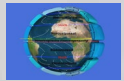


MARINE METEOROLOGY

Deutscher Wetterdienst, Maritime Met Office Hamburg

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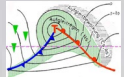
www.vorticity.de



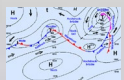
➤ 01 Global Circulation



➤ 02 Meteorological Parameters



➤ 03 Ideal Cyclone  Clouds



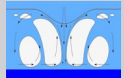
➤ 04 Other Pressure Patterns



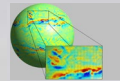
➤ 05 Small-scale Processes



➤ 06 Synoptic Weather Regimes



➤ 07 Tropical Storms, Severe Weather



➤ 08 Weather Analysis and Forecast



➤ 09 Weather Forecast Products, GRIB



➤ 10 Remote Sensing Satellite and Radar



➤ 11 Sea and Swell

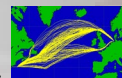
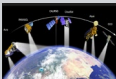


➤ 12 Currents ICE AMOC Tides



➤ 13 Maritime Climatology

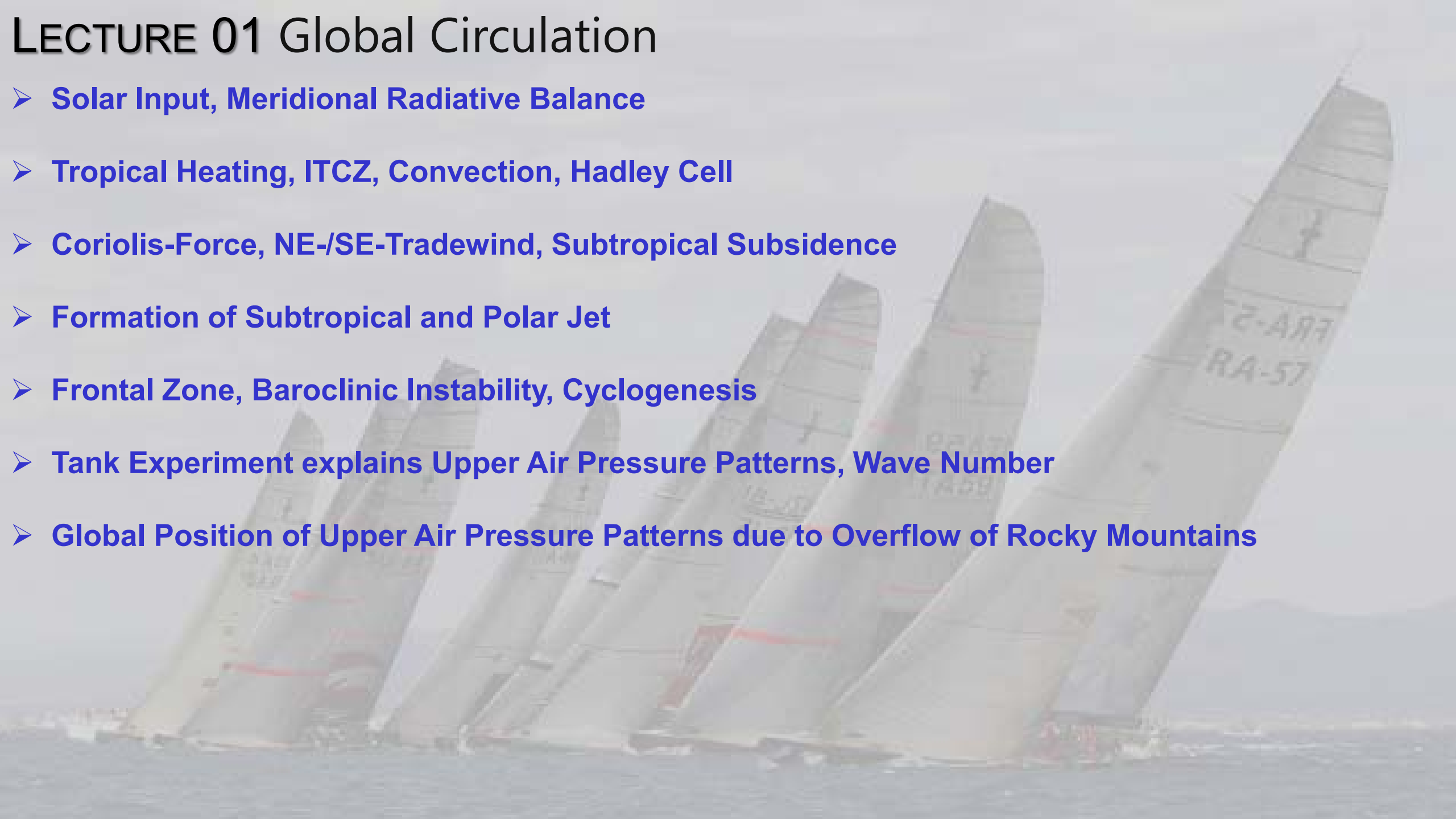
➤ 14 Weather online



Weather forecast is not everything – but without, everything could be nothing!

