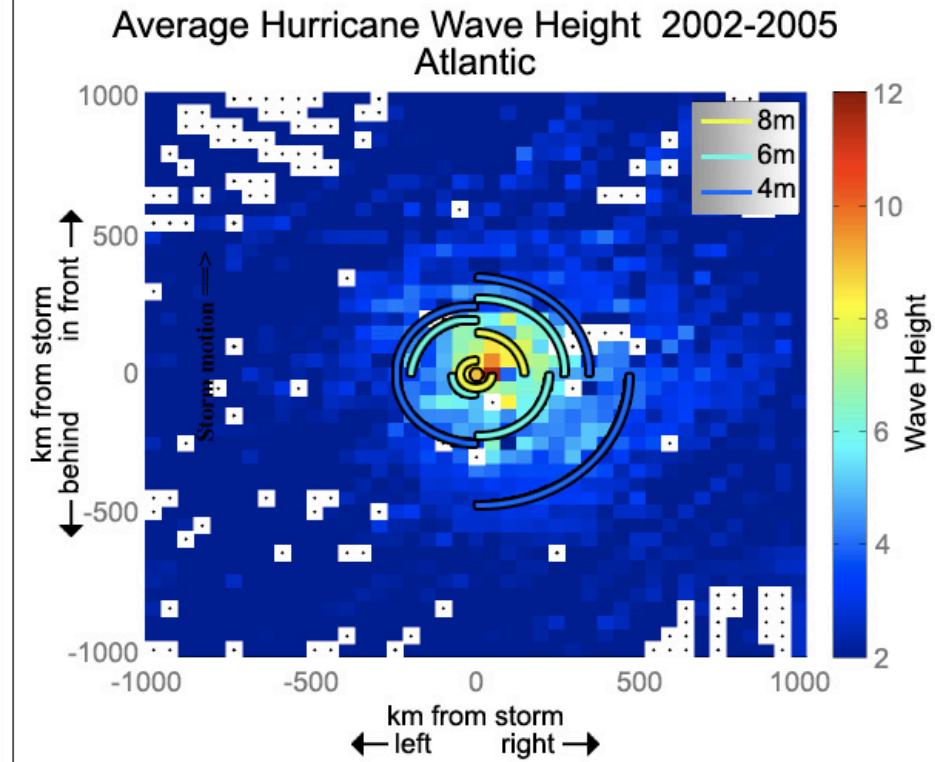
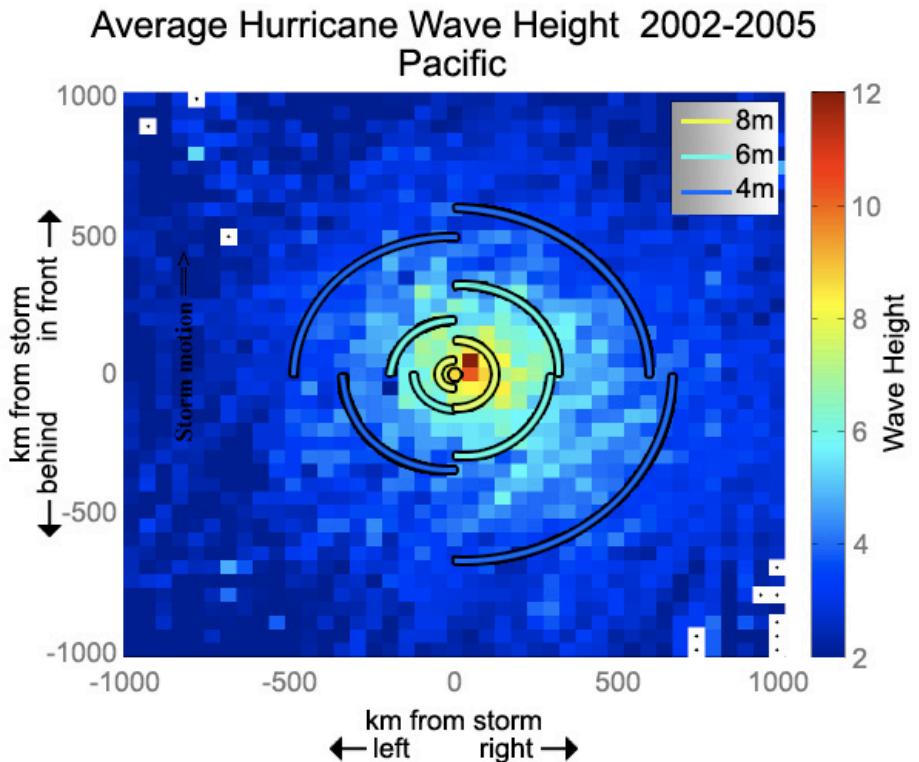
The idea...

Lin et al 2015



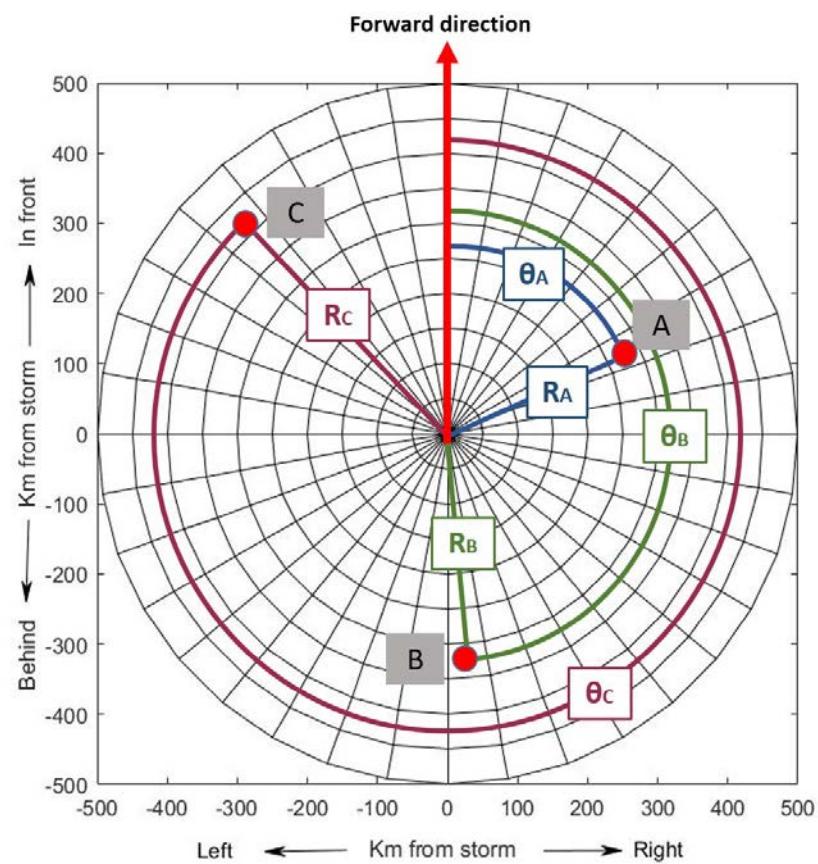
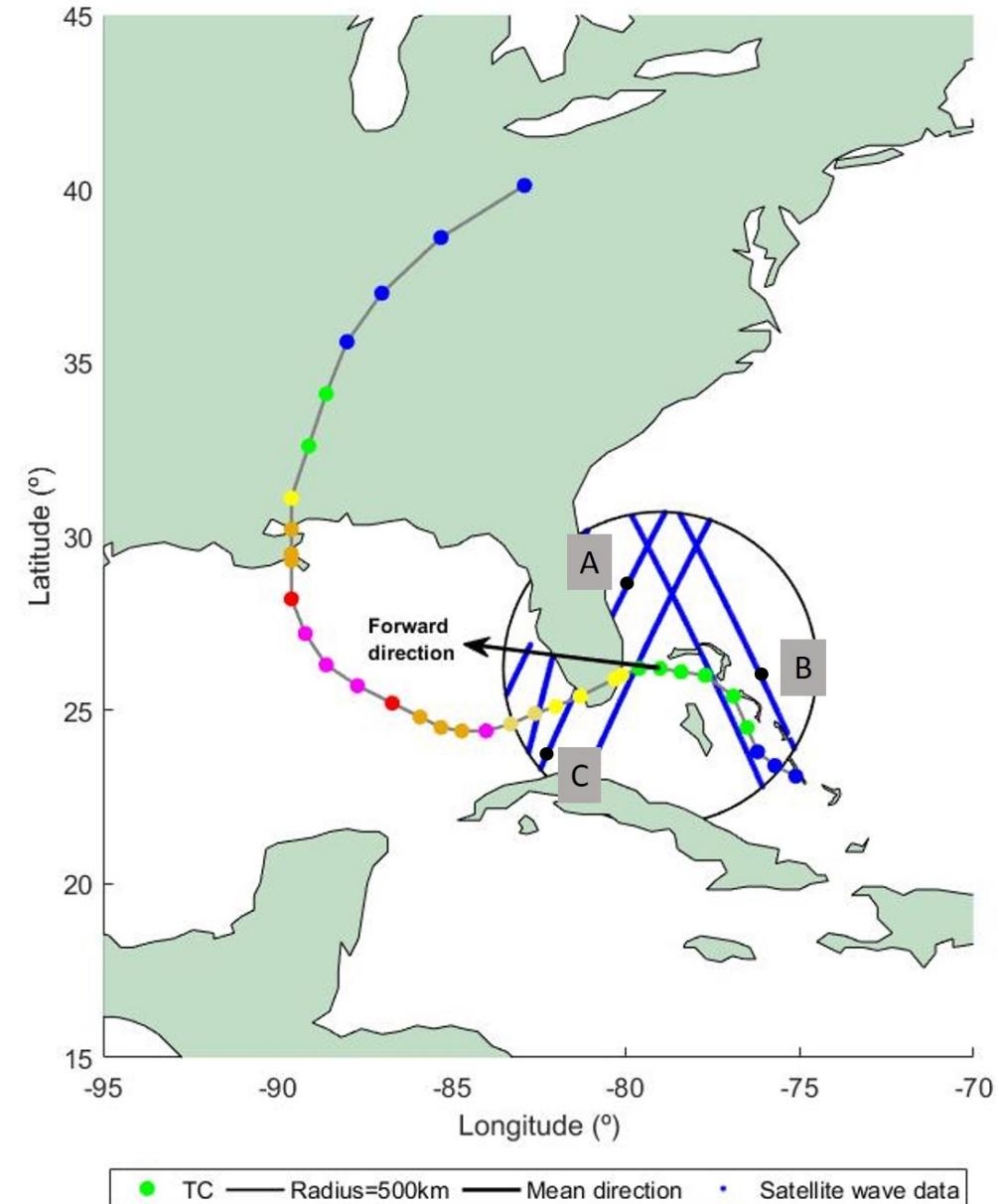
Model R-CLIPER, Marks and DeMaria 2003

