Examples of the use of Copernicus data

in research of meso to large scale climate of Iceland and the Arctic

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CARRA Dataset

- C3S Arctic Regional Reanalysis
- From Climate Data Store
- West domain covers Iceland and Greenland
- East domain covers Svalbard and northern parts of Skandinavia
- Data for years 1998 to present

Copernicus API

- Personal access token
- Simple Python scripts
- Alternative for small datasets: web interface

```python
import cdsapi

years = [
            '1991', '1992',
            '1993', '1994', '1995',
            '1996', '1997',
            '1998', '1999', '2000',
            '2001', '2002', '2003',
            '2004', '2005', '2006',
            '2007', '2008', '2009',
            '2010', '2011', '2012',
            '2013', '2014', '2015',
            '2016', '2017', '2018',
            '2019', '2020', '2021'
        ]

months = [
            '01', '02', '03',
            '04', '05', '06',
            '07', '08', '09',
            '10', '11', '12',
        ]

c = cdsapi.Client()

for year in years:
    for month in months:
        c.retrieve(
            'reanalysis-carra-single-levels',
            {
                'domain': 'west_domain',
                'level_type': 'surface_or_atmosphere',
                'variable': [
                    '10m_wind_direction', '10m_wind_speed',
                ],
                'product_type': 'forecast',
                'time': [
                    '00:00', '12:00',
                ],
                'leadtime_hour': '6',
                'year': year,
                'month': month,
                'day': [
                    '01', '02', '03',
                    '04', '05', '06',
                    '07', '08', '09',
                    '10', '11', '12',
                    '13', '14', '15',
                    '16', '17', '18',
                    '19', '20', '21',
                    '22', '23', '24',
                    '25', '26', '27',
                    '28', '29', '30',
                    '31',
                ],
                'format': 'grib',
            },
            f'{year}_{month}_wind_data.grib')
```