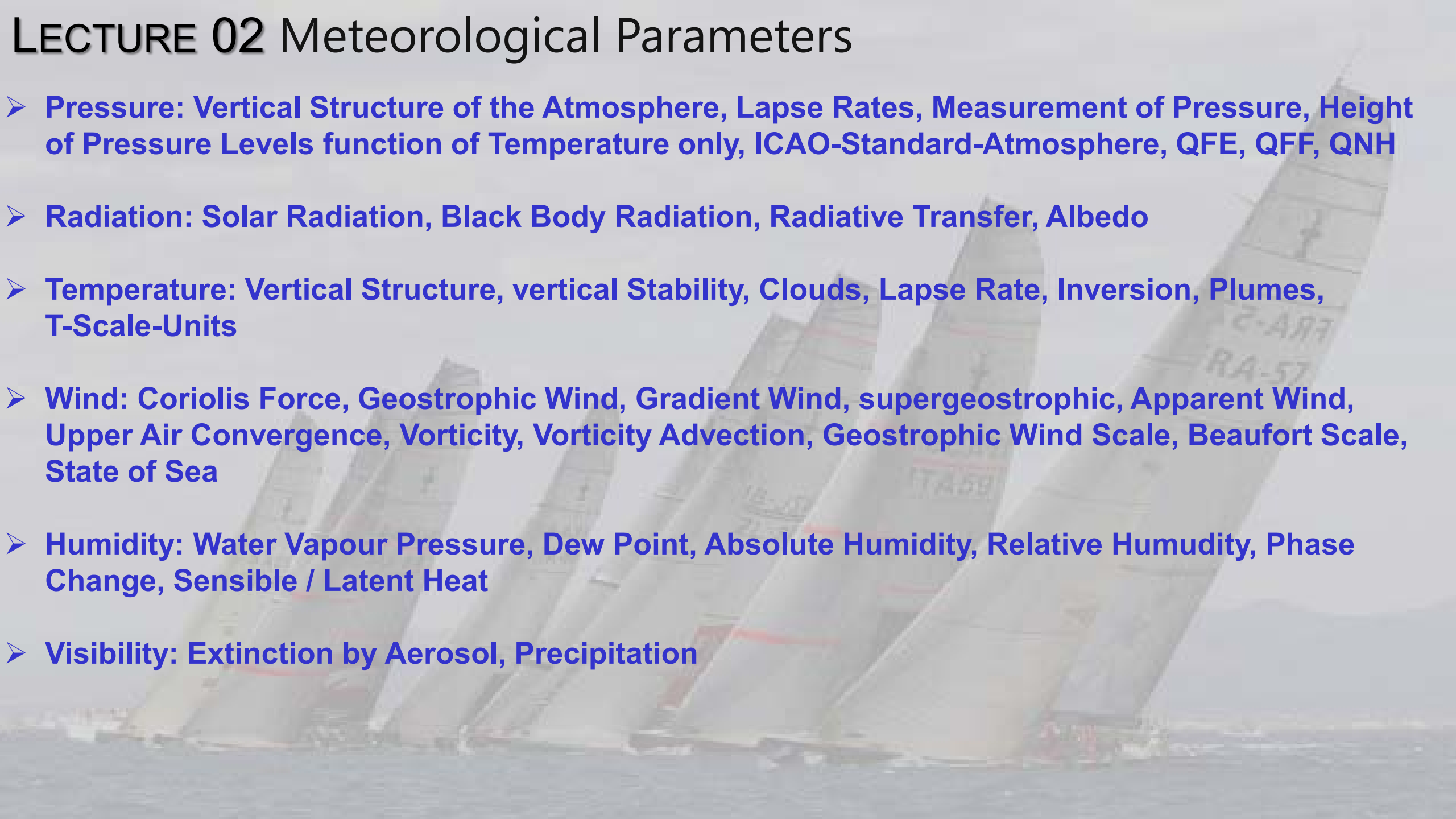
LECTURE 01 Global Circulation

- **Solar Input, Meridional Radiative Balance**
- **Tropical Heating, ITCZ, Convection, Hadley Cell**
- **Coriolis-Force, NE-/SE-Tradewind, Subtropical Subsidence**
- **Formation of Subtropical and Polar Jet**
- **Frontal Zone, Baroclinic Instability, Cyclogenesis**
- **Tank Experiment explains Upper Air Pressure Patterns, Wave Number**
- **Global Position of Upper Air Pressure Patterns due to Overflow of Rocky Mountains**