First attempts for modelling TC-induced wind wave height

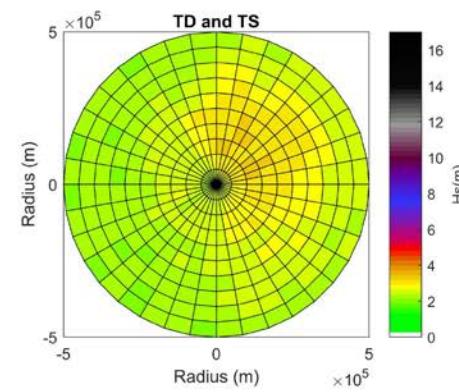
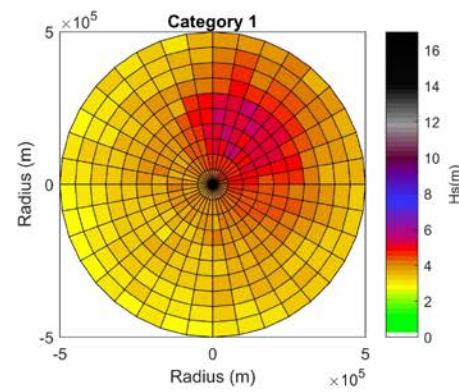
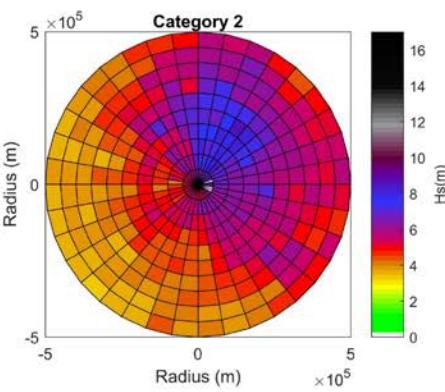
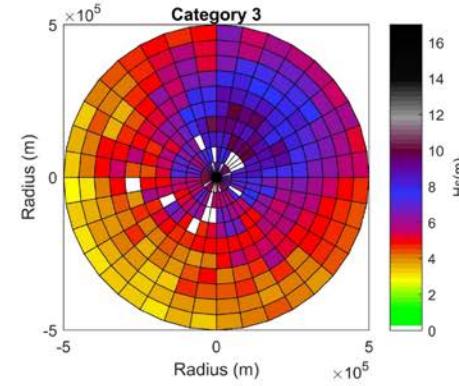
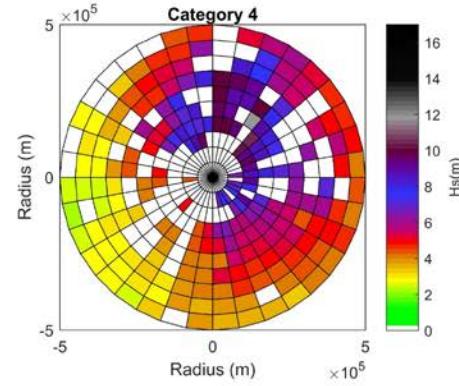
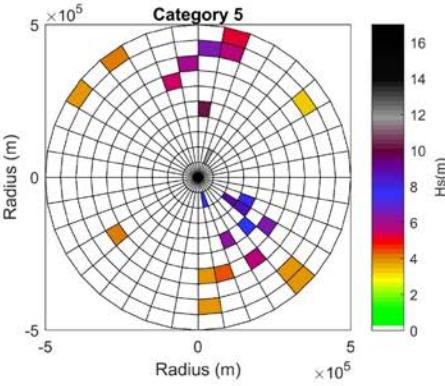


Oslund and Callahan (2010) Ocean Sciences Meeting, Portland.