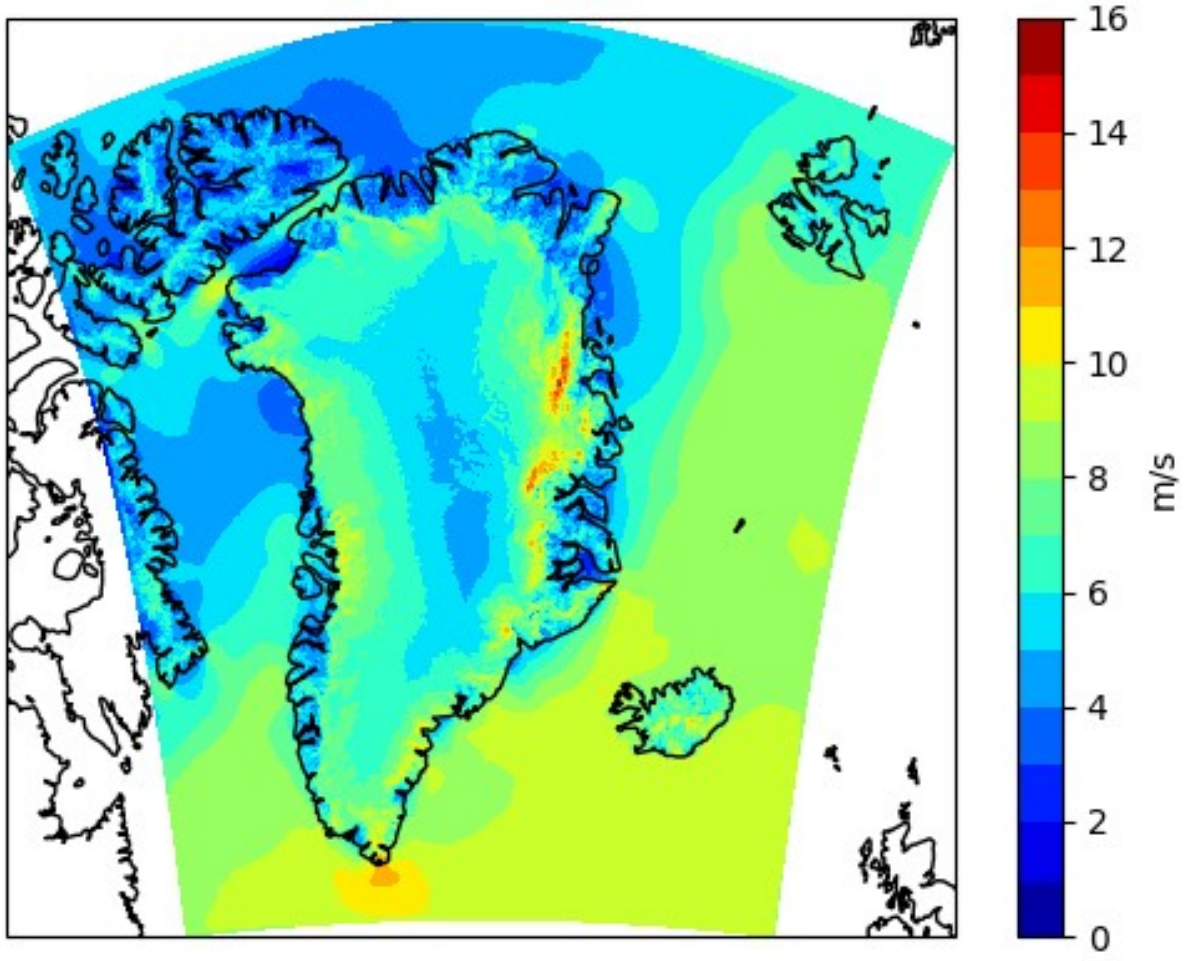
Handling large datasets

- Xarray/GeoPandas to read NetCDF/GRIB files
- Dask to parallelise processing
- HPC or patience needed