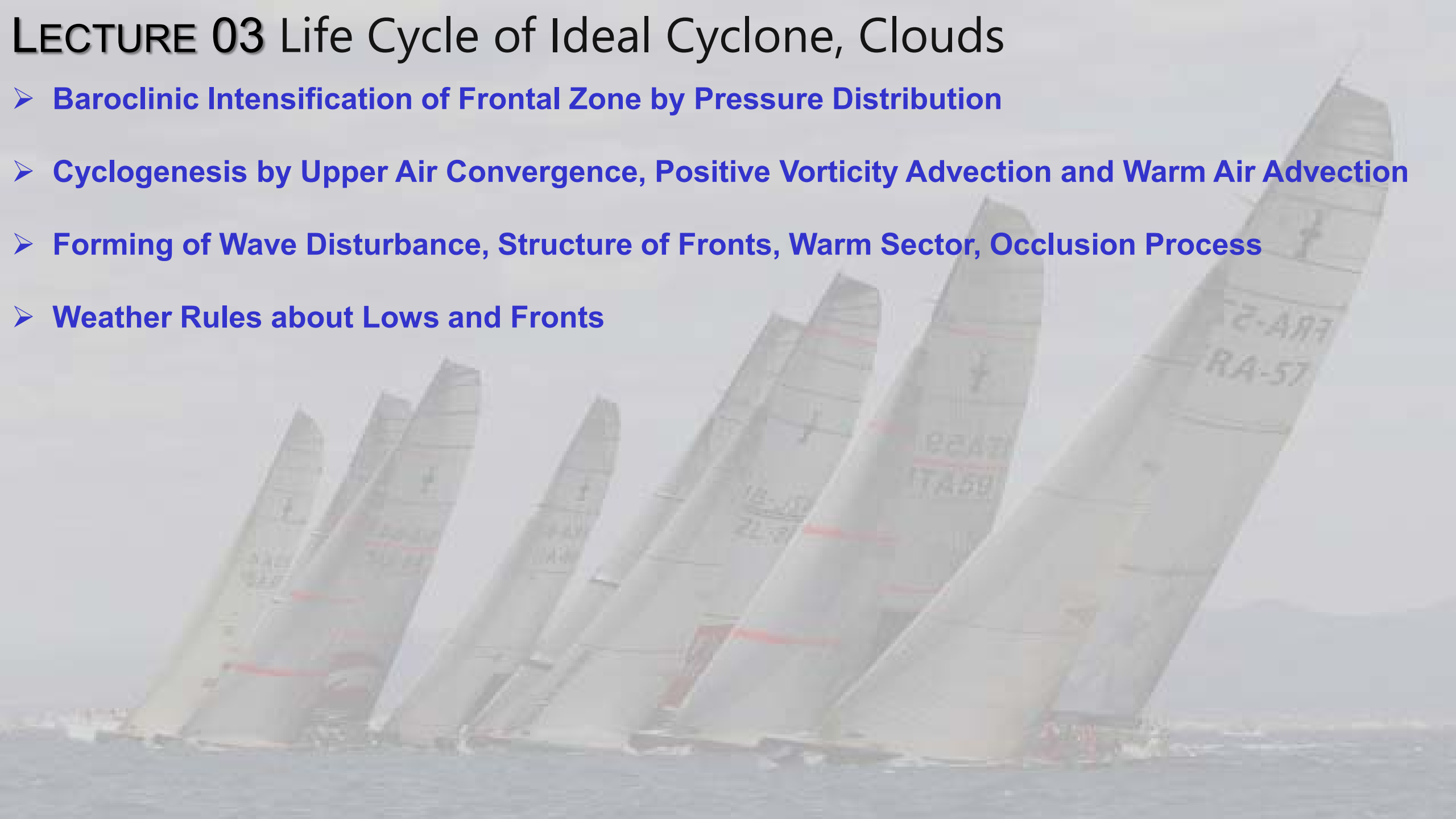
LECTURE 02 Meteorological Parameters

- **Pressure: Vertical Structure of the Atmosphere, Lapse Rates, Measurement of Pressure, Height of Pressure Levels function of Temperature only, ICAO-Standard-Atmosphere, QFE, QFF, QNH**
- **Radiation: Solar Radiation, Black Body Radiation, Radiative Transfer, Albedo**
- **Temperature: Vertical Structure, vertical Stability, Clouds, Lapse Rate, Inversion, Plumes, T-Scale-Units**
- **Wind: Coriolis Force, Geostrophic Wind, Gradient Wind, supergeostrophic, Apparent Wind, Upper Air Convergence, Vorticity, Vorticity Advection, Geostrophic Wind Scale, Beaufort Scale, State of Sea**
- **Humidity: Water Vapour Pressure, Dew Point, Absolute Humidity, Relative Humidity, Phase Change, Sensible / Latent Heat**
- **Visibility: Extinction by Aerosol, Precipitation**



LECTURE 03 Life Cycle of Ideal Cyclone, Clouds

- **Baroclinic Intensification of Frontal Zone by Pressure Distribution**
- **Cyclogenesis by Upper Air Convergence, Positive Vorticity Advection and Warm Air Advection**
- **Forming of Wave Disturbance, Structure of Fronts, Warm Sector, Occlusion Process**
- **Weather Rules about Lows and Fronts**



LECTURE 04 Other Pressure Patterns

- **Secondary Low**
- **Trough**
- **Cut-off-Low, Cold Air Pool**
- **Low / High: Thermal / Dynamical, Warm / Cold**
- **Mediterranean Weather Systems**



LECTURE 05 Small Scale Phenomena

- Land-/Seebreeze
- Coastal Convergence / Divergence
- Orographic Deflection of Winds
- Kármán – Vortices
- Foehn
- Mountain / Valley Winds
- Fog, Types of Fog
- Visibility



LECTURE 06 Typical Weather Patterns ('Grosswetterlage')