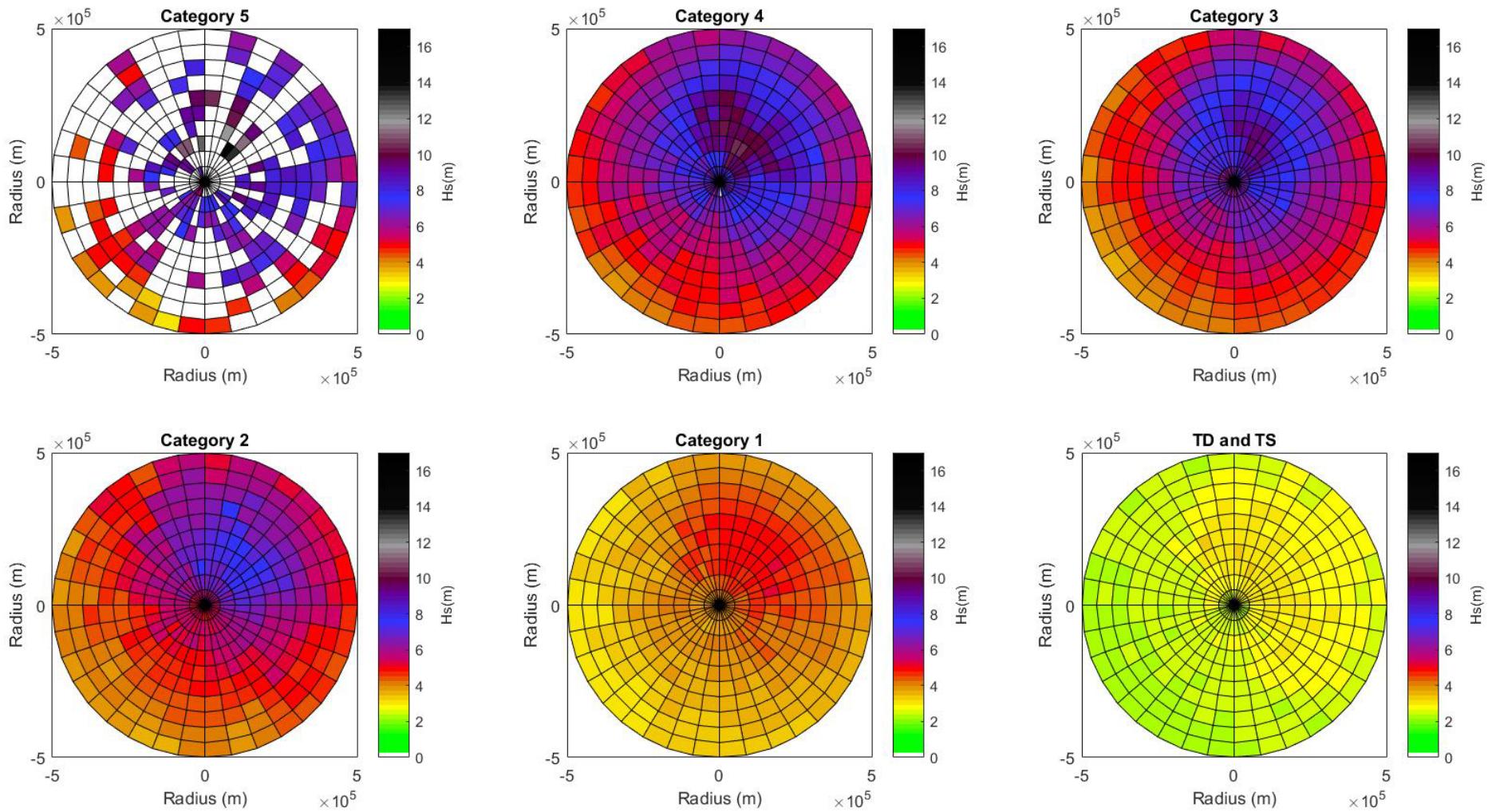
Conceptual Model



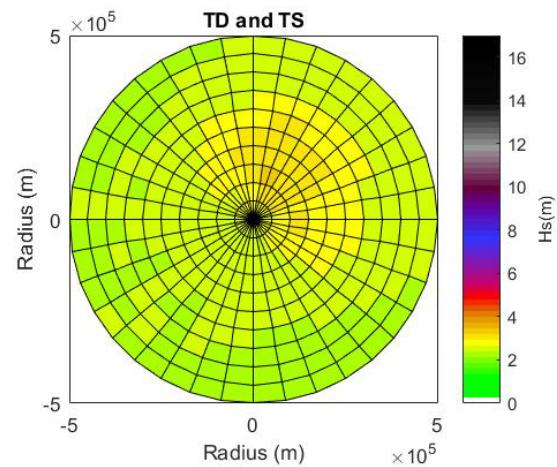
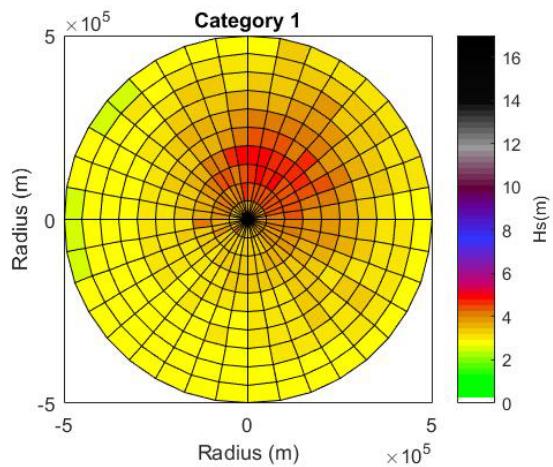
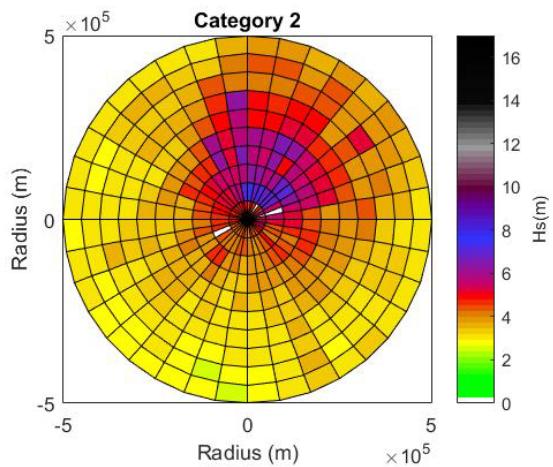
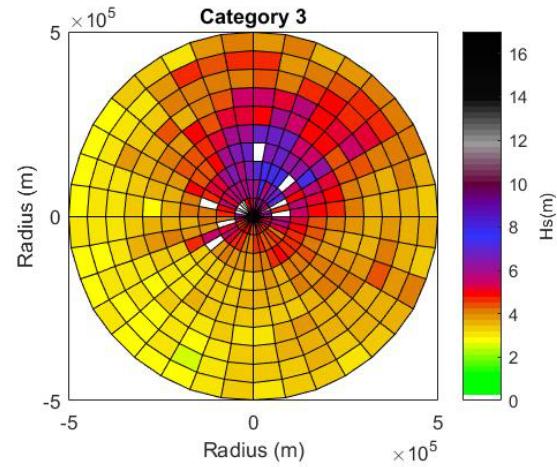
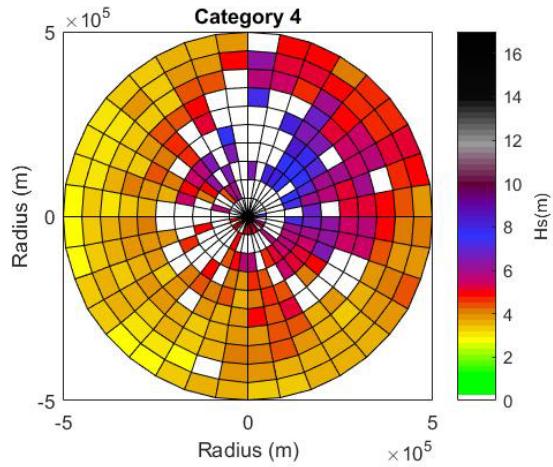
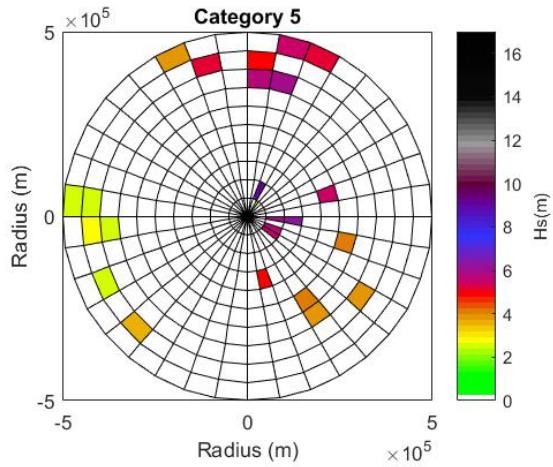
Data from North
Atlantic +
Caribbean + Gulf
of Mexico



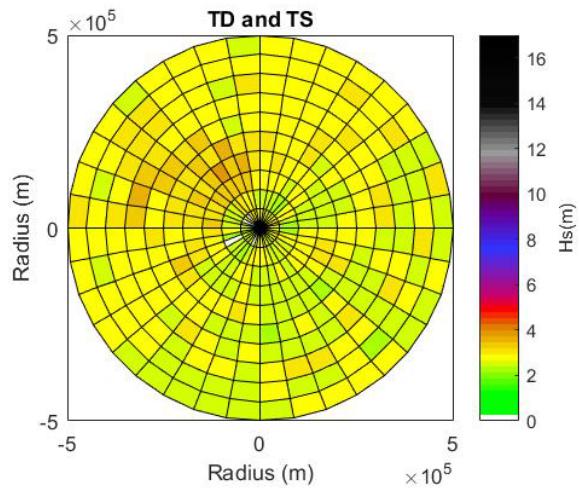
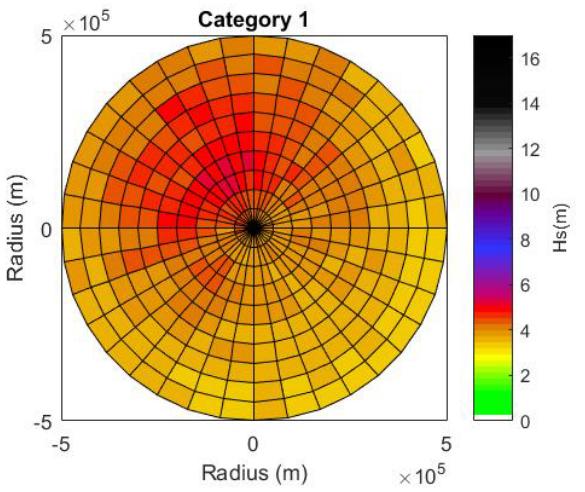
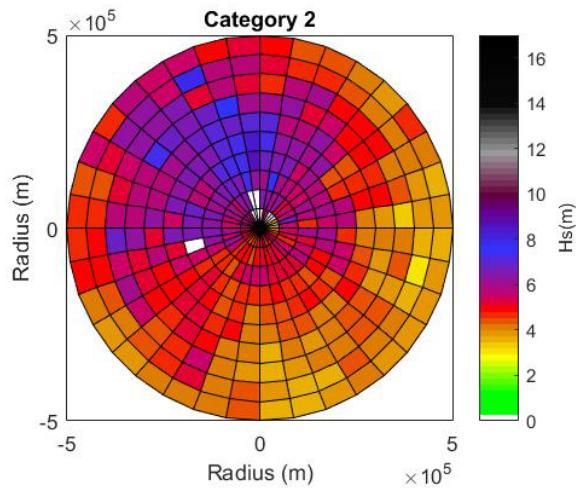
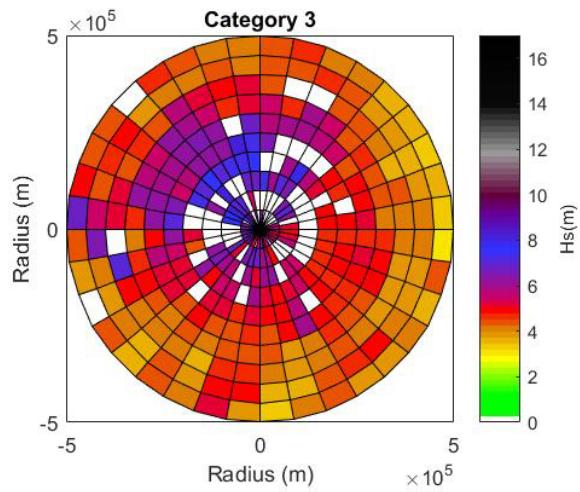
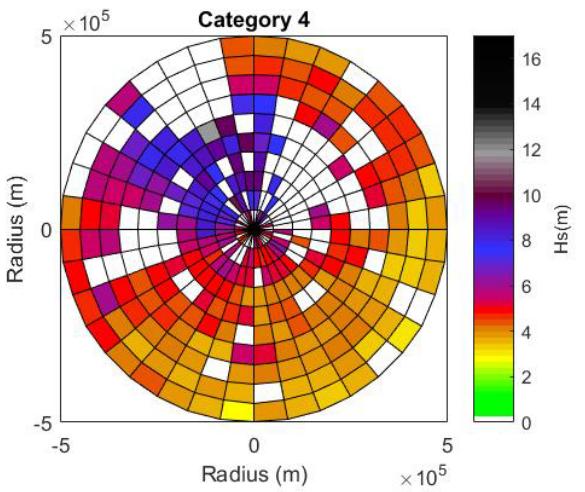
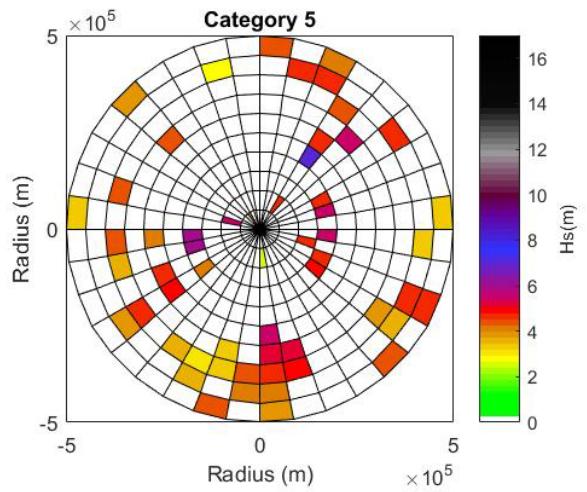
PRESSURE	CATEGORY
<920	5
920-944	4
944-964	3
964-979	2
980-1000	1
>1000	TD/TS