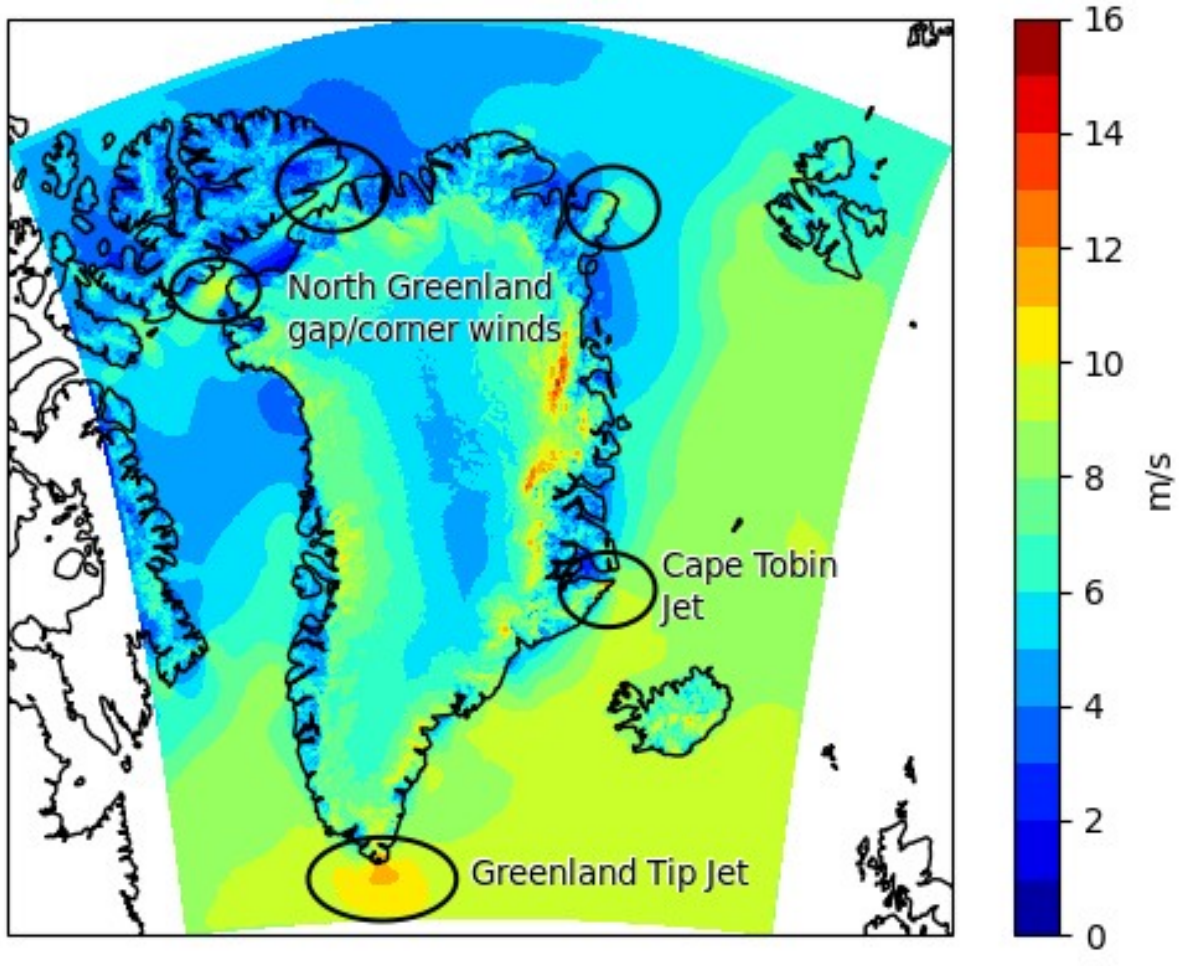
Maps

- Various mapping libraries eg. Cartopy, PyGMT
- Be aware of projection conversions
- Other compatibility problems can occur
  eg. Longitude in [0,360] or [-180,180]