- **Main Wind Directions N, NE ...NW**
- **Type cyclonic / anticyclonic**
- **Other: Low British Isles, Low Central Europe...**
- **Airmass Characteristics Summer / Winter as a function of wind direction**
- **Persistence of various Weather Types**
- **Climatology of various Weather Types**
- **Expected Weather Characteristics**



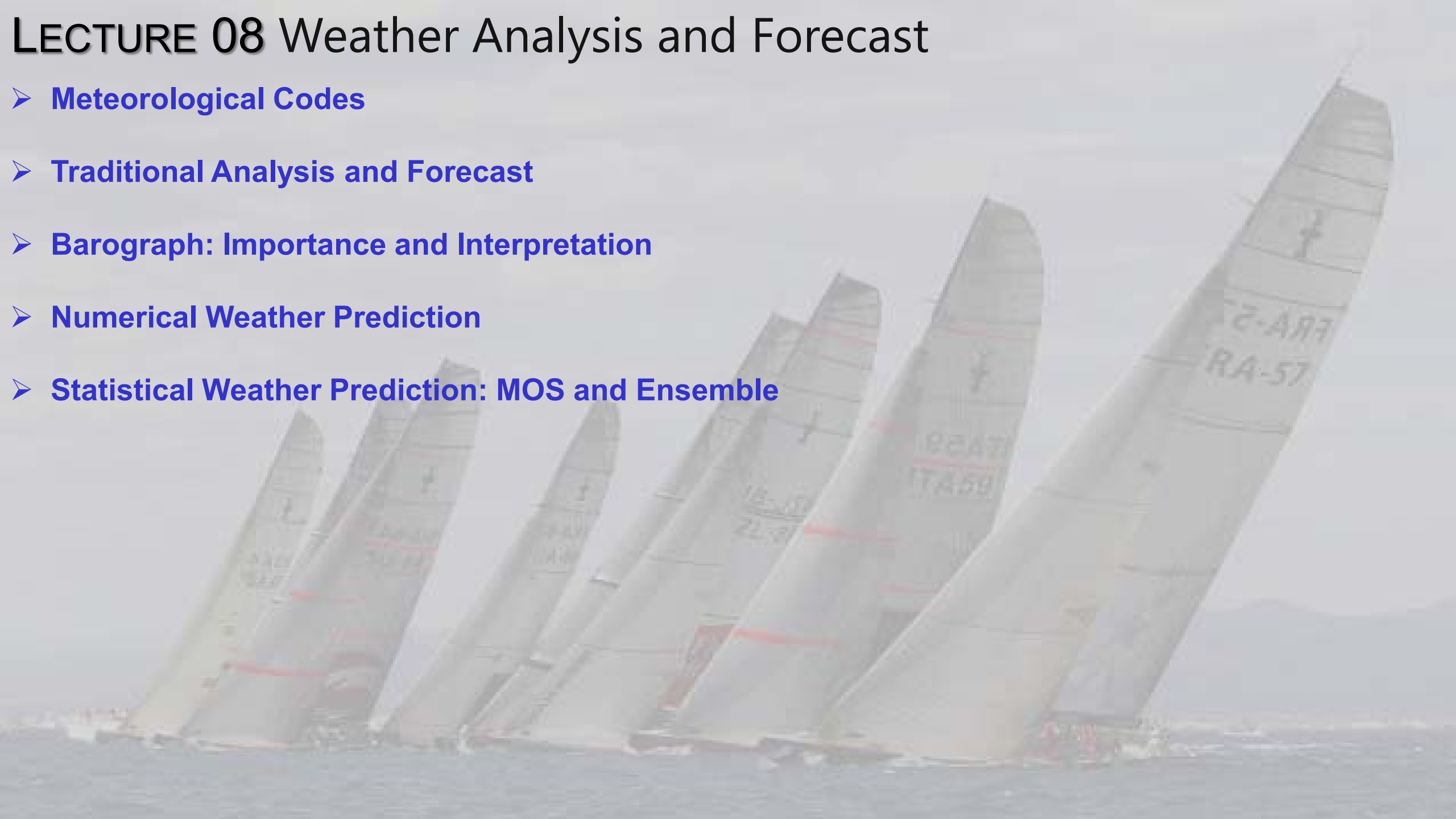
LECTURE 07 Tropical Storms, Severe Weather

