香港天文台
HONG KONG OBSERVATORY

I·F·A·L·P·A
THE GLOBAL VOICE OF PILOTS

WIND SHEAR - WARNING AND ALERTING

OBSERVATIONS

ANEMOMETER NETWORK

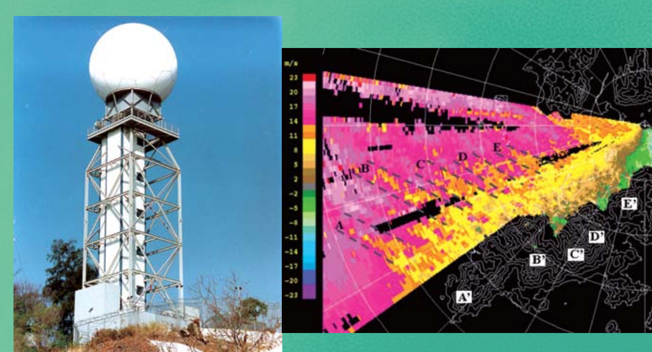
WEATHER BUOY

- Specifically for detection of sea breeze induced shear

ANEMOMETER
(on airport level or nearby hilltop)

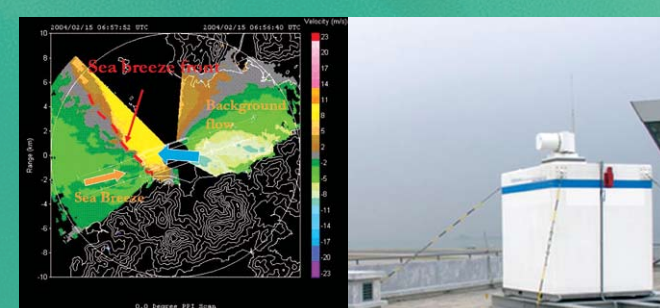
- Specifically for detection of horizontal shear near ground level or vertical shear between hilltop and ground level
- Effective for low-level shear line e.g. land/sea breeze and gust front

TERMINAL DOPPLER WEATHER RADAR (TDWR)



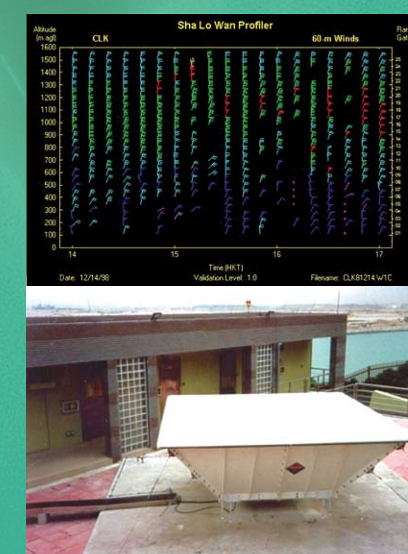
- Specifically for detection of thunderstorm induced wind shear
- Well-proven for microburst and gust front

LIGHT DETECTION AND RANGING (LIDAR)



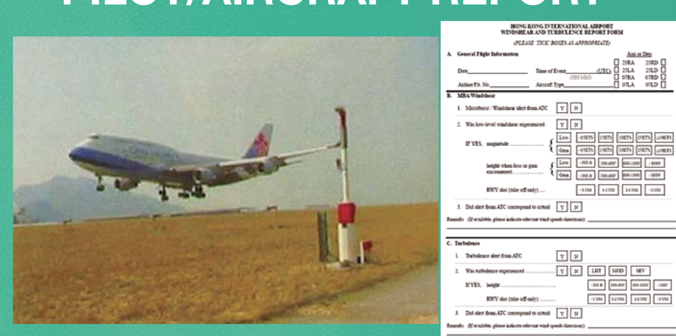
- Specifically for detection of wind shear in clear air
- Effective for detecting headwind change along glide paths
- Proven for terrain-induced wind shear, sea breeze, gust front and low-level shear line

WIND PROFILER



- Specifically for detection of vertical wind shear (e.g. low-level jet)
- Be mindful on data quality

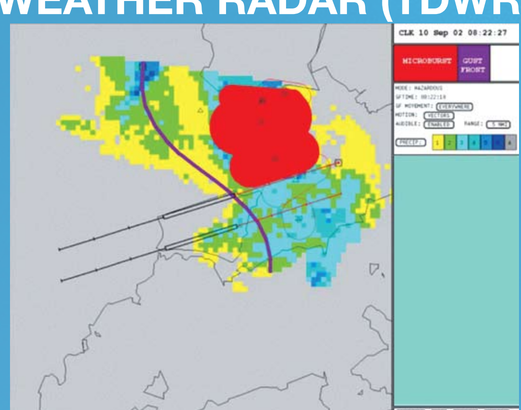
PILOT/AIRCRAFT REPORT



- Provide "sky truth" of wind shear via ATC and local arrangements (e.g. wind shear reporting form)
- Mandatory for ATC to warn subsequent aircraft
- Aircraft Meteorological DAta Relay (AMDAR) can provide high-resolution wind data for wind shear reporting

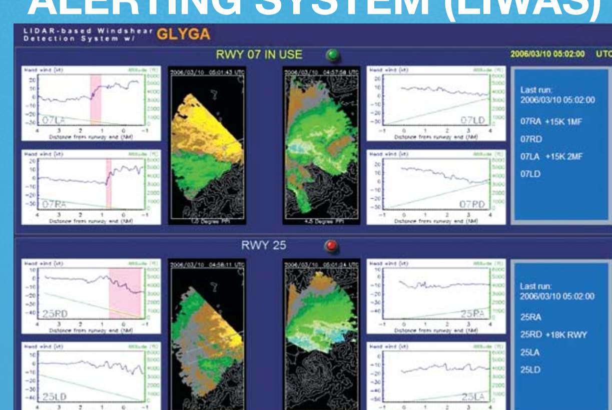
TECHNIQUES

TERMINAL DOPPLER WEATHER RADAR (TDWR)