Data from Western North Pacific

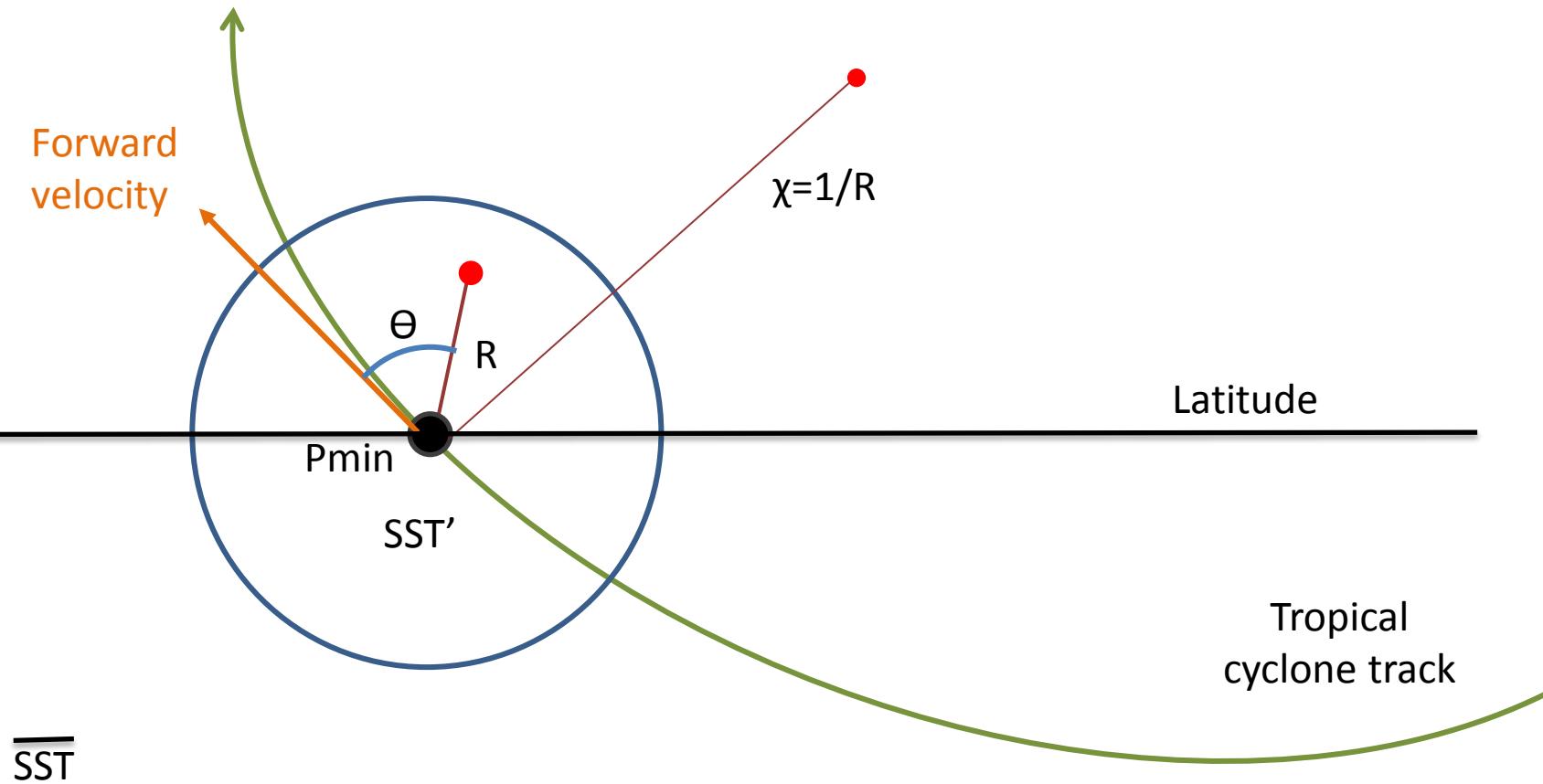


Data from Eastern North Pacific

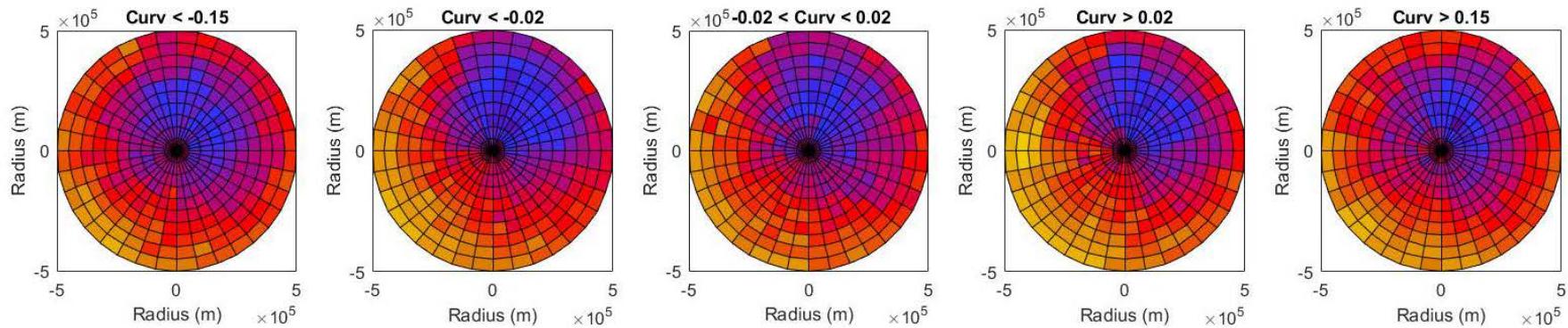
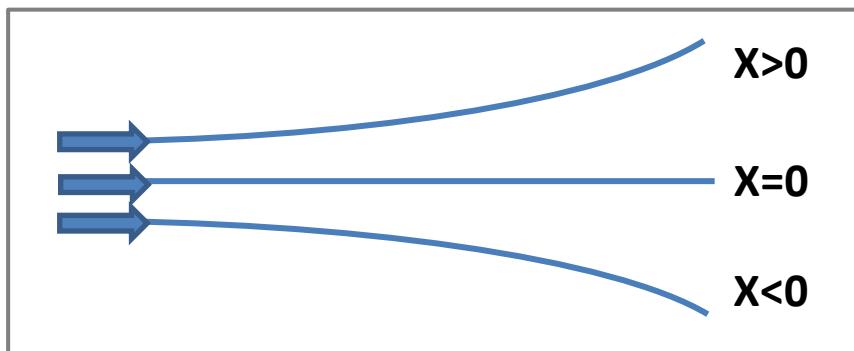