- **Easterly Wave, favourable conditions**
- **Tropical Depression / Storm, Saffir-Simpson Scale**
- **Seasons for Tropical Storms**
- **Forecast and Watch of Tropical Storms**
- **1-2-3 Rule**
- **Brown Ocean Effect**
- **Thunderstorm, Mesoscale Convective Cluster, Squall Line**
- **Tornadoes, Fujita Scale**



LECTURE 08 Weather Analysis and Forecast

- **Meteorological Codes**
- **Traditional Analysis and Forecast**
- **Barograph: Importance and Interpretation**
- **Numerical Weather Prediction**
- **Statistical Weather Prediction: MOS and Ensemble**



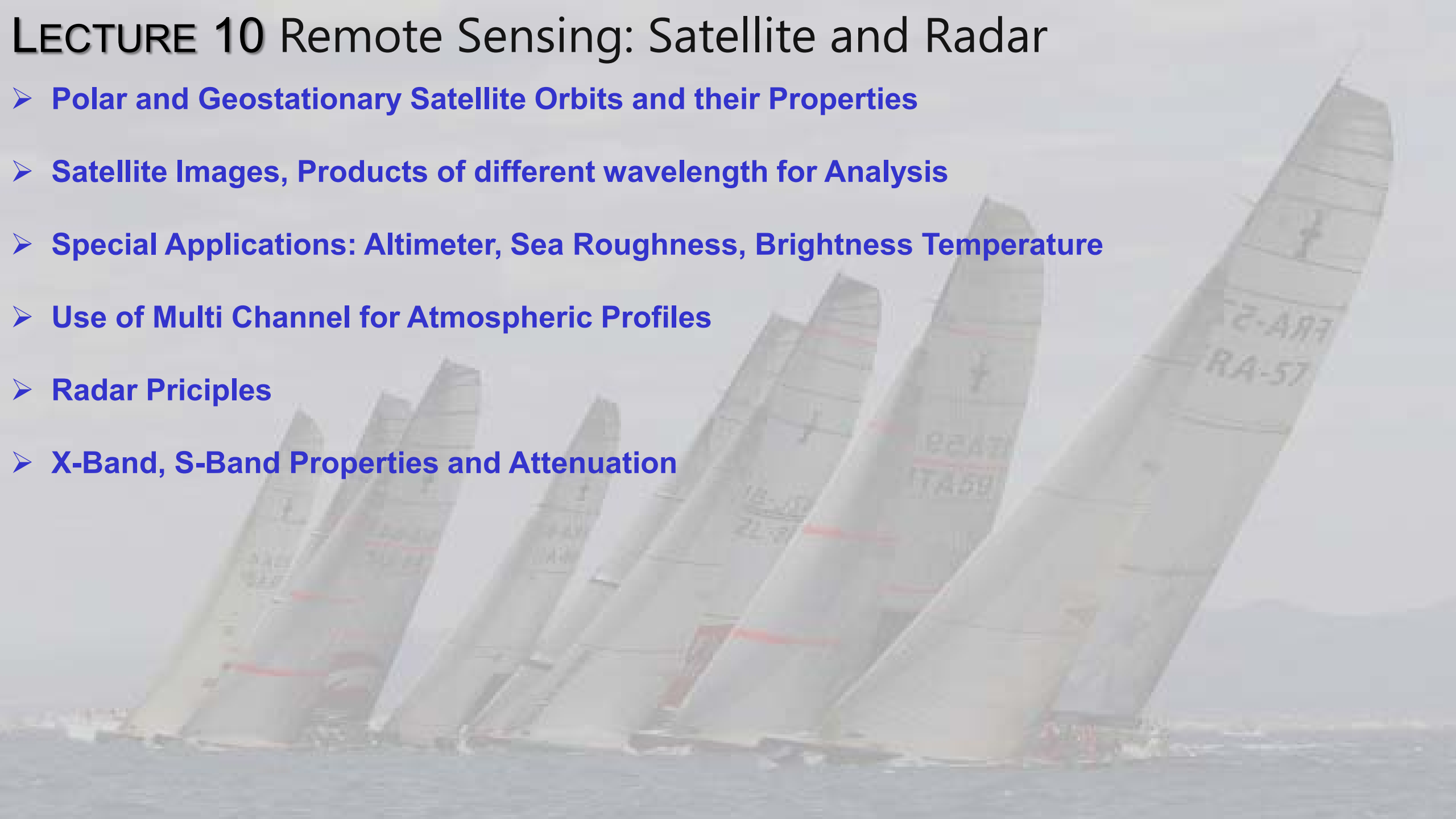
LECTURE 09 Weather Forecast Products

- Reception of Meteorological Data via HF, Satellite, Internet
- NOAA OPC, NHC
- GRIB Forecast: Use and Interpretation



LECTURE 10 Remote Sensing: Satellite and Radar

- **Polar and Geostationary Satellite Orbits and their Properties**
- **Satellite Images, Products of different wavelength for Analysis**
- **Special Applications: Altimeter, Sea Roughness, Brightness Temperature**
- **Use of Multi Channel for Atmospheric Profiles**
- **Radar Principles**
- **X-Band, S-Band Properties and Attenuation**



LECTURE 11 Sea and Swell

- **Mathematical Description of Sea and Swell, Wave Spectrum**
- **Use of Nomogram to take into account the effect of Fetch and Duration of Wind**
- **Effects of Water Depth and Current on Sea**
- **Freak Wave**
- **Parametric Rolling**