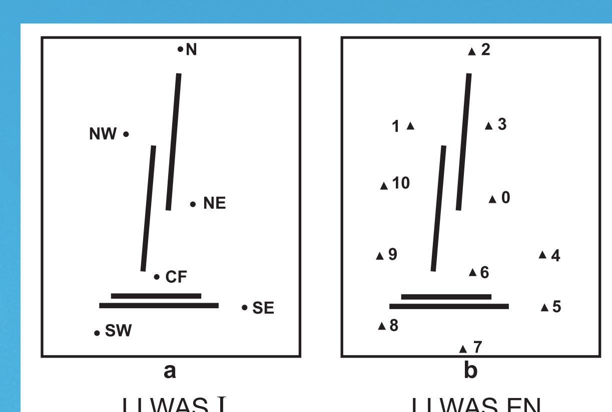
- Need careful siting of the radar relative to airport and runways
- Use low elevation scans for the lowest 100-300 m
- Ground clutter and moving targets need to be removed to ensure data quality
- Detection of shear along the radar beam (radial) direction
- Algorithm enhanced by knowledge of the microburst model

LIDAR WIND SHEAR ALERTING SYSTEM (LIWAS)



- Need careful siting of the LIDAR relative to runways and glide paths
- Optimal performance depending on alignment of laser beam with the runway
- Conduct scans towards glide paths
- Derive headwind profile to be encountered by aircraft along glide paths
- Automatic direct detection of wind shear from headwind change

ANEMOMETER BASED SYSTEM



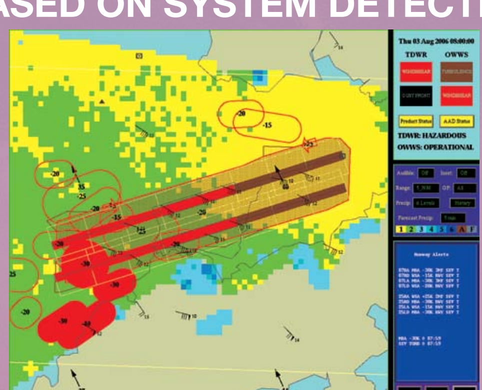
- Install the anemometers at strategic locations
- Calculate head wind difference between adjacent anemometers, or divergence/convergence within areas bounded by anemometers
- Works best for low-level shear line
- Small-size microburst/wind shear might be missed

MET FORECAST

- Pilot report based warning (ICAO Annex 3)
- Objective forecasting methods
  - based on broad meteorological conditions
  - based on real-time data from weather sensors
  - warning thresholds tuned with reference to reports

ALERT/WARNING & TERMINOLOGY

AUTOMATIC ALERTS VIA ATC (BASED ON SYSTEM DETECTION)



07RD MB² -30KT RWY SEV TURB⁴ (Hong Kong)¹
07LA WSA³ 20K- 3MF (USA)¹

Runway Designator [MB²|WS³] [+|-]nnKT [RWY|APP|DEP] [SEV|MOD] [TURB⁴] (Hong Kong)¹
Runway Designator [MBA²|WSA³] nnK[+|-] [RWY|nMF|nMD] (USA)¹

Notes:
1. ATC alert format subject to local agreement
2. MB / MBA: Microburst / Microburst Alert
3. WS / WSA: Wind Shear / Wind Shear Alert
4. TURB: Turbulence

WARNING VIA ATIS (BASED ON REPORT AND FORECAST)

WIND SHEAR WARNING

WARNING FOR ATIS[1,3]
SIG WS FCST AND REP 07L

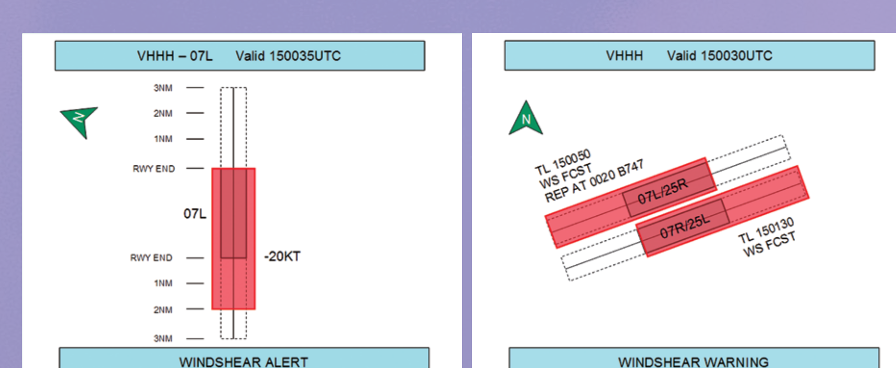
WARNING FOR ATC[2]
WS WRNG 10: 150830 VALID TL 151030 SIG WS APCH RWY07L FCST. WS APCH RWY07L REP AT 0942 B747 15KT ASPEEDL FNA

[MBST AND|SIG WS] [FCST|FCST AND REP] Runway Designator[1]

Notes:
1. ATIS (Automatic Terminal Information Service) warning format subject to local agreement
2. Wind shear warning format should follow ICAO Annex 3 template
3. Separate ATIS warning for arrival and departure

FUTURE DEVELOPMENT

UPLINK TO COCKPIT



- Uplink of textual and graphical wind shear alert and warning to the cockpit directly in future
- Terminal Weather Information for Pilots (TWIP) messages being used at some airports

World Meteorological Organization

ICAO • OACI • ИКАО