Data from South Pacific

Influence of geometry and environment

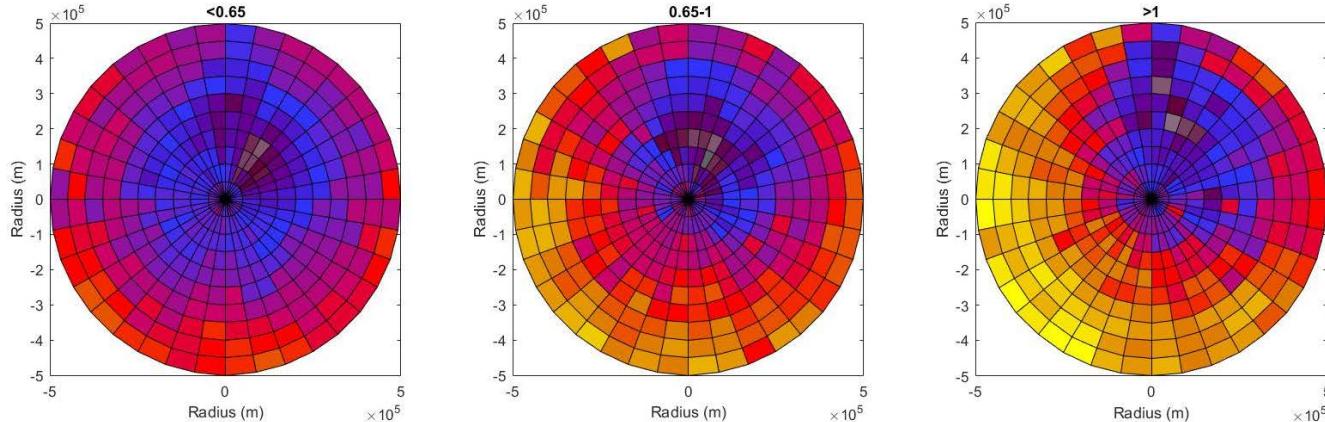


Curvature

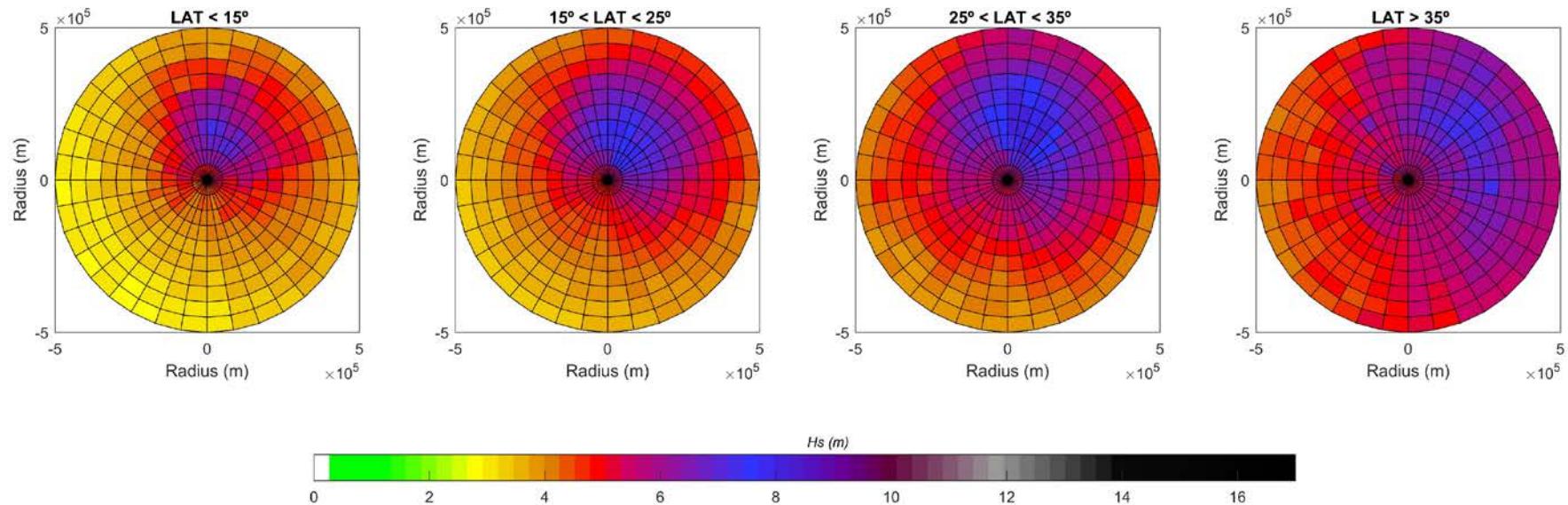


Forward Velocity

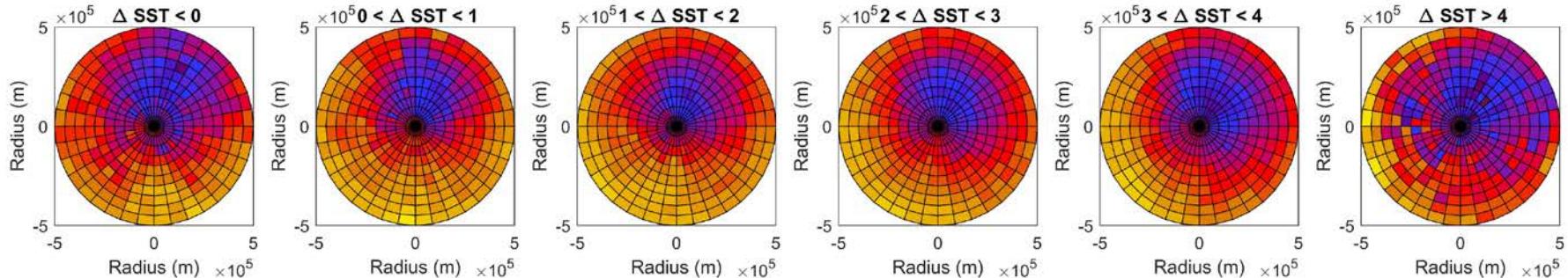
$$\frac{V}{\overline{V}}$$



Latitude



Sea Surface Temperature Anomalies



Classification in 5D of Hs(Dir,R).... 1.1 million data

- Pmin
- Latitude
- Relative SST
- Curvature
- Forward Velocity
- K-means
- Self Organizing Maps... SOM



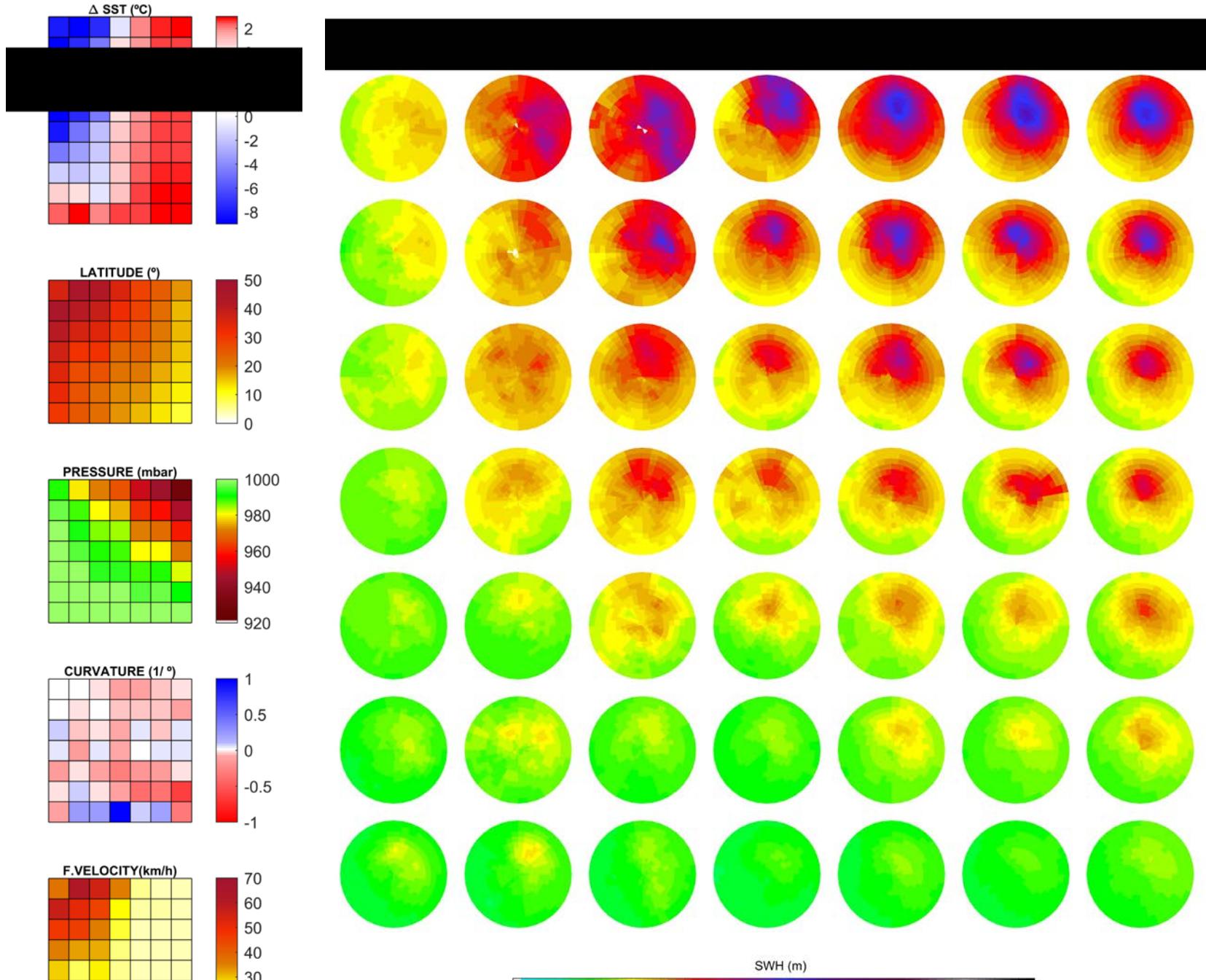
Example: Classification of Tomatos

- Size
- Color
- Ripeness

2D lattice

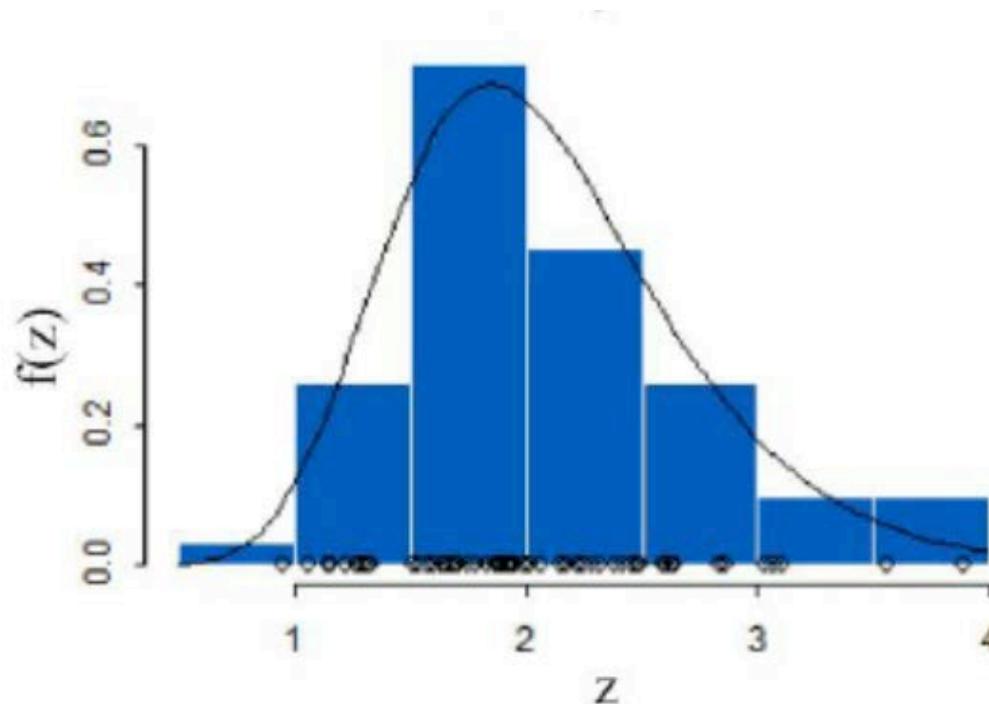
Smooth transition between groups

Classification in 5D ... Self Organizing Maps SOM (N=49 groups)