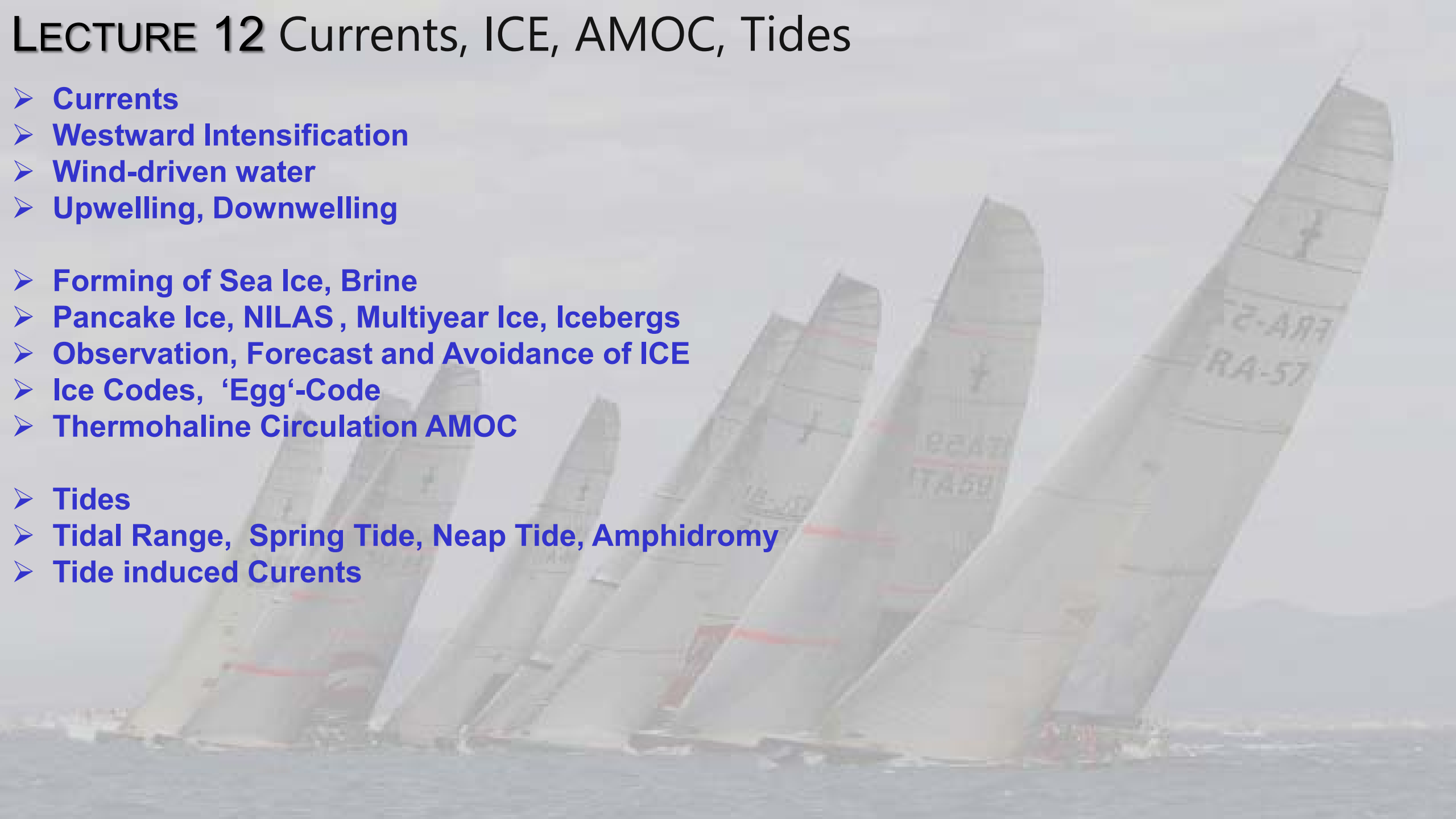


LECTURE 12 Currents, ICE, AMOC, Tides

- **Currents**
- **Westward Intensification**
- **Wind-driven water**
- **Upwelling, Downwelling**

- **Forming of Sea Ice, Brine**
- **Pancake Ice, NILAS, Multiyear Ice, Icebergs**
- **Observation, Forecast and Avoidance of ICE**
- **Ice Codes, 'Egg'-Code**
- **Thermohaline Circulation AMOC**

- **Tides**
- **Tidal Range, Spring Tide, Neap Tide, Amphidromy**
- **Tide induced Currents**



LECTURE 13 Maritime Climatology

- Annual Variation of Global Pressure Patterns
- Monsoon
- Annual Variation of ITCZ



LECTURE 14 Course Summary

- ...
- ...
- ...



The weather colours every aspect of a pilot's day. It influences everything he does and every decision he makes. Technology has reduced the impact of extreme weather and distanced the pilots from the most intimate involvement with it, but still cannot be ignored. The first information a pilot reaches for when he checks into the crew room (after he has checked his pay slip) is the weather forecast. It will influence how much fuel he takes, the route he follows, the altitude at which he flies, what sort of approach he will make at his destination, the alternative airfields he chooses and even the information he provides for the passengers. In this respect he is like a farmer - the only passenger in my experience who could be relied upon not to complain if weather delayed their flight.

When I leave my home in the morning, even now, I glance up at the sky and search for clues to explain the nature of the air mass and how it might impinge upon whatever I have planned to do. I check the wind strength and direction, the visibility, the cloud type and height and I feel the temperature. I use all the knowledge and experience I have accumulated during a lifetime in aviation and, spurning the BBC and the UK Met Office, I make my own forecast. Sadly, its accuracy has not improved.

