Outline of Plan to Use SLP data in Hurricane Wind Retrievals

Ralph Foster, APL, UW
Jerome Patoux, Atmos Sci, UW
RA Brown, Atmos Sci, UW
All swaths between this buy pair

All Buoy Combinations

Patoux et al., (2008)
CSA Hurricane Watch

- RadarSAT-1 C-Band SAR (HH-Pol)
- 160 ScanSAR (~450 km wide) images of hurricane or typhoon eyes
  - Data access only, unique opportunity
- Can we retrieve very high winds, surface waves and surface pressure?
- Can we use surface pressure to improve/validate high winds ala Zeng and Brown (1998)
\[ \sigma_0 \rightarrow \text{GMF} \rightarrow \text{"U}_{10}^N" \rightarrow \text{PBL Model} \rightarrow \text{gradP} \]

SLP Pattern \( \rightarrow \Delta P \rightarrow U_{10}^N \rightarrow \text{Optimize} \)

Optimize

Minimize

\[ \sum (\Delta P_{SAR} - \Delta P_{sonde})^2 + w \sum |U_{SAR} - U_{SFMR}|^2 \]
Research Plan

• Choose some well-observed cases
• Estimate SLP pattern from SAR
• PBL model is crucial: $\nabla U U$ is key
  – 1st Existing UW PBL model (+gradient wind correction)
  – 2nd New Hurricane BL model
  – 3rd New generic nonlinear BL model
• Use optimization to LS minimize $\Delta P$ bwt SAR and sondes ($+ \Delta U_{10}^N +$ smoothness)
  – Vary U,V winds
• No results yet, just a sample of building blocks
Katrina (28 Aug 2005 23:50)

• QS swath close in time
• RAINEX IOP
  – Multi-aircraft
  – Sondes, SFMR, Radar
  – 3-way Atmos/Wave/Ocean km-scale resolution numerical model output (Shuyi Chen, U Miami)
NOAA P3 & GIV data within 1 hour

SAR Quick Look (CMOD w/ const wind dirn)

Note image processing artifacts
Wind Retrievals

• Previously developed Matlab SAR processing system
  – CMOD4
  – CSA- & ASF-Processed images
• Converted for HW/Cstars imagery
  – Calibration
  – Image artifacts
• Incorporate CMOD5
• Need wind directions
  – 1\textsuperscript{st}: Use QS & Hwind
  – 2\textsuperscript{nd}: Use roll directions (collaborate w/ Horstmann NATO/GKSS)
Hurricane Katrina 0000 UTC 29 AUG 2005

Max 1-min sustained surface winds (kt)

Valid for marine exposure over water, open terrain exposure over land

Analysis based on
AFREC from 0105 - 0259 z
SMHI from 2300 - 0120 z
CMAN from 2100 - 0300 z
PCMF TOWER from 2109 - 0255 z
ASOS from 2105 - 0259 z
BACKGROUND FIELD from 0000 - 0000 z
OSCAT from 2349 - 2351 z
SHIP from 2118 - 0300 z
GPIR/IRDEITIONAL from 2103 - 0259 z
METAR from 2105 - 0255 z
MODISRE_6048 from 2100 - 0300 z
TALL_DOPPLER43 from 2331 - 2328 z
MESONET from 2100 - 0300 z
0000 z position interpolated from 2328 Army Corps, mbp = 984.0 mb

Hwind & P3 data 2100 to 0200
JHU processing

CMOD4?

Note “hourglassing”

Likely problem with direction,
But possibly errors in new wind
Retrieval code – debugging continues
Calibration?
VV/HH conversion?
Wind direction?
High winds in low incidence
Probably all 3(4) contribute
Not close enough for 1\textsuperscript{st} guess (GIGO)

May need to tune std. model parameters
Progress

- Amazing computer issues (incompatible compilers, link libraries, OS)
  - Need to upgrade OS & compiler (~1 year old!)
- Need to assess calibration
  - Need reasonable 1st guess winds or optimization will stray too far from “correct” combined wind/SLP
  - First guess directions are important
- Gradient wind correction may be inadequate.
  - Move to new BL models sooner
- Hope to report some results at next annual meeting (in 6 months?)