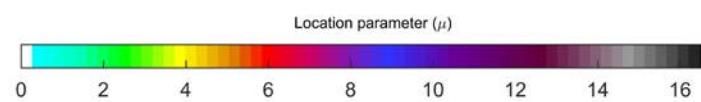
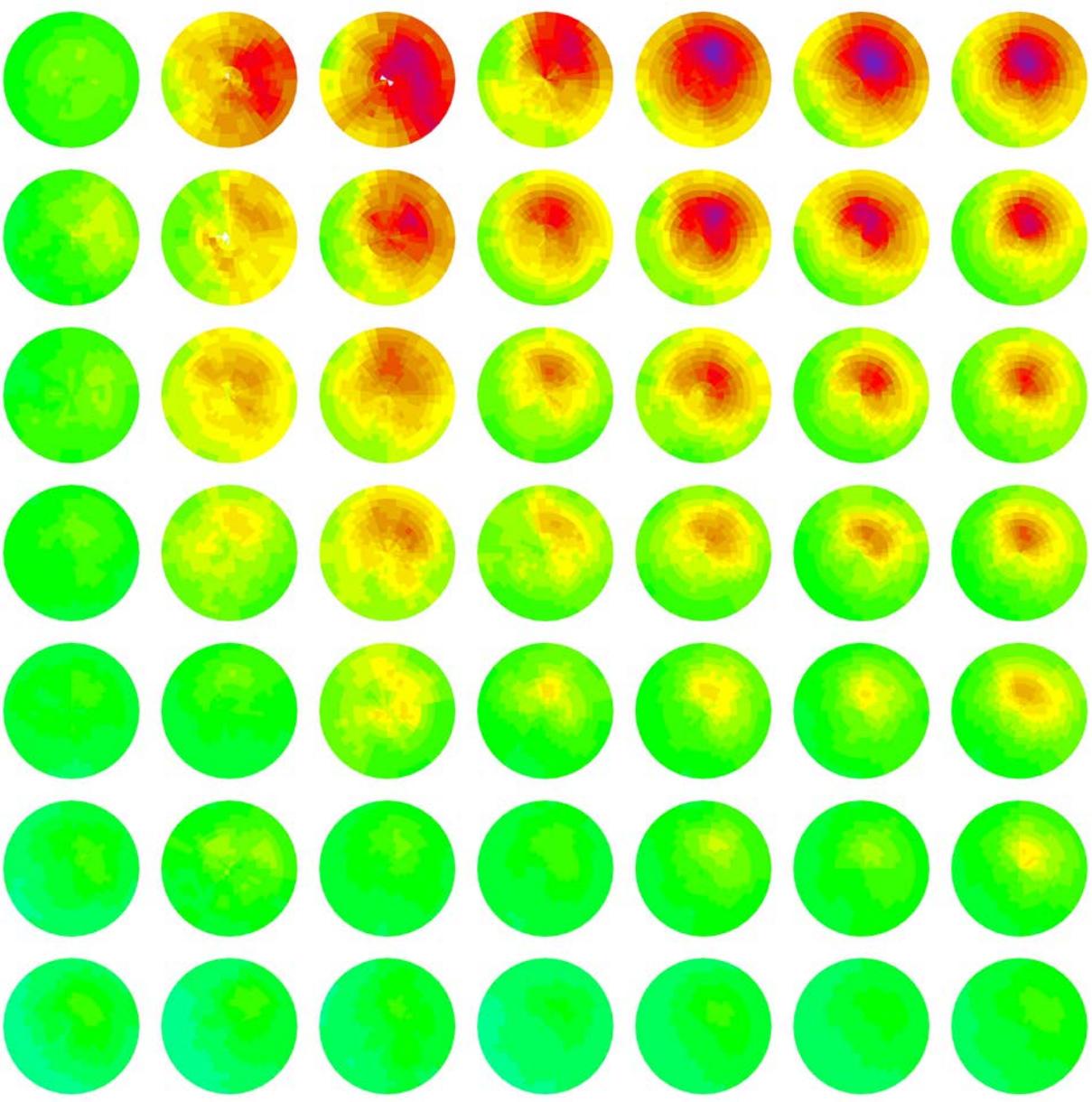
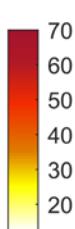
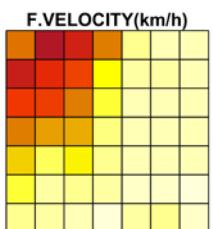
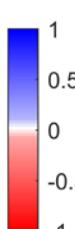
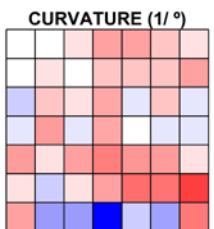
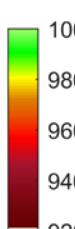
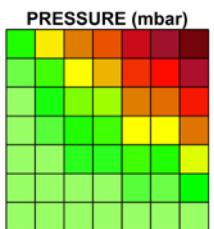
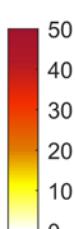
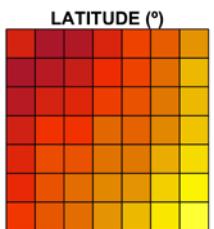
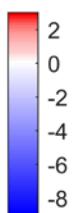
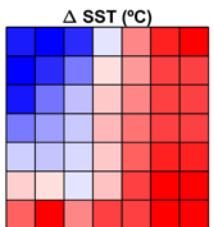


Classification in 5D ... SOM + Statistical Model

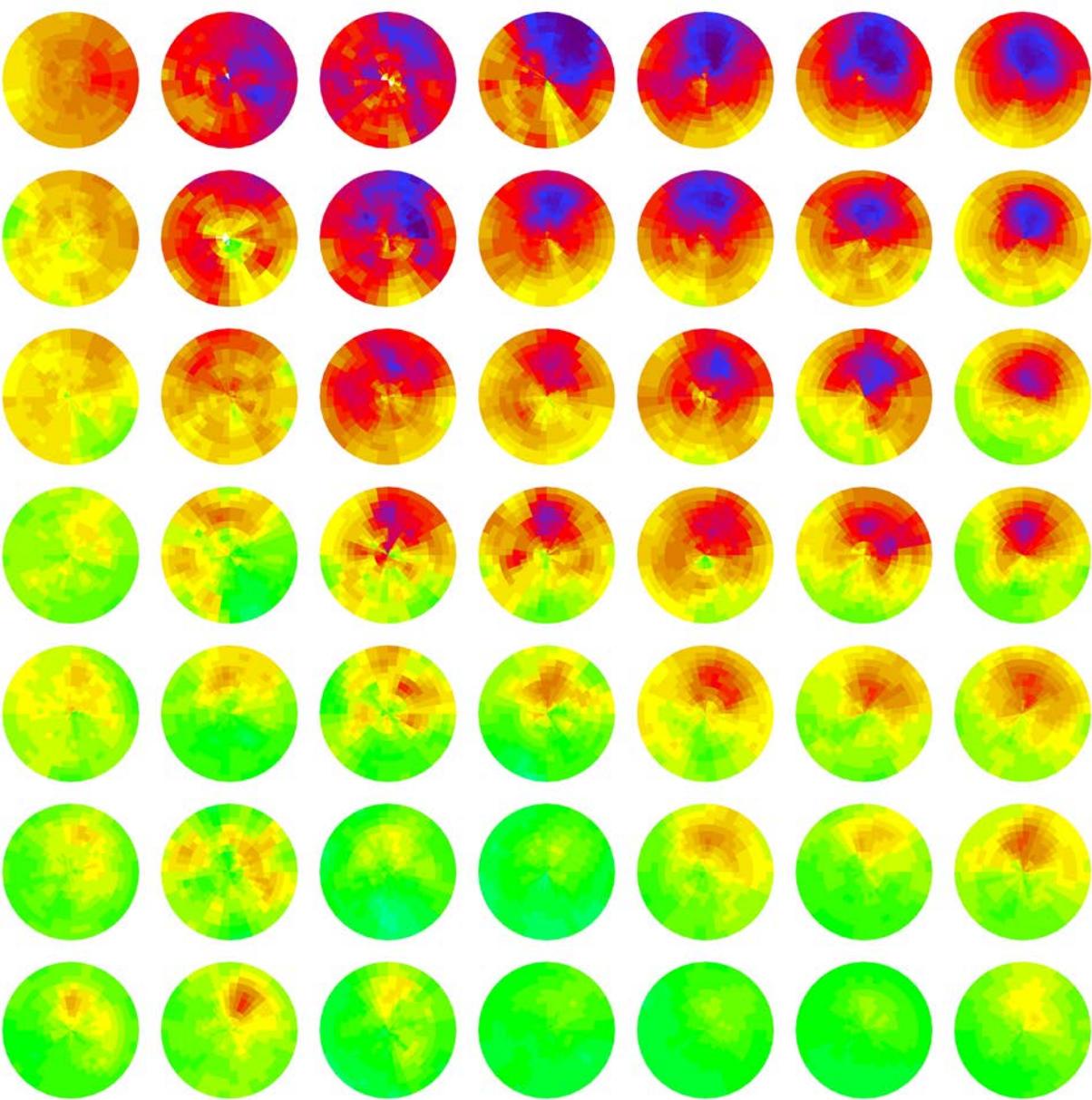
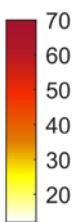
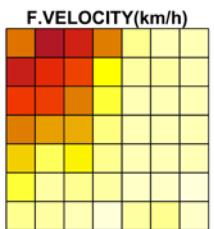
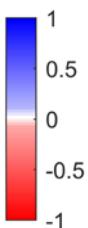
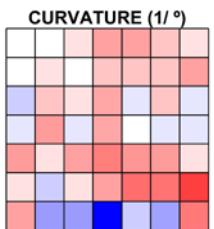
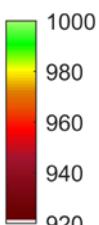
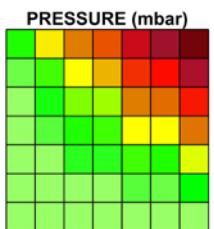
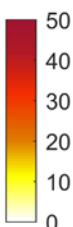
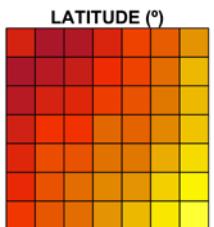
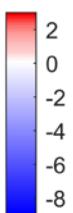
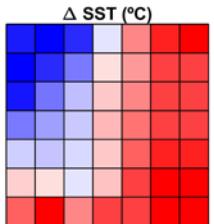
$$F(x; \theta) = \exp \left\{ - \left[1 + \xi \left(\frac{x - \mu}{\psi} \right) \right]^{-1/\xi} \right\}$$