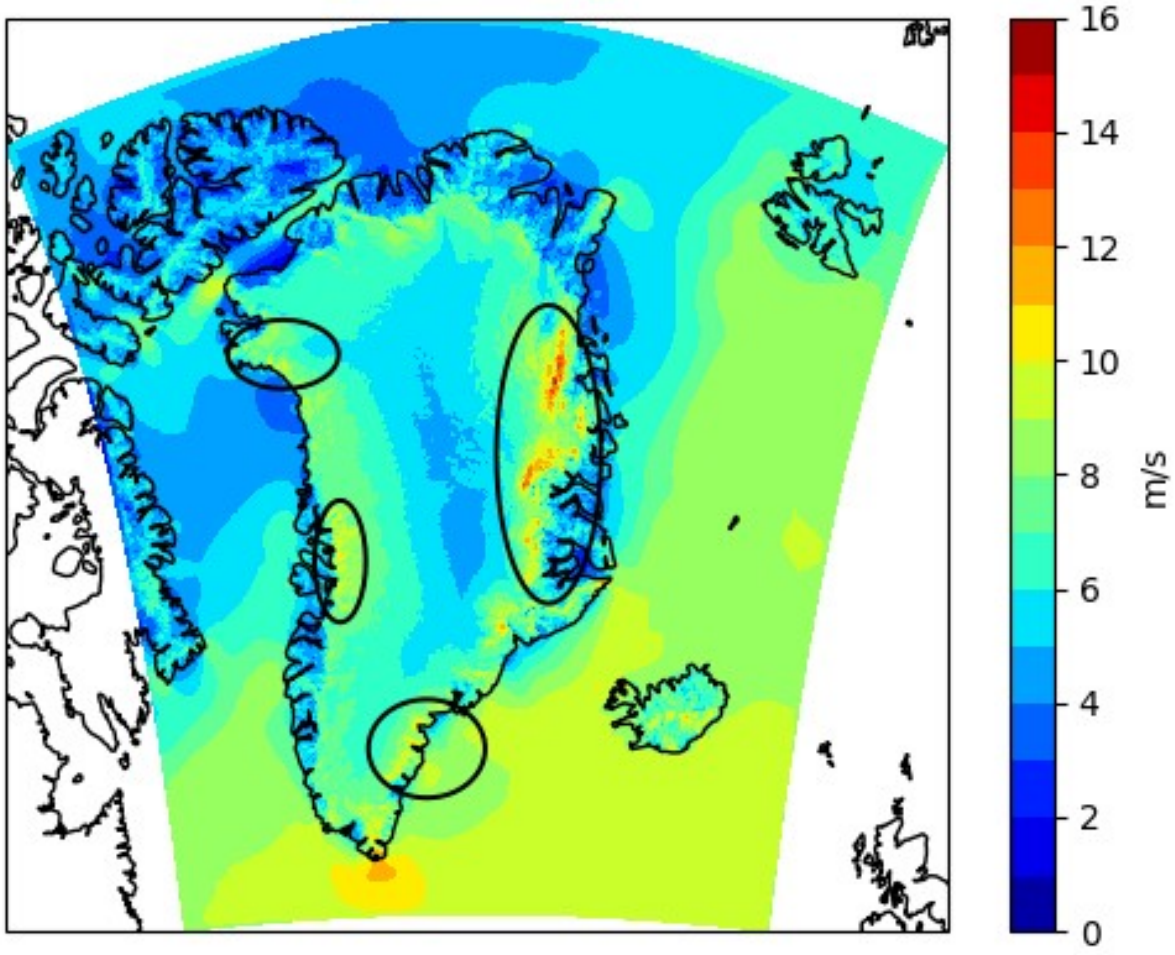
Mean windspeed



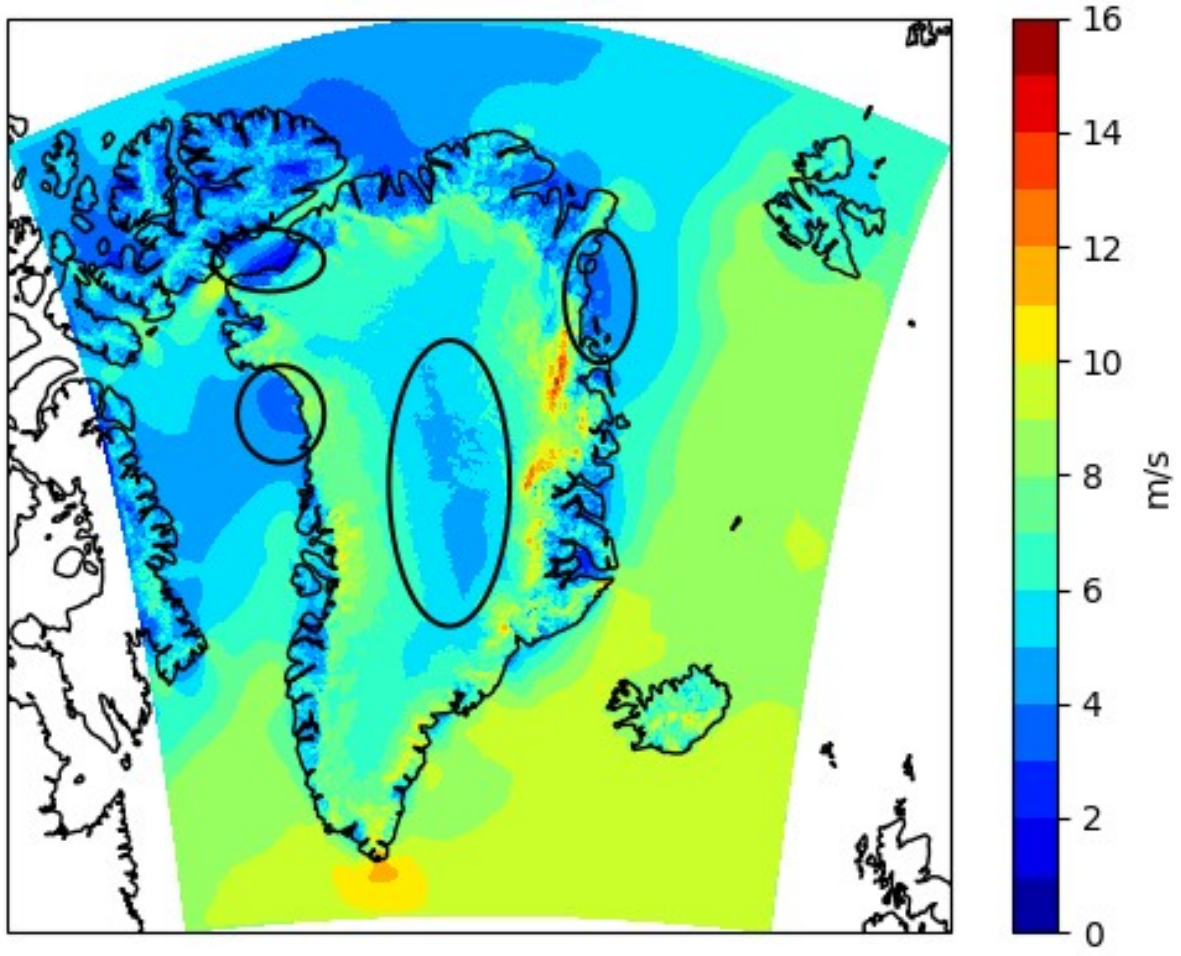
Known jets


North Greenland
gap/corner winds
Cape Tobin
Jet
Greenland Tip Jet
16
14
12
10
8
6
4
2
0
m/s