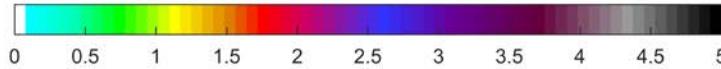
Location Parameter



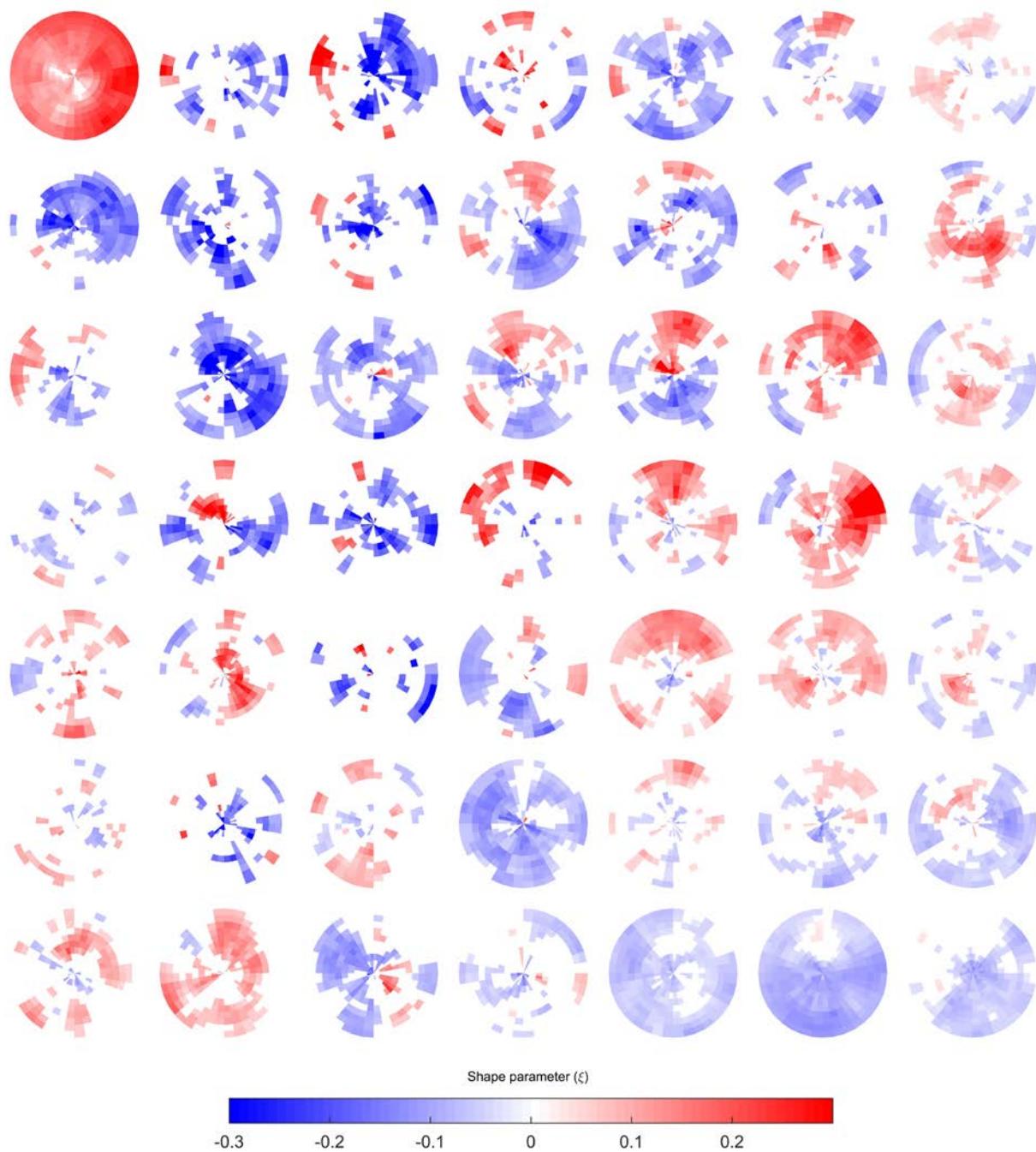
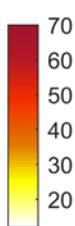
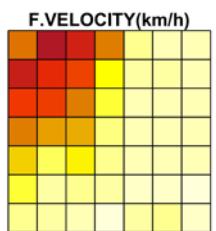
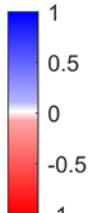
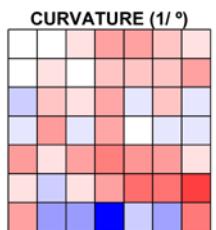
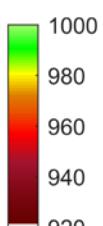
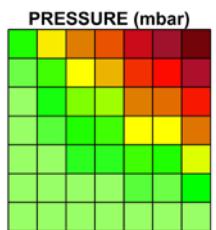
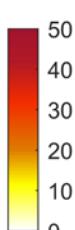
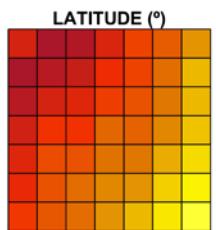
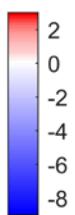
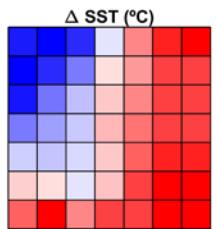
Scale Parameter



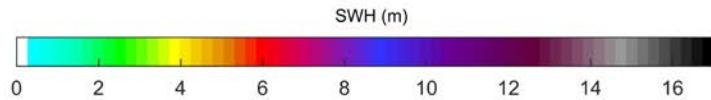
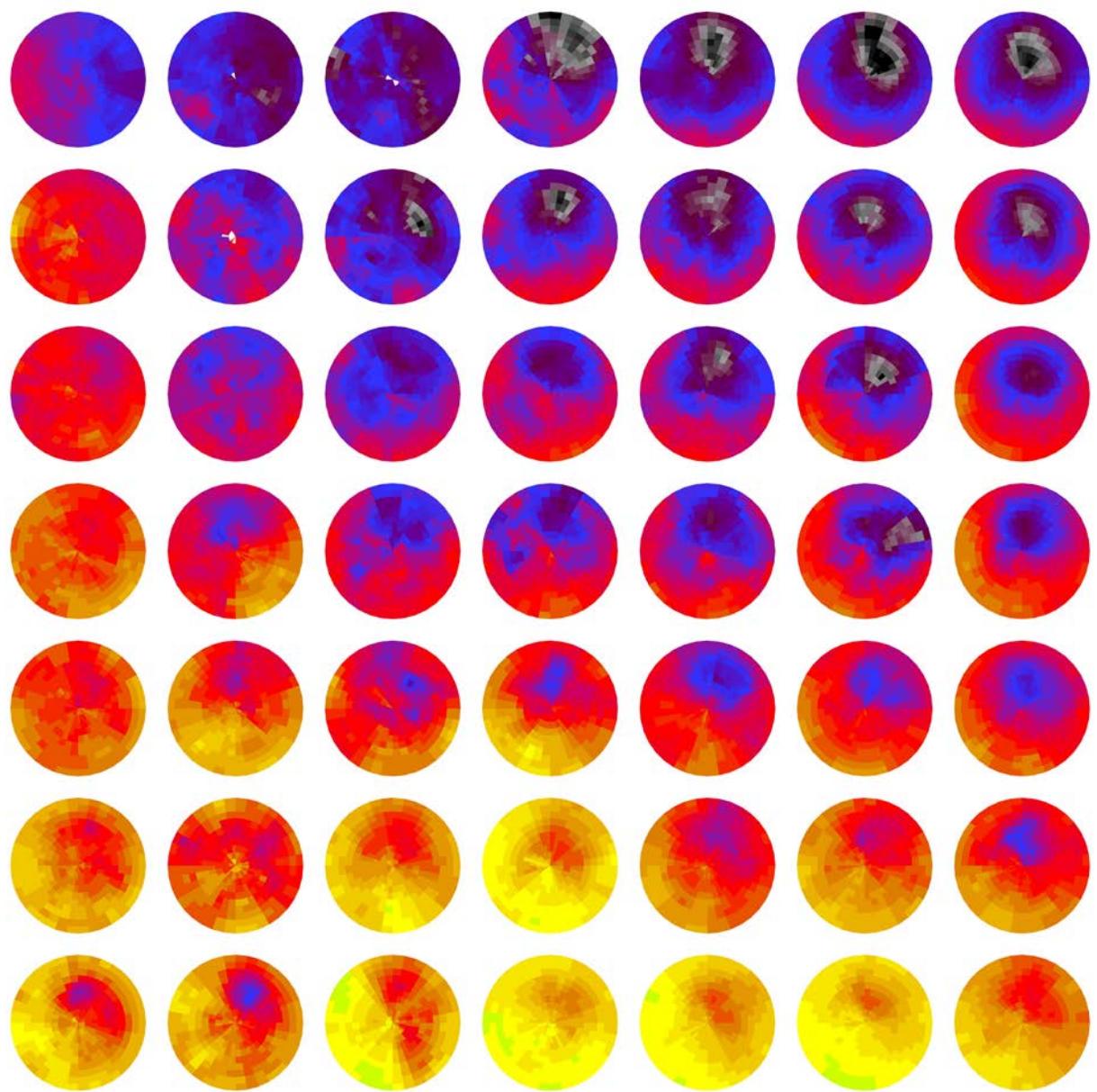
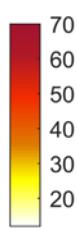
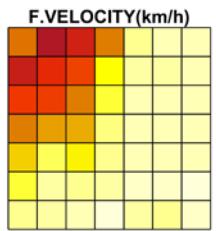
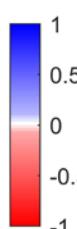
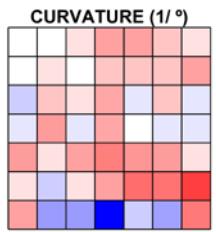
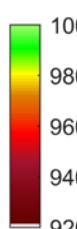
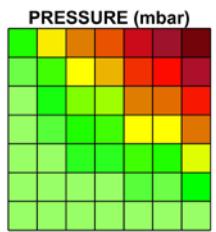
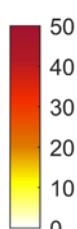
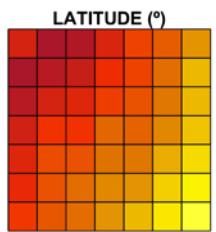
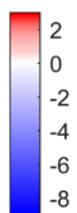
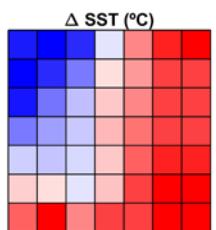
Scale parameter (σ)



Shape Parameter

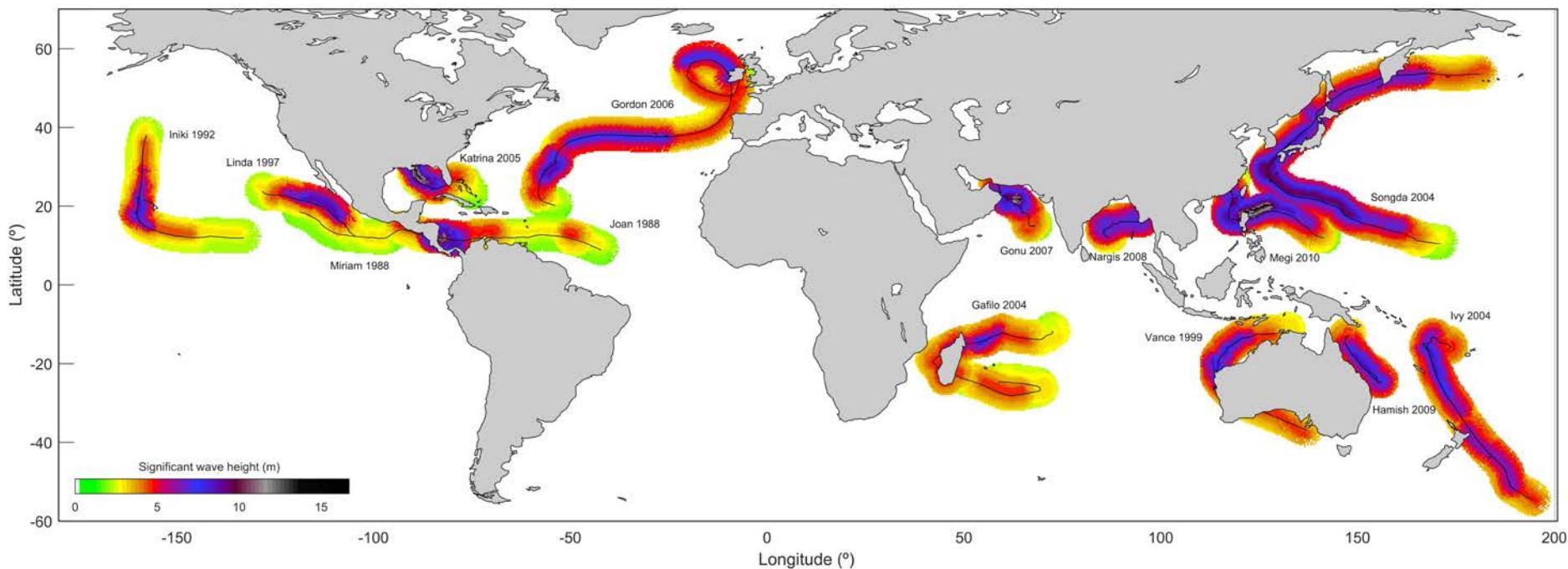


Hs95%



Applications

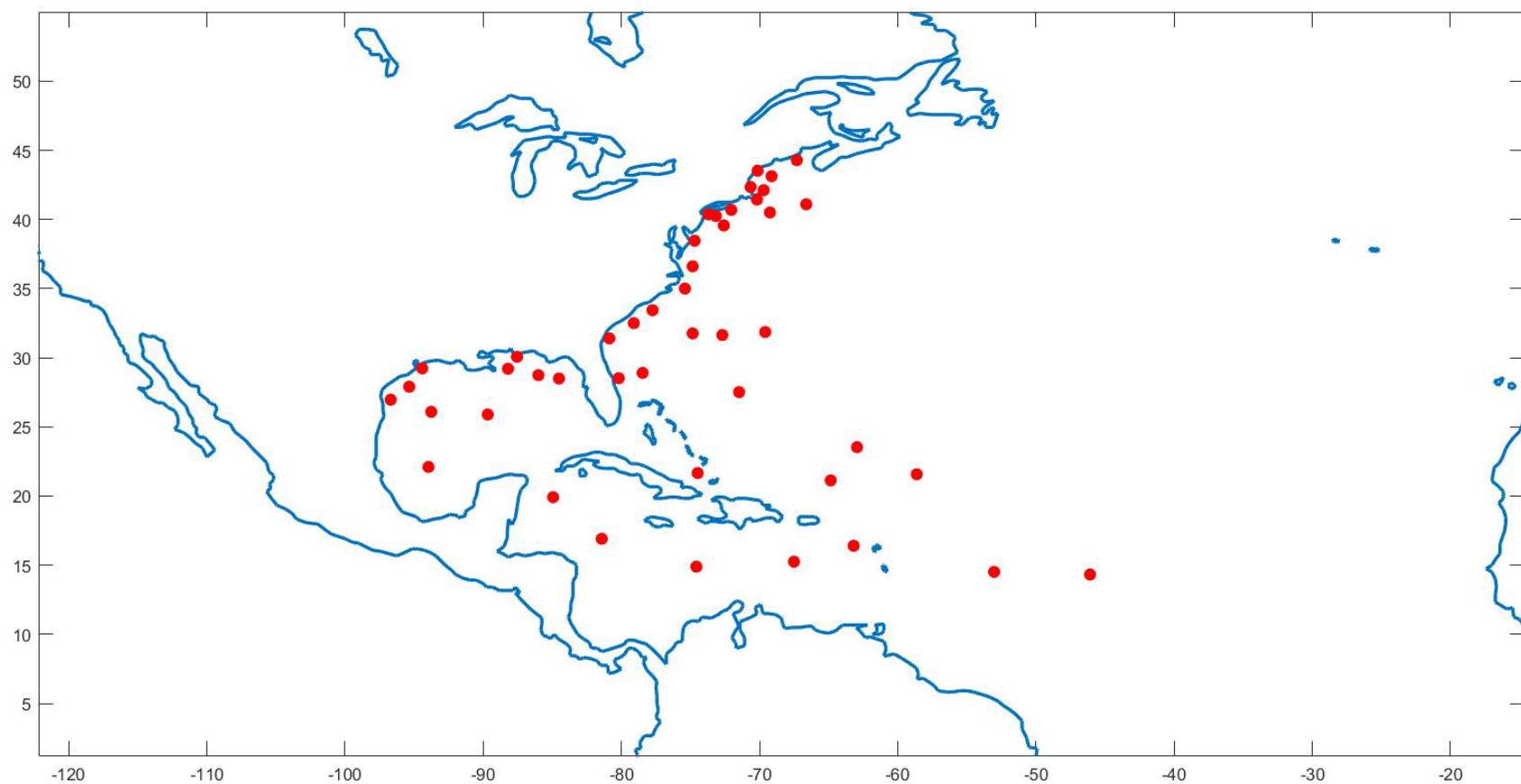
- Fast Early Warning systems
- Risk Assessment
- Climate Change Projections of TC-induced wave height





Wind Wave Footprint of Tropical Cyclones based on satellite data

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Mean Wave Direction from buoys