New jets



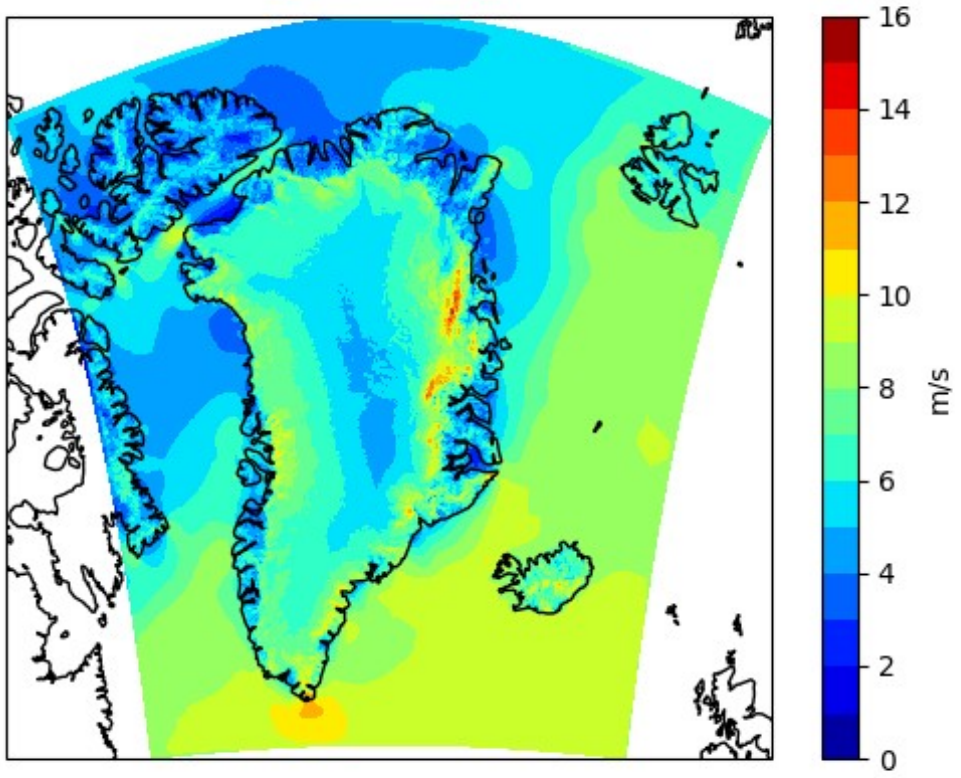
Significant shelters

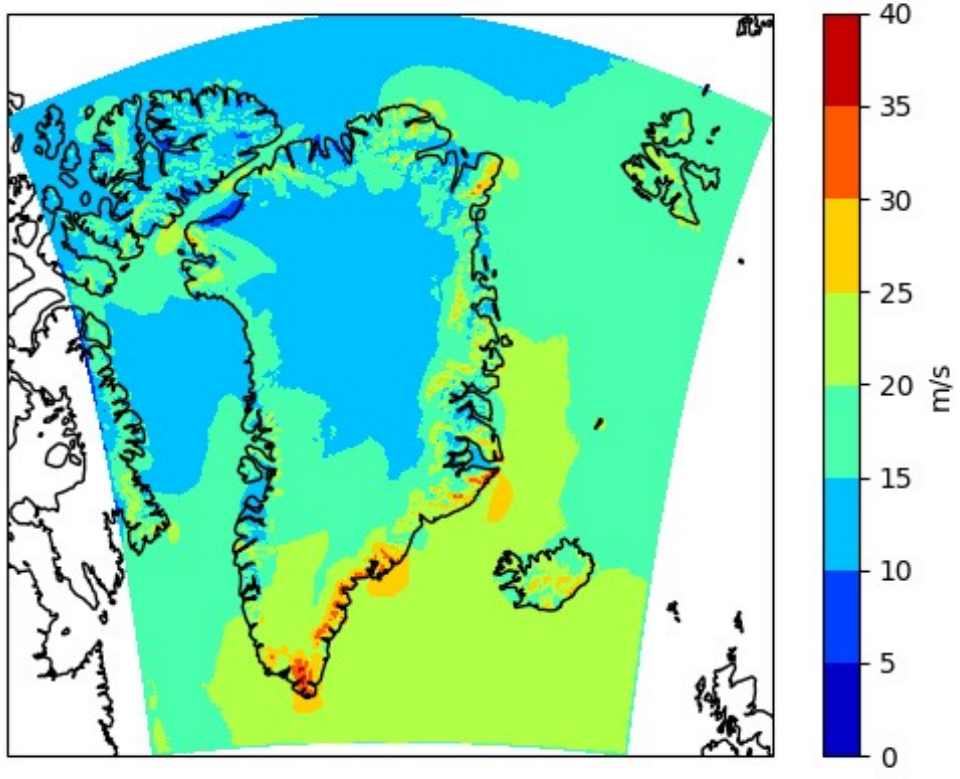


Main results

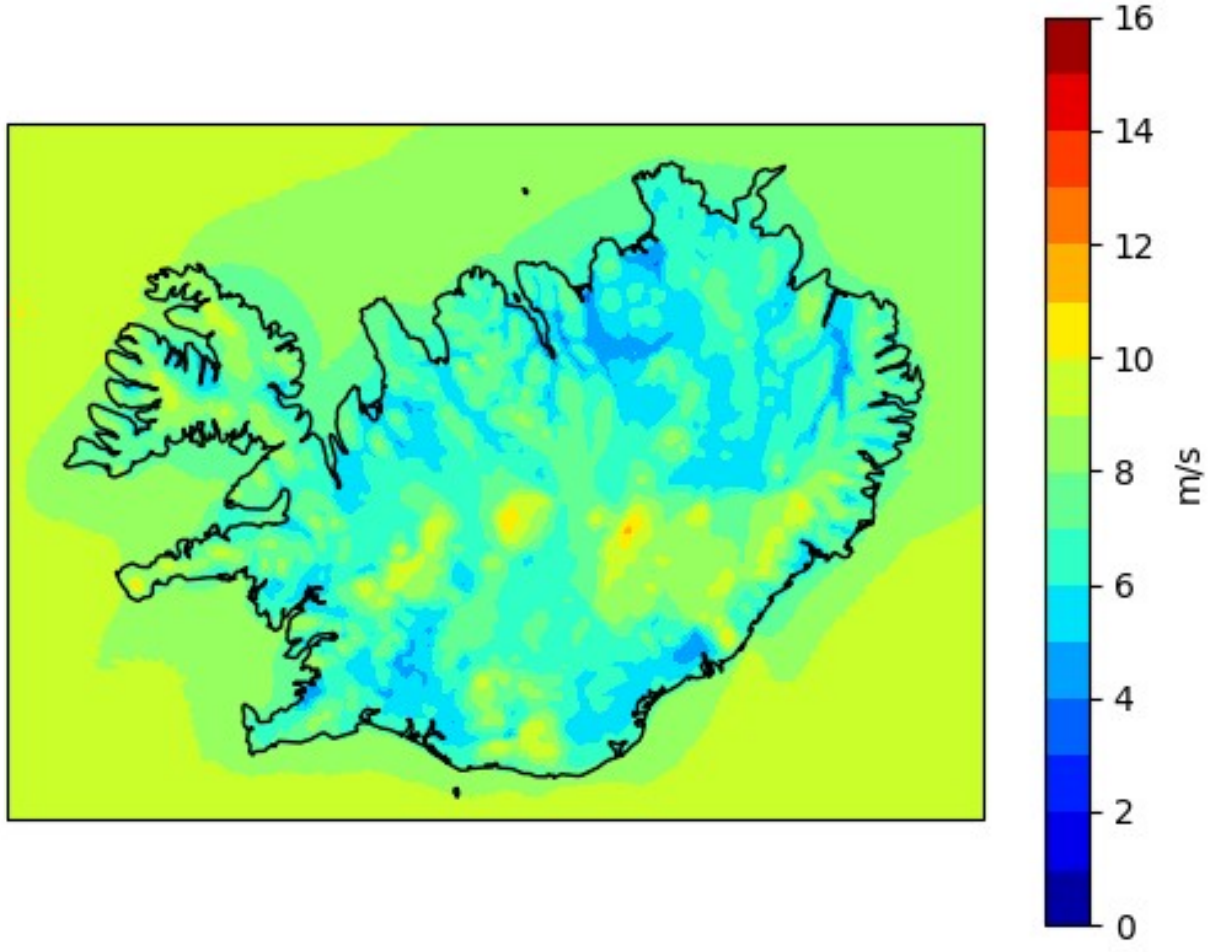
- Surprisingly good shelter in the center of Greenland and some coastal areas
- Very strong wind on both west and east coast of Greenland
- Known jets reproduced but the tip jet extends further west then expected

Mean vs 99th percentile





Iceland



Upcoming analysis

- Specific characteristics of jets and shelters over time

- Analysis of smaller scale phenomena over Iceland